PRODUCTION DRAWING AND PRACTICE

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UNIT I

Representation Materials & Machine Components

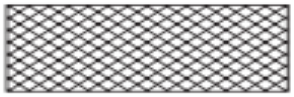
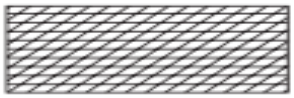
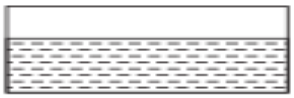
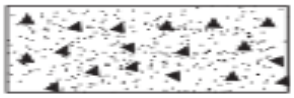
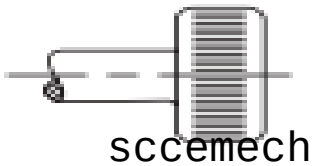
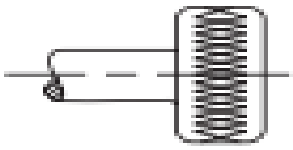
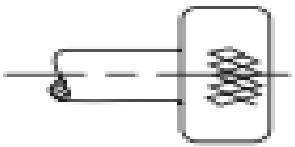
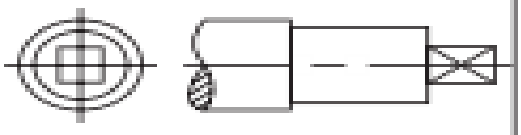
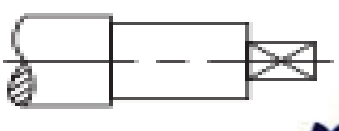
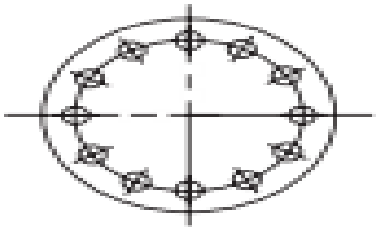
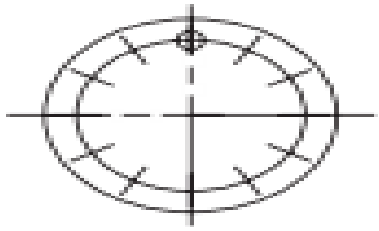
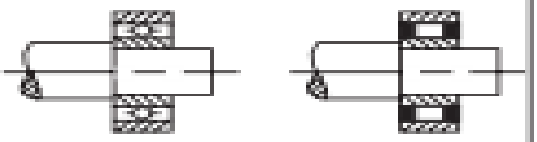
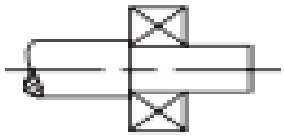
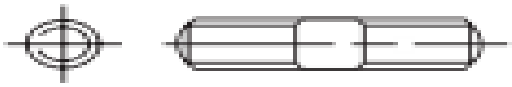
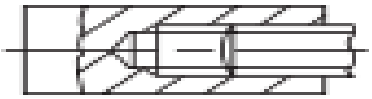
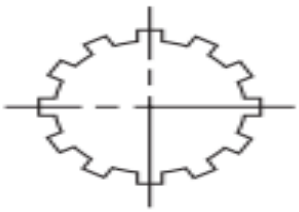
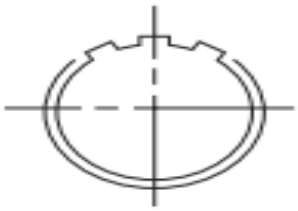
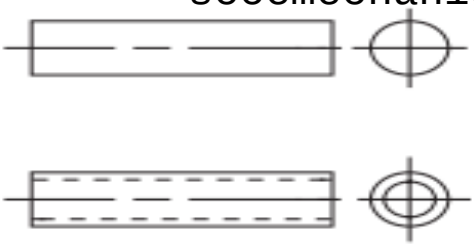
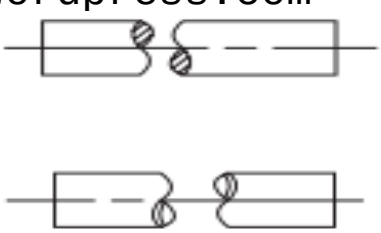
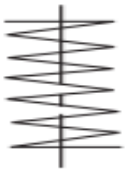
Type	Convention	Material
Metals		Steel, Cast Iron, Copper and its Alloys, Aluminium and its Alloys, etc.
		Lead, Zinc, Tin, White-metal, etc.
Glass		Glass
Packing and Insulating material		Porcelain, Stoneware, Marble, Slate, etc.
		Asbestos, Fibre, Felt, Synthetic resin products, Paper, Cork, Linoleum, 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

Fig. 2.26 Conventional representation of materials

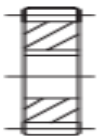
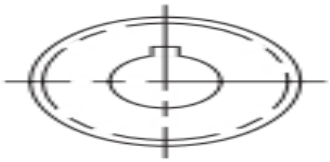
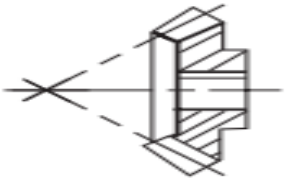
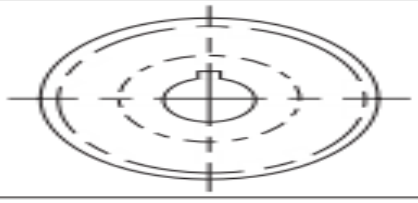
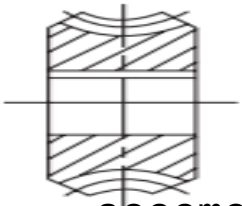
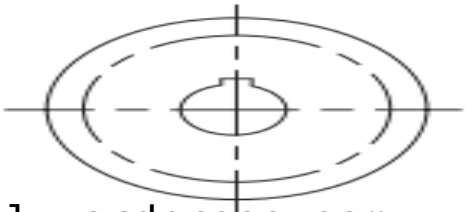
Title	Subject	Convention
Straight knurling		
Diamond knurling		
Square on shaft		

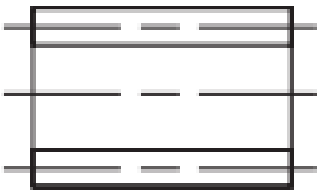
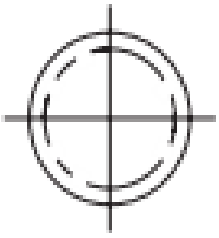
Holes on circular pitch		
Bearings		
External screw threads (Detail)		
Internal screw threads (Detail)		
Screw threads (Assembly)		

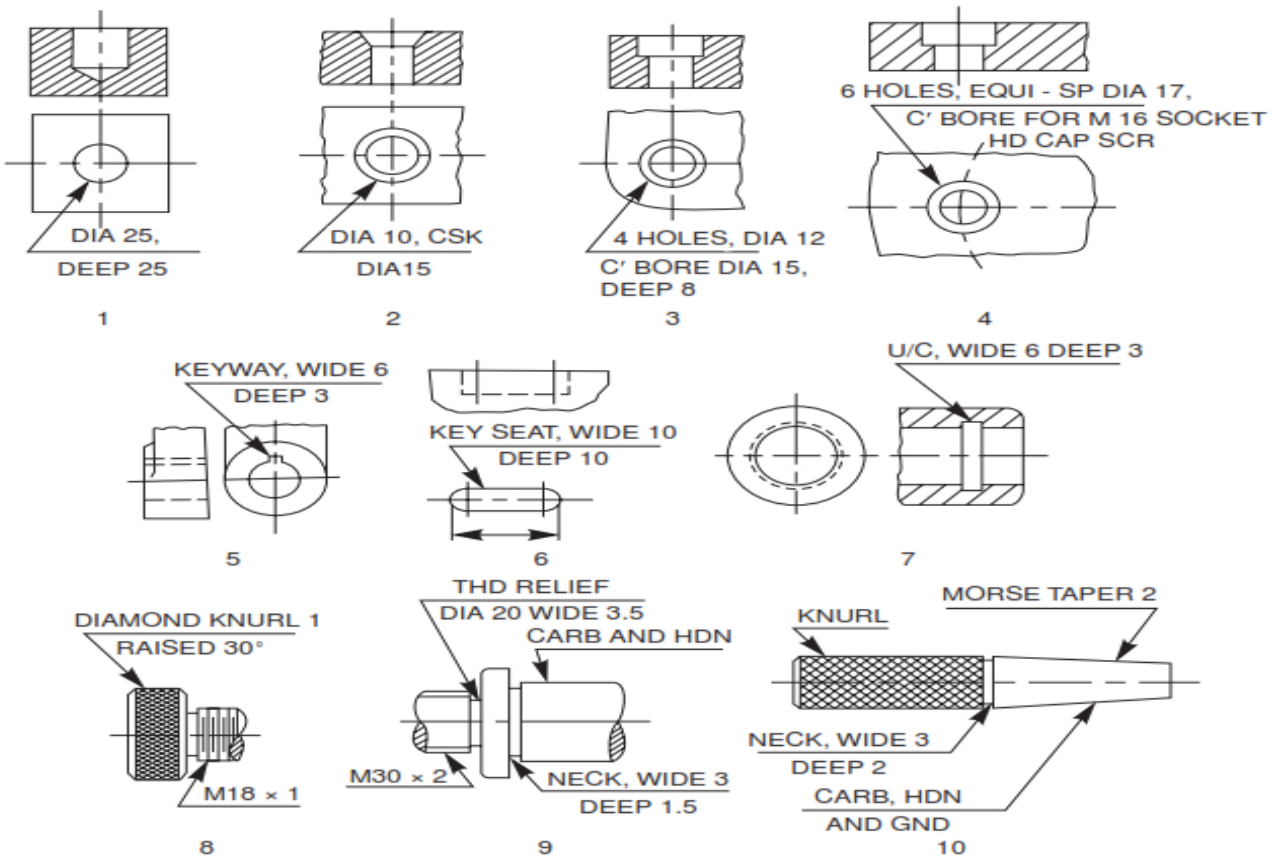
Splined shafts		
Interrupted views		
Semi-elliptic leaf spring		

Semi-elliptic leaf spring with eyes			
	Subject	Convention	Diagrammatic Representation
Cylindrical compression spring			
Cylindrical tension spring			

Conventional representation of machine components

Title	Convention	
Spur gear		
Bevel gear		
Worm wheel		

Worm		



Method of indicating notes

S.No.	Note	Meaning / Instruction
1.	DIA 25 DEEP 25	Drill a hole of diameter 25 mm, to a depth of 25 mm.
2.	DIA 10 CSK DIA 15	Drill a through hole of diameter 10 mm and countersink to get 15 mm on top.
3.	4 HOLES, DIA 12 C BORE DIA 15 DEEP 8	Drill through hole of ϕ 12 mm, counterbore to a depth of 8 mm, with a ϕ 15 mm, the number of such holes being four.
4.	6 HOLES, EQUI-SP DIA 17 C BORE FOR M 16 SOCKET HD CAP SCR	Drill a through hole of ϕ 17 and counterbore to insert a socket headed cap screw of M 16. Six holes are to be made equi-spaced on the circle.
5.	KEYWAY, WIDE 6 DEEP 3	Cut a key way of 6 mm wide and 3 mm depth.
6.	KEY SEAT, WIDE 10 DEEP 10	Cut a key seat of 10 mm wide and 10 mm deep to the length shown.
7.	U/C, WIDE 6 DEEP 3	Machine an undercut of width 6 mm and depth 3 mm.
8.	(a) DIAMOND KNURL 1 RAISED 30°	Make a diamond knurl with 1 mm pitch and end chamfer of 30°.
	(b) M 18 × 1	Cut a metric thread of nominal diameter 18 mm and pitch 1 mm.
9.	(a) THD RELIEF, DIA 20 WIDE 3.5	Cut a relief for thread with a diameter of 20.8 mm and width 3.5 mm.
	(b) NECK, WIDE 3 DEEP 1.5	Turn an undercut of 3 mm width and 1.5 mm depth
	(c) CARB AND HDN	Carburise and harden.
10.	(a) CARB, HDN AND GND	Carburise, harden and grind.
	(b) MORSE TAPER 2	Morse taper No. 1 to be obtained.
	A 6 REAM FOR TAPER N	Drill and ream with taper reamer for a diameter of 6 mm to suit the pin specified.
	ACME THD	Cut an ACME thread of pitch 6 mm.

