Draft Study Material

PLUMBER GENERAL

(Qualification Pack: Ref. Id. PSC/Q0104)

Sector: Plumbing

(Grade XII)

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Preface

Vocational Education is a dynamic and evolving field, and ensuring that every student has access to quality learning materials is of paramount importance. The journey of the PSS Central Institute of Vocational Education (PSSCIVE) toward producing comprehensive and inclusive study material is rigorous and time-consuming, requiring thorough research, expert consultation, and publication by the National Council of Educational Research and Training (NCERT). However, the absence of finalized study material should not impede the educational progress of our students. In response to this necessity, we present the draft study material, a provisional yet comprehensive guide, designed to bridge the gap between teaching and learning, until the official version of the study material is made available by the NCERT. The draft study material provides a structured and accessible set of materials for teachers and students to utilize in the interim period. The content is aligned with the prescribed curriculum to ensure that students remain on track with their learning objectives.

The contents of the modules are curated to provide continuity in education and maintain the momentum of teaching-learning in vocational education. It encompasses essential concepts and skills aligned with the curriculum and educational standards. We extend our gratitude to the academicians, vocational educators, subject matter experts, industry experts, academic consultants, and all other people who contributed their expertise and insights to the creation of the draft study material.

Teachers are encouraged to use the draft modules of the study material as a guide and supplement their teaching with additional resources and activities that cater to their students' unique learning styles and needs. Collaboration and feedback are vital; therefore, we welcome suggestions for improvement, especially by the teachers, in improving upon the content of the study material.

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Date: 20 June 2024

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Module 1	INSTALLATION OF PLUMBING FIXTURES

Module Overview
This module provides a comprehensive guide to the installation of plumbing fixtures and accessories. It highlights key considerations before installation and the process for installing wall-hung and basic plumbing fixtures. The module covers the joining of pipes and introduces advanced sensor-based fittings like faucets and solenoid ball valves. It explains the importance of valves in plumbing systems and techniques for proper alignment and elevation. Additionally, the module emphasizes the role of codes, standards, and regulations in plumbing work and introduces advanced plumbing accessories for modern systems.

Learning Outcomes
After completing this module, you will be able to: • Install plumbing fixtures, including wall-hung and basic fixtures, effectively. • Identify key considerations before the installation process. • Understand the use and installation of sensor-based fittings and advanced plumbing accessories. • Apply alignment and elevation techniques to ensure proper fixture placement.

Module Structure
1.1 Installation of fixtures 1.2 Important points before installation 1.3 Installation of Wall hang fixtures 1.4 Joining of Pipes 1.5: Installation of Basic Plumbing fixtures 1.6: Sensor Based Fittings and Fixtures 1.7: Sensor Faucet and Solenoid ball Valves 1.8 Importance of Valves 1.9 Alignment and Elevation Techniques 1.10 Codes, Standards and Regulations 1.11 Advance Plumbing Accessories

You must have seen plumbing and sanitary fittings and fixtures installed in the kitchen, bathroom or toilets of your home, school or other buildings. Many people confuse the words plumbing fittings and plumbing fixtures.

A plumbing fixture is a part that is connected to a plumbing system and carries water through a building. The most common plumbing fixtures are bathtubs, sinks, showers, tubs, toilets and faucets. While a fixture can be fixed into walls or the floor, a fitting is an item that can be hung by hook, screw or nail. Plumbing fittings various types of pipe fitting are available in plumbing systems for different purposes and functions.

A pipe fitting is used in the plumbing system to join multiple pipes of same size or different sizes, to regulate the flow or to measure the flow. They are made, up of different materials like copper, iron, brass, PVC, etc. There are many different kinds of fittings, made from a variety of materials.

Let us read a short story!

Due to some upcoming plans, I called a plumber emergently he billed me $130 for his labour and expertise.

The next day I went to the hospital. Doctor charged me $75 for 70 minutes.

Hence No Profession is below other. Each had their own importance.

We have already learned about different types of fixtures, fittings, necessary hand and power operated tools used in plumbing in Unit 2 'Basics of Plumbing' of Class XI Plumber general book. Here we will study how these fixtures are installed using different tools in plumbing system.

1.1 INSTALLATION OF FIXTURES

It refers to the act of placing or fixing in position a plumbing fixture such as a washbasin, a water closet, etc. Installation is an important step in fixing the components of a system as per the design. During the installation of plumbing system in a building, home or a housing colony, planning is done as per the standard procedure of designing. A good installation system prevents water leakage,

allows optimum installation of the money spent and enhances the life of the plumbing fixtures. Instructions for installation are given either by the manufacturer on one's own or the specifications in the construction map. If the standard procedure is followed during the installation of plumbing system, it allows for smooth and efficient functioning of the system.

1.2 IMPORTANT POINTS BEFORE INSTALLATION

Following are the points to be kept in mind before starting any installation of plumbing system:

1. **Read the plumbing drawing** - Study the drawing of the bathroom, washroom, kitchen or other places where installation is to be done. The drawing will help the Plumber General to understand various aspects of plumbing fittings, fixtures, distance and height to be maintained during installation.
2. **Install the basic sanitary fixture** - Fittings (faucets and valves) are used more often than any other part of the plumbing system. The best modern fittings selected should use chrome-plated brass as it bears the effect of water quality and has a high durability. They can be cleaned easily with soap and warm water.
3. **Protection against backflow** - The supply lines and fittings for every plumbing fixture should be installed in such a way that there is no backflow. There may be a backflow due to improper design.
4. **Access for cleaning** - Plumbing fixtures should be installed in such a way that they can have easy access for cleaning, for both the fixture and the area around the fixture.
5. **Check for alignment and setting** - The fixtures must be set level in proper alignment with the adjacent walls. As per the Indian Plumbing Association Code, a water closet, lavatory or bidet should not be set closer than 15 inches (381 mm) from its centre to any sidewall, partition, vanity or other obstruction, or closer than 30 inches (762 mm) centre-to-centre between toilets or adjacent fixtures. An 18-inch (457 mm) distance must be in front of the water closet or bidet to any wall, fixture or door. Water closet compartments should not be less than 30 inches (762 mm) wide and 60 inches (1524 mm) deep. There must be at least 18 inches (457 mm) clearance in front of a lavatory to any wall, fixture or door. A urinal shall not be set closer than 15 inches (381 mm) from the centre of the urinal to any sidewall, partition, vanity or other obstruction, or closer than 30 inches (762 mm) centre-to-centre between urinals.
6. **Make floor and wall drainage connections** - Connections between the drain and floor outlet plumbing fixtures must be made with a floor flange. The flange shall be attached to the drain and anchored to the structure. Connections between the drain and wall-hung water closets should be made with an approved extension nipple or horn adapter. The water closet must be bolted to the hanger with corrosion-resistant bolts or screws. Joints should be sealed with an approved elastomeric gasket or setting compound.
7. **Check for floor flanges** - Floor flanges for water closets or similar fixtures shall not be less than 1/8 inch (3.2 mm) thick for brass, 1/4 inch (6.4 mm) thick for plastic, and not less than

a 2-inch (51 mm) caulking depth for cast-iron or galvanised malleable iron. Floor flanges of hard lead shall weigh not less than 0.7 kg and shall be composed of lead alloy with not less than 7.75 percent antimony (a chemical element which is a brittle, silvery-white metalloid) by weight. Closet screws and bolts shall be of brass. Flanges shall be secured to the building structure with corrosion-resistant screws or bolts.

8. **Secure floor outlet fixtures -** Floor outlet fixtures must be secured to the floor or floor flanges by screws or bolts of corrosion-resistant material.
9. **Secure wall-hung water closet bowls** - Wall-hung water closet bowls should be supported by a concealed metal carrier that is attached to building the structural members so that strain is not transmitted to the closet connector or any other part of the plumbing system.
10. **Make water-tight joints -** All the joints of fixtures close to the wall or floor must be sealed to prevent water from entering or passing through. Plumbing in mental health centres In mental health centres, pipes or traps should not be exposed, and fixtures must be bolted through walls.
11. **Design of overflows** - Where any fixture is provided with an overflow, the waste should be designed and installed in such a way that standing water in the fixture will not rise in the overflow when the stopper is closed, and no water will remain in the overflow when the fixture is empty.
12. **Connection of overflows** - The overflow from any fixture should be discharged into the drainage system on the inlet or fixture side of the trap. The only exception exists in case of the overflow from a flush tank serving a water closet or urinal, which should be discharged into the fixture served.
13. **Access to concealed connections**

    Fixtures with concealed slip-joint connections should be provided with an access panel or utility space at least 12 inches (305 mm) in its smallest dimension or other approved arrangement so as to provide access to the slip connections for inspection and repair where such access cannot be provided, access doors shall not be required, provided that all joints are soldered, solvent cemented or screwed so as to form a solid connection.

1.2 INSTALLATION OF WALL HANG FIXTURES

Step 1. Install the mounting board between the studs at the proper height, using the same method as for a wall-hung flush tank.

Step 2. Attach a hanger bracket on the finished wall using the proper length of wood screws at the recommended height. The metal bracket must be level.

Step 3. Place the lavatory on the bracket and push down. Make sure the lavatory is level.

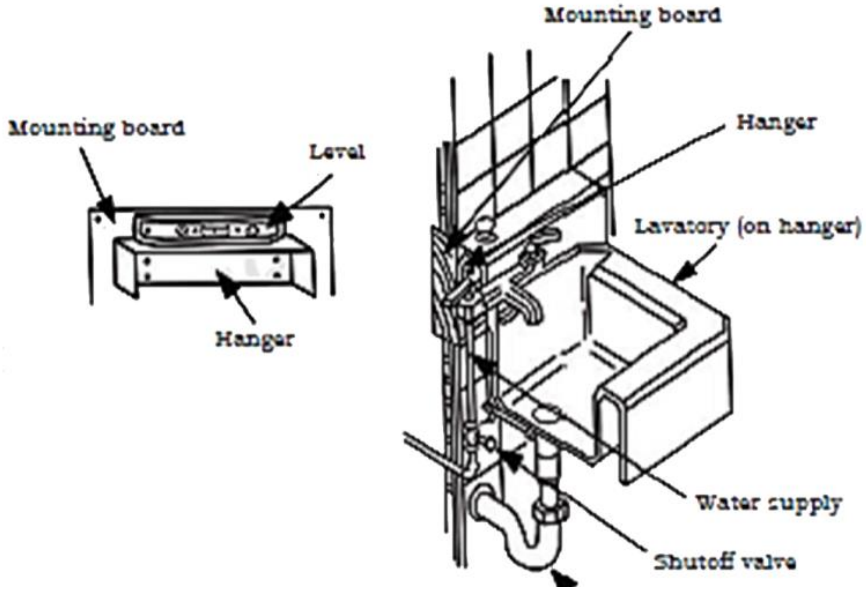
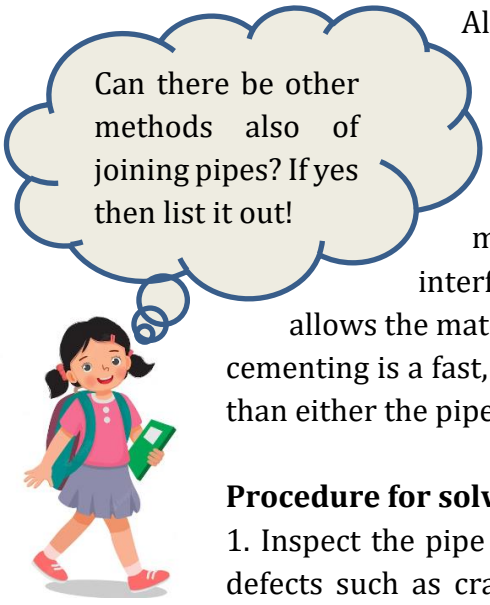


Fig 1.1 Wall Hung Lavatory installation

1.4 JOINING OF PIPES

Proper solvent cementing techniques are fundamental to the successful installation of pipes. Such techniques provide the basis for strong and durable solvent cement joints.

Solvent cementing



Also known as solvent welding, solvent cementing is a chemical process that uses a primer, or the cement itself, to soften the surface of a plastic pipe and fittings in order to weld, or fuse them together. When applied, the solvents soften and dissolve the top layer of the pipe and fitting material, loosening its molecular structure. A taper in the fitting socket creates an interference fit that ensures contact between the pipe and fitting. This allows the material to fuse to itself when the two pieces are connected. Solvent cementing is a fast, easy and highly reliable process that produces a joint, stronger than either the pipe or fitting alone.

Procedure for solvent cementing

1. Inspect the pipe and fittings for overall appearance and compatibility. Obvious defects such as cracks, burrs and incompatible materials must be addressed as required. The joining surfaces must be clean and dry. In addition, the cement for the type and size

of pipe and fittings should be determined. Also, remember both temperature and humidity may be issues to consider. Another detail that is often overlooked is the need to have the correct size applicator for the size of pipe. The size of the applicator should be about half the size of the pipe diameter in order to ensure proper and timely solvent cement coverage.

2. Cut the pipe with a cutter or saw in square to provide optimal bonding area. See Fig.1.2.

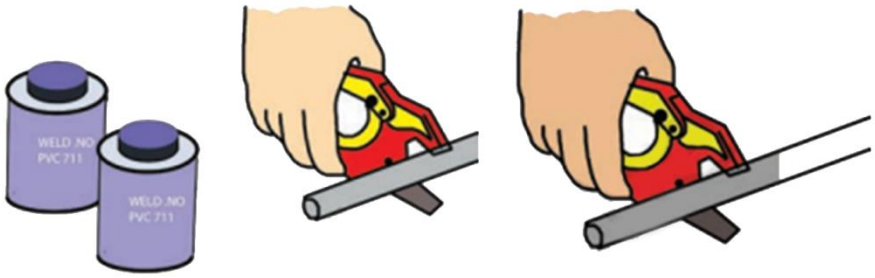


Fig 1.2 Solvent cementing is the most popular kind of Chlorinated Poly vinyl Chloride joining method

3. De-burr the pipe with a chamfering tool or file to ensure proper contact between pipe and fitting. Remove all burrs from both the inside and outside of the pipe with a knife, file or reamer. Burrs can scrape channels into pre-softened surfaces or create hang-ups inside surface walls. Remove dirt, grease and moisture. A thorough wipe with a clean dry rag is usually sufficient.

4. Apply a heavy, even coat of CPVC primer (if necessary) to the fitting. Use the right applicator for the size of pipe or fittings being joined. The applicator size should be equal to 1/2 the pipe diameter. It is important that a satisfactory size applicator be used to help ensure that sufficient layers of cement are applied.

5. Apply a heavy, even coat of primer (if necessary) to the pipe end. The purpose of a primer is to pierce through and soften the surfaces so they can fuse together. The proper use of a primer and checking its softening effect provides assurance that the surfaces are prepared for fusion in a wide variety of conditions. Check the piercing or softening on a piece of scrap before you start the installation or if the weather changes during the day. Using a knife or other sharp object, drag the edge over the coated surface.

Proper piercing has been made if you can scratch or scrape a few thousandths of the primed surfaces away. Because weather conditions do affect priming and cementing action, repeated applications to either or both surfaces may be necessary. In cold weather, more time is required.

6. Apply a heavy, even coat of CPVC cement (if necessary) to the fitting. Then apply to the pipe end. Stir the cement or shake can before using. Using the proper size applicator for the pipe size,

aggressively work a full even layer of cement onto the pipe-end equal to the depth of the fitting socket. Do not brush it out to a thin paint type layer, as this will dry within a few seconds.

7. Insert the pipe into the fitting socket, rotating ¼ to ½ turn. Hold the pipe for 10 seconds, allowing the joint to set. A merit of using plastic pipes is that if you make a mistake, you can cut the section out and re-do it.

Fig 1.3 Joining of elbow after application of solvent

8. The joining is finished. The cure (drying) time depends on pipe size, temperature and relative humidity. If local codes permit, successful joints can be made without a primer using cement alone, but extra care must be taken during the installation. It is important that a good interference fit exists between the pipe and fittings. It is for this reason that we recommend that joints being made without a primer be limited to systems 2" and smaller for pressure applications (water systems only) or 6" and smaller for drain waste vent (DWV) or non-pressure applications. Extra care must also be taken in applying the cement to make sure proper piercing (insertion) and softening of the pipe and fitting surfaces is achieved.

9. Joint strength develops as the cement dries. In the tight part of the joint, the surfaces will tend to fuse together; in the loose part, the cement will bond to both surfaces. These areas must be softened and pierced through. Piercing and softening can be achieved by the cement itself, by using a suitable primer or by the use of both primer and cement. For certain materials and in certain situations, it is necessary to use a primer. A suitable primer will usually slip into and soften the surfaces more quickly than cement alone.

1.5 INSTALLATION OF BASIC PLUMBING FIXTURE

Installing various plumbing fittings and fixtures requires different procedures for each type. Here are step-by-step instructions for installing some common plumbing fixtures:

1. **Faucet Installation:**

- Shut off the water supply to the faucet.
- Remove the old faucet, if present, by disconnecting the supply lines and removing any mounting hardware.
- Clean the sink surface and ensure it is smooth and free of debris.
- Apply plumber's putty or a silicone-based sealant around the base of the new faucet.
- Insert the faucet into the mounting holes on the sink, aligning it properly.

- From underneath the sink, secure the faucet in place using mounting nuts or brackets provided.
- Connect the supply lines to the corresponding hot and cold-water valves.
- Turn on the water supply and check for any leaks. Make sure the faucet handles operate smoothly.

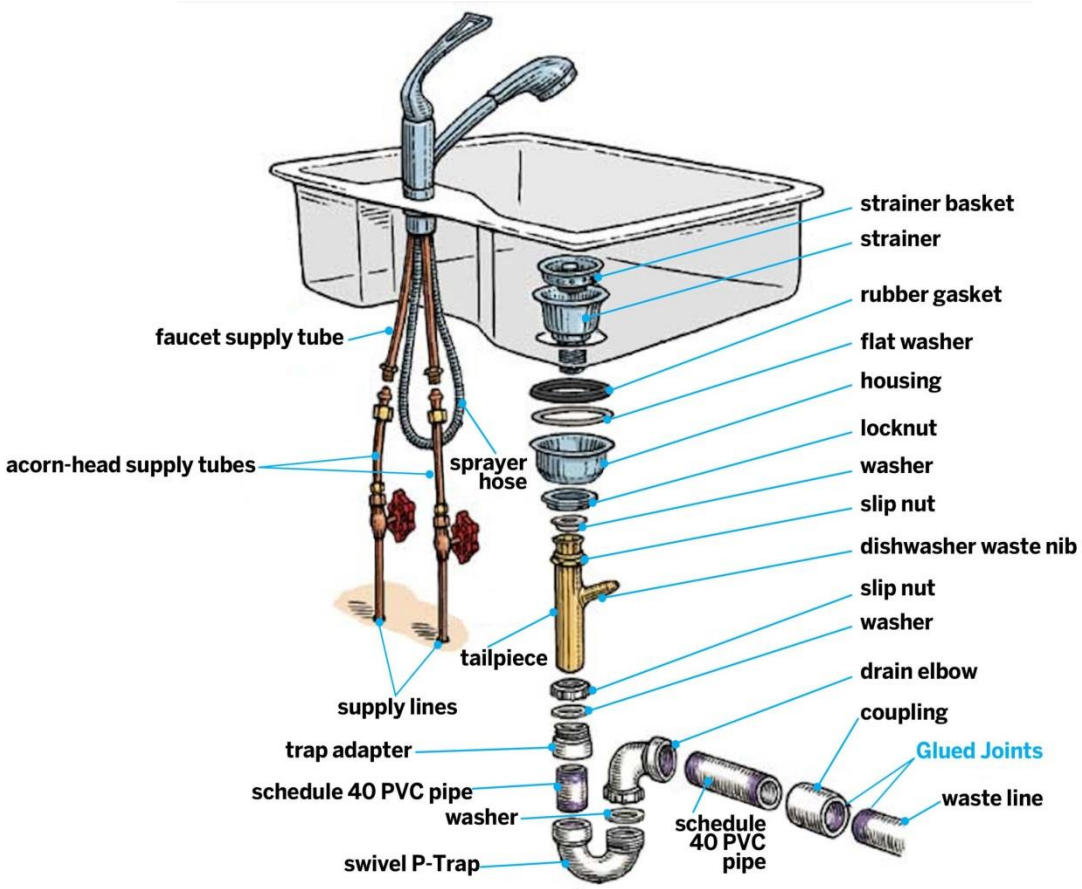


Fig 1.4 Faucet and washbasin with detailed parts

2. Toilet Installation:

- Shut off the water supply to the toilet and flush to drain the tank and bowl.
- Remove the old toilet by disconnecting the water supply line and unscrewing the mounting bolts at the base.
- Place a new wax ring or toilet gasket on the flange of the drain pipe.
- Carefully position the new toilet over the flange, aligning the mounting bolts with the holes on the base of the toilet.
- Apply downward pressure to compress the wax ring and create a seal.

