INTRODUCTION

A Lathe is an important and oldest known machine tool in any workshop. The job to be machined is held and rotated in a chuck, face plate, catch plate, between centres etc. A suitable cutting tool is advanced against rotating job. Since the cutting tool material is harder than the workpiece, the metal is easily removed from the job in the form of chip. Cutting tool used is a single point cutting tool.

- **Common operations performed on lathe machine**
  Some common operations are facing, turning, chamfering, parting off, drilling, knurling, boring, thread cutting etc.

- **The principal parts of Lathe machine are shown in Fig. 1.**

![Fig. 1. Lathe Machine.](image-url)
Raw material: Mild steel bar of φ 35 mm
All dimensions are in mm.
Drawing: Not to scale.

TOOLS AND ACCESSORIES REQUIRED

(i) Lathe Machine
(ii) 3-jaw Chuck
(iii) Facing Tool
(iv) Turning Tool
(v) Chamfering Tool
(vi) Marking and Measuring Tool
(vii) Odd leg Caliper
(viii) Outside Caliper
(ix) Combination Drill
(x) Lathe Dog

PROCEDURE

(i) Select the speed, feed and depth of cut for different operations.
(ii) Load the job on three-jaw chuck.
(iii) Perform facing operation on both ends of the job one after another by a facing tool.
(iv) Perform centre drilling operation on both ends of the job by a combination drill.
(v) Hold the job between centres using Lathe dog.
(vi) Turn the job to reduce diameter to φ 25 mm over a length of 75 mm and to φ 33 mm over a length of 25 mm by a turning tool.
(vii) Chamfer one end by chamfering tool.
(viii) Check the dimensions.

DISCUSSIONS/CONCLUSIONS

Write your comments on the dimensions and quality of the job obtained and discuss about the discrepancies or errors, if any.

Signature of the Teacher
1. What is a machine tool?

2. How is a lathe specified?
3. Explain the terms: cutting speed, feed, depth of cut in relation to turning.

4. Which materials are commonly used as cutting tool material?
5. Write functions of lead screw and feed rod of a lathe machine.

6. Name and explain five operations that can be performed on a lathe machine.
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INTRODUCTION

Milling machine is a machine tool in which metal is removed by means of a rotating cutter with multiple number of teeth (or multipoint). Each teeth has cutting edge which removes metal from workpiece.

The feed and depth of cut to the job is provided by feeding the job to the cutter, longitudinally, transversely or vertically.

- **Up Milling and Down Milling**
  
  When cutter rotates against the direction of feed of job then it is called Up or Conventional milling.

  When cutter rotates in the same direction as feed of job then it is called Down milling/Climb milling.

- **Common operations performed on Milling Machine**
  
  Plain milling, Face milling, Angular milling, Gear milling, Form milling, Milling slots, Keyways etc.

- **Principal parts of Milling machine are shown in Fig. 3.**

![Fig. 3. Milling Machine.](image-url)
SCHEMATIC DIAGRAM

Raw Material: Mild steel bar of \( \phi \) 35 mm.

All dimensions are in mm.

Drawing: Not to scale (NTS).

TOOLS AND ACCESSORIES REQUIRED

(i) Milling Machine

(ii) Vice/Clamping Device
(iii) Cylindrical Milling Cutter (Plain)
(iv) Surface Plate, Gauge
(v) Hammer, Try Square, V-Block, Punch

PROCEDURE

(i) Select speed, feed, depth of cut of milling machine for operation.
(ii) Mark both ends of round bar as per the dimension required by using V-block, Surface gauge, Surface plate, Try square etc.
(iii) Make the mark permanent by punch and hammer.
(iv) Load the job on machine vice, keeping its axis perpendicular to the axis of cutter. Take help of surface gauge to set the job properly.
(v) Remove material from the surface of job to produce one plane of square bar to be produced.
(vi) After completion of one plane follow the same procedure to cut other three planes.
(vii) Check dimensions of job.

DISCUSSIONS/CONCLUSIONS

Write your comments on the dimensions and quality of the job obtained and discuss about dimensional errors, if any.

Signature of the Teacher
1. How is a milling machine specified?

2. Differentiate between Up milling and Down milling.
3. Name few cutters used in milling machine.
1. How is a milling machine specified?

2. Differentiate between Up milling and Down milling.
3. Name few cutters used in milling machine.
INTRODUCTION

Shaper is a reciprocating type machine tool which is primarily intended to produce flat surfaces. The surfaces may be horizontal, vertical or inclined. This machine involves the use of a single point cutting tool similar to a tool used in lathe machine.

