PRODUCTION PRACTICELAB

LAB MANUAL

Subject Code: 4ME4-23

Class: 2nd Year - IV Semester (MECH.)

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LECT. NO	TOPIC(S) PLANNED
	Turning Shop
1	To study lathe machine construction and various parts including attachments, lathe tools cutting speed, feed and depth of cut.
2	To perform step turning, knurling and chamfering on lathe machine as per drawing
3	To cut multi-start Square/Metric threads on lathe machine.
4	Boring using a boring bar in a centre lathe and cut BSW/Metric internal threads on lathe machine.
5	To perform taper turning using compound rest.
	Machine shop
6	To study the milling machine, milling cutters, indexing heads and indexing methods and to prepare a gear on milling machine.
7	To machine a hexagonal /octagonal nut using indexing head on milling machine
8	To study of single point cutting tool geometry and to grind the tool as per given tool geometry.
9	To study shaper machine, its mechanism and calculate quick return ratio. To prepare a job on shaper from given mild steel rod.
10	Cylindrical grinding using grinding attachment in a centre lathe
	Demonstration and study
11	Demonstration for job by eccentric turning on lathe machine.
12	Study of capstan lathe and its tooling and prepare a tool layout & job as per given drawing.
13	Demonstration on milling machine for generation of plane surfaces and use of end milling cutters
14	Grinding of milling cutters and drills.
	Foundry Shop
15	To prepare mould of a given pattern requiring core and to cast it in aluminium.
16	To perform moisture test and clay content test.
17	To perform permeability test
18	A.F.S. Sieve analysis test.
19	Strength Test (compressive, Tensile, Shear Transverse etc. in green and dry conditions) and Hardness Test (Mould and Core)
	Welding Shop
20	Hands-on practice on spot welding.

Objective: To study lathe machine construction and various parts including attachments, lathe tools cutting speed, feed and depth of cut.

Theory

Lathe machine: The lathe machine is the one of the oldest machine tools and came the early tree lathe which was a device for rotating and machining a piece of lathe between two adjacent trees a rope would round the work with its one end attached to a flexible branch of trees and end is pulled by a man to rotate the job hard tools are used them.

Function of lathe machine: The main function of lathe machine is to remove metal from a piece of work to give it the required shape and size. The work is held securely and rigidly on the machine and then turn against the cutting tools which is removing metal from the work in the forms of chips.

Different parts of a lathe:

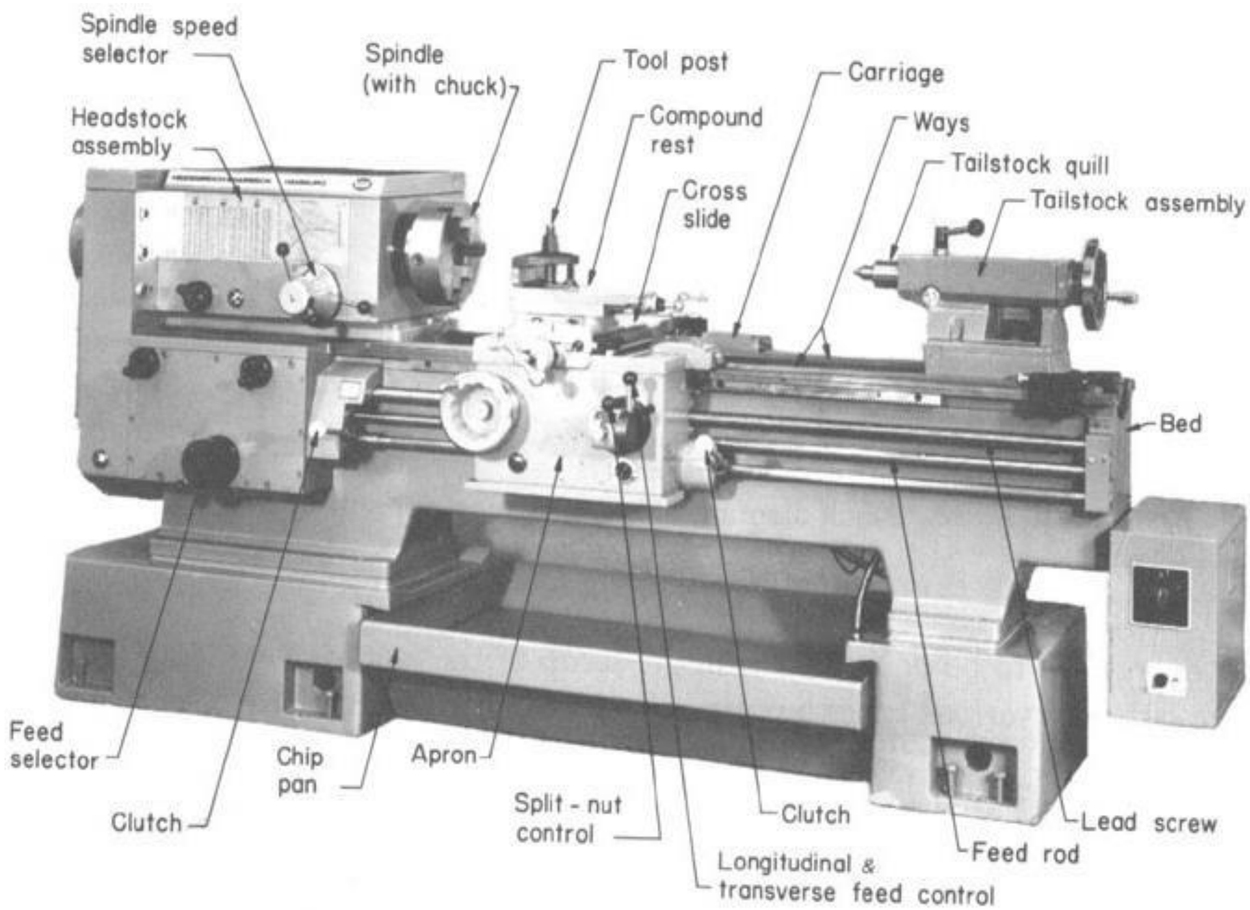


Fig. 1.1 Engine Lathe

Lathe and its Parts:-

Headstock	Contains the spindle in two preloaded ball bearings
Spindle	The spindle is inside the headstock and is driven with a belt running from the motor pulley to a pulley on the rear end of the spindle shaft. The nose of the spindle is treaded on the outside to receive chucks and tapered on the inside to receive other accessories.
Chucks	A 3-jaw or 4-jaw chuck threads onto the spindle nose to hold your work, a drill chuck are used on the tailstock to center drill your part.
Tool Post	Attaches to the lathe table and holds a 1/4" square cutting tool
Cross Slide Table	Also sometimes spelled "cross slide," it is the table with two T-slots that holds the tool post.
Cross Slide Gib	A tapered plastic wedge that is held in place by a gib lock. It fits between the angled surfaces of the dovetail and is used to adjust for wear. As wear occurs and the table develops "slop," the lock is loosened and the gib is pushed further into the gap, taking up any play. This allows the machine to always be kept in peak adjustment.
Tail Stock spindle	Has a Morse internal taper for holding chucks and other tools. A hand wheel moves it in and out for drilling.

Tail Stock Locking Screw	Locks the tailstock in place on the bed to keep it from moving. When loosened, the tailstock can be slid up and down the bed.
Bed	The dovetailed steel bar that the saddle and tailstock are moved back and forth on.
Saddle	The part that supports the cross slide table and is moved up and down the bed using the lead screw hand wheel.
Saddle Gib	Functions like the cross slide gib to keep the saddle in tight adjustment against the dovetailed bed.
Lead Screw	The threaded screw under the bed that controls movement of the saddle. A "saddle nut" underneath attaches the bed to the leadscrew. Turning the lead screw hand wheel moves the saddle down the bed.
Tail Stock Gib	A brass part attached to the base of the tailstock that runs on one of the bed dovetails. The brass part is expected to wear rather than the more expensive bed and can be adjusted for tightness as it wears.
Lathe Base	The cast metal base upon which the lathe bed and headstock sit.
Drawbolt	Goes through the hole in the spindle to draw chucks and other accessories into the headstock taper inside the spindle. A special washer locates it on center in the spindle hole.

Morse Arbor

The tailstock drill chuck normally has a Morse arbor threaded into the back of it for use in the tailstock spindle. That arbor can be removed and replaced with the Morse arbor so the drill chuck can be used in the headstock.

Dead Centers

Morse arbors have a 60° point and are used to locate and hold work "between centers" on the lathe. The Morse arbor rotates with the headstock, but because the tailstock spindle does not rotate, the rear. Morse arbor is called a "dead" center. This needs to be kept lubricated because it creates friction with the moving part it is locating. Most machinists eventually replace this with a "live" center that turns on a ball bearing.

Tommy Bars

Round steel bars used to tighten and loosen chucks and other spindle accessories. Sometimes called "Spindle Bars."

Faceplate

A cast plates those threads onto the spindle nose. A work piece can be bolted to it as an alternative to using a chuck. It has three slots to drive a drive dog.

Drive Dog

Also called a "Lathe Dog," this part is attached to a piece of bar stock by means of a screw that goes through the side and the long point is placed into one of the slots in the faceplate. The part is located between the lathe centers (live or dead) and when the faceplate turns, the dog actually

	drives the piece to rotate it for cutting. It also acts as a universal joint when turning a part between centers when the headstock is rotated to a slight angle, allowing a tapered part to be cut.
Head Stock Locking Screw	Holds the headstock in place. The screw is a pointed set screw. The point engages a tapered groove in the pin that sticks up out of the lathe bed. When the screw is tightened, it pulls the headstock down onto the alignment key and holds it tight against the lathe bed.
Alignment Key	A precision ground key that fits in slots in the top of the bed and bottom of the headstock to keep the headstock aligned straight with the tailstock. Removing this key and rotating the headstock allows tapers to be cut.
V-belt	A Kevlar-reinforced Urethane belt that drives the spindle by means of the pulleys.
2-Position Pulley	The motor turns a maximum of about 6000 RPM. Putting the drive belt in the normal (rear) position gears the motor down about 2:1 for a maximum speed of about 2800 RPM. The "High Torque" position (closest to the headstock) gears it about 4:1 for lower speed but more torque when needed for heavy cuts.
Variable Speed Control Knob	Controls motor speed from 0 to 2800 RPM.

Types of Lathes:

1. Engine Lathe: The most common form of lathe, motor driven and comes in large variety of sizes and shapes.

2. Bench Lathe: A bench top model usually of low power used to make precision machine small work pieces.

3. Tracer Lathe: A lathe that has the ability to follow a template to copy a shape or contour.

4. Automatic Lathe: A lathe in which the work piece is automatically fed and removed without use of an operator. Cutting operations are automatically controlled by a sequencer of some form.

5. Turret Lathe: Lathes which have multiple tools mounted on turret either attached to the tailstock or the cross-slide, which allows for quick changes in tooling and cutting operations.

6. Computer Controlled Lathe: Highly automated lathes, where cutting, loading, tool changing, and part unloading are automatically controlled by computer coding.

Machining Parameters:

Cutting Speed: The speed in surface feet per minute or meters per minute at which the metal may be machined efficiently

Lathe Cutting Speed: It may be defined as the rate at which a point on the work circumferences travels past the cutting tool. When work is machined in a lathe, it must be turned at a specific number of revolutions per minute(r/mint), depending on its diameter, to achieve the proper cutting speed. Cutting speed is always expressed in feet per minute (ft/mint) or in meters per minute (m/mint).

Lathe Feed: The feed of a lathe may be defined as the distance the cutting tool advances along the length of work for every revolution of spindle. Feed of the lathe is dependent on the speed of the lead screw or feed rod. Speed is controlled by the change gears in the quick – change gear box.

Cutting Speed: Cutting speed is how fast the metal comes into contact with the tool at the cutting point. On a lathe, it is the rate at which the surface of the job passes the cutting tool. This takes into account the diameter of the job.

Feed: The feed of a lathe may be defined as the distance the cutting tool advances along the length of the work for every revolution of the spindle.

Various operations performed on Lathe machine:-

Turning: Produces straight, conical, curved, or grooved work pieces

Facing: Produces a flat surface at the end of the part

Boring: To enlarge a hole

Drilling: To produce a hole

Cutting off: To cut off a work piece

Threading: To produce threads

Knurling: Produces a regularly shaped roughness

Profiling: To turn cylindrical work pieces with rough and finished cuts

Grooving: To make furrows or channels.

Operations on a Lathe:

Turning:

cutting tool is moved parallel to the axis of the work piece to produce a cylindrical surface by removing the unwanted material in the form of chips. Here depth of the cut is given by moving the tool perpendicular to the lathe axis.

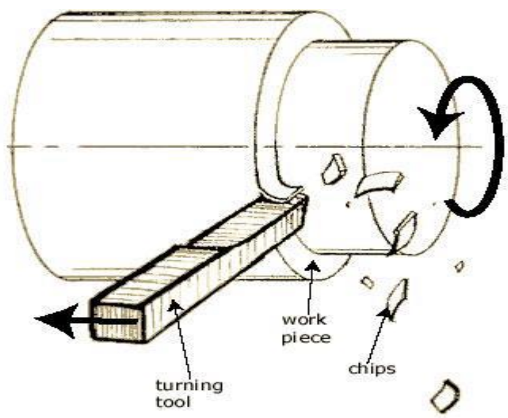


Fig.1.2 Plain Turning

Facing: It is an operation to produce flat surface on the ends of the work piece. Here the cutting tool is fed against the rotating work piece perpendicular to the lathe axis and the depth of the cut is given by moving the tool parallel to the lathe axis.

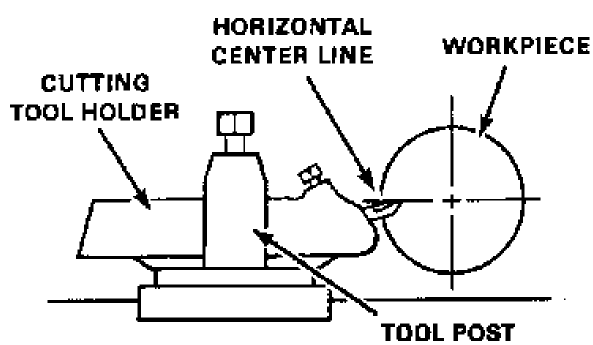


Fig.1.3 Facing Operation

Thread Cutting: A thread is a helical groove formed on a cylindrical surface of the work piece. The shape of the groove will be normally v or shape which is called as v-thread or square thread cutting cannot be done in single pass. It will be carried out in many passes with incremental depth, till the required thread is formed. A typical thread cutting operation is shown in the figure. Thread cutting can be performed both on external and internal surfaces.

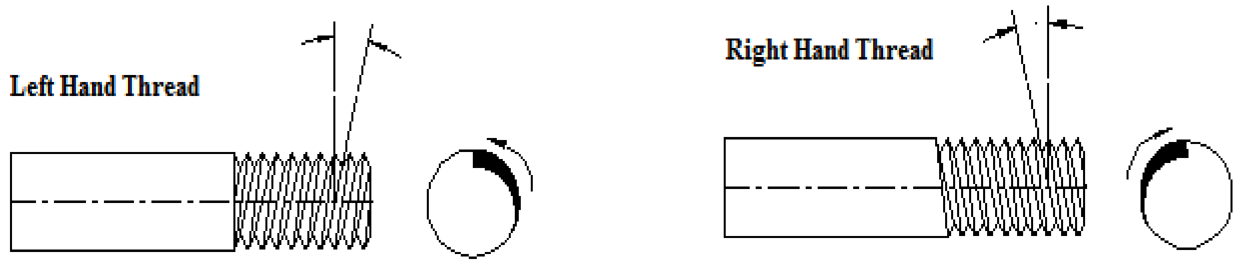
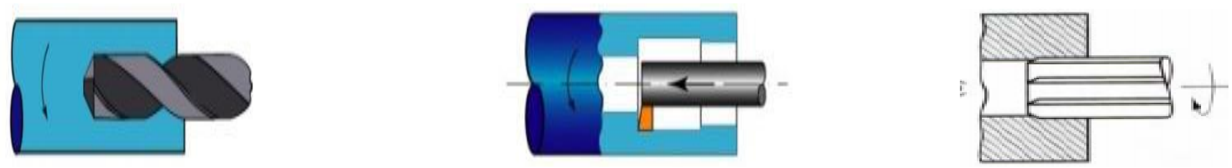


Fig.1.4 Left and Right hand thread cutting

Drilling: Drilling operation is performed by fixing twist drill bit on the tail stock and advancing the tool towards the work piece and making hole to the desired length. Other operations like Boring, Centre Drilling, Counter Boring, Counter Sinking, Reaming, Tapping, etc can also be performed using suitable tools.



Drilling **Boring** **Reaming**

Fig.1.5 Types of Drilling operations performed on Lathe Machine

Parting/Cutting Off/slotting/grooving operation: This operation is used to cutoff the finished part from the lengthen work piece or to make groove on the work piece. Flat cutting tool is used for this operation.

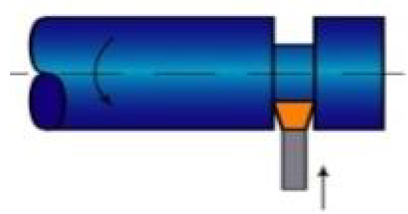


Fig.1.6 Grooving operation on Lathe Machine

Forming Operation: A tool which is in the shape of the impression to be made on the work piece is fixed to the tool post and is advanced towards the work piece. This operation saves time and is costly.

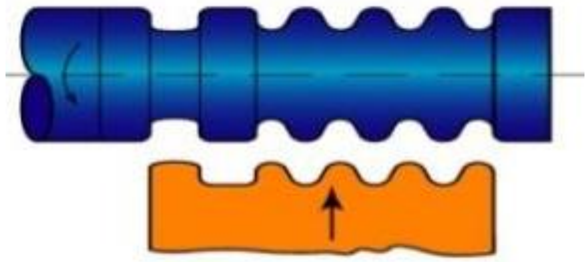


Fig.1.7 Forming operation on Lathe Machine

Knurling Operation: Knurling is an operation performed on the lathe to generate serrated surface on the work piece. This is used to produce a rough surface for griping like the barrel of the micrometer. This is done by a special tool called knurling tool. This has a set of hardened roller with the desired serrations. There are 3 different knurling operations such as diamond, angled and straight.

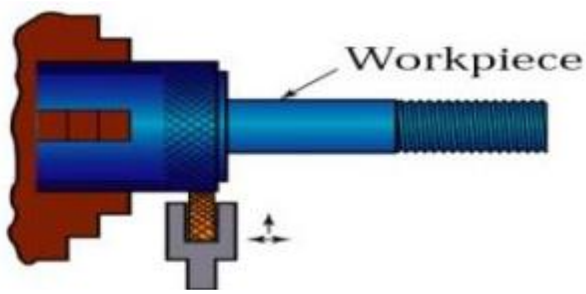


Fig.1.8 Knurling operation on Lathe Machine

Work Holding Devices

The self-centering chuck (3 – Jaw Chuck): This is the most convenient and most used method of work holding. This can take wide range of diameters. When adjusting jaws move equal amount light cuts should carry out, because the work may slip in the jaws. In addition, the work should be firmly round to fix in this chuck.

The independent centering chuck (4 – Jaw Chuck): Each jaw is individually adjust and moves along its own slot. One advantage of this four-jaw chuck is that work can be located in the centre to run true or off centre. One of the most useful applications of this type is to hold square or rectangular material positioned either centrally or off centre. Setting time is greatly increased when compared to three-jaw chuck. However, for highly accurate work, this is the most suitable method.

Fig.1.9 Three and Four Jaw Chuck.

Result: Successfully studied about the Lathe Machine.

Objective: To perform step turning, knurling and chamfering on lathe machine as per drawing.

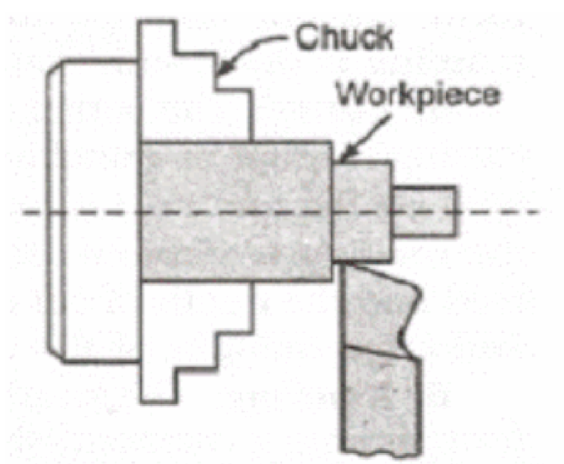
AIM: To perform step turning, knurling and chamfering on lathe machine as per drawing.

