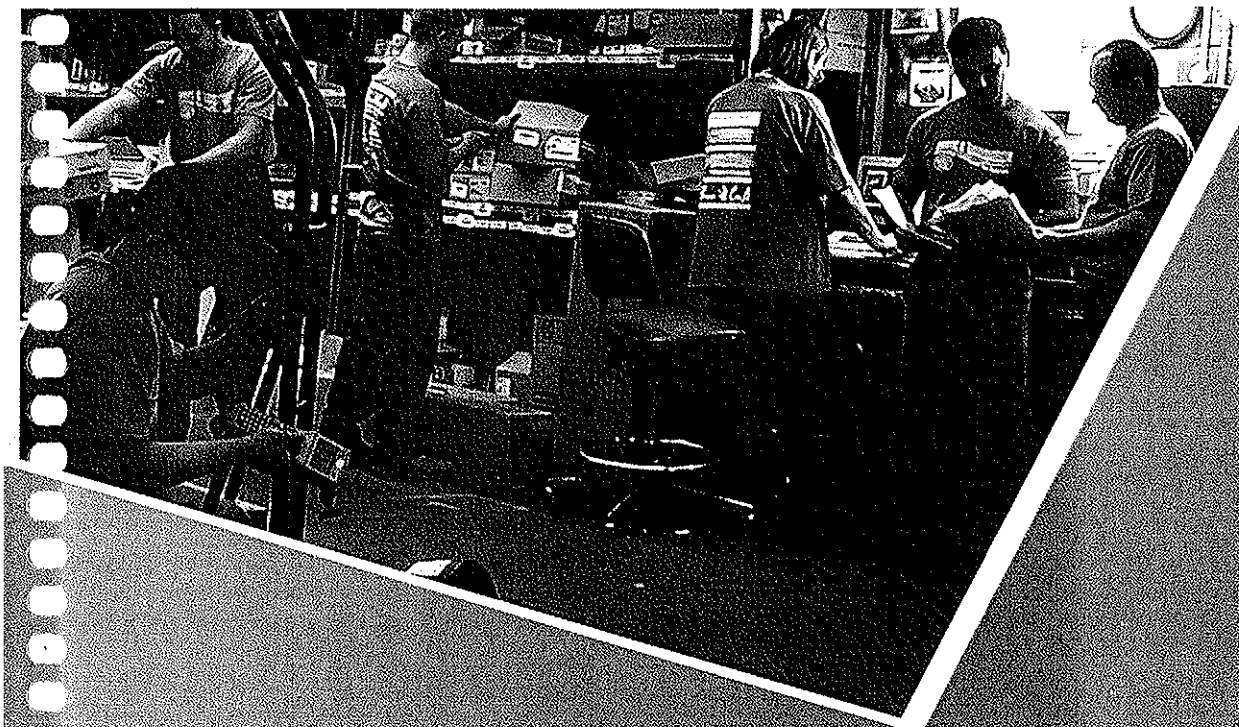
ASA UNIVERSITY

Basics of PHCP/Industrial PVF

Introduction to Pipe, Valves and Fittings©



BOOK #1

CERTIFICATE COURSE

THIRD EDITION

ProductPro®

The Standard in Product Knowledge Solutions

Basics of PHCP/Industrial PVF

Introduction to Pipe, Valves and Fittings©

from the

ASA Education Foundation

THIS COURSE INCLUDES AN ONLINE FINAL EXAM

This course is limited to a single user. When you are ready to take the final exam to earn Certificate of Completion, please contact ASA at info@asa.net. You will be contacted about how to access your final exam.

Introduction to Pipe, Valves and Fittings© provides new warehouse, counter and sales personnel with the basic knowledge needed to accurately take and pick orders as well as service customers effectively. Employees quickly master the components and functions of supply and DWV systems, identify the types and characteristics of pipe, and recognize the types of valves and their uses.

ProductPro®

The Standard in Product Knowledge Solutions

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Welcome to the *ProductPro® Product Knowledge Training* series!

The Plumbing-Heating-Cooling-Piping (PHCP) and Industrial Pipe, Valves, and Fittings (PVF) industry is an important business channel. The products we sell keep people healthy, comfortable, and productive. However, very few people understand the products we distribute and how much they contribute to our nation's health and economic welfare. Although many people seldom think about industrial pipe, valves, and fittings, they play an important part in the quality of people's lives. Without modern industrial systems, our lives would be far less comfortable than they are today. Consider for a moment that plumbing systems protect health, industrial PVF systems keep cities and industries working, heating and cooling systems increase productivity, and refrigeration promotes health, safety, and enjoyment. In the United States, thousands PHCP/ Industrial PVF wholesaler-distributor locations are generating billions of dollars in wholesale sales. It is an exciting and very competitive industry, and managing a successful company requires cooperative efforts from educated and motivated employees. To sell products in a highly competitive atmosphere, it is crucial that all employees understand the products their company sells. Employees must be knowledgeable enough to provide customers with the products they need to keep their operations running smoothly.

What you will learn from this training

In the ProductPro® courses, you will learn about a wide variety of basic products. You will learn what the products are and how they are used. You will pick up the vocabulary needed to talk intelligently about the products so you can help your customers and communicate effectively with your colleagues. You will learn how to order or specify each type of product. In addition, you will learn about some products that your own company does not carry because your customer may request them and you need to be able to offer an alternative product or find the product from another source.

How the course is organized

The ProductPro® courses are divided into separate chapters, and each chapter contains separate sections that cover a particular category of products. After reading each section within the given chapter, you will test your progress with a short quiz that you can correct yourself. The course provides a Glossary of Terms at the back of the book to help you develop the vocabulary needed to enhance your ability to communicate well with your customers and colleagues. The glossary terms are also highlighted in the text.

At the end of each self-correcting quiz, you will find Applying What You've Learned exercises so you can use the new information you have learned within your own company.

Once you understand the basic concepts presented, know the important facts, and can confidently answer the questions correctly on all the quizzes, you are ready to take the final course exam.

How to complete the course

The exam has 60 questions, which are graded automatically. Each question has only one correct answer.

When you are ready to take the finally exam to earn your Certificate of Completion, please email ASA at info@asa.net. ASA staff will contact you with information about how to register for and take the final exam.

Some hints for a successful course completion

Read the learning objectives

Read the learning objectives at the beginning of each chapter. They will tell you what you should know when you complete the course. Go back after you read the chapter material and ask yourself if you are confident in your command of the material. If you are not, reread anything you did not understand. To help clarify the material you did not "get" the first time, ask your supervisor or colleagues questions.

Search for the important ideas

Use a highlighter marker or a pen to highlight or underline the most important points as you read. Think about how each idea relates to the rest of the chapter. Write notes in the margins about points you don't understand or about how the material you read applies to your own company.

Ask lots of questions

Ask your supervisor or mentor about any points you do not understand. Ask if the products you are studying are carried by your company. Ask how well the products sell, and how important are they in the overall inventory.

Apply what you are learning to your job

Always think about what you have just read or learned. Compare your company's products to the products you have read about in the book. Do the *Applying What You've Learned* exercises using the real setting of your job.

Pace yourself in your studying

Don't try to complete the course all at once. You will remember what you learn more effectively if you make sure you understand each chapter thoroughly before you move on to the next. Take some time to "plug in" what you have just studied before acquiring more new information.

Be proud of what you have accomplished
When you successfully complete the course, be sure to proudly display your course certificate. You earned it.

Commit to learning something new every day
This course is just one step in developing your professional knowledge and your career skills. Read industry trade journals, study the manufacturers' literature and attend any training the manufacturers offer. Listen to what company and industry experts say. Continue to enthusiastically take any additional training your company offers.

Visit the ASA Education website at www.asa.net regularly to find out about other learning opportunities to advance your career.

Acknowledgements

Developing new editions of the *ProductPro® Product Knowledge Training* courses is an ambitious undertaking. In this course, many individuals shared their expertise, input, and resources to significantly improve the interest and energy in the program. We are grateful to Andy Nord with Nord Consulting, who acted as the primary author of this course. Also of special value were those reviewers, such as Shaun Opsahl of First Supply LLC, Cyndee Pilbeam of WinWholesale and Jerry Radomski of Milwaukee Valve Company, who thoroughly and diligently reviewed the course text, quizzes, illustrations, and final exam to ensure accurate and highly readable information. Their expertise and experience ensure that this high-level content demonstrates real world applications employees can put to work immediately in their day-to-day duties.

The Foundation also expresses its very special gratitude to the visionaries who established and led the charge to develop the Karl E. Neupert Endowment Fund. Contributions that established the Fund were provided by hundreds of manufacturers, wholesalers, and individuals who recognized the need for a permanent endowment fund that would ensure the ASA Education Foundation's ability to provide programs needed by the industry in perpetuity. Their generous contributions continue to have a major impact on the education and training opportunities available to the industry. We are deeply grateful for their commitment.

– The ASA Education Foundation

Table of Contents

continued

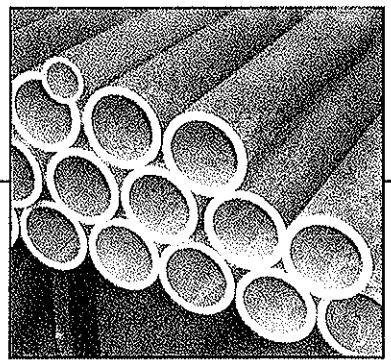
Table of Contents

1 INTRODUCTION TO PIPE

LEARNING OBJECTIVES

When you finish this Chapter you will be able to:

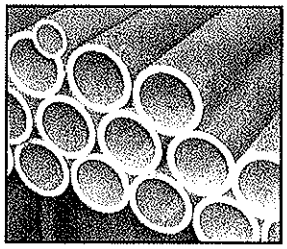
1. Recognize and use common terms related to pipe.
2. Describe the two basic types of piping systems that make up a total plumbing system.
3. Read and understand pipe specifications.
4. Describe the four most commonly ordered types of pipe ends.



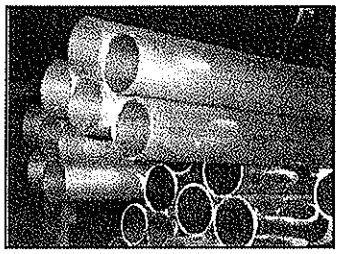
Common Pipe Terms

The core products of the plumbing industry are pipe and tube. National standards for the United States Standard Tapered Pipe Thread define the difference between pipe and tube.

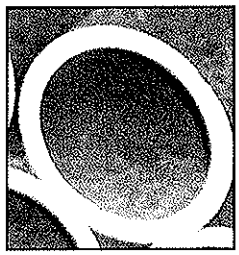
PIPE AND TUBE



PIPE
is a cylindrical conductor with a wall thickness sufficient to receive a standard pipe thread.



TUBE
is a cylindrical conductor with a wall thickness less than that needed to receive a standard pipe thread.



WALL
is the term for the structure shaped to conduct the flow.

PVF 1.1.01

Traditionally, the difference between pipe and tube has been based on wall thickness. Pipe wall is thick enough to allow pipe to be screwed to other pipe. In general, tube wall is too thin to allow connection by screwing. However, as you will see in later units, modern methods of manufacturing have resulted in tube with thin walls that can be threaded. The most commonly accepted difference between pipe and tube is that tube walls are thinner. Also tubing is measured using the outside diameter (O.D.) while pipe is measured using the inside diameter (I.D.).

Pipe or tube can be made from a variety of materials. In the plumbing, heating, and cooling industry, pipe is usually made of either metal or plastic. The word "pipe" is used for both singular and plural references.

Many different metals are used in the manufacture of pipe and tube. While metals are sometimes used in their pure or almost-pure forms, metals are also used in alloys. An **ALLOY** is a combination of two or more metals (or a metal and a non-metal substance) which are heated until they blend together to form a new material.

Several factors contribute to the deterioration of metal and metal alloys. Two major factors are corrosion and galvanic action. **CORROSION** is the deterioration of metals caused by chemicals or materials in the air, water, and soil. Corrosion that occurs in metals that contain iron is commonly called rust, tuberculation, or scale. The velocity of fluids through the piping system also causes a phenomenon known as corrosion erosion, where the constant scouring of the pipe and fitting walls removes material resulting in a reduction of wall thickness.

GALVANIC ACTION is the destruction of a metal or metal alloy caused by an electrical current, which can form when two different metals touch each other and moisture is present. When pipe of different metals are used in one system, special connectors called **DIELECTRIC ADAPTERS**, or "insulators," are used to keep the two metals from making contact.

Metals can be divided into two groups: ferrous and non-ferrous. **FERROUS METALS** contain iron. Ferrous metal pipe is strong and generally not affected by heat or cold. It is easily threaded to allow piping systems to be taken apart if necessary. Iron alloys, steel, and stainless steel are ferrous metals used in the manufacture of pipe and tube.

NON-FERROUS METALS do not contain iron. Non-ferrous metals will not rust. Copper and its alloys, brass and bronze, are the most popular non-ferrous piping metals. Aluminum and other non-ferrous metals are also used in the manufacture of pipe and tube.

Plastics are another major division of pipe and tube materials. Plastic is non-corrosive and usually much lighter in weight than metal. These and other advantages have made plastic piping popular in many residential and industrial applications, depending on local codes.

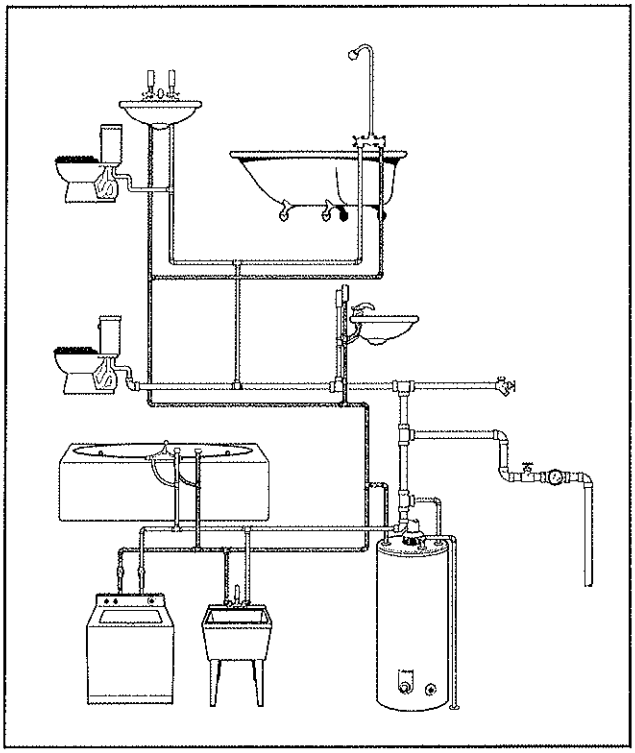
FERROUS, NON-FERROUS AND NON-METAL PIPING MATERIALS

FERROUS METALS	NON-FERROUS METALS	NON-METAL MATERIALS
Cast iron	Copper	Plastic
Malleable iron	Brass	Glass
Galvanized steel	Aluminum	
Stainless steel	Lead	
Black steel	Bronze	

PIPING is the term used to describe an assembly of pipe and/or tube used in a plumbing system. There are two major types of plumbing piping systems: supply systems and drain, waste, and vent systems.

A **SUPPLY-PIPING SYSTEM** is used to distribute liquids or gases throughout a building.

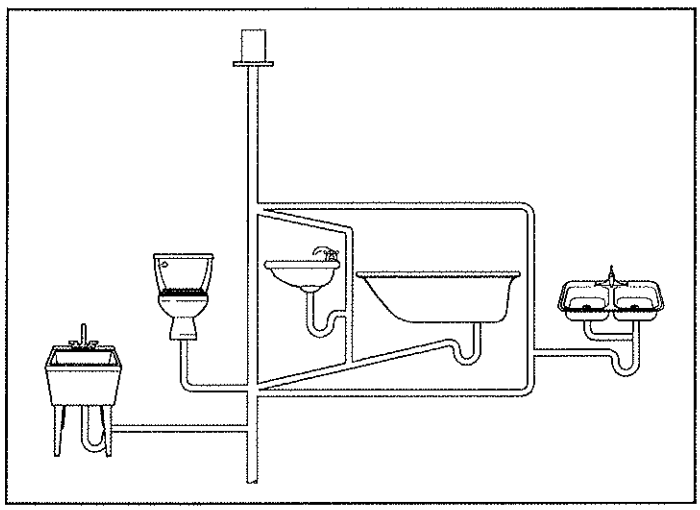
SUPPLY PIPING SYSTEM



PVF 1.1.03

A **DRAIN, WASTE AND VENT (DWV) PIPING SYSTEM** is used to collect and transport solids, liquids, and gas waste out of a building.

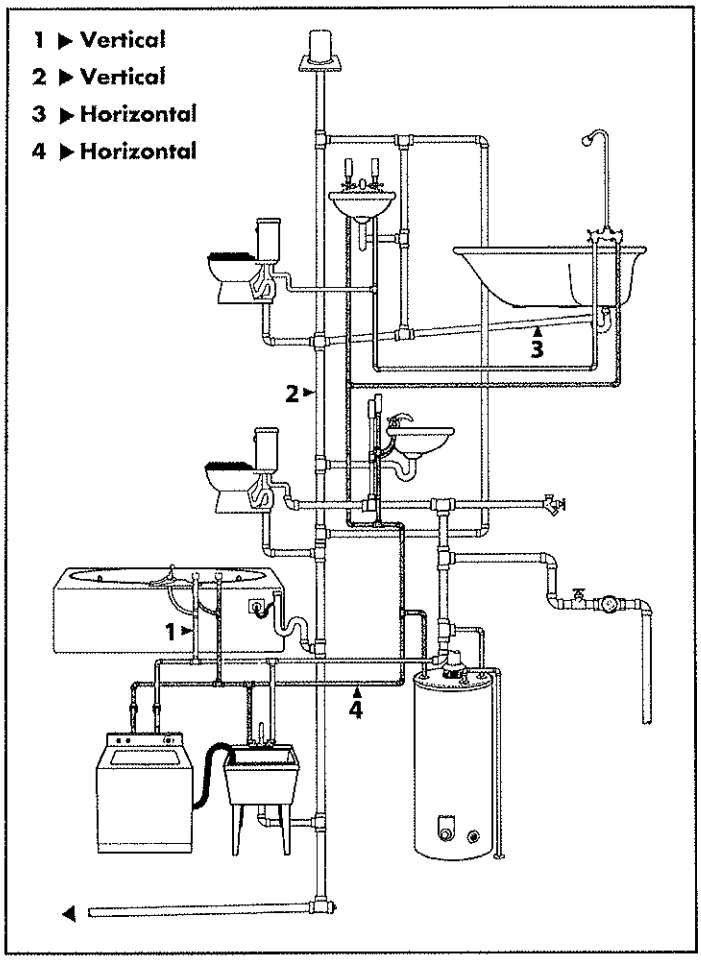
A DRAIN, WASTE AND VENT (DWV) PIPING SYSTEM



PVF 1.1.04

The **RUN** is the part of pipe that lies on a straight line in the direction of the flow of materials. A run can be either horizontal (across) or vertical (up and down), as shown in illustration PVF 1.1.05. A vertical pipe is called a **RISER** in a supply system. In a DWV system, a vertical pipe is usually called a **STACK**.

VERTICAL AND HORIZONTAL PIPE



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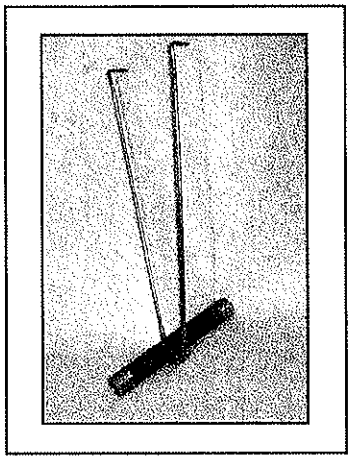
HANGER OR PIPE SUPPORT transfers load from pipe to the supporting structure. The load includes pipe, contents of pipe, fittings, and insulation.

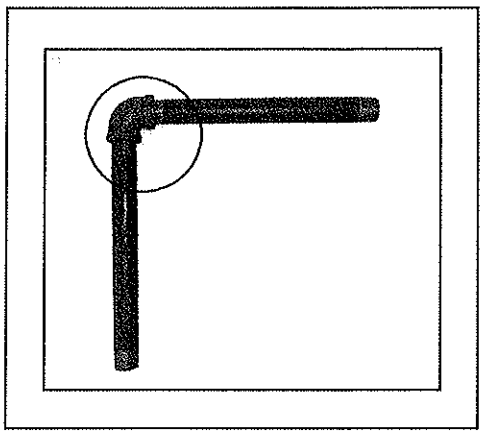
PIPE HANGERS



PVF 1.1.06

A **JOINT** is any point in a piping system at which a connection is made. Joints can be created by screwing, welding, soldering, fusion, gluing, applying pressure and using mechanical coupling devices.

PIPE JOINT



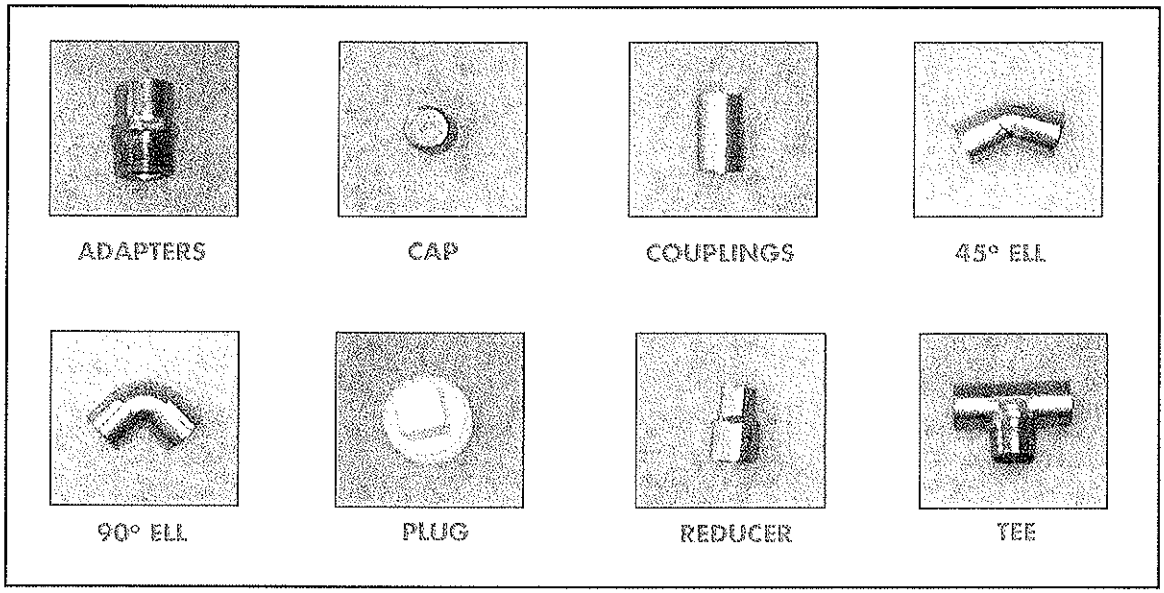
PVF 1.1.07

Every piping system has three basic elements:

- **PIPE** or **TUBE** to conduct the flow
- **FITTINGS** to connect the pipe or tube
- **VALVES** to control the flow.

FITTINGS have two general uses, which are to join two or more pieces of pipe or to close off the end of a pipe. A fitting may connect pipe in a straight line, change the direction of the flow, reduce or increase the flow, or close the pipe end to stop the flow.

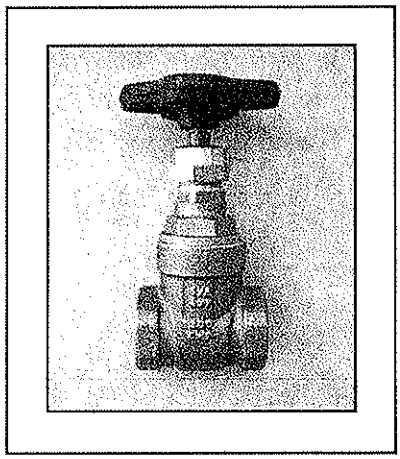
SOME COMMON FITTINGS



PVF 1.1.08

A **VALVE** will start, stop, or regulate the flow with a moveable part which opens or obstructs the passage through the body of the valve.

GLOBE VALVE



PVF 1.1.09

REVIEW OF COMMON PIPE TERMS

Answers appear on page 33

1–3. The basic parts of any piping system are _____, _____, _____.

4. Tube is generally ordered based on its _____ diameter.

5. What is the term used to describe the deterioration of metals caused by chemicals or materials in the air, water or soil?
   a. Galvanic Action b. Corrosion

6. _____ is the destruction of a metal or metal alloy caused by an electrical current, which can form when two different metals touch each other and moisture is present.

7–8. _____ are metals that contain iron and _____ are metals that do not contain iron.

9. Which of these types of pipe would be non-ferrous pipe?
   a. Iron b. Copper c. Stainless steel d. Galvanized steel

10. What is a material that is made up either of two metals or a metal and a non-metal?
   a. Alloy b. Pipe dope c. Polymer d. Compound

11. In plumbing terminology, the DWV stands for
   _____ _____ _____.

12. What is the term for any portion of the piping system that lies on a straight line in the direction of the flow through the system?
   a. Joint b. Run

13–14. The vertical pipe in a supply system is called a _____ and in a DWV system a vertical pipe is usually called a _____.

REVIEW OF COMMON PIPE TERMS

Answers appear on page 33

15. The point at which a pipe connection is made is called _____.

16. What is the term for a device that is designed to either close off the end of a pipe or join two or more pieces of pipe?
    a. Stop b. Fitting

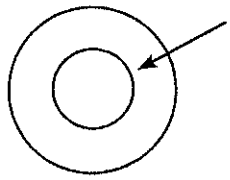
17. When pipes that contain different metals are used in one system, special connectors called _____ _____, or "insulators," are used to keep the two metals from making contact.

18. A _____ _____ _____ is used to bring liquids or gases into a building or to distribute them through the building.

19. Which parts of a piping system stop, start or regulate flow through the system?
    a. Valves b. Hangers

20. _____ transfer the load from the pipe to the supporting structure.

21. This part of a pipe is called the _____.



APPLYING WHAT YOU HAVE LEARNED:

By observing and asking questions, fill in the blanks. If you are not sure of the answers, ask your supervisor.

A. List the kind(s) of ferrous pipe commonly sold in your company.

_____

_____

B. Circle the markets for which your company sells supply pipe.
   Residential/single family homes
   Residential/multiple family (apartments)
   Industrial market (factories, processing plants)
   Institutional market (schools, hospitals, etc.)

Piping Systems

A supply piping system is an assembly of pipe, fittings and valves used to bring gas, oil, air, chemicals or water from a point of supply to a point of usage. Because it is made to withstand a specified level of internal pressure, supply pipe is also called **PRESSURE PIPE**. Within a supply system, pipe, valves and fittings are all pressure-rated products.

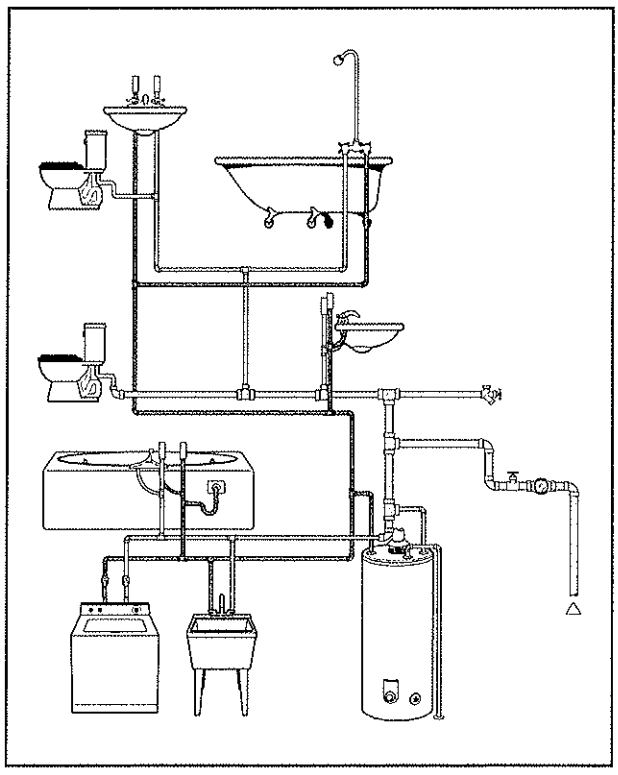
Household Supply Systems

The most common supply system is the household water system. In the illustration below of a household supply piping system, you can see that the system may involve numerous fixtures.

FIXTURES include sinks, tubs, showers, toilets or any other devices that can demand and hold water from a supply line.

In addition to fixtures, a water supply system may involve a water meter, water heater, water filter, water softener or other pieces of equipment that affect the water before it reaches the point of usage.

HOUSEHOLD WATER SUPPLY SYSTEM



PVF 1.1.10

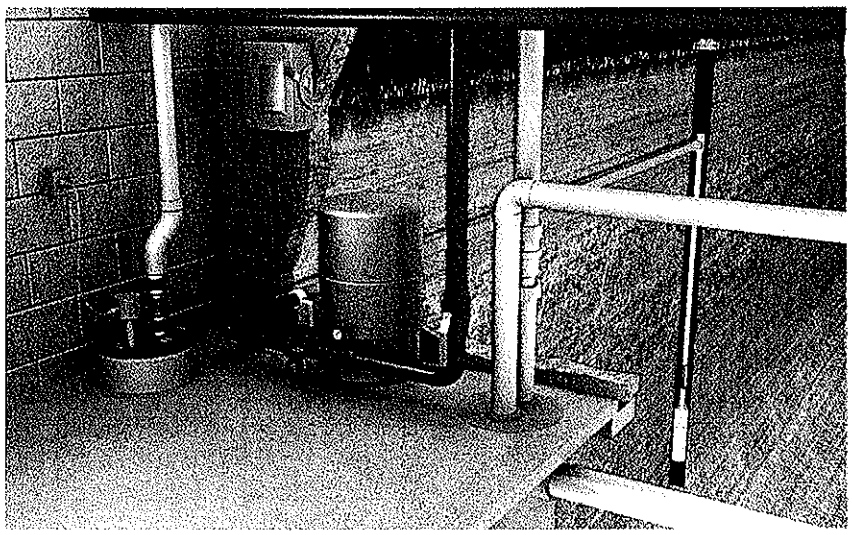
The source of water in a household water supply system may be a municipality (city or town), a utility company (company that provides water to many people), or a private water source (usually a private well).

Force is needed to make the fluid flow from the source to the point of usage. Sometimes a pump may be used to drive the fluid through the piping system. A **PUMP** is a device that raises, transfers, or moves fluids by suction, pressure, or both.

In some supply systems, a **PRESSURE TANK** is used to store both the water and the pressure needed to move the water through the supply system. In well systems, both pumps and pressure tanks are usually used.

Hydronic heating systems are another type of piping system used in the plumbing and heating industry (see page 15).

WATER WELL SYSTEM



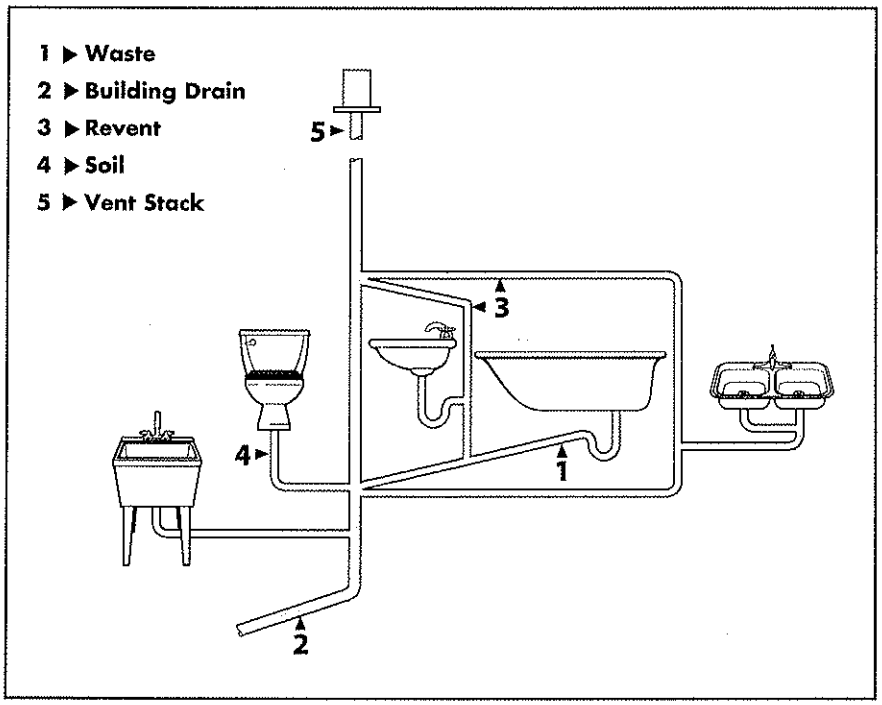
WATER SUPPLY SOURCE

PVF 1.1.11

Drain, Waste and Vent (DWV) Systems

The second major household plumbing system is the Drain, Waste and Vent piping system. A DWV SYSTEM (also called a sanitary system) has two functions. It carries away excess fluids and wastes (Drain/Waste function), and it vents fresh air in and sewer gases to the outside (Vent function).

TYPICAL DWV SYSTEM



PVF 1.1.12

The *soil line* is the part of a DWV system inside a building that carries sewage from the toilets to the building or house drain.

The *waste line* carries the waste water from tubs, sinks, and lavatories to the building or house drain. Soil and waste lines are often combined to form a single drainage system, like the one shown above.

Tubular goods link sinks, tubs, and lavatories to the drainage piping, including the waste line. A laundry-tray pump is sometimes installed under the laundry sink to pump laundry water into the waste line.

The *building drain* receives the discharge from both the soil line and the waste lineand conducts it to the sewer outside the wall of the building.

The *vent stack*, also called the "stack vent," relieves pressure or vacuum in the system, usually through the roof. The same pipe run that is called the vent stack above the roof is called the *waste stack* at lower levels, usually up to the highest connection to a fixture. From that connection point up through the roof, it's called the vent stack. (Stack is the general name for any vertical line in a DWV system.) A proper vent is very important in the correct operation of a DWV system.

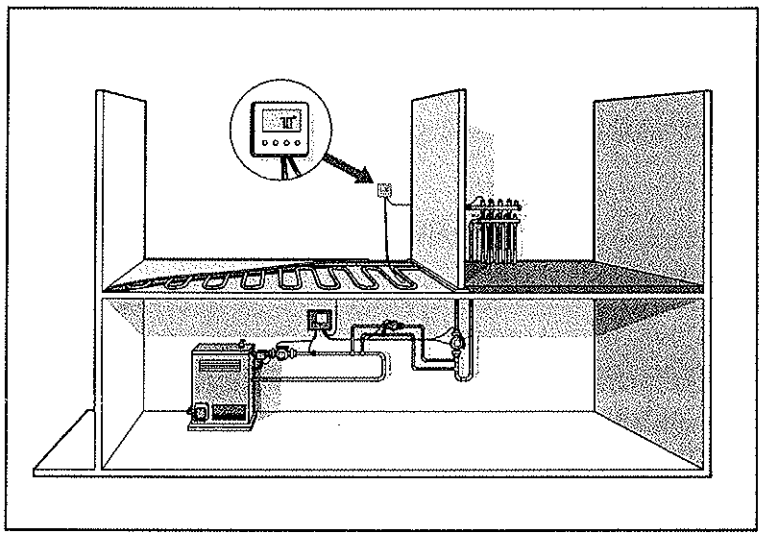
The *revent pipe* is connected to the vent stack to provide circulation between the vent and the soil and waste pipes- and equalize pressure in the DWV system.