UNIT –II
LIMITS and FITS

Sheet No.2

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.

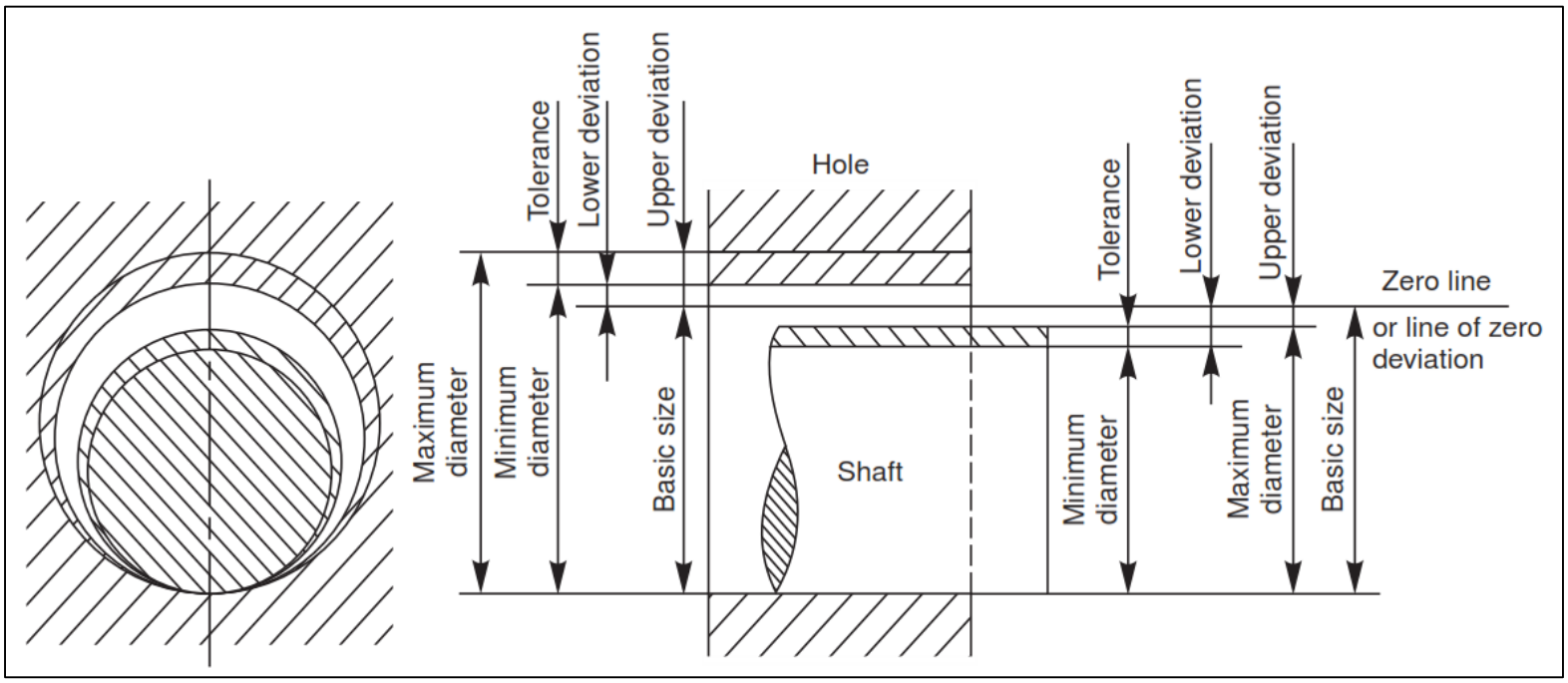
Deviation: It is the algebraic difference between a size (actual, maximum, etc.) and the corresponding basic size.

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 corresponding basic 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 in 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.

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.

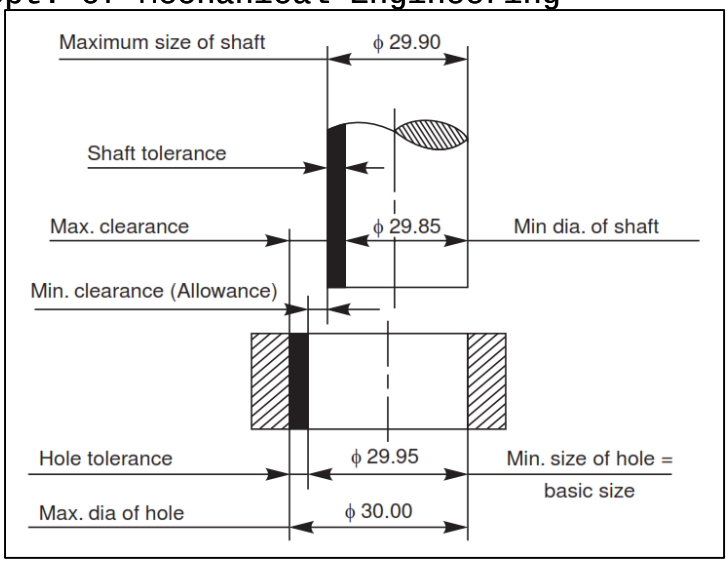
Interference Fit: If the difference between the hole and shaft sizes is negative before assembly; an interference fit is obtained.

HOLE BASIS SYSTEM, SHAFT BASIS SYSTEM

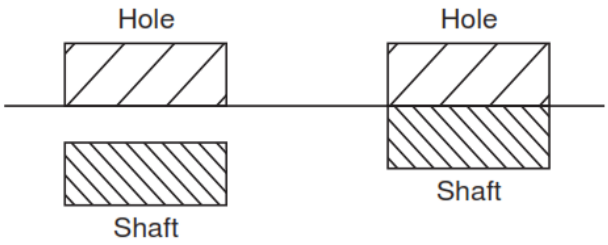
In working out limit dimensions for the three classes of fits; two systems are in use, *viz.*, the hole basis system and shaft basis system

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*'.

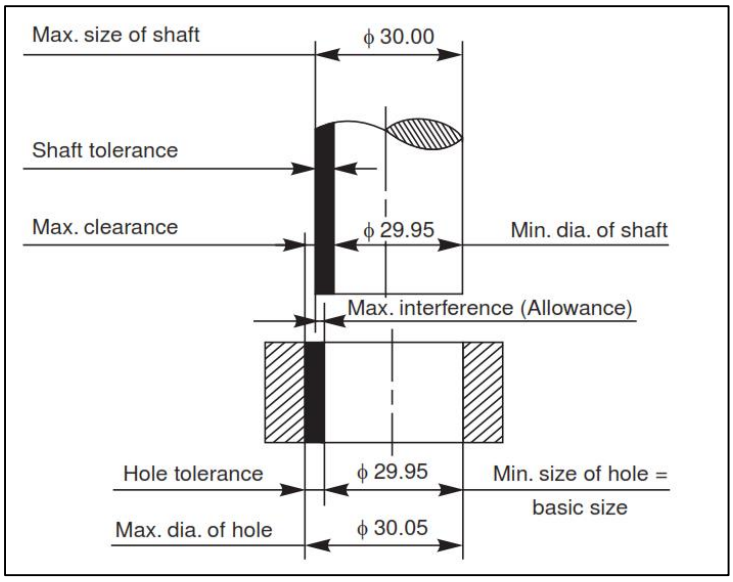
HAFT BASIS SYSTEM: In this system, the size of the hole is obtained by adding the allowance to the basic size of the Shaft. plied to each part. In this system, the upper deviation of the shaft is zero. The letter symbol for this situation is '*h*'.



