MACHINE WORKSHOP

OBJECTIVES:
The student will able to

- ✓ Know basic workshop processes.
- ✓ Read and interpret job drawing.
- ✓ Identify, select and use various marking, measuring, holding, striking and cutting tools & equipments.
- ✓ Operate, control different machines and equipments.
- ✓ Inspect the job for specified dimensions
- ✓ Produce jobs as per specified dimensions.
- ✓ Adopt safety practices while working on various machines.

General Safety Rules
The following is a list of *some* basic safety rules that must be followed while you are in the machine shop. It should not be considered an exhaustive list.

- ✓ Always wear safety glasses while in the shop.
- ✓ Do not wear gloves while operating machinery (except welding equipment).
- ✓ Do not use any machine unless you have been instructed in the use of that equipment.
- ✓ Do not leave machines unattended while running.
- ✓ Keep your hands away from moving machinery and cutters.
- ✓ Do not run or yell unnecessarily while in the shop.
- ✓ If you are uncertain about any aspect of a machining operation you wish to perform then please ask the person in charge before proceeding.

LATHE MACHINE

Lathe is a machine, which removes the metal from a piece of work to the required shape & size. The lathe is a machine tool used principally for shaping articles of metal, wood, or other material.

***Types of Lathes*:**
Lathes can be conveniently classified as engine lathes, turret lathes, and special purpose lathes. All engine lathes and most turret and special purpose lathes have horizontal spindles and, for that reason, are sometimes referred to as horizontal lathes. The smaller lathes in all classes may be classified as bench lathes or floor or pedestal lathes.

1. Wood Lathes

The simplest lathe type is the wood lathe. As the name suggests, it is designed for turning wood. Wood lathes are small machines consisting of a bed, headstock, tailstock and tool rest. There are no precision ways as are found on a metal-working machine, since the cutting tools are moved by hand and not by machine power. Great skill is needed to control the cutting tool to accurately turn smooth curves and complex contours on the work piece.

The spindle is usually driven by a belt connected to a motor, and speed changes are made by manually moving the belt to one of several pulleys mounted to the back of the spindle.

Lathe tools are held manually against the work, with the support of the tool rest. The tool rest is adjustable and is clamped to the bed at a position convenient for the operation at hand.

2. Engine Lathes

Engine lathes are the classic metal turning workhorses of the production machine shop. They come in many sizes and are adaptable to working virtually any material. These machines have a longitudinal bed to which is mounted a headstock and tailstock.

As in the wood lathe, the headstock contains the spindle. However, the spindle drive is more complex, including variable speed capability or selectable gearing to provide a much wider range of speeds. A carriage moves back forth on bed ways for longitudinal turning. A cross-slide and compound rest are mounted to the top of the carriage to provide cross and angular cutting capability.

The lathe cutting tools are moved against the work manually using hand wheels or automatically under the power of a lead screw that is driven by gears in the headstock.

3. Tool room Lathe

The tool room lathe is a small- to medium-sized engine lathe specially designed for high-precision work. These machines find use in tool and die shops, where custom parts and precision fixtures are produced, often in support of production machining operations.

Tool room lathes are manufactured with special attention to spindle accuracy, smooth operation and precise alignment of the carriage and cross slide. A tool room lathe is capable of better accuracy and precision than a standard engine lathe.

4. Turret Lathe

Turret lathes are used in production machine shops where several sequential operations are needed on single workpiece. It is costly and time consuming to remove a workpiece from one machine and hold it in another. Removing and reholding a workpiece also introduces errors in work alignment and machining accuracy.

The turret lathe has a rotating turret mounted to the carriage so that as soon as an operation with one tool is completed, the turret is indexed to bring another tool into working position. The part is then machined again without having to remove it from the chuck or collet. Eight (or more) different operations can be performed on a work piece using this type of machine.

5. CNC Lathe

Computer numerically controlled lathes have largely supplanted engine lathes in production machining environments. CNC lathes offer the advantages of greater powered axis drives, feedback control to monitor and maintain tool positioning and high-speed repeatability of complex machine motions. Once a program is verified, an operation can be quickly set up again without the need for tedious manual adjustments.

CNC lathes excel at cutting curved contours without the need for specially shaped tools. This is done by programmed variation of the speed of two motion axes and the spindle simultaneously---an operation that is impossible with other manual lathes.

