HERITAGE INSTITUTE OF TECHNOLOGY

DEPARTMENT OF MECHNICAL ENGINEERING
WORKSHOP PRACTICE (MECH1011)
WORK INSTRUCTION SHEET

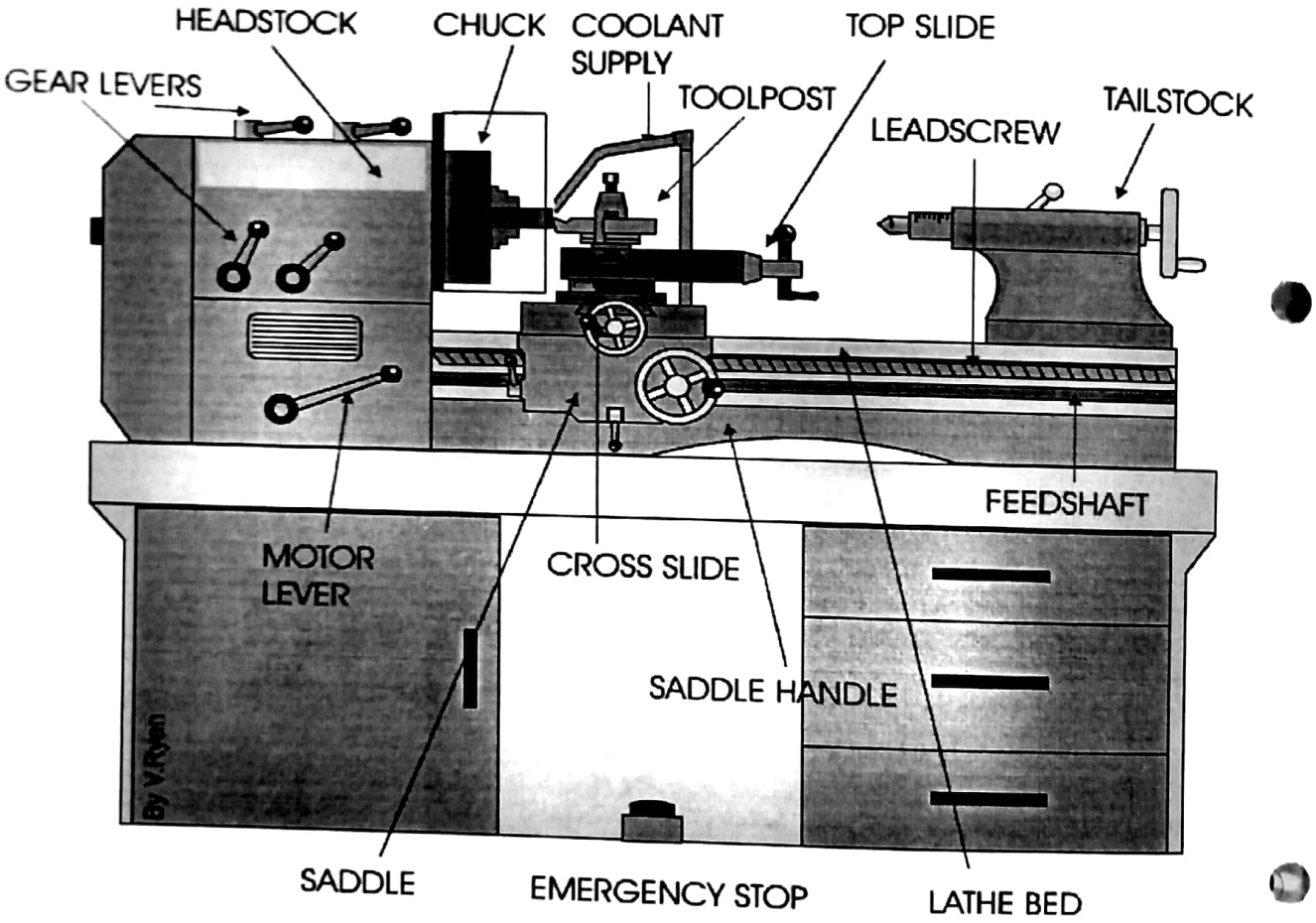
MACHINE SHOP

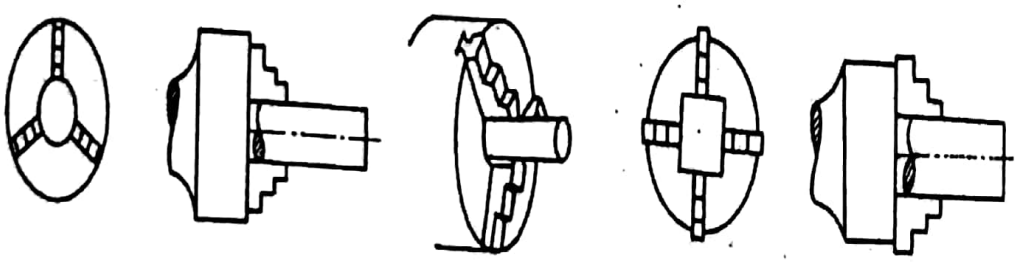
Introduction: In a machine shop, metals are cut to shape on different machine tools. A lathe is used to cut and shape the metal by revolving the work against a cutting tool. The work is clamped either in a chuck, fitted on to the lathe spindle or in-between the centers. The cutting tool is fixed in a tool post, mounted on a movable carriage that is positioned on the lathe bed. The cutting tool can be fed on to the work, either lengthwise or cross-wise. While turning, the chuck rotates in counter-clockwise direction, when viewed from the tail stock end.

TOOLS USED:

Types of Tool	Name of Tools	Specification	
		Size	Materials of Construction
A. Machine Tool	Centre Lathe (Head stock, Tail stock, Carriage, Saddle, Cross Slide, Compound rest, Tool post, Tool holder, Lead Screw, Feed Rod, Centre's)	Largest work diameter that can be swung over the lathe bed. Shape of bed ways and horse power of the driving motor. Distance between head stock and tail stock center. Length of the bed.	Cast Iron Body,
B. Holding Tools	Three Jaw Chuck		
	Four Jaw Chuck		
	Face Plate		
	Lathe dogs and driving		
	Steady rest and follower rest		
C. Cutting Tool	Single point cutting tool		Carbon steel or tool steel or high speed steel (18-4-1 HSS) or Carbide tipped tools fixed in tool holders