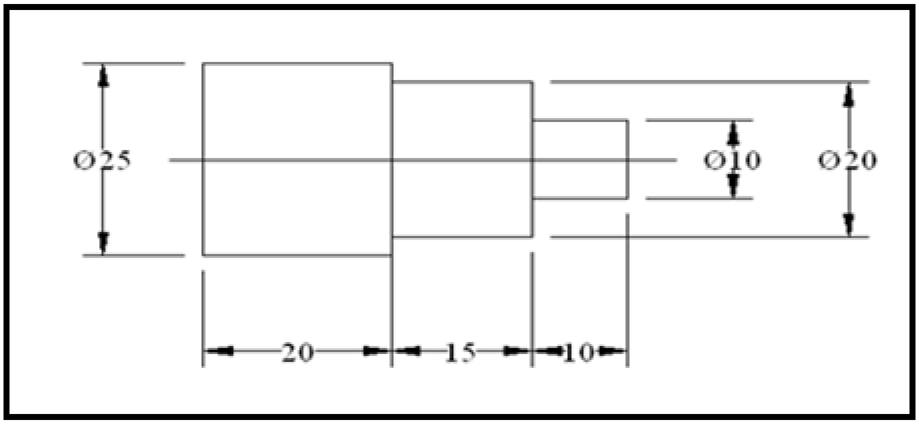
TOOLS REQUIRED:
1) Marking Block
2) Tool key
3) Chuck key
4) Single point cutting tool

MEASURING INSTRUMENTS REQUIRED:
1) Steel rule
2) Out – side calipers
3) Vernier caliper

MATERIAL REQUIRED:
A mild steel rod of length 45 x φ 25 mm pieces

OPERATIONS:
1) Fixing the job on the chuck
2) Fixing the cutting tool in tool post
3) Facing
4) Plane turning
5) Step turning
6) Knurling
7) Chamfering





PROCEDURE:

1. With the help of marking block and chuck key, the job is fixed in the chuck so that the axis of job coincides with the axis of lathe.

2. The single point cutting tool is fixed on the tool post and sufficiently tightened with spanner.

3. Facing is done by giving cross feed with cross slide at one end.

4. Plain turning is done by giving longitudinal feed with carriage up to possible length of the job.

5. The required taper angle is maintained by swiveling the compound slide.

6. The required chamfer is maintained.

7. The job is reversed & operations are repeated.

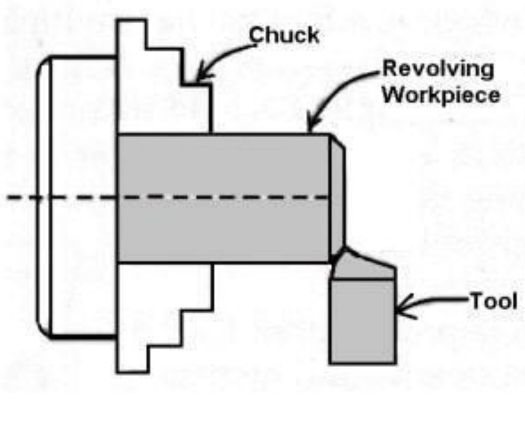
8. Required dimensions as per figure are maintained with accuracy using outside calipers, steel rule and Vernier calipers.

9. Chamfer is made as per figure.

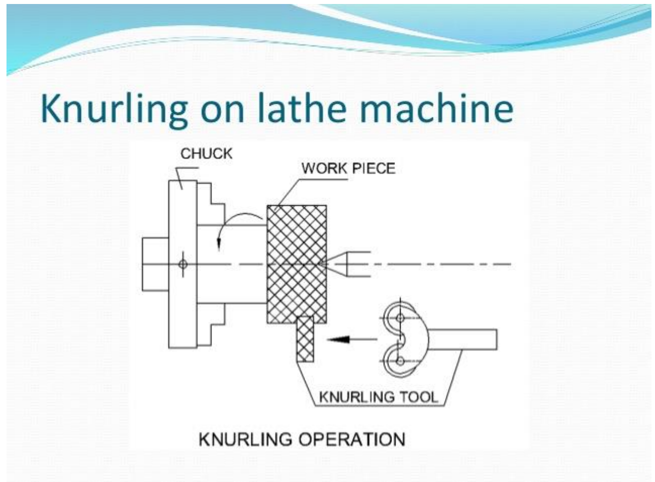
10. Fix the knurling tool in the tool post.

11. The cutting speed of the job is reduced by changing the pulley belts and by engaging back

12. Knurling operation is performed.



Chamfering



PRECAUTIONS:

1) The job is tightly fixed in the chuck.
2) The cutting tool should be held rigidly in the tool post.
3) In running condition the cutting tool and tool post should not touch chuck.
4) Dimensional accuracy is to be machined.
5) During knurling operation sufficient lubrication should be done.

RESULT: The job of required dimensions is obtained.

Objective: To cut multi-start Square/Metric threads on lathe machine.

To perform thread cutting on a given work piece of mild steel as per dimensions

TOOLS REQUIRED:

1) Marking Block
2) Tool key
3) Chuck key
4) Single point cutting tool
5) Thread cutting tool

MEASURING INSTRUMENTS REQUIRED:

1) Steel rule
2) Out – side calipers
3) Vernier calipers
4) Pitch Gauge

MATERIAL REQUIRED: A mild steel rod of length 100 x φ 25mm piece

OPERATIONS:

1) Fixing the job in the chuck
2) Fixing single point cutting tool in the tool post
3) Facing
4) Plain turning
5) Step turning
6) Thread cutting

PROCEDURE:

1. With the help of marking block and chuck key, the job is fixed in the chuck so that the axis of job coincides with the axis of the lathe.
2. The cutting tool is fixed in the tool post with spanner.
3. Facing is done by giving cross feed with cross slide at one end.
4. Marking is done along the work piece where steps are to be made.
5. By giving longitudinal feed and depth of cut steps are made according to dimensions.
6. For doing thread cutting speed of work should be as low as possible. It is done by changing pulley belts and by engaging back gear.
7. In the gear train we have to arrange suitable gear wheels for setting the required pitch using the formula given below.

8. By engaging the lead screw and half nut the thread cutting tool is made to move as per the pitch of the work piece on the job and required threading is done.
9. Using pitch gauge the obtained threading is inspected.
10. Chamfer is made.
11. The job is reversed and facing, plain turning and step turning is done as per the required dimensions using steel rule, outside calipers and vernier calipers.
12. Chamfer is made.

CHANGE GEAR CALCULATIONS:

$$\frac{\text{Driver teeth}}{\text{Driven teeth}} = \frac{5pn}{127}$$

Where P = Pitch of the work piece to be made in mm.
And n = Pitch of the lead screw in mm

PRECAUTIONS:
1. The job & the tool should be fixed tightly in the chuck & tool post respectively.
1. During operations work piece & tool should not be touched by hand.
2. Proper care should be taken so that the tool should not touch the chuck.
3. During thread cutting operation sufficient coolant oil should be poured to cool the work piece and tool.

RESULT: The job of required dimensions is obtained.

Objective: Boring using a boring bar in a centre lathe and cut BSW/Metric internal threads on lathe machine.

Experiment No. 4(A)

Object: Boring using a boring bar in a centre lathe and cut Metric internal threads on lathe machine.

Apparatus: - Centre lathe machine, Boring Bar, single point cutting tool.

Theory: In machining, boring is the process of enlarging a hole that has already been drilled (or cast), by means of a single-point cutting tool (or of a boring head containing several such tools), for example as in boring a gun barrel or an engine cylinder. Boring is used to achieve greater accuracy of the diameter of a hole, and can be used to cut a tapered hole. Boring can be viewed as the internal-diameter counterpart to turning, which cuts external diameters.

There are various types of boring. The boring bar may be supported on both ends (which only works if the existing hole is a through hole), or it may be supported at one end (which works for both through holes and blind holes). Line boring (line boring, line-boring) implies the former. Back boring (back boring, back-boring) is the process of reaching through an existing hole and then boring on the "back" side of the work piece (relative to the machine headstock).

Boring with lathe: Lathe boring is a cutting operation that uses a single-point cutting tool or a boring head to produce conical or cylindrical surfaces by enlarging an existing opening in a work piece. For non tapered holes, the cutting tool moves parallel to the axis of rotation. For tapered holes, the cutting tool moves at an angle to the axis of rotation. Geometries ranging from simple to extremely complex in a variety of diameters can be produced using boring applications. Boring is one of the most basic lathe operations next to turning and drilling.
On the lathe, boring is accomplished in either of these two methods:

- Mounting the holder and boring tool bar with cutter bit on the tool post and revolving the work piece.

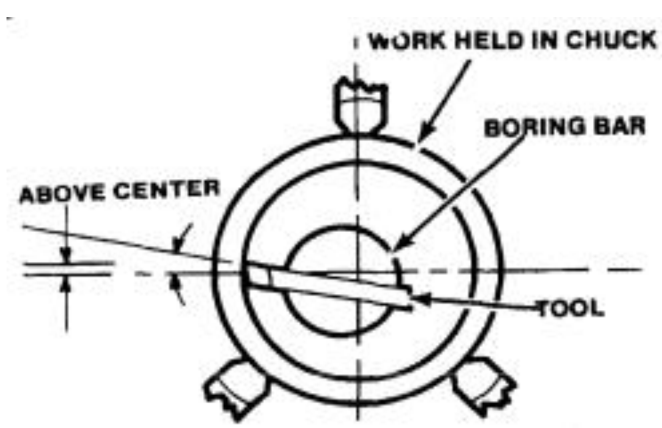
- Mounting the work piece in a fixed position to the carriage and revolving the boring tool bar and cutter bit in a chuck attached to the headstock spindle. (This is a special process and not used in most machine shops).

Mounting Workpiece for Boring

The work piece may be supported in a chuck or fastened to a faceplate for boring operations depending upon of the material to be machined. When boring is to be performed on the ends of long stock, the work piece is mounted in a chuck and a steady rest is used to support the right end near the cutter bit. Some boring operations require the use of special chuck-mounted mandrels to hold workplaces that cannot be successfully mounted otherwise. The boring tool bar should be clamped as close to the holder and tool post as possible considering the depth of boring to be done. The bar will have a tendency to spring away from the work piece if the bar overhangs the tool post too far. If deep boring is to be performed, it will be necessary that the bar be as thick as possible to counteract this springing tendency.

Straight Boring Operation

The cutter bit is positioned for straight boring operations with its cutting edge set slightly above center. Depending on the rigidity of the setup, the boring tool will have a tendency to spring downward as pressure is applied to the cutting edge. By setting the cutter slightly above center, compensation has been made for the downward spring and the cutter will actually be positioned on the exact center of the work piece during machining operations (Figure). The cutting edge faces forward for most operations so the lathe can turn in its normal counterclockwise direction. If it becomes necessary to position the cutter bit against the rear wall of the hole for a special operation, a right-hand turning cutter bit is used and the spindle rotation is reversed.



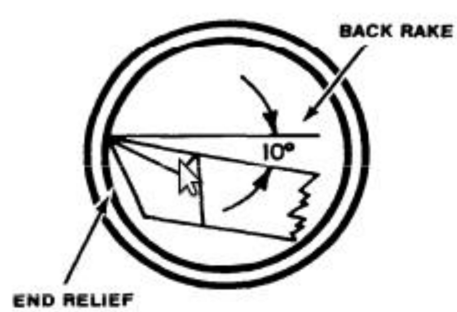
Boring cutter bit above center

Boring Cutter Bit Setup

The cutter bit used for boring is similar to that used for external turning on the lathe. The bit is usually held in a soft or semisoft bar called a boring tool bar. The boring tool bar is supported by a cutting tool holder which fits into the lathe tool post.

Boring tool bars are supplied in several types and sizes for holding different cutter bits. The bit is supported in the boring tool bar at a 90°, 30°, or 45° angle, depending upon the nature of the work piece being bored. Most general boring is accomplished with a 90° cutter bit. The bit is mounted at a 30° or 45° angle to the axis of the boring tool bar when it is necessary to cut up to the bottom of a hole or finish the side of an internal shoulder. It is desirable that the boring tool bar be as large as possible without interfering with the walls of the hole. The cutter bit should not extend far beyond the boring tool bar and the bit securely in the bar, yet not have the shank-end protrude far from the bar.

The cutter bits used for boring are shaped like left-hand turning and facing cutter bits. Greater attention must be given to the end clearance angle and the back rake angle because of the curvature of the hole.



Proper position of boring cutter bit.

Position the cutter bit so that the cutting edge is immediately to the right of the work piece and clears the wall of the hole by about 1/1 6 inch. Traverse the carriage by hand, without starting the lathe, to move the cutter bit and boring tool bar into the hole to the depth of the intended boring and out again to determine whether there is sufficient clearance to prevent the back of the cutter bit and the boring tool bar from rubbing the inside of the hole. When the clearance is satisfactory, position the cutter bit to the right of the work piece ready for the first cut. Use the micrometer carriage stop to control the depth of tool travel.

The same speeds recommended for straight turning should be used for straight boring. Feeds for boring should be considerably smaller than feeds used for straight turning because there is less rigidity in the setup. Decrease the depth of cut for each pass of the tool bit for the same reason. It is often advisable to feed the cutter bit into the hole to the desired depth and then reverse the feed and let the cutter bit move out of the hole without changing the depth of feed. It is also good practice to take a free cut every several passes to help eliminate bell mouthing of the work piece. This practice will correct any irregularities caused by the bit or boring tool bar springing because of the pressure applied to the bit.

Result: We successfully studied about the boring using a boring bar in a centre lathe.

Experiment 4(B)

OBJECT: - To cut Metric internal threads on lathe machine.

TOOLS REQUIRED: **-** Single point cutting tool, single point boring tool, internal thread cutting tool, chuck key, spanner, Steel rule, vernier caliper and outside caliper.

SEQUENCEI OF OPERATION: -

Job setting

Tool setting

Facing Plain

Turning Marking

Drilling, boring & thread cutting

PROCEDURE:

Job setting: The job setting is held in the chuck and is tightened by using chuck key such that ¾ of the length is projected outside of the chuck.

Tool setting: The single point cutting tool is held on the toll post. The tool is adjusted so that the tool tip must coincide with the lathe axis. This is can be done by keeping the tip nearer to the dead center of tailstock and then adjusted. Facing: Facing is on operation on lathe, which is used to bring the length of the cylinder to required dimension. Rough facing is done first and then smooth facing is done.

Plain turning: Now the carriage is moved parallel to the job by giving a depth of cut by means of cross slide. This is done for reducing the outer diameter to the required dimension.

Marking Chalk is applied on the surface of the job. By using jenny caliper, mark the required dimension on the job drilling. The drill bit of required dimension is fitted in the tail stock and center hole is made by drilling operation.

Boring when the internal surface of a hollow part is turned that is a single point tool is used for enlarging a hole. The operation is called boring. The single point tool for this purpose is mounted on a bar called “boring bar” The drilled hole is finished by boring operation. Boring is done for precision sizing, location and surface finish accuracy.

CUTTING INTERNAL THREAD: Internal threads are cut in the same general way as the external threads. However, the cutting is more difficult because one can't see the cutting operation. Also it is not possible to hold the tool so rigidly. A forged long tool can be used with the end group the same way as for external thread cutting. The cutting edge may need a little more end relief to keep the bottom of the tool from rubbing bar if the hole is large enough. A center gauge is used for grinding the tool setting it.

Setting up the Lathe:

I. The size of the hole to be threaded must be no smaller than miner diameter of the thread. This would give a full depth of thread.

II. If the thread is cut only part way through the hole it is good to cut recess at the end of the thread. This recess should equal to a depth of the thread this will permit as to release the split nut without turning in the cross feed

III. Set the compound rest to 30 degrees to the left of (clock wise) cross feed. (This is just the opposite of the setting for external threading). Fasten the threading tool in holder or boring bar.

IV. Fasten the threading tool in holder or boring bar.

V. Hold the center gauge against the face surface or side of the work piece adjusts the tool on center and at right angles to the work piece. To set the tool at center height, use the surface gauge scriber point.

VI. (If the thread is cut openly partially through the hole move the carriage by hand to the point where the thread will end. Mark the line on the lathe bed with a piece of chalk or a pencil. During thread cutting, this reference line will indicate that the tool bit has reached the end of the thread length so that the operator can open split nut lever and stop carriage)

Cutting the threads set the micro meter collar of the cross feed a zero.

a. Turn the compound rest feed out until the point of tool just touches the work piece. Set the micrometer collar at zero

b. Then the same general procedure is followed us explained for cutting the external threads

Note:

1. The cross feed must be turned in rather than out when opening the split nut at the end of the threading

2. If a recess was already machined at the end of the threaded area, the split nut can be opened with put turning in the cross slide to stop the carriage however the cross feed must be turned in before moving the carriage back for the next cut.

Objective: To perform taper turning using compound rest.

Aim: To perform Taper turning operation by Compound Rest Swiveling method on the given cylindrical work piece.

Apparatus:

1. Lathe with standard accessories.
2. Work piece

Principle: Cutting Tapers on a lathe is common application. A number of methods are available for cutting tapers on a lathe.

They are:

1. Compound rest Swiveling Method.
2. Using form tools.
3. Tail stock offset method.
4. Taper attachment method.

These methods are used for turning steep and short tapers. There is a circular base graduated in degrees which can be swiveled at any angle from the center line of the lathe centers.

Taper turning angle is calculated using the taper angle formula and the compound rest is swiveled to the angle **"θ"** in degrees (as per the calculation) with the help of align key.

$$\boldsymbol{\theta} = \tan^{-1} (\boldsymbol{D}-\boldsymbol{d})/2\boldsymbol{l}$$

Tools: Chuck key, high speed Steel (HSS) cutting tool bit, outside calipers, Tool Holder with key, spanner etc.

Material: Mild Steel round rod of diameter 20 mm

Procedure: The work piece is fixed in the tool post tightly and the center of head stock and tail stock is coincided with the centers of head stock and tail stock. Facing and plain turning operations are performed to get the required diameter on the work piece. The compound rest is set on the required half taper angle and is locked by the cutting rod is adjusted to a fixed position for the best possible to the open hand wheel and cross feed.

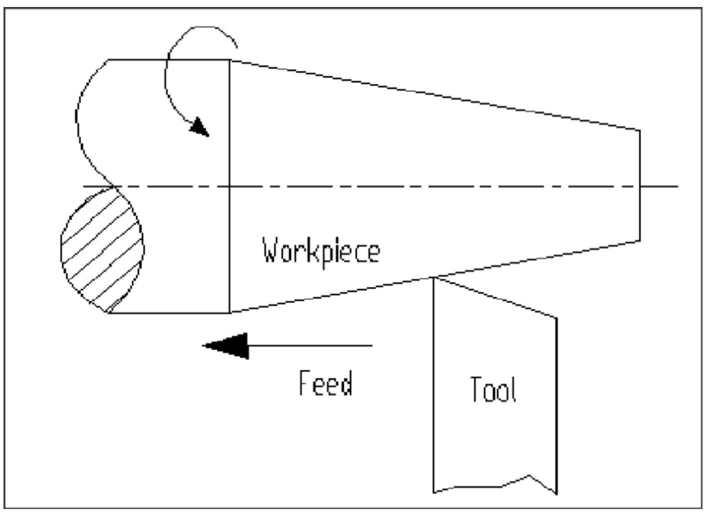
Then the carriage is locked and first cut is made at the end of the cut, the tool is again cross fed is given for the next cut. Cuts are repeated piece is then removed from the chuck and dimensions obtained are noted.

Precautions:

1. The work piece should be fixed tight in the jaw.
2. The power supply switched off before measuring diameters.

Result: The required steps are made on the work piece for the given dimensions.

Diagram:



Taper Turning

6
EXPERIMENT

Objective: To study the milling machine, milling cutters, indexing heads and indexing methods and to prepare a gear on milling machine

MILLING MACHINE

Introduction: Milling machine is one of the most versatile conventional machine tools with a wide range of metal cutting capability. Many complicated operations such as indexing, gang milling, and straddle milling etc. can be carried out on a milling machine. Milling machines are among the most versatile and useful machine tools due to their capabilities to perform a variety of operations.

They can be broadly classified into the following types:

Column and Knee type milling machines: Used for general purpose milling operations, column and knee type milling machines are the most common milling machines. The spindle to which the milling cutter is may be:

Horizontal Milling Machine

Vertical Milling Machine.

Universal milling Machine.

Bed type Milling Machines:

In bed type machines, the work table is mounted directly on the bed, which replaces the knee, and can move only longitudinally. These machines have high stiffness and are used for high production work.

Planer Milling Machines:

Planer machines are similar to bed type machines but are equipped with several cutters and heads to mill various surfaces.