6. Bench-Type Engine Lathe

It commonly has an 8 to 12 inch swing and a 3 to 5 foot bed length, the size being limited by the practicality of bench mounting. The bench upon which the lathe is mounted may be a standard wood-topped shop bench or a special metal lathe bench with drawers for storing the lathe accessories.
The bench-type engine lathe is generally powered by an electric motor, mounted to the bench behind the lathe headstock, and is driven by means of a flat leather belt. Some bench lathes use an underneath motor drive where the drive belt passes through a hole in the bench. This arrangement is convenient where space in the shop is limited. The benchtype engine lathe is generally equipped with the necessary tools, chucks, lathe dogs, and centers for normal operation. The lathe may have a quickchange gearbox for rapid change of threading feeds, or gears may have to be installed singly or in combination to achieve the proper threading feeds.

PARTS OF LATHE AND THEIR FUNCTION

Bed: Almost all lathes have a horizontal beam is called as bed. It has guide ways on it for sliding and supporting tail stock and carriage.

Head stock:
At one end of the bed (almost always the left, as the operator faces the lathe) is a headstock. It contains drive mechanism with necessary speed change arrangement to achieve different speeds. It also has chuck which is used to hold the job.

Tail stock:
It is places opposite to headstock. It can move along guide ways. Its main applications are to hold long jobs to avoid vibrations and excessive deformation and for drilling axial holes in the

work piece it can also hold the tools such as drill, reamer, tap to do the operations like drilling, reaming etc.

Carriage: It is located between head stock and tail stock. It can be moved in longitudinal direction and can be fixed at any position. Carriage has following parts

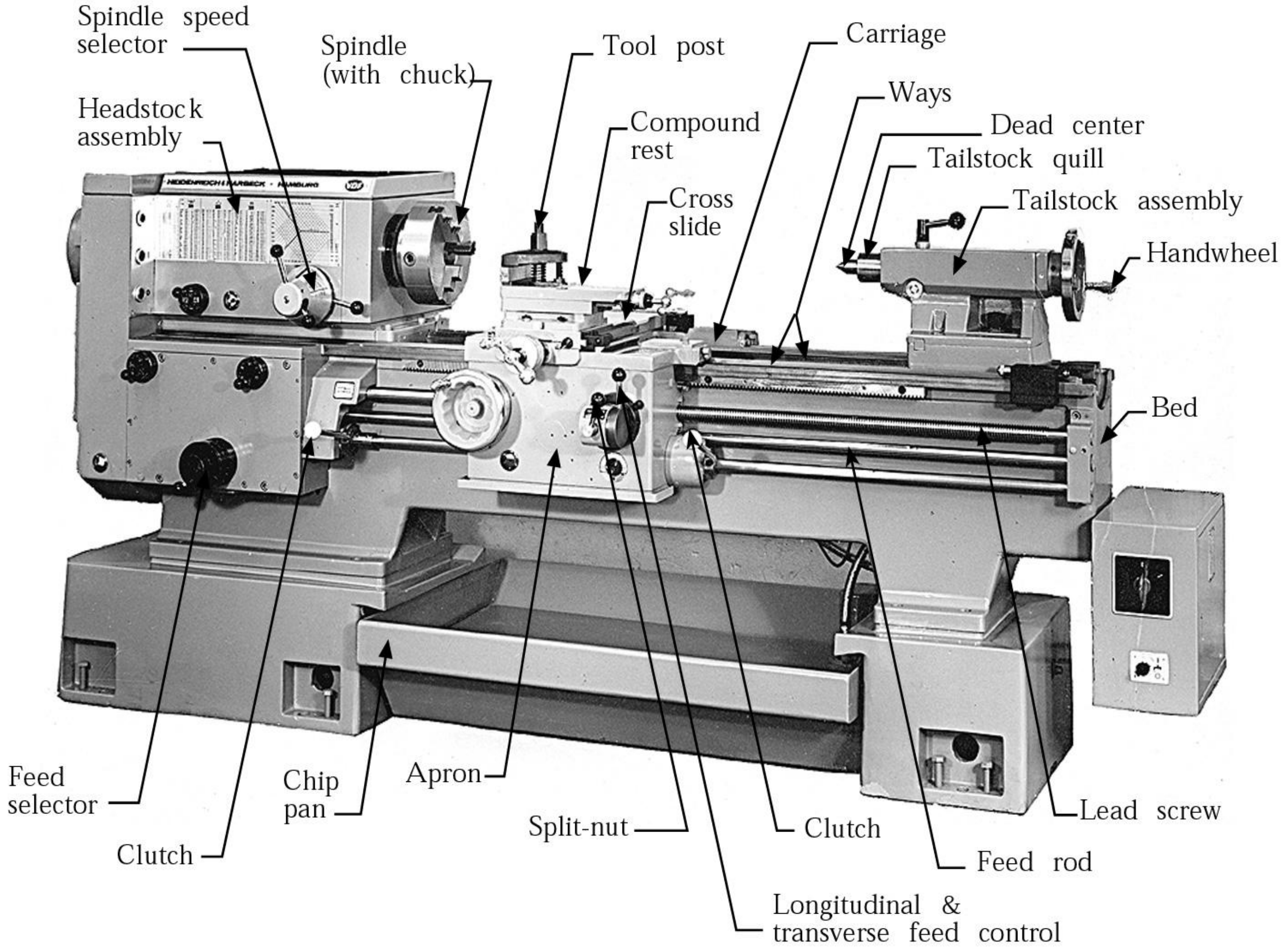
a. Saddle: Its base portion, located across lathe bed and carries cross slide and tool post, it can be moved longitudinally along the bed.

