

MEASUREMENT AND HAND TOOLS

The right tools can make tasks easier and faster to complete.



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First published 2024

e ISBN 978-629-7635-43-9

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Published by:

Politeknik Ungku Omar,
Jalan Raja Musa Mahadi,
31400 Ipoh, Perak.

Tel: 1-300-88-1693

Fax: 05-5471162

PREFACE

Alhamdulillah and gratitude to God for giving me health and the opportunity to complete this EBOOK. I am also very grateful that all the efforts to carry out this task were able to run smoothly so that I was able to complete it within the given time period.

This EBOOK is a guide for students, especially early semester students who are new to the world of Engineering. The content of this EBOOK is related to safety, hand tools and also measuring tools.

Students will be exposed to safety in the work workshop as well as the necessary hand tools when doing work in the workshop.

Thank you to everyone who has given a lot of cooperation in the preparation of this EBOOK. May Allah SWT reward everyone who has helped. Hopefully it will benefit everyone.



ACKNOWLEDGEMENT

First of all, thanks to ALLAH S.W.T for his grace and guidance in giving me full strength to complete this "EBOOK". Despite facing some difficulties in completing this task, I still managed to complete it. A million thanks to my colleagues for all the support and guidance in helping me complete this EBOOK which really tested my abilities in terms of mental and physical and never gave up on giving me support in all aspects of life. Thank you very much friends, I will never forget your good service.

Thank you.

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SAFETY



CHAPTER : 01

INTRODUCTION

Safety

Safety is a method or process in place to prevent injury from occurring.

An accident is an unplanned and unexpected event that will increase the risk of injury, health, death and loss of property and environmental damage.

Accident prevention is the planning, preparation and actions that need to be taken to prevent accidents before they happen.



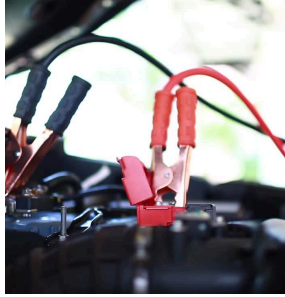
SCAN ME NOW!



WORKPLACE SAFETY RULES



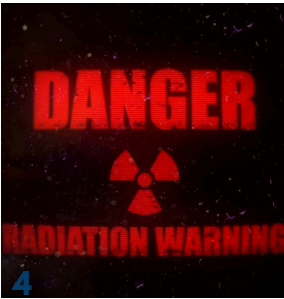
1 ALWAYS WEAR PPE



2 FOLLOW SAFETY PROCEDURE



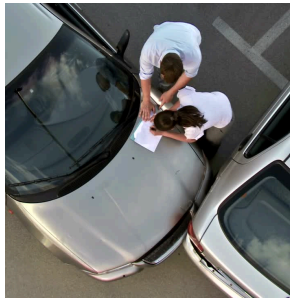
3 DON'T TAKE SHORTCUTS.
ALWAY FOLLOW THE RULES



4 BE ALERT ON THE JOB



5 FOLLOW SIGN



6 IMMEDIATE REPORT
ACCIDENT



7 USE THE RIGHT TOOLS
AND EQUIPMENTS



8 KNOW THE EMERGENCY
EXITS LOCATION

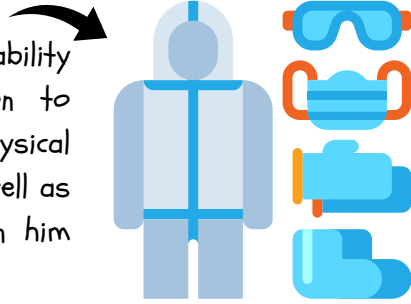


9 PRACTICE GOOD
HOUSKEEPING

3 FACTORS TO PREVENT ACCIDENT

1. Personal Safety

It can be defined as the ability or ability of a person to protect himself from physical and emotional harm as well as things that can threaten him and those around him.

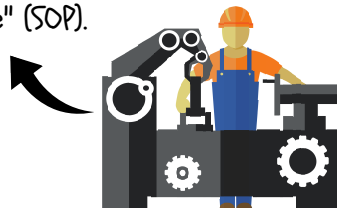


2. Safety at Work Place

Workplace safety refers to the work environment including all factors that affect the safety, health and well being of employees.

3. Machine Safety and Equipment

The safety equipment in the workshop needs to be given special attention by the users and the management of a workshop. The equipment in the workshop needs to be properly and regularly maintained. This way can prevent damage to the equipment used and can detect equipment that has been damaged. In addition, rules for the correct use of equipment or machines must be included with the equipment or machines, which is better known as "Standard Operating Procedure" (SOP).



Personal Protective Equipment (PPE)



Personal protective equipment (PPE) is clothing or equipment designed to be worn by someone to protect them from the risk of injury or illness that may occur due to the workplace environment.

Including gloves, gloves, shoe covers, head covers, masks, respirators, eye protection, face shields, and goggles.

SCAN ME NOW!



HAND TOOLS



CHAPTER : 02



HAND TOOLS

A hand tool is a tool that is operated by hand instead of a motor. Hand tool categories include wrenches, pliers, cutters, file, impact tools, hammered or hammered tools, screwdrivers, cutters, saws, drills and knives.



Hand tools are used in the manufacturing and production process of a project.

Hand tools must be suitable for the materials and purpose of the tools used.

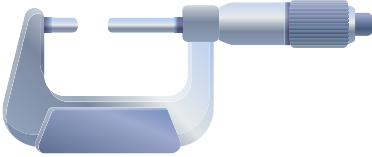
The selection criteria for hand tools are:

- a. Compatibility of hand tools with materials.
- b. Skill in handling tools.
- c. Ease of obtaining tools.
- d. Safety factors when using tools.



4 CATEGORIES OF HAND TOOLS

What are the hand tools used for?



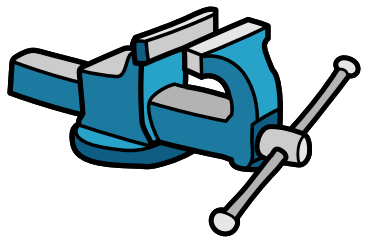
Laying out the tools -
measuring tools.



Striking tools - hammers,
and sledges.

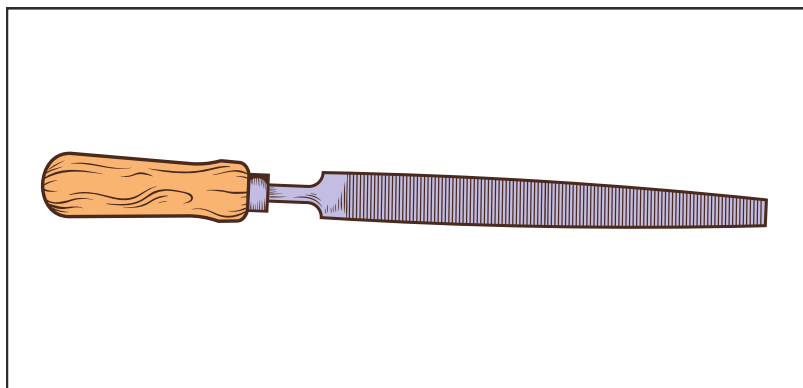


Metal cutting tools - files,
drills, reamers, etc.



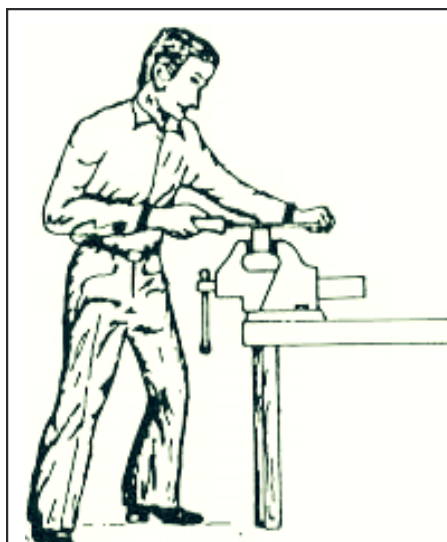
Holding tools - Pliers and
clamps.

