

# Determining Metric Tolerances

**Table 1: Description of Preferred Fits**

Table 1 is pulled from the ANSI metric tolerances section of the machinists' handbook, which conforms to the ISO and DIN tolerances for hole basis and shaft basis fits. Table 1 provides an overview of the hole basis and shaft basis fits that make up clearance fit, transition fit and interference fit combinations.

	ISO SYMBOL			
	HOLE BASIS	SHAFT BASIS		
CLEARANCE FITS	H11/c11	C11/h11	LOOSE RUNNING FIT	FOR WIDE COMMERCIAL TOLERANCES OR ALLOWANCES ON EXTERNAL MEMBERS.
	H9/d9	D9/h9	FREE RUNNING FIT	NOT FOR USE WHERE ACCURACY IS ESSENTIAL, BUT GOOD FOR LARGE TEMPERATURE VARIATIONS, HIGH RUNNING SPEEDS, OR HEAVY JOURNAL PRESSURES.
	H8/f7	F8/h7	CLOSE RUNNING FIT	FOR RUNNING ON ACCURATE MACHINES AND FOR ACCURATE LOCATION AT MODERATE SPEEDS AND JOURNAL PRESSURES.
	H7/g6	G7/h6	SLIDING FIT	NOT INTENDED TO RUN FREELY, BUT TO MOVE AND TURN FREELY AND LOCATE ACCURATELY.
	H7/h6	H7/h6	LOCATIONAL CLEARANCE FIT	PROVIDES SNUG FIT FOR LOCATING STATIONARY PARTS; BUT CAN BE FREELY ASSEMBLED AND DISASSEMBLED.
TRANSITION FITS	H7/k6	K7/h6	LOCATIONAL TRANSITION FIT	FOR ACCURATE LOCATION, A COMPROMISE BETWEEN CLEARANCE AND INTERFERENCE.
	H7/n6	N7/h6	LOCATIONAL TRANSITION FIT	FOR MORE ACCURATE LOCATION WHERE GREATER INTERFERENCE IS PERMISSIBLE.
INTERFERENCE FITS	H7/p6*	P7/h6	LOCATIONAL INTERFERENCE FIT	FOR PARTS REQUIRING RIGIDITY AND ALIGNMENT WITH PRIME ACCURACY OF LOCATION BUT WITHOUT SPECIAL BORE PRESSURE REQUIREMENTS.
	H7/s6	S7/h6	MEDIUM DRIVE FIT	FOR ORDINARY STEEL PARTS OR SHRINK FITS ON LIGHT SECTIONS, THE TIGHTEST FIT USABLE WITH CAST IRON.
	H7/u6	U7/h6	FORCE FIT	SUITABLE FOR PARTS WHICH CAN BE HIGHLY STRESSED OR FOR SHRINK FITS WHERE THE HEAVY PRESSING FORCES REQUIRED ARE IMPRACTICAL.

Excerpt from *Machinists' Handbook*, pg. 661, 25 Ed., Industrial Press.  
 \*The H7/p6 Hole Basis fit is a transition fit for basic sizes in ranges from 0 through 3mm.

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**Table 2: Commonly used Hole-Basis System of fits**

Table 2 shows closer detail on the hole-basis system of fits than Table 1. When using the hole-basis system of fits, the smallest diameter in the hole tolerance range is fixed to the zero line (basic nominal hole size or diameter), and the clearance between the shaft and hole extends below the zero line, or negative relative to the basic nominal hole size.

BASIC HOLES	LETTER SYMBOLS AND GRADE NUMBERS OF SHAFTS																
	CLEARANCE FITS						TRANSITION FITS				INTERFERENCE FITS						
	b	c	d	e	f	g	h	js	k	m	n	p	f	s	t	u	x
H5						4	4	4	4	4							
H6						5	5	5	5	5							
					6	6	6	6	6	6	6*	6*					
H7				6	6	6	6	6	6	6	6	6*	6*	6	6	6	6
				7	7	7	7	7	7	7	7	7*	7*	7	7	7	7
					7		7										
H8				8	8		8										
			9	9													
H9			8	8			8										
		9	9	9			9										
H10	9	9	9														

\*Exceptions occur in some steps of dimensions.

**Table 3: Commonly used Shaft-Basis System of fits**

Table 3 shows closer detail on the shaft-basis system of fits than Table 1. When using the shaft-basis system of fits, the largest diameter in the shaft tolerance range is fixed to the zero line (basic nominal shaft size or diameter), and the clearance between the shaft and hole extends above the zero line, or positive relative to the basic shaft size.

BASIC SHAFTS	LETTER SYMBOLS AND GRADE NUMBERS OF HOLES																
	CLEARANCE FITS						TRANSITION FITS				INTERFERENCE FITS						
	B	C	D	E	F	G	H	Js	K	M	N	P	F	S	T	U	X
h5							5	5	5	5							
h6							6	6	6	6	6*	6					
					6	6	6	6	6	6	6	6*					
h7				7	7	7	7	7	7	7	7	7*	7	7	7	7	7
				7	7	7	7	7	7	7	7	7	7*	7			
					8		8										
h8			8	8	8		8										
			9	9			9										
h9			8	8			8										
		9	9	9			9										
h10	10	10	10														

\*Exceptions occur in some steps of dimensions.