b. Apron: it is attached to saddle and appears as hanging on front side. It consists of gears for motion transmission.

c. Cross slide: it is mounted on top of the saddle and acts as support to compound rest

d. Compound rest: This part of the carriage can be rotated to a specific angle by undoing the two locknuts. This is useful for making angle cuts It is mounted on cross slide and it consists of swivel and top slide. The tool post is mounted on top slide.

e. Tool-post: The tool post is the attachment point for the tool holder, in which the lathe tool bit is installed. The nut at the top of the tool post allows the tool post to be rotated if necessary.



LATHE CUTTING TOOLS

A machine tool is no more efficient than its cutting tool. There is nothing in shop work that should be given more thoughtful consideration than cutting tools. Time is always wasted if an improperly shaped tool is used. The cutting action of the tool depends on its shape and its adjustment in the holding device.

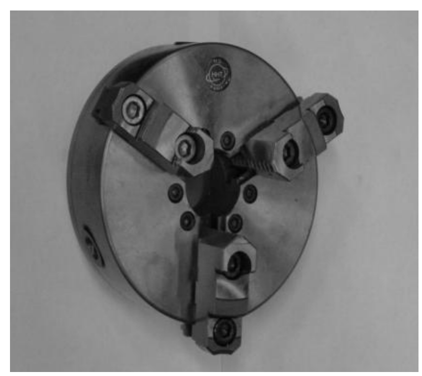
Cutter bits are made from several types of steel, the most common of which are

1) *Carbon steel:* The carbon-steel tool will give good results as long as constant care is taken to avoid overheating.
2) High-Speed Steel. High-speed steel is alloyed with tungsten and sometimes with chromium, vanadium, or molybdenum.
3) *Tungsten Carbide*. Tungsten carbide is used to tip cutter bits when maximum speed and efficiency is required for materials which are difficult to machine.
4) Tantalum Carbide and Titanium Carbide. These cutting tools are similar to tungsten carbide tools but are used mostly for machining steel where extreme heavy cuts are taken and heat and pressure tend to deform the cutting edge of the other types of cutting tools.

LATHE ACCESSORIES

CHUCKS

Workpieces are held to the headstock spindle of the lathe with chucks. A lathe chuck is a device that exerts pressure on the work piece to hold it secure to the headstock spindle or tailstock spindle.



Commonly used with the lathe are the

- Independent chuck

The independent chuck generally has four jaws which are adjusted individually on the chuck face by means of adjusting screws.

- Universal Scroll Chuck

The universal scroll chuck (figure 14 on the previous page) usually has three jaws which move in unison as an adjusting pinion is rotated. The advantage of the universal scroll chuck is its ease of operation in centering the work for concentric turning. This chuck is not as accurate as the independent chuck but, when in good condition, it will center the work automatically within 0.003 of an inch of complete accuracy.

- The combination chuck

A combination chuck combines the features of the independent chuck and the universal scroll chuck and can have either three or four jaws. The jaws can be moved in unison on a scroll for automatic centering or can be moved individually if desired by separate adjusting screws.

- Drill Chuck

The drill chuck is a small universal-type chuck which can be used in either the headstock spindle or in the tailstock for holding straight-shank drills, reamers, taps, or small-diameter work pieces.

