EXPERIMENT NO : 06

MAKE A PLUMBING LINE USING PVC FITTINGS

18MES103L- CIVIL AND MECHANICAL ENGINEERING WORKSHOP

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A.P(SR.G)/ MECHANICAL

INTRODUCTION

- The plumbing and sanitary system is an essential part of every house or building. Proper planning and designing of plumbing system is crucial as it takes care of the hygiene requirements of the occupants. It has been reported that about 8 per cent of the construction cost of a building is marked for plumbing and sanitary work.
- A plumber's job role consists of installation, repair, maintenance and servicing of plumbing fittings and fixtures. Besides having a thorough understanding of the mechanisms required for performing various tasks, a plumber should be laborious, have effective communication skills and be a result-oriented worker with a positive attitude.

ROLE OF PLUMBING

- As you may be aware, water is supplied to a house or a building from storage tanks through pipes. Similarly, the waste water from kitchen and washrooms is drained out with the help of pipes. Any building, be it a residential, commercial or industrial, cannot function properly without having plumbing and sanitary arrangements in place.
- It is, therefore, important to have regular and adequate water supply and a proper system for the disposal of waste water.
- Plumbing cycle refers to a mechanism through which water is taken from a source, then supplied to the users, and finally waste water is collected and recycled to the source after proper treatment (Fig. 1.1).
- Plumbing and pipe-fittings play a major role in the construction of all types of buildings.
- An efficient plumbing work keeps the atmosphere free from bad smell and ensures better sanitation.

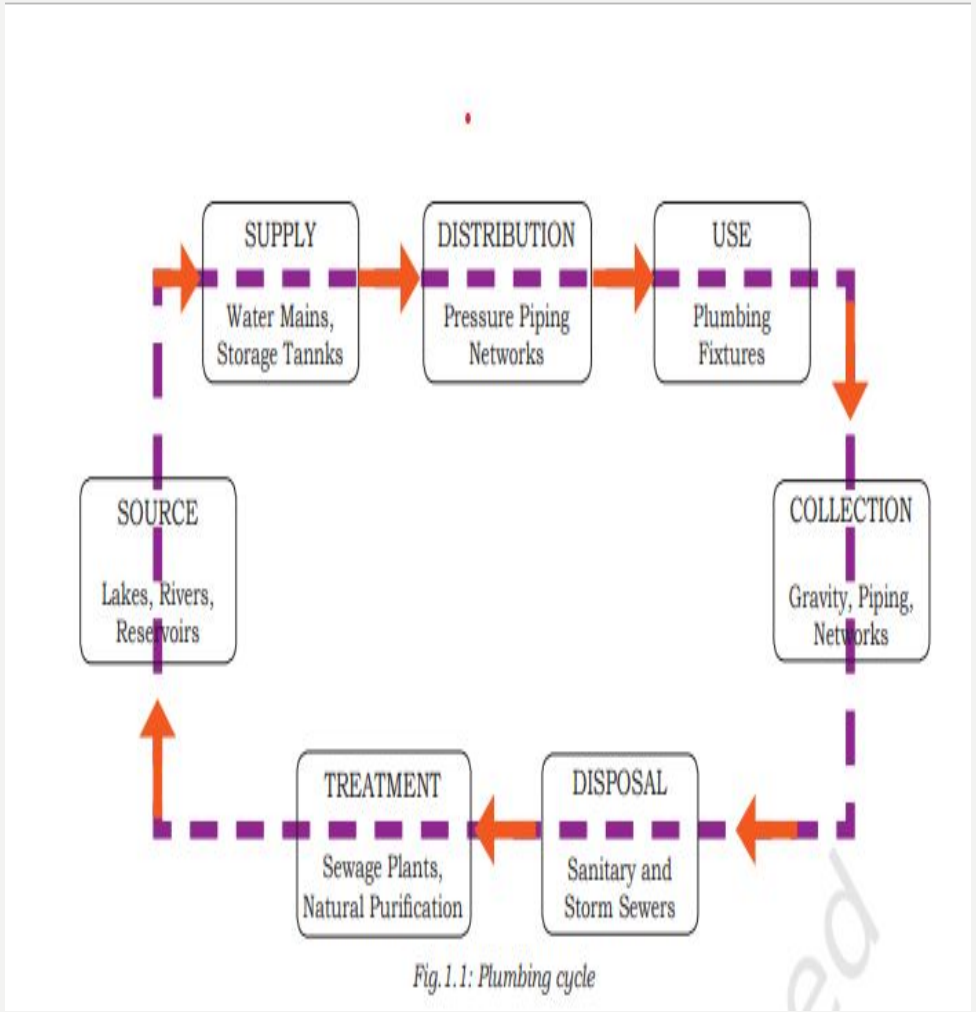


Fig. 1.1: Plumbing cycle

PLUMBING

- The skill and art that is needed to transport water from the source to the users, then to the treatment plants, and finally supplying the treated water to the users through a distribution system is known as plumbing.
- It is a system of pipes and fittings that carry water.

SANITARY WORK

- Sanitary work refers to carrying the waste water to the waste disposal system (sewerage system) through plumbing fixtures.
- The plumbing installation is governed by the regulations and rules adopted by the concerned municipal corporations or committees of different States and Union Territories. Plumbing and sanitation work thus plays an important role in the construction of a building. A plumbing system consists of pipe fittings and appliances used for water supply and drainage, as you see the fitting for the washbasin in Fig. 1.2. In this system, different pipes are used for different purposes. The plumbing system includes:
- water supply, galvanized iron (or plastic) pipes and fixtures;
- soil pipes and fixtures;
- sanitary drainage system; and
- rainwater drainage system. For an efficient plumbing system, it is important that standard plumbing and sanitary material, as per the Bureau of Indian Standards (BIS), are used.