Rotary Table Milling Machines:

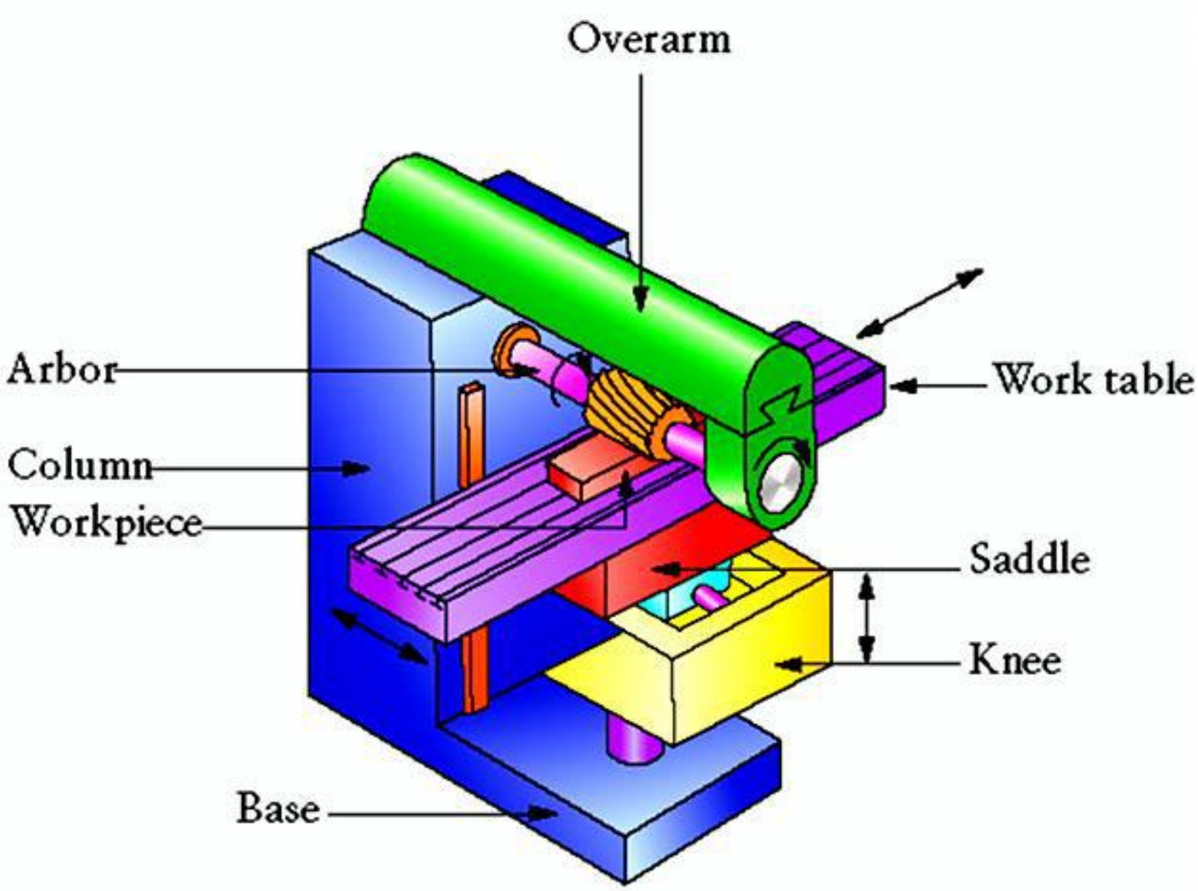
Rotary table machines are similar to vertical milling machines and are equipped with one or more heads to do face milling operations.

Tracer Controlled Milling Machines:

Tracer controlled machines reproduce parts from a master model. They are used in the automotive and aerospace industries for machining complex parts and dies.

Computer Numerical Control (CNC) Milling Machines: Various milling machine components are being replaced rapidly with computer numerical control (CNC) machines. These machine tools are versatile and are capable of milling, drilling, boring and tapping with repetitive accuracy.

Horizontal Milling Machine:



Horizontal Milling Machine

Parts

Column:

The column houses the spindle, the bearings, the gearbox, the clutches, the shafts, the pumps, and the shifting mechanisms for transmitting power from the electric motor to the spindle at a selected speed.

Knee:

The knee mounted in front of the column is for supporting the table and to provide an up or down motion along the Z axis.

Saddle:

The saddle consists of two slide ways, one on the top and one at the bottom located at 90º to each other, for providing motions in the X or Y axes by means of lead screws.

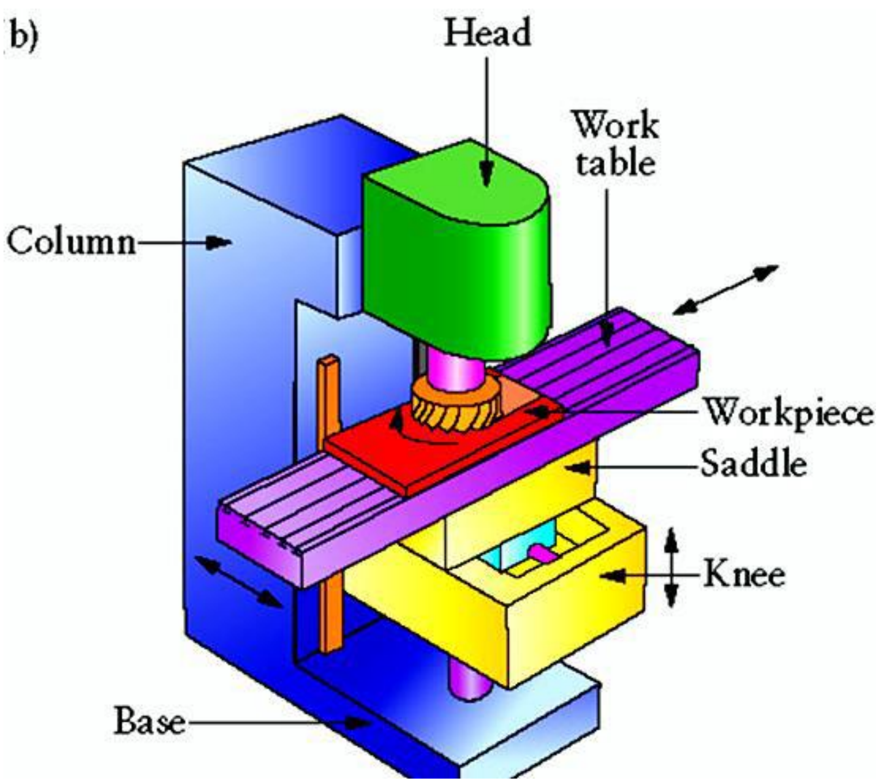
Table:

The table is mounted on top of the saddle and can be moved along the X axis. On top of the table are some T-slots for the mounting of workpiece or clamping fixtures.

Arbor:

The arbor is an extension of the spindle for mounting cutters. Usually, the thread end of an arbor is of left hand helix.

Vertical Milling Machine:



Vertical Milling Machine

Column: The column houses the spindle, the bearings, the gearbox, the clutches, the shafts, the pumps, and the shifting mechanisms for transmitting power from the electric motor to the spindle at a selected speed.

Knee: The knee mounted in front of the column is for supporting the table and to provide an up or down motion along the Z axis.

Saddle: The saddle consists of two slide ways, one on the top and one at the bottom located at 90º to each other, for providing motions in the X or Y axes by means of lead screws.

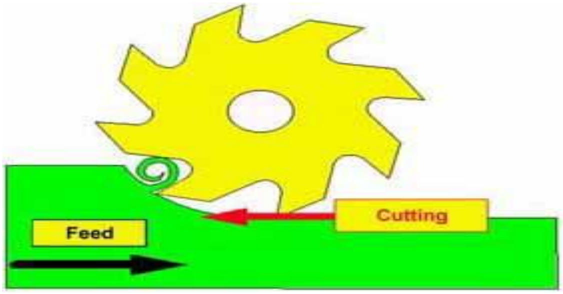
Table: The table is mounted on top of the saddle and can be moved along the X axis. On top of the table are some T-slots for the mounting of workpiece or clamping fixtures.

Milling head: The milling head consisting the spindle, the motor, and the feed control unit is mounted on a swivel base such that it can be set at any angle to the table.

Ram: The ram on which the milling head is attached can be positioned forward and backward along the slide ways on the top of the column.

Milling Methods:

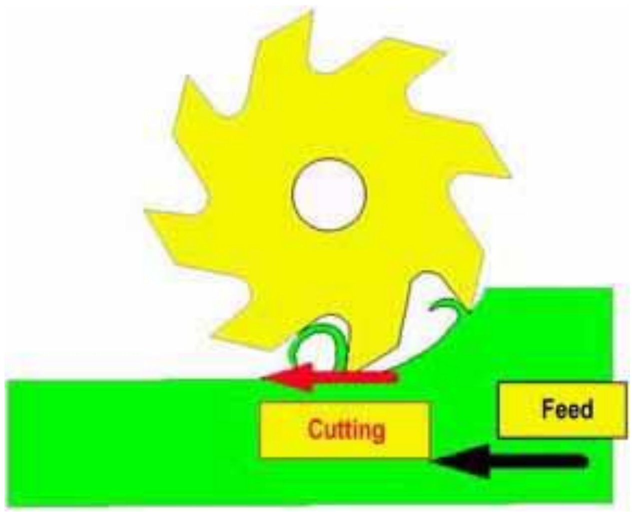
1.) Up Milling:
In up cut milling, the cutter rotates in a direction opposite to the table feed as illustrated in the following Figure. It is conventionally used in most milling operations because the backlash between the lead screw and the nut of the machine table can be eliminated.



Up Cut Milling

Down Milling:

In down cut milling, the cutter rotates in the same direction as the table feed as illustrated in the following Figure. This method is also known as Climb Milling and can only be used on machines equipped with a backlash eliminator or on a CNC milling machine. This method, when properly treated, will require less power in feeding the table and give a better surface finish on the workpiece.



Down Cut Milling

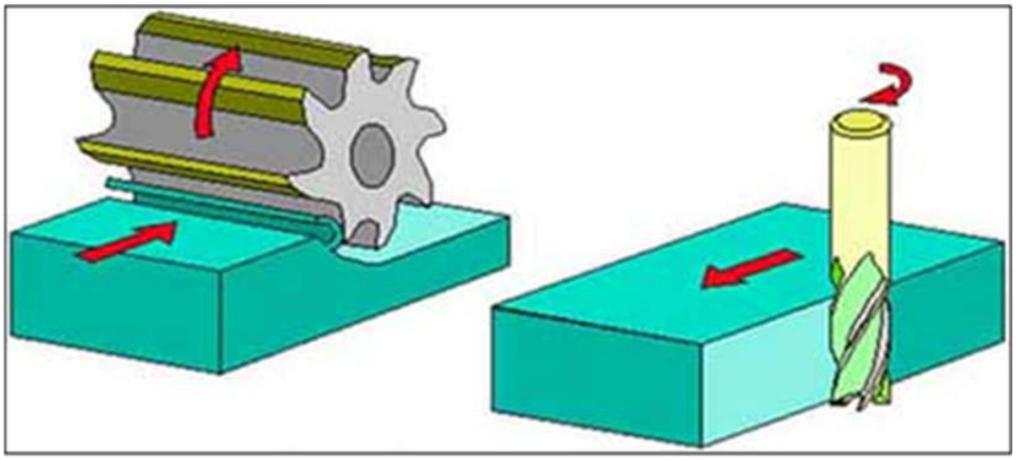
Milling Operations:

Milling operations are classified into two major categories

1.) **Peripheral Milling**

Generally in a plane parallel to the axis of the cutter

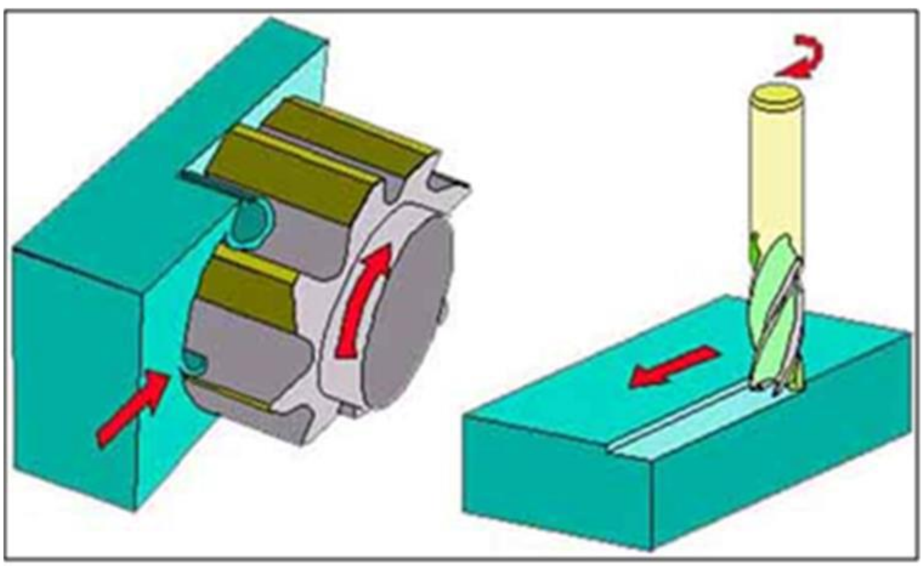
Cross section of the milled surface corresponds to the contour of the cutter.



Peripheral Milling

Face Milling

Generally at right angles to the axis of rotation of the cutter. Milled surface is flat and has no relationship to the contour of the cutter combined cutting action of the side and face of the milling cutter.

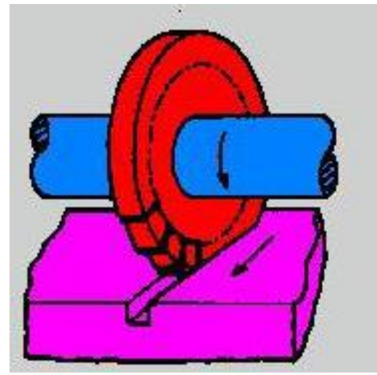


Face Milling

Slab milling: A milling operation that uses a cylindrical mill on an axis parallel to the worktable to create a flat surface.

Slotting: A milling operation that cuts a narrow ridge into the surface of a work piece.

Slab Milling



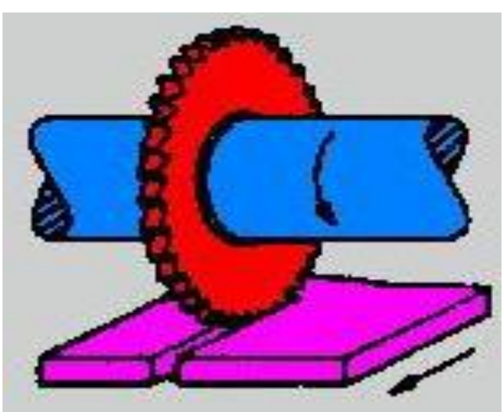
Slotting

Slitting: A rotary tool-steel cutting tool with peripheral teeth, used in a milling machine to remove material from the work piece through the relative motion of work piece and cutter.

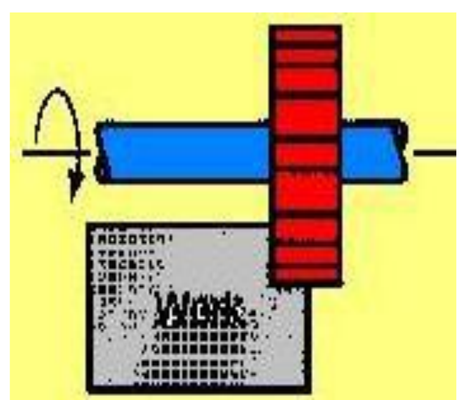
Side milling: Milling with a side-milling cutter to machine one vertical surface.

Form milling: A milling operation that uses a mill with a unique shape to create that shape into the work piece.

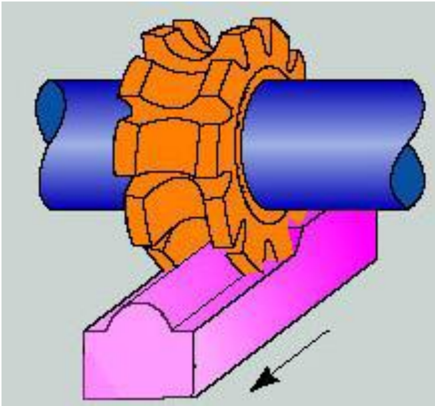
Straddle milling: Face milling of two parallel vertical surfaces of a work piece simultaneously by using two side-milling cutters.



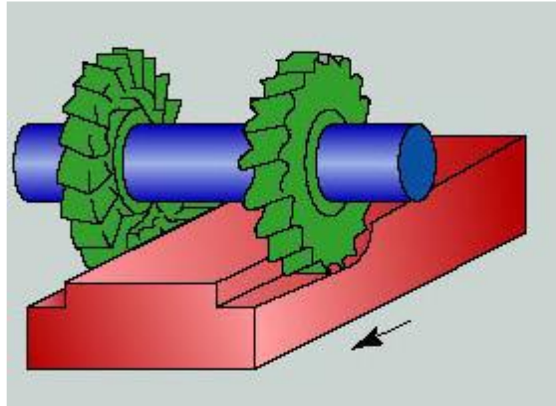
Slitting



Side Milling



Form Milling



Straddle Milling

Face Milling

Conventional milling: The diameter of the cutter is greater than the work part width, so that the cutter overhangs the work on both sides.

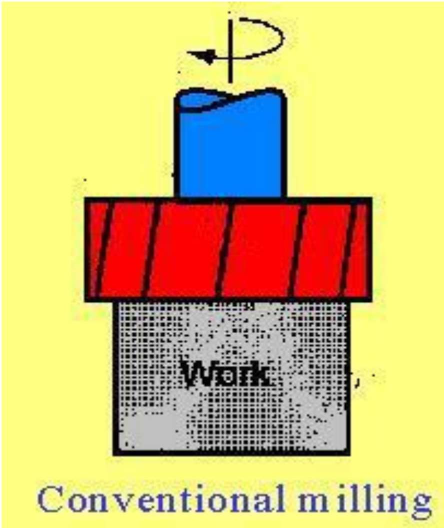
Artial face milling: The cutter overhangs the work on only one side.

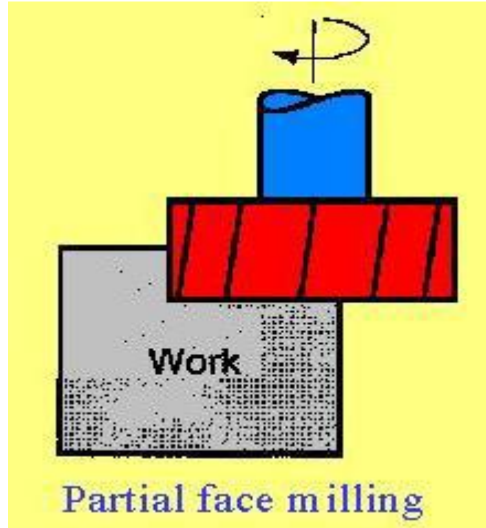
End milling: The cutter diameter is less than the work width, so a slot is cut into the part.

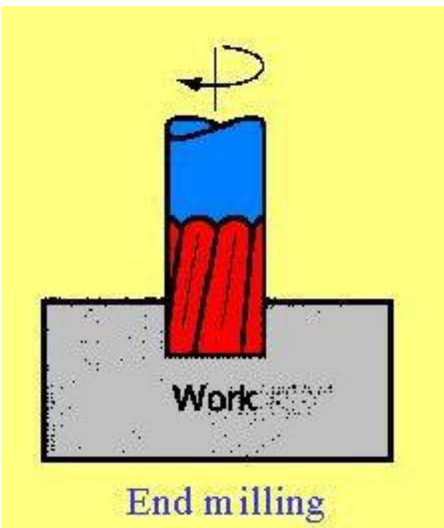
Surface contouring: A ball-nose cutter (rather than square end cutter) is fed back and forth across the work along a curvilinear path at close intervals to create a three-dimensional surface form.

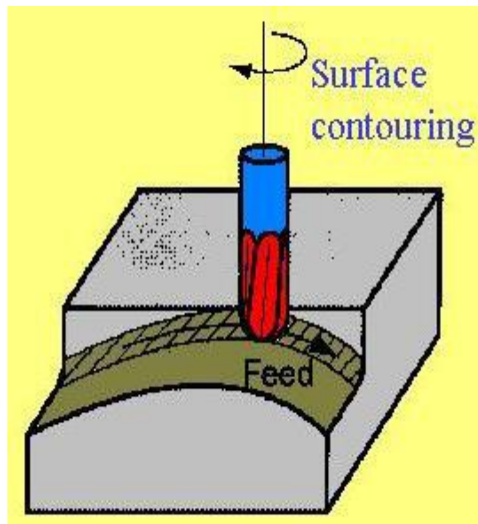
Pocket milling: Another form of end milling, this is used to mill shallow pockets into flat parts.

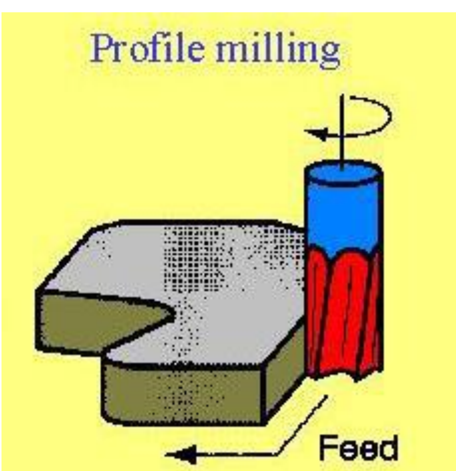
Profile milling: This is form of end milling in which the outside periphery of a flat part is cut.