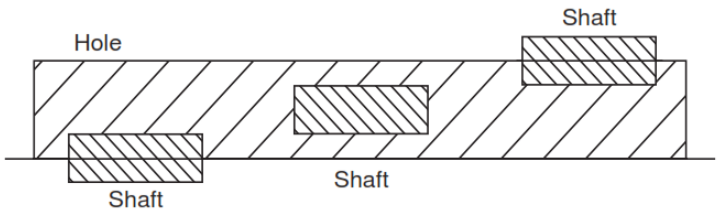
Clearance fit



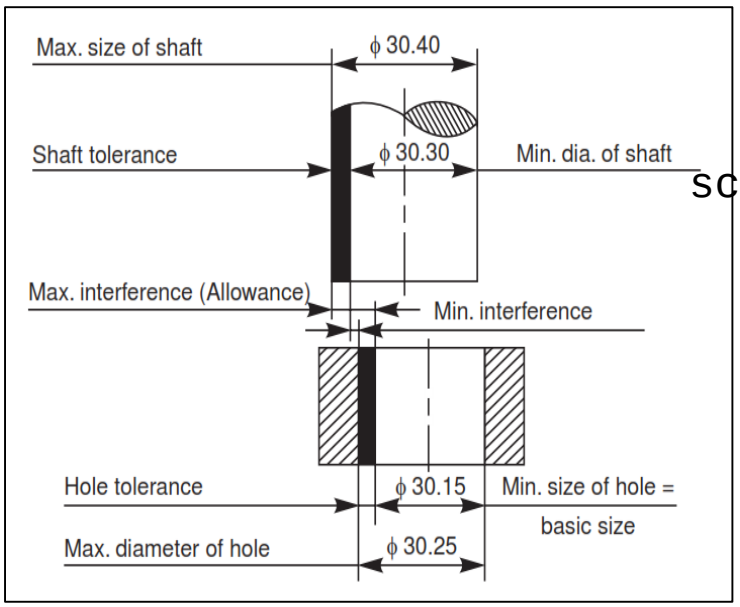
Clearance fit



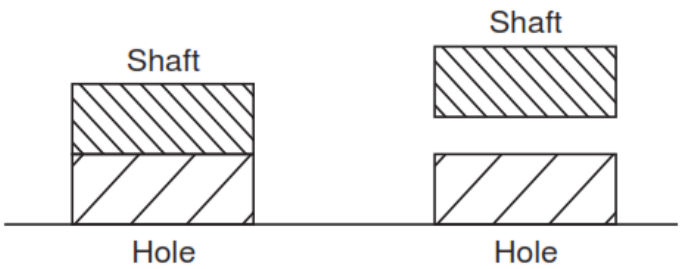
Transition fit



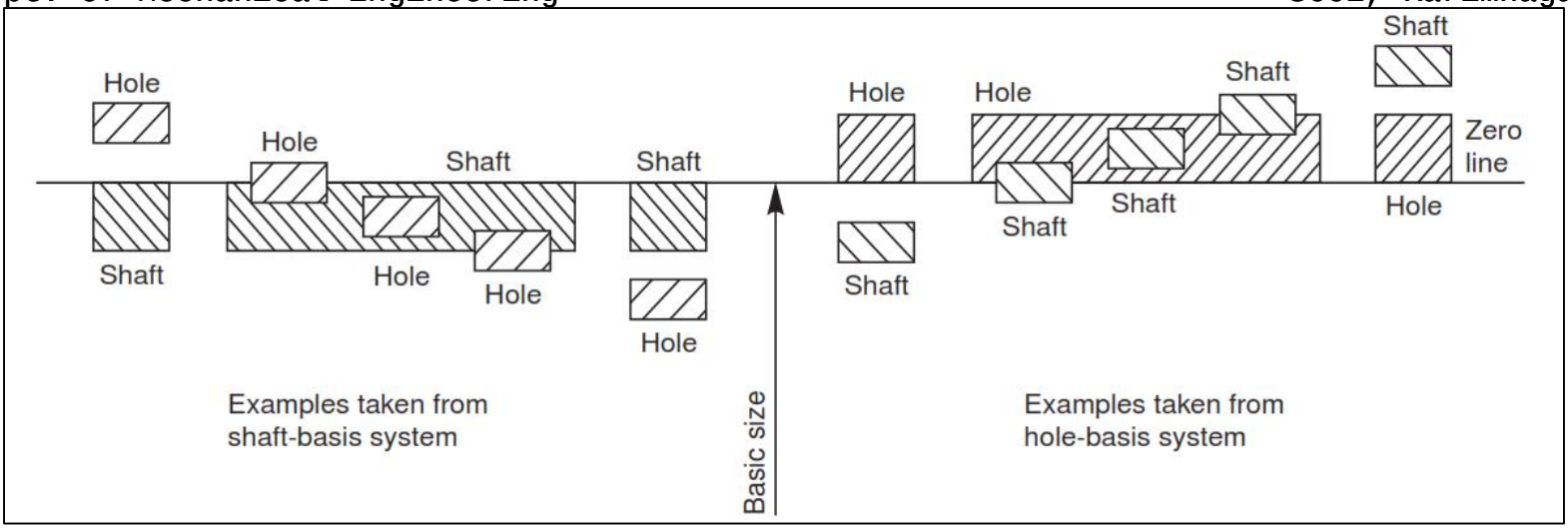
Transition fit



Interference fit



Interference fit

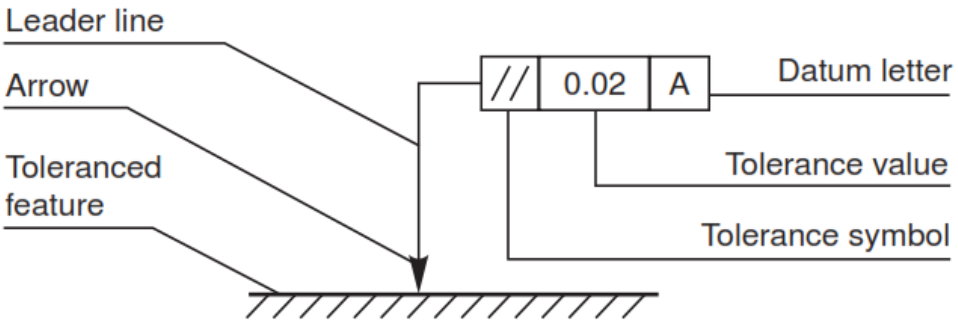


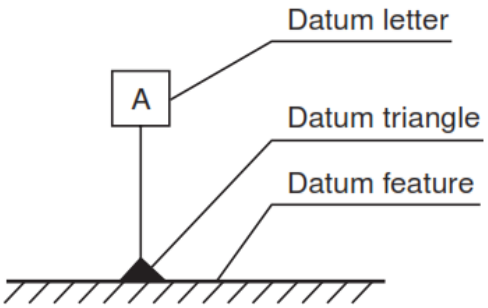
shaft basis and hole basis systems

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	

Symbols representing the characteristics to be toleranced

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



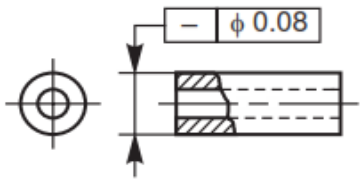
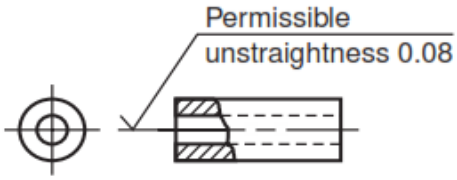
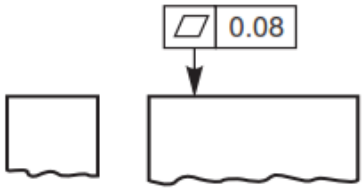
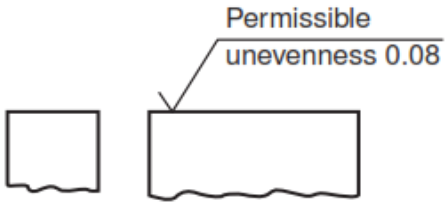
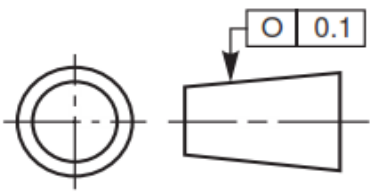
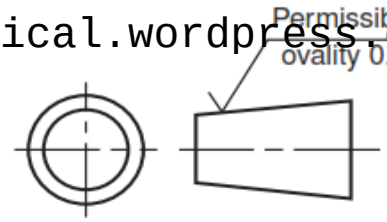
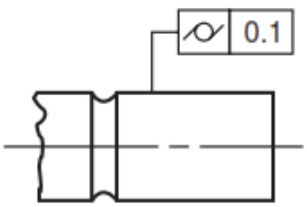
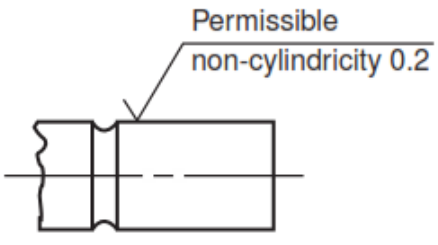


ΘΘΘΦΦΘΘΘ

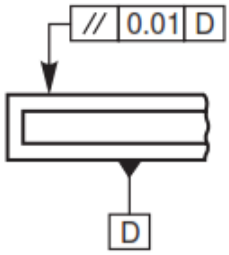
UNIT III

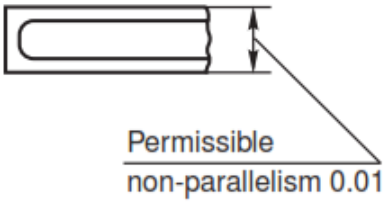
Sheet no.3

FORM AND POSITIONAL TOLERANCES

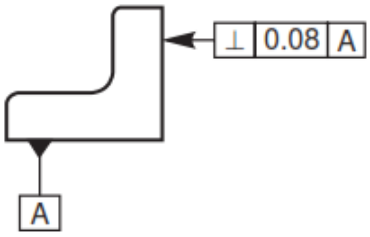
As per the standard	*As prevalent in industry*
1. Straightness tolerance	
	
2. Flatness tolerance	
	
3. Circularity tolerance	
	
4. Cylindricity tolerance	
	

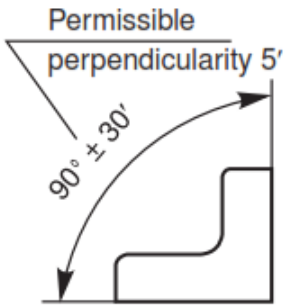
5. Parallelism tolerance



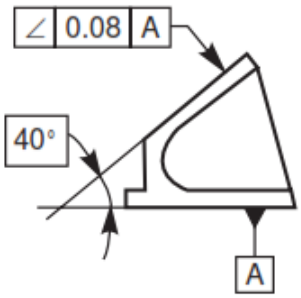


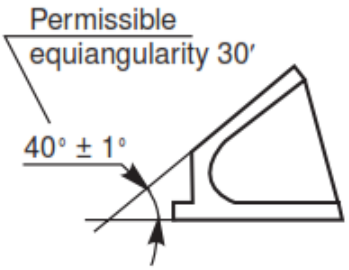
6. Perpendicularity tolerance



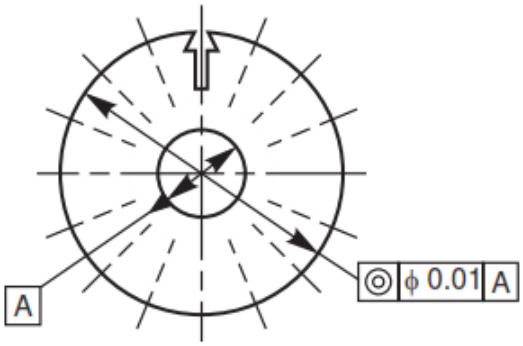


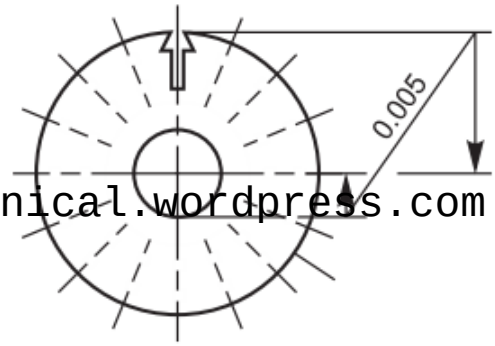
7. Angularity tolerance



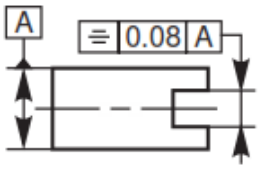


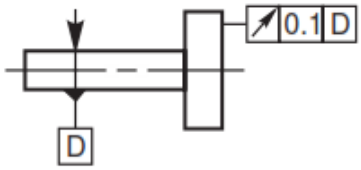
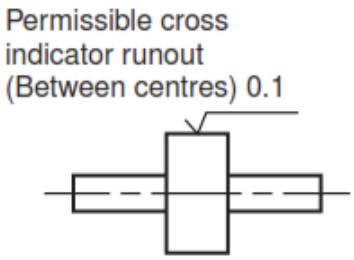
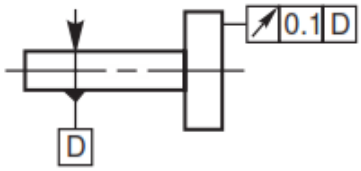
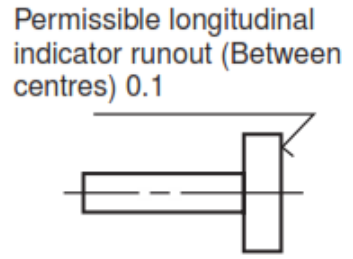
8. Concentricity and coaxiality tolerance





9. Symmetry tolerance



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

Systems of indication of tolerances of form and of position

ΘΘΘΦΦΘΘΘ

UNIT IV & UNIT V

Sheet no.4

Surface Roughness and its Indication & Heat and Surface Treatment Symbols

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 parts is also reduced due to better surface finish.

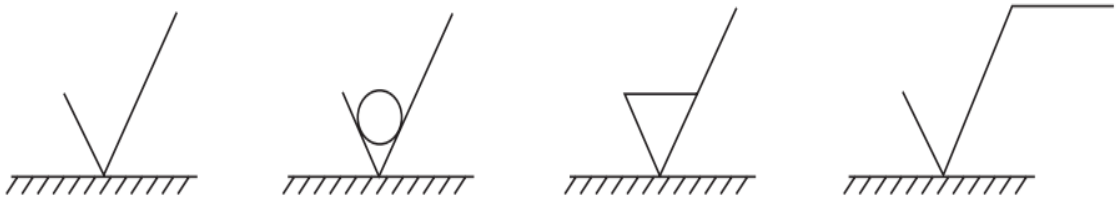
Surface Roughness Number: The surface roughness number represents the average departure of the surface from perfection over a prescribed sampling length and is expressed in microns.