FILE

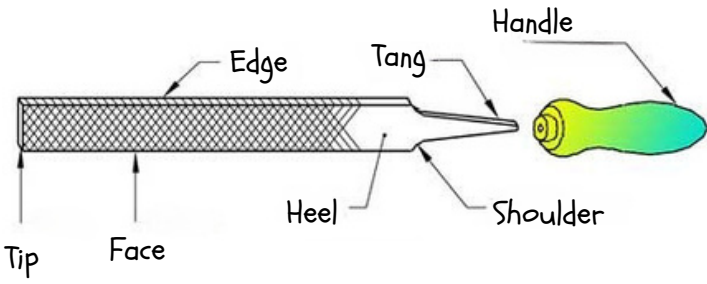


A file is a tool used to remove fine amounts of material from a workpiece.

Hand files are used in the workshop to smooth rough edges.



Parts of File

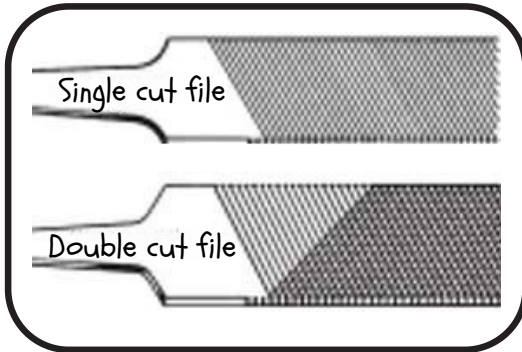


Types of File



Types of File Cut

The classification of file tooth cut is according to the roughness or spacing of the file teeth. It is limited to single and double cut file. The number of teeth per inch is different for different shapes and sizes.

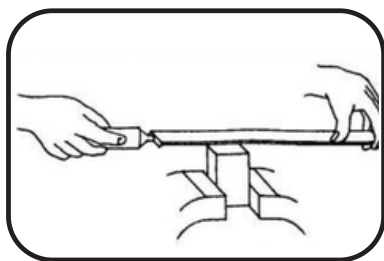


File are available in a wide range of shapes, section and cut. The term cut refers to the size and shape of the file teeth.



Techniques or Method to Filing

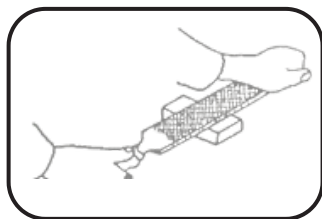
There are three commonly used filing techniques that are widely used which are straight filing, cross filing and draw filing.



STRAIGHT FILING

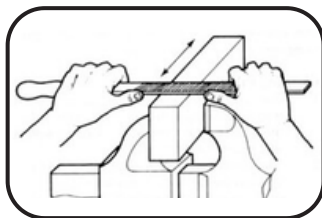
The most basic filing technique is called straight filing and involves pushing the file lengthwise across the work, making contact only on the front of the material.

SCAN ME NOW!



CROSS FILING

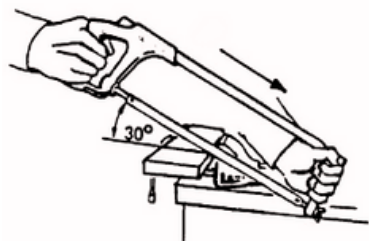
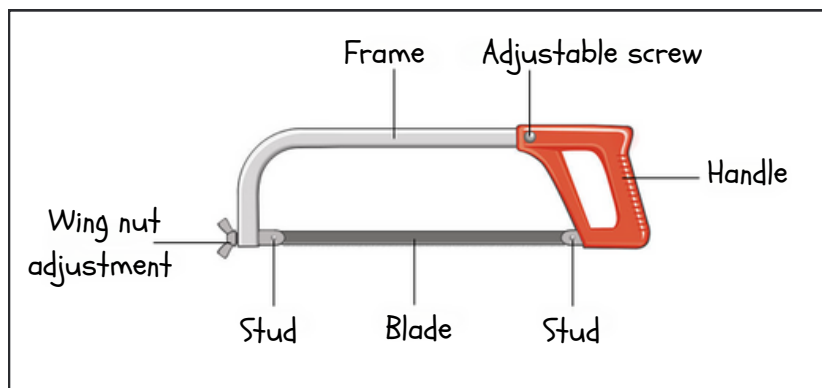
Cross filing is used for the efficient removal of the maximum amount of metal in a short time. Also called simple filing, this technique involves pushing a file across the edge of the material. It can be used for finishing, shaping, or sharpening.



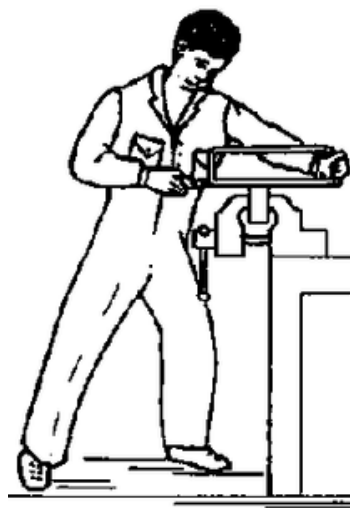
DRAW FILING

Draw filing is a technique for rapidly removing material where the user holds the file handle in the left hand and the tip of the file in the right hand. Material is removed by applying downward force of the file on the workpiece while pulling the file toward the user.

HACKSAW



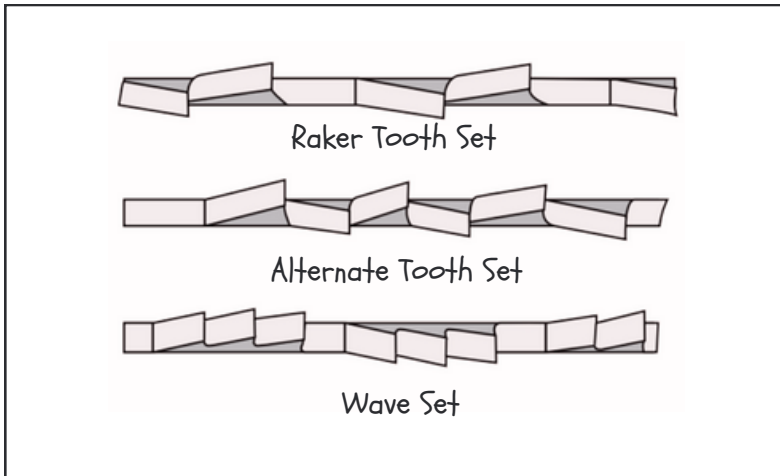
A hacksaw is a type of hand tool designed specifically for cutting through materials such as plastic, steel, and other metals.



A hacksaw is mainly used for cutting thin metal such as aluminum, brass, steel, or copper. Hacksaws are also used for cutting plastics such as PVC, PEX, or ABS on pipes or on sheet goods made of PVC, polystyrene and more.

Set of Hacksaw Teeth / Blade

While high speed steel blades are perfect for cutting hard materials such as steel and alloys. Regular blades do not last long as high speed steel blades. The three most common types of hacksaw blades are effective for cutting various types of metal such as regular blades, raker blades, and wavy blades

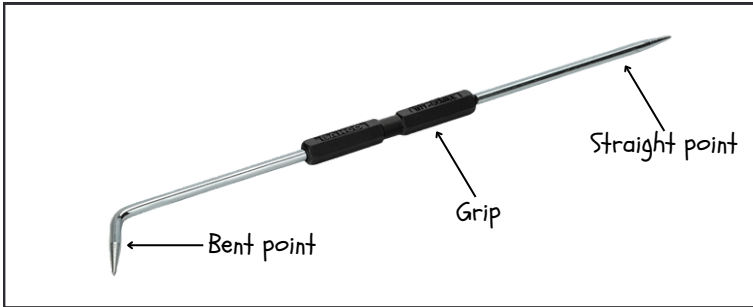


Hacksaw blades are available in a variety of sizes for cutting different materials. They can be as small as six inches (150mm) in length but the most common length for hacksaw blades is 12 inches (300mm).

