Al-Mustansiriyah University

College of Engineering

Mechanical Engineering Dept.

Class : 2 nd

Mechanical Drawing

Lect. Saad Najeeb Shehab

Auxiliary Views :

I. Inclined Surface :-

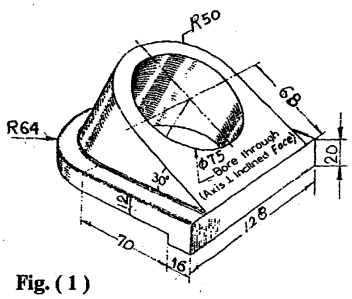


Fig. (1)

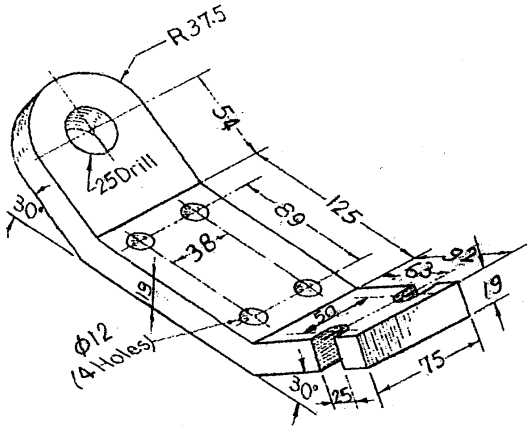


Fig. (2)

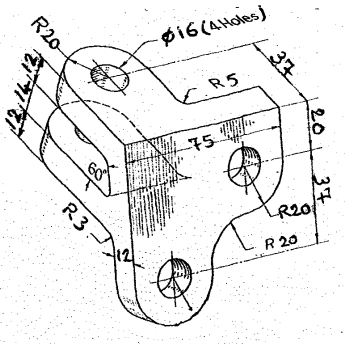


Fig. (3)

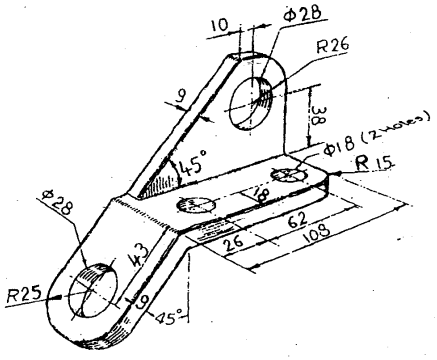


Fig. (4)

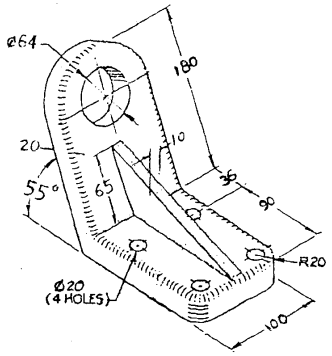


Fig. (5)

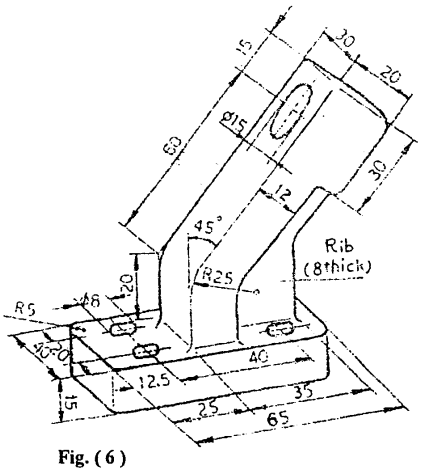


Fig. (6)

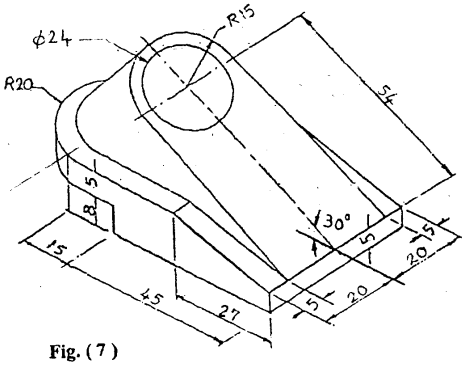


Fig. (7)

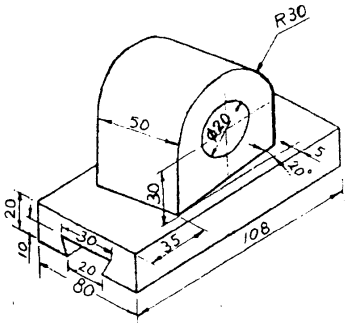


Fig. (8)

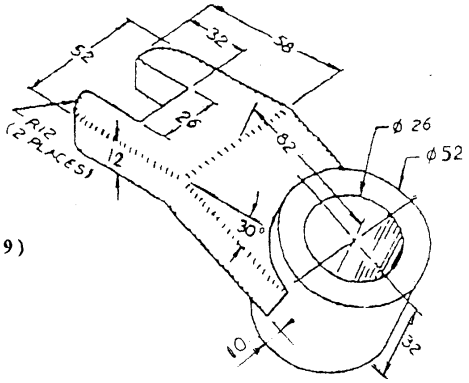


Fig. (9)

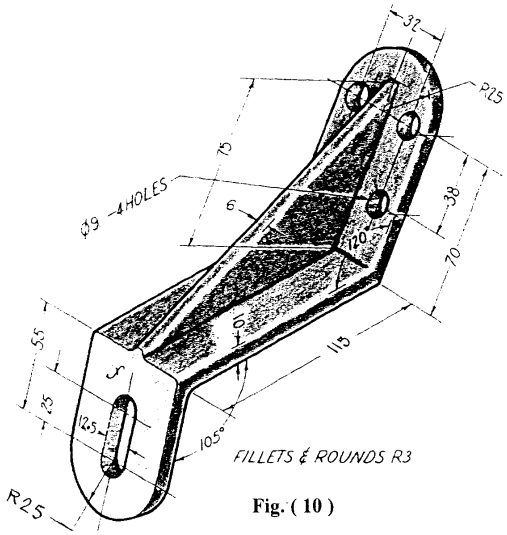

32
R15
75
Ø9 -4HOLES
6
38
10
70
55
5
60
115
25
12.5
105°
FILLETS & ROUNDS R3
R25

Fig. (10)

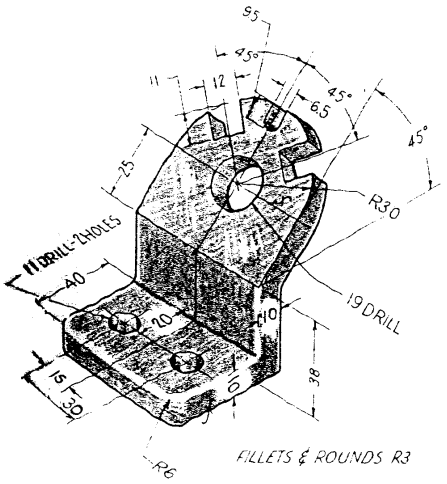

55
45°
11
12
45°
6.5
45°
25
R30
11 DRILL-2HOLES
40
19 DRILL
20
40
15
30
10
38
FILLETS & ROUNDS R3
R6

Fig. (11)

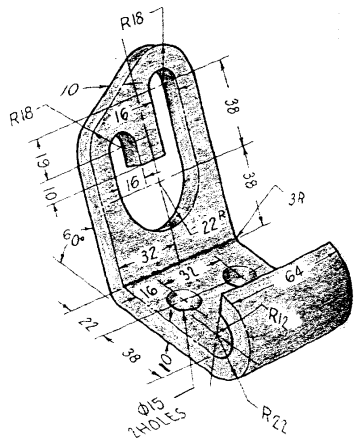

R18
10
R18
16
38
19
16
38
10
38
22R
60°
32
16
32
64
R12
22
38
10
Φ15
2 HOLES
R22

Fig. (12)

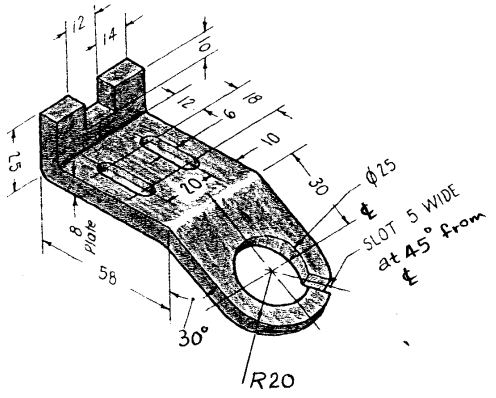

12
14
10
12
6
18
10
30
Φ25
℄
SLOT 5 WIDE
at 45° from
℄
25
70
8 PLATE
58
30°
R20

Fig. (13)

II. Skew Surface :-

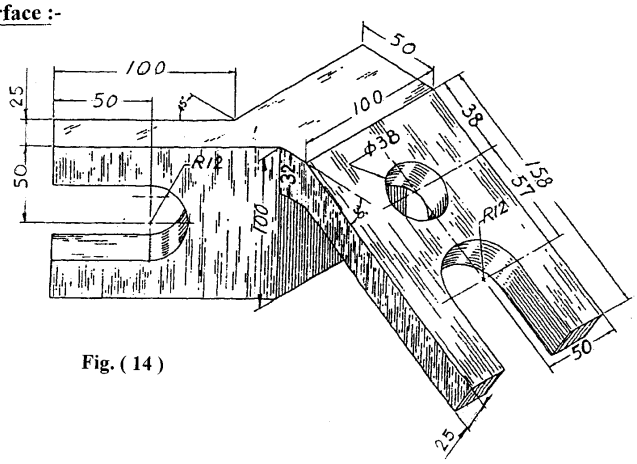


Fig. (14)

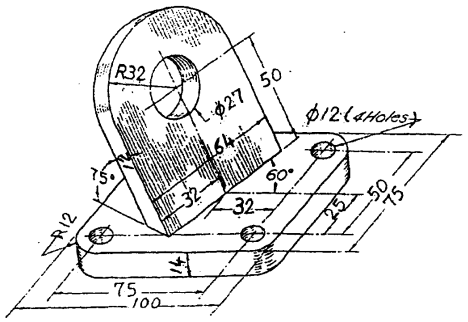


Fig. (15)

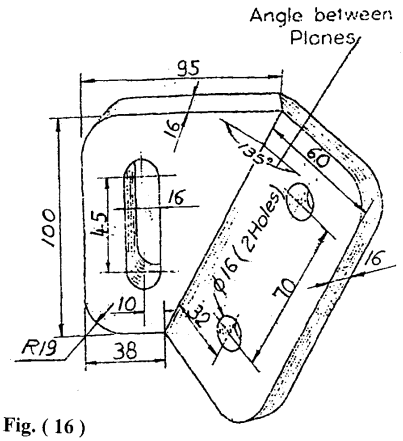

Angle between
Planes
95
16
135°
60
100
45
16
16
φ16 (2Holes)
70
16
10
35
R19
38

Fig. (16)

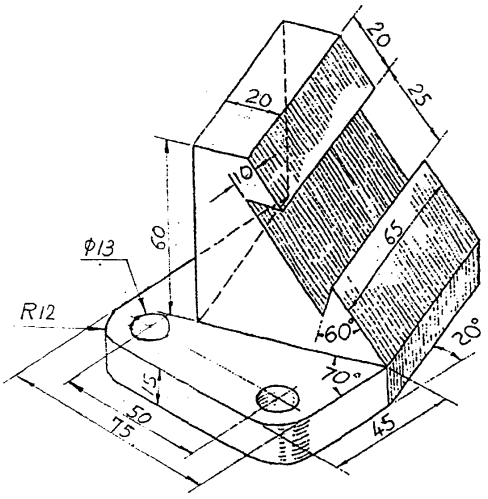
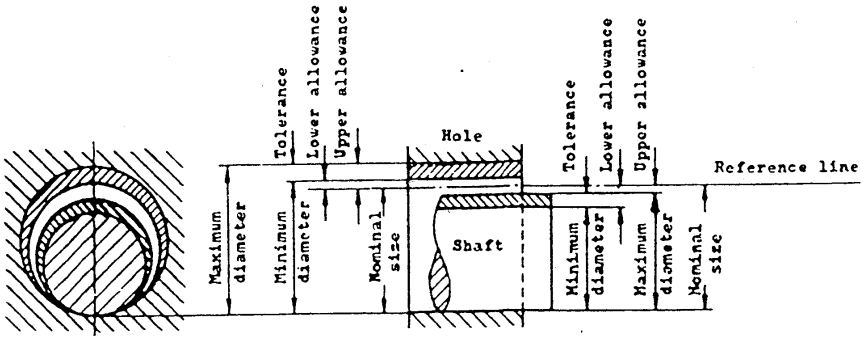
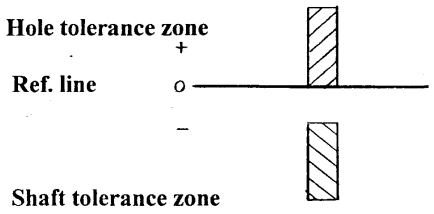

20
20
25
10
60
65
φ13
R12
60°
20°
70°
15
50
75
45

Fig. (17)

Tolerance and Fit :