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

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

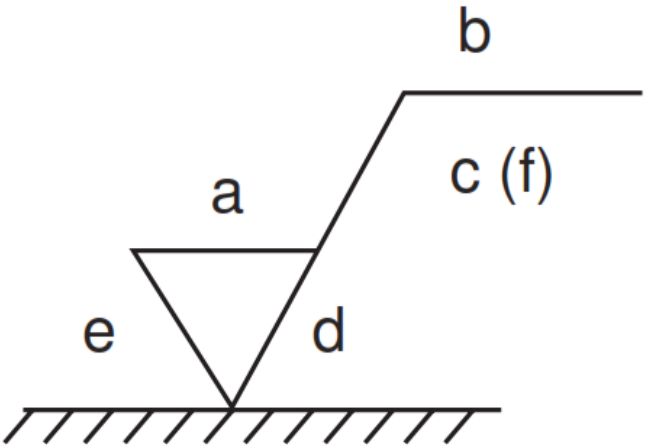
1. Straight edge 2. Surface gauge 3. Optical flat 4. Tool maker's microscope 5. Profilometer 6. Profilograph 7. Talysurf.

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



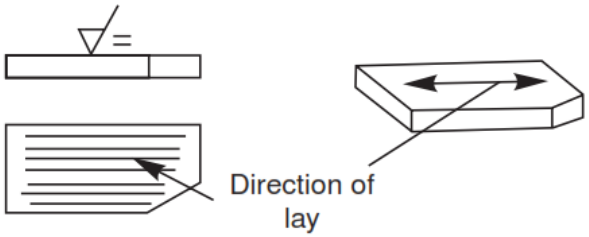
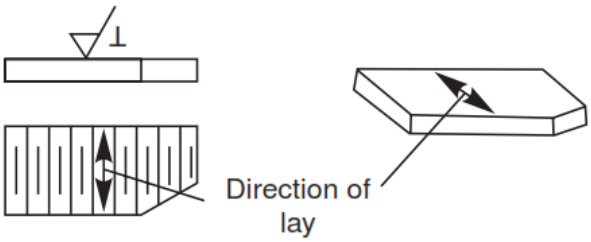
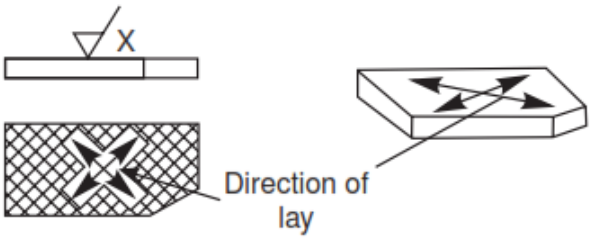
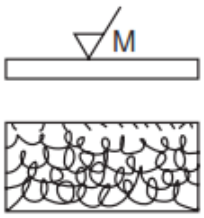
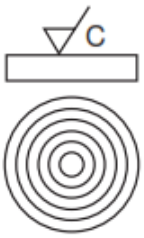
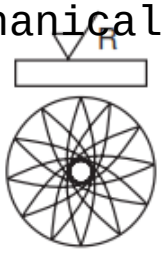
a. Roughness Number,
b. Type Of machining Process,
c. C(f): Sampling Length,
d. Direction Of Lay,
e. Machining Allowance

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.

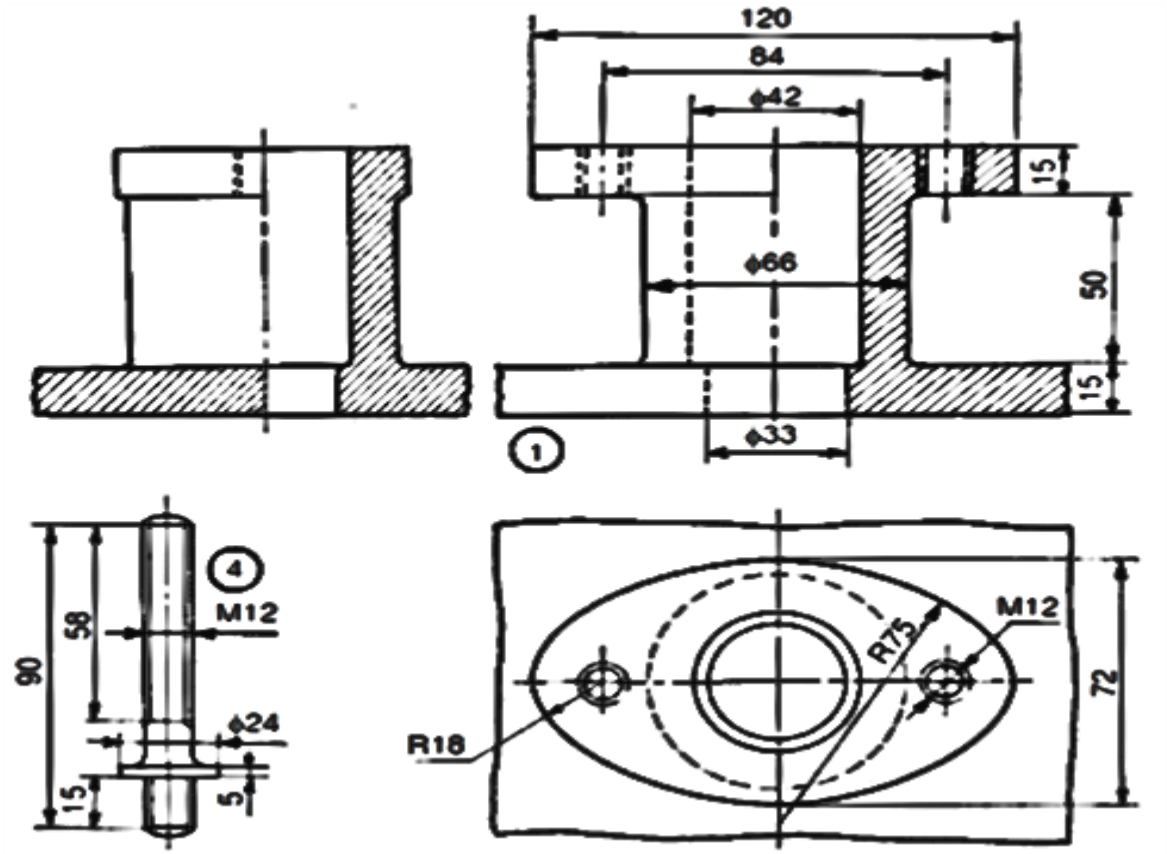
Symbol	*Interpretation*	
=	Parallel to the plane of projection of the view in which the symbol is used	
⊥	Perpendicular to the plane of projection of the view in which the symbol is used	
X	Crossed in two slant directions relative to the plane of projection of the view in which the symbol is used	
M	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	

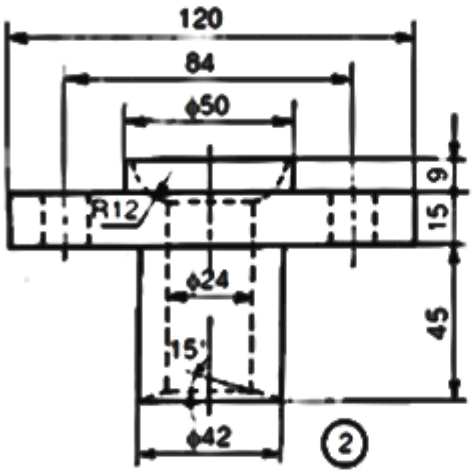
Symbols specifying the directions of lay

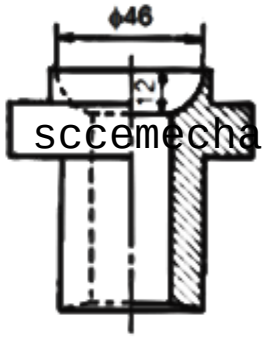
UNIT VI **Sheet No: 5-16**

DETAILED and PART DRAWINGS

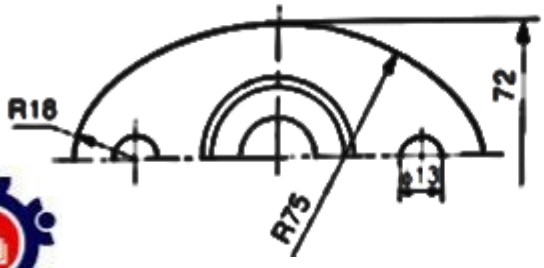
Stuffing Box is used to prevent loss of fluid such as steam, between sliding or turning parts of machine elements. In a steam engine, when the piston rod reciprocates through the cylinder cover; stuffing box provided in the cylinder cover, prevents leakage of steam from the cylinder.

