SHEET NO 1

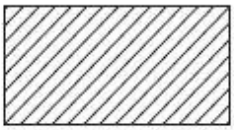
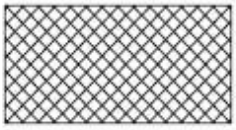
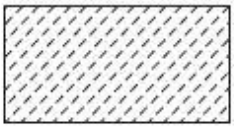
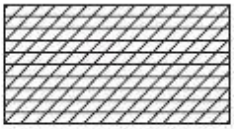
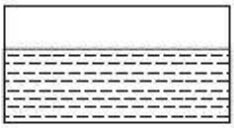
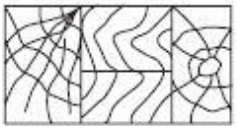
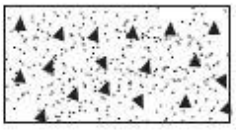
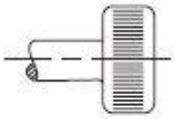
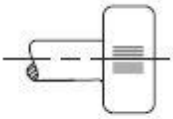
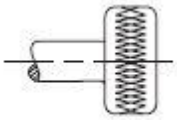
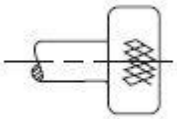
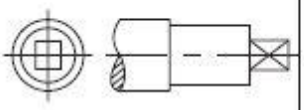
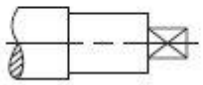
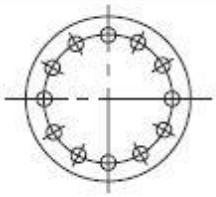
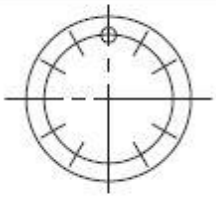
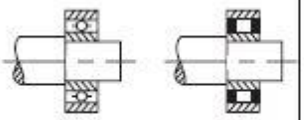
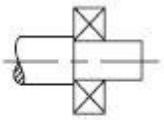
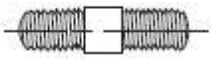
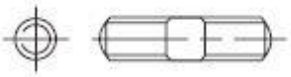
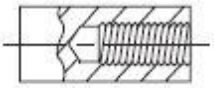
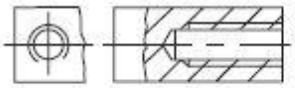
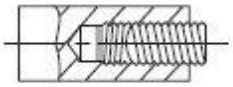
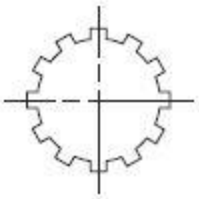
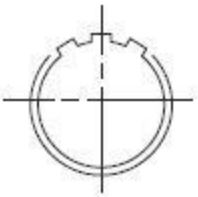
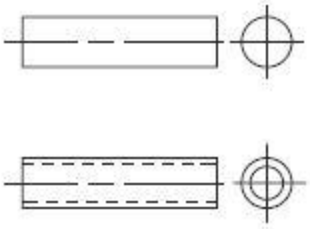
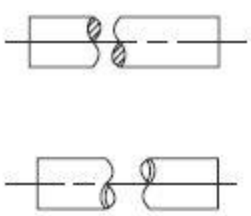
Type	Convention	Material
Metals		Steel, Cast Iron, Copper and its Alloys, Aluminium and its Alloys, etc.
		Lead, Zinc, Tin, White-metal, etc.
Glass		Glass
Packing and Insulating material		Porcelain, Stoneware, Marble, Slate, etc.
		Asbestos, Fibre, Felt, Synthetic resin products, Paper, Cork, Linoleum,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

(a)

g. 2.27 Conventional representation of machine components (*Contd.*)

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

	Subject	Convention	Diagrammatic Representation
Cylindrical compression spring			
Cylindrical tension spring			

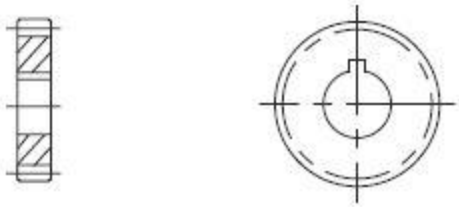
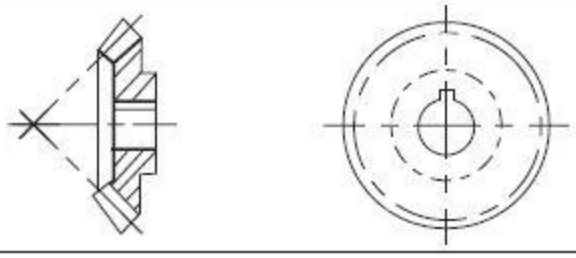
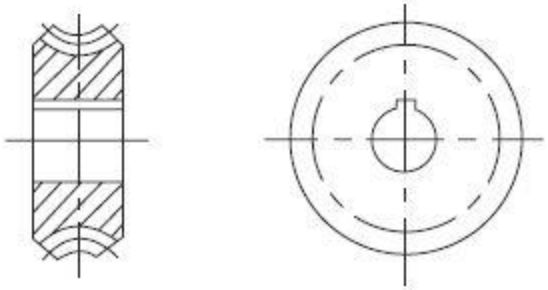
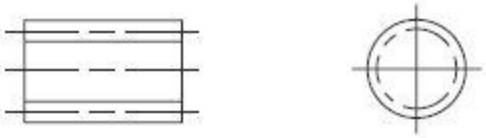
Title	Convention
Spur gear	
Bevel gear	
Worm wheel	
Worm	

