GBN GOVT. POLYTECHNIC NILOKHERI

Branch: Mechanical Engineering

Semester: 3rd

Subject: Mechanical Engineering Drawing

Chapter 1
Limit, fits and tolerance

Need of limits, fits and tolerances

- For mass production and specialization.
- Standardization.
- Interchangeability.

❑ Dimensional Tolerances

- The difference between maximum and minimum limits.
- The system in which deviations are accepted is called limit system.

Term Related to Dimensional Tolerance

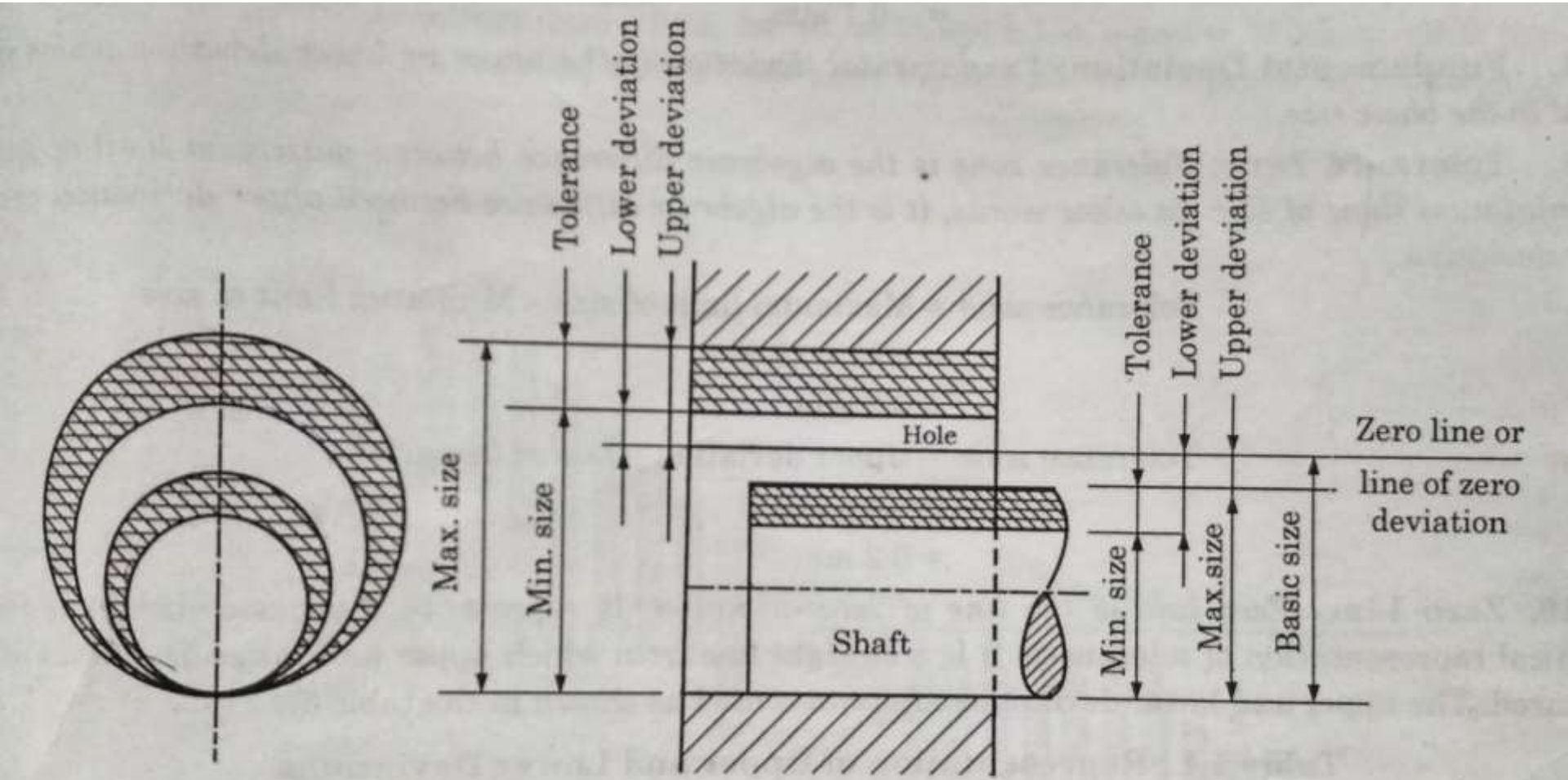


Fig. 1.1 : Basic size, Tolerances and Deviations

Term relating to dimensional tolerance

- **Basic size:**
  - The nominal diameter of the shaft (or bolt) and the hole. This is, in general, the same for both components.
- **Deviation:**
  - The algebraic difference between the actual measured size and the corresponding basic size.
- **Lower deviation:**
  - The difference between the minimum possible component size and the basic size.
- **Upper deviation:**
  - The difference between the maximum possible component size andthe basic size.

Term relating to dimensional tolerance

❑ Fundamental deviation:

- The minimum difference in size between a component and the basic size. This is identical to the upper deviation for shafts and the lower deviation for holes.

- Upper or lower deviation which is closest to the basicsize.
- Fundamental deviation is a form of allowance rather than tolerance.

❑ 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. If the variation is provided on one side of the basic size, it is termed as unilateral tolerance. Similarly, if the variation is provided on both sides of the basic size, it is known as bilateral tolerance.

❑ Zero line:

- Zero line is the line of zerodeviation.

Term relating to dimensional tolerance

- **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.

- **Unilateral limits:**

  - Both the limits of size are on the same side of zeroline.

- **Bilateral limits:**

  - One of the limits of size is one side of zero line while the other is on the otherside.

- **Allowance:**

  - The difference between the dimensions of two mating parts is called allowance.
  - Allowance is the difference between the max. material hole and shaft either it is max. interference or min. clearance.

Term relating to dimensional tolerance

- **Basic hole:**
  - Hole whose lower deviation is zero.

- **Basic shaft:**
  - Shaft whose upper deviation is zero.

- **Design size:**
  - It is the size on which the design of individual feature is based and so the size which should be specified on thedrawing.
  - When there is no allowance ,it is identical as basicsize.

Clearance

- **Clearance:**
  - The difference between the dimensions of the hole and the shaft assigned intentionally to obtain a particular type of fit.

- **Maximum clearance**:
  - The difference between the maximum size of hole and minimum size of shaft.

- **Minimum clearance:**
  - Thedifferencebetweentheminimumsizeofholeandmaximumsizeof shaft.

Fits

❑ Fits:

- When two mating parts are to be assembled is called Fits.

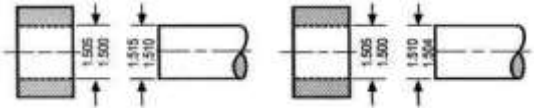
❑ Clearance Fit:

- This is the difference between the size of the Hole and Shaft before Assembly.
- This difference is Positive.
- These are loose fittings.

Fits

❑ Interference Fit:

- ➢ There is always a negative allowance between the Largest size and smallest shaft size .e.g. Driving fit or forcefit.
- ➢ The shaft size is always larger than theHole.



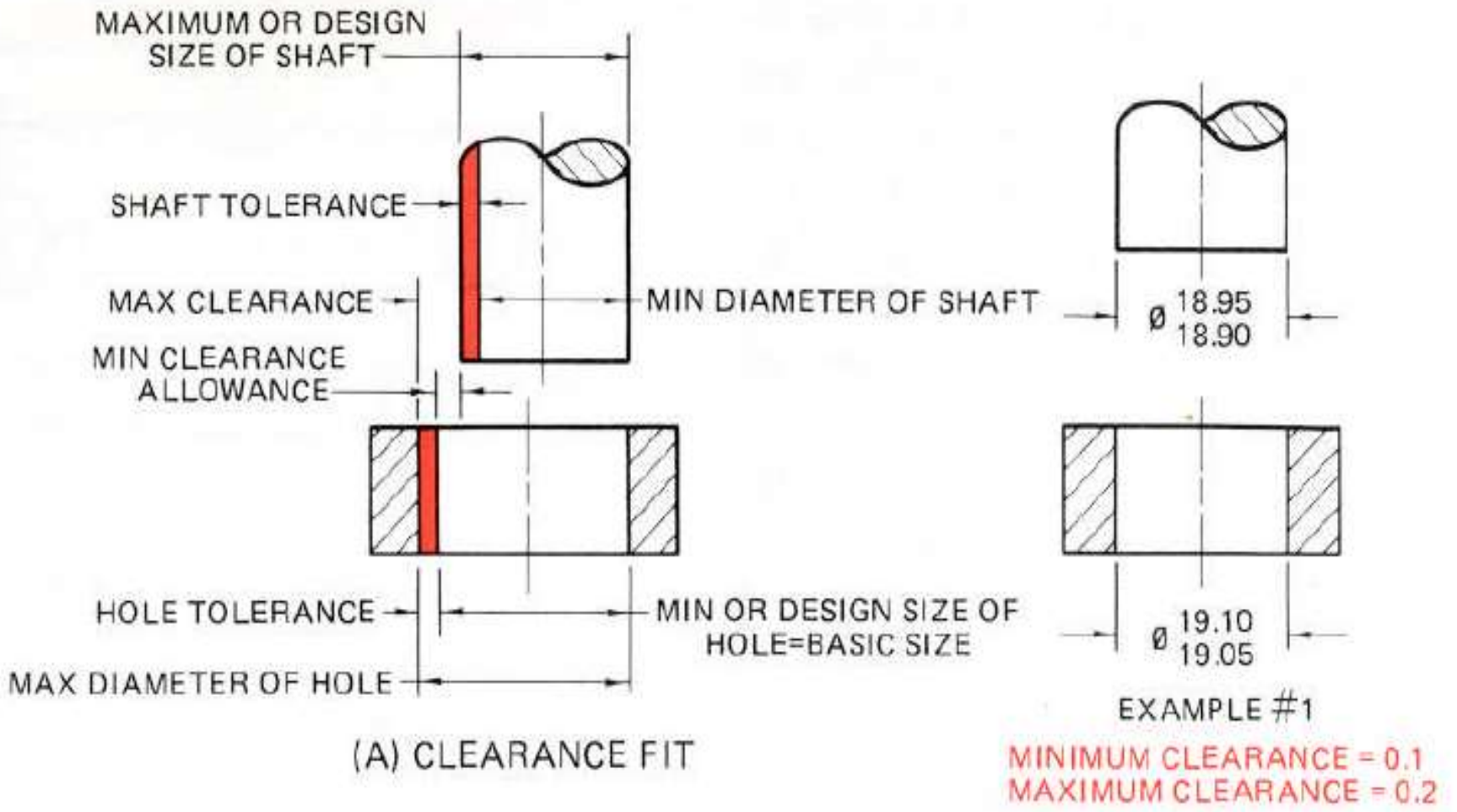
❑ Transition Fit:

- ➢ It is the fit which may provided either a clearance or ainterference.

❑ These are categorized into

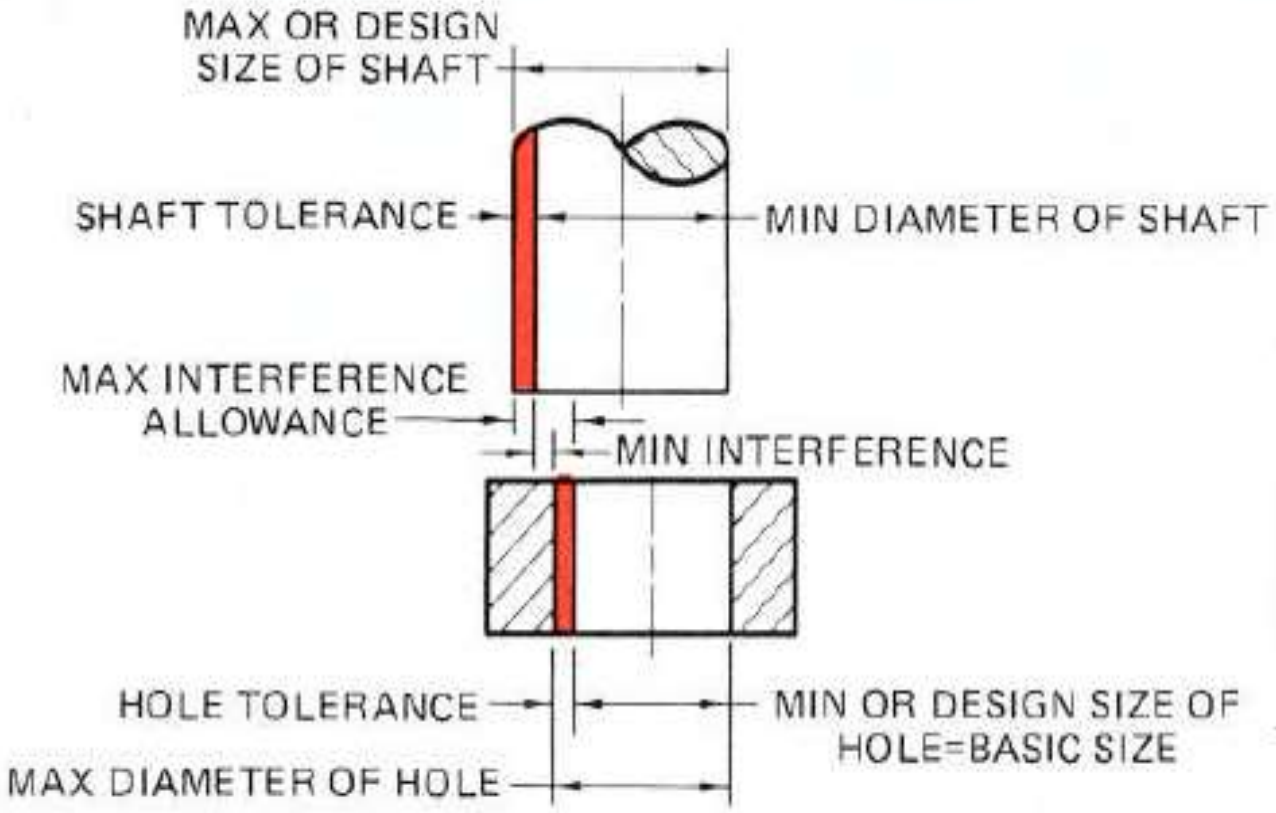
1. Force fit e.g. Railway fit, Tramcard.
2. Running fit e.g. shaft is rotating inbearing.
3. Pushfit.
4. Driving fit. e.g. pulley fitted on a shaft withkey.

Clearance fit

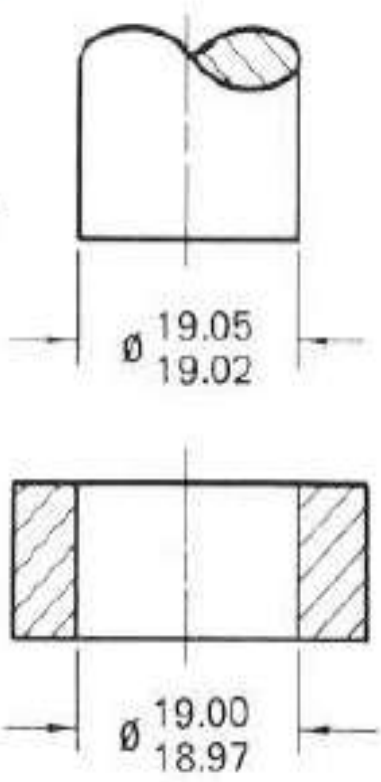


(A) CLEARANCE FIT

Interference Fit



(C) INTERFERENCE FIT



EXAMPLE #3

MINIMUM INTERFERENCE = 0.02

MAXIMUM INTERFERENCE = 0.08

Hole/Shaft basis system

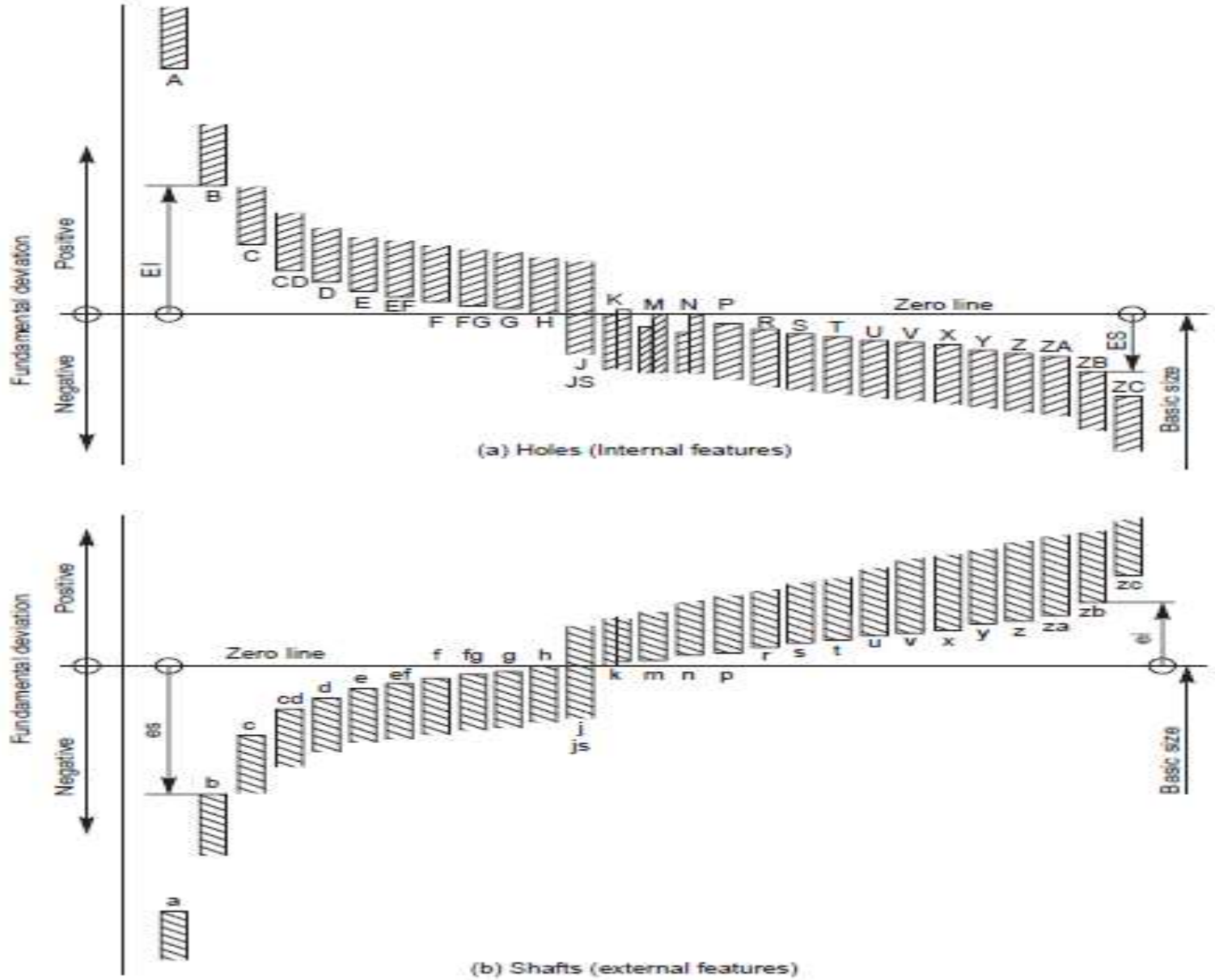
- **Shaft basis system:**

- The design size of the shaft and the allowance is applied to hole i.e. the shaft size kept constant.

The design size of the hole is obtained by adding the allowances to the base size of the shaft. The lateral symbol is h.

- **Hole basis system:**

- It is the system of fit in which design size of the hole is the basic size and allowance is applied to the shaft i.e. the size of the hole remains constant.
- The design size obtained by the subtracting allowance from the basic size of the Hole. The lateral symbol is H.



Letter Symbols for Tolerances

Table: Fundamental tolerances of grades 01, 0 and 1 to 16 (values of tolerances in microns) (1 micron = 0.001 mm)

Diameter steps in mm	*Tolerance Grades*																	
	01	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14**	*15**	*16**
To and inc 3	0.3	0.5	0.8	1.2	2	3	4	6	10	14	25	40	60	100	140	250	400	600
Over 3 To and inc 6	0.4	0.6	1	1.5	2.5	4	5	8	12	18	30	48	75	120	180	300	480	750
Over 6 To and inc 10	0.4	0.6	1	1.5	2.5	4	6	9	15	22	36	58	90	150	220	360	580	900
Over 10 To and inc 18	0.5	0.8	1.2	2	3	5	8	11	18	27	43	70	110	180	270	430	700	1100
Over 18 To and inc 30	0.6	1	1.5	2.5	4	6	9	13	21	33	52	84	130	210	330	520	840	1300
Over 30 To and inc 50	0.6	1	1.5	2.5	4	7	11	16	25	39	62	100	160	250	390	620	1000	1600
Over 50 To and inc 80	0.8	1.2	2	3	5	8	13	19	30	46	74	120	190	300	460	740	1200	1900
Over 80 To and inc 120	1	1.5	2.5	4	6	10	15	22	35	54	87	140	220	350	540	870	1400	2200
Over 120 To and inc 180	1.2	2	3.5	5	8	12	18	25	40	63	100	160	250	400	630	1000	1600	2500
Over 180 To and inc 250	2	3	4.5	7	10	14	20	29	46	72	115	185	290	460	720	1150	1850	2900
Over 250 To and inc 315	2.5	4	6	8	12	16	23	32	52	81	130	210	320	520	810	1300	2100	3200
Over 315 To and inc 400	3	5	7	9	13	18	25	36	57	89	140	230	360	570	890	1400	2300	3600
Over 400 To and inc 500	4	6	8	10	15	20	27	40	63	97	155	250	400	630	970	1550	2500	4000

*Upto 1 mm, Grades 14 to 16 are not provided.

Manufacturing Process and IT Grade Produced

Tolerance Grade	Manufactring Process that Can Produce
16	Sand casting, Flame Cutting
15	Stamping
14	Die casting or Moulding, Rubber Moulding
13	Press Work, Tube Rolling
12	Light Press Work, Tube Drawing
11	Drilling, rough turning, boring, precision tube drawing
10	Milling , Slotting, Planning, Metal rolling or extrusion
9	Capstain or automatic turning, horizontal or vertical boring
8	Centre lathe turning and boring, reaming
7	High quality turning, broaching
6	Grinding
5	Fine grinding, honing, diamond boaring

Supplementary table 6 Shaft tolerances (deviation from nominal dimensions)

Unit : μm

Nominal shaft dia. (mm) over	up to	Deviation classes of shaft dia. d6	e6	f6	g5	g6	h5	h6	h7	h8	h9	h10	js5	js6	js7	j5	j6	k5	k6	k7	m5	m6	m7	n5	n6	p6	r6	r7	Nominal shaft dia. (mm) over	up to	Δ_{dmp} [1] of bearing (class 0) (Refer.)
3	6	-30 -38	-20 -28	-10 -18	-4 -9	-4 -12	-0 -5	-0 -8	0 -12	0 -18	0 -30	0 -48	±2.5	±4	±6	+3 -2	+6 -2	+6 +1	+9 +1	+13 +1	+9 +4	+12 +4	+16 +4	+13 +8	+16 +8	+20 +12	+23 +15	+27 +15	3	6	0 -8
6	10	-40 -49	-25 -34	-13 -22	-5 -11	-5 -14	-0 -6	-0 -9	0 -15	0 -22	0 -36	0 -58	±3	±4.5	±7.5	+4 -2	+7 -2	+7 +1	+10 +1	+16 +1	+12 +6	+15 +6	+21 +6	+16 +10	+19 +10	+24 +15	+28 +19	+34 +19	6	10	0 -8
10	18	-50 -61	-32 -43	-16 -27	-6 -14	-6 -17	-0 -8	0 -11	0 -18	0 -27	0 -43	0 -70	±4	±5.5	±9	+5 -3	+8 -3	+9 +1	+12 +1	+19 +1	+15 +7	+18 +7	+25 +7	+20 +12	+23 +12	+29 +18	+34 +23	+41 +23	10	18	0 -8
18	30	-65 -78	-40 -53	-20 -33	-7 -16	-7 -20	-0 -9	0 -13	0 -21	0 -33	0 -52	0 -84	±4.5	±6.5	±10.5	+5 -4	+9 -4	+11 +2	+15 +2	+23 +2	+17 +8	+21 +8	+29 +8	+24 +15	+28 +15	+35 +22	+41 +28	+49 +28	18	30	0 -10
30	50	-80 -96	-50 -66	-25 -41	-9 -20	-9 -25	0 -11	0 -16	0 -25	0 -39	0 -62	0 -100	±5.5	±8	±12.5	+6 -5	+11 -5	+13 +2	+18 +2	+27 +2	+20 +9	+25 +9	+34 +9	+28 +17	+33 +17	+42 +26	+50 +34	+59 +34	30	50	0 -12
50	80	-100 -119	-60 -79	-30 -49	-10 -23	-10 -29	0 -13	0 -19	0 -30	0 -46	0 -74	0 -120	±6.5	±9.5	±15	+6 -7	+12 -7	+15 +2	+21 +2	+32 +2	+24 +11	+30 +11	+41 +11	+33 +20	+39 +20	+51 +32	+60 +41	+71 +41	50	65	0 -15
																											+62 +43	+73 +43	65	80	
80	120	-120 -142	-72 -94	-36 -58	-12 -27	-12 -34	0 -15	0 -22	0 -35	0 -54	0 -87	0 -140	±7.5	±11	±17.5	+6 -9	+13 -9	+18 +3	+25 +3	+38 +3	+28 +13	+35 +13	+48 +13	+38 +23	+45 +23	+59 +37	+73 +51	+86 +51	80	100	0 -20
																											+76 +54	+89 +54	100	120	
120	180	-145 -170	-85 -110	-43 -68	-14 -32	-14 -39	0 -18	0 -25	0 -40	0 -63	0 -100	0 -160	±9	±12.5	±20	+7 -11	+14 -11	+21 +3	+28 +3	+43 +3	+33 +15	+40 +15	+55 +15	+45 +27	+52 +27	+68 +43	+88 +63	+103 +63	120	140	0 -25
																											+90 +65	+105 +65	140	160	
																											+93 +68	+108 +68	160	180	

