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WATER
MANAGEMENT
AND PLUMBING
SKILL COUNCIL

Participant Handbook

Sector

Plumbing

Sub-Sector

**Industrial / Non-Industrial
Plumbing**

Occupation

**Plumbing Systems Installation
and Maintenance**



Reference ID: PSC/Q0102, Version - 4.0

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**Assistant
Plumber-General**

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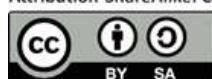
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“ Skilling is building a better India.
If we have to move India towards
development then Skill Development
should be our mission. ”

Shri Narendra Modi

Prime Minister of India



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Certificate

COMPLIANCE TO QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

WATER MANAGEMENT AND PLUMBING SKILL COUNCIL OF INDIA

for

Assistant Plumber General - PARTICIPANT HANDBOOK

Complying to National Occupational Standards of

Job Role/Qualification Pack: Assistant Plumber-General_QP NSQF PSC/Q0102 Level 3.0

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*Valid up to date mentioned above (whichever is earlier)

A handwritten signature in black ink.

Authorised Signatory
(Skilling India In Electronics)

Acknowledgements

This participant's handbook meant for Assistant Plumber-General is a sincere attempt to ensure the availability of all the relevant information to the existing and prospective job holders in this job role. We have compiled the content with inputs from the relevant Subject Matter Experts (SMEs) and industry members to ensure it is the latest and authentic. We express our sincere gratitude to all the SMEs and industry members who have made invaluable contributions to the completion of this participant's handbook.

I would like to thank the team of Feedback Advisory for their support to develop the content, the SME and the team at the ESSCI along with the industry partners for the tireless effort in bringing the handbook in the current format.

This handbook will help deliver skill-based training in the field of drone service and maintenance. We hope that it will benefit all the stakeholders, such as participants, trainers, and evaluators. We have made all efforts to ensure the publication meets the current quality standards for the successful delivery of QP/NOS-based training programs. We welcome and appreciate any suggestions for future improvements to this handbook.

About this Book

This participant handbook has been designed to serve as a guide for participants who aim to obtain the required knowledge and skills to undertake various activities as a Assistant Plumber-General. Its content has been aligned with the latest Qualification Pack (QP) prepared for the job role. With a qualified trainer's guidance, the participants will be equipped with the following for working efficiently in the job role:

- Knowledge and Understanding: The relevant operational knowledge and understanding to perform the required tasks.
- Performance Criteria: The essential skills through hands-on training to perform the required operations to the applicable quality standards.
- Professional Skills: The Ability to make appropriate operational decisions about the field of work.

The handbook details the relevant activities to be carried out by a Assistant Plumber-General. After studying this handbook, job holders will be adequately skilled to carry out their duties efficiently according to the applicable quality standards, with minimum supervision.

The handbook has been divided into an appropriate number of units and sub-units based on the content of the relevant QP. We hope it will facilitate easy and structured learning for the participants. We sincerely hope that participants will obtain enhanced knowledge and skills after studying this handbook and make career progress in the relevant and senior job roles.

The Participant Handbook is designed based on the National Skill Qualification Framework (NSQF) aligned Qualification Pack (QP) and it comprises of the following National Occupation Standards (NOS)/topics:

- 1.PSC/N0139 : Carry out Support Activities for Plumbing Work
- 2.PSC/N0140 : Maintain Plumbing Tools and Equipment
- 3.PSC/N0136 : Apply Health and Safety Practices at the Workplace
- 4.PSC/N0137 : Work Effectively with Others
- 5.DGT/VSQ/N0101: Employability Skills (30 Hours)

Symbols Used



Key Learning Outcomes



Unit Objectives



Notes



Summary



Exercise

Table of Contents

Sl.No	Modules and Units	Page No
1.	Introduction to the sector and the job role (PSC/N0139)	1
	Unit 1.1 - Plumbing Industry-An Introduction	3
2.	Basics of Plumbing (PSC/N0139)	13
	Unit 2.1 - Introduction to Plumbing	15
	Unit 2.2 - Plumbing Materials	30
	Unit 2.3 - Plumbing Tools and Equipment	53
3.	Basic Tasks to Facilitate Plumbing Work (PSC/N0139)	66
	Unit 3.1 - Standard Operating Procedures	68
4.	Maintaining the Plumbing Tools and Equipment (PSC/N0140)	79
	Unit 4.1 - Tool Maintenance	81
	Unit 4.2 - Plumbing Tools Defects	83
	Unit 4.3 - Advanced Tools, Equipment, and Materials	87
5.	Health and safety (PSC/N0136)	93
	Unit 5.1 - Dealing with workplace Hazards & Risks	95
	Unit 5.2 - Fire Safety Practices	107
	Unit 5.3 - First-aid Practices	112
6.	Working Effectively With Others (PSC/N0137)	118
	Unit 6.1 - Work and Communicate Effectively at Workplace	120
	Unit 6.2 - Work in a Disciplined and Ethical Manner	130
	Unit 6.3 - Uphold Social Diversity at the Workplace	137
7.	Employability Skills (DGT/VSQ/N0101)	145

The book on New Employability Skills is available at the following location:

<https://eskillingindia.org/NewEmployability>



Table of Contents

Sl.No	Modules and Units	Page No
8.	Annexure	146
	Annexure - QR Codes	147



1. Introduction to the sector and the job role

Unit 1.1 - Plumbing Industry-An Introduction



Key Learning Outcomes



At the end of this module, the trainee will be able to:

1. Explain the importance of plumbing industry
2. Describe the key responsibilities of an assistant plumber general

UNIT 1.1 - Plumbing Industry-An Introduction

Unit Objectives



At the end of this Unit the trainee will be able to:

1. Outline the overview of the plumbing industry
2. List the common types of plumbing systems that are installed in residential setups
3. Discuss the scope of employment in the contracting segment of the industry
4. List the key responsibilities of an assistant plumber general

1.1.1 Overview of the Plumbing Industry

As India's real estate market continues to expand people are spending more money on bathroom fixtures and luxuries than on their living rooms. Today, the pipes and fittings industry is crucial to ensuring the ethical and safe use of water. Irrigation, sanitation, and building have seen an increase in demand for plastic pipes; these industries have emerged as major contributors to the market's quick expansion in India. According to Technopak Advisors Pvt Ltd, a Delhi-based retail consultancy firm the luxury home decor market is expanding at a rate of 25% per year and is predicted to reach \$2 billion by 2015. With more complicated structures being developed and built, there is an increasing demand for trained plumbers. A National Skill Development Council study found that only 0.5% of plumbers in this country are properly trained. There will be a huge need for 12 lakh trained plumbers in the future but presently only 2.5 lakh and the majority of them are untrained or self-taught.

India is predicted to have substantial growth over the next few years on the back of expanding urbanization, rising infrastructure development, and the government's push for infrastructural growth. Between FY 2018 and FY 2026, the pipes and plastic fittings industry is anticipated to have a CAGR of 14%. Favorable legislative environments and citizen-focused efforts, such as the implementation of "Housing for All" programs and the goal of increasing farmer income through improved infrastructure, are among the main drivers of the sector's expansion. The identification of fresher uses for CPVC and the expansion of UPVC pipes into new markets have also turned out to be helpful accelerators. The domestic plastic pipe market is expected to be worth Rs. 315 billion, with organized companies holding a 60% share of the market. Although the epidemic forced most industries to reassess how they conduct business, the building sector found itself with a rare chance to innovate and expand. As unorganized producers continue to lose market share, organized players have outpaced industry growth.

Future of the Plumbing Industry

Hands-free products will be widely used, particularly in public restrooms. Sensor-based parts would be the ideal option, for the commercial environment. Although practically all significant businesses have had to reevaluate how they conduct business as a result of the pandemic, the construction sector in particular offers a special chance to change and advance.

1.1.2 Common Types of Plumbing Systems

Residential buildings are made as per the requirements of people. The residential setups may be single-floor independent houses as well as multi-storey apartments. Water is supplied to a house or a building from a storage tank through pipes. Similarly, the wastewater from the kitchen and washrooms is drained out with the help of pipes.

Common types of plumbing systems for water supply are:

Lifting of water from storage tank to overhead water tank

Distribution of water from overhead tank to different outlets like washroom, kitchen etc

Fig 1.1 Plumbing Systems for Water Supply

The most common types of plumbing systems for disposal of wastewater are:

Single Stack System

Partially Vented Single Stack System

One-Pipe System

Two-Pipe System

Fig 1.2 Plumbing Systems for Waste Water

Notes



1.1.3 Various Types of Plumbing Systems in Residential Setups

Building plumbing systems consist of an underground tank that receives water from municipal or water department supply lines, an above tank that receives water from pumps and piping distribution systems, and residential outlets that receive water via gravity. Different types of plumbing systems are:

Sanitary drainage system

Stormwater drainage system

Potable water system

Fig 1.3 Different types of plumbing systems

1. Sanitary Drainage

A drainage system (drainage piping) refers to all piping within public or private property that transports sewage, rainwater, or other liquid wastes to a legal point of disposal. The mains of a public sewer system and sewage treatment or disposal facilities are not included in a drainage system.



Fig 1.4 Sanitary Sewer System

Source: <https://www.dreamstime.com/stock-illustration-sanitary-system-diagram-text-schematic-section-view-illustration-contemporary-sewer-depicting-residential-connection-image63622857>

2. Storm Water Drainage System

You may have observed some little holes on the sidewalk which are known as storm drains. These are employed to transport extra water away from a building. The water that entered a storm drain used to drain into a sanitary drainage system in the old days. Moreover, they still do in some places. Rainwater is now, however, diverted to a storm drain. Gutters play an important role in draining rainwater. However, neglecting to maintain the gutters can result in significant problems. Following are the common signs of malfunctioning gutters:

- The paint starts peeling off the house
- The gutters are cracked
- The gutters are split
- Your home has sustained water damage

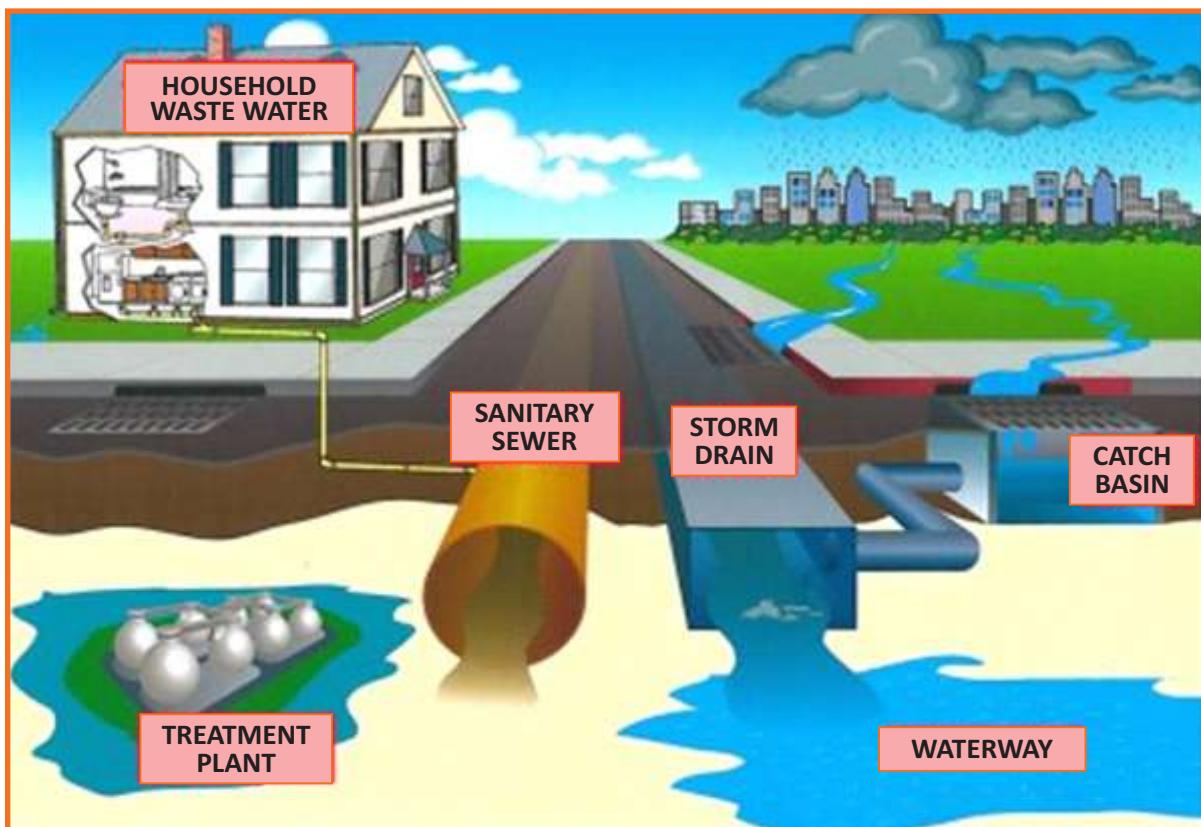


Fig 1.5 Stormwater Drainage System

Source: <https://www.deep trekker.com/resources/storm-water>

3. Potable Water System

A potable water system is what enables people to use water within a building. A single system connects a number of different pipes that make up this system. This system has a valve that can be used to shut off the water supply. Additionally, a meter that displays the amount of water consumed throughout the facility is typically included.

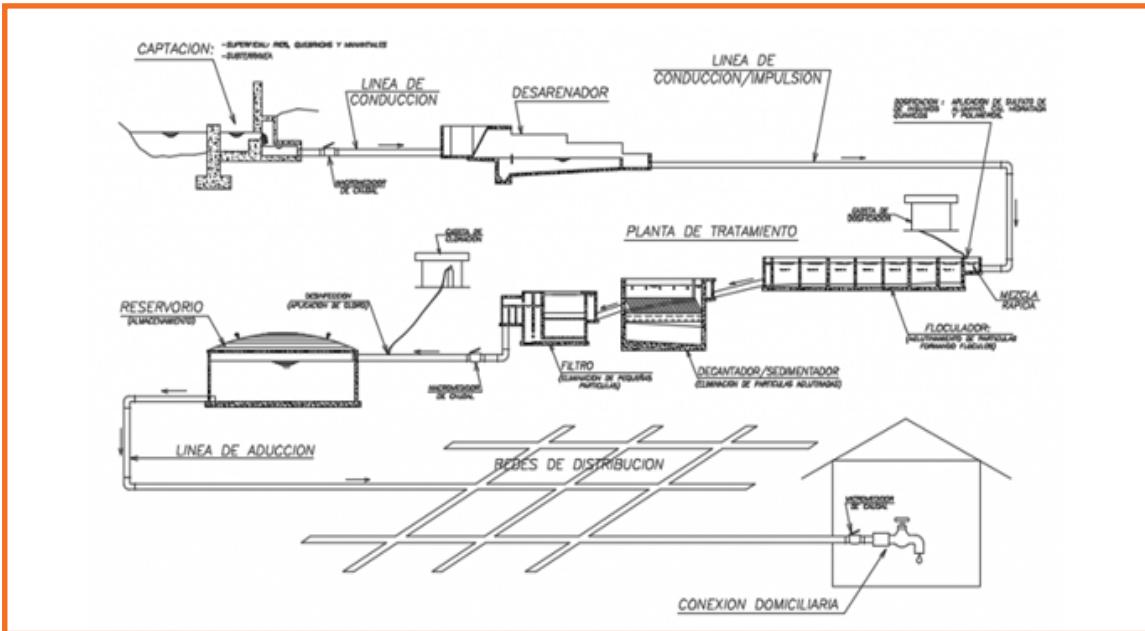


Fig 1.6 Potable Water System

Source: <https://in.pinterest.com/pin/potable-water-system-plumbing-details-of-garden-dwg-file--306315212157645288/>

1.1.4 Scope of Employment in the Contracting Segment

The plumbing Industry in India faces a huge challenge of a skill gap between the availability and demand of skilled workers. Odisha's Kendrapara district has a greater number of plumbers in India but only 10% are organized, and 90% of the total plumbers are from the unorganized sector. Most plumbers learn their work from their experience, they do not get any formal training. The plumbing industry is in desperate need of training that can spread the necessary information and help to meet the rising demand. The plumbing industry as a whole is mostly disorganized and depends on a contract workforce. Contractors, manufacturers, and consultants mostly work independently without proper knowledge of tools and safety practices.

Plumbers are trained through programs like the Pradhan Mantri Kaushal Vikas Yojana (PMKVY), DAY-NULM (Deendayal Antyodaya Yojana-National Urban Livelihoods Mission), and state-specific skill development programs. Women plumbers in India now have the chance to participate in IPSC training. Similar to this, brands like Truflo by Hindware are partnering with IPSC to release relevant training modules, as are educational/training institutions like the International Association of Plumbing and Mechanical Officials (IAPMO), Indian Institute of Plumbing (IIP), MKG Consultants, and Northern Sanitations P. Ltd. All India Council of Technical Education (AICTE) has signed a Memorandum of Understanding (MoU) with Indian Plumbing Education (IPA) in order to establish plumbing education in Engineering and Architecture schools across India. As per the recent data from the U.S. Bureau of Labor Statistics (BLS) the demand for services provided by the plumbing industry is anticipated to grow over the following 5 years.

1.1.5 Plumbing Industry Sub-Sectors

The services of plumbers are required in the following sectors:

Construction

Fire Fighting

Air-Conditioning

Industrial Waste Management

Gas Supply

Sewage and Drainage

Water Supply and Water Treatment

Fig 1.7 Plumbing Sub Sectors

There are three main divisions in the plumbing industry:

- I. Plumbing consultants
- II. Manufacturers of Plumbing related products
- III. Contractors and Plumbers in the construction industry

Notes



1.1.6 Key Responsibilities of an Assistant Plumber General

An assistant plumber general helps the plumber install and fix plumbing fixtures and fittings. The person performing the job sets up and distributes tools, cleans up the workspace, and cuts and bends pipes according to the required dimensions. Along with helping the plumber, the person performs other jobs as directed. Assistant Plumber - General must be able to perform laborious work, be good at receiving and following instructions, and be a good team player. The person must have good listening skills, be result oriented and have an eye for detail. The roles and responsibilities of an assistant plumber general are listed below:

- Assists the plumber in installation and repair of plumbing fittings and fixtures
- Prepare the work area, tools and materials for plumbing tasks
- Carry out basic plumbing related tasks such as handing over tools, fit off of pipes, securing the pipes and fixtures, etc.
- Maintain plumbing tools and equipment
- Adhere to health and safety practices at the workplace
- Work in an effective manner
- Optimize resource utilization at the workplace

Fig 1.8 Roles and Responsibilities of an Assistant Plumber General

Notes



Summary



- Today, the pipes and fittings industry is crucial to ensuring the ethical and safe use of water. Irrigation, sanitation, and building have seen an increase in demand for plastic pipes; these industries have emerged as major contributors to the market's quick expansion in India.
- A National Skill Development Council study found that only 0.5% of plumbers in this country are properly trained.
- There will be a huge need for 12 lakh trained plumbers in the future but presently only 2.5 lakh and the majority of them are untrained or self-taught.
- India is predicted to have substantial growth over the next few years on the back of expanding urbanization, rising infrastructure development, and the government's push for infrastructural growth.
- Hands-free products will be widely used, particularly in public restrooms. Sensor-based parts would be the ideal option, for the commercial environment.
- The residential setups may be single-floor independent houses as well as multi-storey apartments. Water is supplied to a house or a building from a storage tank through pipes. Similarly, the wastewater from the kitchen and washrooms is drained out with the help of pipes.
- A drainage system (drainage piping) refers to all piping within public or private property that transports sewage, rainwater, or other liquid wastes to a legal point of disposal.
- You may have observed some little holes on the sidewalk which are known as storm drains. These are employed to transport extra water away from a building.
- A potable water system is what enables people to use water within a building. A single system connects a number of different pipes that make up this system.
- The plumbing Industry in India faces a huge challenge of a skill gap between the availability and demand of skilled workers.
- Odisha's Kendrapara district has a greater number of plumbers in India but only 10 % are organized, and 90% of the total plumbers are from the unorganized sector.
- The plumbing industry is in desperate need of training that can spread the necessary information and help to meet the rising demand.
- Plumbers are trained through programs like the Pradhan Mantri Kaushal Vikas Yojana (PMKVY), DAY-NULM (Deendayal Antyodaya Yojana-National Urban Livelihoods Mission), and state-specific skill development programs.
- An assistant plumber general helps the plumber install and fix plumbing fixtures and fittings. The person performing the job sets up and distributes tools, cleans up the workspace, and cuts and bends pipes according to the required dimensions.

Exercise



Answer the following questions :

1. Write a brief note on the plumbing industry and its future.

2. Write a brief note on common types of plumbing systems used in residential buildings.

3. List the roles and responsibilities of an assistant plumber general.

Notes



Notes

QR Code

Scan the QR Code to watch the related video



<https://youtu.be/Rfz1zVu8VaQ>
Overview of the Plumbing Industry



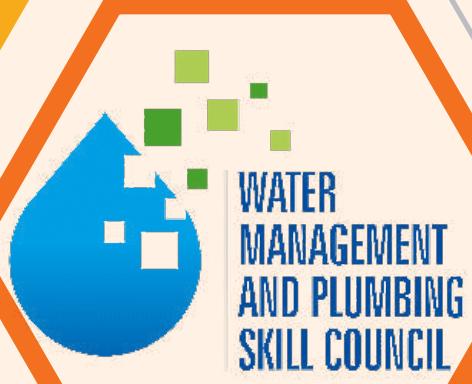
<https://youtu.be/Fq7FlsuNCQI>
2 Scope of Employment in the Contracting Segment



<https://youtu.be/-bvZCdMecEo>
Plumbing Cycle



https://youtu.be/8jxRn-T_LCs
Various Types of Plumbing Systems in Residential
and Commercial Setups



2. Basics of Plumbing

Unit 2.1 - Introduction to Plumbing

Unit 2.2 - Plumbing Materials

Unit 2.3 - Plumbing Tools and Equipment



Key Learning Outcomes



At the end of this module, the trainee will be able to:

1. Identify the various plumbing related systems, materials, tools and equipment
2. Summarize the common terms, symbols and jargon used in plumbing

Unit 2.1 - Introduction to Plumbing

Unit Objectives



At the end of this Unit the trainee will be able to:

1. Explain the process of mains supply of water and drainage
2. Identify the various types of symbols and terminologies used in plumbing installation and maintenance
3. Describe the International System (SI) of measurement relevant to plumbing work

2.1.1 Plumbing System

Plumbing is defined as a system of pipes and fixtures installed in a building used for supplying water and removing the used water and waterborne wastes. Every home and building must have a plumbing and sanitary system. The plumbing system must be planned and designed properly in order to meet the residents' needs for hygiene. According to reports, plumbing and sanitary work account for around 8% of a building's construction costs. The primary functions of a plumbing system are:

- I. To provide a sufficient amount of potable hot and cold-water supply for a house's occupants.
- II. To drain all sewage and wastewater from fixtures into a public sewer system.

Water is supplied from storage tanks to a home or building through pipes. Similar to that, pipes are used to drain out the wastewater from the kitchen and bathrooms. Plumbing and sanitary systems are necessary for any structure to operate correctly, whether it is residential, commercial, or industrial. Therefore, it is crucial to have a consistent and ample water supply as well as an appropriate method for disposing of wastewater. Plumbing and pipe-fittings play an important role in all types of building constructions. An effective plumbing system ensures greater sanitation and keeps the atmosphere free from bad smells. Any building should be constructed with an effective plumbing plan and general sanitation. The plumbing in many buildings has suffered as a result of inadequate consideration given to these factors, which has led to major difficulties for building occupants. A properly designed plumbing system helps to avoid the possibility of contamination of protected water.

2.1.2 Process of Mains Supply of Water and Drainage

Water is supplied to a house or a building from a storage tank through pipes. Similarly, the wastewater from the kitchen and washrooms is drained out with the help of pipes. Plumbing systems are designed as per the water requirement. The plumbing system installed in the building is used for the supply of water for human use and the disposal of human waste. The plumbing system of a building will include the water distribution pipes, the fixture, and the fixture traps, the waste, soil and the vent pipes, the building drain and building sewer, storm drainage system with their connected devices, connections, and appurtenances within the building and outside, that is within the premises.

Common types of plumbing systems for water supply are as:

- I. Lifting of water from the storage tank to the overhead water tank.
- II. Distribution of water from the overhead tank to different outlets like washroom, kitchen, etc.

The most common types of plumbing systems for disposal of wastewater are:

- I. Single stack system
- II. Partially vented single stack system
- III. One pipe system
- IV. Two pipe system

1. Single Stack System

The single stack system is the simplest form of plumbing system among the four categories mentioned. This network of pipes transports the wastewater from the sinks, toilets, and washrooms as well as the gross materials from the water closets. This is joined to the final single pipe. The pipe will terminate as the vent pipe at its top. Traps filled with 75mm water seal must be used with a single stack system.

2. Partially Vented Single Stack System

The single stack system has been modified by this system. Similar in that all soil and waste pipes merge into a single vertical pipe, each toilet has a relief vent pipe built to provide ventilation for its water traps in order to prevent siphonage's detrimental consequences. Sinks, showers, and basin pipes do not have separate vent pipes. Once more, this style of plumbing system is more than suitable for our wet floor drain. The below figure shows the basic arrangement of a partially vented single stack system.

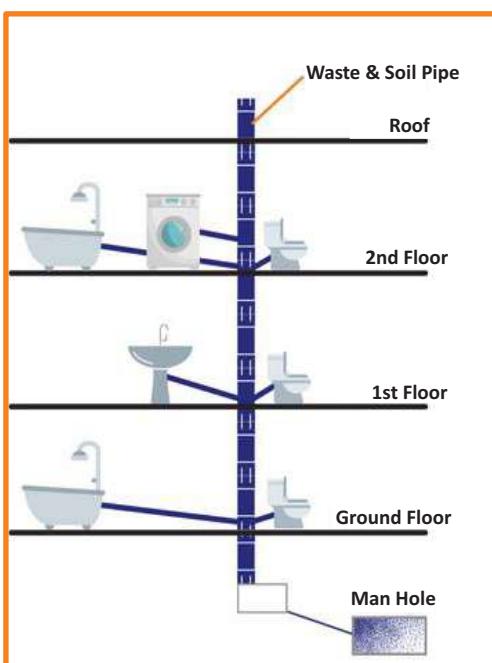


Fig 2.1 Single Stack System

Source :

<https://seaqual.co.za/blogs/news/plumbing-systems-in-buildings>

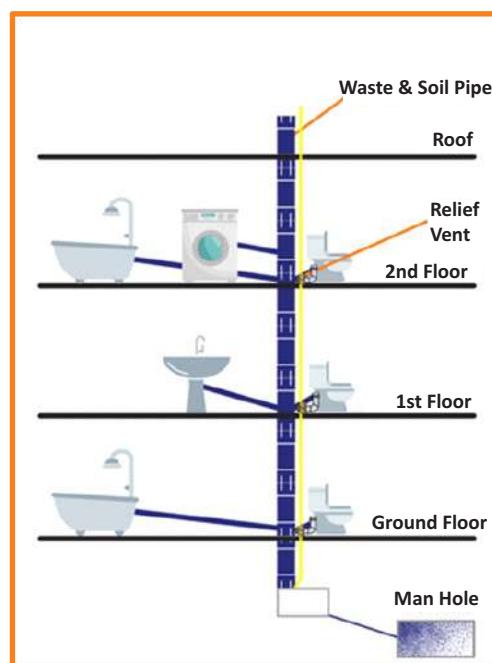


Fig 2.2 Partially Vented Single Stack System

Source:

<https://seaqual.co.za/blogs/news/plumbing-systems-in-buildings>

3. One Pipe System

In this system, soil pipes and waste pipes are joined to form a single pipe that empties into the sewage system. Toilets must be built exactly above one another in a multi-story building, and every trap must have a vent linked to it to keep waste from being sucked out. A single-stack system is less expensive than this one.

