SAFETY RULES AND PRECAUTIONS

OBJECT

To study Safety Rules for Manufacturing Technology Lab.

SAFETY RULES

DO's 

1. Wear clothes that are comfortable but close fitting i.e. Shirt, Trousers and Lab Coats. Dresses that are long and loose may accidentally get stuck in moving machinery.
2. Keep your hair short or wear a cap, net or hair band. Long head dresses may be a safety hazard.
3. Either roll up your overall sleeves or button up the cuffs.
4. You must wear closed-toed hard shoes in the lab. Sandals and flip-flops are not allowed.
5. Immediately report any accident even if it is small.
6. Keep machine and all equipment clean before starting the operation.
7. Keep the machine and surrounding area tidy.
8. Check that work area is clean before starting the machine.
9. Report immediately to your instructor if any mechanical or electrical fault occurs in the lab.
10. Ensure that all machine parts are in position before starting.
11. Check that chucks or clutches rotate in the correct directions before commencing cutting operations.
12. Ensure that everything is properly secure before starting the machine.
13. Ensure that feed mechanisms are not engaged before starting the machine.
14. Keep tools and cutters in boxes or cupboard when not in use.
15. Switch off the machine when the task/job is completed.
16. The manufacturing lab is a place where oil and grease usage is normal, expect clothes to get dirty and plan accordingly.

DON'Ts 

1. Don't wear rings or watches while operating a machine.
2. Don't keep sharp tools in your overall clothing.
3. Don't remove metal chips/waste with your bare hand; use a brush for that purpose.
4. Don't manually lift heavy equipment. If it is necessary to do so ask a friend for help.
5. Don't lean on the machine.
6. Don't attempt to operate a machine until know how to correctly use it.
7. Don't tamper with the machine unnecessarily.
8. Don't throw things.
9. Don't walk away and leave your machine running.
10. Don't touch a switch with wet hands which may cause an electric shock.
11. Don't operate switches with gloves on which may cause malfunctions or even danger.
12. Don't place any tools or unnecessary items on the machine.

STRUCTURE OF SAFETY INSTRUCTIONS

The signal words **DANGER**, **WARNING** OR **CAUTION** indicate the probability and potential severe of injury.

An additional symbol indicates the nature of hazard or required action.

Signal word	Explanation
⚠ DANGER	Indicates a situation which, if not avoided, **will** result in **death or serious injury**.
⚠ WARNING	Indicates a situation which, if not avoided, **may** result in **death or serious injury**.
⚠ CAUTION	Indicates a situation which, if not avoided, may result in **minor or moderately serious injury**.
NOTICE	Indicates a situation which may result in **damage to equipment**, or provides instructions on **operation of the equipment**.

Symbol	Explanation
	Notice

QUESTIONS

Q01: What safety practices are used in your lab to promote general safety?

Q02: What do you understand by the term PPE and why do you wear PPE?

Q03: What instructions are given regarding handling and storage of material and tools?

Q04: Which safety structure instruction if avoided, may result in minor to moderate injury?

Q05: What procedure should you follow if you see an accident happens?

Q06: What procedures should you follow before starting any machine in the lab?

Q07: What procedures should you follow regarding the usage of electrical components of machine?

OBJECTIVE: To take measurements of various samples using Vernier Calipers, internal micrometer screw gages and quick calipers.

THEORY:

Testing – Measuring – Gauging

Testing generally means comparison of an actual value with a set or specified value. We can differentiate between testing, measuring and gauging.

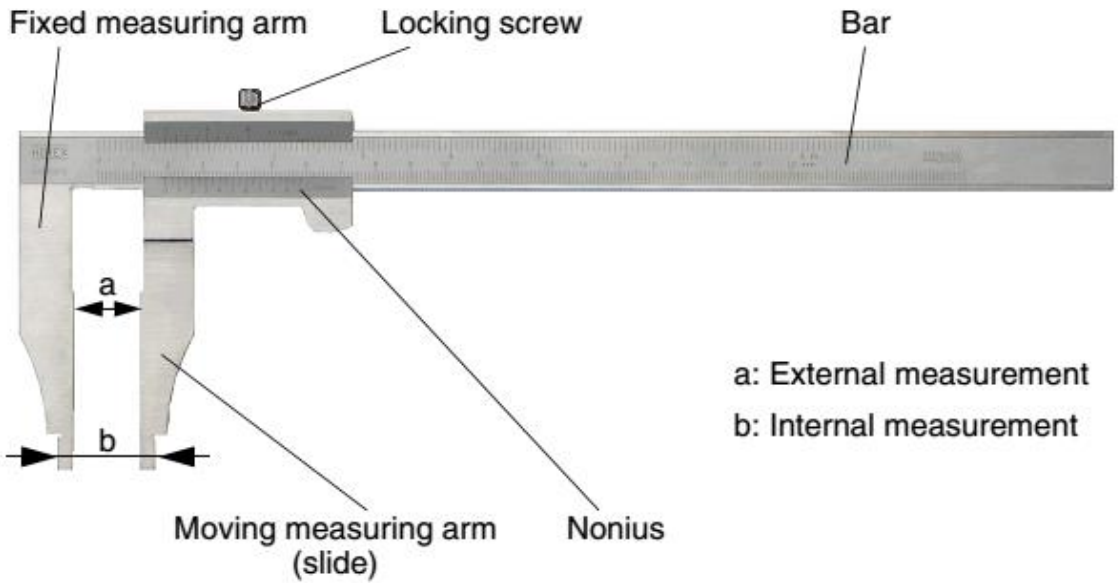
TESTING: Testing involves using **test equipment** to establish whether a **test object** meets the specified requirements.

MEASURING: Measuring involves using a measuring instrument with a scale from which the measured variable can be **read off**. The **measuring instrument** has a scale. It can be fixed (solid measure, e.g. ruler) or adjustable (indicating measuring instrument, e.g. caliper gauge). The result is a **measured value**, consisting of a numerical value and a unit.
Examples: Caliper gauge, Micrometer, Dial gauge

GAUGING: Gauging involves **comparing** a dimension or shape with a gauge that has the specified dimension or shape. The **gauge** represents the negative shape, i.e. it is the counterpart to the test object. It is fixed, has no scale and, in general, no moving parts. There are dimension gauges, form gauges and limit gauges. The result is a **conclusion** as to whether the test object lies within specified limits.
Examples: Radius gauge, Taper gauge, Slip gauge.

EQUIPMENT:

VERNIER CALIPERS:

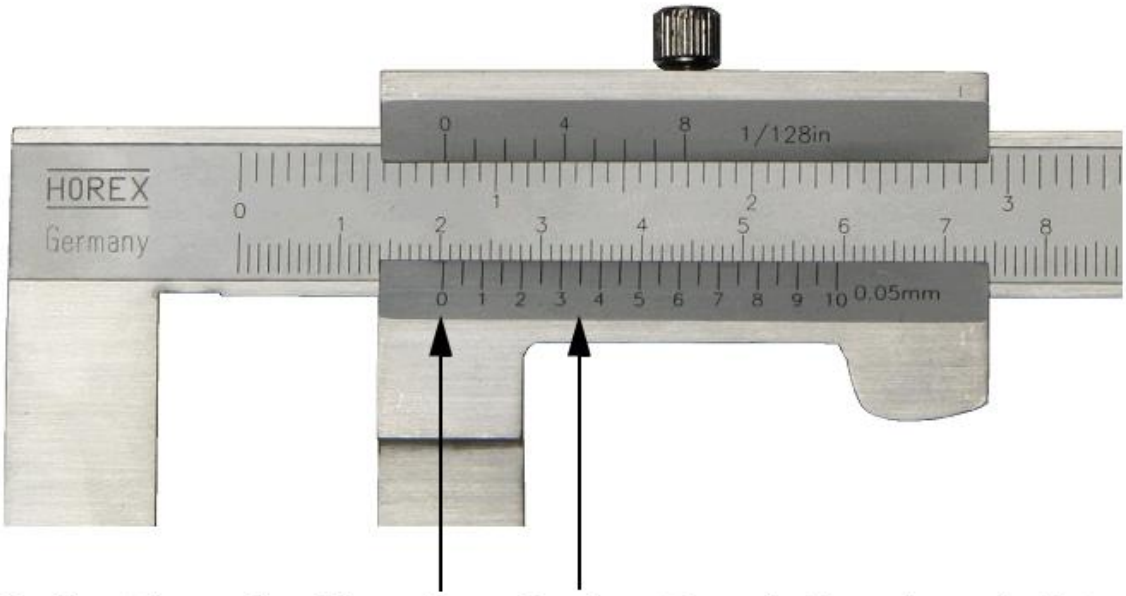


The caliper gauge consists of a bar with millimeter graduations and a fixed measuring arm, which makes a right angle with the bar. The moving measuring arm or slider also has a scale, known as the nonius.
The caliper gauge shown in figure can be used to perform the following measurements:

- External measurement using inner sides of measuring arm (distance **a**).
- Internal measurement using outer sides of measuring arm (distance **b**). In this case, 10mm (length of two measuring arms) must be added to the measured dimension.

The caliper gauge is read as follows:

- View the zero line of the nonius as the decimal point. Read off the full millimeters at the zero line of the nonius.
- Then look to the right of the zero line for the graduation on the nonius that coincides with a graduation on the scale. Read off the tenths of millimeters there.
- Note that the reading accuracy of the caliper is 0.05mm. (least count)



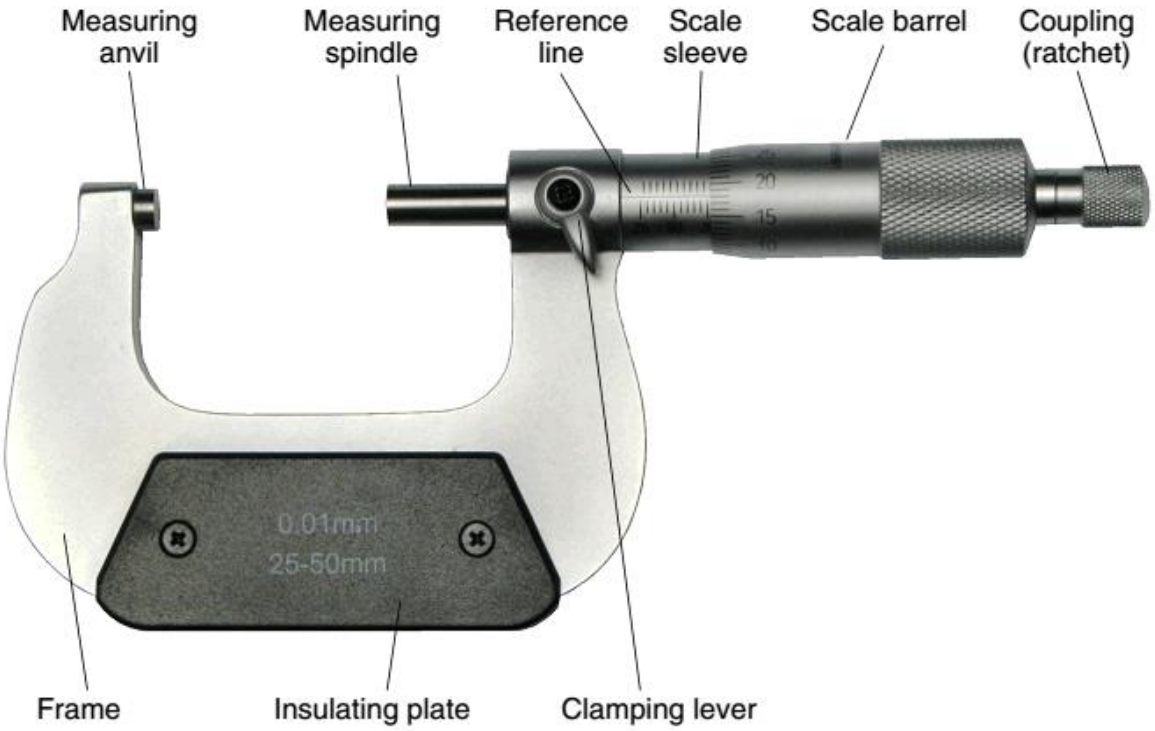
Reading at the zero line of the nonius
Value: 20

