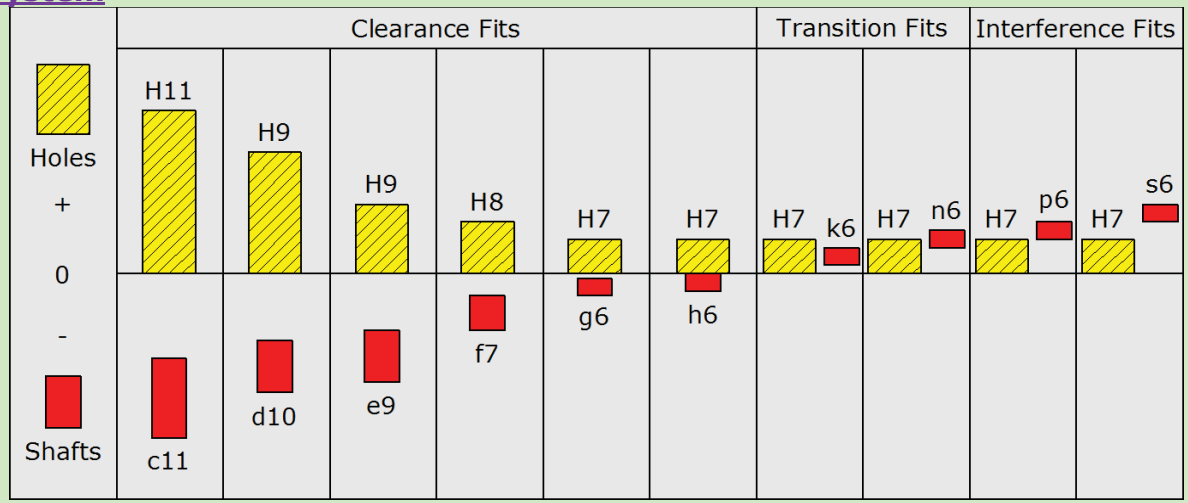
Table 17 - Hole Basis System



Over	Up to	H11	C11	H9	d10	H9	e9	H8	f7	H7	g6	H7	h6	H7	k6	H7	n6	H7	p6	H7	s6
		+	-	+	-	+	-	+	-	+	-	+	-	+	+	+	+	+	+	+	+
-	3	60	60	25	20	25	14	14	6	10	2	10	0	10	6	10	10	10	12	10	20
		0	120	0	60	0	39	0	16	0	6	0	6	0	0	0	4	0	6	0	14
3	6	75	70	30	30	30	20	18	10	12	4	12	0	12	9	12	16	12	20	12	27
		0	145	0	78	0	50	0	28	0	12	0	8	0	1	0	8	0	12	0	19
6	10	90	80	36	40	36	25	22	13	15	5	15	0	15	10	15	19	15	24	15	32
		0	170	0	98	0	61	0	28	0	14	0	9	0	1	0	10	0	15	0	23
10	18	110	95	43	50	43	32	27	16	18	6	18	0	18	12	18	23	18	29	18	39
		0	205	0	120	0	75	0	34	0	17	0	11	0	1	0	12	0	18	0	28