# Determining Metric Tolerances

**Table 4: IT Standard Tolerances**

Table 4 details the ISO-basic tolerances (International Tolerance Grades, or, "IT") which apply to all linear sizes (external and internal sizes, diameters, lengths, widths and thicknesses). An IT-grade number establishes the magnitude of the tolerance zone, while the tolerance position letter determines where the tolerance zone is in relation to the zero line. The combination of tolerance position letter (A-X, a-x) and IT-grade number (01-8) creates the overall tolerance symbol (i.e., F8/h7 when using the shaft-basis system of fits).

For nominal size range up to 500mm according to DIN 7151/ISO 286, and for nominal size range over 500mm, according to DIN 7172/ISO 286.

ITEMS IN MM		IT STANDARD TOLERANCES (UNITS IN 0.001MM)																			
OVER	TO	IT01	IT0	IT1	IT2	IT3	IT4	IT5	IT6	IT7	IT8	IT9	IT10	IT11	IT12	IT13	IT14	IT15	IT16	IT17	IT18
0	3	0.3	0.5	0.8	1.2	2	3	4	6	10	14	25	40	60	100	140	250	400	600	—	—
3	6	0.4	0.6	1	1.5	2.5	4	5	8	12	18	30	48	75	120	180	300	480	750	—	—
6	10	0.4	0.6	1	1.5	2.5	4	6	9	15	22	36	58	90	150	220	360	580	900	1500	—
10	18	0.5	0.8	1.2	2	3	5	8	11	18	27	43	70	110	180	270	430	700	1100	1800	2700
18	30	0.6	1	1.5	2.5	4	6	9	13	21	33	52	84	130	210	330	520	840	1300	2100	3300
30	50	0.6	1	1.5	2.5	4	7	11	16	25	39	62	100	160	250	390	620	1000	1600	2500	3900
50	80	0.8	1.2	2	3	5	8	13	19	30	46	74	120	190	300	460	740	1200	1900	3000	4600
80	120	1	1.5	2.5	4	6	10	15	22	35	54	87	140	220	350	540	870	1400	2200	3500	5400
120	180	1.2	2	3.5	5	8	12	18	25	40	63	100	160	250	400	630	1000	1600	2500	4000	6300
180	250	2	3	4.5	7	10	14	20	29	46	72	115	185	290	460	720	1150	1850	2900	4600	7200
250	315	2.5	4	6	8	12	16	23	32	52	81	130	210	320	520	810	1300	2100	3200	5200	8100
315	400	3	5	7	9	13	18	25	36	57	89	140	230	360	570	890	1400	2300	3600	5700	8900
400	500	4	6	8	10	15	20	27	40	63	97	155	250	400	630	970	1550	2500	4000	6300	9700
500	630	4.5	6	9	11	16	22	30	44	70	110	175	280	440	700	1100	1750	2800	4400	—	—
630	800	5	7	10	13	18	25	35	50	80	125	200	320	500	800	1250	2000	3200	5000	—	—
800	1000	5.5	8	11	15	21	29	40	56	90	140	230	360	560	900	1400	2300	3600	5600	—	—

NOMINAL SIZE RANGE

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**Table 5: Fundamental deviations of holes and shafts**

Table 5 details fundamental deviations between holes and shafts, and is provided for reference.

HOLES	GRADE		IT6 TO IT16													
	DIVISIONS		FUNDAMENTAL DEVIATIONS (LOWER DEVIATIONS)					Js	FUNDAMENTAL DEVIATIONS (UPPER DEVIATIONS)							
	LETTER SYMBOLS		D	E	F	G	H		K	M	N	P	R	S	T	U
	SIGNS		+	+	+	+			-	-	-	-	-	-	-	
ABOVE	UP TO															
500	560	260	145	76	22	0	DEVIATIONS (+/-) IT/2	0	26	44	78	150	280	400	600	
560	630											155	310	450	660	
630	710	290	160	80	24	0		0	30	50	88	175	340	500	740	
710	800											185	380	560	840	
800	900	320	170	86	26	0		0	34	56	100	210	430	620	940	
900	1000											220	470	680	1050	
1000	1120	350	195	98	28	0		0	40	66	120	250	520	780	1150	
1120	1250											260	580	840	1300	
1250	1400	390	220	110	30	0		0	48	78	140	300	640	960	1450	
1400	1600											330	720	1050	1600	
1600	1800	430	240	120	32	0		0	58	92	170	370	820	1200	1850	
1800	2000											400	920	1350	2000	
2000	2240	480	260	130	34	0		0	68	110	195	440	1000	1500	2300	
2240	2500											460	1100	1650	2500	
2500	2800	520	290	145	38	0		0	76	135	240	550	1250	1900	2900	
2800	3150											580	1400	2100	3200	
ABOVE	UP TO															
SIGNS		-	-	-	-			+	+	+	+	+	+	+		
LETTER SYMBOLS		d	e	f	g	h	js	k	m	n	p	r	s	t	u	
DIVISIONS		FUNDAMENTAL DEVIATIONS (UPPER DEVIATIONS)					FUNDAMENTAL DEVIATIONS (LOWER DEVIATIONS)									
GRADE		IT6 TO IT16														

# Determining Metric Tolerances

**Table 6: Tolerances for inside dimensions (holes)**

Table 6 details tolerances for inside dimensions (holes) based relative to the tolerance symbol. Upper and lower values are provided as either positive or negative (or zero) values relative to the nominal size chosen. Pick the range in which the desired nominal value falls into, and then either add or subtract the tolerances to find the upper and lower tolerance range for the desired nominal size.