- The hollow headstock spindle chuck

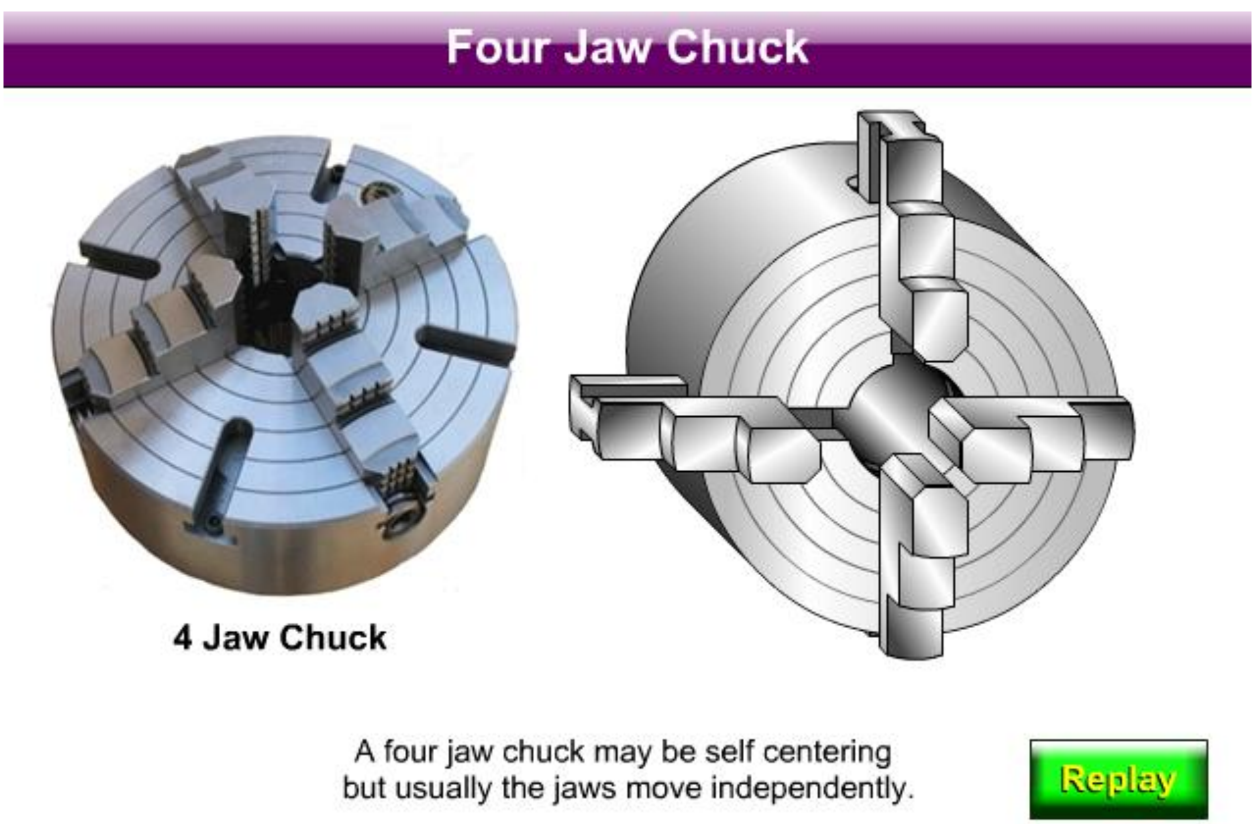
The hollow headstock spindle chuck is similar to a drill chuck but is hollow. It is provided with threads to screw it onto the headstock spindle nose.