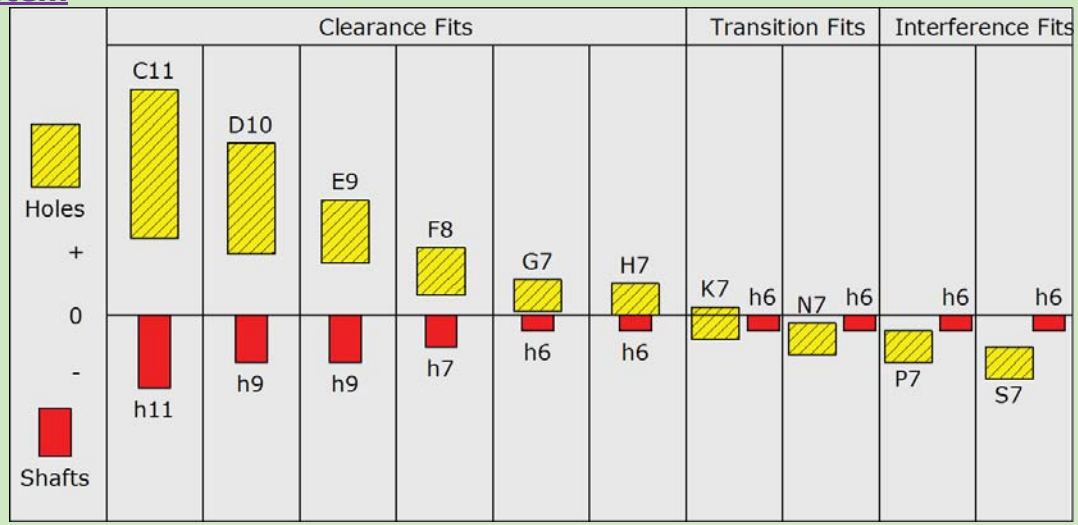
Tables

Over	Up to	H11	C11	H9	d10	H9	e9	H8	f7	H7	g6	H7	h6	H7	k6	H7	n6	H7	p6	H7	s6
		+	-	+	-	+	-	+	-	+	-	+	-	+	+	+	+	+	+	+	+
18	30	130	110	52	65	52	40	33	20	21	7	21	0	21	15	21	28	21	35	21	48
		0	240	0	149	0	92	0	41	0	20	0	13	0	2	0	15	0	22	0	35
30	40		120																		
		160	280	62	80	62	50	39	25	25	9	25	0	25	18	25	33	25	42	25	59
40	50	0	130	0	180	0	112	0	50	0	25	0	16	0	2	0	17	0	26	0	43
			290																		
50	65		140																		72
		190	330	74	100	74	60	46	30	30	10	30	0	30	21	30	39	30	51	30	53
65	80	0	150	0	220	0	134	0	60	0	29	0	19	0	2	0	20	0	32	0	78
			340																		59
80	100		170																		93
		220	390	87	120	87	72	54	36	35	12	35	0	35	26	35	45	35	59	35	71
100	120	0	180	0	260	0	159	0	71	0	34	0	22	0	3	0	23	0	37	0	101
			400																		79
120	140		200																		117
			450																		92
140	160	250	210	100	145	100	84	63	43	40	14	40	0	40	28	40	52	40	68	40	125
		0	460	0	305	0	185	0	83	0	39	0	25	0	3	0	27	0	43	0	100
160	180		230																		133
			480																		108

Tables

Over	Up to	H11	C11	H9	d10	H9	e9	H8	f7	H7	g6	H7	h6	H7	k6	H7	n6	H7	p6	H7	s6
		+	-	+	-	+	-	+	-	+	-	+	-	+	+	+	+	+	+	+	+
180	200		240																		151
			530																		122
200	225	290	260	115	170	115	100	72	50	46	14	46	0	46	33	46	60	46	79	46	159
		0	550	0	355	0	215	0	96	0	44	0	29	0	4	0	31	0	50	0	130
225	250		280																		169
			570																		140
250	280		300																		190
		320	620	130	190	130	110	81	56	52	17	52	0	52	36	52	66	52	88	52	158
280	315	0	330	0	400	0	240	0	108	0	49	0	32	0	4	0	34	0	56	0	202
			650																		170
315	355		360																		226
		360	720	140	210	140	125	89	62	57	18	57	0	57	40	57	73	57	98	57	190
355	400	0	400	0	440	0	265	0	119	0	54	0	36	0	0	0	37	0	62	0	244
			760																		208