UNITS IN MM		TOLERANCES FOR INSIDE DIMENSIONS (HOLES) (UNITS IN 0.001MM)																				
OVER	TO	A11	B8	B11	C11	D9	D10	D11	E8	E9	F6	F7	F8	G6	G7	H5	H6	H7	H8	H9	H10	
0	1	—	—	—		+120	+45	+60	+80	+28	+39	+12	+16	+20	+8	+12	+4	+6	+10	+14	+25	+40
1	3	+330 +270	+154 +140	+200 +140		+60	+20	+20	+20	+14	+14	+6	+6	+6	+2	+2	0	0	0	0	0	0
3	6	+345 +270	+158 +140	+215 +140	+145 +70	+60 +30	+78 +30	+105 30	+38 +20	+50 +20	+18 +10	+22 +10	+28 +10	+12 +4	+16 +4	+5 0	+8 0	+12 0	+18 0	+30 0	+48 0	
6	10	+370 +280	+172 +150	+240 +150	+170 +80	+76 +40	+98 +40	+130 +40	+47 +25	+61 +25	+22 +13	+28 +13	+35 +13	+14 +5	+20 +5	+6 0	+9 0	+15 0	+22 0	+36 0	+58 0	
10	14	+400	+177	+260	+205	+93	+120	+160	+59	+75	+27	+34	+43	+17	+24	+8	+11	+18	+27	+43	+70	
14	18	+290	+150	+150	+95	+50	+50	+50	+32	+32	+16	+16	+16	+6	+6	0	0	0	0	0	0	
18	24	+430	+193	+290	+240	+117	+149	+195	+73	+92	+33	+41	+53	+20	+28	+9	+13	+21	+33	+52	+84	
24	30	+300	+160	+160	+110	+65	+65	+65	+40	+40	+20	+20	+20	+7	+7	0	0	0	0	0	0	
30	40	+470 +310	+209 +170	+330 +170	+280 +120	+142	+180	+240	+89	+112	+41	+50	+64	+25	+34	+11	+16	+25	+39	+62	+100	
40	50	+480 +320	+219 +180	+340 +180	+290 +130	+80	+80	+80	+50	+50	+25	+25	+25	+9	+9	0	0	0	0	0	0	
50	65	+530 +340	+236 +190	+380 +190	+330 +140	+174	+220	+290	+106	+134	+49	+60	+76	+29	+40	+13	+19	+30	+46	+74	+120	
65	80	+550 +360	+246 +200	+390 +200	+340 +150	+100	+100	+100	+60	+60	+30	+30	+30	+10	+10	0	0	0	0	0	0	
80	100	+600 +380	+274 +220	+440 +220	+390 +170	+207	+260	+340	+126	+159	+58	+71	+90	+34	+47	+15	+22	+35	+54	+87	+140	
100	120	+630 +410	+294 +240	+460 +240	+400 +180	+120	+120	+120	+72	+72	+36	+36	+36	+12	+12	0	0	0	0	0	0	
120	140	+710 +460	+323 +260	+510 +260	+450 +200																	
140	160	+770 +520	+343 +280	+530 +280	+460 +210	+245	+305	+395	+148	+185	+68	+83	+106	+39	+54	+18	+25	+40	+63	+100	+160	
160	180	+830 +580	+373 +310	+560 +310	+480 +230	+145	+145	+145	+85	+85	+43	+43	+43	+14	+14	0	0	0	0	0	0	
180	200	+950 +660	+412 +340	+630 +340	+530 +240																	
200	225	+1030 +740	+452 +380	+670 +380	+550 +260	+285	+355	+460	+172	+215	+79	+96	+122	+44	+61	+20	+29	+46	+72	+115	+185	
225	250	+1110 +820	+492 +420	+710 +420	+570 +280	+170	+170	+170	+100	+100	+50	+50	+50	+15	+15	0	0	0	0	0	0	
250	280	+1240 +920	+561 +480	+800 +480	+620 +300	+320	+400	+510	+191	+240	+88	+108	+137	+49	+69	+23	+32	+52	+81	+130	+210	
280	315	+1370 +1050	+621 +540	+860 +540	+650 +330	+190	+190	+190	+110	+110	+56	+56	+56	+17	+17	0	0	0	0	0	0	
315	355	+1560 +1200	+689 +600	+960 +600	+720 +360	+350	+440	+570	+214	+265	+98	+119	+151	+54	+75	+25	+36	+57	+89	+140	+230	
355	400	+1710 +1350	+769 +680	+1040 +680	+760 +400	+210	+210	+210	+125	+125	+62	+62	+62	+18	+18	0	0	0	0	0	0	
400	450	+1900 +1500	+857 +760	+1160 +760	+840 +440	+385	+480	+630	+232	+290	+108	+131	+165	+60	+83	+27	+40	+63	+97	+155	+250	
450	500	+2050 +1650	+937 +840	+1240 +840	+880 +480	+230	+230	+230	+135	+135	+68	+68	+68	+20	+20	0	0	0	0	0	0	