- The collet chuck

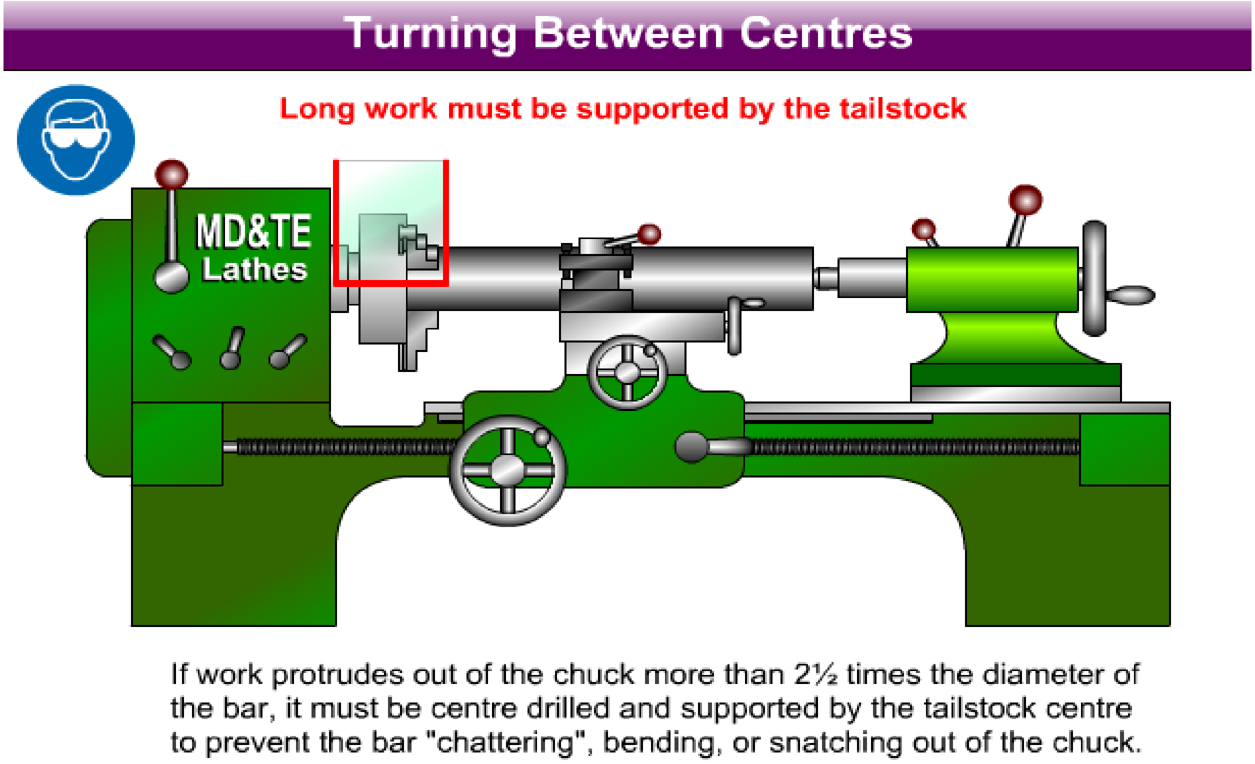
The collet chuck is the most accurate means of holding small work pieces in the lathe. The collet chuck consists of a spring machine collet and a collet attachment which secures and regulates the collet on the headstock spindle of the lathe.