- Secure the toilet in place by tightening the mounting bolts evenly.
- Connect the water supply line to the fill valve on the bottom of the toilet tank.
- Turn on the water supply and allow the tank to fill.
- Check for any leaks at the base of the toilet and around the water supply connection.

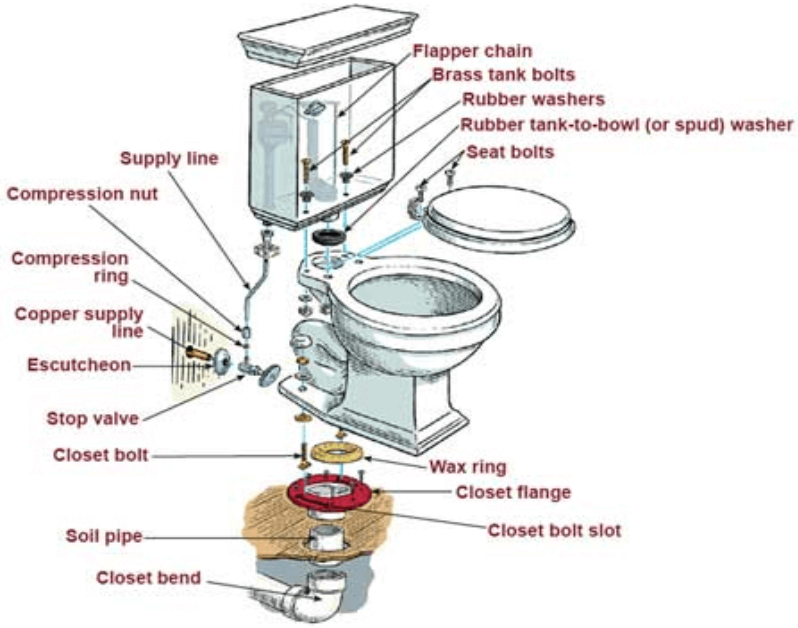
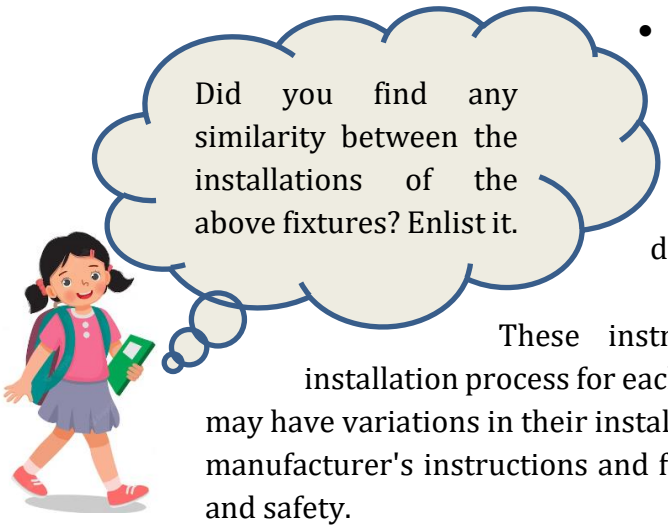


Fig 1.4 Installation of toilet

3. Shower Installation:

- Shut off the water supply to the shower.
- Remove the old showerhead, shower arm, and any existing fixtures.
- Clean the shower arm threads and apply plumber's tape to ensure a watertight seal.
- Screw the new shower arm onto the pipe, ensuring it is tight.
- Install any additional components, such as a shower diverter, valve, or trim kit, following the manufacturer's instructions.



- Apply plumber's tape to the threads of the new showerhead and screw it onto the shower arm.
- Turn on the water supply and check for any leaks at the connections.
- Adjust the showerhead angle and flow direction as desired.

These instructions provide a general overview of the installation process for each fixture. It's important to note that specific fixtures may have variations in their installation procedures, so it's always best to consult the manufacturer's instructions and follow local plumbing codes for proper installation and safety.

1.6 SENSOR BASED FITTINGS AND FIXTURES

In plumbing fittings and fixtures, various sensors can be used to monitor and control different aspects of water flow, temperature, and safety. Here are some sensor types commonly found in plumbing applications:

1. **Flow Sensors**: Flow sensors, such as turbine or paddle wheel sensors, measure the rate of water flow through pipes. They are often used in plumbing systems to monitor water usage, detect leaks, or control the flow of water in response to demand.
2. **Pressure Sensors**: Pressure sensors measure the pressure of water in pipes or plumbing systems. They are used to ensure proper water pressure, detect abnormalities or leaks, and provide feedback for regulating flow or controlling water pressure.
3. **Temperature Sensors**: Temperature sensors, such as thermistors or thermocouples, monitor the temperature of water in plumbing systems. They can be used to maintain desired water temperatures in showers, faucets, or thermostatic mixing valves.
4. **Leak Sensors**: Leak sensors are designed to detect water leaks in plumbing systems. They are typically placed in strategic locations, such as near fixtures or in areas prone to water damage, and trigger alarms or shut off the water supply when a leak is detected.
5. **Water Level Sensors**: Water level sensors are used to monitor the level of water in tanks, reservoirs, or other plumbing containers. They are often found in toilets, sump pumps, or water storage tanks to maintain proper water levels or activate pumps when needed.
6. **Backflow Sensors**: Backflow sensors detect the reverse flow of water in plumbing systems, which can occur due to changes in pressure or other factors. They are used to prevent contaminated water from flowing back into the main water supply and are commonly found in sprinkler systems or in buildings with specialized plumbing requirements.

1.7 SENSOR FAUCET AND SOLENOID BALL VALVES

A sensor faucet, also known as a touch less faucet or electronic faucet, operates through the use of motion or proximity sensors. The working principle involves the following steps:

- **Motion/Proximity Sensing**: The faucet is equipped with a sensor that detects the presence of a user's hand or object within its sensing range. This can be achieved using infrared (IR) sensors or other motion/proximity detection technologies.
- **Activation**: When the sensor detects movement or proximity, it sends a signal to an electronic control unit (ECU) located inside the faucet.
- **Water Flow Control**: The ECU controls a solenoid valve that regulates the flow of water. Upon receiving the signal from the sensor, the ECU opens the solenoid valve, allowing water to flow through the faucet.
- **Timed Flow or Shut-Off**: The sensor faucet may have a pre-programmed time duration for water flow. Once the set time elapses or when the user removes their hands from the sensing area, the ECU sends a signal to the solenoid valve to close, stopping the water flow.

Fig 1.5 Sensor Faucet

1.7.1 Solenoid Ball Valves:

Solenoid ball valves are commonly used in plumbing systems for various applications, including water supply control and automation. The basic working principle involves the following steps:

- **Solenoid Activation**: A solenoid is an electromagnetic coil that, when energized, generates a magnetic field. When an electric current pass through the solenoid, the magnetic field causes the plunger or armature within the solenoid to move.
- **Valve Operation**: The movement of the plunger or armature in response to the magnetic field either opens or closes the valve. In the case of a solenoid ball valve, the plunger or armature moves to allow or block the flow of water through the valve.

Fig 1.6 Solenoid ball valves

- **Control Signal**: The solenoid valve is typically connected to a control system or an electronic circuit. When the control system sends an electrical signal to the solenoid, the solenoid coil is energized, initiating the valve's opening or closing action.

1.8 IMPORTANCE OF TRAPS

Traps play a crucial role in sanitary fittings to prevent the entry of foul odours, gases, and pests from the sewer system into the living or working spaces. Both deep seal traps and low seal traps serve this important function, albeit with some differences.

Deep seal traps, also known as S-traps or U-traps, are commonly used in plumbing systems. They have a greater depth, which allows for a larger water seal, typically 50mm (2 inches) or more. The importance of deep seal traps includes:

- **Odour Prevention**: The water seal in deep traps acts as a barrier, preventing foul odours from sewage or drains from entering the building. The standing water in the trap forms a seal that blocks the passage of gases.
- **Pest Control**: Deep traps help deter pests, such as insects or rodents, from entering the premises through drainage pipes. The water seal acts as a physical barrier, making it difficult for pests to traverse and enter the building.
- **Hygiene and Health**: Deep traps help maintain a sanitary environment by preventing the spread of harmful bacteria, viruses, and other pathogens present in sewage or drains.

Low seal traps, also known as bottle traps or P-traps, have a shallower water seal, typically around 25mm (1 inch). While the water seal in low seal traps is smaller than in deep traps, they still provide important benefits, such as:

- **Space-Saving Design**: Low seal traps are often used in applications where vertical space is limited, such as under sinks or basins. Their compact design allows for easy installation in tight spaces.
- **Maintenance and Cleaning**: Low seal traps are relatively easier to clean and maintain compared to deep seal traps. The shallower water seal minimizes the risk of blockages caused by debris accumulation.
- **Aesthetic Appeal**: Low seal traps are available in various designs and materials, allowing for customization to match the overall aesthetic of the sanitary fittings. They can add a visually appealing element to the plumbing system.

Fig 1.7 Types of Traps

1.9 ALIGNMENT AND ELEVATION TECHNIQUES

Alignment and elevation techniques are important considerations in plumbing systems to ensure proper functionality, water flow, and structural integrity.

1. **Alignment Techniques:**

- **Straight Alignment**: Straight alignment involves ensuring that pipes, fittings, and fixtures are properly aligned in a straight line without any bends or offsets. This is important for maintaining smooth water flow and minimizing restrictions or blockages.
- **Angular Alignment**: Angular alignment refers to the proper alignment of pipes at specific angles, such as 45 degrees or 90 degrees, to accommodate changes in direction or to connect different sections of the plumbing system. It helps to maintain efficient water flow and facilitates the installation of valves, fittings, or branches.
- **Offset Alignment:** Offset alignment is used when pipes need to be shifted horizontally or vertically to avoid obstructions, structural elements, or other utilities. It allows for the plumbing system to be routed around obstacles while maintaining the required slope and alignment.
- **Vertical Alignment**: Vertical alignment is essential for drainage pipes to ensure proper flow of wastewater or sewage. Pipes must be aligned vertically to maintain the required gradient or slope for effective drainage, preventing the accumulation of stagnant water.

2. **Elevation Techniques:**

- **Sloping or Grading**: Proper sloping or grading is critical for drainage pipes to ensure the flow of wastewater away from fixtures and towards the main sewer line or septic system.

Gravity helps facilitate the movement of wastewater, so pipes are installed with a specific slope or gradient to achieve efficient drainage.

- **Vent Pipe Elevation**: Vent pipes are installed to provide airflow and prevent air pressure build-up within the plumbing system. The elevation of vent pipes is important to ensure proper venting and avoid issues such as siphoning or trap seal loss. Vent pipes are typically extended vertically above the roofline to prevent obstruction.
    - **Fixture Height Elevation**: When installing fixtures such as sinks, toilets, or showers, their height is elevated to provide proper functionality and comfort. The height of fixtures should be adjusted to meet ergonomic requirements and user convenience while ensuring proper connection to the plumbing system.
    - **Floor or Wall Penetration**: Plumbing pipes often need to pass through floors, walls, or other building elements. Proper elevation techniques are used to ensure the pipes are elevated above the floor level or properly aligned within wall cavities to maintain structural integrity and prevent water leaks.

1.10 CODES, STANDARDS & REGULATIONS

Here are some commonly referenced codes and standards applicable to the installation of plumbing fixtures in India:

1. **National Building Code of India (NBC**): The NBC provides guidelines and regulations for the design, construction, and maintenance of buildings in India. Part 4 of the NBC covers plumbing services, including the installation of fixtures, water supply, and drainage, venting, and related aspects.
2. **Bureau of Indian Standards (BIS**): BIS is the national standards body in India, responsible for formulating and maintaining standards across various industries. The following standards related to plumbing fixtures are commonly referenced:
   IS 771: Specification for Cast Iron Spigot and Socket Soil, Waste and Ventilating Pipes, Fittings, and Accessories
   IS 783: Specification for Enamel Urinals
   IS 774: Specification for Vitreous China Sanitary Appliances
   IS 976: Specification for Cast Iron Manhole Covers and Frames
   IS 1172: Specification for Water Closet Pans
   IS 2556: Specification for Plastic Toilet Seats
3. **Local Building Bylaws and Regulations**: In addition to national standards, local authorities and municipalities may have their own building bylaws and regulations that dictate the requirements for plumbing fixture installation. These bylaws may include provisions for water supply, drainage, waste disposal, venting, and accessibility.
4. **Indian Plumbing Association (IPA) Guidelines**: The Indian Plumbing Association has developed guidelines and best practices for plumbing installations in India. These guidelines

cover various aspects of plumbing, including fixtures, water supply, drainage, venting, and more.

1.11 ADVANCE PLUMBING ACCESSORIES

Advanced plumbing accessories refer to innovative and technologically advanced products used in plumbing systems to enhance efficiency, functionality, and convenience. These accessories often incorporate smart features, automation, or advanced materials. Here are some examples of advanced plumbing accessories:

1. **Smart Faucets**: Smart faucets are equipped with sensors or touchless technology, allowing for hands-free operation. They often include features like temperature control, water flow adjustment, and automated shut-off to conserve water and improve hygiene.

2. **Digital Shower Systems**: Digital shower systems offer precise control over water temperature, flow rate, and spray patterns. They typically feature touchscreen interfaces or smartphone connectivity, allowing users to customize their shower experience.

Fig 1.8 Digital Shower System

3. **Water-Saving Devices**: Various water-saving devices are available, such as aerators, flow restrictors, and dual-flush toilet mechanisms. These accessories reduce water consumption without compromising performance, helping to conserve water and lower utility bills.

4. **Leak Detection Systems**: Advanced leak detection systems use sensors or smart technology to monitor plumbing systems for leaks. They can send real-time alerts to homeowners or property managers, enabling timely detection and repair of leaks, minimizing water damage and wastage.

5. **Automatic Shut-off Valves**: Automatic shut-off valves are designed to prevent water damage in the event of a leak or excessive flow. These valves use sensors or smart technology to detect abnormal water flow and automatically shut off the water supply, helping to minimize property damage.

Fig 1.9 Automatic shutoff valves

6. **Touch less Flush Systems**: Touchless flush systems for toilets eliminate the need for physical contact, promoting hygiene and reducing the spread of germs. They utilize motion sensors or proximity sensors to detect when the user leaves and initiate the flushing process automatically.

Fig 1.10 Touch less Flush Systems

ACTIVITIES

Activity 1: Assembling and Installing a Water Supply System

Materials Required:

1. Plumbing Pipes
2. Plumbing fittings
3. A water sources
4. Measuring tape
5. Marker

Procedure:

1. Divide the students into pairs.
2. Provide each pair with a set of plumbing pipes, fittings, and a water source.
3. Instruct the students to work together to assemble and install a water supply system using the given materials.
4. Guide the students through the process, emphasizing proper techniques for measuring, cutting, and connecting pipes and fittings.
5. Encourage the students to test the system for leaks and make necessary adjustments.
6. Facilitate a discussion where students share their experiences and challenges encountered during the activity.
7. Summarize the importance of accuracy, precision, and attention to detail in plumbing installations.

Activity 2: Designing a Bathroom Layout

Materials Required:

1. Graph paper

2. Rulers
3. Pencil
4. Markers

Procedure:

1. Provide students with graph paper and rulers.
2. Explain the basics of bathroom layout design, including the placement of fixtures, water supply lines, drainage systems, and ventilation.
3. Instruct the students to design a bathroom layout, considering factors such as available space, functionality, and accessibility.
4. Encourage them to incorporate advanced plumbing fixtures and sustainable plumbing practices into their designs.
5. After completing their designs, ask the students to present and explain their layouts to the class, highlighting the reasoning behind their choices.
6. Facilitate a discussion on the importance of proper planning and design in plumbing installations, considering factors such as code compliance, user comfort, and efficiency.

CHECK YOUR PROGRESS

A. Answer the following

1. List out the important points to be kept in mind before installation in plumbing.
2. How plumbing pipes are joined?
3. Write the steps to install:
   a. Faucet
   b. Shower
4. What do you mean by Solenoid Ball Valve?
5. Explain the types of traps.

B. Fill in the blanks

1. The ECU controls a …….. valve that regulate the flow of water.
2. ……seal traps are also called U Traps.
3. …….. seal traps are knowing as P traps.
4. …….. provides guidelines and regulations for the design, construction, and maintenance of buildings in India
5. Automatic……valves are designed to prevent water damage in the event of a leak or excessive flow.

Module 2	TROUBLESHOOTING AND MAINTENANCE FOR PLUMBING

Module Overview
This module focuses on identifying and addressing common plumbing issues. It explains the sources of leakage and provides remedies, including temporary repairs for minor leaks. The module covers the causes and effects of scale in plumbing systems and methods to handle water system stoppages. It also discusses the maintenance and troubleshooting of lavatories, sinks, and water closets. Additionally, the module introduces common organizational policies that guide plumbing practices.

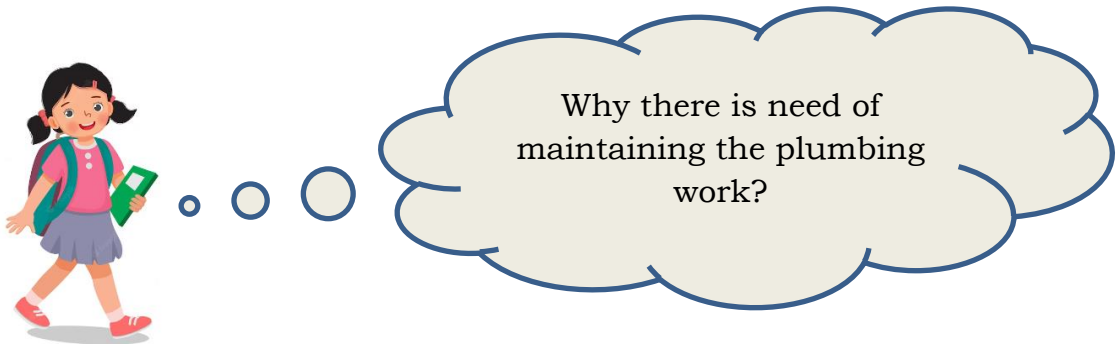
Learning Outcomes
After completing this module, you will be able to: • Identify common sources of leakage in plumbing systems. • Apply appropriate remedies and temporary repair methods for minor leaks. • Understand the causes and effects of scale and methods to address it.

