Unit 5

Pipe Fittings, Joints and Valves

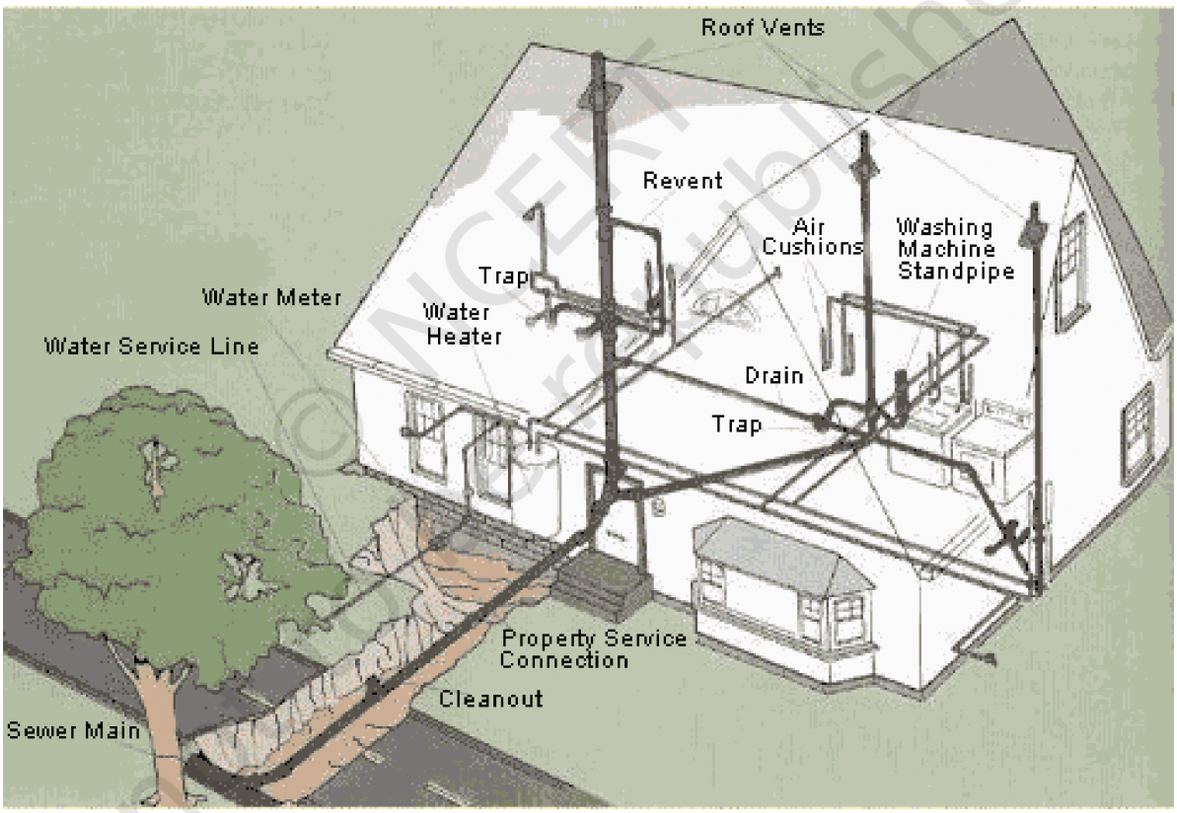


Fig. 5.1: Layout of pipeline (internal) in a building

Introduction

In Unit 4, we studied the importance of measurements in carrying out various plumbing tasks. At the same time,

a plumber must also have knowledge of the various pipe fittings like elbow, union, gasket, etc., joints and valves, and where these should be used while carrying out the tasks. Not only does this help in smooth functioning, but also ensures cost-effectiveness. For proper installation of the plumbing system in a building, various types of joints are used, which are shown in Fig. 5.1. As already mentioned, various types of fittings like elbow, gasket, union, etc., are used for making joints. It helps in changing the direction of water supply from main pipes to subsidiary pipes. Proper fitting also helps in checking leakage in the plumbing lines.

Pipe Fittings

Pipe fittings are an important component of the plumbing system. In plumbing, many types of fixtures are joined with the help of various types of material as per the requirement. Fittings are fixed in the plumbing system to join straight pipes or any section of tubes. We can say that the water-supply fittings like elbow, tee, socket, reducer, etc., are fitted to change the direction of flow, distribute the water supply from the main pipe to other pipes of equal size or lower size, etc.