TABLE OF TOLERANCES

Diameter Steps, mm

		Over	3	6	10	18	24	30	40	50	65	80	100	120	140	160	180	200	225	250	280	315	355	400	450
		To	3	6	10	18	24	30	40	50	65	80	100	120	140	160	180	200	225	250	280	315	355	400	450	500
j5	G		+02	+03	+04	+05	+05		+06		+06		+06		+07			+07			+07		+07		+07	
	N		-02	-02	-02	-03	-04		-05		-07		-09		-11			-13			-16		-18		-20	
j6	G		+04	+06	+07	+08	+09		+11		+12		+13		+14			+16			+16		+18		+20	
	N		-02	-02	-02	-03	-04		-05		-07		-09		-11			-13			-16		-18		-20	
j7	G		+06	+08	+10	+12	+13		+15		+18		+20		+22			+25			+26		+29		+31	
	N		-04	-04	-05	-06	-08		-10		-12		-15		-18			-21			-26		-28		-32	
k5	G		+04	+06	+07	+09	+11		+13		+15		+18		+21			+24			+27		+29		+32	
	N		+00	+01	+01	+01	+02		+02		+02		+03		+03			+04			+04		+04		+05	
k6	G		+06	+09	+10	+12	+15		+18		+21		+25		+28			+33			+36		+40		+45	
	N		+00	+01	+01	+01	+02		+02		+02		+03		+03			+04			+04		+04		+05	
k7	G		+10	+13	+16	+19	+23		+27		+32		+38		+43			+50			+56		+61		+68	
	N		+00	+01	+01	+01	+02		+02		+02		+03		+03			+04			+04		+04		+05	
m5	G		+06	+09	+12	+15	+17		+20		+24		+28		+33			+37			+43		+46		+50	
	N		+02	+04	+06	+07	+08		+09		+11		+13		+15			+17			+20		+21		+23	
m6	G		+08	+12	+15	+16	+21		+25		+30		+35		+40			+46			+52		+57		+63	
	N		+02	+04	+06	+07	+08		+09		+11		+13		+15			+17			+20		+21		+23	
m7	G		+14	+16	+21	+25	+29		+34		+41		+48		+55			+63			+72		+78		+86	
	N		+02	+04	+06	+07	+08		+09		+11		+13		+15			+17			+20		+21		+23	
n5	G		+08	+13	+16	+20	+24		+28		+33		+38		+45			+51			+57		+62		+67	
	N		+04	+08	+10	+12	+15		+17		+20		+23		+27			+31			+34		+37		+40	
n6	G		+10	+16	+19	+23	+28		+33		+39		+45		+52			+60			+66		+73		+80	
	N		+04	+08	+10	+12	+15		+17		+20		+23		+27			+31			+34		+37		+40	
p5	G		+10	+17	+21	+26	+31		+37		+45		+52		+61			+70			+79		+87		+95	
	N		+06	+12	+15	+18	+22		+26		+32		+37		+43			+50			+56		+62		+68	
p6	G		+12	+20	+24	+29	+35		+42		+51		+59		+68			+79			+88		+98		+108	
	N		+06	+12	+15	+18	+22		+26		+32		+37		+43			+50			+56		+62		+68	
r5	G		+14	+20	+25	+31	+37		+45		+54	+56	+66	+69	+81	+83	+86	+97	+100	+104	+117	+121	+133	+139	+153	+159
	N		+10	+15	+19	+23	+28		+34		+41	+43	+51	+54	+63	+65	+68	+77	+80	+84	+94	+98	+108	+114	+126	+132
r6	G		+16	+23	+28	+34	+41		+50		+60	+62	+73	+76	+88	+90	+93	+106	+109	+113	+126	+130	+144	+150	+166	+172
	N		+10	+15	+19	+23	+28		+34		+41	+43	+51	+54	+63	+65	+68	+77	+80	+84	+94	+98	+108	+114	+126	+132
r7	G		+20	+27	+34	+41	+49		+59		+71	+73	+86	+89	+103	+105	+108	+123	+126	+130	+146	+150	+165	+171	+189	+195
	N		+10	+15	+19	+23	+28		+34		+41	+43	+51	+54	+63	+65	+68	+77	+80	+84	+94	+98	+108	+114	+126	+132
s5	G		+18	+24	+29	+36	+44		+54		+66	+72	+86	+94	+110	+118	+126	+142	+150	+160	+181	+193	+215	+233	+259	+279
	N		+14	+19	+23	+28	+35		+43		+53	+59	+71	+79	+92	+100	+108	+122	+130	+140	+158	+170	+190	+208	+232	+252
s6	G		+20	+27	+32	+39	+48		+59		+72	+78	+93	+101	+117	+125	+133	+151	+159	+169	+190	+202	+226	+244	+272	+292
	N		+14	+19	+23	+28	+35		+43		+53	+59	+71	+79	+92	+100	+108	+122	+130	+140	+158	+170	+190	+208	+232	+252
t7	G		+28	+35	+43	+51	+62		+73	+79	+96	+105	+126	+139	+162	+174	+186	+212	+226	+242	+270	+292	+325	+351	+393	+423
	N		+18	+23	+28	+33	+41		+48	+54	+66	+75	+91	+104	+122	+134	+146	+166	+180	+196	+218	+240	+268	+294	+330	+360
u5	G		+22	+28	+34	+41	+50	+57	+71	+81	+100	+115	+139	+159	+188	+208	+228	+256	+278	+304	+338	+373	+415	+460	+517	+567
	N		+18	+23	+28	+33	+41	+48	+60	+70	+87	+102	+124	+144	+170	+190	+210	+236	+258	+284	+315	+350	+390	+435	+490	+540
u6	G		+24	+31	+37	+44	+54	+61	+76	+86	+106	+121	+146	+166	+195	+215	+235	+265	+287	+313	+347	+382	+426	+471	+530	+580
	N		+18	+23	+28	+33	+41	+48	+60	+70	+87	+102	+124	+144	+170	+190	+210	+236	+258	+284	+315	+350	+390	+435	+490	+540

Note:- G - Go; N - No go; Tolerances in microns 1 micron = 0·001mm = 1×10^{-6}m

Table of Tolerances for Selected Fits

Bore & shaft tolerances (hole basis).

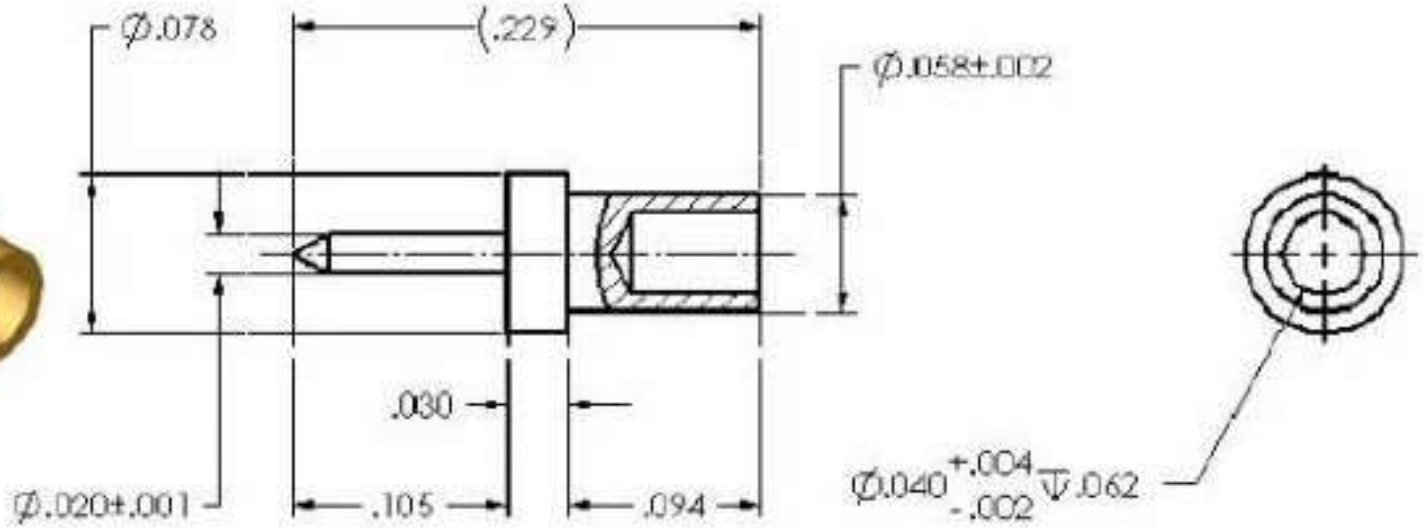
Range (mm)		BORE TOLERANCES (units 0.001 mm)				SHAFT TOLERANCES (units 0.001 mm)											
						Clearance				Transition				Interference			
		H7		H8		f7		g6		k6		n6		p6		s6	
over	up to	low	high	low	high	high	low	high	low	high	low	high	low	high	low	high	low
0	3	0	10	0	14	-5	-16	-2	-8	6	0	10	4	12	6	20	14
3	6	0	12	0	19	-10	-22	-4	-12	9	1	16	8	20	12	27	19
6	10	0	15	0	22	-13	-28	-5	-14	10	1	19	10	24	15	32	23
10	18	0	18	0	27	-16	-34	-6	-17	12	1	23	12	29	18	39	28
18	30	0	21	0	33	-20	-41	-7	-20	15	2	28	15	35	22	48	35
30	50	0	25	0	39	-25	-50	-9	-25	18	2	33	17	42	26	59	43
50	80	0	30	0	46	-30	-60	-10	-29	21	2	39	20	51	32	72	53
80	120	0	35	0	54	-36	-71	-12	-34	25	3	45	23	59	37	93	71

What is GD&T

- Geometric Dimensioning and tolerancing (GD&T) is a language used on mechanical engineering drawings composed of symbols that are used to efficiently and accurately communicate geometry requirements for associated features on component and assemblies.
- A method to specify the shape of a piece of hardware on an engineering drawing.

- A set of fourteen symbols used in the language of GD&T. It consists of well-defined of symbols, rules, definitions and conventions, used on engineering drawings to accurately describe a part.
- GD&T is a precise mathematical language that can be used to describe the size, form, orientation, and location of part features.
- GD&T is also a design philosophy on how to design and dimension parts

As drawn



As manufactured –
Without geometric tolerance control

Manufactured parts

Advantages of GD&T

- Create a part design that focuses on the product function.
- Convert product requirements into dimensional specifications.
- Better define parts without the need for assumptions.
- Document the design for future use.
- Discover problems in the design stage
- Ensure that parts will assemble.
- Have less "hand fitting" at assembly.
- Ensure that parts are inspected as intended.
- Inspect parts more quickly.
- Reduce scrap or rework.
- Make a replacement that fits into the assembly

Geometric Tolerances are divided into five categories

- 1.Form control
- 2.Orientation control
- 3.Location control
- 4.Composite control
- 5.Profile controls

Form control

Geometric Characteristic	Symbol
Straightness	
Flatness	
Circularity	
Cylindricity	

Orientation control

Geometric Characteristic	Symbol
Angularity	
Perpendicularity	
Parallelism	

Location control

Geometric Characteristic	Symbol
Position	
Concentricity	
Symmetry	

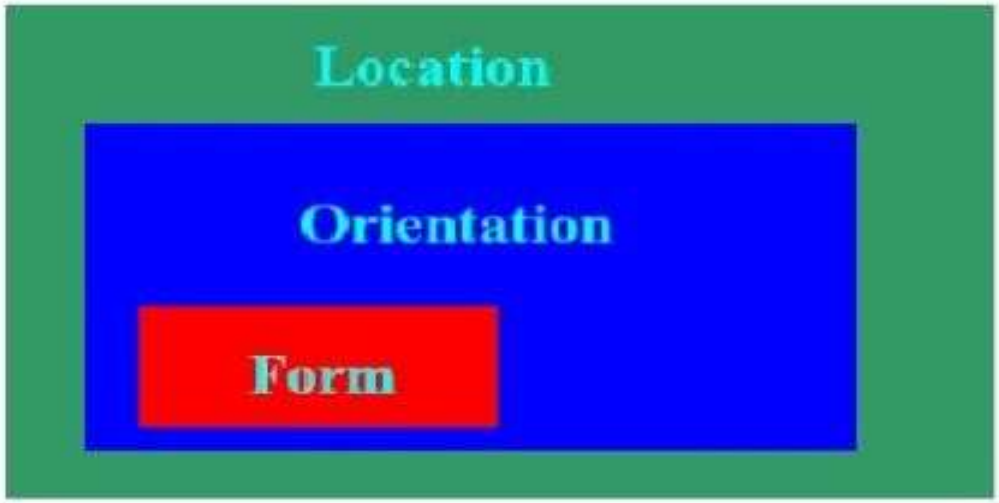
Composite control

Geometric Characteristic	Symbol
Circular Runout	
Total Runout	

Profile control

Geometric Characteristic	Symbol
Profile of a Line	
Profile of a Surface	

Summary of control tolerances



- Orientation is refinement of location.
- Form is refinement of orientation

Geometric Dimensioning &Tolerancing

GENERAL TOLERANCE SYMBOLS

Ø	Diameter
XX.XX	Basic
Ⓜ	Maximum Material Condition (MMC)
Ⓛ	Least Material Condition (LMC)
Ⓢ	Regardless of Feature Size
SYMBOL NOT DEFINED	Full Indicator Movement (FIM)
Ⓟ	Projected Tolerance Zone
⌖	Dimension Origin
⌀	All-Around
R	Radius
( )	Reference Dimension (REF)
SØ	Spherical Diameter (SD)
SYMBOL NOT DEFINED	Spherical Radius (SR)
⌒	Arc Length
— · —	Chain Line
⊳	Conical Taper
◺	Slope
⌴	Counterbore/Spotface
∨	Countersink
⌶	Depth/Deep (DP)
XX.XX	Dimension Not To Scale
X	Times/Places

FORM AND ORIENTATION TOLERANCE SYMBOLS

⏤	Straightness
▱	Flatness
○	Circularity
⌭	Cylindricity
⊥	Perpendicularity
∠	Angularity
//	Parallelism
⌓	Surface Profile
⌒	Line Profile
⌰	Total Runout
↗	Circular Runout
SYMBOL NOT DEFINED	Unit Control

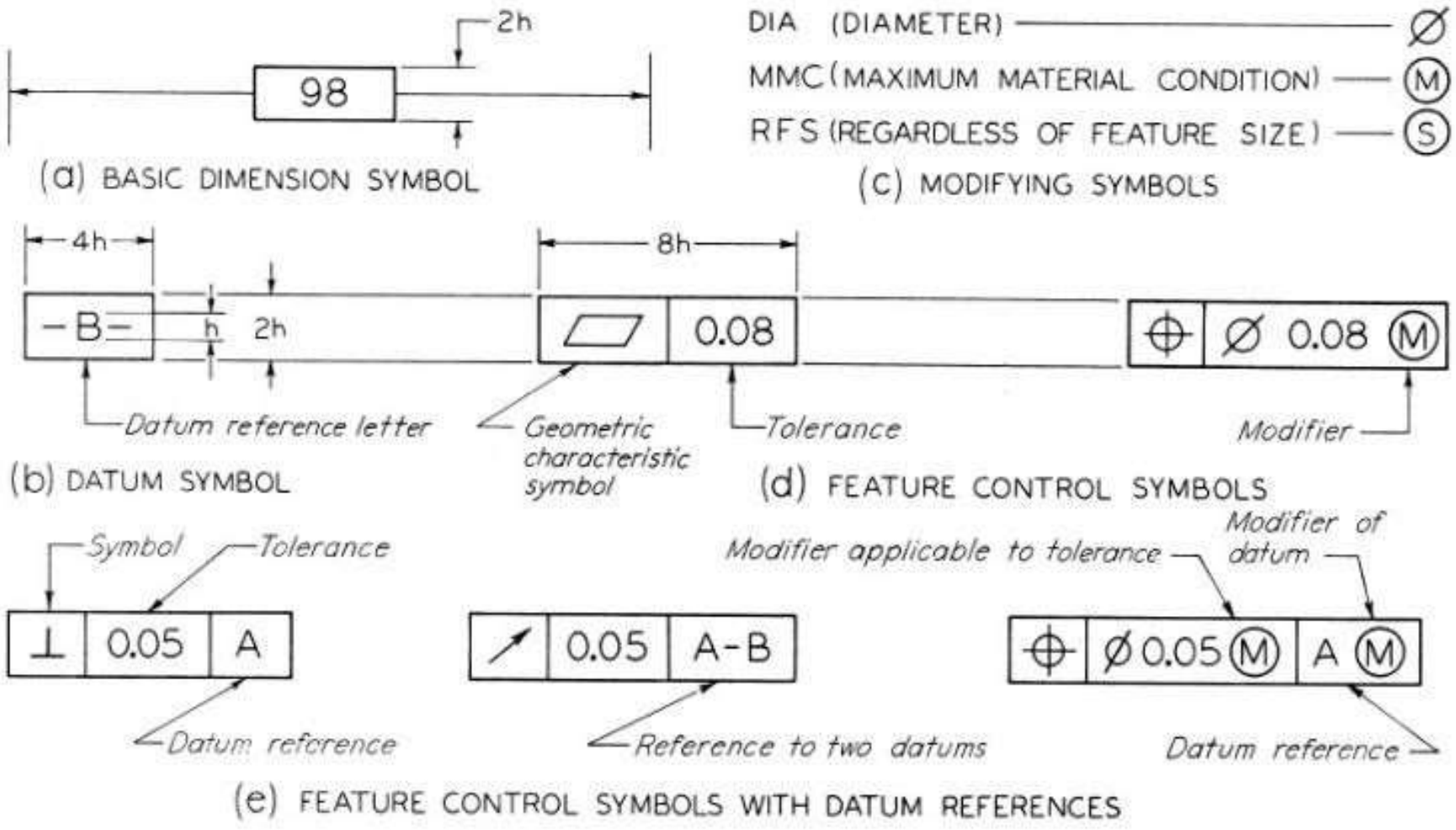
TOLERANCE SYMBOLS OF LOCATION

◎	Concentricity
⌖	Position
⌯	Symmetry

Modifiers

Ⓕ	FREE STATE
Ⓛ	LEAST MATERIAL CONDITION
Ⓜ	MAXIMUM MATERIAL CONDITION
Ⓟ	PROJECTED TOLERANCE ZONE
Ⓢ	REGARDLESS OF FEATURE SIZE
Ⓣ	TANGENT PLANE
Ⓤ	UNILATERAL

Feature control symbols with datum references



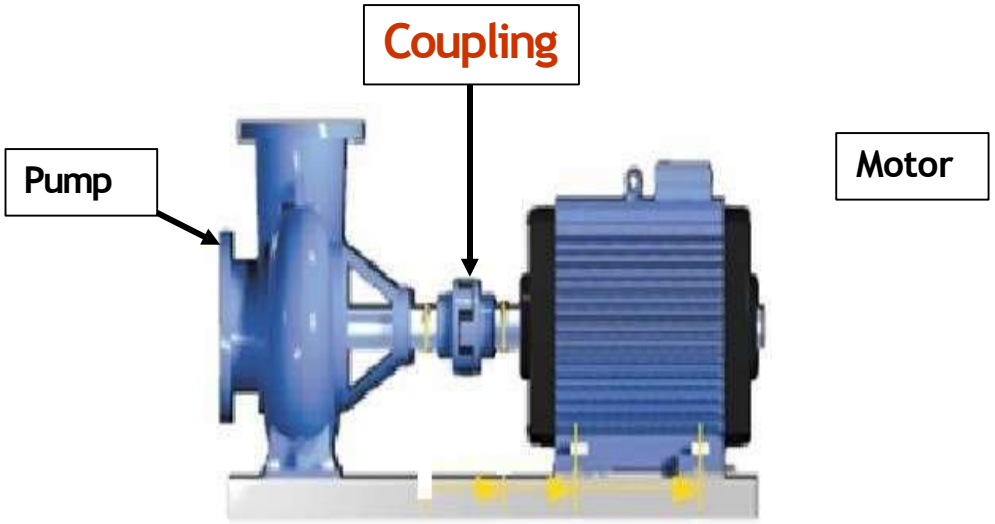
Use of Symbols for Tolerance of Position and Form (ASME Y14.5M–1994).

Chapter 2

Couplings, Bearings, Pulleys, Pipe Joints and Lathe Tool Holder

Coupling

- Coupling is a device used to connect two shafts together at their ends for the purpose of transmitting power.



Uses of coupling

- To provide connection of shafts made separately.
- To allow misalignment of the shafts or to introduce mechanical flexibility.
- To reduce the transmission of shockloads.
- To introduce protection against overloads.
- To alter the vibration characteristics.

Types of coupling

- Rigid
- Flexible
- Universal

Flexible coupling

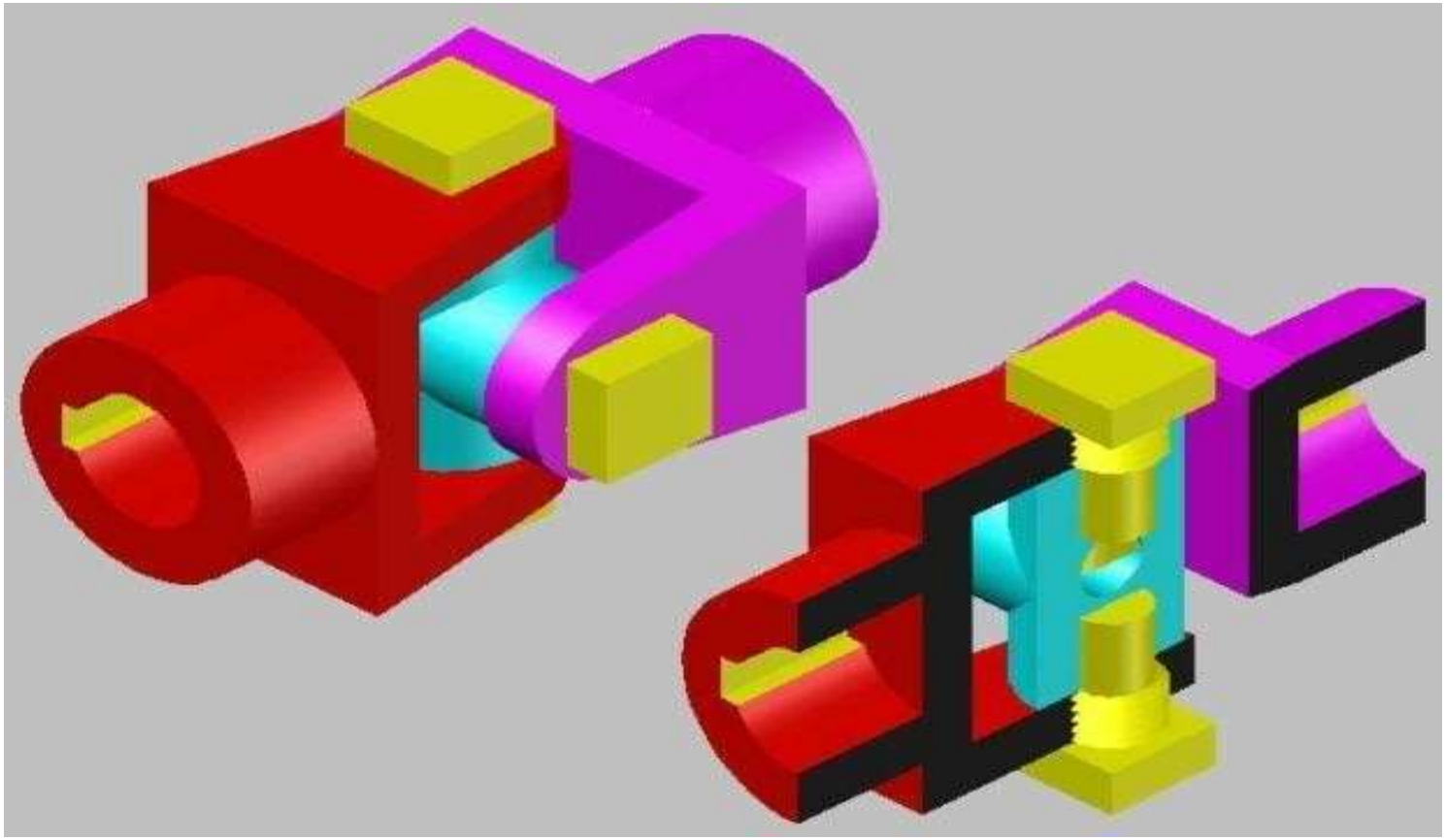
Rigid coupling

Universal coupling

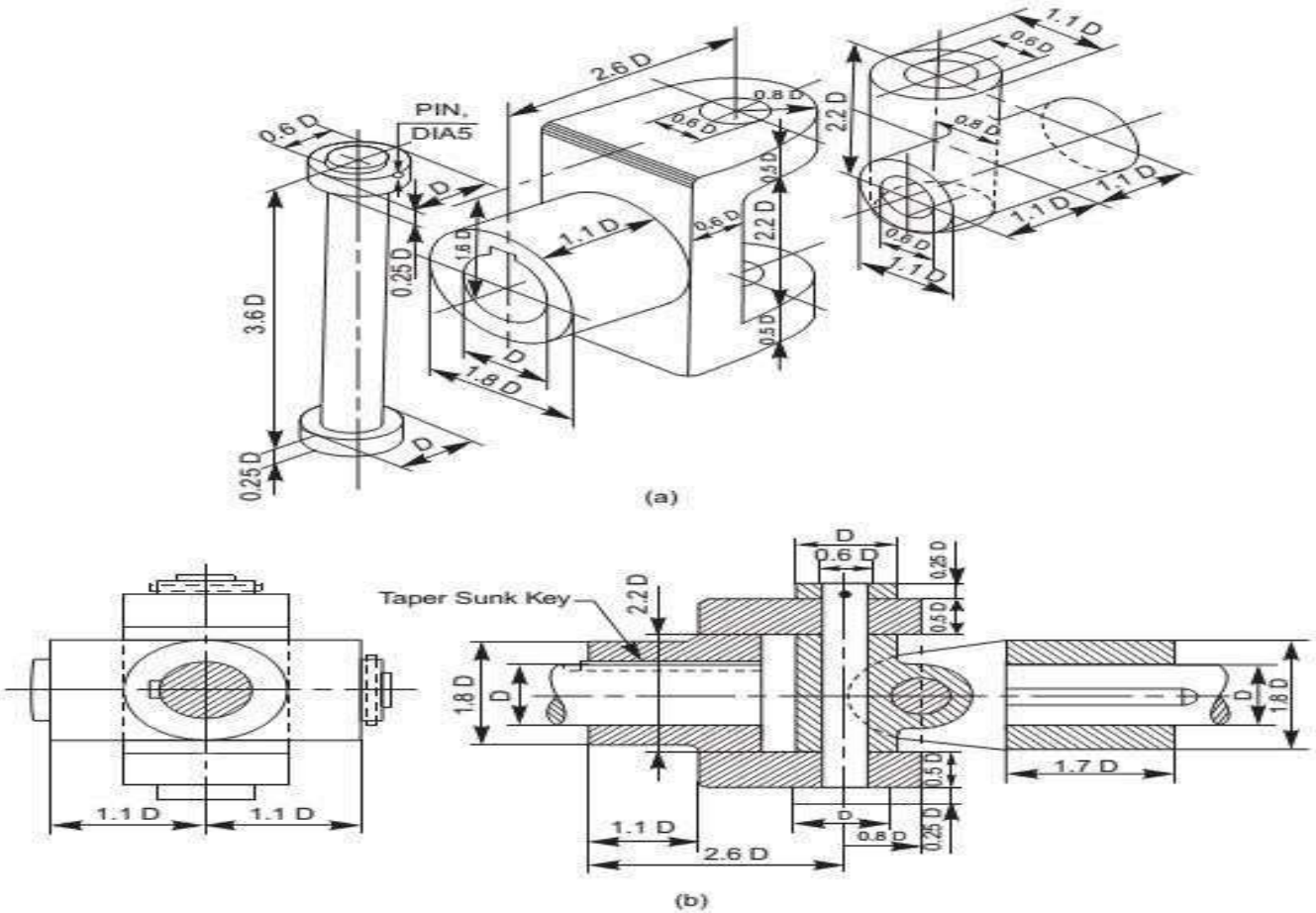
Universal coupling

- **Universal coupling**
- It is a rigid coupling that connects two shafts, whose axes intersect if extended.
- It consists of two forks which are keyed to the shafts.
- The two forks are pin joined to a central block, which has two arms at right angle to each other in the form of a cross.
- The angle between the shafts may be varied even while the shafts are rotating.