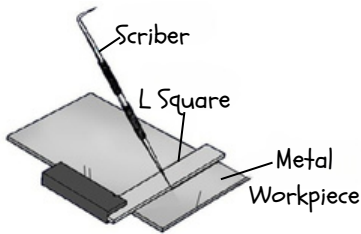
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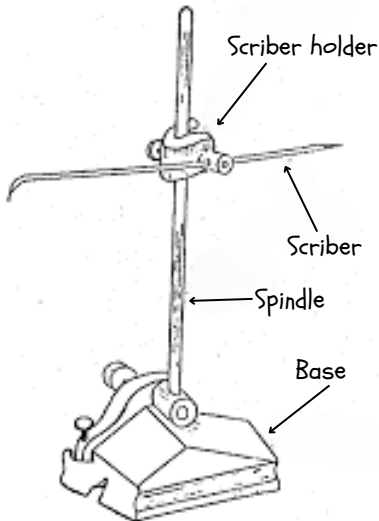
SCRIBER



Marking Out



A scribe is a hand tool used in metalworking to mark lines on a workpiece before the machining process. The process of using a scribe is called scribing and is only part of the marking process.



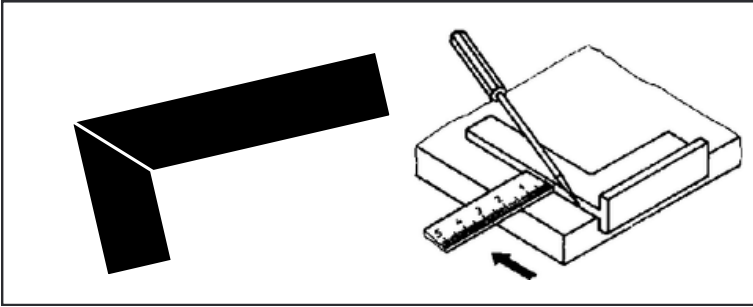
Universal Marking Gauge



SCAN ME NOW!



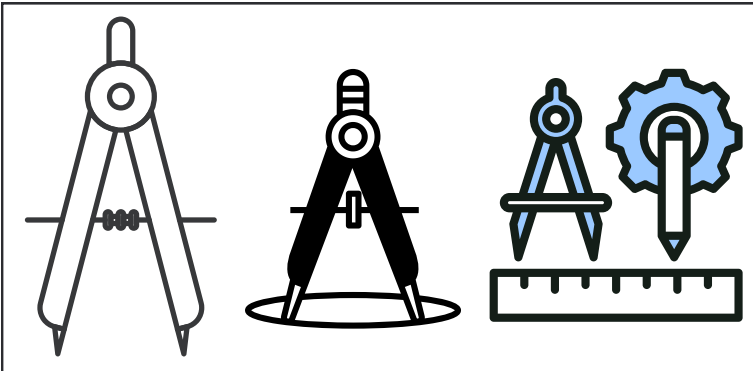
L SQUARE



L squares are used to accurately check and used for marking and referencing a 90° angle, or to verify the squareness of straight edges and lines.

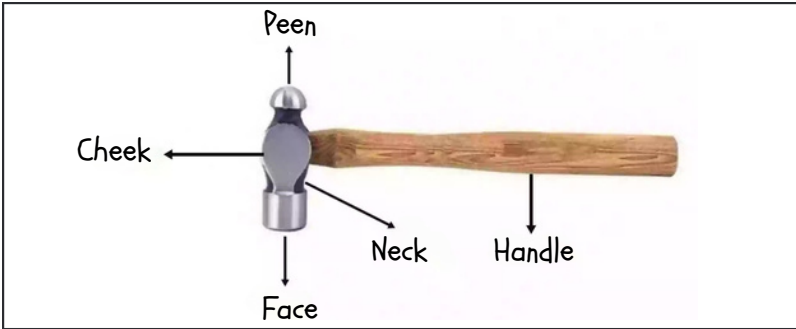
High-quality squares are precision made to form a perfect 90-degree right angle, against which you can test all manner of edges, planes and corners on a workpiece.

DIVIDER



A tool with two legs. The material of tool is steel or high carbon steel. A tool use for layout an arcs or circles, divide distance along a straight line and to step off measurements.

HAMMER



A hammer or mallet is a tool used to knock something, most often a hand tool, consisting of a weighted "head" fixed to a long handle that is swung to deliver an impact to a small area of an object.

Difference types of hammer

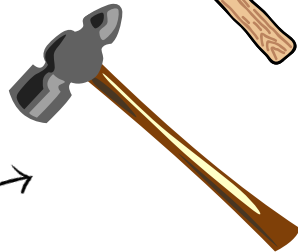
01. Claw hammer

Claw hammers come with the round head mainly used for driving the nails..



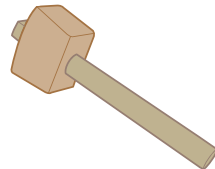
02. Ball Pein

The ballpein hammer is generally used for metal work that involves peening or shaping metal

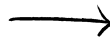


03. Wooden mallet

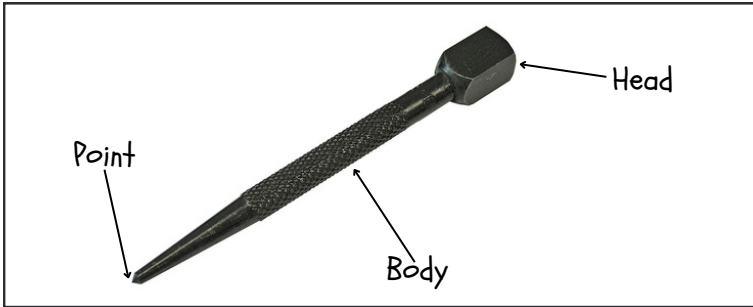
A wooden mallet is usually used in carpentry to knock pieces of wood, chisel and put pressure on joints.



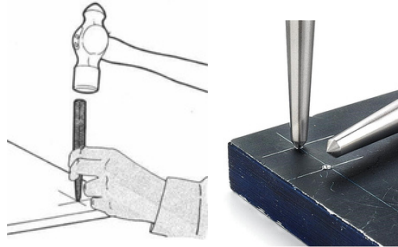
04. Soft -Face Hammer
Serve with freshly grated Pecorino-romano.



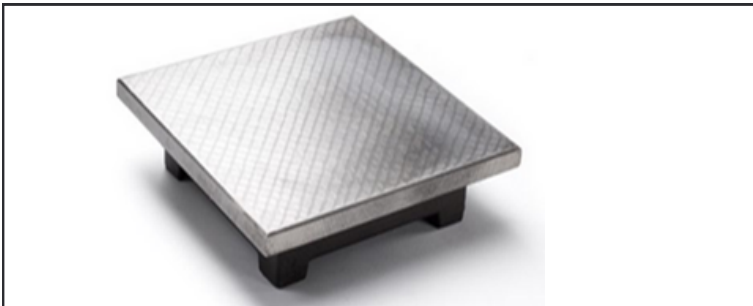
CENTER PUNCH



Center punch tools are used to create holes in workpieces by puncturing the surface.



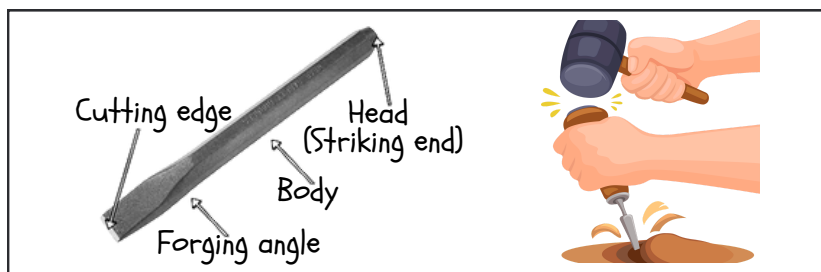
SURFACE PLATE



Surface plate is a flat plate used as the main reference resistor plane for precision checking, marking (layout), and tool supplies.