Module Structure
2.1 Sources of leakage 2.2 Remedies 2.3 Temporary Repair for Minor leaks 2.4 Scale 2.5 Water System Stoppages 2.6 Water Closet Stoppages 2.7 Lavatories and Sinks 2.8 Common Organization Policies

A water leak can cause a major disturbance in the plumbing system. Leaks from water pipes, plumbing fixtures and fittings are a sizeable source of water wastage in our homes. Sometimes, considerable water leakages from the system may cause problems related to pressure molding and significant water losses. Thus, as soon as a leak is found, its repair becomes an absolute necessity.

When you find a leakage in the plumbing fixtures, it is necessary to repair it as soon as possible to avoid damage to structures or surroundings, and to possibly make it cost effective in the long run.

Some leaks can be visible, and some cannot be seen with the naked eye. The result could be an unusually high-water consumption, which will also reflect in your water meter.



So, what causes a plumbing leak?

Old pipes, cold climate and other old plumbing fittings and fixtures like geyser and toilets may also cause leaks. How do you detect the point of leakage? First, check those areas where leaking in fixtures is common, that is, joints. If the leak is inside the house, check the toilets, sinks, faucets, and showerheads. It is possible that the leak is minor enough for you to notice it. Leaking toilets and kitchen faucets are the most common and most unnoticed leaks.

Even when you cannot see a leak in the pipes, you might be able to hear or observe it. Move slowly to each and every point of the distribution system, starting from the lowest level and working your way up. Listen to the pressurized sound of water or dripping. Look for a small pool of liquid or water stain under the floor or up on the ceiling. Water damage on wood panelling, cabinets, drawers, or wallpaper can all be signs of an 'invisible' leak too.

If the leak is from outside, we can check the spigots. Double check to make sure they are fully tightened. Listen for the sound of dripping or running water. Underground leakage can be found by a wet surface or swelled surface due to excessive moisture.

If you think you have found the leak and can get to it, you could try to fix the problem. Most toilet and faucet leaks can easily be fixed by replacing the O-ring or tightening the fixtures. If you can reach a fractured pipe, you could apply the plumber's tape as a temporary solution until you have the chance to change the pipe.

The various sources of visible and invisible leaks along with remedies have been discussed in this module. If you find any of these, you will have to take immediate action to replace or repair before any further damage occurs.

2.1 SOURCES OF LEAKAGE

2.1.1 Water supply line leaks

Sometimes, there are leaks in the water supply line coming to home from the meter. These are often difficult to detect because the supply pipe is usually buried at least 3 feet below the ground. Sometimes, the leaking water will travel along the pipe.

Another common exact point for the leaking water might be where the supply line rises above the ground and enters the house or building. If the soil is constantly damp at these locations, it might indicate a leak.
In case of sewer leaks, the water will seep towards the ground surface, usually directly above the path of the underground pipe.

2.1.2 Leaks due to pipe corrosion

Pipe corrosion is a process that results in a reduction of thickness of the wall of a metal pipe, caused by electrolysis (chemical breakdown by electric current), junk, or acidity of water. Galvanic corrosion (resulting from a direct current of electricity) is created in a plumbing installation system in which two different kinds of metal pipes are joined, such as galvanized and copper pipe.
The principal indication of corrosion might be a leak in the framework inside the walls or floors of the structure. Water may appear a few dimensions beneath the leak. Use a piece of wood as a resonator to recognize and amplify the sound of the leak. Spot one end of the wood against your ear and the opposite end against the pipe and follow the sound. There will be sounder while drawing nearer to the leak.

2.2 REMEDIES

A. Galvanized pipes

After locating the leak, cut and replace the corroded pipe:
Step 1. Close the water at the nearest valve below the leak, and drain the pipe.
Step 2. When the fittings on both sides of the leak are not readily available, cut out the leaking section. One plumber should hold the pipe with a wrench to prevent its turning in the adjoining fitting, while another plumber cuts a thread on it.
Step 3. Replace the cut-out section with a desired coupling, a pipe section of the given length, and a similar union.

B. Copper pipes

Copper pipe resists corrosion, except when attacked by acids. However, if a leak occurs in the copper pipe, then the steps listed below must be followed.
Step 1. Close the water at the nearest valve below the leak, and drain the pipe.
Step 2. Replace it with either soldered or compression joints.
We can also go with some more alternatives before and after, to prevent leakage. It can also be achieved by reducing corrosion. The following can be done to reduce corrosion.

- **Use of di-electric unions**
  These are fixed in the hot and cold-water take-offs from the tank and it reduces the galvanic corrosion of water tanks. A di-electric union consists of a fibre washer, which shields or

insulates the tank from the rest of the plumbing installations, preventing the flow of current from the tank to the system.

- **Use of magnesium rods**
  These are also used in a few geysers, such as the gas operated type, to save against rust and corrosion. They act as electrolytic cells in which the magnesium dust goes into the solution, flows through the water, and is stored on the metal to be protected. The electrolytic action (electrolysis) diffuses the rods. The maximum life of the rods is 1½ years; then they must be changed.

C. Leaks in Valves and Faucets

All valves should be checked regularly for leaks. Most leaks are from washers or bonnets.
A faucet is a device that allows you to turn the flow of water on and off. Since faucets help dispense water, thus, keeping them in working condition is very important. The typical causes for a leaky faucet include corrosion, mineral deposit on the internal parts or defective gaskets, O-rings or washers. Before repairing any faucet, drain it by turning the water off at the fixture of the shut-off valve.

- **Compression faucets** - These faucets have separate hot and cold water handles and their action requires you to tighten the handle down to turn the water flow off. Such faucets use a compression stem, which is a type of screw with a washer at the end of it pressing against a valve seat. While repairing compression (or washer) faucets, first check the valve seat. If it is chipped or rough, reface it with a refacing tool or replace it.

Use the following procedures to repair single compression faucets. During disassembly, check all parts for wear and replace as needed.

1. **Leak at the stem and the packing nut and washer**

Step 1. Turn the water supply off at the shut off valve, and remove the cap, screw and handle.
Step 2. Remove the packing nut with a wrench, the old packing material and the washer.
Step 3. Place a new washer onto the stem's lower end, and reassemble all parts in order.
Step 4. Turn the water supply on and check for leaks and proper operation.

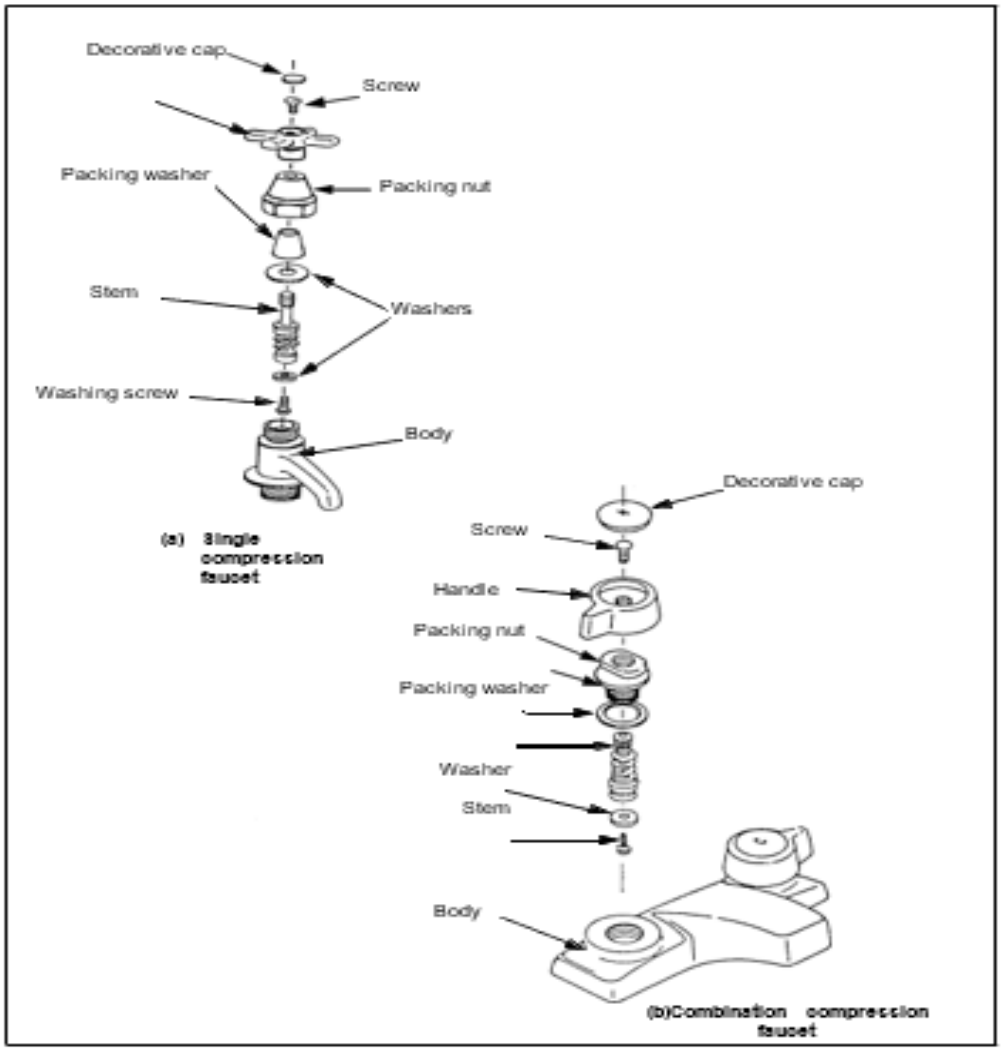


Fig 2.1(a, b) Components of faucets

What can be preventive measures to stop leakages in pipes?

2. Leak at the spout

Step 1. Turn the water supply off at the shut-off valve. Remove the cap, screw and handle.
Step 2. Remove the packing nut with a wrench; then remove the stem from the body.
Step 3. Remove the screw and washer from the bottom of the stem.
Step 4. Place a new washer onto the bottom of the stem.
Step 5. Check the valve seat inside the body. If it is chipped or rough, reface the seat with a refacing tool. If the seat is even, place the stem into the body. Replace if needed.
Step 6. Reassemble all the parts in the proper order.
Step 7. Turn the water supply on and check for leaks and proper operation.

3. Leak at the base of the body

Step 1. Turn the water supply off at the shut-off valve. Remove the cap, screw and handle.
Step 2. Remove the packing nut with a wrench.
Step 3. Remove the worn washer from the packing nut.
Step 4. Slide a new washer into the packing nut for a snug fit.
Step 5. Reassemble the parts in the proper order.
Step 6. Turn the water supply on and check for leaks and proper operation.

NOTE: Before repairing a faucet, drain it by turning the water off at the shut off valve. During disassembly, check all parts for wear and replace as needed.

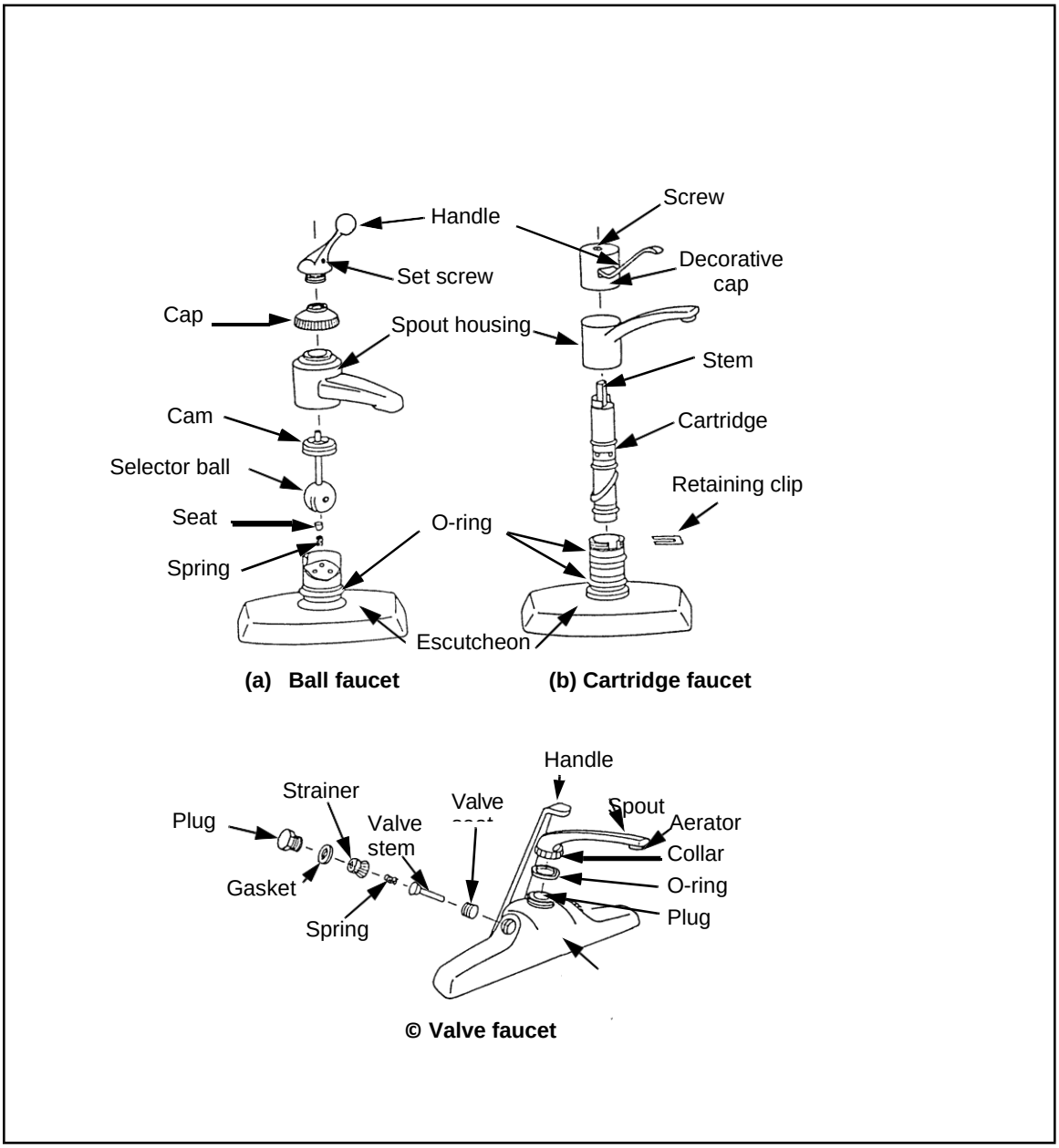


Fig 2.2(a, b) Components of faucets

- **Non-compression faucet repairs**

1. Ball faucets

Commonly used in kitchen sinks, these washers less faucets can be identified by their single handle that regulates a special plastic or metal ball inside the faucet body. Because of the number of parts which make up this type of faucet, ball faucets tend to leak more than other washer less faucets such as cartridge or disk faucet. Leaks in this type of a faucet can be caused by a corroded or gouged selector ball or by worn rubber valve seats.

Step 1. Remove the handle by loosening the set screw.
Step 2. Remove the cap and pull out the ball with the cam assembly.
Step 3. Use needle nose pliers to remove the two rubber valve seats and springs.
Step 4. Replace the rubber seats and/or the selector ball.
Step 5. Reassemble the faucet, ensuring that the slot in the ball aligns with the metal protection on the housing. Check for leaks.

2. Metal cartridge faucets

Such faucets look quite identical to a compression washer faucet. However, the action to turn off the water flow is smoother and more consistent in such faucets. The faucet turns off without additional pressure being required as in case of a compression faucet. Leaks in these faucets are usually caused by two O-rings in the faucet body. Replacing the O-rings should eliminate the leaks.
Step 1. Remove the screw and push a screwdriver down the hole to keep the stem in place while removing the handle and cover.
Step 2. Unscrew the retaining nut and remove the spout. The body of the faucet is exposed to get to the O-rings.
Step 3. Replace the O-rings.
Step 4. Reassemble the faucet and check for leaks.

3. Ceramic-disk cartridge faucet

Such faucets can be identified by their single lever over a wide cylindrical body. The disk faucet mixes hot and cold water inside a mixing chamber. Such faucets generally use in up-down motion to regulate water flow and left-right motion to control temperature. In the ceramic disk, leaks are caused by a worn out or corroded disk.
Step 1 Press the tile handles all the way back to remove the set screw.
Step 2 Remove the handle and the two set screws under the spout.
Step 3 Disengage the stopper mechanism under the lavatory and remove the ceramic cartridge, which is held by two brass screws.
Step 4 Replace the cartridge.
Step 5 Reassemble the stopper mechanism and the faucet. Check for leaks.

NOTE: If the faucet malfunctions due to corrosion or wear, use the manufacturer's instructions to make repairs.

4. Valve faucets

Leaks in this type of faucet can be caused by a worn O-ring at the base of the spout or by other worn internal parts. See Fig. 2.2(c).
Step 1 Remove the spout and lift off the escutcheon. Remove the plugs on each side by turning them counter clockwise and pulling out the gasket, strainer, spring, valve stem, and valve seat.

Step 2 Remove the seat with a seat-removal tool or Allen wrench.
Step 3 Reassemble the faucet and check for leaks.

5. **Shower heads**
   It is one of the main components of a shower that allows water to dribble through it. Shower heads deteriorate due to the following reasons:

1. **Mineral build-up:** This causes clogging, resulting in reduced water pressure.
2. **Rust and leak**: This reduce the life of the shower head, leading to reduction in pressure and unnecessary dripping. This creates the need to replace or repair the shower head.

Procedure for changing shower heads

1. **Turn off the water**—First; turn off the main pipeline, which is normally located at the basement towards the front of the home or near the water tank.
2. **Clean the shower arm**—Use a toothbrush to clean the shower arm's threads.
3. **Install the shower arm**—Wrap the head of the shower arm in Teflon or pipe-thread tape and screw it into the pipe opening in the wall or ceiling.
4. **Prep the shower arm**—Slide the backing onto the shower arm and wrap the open end in tape.
5. **Install the shower head**—Screw on the shower head by hand until it is snug. Wrap the shower arm and head in rags and use adjustable wrench to tighten the shower head further.