D. Measuring Tool	Inside Caliper	Length of the leg : 6''	Case hardened mild steel or hardened and tempered low carbon steel
	Outside Caliper	Length of the leg : 12'' / 6''	Case hardened mild steel or hardened and tempered low carbon steel
	Vernier Caliper	Range : 0-150mm Least count:0.01mm	Stainless Steel, Carbide tipped Jaws

	Micrometer	Range: Graduation / Resolution: Dial / Analog / Direct Reading Scale	
	Steel Rule	Maximum measureable length Least Count	Stainless Steel





CUTTING PARAMETERS

I. **Cutting Speed:** It is defined as the speed at which the material is removed and is specified in meters per minute. Ti depends upon the work piece material, feed, depth of cut, type of operation and so many other cutting conditions. It is calculated from the relation,

Spindle speed (RPM) = cutting speed x 1000 / (πD) Where D is the work piece diameter in mm.

II. **Feed Rate:** It is the distance traversed by the tool along the bed, during one revolution of the work. Its value depends upon the depth of cut and surface finish of the work desired.

III. **Depth of Cut:** It is the movement of the tip of the cutting tool, from the surface of the work piece and perpendicular to the lathe axis. Its value depends upon the nature of operation like rough turning or finish turning.

CUTTING TOOL GEOMETRY: A single point cutting tool used on lathe may be considered as a simple wedge.