Fig. 2.27 Conventional representation of machine components

SHEET NO 2

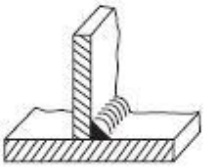
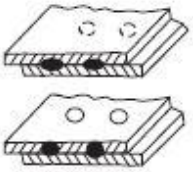
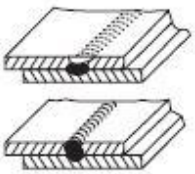
No.	Designation	Illustration	Symbol
1.	Butt weld between plates with raised edges (the raised edges being melted down completely)		
2.	Square butt weld		
3.	Single-V butt weld		
4.	Single-bevel butt weld		
5.	Single-V butt weld with broad root face		
6.	Single-bevel butt weld with broad root face		
7.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

Table 11.2 Supplementary welding symbols

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

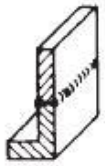
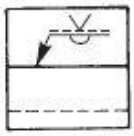
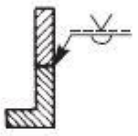
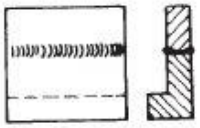
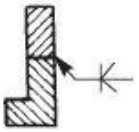
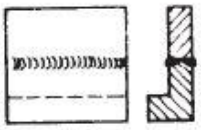
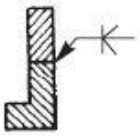
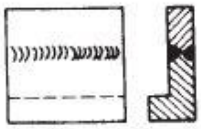
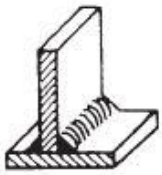
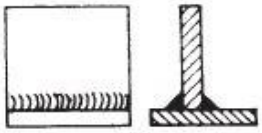
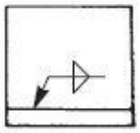
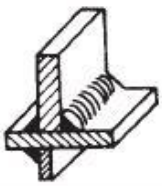
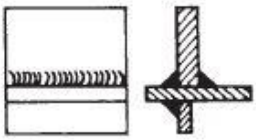
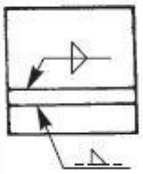
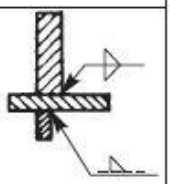
Table 11.3 Combination of elementary and supplementary symbols

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

Table 11.4 Combination of elementary symbols (*contd.*)

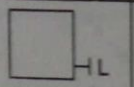
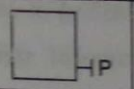
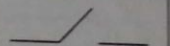
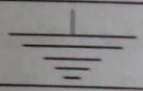
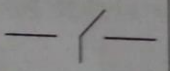
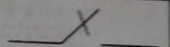
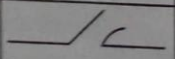
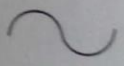
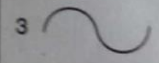
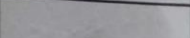
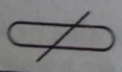
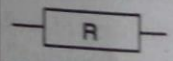
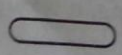
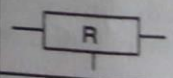
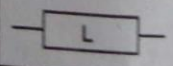
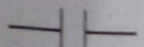
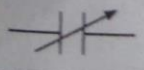
No.	*Designation symbol (For number refer to Table 11.1)*	*Illustration*	*Representation*	*Symbolization*	
				either	*or*
1.	Square butt weld 2 welded from both sides 2–2				
2.	Single-V butt weld 3				

Table 11.4 Combination of elementary symbols

No.	*Designation symbol (For number refer to Table 11.1)*	*Illustration*	*Representation*	*Symbolization*	
				either	*or*
3.	and backing run 9 3–9				
4.	Double-V butt weld 3 (X weld) 3–3				
5.	Double bevel butt weld 4				
6.	(K weld) 4–4				
7.	Double-U butt weld 7 7–7				
8.	Fillet weld 10 and fillet weld				
9	10 10–10				

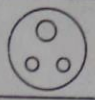
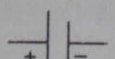
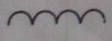
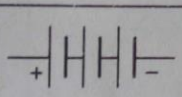
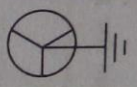
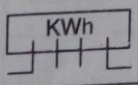
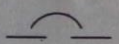
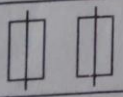
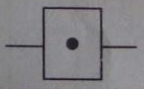
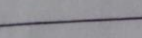
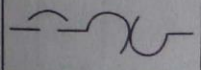
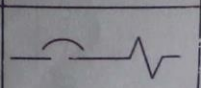
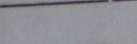
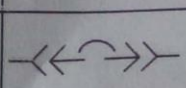
SHEET NO 3

Table 13.8. Circuit symbols for electrical items

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

(Contd...)

