



GOVERNMENT OF TAMIL NADU

**DIPLOMA COURSE IN
ENGINEERING & TECHNOLOGY**

WORKSHOP PRACTICE

FIRST SEMESTER

**A publication under Government of Tamilnadu
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**Untouchability is a sin
Untouchability is a crime
Untouchability is inhuman**

**DIRECTORATE OF TECHNICAL EDUCATION
GOVERNMENT OF TAMILNADU**

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THE NATIONAL ANTHEM FULL VERSION

Jana-gana-mana-adhinayaka jaya he
Bharata-bhagya-vidhata
Punjaba-Sindhu-Gujarata-Maratha-
Dravida-Utkala-Banga
Vindhya-Himachala-Yamuna-Ganga
Uchchhala-jaladhi-taranga
Tava Subha name jage, TavaSubhaasisa mage,
Gahe tava jaya-gatha.
Jana-gana-mangala-dayaka jaya he
Bharata-bhagya-vidhata.
Jaya he, jaya he, jaya he,
Jaya jaya jaya jaya he.

-Rabindranath Tagore

SHORT VERSION

Jana-gana-mana-adhinayaka jaya he
Bharata-bhagya-vidhata.
Jaya he, jaya he, jaya he,
Jaya jaya jaya jaya he.

AUTHENTIC ENGLISH TRANSLATION OF THE NATIONAL ANTHEM

Thou art the ruler of the minds of all people,
Thou dispenser of India's destiny.
Thy name rouses the hearts of the Punjab, Sind,
Gujarat and Maratha, of Dravida, Orissa and Bengal
It echoes in the hills of the Vindhyas and Himalayas,
mingles in the music of the Yamuna and Ganges
and is chanted by the waves of the Indian Sea.
They pray for Thy blessings and sing Thy praise
The saving of all people waits in Thy hand,
Thou dispenser of India's destiny.
Victory. Victory, Victory to Thee



THE NATIONAL INTEGRATION PLEDGE

“I solemnly pledge to work with dedication to preserve and strengthen the freedom and integrity of the nation.”

“I further affirm that I shall never resort to violence and that all differences and disputes relating to religion, language, region or other political or economic grievances should be settled by peaceful and constitutional means.”

INVOCATION TO GODDESS TAMIL

Bharat is like the face beauteous of Earth clad in wavy seas;
Deccan is her brow crescent-like on which the fragrant ‘Tilak’ is the blessed
Dravidian land.
Like the fragrance of that ‘Tilak’ plunging the world in joy supreme reigns
Goddess Tamil with
renown spread far and wide.
Praise unto You, Goddess Tamil, whose majestic youthfulness, inspires awe and
ecstasy



PREFACE

Welcome to the “Workshop Practices” book, designed specifically for polytechnic students seeking to acquire essential skills in various shop floor practices. This comprehensive guide is tailored to introduce you to the fundamental practices and instruments necessary for fitting, plumbing work and wiring work. In today’s dynamic industrial landscape, possessing a strong foundation in workshop practices is indispensable. This book serves as your gateway to mastering these crucial skills, ensuring that you are well-equipped to tackle real-world challenges with confidence.

The book is divided into five units, each unit meticulously crafted to provide a structured learning experience. It begins with “Safety,” emphasizing the paramount importance of workplace safety and the necessary precautions to be taken. Understanding the “Geometric Dimensioning System,” offering a detailed insight into the standards and practices essential for reading the engineering drawings. Moving forward, “Basic Measuring Instruments” introduces you the important instruments used for precise measurements, laying the groundwork for accurate and efficient work. “Basic Tools” deals with the essential tools utilized across various workshop practices, acquainting you with their functions and applications.

Finally, “Basic Practices” consolidates the steps and procedures for your learning and provides hands-on guidance on the core practices that form the backbone of workshop operations. Through practical examples and step-by-step instructions, this unit ensures that you not only understand the concepts but also develop the necessary skills to apply them effectively. Throughout this journey, your safety and understanding are our top priorities. Each concept is presented in a clear and concise manner, with emphasis placed on practical relevance and real-world applications. Additionally, safety guidelines and best practices are reiterated to ensure a secure learning environment.

As you embark on this learning adventure, remember that mastery comes through practice and dedication. Utilize this book as a tool to hone your skills, and let it be the stepping stone to a successful career in engineering and related fields. We hope that this book enriches your learning experience and equips you with the skills needed to excel in your future endeavours. Happy learning!

- AUTHORS

SYLLABUS

1000231740	Basic Workshop Practices	L	T	P	C
Practicum		1	0	2	2

Introduction

Basic Workshop Practices help to develop the technical hands-on skills required by the technicians working in various Engineering sectors. This course intends to impart the basics of hand tools and their uses in different sections of manufacturing. The topics covered are based on the syllabus for diploma studies in Engineering. The course is planned to include basic practical experience in Fitting, Wiring and Plumbing. The courses are arranged in sequence, that starts from the basic concepts on safety rules followed in Industries, Dimensioning system, Basic Measuring instruments & basic tools used for Manufacturing processes. In this course, it is expected that the students would be able to get workshop experience, which helps to build an understanding of the complexity of the industrial job and the skills requirement of the jobs.

Course Objectives

The objective of this course is to enable the student to

1. Understand the importance of safety & Precautions in Industries.
2. Understand and practice the 5S system in Industries.

3. Identify suitable marking and measuring tools for materials.
4. Read the drawing and understand the dimensioning system.
5. Practical skills on Fitting, Plumbing & Wiring trades.

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Illustrate the safety aspects and 5s system in Industry.

CO2: Identify & select the appropriate tools required for specific operations.

CO3: Prepare the jobs according to the drawing for Fitting, Plumbing and Wiring.

CO4: Produce jobs as per specified dimensions and inspect the job for quality

CO5: Demonstrate the Fitting, Wiring and plumbing practices for house wiring practice, install and test a battery with hydrometer.

Pre-requisites

Nil

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Practicum		1	0	2	2

CO/PO Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	2	3	2		1
CO2	3	1		3			2
CO3	3	3		3	1		1
CO4	3	2	1	3	1		2
CO5	3	1	1	2	1		3

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy

It is advised that teachers take steps to pique pupils' attention and boost their learning confidence.

To help students learn and appreciate numerous concepts and principles in each area, teachers should provide examples from daily life, realistic situations, and real world engineering and technological applications.

The demonstration can make the subject exciting and foster in the students a scientific mindset. Student activities should be planned on all the topics.

Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome- and employability-based.

All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).

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Assessment Methodology

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Lab Assessment (Ex. 1, 2, 4, 7 & 8)	Lab Assessment (Ex. 3, 5, 6, 9 & 10)	Model Exam (Ex 1 to 10)	Class Assessment	Practical Examination
Duration	2 hours		3 hours	During Practice Hours, every exercise should be evaluated to 10 marks	3 hours
Exam Marks	80	80	100	100	100
Converted to Marks	10	10	10	10	60
	20		20		60

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THEORY

Unit I	SAFETY	
Introduction to safety – safety slogans – personal safety – personal protective Equipment - safety signs – caution sign, fire safety sign – sign posters – Industrial safety – machine safety rules – safety working practices, precaution to be taken to prevent electric shock-5S Principle – Sort, Set in order, Shine, Standardize and Sustain		3
Unit II	DIMENSIONING SYSTEM	
Limits - fits – tolerances – Allowances - types of fits – hole basis system - shaft basis system – simple examples – difference – geometric dimensioning – flatness, straightness, circularity, concentricity, run out, parallelism, perpendicularity, Angularity, cylindricity		3
Unit III	BASIC MEASURING INSTRUMENTS	
Basic instruments – steel rule, divider, caliper, try square, measuring tape, vernier caliper, micrometer - inside micrometer, outside micrometer - protractor- height gauge - dial gauge - V block, surface plate radius gauge, sine bar, slip gauge set, feeler gauge, wire gauge, Voltmeter, Ammeter, Multimeter.		3
Unit IV	BASIC TOOLS	
Fitting : Work holding devices – bench vice, machine vice, fixture - tool holding devices – hacksaw frame, drill chuck, sleeve – fitting tools – files - types – punches - center, dot punches – hammer – types - claw hammer- scribes – chisel - drill bit - straight shank - Taper shank-hand reamer -hand taps. Screwdriver – types, uses - cutting pliers-types, uses, hand drilling machine.		3
Wiring : Types of electrical wiring system – Single phase wiring - Three phase wiring – differences & applications		
Plumbing : Pipe vice, wrenches- types - pipe wrench, adjustable wrench, chain wrench, pipe cutter, Solution to join pipes, thread sealing tape for pipe fitting screws-types.		
Unit V	BASIC PRACTICES	
Fitting - Tools - Cutting practice – Filing practice.		3
Wiring – Tools - wiring symbols - Circuit – Connection practice. Plumbing – Tools – type of joints - Joint practice.		

Note - 1 : Mark questions should be prepared unit wise (I to IV) as a question bank, the same can be used for the end semester examinations for 20 marks

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PRACTICAL

Ex. No	Name of the Exercise	Hours
1	Fitting - Cutting & Filing of a profile	2
2	Fitting - Drilling, Reaming, Tapping	2
3	Fitting - L-Mating	2
4	Wiring – Draw the circuit diagram and connect for the connection of Two lamp, two switches with socket – parallel and series connection.	2
5	Wiring - Draw the circuit diagram and connect the connection for Fan switch-regulator.	2
6	Wiring - Draw the circuit diagram and connect for the Stair case wiring	2
7	Installation of a battery, Charging and testing a Battery with hydrometer	2
8	Plumbing - Connect a tap using - PVC pipe, fittings and a tap	2
9	Plumbing – Connect the pipe line for the Sink / wash basin	2
10	Plumbing - Connect the pipe line for the connection for Rain water harvesting	2
Practice + Continuous Test + Revision		10
TOTAL HOURS		30

Suggested list of Students Activity

Prepare / Download a specification of the following:

- Various tools & Equipment in various shops.
- Precision equipment in the workshop.
- Various machinery in the workshop.
- Visit any fabrication / woodworking workshop and prepare a report.
- Prepare a 5S chart for each machine in your workshop and maintain this report during your Lab hours.

Text Books

- A Textbook of Manufacturing Process, Gupta, J.K., Khurmi, R.S. S.Chand and Co. New Delhi ISBN:81-219-3092-8 (Workshop Tech.) Publication.
- A Textbook of Electrical Technology B.L.Theraja, A.K.Theraja – S.Chand & Company Ltd.

Reference Books

- Basic Manufacturing “Roger Timings” Third Edition – Newnes, An imprint of Elsevier.
- Industrial Organisation and Engineering Economics – “T.R. Banga, S.C.Sharma”- Khanna Publishers
- Industrial Engineering and Management “O.P.Khana” – Dhanbat Rai Publications.

Allocation of Marks

Part	Description	Marks
Fitting / Wiring / Plumbing		
A	Marking / Circuit diagram	25
B	List of tools	10
C	Cutting and Filing / Circuit / Pipe Connection	25
D	Dimension / Verification of Connection	20
E	Written Test (Theory Portion)	20
TOTAL MARKS		100

Note: One Mark questions shall be given from the Theory Portions. 20 X 1 = 20 Marks

Machine Drawing -K.L.Narayana, P.kannaiah, K.Venkatareddy – New Age International Publishers.

- Workshop practices, H S Bawa, Tata McGraw-Hill, 2009
- Elements of workshop Technology, Hajra Choudhury S. K., Hajra Choudry A.K. and Nirjhar Joy.
- Workshop Technology by Chapman W.A.J and Arnold E.

Web-based/Online Resources

<https://onlinecourses.nptel.ac.in>

Additional Instructions

- For the record of work done, a notebook or manual may be used. In this, the student should draw a diagram, and mention the readings/observations, calculations and result manually. The same has to be submitted for the end semester examination on the first attempt.
- The proper safety procedure and norms should be followed with proper uniform (Khaki pants & half-hand shirt) with safety shoes during the practices. All the Exercise should be completed, One Exercise should be given by lot or question paper received from DOTE should be followed for the end semester Examination.

CONTENTS

WORKSHOP PRACTICE

UNIT	TITLE	PAGE No.
1	Safety	1
2	Dimensioning System	9
3	Basic Measuring Instruments	17
4	Basic Tools	31
5	Basic Practices	59
	Practices	72



**DIPLOMA COURSE IN
ENGINEERING & TECHNOLOGY**

WORKSHOP PRACTICE

FIRST SEMESTER





UNIT I

SAFETY

(3 Periods)

Introduction:

Safety can be defined as an attitude to keep away damages or accidents. Industrial safety refers to the management of all operations and events within an industry in order to protect its employees and assets by minimizing hazards, risks, accidents, and near misses.

In order to prevent the loss of human lives, safety should be enforced at all costs. Safety is an attitude and working safely is a state of mind.

ACCIDENTS

Accidents can be called as an unexpected event which takes place suddenly causing damages to human lives and materialistic loss. Accidents may occur to every- one in factories, workplace, on roads and at home. The main reason for accidents can be attributed to carelessness and not correcting some minor faults or deficiencies.

Cause of Accident

In industries, accidents can be avoided by placing proper attention on the activities that take place.

Some important causes for accidents are:

- Unnecessary conversation and lack of attention to the work.
- Not possessing adequate experience in the task to be done.
- Showing a sense of urgency in the work.
- Desire for making quick money.
- Lack of adequate rest or sleep, working with poor health.

- Improper handling of hand tools.
- Improper environment.
- Inadequate facilities in the workplace.
- Wearing an improper dress.
- Improper holding of work pieces and tools in machines.

Generally accidents do not happen, they are caused. Safety is necessary to live a normal life and a condition of maintaining a safe working environment. Hence it is important to practice safety precautions and safety rules in the workplace.

Safety Policy:

There is no job or task to perform that would endanger the health or safety of any employee and each employee has the responsibility to work and act safely all times, in the facility or on assigned duties away from the office.

If any task is unhealthy or unsafe to perform, no one shall perform that task.

Safety Slogans:

Safety slogans are the catchy statements or phrases that are often used in the workplace to promote safety awareness and for safety culture in any organization.

Some of the safety slogans are;

- Prevention is better than cure
- Safety is Gain full, Accident is pain full
- Safety never takes a holiday.
- Safety is a state of mind-Accidents are an absence of mind.



- Put Safety into action - stay out of Traction!
- Make safety a reality and don't be a fatality.
- Safety isn't a slogan, It's a way of life.
- You are the key to your safety.
- Make safety as your 1st priority.
- Safety starts with me.
- Better safe than sorry.
- Safety has no time out.
- Safety is not a choice, it's a habit.
- Safety is a journey, not a destination.

Personal Safety:

- Wear a one piece overall or boiler suit.
- Keep the overall buttons fastened.
- Don't use ties and scarves.
- Roll up the sleeves tightly above the elbow.
- Wear safety shoes or boots.
- Cut the hair short.
- Don't wear a ring, watch or chain.
- Never lean on the machine.
- Don't clean hands in the coolant fluids.
- Don't remove guards when the machine is in motion.
- Don't use cracked or chipped tools.
- Don't start the machine until,
 - The work piece is securely mounted.
 - The feed of machinery is in the neutral.
 - The work area is clear and neat.
- Don't adjust clamp or holding devices while the machine is in motion.
- Never touch the electrical equipment with wet hands.

- Ensure that electrical connections are made by an authorized electrician only.
- Concentrate on your work. Have a calm attitude.
- Do things in a methodological way.
- Don't engage yourself in conversation with others while concentrating on your job.
- Don't distract the attention of others.
- Don't try to stop a running machine with your hands.

PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment, commonly referred to as "PPE", is equipment worn to minimize exposure to hazards that cause serious workplace injuries and illness. These injuries and illness may result from contact with chemical, radiological, physical, electrical, mechanical or other workplace hazards.

The Occupational Safety and Health Administration (OSHA) states that employers are responsible for the provision of any necessary PPE in accordance with OSHA standards. This includes performing a hazard assessment, identifying and providing appropriate PPE, training employees in the use of that PPE, and reviewing and replacing damaged equipment as necessary.

Depending upon the nature of hazards, the PPE is broadly classified into two categories.

Non-respiratory: Those used for protecting against injury from outside the body. i.e., for protecting head, eye, face, hand, arm, foot, leg and other body parts.

Respiratory: Those used for protection from harm due to inhalation of contaminated air.

1) Head Protection: Helmets, Hard Hats

A head injury can impair an employee for life or it can be fatal. Wearing a safety helmet or hard hat is one of the easiest ways to protect an



employee's head from objects falling from above and striking them on the head. Hard hats can protect employees from impact and penetration hazards as well as from electrical shock and burn hazards.

2) Foot protection: Leather leg guards, safety shoes, Gum boots



Employees who face possible foot or leg injuries from falling or rolling objects or from crushing or penetrating materials

should wear protective footwear. Also, employees whose work involves exposure to hot substances or corrosive or poisonous materials must have protective gear to cover exposed body parts, including legs and feet.

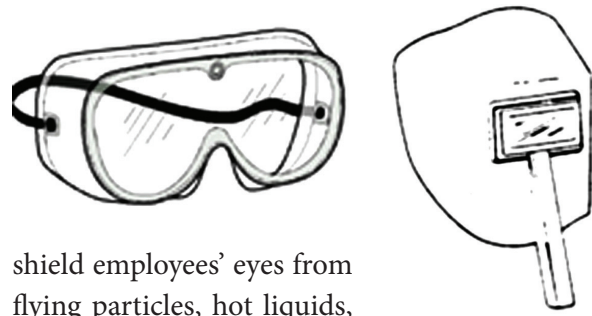
3) Nose protection: Nose masks, Respirators

Nose Protection has long been used in a manufacturing setting to protect employees from inhaling air contaminated with harmful dust, fumes, gases, or sprays. This PPE must fit closely to the face and cover the nose and mouth to be effective. N95 filtering facepiece respirators are most commonly used and recommended by OSHA. Once manufactured, a sample from each batch is tested for flammability, breathing and splash resistance, particle filtration efficiency, and bacteria filtration efficiency.



4) Eyes Protection: Safety Spectacles, Goggles, Welding shields

Employees can be exposed to a large number of hazards that pose danger to their eyes. Protective eyewear is important in certain workplaces to



shield employees' eyes from flying particles, hot liquids, molten metal, chemical gases, and harmful radiation. This PPE must fit closely and comfortably to the wearer's face, be cleanable, and not restrict vision or movement.

5) Hearing Protection: Ear plug, Ear muff

In a workplace where employees are consistently subjected to high levels of noise, workers should be fitted for specially molded earplugs. For continuous exposure, i.e., for eight hours in any one day, the sound level should not exceed 85 db. Workers should not be exposed to sound levels exceeding 85 db unless they are wearing suitable hearing protectors, which effectively reduce the sound level at the user's ear to below 85db.



6) Face protection: Face shield, Head shield with or without ear muff

Face shield is required when there is a possibility of materials penetrating the skin area of the face, specifically in grinding operation and abrasive blast cleaning operations. Providing full face protection, this PPE is typically worn on top of masks or goggles to prevent the inhalation of toxic substances or, as in the case of COVID-19, virus-carrying aerosol droplets.



7) Body Protection:

In particularly hazardous conditions, workers might be required to protect their entire body. Body protection comes in the form of jackets, aprons, lab coats, overalls, and full bodysuits. They are made from a range of materials including fire-retardant wool or cotton, rubber, leather, and plastic.

Body protection of this kind must be carefully measured for each employee to ensure a proper fit.



SAFETY SIGN

Safety sign is a sign providing information or instruction about safety or health at work by means of a sign board, a color, an illuminated sign or acoustic signal, a verbal communication or hand signal.

Sign board - a sign which provides information or instruction by a combination of shape, colour and a symbol which is rendered visible by light of sufficient intensity.

1. Prohibition Sign – a sign prohibiting behavior likely to increase or causing danger.

Intrinsic features:

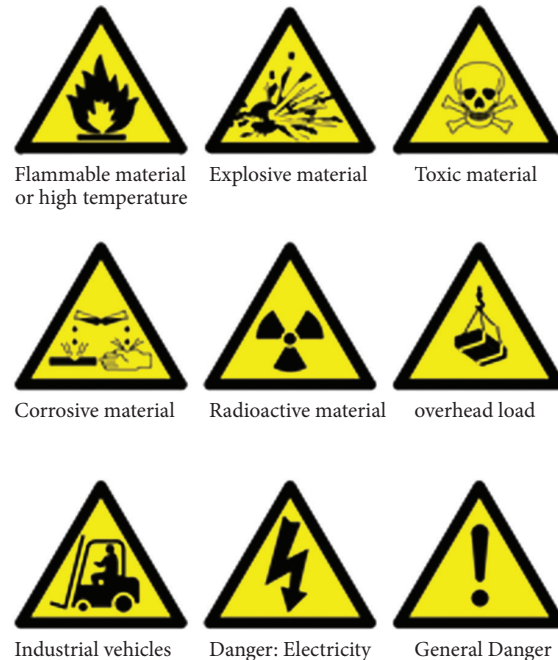
- Round shape.
- Black pictogram on white background, red edging and diagonal line.



2. Warning sign – a sign giving warning of a hazard or danger.

Intrinsic features:

- Triangular shape.
- Black pictogram on a yellow background with black edging.



3. Mandatory sign - a sign prescribing specific behavior.

Intrinsic features:

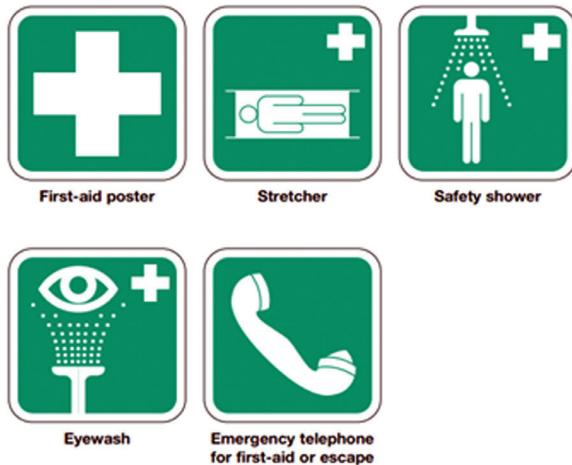
- Round shape
- White pictogram on a blue background.



4. Emergency escape or First aid sign – a sign giving information on emergency exits, first aid or rescue facilities.

Intrinsic features:

- Rectangular or square shape.
- White pictorial on a green background.



Caution Sign:

Caution signs are required to be posted at the entrance to a space where hazardous materials are stored or used. The caution sign alerts emergency responders and visitors of potential hazards and precautions for entry.



Fire Fighting Sign:

A fire fighting sign is defined as a sign which including an illuminated sign or an acoustic signal which,

- Provides information on escape routes and emergency exits in case of fire.
- Provides information on the identification or location of firefighting equipment.
- Gives warning in case of fire.

Intrinsic features:

- Rectangular or square shape.
- White pictogram on a red background.



Safety Sign Posters:

Workplace safety posters play a pivotal role in reminding employees about the necessity of workplace safety practices. Workplace safety posters are valuable educational tools, providing information on various safety-related topics.

Example:



Industrial safety:

Industrial safety is defined as the management of all operations and procedures in an industry in order to protect the employees and assets by minimizing hazards, risks, accidents, and near misses.

- Industrial safety is needed to check all the possible chances of accidents for preventing loss of life and permanent disability of any industrial employee, any damage to machine and material.



- It is needed to eliminate accidents causing work stoppage and production loss.
- It is needed to reduce workman's compensation, insurance rate, and all the cost of accidents.
- It is needed to achieve better morale among industrial employees.
- It is needed to increase production to a higher standard of living.
- It is needed to prevent accidents in the industry by reducing any hazards.

Machine Safety Rules:

1. Machines must be switched off immediately, if it sounds abnormal.
2. Keep the machine clean.
3. Remove or replace any worn out or damaged accessories, holding devices, nuts, bolts etc. as soon as possible
4. Do not attempt operating the machine until you know how to operate it properly.
5. Do not adjust the tool or the work piece unless the power is off.
6. Stop the machine before changing the speed.
7. Ensure the oil level before starting the machine.
8. Always take measurements on Work piece only after the machine stops.
9. Use wooden planks over the bed while loading and unloading heavy jobs.
10. Ensure all safety guards are in position before starting a machine.

Safe Working Practices:

- Inspect all tools before use to see they are clean and in good condition.
- Ensure all safety guards are installed and wear safety protective equipment.
- Disconnect the power source from the tool before adjusting, oiling or changing accessories.
- Each employee has been or will be trained in the safe lifting method and each employee

must exercise these techniques and methods when lifting anything.

- Keep hand saws sharp and free of rust to prevent them from binding or jumping and causing injuries.
- Each employee has the responsibility to communicate with management, openly and without fear of reprisal, any aspect of safety and health, specifically to make recommendations for safety and health improvement in the facilities, equipment and procedures.
- Rings and jewelry should not be worn on, around or near moving machinery.
- Each employee has been, or will be trained in the safe lifting method and each employee must exercise these techniques and methods when lifting anything.
- Each employee has the responsibility to work and act safely at all times, on all jobs, every day.
- "Danger Do Not Start Machine", this indicates that the machine is being repaired, serviced or otherwise out of service and must not be started or tampered with while the lock or tag is in place. Only the person installing the lock or tag is authorized to remove the lock or tag.

Precautions to be Taken to Prevent Electric Shock:

- Before handling any conductors or apparatus, adequate precautions shall be taken, by earthing to prevent accidents.
- All panels shall be painted with name description of its identification at front and at the rear.
- Every person working on an electric supply line must use gloves, rubber shoes, safety belts, ladders, earthing devices, helmets, line testers, hand lines which protect from mechanical and electrical injury.



- In every manned generating station, sub-station or switching station of voltage exceeding 650 V, an artificial respirator shall be provided and kept in good working condition.
- While working with electrical devices, use tools and equipment with non-conducting handles.
- Avoid touching electrical equipment with wet hands, feet or body.

5S PRINCIPLE

5S is one of the most widely adopted techniques from the lean manufacturing toolbox. The primary objective of 5S is to create a clean, orderly environment – an environment where there is a place for everything and everything in its place.

Seiri - Sort:

Sort is the process of removing all the items which is not needed for current production form work space

The goal of sort is to eliminate all the unneeded tools and materials and create a space for free workflow from distraction.

A good rule is “If you do not use it on a daily basis, throw it out”.

5S has an effective tool that will help to sort process: Red tags

- Red tags help to identify objects that need to be removed from the workplace.
- The red tag indicated what action should be taken
 1. Leave the item where it is
 2. Relocate the item
 3. Dispose the item
 4. Recycle the item



Red Tag

Seiton -Set in Order:

Set in order is the process of putting everything in a place that is easy to get to. All items should be clearly marked so anyone can easily find its proper home.

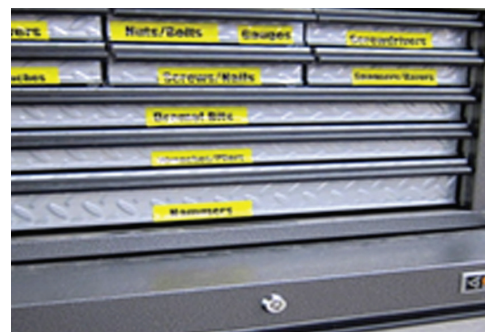
The goal of set in order is to create a standardized and consistent way to store and retrieve tools and materials.

The set in order utilizes several strategies to accomplish its goal.

1) **Label and Signs:** Labeling is the easiest way to identify proper placement of tools, materials and equipment quickly and visually.

Example:

- Drawers of tools chests can be labeled with their contents.



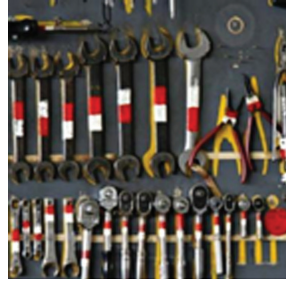
Labels

- Tool Foam: Tool drawers can be customizable foam to create a tool organization system.





Shadow Board / Tool Outlining: Tool outlining means creating a visual outline of your tool so you can quickly return it to its proper home.



Seiso- Shine: Shine means removing all the dirt and grime and keeping the workplace clean on a daily basis.

The goal for shine is to keep everything in great working order so it lasts as long as possible and doesn't break down.

Clean and properly maintained tools and machines also increase safety in the workplace. Fewer injuries and less down time equate to higher morale and high productivity.

Seiketsu – Standardize: Standardize is a process that creates a system of tasks and procedures that will ensure the principles of 5S are performed on a daily basis.

The standardized pillar utilizes a set of schedules and checklists that can be easily followed, so each step of 5S is performed the same way every day.

Standardize uses three steps to make sure that the 5S pillars are getting done consistently and correctly.

1. Make sure each employee knows his responsibilities.

Employees should have a clear understanding of their daily and weekly sort, set in order and shine tasks. Their responsibilities should be clearly written out on a check list or a chart so they can be easily accessed throughout the day.

2. Make it a part of their daily routine.
3. Periodic evaluation.

Shitsuke – Sustain: Sustain is a process that makes employees more committed and motivated to follow each step.

The sustain pillar is designed to keep employees motivated and on track.

The five suggestions that help sustain functioning well.

1. Assign the time to do it.
2. Start from the top.
3. Create a reward system.
4. Get everyone involved.
5. Let them see it.

STUDENT ACTIVITY:

Prepare a 5S chart for each machine in your workshop and maintain this report during your Lab hours.



UNIT II

DIMENSIONING SYSTEM (3 Periods)

Terminology

- **Basic Size:** is the size from which limits or deviations are assigned. Basic sizes, usually diameters, should be selected from a table of preferred sizes.
- **Deviation:** is the difference between the basic size and the hole or shaft size.
- **Upper Deviation:** is the difference between the basic size and the permitted maximum size of the part.
- **Lower Deviation:** is the difference between the basic size and the minimum permitted size of the part.
- **Fundamental Deviation:** is the deviation closest to the basic size.
- **Tolerance:** is the difference between the permitted minimum and maximum sizes of a part.

Limits:

The maximum and minimum permissible sizes within which the actual size of a component lies are called Limits.

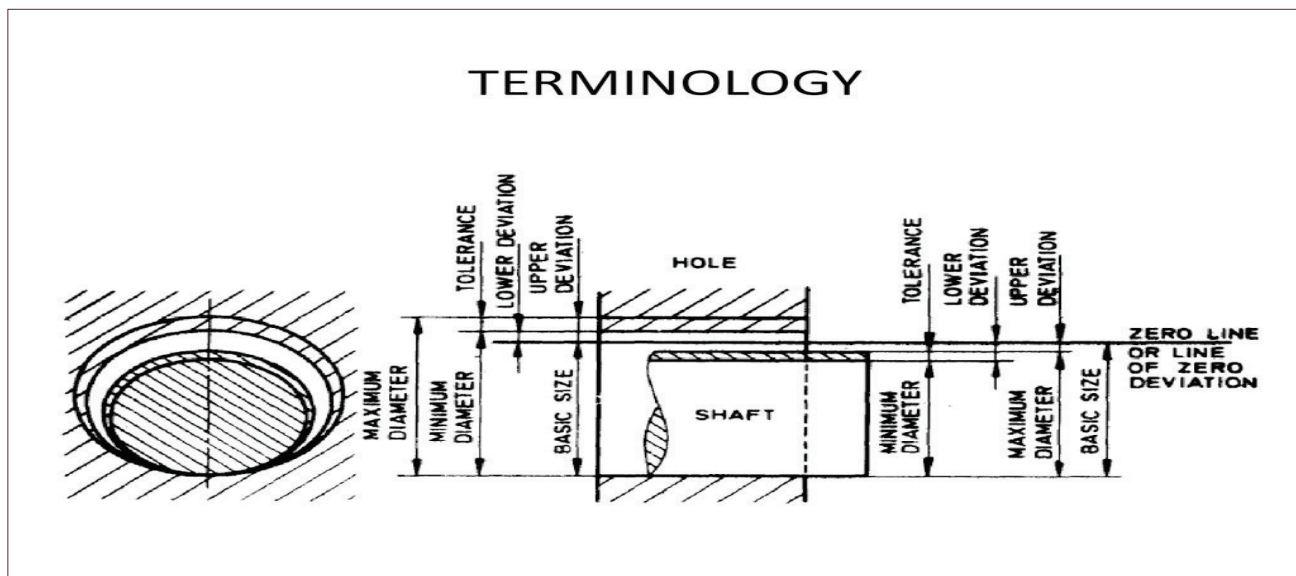
Tolerance:

The term tolerance refers to the difference between the upper (maximum) limit and lower (minimum) limit of a dimension. In other words, tolerance is the maximum permissible variation in a dimension. The tolerance may be of two types i.e. unilateral or bilateral.

