MALLA REDDY ENGINEERING COLLEGE
(UGC Autonomous Institution, Approved by AICTE, New Delhi &Affiliated to JNTUH, Hyderabad). Accredited 2nd time by NAAC with 'A' Grade,
Maisammaguda (H), Medchal-Malkajgiri District, Secunderabad,
Telangana State – 500100, www.mrec.ac.in

Department of Mechanical Engineering

B.Tech – IV Year I Semester

PRODUCTION DRAWING PRACTICE

LABORATORY MANUAL

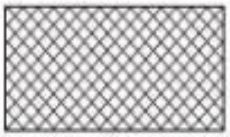
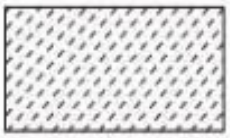
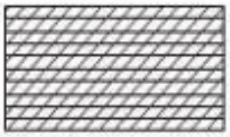
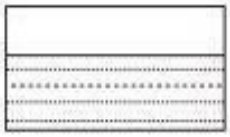
UNIT I
CONVENTIONAL REPRESENTATION

INTRODUCTION:

Certain standard conventions are used to represent the following in the draughting practice, which will help in reducing draughting time:

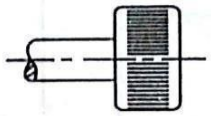
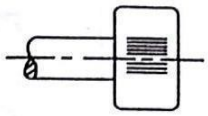
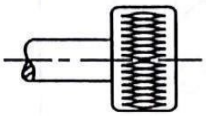
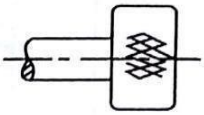
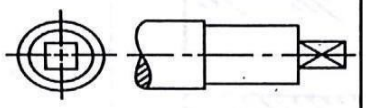
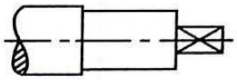
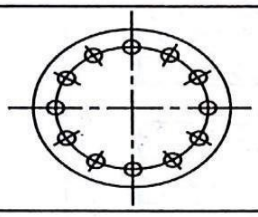
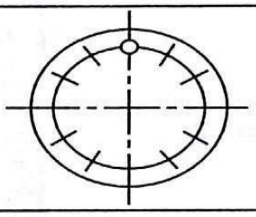
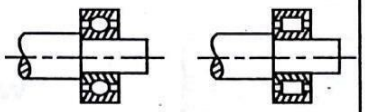
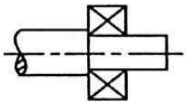
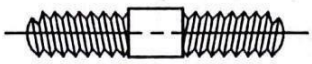
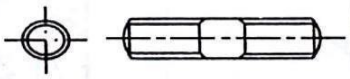
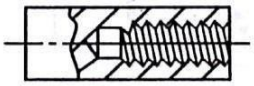
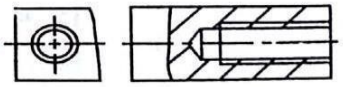
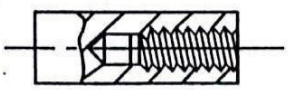
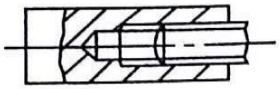
1. Materials
2. Machine components
3. Welded joints
4. Electrical circuits
5. Hydraulic circuits
6. Pneumatic circuits

CONVENTIONAL REPRESENTATION OF MATERIALS

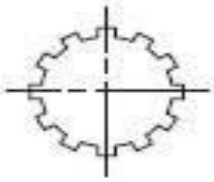
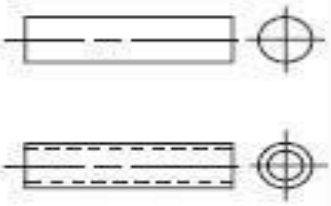
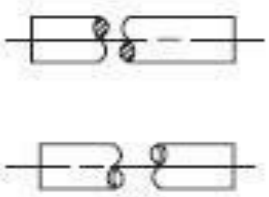
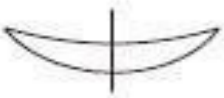
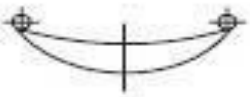
Type	Convention	Material
Metals		Steel, Cast Iron, Copper and its Alloys, Aluminium and its Alloys, etc.
		Lead, Zinc, Tin, White-metal, etc.
Glass		Glass
Packing and Insulating material		Porcelain, Stoneware, Marble, Slate, etc.
		Asbestos, Fibre, Felt, Synthetic resin products, Paper, Cork, Linoleum, Rubber, Leather, Wax, Insulating and Filling materials, etc.
Liquids		Water, Oil, Petrol, Kerosene, etc.
Wood		Wood, Plywood, etc.
Concrete		A mixture of Cement, Sand and Gravel

Conventional Representation of Materials

CONVENTIONAL REPRESENTATION OF MACHINE COMPONENTS

Title	Subject	Convention
Straight knurling		
Diamond knurling		
Square on shaft		
Holes on circular pitch		
Bearings		
External screw threads (Detail)		
Internal screw threads (Detail)		
Screw threads (Assembly)		

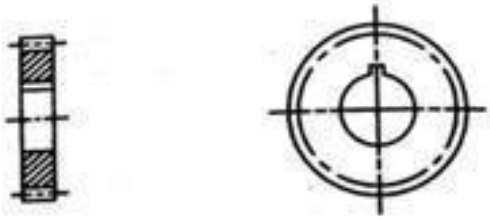
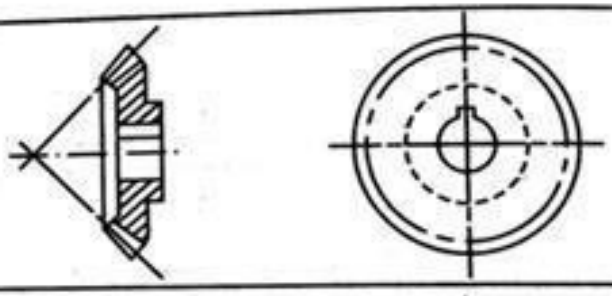
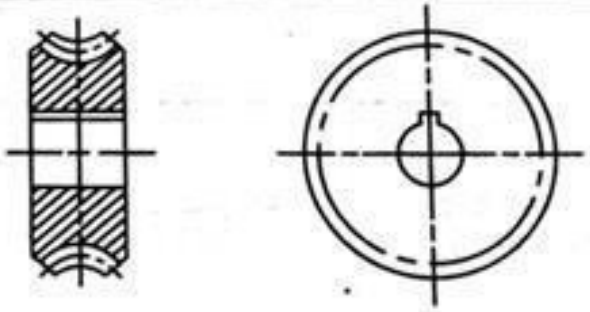
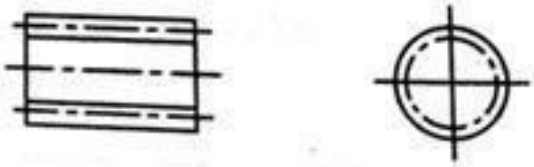
CONVENTIONAL REPRESENTATION OF MACHINE COMPONENTS

Title	Subject	Convention
Splined shafts		
Interrupted views		
Semi-elliptic leaf spring		
Semi-elliptic leaf spring with eyes		

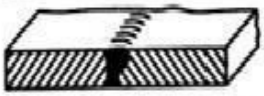
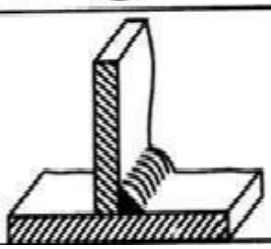
Title	Subject	Convention	Diagrammatic Representation
Cylindrical compression spring			
Cylindrical tension spring			

(b)

CONVENTIONAL REPRESENTATION OF MACHINE COMPONENTS

Title	Convention
Spur gear	
Bevel gear	
Worm wheel	
Worm	

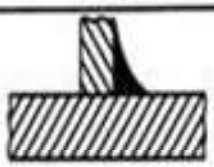
Elementary welding symbols

No.	Designation	Illustration	Symbol
1	Butt weld between plates with raised edges (the raised edges being melted down completely)		
2	Square butt weld		
3	Single-V butt weld		
4	Single-bevel butt weld		
5	Single-V butt weld with broad root face		
6	Single-bevel butt weld with broad root face		
7	Single-U butt weld (parallel or sloping sides)		
8	Single - J butt weld		
9	Backing run; back or backing weld		
10	Fillet weld		