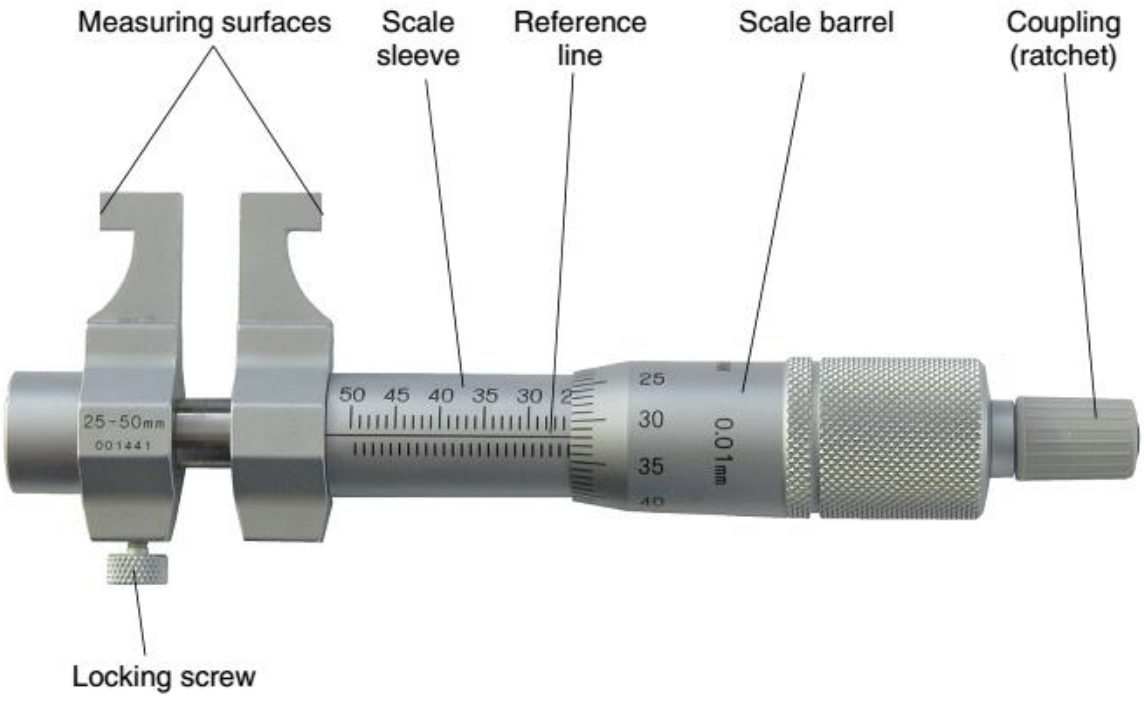
Reading at the graduation on the nonius that coincides with a graduation on the scale
Value: 0,35

Value read: 20,35mm

EXTERNAL AND INTERNAL MICROMETERS:

With a micrometer, the rotational movement of the scale barrel creates a longitudinal movement. The measuring accuracy and measuring range are specified on the micrometer. The measuring accuracy of the micrometer is normally greater than that of a caliper gauge. However, the measuring range of the micrometer is smaller than that of a caliper gauge.



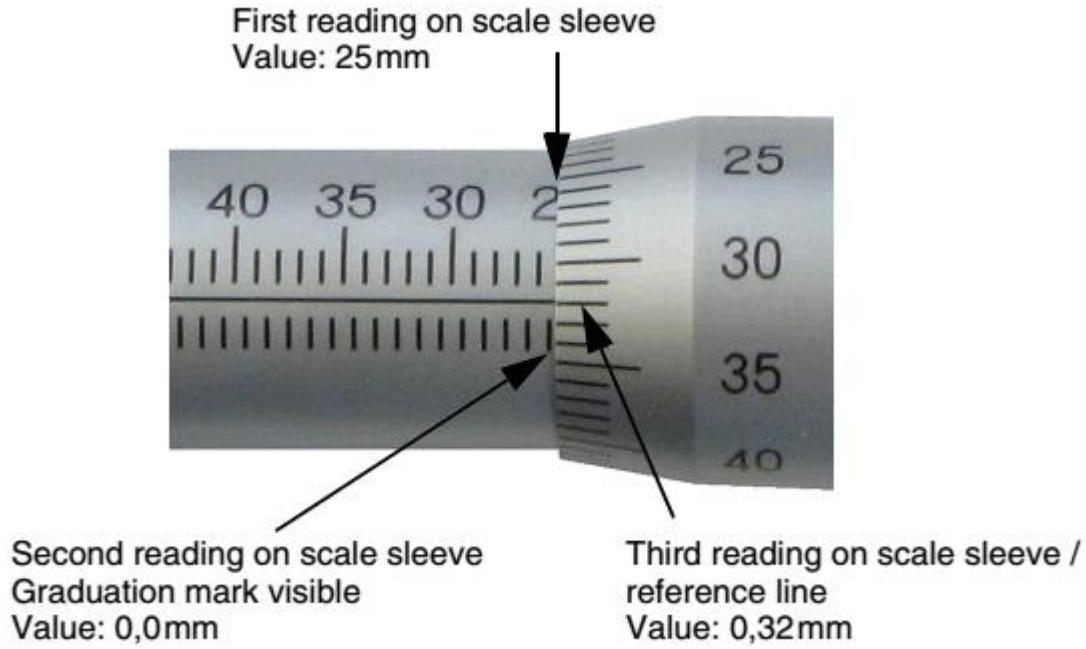


PROCEDURE:

The test object is positioned between the two measuring surfaces. The coupling (ratchet) limits the pressure applied to the test object via the thread, thus preventing deformation and measuring variations. The locking screw allows the micrometer to be fixed and used as a gauge. The spindle thread normally has a pitch of 0,5mm, i.e. a complete rotation moves the spindle 0,5mm in a longitudinal direction. The scale barrel is divided into 50 equal intervals by graduation marks. Rotation from one graduation mark to another corresponds to spindle longitudinal movement of

$$\frac{0.5\ mm\ \ pitch}{50\ graduation} = 0.01mm$$

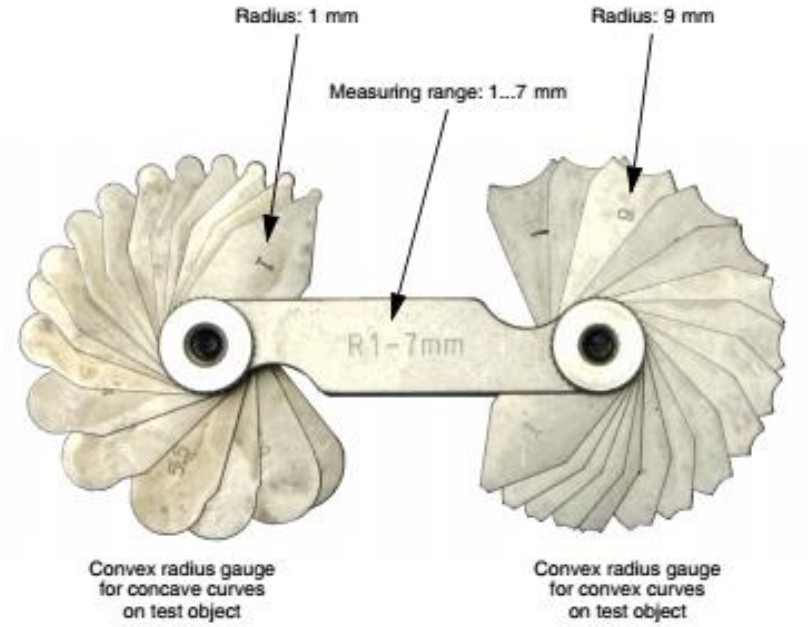
- (First part of reading) Read the full millimeters from the scale on the scale sleeve with numbers.
- Decimal places: – On the scale on the barrel that does not have numbers; each graduation mark divides the full millimeter scale into 0,5mm. If a graduation mark on this scale is visible between the edge of the barrel and the graduation mark read for the full millimeters, the value is 0,0mm. If no graduation mark is visible, the value is 0,5mm. This is the second part of the reading.
- Each graduation mark on the scale barrel represents 0,01mm. Read off this value at the reference line (third reading).
- Add the values from the second and third reading, which give the tenths and hundredths of millimeters respectively.



VARIOUS TYPES OF GAUGES:

RADIUS GAUGES:

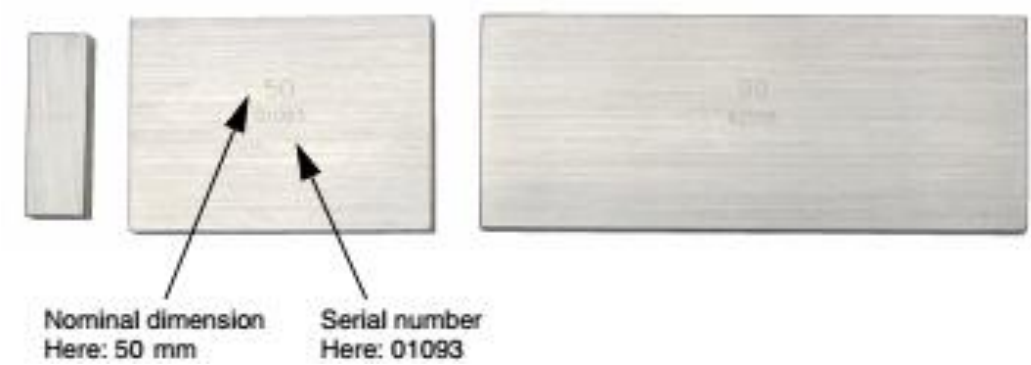
Radius gauges are used to test convex and concave curves. The curves on the specimen/test objects are comparede with different radius gauges and thus classified. The measuring range is specified on each set of radius gauges. The relevant radius is specified on each individual radius gauge.



Radius Gauges

SLIP GAUGES:

Slip gauges are small blocks with high accuracy in length and are used calibrating measuring instruments.



Slip Gauges

OBSERVATIONS:

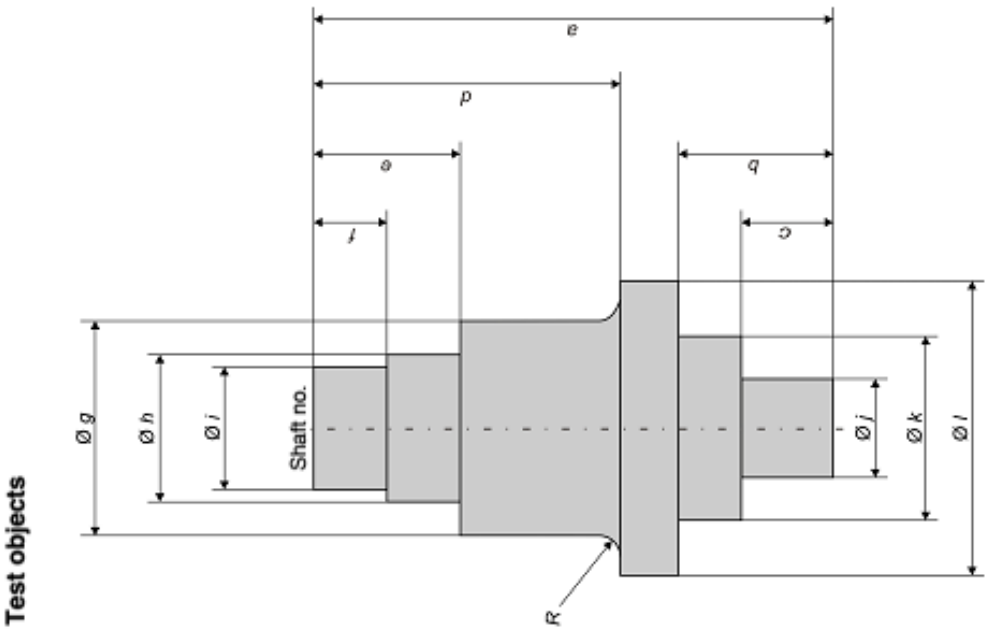


Fig. 4.9 Dimension drawing of shafts, scale 1 : 1

Test report		
Test object: Shaft _____		
Date: _____		
Dimension name	**Measured dimension in mm**	**Measuring instrument or gauge**
Lengths		
a		
b		
c		
d		
e		
f		
Diameter		
Ø *g*		
Ø *h*		
Ø *i*		
Ø *j*		
Ø *k*		
Ø *l*		
Radii		
R		

QUESTIONS:

Q01: You have a test work piece with a length of 37 mm and a length tolerance of 0.025mm. What measuring instrument will you use?