Surface plates are often used as the baseline for all measurements on the workpiece.

CHISEL




A chisel is a type of hand tool used to cut or remove metal. It must be used with a regular hammer or a pneumatic hammer. The chisel is made of high-quality steel that is hardened at the point, forged to a specific size and shape.

Metal chisel

Cold and hot chisels are the two main types of chisels that shape and cut metal. Cold chisels work on metal that has not been heated by hammering, while hot chisels work on metal that has been softened by the heat from the forging or torching process.


Types of chisel

Flat chisel




Flat chisel points are wide and thin. This type of chisel is used for sharpening workpieces or cutting metal.

Cross cut/Cape chisel



This chisel is used to cut grooves, grooves or scroll thick workpieces before a flat chisel is used.

Half round chisel



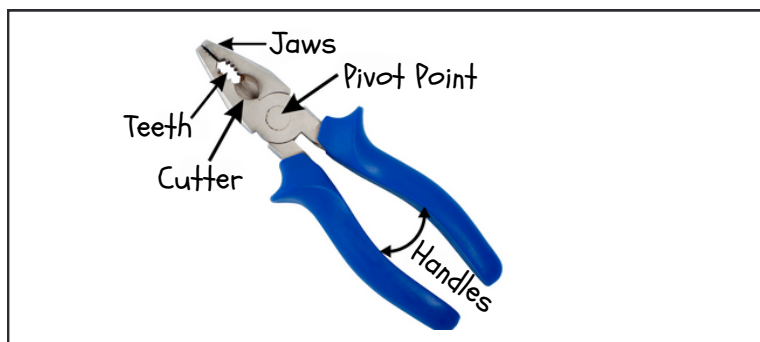
This chisel is used to clean holes, convex corners and punch semi-circular mortars.

Diamond point chisel



This chisel is used to remove material or debris from hard to reach areas.

PLIER



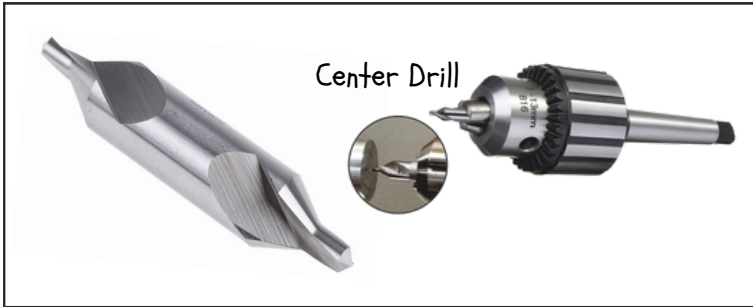
Pliers are made in various shapes and sizes and for many uses. Some are used for gripping something round like a pipe or rod, some are used for twisting wires, and others are designed to be used for a combination of tasks including cutting wire.

WRENCH

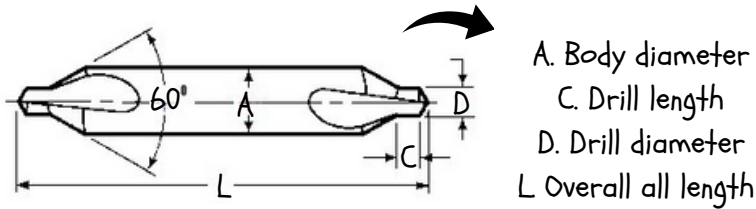


A wrench or spanner is a tool used to provide grip and mechanical advantage in applying torque to turn objects usually rotary fasteners, such as nuts and bolts.

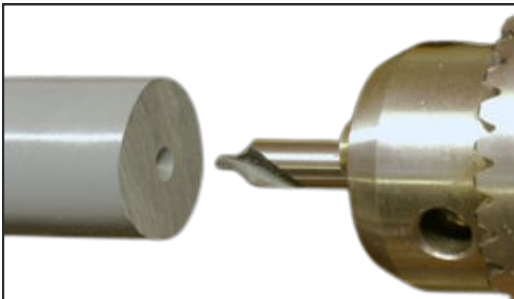
CENTER DRILL



The use of a center drill is for centering work on either a lathe or a drill.



Center drill bits are used in metalworking to provide a starting hole for a larger sized drill bit or to make a conical indentation in the end of a workpiece in which to mount a lathe center.



SCAN ME NOW!



TAP AND DIE

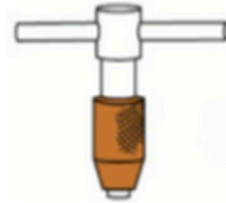


Taps and die are tools used to create screw threads, which is called threading.

A tap is a screw-like tool which has threads like a bolt and three or four flutes cut across the thread.

It is used to cut threads on the inside of hole, as in a nut. The lower part of the tap is somewhat tapered so that it can well attack the walls of the drill hole.

The upper part of the tap consist of a shank ending in a square for holding the tap by a tap wrench. The adjustable wrenches may be used for taps of various sizes.



T-handle Tap Wrench



Hand Tap Wrench



SCAN ME NOW!



Set of Hand Tap

1.



Taper Tap

2.



Plug Tap

3.



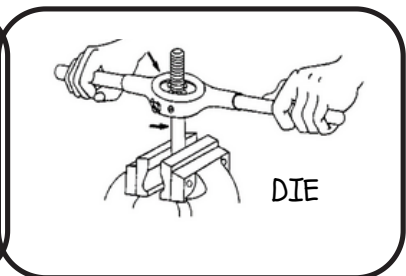
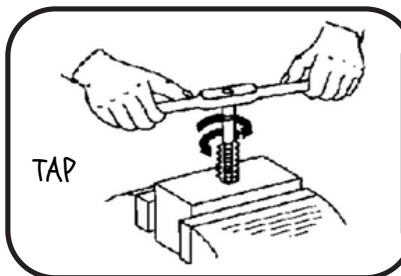
Bottoming Tap

Taper tap - Tapered from the end approximately six threads and used to start thread easily.

Plug tap - Tapered for approximately three threads and used to thread a hole going through a work piece.

Bottoming tap - Not tapered but chamfered at the end for one thread. Used for threading to the bottom of a blind hole.

Tap and Die Process



MEASUREMENT

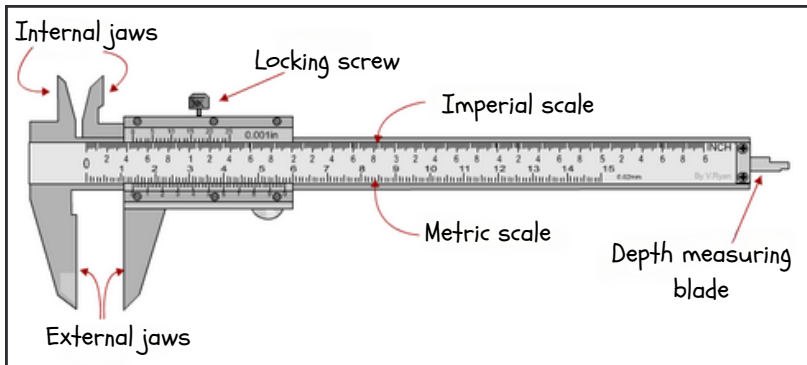


CHAPTER : 03

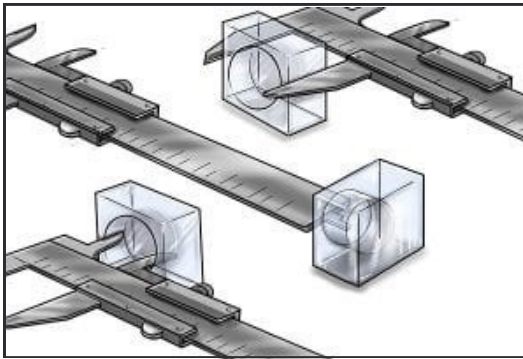


INTRODUCTION

VERNIER CALIPER



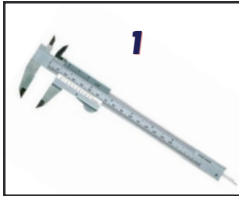
Vernier calipers can be used to accurately measure the internal and external dimensions and height of objects.