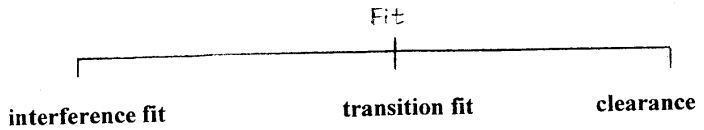
I. Tolerance :-

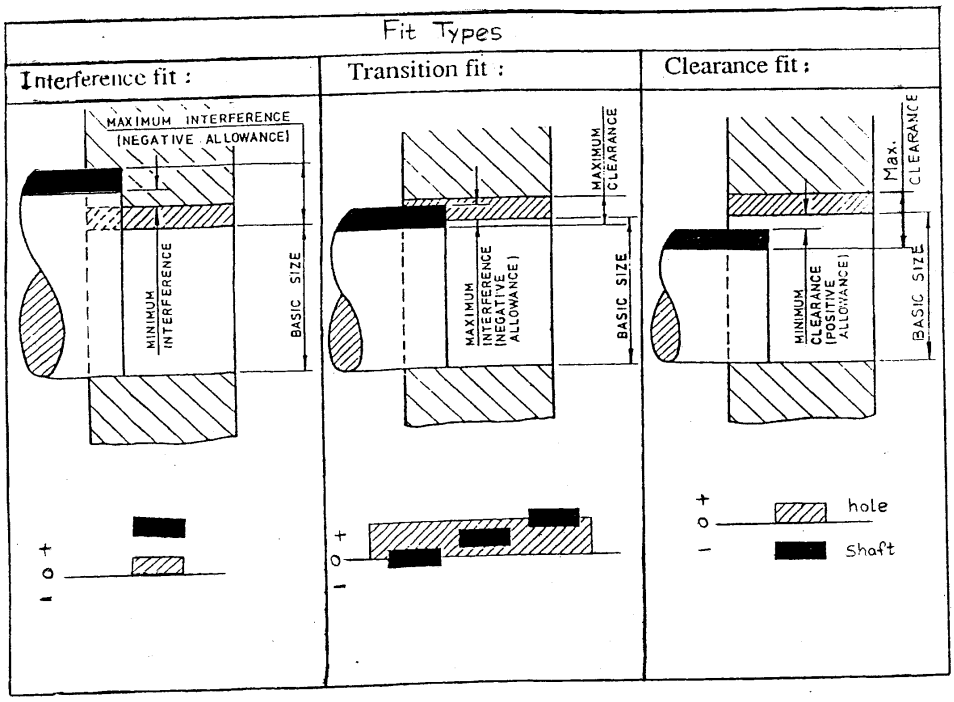




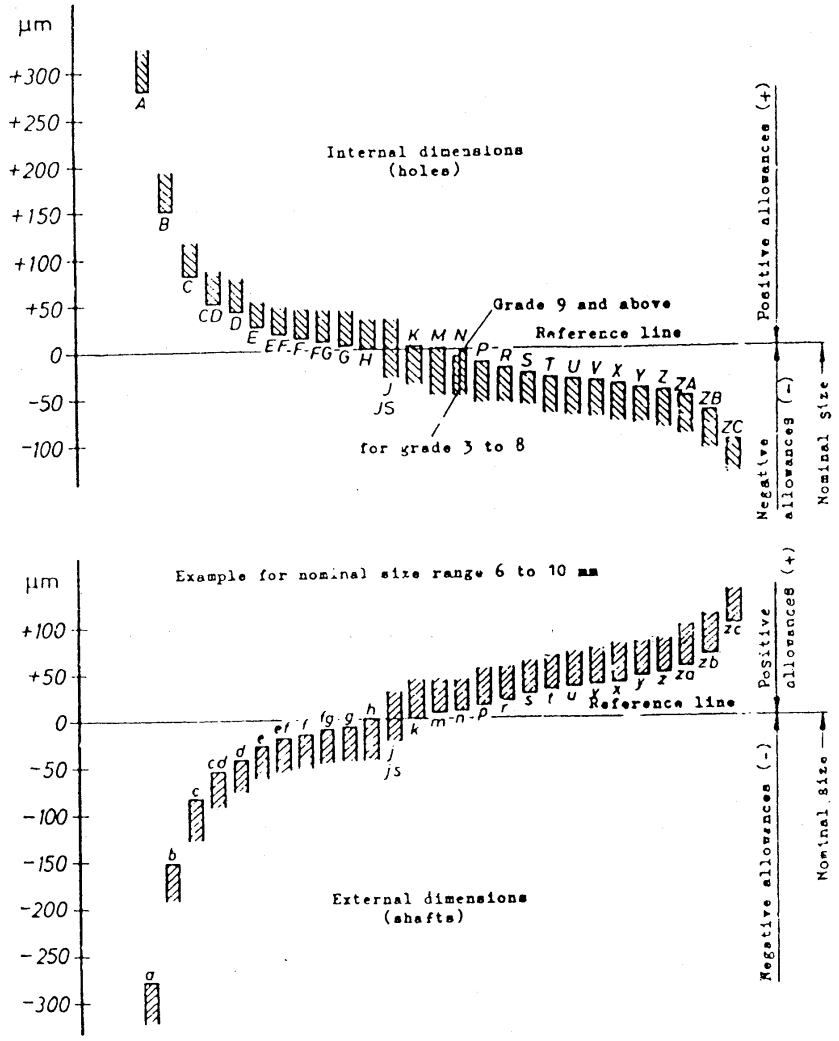
Tol. = max. diam. – min. diam.
Max. diam. = nominal size + upper allowance
Min. diam. = nominal size + lower allowance

II. Fit :-

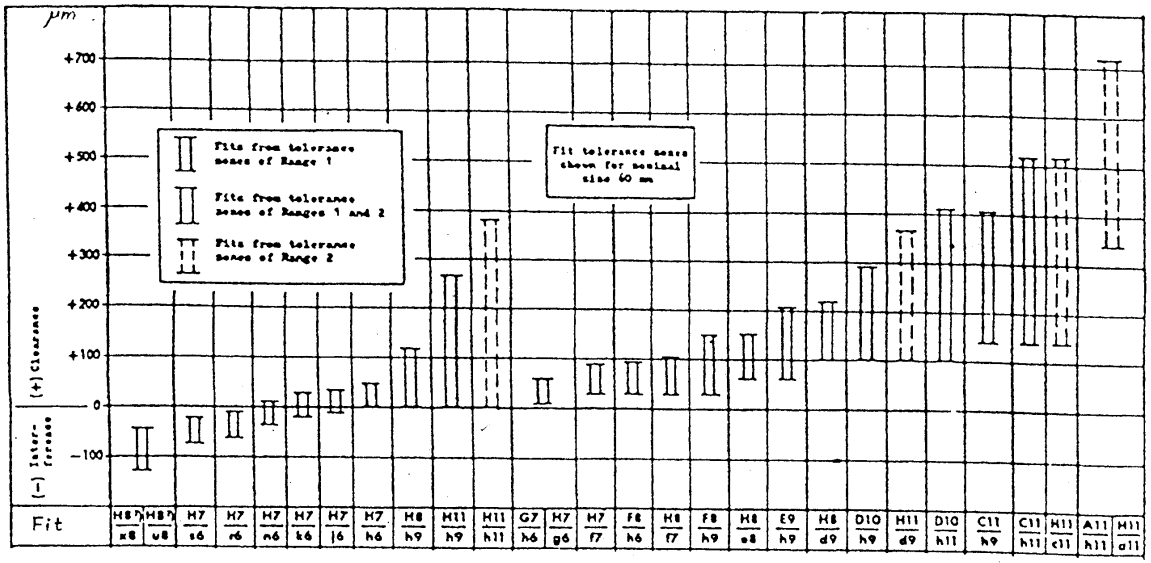




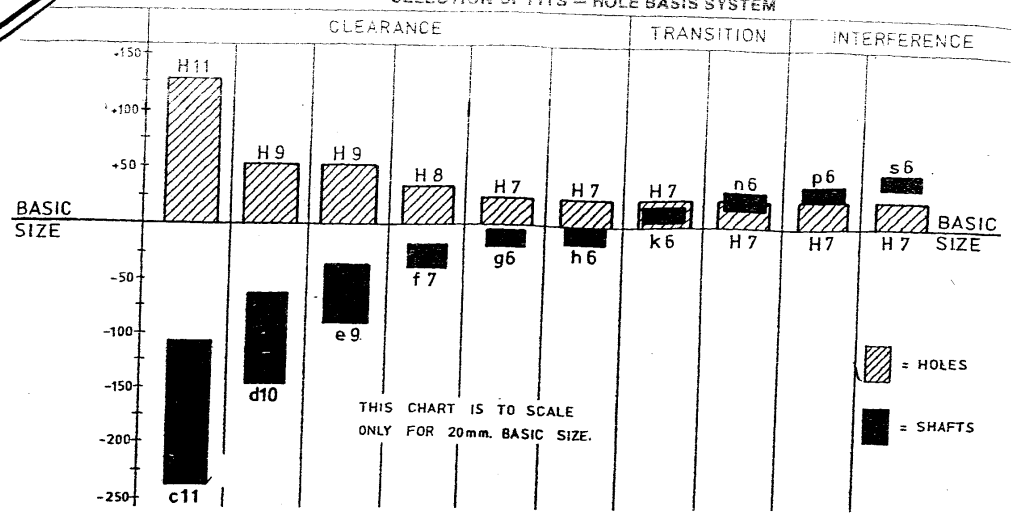
Clearance fit :
Max. clearance = max. diam. of hole – min. diam. of shaft
Min. clearance = min. diam. of hole – max. diam. of shaft
Transition fit :
Max. clearance = max. diam. of hole – min. diam. of shaft
Max. interference = min. diam. of hole – max. diam. of shaft
Interference fit :
Max. interference = min. diam. of hole – max. diam. of shaft
Min. interference = max. diam. of hole – min. diam. of shaft


µm
+300
+250
+200
+150
+100
+50
0
-50
-100
A
B
C
CD
D
E
EF
F
FG
G
H
J
JS
K
M
N
P
R
S
T
U
V
X
Y
Z
ZA
ZB
ZC
Internal dimensions
(holes)
Grade 9 and above
Reference line
for grade 3 to 8
Positive allowances (+)
Negative allowances (-)
Nominal size
Example for nominal size range 6 to 10 mm
µm
+100
+50
0
-50
-100
-150
-200
-250
-300
a
b
c
cd
d
e
ef
f
fg
g
h
j
js
k
m
n
p
r
s
t
u
v
x
y
z
za
zb
zc
Reference line
External dimensions
(shafts)
Positive allowances (+)
Negative allowances (-)
Nominal size

Clearances and interferences in μm



SELECTION OF FITS – HOLE BASIS SYSTEM



TOLERANCE UNIT = 0.001mm.		COARSE	LOOSE	EASY	NORMAL	PRECISION RUNNING,	AVERAGE	LIGHT	HEAVY	PRESS FIT	HEAVY PRESS FIT
		TOLERANCE	RUNNING FIT		RUNNING	LOCATION	LOCATION	PUSH FIT		(FERROUS)	(NON – FERROUS)
BASIC SIZES (mm)		H11 – c11	H9 – d10	H9 – e9	H8 – f7	H7 – g6	H7 – h6	H7 – k6	H7 – n6	H7 – p6	H7 – s6
OVER	TO										
—	3	+60 0 / -60 -120	+25 0 / -20 -60	+25 0 / -14 -39	+14 0 / -6 -16	+10 0 / -2 -8	+10 0 / 0 -6	+10 0 / +6 0	+10 0 / +10 +4	+10 0 / +12 +6	+10 0 / +20 +14
3	6	+75 0 / -70 -145	+30 0 / -30 -78	+30 0 / -20 -50	+18 0 / -10 -28	+12 0 / -4 -12	+12 0 / 0 -8	+12 0 / +9 +1	+12 0 / +16 +8	+12 0 / +20 +12	+12 0 / +27 +19
6	10	+90 0 / -80 -170	+36 0 / -40 -98	+36 0 / -25 -61	+22 0 / -13 -28	+15 0 / -5 -14	+15 0 / 0 -9	+15 0 / +10 +1	+15 0 / +19 +10	+15 0 / +24 +15	+15 0 / +32 +23
10	18	+110 0 / -95 -205	+43 0 / -50 -120	+43 0 / -32 -75	+27 0 / -16 -34	+18 0 / -6 -17	+18 0 / 0 -11	+18 0 / +12 +1	+18 0 / +23 +12	+18 0 / +29 +18	+18 0 / +39 +28
18	30	+130 0 / -110 -240	+52 0 / -65 -149	+52 0 / -40 -92	+33 0 / -20 -41	+21 0 / -7 -20	+21 0 / 0 -13	+21 0 / +15 +2	+21 0 / +28 +15	+21 0 / +35 +22	+21 0 / +48 +35
30	40	+160 0 / -120 -280	+62 0 / -80 -180	+62 0 / -50 -112	+39 0 / -25 -50	+25 0 / -9 -25	+25 0 / 0 -16	+25 0 / +18 +2	+25 0 / +33 +17	+25 0 / +42 +26	+25 0 / +59 +43
40	50										
50	65	+190 0 / -140 -330	+74 0 / -100 -220	+74 0 / -60 -134	+46 0 / -30 -60	+30 0 / -10 -29	+30 0 / 0 -19	+30 0 / +21 +2	+30 0 / +39 +20	+30 0 / +51 +32	+30 0 / +72 +53
65	80										+78 +59
80	100	+220 0 / -170 -390	+87 0 / -120 -260	+87 0 / -72 -159	+54 0 / -36 -71	+35 0 / -12 -34	+35 0 / 0 -22	+35 0 / +25 +3	+35 0 / +45 +23	+35 0 / +59 +37	+35 0 / +93 +71
100	120										+101 +79
120	140	+250 0 / -200 -450	+100 0 / -145 -305	+100 0 / -84 -185	+63 0 / -43 -83	+40 0 / -14 -39	+40 0 / 0 -25	+40 0 / +28 +3	+40 0 / +52 +27	+40 0 / +68 +43	+40 0 / +117 +92
140	160										+125 +100
160	180										+133 +108
180	200	+290 0 / -240 -530	+115 0 / -170 -355	+115 0 / -100 -215	+72 0 / -50 -96	+46 0 / -15 -44	+46 0 / 0 -29	+46 0 / +33 +4	+46 0 / +60 +31	+46 0 / +79 +50	+46 0 / +151 +122
200	225										+155 +130
225	250										+169 +140
250	280	+320 0 / -300 -620	+130 0 / -190 -400	+130 0 / -110 -240	+81 0 / -56 -108	+52 0 / -17 -49	+52 0 / 0 -32	+52 0 / +36 +4	+52 0 / +66 +34	+52 0 / +88 +56	+52 0 / +190 +158
280	315										+202 +170
315	355	+360 0 / -360 -720	+140 0 / -210 -440	+140 0 / -125 -265	+89 0 / -62 -119	+57 0 / -18 -54	+57 0 / 0 -36	+57 0 / +40 +4	+57 0 / +73 +37	+57 0 / +98 +62	+57 0 / +226 +190
355	400										+244 +208
400	450	+400 0 / -440 -840	+155 0 / -230 -480	+155 0 / -135 -290	+97 0 / -68 -131	+63 0 / -20 -60	+63 0 / 0 -40	+63 0 / +45 +5	+63 0 / +80 +40	+63 0 / +108 +68	+63 0 / +272 +232
450	500										+292 +252