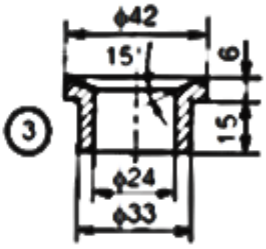






Stuffing box

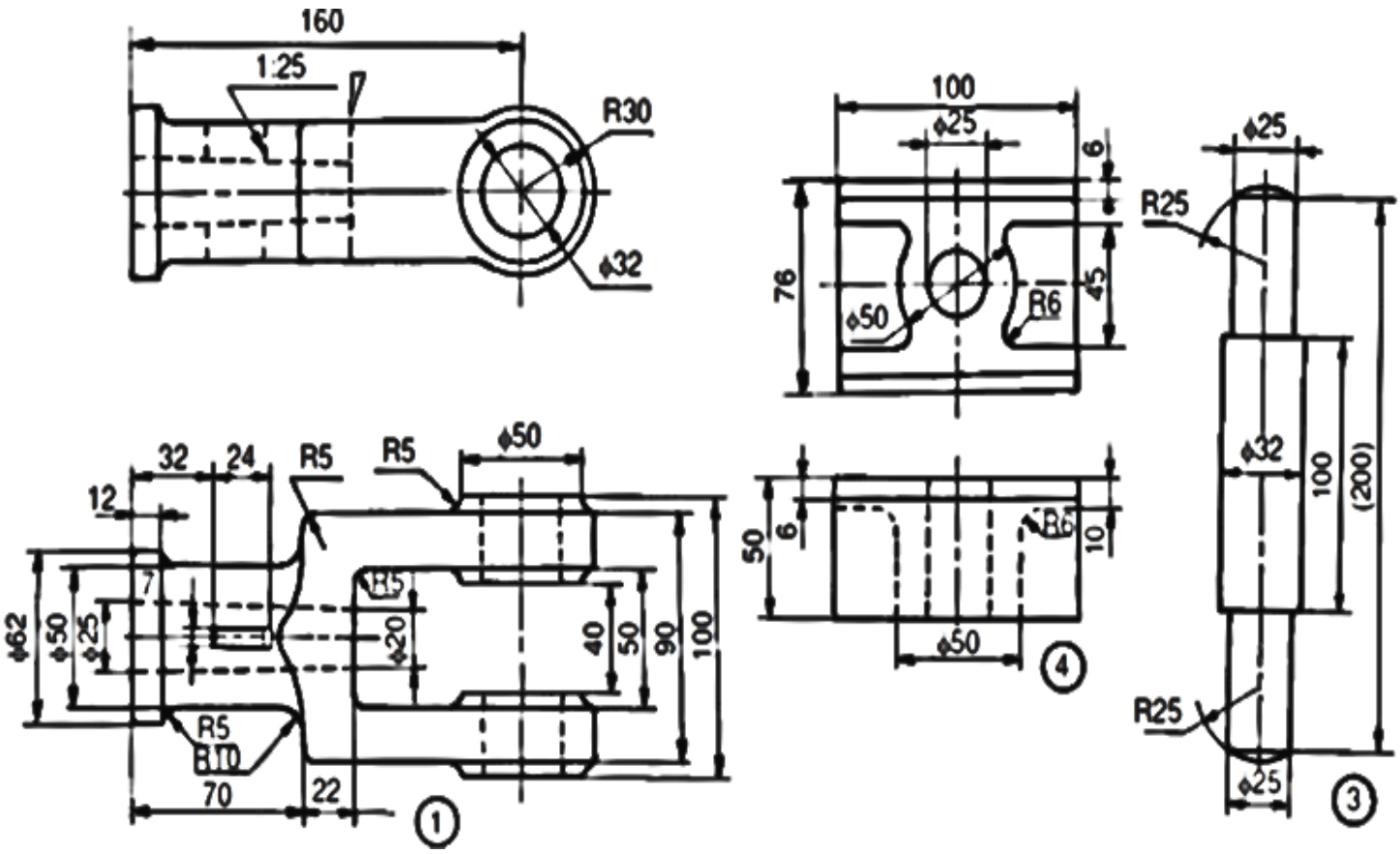


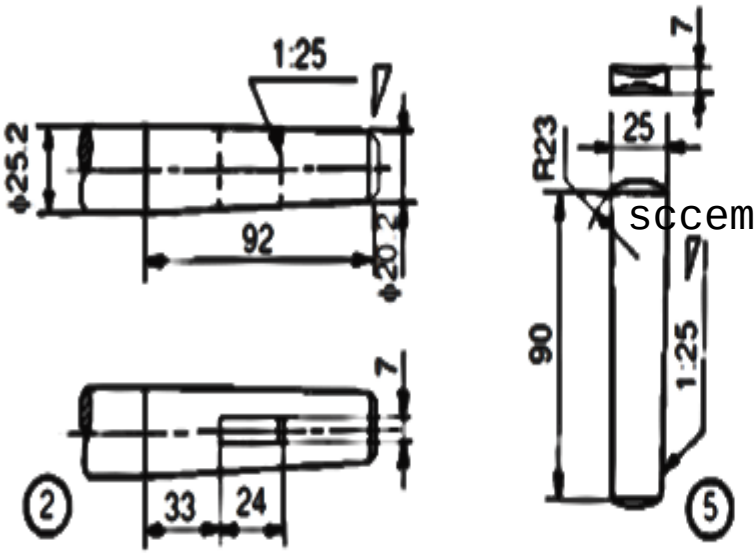


Parts list

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

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 gudgeon 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.



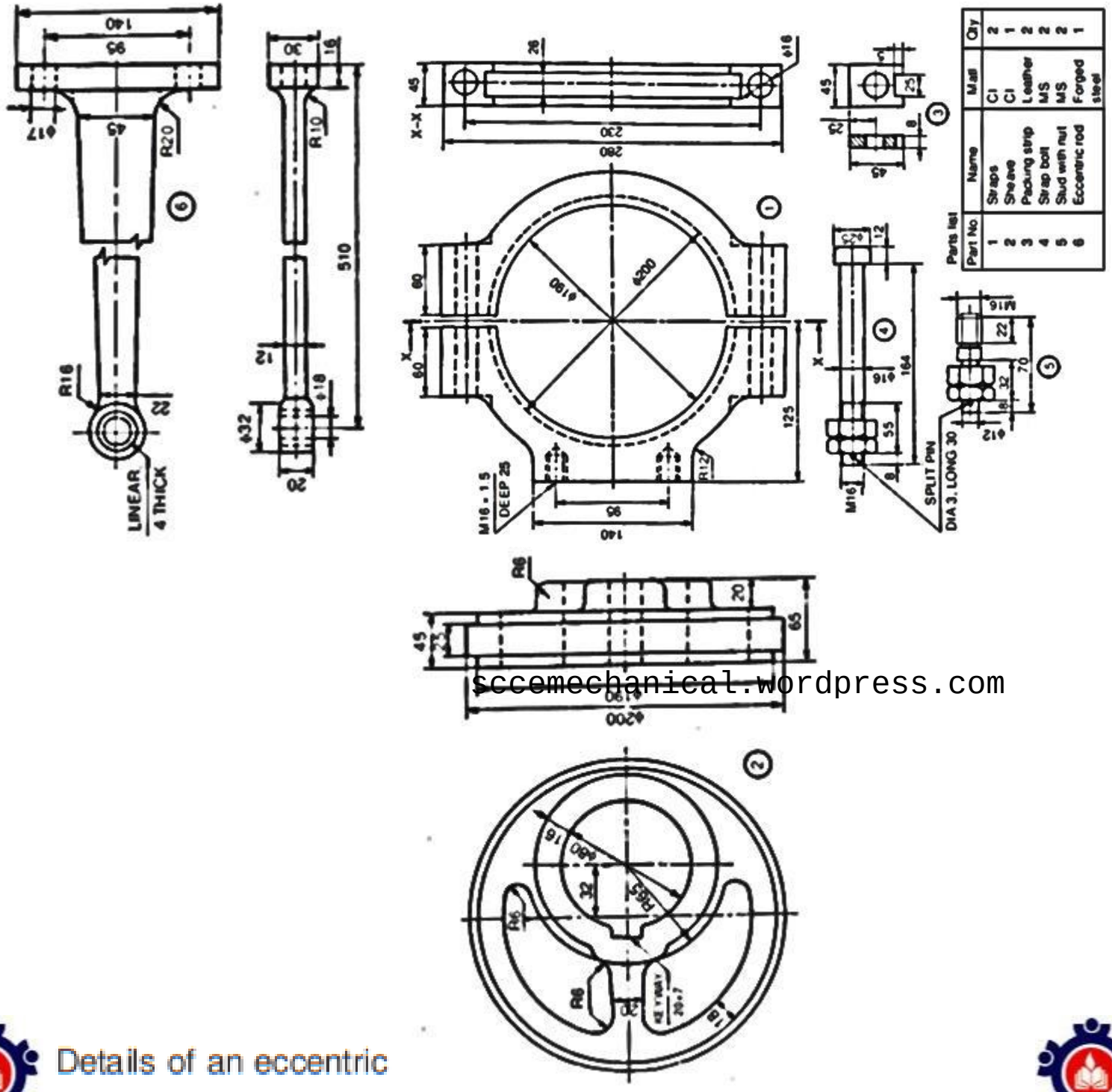


Parts list

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

Steam engine crosshead

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.

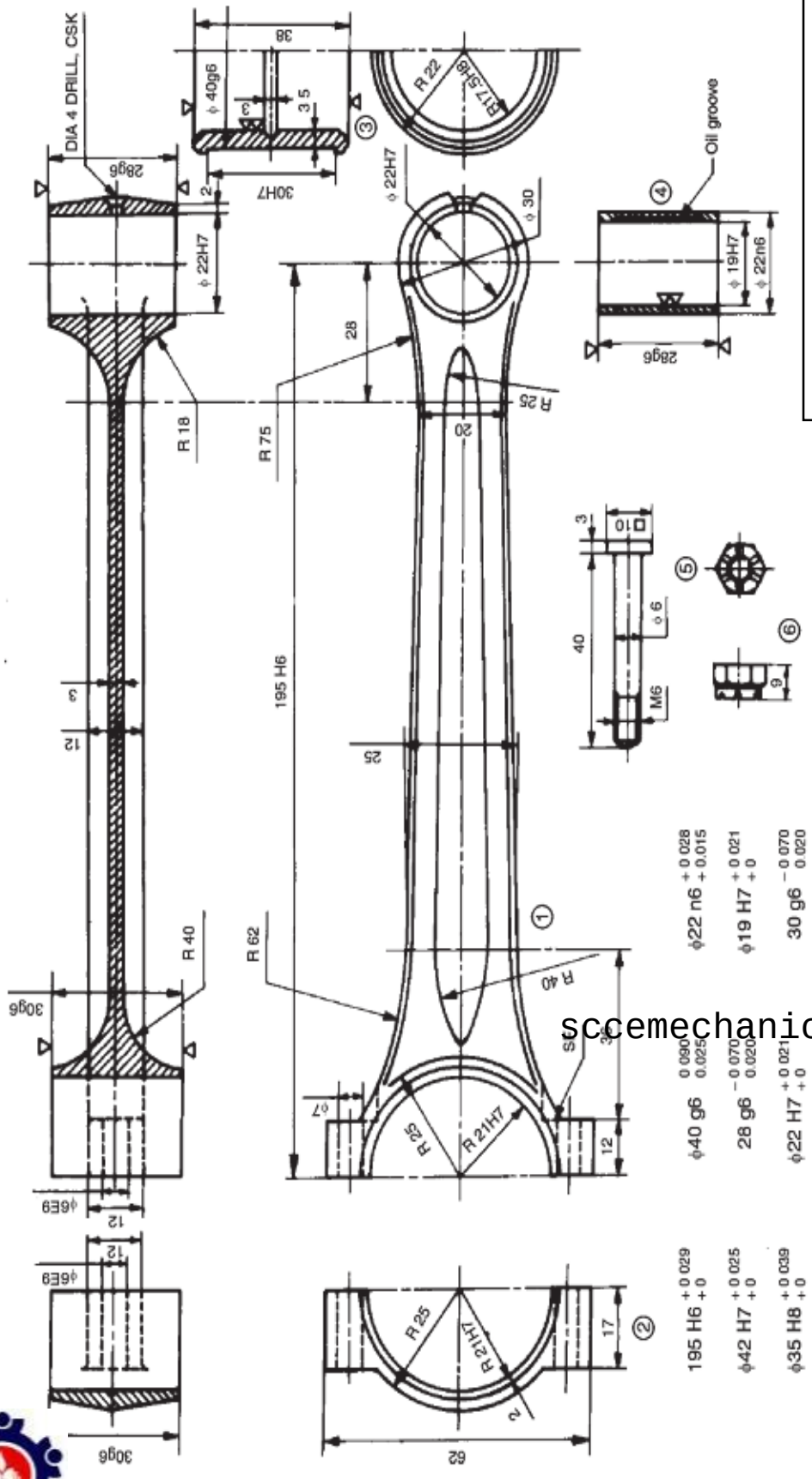


Details of an eccentric

Connecting rod is used in center 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 center 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.