_____

_____

Q02: Define measurements and name some of the geometric attributes that can be measured?

_____

_____

Q03: What is the difference between testing instruments and gauges?

_____

_____

Q04: What is a nonius? Also explain the purpose of internal micrometer?

_____

_____

Q05: Give one advantage and one disadvantage of the micrometer screw gauge over the Vernier caliper?

_____

_____

Q06: Why slip gauge is being used in inspection. Also discuss the material of slip gauges?

_____

_____

OBJECTIVE: To demonstrate the use of different gauges for specialized measurements.

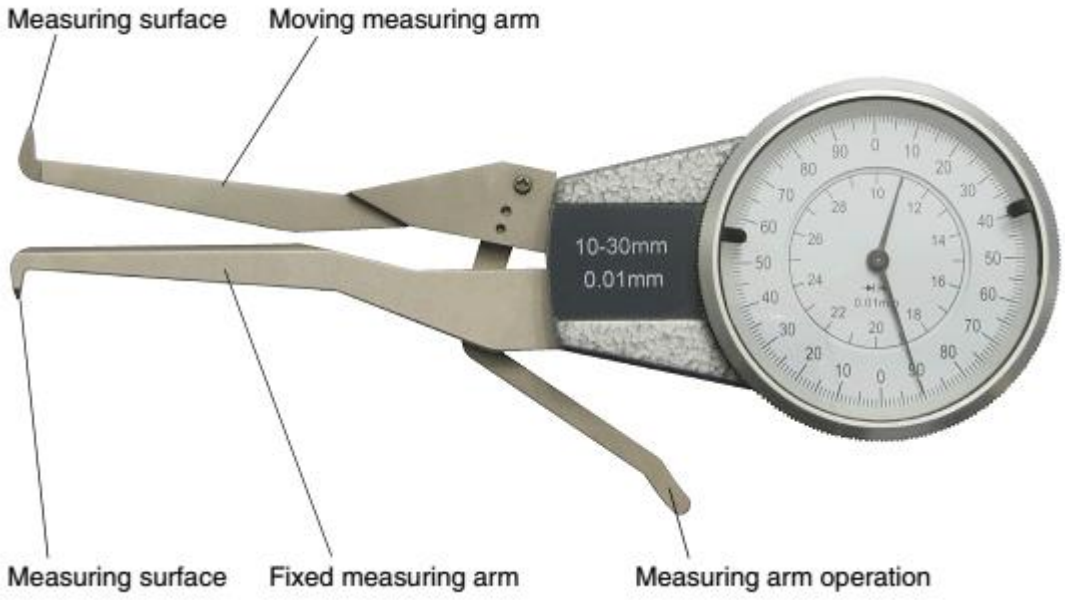
THEORY:

In the previous lab, two of the most common gauges used for taking measurements in mechanical engineering were discussed. In this handout, a few gauges will be presented which are very useful for taking measurements in specific situations.

QUICK CALIPER

Quick calipers are used to measure external and internal dimensions at locations that cannot be reached with a caliper gauge or a micrometer. The lab training kit contains an internal quick caliper. The measuring range and measuring accuracy are specified on the housing of the quick caliper.

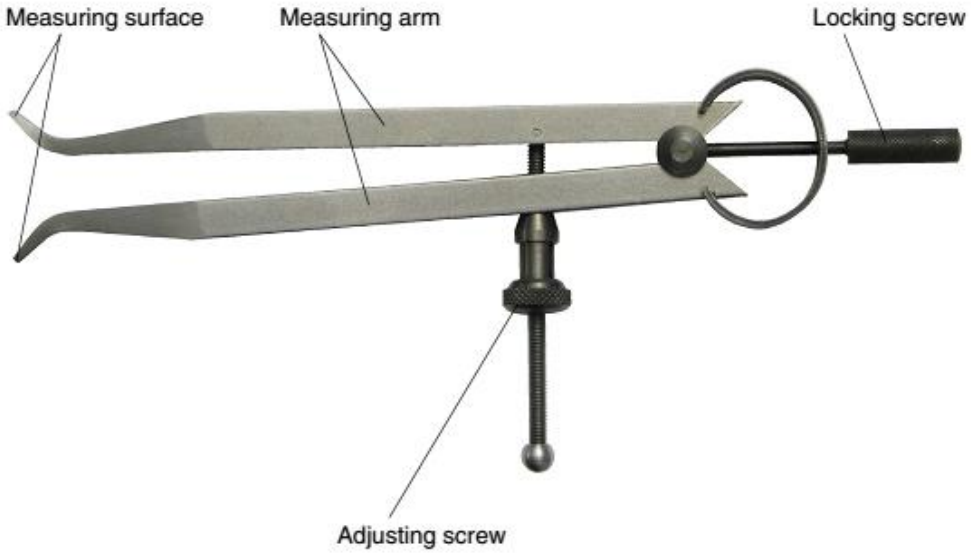
The measuring accuracy of the quick caliper is normally greater than that of a caliper gauge. However, the measuring range of the quick caliper is smaller than that of a caliper gauge. The internal quick caliper is fed into a hole so that the measuring surfaces are in contact with the inner sides of the hole. The longitudinal movement of the measuring arm is transmitted to two pointers and the measured value is read on the scale.



1: QUICK CALIPER

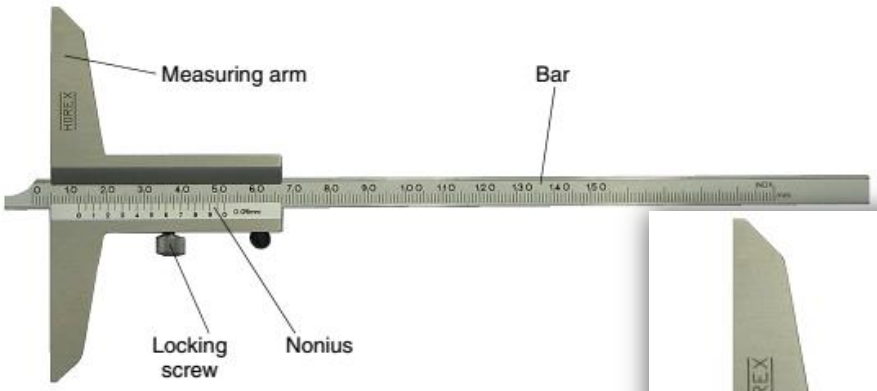
SPRING CALIPER

The spring caliper is used to measure the **roundness** of an object. It is fixed using a locking screw located at the top.

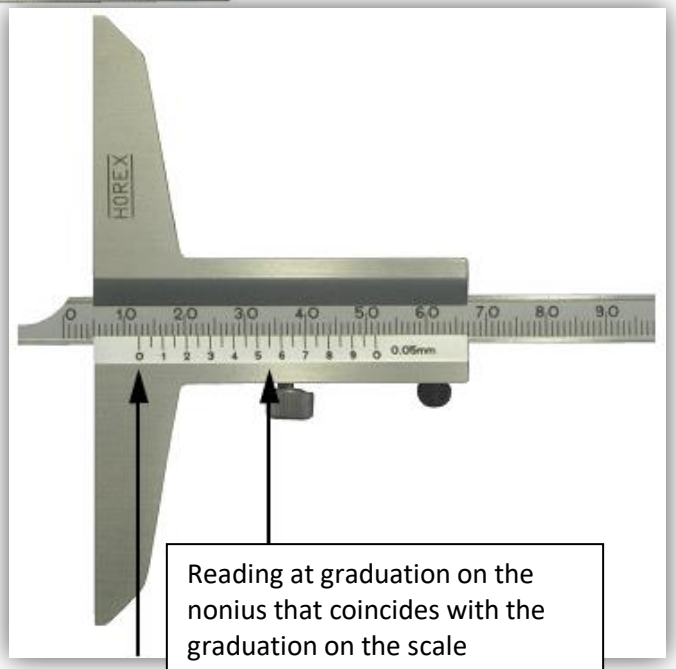


2: INSIDE SPRING CALIPER

DEPTH GAGE:



The depth caliper gauge consists of a bar with millimeter graduations and a measuring arm, which makes a right angle with the bar. The measuring arm has a scale, known as the nonius. The depth caliper gauge is used to measure depths. The locking screw allows the depth caliper gauge to be used as an adjustable gauge.



TAPER MEASUREMENT:

Work pieces can have internal and external tapers. In order to measure tapers we can use **Taper gauges** and **Taper Plug Gauges**.

3: TAPER GAUGE

4: TAPER PLUG GAUGE

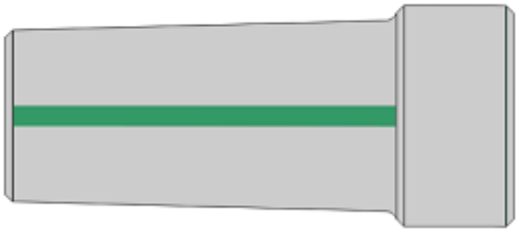
Taper gauges are used to test external tapers while taper plug gauges are used to test internal tapers. Both are gauges, i.e. the angle and shape of a test taper is compared with the angle and shape of the gauge taper. The result is an indication of whether the test object is within specified limits ("Good") or outside specified limits ("Reject").

The information on the taper gauges has the following meaning:

MT or MK	**Morse taper**, named after the American Stephen A. Morse (lived in 19th Century)
A or C	**Shape of taper** A: Sleeve with draw-in thread for fixing C: Pin with draw-in thread for fixing
3	**Taper size** The sizes MT 0 (smallest diameter) to MT 6 (largest diameter) are included
DIN 229	**Technical Standard** for Morse tapers

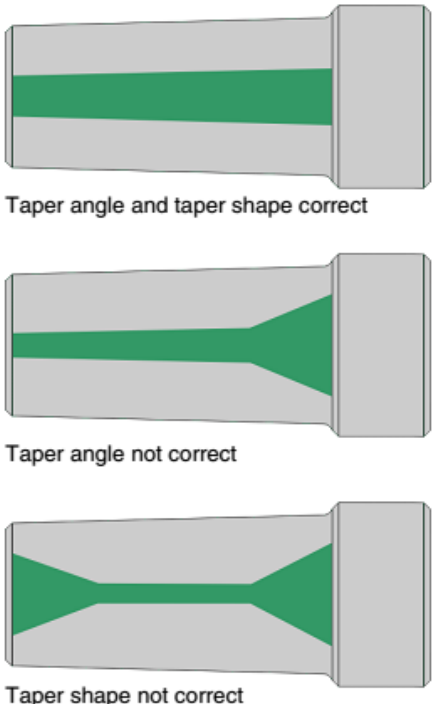
The procedure for **testing the taper angle** and taper shape of an external or internal taper is as follows:

- Draw three markings at equal intervals along the length of the taper with chalk or surface paste. The taper can be the test object (external taper) or the taper plug gauge.