NOMINAL SIZE RANGE

Technical Reference | Determining Metric Tolerances

# Determining Metric Tolerances

Table 6: Tolerances for inside dimensions (holes) — continued

UNITS IN MM		TOLERANCES FOR INSIDE DIMENSIONS (HOLES) (UNITS IN 0.001MM)																			
OVER	TO	H11	H12	H13	J6	J7	J8	K6	K7	K8	M6	M7	M8	N6	N7	N8	R7	JS6	JS7	JS8	JS9
0	1	+60	+100	+140	+2	+4	+6	0	0	0	-2	-2	-2	-4	-4	-4	-10	+3	+5	+7	+12.5
1	3	0	0	0	-4	-6	-8	-6	-10	-14	-8	-12	-16	-10	-14	-18	-20	-3	-5	-7	-12.5
3	6	+75	+120	+180	+5	+6	+10	+2	+3	+5	-1	0	+2	-5	-4	-2	-11	+4	+6	+9	+15
		0	0	0	-3	-6	-8	-6	-9	-13	-9	-12	-16	-13	-16	-20	-23	-4	-6	-9	-15
6	10	+90	+150	+220	+5	+8	+12	+2	+5	+6	-3	0	+1	-7	-4	-3	-13	+4.5	+7.5	+11	+18
		0	0	0	-4	-7	-10	-7	-10	-16	-12	-15	-21	-16	-19	-25	-28	-4.5	-7.5	-11	-18
10	14	+110	+180	+270	+6	+10	+15	+2	+6	+8	-4	0	+2	-9	-5	-3	-16	+5.5	+9	+13.5	+21.5
14	18	0	0	0	-5	-8	-12	-9	-12	-19	-15	-18	-25	-20	-23	-30	-34	-5.5	-9	-13.5	-21.5
18	24	+130	+210	+330	+8	+12	+20	+2	+6	+10	-4	0	+4	-11	-7	-3	-20	+6.5	+10.5	+16.5	+26
24	30	0	0	0	-5	-9	-13	-11	-15	-23	-17	-21	-29	-24	-28	-36	-41	-6.5	-10.5	-16.5	-26
30	40	+160	+250	+390	+10	+14	+24	+3	+7	+12	-4	0	+5	-12	-8	-3	-25	+8	+12.5	+19.5	+31
40	50	0	0	0	-6	-11	-15	-13	-18	-27	-20	-25	-34	-28	-33	-42	-50	-8	-12.5	-19.5	-31
50	65	+190	+300	+460	+13	+18	+28	+4	+9	+14	-5	0	+5	-14	-9	-4	-30	+9.5	+15	+23	+37
		0	0	0	-6	-12	-18	-15	-21	-32	-24	-30	-41	-33	-39	-50	-60	-9.5	-15	-23	-37
65	80																	-32			
																		-62			
80	100	+220	+350	+540	+16	+22	+34	+4	+10	+16	-6	0	+6	-16	-10	-4	-38	+11	+17.5	+27	+43.5
		0	0	0	-6	-13	-20	-18	-25	-38	-28	-35	-48	-38	-45	-58	-73	-11	-17.5	-27	-43.5
100	120																	-41			
																		-76			
120	140																	-48			
																		-88			
140	160	+250	+400	+630	+18	+26	+41	+4	+12	+20	-8	0	+8	-20	-12	-4	-50	+12.5	+20	+31.5	+50
		0	0	0	-7	-14	-22	-21	-28	-43	-33	-40	-55	-45	-52	-67	-90	-12.5	-20	-31.5	-50
160	180																	-53			
																		-93			
180	200																	-60			
																		-106			
200	225	+290	+460	+720	+22	+30	+47	+5	+13	+22	-8	0	+9	-22	-14	-5	-63	+14.5	+23	+36	+57.5
		0	0	0	-7	-16	-25	-24	-33	-50	-37	-46	-63	-51	-60	-77	-109	-14.5	-23	-36	-57.5
225	250																	-67			
																		-113			
250	280	+320	+520	+810	+25	+36	+55	+5	+16	+25	-9	0	+9	-25	-14	-5	-74	+16	+26	+40.5	+65
		0	0	0	-7	-16	-26	-27	-36	-56	-41	-52	-72	-57	-66	-86	-126	-16	-26	-40.5	-65
280	315																	-78			
																		-130			
315	355	+360	+570	+890	+29	+39	+60	+7	+17	+28	-10	0	+11	-26	-16	-5	-87	+18	+28.5	+44.5	+70
		0	0	0	-7	-18	-29	-29	-40	-61	-46	-57	-78	-62	-73	-94	-144	-18	-28.5	-44.5	-70
355	400																	-93			
																		-150			
400	450	+400	+630	+970	+33	+43	+66	+8	+18	+29	-10	0	+11	-27	-17	-6	-103	+20	+31.5	+48.5	+77.5
		0	0	0	-7	-20	-31	-32	-45	-68	-50	-63	-86	-67	-80	-103	-166	-20	-31.5	-48.5	-77.5
450	500																	-109			
																		-172			