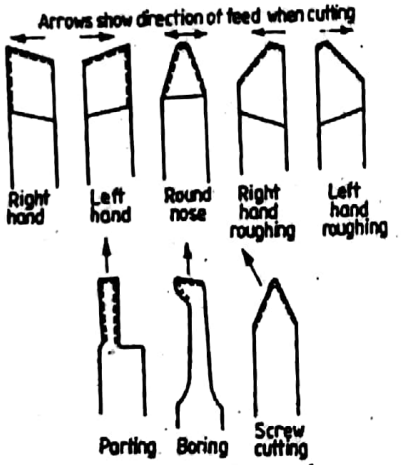


Figure 1: Common turning tools

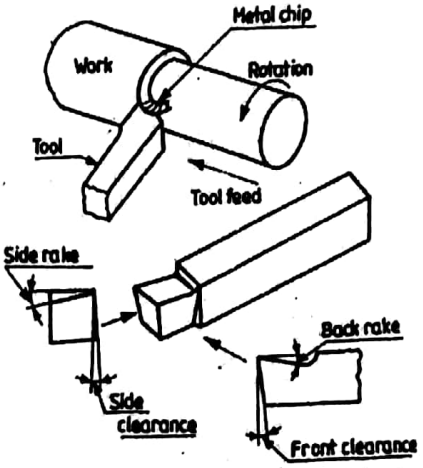


Figure 2: Tool geometry

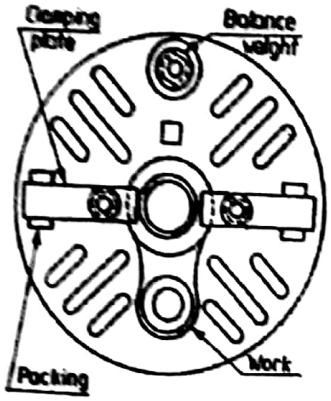
LATHE OPERATIONS

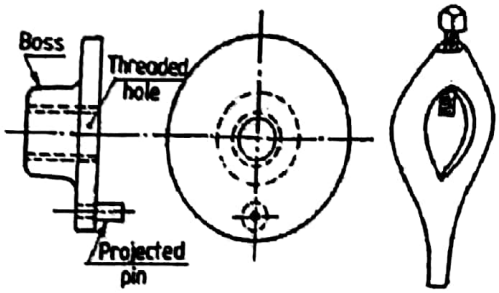
I. **Turning:** Cylindrical shapes, both external and internal, are produced by turning operation. Turning is the process in which the material is removed by a traversing cutting tool, from the surface of a rotating work piece. The operation used for machining internal surfaces is often called the boring operation in which a hole previously drilled is enlarged.
For turning long work, first it should be faced and center drilled at one end and then supported by means of the tail-stock centre.

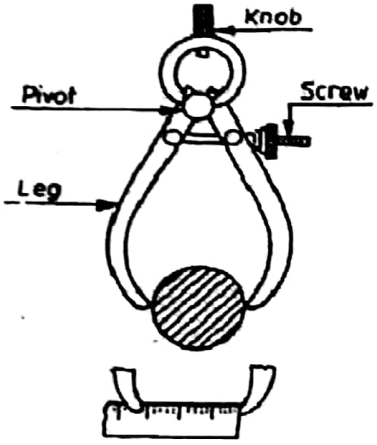
II. **Taper Turning:** A taper is defined as the uniform change in the diameter of a work piece, measured along its length. It is expressed as a ratio of the difference in diameters to the length. It is also expressed in degrees of half the included (taper) angle.
Taper turning refers to the production of a conical surface, on the work piece on a lathe.
Short steep tapers may be cut on a lathe by swiveling the *compound rest* to the required angle. Here, the cutting tool is fed by means of the compound slide feed handle. The work piece is rotated in a chuck or face plate or between centers.