When the tolerance is allowed on one side of the nominal size then it is said to be a unilateral system of tolerance. 'When tolerance is allowed on both sides of the nominal size then it is said to be a bilateral system of tolerance.

Example:

$2.00^{+.005}_{-.000}$	$2.00 \pm .003$
Unilateral form	Bilateral form





Allowance: It is the intentional difference between the hole dimensions and shaft dimension for any type of fit. The term allowance refers to the difference between the basic dimensions of mating parts. The allowance may be Positive or negative. In positive allowance the shaft size is less than the hole size, and in negative allowance the shaft size is greater than the hole size. Allowance tells the type of fit. Positive allowance provides clearance fit while negative allowance provides interference fit.

SYSTEM OF FITS

Fit is an assembly condition between 'Hole' and 'Shaft'. The term fits refers to the degree of tightness or looseness between two mating parts. Depending upon the actual limits of the hole and shaft.

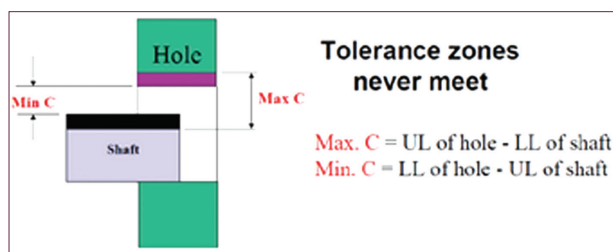
Hole: A feature engulfing a component. The term hole refers not only to the diameter of a circular hole but to any internal dimension of a component.

Shaft: A feature being engulfed by a component. The term shaft refers not only to the diameter of a circular shaft but to any external dimension on a component.

TYPES OF FITS

Clearance Fit: In this type of fit, the largest permitted shaft diameter is less than the smallest hole diameter so that the shaft can rotate or slide according to the purpose of the assembly.

The clearance fit may be of different types, e.g., slide fit, easy sliding fit, running fit, slack running fit and loose running fit, etc.

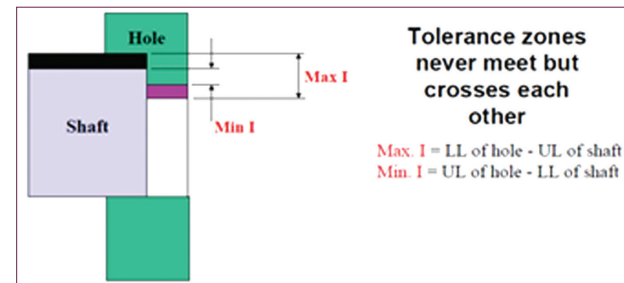


Interference Fit:

It is defined as the fit established when a negative clearance exists between the sizes of holes and the shaft. In this type of fit, the minimum permitted

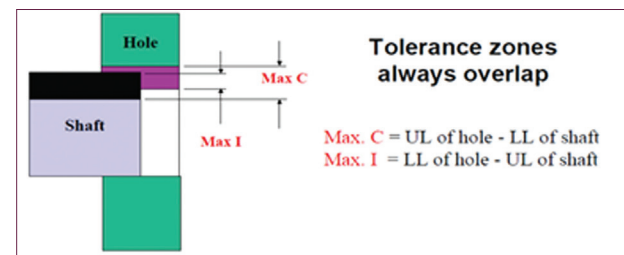
diameter of the shaft is larger than the maximum allowable diameter of the hole. In interference fit, the difference between the minimum size of the hole and the maximum size of the shaft is called maximum interference. Whereas difference between the maximum size of the hole and the minimum size of the shaft is known as minimum interference,

Ex: Bearing bushes, Keys & key ways



Transition Fit: In this type of fit, the diameter of the largest allowable hole is greater than the smallest shaft, but the smallest hole is smaller than the largest shaft, such that a small positive or negative clearance exists between the shaft & hole.

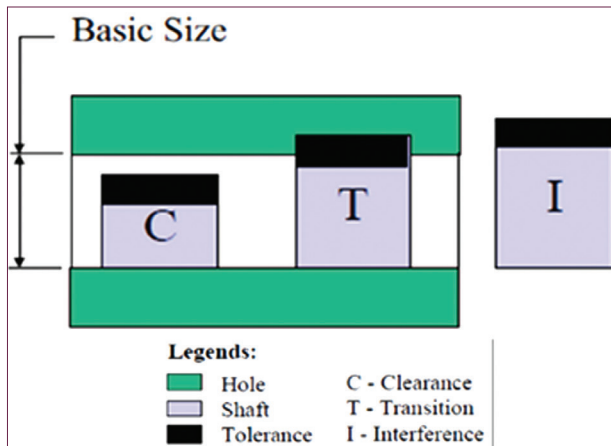
Ex: Coupling rings, Spigot in mating holes, etc.



Hole Basis: In this system, the basic diameter of the hole is constant while the shaft size is varied according to the type of fit.

Significance of Hole basis system: The bureau of Indian Standards (BIS) recommends both hole basis and shaft basis systems, but their selection depends on the production methods. Generally, holes are produced by drilling, boring, reaming, broaching, etc. whereas shafts are either turned or ground.

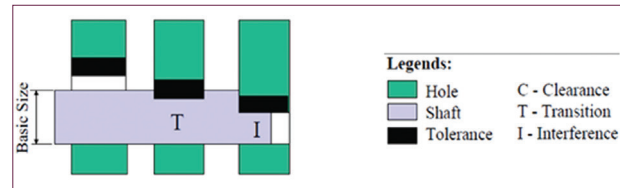
If the shaft basis system is used to specify the limit dimensions to obtain various types of fits, a number of holes of different sizes are required, which in turn requires tools of different sizes.



If the hole basis system is used, there will be reduction in production costs as only one tool is required to produce the hole and the shaft can be easily machined to any desired size. Hence hole basis system is preferred over the shaft basis system.

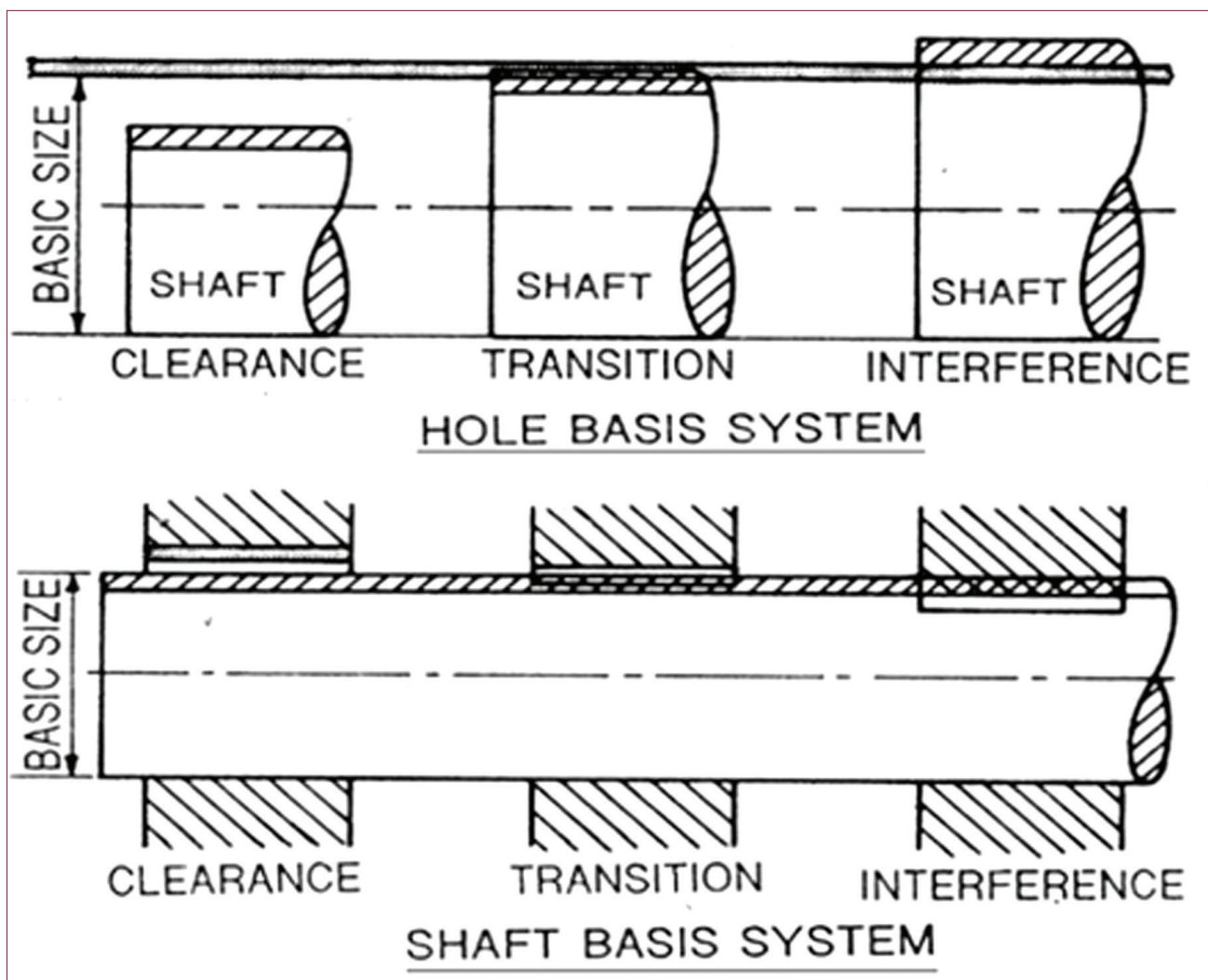
Shaft Basis System:

In this system, the basic diameter of the shaft is constant while the hole size is varied according to the type of fit.



It may, however, be necessary to use a shaft basis system where different fits are required along a long shaft.

For example, in the case of driving shafts where a single shaft may have to accommodate a variety of accessories such as couplings, bearings, collars, etc., it is preferable to maintain a constant diameter for the permanent member, which is the shaft, and vary the bore of the accessories.





Example 1.

A shaft of 25 mm basic size is given as 25 ± 0.02 mm. Find the tolerance.

Solution.

The maximum permissible size (upper limit) = 25.02 mm and

the minimum permissible size (lower limit) = 24.98 mm

Then,

$$\begin{aligned}\text{Tolerance} &= \text{Upper Limit} - \text{Lower Limit} \\ &= 25.02 - 24.98 \\ &= 0.04 \text{ mm} = 4 \times 10^{-5} \text{ m}\end{aligned}$$

Example 2.

A 50 mm diameter shaft is made to rotate in the bush. The tolerances for both shaft and bush are 0.050 mm. Determine the dimension of the shaft and bush to give a maximum clearance of 0.075 mm with the hole basis system.

Solution.

In the hole basis system, lower deviation of hole is zero, therefore low limit of hole = 50 mm.

$$\begin{aligned}\text{High limit of hole} &= \text{Low limit} + \text{Tolerance} \\ &= 50.00 + 0.050 \\ &= 50.050 \text{ mm} \\ &= 50.050 \times 10^{-3} \text{ m}\end{aligned}$$

$$\begin{aligned}\text{High limit of shaft} &= \text{Low limit of hole} - \text{Allowance} \\ &= 50.00 - 0.075 \\ &= 49.925 \text{ mm} = 49.925 \times 10^{-3} \text{ m}\end{aligned}$$

$$\begin{aligned}\text{Low limit of the shaft} &= \text{High limit} - \text{Tolerance} \\ &= 49.925 - 0.050 \\ &= 49.875 \text{ mm} = 49.875 \times 10^{-3} \text{ m}\end{aligned}$$

Example 3.

For each of the following hole and shaft assembly, find shaft-tolerance, hole tolerance and state whether the type of fit is (a) clearance, (b) transition, and (c) interference:

- (i) Hole : $50_{+0.00}^{+0.25}$ Shaft : $50_{+0.005}^{+0.05}$ mm
- (ii) Hole : $30_{+0.00}^{+0.05}$ Shaft : $30_{+0.05}^{+0.02}$ mm
- (iii) Hole : $25_{+0.00}^{+0.04}$ Shaft : $25_{+0.04}^{+0.06}$ mm

Solution

$$\begin{aligned}\text{(a) Hole:} \quad & \text{High limit of hole} = 50.025 \text{ mm} \\ & \text{Low limit of hole} = 50.00 \text{ mm} \\ & \text{Hole tolerance} = 50.025 - 50.00 \\ & \quad = 0.025 \text{ mm} = 25 \times 10^{-6} \text{ m}\end{aligned}$$

$$\begin{aligned}\text{Shaft :} \quad & \text{High limit of shaft} = 50.05 \text{ mm} \\ & \text{Low limit of shaft} = 50.005 \text{ mm} \\ & \text{Shaft tolerance} = 50.05 - 50.005 \\ & \quad = 0.045 \text{ mm} = 45 \times 10^{-6} \text{ m}\end{aligned}$$

If we choose high limit of hole with high limit of shaft then

$$\begin{aligned}\text{Allowance} &= 50.025 - 50.05 \\ &= -0.025 \text{ (Interference)}\end{aligned}$$

Similarly, if we choose low limit of hole and either high limit or low limit of shaft, it is clear that there will be interference.

Thus, we conclude that the type of fit is **Transition fit.**

$$\begin{aligned}\text{(b) Hole :} \quad & \text{High limit} = 30.05 \text{ mm} \\ & \text{Low limit} = 30.00 \text{ mm} \\ & \text{Tolerance} = 0.05 \text{ mm} = 5 \times 10^{-5} \text{ m} \\ \text{Shaft :} \quad & \text{High limit} = 30 - 0.02 = 29.98 \text{ mm} \\ & \text{Low limit} = 30 - 0.05 = 29.95 \text{ mm} \\ & \text{Tolerance} = 29.98 - 29.95 \\ & \quad = 0.03 \text{ mm} = 3 \times 10^{-5} \text{ m}\end{aligned}$$

If we select high limit of hole and high limit of shaft then



Allowance = $30.05 - 29.98 = 0.07$ mm If we choose low limit of hole and high limit of shaft then Allowance = $30.00 - 29.98 = 0.02$ mm Thus, we conclude that the type of fit is Clearance fit. (c) Hole : High limit = 25.04 mm Low limit = 25.00 mm Tolerance = $25.04 - 25.00$	= $0.04 \text{ mm} = 4 \times 10^{-5} \text{ m}$ Shaft : High limit = 5.06 mm Low limit = 25.04 mm Tolerance = $25.06 - 25.04$ = $0.02 \text{ mm} = 2 \times 10^{-5} \text{ m}$ If we select high limit of shaft and low limit of hole, then Allowance = $25.00 - 25.06$ = $-0.06 \text{ mm} = -6 \times 10^{-5} \text{ m}$ It is clear that for any combination of hole and shaft the allowance will be negative.
---	--

Sl. No.	Hole Basis System	Shaft Basis System
1	Size of the hole whose lower deviation is zero is assumed as the basic size.	Size of the shaft whose upper deviation is zero assumed as basic size.
2	Limits on the hole are kept constant and those of shafts are varied to obtain desired type of fit.	Limits on the shaft are kept constant and those of holes are varied to have necessary fit.
3	Hole basis system is preferred in mass production because it is convenient and less costly to make a hole of correct size due to availability of standard drills and reamers.	This system is not suitable for mass production because it is inconvenient time consuming and costly to make a hole of any size with respect to field size so as to obtain required fit.
4	It is much more easy to vary the shaft sizes according to the fit required.	It is rather difficult to vary the hole sizes according to the fit required.
5	It required less amount of capital and storage space for tools needed to produce shaft of different sizes.	It needs large amount of capital and storage space for large numbers of tools required to produce holes of different sizes.
6	Changing of shafts can be easily and conveniently done with suitable gap gauges.	Being internal measurement gauging of holes cannot be easily and conveniently done.

Thus, we conclude that the type of fit is **Interference fit.**

Geometric Dimensioning and Tolerances (GD & T) Symbols:

Geometric Dimensioning and Tolerances is a system of symbols, rules and definitions used to define the size, shape, form, orientation, and location of features on a part.

- Geometric tolerance is concerned with the accuracy of the relationship of one component to another and should be specified separately.
- Geometrical tolerance may be defined as the maximum possible variation of form, or position of form or position of a feature.

Types of Geometric Tolerances:

Form control: Straightness, flatness, Circularity, cylindricity.

Profile control: Line profile, Surface profile.

Orientation control: Perpendicular, parallelism, angularity.

Location control: Position, Concentricity, Symmetry.

Run out control: Circular run out, Total run out.

Datum: A datum is a theoretical exact feature from which dimensional measurement is done, Which is generally chosen as an edge of feature which has the greatest influence in a specific measurement.

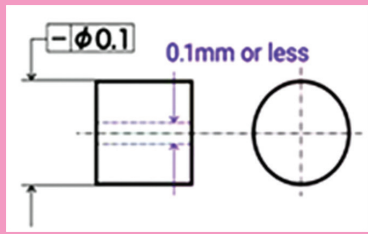
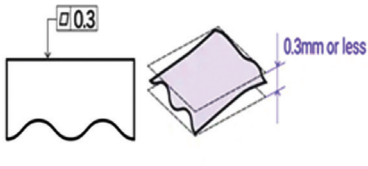
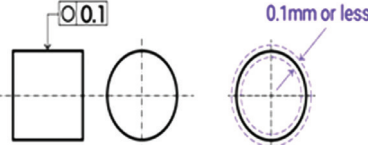
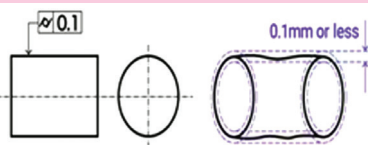
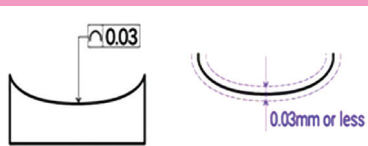
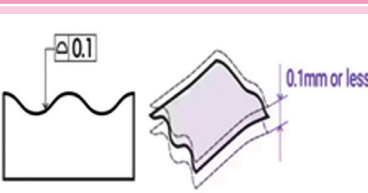
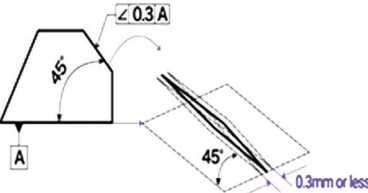
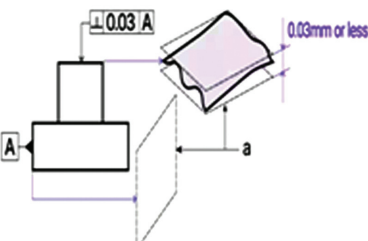
It is denoted by



Geometric Characteristics Symbols:

Type	Geometric Characteristics	Symbols	Datums	Explanation
Form	Straightness		Datums not required	To control the straightness of the line on a surface.
	Flatness			To control the flatness of a surface.
	Circularity			To control the errors of roundness of a circle in the plane in which it lies.
	Cylindricity			To control the combination of roundness, straightness, and parallelism of a cylindrical surface.
Profile	Profile of a line		Datums sometimes required	To control the tolerance zone around any line in any feature of curved shape
	Surface profile			To control the 3 Dimensional tolerance zone around surface of advanced curve shape
Orientation	Angularity		Datums required	To control the inclination of a line or surface w.r.t a datum.
	Perpendicularity			To control the perpendicularity of a line or surface w.r.t a datum.
	Parallelism			To control the parallelism of a line or surface w.r.t some datum.
Location	Position			To control the variation of feature from the specified exact location in terms of axis, point or plane
	Concentricity			To control the deviation of the position of the center or axis of the tolerance circles or cylinders.
	Symmetry			To control the uniformity of two features on a part across a datum plane
Run out	Circular run out			To controls circularity and co axiality of each circular segment of a surface independently about a coaxial datum
	Total run out			To control circularity, straightness, co axiality and taper of a cylindrical surface about a a coaxial datum

Geometric Tolerance on Drawing:

Geometric Characteristics	Sample Drawings	Explanation for Drawings
Straightness		If a tolerance frame is connected to the size indicating the diameter of a cylinder, the axis of that cylinder must be within a cylinder with a diameter of 0.1 mm.
Flatness		This surface must be between two parallel planes separated by only 0.3 mm.
Circularity		The outer circumference of any cross-section of a shaft cut perpendicularly should be between two concentric circles just 0.1 mm apart on the same plane.
Cylindricity		The target plane must be between two coaxial cylinders just 0.1 mm apart.
Profile of a line		The target profile on any cross-section parallel to the projection plane must be between the two envelopes created by a circle with a diameter of 0.03 mm and a center on the line having a theoretically exact profile.
Surface profile		The target plane must be between two envelope planes created by a sphere with a diameter of 0.1 mm and a center on the plane having a theoretically exact profile.
Angularity		The plane indicated by the indication arrow must be theoretically exactly angled by 45 degrees to the datum plane A and between two parallel planes only 0.3 mm apart in the direction of the indication arrows.
Perpendicularity		The perpendicularity requirement specifies the accuracy of how perpendicular a target is to the datum (reference plane or line). Instead of degrees, millimeters are used as the unit for the value of perpendicularity indication.



Geometric Characteristics	Sample Drawings	Explanation for Drawings
Parallelism		The plane indicated by the indication arrow must be within two parallel planes perpendicular to datum plane A and with a diameter of 0.03 mm.
Position		The center of the circle indicated by the indication arrow must be within a circle with a diameter of 0.1 mm.
Concentricity		The axis of the cylinder indicated by the indication arrow must be within a cylinder with datum axis line A as the axis and a diameter of 0.03 mm.
Symmetry		The center plane indicated by the indication arrow must be between two parallel planes symmetrical to the datum center plane A and separated from each other by 0.05 mm.
Circular run out		The run-out of the cylindrical surface in the radial direction, indicated by the indication arrow, must not surpass 0.03 mm on any measurement plane perpendicular to the datum axis line when the target is rotated once on the datum axis line.
Total run out		The total run-out of the cylindrical surface in the radial direction, indicated by the indication arrow, must not surpass 0.03 mm at any point on the cylindrical surface when the cylinder part is rotated on the datum axis line.



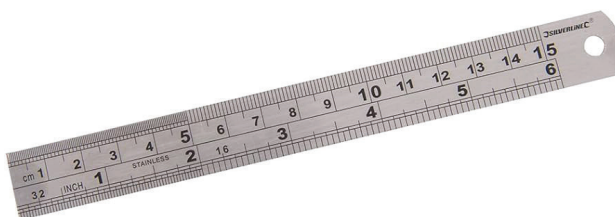


UNIT III

BASIC INSTRUMENTS (3 Periods)

Steel Rule

One of the most frequently used measuring tools is the steel rule. This measuring instrument enables work to be laid out accurately, and distances and sizes measured with precision. It is made from spring steel with a high degree of accuracy in both overall length graduations. A 6-inch rule is the most common size, although the 12-inch rule is also used. To secure an exact measurement it is necessary to measure precisely from center to center of the graduation marks. A steel rule must always be handled carefully. Guard against rough usage that may cause nicks or scratches, as these reduce accuracy. The rule should be oiled slightly to prevent rusting and discoloration which would make the graduations difficult to read.



DIVIDERS

It is a marking tool used to draw circles, segments, and other geometrical textures. Using a divider, you can easily divide a line into equal parts and make them. These are generally made of mild steel.

Its pointed ends are case-hardened so that they do not wear out easily. A divider can be classified based on how many marks it can open. On the basis of a combination of their legs, they are classified into two parts.

Firm Joint-dividers

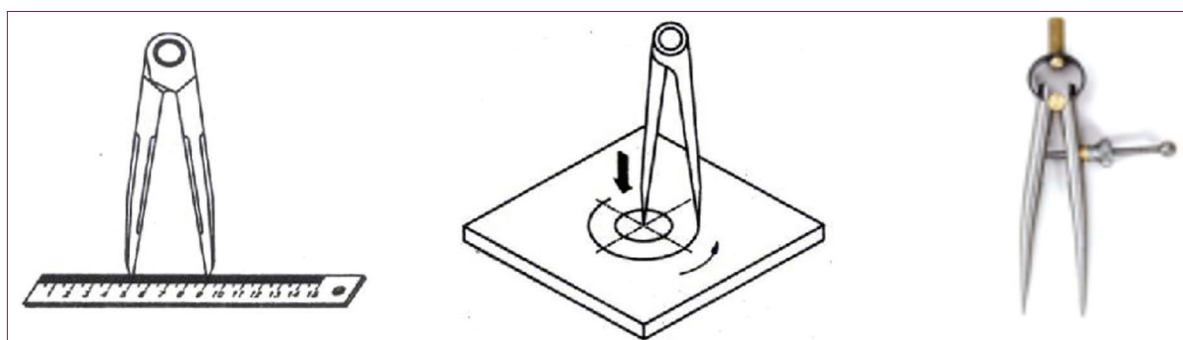
In this type of divider, their legs are joined by a rivet and washer at the top. But the rivet is not fixed tightly so that its legs can be opened easily.

Spring Joint-divider

In this type, both the legs of the divider are tightened on a pin with a spring. Their legs are also joined with each other by an extra screw and split nut. The legs can be easily opened or closed as required by moving its nut.

Uses of Divider

1. It is mainly used to measure the distance between two points.
2. Used to mark circles and arcs on metal jobs.





Calipers

Calipers are used for measuring diameters and distances or for comparing distances and sizes.

Outside calipers are used for measuring outside dimensions, for example, the diameter of a piece of round stock.

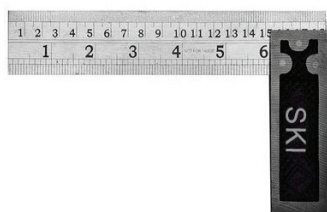
Inside calipers have curved legs for measuring inside diameters, such as the diameters of holes, the distance between two surfaces, the width of slots, etc.

Odd leg or Jenny calipers are generally used to scribe arcs, or as a marking gauge in layout work.



Try Square

A try square is used to mark and check 90° angles on pieces of wood. It is commonly used to draw vertical lines on the workpiece. By using a try square, you can ensure that the paths are parallel and draw lines at right angles to the edges.



Uses of Try Square

1. It is used to check the surface's flatness.
2. To check the angle of 90°, the try square is widely used.
3. It is used to mark vertical lines on the edge of the job.

Measuring Tape

A measuring tape is a flexible ruler that can be folded into any shape and used to measure size or distance. In their simplest form, they consist of a ribbon of fabric or plastic marked

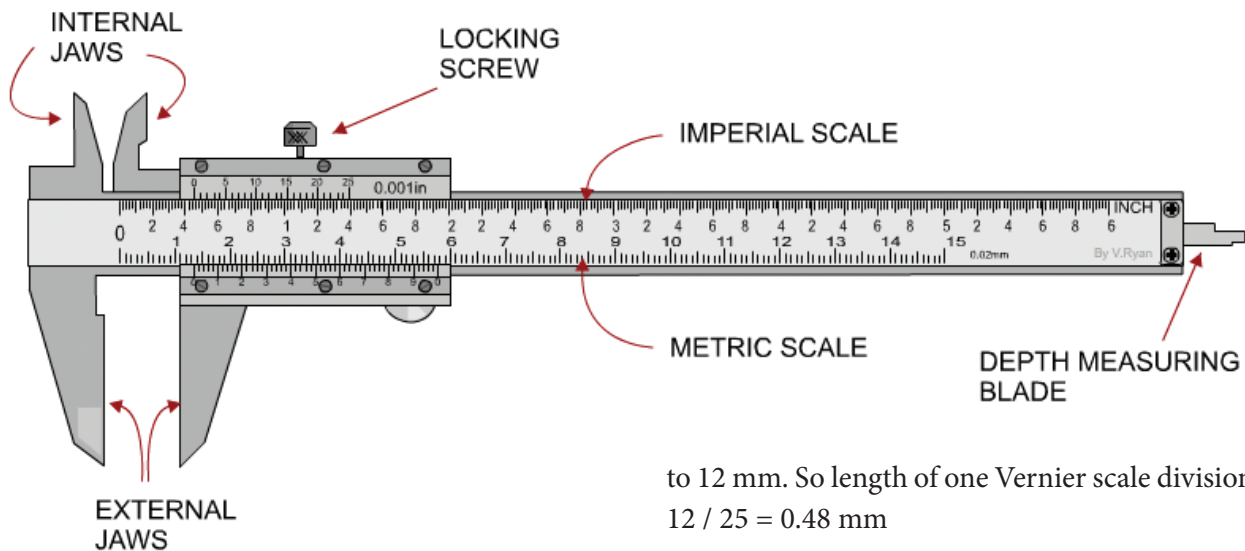


with measurements in inches, centimeters, and/or millimeters.

The most common tape measures range from 12 feet, 25 feet, or 100 feet in length. Its design allows large length measurements to be easily carried in the pocket and also allows measuring curves or corners.

VERNIER CALIPER

Length, width, depth, outside diameter and inside diameter of a component can be measured by using Vernier caliper. The accuracy of the



Vernier caliper is 0.02 mm. The Vernier caliper has a main beam called the rule. It is graduated in millimeters. It has a fixed jaw at one end. There is a Vernier head with a sliding jaw. It has a Vernier scale marked on it. The sliding jaw slides over the rule and can be locked in any position by using locking screws. A fine adjustment screw is fitted in the Vernier head. The inside face of the fixed and sliding jaw are parallel with each other.

For measuring the outside diameter, the work piece is placed between the two jaws. The sliding jaw is moved and made to touch the workpiece correctly. The Vernier head is locked by tightening the locking screw. The sliding jaw can be minutely adjusted to touch the work piece exactly by using a fine adjustment screw. Then main scale and Vernier scale readings are noted.

Reading

The length of one main scale division is 0.5 mm. The length of 25 divisions in the Vernier scale equal

to 12 mm. So length of one Vernier scale division = $12 / 25 = 0.48$ mm

Least count = Length of one main scale division
– Length of one Vernier scale division = $0.50 - 0.48$
= 0.02 mm

In some Vernier calipers, the length of one main scale division will be 1 mm. The length of 50 divisions in the Vernier scale is 49 mm.

So length of one Vernier scale division = $49 / 50$
= 0.98 mm.

Least count = Length of one main scale division
– Length of one Vernier scale division = $1.00 - 0.98$
= 0.02 mm

While reading the Vernier, the main scale reading just before the zero line of Vernier is noted. Then the Vernier scale division which exactly coincides with any one of the main scale division is noted. This number is multiplied by the least count and added with the main scale reading. This is the correct reading of the work piece

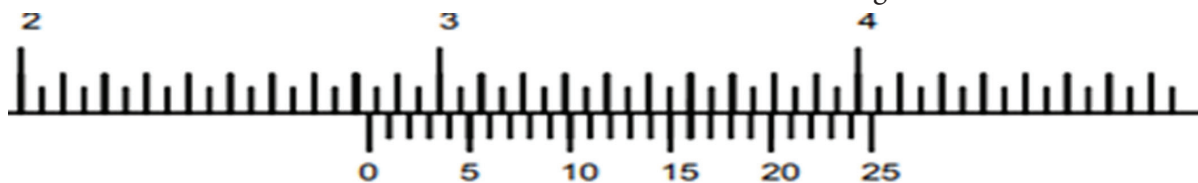
For example, as shown in the figure.

Main scale reading = 28 mm,

Vernier scale coincidence = 16 divisions

Vernier scale reading = $16 \times 0.02 = 0.32$ mm

Correct reading = $28 + 0.32 = 28.32$ mm

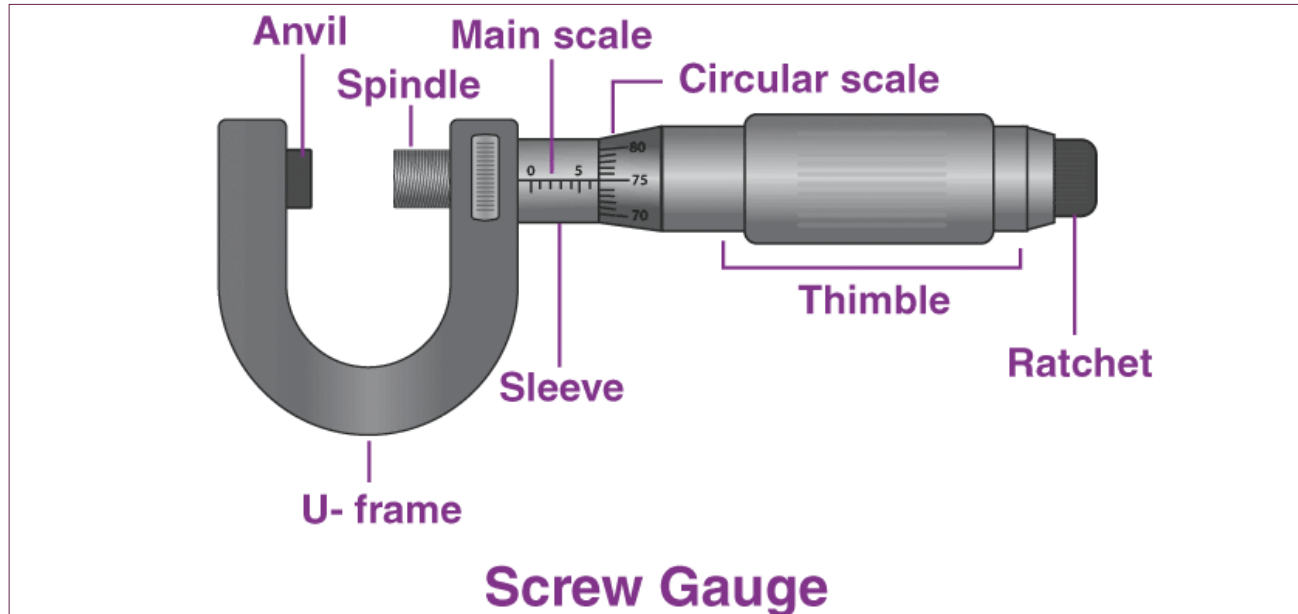


Reading = $28 + (16 \times 0.02) = 28.32$ mm

Reading of Vernier

MICROMETER

The micrometer is used to measure length, width, thickness and diameter of small and medium size components. The outside micrometer used for measuring external dimension shown in the fig.