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Table 6: Tolerances for inside dimensions (holes) — continued

UNITS IN MM		TOLERANCES FOR INSIDE DIMENSIONS (HOLES) (UNITS IN 0.001MM)									
OVER	TO	JS10	JS11	JS12	JS13	JS14	JS15	JS16	JS17	JS18	
NOMINAL SIZE RANGE	0	1	+20	+30	+50	+70	+125	+200	+300	—	—
	1	3	-20	-30	-50	-70	-125	-200	-300	—	—
	3	6	+24	+37.5	+60	+90	+150	+240	+375	—	—
			-24	-37.5	-60	-90	-150	-240	-375	—	—
	6	10	+29	+45	+75	+110	+180	+290	+450	+750	—
			-29	-45	-75	-110	-180	-290	-450	-750	—
	10	14	+35	+55	+90	+135	+215	+350	+550	+900	+1350
	14	18	-35	-55	-90	-135	-215	-350	-550	-900	-1350
	18	24	+42	+65	+105	+165	+260	+420	+650	+1050	+1650
	24	30	-42	-65	-105	-165	-260	-420	-650	-1050	-1650
	30	40	+50	+80	+125	+195	+310	+500	+800	+1250	+1950
	40	50	-50	-80	-125	-195	-310	-500	-800	-1250	-1950
	50	65	+60	+95	+150	+230	+370	+600	+950	+1500	+2300
	65	80	-60	-95	-150	-230	-370	-600	-950	-1500	-2300
	80	100	+70	+110	+175	+270	+435	+700	+1100	+1750	+2700
	100	120	-70	-110	-175	-270	-435	-700	-1100	-1750	-2700
	120	140	+80	+125	+200	+315	+500	+800	+1250	+2000	+3150
	140	160	-80	-125	-200	-315	-500	-800	-1250	-2000	-3150
	160	180									
	180	200	+92.5	+145	+230	+360	+575	+925	+1450	+2300	+3600
200	225	-92.5	-145	-230	-360	-575	-925	-1450	-2300	-3600	
225	250										
250	280	+105	+160	+260	+405	+650	+1050	+1600	+2600	+4050	
280	315	-105	-160	-260	-405	-650	-1050	-1600	-2600	-4050	
315	355	+115	+180	+285	+445	+700	+1150	+1800	+2850	+4450	
355	400	-115	-180	-285	-445	-700	-1150	-1800	-2850	-4450	
400	450	+125	+200	+315	+485	+775	+1250	+2000	+3150	+4850	
450	500	-125	-200	-315	-485	-775	-1250	-2000	-3150	-4850	

# Determining Metric Tolerances

**Table 7: Tolerances for outside dimensions (shafts)**

Table 7 details tolerances for outside dimensions (shafts) based relative to the tolerance symbol. Upper and lower values are provided as either positive or negative (or zero) values relative to the nominal size chosen. Pick the range in which the desired nominal value fall into, and then either add or subtract the tolerances to find the upper and lower tolerance range for the desired nominal size.