4. Two Pipe System

Plumbing systems with two pipes are secure and have been used for a long time. When you wish to recycle wastewater for use in your garden, they are a particularly wise choice. There are two vertical pipes placed in this plumbing setup. One is connected to the building's toilets and urinals by a dirt pipe, and the other is connected to sinks, showers, a washing machine, etc (waste pipe). Every pipe has a pipe vent that carries waste gases to the roof. The waste pipe is connected to the stormwater system or recycled for use in the garden via a trapped gully, while the soil pipe is directly connected to the sewage system. This method can be costly because it requires a total of 4 pipes.

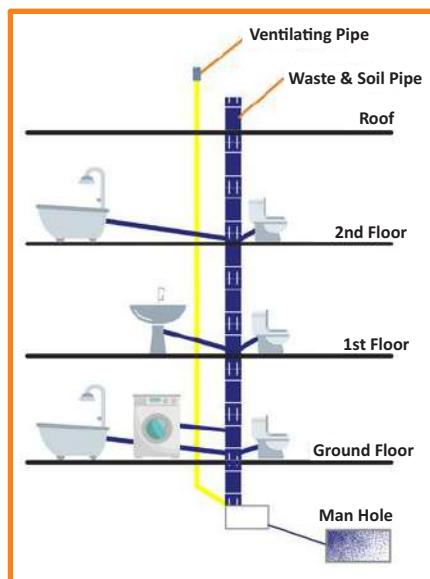


Fig 2.3 One Pipe System

Source:
<https://seaqual.co.za/blogs/news/plumbing-systems-in-buildings>

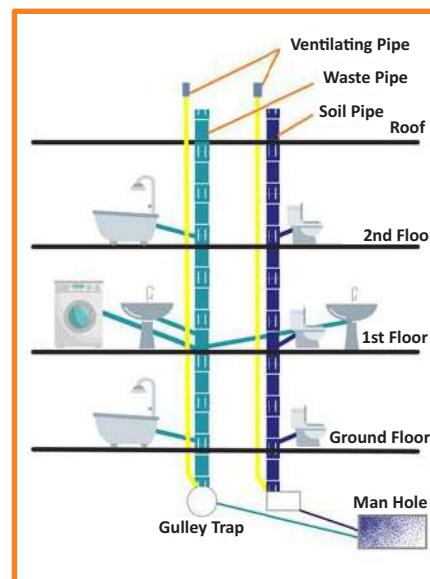


Fig 2.4 Two Pipe System

Source:
<https://seaqual.co.za/blogs/news/plumbing-systems-in-buildings>

Notes



2.1.3 Plumbing Symbols

A trained plumber does the installation of the fittings and fixtures as per the drawing provided in the assembly sheet of the plumbing fixture in the manufacturer's catalog. Identification of the symbol given in the drawing in the fixtures makes the installation work easy for a plumber. Different Plumbing symbols are listed below:

	ILLUSTRATED	SYMBOLS (THREADED)
90° ELBOWS		
STRAIGHT TEE		
REDUCING TEE		
SANITARY TEE		
P-TRAP		
GATE VALVE		
SHOWER HEAD		
LAVATORY (SINKS)		
BATH TUBS		
SHOWER STALL		

Fig 2.1 Plumbing Symbols

Source: <https://www.pinterest.com/pin/566679565596238989/>

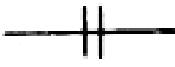
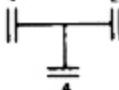
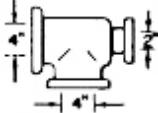
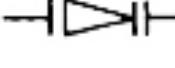
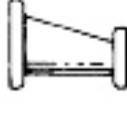
ITEM	SYMBOL	SAMPLE APPLICATION (S)	ILLUSTRATION
PIPE	SINGLE LINE IN SHAPE OF PIPE USUALLY WITH NOMINAL SIZE NOTED		
JOINT- FLANGED	DOUBLE LINE		
SCREWED	SINGLE LINE		
BELL AND SPIGOT	CURVED LINE		
OUTLET TURNED UP	CIRCLE AND DOT		
OUTLET TURNED DOWN	SEMICIRCLE		
REDUCING OR ENLARGING FITTING	NORMAL SIZE NOTED AT JOINT		
REDUCER CONCENTRIC	TRIANGLE		
ECCENTRIC	TRINGLE		
UNION SCREWED	LINE		
FLANGED	LINE		

Fig 2.2 Plumbing Symbols

Source: <https://www.pinterest.com/pin/566679565596238989/>

	WATER METER		COLD WATER
	HOT WATER		VENT LINE
	SANITARY WASTE		GAS PIPE
	GATE VALVE		WATER HEATER SHUT OFF
	WATER CLOSET		LAVATORY
	WATER HEATER		DISHWASHER
	CLOTHES WASHER		FLOOR DRAIN
	CLEAN OUT		VENT THRU ROOF
	90 DEGREE ELBOW		PIPE TURNS UP
	PIPE TURNS DOWN		TEE
	UNION		CAP

Fig 2.3 Plumbing Symbols

Source: <https://www.pinterest.com/pin/566679565596238989/>

2.1.4 Plumbing Terminologies

It is important to understand the basic terminologies used in plumbing. Understanding these words can assist the Plumber general to prepare and estimate their work as well as comprehend the plumbing fixture assembly page in the manufacturer's catalog. Some commonly used plumbing terminologies are listed below:

Plumbing Terminology	Description
Airgap	The distance between the lowest point of a water inlet or pipe to a tank and the overflowing level of the tank
AC pipes	Asbestos-Cement pipe used in water distribution systems
Appliance	a container or equipment where water is heated, treated, metered, or used before passing to waste
Auger	A tool having a rotating helical screw blade used for drilling a hole
Available head	The head of water available at the point of consideration due to main's pressure or overhead tank or any other source of pressure
Backflow	It is an unwanted flow of water in the reverse direction. It leads to wastage of water and it is due to leakage or defect in the system.
Backflow prevention device	It allows water to flow in one direction but never in the opposite direction. It also helps to prevent drinking water from being contaminated due to backflow
Back siphonage	The backflow of used, contaminated, or polluted water into a water supply pipe from a plumbing fixture or vessel as a result of lowered pressure in that line.
Bathroom vanity	The combination of the bathroom sinks or basin and the storage that surrounds it.
Bidet	It is a special plumbing device that enables someone to wash their inner buttocks, anus, and genitalia with water after using the restroom. In developed countries, these fittings are quite popular
Branch	Any part of the piping system other than a main pipe is known as branch
Branch Soil Waste Pipe (BSWP)	It is used to connect one or more soil appliances to the main soil pipe
Branch Ventilating Pipe (BVP)	A pipe, one end of which is connected to the system adjacent to the trap of an appliance and the other to a main ventilating pipe or a drain-ventilating pipe. It is fitted to prevent loss of water seal from a trap, owing to partial vacuum back pressure, or surging caused by air movement within the pipe system. It also provides ventilation for the branch waste pipe.

Continued...

Plumbing Terminology	Description
Branch Waste Pipe (BWP)	It is used to connect one or more waste appliances to the main waste pipe
Building drain	The building (house) drain is a component of a drainage system's lowest horizontal pipework that collects the drainage from soil, waste, and other drainage pipes located inside the structure's walls. Beginning one meter outside the building wall, it transports the discharge to the building (house) sewer.
Building sewer	The portion of the horizontal drainage system known as the building (house) sewer extends from the end of the building drain and collects the building drain's discharge before transporting it to a public sewer, a private sewer, a person's individual sewage-disposal system, or another point of disposal.
Burr	It is a raised edge or a little piece of material that is still attached to the workpiece after a modification operation. Deburring is the process of removing an undesired portion of material using a de-burring tool.
Cistern	It is a tank for storing water, especially one supplying taps or as part of a flushing toilet
Cleaning eye	It is referred to as an access eye or cleaning eye when a removable plug with a removable cover is installed into the pipe fitting as an eye opening and obstacles are removed through this opening.
Couplers	A pipe connector known as a coupler is used to unite two pieces of pipe that are either the same diameter or of different diameters. Depending on the need, a coupler's one end may have a larger or smaller diameter.
Crown of trap	The top-most point of the inside of a trap outlet.
Direct tap	A tap or faucet, which is connected to a supply pipe and subject to pressure from the water main
Down take tap or faucet	A tap or faucet connected to a system of piping, not subject to water pressure from the water main
Drain water outlet	Any pipe which conveys discharges from sanitary appliances in a drainage system.
Drain ventilating pipe (DVP)	It is a pipe that was installed to supply airflow to or from a drain in order to avoid an excessive concentration of sluggish air in the drain. Anywhere the main soil pipe or main waste pipe's higher portions, which do not receive discharges, are extended to roof level and left open to the air, they can be used as drain ventilating pipes.

Plumbing Terminology	Description
Dwelling	It is a structure that was made, built, or specifically designed with human habitation in mind. It might consist of garages, additional outhouses, etc.
Escutcheon	A flat piece of metal for protection and often ornamentation, around a keyhole, door handle, or light switch
Fitting	It refers to the plumbing system's fittings used to connect any section of tubes or straight pipes. Elbow, tee, socket, reducer, etc. are a few examples.
Fixture unit	A measurement that expresses the load-producing impacts on the plumbing system caused by various types of plumbing fittings on a randomly selected scale.
Flange	it is a plate or ring that forms a rim at the end of the pipe when attached to a pipe. A flange junction is a pipe connection where the connecting sections are fastened together using flanges.
Fracture	Plumbing pipes, fixtures, or fittings may have portions that are fractured or cracked as a result of high pressure or clogging, which leads to leakage.
Gasket	Mechanical seals, generally ring-shaped and fitted for sealing flange joints
Horizontal pipe	Any pipe or fitting which makes an angle of more than 45° with the vertical
Induced siphonage	The extraction of water from a trap by a siphonage set up by the reduction of pressure at the outlet of the trap
Main soil pipe (MSP)	A pipe connecting one or more branch waste pipes to the drain
Main soil waste pipe (MSWP)	A pipe connecting one or more branch soil waste pipe to the drain
Main ventilating pipe (MVP)	A pipe that receives a number of branch ventilating pipes
Main waste pipe (MWP)	A pipe connecting one or more branch waste pipes to the drain
Nipple	It is a length of pipe with thread on both sides that can be used to extend plumbing lines quickly
O-ring	An O-shaped ring that is attached to the faucet to prevent water from oozing out of the spout
Pipe ears	Two wings cast integrally with the pipe socket provided with holes to take fixing nails or screws

Plumbing Terminology	Description
Plunger	It is a tool used for cleaning normal blockage in drains and pipes, washbasin, etc.
Potable water	Water that satisfies the specifications of the Bureau of Indian Standards and is suitable for drinking, cooking, and domestic uses (BIS)
Sealing ring	It is a type of gasket used in connecting any fixture or joints to create leak-proof conditions.
Service pipe	The pipe that connects a multi-story building's distribution main on the street to its riser, or a single home's water supply, is subjected to water pressure from that main.
Soil pipe (SP)	The pipe that carries waste water and toilet waste
Supply pipe	The pipes which lead from the distribution main of water supply to the plumbing system of the house
Trap	It prevents sewer gases from entering the buildings
Vertical pipe	Any pipe which is installed in a vertical position or which makes an angle of not more than 45° with the vertical
Warning pipe	An overflow pipe so fixed that its outlet, whether inside or outside a building, is in a visible position where the discharge of any water from it can be readily seen
Washout valve	A device at the bottom of the tank used to empty the tank so it may be cleaned, maintained, etc.
Water line	A line drawn inside a cistern to designate the level at which the supply valve should be adjusted to cut off the water supply.
Water main	It is a pipe installed by the water undertakers with the intention of providing a broad water supply as opposed to delivery to specific clients. It also includes any equipment connected to such a pipe.
Water seal	Water in a trap that serves as a barrier to airflow through the trap
Water supply system	It is made up of the water supply pipe, the water distribution pipe, and all fittings, control valves, and connecting pipes that are inside or close to the building or premises

Table 2.1 Plumbing Terminologies

2.1.5 International System (SI) of Measurement

A plumber needs to be proficient at measuring plumbing supplies with the aid of measuring instruments and have no trouble handling unit conversions. A plumber should also be able to read and comprehend the various symbols used in plumbing designs. According to the plumbing work's requirements and strategy, plumbing supplies are required. Plumbing accessories and fixtures come in a variety of sizes and styles on the market. The plumbing fixtures can range in size from an inch to a foot and a meter in height. Plumbing supplies including water tanks, storage containers, and flush tanks are also available based on volumetric capacity.

Measurement of Length

A plumber uses metallic tapes, cloth tapes, a scale, and foot rule for measuring. Metallic tape should be used for accuracy in the measurement. Meter and its divisions are printed on measuring tapes.

The symbol of feet is ('') and the symbol of inch is ("").

- For example, the meaning of 4'-9" is 4 feet 9 inches.
- Both the systems i.e., metric system and F.P.S. are used in plumbing.

The conversion table for length is depicted below:



Metric System	
1 metre	= 10 decimeter (dm)
1 metre	= 100 centimetre (cm)
1 metre	= 1000 millimetre (mm)
10 millimetre	= 1 centimetre (cm)
10 centimetre	= 1 decimeter (dm)
10 decimetre	= 1 meter (m)
FPS System	
1 feet	= 12 inches
3 feet	= 1 yard
Inter-relation of Metric and FPS system	
Both type of systems can be interrelated, for taking length, in the following manner:	
1 inch = 25.4 mm = 2.54 cm	
1 metre = 39.37 inches = 1.09 yard	

Table 2.2 Length Conversion Table

Measurement of Weight

Weight measurement, using both the systems, is done in the following:

1 kilogram	= 10 hectograms
1 kilogram	= 100 decagram
1 kilogram	= 1000 gram
100 kilogram	= 1 Quintal
1000 kilogram	= 1 metric ton
1 kilogram	= 2.2046 pounds

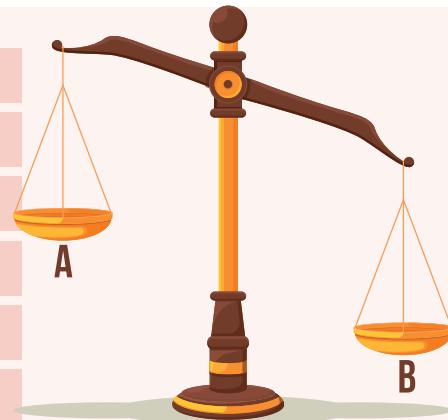


Table 2.3 Weight Conversion Table

Measurement of Volume

Capacity conversion is depicted in the following table:

1 liter (l)	= 1 cubic decimeter	= 61.0270515 cu.in. or 0.03531 cu. ft. or 1.0567
1 liter (l)	= 1 cubic decimeter	= 61.0270515 cu.in. or 0.03531 cu. ft. or 1.0567
10 liters	= 1 deciliter (Dl.)	= 2.6417 gal., or 1.135 pk.
10 deciliters	= 1 hectoliter (Hl.)	= 2.8375 bu.
10 hectoliters	= 1 kiloliter (Kl.)	= 61027.0515 cu.in. or 28.375 bu.
1 cubic foot	= 28.317	
1 gallon, Amer	= 3.785 l.	
1 gallon, Brit	= 4.543 l.	
1 gallon	= 4.546 liter	

Table 2.4 Volume Conversion Table

Measurement of Density

Density conversion is depicted in the following table:

1 lb./ft ³	= 16.018 kg/m ³
1 kg./m ³	= 0.0624 lb./ft ³
1 lb./cu.inch	= 27.68 gms/cu.cm.

Table 2.5 Density Conversion Table

Measurement of Pressure

Pressure conversion is depicted in the following table:

1 lb./ft ²	= 4.8824 kg/m ³	= 1 lb/meter ² = 6.895 Kg. Newton/M ²
1 lb./inch ²	= 0.0703 kg/cm ³	

Table 2.6 Pressure Conversion Table

Comprehensive Conversion Table

Millimeters	= 25.400	x inches
Meters	x 3.2809	= feet
Meters	= 0.3048	x feet
Kilometers	x 0.621377	= miles
Kilometers	= 1.6093	x miles
Square centimeters	x 0.15500	= square inches
Square centimeters	= 6.4515	x square inches
Square meters	x 10.76410	= square feet
Square meters	= 0.09290	x square feet
Square kilometers	x 247.1098	= acres
Square kilometers	= 0.00405	x acres
Hectares	x 2.471	= acres
Hectares	0.4047	x acres
Cubic centimeters	x 0.061025	= cubic inches
Cubic centimeters	= 16.3266	x cubic inches
Cubic meters	x 35.3156	= cubic feet
Cubic meters	= 0.02832	x cubic feet
Cubic meters	x 1.308	= cubic yard

Continued...

Cubic meters	= 0.765	x cubic yard
Liters	x 61.023	= cubic inches
Liters	= 0.01639	x cubic inches
Liters	x 0.26418	= U.S.gallons
Liters	= 3.7854	x U.S.gallons
Grams	x 15.4324	= grains
Grams	= 0.0648	x grains
Grams	x 0.03527	ounces, avoirdupois
Grams	= 28.3495	x ounces, avoirdupois
Kilograms	x 2.2046	= pounds
Kilograms	= 0.4536	x pounds
Kilograms per sq.cm.	x 14.2231	= lb. Per. sq.in.
Kilograms per sq.cm.	= 0.0703	x lb.per.sq.in
Kilogram per cubic meter	x 0.06243	= lb.per.cu.ft.
Kilogram per cubic meter	= 16.01890	xlb.per.cu.ft.
Metric tons (1000 kilograms)	x 1.1023	x tons(2000 lb.)
Metric tons (1000 kilograms)	= 0.9072	x tons (2000 lb.)
Kilowatts	x 1.3405	= horsepower
Kilowatts	= 0.746	x horsepower
Calories	x 3.9683	= B.t.u.
Calories	= 0.2520	x B.t.u.
Francs	x 0.193	= dollars
Francs	= 5.18	x dollars

Table 2.7 Comprehensive Conversion Table

Measurement Tips

- To find the circumference of a circle, multiply the diameter by 3.1416.
- To find the diameter of a circle, multiply the circumference by .31831.
- To find the area of a circle, multiply the square of the diameter by .7854.
- The radius of a circle $\times 6.283185 =$ the circumference.
- The square of the circumference of a circle $\times .07958 =$ the area.
- Half the circumference of a circle \times half its diameter = the area.
- The circumference of a circle $\times .159155 =$ the radius.
- The square root of the area of a circle $\times .56419 =$ the radius.
- The square root of the area of a circle $\times 1.12838 =$ the diameter.
- To find the diameter of a circle equal in area to a given square, multiply a side of the square by 12838.
- To find the side of a square equal in area to a given circle, multiply the diameter by .8862.
- To find the side of a square inscribed in a circle, multiply the diameter by .7071.
- To find the side of a hexagon inscribed in a circle, multiply the diameter of a circle by .500.
- To find the diameter of a circle inscribed in a hexagon, multiply a side of the hexagon by 1.7321.
- To find the side of an equilateral triangle inscribed in a circle, multiply the diameter of a circle by .866
- To find the diameter of a circle inscribed in an equilateral triangle, multiply a side of the triangle by .57735.
- To find the area of the surface of a ball (sphere), multiply the square of the diameter by 3.1416.
- To find the volume of a ball (sphere), multiply the cube of the diameter by .5236.
- Doubling the diameter of a pipe increases its capacity four times.
- To find the pressure in pounds per square inch at the base of a column of water, multiply the height of the column in feet by .433.
- A gallon of water (U.S. standard) weighs 8.336 pounds and contains 231 cube inches. A cubic foot of water contains $7\frac{1}{2}$ gallons, 1728

Notes



Unit 2.2 - Plumbing Materials

Unit Objectives



At the end of this Unit the trainee will be able to:

1. State the names, characteristics and applications of different pipes, pipe fittings, fixtures supports and materials used in plumbing
2. Discuss the uses and limitations of various types of fixtures
3. List the types and grades of pipes, fittings, fastening hardware (such as anchors, studs, bolts, clamps and nuts), supports, restraints, blocking and wall hangers and their properties
4. Describe the installation process of pipes and fittings for various plumbing applications

2.2.1 Pipe Materials

The plumbing system in a building distributes water for drinking, heating, and washing, as well as for the removal of waterborne wastes. It consists of pipes, drain fittings, valves, valve assemblies, and devices.

Pipe Materials

There are various types of materials that are used for manufacturing pipes include:

Cast Iron

Carbon Steel

Low Temperature Service
Carbon Steel (LTCS)

Stainless Steel (SS)

Non Ferrous Metals
(Inconel,Incoloy,Cupro-nickel)

Non Metallic
(ABS, GRE, PVC, HDPE, Tempered Glass)

Chrome-Molybdenum, Steel
(Alloy Steel)

Fig 2.4 Pipe Materials

2.2.2 Types of Pipes

I. Cast Iron Pipe

- Cast Iron Pipe is used as a pressure pipe for transmission of water, gas, and sewage, and as a water drainage pipe.
- These are available with flanged ends or one end with socket & other with a spigot.

II. Ductile Iron Pipe

- Ductile Iron Pipes are improved versions of Cast Iron pipes.
- It is commonly used for potable water transmission and distribution.

III. Galvanized Pipe

- Galvanized Iron Pipe is mainly used in water supply distribution.
- These pipes are made of different grades i.e. Light, Medium, and Heavy depending upon the thickness of the pipe used. These are color-coded for identification - light – yellow band, medium – blue band, and heavy – red band
- Pipes with diameters in size from 15 mm to 150 mm are used in distribution.

IV. CPVC Pipes

- Chlorinated Polyvinyl Chloride (CPVC) Pipe is primarily used for supplying hot and cold potable water.
- It is also used in industrial liquid applications.
- Chlorinated polyvinyl chloride is a thermoplastic pipe material.



Fig 2.5 Cast Iron Pipe

Source : <https://www.indiamart.com/proddetail/cast-iron-pipes-1380828930.html>



Fig 2.6 Ductile Iron Pipe

Source : <https://www.indiamart.com/proddetail/ductile-iron-double-flanged-pipe-16004615973.html>



Fig 2.7 Galvanized Pipe

Source : <https://www.indiamart.com/proddetail/galvanized-iron-pipe-18923021033.html>

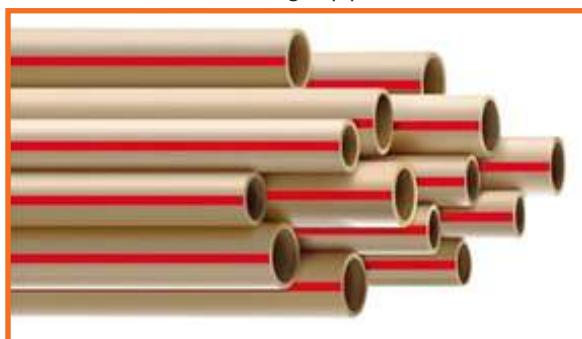


Fig 2.8 CPVC Pipe

Source : <https://www.indiamart.com/proddetail/cpvc-pipe-4355787688.html>

V. PEX or XLPE Pipes

- PEX or XLPE is a form of polyethylene with cross-links, formed into tubing.
- PEX Pipe is primarily used in - building services, pipe work systems, domestic water piping, natural gas and offshore oil applications, chemical transportation and transportation of sewage and slurries.

VI. Polypropylene Pipes

- These are made of polypropylene “random copolymer”.
- Polypropylene Pipe is primarily used for - inner hot water and cold-water supply conduits, industrial pipelines.

VII. Stoneware Pipes

- Stoneware pipes are made of clay.
- They are primarily used in - sewerage systems for underground drainage, industrial drainage, irrigation, chemical industry for transporting the highly corrosive chemical etc.

VIII. Un-Plasticized Pipes

- Un-plasticized Polyvinyl (UPVC) Pipe is primarily used in - ventilation pipe work, rainwater applications, soil and wastewater discharge system.



Fig 2.9 PEX Pipe

Source : <https://dir.indiamart.com/impcat/pex-pipe.html>



Fig 2.10 Polypropylene Pipe

Source : <https://www.pvcipelocators.com/pvc-vs-pp-pipe/>



Fig 2.11 Stoneware Pipes

Source : <https://www.indiamart.com/proddetail/stoneware-pipe-22698988248.html>



Fig 2.12 Un-Plasticized Pipes

Source : <https://www.indiamart.com/proddetail/unplasticized-polyvinyl-chloride-pipes-6394822973.html>

IX. Copper Pipes

- Copper Pipe as the name suggests are made up of copper. It is most often used in - supply of hot and cold tap water, as refrigerant line in HVAC systems.
- Copper offers a high level of resistance to corrosion however; it is becoming very costly.

X. Stainless Steel Pipes

- Stainless Steel Pipe is used in marine environments where salt water would erode another metal pipe.
- These pipes are strong and highly resistant to corrosion.
- However, even more, expensive than copper pipes.



Fig 2.13 Copper Pipe

Source : <https://www.indiamart.com/proddetail/copper-pipes-17500110133.html>



Fig 2.14 Stainless Steel Pipe

Source : <https://www.indiamart.com/proddetail/stainless-steel-pipe-20989662455.html>

2.2.3 Pipe Fittings

In pipe plumbing systems, fittings are used to join straight pipe or tubing pieces, to adapt to various sizes or forms, as well as for additional uses like regulating or metering fluid flow. Fittings are a small part of the plumbing system. In a pipe plumbing system, fittings are used to join sections of straight pipe or tubing, to adapt to various sizes or forms, and for additional uses, such as regulating or metering fluid flow. We can state that water supply fittings, such as elbows, tees, sockets, reducers, etc., are used to distribute water from the main pipe to other pipes of equal or smaller size, change the direction of flow, etc. Different types of fittings are listed below:

Collar

Elbow

Gasket

Couplings

Union

Reducer

Tee

Nipple

Valve

Trap

Fig 2.15 Different types of fittings

I. Collar

- A pipe fitting in the form of a sleeve for jointing the spigot ends of two pipes in the same alignment is known as a collar.