Any part used in connection with water supply, distribution, measurement, controlling, use and disposal of water is known as a pipe fitting (Fig. 5.2).

Fig. 5.2: Pipe fittings

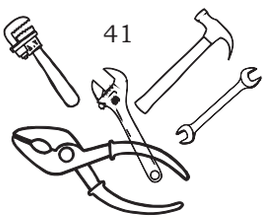
Type of Fittings

1. Collar
2. Elbow
3. Gasket
4. Union
5. Reducer
6. Tee
7. Nipple
8. Trap

Collar

While joining two pipes in the same length, collar is used. Collar is fitted in the end of pipe (Fig. 5.3).

Fig. 5.3: Collars



Elbow

It is installed at the time of joining two pipes. With the help of an elbow, the direction of liquid is changed. Normally a 45° or 90° elbow is used. When the two sides of pipes differ in size, an elbow of reducing size is used. This is called reducing type elbow or reducer type elbow. Elbows are categorised as follows—

Long Radius (LR) Elbows

Here, the radius is 1.5 times the diameter of pipe.

Short Radius (LR) Elbows

In this, the radius is 1.0 times the diameter of pipe.

90° Elbow

This is used when the change in direction required is 90° (Fig. 5.5).

45° Elbow

This is used when the change in direction required is 45° (Fig. 5.4).