Fig. 1.2 – Basic Sanitary work

ROLES OF A PLUMBER

- Can easily measure,
- cut and
- install the pipes for proper functioning.
- Joins pipes if water is needed to be transferred for long distances.
- Maintain pipes for proper use by testing them regularly,
- to detect any leak or any flaw.
- Solves problems regarding sewage and draining system

TOOLS FOR PLUMBING

- We will now look at the various tools that help a plumber perform the plumbing activities effectively. Like any other sector, a thorough knowledge and working of tools and equipment used in plumbing are essential for a plumber to carry out the tasks.
- A plumber requires several tools for the fitting work for plumbing, fixing a tap or to carryout repairs.
- These tools help the plumber in performing his/her work properly, and therefore it is important that the tools are used systematically and handled carefully to avoid any damage. They should be kept at a designated place after use.
- The tools can be categorized as per the nature of work like holding tools, fitting tools, cutting tools, pipe threading and bending tools, etc.

THE MAJOR TOOLS USED IN PLUMBING

1. Holding tools

(a) Bench vice (b) Pipe vice

2. Fitting tools (a) Wrenches (b) Water-pump pliers (c) Spanners

3. Cutting tools (a) Pipe cutter (b) Hacksaw

4. Pipe bending tools (a) Pipe bending machine (b) Threading dies

5. Other tools

(a) Chisel (b) Hammer (c) Chain wrench (d) Rover jumper

(e) Trowel (f) Screw driver (g) File

(h) Plier

(i) Caulking tools (j) Drill machine (k) Drill bit

(l) Hanger (m) Measuring tape (n) Plumb rule and bob (o) Spirit level (p) Spade (q) Shovel (r) Pickaxe (s) Mortar pan (t) Masons' square

(u) Water level tube

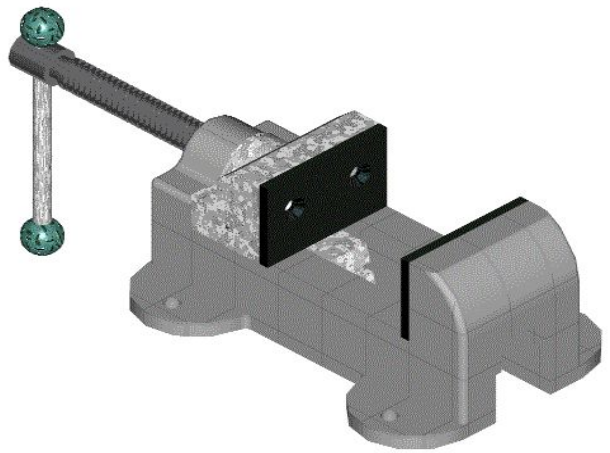
HOLDING TOOLS

- Tools which are used for holding the pipes, pipe fittings and fixtures for plumbing operations are called holding tools. Some of the commonly used holding tools are mentioned below.

(a) Bench vice

- A vice is a tool used for holding an object for various tasks like filing, chipping, sawing, threading, tapping, bending, etc.
- The bench vice has two jaws, one of which is fixed and the other is movable.
- These jaws are fitted with plates for a better grip on the object during the task.
- The vice size depends on the width of the jaw.
- A bench vice is fixed to a table or a bench through a bolt.
- A vice is opened and closed with the help of a handle attached to a spindle. In this way, the object is held tightly.
- Bench vices hold the objects and allow use of other tools to complete the tasks (Fig. 2.1).

Fig. 2.1: Bench vice



HOLDING TOOLS

(b) Pipe vice

It is a tool used for holding a pipe for carrying out assembly, disassembly, threading, cutting, etc. Pipe vices are of two types: (i) Open side pipe vice (ii) Fixed side pipe vice Standard sizes of vices are 80 mm, 105 mm, 130 mm, 170 mm, etc., as per the opened size of the jaws. (Fig. 2.2).

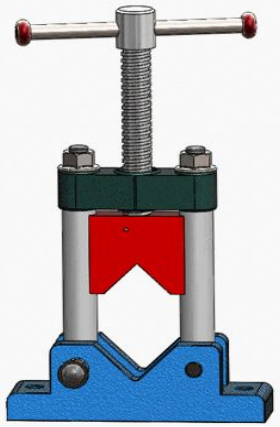


Fig. 2.2: Pipe vice

FITTING TOOLS

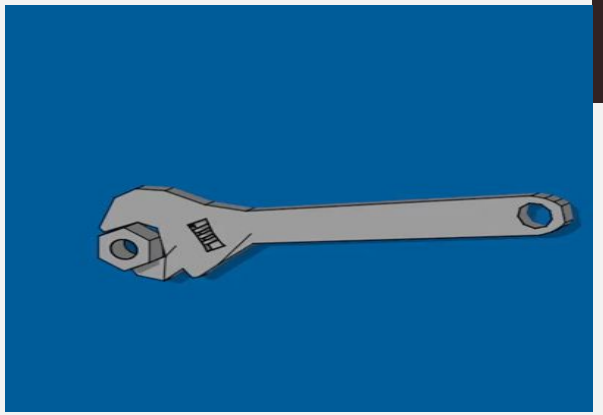
- These are hand tools used for tightening and loosening the nuts and bolts.
- Wrenches hold slippery or small nuts and bolts for loosening or tightening them.
- Mostly, two types of wrenches are used

(a) adjustable and

(b) non-adjustable.

These are useful particularly in case of odd-sized nuts and bolts. These tools hold a pipe and pipe fittings for screwing or unscrewing. This is a very common tool, especially for small diameter pipes up to 50 mm. (Fig. 2.3).

Fig. 2.3: Pipe wrenches



ADJUSTABLE WRENCH

- This type of wrench is used to loosen or tighten the nuts and bolts of any odd and regular sizes. It is used for tightening and loosening valves, cocks, geysers, flexible pipes, etc. It is a good maintenance tool for repair of plumbing items like valves, cocks, pumps, etc.
- It has a fixed flat jaw with a handle and a square toothed screw (Fig. 2.5). The movable flat jaw slides in the body of the fixed jaw with the support of a screw. The gap between the flat jaws is used to hold the object to be twisted for screwing or unscrewing.