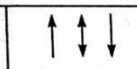
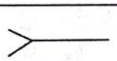
Table 13.8. Circuit symbols for electrical items

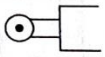
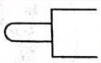
S. No.	Description	Symbol	S. No.	Description	Symbol
29	Two pin socket		42	Commutating or compensating wiring	
30	Three pin socket		43	Series winding	
31	Cell		44	Shunt winding or separate winding	
32	Battery		45	1-Phase	
33	D.C volt meter		46	2-Phase	
34	D.C ampere meter		47	3-Phase wye (ungrounded)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

ncorporated with a variety of driving and controlling electrical equipment. There are a number f electrical measuring devices, used for monitoring the speeds of spindles and positions of

SHEET NO 4

Table 13.12 Symbols for hydraulic and pneumatic parameters/devices

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

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

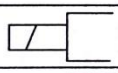
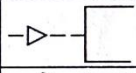
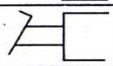
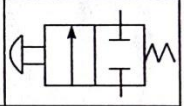
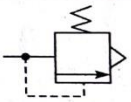
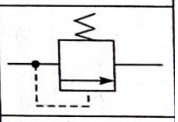
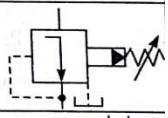
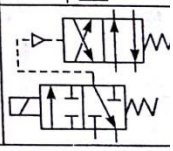
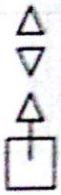
Description	Symbol
By solenoid	
By application of pneumatic pressure	
By pedal	
5. 2/2 valve	
6. Pressure relief valve	
7. Sequence valve	
8. Pressure reducing valve	
9. Pilot operated valve	

Table 13.13 Graphic symbols

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

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 a 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 keyway 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 1	Morse taper No. 1 to be obtained.
11.	DIA 6 REAM FOR TAPER PIN	Drill and ream with taper reamer for a diameter of 6 mm to suit the pin specified.
12.	6 ACME THD	Cut an ACME thread of pitch 6 mm.

SHEET NO 5

INTERCHANGEABILITY

The term interchangeability refers to the parts which go into the assembly at random, from a lot.
Eg:- A nut and a bolt of a particular size may be assembled by selecting at random from the lots. In this any nut should be able to get assembled with any bolt.

BASIC SIZE or NOMINAL SIZE

It is size of the job which is taken as reference to apply maximum limit and minimum limit for job manufacturing.

ZERO LINE:-

Deviations from basic size are measured with respect to a line called zero line. It represents zero deviation to basic size.

Above zero line +ve deviation.

Below zero line -ve deviation.

DEVIATION:-

It means the amount by which the dimension differs (goes away) from zero line.

UPPER DEVIATION:-

The amount by which upper limit deviates from zero line is known as upper deviation. It is designated by letter ES for hole & es for shaft. Where es is E Cart superior.

LOWER DEVIATION:-

The amount by which lower limit deviates from zero line is known as lower deviation. It is designated by letter EI for hole & ei for shaft. EI indicates E cart inferior.