Table 18 – Shaft Basis System



Over	Up to	C11	h11	D10	h9	E9	h9	F8	h7	G7	h6	H7	h6	K7	h6	N7	h6	P7	h6	S7	h6
		+	-	+	-	+	-	+	-	+	-	+	-	+&-	-	-	-	-	-	-	-
-	3	120	0	60	0	39	0	20	0	12	0	10	0	0	0	4	0	6	0	14	0
		60	60	20	25	14	25	6	10	2	6	0	6	-10	6	14	6	16	6	24	6
3	6	145	0	78	0	50	0	28	0	16	0	12	0	3	0	4	0	8	0	15	0
		70	75	30	30	20	30	10	12	4	8	0	8	-9	8	16	8	2	8	27	8
6	10	170	0	98	0	61	0	35	0	20	0	15	0	5	0	4	0	9	0	17	0
		80	90	40	36	25	36	13	15	5	9	0	9	-10	9	19	9	24	9	32	9
10	18	205	0	120	0	75	0	43	0	24	0	18	0	6	0	5	0	11	0	21	0
		95	110	50	43	32	43	16	18	6	11	0	11	-12	11	23	11	29	11	39	11
18	30	240	0	149	0	92	0	53	0	28	0	21	0	6	0	7	0	14	0	27	0
		110	130	65	52	40	52	20	21	7	13	0	13	-15	13	28	13	35	13	48	13

Tables

Over	Up to	C11	h11	D10	h9	E9	h9	F8	h7	G7	h6	H7	h6	K7	h6	N7	h6	P7	h6	S7	h6
30	40	280	0																		
		120	160	180	0	112	0	64	0	34	0	25	0	7	0	8	0	17	0	34	0
40	50	290	0	80	62	50	62	25	25	9	16	0	16	-18	16	33	16	42	16	59	16
		130	160																		
50	65	330	0																	42	0
		140	190	220	0	134	0	76	0	40	0	30	0	9	0	9	0	21	0	72	19
65	80	340	0	100	74	60	74	30	30	10	19	0	19	-21	19	39	19	51	19	48	0
		150	190																	78	19
80	100	390	0																	58	0
		170	220	260	0	159	0	90	0	47	0	35	0	10	0	10	0	24	0	93	22
100	120	400	0	120	87	72	87	36	35	12	22	0	22	-25	22	45	22	59	22	66	0
		180	220																	101	22
120	140	450	0																	77	0
		200	250																	117	25
140	160	460	0	305	0	185	0	106	0	54	0	40	0	12	0	12	0	28	0	85	0
		210	250	145	100	85	100	43	40	14	25	0	25	-28	25	52	25	68	25	125	25
160	180	480	0																	93	0
		230	250																	133	25

Tables

Over	Up to	C11	h11	D10	h9	E9	h9	F8	h7	G7	h6	H7	h6	K7	h6	N7	h6	P7	h6	S7	h6
180	200	530	0																	105	0
		240	290																	151	29
200	225	550	0	355	0	215	0	122	0	61	0	46	0	13	0	14	0	33	0	113	0
		260	290	170	115	100	115	50	46	15	29	0	29	-33	29	60	29	79	29	159	29
225	250	570	0																	123	0
		280	290																	169	29
250	280	620	0																	138	0
		300	320	400	0	240	0	137	0	62	0	52	0	16	0	14	0	36	0	190	32
280	315	650	0	190	130	110	130	56	52	17	32	0	32	-36	32	66	32	88	32	150	0
		330	320																	202	32
315	355	720	0																	169	0
		360	360	440	0	265	0	151	0	75	0	57	0	17	0	16	0	41	0	226	36
355	400	760	0	210	140	125	140	62	57	18	36	0	36	-40	36	73	36	98	36	187	0
		400	360																	244	36