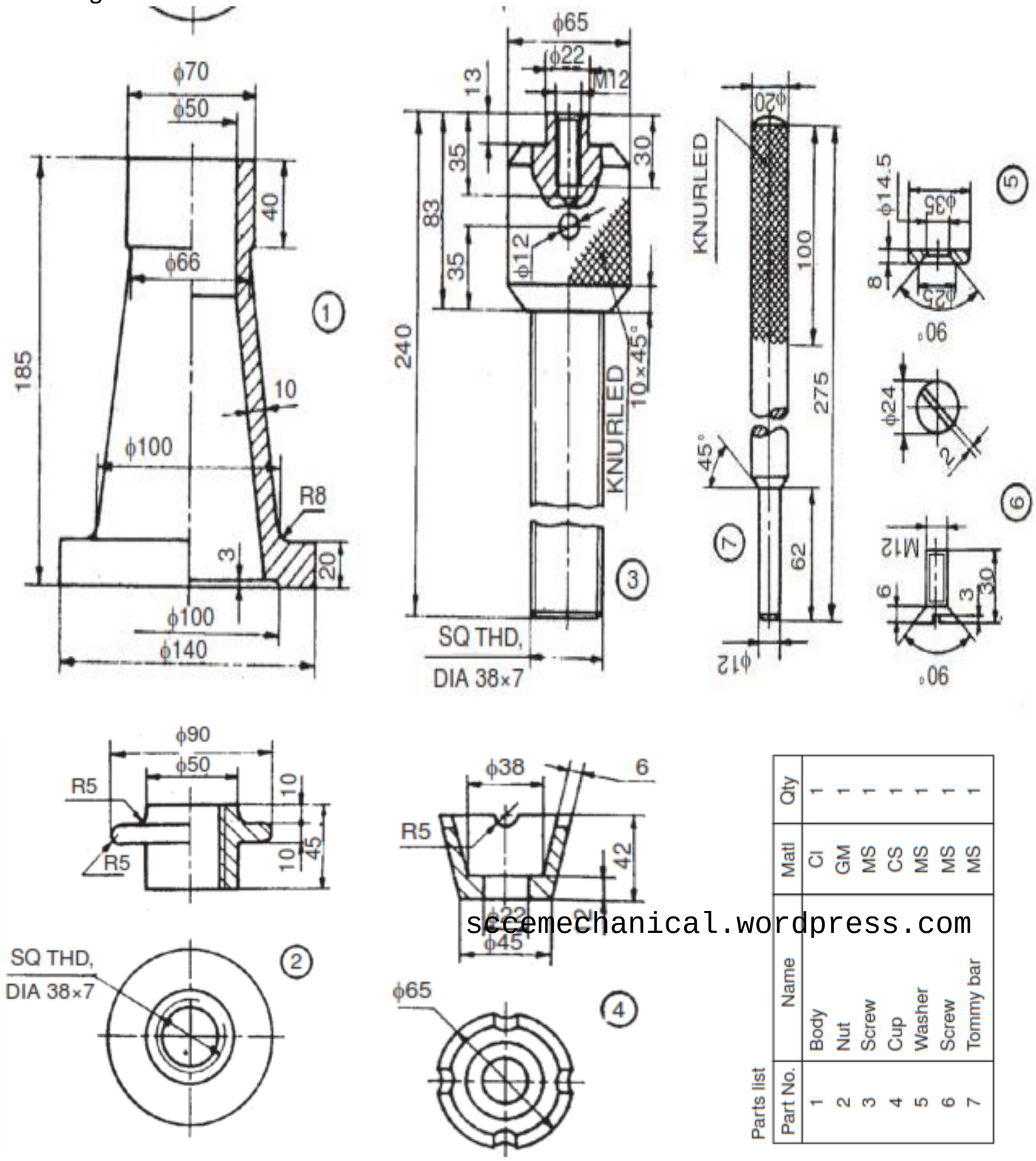
Parts list

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



Details of petrol engine connecting rod

Screw jacks are used for raising heavy loads through very small heights. 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.

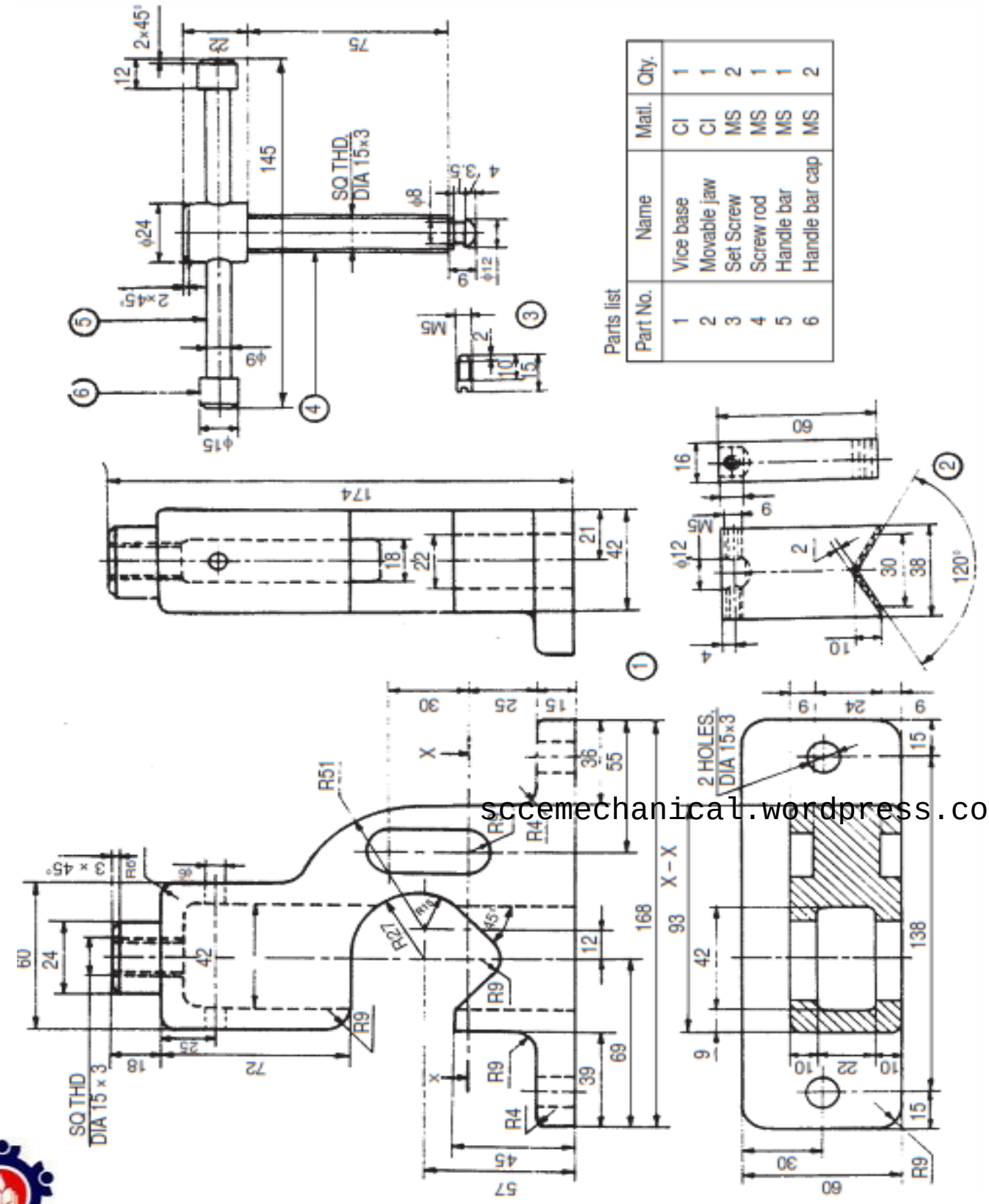


Parts list

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

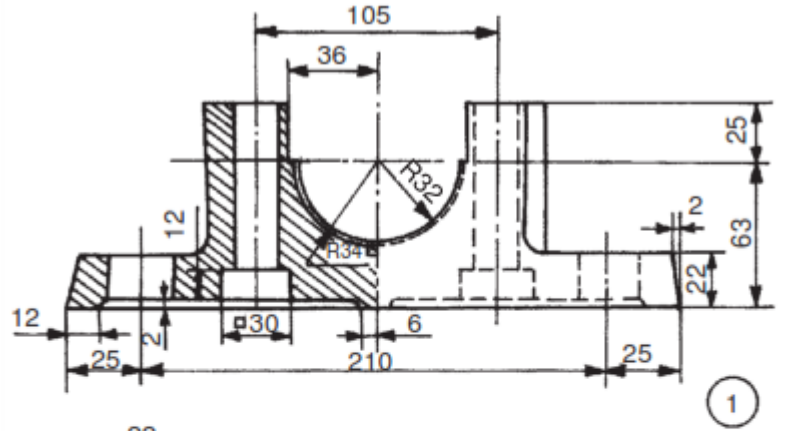
Screw jack

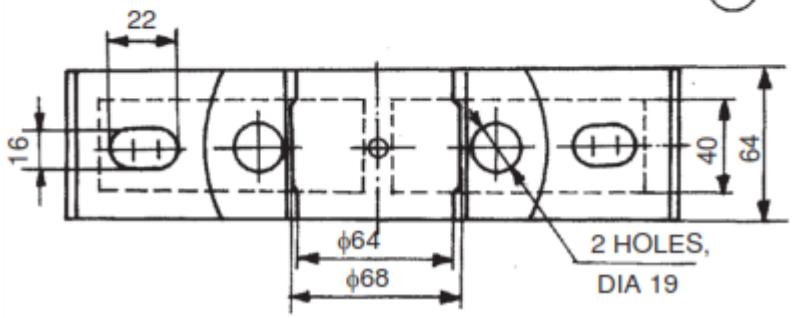
Pipe vices are designed for holding pipes, to facilitate operations such as threading or cutting-off to required length. To assemble the vice, the screw rod 4 is screwed into the base 1 from above. When the circular groove at the end of the screw rod is in-line with the 6 mm diameter transverse hole in the housing, the movable jaw 2 is inserted from below. After alignment, two set screws 3 are inserted into the jaw. This arrangement allows the jaw to move vertically without rotation when the handle is operated and the screw is turning. The V-shaped base of the housing can accommodate pipes of different diameters. The serrations provided on the V-shaped end of the movable jaw provide effective grip on the pipe surface.

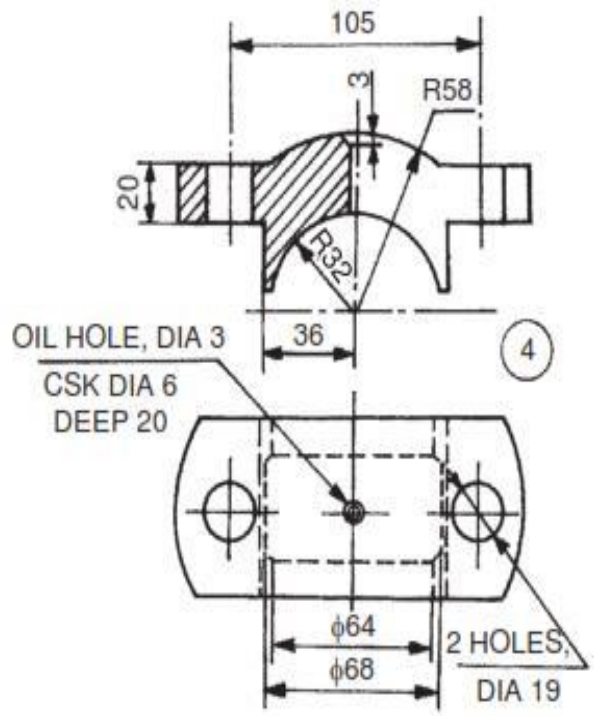


pipe vice

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.