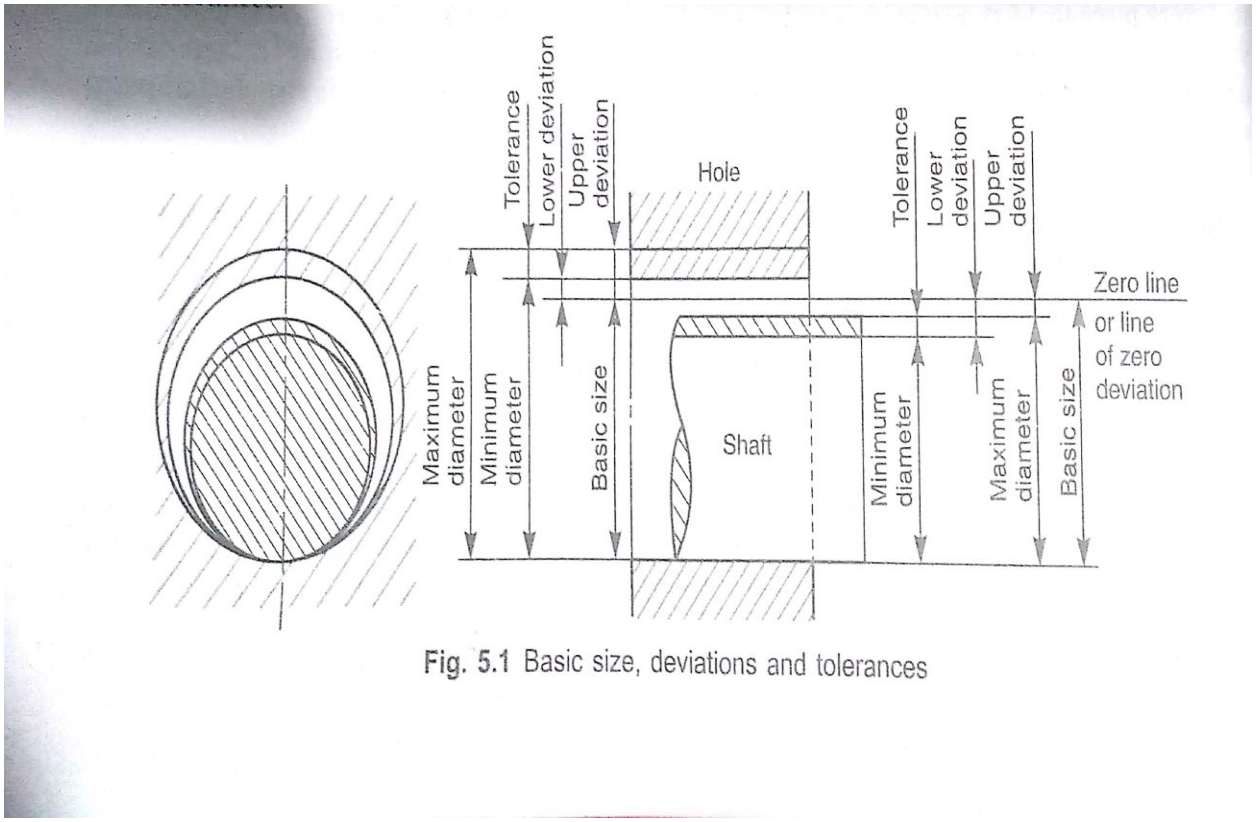


Fig. 5.1 Basic size, deviations and tolerances

FUNDAMENTAL DEVIATION

- This may be either upper deviation or lower deviation which is nearer to zero line.
- For hole lower deviation is a fundamental deviation.
- For shaft upper deviation is a fundamental deviation.

TYPES OF FUNDAMENTAL DEVIATION:-

There are 25 types of fundamental deviation. These are indicated by letter symbols.
Fundamental deviations for HOLE represented by CAPITAL LETTERS they are
A,B,C,D,E,F,G,H,JS,J,K,M,N,P,R,S,T,U,V,X,Y,Z,Za,Zb,Zc.
Fundamental deviations for SHAFT represented by SMALL LETTERS they are
a,b,c,d,e,f,g,h,js,j,k,m,n,p,r,s,t,u,v,x,y,z,za,zb,zc.

LIMITS:-

The two extreme permissible sizes between which the actual size is contained are called limits.
Maximum acceptable extreme size is called upper limit. And minimum acceptable extreme size is called lower limit.

TOLERANCE :-

It is the difference between the maximum and minimum permissible limits of the given size.

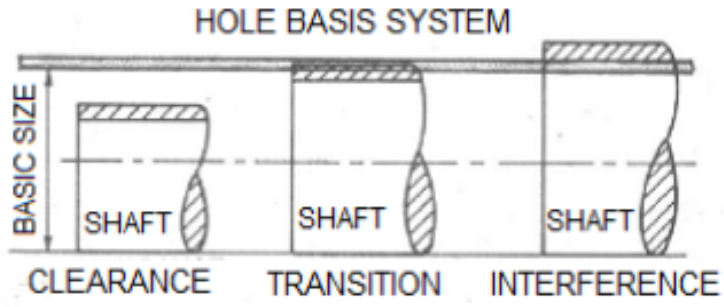
Tolerance = upper limit – lower limit.

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.

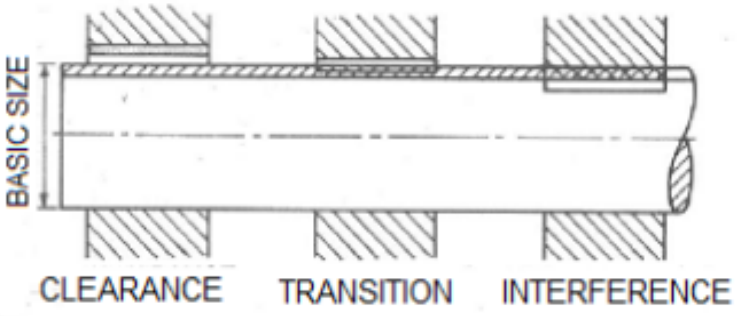
ALLOWANCE :-

It is the internal difference between the hole and shaft dimensions after their assembly is called allowance.