III. **Facing:** Facing is a machining operation, performed to make the end surface of the work piece, flat and perpendicular to the axis of rotation. For this, the work piece may be held in a chuck and rotated about the lathe axis. A facing tool is fed perpendicular to the axis of the lathe. The tool is slightly inclined towards the end of the work piece.

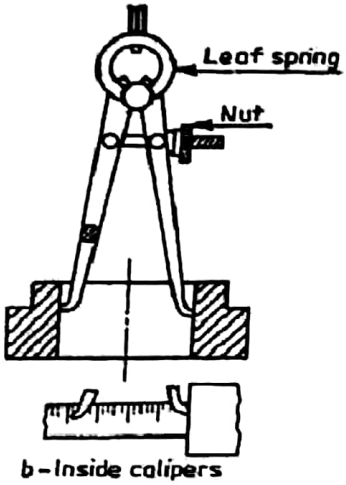
IV. **Boring:** Boring is enlarging a hole and is used when correct size drill is not available. However, it should be noted that boring cannot make a hole.



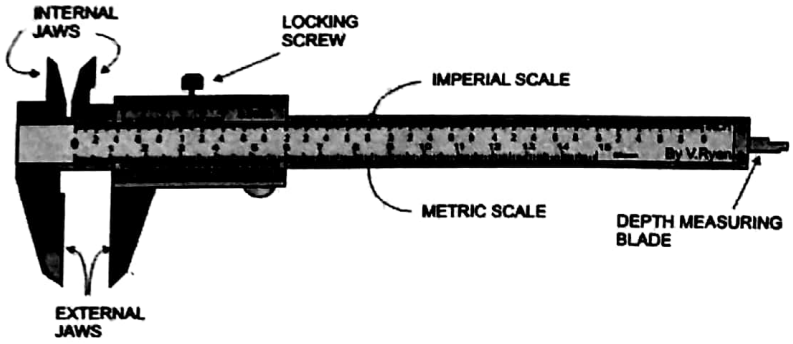




a–Outside calipers



b–Inside calipers



V. **Drilling:** Holes that are axially located in cylindrical parts are produced by drilling operation, using a twist drill. For this, the work piece is rotated in a chuck or face plate. The tail stock spindle has a standard taper. The drill bit is fitted into the tail stock spindle directly or through drill chuck. The tail stock is then moved over the bed and clamped on it near the work. When the job rotates, the drill bit is fed into the work by turning the tail stock hand wheel.

VI. **Knurling:** It is the process of embossing a diamond shaped regular pattern on the surface of a work piece using a special knurling tool. This tool consists of a set of hardened steel rollers in a holder with the teeth cut on their surface in a definite pattern. The tool is held rigidly on the tool post and the rollers are pressed against the revolving work piece to squeeze the metal against the multiple cutting edges. The purpose of knurling is to provide an effective gripping surface on a work piece to prevent it from slipping when operated by hand.

VII. **Threading:** Threading is nothing but cutting helical groove on a work piece. Threads may be cut either on the internal or external cylindrical surfaces. A specially shaped cutting tool, known as thread cutting tool, is used for this purpose. Thread cutting in a lathe is performed by traversing the cutting tool at a definite rate, in proportion to the rate at which the work revolves.

VIII. **Chamfering:** It is the operation of beveling the extreme end of a work piece. Chamfer is provided for better look, to enable nut to pass freely on threaded work piece, to remove burrs and protect the end of the work piece from being damaged.