Other Piping Systems

SUMP PUMPS are used to remove unwanted ground water that collects in a drainage pit called the "sump." The piping to carry this unwanted ground water is not part of the DWV or the supply system. Sump pumps are commonly used to relocate the unwanted ground water from collection points around a structure. Leaving the collected water may cause damage or erosion that could compromise the integrity of the structure. The need for sump pumps and the codes to control sump pump installations vary depending on the locality. Check with your supervisor to see how commonly sump pumps are used in your area and what codes apply.

A **HYDRONIC HEATING SYSTEM** includes a source to add heat energy to water; a system of pipe, fittings, and valves to control water flow; and heat-releasing devices such as radiators, baseboard heat outlets, or under-floor tube. Piping systems used in hydronic applications must withstand the high temperatures as indicated in the heating specifications.

HYDRONIC HEATING SYSTEM



PVF 1.1.13

Piping systems also are used for industrial purposes. The piping systems used in manufacturing plants, factories, processing plants, laboratories, and other commercial situations are called **INDUSTRIAL PIPING** or "process piping." The selection of pipe, fittings, and valves for industrial piping systems depends on the type of material to be carried, the temperatures involved, the pressure required, and many other situation-specific factors.

The materials used for supply and DWV piping systems vary from place to place. Geographical conditions, local codes, and cost all affect the choice for both supply and DWV pipe.

Supply pipe must be pressure-rated pipe and meet specifications related to water quality. DWV piping must have gentle curves so no waste is caught. It must also resist damage from drainage and waste materials, which can be very corrosive. Be sure to learn what kinds of pipe are used in your area.

REVIEW OF PIPING SYSTEMS

Answers appear on page 33

1. What is another term for a supply pipe?
   a. Soil pipe b. Pressure pipe

2. Which is an example of a fixture?
   a. Toilet b. Hydronic heating system

3. Where would a riser be found?
   a. DWV system b. Supply system

4. A _____ is a device that raises, transfers, or moves fluids by suction, pressure, or both.

5. What is the portion of a household plumbing system that carries away waste water or sewage called?
   a. Sump system b. DWV system

6. _____ _____ is the part of a DWV system inside a building that carries sewage from the toilets to the building or house drain.

7. What is the name for the piping that carries waste materials from the toilets to the house drain?
   a. Waste line b. Soil line

8. _____ _____ link sinks, tubs, and lavatories to drainage piping, including the waste line.

9. _____ _____ receives the discharge from both the soil line and waste line and conducts it to the sewer outside the wall of the building.

10. What is a vertical pipe called in a DWV system?
    a. Stack b. Riser

REVIEW OF PIPING SYSTEMS

Answers appear on page 33

11. What stabilizes the pressure in a DWV system?
    a. Vent stack b. Waste line

12. _____ _____ is connected to the vent stack to provide circulation between the vent and the soil and waste pipes and equalize pressure in the DWV system.

13. A _____ _____ is used to remove unwanted water that collects in a drainage pit called the "sump."

14. _____ _____ _____ includes a boiler to heat water; a system of pipe, fittings and valves to control water flow; and heat-releasing devices, such as radiators, baseboard heat outlets or under-floor tube.

15. The piping systems used in manufacturing plants, factories, processing plants, laboratories and other commercial situations are called _____ _____ or "process piping".

APPLYING WHAT YOU HAVE LEARNED:

By observing and asking questions, fill in the blanks. If you are not sure of the answers, ask your supervisor.

A. List the kinds of pipe (materials) your company sells for DWV systems.

_____

_____

_____

B. Are sump pumps common in your area?
   Yes No

   If so, what brands do you carry?

   1. _____ 2. _____ 3. _____

Pipe Specifications

Pipe is ordered using several specifications:

- Material from which pipe is made
- Amount of pipe, expressed in length
- Wall thickness of the pipe, expressed in terms of the "Type"or "Schedule"
- Pipe diameter
- Type of pipe ends.

Pipe Length

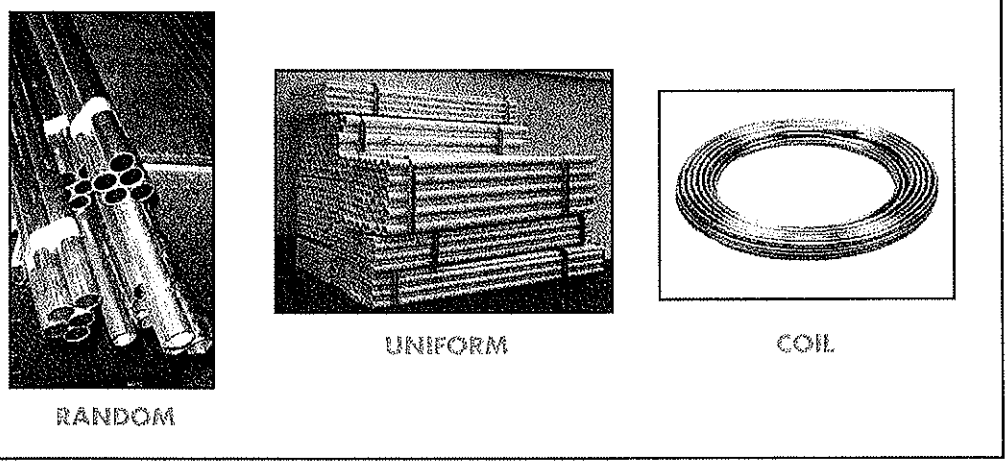
Pipe or tube may be shipped either in coils or straight lengths. Straight pipe may be in either uniform or random lengths. The specific lengths and shipping options depend upon the pipe material.

Pipe is usually ordered in lengths measured by feet and inches. These are usually expressed by the following symbols:

Feet **expressed as** ′ **or** ft.

Inches **expressed as** ″ **or** in.

HOW PIPE IS SHIPPED



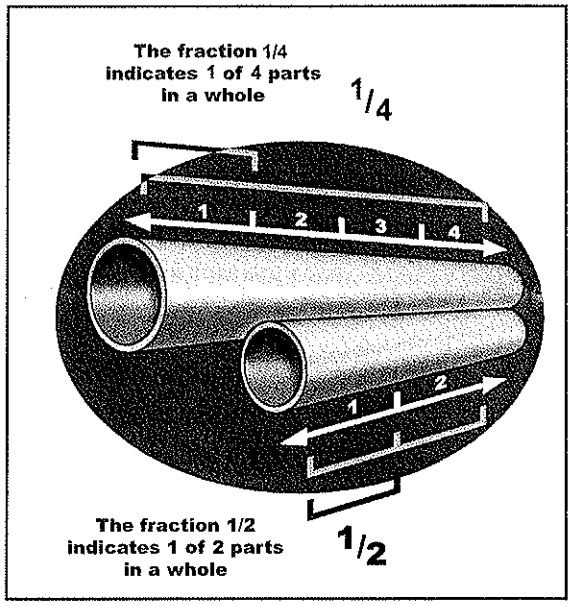
PVF 1.1.14

The purpose of any fraction is to indicate the number of parts, or fraction, of a whole as compared to a whole. The bottom number of a fraction (denominator) is the total number of parts in the whole. The top number (numerator) indicates the number of parts being considered. For example, if the whole number of parts used is ten and only eight parts are used, 10 is the bottom number (denominator) and 8 is the top number (numerator). The fraction would be written as $^{8}/_{10}$.

The method of measuring determines how the denominator will be determined. For example, a machinist or steel mill may divide the inch into 1000 pieces for an extremely accurate measurement. Conversely, someone cutting pipe in a supply house may divide an inch into 8 pieces for measurements that are easy to read on the ruler, and close enough to use on a job site.

For example, the fraction ½ indicates that the whole has been divided into two parts and that only one of those two parts is being considered. The fraction ¼ indicates that one of four parts in a whole is being considered.

MEASURING PIPE IN FRACTIONS OF AN INCH



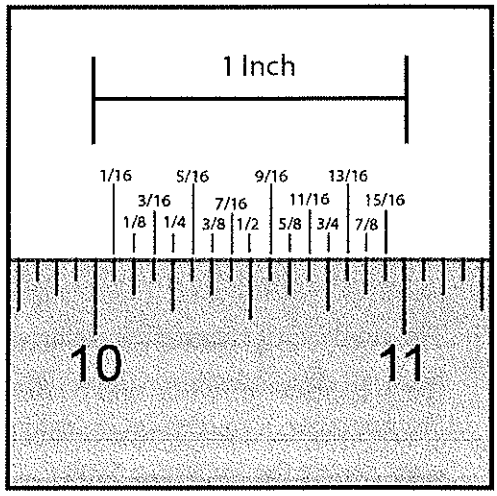
PVF 1.1.15

When making a cut on a piece of material, you may hear a dimension such as ten feet, eleven inches and three eighths (written as 10′ 11-⅜″. This may sound confusing at first, but the dimension can easily be broken down to understandable terms. Take a second and go find a ruler that is longer than 12 feet, so you can follow along with this example. In this example, more than 10 feet but less than 11 feet of material is needed.

Extend the ruler to 11 feet. Notice the smaller divisions between the 10 foot mark and the 11 foot mark.

To continue the measurement (10′ 11-⅜″) the 11 inch mark must be found. This denotes 10′-11 inches on the ruler, close to the measurement desired, but still not quite enough. An additional ⅜ of an inch must be provided to be complete.

To find the $^{3}/_{8}$ portion take a closer look at the scale between each inch. The scale uses lines of varying lengths to divide the inch into segments. The number of divisions determines how accurate a measurement can actually be. In the example shown the inch is divided into 16 pieces. This means a measurement can be made to the nearest $^{1}/_{16}$th of an inch. If the ruler has 32 divisions then the accuracy increases to the nearest $^{1}/_{32}$. Imagine a ruler with 64 or 128 divisions!



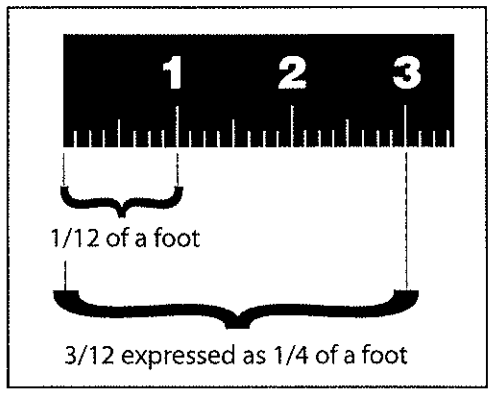
It is apparent on the ruler that although there are 16 divisions, the dividing marks consist of varying lengths. These marks make it easy to identify the accuracy desired. For example: the largest mark is right in the center. This divides the inch into two equal sized pieces, also known as half inches or ½ ".

The next largest lines in the ruler divide the inch into 8 equal pieces. (Each ¼ is divided in half). These marks make it easy to measure to the nearest ⅛ of an inch. To find the measurement ⅜ of an inch one simply counts 3 of the larger divisions from left to right. (⅛, ²⁄₈ ((¼)) ³⁄₈)

The measurement 10′ 11-$^{3}/_{8}$″ can now be marked and an accurate cut can be made on the mark.

There are 12 inches in a foot; 1 inch is $^{1}/_{12}$ of a foot. So, 3 inches would be $^{3}/_{12}$ of a foot. This measure can also expressed as ¼ of a foot, or 0.25 inches.

MEASURING PIPE IN FRACTIONS OF A FOOT



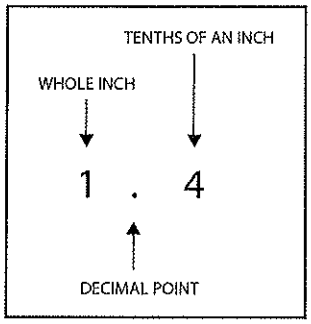
PVF 1.1.16

Pipe Wall Thickness

The thickness of a pipe wall is often measured in fractions of an inch. Measurements taken to the nearest ⅛, or even 1/16, would not be small enough to accurately describe the wall thickness of the pipe, which can be less than 1/16 inch metal.

To make measurements easier to work with pipe walls need to be measured accurately so precision equipment is used. This equipment uses 1/10 inch increments. A decimal point is used to show where the whole inch stops and the fraction of an inch begins.

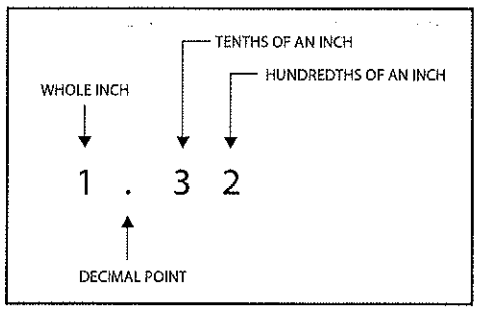
PLACE VALUES OF DECIMAL WITH ONE PLACE



PVF 1.1.18

Where there is one number to the right of the decimal point, that number is a fraction of an inch that has been divided into 10 parts. The expression 1.4" indicates a distance of 1 full inch plus 4 of 10 parts of another inch (4 divided by 10 equals .4)

PLACE VALUES OF DECIMAL WITH TWO PLACES

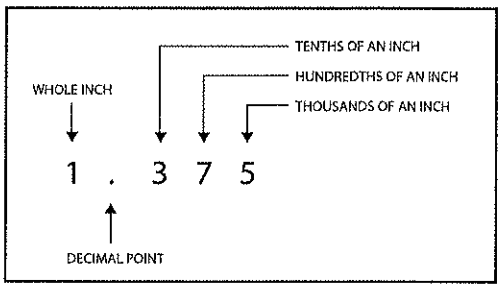


PVF 1.1.18

When there are two numbers to the right of the decimal, the inch has been divided into 100 parts. The expression 1.32" indicates 1 full inch and 32 hundredths of another inch. (32 divided by 100 equals .32)

If there are three numbers to the right of the decimal, the inch has been divided into 1,000 parts. The expression 1.375" indicates 1 full inch and .375 of 1,000 parts of another inch. (375 divided by 1000 equals .375)

PLACE VALUES OF DECIMAL WITH THREE PLACES



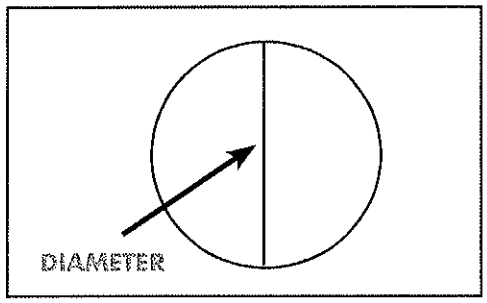
PVF 1.1.18

Pipe wall thicknesses are required to be uniform for manufacturers and specifiers. The large amount of options is simplified into categories known as schedules. When referring to a typical pipe wall thickness, the term "schedule" or "SCH" is often used. SCH. 40 is referred to as a standard wall, while thicker walls would have higher schedules, such as SCH. 80 Thinner walls are represented by smaller schedules, such as SCH. 10.

Pipe Diameter

To understand pipe specifications, you also have to understand a little about circles, since pipe walls are circular. Two parts of a circle, the diameter and the radius, are important in working with pipe and fittings. The **DIAMETER** of a circle is the length of a straight line that passes directly through the center of the circle from one side of the circle to the other. Diameter is critical in ordering pipe and tube.

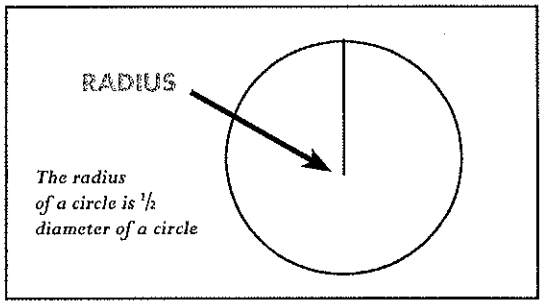
DIAMETER OF A CIRCLE



PVF 1.1.19

The **RADIUS** is the distance from the center to any point on the line forming the circle. The radius is an important consideration in ordering some fittings.

RADIUS OF A CIRCLE

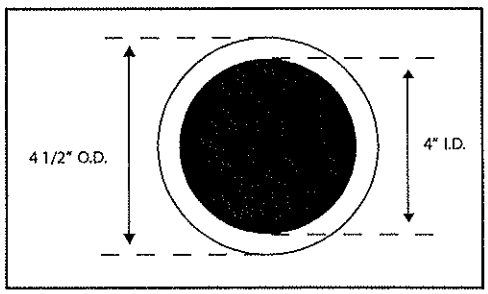


PVF 1.1.20

All pipe has <u>two</u> diameters: an outside diameter and an inside diameter. The **OUTSIDE DIAMETER (O.D.)** measures the distance from one outside rim of the pipe wall through the center of the pipe to the outside rim of the opposite pipe wall.

The **INSIDE DIAMETER (I.D.)** measures the distance from the inside rim of the pipe wall through the center of the pipe to the inside rim of the opposite pipe wall.

O.D. = I.D. + (WALL THICKNESS X 2)



PVF 1.1.21

In the illustration PVF 1.1.21, the O.D. is 4 ½" and the I.D. is 4 inches. The wall of this pipe is ¼ " thick. The difference between the O.D. and the I.D. is the thickness of the pipe wall x 2, since the O.D. includes the wall thickness at both edges.

Pipe Size

Pipe measurement is frequently expressed in terms of nominal pipe size (NPS), sometimes called simply "nominal size" or "NS." **NOMINAL PIPE SIZE (NPS)** is the standard measurement for any pipe as indicated by the **AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)** specification system. For pipe with an I.D. under 14" , the NPS size is approximately the same as the I.D. For pipe with an I.D. of 14" or greater, the NPS is actually the same as the O.D.

However, the term **ACTUAL SIZE** refers to the real measurement (as measured by ruler) for either the I.D. or the O.D. of pipe. If you measured by ruler, the NPS size and the actual size are not the same. For example, if a common steel pipe is indicated as having an I.D. of ½ inch (.500 ") NPS, the actual I.D. (by ruler measurement) would be .622 inches, according to the ANSI specifications for pipe manufacture. Exact dimensions are provided in a specification sheet called a pipe schedule as in schedule 40 pipe.

Pipe and tube are more often ordered by NPS than by actual size.

SCHEDULE 40 PLASTIC, STAINLESS AND BRASS PIPE

SIZE	½"	¾"	1"	1-¼"	1-½"	2"	2-½"	14"
OD	0.840	1.050	1.315	1.660	1.900	2.375	2.875	14
ID	0.622	0.824	1.049	1.380	1.610	2.067	2.469	13.13
WALL THICKNESS	0.019	0.113	0.133	0.140	0.145	0.154	0.203	.44

In addition, the actual sizes of pipe with the same NPS designation will not differ based upon the material from which the pipe is made. For example, iron pipe with an NPS of 1 inch (1") will have the same actual I.D. and O.D. as stainless steel pipe with the NPS sizing of 1 inch. The relationships between NPS sizes and actual sizes are all spelled out in the ANSI rules for the manufacture of pipe.

Sometimes you will hear references to Iron Pipe Size, or IPS. ANSI set its first standards for pipe made of iron, so they were referred to—and sometimes still are referred to—as Iron Pipe Size. However, **IRON PIPE SIZE (IPS)** is actually the same as NPS, and either term is used to identify sizes of pipe made from any materials. So, NPS = IPS.

By this point you should understand the basic terms and concepts related to the first four of the five types of specifications involved in ordering pipe and tube:

- Material from which the pipe is made
- Amount of pipe, expressed in length
- Wall thickness of the pipe expressed as schedules
- Diameter of the pipe.

In the next section, we will consider the fifth specification for ordering pipe: type of pipe ends.

REVIEW OF PIPE SPECIFICATIONS

Answers appear on page 34

1–3. List the three ways that pipe may be shipped.

_____, _____, _____

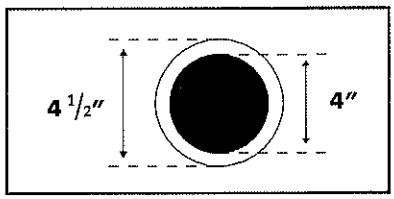
4.–5. List two other ways that "8 feet 5 inches" may be expressed.

_____, _____

6. Pipe is usually ordered in lengths measured by _____ and _____.

7. When comparing schedule or SCH 40 and schedule or SCH 80, the SCH _____ pipe refers to a standard pipe and SCH _____ refers to a heavier pipe.

8. What is the O.D. of the pipe shown in the drawing? _____



9. How would 2 feet, 6 inches be written as a decimal fraction?

_____

10. If a pipe has an O.D. of 2 ½ inches (2.5 inches) and an I.D. of 2 inches (2.0 inches), what would be the wall thickness of the pipe?

_____

11. The _____ of a circle is the length of a straight line that passes directly through the center of the circle from one side of the circle to the other.

12. The _____ is the distance from the center to any point on the line forming the circle.

REVIEW OF PIPE SPECIFICATIONS

Answers appear on page 34

13. The _____ measures the distance from one outside rim of the pipe wall through the center of the pipe to the outside rim of the opposite pipe wall.

14. The _____ measures the distance from the inside rim of the pipe wall through the center of the pipe to the inside rim of the opposite pipe wall.

15. What is the Outside Diameter of a pipe with an Inside Diameter of 7″ and a ½″ wall?
    a. 7 ½″ b. 8″

16. _____ _____ _____ is the standard measurement for any pipe as indicated by the _____ _____ _____ _____ specification system.

17. The term _____ refers to the real measurement (as measured by ruler) for either the I.D. or the O.D. of pipe.

18. The NPS of pipe under 14″ is approximately the same size as the:
    a. I.D. b. O.D.

APPLYING WHAT YOU HAVE LEARNED:

By observing and asking questions, fill in the blanks. If you are not sure of the answers, ask your supervisor.

A. What kinds of pipe or tube does your company receive in coils?

_____ _____ _____

B. What NPS size pipe is most commonly used for water supply pipe in your area?

_____

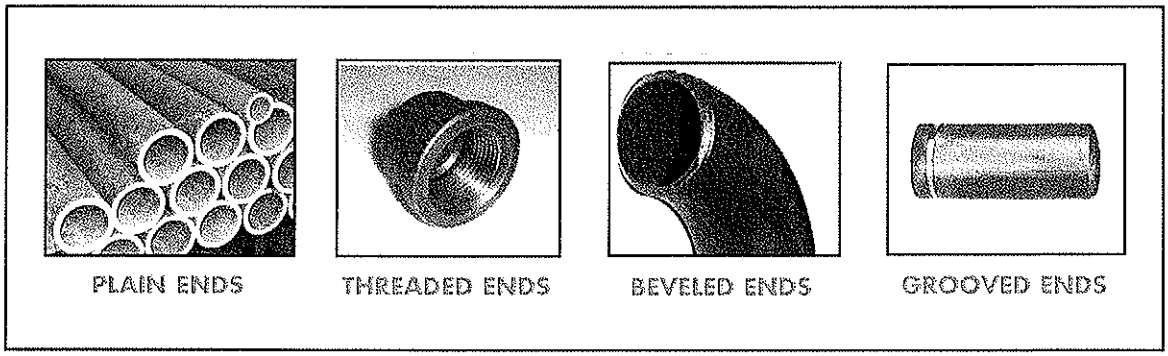
Pipe Ends

The method used to join two pieces of pipe determines the type of pipe end required. The type of ends available differ, depending upon the materials from which the pipe is made and the application for which it is to be used. Any point in a piping system at which a connection is made is called a **JOINT**. A joint may connect pipe to pipe, pipe to fittings, or pipe to valves.

The four commonly ordered types of pipe ends are:

- Plain ends
- Threaded ends
- Beveled ends
- Grooved ends

COMMON TYPES OF PIPE ENDS



PVF 1.1.24

PLAIN ENDS have received no special end treatment and are left as they are cut—straight across. Pipe delivered with plain (straight) ends may be cut to size in the field, and the straight ends may be treated to allow for different methods of joining.

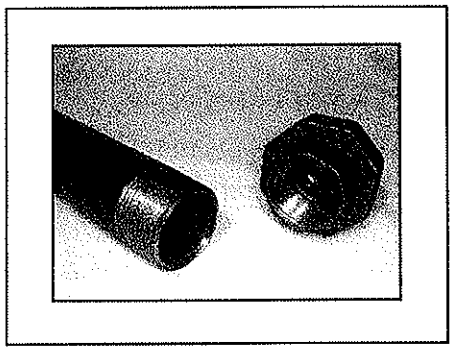
THREADED ENDS have regularly spaced grooves (threads), which allow the pipe to be connected in a threaded joint.

The walls of **BEVELED ENDS** have been cut at an angle and are used in brazing and welding applications.

GROOVED ENDS have one or two narrow cuts (grooves) in the outside wall. A coupling assembly, including a gasket, is used to make the joint.

Pipe can be threaded on the outside of the pipe wall or the inside of the pipe and fittings wall. Pipe ends that are threaded on the outside are said to have **MALE PIPE THREADS (MPT)**. Pipe ends that are threaded on the inside are called **FEMALE PIPE THREADS (FPT)**.

MALE AND FEMALE PIPE THREADS



PVF 1.1.25

There are industry standards to guarantee accurate, uniform pipe threads and ensure that threaded pipe joints are tight and leak-proof. Several agencies, including ANSI, set pipe thread standards that indicate the depth and width of threads.

A threaded joint is made by connecting a pipe end with MPT to fittings with FPT. To lubricate pipe threads and prevent corrosion, a thread lubricant, called **PIPE DOPE**, is often applied to the male threads. Lubricant is not applied to female pipe threads. Pipe dope, also called "thread compound," may be made of a variety of lubricating materials.

Tape

Tape acts as a sealing compound and makes the pipe fitting leak proof and pressure tight. Minor imperfections in the male and female pipe threads require a sealant to lubricate the mechanical connection and fill any voids in the threads through which fluid may find a path to leak through. This lubricant is also known as pipe dope, thread compound, or thread sealant. Thread sealant is applied to the male end of the joint, as application to the female fitting would allow the sealant to be pushed into the fitting and piping system. Another product known as thread seal tape, PTFE tape, or plumber's tape can be used to lubricate and seal the joint. The tape is supplied in spools of various sizes to aid in winding around the helical threads.

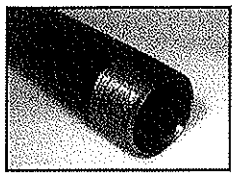
Joints

There are dozens of types of compounds used for a variety of applications. It is important to verify that the correct compound is supplied to insure a leak free joint.

REVIEW OF PIPE ENDS

Answers appear on page 34

1. What type of pipe end is shown here? _____.



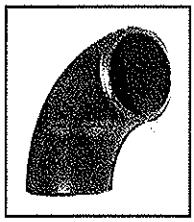
2. When FPT is used to describe fittings, it stands for:

_____ _____ _____.

3. Which term refers to a pipe end or fitting with the threads on the inside?

a. MPT b. FPT

4. What type of pipe end is shown here? _____.

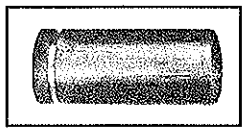


5. Any point in a piping system at which a connection is made is called a

_____.

6. What type of pipe end is shown here?

_____.



7. _____ _____ has one or two narrow cuts in the outside wall.

8. The _____ _____ _____

_____

sets standards for threading pipe.

REVIEW OF PIPE ENDS

Answers appear on page 34

9. Pipe ends that are threaded on the outside are said to have _____ _____ _____.

10. To lubricate pipe threads and prevent corrosion, a thread lubricant, called _____ _____ is often applied to the male threads. However it is never applied to the _____ _____ _____.

APPLYING WHAT YOU HAVE LEARNED:

By observing and asking questions, fill in the blanks. If you are not sure of the answers, ask your supervisor.

A. List several types (materials) of pipe that your company buys already threaded.

_____ _____ _____

B. List several types of pipe joint lubricant you sell.

_____ _____ _____

ANSWERS TO REVIEW QUESTIONS

CHAPTER 1

INTRODUCTION TO PIPE

Answers for REVIEW OF COMMON PIPE TERMS (pages 9–10)

1–3. Pipe, Valves. Fittings
4. Thinner
5. Corrosion
6. Galvanic Action
7–8. Ferrous Metals, Non-Ferrous Metals
9. b. Copper
10. a. Alloy
11. Drain, Waste, Vent
12. b. Run
13–14. Riser, Stack
15. Joint
16. b. Fitting
17. Dielectric Adaptors
18. Supply Piping System
19. a. Valves
20. Hangers
21. Wall

Applying What You Learned:

A. Depends upon the company
B. Depends upon the company

Answers for REVIEW OF PIPING SYSTEMS (pages 16–17)

1. b. Pressure Pipe
2. a. Toilet
3. b. Supply System
4. Pump
5. b. DWV System
6. Soil Line
7. b. Soil Line
8. Tubular Goods
9. Building Drain
10. a. Stack
11. a. Vent Stack
12. Revent Pipe
13. Sump Pumps
14. Hydronic Heating System
15. Industrial Piping

Applying What You Learned:

A. Depends upon the company
B. Depends upon the company

Answers for REVIEW OF PIPE SPECIFICATIONS (pages 24–25)

1–3. Uniform Lengths, Random Lengths, Coils

4–5. 8 ft. 5 in., 8 ′ 5 ″

6. Feet, Inches

7. SCH 40, SCH 80

8. 4 ½ inches

9. 2.5 feet
(6 inches = ½ foot which is expressed as .5 foot. So the correct expression is 2.5 feet)

10. ¼ inch (or .25 inches)
O.D. = I.D. + (wall thickness x 2)

11. Diameter

12. Radius

13. Outside Diameter (O.D.)

14. Inside Diameter (I.D.)

15. b. 8″ [OD=ID+(wall x 2)]

16. Nominal Pipe Size (NPS), American National Standards Institute (ANSI)

17. Actual Size

18. a. I.D.

Applying What You Learned:

A. Depends upon company

B. Depends upon company

Answers for REVIEW OF PIPE ENDS (pages 28–29)

1. Threaded

2. Female Pipe Threads (FPT)

3. b. FPT

4. Beveled

5. Joint

6. Grooved

7. Grooved Ends

8. American National Standards Institute (ANSI)

9. Male Pipe Threads (MPT)

10. Pipe Dope, Female Pipe Threads

Applying What You Learned:

A. Depends upon company

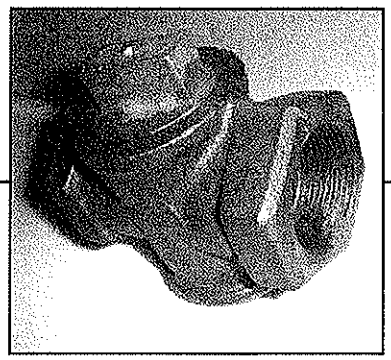
B. Depends upon company

2 INTRODUCTION TO VALVES

LEARNING OBJECTIVES

When you finish this Chapter you will be able to:

1. Recognize common valve terms.
2. Describe the basic functions of valves.
3. Recognize various types of valves used in PHCP systems.



Common Types of Valves

VALVES are devices used to control the flow of fluids and gas in a piping system. A **FLUID** is anything that can flow and easily change its shape. For centuries valves have been used to control the flow of water. Today, valves are used to control many fluids.

Valves perform three basic functions:

1. Turn the flow ON or OFF
2. **THROTTLE** (increase or decrease) the flow
3. Control direction of flow (prevent backflow).

On/Off Valves

Three types of valves are commonly used only as on/off valves. These are

- Plug valves
- Ball valves
- Gate valves.

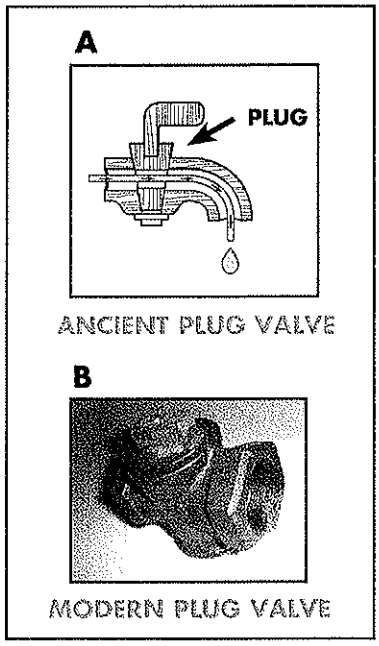
Globe valves and butterfly valves are **both** used to turn flow on/off and to throttle the flow.

PLUG VALVES are generally used to turn the flow completely ON or completely OFF. In some special cases, not covered here, plug valves may be used to balance and throttle the flow.

Some of the earliest valves were plug valves made of wood. A plug valve like the simple one shown to the right was used in ancient Pompeii, Italy, as early as 79 A.D. to control water in closed pipelines.

A modern **PLUG VALVE** is made up of a stopper across a passageway. The stopper is a plug with a hole through it. This hole is called a **PORT**. The plug can be rotated so the port is in line with the pipe openings. When the plug is turned so the port opening is in line with the pipe openings, the passageway is open and the flow passes through the valve. When the plug is turned by 90° (a quarter turn), the port opening is not in line with the pipe openings and the flow is stopped. When a valve is completely ON (open) or OFF (closed), it is often referred to as being **FULL ON** or **FULL OFF**. The plug valve often has some pressure drop. And is most often used for gas.

ANCIENT AND MODERN PLUG VALVES

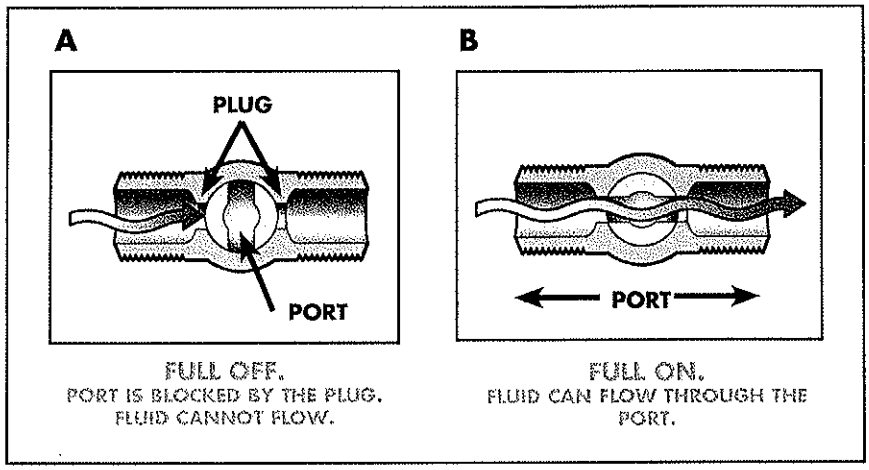


PVF 1.3.01

To open the valve, the head is turned 90° (a quarter turn). As the head turns, the plug also turns. The plug rotates so the port openings are matched with the end openings on the valve. Fluid can now pass through the valve.

Illustration A shows what happens to the valve when the valve is full off. Illustration B shows the valve when it is full on.