Fig 2.16 Collar

Source: Indiamart

II. Elbow

- An elbow is a pipe fitting used to provide a change in direction, often a 90° or 45° angle, between two lengths of pipe or tubing. The ends could be socketed, threaded (often female), butt-welded, etc. The fitting is referred to as a reducing elbow or reducer elbow when the two ends are of different sizes. Elbows are categorized based as below:
 - Long Radius (LR) Elbows**—radius is 1.5 times the pipe diameter
 - Short Radius (SR) Elbows**—radius is 1.0 times the pipe diameter.
 - 90° Elbow**—where change in direction required is 90°
 - 45° Elbow**—where change in direction required is 45°



Bend 45°



Bend 90°



YT Joint



Double YT Joint



T Trap

Table 2.8 Joints
Source: Indiamart

III. Gasket

Gaskets or Mechanical seals are used to seal flange joints. It comes in a variety of designs, compositions, and features. These are non-metallic, spiral-wound, and ring-jointed and are frequently employed.

IV. Coupling

Couplings are used to connect two pipes to each other. If the pipe sizes are different, the fitting may be referred to as an adapter, a reducing coupling, or both. A piece of pipe with internal threads for joining two pipes with screwed ends.

V. Union

A pipe fitting is used to connect two ends of pipes that cannot be turned independently of one another. A nut, a female end, and a male end make up the three components of a typical union pipe. The nuts then apply the necessary pressure to seal the connection after the female and male ends have been linked. Since the union's mating ends may be switched out, changing a valve or other device can be done with the least amount of downtime.

VI. Reducer

A reducer is used for a change in pipe size to meet hydraulic flow requirements of the system.

VII. Tee

A tee is used to combine (or split) fluid flow. It is offered with a female-threaded side outlet, opposing solvent-weld sockets, or female thread sockets. Tees can be used to shift a pipe run's direction or connect pipes of various diameters. They are used to move two-fluid combinations and come in a range of materials, sizes, and finishes. Tees can vary in size from equal to unequal, with equal tees being the most popular.



Fig 2.17 Gasket
Source: Indiamart



Fig 2.18 Coupling
Source: Indiamart



Fig 2.19 Union
Source: Indiamart



Fig 2.20 Reducer
Source: <https://www.enggcyclopedia.com/2019/04/piping-reducer/>



Fig 2.21 Tee
Source: Indiamart

VIII. Nipple

A nipple is a small section of pipe that joins two other fittings. It is often made of male-threaded steel, brass, chlorinated polyvinyl chloride (CPVC), or copper (sometimes bare copper). A "close nipple" is a nipple with uninterrupted threading. Plumbing and hoses frequently employ nipples, a tubular pipe for connecting the pipes that is smaller than 300 mm in length and has both ends threaded.



Fig 2.22 Nipple

Source: Indiamart

IX. Trap

A trap in plumbing is a P, U, S, or J-shaped pipe that is positioned beneath or inside a plumbing device. To stop sewer gases from entering the building, the bend is used. In addition to smelling bad, the gases might make you sick and possibly explode if they were allowed back inside the house.

X. Cross

Four-way fittings, commonly referred to as cross branch lines, are a type of pipe fitting that joins four pipes. A cross often has solvent-welded socket or female-threaded ends and has one inlet and three outlets (or vice versa). Cross fittings, which are in the middle of four connection sites, may cause pipes to become stressed as temperatures fluctuate.

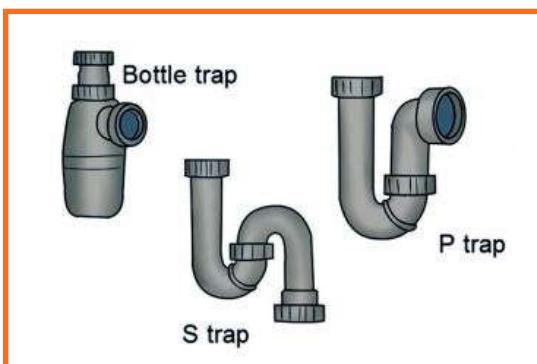


Fig 2.23 Trap
Source: <https://www.mepskills.com/2020/07/what-is-pipe-fitting-what-are-types-of.html>



Fig 2.24 Cross
Source: Indiamart

XI. Offset

A combination of elbows, which bring the pipe out of line but parallel with it.



Fig 2.25 Offset
Source: Indiamart

2.2.4 Pipe Joints

Joints are used to attach pipes together. The assembling of pipes uses a variety of joints. Fitting refers to the process of joining two or more pipes together. Depending on the demand, several pipe joints are utilized for various pipes. Major plumbing system components that connect many pipes together are called pipe joints. The specified pipe junction must bear the pressure of each pipe. Different types of pipe joints used in plumbing are listed below:

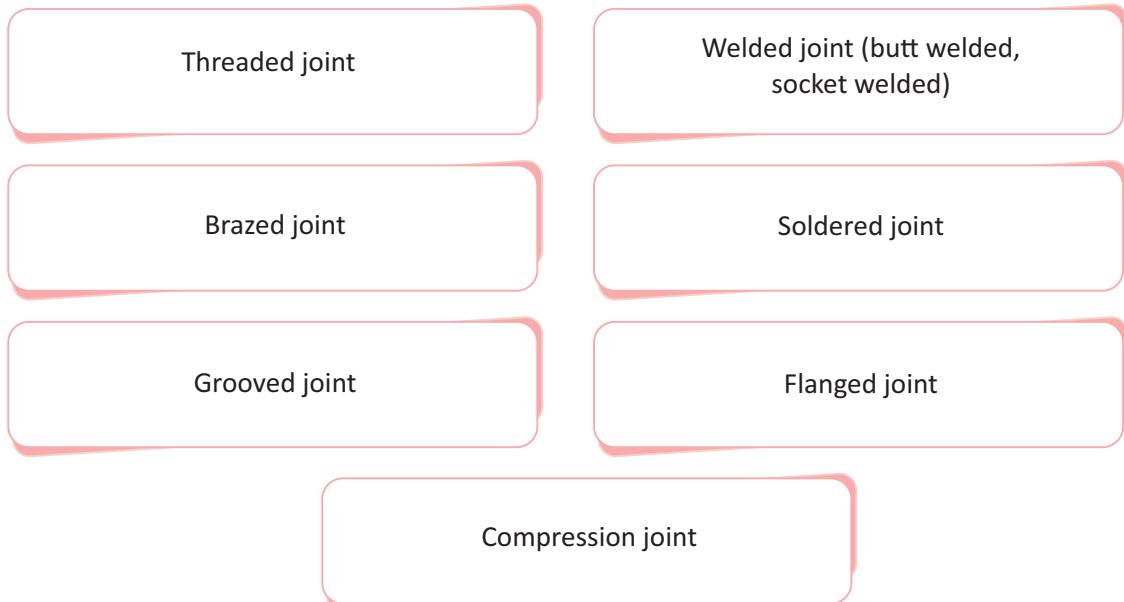


Fig 2.26 Types of Joints

I. Threaded Joint

A threaded joint is one in which the pipes are screwed together using threads that are built into each pipe. One pipe has threads on the inside, while the other has threads on the outside. There are threaded cast iron, copper, PVC, and G.I. pipes available. There are threaded joints for pipes with a diameter of 6 mm to 300 mm. For low-temperature and low-pressure flows, they are preferred. The joints may expand and leak in hot places as a result of thermal expansion. Threaded joints are simple to install, but they need to be well-maintained.

II. Welded Joints (Butt-welded joints)

Butt-welding is the most common method of joining piping used in large commercial, institutional, and industrial piping systems. Material costs are low, but labour costs are moderate to high due to the need for specialized welders and fitters. The interior surface of a butt-welded piping system is smooth and continuous which results in low pressure drop.



Fig 2.27 Threaded Joint

Source : <https://www.amazon.com/Stainless-Female-Degree-Threaded-Fitting/dp/B01MR0N5IF>

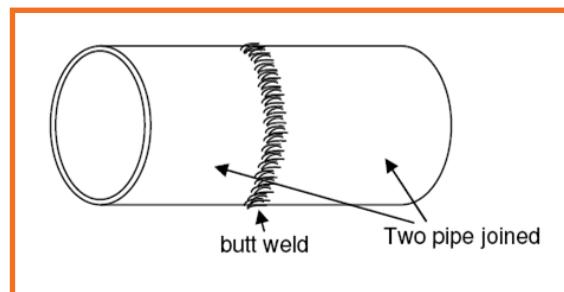


Fig 2.28 Butt-welded joint

Source : <https://www.enggcyclopedia.com/2011/08/butt-weld/>

III. Socket-Welded Joints

In situations when there is a substantial probability of joint leakage, socket welded joints are used. As demonstrated above, pipes are joined by inserting one into another and welding around the connection. Pipes with various diameters work well in this kind of junction. Compared to other mechanical joints, socket welded joints produce good results.

IV. Brazed Joints

Brazing is the process of joining pipes using molten filler material at temperatures above 840°C. Copper or copper alloy pipes are brazed together to form connections. It is crucial to remember that the pipe material's melting point should be higher than the filler materials. When temperatures are moderate, brazed joints are recommended since they have less mechanical strength.

V. Soldered Joints

Brazing and soldering are similar processes. The filler material melts when soldering below 840°C. Copper and copper alloy pipes are connected by soldering. Flux or another metal-joining agent is used during soldering to stop metal from oxidizing owing to the flame. Soldered joints have low mechanical strength and are ideal for low-temperature environments.

VI. Grooved Joints

Grooved joints are those where two pipes are connected by creating narrow incisions or depressions at the ends of the pipes with the use of sockets or couplings. The labor cost is lower since the grooved joints are simpler to assemble. For routine maintenance, it is simple to remove and reinstall the piping system. Their primary purpose of them is fire protection.

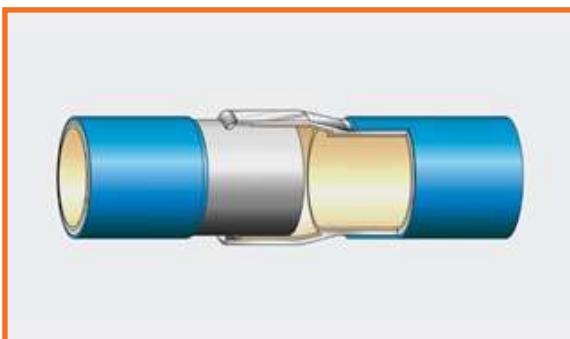


Fig 2.29 Socket-welded joints
Source : <https://ftpipelinesystems.co.uk/pipe-joints/socket-weld-joint/>



Fig 2.30 Brazed joint
Source : <https://theconstructor.org/building/types-of-pipe-joints-in-plumbing/12559/>

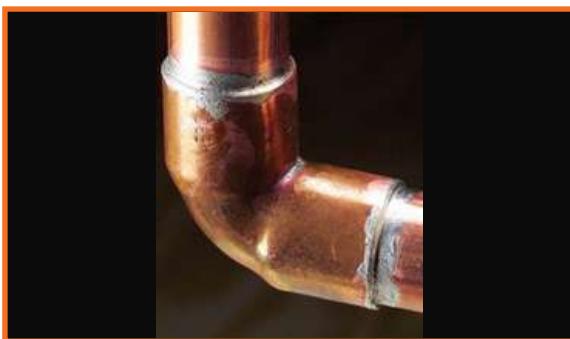


Fig 2.31 Solder joint
Source : <https://www.familyhandyman.com/project/how-to-solder-copper-pipe-joints/>



Fig 2.32 Grooved joint
Source : <https://www.victaulic.com/grooved-technology/>

VII. Flanged Joints

Pipes in pumping stations, filter plants, hydraulic labs, boiler buildings, etc. are frequently joined using this junction. Although these connections are expensive, they are preferred because of how simple it is to assemble and disassemble them. When necessary, these joints can be taken apart and put back together. Flanged ends are present at both ends of a pipe. Pipes are linked at the proper level and close to one another on both ends. Between the flanges is a strong rubber washer that is fastened. In most cases, welding or threading is used to attach flanges to the pipe. A flange-type joint may also be referred to as a lap joint in some circumstances. It can also be produced using a forging technique and pipe end machining.

VIII. Compression Joints

These are used to connect the pipe without any prior preparation. These joints can be installed at a very low price. Compression joints are used to link pipes with plain ends by mounting fittings at the ends of the pipes. Threaded couplings or fittings are used to attach the ends of the pipes. Joints are positioned correctly to monitor the flow pressure because leakage could otherwise happen. Different types of materials are used to make these fittings. The fittings are chosen based on the needs.



Fig 2.33 Flanged Joint

Source : <https://ftpipelinesystems.co.uk/pipe-joints/socket-weld-joint/>

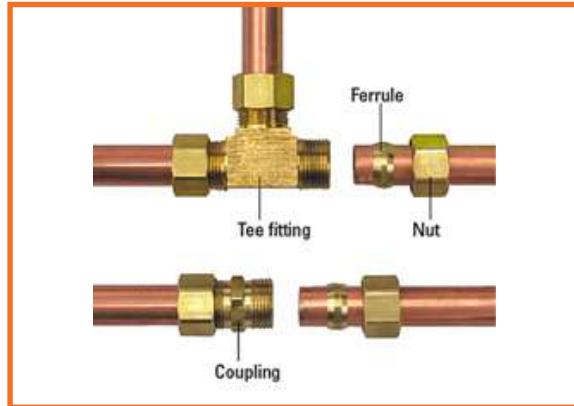


Fig 2.34 Compression Joint

Source : <https://piping-info.blogspot.com/2009/08/types-of-piping-joints.html>

Notes



2.2.5 Valves

The water supply mains use brass or iron valves to ensure good pipeline operation. The flow of fluids such as liquid, gas, condensate, etc. is stopped or controlled by valves. These are divided into categories based on how they are used, such as isolation, throttling, and non-return corrector. According to their intended application and style of construction, many types of valves are produced. Various type of valves are available depending upon the type of construction as follows:

I. Sluice Valve

It is positioned at a crucial location, such as any pipe entry. It could be the beginning of a brand-new pipe coming from a tank, one of the tank's many branches, or the main header. When necessary, this valve isolates the water supply. The nominal bore of the waterway serves as a specification for the sluice valve. 50 mm, 65 mm, 80 mm, 100 mm, 150 mm, 200 mm, 250 mm, and 300 mm are the standard sizes. Class 1 and Class 2 sluice valves are available.



Fig 2.35 Sluice Valve

Source: Indiamart

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

Table 2.9 Test pressure in sluice valve

II. Air Valve

When the pipe is filled with water, it is configured to automatically release the air. Additionally, when the pipe is drained, this valve allows air to enter. This valve, which is permanently attached to the end of a communication line, regulates or interrupts the flow of water. The standard bore (diameter) of the socket or pipe outlet to which it is affixed serves as the specification for this valve. 8 mm, 10 mm, 15 mm, 20 mm, 25 mm, 32 mm, 40 mm, and 50 mm are the standard sizes. Leaded tin bronze or cast brass are used to make the washer plate and body components. The washers are constructed of nylon, rubber, leather, or fibre. Both an internally threaded and an externally threaded version of this valve are available.



Fig 2.36 Air Valve

Source: Indiamart

III. Scour Valve

This valve is installed at a pipeline's lower level so that such sections can be fed with fluid and emptied for maintenance. Natural drains receive the water and disperse it there. It functions essentially like a sluice valve, but the nomenclature is different because of how it is used.

IV. Gate Valve

It is used to start or stop the water flow. It can also be used to achieve minimum flow restriction for fluid flowing in a straight line. These valves are typically either fully open or fully closed when in use. These valves have a variety of liquid applications and create a secure seal when closed.

V. Parallel Side Gate Valve

It has two discs that glide between the two parallel body seats without using a spreading mechanism. The internal and external screws on the spindle, which might be of the rising or non-rising kind, activate the valve discs.

VI. Globe Valve

It is a kind of valve used to manage pipeline flow. A moving disc element and a stationary ring seat placed in a usually spherical body make up a valve component. The globe valve is utilized to regulate flow.



Fig 2.37 Scour Valve
Source: Indiamart



Fig 2.38 Gate Valve
Source: Indiamart



Fig 2.39 Parallel Side Valve
Source: Indiamart



Fig 2.40 Globe Valve
Source: Indiamart

VII. Angle Valve

It is used to control the passage of a fluid like liquids, gases, fluidized solids, or slurries by opening, closing, or partially obstructing multiple channels. This kind of valve typically has a spherical body with body ends that are fitted at an angle to one another and a disc that rotates up and down. The internal or exterior screw on the spindle turns the valve into action. The spindle could be of the rising or non-rising type.

VIII. Check valve or non-return valve

It is a valve that allows (fluid) water to flow in one direction while stopping all backflow. It is controlled by the pressure from above and lacks any external controls.

IX. Ferrule

It is used for connecting a service pipe to the water main. It is usually made of non-ferrous metal and screwed to the main pipe.

X. Foot Valve

It is a valve that the pump uses. Since it ensures that the pump is prepared for operation, it is also known as a check valve. The foot valve ensures that there is enough fluid in the pump even when it is turned off so that it may restart. The foot valve in a well will be situated between the pump and the water's surface. The foot valve for a water intake system is located at the end of the water intake pipe. A strainer on the outside of the foot valve prevents blockages as well.

XI. Float Valve

When the water tank or flush toilet is filled, it is used to stop the flow of water to prevent overflow. The float rises along with the rising water level, and when it reaches a preset level, the lever is forced to close the valve, stopping the flow of water. A fitting called a float valve is used to fill water tanks and flush toilets.



Fig 2.41 Angle Valve
Source: Indiamart



Fig 2.42 Non-Return Valve
Source: Indiamart



Fig 2.43 Ferrule Valve
Source: Indiamart



Fig 2.44 Foot Valve
Source: Indiamart



Fig 2.45 Float Valve
Source: Indiamart

2.2.6 Fixtures

A plumbing fixture is a component that connects to the building's plumbing system and transports water. Showers, tubs, sinks, faucets, and bathtubs are the most popular plumbing fixtures. A fitting is something that can be hung by a hook, screw, or nail as opposed to a fixture, which can be installed into walls or the floor. Commonly used sanitary fittings and fixtures are explained below:

I. Bathtub

It is installed in a bathroom and is made of marble, plastic, enameled iron, vitreous material, etc. Its dimensions range from 1.7 to 1.85 meters in length, 70 to 75 centimeters in width, and 43 to 45 centimeters in depth to the outlet end. The tank may be filled with cold and hot water using the provided faucets, and any extra water can be drained using the overflow line. Similar to the sink, the drain has a rubber plug and a waste coupling with a waste seal trap.

II. Washbasin

It is used for cleaning hands, faces, etc. These are typically made of Vitreous China, glass, marble, burned fireclay, ceramic, enamel over steel, etc. Washbasins come in a variety of colors, styles, and shapes.

III. Water Closet

It is designed to take human waste. It is connected to the soil pipe, then to a municipal sewer or septic tank, through a suitable trap. Water from the cistern tank is used to flush the excreta. There are two types of water closets:

1. Indian type
2. European type

IV. Faucet

Faucet is used to control the liquid flow, especially water, from a pipe. It is also known as water tap. It is available in a bathroom, kitchen or sink, as per use.



Fig 2.46 Bathtub
Source: Indiamart



Fig 2.47 Washbasin
Source: Indiamart



Fig 2.48 Indian type
Source: Indiamart



Fig 2.49 European type
Source: Indiamart



Fig 2.50 Faucet
Source: <https://www.ubuy.co.in/product/4W3A7JS-amazing-force-brushed-nickel-kitchen-faucet-with-pull-down-sprayer-kitchen-sink-faucet-single-handle>

V. Sink

It is a rectangular, shallow, watertight tank constructed out of stainless steel, vitreous china, fireclay, or concrete. It is used to clean utensils, clothes, and other items. There is a hole in the floor of a sink where a waste coupler and waste pipe can be fixed.

VI. Flushing cistern

It is a small tank that stores water for flushing toilets and urinals. Cast iron, glazed earthenware, glazed vitreous, or any other material can be used to make it. A cistern's water storage capacity ranges from 5 to 10 to 15 litres, depending on its size. The most typical cistern size is 10 litres.

VII. Geyser

It is used to heat water. It is available in various capacities as per the requirement.



Fig 2.51 Sink

Source: Indiamart



Fig 2.52 Flushing cistern

Source: Indiamart



Fig 2.53 Geyser

Source: Indiamart

2.2.7 Fastener

A fastener is any one of a large variety of mechanical tools or components that are used to rigidly attach two or more items to one another. Fasteners make it possible to separate or disassemble the parts without causing damage. They can also be utilized as long-term joints, though. Different types of fasteners include screws, nuts, bolts, nails, washers, and more. Different types of fasteners used in industrial applications are listed below:

- | | |
|--------------------------|------------------------------|
| I. Nuts and Bolts | II. Washers |
| III. Screws | IV. Nails |
| V. Anchors | VI. Rivets |
| VII. Pins | VIII. Retaining Rings |
| IX. Inserts | |

I. Nuts and Bolts

One of the most popular types of industrial fasteners is the nut and bolt. They work together in tandem and hold two or more components together. The nut is tightened on one end of the bolt after it has been inserted through the bolt holes between the parts. There are various types of nuts and bolts as mentioned below:

- | | | |
|----------------|------------------|--------------|
| a) Hex nuts | b) Coupling nuts | c) Lock nuts |
| d) Square nuts | e) Flange nuts | f) Wing nuts |

- | | | |
|---------------------|-----------------------|--------------------|
| g) Slotted nuts | h) U-nuts | i) Speed nuts |
| j) Push nuts | k) Jam nuts | l) Axle nuts |
| m) Castle nuts | n) Rivet Nuts | o) Weld Nuts |
| p) Barrel Nuts | q) Shear Nuts | r) Tri-Groove Nuts |
| s) Keps-K Lock Nuts | t) Knurled Thumb Nuts | u) Wheel Nuts |

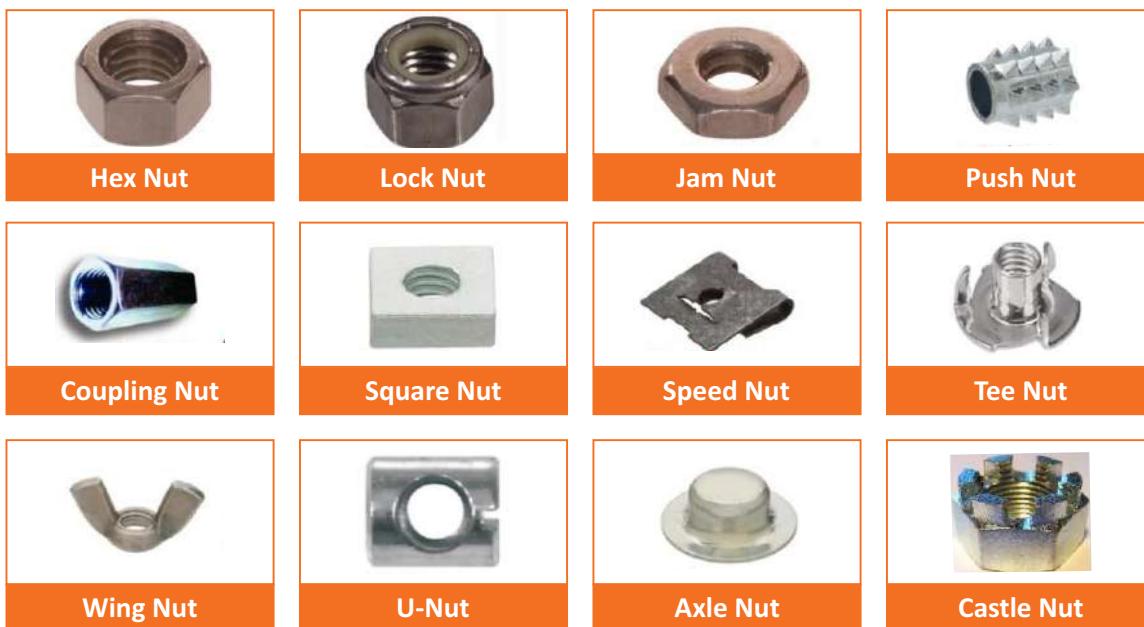


Fig 2.54 Different Types of Nuts

Source: <https://whatispiping.com/types-of-fasteners/>

Many different types of bolts are available in the market. The most common types of bolts that are used for industrial applications are:

- | | | |
|-------------------------------------|---------------|----------------------|
| a) Carriage bolts | b) Hex bolts | c) U-bolts |
| d) Eye bolts | e) Leg bolts | f) Flange bolts |
| g) Allen bolts | h) Plow bolts | i) Square head bolts |
| j) Shoulder bolts or Stripper bolts | | |



Fig 2.55 Different Types of Bolts

<https://whatispiping.com/types-of-fasteners/>

I. Washers

In order to distribute the load of the fastener uniformly throughout the surface of the material, washers are occasionally inserted in between nuts and bolts. A washer is a flat, elongated disc with a hole in the middle. Washers can be constructed from non-metals or from metals. Following are the purpose of washers:

- Isolation of Components
- Reduction of leakage
- Alleviation of friction, and
- Prevention of loosening during vibration

Some common types of washers are:

- **Plain Washers:** Plain washers are used for load distribution and isolation purposes. Plain washers can be of various types like:
 - Round and thin Flat Washers for general use.
 - Torque Washers for use in woodworking projects.
 - Fender Washer used in car fenders.
 - Finishing Washers used with countersink screws, and
 - C-washers
- **Spring Washers:** These types of fasteners act like a spring as they develop axial flexibility to make the joint more elastic. This can avoid unintended loosening during vibration. The main types of Spring Washers are:
 - Belleville Washer
 - Crescent Washer
 - Dome Spring Washers, and
 - Wave Spring Washers
- **Lock Washers:** This type of washer uses various mechanisms to prevent nuts, screws, and bolts from loosening. Lock washers are much better than spring washers and can be of the following types:



Plain Washers



Spring Washers



Locking Washers

Fig 2.56 Different Types of Washers

Source : <https://whatispiping.com/types-of-fasteners/>

- External tooth lock washer
- Internal tooth lock washer
- Split lock washer, and
- Tab washer
- **Beveled Washers:** These washers add stability when attaching unparallel surfaces.
- **Structural Washers:** Usually thicker, Structural washers are used in heavy-duty applications.