Universal coupling



Universal coupling



Bill of Materials – Universal Coupling

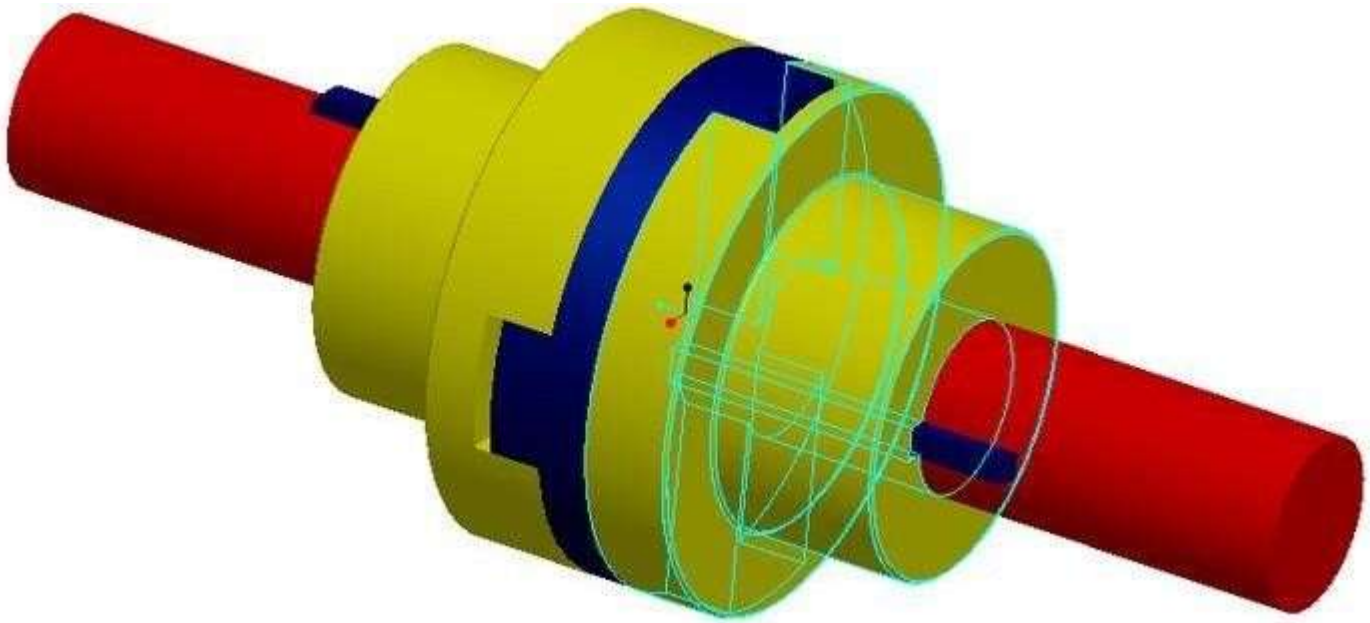
S No.	Part's Name	Material	No. off
1.	Fork	C.I.	02
2.	Centre Block	C.I.	01
3.	Collar	M.S.	02
4.	Pin	M.S.	02
5.	Taper Pin	M.S.	02

Oldham coupling

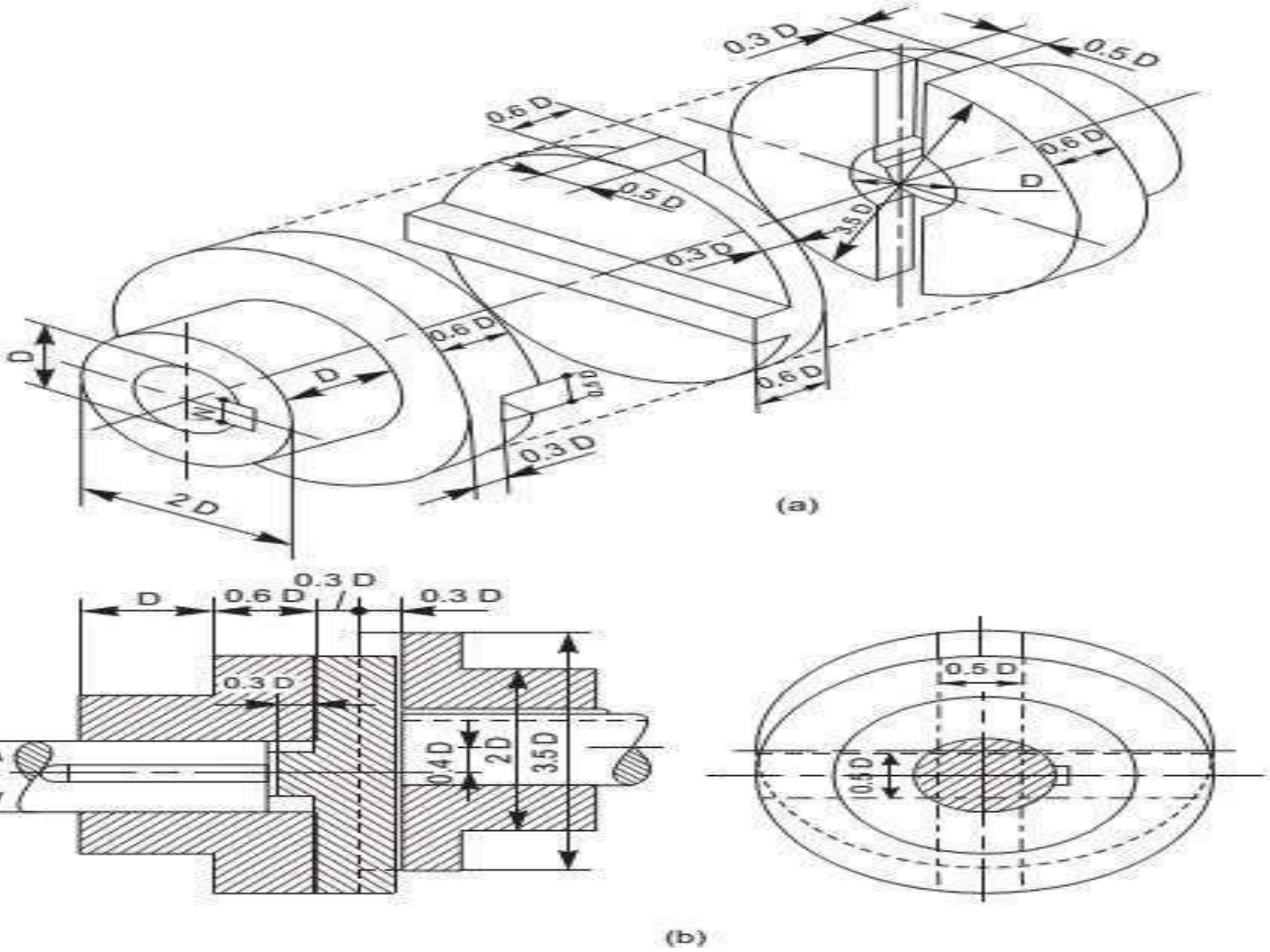
❑ Oldham coupling

- It is used to connect two parallel shafts whose axes are at a small distanceapart.
- Two flanges, each having a rectangular slot, are keyed, one on each shaft.
- The two flanges are positioned such that, the slot in one is at right angle to the slot in theother.
- To make the coupling, a circular disc with two rectangular projections on either side and at right angle to each other, is placed between the twoflanges.
- During motion, the central disc, while turning, slides in the slots of the flanges. Power transmission takes place between the shafts, because of the positive connection between the flanges and the centraldisc.

Oldham coupling



Oldham coupling



Bill of Materials –Oldham's Coupling

S No.	Part's Name	Material	No. off
1.	Flange	C.I.	02
2.	Disc	C.I.	01
3.	Shaft	M.S.	02
4.	Key	M.S.	02

Bearing

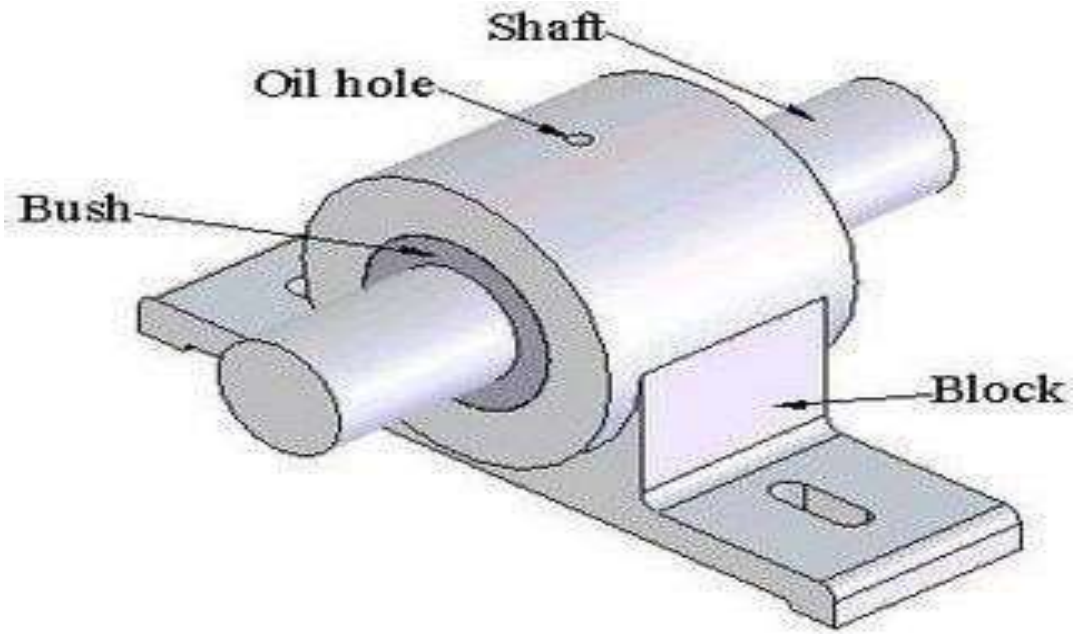
- Rotating shafts, which transmit motion and power, need to be supported on bearings.
- Long shafts,if supported only at its two ends,deflects at their centers. So

for the smooth running of the shafts, bearings are used at some intervals.

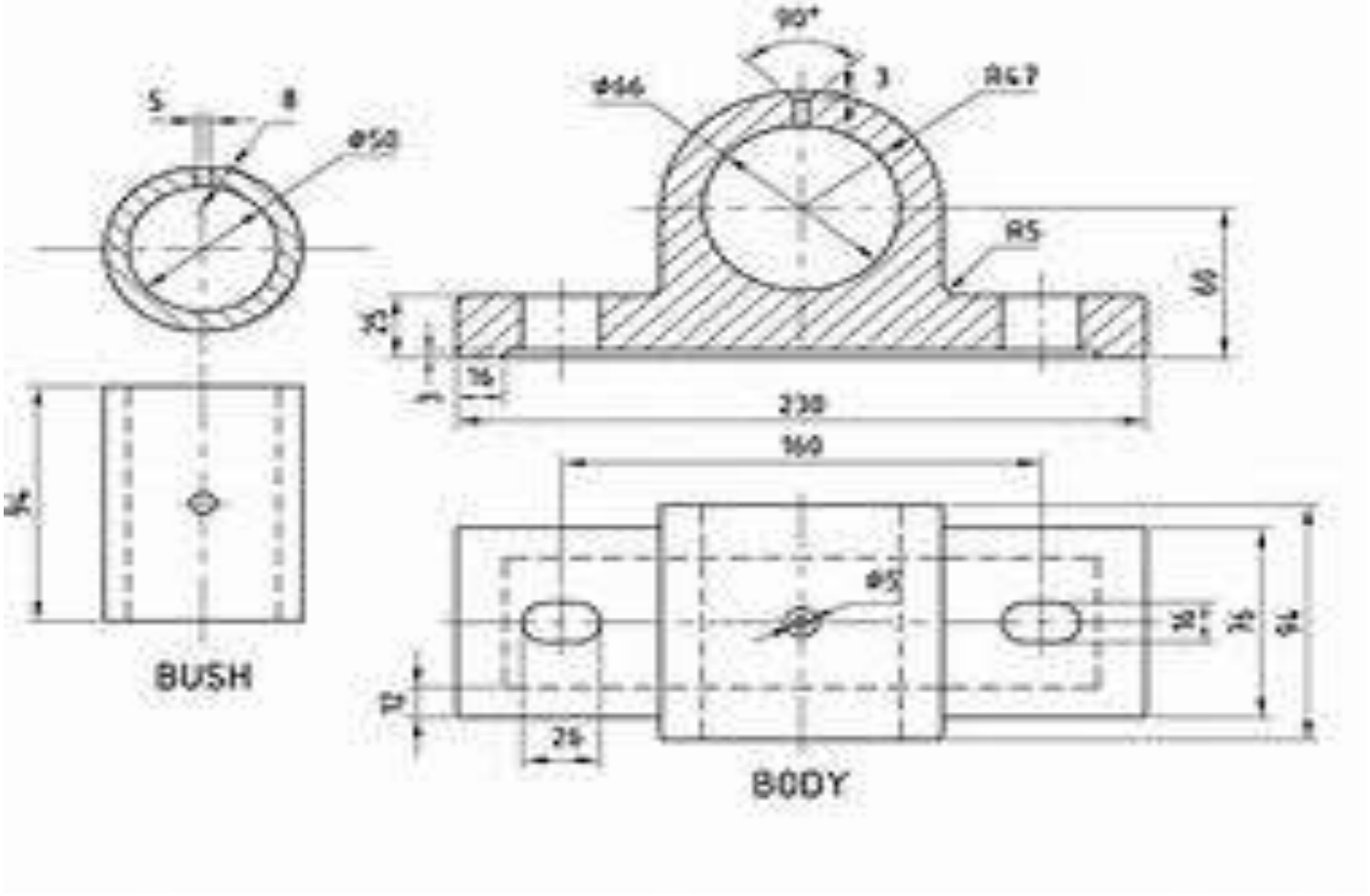
❑ Bushed bearing

- It is a modification of solid bearing. A bush of brass or gunmetal is press fitted inside the bearing. Shaft sits on the bush instead directly in contact withbearing.
- A grub screw or a pin inserted half inside the bush and half in the block prevents sliding or rotating of bush against bearing. The basic purpose of bush is that when bush gets worn out, it can be easily replaced instead replacing the wholebearing.
- The bolt holes in the block are made longer with semi-circular ends for adjusting the position of the bearing.

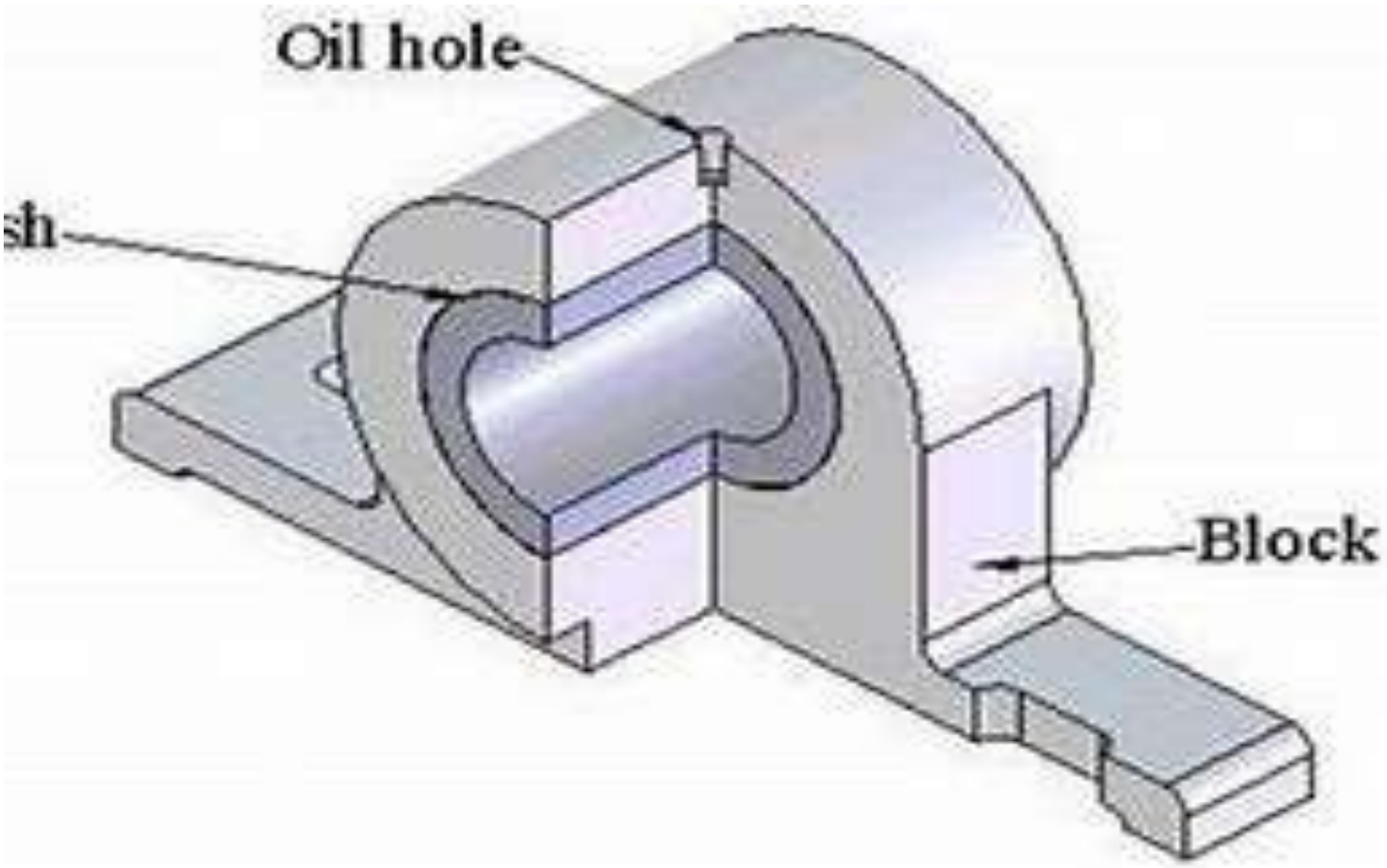
Bushed bearing



BUSHED BEARING



Bush bearing



Bill of Materials –Bushed Bearing

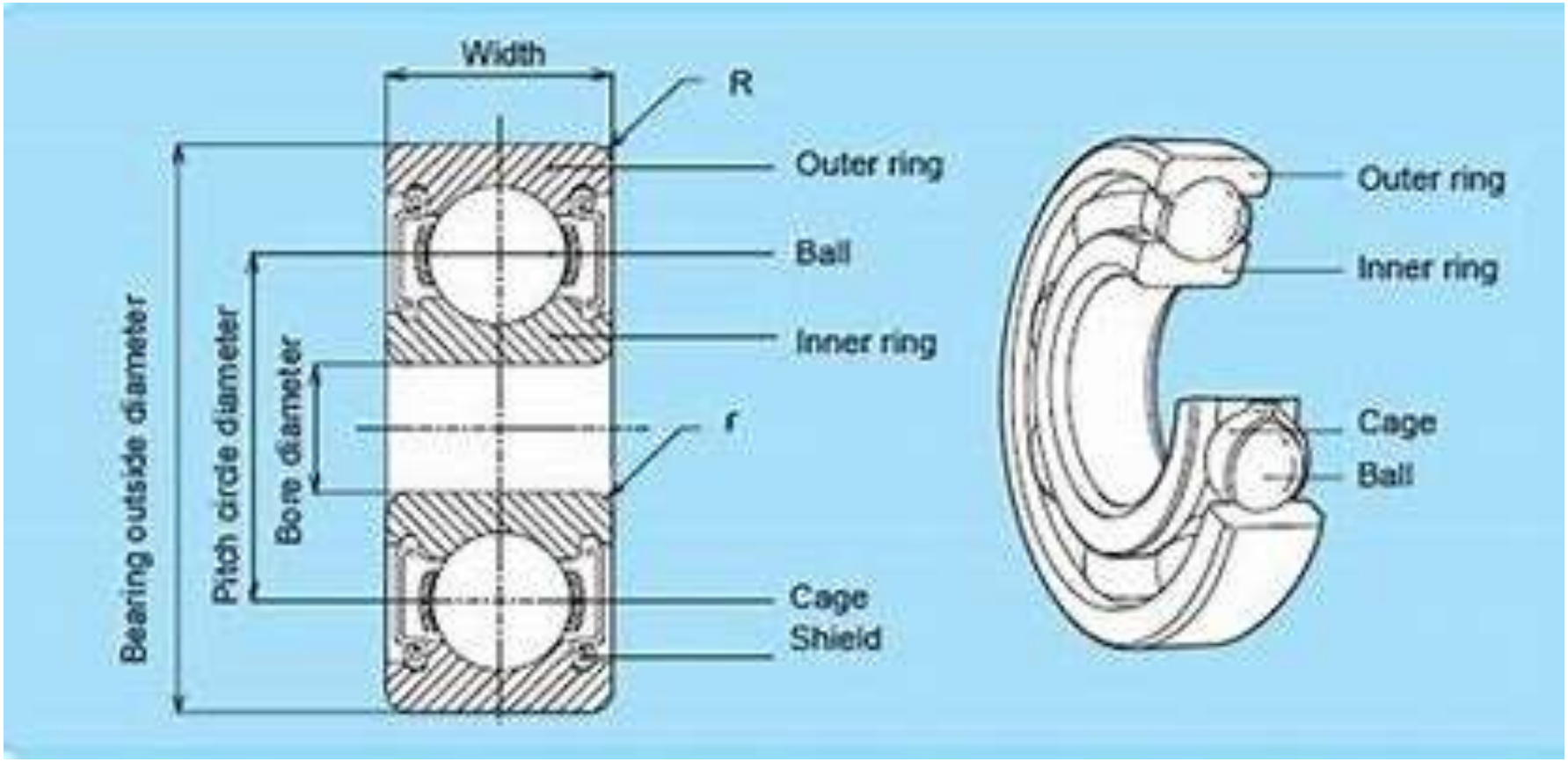
S No.	Part's Name	Material	No. off
1.	Body	C.I.	01
2.	Bush	Brass or Gun Metal	01

Ball bearing

- A ball bearing is a type of rolling-element bearing that uses balls to maintain the separation between the bearing races.

- The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads.

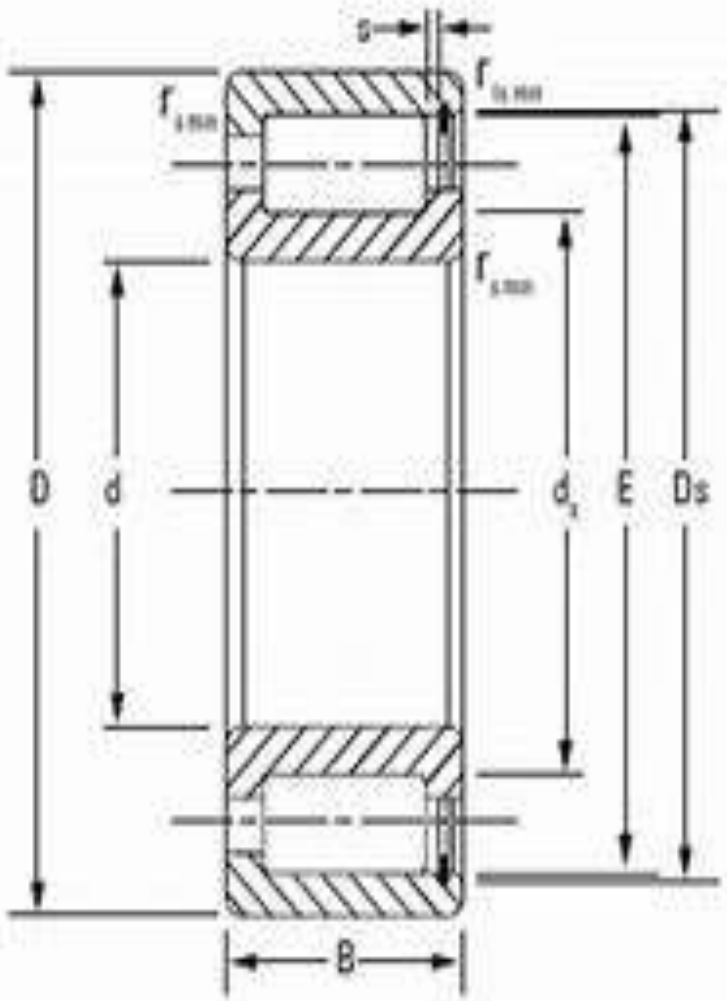
Ball Bearing

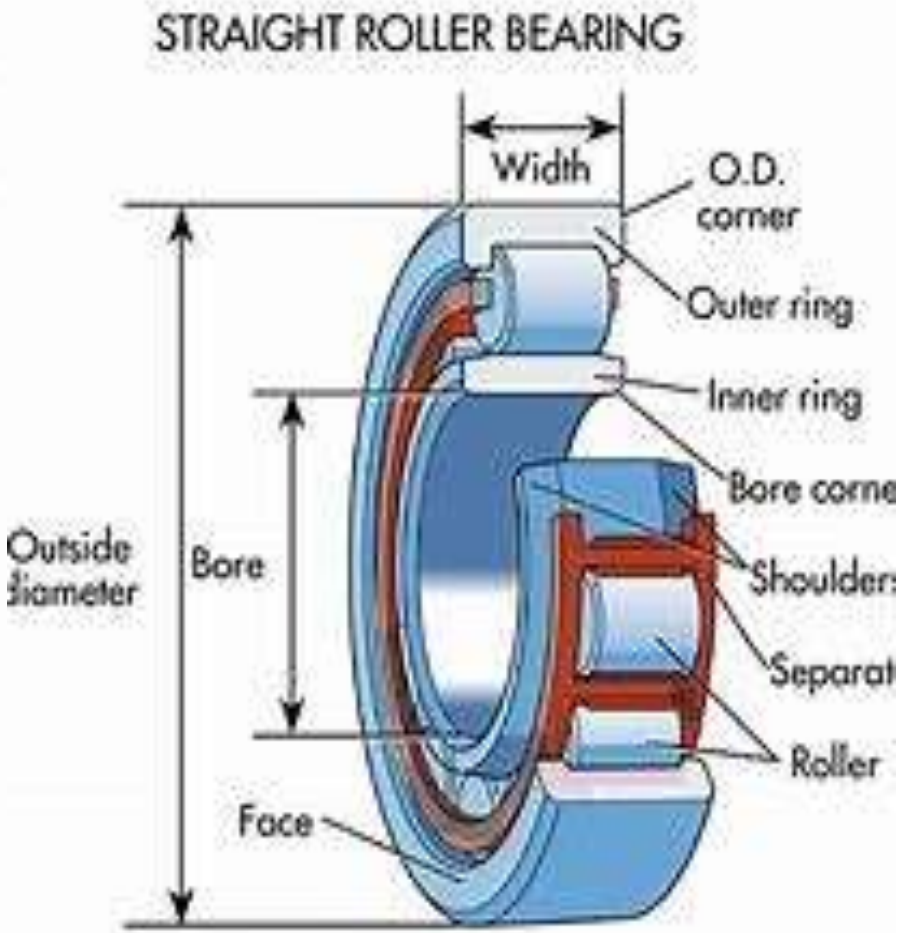


Roller Bearings

- Roller Bearings are a type of rolling-element bearing that uses cylinders (rollers) to maintain the separation between the moving parts of the bearing (as opposed to using balls as the rollingelement).
- The purpose of a roller bearing is to reduce rotational friction and support radial and axial loads.