It has a 'C' shaped frame made of steel. An anvil is fitted at the left end and a barrel is fitted at the right end of the frame. The main scale is graduated on the barrel. The barrel has a bore with threads of 0.5 mm pitch. A screw of 0.5 mm pitch passes through this bore. The spindle is fitted in the left end and the thimble is fitted at the right end of the screw.

When the thimble is rotated, the spindle moves as the screw rotates. Vernier scale is graduated in the beveled edge at the left end of the thimble. Ratchet is fitted at the right end of the thimble. The ratchet will slip when the pressure on the screw exceeds a certain limit.

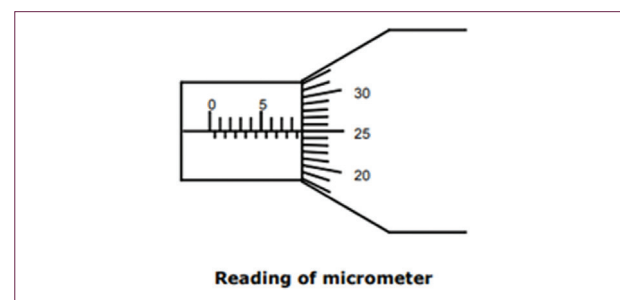
A clamp is provided at the right end of the 'C' frame. The spindle can be locked at any position by using the clamp. For measuring the dimension, the work piece is placed between the spindle and anvil. The ratchet is screwed until the spindle face touches the workpiece. Then the spindle is clamped. Main scale and Vernier scale readings are noted.

Reading

The value of one main scale division is 0.5 mm. Spindle moves 0.5 mm for one complete rotation of thimble. Thimble is divided into 50 equal divisions.

So value of one Vernier scale division = $0.5 / 50 = 0.01 \text{ mm}$

Dimension of component = Main scale reading + (Vernier scale division coinciding with the datum line x 0.01 mm)

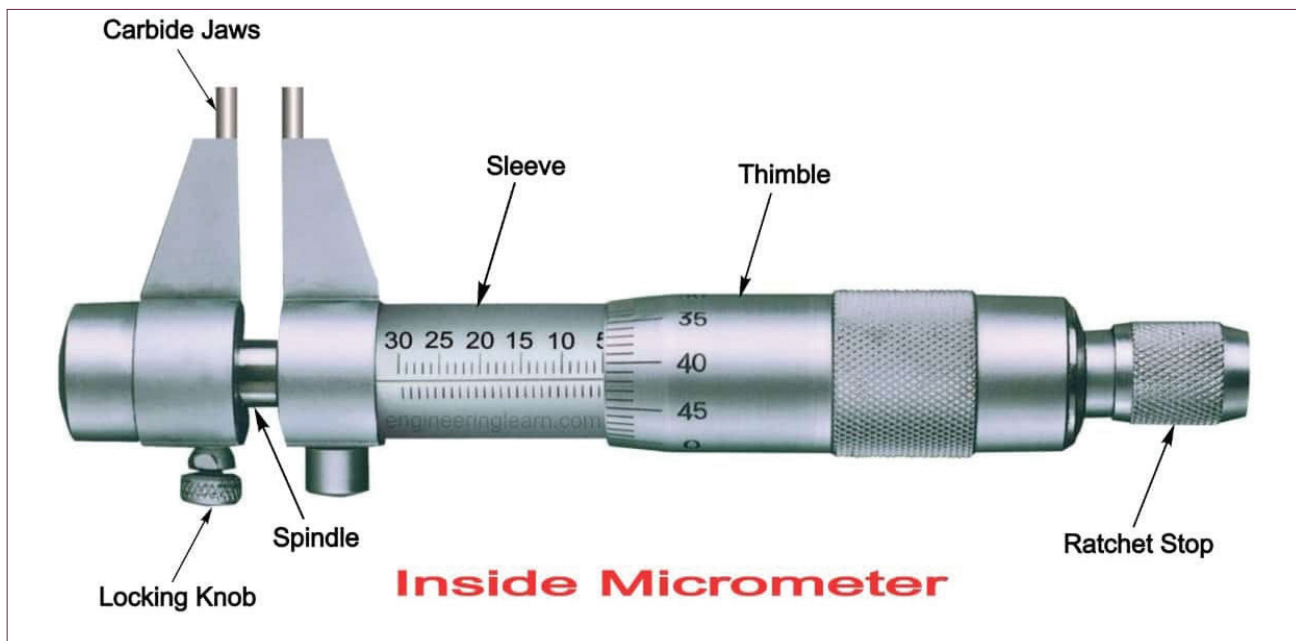


For example, as shown in the figure, Dimension of component = $8.50 + (25 \times 0.01) = 8.50 + 0.25 = 8.75 \text{ mm}$

Inside micrometer:

Inside micrometer is used to measure the inside diameter of a hole. It works on the same principle as the outside micrometer. The dimensions above 50 mm only can be measured by this instrument. It has an anvil at one end and a spindle at the other end. The spindle moves when the thimble is rotated. A long handle is provided to insert the micrometer

into the hole. The spindle can be moved to the maximum of 13 mm. So this micrometer is directly used for measuring the dimensions from 50 mm to 63 mm. For measuring larger dimensions, the anvil is removed and a suitable extension rod is fitted. The extension rods of 25, 50, 100, 150, 200 and 600 mm are available. The accuracy of this micrometer is 0.01 mm



Outside Micrometer

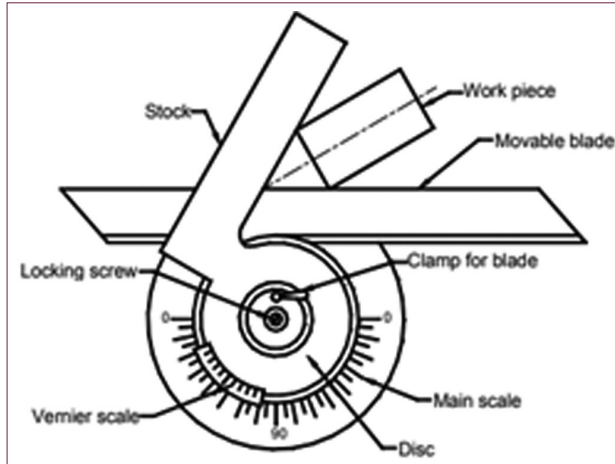
For measuring the thickness of an object, an outside micrometer is essential. Outside

micrometers look like a clamp, a moving spindle comes together with a fixed “anvil” to measure the thickness or diameter of a part.



Bevel protractor

Bevel protractor is used for measuring angle between two adjacent surfaces with an accuracy of 5 minutes. This instrument has a rectangular stock beam integral with a circular disc. This circular disc is pivoted at the centre of another circular dial. Main scale is graduated on the circular dial.



A Vernier scale is fitted to the disc. A movable blade is fitted in the groove of circular dial. This blade is suitably adjusted and clamped. A locking screw is provided to lock the circular disc with the dial. The stock can be tilted to any angle with respect to the movable blade.

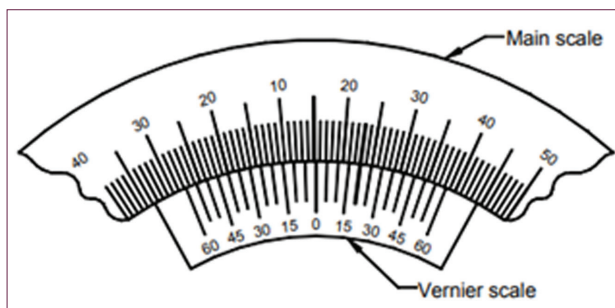
Reading

The value of one main scale division is equal to 1° . Vernier scale is divided into 12 equal parts. The value of 12 Vernier scale division is equal to 11° . So, the value of one Vernier scale division = $23^\circ/12$

Least count = 2 Main scale division – 1 vernier scale division

$$= 2^\circ - (23^\circ/12)$$

$$= 1^\circ/12 = 60 \text{ minutes}/12 = 5 \text{ minutes}$$



As shown in the figure,

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Main scale reading = 15°

Vernier scale coincidence = 4 division

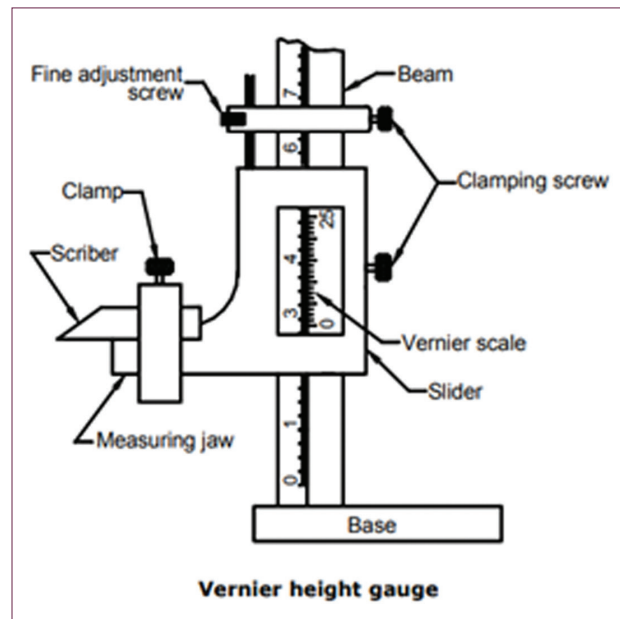
Vernier scale reading = $4 \times 5 = 20 \text{ minutes}$

Actual reading = Main scale reading + Vernier scale reading = $15 + 20 \text{ Minutes} = 15^\circ 20'$

VERNIER HEIGHT GAUGE

Vernier height gauge is used to measure the height of the work piece and to mark the specified dimension exactly on the workpiece. The accuracy of this instrument is 0.02 mm. The dimensions are measured after placing the workpiece and the height gauge on a surface plate.

It has a solid base made of steel. A vertical beam is mounted over the base. Main scale is graduated in the beam. A slider slides up and down along the beam. Vernier scale is graduated in the slider. The slider can be moved and locked in any position using a clamping screw. The slider can be adjusted accurately using a fine adjustment screw. A measuring jaw is fitted with the slider. A scriber is clamped with the measuring jaw.



For measuring the height of the workpiece, it is placed on the surface plate. The slider is adjusted so that the lower face of the slider touches the top surface of the workpiece. Then main scale and Vernier scale readings are noted. The least count of Vernier is 0.02 mm.

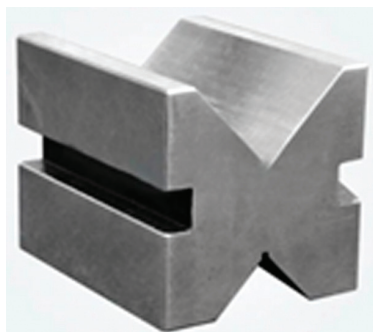
Dial gauge

Dial gauges are measuring instruments that can accurately measure minute lengths and displacements



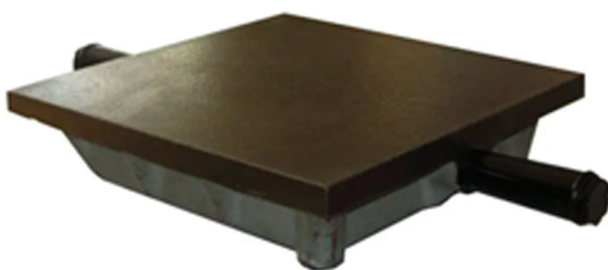
V- BLOCK

This is a rectangular block that has a “V” shaped groove on its upper surface. V-blocks are often made of hardened steel or cast iron, found in different sizes. Its surface is well-machined and grinded. A V shaped slot is made in the center with 90° angles on either side. On the remaining two sides, rectangular grooves are formed where the clamp is fixed.



SURFACE PLATE

A surface plate is a solid, flat plate used as the main horizontal reference plane for precision inspection, marking out (layout), and tooling setup. Their upper surface has a fine finish.

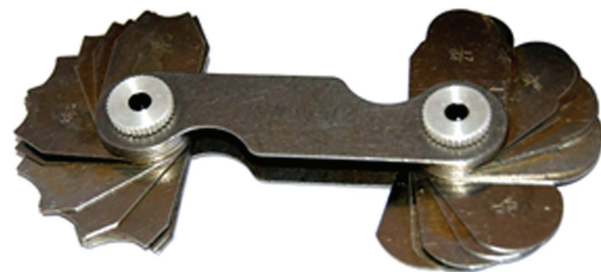


Uses of Surface Plate

1. To measure the smoothness of the job with the main surface of the surface plate.
2. To measure the right angle of a job.
3. Used to measure or mark the angle of a job with the help of a sine bar.
4. To measure a job with a Dial Test Indicator.

Radius gauge

A radius gauge is a measuring instrument for measuring the radius of a curved part. It is used to measure the dimensions of workpieces, dies and wooden patterns.

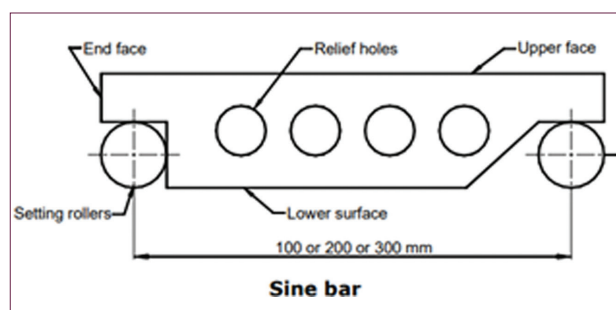


SINE BAR

Sin bar is used for measuring angles accurately. It is a rectangular beam made of steel all the surfaces of the sine bar are finished by lapping. Two rollers of equal diameter are fitted at both the ends of the sine bar. The size of the sine bar is specified by the distance between the centers of these two rollers. The size varies from 100 mm to 300 mm The line drawn between the centers of two rollers will be parallel with the top and bottom surface of the sine bar.

Types of Sine Bar

1. Sine center
2. Sine table
3. Compound sine table





1. SINE CENTER

Sine centers are used for mounting conical work pieces which cannot be held on a simple sine bar. Sine center consists of a self-contained sine bar hinged at one roller and mounted on its own datum surface. The top surface of the bar is provided with clamps and centers to hold the conical work pieces. It cannot measure the angle more than 45 degrees.

2. SINE TABLE

A sine table or sine plate is a large and wide sine bar. It is equipped with a mechanism for locking it in place after positioning. It is used to hold work pieces during measurement.

3. COMPOUND SINE TABLE

It is used to measure compound angles of large work pieces. In this case two sine tables are mounted one over the other at right angles. The tables can be twisted to get the required alignment.

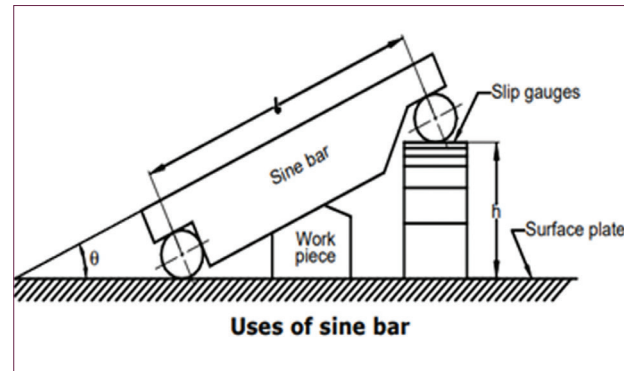
Use of Sine Bar

Measure the angle of the tapered surface.

The figure shows an arrangement for measuring the angle of the tapered surface of a workpiece by using the sine bar and slip gauges.

The workpiece is placed on a surface plate. The bottom surface of the sine bar is placed over the tapered surface of the workpiece. One roller of the sine bar rests on the surface plate. Slip gauges are

built up between the other roller and the surface plate. The slip gauges are built up so that there is no gap between the sine bar and workpiece surface the total height of slip gauge is added.



From the figure,

$$\text{Length of sine bar} = l$$

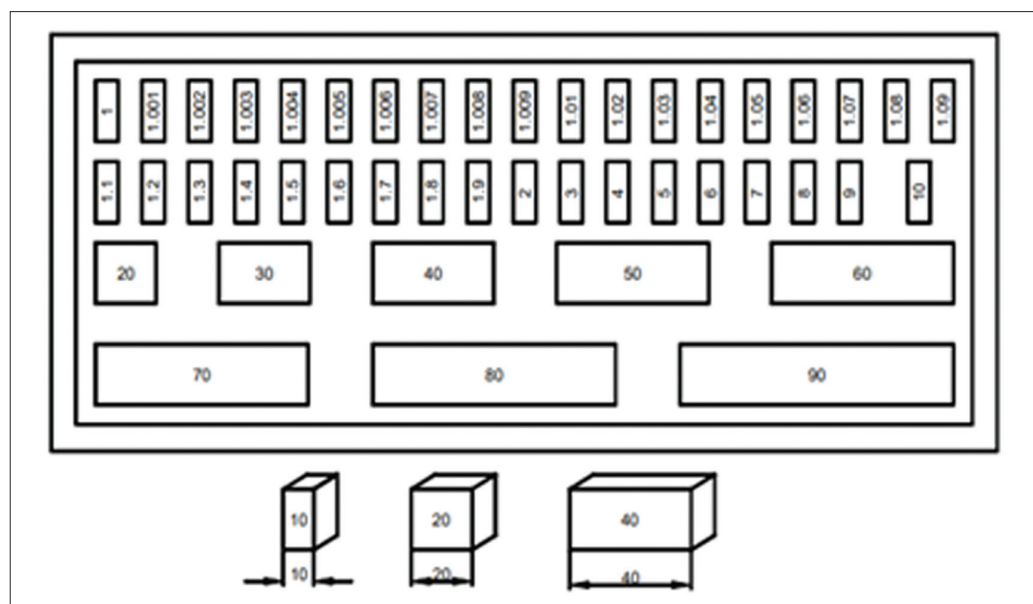
$$\text{Height of slip gauge block} = h$$

$$\sin \theta = h/l$$

By using the above formula, the taper angle θ can be calculated.

Setting up a known angle.

From the sine principle $\sin \theta = h/l$ the height h can be calculated by knowing the values θ and l . One of the roller of the sine bar is placed on the surface plate. The other roller is placed on the slip gauges of height h . Now the sine bar is inclined at an angle of θ . Thus a workpiece can be set to any required angle.



SLIP GAUGE

Slip gauges are precision gauge blocks used for measuring linear dimension; they are in the shape of cuboids. They are made of hardened alloy steel and the surface is finished by lapping. They have various thickness. The length of all slip gauges are the same and the width of all slip gauges are the same.

One or more slip gauges are used to build up the required dimension. Slip gauges are placed one over another and combined by wringing. The two gauges will stick together due to the adhesion between the two highly finished surfaces.

A normal set of slip gauges has 45 pieces. The thickness of gauge blocks will be from 1 mm to 90 mm. The size of each block is marked on it. Different sets of slip gauges having 27, 33, 87, 112 and 165 pieces are available.

Requirements of slip gauges

The following are the basic requirements of slip gauges:

1. The end faces of the gauges must be flat and parallel to each other.
2. All the adjacent faces must be perfectly square to each other.
3. They must possess a high degree of surface finish.
4. The actual size must be within tolerances.
5. The edges must be deburred.

Indian standard on slip gauges (IS:2984-1966)

Slip gauges are graded according to their accuracy as Grade 0, Grade I & Grade II.

- Grade II is intended for use in workshops during actual production of components, tools and gauges.
- Grade I is of higher accuracy for use in inspection departments.
- Grade 0 is used in laboratories and standard rooms for periodic calibration of Grade I and Grade II gauges.

M-87 set of slip gauges:

Range	Steps	No. of pieces
1.001 to 1.009	0.001	9
1.01 to 1.49	0.01	49
0.5 to 9.5	0.5	19
10 to 90	10	9
1.0005	--	1
Total		87

M-112 set of slip gauges:

Range	Steps	No. of pieces
1.001 to 1.009	0.001	9
1.01 to 1.49	0.01	49
0.5 to 24.5	0.5	49
25, 50, 75, 100	25	4
1.0005	--	1
Total		112

Care of slip gauges

The following care should be taken for slip gauges to maintain their accuracy for a long period.

1. The gauges should not be left in the wrung condition when not in use.
2. Before the use of slip gauges, they must be properly cleaned to remove dust and grease traces.
3. The slip gauges should be kept in their case when not in use.
4. Do not break the wring after use. Slide one gauge over the other to separate them.
5. Slip gauges should be used in an atmosphere free from dust.
6. The blocks are not to be used again immediately after separating them.
7. A thin layer of good quality grease should be applied on their faces before they are kept in their case.

Uses of slip gauges

The following are the uses of slip gauges :

1. Slip gauges are used in the metrology laboratory, tool room and machine shop for the calibration of precision measuring instruments.



2. Slip gauges are used in setting sine bars for establishing angles.
3. They are used to set other measuring instruments such as snap gauges.
4. They are used to check comparators and optical inspection devices.
5. They are used as auxiliary measuring systems on milling machines.

FEELER GAUGE

A feeler gauge is a tool used to measure gap widths. Feeler gauges are mostly used in engineering to measure the clearance between two parts.



Description

They consist of a number of small lengths of steel of different thicknesses with measurements marked on each piece. They are flexible enough that, even if they are all on the same hinge, several can be stacked together to gauge intermediate values. It is common to have two sets: one for imperial units (typically measured in thousandths of an inch), and one for metric (typically measured in hundredths of a millimetre) measurements (with intervals of thousandths of an inch and hundredths of a millimetre being roughly in the same order of magnitude).

The same device with wires of specific diameter instead of flat blades is used to set the gap in spark plugs to the correct size; this is done by increasing or decreasing the gap until the gauge of the correct size just fits inside the gap.

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The lengths of steel are sometimes called leaves or blades, although they have no sharp edge.

Stainless steel is a common material for feeler gauges. Some feeler gauge sets have a single blade of brass due to the historical reason that early electronic ignition systems required the air gap between the reluctor and the pickup part being set with a non-ferrous metal.

WIRE GAUGE

For every electrical need in your house, it is essential to install cables that pass an electrical inspection. These cables will ensure an electrical connection that carries power guardedly. Maintaining high-quality during selection will guarantee a competent circuit system throughout the residence.

Wire Vs. Cable

Typically both wires and cables are the same, The only difference being, the wire is an electrical conductor, while a cable is a group of conductors enclosed in a guarded covering. There are regulations regarding which wires and cables suit specific electrical applications and their precise installation methods.

How are wires sized, and what is an electrical wire gauge?

While different wires serve specific purposes, knowing the right wire size, also known as the gauge, will aid your electrical. The measurements determine the amount of current that can safely pass through the wire without generating damages. In addition to this, each wire gauge size has a safe Ampacity, which is a measure of electrical current.

What is Wire Gauge?

Wire gauge refers to the physical size and current carrying capacity of the wire. A fixed numerical designation is given to it that is inversely proportional to the diameter of the conductors. In simple terms, if the wire gauge number is small, it will have a larger diameter. It is vital to know the sizes in the cable to ensure it carries an appropriate amount of current securely. The gauge rank also determines the resistance of the wire and its weight per unit length.



Is it ‘Gauge’ or ‘AWG’?

Both Gauge and AWG are ideally the same. When writing, we call it a gauge for clear understanding. AWG measurements do not consider the insulation of the conductor. The higher the AWG number, the smaller the conductor.

Wire Gauge Chart

American Wire Gauge (AWG) standards range from 0000 (which can handle up to 302 amps) to 40 (which can handle up to 0.0137 amps). Most household and commercial wiring demands range from 2 (95 amp maximum) or 3 (85 amp maximum) to 14 (15 amp maximum).

Check the table below for the AWG wire size chart

American Wire Gauge (AWG)	Diameter (inches)	Diameter (mm)	Cross Sectional Area (mm ²)
0000	0.46	11.68	107.16
000	0.4096	10.4	84.97
00	0.3648	9.27	67.4
0	0.3249	8.25	53.46
1	0.2893	7.35	42.39
2	0.2576	6.54	33.61
3	0.2294	5.83	26.65
4	0.2043	5.19	21.14
5	0.1819	4.62	16.76
6	0.162	4.11	13.29
7	0.1443	3.67	10.55
8	0.1285	3.26	8.36
9	0.1144	2.91	6.63
10	0.1019	2.59	5.26
11	0.0907	2.3	4.17



American Wire Gauge (AWG)	Diameter (inches)	Diameter (mm)	Cross Sectional Area (mm ²)
12	0.0808	2.05	3.31
13	0.072	1.83	2.63
14	0.0641	1.63	2.08
15	0.0571	1.45	1.65
16	0.0508	1.29	1.31
17	0.0453	1.15	1.04
18	0.0403	1.02	0.82
19	0.0359	0.91	0.65
20	0.032	0.81	0.52
21	0.0285	0.72	0.41
22	0.0254	0.65	0.33
23	0.0226	0.57	0.26
24	0.0201	0.51	0.2
25	0.0179	0.45	0.16
26	0.0159	0.4	0.13

Common AWG Gauge sizes

Wire gauges come in a set of standard sizes you can choose from, depending on the amount of current you want it to carry, and the purpose it is going to serve. Common AWG Gauge sizes are:

1. 14-gauge wire.
2. 12-gauge wire.
3. 10-gauge wire.
4. 8- gauge wire.
5. 6-gauge wire.
6. 2-gauge wire.

Importance of electrical wire gauge

Given that a cable's gauge indicates the thickness of the conductor that carries the electron flow, the conductor also has to suppress resistance and support an improved transmission.

Knowing the gauge of wire allows industry professionals and homeowners to quickly and easily determine whether it is appropriate for a specific application.

A gauge helps users to know the current-carrying capacity of the solid, electrically conducting cables by using the cross-sectional area of the wire as a defining aspect.

Choosing Electrical Wire Size

You may determine the gauge based on the helpful pointers below assigned according to Wire Use-Rated capacity:

- 18-gauge are used for low-voltage lighting and lamp cords in 10 amps.
- 16-gauge are used for light-duty extension cords supporting 13 amps.
- 14-gauge are used for light fixtures, lamps, lighting circuits with 15 amps.
- 12-gauge are used in kitchen, bathroom, outdoor receptacles, and 120-volt air conditioners supporting 20 amps.
- 10-gauge are used in electric clothes dryers, 240-volt window air conditioners, electric water heaters supporting 30 amps.
- 6-gauge are used for cook tops and ranges carrying 40-50 amps.
- 4-gauge are used for electric furnaces and large electric heaters protected at 60 amps.

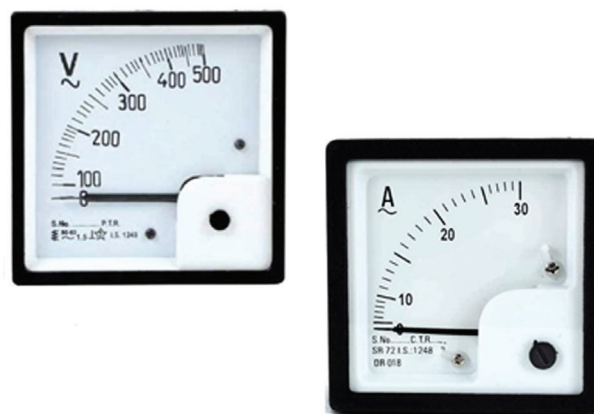
VOLTMETER

Voltmeter is an instrument that measures voltages of either direct or alternating electric voltage on a scale usually graduated in volts, millivolts (0.001 volt), or kilovolts (1,000 volts). Many voltmeters are digital, giving readings as numerical displays. The instruments just described can also provide readings in analogue form, by moving a pointer that indicates voltage on a scale, but digital voltmeters generally have a higher order of accuracy than analogue instruments.

For example, a common analogue voltmeter is likely to employ an electromechanical mechanism in which current flowing through turns of wire is translated into a reading of voltage. Other types of voltmeters include the electrostatic voltmeter, which uses electrostatic forces and, thus, is the only voltmeter to measure voltage directly rather than by the effect of current. The potentiometer operates by comparing the voltage to be measured

with known voltage; it is used to measure very low voltages. The electronic voltmeter uses amplification or rectification (or both) to measure either alternating- or direct-current voltages. The current needed to actuate the meter movement is not taken from the circuit being measured; hence, this type of instrument does not introduce errors of circuit loading.

An instrument that also measures ohms and amperes (in milliamperes) is known as a multimeter or sometimes as a volt-ohm-milliammeter (VOM).



AMMETER

Ammeter is an instrument for measuring either direct (DC) or alternating (AC) electric current, in amperes. An ammeter can measure a wide range of current values because at high values only a small portion of the current is directed through the meter mechanism; a shunt in parallel with the meter carries the major portion. In circuit diagrams, the symbol for an ammeter is a circle with a capital A inside.

Ammeters vary in their operating principles and accuracies. The D'Arsonval-movement ammeter measures direct current flowing through a coil suspended between the poles of a magnet with accuracies of from 0.1 to 2.0 percent. The electrodynamic ammeter uses a moving coil rotating in the field produced by a fixed coil. It measures direct and alternating current (by using a rectifier to convert the AC to DC) with accuracies of 0.1 to 0.25 percent. In the thermal (or hot-wire) ammeter, used primarily to measure AC with

accuracies of 0.5 to 3 percent, the measured current heats a piece of wire, and the current is indicated by how much the wire expands.

Digital ammeters, with no moving parts, use a circuit such as the dual slope integrator to convert a measured analog (continuous) current to its digital equivalent. Many digital ammeters have accuracies better than 0.1 percent.

MULTIMETER

A digital multimeter is a test tool used to measure two or more electrical values—principally voltage (volts), current (amps) and resistance (ohms). It is a standard diagnostic tool for technicians in the electrical/electronic industries.

Digital multimeters long ago replaced needle-based analog meters due to their ability to measure with greater accuracy, reliability and increased impedance.

How to use a Multimeter

Digital multimeters combine the testing capabilities of single-task meters—the voltmeter (for measuring volts), ammeter (amps) and ohmmeter (ohms). Often, they include several additional specialized features or advanced options. Technicians with specific needs, therefore, can seek out a model targeted to meet their needs.

The face of a multimeter typically includes four components:

- **Display:** Where measurement readouts can be viewed.
- **Buttons:** For selecting various functions; the options vary by model.
- **Dial (or rotary switch):** For selecting primary measurement values (volts, amps, ohms).
- **Input jacks:** Where test leads are inserted.

Test leads are flexible, insulated wires (red for positive, black for negative) that plug into the DMM. They serve as the conductor from the item being tested to the multimeter. The probe tips on



each lead are used for testing circuits.

The terms counts and digits are used to describe a digital multimeter's resolution—how fine a measurement a meter can make. By knowing a multimeter's resolution, a technician can determine if it is possible to see a small change in a measured signal.

Example: If a multimeter offers a resolution of 1 mV on the 4 V range, it is possible to see a change of 1 mV (1/1000th of a volt) while reading 1V.

Digital multimeters are typically grouped by their number of counts (up to 20,000) they display.

Broadly speaking, multimeters fall into one of a handful of categories:

- General purpose (aka Testers)
- Standard
- Advanced
- Compact
- Wireless

Multimeter safety

Each application with a digital multimeter presents potential safety hazards that must be considered when taking electrical measurements. Before using any electrical test equipment, people should always first refer to the user's manual for proper operating procedures, safety precautions, and limits.



UNIT IV

BASIC TOOLS

(3 Periods)

Types of work holding devices.