Table 19 – Typical Surface Roughness Height Application

Roughness Value	Roughness Grade Number	Process and Application
50	N12	
25	N11	A very rough surface produced by lathes, millers and other machine tools using heavy cuts and very coarse feeds. Other processes such as filing, snagging, disc grinding, sand casting and rough forging also produce a texture of this value.
12.5	N10	A very rough coarse surface obtained by sand casting saw cutting, chipping, rough forging, and oxy cutting. Suitable for clearance areas on machinery, jigs and fixtures.
6.3	N9	A coarse production finish obtained by using coarse feeds on lathes, millers, shapers, boring and drilling machines and is acceptable when tool marks have no bearing on performance and quality. The surface can be produced economically and is used on parts where stress requirements, appearance and conditions of operations, and design permit.
3.2	N8	A medium commercial finish easily produced on lathes, milling machines and shapers. The finish is commonly used in general engineering machining operations, which is economical to produce and of reasonable appearance. This is the roughest surface recommended for parts subject to loads, vibration and high stress; it is also permitted for bearing surfaces when motion is slow with light loads.
1.6	N7	A good machine finish that can be maintained on production lathes and milling machines using sharp tools, fine feeds and high cutting speeds. It may be specified for close fits and used for all stress parts except fast rotating shafts, axels and parts subject to severe vibration or extreme tension. It is also suitable for bearing surfaces when motion is slow and loads light.
0.8	N6	A first class machine finish which can be easily produced on cylindrical surface and centerless grinders but requires great care on lathes and milling machines. It is satisfactory for bearings and shafts carrying light loads and running at medium to slow speeds.
0.4	N5	A fine quality surface that can be produced by fine cylindrical grinding, coarse honing, buffing and lapping methods. The finish is specified where smoothness is of primary importance, such as rapidly rotating shaft bearings, heavily loaded bearings and extreme tension members.
0.2	N4	A fine surface produced by honing, lapping and buffing methods. The finish could be specified on precision gauge and instrument work on high speed shafts and bearings. Cost of construction is high.
0.1	N3	Very refined surfaces require this degree of finish that are produced by honing, lapping and buffing methods and are expensive to produce. The finish is specified for surfaces on instrument and gauge work, and where packings and rings must slide across the direction of surface grain such as chrome-plated piston rods where lubrication is not dependable.
0.05	N2	Very smoothly finished surfaces produced by honing, lapping, buffing or super finishing machines. The surfaces may have a satin or highly polished appearance depending on the finishing operation and material. Expensive finishes to produce that are rarely required but can be specified on fine or sensitive instrument parts or other laboratory items and precision gauge blocks.
0.025	N1	Very smoothly finished surfaces produced by honing, lapping, buffing or super finishing machines. The surfaces may have a satin or highly polished appearance depending on the finishing operation and material. Extremely expensive finishes to produce that are rarely required but can be specified on fine or sensitive instrument parts or other laboratory items and precision gauge blocks.

Tables

Process	Roughness Average R_a – Micrometres *um*											
	50	25	12.5	6.3	3.2	1.6	0.8	0.4	0.2	0.1	0.05	0.025
Flame Cutting												
Snagging												
Sawing												
Planing, Shaping												
Drilling												
Chemical Milling												
Elect discharge												
Milling												
Broaching												
Reaming												
Electron Beam												
Laser												
Electro-chemical												
Boring, Turning												
Barrel finishing												
Electrolytic grinding												
Roller burnishing												
Grinding												
Honing												
Electro-polish												
Polishing												
Lapping												
Superfinishing												
Sand casting												
Hot rolling												
Forging												
Perm mold casting												
Investment casting												
Extruding												
Cold rolling, drawing												
Die casting												

The ranges shown above are typical of the processes listed.

Higher or lower values may be obtained under special conditions.