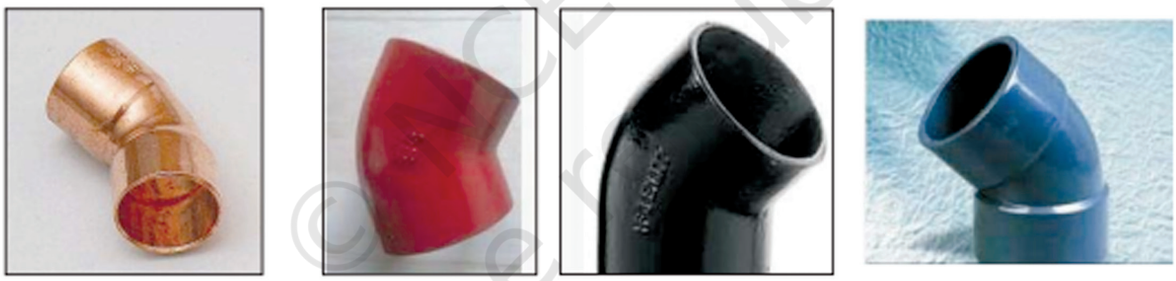


Fig. 5.4: Bend 45°

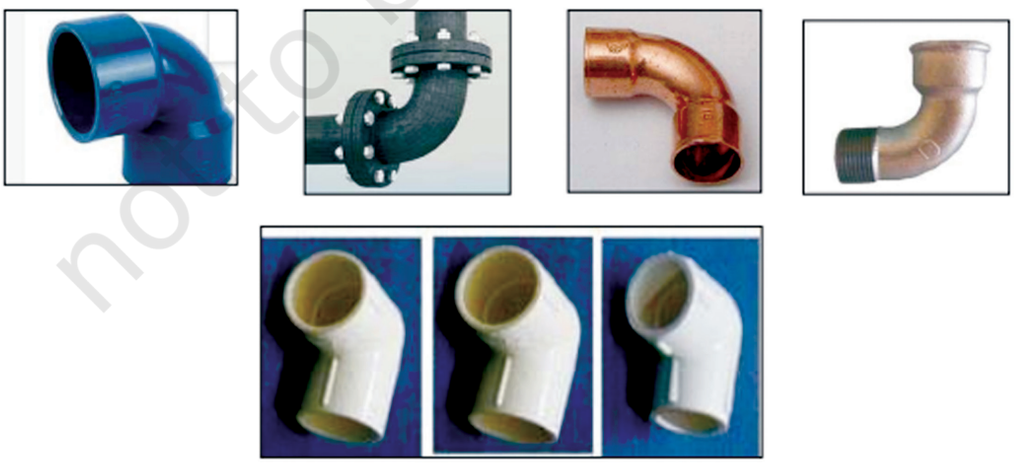


Fig. 5.5: Bend 90°

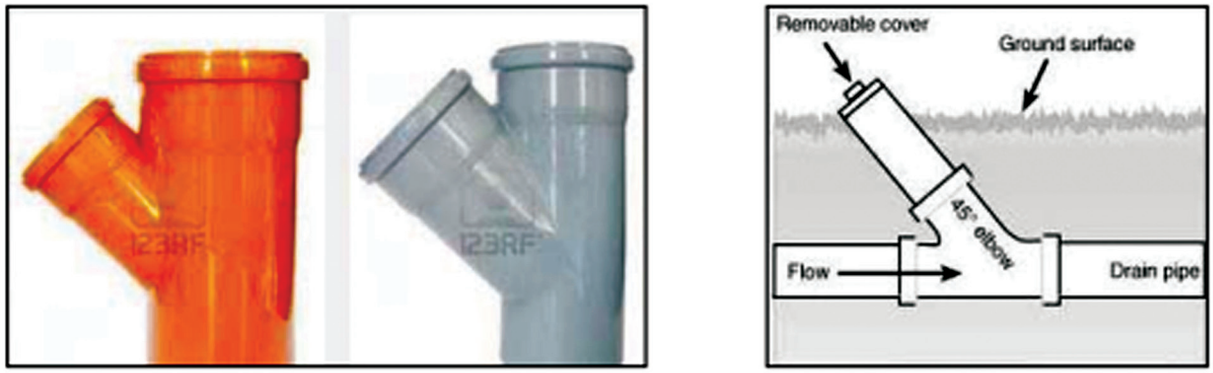


Fig. 5.6: Y-T Joint

Fig. 5.7: Double Y-T Joint-1

Fig. 5.8: Double Y-T Joint-2

Fig. 5.9: T Trap

Gasket

Fig. 5.10: Gasket

They are mechanical seals, generally ring-shaped type and fitted for sealing flange joints. A flange joint is a plate or ring to form a rim at the end of a pipe when fastened to the pipe. Gaskets are made as per by construction, materials and features. Important gaskets used are non-metallic, spiral-wound and ring-joint type (Fig. 5.10).

Union

Fig. 5.11: Union

When two ends of pipes are joined, the pipe fitting used is called union. A union is made of three parts namely a nut, a male end and a female end. The male and female ends are assembled with the support of the nuts, and necessary pressure is made to connect the joint. Since the pairing ends of the union are interchangeable, the union can be changed easily in a short time (Fig. 5.11).

Reducer

It is used to connect pipes of different diameters. A reducer may be of various types like reducer tee, reducer elbow and reducer socket (Fig. 5.12).

Fig. 5.12: Reducers

Tee

It is an important fitting with a side outlet at 90^0 to the run of the pipe. Tees connect pipes of various diameters and help in changing the direction of water or material in a pipe. Tees are made in various sizes like equal or

unequal. The equal tee is most commonly used (Figs. 5.13–5.15).