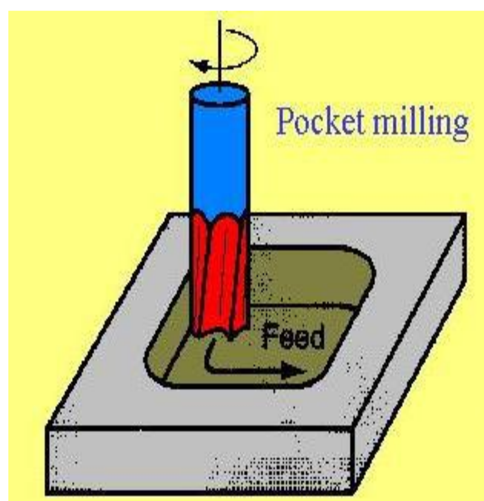

Work
Conventional milling


Work
Partial face milling


Work
End milling


Surface
contouring
Feed


Profile milling
Feed


Pocket milling
Feed

INDEXING:

It is defined as the method of dividing the circumference of the circular work piece into equally spaced divisions. Indexing head are of three types :-

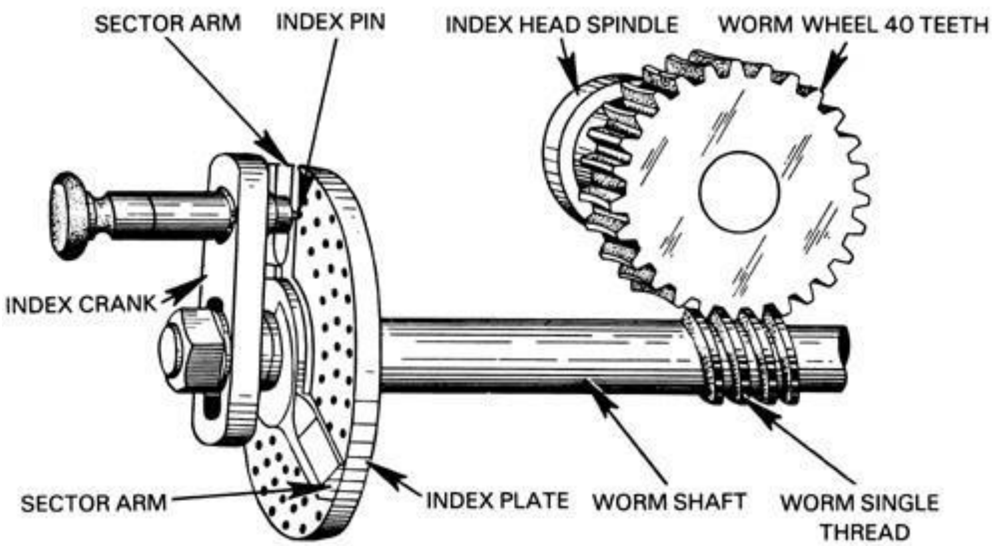
a.) Plain or Simple Indexing Head
b.) Universal Dividing Head
c.) Optically Dividing Head

Methods of Indexing:

a.) Direct or Rapid Indexing
b.) Simple or plain Indexing
c.) Compound Indexing
d.) Differential Indexing
e.) Angular Indexing

Simple or Plain Indexing:

In this Indexing, the work piece is rotated by turning the crank as shown. When the crank is rotated the worm shaft rotates causing the worm to drive the worm wheel and consequently the spindle to turn. As spindle rotates, the work piece that is secured to spindle by means of a suitable holding device which also rotates.



Simple Indexing Mechanism

Compound Indexing:

In this type of indexing is employed in those cases when the number of divisions required on the work piece cannot be obtained with the simple or plain index method.

This method involves two separate indexing movements that give the name compound indexing method.

This is performed in two stages:

1. The first movement is obtained by turning the work a definite amount in one direction in same way as in simple indexing.

2. The second index movement is obtained by turning the indexing plate along the crank.

Differential Indexing:

This is similar to compound indexing where the required division of the periphery of job is obtained by the combination of two movements.

1) The movement of Indexing crank through the required number of spaces in one of whole circle of index plate as in case of simple indexing.

2) The simultaneous movement of index plate along with cranks either in same direction or reverses direction.

To perform gear cutting operation on milling machine

Aim: To cut a spur gear teeth on a given circular blank by gear cutting processes.

Tools required: Horizontal milling machine, Spur gear cutter, vernier caliper, gear tooth vernier, indexing attachment.

Sequence of Operations:

1) Gear blank obtained by turning casted circular rod to desired dimensions with help of lathe.

2) A hole of 15mm is drilled exactly at the face center of the turning bar to the desired depth.

3) The blank of 25 mm width and 81mm external diameter and 15mm is parting off form the bar.

4) Select suitable cutter for spur gearing of module 2mm.

5) The gear blank is fixed in between dead center and dividing head center of the milling machine table.

6) Select suitable index plate and fix properly in the dividing head.

7) Raise the milling machine table by elevating screw, it will approach the cutter and check the alignment of the gear blank and the cutter and check the table moment limits for both transverse and cross feed.

8) Select the cutting speed of m/mm shifting, shifting speed lever and feed lever of the milling machine in milling head.

9) Switch on the machine, check for direction of cutter with respect to work piece.

10) Feed the gear blank against the rotating cutter by manual feeding of table by giving depth of cut in twice or thrice.

11) After completion of each tooth of gear, gear blank is moved away from the cutter.

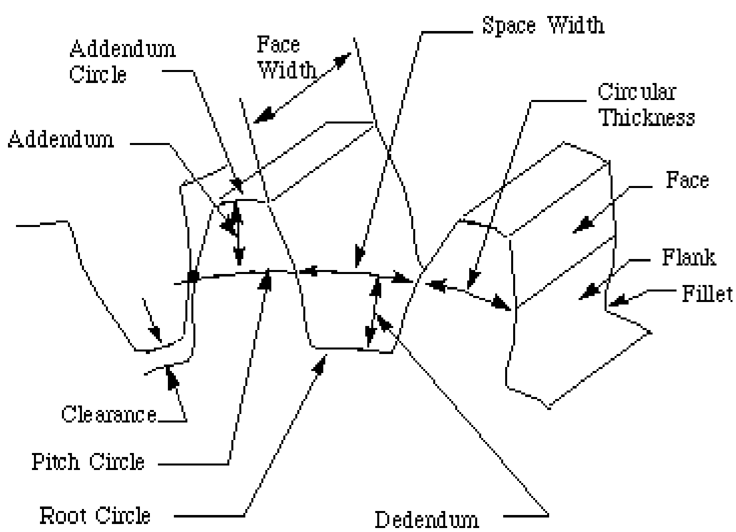
12) Form dividing head suitable method of indexing is adopted to get the equal number is visions or made on gear blank according to indexing calculations.

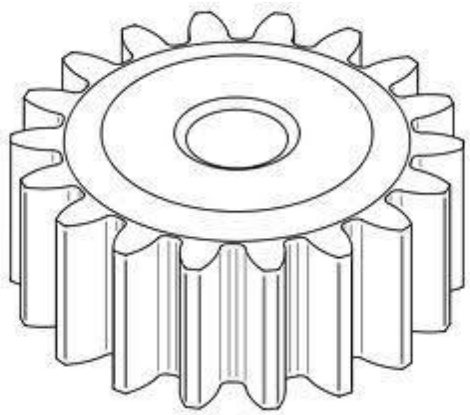
13) Now move the sector arm of the dividing head to the next point and rotate the crank of dividing head to the desired number of rotation and move the crank pin on desired number of holes of the index plate to exact number of equal division on the gear blank.

14) Again the gear blank is fed on the rotating cutter and second teeth are completed by following step number 9.

15) Supply suitable cutting fluids at the time of machining and wear safety devises while machining is going on.

Result: The desired spur gear is obtained by gear cutting operation and dimensional accuracy.





Observations & Calculation:

No. of Teeth cut on gear blank is (N)……..ex: 30

Blank diameter = (Z +2) M

Where Z = no. of teeth

Simple indexing

No. of turns of index crank = $40/N$ = $40/30$ = 4/3

Multiply by 9

4/3 X $9/9$= 36/27

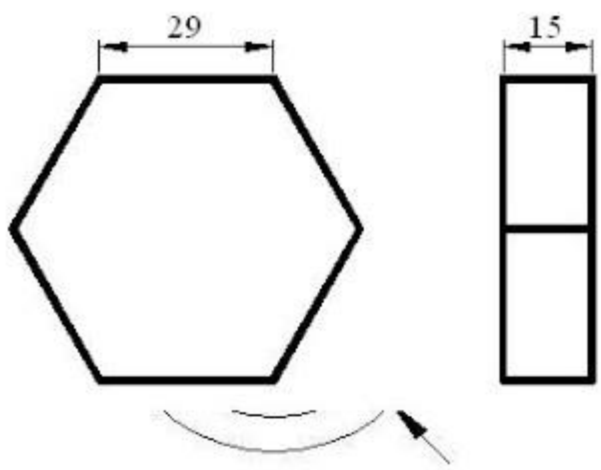
i.e. each time, after cutting one teeth, the crank is given one complete rotation and crank pin can be moved by 9 holes on 27th hole circle of index plate.

Depth of cut = 2.25 X MM = Module = 2mm

Tooth depth = 2.25 X 2 = 4.5mm

Objective: To machine a hexagonal nut using indexing head on milling machine.

Aim : To machine a hexagonal nut using indexing head on milling machine



Tools Required: Milling Machine, Indexing head, Divider, Steel Rule.

Procedure:

1. Fit the helical cutter on the arbor and hold the specimen between the centers of the dividing head and the tail center with help of dog carrier.
2. Carefully adjust the work piece so that the cutter just touches the top surface of the specimen.
3 Calculate the necessary depth of cut and then mill the six faces of the hexagonal nut in succession.

4. Change the cutter and mill the rectangular slot.
5. The workpiece is now checked for final dimensions.

Observations

(a) Measure all dimensions (up to second decimal place) on the specimen milled by your group. Make a neat sketch and indicate all measured dimensions.
(b) Explain in brief how the required indexing was obtained with the dividing head.
(c) Explain up-milling and down-milling operations. Which one did you use for slot milling and why? (d) Explain the advantages of using a helical milling cutter.

Result:

exagon is machined in the given work piece to the dimensions as shown re using Milling Machine.

8
EXPERIMENT

Production Practice Lab

4ME4-23

Objective: To study of single point cutting tool geometry and to grind the tool as per given tool geometry.

Machine Tool:

Machine tool is a non-portable power operated device in which the energy is utilized to produce jobs of desired shape and size and surface finish by removing excess material from the formed blanks in the form of chips with the help of cutting tools moved part the work surface.

It is machining equipment that cuts, shears, punches, presses, drills, rolls, grinds, sands, or forms metal, plastic, or wood stock. It may be automatic or semi-automatic.

Machine tools are generally power- driven metal cutting or forming machines used to shape metals by:

1.) The removal of chips.
2.) Pressing drawing or shearing
3.) Controlled electrical machining process
4.) Any machine tool has generally has capability of
5.) Holding and supporting the work piece
6.) Holding and supporting a cutting tool
7.) Imparting a suitable movement (rotating or reciprocating) to the cutting tool or the work
8.) Feeding the cutting tool so that the desired cutting action and accuracy will be achieved

9.) The performance of any machine tool is generally stated in terms of its metal removal rate, accuracy and repeatability.

Cutting Tool:-A tool is a device or a piece of equipment which typically provides a mechanical advantage in accomplishing a physical task, or provides an ability that is not naturally available to the user of a tool. These tools are hand-held, portable powers, or manual tools.

There are 2 types of cutting tools:-

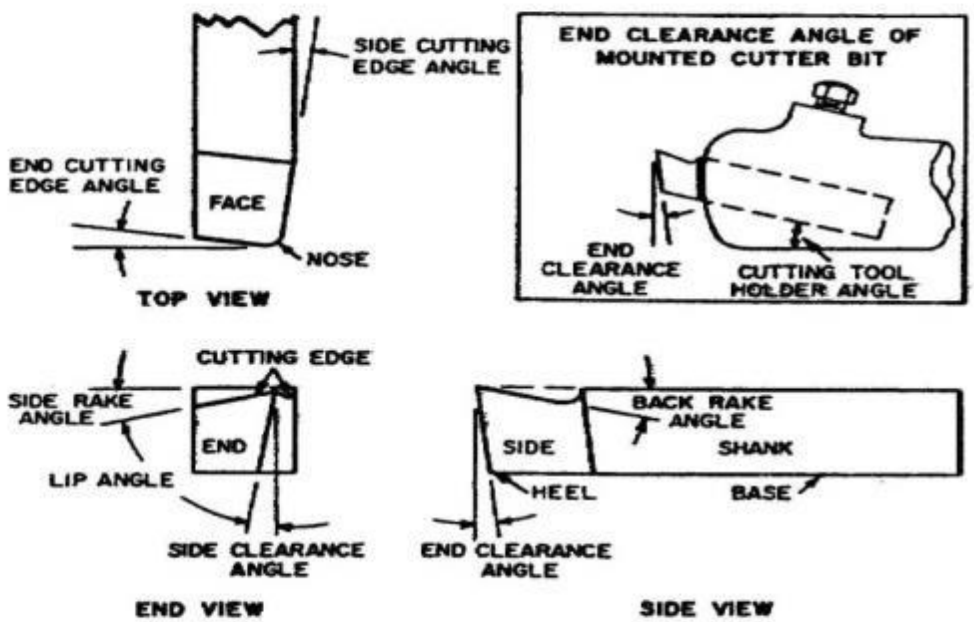
a) Single Point Cutting Tool
b) Multi point Cutting Tool

a) Single Point Cutting Tool:

The tool generally refers to a non-rotary cutting tool used in metal lathes, shapers, and planers. Such cutters are also often referred to by the set-phrase name of single-point cutting tool. The cutting edge is ground to suit a particular machining operation and may be re sharpened or re shaped as needed. The ground tool bit is held rigidly by a tool holder while it is cutting. Single-point tools are used in turning, shaping and planning operations and similar operations to remove material by means of one cutting edge.

Cutting tools must be made of a material harder than the material which is to be cut, and the tool must be able to withstand the heat generated in the metal-cutting process. Also, the tool must have a specific geometry, with clearance angles designed so that the cutting edge can contact the work piece without the rest of the tool dragging on the work piece surface. The angle of the cutting face is also important, as is the flute width, number of flutes or teeth, and margin size. In order to have a long working life, all of the above must be optimized, plus the speeds and feeds at which the tool is run.

SINGLE POINT CUTING TO NOMENCLATURE



Showing parts &important angles cut on single point cutting tool

Single point cutting tool terms and definitions:

(1) Shank: The shank is the main body of the tool.

(2) Nose: The nose is the part of the cutter bit which is shaped to produce the cutting edges.

(3) Face: The face of the cutter bit is the surface at the upper side of the cutting edge on which the chip strikes as it is separated from the workpiece.

(4) Side: The side of the cutter bit is the near-vertical surface which, with the end of the bit, forms the profile of the bit. The side is the leading surface of the cutter bit used when cutting stock.

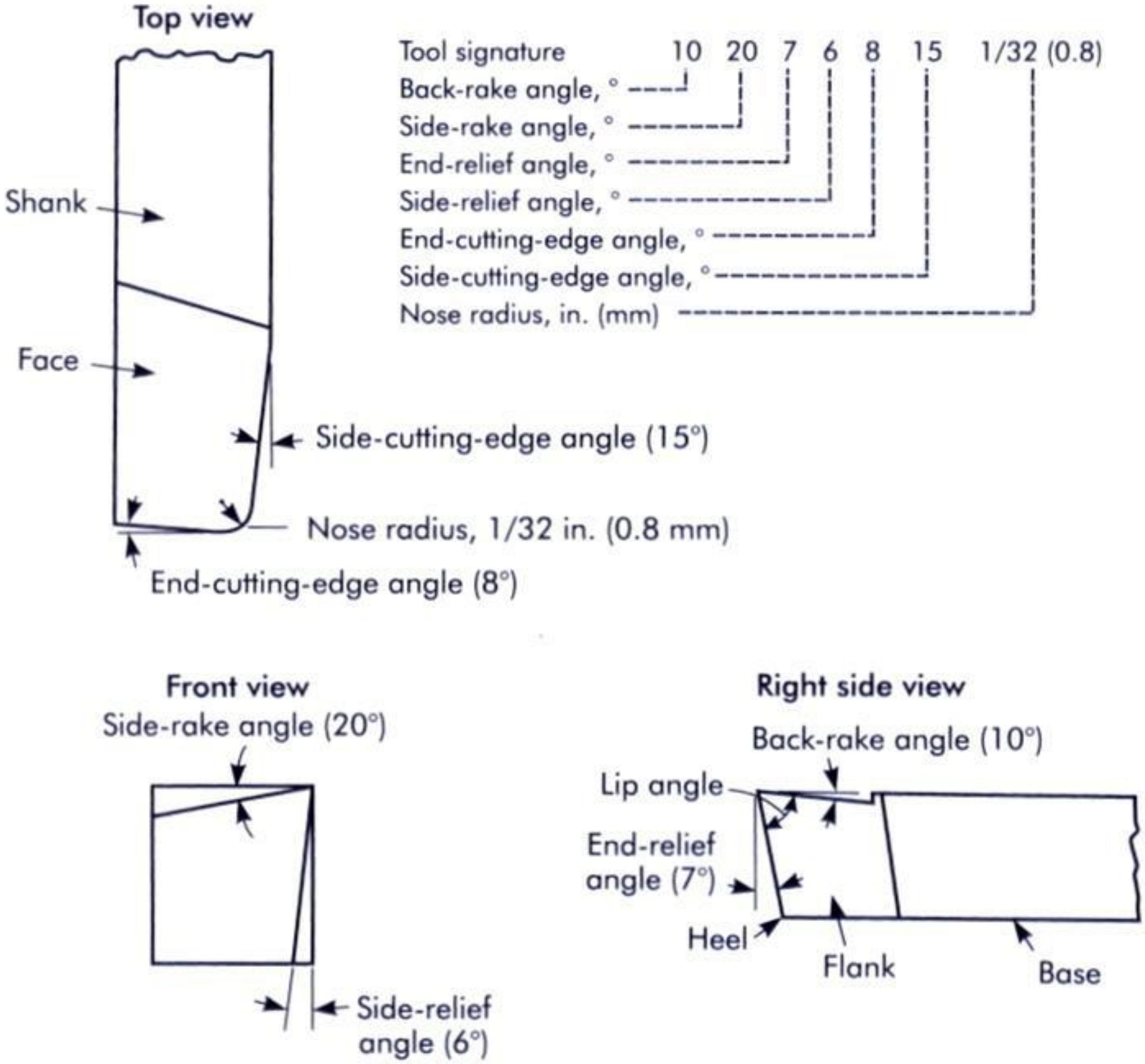
(5) Base: The base is the bottom surface of the shank of the cutter bit.

(6) End: The end of the cutter bit is the near-vertical surface which, with the side of the bit, forms the profile of the bit. The end is the trailing surface of the cutter bit when cutting.

(7) Heel: The heel is the portion of the cutter bit base immediately below& supporting the face.

Important angles of a Single Point Cutting Tool:

Angle	Details
Back Rake Angle	It is also called as Top Rake Angle. It is the slope given to the face or the surface of the tool. This slope is given from the nose along the length of the tool.
Side Rake Angle	It is the slope given to the face or top of the tool. This slope is given from the nose along the width of the tool. The rake angles help easy flow of chips
Relief Angle	These are the slopes ground downwards from the cutting edges. These are two clearance angles namely, side clearance angle and end clearance angle. This is given in a tool to avoid rubbing of the job on the tool.
Cutting Edge Angle	There are two cutting edge angles namely side cutting edge angle and end cutting edge angle. Side cutting edge angle is the angle, the side cutting edge makes with the axis of the tool. End cutting edge angle is the angle, the end cutting edge makes with the width of the tool.
Lip Angle	It is also called cutting angle. It is the angle between the face and end surface of the tool.
Nose Angle	It is the angle between the side cutting edge and end cutting edge.



Tool Signature

Result: We have successfully studied about the single point cutting tool geometry.