Key — Average Application

Less frequent application

Table 20 – Lay Symbols

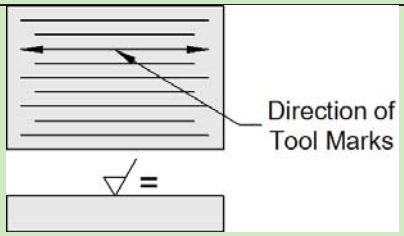
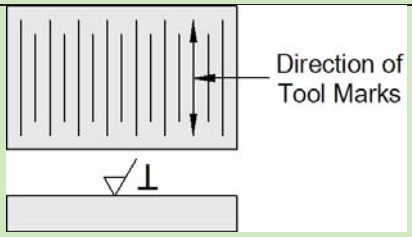
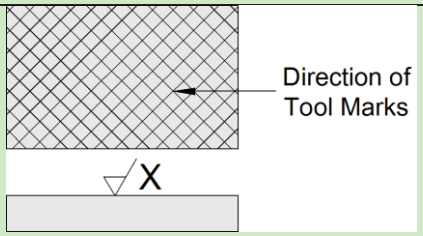
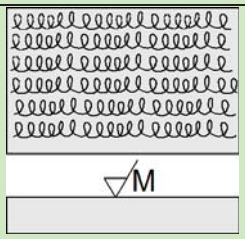
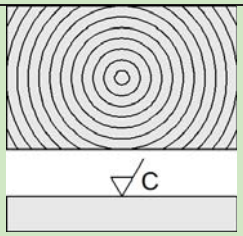
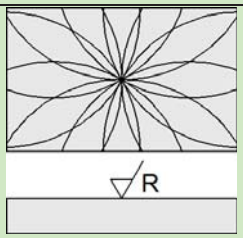
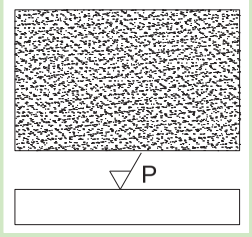
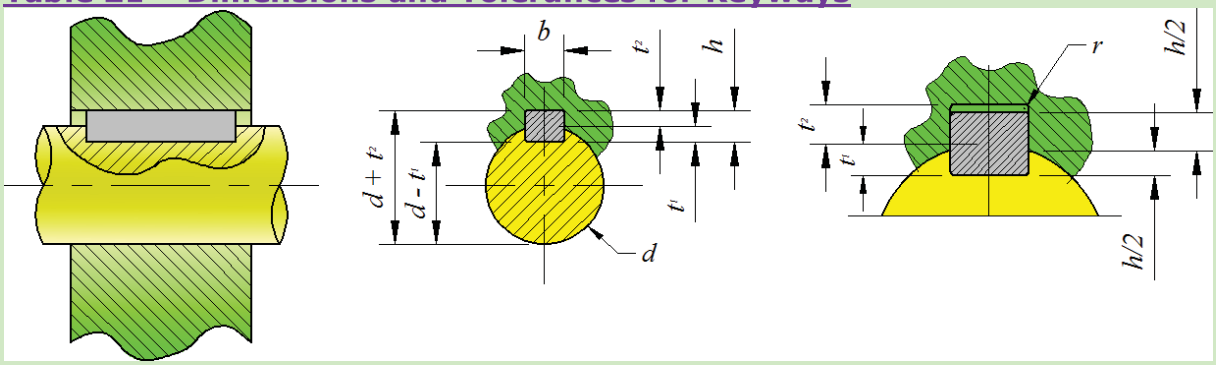
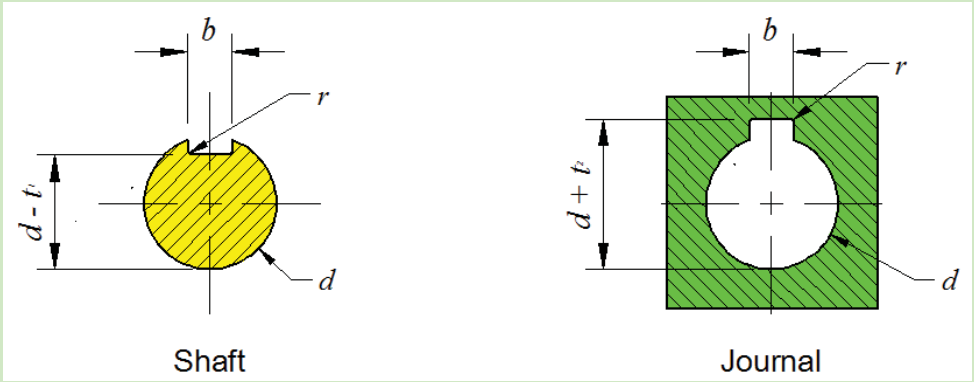
Symbol	Designation	Example
=	Lay parallel to the line representing the surface to which the symbol is applied.	
T	Lay perpendicular to the line representing the surface to which the symbol is applied.	
X	Lay angular in both directions.	
M	Lay multidirectional.	
C	Lay approximately circular relative to the center of the surface to which the symbol is applied.	
R	Lay approximately radial relative to the centre of the surface to which the surface is applied.	
P	Lay nondirectional, pitted or protuberant.	