Tool is held in the tool post mounted at the end of ram. Workpiece is held in a vice or clamped directly on table. The ram reciprocates in to and fro direction and cutting of material takes place during forward stroke while the return stroke is idle. Return stroke time is less as compared to forward stroke and this is obtained by a quick return mechanism. Feed is provided by moving job relative to tool in a direction perpendicular to the movement of ram. Depth of cut is adjusted by moving tool downward towards the workpiece.

- Principal parts of a Shaper machine are shown in Fig. 5.

![Shaper Machine Diagram](image-url)
**Raw material:** Cast iron block—50 mm × 50 mm × 50 mm.

All dimensions are in mm.

**Drawing:** Not to scale (NTS).

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**Tools and Accessories Required**

(i) Shaper  
(ii) Machine Vice/Clamping Device  
(iii) Surface Plate
(iv) Try square, Surface gauge
(v) Scriber, Punch, Hammer
(vi) Cutter

PROCEDURE

(i) Select stroke length, speed, feed and depth of cut.
(ii) Load the job on machine vice.
(iii) Remove material from one face to make it plain.
(iv) By following above procedure remove material from other five surfaces, obtain a block of dimensions 45 mm × 45 mm × 45 mm.
(v) Check corners by Try square to ensure that all three edges from corner are perpendicular to each other.
(vi) Unload the job from machine.
(vii) Mark the job as per drawing using surface plate, gauge, scale, scriber etc.
(viii) Make the mark permanent by punch and hammer.
(ix) Again load the job on vice.
(x) Remove material to produce V-shape by titling the tool to required angle of inclination.
(xi) Cut a slot at the bottom of V groove.
(x) Cut another slot at the bottom of block.
(xi) Measure dimensions of job.

DISCUSSIONS/CONCLUSIONS

Write your comments on dimensional error and surface quality of job obtained and discuss the reasons of dimensional errors, if any.
1. How is a shaper specified?

2. Explain the function of Clapper box.
3. What are the different types of quick return mechanism used in Shaper machine?

4. Explain any one quick return mechanism with a neat sketch.
Assignments on Shaper

1. How is a shaper specified?

2. Explain the function of Clapper box.
3. What are the different types of quick return mechanism used in Shaper machine?

4. Explain any one quick return mechanism with a neat sketch.
INTRODUCTION

- **Drilling Machine**
  
  Drilling machine is used to produce or generate a round hole in the workpiece. The tool used for drilling holes is called Drill. The Drill is placed in the chuck of the machine which rotates about its axis. The linear motion is given to the drill towards the workpiece.

- **Taps**
  
  A tap is a tool used for making internal threads. The taps are provided with cutting edges and three or four flutes cut across it, so that when it is screwed into a hole, it cuts an internal thread. These are made in sets of three. First use taper tap, then medium tap and then bottoming or plug tap. These are made of high carbon steel or high speed steel and hardened and tempered.

OPERATIONS PERFORMED ON DRILLING MACHINE

The common operations performed on drilling machine are drilling, boring, reaming, tapping, counter boring etc.

Principal parts of the drilling machine are shown in Fig. 7.
SCHEMATIC DIAGRAM

**Raw Material:** Mild steel plate of dimension 80 mm × 50 mm × 10 mm.

All dimensions are in mm.

**Drawing:** Not to scale.

![Diagram](image_url)

**Fig. 8**

**TOOLS AND ACCESSORIES REQUIRED**

(i) Drilling Machine

(ii) Drills of size 5 mm and 12 mm

(iii) Bench Vice
(iv) Try Square, Steel Rule, Centre Punch, Hammer, Surface Plate, Odd leg Caliper
(v) BSW tap set
(vi) Tap Wrench
(vii) File
(viii) Tool maker’s Vice
(ix) Odd leg Caliper

PROCEDURE

(i) Clamp the workpiece in bench vice and file sides of the workpiece by flat file.
(ii) Check corners by try square.
(iii) Mark centre of holes to be produced as per drawing using surface plate, odd leg caliper.
(iv) Make the marking permanent by punch and hammer.
(v) Load the workpiece in tool maker vice on drilling machine table.
(vi) Clamp the required drill and produce 2 holes of diameter 5 mm and 1 hole of diameter φ 12 mm. Apply cutting oil during operation.
(vii) Unload the job from machine table.
(viii) Load the job on bench vice.
(ix) Fix the taper top in tap wrench and insert taper tap into the hole of φ 12 mm positioned perpendicular to the surface of the job.
(x) Cut the thread by rotating the top wrench in clockwise direction by applying a little downward force on it.
(ix) Use medium tap and fine tap to complete the thread.

DISCUSSIONS/CONCLUSIONS

Write your comments on dimensional error and surface quality of job obtained and discuss about reasons of dimensional errors, if any.
1. How do you specify a drilling machine?