III. Screws

Screws are the most versatile types of fasteners. It is quite easy to use. A pilot hole must first be drilled in a material before the screw can be simply fitted using a screwdriver. Typically, they have male threads that begin at the tip. Typically, self-threading screws produce the thread while being installed. Different types of screws are listed below:

- a) Self-drilling screws
- b) Machine screws
- c) Sheet metal screws
- d) Deck screws having a self-tapping design.
- e) Wood screw having coarse thread and tapered head.
- f) Grub Screws without a head used to prevent rotation or movement between two parts.
- g) Masonry screws having a flat tip and hex-head designs.
- h) Countersunk screw
- i) Hex lag screw
- j) MDF screws
- k) Drywall screws

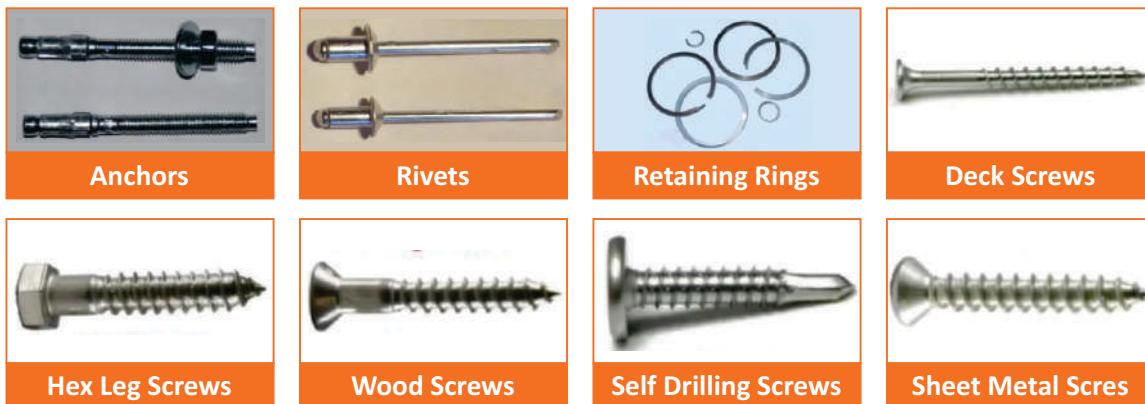


Fig 2.57 Different Types of Screws
 Source : <https://whatispiping.com/types-of-fasteners/>

IV. Nails

The oldest types of fasteners still in use today are nails. It continues to be a standard home item. Since they lack threads, nails typically have less force than screws. The most widely used types of nails are:

- Common nails have a thicker shank.
- Box nails with a diamond point tip.
- Roofing nails with a wide head.
- Framing nails are specially designed for flush installation and easy concealment.
- Brad nails for easily blending into wood trims.
- Flooring nails for use with flooring materials.
- Drywall nails for reduced slippage.
- Finishing nails with small flatheads

V. Anchors

A specific kind of fastener called an anchor is used to secure objects to drywall or concrete. They ingrain themselves into the substance and secure the thing. Different types of anchors are employed for various functions. Some common types of anchors are:

- Internally threaded anchors
- Externally threaded anchors
- Acoustical wedge anchors
- Masonry screw and pin anchors
- Bonded anchors
- Screw anchors
- Double expansion shield anchors
- Hollow wall anchors
- Drop-in anchors
- Sleeve anchors
- Plastic anchors
- Drive anchors

VI. Rivets

Rivets are referred to as permanent fasteners because they establish a permanent junction between two items. Rivets, which are made comprised of a cylindrical shaft with a head and a tail at either end, provide excellent support against shearing forces. This kind of fastener is surprisingly strong while being lightweight. Installing rivets requires the use of a specialized tool known as a rivet gun. After removal, rivets cannot be used again. Some common types of rivets are:

- Blind rivets
- Pop rivets (Closed-end, Open end, Countersunk)
- Semi-tubular rivets

- Large flange rivet
- Solid rivets
- Tri-fold rivet
- Split rivets
- Drive rivets
- Structural rivets
- Colored rivets
- Multi-grip rivet

VII. Pins

Pins are unthreaded mechanical fasteners usually inserted through preformed holes. The most common types of pins for industrial usage are:

- Dowel pin
- Slotted pin
- Coiled pin
- Roll pin
- Grooved pin
- Split pin
- Wedge pin or tapered pin, known as cotter

VIII. Retaining Rings

Retaining rings are a sort of metallic fastener that is used to hold many elements together but is not permanent. Metal spirals and semi-circular sections are typically used. Many different types of machinery and housing parts need retaining rings. The various types of retaining rings are:

- Constant section retaining ring
- Snap retaining ring
- Tapered section retaining ring
- Axially assembled retaining rings
- Spiral retaining ring
- Radially assembled retaining ring
- Circular push-on
- Bowed-E retaining rings
- External shaft retaining rings
- Self-locking retaining rings

IX. Inserts

As mechanical fasteners, inserts handle a variety of duties. Typically, they are employed to secure anchor bolts to dangling pipelines, reinforce couplings, repair damaged internal threads, or serve as keys in rotating machinery. Inserts are available in different forms like:

- Keys in shaft key-ways
- Threaded rod
- Unthreaded rod
- Helical threaded inserts
- Keystock

X. Other Types of Fasteners

There are many other types of fasteners that are used. Some of those fasteners are:

- Clamps
- Staples
- Straps
- Hooks and Eyes
- Twist ties

2.2.8 Fastener Materials

Fasteners are made of a variety of materials. Proper selection of a fastener material should be based on the working environment, weight, expected life, reusability, magnetic properties, and reusability. Common materials that are used for manufacturing fasteners are:

- Steel
- Brass and Bronze
- Copper
- Nickel
- Aluminum
- Stainless Steel
- Inconel
- Monel
- Titanium
- Nylon and Plastics

2.2.9 Pipe Supporting Materials

I. Pipe Hanger or Pipe Support

An element that is meant to transfer load from a pipe to supporting structures is called a pipe support or pipe hanger. The load consists of the weight of the pipe itself, the contents it transports, all of the pipe fittings that are connected to it, and any insulation used to cover the pipe.

II. Pipe Restraint

It's a structural component used to control or restrict how much heat moves through a series of pipes.

III. Pipe Anchor

A pipe anchor is a support that is intended to limit movement and prevent three-dimensional pipe from moving. Traditional pipe anchors are essentially designed to secure pipes to a location and prevent them from moving.

IV. Studs

Studs can be load-bearing, as in partition walls, which just divide spaces, or non-load-bearing, as in walls that create walls and carry vertical structural loads. They maintain the structure of a building by holding in place the windows, doors, inside finish, outside sheathing or siding, insulation, and utilities.



Fig 2.58 Pipe Hanger
Source: Indiamart



Fig 2.59 Pipe Restraint
Source: Indiamart



Fig 2.60 Pipe Anchor
Source:
[https://stourflex.co.uk/
products/jp171/](https://stourflex.co.uk/products/jp171/)



Fig 2.61 Pipe Studs
Source:
[https://stourflex.co.uk/
products/jp171/](https://stourflex.co.uk/products/jp171/)

2.2.10 Installation Process of Pipes and Fittings

Installation process of pipes and fittings for various plumbing applications are to be done as per drawing provided by the plumber or construction engineer. This work should be done under the guidance of senior plumber. Standard procedure of installation of pipes and fittings should be followed.

- Following points should be considered by the plumber prior to start work
- When a job work is allotted to a plumber, a drawing and plans of plumbing are provided, Plumber should read the drawing properly
- Identify the jobs to be carried out.
- Make the list of items required to carry out the job.
- Make a list of tools and machines required to carry out the job.
- Calculate the quantity required for plumbing materials required.
- Make a specification of items required.
- Make a list of the number of items required.

- As per the drawing plan, identify the various plumbing material and note them down in the plumbing material list. A sample plumbing material list is shown below:

List of Plumbing Material Required			
S.No	Name of items	Specifications	Quantities
1.	Plumbing pipes		
2.	Fixtures		
	Faucet		
	Shower		
	Wash basin		
	Toilet seat		
	Pipe fittings		
	Tee		
	Elbow		
	Socket		
	Washer		
	Clamp		
3.	Raw material		
	Blade		
	Adhesive		
	Nail		
4.	Tools		
5.	Equipment/Machine		
6.	Any other		

Fig 2.62 Sample Material List

- Calculate the quantity, dimensions, and type of pipes, pipe fittings, devices, and materials required from design drawings/specifications.
- Prepare a work plan as per specified timelines. Proper planning must be ensured.

Unit 2.3 - Plumbing Tools and Equipment

Unit Objectives



At the end of this Unit the trainee will be able to:

1. Identify various plumbing tools and equipment correctly
2. Describe the commonly used corrosion protection measures such as applying coatings and using tape
3. Discuss quality procedures and standards commonly used by organisations in plumbing related work

2.3.1 Different Types of Plumbing Tools and Equipment

A plumber needs a variety of tools and equipment to complete repair work, fix a tap, or perform fitting work. These devices enable a plumber to do their job well. Tools for plumbers should be used systematically. In order to prevent damage, tools should be handled carefully. After use, tools should be stored correctly. Tools can be categorized based on the type of task they are used for, such as holding, fitting, cutting, pipe threading, and bending tools, among others. The important tools used in plumbing are classified as:

Holding Tools	Fitting Tools	Cutting Tools	Pipe Bending Tools	Other Tools
<ul style="list-style-type: none"> • Bench Vice • Pipe Vice 	<ul style="list-style-type: none"> • Wrenches • Spanners • Pliers 	<ul style="list-style-type: none"> • Pipe Cutter • Hacksaw 	<ul style="list-style-type: none"> • Pipe Bending Machine • Threading Dies 	<ul style="list-style-type: none"> • Chisel • Hammer • Rover Jumper • Trowel • Screw Driver • File • Caulking Tools • Drill Machine • Drill Bit • Hangers • Measuring Tape

Fig 2.63 Plumbing Tools

1. Holding Tools

Holding tools are used for holding pipes, pipe fittings, and fixtures in plumbing operations. Some of the commonly used holding tools are mentioned below.

a) Bench Vice

A vice is a work-holding tool used for holding an item for various work like filing, chipping, sawing, threading, bending of various jobs, fitting, tapping, etc. The bench vice has two jaws, one of which is fixed and the other is moveable. These jaws are fitted with plates for gripping the job. The vice size depends on the width of the jaw. Bench Vice is fixed through a bolt to a

table or bench. Vice is opened and closed with the help of an attached handle to a spindle. In this way, the material is held tightly. Bench vices hold the objects and allow the use of other tools to complete a task.

b) Pipe Vice

A pipe vice is a tool used for holding a pipe for carrying out assembly, disassembly, threading, cutting, etc. The pipe vice is of two kinds:

- I. Open side pipe vice
- II. fixed side pipe vice

The pipe's vice sizes are known by the opened size of the jaws. Standard sizes of vices are from 80mm, 105 mm, 130 mm, 170 mm, etc.



Fig 2.64 Bench Vice
Source: Indiamart



Fig 2.65 Pipe Vice
Source: Indiamart

4. Fitting Tools

Tools that are used for carrying out various plumbing operations like cutting, tightening, fixing, and other small tasks are called fitting tools. Some of the commonly used fitting tools are mentioned below.

a) Wrenches

Wrenches are used to tighten and loosen nuts and bolts. For removing or reinstalling nuts and bolts, wrenches grasp tiny or slick ones. Adjustable and non-adjustable wrenches are the two most common types utilized. These are particularly helpful when dealing with nuts and bolts of unusual sizes. These devices allow you to screw or unscrew a pipe and pipe fittings. This is a highly popular instrument, particularly for pipes with a small diameter up to 50 mm.

Adjustable wrenches are used to tighten or loosen nuts and bolts of all irregular and standard sizes. It is employed to tighten and loosen geysers, flexible pipes, cocks, and valves. It works well for maintaining and repairing plumbing components including valves, cocks, pumps, etc. It has a handle, a fixed flat jaw, and a square-toothed screw. With the aid of a screw, the movable flat jaw slips into the fixed jaw's body. The object that needs to be turned in order to screw or unscrew anything is held in the space between the flat jaws.



Fig 2.66 Adjustable Wrench
Source: Indiamart

b) Water Pump Plier

Plumbers frequently use this type of plier to grip, tighten, and loosen work while fixing something. The material utilized to make water-pump pliers is steel. There is only one standard size of them, measuring 250 mm in length. The two jaws can be separated by a maximum of 40 mm.



Fig 2.67 Water Pump Plier
Source: Indiamart

c) Spanners

Spanners are used for tightening and loosening nuts and bolts of standard size. Different types of spanners are listed below:

- I. **Ring Spanners:** At both ends of these spanners are entire, closed circles. It is challenging to slip and hurt yourself. It is forged, and either has a burnished finish or is chrome-plated.
- II. **Open-ended Spanners:** These kinds of spanners are used to tighten and loosen nuts and bolts since they are open on both sides. The square or hexagonal-headed nut or bolt is passed through by a spanner with open-ended jaws. After that, the bolts or nuts are rotated with the necessary force to screw or unscrew them. The two jaws are two sizes that come after one another, such as 6 mm and 7 mm or 1/4" and 5/16", etc.
- III. **Combination Spanners:** These spanners are open at one end and closed at the other.
- IV **Bi-hexagonal Ring Spanner:** To handle a nut or bolt with a square or hexagonal bolt head, it has bi-hexagonal shapes at both ends. The two ends' sizes are sequential, such as 6 and 7 millimeters, 1/4 and 5/16 inches, etc.



Fig 2.68 Ring Spanners
Source: Indiamart



Fig 2.69 Open-ended Spanner
Source: Indiamart



Fig 2.70 Combination Spanner
Source: Indiamart



Fig 2.71 Bi-hexagonal Ring Spanner
Source: Indiamart

5. Cutting Tools

Cutting tools are used for cutting pipes, fixtures, and s, etc. Some of the commonly used cutting tools are listed below:

a) Pipe Cutter

When using a hacksaw frame is challenging, a pipe cutter is used to cut a pipe on the job site. For cutting a pipe, this tool has a pointed, round cutting wheel that rotates in a to-and-fro rotary motion.

b) Hacksaw

Typically, both hands are used to use this tool. It can cut materials like steel rod, plastic pipe, angle iron, sheets, and iron pipes. When nuts and bolts become stuck, it can also be used to cut their heads. A hacksaw's grip, frame, blade, and adjusting wing nut are all significant components. A power hacksaw is used in a workshop to quickly cut heavy pipes, whereas a hand-operated hacksaw is used for site work.



Fig 2.72 Pipe Cutter
Source: Indiamart



Fig 2.73 Hacksaw
Source: Indiamart

6. Pipe Bending Tools

In most plumbing operations, pipes are required to be bent at different angles as per requirement, for which pipe bending tools are used. Some of these tools are mentioned below.

a) Pipe Bending Machine

Pipes can be bent or turned using a pipe bending machine. The diameter of the pipe and the kind of pipe material to be bent determine the machine's size and strength. For pipes with a diameter of 3/8 to 1", mechanical or manually operated pipe bending equipment is offered. Higher ranges, such as 1/2-2", 1/2- 3", 1/2- 4", and 2- 6", are covered by hydraulic hand-operated equipment.



Fig 2.74 Pipe Bending Machine
Source: Indiamart



Fig 2.75 Threading Dies
Source: Indiamart

7. Other Tools

Various other tools are also used in plumbing operations apart from the already mentioned holding, fitting, cutting, and bending tools. The other tools used for plumbing operations are listed below.

a) Chisel

It is made of hard metal and is mostly used for cutting concrete surface and making grooves in the walls with the help of a hammer.

b) Hammer

These are all-purpose workshop hand tools used for keyway insertion and fitting by striking, riveting, riveting, striking of nails, and straightening of sections. The hammer has a wooden grip and a head made of strong, distorted steel. The opposing side of the head is referred to as pein and has a flat, striking face. The peins are categorized according to their various shapes, including ball, cross, and straight. Engineer's hammers are commonly used when working with steel components and are made of hardened steel.

c) Chain Wrench

When it comes to huge-diameter pipes, the usual holding tools are not very helpful. Chain wrenches are employed for these. A handle, a chain, and a toothed block make up a chain wrench. The chain is held on the toothed end of the block and is circular with grooves. The chain tightens or loosens the pipe fitting while holding onto it. The chain wrench comes in lengths of 3", 4", 6", 8", and 12", measuring 475, 585, 834, 1100, and 1360 mm, respectively. These sizes are indicated by the largest pipe diameter that they can accommodate.

d) Screw Driver

Plumbers frequently use this tool to tighten the screws. The pointed tip of a screwdriver may easily fit into a variety of screws. For various screw kinds, various screwdriver types are used. Plumbers employ a variety of screwdriver head types.



Fig 2.76 Chisels
Source: Indiamart



Fig 2.77 Hammers
Source: Indiamart



Fig 2.78 Chain Wrench
Source: Indiamart



Fig 2.79 Screw Drivers
Source: Indiamart

e) Files

Files are used for a range of tasks, including the removal of sharp edges, the removal of metal, the shaping of tasks, the smoothing out of surfaces, the finishing, the creation of various shapes, etc. Tang, heel, face, edge, and point or tip make up the five components of a file. Depending on the task, numerous types of files with various forms are employed, including hand round, pillar, square, three square, half round, flat, knife edge, and needle files.

f) Pliers

Pliers are used to tighten or loosen various elements as well as grasp small objects. A plumber uses a variety of pliers when working. Pliers can also be used to make cuts. Various sizes and shapes of pliers are available in the market.

g) Caulking Tools

Caulking tools are used to seal any holes in the wall. This device aids in adding and removing materials in the building.

h) Drill Machine

One of the common but crucial equipment used to drill a hole in a surface made of metal, wood, or concrete. A cutting instrument, such as a drill bit, is attached to a drill machine. A key is used to tighten the attachment.



Fig 2.80 Files
Source: Indiamart



Fig 2.81 Plier



Fig 2.82 Caulking Tools
Source: Pinterest



Fig 2.83 Drill Machine

i) Hangers

Pipe hangers are used to hold or support a pipe or a group of pipes from a slab, beam, ceiling, or other structural elements.

j) Measuring Tape

It is used to measure an object's length. Steel, fabric, and PVC are just a few of the materials used to make measuring tapes. The available lengths include one meter, two meters, three meters, five meters, 10 meters, fifteen meters, etc.

k) Plumb Bob

This is a practical tool to use while building walls, columns, and wooden window and door frames to ensure verticality and uniformity. Additionally, it aids in leveling the floor's surface. It is made up of a holding pipe, thread, and a metal and wood plumb bob. The thread is used to join the plumb bob to the holding pipe.

l) Spirit Level

It is used to check the horizontality or levelling of the floor, roof, door, window frame, etc.



Fig 2.84 Pipe Hanger
Source: Indiamart



Fig 2.85 Measuring Tape



Fig 2.86 Plumb Bob
Source: Indiamart



Fig 2.87 Hammers
Source: Indiamart

m) Trowel

It is used for mixing cement and sand for masonry work. It is used for plastering the surface.



Fig 2.88 Trowel
Source: Indiamart

n) Spade

A spade is used to mix cement, sand, and concrete as well as for digging purposes. It is constructed up of a flat steel form with a hole for the wooden handle. A spade's size is determined by the length and width of the board.

o) Shovel

It is used for mixing concrete and also for carrying concrete to mortar pans. Shovels are made of steel sheets. The size is designated by its length and width.

p) Pickaxe

It is made of steel and is used to excavate hard soil. One end of the pickaxe is flat whereas, the other end is sharp in design.

q) Mortar Pan

This is used to carry concrete, cement mortar, and other excavated materials. Never use it to measure cement mortar that has been mixed, etc. For the construction of mortar pans, mild steel sheet is employed.



Fig 2.89 Spade
Source: Indiamart



Fig 2.90 Shovel



Fig 2.91 Pickaxe
Source: Indiamart



Fig 2.92 Mortar Pan
Source: Indiamart

r) Mason's square

It is used to check if the internal and external corners are rectangular. It is built of sheet carbon steel. Additionally, the dimension is marked on both sides in either an inch or a centimeter.

s) Water level tube

Water level tubes are used to check and transfer water levels, among other things. When using the tube, water is put inside of it. Polythene tubes with diameters ranging from 10 to 15 mm and lengths varied according to the need.

t) Rover Jumper

It is used for making a gap in the wall so that plumbing fixtures can be fixed.



Fig 2.93 Mason's Square
Source: Indiamart



Fig 2.94 Water level tube
Source: Indiamart



Fig 2.95 Rover Jumper
Source: Indiamart

2.3.2 Corrosion Protection Measures

Use of barrier coatings, such as paint, plastic, or powder, is among the simplest and least expensive techniques to prevent corrosion. Epoxy, nylon, and urethane powders stick to the metal surface to form a thin layer. Metal surfaces are frequently treated with plastic and waxes.

The most common materials to coat pipes externally are:

- Non-metallic pipe coating:
- Paints
- Varnishes
- Lacquers
- Bituminous coatings
- Resins
- Plasticizers
- Greases
- Waxes
- Oils
- Plastics (Polyurethane, Polyethylene, Rilsan, PTFE, PVC)
- Elastomers (various types)
- Vitreous enamel
- Cement mortar

Coating on Steel Pipes

Common lining types are FBE (Fusion Bond Epoxy) & Cement lining. These coatings are widely used to protect the steel pipe used in pipeline construction, reinforcement steel, and on a wide variety of piping connections. PVC pipes are manufactured in such a manner that they do not require any coating or painting.



Fig 2.96 Steel Pipe Coating

Source: <https://kellypipe.com/steel-pipe-services/steel-pipe-coatings/>

2.3.3 Quality Procedures and Standards

The quality procedures and standards commonly used by organizations in plumbing related work are listed below:

- All the materials required for plumbing work should be checked before purchasing for BIS mark.
- Quality should not be compromised.
- All standard material should be used in plumbing work.
- Proper procedure should be followed during installation, fixing of plumbing and sanitary fixtures works.
- Proper monitoring should be done during the installation of plumbing works.
- All over activity should be done in a systematic manner.
- Coordination with other work agency is must. This also helps to maintain the safety of the workers employed by other contractors.
- All work should be done with proper tools.
- All the rules related to plumbing by laws should be followed.

Notes



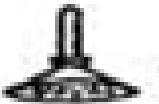
Summary



- Plumbing is defined as a system of pipes and fixtures installed in a building used for supplying water and removing the used water and waterborne wastes. Every home and building must have a plumbing and sanitary system.
- Water is supplied to a house or a building from a storage tank through pipes. Similarly, the wastewater from the kitchen and washrooms is drained out with the help of pipes.
- In one pipe system, soil pipes and waste pipes are joined to form a single pipe that empties into the sewage system.
- A trained plumber does the installation of the fittings and fixtures as per the drawing provided in the assembly sheet of the plumbing fixture in the manufacturer's catalog. Identification of the symbol given in the drawing in the fixtures makes the installation work easy for a plumber.
- Airgap is the distance between the lowest point of a water inlet or pipe to a tank and the overflowing level of the tank.
- A plumber needs to be proficient at measuring plumbing supplies with the aid of measuring instruments and have no trouble handling unit conversions.
- The plumbing system in a building distributes water for drinking, heating, and washing, as well as for the removal of waterborne wastes. It consists of pipes, drain fittings, valves, valve assemblies, and devices.
- Cast Iron Pipe is used as a pressure pipe for transmission of water, gas and sewage, and as a water drainage pipe.
- In pipe plumbing systems, fittings are used to join straight pipe or tubing pieces, to adapt to various sizes or forms, as well as for additional uses like regulating or metering fluid flow.
- A pipe fitting in the form of a sleeve for joining the spigot ends of two pipes in the same alignment is known as a collar.
- An elbow is a pipe fitting used to provide a change in direction, often a 90° or 45° angle, between two lengths of pipe or tubing.
- Gaskets or Mechanical seals are used to seal flange joints. It comes in a variety of designs, compositions, and features.
- Couplings are used to connect two pipes to each other. If the pipe sizes are different, the fitting may be referred to as an adapter, a reducing coupling, or both.
- A tee is used to combine (or split) fluid flow. It is offered with a female-threaded side outlet, opposing solvent-weld sockets, or female thread sockets.
- The water supply mains use brass or iron valves to ensure good pipeline operation. The flow of fluids such as liquid, gas, condensate, etc. is stopped or controlled by valves.
- A plumbing fixture is a component that connects to the building's plumbing system and transports water. Showers, tubs, sinks, faucets, and bathtubs are the most popular plumbing fixtures.
- A plumber needs a variety of tools and equipment to complete repair work, fix a tap, or perform fitting work.
- Use of barrier coatings, such as paint, plastic, or powder, is among the simplest and least expensive techniques to prevent corrosion.

Exercise

1. Match the following

S. No	Symbol	Symbol Name
1.		Straight Tee
2.		P-Trap
3.		Shower Head
4.		Gate Valve
5.		Sanitary Tee

2. What is the difference between PEX and Polypropylene pipes?

3. What is the advantage of using copper pipe?

4. List any three Plumbing fixtures and their purpose.

5. List any three Plumbing tools and their purpose.

Notes



QR Code

Scan the QR Code to watch the related video



<https://youtu.be/wpQD4XzjKDM>

Process of Mains Supply of
Water and Drainage



https://youtu.be/1YQ9dpa6_lw

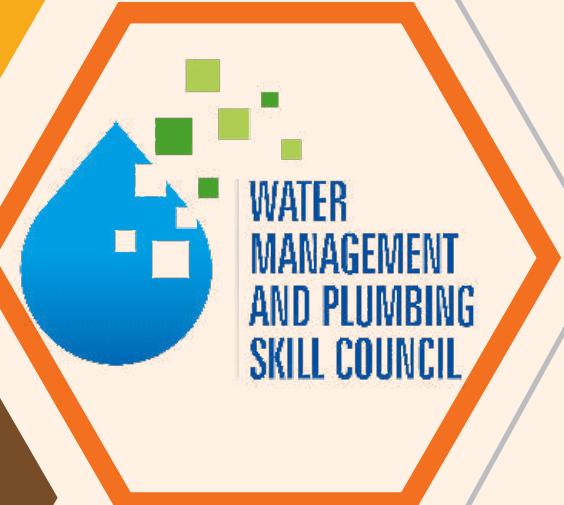
Pipe Materials



<https://youtu.be/GfNUaVFmxaY>

Different Types of Plumbing Tools and Equipment

3. Basic Tasks to Facilitate Plumbing Work



Unit 3.1 - Standard Operating Procedures



Key Learning Outcomes



At the end of this module, the trainee will be able to:

1. Demonstrate the steps involved in preparing for plumbing work
2. Perform supporting tasks in plumbing work

Unit 3.1 - Standard Operating Procedures

Unit Objectives



At the end of this Unit the trainee will be able to:

1. Discuss the importance of obtaining clarity about the tasks to be performed and following instructions and standard operating procedures
2. Discuss the importance of unpacking of plumbing materials safely and in compliance with the manufacturer's guidelines
3. Explain the process of checking and reporting shortage of materials as per specifications
4. State the precautions to be observed while operating hand tools and power tools
5. Discuss the various pipe fit-off processes employed in plumbing work such as cutting, bending, forming, assembling, and securing of plumbing pipes and fittings
6. Explain the importance of holding the pipework and/or fixture steadily for installation

3.1.1 Introduction to SOP

A standard operating procedure (SOP) is a set of detailed instructions created by a company to aid employees in doing common tasks. SOPs are designed to increase productivity, quality output, and consistency of performance while minimizing misunderstandings and noncompliance with industry rules.