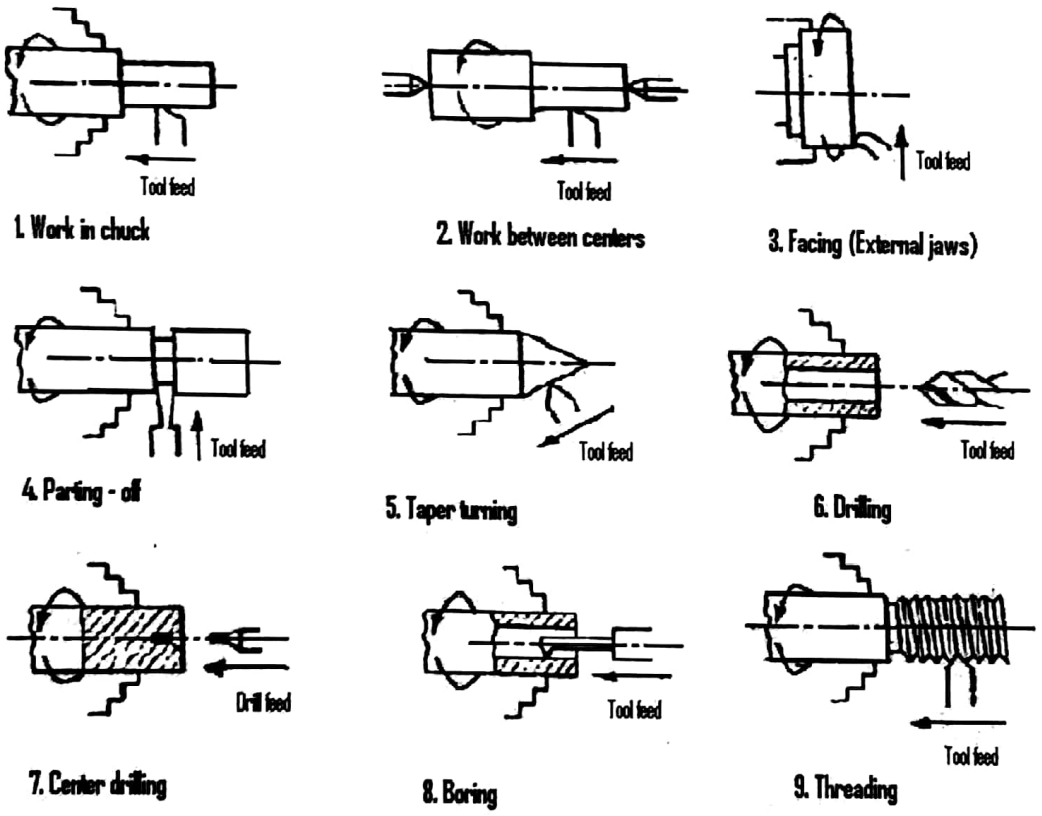


Figure 3: Operations of Lathe

JOB 1

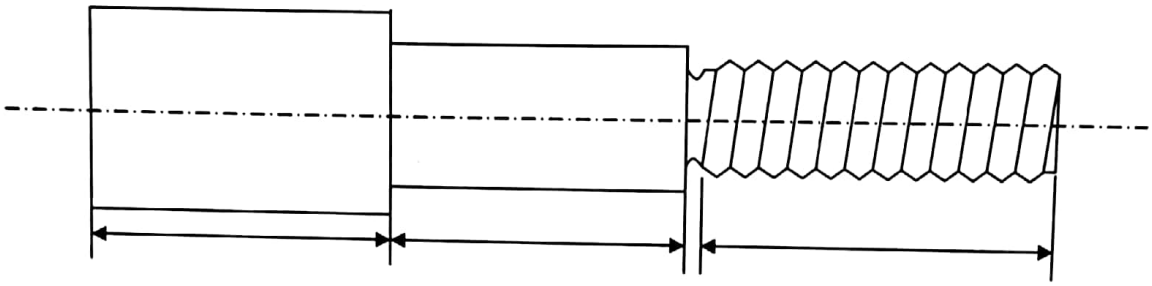
Name of the Job: Making of a stepped Pin with thread at one end on a MS bar

Raw Materials: Mild steel bar.