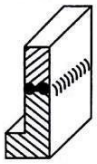
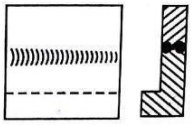
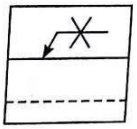
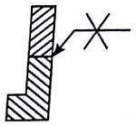
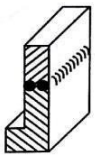
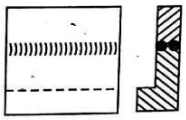
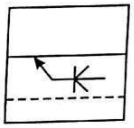
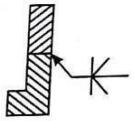
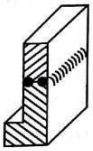
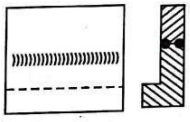
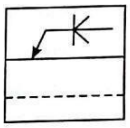
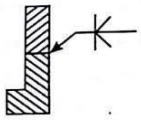
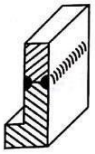
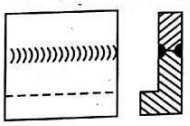
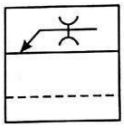
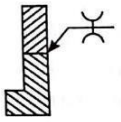
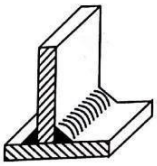
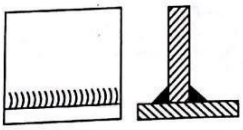
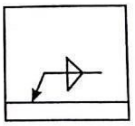
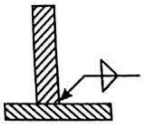
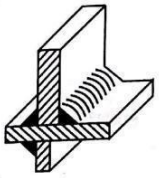
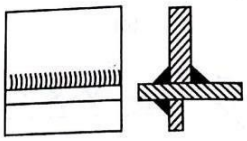
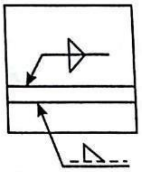
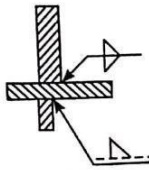
Supplementary welding symbols

Shape of weld surface	Symbol
(a) Flat (usually finished flush)	
(b) Convex	
(c) Concave	

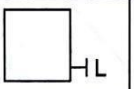
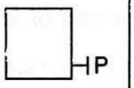
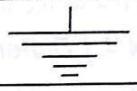
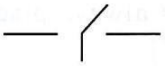
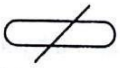
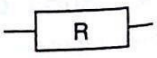
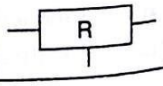
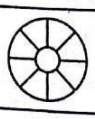
Combination of elementary and supplementary symbols

Designation	Illustration	Symbol
Flat (flush) single-V butt weld		
Convex double-V butt weld		
Concave fillet weld		
Flat (flush) single-V butt weld with flat (flush) backing run		

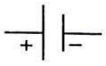
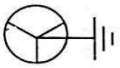
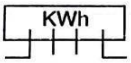
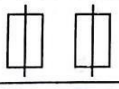
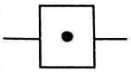
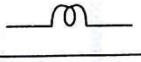
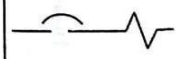
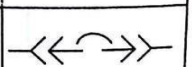
COMBINATION OF ELEMENTARY ELEMENTS

No.	Designation symbol (Number refer to Table 13.3)	Illustration	Representation	Symbolization	
				either	or
4	Double-V butt weld 3 (X weld) 3–3				
5	Double bevel butt weld 4 (K weld) 4–4				
6					
7	Double-U butt weld 7 7–7				
8	Fillet weld 10				
9	10–10				

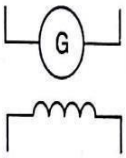
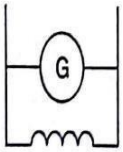
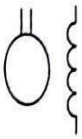
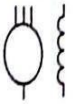
CIRCUIT SYMBOLS FOR ELECTRICAL ITEMS

S. No.	Description	Symbol	S. No.	Description	Symbol
1	Main switch (light)		15	Bracket fan	
2	Main switch (power)		16	Exhaust fan	
3	Single throw switch, general		17	Earth	
4	Double throw switch, general		18	Fire alarm	
5	Knife switch, general		19	D.C	
6	Switch with horn gap		20	A.C	
7	Two pin socket, 5 Amp		21	Single phase alternating current	
8	Two pin socket with switch, 5 Amp		22	Three phase alternating current	
9	Three pin socket with switch, 5 Amp		23	Neutral	N
10	Single tube light		24	Resistor	
11	Double tube light		25	Variable resistor	
12	Horn		26	Inductor	
13	Siren		27	Capacitor	
14	Ceiling fan		28	Variable capacitor	

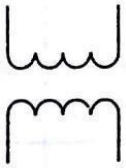
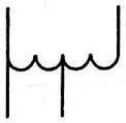
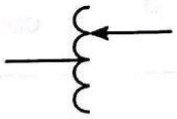
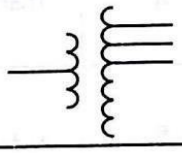
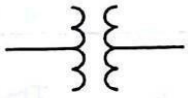
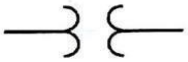
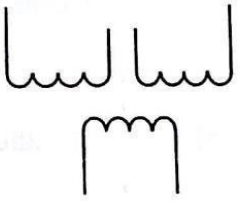
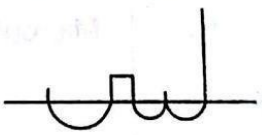
CIRCUIT SYMBOLS FOR ELECTRICAL ITEMS

S. No.	Description	Symbol	S. No.	Description	Symbol
29	Two pin socket		42	Commutating or compensating wiring	
30	Three pin socket		43	Series winding	
31	Cell		44	Shunt winding or separate winding	
32	Battery		45	1-Phase	
33	D.C volt meter		46	2-Phase	
34	D.C ampere meter		47	3-Phase wye (ungrounded)	
35	D.C/A.C ampere meter		48	3-Phase wye (grounded)	
36	Watt meter		49	3-Phase delta	
37	Ohm meter			Circuit breakers	
38	Energy meter		50	Air or general	
39	Fuse		51	Oil or other types	
40	Lamp		52	3-Pole with thermal overload device	
	Wiring symbols		53	3-Pole with magnetic overload device	
41	General		54	3-Pole draw-out type	

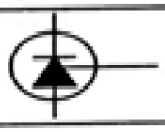
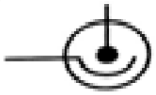
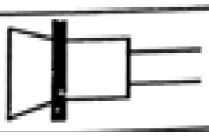
SYMBOLS FOR MOTORS

Description	Symbol	Description	Symbol
Machine (motor or generator) or rotating armature (basic symbol)		Induction motor, single phase, squirrel cage	
D.C motor (M), D.C generator (G)- General symbol		Induction motor, 3 phase, squirrel cage	
A.C motor (M), A.C generator (G)- General symbol		Induction motor, 3 phase with wound rotor	
D.C two wire generator (G) or motor (M)- Separately excited		Induction motor, 3 phase, squirrel cage, both leads of each phase brought-out	
D.C two wire shunt generator (G) or motor (M)		Single phase synchronous generator	
Separately excited D.C generator or motor with commutating and/or compensating field winding		Three phase synchronous motor or generator or condenser	
One phase magneto-electric generator		Three phase synchronous motor or generator or condenser with neutral brought-out	
Three phase magneto-electric generator			

SYMBOLS FOR TRANSFORMERS

S. No.	Description	Symbol
1	Transformer, general	
2	Auto transformer, general	
3	Transformer, adjustable	
4	Single phase transformer with taps	
5	Single phase, 2 winding transformer	
6	Potential transformer	
7	Transformer with three separate windings	
8	Current transformer	
9	Bushing type current transformer	

Graphical symbols for electronic devices

S. No.	Description	Symbol
1	Rectifier, diode	
2	Zener diode	
3	Rectifier equipment in bridge connector	
4	Transistor type PNP	
5	Transistor type NPN	
6	Thyristor (general)	
7	Contactor-make contact	
8	Contactor-break contact	
9	Photo electric cell	
10	Microphone	
11	Loudspeaker	

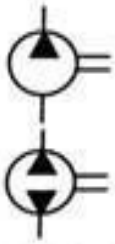
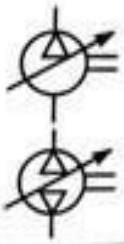
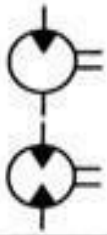
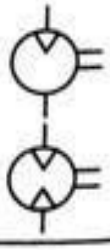
SYMBOLS FOR HYDRAULIC AND PNEUMATIC PARAMETERS

Description	Symbol
1. Arrows	
Indication of direction	
Regulation/variability	
2. Flow lines	
Pipe line	
Free end of a pipe line	
Earthed/vented end	
Fixed throttle	
Adjustable throttle	
Pneumatic contact	
Actuator	

Description	Symbol
Capacity	
3. Control valves	
Flow path	
Flow shut-off	
Initial connections	
4. Valve actuation symbols	
Push-button	
By lever	
By roller	
By plunger	
By spring	

Description	Symbol
By solenoid	
By application of pneumatic pressure	
By pedal	
5. 2/2 valve	
6. Pressure relief valve	
7. Sequence valve	
8. Pressure reducing valve	
9. Pilot operated valve	

Graphic symbols

Hydraulic	Parameter/device	Pneumatic
	Uni-direction of flow	
	Bi-direction of flow Exhaust to atmosphere	
	1. Fixed displacement pump Uni-directional Bi-directional	
	2. Variable displacement pump Uni-directional Bi-directional	
	3. Fixed displacement motor Uni-directional Bi-directional	
	4. Variable displacement motor Uni-directional Bi-directional	

UNIT –II

LIMITS and FITS

LIMIT SYSTEM

Following are some of the terms used in the limit system,

Tolerance: The permissible variation of a size is called tolerance. It is the difference between the maximum and minimum permissible limits of the given size.