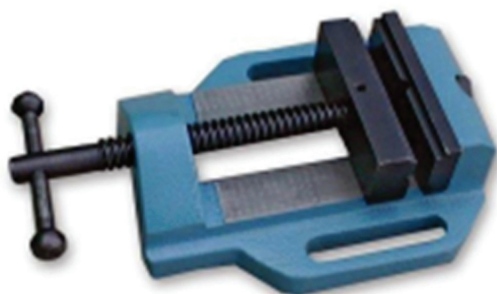
Various types of work holding devices are explained in the following paragraphs.

T- Bolts and clamps: Bulky work pieces of irregular shapes are clamped directly on the milling machine table by using T- bolts and clamps. Different types of clamps are used for different patterns of work.

All these clamps carry a long hole, through which clamping bolts pass. This hole permits the bolts for adjustment according to the size and shape of the job.

Angle plates: When work surfaces are to be milled at right angles to another face, angle plates are used for supporting the work.

Plain Vice: The plain vice is directly bolted on the milling machine table is the most common type of vice used on plain milling operations, which involves heavy cuts, such as in slab milling. Its especially low construction enables the work to remain quite close to the table. This reduces the chance of vibration to minimum. The base carries slots to accommodate 'T' bolts to fix the vice on the table. Work is clamped between the fixed and movable jaw and for holding work pieces of irregular shape special jaws are sometimes used.



Swivel Vice: The swivel vice is used to mill an angular surface in relation to a straight surface without removing the work from the vice. It has got circular base graduated in degrees. The base is clamped on the table by means of T- bolts.



Universal Vice: It can be swiveled in a horizontal plane similar to a swivel vice and can also be tilted in any vertical position for angular cut. The vice is not rigid in construction and is used mainly in tool room work. It enables the milling of various surfaces, at an inclination to one another, without removing the work piece.

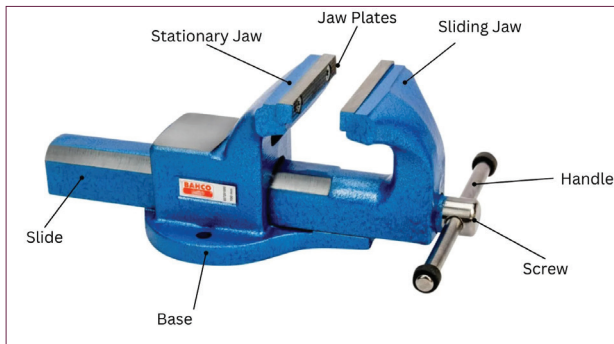


Bench Vice

The most commonly used in the engineer's parallel join bench coach screws or with nuts and bolts. The vice essentially consists of a cast iron body, a fixed jaw, both made of cast steel, a handle, a square headed screw, and a nut all made of mild steel. Separate cast iron plates known as jaw plates are fixed to the jaws by means of set screws.

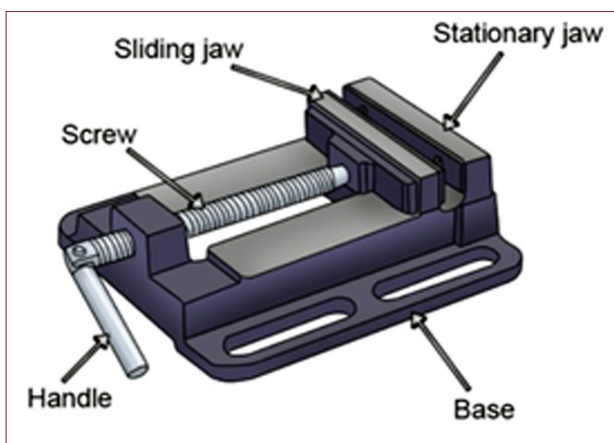


Protective grips or clamps which can be made of lead, fibre-tin plate, etc. are usually fitted over the jaws. The width suitable for common work varies from 80 to 140 mm the maximum opening being 95- 180 mm.



Machine vice

Machine vices are employed on machine tools like milling machines, drilling machines and surface grinding machines, to hold the workpiece securely in position for machining. The machine vice is located either parallel or square to the T-slot of the machine table by means of a pair of tenons, fixed in the tenon-slot of the machine vice base, and then clamped to the table by means of T-bolts and nuts.



Fixture

- A fixture is a device used to “fix” (constrain all degrees of freedom) a workpiece in a given coordinate system relative to the cutting tool.
- Primary functions of a fixture:

Location: To accurately position and orient a part relative to the cutting tool.

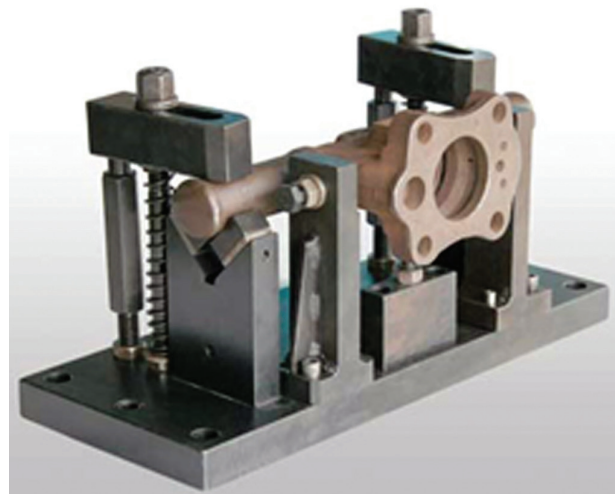
Support: To increase the stiffness of compliant regions of a part.

Clamping: To rigidly clamp the workpiece in its desired location (relative to the cutting tool).

- Fixtures routinely used in machining, welding, and manual/robotic assembly operations.

Types of fixtures:

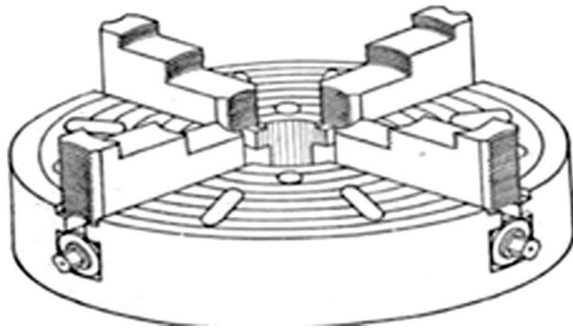
- General purpose: Mechanical vice, lathe chucks.
- Permanent/Dedicated: Specially designed to hold one part for a limited number of operations; commonly used in high volume production.
- Flexible/Reconfigurable: can be used for more than one part and for multiple operations e.g. modular fixtures, pin array, phase change, etc.



TOOL HOLDING DEVICES

Holding Devices

When cutting operations are performed on the machine, lots of forces are generated. To balance these forces the work and the tool have to be held rigidly so that during cutting operation there should not be any vibration or jerk. The tool is held rigidly in the tool post with the help of bolts. The work is held in the various types of work holding devices like three jaw chuck, four jaw chuck, combination



3-Jaw
Chuck



6-Jaw
Chuck

chuck, magnetic chuck, hydraulic chuck, face plate, driving plate, angle plate and lathe carriers.

Types of Work Holding Devices The following are the various work holding devices used on lathe machine:

Chuck

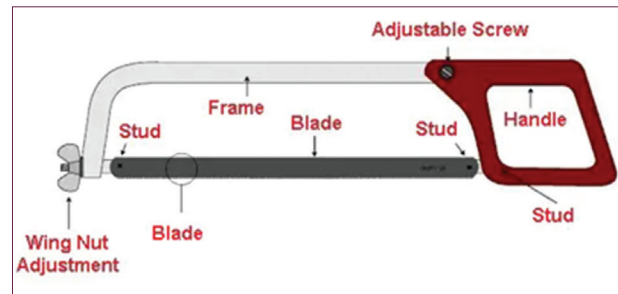
Chucks are used for holding the work on the lathe during the operation. The most common types of chucks are:

- (a) **Three jaw chuck:** It is also known as three jaw self centering chuck. It consists of a cylindrical body having three jaws fixed radially at its front. All the jaws move in the radial direction simultaneously.
- (b) **Four jaw chuck:** All the jaws can be moved separately and adjusted at desired distance from the centre of the chuck. Due to this it is also known as independent jaw chuck. This enables the chuck to successfully hold irregular or eccentric jobs in addition to the regular cylindrical shaped jobs.
- (c) **Magnetic chuck:** It holds the job by magnetic force.
- (d) **Combination chuck:** As the name implies, a combination chuck may be used as a self centering or as an independent chuck to take the advantages of both types. The jaws may be operated individually by separate screws or simultaneously by the scroll disc.
- (e) **Collet chuck:** It fits into the spindle nose of the headstock. It can be used on a centre lathe, Capstan lathe, or turret lathe for producing items from bar stock. It is constructed with a hollow body having internal threads for screwing on the spindle nose.

HACKSAW FRAME

Following are the main two parts of a hacksaw:

1. Hacksaw frame
2. Hacksaw blade
3. Adjustable screw
4. Adjustable wingnut
5. Stud
6. Handle



In shape, it looks like the English letter “C”. On one end of these arms, a handle is fixed and on the other end, a pin is fixed. A pin at each end is the fixed handle and sliding screw itself in which hacksaw blade is fitted. A hacksaw blade is fitted on these pins and then it is tightened according to need with fly nut or wing nut. Mainly hacksaw frames are of two types.

Types of Hacksaw Frame

Following are the main two types of hacksaw frame:

1. Fixed Hacksaw Frame
2. Adjustable Hacksaw

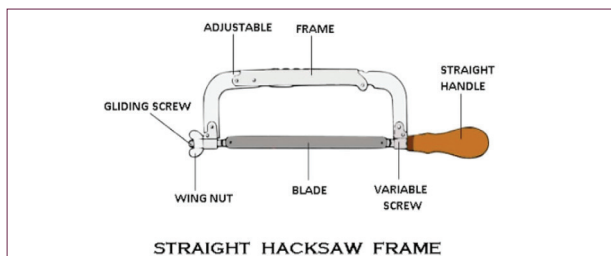
Fixed Hacksaw Frame

For making this type of hacksaw frame, one-piece flat iron strip or pipe is bent at a right angle. In these types of hacksaw frame, only hacksaw blades of a specific size can be fixed, not of the short size or long size.



Adjustable Hacksaw

In these types of hacksaw frames, Its structure is a bit different from a fixed frame. The frame is made in two parts. These parts can be adjusted at different distances. Therefore in this adjustable hacksaw, big and small hacksaw blades of a different standard can be used.

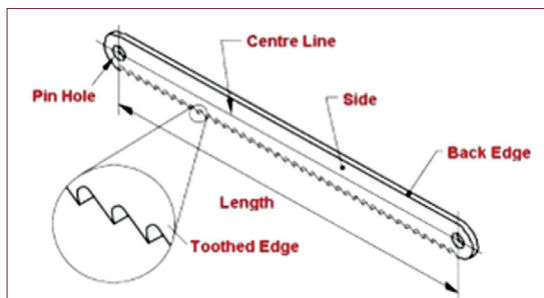


Hacksaw Blade

On the basis of metal of the job, different types of hacksaw blades are used in a hacksaw. These are made of tungsten steel, high-speed steel and they are hardened and tempered. Their classification depends on three points:

1. Size of the blade.
2. The number of dents cut on the blade per inch.
3. Nature of the blade.

Length of hacksaw blade is generally 8", 10" or 12". Dents of four different grades are cut on them.



Types of Hacksaw Blades

Following are the main **types of hacksaw blades**:

1. Coarse Grade Hacksaw Blade
2. Medium Grade Hacksaw Blade
3. Fine Grade Hacksaw Blade
4. Superfine Grade Hacksaw Blade
5. All Hard Blade

DRILL CHUCK

A drill chuck is a type of clamp used to hold bits and other drilling implements. Chucks are used to hold tools that are roughly cylindrical in shape. On a drill, the chuck attaches to the mandrel. Different drill bits can be inserted into the chuck, allowing the same base tool to be used for many different purposes.



SLEEVE

These are used to reduce the spindle or adapter internal taper to receive smaller tapered shank tools.



FITTING TOOLS

FILES

A file is used to cut, trim or finish a job of metal or wood, in order to give them a shape according to our needs such as making the job round, square or angular. File is made from high carbon steel.

The file is a hard steel instrument with numerous cutting points. Metal is cut in small or tiny particles with the help of a file. Therefore, mostly a file is used for giving final finishing touches to a job of metal or wood.

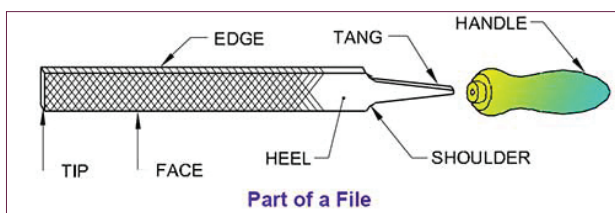
After chipping a job of metal generally becomes rough and a file is used to make it smooth. In case of a machine, the part is larger in size than the required size, a file is used to make it suitable.

In addition, a file is used where other cutting tools cannot be used. Files are also used for sharpening the edge of some other cutting tools.

Parts of a File

It has the following main parts of a file:

1. Handle
2. Tang
3. Heel
4. Face
5. Edge
6. Tip or Point



A wooden handle is fitted on its tang. Teeth are cut on its face and edge so that it can perform the job of cutting. The part having no teeth is called as heel. Thick side of file is called edge and its lower end is known as tip or point.

Types of Files

While making a selection of files for a specific job, some important points should be considered.

The files can be classified into the following categories:

1. On the basis of length
 1. Flat file
 2. Round file
 3. Half-round file
 4. Triangular file
 5. Square file
 6. Hand file
 7. Knife file
3. In the basis of grades
 1. Rough File
 2. Bastard File
 3. Second cut File
 4. Smooth File
 5. Dead Smooth File
4. On the basis of cut
 1. Single Cut File
 2. Double Cut File
 3. Curved Cut File
 4. Spiral Cut File
 5. Rasp Cut File

1. Classification According to Length

A file is measured according to its length. This length includes whole file except its tang portion i.e. length from heel to tip is the measurement of the file. In fitter trade, file of 100 mm to 450 mm length are used.



2. Classification According to Shape

Following are the different types of file tools according to its shape:

1. Flat File

This file is of rectangular cross-section in shape. It is made slightly tapered both in width and thickness. Double cut teeth are cut on the face and simple-cut teeth are cut on the edge. These are used to reduce flat surfaces by filing or finishing.



2. Round File

This type of file has a round section. It is used for rubbing or finishing keyhole of small diameter.



3. Half-round File

It is a file which is on the side and curved on the other side. Double cut dents are cut on it and like a round file, it is also tapered. With this file, the damaged hole can be set in order again.



3. Triangular File

It is triangular in shape. Its angles are of 60°. Filing of “V” slots job, square and rectangular jobs of above 60° and below 90° angle are done with this file. It is also known as three square files.



4. Square File

It is square in shape and is somewhat tapered. Filing of rectangular, square groove, slots and key-way is done with this file.



5. Hand File

This file is almost similar to the flat file. It is used for filing of internal right angle side of a job. It is also called safe edge file.



6. Knife Edge File

Its shape is like the edge of a knife. Its thin edge is about 10° angle. It is used for filing small grooves and slots whose angle is less than 60°. It is generally used in the lock industry for making keys.



PUNCH

A punch is a tool used to indent or create a hole through a hard surface. They usually consist of a hard metal rod with a narrow tip at one end and a broad flat “butt” at the other.

When used, the narrower end is pointed against a target surface and the broad end is then struck with a hammer or mallet, causing the blunt force of the blow to be transmitted down the rod body and focused more sharply onto a small area.

A punch tool is a small and narrow piece metal rod featuring a sharp point. A punch tool features a sharp point at the end. The other end of the punch tool features a larger and blunter tip.

There are several types of punch tools, most of them use this otherwise basic design. They require the use of a separate tool, such as a hammer or mallet, to “punch” a workpiece.



Mechanical engineering workshops extensively use various types of punches. A few of the basic types include center punch, prick punch, pin punch, and drift punch.

Workshops use punches for locating centers for drawing circles, punch holes in sheet metals, start holes for drilling, remove damaged rivets, bolts, or pins, and transfer the location of holes in patterns. Some punches used are hollow.

Major types of punches:

- Centre punch
- Prick punch
- Hollow punch
- Dot punch
- Letter punch

Centre Punch

A center punch is used to mark the center of a point. It is usually used to mark the center of a hole when drilling holes. A drill has the tendency to “wander” if it does not start in a recess. A center punch forms a large enough dimple to “guide” the tip of the drill.

The tip of a center punch has an angle between 60 and 90 degrees. When drilling larger holes, where the drill bit is wider than the indentation produced by a center punch, the drilling of a pilot hole is usually needed.



Prick Punch

A prick punch is similar to a center punch but used for marking out. It has a sharper angled tip to produce a narrower and deeper indentation. The indentation can then be enlarged with a center punch for drilling.

The tip of a prick punch is 40 degrees (the angle depends on what type of prick punch one is using). It is also known as a dot punch. This is also made of high carbon steel; prick punch is also made hard and tempered.



Dot Punch

The dot punch is similar to a center punch but typically thinner, lighter, and having a sharper tip, used for marking the center of a hole that is to be drilled, or (more generally) for making an indentation in the surface of an object. However, it is more accurate as the dot produced is smaller.

Both the center and dot punches are used in the same way. A ball pein hammer is used to tap the head of the punch and this delivers enough force to the point of the punch to put a small indentation into the surface of the material.



Letter Punch

Also known as letter stamps or number stamps, letter punches are used to emboss the impression of a letter or number into a workpiece. They are most common in the reverse image, this allows the end result to be immediately readable, however, they may be made as a positive image.

This is essential in the case of die or mold making and ensures that the finished product will be readable, as a die is a negative image.



HAMMER

Hammer is a very useful tool. It is used to beat or striking blows on jobs or metals or jobs driving nails etc. It is used to straighten or bend a job made of metal. In addition, it is also used for riveting, chipping, and forging jobs.

Types of Hammers

Based on their utility the hand hammers are of several types.

- Hand hammer
- Ball Peen hammer
- Sledge hammer
- Claw hammer

Hand Hammer

These hammers are made of cast steel of carbon steel. Their pan and face are hardened and tempered. The middle body is kept soft. On one end of the body, face and pan are made.



Ball Peen Hammer

These types of hammers are most widely used in the workshops. On one end of this ball peen hammer, a plain face is made and on the other end, a pane of 3/4 like a round ball is made.



It is used for setting the rivet. It is also used to strike blows on a metal sheet up to a certain depth. This types of hammers has been shown in the figure. Its weight is between 0. 11 to 0.91 kg.

Sledge Hammer

These are mostly used in blacksmithy for straightening round rods, iron bars, angle iron, channel, or flat iron.

Its shape is similar to a double face hammer. These are used for heavy jobs their weight is more. Their weight is from 4 Kg to 10 Kg. It has been illustrated in the figure.



4. Claw Hammer

These are special types of hammers. On one end of this hammer, a round face is made and on the other end, its pane is inclined towards the handle.

In its center, a slot is cut, with whose help nails, etc. Can be easily extracted (taken out). This hammer generally used by the carpenters in the carpentry trade. It has been shown in the figure.



SCRIBER

It is a widely used workshop or fitting shop to help mark a line on a material. A scriber is generally made of steel or carbon steel wire of 3 mm to 5 mm, whose one end is straight and the other is bent at about 90° angles.



It is used along with engineer square, steel rule, and straight gauge. A scribe should always be slanted in the direction of the movement, and the steel rule must be moved with the appropriate pressure. Its length varies from 150mm to 300mm.

Both ends of the scribe are pointed. If it is not in use, a cork or cloth should be placed so that its point does not hurt our fingers.



CHISEL

Chisel is used to cut flat, round or angle iron and thick metal sheets. It is also used to remove the unwanted metal from the surface of a job by cutting it in bits and small pieces. This act is known as chipping.

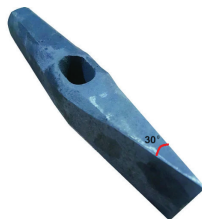
The cutting done by a chisel is rough. Therefore, there is need for finishing after chipping done by the chisel. It saves time. Chisels are used both on hot and cold metals. As such chisels have been divided into two categories.

Classifications of Chisel

1. Hot chisel
2. Cold Chisel

1. Hot Chisel

Hot chisel is used for cutting hot metals in blacksmith's workshop. There is a hole in a chisel in which a wooden handle is fixed. Their cutting edge is made at an angle of 30° . While using this part, it is frequently dipped into water for making it cold so that its edges remain intact.



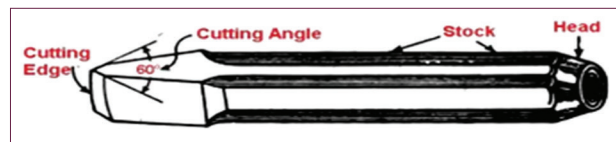
2. Cold Chisel

Cold chisels are generally used in sheet metal and fitter trade workshops. With cold chisel cutting or chipping of metal can be done when these metals are in cold condition.

Parts of a Chisel

Following are the different parts of a chisel:

1. Head
2. Body
3. Forging angle
4. Cutting edge
5. Cutting angle



DRILL BIT

In order to bore round holes in different jobs, drill and drill machines are used. The tool used for the making hole is called a drill. The machine with whose help the drill is moved is called a drill machine. The process of making holes with drill and drill machines is called drilling.

A drill bit is a cutting tool used to originate or enlarge a hole in solid metal. These are typically used with a manual operated drill or drill press provided with a chuck. In these machines use a key to tighten or loosen the drill bit.

Material Used in Drill Bit

The materials for the manufacturing of twist drills are as follows:

1. One-piece construction: High-speed steel or carbon steel.
2. Two-piece construction:
 1. Cutting portion - high-speed steel.
 2. Shank portion - Carbon steel.

High-speed drills are widely used due to their greater cutting efficiency. Cemented carbide tipped drills are also used in mass production work.



TYPES OF DRILL BITS

Following are the main types of drill bits:

- Flat drill
- Straight fluted drill
- Twist drill
- Centre drill
- Countersinking drill
- Counter boring drill
- Masonry Drill

Flat Drill



This type of drill is generally made by beating slender sticks of high carbon steel. Its cutting edge is ground and then hardened and tempered. It can be made easily in any shape or size. These are made in different sizes after forging them. These drills are very cheap.

It is not used for boring holes in iron. It is usually used for boring holes in carpentry work and soft metals. The cutting point is kept at a 90° angle. On those solid metals where other drills get broken, this drill can be used after properly hardening and temping.

Straight Fluted Drill

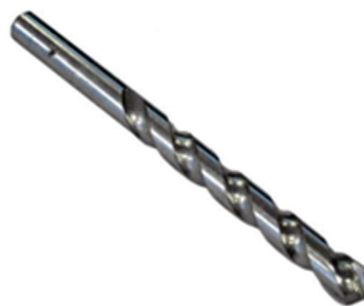


A straight fluted drill has grooves or flutes running parallel to the drill axis. A straight fluted

drill may be considered as a cutting tool having zero rakes. This type of drill is inconvenient in standard practice as the chips do not come out from the hole automatically.

They are essentially used in drilling brass, copper, or other softer materials. In drilling brass, the twist moves faster than the rate of the drill feed, and the drill digs into the metal. No such difficulty occurs in the use of a straight fluted drill.

Twist Drill Bit



Nowadays, twist and thick drills are used for boring holes quickly, clean, and of accurate size. These are often made of slender sticks of high-speed steel and alloy steel.

Then cutting edge is made on the bottom end and a twisted groove is cut on its body from top to bottom which is known as a flute. Because of the twisted flute, it is called a twist drill. It contains the main parts such as tang, shank, body, point, and neck.

Centre Drill



It is also known as a combination drill. On both its ends a cutting point is made and its middle portion is plain. Drilling and countersinking can be performed simultaneously with this drill. It is used for fastening the lengthy job from centre to centre on the lathe machines and also to do centre drill in a rod. It has been shown in the figure.



Counter Sinking Drill



At places where counter head screws are to be fitted, after making holes with a drill, countersinking is done with this drill. In this way, the head job of the screw fits well.

This is a multi-fluted drill in which four flutes are cut. Its cutting point is grinded at 60° or 82° . In the figure, this type of drill and a screw fitted in a hole bored by it has been shown.

Counter Boring Drill



When Allen screws are fitted, counterboring is done with this drill. These types of screws are also fitted like the counter screw on the surface of the job. It is used to enlarge a hole. Boring in a hole is done from the upper side up to the height of the screw head.

For fitting this type of screw the surface of the job remains similar to the plain surface. The screw heads do not pose any hindrance in their functioning.

A noteworthy point is that in countersinking the holes cut slanting at 60° or 82° angle from the top whereas in counterboring the hole is made deeper in the increased size up to the height of the screw head.

The drill used for counterboring is also called a counterboring cutter. A pilot is built on its lower side. This pilot sits in the hole and helps in straight counterboring.

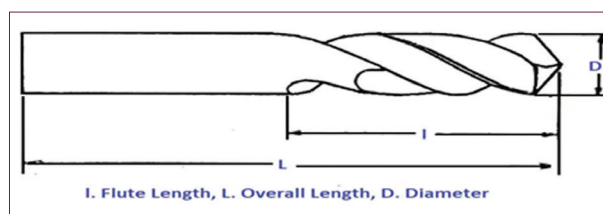
Masonry Bit



These drill bits are used where brick, stone, and concrete work is going on. As hard as these bits are, you need to replace them almost regularly as they wear out.

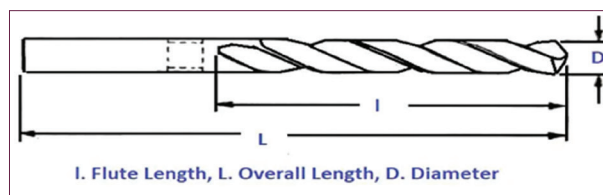
If you want to drill into the concrete for a long time, it causes the tip to be melt. You can reduce that problem by periodically changing the drill out of the concrete.

Parallel Shank Twist Drill



The drill is a shortened type of the parallel shank twist drill, the shortening being on the flute length. The diameter of the drill ranges from 0.5 to 40 mm increasing by 0.3 mm in lower series to 0.25 to 0.5 mm in higher series.

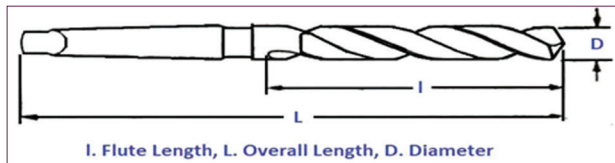
The drill has two helical flutes with a parallel shank of approximately the shank diameter as the cutting end, which however does not exceed the diameter at the drill point.



The overall length of this drill is the same as the of a taper shank twist drill of the corresponding diameter. The diameter varies from 1.5 to 26 mm increasing by 0.3 mm in lower series to 0.25 mm in higher series.

Taper Shank Twist Drill

The drills have two helical flutes with a tapered shank for holding and driving the drill. The shank for these drills conforms to Morse tapers. The diameter ranges from 3 to 100 mm.



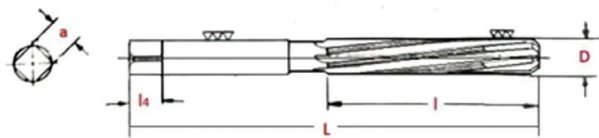
The diameter increases by 0.3 mm in lowest series having Morse taper shank No. 1, by 0.25 mm in Morse taper shank number 2 and 3, by 0.5mm in Morse taper shank No. 4, and by 1 mm in Morse taper shank number 5 and 6.

The Morse taper shank used below 6 mm size is not preferred. A drill gauge allows any drill to be easily selected by truing into the holes of the gauge.

Reamer

A reamer is a tool used for expanding or finishing pre-drilled holes, bored, or cored to give a good finish and an exact dimension.

A reamer is a multi-tooth cutter that cut relatively small amounts of material. There are various classifications of reamers depending upon the operation, purpose, and shape. The commonly used reamer details in I.S. specifications are below.



I. Length of Cutting Edge, L. Overall Length, I4. Length of Driving Square, D. Nominal Diameter, a. Driving Square Size



HAND TAP

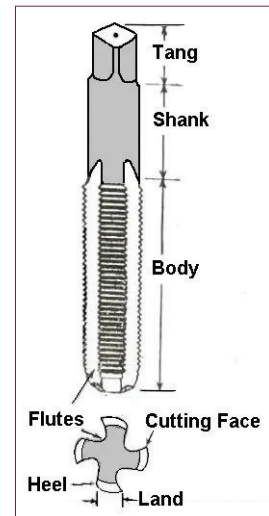
Hand taps are specially designed tools used to cut the inside threads in different parts of machines. These are used by hands with a tap handle or with the help of a wrench and are also used with the help of drilling machines.

Taps are made of high carbon steel, high-speed steel, alloy steel, etc. These are hardened and tapered. Their shape is almost like a headless bolt with full threads. The upper portion is square and four flutes are made on the entire part in which threads are there.

Parts of a Tap

Following are the main parts of tap, which are described in detail below:

1. Body
2. Shank
3. Tang
4. Land
5. Flutes
6. Heel
7. Cutting Face



Body: It is the main part of the tap on which threads are cut.

Shank: The smooth part above the body on which threads are cut, is called the shank. It is round and the pitch of threads which are to be cut by shank is indicated on it.

Tang: The part above the shank is called the tang. It is square in shape and is revolved by holding it in a tap handle.

Land: Space between flutes i.e. where threads are cut.

Flutes: On the entire body of tap the grooves cut on the space between two lands, are called flutes. These are made in length from top to bottom. The particles of metal cut while cutting threads are coming out of these flutes and these are also used for supplying lubricant inside.

Heel: The tilted part behind the threads cut on the land is called the heel.

Cutting Face: The face of the cutting tool against which the material is moved is called the cutting face.

These hand taps are used in the form of a set. This set includes three taps:



1. Taper Tap

In which 8 to 10 threads are rubbed and chamfered on the lower side. These are easily set in the drill holes and perform the job of starting a thread.

The lower end of this tap is equal to the tap size drill.



2. Intermediate Tap



It is also known as a second tap. Taper up to 3 to 5 threads is made on the lower side in this tap. It is used to provide proper depth and shape to threads that have been made by the taper tap. If threads are to be cut through the drill holes then only these two taps are used.

3. Bottom Tap or Finishing Tap



This is the third tap of the set. It is used after using the above-mentioned taps, at places where the hole is not across the job. Besides, it is also used for cleaning and finishing the threads which are cut through the entire drill. A taper is cut at its end on one or one and a half threads.

Tap Handle

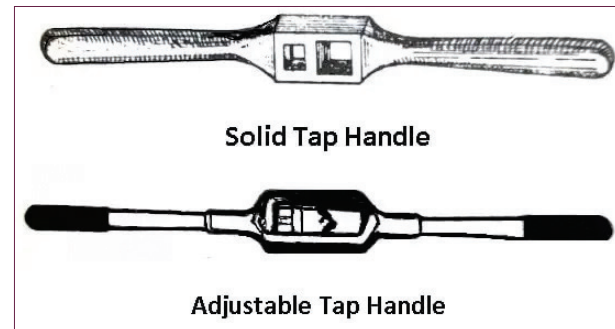
For cutting threads in a job by hand with the help of a tap is moved inside the hole with the tap handle. These tap handles are of three types:

1. Solid Tap Handle
2. Adjustable Tap Handle

The solid tap handle is made solid on both sides and handles are fixed for convenience. In the

middle rectangular part, two separate rectangular grooves are cut across the tap. Taps of two sizes can be moved in these.

An adjustable tap in the middle part, a set of two pieces there which are held by the adjusting screw, and taps of different sizes can be moved as shown in the figure.



SCREWDRIVER

A screwdriver is used for tightening or loosening the screw. A round rod with a flat end, having a handle at the other end, is called a screwdriver. The length of a screwdriver is measured, excluding the handle. One of the greatest tool inventions ever made is the screwdriver. You could find them in almost every toolbox.

A screwdriver has three main parts, as shown in the figure.

Parts of Screwdriver

The following are the main parts of a screwdriver:

1. Handle
2. Shank
3. Blade

1. Handle

Handle, generally wooden or plastic handles, are fixed to the screwdrivers. To save the wooden handle from being broken, an iron is fixed to the handle.

2. Shank

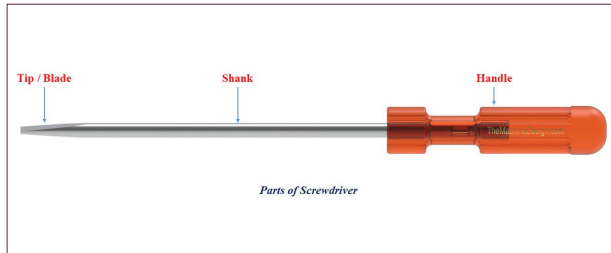
The middle part between the blade and the handle is called the shank. On its lower part tip or blade is made.