2. Draw the sketch of a taper shank twist drill and show its different parts.
3. What are the commonly used drill bit materials?

4. Name and explain different taps used to cut internal thread with neat sketch.
1. How do you specify a drilling machine?

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Grinding is generally called as finishing operation which removes material from the surface of the job by means of a rotating grind wheel. Grinding is useful in removing unwanted material from workpiece, rounding corners of workpiece, sharpening cutting tools etc.

In grinding, the work is held pressed against the high speed rotating grinding wheel to remove material by abrasion.

Grinding wheel is generally made from abrasives (like silicon carbide, aluminium oxide etc) embedded in the bond (like Resinoid, Rubber, Vitrified etc).

Different parts of a bench Grinder are shown in Fig. 9.
**SCHEMATIC DIAGRAM**

**Raw material:** Job No. ME292/04.

All dimensions are in mm.

**Drawing:** Not to scale (NTS).

![Diagram](image)

**TOOLS AND ACCESSORIES REQUIRED**

(i) Steel Rule

(ii) Odd Leg Caliper
(iii) Divider  
(iv) Surface Plate  
(v) Centre Punch  
(vi) Ball Peen Hammer  
(vii) Bench Grinder

**PROCEDURE**

(i) Place the job on the surface plate and locate four centres of arc to be produced by grinding as per drawing.  
(ii) Mark centres by centre punch and hammer  
(iii) Draw arcs from centres with required radii by divider.  
(iv) Make some punch mark on arcs.  
(v) Hold the job tightly by both hands/tongs and press it against the rotating grinding wheel to produce round corners as per drawing.

**DISCUSSIONS/CONCLUSIONS**

Write comments on dimensional error and surface quality of job obtained and discuss about the probable reasons of dimensional error, if any.
1. Write short notes on
   (a) Rough Grinding
   (b) Precision Grinding

2. How is a grinding wheel specified?
1. Write short notes on
   (a) Rough Grinding
   (b) Precision Grinding

2. How is a grinding wheel specified?
INTRODUCTION

Working of thin metallic sheets with the help of hand tools and some simple machines is known as sheet metal work. It is very important to know that for efficiently working in sheet metal one should have knowledge about constructional features and working principle of hand tools and machines. Also it is necessary to have knowledge of development of surfaces, properties of metal sheets etc.

Many engineering articles made of sheet metal find their application in decorative articles, machinery, household products etc.

Types of Sheet Metal

Sheets

Ferrous Sheets

Non-Ferrous Sheets

Galvanised Sheets
(Coated)

Plain Sheets
(Uncoated)

Sheet metal Working Machines

Machines generally used to carry out different sheet metal operations are:

Rolling and bending machine, cutting machine, grooving machine, shearing machine, swaging machine etc.

Sheet Metal Joints

Many different types of joints are used in sheet metal work. Commonly used form of joints are lap joint, seam joint, hem (single, double), wired edge, cup etc.
Soldering

It is a process of joining two or more metals by application of a low melting point temperature alloy called solder in liquid state. Solder is essentially an alloy of lead and tin. It is widely used in sheet metal work, electronic circuit etc.

SCHEMATIC DIAGRAM

Raw Material: G.I. sheet (26 SWG), G.I. wire φ 3 mm.

Drawing: Not to scale (NTS).

Fig. 11. Layout of job.

Fig. 12. Job.

TOOLS AND ACCESSORIES REQUIRED

(i) Mallet

(ii) Ball peen hammer
(iii) Stake
(iv) Snip
(v) Steel Rule
(vi) Steel Square
(vii) Scribe, Divider
(viii) Straight edge soldering iron, Solder.

PROCEDURE

(i) Flatten the metal sheet by mallet.
(ii) Develop the surface on given sheet as per drawing by the help of divider, steel rule, steel square, scriber etc.
(iii) Cut the sheet as per the lay out.
(iv) Fold and bend different portion as per requirement by stake and mallet.
(v) Make the joints with soldering iron and solder.
(vi) Place wire of \(\phi 3\) mm at the outer surface of edges and form edges round-shaped keeping the wire inside it, with the help of suitable hammer, stake etc.

DISCUSSIONS/CONCLUSIONS

Write comments on dimensional error and quality of the joint obtained, if any.

________________________________________
Signature of the Teacher
1. What is edge forming in sheet metal work? State functions of it.

2. What are the different types of solders? State their composition and application.
3. What are the advantages of soldering over other joining processes?

4. Name three sheets that are used in sheet metal.
5. How is sheet metal specified?

6. Name and briefly explain various hand tools used in sheet metal work.

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