Proper planning and designing of the plumbing work system serve the hygiene requirements of its occupants. Therefore, plumbing and sanitation play an important role in construction. A plumber should have drawing details, considering local authority rules and regulations, regarding the water supply system, internal piping, details of all plumbing and sanitary fittings, general drainage disposal layout, stormwater drainage details, and boosting system details. A plumber should have knowledge of proposed roads and buildings in order to provide proper slopes for drainage. All the above information plumber should obtain from the site engineer/plumbing consultant. Following are the common procedures involved in plumbing work:

Construction Schedule

Material Proposal

Workforce Plan

Project Management

Safety Plan

Fig 3.1 Procedures Involved in Plumbing

1. Construction Schedule

Based on the target dates provided by the client or consultant, a construction schedule must be created. The schedule shall be followed with every possible effort. It will be examined each week and changed if there are any delays brought on by unavoidable or unexpected events, keeping in mind the deadline for completion.

2. Material Proposal

The client or consultant must get a "Material Proposals" schedule that includes information on the materials, manufacturer, technical specifications, etc. Following their approval, a "Material procurement schedule" will be provided, and procurement will start. The storekeeper and site engineer should be in charge of making sure that all specifications and the bill of quantities are met by the materials when they ultimately arrive on site.

3. Workforce Plan

To adhere to the agreed construction timetable, adequate manpower must be deployed at all times. The workforce must be appropriately increased as necessary to meet the demands of the actual location.

4. Project Management

An "Organization Chart" that was released at the start of the Project will be used to organize the site workers. Any changes to the site's layout will be properly documented and communicated to the project managers. A senior member of the contractor's team must show up to weekly site meetings. The Executive Management should stop by on a regular basis. The "As Installed" drawings that will be provided at the conclusion of the project must include any deviations from authorized working drawings caused by site instructions provided by the Client or Consultant. Before the necessary adjustments or deviations are made, these instructions must be formally confirmed. If there are any time or financial repercussions, they will be communicated to the client later. When necessary, the site engineers will coordinate with organizations in charge of other services like electrical, HVAC, interiors, etc. Implementing a strong quality control program and making every effort to achieve and maintain a high level of workmanship are both necessary.

5. Safety Plan

In addition, a safety plan must be presented before work can begin. The safety components of the work must all be handled with the utmost care. All people working on the installation must wear the proper PPE (Personal Protective Equipment).

3.1.2 Unpacking of Plumbing Materials

Unpacking plumbing materials is an important step. It should be unpacked safely and in compliance with the manufacturer's guidelines. Unpacking details are provided on the cover of the packaging. It will help to reduce the damage to the plumbing materials. Similarly, a video should also be made will opening and unpacking of the plumbing materials, if a broken/damaged material is found then it should be immediately returned to the supplier. All the plumbing material should be assembled and used as per manufacturers' guidelines.

3.1.3 Inspection of Materials

A receiving inspection or material inspection, also known as an incoming inspection, verifies the quality of purchased materials in accordance with predetermined acceptance criteria. To address quality issues during pre-production, quality assurance staff in the manufacturing site do this task. When an item is tagged as acceptable, conditionally accepted, or refused, the results of the incoming inspection are used to determine the necessary next steps. The primary goal of the inspection is to prevent the usage of non-standard items in plumbing. As a result, it is crucial to thoroughly evaluate the materials; both their quality and quantity need to be checked. The main objectives of material inspection are listed below:

- To maintain product quality
- To receive correct quantity of materials
- To identify the defected materials
- Project Management
- Safety Plan

Fig 3.2 Objectives of Material Inspection

Follow the below steps while carryout material inspection:

- A checklist should be made to note down the plumbing materials received and check with the list of materials provided by the supplier/manufacturer.
- If there any shortage of material as per specification, complaint in writing should be made with full details to the supplier of material.
- Full payment should not be made until the defective material is replaced.

Notes



A sample material receiving inspection report is shown below:

Material Receiving Inspection Report					
Vendor Name:					
Purchase Order No:					
Date:					
S. No	Product Code	Product Description	Qty	Defects Identified	Remarks
Received by:			Inspected by:		Approved by:

Fig 3.3 Sample Material Receiving Inspection Report

3.1.4 Safe Handling of Hand Tools and Power Tools

As a plumber, it is necessary to use our plumbing tools, equipment, and plumbing material properly in a workplace and storage unit. These materials should be kept in an organized way and in a safe and secure location. This means that they should be away from any areas where they could be damaged or contaminated. Second, one should ensure that the materials are easily accessible. Materials should be kept on shelves. Similarly, shelves and racks should be sturdy and in good condition. Stacking of all materials should be done on a flat base. heavier objects should be placed closer to the floor and lighter/smaller objects at a higher level.

Plumbing tools and materials should be used safely so that no injury is made. Handling of tools and materials should be done as per the standard procedure. All safety precautions should be adopted in the handling of tools. Plumbing materials should be properly packed and transported safely so that it does not get damaged. A standard transport facility should be used for transporting the plumbing materials.



Fig 3.3 Sample Material Receiving Inspection Report

Source : <https://gibadi.com/products/knipex-l-boxx%C2%AE-sanitar>

3.1.5 Safe use of Plumbing Tools

The following safety measures may be taken for the safe use of the plumbing tools:

- Use the tools as per the instructions mentioned in the manual
- Use appropriate tools for specific tasks
- Perform regular maintenance of tools
- Follow proper safety measures while using electrical wires
- Wear appropriate Personal Protective Equipment
- Use kerosine to remove dust from rusty nuts
- Do not use damaged tools
- Remove burrs or stuck material from the edges of tools
- Lubricate the tools properly
- Do not apply excessive pressure or force on tools

Fig 3.5 Safety Measures for Using Plumbing Tools

3.1.6 Various Pipe Fit-Off Processes

Various pipe fit-off processes involved in plumbing are listed below:

Pipe Cutting

Pipe Bending

Forming

Assembling

Fig 3.6 Various Pipe Fit-off Processes

1. Pipe Cutting

The pipe is one of the important materials in plumbing work. As per requirement, a pipe is cut into different sizes. A pipe is cut manually or with a machine. The length of a pipe to be cut should be marked on the pipe with a pencil.

Common tools used for pipe cutting

- a) Plastic tubing cutters
- b) Wheel cutters
- c) Hacksaws

2. Pipe Bending

Nowadays PVC pipes are mostly used in plumbing work where elbows are used for joining the pipes in different directions. Other types of pipe like GI, copper, and aluminum is bent manually as well as with help of a pipe bending machine. Pipe bending machines may be operated manually/pneumatic powered, hydraulic assisted, or electric motor. The use of appropriate bending machines will help in bending the pipes as per requirements. In the pipe bending operation the tube may be supported internally or externally to preserve the cross-section of the pipe.



Fig 3.7 Pipe Cutting Machine
Source: Indiamart



Fig 3.8 Manual Pipe Bending Machine
Source: Indiamart

3. Forming

By applying the appropriate stresses, such as compression, shear, and tension, materials (mainly metals) undergo plastic deformations and take on the desired forms and sizes during the mechanical process known as "forming. The plumbing fittings/material manufacturing section uses experienced technicians to assist with this practice.

4 Assembling

To join the different fittings and fixtures properly, assembling is done in a systematic way. This assembled unit should be properly installed or fixed at the appropriate place as per the drawing. Improper assembly will lead to leakage and blockage in the unit, so proper care should be taken during the assembling and installation of the plumbing system.

5 Securing

Plumbing pipes and fixtures are supported with the plumbing fittings like clamps, hangers, anchors, nuts, bolts, etc. A better secure plumbing system should be secured with the help of a clamp and others supporting tools in its place. All the fixtures should be fixed in a proper way so that it does not collapse after some time of use.

3.1.7 Importance of Holding the Pipework

Pipework and fixture should be properly fixed or held with the help of appropriate holding tools. It helps in better handling and stability. There should be no compromise for the loose holding of pipework and fixtures. The proper operation of the pipe systems depends heavily on piping support. A pipe needs to be supported after the proper span in order to retain the integrity of the piping system. Any project's success depends heavily on pipe support engineering since it is necessary to make a precise and intelligent choice of piping support. Pipes are atypical space frames that cannot maintain themselves and hence require support. Pipe supports are used to convey piping loads from the pipe to the supporting structures. It is advantageous to have knowledge of proper pipe support during the planning phase. The purpose of pipe support is listed below:

- To prevent excess pipe stress
- To avoid leakage in joints
- To absorb excess vibrations
- To remove accidental disengagement (lift-off) of piping from its supports
- To prevent unnecessary pipe sag
- To protect equipment from overloading
- To prevent equipment from being exposed to temperature extremes that are beyond their intended range

I. Pipe Supports for Carrying Loads

Pipe supports are necessary to hold up the line under all circumstances, including use and testing. Due to hydro testing, this difference will be particularly significant in the case of the vapor line. Supports ought to be built to withstand this load (unless otherwise decided in the project). Although the line may occasionally be able to span a greater distance, the weight on the support may occasionally be very heavy (especially with large-diameter pipelines). Then the number of supports should be provided with a lower span in order to distribute the load evenly.

II. Pipe Supports for Thermal Expansion

Every time pipe supports limit thermal expansion, the support is put under more strain. Support restraints must be constructed to take this load in addition to all other loads.

III. Pipe Supports for Earth Quake Loads

The earthquake often has a horizontal acceleration of 1 to 3 m/sec² or greater. This introduces a horizontal force that is about equal to 10% to 30% of the vertical load and represents 10% to 30% of the gravitational acceleration (or supported mass). This needs to be considered while planning pipe support.

IV. Pipe Supports for Vibration

The pipe may begin to vibrate violently and eventually fail when exposed to moving machinery, pulsating flow, or extremely high flow, especially if the span is considerable. In addition to other criteria, it could be necessary to add more supports at a narrower span to prevent this. It might not support axial stress, but it must restrain lateral motions.

V. Pipe Supports for Noise Control

Most plants produce noise as a result of vibration, and if these vibrations are regulated, noise is much diminished. To reduce noise and absorb vibration in such lines, the asbestos cloth is placed between the clamp (also known as the support) and the pipe.

VI. Pipe Supports for Wind Load

On the line, wind causes lateral load. This load grows with line size and is significant, especially for big-diameter pipes. To prevent any form of problem, the line must be appropriately steered against this weight, which tends to sway it from its natural position. Wind load causes significant bending moments and should be carefully taken into consideration when it comes to large-diameter overhead lines supported by tall supports that are extended from the floor.

Notes



Summary



- A standard operating procedure (SOP) is a set of detailed instructions created by a company to aid employees in doing common tasks. SOPs are designed to increase productivity, quality output, and consistency of performance while minimizing misunderstandings and noncompliance with industry rules.
- The client or consultant must get a "Material Proposals" schedule that includes information on the materials, manufacturer, technical specifications, etc.
- An "Organization Chart" that was released at the start of the Project will be used to organize the site workers.
- Unpacking plumbing materials is an important step. It should be unpacked safely and in compliance with the manufacturer's guidelines.
- A receiving inspection or material inspection, also known as an incoming inspection, verifies the quality of purchased materials in accordance with predetermined acceptance criteria.
- A checklist should be made to note down the plumbing materials received and check with the list of materials provided by the supplier/manufacturer.
- As a plumber, it is necessary to use our plumbing tools, equipment, and plumbing material properly in a workplace and storage unit.
- Plumbing tools and materials should be used safely so that no injury is made. Handling of tools and materials should be done as per the standard procedure.
- The pipe is one of the important materials in plumbing work. As per requirement, a pipe is cut into different sizes.
- Nowadays PVC pipes are mostly used in plumbing work where elbows are used for joining the pipes in different directions.
- By applying the appropriate stresses, such as compression, shear, and tension, materials (mainly metals) undergo plastic deformations and take on the desired forms and sizes during the mechanical process known as "forming".
- Plumbing pipes and fixtures are supported with the plumbing fittings like clamps, hangers, anchors, nuts, bolts, etc.
- Pipework and fixture should be properly fixed or held with the help of appropriate holding tools. It helps in better handling and stability.
- The pipe may begin to vibrate violently and eventually fail when exposed to moving machinery, pulsating flow, or extremely high flow, especially if the span is considerable.
- The earthquake often has a horizontal acceleration of 1 to 3 m/sec² or greater.
- Most plants produce noise as a result of vibration, and if these vibrations are regulated, noise is much diminished.

Exercise



1. What is meant by SOP?

2. List the objectives of the material inspection.

3. List the safety measures to handle plumbing tools.

4. List various pipe fit-off processes.

5. Explain the importance of holding the pipe work.

Notes



Notes



QR Code

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<https://youtu.be/AI9Yly-86v8>
Safe use of Plumbing Tools



<https://youtu.be/q33WAVm0K5o>
Various Pipe Fit-Off Processes



4. Maintaining the Plumbing Tools and Equipment

Unit 4.1 - Tool Maintenance

Unit 4.2 - Plumbing Tools Defects

Unit 4.3 - Advanced Tools, Equipment, and Materials



Key Learning Outcomes



At the end of this module, the trainee will be able to:

1. Discuss the need for maintenance of plumbing tools and equipment
2. Perform basic repair and maintenance of plumbing tools and equipment

Unit 4.1 - Tool Maintenance

Unit Objectives



At the end of this Unit the trainee will be able to:

1. List the key considerations in ensuring proper usage and maintenance of plumbing resources (tools, equipment and related materials)
2. Discuss the importance of referring to documents such as manufacturer guidelines, organisational documents, product catalogues in storing the plumbing resources

4.1.1 Proper Usage and Maintenance of Plumbing Tools

Tools have always been the most crucial asset for plumbers. Proper care and routine maintenance of plumbing tools and equipment make any plumbing project easier, safer, and more successful. Proper care of plumbing tools and equipment properly can save a lot of time and money in the long run. It helps to ensure the technician's ability to do the job to the best of his abilities. For proper usage and maintenance of plumbing resources, it is necessary to follow the key considerations:

Store the tools and equipment with care

Clean the tools and equipment after every use

Inspect the tools and equipment periodically

Lubricate the tools frequently

Fig 4.1 Tips for Plumbing Tools Maintenance

1. Store the tools and equipment with care

Make sure each type of tool has its own compartment in your toolbox to prevent them from coming into contact with something that can harm them. Be sure to follow any particular storage instructions that may be specified for specific instruments, such as the requirement to loosen torque wrenches at the spring to prevent deterioration. The humidity in enclosed storage areas like garages and basements can be problematic and harm your equipment. Invest in a dehumidifier, silica gel packs, rust collectors, and anti-rust liners if you must maintain them in a setting like this.

2. Clean the tools and equipment after every use

While the majority of your equipment will only need a quick wipe down, most hand tools that appear to be a little unclean may be quickly cleaned by soaking them in a bowl of hot, soapy water and then thoroughly drying them. But some will need a little more tender loving care. Check your tool's instruction manual to determine if a particular oil is advised in order to preserve its optimal level of performance and assist battle rust growth. This is true for both hand and power tools with adjustable parts. However, immediately after usage, spraying them with WD-40 and making careful to keep a thin layer of it on, can be equally as effective. Create a solution of detergent and bleach in the toilet bowl and swirl the plunger around for a minute or two to clean equipment like toilet plungers. Keep in mind, though, that even after following this schedule, not all of the germs may have been eliminated.

3. Inspect the tools and equipment periodically

If you periodically and properly inspect your tools, you can also extend their lifespan. In order to guarantee that their work is made simpler, safer, and of a high grade, plumbers are often advised to inspect their tools for any signs of damage after each usage. It is crucial to take good care of your instruments because doing so enhances the likelihood that they will last longer.

4. Lubricate the Tools

Proper lubrication of tool helps to keep the tools in good operating order and prevents any performance issues. You must be aware of the proper way to lubricate the instrument before using it; if you are unsure, review the handbook. Additionally, appropriate tool lubrication prevents corrosion, chafing, and heating. In the end, the tools' lifespan lengthens.

4.1.2 Importance of Referring Manufacturer Guidelines

As all the plumbing tools, and equipment is manufactured by the standard manufacturer, these manufacturers provide organizational document product catalogs, and manufacturer guidelines. These documents provide details regarding storing plumbing resources. It is necessary that the standard procedure mentioned in these documents should be followed. Similarly, a plumber can access the website of the manufacturer and get the desired information. If there is any confusion then the helpline number of manufacturers can be used.

Notes

Unit 4.2 Plumbing Tools Defects

Unit Objectives



At the end of this Unit the trainee will be able to:

1. Describe the various types of damages and defects that can occur to the plumbing tools, equipment and materials and their indicators
2. Describe the impact of factors such as temperature, pH (acidity levels), chemical composition, oxidation and ageing on plumbing tools, equipment, products and materials
3. Explain the processes of prevention and treatment of damaged plumbing tools and equipment
4. Describe the various types of lubricants and their application used in the plumbing industry
5. Explain the correct material disposal procedures for plumbing waste such as oily rags and other plumbing garbage

4.2.1 Types of Damages and Defects

Thousands of plumbers are hurt and even killed every year because they unintentionally used a tool or piece of equipment at work that was either defectively made or created irresponsibly. Tools with flaws can lead to severe and serious injuries. In addition to common hand-held tools like hammers, wrenches, and screwdrivers, defective tools can also be found in power instruments like table saws and drills. Always remember to examine all tools before using them, and to keep damaged or broken instruments in a separate toolbox. Air, petrol, diesel, or electric power tools, require skill and complete attention on the part of the user even when they are in good condition. The most common defect with power tools is a broken, displaced, or inoperative guard. Guards are placed on equipment to prevent injuries. Never use power tools that are broken in any way. Various types of damage and defect that can occur to the plumbing tools and equipment are listed below:

- Mushroomed heads on chisels and wedges
- Files without handles
- Loose, split, cracked, or crooked handles
- Chipped or broken drill bits
- Wrenches with worn out jaws
- Workers have lost eyes from using chisels with mushroomed heads
- Loose handles on hammers and picks have resulted in serious head and body injuries
- Slipping wrenches have caused people to fall from ladders or scaffolds
- Loose or broken power cords as these can cause electric shocks or fires
- Cracked, or blades that are blunt

Fig 4.2 Types of Tool Defects

A plumber should be alert for the following problems:

- Broken or inoperative guards
- Insufficient or improper grounding due to damage on double insulated tools
- No ground wire (on plug) or cords of standard tools
- The on/off switch is not in good working order
- The tool blade is cracked
- The wrong grinder wheel is being used
- The guard has been wedged back on a power saw

Using tools with inoperative or broken guards can lead to disaster. Do not use:

- Electric-powered tools that have defective switches, poorly insulated cords, and no grounding.
- Air-powered tools and equipment that show up on the job with valves that will not completely open or close.
- Gasoline-powered tools that have a broken throttle.

To ensure safe use of hand tools, remember:

- Double-check all tools before you use them.
- Put a tag on any defective tools you find.
- Turn in all defective tools right away. Never use a defective tool
- Ensure defective tools are repaired

4.2.2 Impact of Different Factors on Plumbing Tools

In plumbing, the impact of factors such as temperature, pH (acidity levels), chemical composition, oxidation, and aging plays an important role in plumbing tools, equipment, products, and materials. The availability of water at a known level of purity is always desired. To determine the purity, the easy and quickest method is to check the pH of that water. The pH of a solution will change according to its temperature. Many common contaminants, including dissolved air, carbon dioxide, and ionic salts have a direct effect on acidity or alkalinity. The pH scale provides a standard method for the measurement of the acidity or alkalinity of a solution. Unless you have no other choice, avoid using copper and metal piping while working with a less-than-neutral water supply. Both acidic and alkaline water can corrode metals. Acidic water makes copper leach out into the supply and alkaline water often carries excess mineral content that can cause build-up on the pipes. Iron piping isn't immune from the effects of problematic water, either. Both acidic and alkaline water supplies can cause build-up and leaching of chemicals contained in the pipes themselves and in the fittings used to couple them. It is recommended that PVC or PEX piping for clients with a problematic water pH should be used.

Water or chemical should have proper pH and they should be maintained during plumbing operations. The proper temperature should be maintained for a better quality of water. Chemical composition and oxidation deteriorate the quality of plumbing tools, equipment, products, and materials. It is always advisable to clean plumbing tools, equipment, and product and keep them dried so that life of the equipment doesn't get reduced. A damp cloth, chemical cleaners, plumbing tools, spray (for removing rust), steel wool, stiff wire brush, bladed tools (such as cutters, filers, pliers, chisels), sharpening tools (such as a coarse file, medium-grit sharpening stone), power tools (such as power cords, insulation wires, cord's prongs), industry approved lubricants.

4.2.3 Prevention Process of Damaged Tools

Plumbing tools and equipment should be properly handled to avoid its damage. Proper exposure of tool handling should be given prior to use of tools and equipment. Standard operative procedure should be followed in handling of tools and equipment. This procedure should be practiced three to four times so that technician get confidence in its handling. Damaged plumbing tools and equipment should be repaired or replaced as per its quality. Use of damaged tool and equipment will lead to accident and loss of materials.

4.2.4 Lubricants Used in the Plumbing Industry

Lubricants are substances that are used to reduce friction between two surfaces in mutual contact. It is applied where the two surfaces meet. Additionally, lubricants aid in reducing the heat produced at the point where two moving surfaces come into touch with one another. The main functions of lubricants are:

- Keep parts moving smoothly
- Prevent parts from over heating
- Reduce friction between moving parts
- Prevent from foreign particles
- Transmit power from one equipment to another
- Prevent from corrosion
- Seal the gas from escaping or losing pressure
- Increase the component life span
- Prevent against wear and tear
- Carry away debris to prevent clogging

Fig 4.3 Functions of Lubricants

Types of Lubricants

Various types of lubricants are used in plumbing industry. These lubricants are applied to pipes of all materials, including PVC and ductile iron. Pipes and fittings may be inserted more easily with the help of lubricants. The water utility business uses a variety of pipe with gasketed joints, including PVC and Ductile iron. All of these pipes require field application of lubricant to reduce friction upon the gasket during assembly. For push-on joint pipes, the lubricant lowers the possibility of rolling gaskets during the pipe's homing process and makes it easier for the spigot to slip into the bell next to it. The most common lubricants used in plumbing industry are listed below:

- Grease
- Oil
- Penetrating Lubricants
- Dry Lubricant

Fig 4.4 Types of Lubricants

I. Grease

Grease is made by combining thickeners with oil, often mineral oil (such as lithium-based soaps). Particles may be mixed with lubricants like graphite, molybdenum disulfide, and others. Grease has the capacity to combine favorably with the lubricants in the oil, creating stickiness and enabling the lubricants to accumulate on the surfaces. Additionally, grease can serve as a barrier to keep impurities from harming surfaces.

II. Oil

The lengthy polymer chains that make up these thin liquids are combined with other ingredients. For instance, antioxidants stop the oil from oxidizing, corrosion inhibitors stop corrosion, and detergents stop the buildup of deposits.

III. Penetrating Lubricants

These lubricants protect a variety of stuck-bolts. On the other hand, these penetrating lubricants for covered elements are not intended for long-term lubrication. These oils were created specifically to penetrate tiny surface cracks, promote lubrication, and disintegrate rust because of their low viscosity.

IV. Dry Lubricants

Dry lubricants contain particular kinds of lubricants, including silicon, molybdenum, graphite, and PTFE. Because of their extremely slippery molecular composition, these particles cause less friction between these surfaces. They can also be purchased in spray form, where they are combined with water, alcohol, or other flammable solvents before being applied.

4.2.5 Proper Waste Disposal

Waste disposal is the process used to remove or recycle domestic, agricultural, medical, or industrial waste that is no longer needed or wanted. The correct collection of waste and scientific treatments that may reduce air, water, and soil contamination are all vital steps in proper waste management.

Plumbing waste needs to be appropriately separated and stored in distinct disposal bags. It could be disposed of at a waste disposal facility depending on the type of garbage. Never put oily rags in trash compactors, dumpsters, or regular trash cans because they could catch fire. Oily rags that are used frequently should be soaked in water in a metal container that may be sealed. Oil-contaminated products, like rags and filters, should be stored and managed properly to maintain an ordered workspace as well as to safeguard equipment and coworkers. Valuable resources won't be contaminated and used poorly if storage containers are labeled and handled properly. Of course, safe storage can help avoid accidents like fires.

Notes

Unit 4.3 Advanced Tools, Equipment and Materials

Unit Objectives



At the end of this Unit the trainee will be able to:

1. Discuss about new advanced tools, equipment and materials being introduced in the industry

4.3.1 Advanced Plumbing Tools

Nowadays various new innovations are being practiced in the plumbing industry. These new technologies are mobile-based and have other advanced features like Bluetooth shower heads, smart water heaters, sensors to detect leaking pipes, better filtration systems, and touchless digital faucets that reduce water flow. The plumbing industry also sells intelligent toilets that save water or have features like seat warmers and nightlights. Gray water systems recycle water from baths, basins, and showers to water plants. A few plumbing businesses also put in HVAC units, water treatment systems, water conservation systems, landscape sprinkler systems, fire sprinkler systems, and waste management systems—all of which use technology to be as effective as possible. Some advanced plumbing tools are listed below:

Sink Auger

Hydro Jetting Machine

Flex Shaft Drain Cleaning Machines

Soldering Torch

Drain Inspection Camera

PEX Plumbing Tools

Metal Detectors

Fig 4.5 Advanced Plumbing Tools

I. Sink Auger

A sink auger makes clearing and dislodging difficult obstructions in tubs and sink drains much simpler. This tool has a stainless-steel flexible cable with a corkscrew tip at one end. To reach and unclog obstructions, the cable is wrapped within a drum canister. This allows it to extend further into a drain. A thumbscrew secures the flexible cable to the canister, and the drum has a handle. When the cable is inserted into the drain and the handle is turned, the revolving drum snakes the cable through the drain pipe's many bends. As a result, the cable tip may quickly eliminate the clogs in addition to penetrating them all.

II. Hydro Jetting Machine

An obstruction in the sewer lines or plumbing may be the primary reason for clogged drains and tainted water sources. Hydro-jetting devices can help in this situation. Even the toughest jams and accumulated trash can be removed by this high-pressure water system. These devices are used by advanced plumbing services to remove soap scum, hair that has become stuck, and other debris from pipes as well as to remove grease or sludge. Hydro-jetting devices ensure a thorough cleaning of the plumbing pipes in contrast to rodding, which involves using a tool to punch a hole through the debris.

III. Flex Shaft Drain Cleaning Machines

High-speed flex shaft drains cleaning machines, one of the most sophisticated plumbing instruments, are a more recent development in plumbing technology. Chain knockers attached to a flexible cable operated by a cordless drill are the major component of this machine. Plumbing professionals can swiftly and effectively clear pipes using these drain cleaning devices.