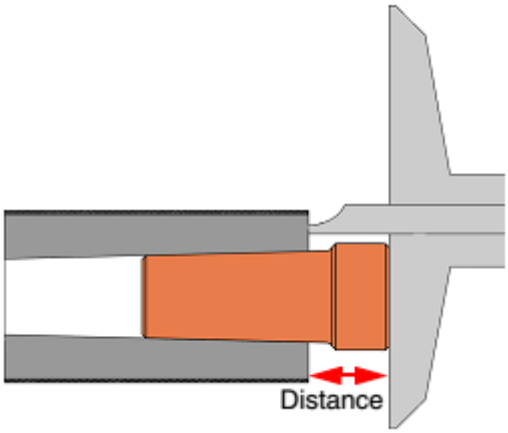
5: Apply the marking

- Slide the test object carefully into the sleeve and turn it slightly back and forth.
- The sleeve can be the test object (internal taper) or the taper gauge.
- Remove the taper from the sleeve.
- The distribution of the chalk or surface paste represents the contact pattern.
- Where there is contact with the taper, the chalk or paste is rubbed in evenly.
- Where there is no contact with the taper, the marking is unchanged.



6: Examples of Contact Patterns

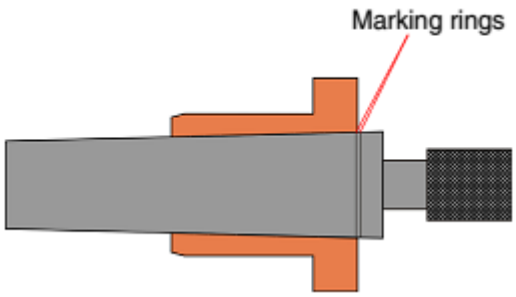
- **Testing the taper diameter of an external taper:**
- Slide the test object carefully into the taper gauge. The nominal diameter is the larger diameter on the front of the taper gauge.
- Use a depth caliper gauge to measure the distance between the front of the test object and the position of the nominal diameter.
- If the measured value lies within the tolerance specified in the external taper drawing, the diameter is "Good".
- If the measured value lies outside the tolerance specified in the external taper drawing, the diameter is a "Reject".



7: Testing the diameter of External Taper

Testing the taper diameter of an internal taper:

- Slide the test object carefully over the taper plug gauge.
- On the taper plug gauge are two marking rings (tolerance markings).
- If the front surface of the test object is between the two marking rings, the diameter is within the tolerance and is "good".
- If the front surface of the test object is outside the two marking rings, the diameter is outside the tolerance and is thus a "reject".



8: Testing the diameter of an internal taper

Calibration – Adjustment – Official calibration

Calibration

Comparison of the values measured using an item of test equipment (measuring instrument or gauge) with a reference.

This identifies the level of variation between two values (measuring instrument) or whether the variation between two values lies within certain limits (gauge).

This variation is noted.

Calibration does not involve any modification of the test equipment.

Adjustment

Changing the display on a measuring instrument due to a variation identified during calibration.

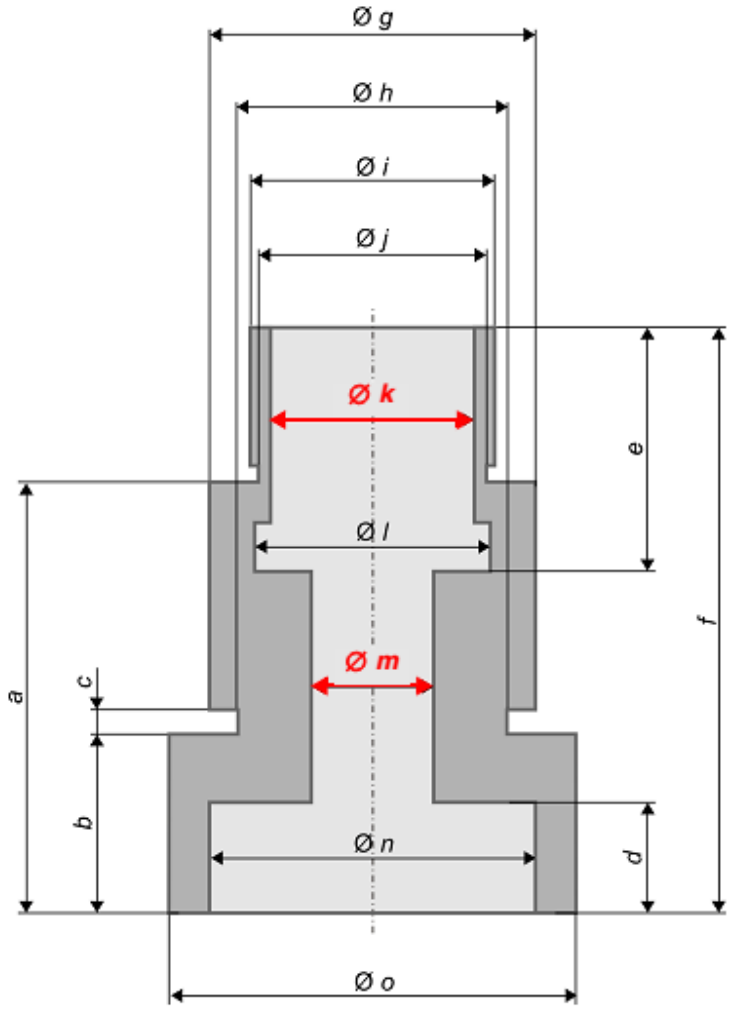
Gauges cannot be adjusted.

Official calibration

Calibration and adjustment of a measuring instrument by a **statutory body**, for example the state calibration authority.

EXERCISE -01

Determine the dimensions of the sleeve shown in the figure below and enter the values in the test report.

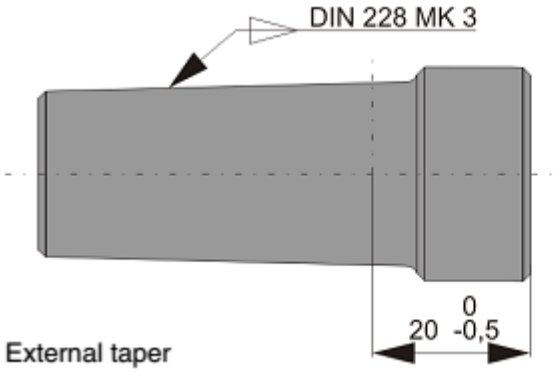


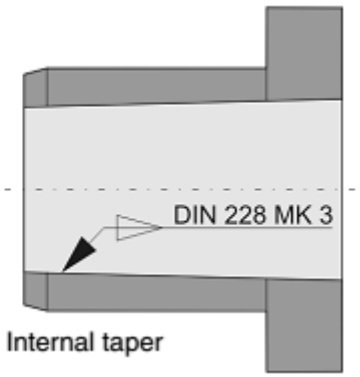
Dimension Name	Measured Dimension in mm	Measuring Instrument	Dimension Name	Measured Dimension in mm	Measuring Instrument
Lengths			**Diameters**		
a			***Φ g***		
b			***Φ h***		
c			***Φ i***		
d			***Φ j***		
e			***Φ k***		
f			***Φ l***	X	X
			Φ m		
			Φ n		
			Φ o		

EXERCISE -02

Check the quality of the taper for the given specimens against the drawings given below:

	External Taper				Internal Taper			
	101	102	103	104	201	202	203	204
Quality of Taper angle								
Quality of Taper shape								
Quality of Taper diameter								





QUESTIONS:

Q01: What can you test with gauges?

_____

_____

Q02: What are the advantages and disadvantages of a quick calliper compared to a calliper gauge?

_____

_____

Q03: What is the difference between internal micro meter and 3-point internal micro meter? Which is more accurate? Explain its advantages and disadvantages?

_____

_____

Q04: What is calibration? Illustrate the difference between calibration and official calibration?

_____

_____

Q05: What is tolerance? Discuss unilateral and bilateral tolerances in detail?

_____

_____

Q06: Discuss the advantages of bilateral tolerances over unilateral tolerances?

_____

_____

Q07: Classify the following inspection instruments as **measuring instrument** or **gauges**?
Taper Gauge, Depth caliper gauge, Taper plug gauge, Caliper gauge, Micrometer screw gauge, Slip Gauge.

_____

_____

Q08: Discuss 3-point internal micrometer and depth micrometer in detail with the help of figures?

_____

_____

OBJECTIVE: To study various parts and cutting tools used for a Centre Lathe Machine.

THEORY:

INTRODUCTION TO THE LATHE MACHINE

Definition:

The lathe is the most versatile and commonly used among all machine tools. A work piece is held in a holding device (e.g. chuck) and rotated on the axis, while the cutting tool is advanced along the line of the desired cut. Lathe size is determined by the "SWING" and "BED LENGTH". Swing indicates the largest diameter that can be turned. Bed length is the entire length of the ways and should not be mistaken for the maximum length of the metal that can be turned.

Operations performed on lathe:

A lathe machine is extremely versatile and with suitable attachments the lathe may be used for performing a very large number of machining operations. Typical machining operations that are performed on a lathe turning, facing, tapering, taper turning, drilling, boring, spinning, grinding, threading, tapping and polishing operation.

Major Parts of Lathe Machine

Each part of the lathe falls into one of the three functional divisions:

1. Driving the lathe
2. Holding and rotating the work.
3. Holding and moving the cutting tool.

Main parts of a center lathe:

1. The bed and ways.
2. The head Stock.
3. The quick change gear box.
4. The carriage assembly.
5. The tail stock.

1. Bed:

The bed is a heavy, rugged casting made to support the working parts of the lathe. On its top section are machined ways that guide and provide for precise alignment of the headstock and tail stock.

2. The Head Stock:

The head stock is clamped on the left hand side of the bed. A hollow spindle supported by the bearings, provides a drive through the gears from the motors to the work piece holding devices. 3-jaw or 4-jaw chucks can be fitted on to the spindle in order to hold and drive the work piece that would allow the cutting tool to perform various operations.

3. Feed Mechanism:

The feed mechanism transmits power through a gear train to the quick change gear box which in turn regulates the distance of tool travel per revolution of the spindle. The LEAD SCREW transmits the power to the carriage through a gearing and clutch arrangement in the apron. Feed change levers on the apron control the operation of power feed and when placed in neutral, permits the half nuts to be engaged for threading operations.

4. Carriage Assembly:

The Carriage Assembly consists of three main parts.

a. The saddle b. Apron c. Cross Slide

a. The Saddle

It is used to move the cutting tool along the lathe bed. The saddle is an H-Shaped, casting mounted on the top of the lathe ways, provides a means of mounting the cross slide and the apron.

b. Apron

It is the part of carriage assembly on the side of the operator. It contains levers for engaging and dis-engaging the feed rod and lead screw via a half nut. Apron fastened to the saddle houses the gears and mechanism required to move the carriage or cross side automatically. The apron hand wheel can be turned manually to move the carriage along the lathe bed. This hand wheel connected to a gear that meshes on a rack fastener to the lathe bed.

c. ***The cross slide:***

The cross slide mounted on top of the saddle, provides a manual or automatic cross movements for the cross movement of cutting tools. The compound rest, fitted on the top of the cross slide is used to support the cutting tool.

5. Tail Stock:

It consists of the upper and lower castings. It can be adjusted along the lathe ways to accommodate works of different lengths. The tail stock can be locked in any position along the bed of the laths by the tail stock clamp. The tail stock spindle has an internal taper to receive the dead center, which provides support for the right hand end of the work. Other standard tapered shank tool such as reamer and drill can be held in the tail stock spindle. A spindle clamp is used to hold the tail stock spindle in or out of the tail stock casting. It can be used to provide a hand feed for drilling and reaming operations.