HOW A PLUG VALVE WORKS



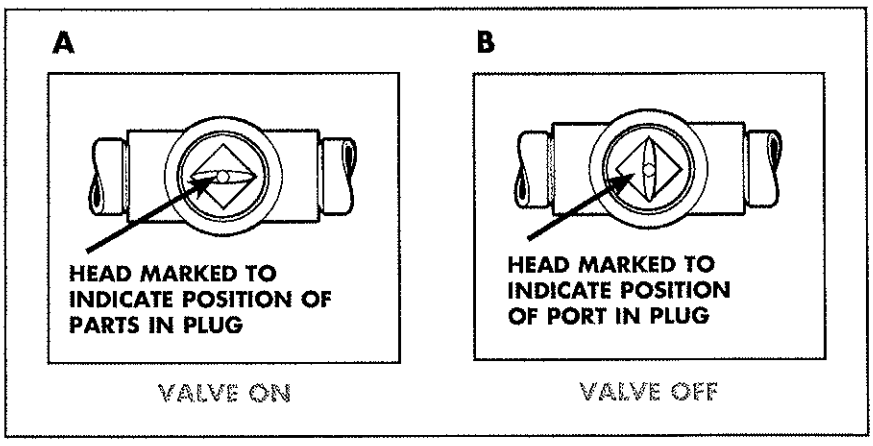
PVF 1.3.02

The head of a plug valve is designed to show whether the valve is open or closed. The top of the plug head indicates where the port openings are in relation to the openings of the valve.

In the top view of a plug valve shown below, valve A is open or on. The head indicates that the port openings are parallel with the valve end openings.

In Figure B, the valve is closed or off. The head shows that the port openings are facing the inside wall of the valve body instead of being aligned with the valve openings. Note: Some plug valve are designed to enable lubrication of the rotating parts without removing the valve from service.

PLUG-VALVE HEAD

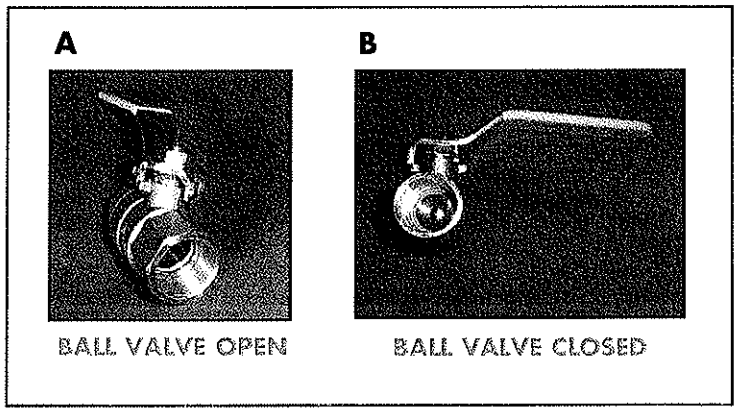


PVF 1.3.03

BALL VALVES also are used to provide on/off control of the flow. The ball valve operates much like the plug valve. The ball-in-a-ball valve has ports like plug valves. When the head of the valve is rotated 90°, the ball is turned so that the port openings are matched with the valve end openings and the fluid can flow through. The ball valve (full port) offers no pressure drop.

Notice that in Figure A, the handle is parallel to the run of the valve, and in Figure B the handle is perpendicular to the run of the valve.

BALL VALVES

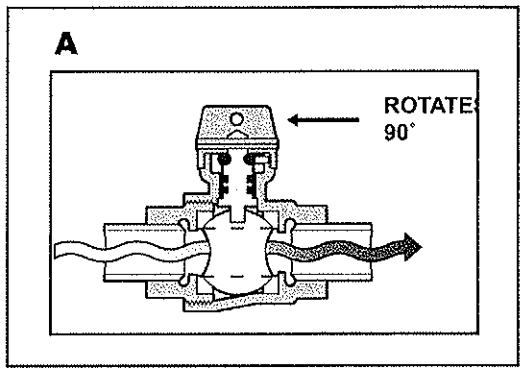


PVF 1.3.04

The ball itself is cushioned between two plastic, Teflon, or O-ring seats. These resilient (flexible) seats hold the ball in position between them. Unlike the metal-to-metal seats of a plug valve, the resilient seats of the ball valve also provide leak-proof seals. This is a major difference between the two types of valves.

The valve in the drawing is in full on position. The ball has been rotated so that the port is open and water is passing through the port in the ball.

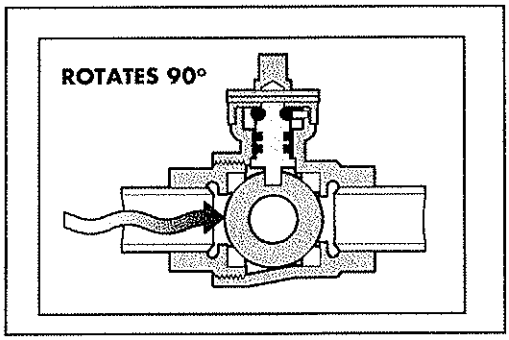
OPEN BALL VALVES



PVF 1.3.05

To close the valve, the head is turned 90° (a quarter turn). The port openings are no longer in line with the valve end openings and no fluid is going through. The valve is full off. When the head is turned back the other direction by 90°, the valve will be back in full on position.

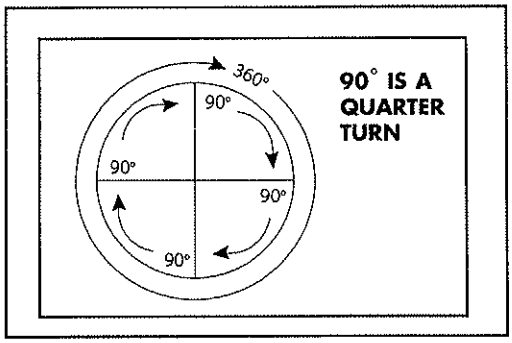
CLOSED BALL VALVES



PVF 1.3.06

Ball valves and plug valves are examples of quarter-turn valves. Quarter-turn valves open and close with 90° rotation. Since a full circle contains 360°, or four 90° arcs, a 90° turn is a ¼ turn or "quarter turn."

CLOSED BALL VALVES

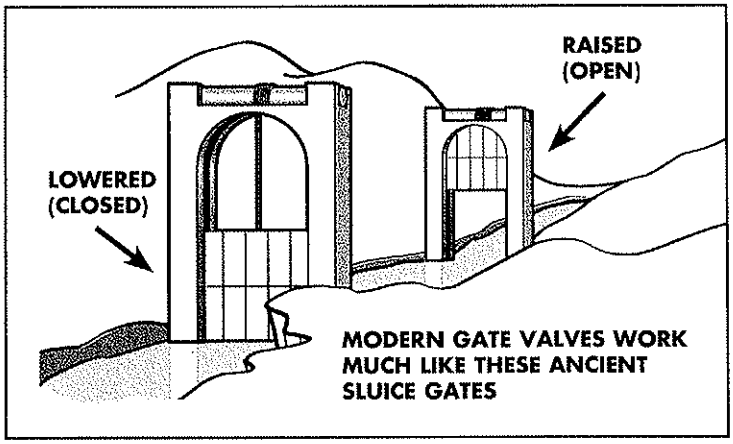


PVF 1.3.07

GATE VALVES are a third type of ON/OFF valve. They are called gate valves because they operate much like sluice gates.

SLUICE GATES

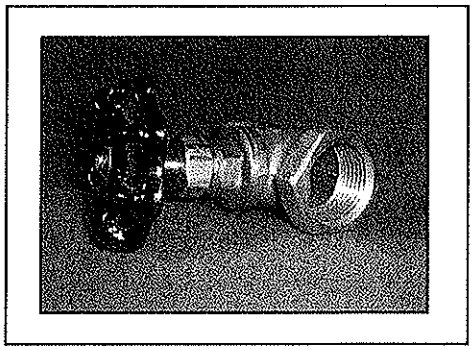
The Dutch used wooden sluice gates to control the water in canals in the 1200s. By the 1300s, builders in Italy were making wooden gates that could be raised or lowered to control water flow. Modern gate valves operate much like these ancient sluice gates.



PVF 1.3.08

The portion of the gate valve that is most like the sluice gate is called the wedge, or gate. When the gate valve is open, the wedge moves up into the body of the valve above the port openings. The metal wedge is moved up to open or down to close to the port openings.

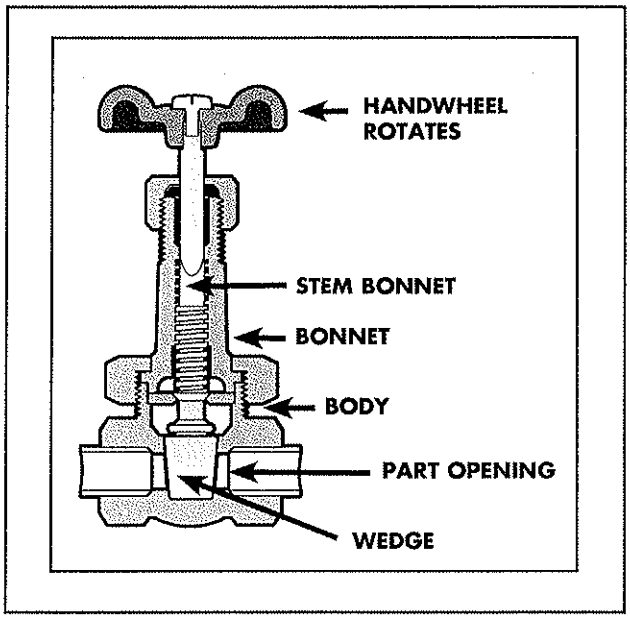
GATE VALVE



PVF 1.3.09

Like other valves, the gate valve has a **STEM**, which is typically enclosed within the bonnet. The **BONNET** is the cover that encases the moving parts of the valve. The bonnet is essential for the initial assembly and eventual service of the valve. The bonnet is a pressure boundary in the valve and the part into which the wedge rises when the valve is opened by turning the handwheel.

PARTS OF A GATE VALVE

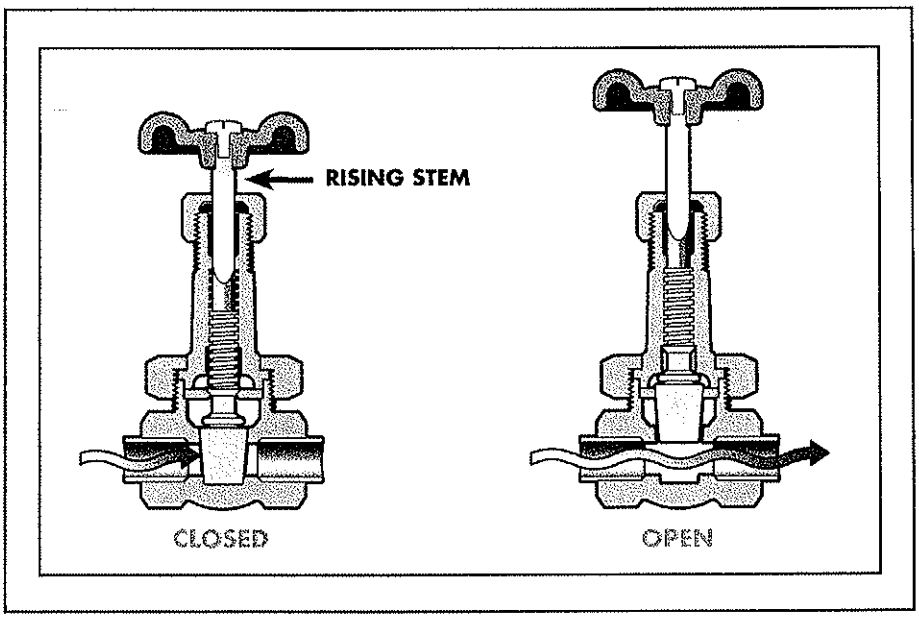


PVF 1.3.10

In small plumbing lines with lower pressure and, therefore, less danger, a threaded bonnet is most often used. In cases where valve failure could be dangerous (such as when the valve will be under high pressure), special kinds of bonnets, such as union bonnets, bolted bonnets or pressure seal bonnets, are required. Always check a manufacturer's literature for recommendations about valve usage.

Gate valves are available with two types of stems: non-rising and rising. In gate valves with ***rising stems,*** the handwheel, stem, and wedge all rise together when the handwheel is turned to open the valve. The drawings below illustrate gate valves with rising stems. Notice here that more of the stem is showing above the body of the valve when the valve is in the open position. This is good for quick verification of valve position, fire safety system, and valves in hard to reach places.

GATE VALVES WITH RISING STEMS



PVF 1.3.11

If this was a non-rising stem, there would be no difference in the amount of stem visible above the valve body, because the handwheel and the stem rotate but do not rise. The non-rising stem gate valves are typically used where the handle clearance is a major factor.

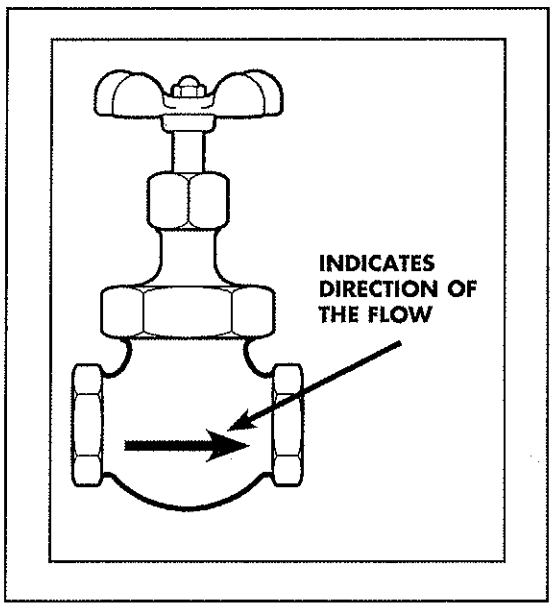
A gate valve has two important advantages. When the valve is opened, there is almost no obstruction in the flow and there is very little pressure drop.

Gate valves should be used to turn the flow full on or full off. If gate valves are used to throttle the flow—to partly increase or decrease it—the velocity and turbulence of the partial flow through the valve will damage the sealing areas of the valve.

Throttling Valves

The GLOBE VALVE is another type of valve used to turn flow on or off. Globe valves are designed to also provide the throttling function, which controls the rate at which water flows. Originally called a "globe" valve because of the shape of the valve body, the portion of the valve containing the port was more rounded than other valves, but no longer applies. A globe valve is often used where frequent operation of the valve is necessary. One example of a globe valve is a compression faucet. The direction of flow for this valve is important. Unlike ball valves and gate valves, globe valves must be installed correctly in regard to the direction of the fluid passing through it. This direction is normally stamped or printed on the valve body.

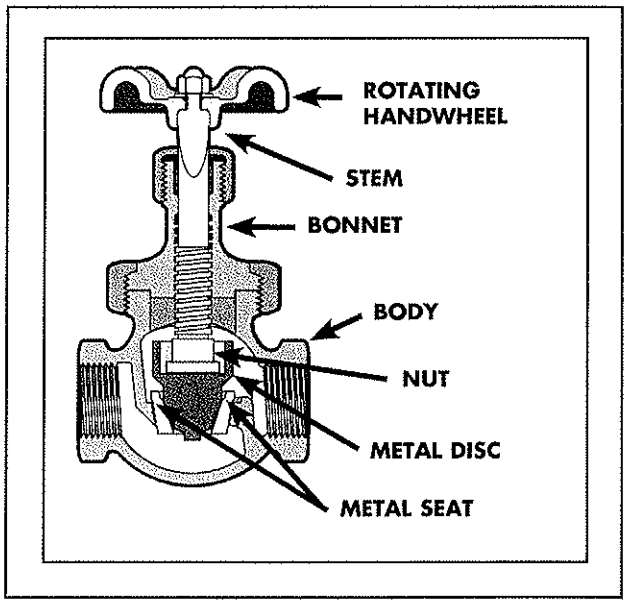
GLOBE VALVE



PVF 1.3.12

The drawing is a cut-away view of a globe valve. To operate the valve, the handle is rotated. This causes the threaded stem to rotate in a threaded bonnet.

PARTS OF A GLOBE VALVE



PVF 1.3.13

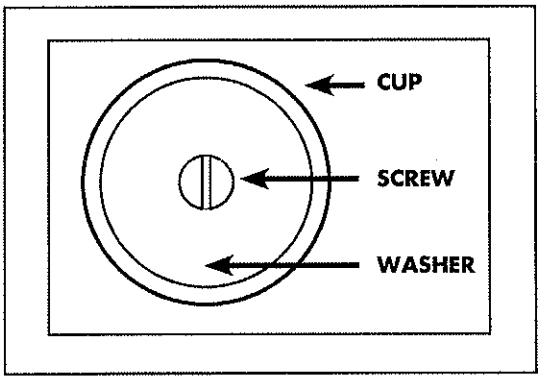
Attached to the bottom of the stem is a disc or plug. The disc is the closing mechanism for the valve. As the stem rotates, the disc is moved either toward or away from the seat.

A globe valve can stop the flow completely or regulate (throttle) the flow, depending upon how far it is opened. When the disc is farthest away from the seat, the valve is full on. As the disc moves toward the seat, the flow is throttled. When the disc is against the seat, the valve is full off. The globe valve pictured on page 43 has a metal disc and a metal seat. The disc is held in place by a screw.

Discs for globe valves can be made from a variety of materials. The composition disc made from non-metallic materials is the most common type.

The type of disc used in a globe valve is commonly called a **WASHER.** A washer is circular in shape and has a flat face. The washer fits into a recessed cup and is held in place by a screw or nut. The cup surrounds the disc to hold its shape.

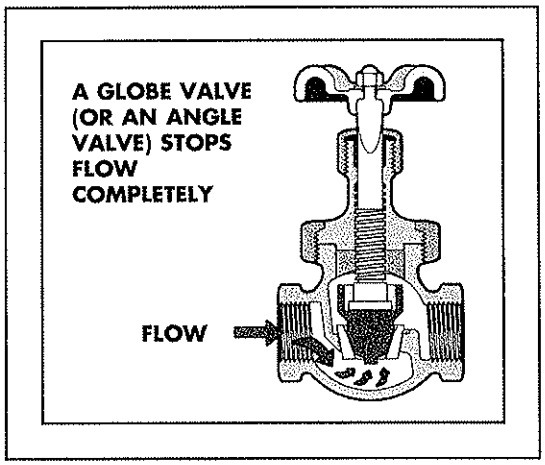
WASHER



PVF 1.3.14

The easiest way to understand how a globe valve works is to get one from stock and examine it. By looking in the ends, you will see that the valve body forms two compartments, which are joined by a seat opening. This opening can be closed by the disc, as shown in the drawing.

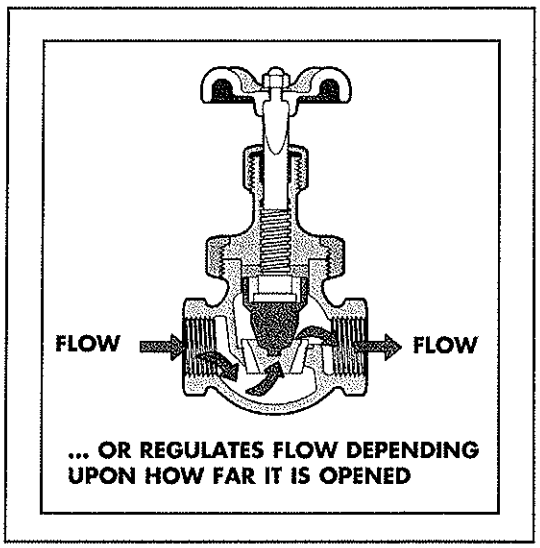
GLOBE VALVE FULL OFF STOPS FLOW



PVF 1.3.15

In the drawing, the flow is throttled. The direction of the flow is not straight through. Changes in the direction of the flow create turbulence, causing friction and a drop in flow pressure.

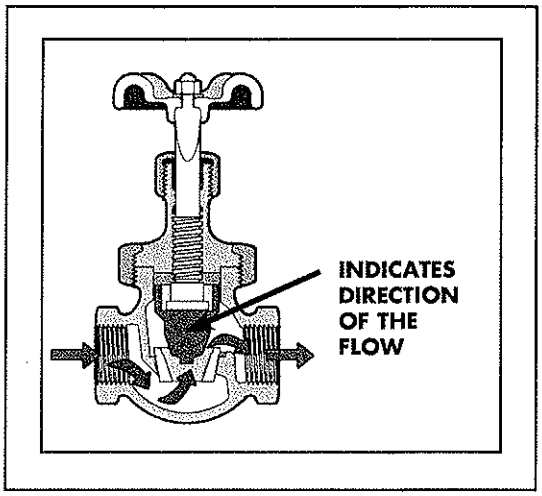
PARTLY OPEN GLOBE VALVE THROTTLES FLOW



PVF 1.3.16

Globe valves always should be installed so that when the valve is in full off, pressure is always being exerted under the disc. Usually, a globe valve has a marking on the outside body to indicate the direction of flow through the valve.

GLOBE VALVE WITH FLOW DIRECTION MARKING

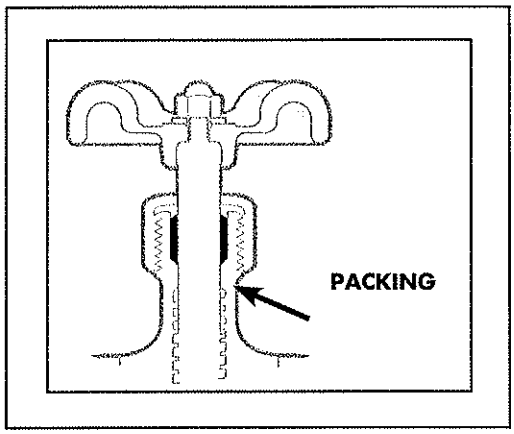


PVF 1.3.17

The upper portions of gate valves and globe valves are similar in construction. They also have a common problem: leaking, which can occur around the stem.

To prevent leaking, packing is used to surround the stem area at the top of the bonnet. Packing can be plastic, fibrous (rope-like), or O-rings. If leaking occurs, the packing nut can be tightened to compress the packing more firmly and reseal the stem. If leaking continues, the packing material must be replaced.

PACKING HELPS PREVENT LEAKING ON GATE AND GLOBE VALVES



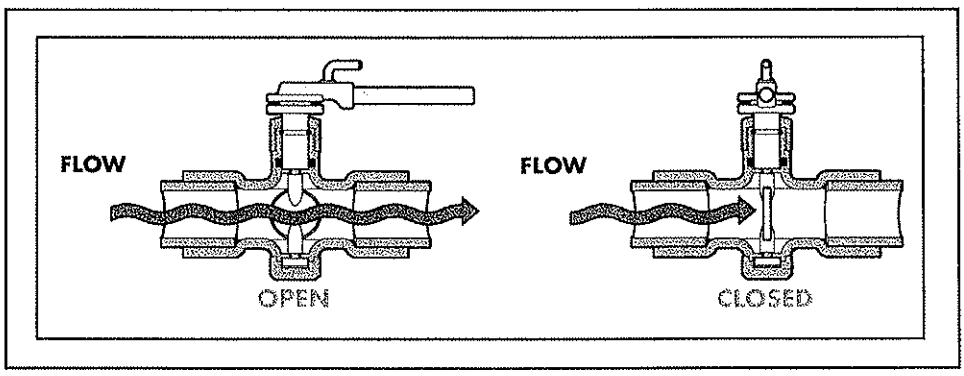
PVF 1.3.18

Most globe and rising stem gate valves have a back seat. When the valve is fully open, the shape of the back seat seals the lower threaded portion of the stem. When working properly, this relieves the packing from being exposed to the pressure within the valve. Re-packing a valve under pressure is always hazardous and not recommended.

Butterfly Valve

A butterfly valve is a quarter-turn valve that uses a flat disk that pivots on a stem to allow or stop the flow. Some butterfly valves also are used for throttling purposes. In general, the valve is operated by turning the stem 90 ° for full open or full closure. Butterfly valves are generally used for high-volume, low-pressure applications. Butterfly valves are somewhat unique in that the disk remains in the stream of liquid as it flows through the pipe. Butterfly valves are a good choice, because they usually cost less and are lighter in weight when compared to similar valves. The thin profiles of wafer- and lug-style butterfly valves allow them to be installed in a fraction of the space a conventional gate, globe or ball valve requires.

BUTTERFLY VALVE

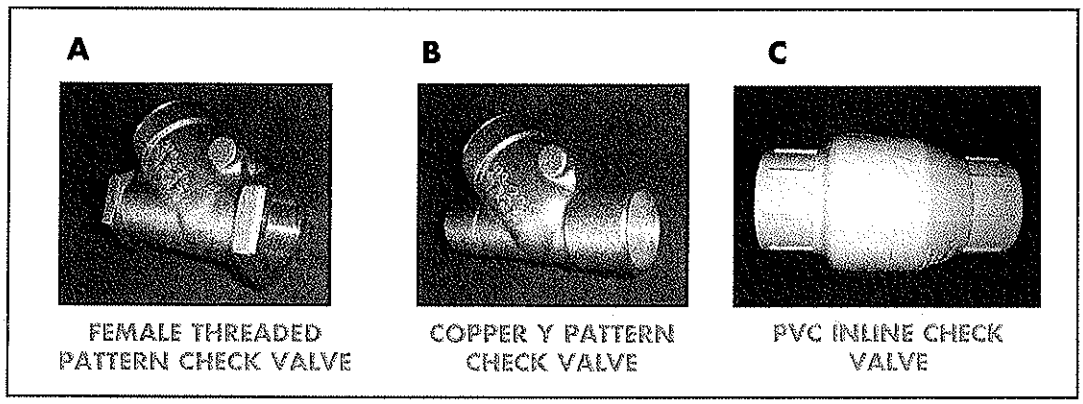


PVF 1.3.18

Check Valves

The valves reviewed so far perform either the On/Off or throttling functions. The third basic function a valve can provide is to prevent backflow. CHECK VALVES are commonly used to prevent the undesired reversal of flow. Preventing backflow means that water can flow in only one direction. The arrow on the valve body indicates the direction of the flow.

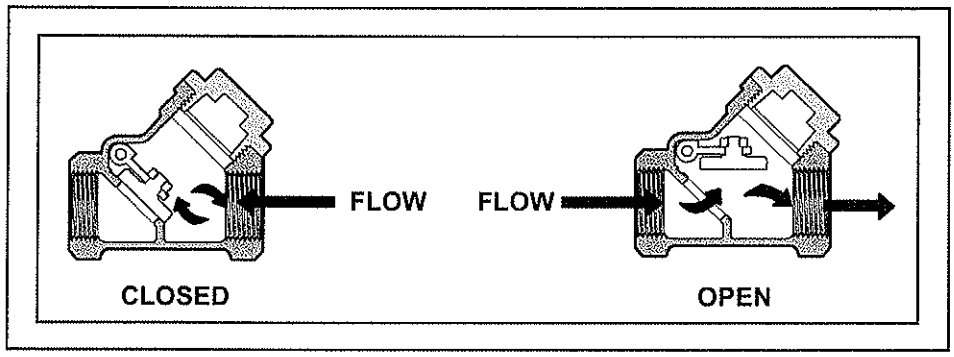
CHECK VALVES



PVF 1.3.19

The most common type of check valve is the swing-check valve. A SWING-CHECK VALVE has a disc that acts as a trap door over the seat. The hinge lets the disc and holder swing away from the seat. A pin secures the holder to the hinge.

SWING CHECK VALVE

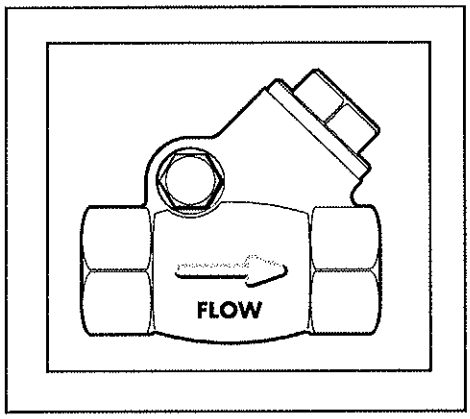


PVF 1.3.20

When water flows through a check valve, it pushes against the disc. This flow pushes the disc away from the seat and up against the top of the valve.

When water tries to flow backward, gravity pulls the disc down against the seat. The pressure of the backward flow helps provide a firmer seal of the disc against the seat. To work properly, the swing-check valve must be installed so the disc naturally falls against the seat. An arrow on the outside of the valve indicates the direction of the flow through the valve.

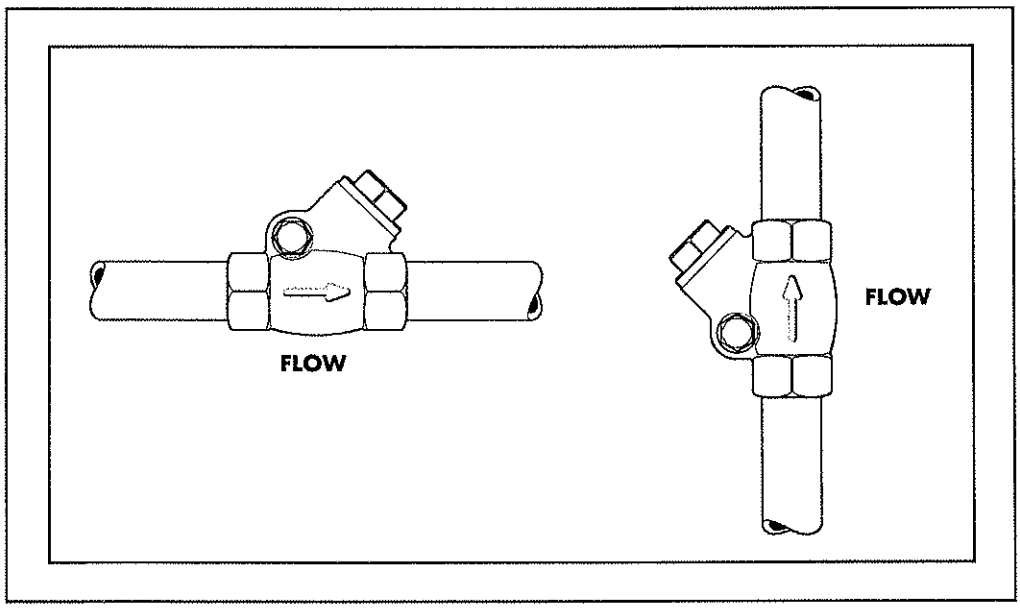
CHECK VALVES HAVE FLOW DIRECTION MARKINGS



PVF 1.3.21

The swing-check valve must be placed properly in a pipe run. It can be used with gate valves in horizontal pipe runs or in vertical runs with an upward flow. They should not to be installed on their sides or upside down.

PROPER SWING-CHECK VALVE



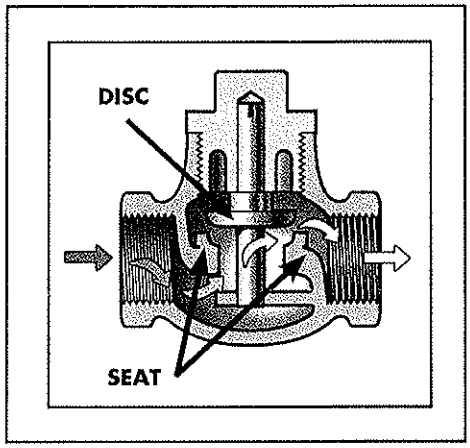
PVF 1.3.22

Another common check valve is the **LIFT-CHECK VALVE.** Lift-check valves are often used with globe or angle valves. Flow through the inlet pushes underneath the disc, moving it away from the seat. Even when the valve is fully open, the flow is partially obstructed.

There are both horizontal and vertical lift-check valves, and they operate the same way. The flow through a lift-check valve can move only in one direction. If the flow starts to reverse, the disc falls back against the seal. As with the swing-check valve, the pressure of this reverse flow presses the disc even more firmly against the seat.

Horizontal lift-check valves can be used only for horizontal runs. Vertical check valves can be used only on vertical runs with an upward flow. To operate correctly, the pressure of the flow must always be exerted underneath the disc. The cutaway view to the right shows a horizontal lift-check valve.

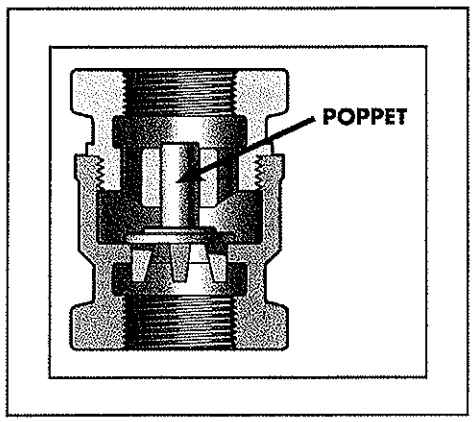
HORIZONTAL LIFT-CHECK VALVE



PVF 1.3.23

The vertical lift valve in the diagram to the right has a poppet which slides back and forth to control the flow.

VERTICAL LIFT-CHECK VALVE



PVF 1.3.24

REVIEW OF COMMON TYPES OF VALVES

Answers appear on page 91

1. _____ are devices used to control the flow of fluids and gas in a piping system, and a _____ is anything that can flow and change its shape easily.

2. To _____ the flow means to increase or decrease the flow.

3. _____ _____ are generally used to turn the flow completely ON or completely OFF.

4. When a valve is completely ON (open) or OFF (closed), it is often referred to as being _____ _____ or _____ _____.

5. When the head of the _____ _____ is rotated 90° the ball is turned so the port openings are matched with the valve end openings and the water can flow through.

6. Like other valves, the gate valve has a _____, and the _____ is the cover used to guide and enclose the stem of a valve.

7. In gate valves with _____ _____, the handwheel, stem and wedge all rise together when the handwheel is turned to open the valve.

8. The type of disc used in a globe valve is commonly called a _____.

REVIEW OF COMMON TYPES OF VALVES

Answers appear on page 91

9. A _____ _____ is a quarter-turn valve that uses a flat disk that pivots on a stem to allow or prevent the flow.

10. The most common type of check valve is the _____ _____ _____ that has a disc, which acts as a trap door over the seat.

11. Another common check valve is the _____ _____ _____ that even when it is fully open, the flow is partially obstructed.

12. What is the function of a check valve?
    a. Control pressure on the line b. Prevent backflow

13. Which valve is designed to be used either to turn flow ON/OFF or to throttle flow?
    a. Globe valve b. Gate valve

14. How many degrees would the head of a plug valve have to rotate to go from a full off to a full on position?
    a. 90° b. 45°

15. In a plug valve or a ball valve, what is the name for the hole through which water flows?
    a. Inlet b. Port

16. What is one advantage of a gate valve?
    a. It can be used to change flow direction as well as provide ON/OFF control
    b. When open, it causes very little pressure drop

REVIEW OF COMMON TYPES OF VALVES

Answers appear on page 91

APPLYING WHAT YOU HAVE LEARNED:

By observing and asking questions, fill in the blanks. If you are not sure of the answers, ask your supervisor.