Fig. 2.5: Adjustable wrench

Fig. 2.4: Different type of wrenches (adjustable)

WATER-PUMP PLIER

- It is a common plier used by plumbers for holding, tightening and loosening work during fixing process. Steel is used for manufacturing water-pump pliers. These are available in only one standard size of 250 mm length. The maximum width possible between the two jaws is 40 mm (Fig. 2.6).

Fig. 2.6: Water-pump pliers

SPANNERS

- This tool is used for tightening and loosening nuts and bolts of standard size.
- The standard spanners used are:

(a) Ring spanners -These spanners have full circular closed ring at both ends. It is difficult to slip and cause damage. It is made through forging process, with a burnished finish or a chrome-plating (Fig. 2.7a).
(b) Open-ended spanners- These types of spanners are open from both sides and are used for tightening and loosening nuts and bolts (Fig. 2.7b).

A spanner having open-ended jaws slides through the nut or bolt with square or hexagonal heads. The bolts or nuts are then turned with the required force to screw or to unscrew. The two jaws have two consecutive sizes like 6 mm and 7 mm or 1/4″ and 5/16″, etc.

Fig. 2.7a: Ring spanner

Fig. 2.7b: Open-ended spanner

CUTTING TOOLS

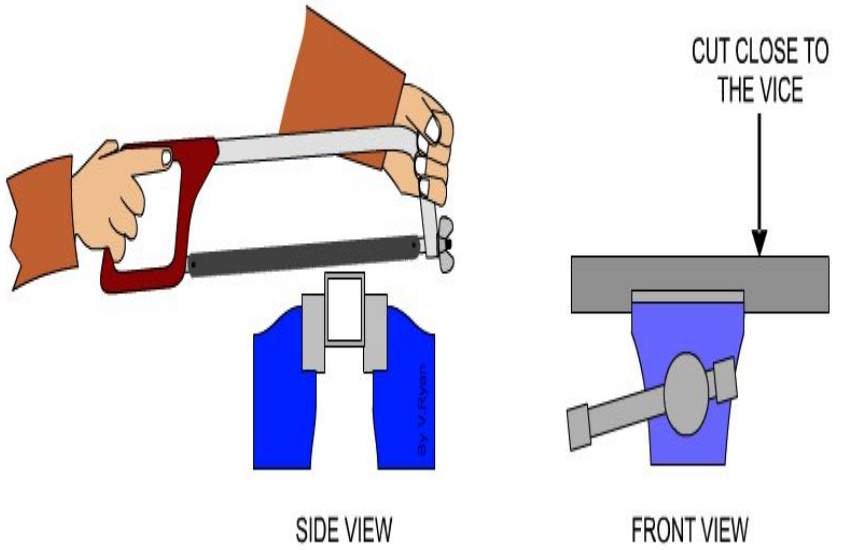
- Pipe cutter -This is a manual tool used to cut a pipe at the work site, especially when it is difficult to use a hacksaw frame. This tool has a sharp, round cutting wheel which is pressed with to and fro rotary motion for cutting a pipe (Fig. 2.9).
- Hacksaw -This tool is generally used with both the hands. It cuts material like plastic pipe, steel rod, angle iron, sheets, iron pipes, etc. It can also be used for cutting the bolt heads and nuts when they are jammed. Important parts of a hacksaw are—handle, frame, blade and adjusting wing nut (Fig. 2.10).
- A hand-operated hacksaw is used for site work while a power hacksaw is used in a workshop for cutting heavy pipes quickly (Fig. 2.11).