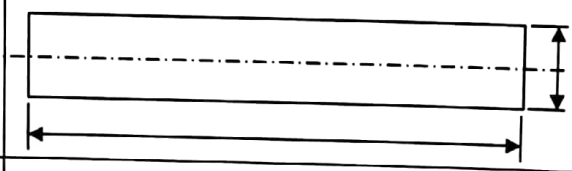
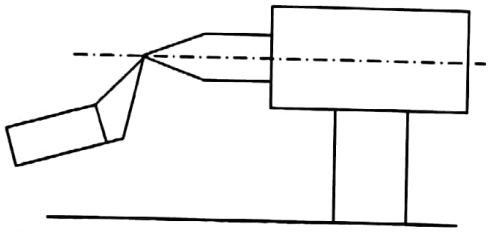
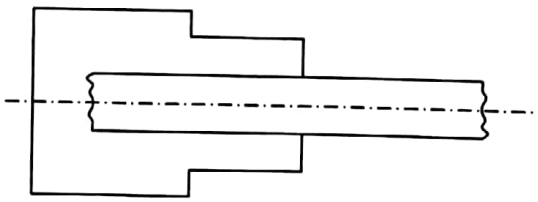
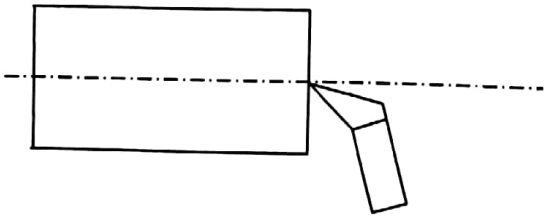
Raw material size: Mild steel bar of 35mm diameter and 120mm length.

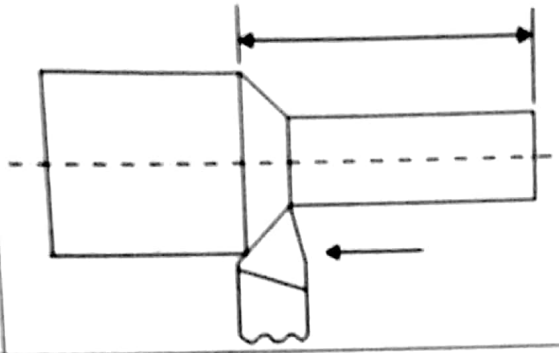
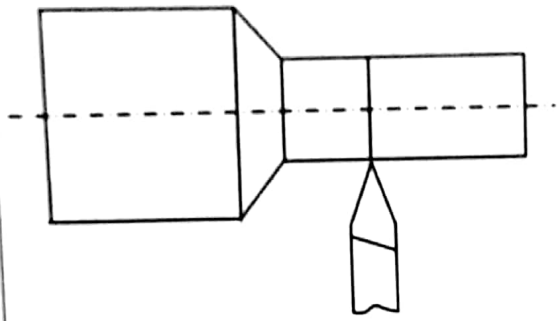
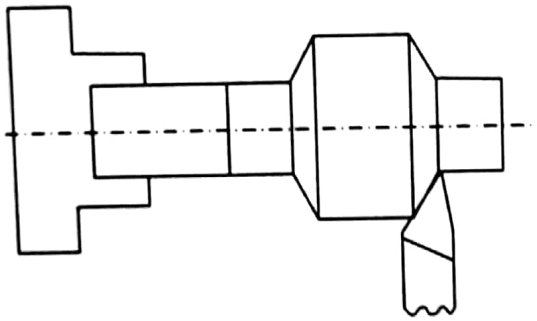
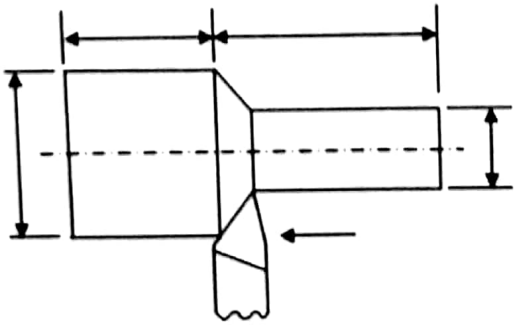
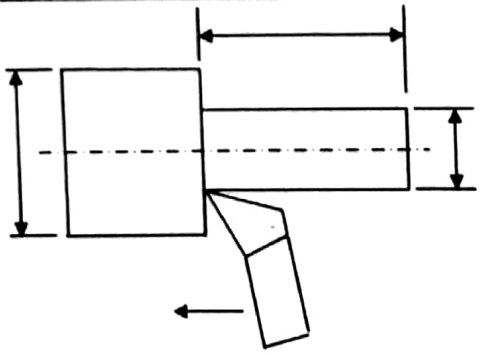
Tools Required: Lathe machine, Mild steel bar, right hand cutting tool, box key or tool post key, chuck key, steel rule, Vernier caliper, outside calipers.