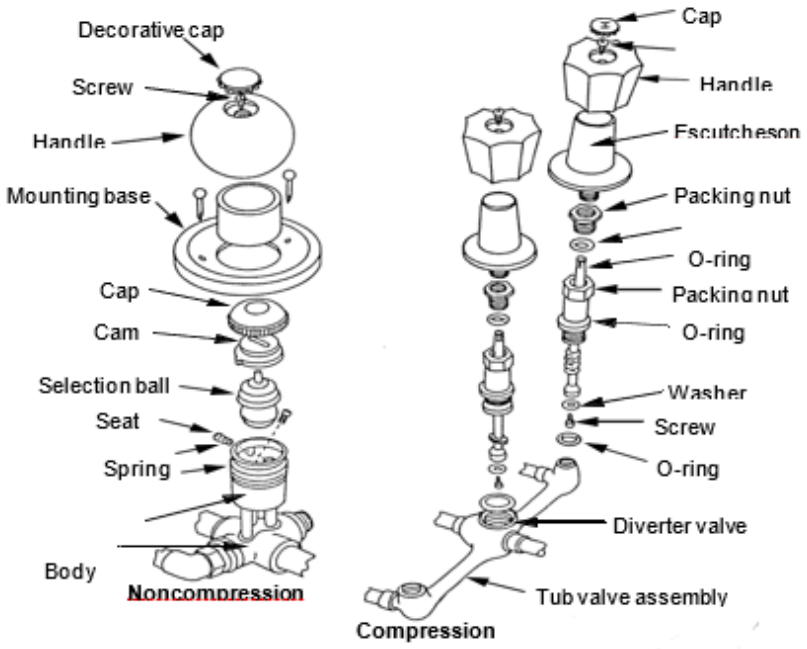


Fig 2.3 Bathtub and Shower faucet

6. Shower faucets

These faucets function the same as compression and non-compression faucets on sinks and lavatories. Although bathtub and shower faucets are developed differently than sink and lavatory faucets, yet the repairing methods are similar. Showers use various types of faucets. These include—

1. Single-handle/single valve faucet
2. Double-handle faucet
3. Three-handle faucet

1. Single-handle/single valve faucet

Single-handle faucets are commonly used. Valve cartridges in faucets are cylindrical devices that use O-rings to control the flow of water. Replacement is the easiest way to fix cartridge-related problems. The procedure to replace single-handle faucet is given here:

1. Turn off the water.
2. Locate the set screw under the handle or cap at the front of the unit. Remove the screw and pull.

3. Use a screwdriver to remove the retainer clip at the top of the cartridge housing. Be sure not to lose this piece.
4. Remove the cartridge by gently pulling with pliers.
5. Take the old cartridge to the hardware store to ensure you get the right replacement. Cartridges are specific to faucet make a model.
6. Insert the new cartridge.
7. Replace the retaining clip and reassemble your faucet. Turn the water back on to make sure your faucet does not leak.

Fig 2.4 Single Valve Faucet

2. Two-handle faucet

These faucets also have a mechanism that uses threaded handles and rubber seals to open and close water lines (Fig. 5.5). Installing a new stem is the easiest way to fix a malfunction, but we can also replace faulty hardware like seals and O-rings.

Fig 2.5 Two handle faucet

3. Three-handle and diverter faucets

These faucets have temperature stems (hot and cold handles) and diverter stems (Fig. 2.6). The procedure for repair has been discussed below.

Fig 2.6 Three handle faucet

Temperature stems

We can fix temperature stem issues the same way, we would a two-handle faucet.

1. Pry away the index cap at the front of the handle to access the handle screw. Remove the screw and pull. Use a handle puller if it is stuck. Use pliers or a deep-socket wrench to gently turn the stem counter clockwise.
2. Wrap Teflon tape around the base of your stem and screw it into place.
3. Replace the handle hardware.

Wall diverter stems

This is usually the third handle in a three-handle valve. Replacing the faulty diverter valve is the easiest way to solve the problem. The steps to replace are given here.

1. Remove the cap and handle as in the single handle guide. Gently remove it, being careful not to mar the finish.
2. With a socket wrench, remove the old valve.
3. Wrap Teflon tape around the threads of the new valve, leaving the first few threads bare to ensure a grip.
4. Insert the new diverter and give it an extra quarter turn after it is tight. Do not force it.
5. With the handle, turn it and test the water to make sure it only comes out of where it is supposed to. This is also a good time to shine a flashlight into the valve and make sure there are no leaks.
6. Reassemble the diverter handle.

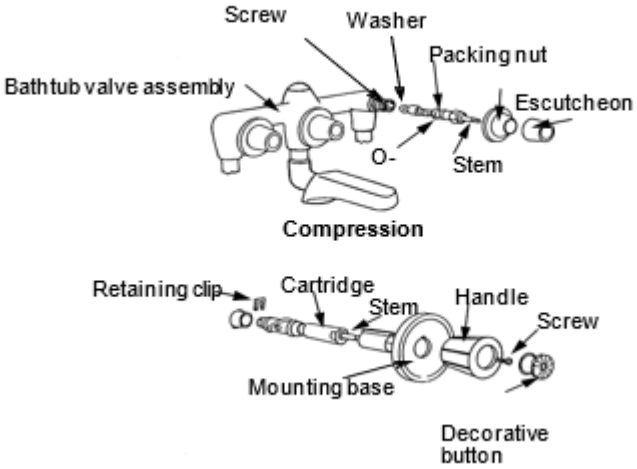


Fig 2.7 Bathtub faucet Breakout

It is important to ensure you routinely monitor any minor water leaks at home. This will prevent damages that will be costly to repair as well as lower our water bill. If you still cannot repair leakage

due to severity of damage and it is required to stop leakage on urgent basis, we might look for some of the temporary repairs.
Remember to not risk a serious injury in trying to inspect or repair it.

Repair of bathtub faucet
The following steps are to be followed for the repair of a bathtub faucet.
1. Disassemble the faucet—Removing the faucet handle is a difficult task. Due to corrosion, the handle gets jammed or weld the handle to the stem. Close the water supply to the faucet and open the valves to drain excess water present in faucet or tap. With the help of a thin blade of a pocketknife loosen the handle screw.

2. Remove the handle screw—Remove the handle screw. Then give a little jerk to the handle and pull it off. However, be gentle; if it is too hard, it may break, use a gentle push.

3. Loosen the handle—When the handle is not able to come out and we use force, it may break. Thus, use a special handle puller. Rotate the handle screw about halfway back into the stem. Fix the handle puller's post against the screw head and press the arms together behind the handle. Turn the post clockwise until the handle pops loose. Remove the handle screw and handle. Then pull off or unscrew the escutcheon plate.

4. Remove the stem—When the handle is removed, unscrew the escutcheon and stem assembly. The stem assembly is an important component which controls the amount and temperature of the water dispensed through the tub spout or shower head. The stem assembly is removed with a special bath socket wrench. Fix the bath socket with the stem bonnet and turn it counter clockwise so that it gets loosened. Unscrew and remove the stem.

5. Use a seat wrench—As, you understand that leaks usually occur for two reasons, first the seat washer stiffens and would not seal properly. Sometimes, the water pressure gradually erodes the brass rim of the seat. Replace the seat using a special seat wrench.

6. Replace the faucet stem parts—Change the broken washer and apply.

- **Frozen pipes**

  Water supply lines may freeze when exposed to temperatures below zero degrees Celsius. Outside pipes must be buried below the frost line. In northern zones, this may be 4 feet or more. If the temperature of a building deviates below freezing, inside pipes may also freeze, causing the pipe to break at the lowest point. Procedures for thawing above- and below-ground pipes are discussed in the paragraphs below.

- **Exposed pipes**

A blowtorch is the best method to thaw the aboveground pipes, but there is a risk of fire. Use the following steps when using a blowtorch.

Step 1. Open the faucets in the line.

Step 2. Apply heat from the blowtorch at one end of the pipe and work along the entire length of the pipe.

Step 3. Continue to heat the pipe until the water starts to flow freely.

Pipes can be thawed by wrapping them with burlap or other cloth and pouring boiling water over the wrappings, thus transmitting heat to the frozen pipe. When internal freezing is due to a failure in the heating plant, the heating plant must be repaired; a high temperature should be maintained in the building until the pipes thaw.

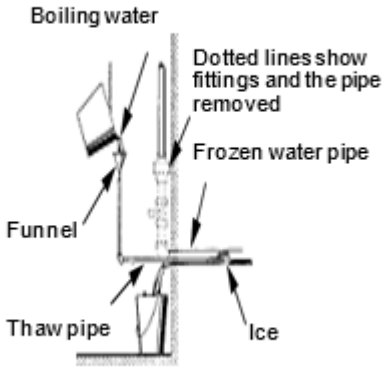


Fig 2.8 Thawing Frozen Pipe

Note: Do not overheat as the solder joints will break loose when the solder melts.

- **Underground pipes**

Use the following steps to thaw a frozen underground pipe.

Step 1. Remove the pipe fittings.

Step 2. Place a small warm up pipe or tube into the frozen pipe.

Step 3. Add an elbow and a piece of vertical pipe to the outer end of the warm up pipe.

Step 4. Keep a bucket below the opening to the frozen pipe

Step 5. Insert a funnel into the open end of the vertical pipe.

Step 6. Pour boiling water into the funnel and as the ice melts, push the thaw pipe forward.

Step 7. After the flow starts, withdraw the pipe quickly. Allow the flow to continue until the thaw pipe is completely withdrawn and cleared of ice.

NOTE: A small pump may be used to clear a piece of pipe. However, excessive pump pressure can cause a backup; therefore, this procedure must be carefully monitored.

2.3 TEMPORARY REPAIRS FOR MINOR LEAKS

Minor leaks in a fixture require temporary or emergency repairs. Before making any repairs, turn off the water and relieve the pressure from the distribution system. Pipes can be temporarily repaired using the following steps:

- **Rubber hose or plastic tubing**

  Cut the pipe on either side of the leak with a hacksaw or pipe cutter. The section damaged pipe may be removed and replaced with a similar length of rubber hose or plastic tubing. To do this, slip the ends over the pipe and fasten them with hose clamps. The inside diameter of the hose must fit the outside diameter of the pipe.

- **Sheet rubber**

  Wrap the leaking area with sheet rubber. Place two sheet-metal clamps on the pipe (one on each side). Then, fasten the clamps with nuts and bolts.

- **Electrician's friction tape**

  Wrap several layers of friction tape around the hole or crack, extending the tape about 2 inches above and below the leak.

- **Wood plugs**

  Small holes can be filled with wood plugs. Drive a wooden plug into the hole after it is drilled or reamed. The plug will swell as it absorbs water, preventing it from being blown out by water pressure.

NOTE: It is always recommended that repair should be made as soon as possible to permanently replace the broken, weak or defective part. Replace it with a unit (and insulation if used) that is the same size and quality as the original installation.

2.4 SCALE

It is a deposit that is typically indicative of hard water. Scale can sharply reduce the flow of water to the fixtures. Calcium and magnesium compounds are found in hard water which prevent soap from lathering. This forms a scum, which slows down the flow of water. The scum deposits harden and form scale.

Reducing scale

In localities where water is unusually hard, a water softener is used to reduce the hardness. The softener normally contains zeolite, which should be recharged at regular intervals. Add sodium chloride (table salt) to the water to recharge. Water softeners are programmed to recharge at a set time each day. The softened water is then piped into the distribution system.

Removing scum

- To remove scum that has formed on the inside of a pipe, do one of the following.
- Flush with hot water.

- Use lye, or lye mixed with a small quantity of aluminum shavings. Only cold water should be used with lye.
- Replace the entire pipe when there is a sharp reduction of water flow.

NOTE: Chemical cleaners should not be used in pipes that are completely stopped up because the cleaners must come in contact with the stoppage directly.

2.5 WATER SYSTEM STOPPAGES

A common problem in waste systems is a stoppage of waste. This stoppage can occur in any drain, like, floor drain, branch line, or main line. It can be due to stone, pulp, hair, grease, or other foreign matter that holds back or stops the flow of waste disposal. Use the path clearing tools to clear the stoppages in water closets, lavatories sink, urinals, bathtubs, shower drains, branch, main waste lines, and grease traps.

(a) Force Up Plunger

(c) Cleaning the basin with a snake

(b) Water closet snake

Fig 2.9(a, b and c) Stoppage cleaning tools

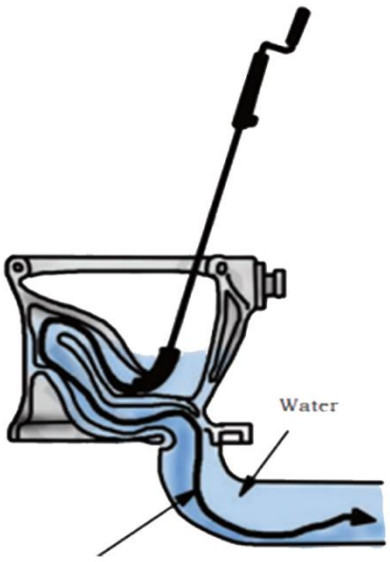


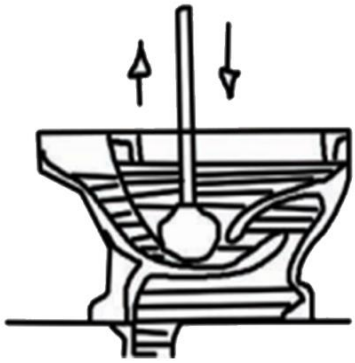
Fig 2.10 Cleaning the toilet with a snake

2.6 WATER CLOSET STOPPAGES

Such stoppages can be cleared using the following tools.

1. **Force-cup plunger**
   Following are the steps to clear stoppages with a force cup plunger.
   Step 1. Pump the plunger up and down until the water level drops.
   Step 2. Place toilet paper in the bowl and flush the water closet to check if the stoppage is cleared.

2. **Water closet snake**
   It is a long coil of wire with a corkscrew line tip that is inserted into the pipes till it reaches the stoppage. The following steps can be used to clear stoppages with a water closet snake.
   Step 1. Push the snake into the bowl and turn the handle clockwise with a push-pull action until the water level drops.
   Step 2 Check to see if the stoppage is cleared as in step 2 (like in the force-cup plunger above).



(a)Cleaning the toilet with a force up plunger

(b)Cleaning the toilet with a snake

Fig 2.11Cleaning the water closet stoppages

2.7 LAVATORIES AND SINKS

Clearing lavatory and sink P-trap stoppages

- **Plunger**

Step 1. Place a wet rag in the bowl's overflow opening. If the lavatory has a pop-up plug, remove the plug.
Step 2. Set a plunger over the waste outlet and push it up and down until the water completely drains out of the bowl.
Step 3. Remove the rag from the overflow opening and replace the pop-up plug, if necessary.
Step 4. Run water through the drain to ensure that the stoppage is removed.

- **Snake (¼- to ½-inch)**

Step 1. Remove the plug if the lavatory has a pop-up plug.
Step 2. Push the snake down into the waste outlet as far as it will go.
Step 3. Use a push-pull and turning action until the water completely drains out of the bowl.
Step 4. Remove the snake and replace the pop-up plug, if applicable.

NOTE: Stoppage in a P-trap can be removed by disassembling the P-trap, then removing the stoppage. Reassemble the P-trap after the stoppage is removed and flush with water to ensure good drainage of water.

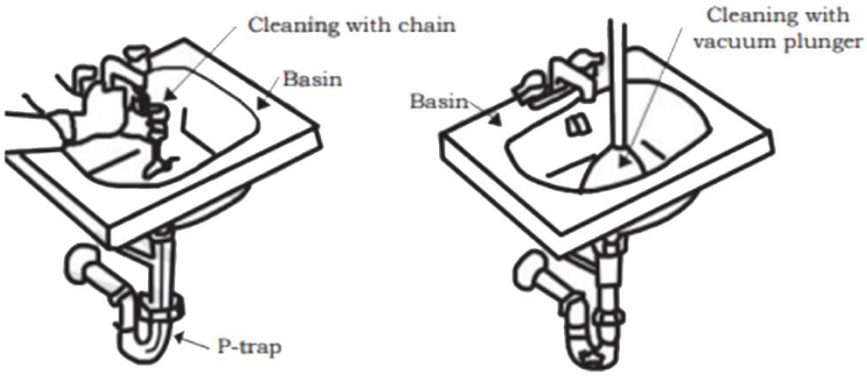


Fig 2.12 Cleaning lavatory and sink stoppages

2.6.1 Clearing stoppages beyond the P-trap

- **Lavatory and sink drain line using Snake**

Step 1. Place a container under the P-trap to catch the water spillage, then disassemble the P-trap.
Step 2. Push the snake into the drain line, turning it with a push-pull action until it moves freely.
Step 3. Remove the snake and replace the P-trap, then run water through the drain line to ensure that the water flows freely.

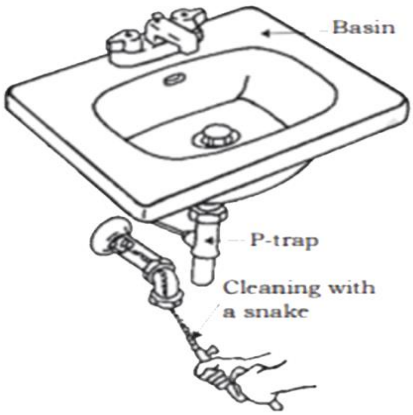


Fig 2.13 Cleaning lavatory and sink stoppages beyond P-Trap using snake

- **Urinals**

A stoppage in a urinal with a water seal or an exposed P-trap is cleared the same as a lavatory (using a plunger and a ¼- to ½-inch snake)

- **Bathtubs**

Use the steps below to clear bathtub P-trap stoppages.
Step 1. Remove the stopper linkage and the overflow cover.
Step 2. Push a ¼- to ½- inch drain snake into the overflow opening until it meets some resistance.
Step 3. Turn the snake using a push-pull motion until it turns freely.
Step 4. Remove the snake and run water through the drain to check if the stoppage is cleared.
Step 5. Replace the overflow cover and linkage.

NOTE: Stoppages can often be removed with a vacuum plunger. Try a plunger first; if the plunger does not work, use a snake.

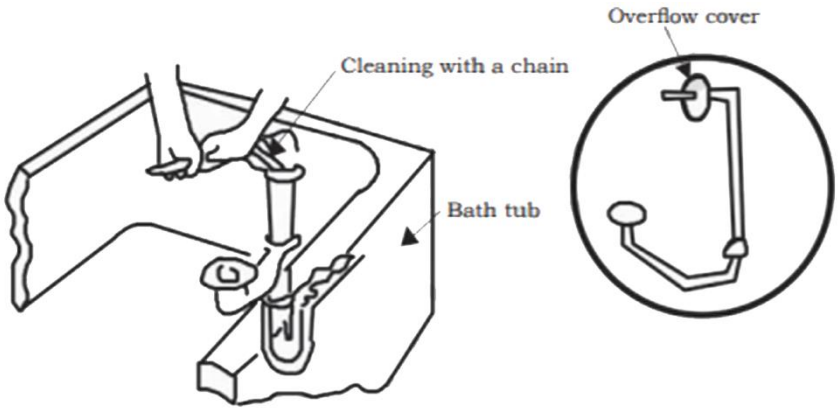


Fig 2.14 Cleaning Bathtub P-trap stoppages

- **Bathtub drum-trap stoppages**

Use the following steps to clear drum-trap stoppages
Step 1. Remove the drum-top cover and gasket and push a ¼- to ½- inch snake into the trap's lower line to search for the stoppage.
Step 2. If a stoppage exists, clear it.
Step 3. If there is no stoppage in the lower line, remove the snake and push it into the upper line.
Step 4. Turn the snake with a push-pull action to remove the stoppage and replace the gasket and cover.
Step 5. Run water through the drain to see if the stoppage is cleared.

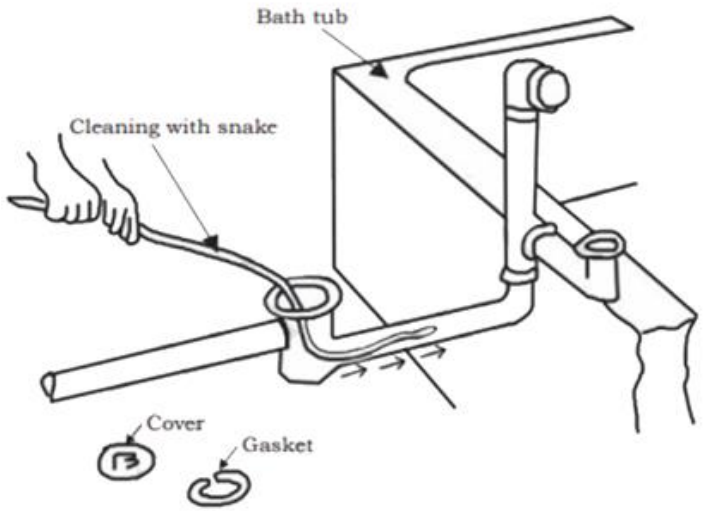


Fig 2.15 Cleaning Bathtub Drum-trap stoppages

- **Shower drains**

These can be cleared by using a hose. Use the steps below to clear drains.