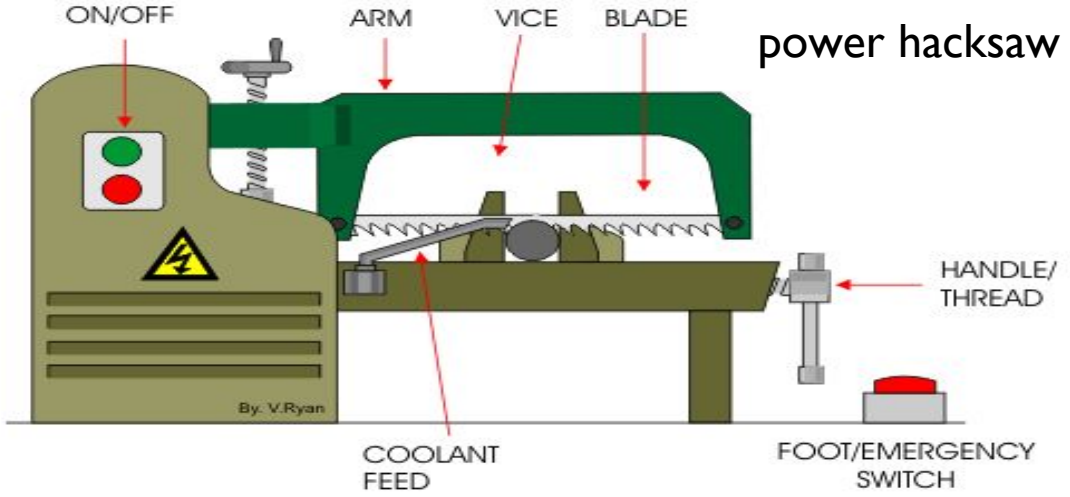
Fig. 2.9: Pipe Cutter

Fig. 2.10: Hand-operated hacksaw

Fig. 2.11: Power hacksaw

Hacksaw

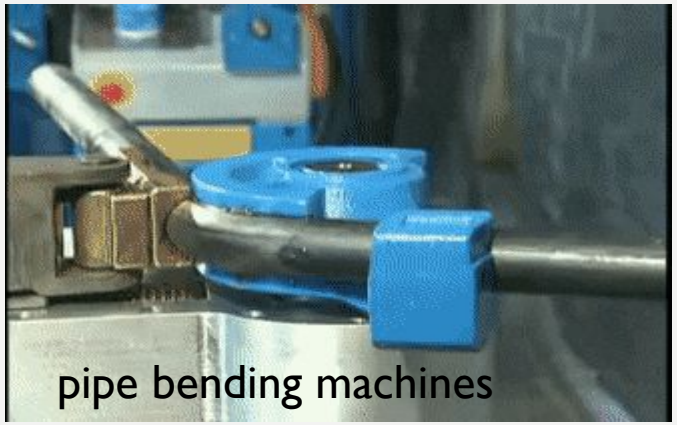




power hacksaw

PIPE BENDING TOOLS

- In most of the plumbing operations, pipes are required to be bent at different angles as per requirement, for which pipe bending tools are used. Some of these tools are mentioned below.
- Pipe bending machine -This equipment is used to bend or turn pipes. The size and strength of the machine depends upon the diameter of the pipe and the type of the pipe material to be bent.
- The mechanical or hand-operated pipe bending machines are available for 3/8– 1″ diameter pipes.
- For higher ranges, i.e., 1/2–2″, 1/2 – 3″, 1/2– 4″ and 2– 6″, hydraulic hand-operated machines are used (Fig.2.12).



pipe bending machines

Fig. 2.12: Pipe bending machine

hand-operated pipe bending

THREADING DIES

- Threading dies -Threading is crucial for joining pipes and fixtures effectively. A threading die is used for making threads in a pipe where it is to be joined with another pipe or fixture (Fig. 2.13).

Fig. 2.13: Threading die

OTHER TOOLS

Apart from the already mentioned holding, fitting, cutting and bending tools, various other tools are also used in plumbing operations. These are listed below.

- Chisel - It is made of hard metal and is mostly used for cutting concrete surface and making grooves in the walls with the help of a hammer. (Fig. 2.14)
- Hammer -These are general purpose workshop hand tools used for straightening of sections, riveting, striking of nails and inserting the component by striking, inserting keyways and fitting by striking.

The hammer consists of a head made of hard and tampered steel, and a wooden handle. The head has a flat striking face and the other side is called pein. The peins are classified as per different shapes such as ball pein, cross pein and straight pein.

The hammers made of hardened steel are known as engineer's hammers and are usually used while working with steel components. A one-kilogram hammer is the most commonly used hammer (Fig. 2.15).

Fig. 2.14: Chisel

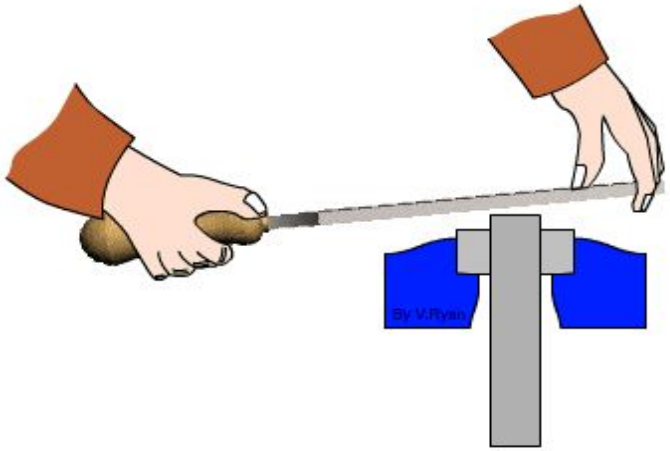
Fig. 2.15: Hammers

OTHER TOOLS

- Screwdriver -This tool is often used by plumbers to fit the screws. Screwdrivers have a sharp tip which can easily fit into various screws. Different types of screwdriver are used for various types of screw. Various types of heads of the screwdriver are used by plumbers (Fig. 2.17).
- Files -These hand tools are used for a variety of work, like removing of sharp edges, metal removal, shaping of jobs, smoothening of surfaces, finishing, producing different shapes, etc. The file has five parts: tang, heel, face, edge and point or tip. Various types of files of different shapes like hand round, pillar, square, three square, half round, flat, knife edge and needle file are used as per the work (Fig. 2.18).

Fig. 2.17: Screwdriver

Fig. 2.18: File



OTHER TOOLS

- Pliers -They are important tools used for holding small objects and for tightening or loosening various parts. Several types of pliers are used by a plumber during work. Pliers can be used for cutting purpose also. Various shapes and sizes of pliers are available in the market. Pliers of different types are shown in Fig. 2.19

Fig. 2.19: Plier

OTHER TOOLS

- Drill machine -One of the common but important tools used for making a hole in a metal or wood, or concrete surface. A drill machine (Fig. 2.21) is fitted with a cutting tool like a drill bit. The attachment is tightened with a key. Safety precautions Before installing the bit in a drill machine, it should be sharpened. The key in the chuck, a part of the drill machine used for tightening the drill bit, should be removed after tightening.
- Drill bits - These are the tools used to make cylindrical holes by cutting the material. Bits are fitted in a tool which rotates it and make the hole. For non-cylindrical shaped holes, specialised bits are used (Fig. 2.22).

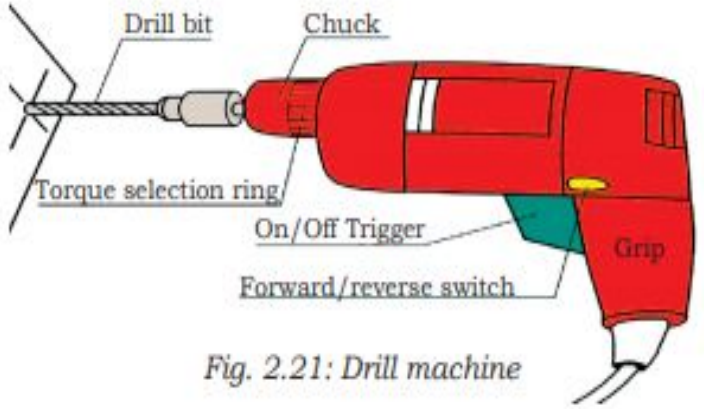


Fig. 2.21: Drill machine


Fig. 2.22: Drill bits

OTHER TOOLS

- Measuring tape -It is used for measuring the length of an item. The measuring tape is manufactured in various material like steel, cloth and PVC. The length range available is one metre, two metres, three metres, five metres, 10 metres, 15 metres, etc. (Fig. 2.24).
- Spirit level -It is used to check the horizontality or levelling of the floor, roof, door, window frame, etc. (Fig. 2.26).
- Mason's square -It is used to check rectangularity of external and internal corners. It is made of carbon steel sheet. The dimension is also marked on both the sides, either in inch or centimetre (Fig. 2.32).