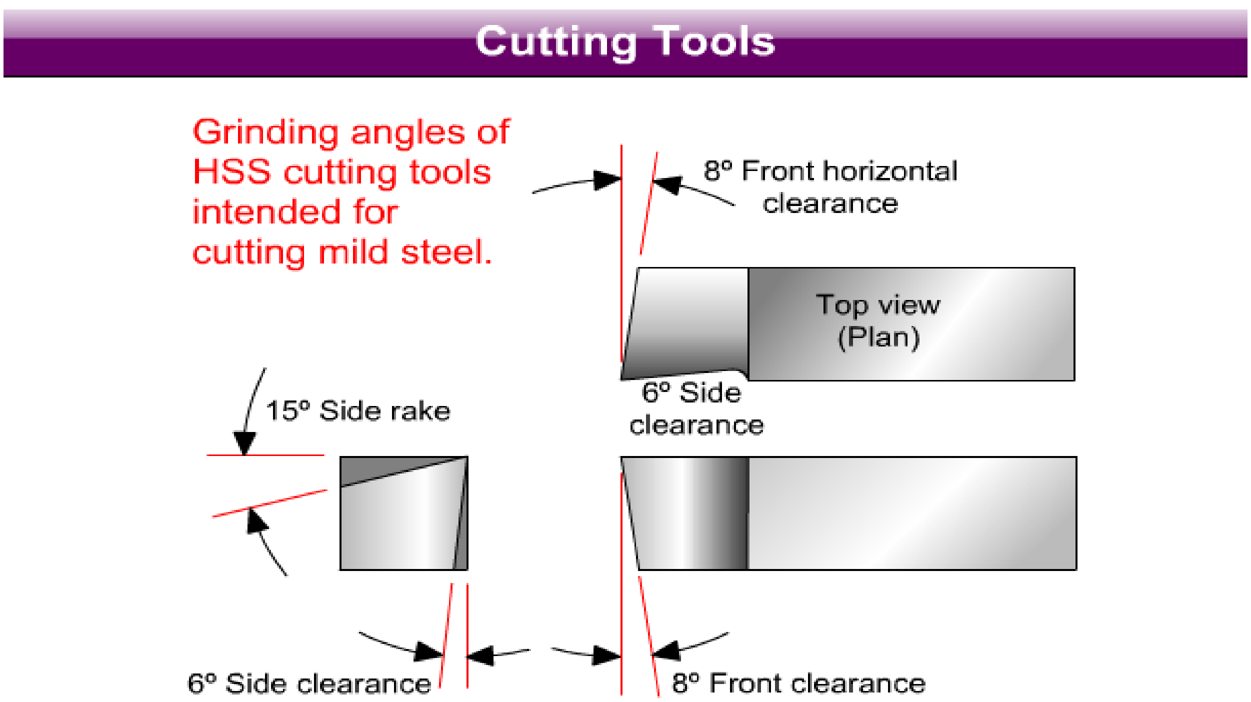
- The lathe tailstock chuck

The lathe tailstock chuck is a device designed to support the ends of the work pieces in the tailstock when a lathe center cannot be conveniently used.



LATHE CENTERS





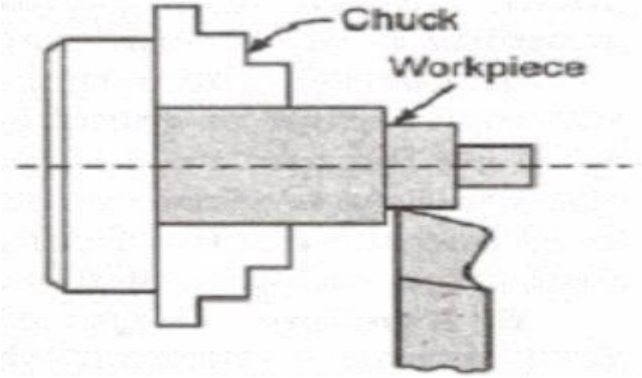
Lathe centers are the most common devices for supporting work pieces in a lathe headstock spindle and one in the tailstock spindle. The centers are referred to as **live centres** or **dead centers**, depending upon whether they move with the work piece or remain stationary.

Live Centre **Counter Sinking Tool**

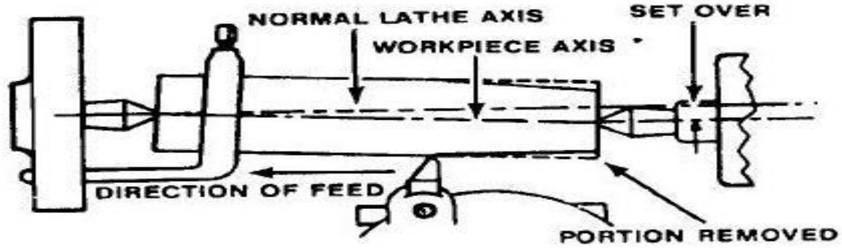
LATHE OPERATIONS

TURNING: Turning is a lathe operation in which the cutting tool removes metal from the outside diameter of a workpiece.

STEP TURNING: It is the process of obtaining different diameters on a work piece along the length by adjusting depth of the tool



TAPER TURNING: It is the process of giving the angle to the work piece with the help of compound slide.



BORING:

Boring is an operation in which a hole is enlarged with a single point cutting tool. A boring bar is used to support the cutting tool as it extends into the hole. Because of the extension of the boring bar, the tool is supported less rigidly and is more likely to chatter. This can be corrected by using slower spindle speeds or by grinding a smaller radius on the nose of the tool.A boring tool is essentially a sharp blade that plugs into the tool holder on a lathe going straight into the center of the workpiece. As you turn the workpiece, the boring tool cuts material; as you move the cross-slide, the boring tool cuts a larger and larger diameter hole.

KNURLING:

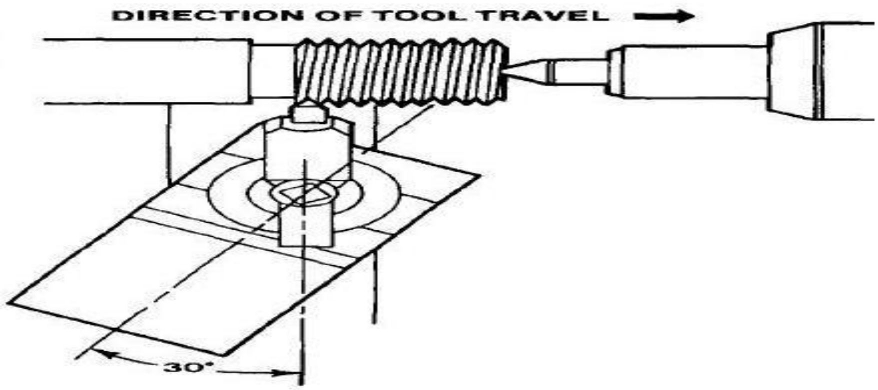
A forming process that adds a pattern on the exterior of a work piece, either for cosmetic reasons or better handling. Or the cutting of a serrated pattern onto the surface of a part to use as a hand grip using a special purpose knurling tool.