On the upper part, either there is a hole through which a wire is passed, or this end is made flat so that when this part is fixed to handle, it does not allow the shank to move separately. These are generally made of carbon steel.

3. Blade

The blade is the lower part of the shank. It is also known as a tip. This part is hardened and tempered.



The different functional screwdriver design types are described below.

1. **Manual Screwdriver:** It has a thick handle and a cylindrical rod, making up its most typical design. The working end of the rod is inserted into the screw heads for which it is designed.
2. **Powered Screwdriver:** This screwdriver is powered by electricity or a battery. Power drills with flat or Phillip's heads are frequently used along with multi-bit screwdrivers.
3. **Ratchet Screwdriver:** Ratcheting screwdrivers feature an internal ball-bearing mechanism that makes turning the screw simple and repetitive. You can do this without taking out the screw's driver head.
4. **Magnetic Screwdriver:** It is a standard screwdriver with a practical feature: The screws are held in place by a magnetized tip, making it simpler to install or remove the screws.
5. **Yankee Screwdriver:** Instead of using ball bearings, this screwdriver uses a spring-loaded mechanism. Instead of twisting the screw with your wrist, you place the screw head against the screw and push it to tighten.

Some Important Types of Screwdrivers

1. Flat Head
2. Philips
3. Torx Screwdriver
4. Offset

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5. Watchmaker

6. Multipurpose screwdriver

1. Flat Head Screwdriver

As its name indicates these types of screwdrivers are used for tightening or loosening different types of screws. These are available in small as well as larger sizes. Flat head screwdrivers have a handle of wood or plastic fixed to them.



2. Philips Screwdriver

The tip of these types of screwdrivers is different from that of others. This tip is pointed and is made after cutting four flutes. Philips screwdrivers are used where the screw has a T cross-shaped groove at their heads. These screws are available in varying numbers and measurements.



3. Torx Screwdriver

Torx screwdrivers are very common and are often used by automotive engineers. Sometimes they are also called star tips by an engineer. This driver has a star-shaped tip with 6 round lobes.

Torx-type screwdrivers come in various sizes and use a numbering system such as T8, T10, T15, T25, etc. to determine the tip size. As the number increases, the tooltip size increases.





4. Offset Screwdriver

The Offset screwdrivers also have a flat blade. But no handle is used in these screwdrivers. Their shank is turned at 90 angles at both ends, and bits are made on both ends. In cases of narrow or slanting spaces, where an ordinary flat screwdriver cannot work, this offset screwdriver is used. It is shown in the figure.



5. Watchmaker Screwdriver

Watchmaker screwdrivers are available in sets. In a set there are six screwdrivers, having number markings from 0 to 5. The smaller the number of the screwdriver, the smaller and thinner its bit. In place of the handle, a cap is fixed to the shank.



The cap is fixed to the shank so that both cap and the shank can be moved independently. For tightening or loosening a screw, the tip is placed at the head of the screw, and the cap is pressed with one finger, while the other finger shank is rotated.

A watchmaker screwdriver can be used in all kinds of instruments and watches.

6. Multipurpose Screwdriver

The multipurpose screwdriver has a shank with a hexagonal hole at the end where it can fit a variety of drivers on both sides, with drivers or depending on the use of the set. Because they offer more versatility and economy of space, they are a very common toolset among those with only basic requirements.



CUTTING PLIERS

Types of Pliers

Plier is a very useful tool, with the help of a plier, small jobs and articles can be held. It is also used to cut or turn wires. Its jaws are hardened and tempered. The size of a plier varies from 4" to 10" for different kinds of jobs. In the workshops, normally, the following all types of pliers are used.



Types of Pliers

The following are the different types of pliers and their uses:

1. According to the standard types of pliers

1. Hose clamp plier
2. Crimping plier
3. Long nose plier
4. Diagonal plier
5. Slip joint plier
6. Tongue and Groove plier
7. Bent nose plier
8. Flat or Combination plier

1. Hose Clamp Plier



A Hose clamp plier is manufactured to compress the hose and spring clamp, making the joint tight. They come in a wide range of forms. It is also known as spring clamp plier and radiator hose plier.

This plier has a peg-shaped tooth on each jaw, which is used to pinch the clamp. Some models used directly on the hose.

2. Crimping Plier



A Crimping plier consists of a fulcrum at the end and is used as a nutcracker. The wires are fed first into the jaw jack, then to the connector. It is also known as crimping tools.

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Pressing the handle will damage the plastic coating and causes to deform (or collapse) in such a way that they stick together and provide the data to pass through. They are massively used in networking and telecommunication applications.

3. Long Nose Plier



The Jaws of this type of pliers are tapered in length and are conical. These pliers do not have a cutting edge.

These are used where there is no adequate space for a combination of the plier. They are mainly used in the gold smithy, radio, and T.V. jobs for making hooks of wires bending wires. Bearing locks can also be opened with it.

4. Diagonal Plier



The jaws of diagonal plier have an angled edge that is made to cut through the thick wire. They are very strong and can also be used to cut nails.

Hence they are useful in carpentry and also in electrical work. It is also known as side-cutting plier, wire cutter, diagonal cutting plier, and flush cut plier.

5. Slip Joint Plier

As per their name, these are plier that permit adjustment to a greater range of opening by slipping motion of the two halves about the pin or rivet which connects them. Their jaws are square so they can hold only square jobs. They can not cut wires etc.



6. Tongue and Groove Plier



The Tongue and groove pliers are adjustable **types of pliers** with a jagged groove with an upper handle, allowing the lower jaw to be closed in multiple positions. These jaws make this tool helpful for turning nuts and bolts. It is also known as channel locks.

7. Bent Nose Plier



This variation of needle nose pliers consists of a set of jaws that tilt at an angle at the midpoint (45 or 90 meters at most). This allows them to fasten surfaces when multiple pliers are needed.

As a result of this, they are useful in jewelry making, electrical work, and other businesses that deal with shaping wire.

8. Flat or Combination Plier



This piler has flat jaws. One side of the jaw is sharp for cutting purposes. These pilers are useful in a large number of jobs like cutting wires, turning nails, and each small job. Pilers used in electrical jobs have insulated handles.

A combination of pliers should not be used for cutting a very hard metal else its edge would be spoiled. For strong grip of jobs parallel slots are made on the inner side of its jaws.

Cutting plier uses

It is used for cutting, removing insulation, jointing and twisting the electric wires and cables even on live-line.

DRILLING MACHINE

The drilling machine is defined as a machine which is used to make a circular hole, a tool used to drill the holes of different size and other related operations using a drill bit. The drilling machine is one of the most important machines in a workshop.

In drilling machines, holes may be drilled quickly and at a low cost. The hole is generated by the rotating edge of a cutting tool known as the drill bit which applies a large force on the work clamped on the table.



Parts of Drilling Machine

Following are the main parts of drilling machines:

1. Base
2. Column
3. Table
4. Radial Arm
5. Drill head
6. Spindle speed and Feed mechanism.



Base

The base is the part of the machine on which the vertical column is mounted. The base is made of casting. A base supports the column and worktable with other attachments. The top of the base is round column section type upright drilling machined and has T-slots on it so that large workpieces and work holding devices may be set up and bolted to it. The base of the machine may be mounted on a bench or on the floor.

Column

The Column is the vertical member of the machine which supports the table and the head

containing all the driving mechanisms. It is a cylindrical casting mounted vertically at one end of the base and supports the radial arm, which slides up and down.

An electric motor at the top of the column helps in the vertical adjustment of the arm by rotating a screw passing through a nut attached to the arm.

Table

The table is mounted on the column and is provided with T-slots for clamping the work directly on its face. A table is round or rectangular in shape.

Radial Arm

It is mounted on the column and extends horizontally over the base. It has guide ways on which drill head slides. The radial arm moves around the column.

Drill head

It is mounted on the radial arm and drives the drill spindle. In some of the drill machines, the drill head may be adjusted up or down for accommodating different heights of the work in addition to the table adjustment.

It encloses all the mechanisms for driving the drill at a different speed and feeds. In lighter machines, the driving motor is mounted at the rear end of the head counterbalancing the weight of the drill spindle.

Spindle speed and feed mechanism

The motor at the top of the drill head drives the horizontal spindle and the motion is transmitted to the drill head through a group of bevel gears. With another group of gears, different spindle speed and feed are obtained.

Hand drilling machine

A hand drilling machine is a small compact unit and used for drilling holes in workpieces in any position, which cannot be drilled in a standard drilling machine. It may be used for drilling small diameter holes in large castings or weldments at that place itself where they are lying. Portable



drilling machines are fitted with small electric motors, which may be driven by both A.C. and D.C. power supply. These drilling machines operate at fairly high speeds and accommodate drills up to 12 mm in diameter.

WIRING

Electrical Wiring

A process of connecting various accessories for distribution of electrical energy from supplier's meter board to home appliances such as lamps, fans and other domestic appliances is known as Electrical Wiring.

The wiring system selected will depend to a large extent on the types of service required.

Factors Affecting the Selection of Wiring

- Durability
- Safety
- Appearance
- Cost
- Accessibility

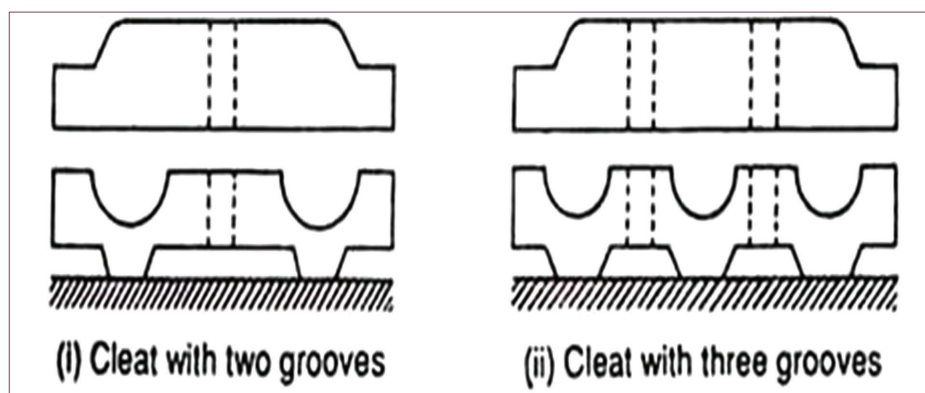
- Maintenance Cost

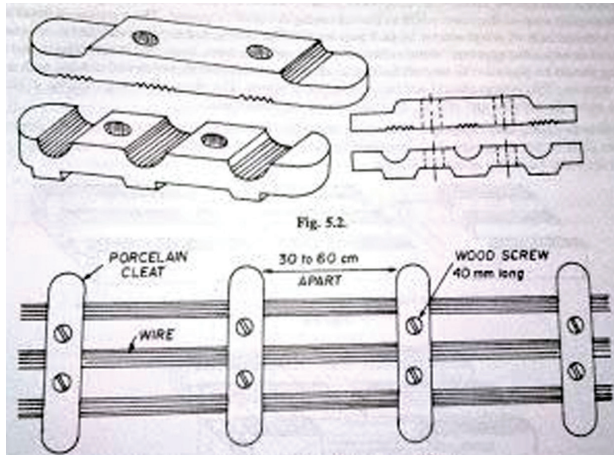
Types of Internal Wiring

- Cleat wiring
 - CTS or TRS or PVC sheath wiring
 - Lead sheathed or metal sheathed wiring
- Batten wiring
 - CTS or TRS or PVC sheath wiring
 - Lead sheathed or metal sheathed wiring
- Conduit wiring
 - Surface or open Conduit type
 - Concealed or underground type Conduit

Cleat Wiring

- In this system of wiring, cables are supported and gripped between porcelain cleats and 6mm. above the wall or roof.
- The main part is base, which is grooved to accommodate the cables, the other part is the cap which is put over the base
- Cleats are placed above the wall or roof at an interval of 30 to 60 cm.
- The cables recommended for this type of wiring are VIR or PVC cables and any other approved insulated cables.





Advantages

- It is the cheapest system.
- Installation and dismantling is easy.
- Less skilled persons are required.
- Inspection is easy.
- Alterations and additions are easy.

Disadvantages

- It is a purely temporary wiring system.
- Appearance is not good.
- Cables are exposed to the atmosphere and there is a possibility of mechanical injury.
- This system should not be used in damp places otherwise insulation gets damaged.

Casing and Capping Wiring

- It consists of rectangular blocks made from seasoned and knot free wood (preferably teak- wood).

- The casing has usually two (or three) 'U' shaped grooves, into which the VIR or PVC cables are laid in such a way that the opposite polarity cables are laid in different grooves.
- The casing is covered by means of a width as that of casing known as capping and is screwed to it.
- This system of wiring is suitable for low voltage rectangular strip of the same installations.

Advantages

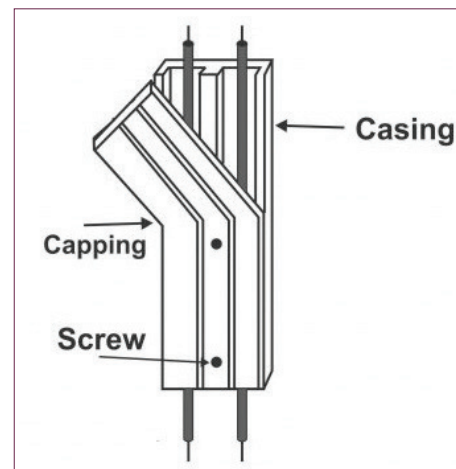
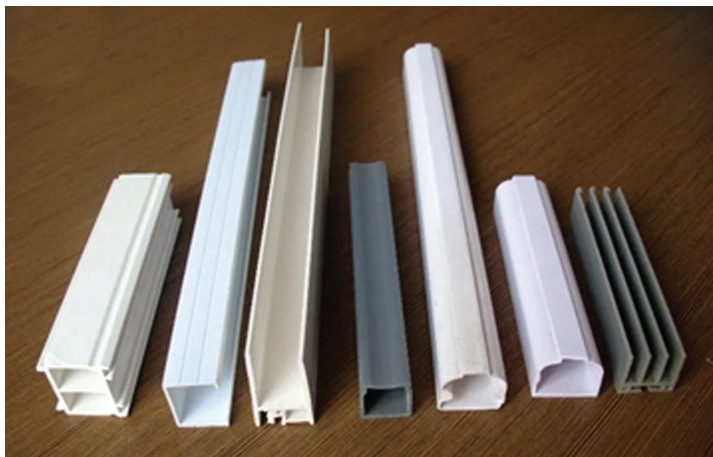
- It provides good insulation as conductors are apart.
- It provides good mechanical strength.
- Easy to inspect by opening the capping.

Disadvantages

- It is a costly system now – a – days because it needs seasoned, knot free wood.
- There is every risk of fire.
- The labor cost is more because it requires skilled carpenters.
- This system can not be used in damp places.

CTS or TRS or PVC Sheath Wiring

- CTS cables are available in single-core, twin-core or three-core with a circular or oval in shape.





- CTS cables are sufficiently chemical proof, water proof, and steam proof.
- The cables are run or carried on well seasoned, perfectly straight and well varnished (on all four sides) teak wood batten of thickness 10 mm. at least.
- The width of the batten depends upon the number and size of cables to be carried by it. Battens are fixed to the walls or ceilings by means of gutties or wooden plugs.
- The cables are held on the wooden batten by means of tinned brass link clips spaced at an interval of 10 cm.
- This system is suitable for low voltage installations.



Advantages

- It's appearance is good, if carried properly.
- It's life is sufficiently long.
- It can withstand the action of most chemicals such as acids and alkalies.
- It's installation is easy and quick compared to casing- capping.
- It is cheap compared to casing – capping, metal conduit and lead sheathed wiring.

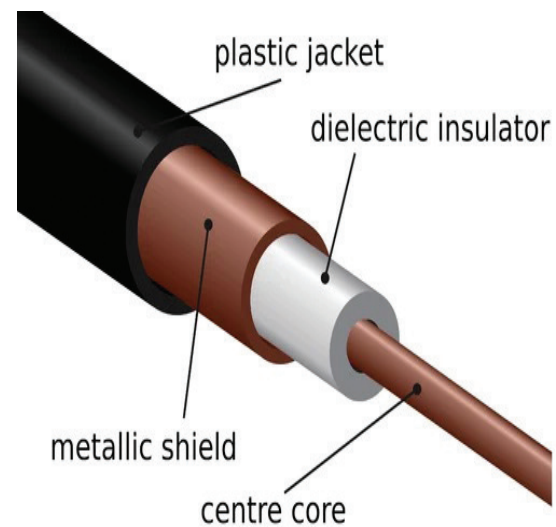
Disadvantages

- This system of wiring is not recommended in situations exposed to sun and rain, unless preventive steps are taken.
- It can not be used in damp places.

- Good work man ship is required to make a sound job.
- Only suitable below then 250V.

Metal Sheathed Wiring

In lead sheathed or metal sheathed wiring the cables used are insulated wires, TRS or PVC, with metal outer covering of about 1 mm. thick. The metal covering is known as sheathing and is made of lead – aluminium alloy containing about 95% of lead. The metal sheathed cables are run on wooden batten and are fixed to it by link – clips. The whole metal sheathing efficiently earthed as per IS 732-1983.

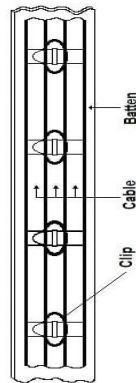


Advantages

- It provides protection against mechanical injury.
- It can be used in damp situations.
- It can be used in situations exposed to-sun, and rain provided no joint is exposed.
- It has longer life.

Disadvantages

- It is costly system of wiring.
- It is not suitable where chemical (acids and alkalies) corrosion may occur.
- In case of insulation damage, the metal sheath become alive and gives shock.



Batten Wiring
Old Wiring System

Conduit Wiring System

- Conduit wiring system consists of either VIR or PVC cables taken through tubes or pipes and terminated at the outlets or switches / sockets. The tube or pipe is known as “conduit”. Conduit wiring may run over the surface of the walls and ceiling or may be concealed under masonry work.

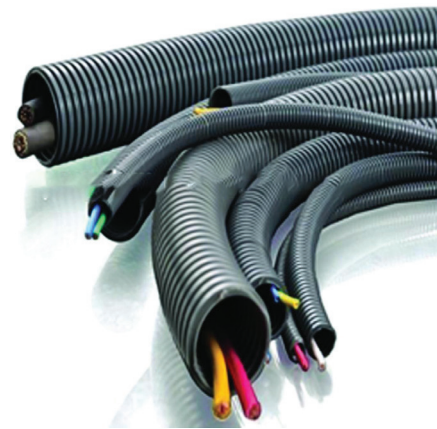
Types of Conduits

- Rigid steel / metal conduit.
- Rigid PVC / non-metallic conduit.
- Flexible steel conduit.
- Flexible PVC / non-metallic conduit.



Workshop Practices

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Surface Conduit Wiring

All steel conduits should be coated or finished with galvanized or enameled surface. Conduit accessories must be of threaded type. No steel conduit less than 12.7 mm. in diameter should be used.

The conduit should be laid over the wooden gutties, and should be fixed to the wall by means of saddles at an interval of not more than 1.2 m.

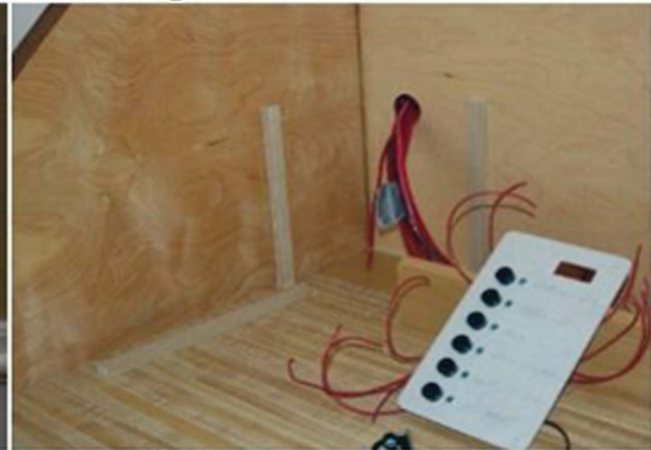
Concealed Conduit Wiring

The conduits (metal or PVC) are embedded along walls or ceiling in plaster at the time of building construction. The conduits are fixed by means of saddles not more than 60 cm. apart. The VIR or PVC cables are drawn into the concealed by means of GI wire of size 18 SWG.

PVC conduits are increasingly being used in place of steel conduits. PVC conduits are less expensive and the labour time saved may be as much as 25% to 50% compared to the time taken when installing steel conduits. PVC conduits are resistant to acids alkalies, oil and moisture.



Surface Conduit Wiring



Concealed Conduit wiring

Advantages

- It provides protection against mechanical damage.
- Metal conduits provides protection against fire due to short circuit etc.
- The whole system is water proof.
- It's life is long.
- Replacement of defective wiring is easy.
- It is shock proof if earthing is done properly.
- PVC conduit wiring (particularly concealed) is cheap.
- PVC conduit wiring requires less time.
- Concealed conduit wiring appearance is very good.

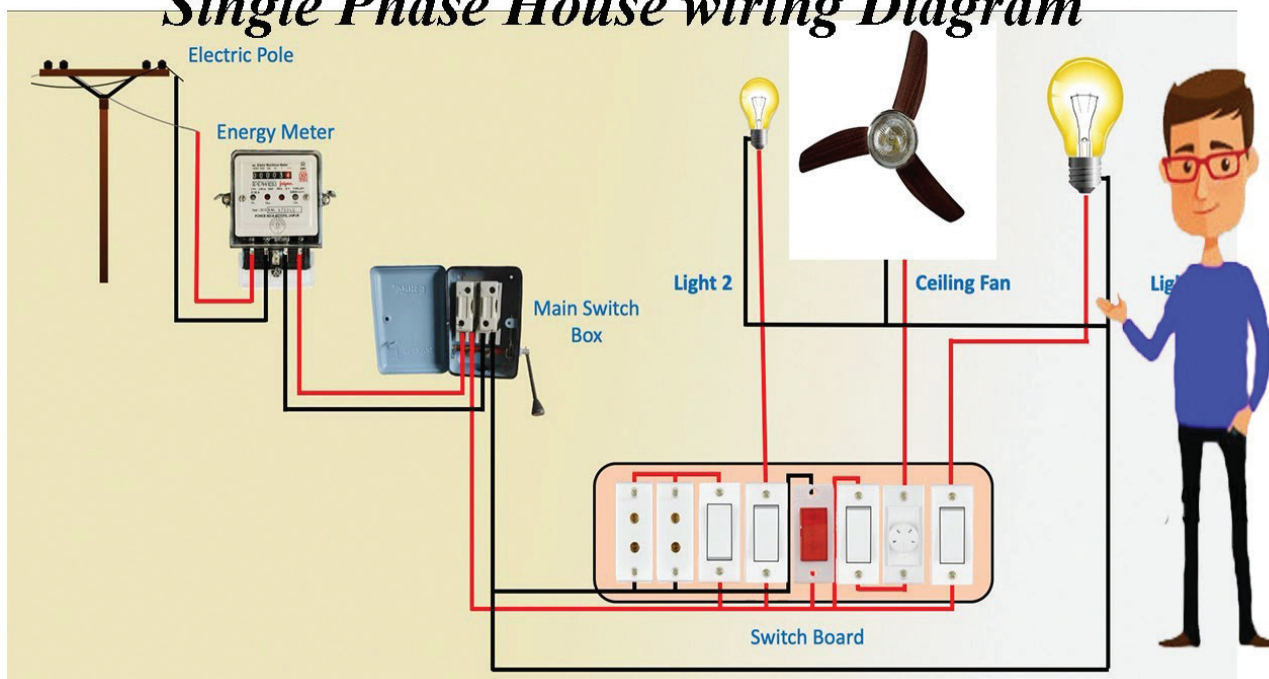
Disadvantages

- PVC conduit does not provide protection against fire.
- Metal conduit wiring is very costly.
- Metal conduit wiring requires more time.
- Metal conduit wiring needs skilled labour.
- Very hard to find the defects in the wiring.
- Very complicated to manage additional connections in the future.

General Rules for Wiring

- The following general rules should be kept in mind while executing the electrical wiring work:
- The current rating of the cable / conductor should be slightly greater (at least 1.5 times) than the load current.

Single Phase House wiring Diagram



- Every live wire / line should be protected by a fuse of suitable rating as per load requirements.
- Every sub-circuit should be connected with the fuse distribution board.
- All metal coverings used for the protection of earth must be connected to earth.
- No switch or fuse is used in earth or neutral conductor.
- Every apparatus should be provided with a separate switch.
- No additional load should be connected to the existing installation until it has been satisfied that the installation can safely carry the additional load.
- All the switches and starters should be accessible to the operator.
- A caution notice (danger plate) should be fixed on every equipment.
- In any building light wiring and power wiring should be kept separately.
- When the installation has been completed it should be tested before giving the supply and the leakage in the wiring should not

exceed $1/5000$ of the maximum current of the load.

- In 3-phase, 4 – wire installation the load should be distributed almost equally on all the phases.

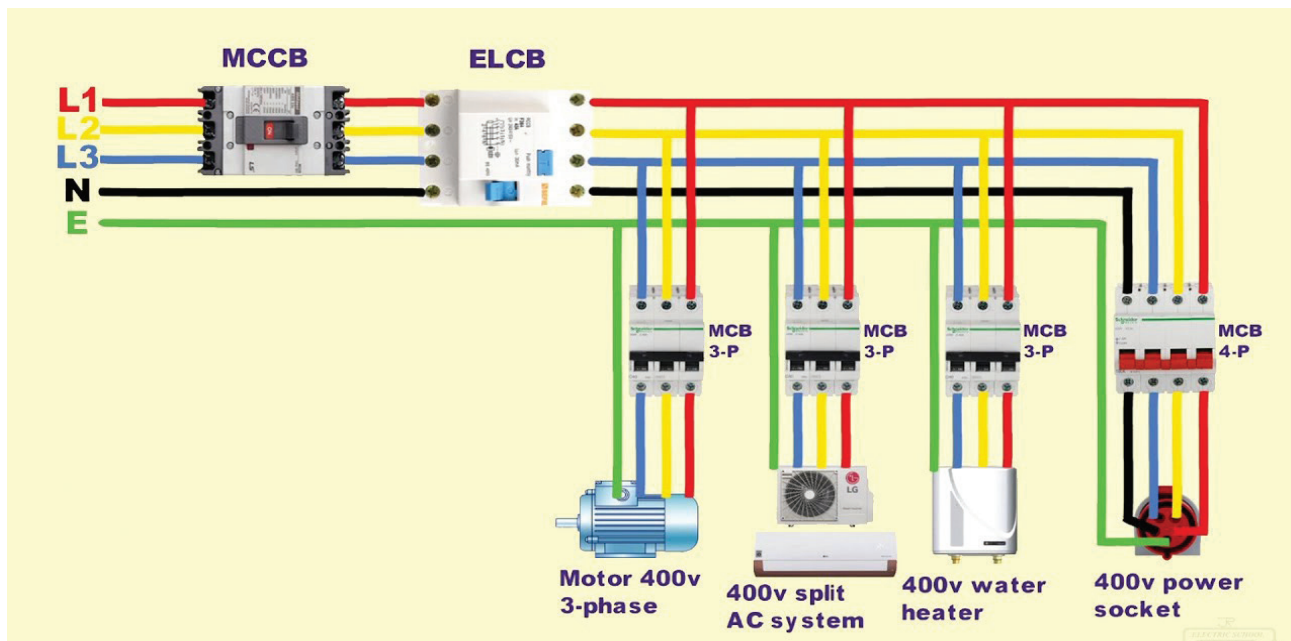
In case of 3-phase, 4-wire system, at the main board, indication should be done in Red, Yellow and Blue. Neutral should be indicated in black.

SINGLE PHASE WIRING

Single-phase power is a two-wire alternating current (ac) power circuit. Typically, there is one power wire—the phase wire—and one neutral wire, with current flowing between the power wire (through the load) and the neutral wire.

THREE PHASE WIRING

Three-phase power can be defined as the common method of alternating current power generation, transmission, and distribution. It is a type of polyphase system and is the most common method used by electric grids worldwide to transfer power and industrial applications.



Difference between 3-phase and single-phase configurations

Some three-phase power supplies do use a fourth wire, which is a neutral wire. The two most common configurations of three-phase systems are known as wye and delta. A delta configuration has only three wires, while a wye configuration may have a fourth, neutral, wire. Single-phase power supplies have a neutral wire as well.

Both single-phase and three-phase power distribution systems have roles for which they are well-suited. But the two types of systems are quite different from each other.

Applications of single phase wiring

Single-phase connections are intended for domestic supplies and residential homes. That's because most of the appliances require a small amount of electricity to perform such as television, lights, fans, refrigerator, etc. The functioning of a single-phase connection is simple and ordinary.

Applications of three phase wiring

The applications of the three-phase system include the following. A three-phase system is directly used for providing power to large induction motors, heavy loads & different electric motors. Three-phase power is a very efficient power source and it is pretty helpful for industrial or commercial applications.

PLUMBING

Introduction

The plumbing system is an essential part of every house or building. Proper planning and designing of plumbing system is crucial as it takes care of the hygiene requirements of the occupants. It has been reported that about 8 percent of the construction cost of a building is marked for plumbing and sanitary work.

Pipe vice

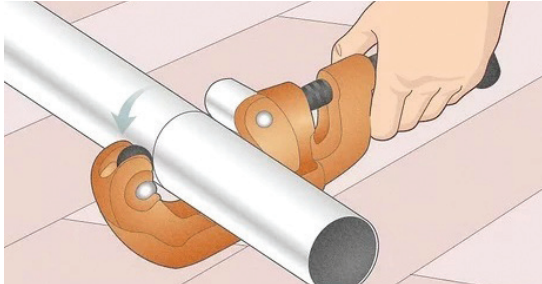
A pipe vice is fitted on the work bench. This has a set of jaws to grip the pipe and prevent it from turning while cutting, threading and fitting of bends, couplings etc. The yoke vice is commonly used in plumbing used in plumbing practice.





Pipe wrench

A pipe wrench is used for holding and turning the pipes, rods and machine parts. Wrenches are classified as follows. 1. Fixed wrenches 2. Adjustable wrenches



Adjustable wrench

An adjustable spanner or adjustable wrench is any of various styles of spanner (wrench) with a movable jaw, allowing it to be used with different sizes of fastener head (nut, bolt, etc.) rather than just one fastener size, as with a conventional fixed spanner.



Chain wrench

Chain wrenches are ideal for turning, loosening and tightening, large, smooth parts where it is difficult to apply conventional tools. As such, they are ideal for parts like oil filters, or for bulky pipework.



Pipe cutter

The pipe cutter mainly consists of three wheels which are hardened with sharp cutting edges along their periphery. Of these three wheels, one can be adjusted to any desired distance to accommodate different size of pipes. After adjusting the cutter on a pipe, it is around the pipe, so that the cutter wheels cut the pipe along a circle as shown in the figure.



SOLUTIONS TO JOIN PIPES

PVC Solution is a type of PVC cement or solvent cement. It is used to join two pieces of PVC pipe together. It can also be used to repair cracks in PVC pipes. PVC Solution is a water-based cement. It is white and has a thick, creamy consistency. It dries quickly and forms a strong bond between the two pieces of PVC pipe. PVC Solution is an easy-to-use product that requires no mixing or measuring. Simply apply the cement to the clean, dry surface of the PVC pipe and join the two pieces together. It dries clear, so you can see if the joint is properly aligned before it sets. The following are the various types of solvents

- Cyanoacrylate (Super Glue)
- Toluene & Xylene (Plastics Cements)
- Rubber Cement

THREAD SEALING TAPE

Thread seal tape (also known as Teflon tape or plumber's tape) is a polytetrafluoroethylene (PTFE) film tape commonly used in plumbing for sealing pipe threads. It protects the threads of both pieces from direct contact with each other and physical



wear, and helps seal and prevent leaks from the connection.