Fig. 2.24: Measuring tape

Fig. 2.26: Spirit level

Fig. 2.32: Mason's square

SAFETY DURING WORK

The following precautionary measures may be taken for the safe use of the plumbing tools.

1. Use the correct methods given in the 'Instruction Manual of tools' while using them.
2. Use the appropriate tools required for the specific work or job. For example, do not use pliers instead of a hammer; use only a hacksaw to cut.
3. Keep the tools in working condition and ensure the required maintenance.
4. Ensure that the necessary protective equipment are available.
5. Follow safety methods while using electrical wires.
6. Use kerosene oil for removing dust from rusty nuts.
7. Do not use tools without a handle as they may not give proper grip.
8. Remove burrs or stuck material from the head of the chisel and the edges of tools.
9. Wear safety glasses while using power tools like a drill machine.
10. Keep metal parts lightly lubricated.
11. Do not apply excessive pressure or force.
12. Inspect the tools regularly.
13. Use or wear safety gear (helmet, gloves, goggles, safety shoes, ear plugs, etc.).

MEASUREMENTS AND SYMBOLS

- a plumber must also be efficient in measurement of plumbing material with the help of measurement tools and be able to manage conversion of units easily. Similarly,
- a plumber should also be able to understand and read the various symbols used in plumbing drawings.
- Plumbing material is needed as per the requirement of the plumbing work to be done and its plan.
- Plumbing fitting and fixtures are available in the market in different sizes and types.
- The size of the plumbing items can vary from inch to feet and meter in height.

Measurement of Length	
1 millimetre (mm)	= 0.03937079 in, or about 1/25 in
10 millimetre	= 1 centimetre (cm) = 0.3937079 in
10 centimetres	= 1 decimetre (dm) = 3.937079 in
10 decimetres	= 1 metre (m) = 39.37079 in, 3.2808992 ft, or 1.09361 yd
10 metres	= 1 decametre = 32.808992 ft
10 decametres	= 1 hectometres = 19.927817 rods
10 hectometres	= 1 kilometre = 1093.61 yd, or 0.621377 metre
1 inch	= 2.54cm, 1 foot = 0.3048 m, 1 yard = 0.9144 metre
1 rod	= 0.5029 decametre
1 mile	= 1.6093 kilometre

MEASURING INSTRUMENTS

- Measuring tools -These are important tools in a workshop, which help the plumber to measure size and dimensions of various components of plumbing. Measuring tools are commonly used. A plumber should know the use and handling of these tools. The important measuring tools are steel rule, calliper, screw gauge, pressure gauge, etc.
- Steel ruler - It is used to measure lengths and to draw straight lines (Fig. 4.2)
- Calliper - It is a tool used to determine the shorter lengths between two sides of an item. The tips of the calliper are kept to the distance to be measured; the calliper is then removed and the distance is measured between the tips with the ruler (Fig. 4.3 and Fig. 4.4)

Fig. 4.2: Steel ruler


Fig. 4.3: Outside callipers


Fig. 4.4: Inside callipers

MEASURING INSTRUMENTS

- Screw gauge (Micro metre) - It is a device incorporating a calibrated screw used widely for precise measurement of small lengths. Proper handling of this tool is important in measuring any dimension (Fig. 4.5).
- Measuring tape -It is used for measuring the dimension of plumbing items. Tapes are available in various lengths like 10 metres, 20 metres, etc. (Fig. 4.6)
- Pressure gauge - It is the instrument used for measuring the pressure in the unit (Fig. 4.7).