UNITS IN MM		TOLERANCES FOR OUTSIDE DIMENSIONS (SHAFTS) (UNITS IN 0.001MM)																				
OVER	TO	a11	b8	b11	c11	d9	d10	d11	e7	e8	e9	f6	f7	f8	f9	g5	g6	g7	h4	h5	h6	h7
0	1	—	—	—	-60	-20	-20	-20	-14	-14	-14	-6	-6	-6	-6	-2	-2	-2	0	0	0	0
1	3	-270 -330	-140 -154	-140 -200	-120	-45	-60	-80	-24	-28	-39	-12	-16	-20	-31	-6	-8	-12	-3	-4	-6	-10
3	6	-270 -345	-140 -158	-140 -215	-70 -145	-30 -60	-30 -78	-30 -105	-20 -32	-20 -38	-20 -50	-10 -18	-10 -22	-10 -28	-10 -40	-4 -9	-4 -12	-4 -16	0 -4	0 -5	0 -8	0 -12
6	10	-280 -370	-150 -172	-150 -240	-80 -170	-40 -76	-40 -98	-40 -130	-25 -40	-25 -47	-25 -61	-13 -22	-13 -28	-13 -35	-13 -49	-5 -11	-5 -14	-5 -20	0 -4	0 -6	0 -9	0 -15
10	14	-290 -400	-150 -177	-150 -260	-95 -205	-50 -93	-50 -120	-50 -160	-32 -50	-32 -59	-32 -75	-16 -27	-16 -34	-16 -43	-16 -59	-6 -14	-6 -17	-6 -24	0 -5	0 -8	0 -11	0 -18
14	18	-300 -430	-160 -193	-160 -290	-110 -240	-65 -117	-65 -149	-65 -195	-40 -61	-40 -73	-40 -92	-20 -33	-20 -41	-20 -53	-20 -72	-7 -16	-7 -20	-7 -28	0 -6	0 -9	0 -13	0 -21
18	24	-310 -470	-170 -209	-170 -330	-120 -280	-80 -142	-80 -180	-80 -240	-50 -75	-50 -89	-50 -112	-25 -41	-25 -50	-25 -64	-25 -87	-9 -20	-9 -25	-9 -34	0 -7	0 -11	0 -16	0 -25
30	40	-320 -480	-180 -219	-180 -340	-130 -290	-100 -174	-100 -220	-100 -290	-60 -90	-60 -106	-60 -134	-30 -49	-30 -60	-30 -76	-30 -104	-10 -23	-10 -29	-10 -40	0 -8	0 -13	0 -19	0 -30
40	50	-340 -530	-190 -236	-190 -380	-140 -330	-120 -207	-120 -260	-120 -340	-72 -107	-72 -126	-72 -159	-36 -58	-36 -71	-36 -90	-36 -123	-12 -27	-12 -34	-12 -47	0 -10	0 -15	0 -22	0 -35
50	65	-360 -550	-200 -246	-200 -390	-150 -340	-145 -245	-145 -305	-145 -395	-85 -125	-85 -148	-85 -185	-43 -68	-43 -83	-43 -106	-43 -143	-14 -32	-14 -39	-14 -54	0 -12	0 -18	0 -25	0 -40
65	80	-380 -600	-220 -274	-220 -440	-170 -390	-170 -285	-170 -355	-170 -460	-100 -146	-100 -172	-100 -215	-50 -79	-50 -96	-50 -122	-50 -165	-15 -35	-15 -44	-15 -61	0 -14	0 -20	0 -29	0 -46
80	100	-410 -630	-240 -294	-240 -460	-180 -400	-190 -320	-190 -400	-190 -510	-110 -162	-110 -191	-110 -240	-56 -88	-56 -108	-56 -137	-56 -186	-17 -40	-17 -49	-17 -69	0 -16	0 -23	0 -32	0 -52
100	120	-460 -710	-260 -323	-260 -510	-200 -450	-210 -330	-210 -440	-210 -570	-125 -182	-125 -214	-125 -265	-62 -98	-62 -119	-62 -151	-62 -202	-18 -43	-18 -54	-18 -75	0 -18	0 -25	0 -36	0 -57
120	140	-520 -770	-280 -343	-280 -530	-210 -460	-210 -350	-210 -440	-210 -570	-125 -182	-125 -214	-125 -265	-62 -98	-62 -119	-62 -151	-62 -202	-18 -43	-18 -54	-18 -75	0 -18	0 -25	0 -36	0 -57
140	160	-580 -830	-310 -373	-310 -560	-230 -480	-230 -350	-230 -440	-230 -570	-135 -198	-135 -232	-135 -290	-68 -108	-68 -131	-68 -165	-68 -223	-20 -47	-20 -60	-20 -83	0 -20	0 -27	0 -40	0 -63
160	180	-660 -950	-340 -412	-340 -630	-240 -530	-230 -350	-230 -440	-230 -570	-135 -198	-135 -232	-135 -290	-68 -108	-68 -131	-68 -165	-68 -223	-20 -47	-20 -60	-20 -83	0 -20	0 -27	0 -40	0 -63
180	200	-740 -1030	-380 -452	-380 -670	-260 -550	-230 -350	-230 -440	-230 -570	-135 -198	-135 -232	-135 -290	-68 -108	-68 -131	-68 -165	-68 -223	-20 -47	-20 -60	-20 -83	0 -20	0 -27	0 -40	0 -63
200	225	-820 -1110	-420 -492	-420 -710	-280 -570	-230 -350	-230 -440	-230 -570	-135 -198	-135 -232	-135 -290	-68 -108	-68 -131	-68 -165	-68 -223	-20 -47	-20 -60	-20 -83	0 -20	0 -27	0 -40	0 -63
225	250	-920 -1240	-480 -561	-480 -800	-300 -620	-230 -350	-230 -440	-230 -570	-135 -198	-135 -232	-135 -290	-68 -108	-68 -131	-68 -165	-68 -223	-20 -47	-20 -60	-20 -83	0 -20	0 -27	0 -40	0 -63
250	280	-1050 -1370	-540 -621	-540 -860	-330 -650	-230 -350	-230 -440	-230 -570	-135 -198	-135 -232	-135 -290	-68 -108	-68 -131	-68 -165	-68 -223	-20 -47	-20 -60	-20 -83	0 -20	0 -27	0 -40	0 -63
280	315	-1200 -1560	-600 -689	-600 -960	-360 -720	-230 -350	-230 -440	-230 -570	-135 -198	-135 -232	-135 -290	-68 -108	-68 -131	-68 -165	-68 -223	-20 -47	-20 -60	-20 -83	0 -20	0 -27	0 -40	0 -63
315	355	-1350 -1710	-680 -769	-680 -1040	-400 -760	-230 -350	-230 -440	-230 -570	-135 -198	-135 -232	-135 -290	-68 -108	-68 -131	-68 -165	-68 -223	-20 -47	-20 -60	-20 -83	0 -20	0 -27	0 -40	0 -63
355	400	-1500 -1900	-760 -857	-760 -1160	-440 -840	-230 -350	-230 -440	-230 -570	-135 -198	-135 -232	-135 -290	-68 -108	-68 -131	-68 -165	-68 -223	-20 -47	-20 -60	-20 -83	0 -20	0 -27	0 -40	0 -63
400	450	-1650 -2050	-840 -937	-840 -1240	-480 -880	-230 -350	-230 -440	-230 -570	-135 -198	-135 -232	-135 -290	-68 -108	-68 -131	-68 -165	-68 -223	-20 -47	-20 -60	-20 -83	0 -20	0 -27	0 -40	0 -63
450	500	-1800 -2200	-920 -1017	-920 -1320	-520 -920	-230 -350	-230 -440	-230 -570	-135 -198	-135 -232	-135 -290	-68 -108	-68 -131	-68 -165	-68 -223	-20 -47	-20 -60	-20 -83	0 -20	0 -27	0 -40	0 -63