HOLE AND SHAFT BASIS SYSTEM



HOLE BASED SYSTEM
Size of the Hole is kept constant, Shaft size is varied to get different fits



SHAFT BASED SYSTEM
Size of the Shaft is kept constant, Hole size is varied to get different fits

FIT

It is the degree of looseness or tightness between two mating parts to perform a definite function.

TYPES OF FITS:-

There are three types of fits

1)Clearance fit

2)Interference Fit

3)Transition Fit

- ***1)Clearance fit***

This fit arises when the diameter of shat is smaller than hole. The minimum diameter of hole is greater than the largest permissible diameter of the shaft. The value of clearance fit is always positive.

- ***2)Interference Fit***

In this type of fit the minimum permissible diameter of the shaft is larger than the maximum allowable diameter of the hole. As the diameter of shaft is larger than the diameter of hole, the hole and shaft are intended to be attached permanently.

- ***3)Transition Fit***

This fit may result in either interference or a clearance, depending on the actual values of the tolerance of individual parts.

SHEET NO 6(PROBLEMS)

FOR SOLVING PROBLEMS REFER BELOW MENTIONED TABLES

(Values in microns)

Nominal sizes	Tolerances of holes H7	H8	H9	H10	H11	Tolerances of shafts d9	e8	f7	g6	h6
From 1 upto 3	+10 0	+14 0	+25 0	+40 0	+60 0	−20 −45	−14 −28	−6 −16	−2 −8	0 −6
Over 3 upto 6	+12 0	+18 0	+30 0	+45 0	+75 0	−30 −60	−20 −38	−10 −22	−4 −12	0 −8
Over 6 upto 10	+15 0	+22 0	+36 0	+58 0	+90 0	−40 −75	−25 −47	−13 −28	−5 −14	0 −9
Over 10 upto 18	+18 0	+27 0	+43 0	+70 0	+110 0	−50 −93	−32 −59	−16 −34	−6 −17	0 −11
Over 18 upto 30	+21 0	+33 0	+52 0	+84 0	+130 0	−65 −117	−40 −73	−20 −41	−7 −20	0 −13
Over 30 upto 50	+25 0	+39 0	+62 0	+100 0	+160 0	−80 −142	−50 −89	−25 −50	−9 −25	0 −16
Over 50 upto 80	+30 0	+46 0	+74 0	+120 0	+190 0	−100 −174	−60 −105	−30 −60	−10 −29	0 −19
Over 80 upto 120	+35 0	+54 0	+87 0	+140 0	+220 0	−120 −207	−72 −126	−36 −71	−12 −34	0 −22
Over 120 upto 180	+40 0	+63 0	+100 0	+160 0	+250 0	−145 −245	−85 −148	−43 −83	−14 −39	0 −25
Over 180 upto 250	+45 0	+72 0	+115 0	+185 0	+290 0	−170 −285	−100 −172	−50 −96	−15 −44	0 −29
Over 250 upto 315	+52 0	+81 0	+130 0	+210 0	+320 0	−190 −320	−110 −191	−56 −108	−17 −49	0 −32
Over 315 upto 400	+57 0	+89 0	+140 0	+230 0	+360 0	−210 −350	−125 −214	−62 −119	−18 −54	−0 −35
Over 400 upto 500	+63 0	+97 0	+155 0	+250 0	+400 0	−230 −385	−135 −232	−68 −131	−20 −60	0 −40

Nominal sizes	Tolerances of holes D10	E9	F8	G7	JS7	K7	Tolerances of shafts j6	k6	n6	p6
From 1 upto 3	+60 +20	+39 +14	+20 +6	+12 +2	+5 −5	0 −10	+3 −3	+6 0	+10 +4	+12 +6
Over 3 upto 6	+78 +30	+50 +20	+28 +10	+16 +4	+6 −6	+3 −9	+4 −4	+9 +1	+16 +8	+20 +12
Over 6 upto 10	+98 +40	+61 +25	+35 +13	+20 +5	+7.5 −7.5	+5 −10	+4.5 −4.5	+10 +1	+19 +10	+24 +15
Over 10 upto 18	+120 +50	+75 +32	+43 +16	+24 +6	+9 −9	+6 −12	+5.5 −5.5	+12 +1	+23 +12	+29 +18
Over 18 upto 30	+149 +65	+92 +40	+53 +20	+28 +7	+10.5 −10.5	+6 −15	+6.5 −6.5	+15 +2	+28 +15	+35 +22
Over 30 upto 50	+180 +80	+112 +50	+64 +25	+34 +9	+12.5 −12.5	+7 −18	+8 −8	+18 +2	+33 +17	+42 +26