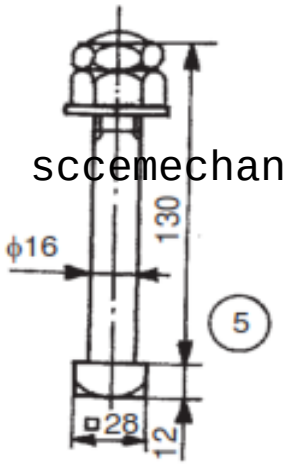


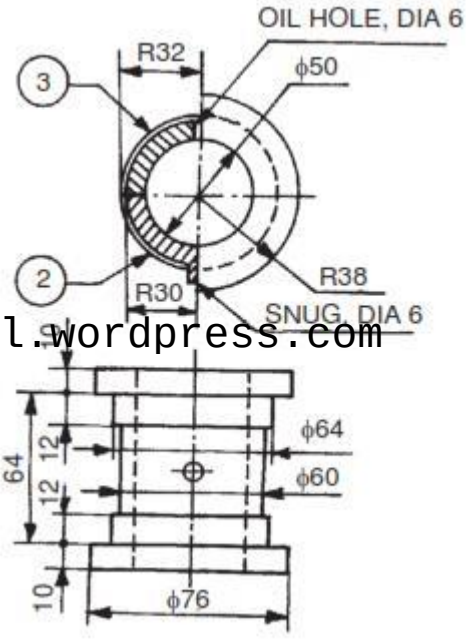




Sl. No.	Name	Matl.	Qty.
1	Base	CI	1
2	Bearing brass	Bronze	1
3	Bearing brass	Bronze	1
4	Cap	CI	1
5	Bolt with nuts	MS	2

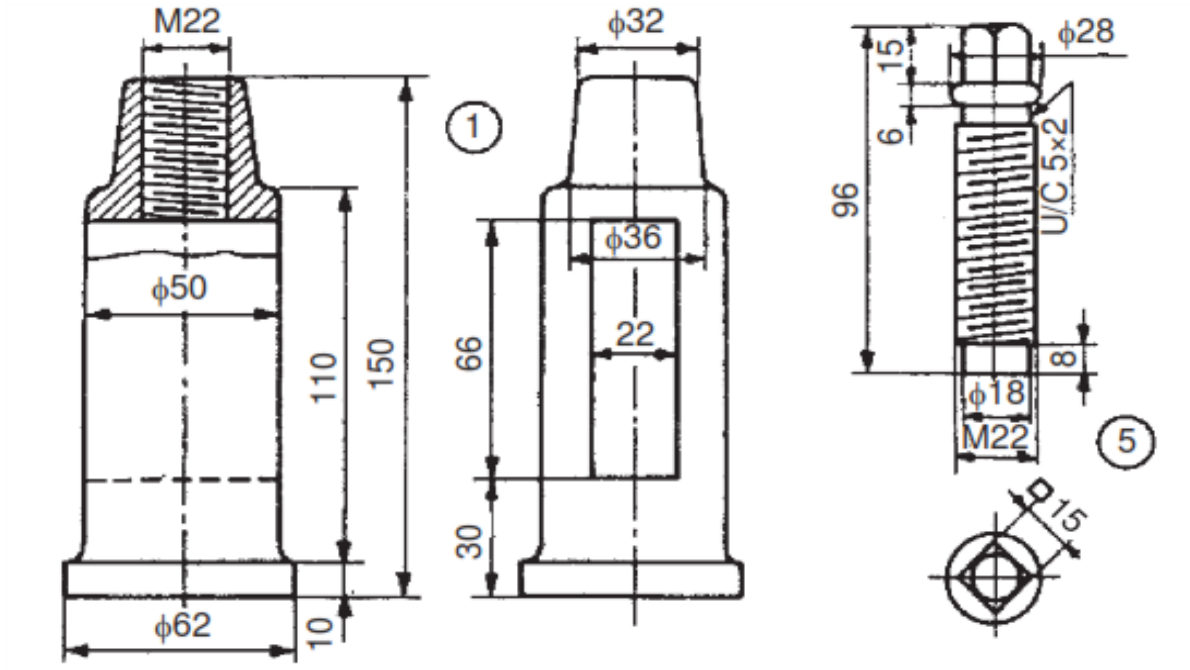
Parts list

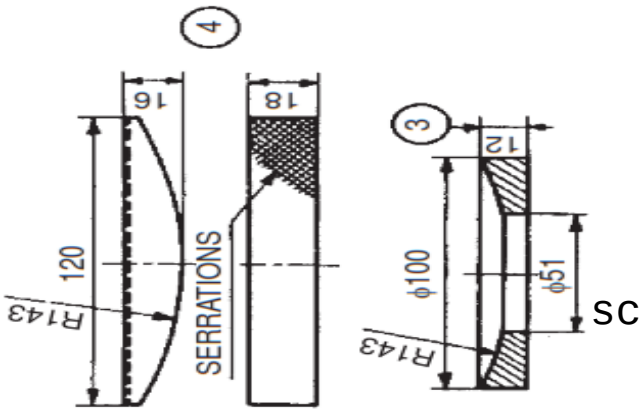


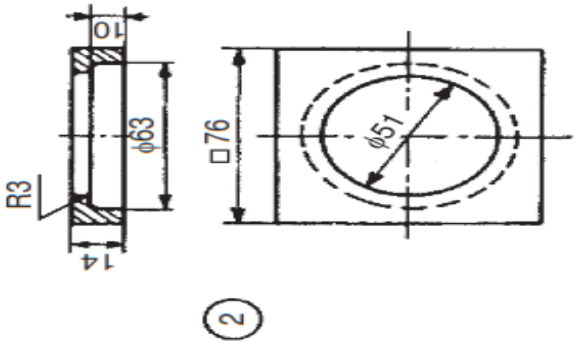


Plummer block

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.





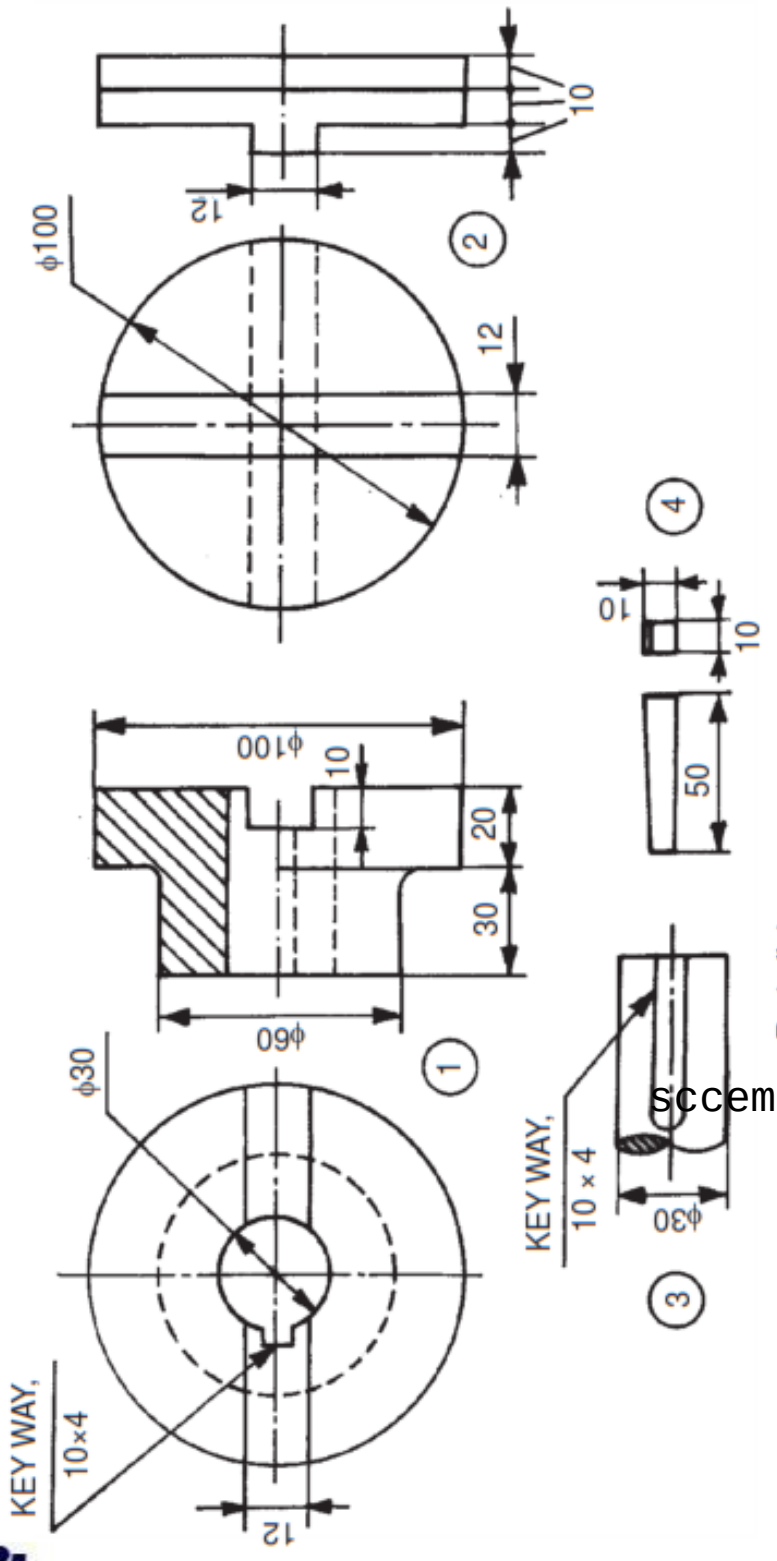


Parts list

No.	Name	Mtl	Qty
1	Piller	MS	1
2	Block	MS	1
3	Ring	MS	1
4	Wedge	MS	1
5	Screw	T6	1

tool post

Oldham coupling is known as a non-aligned coupling and is used to connect two parallel shafts, whose axes are at a small distance apart. The two flanges 1 are mounted on the ends of shafts 3 by means of sunk keys 4. The flanges are having rectangular slots in them. These flanges are set such that, the slots in them are at right angle to each other. The circular disc 2 is now positioned in-between them so that the projections in the circular disc, enter into the corresponding slots of the flanges. During rotation of the shafts, the central disc slides in the slots of the flanges.

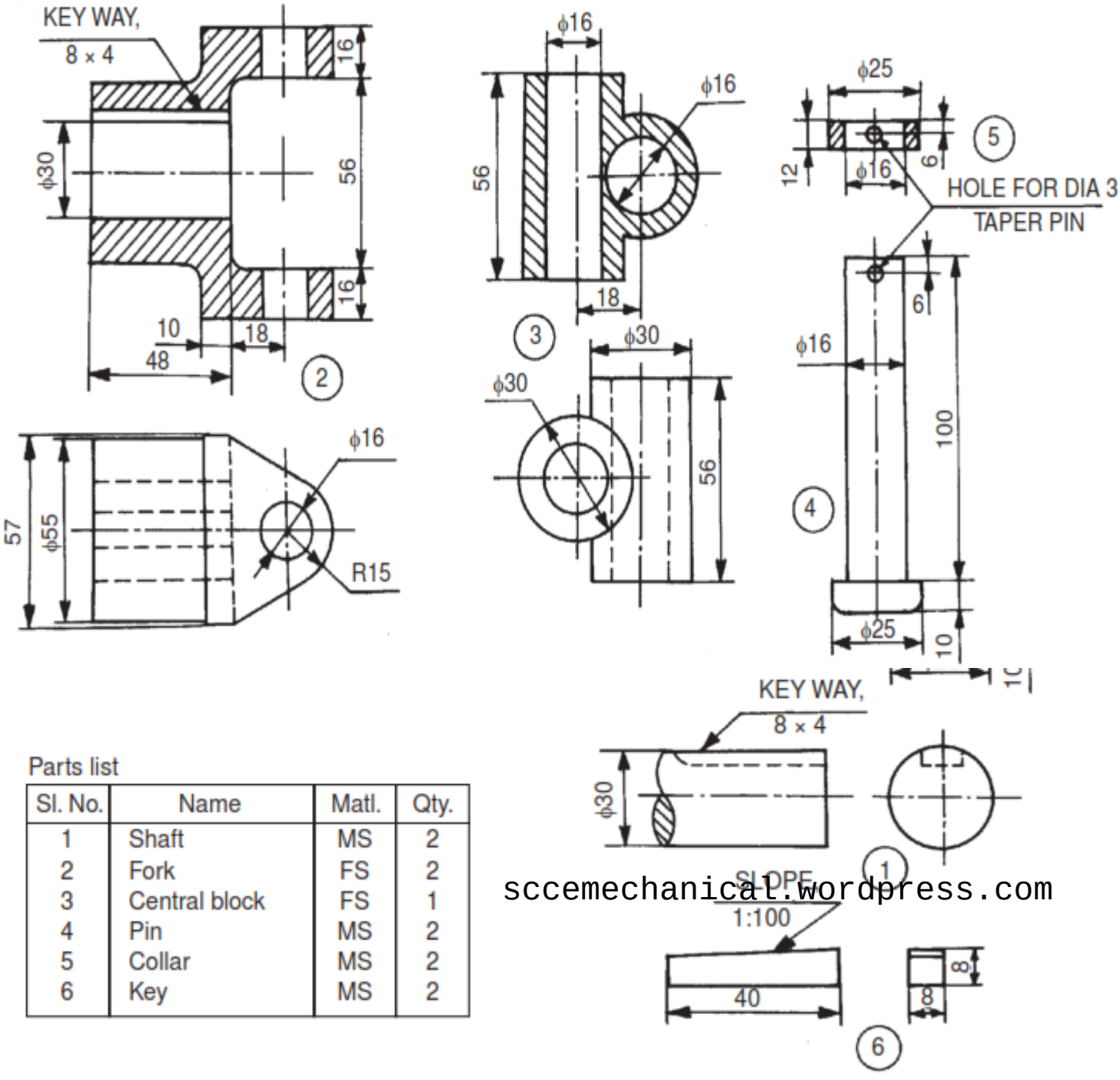


Parts list

Sl. No.	Name	Matl.	Qty.
1	Flange	MS	2
2	Disc	MS	1
3	Shaft	MS	2
4	Key	MS	2

Oldham coupling

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.