A. Find out which are the two types of common valves that your company sells most. List them.

_____

_____

_____

B. List two applications for which people buy check valves from you and what kinds of valves they buy.

_____

_____

Service Connection Valves: From the Main to the House

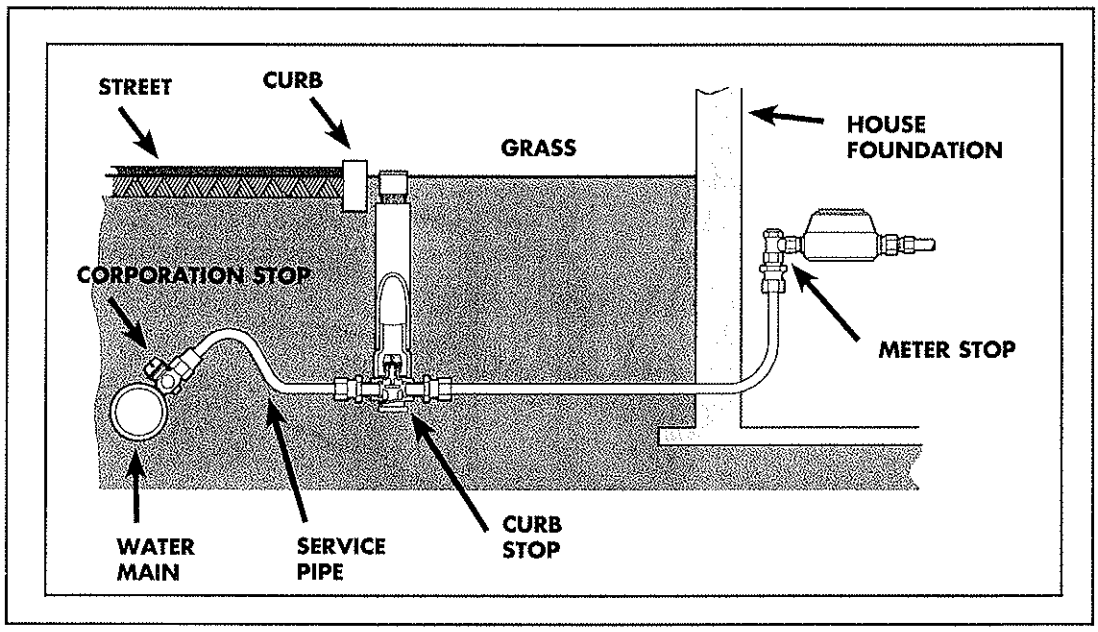
One important use for valves is controlling the flow of water to the household water supply system from a supply source such as a city water system. The connection between a public utility and the user is called a **SERVICE CONNECTION.** This section will deal with valves from the main to the house, to make you familiar with terms related to city connections. Meter placement varies with locality.

The diagram below illustrates a typical piping distribution system used to connect a house to the city water system. The pipe used to make this service connection from city water main to household or building supply line is called the **SERVICE PIPE.**

As shown in the diagram below, service pipe and valves must be placed below the frost line. The **FROST LINE** indicates the depth to which the ground will freeze. Service pipe and valves are placed below the frost line so that water will continue to flow even in the coldest temperatures.

Because temperatures vary throughout the country, the depth of the frost line also varies from state to state and even from city to city. Frost penetration in different parts can be found on the NOAA website or through local building codes.

CONNECTING THE HOUSEHOLD TO A CITY WATER SUPPLY



PVF 1.3.25

Stops Used in Service Connection Piping

STOPS are important parts of such a system because they allow all or part of the system to be shut off. The stops are actually different types of valves. There are three types of stops that can be used in this type of piping system.

1. *Corporation stops* are installed in the city water main to control the flow of water from the city's water supply. Plug valves and ball valves, such as we have previously studied, are generally used as corporation stops. Corporation stops are installed on the water main when a service will be provided to a consumer. Once the service is installed the corporation stop is buried with the water main and remains inaccessible unless excavated.

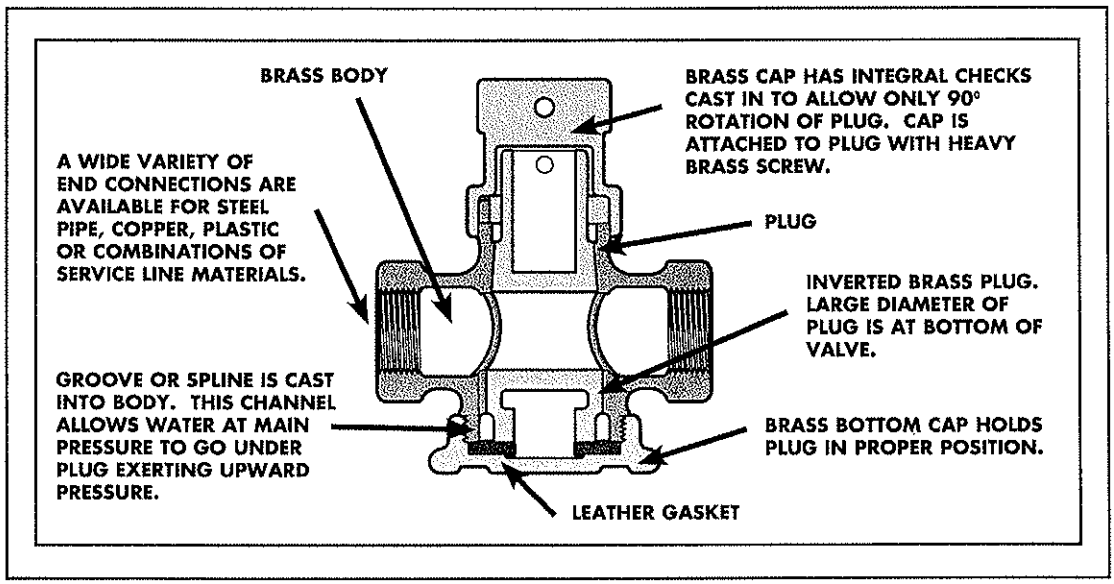
2. *Curb stops* are used to stop the flow at the street curb. The curb stop makes it possible to turn off water service to the house for necessary repairs or emergencies.

3. *Meter stops* are installed just in front of the meter (between the main and the meter) and allow the water to be turned off before it reaches the meter.

We will look at curb stops and meter stops in a little more detail.

Curb stops are available in a variety of valve styles. Curb stops can be ball valves tapered plug valves or inverted plug valves. An inverted plug curb stop is illustrated below.

CURB STOP: INVERTED PLUG STYLE



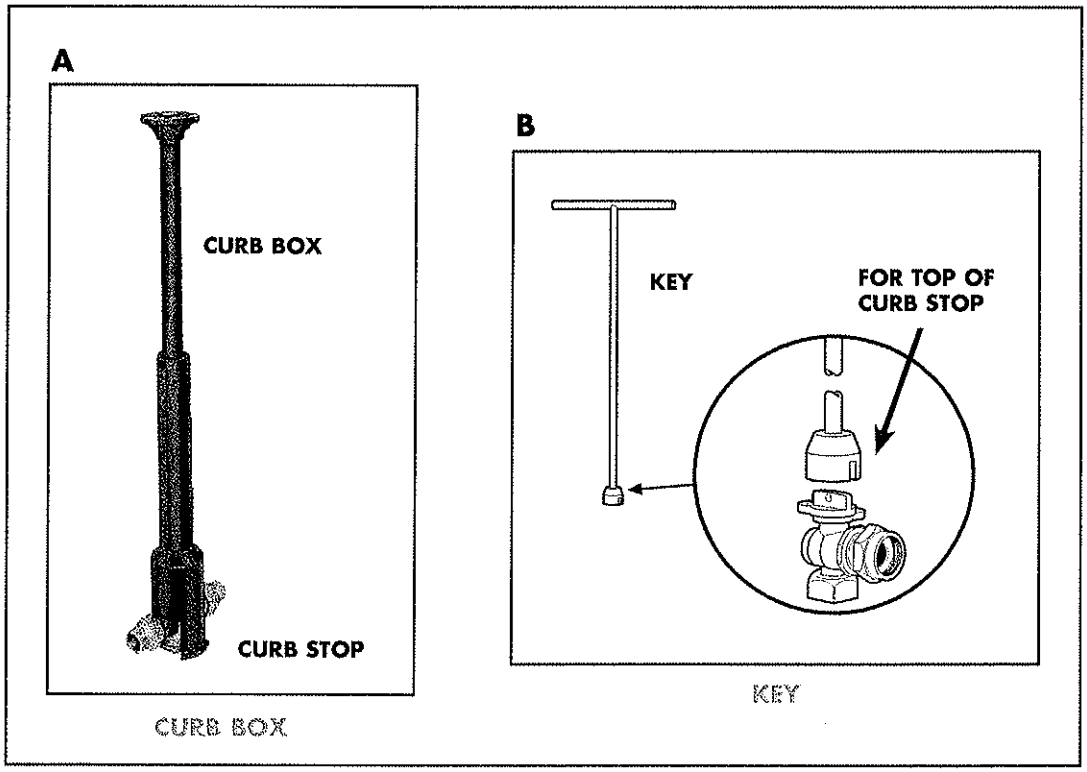
PVF 1.3.26

The main difference between a tapered plug and an inverted plug is that in an inverted plug, the wider part of the plug is at the bottom of the valve; while in a tapered plug, the wider portion of the plug is at the top. The second difference is that the inverted plug valve also has a gasket at the bottom of the plug. This gasket helps provide a tight seal.

Since the curb stop must be placed below the ground, a special access pipe is installed to allow valve operation without digging. This special access pipe is called the **CURB BOX**. One end of the curb box is placed directly over the curb stop. The other end extends upward to the surface of the ground. The surface end of the curb box has a cap.

Whenever service to the house must be turned off, the cap is removed and a special key is inserted into the curb box. This long key reaches down to the top of the curb stop so the valve may be turned off and on. Many curb boxes have a built-in key.

CURB BOX WITH KEY

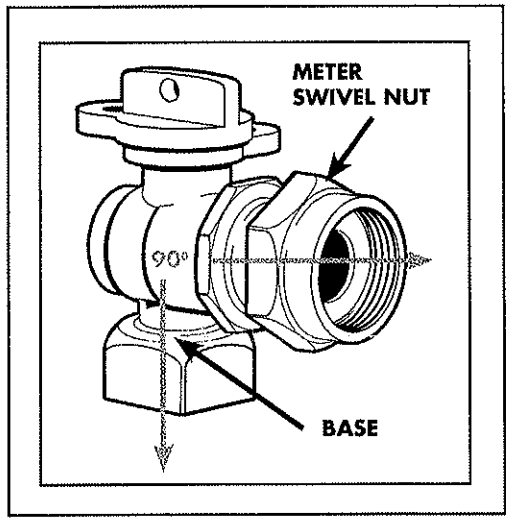


PVF 1.3.27

The **METER STOP** is a valve that allows the water to be turned off before it reaches the meter. It is placed immediately in front of the meter. The meter stop may be either a ball valve or a plug valve. The meter stop has a meter swivel nut on the outlet so that it can be attached to the water meter. Some meter stops will be angle valves. **ANGLE VALVES** change the direction of the flow by 90°. These valves often are used when the service and house lines are to be connected at 90° angles to each other.

The illustration to the right shows a meter stop, which is also an angle valve. Water flows through the opening at the base of the plug. The flow makes a 90° turn and is directed out the side port opening. When the valve is closed, the side port opening rotates away from the outlet and faces the inside wall of the valve body, stopping the flow. Water pressure at the base of the plug aids in maintaining a tight seal.

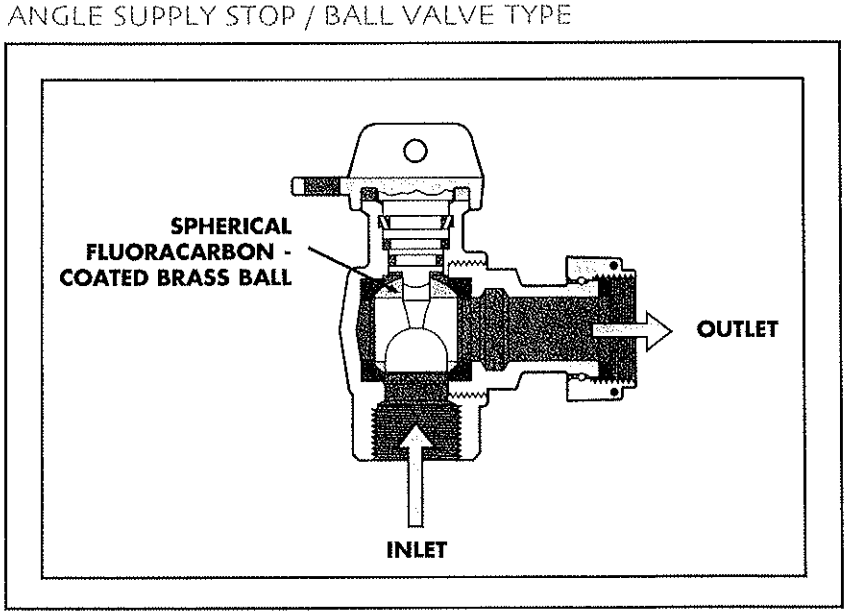
PLUG-STYLE METER STOP/ANGLE VALVE



PVF 1.3.28

The angle stop discussed above was a plug valve. Angle stops may also be ball or globe valves. The angle stop shown to the right is a ball valve angle stop.

ANGLE SUPPLY STOP / BALL VALVE TYPE



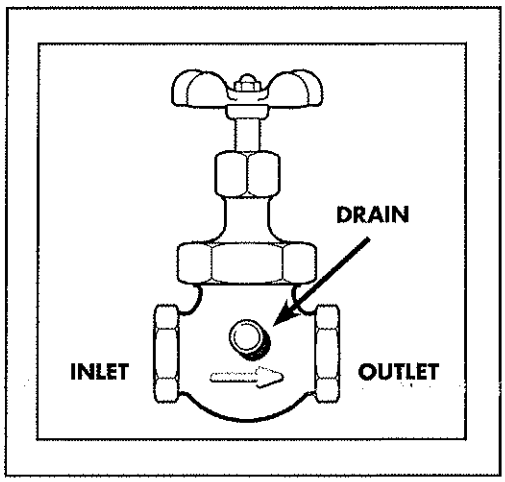
PVF 1.3.29

Other Valves Used in Service Connections

A **STOP AND WASTE VALVE** is sometimes used in place of the meter stop. Local codes and other standards determine whether a stop and waste valves can be used. It has a special feature called "waste" or "drain." The waste (drain) allows water to be drained out of the line and permits air to enter the line.

The waste is constructed so a line can be drained from the outlet-side of the valve. To work properly, the stop and waste valve must be installed so flow pressure is always exerted underneath the washer. Usually, a stop and waste valve has an arrow on the outside body to indicate flow direction for proper installation.

STOP AND WASTE VALVE



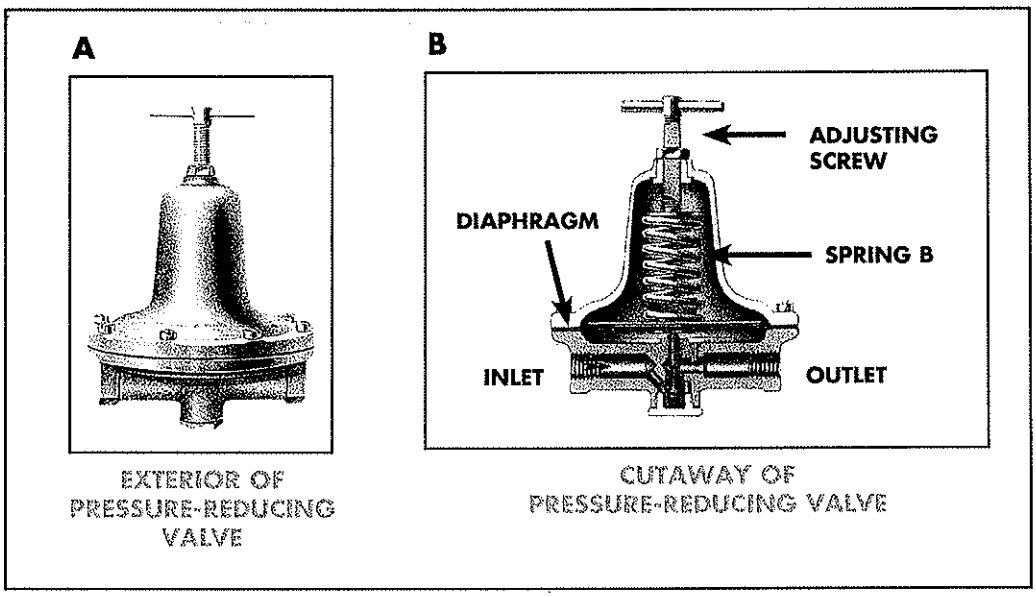
PVF 1.3.30

A check valve is used on the house side ("after" or "down-stream") of the water meter. This valve prevents water from flowing backward through the meter and back into the water main. A backward flow of hot water might otherwise ruin the meter. It is even possible that backflow from the house could contaminate the water main.

To lower and control the water pressure, a **PRESSURE-REDUCING VALVE** is sometimes installed downstream (house side) from the water meter. Not all users connected to a water distribution system have the same water pressure. If adequate pressure is provided to users at the farthest distance from the water pressure source, users closer to the source may have excessive pressure. This excess pressure may cause noise and stress to the household water supply system. This stress will lead to premature failure of appliances, faucets, and plumbing fixtures.

The drawing below shows only one example of a pressure-reducing valve. Become familiar with the pressure-reducing valves stocked by your company.

PRESSURE-REDUCING VALVE



PVF 1.3.31

REVIEW OF SERVICE CONNECTION VALVES: FROM THE MAIN TO THE HOUSE

Answers appear on page 91

1. The connection between a public utility and the user is called a _____ _____.

2. The pipe used to make the service connection from the city water main to the household supply line is called the _____ _____.

3. The _____ _____ indicates the depth to which the ground will freeze.

4. _____ _____ are used to stop the flow at the street curb.

5. _____ _____ are installed just in front of the meter and allow the water to be turned off before it reaches the meter.

6. _____ _____ change the direction of the flow by 90° and are often used when the service and house lines are to be connected at 90° angles to each other.

7. The curb stop must be placed below the ground, and a special access pipe called _____ _____ is installed to allow valve operation without digging.

8. A _____ _____ _____ _____ is sometimes used in place of the meter stop.

REVIEW OF SERVICE CONNECTION VALVES: FROM THE MAIN TO THE HOUSE

Answers appear on page 91

9. To lower and control the water pressure, a _____ _____ is installed downstream (house side) from the water meter.

10. What are stops designed to do?
    a. Stop the flow of sewer gases back into the house.
    b. Stop the flow at a location so part or all of the system can be shut off.

11. What is the term used for the valve that controls the flow of water out of the city's water main into the line to a building?
    a. Service stop b. Corporation stop

APPLYING WHAT YOU HAVE LEARNED:

By observing and asking questions, fill in the blanks. If you are not sure of the answers, ask your supervisor.

A. Check all that apply:

My company sells corporation stops that are:

_____ Plug valves

_____ Ball valves

_____ Other types of valves: _____ _____

B. What is the depth of the frostline in your area?

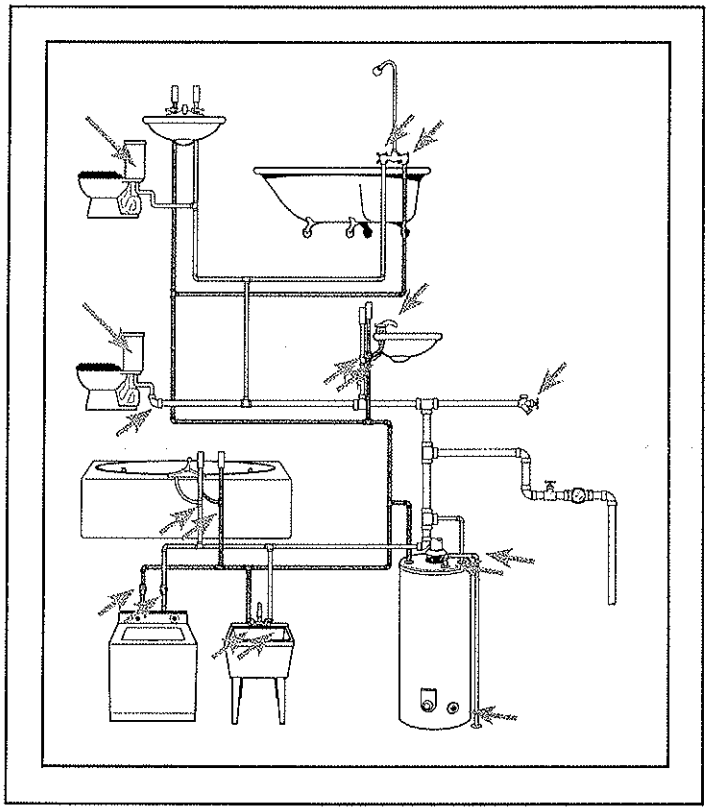
_____

_____

Household Water System: Water Supply System Valves

The water supply system within a house contains many valves. The diagram below shows an average system. The symbol ↗ marks the location of a valve.

VALVES IN A HOUSEHOLD WATER SYSTEM

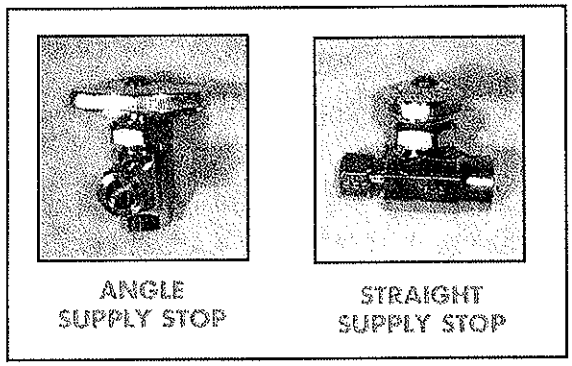


PVF 1.3.32

Stops

The stop valves ahead of outlets of fixtures, such as sinks, toilets, and lavatories, are called **SUPPLY STOPS**. They are installed at the top of risers under the fixtures. They may be either angle-supply stops for connections to wall risers or straight-supply stops for connections to floor risers.

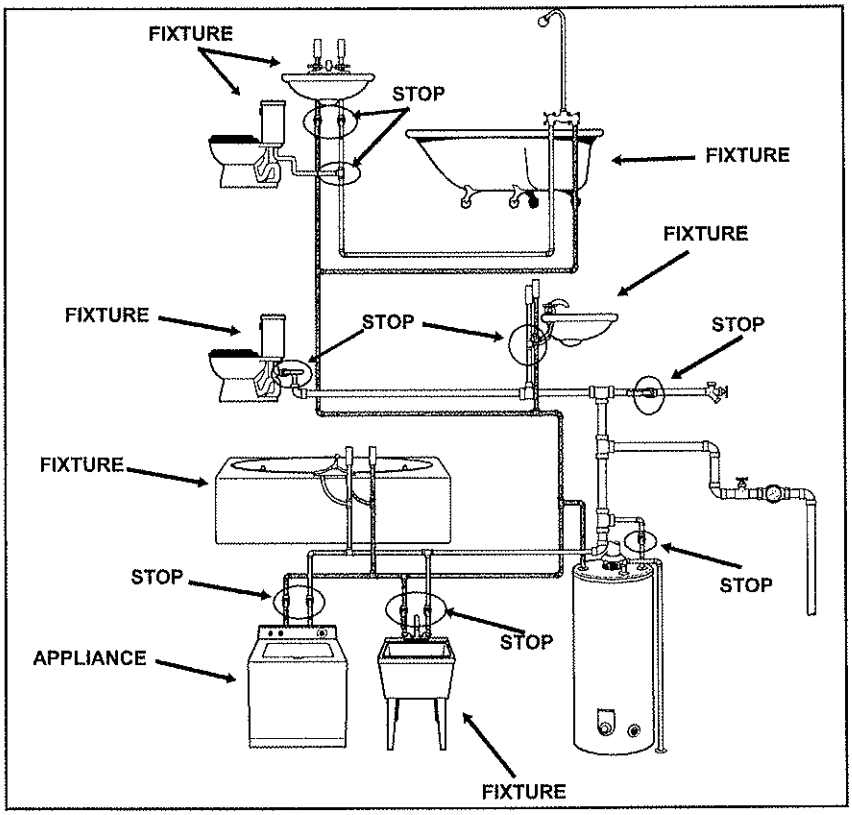
SUPPLY STOPS



PVF 1.3.33

In the drawing below, you can see valves labeled "Stop" or 'Stop and Waste." Both of these are used to shut off all or part of the water supply system within the house. The valves called "stops" do not have drains.

STOP, AND STOP AND WASTE VALVES



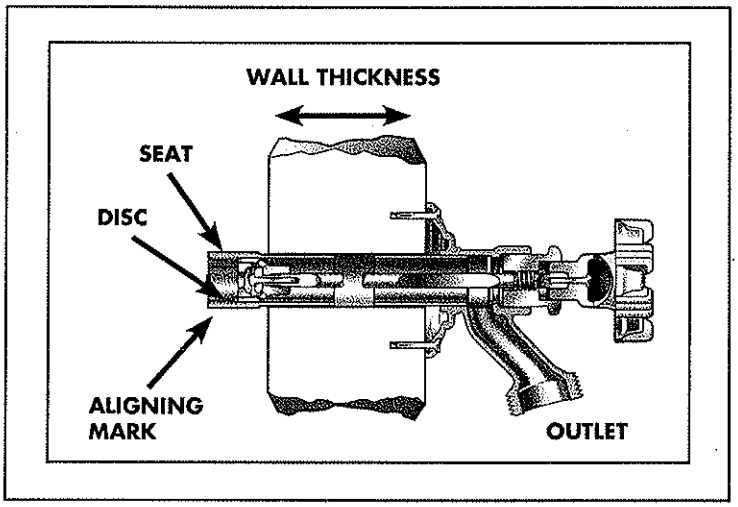
PVF 1.3.34

Sillcocks and Other Faucet Designs

FAUCETS are valves located at outlets in the piping system. The SILLCOCK, also called a lawn faucet or hose bibb, usually is found on the outside wall of a house. Sillcocks are designed so a hose can be attached. In some areas, frost-proof sillcocks are used. These faucets are especially designed to prevent water from freezing at the outlet and harming the valve.

A frost-proof sillcock extends past the wall of the foundation or the house. The seat and disc of the faucet are far from the outlet, with the inlet usually being inside the house. This way, any water left in the faucet drains off after the valve has been closed.

FROST-PROOF SILLCOCK

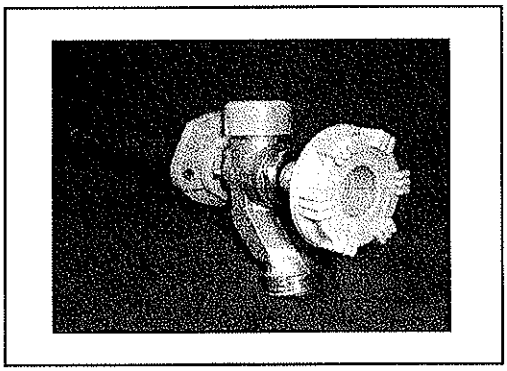


PVF 1.3.35

Because wall thicknesses vary from house to house, frost-proof sillcocks are available in different lengths. The faucet must be installed in a level position, and any hose (such as garden hose) that has been attached must be removed, which allows any remaining water to drain and prevent from freezing.

Sillcocks are available with vacuum breakers to prevent back-siphoning of water if a negative pressure occurs. Negative pressure can occur in any water piping system. For example, if the pressure in the hose attached to the sillcock is greater than the pressure in the household piping system, a negative pressure will occur in the piping system. When this negative pressure occurs, a vacuum is created. This vacuum works like a siphon to draw dirty water back through the sillcock into the piping system. Most municipalities require this type.

SILLCOCK WITH VACUUM BREAKER

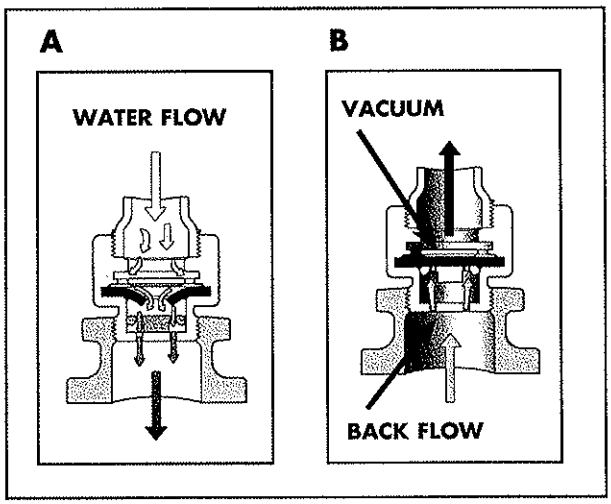


PVF 1.3.36

In some applications both hot, cold and mixed temperature water may be desired outside the home or business. Mixing type hose bibs come in a variety of configurations to accommodate this request.

The **VACUUM BREAKER** lets air into the system to break the vacuum to prevent the back-siphoning effect. Vacuum breakers are available in many different styles. Sometimes devices listed as "vacuum breakers" are not really vacuum breakers, but are actually only backflow preventers. These devices do not break a vacuum; they simply prevent reverse or backflow.

HOW A VACUUM BREAKER WORKS



PVF 1.3.37

Valves that are true vacuum breakers will let air into the system while also preventing backflow. The air added to the system breaks the vacuum. The vacuum breaker pictured here uses a diaphragm with cross slits to prevent backflow.

When the sillcock is turned on (A), water pushes against the diaphragm and opens the slits. A spring plunger is pushed away from the diaphragm by the water flowing through the slits. If a vacuum occurs in the system (B), reversing the flow, the spring recoils to push the plunger up against the diaphragm, sealing the valve. Should the diaphragm fail to close, the air admittance ports are open to let air into the system and break the vacuum.

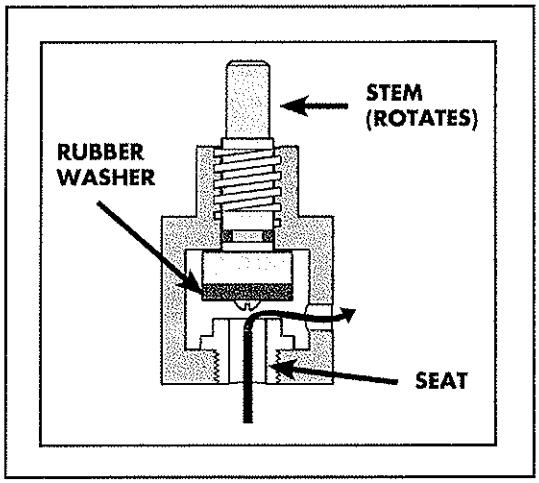
Utility Faucets

Various types of faucets are used in the household water system as outlet connections to appliances and fixtures. "FIXTURE" is a common industry term for a receptacle that holds or receives water at an outlet in the supply system. Faucets used for kitchen sinks, lavatories, and bathtubs/showers are called BRASSWARE. Other faucets on laundry trays and washing machines are called UTILITY FAUCETS. In this section we will look at some utility faucets.

In general, household faucets come in two types: washer designs and washerless designs. The WASHER-DESIGN FAUCET, often called a "compression seal" type, operates much like the globe valve discussed earlier in this manual. The diagram to the right is a cut away of a two-handle washer-design faucet.

The flow of water is controlled by turning the handle. This turns the stem and moves the rubber washer toward or away from the seat.

WASHER DESIGN FAUCET



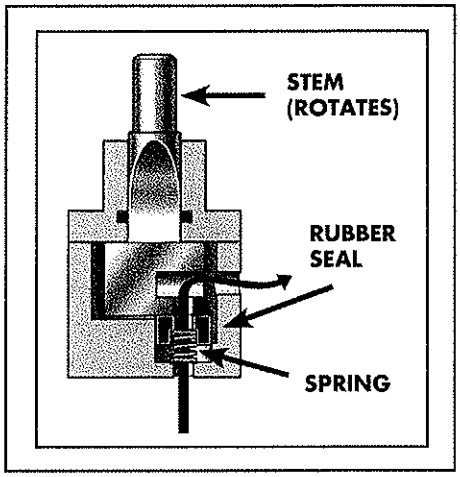
PVF 1.3.38

Although there are many variations, WASHERLESS FAUCETS come in three general types: rubber seal shearing, ceramic (disc) shearing and diaphragm.

In a RUBBER-SEAL SHEARING-TYPE WASHERLESS FAUCET, the flow is controlled with an O-ring, resilient seal or rubber diaphragm. The drawing to the right shows this type of two-handle washerless faucet.

The spring positions the rubber seal in line with the bottom surface of a rotating cylinder. The flow is controlled by rotating the cylinder with the faucet handle. Water flows when the opening in the cylinder is in line with the seal. When a solid portion of the cylinder is in line with the seal, flow is stopped.

RUBBER-SEAL SHEARING-TYPE WASHERLESS FAUCET

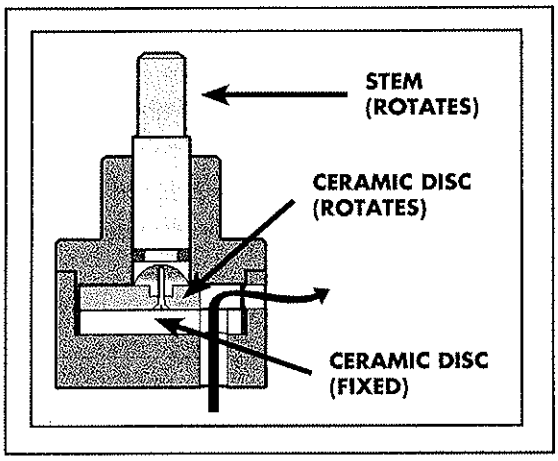


PVF 1.3.39

In the **CERAMIC-SHEARING-TYPE WASHERLESS FAUCET** shown here water flow is controlled by the position of the lower of two ceramic discs. When the opening in the rotating upper disc is in line with the opening in the fixed lower disc, the valve is open.

The rubber seal and ceramic-disc-type washerless faucets are called **"SHEARING"** because the flow of water is sliced or "sheared" off by moving two openings out of line with each other.

CERAMIC-SHEARING-TYPE WASHERLESS FAUCET

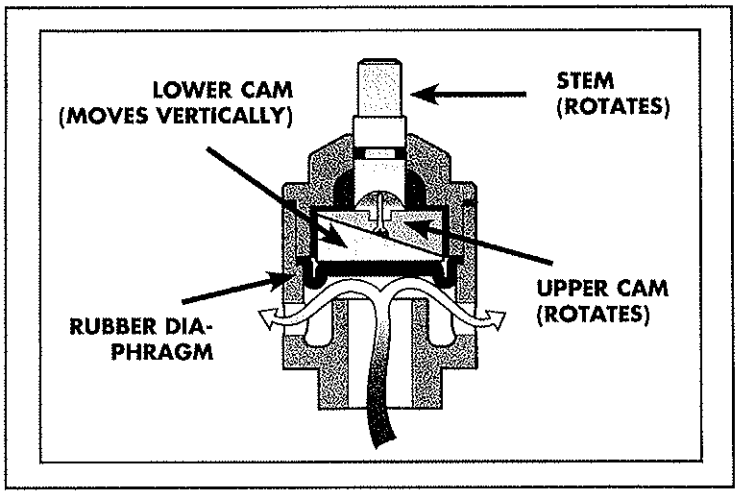


PVF 1.3.40

In the **DIAPHRAGM-TYPE WASHERLESS FAUCETS**, shown here, the flow of water is controlled by a rubber diaphragm. When the diaphragm compresses, it lifts away from the seat and the valve is in the on position. The amount of flow depends on the position of the diaphragm. The diaphragm is moved by rotating the stem with the handle.