TYPES OF SCREWS

A Screw is a sharp-pointed short metal pin of certain pitch length with helical threads running round of it. It is used to fasten two pieces together or join them for a desired working. It can fasten any type of piece made of either wood or metal. There are number of types of screws used to fasten various types of parts performing different functions

Basic Types of Screws

TYPES	Basics	Positive	Negative
Masonry Screws	Designed for use with masonry materials	Common for outdoors	Requires pilot hole and special tools
Wood Screws	Most common screw for wood	Does not require pilot hole	Can only be used with wood
Drywall Screws	Secures drywall to wood studs and beams	Easy to use and conceal	Cannot connect drywall to metal
Decking Screws	Used to build and repair decks	Countersinks easily and resists rusting	Should only be used for decks and no other structural wood
MDF Screws	Used with medium-density fiberboard	No need for pilot holes	Used only with MDF wood
Sheet Metal Screws	Attaches wood, plastic, and other metal to sheet metal	Steel screws are rust resistant	Carbon-steel versions can only be used indoors
Self- Tapping Screws	Used for a variety of installations	Creates its own pilot hole with sharp tip	May split soft materials
Double-Ended Screws	Designed to be inserted into two pre-drilled pilot holes to fasten wood pieces	Adds durability in pre-fabricated furniture	Can't be removed after installation



TYPES	Basics	Positive	Negative
Mirror Screws	Secures mirrors to walls	Won't corrode and does not damage walls	Requires pre-drilled hole
Security Screws	Standard screws meant to prevent tampering	Delays or prevents vandalism and theft	Not immune to removal with the right tools
Hammer-Drive Screws	Secures items from signs and nameplates to tech and auto parts	Extremely durable	Cannot be removed after installation, needs special tools
Machine Screws	Joins various machinery or electronic parts	Wide range in sizes and drives for numerous projects	No pointed tip
Pocket Hole Screws	Secures two boards or parts of wood furniture	Designed for pocket hole joinery	Designed only for wood furniture





UNIT V

BASIC PRACTICES (3 Periods)

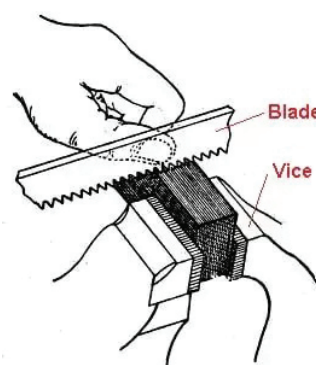
MARKING

1. We should draw a picture of the work that we think is proper to make and understand it.
2. Before marking, the two adjacent sides and the job surface must be thoroughly prepared after filling, scraping, and another machining.
3. The marking surface should be coated with a thin paste of Persian blue, copper sulfate, or chalk as desired before marking.
4. If a surface gauge or vernier gauge is to be used for marking, the job must be placed appropriately on the surface with the angle plate and "V" block.
5. While marking, the scribe or punch should be pointed.
6. Marking tools should be selected according to the job.
7. If you want to make an arc or a circle on the work, then a deep mark should be made in the middle of the work with the help of a center punch. Otherwise, there is a possibility of the divider slipping.
8. If drill marking is necessary, we should draw a circle of the same size outside the center and also draw another larger circle from the same center so that we know that the drill is being done at the right place.
9. After marking as per the drawing, it should be rechecked.
10. When the marking is done correctly, it should be made permanent with a dot punch or any other punch, as the case may be. But the other helping lines should be cleared before making the marking permanent.

CUTTING

Use of Hacksaw

1. Selection of hacksaw blade should be done according to the metal for which it is to be used.
2. While fixing the blade on the frame it should be ensured that its teeth should cut the metal when they are driven forward.
3. The job should be held in the vice in such a way that its cutting lines are clearly visible.
4. Before starting a cut with a hacksaw blade, the blade should be kept on the marking line, the left-hand thumb should be placed with its support as shown in fig. It would ensure that the blade would move only on the line and there would be no risk of its slip.
5. After marking with the support of the thumb we should hold the handle with right-hand palm and fingers and with the left-hand palm and fingers, we should hold the other end of the hacksaw frame as shown in fig.



Starting A Hacksaw



Operating A Hacksaw



6. You should stand on the left hand of the vice and keep your right foot backwards and the left foot a little ahead of the right.
7. Contact between the blade and the job should be in such a way that at least two teeth should remain in contact with the surface of the job.
8. The speed of operating hacksaw should be 40 to 50 strokes per minute.
9. Pressure should be exerted on the forward stroke and it should be withdrawn on backward stroke.
10. Before finishing cutting with a hacksaw the cutting speed should be slowed down.

Following are the precautions of using hacksaw:

1. Hacksaw blade should be fitted on the frame very carefully. It should not be very tight nor very loose.
2. The job which is to be cut should not be held in a vice much high otherwise there would be vibrations in it.
3. While cutting thin metal sheet, packing of wood, plastic or any other appropriate material should be used in its front and back.
4. Hacksaw blade should not be allowed to become slanting while using a hacksaw. If it becomes slanting, there are chances that it may break.
5. If the blade starts cutting in a slanting manner we should start a fresh cut. Operating a hacksaw in an old cut may break it.
6. If a blade gets broken while working, then we should replace it with a blade which has been used almost for the same period rather than using a brand new blade. The new blade can break if it is operated in that old slot.
7. If necessary, water should be used as a coolant.
8. After using a hacksaw either its blade should be taken out or it must be made loose.

FILING

It is required after chipping or cutting operation to remove burr and clean the face of the cuts and finish the final shape of the workpiece.

Workshop Practices

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Steps of the filing operation:

- The work should be held firmly in the vice with the minimum amount of projection and with the surface to be filed truly horizontal.
- The file handle should be grasped in the right hand and the end of the file handle should be pressed against the palm of the hand.
- The pressure on the work should be applied by holding the end of the blade with the left hand.
- The person should take his position on the left side of the vice with the feet firmly planted, slightly apart.
- A stroke should be made by a slight movement of the right arm from the shoulder and by a sway of the body towards the work, each of these movements being about equal.
- The file must remain horizontal throughout the stroke with pressure only applied on the forward motion.
- The file on the return stroke remains in contact with the work but the pressure is relieved from it.
- In order to test the surface of work during filing, a straight edge should be placed on it occasionally and the line of contact is viewed for daylight.
- When any considerable amount of metal has to be removed, the bulk of it should be removed by a rough or bastard cut file and the surface progressively brought to a finish by second cut and smooth files.

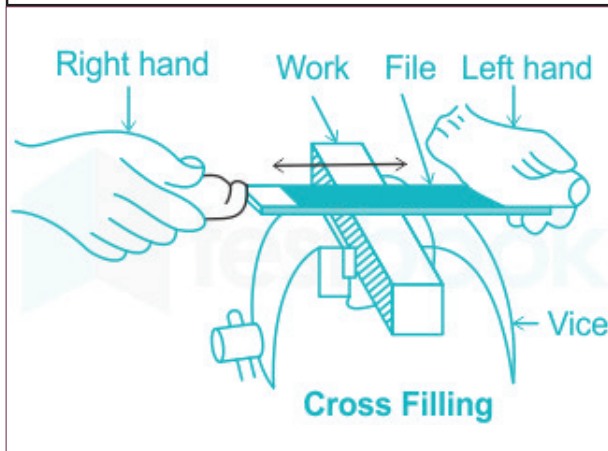
Methods of Filing:

- Cross Filing
- Draw Filing



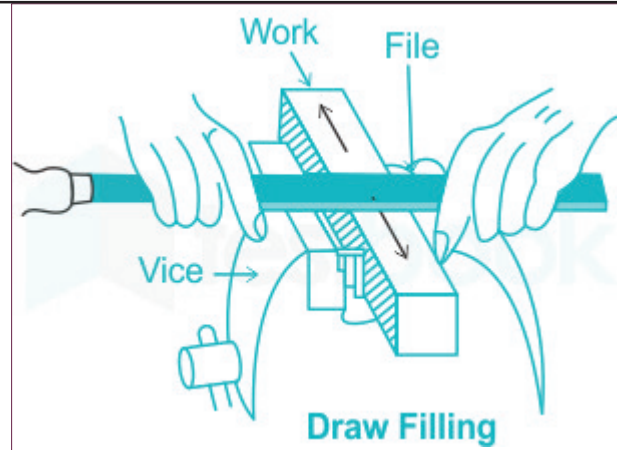
Cross Filing:

Filing in a direction perpendicular to the axis of a component is called Cross Filing. This filing method is used mostly in the Fitting Workshop.



Draw Filing:

Filing in a direction parallel to the axis of a component is called Draw Filing.



Care of Files:

- The files should not be used without a handle or with a loose fitting handle.
- A file should never be used on hardened steel, hard surface scale or allowed to strike against the hardened vice jaws.
- The new file should be used first on copper, brass and then on wrought iron and mild steel.
- Sometimes when soft metals are filed, they tend to clog the file teeth with minute particles of metal. These pins will not only spoil the efficient cutting action but they also spoil the work with scratches. These pins are removed and the file is cleaned with a thin hard wire brush or a file card.
- The file should not be allowed to rust and to prevent it, the file is coated with machine oil. The oil should be removed before the file is put to use by carbon tetrachloride or caustic soda.
- The worn out files may be reused by dipping it in hydrochloric acid. The worn out files are best suited for making scrapers, punches, chisels etc.



Tapping Operation :

Tapping is the operation of cutting internal threads in a hole using a cutting tool called Tap. A tap has cutting edges in the shape of threads. When the tap is screwed into a hole it removes metal and cuts internal threads for tapping the hole drilled will be smaller than the tap size.

Tap drill size = $0.8 \times \text{Outer diameter of the threads}$

Example: M8 Size tap,

Drill Size should be = $0.8 \times 8 = 6.8$
mm Diameter

Step 1: Drill the Hole

Prior to drilling the hole you will eventually tap, determine what size you need to drill for the bolt you are trying to screw in. Your hole will be smaller than the diameter of the bolt, because the threads tapped will increase the diameter.



Once you know what size hole you need to drill, go ahead and drill it in the designated location. Be conscious of how deep the hole is if it does not go all of the way through. If you are using a taper tap, you may need to drill a deeper hole to account for the part of the tap at the end that doesn't create complete threads. It is important to be conscious of how much depth will actually be able to be tapped and secured with whatever fastener you are using.

Step 2: Tapping the Hole

To begin tapping, rotate the taper bit clockwise until you feel resistance from the threads cutting into the material. From there, for every full rotation clockwise, make a half rotation counterclockwise. This will break off any chips that have been created and clear the space for the cutting teeth of the tap to keep cutting. Taps are very brittle, so accumulation of these chips or any other extra stress on the tap could cause it to break in your material.

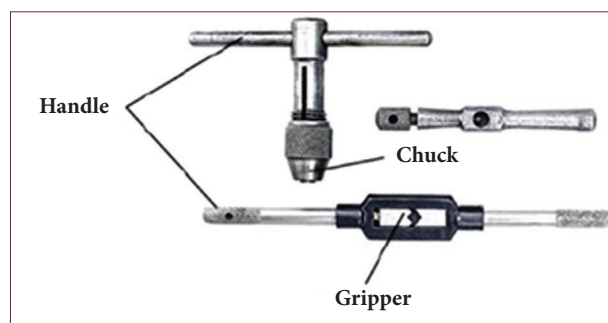
Make sure to pay attention to any abnormal resistance or binding you feel as tapping, and when in doubt, back the tap out a few threads and retry. You can also use lubricant of some sort to make tapping the hole easier.

Once you have used the taper tap to go either all the way through the hole, or as deep as a blind hole will allow, you can use a bottom tap (if available) to complete the threading closer to the bottom of the hole.

Step 3: Cleaning and Testing the Hole

After you finish tapping the hole, remove the tap and clean out the chips from both the tap and your material. Compressed air can be very helpful for removing chips. You will also want to clean off any lubricant you used in the process.

Once the hole and material is cleaned, test the threads of the hole with the bolt or machine screw you plan on using. If there is a lot of resistance and the bolt does not screw in easily, run the tap through the hole again. It should be easier this time because the threads are already formed. However, it is important to make sure the threads begin in the same place within the hole to avoid cross threading.



WIRING : SAFETY RULES

(Electricity is a good servant but a bad master)

1. SAFETY is of paramount importance in the Electrical Engineering Laboratories.
2. Electricity NEVER EXECUSES careless persons. So exercise enough care and attention in handling electrical equipment and follow safety practices in the laboratory.
3. Avoid direct contact with any voltage source and power line voltages. (Otherwise, any such contact may subject you to electrical shock)
4. Wear rubber-soled shoes. (To insulate you from earth so that even if you accidentally contact a live point, current will not flow through your body to earth and hence you will be protected from electrical shock)
5. Wear laboratory-coat and avoid loose clothing. (Loose clothing may get caught on an equipment/instrument and this may lead to an accident particularly if the equipment happens to be a rotating machine)
6. Girl students should have their hair tucked under their coat or have it in a knot.
7. Do not wear any metallic rings, bangles, bracelets, wristwatches and neck chains. (When you move your hand/body, such conducting items may create a short circuit or may touch a live point and thereby subject you to electrical shock)
8. Be certain that your hands are dry and that you are not standing on wet floor. (Wet parts of the body reduce the contact resistance thereby increasing the severity of the shock)
9. Ensure that the power is OFF before you start connecting up the circuit. (Otherwise you will be touching the live parts in the circuit)



10. Get your circuit diagram approved by the staff member and connect up the circuit strictly as per the approved circuit diagram.
11. Check power chords for any sign of damage and be certain that the chords use safety plugs and do not defeat the safety feature of these plugs by using ungrounded plugs.
12. When using connection leads, check for any insulation damage in the leads and avoid such defective leads.
13. Do not defeat any safety devices such as fuse or circuit breaker by shorting across it. Safety devices protect YOU and your equipment.
14. Switch on the power to your circuit and equipment only after getting them checked up and approved by the staff member.
15. Do not make any change in the connection without the approval of the staff member.

ELECTRICAL SYMBOLS

COMPONENT	SYMBOL
CROSS, NO CONNECTION	
CONNECTION	
FAULT	
CONNECTION, EARTH GROUND	
CONNECTOR	
DIODE, SEMICONDUCTOR	
FULL-WAVE, BRIDGE-TYPE RECTIFIER	
FUSE	
AC GENERATOR	



COMPONENT	SYMBOL
DE GENERATOR	
HEATER	
TERMINAL	
TRANSFORMER, IRON CORE	
THERMISTOR	
NEUTRAL, LINK	
WATT METER	
V - VOLTMETER	
AMMETER	
BATTERY (LONG LINE IS ALWAYS POSITIVE)	
SINGLE CELL	
MULTICELL	





COMPONENT	SYMBOL
CAPACITOR FIXED	
POLARIZED	
CIRCUIT BREAKER	
CONTACTS NORMALLY CLOSED	
NORMALLY OPEN	
IGNITORS SPARK IGNITOR, GROUNDED	
SPARK IGNITOR, UNGROUNDED	
GLOW COIL; GLOW BAR; HOT WIRE	
INDUCTOR (COIL)	
INDUCTOR (SOLENOID)	



COMPONENT	SYMBOL
LAMP	
MOTOR, AC	
MOTOR, RC	
OHMMETER	
MOTOR - GENERATOR SET	
THREE PIN PLUG SOCKET	
TWO PIN PLUG SOCKET	



WIRING MATERIALS



PENDENT HOLDER



STEADY BATTEN HOLDER



ANGLE BATTEN HOLDER



GANG BOX



ROUND BLOCK



CEILING ROSE



3WAY JUNCTION BOX



4WAY JUNCTION BOX



ELBOW



TWO PIN PLUG



TWO PIN SOCKET



SADDLE



SADDLE



TEE



THREE PIN SOCKET

TOOLS



SIDE CUTTING PLIER



NOSE PLIER



COMBINATION PLIER



SCREW DRIVER



STAR



CRIMBING TOOL



WIRE STRIPPER



LINE TESTER



BALL PEEN HAMMER



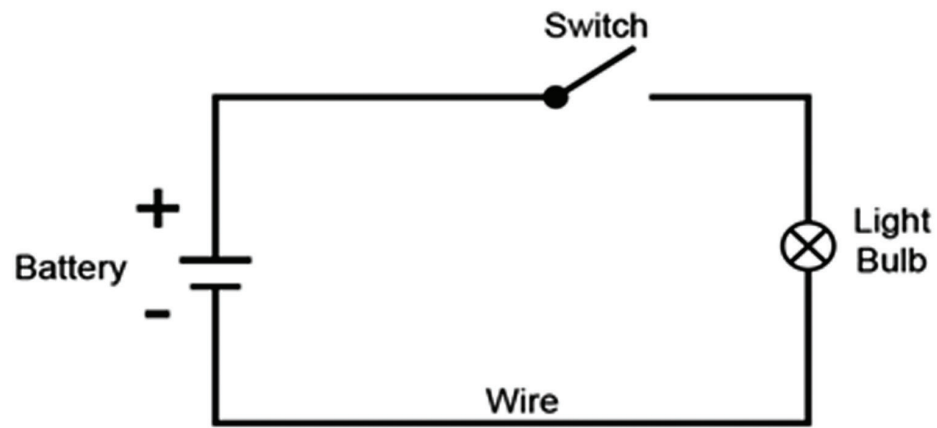
HACK SAW



MALLET

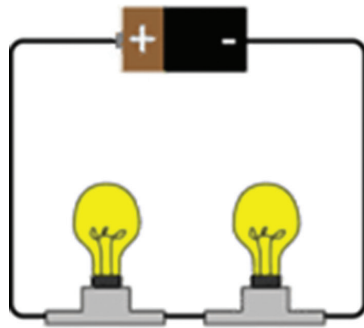


Simple wiring connections

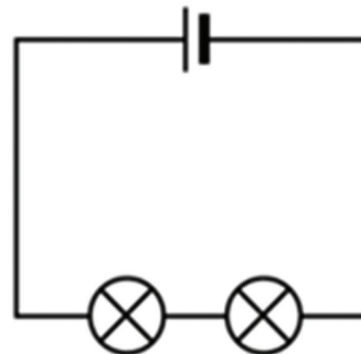


Series Circuit

Circuit Drawing

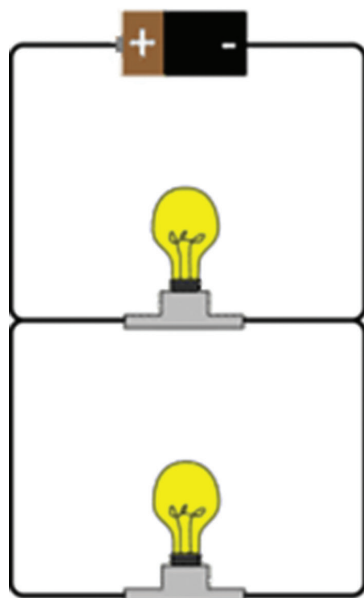


Circuit Diagram

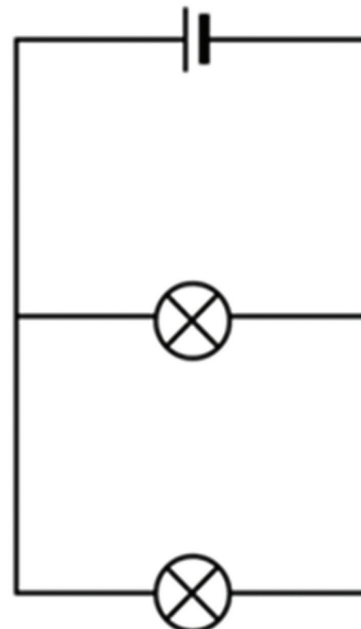


Parallel Circuit

Circuit Drawing



Circuit Diagram



PLUMBING

TYPES OF JOINTS

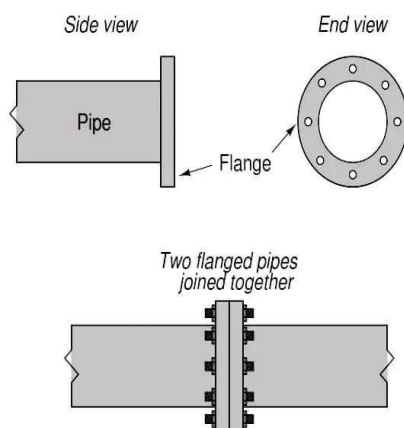
1. Bell and spigot joints

A connection between two sections of pipe i.e. the straight spigot end of one section is inserted into the flared out end of the adjoining section. The joint is sealed by a sealing component.



2. Flanged joints

A flanged joint helps to connect and disconnect two pipes as per the need. A similar example is as shown in figure.



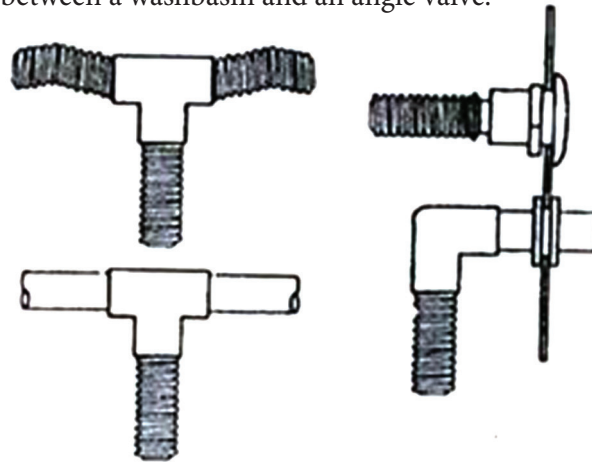
3. Threaded joints

Threads are formed in a pipe, flange coupling to connect them with each other and these joints are called threaded joints.



4. Flexible joints

The flexible joints are generally used to connect between a washbasin and an angle valve.



5. Expansion joints

Expansions joints are specially designed in pipeline where a small extension of pipe is required.



COMMON JOINTS IN PRACTICE

BEND

The bend is used when the direction of a pipe line is to be changed.] The bends has threads externally at both ends. Due to external threads two coupling are required for each bend

ELBOW

Elbow is used when the direction of the pipeline is to be changed Elbow has threads internally at both ends. The sudden turn produces more loss of head of water due to friction and hence it is not used in main lines.

UNIONS

It has three parts internal jaw, external jaw and a check out. It is used at the start of any branch line. It is also known as running joint.

FLANGES

It is used to connect pipes having diameter more than 3 8cm) It has holes circumferentially. The flanges are screwed to pipes and jointed by bolts and nuts.

TEE

A tee is a fitting that has one side outlet at a right angle to the run. It is used for a single outlet branch pipe.

COUPLING

It is a short a cylindrical sleeve with internal threads throughout. A couplings is used for joining two pipes in a straight and bend where at least one pipe can be turned.

CROSS

When there are four pipes connected at a junction the connecting special used is known as cross. It has threads internally at all the four ends.

ADAPTERS

If the pipes are not having special ends or plain ends then adaptors make them threaded either male or female whichever is needed. Adaptors are generally used for copper and PVC pipes.

Male adapters contain male threads and **female adapters** contains female threads. One end of adapter is plain which is glued or welded or soldered to the plain pipe end.

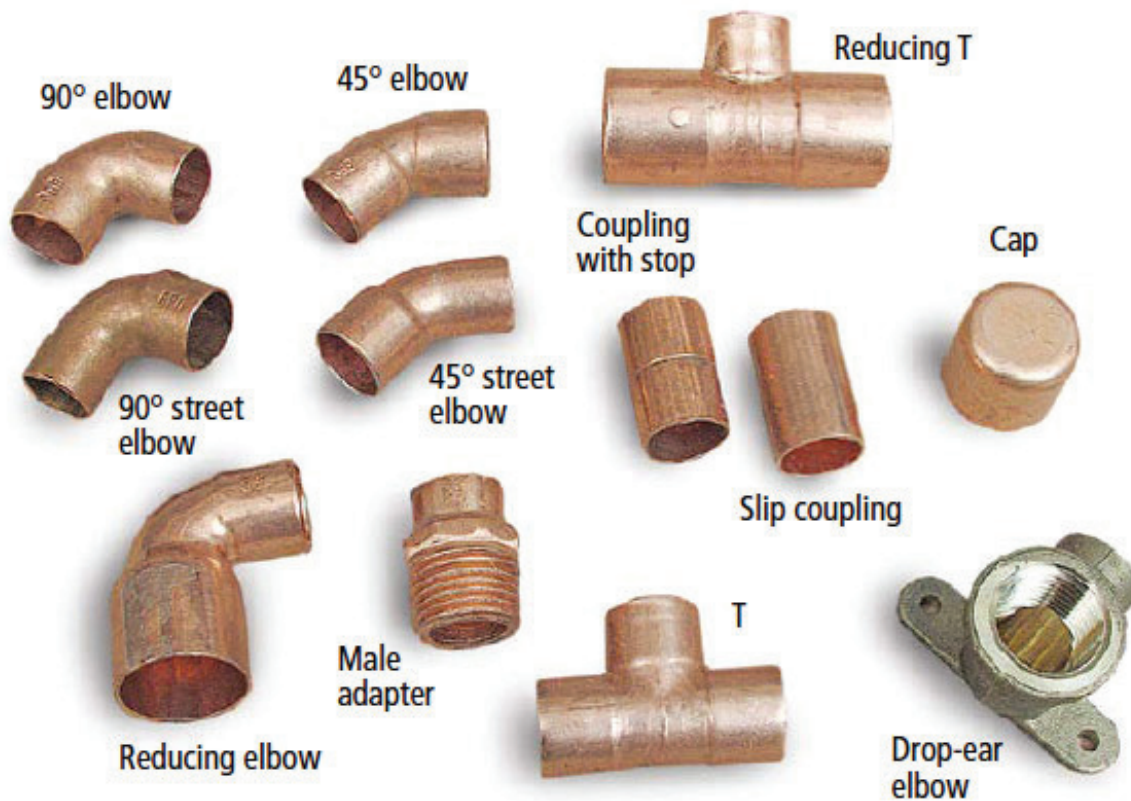
PLUG

It is used to screw on to a threaded opening, for closing it temporarily.

REDUCER

It is used to connect two different sized of pipes.

SUPPLY FITTINGS





**DIPLOMA COURSE IN
ENGINEERING & TECHNOLOGY**

BASIC WORKSHOP PRACTICES

EXERCISE





1000231740	Basic Workshop Practices	L	T	P	C
Practicum		1	0	2	2

PRACTICAL

Ex. No.	Name of the Exercise	Date	Marks	Staff sign.
1	Fitting - Cutting & Filing of a profile			
2	Fitting - Drilling, Reaming, Tapping			
3	Fitting - L-Mating			
4	Wiring – Draw the circuit diagram and connect for the connection of Two lamp, two switch with socket – parallel and series connection.			
5	Wiring - Draw the circuit diagram and connect the connection for Fan switch-regulator.			
6	Wiring - Draw the circuit diagram and connect for the Stair case wiring			
7	Installation of a battery, Charging and testing a Battery with hydrometer			
8	Plumbing - Connect a tap using - PVC pipe, fittings and a tap			
9	Plumbing – Connect the pipe line for the Sink / wash basin			
10	Plumbing - Connect the pipe line for the connection for Rain water harvesting			
TOTAL				
CONVERTERED TO 10				





SINGLE PIECE CUTTING AND FILING

Exercise Number:

DATE:

AIM:

To make a given shape in the given MS flat plate.

RAW MATERIAL REQUIRED:

50 mm X 75 mm X 3 mm M.S. Plate

TOOLS REQUIRED:

1. Bench Vice
2. Try Square
3. Steel rule
4. Prick punch
5. Scriber
6. Ball peen hammer
7. Hacksaw blade with frame
8. Flat file
9. Round file
10. Triangular file
11. Surface plate
12. Surface gauge
13. Vernier height gauge
14. Vernier caliper

PROCEDURE

1. Study the given drawing and dimension.
2. Select the required dimension of raw material.
3. Clamp the given work piece in between the jaws of the bench vice with the surface to be filed remains horizontal and also at the top.
4. The height of projection of the workpiece above the clamp is not to exceed 5 mm in order to minimize vibration and noise during filing operation.
5. Use flat file (rough) for removing excessive material and flat (smooth) file for finishing operation.
6. Carry out filing operation on the top surface of the workpiece without any irregularity in material removal and ensure a perfect flat surface.
7. This new flat surface can be used as one of the reference plane for marking the required dimensions.
8. Unclamp the work piece from the bench vice and clamp it again after tilting the work piece to 90 degrees such that this new surface comes on top, for filing operation.
9. Carry out the filing operation on this new top surface and ensure flatness.



Dimensions

Sl.No	ACTUAL	OBTAINED	VARIATION





10. Check the two right angled surfaces that are filed for perpendicularity using trisquare.
11. Carry out further filing on these two surfaces if required to ensure perpendicularity of its surfaces.
12. Mark the required geometry in the workpiece as per the drawing using steel rule and scribe and punch.
13. Clamp the workpiece in between the jaws of the bench vice.
14. Use a hacksaw frame fitted with a sharp blade to remove the unwanted excess material.
15. Use different files to make the geometry in the workpiece.
16. Measure the dimensions of the finished work pieces and compare it with the required values for accuracy using Vernier caliper / Steel rule.

RESULT:

The required job was completed and dimensions are checked for accuracy.



Drawing





L – JOINT

Exercise Number:

DATE:

AIM:

To make a given L-Joint in the given MS flat plate.

RAW MATERIAL REQUIRED:

50 mm X 75 mm X 3 mm M.S.Plate – 2 Nos.

TOOLS REQUIRED:

1. Bench Vice
2. Try Square
3. Steel rule
4. Scriber
5. Prick punch
6. Ball peen hammer
7. Hacksaw blade with frame
8. Flat file
9. Triangular file
10. Surface plate
11. Surface gauge
12. Vernier height gauge
13. Vernier caliper

PROCEDURE

1. Study the given drawing and dimension.
2. Select the required dimension of raw material.
3. Clamp the given work piece in between the jaws of the bench vice with the surface to be filed remains horizontal and also at the top.
4. The height of projection of the workpiece above the clamp is not to exceed 5 mm in order to minimize vibration and noise during filing operation.
5. Use flat file (rough) for removing excessive material and flat (smooth) file for finishing operation.
6. Carry out filing operation on the top surface of the workpiece without any irregularity in material removal and ensure a perfect flat surface.
7. This new flat surface can be used as one of the reference plane for marking the required dimensions.
8. Unclamp the work piece from the bench vice and clamp it again after tilting the work piece to 90 degrees such that this new surface comes on top, for filing operation.



Dimensions

Sl.No	ACTUAL	OBTAINED	VARIATION





9. Carry out the filing operation on this new top surface and ensure flatness.
10. Check the two right angled surfaces that are filed for perpendicularity using trisquare.
11. Carry out further filing on these two surfaces if required to ensure perpendicularity of its surfaces.
12. Repeat the above procedure for the next work piece also.
13. Mark the required geometry in the work pieces as per the drawing using steel rule and scriber and punch.
14. Clamp the workpiece in between the jaws of the bench vice.
15. Use a hacksaw frame fitted with a sharp blade to remove the unwanted excess material.
16. Use different files to make the geometry in the work pieces.
17. Join the work pieces to fix properly.
18. Measure the dimensions of the finished work pieces and compare it with the required values for accuracy using Vernier caliper / Steel rule.

RESULT:

The required L – Joint was completed and dimensions are checked for accuracy.



Drawing





DRILLING AND TAPPING

Exercise Number:

DATE:

AIM:

To make a given shape in the given MS flat plate.

RAW MATERIAL REQUIRED:

50 mm X 50 mm X 5 mm M.S.Plate – 1 No.

TOOLS REQUIRED:

1. Bench Vice
2. Try Square
3. Steel rule
4. Scriber
5. Prick punch
6. Ball peen hammer
7. Drilling machine
8. Drill bit
9. Tap set
10. Surface plate
11. Surface gauge
12. Vernier height gauge
13. Vernier caliper

PROCEDURE

1. Study the given drawing and dimension.
2. Select the required dimension of raw material.
3. Clamp the given work piece in between the jaws of the bench vice with the surface to be filed remains horizontal and also at the top.
4. The height of projection of the workpiece above the clamp is not to exceed 5 mm in order to minimize vibration and noise during filing operation.
5. Use a rough flat file for removing excessive material and a smooth flat file for finishing.
6. Carry out filing operation on the top surface of the workpiece without any irregularity in material removal and ensure a perfect flat surface.
7. First drill a hole equal to the core diameter of the thread. This diameter is known as the tapping size and is mathematically or as per the table of reference.

Dimensions

Sl.No	ACTUAL	OBTAINED	VARIATION



8. After drilling a hole of the required size, the taper tap is fixed in the tap wrench and screwed into the hole. Before the start of the tapping operation the screw position must be adjusted until it stands square with the tap surface of the work.
9. Apply a little oil on the tap for all materials except cast iron, because lubrication improves the surface finish of the threads and cast iron is self lubricating material.
10. Start the cutting action keeping in mind that the tap is not turned continuously but after every half turn it should be reversed slightly to clear the threads.
11. Proceed till the taper tap is through to the hole.
12. While tapping a blind hole the tap should be withdrawn every time and the metal should be cleared from the bottom of the hole.
13. Repeat the above operations with the middle tap and finishing tap to finish the hole.
14. This new flat surface can be used as one of the reference plane for marking the required dimensions.
15. Unclamp the work piece from the bench vice and clamp it again after tilting the work piece to 90 degrees such that this new surface comes on top, for filing operation.
16. Carry out the filing operation on this new top surface and ensure flatness.
17. Check the two right angled surfaces that are filed for perpendicularity using trisquare.
18. Carry out further filing on these two surfaces if required to ensure perpendicularity of its surfaces.
19. Mark the required centres in the workpiece as per the drawing using steel rule and scribe and punch.
20. Clamp the workpiece in between the jaws of the vice.
21. Use a drilling machine to make the required drills.
22. Use the tap set to make the internal thread in the drills in steps (1ST, 2ND, 3RD TAPS).
23. Measure the dimensions of the finished work pieces and compare it with the required values for accuracy using Vernier caliper / Steel rule.