Step 1. Remove the strainer from the drain.

Step 2. Attach the water hose to a source of water and place the other end of the hose into the drain.

Step 3. Stuff rags around the hose to form a tight seal.

Step 4. Turn the water on full force, then off and on again. The surge of water (pressure) will clear the stoppage.

Step 5. Replace the strainer.

- **Snake (¼- to ½-inch)**

Step 1. Remove the strainer from the drain.

Step 2. Push the snake into the drain and turn the snake with a push-pull action until it moves freely.

Step 3. Remove the snake and replace the strainer.

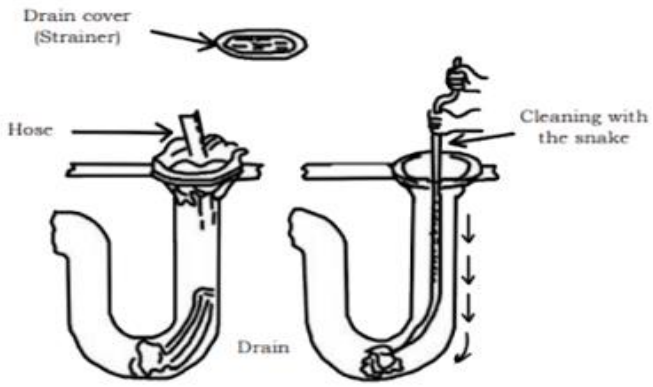
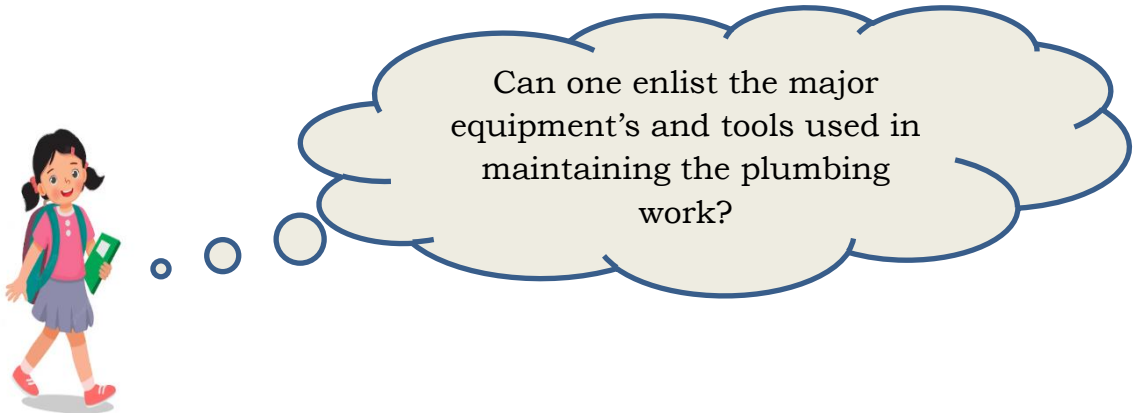


Fig 2.16 Cleaning Shower drain stoppages

- **Floor drain stoppage**
  These stoppages are cleared the same way as shower drains. A floor drain may have the strainer cemented to the floor. If so, remove it by chipping the cement around the strainer. Once the stoppage is cleared, cement the strainer back in place.



Branch and main waste lines

Stoppages that occur in a branch or main waste line in a building are cleared through a cleanout plug. Following steps may be adopted for clearing branch lines.

Step 1. Open and remove the closest cleanout plug.
Step 2. Clear the stoppage with a snake.
Step 3. Replace the cleanout plug.
Step 4. Run water through the drain to ensure that the stoppage is cleared.

Clear main lines by using the following steps:

Step 1 Remove the closest cleanout plug.
Step 2 Clear the stoppage with a ¾- to 1-inch heavy-duty snake.
Step 3 Replace the cleanout plug.

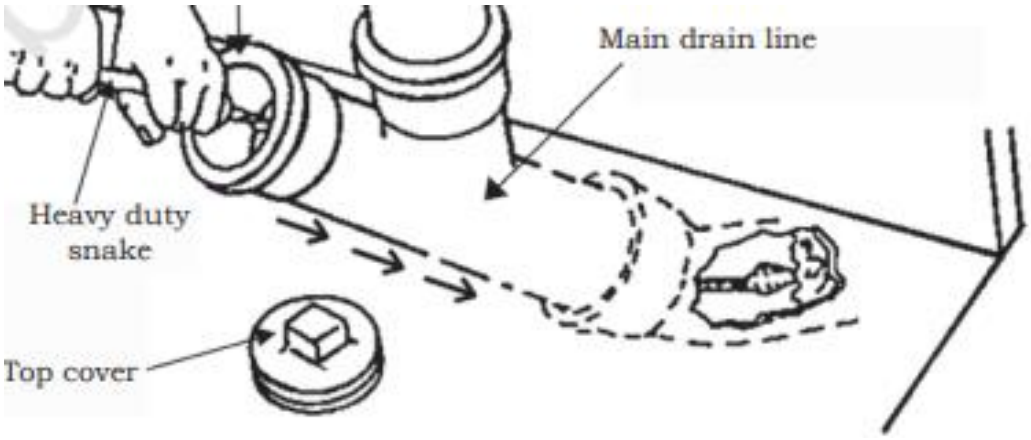


Fig 2.17 Cleaning Waste-line stoppages

2.8 COMMON ORGANIZATIONAL POLICIES

Common Policies related to costing, scheduling, procurement, and documentation for plumbing maintenance and repair work may include the following:

1. **Costing Policies:**
   a. **Standardized pricing**: Establishing standard rates for various plumbing services, including hourly rates, material costs, and mark-up percentages.
   b. **Cost estimation guidelines**: Providing guidelines for estimating the cost of plumbing maintenance and repair projects, considering factors such as labour, materials, permits, and overhead costs.
   c. **Approval processes**: Implementing procedures for obtaining approval for cost estimates and budgets before commencing work.

2. **Scheduling Policies**:
   a. **Prioritization criteria**: Defining criteria for prioritizing plumbing maintenance and repair tasks based on urgency, safety concerns, customer needs, and other relevant factors.
   b. **Service level agreements (SLAs):** Setting clear expectations regarding response times and completion deadlines for different types of plumbing work.

c. **Resource allocation**: Establishing procedures for allocating available resources (e.g., plumbers, equipment, materials) efficiently to meet scheduling requirements.

3. **Procurement Policies:**
   a. **Supplier selection criteria**: Defining criteria for selecting suppliers of plumbing materials and equipment, such as reliability, quality, pricing, and compliance with industry standards.
   b. **Purchase approval process**: Implementing procedures for obtaining approvals for purchasing plumbing materials and equipment, ensuring compliance with budgetary limits and quality standards.
   c. **Vendor management**: Establishing protocols for managing relationships with plumbing suppliers, including monitoring performance, negotiating contracts, and evaluating vendor compliance.

4. **Documentation Policies**:
   a. **Work order documentation**: Requiring comprehensive documentation of each plumbing maintenance or repair task, including details such as work performed, materials used, labour hours, and any relevant notes or observations.
   b. **Recordkeeping requirements:** Establishing guidelines for documenting and maintaining records of plumbing work, including invoices, receipts, inspection reports, and warranty information.
   c. **Compliance and regulatory documentation**: Ensuring compliance with applicable building codes, permits, and regulations, and maintaining the necessary documentation to demonstrate adherence.

These policies may vary depending on the specific organization and industry regulations. It's important for plumbing maintenance and repair companies to establish clear policies and procedures to ensure consistency, efficiency, and compliance in their operations.

ACTIVITIES

Activity 1: Draw the figure of a single compression faucet.
Material required
1. Pen
2. Pencil
3. Notebook
4. Single compression faucet

Procedure

1. Take a single compression faucet.
2. Observe it carefully
3. Now, draw its figure and label it.

Activity 2: Identify the components of a ball faucet.

Material required

1. Pen
2. Notebook
3. Pencil
4. Ball

Procedure

1. Take a ball faucet.
2. Observe it carefully and try to identify its components.
3. Draw its figure.

Activity 3: Identifying blockages at home.

Procedure

1. Ask your parents if there has been a blockage at home.
2. Discuss with them the extent of such a blockage and try to identify why it happened.

CHECK YOUR PROGRESS

A. Answer the following questions

1. Explain the different sources of leakage.
2. Write the procedure for repairing of faucets.
3. Discuss pipe corrosion. How can such a pipe be repaired?
4. What do you mean by frozen pipes?

B. Fill in the blanks

1. Reduction in the thickness of wall of a metal pipe, caused by electrolysis and acidity of water is called _____.
2. A common problem in waste systems is _____.
3. _____ resists corrosion.
4. A corroded pipe can be replaced with _____ and _____pipes.

C. Multiple choice questions

1. Water leakage can happen _____time.

(a) Always (b) any (c) ever (d) none of these

2. Pipe corrosion is _____of the wall of metal pipe.

(a) thinning (b) thickening (c) cutting (d) none of these

3. Magnesium rods are used to protect against_____.
(a) cold (b) rust (c) heat (d) None of these

4. Water supply may freeze when temperature reaches below _____ degree Fahrenheit.
(a) 0 (b) 23 (c) 32 (d) None of these

Module 3	HEALTH & SAFETY

Module Overview

This module focuses on safety practices and accident prevention in plumbing work. It highlights the importance of identifying and communicating potential accident points and common hazards faced by plumbers. The module emphasizes the role of safety checks, interpreting site signs and symbols, and the proper use of personal protective equipment (PPE). It also covers the types of fire, basic first aid procedures, and essential safety guidelines to ensure a secure working environment.

Learning Outcomes

After completing this module, you will be able to:

- Identify and communicate potential accident points on plumbing sites.
- Recognize common hazards and implement safety checks.
- Understand site signs, symbols, and the proper use of PPE.
- Differentiate between types of fire and perform basic first aid.

Module Structure

3.1 Communicating Potential Accident Points
3.2 Hazards to the Plumber
3.3 Safety Check
3.4 Signs and Symbol Site
3.5 Personal Protective Equipment at Work (PPE)
3.6 Types of fire
3.7 First Aid

3.8 Safety Guidelines

As plumbers, you play a crucial role in ensuring the smooth functioning of water and sewage systems, which is vital for the health and well-being of communities. However, it's important to remember that your own health and safety should also be a top priority. This briefing will highlight key areas of concern and provide practical guidance to help you work safely and protect yourself and others.

3.1 COMMUNICATING POTENTIAL ACCIDENT POINTS

Nothing is more valuable than a human life. So, Health and safety of the worker is in the priority list always.

An accident can occur anywhere if we don't follows secure environment. Expressing concern over under-reporting of accidents at workplace in India. The construction industry contributes to 24.20 percent of occupation fatalities, the highest in the country annually. Within the plumbing industry, the plumber may be involved in a range of work activities such as:

- Installing hot water and gas services
- Replacing guttering and down pipes
- Laying and connecting water and sewage pipes
- Fixing washbasin or sewage blockage

Fig 3.1 Using power drill machine

3.2 HAZARDS TO THE PLUMBER

It is important to know about these hazards and it can be controlled easily so that worker can be safe guarded against these hazards. A plumber may face risk from the following hazards:

1. Use of powered tools
2. Use of hand tools
3. Falls
4. Manual handling

5. Hazardous substances
6. Biological hazards
7. Electricity
8. Burns
9. Trenches and confined spaces
10. Sunburn and heat stress
11. Scaffolding

1. Use of Power Tools

Power tools are used to carry out everyday tasks in the plumbing industry. Power tools are operated by an additional power source, using electric motors, engines and compressed air, etc. These can present serious risks if not used and maintained correctly. The most common injury that can occur while using power tools is to the hands and fingers, which could be cut, broken or crushed. Eye injuries are often caused by pieces of material flying off while being cut or ground by power tools. Such injuries can lead to long periods away from work and sometimes result in permanent disability. Some commonly used power tools include air compressor, pneumatic wrench, power drill machine, etc.

2. Use of Hand Tools

These tools are manually operated and do not rely on a power source. Some commonly used hand tools include hammers, pliers, monkey wrenches, etc. These can also be dangerous if they are not used correctly. A common cause of accidents with hand tools is using the wrong tool for the job. For instance, if one uses a wrench for hammering work then it may hit one's fingers and cause injury. Thus, one should use hammer in place of a wrench.

It is important for the plumber to wear the appropriate personal protective equipment (PPE) in order to protect oneself.

The personal protective equipment includes safety glasses or goggles, ear plugs or earmuffs, protective gloves, overalls or other close-fitting clothing. Safety shoes or boots with reinforced toe-caps will protect one's feet if any heavy or sharp items are dropped.

Fig 3.2 Holding tools

3. Falls

Many plumbing tasks are carried out at varied heights and depths. These include plumbing work on roofs, installing or repairing gutters and down pipes, accessing roof cavities through manholes, etc. Safe work methods must be established before a worker is required to access the task. The

options for work at height (in their preferred order) are as follows:

a. Use fall protection devices (such as temporary work platforms or scaffolding)
b. Use a work positioning system (such as a rope access system to position and support the worker for the duration of the task).
c. Use a fall injury prevention system (such as an industrial safety net or a safety harness).
d. Use a ladder, as long as it can be employed safely for the duration of the task. This will require procedures and training for the workers who will use it.

Fig 3.3 Fall

Protection from falls

Each year, falls consistently account for the greatest number of fatalities in the construction industry. A number of factors are often involved in falls, including unstable working surfaces, misuse or failure to use fall protection equipment and human error. Using guardrails, fall arrest systems, safety nets, covers and restraint systems can prevent many deaths and injuries from falls.

Precautions

a) Aerial lifts or elevated platforms should be considered to provide safer elevated working surfaces.
b) Erect guard rail systems with toe boards and warning lines or install control line systems to protect workers near the edges of floors and roofs.
c) Cover floor holes; and/or use safety net systems or personal fall arrest systems.

Ladders

Ladders and stairways are another source of injuries and fatalities among construction workers. Injuries could occur due to bad quality ladder, loose ladder and narrow or steep, slippery stairways.

Precautions

a) Use a ladder which is hardy and strong for the task.
b) Make sure that ladders are long enough to safely reach the work area.
c) Mark or tag ("Do Not Use") damaged or defective ladders for repair or replacement, or

destroy them immediately.

d) Never load ladders beyond the maximum intended load or beyond the manufacturer's rated capacity.
e) Ensure that the load rating can support the weight of the user, including materials and tools.
f) Avoid using ladders with metallic components near electrical work and overhead power lines.

Stairways

Slips, trips and falls on stairways are a major source of injuries and fatalities among the construction workers.

Precautions

1. Stairway treads and walkways must be free of dangerous objects, debris and materials.
2. Slippery conditions on stairways and walkways must be corrected immediately.
3. Make sure that treads cover the entire step and landing. The treads should be made enough wide so that there is no slipping. Stairways having four or more risers or rising more than 30 inches must have at least one hand rail.

4. Manual Handling

A Plumber's work often involves significant manual handling hazards. Handling heavy objects and moving them, often in uncomfortable postures because of lack of space to move freely, creates a risk of traumatic injury such as a strained back. The need for continuous repetitive movements can lead to injuries due to exertion, affecting the neck, back, hand and arms over a period of time. Work should be arranged and monitored to minimize the risk of overuse injuries.

5. Hazardous Substances

Hazardous substances are chemicals used to carry out work, or present in the work environment. All of these may create hazards for plumbers if their use in the workplace is not managed with care. These hazard substances may be Oxy-acetylene, Fluxes (solder), Lead, Hydrochloric acid, Degreasers and solvents, Adhesives or Caulking compound.

Fig 3.4(a) Acid injury on hands

Fig 3.4(b) Fire Hazard

6. Biological Hazards

Health effects of exposure to sewage include tetanus (caused by a toxin produced by a bacterium common in soil and sewage), leptospirosis (caused by a parasitic worm), hepatitis A, and parasites such as giardia and cryptosporum. The degree of harm that can result depends on the microbe's present, and the extent and duration of exposure. Microbes in raw sewage can enter the body through the nose or mouth, particularly if a person drinks contaminated water or by hand-to-mouth transmission.

a) Assume anything touched by sewage as contaminated
b) Do not eat or drink in any sewage handling area.
c) Wash hands well with soap and clean water preferably hot before eating or drinking, and after touching any surface or object that may be contaminated by sewage.
d) Immediately wash and disinfect any wound that comes into contact with sewage.
e) Change out of work clothes before leaving the work site (soiled work clothes should be bagged and laundered separately from other clothing).
f) Wear appropriate protection. This will include rubber boots and gloves, overalls and eye protection (wear goggles if a hose will be used, as safety glasses will not protect against splashing).

Fig 3.5 Inhalation hazard Sign

7. Electricity

Electric leads must be kept away from water. Because plumbers use powered tools in proximity to water supply in all weather conditions, there is always the possibility of electrocution if work practices do not consider the presence of electrical hazard. Insulated hot water pipes with 240-volt heat trace cables are used to maintain water temperature in many modern apartments. If power to the heat trace cable is not isolated, there is potential for electrocution when a plumber unknowingly cuts through the insulated pipe. Simply turning off the water supply valve will not shut down the power to the cable but need to shut down power supply.

.

Fig 3.6 Electric Plug

8. **Burns**

Hot water services store water at high temperatures. Maintenance and repair work must be carried out carefully to avoid scalds and steam burns. The unexpected release of hot water or steam could result in serious injury and permanent disfigurement.

Fig 3.7 Burn on hand

9. Trenches and Confined Spaces

Plumbers working in trenches, pits, tanks, beneath houses and in roof cavities must understand and plan for the significant hazards in confined spaces. In sewage systems, the release of toxic gases can cause the plumber to collapse, become unconsciousness and die. The lack of oxygen is also potentially fatal. Before any worker begins a job in a confined space (such as a pitor tunnel) where gases could be present or oxygen may be deficient, there must be a full assessment of the worksite and the safeguards required.

Fig 3.8 Hazardous toxic gas

10.Sunburn and Heat Stress

Workers who are exposed to extreme heat or work in hot environments may be at risk of heat stress. Heat stress can result in heat stroke, heat exhaustion, heat cramps, or heat rashes. Heat stress, sunburn and skin cancer can all result from prolonged exposure to ultraviolet radiation from the sun. The longer the skin is exposed, the greater the risk, regardless of tan or skin pigment.

Fig 3.9 Blisters due to sunburn

11. Scaffolding

A scaffold is a temporary structure made of bamboo or iron pipe to support worker to carry out the work. When scaffolds are not erected or used properly, fall hazards can occur.