Table (1) Tolerances of Holes

FOR DIAMETER STEPS IN MILIMETER	ISO - TOLERANCE ZONE FOR HOLE — VALUES OF DEVIATIONS IN MICRONS (1μ = 0.001 mm)															
	A_{11}	B_{11}	C_{11}	D_{10}	E_9	F_8	G_7	H_{11}	H_9	H_8	H_7	J_{S7}	K_7	N_7	P_7	R_7	S_7
— 3	+ 330 + 270	+ 200 + 140	+ 120 + 60	+ 60 + 20	+ 39 + 14	+ 20 + 6	+ 12 + 2	+ 60 0	+ 25 0	+ 14 0	+ 10 0	+ 5 − 5	0 − 10	− 4 − 14	− 6 − 16	− 10 − 20	− 14 − 24
> 3 — 6	+ 345 + 270	+ 215 + 140	+ 145 + 70	+ 98 + 30	+ 50 + 20	+ 28 + 10	+ 16 + 4	+ 75 0	+ 30 0	+ 18 0	+ 12 0	+ 6 − 6	+ 3 − 9	− 4 − 16	− 8 − 20	− 11 − 23	− 15 − 27
> 6 — 10	+ 370 + 280	+ 240 + 150	+ 170 + 80	+ 98 + 40	+ 61 + 25	+ 35 + 13	+ 20 + 5	+ 90 0	+ 36 0	+ 22 0	+ 15 0	+ 7.5 − 7.5	+ 5 − 10	− 4 − 19	− 9 − 24	− 13 − 28	− 17 − 32
> 10 — 18	+ 400 + 290	+ 260 + 150	+ 205 + 95	+ 120 + 50	+ 75 + 32	+ 43 + 16	+ 24 + 6	+ 110 0	+ 43 0	+ 27 0	+ 18 0	+ 9 − 9	+ 6 − 12	− 5 − 23	− 11 − 29	− 16 − 34	− 21 − 39
> 18 — 30	+ 430 + 300	+ 290 + 160	+ 240 + 110	+ 149 + 65	+ 92 + 40	+ 53 + 20	+ 28 + 7	+ 130 0	+ 52 0	+ 33 0	+ 21 0	+ 10.5 − 10.5	+ 6 − 15	− 7 − 28	− 14 − 35	− 20 − 41	− 27 − 48
> 30 — 40	+ 470 + 310	+ 330 + 170	+ 280 + 120	+ 180	+ 112	+ 64	+ 34	+ 160	+ 62	+ 39	+ 25	+ 12.5	+ 7	− 8	− 17	− 25	− 34
> 40 — 50	+ 480 + 320	+ 340 + 180	+ 290 + 130	+ 80	+ 50	+ 25	+ 9	0	0	0	0	− 12.5	− 18	− 33	− 42	− 50	− 59
> 50 — 65	+ 530 + 340	+ 380 + 190	+ 330 + 140	+ 220	+ 134	+ 76	+ 40	+ 190	+ 74	+ 46	+ 30	+ 15	+ 9	− 9	− 21	− 30 − 60	− 42 − 72
> 65 — 80	+ 550 + 360	+ 390 + 200	+ 340 + 150	+ 100	+ 60	+ 30	+ 10	0	0	0	0	− 15	− 21	− 39	− 51	− 32 − 62	− 48 − 78
> 80 — 100	+ 600 + 380	+ 440 + 220	+ 390 + 170	+ 260	+ 159	+ 90	+ 47	+ 220	+ 87	+ 54	+ 35	+ 17.5	+ 10	− 10	− 24	− 38 − 73	− 58 − 93
> 100 — 120	+ 630 + 410	+ 460 + 240	+ 400 + 180	+ 120	+ 72	+ 36	+ 12	0	0	0	0	− 17.5	− 25	− 45	− 59	− 41 − 76	− 66 − 101
> 120 — 140	+ 710 + 460	+ 510 + 260	+ 450 + 200	+ 305	+ 185	+ 106	+ 54	+ 250	+ 100	+ 63	+ 40	+ 20	+ 12	− 12	− 28	− 48 − 88	− 77 − 117
> 140 — 160	+ 770 + 520	+ 530 + 280	+ 460 + 210	+ 145	+ 85	+ 43	+ 14	0	0	0	0	− 20	− 28	− 52	− 68	− 50 − 90	− 85 − 125
> 160 — 180	+ 830 + 580	+ 560 + 310	+ 480 + 230													− 53 − 93	− 93 − 133
> 180 — 200	+ 950 + 660	+ 630 + 340	+ 530 + 240	+ 355	+ 215	+ 122	+ 61	+ 290	+ 115	+ 72	+ 46	+ 23	+ 13	− 14	− 33	− 60 − 106	− 105 − 151
> 200 — 225	+ 1030 + 740	+ 670 + 380	+ 550 + 260	+ 170	+ 100	+ 50	+ 15	0	0	0	0	− 23	− 33	− 60	− 79	− 63 − 109	− 113 − 159
> 225 — 250	+ 1110 + 820	+ 710 + 420	+ 570 + 280													− 67 − 113	− 123 − 169
> 250 — 280	+ 1240 + 920	+ 800 + 480	+ 620 + 300	+ 400	+ 240	+ 137	+ 69	+ 320	+ 130	+ 81	+ 52	+ 26	+ 16	− 14	− 36	− 74 − 126	− 138 − 190
> 280 — 315	+ 1370 + 1050	+ 860 + 540	+ 650 + 330	+ 190	+ 110	+ 56	+ 17	0	0	0	0	− 26	− 36	− 66	− 88	− 78 − 130	− 150 − 202
> 315 — 355	+ 1560 + 1200	+ 960 + 600	+ 720 + 360	+ 440	+ 260	+ 151	+ 75	+ 360	+ 140	+ 89	+ 57	+ 28.5	+ 17	− 16	− 41	− 87 − 144	− 169 − 226
> 355 — 400	+ 1710 + 1350	+ 1040 + 680	+ 760 + 400	+ 210	+ 125	+ 62	+ 18	0	0	0	0	− 28.5	− 40	− 73	− 98	− 93 − 150	− 187 − 244
> 400 — 450	+ 1900 + 1500	+ 1160 + 760	+ 840 + 440	+ 480	+ 290	+ 165	+ 83	+ 400	+ 155	+ 97	+ 63	+ 31.5	+ 18	− 17	− 45	− 103 − 166	− 209 − 272
> 450 — 500	+ 2050 + 1650	+ 1240 + 840	+ 880 + 480	+ 230	+ 135	+ 68	+ 20	0	0	0	0	− 31.5	− 45	− 80	− 108	− 109 − 172	− 229 − 292

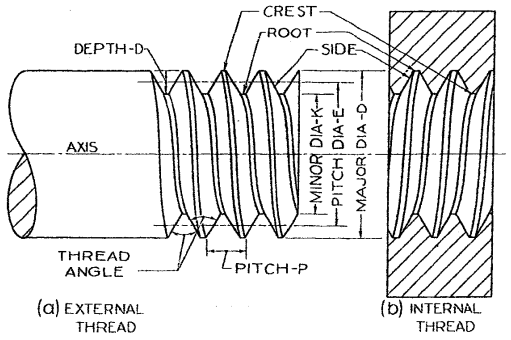
Table (2) Tolerances of Shafts

FOR DIAMETER STEPS IN MILIMETER	ISO - TOLERANCE ZONE FOR SHAFT — VALUES OF DEVIATION IN MICRONS (1μ = 0 . 001 mm)															
	a_{11}	b_{11}	c_{11}	d_9	e_8	f_7	g_6	h_{11}	h_9	h_7	h_6	j_{S6}	k_6	n_6	p_5	r_6	S6
— 3	− 270 − 330	− 140 − 200	− 60 − 120	− 20 − 45	− 14 − 28	− 6 − 16	− 2 − 8	0 − 60	0 − 25	0 − 10	0 − 6	+ 3 − 3	+ 6 0	+ 10 + 4	+ 12 + 6	+ 16 + 10	+ 20 + 14
> 3 — 6	− 270 − 345	− 140 − 215	− 70 − 145	− 30 − 60	− 20 − 38	− 10 − 22	− 4 − 12	0 − 75	0 − 30	0 − 12	0 − 8	+ 4 − 4	+ 9 + 1	+ 16 + 8	+ 20 + 12	+ 23 + 15	+ 27 + 19
> 6 — 10	− 280 − 370	− 150 − 240	− 80 − 170	− 40 − 76	− 25 − 47	− 13 − 28	− 5 − 14	0 − 90	0 − 36	0 − 15	0 − 9	+ 4.5 − 4.5	+ 10 + 1	+ 19 + 10	+ 24 + 15	+ 28 + 19	+ 32 + 23
> 10 — 18	− 290 − 400	− 150 − 260	− 95 − 205	− 50 − 93	− 32 − 59	− 16 − 34	− 6 − 17	0 − 110	0 − 43	0 − 18	0 − 11	+ 5.5 − 5.5	+ 12 + 1	+ 23 + 12	+ 29 + 18	+ 34 + 23	+ 39 + 28
> 18 — 30	− 300 − 430	− 160 − 290	− 110 − 240	− 65 − 117	− 40 − 73	− 20 − 41	− 7 − 20	0 − 130	0 − 52	0 − 21	0 − 13	+ 6.5 − 6.5	+ 15 + 2	+ 28 + 15	+ 35 + 22	+ 41 + 28	+ 48 + 35
> 30 — 40	− 310 − 470	− 170 − 330	− 120 − 280	− 80	− 50	− 23	− 9	0	0	0	0	+ 8	+ 18	+ 33	+ 42	+ 50	+ 59
> 40 — 50	− 320 − 480	− 180 − 340	− 130 − 290	− 142	− 89	− 50	− 25	− 160	− 62	− 25	− 16	− 8	+ 2	+ 17	+ 25	+ 34	+ 42
> 50 — 65	− 340 − 530	− 190 − 380	− 140 − 330	− 100	− 60	− 30	− 10	0	0	0	0	+ 9.5	+ 21	+ 39	+ 51	+ 60 + 41	+ 72 + 53
> 65 — 80	− 360 − 550	− 200 − 390	− 150 − 340	− 174	− 106	− 60	− 29	− 190	− 74	− 30	− 19	− 9.5	+ 2	+ 20	+ 32	+ 62 + 43	+ 78 + 59
> 80 — 100	− 380 − 600	− 220 − 440	− 170 − 390	− 120	− 72	− 36	− 12	0	0	0	0	+ 11	+ 25	+ 45	+ 59	+ 73 + 51	+ 93 + 71
> 100 — 120	− 410 − 630	− 240 − 460	− 180 − 400	− 207	− 126	− 71	− 34	− 220	− 87	− 35	− 22	− 11	+ 3	+ 23	+ 37	+ 76 + 54	+ 101 + 79
> 120 — 140	− 460 − 710	− 260 − 510	− 200 − 450	− 145	− 85	− 43	− 14	0	0	0	0	+ 12.5	+ 28	+ 52	+ 68	+ 88 + 63	+ 117 + 92
> 140 — 160	− 520 − 770	− 280 − 530	− 210 − 460													+ 90 + 65	+ 225 + 100
> 160 — 180	− 580 − 830	− 310 − 560	− 230 − 480	− 245	− 148	− 83	− 39	− 250	− 100	− 40	− 25	− 12.5	+ 3	+ 27	+ 43	+ 93 + 68	+ 133 + 108
> 180 — 200	− 660 − 950	− 340 − 630	− 240 − 530	− 170	− 100	− 50	− 15	0	0	0	0	+ 14.5	+ 33	+ 60	+ 79	+ 106 + 77	+ 151 + 122
> 200 — 225	− 740 − 1030	− 380 − 670	− 260 − 550													+ 109 + 80	+ 159 + 130
> 225 — 250	− 820 − 1110	− 420 − 710	− 280 − 570	− 285	− 172	− 96	− 44	− 290	− 115	− 46	− 29	− 14.5	+ 4	+ 31	+ 50	+ 113 + 84	+ 169 + 140
> 250 — 280	− 920 − 1240	− 480 − 800	− 300 − 620	− 190	− 110	− 80	− 17	0	0	0	0	+ 18	+ 38	+ 86	+ 88	+ 126 + 94	+ 190 + 158
> 280 — 315	− 1050 − 1470	− 520 − 860	− 330 − 650	− 320	− 191	− 108	− 49	− 320	− 130	− 52	− 32	− 16	+ 4	+ 34	+ 56	+ 130 + 98	+ 202 + 170
> 315 — 355	− 1200 − 1560	− 600 − 960	− 360 − 720	− 210	− 125	− 62	− 18	0	0	0	0	+ 18	+ 40	+ 73	+ 98	+ 144 + 108	+ 226 + 190
> 355 — 400	− 1350 − 1710	− 680 − 1640	− 400 − 760	− 350	− 214	− 119	− 54	− 360	− 140	− 53	− 36	− 18	+ 4	+ 37	+ 62	+ 150 + 114	+ 244 + 208
> 400 — 450	− 1500 − 1900	− 710 − 1160	− 440 − 840	− 230	− 135	− 68	− 20	0	0	0	0	+ 20	+ 45	+ 80	+ 108	+ 166 + 126	+ 272 + 232
> 450 — 500	− 1650 − 2050	− 840 − 1240	− 480 − 880	− 385	− 232	− 131	− 60	− 400	− 155	− 63	− 40	− 20	+ 5	+ 40	+ 68	+ 172 + 132	+ 292 + 252

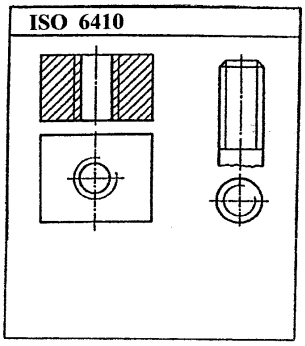
مرحلة ثانية
قسم ميكانيكا / هندسة ميكانيكية
أ. سعد حسين