Roller Bearing

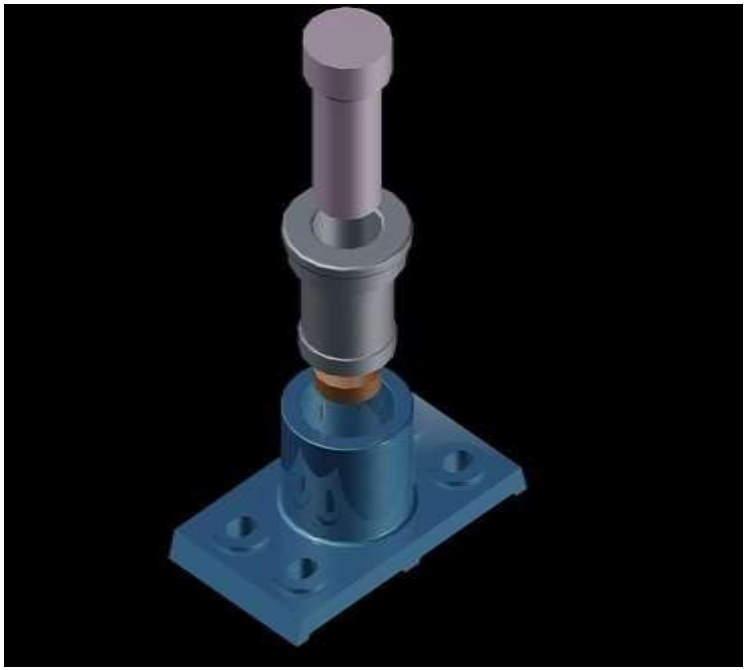


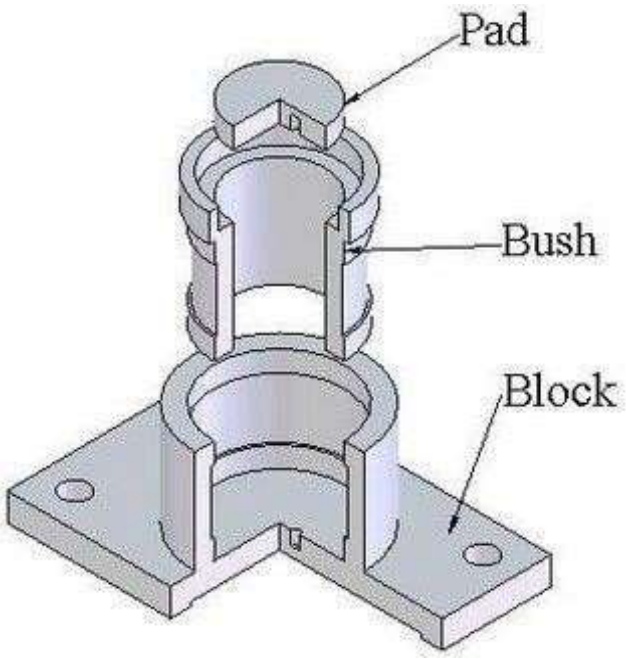


Foot step bearing

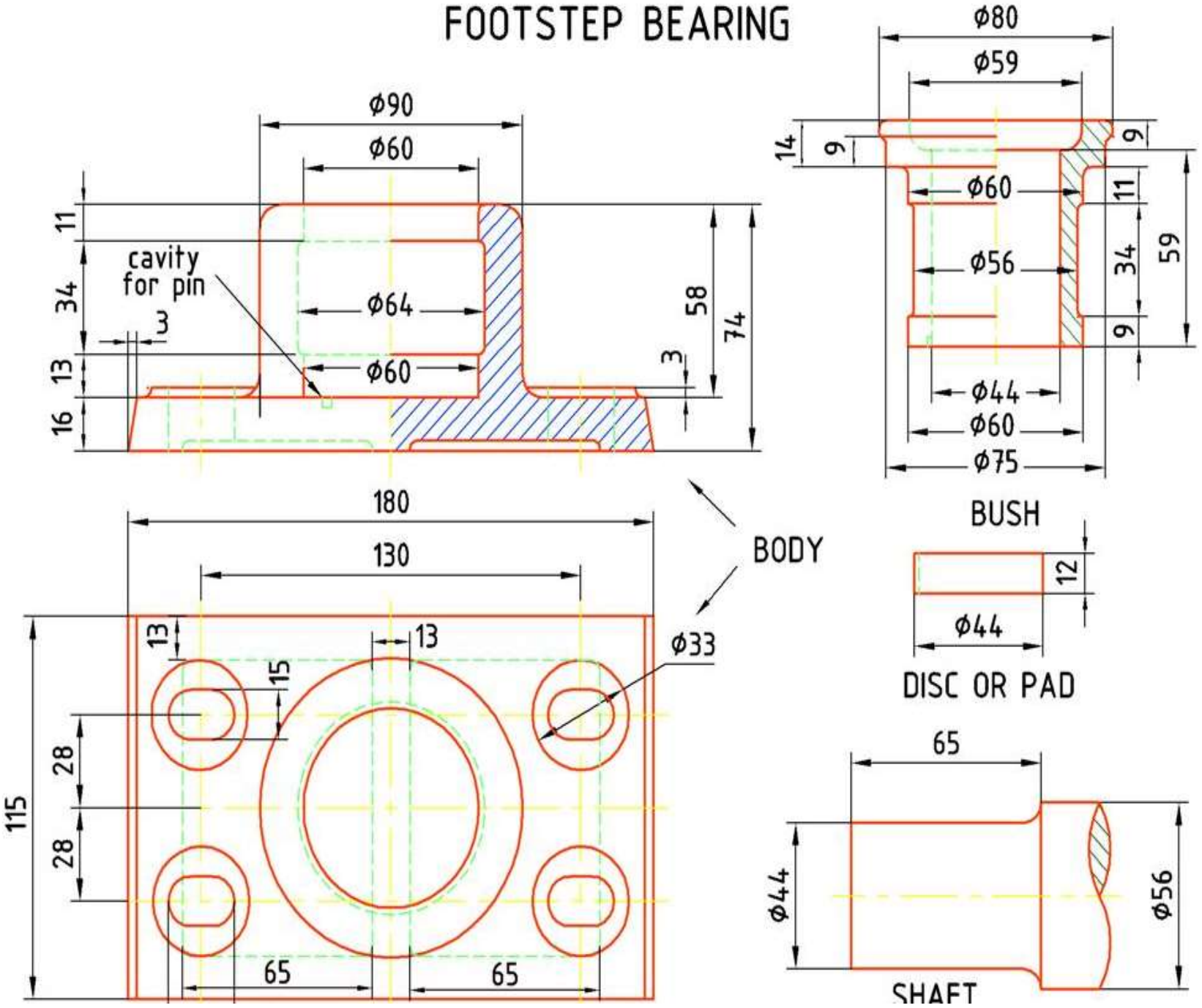
- Foot step bearing is used to support shaft vertically. It consists of a cast iron block into which a gun metal bush having a collar at the top is fitted.
- The shaft rests on a steel pad. The pad is prevented from rotating by a pin, inserted half inside the block and half in the pad and away from the centre.
- The collar of the bush is made hollow to serve as an oil cup for lubrication of the bearing.

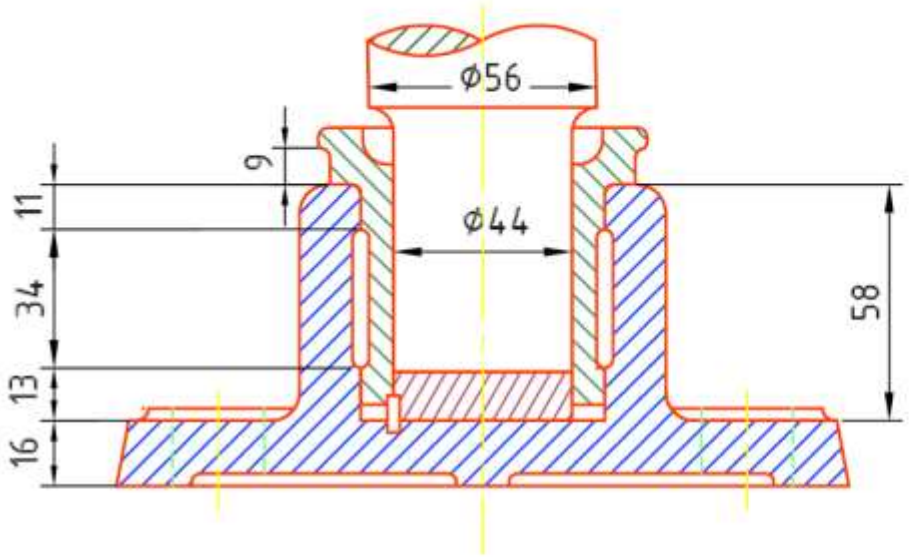
Foot step bearing



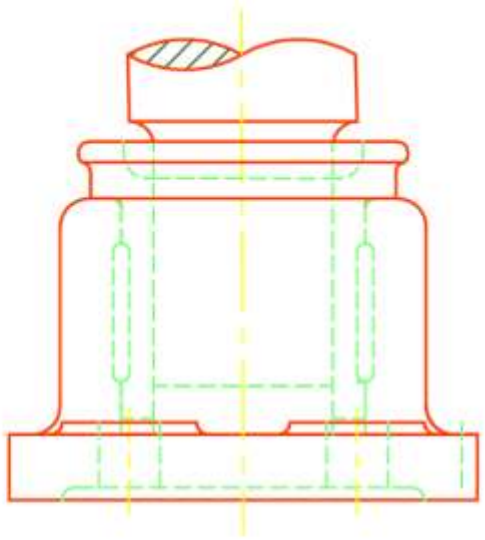


FOOTSTEP BEARING

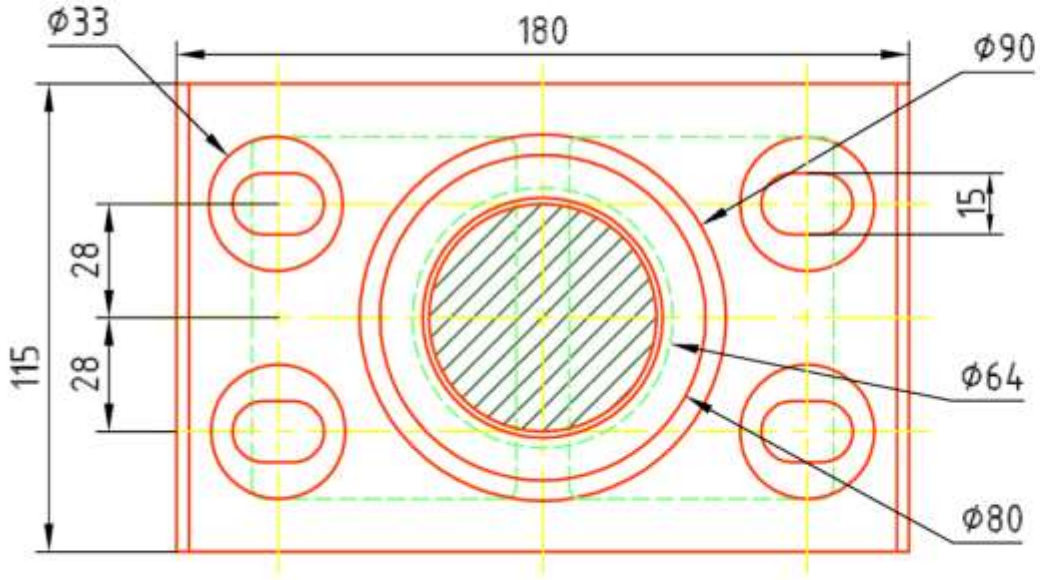




Sectional Front View



Side View



Top View

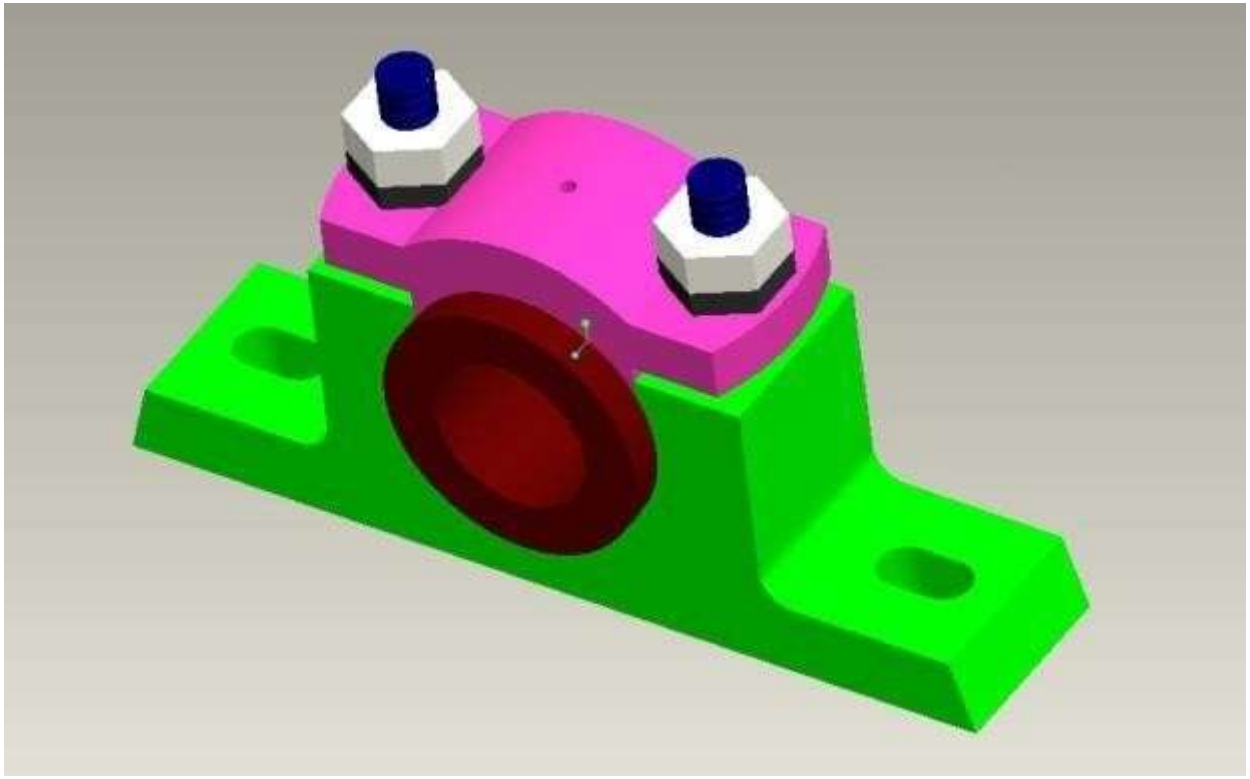
S.No.	PART NAME	MATERIAL	NO. OFF
1.	BODY	CAST IRON	1
2.	BUSH	BRASS	1
3.	DISC OR PAD	BRASS	1
4.	SHAFT	STEEL	1

Pedestal bearings or plummer block

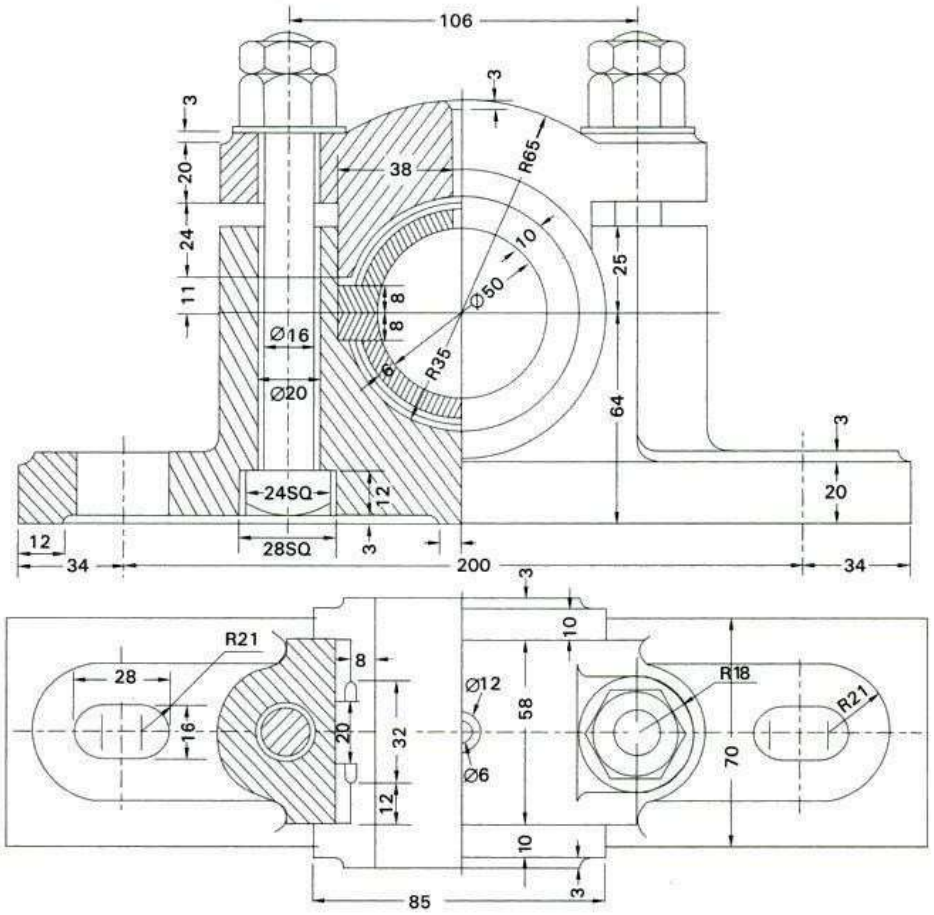
Bearing consists of

- Cast iron pedestal.
- Gun metal, or brass bush split into two halves called brasses.
- Cast iron cap and two mild steel bolts.
- The rotation of the bush inside the bearing housing is arrested by a snug at the bottom of the lower brass.
- The cap is tightened on the pedestal block by means of bolts and nuts.

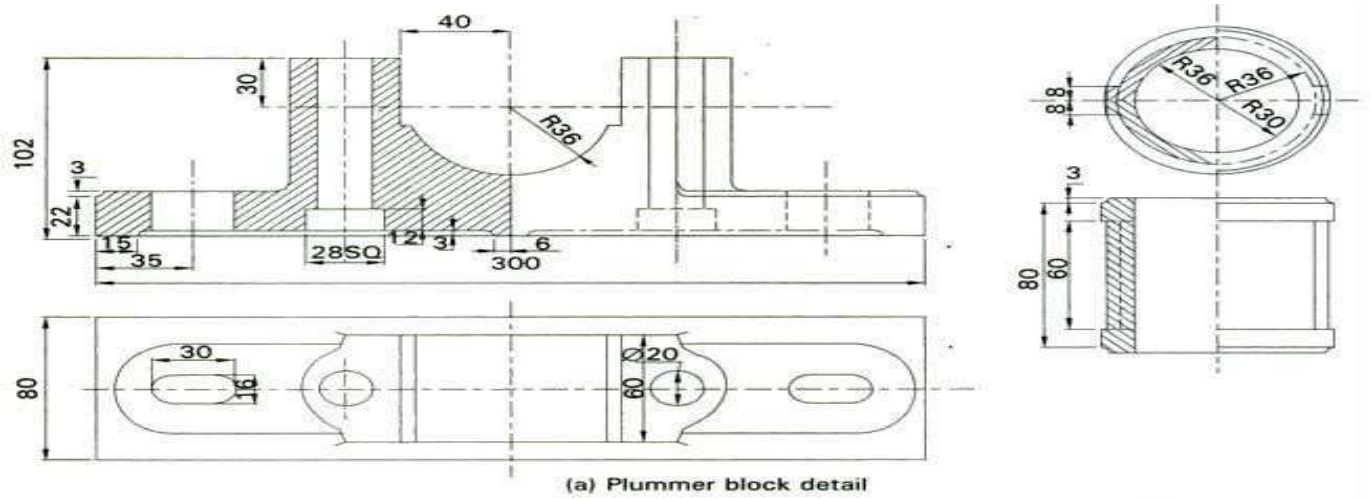
Pedestal Bearings or Plummer Block



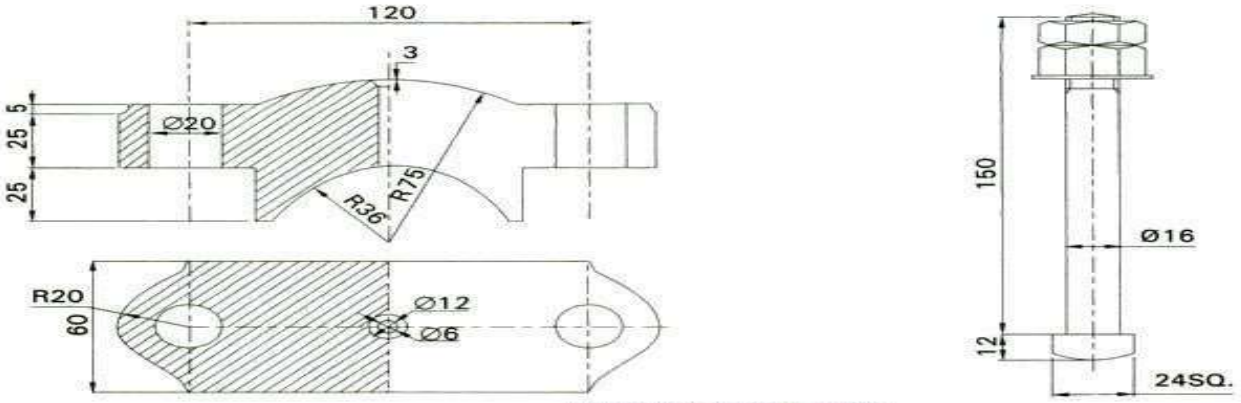
Pedestal Bearings or Plummer Block



Pedestal Bearings or Plummer Block



(a) Plummer block detail



(b) Plummer block detail

Bill of Material – Plummer Block

S No.	Part's Name	Material	No. off
1.	Body	C.I.	01
2.	Cap	C.I.	01
3.	Bush- 2 Halves	Gun Metal	01
4.	Bolt	M.S.	02

Pulleys

- ***Pulley*** is a wheel on an axle or shaft that is designed to support **movement** and change of direction of a taut cable or belt along itscircumference.
- Pulleys are used in a variety of ways to lift loads, apply forces, and to transmit **power**.

❑ **Types ofpulleys:**

- Speed Cone or SteppedPulleys
- Split Pulleys
- RopePulleys
- V-belt Pulleys

Flat Cone Pulley

V Cone Pulley

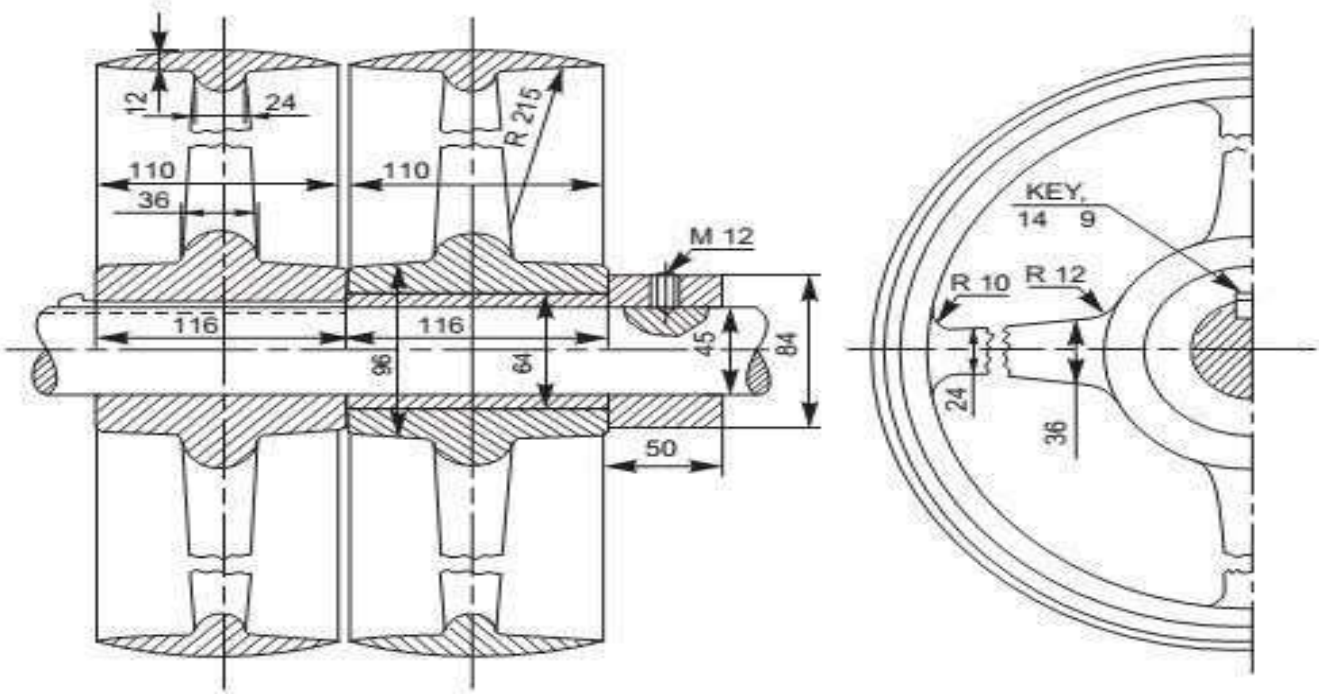
Rope Pulley

Material used for pulleys

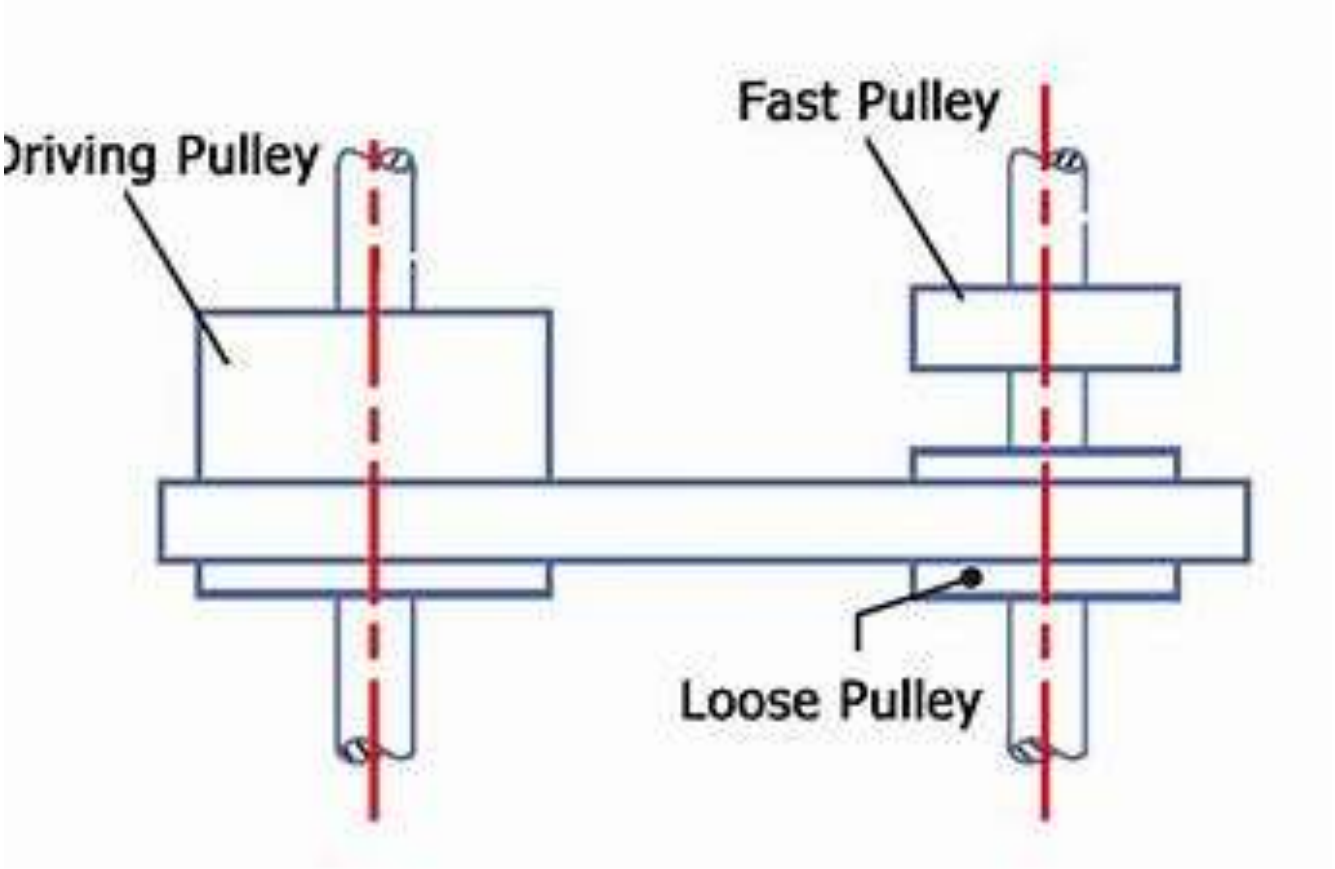
- Pulleys can be made from a variety of materials, including an extensive range of plastics, wood andmetals.