# Determining Metric Tolerances

Table 7: Tolerances for outside dimensions (shafts) — continued

UNITS IN MM		TOLERANCES FOR OUTSIDE DIMENSIONS (SHAFTS) (UNITS IN 0.001MM)																			
OVER	TO	h8	h9	h10	h11	j5	j6	j7	k5	k6	k7	k8	m5	m6	m7	n5	n6	n7	r6	js6	js7
0	1	0	0	0	0	+2	+4	+6	+4	+6	+10	+14	+6	+8	+12	+8	+10	+14	+16	+3	+5
1	3	-14	-25	-40	-60	-2	-2	-4	0	0	0	0	+2	+2	+2	+4	+4	+4	+10	-3	-5
3	6	0	0	0	0	+3	+6	+8	+6	+9	+13	+18	+9	+12	+16	+13	+16	+20	+23	+4	+6
		-18	-30	-48	-75	-2	-2	-4	+1	+1	+1	0	+4	+4	+4	+8	+8	+8	+15	-4	-6
6	10	0	0	0	0	+4	+7	+10	+7	+10	+16	+22	+12	+15	+21	+16	+19	+25	+28	+4.5	+7.5
		-22	-36	-58	-90	-2	-2	-5	+1	+1	+1	0	+6	+6	+6	+10	+10	+10	+19	-4.5	-7.5
10	14	0	0	0	0	+5	+8	+12	+9	+12	+19	+27	+15	+18	+25	+20	+23	+30	+34	+5.5	+9
14	18	-27	-43	-70	-110	-3	-3	-6	+1	+1	+1	0	+7	+7	+7	+12	+12	+12	+23	-5.5	-9
18	24	0	0	0	0	+5	+9	+13	+11	+15	+23	+33	+17	+21	+29	+24	+28	+36	+41	+6.5	+10.5
24	30	-33	-52	-84	-130	-4	-4	-8	+2	+2	+2	0	+8	+8	+8	+15	+15	+15	+28	-6.5	-10.5
30	40	0	0	0	0	+6	+11	+15	+13	+18	+27	+39	+20	+25	+34	+28	+33	+42	+50	+8	+12.5
40	50	-39	-62	-100	-160	-5	-5	-10	+2	+2	+2	0	+9	+9	+9	+17	+17	+17	+34	-8	-12.5
50	65	0	0	0	0	+6	+12	+18	+15	+21	+32	+46	+24	+30	+41	+33	+39	+50	+60	+9.5	+15
		-46	-74	-120	-190	-7	-7	-12	+2	+2	+2	0	+11	+11	+11	+20	+20	+20	+41	-9.5	-15
65	80																		+62		
																			+43		
80	100	0	0	0	0	+6	+13	+20	+18	+25	+38	+54	+28	+35	+48	+38	+45	+58	+73	+11	+17.5
		-54	-87	-140	-220	-9	-9	-15	+3	+3	+3	0	+13	+13	+13	+23	+23	+23	+51	-11	-17.5
100	120																		+76		
																			+54		
120	140																		+88		
																			+63		
140	160	0	0	0	0	+7	+14	+22	+21	+28	+43	+63	+33	+40	+55	+45	+52	+67	+90	+12.5	+20
		-63	-100	-160	-250	-11	-11	-18	+3	+3	+3	0	+15	+15	+15	+27	+27	+27	+65	-12.5	-20
160	180																		+113		
																			+84		
180	200																		+106		
																			+77		
200	225	0	0	0	0	+7	+16	+25	+24	+33	+50	+72	+37	+46	+63	+51	+60	+77	+109	+14.5	+23
		-72	-115	-185	-290	-13	-13	-21	+4	+4	+4	0	+17	+17	+17	+31	+31	+31	+80	-14.5	-23
225	250																		+113		
																			+84		
250	280	0	0	0	0	+7	+16	+26	+27	+36	+56	+81	+43	+52	+72	+57	+66	+86	+126	+16	+26
		-81	-130	-210	-320	-16	-16	-26	+4	+4	+4	0	+20	+20	+20	+34	+34	+34	+94	-16	-26
280	315																		+130		
																			+98		
315	355	0	0	0	0	+7	+18	+29	+29	+40	+61	+89	+46	+57	+78	+62	+73	+94	+144	+18	+28.5
		-89	-140	-230	-360	-18	-18	-28	+4	+4	+4	0	+21	+21	+21	+37	+37	+37	+108	-18	-28.5
355	400																		+150		
																			+114		
400	450	0	0	0	0	+7	+20	+31	+32	+45	+68	+97	+50	+63	+86	+67	+80	+103	+166	+20	+31.5
		-97	-155	-250	-400	-20	-20	-32	+5	+5	+5	0	+23	+23	+23	+40	+40	+40	+126	-20	-31.5
450	500																		+172		
																			+132		