Over 50 upto 80	+220 +100	+134 +60	+76 +30	+40 +10	+15 −15	+9 −21	+9.5 −9.5	+21 +2	+39 +20	+51 +32
Over 80 upto 120	+260 +120	+159 +72	+90 +36	+47 +12	+17.5 −17.5	+10 −25	+11 −11	+25 +3	+45 +23	+59 +37
Over 120 upto 180	+305 +145	+185 +85	+106 +43	+54 +14	+20 −20	+12 −28	+12.5 −12.5	+28 +3	+52 +27	+68 +43
Over 180 upto 250	+355 +170	+215 +100	+122 +50	+61 +15	+23 −23	+13 −33	+14.5 −14.5	+33 +4	+60 +31	+79 +50
Over 250 upto 315	+400 +190	+240 +110	+135 +55	+69 +17	+26 −26	+16 −36	+16 −16	+36 +4	+66 +34	+88 +56
Over 315 upto 400	+440 +210	+265 +125	+151 +69	+75 +18	+28.5 −28.5	+17 −40	+18 −18	+40 +4	+73 +37	+98 +62
Over 400 upto 500	+480 +230	+290 +135	+165 +68	+83 +20	+31.5 −31.5	+18 −45	+20 −20	+45 +5	+80 +40	+108 +68

	Tolerances of holes					Tolerances of shafts				
Nominal sizes	C11	N7	P7	R7	S7	r6	s6	t6	u6	u7
From 1 upto 3	+120 +60	−4 −14	−6 −16	−10 −20	−1 −24	+16 +10	+20 +14		+24 +10	+28 +18
Over 3 upto 6	+145 +70	−4 −16	−8 −20	−11 −23	−15 −27	+23 +15	+27 +19		+31 +23	+35 +23
Over 6 upto 10	+170 +80	−4 −19	−9 −24	−13 −28	−17 −32	+28 +19	+32 +28		+37 +28	+43 +28
Over 10 upto 18	+205 +95	−5 −23	−11 −29	−16 −34	−21 −39	+34 +23	+39 +28		+44 +33	+51 +33
Over 18 upto 30	+240 +110	−7 −28	−14 −35	−20 −41	−27 −48	+41 +28	+48 +35	+54 +41	+61 +41	+62 +41
Over 30 upto 40	+280 +120	−8	−17	−25	−34	+50	+59	+64 +48	+76 +60	+85 +60
Over 40 upto 50	+290 +130	−33	−42	−50	−59	+34	+43	+70 +54	+88 +70	+95 +70
Over 50 upto 65	+330 140	−9	−21	−30 −60	−42 −72	+60 +41	+72 +53	+85 +66	+106 +87	+117 +87
Over 65 upto 80	+340 +150	−39	−51	−32 −62	−48 −78	+62 +43	+78 +59	+94 +75	+121 +102	+132 +102
Over 80 upto 100	+390 +170	−10	−24	−38 −73	−59 −93	+73 +51	+93 +71	+113 +91	+146 +124	+159 +124

(Contd...)

Over 100 upto 120	+400 +180	−45	−59	−41 −76	−66 −101	+76 +54	+101 +79	+126 +104	+166 +144	+175 +144
Over 120 upto 140	+450 +200	−12	−28	−48 −88	−77 −117	+88 +63	+117 +92	+147 +122	+195 +170	+230 +170
Over 140 upto 180	+480 +210	−52	−68	−50 −93	−85 −133	+93 +65	+133 +100	+171 +134	+235 +190	+250 +190
Over 180 upto 250	+570 +240	−14 −60	−33 −79	−60 −113	−105 −169	+113 +77	+169 +122	+225 +166	+330 +236	+330 +236
Over 250 upto 315	+650 +300	−14 −66	−36 −88	−74 −130	−138 −202	+130 +94	+202 +158	+272 +218	+382 +350	+402 +315
Over 315 upto 400	+760 +360	−16 −73	−41 −98	−87 −150	−169 −224	+150 +108	+244 +190	+330 +268	+471 +390	+492 +390
Over 400 upto 500	+880 +440	−17 −80	−45 −108	−103 −172	−209 −292	+172 +126	+292 +232	+400 +330	+580 +490	+603 +490