A washerless-design faucet usually has a single cartridge that holds the operating parts of the valve. Some manufacturers refer to this unit as a "replacement valve." The advantage of a washerless design is that repair is often a matter of simply replacing the cartridge. The myriad of replacement parts makes repairs challenging.

DIAPHRAGM-TYPE WASHERLESS FAUCET



PVF 1.3.41

Other Household Water Supply Valves

The industry name for a laundry sink is **LAUNDRY TRAY**. Like the sillcock, the laundry-tray faucet has a male hose thread on the outlet. A laundry tray may have either a single faucet with two handles and one spout or a single handle.

A faucet that is designed so hot and cold water are mixed internally and flow, blended together, out of a single spout is called a **MIXING-TYPE FAUCET**. The spout of a mixing-type laundry-tray faucet can be moved from side to side. Moving spouts are commonly called **SWING SPOUTS** or swivel spouts.

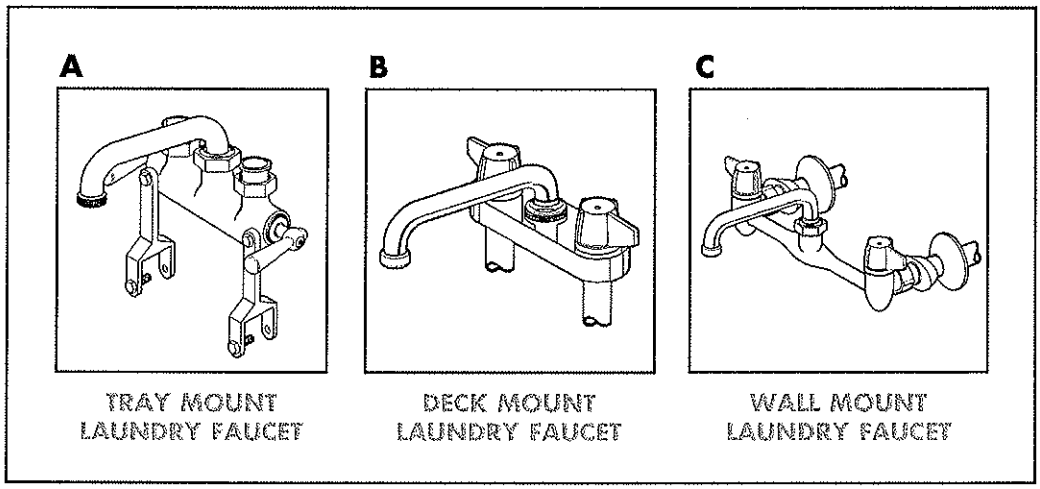
The mounting design of a mixing-type laundry-tray faucet determines how the faucet is attached. Mixing-type laundry-tray faucets are available in three basic mounting designs:

1. *Clamp or tray mount:* attached to the back of the laundry tray with clamps.

2. *Deck mount or top mount:* mounted through holes on the back ledge of the laundry tray.

3. *Wall mount:* mounted on the wall with flanges on the inlet to cover the holes in the wall.

LAUNDRY TRAY FAUCETS

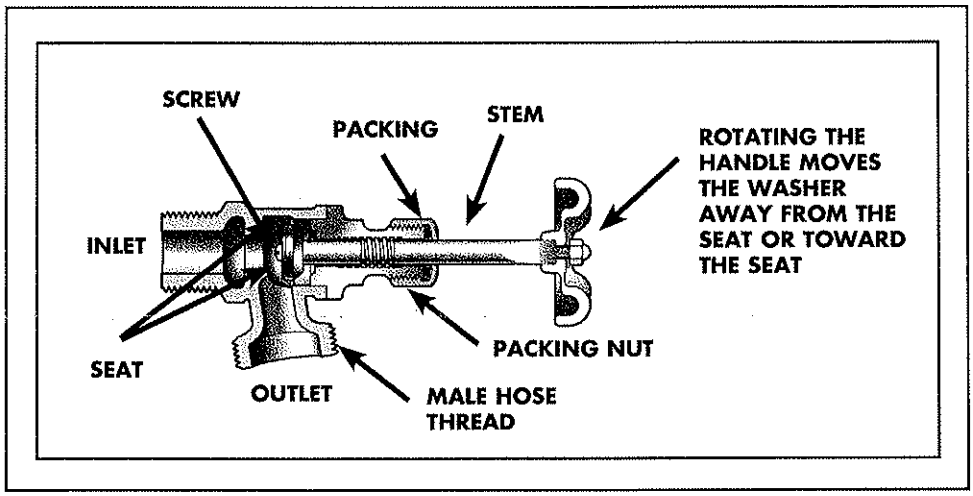


PVF 1.3.42

BOILER DRAINS are faucets with male hose threads. They are often used as hot and cold water connections to the washing machine. Hoses from the machine are attached to the outlets of the boiler drains.

The boiler drain is a good example of a compression faucet. The closing mechanism of a compression faucet is a rubber washer. As shown in the drawing below, the boiler drain works much like a globe valve.

BOILER DRAIN



PVF 1.3.43

Since these faucets are operated frequently, leaking can occur at the stem. To prevent leaking, fibrous or O-ring packing (like that used in gate valves or globe valves) is compressed into the small cavity around the stem.

Boiler drains also are used as drains on water heaters.

REVIEW OF HOUSEHOLD WATER SYSTEM: WATER SUPPLY SYSTEM VALVES

Answers appear on page 92

1. _____ are valves located at outlets in the piping system.

2. _____ is a common industry term for a receptacle that holds or receives water at an outlet in the supply system.

3. Faucets used for kitchen sinks, lavatories and bathtubs/showers are called _____.

4. Other faucets, such as those found on laundry trays and washing machines, are called _____ _____.

5. The _____ _____ _____, often called a "compression-seal" type, operates much like the globe valve discussed earlier in this book.

6. A _____ faucet relies on the action of squeezing a rubber washer against an integral valve seat to control the flow of water.

7. The rubber seal and ceramic disc type washerless faucets are called _____ because the flow of water is sliced or sheared off by moving two openings out of line with each other.

8. In the _____ _____ _____, the flow of water is controlled by a rubber diaphragm.

9. The industry name for a laundry sink is _____ _____.

REVIEW OF HOUSEHOLD WATER SYSTEM: WATER SYSTEM SUPPLY VALVES

Answers appear on page 92

10. A faucet that is designed so hot and cold water are mixed internally and flow, blended together, out of a single spout is called a _____ faucet.

11. The spout of a mixing-type laundry-tray faucet can be moved from side to side. These moving spouts are commonly called _____ _____ or swivel spouts.

12. _____ _____ are faucets with male hose threads.

13. Which statement is true about lawn faucets?
    a. They are also called sillcocks b. They are not repairable.

14. What is the vacuum breaker designed to do?
    a. Let air into the system b. Relieve excess pressure

15. Which stop valves are placed ahead of the outlets to fixtures?
    a. Curb stops b. Supply stops

16. What is one advantage of a washerless faucet?
    a. Repair components are often more costly b. Repair is often easier

REVIEW OF HOUSEHOLD WATER SYSTEM: WATER SUPPLY SYSTEM VALVES

Answers appear on page 92

APPLYING WHAT YOU HAVE LEARNED:

By observing and asking questions, fill in the blanks. If you are not sure of the answers, ask your supervisor.

A. Look at your inventory: Compare the prices of some washerless faucets with a washer-type faucet.

Washerless faucet: $_____

Washerless faucet: $_____

Washer faucet: $_____

B. Review the three types of mountings for laundry-tray faucets. Does your company carry all three types?

a. Yes b. No

Household Water System: Brassware

The faucets found in the kitchen, bathroom or powder room are often referred to as "fittings", "trim," or "BRASSWARE." In catalogs, these faucets are divided into three groups: kitchen, lavatory, and tub and shower. "LAVATORY" is the industry term for wash basin or bathroom sink.

Kitchen Faucets

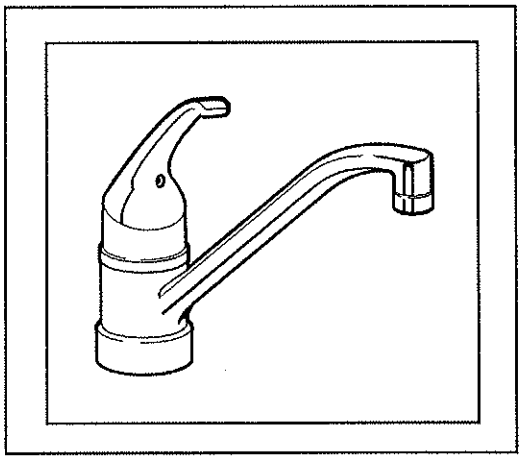
The faucets used in the kitchen may be listed as kitchen faucets, sink faucets or kitchen sink faucets. Many different types of faucets may be used in the kitchen.

A SINGLE-CONTROL FAUCET has one handle to operate the flow for both the hot and cold supply lines. A single-control faucet may have a flat, circular or ball-shaped closing mechanism. However, there is no single-control compression type of faucet with a rubber washer as a closing mechanism.

By moving the handle or lever of a single-control faucet, it's possible to:

- Turn the faucet on or off
- Regulate the volume or amount of the flow
- Obtain water temperatures that range from all cold to warm to all hot.

SINGLE-CONTROL KITCHEN FAUCET

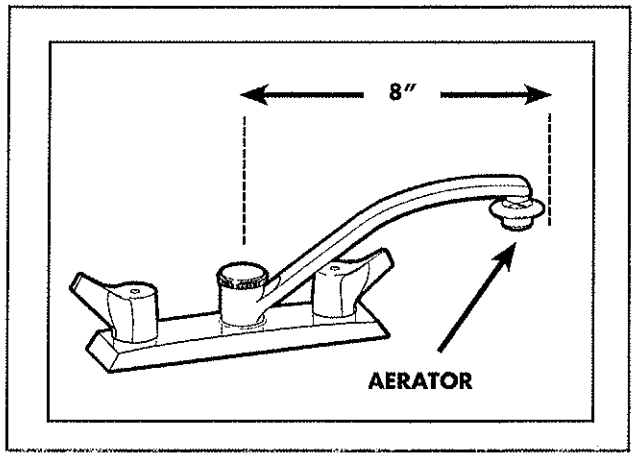


PVF 1.3.44

Other kitchen faucets have dual controls, with separate controls for hot and cold water. Most kitchen faucets have standard 8" spouts, but faucets are available with spouts from 5" to 15". All spouts will be **SWING** or swivel models, which move from side to side. Some spouts also pull out.

Many kitchen faucets also have aerators at the spout outlet. **AERATORS**, which are also found in lavatory faucets and some showerheads, admit tiny air bubbles into the water flow. This mixture dramatically reduces splash and the amount of water used (water consumption), shapes stream, reduces noise, and increases perceived pressure.

DUAL-CONTROL KITCHEN FAUCET WITH AERATOR



PVF 1.3.44

Kitchen faucets also are available with **HOSE SPRAY** attachments. These faucets have a diverter valve, which is located in the faucet body under the spout pivot. The hose is connected to the main faucet body under the diverter.

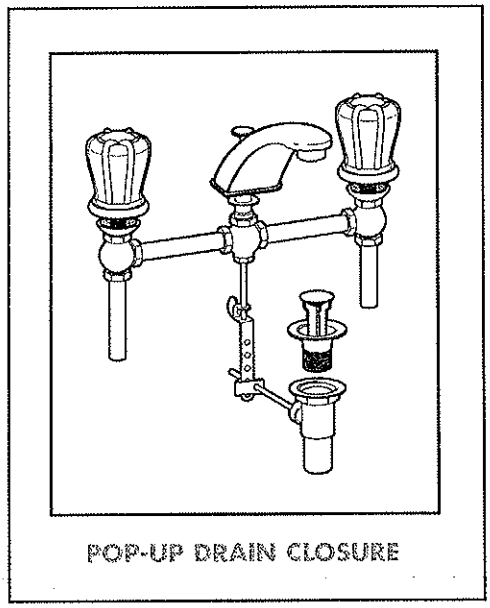
Normally, water flows through the faucet spout. When the spray valve handle is depressed, the diverter valve handle is depressed and the diverter valve switches the flow from the faucet spout to the hose spray. Whenever the faucet is turned on, pressure is exerted on the hose. The hose should be replaced when it becomes worn.

Residential kitchen sink faucets are also commonly available with touchless activation, as well as touch style activation. The greatest advantage to touchless technology is in water conservation. When the users hands are removed from the faucets range, the water shuts off. The primary advantage of touch style-faucets is that a user with full hands, or with dirty hands, needs to merely touch the faucet with the back of a hand to activate the flow. Temperature is still controlled with a handle at the faucet. Commercial and institutional model faucets that stand up to the heavy use and abuse often found in a commercial kitchen application are available.

Lavatory Faucets

Like kitchen faucets, lavatory faucets can be mixing-type, with only one spout. A mixing-type faucet may be controlled with either one-handle or two-handle controls. Mixing types are the most popular lavatory faucets for home use. The mixing of hot and cold water take place within the body of the faucet, safely out of the way of the users hands. Mixing types are the most popular lavatory faucet for both residential and commercial/ industrial applications.

DRAIN CLOSURE FOR LAVATORIES



POP-UP DRAIN CLOSURE

PVF 1.3.48

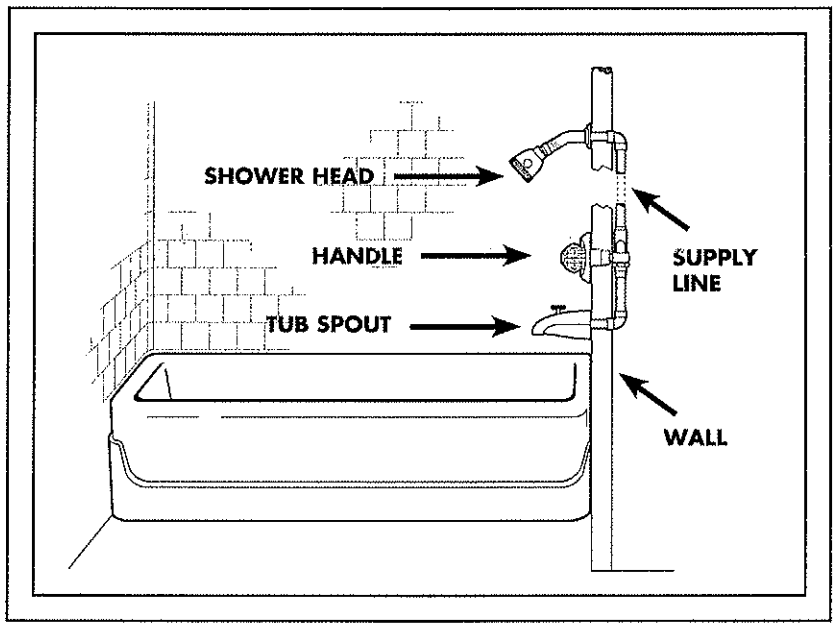
Lavatory faucets usually come with a pop-up drain plug. The pop-up drain plug has a control rod, which is part of the faucet. The drain is opened and closed by moving the rod up and down. This style also has an overflow device for draining excess water when the drain is closed. There are also hands free models available for lavatory faucets.

Tub and Shower Valves

Faucets used for the tub and shower are very often called "valves." However, they are listed with the faucet line in most catalogs. Either two-handle or single-control valves can be used for a bathtub that has no shower.

Unlike the faucets discussed so far, tub and shower valves are usually connected to the supply lines behind the wall. As the drawing below shows, the tub spout, handles and shower-head are generally the only exposed components.

TUB AND SHOWER VALVES (SINGLE CONTROL)



PVF 1.3.49

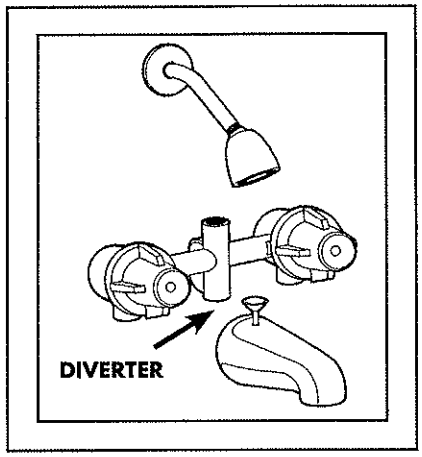
There are three types of valves for the tub and shower combination:

- Single-control
- Two-valve
- Three-valve.

The number indicated in the style tells how many handles there are. A single-control valve has one handle to control both hot and cold water. A diverter used to operate the shower may be located on the tub spout or on the mounting plate near the handle.

Two-valve models are two-handle valves with separate handles to control the hot and cold water flow. The shower is controlled by a small diverter knob on the tub spout. These are less common in showers due to pressure/temperature balancing requirements of the ADA.

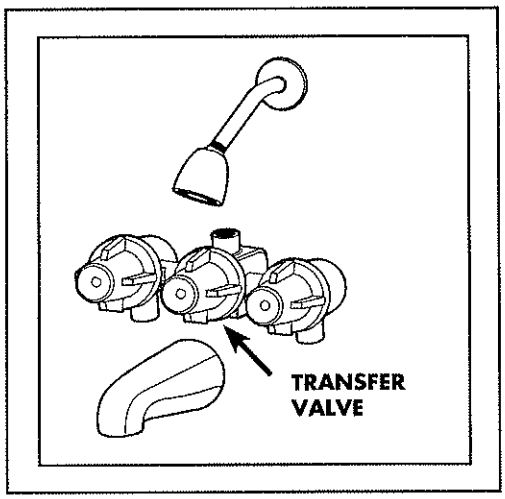
TWO-VALVE TUB AND SHOWER VALVES



PVF 1.3.50

Three-valve designs have separate valves for hot and cold water and a third valve called a transfer or DIVERTER. This valve is used to direct flow to the showerhead or the tub spout. This style is also being rapidly moved away from.

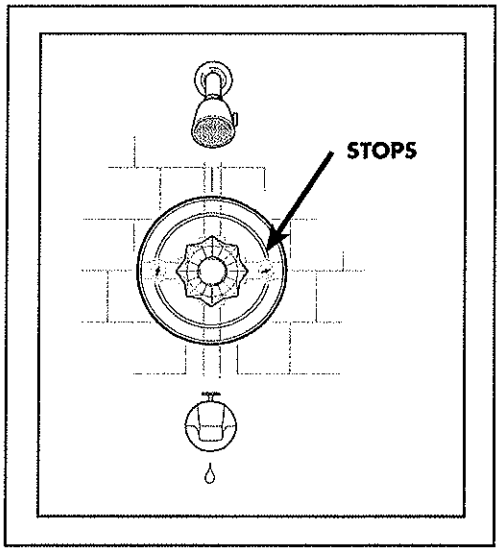
THREE-VALVE TUB AND SHOWER VALVES



PVF 1.3.51

Some single-control and two-handle tub and shower valves are available with special screwdriver stops. These stops make it easier to service the tub and shower valves for repairs. The stops shut off the flow at the supply inlets. These special stops are found more often in apartment buildings than in single family homes. Stops are operated by simply turning the screws with a screwdriver.

SCREWDRIVER STOPS ON TUB AND SHOWER CONTROL



PVF 1.3.52

PRESSURE-BALANCING VALVES automatically correct for pressure variations in the hot and cold water lines, thus preventing sudden bursts of hot or cold water.

Valves that automatically limit how hot the water can get are called **THERMOSTATIC CONTROLS.** Some specialized valves provide both pressure and temperature control.

REVIEW OF HOUSEHOLD WATER SYSTEM: BRASSWARE

Answers appear on page 92

1. The faucets found in the kitchen, bathroom or powder room are often referred to as "fittings," "trim," or _____.

2. _____ is the industry term for wash basin or bathroom sink.

3. A _____ _____ has one handle to operate the flow for both the hot and cold supply lines.

4. All spouts have _____ or swivel models, which move from side to side.

5. _____ _____allows water to be temporarily diverted from a kitchen faucet through a spray to be used at the kitchen sink.

6. _____ _____ automatically correct for pressure variations in the hot and cold water lines, thus preventing sudden bursts of hot or cold water.

7. Valves that automatically control temperature are called _____ _____.

8. One of the purposes of the _____ on a faucet is to reduce the amount of water used.

REVIEW OF HOUSEHOLD WATER SYSTEM: BRASSWARE

Answers appear on page 92

APPLYING WHAT YOU HAVE LEARNED:

By observing and asking questions, fill in the blanks. If you are not sure of the answers, ask your supervisor.

A. Are pressure-balancing valves ever required on installations in your area?
a. Yes b. No

If yes, when? _____

B. Which of the three types is the most popular model of tub and shower valves sold by your company?

_____

_____

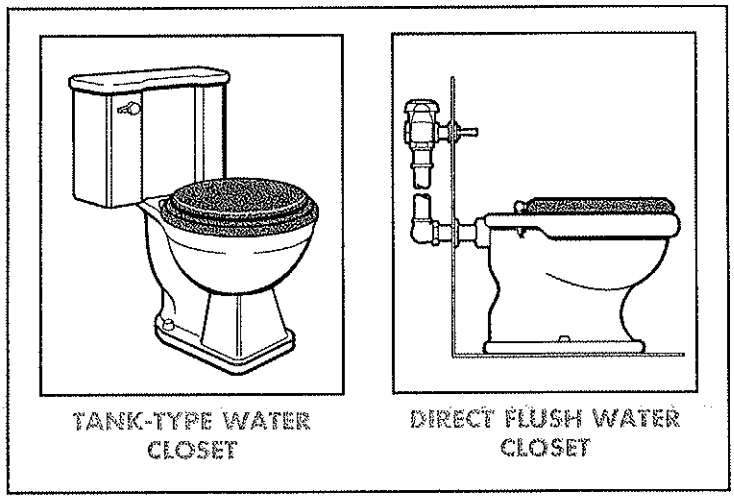
_____

Toilet Valves and Water Heater Valves

WATER CLOSET is another plumbing industry term for a toilet. The toilet is used to dispose of bodily waste and is the most common type of sanitary fixture. There are three major categories of water closets: residential, commercial, and institutional.

Residential (home) toilets are typically tank-type water closets. Toilets meant to serve the general public, such as in institutional or commercial buildings, are generally tankless water closets. Sometimes light commercial buildings, such as small offices, will also use direct flush closets.

TWO TYPES OF WATER CLOSETS



TANK-TYPE WATER CLOSET

DIRECT FLUSH WATER CLOSET

PVF 1.3.53

Tank-Type Water Closets

The **TANK-TYPE WATER CLOSET** is the most common water closet used in homes. In the tank-type closet, the water used for flushing is stored in a tank above the bowl.

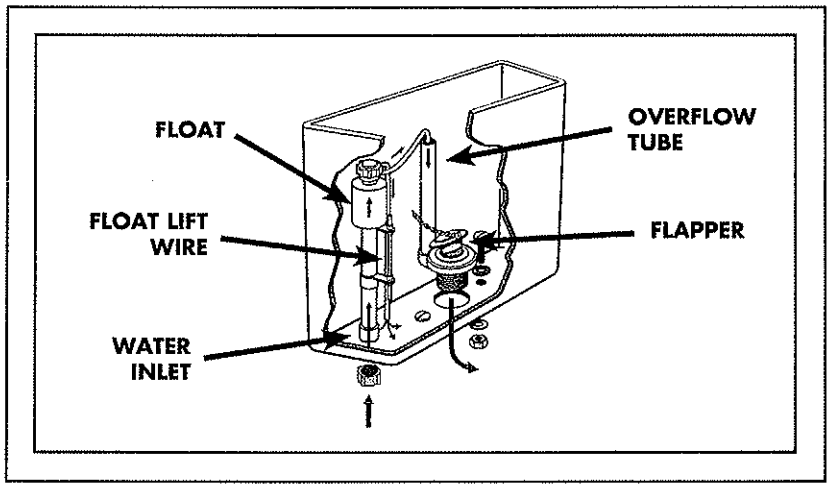
Since 1992, all toilets manufactured for sale in the United States are required to flush with no more than 1.6 gallons of water. This requirement was made to conserve water. Toilets manufactured before 1992 used between 3.5 and 7 gallons per flush. The 1.6-gallon toilets are generally referred to as **LOW-CONSUMPTION WATER CLOSETS**. In 2013 the California Commission approved newly adopted standards and changed the required maximum flow rates for toilets from 1.6 gallons to 1.28 gallons per flush.

There are three types of low-consumption toilets used in residential settings: gravity-feed, pressure-assisted and vacuum-assisted water closets.

GRAVITY-FEED WATER CLOSETS use the natural force of gravity to drain the toilet when it flushes. The water drops naturally in the tank because of the weight of the water and the siphoning effect as water is flushed out through the trapway. There are two valves in a tank-style closet: the flush valve and the refill valve. The two work together to complete the flushing action.

Shown below are the components of a toilet with the classic flush valve and ballcock refill valve configuration, which has been around for many years. While the flush valves and refill valves from different manufacturers may look slightly different, they all perform the same functions.

COMPONENTS OF A GRAVITY-FEED TOILET
FLUSH SYSTEM VALVE WITH BALLCOCK



PVF 1.3.54

The **FLUSH VALVE** opens when the flush handle lever is depressed. Depressing the handle raises the horizontal rod upward and lifts the stopper (or "flapper") via a chain or rod; this pulls the stopper away from the seat and opens the valve, allowing water to flush into the bowl through the valve opening that was previously blocked by the stopper. The flush valve then closes. Newer flush valves use larger drain ports and vertically rising stoppers (instead of flappers). This style achieves a more consistent interface between the gasket and seat, and a more positive shut-off.

The **REFILL VALVE** controls the water level in the tank, allowing the tank to refill but not overflow. This valve has a float, or some other kind of water-level sensing device, which reacts to changes in the water level in the tank. The classic **BALLCOCK VALVE**, one type of refill valve, is shown in the drawing above and is described below. It uses a ball-shaped float to regulate the flow of water back into the tank after a flush.

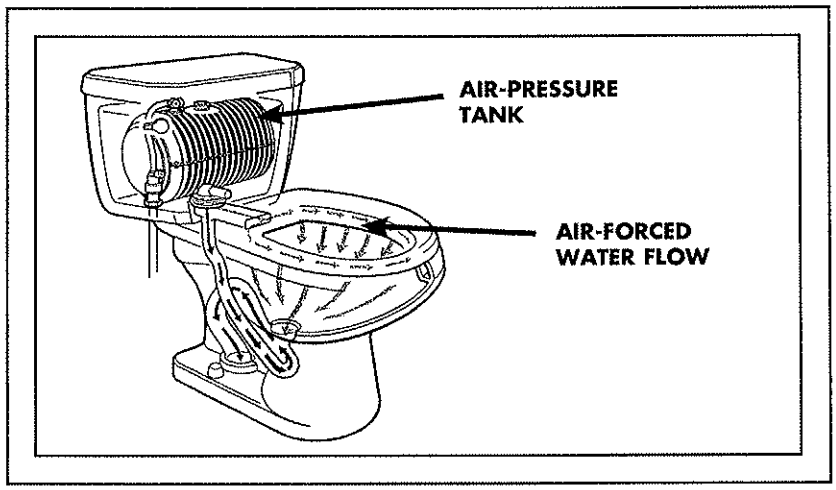
When the tank is flushed the water level lowers, the float drops, which activates the fill valve. After the flush valve closes, the tank and bowl begin to refill. When the water reaches the proper level and the float is lifted to the prescribed position, the fill valve closes and the flow is shut off. The overflow pipe will drain excess water into the bowl to prevent the tank from overflowing in case the level control does not work properly. The overflow tube also helps to maintain a physical air gap between the potable water supply and the drain connection.

While the tank is refilling, some water is diverted into a small refill tube, which empties into the overflow pipe, sending enough water into the bowl to cover and seal the trap.

Most refill valves have either vacuum breakers or backflow preventers to keep water from flowing backwards into the supply system.

THE PRESSURE-ASSISTED WATER CLOSET has a different kind of flushing mechanism, which was originally designed to work with the low-consumption toilets. The pressure-assisted water closet has a specialized pressure tank within the outside tank. If you were to remove the lid from the toilet tank of a pressure-assisted water closet that is not being flushed, you would not see much water. The water is stored within the inner specialized pressure-assist tank. The pressure-assist tank (or "vessel") is designed so there is always a pocket of trapped air in the top of the vessel.

COMPONENTS OF A PRESSURE-ASSISTED WATER CLOSET FLUSH SYSTEM



PVF 1.3.55

As water flows in from the supply line at the bottom, the air is squeezed under greater and greater pressure from the water. When the pressure in the pressure-assist vessel reaches the same pressure level as the pressure in the water supply line, the water stops flowing into the vessel and the toilet is ready to be flushed.

A pressure-assisted toilet might have a side lever or a button on top of the tank, which are pushed to start the flushing action. Pushing the button increases the pressure against the air pocket at the top, and the increased pressure in the tank pushes the water into the bowl to start the flush. Rather than flowing out of the bowl because of a gravity-induced siphon effect, the water from the gravity-pressure toilet is forced out of the bowl under pressure.

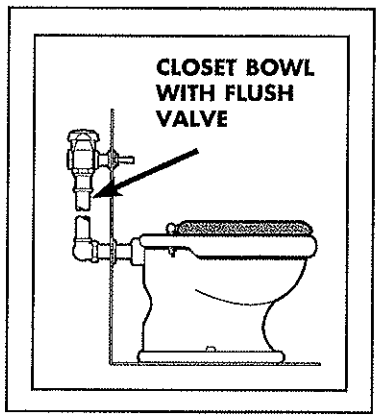
A pressure-assisted toilet generally requires a supply line pressure of at least 25 pounds per square inch (psi), while gravity feed toilets will operate at lower pressure ratings. Due to the California standards, as well as the general movement toward water conservation, toilets have been rapidly changing to meet the 1.28 gallon flush restrictions. This is often achieved through the use of dual flush technology. Newer flush valves are designed to provide two flushes depending upon the contents of the bowl. For solid waste, the 1.6 gallon flush can easily evacuate the contents of the bowl. The smaller flush accommodates liquid waste with a flush of .8 gallons. The average of the .8 and the 1.6 gallon flush toilet equals 1.28 gallons, which meet the new conservation standards.

Direct Flush Water Closets

Tankless water closets are installed in commercial and institutional applications, or other sites where the toilets are expected to serve the general public. Light commercial buildings, such as small offices, may use tankless water closets or tank-type closets.

As the name implies, a tankless water closet has no tank to hold and store water for the flush. Instead, the flush valve on a tankless closet is connected to the water supply piping in the building. When the toilet's flush handle is depressed, the valve opens and water rushes into the bowl from the building supply piping. The water for flushing is immediately available; there is no need to wait for a tank to refill.

TANKLESS WATER CLOSET WITH FLUSH VALVE



PVF 1.3.56

It is the pressure in the supply piping that provides the force to push water into the bowl. This type of toilet requires a larger-size supply pipe and greater operating pressure to provide fast enough and strong enough delivery of water to successfully flush the toilet. The tankless closet has a vacuum breaker to prevent backflow into the supply piping system.

Water Heater Valves

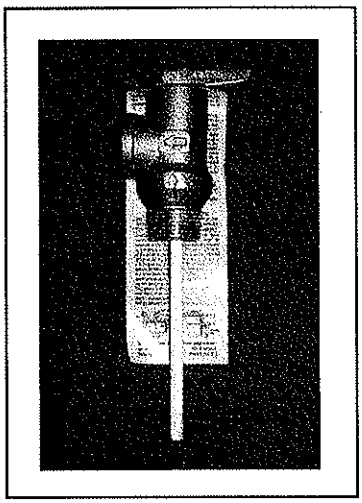
Water heaters also have valves that you need to know about. There are two types of valves on water heaters that are important to understand.

Temperature and Pressure Relief Valve

A **TEMPERATURE AND PRESSURE RELIEF (T&P) VALVE** is a safety device typically installed near the top of a water heater, which prevents damage to the heater (and danger to persons nearby) from the build-up of excessive temperatures and pressure. Pressure is the force exerted per square unit of area, for example, pounds per square inch (psi).

As cold water is heated, water temperature increases. As the temperature increases, the pressure inside the tank also increases. If either the temperature or pressure gets too high, the valve opens, and excess hot water or steam is discharged.

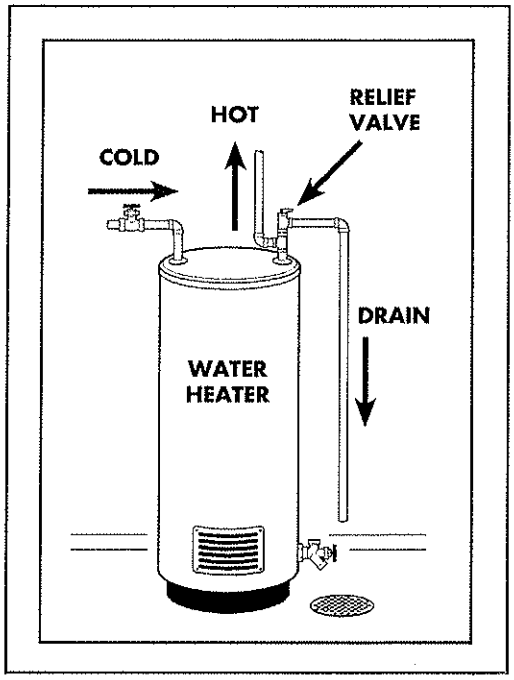
TEMPERATURE AND PRESSURE RELIEF VALVE



PVF 1.3.57

A piece of pipe attached to the outlet directs the discharge down to the floor and to a safe place for disposal. This discharge pipe is a safety precaution that prevents injury to anyone nearby. The discharge pipe cannot reduce the diameter of the relief valve discharge opening, and must maintain minimal fittings to avoid restricting the safe discharge of heat energy.

T&P VALVE WITH DISCHARGE PIPE



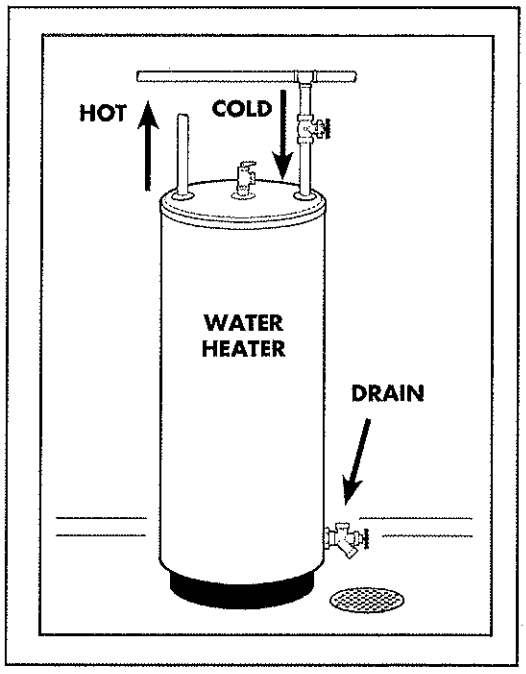
PVF 1.3.57

Boiler Drain

A boiler drain (or water heater drain) is used to drain the heater or, in regular maintenance, to prevent residue from building-up. As discussed previously in connection with its use on washing machines, a boiler drain can be of a compression or a ball-valve design to drain or flush the water heater. A boiler drain has male hose threads.