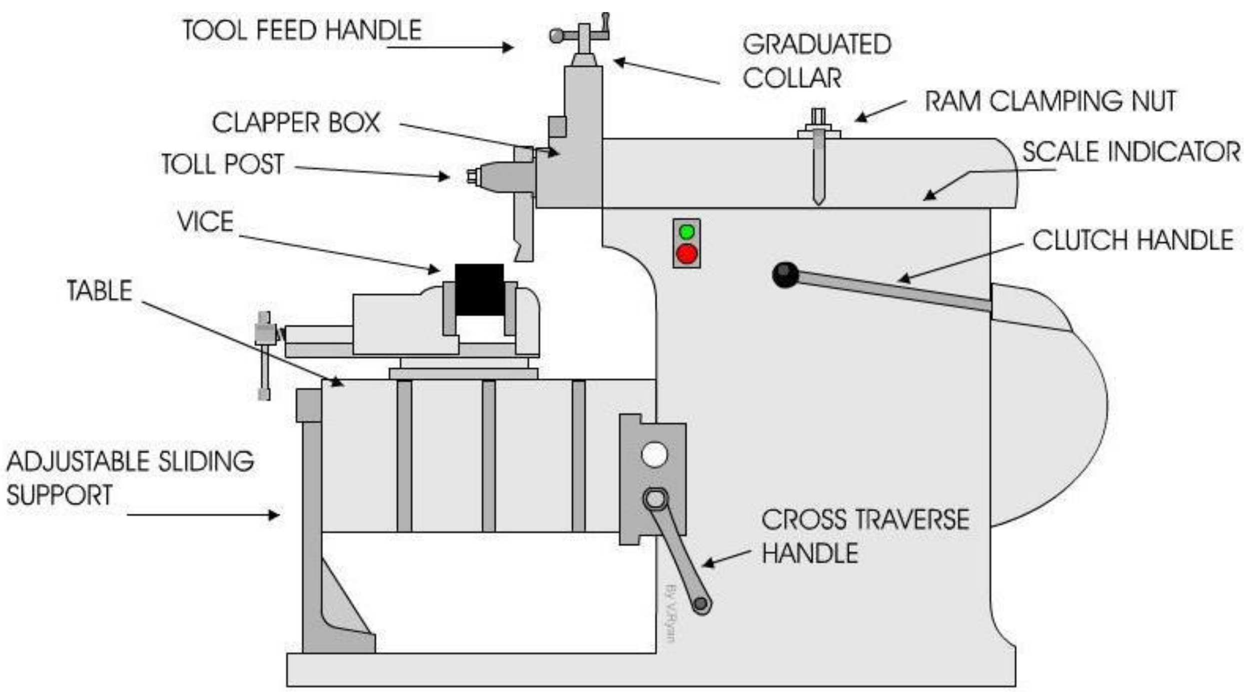
Objective: To study shaper machine, its mechanism and calculate quick return ratio. To prepare a job on shaper from given mild steel rod.

Introduction:

A shaper is a type of machine tool that uses linear relative motion between the work piece and a single-point cutting tool to machine a linear tool path. The shaper is a relatively simple machine. It is used fairly often in the tool room or for machining one or two pieces for prototype work. Tooling is simple, and shapers do not always require operator attention while cutting. A shaping machine is used to machine flat surface. It can cut grooves, angles and many other shapes. The Main Function of shaper is to generate a flat surface by combination of linear movement of cutting tool and work piece.

Shaping is where the work piece is fed at right angles to the cutting motion between successive strokes of the tool. Shaping and planners among the oldest techniques used and Shapers are where the work piece is fed at right angles to the cutting motion between successive strokes of the tool. In Planners the work piece is reciprocated and the tool is fed at right angles to the cutting motion. These processes require skilled operators and for the most part have been replaced by other processes

The horizontal shaper is the most common type and its principal components are shown below and described as follows:



Horizontal Shaper Machine

Parts of Shaper:

Base: It is a heavy and robust cast iron body. The base supports the column or pillar which supports all the working parts such as ram, work-table, drive mechanism etc.

Column or Pillar: The column is a ribbed casting of cellular construction. The ram slide ways are provided on the top of the column while the table slide ways are machined on the front. The crank and slotted link mechanism that drives the ram is contained within the column. The driving motor, variable speed gear box, levers, handles and other controls of shaper are also contained in the column.

Ram:
Ram is a rigidly braced casting and is located on the top of the column. The ram slides back and forth in dovetail or square ways to transmit power to the cutter. The starting point and the length of the stroke can be adjusted using stroke positioning mechanism and the down feed mechanism.

Tool head:
It is the device which holds the tool. The tool head slides in a dovetail at the front of the ram by means of T-bolt sand is fastened to the ram on a circular plate so that it can be rotated for making angular cuts. It can swivel from 0° to 90° in a vertical plane. The tool head can be raised or lowered by hand feed for vertical cuts on the work piece by its hand crank for precise depth adjustments.

Clapper Box:
The clapper box is needed because the cutter drags over the work on the return stroke. The clapper box is hinged so that the cutting too] will not dig in. Often this clapper box is automatically raised by mechanical, air, or hydraulic action.

Cross Rail:
The Cross rail is a heavy casting attached to the column at its front on the vertical guide ways. It carries the horizontal table slide ways. The cross rail can be raised or lowered by means of an elevating screw in order to compensate for different thicknesses of work.

Table: It is made of cast iron and has box type construction. It holds and supports the work during the operation and slides along the cross rail to provide feed to the work. T-slots are provided on its top and sides for securing the work to it. The table is moved left and right, usually by hand, to position the work under the cutter when setting up. Then, either by hand or more often automatically, the table is moved sideways to feed the work under the cutter at the end or beginning of each stroke.

Saddle:

The saddle moves up and down (Y axis), usually manually, to set the rough position of the depth of cut. Final depth can be set by the hand crank on the tool head.

Tool holders:

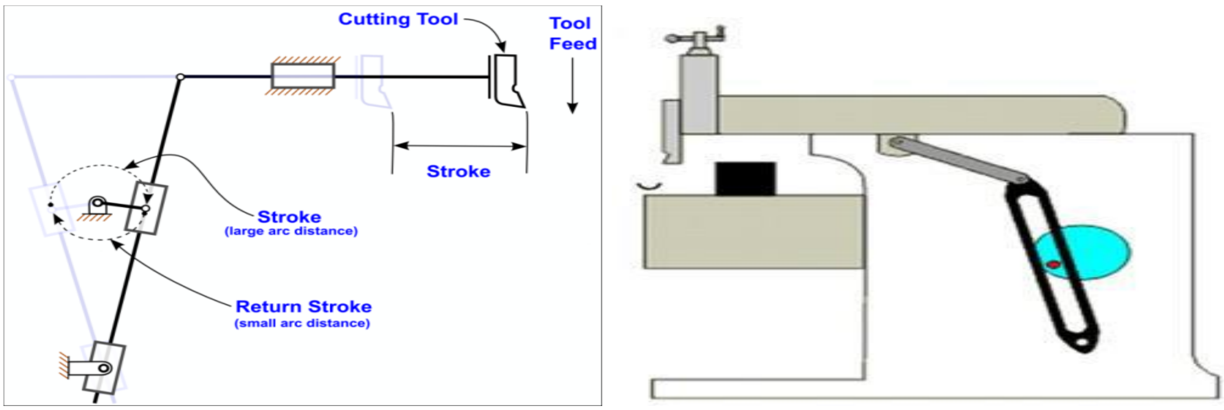
Tool holders are the same as the ones used on at engine lathe, though often larger in size. The cutter is sharpened with rake and clearance angles similar to lathe tools though the angles are smaller because the work surface is usually flat. These cutters are fastened into the tool holder.

Work holding:

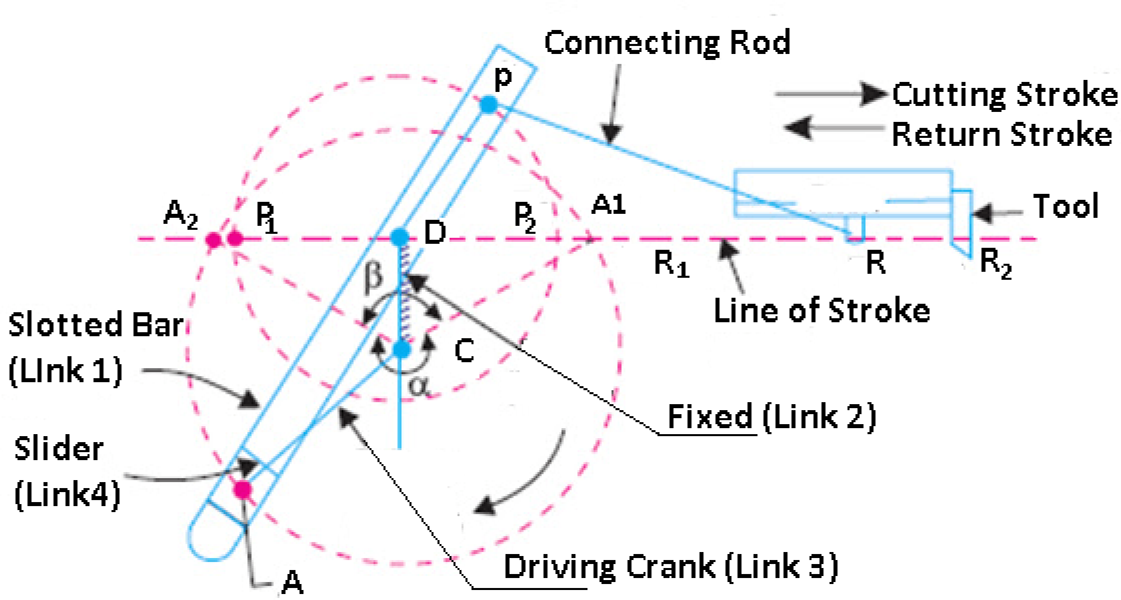
Work holding is frequently done in a vise. The vise is specially designed for use in shapers and has long ways which allow the jaws to open up to 14" or more, therefore quite large work pieces can be held. The vise may also have a swivel base so that cuts may be made at an angle. Work that cannot be held in the vise (due to size or shape) is clamped directly to the shaper table in much the same way as parts are secured on milling machine tables.

Quick Return Mechanism

This is the most common type of shaper in which a single point cutting tool is given a reciprocating equal to the length of the stroke desired while the work is clamped in position on an adjustable table. In construction, the crank shaper employs a crank mechanism to change circular motion of a large gear called “bull gear” incorporated in the machine to reciprocating motion of the ram. The bull gear receives power either from an individual motor or from an overhead line shaft if it is a belt driven shaper. The shaping machine is used to machine flat metal surfaces. The reciprocating motion of the mechanism inside the shaping machine can be seen in the diagram. As the disc rotates the top of the machine moves forwards and backwards, pushing a cutting tool. The cutting tool removes the metal from work which is carefully bolted down.



Quick return mechanism for shaper



Arrangement of parts

The link 2 matches to a crank in a reciprocating steam engine. The driving crank “CA” (link 3) rotates at a similar angular speed. The slider (link 4) connected to the crank pin at “A” moves along the slotted bar “PA” (link 1) which oscillates at a pivoted point D.

The connecting rod PR carries the ram at R to which the cutting tool is fixed. The movement of the tool is constrained along the line RD produced. i.e. along a line passing through D and perpendicular to CD.

Working: - When the driving crank CA moves from the point CA1 to CA2. (or the link DP from the point DP1 to DP2) through an angle α in the clockwise direction, the tool moves from the left hand end of its stroke to the right hand end by a distance 2 PD.

Now when the driving crank moves from the point CA2 to CA1 (or the link DP from DP2 to DP1) through an angle β in the clockwise direction, the tool moves back from the right-hand end of its stroke to the left-hand end.

A little consideration will show that the time taken during the right movement of the ram (i.e. during forward stroke) will be equal to the time taken by the driving crank to move from CA1 to CA2.

Similarly, the time needed during the right to left movement of the ram (or during the idle or return stroke) will be equal to the time taken by the driving crank to move from CA2 to CA1.

Since the crank link CA rotates at uniform angular velocity, thus, the time taken during the cutting stroke (or forward stroke) is more than the time taken during the return stroke.

$$\frac{\text{Time of Cutting Stroke}}{\text{Time of Return Stroke}} = \frac{\alpha}{\beta} = \frac{\alpha}{360^\circ - \alpha} \text{ or } \frac{360^\circ - \beta}{\beta}$$

In other words, the mean speed of the ram during a cutting stroke is less than the mean speed during the return stroke. The ratio between the time taken during the cutting and return stroke is given by the formula shown in the above image.

Shaper Specifications:

Shaper machine are manufactured by taking account of the following specifications:

1. Length of Stroke
2. Maximum Horizontal Travel of Table
3. Maximum Vertical Travel of Table
4. Maximum distance from Table to Ram
5. Maximum Vertical Travel of Tool Slide
6. Length &Width of Table Top
7. Length &Depth of Table Side
8. Power of Motor.

Aim: To produce a rectangular groove on a given casted rectangular blank with the help of shaping operations.

Tools Required: Shaper machine, spirit level gauge, shaper tools, surface plate, vernier height gauge, scriber, vernier caliper.

Sequence of operations:

1) Select suitable horizontal shaper.

2) Fix the given work piece on shaper table with the help of universal vice rigidly.

3) Set the cutting stroke and return stroke of the shaper, the length of the shaper should not exceed 3 times length of rectangular blank.

4) Select proper shaper tool and fix the tool on tool head of the shaper with minimum clearance of 5 to 6mm.

5) The exact position of the tool is perpendicular to the rectangular face of the work piece.

6) Switch on the shaper; feed the reciprocating tool against the rigidly fixed rectangular bank by table feeding mechanism.

7) Required depth of cut 1.5mm isgiven by rotating the tool head hand wheel with graduated micrometer.

8) Desired feed like 0.5mm/stroke is given to the work piece through the feeding mechanism incorporated for each cutting stroke up a length of 10mm.

9) Machine surface" A' de clamp and deburr corners.

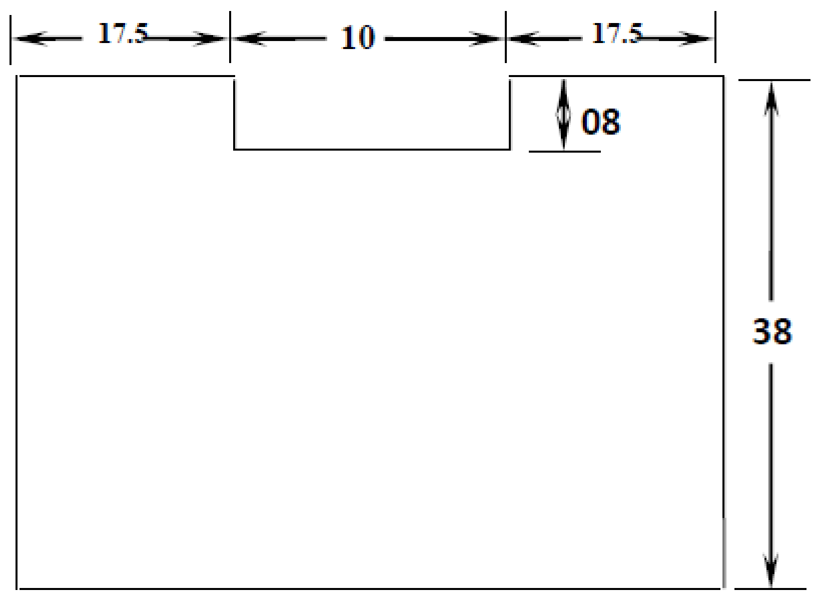
10) Butt Finish the surface A against the fixed jaw so that A and B are perpendicular to each other.

11) Machine surface de clamp and deburr corners.

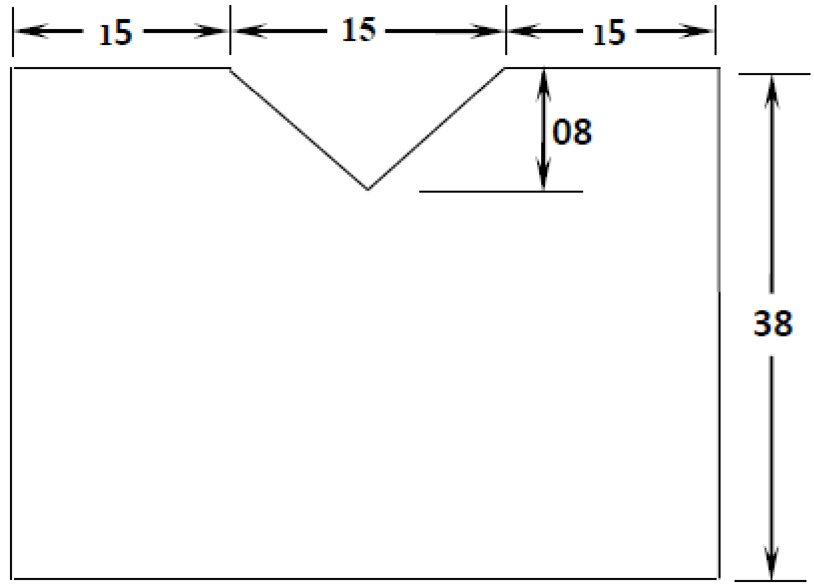
12) Check the squareness between surface A & B with tray square, if it is not square check the setting machine till squareness is obtained.

13) Butt surface B against the fixed jaw and rest surface A on the parallel and clamp.

14) Machine surface D to size and deburr check the size and squareness.
15) Machine surface E to size and check the squarness
16) Machine surface F to size and check the squarnes.



Rectangular Groove on work piece



V-Groove on the work piece

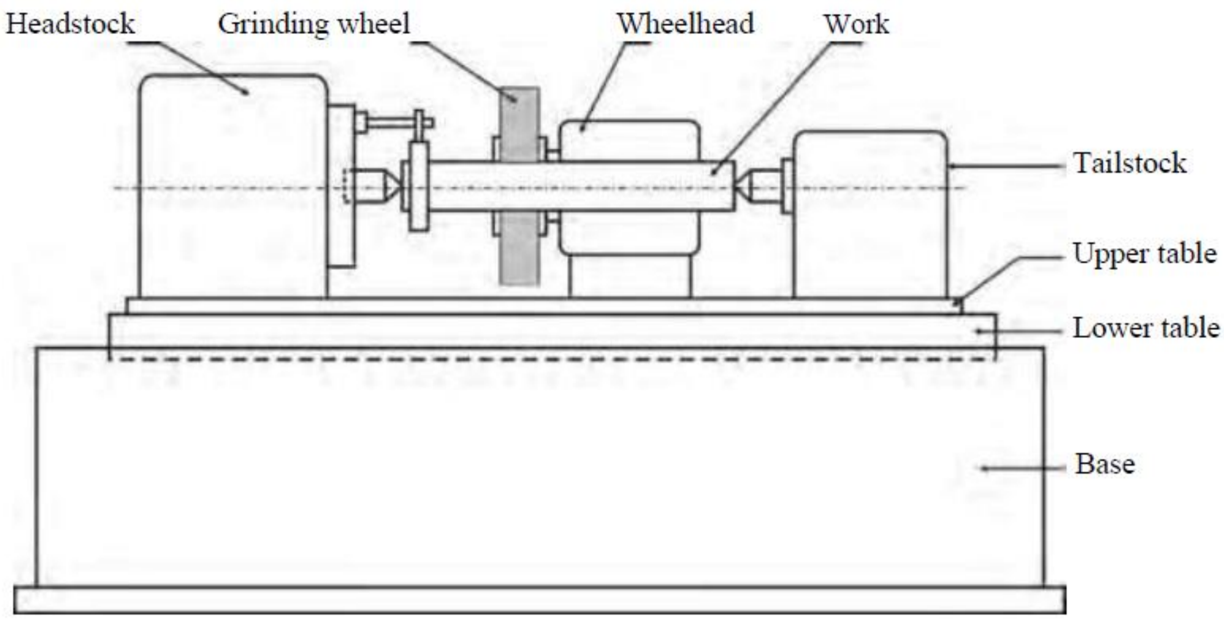
Result: The required model is obtained and its dimensional accuracy is verified.

Objective: Cylindrical grinding using grinding attachment in a centre lathe.

Cylindrical grinding machine

Cylindrical grinders are generally used to grind external surfaces like cylinders, taper cylinders, faces and shoulders of work. There are two types of cylindrical grinding machines and they are

1. External cylindrical grinding machines
2. Internal cylindrical grinding machines



Cylindrical grinding machine

To grind the cylindrical surface of the given materials as per the given dimensions

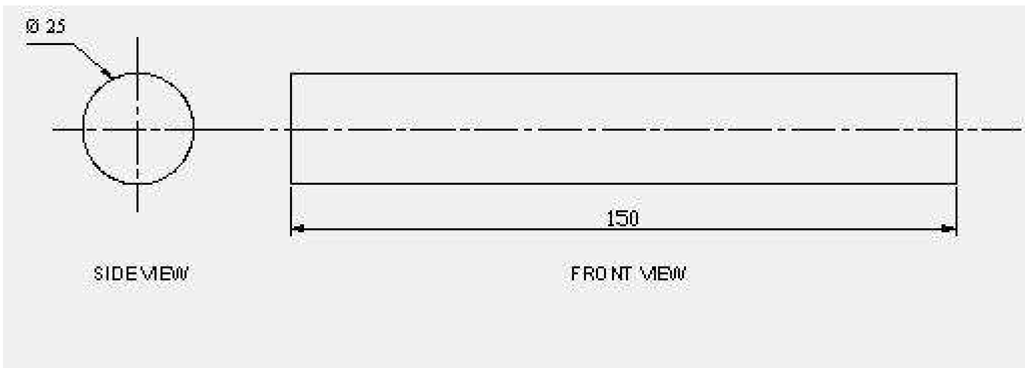
REQUIREMENTS:

Grinding Machine
Grinding Wheel
Work Piece
Steel rule.
Outside calipers.
Cutting tool.