IV. Soldering Torch

A precision soldering torch's function is to create watertight seals on pipes. MAPP gas or MAPP gas alternatives may be safer alternatives to propane when it comes to the gas used.



Fig 4.6 Sink Auger
Source: <https://www.thespruce.com/how-to-use-a-sink-auger-1825090>



Fig 4.7 Hydro Jetting Machine
Source: Indiamart



Fig 4.8 Flex Shaft Drain Cleaning Machine
Source: <https://www.drainrehabolutions.com/flex-shaft-drain-cleaning-machines>



Fig 4.9 Soldering Torch
Source: https://www.lsttsale.com/?category_id=663653

V. Drain Inspection Camera

Cameras for drain and sewer inspection are crucial to modern plumbing service technologies. They enable a complete examination of the interior of pipes and sewer systems. These systems have self-leveling camera heads, high-definition video, long-lasting batteries, and portability.

VI. PEX Plumbing Tools

Plumbing pipes constructed of PEX or cross-linked polyethylene are gradually taking the place of PVC and copper pipes. Direct pipe routes, flexibility, ease of installation, and higher water pressure are only a few advantages of the material. It is very inexpensive and rust-proof. It might be necessary to use a few specialized plumbing instruments, such as PEX pipe expanders and a PEX crimper, to incorporate PEX into service offerings.

VII. Metal Detector

A metal detector is an incredibly useful tool that works wonders in simplifying challenging plumbing operations. A metal detector can be used to find buried iron and steel things such as pipes, valve boxes, manhole covers, reinforced septic tanks, and more as well as well casing.



Fig 4.10 Drain Inspection Camera
Source: Amazon



Fig 4.11 PEX Plumbing Tools
Source: Pinterest



Fig 4.12 Metal Detector
Source: <https://www.bosch-pt.co.in/in/en/products/gms-120-0601081000>

Summary



- Tools have always been the most crucial asset for plumbers. Proper care and routine maintenance of plumbing tools and equipment make any plumbing project easier, safer, and more successful. Proper care of plumbing tools and equipment properly can save a lot of time and money in the long run.
- Proper lubrication of tool helps to keep the tools in good operating order and prevents any performance issues.
- As all the plumbing tools, and equipment is manufactured by the standard manufacturer, these manufacturers provide organizational document product catalogs and manufacturer guidelines. These documents provide details regarding storing plumbing resources.
- Thousands of plumbers are hurt and even killed every year because they unintentionally used a tool or piece of equipment at work that was either defectively made or created irresponsibly. Tools with flaws can lead to severe and serious injuries.
- In plumbing, the impact of factors such as temperature, pH (acidity levels), chemical composition, oxidation, and aging plays an important role in plumbing tools, equipment, products, and materials.
- Plumbing tools and equipment should be properly handled to avoid its damage. Proper exposure of tool handling should be given prior to use of tools and equipment.
- Lubricants are substances that are used to reduce friction between two surfaces in mutual contact. It is applied where the two surfaces meet.
- Various types of lubricants are used in plumbing industry. These lubricants are applied to pipes of all materials, including PVC and ductile iron.
- Waste disposal is the process used to remove or recycle domestic, agricultural, medical, or industrial waste that is no longer needed or wanted.
- Nowadays various new innovations are being practiced in the plumbing industry. These new technologies are mobile-based and have other advanced features like Bluetooth shower heads, smart water heaters, sensors to detect leaking pipes, better filtration systems, and touchless digital faucets that reduce water flow.
- A sink auger makes clearing and dislodging difficult obstructions in tubs and sink drains much simpler. This tool has a stainless-steel flexible cable with a corkscrew tip at one end.
- An obstruction in the sewer lines or plumbing may be the primary reason for clogged drains and tainted water sources. Hydro-jetting devices can help in this situation.
- High-speed flex shaft drains cleaning machines, one of the most sophisticated plumbing instruments, are a more recent development in plumbing technology.
- A precision soldering torch's function is to create watertight seals on pipes. MAPP gas or MAPP gas alternatives may be safer alternatives to propane when it comes to the gas used.
- Cameras for drain and sewer inspection are crucial to modern plumbing service technologies. They enable a complete examination of the interior of pipes and sewer systems.
- Plumbing pipes constructed of PEX or cross-linked polyethylene are gradually taking the place of PVC and copper pipes.
- A metal detector is an incredibly useful tool that works wonders in simplifying challenging plumbing operations.

Exercise



1. Explain the importance of tool maintenance.

2. List different types of damages that occur to the plumbing tools.

3. Explain the importance of lubrication.

4. List any four advanced plumbing tools and their uses.

Notes



Notes



QR Code

Scan the QR Code to watch the related video



<https://youtu.be/MxmNxqwLAP4>

Advanced Plumbing Tools



5. Health and safety

- Unit 5.1 - Dealing with workplace Hazards & Risks
- Unit 5.2 - Fire Safety Practices
- Unit 5.3 - First-aid Practices



Key Learning Outcomes



At the end of this module, the trainee will be able to:

1. Describe the various risks and hazards at the workplace and their preventive and corrective measures
2. Employ preventive and corrective measures to protect self and others from common workplace hazards and risk

Unit 5.1 Dealing with Workplace Hazards & Risks

Unit Objectives



At the end of this Unit the trainee will be able to:

1. Differentiate between risks and hazards
2. Discuss the specific safety and health-related problems faced in domestic, commercial and institutional setups
3. List the various types of hazards (such as physical, fire, chemical compounds and electrical) that could affect the work process
4. List the various hazardous environments and common hazards that can occur during plumbing installation and maintenance along with their precautions and remedial measures
5. Discuss the importance of various types of personal protective equipment (PPE)
6. Discuss where the general health and safety equipment commonly is kept at the workplace
7. Explain the various types of safety signs and their significance in the work process

5.1.1 Safety Hazards and Risks

A **hazard** is something or someone that has the possibility of causing, serious harm, damage, or negative health effects. It has the potential to cause human injury or illness, property damage, environmental damage, or a combination of these effects.

Probability of Hazard

Frequent	Likely	Occasional	Remote	Unlikely
<ul style="list-style-type: none"> • Continuously experienced during operation. 	<ul style="list-style-type: none"> • Occurs several times in career/ equipment service life. 	<ul style="list-style-type: none"> • Occurs sometimes in career/ equipment service 	<ul style="list-style-type: none"> • Possible to occur in career/ equipment service life. 	<ul style="list-style-type: none"> • Possible, but improbable; occurs only very rarely during operation.

Fig.5.1 Probability of Hazards

Risk is the possibility or likelihood that someone will suffer harm or have a negative impact on their health as a result of being exposed to danger. It may also apply when there is a loss of property or equipment or when there are negative environmental repercussions.

Risk levels

- 1) **Extremely high** - Loss of ability to achieve the task
- 2) **High** - Significantly degrades mission capabilities in terms of required mission standards
- 3) **Moderate** - Degrades mission capabilities in terms of required mission's standards
- 4) **Low** - Little or no impact on the accomplishment of a mission

Difference between Hazard and Risk

Basis	Hazard	Risk
Definition	A source of possible harm or risk is referred to as a "hazard."	Risk is the likelihood that damage or injury will take place as a result of exposure to a hazard.
Safety	Even if the risk is reduced, the hazard may still exist.	In order to reduce risk, it's crucial to identify the danger and the possible harm it poses.
Example	A workplace might have a variety of hazards, including chemicals, loud noise, pollutants, electricity, etc.	Risk is the chance of suffering harm as a result of exposure to chemicals, noise, pollutants, etc.

Table 5.1 Difference between Hazard and Risk

5.1.2 Types of Hazards

The following figure represents the various hazards at the workplace:



Fig. 5.2 Hazards and Risks at Workplace

5.1.3 Common Hazards

Here are some of the various hazards that plumbers encounter while working on a home or commercial plumbing project, frequently on a daily basis.

Slip and Fall Injuries	It should come as no surprise that a professional plumber working on the job could get a slip and fall injury due to slippery surfaces in homes and places of business.
Tight Spaces	As a result of the limited oxygen present in the cramped locations like crawl spaces, boilers, pits, water tanks, or pipes which are frequently inadequately aired, performing plumbing duties can be dangerous and even fatal.
Rodents and Contaminated Waters	Speaking about confined areas, disease-carrying rodents and tainted streams find them to be very alluring. Because they can result in illnesses like E. coli, exposure to these things can be exceedingly dangerous.
Chemical Hazards	Plumbers may experience significant breathing issues as a result of chemical risks like lead and asbestos found in older homes.
Tool Injuries	Any plumbing task requires the use of tools. Numerous injuries can be caused by these equipment, such as cuts from hacksaws, burns from torches, and blunt force trauma from wrenches.
High and Low Temperatures	Plumbers frequently have to operate in hot conditions. Extreme temperatures in the room can occur for a variety of reasons, including working in small quarters during cold or hot weather and hot or cold pipes.
Skin Hazards	Working with toxic chemicals, contaminated water, or even boiling water can be quite dangerous for skin.
Hearing Impairments	Plumbing jobs, particularly those for new buildings or commercial properties, can be extremely noisy. Hearing damage or even complete hearing loss can result from banging tools, loud machinery, and reverberating pipes.
Eye Hazards	Plumbers are constantly required to thoroughly inspect pipes, nuts, bolts, and fixtures. The high-pressure pipes they are working on might send objects flying across the room. They frequently also do their duties in environments that are rife with chemical and microbial risks.
Indoor Mold	Bathrooms and leaky pipes in small, poorly ventilated spaces are the perfect breeding grounds for mould since it thrives in moist settings. Because indoor mould can result in major health issues for people, it poses a considerable risk to both plumbers and inhabitants.

Fig 5.3 Common Hazard

It is significant to ensure a high level of safety that no machine tool should be used unless the risk management process outlined below is understood and applied by the user:

1. Determine the potential hazard(s) that the machine tool may produce.
2. Using the Risk Assessment Matrix, determine the likelihood and severity of the hazard(s). The following individuals have risk acceptance decision authority for the risk levels:
 - a. very high
 - b. very high
 - c. moderate and low
3. Determine the risk-control measures that will eliminate or reduce the hazard(s). Then, implement risk control measures before and during machine tool operation to eliminate threats or mitigate their risks.
4. Monitor and evaluate the process. Enforce the established standards and risk management procedures. Evaluate the effectiveness of the control measures and make any necessary adjustments/updates.

Remedial Action Procedure

In case of any problem or hazard situation, remedial action should be completed as soon as possible. Therefore, apply these guidelines to expedite the correction of hazardous conditions.

1. Give remedial action priority to hazards with more severe loss potential.
2. Obtain target dates for correction. Use hazard classification to motivate modification.
3. Write a detailed explanation of the hazard and its potential loss severity as justification for any action requiring a significant expenditure and forward it to the person most responsible for corrective action.
4. Encourage responsible persons to take permanent corrective action (repetitive remedy is costly).
5. Ensure intermediate (temporary) safety measures are taken whenever permanent or complete remedy requires additional time.
6. At a reasonable time after the inspection is conducted and necessary action is taken, do a follow-up walk-through to ensure that the corrective action has been completed.
7. Make sure all reports are properly filed and maintained for record purposes.

Notes



5.1.4 Safety and Health-related Problems

When working with machinery, tools and equipment, employees are exposed to a variety of safety and health problems that can result in a variety of injuries. The following are the most common safety and health issues in the workplace:

Accidents and injuries from poor illumination

Fire/explosion caused by gas leaks, backfires and flashbacks

Risk of electrocution due to faulty electrical components

Prolong exposure of excessive loud noise by machines can cause noise-induced deafness(NID)

Burns from hot equipment parts, steam lines, and the release of hot water or steam.

Working in awkward positions, or performing awkward manual tasks

Working at heights (e.g., on platforms/scaffolding or ladders)

Shift work or extended work days

Stress and distractions

Fig 5.4 Safety and Health-related Problems

5.1.5 Personal Protective Equipment

While working on the shop floor, every worker has to take care of several things about personal safety and their co-workers' safety. To avoid accidents and hazards, a person has to take different precautions for different situations. Firstly, on the shop floor, every person has to wear Personal Protective Equipment (PPE) for their safety.



Fig. 5.5 PPE

PPE refers to the clothing or equipment designed to protect the workers/employees from shop floor hazards. It consists of items for example; hard hats, safety boots, coveralls, gloves, safety glasses, earplugs, high visibility clothing and lifejackets, fall protection, and respirators.

Common types of PPE include the following:



Eye and Face Protection



Hand Protection



Head Protection



Hearing protection



Foot Protection



Body Protection



Fall Protection



Respiratory protection

Fig. 5.6 Types of Personal Protective Equipment

5.1.6 Health and Safety Equipment

Eye and Face Protection

Possible eye and face injuries include:

1. Eye injury during cutting, grinding, nailing.
2. Chemical reactions from acidic substances, solvents, or other hazardous solutions.
3. Objects fly into the eye from chains, tools, tree limbs, or ropes.
4. Radiant light during welding.

Following elements should take into consideration while selecting eye and face security equipment:

- a. Capability to defend from hazards.
- b. Wear suitably and comfortably.
- c. Give unobstructed body movement and vision.
- d. Durable
- e. Permit unobstructed working of other equipment

Some of the most common types of eye and face protection equipment include the following:

Safety spectacles	Goggles	Welding shields
		

Safety spectacles having frame with plastic and impact-resistant lenses.

These are eye safety spectacles which cover the eyes tightly and give safety from dust and debris.

These are made of vulcanized fiber which is fitted in lens. Welding shields guard your eyes from fire sparks produce during welding

Fig. 5.7 Types of Eyes & Face Protection

Head Protection

Head protection in PPE terms is considered as protection against impact injury and some burn injuries.

Protective helmets or hard hats should do the following:

1. Oppose injuries by falling objects
2. Save from blows if any heavy object hits on the head
3. Guard from welding sparks



Fig. 5.8 Workers wearing Hard Hats

Foot Protection

Safety boots guard the feet from puncture wounds, injuries, and slipping.

Make sure that foot protection is available where following risks are present:

1. When heavy objects roll on or fall on the feet
2. Working with pointed items like nails or wires
3. Risk of falling of molten metal on feet or legs
4. Working on warm, damp and greasy surfaces



Fig. 5.9 Safety Boots

Hand Protection

Employees face potential injury to hands and arms that cannot be eliminated through engineering and work practice controls. Potential hazards include skin absorption of harmful substances, chemical or thermal burns, electrical dangers, bruises, abrasions, cuts, punctures, fractures, and amputations. Hand Protective equipment includes gloves, finger guards, and arm coverings or elbow-length gloves.



Fig. 5.10 Safety Gloves

Body Protection

Body protection is principally designed to protect the torso, i.e. the chest and abdomen, from various hazards and risks which can cause injuries due to:

1. Extreme temperatures
2. Hot splashes from molten metals and other hot liquids
3. Potential impacts from tools, machinery and materials
4. Hazardous chemicals



Fig. 5.9 Safety Boots

There are many varieties of protective clothing available for specific hazards. In addition, protective clothing comes in a variety of materials, each effective against particular threats, such as:

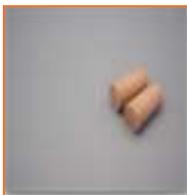
- a. **The paper-like fiber** used for disposable suits protects against dust and splashes.
- b. **Treated wool and cotton** adapt well to changing temperatures, are comfortable and fire-resistant, and protect against dust, abrasions, and rough and irritating surfaces.
- c. **Leather** is often used to protect against dry heat and flames.
- d. **Rubber, rubberized fabrics, neoprene, and plastics** protect against certain chemicals and physical hazards.

Ear Protection

Employees' exposure to excessive noise depends upon several factors, including:

1. The duration of each employee's exposure to the noise.
2. Whether employees move between work areas with different noise levels.
3. Whether the noise is generated from one or multiple sources.

Some types of hearing protection include:



Earplugs

They are made of waxed cotton, foam, silicone rubber or fiberglass wool. They are self-forming and, when properly inserted, they work as well as most molded earplugs.



Earmuffs

It require a perfect seal around the ear. Glasses, facial hair, long hair or facial movements such as chewing may reduce the protective value of earmuffs.

Fig. 5.12 Types of Ear Protection

Other Safety Instruments



Safety belt:

Safety harnesses protect workers from falling from heights.



Respirator:

Respirators protect the respiratory system of the wearer from the attack of poisonous gases, fumes, mist and dust.

Fig. 5.13 Safety Instruments

Maintaining PPE - Proper maintenance of PPE is necessary to ensure that the equipment continues to provide the level of protection for which it is designed. Periodical inspection of the PPE for any breaks, tears, and visible signs of stress or damage is essential. Maintenance may include visual inspection, dusting, replacement, restoration, and functional testing.

The following figure represents the responsibilities of an employee regarding PPE:

PPE must be worn and used in accordance with the instructions provided

Employees must take all reasonable steps to ensure that PPE is returned to proper storage after it has been used

PPE must be examined before use

Any loss or obvious defect must be immediately reported to their supervisor

Employees must take reasonable care of any PPE provided to them

Employees must not carry out any maintenance or repair of PPE unless trained and authorized to do so

Fig. 5.14 Responsibilities of the Employees Regarding PPE

5.1.7 Warning and Safety Signages

Workplace safety signage evolved with the Industrial Revolution when workplace safety became a major concern. A workplace safety sign's main function is to detect and alert employees who might be exposed to various risks. Safety signs help to communicate important instructions, reinforce safety messages, and provide emergency instructions. Workplaces that lack the necessary safety signs not only violate safety regulations but may also face hefty fines and regulatory action if they are audited by legal authorities. If an accident occurs and it is determined that proper safety signs were not present, the employer or other responsible parties could face legal consequences. It is essential to know the

meaning of safety signs. Such signs warn us of danger and allow us to take precautions to keep safe. There are four main types of safety signs:

1. Prohibition signs
2. Mandatory signs
3. Warning signs
4. Information signs
5. Fire Safety signs
6. Danger Signs

The following table represents the various signages related to health and safety measures:

S. No.	Signage	Message
1.		Basic floor sign to stop moving ahead
2.		Stop Look Out for Forklifts
3.		Eye safety warnings
4.		Fire exit sign
5.		Authorized personnel only
6.		Fire hose notification
7.		Caution signage

Continued...

S. No.	Signage	Message
8.		Caution signage
9.		Wet floor warning
10.		Watching out for step
11.		Water-saving signage

Table. 5.2 Safety & Warning Signages

Notes

Exercise**Answer the following questions:**

1. Explain potential risks and hazards at the workplace.

2. Explain any two types of Personal Protective Equipment.

3. What is PPE?

4. List any five safety and warning Signages used at the workplace.

Fill in the blanks:

1. _____ has the potential to cause human injury or illness, property damage, environmental damage, or a combination of these effects.
2. The purpose of _____ is to identify and warn employees who may be exposed to various hazards.
3. _____ bear more responsibility than their employees because they are held accountable for their employee's safety and well-being.
4. Earmuffs are used to protect employees from _____.

Choose the correct answers (MCQ)

- a) The way of protecting individuals' well-being of health is classified as:

- | | |
|----------------------|-------------|
| 1) Safety | 2) Health |
| 3) Adverse Situation | 4) Security |

- b) What are the most common risks in the workplace?

- | | |
|---------------------------------|---|
| 1) Risk of electrocution | 2) Risk of injuries from faulty equipment |
| 3) Being hit by falling objects | 4) All of the above |

- c) Items included in PPE:

- | | |
|------------|----------------|
| 1) Aviator | 2) Face Shield |
| 3) Uniform | 4) Caps |

Unit 5.2 Fire Safety Practices

Unit Objectives



At the end of the unit, the trainee will be able to:

1. Discuss various causes of fire and precautionary activities to prevent the fire accident
2. List the different techniques that employ various methods (such as using extinguishers, water hose, sprinklers, sand bucket, wet blanket, etc.) and materials such as water, powder, foam, CO₂, fire extinguishing chemical, sand, blanket, etc. used for extinguishing fire as per the type (as per class A, B, C and D)
3. Describe rescue techniques applied during a fire hazard or electrocution.

5.2.1 Causes and Prevention of Fire

Due to the number of individuals in the workplace and the various elements that could enhance the risk of a fire, the proper precautions must be taken to lower these risks.

Following are the common causes of fire in the workplace:



Fig. 5.15 Common causes of Fire

How to deal with a fire emergency?

Precautions

The manager is responsible for ensuring safety from fire accidents. To be familiar with all types of evacuation procedures and fire control methods, they must attend safety workshops or fire drills organized by the organization. Some precautionary measures and awareness would include placing a "No Smoking" signboard in sensitive areas of the organization. Please note that water should not be used to extinguish a fire if the source of the fire is electrical power. Hose reels and hydrants should not be used except in the event of a fire. In the event of a fire, immediately switch off the main power supply and make an attempt to extinguish the fire with the help of available firefighting equipment.



Fig. 5.16 Precaution at the Time of Fire Emergency

Source: <https://learnpac.co.uk/wp-content/uploads/2016/06/fire-action.jpg>

Do's and Don'ts

Do's	Don'ts
Keep the work area clean.	Do not wear inflammable materials like nylon etc.
If empty containers contain inflammable materials, fill them with water.	Do not use inflammable materials near electrical lines.
Report any unsafe situation that may cause a fire.	Never weld near combustible materials.
Watch where the sparks and metals are falling from your work.	Never leave any cable without insulation.

Table. 5.3 Do's and Don'ts of Preventing Fire

5.2.2 Fire Extinguishers

Electrical fires are different from regular fires. They cannot be extinguished with water. Also, using water to put out an electrical fire is very dangerous and could lead to electrocution. To put out an electrical fire, the right type of fire extinguisher must be used. The following figure represents the different classes of fires:

**Class of Fire - A**

- Type of Fire - Ordinary Combustible : wood, paper, rubber, fabrics and many plastics.
- Type of Extinguisher- Water, dry powder, halon

**Class of Fire - B**

- Type of Fire - Flammable liquids and Gases: Gasoline, Oils, paint, lacquer and tar.
- Type of Extinguisher- Carbon Dioxide, dry powder, halon

**Class of Fire - C**

- Type of Fire - Fires involves live electrical equipment .
- Type of Extinguisher- Carbon Dioxide, dry powder, halon

**Class of Fire - D**

- Type of Fire -Combustible metals or combustible metal alloys
- Type of Extinguisher- Special Agents

Continued...



Class of Fire - K

- Type of Fire - Fires in cooking appliances that involve combustible cooking media: vegetable or animal oils and fats.
- Type of Extinguisher - Wet Chemical

Fig. 5.17 Types of Fire



Fig. 5.18 Types of Fire Extinguishers

HOW TO USE EXTINGUISHER

REMEMBER WORD PASS



Fig. 5.19 Using a Fire Extinguishers

5.2.3 Fire Safety

Fire safety refers to a set of practices designed to reduce the devastation caused by fire. Fire safety measures include those used to prevent the ignition of an uncontrolled fire as well as those used to limit the development and effects of a fire once it has begun. Following are the standard practices for fire safety at workplace.

- 1. Follow the emergency instruction in case of fire**
 - a. Activate the ALARM.
 - b. Evacuate the area.
 - c. Call the fire department.
 - d. Stay Calm
- 2. Fight the fire only if:**
 - a. You know-how.
 - b. The fire is small.
 - c. You are confined to the area where it started.
 - d. You have a way out.
 - e. You can work with your back to the exit.
 - f. You have the right type of extinguisher.
 - g. You feel confident that you can operate it effectively.
- 3. Do not fight the fire if:**
 - a. You have any doubts about fighting it.
 - b. It is spreading beyond the area where it started.
 - c. It could block your escape route.
- 4. Precautions to be taken during the fire:**

Following precautions are to be taken in case of fire –

 - a. Switch off the main switch.
 - b. Snuff the fire by throwing dry sand on it.
 - c. Make sure that the fire extinguisher is operational and not expired.
 - d. Do not use water to extinguish an electrical fire.
 - e. Know the location of emergency exits and procedures.

Exercise



Answer the following questions:

1. Explain various types of fire and fire extinguishers.

2. Write a short note on fire safety.

3. Explain do's and don'ts of preventing fire.

4. List the precautions to be taken during the fire.

5. Explain common causes of fire in the workplace.

Fill in the blanks:

1. _____ cannot be extinguished with water.
2. Safety is _____ responsibility.
3. _____ in case of fire.
4. Do not fight the fire if _____.

Unit 5.3 First-aid Practices

Unit Objectives



At the end of the unit, the trainee will be able to:

1. Discuss appropriate basic first aid treatment relevant to the condition e.g. shock, electrical shock, bleeding, minor burns, poisoning, eye injuries, etc
2. Discuss potential injuries and health problems associated with incorrect handling of tools and equipment.

5.3.1 First-aid

First aid is the assistance given to a person experiencing an unexpected illness or injury to save a life, prevent the condition from worsening, or promote recovery.

There are numerous circumstances which may require first aid, and numerous nations have legislation, regulation, or guidance which specifies a basic level of first aid provision in specific conditions. This can grasp specific training or equipment to be procurable within the work zone, (for example, an Automated External Defibrillator).

Injury	Symptom	Do's	Don'ts
Fracture	<ul style="list-style-type: none"> • Pain • Swelling • Visible bone 	<ul style="list-style-type: none"> • Immobilise the affected part • Stabilise the affected part • Use a cloth as a sling • Use the board as a sling • Carefully transfer the victim on a stretcher • Do not move the affected part • Do not wash or probe the injured area 	<ul style="list-style-type: none"> • Do not move the affected part • Do not wash or probe the injured area
Electric Shock	<ul style="list-style-type: none"> • Pale, cold, clammy skin. It may appear grayish, and the lips and fingernails may look blue. • The pulse and breathing are rapid. 	<ul style="list-style-type: none"> • Place his or her legs on a pillow to elevate them about 12 inches above the head • If the person is not breathing, perform CPR. • Loosen the collars and unbutton or cut away tight clothing. 	<ul style="list-style-type: none"> • Do not move the person's head.

Continued...