Water commonly contains minerals that tend to settle at the bottom of the unit as the water is heated. If the heater is not drained regularly, these minerals will eventually form a solid deposit of residue at the bottom of the heater.

BOILER DRAIN ON WATER HEATER



PVF 1.3.58

REVIEW OF TOILET VALVES & WATER HEATER VALVES

Answers appear on page 93

1. Another term for a toilet is the "_____."

2. The _____ _____ _____ is the most common water closet used in homes, in which the water used for flushing is stored in a tank above the bowl.

3. There are two valves in a tank-style closet, the _____ _____ and the _____ _____, which work together to complete the flushing action.

4. A _____ _____ _____ has no tank to hold and store water for the flush, but instead the flush valve is connected to the water supply piping in the building.

5. A _____ _____ _____ _____ _____ opens when pressure or temperature gets too high, in a water heater.

6. A _____ _____ is used to drain the heater or, in regular maintenance, to prevent residue build-up.

7. What term applies to the traditional residential water closet?
   a. Pressure-assisted water closet b. Gravity-feed water closet

8. Which valve refills the tank of a water closet and controls the water level?
   a. Flush valve b. Refill valve

REVIEW OF TOILET VALVES & WATER HEATER VALVES *Answers appear on page 93*

9. How much water does the now-common residential low-consumption toilet use per flush?
   a. 1.6-gallons b. 0.5-gallons

10. What is the minimum household water system pressure required for a pressure-assisted toilet to work effectively?
   a. 25 psi b. 18 psi

APPLYING WHAT YOU HAVE LEARNED:

By observing and asking questions, fill in the blanks. If you are not sure of the answers, ask your supervisor.

A. Find out which of the "best-seller" tank-type toilets is sold by your company. Then study the "innards" inside the tank and describe to a colleague how you think the flushing mechanism works. If you need help, ask your supervisor or look at the manufacturer's literature.

B. Find out whether you sell more tank-type toilets or more tankless toilets. Write the approximate percentages below:

Tank-style water closets = _____% of toilet sales

Tankless water closets = _____% of toilet sales

ANSWERS TO REVIEW QUESTIONS

CHAPTER 2

INTRODUCTION TO VALVES

Answers for REVIEW OF COMMON TYPES OF VALVES (pages 50–52)

1. Valves, Fluid
2. Throttle
3. Plug Valves
4. Full On, Full Off
5. Ball Valve
6. Stem, Bonnet
7. Rising Stems
8. Washer
9. Butterfly Valve
10. Swing-check Valve
11. Lift-Check Valve
12. Prevent Backflow
13. Globe Valve
14. a. 90°
15. b. Port
16. b. When open, it causes very little pressure drop.

Applying What You Learned:

A. Depends upon the location

B. Depends upon the location

Answers for REVIEW OF SERVICE CONNECTION VALVES FROM THE MAIN TO THE HOUSE (pages 59–60)

1. Service Connection
2. Service Pipe
3. Frost Line
4. Curb Stops
5. Meter Stops
6. Angle Valves
7. Curb / Box
8. Stop and Waste Valve
9. Pressure-Reducing Valve
10. b. Stop the flow at a location so that part or all of the system can be shut off
11. b. Corporation Stop

Applying What You Learned:

A. Varies by location

B. Varies by geographic area and climate

Answers for REVIEW OF HOUSEHOLD WATER SYSTEM: WATER SUPPLY SYSTEM VALVES (pages 69–71)

1. Faucets
2. Fixture
3. Brassware
4. Utility Faucets
5. Washer Design Faucets
6. Compression
7. Shearing
8. Diaphragm-Type Washerless Faucets
9. Laundry tray
10. Mixing-Type Faucet
11. Swing Spouts
12. Boiler Drains
13. a. They are also called sillcocks
14. a. Let air into the system.
15. b. Supply Stops
16. b Repair is often easier

Applying What You Learned:

A. Prices vary by location, but washerless faucets generally are cheaper

B. Check your inventory. Varies by location.

Answers for REVIEW OF HOUSEHOLD WATER SYSTEM: BRASSWARE (pages 78–79)

1. Brassware
2. Lavatory
3. Single-Control Faucet
4. Swing
5. Hose Spray
6. Pressure-Balancing Valves
7. Thermostatic Controls
8. Aerator

Applying What You Learned:

A. Depends upon location

B. Depends upon location

Answers for REVIEW OF TOILET VALVES & WATER HEATER VALVES (pages 86–87)

1. Water Closet
2. Tank-Type Water Closet
3. Flush Valve, Refill Valve
4. Tankless Water Closet
5. Temperature and Pressure Relief (T&P) Valve
6. Boiler Drain
7. b. Gravity-Feed Water Closet
8. b. Refill valve
9. a. 1.6-Gallons
10. a. 25 psi

Applying What You Learned:

A. Depends upon location

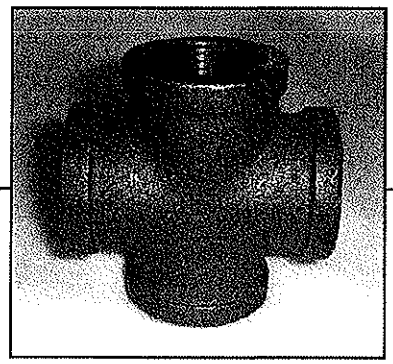
B. Depends upon location

3 INTRODUCTION TO FITTINGS

LEARNING OBJECTIVES

When you finish this Chapter you will be able to:

1. Recognize and use common fittings terms.
2. Describe the characteristics and functions of straight line fittings:
   - Nipples and Couplings
   - Adapters, Bushings and Flanges.
3. Describe the characteristics and functions of fittings that change flow direction:
   - Elbows
   - Tees and Wyes (Ys)
4. Describe the characteristics and functions of fittings that stop the flow.



FITTINGS

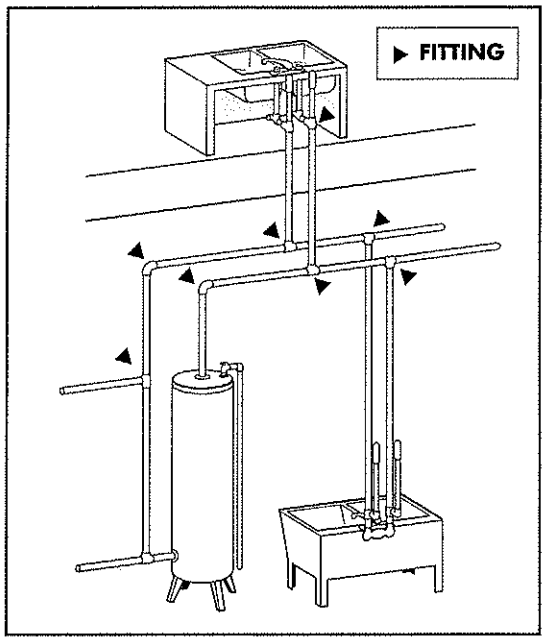
Common Fitting Terms

Every type of piping system contains fittings. **FITTINGS** are used to connect pipe into systems. Like pipe, fittings can be made of ferrous metals, non-ferrous metals or plastic.

Uses of Fittings

As illustrated in the drawing to the right, pipes run both horizontally and vertically. Fittings may connect to make horizontal or vertical pipe runs. Generally, fittings are used for three purposes: to connect pipe to form long straight-line runs, to change the direction of runs, or to close off ends of pipe.

FITTINGS CONNECT PIPE

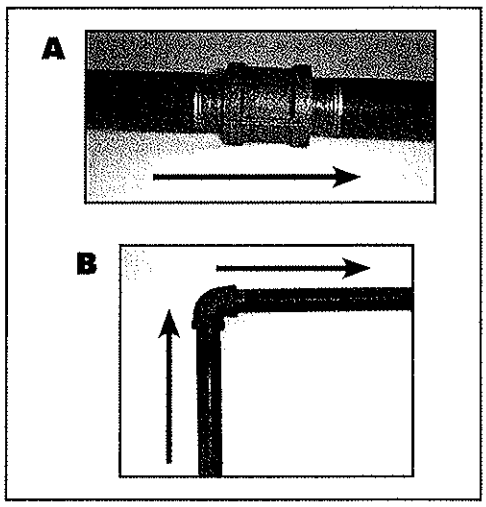


PVF 1.2.01

Fitting A, shown to the right, is called a **COUPLING** and will connect two pieces of pipe in a straight line. It will not change the direction of the flow.

Besides connecting pipe in a straight line to make a run longer, fittings can change the direction of the flow. Fitting B, called an **ELBOW** or **ELL**, will turn the flow in a different direction. The elbow shown here is a 90° elbow because it changes the direction of the flow by 90°. There are also 22°, 45° and 180° elbows.

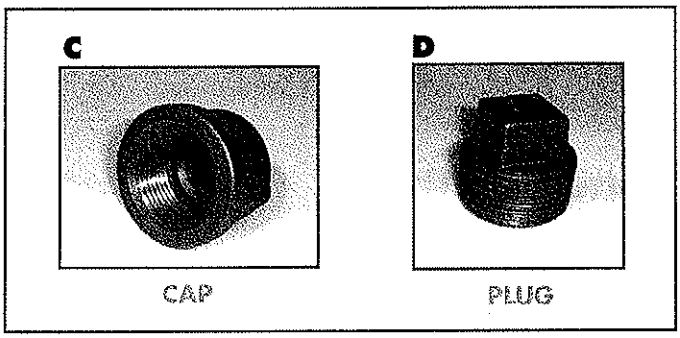
STRAIGHT LINE AND CHANGE OF FLOW FITTINGS



PVF 1.2.02

Fittings also can be used to close off the end of a pipe. Fitting C is a **CAP**. Fitting D is a **PLUG**. Caps are used to close off pipe with plain or male-threaded ends. Plugs are used to close off female-threaded pipe.

FITTINGS THAT CLOSE OFF PIPE AND STOP FLOW

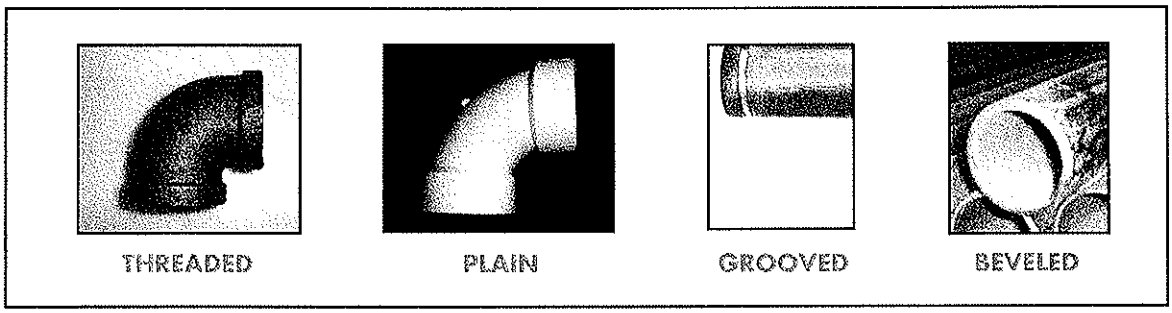


PVF 1.2.03

Fitting Ends

Just as pipe may have different types of ends, fittings also come in plain, beveled, threaded, grooved, and mechanical joint ends. The common types are shown below.

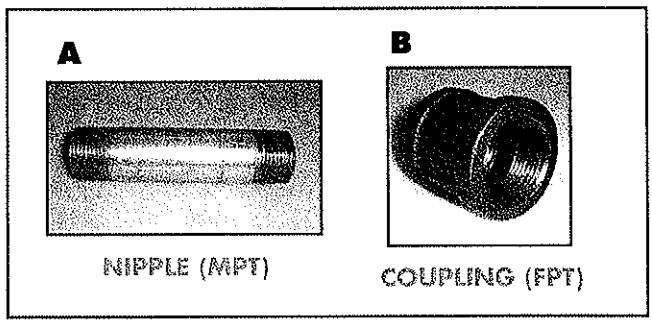
FITTINGS ENDS



PVF 1.2.04

Fittings that are threaded on the outside diameter have **MALE PIPE THREADS** (MPT or M). Fitting A has MPT at both ends. Fittings that are threaded on the inside diameter have **FEMALE PIPE THREADS** (FPT or F) Fitting B has FPT at both ends.

THREADED FITTINGS



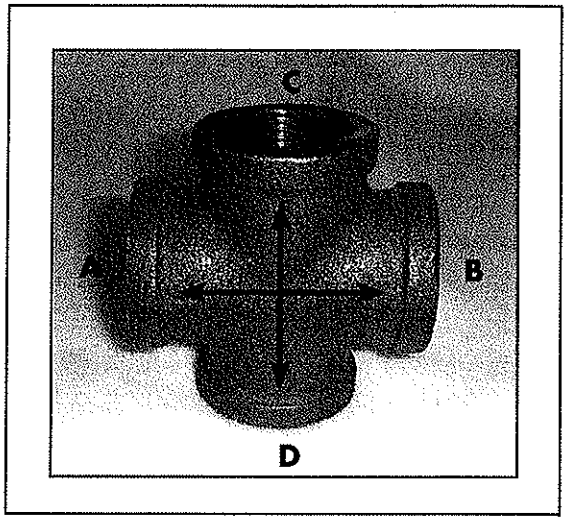
PVF 1.2.05

Fitting Runs and Openings

The run in pipe is the portion continuing in a straight line. Like pipe, fittings have runs. The straight portion between two ends is the **RUN** of a fitting. The run moves in the direction of the flow of the pipe to which the fitting is connected.

In the illustration of the cross tee, there are actually two runs: a horizontal run (A-B) and a vertical run (C-D). We cannot tell which way the actual flow will go in a particular situation from the drawing. However, most fittings have only one run.

FITTING RUNS

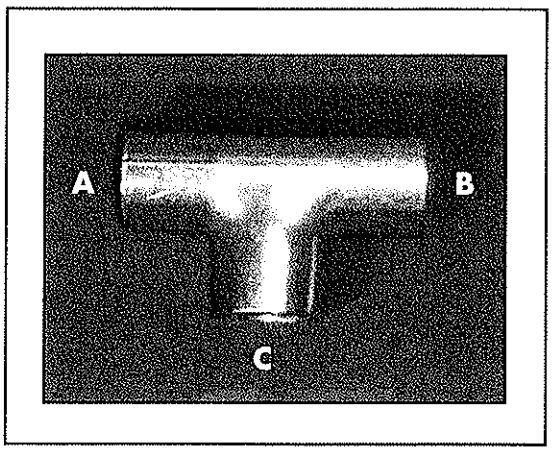


PVF 1.2.06

Fittings often have branches. A **BRANCH** is an end opening that is not in line with the run of the fitting. In the illustration below, the branch is the C opening, shown here at the bottom of the drawing.

A branch opening may be called an inlet or an outlet, depending on how it is used. An **INLET** is a branch opening that allows flow to join the run. An **OUTLET** is a branch opening that allows some of the flow to leave the run. In this drawing, we cannot really tell for sure whether the branch (C) is an inlet or an outlet because we do not know in which direction the flow will go through the branch.

BRANCH OPENINGS



PVF 1.2.07

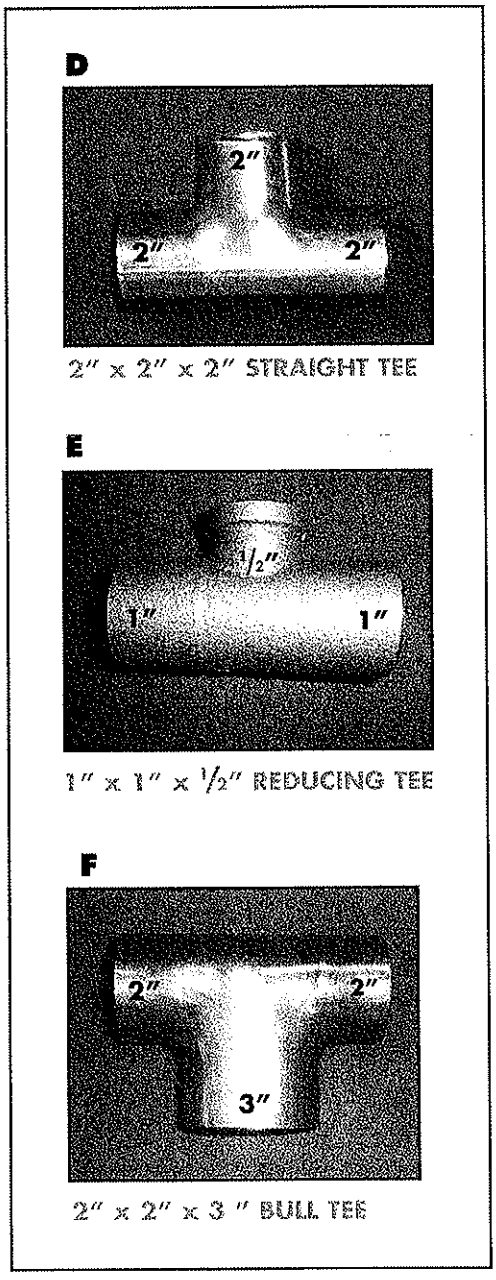
General Rules for Specifying Fittings

A branch can be the same size as the openings on the fitting, referred to as a straight tee (Fitting D below). A branch can be smaller than the run openings, referred to as a reducing tee (Fitting E). A branch also can be larger than the run openings, referred to as a bullhead tee (Fitting F).

In general, the specifications for a fitting indicate the sizes for both ends of the run first, followed by the size of the branch. In the case of run openings being different sizes, the larger run opening would be listed first. In similar fashion, if there are two branches of differing sizes, the larger branch opening would be listed before the smaller branch opening. (But branches are always listed after run openings.)

Fitting D would be listed as a 2" tee because all of the openings are the same size. The specification listing for Fitting E would be 1" x 1" x ½". The Fitting F listing would be 2" x 2" x 3".

SPECIFYING FITTINGS



PVF 1.2.08

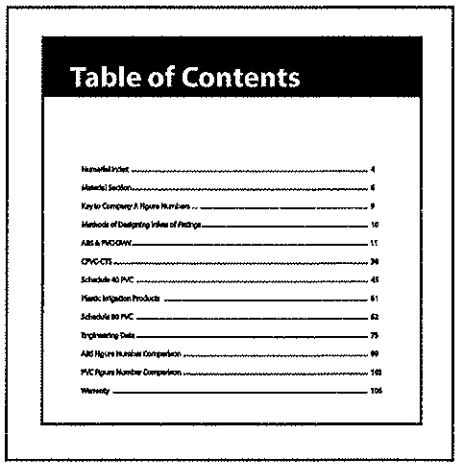
Finding Information in Print Catalogs and Electronic Media

When working with customers to help them place correct orders and/or finalize accurate job proposals, wholesaler employees need to be able to locate and provide complete, accurate product descriptions and catalogue references. Catalog pages containing detailed descriptions, technical data and sometimes pictures of the product are often included as part of customers' bids and proposals. It also is important to be able to find your manufacturers' equivalent of the requested product from other manufacturers via a cross reference chart so your company can provide what is needed for a complete order. This ability to provide one-stop shopping is critical to a wholesaler's competitiveness. Here is a common way to use a manufacturer's catalog:

Start with the catalog index or table of contents.

Every catalog contains some type of index or table of contents that lists the broad categories of products they carry and the pages on which detailed descriptions and ordering instructions are provided. The index to the right shows a typical table of contents listing from a fittings manufacturer.

TABLE OF CONTENTS

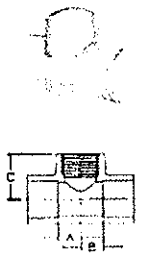


PVF 1.2.60

Select the detail you want for the requested product.

If you are looking for information on schedule 40 PVC from the table of contents above, you would find the information you need on pages 45-61 of the catalogue. For example, if you are looking for a schedule 40 reducing tee you would find it on page 45. Information describing the tee, a picture and other technical information would be provided. You would be able to find pricing, packaging and shipping information elsewhere in the same catalog. See the example below.

REDUCING TEE CHART



REDUCING TEE (SLIP X SLIP X FPT)

UNIV FIG NO.	NOM. SIZE	APPROX NET WT./LBS.	DIM. A INCHES	DIM. B INCHES	DIM. C INCHES
402-074	1/2 x 1/2 x 3/4	.145	21/32	21/32	1 9/16
402-094	3/4 x 1/2 x 1/2	.145	1/2	1/2	1 3/32
402-101	3/4 x 3/4 x 1/2	.088	1/2	1/2	1 3/32
402-124	1 x 3/4 x 1/2	.111	1/2	1/2	1 7/32

PVF 1.2.61

Use a cross reference chart to find your manufacturer's equivalent of the requested product.

Since several manufacturers often provide equivalent product, your manufacturers catalog may include a cross reference so you can find the product you need in your vendor's catalog.

Manufacturers' websites and electronic databases can speed the process.

The same information found in print catalogs generally can be found on manufacturers' websites. The on-line indexes usually will provide electronic links to the needed pages, which can be copied or downloaded in Excel or PDF formats and directly entered into bid submittal pages and other documents.

Finding product information in electronic catalogs.

It is important for distributors to quickly find product information, specifications, and pictures so they can answer inquiries from customers and help with bid submittals. Some distributor employees use computers and the internet to access product information electronically in "libraries" of catalogs from many manufacturers. These electronic libraries help users quickly find the product information they want, usually in a fraction of the time and cost that it takes them to search through print catalogs.

Electronic catalogs are used by all employees who interact with customers, including inside sales, showroom attendants, counter personnel, and outside salespeople. They access needed information by simply entering a model number, keyword, or description of the product.

When new catalogs and updates are delivered electronically, they, too, are provided at a fraction of the time and expense of printed and mailed catalogs.

REVIEW OF COMMON FITTING TERMS

Answers appear on page 139

1. _____ are used to connect pipe into systems.

2. Which of the following always joins two pieces of pipe in a straight line?
   a. Elbow b. Coupling

3. _____, also called _____, will turn the flow in a different direction.

4. _____ are used to close off pipe with plain or male-threaded ends and _____ are used to close off fittings with female pipe thread.

5. Fittings that are threaded on the outside diameter have _____ _____ _____ and fittings that are threaded on the inside diameter have _____ _____ _____.

6. The _____ of a fitting is the straight portion between two ends.

7. A _____ is an end opening that is not in line with the run of the fitting.

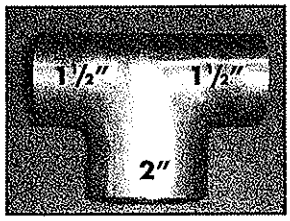
8. An _____ is a branch opening that allows flow to join the run, and an _____ is a branch opening that allows some of the flow to leave the run.

REVIEW OF COMMON FITTING TERMS

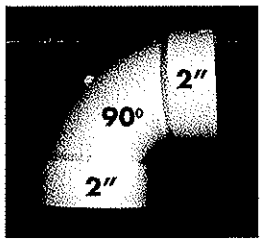
Answers appear on page 139

Write the specifications for each fitting for questions 9–11:

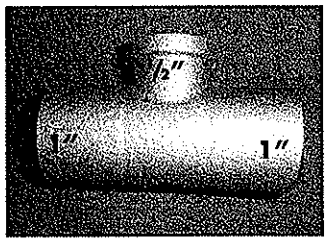
9. _____ x _____ x _____ Bull Tee



10. _____ _____ Ell



11. _____ x _____ x _____ Reducing Tee



REVIEW OF COMMON FITTING TERMS

Answers appear on page 139

CROSS REFERENCE TABLE FOR FITTINGS

XYZ Company	Nominal Size	A Company	B Company	C Company	D Company
ABS		ABS	ABS	ABS	ABS
8503	1 ¼"	- - - -	5740	3840	A 890A
8504	1 ½"	101	5741	3841	A 891A
8505	2"	102	5742	3842	A 892A
8506	3"	103	5743	3843	A 893A
8507	4"	104	5744	3844	A 894A

12. According to cross-reference table above, what fitting made by B Company could be substituted for fitting 8504 from XYZ Company?

_____

13. What A Company fitting could be substituted for A 890A ?

_____

14. What is one general rule that usually applies when specifying a fitting?

    a. You generally list a smaller opening before you list a larger opening.

    b. You generally list a larger opening before you list a smaller opening.

15. Generally speaking, which characteristics are the most important in choosing fittings?

    a. Length of pipe, pressure capacity, cost of fitting needed.

    b. Pressure capacity, pipe material, pipe weight.

REVIEW OF COMMON FITTING TERMS

Answers appear on page 139

APPLYING WHAT YOU HAVE LEARNED:

By observing and asking questions, fill in the blanks. If you are not sure of the answers, ask your supervisor.

A. Ask your supervisor if you can see a fitting catalog with cross reference tables. How many companies are listed for cross reference purposes?

_____

_____

_____

B. What type of fitting do you sell most often for changing flow direction?

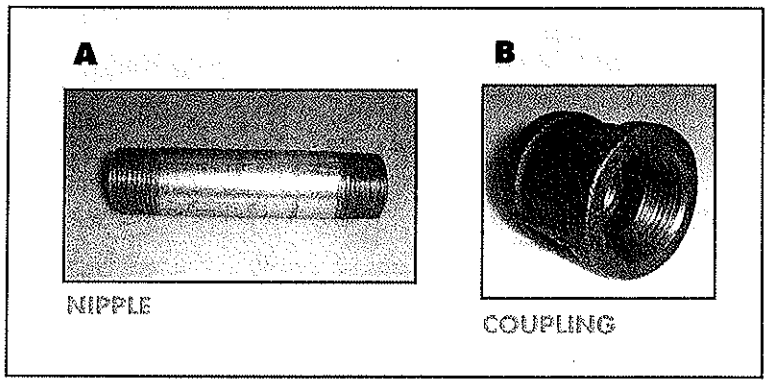
_____

Straight-line Fittings

Straight-line fittings do not change the direction of the flow, but simply connect pipe in a long straight-line run. Two types of fittings—nipples and couplings—are simply pieces of pipe (sometimes tube) that have been altered for use as fittings.

Both nipples and couplings are straight-line fittings. They are used to join pipe, valves or other fittings in a way that does not change the direction of flow.

STRAIGHT-LINE FITTINGS



PVF 1.2.16

Characteristics of Nipples

NIPPLES are short pieces of pipe, plain inside and threaded on the outside (MPT), that are used to connect pipe, fittings and valves. Nipples can be made from any pipe that can be threaded. Nipples are considered male fittings.

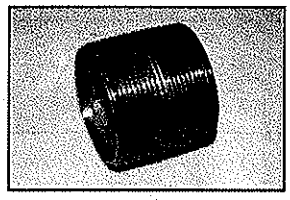
The most common nipples are made of standard weight black or galvanized steel. On specification sheets, black steel sometimes appears as "Bl. St.," while galvanized steel is written as "GAL. ST." You also may carry nipples made of extra-heavy steel, brass, and stainless steel. The larger the stock and the broader your company's market, the more types of nipples you are likely to carry.

The specification for a nipple includes the size of the pipe, the length of the nipple and the material from which the nipple is made – listed in that order.

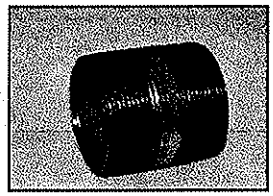
Types of Nipples

There are three classifications of nipples by length: close nipples, shoulder nipples (sometimes called "short") and long nipples.

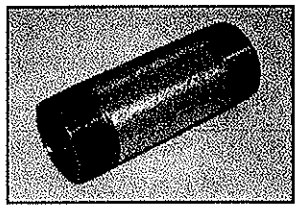
TYPES OF NIPPLES



CLOSE NIPPLE



SHOULDER NIPPLE



LONG NIPPLE

PVF 1.2.17

CLOSE NIPPLES have MPT that meet in the center. The surface of the nipple is totally covered by MPT. A close nipple will be as long as it needs to be to assure that two ends of the pipe will be properly connected.

The larger the diameter of the pipe to be joined, the longer the close nipple must be to join it. For example, an ⅛" close-black-steel nipple is generally ¾" long.

You usually will have a chart to help you determine the correct length for nipples. Remember that the length of a close nipple must increase with the diameter of the pipe to be joined.

PIPE DIAMETERS/
CLOSE NIPPLE LENGTHS

Pipe Diameter	Nipple Length
⅛ "	¾ "
¼ "	⅞ "
⅜ "	1 "
½ "	1 ⅛ "
1 "	1 ½ "
1 ¼ "	1 ⅝ "
2 ½ "	2 ½ "
3 "	2 ⅝ "

PVF 1.2.18

SHOULDER NIPPLES are the next larger size from close nipples. These nipples have some unthreaded pipe between the threaded ends. Shoulder nipples are also referred to as "short nipples."

The length of a shoulder nipple will increase as the size of the pipe increases. In the drawing, the pipe is ½" and the nipple length is 1 ½". For the 1" pipe, the nipple is 2" long.

PIPE DIAMETERS/
SHOULDER NIPPLE LENGTHS

Pipe Diameter	Nipple Length
½ "	1 ½ "
¾ "	1 ½ "
1 "	2 "
1 ¼ "	2 ½ "
2 "	2 ½ "
2 ½ "	3 "
3 "	3 "

PVF 1.2.18

LONG NIPPLES are the third category of nipples. The amount of the unthreaded pipe between the threaded ends of a long nipple is greater than that of a short or shoulder nipple of the same diameter. The space between the threads of a long nipple is greater than that of a shoulder nipple. Long nipples are available in a variety of sizes.

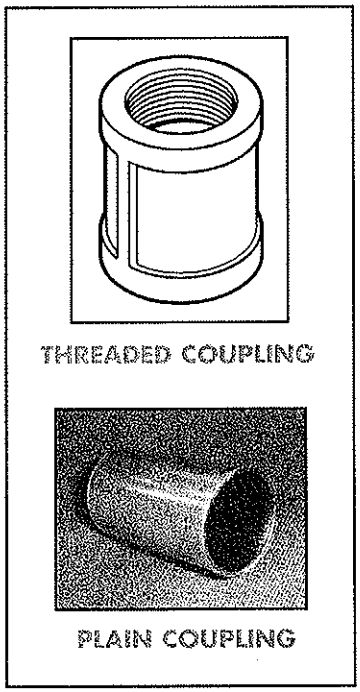
Characteristics of Couplings

COUPLINGS are also fittings that join pipe, valves, or fittings while maintaining a straight-line flow. Couplings can be made from pipe o r tube, since not all couplings are threaded.

All couplings are considered to be female fittings because the ends of the pipe to be joined will fit within the coupling. The pipe, valves, or other fittings to be joined by a coupling are considered to have male ends, whether or not they are male threaded.

A coupling may have FPT at one end or both ends. A coupling also may be plain inside. Plain couplings may be soldered, welded, or sealed with a special cement. Still other couplings have special ends, depending upon application.

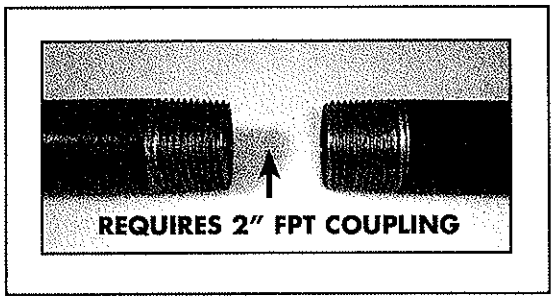
COUPLING ENDS



PVF 1.2.20

A coupling must be specified and ordered according to the size (diameter) of the pipe to be joined. Couplings are specified by first stating the end size and then the end type (threaded, plain, or other). The coupling in the illustration would be specified as a 2" FPT coupling.

SPECIFYING COUPLINGS

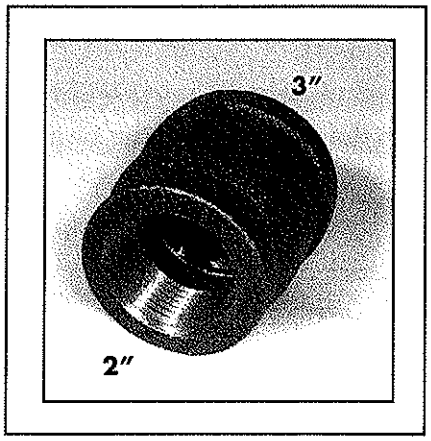


PVF 1.2.21

Reducing Couplings

Some couplings are used to join two pipes of different diameters. These fittings are called reducing couplings or reducers. A REDUCER joins one pipe to another pipe that has a smaller diameter.

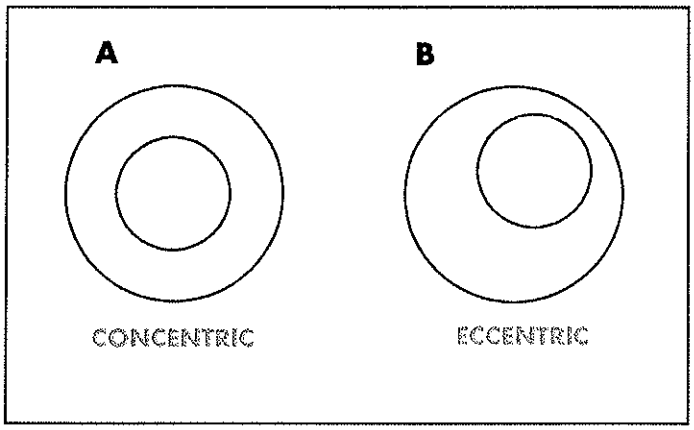
REDUCING COUPLING



PVF 1.2.22

There are two basic types of reducing fittings: concentric and eccentric. Concentric circles have the same center, such as illustrated in A. Eccentric circles have two different centers, as in B.

CONCENTRIC AND ECCENTRIC CIRCLES

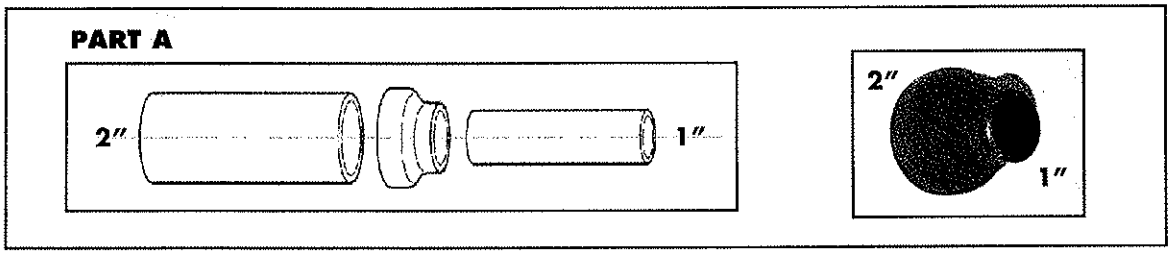


PVF 1.2.23

A **CONCENTRIC REDUCER** is used in pressure systems in either vertical or horizontal systems. When used in the drainage system, it is used only in the vertical runs.

Similarly, in a **CONCENTRIC REDUCER**, the opening of the fitting and the opening of the pipe run are the same.