Knurling Process on Lathe:

Knurling is a manufacturing process, typically conducted on a lathe, whereby a visually-attractive diamond-shaped (criss-cross) pattern is cut or rolled into metal. This pattern allows hands or fingers to get a better grip on the knurled object than would be provided by the originally-smooth metal surface.

THREADING:

It is the process of producing the helical V grooves on the surface with the help of lead screw.



PARTING

One of the methods of cutting off a piece of stock while it is held in a lathe is a process called parting. This process uses a specially shaped tool with a cutting edge similar to that of a square nose cutting tool. The parting tool is fed into the rotating workpiece, perpendicular to its axis, cutting a progressively deeper groove as the workpiece rotates. When the cutting edge of the tool gets to the center of the workpiece being parted, the workpiece drops off. Parting is used to cut off parts that have already been machined in the lathe, or to cut tubing and bar stock to their required lengths.

FACING

It is the process of removing the material from the end surface or face of work piece. A lathe can be used to create a smooth, flat, face very accurately perpendicular to the axis of a cylindrical part. First, clamp the part securely in a lathe chuck. Then, install a facing tool. Bring the tool approximately into position, but slightly off of the part. Always turn the spindle by hand before turning it on. This ensures that no parts interfere with the rotation of the spindle. Move the tool outside the part and adjust the saddle to take the desired depth of cut. Then, feed the tool across the face with the cross slide. The following clip shows a roughing cut being made; about 50 thousandths are being removed in one pass. If a finer finish is required, take just a few thousandths on the final cut and use the power feed. Be careful clearing the ribbon-like chips; They are very sharp. Do not clear the chips while the spindle is turning. After facing, there is a very sharp edge on the part. Break the edge with a file.

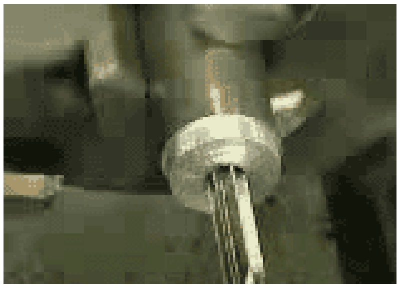
REAMING:

Reaming is a sizing operation that removes a small amount of metal from a hole already drilled. The reamer is the tool used for this operation.

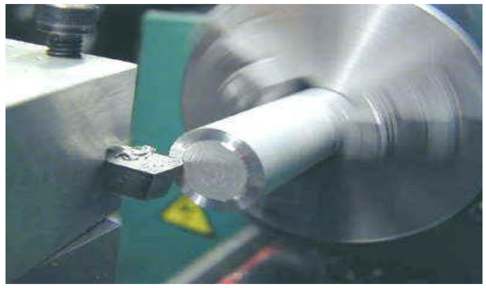
GROOVING:

It is the process of producing V shape cyclical groove on the surface, the tool has similar V shape as required to produce on work piece.

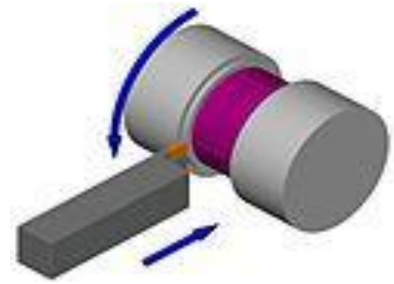
Reaming



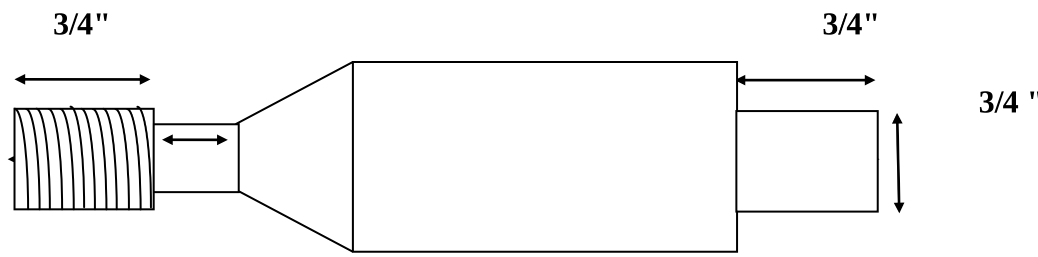
Facing



Grooving



JOB/WORK PIECE TO BE PREPARED



EXPERIMENT # 1

AIM
To perform the facing, plain turning and step turning in a centre lathe on the given cylindrical work piece for the given dimensions.