Limits: The two extreme permissible sizes between which the actual size is contained are called limits. The maximum size is called the upper limit and the minimum size is called the lower limit.

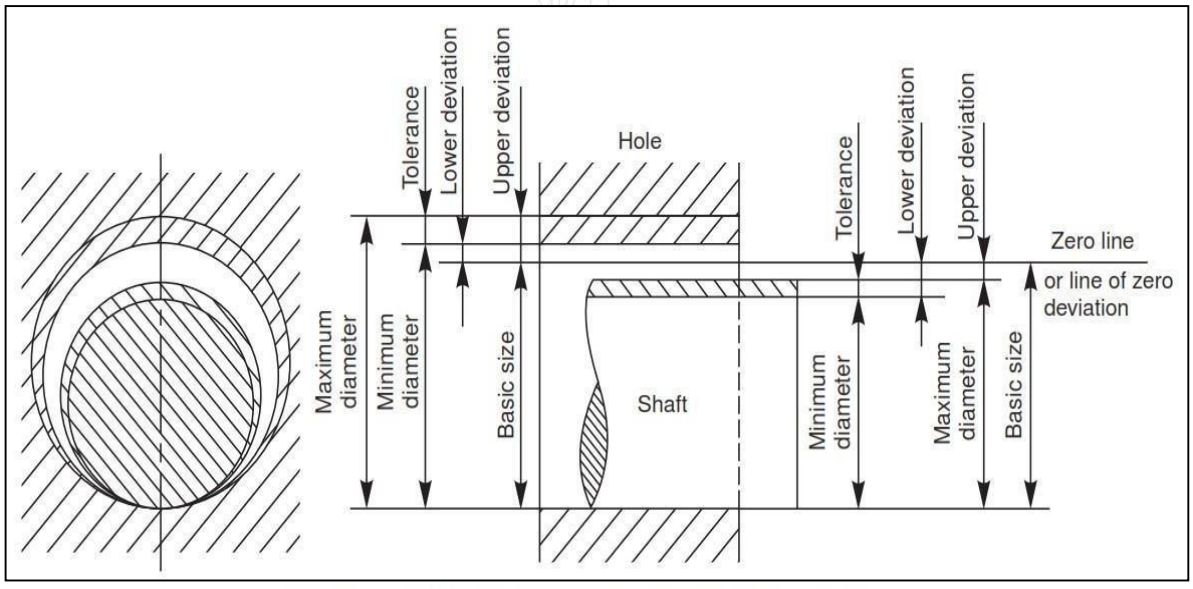
Deviation: It is the algebraic difference between a size (actual, maximum, etc.) and the corresponding basic size.

Actual Deviation: It is the algebraic difference between the actual size and the corresponding basic size.

Upper Deviation: It is the algebraic difference between the maximum limit of the size and the corresponding basic size.

Lower Deviation: It is the algebraic difference between the minimum limit of the size and the correspondingbasic size.

Allowance: It is the dimensional difference between the maximum material limits of the mating parts, intentionally provided to obtain the desired class of fit. If the allowance is positive, it will result in minimum clearance between the mating parts and if the allowance is negative, it will result maximum Interference.



basic size deviations and tolerances

FITS : The relation between two mating parts is known as a fit. Depending upon the actual limits of the hole or shaft sizes, fits may be classified as clearance fit, transition fit and interference fit.

Types of fits

1. Clearance fit 2.Transtion fit 3.Interference fit

Clearance Fit: It is a fit that gives a clearance between the two mating parts.

Transition Fit: This fit may result in either an interference or a clearance, depending upon the actual values of the tolerance of individual parts.

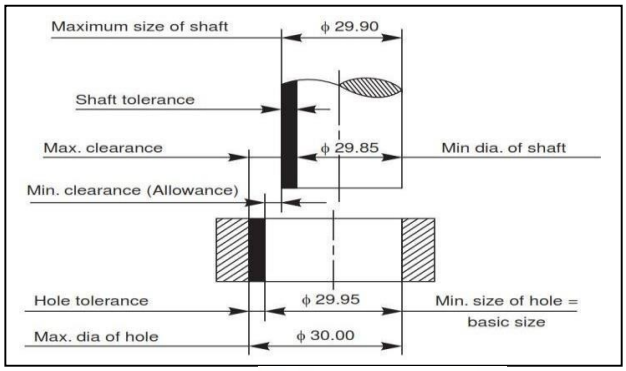
Interference Fit: If the difference between the hole and shaft sizes is negative before assembly; an interference fit is obtained.

HOLE BASIS SYSTEM, SHAFT BASIS SYSTEM

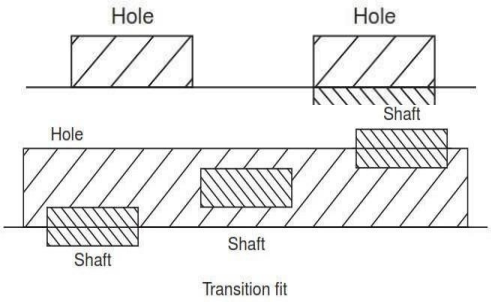
In working out limit dimensions for the three classes of fits; two systems are in use, viz., the hole basis system and shaft basis system.

HOLE BASIS SYSTEM: In this system, the size of the shaft is obtained by subtracting the allowance from the basic size of the hole. In this system, the lower deviation of the hole is zero. The letter symbol for this situation is 'H'.

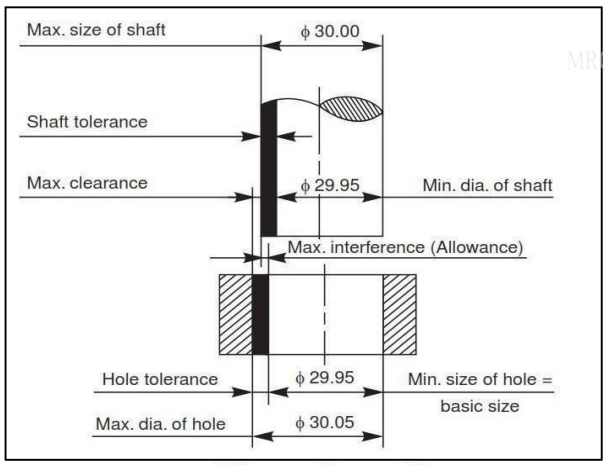
HAFT BASIS SYSTEM: In this system, the size of the hole is obtained by adding the allowance to the basic size of the Shaft. plied to each part. In this system, the upper deviation of the shaft is zero. The letter symbol for this situation is 'h'.



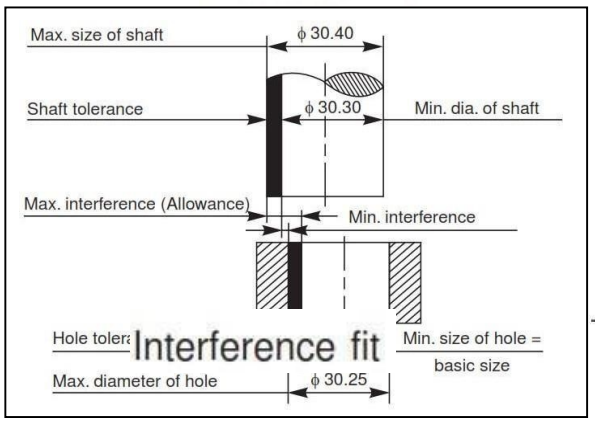
Clearance fit



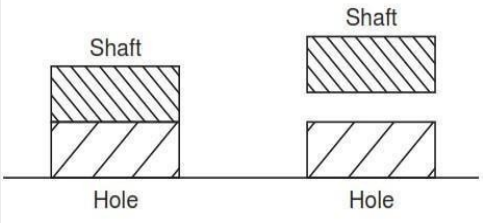
Transition fit



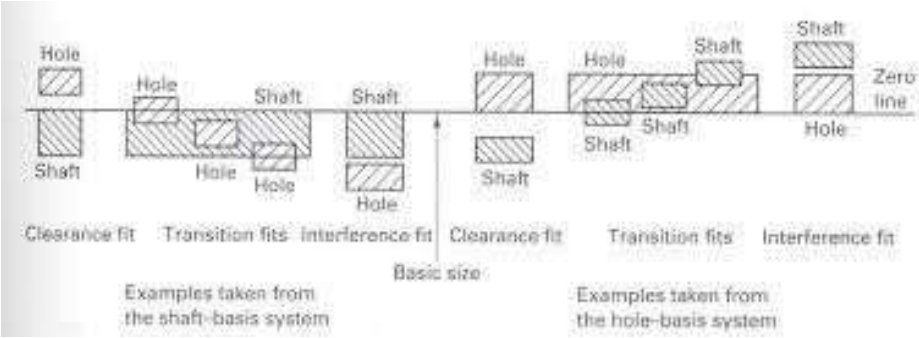
Transition fit



Interference fit



Interference fit

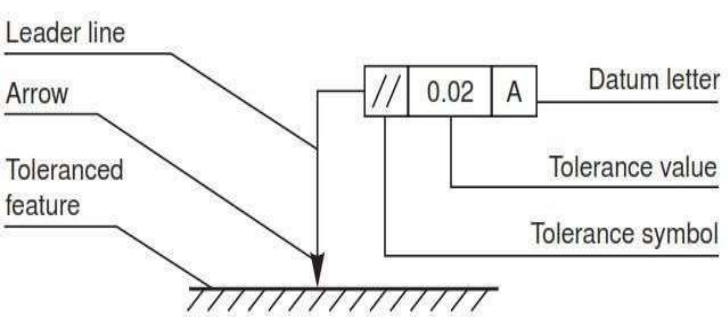


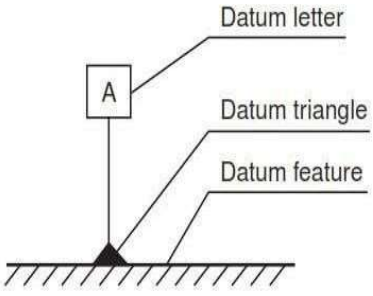
Hole basis and shaft basis system

Symbols representing the characteristics to be toleranced

Characteristics to be toleranced		*Symbols*
Form of single features	Straightness	
	Flatness	
	Circularity (roundness)	
	Cylindricity	
	Profile of any line	
	Profile of any surface	
Orientation of related features	Parallelism	
	Perpendicularity (squareness)	
	Angularity	
Position of related features	Position	
	Concentricity and coaxiality	
	Symmetry	
	Run-out	