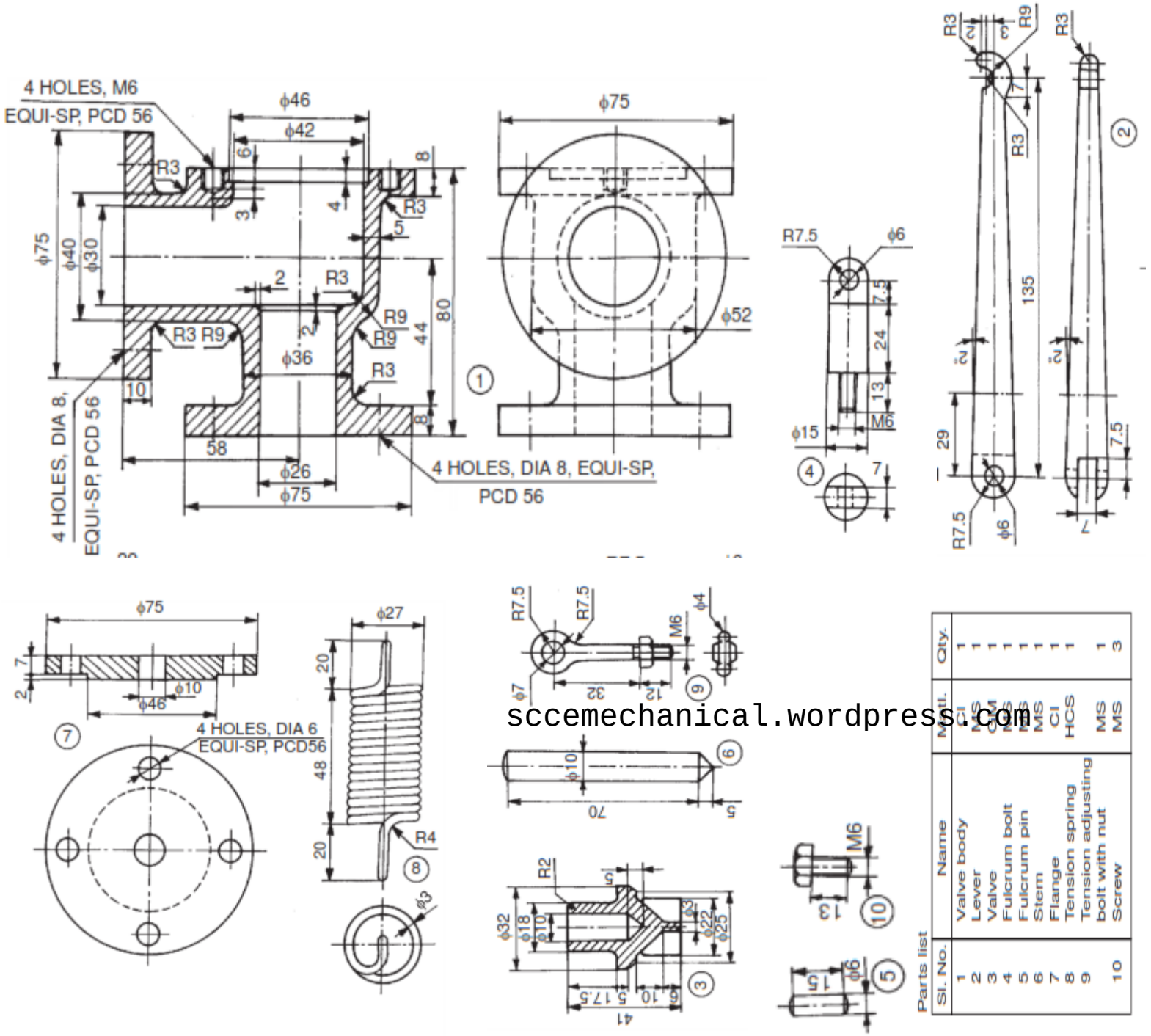


Parts list

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

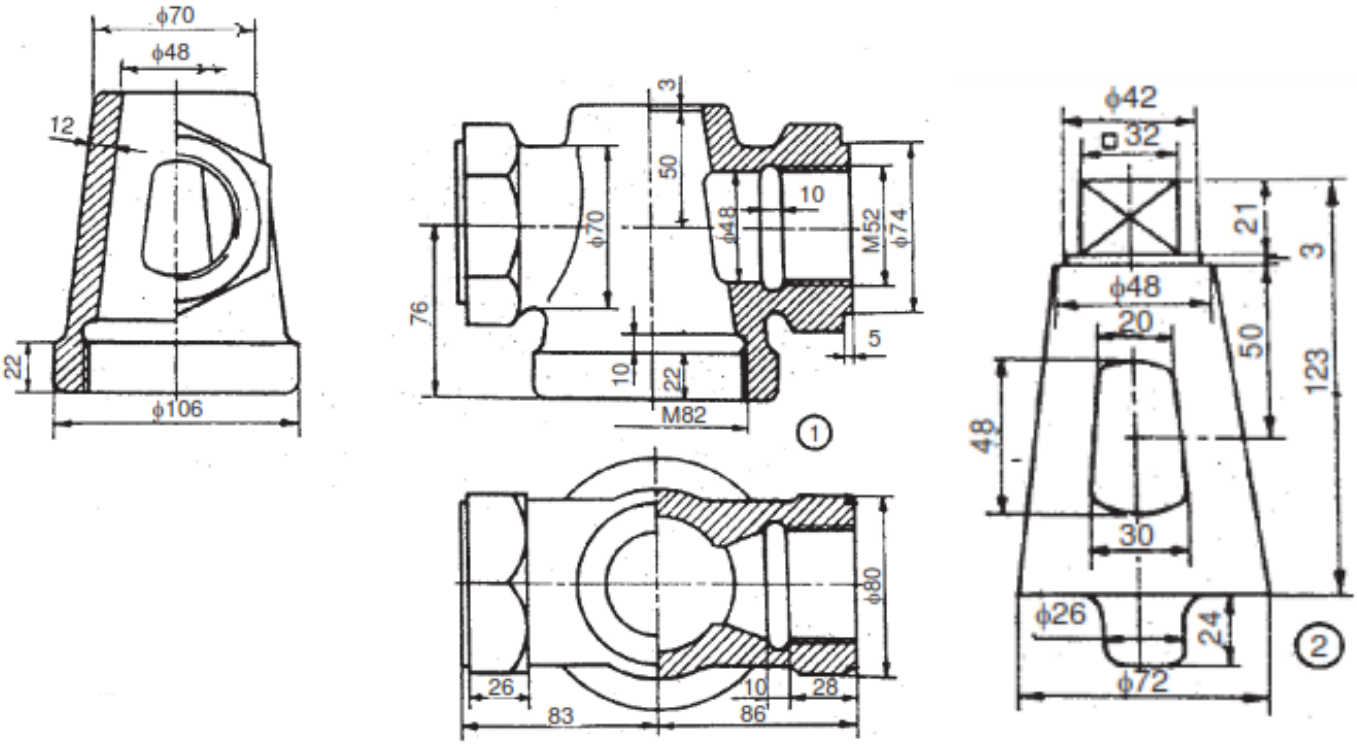
Universal coupling

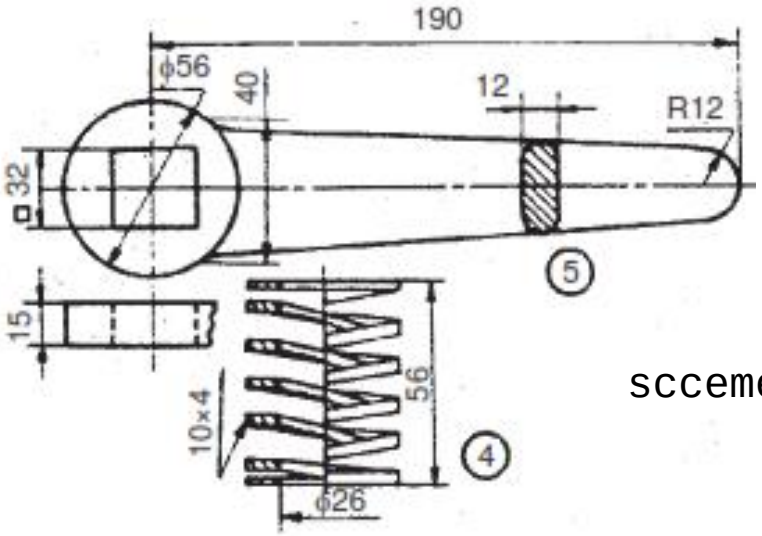
Safety or relief valves are used as boiler mountings and they let off steam from inside the boiler Whenever the pressure exceeds the set value. Thus, these valves safe guard the boilers. The pressure may be set by using a dead weight or a tension spring with tension adjustment arrangement. **Spring loaded relief valve** in which a tension spring is used to set a pre-determined value for the steam pressure in the boiler. Valve 3 is placed vertically inside the valve body 1 and the valve seat is an integral part of the valve body, in the design considered. Stem 6 is located in the valve, with pointed end entering into the valve. Flange 7 is now placed over this assembly and fastened to the valve body by fulcrum bolt 4. Lever 2 is attached to the fulcrum bolt by using the fulcrum pin 5 such that, the lever rests on the stem 6. One end of the tension spring 8 is attached to the lever and the other end to the tension adjusting bolt 9. The tension adjusting bolt is attached to a base and the spring tension can thus be adjusted to any required value.



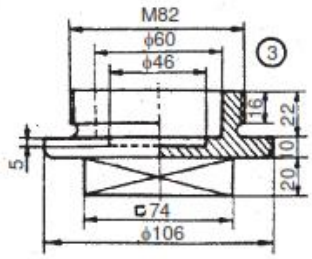
Spring loaded relief valve

Air cock valve is used to control air or gas supply. It consists of a plug 2 which is inserted into the body 1, from the bottom. The rectangular sectioned spring 4 is placed in position at the bottom of the plug and seated over the screw cap 3. The screw cap is operated to adjust the spring tension. Lever 5 with square hole is used to operate the cock. By a mere 90° turn, the cock is either opened or closed fully.





Parts list			
Part No.	Name	Matl	Qty
1	Body	CI	1
2	Plug	CI	1
3	Screw cap	MS	1
4	Spring	Spring S	1
5	Lever	FS	1



Air cock