- Steels and aluminum alloys are regularly used in industrial pulleymanufacture.

Fast and loose pulley



Fast and loose Pulley



Pipe joints

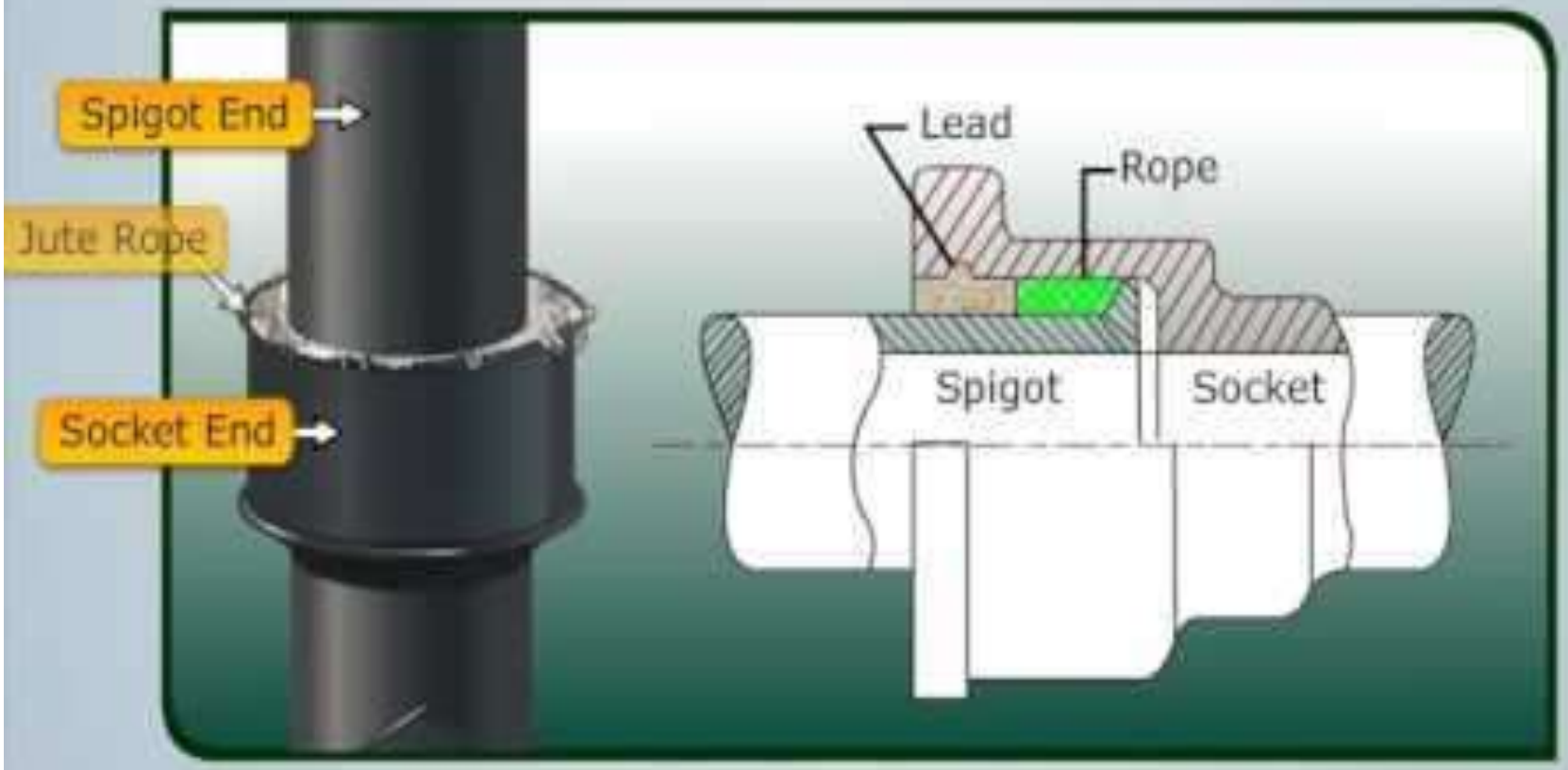
- Flanged joints are used for high pressure flows and for large diameter pipes. In general they are used for plain end pipes or threaded pipes.

- Two flange components are connected by bolts at the pipe joint to prevent leakage.

Types of Pipe Fitting

There are different types of pipe fitting used in piping.

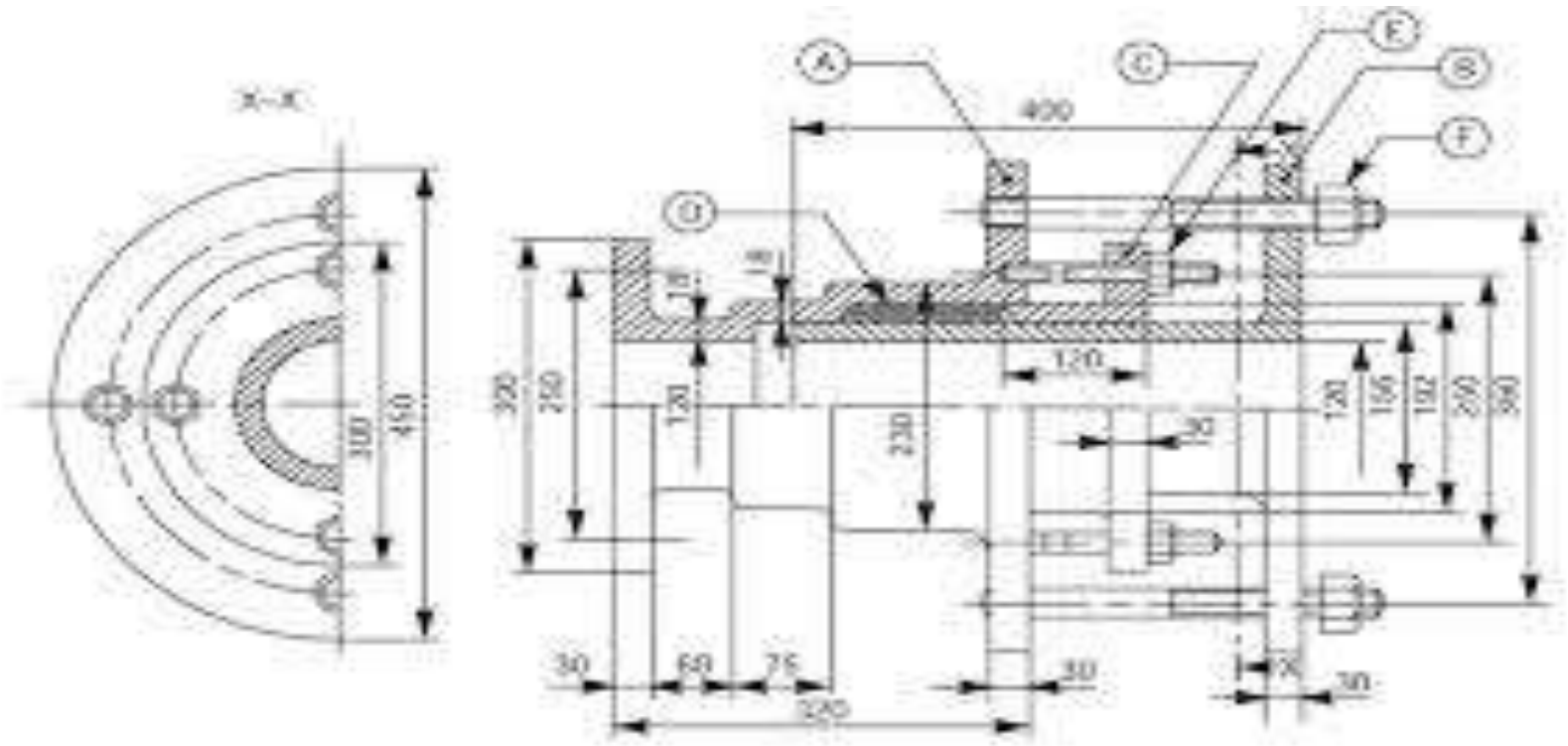
- Elbow, Tee,
- Union,
- Coupling,
- Swage Nipple,
- Expansion Joint,
- Steam Traps,
- Flanges and Valve.



Spigot and Socket Joint

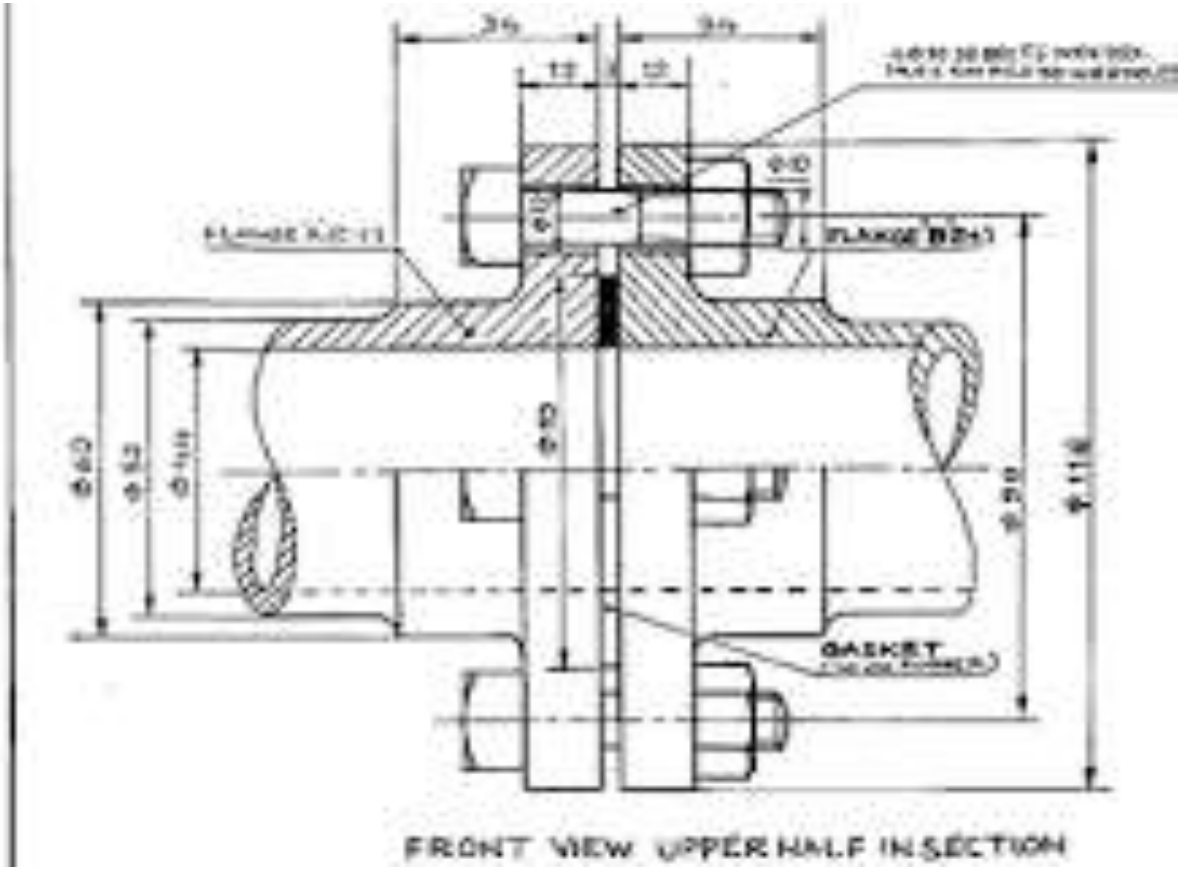
The Clearance Space between them is filled by Covering it with Jute Rope and a Ring of Lead, this Ring when Solidifies it Seals the joint between the Two Pipes.