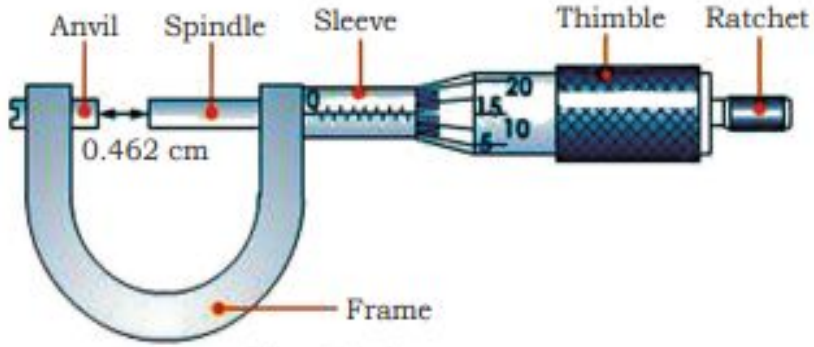


Fig. 4.5: Screw gauge


Fig. 4.6: Measuring tape

Fig. 4.7: Pressure gauge

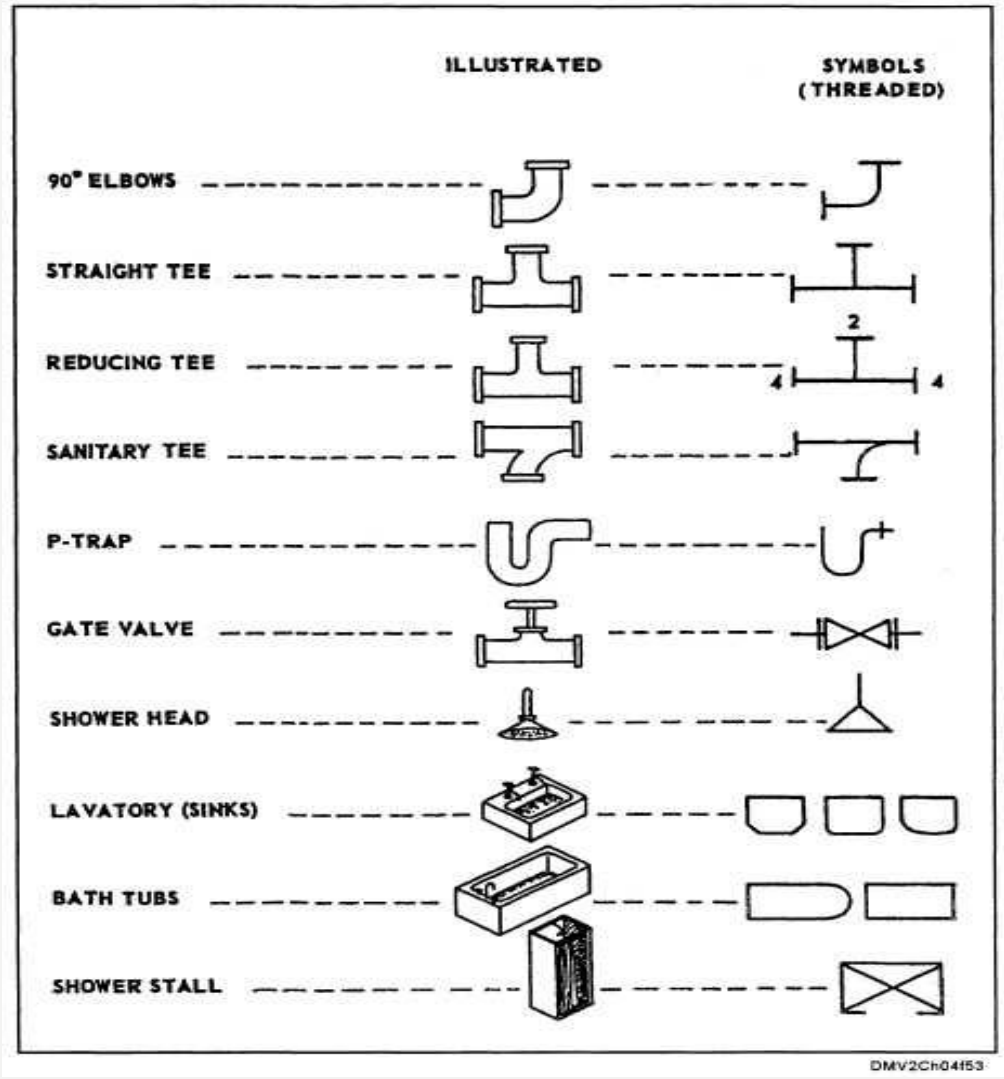
MEASURING INSTRUMENTS

- Vernier calliper -The metre scale is used to measure the length to the nearest millimetre only. For measuring smaller lengths precisely, Vernier calliper is used. Vernier calliper is a precision instrument used to measure the internal and external lengths. It is usually a manual calliper, as shown in Fig. 4.9.

Fig. 4.9: Vernier callipers

PLUMBING SYMBOLS

- Importance of plumbing symbols A well-trained plumber does the installation of the fittings and fixtures as per the drawing given in the assembly sheet of the plumbing fixtures in the manufacturer's catalogue. These drawings consist of symbols, assembly of fixture and installation method. Identification of the symbols given in the drawings of fixtures makes the installation work easy for the plumber. Plumbing symbols are given in this Unit. The students should identify and learn the symbols so that it will be helpful in future.