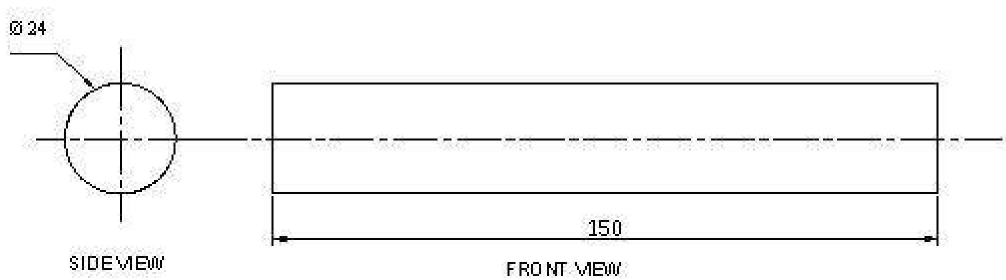
PROCEDURE:

- The given work piece is first fitted in the chuck of the lathe.
- By fitting the tool in tool post the work piece will be reduced to given dimensions.

- First reduce the diameter to 23mm size then reduced the diameter to 15mm and 18mm at the middle.
- By facing the work piece to the tool work piece is reduced to 70mm.
- After the preliminary lathe operation, the work piece is held in the ends of the cylindrical grinder.
- The grinding wheel is turned on and it is moved towards the work piece such that the surfaces of the cylindrical position are grinded to +-0.2mm.



BEFORE GRINDING



AFTER GRINDING

RESULT: Thus the required dimension of cylindrical surface is obtained.

Objective: Demonstration for job by eccentric turning on lathe machine.

Aim: To machine the given cylindrical rod as per the diagram, by using the lathe machine.

Tools required:

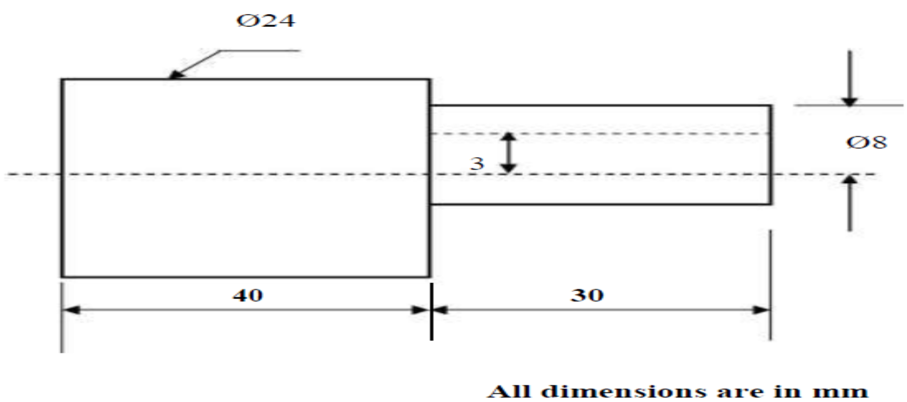
- Chuck Key
- Tool post spanner
- Turning tool
- Chamfering tool
- Vernier caliper
- Drill bit ø 10mm
- Steel rule

Procedure:

1. The work piece is held in the lathe spindle and it is rotated about lathe axis
2. The tool is held in the tool post and it is set to lathe axis
3. The facing and turning operations are carried out to the required dimensions
4. Then the axis of the work piece is shifted to the required eccentricity
5. The longitudinal feed is given to the required length and job is eccentrically turned.
6. Two or more cuts with suitable depth of cut are given to obtain required diameter
7. Then both ends of the job are chamfered by chamfering tool.

Result:

The given work piece machined as per the diagram by using the lathe machine.



JOB DRAWNG

Objective: Study of capstan lathe and its tooling and prepare a tool layout & job as per given drawing.

Capstan and Turret Lathe

A capstan and turret lathe is used to manufacture any number of identical work pieces in the less time. These lathes are the development of engine lathes. For the first time in 1860, Pratt and Whitney developed the capstan lathe.

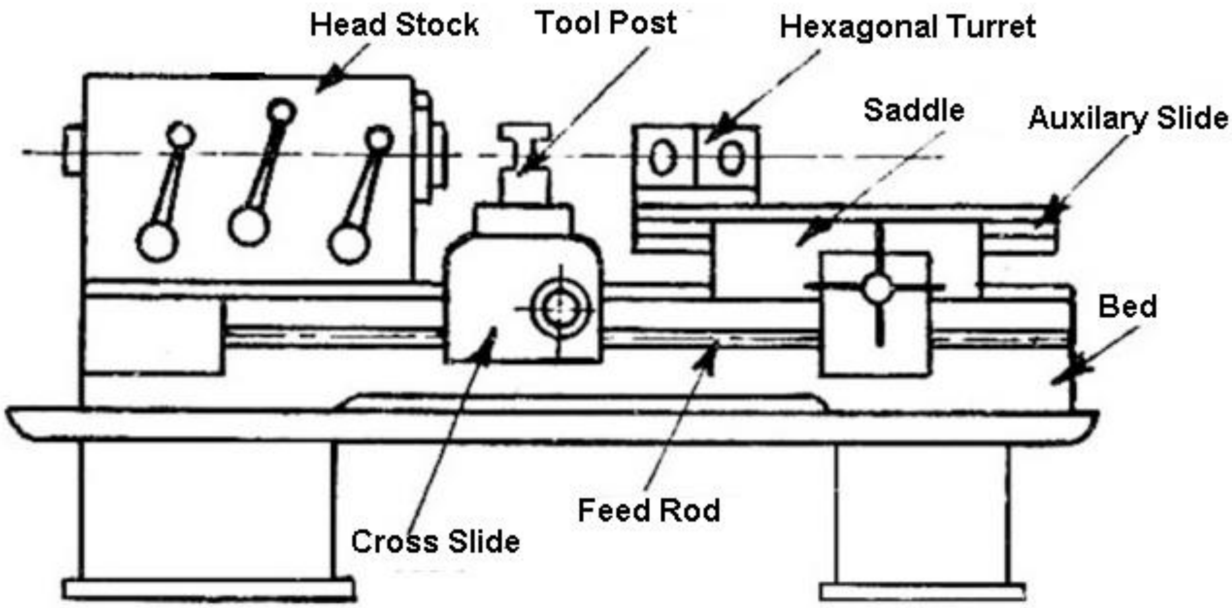
The capstan lathe consists of:

1. Bed
2. All geared headstock
3. A saddle provided on which a 4-station tool-post is mounted to hold 4 different tools.
4. A tool-post fitted at the back of the carriage. It holds a parting tool in an inverted position. The tool post mounted on the cross slide is indexed by hand.
5. This machine has no tailstock, but in its place, a hexagonal turret is mounted on a slide which rests upon the bed.

These special characteristics of a capstan and turret lathe enable it to perform a series of operations such as:

1. Turning.
2. Drilling.
3. Boring.
4. Thread cutting.
5. Reaming.
6. Necking.
7. Chamfering.
8. Cutting-off.
9. And many other operations in a regular sequence to produce a large number of identical pieces in a less amount of time.

The capstan type lathe is shown in the figure. This machine carries the hexagonal turret on ram or a short slide.



CAPSTAN LATHE MACHINE

The ram slides longitudinally on a saddle positioned and clamped on lathe bed ways. This type of machine is lighter in construction and is suitable for machining bar is smaller diameter.

The tools are mounted on the square turret and 6 faces of the hexagonal turret.

The feeding movement is obtained when the ram moves from left to the right. And when the ram is moved backwards the turret indexes automatically and the tool mounted on the next face comes into operation.

Principle Parts of Capstan Lathes

The turret lathe has essentially the same parts like the engine lathe except for the turret and complex mechanism incorporated in it for making it suitable for mass production work.

Following are the main parts of a capstan and turret lathe,

1. Bed.
2. Headstock.
3. Cross slide and saddle.
4. The turret saddle and auxiliary slide.

1. Bed

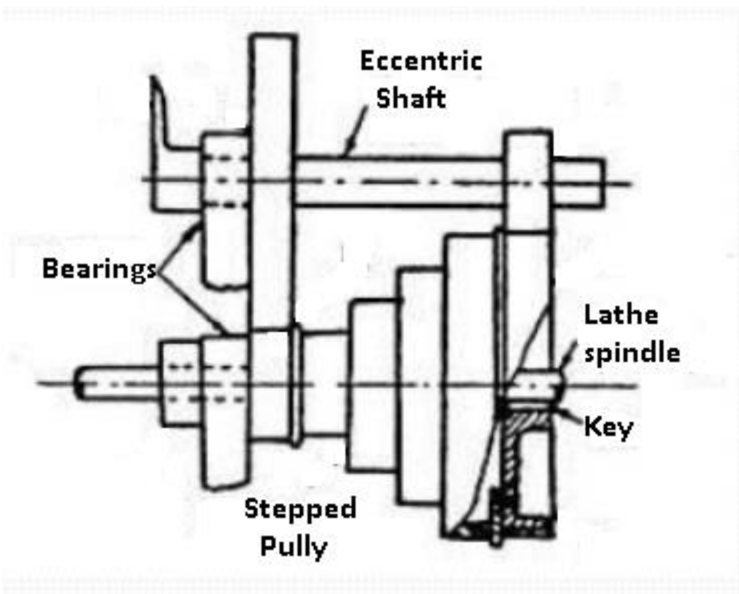
The bed is a long box like casting provided with accurate guide ways upon which are mounted the carriage and turret saddle. The bed is designed to ensure strength, rigidity and permanency of alignment under heavy duty services.

2. Headstock

The headstock is a made up of large casting. It is located at the left-hand end of the bed. The different types of headstocks in capstan and turret lathe are as follows:

1. Step cone pulley driven headstock.
2. Direct electric motor driven headstock.
3. All geared headstock.
4. Preoptive or preselective headstock.

2.1 Step Cone Pulley Driven Headstock



Back Geared Headstock

This is the simplest type of headstock and is fitted with small capstan lathes where the lathe is engaged in machining small and almost constant diameter of workpieces. Only three or four steps of the pulley can cater to the needs of the machine.

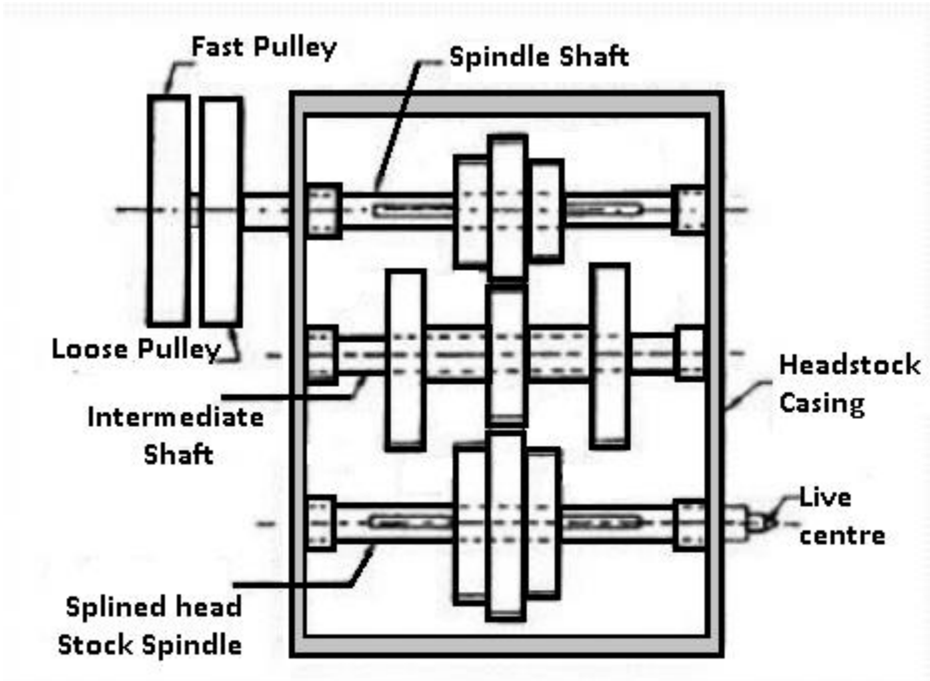
The machine requires special countershaft unlike that of an engine lathe, where starting, stopping and reversing of the machine spindle can be affected by simply pressing a foot pedal.

2.2 Electric Motor Driven Headstock

In an electric motor driven headstock, both spindles of the machine, and the armature shaft of the motor are one and the same.

Any speed difference or reversal is achieved by directly controlling the motor. Three or four are available and the machine is suitable for smaller diameter of work pieces rotated at high speeds.

2.3 All Geared Headstock



All Geared HeadStock

On the larger lathes, the headstocks are geared and the different mechanism is employed for speed changing by actuating levers. The speed changing has done by without stopping the machine.

It is an all geared headstock with provisions for rapid stopping, starting and speed charging for different operations and for pushing a button or pulling a lever.

For different operations and for turning different diameter, the speed of the spindle must change. The required speed for the next operation is selected beforehand and the speed changing lever is placed at the selected position.

After the first operation is complete, a button or a lever is simply actuated and the spindle starts rotating at the selected speed required for the second operation without stopping the machine. This novel mechanism is affected by friction clutches.

3. Cross-slide and saddle

In small capstan lathes, hand operated cross slide are used which are clamped on the lathe bed at the required position. The larger lathes and heavy duty turret lathes are equipped with usually two designs of the carriage.

1. Conventional type carriage
2. Side hung type carriage

3.1 The conventional type carriage

The conventional type carriage bridges the gap between the front and rear bed-ways and is equipped with four station type tool post at the front, and one rear tool post at the back of the cross slide.

3.2 The side-hung type carriage

The side-hung type carriage is generally fitted with heavy duty turret lathes where the saddle rides on the top and bottom guide ways on the front of the lathe bed. The design facilitates swinging of larger diameter of the workpiece without being interfered by the cross slide. The saddle and the cross slide may be fed longitudinally or crosswise by hand or power.

The longitudinal movement of each tool may be regulated by using stop-bars or shafts set against the stop fitted on the bed and carriage. These stops are set so that each tool will feed into the work to the desired length for the purpose of duplicating the job without checking the machining length for different operations each time.

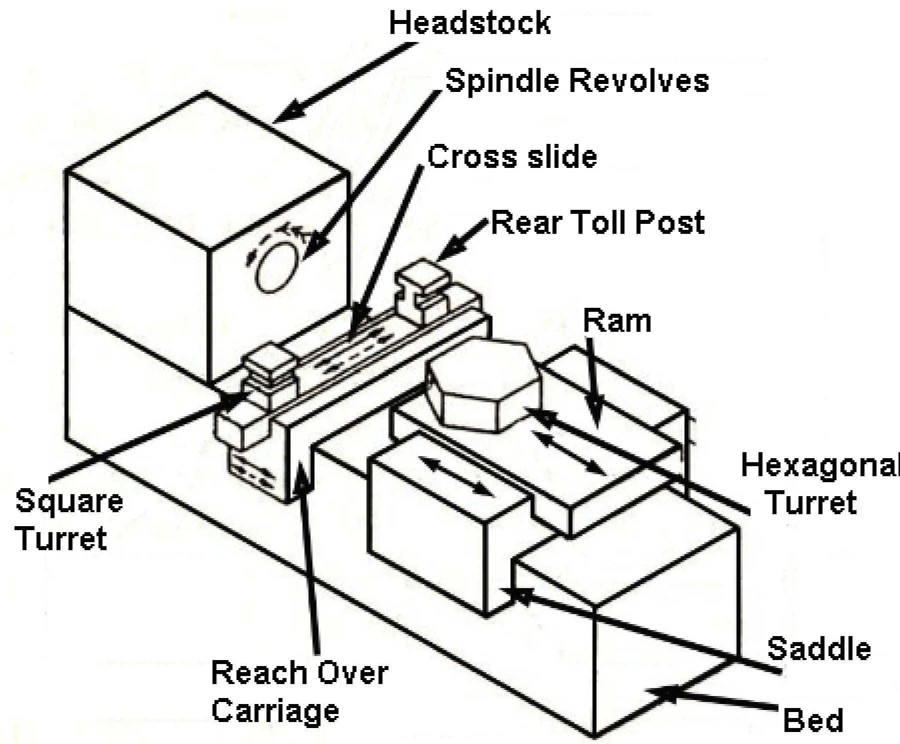
These stop the first trip out the feed and then serve as a dead-stop for small head operated movement of the tool to complete the cut. The stop bars are indexed by hand to synchronies with the indexing of the tool.

The tools are mounted on the tool post and correct heights are adjusted by using a rocking or parking piece.

4. The turret saddle and auxiliary slide

In a capstan lathe, the turret saddle bridges the gap between two bed-ways and the top face is accurately machined to provide a bearing surface for the auxiliary slide. The saddle is adjusted on lathe bed-ways and clamped at the desired position. The hexagonal turret is mounted on the auxiliary slide.

In a turret is directly mounted on the top of the saddle and any movement of the turret is affected by the movement of the saddle. The movement of the turret may be effected by hand or power. The turret is a hexagonally shaped tool holder intended for holding six or more tools.



Each face of the turret is accurately machined. Through the centre od, each face accurately bored holes are provided for accommodating shanks of different tool holders.

The centre line of each hole coincides with the axis of the lathe when aligned with the headstock spindle. In addition to these holes, there are four tapped holes on each face of the turret for securing different tool holding attachments. At the centre of the turret on the top of it, there is a clamping lever which locks the turret on the saddle.

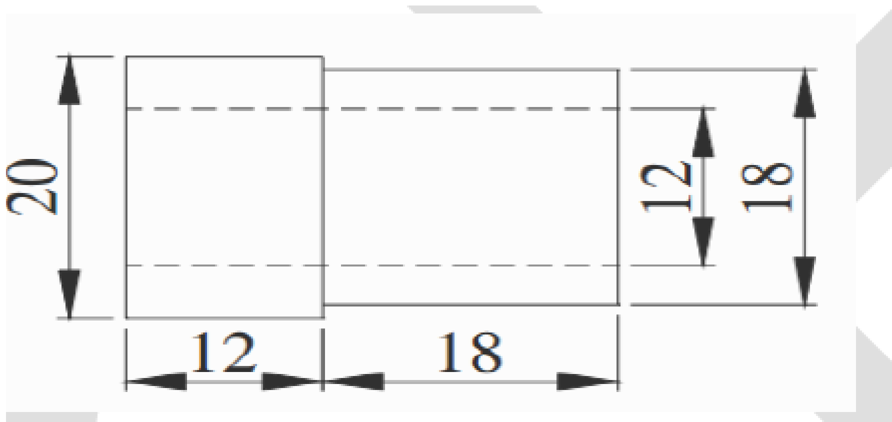
Six stop bars mounted on the saddle which restricts the movement of each tool mounted on each face of the turret to be fed to a predetermined amount for duplicating workpiece.

After one operation is completed, as the turret is brought back away from the spindle nose, the turret indexes automatically by a mechanism incorporated on the bed and in turret saddle, so that the tool mounted on the next face are aligned with the work.

Aim: To machine the work piece to the given dimensions using capstan lathe

Tools and equipments required: Capstan Lathe, stopper, drill chuck, counter sink bit, drill bit, turning tool, parting off tool, Vernier Caliper.

Specimen drawing:



All dimensions are in mm

Procedure:

1. Prepare the tooling layout for the given workpiece.
2. Set the tools in their respective positions of the tool stations.
3. The workpiece is chucked and checked for the rotation.
4. The adjustment to the length of feed for each tool is adjusted by rotating the adjustment screws.
5. Feed the tools in the required sequence to machine the given workpiece.

Result:

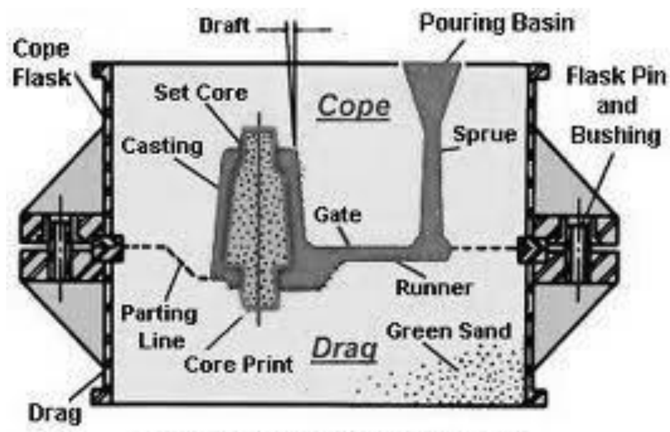
Thus the given workpiece is machined to the given dimensions using capstan lathe.