Expansion joint

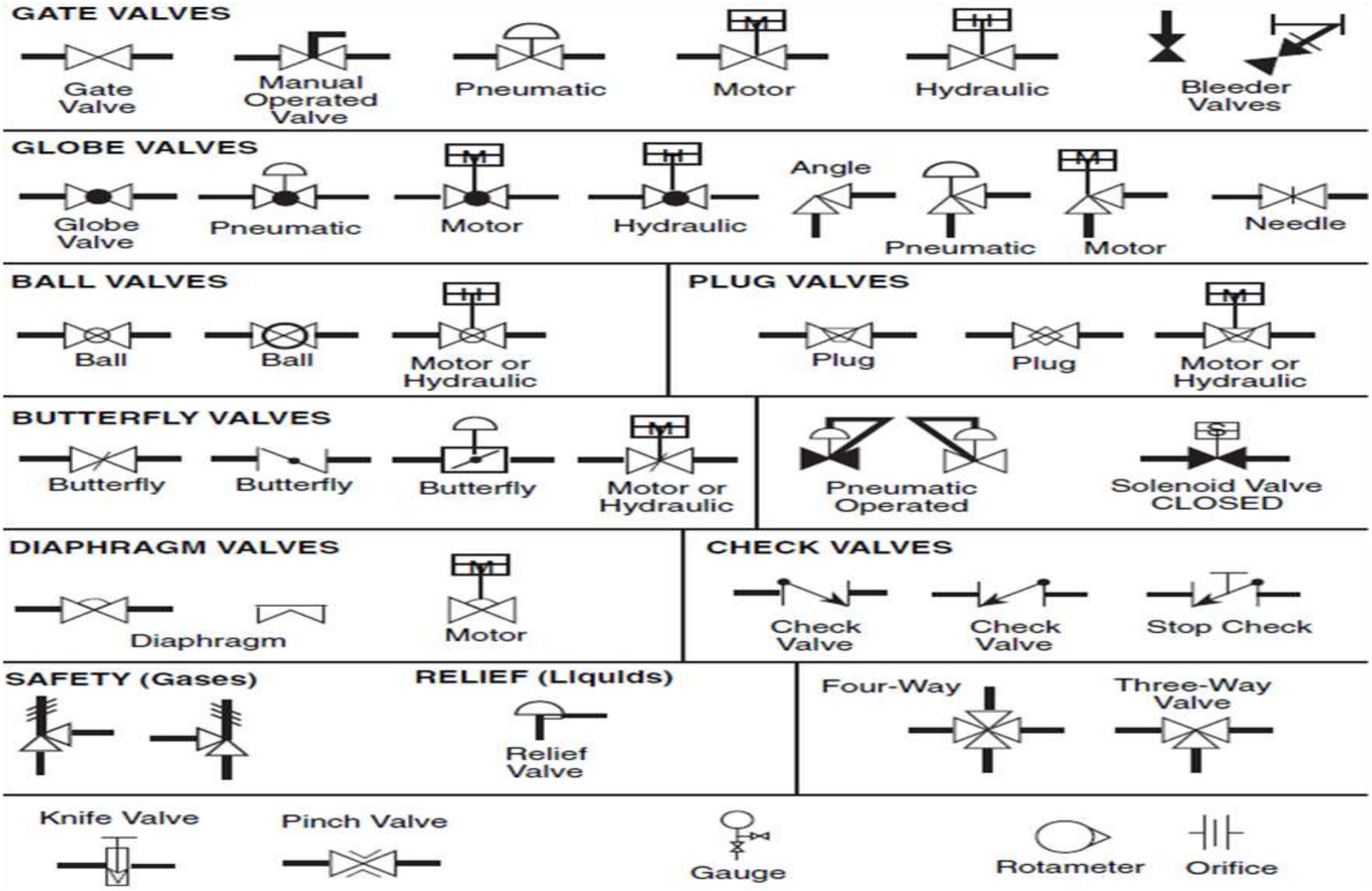


Flanged pipe joint

Flanged pipe joint

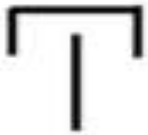


Piping Symbols

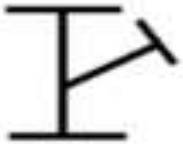


Plumbing Pipe and Fittings - Symbols

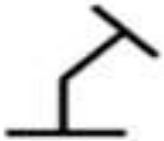
90 Degree Elbow



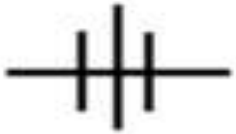
Cap



Wye



45 Degree Elbow



Union

Vent

P-Trap

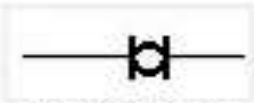
Tee

Running Trap

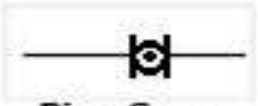
Pipe going down

Pipe going up

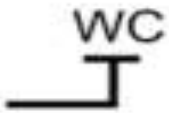
Pipe Guide



Pipe Tee Up



Pipe Cross Up-Down



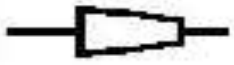
Water Closet

Floor Drain

Kitchen Sink

Lavatory

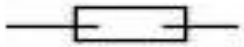
Laundry Tray



Brushing

Concentric Reducer

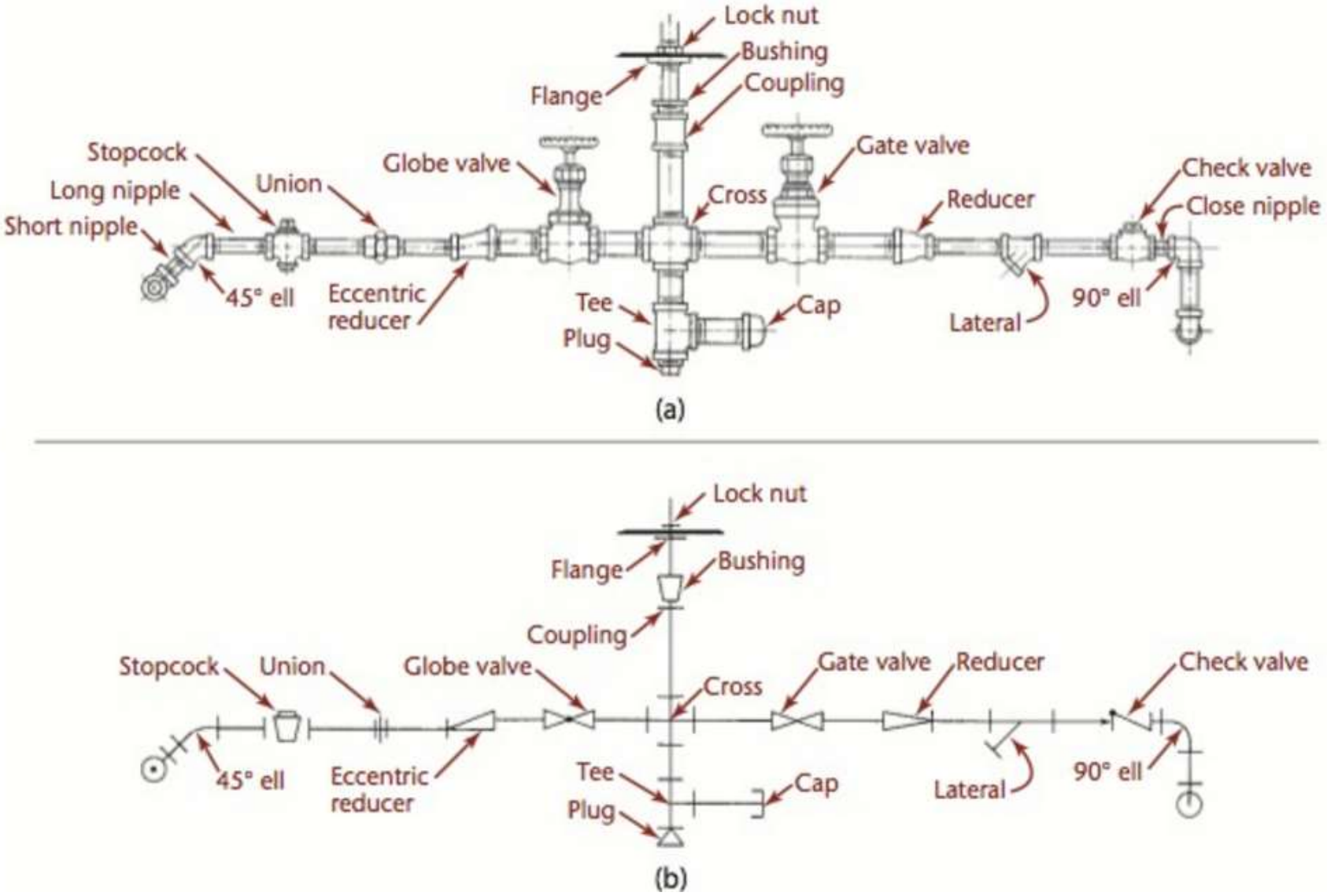
Eccentric Reducer



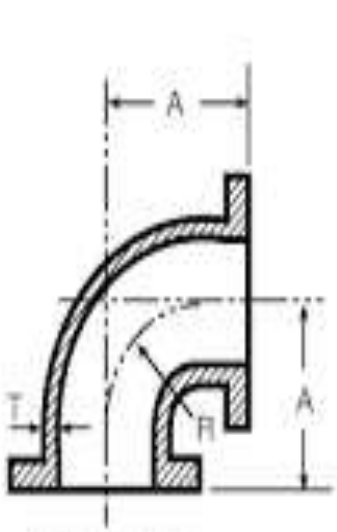
Expansion Joint

Flexible Connection

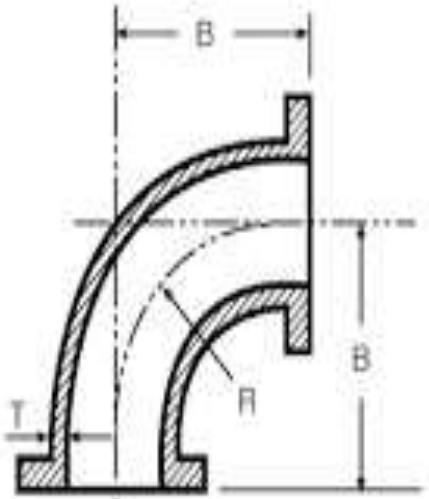
Piping symbols



Right angled bend

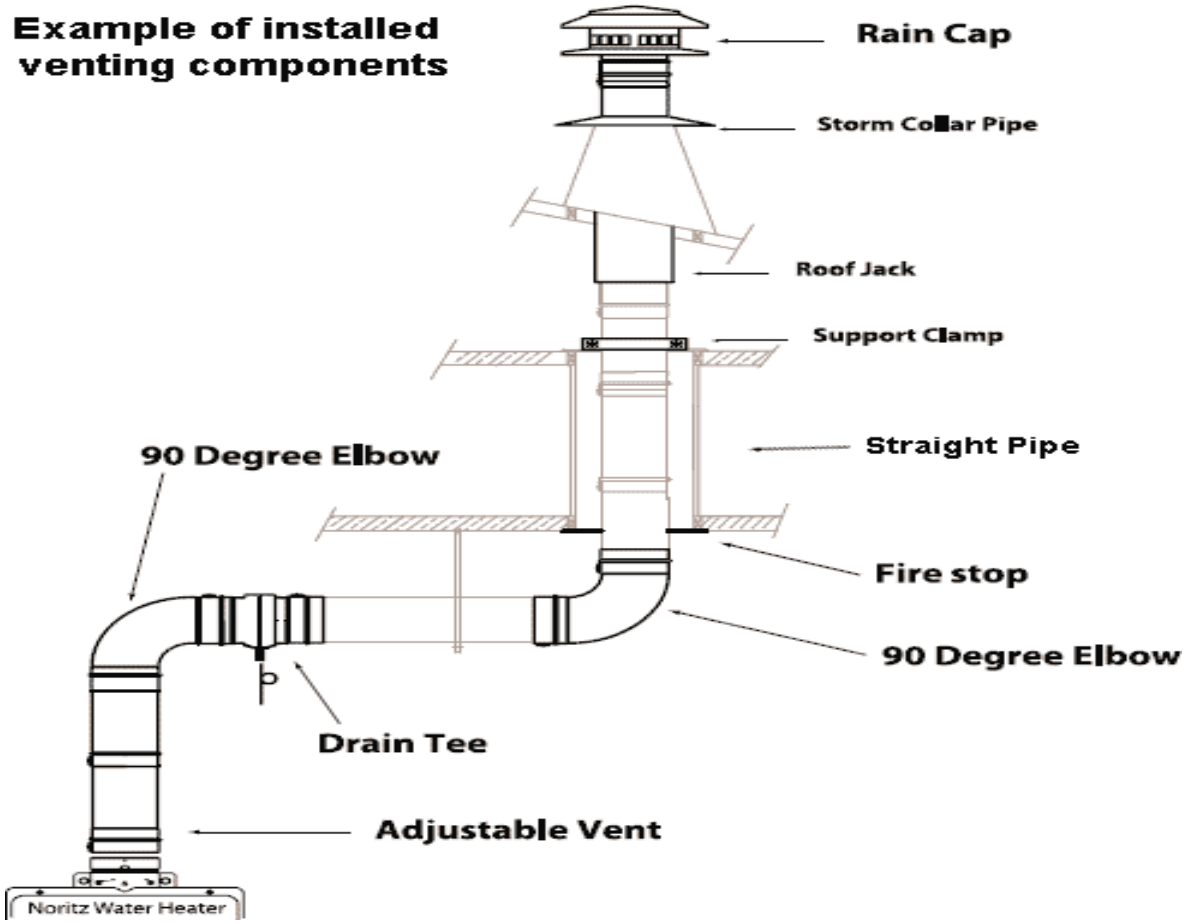


Short Radius



Long Radius
AMERICAN Standard

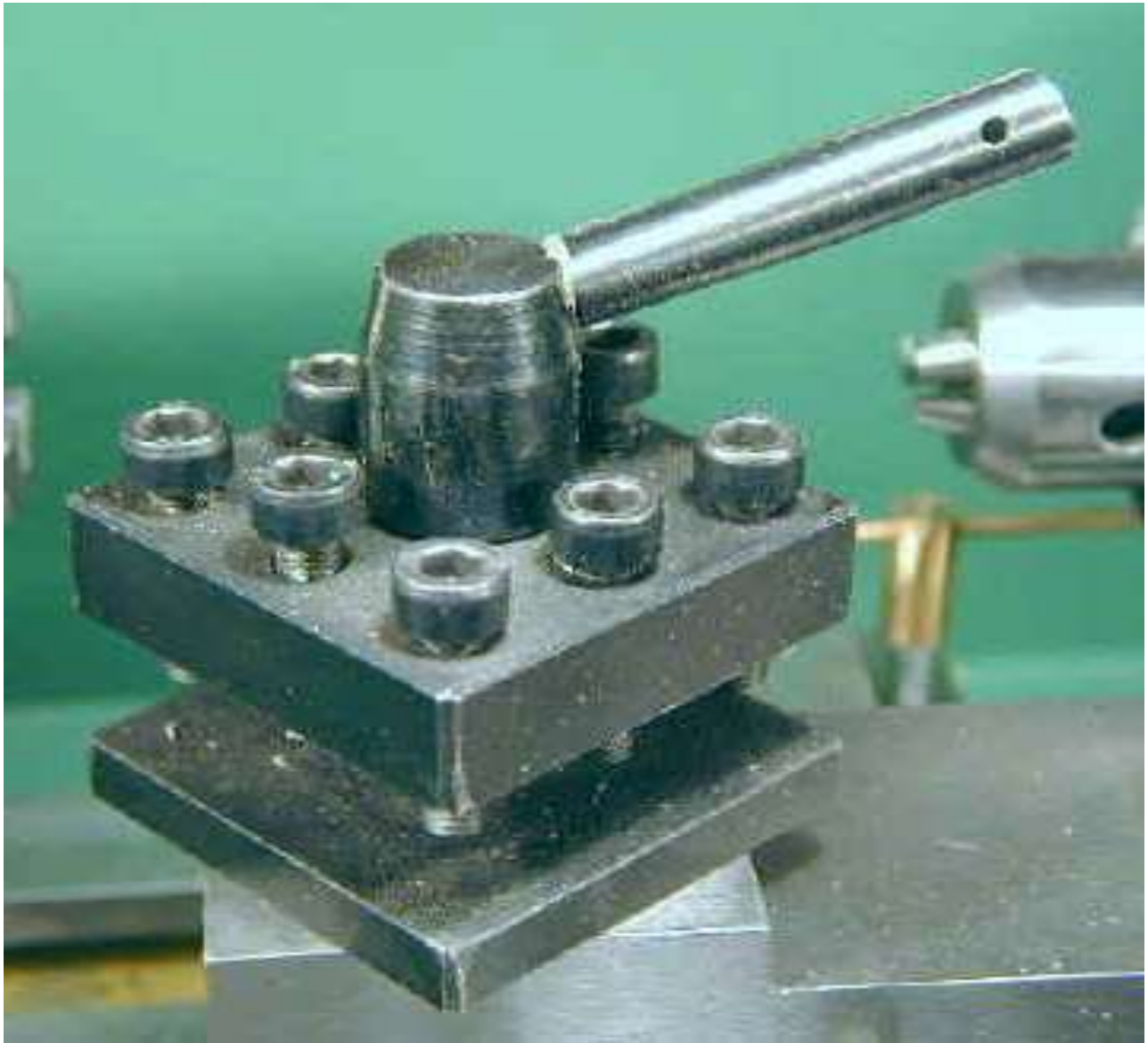
Right angle bend pipe



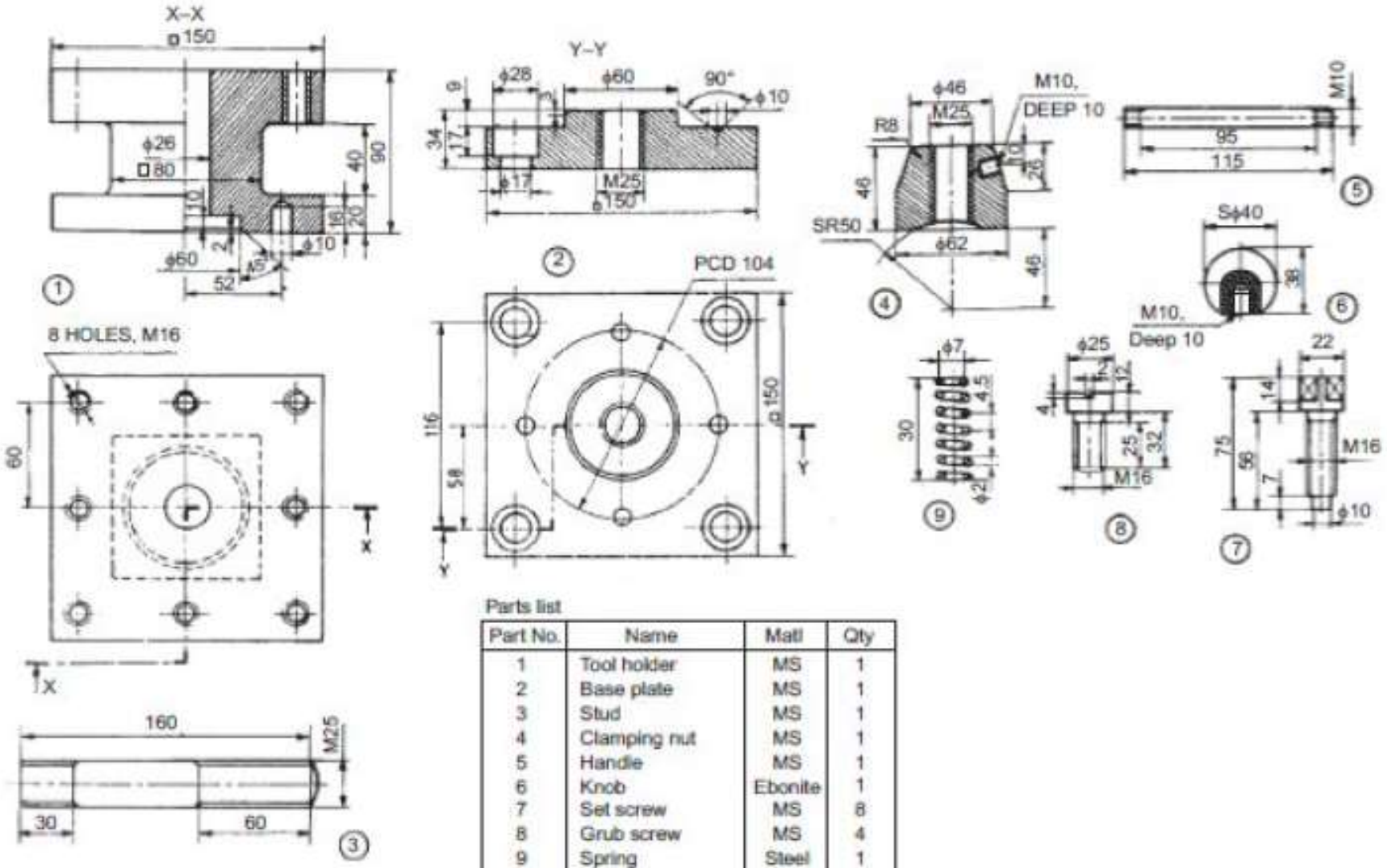
Lathe Tool Holder

Tool Holder: It is used to hold the cutting tool in the lathe machine. Tool holder can be rotated and clamped in any direction so that all tools should works.

Square Lathe Tool Holder



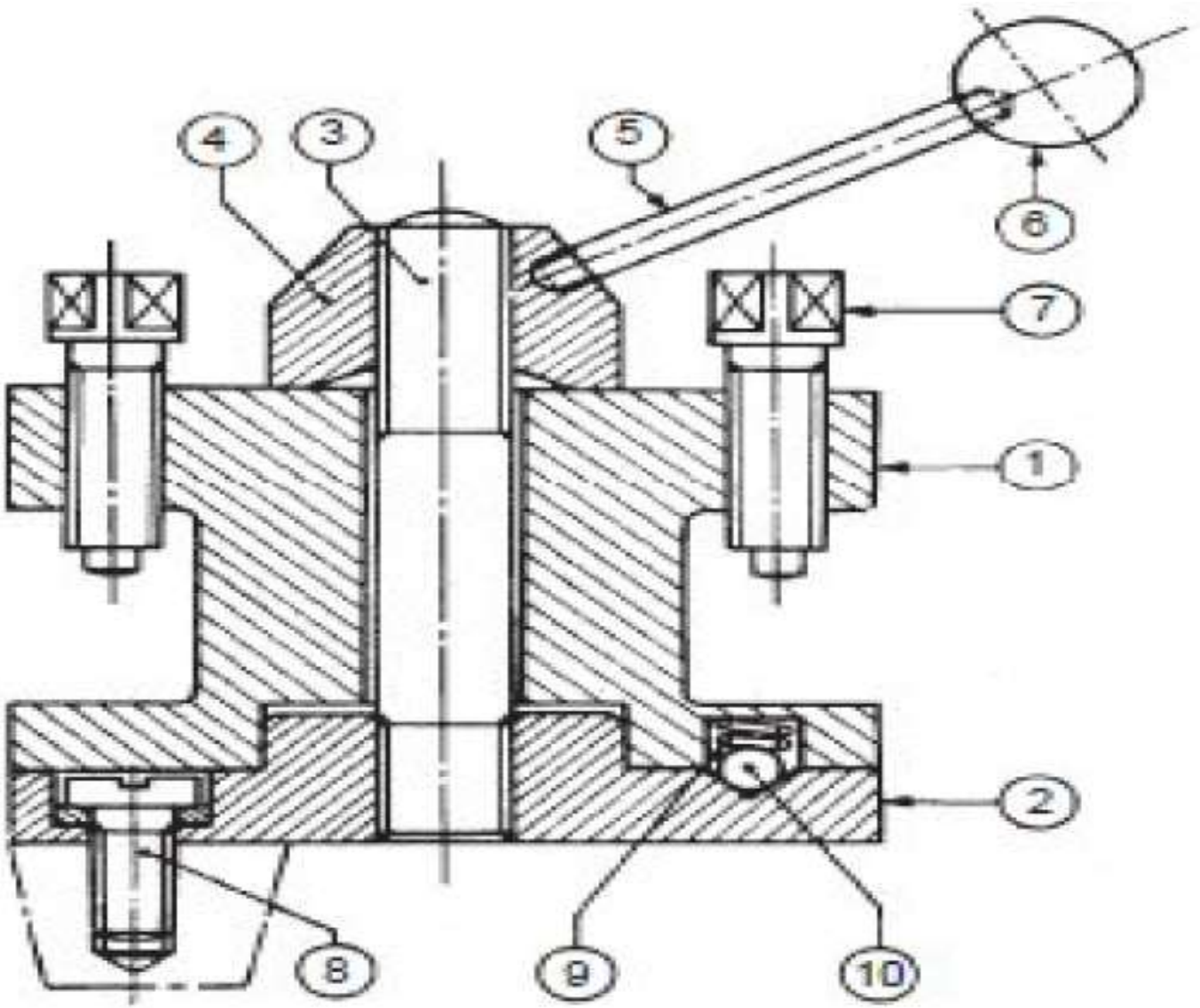
Details of Square Lathe Tool Holder



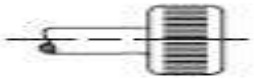
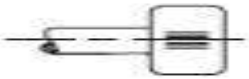
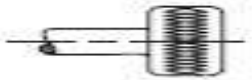
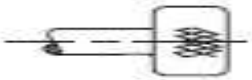
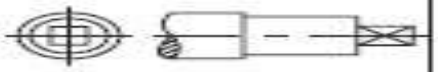
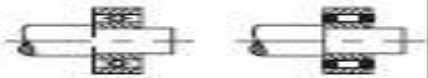
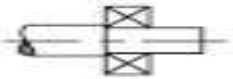
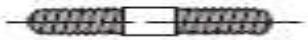
Parts list

Part No.	Name	Matl	Qty
1	Tool holder	MS	1
2	Base plate	MS	1
3	Stud	MS	1
4	Clamping nut	MS	1
5	Handle	MS	1
6	Knob	Ebonite	1
7	Set screw	MS	8
8	Grub screw	MS	4
9	Spring	Steel	1
10	Ball φ9	MS	1

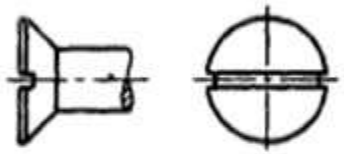
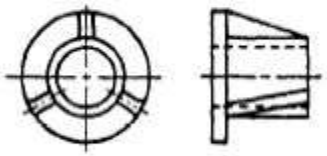
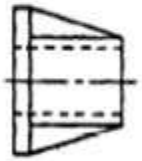
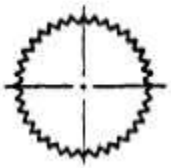
Assembly of Square Lathe Tool Holder

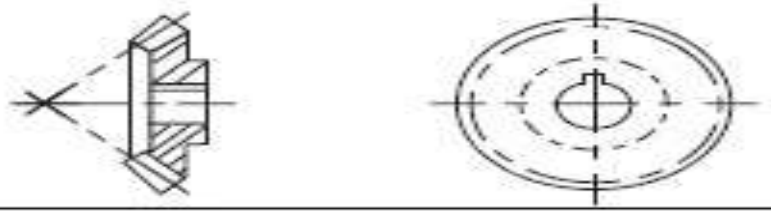
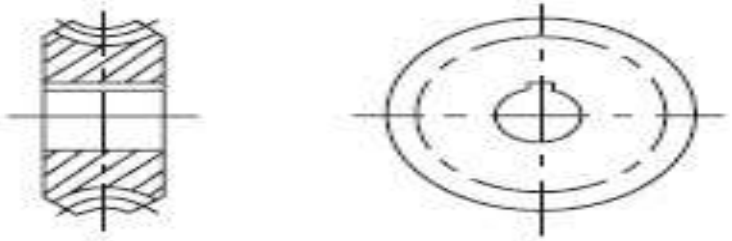


Conventional representations of common features

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 COMMON FEATURES

Title	Actual projection	convention
Slotted head		
Radial ribs		
Serrated shaft		

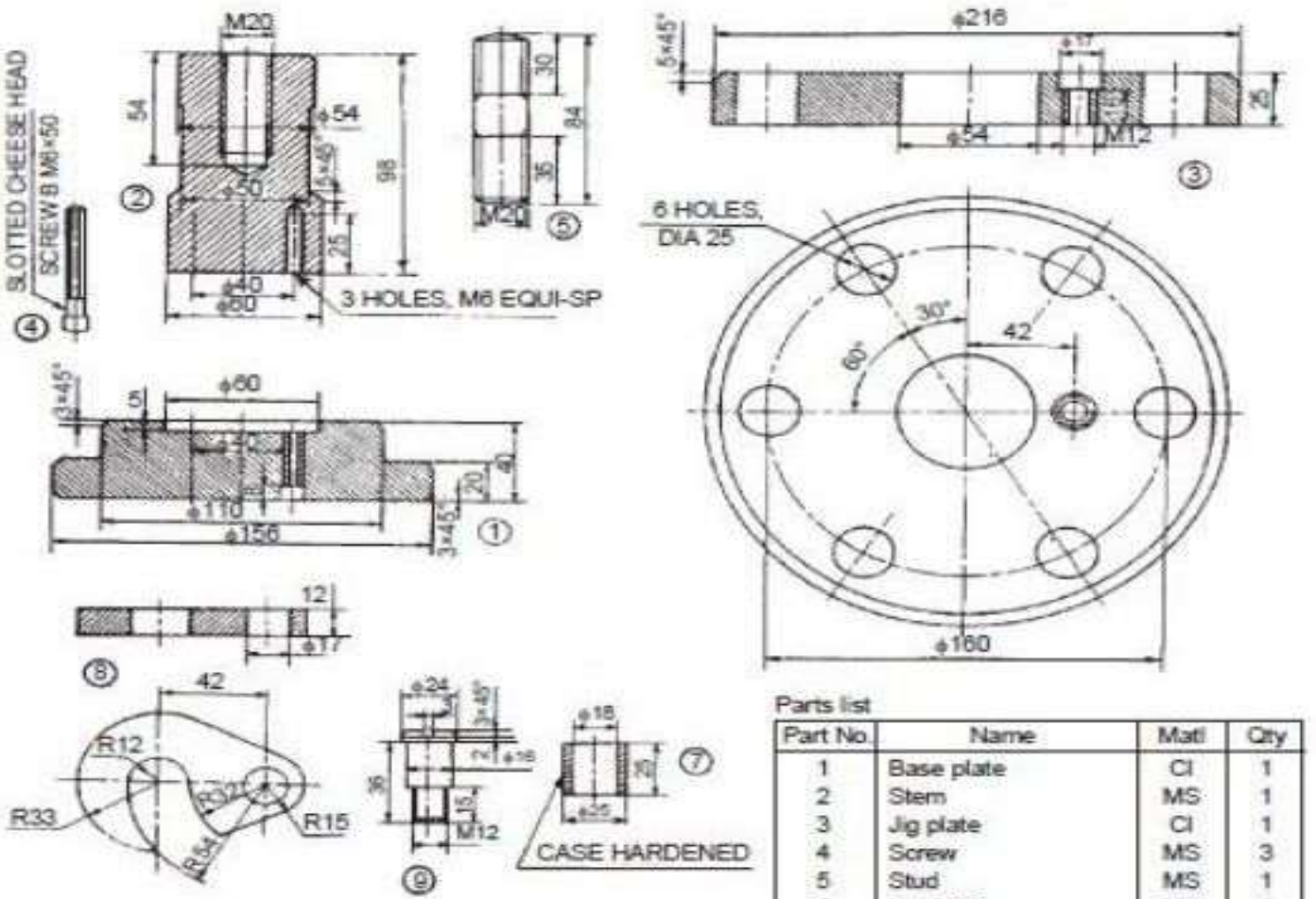
Title	Convention
Spur gear	
Bevel gear	
Worm wheel	
Worm	

Chapter 3 Drilling Jig

Jig: A jig is a device is which is used to hold and support the work piece. It also guides the path of cutting tool during operation. Jig are widely used for various operations such as drilling, reaming, counter-boring, tapping etc.

Drilling Jig: It is used to six equally spaced holes in a circular flange. The Jig plate is made by cast iron.

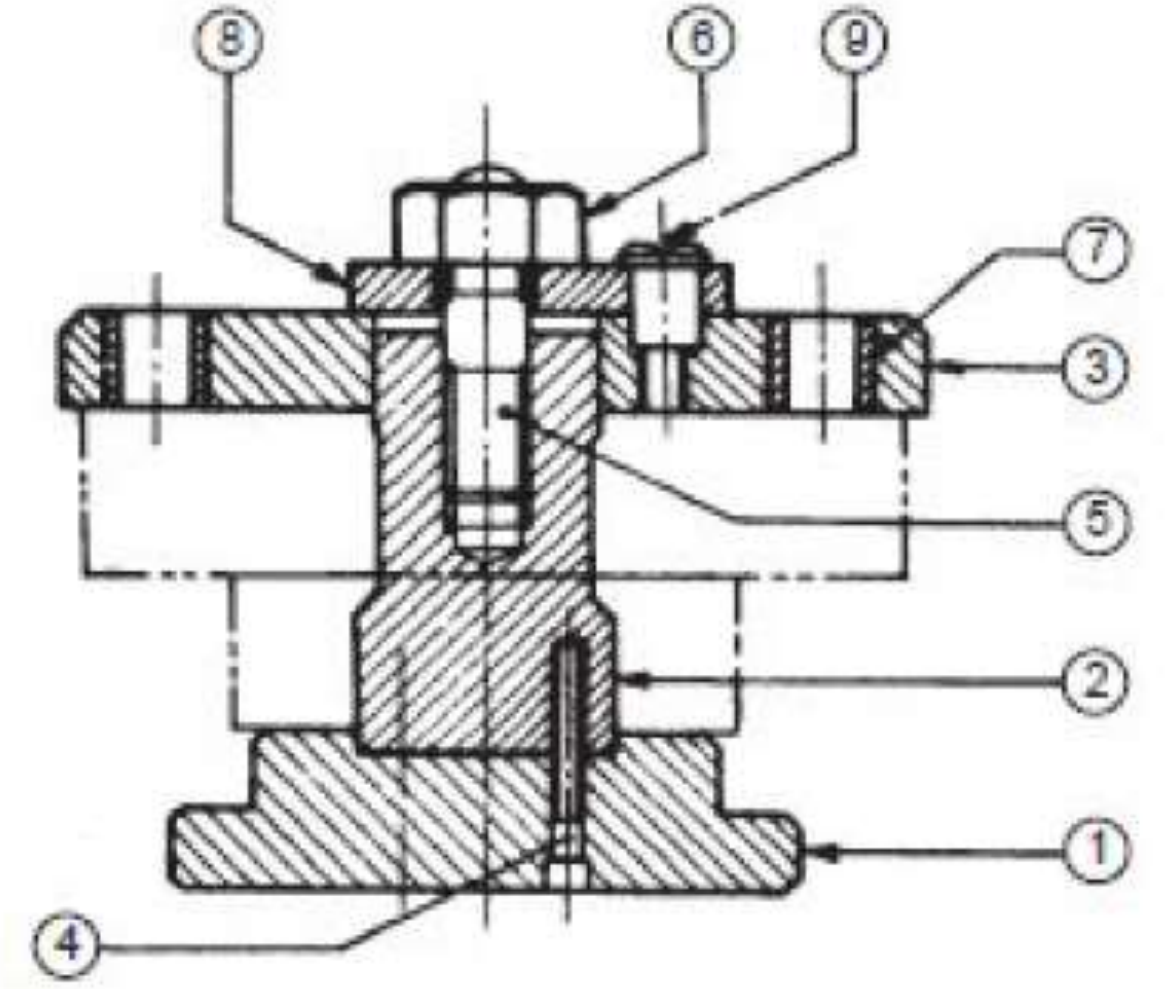
Details of Drilling Jig



Parts list

Part No.	Name	Matl	Qty
1	Base plate	CI	1
2	Stem	MS	1
3	Jig plate	CI	1
4	Screw	MS	3
5	Stud	MS	1
6	Nut M20	MS	1
7	Bush case hardened	Steel	6
8	Latch washer	MS	1
9	Screw	MS	1

Assembly of Drilling Jig

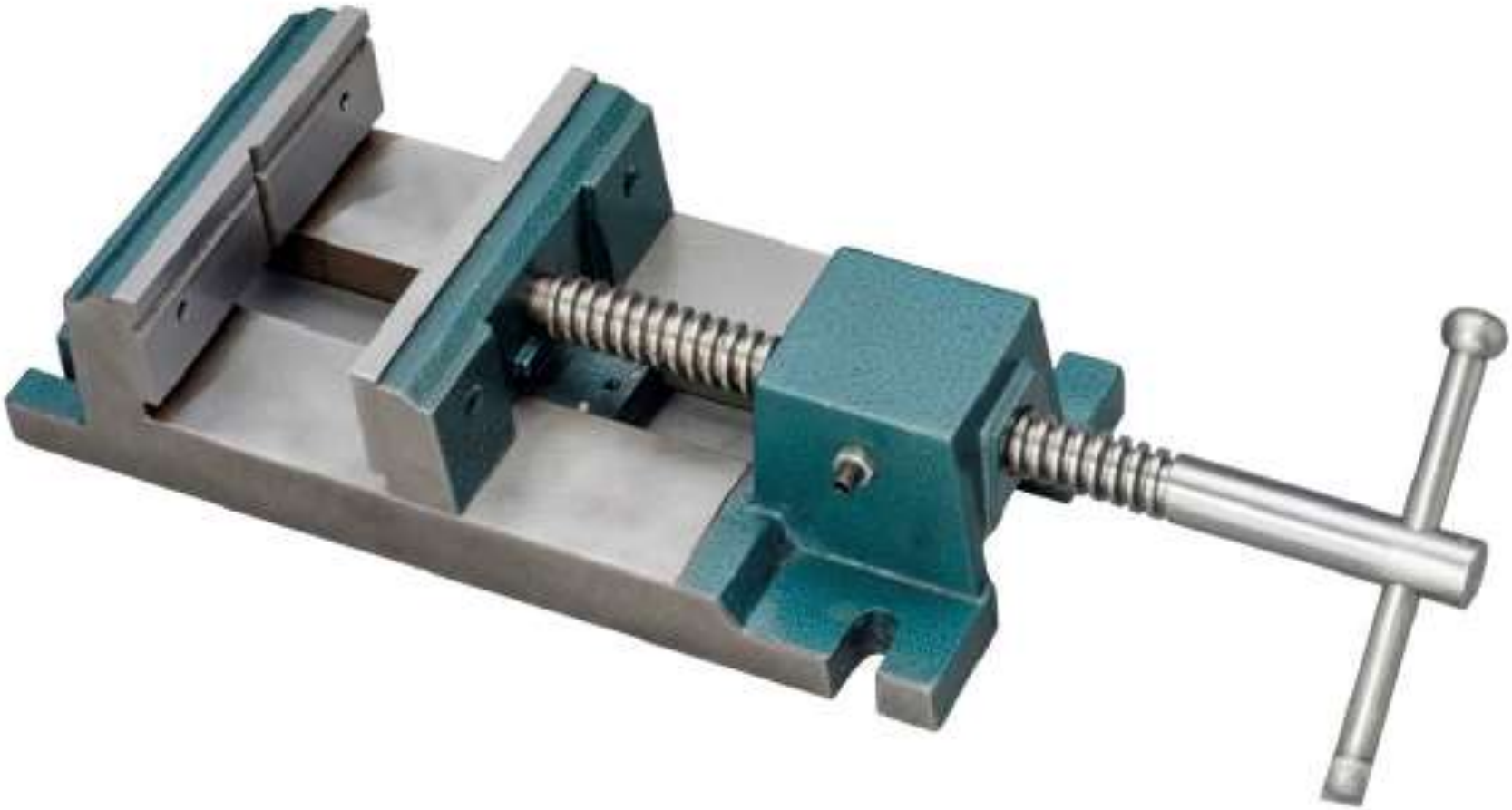


MACHINE VICE

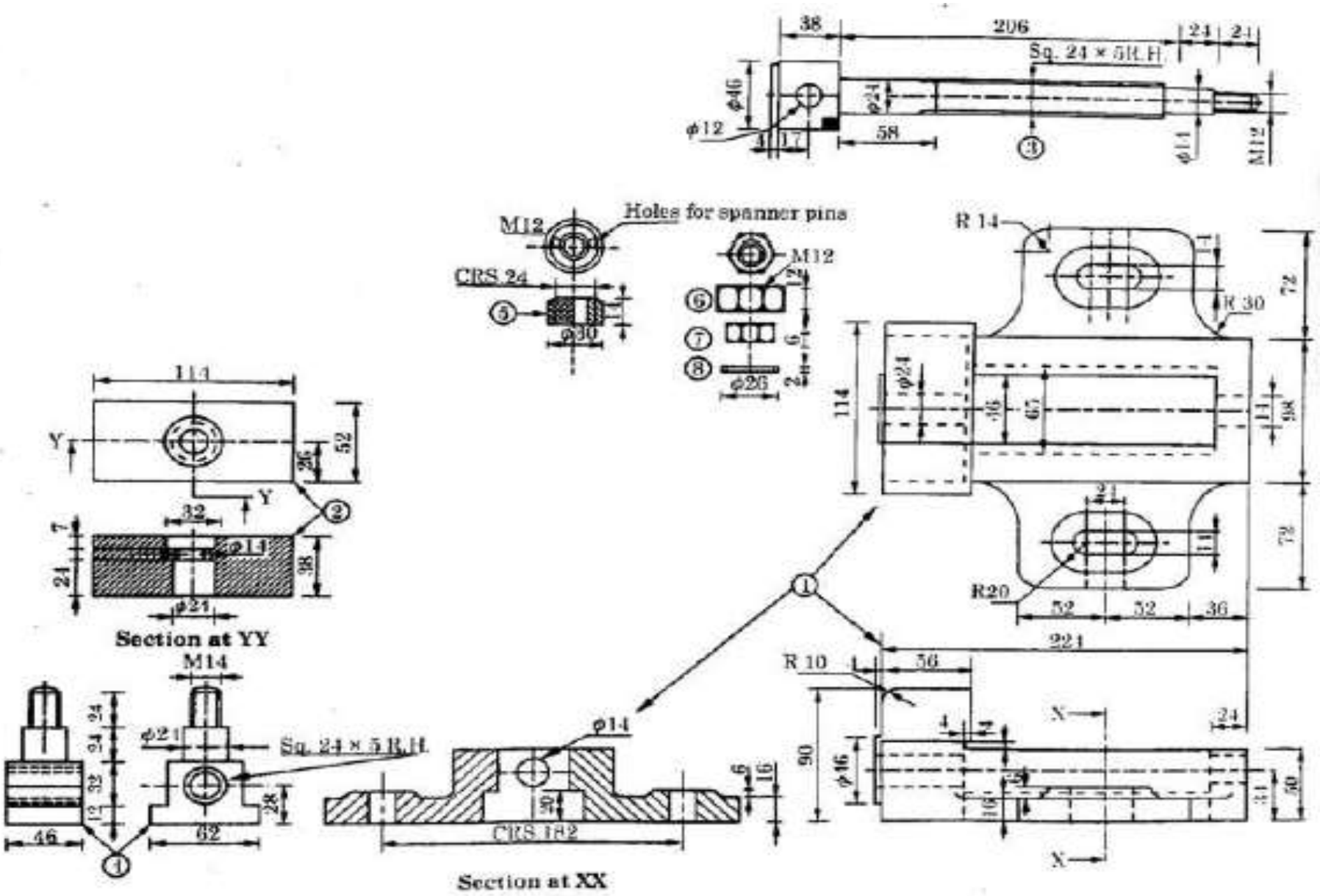
A vice is an important device used to hold the work-piece to carry out various operations. It may be fitted on a work table or a machine table. It is also called bench vice or machine vice. Each vice has four main parts