Fig. 5.13: Single tee socket

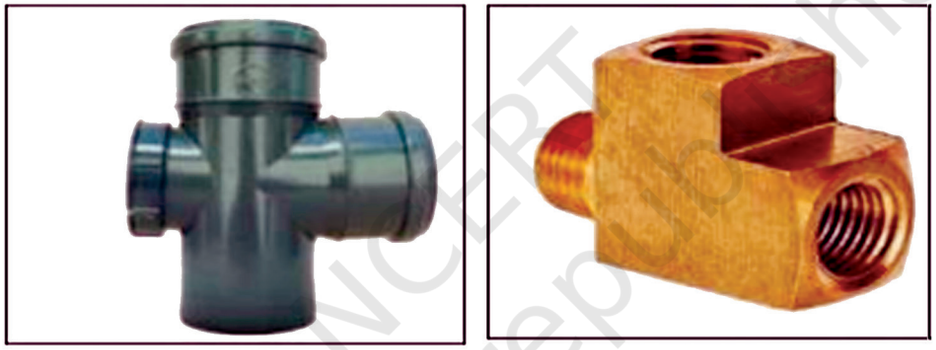


Fig. 5.14: Single tee socket

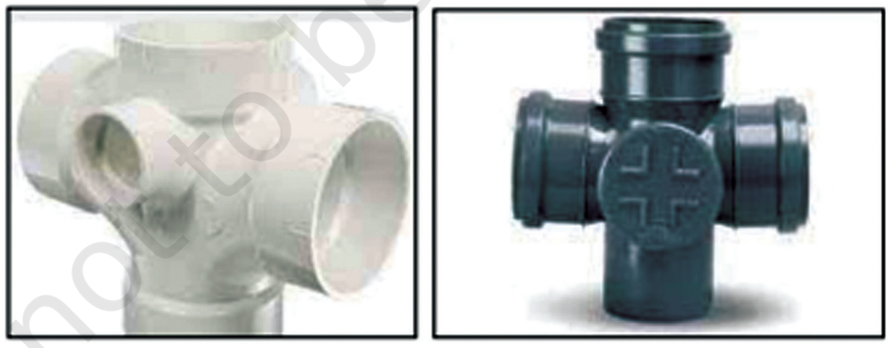


Fig. 5.15: Double tee socket

Nipple

It is a piece of pipe having thread at both sides, and could be used for short extension of plumbing lines. It

Fig. 5.16: Nipple

can also be used for connecting two fittings within small distance (Fig. 5.16).

Trap

It is a fitting in a P, U, S or J-shaped type (Fig. 5.17). Traps are fitted near a plumbing fixture. The trap bend is fitted to prevent sewer gases from entering the building. If the gases are inserted back into home, then it could lead to people inhaling foul smell, which could cause illnesses. It could even explode.

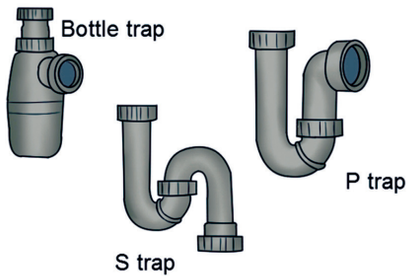


Fig. 5.17: Trap

Cross

When four pipes are joined,a cross is formed. It is also called a cross branch line or a four-way fitting (Fig. 5.18). This fitting has three outlets and one inlet. Cross fittings may deteriorate when temperatures change, because cross fitting is made at the centre of the four connection points.

Fig. 5.18: Cross

Offset

When an assembly of fittings on a pipeline makes one section of pipe out of line and parallel to a second section, then it is known as an offset (Fig. 5.19).

Fig. 5.19: Offset

Laying of GI Pipes in Buildings (Internal Work)

GI (galvanised iron) pipes in the internal work of a building are laid either on the surface or concealed in the wall. For fixing on the surface, the pipes should be kept 1.5 cm apart from the wall and should be laid perfectly vertical or horizontal. The pipes should be held in pipe clamps which are embedded in the wall, roof, etc., with cement mortar 1:3 (1 cement: 3 coarse sand) (Table 5.1).

Table 5.1: Pipe clamp spacing

Diameter of pipe(mm)	Horizontal length (metres)	Vertical length (metres)
15	2.00	2.5
20	2.5	3.0
25	2.5	3.0

32	2.5	3.0
40	3.0	3.5
50	3.0	3.5
65	3.5	5.0
80	3.5	5.0

The following points should be kept into consideration during laying of pipes.

1. GI pipes should not come in contact with lime or lime-mortar. They should be treated with anti-corrosive paints.
2. Whenever a pipe passes through a wall, provision of expansion should be made.
3. Under the floors, the pipes must be placed in the layer of sand to allow expansion.

Pipe Joints

Pipes are connected with the help of joints. A variety of joints are used in an assembly of pipes. Connecting two or more pipes together is called a fitting. Various types of joints could be used in a pipe as per the requirement. Joints are also used for multiple pipe connections, and are an important component of the plumbing system. Generally, the pipe joint fitted can easily sustain the pressure created in the pipe.

Types of pipe joints

Various types of pipe joints are as follows.

1. Threaded joint
2. Welded joint (butt welded, socket welded)
3. Brazed joint
4. Soldered joint
5. Grooved joint
6. Flanged joint
7. Compression joint

Threaded joint

When pipes are joined by screwing in threads which are provided in the pipe, it is called a threaded joint. In this

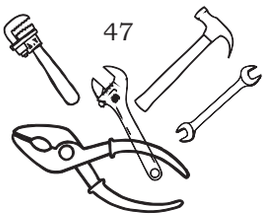


Fig. 5.20: Threaded joint

joint, one of the pipes has internal threads whereas the other pipe has threads externally. Thethreads are also made in various pipes like PVC, CI pipes, copper pipes and GI pipes, etc. (Fig. 5.20).