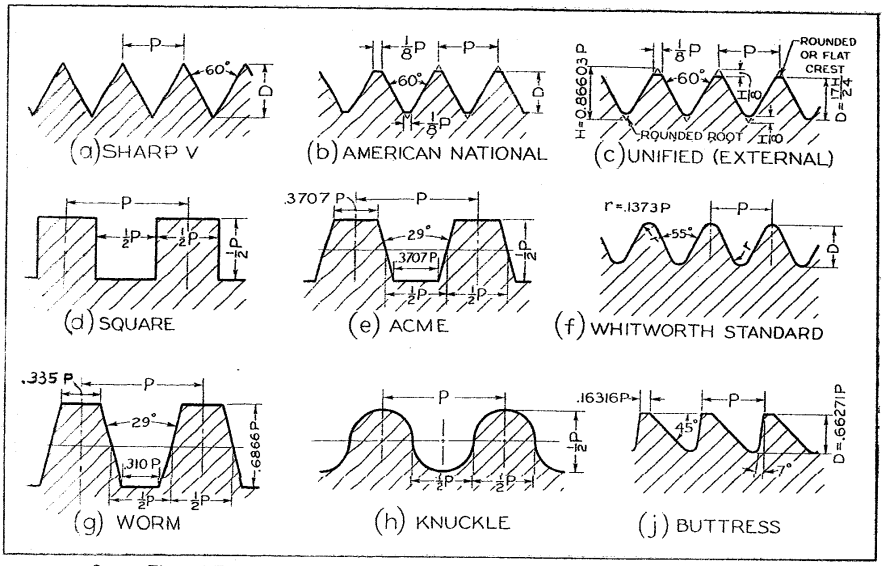
Al-Mustansiriya University
College of Engineering
Mechanical Eng. Department
Mechanical Drawing *Sheet No. (2)* *Lect. Saad N. Shehab*

Screw and Nuts :-



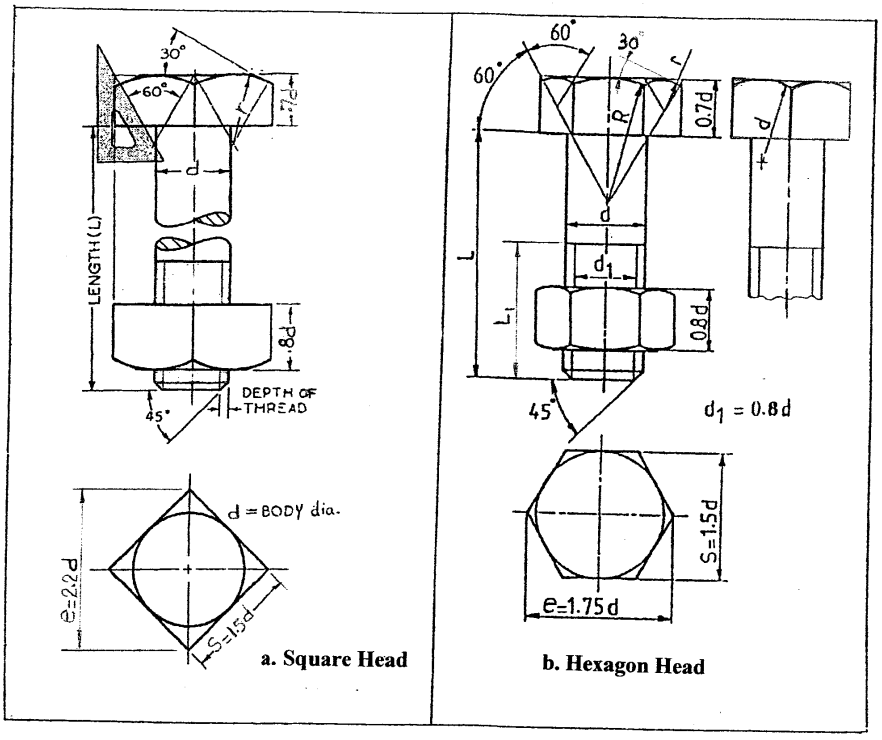
Screw-Thread Nomenclature





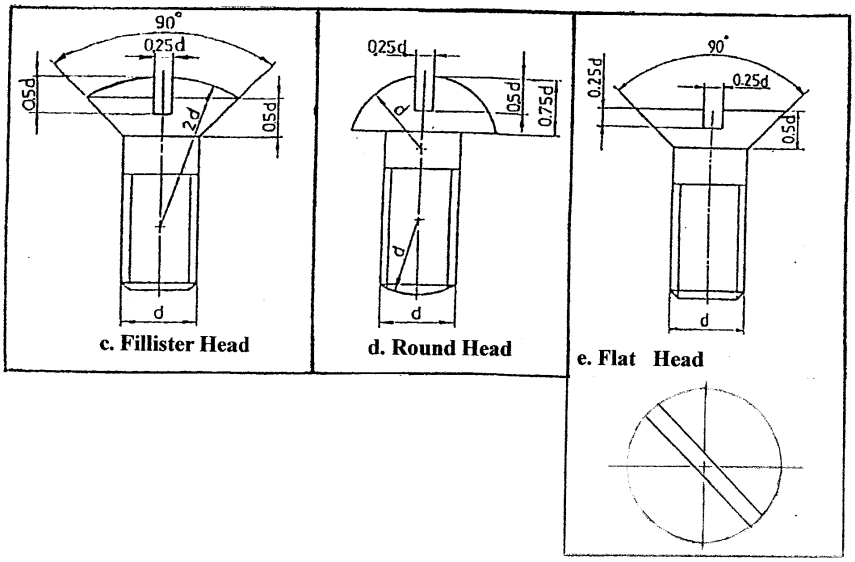
Screw-Thread Forms

Standard Types of Bolt and Screw Heads :-



a. Square Head

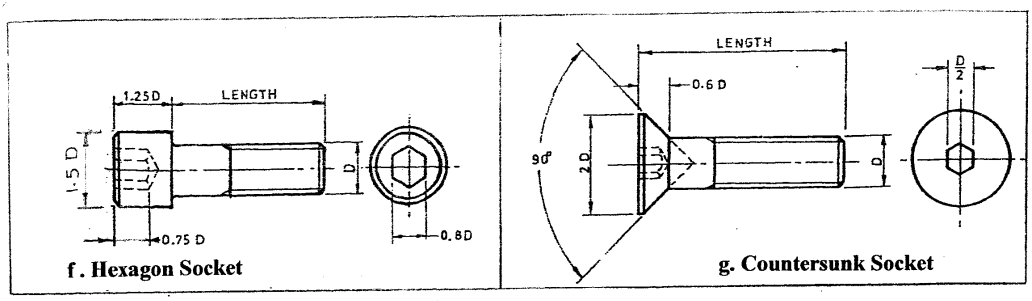
b. Hexagon Head



c. Fillister Head

d. Round Head

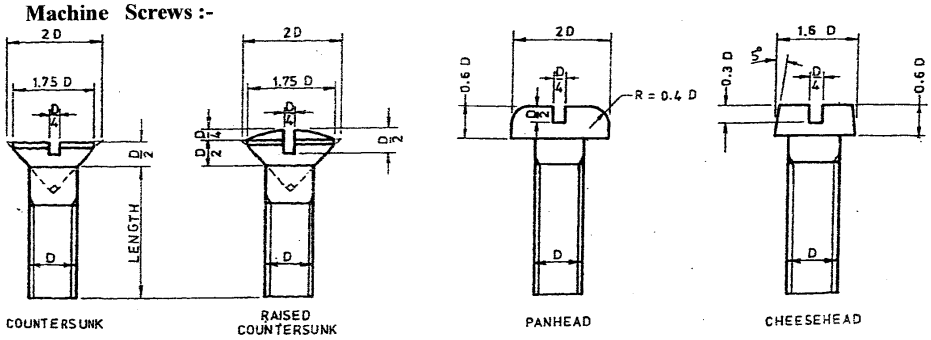
e. Flat Head



f. Hexagon Socket

g. Countersunk Socket

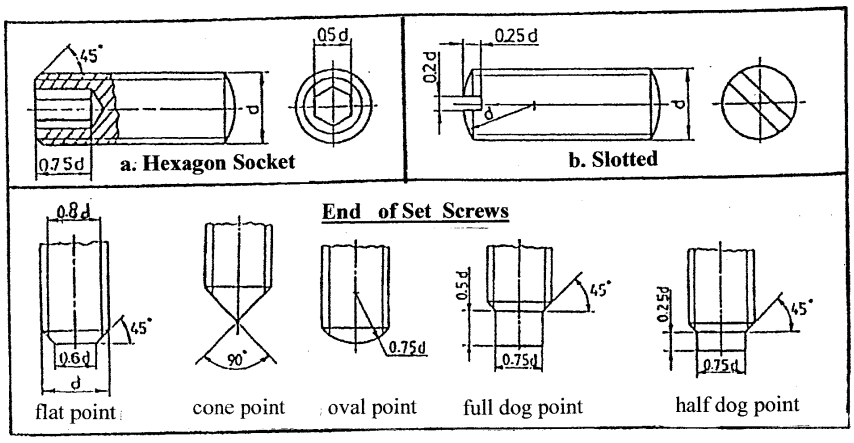
Machine Screws :-



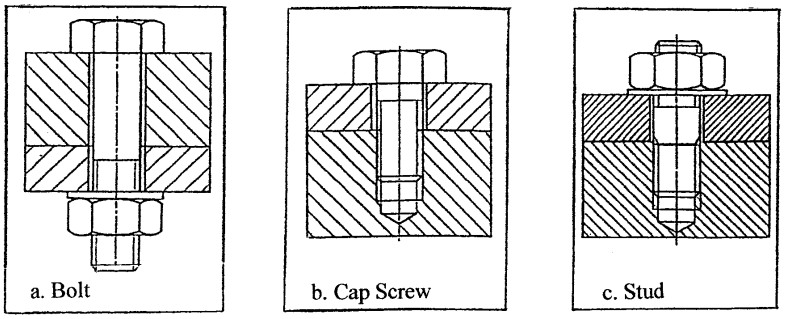
The preferred diameters and minimum lengths for machine screws are:—

DIAMETER	M1,6	M2	M2,5	M3	M4	M5	M6	M8	M10	M12	M16	M20
LENGTH	15	16	18	19	22	25	28	34	40	46	58	70

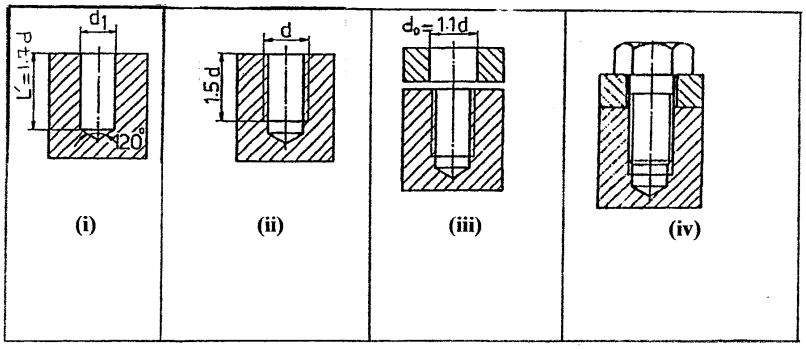
Set Screws :-



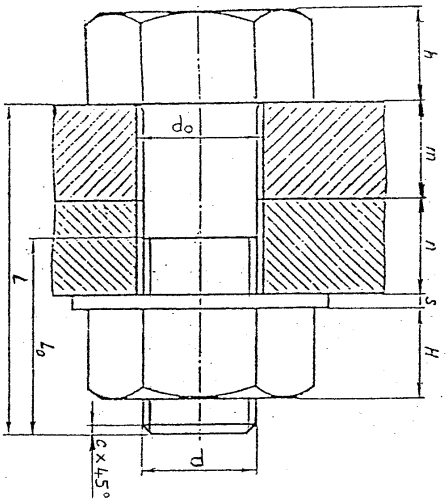
Bolts , Cap Screw , and Studs :-

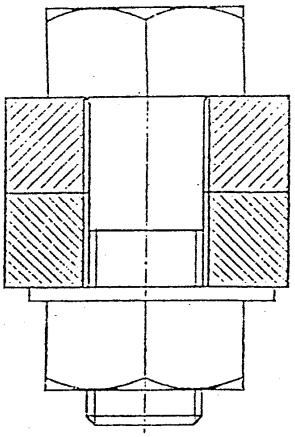


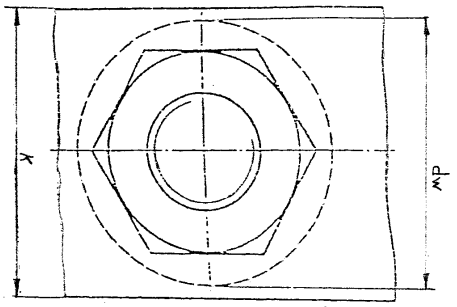
Drilled and Tapped Holes :-
- Cap Screw :