SHEET NO 7

Draughting Abbreviations

Term	Abbreviation	Term	Abbreviation
Across corners	A/C	Manufacture	MFG
Across flats	A/F	Material	MATL
Approved	APPD	Maximum	max.
Approximate	APPROX	Metre	m
Assembly	ASSY	Mechanical	MECH
Auxiliary	AUX	Millimetre	mm
Bearing	BRG	Minimum	min.
Centimetre	Cm	Nominal	NOM
Centres	CRS	Not to scale	NTS
Centre line	CL	Number	NO.
Centre to centre	C/L	Opposite	OPP
Chamfered	CHMED	Outside diameter	OD
Checked	CHD	Pitch circle	PC
Cheese head	CH HD	Pitch circle diameter	PCD
Circular pitch	CP	Quantity	QTY
Circumference	OCE	Radius	R
Continued	CONTD	Radius in a note	RAD
Counterbore	C BORE	Reference .	REF
Countersunk	CSK	Required	REQD
Cylinder	CYL	Right hand	RH
Diameter	DIA	Round	RD
Diametral pitch	DP	Screw	SCR
Dimension	DIM	Serial number	SL. NO.
Drawing	DRG	Specification	SPEC
Equispaced	EQUI-SP	Sphere/spherical	SP
External	EXT	Spot face	SF
Figure	FIG.	Square	SQ
General	GNL	Standard	STD

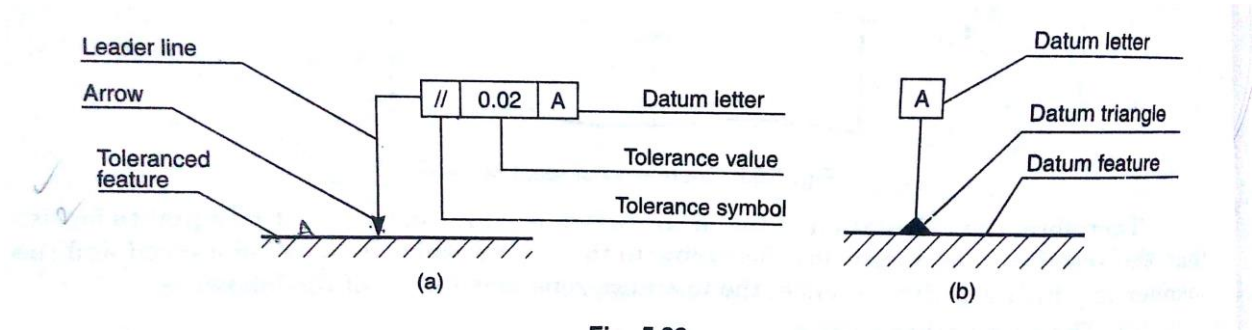
Ground level	GL	Symmetrical	SYM
Ground	GND	Thick	THK
Hexagonal	HEX	Thread	THD
Inspection	INSP	Through	THRU
Inside diameter	ID	Tolerance	TOL
Internal	INT	Typical	TYP
Left hand	LH	Undercut	U/C
Machine	M/C	Weight	WT

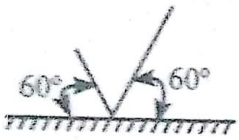
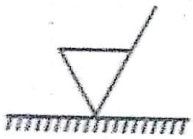
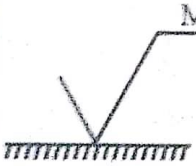
Table 3.2
Abbreviations for Materials

Material	Abbreviation
Cast iron	CI
Cast steel	CS
Chromium steel	CrS
Forged steel	FS
Galvanised iron	GI
Gray iron	FG
High carbon steel	HCS
High speed steel	HSS
High tensile steel	HTS
Low carbon steel	LCS
Mild steel	MS
Nickel steel	Ni S
Pearlitic malleable iron	PM
Sheet steel	Sh S
Spring steel	Spring S
Structural steel	St
Tungsten carbide steel	TCS
Wrought iron	WI
Aluminium	Al
Brass	BRASS
Bronze	BRONZE
Copper	Cu
Gunmetal	GM
Phosphor bronze	PHOS B
White metal	WM

Datum feature:

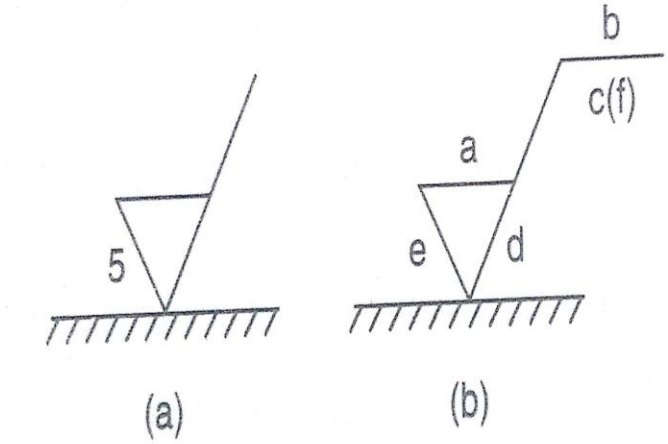
A datum feature is a feature of a part, such as an edge, surface, or a hole, which forms the basis for a datum or is used to establish its location.