Injury	Symptom	Do's	Don't's
	<ul style="list-style-type: none"> The person is exhibiting disorientation or giddiness. Nausea or vomiting may occur. The person seems weak, with vacant eyes. 	<ul style="list-style-type: none"> Unbuckle the person's belt, loosen the shoes and remove all tight jewelry on the person's wrists or neck. Cover the person with a blanket Observe vomit or blood coming from the mouth or nose, and turn the person on his or her side to prevent him or her from choking. 	<ul style="list-style-type: none">
Burns (see Degrees of Burn table)	<ul style="list-style-type: none"> Redness of skin Blistered skin Injury marks Headache/ seizures 	<ul style="list-style-type: none"> In case of electrical burn, cut-off the power supply In case of fire, put out fire with blanket/coat Use water to douse the flames Remove any jewellery from the affected area Wash the burn with water 	<ul style="list-style-type: none"> Do not pull off any clothing stuck to the burnt skin Do not place ice on the burn Do not use cotton to cover the burn
Bleeding	<ul style="list-style-type: none"> Bruises Visible blood loss from body Coughing blood Wound/Injury marks Unconsciousness due to blood loss Dizziness Pale skin 	<ul style="list-style-type: none"> Check victim's breathing Raise the wounded portion above heart level Put a direct pressure to the wound with the help of clean cloth or hands Remove any visible objects from the wounds Apply bandage once the bleeding stops 	<ul style="list-style-type: none"> Do not clean the wound from out to in direction Do not apply too much pressure (not more than 15 mins) Do not give water to the victim
Heat Stroke/ Sun Stoke	<ul style="list-style-type: none"> High body temperature Headache Hot and dry skin Nausea/Vomiting Unconsciousness 	<ul style="list-style-type: none"> Move the victim to a cool, shady place Wet the victim's skin with a sponge If possible, apply ice packs to victim's neck, back and armpits Remove any jewellery from the affected area Wash the burn with water 	<ul style="list-style-type: none"> Do not let people crowd around the victim Do not give any hot drinks to the victim

Injury	Symptom	Do's	Don't's
Poisoning	<ul style="list-style-type: none"> • Burns or redness around the mouth and lips • Breath that smells like chemicals, such as gasoline or paint thinner • Vomiting • Difficulty breathing • Drowsiness • Confusion or another altered mental status 	<ul style="list-style-type: none"> • Remove anything remaining in the person's mouth. • Get the person into fresh air as soon as possible. • If the person vomits, turn his or her head to the side to prevent choking. • Begin CPR if the person shows no signs of life 	<ul style="list-style-type: none"> • Don't give syrup or do anything to induce vomiting.
Eye Injury (For Chemical Exposure)	<ul style="list-style-type: none"> • Pain and swelling • Bruising and redness • Problems with eye movement • Changes in eye appearance 	<ul style="list-style-type: none"> • Immediately wash out the eye with lots of water. Use whatever is closest -- water fountain, shower, garden hose. • Get medical help while doing this, or after 15 to 20 minutes of continuous flushing 	<ul style="list-style-type: none"> • Don't rub eyes • Don't bandage the eye
Eye Injury (For a Foreign Particle in Eye)	<ul style="list-style-type: none"> • Pain and swelling • Bruising and redness • Problems with eye movement • Changes in eye appearance 	<ul style="list-style-type: none"> • Pull the upper lid down and blink repeatedly. • If particle is still there, rinse with eyewash. • If rinsing doesn't help, close eye, bandage it lightly, and see a doctor. 	<ul style="list-style-type: none"> • Don't rub the eye.

Table 5.4 First-aid Procedures

5.3.2 Safety and Health Issues while handling Tools and Equipment

Workers depend on their employers to provide safe working conditions, and part of that process entails routine inspections of workplaces, vessels, etc., as well as maintenance of the machinery used at and on all of these locations. Employers must also make sure that the employees they hire have the necessary credentials and training. Finally, companies need to make sure that their staff members are adhering to the right safety protocols and guidelines and not working too much.

These kinds of accidents can result in a variety of severe injuries, such as:

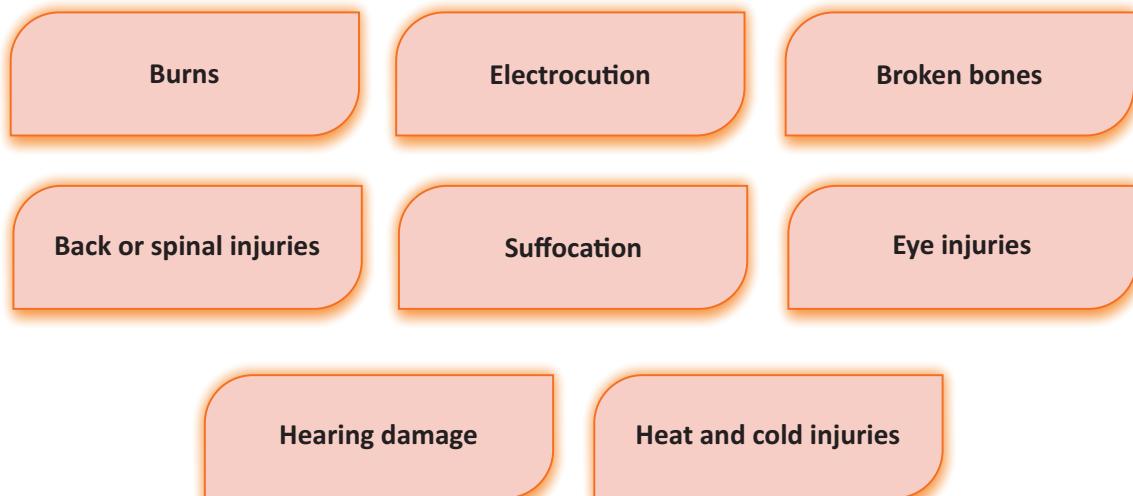


Fig 5.20 Safety and Health Issues

Notes



Summary



- Workplace safety is one of the most significant concerns for any manufacturing company or facility. Getting it right can improve the overall performance of the operation and lead to growth.
- It is the responsibility of everyone, whether employer or employee, to keep the workplace clean, healthy, and safe.
- A hazard is something or someone that has the potential to cause damage, harm, or adverse health effects.
- Risk is the possibility or likelihood that someone will suffer harm or have a negative impact on their health as a result of being exposed to danger. It may also apply when there is a loss of property or equipment or when there are negative environmental repercussions.
- Workplace safety signage evolved with the Industrial Revolution when workplace safety became a major concern. The purpose of a workplace safety sign is to identify and warn employees who may be exposed to various hazards.
- Employers bear more responsibility than their employees because they are held accountable for their employee's safety and well-being.
- PPE refers to the clothing or equipment designed to protect the workers/employees from shop floor hazards. It includes items such as hard hats, safety boots, coveralls, gloves, safety glasses and goggles, earplugs, high visibility vests, lifejackets, fall protection, and respirators.
- Fire safety refers to a set of practices designed to reduce the devastation caused by fire. Fire safety measures include those used to prevent the ignition of an uncontrolled fire as well as those used to limit the development and effects of a fire once it has begun.
- Electrical fires are different from regular fires. They cannot be extinguished with water. Also, using water to put out an electrical fire is very dangerous and could lead to electrocution. To put out an electrical fire, the right type of fire extinguisher must be used.
- First aid is the assistance given to a person experiencing an unexpected illness or injury to save a life, prevent the condition from worsening, or promote recovery.
- Workers depend on their employers to provide safe working conditions, and part of that process entails routine inspections of workplaces, vessels, etc., as well as maintenance of the machinery used at and on all of these locations.

Notes



Exercise



Answer the following questions:

1. Explain first-aid procedures to deal with bleeding and burns.

2. List some health and safety issues that occur while handling tools and equipment.



6. Working Effectively With Others

Unit 6.1 - Work and Communicate Effectively at Workplace

Unit 6.2 - Work in a Disciplined and Ethical Manner

Unit 6.3 - Uphold Social Diversity at the Workplace



Key Learning Outcomes



At the end of this module, the trainee will be able to:

1. Apply effective communication techniques
2. Demonstrate teamwork and a positive attitude
3. Demonstrate responsible and disciplined behaviour

Unit 6.1 Work and Communicate Effectively at Workplace

Unit Objectives



At the end of this Unit the trainee will be able to:

1. State the importance of effective communication in the workplace
2. Describe the typical organisational hierarchy and the various categories of people that one is required to communicate and coordinate with
3. List various components of effective communication
4. State the importance of using inclusive language (verbal, non-verbal and written) that is gender, disability and culturally sensitive
5. State the importance of teamwork and developing effective working relationships for professional success
6. Discuss the importance and ways of managing interpersonal conflict effectively
7. Discuss how to express and address grievances appropriately and effectively
8. State the importance of ethics and discipline for professional success.
9. Explain what constitutes disciplined behaviour and integrity for a working professional
10. Discuss the legislation, standards, policies, and procedures relevant to own employment and performance conditions
11. Discuss importance of dress code in organisations

6.1.1 Significance of Effective Communication

Effective communication is required for all employees in the organization to perform basic management functions and carry out their jobs and responsibilities. The ability to communicate effectively at work is essential regardless of industry. Effective communication entails more than just exchanging information; it also encompasses the emotion and intentions behind the facts and conveying a message. Therefore, communicating more clearly and effectively requires learning some essential skills. Learning these skills can assist employees in developing stronger bonds, gaining more trust and respect, improving teamwork, problem-solving, and overall social and emotional health. As a result, we can state that "effective communication is a foundational component of successful organizations."

Build strong professional relationships with co-workers and clients	Helps to express thoughts and convey clear message	Manage and assist the team where required
Motivate and boost teamwork and lead to better project collaboration	Enhance leadership and negotiation skills	Bridge gaps between clients, colleagues, and partners
Recognize each others' good work and give constructive feedback	Resolves issues and conflicts	Improve productivity by sharing information and ideas

Fig. 6.1 Importance of Effective Communication

6.1.2 Communication Process

The process of communication is a dynamic structure that explains how a message is transmitted between a sender and a receiver via various communication channels. Its purpose is to ensure that the receiver accurately decodes the message and can provide feedback with precision and convenience.

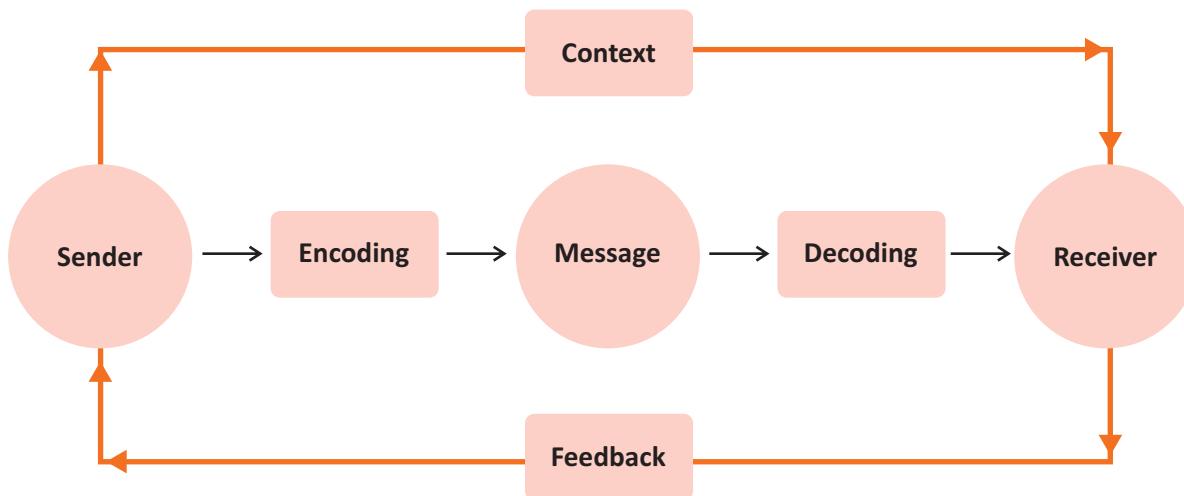


Fig. 6.2 Process of Communication

As demonstrated in the exhibit above, there are 8 elements of communication:

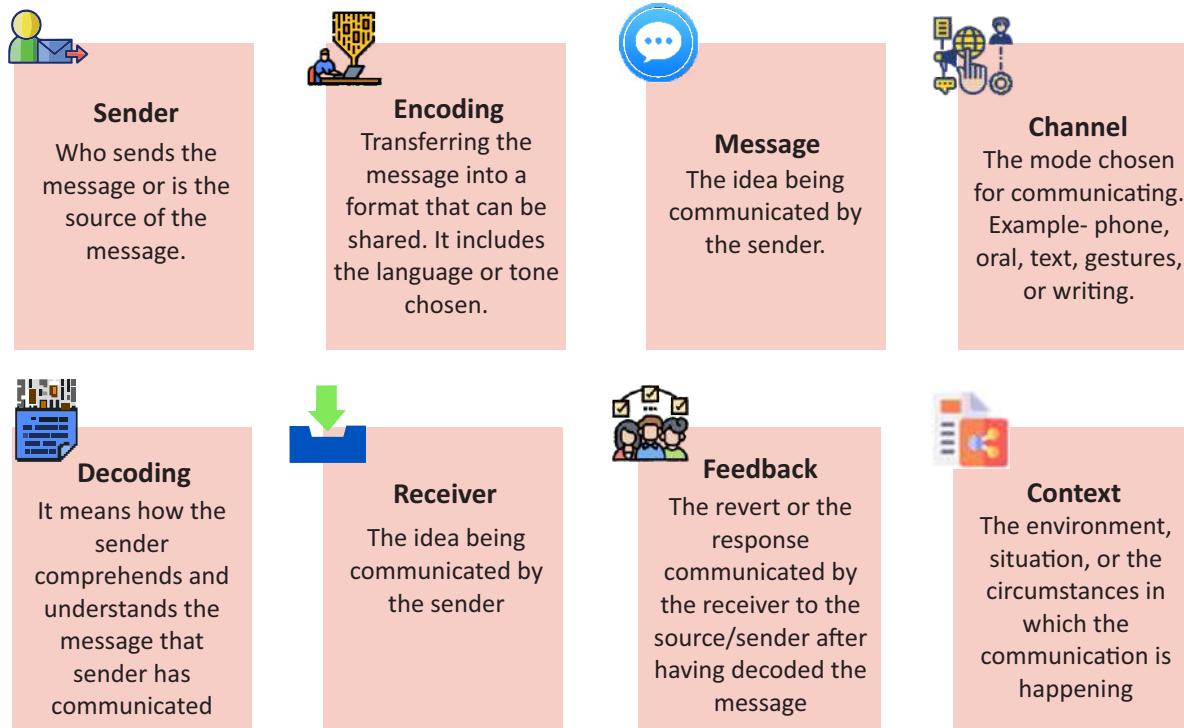


Fig. 6.3 Elements of Effective Communication

6.1.3 Communication Barriers

All of the elements depicted above can also act as a barrier to communication. Communication barriers are factors that prevent a message from being received in the way the sender sent it. People frequently face the problem of the message being received in an assumed manner when communicating. As a result, it leads to miscommunication and misunderstandings. Let us look at the table below to understand four significant barriers to communication.

	Physical or Environmental Barriers <ul style="list-style-type: none"> The barriers in the surroundings or in the environment are the physical barriers. Example- Noise in the surroundings, the physical distance between the sender & receiver, defects in the communication system like network problems, poor signal, etc.
	Language Barriers <ul style="list-style-type: none"> This barrier arises due to the different language or differences in the language of the sender and receiver. This problem often occurs because of the different meanings perceived in the same word, or the receiver does not understand the jargon used in the message. The language barrier is not limited to spoken language. It also includes body language. The same message is perceived differently by the receiver said with different body language.
	Psychological Barriers <ul style="list-style-type: none"> Barriers or problems arising due to the differences in perception, ego clashes, prejudices, state of mind, poor past experiences, behaviors, attitudes, moods, and value systems are psychological barriers. These barriers are generally exceedingly difficult to overcome.
	Socio-Cultural Barriers <ul style="list-style-type: none"> Sometimes the differences in social or cultural norms cause communication problems. These include how the people generally speak, wear, follow customs, behave, or eat is not completely understood by the receivers who are not accustomed to the differences. For example, some communities are louder and

Table. 6.1 Potential Barriers in Communication

6.1.4 Inclusive Languages

An inclusive language avoids stereotypes, slang, and idioms that stigmatise certain racial, gender, socioeconomic, and ability-based groups of people. When used, communicate with more people by speaking and writing in a way that is welcoming to all and that everyone can comprehend.

Any type of communication style is effective only when one knows how to actively listen, observe and empathize.

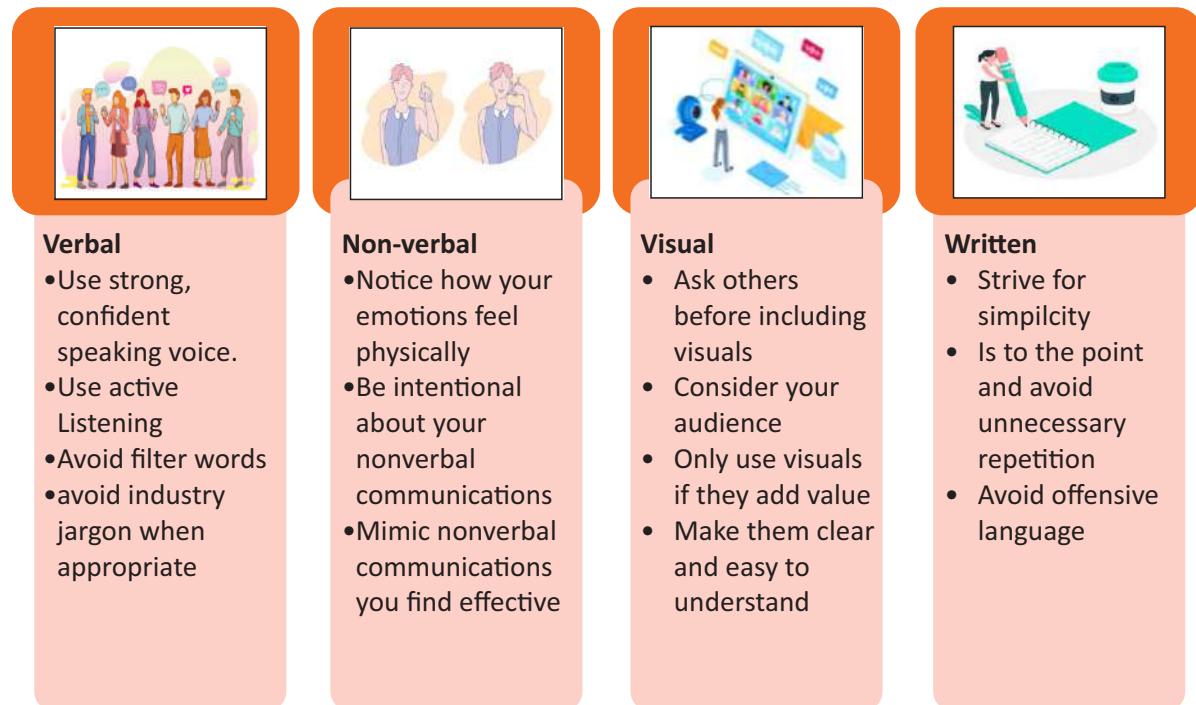


Fig. 6.4 Inclusive Languages

6.1.5 Organizational Structure

An organizational structure is a system that defines how specific activities are directed in order to achieve an organization's goals. These activities may include rules, roles, and responsibilities. The organizational structure also governs how information flows within the company. There are numerous types of organizational reporting structures, each with its own set of benefits and drawbacks. The reporting structure is chosen based on the organizational requirements. The following are the top organizational reporting structures.

Hierarchical organizational structure

- It is a pyramid-like top-down management structure.

Functional organizational structure

- It is a business structure that divides a company into departments based on areas of expertise.

Continued...

Divisional or product organizational structure

- In a product-based structure (also known as a divisional structure), employees are assigned to self-contained divisions based on the market, product line and geography.

Line-and-staff organizational structure

- In this structure, authorities (e.g., managers) establish goals and directives that are then carried out by employees and other workers.

Flat organizational structure

- A flat organizational structure means that there are few (if any) levels of management between the workforce and the highest-level managers.

Matrix organizational structure

- A matrix organization is a work structure in which team members report to multiple leaders.

Network organization structure

- It is a type of internal structure that prioritizes communication and relationship goals over hierarchy.

Fig. 6.5 Types of Organizational Structure

Notes

Significance of Effective Communication with Team members

It is significant to convey information as per defined protocols to the authorized person's/team members, as it reduces communication gaps, strengthens alignment with all levels of leadership, and ensures that employees receive consistent messages. The Communication Protocol specifies the types of information to be communicated to the organization, as well as the person(s) in charge of communicating specific topics. The audience, frequency, and suggested communication vehicles are also discussed. The Protocol, which is prominently displayed in all common areas such as lobbies and conferences, and is distributed to all new hires, ensures that communications align with the company's key strategic priorities.

Effective communication with the supervisor is essential for professional development and advancement. Refer to the exhibit below for tips on communicating with the supervisor effectively.

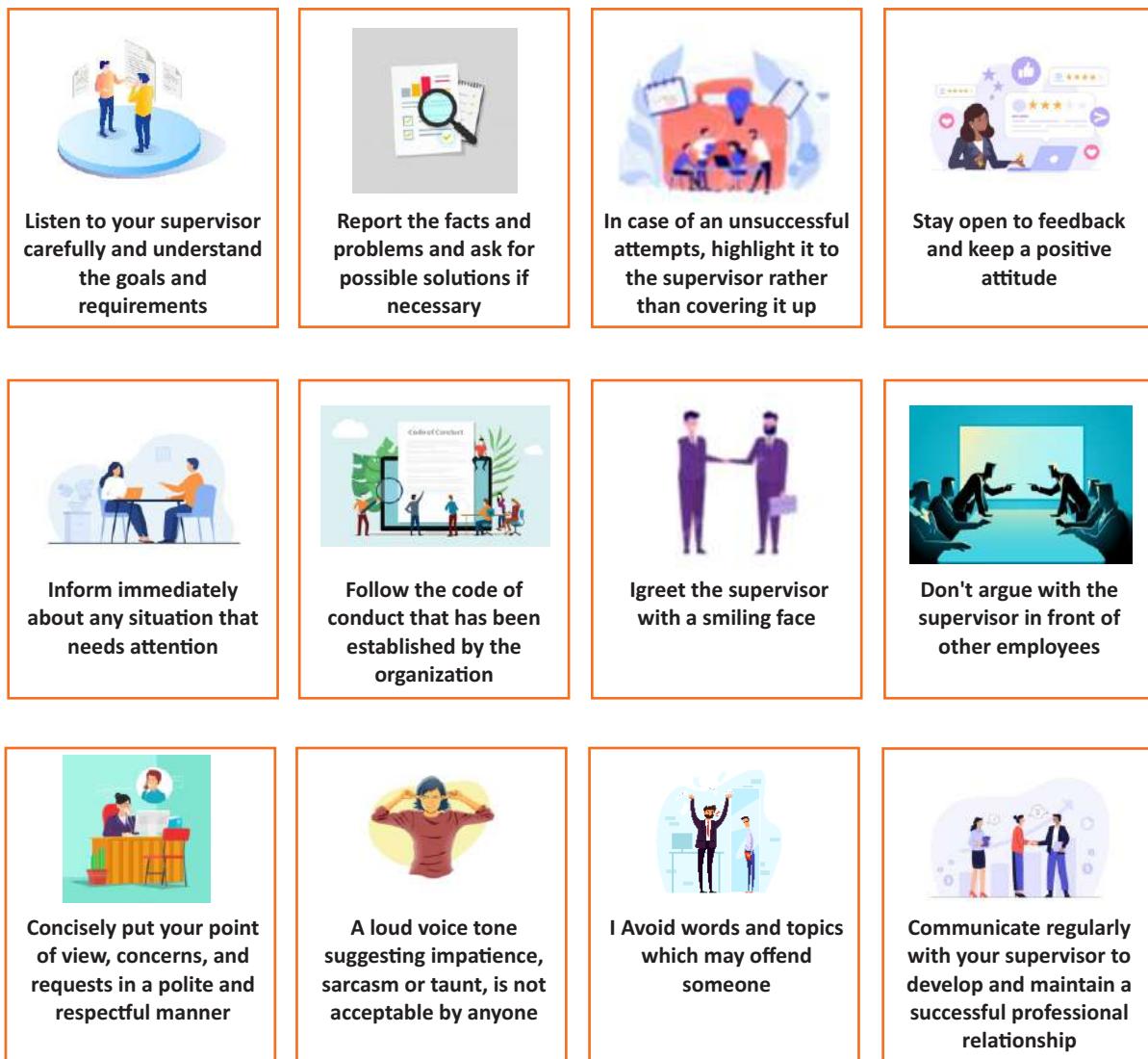


Fig. 6.6 Effective Communication with Superior

Following proper communication, rules are critical to keeping a **healthy relationship with colleagues and co-workers**. The quality of the relationship with colleagues and co-workers will depend on the behavior you demonstrate while interacting with them. A relationship built on trust, excellent, clear communication, polite language, and appropriate behavior helps you succeed at work.

Greet everyone with a smile and positive body language.

Listen actively and avoid jumping to conclusions

Offer help to a new colleague in your crew

Show courtesy and respect to colleagues

Speak in a polite and respectful tone

Make an eye contact while you speak

Use positive words and body language

Appreciate each other's work

Learn from your team members and collaborate with them

Keep commitments made to your colleagues or team members

Inform your colleagues in case of delay in the work

Do not be a grump. Leave your bad mood out of the worksite

Do not engage in any kind of gossip

Do not disturb others when they are working

Do not waste your time and others' time by holding conversations which are not related to work

Do not interrupt when the other person is speaking. Wait for them to complete

Avoid controversial conversations

Fig. 6.7 Effective Communication with Colleagues

Notes



6.1.6 Managing and Coordinating with Team

Coordination is the core of every successful organization. It is basically a mechanism or strategy that enables different entities to work together. Coordination helps to maintain and improve efficiency while striving for a common goal or target. Hence, team management and coordination are of utmost importance for work integration.



Fig. 6.7 Effective Communication with Colleagues

6.1.7 Individual and Team Goals

Goal setting is undoubtedly one of the most effective motivational tools in the organization. Almost every organization requires employees to set goals regularly. Even when times change, continuously updating and setting goals is necessary to keep your business on track. Goals in each organization should be **S.M.A.R.T: specific, measurable, actionable, realistic, and timely**. It helps you and your team feel a stronger sense of purpose and direction. In addition, setting goals in place will help you and your team feel productive with each bit of accomplishment and ensure that more significant production stays on track.

Individual goals are significant because they give direction to the employees. While team goals are great for the overall guidance, personal goals will allow your team members to take distinct paths to digest the larger plan and turn it into action.

Team goals are necessary to guide the entire organization. It includes broad objectives that can be broken down into team projects and initiatives with individual key results. In addition to helping the organizations achieve their objectives, setting team goals also **boost employee engagement, productivity and retention by ensuring that every team member has a complete understanding of their role in the overall approach.** This also **saves time and improve efficiency.** In addition, setting team goals also offers organizations the following benefits:



Fig. 6.9 Benefits of Team Goals in an Organisation

Notes



Exercise**1. Fill in the blanks:**

- a) _____ is a building block of successful organizations.
- b) A healthy relationship with colleagues is built on _____, _____ and _____.
- c) _____ is a part of your organization's duties to its community and stakeholders.
- d) Sharing information helps employees to limit the _____ gap.
- e) _____ is a mechanism or strategy that enables different entities to work together.
- f) _____ facilitates meaningful and necessary communication for employee _____ and manage the communication flow within and outside the organization.
- g) Fill in the Blanks-
- h) _____ is a set of rules indicating the proper and polite way to behave at work.
- i) _____ include how the people generally speak, wear, follow customs, behave by the receivers who are not accustomed to the differences.
- j) _____ is the response communicated by the receiver to the source/sender after having decoded the message.
- k) The quality of the relationship with colleagues and co-workers will depend on the _____ demonstrate while interacting with them.