Objective: To prepare mould of a given pattern requiring core and to cast it in aluminium.

Aim: To prepare mould of a given pattern requiring core and to cast it in aluminium.

Tools and Pattern: Wooden pattern made in two halves, dowelled together, the division passing through the center of the grooves; cope and drag moulding tools are parting sand, brick dust etc.

Stage Sketches:
The mould can be prepared by using three boxes without any difficulty. However the same can be prepared using two boxes using an ingenious method known as false-core method.



Green Sand Mold Section

Procedure:

1. One half of the pattern is molded in the bottom box, the parting being cut an incline as shown. The other half pattern is then placed in position and sand poured and rammed to form the second parting with a slope down wards from the upper flange of the pulley.

2. The top box is next placed on the bottom box and properly located. Sand is poured and rammed without damaging the false core.

3. The top box is gently removed; the upper half pattern is gently taken out from the top box.

4. The top box is replaced on the drag and the entire mould is turned upside down. The bottom box, which now is at the top, is gently lifted and the remaining half of the pattern is withdrawn.

5. The bottom box is replaced and the mould id inverted. The spruces are removed, pouring basin is cut and the mould is finished after piercing holes (vents).

Observations:

1. After ramming using moulds hardness tester check the mould hardness on all the four sides of the pattern.

2. Locate the rumen and riser 90^o exactly.

Precautions:

1. Ramming should be uniform to impart uniform strength to the mould.
2. Apply parting sand at the partitions for esy separation of boxes.
3. Locate the two halves of pattern properly to avoid mismatch.

Result: Sand mould is prepared for the given pattern.

Objective: To perform moisture test and clay content test.

Aim: To perform moisture test and clay content test.

CLAY CONTENT TEST

AIM: To determine the percentage of clay present in base sand.

Materials used: Base sand, 5 % NaoH solution and water.

Apparatus used: Wash bottle, measuring jar, mechanical stirrer and siphon tube.

Theory:

1. Clay can be those particles having less than 20 microns size. Moulding sand contains 2 to 50 percent of clay. When mixed with water it imparts, binding strength and plasticity.

2. Clay consists of two ingredients a) Fine silt and b) True clay. Fine silt as no binding power where as true clay imparts the necessary boundary strength to the moulding sand; thereby the mould does not lose its shape after ramming.

3. Clay also can define as those particles which when mixed with water, agitated and then made to settled, fails to settle down at the rate of 1”/mm.

4. The particles of clay are plate like from and have a very large surface area compared to its thickness and therefore have a very high affinity to absorb moisture.

5. Clay is the main constituent in a moulding sand and mixture other than sand grains. Clay imparts binding action to the sand and hence the strength.

6. Clay is of mineral origin available in plenty on earth. It is made of alumina silicate. The types of clay are

a) montmorillonite
b) Kaolinite
c) illite

the first type is generally referred to as Bentonite.

Clay is the main constituent in a moulding sand mixture other than sand grain. Clay help impart binding action to the sand and hence strength to the sand.

Procedure:

1. Take 100g of base sand in a wash bottle and add 475ml of distilled water and 25ml of NaOH solution to it.

2. Using the mechanical stirrer, stir the mixture for about 5 minutes adds distilled water to make up the level to 6"height. Stir the mixture again for 2 minutes. Now allow the content of the bottle to settle down.

3. Siphon out 5” level of unclean water using a standard siphon.

4. Add distilled water again up to 6" height and stir the content again. Allow the mixture to settle down for 5minutes.

5. Siphon out 5” level of water from the bottom of the bottle Repeat the above procedure for 3-4times till the water becomes clear in the wash bottle.

6. Transfer the wet sand from the bottle in to a tray and dry in it in an oven at 110ºC to remove moisture. Note down the dry sand weight accurately. Using the calculations find percentage of clay.

Calculations

Weight of sand W_1= 100 gms

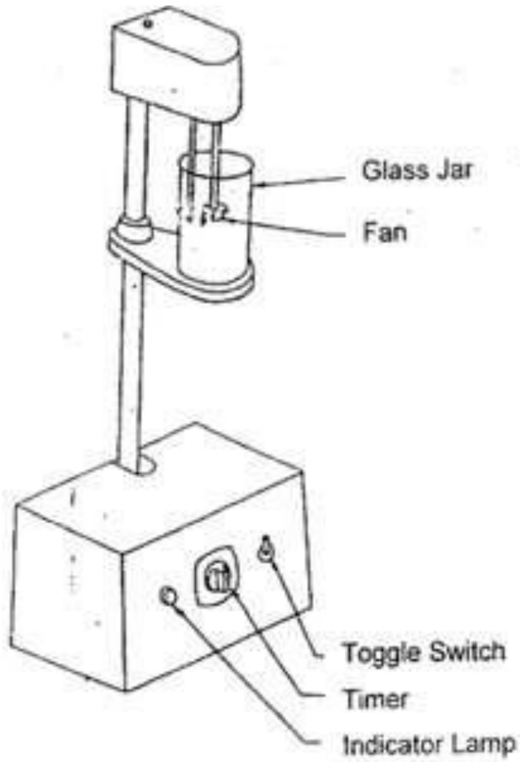
Weight of dried sand W_2 = ----------- gms

% of clay = $\frac{(W1-W2)*100}{100}$

Results and discussion:

The % of clay is -----------------%

Discuss whether the % of Water is present is high or low and whether this % is enough to act as binder in the sand.



CLAY WASHER

Moisture test

Objective: - Water content determination generally takes 16 to 24 hours by oven drying method. To quickly determine the water content at site, use of Rapid Moisture Meter is very advantageous. In this method, water content is determined from the gas pressure developed by the reaction of calcium carbide (Absorbent) with free water of the soil sample. From the calibrated scale of the pressure gauge, the percentage of water on total (wet) mass of soil sample is obtained and the same is converted to water content on dry mass of soil.

Apparatus Required

A. Metallic pressure vessel, with a clamp for sealing the cup, along with a Pressure gauge calibrated in percentage water content as per IS-12175:1987.

B. Counterpoised balance, for weighing the sample.

C. 3 steel balls of about 12.5mm diameter and 1 steel ball of 25mm diameter

D. Cleaning Brush

E. Calcium Carbide Powder (Absorbent)

F. Standard Scoop - for measuring absorbent.

Setup for Rapid Moisture content Determination

Procedure

1. Preparation of Soil Sample: Sand requires no special preparation. Coarse powders may be ground and pulverized. Cohesive and plastic soil is tested with addition of steel balls in the pressure vessels. The test requires about 6 grams of soil sample.

2. Set up the balance, place the soil sample in the pan till the mark matches with the index mark. 3. Unclamp the clamping screw of the instrument sufficiently to move the U-clamp off the cup. Lift off the cup. Check that cup and body are clean; otherwise clean it using a brush.

4. Hold the Moisture Meter horizontally and gently deposit the one level scoop-full of the absorbent (Calcium Carbide) inside the chamber.

5. Transfer the weighed soil from the pan to the cup.

6. Holding cup and chamber horizontally, bringing them together without disturbing the sample and the absorbent. Clamp the cup tightly into place.

7. In the case of clayey soils and pastes, place the 3 smaller steel balls in the cup along with the sample and larger one in the body along with the absorbent. Shake the moisture meter up and down vigorously for 5 seconds, then quickly turn it so that the gauge is upwards, give a tap to the body of the moisture meter to ensure that all the contents fall into the cup. Hold the rapid moisture meter downwards, again shake for 5 seconds, then turn it with gauge upwards and tap. Hold for one minute. Repeat this for a third time.

8. Once more invert the rapid moisture meter and shake up and down to cool the gas. Turn the rapid moisture meter with the gauge upwards and dial horizontal held at chest height. When the needle comes to rest, take the reading. The readings on the meter are the percentages of water on the wet mass basis.

9. For other than Clayey soils, place the 3 smaller balls in the cup along with the soil and the larger one in the body along with the absorbent and seal up the unit as usual.

10. Hold the rapid moisture meter vertical so that the material in the cup falls into the body. Now holding the unit horizontal rotate it for 10 seconds so that the balls are rolled round the inside circumference of the body.

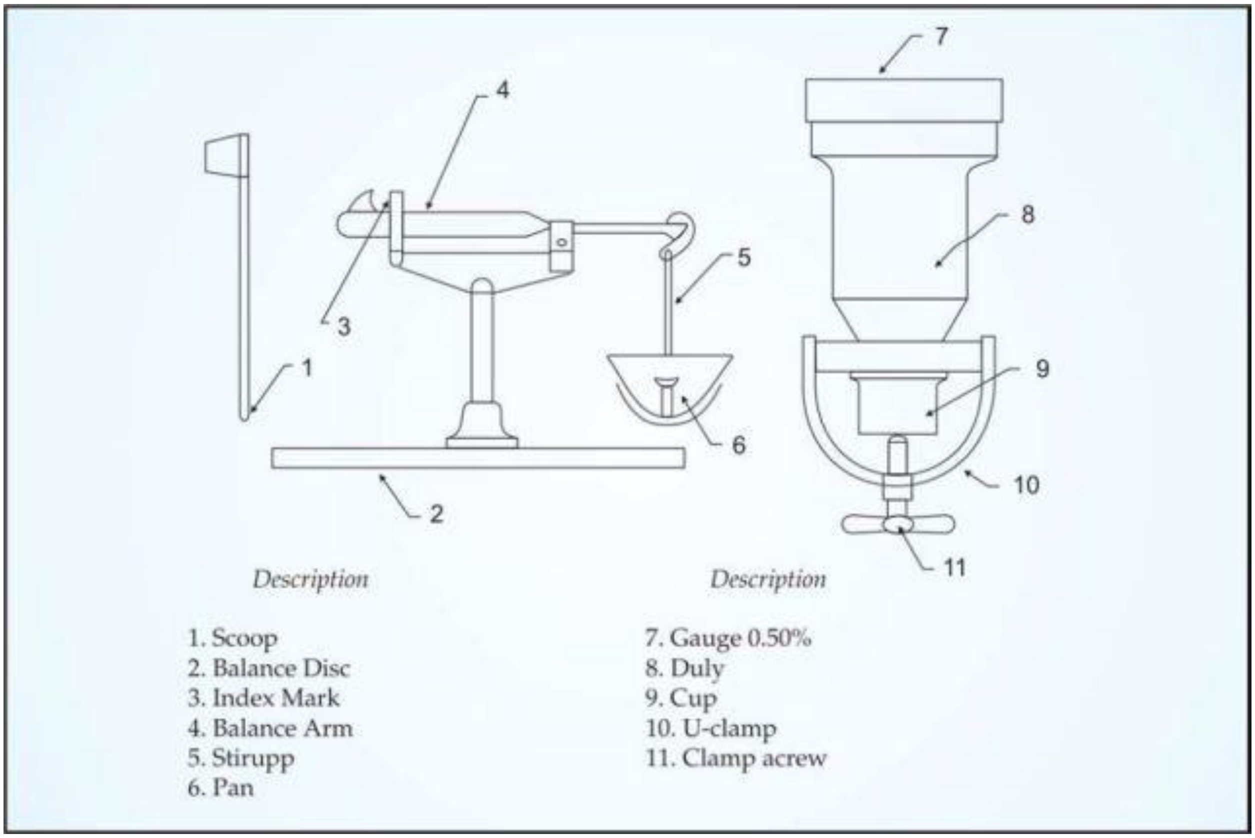
11. Rest for 20 seconds. Repeat the rotation-rest cycle until the gauge reading is constant (Usually this takes 4 to 8 minutes). Note the reading as usual.

12. Finally release the pressure slowly (away from the operator) by opening the clamp screw and taking the cup out, empty the contents and clean the instrument with a brush.

Observation and Recording: From the water content (m) obtained on the wet mass basis as the reading on the rapid moisture meter, the water content (w) on the dry mass basis shall be calculated as follows:

w= [m / (100-m)] X 100 % 6.

Interpretation and Reporting of Result: The natural moisture content of the soil sample is ________ %. The result should be reported to two significant figures.



Moisture Content Test Equipment

Objective: To perform permeability test.

Aim: To perform permeability test.

Materials used: Base sand, clay and water.

Apparatus used: Sand rammer, Permeability meter, Electronic weighing scale, stripper, stopwatch, measuring jar, specimen tube, specimen tube cup.

Theory:

1. Molten metals always contain certain amount of dissolved gases, which are evolved when the metal starts freezing.
2. When molten meal comes in contact with moist sand, generates steam or water vapour.
3. Gases and water vapour are released in the mould cavity by the molten metal and sand. If they do not find opportunity to escape completely through the mould, they will get entrapped and form gas holes or pores in the casting. The sand must therefore be sufficiently porous to allow the gases and water vapour to escape out. This property of sand is referred to as permeability.
4. Permeability is one of the most important properties affecting the characteristic of moulds which depends upon the grain size, grain shape, grain distribution, binder content, moisture level and degree of compactness.
5. Permeability is a physical property of the physical sand mixture, which allows gases to pass through it easily.
6. The AFS (American Foundry Men Society) definition of permeability is “the number obtained by passing 2000cc of air through a standard specimen under a pressure of 10gm/cm^2 for a given time in minutes”.
7. The permeability number P_N can be found out by the equation.

$$P_N = \frac{VH}{PAT}$$

Where

V = Volume of air passing through the specimen, 2000cc

H = Height of the specimen = 50.8 mm (standard value)

P = Pressure as read from the manometer in gm/cm2

A = Area of the specimen = πd2/4

Where d = 50.8 mm (standard value)

T= time in minutes for 2000 cc of air passed through the sand specimen.

Experimental setup details:

Permeability meter has a cylindrical water tank in which an air tank is floating. By properly opening the valve, air from the air tank can be made to flow through the sand specimen and a back pressure is setup. The pressure of this air is obtained with the water manometer. The meter also contains the chart, which directly gives the P_N depending on pressure.

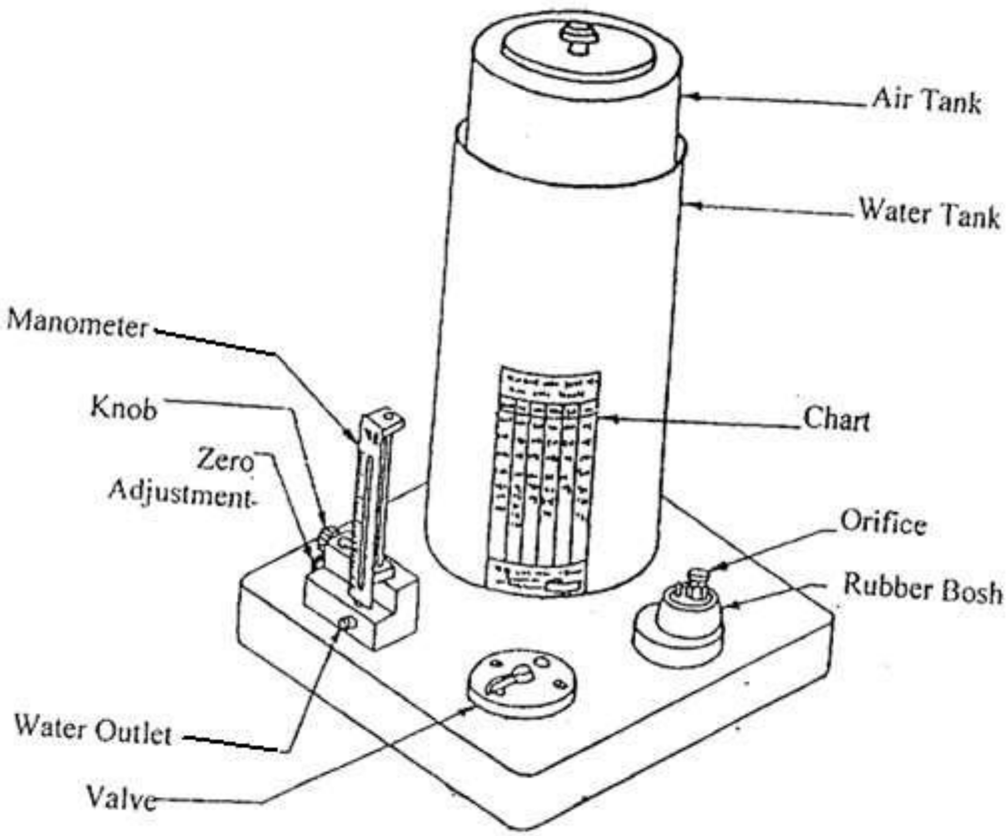
Procedure:

1. Conduct the experiment in two parts. In the first case vary water percent keeping clay percent constant. In the second case vary clay percent and keep water percent constant.
2. Take weighed proportions of sand dry mix them together for 3 minutes. Then add required proportions of water and wet mix for another 2 minutes, to get a homogeneous and mixture. Take the total weight of the mixture between 150-200 grams. The correct weight has to be determined by trail and error method.
3. Fill the sand mixture into the specimen tube and ram thrice using sand rammer. Use the tolerance limit provided at the top end of the rammer for checking the specimen size. If the top end of the rammer is within the tolerance limit, the correct specimen is obtained. If it lies below the limit, increase the weight of sand mixture and prepare a new specimen. The specimen conforming to within limits represent the standard specimen required.
4. Now the prepared standard specimen is having a dia.50.8mm and height 50.8mm.
5. Place the standard specimen along with the tube in the inverted position on the rubber seal or on the mercury cup (specimen in the top position in the manometer reading).
6. Operate the valve and start the stop watch simultaneously. When the zero mark on the inverted jar just touches the top of water tank, note down the manometer reading.
7. Note down the time required to pass 2000cc of air through the specimen. Calculate the permeability number by using the formula given.

Direct scale reading: The permeability can also be determined by making use of the graduated marker provided near the manometer.

Procedure to be followed:

- Coincide the graduations on the transparent scale with the meniscus of the manometer liquid.
- Note the reading of the scale.
- This reading represents the permeability number of the sand.



PERMEABILITY METER

Objective: To perform A.F.S. Sieve analysis test.

AIM: To find the distribution of sand grains using a set of sieves and to find the average grain fineness number.

Materials used: Base sand- Silica sand.

Apparatus used: Electronic weighing scale, stop watch, sieve shaker.

Theory:

1. The base sand is a mixture of grains having a variety of shapes such as
a) Round b) sub-angular c) angular d) compounded grains. Base sand is relatively free from any binder or additives.

2. Depending on the average size of the grains, the sand can be grouped into:
a) Fine b) Medium and c) Coarse grains.

3. The shape and size of grains has a large influence on the permeability of sand mix as well as on the bonding action.

4. The shape and size of grains determine the possibility of its application in various types of foundry practice.
Ex: Fine grain sand results in good surface, on the casting but gases cannot escape out of the mould made from it. Coarse grain sand allows gases to escape out easily but the casting surface will be very rough. Hence grain size should select appropriately.

5. The given size of sand grains is designated by a number called grain fineness number that indicates the average size of grains in the mixture.

6. The size is determined by passing the sand through sieves having specified apparatus which are measured in microns.

7. The sieve number designates the pore size through which the sand grains, may pass through it or retained in it.

8. Average grains fineness number can be found out by the equation
GFN = Q/P Where Q = sum of product of percentage sand retained in sieves and Corresponding multiplier. P = sum of percentage of sand retained in sieves.

Procedure:

1. Take 50 gm or100 gm of dry sand and place in the top sieve of a series and close the lid.

2. Place the whole assembly of sieves on the vibratory sieve shaker and clamp it.

3. Switch on the motor and allow the sieve assembly to vibrate for 5 minutes. Then switch off the motor.

4. Collect the sand particles retained in each of the sieve separately and weigh in Electronic weighing scale and enter into the tabular column. Calculate the percentage weight retained by each of the sieves. Multiply this value with the multiplier for each sieve.

(Calculate the average GFN using the formula as shown below.)