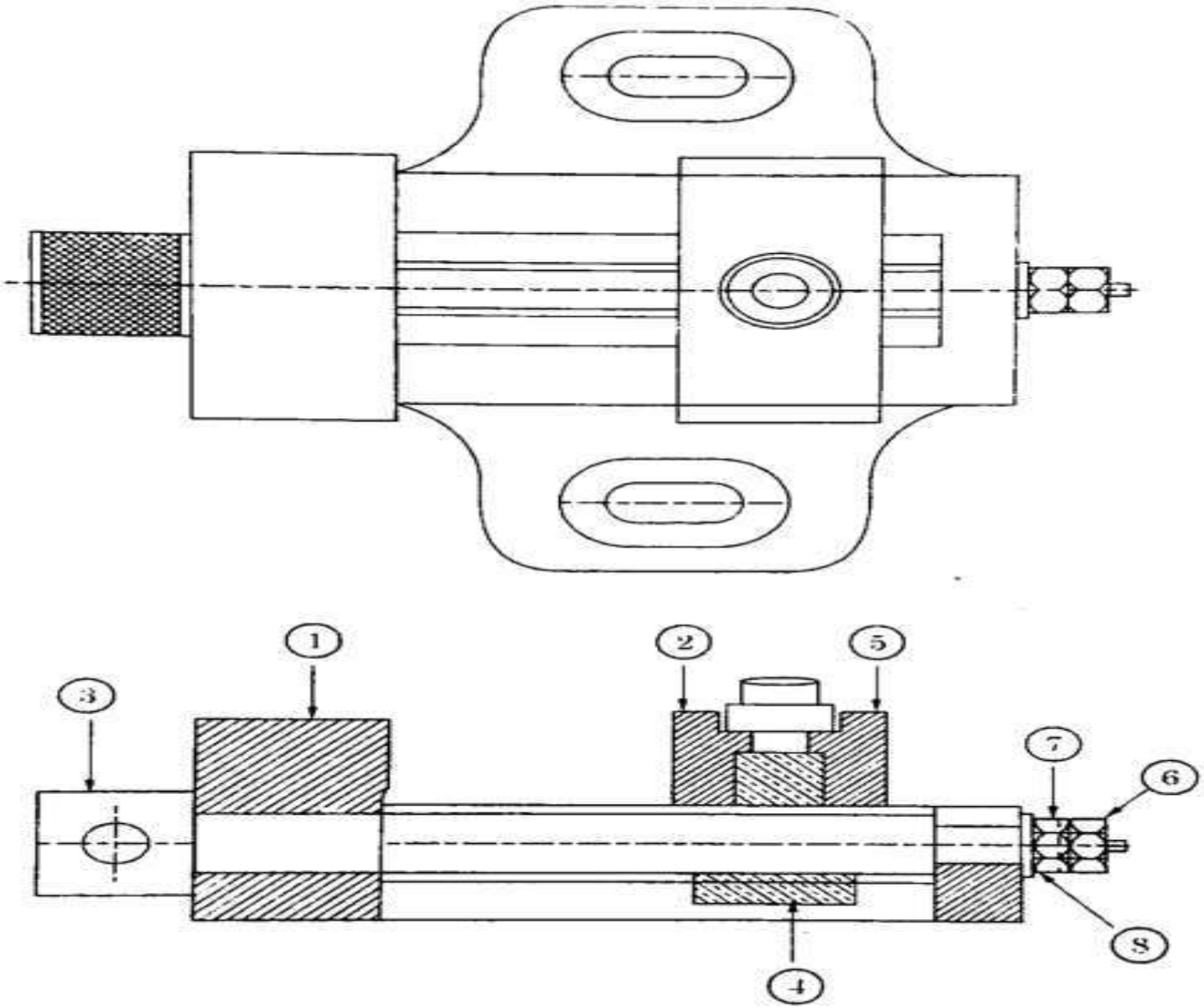
1. **Casting:** it constitutes the base of the vice and has ways for the movable jaw.
2. **Fixed Jaw**: It is usually cast integral with the vice base.
3. **Movable Jaw**: It slides on the ways provided in the casting and is operating with a screw.
4. **Screw**: It gives forward or backward movement to the movable jaw and to do so, it is rotated by handle called screw bar.

Machine Vice



Details of Machine Vice





Machine Vice (General Arrangement)

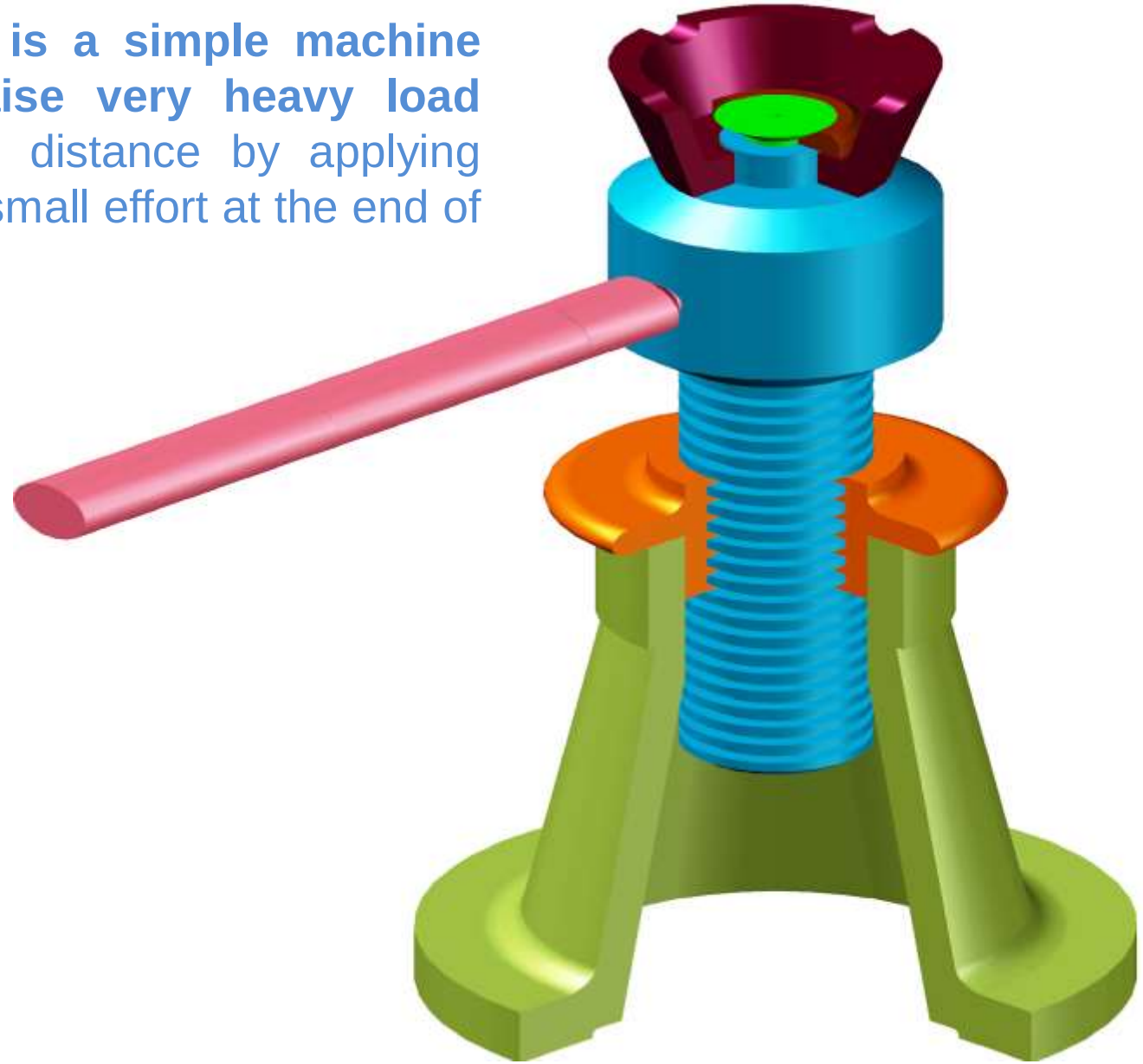
Bill of Materials Machine Vice

Part No.	Name of Part	Material	No. Off.
1.	Base	C.I.	01
2.	Movable jaw	M.S.	01
3.	Screw	M.S	01
4.	Movable jaw clamping bolt	M.S	01
5.	Circular nut	M.S	01
6.	Hexagonal nut	M.S	01
7.	Lock nut	M.S	01
8.	Washer	M.S	01

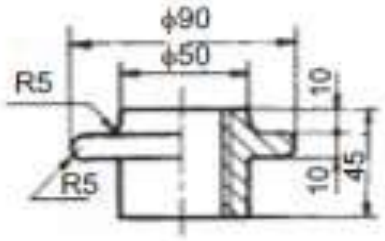
SCREW JACK

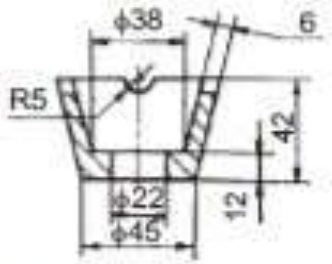
Screw Jack

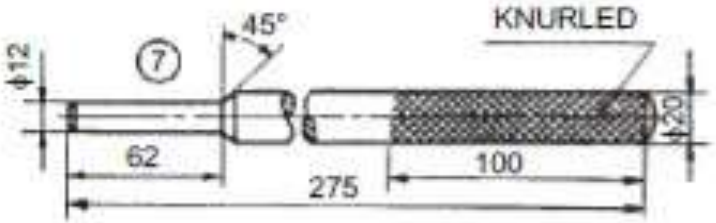
A screw jack is a simple machine which can raise very heavy load through some distance by applying comparatively small effort at the end of a long lever.

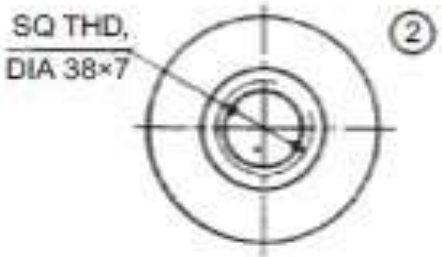


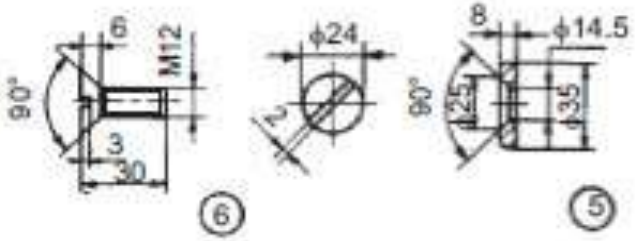
Details of Screw Jack

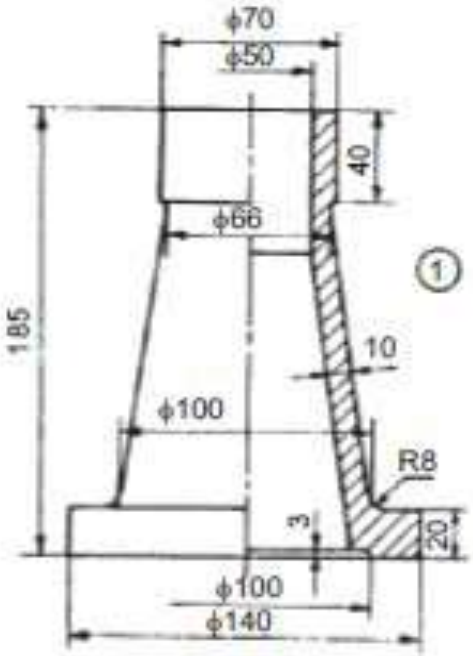


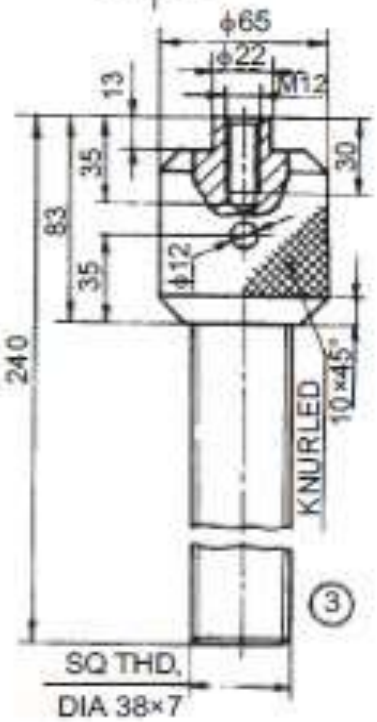








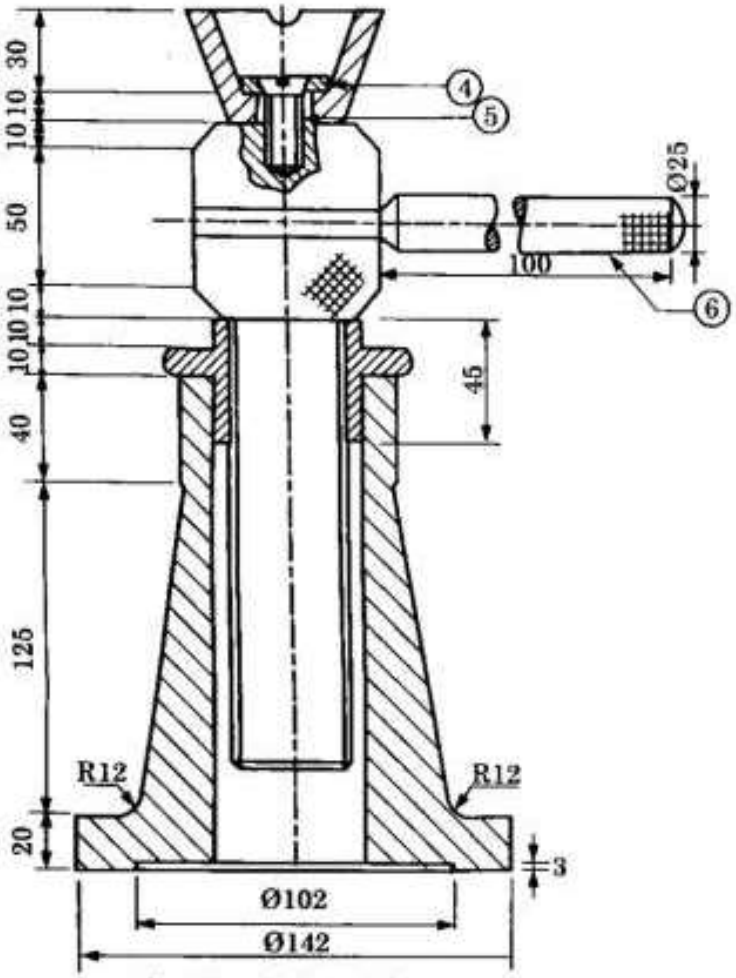




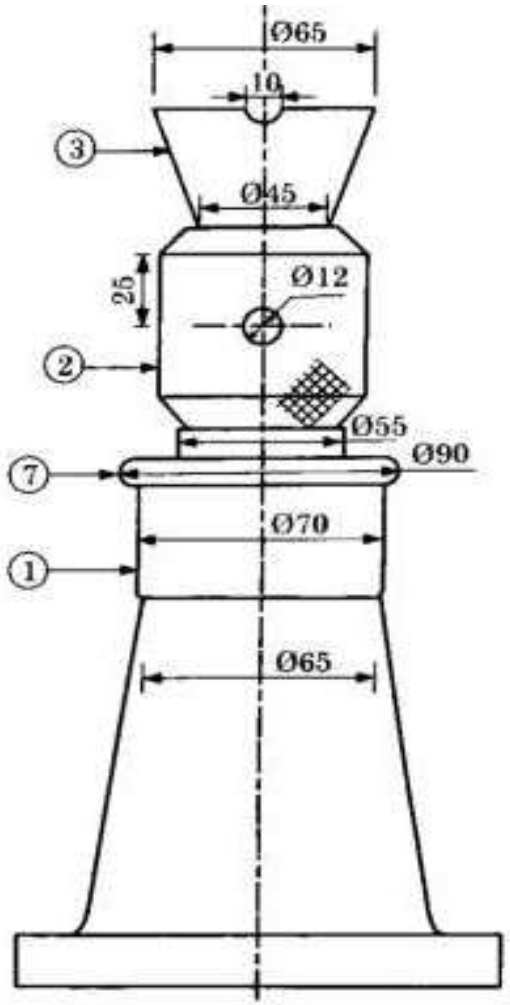
Parts list

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

Assembly of Screw Jack



Sectional Front View



Side View

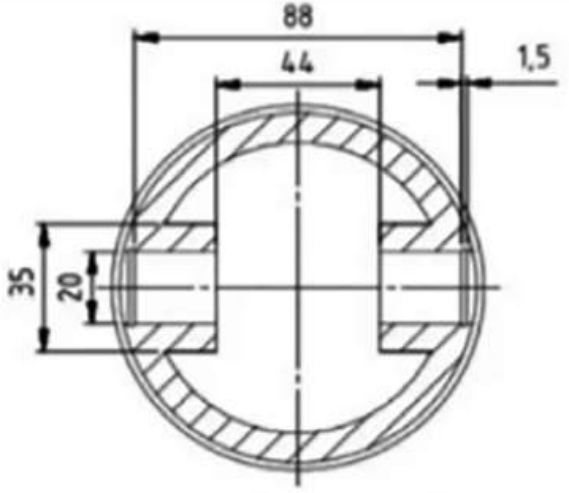
I.C. ENGINE PARTS

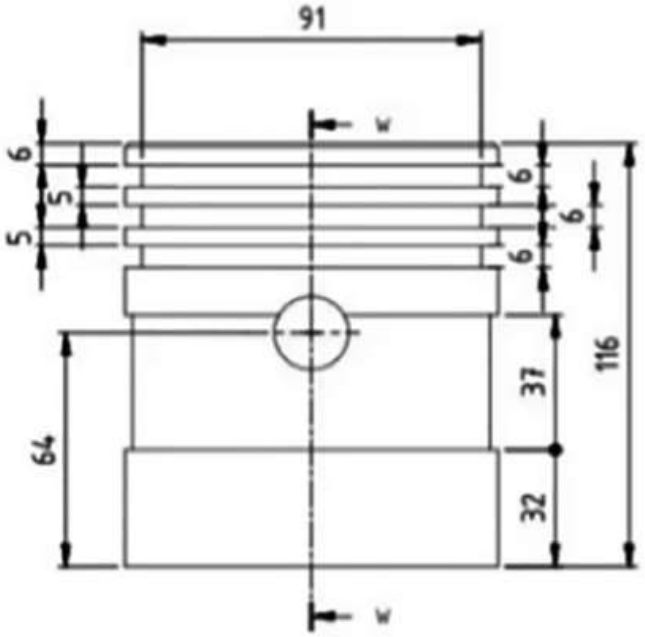
I.C. Engine: The engine in which is combustion of fuel take place inside the engine cylinder is called internal combustion engine. These engines convert chemical energy of fuel into heat energy during burning and further the heat energy is converted into mechanical energy through a mechanism.

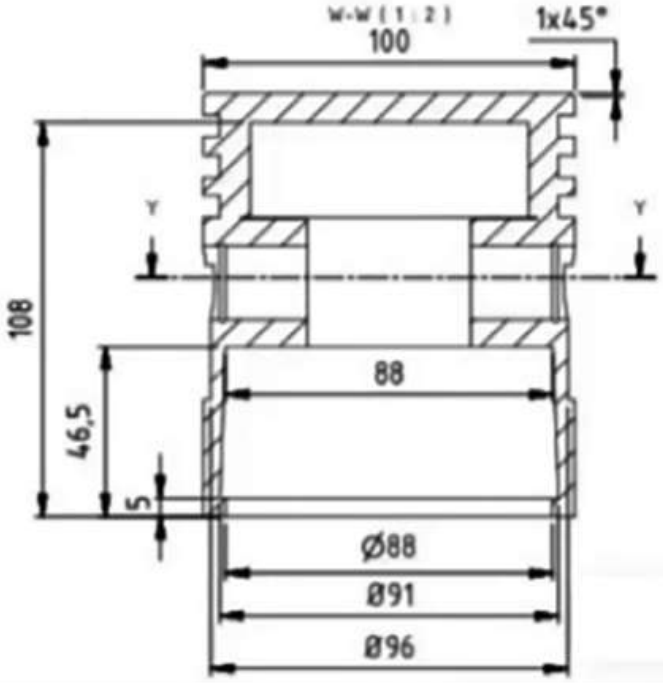
Piston: A piston is cylindrical piece which moves to and fro within the cylinder by the force exerted an it due to the burning of fuel.

Connecting Rod: The function of connecting rod is to convert the reciprocating motion of the piston into rotary motion of the crankshaft. These are made of forged steel.

I.C. Piston

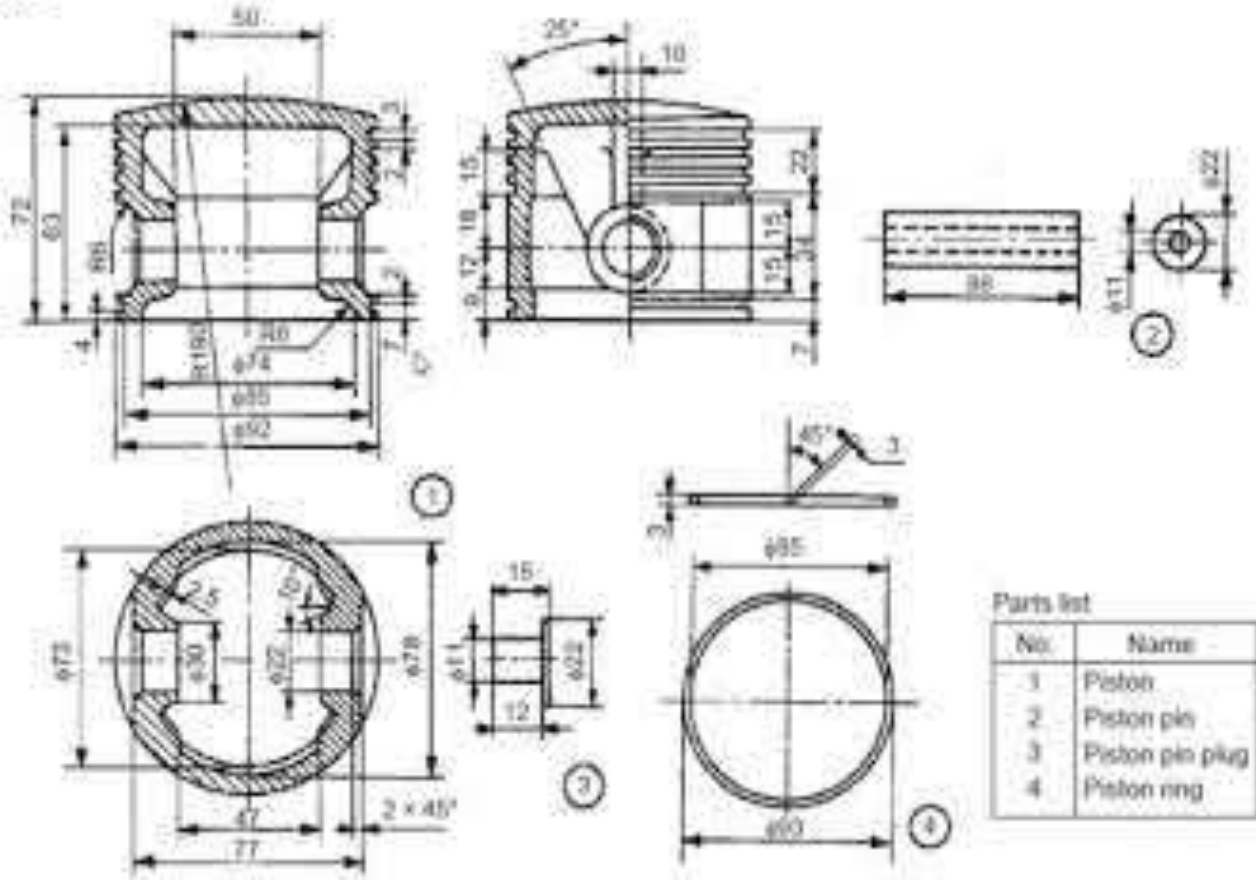

88
44
1,5
35
20


91
W
6
5
5
6
6
6
6
116
37
64
32
W


W-W (1 : 2)
1x45°
100
Y
Y
108
88
46,5
5
Ø88
Ø91
Ø96

Details of Piston

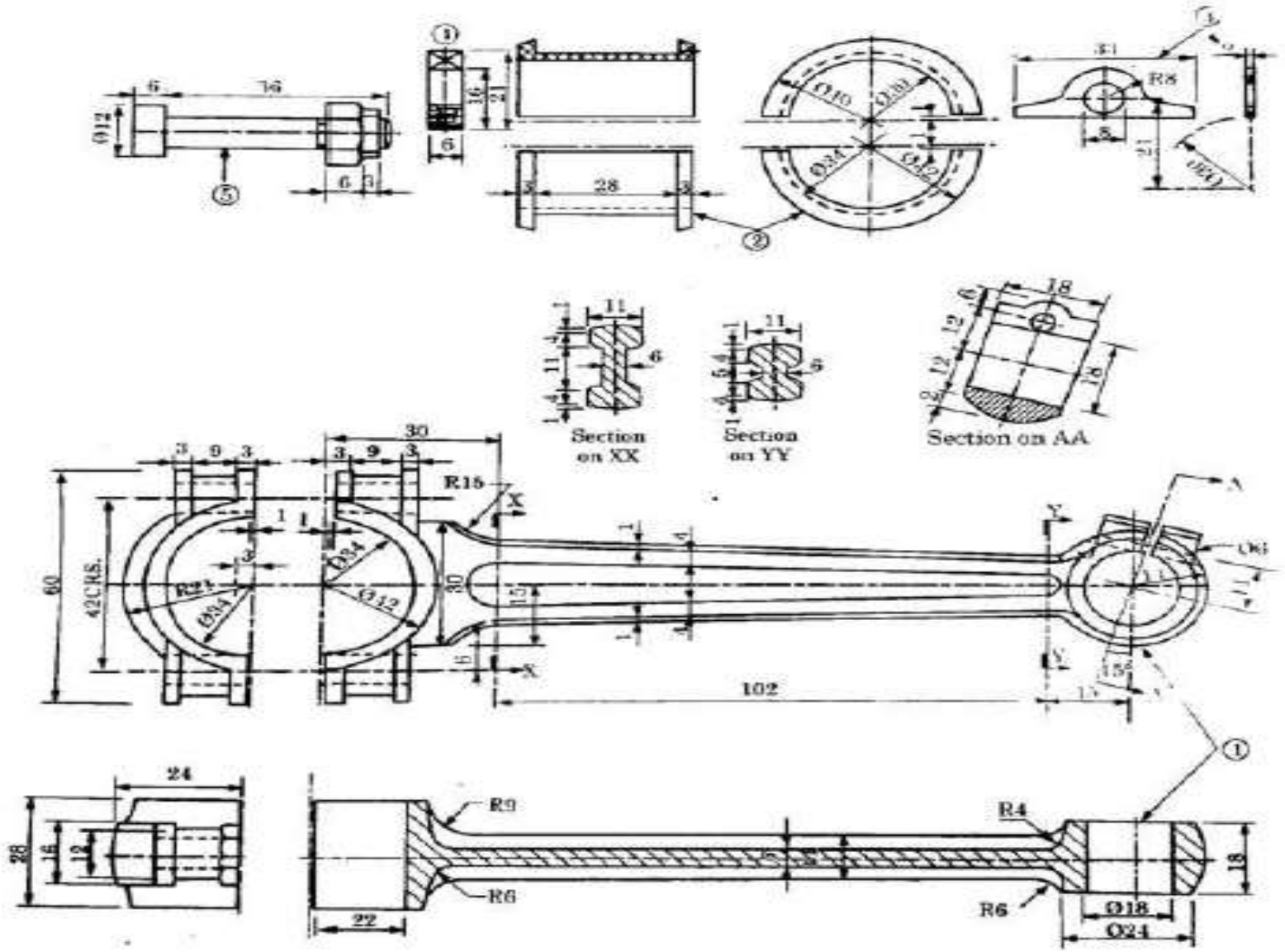
Problem : Assemble the parts of the piston, shown in Fig. and draw the following views:
(*i*) Sectional view from the front,
(*ii*) View from the left, and
(*iii*) View from above.