Threaded joints are used from 6 mm diameter to 300 mm diameter pipes.

Welded joints (Butt-welded joints)

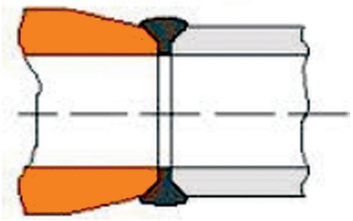


Fig. 5.21: Welded joint

It is one of the most common methods of joining pipes used in large infrastructure like commercial, institutional and industrial systems. Cost of material are low, but the labour costs are more due to the non-availability of trained welders and fitters. (Fig. 5.21).

Socket-welded joints

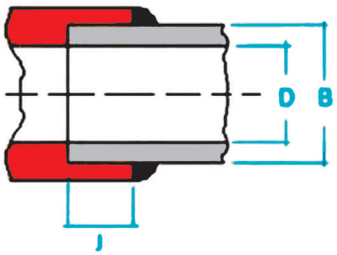


Fig. 5.22: Socket-welded joint

These are used when there is a high chance of leakage in the joints. Pipes are joined as putting one into other and welded around the joint, as shown in Fig. 5.22. Pipes having different diameters are suitable for this type of a joint. Socket-welded joint gives good results as compared to other joints.

Brazed joints

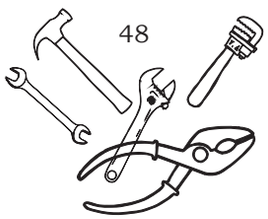
Fig. 5.23: Brazing

When pipes are joined with the help of molten filler material at above 840°C, it is called brazing. Brazing is done for connecting copper pipes or copper alloy pipes. It is important to note that the melting point of the parent material (pipe material) should be higher than the filler material. Brazed joints have less mechanical strength, and are preferred in case of moderate temperatures (Fig. 5.23).

Soldered joints

Fig. 5.24: Brazed and soldered joint

Soldering and brazing are similar activities. In soldering, the filler material melts below 840°C. With the help of soldering, copper and copper alloy pipes are joined. During soldering, flux or metal joining material is used to prevent oxidation due to the flame. Soldered joints are suitable for low temperature areas and have low mechanical strength (Fig. 5.24 and Fig. 5.25).



Grooved joints

Fig. 5.25: Solder joint

When two pipes are joined together by making grooves (narrow cuts or depression) at the end of pipes with the help of sockets or couplings, such joints are called grooved joints. Due to the ease of assembly of the grooved joints, the labour cost is less. The piping system can be easily uninstalled and reinstalled frequently for maintenance (Fig. 5.26). These are mostly used for fire protection.

Fig. 5.26: Grooved joint

Flanged joints

This joint is commonly used for joining pipes in pumping stations, filter plants, hydraulic laboratories and boiler houses, etc. (Fig. 5.27). These joints are preferred due to easy process of assembly and disassembly, however these connections are costly. These joints can be disassembled and re-assembled when required. A pipe has flanged ends on both sides of the pipe length. Both the ends of pipes are joined at a proper level near one another. A hard rubber washer is placed between flanges and bolted. Flanges are generally fixed to the pipe by welding or threading. In certain cases, a flange-type joint is also called a lap joint. It may also be made by forging the process and machining the pipe end. There is no leakage in flanged joints even after rapid temperature fluctuations.

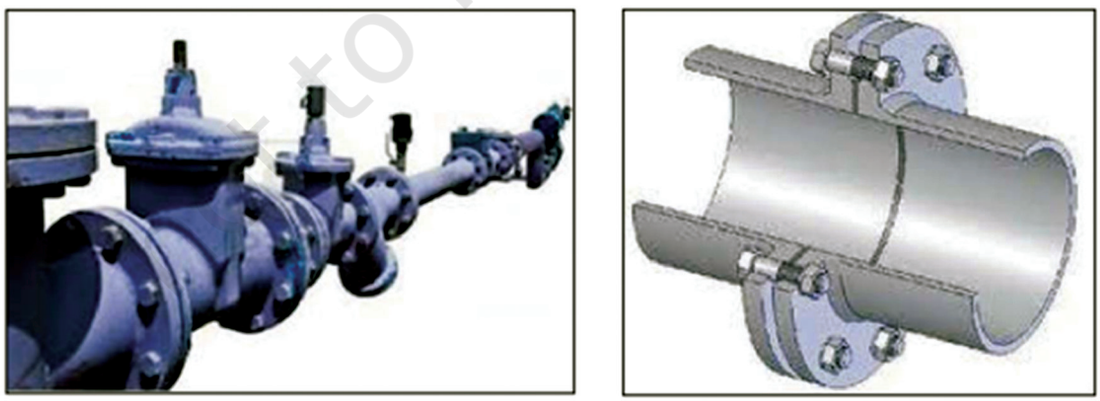
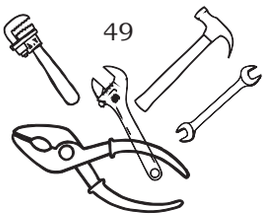