Tabular Column:

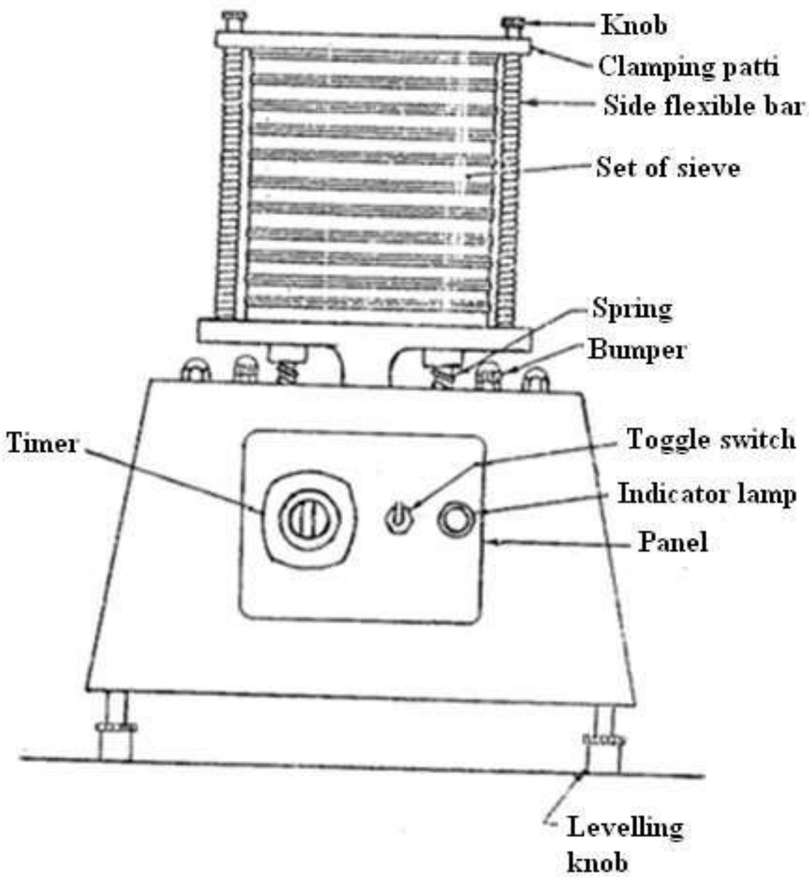
Total weight of sand taken = 100g.

S.No.	(a) Sieve No. in microns	(b) Weight in grams		(c) % Retained	(d) Multiplying factor	(e) Product $\sum e = c \times d$
1	1700				5	
2	850				10	
3	600				20	
4	425				30	
5	300				40	
6	212				50	
7	150				70	

8	106				100	
9	75				140	
10	53				200	
11	Sieve pan				300	
				P = ∑c		Q = ∑e

% Retained C = $\frac{\text{Weight of sand in each sieve x 100}}{\text{Total weight of sand}}$

Calculation: AFS grain number = Q (sum) / P (total)
Results; The average grain fineness number is =



SIEVE SHAKER

Objective: Strength Test (compressive, Tensile, Shear Transverse etc. in green and dry conditions) and Hardness Test (Mould and Core).

COMPRESSION STRENGTH TEST FOR MOULDING SAND

AIM: To find the green compression strength of the given specimen at different percentage of clay and moisture.

Materials used: Base sand, clay, water.

Apparatus used: Sand Ramming machine (Rammer) with specimen tube with base, stripper, universal sand testing machine with Compression shackles, weighing pan, measuring jar, steel scale, Electronic weighing scale.

Theory:

1. Periodic tests are necessary to check the quality of foundry sand and compression strength test is one among them.
2. The constituents of moulding sand are silica sand, clay, water and other special additives.
3. Clay imparts the necessary bonding strength to the moulding sand when it is mixed with water etc. bentonite.
4. Compression test determines the bonding or adhesiveness power of various bonding materials in green sand.
5. The green compressive strength of foundry sand is the maximum compression strength a mixture is capable of developing when it is in most condition.

Procedure:

1. Conduct the experiment in two parts:

a) Vary the clay content keeping the water content constant

b) Vary the water content keeping the clay content constant

2. Take weighed proportions of sand and clay and dry mix them together in a Muller for 3 minutes.
3. Adjust the weight of the sand to get standard specimen
4. Remove the standard specimen by the stripper and place it between shackles which are fixed in the sand testing machine.
5. Rotate the handle of the testing machine to actuate the ram. Thus hydraulic pressure is applied continuously till the specimen raptures.
6. Read the compression strength from the gauge and record the same.
7. Conduct the experiment for the above said two cases and tabulate the result.

Result and discussion: Discuss the result with respect to the variation of percentage of clay on compression strength and percentage of water on compression strength.

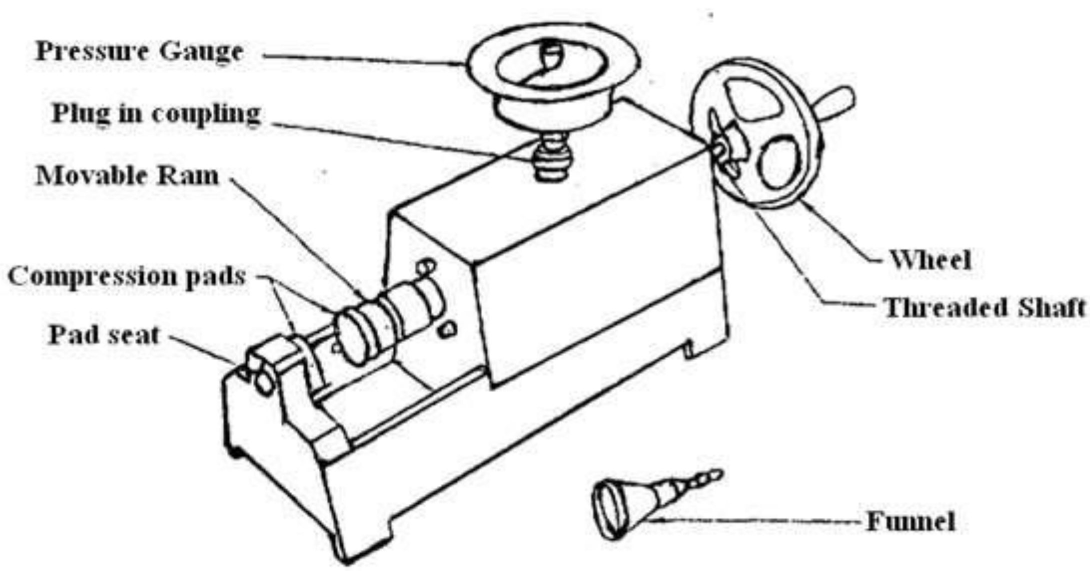
Tabular Column

Varying the % of clay

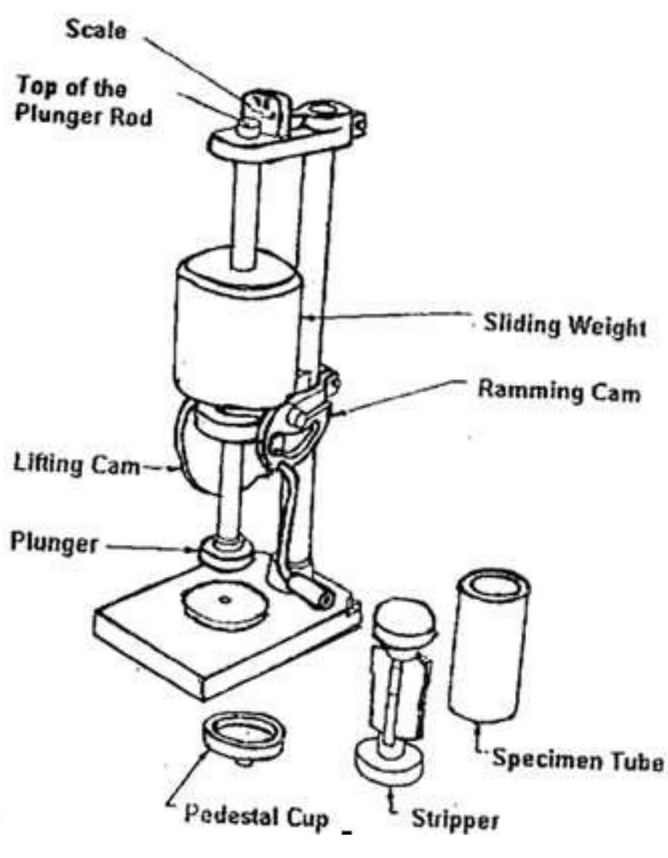
S.No.	Percentage of sand	Percentage of clay	Percentage of water	Compression strength gm/cm^2
1				
2				
3				

Varying the % of Water

S.No.	Percentage of sand	Percentage of clay	Percentage of water	Compression strength gm/cm^2
1				
2				
3				



UNIVERSAL STRENGTH MACHINE



SAND RAMMER

SHEAR STRENGTH TEST FOR MOULDING SAND

AIM: To determine the green shear strength of the given specimen for different percentages of clay and moisture.

Materials used: Base sand, clay, water.

Apparatus used: Sand ramming machine (rammer), universal sand testing machine with attachments, weighing pan.

Theory:

1. Shear strength is the ability of sand particles to resist the shear stress and to stick together.

2. Insufficient Shear strength may lead to the collapsing of sand in the mould or its partial destruction during handling. The mould and core may also be damaged during flow of molten metal in the mould cavity.

3. The moulding sand must possess sufficient strength to permit the mould to be formed to the desired shape and to retain the shape even after the hot metal is poured into the mould cavity.

4. In shearing, the rupture occurs parallel to the axis of the specimen.

Procedure:

1. Conduct the experiment in two parts:
a) Vary the clay content keeping the water content constant
b) Vary the water content keeping the clay content constant

2. Take weighed amount of foundry sand (mixture of sand, clay & water as specified).

3. Transfer the sand mixture into the tube and ram it with the help of a sand rammer thrice.

4. Fix the shackles to the universal sand testing machine.

5. Remove the specimen from the tube with the help of a stripper and load it into the universal sand testing machine.

6. Apply the hydraulic pressure by rotating the handle of the universal sand testing machine continuously until the specimen ruptures.

7. Read the shear strength directly from the scale and tabulate the readings.

TABULAR COLUMN

Varying of the % of Clay

S.No.	Percentage of sand	Percentage of clay	Percentage of water	Compression strength gm/cm^2
1				
2				
3				

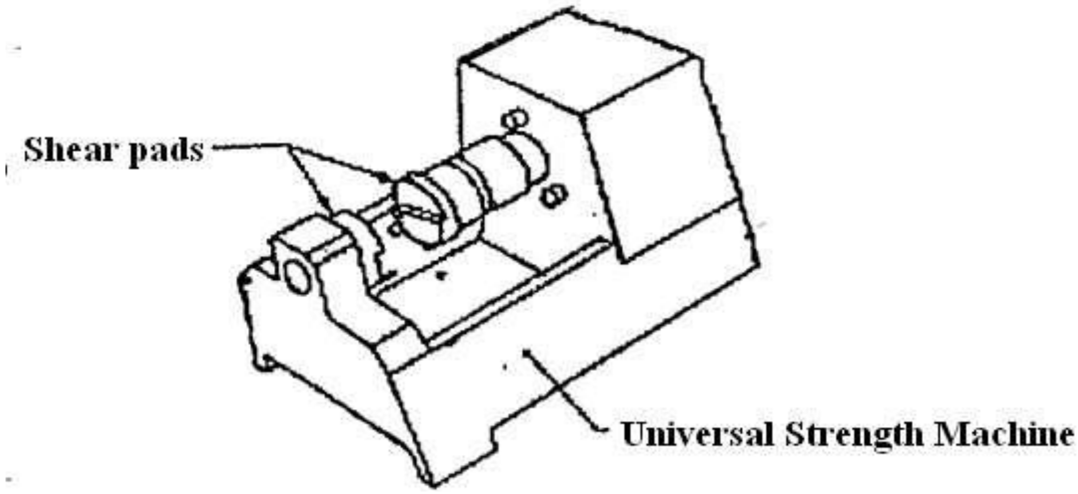
Varying of the % of water

S.No.	Percentage of sand	Percentage of clay	Percentage of water	Compression strength gm/cm^2
1				
2				
3				

Results and Discussions:

a) With the increase in the percentage of water the shear strength of the specimen …………………………….

b) With the increase in the percentage of clay the shear strength of the specimen …………………………….


Shear pads
Universal Strength Machine

TENSILE STRENGTH TEST OF CORE SAND

AIM: To determine the tensile strength of sand using two types of binders Viz. core oil binder and sodium silicate binder.

Materials used: Base sand, core oil, sodium silicate.

Apparatus used: universal sand testing machine, Split core box, Sand rammer, oven, tension shackles.

Theory:

1. A core is compacted sand mass of a known shape.

2. When a hallow casting (to have a hole – through or bind) is required, a core is used in the mould or when a complex contour is required a mould is created out of cores. This core has to be properly seated in the mould on formed impressions in the sand. To form these impressions extra projections called core points are added on the pattern surface at proper places.

3. Core boxes are used for making cores. They are either made single or in two parts. Their classification is generally according to the shape of the core or the method of making the core.

4. Split core box is very widely used and is made in two parts, which can be joined together by means of dowels to form the complete cavity for making the core.

5. The purpose of adding binder to the moulding sand is to impart strength and cohesiveness to the sand to enable it to retain its shape after the core has been rammed.

6. Binders used can be
a) organic: ex. Dextrin, core oil
b) Inorganic: ex. Sodium silicate, Bentonite

7. Classification of binders:
a. Baking type: Binding action is realized in the sand after baking the sand mixture in an oven.
b. Gassing type: Binding action is obtained in the sand after passing a known gas through the sand mixture.
Ex. CO_2 gas passed through a mixture of sand and sodium silicate.

8. Core oil is used as binder that hardens with the addition of heat. The sand and binder is mixed and backed at a temperature of 25ºC – 300ºC and binding action takes place within few hours.

9. Sodium silicate is a self setting binder and no external heat is required for the binding action which takes place at room temperature when CO_2 gas is passed.

10. During casting the core is placed inside the mould and the molten metal is poured in to the cavity. As the molten metal begins to cool, it begins to contract on the inner radius as well as the outer radius. Due to the contraction of the inner radius the core sand will be pulled outwards causing a tensile load around the core. Hence knowledge of tensile strength of core sand is important.

Procedure:

1. Conduct the experiment in two parts.
a. Using core oil as binder and
b. Using sodium silicate as binder.

2. Take proper proportions of base sand and binder then mix them together thoroughly.

3. Assembly the core box and fill the mixture into it.

4. Place the core box under sand rammer and ram the sand thrice.

5. Using a wooden piece tap the core box gently from sides. Remove the core box leaving the rammed core on a flat metal plate

6. Bake the specimen (which is on a plate) for about 30 minutes at a temperature of 150º – 200ºC in an oven. (When the binder is core oil)

7. If the binder is sodium silicate, pass CO_2 gas for 5secs. The core hardens instantly and the core can be directly used.

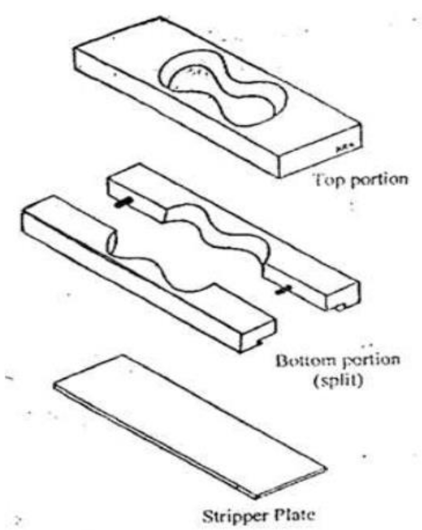
8. Fix the tension shackles on to the sand testing machine, and place the hardened specimen in the shackles.

9. Apply the load gradually by turning the hand wheel of the testing machine. Note down the readings when the specimen breaks.

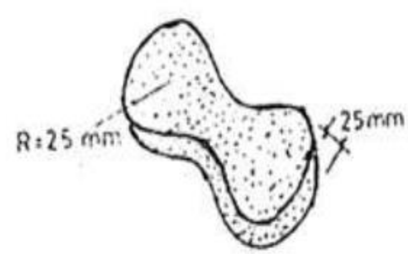
10. Repeat the procedure for the different percentage of binder and tabulate the readings.

TABULAR COLUMN

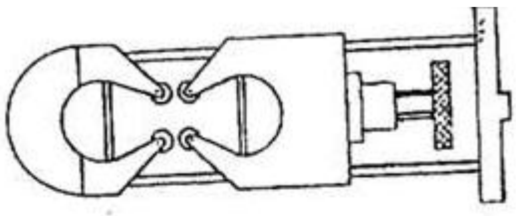
S.No.	Percentage of sand	Percentage of sodium Silicate or core oil	Tensile Strength strength N/m^2	
1				
2				
3				
4				
5				
6				



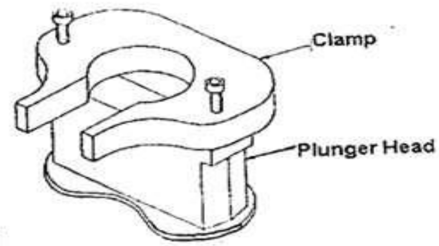
Split Core Box - Tensile

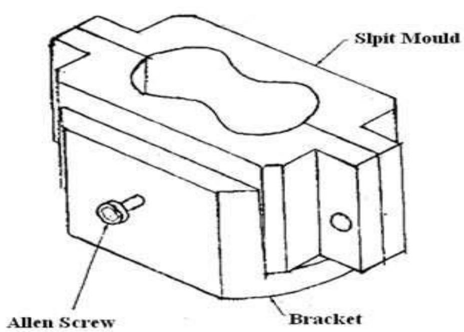


Standard tensile specimen

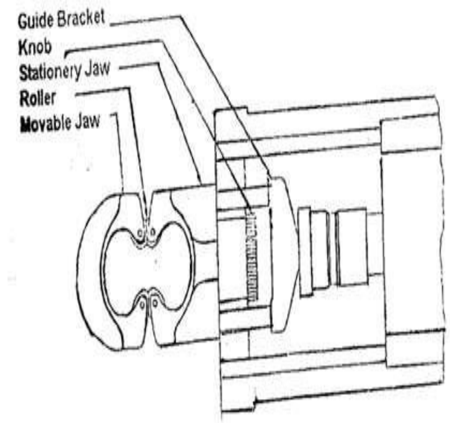


Tension Test Shakers





Tensile Core Box

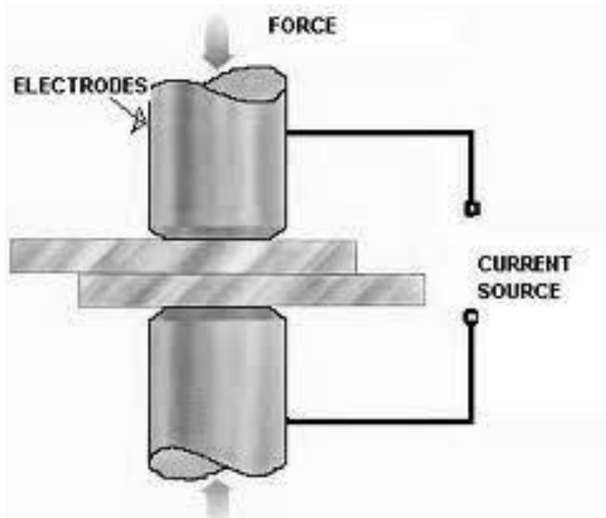


Objective: Spot Welding.

Aim: Hands-on practice on spot welding.

Equipment: Spot welding machine

Material required: two metal pieces of size 4”x2”



Description of the equipment:

A typical resistance spot welding machine essentially consists of two electrodes, out of which one is fixed. The other electrode is fixed to a rocker arm (to provide mechanical advantage) for transmitting mechanical force from a pneumatic cylinder. This is simplest type of arrangement. The other possibility is that of a pneumatic or hydraulic cylinder being directly connected to the electrode without any rocker arm.

For welding large assemblies such as car bodies, portable spot welding machines are used. Here the electrode holder and the pneumatic pressurizing system are present in the form of a portable assembly which is taken to the place, where the spot is to be made. The electric current, compressed air and the cooling water needed for the electrodes is supplied through cable and hoses from the main welding machine to the portable unit.

In spot welding, a satisfactory weld is obtained when a proper current density (A/Sq mm) is maintained. The current density depends on the contact area between the electrode and the work piece. With the continuous use, if the tip becomes upset and the contact area increases, the current density will be lowered and consequently the weld is obtained over a large area. This would not but able to melt the metal and hence there would be no proper fusion.

A resistance-welding schedule is the sequence of events that normally take place in each of the welds. The events are the squeeze time is the time required for the electrodes to align and clamp the two work pieces together under them and provides the necessary electrical contact.
The weld time is the time of the current flow through the work pieces till they are heated to the melting temperature. The hold time is the time when the pressure is to be maintained on the molten metal without the electric current. During this time, the pieces are to be forging welded. The off time is time during which, the pressure on the electrode is taken off so that the plates can be positioned for the next spot. The off time is not normally specified for simple spot welding, but only when a series of spots are to be made in a predetermined pitch.

Procedure:

1. Switch on the machine and set the current in the machine to 2 Ampere
2. Set the timer to two seconds
3. Overlap the two metal pieces to the required size and place them between the two electrodes.
4. Apply pressure by foot on the lever such that two electrodes come into contact if the over lapped metals.
5. After 2 seconds remove the pressure on the lever slowly.
6. Now the joint is ready for use.
7. Repeat the same procedure at various amperes
8. Test the strength of the joints using universal testing machine.

Precautions:

1. Ensure that the electrodes should not be touched.
2. Don’t touch the welded potion by hand immediately after the welding is done.

Result: Hence spot welding is studied.