Table 21 – Dimensions and Tolerances for Keyways





All dimensions are in millimetres

NOTE: The relations between shaft diameter and key section given above are for general applications. The use of smaller key sections is permitted if suitable for the torque transmitted. In cases such as stepped shafts when larger diameters are required, for example to resist bending, and when fans, gears and impellers are fitted with a smaller key than nominal, an unequal disposition of key in shaft with relation to the hub results. Therefore, dimension $d - t_1$ and $d + t_2$ should be recalculated to maintain the $h/2$ relationship. The use of larger key sections is not permitted.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Shaft		Key	Keyway											
nom dia see note *d*		Section *b x h* Width x thickness	Tolerance for class of fit						depth				radius	
			nom	free		normal		close	shaft t_1		hub t_2		r	
				shaft (H9)	hub (D10)	shaft (N9)	Hub (J9)*	shaft & Hub (F9)	Nom	Tol	nom	tol	max	min
6	8	2 x 2	2	+0.025	+0.060	-0.004	+0.012	-0.006	1.2		1		0.16	0.08
8	10	3 x 3	3	0	+0.020	-0.029	-0.012	-0.031	1.8		1.4		0.16	0.08
10	12	4 x 4	4	+0.030	+0.078	0	+0.015	-0.012	2.5	+0.1	1.8	+0.1	0.16	0.08
12	17	5 x 5	5	0	+0.030	-0.030	-0.015	-0.042	3	0	2.3	0	0.25	0.16
17	22	6 x 6	6						3.5		2.8		0.25	0.16
22	30	8 x 7	8	+0.036	+0.098	0	+0.018	-0.015	4		3.3		0.25	0.16
30	38	10 x 8	10	0	+0.040	-0.036	-0.018	-0.051	5		3.3		0.40	0.25
38	44	12 x 8	12						5		3.3		0.40	0.25
44	50	14 x 9	14	+0.043	+0.120	0	+0.021	-0.018	5.5		3.8		0.40	0.25
50	58	16 x 10	16	0	+0.050	-0.043	-0.021	-0.061	6	+0.2	4.3	+0.2	0.40	0.25
58	65	18 x 11	18						7	0	4.4	0	0.40	0.25
65	75	20 x 12	20						7.5		4.9		0.60	0.40
75	85	22 x 14	22	+0.052	+0.149	0	+0.026	-0.022	9		5.4		0.60	0.40
85	95	25 x 14	25	0	+0.065	-0.052	-0.026	-0.074	9		5.4		0.60	0.40
95	110	28 x 16	28						10		6.4		0.60	0.40

Tables

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Shaft		Key	Keyway											
nom dia see note *d*		Section *b x h* Width x thickness	Tolerance for class of fit						depth				radius	
			nom	free		normal		close	shaft t_1		hub t_2		r	
				shaft (H9)	hub (D10)	shaft (N9)	Hub (J9)*	shaft & Hub (F9)	Nom	Tol	nom	tol	max	min
110	130	32 x 18	32						11		7.4		0.60	0.40
130	150	36 x 20	36	+0.062	+0.180	0	+0.031	-0.026	12		8.4		1.00	0.70
150	170	40 x 22	40	0	+0.080	-0.062	-0.031	-0.088	13		9.4		1.00	0.70
170	200	45 x 25	45						15		10.4		1.00	0.70
200	230	50 x 28	50						17		11.4		1.00	0.70
230	260	56 x 32	56						20	+0.3	12.4	+0.3	1.60	1.20
260	290	63 x 32	63	+0.074	+0.220	0	+0.037	-0.032	20	0	12.4	0	1.60	1.20
290	330	70 x 36	70	0	+0.100	-0.074	-0.037	-0.106	22		14.4		1.60	1.20
330	380	80 x 40	80						25		15.4		2.50	2.00
380	440	90 x 45	90	+0.087	+0.260	0	+0.043	-0.037	28		17.4		2.50	2.00
440	500	100 x 50	100	0	+0.120	-0.087	-0.043	-0.124	31		19.5		2.50	2.00