PIPE FITTINGS, JOINTS AND VALVES

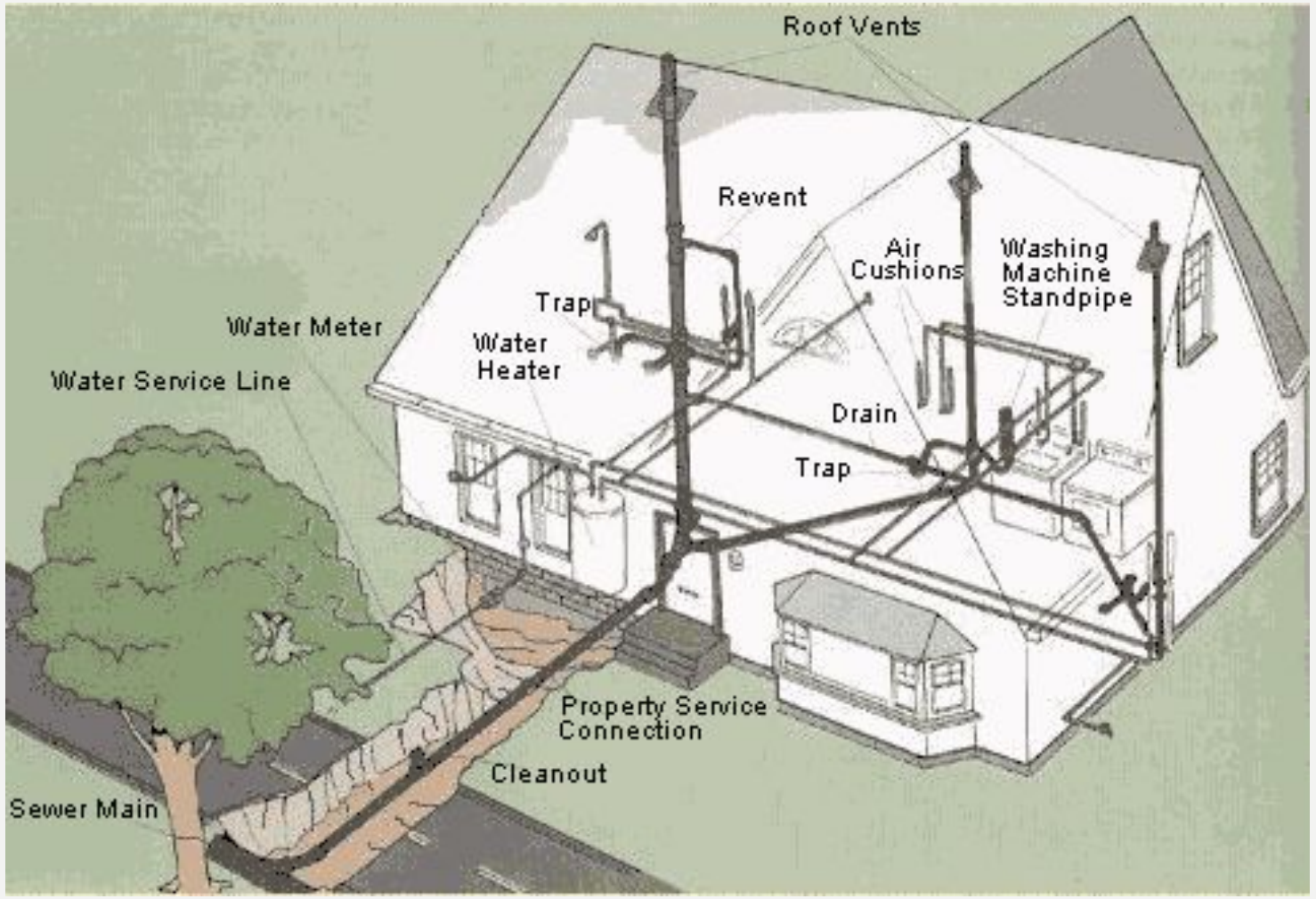


Fig. 5.1: Layout of pipeline (internal) in a building

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

- 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).
- 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 categorized 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. 5.3: Collars

PVC FOR PLUMBING

- For decades, copper has been the go-to material for plumbers everywhere. But more recently, clever plumbers have realized that PVC pipe can do the job just as well, if not better. PVC pipe uses its superior properties to beat its competitors in most applications. PVC is also durable.

HOW DO YOU MAKE PVC?

- The electrolysis of salt water produces chlorine.
- The chlorine is then combined with ethylene that has been obtained from oil.
- The resulting element is ethylene dichloride, which is converted at very high temperatures to vinyl chloride monomer.
- These monomer molecules are polymerized forming polyvinyl chloride resin (PVC).

WHAT ARE THE DIFFERENT TYPES OF PVC?

- Plain PVC: These are low in cost, light and corrosion resistant.
- CPVC: CPVC means chlorinated PVC.
- UPVC: UPVC means unplasticized PVC.
- PVC-U, PVC-M and PVC-O: PVC with a dash followed by a character signifies the thickness of the pipe walls.

WHAT IS THE DIFFERENCE BETWEEN PLUMBING PVC AND ELECTRICAL PVC?

- **Electrical PVC** typically has flared ends that allows for individual **pipes** to be easily attached to one another without the use of a coupler.
- **Plumbing PVC** requires couplers and **PVC** cement to join individual pieces together.

HOW MANY TYPES OF PLUMBING PVC PIPES ARE THERE?

Two main types of Plumbing PVC pipe exist:

- schedule 40 and
- schedule 80.

The difference lies in the thickness of the pipe wall.

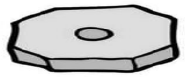
APPLICATIONS

- Economical, versatile polyvinyl chloride (PVC or vinyl) is used in a variety of applications in
- the building and
- construction,
- health care,
- electronics,
- automobile and other sectors, in products ranging from piping and siding,
- blood bags and tubing,
- to wire and cable insulation,
- windshield system components and
- more.

TOOLS & EQUIPMENT

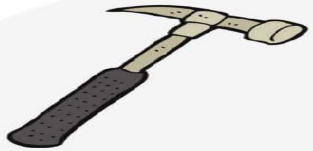

BOLT

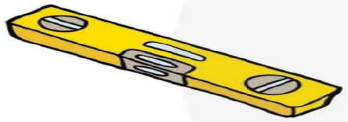

NAILS


NUT

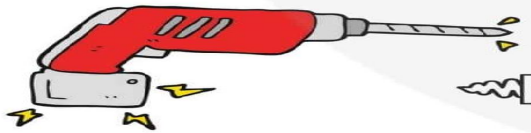

SCREWS


MALLET

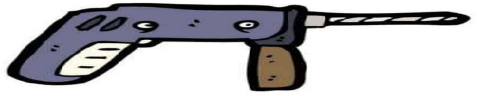

HAMMER


SPIRIT LEVEL


POCKETKNIFE


CORDLESS DRILL


BRACE


ELECTRIC DRILL


CORKSCREW


CAULKING GUN

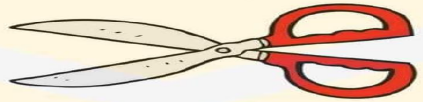

SCREWDRIVER


BRADAWL

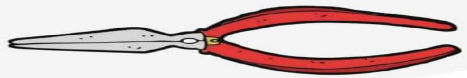

WRENCH

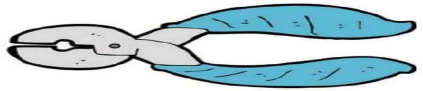

ADJUSTABLE WRENCH

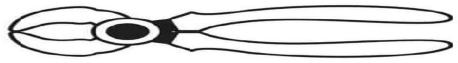

PIPE WRENCH


A PAIR OF SCISSORS

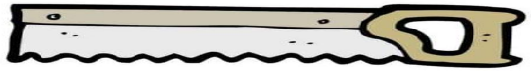

LINEMAN'S PLIERS

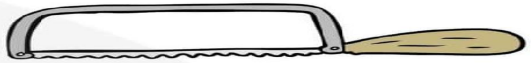

NEEDLE NOSE PLIERS


DIAGONAL PLIERS


SLIP JOINT PLIERS


HANDSAW


BACKSAW


COPING SAW

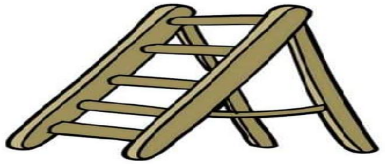

HACKSAW


CHAINSAW


TOOLBOX


TAPE MEASURE


PLUNGER


STEPLADDER

6. PLUMBING

AIM: Using the given components completely join the pieces to make the arrangement as shown in figure.