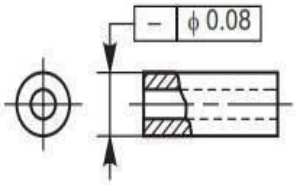
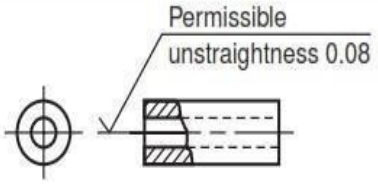
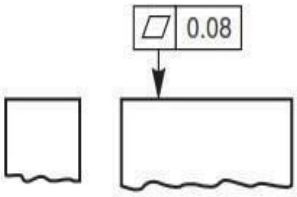
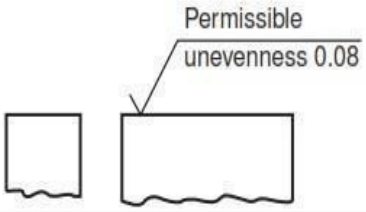
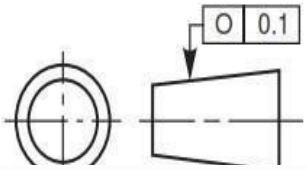
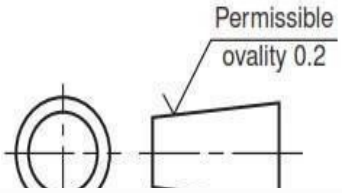
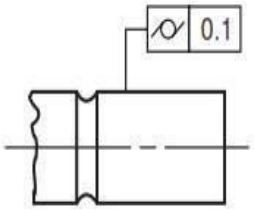
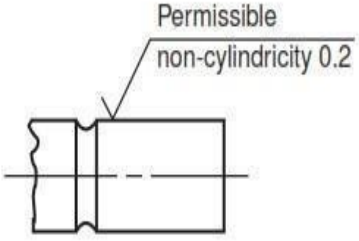
Datum feature: A datum feature is a feature of a part, such as an edge, surface, or a hole, which forms the basis For a datum or is used to establish its location

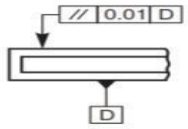
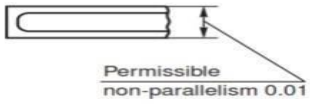
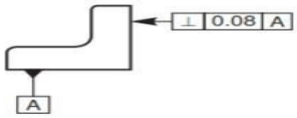
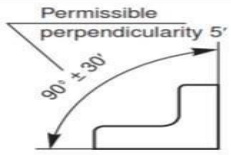
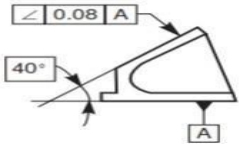
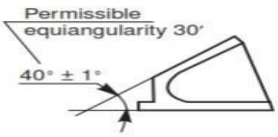
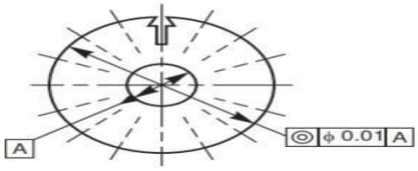
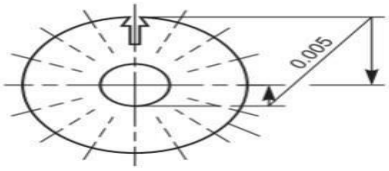
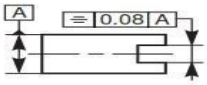


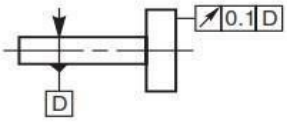
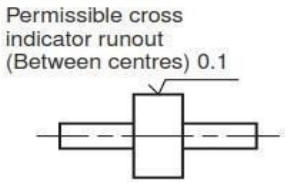
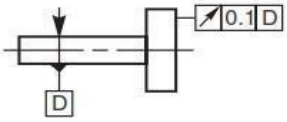
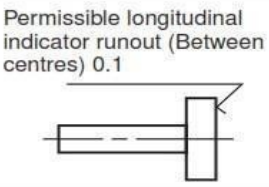


UNIT III

FORM AND POSITIONAL TOLERANCES

As per the standard	*As prevalent in industry*
1. Straightness tolerance	
	
2. Flatness tolerance	
	
3. Circularity tolerance	
	
4. Cylindricity tolerance	
	

5. Parallelism tolerance	
	
6. Perpendicularity tolerance	
	
7. Angularity tolerance	
	
8. Concentricity and coaxiality tolerance	
	
9. Symmetry tolerance	
	

10. Radial run-out	
	
11. Axial run-out	
	

Systems of indication of tolerances of form and of position

UNIT IV

SURFACE ROUGHNESS AND ITS INDICATION

Surface Roughness: The properties and performance of machine components are affected by the degree of roughness of the various surfaces. The higher the smoothness of the surface, the better is the fatigue strength and corrosion resistance. Friction between mating g parts is also reduced due to better surface finish.

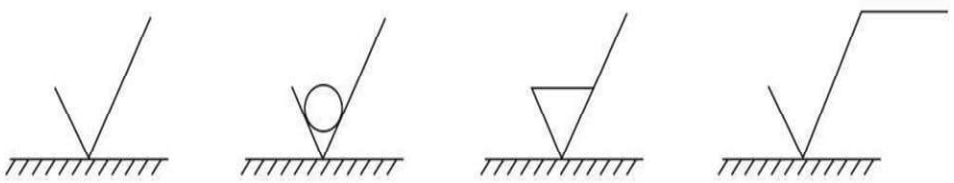
Surface Roughness Number: The surface roughness number represents the average departure of the surface from perfection over a prescribed sampling length and is expressed in microns.

$$R_a = \frac{h_1 + h_2 + h_3 + \ldots + h_n}{n}$$

The surface roughness may be measured, using any one of the following:

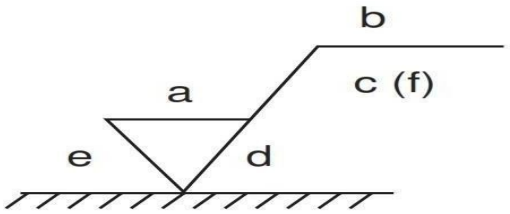
1. Straight edge
2. Surface gauge
3. Optical flat
4. Tool makers Microscopes
5. Profilometer
6. Profilograph
7. Talysurf

Machine Symbols: The basic symbol consists of two legs of unequal length, inclined at approximately 60° to the line, representing the surface considered. This symbol may be used where it is necessary to indicate that the surface is machined, without indicating the grade of roughness or the process to be used.

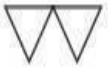
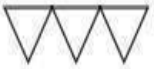
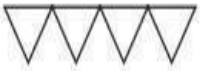


(a) (b) (c) (d)

a) Basic symbol.
b) Material Removal is Not Allowed
c) Removal Of Material Is Allowed.
d) Special surface characteristics



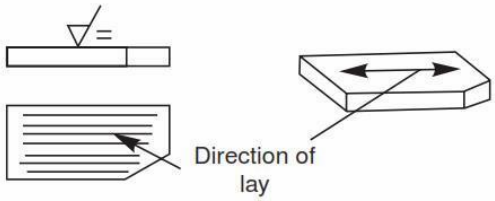
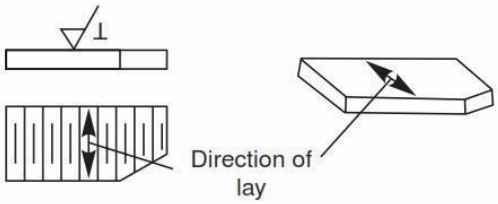
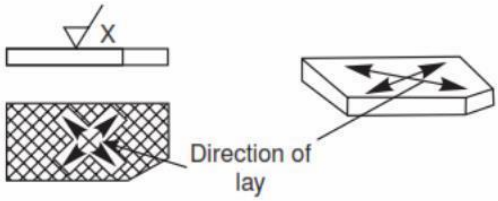
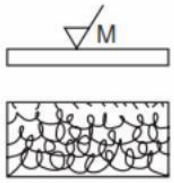
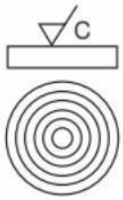
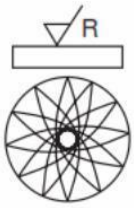
Indication of Machining Allowance

Roughness values R_a *μm*	*Roughness grade number*	*Roughness grade symbol*
50	N12	
25	N11	
12.5	N10	
6.3	N9	
3.2	N8	
1.6	N7	
0.8	N6	
0.4	N5	
0.2	N4	
0.1	N3	
0.05	N2	
0.025	N1	

Equivalent surface roughness symbols

Indication of Special Roughness Characteristics: In certain circumstances, for functional reasons, it may be necessary to specify additional special requirements, concerning surface roughness. If it is required that the final surface texture be produced by one particular production method, this method should be indicated on an extension of the longer arm of the symbol. Also, any indications relating to treatment of coating may be given on the extension

of the longer arm of the symbol.