Lathe Tools: -

The tools used for common machining operations on a lathe are single point cutting tools i.e. they have only one cutting edge that must be re-sharpened when becomes dull or worn out after a certain period of machining. The most commonly used tool material is High Speed Steel, although carbides and ceramics tool inserts are gaining increased usage due to their many superior characteristics over HSS tools. The next hand out will refer to various configurations of lathe tools.

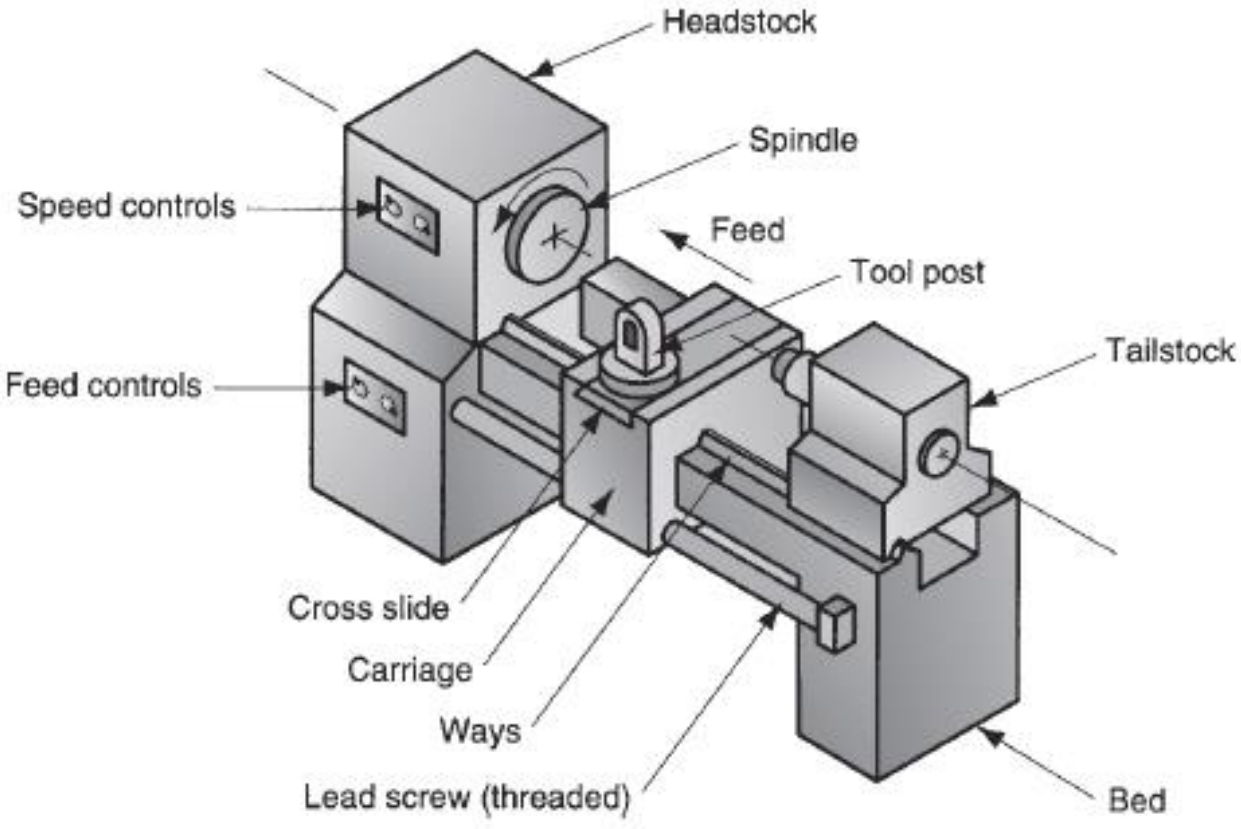
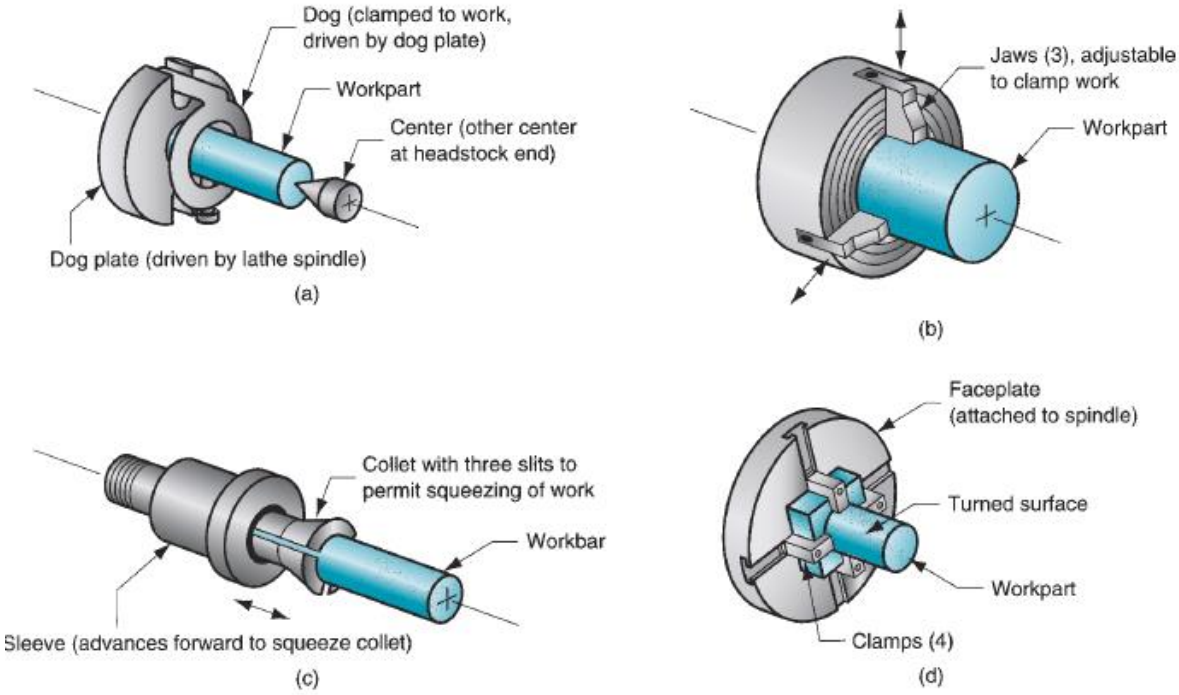


Figure 1: Basic Components of a Lathe

METHODS OF WORK HOLDING IN LATHE MACHINE

There are four common methods used to hold work parts in turning.

1. Mounting the work between centers.
2. Chuck.
3. Collet.
4. Face plate.



Four workholding methods used in lathes: (a) mounting the work between centers using a dog, (b) three-jaw chuck, (c) collet, and (d) faceplate for noncylindrical workparts.

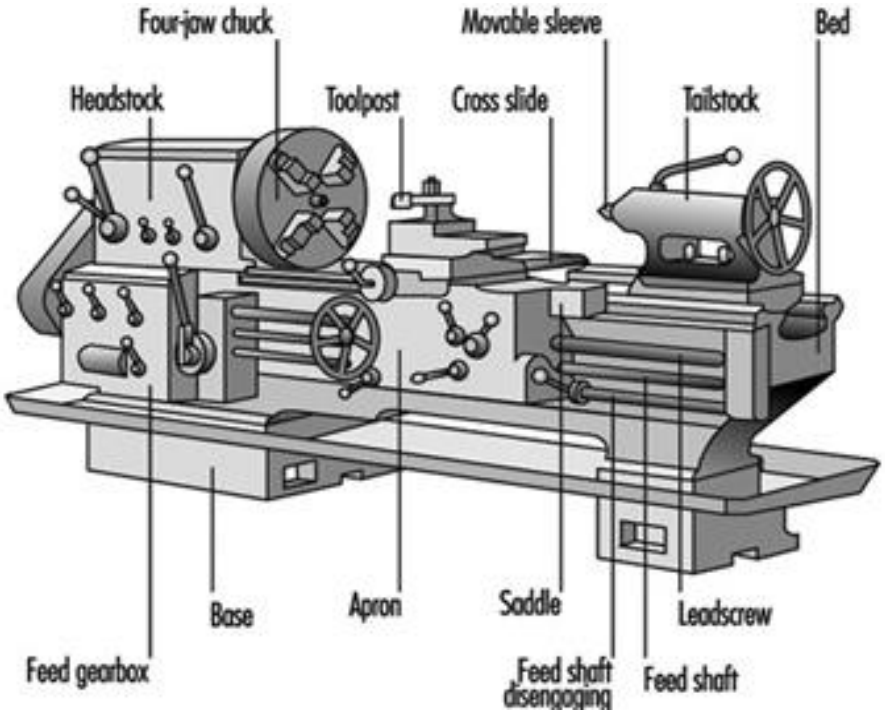


Figure 2: Details of Lathe components

OBJECTIVE: To study various operations that can be performed on lathe machine.

THEORY:

OPERATIONS THAT CAN BE PERFORMED ON LATHE

1. Turning.
   a) Taper Turning.
   b) Contour Turning.
   c) Forming.
2. Facing.
3. Chamfering.
4. Parting
5. Threading.
6. Boring.
7. Drilling
8. Knurling.

1. TURNING: -

Turning constitutes the majority of the lathe work. It is an operation to produce straight, curved or grooved work pieces such as shafts and spindles. The cutting forces resulting from feeding the tool right to left should be directed towards the head stock to force the work piece against the work holder and thus provides better work support.

a. Taper Turning: -

In this process, the tool is fed at an angle to create a tapered cylinder or conical shape.

b. Contour Turning: -

In this process, the tool follows a contour to create a contoured form in the turned part.

c. Forming: -

It is also called form turning. In this process, a tool has a shape that is imparted to the work by plunging the tool radially into the work piece.

2. FACING: -

It is the operation to produce a flat surface as the result of the tool being fed across the end of the rotating work piece. In facing the length of the work piece is reduced in contrast to turning, where the diameter is reduced. Facing can also be used to produce grooves in a work piece.

3. CHAMFERING: -

In this process, the cutting edge of the tool is used to cut an angle on the corner of the cylinder, forming a **"chamfer"**.

4. PARTING: -

It is also known as cutoff operation. In this process, the tool is radially into the rotating work at some location along its length to cut the end of the part.

5. THREADING: -

In this process, a pointed tool is fed linearly across the outside surface of the rotating work part in a direction parallel to the axis of rotation at a large effective feed rate.

6. BORING: -

Boring always involves the enlarging of the existing hole, which have been made by a drill or may be a result of a core in a casting. An equally important and concurrent purpose of boring may be to make the hole concentric with the axis of rotation of the work piece.