MATERIALS REQUIRED
Mild steel rod of specified length and diameter.

TOOLS REQUIRED
Single point cutting tool, measuring compass or vernier calliper, chuck key & tool post key

PROCEDURE
- The dimensions of the given cylindrical work piece is checked.
- The work piece is held in the chuck properly and tightened by chuck key
- The single point cutting tool is held on tool post and tightened by tool post key.
- The facing operation is done on both side of the work piece to get the required length.
- The plain turning operation is done on work piece to get the initial dimension.
- Then the plain turning operation is further continued to specific dimension to form steps.
- Thus the step turning operation is done on the given work piece.
- Finally the dimensions are checked using vernier calliper before work piece is removed from the chuck.

RESULT
Thus the work piece for the required dimensions is obtained by performing facing, plain turning & step turning operations in lathe.

EXPERIMENT # 2

AIM

To perform the taper turning using compound rest in a centre lathe on the given cylindrical work piece for the given dimensions.

MATERIALS REQUIRED

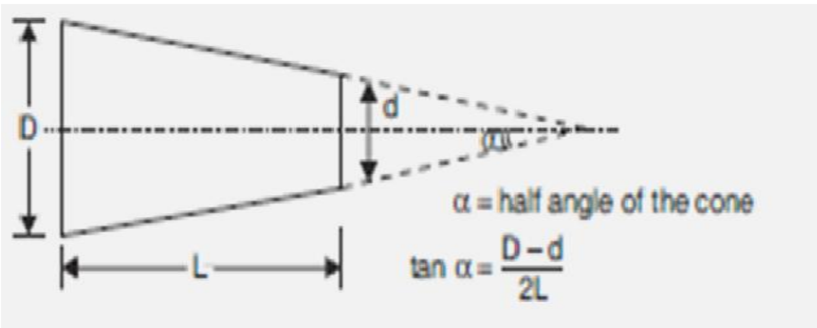
Mild steel rod of specified length and diameter.

TOOLS REQUIRED

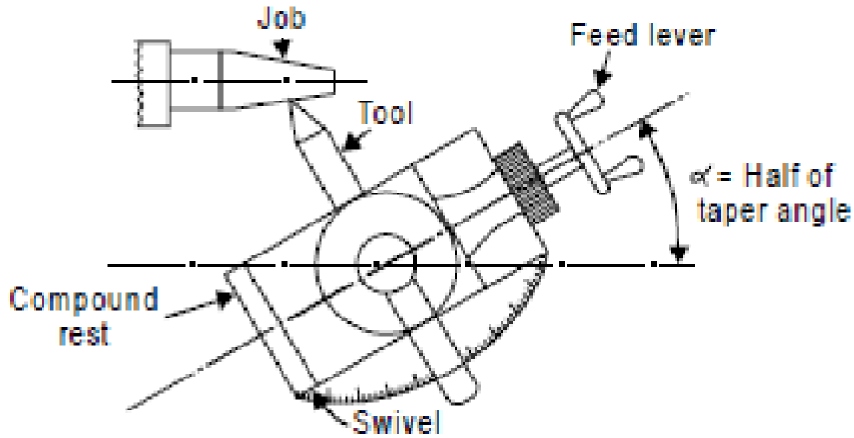
Single point cutting tool, measuring compass or vernier calliper, chuck key & tool post key

PROCEDURE

- The dimensions of the given cylindrical work piece is checked
- The work piece is held in the chuck properly and tightened by chuck key
- The single point cutting tool is held on tool post and tightened by tool post key
- The facing operation is done on both side of the work piece to get the required length
- The plain turning operation is done on work piece to get the initial dimension
- Then the plain turning operation is further continued to specific dimension to form steps
- Thus the step turning operation is done on the given work piece
- Then the compound rest is adjusted to an angle found out by the formula to get the taper position. Tan θ = D – d / 2L, where D – large diameter; d – smaller diameter; L – length of the taper.
- Thus the compound rest is adjusted and saddle is moved for performing the operations.
- Thus the final taper shape is obtained and checked for dimensions before it is removed from the chuck.



Taper turning calculation



RESULT

Thus the work piece for the required dimensions is obtained by performing taper turning using compound rest in lathe.