Symbol	*Interpretation*	
=	Parallel to the plane of projection of the view in which the symbol is used	
⊥	Perpendicular to the plane of projection of the view in which the symbol is used	
X	Crossed in two slant directions relative to the plane of projection of the view in which the symbol is used	
M	Multi-directional	
C	Approximately circular, relative to the centre of the surface to which the symbol is applied	
R	Approximately radial, relative to the centre of the surface to which the symbol is applied	

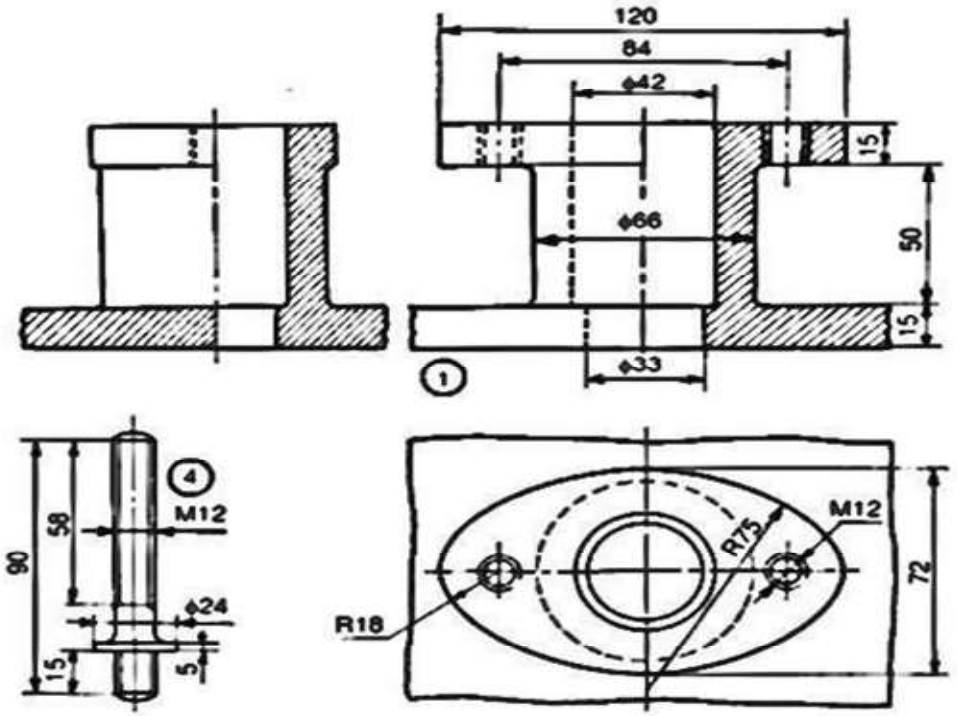
Symbols specifying the directions of lay

UNIT V

DETAILED and PART DRAWINGS

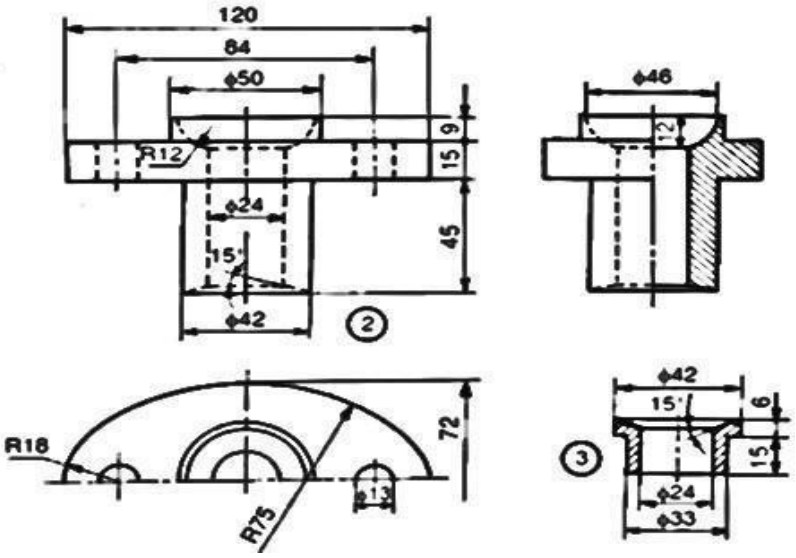
Heat treatment and surface treatment symbols used on drawings

Stuffing Box is used to prevent loss of fluid such as steam, between sliding or turning parts of machine elements. In a steam engine, when the piston rod reciprocates through the cylinder cover; stuffing box provided in the cylinder cover, prevents leakage of steam from the cylinder.



Detailed part drawings of stuffing box

Assembly of stuffing box



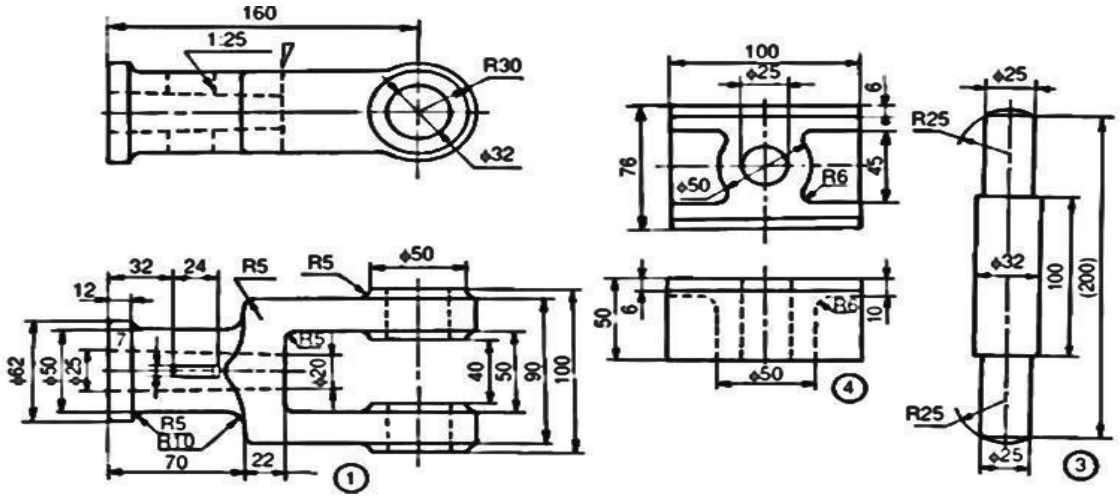
Stuffing box

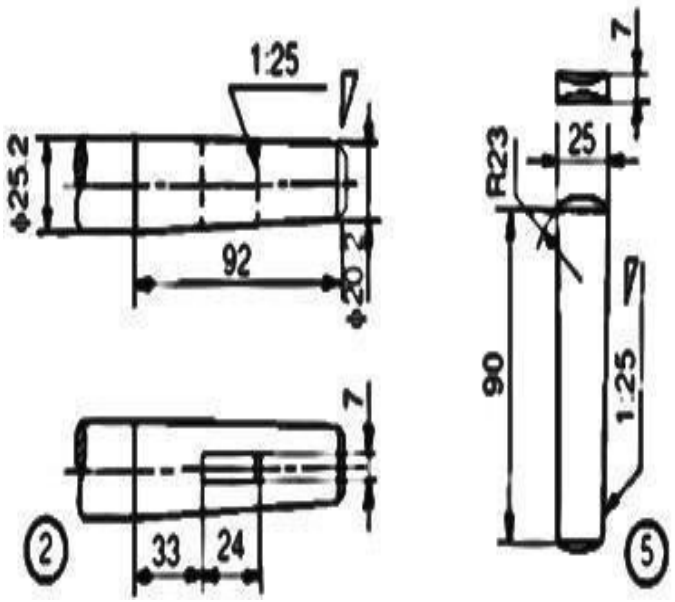
Parts list

Part No.	Name	Matl	Qty
1	Body	CI	1
2	Gland	Brass	1
3	Bush	Brass	1
4	Stud	MS	2
5	Nut, M12	MS	2

Detailed part drawings of stuffing box

CROSSHEAD is used in horizontal steam engines for connecting the piston rod and connecting rod. The **crosshead**, with the help of slide block 4, reciprocates between two guides provided in the engine frame. The dudgeon pin 3 connects the slide blocks with the crosshead block 1. This acts as a pin joint for the connecting rod (not shown in figure). The piston rod 2 is secured to the **crosshead** block by means of the cotter 5. The assembly ensures reciprocating motion along a straight line for the piston rod and reciprocating cum oscillatory motion for the connecting rod.