Fig. 5.27: Flanged joints



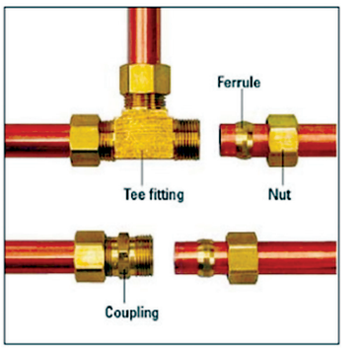


Fig. 5.28: Compression joints

Compression joints

These are applied to join the pipe without any preparations. The cost of installation of these joints is very economical. The pipes having plain ends are joined by fixing fittings at their ends, and such a joint is called a compression joint. The pipe ends are joined with threaded fittings or couplings. Joints are placed properly to check the flow pressure, otherwise, leakage may occur. These fittings are manufactured from different types of material. Selection of fittings is done as per requirement (Fig. 5.28).

Valves

For proper functioning of the pipeline, valves made of iron or brass are used in the water-supply mains. Valves stop or control the flow of fluid like liquid, gas, condensate, etc. These are classified according to their usage like isolation, throttling and non-return corrector. Various types of valves are manufactured depending upon their use and type of construction.

Fig. 5.29: Sluice valve

Sluice valve

It is fitted at an important place like at the entrance of a pipe. It may be the start of a new pipe from a tank, or a number of branches from the tank. This valve isolates the water-supply, as and when required. The sluice valve is specified by the pipe bore (diameter) of the water-way. The standard sizes are 50 mm, 65 mm, 80 mm, 100 mm, 150 mm, 200 mm, 250 mm and 300 mm. The sluice valves are classified as Class 1 and Class 2 (Fig. 5.29 and Table 5.2).

Table 5.2: Test pressure in sluice valve

Class	Test Pressure kg/cm²		Max. working Pressure kg/cm²
	Body	Seat	
Class 1	20	10	10
Class 2	30	15	15

Scour valve

This valve is provided at the lower level in a pipeline, so that such sections can be supplied and drained for maintenance purpose. The water is distributed into natural drains. It is basically a sluice valve and the very nature of its use has created the difference in the name (Fig. 5.30).

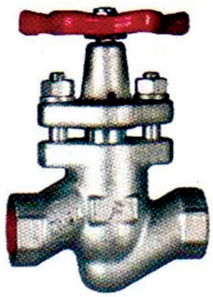


Fig. 5.30: Scour valve

Air valve

It is fitted to release the air automatically when the pipe is filled with water. This valve also permits entry of air when the pipe is drained. This valve is fixed at the end of a communication pipe and controls or stops the supply of water. This valve is specified by the standard bore (diameter) of the socket or pipe outlet, to which it is fitted. The standard sizes are 8 mm, 10 mm, 15 mm, 20 mm, 25 mm, 32 mm, 40 mm and 50 mm (Fig. 5.31).

Fig. 5.31: Air valve

The body components and washer plate are made of cast brass or leaded tin bronze. The washers are made from fibre, leather, rubber or nylon. This valve is available in two types: internally threaded and externally threaded.

Gate valve

It is used for starting or stopping flow. For a straight-line flow of fluid, minimum flow restriction can also be done with gate valve. In service, these valves are generally either fully open or fully closed. These valves are used for various types of liquids and make a tight seal when closed.

Fig. 5.32: Split taper non-rising gate valve

Types of gate valve

Gate valves have gates of wedge type, solid or split type, or gate of double disc or parallel type. The movement of the gate shall be by the internal or external screw on the spindle. The spindle, which controls the flow of a liquid, can be of the rising or non-rising type. See Fig. 5.32 and Fig. 5.33.