Vernier calipers are used to measure:

- i. The length of a rod or any object.
- ii. The diameter of a sphere.
- iii. The internal and external diameter of a hollow cylinder.
- iv. The depth of a small beaker.

Type of Vernier Caliper



Standard Vernier

It can measure the internal and external dimensions and even the height of an object with accuracy.

Dial Vernier

The Dial Vernier Caliper is a very easy and reliable precision tool. This tool is usually used for machining and automotive applications.

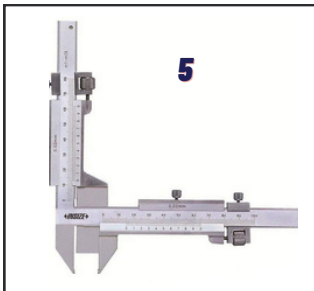
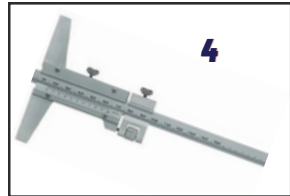


Digital Vernier

This vernier is for measuring the width or diameter of an object. This type of caliper allows high resolution for measurements.

Vernier Depth Gauge

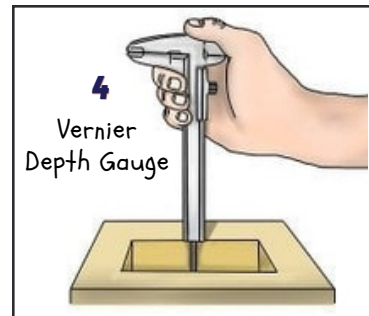
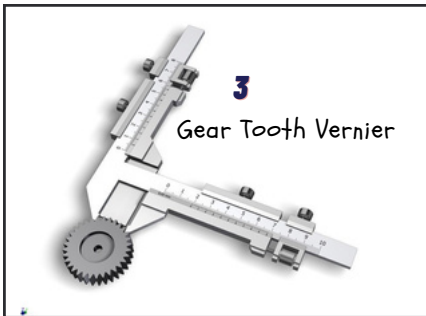
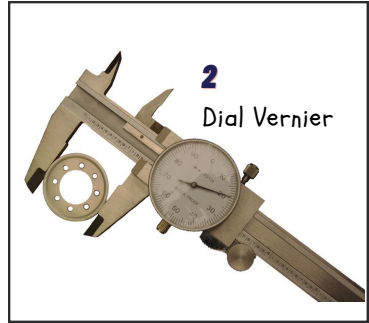
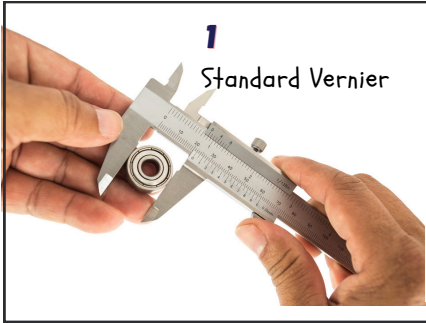
Vernier depth gauge is used for measuring the depth of holes.



Gear Tooth Vernier

It is used for measuring the chordal thickness of a gear tooth at the pitch circle of gear.

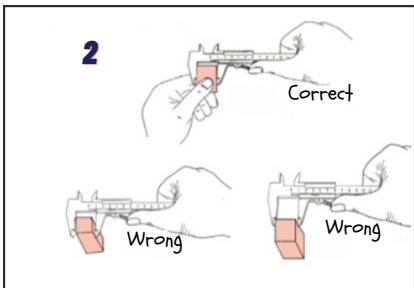
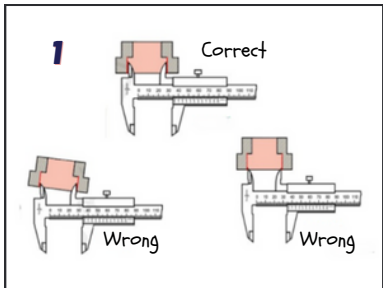
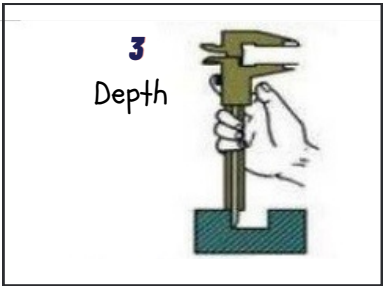
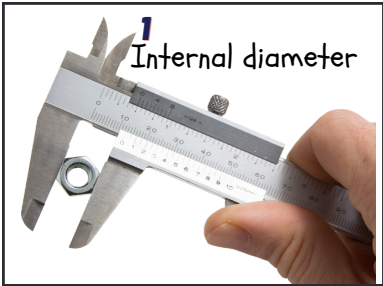
How to use Vernier Caliper?



SCAN ME NOW!

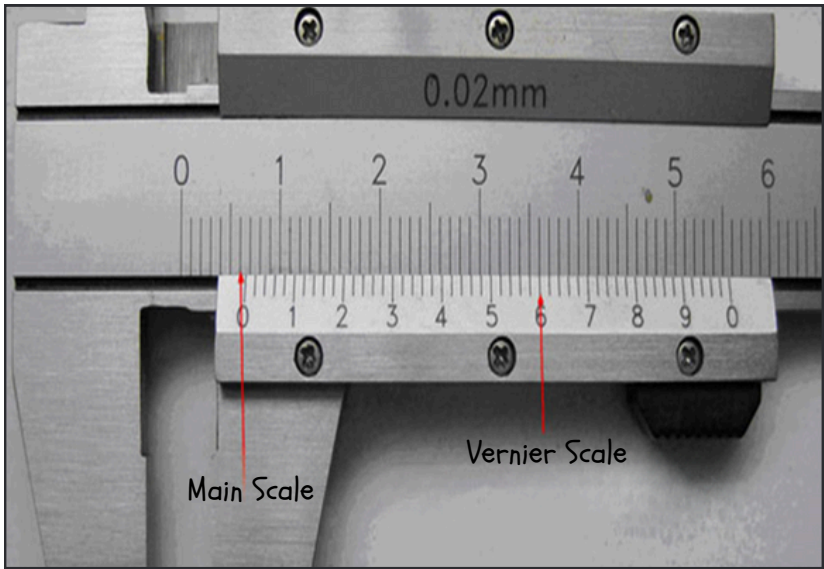


How to Measure?



Do you have
any
Questions? 😊

How To Read Vernier Caliper?



EXAMPLE 1:

STEP 1: (A: Main scale reading)

*Read the "0" position of the vernier scale on the main scale to get a rough reading.

(1 Scale=1mm). Rough reading = 6.00mm

STEP 2: (B: Vernier scale reading)

*This 6 is multiplied by 0.02 giving 6mm as the answer.

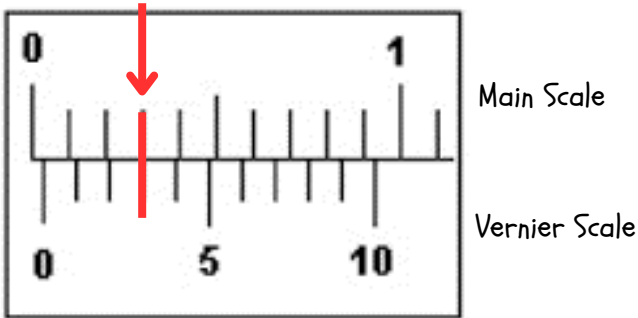
(1 Scale=0.02mm)

STEP 3: (C: Reading (=A+B))

*The reading is 6.60 mm

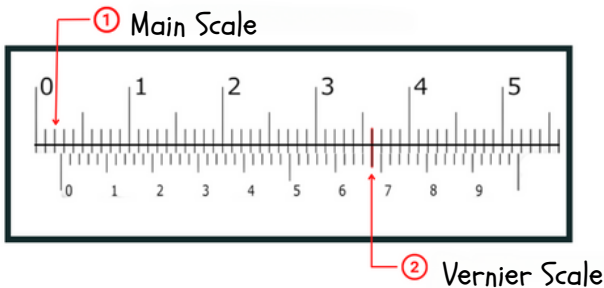
How To Read Vernier Caliper?