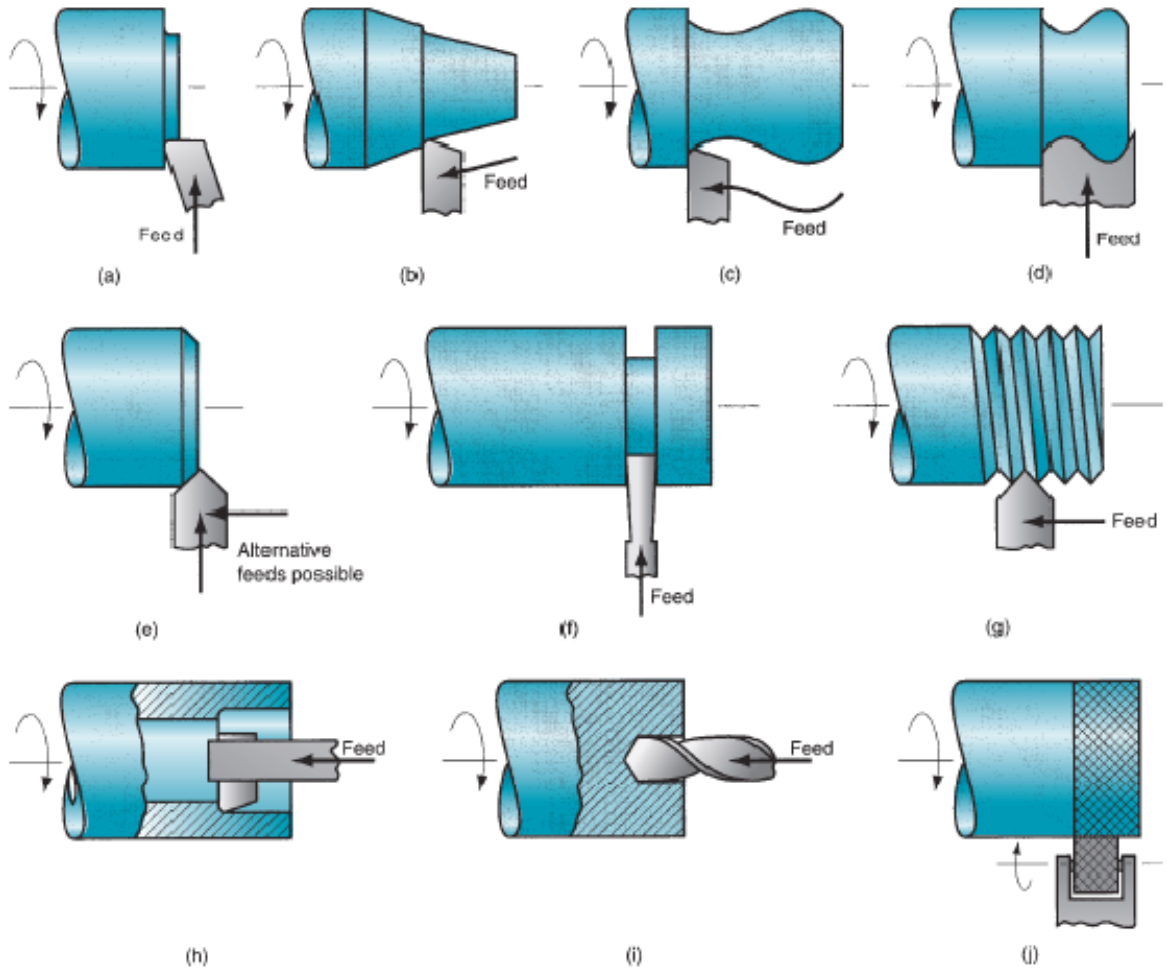
7. DRILLING: -

Drilling on lathe machine is done, with the drill mounted in the tail stock quill of the center lathe and fed by hand against a rotating work piece. Drills can also be mounted on the turrets of modern bed lathes and fed automatically along the rotational axis of the work piece. It is also possible to drill on a lathe with the drill bit mounted and rotated in the spindle, while the work piece remains stationary supported on the tail stock or the carriage of the lathe.

8. KNURLING: -

It produces a regular shaped surface on a work piece. Although knurling can be applied on flat surfaces, in most cases it is done on external cylindrical surfaces using lathes. Knurling is a chip less, cold forming process. The two hardened tools are pressed against the rotating work piece with sufficient forces to cause a slight lateral displacement of the metal so as to form the knurl e.g. a raised diamond pattern. Because it involves less pressure, therefore knurling does not band the work piece. This method is often preferred for work piece of small diameter and for use in automatic or semi-automatic machines.

1: MACHINING OPERATIONS OTHER THAN TURNING THAT ARE PERFORMED ON A LATHE



Machining operations other than turning that are performed on a lathe: (a) facing, (b) taper turning, (c) contour turning, (d) form turning, (e) chamfering, (f) cutoff, (g) threading, (h) boring, (i) drilling, and (j) knurling.

CUTTING FLUIDS:

A cutting fluid is any liquid or gas that is applied directly to the machining operation to improve cutting performance. Following are trouble shooting guidelines for cutting fluids related problem.

Problem	Likely conditions and symptoms	Possible Changes in Cutting Fluid
Heat	Premature tool failure due to high temperature	Increase fluid flow rate
	Cutting speed too high for tool	If cutting oil, reduce viscosity level
	Chip adheres to rake face	If cutting oil, try emulsifiable oil
	Continuous cutting (e.g., turning, drilling)	If emulsifiable oil, increase water proportion
		If emulsifiable oil, try chemical or semichemical fluid
Wear	Low cutting speed	If emulsifiable oil, try cutting oil
	Rapid tool wear	If emulsifiable oil, increase oil proportion
	Work metal is high tensile strength steel or heat-resistant alloy	If chemical fluid, try emulsifiable oil
		Try fluid with chemically active additives for extreme pressure lubrication
	Work metal is abrasive (e.g., sand casting)	
Chatter	Vibration	If dry, try using a cutting fluid to address vibration problem through hydraulic dampening
	Inadequate rigidity of setup	If cutting fluid, use fluid with higher viscosity

QUESTIONS

Q01: List the components you have studied from this handout and with the help of your instructor locate each one of them on the lathe machine in your lab. If a component is not found mention why it is missing and how your machine is different from a conventional lathe?

_____

_____

Q02: Write down the names of the basic machining processes in manufacturing?

_____

_____

Q03: What is a tool insert and illustrate various types of tool insert?

_____

_____

Q04: Illustrate various advantages and disadvantages of using tool inserts in cutting tools?

_____

_____

Q05: Illustrate various type of cutting fluids/ lubricants used in various machining operations?

_____

_____

OBJECTIVE: To study drill machines with related tools and operations.

THEORY:

INTRODUCTION:

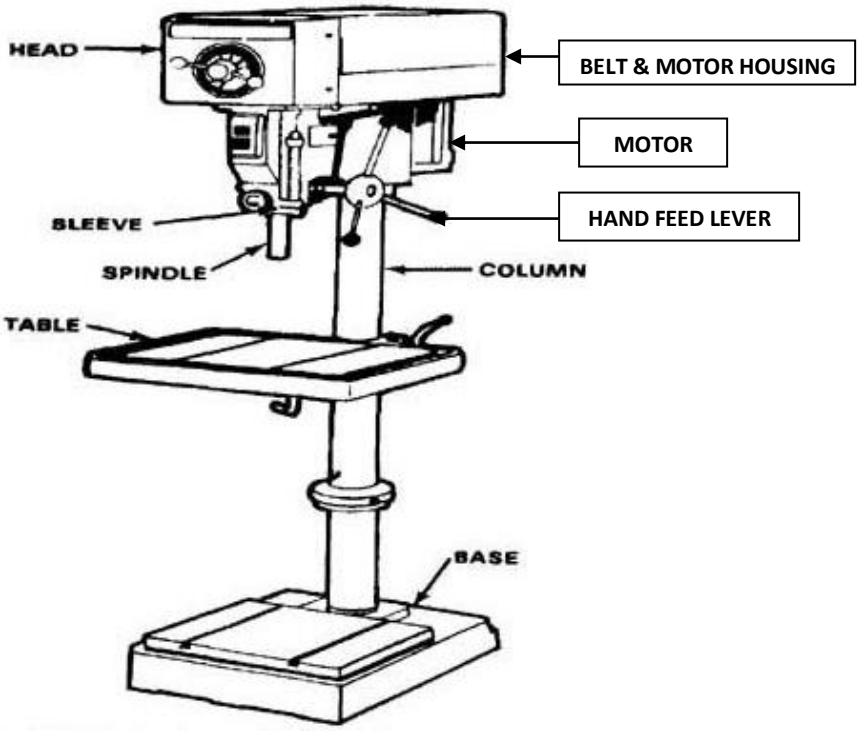
Drilling holes is one of the most basic of machining operations, and probably is the one which produces maximum chip volume. Drilling often is not the ultimate operation in the production of holes. Because the finishing is not very good, and there may be tapering of the hole-diameter with depth, therefore, drilling is most often followed by finishing operations like reaming, boring and honing. Various other hole-modification operations are also performed subsequent to drilling which include counter-boring, counter-sinking and spot-facing.

DRILL PRESS:

The commonly used drill press is **(1) Upright or Center drill press (2) Radial Arm Drill Press.** The major parts of these machines are illustrated in the attached figures.

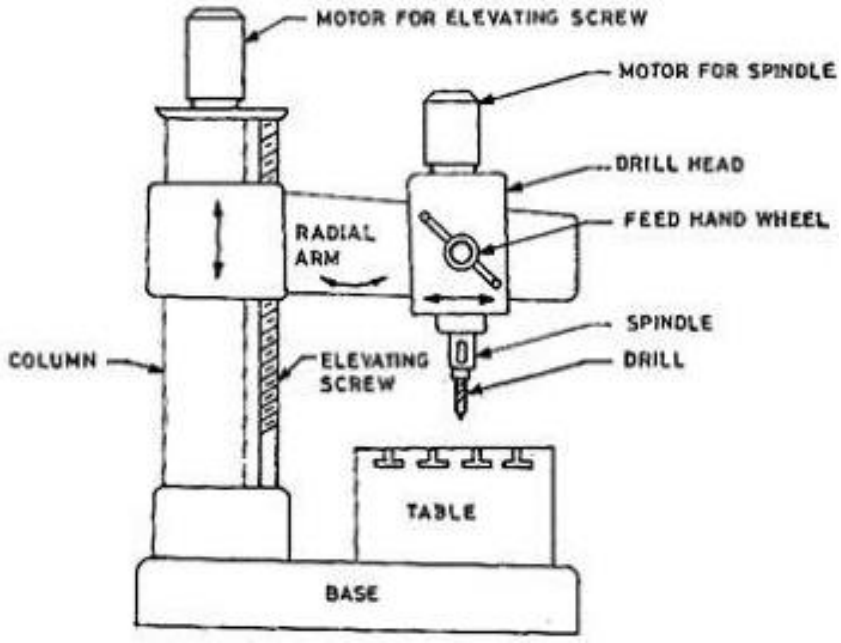
In an **UPRIGHT DRILLING MACHINE** the major parts include:

a. Motor
b. Driving system that contains belts/pulleys or gear train for speed change.
c. Head
d. Column
e. Table
f. Base that supports the whole structure.



UPRIGHT DRILLING MACHINE

The **RADIAL ARM DRILL PRESS** is the most versatile drilling machine. Its size is determined by the diameter of the column and length of the arm measured from center of spindle to the outer edge of the column. It is useful for the operation on large and heavy parts and casings that are too heavy to be re-positioned by the operator for drilling every hole. The radial arm drill press is used for drilling very small to very large holes and for boring, reaming, counter-boring and counter-sinking. Like the upright drill press it also has a power feed mechanism and a hand feed lever.