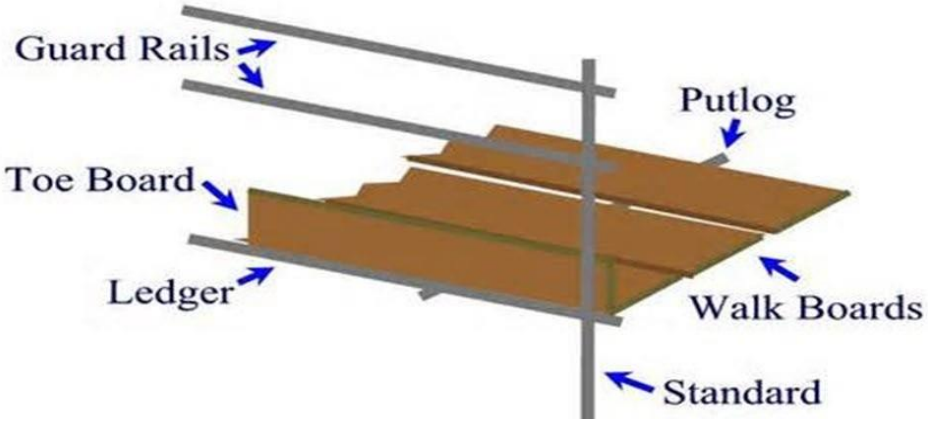


Fig 3.10 Components of Scaffolding

Precautions during handling of scaffolding

a) Scaffold must be sound, rigid and sufficient to carry its own weight, plus four times the maximum intended load without settling or displacement. It must be erected on solid footing.
b) Unstable objects, such as barrels, boxes, loose bricks or concrete blocks must not be used to support scaffolds or planks.

c) The scaffold must not be erected, moved, dismantled or altered except under the supervision of person who supplies, installs and dismantles the scaffolding.
d) The scaffold must be equipped with guard rails, mid rails and toe boards.
e) Scaffold accessories such as braces, brackets, trusses, screw legs or ladders that are damaged or weakened must be immediately repaired or replaced.
f) Scaffold platforms must be tightly planked with scaffold plank grade material or equivalent. A plank is timber that is flat, elongated, and rectangular with parallel faces that are higher and longer than wide.
g) Synthetic and natural rope used in suspension scaffolding, that is a hanging-type scaffolding, must be protected from heat – producing sources.
h) The scaffold can be accessed by using ladders and stairwells.
i) The scaffolds must be at least 10 feet from electric power lines at all times.

3.3 SAFETY CHECK

For quality control of any work, a checklist for safety is prepared. A Checklist is a list of items you need to verify, check or inspect. Checklists are used in every imaginable field — from building inspections to complex medical surgeries. Using a checklist allows you to ensure you don't forget any important steps. These checklists are prepared for office work, construction site, handling of equipment etc. These checklists are available with the user and agencies. This checklist should be followed in routine practice to maintain standard and quality. Adoption of these checklists will reduce accidents and hazards.

3.3.1 Precautions at Workplaces

For safe operation, following precaution should be ensured in workplace.

- Precautions must be taken against a person falling from working plate form erected at various heights in a building.
- Protection against structural collapse (while work is taking place), i.e. the building falling down.
- Safeguards when a person working in excavations like well or mine.
- Care should be taken to prevent drowning (falling into water).
- Steps should be made for safe traffic routes (on sites) to avoid accidents.
- Prevention and control of emergencies services (site emergency evacuation procedures, etc.)
- Provision of welfare facilities – washroom, washing facilities, canteens/rest areas, shower facilities (if required)
- Provision of site-wide issues–clean and tidy sites, adequate lighting, constant and fresh air supply, etc.
- Training, inspection and reports – proper training of staff, use of properly trained staff to do

the work, proper supervision of staff and monitoring the work carried out by staff to ensure it is carried out in a safe manner.

3.3.2 Reporting of Injuries, Diseases and Danger

For better working condition in a factory or industry, it is necessary to record and report the injuries, diseases occur to a worker or employee. Special care should be taken to avoid dangerous occurrences like collapse of building, excavation. It is always advisable to maintain an accident book document where detail of all accidents is recorded, no matter how minor.

More over following points should be also checked:

- Maintain a Material Safety Data Sheet (MSDS) for each chemical in the facility. Make this information accessible to employees at all times in a language or format that is clearly understood by all affected personnel.
- Train employees on how to read and use the MSDS.
- Follow the manufacturer's MSDS instructions for handling hazardous chemicals.
- Train employees about the risks of each hazardous chemical being used.
- Provide spill clean – up kits in areas where chemicals are stored.
- Have a written spill control plan.
- Train employees to clean-up spills, protect themselves and properly dispose of used materials.
- Provide proper personal protective equipment and enforce its use.
- Store chemicals safely and securely.

3.4 SIGNS AND SYMBOLS SITE

Sign and symbols are used to inform and alert the people on all aspects. Some common safety symbol is discussed here.

Fig 3.11 Signs and Symbols Site

- Circular red borders and cross bar. Black symbols on white back ground indicates Shows what must Not bed one like No smoking.
- White symbol on blue back ground shows what must be done like Wear eye protection.

- Triangular yellow back ground with black border and symbol indicates Warms of hazard or danger like Danger electric shock risk.
- Square or rectangular symbol White symbols and green back ground Indicates or gives information on safety provision like First-aid facilities.

3.5 PERSONAL PROTECTIVE EQUIPMENT AT WORK (PPE)

It is defined as any equipment (including clothing affording protection against the weather) which is intended to be worn or held by a person at work and which protects him against one or more risks to his health.

3.5.1 Safety Equipment

1. **Eye protection:** It comes in the form of
   i) Safety glasses – a typical application could be lead welding
   ii) Safety goggles –these provide a higher level of protection than safety glasses, as they should fit closely to the face
   iii) Welding goggles – these include specialist coloured lenses.

Fig 3.12 Eye Protection

2. **Hand protection:** Hand protection that is normally used in plumbing includes the following:
   i) General-purpose gloves –these helps protect against cutting or puncture, wounds; an example of their use could be lifting concrete blocks or lifting steel tube.
   ii) Specialist gloves – these are typically used to deal with hazardous substances such as dry ice used in pipe – freezing applications
   iii) Rubber gloves –these helps protect against contact with used soil and waste systems and sanitary appliances. Gloves also provide protection against a disease known as dermatitis, which is caused by the hands coming into contact with materials class as irritants.

Fig 3.13 Hand Protection

3. **Head Protection:** One of the important injuries is known as Head injuries. It happens when we are not prepared to protect our head in a home, road, factory or construction site etc. Serious head injuries can result to fatal injuries.

It is a mandatory requirement to wear a safety helmet when working on a newly -built and major construction sites like Multistory building or commercial housing, industrial building construction. In addition, a safety helmet will need to be worn when work is taking place at heights or above the point where people are working – that could be in a trench.

A safety helmet must: (i) Be properly adjusted to fit (ii) Be replaced if it becomes defective or damaged.

Fig 3.14 Head Protection

4. **Foot protection:** It is necessary to protect foot from the injury caused during plumbing installation work being carried out. It is necessary for worker to wear the standard safety boots.

Fig 3.15 Boot

5. **Ear protection:** Ear protection should be made when working in noisy areas or with equipment that generates high levels of noise. Ear protection is done usually in the form of:

i) Ear defenders
ii) Ear plugs

The need to wear ear protection should be indicated by safety signs or through risk assessments carried out by construction or plumbing companies.

6. **Respiratory protection**: When there is dust in workplace, the efficiency of worker is affected hence it is necessary to use respiratory protection system.
Important respiratory equipment is:

i) **Simple dust mask** - this mask is used against normal pollution dust etc.
ii) **Cartridge-type respirator** – these masks can guard against a range of substances such as high levels of dust or fumes; different disposable cartridges are required to protect against different types of substances.
iii) **Full breathing apparatus** – usually used in specialist work in confined spaces such as drains or sewers.

3.6 TYPES OF FIRE

The plumber tool kit and tool belt should be equipped with gloves and necessary tools at hand so that he /she need not move around the work area unnecessarily.

Fire is classified into groups according to the type of fuel.

I. **Class A** – fires involving solid materials, extinguished by water.
II. **Class B** –fires involving flammable liquids, extinguished by foam or carbon dioxide.
III. **Class C** – fires involving flammable gases, extinguished by dry powder.
IV. **Class D** – fires involving flammable metals, extinguished by dry powder.

Fig 3.16 Respiratory Protection

What is the role of PPE kit in the safety of workforce?
Will it also protect from the fire damage?

3.6.1 Fire-fighting equipment*:* There is a variety of different types of firefighting equipment. In undertaking plumbing work, you are more likely to come across the fire extinguisher as the main source of protection; here are some points to it use.

i) An extinguisher should be kept in the immediate work area when hot working, e.g. Using LPG gas heating equipment.
ii) A fire extinguisher should only be used when it is safe to do so personal safety must come before at tempts to contain a fire.
iii) Fire extinguishers should only be used by those trained in their use.
iv) The following table shows the colour coding for extinguishers for dealing with the different types of fire.

Type of extinguisher	Colour code	Main use
Water	Red	Wood paper or fabrics
Foam	Cream	Petrol oil, fats and paints
Carbon Dioxide	Black	Electrical Equipment
Dry powder	Blue	Liquids, gases, electrical equipment's

3.6.2 Emergency Services and First Aid

During emergency period, the following action should be made:

- Find a telephone in a safe environment, well away from the emergency.
- Dial the emergency service number, Fire 102, Police 100, Ambulance 101.

3.6.3 Summoning the Emergency Services

a. Minimize the time taken for the emergency services to reach you.

a. Minimize the risk to operators if there is an emergency.

b. Include environmental and other emergencies in your plan.

c. Employers and the self-employed need to assess the first aid requirements of their work.

d. Make sure there are enough trained first aiders and facilities to help casualties of illness or injury immediately, and that an ambulance or other professional help can be summoned without delay.

3.7 FIRST-AID

It is necessary to have the following items in a first-aid kit. These items help patient immediate relief from pain or injury.

a) Plasters
b) Sterile dressings
c) Triangular bandage
d) Safety pins(sling)
e) Disposable gloves
f) Crepe bandages
g) Scissors, Tweezers
h) Cotton wool Tap/Faucete
i) Alcohol-free antiseptic wipes
j) Sterile pads

First aid assessment should consider:

- The nature of the work.
- The history and consequences of injuries.
- The nature and distribution of the work force.
- The remoteness of the site from the emergency services, including location, terrain and weather conditions.
- Working on shared or multi-occupied sites.
- Holidays and other absences of first aiders.

Fig 3.17 First Aid Box

- The presence of trainees and the public.
- The possibility of medical conditions or allergies.

3.8 SAFETY GUIDELINES

Step 1 – Identify Potential causes of workplace injury and illness.

a) Does the nature of the work being carried out pose a hazard to people's health and safety?
ii) Have these hazards been identified in work that is being carried out?
iii) Has incident and injury data been reviewed?
iv) Has consultation with workers and their health and safety representatives occurred?
v) Is specialist or external assistance required?

Step 2 – Assess the risk of workplace injury and illness.

i) How often does a hazard have the potential to cause harm?
ii) What type of injuries would the hazard cause?
iii) How serious are the injuries?
iv) Does the number and composition of workers and other people affect how first aid should be provided?
v) Could the size and location of the workplace affect how first aid is provided?

Step3 – What first aid is required?

(a) First aiders

i) How many first aid helpers are needed?
ii) What competencies do they require?
iii) What training do they need?

(b) First aid kits and procedures

i) What kits/modules are needed and where should they be located?
ii) Is other first aid equipment needed?
iii) Who is responsible for maintaining the kits?
iv) What procedures are needed for my workplace?

(c) First aid facilities

i) Is a first aid room or health centre required?

ACTIVITIES

Activity1: Visit to Fire station

Material Required

1. Copy
2. Pencil

Procedure

1. Fix the appointment with fire station manager for visit.
2. Reach the station as per schedule.
3. Discuss about all the safety tools, gadget and machines.
4. Do the handling and operating practice under the supervisor of Fire station and teacher.

Activity 2: Drawing of first aid equipment

Material Required

1. First aid equipment
2. Tools
3. Drawing copy
4. Pencil
5. Rubber/ eraser

Procedure

1. Select the fire safety equipment.
2. Open the components with tools.
3. Draw the images of first aid equipment.

Activity 03: Draw the symbol and signs of safety at site

Material Required

1. Pencil
2. Paper
3. Drawing sheet
4. Poster

Procedure

1. Identify the symbols and signs.
2. Draw the images.
3. Write also uses of these symbols.
4. Display these posters in the classroom.

Activity 04: Make a plumber tool kit.

Activity 05: Make a safety tool kit for a plumber.

CHECK YOUR PROGRESS

A. Answer the following

1. Why is it important to comply with health and safety on site?
2. What general hygienic practices must be adhered to in own work environment?
3. Why should the correct clothing, footwear and head gear be worn at all times?
4. Why is it important to maintain good personal hygiene?
5. What are the possible causes of fire in the working environment?
6. What preventive actions can be taken to minimize the risk of fire?
7. What organizational procedures should be followed in the event of a fire?
8. Why a fire should never be approached unless it is safe to do so?
9. Why suspicious items and packages should be reported?
10. What basic first aid should be applied in the event of an accident?
11. What action should be taken to ensure the safety of the injured and uninjured?
12. What the potential hazards with are in own working environment?
13. Why it is important to use correct lifting techniques?
14. What are the employee's responsibilities in relation to health and safety regulations?

B. Fill in the blanks

1. ……. tools are used to carry out Everyday tasks in the plumbing industry if not to be done manually.
2. Electric leads must be kept away from ……..
3. Heat stress, sunburn and skin cancer can all result from prolonged exposure to ultraviolet radiation from the ……

C. Multiple Choice Questions

1. Fall hazard occurs when scaffoldings are erected
   a. Not properly b. Properly
   b. Timely d. None of these
2. Slips, trips and falls on stairways are a major source of injuries and fatalities among workers.
   a. Construction worker b. Retail
   b. Automotive d. None of these
3. Trench collapses cause dozens of fatalities and hundreds of injuries each……
   a. Year b. Month
   b. Time d. None of these
4. Head can be protected by wearing the……..
   a. Helmet b. Safety cap
   b. Gloves d. None of these
5. Eye injuries can be prevented during work by wearing the……..

a. Safety glass
b. Cap
b. Safety glass with side shield
d. None of these

Module 4	WORKING EFFECTIVELY WITH OTHERS

Module Overview

This module highlights the importance of teamwork and effective communication in the workplace. It explores strategies for managing teams, fostering teamwork, and resolving disputes or conflicts. Learners will understand the skills needed for successful collaboration and maintaining positive relationships with colleagues. The module also emphasizes the significance of site diaries, log reports, and their role in ensuring accurate documentation and smooth workflow management.

Learning Outcomes

After completing this module, you will be able to:

- Demonstrate effective team management and teamwork skills.
- Resolve disputes and handle workplace conflicts constructively.
- Maintain good relationships with colleagues and understand their importance.
- Use site diaries and log reports for accurate documentation.
- Recognize the value of building professional relationships for a positive work environment.

Module Structure

4.1 Team management
4.2 Team Work
4.3 Resolving Disputes
4.4 Conflict
4.5 Team Working Skills
4.6 Maintaining good relationship with colleagues
4.7 Where to Build Good relationship?
4.8 Diaries and Log reports
4.9 Importance of Site diaries

There are some tasks which can't be alone. Teamwork is the collaborative effort of a group to achieve a common goal or to complete a task in the most effective and efficient way. This concept is seen within the greater framework of a team, which is a group of inter dependent individuals who work together towards a common goal. And it should have similar objective and interests. As a plumber you may be employed with a construction company, Maintenance Company or you may free-lance with few others as a team. In each case interaction with more professionals handling the job is a must.

Fig 4.1 Team Management

4.1 TEAM MANAGEMENT

To achieve the set of goals, the team management play major role and with help of different activities which actually bind a team member individually.

Characteristics of a Good/Effective Team

- **Elevating goal:** A goal which has been circulate/communicated with all.
- **Result driven structure**: The target has been combining fixed by all the team members. For getting it, they will fully commit.
- **Competent members**: Obtain the team target, each team member must have the necessary skill set.
- **Unified Commitment**
- **Collaborative Climate:** This will enhance the overall workability of the team members. A better leader can create such to keep their workers highly motivated to achieve their targets.
- **Standards of excellence:** In any organization, quality orientation play vital role to achieve success.

4.2 TEAM WORK

To obtain the team objective, sum of the attempts by each team member are called team work. In other words, team work is the backbone of any team.

1. Think about your team first.
2. Never underestimate your team member
3. Discuss – Before implementing any new idea, it must be discussed with each and every member on an open platform.

4. Avoid criticism–Stay away from criticism and making fun of your team members. Help each other and be a good team player.
5. Transparency must be maintained and healthy interaction must be promoted among the team members.
6. The team leader must take the responsibility of encouraging the team members to give their level best and should intervene immediately in cases of conflicts.
7. Avoid conflicts in your team. Don't fight over petty issues and find faults in others. One should be a little adjusting with each other and try to find an alternative best suited to all the team members.
8. Rewards and Recognition – Healthy competition must be encouraged among the team members.

4.3 RESOLVING DISPUTES

It is defined as an argument or disagreement, especially an official one between, for example, workers and employers or two countries with a common border**.**

There are two ways of solving a dispute:

(a) Consensual process: Collaborative Law, Conciliation or Negotiation - It is a dialogue between two or more people or parties intended to reach a beneficial outcome.

(b) Litigation: Litigation or arbitration is the costliest and time -consuming way to resolve a dispute. Each party is represented by an attorney while witnesses and evidence are presented. Once all information is provided on the issue, the arbitrator makes a ruling which provides the final decision. The arbitrator provides the final decision on what must be done and it is a binding agreement between each of the disputing parties.

4.4 CONFLICT

Everyone, rich or poor, young or old, at workplace or even at home, if is in contact with others, faces one kind or the other type of conflict at many points of time. Conflict is a situation in which one person or a group perceives that its interests are being opposed or negatively affected by another person or group. Basically, it is a mismatch in the concerns of people involved in a particular activity.

4.4.1 How you can avoid conflict?

No one wants to be in a conflict situation. By adopting some minor attitudinal changes one can easily avoid conflicts. These are:

- **Focus on solution than problem** - Rather than dwelling on the past happenings and events, talk about how you want things to be.
- **Avoid blaming and criticizing others by using words** – 'you should…., you make me feel……'
- **Never give any personal comments**: If you do not like at any given point of time any action or reaction of any of your colleagues, do not comment on the person, and just talk about the behaviour not about the person

- Offer support and collaboration and make it obvious that you are a part of the solution.
- Recognize the positive intention.

4.4.2 Resolving Conflict

When a team oversteps the mark of healthy difference of opinion, resolving conflict requires respect and patience. There are the following ways of solving a conflict:

- Negotiation
- Mediation
- Arbitration
- Litigation

4.4.3 Preventing Conflict

Following are some tips to keep the conflict situations apart**:**

- **Dealing with conflict immediately** – avoid the temptation to ignore it.
- **Being open** –if people have issues, they need to be expressed immediately and not allowed to fester.
- **Practicing clear communication** – articulate thoughts and ideas clearly.
- **Practicing active listening** – paraphrasing, clarifying, questioning.
- **Practicing identifying assumptions** – asking yourself "why" on a regular basis.
- **Encouraging different points of view** – insist on honest dialogue and expressing feelings.
- **Not looking for blame** – encourage ownership of the problem and solution.
- **Demonstrating respect** – if the situation escalates takes a break and waits for emotions to subside.
- **Keeping team issues within the team** –talking out side allows conflict to build and fester, without being dealt with directly.
- To explore the process of conflict resolution in more depth, take our Bite -Sized Training session on Dealing with Conflict.