EXAMPLE 2:



$$\begin{aligned}\text{Measured value} &= 0.0 + 0.03 \\ &= \underline{0.03 \text{ mm}}\end{aligned}$$

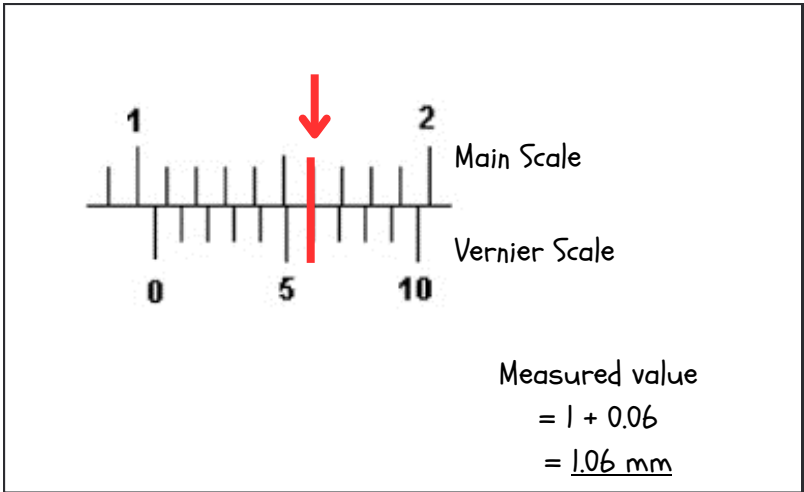
EXAMPLE 3:



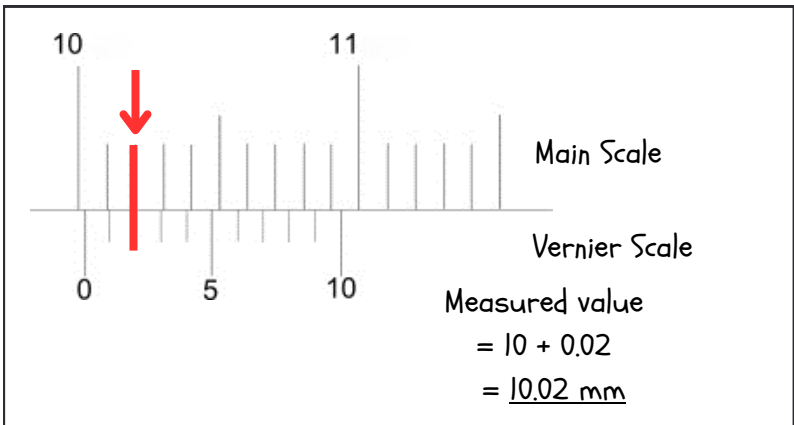
$$\begin{aligned}\text{Measured value} &= 2 + 0.6 + 0.08 \\ &= \underline{2.68 \text{ mm}}\end{aligned}$$

How To Read Vernier Caliper?

EXAMPLE 4:



EXAMPLE 5:



ADVANTAGES OF VERNIER CALIPERS

01.

Accuracy and Precision

Vernier calipers provide accurate and precise measurements over a large range.

02.

Integrated Scales

As the main scale and vernier scale are built into the tool, another measuring instrument such as a ruler or tape measure is not required.

03.

Versatility

Vernier calipers can be used to take a variety of different measurements.

04.

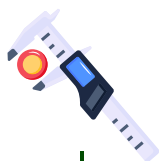
Durability

Most vernier calipers are made out of stainless steel. Since steel is a very durable material, with proper care, a stainless steel vernier caliper can last a lifetime.

05.

Cost

Compared to other types of caliper, vernier calipers are relatively inexpensive.



DISADVANTAGES OF VERNIER CALIPERS

01.

Good Eyesight is Required

The vernier scale of a vernier caliper is quite small, and so can sometimes be difficult to read. It is not difficult to misread the last digit of your measurement.

02.

Knowledge of Vernier Calipers is Required

As the vernier scale is a unique measuring instrument, users must learn how to read a vernier caliper before taking measurements.

03.

Possibility of Errors

Taking a series of measurements one after the other can lead to reading errors, because concentration is required.

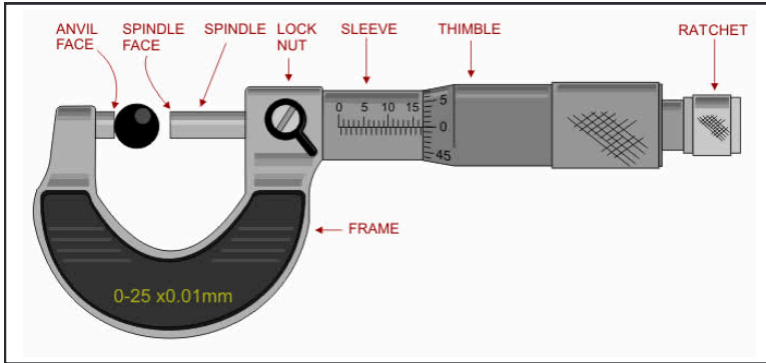
04.

More Accurate Tools Available

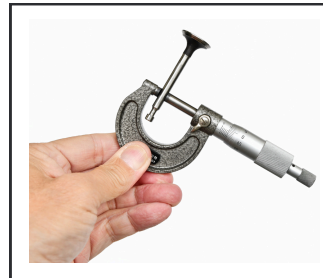
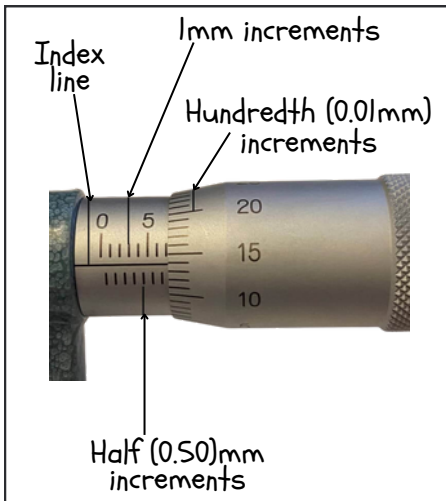
Vernier calipers are not the most accurate precision measuring tool available. For example vernier calipers are not as accurate as digital calipers.

INTRODUCTION

MICROMETER



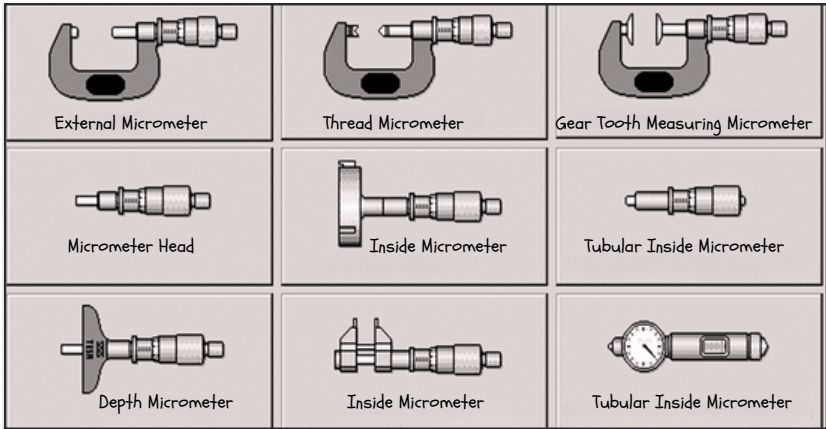
A micrometer is an instrument used specially to get a more accurate measurement compared to a Vernier calliper. The micrometer comes in both imperial and metric measurements. The smallest reading on the micrometer is 0.01mm and gives an accurate measurement up to 0.001mm.



SCAN ME NOW!