Bolt :-

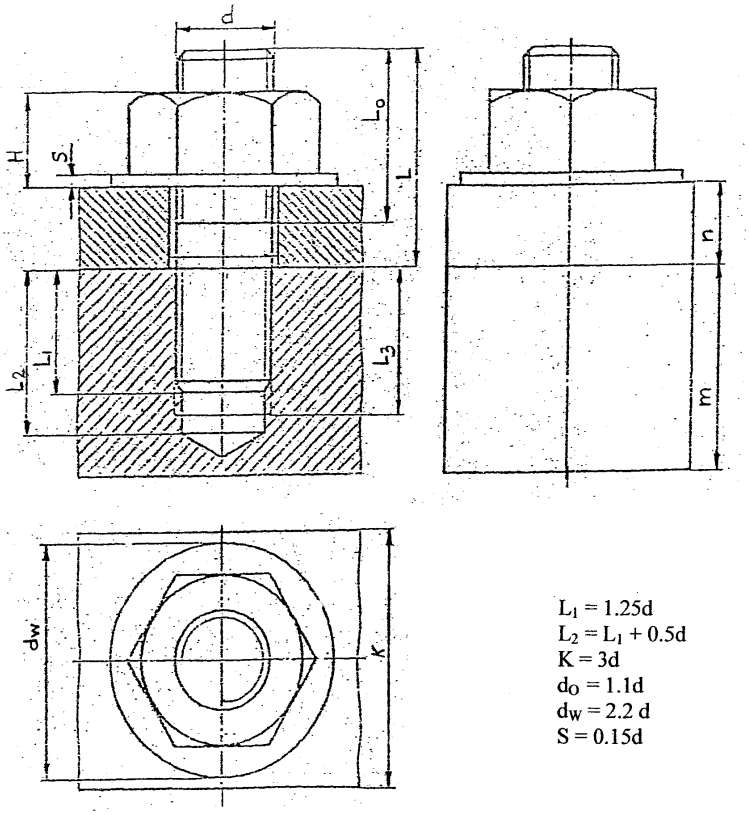






$L_O = 2d$ to $2.8d$
$K = 3d$
$d_O = 1.1d$
$d_W = 2.2\ d$
$S = 0.15d$
$C = 0.1d$

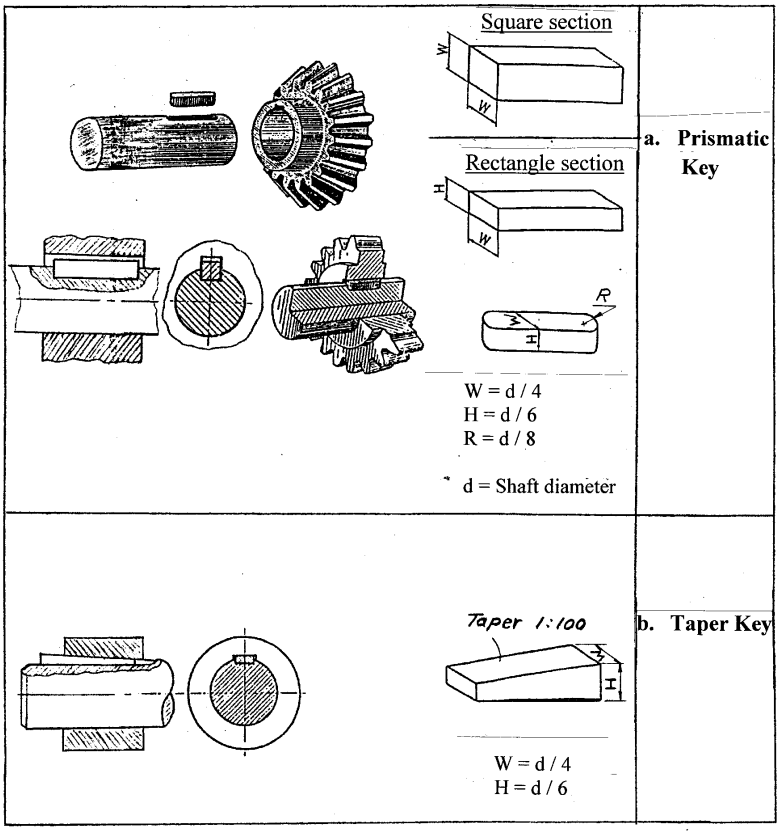
Stud :-



$L_1 = 1.25d$
$L_2 = L_1 + 0.5d$
$K = 3d$
$d_O = 1.1d$
$d_W = 2.2\ d$
$S = 0.15d$

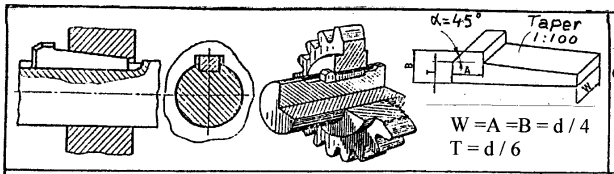
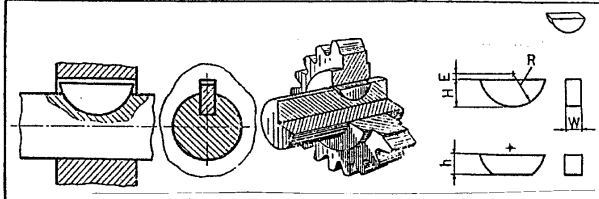
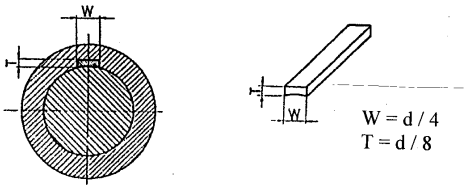
Keys :-

Types of Keys :-



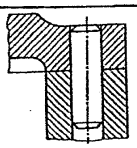
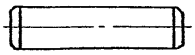
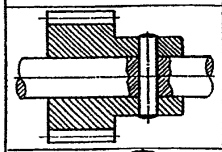
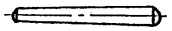
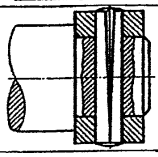
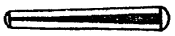
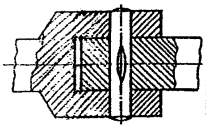
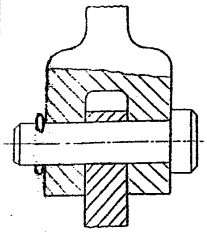
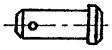
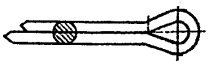
a. Prismatic Key

b. Taper Key

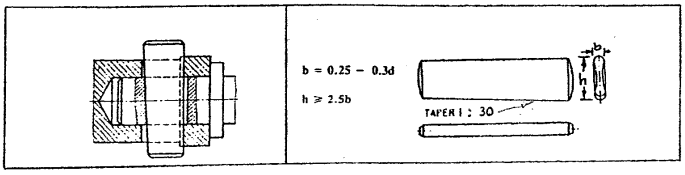
	**c. Gib Head Key**
	**d. Woodruff Key**
	**e. Saddle Key**

Pins and Cotters :-

Types of Pins :-

Using	Pin Type
	 **a. Cylindrical Pin**
	 **b. Taper Pin**
	
	 **c. Slot Pin**
	 **d. Joint Pin**
	 **e. Split Pin**

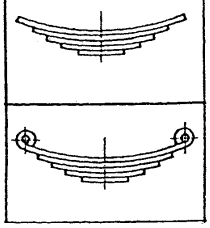
Cotters :-



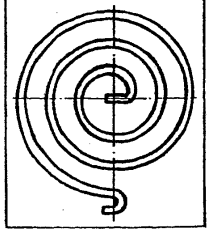
Springs :-

- **Springs**
  - **Flat springs**
    - **Leaf spring**
    - **power spring**
    - **Dish Spring**
  - **Helical springs**
    - **Compression Spring**
    - **Tension Spring**
    - **Torsion spring**

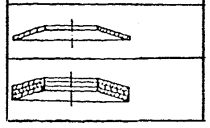
Leaf Spring

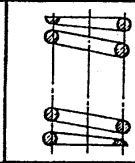
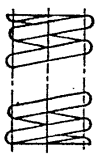
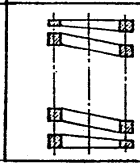
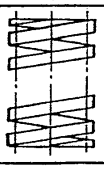


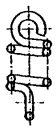
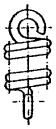
Power Spring

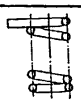
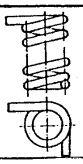


Dish Spring

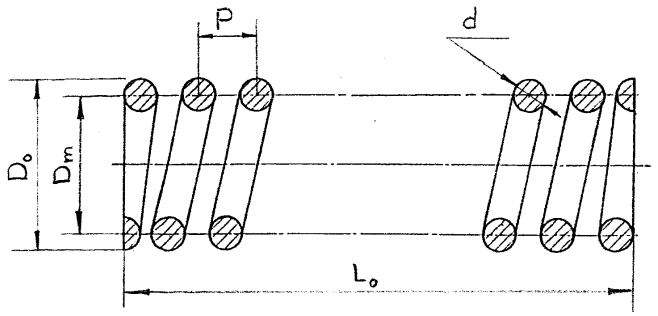


	Compression Spring	
	Section	View
Circular section		
Rectangular section		

Tension Spring	
Section	View
	

Torsion spring	
Section	View
	

Compression Springs :-



$L_0 = n \times p + d$
$n = n_1 - 2$
$L = \pi \; n_1 \; D_m$
$D_m = D_0 - d$

Where :-

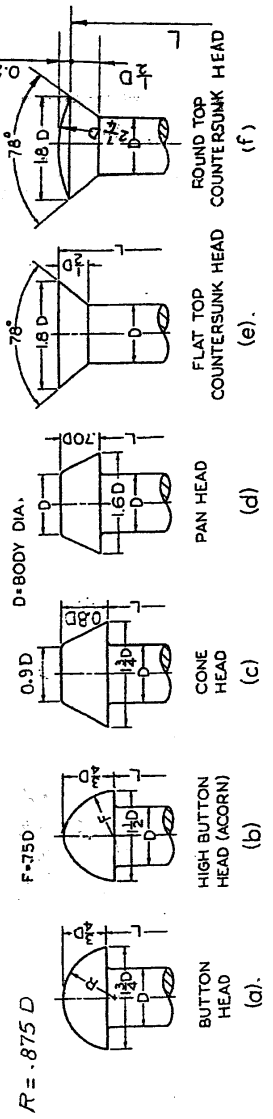
L_0 = free length of spring .
n = No. of active coils of spring .
p = pitch .
d = wire diam.
n_1 = No. of total coils of spring .
L = Length of wire spring.
D_m = mean diam. of spring .
D_0 = outside diam. of spring .

قسم : الهندسة الميكانيكية
المرحلة : الثانية
المادة : رسم ميكانيكي / Sheet No. 3
أ. سعد نجيب

Al-Mustansiriya University
College of Engineering
Mechanical Eng. Department

Rivets and Rivet Joints :-

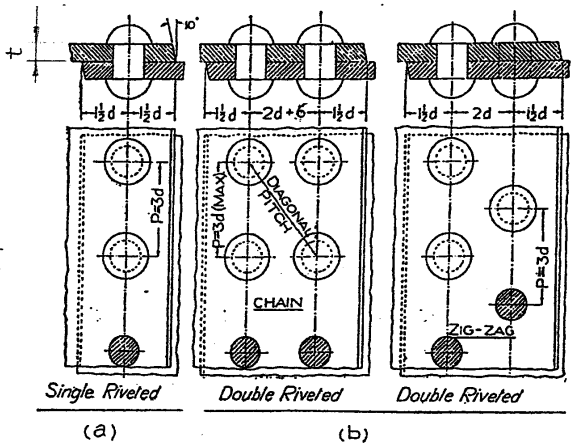
Rivet Types :



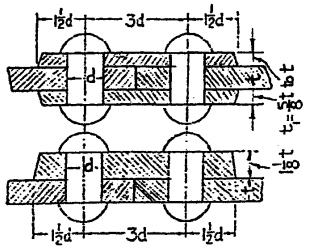
Rivet Joints :

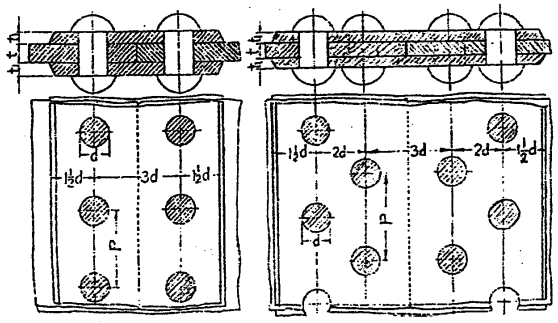
i. Lap Joint :

$d = 1.2\sqrt{t} \rightarrow 1.4\sqrt{t}$



ii. Butt Joint :

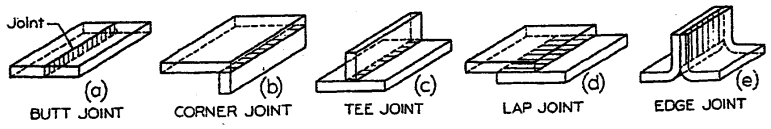




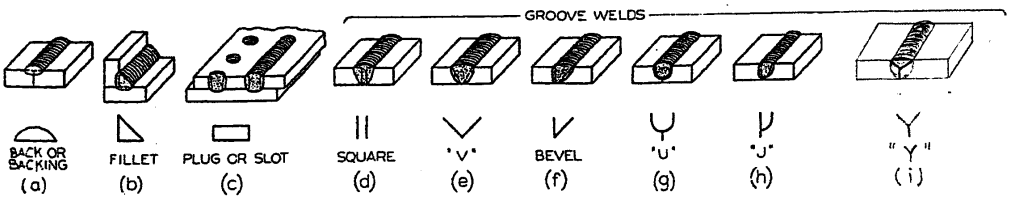
(a) Single Riveted (b) Double Riveted (Zig-Zag)

Welding and Welding Joints :-

Types of Welding Joints :

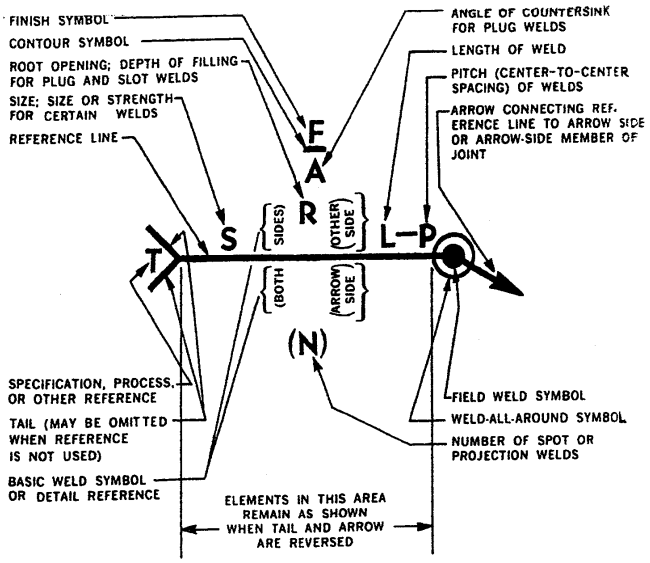


Symbols of Arc and Gas Welding :

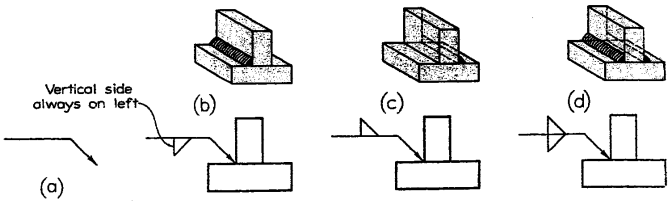


SUPPLEMENTARY SYMBOLS					
WELD ALL AROUND	FIELD WELD		CONTOUR		
			FLUSH	CONVEX	CONCAVE
			—		

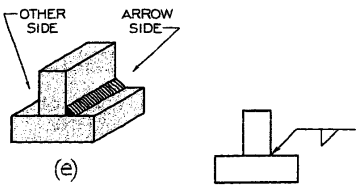
Supplementary Symbols

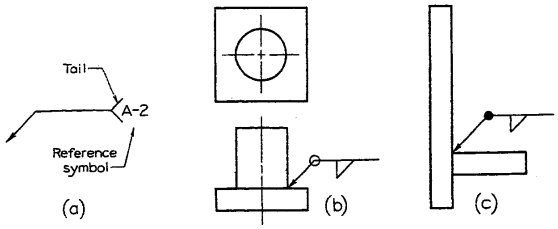


Applications :

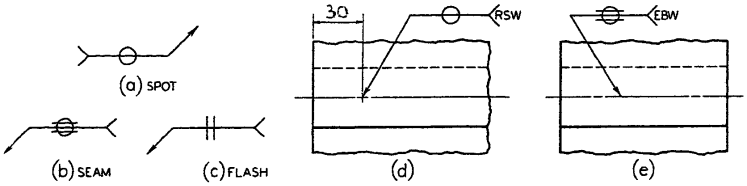


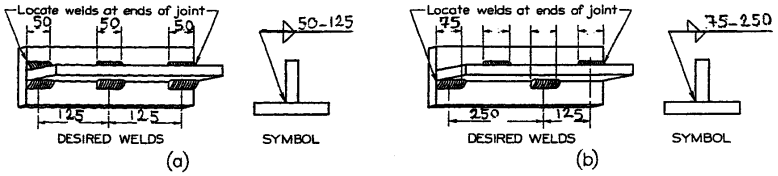
Arrow Side and Other Side.