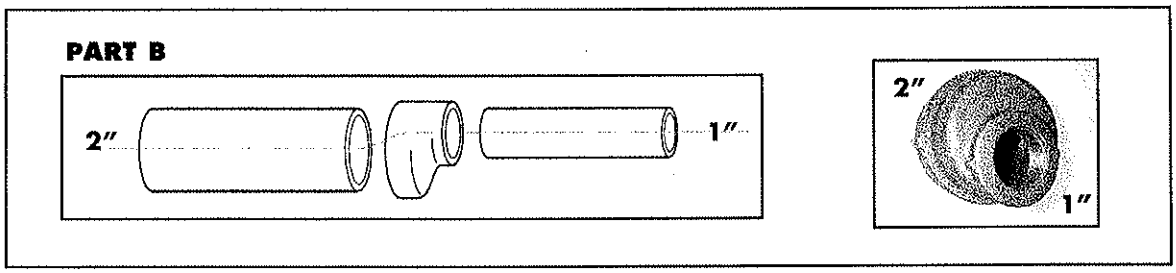
CONCENTRIC REDUCERS



PVF 1.2.24

ECCENTRIC REDUCERS are used in drainage or return systems in horizontal runs only. The small end is always on the underside of the piping system to ensure that all media flows from the system.

In an **ECCENTRIC REDUCER**, the centers of the fitting and the pipe run are different. When specifying a reducing coupling, you state the larger opening first, then the smaller opening. So the fitting needed in the drawing below would be a 2″ x 1″ eccentric reducer.



PVF 1.2.25

REVIEW OF STRAIGHT-LINE FITTINGS

Answers appear on page 139

1. The terms close, shoulder and long are used to describe what kind of fitting?
   a. Nipples b. Elbows

2. Which of the fittings below always has MPT?
   a. Tee b. Nipple

3. On specification sheets, black steel sometimes appears as _____ while galvanized steel is written as _____.

4. _____ _____ have MPT that meets in the center and _____ _____ have some unthreaded pipe between the threaded ends.

5. The space between the threads of a _____ _____ is greater than 2″.

6. Which of the materials below is considered ferrous material?
   a. Blk. St. b. Brass

7. Which of the following always joins two pieces of pipe in a straight line?
   a. Trap b. Coupling

8. A _____ joins one pipe to another pipe with a smaller diameter.

9. What type of fitting joins one pipe to another pipe with a smaller diameter so that the run openings have the same center?
   a. Concentric reducer b. Eccentric reducer

REVIEW OF STRAIGHT LINE FITTINGS

Answers appear on page 139

10. Circle the letter for the name of a fitting that joins two pipe with different centers.
    a. Concentric reducer b. Eccentric reducer

11. Circle the letter for the proper specification for a nipple.
    a. 3″ black steel shoulder nipple
    b. 3″ shoulder nipple black steel

12. What is true about the specifications for nipples that join 3″ pipe versus 2″ pipe?
    a. The nipple for the 2″ pipe would be longer.
    b. The nipple for the 3″ pipe would be longer.

APPLYING WHAT YOU HAVE LEARNED:

By observing and asking questions, fill in the blanks. If you are not sure of the answers, ask your supervisor.

A. Pick up a concentric reducer and look into the run.
See if you can observe how the flow goes.

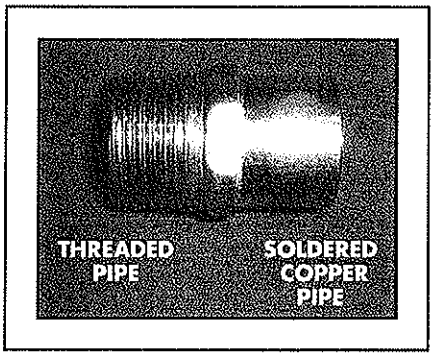
B. Go to a shelf and pick up one of each kind of nipple.
Can you see the difference?

Adapters, Bushings and Flanges

ADAPTERS are also straight-line fittings. They are used to join pipe of different materials or one pipe to another pipe (or fitting), when it requires a different joining method.

Adapters are **TRANSITION FITTINGS**, because they create a link between pipe that might not otherwise be possible to connect. The adapter joins threaded pipe to soldered copper.

ADAPTER



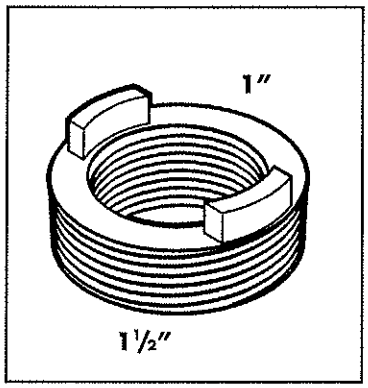
PVF 1.2.28

A **BUSHING** is a fitting that is inserted into an end of pipe of one diameter to allow connection of a pipe or fitting with a smaller diameter. It is a straight-line fitting with one male end and one female end. The male end of the bushing is inserted into a Larger-diameter pipe, while the smaller-diameter pipe is inserted into the female end of the bushing.

A bushing may be plain on the inside and the outside, threaded on either inside or outside, or threaded on both inside and outside.

The specifications for a bushing give the outside diameter first, followed by the inside diameter. A bushing to join a 2″ fitting to pipe with 1 ½″ pipe thread would be a 2″ x 1 ½″ bushing.

SPECIFYING BUSHINGS



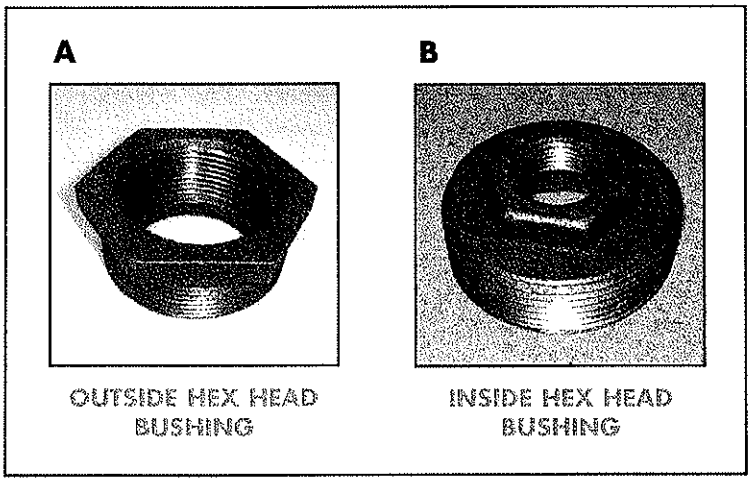
1½″ x 1″
FACED BUSHING

PVF 1.2.29

A bushing sometimes has a hex head at the end of the MPT. This type of fitting is called a **HEX-HEAD BUSHING**. If the hex head is larger than the surface of the bushing, the fitting is sometimes called an **OUTSIDE HEX-HEAD BUSHING**. If the hex head is smaller than the MPT surface of the bushing, the fitting is called an **INSIDE HEX-HEAD BUSHING**.

Some bushings do not have hex heads. A bushing with the hex head removed is called a **FACED BUSHING**.

(OUTSIDE AND INSIDE) HEX-HEAD BUSHING



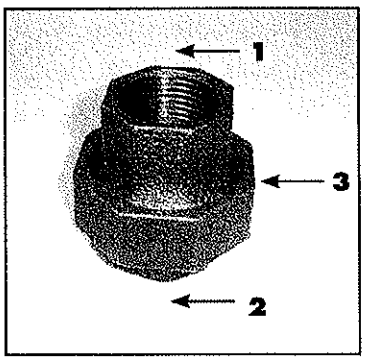
PVF 1.2.30

Another type of fitting used to join pipe or tube in a straight line is a **UNION**. A union is a fitting with three parts. The top and bottom (1 and 2) are connected to the pipe or tube to be joined. The nut (3) tightens down the joint. One advantage of a union is that it allows the pipe to be disconnected without turning the pipe.

The surfaces where the two connections touch (sit on) each other and seal the joint are called seats. Seats may be made from the same material as the union or from a softer metal.

Both connections in a female union have female ends, either FPT or an unthreaded female end, such as a solder cup or hub. In a male/female union, one connection typically has MPT and the other has a female end.

UNION

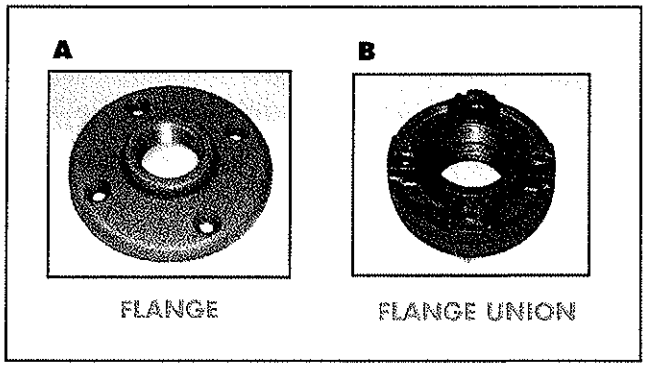


PVF 1.2.31

Pipe also can be connected with the use of flanges. A **FLANGE** is a metal disc with female pipe threads on the inside diameter and bolt holes on the outside around the rim. It can be threaded, welded, soldered, or glued to a pipe.

A **FLANGE UNION** is a connection made by bolting two flanges together. A pipe with MPT is screwed into one flange. The other pipe (also with MPT) that is to be joined to the run is screwed into another flange. A **GASKET** is inserted between the two flanges, and then they are bolted together to make the joint. One of the two flanges designed to be connected in a flange union is sometimes called a **COMPANION FLANGE.**

FLANGES



PVF 1.2.33

A standard cast iron flange union consists of a number of parts: two union flanges, the correct size and number of bolts, and the correct size of gasket to be inserted between the faces of the flanges.

In addition to straight companion flanges, there are reducing companion flanges. A **REDUCING FLANGE** is a flange tapped or bored with a smaller center opening than the other flange to be used in a flange union. This allows pipe of two different sizes to be joined.

Because they allow piping systems to be quickly disassembled and repaired, flange unions are often found in larger installations. In PVF applications, a larger installation is 14" and above. In plumbing installations, 4" and greater is considered larger.

REVIEW OF ADAPTERS, BUSHINGS AND FLANGES

Answers appear on page 140

1. _____ are used to join pipe of different materials or one pipe to another pipe (or fitting) when it requires a different joining method.

2. _____ _____ create a link between two pieces of pipe that might not otherwise be possible to connect.

3. Which of these fittings has one male and one female end?
   a. Coupling b. Bushing

4. A bushing that has a hex head at the end of the MPT is a _____ _____ _____, and if the hex head is larger than the surface of the bushing, the fitting is sometimes called an _____ _____ _____ _____.

5. A bushing with the hex head removed is called a _____ _____.

6. What kind of fitting is used especially so that the joint can be taken apart quite easily?
   a. Bushing b. Union

7. What is the name for a metal disk with a FPT center opening and bolts around the rim?
   a. Solder disk b. Flange

REVIEW OF ADAPTERS, BUSHINGS AND FLANGES

Answers appear on page 140

8. A _____ _____ is a connection made by bolting two flanges together.

9. A single flange designed to be connected in a flange union is sometimes called a _____ _____.

10. A _____ is inserted between the two flanges, which are then bolted together to make the joint.

11. A_____ _____ is a flange tapped or bored with a smaller center opening than the other flange to be used in a flange union.

12. What are the contact sealing surfaces of a union called?
    a. Contact seals b. Seats

APPLYING WHAT YOU HAVE LEARNED:

By observing and asking questions, fill in the blanks. If you are not sure of the answers, ask your supervisor.

A. Find out what material is used to make the gaskets you sell that seal the joints for fittings described in Question 5 above.

B. Look at and compare the difference between an inside hex-head bushing and an outside hex-head bushing.

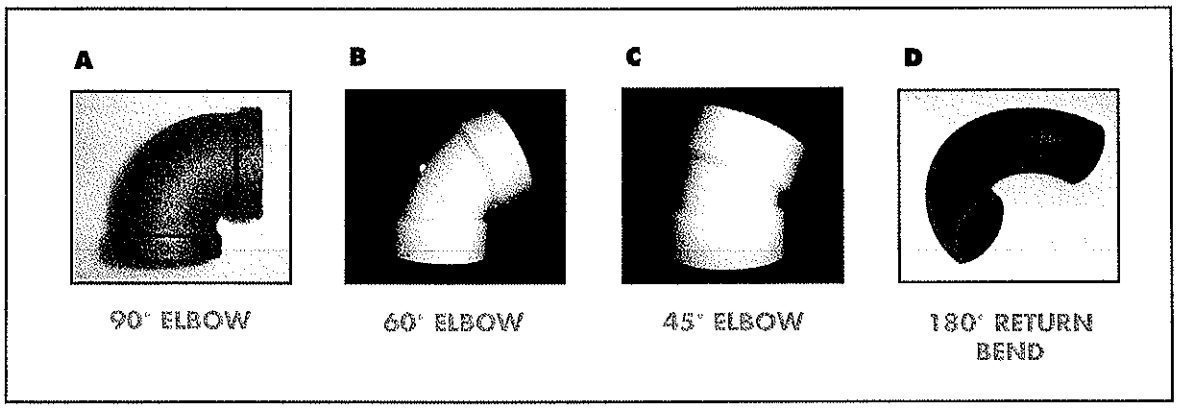
Fittings That Change Flow Direction

Some fittings change the direction of the flow at the joint. Among the fittings that do this are elbows, tees, and wyes (Ys).

Elbows

Elbows (or ells) are fittings found for every class of piping. An elbow changes the direction of the run and, therefore, the flow by joining pipe or tube at an angle. Cast iron or plastic soil pipe elbow fittings are called "bends." Bends are expressed in fractions of a circle rather than by degrees. For example, 90° would be expressed as a ¼" bend.

COMMON TYPES OF ELBOWS



PVF 1.2.35

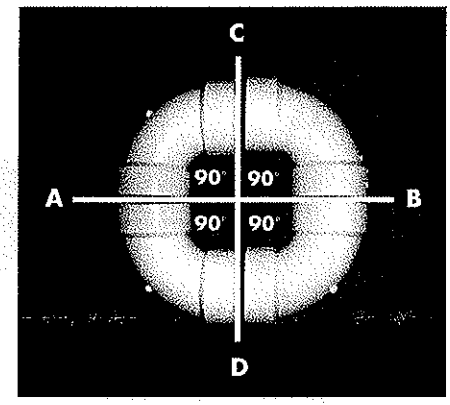
Ells are identified by the degree of angle that the run is changed. The bend in an elbow is measured in terms of degrees. A 90° ell will change the run by 90°; a 45° ell will change the run by 45°.

To understand the degree calculations for elbows, first think of a circle. A full circle has a total of 360°. If you divide the circle in half, as in the figure below, by drawing a straight line (diameter) through the center, each half has 180°. That is, it is 180° from point A to point B. Now, think of that line (A to B) as a pipe run. This is the path that the flow would take if a fitting was not used to change it. If an elbow is added, it will change the run and the direction of flow by a certain angle (number of degrees) in comparison with straight line of flow.

The circle to the right is divided into four equal parts; each quarter of the circle has 90° (360° divided by 4). So imagine a horizontal flow entering at point A. If there were no fittings, the flow would naturally continue to point B. But, with a 90° ell the flow would be changed by 90°, meaning it would be deflected either up to point C or down to point D.

There are several possible ways to change the flow by 90°. One 90° elbow will do it.

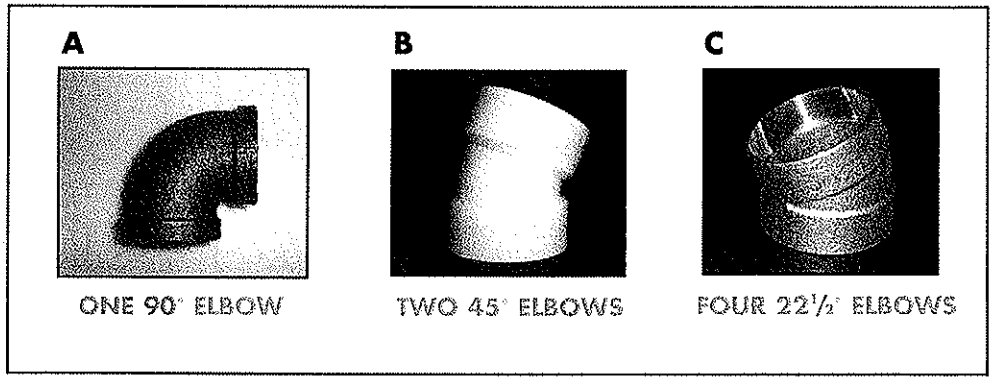
A CIRCLE HAS 360°



PVF 1.2.36

So will two 45° elbows or four 22 ½° elbows. Not all flow changes are 90° changes. Some will be less; some greater.

WAYS TO CHANGE FLOW BY 90°

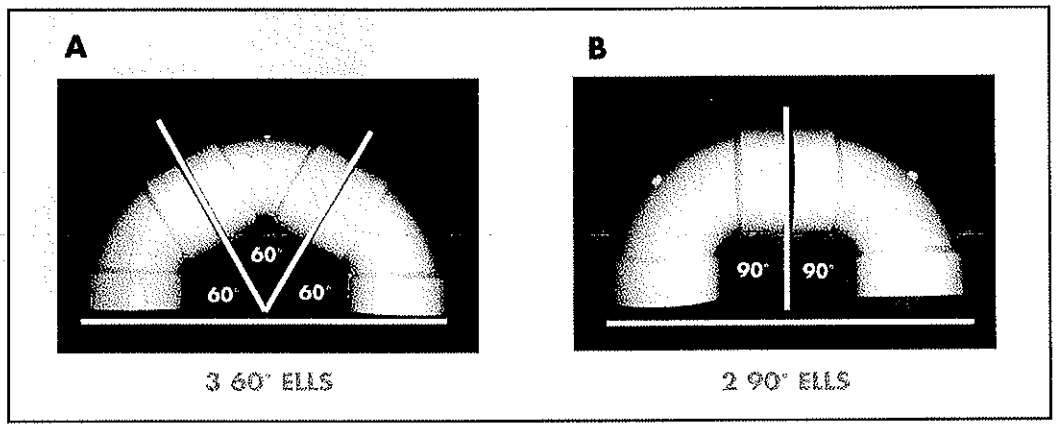


PVF 1.2.37

In the drawing below, we can see several ways to change the flow by 180°. This would have the effect of reversing the flow, or sending it in the opposite direction. It is possible to do that using three 60° elbows, two 90° elbows or even four 45° elbows. Or, it could be done using a single 180° elbow, which is often called a return bend.

In determining which elbow will fit in a particular situation, it is neccessary to be able to determine where the center of the elbow is. The distances from the center of the ell to the two ends of the ell are important because these distances will affect the length of the total run of pipe.

CHANGING FLOW BY OTHER COMBINATIONS OF ELBOWS

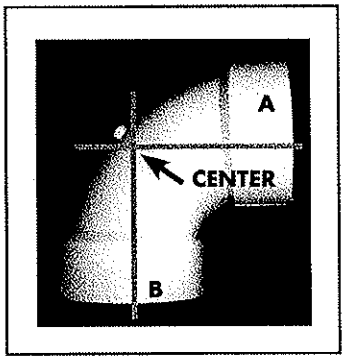


PVF 1.2.38

The center of an elbow can be found by imagining a line that goes through the center of one end and crosses a line through the center of the other end. The point at which the two lines cross is the center of the ell. These imaginary lines with the measurements will usually be shown in the manufacturers' catalogs of elbows. The distance from the center of the ell to the end of the ell is important because it can increase the length of the run of pipe.

In the drawing to the right, A measures the distance from the center to one end of the ell. B measures the distance from the center to the beginning of the other end of the ell.

FINDING THE CENTER OF AN ELBOW



PVF 1.2.39

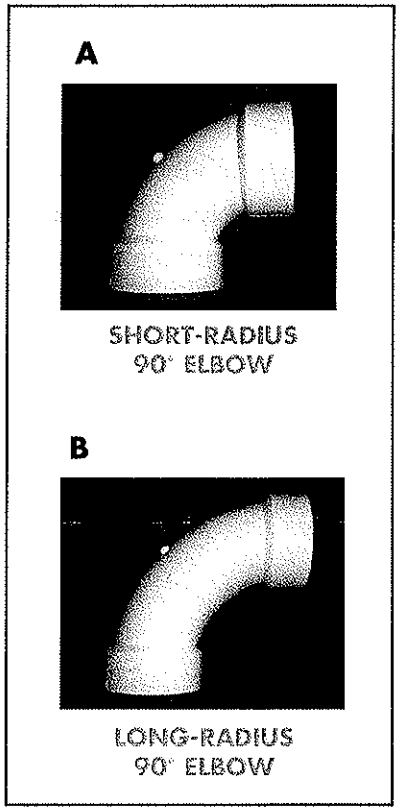
Some elbows require more space than others to make the same degree of change in flow. That is, one fitting may be physically longer than another fitting to bring the same degree of change in flow.

The length of the fitting is measured from the center of one opening to the center of the other opening. The distance between the centers of the openings, called the center-line radius, is measured. If the distance is short, it is a called a short-radius ell; if the distance is longer, it is called a long-radius elbow.

LONG-RADIUS ELLS, which take a longer distance to make a gentler turn, are more common. The distance (called the center-line radius) between the center of the openings of a long-radius ell is 1 ½ times the diameter of the pipe.

The center-line radius of a **SHORT-RADIUS ELL** is equal to the pipe diameter. Short-radius ells are for use in extremely limited spaces. They have several drawbacks: the sharper and more abrupt curve causes a greater drop in pressure and increased stress.

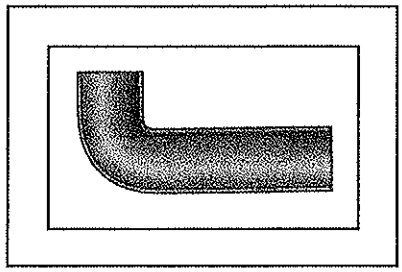
SHORT AND LONG RADIUS ELBOWS



PVF 1.2.40

Both long and short-radius elbows are available as either regular ells or long tangent ells. A **LONG TANGENT ELL** has extensions on each end of the curved portion. Long tangent ells have several advantages. They save on pipe costs and simplify alignment in clamping during installation. They also place the welds at greater distances from the curve, which reduces stress on the welds. When replacing a long tangent ell, it is not necessary to cut through the old welds.

LONG TANGENT ELL

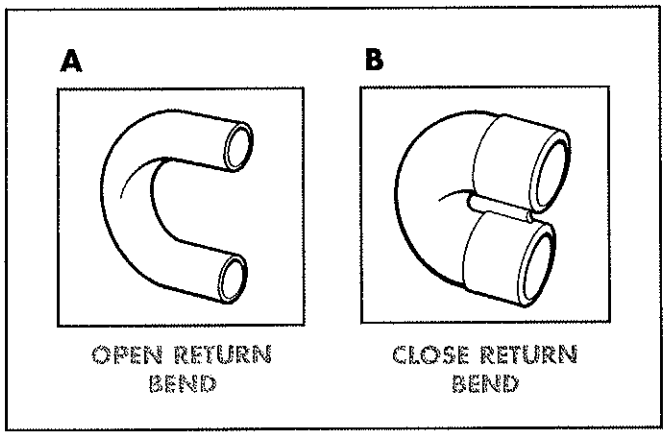


PVF 1.2.41

A **RETURN BEND** is a 180° elbow. Shaped like a U, it joins two lengths of parallel pipe and changes the flow by an entire 180°. That is, the return bend reverses the direction of flow. The terminology used with return bends often classifies them as close (or closed), medium, and open bends. In close bend, the two openings are very close together, while the two openings in a wide bend are farther apart.

Because an elbow joins two pieces of pipe, ells must be ordered to match the sizes of the pipe to be joined. The size specification for a 90° elbow that will join two pieces of 2″ pipe is 2″ 90° elbow.

RETURN BENDS

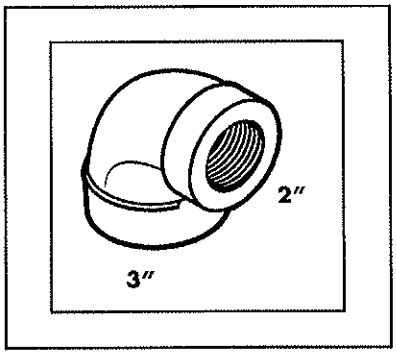


PVF 1.2.42

Elbows with ends to join pipe of different diameters are called reducing ells. Reducing ells produce less turbulence and cause fewer pressure problems than reducing joints. They have a better appearance and take up less space. They also decrease the number of joints by removing a reducer, coupling or bushing.

In a specification for a reducing ell, the larger diameter is listed first, followed by the smaller diameter. The elbow shown is a 3″ x 2″ 90° reducing ell.

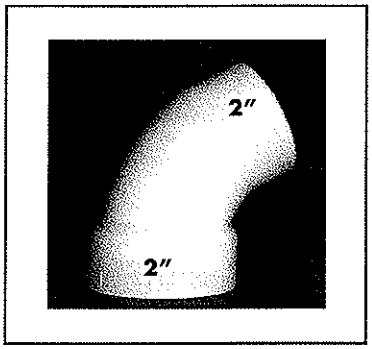
REDUCING ELL



PVF 1.2.43

Another type of elbow has a male end and a female end. These elbows are called street ells service ells, or fitting ells.

STREET ELL

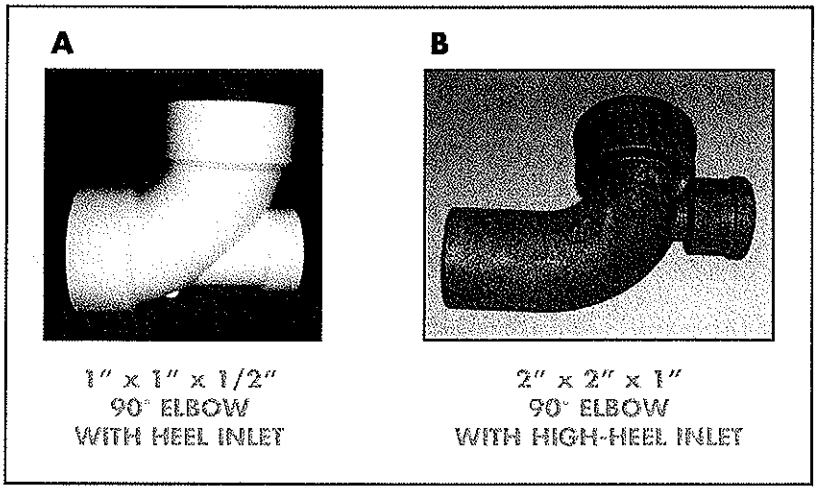


PVF 1.2.44

Ells can have branch inlets or outlets to connect other lines. These branches can be on either the right side or the left of the elbow. Elbows also can have an inlet or outlet on the back. Back inlets are called **HEEL INLETS**. When an inlet is near the top of the ell, it is called a **HIGH-HEEL INLET**.

The elbow specifications first list the size of the run openings and then the size of the inlet. If all openings are the same size, only one measurement should be listed.

ELBOWS WITH INLETS



PVF 1.2.45

REVIEW OF FITTINGS THAT CHANGE FLOW DIRECTION

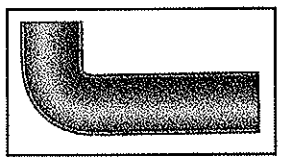
Answers appear on page 140

1. An _____ changes the direction of the run and, therefore, the flow by joining pipe or tube at an angle.

2. _____ _____ells take a longer distance to make a gentler turn than a common ell.

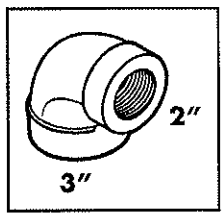
3. The center-line radius of a _____ _____ ell is equal to the pipe diameter.

4. What is the name of the elbow to the right?



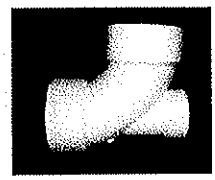
_____ _____ _____ Ell

5. Write the complete specifications for the ell to the right.



_____ x _____ 90° _____ Ell

6. The elbow to the right is a:



_____ Elbow with _____ _____

7. What is the name used for a 180° elbow?
   a. Return bend b. Double tee

8. If you wanted to join a 3″ pipe to a 2″ pipe and change direction of the run by 45°, how would you specify the fitting needed?
   a. 3″ x 2″ 45° reducing ell
   b. 2″ x 3″ 45° reducing ell

REVIEW OF FITTINGS THAT CHANGE FLOW DIRECTION

Answers appear on page 140

9. Elbows with ends to join pipe of different diameters are called _____ _____.

10. Which elbow has both female and male ends?
    a. Return bend b. Street ell

11. Back inlets are called _____ _____.

12. What is the name for a branch that is located on the back near the top of an ell and allows flow to enter the ell?
    a. Top ell inlet b. High-heel inlet

13. To change the full flow by a 90° angle, which of the following would you use?
    a. Return bend b. Four 22.5° ells

APPLYING WHAT YOU HAVE LEARNED:

By observing and asking questions, fill in the blanks. If you are not sure of the answers, ask your supervisor.

A. Look at the catalog from one of your major fittings manufacturers. What do they call a return bend with the openings very close together?

_____

_____

B. Ask your warehouse manager how many different kinds of materials (plastic, copper, iron, etc.) your company offers in 90° elbows.

_____

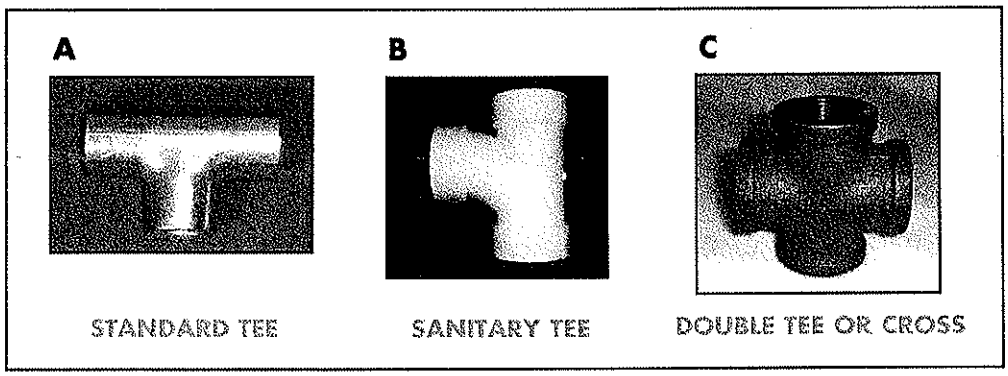
Tees and Ys (Wyes)

There are several other kinds of fittings that change the flow. Generally, these are called branch connections and include tees, Ys (wyes) and crosses.

Tees

A TEE joins three sections of pipe. Two sections of pipe are joined in a run and a third section of pipe is joined at a right angle (90°) to the run.

TEES

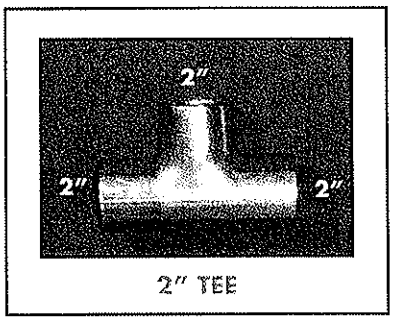


PVF 1.2.49

Catalogs have illustrations for tees similar to those for elbows. The lettered dimensions correspond to measurements in the dimensions charts and the lines show the center of the fitting.

The specifications for a tee first indicate the size of the run openings and then the size for the branch. If the run and branch openings have the same diameter, only one measurement is given.

TEE SPECIFICATIONS

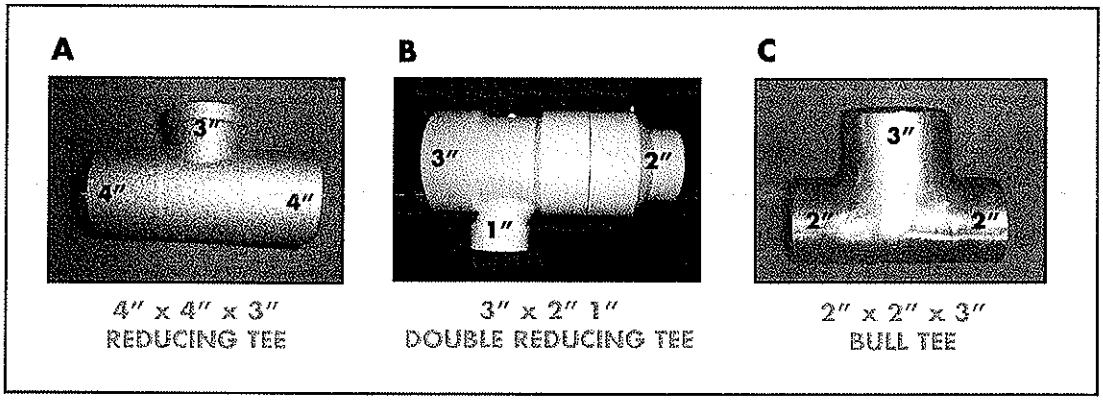


PVF 1.2.50

If any end is smaller than the others, the tee is called a **REDUCING TEE**. A tee may have a smaller opening at the branch than at the run ends. The specifications list the run measurements first, then the branch measurements. The specifications for a tee with 4″ run openings and a 2″ branch opening would be a 4″ x 4″ x 2″ reducing tee.

Tees also can reduce on the run. Specifications for this type of tee list the larger size run opening first, followed by the other run opening and then the branch opening. Some tees reduce on both the run and the outlet. These are called **DOUBLE REDUCING TEES**. A reducing tee with a branch outlet larger than the run openings is sometimes called a **BULL TEE** or **BULL HEADED TEE**.

REDUCING TEES

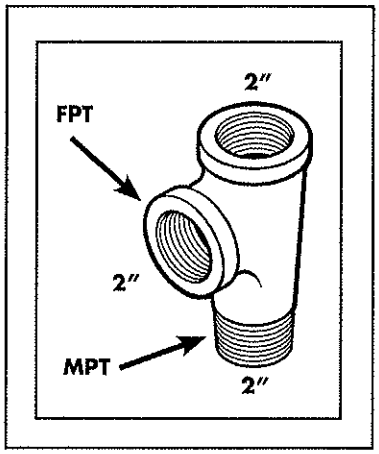


PVF 1.2.51

A **STREET TEE** (or service tee) is similar to a street ell. One end of the tee is male and the other two openings are female. In threaded pipe this means one end has MPT and the other two openings have FPT. If all the openings are the same size, only one measurement is given. The street tee shown to the right is specified as a 2″ tee because all the openings have the same measurements.

If the openings are of different sizes, the first measurement listed in the specification for a street tee is the female run end, followed by is the male run end, and then the other female end.

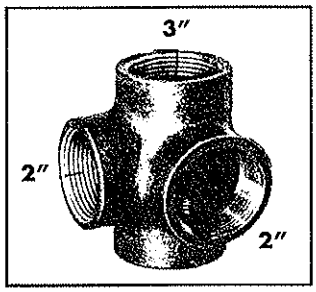
STREET TEE



PVF 1.2.52

In addition to the opening at 90° to the run, a tee also can have a side inlet or outlet. In the specification for this type of tee, the size of the side inlet is given as the very last measurement.