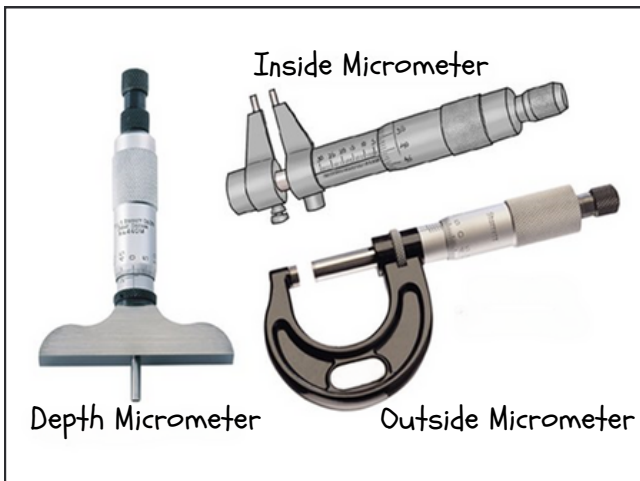


Types of Micrometer

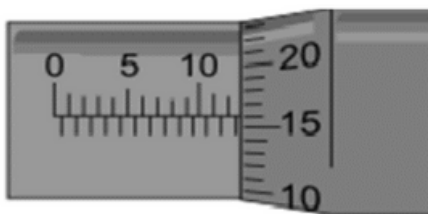


The metric micrometers provide measurements in increments of 0.01mm, whilst imperial micrometers measure in increments of 0.001 inches. There are a number of different types of micrometer. The most common types are outside micrometers. Inside micrometers and depth micrometers are also widely available.

Basic Types of Micrometer

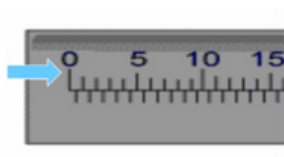


PROCEDURE IN USING A MICROMETER

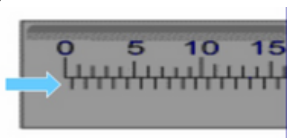


1. Read the scale on the sleeve. The example clearly shows 12 mm divisions.
2. Still reading the scale on the sleeve, a further $\frac{1}{2}$ mm (0.5) measurement can be seen on the bottom half of the scale. The measurement now reads 12.5mm.
3. Finally, the thimble scale shows 16 full divisions (these are hundredths of a mm).
4. The final measurement is $12\text{mm} + 0.5 + 0.16\text{mm} = 12.66\text{mm}$.

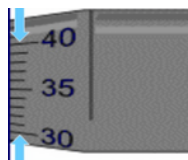
- Each line of the numbered scale on the sleeve
= 1 mm



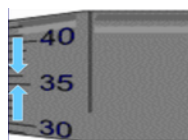
- The lines opposite the numbered scale on the sleeve
= 0.50mm ($\frac{1}{2}\text{mm}$)



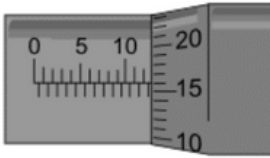
- The distance show on the thimble
= 0.10mm



- Each line on the thimble
= 0.01mm

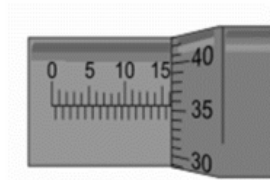


EXAMPLES :



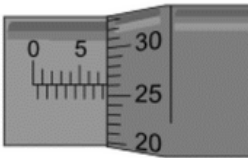
01.

- Sleeve reads full mm = 12.00
- Sleeve reads 1/2 mm = 0.50
- Thimble reads = 0.16
- TOTAL MEASUREMENT = 12.66 mm



02.

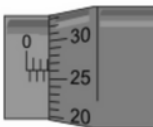
- Sleeve reads full mm = 16.00
- Sleeve reads 1/2 mm = 0.00
- Thimble reads = 0.355
- TOTAL MEASUREMENT = 16.355 mm



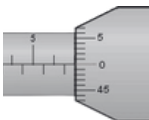
03.

- Sleeve reads full mm = 7.00
- Sleeve reads 1/2 mm = 0.50
- Thimble reads = 0.26
- TOTAL MEASUREMENT = 7.76 mm

WHAT IS THE READING:



ANSWER 1 :



ANSWER 2 :



ANSWER 3 :

ADVANTAGES OF MICROMETER

01.

Micrometers provide very accurate measurements.

02.

Ratchet speeder helps to provide reliable measurements.

03.

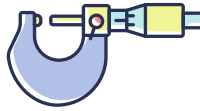
It exists in different types for different applications.

04.

It has a wide application.

05.

Retains accuracy better than vernier caliper.



DISADVANTAGES OF MICROMETER

01.

Limited range.

02.

Larger micrometers can be expensive.

03.

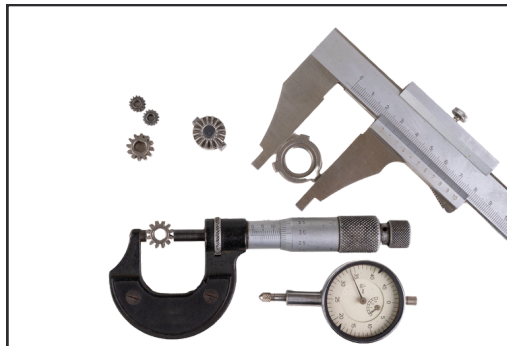
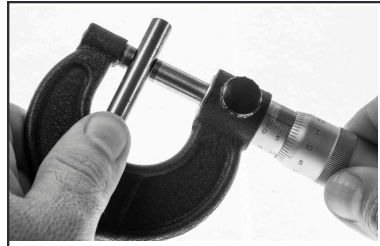
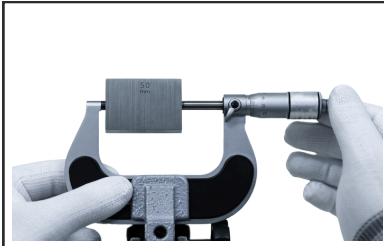
Different types are required for different measuring tasks.

04.

Limited wear area of anvil and spindle tip.

05.

Single purpose instrument.



TUTORIAL



1

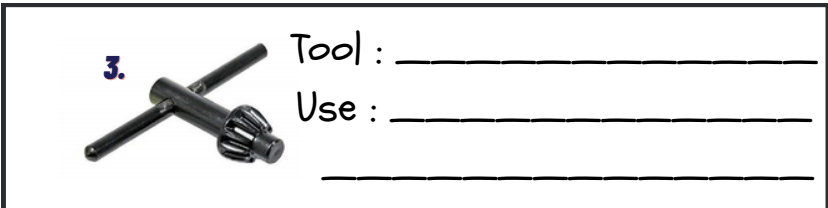
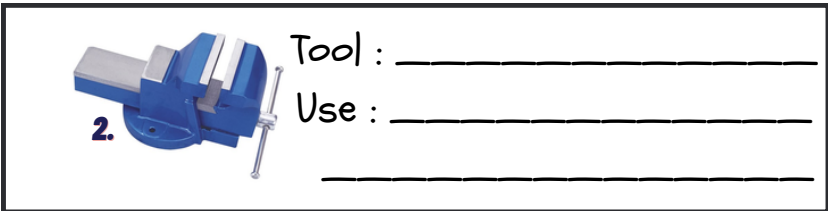
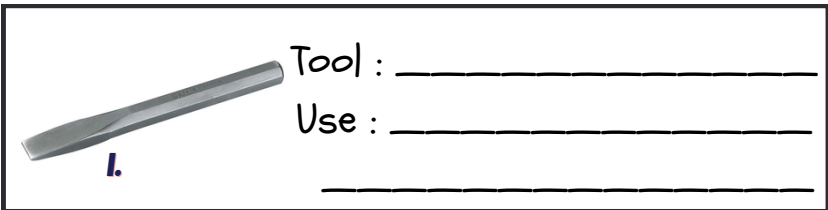