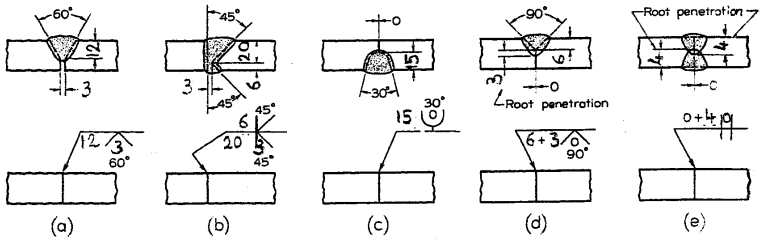


Spot, Seam, and Flash Weld Symbols.





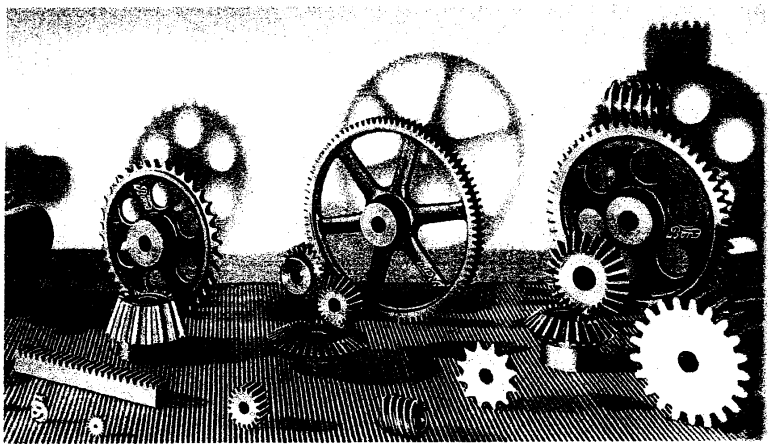
Intermittent Welds.



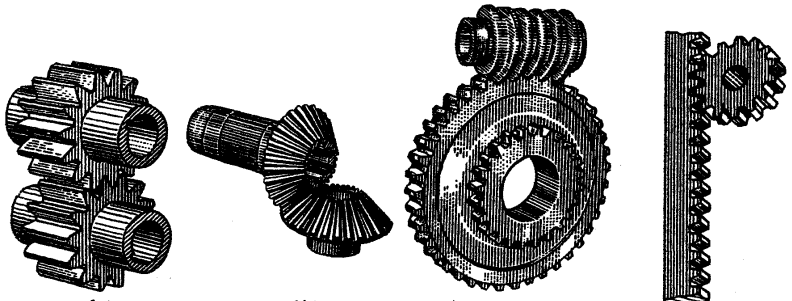
Groove Welds.

Gears :-

- Gears
  - Cylindrical Gear
    - spur gear
    - Helical gear
  - Bevel Gear
    - Straight bevel gear
    - Spiral bevel gear
  - worm &worm gear
  - Rack & Pinion Gear



An Assortment of Gears



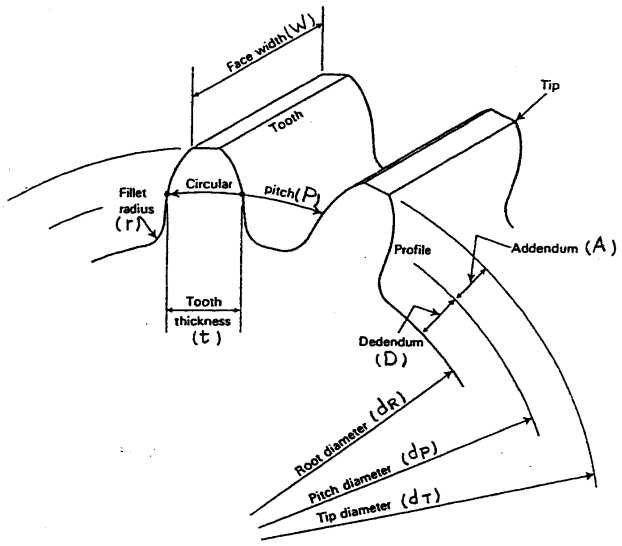
(a) CYLINDRICAL GEAR

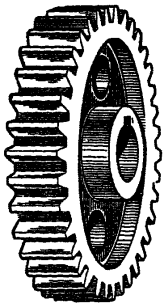
(b) BEVEL GEAR

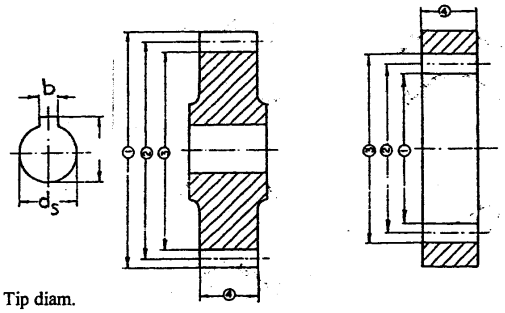
(c) WORM & WORM GEAR

(d) RACK & PINION GEAR

1. **Spur Gear :**





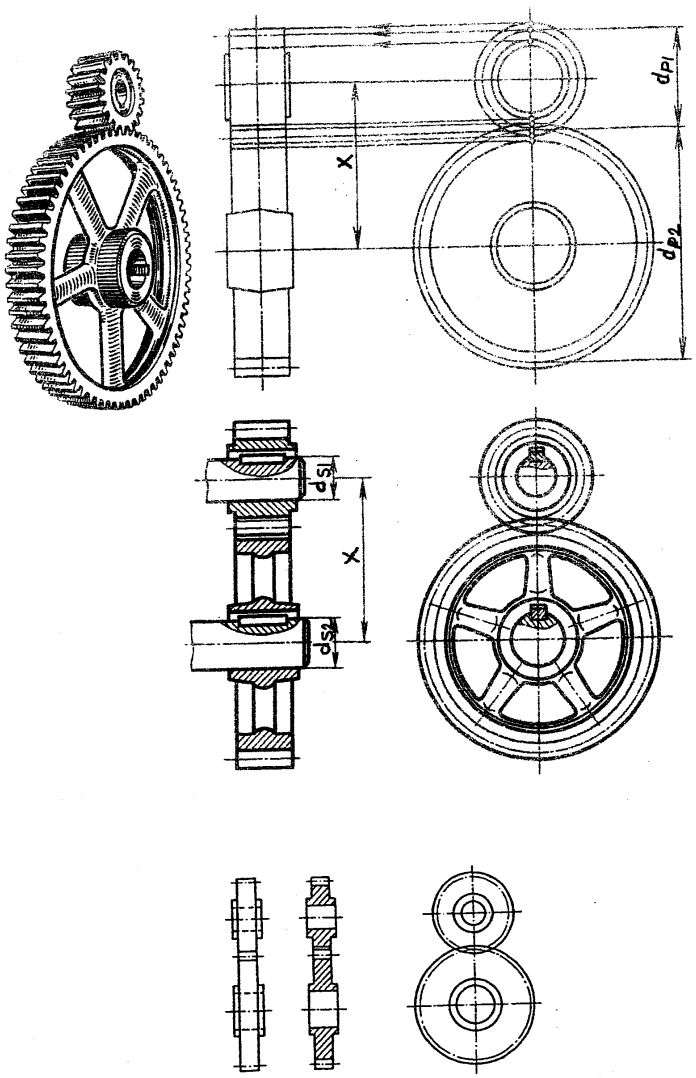


1. Tip diam.
2. Pitch diam.
3. Root diam.
4. Face width

External Internal

Spur Gear

Assembly of Spur Gear :



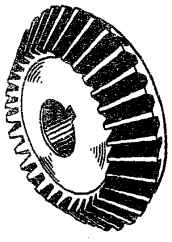
The Basic Relationships for Spur Gear :

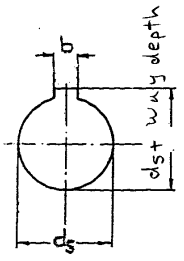
$M = P / \pi = d_P / Z$
$A = (d_T - d_P) / 2 = 0.3138\ P$
$D = (d_P - d_R) / 2 = 0.3683\ P$
$X = (d_{P1} + d_{P2}) / 2$
$P = \pi d_P / Z$
$c = P / 20$
$h = A + D + c$
$t = P / 2$
$W = (6 \rightarrow 10)\ M$
$r = \frac{1}{6} M$

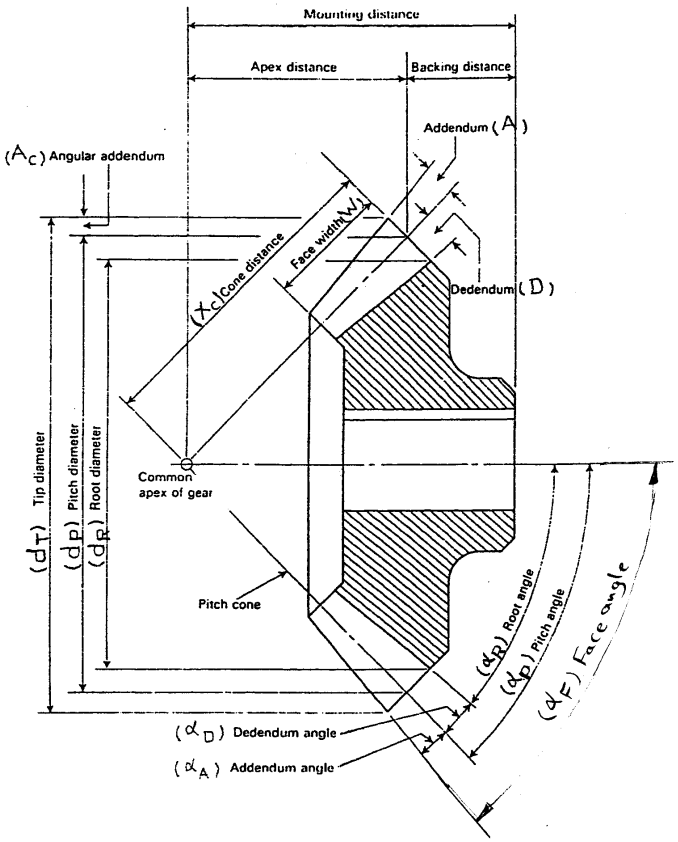
Where :–

M = Modul.
d_P = pitch diam.
Z = No. of teeth.
A = Addendum.
D = Dedendum.
d_R = root diam.
d_T = tip diam.
d_{P1} , d_{P2} = pitch diam. for pinion & gear.
c = clearance.
h = whole depth of tooth.
t = mean thickness of tooth.
W = face width.
r = fillet radius.
P = Circular pitch.

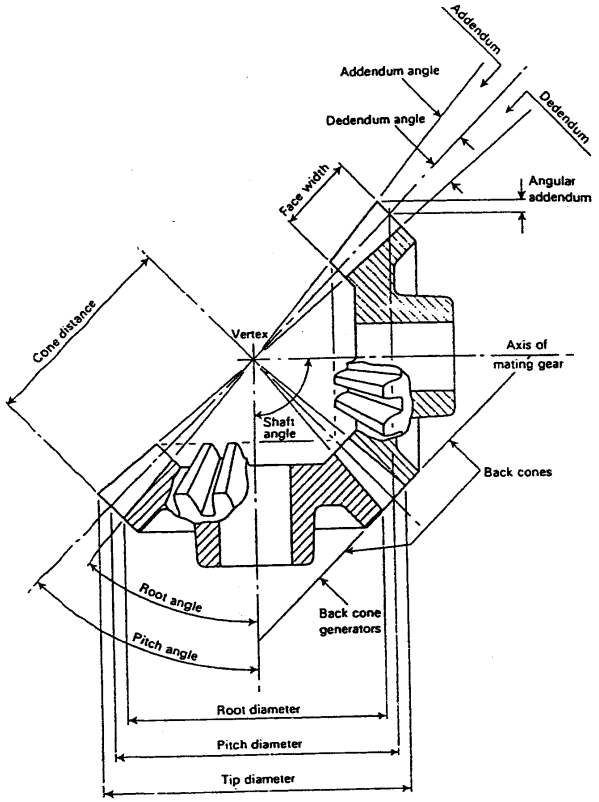
2. Straight Bevel Gear :

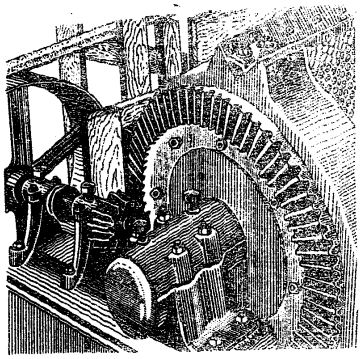


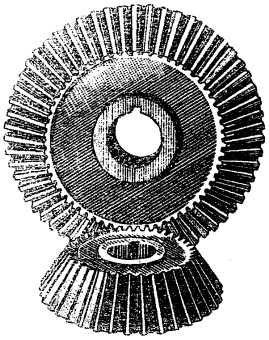


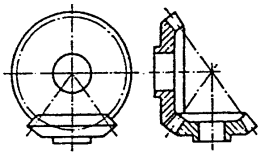


Assembly of Straight Bevel Gear :









The Basic Relationships for Straight Bevel Gear :

$d_P = M \times Z$
$P = \pi d_P / Z$
$X_C = d_P / 2 \sin \alpha_P$
$\tan \alpha_A = A / X_C$
$\tan \alpha_D = D / X_C$
$\alpha_R = \alpha_P - \alpha_D$
$\alpha_F = \alpha_P + \alpha_A$
$\alpha_b = \alpha_P$
$W = X_C / 3$