APPLICATION: Used for house hold purpose..

SUPPLIED MATERIAL:

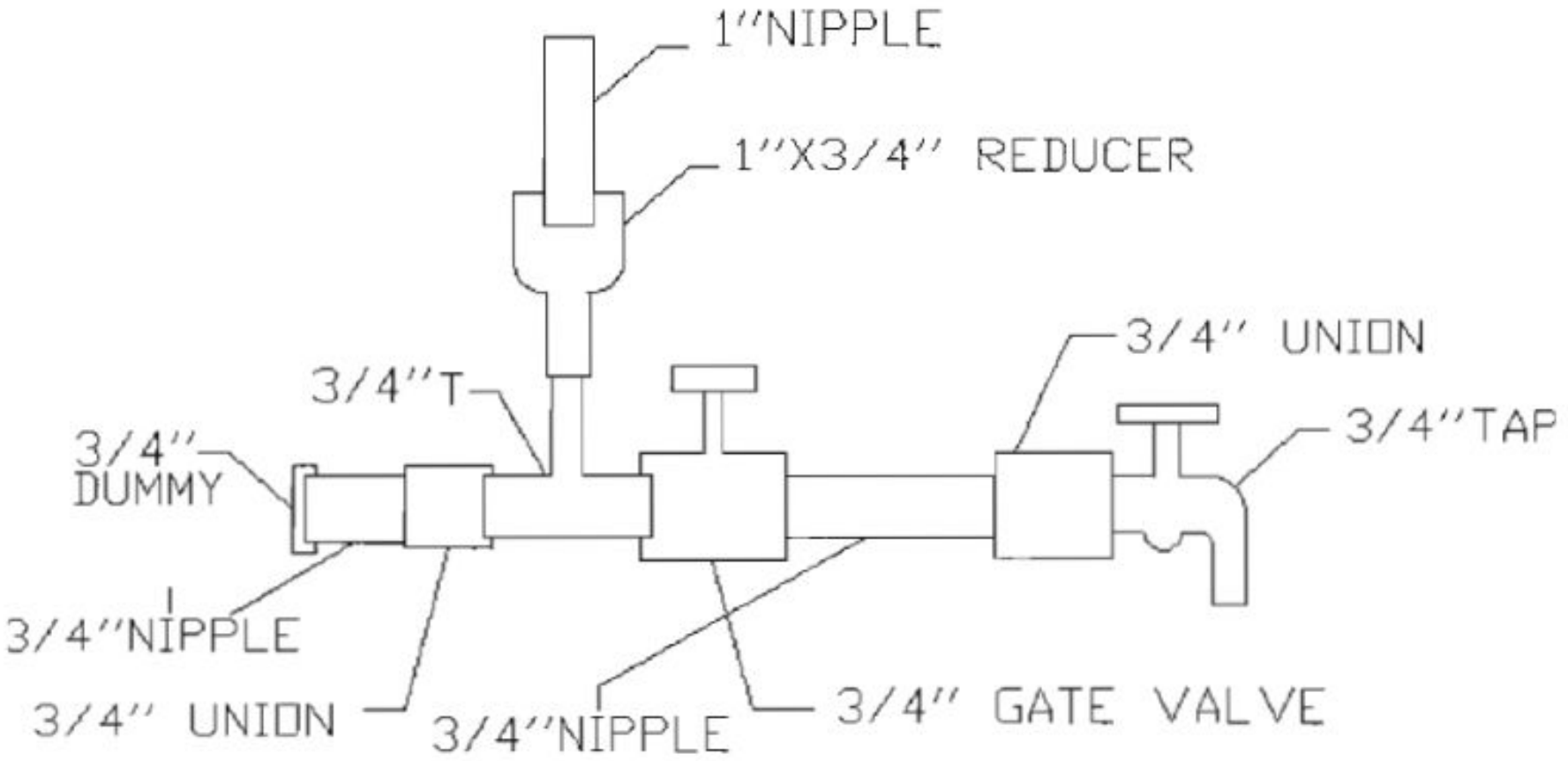
1) 1" x 6" GI pipe
2) 3/4" x 6" GI pipe
3) 1/2" x 6" GI pipe
4) 1/2" x 3" GI pipe
5) 1/2" PVC pipe tap
6) 1/2" Dummy
7) 3/4" x 1/2" reducer
8) Ball valve
9) 1/2" Steel plug
10) 1/2" Coupling

TOOLS REQUIRED:

1) Adjustable spanner.
2) Pipe Wrench.
3) Pipe Vice.
4) Double end Spanner
5) Ring Spanner.

SEQUENCE OF OPERATION:

1) Setting.
2) Joining.
3) Tightening.
4) Checking


1''NIPPLE
1''X3/4'' REDUCER
3/4'' UNION
3/4''T
3/4''TAP
3/4''
DUMMY
3/4''NIPPLE
3/4'' UNION
3/4''NIPPLE
3/4'' GATE VALVE

WORKING STEPS:

1) SETTING: Set the given materials as required in the figure

2) JOINING: The given materials are joined as required in the figure

3) TIGHTENING: The joints are tightened by using pipe wrench or Adjustable spanner or Double end spanner or all

4) CHECKING: This step is done, only to check whether there is any leakage or not.

RESULT: The pipe has been joined together as it was shown in the figure.