RESULT:

The required job was completed and dimensions are checked for accuracy



Circuit Diagram



TWO LAMP CONTROLLED BY TWO SWITCH WITH SOCKET OUTLET (SERIES AND PARALLEL CONNECTION)

Exercise No:

Date:

AIM:-

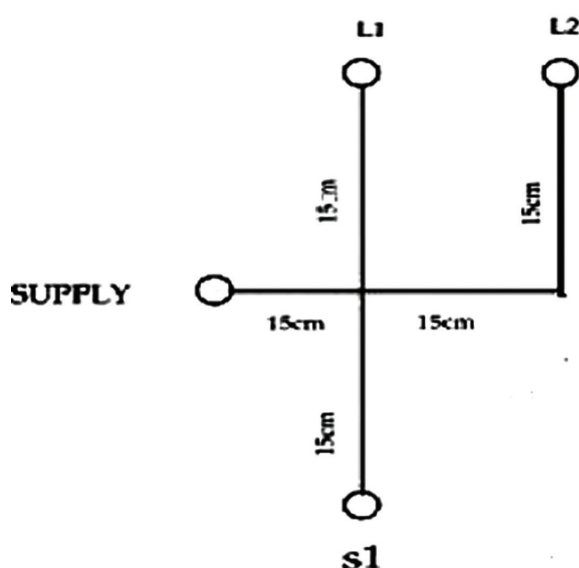
To wire up a circuit in conduit system two lamps and a socket out let each controlled by series and parallel connection

TOOLS AND INSTRUMENTS REQUIRED

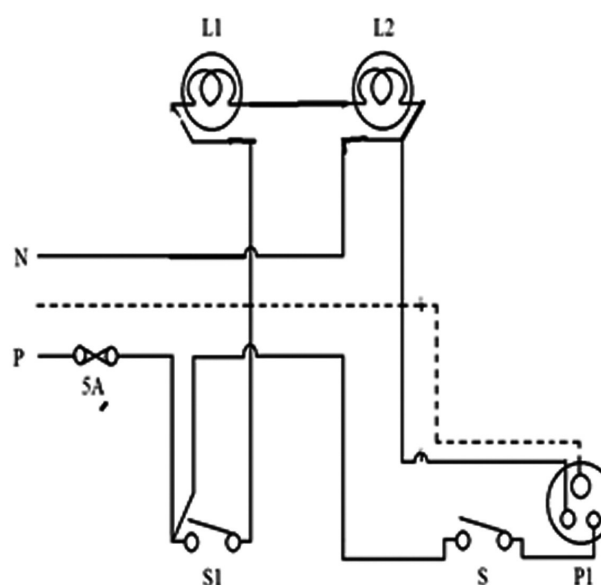
1	Steel rule 300mm	1 No.
2	Combination Plier 200mm	1 No.
3	Electricians Knife	1 No.
4	Screw driver 200mm, 10mm tip	1 No.
5	Ball peen hammer 220gm	1 No.
6	Gimlet 25mm	1 No.
7	Neon tester 0-500V	1 No.
8	Wire stripper	1 No.
9	Firmer chisel 5/8"	1 No.

TWO LAMPS CONNECTED IN SERIES WITH SOCKET

LAYOUT



CONNECTION DIAGRAM

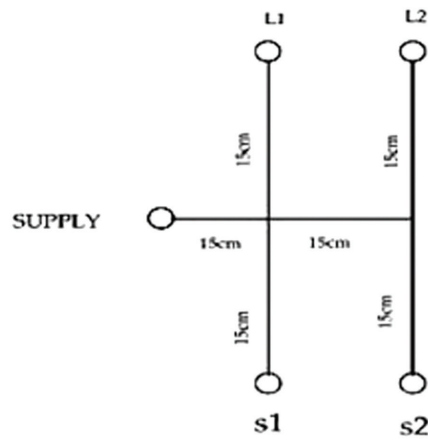




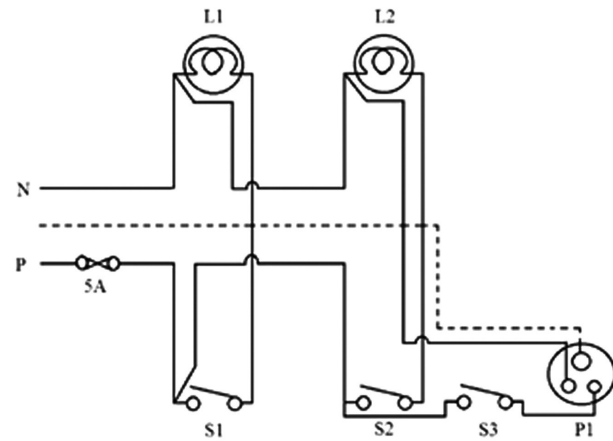


TWO LAMPS CONNECTED IN PARALLEL WITH SOCKET

LAYOUT



CONNECTION DIAGRAM



PROCEDURE:-

1. Draw the layout and connection diagram.
2. Collect the required wiring materials.
3. Connect the required materials on the work board as per connection diagram.
4. Check the circuit for continuity.
5. Given the supply to the circuit after checking.
6. Finish the work neatly and correctly.

RESULT:-

Wired up a circuit in conduit system two lamps and a socket out let each controlled by series and parallel connection.



Circuit Diagram



DRAW THE CIRCUIT DIAGRAM AND CONNECT THE CONNECTION FOR FAN SWITCH-REGULATOR

Exercise No:

DATE:

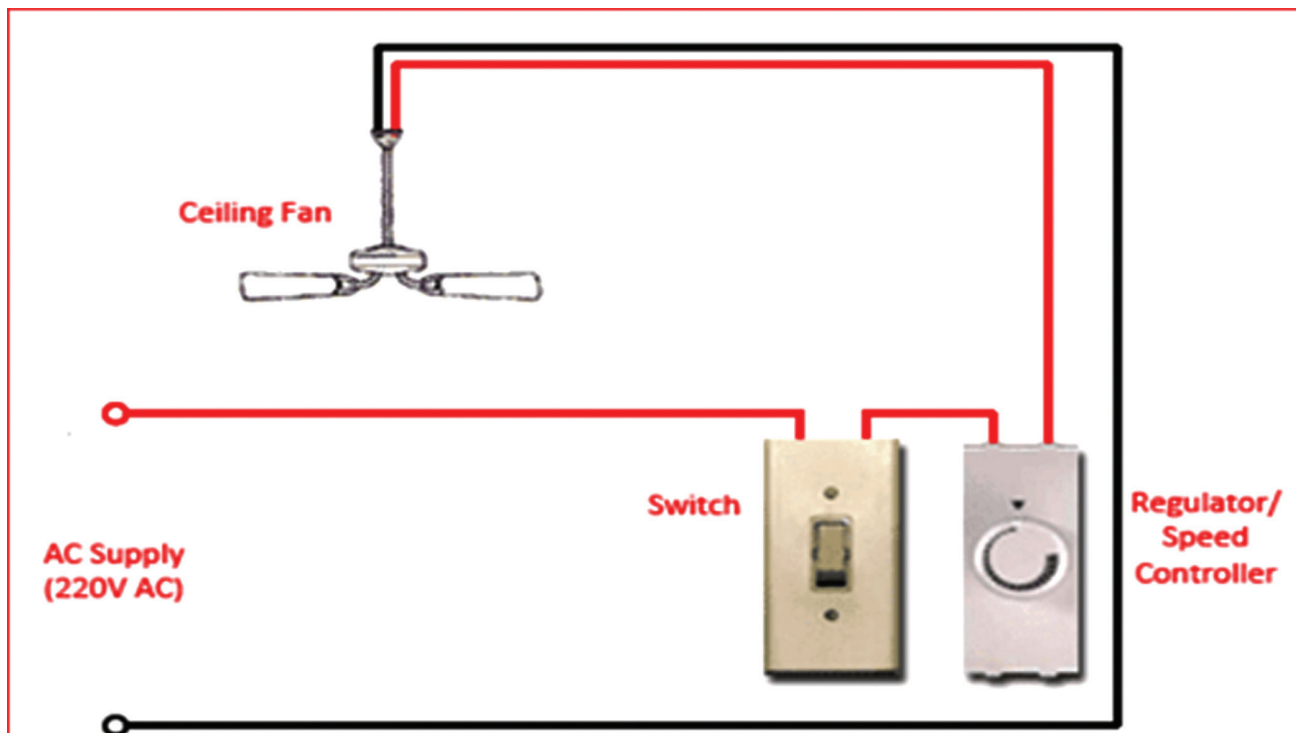
AIM:-

To draw the circuit diagram and connect the connection for fan switch-regulator

TOOLS AND INSTRUMENTS REQUIRED

1	Steel rule 300mm	1 No.
2	Combination Plier 200mm	1 No.
3	Electricians Knife	1 No.
4	Screw driver 200mm, 10mm tip	1 No.
5	Ball peen hammer 220gm	1 No.
6	Gimlet 25mm	1 No.
7	Neon tester 0-500V	1 No.
8	Wire stripper	1 No.
9	Firmer chisel 5/8"	1 No.

CONNECTION DIAGRAM







PROCEDURE:-

1. Draw the layout and connection diagram.
2. Collect the required wiring materials.
3. Connect the required materials on the work board as per connection diagram.
4. Check the circuit for continuity.
5. Given the supply to the circuit after checking.
6. Finish the work neatly and correctly.

RESULT:-

Wired up and checked the connection for fan switch-regulator.



Circuit Diagram





STAIRCASE WIRING

Exercise No:

Date:

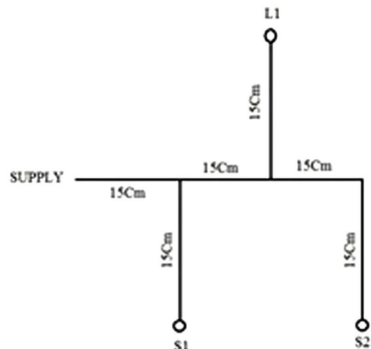
AIM:-

To wire up a circuit in conduit system one lamp controlled by two switches (stair case wiring) in two different places.

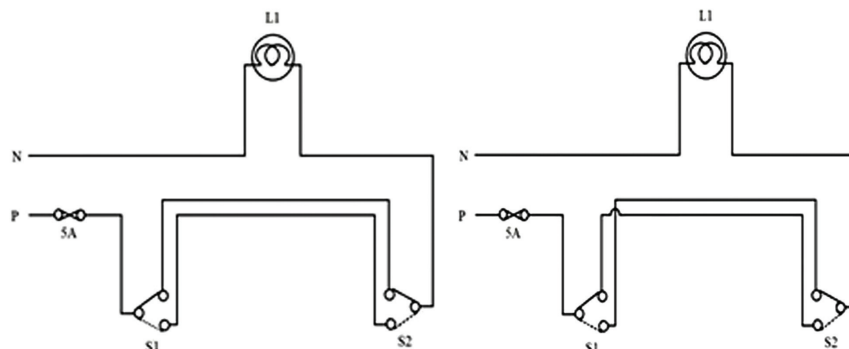
TOOLS AND INSTRUMENTS REQUIRED

1	Steel rule 300mm	1 No.
2	Combination Plier 200mm	1 No.
3	Electricians Knife	1 No.
4	Screw driver 200mm, 10mm tip	1 No.
5	Ball peen hammer 220gm	1 No.
6	Gimlet 25mm	1 No.
7	Neon tester 0-500V	1 No.
8	Wire stripper	1 No.
9	Firmer chisel 5/8"	1 No.

LAY OUT



CONNECTION DIAGRAM



ESTIMATE:-

CONDITIONS		
S1	S2	L1
OFF	OFF	DARK
ON	OFF	BRIGHT
ON	ON	DARK
ON	OFF	BRIGHT
OFF	OFF	DARK

CONDITIONS		
S1	S2	L1
OFF	ON	DARK
ON	OFF	BRIGHT
OFF	ON	DARK
OFF	OFF	BRIGHT
ON	OFF	DARK





PROCEDURE:-

1. Draw the layout and connection diagram.
2. Collect the required wiring materials.
3. Connect the required materials on the work board as per connection diagram.
4. Check the circuit for continuity.
5. Given the supply to the circuit after checking.
6. Finish the work neatly and correctly.

RESULT:-

Wired up a circuit in conduit system one lamp controlled by two switches (stair case wiring) in two different places





INSTALLATION OF A BATTERY, CHARGING AND TESTING A BATTERY WITH HYDROMETER

Exercise No.

Date:

AIM:-

To Installation of a battery, Charging and testing a Battery with hydrometer

TOOLS AND INSTRUMENTS REQUIRED

1	Steel rule 300mm	1 No.
2	Combination Plier 200mm	1 No.
3	Electricians Knife	1 No.
4	Screw driver 200mm, 10mm tip	1 No.
5	Ball peen hammer 220gm	1 No.
6	Gimlet 25mm	1 No.
7	Neon tester 0-500V	1 No.
8	Wire stripper	1 No.
9	Firmer chisel 5/8"	1 No.

PROCEDURE:

Battery installation

1. The positive and negative terminal nuts and bolts of the battery are cleaned with cleaning brush and loosened using appropriate spanners.
2. The positive cable is first connected with the positive terminal of the battery.
3. Then the negative or earth cable is connected with the negative terminal of the battery.
4. The nuts on both the terminals are tightened securely.
5. The vent caps are removed from the battery cells and filled with sufficient distilled water.
6. The battery is placed in a secured place.

Battery charging

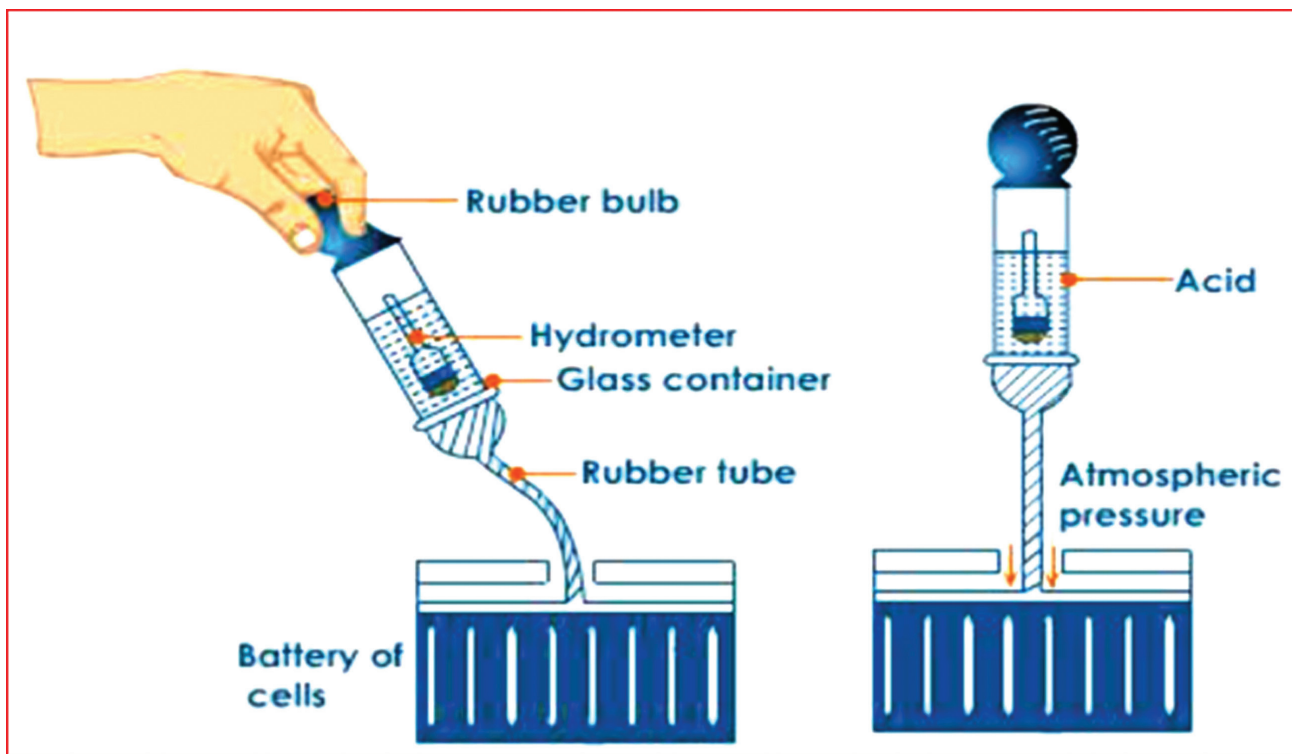
The charging of battery is done under two methods:

- (i) Constant ampere method: In this method, the current input to the battery is kept at a constant value. The batteries are connected in series while charging.
- (ii) Constant voltage method: In this method, the voltage input to the battery is kept at a constant value. The batteries are connected in parallel while charging.



1. SPECIFIC GRAVITY TEST (HYDROMETER TEST)

A hydrometer is an instrument used to measure the specific gravity (or relative density) of liquids; that is, the ratio of the density of the liquid to the density of water. A hydrometer is usually made of glass and consists of a cylindrical stem and a bulb weighted with mercury or lead shot to make it float upright. When bulb is squeezed and the pointed rubber tube is inserted in to the cell, then the bulb is released to suck the electrolyte in the glass tube the float in the tube indicates specific gravity.



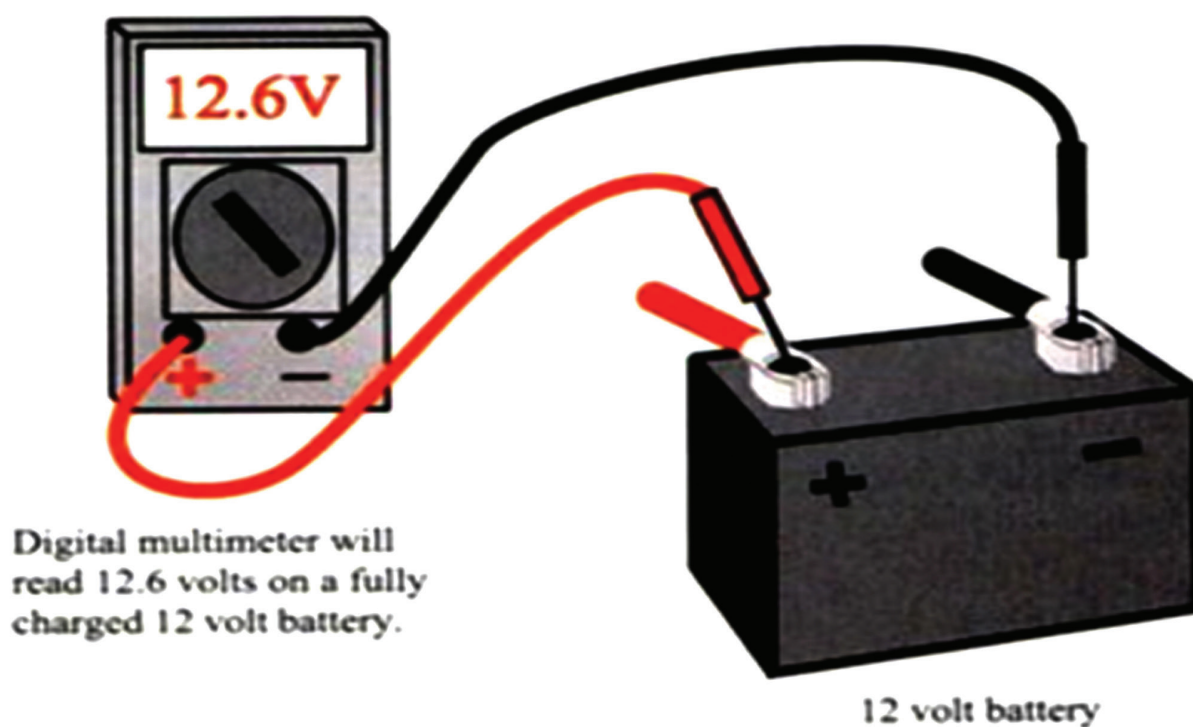
Cell No	Specific Gravity Reading	State of Charge of Battery	Cell Voltage



2. OPEN CIRCUIT VOLTAGE TEST

To conduct this test very accurate and sensitive voltmeter is required in this test. Open voltage of each cell is taken. Voltage of a lead acid cell is 2v. A new battery indicates charge near 2.2v. The batteries which have been just charged should not be tested with +ve voltmeter because of gases in the container will cause high reading. Battery should be allowed to stand for sufficient no of hours after charging to prevent the dissipation of the gases before the test is conducted.

Open Circuit Volts	Percent of Charge
11.7 volts or less	0%
12.0	25%
12.2	50%
12.4	75%
12.6 or more	100%



RESULT:-

Installation, charging and testing for a given battery with hydrometer was carried out.



LAYOUT





CONNECT A TAP USING- PVC PIPE FITTINGS AND A TAP

Exercise No:

Date:

Aim

To prepare a pipe line connection for the installation of the tap.

Material Required

- PVC pipe
- Elbows
- Flexible pipe
- Valve
- Clamps
- Tap
- Gate valve
- Tee Joint
- Solvent

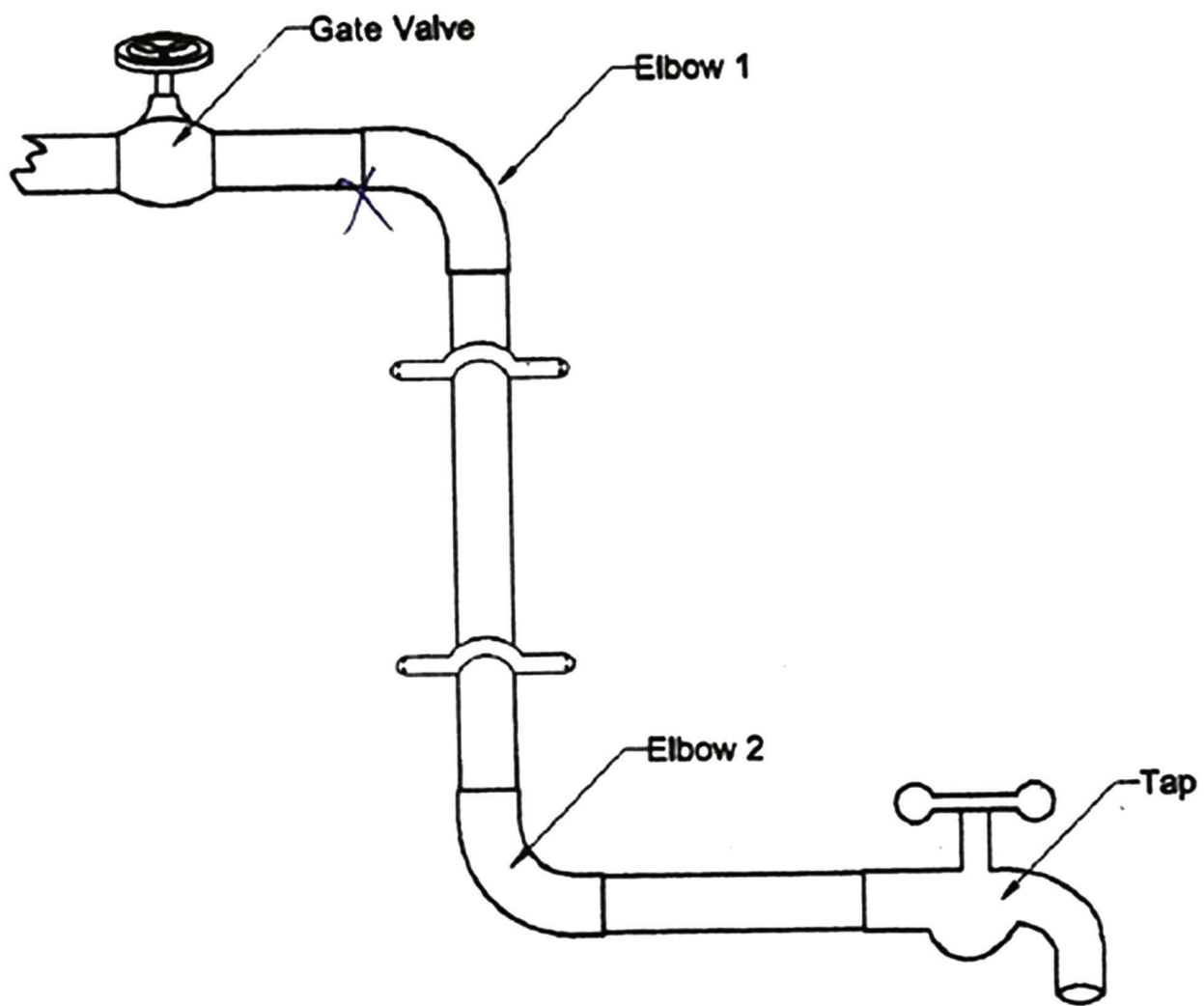
Tools Required

- Pipe wrench
- Hammer
- Screw driver
- Hack saw

Procedure

- Prepare the piping layout for fitting the tap.
- Make the tee and elbow connections in the main pipe line to connect it to the taps
- Fix the gate valve near the water tank
- Connect all the pipe fittings as per the diagram
- Apply the solvent and assemble the components together to complete the required pipeline work.
- The water tank was filled with water and the gate valve was opened slowly to supply water into the pipe line
- The tap were opened to check its function.





PIPELINE TO TAP LAYOUT

Result

Thus the water tap is installed using PVC pipe.





LAYOUT





CONNECT THE PIPELINE FOR THE SINK/WASH BASIN.

Exercise No:

Date:

Aim:

To install a sink / washbasin with tap using different PVC/GI pipe accessories such as bend, tee and gate valve.

Materials required

- Wash basin / Sink
- Gate valve
- Bend
- Tee
- Pipes (PVC / GI) Tap
- Screws
- Flexible drain pipe
- Solutions / Thread and Shellac
- Tools required
- Pipe cutter / Hack saw
- Pipe Vice Pipe wrench Pliers Hammer
- Measuring tape
- Drilling machine
- Chisel

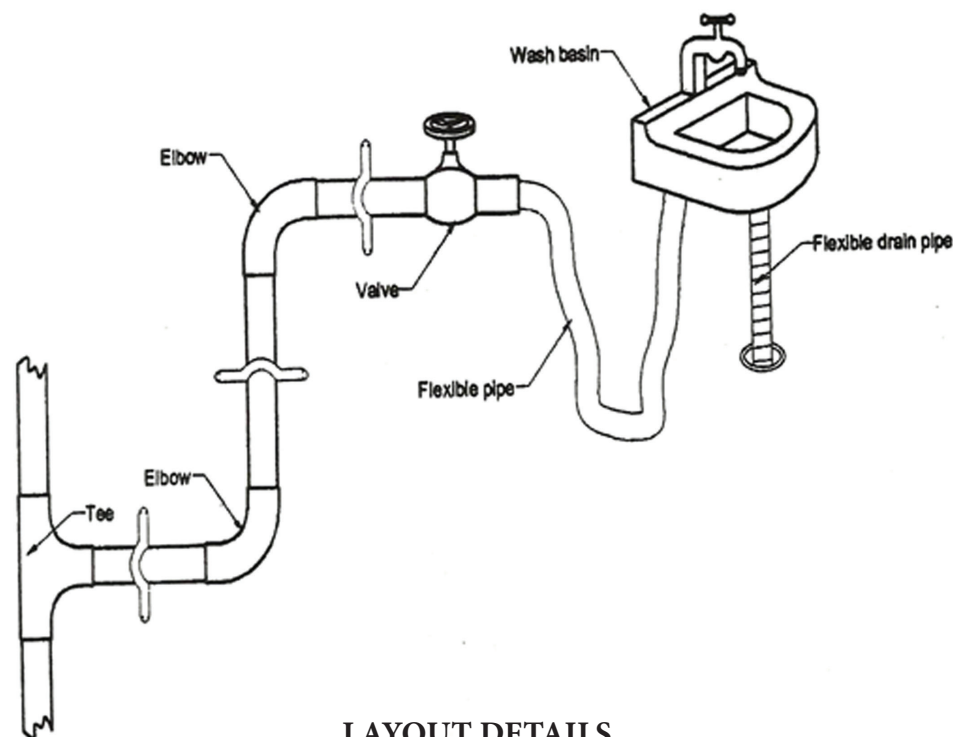
Procedure

- Measure and draw out where the wash basin will be with the help of chalk.
- Draw a line where you would like the top of the wash basin to be.
- Now draw circles where you need to make holes in the wall for the tubes to go through. Use a hand drilling machine, chisel and hammer to make these holes.
- Some wash basins come with a readymade bracket, if not then we have to make one.
- Attach brackets to either end, so that it can be screwed to the wall to support the weight of the wash basin.
- Drill the wash basin to the wall.
- Place the bracket under the wash basin so that it is taking the weight and then drill it in place.

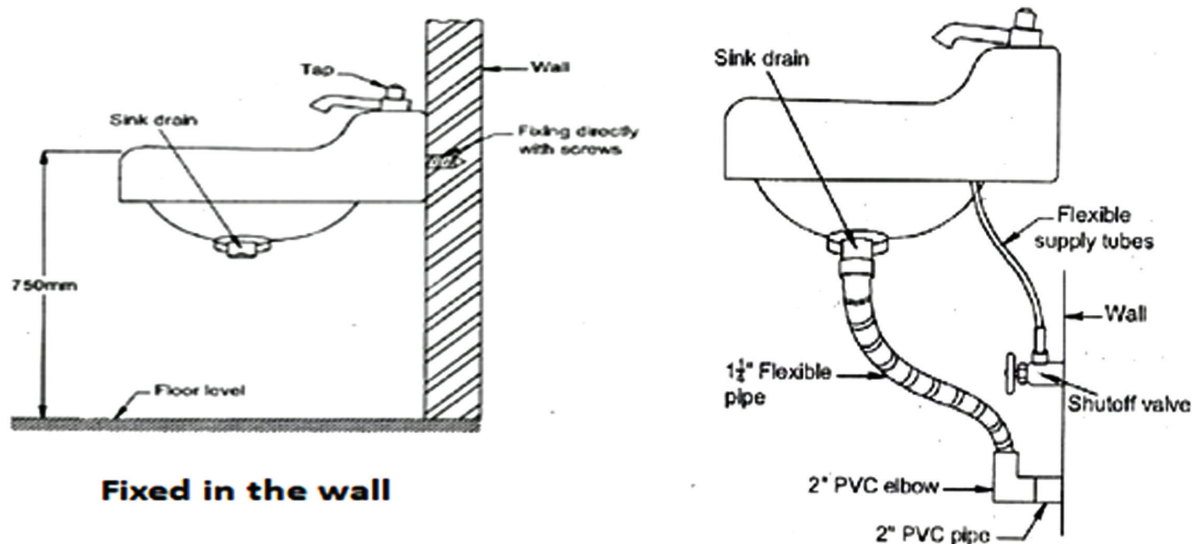




- Unscrew the C.P Waste coupling by removing the locking nut and rubber washer.
- Place the C.P waste fitting in the circular waste hole at the bottom of the basin. This is fitted in place by screwing the rubber washer followed by the locking nut under the basin.
- Attach the flexible PVC waste pipe to the C.P Waste fitting.
- Attach the flexible piping to the PVC internal piping with adhesive to prevent leakages and ensure water tight joints.
- Connect the pipe line with valve with the existing pipe work. Finally attach the tap.
- Turn the water back on and check that the taps are working without any leaks.