RADIAL ARM DRILL PRESS/MACHINE

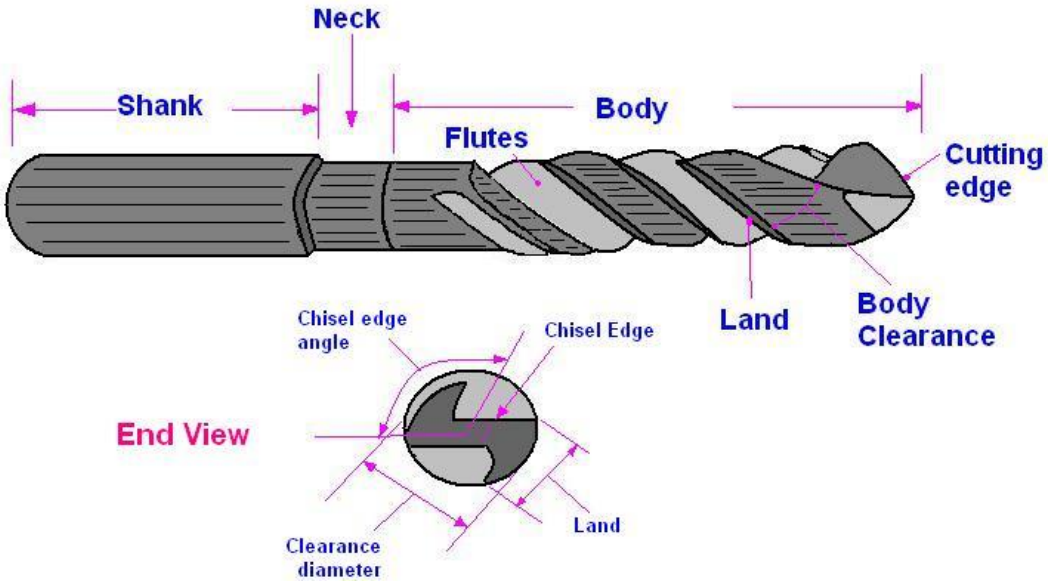
DRILLING TOOLS:

The drilling tool or the DRILL is an end cutting rotary type tool having one or more cutting lips and one or more flutes for the removal of chips and passage of coolant. **TWIST DRILL** is by far the most common type of drill used today. These are made with two or more flutes and cutting lips and available in varieties of design. The twist drill has a straight or taper shank.

Apart from twist drill there are many other types of drills that are used for specific applications. A list of these tools is as follows:

1. High and low helix drill
2. Core drills.
3. 3 or 4 fluted drills.
4. Center drills.
5. Step drills
6. Spade drills.

Parts of Twist Drill



DRILLING RELATED OPERATIONS

1. **REAMING: -**

Reaming is done to precision finish an already drilled hole. In the heavy construction industry, reaming may also be used to enlarge or align existing holes. Reaming can be done machine or hand reamers.

2. **BORING: -**

Boring is used to enlarge and already-drilled hole. Boring has an additional advantage that is straightens the walls of a hole and improves its cylindricity. Boring is done on lathe and specially designed boring machines. Boring tool is a single point cutting tool.

3. **COUNTER BORING: -**

Counter boring is enlarging an already drilled hole to a certain depth. Counter boring is done to provide a bearing surface for nuts, bold heads and pin heads so that they do not protrude above the surface. Counter-bores are the tools used for this operation, and are guided by a pilot to ensure the concentricity of the two holes.

4. **COUNTER SINKING: -**

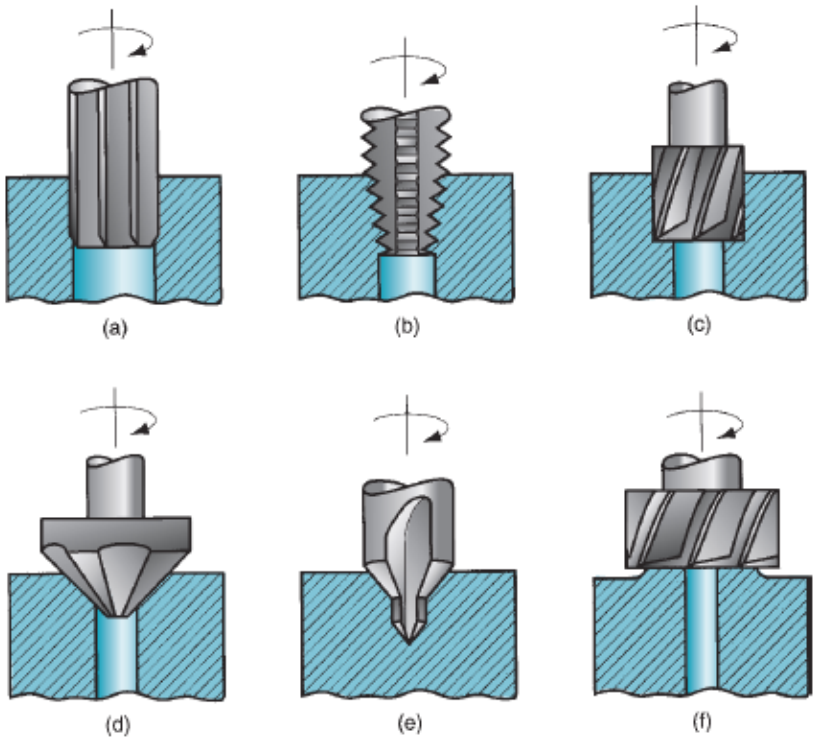
Counter sinking is done to produce a conical enlargement at the ends of holes. The purpose of counter sinking is (a) chamfering or deburring the end of hole to prepare of reaming or tapping (b) modifying a hole to receive a flat head screw or rivet.

5. **SPOT FACING: -**

Spot facing is similar to counter boring except that its main purpose is to provide a flat bearing surface for nut or bolt heads on rough castings and a raised boss. The depth of enlarged hole is much less than in counter boring.

6. **TAPPING: -**

This operation is performed by a tap and is used to provide internal screw threads on an existing hole.



Machining operations related to drilling: (a) reaming, (b) tapping, (c) counterboring, (d) countersinking, (e) center drilling, and (f) spot facing.

Q01: List the components you have studied from this handout? Also elaborate which type of drilling is performed on lathe and how it is different from conventional drilling operations?

_____

_____

_____

Q02: Illustrate the differences between single point cutting tools and multiple point cutting tools? Support your answer with the help of neat sketches/figures?

_____

_____

_____

Q03: What is a drill bit and illustrate various types of drills?

_____

_____

_____

Q04: What are the deficiencies in a drill hole, and how can we rectify those?

_____

_____

_____

Q05: With the help of a neat sketch/ figure, illustrate the nomenclature of a twist drill?

_____

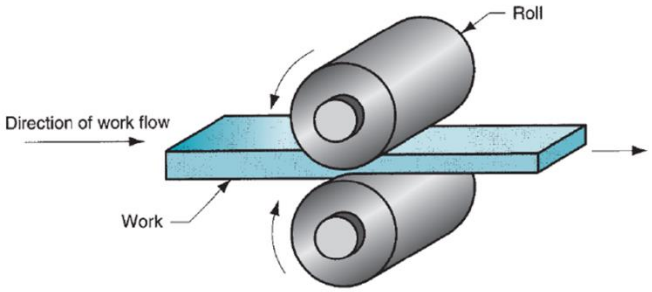
_____

OBJECTIVE: To study and demonstrate the roll bending of various plates using single pinch type roll machine.

THEORY:

CONVENTIONAL ROLLING OPERATIONS: -

Conventional Rolling is the process of reducing the thickness or changing the X-sectional of a long work piece by compressive forces applied through a set of rolls. The initial form of material is ingot. In this process, heated metal is passed b/w the rolls that rotate in opposite direction, the gap b/w the rolls is being less than the thickness of the entering metal. It was first developed in the late 1500,s and It accounts for 90% of all metals produced by metal working processes.



ROLLING MILLS:-

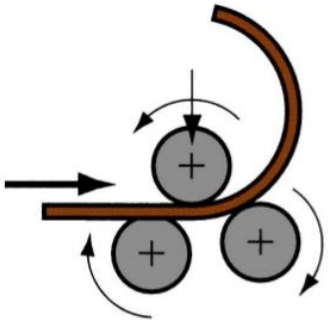
Rolling mills are the arrangement of rollers. Rolling mills are available in a variety of roll configuration.

1. Two high non reversing mills.
2. Two high reversing mills.
3. Three high mills.
4. Four high mills.
5. Cluster arrangements.
6. Minimills
7. Integrated mills.

Mills can be highly automated with rolling speeds as high as **5000 ft/min.**

ROLL BENDING OPERATIONS: -

It is a process in which large metal sheets and plates are formed into curved sections using rollers. It is continuous form of three point bending.



ROLLER MATERIAL: -

● Requirements → Strength & resistance to wear.

- Cast Iron.
- Cast Steel.
- Forged Steel.

LUBRICATION: -

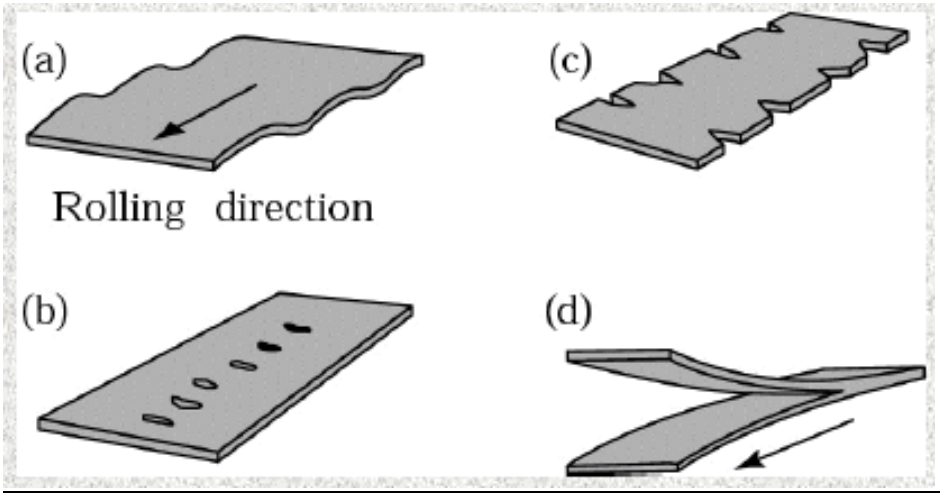
● Plays a vital role in the operation.
● Ferrous alloys are hot rolled without a lubricant, however graphite may be used.
● Aqueous solutions are used to cool the rolls.
● Non ferrous alloys are hot rolled with a variety of compounded oils & emulsions.
● Cold rolling is done with low-viscosity lubricants including mineral oils, emulsions, paraffin & fatty oils.

DEFECTS: -

- **Surface Defects.**
- **Structural Defects.**

● Surface defects may results from inclusions & impurities in the material, rust, dirt, roll marks & causes related to prior treatment & working of material.

● Structural defects are defects that affect the integrity of rolled product. It includes wavy edges, cracks and alligatoring (results from inhomogeneous deformation of the material during rolling).



Schematic illustration of typical defects in flat rolling: (a) wavy edges; (b) zipper cracks in the center of the strip; (c) edge cracks; and (d) alligatoring.

IMPORTANT TERMINOLOGIES

Ingot:-

An ingot is a piece of relatively pure material, usually metal, that is cast into a shape suitable for further processing. In steelmaking, it is the first step among semi-finished casting products.

Bloom:-

A bloom has a square or rectangular X-section with a thickness greater than 6" & a width no greater than twice the thickness.

Billet:-

A billet is usually smaller than a bloom & has a square or circular X-section. It is produced by some of deformation processes such as rolling or extrusion.
Bloom & billets can be further rolled into finished products such as structural shapes or rail road rails or they can be processed into semi-finished shapes such as bar, rod, tube or pipe.

Slab:-

A slab is a rectangular solid where the width is greater than twice the thickness. It can be further rolled to produce plates, sheets & strips.

Plates:-

t > ¼" (6 mm), are used for structural applications such as ship hulls, boilers, bridges, machine structures etc.