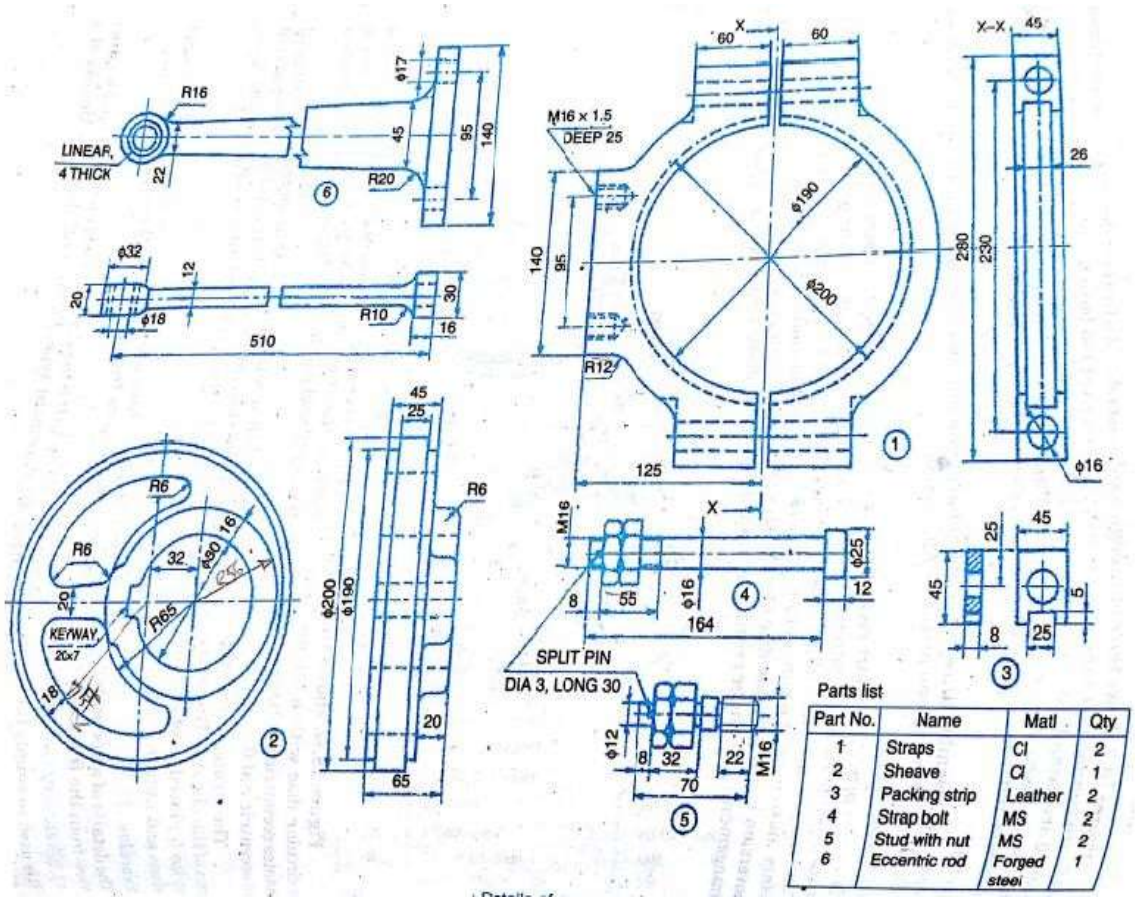


Parts list

Part No.	Name	Matl	Qty
1	Block	CS	1
2	Piston rod	MS	1
3	Gudgeon pin	MS	1
4	Slide block	CI	2
5	Cotter	MS	1

Fig: Steam Engine Cross Head

ECCENTRIC is used to provide a short reciprocating motion, actuated by the rotation of a shaft. Eccentrics are used for operating steam valves, small pump plungers, shaking screens, etc. Rotary motion can be converted into a reciprocating motion with an eccentric, but the reverse conversion is not possible due to excessive friction between the sheave and the strap. The sheave 2 which is in the form of a circular disc with a stepped rim is keyed on the shaft. When the shaft rotates, the sheave rotates eccentrically because of the eccentrically placed hole in it and imparts reciprocating motion to eccentric rod 6. The straps 1 are semi-circular elements with an annular recess to accommodate the stepped rim of the sheave. These are held together on the sheave by means of strap bolts 4, with packing strips 3 placed between them. The eccentric rod is fixed to the eccentric strap by means of the studs and nuts 5.

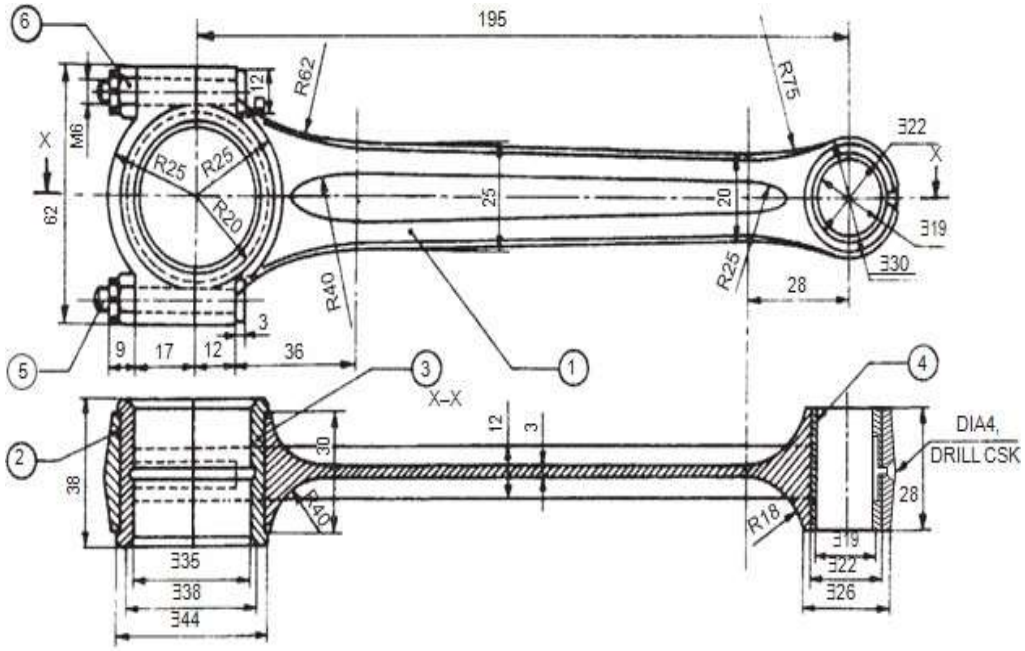


Parts list

Part No.	Name	Matl	Qty
1	Straps	CI	2
2	Sheave	CI	1
3	Packing strip	Leather	2
4	Strap bolt	MS	2
5	Stud with nut	MS	2
6	Eccentric rod	Forged steel	1

Fig:Details of an Eccentric

CONNECTING ROD is used in centre crank engines. The bearing bush 4 which is in one piece, is fitted at the small end of the connecting rod 1. The small end of the rod is connected to the piston. The main bearing bush, which is split into two halves, is placed at the big end of the connecting rod. The big end of the rod is connected to the crank pin of the centre crank. First, the split bearing brasses 3 are placed on the crank pin, then the big end of the connecting rod and the cap 2 are clamped onto these, by means of two bolts 5 and nuts 6.