LAYOUT DETAILS



Result: Thus the sink/Wash basin is fixed along with tap with required accessories



LAYOUT



CONNECT THE PIPELINE FOR THE COLLECTION OF RAIN WATER HARVESTING

Exercise No:

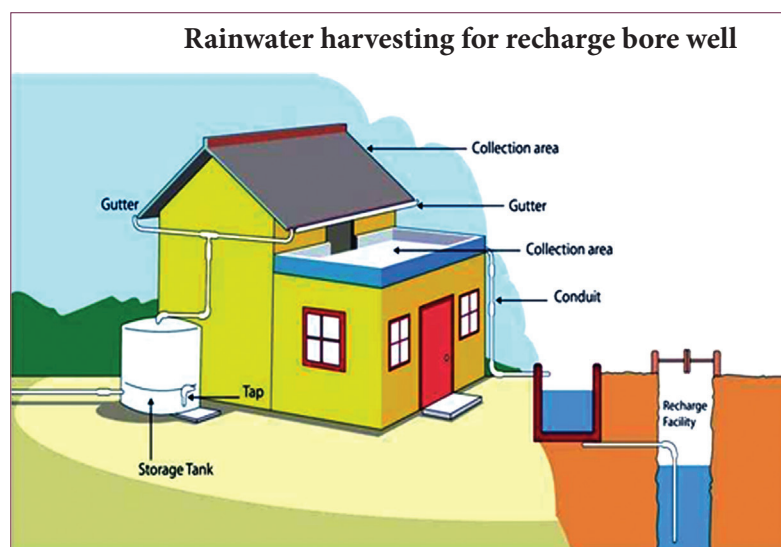
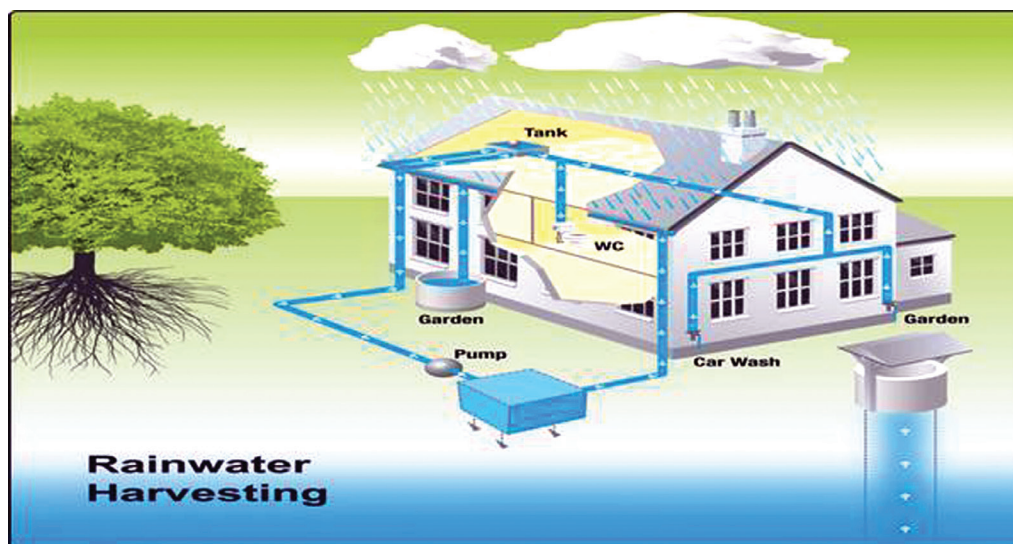
Date:

Aim:

To lay the pipeline for the collection of rain water in a building.

Materials required

- Bend
- Tee
- Stop valve
- PVC Pipes
- Elbow
- Coupler
- Pipe Vice
- Pipe wrench
- Pliers
- Filter Chambers / Sump
- Recharge well / Percolation pits
- Tools required
- Hammer
- Spanners
- Cutting plier
- Screw driver
- Hack saw / Pipe cutter
- Hand drilling machine



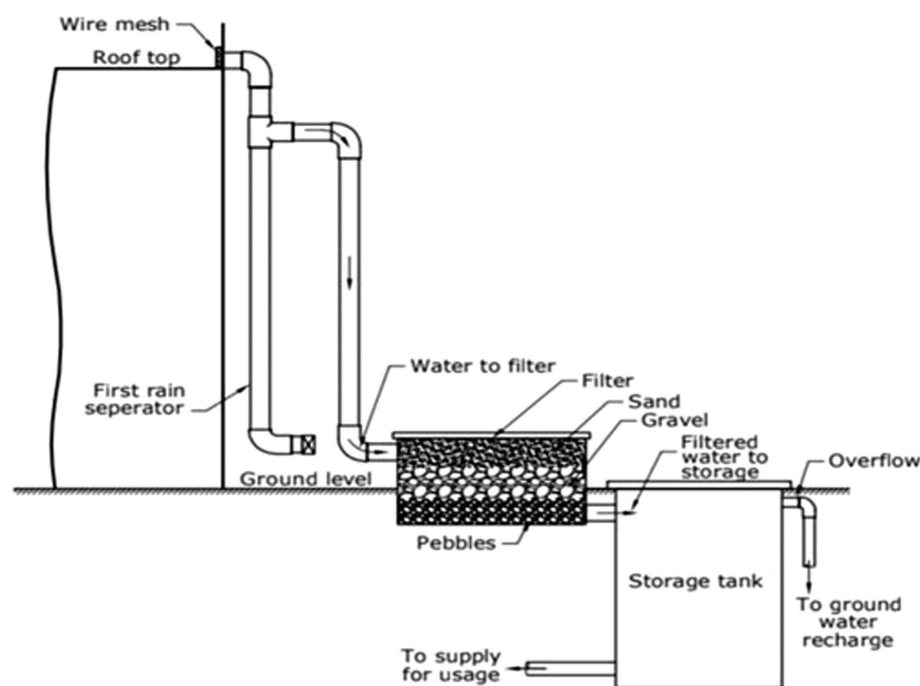
Procedure

- In houses with sloping roofs the rain water may be collected to the PVC pipes fitted along the sloping sides and it may be directed to either sump/open well/bore well or recharge well.
- For the houses with RCC check the rain water drain pipes extend up to the bottom of the building.
- Interconnect the rainwater drain pipes if there is more than one.
- Construct a filter chamber to collect rainwater in a sump.





- The bottom half of the filter chamber has to be filled either with broken bricks / pebbles and followed by one feet of coarse river sand.
- A nylon mesh has to be provided in between the two layers.
- The top portion of the filter chamber should be covered with RCC slab.
- The inlet rainwater drain pipe should be on the top of the filter chamber and the outlet pipe connecting the filter chamber to the sump should be at the bottom.
- Surplus water from the sump may be connected to the recharge well.
- In the absence of sump, filter chamber may be connected to the existing open well / bore well.
- In the absence of sump, open well and bore well the rain water may be recharged through percolation pits and the bottom of pit should be in the sandy formation.
- Lay pipe lines according to the requirement.
- Use bend, tee, sleeve and flanges to connect the water line to the chamber.
- Measure and cut the pipes as per the requirement.
- Join the pipes firmly using proper solutions.
- Provide a wire mesh at the entry of pipe in the roof top.
- Fill filtering elements in the filter chamber and clean periodically.



Layout for rainwater harvesting

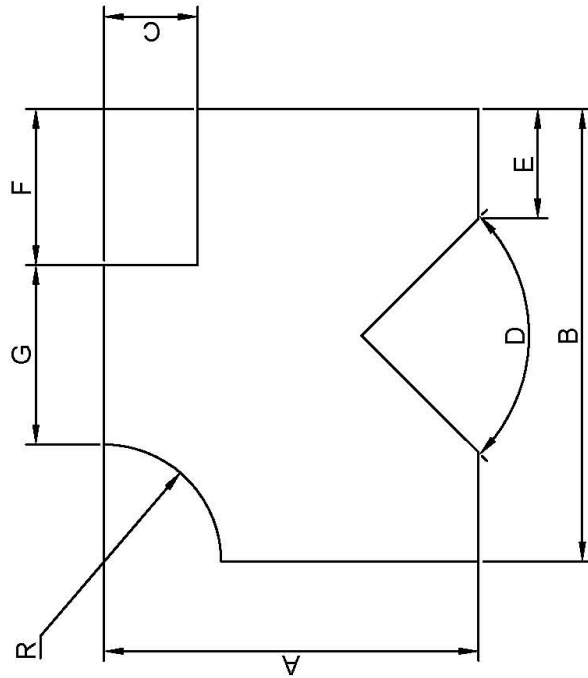
Result:

The rainwater harvesting system was connected with pipes in the building as per the requirement and the accuracy is checked.

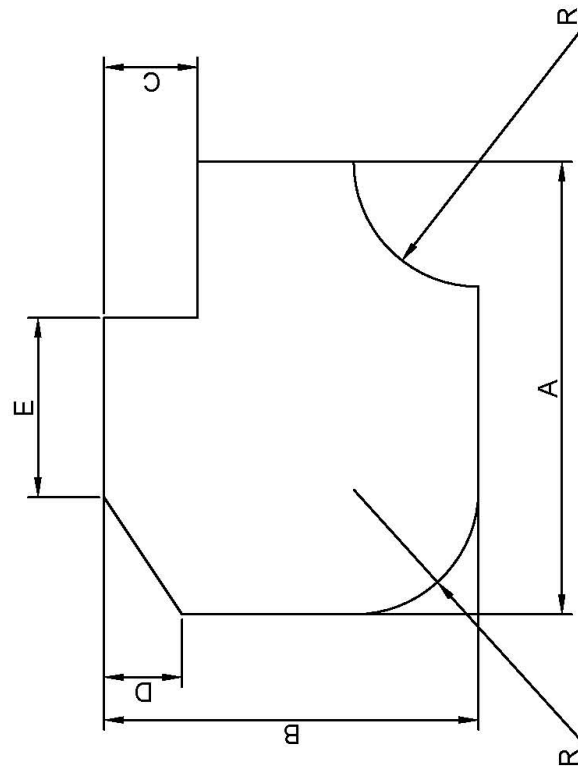


SAMPLE EXERCISE DRAWING - 1A:

CUTTING AND FILING OF A PROFILE



All Dimensions are in "mm"

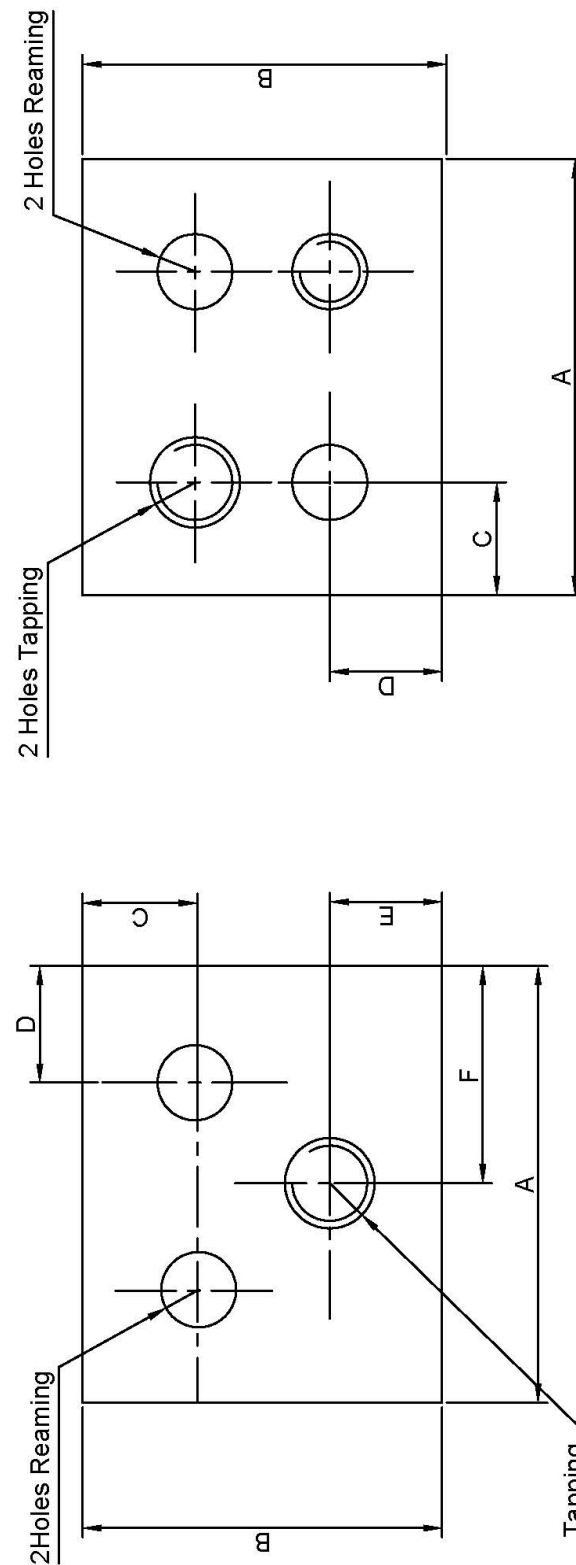


Raw Material : 70 X 50 X 3 mm



SAMPLE EXERCISE - 2A:

DRILLING, REAMING AND TAPPING

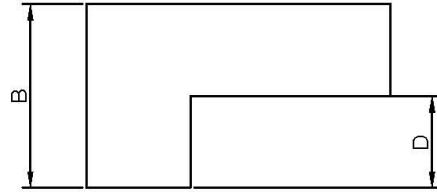


All Dimensions are in "mm"

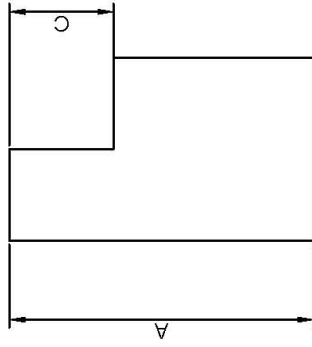
Raw Materials : 50 X 50 X 6 (or) 10 mm



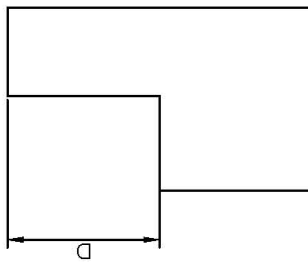
SAMPLE EXERCISE - 3A:



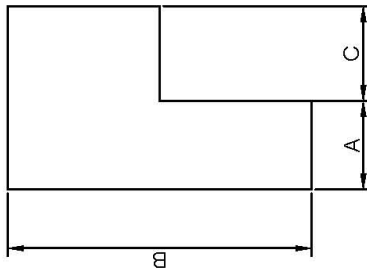
All Dimensions are in"mm"



"L" MATING



Raw Materials : 70 X 50 X 3 mm





BASIC WORKSHOP PRACTICES

QUESTION BANK

UNIT I

1. Which one is the personal safety?
 - A. Keep the machine clean
 - B. Concentrate on your work
 - C. Keep the gang way and floor clean
 - D. Keep the tools at their proper place

2. Name the warning sign.



- A. School
 - B. Guarded
 - C. Unguarded
 - D. Pedestrian crossing
3. Which comes under mechanical occupational hazards?
 - A. Noise
 - B. Toxic
 - C. Unskilled
 - D. Unguarded machinery
4. What is the name of sign?



- B. Guarded
 - C. Unguarded
 - D. Pedestrian crossing
5. What is the first step of avoiding accident in work place?
 - A. By wearing safety equipment
 - B. Doing things in one's own way
 - C. By observing safety precautions
 - D. Doing things with a highly skilled working practice



6. The following safety sign is used for _____.



- A. emergency phone
 - B. danger of high voltage
 - C. first aid station
 - D. emergency exit
7. What is the English equivalent of the Japanese word 'Seiri'?
- A. Sorting out
 - B. Systematic arrangement
 - C. Standardizing
 - D. Self-discipline
8. What is the English equivalent of the Japanese word 'Seiton'?
- A. Sorting out
 - B. Systematic arrangement
 - C. Standardizing
 - D. Self-discipline
9. Which of the following from the 5S technique means 'to separate out all unnecessary things and eliminate them'?
- A. Seiri
 - B. Seiton
 - C. Seiso
 - D. Seiketsu
10. What is the English equivalent of the Japanese word 'Seiso'?
- A. Sorting out
 - B. Systematic arrangement
 - C. Scrub, shine, sweep
 - D. Self-discipline
11. What is the English equivalent of the Japanese word 'Shitsuke'?
- A. Sorting out
 - B. Systematic arrangement
 - C. Standardizing
 - D. Self-discipline
12. Accidents are
- A. Preventable
 - B. Costly
 - C. part of life
 - D. Both A & B



13. **Which of the following situations can cause an accident?**
- A. Asking a supervisor how to work
 - B. Drinking coffee
 - C. Not getting a good sleep before work
 - D. While having lunch
14. **What will be your first step if a fire occurs in cables due to a short circuit in the machine?**
- A. Use ABC fire extinguisher
 - B. Use Co2 Fire Extinguisher
 - C. Switch Off Power supply
 - D. Runaway
15. **Electrical Shock can cause**
- A. Chemical sensitivity
 - B. Blindness
 - C. Hearing loss
 - D. Death
16. **Safety signs provide**
- A. Information about hazardous area
 - B. warning
 - C. Caution information
 - D. All of the above
17. **Full form of PPE**
- A. Personal Protective engineering
 - B. Preventive protective equipment
 - C. Personal protective equipment
 - D. Perfect protective equipment
18. **Most accidents are caused by**
- A. People
 - B. Equipment's
 - C. Poor illumination
 - D. Bad weather
19. **For Class B Fire most suitable extinguishing media is**
- A. Water & Water –CO2 Fire extinguisher
 - B. CO2 Gas type fire extinguisher
 - C. Foam Type fire extinguishers
 - D. DCP Type
20. **In an electrical fire which types of fire extinguishers are most preferred**
- A. DCP
 - B. CO2
 - C. Foam
 - D. Water CO2



UNIT II

1. **The maximum and minimum permissible sizes within which the actual size of a component lies are called**
 - A. Fits
 - B. Limits
 - C. Tolerances
 - D. Allowances

2. **The difference between the upper (maximum) limit and lower (minimum) limit of a dimension refers.**
 - A. Fits
 - B. Limits
 - C. Tolerances
 - D. Allowances

3. **The degree of tightness or looseness between two mating parts are.**
 - A. Fits
 - B. Limits
 - C. Tolerances
 - D. Allowances

4. **The symbol refers to**



- A. Flatness
 - B. Parallel
 - C. Straight ness
 - D. Angularity

5. **The symbol refers to**



- A. Surface profile
 - B. Cylindricity
 - C. Circularity
 - D. Concentricity

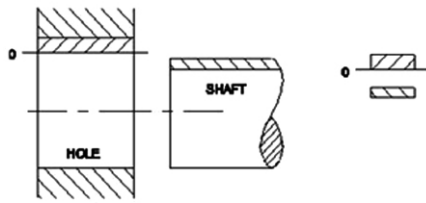
6. **The symbol refers to**



- A. Runout
 - B. Location
 - C. Datum
 - D. Orientation



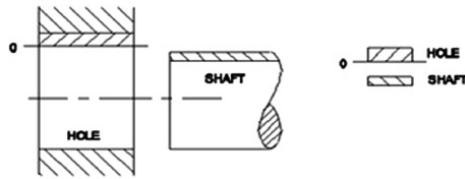
7. What is the name of the fit?



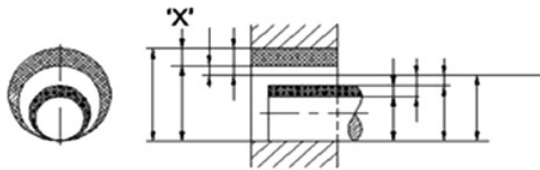
- A. Transition fit
 - B. Clearance fit
 - C. Shrinkage fit
 - D. Interference fit
8. What is the term of the algebraic difference between a size, to its corresponding basic size?
- A. Deviation
 - B. Upper deviation
 - C. Lower deviation
 - D. Actual deviation
9. What is the difference between maximum limit of size and the minimum limit of size?
- A. Tolerance
 - B. Basic size
 - C. Limits of size
 - D. Upper deviation
10. What is the maximum limit of size if the basic size of the hole is 25 mm and the deviation is $\pm 0.2\text{mm}$?
- A. 25.2 mm
 - B. 24.8 mm
 - C. 25.02 mm
 - D. 24.08 mm
11. Which type of fit, the tolerance zone of hole is below the tolerance zone of shaft?
- A. Transition fit
 - B. Clearance fit
 - C. Shrinkage fit
 - D. Interference fit
12. Which term indicates the algebraic difference between the actual size and its corresponding basic size?
- A. Deviation
 - B. Actual deviation
 - C. Upper deviation
 - D. Lower deviation



13. What is the type of fit, if the maximum size hole is larger than minimum size of shaft?



- A. Shrinkage fit
B. Transition fit
C. Clearance fit
D. Interference fit
14. What is marked as X in hole basic system?



- A. Tolerance
B. Maximum dia
C. Lower deviation
D. Upper deviation
15. Which of the following represents a form tolerance?
- A. Flatness
B. Parallelism
C. Concentricity
D. Total run out
16. _____ is a type of geometric tolerance applied to limit the direction of a feature in relation to other features in an assembly.
- A. Unilateral tolerance
B. Form tolerance
C. Positional tolerance
D. Orientation tolerance
17. A shaft has dimension diameter 35 (-0.009 to -0.025). The respective values of fundamental deviation and tolerance are
- A. $-0.025, \pm 0.008$
B. $-0.025, 0.016$
C. $-0.009, \pm 0.008$
D. $-0.009, 0.016$



18. In the unilateral system of tolerance, tolerance is allowed on
- A. One side of the actual size
 - B. One side of the nominal size
 - C. Both sides of the actual size
 - D. Both sides of the nominal size
19. A 50 mm diameter shaft is made to rotate in the bush. The tolerances for both shaft and bush are 0.050 mm. The shaft and bush to give a maximum clearance of 0.075 mm with the hole basis system. What is the high limit of hole?
- A. 50.00
 - B. 50.05 mm
 - C. 49.05
 - D. 49.925
20. A 50 mm diameter shaft is made to rotate in the bush. The tolerances for both shaft and bush are 0.050 mm. The shaft and bush to give a maximum clearance of 0.075 mm with the hole basis system. What is the high limit of shaft?
- A. 50.00
 - B. 50.05 mm
 - C. 49.05
 - D. 49.925

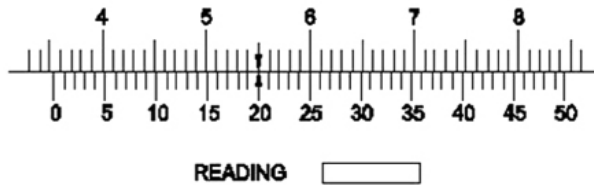


UNIT III

1. What is the use of a try square?

- A. To check right angle
- B. To check acute angle
- C. To check obtuse angle
- D. To check straight angle

2. What is the reading of a vernier caliper?



- A. 35.1 mm
- B. 35.2 mm
- C. 35.3 mm
- D. 35.4 mm

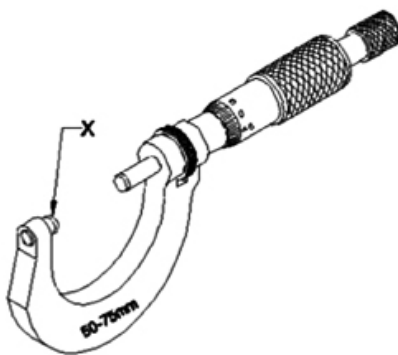
3. What is the use of feeler gauge?

- A. Check the width
- B. Check the height
- C. Check the length
- D. Check the gap between the mating parts.

4. Which caliper is used to mark the centre of round bar?

- A. Jenny caliper
- B. Inside caliper
- C. Outside caliper
- D. Firm joint caliper

5. Name the part marked as x.

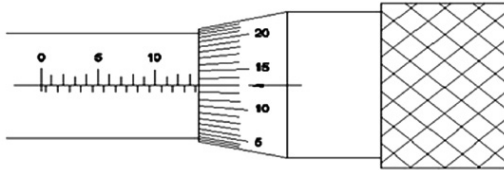


- A. Anvil
- B. Thimble
- C. Spindle
- D. Spindle lock

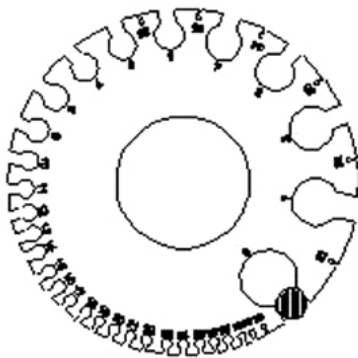




6. What is the name of the caliper having one leg with an adjustable divider point and other leg is bent?
- A. Jenny caliper
 - B. Inside caliper
 - C. Outside caliper
 - D. Spring joint caliper
7. What is the reading of the outside micrometer 50 to 75mm?



- A. 63.63 mm
 - B. 63.00 mm
 - C. 63.36 mm
 - D. 63.13 mm
8. Which gauge is used to check the gap between the mating parts?
- A. Slip gauge
 - B. Plug gauge
 - C. Feeler gauge
 - D. Radius gauge
9. Which material is used to clean the slip gauge?
- A. Wax
 - B. Kerosene
 - C. Soluble oil
 - D. Carbon tetra chloride
10. What is the name of gauge?



- A. Drill gauge
- B. Centre gauge
- C. Profile gauge
- D. Standard wire gauge



11. **What is the purpose of feeler gauge?**
- A. Check the depth of drilled hole
 - B. Check the pitch of screw thread
 - C. Check the radius of work piece
 - D. Check the gap between the mating parts
12. **What is the act of joining the slip gauges together for building up sizes?**
- A. Glazing
 - B. Pinning
 - C. Loading
 - D. Wringing
13. **What material is used to make sine bar?**
- A. Invar steel
 - B. High speed steel
 - C. High carbon steel
 - D. Stabilized chromium steel
14. **How the length of sine bar is specified?**
- A. Distance between outer point of roller
 - B. Distance between inner point of roller
 - C. Distance between centre point of rollers
 - D. Distance between the edges of sine bar
15. **What is the instrument is used to measure Electric current?**
- A. Volt meter
 - B. Ammeter
 - C. Wattmeter
 - D. None of the above
16. **What is the instrument is used to measure Electric Energy?**
- A. Volt meter
 - B. Energy meter
 - C. Wattmeter
 - D. None of the above
17. **A wire gauge is used to measure.**
- A. length of the wire
 - B. area of the wire
 - C. diameter of the wire
 - D. thickness of insulation of a wire
18. **The digital multi-meters are used to measure _____ current?**
- A. AC
 - B. DC
 - C. Both A and B
 - D. None of the above



19. Ammeter is connected in ----- with the circuit.

- A. parallel
- B. series
- C. series - parallel
- D. All of the above

20. Voltmeter is connected in ----- with the circuit.

- A. parallel
- B. series
- C. series - parallel
- D. All of the above

21. What is the unit of Electric Current?

- A. Volts
- B. Ohms
- C. Amps
- D. None of the above

22. What is the unit of Voltage?

- A. Volts
- B. Ohms
- C. Amps
- D. None of the above

23. What is the unit of Power?

- A. Volts
- B. Watts
- C. Kwh
- D. None of the above

24. What is the unit of Energy?

- A. volts
- B. Watt hour
- C. Watts
- D. None of the above

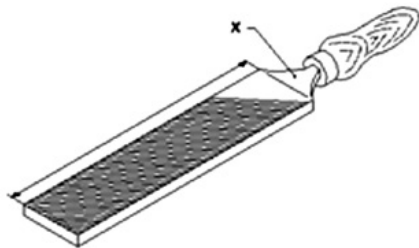
25. What is the unit of resistance?

- A. volts
- B. Ohms
- C. Amps
- D. None of the above



UNIT IV

1. Name the part of file marked as x .

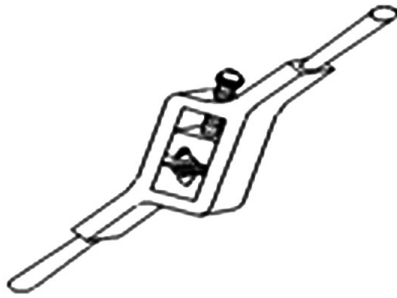


- A. Heel
 - B. Tang
 - C. Ferrule
 - D. File length
2. Which file has the parallel edges throughout the length?
- A. Hand file
 - B. Bastard file
 - C. Rasp cut file
 - D. Single cut file
3. What is the material to manufacture bench vice?
- A. Tool steel
 - B. High carbon steel
 - C. Medium carbon steel
 - D. Cast iron
4. Which type of taper is provided in the drill shank?
- A. Pin taper
 - B. Metric taper
 - C. Morse taper
 - D. Jerno taper
5. Which is used to remove drills and sockets from the machine spindle?
- A. Drift
 - B. Sleeve
 - C. Punch
 - D. Hammer
6. What is the name of part marked as x in drill?
- A. Lip
 - B. Land
 - C. Flank
 - D. Web

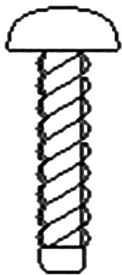




7. What is the name of the process of finishing the drilled hole?
- A. Reaming
 - B. Spot facing
 - C. Counter boring
 - D. Counter sinking
8. What is the name of the operation to enlarge the hole for given depth?
- A. Reaming
 - B. Spot facing
 - C. Counter boring
 - D. Counter sinking
9. What will happen if the spindle running out of centre while drilling?
- A. Drill will break
 - B. Drills are over heated
 - C. Drill make rough hole
 - D. Over sized holes are made
10. What is the name of the die?



- A. Split die
 - B. Half die
 - C. Solid die
 - D. Adjustable screw plate die
11. What is the name of screw?



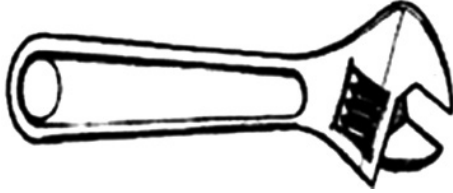
- A. Grub screw
- B. Driver screw
- C. Self tapping screw
- D. Thread cutting screw



12. Scribe is _____ tool.

- A. marking
- B. measuring
- C. planning
- D. drilling

13. Identify the following type of spanner.



- A. Adjustable spanner
- B. Double open-ended spanner
- C. Ring spanner
- D. Double ended ring spanner

14. A tap is also called a _____.

- A. Facet,
- B. Fuller,
- C. Faucet,
- D. Faller

15. Which of these can cause leakage in pipes?

- A. Rusting of pipes in advanced stage
- B. Degraded seals
- C. Excess water pressure
- D. All of these

16. In a mixing tap, hot water connection is given to the _____.

- A. Right side of the user,
- B. Left side of the user,
- C. Either side of the user,
- D. Neither side of the user.

17. A pipe fitting usually short with inside threads used to connect pipes with outside threaded ends is called.

- A. Nipple
- B. Coupling
- C. Union
- D. Cross pipe.



18. Which of these classes of GI pipes is the thinnest?
- A. Class A
 - B. Class B
 - C. Class C
 - D. Class D
19. Which of these covers the end of a pipe?
- A. Plug
 - B. Nipple
 - C. Elbow
 - D. Tee
20. Domestic houses used the following rating of voltage.
- A. 440V
 - B. 230 V
 - C. 110 V
 - D. None of the above
21. Group of cells are connected together is called
- A. Inverter
 - B. converter
 - C. Battery
 - D. None of the above
22. In wiring system, cheapest and simplest method is -----
- A. cleat wiring
 - B. batten wiring
 - C. Lead concealed wiring
 - D. Wooden casing and capping wiring
23. In three phase AC supply, What is the Line to Line voltage
- A. 230 V
 - B. 440 V
 - C. 600 V
 - D. 11000 V
24. Which one of the following used to test the continuity?
- A. Battery tester
 - B. Diode tester
 - C. Continuity tester
 - D. None of the above
25. In domestic wiring, a switch is always placed in the
- A. Earth wire
 - B. Neutral wire
 - C. Live wire
 - D. Earth or neutral wire

ANSWER KEYS

UNIT -I									
Q .No	Ans	Q .No	Ans	Q .No	Ans	Q .No	Ans	Q .No	Ans
1	B	5	C	9	A	13	C	17	C
2	C	6	A	10	C	14	C	18	A
3	D	7	A	11	D	15	D	19	C
4	D	8	B	12	A	16	D	20	B

UNIT -II									
Q .No	Ans	Q .No	Ans	Q .No	Ans	Q .No	Ans	Q .No	Ans
1	B	5	B	9	D	13	C	17	D
2	C	6	C	10	C	14	C	18	B
3	A	7	C	11	B	15	A	19	B
4	A	8	B	12	D	16	D	20	D

UNIT -III									
Q .No	Ans	Q .No	Ans	Q .No	Ans	Q .No	Ans	Q .No	Ans
1	A	6	A	11	D	16	B	21	C
2	D	7	A	12	D	17	C	22	A
3	D	8	C	13	D	18	C	23	B
4	A	9	D	14	C	19	B	24	B
5	A	10	D	15	B	20	A	25	B

UNIT -IV									
Q .No	Ans	Q .No	Ans	Q .No	Ans	Q .No	Ans	Q .No	Ans
1	A	6	A	11	B	16	B	21	C
2	A	7	A	12	A	17	B	22	A
3	D	8	C	13	A	18	A	23	B
4	C	9	D	14	C	19	A	24	C
5	A	10	B	15	D	20	B	25	C