Hand Tools Exercises

A. Name these tools.



B. Name and state its use.



Hand Tools Exercises

C. Can you DRAW these tools?



File

Center Punch

Hammer

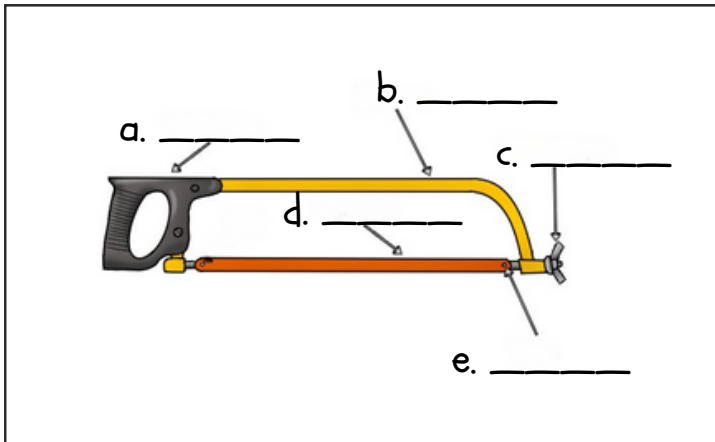
Chisel

Scriber

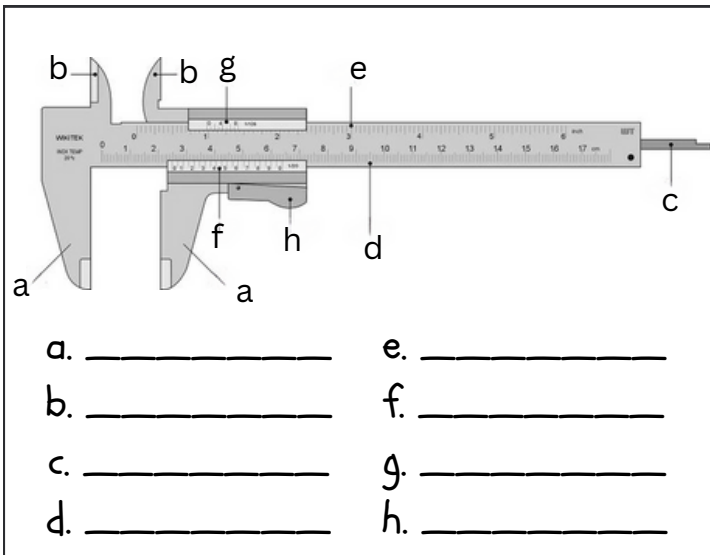
Divider

Hand Tools Exercises

D. Name the PARTS of tools.



E. Name the PARTS of Vernier Caliper.



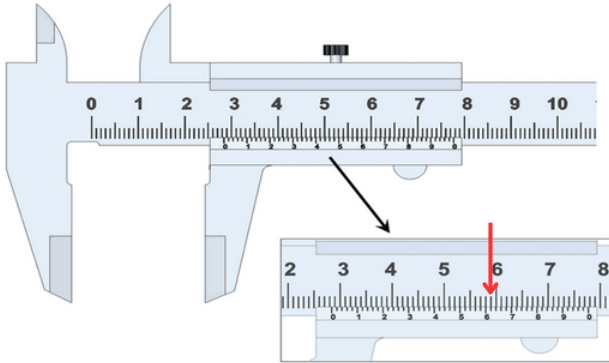
TUTORIAL

2



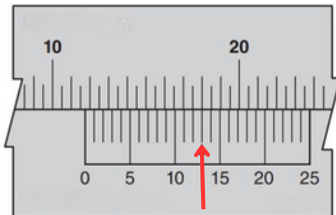
Vernier Caliper Exercises

Question 1 :



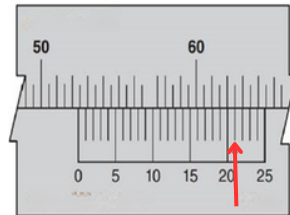
Answer:

Question 2 :



Answer:

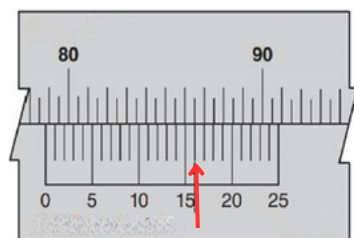
Question 3 :



Answer:

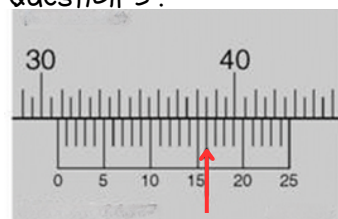
Vernier Caliper Exercises

Question 4 :



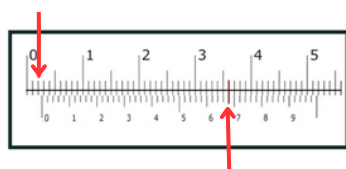
Answer 4:

Question 5 :



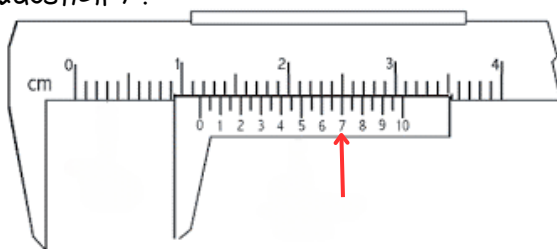
Answer 5:

Question 6 :



Answer 6:

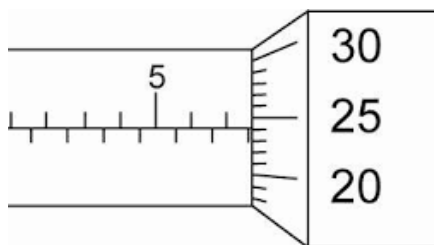
Question 7 :



Answer 7:

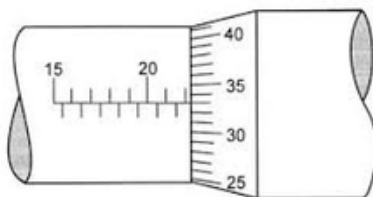
Micrometer Exercises

Question 1 :



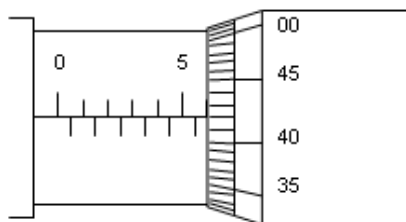
Answer 1:

Question 2 :



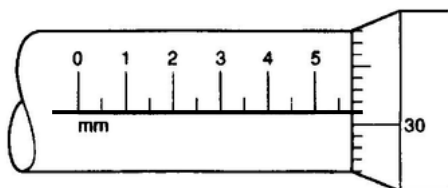
Answer 2:

Question 3 :



Answer 3:

Question 4 :



Answer 4 :

ANSWER

TUTORIAL 1 : HAND TOOLS EXERCISES

- A. Steel wire brush and L square
- B. 1. Chisel – For carving and cutting hard materials such as wood, stone, and metal.
 2. Vise – Consisting of two parallel jaws for holding a workpiece.
 3. Chuck key – Purpose of tightening or loosening the jaws of a chuck.

C.



D. a. Handle b. Frame c. Wing nut d. Blade e. Pin

E. a. External jaws b. Internal jaws c. Depth measuring blade d. Main scale (cm) e. Main scale (inch) f. Vernier scale (cm) g. Vernier scale (inch) h. Retainer

TUTORIAL 2 : VERNIER CALIPER EXERCISES

- | | |
|-------------|-------------|
| 1. 28.62 mm | 5. 30.66 mm |
| 2. 11.63 mm | 6. 2.68 mm |
| 3. 52.21 mm | 7. 11.70 mm |
| 4. 78.66 mm | |

TUTORIAL 2 : MICROMETER EXERCISES

- | | |
|----|----------|
| 1. | 7.74 mm |
| 2. | 22.33 mm |
| 3. | 5.92 mm |
| 4. | 5.81 mm |

- **NORMAH BINTI ISHAK** was graduated in Mechanical Engineering at UTM. Now, working as lecturer at Politeknik Ungku Omar with over 23 years experience in mechanical engineering.
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e ISBN 978-629-7635-43-9



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