Parts list

Part No.	Name	Matl.	Qty.
1	Rod	FS	1
2	Cap	FS	1
3	Bearing brass	GM	2
4	Bearing bush	P Bronze	1
5	Bolt	MCS	2
6	Nut	MCS	2

Fig. Petrol engine connecting rod

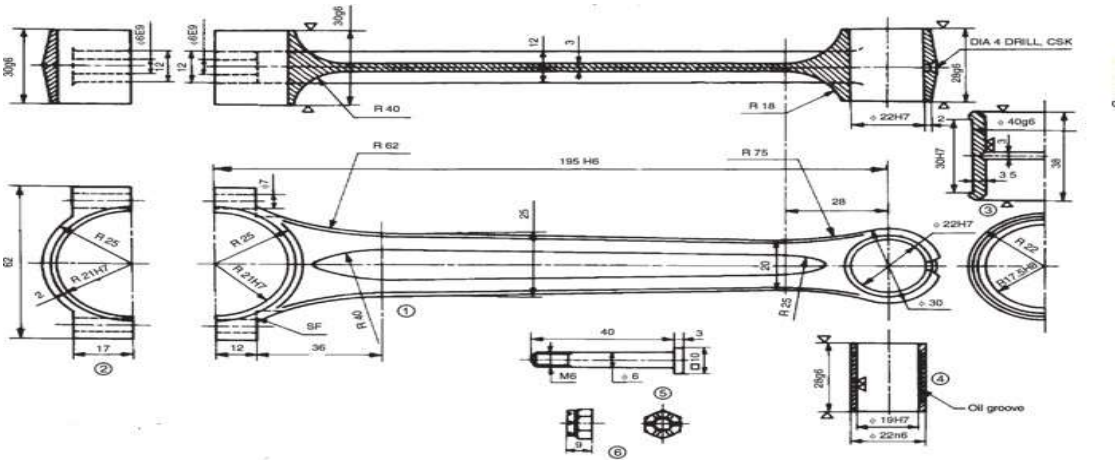
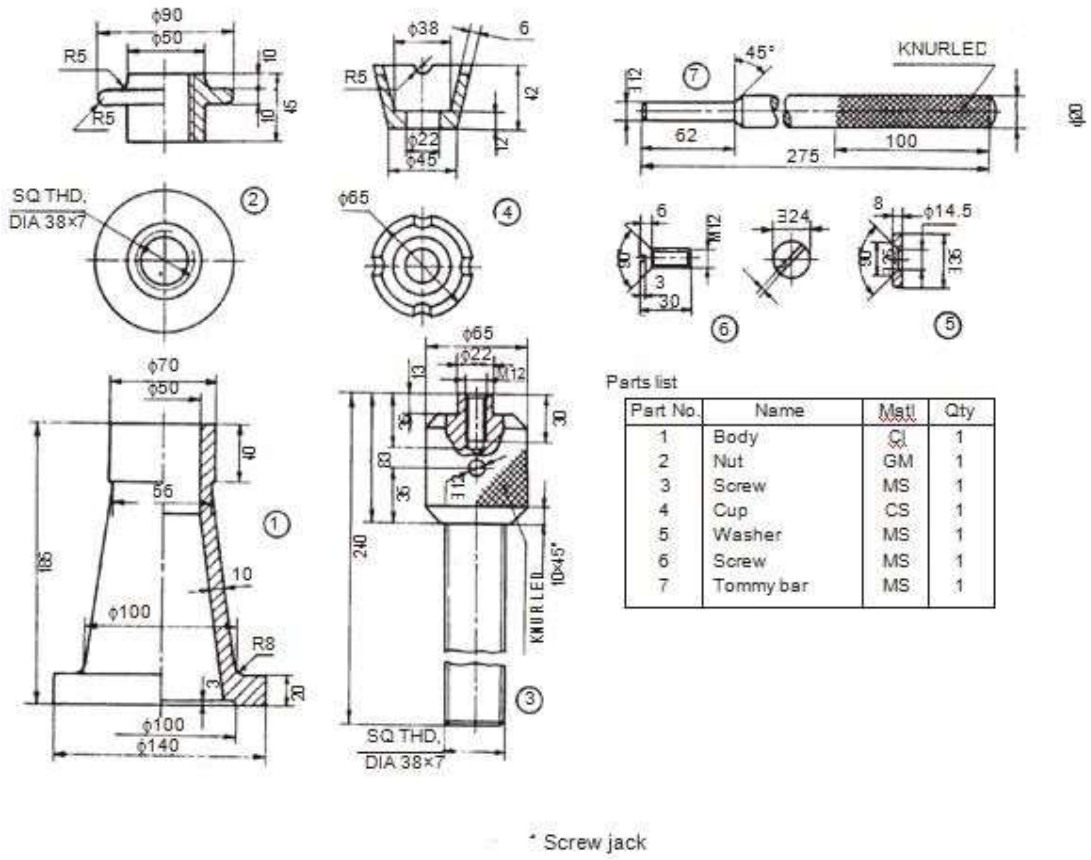


Fig. Details of a Petrol engine connecting rod

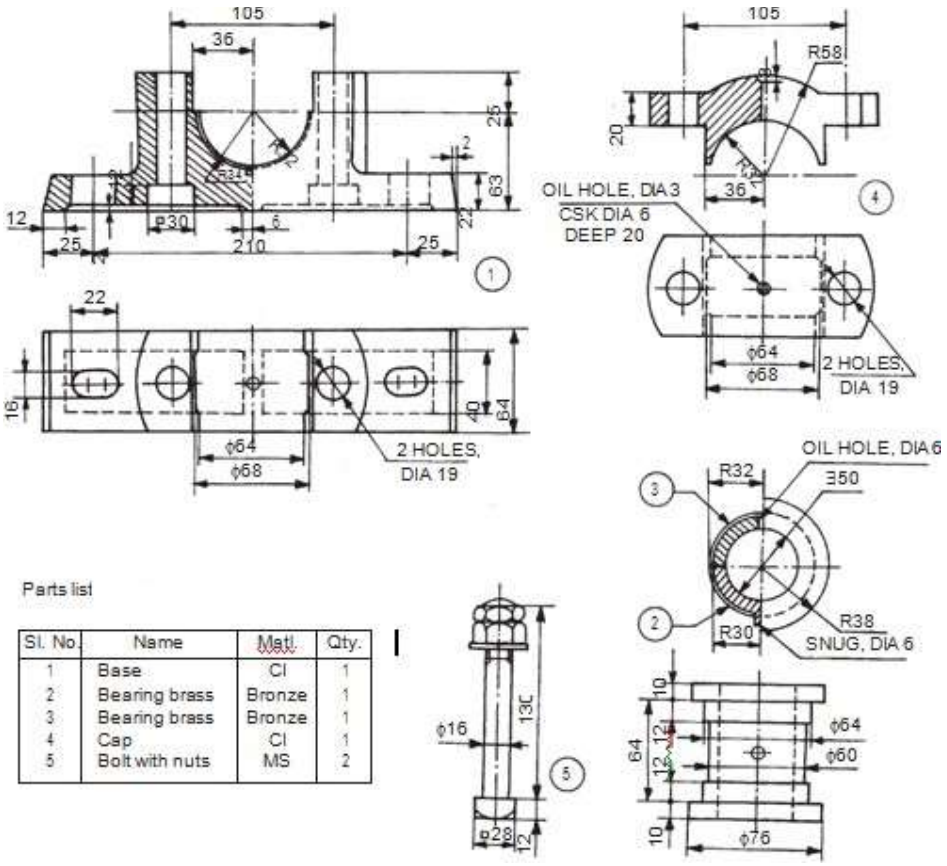
SCREW JACK: Screw jacks are used for raising heavy loads through very small heights. Figure shows the details of one type of screw jack. In this, the screw 3 works in the nut 2 which is press fitted into the main body 1. The tommy bar 7 is inserted into a hole through the enlarged head of the screw and when this is turned, the screw will move up or down, thereby raising or lowering the load.



Part No.	Name	Matl	Qty
1	Body	CI	1
2	Nut	GM	1
3	Screw	MS	1
4	Cup	CS	1
5	Washer	MS	1
6	Screw	MS	1
7	Tommy bar	MS	1

Fig: Screw jack

PLUMMER BLOCK is used for long shafts, requiring intermediate support, especially when the shaft cannot be introduced into the bearing, end-wise. The bottom half 2 of the bearing brass is placed in the base 1 such that, the snug of the bearing enters into the corresponding recess in the base; preventing rotation of the brasses. After placing the journal (shaft) on the bottom half of the bearing brass, kept in the base; the upper half of the bearing brass 3 is placed and the cap 4 is then fixed to the base, by means of two bolts with nuts 5. The bearing is made of two halves so that the support can be introduced at any location of the long shaft.



Parts list

Sl. No.	Name	Matl.	Qty.
1	Base	CI	1
2	Bearing brass	Bronze	1
3	Bearing brass	Bronze	1
4	Cap	CI	1
5	Bolt with nuts	MS	2