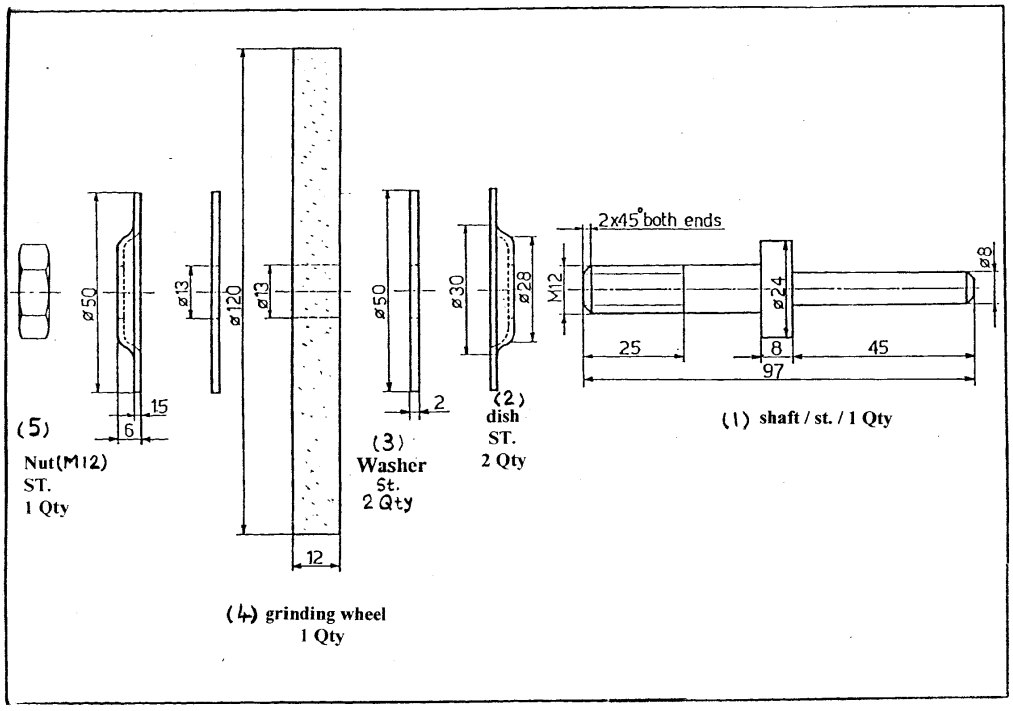
Where :–

d_P = pitch diam.
M = Module.
Z = No. Of teeth.
α_P = pitch angle.
r_{P2}, r_{P1} = pitch radii of big & small gear.
X_C = Cone distance.
α_A = Add. Angle.
α_D = Ded. Angle.
α_R = root angle
α_F = face angle.
A = Addendum.
D = Dedendum.
A_C = angular Addendum.
W = face width.

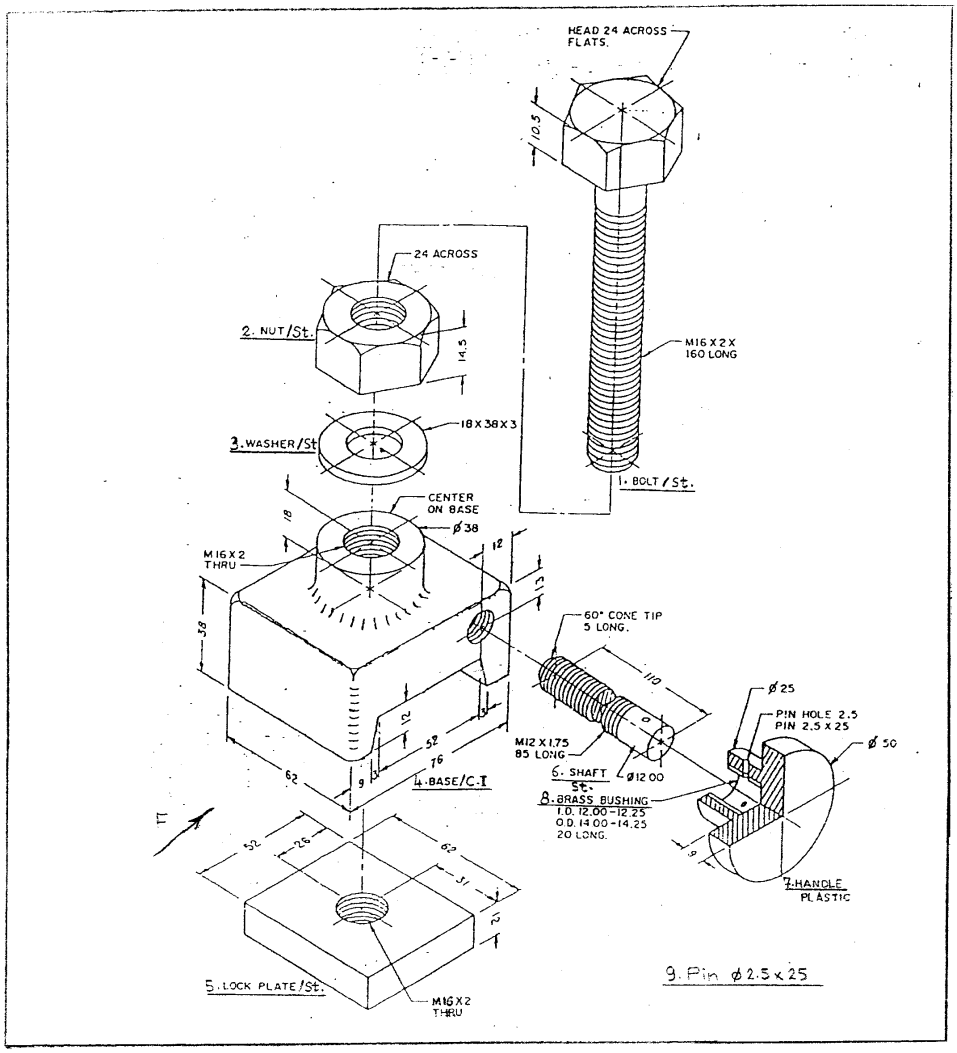
قسم ، هندسة ، ميكانيكية
، مرحلة ، ثانية
رسم ميكانيكي
Sheet no. 4
ا. سعد شهاب

Al-Mustansiriya University
College of Engineering
Mechanical Eng. Department
Mechanical Drawing Sheet No. (4) Lect. Saad N. Shehab

Assembly Drawing :-



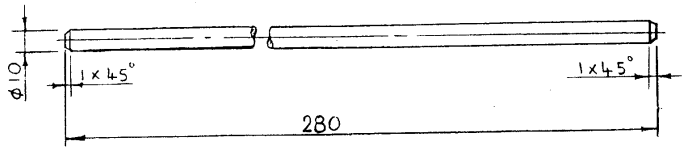
Grinding Tool Holder



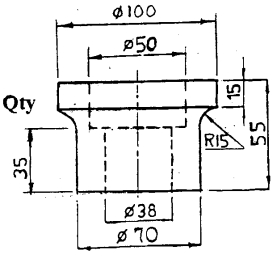
Assembly (2)

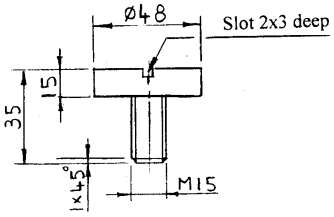
Clamp Stop

(5) Handle/steel/1 Qty

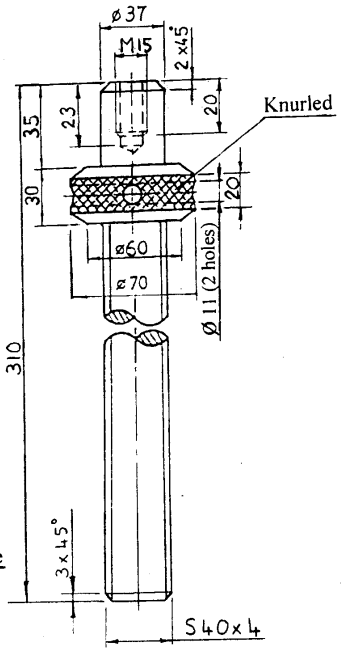


(3) Cup/Cast iron/1 Qty

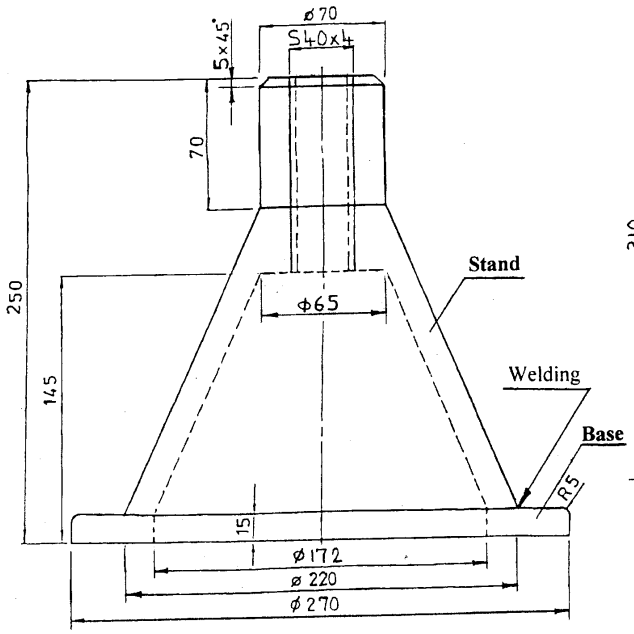




(4) Special bolt/steel/1 Qty



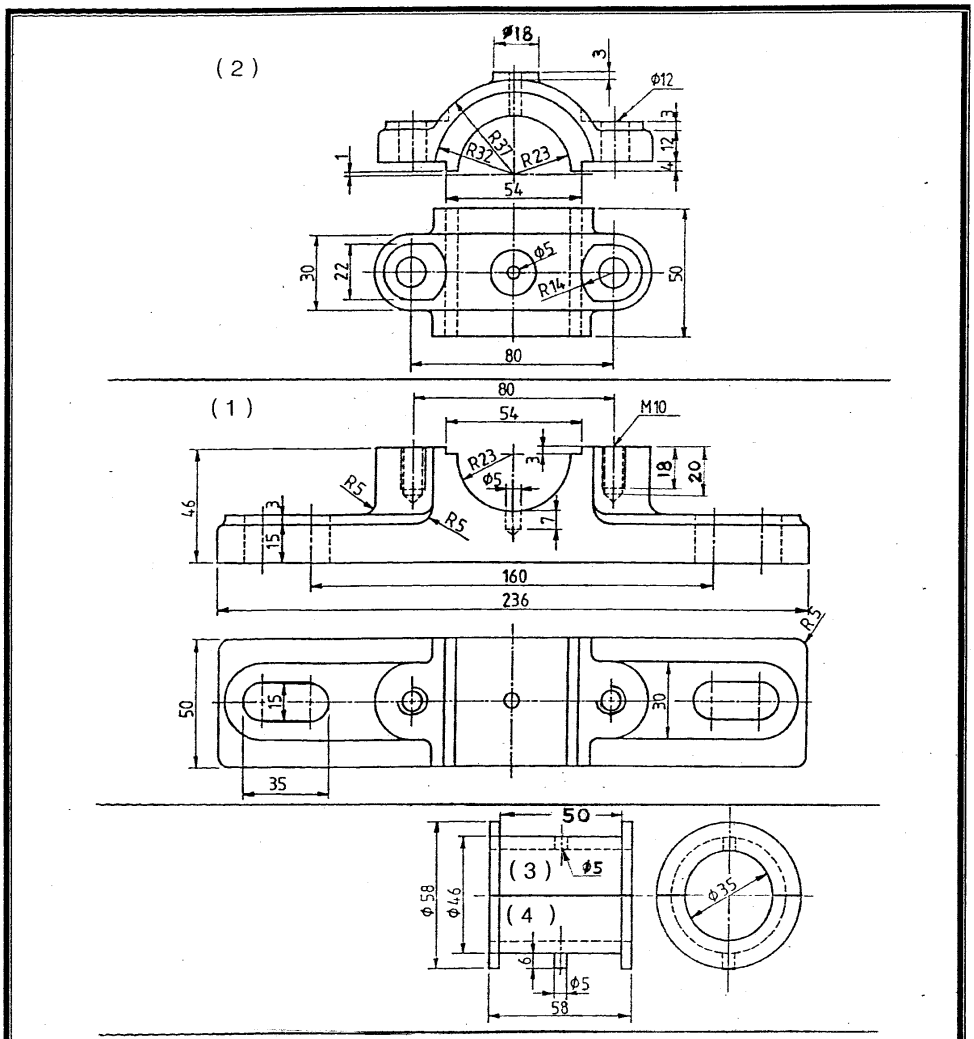
(2) Screw shaft/steel/1 Qty



(1) Frame(welded joint)/steel/1 Qty

NOTE:-The frame consist of 2 parts ; stand & base are welded by :
Concave fillet welding around the stand with thickness 8 mm .