4.5 TEAM WORKING SKILLS

Team work is important because it helps us synergize, it complements our individual weaknesses, it does help in productivity and it helps one build new and better skills. Team work is an important part of a working culture. Good team works enhance effective and efficient achievement of an organization's work. Members of a team are more committed to work on goals that they helped to create. The most important thing about team work is that it enables individuals in the team to focus on one main objective.

Team work is also important since everyone contributes their unique abilities, which make the result of their objective more diverse. Team work is generally important because it gives everyone a sense of belonging.

Fig 4.2 Team Working skills

Some of the skills that will help one in working effectively are as follows:

- **Demonstrates Reliability**
  A reliable team member who gets work done and does his fair share to work hard and meet commitments. He or she follows through on assignments. Consistency is key.
- **Communicates Constructively**
  Teams need people who speak up and express their thoughts and ideas clearly, directly, honestly, and with respect for others and for the work of the team. That's what it means to communicate constructively.
  Such a team member does not shy away from making a point but makes it in the best way possible — in a positive, confident, and respectful manner.
- **Listens Actively**
  Good listeners are essential for teams to function effectively.
  Teams need team players who can absorb, understand, and consider ideas and points of view from other people without debating and arguing every point. Such a team member also can receive criticism without reacting defensively.

- **Functions as an Active Participant**
  Good team players are active participants. They come prepared for team meetings and listen and speak up in discussions. They're fully engaged in the work of the team and do not sit passively on the side lines. Team members who function as active participants take the initiative to help make things happen, and they volunteer for assignments.
- **Shares Openly and Willingly**
  Good team players share. They're willing to share information; knowledge and experience. They take the initiative to keep other team members informed. Much of the communication within teams takes place informally. Beyond discussion at organized meetings, team members need to feel comfortable talking with one another and passing along important news and information day-to-day. Good team players are active in this informal sharing.
- **Cooperates and Pitches – into Help**
  Cooperation is the act of working with others and acting together to accomplish a job. Effective team players work this way by second nature. Good team players, despite differences they may have with other team members concerning style and perspective, figure out ways to work together to solve problems and get work done. They respond to requests for assistance and take the initiative to offer help.
- **Exhibits Flexibility**
  Teams often deal with changing conditions — and often create changes themselves. Good team players roll with the punches; they adapt to ever –changing situations. They don't complain or get stressed out because something new is being tried or some new direction is being set.
  In addition, a flexible team member can consider different points of views and compromise when needed. He or she doesn't hold rigidly to a point of view and argue it to death, especially when the team needs to move forward to decide or get something done.
  Strong team players are firm in their thoughts yet open to what others have to offer — flexibility at its best.
- **Shows Commitment to the Team**
  Strong team players care about their work, the team, and the team's work. They show up every day with this care and commitment up front.
  They want to give a good effort, and they want other team members to do the same.
- **Works as a Problem Solver**
  Teams, of course, deal with problems. Sometimes, it appears, that's the whole reason why a team is created — to address problems.
  Good team players are willing to deal with all kinds of problems in a solution – oriented manner.

They're problem - solvers, not problem-dwellers, problem-blamers, or problem - avoiders. They don't simply rehash a problem the way problem – dwellers do. They don't look for others to fault, as the blamers do. And they don't put off dealing with issues, the way avoiders do.

- **Interact with colleagues, seniors within and outside the team**
  Interaction with seniors is extremely essential and should be done with lot of care. Seniors by virtue of a prolonged experience will offer guidance and support, which will also help to improve your skills. Interaction with seniors should be based on the principles of mutual respect and should not confrontational in nature. Good relationships are also often necessary if we hope to develop our careers. After all, if your boss doesn't trust you, it's unlikely that he or she will consider you when a new position opens up. Overall, we all want to work with people we're on good terms with.

4.6 MAINTAINING GOOD RELATIONSHIP WITH COLLEAGUES

There are several characteristics that make up good, healthy working relationships:

- **Trust** – This is the foundation of every good relationship. If you trust the people you work with, you can be open and honest in your thoughts and actions, and you don't have to waste time and energy "watching your back."
- **Mutual Respect** – When you respect the people that you work with, you value their input and ideas, and they value yours. Working together, you can develop solutions based on your collective insight, wisdom and creativity.
- **Mindfulness**–This means taking responsibility for your words and actions. Those who are mindful are careful and attend to what they say, and they don't let their own negative emotions impact the people around them.
- **Welcoming Diversity** –People with good relationships not only accept diverse people and opinions, but they welcome them. For instance, when your friends and colleagues offer different opinions from yours, you take the time to consider what they have to say, and fact or their insights in to your decision - making.
- **Open Communication** –We communicate all day, whether we're sending emails and IMs, or meeting face – to -face. The better and more effectively you communicate with those around you, the richer your relationships will be. All good relationships depend on open, honest communication.

4.7 WHERE TO BUILD GOOD RELATIONSHIPS?

Although we should try to build and maintain good working relationships with everyone, there are certain relationships that deserve extra attention. Now next question arises how to build good work relationships> Here are some suggestions for that:

- Develop your people skills
- Good relationships start with good people skills.
- Schedule time to build relationships
- Appreciate others
- Be positive
- Avoid gossiping
- Listen actively

4.8 DIARIES AND LOG REPORTS

Importance of log reports

A supervisor is the crew leader on a construction jobsite. It's up to him to plan, organize, and direct work in a safe, and timely, manner. All supervisors will experience conflict at some point, as well as safety violations and work place injuries. By keeping a daily record of all activities, your construction site supervisor can protect your business from arbitration and/or litigation.

4.8.1 What is a Daily Log?

The daily log is a book, or software program, into which a supervisor records the day's activities. Record keeping helps ensure project organization, as well as keeps tabs on day-to-day employee happenings. The daily log is essential because it keeps a consistent record, which could be useful if you're ever sued, and need to prove that your workers performed a safety inspection, or conflict wash and led immediately and efficiently.

Daily log sections include:

- Date and day plan
- Times of incidents
- Work performed
- Safety topics or any safety issue
- Problems and delays
- Employee conflict
- Equipment usage
- Materials purchased
- General management

- Drawing and maps studied with supervisor/team members/self

4.8.2 What is an Incident Report?

In order to understand the incident report, you'll first need to understand what constitutes an incident. There are two types of events that are considered "incidents."

An event that resulted in an injury. For example: An employee is handling materials and suffers a cut to the finger.

An event that resulted in a near-miss, otherwise known as an event that almost resulted in injury or damage. For example: An employee is handling materials and almost suffers a cut to the finger.

4.9 IMPORTANCE OF SITE DIARIES

Diaries: Each member of the project team is expected to keep a project diary. The diary contains summaries of the day's events in the member's own words. While interacting with senior's note down the information, expectation as communicated by the seniors. They are used to keep track of any daily work activity, conversations, observations, or any other relevant information regarding the construction activities. Diaries can be referred to when disputes arise and a diary happens to contain information connected with the disagreement. Hand written diaries can be used as evidence in court.

Logs: Logs keep track of the regular activities on the job site such as phone logs, transmittal logs, delivery logs, and RFI (Request for Information) logs.

Daily Field Reports: Daily field reports are a more formal way of recording information on the job site. They contain information that includes the day's activities, temperature and weather conditions, delivered equipment or materials, visitors on the site, and equipment used that day. We should share these reports with our senior's one daily basis.

- The diaries and daily or other reports are meant to supplement each other and do not need to contain identical information.
- Minimize personal remarks, which may not be factual, about operations or personnel of the Contractor, Agency, or other organization. Such remarks may be used to demonstrate the inspect and was hostile and did not behave in a manner consistent with good faith.
- All entries should be clear, neat, and most importantly, legible.
- Summarize key points of any discussion of work activities with the contractor.

ACTIVITIES

Activity 01: Observation of team work in your school/office
Material Required
1. Notebook
2. Pen or pencil

Procedure
1. Make a group or team.
2. Give some task to each other and perform as team.
3. Write down all task assign by the other team.

Activity 02: Prepare a daily log/activity in your school/office
Material Required
1. Notebook
2. Pen or pencil

Procedure
1. Make a book or software.
2. Record the all daily activities.
3. Check daily log sections.
4. Check the performance of the students/employee.

Activity 03: Make a report of plumbing activity run at any school, building or site.

CHECK YOUR PROGRESS

A. Answer the following questions

1. What do you mean by Team Management and their importance?
2. Define the term team work?
3. What is a Daily Log?
4. What do you mean by Incident Report?
5. What are the methods of resolving a conflict?
6. What considerations you will keep in mind while resolving a conflict?

B. Fill in the blank

1. To achieve the set of goal, the ……play major role and with help of different activities which bind a team member individually.
2. To obtain the team objective, sum of the attempts by each team member are called……..
3. …….. .is a situation in which one person or a group perceives that its interests are being opposed or negatively affected by another person or group.
4. Resolving Conflict is a team of oversteps the mark of healthy difference of opinion, resolving conflict requires……and……..
5. …….. helps ensure project organization, as well as keeps tabs on day-to-day employee happenings.

C. Multiple Choice Questions

1. A goal which has been circulate/communicate with all is……..

a) Elevating goal b) structure goal
c) Final goal d) fixed goal

2.To obtain the team target, each team member has the necessary skill set is known as ……

a) Skill member b) Regular member
c) Knowledgeable member d) Competent member

3. Which is the following way being not of solving a conflict:

a) Negotiation b) Mediation
c) Arbitration d) Opinion

4. Logs keep track of the regular activities on the job site such as:

a) Phone logs b) transmittal logs
c) Delivery logs d) All of above

5. ……..is the act of working with others and acting together to accomplish a job.

a) Cooperation b) Communication
c) Teamwork d) Management

Module 5	OPTIMUM UTILIZATION OF RESOURCES

Module Overview

This module will cover efficient utilization of water and materials during plumbing processes and introduces the basics of electricity relevant to the field. The module highlights the use of common electrical and thermal equipment, energy-efficient devices, and methods for conserving electricity. Learners will understand waste segregation using color-coded dustbins, distinguish between recyclable and non-recyclable waste, and implement efficient waste management practices to minimize waste generated during plumbing activities.

Learning Outcomes

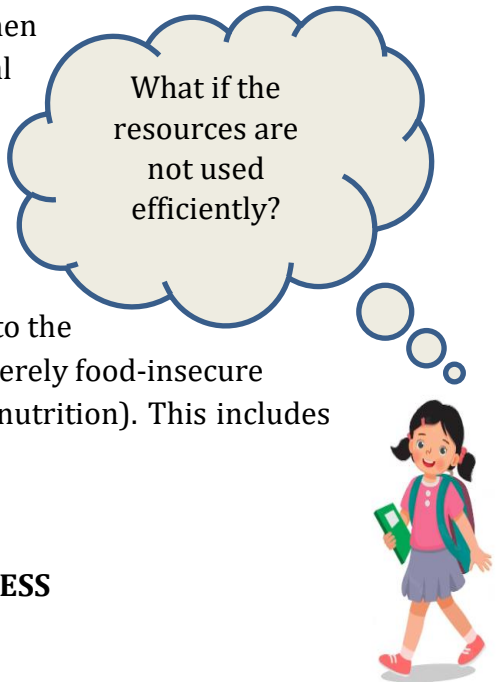
After completing this module, you will be able to:

- Understand basic electricity concepts and identify common equipment used in plumbing workplaces.
- Apply energy-efficient practices and recognize indicators of electrical problems.
- Implement strategies to minimize waste and promote sustainable plumbing practices.

Module Structure

5.1 Efficient utilization of water in plumbing process
5.2 Efficient ways of managing material in plumbing process
5.3 Basics of electricity
5.4 Common Electrical and thermal equipment used in plumbing workplace
5.5 Energy Efficient Devices
5.6 Indicators of common electrical problems
5.7 Common Practices of conserving electricity
5.8 Different colours of Dustbins
5.9 Recyclable and Non-recyclable waste
5.10 Efficient Waste Management Practices
5.11 Common ways to minimize waste generated from plumbing activities

Drinking water is carried through these pipes every day and when choosing plumbing materials we must consider ecological toxicity, air pollution, fossil fuel depletion, and global warming. The environmental impacts from the deteriorated plumbing include holes in pipes formed through corrosion, which allow the influx of contaminants into drinking water systems, the loss of the water resource itself, and resultant property damage.



Water puts food on the table and money in the bank. According to the UN's Food and Agriculture Organization, roughly 60–80% of severely food-insecure people rely on agriculture for their livelihoods (and their own nutrition). This includes farming of crops and raising livestock, as well as fishing.

5.1 EFFICIENT UTILIZATION OF WATER IN PLUMBING PROCESS

Water can be used effectively by using following systems:

1. **Meter/Measure/Manage:** Implementing a system to meter, measure, and manage water consumption is crucial for efficient water management. This involves installing water meters to track usage, collecting and analyzing data on water consumption patterns, and implementing management strategies based on the findings. By monitoring and managing water usage, you can identify areas of high consumption and implement targeted conservation measures.
2. **Optimize Cooling Towers**: Cooling towers are commonly used in large buildings or industrial facilities to remove excess heat from processes or air conditioning systems. Optimizing cooling tower operations involves regularly maintaining and cleaning the towers, adjusting water flow rates and temperatures, and using efficient cooling tower fill materials. By optimizing cooling towers, you can reduce water waste through evaporation and improve overall cooling efficiency.
3. **Replace Restroom Fixtures**: Upgrading restroom fixtures is an effective way to conserve water. Replace older, inefficient fixtures with low-flow toilets, urinals, and faucets. Low-flow fixtures are designed to use less water while still providing adequate performance. They often include features like aerators, flow restrictors, or sensor-based controls to minimize water usage.
4. **Eliminate Single-Pass Cooling:** Single-pass cooling refers to a cooling system where water is used once and then discharged without any treatment or reuse. This approach can be

highly wasteful. Instead, consider implementing closed-loop or recirculating cooling systems, which treat and reuse water, reducing the overall water consumption and minimizing waste.

5. **Use Water-Smart Landscaping and Irrigation:** Landscaping and irrigation practices can have a significant impact on water consumption. Adopt water-smart landscaping techniques, such as choosing drought-resistant plants, grouping plants with similar water needs, and using mulch to retain moisture. Install efficient irrigation systems, such as drip irrigation or smart irrigation controllers, which adjust watering schedules based on weather conditions and plant water requirements.
6. **Reduce Steam Sterilizer Tempering Water Use:** Steam sterilizers, commonly used in healthcare facilities and laboratories, require tempering water to cool down the sterilized items after the process. By implementing water-saving techniques such as using recirculating tempering water systems or optimizing cooling processes, you can reduce the amount of water required for sterilization.
7. **Reuse Laboratory Culture Water:** Laboratories often use large amounts of water for research and testing purposes, particularly in growing cultures. Implement water treatment systems to recycle and reuse laboratory culture water wherever possible. This can involve filtration, disinfection, and monitoring processes to maintain water quality standards for reuse.
8. **Control Reverse Osmosis System Operation**: Reverse osmosis (RO) systems are commonly used to purify water for various applications. However, they can consume a significant amount of water during the purification process. By optimizing RO system operation, such as adjusting recovery rates, monitoring system performance, and implementing efficient membrane cleaning procedures, you can reduce water waste and improve overall system efficiency.

Implementing these strategies can help organizations and individuals effectively manage water usage, reduce waste, and contribute to sustainable water management practices

5.2 EFFICIENT WAYS OF MANAGING MATERIAL IN PLUMBING PROCESS

Efficient management of materials in plumbing work is important for optimizing resources, reducing waste, and ensuring the smooth execution of plumbing projects. Here are some efficient ways to manage materials in plumbing work:

1. **Plan and Estimate Accurately**: Thoroughly plan and estimate the materials needed for each plumbing project. Take accurate measurements, consider the specific requirements of the

project, and factor in potential contingencies. This helps minimize unnecessary material purchases and reduces waste.

2. **Optimize Material Procurement**: Seek competitive bids from suppliers and choose reputable vendors that offer quality materials at reasonable prices. Consider bulk purchasing for commonly used items to take advantage of economies of scale. Additionally, maintain good relationships with suppliers to ensure timely delivery of materials when needed, avoiding project delays.

3. **Inventory Management**: Implement an organized inventory management system for plumbing materials. Regularly track and monitor the stock levels to avoid overstocking or understocking. This helps prevent unnecessary material purchases and ensures that required materials are readily available when needed.

4. **Proper Storage**: Store plumbing materials in a clean, dry, and well-organized manner. Protect them from exposure to moisture, extreme temperatures, or other damaging conditions. Proper storage extends the lifespan of materials, reducing the need for premature replacements and wastage.

5. **Waste Reduction and Recycling:** Minimize waste generation by accurately cutting and measuring materials during installation. Salvage and reuse leftover or excess materials where possible. Additionally, segregate and recycle materials such as plastic pipes, copper fittings, or scrap metals in compliance with local recycling regulations.

6. **Implement Lean Construction Practices**: Apply lean construction principles to plumbing work. This involves optimizing workflow, eliminating unnecessary steps, and minimizing material handling. By reducing waste and improving efficiency, lean practices contribute to more effective material management.

7. **Collaboration and Communication**: Foster effective communication and collaboration among plumbing teams, contractors, and suppliers. Ensure clear channels of communication to address material-related issues promptly. This helps prevent errors, miscommunications, or delays that could result in wasteful practices or material misuse.

8. **Quality Control and Inspections**: Conduct regular quality control checks and inspections

during and after plumbing work. This ensures that materials are installed correctly, minimizing the risk of leaks, failures, or premature replacements. Proper installation extends the lifespan of materials and reduces waste.

9. **Training and Skill Development**: Invest in training and skill development programs for plumbing teams. Well-trained plumbers are more likely to handle materials efficiently, reducing errors, and avoiding unnecessary material waste due to mistakes or rework.

10. **Documentation and Record-Keeping**: Maintain accurate documentation and records of material usage, receipts, and warranties. This helps track material consumption, identify patterns, and make informed decisions for future projects. It also aids in warranty claims and facilitates effective maintenance and repairs.

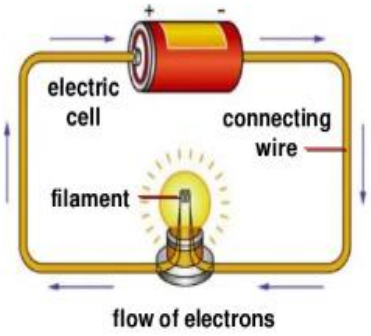


Fig 5.1 Flow of electricity

5.3 BASICS OF ELECTRICITY

An electric current is the rate of flow of electric charges in a circuit. Electricity is a form of energy that can be easily changed to other forms. There are mainly two sources of electricity:

1. Electric cells (batteries)
 - Supply a little electricity, portable, safe

Fig 5.2 Electric cells

2. Power stations
- Supply a lot of electricity, used in many electrical appliances

To make an electrical appliance work, electricity must flow through it.The flow of electricity is called an electric current. The path along which the electric current moves is called the electric circuit.

Fig 5.3 Power stations

5.3.1 Measurement of current

The SI unit for electric current is ampere (A). Smaller currents are measured in milliamperes (mA). Different electrical components and appliances require different sizes of current to turn them on.

1 A = 1000 mA
1 mA = 0.001 A

How does electricity flow?
The battery in a circuit gives energy to the electrons and pushes them around a circuit, from the negative's terminal of the cell, round the circuit and back to the positive terminal of the cell.

An ammeter is an instrument used for measuring electric current.