Fig. 5.33: Rising spindle split wedge gate valve

Parallel slide valve

It has two discs without spreading mechanism which slides between the two parallel body seats. The activation

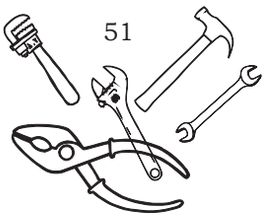


Fig. 5.34: Parallel slide valve

Fig. 5.35: Globe valve

Fig. 5.36: Angle valve-1

Fig. 5.37: Angle valve-2

Fig. 5.38: Check valve or non-return valve

Fig. 5.39: Ferrule

of the valve discs is by the internal and the external screw on the spindle and the spindle may be of the rising or non-rising type (Fig. 5.34).

Globe valve

It is a type of valve used for controlling flow in a pipeline. A component of valve includes a movable disc element and a stationary ring seat fitted in a generally spherical body. The globe valve is used for controlling flow control (Fig. 5.35).

Angle valve

It is used to control the movement of a fluid like liquids, gases, fluidised solids, or slurries by opening, closing or partially obstructing various pathways. This type of a valve generally has a round body, in which the body ends are fitted at right angles with each other and the disc moves up and down. The valve is moved to action by the internal or external screw on the spindle. The spindle may be of the rising or non-rising type. See Fig. 5.36 and Fig. 5.37.

Check valve or non-return valve

It is a valve which permits (fluid) water to move in one direction but checks all the returning flow. It is operated by the pressure above, having no external means of control (Fig. 5.38).

Ferrule

It is used for connecting a service pipe to the water main. It is usually made of non-ferrous metal and screwed to the main pipe (Figs. 5.39–5.42).

Foot valve

It is a valve used in the pump. It is also called check valve, as it makes sure that the pump is ready to use. If

Fig. 5.40: Swing check

Fig. 5.41: Horizontal check

Fig. 5.42: Vertical check

the pump is off, then the foot valve keeps enough fluid in the pump to ensure that it can start again. In a well, the foot valve will be between the water surface and the pump. In a water intake system, the foot valve will be at the end of the water intake line. The foot valve has a strainer on the outside which prevents obstructions also (Fig. 5.43).

Fig.5.43: Foot valve

Float valve

It is used for stopping water when the water tank or flush toilet is filled, so that it stops overflowing. When the water level rises, the float also rises; once it rises to a pre-set level, the water level forces the lever to close the valve and stops the water flow. A float valve is a fitting used for filling water tanks as well as flush toilets (Fig. 5.44).

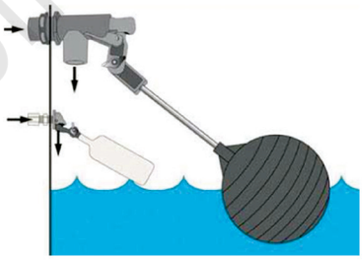


Fig. 5.44: Float valve

Practical Exercises

Activity 1

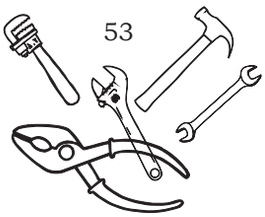
Prepare a list of fittings available in the market.

Material Required

1. Different types of fitting
2. Notebook
3. Pen

Procedure

1. Survey the local market.
2. Visit the plumbing hardware shop.
3. Identify the fittings available in the shop.
4. Prepare a list of the identified fitting items seen in the market.
5. Note down the cost of the fitting items and their manufacturing company's name.



Activity 2

Draw figures of the various types of bends.

Material Required

1. 45° and 90° bend
2. Notebook
3. Pen

Procedure

1. Inspect the plumbing items fitted in the school.
2. Identify the bends fitted.
3. Draw the figures of bends in your notebook.

Activity 3

Practice joining a pipe.

Material Required

1. Joints
2. Pipe
3. Tools

Procedure

1. Collect the pipe joints, pipes and tools.
2. Identify the components.
3. Collect the joints.
4. Join the pipe with the help of proper pipe joining tools.

Activity 4

Draw the figure of joints.