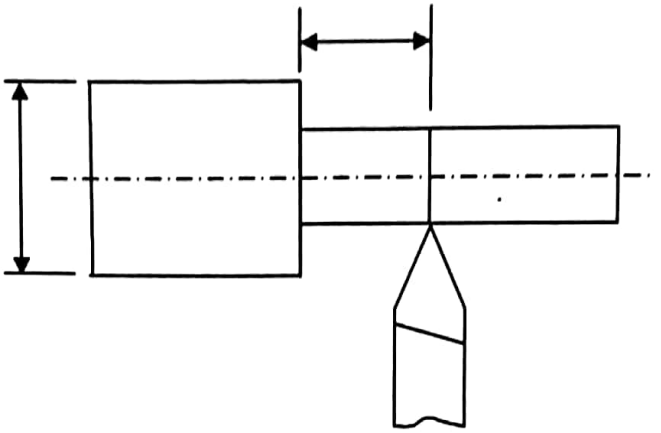
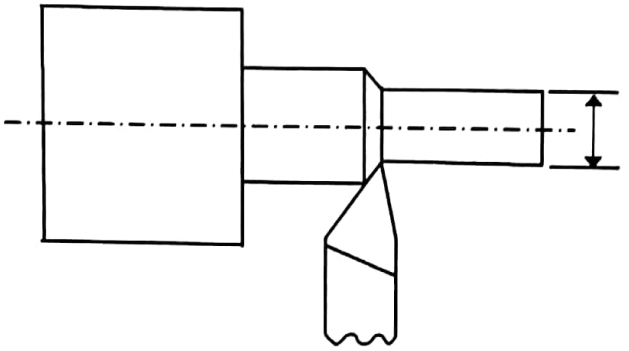
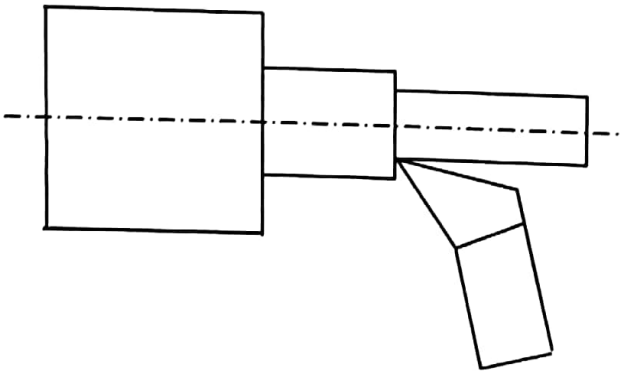
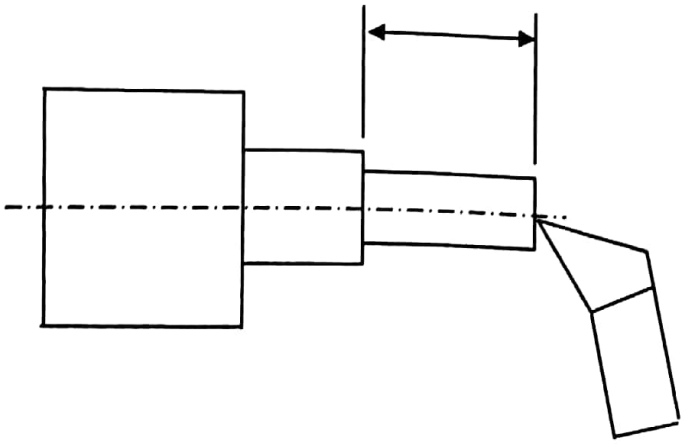
Drawing of the job:

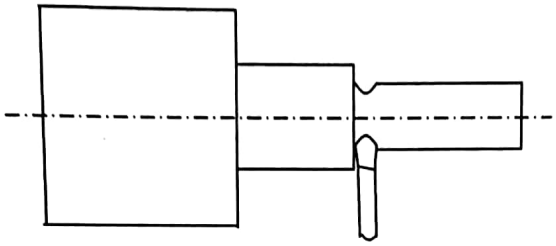
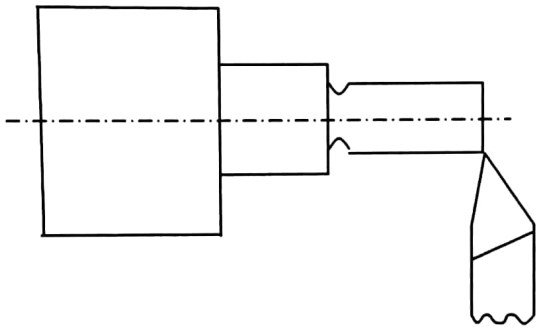
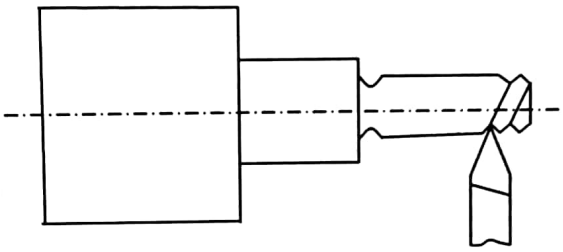


SEQUENCE OF OPERATION:

SL. NO.	NAME OF THE OPERATION	SCHEMATIC DIAGRAM	TOOLS REQUIRED
1.	Check the size of the raw material piece for conformity.		Steel rule, Outside Calipers, Vernier Caliper.
2.	Centre the tool		Right hand single point cutting tool mounted on the tool post.
3.	Hold the job and centre it (if not a self-centering chuck) so that maximum possible. Length is available for machining.		Right hand single point cutting tool, Surface gauge.
4.	Face the right end surface by about 2-3mm.		Right hand single point cutting tool.

5.	Make straight turning with 1mm + 1mm + 0.5mm cut in steps up to maximum length to make the finish diameter of 30mm.		Right hand single point cutting tool.
6.	Make a round mark with the tool at an axial distance of 30mm from the right end.		Right hand single point cutting tool.
7.	Dismantle the job and hold it the other way on 30mm finished diameter.		Right hand single point cutting tool.
8.	Finish the step diameter to 25mm from right end up to the cut mark as in step 5.		Right hand single point cutting tool.
9.	Face side B for obtaining a square face.		Right hand single point cutting tool.

10.	Make a round mark with the tool at an axial distance of 30mm from the left end of 25mm diameter step.		Right hand single point cutting tool.
11.	Finish the next step diameter to 20mm with 1mm +1mm + 0.5mm cut in steps.		Right hand single point cutting tool.
12.	Square face the junction of the 2nd and 3rd step diameter (side C).		Right hand single point cutting tool.
13.	Face the side D to make length of CD to 40mm.		Right hand single point cutting tool.

14.	Make a half round notch on 20mm diameter of a width of 5mm, starting from 25mm diameter step.		Right hand single point cutting tool.
15.	Finish the 3rd step diameter to 19mm by auto feed.		Right hand single point cutting tool.
16.	Adjust the feed to cut 10TPI thread on the 19mm diameter portion for a length of 35mm from right end and make the teeth cutting by adjusting the cut in 2-3 steps.		Right hand single point cutting tool.