Fig 5.4 Ammeter

5.4 COMMON ELECTRICAL AND THERMAL EQUIPMENT USED IN A PLUMBING WORKPLACE

Following are the electrical and thermal equipment used in a plumbing workplace:

1. **Drill machine**: An instrument with an edged or pointed end for making holes in hard substances by revolving or by a succession of blows. A drilling machine, also called a drill press, is a powerful tool used to cut a round hole into or through metal, plastic, wood, or other solid materials by turning and advancing rotary drill bits into a workpiece.

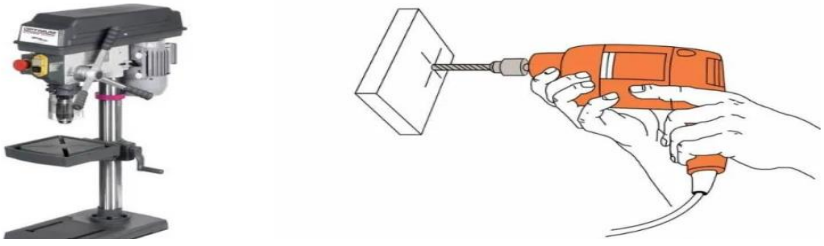


Fig 5.5 Drill Machine

- **Traditional drill:** A drill is a tool used for making round holes or driving fasteners. It is fitted with a bit, either a drill or driver chuck. with hand-operated types dramatically decreasing in popularity and cordless battery-powered ones proliferating.

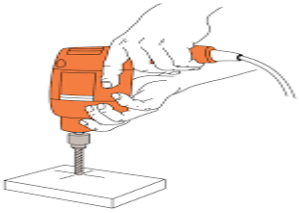


Fig 5.6 Traditional Drill

- **Hammer drill**: Hammer drills are used for drilling holes into concrete and masonry to install brackets to hold up water and waste pipes. A good quality, battery operated hammer drill is a must. When purchasing your hammer drill check the chuck size needed for the type of work you do onsite.

Fig 5.6 Hammer Drill

- **Cordless drill**: A cordless drill is an electric drill which uses rechargeable batteries. Drills are primarily used for drilling circular holes in material, or for inserting screws and other threaded fasteners into material. Drills are also available in the impact driver configuration, high-torque tools primarily used for driving screws and tightening nuts. Impact drivers can be especially useful when driving larger fasteners or driving into harder, more dense materials. Always use a spoil board under your work piece when using a handheld drill.

Fig 5.6 Cordless Drill

2. **Tester**: A test light, test lamp, voltage tester, or mains tester is a piece of electronic test equipment used to determine the presence of electricity in a piece of equipment under test.

Fig 5.7 Tester

3. **Chain saw**: Chainsaws are mechanical power tools that are commonly found everywhere – homes, construction sites, car shops, and machine shops. They are identified by their rotating teeth which are attached to a rotating chain on a guide bar. A cylinder engine with a battery pack or gasoline is essential to power the chainsaw.

Fig 5.8 Chain tester

4. **Air Testing U Gauge Kit**: Used to test drains and sewers in accordance with Building Regulations.

Fig 5.9 Air testing U Gauge kit

5. **Solder Capillary Lead-Free Wire**: Used to produce perfect joints quickly and effectively.

Fig 5.10 Solder Capillary Lead-Free Wire

6. **Super Fire 2 Torch**: Used for soldering and brazing.

Fig 5.11 Super Fire 2 Torch

7. **Propane torch**: A propane torch is a tool normally used for the application of flame or heat which uses propane, a hydrocarbon gas, for its fuel and ambient air as its combustion medium.

Fig 5.12 Propane Torch

8. **Snake Machine**: Used to dislodge clogs in plumbing.

Fig 5.13 Snake Machine

9. **Borescope**: Used to non-destructively inspect industrial systems and equipment for condition, manufactured parts for quality and security, and law enforcement for contraband, intelligence, and safety.

Fig 5.14 Borescope

10. **Heat Shields/Pads**: Used to protect objects from overheating.

Fig 5.15 Heat Shields/Pads

11. **Standard U-Gauge Manometer**: Used to measure the pressure that the difference in column heights is also a common unit.

Fig 5.16 Standard U Gauge Manometer

12. **Abrasive Mini Strips**: Used for roughing up, deburring, and removing paint and oxides from copper pipe and fittings prior to soldering.

Fig 5.17 Abrasive Mini Strips

13. **Fire resistant cloth**: Flame-resistant clothing refers to any garments that are specifically designed to protect the wearer from flames and thermal injury. It resists ignition and self-extinguishes once the source of the ignition is removed.

Fig 5.18 Fire resistant cloth

5.5 ENERGY EFFICIENT DEVICES

Energy efficient appliances and equipment use technologies that are less energy intensive to reduce the amount of electricity used per product.

Energy efficient plumbing can be a great investment for ease and convenience alone! These systems are by far easier to use than older units, as their technology is typically more functional and advanced. Because they conserve energy, these appliances can operate in less time, offering faster results and ultimately improving the quality of your home. They also tend to be more user-friendly and offer a greater degree of unique features for homeowners.

The beauty of energy efficient appliances is that they tend to have longer lifespans because they require less power and force to run properly. With reduced stress on the appliances' operations, there ends up being less wear and tear on the systems at large, resulting in better longevity and less repairs. As long as you have the systems installed by a reputable and experienced professional, you can rest assured they will have a longer lifespan.

Some common examples of Energy- Efficient Devices:

- Smart Thermostats.
- LED Lighting.
- Energy Management Systems.
- Energy Star Appliances.
- Charging Stations.
- Smart Power Strips

5.6 INDICATORS OF COMMON ELECTRICAL PROBLEMS

Here are some common electrical wiring problems and their solutions

1) Electrical surges: It can be occurred due to poor wiring in the house or lightning strikes or faulty appliances or damaged power lines. Surges are common and last for a microsecond but if you experience frequent surges lead to equipment damage that degrade life expectancy particularly.
Check the device that connects to the home grid or the wiring and try disconnecting the poor-quality power boards or devices from the outlet. If the surges don't occur again, your problem is solved. If it is not, you must call an electrician.

2) Overloading: Sometimes your light fixture has a bulb or other fitting with high watts than the designed fixture. This is a code violation and the risk level is quite high. The high heat from the bulb can melt the socket and insulation present in wires of the fixture. This results in sparks from one wire to another and causes electrical fires. Even after the bulb is removed, the socket and wires will still be under damage.
It is always better to fit a bulb or any other fittings by staying within the wattage. If the fixtures are not marked with wattage, it is advisable to use a 60-watt bulb or even smaller ones.

3) Power sags and dips: Sags are dips usually occur when the power grip is faulty and electrical appliances are connected to it. It also occurs when the grid is made of low-quality materials. When this is the case, it draws more power when switched on.

4) A junction box that is uncovered: The junction box has lots of wires that are connected to each other. If it is not covered, a person gets a shock from damaged wire too. This is a code violation and the risk is minimal if the wires are not within the reach. Thus it is better to cover it with the screws provided.

5) Switches of light not working: You can easily point out if it bad workmanship or sub-standard products with dim switches that don't work on adjusting the lights properly. It can also be the fault of wiring or circuit or outlet. You can consult an electrician for this issue.

6) Flickering light: You might have experienced with your frayed wiring when it is windy outside that causes a short when the cables move. It is not a code violation but has a higher level of risk as it can suddenly start a fire. Immediately call the electrician to get Weather head replaced.

7) Tripping circuit breaker: When other high-power consuming items are used before you plug in microwave or hairdryers there is a chance to get it tripped. Tripping is actually a sign that your home is protected. Just check what causes tripping and try using a low setting and also users can be limited to a single circuit too.

8) Less outlets: Nowadays most of the houses have extension cords and power strips to rely heavily on them. If you don't use heavy load extension cords like 14-gauge or thicker the risk will be minimal. Thus, it is advisable to use more outlets with the help of an electrician.

9) Electric shocks: When the electricity is not properly used, it results in electrical shocks with a nasty experience. The chances of such electrical problems in old homes were quite high because the circuits fitted during older days. An electric shock happens when you switch on or off a device. The issue can either be with the appliance or the wiring. To check the issue, you can test with another device.

10) No RCCB (Residual Current Circuit Breaker): RCCB is also known as Earth Leakage Circuit Breaker (ELCB). This is used to disconnect the load from main supply when the circuit has residual current. By using RCCB you can ensure protection against direct and indirect contact, electric fire and protection of earthing against corrosion.

11) Frequent burning out of light bulbs: If your light bulbs burn out too often, check if your issue falls under this:

➤ High wattage

➤ Insulation is near to light

➤ Poor wiring on circuit and mains

➤ More wattage on a dimmer switch

12) Over circuited panel: It is a code violation to place tandem breakers in one slot rather than too many single-pole breakers. The difference between double-pole breakers and tandem breakers are that the latter one doesn't take up two slots in a single circuit. The danger level will be minimal. This problem can be resolved by adding a sub-panel with extra slots or replacing the existing panel with a bigger model.

13) High electric bill: You can reduce electric bills by:

- Repairing damaged circuits or wiring
- Unplugging electronic devices when not in use
- Relying on a cost-effective service provider
- Recognizing power surging devices

14) Aluminum wiring: It has a high danger level as aluminum was used as a cheap substitute for copper in earlier days and is no longer a safe option. This is because corrosion takes place when aluminum is in contact with copper and when the connections loosen, it leads to fires.
The solution for this issue is retrofitting a dielectric wire nut for an aluminum wire to copper connection in case of light fixtures. This helps in stopping corrosion due to the grease in the nuts.

15) Backstabbed wires: The pushed wires at the back can be loose for new switches than those anchored around screw terminals. This is not a code violation as it is allowed for new constructions too. The risk occurs only when the loose wires are worst in case otherwise it stops the switch from working.

5.7 COMMON PRACTICES OF CONSERVING ELECTRICITY

Following are some basic practices which can help in conserving electricity:

1. Adjust your day-to-day behaviours

2. Replace your light bulbs
3. Use smart power strips
4. Install a programmable thermostat
5. Use energy efficient appliances
6. Reduce water heating expenses
7. Install energy efficient windows
8. Upgrade your HVAC system
9. Weatherize your home
10. Insulate your home
11. Wash your clothes in cold water
12. Replace your air filters
13. Use your microwave instead of your stove
14. Use natural light
15. Dress appropriately for the weather inside and outside.

Importance of checking if the equipment/machine is functioning normally before commencing work and ensuring is rectified.
Safety Inspections ensure that all equipment is safe before use. Of course, the primary purpose of safety is the well-being of employees, but there are also compelling business reasons for using equipment inspections to increase safety. Workplace injuries lower productivity due to lost work time.
The purpose of an inspection is to identify whether work equipment can be operated, adjusted and maintained safely, with any deterioration detected and remedied before it results in a health and safety risk.

5.8 DIFFERENT COLOURS OF DUSTBINS

There are the following colours of dustbins-

1. Green colour dustbin: Green-coloured dustbins are meant for wet and biodegradable wastes. For e.g.: kitchen wastes including vegetables and fruit skins.

Fig 5.19 Green Colour dustbin

2. **Blue colour dustbin:** It is meant for disposal of plastic wrappers and non-biodegradable wastes.

Fig 5.20 Blue Colour dustbin

3. **Yellow colour dustbin:** This dustbin is meant for paper and glass bottles.

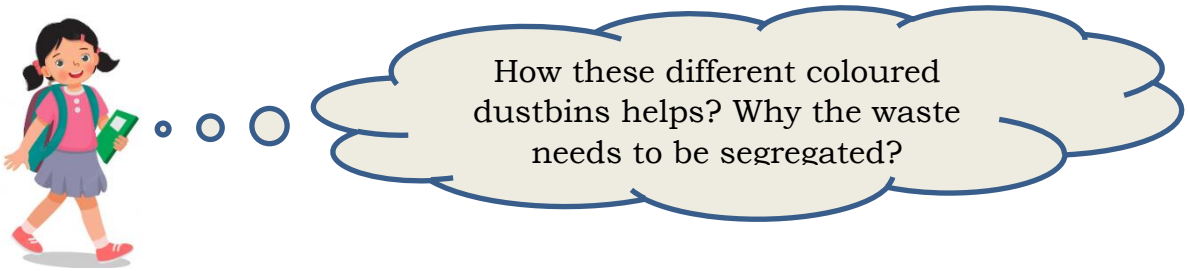
Fig 5.21 Yellow Colour dustbin

4. **Red colour dustbin:** It is used for waste that is not biodegradable. It is also regarded as rejecting dustbins as these wastes cannot be recycled.

Fig 5.22 Red Colour dustbin

5. **Black colour dustbin:** Black bin, make up for the third category, which is used for domestic hazardous waste like sanitary napkins, diapers, blades, bandages, CFL, tube light, printer cartridges, broken thermometer, batteries, button cells, expired medicine etc.

Fig 5.23 Black Colour dustbin



6. **Grey colour dustbin**: Grey bin is for the collection of materials that cannot be recycled. Some local retailers have introduced collections of soft plastics. You may be able to recycle more of your waste using these facilities.

Fig 5.24 Grey Colour dustbin

5.9 RECYCLABLE AND NON-RECYCLABLE WASTE

Recyclable resources: Recyclable resources are those substances that can be reused in any form again and again after use.
For example- one can turn a plastic bottle into a pen stand or can transform it into any other new item by recycling it.
Recycle materials- glass, paper, cardboard, metal, plastic, tires, textiles, batteries, and electronics

Non-recyclable substances: Non-recyclable substances include all those which cannot be used again and again. 90% of toys for example are made from plastics that are not recyclable.
For example- polythene bags, Garbage, Food waste, Food-tainted items (such as used paper plates or boxes, paper towels, or paper napkins), Ceramics and kitchenware, Windows and mirrors, Plastic wrap, Packing peanuts and bubble wrap, Wax boxes.

5.10 EFFICIENT WASTE MANAGEMENT PRACTICES

Waste management is important as it saves the environment from the toxic effects of inorganic and biodegradable element present in waste. Mismanagement of waste can cause water contamination, soil erosion and air contamination. Waste can be recycled if collected and managed efficiently. Some methods for waste management are -

1. Recover through Recycling.
2. Biological Reprocessing.
3. Dump in a Sanitary Landfill.
4. Waste to Energy (WtE)
5. Composting: Creating rich humus for your garden and lawn.
6. Bioremediation.
7. Thermal Treatment: Incineration.

5.11 COMMON WAYS TO MINIMIZE WASTE GENERATED FROM PLUMBING ACTIVITIES

The most desirable method of waste minimization is source reduction, which reduces the impact of chemical wastes on the environment to the greatest extent.

Simply put, waste causes pollution, contributes to climate change and squanders more money, energy and natural resources than most of us realize. Making small changes we make in our everyday lives can make a powerful difference to the health of all living things and the province and planet we call home.

There are a number of ways you can reduce waste and save money. You could:

- Work out your own ways of eliminating waste from your work, e.g. by using leftover materials from one job on the next one - this is usually cheaper than having to dispose of waste and is better for the environment. For example, you could reuse lengths of pipework during and between projects.
- Avoid over ordering, as this increases waste.
- Think about the types of waste you produce and whether they need to be dealt with as hazardous waste.
- Make sure you recycle any waste - this applies to many plumbing materials including copper, steel, lead, cast iron and aluminum.
- Reduce your packaging waste - e.g. some pipework does not require any packaging at all and can be unloaded directly off the delivery vehicle.
- Consider alternative, shorter routes for pipework.
- Purchase pre-fabricated pipework - this will reduce waste generated on site and also cut the cost of labour as installation is much quicker.

- Speak to your suppliers to find out if they use returnable packaging - e.g. crates and pallets - for products, which can be returned for reuse.
- Keep stores secure, dry and organized - bad storage can cause considerable waste.
- Protect completed work so it is not damaged by others. 'Just-in-time' delivery for pre-fabricated pipework could increase available storage on site as well as reducing the likelihood of materials becoming damaged.
- Use materials with recycled content.
- Design pine-runs to use as few fittings as possible and save resources by fitting the minimum sizes of boiler, radiators and tanks.
- Use water-saving dual-flush systems and put hippo bags in existing cisterns to reduce water use.
- Insulate pipework to prevent heat loss and frost damage.
- Avoid flushing systems into surface water drains.
- Make sure customers know how best to use what you have installed - leave manuals and clear maintenance instructions.

ACTIVITIES

Activity 1: Enlist the thermal and electrical equipment used in plumbing system and mention the uses of each.

Material Required:

1. Electrical equipment used in plumbing system
2. Thermal Equipment used in plumbing system
3. Note book
4. Pen

Procedure:

1. With the help of class teacher collect all the thermal and electrical equipment.
2. Write one by one the name of each of the components leaving some space after each title.
3. Write the properties of each of the component.
4. Discuss the properties of every component.

CHECK YOUR PROGRESS

A. Answer the following

1. Explain the common indicators of electrical problems.
2. Define the term electricity?
3. Write the importance of report malfunctioning.
4. Discuss common sources of pollution and ways to minimize.
5. List the important plumbing tool with the power.
6. Name the method of waste management at site.
7. Define waste management.
8. Write the difference between recyclable and non-recyclable resource.
9. How does electricity flow?

B. Fill in the blanks

1. …… dustbin is used for waste that is not biodegradable.
2. …….. resources are those substances that can be used in any form again and again.
3. …….. Wiring is place of copper wiring is used which is not a safer option.
4. The path along which the electric current moves is called……..
5. 1 mA = ……. A.

ANSWER KEY

Unit 1: Installation of Plumbing Fixtures

B. Fill in the blanks

1. Solenoid
2. Deep
3. Low
4. National Building Code (NBC)
5. Shut off

Unit – 02 Troubleshooting and Maintenance for Plumbing

B. Fill in the blanks

1. Corrosion
2. Stoppage
3. Magnesium
4. Galvanized, Copper

C. Multiple choice questions

1. (b) any
2. (a) thinning
3. (b) Rust
4. (c) 32

Unit -03 Health & Safety

B. Fill in the blanks

1. Powered
2. Water
3. Sun

C. Multiple choice questions

1. (a) Not properly
2. (b) Construction Worker
3. (a) Year
4. (b) Safety Cap
5. (a) Safety glass

Unit-04 Working Effectively with Others

B. Fill in the blanks

1. Team management
2. Team Work
3. Conflict
4. Respect and Patience
5. Record keeping

C. Multiple choice questions

1. (a) Elevation Goal
2. (d) Competent Member
3. (d) Opinion
4. (d) All of the above
5. (a)Cooperation

Unit -05 Optimum utilization of resources

B. Fill in the blanks

1. Red
2. Recyclable
3. Aluminum
4. Electric current
5. 0.001

GLOSSARY

C

Corrosion: natural process that converts a refined metal into a more chemically stable oxide. It is the gradual deterioration of materials (usually a metal) by chemical or electrochemical reaction with their environment.

Contaminated: to add a substance this will make something dirty or harmful.

D

Dielectric: materials that don't allow current to flow.

F

Faucet: a fixture for drawing or regulating the flow of liquid especially from a pipe

G

Gasket: mechanical seal that is used to seal two or more surfaces those are in touch with each other.

M

Manholes: an opening to a confined space such as a shaft, utility vault, or large vessel.

P

Procurement: the action of obtaining or acquiring something.

Plunger: tool used to clear blockages in drains and pipes

S

Stoppage: a blockage in either a sewer or drain line.

Sensor: a device that detects and responds to some type of input from the physical environment. The input can be light, heat, motion, moisture or pressure

T

Trap: U-shaped portion of pipe designed to trap liquid or gas to prevent unwanted flow.

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