JACK



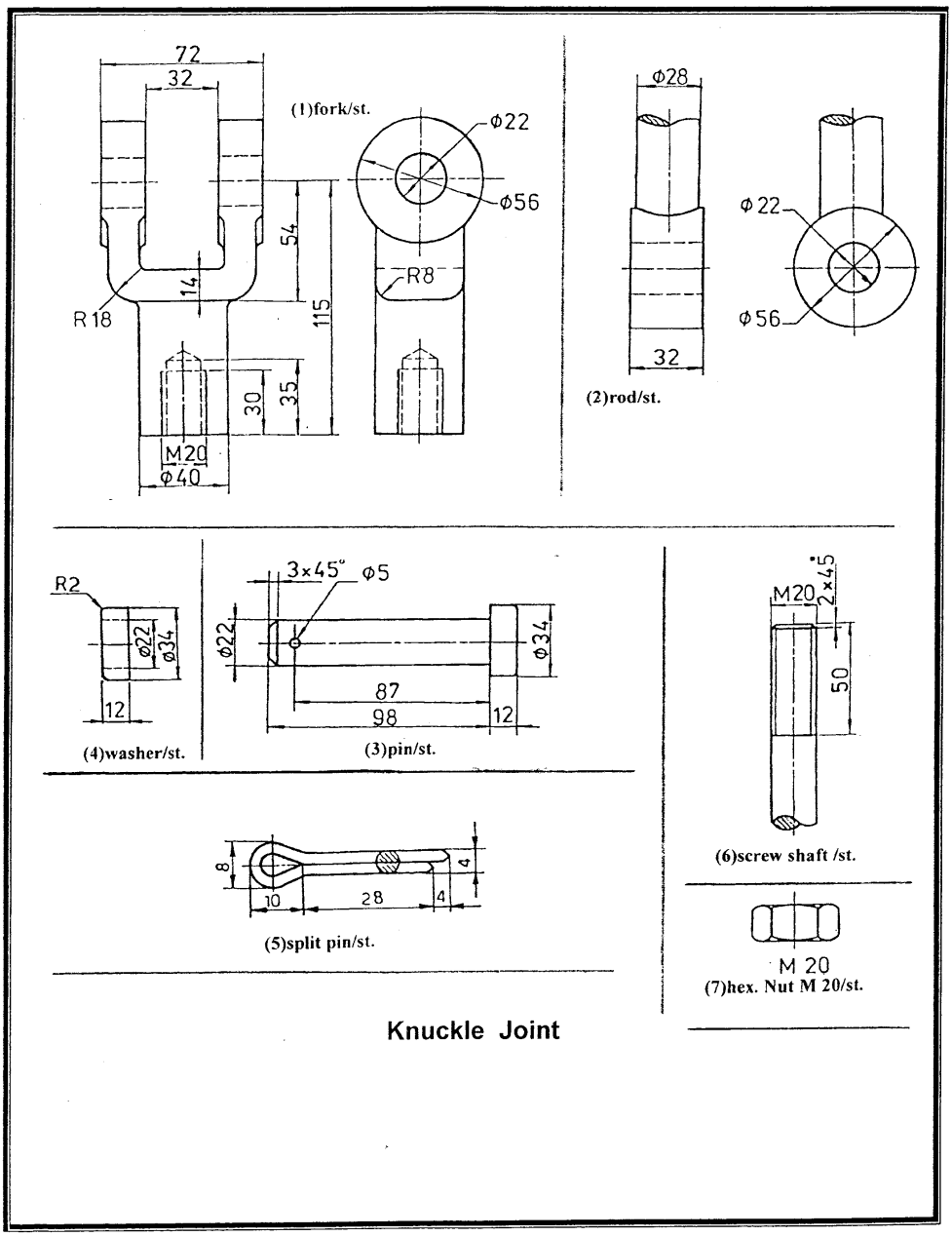
(1) base/C.I/1 req. (2)cover/C.I/1 req. (3)half bush I /bronze/1 req.

(4)half bush II /bronze/1 req. (5) hexagon head bolt M10x32 /St./2req.

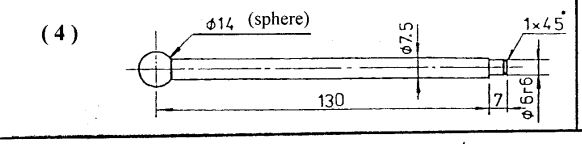
(6)washer 18x11x2/St./2req.

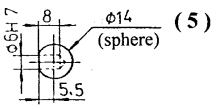
Note :- Unspecified Radii R2 .

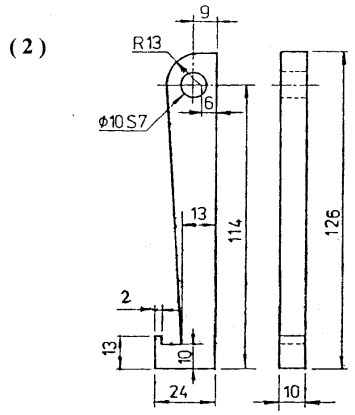
Shaft Carrier

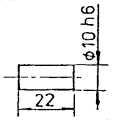


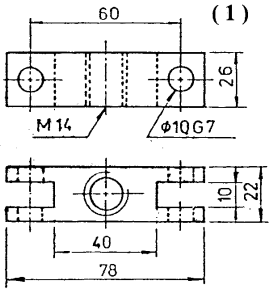
Knuckle Joint

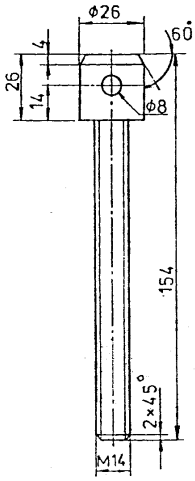








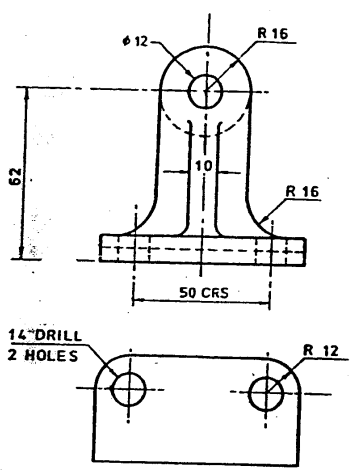




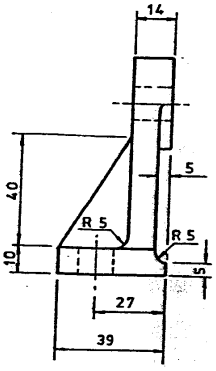
(1)fork/St./1 req. (2)jew/St./2 req.
(3)power screw/St./1 req. (4)handle/St./1 req.
(5)sphere/St./1req. (6)pin/St./2 req.

Note :- All sharp edges chamfered with 1 / 45° .

Tension Tool
(with two jews)

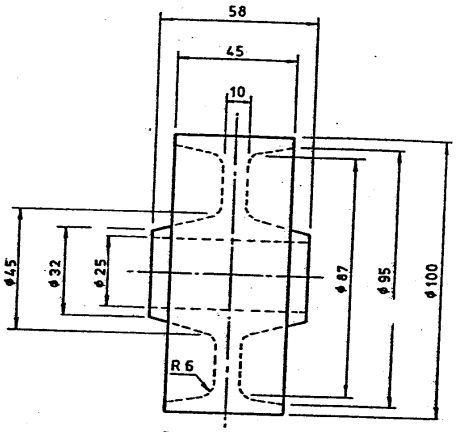


1 BRACKET
(C. I.–2 REQD)

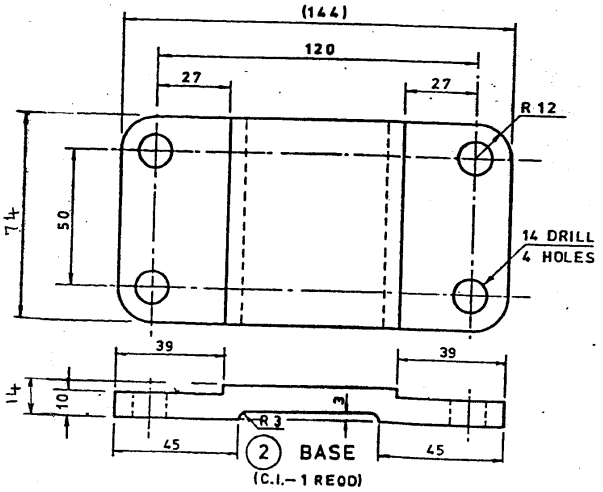


ALSO SUPPLY:

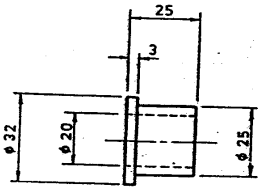
4 ONLY 12 DIA. × 38mm. HEX. BOLTS AND NUTS



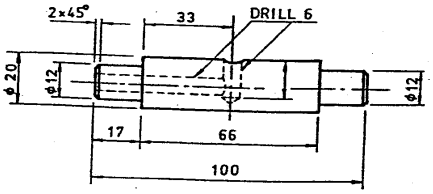
3 ROLLER
(C.I.–1 REQD)



2 BASE
(C.I.–1 REQD)

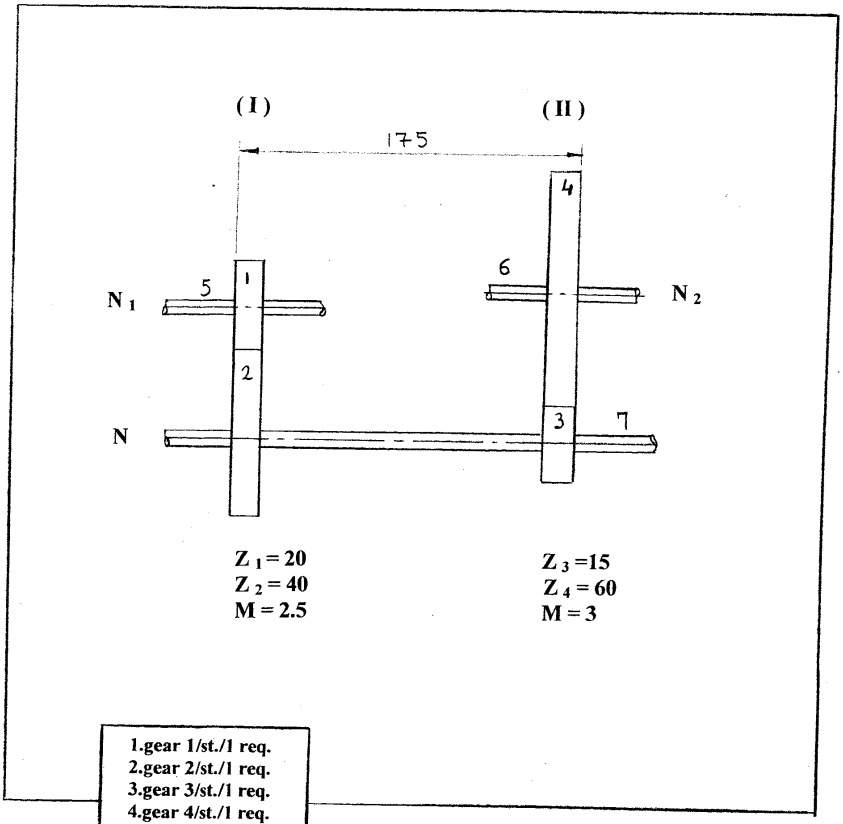


5 BUSH
(G.M.–2 REQD)



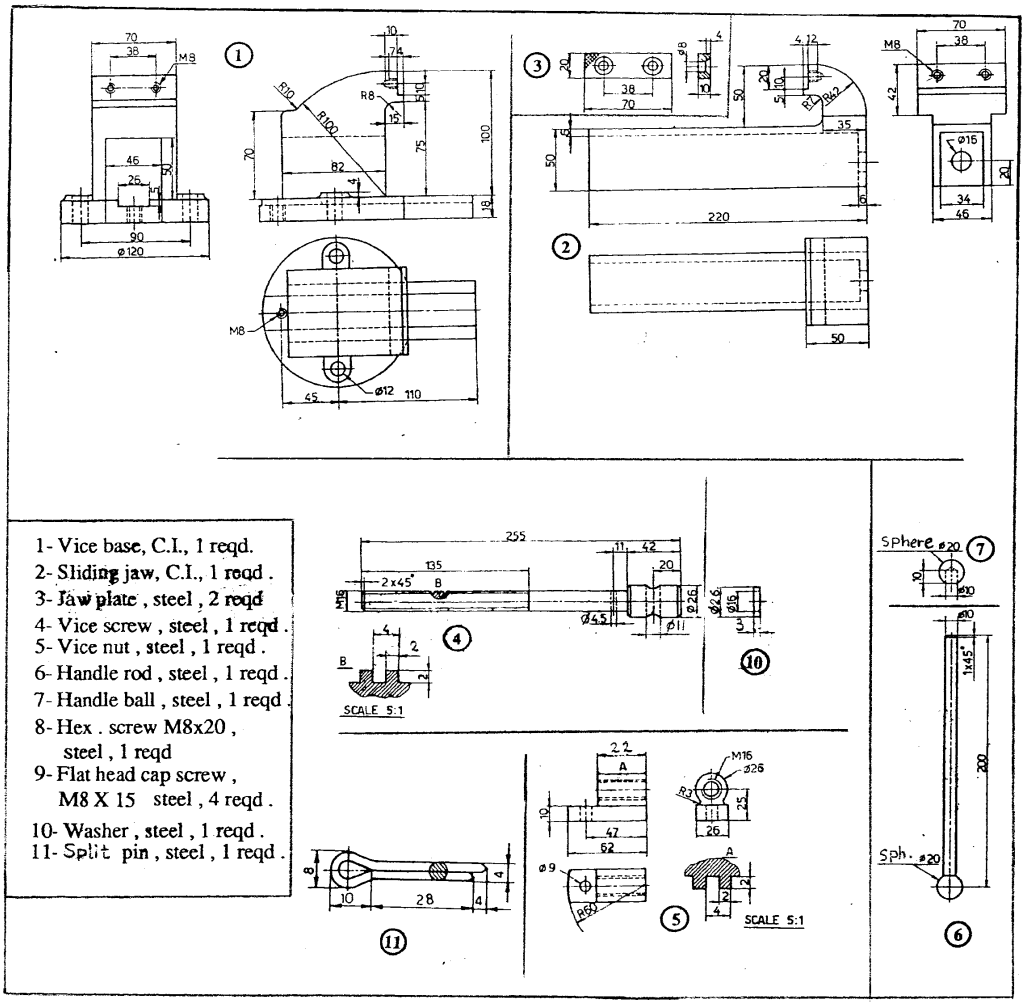
4 SPINDLE
(B.M.S. – 1 REQD)

Pully Carrier



1.gear 1/st./1 req.
2.gear 2/st./1 req.
3.gear 3/st./1 req.
4.gear 4/st./1 req.
5.shaft I/st./1 req.
6.shaft II/st./1 req.
7.shaft/st./1 req.
8.key/st./4 req.

Gear Box


1- Vice base, C.I., 1 reqd.
2- Sliding jaw, C.I., 1 reqd .
3- Jaw plate , steel , 2 reqd
4- Vice screw , steel , 1 reqd .
5- Vice nut , steel , 1 reqd .
6- Handle rod , steel , 1 reqd .
7- Handle ball , steel , 1 reqd .
8- Hex . screw M8x20 , steel , 1 reqd
9- Flat head cap screw , M8 X 15 steel , 4 reqd .
10- Washer , steel , 1 reqd .
11- Split pin , steel , 1 reqd .
SCALE 5:1
SCALE 5:1
Sphere ø20
Sph. ø20

Vice