TEE WITH SIDE INLET



3″ x 3″ x 2″ x 2″ TEE

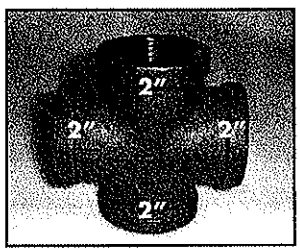
PVF 1.2.53

A tee that has four openings at 90° angles to one another is called a **CROSS TEE**, double tee or cross. The openings are in the same plane, creating a formation like a standard cross. If all the openings are the same size, a cross fitting is called a **STRAIGHT CROSS**. A cross with one or more openings of different sizes is called a **REDUCING CROSS**.

The specifications for a reducing cross begin with the measurement of the largest opening, followed by the opposite opening. Then the measurements of the other two openings are given, with the larger indicated first.

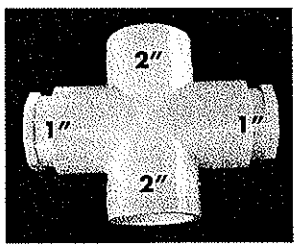
CROSS TEES

A



2″ STRAIGHT CROSS

B



2″ x 2″ x 1″ x 1″
REDUCING CROSS

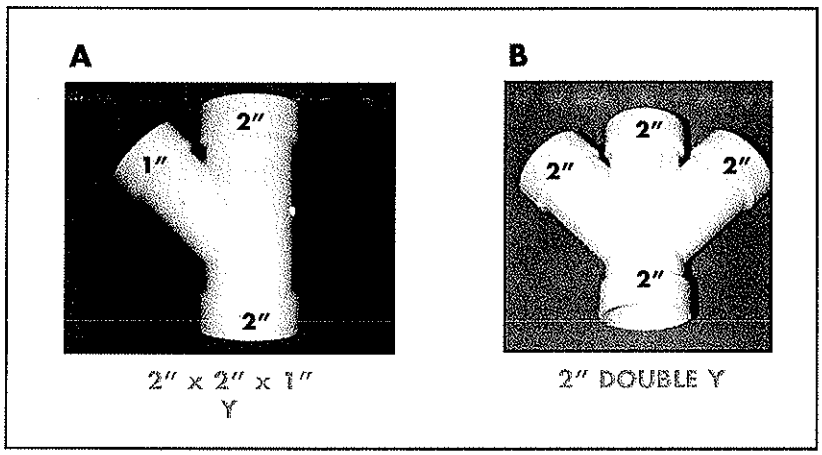
PVF 1.2.54

Ys (Wyes)

A Y (sometimes spelled "WYE") is a fitting that joins three sections of pipe with one pipe at a 45° angle to another. All three openings of a Y may be the same size. However, a Y also can act as a reducer if one of the openings is a different size. The specifications for a Y indicate the measurements for the run openings, followed by the measurement of the branch.

A CROSS Y, or double Y, joins two branch lines to the main run at 45° angles. A cross Y in which all openings are 2" would be specified as a 2" cross Y. To give the specifications for a cross Y with branches of different diameters, indicate the run openings first and then the branches.

Ys (WYES)



PVF 1.2.55

REVIEW OF TEES AND Ys (WYEs)

Answers appear on page 141

1. The fittings that change the flow generally are called _____ _____ and include tees, Ys (wyes) and crosses.

2. What is the name of a fitting that connects two pieces of pipe in a run with a third pipe at a 90° angle?
   a. Ell b. Tee

3. If any end is smaller than the others, the tee is a _____ _____.

4. Tees that reduce on both the run and the outlet are called _____ _____ _____, and a reducing tee with a branch outlet larger than the run openings is sometimes called a _____ _____ or _____ _____ _____.

5. A _____ _____ has one end of the tee that is male and the other two openings that are female.

6. A tee which has four openings at 90° angles to one another is called a _____ _____ or double tee or cross.

7. A cross with one or more openings of different sizes is called a _____ _____.

8. What is the name of the cross in which all four openings are the same size?
   a. Straight cross b. True cross

REVIEW OF TEES AND Ys (WYEs)

Answers appear on page 141

9. What is another name used for a double tee?
   a. Quad tee b. Cross

10. What is the name of the fitting that joins three sections of pipe with one section at a 45° angle to the run?
    a. Wye (Y) b. Tee

11. A _____, or double Y, joins two branch lines to the main run at 45° angles.

APPLYING WHAT YOU HAVE LEARNED:

By observing and asking questions, fill in the blanks. If you are not sure of the answers, ask your supervisor.

A. Which kinds of tees are most commonly sold for household plumbing systems?

_____ _____ _____

B. Are there some kinds of tees and wyes that are more commonly sold for commercial and industrial applications? If so, list several.

_____

_____

_____

Fittings That Stop the Flow

Some fittings stop the flow of fluid through the piping system. Traps prevent the flow of air or gas through the trap, while still allowing the passage of liquid waste. Caps and plugs seal off the ends of pipe, preventing further flow.

Traps

A **TRAP** in a plumbing system is a device that prevents the passage of air or gas through a pipe without materially affecting the flow of solid or liquid wastes. Traps are designed with a bend below the level of the flow through the pipe. When the flow through the system stops, some of the liquid remains in the trap so gases cannot pass through it.

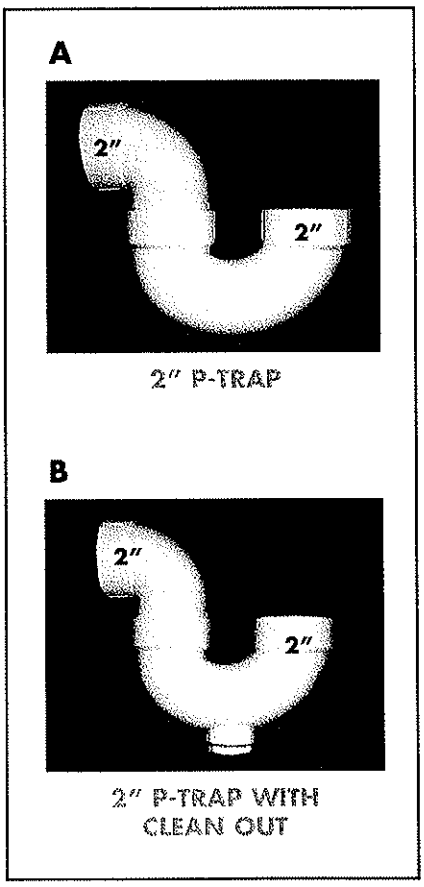
The most common applications for traps are DWV systems. Traps are ordered by the diameter of the ends.

A **P-TRAP**, named for its shape, prevents gases from leaking back into a DWV system. Some types of P-traps come with a plug that can be removed so the entire system is able to be drained. This plug is sometimes called a clean-out plug, since it allows the P-trap to be cleaned out.

Other types of traps are called the "S trap" and "Running trap." The S trap is used in a vertical drain pipe and the running trap is used in horizontal pipe.

There are two different methods for totally closing off the end of a pipe: caps and plugs.

P-TRAPS

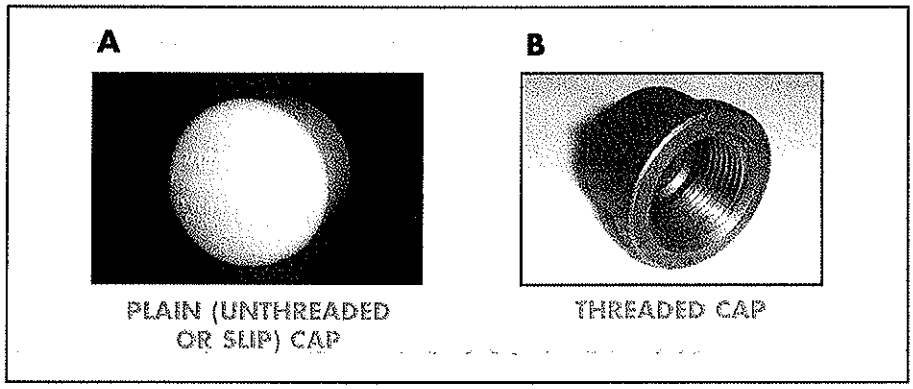


PVF 1.2.56

Caps

A **CAP** is a female fitting into which the end of a pipe or tube is screwed, soldered, welded, or caulked for the purpose of closing the pipe. Caps may be either plain or threaded. Plain caps cover tube or pipe with plain ends. Threaded caps have female pipe threads to close off pipe that has MPT. Caps are specified by the size of the opening to be closed. A 2″ cap would close off a 2″ pipe.

CAPS

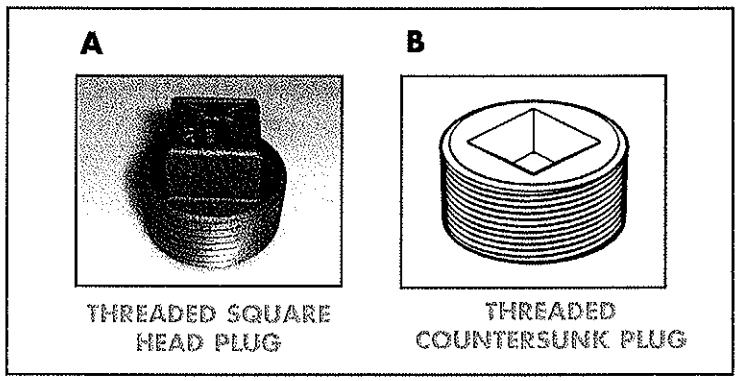


PVF 1.2.57

Plugs

PLUGS are used to close pipe with female openings. A plug may have male pipe threads or be unthreaded. Plugs are specified by the size of the opening to be closed. A 2″ threaded plug would be used to close a pipe fitting with a 2″ female threaded opening. There are three types of plugs: square head, countersunk, and bar head. The most common plug is the square head.

PLUGS



PVF 1.2.58

REVIEW OF FITTINGS THAT STOP THE FLOW

Answers appear on page 141

1. Which fitting is used in a DWV system to prevent backflow of gases?
   a. Cap b. Trap

2. A _____, named for its shape, prevents gases from leaking back into a DWV system. It sometimes comes with a _____ _____ that can be removed so the entire system is able to be drained.

3. A _____ is a female fitting into which the end of a pipe or tube is screwed, soldered, welded or caulked for the purpose of closing the pipe.

4. _____ are used to close pipe with female openings.

APPLYING WHAT YOU HAVE LEARNED:

By observing and asking questions, fill in the blanks. If you are not sure of the answers, ask your supervisor.

A. List two specific applications in which a plug would be used. Ask your supervisor for help if you can't think of two.

1. _____

2. _____

B. Does your company carry plugs with all three types of heads?

_____

_____

ANSWERS TO REVIEW QUESTIONS

CHAPTER 3

INTRODUCTION TO FITTINGS

Answers for REVIEW OF COMMON FITTING TERMS (pages 103–106)

1. Fittings
2. b. Coupling
3. Elbow, Ell
4. Caps, Plugs
5. Male Pipe Thread, Female Pipe Thread
6. Run
7. Branch
8. Inlet, Outlet
9. 1 ½" x 1 ½" x 2" Tee
10. 2" 90° Ell (Elbow)
11. 1" x 1" x ½" Reducing Tee
12. #5741
13. None. Company A does not make a fitting corresponding to Company D's A890A
14. b. You generally list a larger opening before you list a smaller opening
15. b. Pressure capacity, pipe material, pipe weight

Applying What You Learned:

A. Varies by catalog

B. Varies by company

Answers for REVIEW OF STRAIGHT-LINE FITTINGS (pages 113–114)

1. a. Nipples
2. b. Nipple
3. "Bl. St.", "Gal. St."
4. Close Nipples, Shoulder Nipples
5. Long Nipple
6. a. Blk. St.
7. b. Coupling
8. Reducer
9. a. Concentric Reducer
10. b. Eccentric Reducer
11. a. 3" Black Steel Shoulder Nipple
12. b. The nipple for the 3" pipe would be longer

Applying what you Learned:

A. Requires no correct answer, just observation

B. Requires no correct answer, just observation

Answers for REVIEW OF ADAPTERS, BUSHINGS AND FLANGES (pages 118–119)

1. Adapters
2. Transition Fittings
3. b. Bushing
4. Hex-head Bushing, Outside Hex-Head Bushing
5. Faced Bushing
6. b. Union
7. b. Flange
8. Flange Union
9. Companion Flange
10. Gasket
11. Reducing Flange
12. Seats

Applying What You Learned:

A. Requires no correct answer; ask and observe
B. Requires no correct answer; ask and observe

Answers for REVIEW OF FITTINGS THAT CHANGE FLOW DIRECTION (pages 126–127)

1. Elbow
2. Long Radius
3. Short Radius
4. 90° Long Tangent Ell
5. 3″ x 2″ 90° Ell (or Reducing Ell)
6. 90° Elbow with Heel Inlet
7. a. Return Bend
8. a. 3″ x 2″ 45° Reducing Ell
9. Reducing Ells
10. b. Street Ell
11. Heel Inlet
12. b. High-Heel Inlet
13. b. Four 22.5° Ells

Applying What You Learned:

A. Depends upon manufacturer
B. Varies by company

Answers for REVIEW OF TEES AND Ys (WYEs) (pages 132–133)

1. Branch Connections
2. b. Tee
3. Reducing Tee
4. Double Reducing Tees, Bull Tee, Bull Headed Tee
5. Street Tee
6. Cross Tee
7. Reducing Cross
8. a. Straight Cross
9. b. Cross
10. a. Y (Wye)
11. Cross Y

Applying What You Learned:

A. Varies by company

B. Varies by company

Answers for REVIEW OF FITTINGS THAT STOP THE FLOW (page 136)

1. b. Trap
2. P-Trap, Clean-Out Plug
3. Cap
4. Plugs

Applying What You Learned:

A. Many possible applications

B. Yes or No. Depends upon company

CONGRATULATIONS!

You are now ready to take the Final Exam

THIS COURSE INCLUDES AN ONLINE FINAL EXAM

This course is limited to a single user. When you are ready to take the final exam to earn Certificate of Completion, please contact ASA at info@asa.net. You will be contacted about how to access your final exam.

GLOSSARY OF TERMS

Actual size: The real measurement, by ruler, for either the inside diameter (I.D.) or outside diameter (O.D.) of a pipe.

Adapter: A fitting used to connect pipes of different materials or pipes that require different joining methods. For example, a pipe that is threaded to a pipe or tube that is not threaded.

Aerator: A faucet or showerhead attachment that puts tiny air bubbles into the water for purposes of preventing splash and using less water.

Alloy: A combination of two or more metals, or a metal and a non-metal substance, that is heated until the combined substances are blended together to form a new material.

Angle valve: A valve that changes the direction of the flow by 90°.

American National Standards Institute (ANSI): An organization that sets standards and specifications for many products, including standard pipe.

ANSI: *SEE* American National Standards Institute.

Backflow preventer: A device used to prevent the reverse or backflow of water in a piping system.

Ballcock: A type of refill valve that refills and controls the level of water in the tank of a water closet.

Ball valve: A valve that controls flow through pipe by opening and closing a hole in a ball that is cushioned between two plastic or O-ring seats.

Basin cock (basin faucet): An individual faucet used for either cold or hot water in a lavatory.

Bend: (1) A name used for a cast iron soil pipe elbow. (2) Name for an elbow that changes the flow by 180°. *SEE ALSO* Return bend.

Beveled pipe end: Pipe end cut on an angle so piping can be joined by either brazing or welding.

Bl. St.: An abbreviation for black steel.

Boiler drain: (1) A faucet with male hose threads. (2) A faucet used for hot or cold water connections to a washing machine. (3) A faucet used as a water heater drain. Also called water heater drain.

Bonnet: The cover used to guide and enclose the stem of a valve. In a gate valve, the bonnet is the part into which the wedge rises when the valve is opened.

Branch: An outlet or inlet that is not in line with the run of the fitting.

Branch connections: Fittings (including tees, wyes and crosses) that have inlets or outlets not in line with the run of the fittings.

Brassware: A term used for faucets found in the kitchen, bathroom or powder room. Also called fittings (plural) or trim.

Building drain: The lowest section of horizontal pipe in a DWV system, which receives the discharge from both the waste and soil lines and conducts it to the sewer outside the wall of the building.

Bull tee: A reducing tee with a branch opening that has a larger diameter than the diameters of the run openings.

Bushing: A straight-line fitting that has one male end and one female end and is designed to connect a pipe with male pipe threads to a female pipe of a larger diameter. *SEE ALSO* Faced bushing; Hex-head bushing.

Butterfly Valve: A quarter-turn valve that uses a flat disk that pivots on a stem to allow or prevent the flow.

Cap: A female fitting used to close off a pipe with a male end that is either threaded or unthreaded.

Center-line radius: The distance between the centers of the two openings of a fitting. *SEE ALSO* Long-radius elbow; Short-radius elbow.

Ceramic shearing-type washerless faucet: A faucet in which the water flow is controlled by the positions of two ceramic discs, the upper one of which rotates to either open or close the hole in the lower fixed disc.

Check valve: A valve used to prevent reverse flow (backflow) of fluid through pipe. *SEE ALSO* Lift-check valve; Swing-check valve.

Clean-out plug: A metallic plug or cover that fits into (or over) an opening at the bottom of a P-trap and can be removed to allow the trap to be drained and cleaned out.

Close nipple: A nipple on which male pipe threads totally cover the surface; it is usually the shortest in length of the three types of nipples.

Closet: *SEE* Water closet.

Commode: *SEE* Water closet.

Companion flange: One of a pair of flanges designed to be bolted together to form a flange union.

Compression faucet: A faucet that uses a rubber washer as a closing mechanism. Compression faucets work like globe valves. Also called a compression-seal faucet.

Compression-seal faucet: *SEE* Compression faucet.

Compression valve: *SEE* Globe valve.

Concentric reducer: A reducing fitting (such as a reducing coupling) used to connect one pipe with another of a smaller diameter when the centers of the run openings are in line with each other.

Corporation stop: A valve installed in the city water main to control the flow of water from the city's water supply to the user.

Corrosion: The deterioration of metal caused by chemicals or materials in the air, water, and soil.

Coupling: A female pipe fitting used to connect two pipes, fittings, or valves in a straight line. *SEE ALSO* Reducing coupling.

Cross: *SEE* Cross tee.

Cross tee: A fitting used to connect four pipe at right angles. Also called Cross of Double tee. *SEE ALSO* Reducing-cross tee; Straight cross.

Cross Y: A fitting that joins two branch lines to the main run at 45° angles. Also called a Double 45° Y.

Curb box: An access pipe installed to allow above ground operation of a curb stop valve.

Curb stop: A valve installed below the ground at the street curb that allows the flow from the water utility to the house to be stopped for repairs or emergencies.

Diaphragm-type washerless faucet: A faucet in which the flow of water is controlled by a rubber diaphragm.

Diameter: The distance between one edge of a circle and the other as measured on a straight line through the center of the circle.

Dielectric adaptors: The special connectors that are used to keep two different metals in one system from making contact.

Diverter: A valve used to direct the flow of water to the showerhead or tub spout, or to direct flow from kitchen faucet to spray hose. Also called Transfer valve.
Double reducing tee: A type of tee that reduces on both the run and the outlet.

Double 45° Y: *SEE* Cross Y.

Double tee: *SEE* Cross tee.

Drain, Waste and Vent (DWV) piping system: An assembly of pipe, fittings and valves used to bring solid, liquid and gas wastes out of a building. Also called sanitary system.

DWV System: *SEE* Drain, Waste and Vent (DWV) piping system.

Eccentric reducer: A fitting (such as a reducing coupling) used to connect one pipe with another of a smaller diameter when the centers of the run openings are not in line with each other.

Elbow: A fitting designed to change the direction of a run by joining pipe or tube at an angle. Also called an ell. *SEE ALSO* Street elbow.

Ell: *SEE* Elbow.

Faced bushing: A bushing with no hex head.

Faucet: A valve located at an outlet in a pipe system. *SEE ALSO* Basin cock; Boiler drain; Brassware; Compression faucet; Mixing-type faucet; Self-closing faucet; Sillcock; Single-control faucet; Tub and shower valves; Utility faucet; Washer-design faucet; Washerless-design faucet.

Female pipe threads (FPT): Threads that occur on the inside surface of pipe, tube, or fittings.

Ferrous metals: Metals that contain iron.

Fitting: A connector used to either join together two or more pieces of pipe, or to stop the flow through the pipe run.

Fitting ell: *SEE* Street elbow.

Fittings: *SEE* Fitting; Brassware.

Fixture: A receptacle (sink, tub, toilet, etc.) that holds or demands water from a pipeline.

Flange: A metal disc with female pipe threads on the inside diameter and bolt holes around rim. Two flanges are used to make a flange union. SEE ALSO Companion flange; Flange union; Reducing flange.

Flange union: A straight-line connection of two pipes made by bolting two flanges together with a gasket between them.

Fluid: Anything that can flow and easily change shape.

Flush valve: A valve that allows water to be stored in the tank of a toilet and then be emptied when needed. This valve is internal in a tank-style toilet and is external in a tankless toilet.

FPT: *SEE* Female pipe threads.

Frost line: The depth to which ground freezes.

Full off: Term used to describe a valve that is completely closed (off).

Full on: Term used to describe a valve that is completely open (on).

Gal. St.: Abbreviation for galvanized steel.

Galvanic action: The destruction of metal caused by an electrical current that forms when two different metals touch each other in the presence of moisture.

Gasket: A ring (often of flexible material) used to make an opening or joint watertight.

Gate valve: A valve that controls flow through pipe by means of a sliding wedge that can be moved to open or close the port opening.

Globe valve: A valve that controls flow through pipe by means of a disc that moves to and from the valve seat to provide the ON/OFF, or the throttling function. Also called a compression valve.

Gravity-feed water closet: A water closet that uses the natural force of gravity to drain the toilet when it is flushed.

Grooved pipe end: Pipe end having one or two narrow cuts (grooves) in the outside wall.

Hanger: A device used to support pipe in a piping system and prevents sag, sway, and other undesired movement.

Heel inlet: An inlet on the back of an ell fitting. *SEE ALSO* High-heel inlet; Low-heel inlet.

Hex-head bushing: A bushing with a hex head at the end of the male pipe threads. *SEE ALSO* Inside hex-head bushing; Outside hex-head bushing.

High-heel inlet: An inlet on the back and near the top of an ell fitting.

Hose bibb: *SEE* Sillcock.

Hose spray: A pullout attachment that allows water to be temporarily diverted from a kitchen faucet through a spray to be used at the kitchen sink.

Hydronic heating system: A heating system made up of a boiler to heat water; a system of pipe, fittings, and valves to control water flow; and heat-releasing devices, such as radiators or under-floor tube, to release heat from the hot water into the rooms to be heated.

I.D: *SEE* Inside diameter.

Industrial piping: A piping system used in a manufacturing plant, factory, processing plant, laboratory, or other commercial application.

Inside diameter (I.D.): The distance of a straight line passing through the center of a pipe or fitting from one inside pipe wall to the other inside wall.
Inlet: A branch opening that allows a flow to join the run. *SEE ALSO* Heel inlet.

Inside hex-head bushing: A bushing on which the hex head is smaller than the top of the male threaded portion of the bushing.

IPS: *SEE* Iron pipe size.

Iron pipe size (IPS): A term referring to a standard measurement for a pipe that was originally set for iron pipe by the American National Standards Institute (ANSI); IPS is same measurement size as Nominal Pipe Size (NPS).

Joint: A point in a piping system at which a connection is made to connect pipe, fittings or valves together to form a system.

Laundry-tray: A laundry sink.

Laundry-tray pump: A pump installed under a sink to pump laundry water into the waste line.

Lavatory: A wash basin for personal grooming uses; a bathroom sink.

Lawn faucet: *SEE* Sillcock.

Lift-check valve: A valve that prevents reverse flow by means of a suspended disk that is pushed out of the way by a forward flow but is forced closed against a seat if reverse flow occurs.

Long nipple: A nipple with an unthreaded surface of greater than 2″ between the external threads on each end.

Long-radius elbow: An elbow with a center-line radius that is 1 ½ times the diameter of the pipe. *SEE ALSO* Center-line radius; Short-radius elbow.

Long-tangent elbow: An elbow that has an extended length of pipe at the end of the elbow.

Low-consumption water closet: A water closet that uses not more than 1.6-gallons per flush.

Low-heel inlet: An inlet on the back and near the bottom of an ell fitting.

Male pipe threads (MPT): Threads that occur on the outside surface of a pipe, tube or fitting.

Meter stop: A valve installed immediately ahead of a water meter to allow flow from the water utility to be stopped before it reaches the user's meter.

Mixing-type faucet: A faucet designed so hot and cold water can be mixed internally and flow out of a single spout.

MPT: *SEE* Male pipe threads.

Nipple: A male fitting that is a short piece of pipe, plain inside and threaded outside at both ends that is used to connect pipe, valves, and fittings.

Nominal pipe size (NPS): The standard measurement for any pipe as set by the American National Standards Institute (ANSI); NPS size is the same measured size as iron pipe size (IPS).

Non-ferrous metals: Metals that contain no iron.

Non-rising stem: A type of gate-valve stem that does not rise to the top of the bonnet when the handwheel is turned and the stem rotates.

NPS: *SEE* Nominal pipe size.

O.D.: *SEE* Outside diameter.

Outlet: A branch opening that allows part of the flow to leave the run.

Outside diameter (O.D.): The distance of a straight line passing through the center from one outside wall of the pipe to the other outside wall.

Outside hex-head bushing: A bushing on which the hex head is larger than the male threaded portion of the bushing.

Packing: A soft material used in making joints watertight or airtight by being compressed in the joining operation.

Patented overflow (P.O.): Part of a lavatory drain closure that allows excess water to drain out even if the drain is closed.

Pipe: A cylindrical conductor with a wall thick enough to receive a standard pipe thread that complies with the United States Standard Tapered Pipe Thread specifications.

Pipe compound: *SEE* Pipe dope.

Pipe diameter: *SEE* Inside diameter; Outside diameter.

Pipe dope: A lubricating substance applied to male pipe threads to lubricate, prevent erosion and improve the seal of a threaded joint. Also called Pipe lubricant; Pipe compound.

Pipe lubricant: *SEE* Pipe dope.

Piping: The term used to describe an assembly of pipe and/or tube used in a plumbing system.

Plain pipe end: Pipe end that has been left with a straight-across cut.

Plug: A male pipe fitting used to close off a female opening on a pipe or another fitting.

Plug valve: A valve that controls flow through pipe by means of a plug that is rotated to open or close a port that provides passageway to the flow.

P.O.: *SEE* Patented overflow.

Port: The hole that provides a passageway for flow through the closing mechanism of the valve.

Pressure-assisted water closet: A water closet that uses released pressurized air from a special vessel in the toilet tank to push the water and waste out during the flushing process.

Pressure-balancing valve: A shower valve that corrects for pressure variations in hot and cold water lines in order to provide a steady, even pressure and eliminate sudden blasts of hot or cold water.

Pressure pipe: Pipe made to withstand a specified amount of internal pressure, such as pipe used in a water supply system.

Pressure-reducing valve: A valve used to limit and control pressure at any point in a piping system or water-storing appliance.

Pressure tank: A container used to store both the fluid and the pressure needed to move the fluid through the piping system.

P-trap: A trap shaped like the letter "P." *SEE ALSO* Trap.

Pump: A device that raises, transfers or compresses fluids or gases by suction, pressure or both.

Radius: The distance of a straight line from the center of a circle to its edge.

Reducer: A fitting that is larger at one end than at the other; is used to join two pipe of different diameters. *SEE ALSO* Concentric reducer; Eccentric reducer.

Reducing coupling: A coupling with one opening that is larger than the other in order to join pipe of different sizes.

Reducing-cross tee: A cross-tee fitting with one or more openings that are different sizes than the other openings.

Reducing elbow: An elbow with ends of different diameters; used to join pipe of two different sizes.

Reducing flange: A flange tapped or bored smaller than the other flange to be used in a flange union.

Reducing tee: A tee in which any one of the ends is smaller than the others.

Reducing Y (wye): A Y in which one of one openings is smaller than the others.

Refill valve: A valve that refills the water closet after it is flushed and controls the water level. *SEE ALSO* Ballcock.

Return bend: An elbow fitting that joins two parallel pipes and changes the direction of the run by 180°.

Revent pipe: A pipe that connects soil and waste pipe to the vent stack in a DWV system.

Rising stem: A gate valve stem that rises in the bonnet when the handwheel is turned.

Riser: (1) Any vertical pipe which extends one story or more in a water supply system; (2) The principal vertical supply pipe.

Rubber seal shearing-type washerless faucet: A washerless faucet in which flow is controlled by an O-ring, ceramic disc, resilient seal, or rubber diaphragm.

Run: (1) The part of the pipe that lies on a straight line in the direction of the flow of materials in the pipe; (2) The straight portion between the two ends of a fitting.

Sanitary system: *SEE* Drain, Waste and Vent (DWV) system.

Seat: (1) The contact sealing surface in a union; (2) The contact sealing surface in a valve.

Self-closing faucet: A faucet that shuts off automatically.

Service connection: The connection between the service pipe of the public water utility and a water user.

Service elbow: *SEE* Street elbow.

Service pipe: The pipe used to connect the water user to a public water utility.

Service tee: *SEE* Street tee.

Shearing-type faucet: A washerless faucet that stops or "shears" off the flow of water by moving two openings out of line with each other. SEE ALSO Ceramic shearing-type washerless faucet; Rubber seal shearing-type washerless faucet.

Short nipple: *SEE* Shoulder nipple.

Short-radius elbow: An elbow with the center-line radius equal to the pipe diameter. *SEE ALSO* Center-line radius; Long-radius elbow.

Shoulder nipple: A nipple somewhat longer than a close nipple, with an unthreaded surface of two inches or less between the external threads on each end. Also called a short nipple.

Side inlet: An inlet on the side of an elbow or tee.

Sillcock: A faucet with male hose threads that is usually found on the outside wall of a house and provides an outlet for the water supply pipeline. Also called hose bib or lawn faucet.

Single-control faucet: A mixing-type faucet with one handle to operate the flow for both hot and cold water supply lines.

Soil line: The part of a DWV system that carries sewage from the toilets to the building drain.

Stack: A general term used to describe any vertical line in a DWV system.

Stack vent: *SEE* Vent stack.

Stop: A valve placed to be used as a shut-off. *SEE ALSO* Corporation stop; Curb stop; Meter stop; Supply stop; Stop and waste valve.

Stop and waste valve: A valve with a side opening to drain liquid from the line and let air into a water supply system.

Straight cross: A cross tee that has four openings of the same size.

Street elbow (ell): An elbow with a male end and a female end. Also called Service elbow or Fitting elbow.

Street tee: A tee with two female ends and one male end. Also called a service tee.

Sump: A drainage pipe used to store unwanted water until it can be drained to the outside.

Sump pump: A pump used to remove unwanted water and direct it to the sump.

Supply pipe: Pressure pipe used in a supply piping system.

Supply piping system: An assembly of pipe, valves and fittings used to bring liquids or gas into a structure.

Supply stop: A stop valve used ahead of the outlets on fixtures.

Swing-check valve: A valve that prevents backflow by means of a swinging disc that lets water flow through in the desired line of flow but acts as a trap door over the seat if reverse flow occurs.

Swing (swivel) spout: A faucet spout that can move from side to side.

Swivel spout: *SEE* Swing spout.

Tankless water closet: A water closet with a bowl that is connected directly to the building water supply line rather than using a tank to hold flush water. Usually tankless water closets are found in commercial or other applications for use by the general public.

Tank-style water closet: A water closet with a tank that holds the flush water above the bowl.

Tapped: Having female pipe threads.

Tee: A fitting that has a side opening set at a 90° angle to the run.
SEE ALSO Cross tee; Reducing tee; Street tee.

Temperature and pressure (T&P) relief valve: A valve that controls the buildup of temperature and pressure. Such valves are often found on water heaters.

Thermostatic control: A device for automatic regulation of hot water temperature, such as on a shower or water heater.

Thread compound: *SEE* Pipe dope.

Thread lubricant: *SEE* Pipe dope.

Threaded: Having continuous, regularly spaced grooves and ribs that form a spiral pattern around a curved surface.

Threaded pipe end: Pipe end with regularly spaced grooves that allow the pipe to be joined by screwing (threading).

Throttling valves: The type of valves used to control the rate at which water flows.

Throttle: To control flow by increasing or decreasing it.

Toilet: *SEE* Water closet.

Transfer valve: *SEE* Diverter.

Transition fitting: A fitting that allows two pieces of pipe to be joined that could not ordinarily be joined, such as copper pipe to plastic pipe or threaded pipe to soldered pipe.

Trap: A fitting with a U-shaped segment that continuously retains an amount of liquid to form a seal preventing the back passage of air or gases, but does not affect the flow of liquids.

Trim: *SEE* Brassware.

Tub and shower valves: Faucets, shower head, and spout used with a tub and/or shower.

Tube: A cylindrical conductor with a wall too thin to receive a standard pipe thread that meets the national standards for the United States Standard Tapered Pipe Thread.

Tubular goods: Thin pipe or tube lines used to link sinks, tubs, and lavatories to the drainage piping in a DWV system.

Union: A fitting with three parts—two threaded ends with a tightening nut between them—used to join two pieces of pipe so they may be easily disconnected.

Utility faucets: Household faucets, such as laundry-tray faucets, (used to connect washing machines and other household faucets) that are not included in the category of brassware.

Vacuum breaker: A device that allows air into the piping system to prevent the formation of a vacuum and the back siphonage of water that would result from a vacuum.

Valve: A control device used to start, stop, or regulate flow by means of a moveable part that opens or obstructs a passage through the valve body. SEE ALSO Angle valve; Ball valve; Check valve; Faucet; Flush valve; Gate valve; Globe valve; Plug valve; Pressure-balancing valve; Pressure-reducing valve; Refill valve; Temperature and pressure relief valve; Tub and shower valves.

Vent stack: A vertical line of pipe, usually through the building roof, that provides circulation of air and relief of pressure in a DWV system. Also called stack vent.

Wall: The structure of pipe or tube shaped to conduct the flow of fluids.

Washer: A circular disc with a flat face that is used as the closing mechanism in a globe valve.

Washer-design faucet: A compression (globe) valve, often referred to as a "compression-seal" type faucet, which uses a washer to control flow.

Washerless-design faucet: Any type of faucet in which flow is controlled through the movements of ceramic discs, O-rings or resilient seals, and which does not operate like a compression faucet.

Waste: Another name for the drain on a stop and waste valve.

Waste line: Part of a DWV system that carries waste products from tubs, sinks and lavatories to the building drain.

Water-saving toilet (water closet): A water closet that uses no more than 1.6 gallons per flush. *SEE ALSO* Low-consumption water closet.

Waste Stack: A vertical pipe receiving the discharge of waste only.

Water closet: A plumbing fixture used for the disposal of bodily wastes. Also called Closet; Commode; Toilet. *SEE ALSO* Gravity-feed water closet; Low-consumption water closet; Pressure-assisted water closet; Tank-type water closet; Tankless-type water closet; Water-saving water closet.

Water heater drain: *SEE* Boiler drain.

Wye: *SEE* Y.

Y: A fitting that joins three sections of pipe with one pipe at a 45° angle to another. Also called a wye. *SEE ALSO* Cross Y.

Basics of PHCP/Industrial PVF

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