2. Goals in each organization should be:

- a) Specific, monthly, adjustable, realistic, and timely
- b) Smart, measurable, actionable, realistic, and timely
- c) Specific, measurable, actionable, realistic, and timely

3. The following are the types of communication at workplace, except:

- a) Employer – employee
- b) Colleagues
- c) Stakeholders
- d) Customer – friend

4. Which one is not the correct way of verbal and written communication?

- a) Short
- b) Irrelevant
- c) Simple
- d) Direct

4. Differentiate between team goals and individual goals.**5. What is effective communication?****6. How language barriers create gaps in workplace?****7. List any two tips for communicating effectively with superiors.**

Unit 6.2 Work in a Disciplined and Ethical Manner

Unit Objectives



At the end of the unit, the trainee will be able to:

1. Discuss the importance and ways of managing interpersonal conflict effectively.
2. Discuss how to express and address grievances appropriately and effectively.
3. State the importance of ethics and discipline for professional success.
4. Explain what constitutes disciplined behaviour and integrity for a working professional.
5. Discuss the legislation, standards, policies, and procedures relevant to own employment and performance conditions.
6. Discuss importance of dress code in organisations.

6.2.1 Importance of Work Ethics and Discipline

A professional code of ethics establishes an organization's ethical guidelines and best practices for maintaining honesty, integrity, and professionalism. Violations of the code of ethics can result in sanctions, including termination, for members of an organization. The following figure explains the standard practices and professional code of ethics follow in every organization.



Fig.6.10 Professional Code of Ethics

Employee discipline isn't about power or punishment. It is about making the workplace safe and enjoyable for both employees and management. Discipline is most effective when there is mutual trust between managers and employees. It all begins with clear communication and continues with consistency. Discipline assists employees in correcting any shortcomings to become valuable, contributing members of the workforce. Documentation created as a result of the disciplinary process can also help an employer protect itself if termination or other adverse employment decision is required. Here are the ways to maintain workplace discipline in the organization while maintaining employee respect:

Establishing a workplace code of conduct

Lead your team members reach their full potential with patience

Get rid of all the distractions

Ensure that workplace is a desirable place for working

Be considerate of the generation gap

Come up with a set of guidelines

Take corrective actions

Allow personal space for your team members to work

Regularly communicate with team

Fig. 6.11 Tips for Maintaining Discipline at Workplace

Notes



6.2.2 Managing Conflicts at Workplace

Dealing with conflict at the workplace is inevitable. The ability to recognize conflict with your colleagues, understand its nature, and try to bring a quick and fair resolution to the conflict is critical to anyone who works in a team. **Conflict management** is a crucial skill that enables an individual to handle confrontations tactfully and constructively. It aims to yield a positive result from disputes and disagreements that occur between people in the workplace and resolve the conflict in a way that respects everyone's wants and needs. At some point, we need skills for managing conflict in the workplace. The following tips can help us resolve the conflict or a disagreement in that situation.

Stay calm during a conflict

Control your anger by staying conscious of the situation and swaying with the flow

Do not try to assume others' perspectives. Give them the opportunity to speak and one must listen

Leave the site for a time-being, if the situation is heating up

Sometimes it is not necessary to argue. Letting the moment pass shall avoid the conflict

Keep an open mind and compromise where necessary

Mind your language if you enter an argument. Never say something which you may need to regret later

Remember, everyone is different and can have a different point of view to yours

Try to look at the situation from others' point of view

Determine the way in which both the parties could be mutually benefitted

Do not try to overpower your intent

If the conflict intensifies, let a common lead help resolve the conflict

Fig. 6.12 Tips for Managing Conflicts

Notes



6.2.3 Grievance Management

Grievances result in collective disputes when they are not resolved timely. Also, this lowers the morale and efficiency of the employees. Frustration, employee dissatisfaction, low productivity, lack of interest in work, high absenteeism, etc. might be a result of unattended grievances. In short, grievance arises when the organization does not fulfill employees' expectations, resulting in a feeling of discontentment and dissatisfaction. This dissatisfaction must have cropped up from employment issues and not from personal issues.

Grievance may result from the following factors-

- Working Conditions and Safety:** These consists of any complaint or grievance that directly addresses the employees' work environment. These can include everything from unsafe working conditions to difficult and indifferent managers.
- Unreasonable Management Policies:** If employees believe that a particular policy is unfair or unreasonable, they will want their concerns addressed. Such policies can include a gap in production standards or overtime regulation compliance.
- Violations of Rules and Policies:** These are related to any organizational rules which the employees feel are being violated by other workers and/or middle or senior management.

For addressing grievance, Plumber General should adopt the following approach to manage grievance effectively:

1. Complaint: As soon as the grievance arises, it should be identified and resolved. This lowers the detrimental effects of grievance on the employees and their performance.
2. Acknowledging grievance: Acknowledge the grievance put forward by the employee as a manifestation of true and genuine feelings of the employees. Acknowledgment implies that you are eager to look into the complaint impartially and without bias. This creates a conducive work environment with instances of grievance reduced.
3. Gathering facts: Gather relevant and adequate facts that explains the nature of the grievance. These facts must be recorded to be used at a later stage of grievance redressal.
4. Examining the causes of grievance: The actual cause of resentment should be identified. Consequently, remedial actions should be taken to prevent the repetition of the grievance.
5. Decisioning: After identifying the causes of grievance, an alternative course of action should be suggested to manage the grievance. The effect of each action on the existing and future management policies and procedures should be analyzed, and accordingly, the manager should take a decision.
6. Execution and review: The manager should implement the decision quickly, ignoring the fact that it may or may not hurt the concerned employees. After implementing the decision, a follow-up must ensure that the grievance has been resolved completely and adequately.

An effective grievance procedure ensures a pleasant work environment because it redresses the grievance to the mutual satisfaction of the employees and the supervisors.



Fig 6.13 Grievance Addressing Process

6.2.4 Disciplined Behaviour and Integrity

The behaviors of employees in the workplace directly impact the operations and success of a business. Professional behaviour leads to a higher status of an organisation and also boosts the morale of the employees.

Responsible and disciplined behaviour will ensure good maintenance at the workplace, the satisfaction of the customers and an overall conducive atmosphere to continue with the activities to the benefit of all.

Responsible behaviour at workplace includes:

Working well as part of a team or group.	Displaying a positive attitude toward co-workers, the workplace and the tasks of the job.	Maintaining a clean and suitable appearance.
Showing respect for others and respect for individual differences.	Being on time for work and completing the tasks on time.	Following organisation rules and policies.
Reporting to the supervisor as and when necessary.	Helping others.	Showing integrity and honesty
Being disciplined, responsible and accountable		

Fig 6.14 Responsible Behaviour

Employers value individuals who exhibit integrity since it is a desirable quality in the workplace. Integrity-driven individuals are more inclined to work for a company with trustworthy workplace culture. When a person upholds their moral and ethical standards even when they are not in the spotlight, that person is said to have integrity. In whatever circumstance they encounter in life, a person with integrity prefers to act honorably.

Graciousness	Honesty	Trustworthiness
Responsibility	Patience	Helpfulness

Fig 6.15 Character Traits Related To Integrity

6.2.5 Importance of Dress Code

Organizations can let employees know what they consider proper work clothing by using dress codes. An employer can specify expectations for the image it wants its employees to project through a dress code or appearance policy. Uniforms may be worn according to formal or informal dress codes. The way one is dressed speaks volumes about their professional image and attributes.

Dress should be washed clean and stains free, un torn, and neatly ironed. Clothes should fit properly. Wearing clothing that is too big or small in size can make a person look shabby.

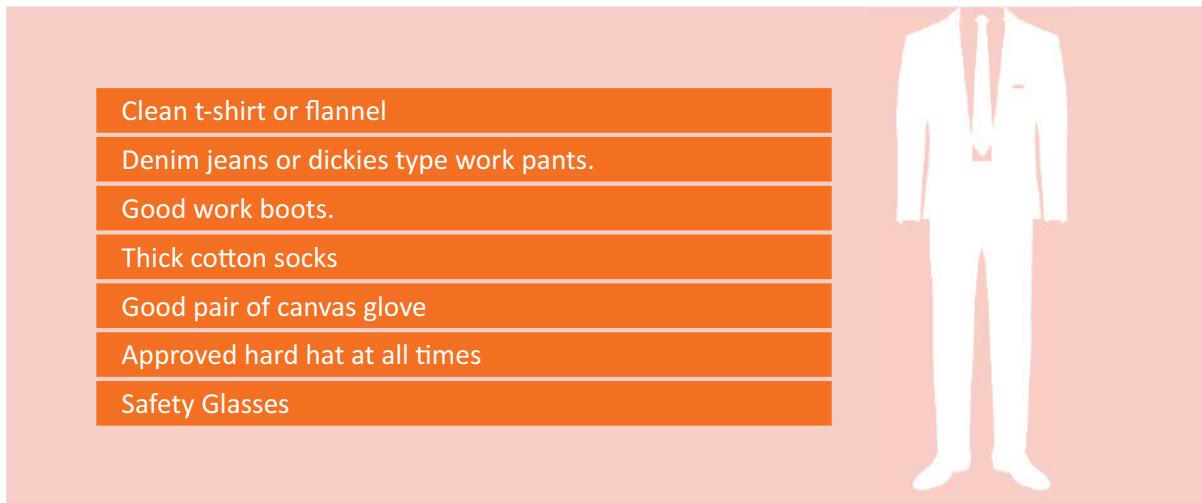


Fig 6.16 Dress code for a Plumber

Notes



Exercise

Answer the following questions:

1. Write a short note on work ethics and workplace etiquette.

2. List any 3 ways of maintaining discipline at the workplace.

3. What is conflict management?

4. Explain confidentiality in the workplace.

5. How language barriers create gaps in workplace?

Notes

Unit 6.3 Uphold social diversity at the workplace

Unit Objectives



At the end of the unit, the trainee will be able to:

1. Explain the impact of gender, disability, cultural and age-related biases, stereotyping at the workplace and in society.
2. List the different types of disabilities and the challenges faced by persons with disability (PWD).
3. State the laws, acts, provisions and schemes defined for PwD by the Government bodies.
4. Discuss gender, disability and cultural biases, stereotypes and impact on others
5. Discuss basic gender concepts such as gender power relations, gender roles, access and control, gender sensitivity, gender equity and equality.
6. Discuss the importance of gender sensitivity and equality.
7. List the indicators of harassment and discrimination based on gender, disability, caste, religion or culture that occurs at a typical workplace.
8. State general organisational norms and procedures applied to protect against harassment and discrimination.
9. Discuss the importance of reporting incidents of harassment and discrimination to appropriate authority.

6.3.1 Sensitivity for Person-With-Disability (PWD)

Disabled workers are a part of the diversity in today's workforce. However, being disabled does not imply that the individual is incompetent or unable to do his/her job. In fact, being disabled simply means the person has an impairment, which can be anything ranging from physical to psychological. Disabled co-workers and employees are not any different in that they are there to earn a living, advance their career, and better the organization through their contributions.

Listed below are some tips for interacting and communicating with people with disabilities.

Speak directly rather than through a companion or the sign language interpreter who may be present.

Offer to shake hands when introduced.

If you offer assistance, wait until the offer is accepted. Then listen or ask for instructions.

Address people with disabilities by their first names only when extending that same familiarity to all others.

Do not lean against or hang on someone's wheelchair or scooter as people with disabilities treat their wheelchairs or scooters as extensions of their bodies.

Listen attentively when talking with people who have difficulty speaking and wait for them to finish.

Continued...

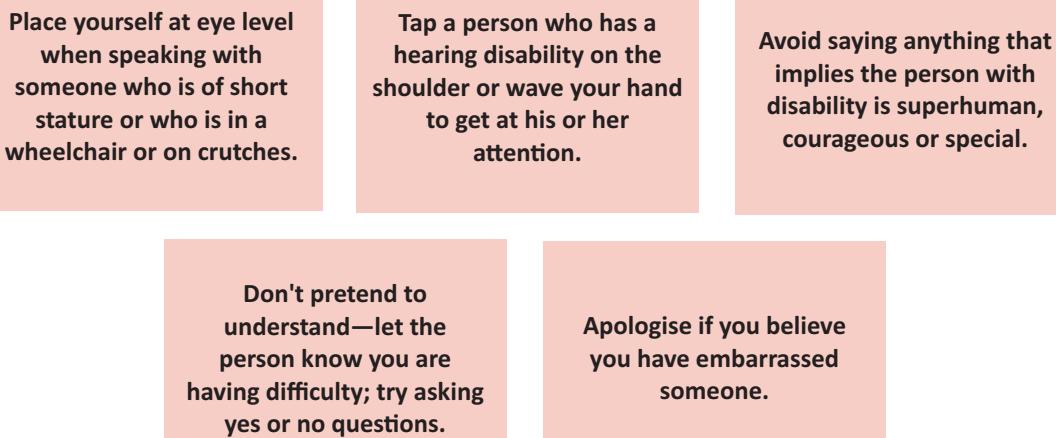


Fig. 6.17 Communicating and Interacting with PWD

The RPWD Act, 2016 provides that “the appropriate Government shall ensure that the PwD enjoy the right to equality, life with dignity, and respect for his or her own integrity equally with others.” The Government is to take steps to utilize the capacity of the PwD by providing appropriate environment.

Gender inequality in an organization's is a complex phenomenon that can be seen in organizational structures, processes, and practices. Following chart explains gender based issues in workplace:

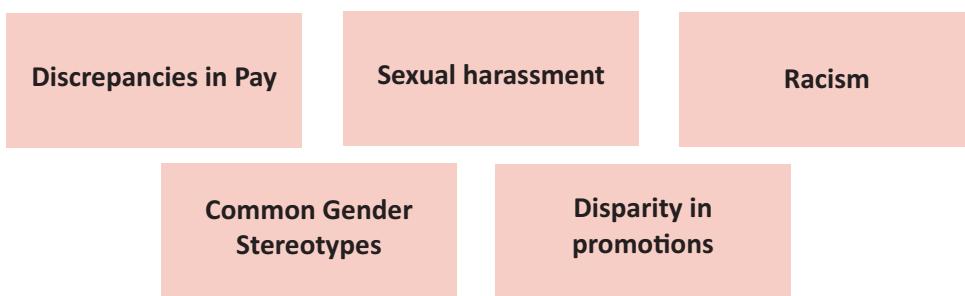


Fig. 6.18 Gender based Issues at Workplace

Females with disabilities are subjected to multiple layers of discrimination. Based on their gender and disability status, they often face double discrimination. They often face disproportionately high rates of gender-based **violence, sexual abuse, neglect, maltreatment and exploitation**. The exclusion experienced by women and girls with disabilities is a social issue that requires active participation of everyone.

It is important to follow organizational standards related to PwD at workplace because, it:

1. Protects them from any physical harm or any accidents
2. Provides them equal rights
3. Protects them from any kind of discrimination and racism
4. Provides security from any kind of violence and harassments
5. Protects their respect and dignity
6. Provides equal opportunities to deserving candidates

6.3.2 Gender Sensitivity

Gender sensitization is vital because representation is important. Representation of a person and community advocates equality and adds a sense of inclusion to the previously marginalized community. For a healthy performance-oriented culture, organizations need the correct mix of talent which is not bound by any gender. More than ever, accountability has become important now, organizations only have today to make the changes that count, as tomorrow they won't be able to hide under the pretext of ignorance. Each member of an organization seeks out to learn and grow at their workplace, and an insensitive place of work not only hinders that but also tends to become an unfriendly workplace. Gender sensitization is extremely significant as it helps the employees feel appreciated and cared for within the organization. Lastly, for the betterment of society, organizations have got an ethical responsibility in shaping the current structures by breaking the old norms. Organizations that do not emphasize on gender sensitization usually develop cultures where inequality and discrimination becomes normal. This kind of culture leads to a higher attrition rate, a higher rate of employee absenteeism, etc. Such policies also propagate the presence of a superior gender.

The concept of gender sensitivity shows the path to reduce barriers to personal and economic development created by gender differentiation. In addition, it helps to generate respect for individuals regardless of their gender.

Gender sensitivity is not about fighting women against men. On the contrary, gender-sensitive education, benefits members of all genders. It helps the individuals determine what assumptions are valid and which are stereotyped generalizations in matters of gender. Gender awareness not only requires intellectual efforts but also sensitivity and open-mindedness. It opens up the broadest possible range of life options for both women and men.

Some of the best practices followed to stay gender-sensitive would be to

- Use respectful language while communicating with each other. Do not reinforce gender stereotypes.
- Provide fair opportunity to everyone irrespective of their gender
- Do not promote creating gender-specific social groups.
- Neither victimize nor patronize based on gender

Notes



6.3.3 Rights and Duties at Workplace concerning PwD

The following chart explains the rights and duties at the workplace with respect to PwD:

Rights	Duties
<ul style="list-style-type: none"> • To an accessible workplace free of hazards and risks • To complete information about the job • To information, education, training and safely equipment that reduces risks and hazards • To equal access to benefits, conditions of employment and promotional opportunities • To special safety procedures and considerations that may relate to one's disability in case of emergency • To be treated with dignity and respect • To special tools and services that are needed to accommodate a disability on the job or in the community 	<ul style="list-style-type: none"> • To provide complete and honest information as it relates to the job • To request reasonable accommodation or assistance if needed • To practice safe procedures and use equipment to reduce risks to self and others • To report illness or injury promptly • To cooperate and work with rehabilitation professionals and employees in good faith regarding return to work. • To use the access and services provided to be fully productive • To advocate, educate and collaborate with legal, service and other systems to meet needs and resolve conflicts

Fig. 6.19 Rights and Duties at Workplace with Respect to PwD

6.3.4 Different Types of Disabilities

Some examples of common disabilities are:

Vision Impairment

Deaf or hard of hearing

Mental health conditions

Intellectual disability

Acquired brain injury

Autism spectrum disorder

Physical disability.

Fig 6.20 Different types of Disabilities

Challenges faced by PwD

- A physical environment that is not accessible
- Lack of relevant assistive technology (assistive, adaptive, and rehabilitative devices),
- Negative attitudes of people towards disability,
- People sometimes stereotype those with disabilities, assuming their quality of life is poor or that they are unhealthy because of their impairments.
- Steps and curbs that block a person with mobility impairment from entering a building or using a sidewalk
- Absence of a weight scale that accommodates wheelchairs or others who have difficulty stepping up

Fig 6.21 Challenges faced by PwD

6.3.5 PwD Policies

The Indian Government respects equality and therefore no discrimination should be made on the ground of disability. The Constitution secures to the citizens including the disabled, a right to justice, liberty of thought, expression, belief, faith and worship, equality of status and opportunity and for the promotion of fraternity. No disabled person can be compelled to pay any taxes for the promotion and maintenance of any particular religion or religious group. To enforce the same, the government has passed laws to protect the disabled and their right to equality. The laws pertaining to disabled are as follows:

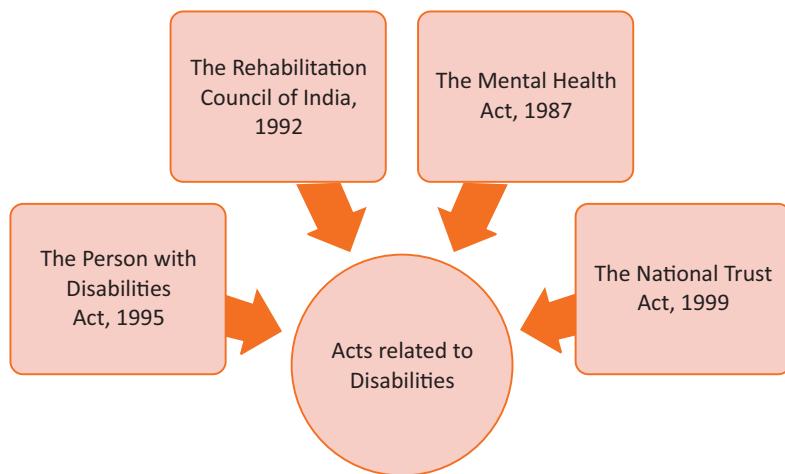


Fig 6.22 Acts related to Disabilities

Summary



- Effective communication is required for all employees in the organization to perform basic management functions and carry out their jobs and responsibilities.
- It is extremely difficult for Quality Managers to manage their teams and coordinate efforts for successfully completion of a project without strong interpersonal communication skills. A project cannot be successful if there is no communication.
- The process of communication is a dynamic structure that explains how a message is transmitted between a sender and a receiver via various communication channels. Its purpose is to ensure that the receiver accurately decodes the message and can provide feedback with precision and convenience.
- Communication barriers are factors that prevent a message from being received in the way the sender sent it. People frequently face the problem of the message being received in an assumed manner when communicating.
- Effective communication with your supervisor is crucial to your professional development and career advancement. Refer to the exhibit below for tips on communicating with the supervisor effectively.
- Following proper communication, rules are critical to keeping a healthy relationship with colleagues and co-workers. The quality of the relationship with colleagues and co-workers will depend on the behavior you demonstrate while interacting with them.
- Transparently sharing data and information ensures that everyone is in the loop and aware of any potential issues with the business, product, or service that can be addressed collaboratively. Employees might have lots of knowledge that is crucial for the organization and other employees. Sharing information helps them connect, perform better, and become more vital as professionals.
- Organizational communication can be divided into two categories: formal and informal communication.
- Emotional outbursts at work could be caused by work-related issues or by stressors from our personal lives spilling over into our work lives. Handling our emotions (especially negative ones) at work is frequently regarded as a test of our professionalism.
- An organizational structure is a system that defines how specific activities are directed in order to achieve an organization's goals.
- . The workflow of an organization consists of the processes that must be completed, the people or other resources that are available to perform those processes, and the interactions between them.
- Communication policies of an organization establish expectations and manage the flow of communications within and outside the organization. As a result, it facilitates meaningful and necessary communication for employee productivity and morale without restricting employees' feeling intimidated and powerless.
- Goals in each organization should be S.M.A.R.T: specific, measurable, actionable, realistic, and timely. It helps you and your team feel a stronger sense of purpose and direction. In addition, setting goals in place will help you and your team feel productive with each bit of accomplishment and ensure that more significant production stays on track.
- Team performance evaluation is a key factor in inspiring teams, improving the quality of work, and keeping them motivated. It is the best channel to understand how the team is performing and an effective measure to get feedback about how production is going, whether the employees are working positively towards achieving goals, and what can be done to improve employees' engagement.

Summary



- A professional code of ethics establishes an organization's ethical guidelines and best practices for maintaining honesty, integrity, and professionalism. Violations of the code of ethics can result in sanctions, including termination, for members of an organization.
- Work ethics are the morals or principles that govern a person's or group's behavior, whereas etiquette is a set of rules indicating the proper and polite way to behave at work.
- Dealing with conflict at the workplace is inevitable. The ability to recognize conflict with your colleagues, understand its nature, and try to bring a quick and fair resolution to the conflict is critical to anyone who works in a team.
- Discipline is most effective when there is mutual trust between managers and employees. It all begins with clear communication and continues with consistency. Discipline assists employees in correcting any shortcomings to become valuable, contributing members of the workforce.
- Confidentiality is important for legal and reputational reasons, but it is also important because future employment may be contingent on it.
- Disabled co-workers and employees are not any different in that they are there to earn a living, advance their career, and better the organization through their contributions.
- The RPWD Act, 2016 provides that “the appropriate Government shall ensure that the PwD enjoy the right to equality, life with dignity, and respect for his or her own integrity equally with others.” The Government is to take steps to utilize the capacity of the PwD by providing appropriate environment.
- Gender inequality in an organization's is a complex phenomenon that can be seen in organizational structures, processes, and practices.
- Females with disabilities are subjected to multiple layers of discrimination. Based on their gender and disability status, they often face double discrimination.
- For a healthy performance-oriented culture, organizations need the correct mix of talent which is not bound by any gender.
- Use respectful language while communicating with each other. Do not reinforce gender stereotypes.
- Gender sensitivity is not about fighting women against men. On the contrary, gender-sensitive education, benefits members of all genders. It helps the individuals determine what assumptions are valid and which are stereotyped generalizations in matters of gender.

Notes



Exercise**1. Write a Short note on :**

- a) Grievance Management

- b) Rights and duties of PwD at the workplace

- c) Gender based issues at workplace

- d) Best practices for gender sensitivity

- e) Best practices for gender sensitivity

2. Match the following:

Column A	Column B
Gender inequality	Gender-specific social groups
Listen attentively	Equal access to benefits
Rights at Workplace concerning PwD	With hearing disability person to get his attention
Tap a person on shoulder	Disparity in promotions
Do not promote	While talking with people having difficulty speaking



7. Employability Skills



<https://eskillindia.org/NewEmployability>



DGT/VSQ/N0101



8. Annexure

Annexure - QR Codes



Annexure - QR Code

Serial No.	Module No.	Unit Number	Topic Name	Page No.	URL	QR Code
1.	Introduction to the sector and the job role	Unit 1.1 Plumbing Industry-An Introduction	Overview of the Plumbing Industry	12	https://youtu.be/Rfz1zVu8VaQ	
			Scope of Employment in the Contracting Segment		https://youtu.be/Fq7FlsuNCQI	
			Plumbing Cycle		https://youtu.be/-bvZCdMecEo	
			Various Types of Plumbing Systems in Residential and Commercial Setups		https://youtu.be/8jxRn-T_LCs	
2.	Basics of Plumbing	Unit 2.1 Introduction to Plumbing	Process of Mains Supply of Water and Drainage	65	https://youtu.be/wpQD4XzjKDM	
		Unit 2.2 Plumbing Materials	Pipe Materials		https://youtu.be/1YQ9dpa6_lw	
		Unit 2.3 Plumbing Tools and Equipment	Different Types of Plumbing Tools and Equipment		https://youtu.be/GfNUaVFmxay	

Annexure - QR Code

Serial No.	Module No.	Unit Number	Topic Name	Page No.	URL	QR Code
3.	Basic Tasks to Facilitate Plumbing Work	Unit3.1 Standard Operating Procedures	Safe use of Plumbing Tools	78	https://youtu.be/AI9Yly-86v8	
			Various Pipe Fit-Off Processes		https://youtu.be/q33WAVmOK5o	
4.	Maintaining the Plumbing Tools and Equipment	Unit 4.3 Advanced Tools, Equipment and Materials	Advanced Plumbing Tools	92	https://youtu.be/MxmNxqwLAP4	



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