Material Required

1. Threaded joints, grooved joints and compression joints
2. Pen
3. Pencil

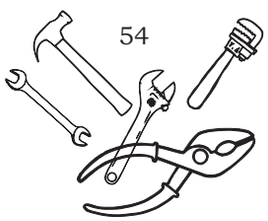
Procedure

1. Collect the figures or joints of threaded joints, grooved and compression joints.
2. Draw the figure of the joints.

Check Your Progress

A. Answer the following questions

1. Why are fittings used in plumbing? Write a short note on any four types of fittings.



2. Why are joints necessary? Discuss in detail, with suitable figures.
3. State the difference between threaded joint and a welded joint.
4. Explain the importance of valves. Write about two types of valves and their uses.
5. What is the role of a float valve? List down its uses and advantages.

B. Mark the correct option

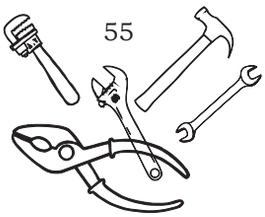
1. Which of the following fittings is used to connect two pipes with each other?
   (a) Tee (b) Connector
   (c) Elbow (d) All of the above

2. Which of the following fittings is used to connect four pipes?
   (a) Offset (b) Union
   (c) Cross (d) Reducer

3. The valve which avoids both overflow and back flow of water is_____.
   (a) float valve (b) angle valve
   (c) foot valve (d) check valve

C. Match the following

Column A	Column B
1. Nipple	(a) 
2. Ferrule	(b) 
3. Soldered joint	(c) 
4. Foot valve	(d) 



Suggested Readings

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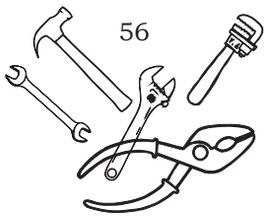
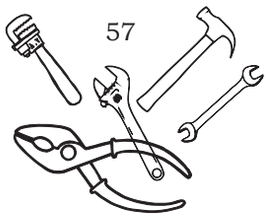


Answers

Unit	Fill in the blanks	Match the following	Mark the correct option	Full forms
1.	1. Water 2. Plumbing fixtures 3. Pipes 4. Installation, repair, maintenance, servicing		1. (c) 2. (d) 3. (d) 4. (a)	
2.	1. Holding 2. Mason's square 3. Pickaxe 4. Drill machine` 5. Cutting	1. (b) 2. (c) 3. (d) 4. (a)		
3.			1. (c) 2. (a) 3. (b)	1. Galvanized Iron 2. Asbestos Cement 3. Unplasticised Polyvinyl 4. Cast Iron
4.	1. 12 2. 1.09 3. 2.2046 4. 4.546 5. 27.68 6. 1		1. (b) 2. (b) 3. (d)	
5.		1. (d) 2. (c) 3. (b) 4. (a)	1. (d) 2. (c) 3. (a)	



Glossary

Assembly: *Process by which part samples (belonging to the same assembly standard [RFC]) are connected to one another. Assembling two basic parts always results in a new, larger composite part that can be used in future assemblies.*

Bending: *A technique used in various metal forming processes with the aim of increasing the fabrication capabilities of plumbing fixtures. The pipe can be bent at varying angles and in different directions. The simplest curve turns the tube at an angle of 90 degrees forming an elbow. Besides, pipe bending can be done in several other geometries that include 2D and 3D dimensions.*

Chipping: *Removal of wood, spatter, rust or old paints from iron work or plumbing work using hammer and cold chisel.*

Die: *It is used to cut or form the male portion of the mating pair (for example, a bolt).*

Disassembly: *When referring to hardware, disassembly is the process of breaking down a device into separate parts. A device may be disassembled to help determine a problem, to replace a part, or to take the parts and use them in another device or to sell them individually.*

Drilling: *Process of creating a smooth hole in a material with a drill and motor.*

Filing: *Process of removing excess material and deburring the surface. Sandpaper may be used as a filing tool for material, such as wood.*

Sawing: *Process wherein a narrow slit is cut into the workpiece by a tool consisting of a series of narrowly spaced teeth, called a saw blade. Sawing is used to separate work parts into two or more pieces, or to cut off an unwanted section of a part.*

Tap: *It is used to cut or form the female portion of the mating pair (e.g., a nut).*

Taps and **dies:** *Tools used to create screw threads, which is called threading. Many are cutting tools; others are forming tools.*

Tapping: *Process of cutting or forming threads using a tap. It is the action that creates a thread into the side of the hole.*

Threading: *Process of cutting or forming threads using a die.*