Fig:Details of Plummer block

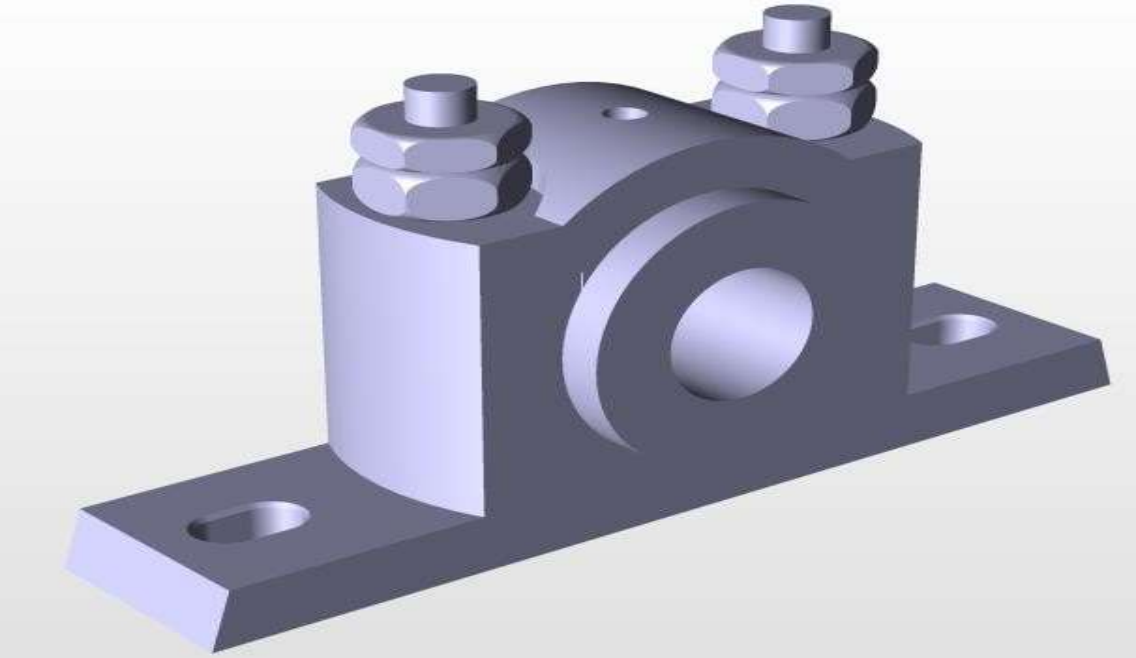
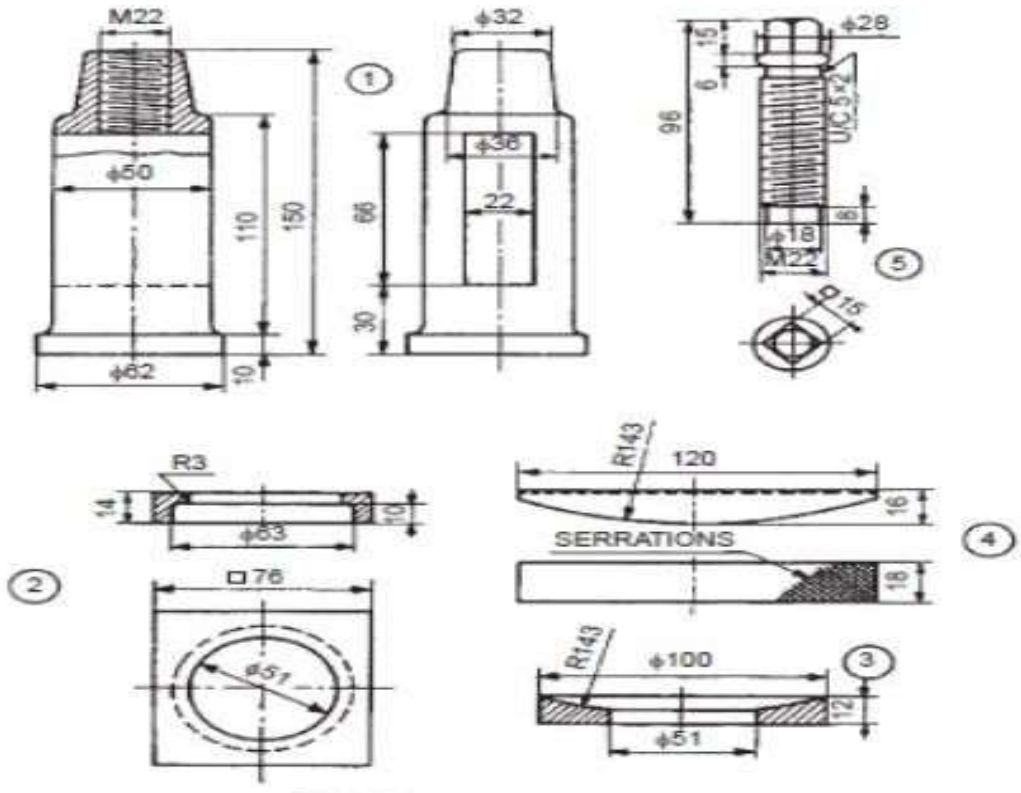


Fig: Plummer block

LATHE TOOL POST supports one cutting tool at a time and is used on small sized lathes. This unit is fixed on the compound rest of the lathe carriage. The tool post consists of a circular body 1 with a collar at one end and a threaded hole at the other. A vertical slot is provided in the body to accommodate the tool/tool holder. The body is slid through the square block 5, which is finally located in the T-slot, provided in the compound rest. The design permits rotation of the body about the vertical axis. A circular ring 4 having spherical top surface is slid over the body and the wedge 3 is located in the vertical slot. The tool / tool holder is placed over the wedge. By sliding the wedge on the ring, the tool tip level can be adjusted. The tool is clamped in position by means of the square headed clamping screw 2, passing through the head of the body.

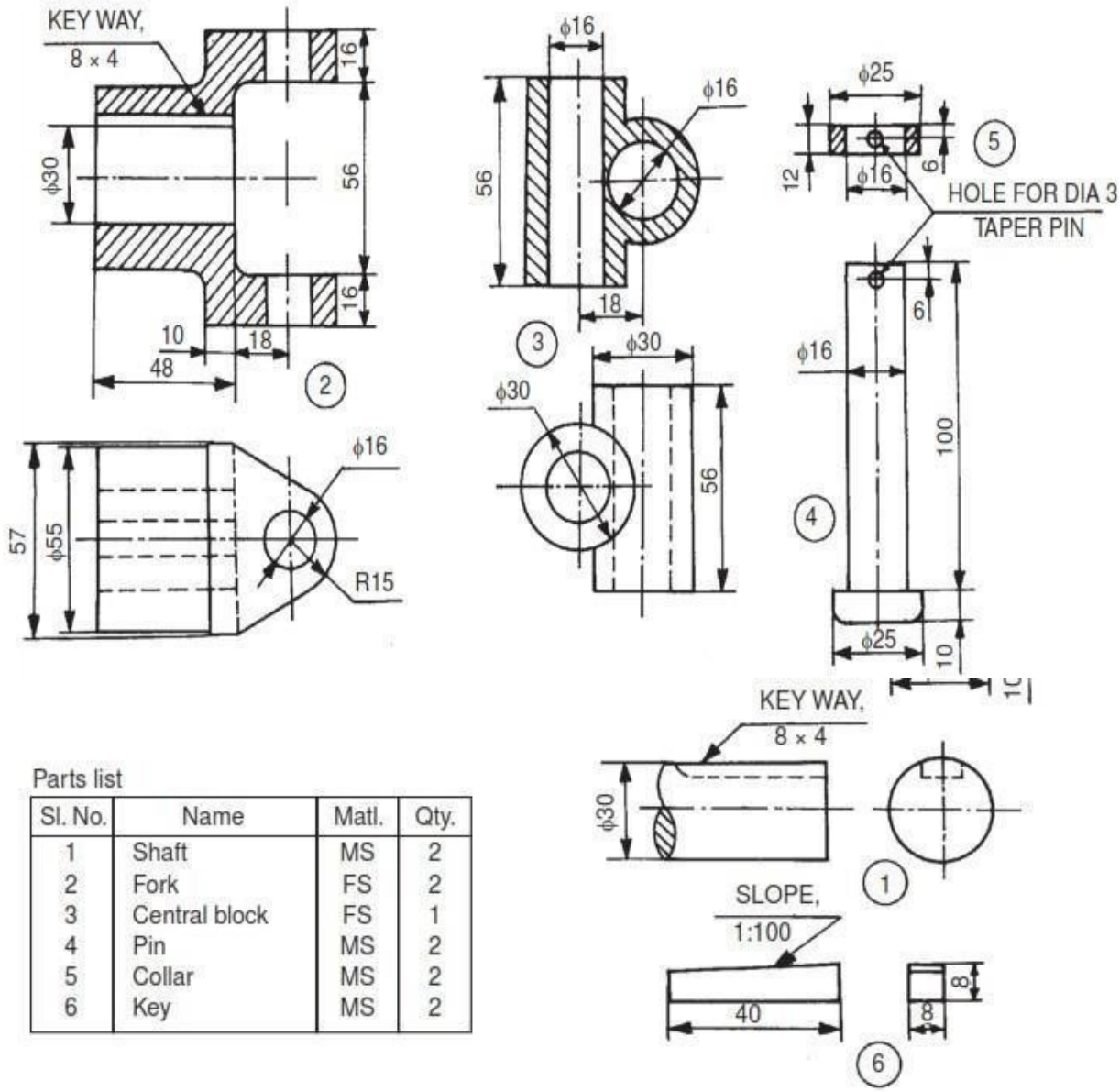


Parts list

No.	Name	Matl	Qty
1	Piller	MCS	1
2	Block	MCS	1
3	Ring	MS	1
4	Wedge	MCS	1
5	Screw	TS	1

FIG 5:LATHE SINGLE TOOL POST

UNIVERSAL COUPLING is a rigid coupling and is used to connect two shafts, whose axes intersect if extended. The forks 2 are mounted at the ends of two shafts 1, making use of sunk keys 6. The central block 3, having two arms at right angle to each other, is placed between the forks and connected to both of them by using pins 4 and collars 5. A taper pin (not shown) is used to keep the pins 4 in position. During rotation of shafts, the angle between them can be varied.



Parts list

Sl. No.	Name	Matl.	Qty.
1	Shaft	MS	2
2	Fork	FS	2
3	Central block	FS	1
4	Pin	MS	2
5	Collar	MS	2
6	Key	MS	2

Universal coupling