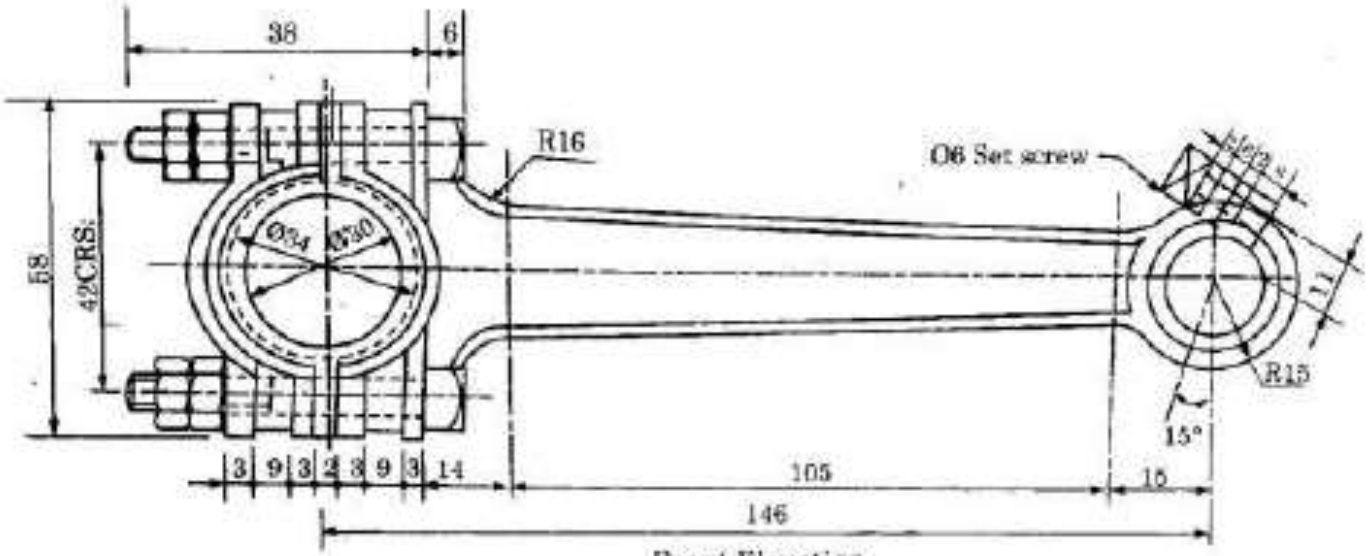
Parts list

No.	Name	Matl	Qty
1	Piston	Al-alloy	1
2	Piston pin	HCS	1
3	Piston pin plug	HCS	2
4	Piston ring	CI	5

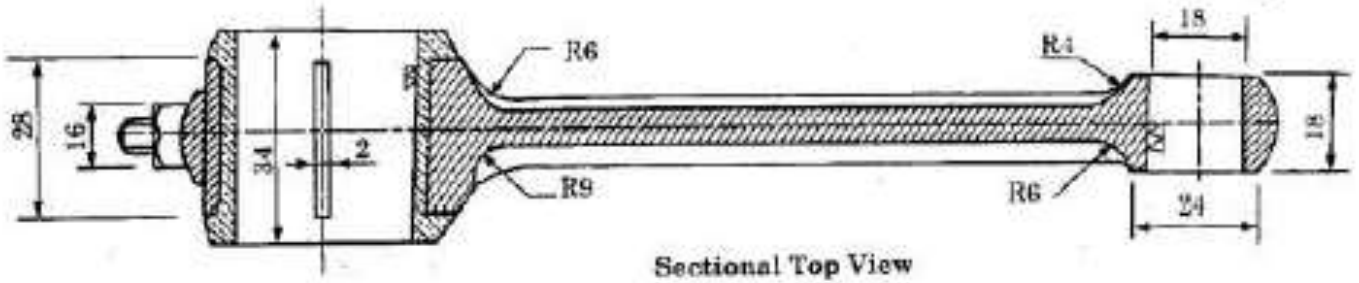
DETAILS OF CONNECTING ROD



Assembly of Connecting Rod



Front Elevation

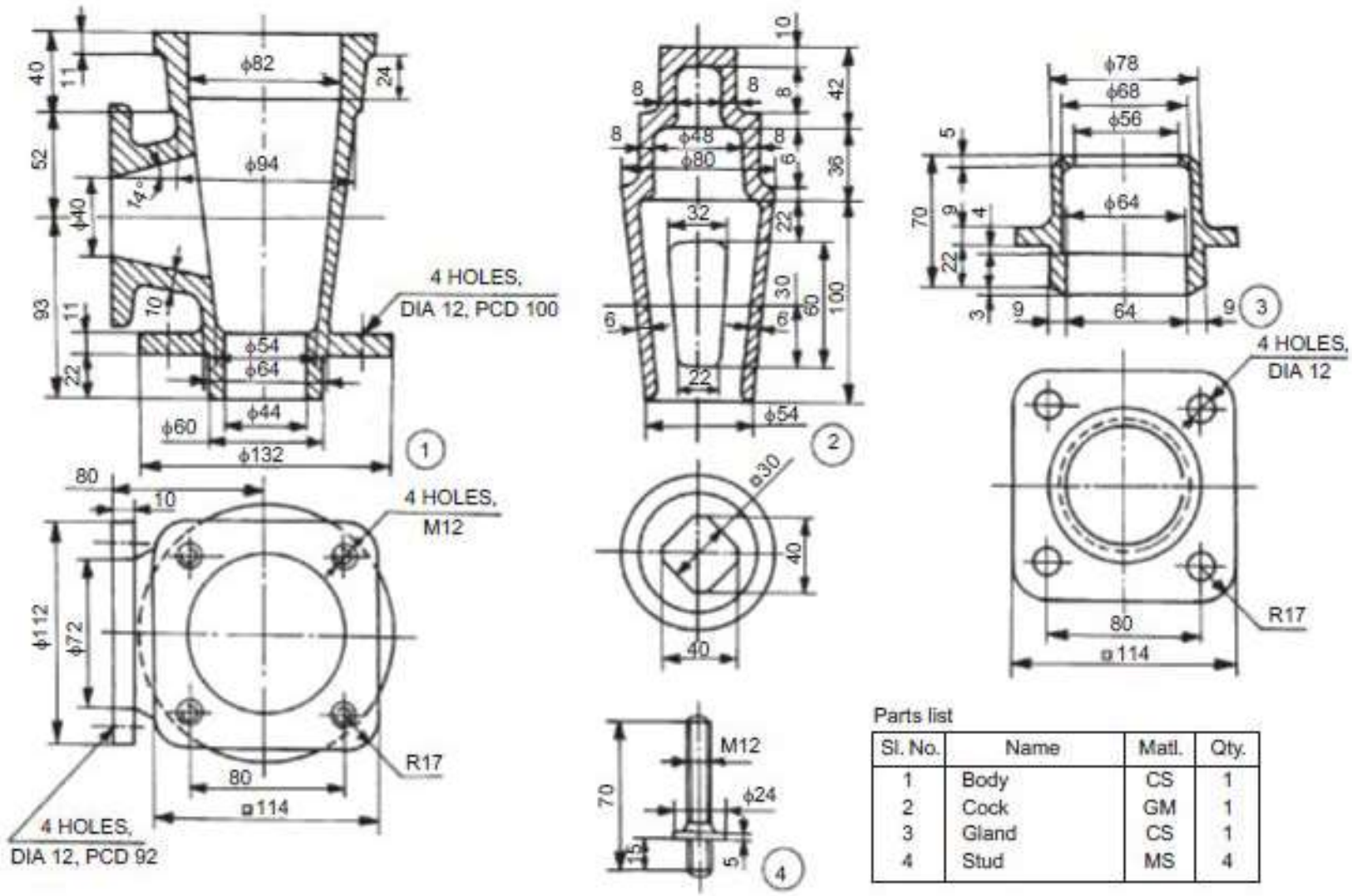


Sectional Top View

Bill of Materials-Connecting Rod

S. No.	Part's Name	Material	No. Off
1.	Connecting rod	Forged steel	01
2.	Brasses	Gun metal	02
3.	Shim	Brass sheet	02
4.	ϕ 6 set screw	Mild steel	01
5.	ϕ 8 bolt with castle nut	Mild steel	02

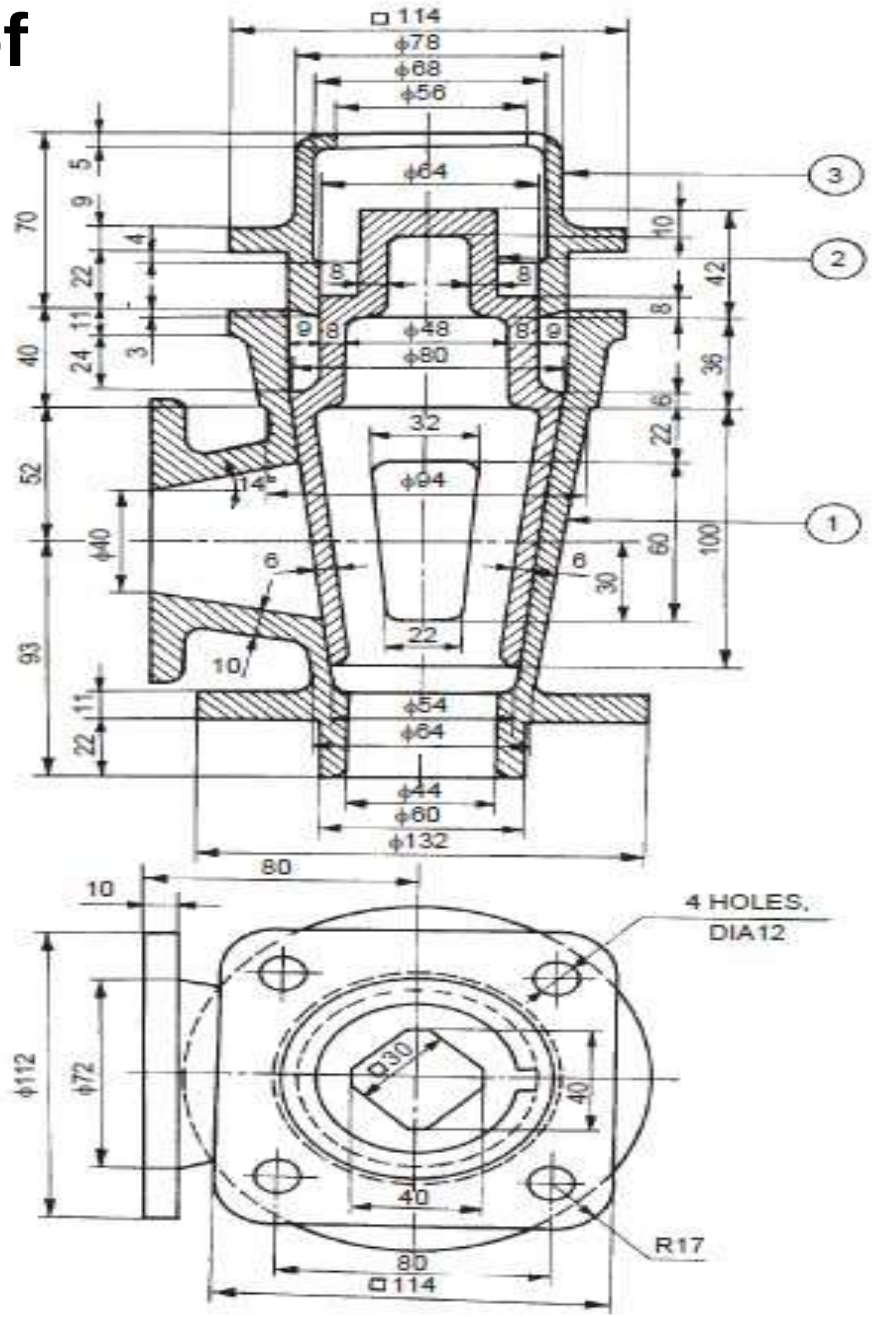
Details of Blow off Cock

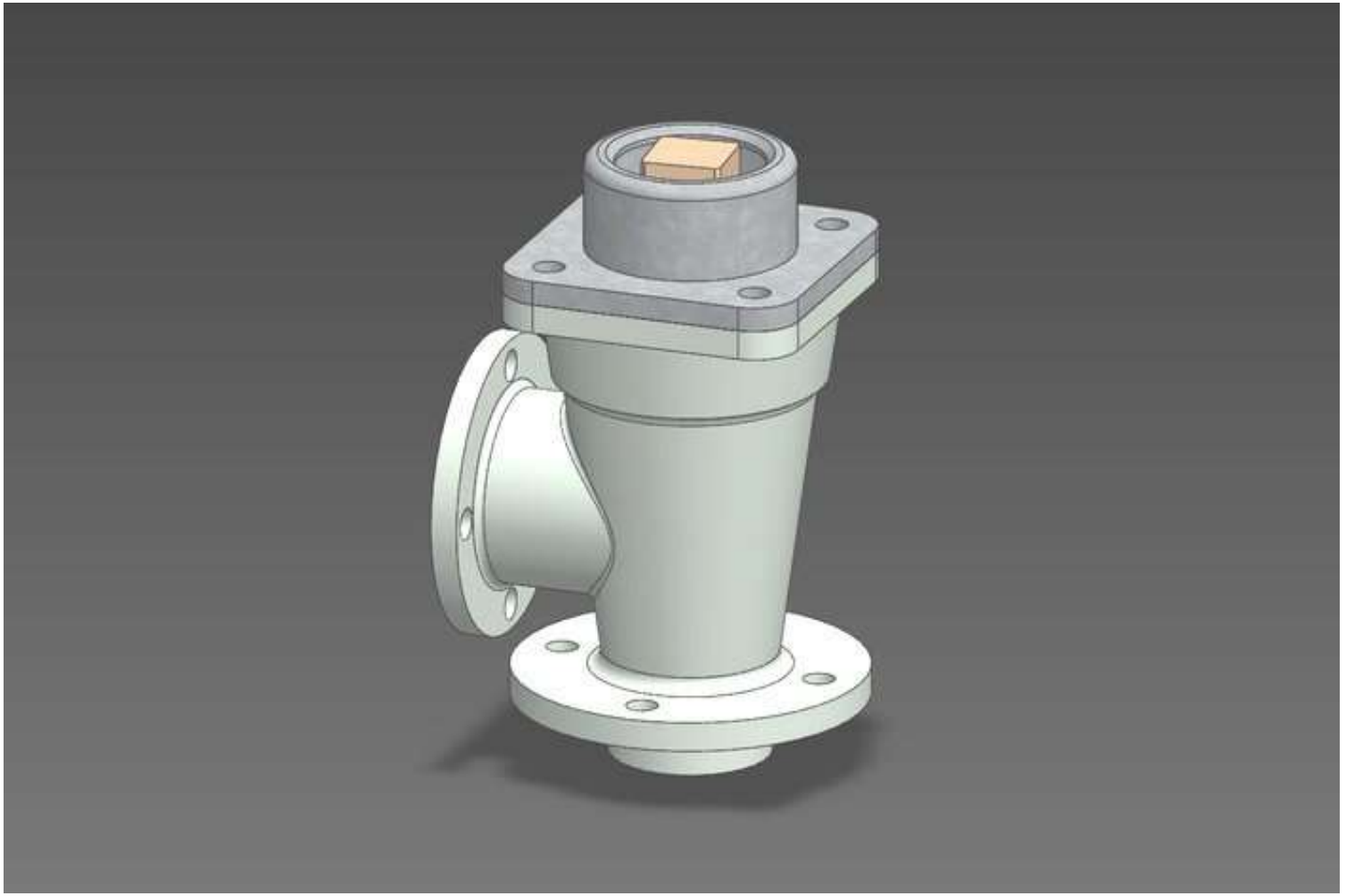


Parts list

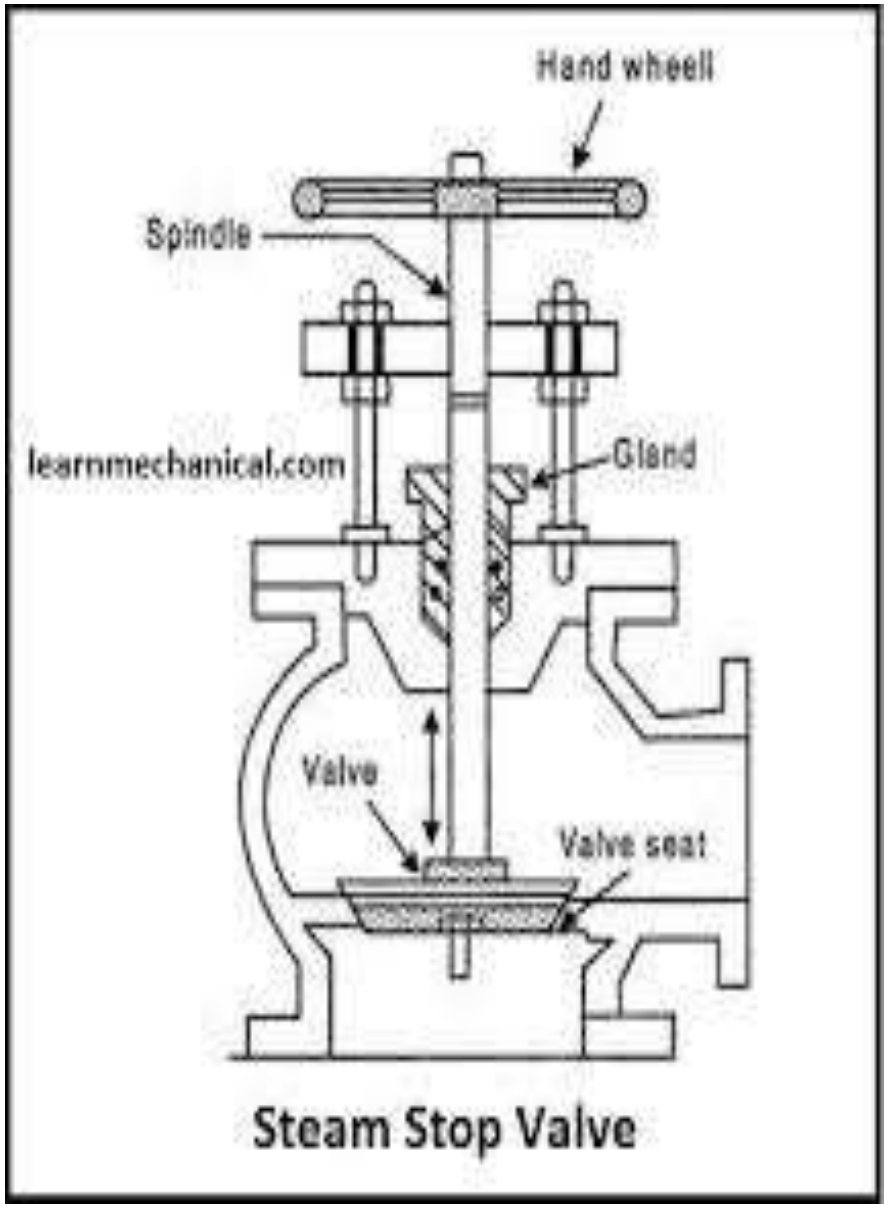
Sl. No.	Name	Matl.	Qty.
1	Body	CS	1
2	Cock	GM	1
3	Gland	CS	1
4	Stud	MS	4

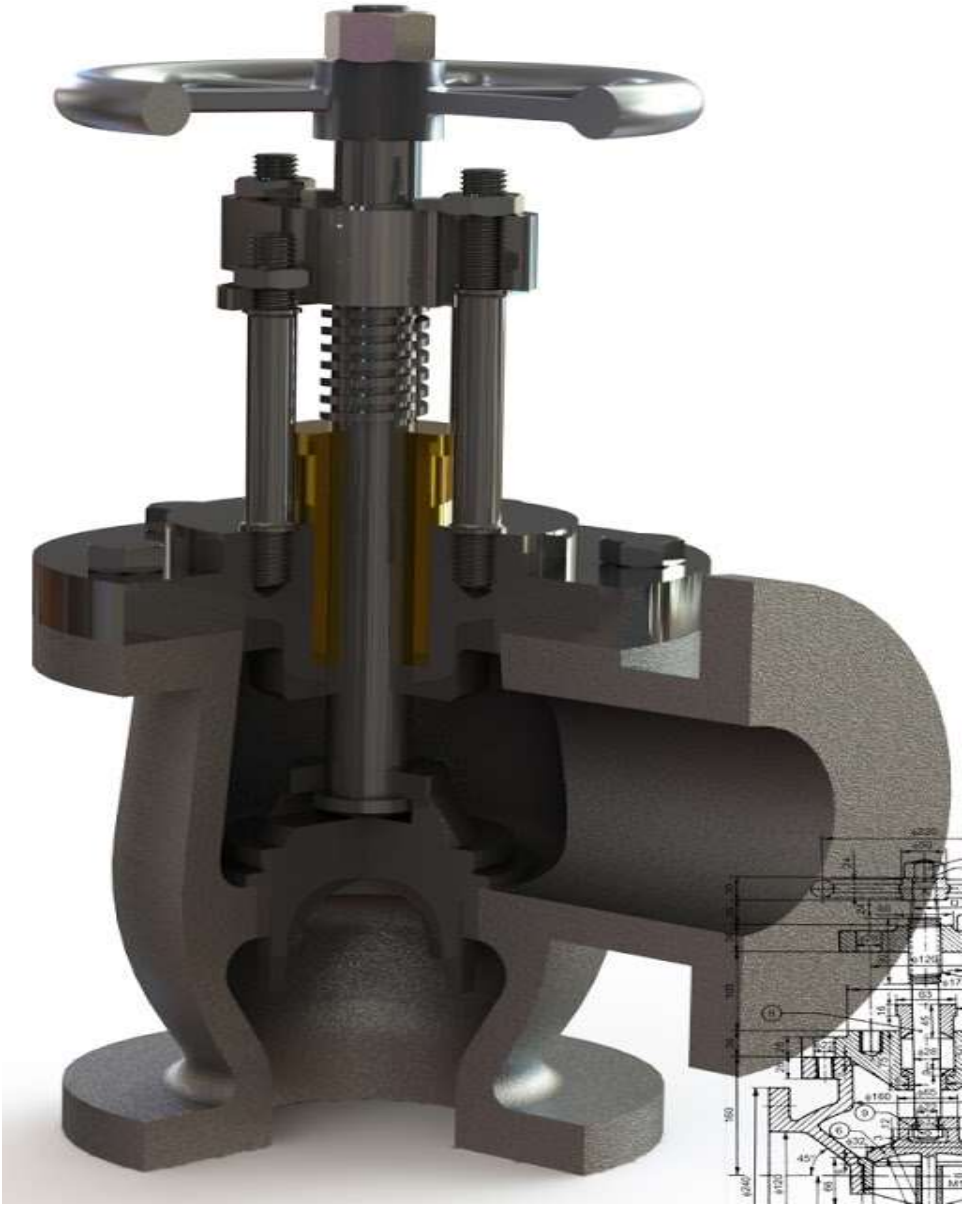
Assembly Drawing of Blow off Cock



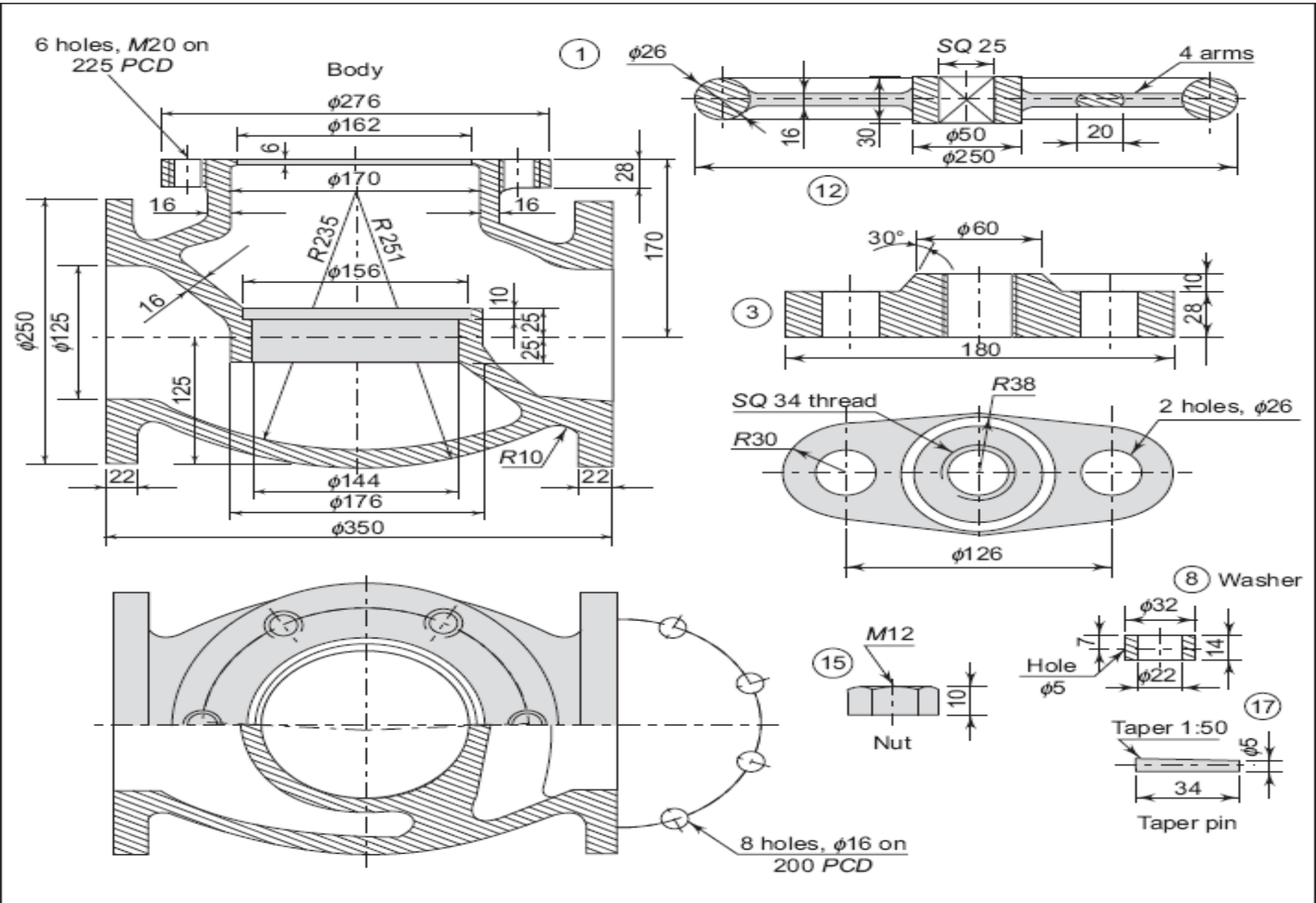


Steam Stop Valve





Details of Steam Stop Valve



Assembly Drawing of Steam Stop valve