S.No.	Symbol	Description
(i)		Basic symbol with a set of unequal legs, that are inclined at 60° to the surface under consideration.
(ii)		Basic symbol used when the removal of material by machining process is needed.
(iii)		Basic symbol used when the removal of material is not allowed.
(iv)		Basic symbol used when special surface features have to be specified.

SHEET NO 8

INDICATION OF MACHINING ALLOWANCE



a = Roughness value R_a

b = Production method, treatment or coating

c = Sampling length

d = Direction of lay

e = Machining allowance

f = Other roughness values

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	

Method of Production	Surface Roughness (Microns) Values
Turning and milling	0.32 to 25
Lapping	0.012 to 0.16
Honing	0.025 to 0.40
Cylindrical grinding	0.063 to 5.0
Surface grinding	0.063 to 5.0
Drilling	1.6 to 20
Reaming	0.4 to 3.2
Boring	0.4 to 6.3
Shaping, planing	1.6 to 25
Forging	1.6 to 25
Sand casting	5 to 50

0.012	0.16	LAPPING
0.016	0.32	SUPER FINISHING
0.025	0.4	HONNING
0.04	0.16	POLISHING
0.04	0.8	BURNISHING
0.063	*5*	*SURFACE GRINDING*
0.063	*5*	*CYLINDRICAL GRINDING*
0.16	5	EXTRUSION
0.25	25	FILING
0.32	2	HIGH PRESSURE CASTING
0.32	25	TURNING AND MILLING
0.4	*3.2*	*REAMING*
0.4	*3.2*	*BROACHING*
0.4	*3.2*	*HOBBING*
0.4	6.3	BORING
0.8	3.2	DIE CASTING
0.8	6.3	PERMANENT MOULD CASTING
1	6.3	RADIAL CUT-OFF SAWING
1.6	20	DRILLING
1.6	*25*	*FORGING*
1.6	*25*	*DISC GRINDING*
1.6	*25*	*SHAPING*
1.6	50	PLANING
2.5	50	HOT ROLLING
5	50	SAND CASTING
6.3	25	HAND GRINDING
6.3	100	FLAME CUTTING, SAWING AND CHIPPING

Table 6.2 Equivalent surface roughness symbols

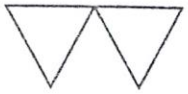
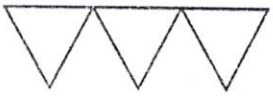
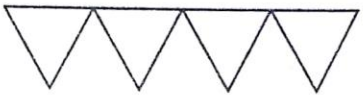
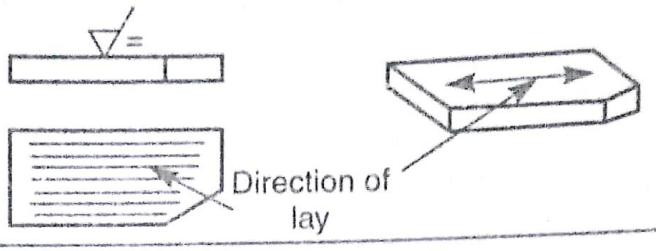
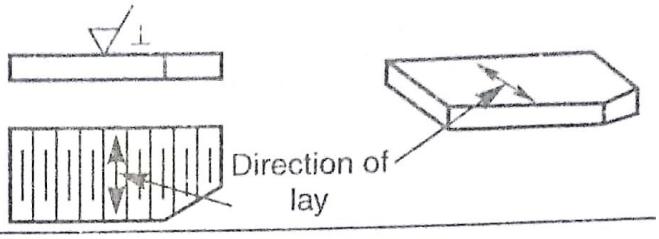
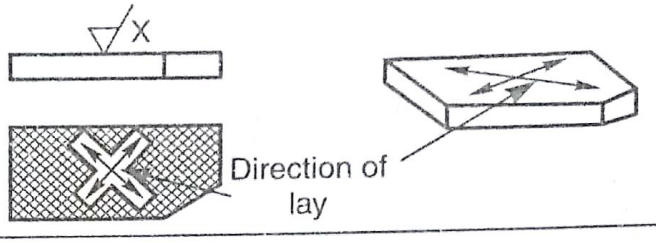
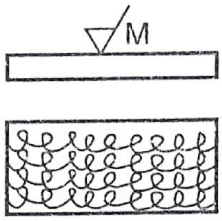
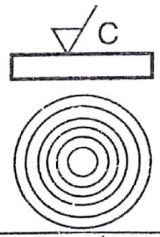
Roughness values R_a µm	Roughness grade number	Roughness grade symbol
50.0	*N*12	
25.0	*N*11	
12.5	*N*10	
6.3	*N*9	
3.2	*N*8	
1.6	*N*7	
0.8	*N*6	
0.4	*N*5	
0.2	*N*4	
0.1	*N*3	
0.05	*N*2	
0.025	*N*1	

Table 6.3 Symbols specifying the directions of lay

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