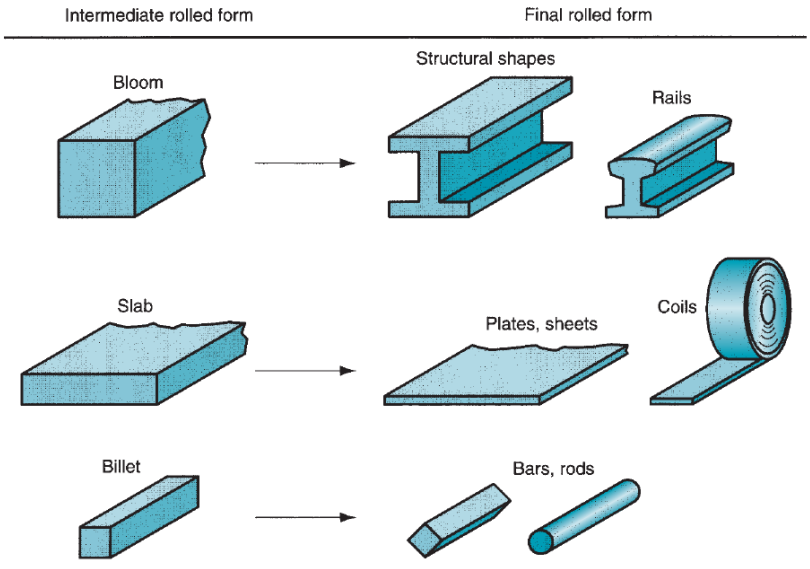
Sheets:-

t < ¼" (6 mm), are used for automobiles bodies, appliances containers for foods & beverages, office equipment. Sheets are provided as flat pieces or as strips in coils to manufacturing facilities for further processing into products.

Steel ingot

Ingot mold

Gold ingot

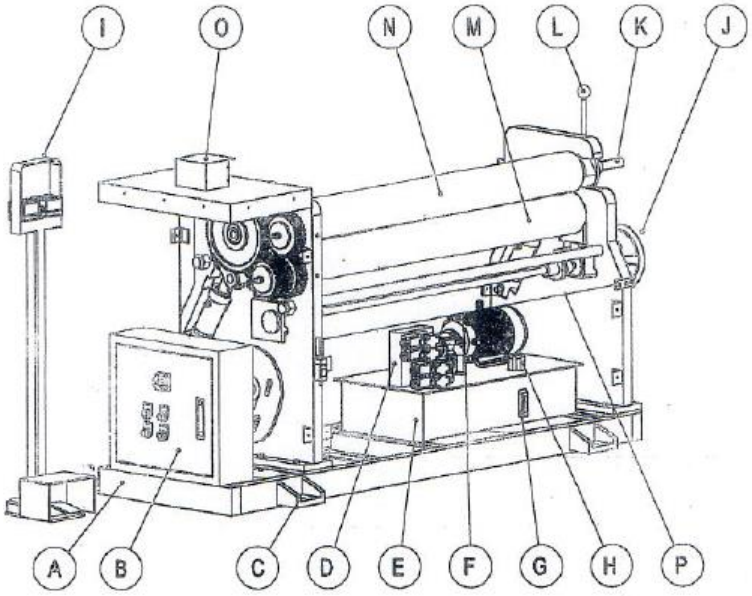


EQUIPMENT: -

A Plate Rolling Machine is a machine that will roll different kind of metal sheet into a round or conical shape. It can be also called “Roll bending machine” or “Plate bending machine”.

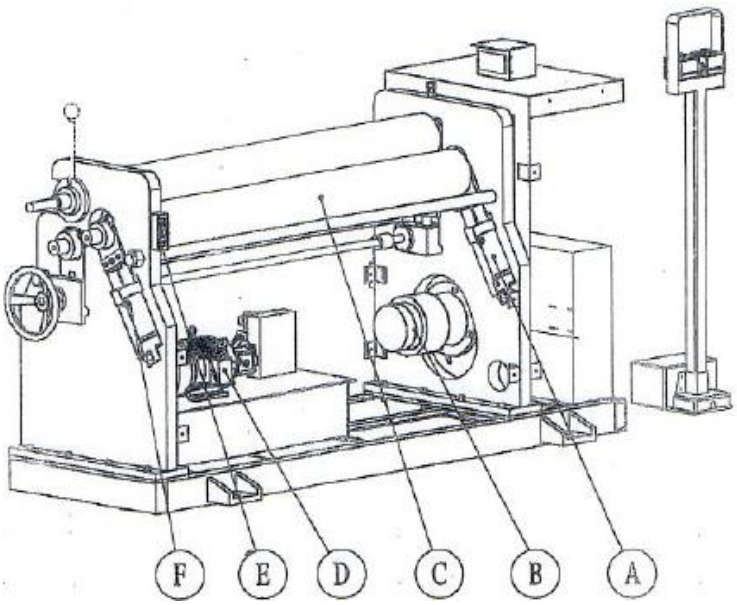
MACHINE PARTS: -

Front View



Part #	Part Name	Part #	Part Name
A	Machine Base	I	Remote Controller
B	Electrical Cabinet	J	Bottom roll adjusting hand wheel
C	Foundation/Leveling Base	K	Upper roll sliding handle
D	Hydraulic Circuit Plates	L	Upper roll lock handle
E	Hydraulic Oil Tank	M	Bottom Roll
F	Main Motor	N	Upper Roll
G	Oil Gauge	O	Pinch Roll position indicator
H	Oil Filling station	P	Emergency stop cable

Rear View



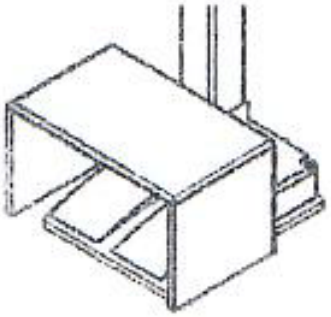
Part #	Part Name	Part #	Part Name
A	Hydraulic Cylinder	D	Main Motor
B	Reducing gear motor	E	Pinch Roll control box
C	Pinch Roll	F	Air-Relieve Valve

PROCEDURE:

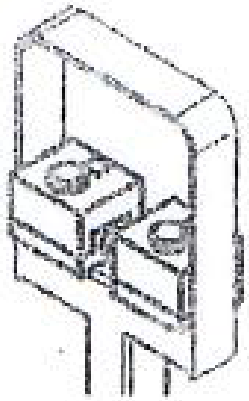
1. Switch on the machine by pressing the pump switch located on electrical cabinet.
2. Set the position of roller from pinch roll position indicator.
3. Make sure the work piece is clean and flawless.
4. Move up pinch roll to proper height.
5. Insert the work piece in between the upper and bottom rolls and lying on pinch roll
6. Adjust bottom roll by manual hand wheel so that the work piece is firmly held.
7. Move pinch roll position to the same height of bottom roll.
8. Depress foot switch pedal so that the work piece travels to the other side.
9. Repeat the procedure until the desired radius will be achieved.

CONTROL COMPONENTS OF MACHINE:

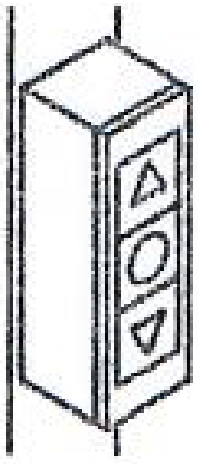
Pedals



Pinch Roll up/down button

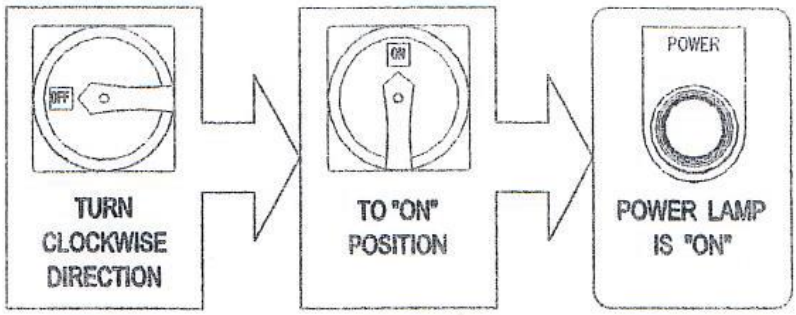


Pinch roll rear end up/down button

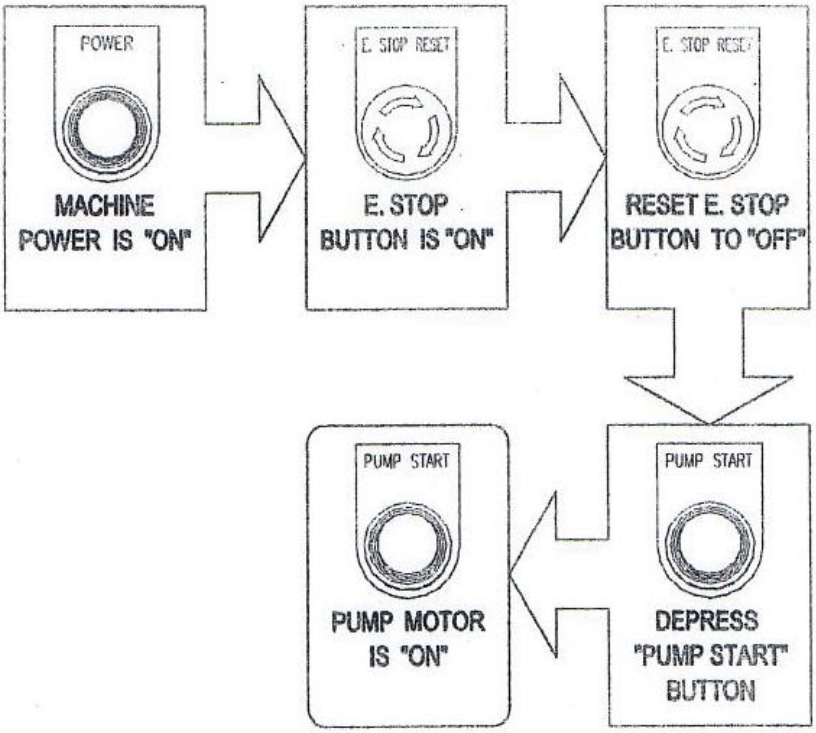


OPERATURE PROCEDEURE:

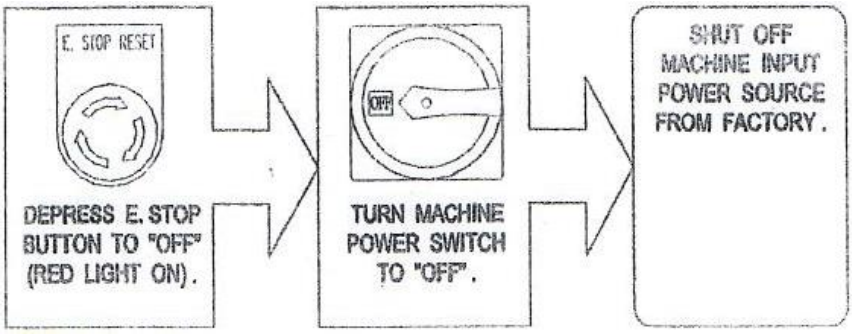
a. **Start machine power**



b. **Start hydraulic pump motor**



c. **Shut off machine power**



DISCUSSION/CONCLUSION: ??? (REQUIRED)

QUESTIONS

Q01: Is our experiment referring to conventional rolling or roll bending operations? Briefly elaborate?

_____

_____

Q02: Identify the purpose of control components of the rolling machine?

_____

_____

Q03: Illustrate the difference between single pinch type and double pinch type rolling machine?

_____

_____

Q04: Illustrate the advantages and drawbacks of sheet rolling process?

_____

_____

Q05: Describe the effect of plate material on sheet rolling process?

_____

_____

Q06: Differentiate bloom, billet and slab with the help of figure using any drawing software?

_____

_____

Q07: What is Alligatoring??

_____

_____

Q08: Discuss and classify various defects in rolling processes?

_____

_____

Q09: Enlist various differences between sheets and plates?

_____

_____

Q10: Discuss the importance of lubrication in rolling and enlist various lubricants used in rolling process?

_____

_____

Q11: What is the final roll form of slab?

_____

_____

Q12: What is an ingot? Which manufacturing process does it require to manufacture?

_____

_____