# Determining Metric Tolerances

Table 7: Tolerances for outside dimensions (shafts) — continued

UNITS IN MM		TOLERANCES FOR OUTSIDE DIMENSIONS (SHAFTS) (UNITS IN 0.001MM)											
OVER	TO	js8	js9	js10	js11	js12	js13	js14	js15	js16	js17	js18	
NOMINAL SIZE RANGE	0	1	+7	+12.5	+20	+30	+50	+70	+125	+200	+300	—	—
	1	3	-7	-12.5	-20	-30	-50	-70	-125	-200	-300	—	—
	3	6	+9	+15	+24	+37.5	+60	+90	+150	+240	+375	—	—
			-9	-15	-24	-37.5	-60	-90	-150	-240	-375	—	—
	6	10	+11	+18	+29	+45	+75	+110	+180	+290	+450	+750	—
			-11	-18	-29	-45	-75	-110	-180	-290	-450	-750	—
	10	14	+13.5	+21.5	+35	+55	+90	+135	+215	+350	+550	+900	+1350
	14	18	-13.5	-21.5	-35	-55	-90	-135	-215	-350	-550	-900	-1350
	18	24	+16.5	+26	+42	+65	+105	+165	+260	+420	+650	+1050	+1650
	24	30	-16.5	-26	-42	-65	-105	-165	-260	-420	-650	-1050	-1650
	30	40	+19.5	+31	+50	+80	+125	+195	+310	+500	+800	+1250	+1950
	40	50	-19.5	-31	-50	-80	-125	-195	-310	-500	-800	-1250	-1950
	50	65	+23	+37	+60	+95	+150	+230	+370	+600	+950	+1500	+2300
	65	80	-23	-37	-60	-95	-150	-230	-370	-600	-950	-1500	-2300
	80	100	+27	+43.5	+70	+110	+175	+270	+435	+700	+1100	+1750	+2700
	100	120	-27	-43.5	-70	-110	-175	-270	-435	-700	-1100	-1750	-2700
	120	140	+31.5	+50	+80	+125	+200	+315	+500	+800	+1250	+2000	+3150
	140	160	-31.5	-50	-80	-125	-200	-315	-500	-800	-1250	-2000	-3150
	160	180											
	180	200											
200	225	+36	+57.5	+92.5	+145	+230	+360	+575	+925	+1450	+2300	+3600	
225	250	-36	-57.5	-92.5	-145	-230	-360	-575	-925	-1450	-2300	-3600	
250	280	+40.5	+65	+105	+160	+260	+405	+650	+1050	+1600	+2600	+4050	
280	315	-40.5	-65	-105	-160	-260	-405	-650	-1050	-1600	-2600	-4050	
315	355	+44.5	+70	+115	+180	+285	+445	+700	+1150	+1800	+2850	+4450	
355	400	-44.5	-70	-115	-180	-285	-445	-700	-1150	-1800	-2850	-4450	
400	450	+48.5	+77.5	+125	+200	+315	+485	+775	+1250	+2000	+3150	+4850	
450	500	-48.5	-77.5	-125	-200	-315	-485	-775	-1250	-2000	-3150	-4850	



# Determining Metric Tolerances

**Table 9: Tolerances for outside dimensions (shafts)**

Table 9 details tolerances for outside dimensions (shafts) based relative to the tolerance symbol. This table works the same way as Table 7, but is pulled from a different source (ANSI standards) and details s6 and u6 fits. Pick the nominal size value that is closest to the desired nominal size to determine the required tolerance range relative to the chosen tolerance symbol.

HOLE BASIS FIT		[mm]	Hole:		
Example:	Nominal size:	24	[mm]		
	Size range to be used:	18 to 30		F6	+0.033 (0.013mm range)
	ISO-Grade No.:	IT6		24	-0
	Tolerance Symbol:	F6/h6	Shaft:		
	Desired Fit:	Clearance Fit	[mm]		
This Gives:	Allowance for hole:	0.013mm		h6	0 (0.013mm range)
	Allowance for shaft:	0.013mm		24	-0.013

TOLERANCES FOR OUTSIDE DIMENSIONS (SHAFTS) (UNITS IN 0.001MM)						
NOMINAL SIZE RANGE	PICK CLOSEST VALUE TO DESIRED DIMENSION (UNITS IN MM)	s6	u6	PICK CLOSEST VALUE TO DESIRED DIMENSION (UNITS IN MM)	s6	u6
		1	+20 +14	+24 +18	25	+48 +35
	1.2	+20 +14	+24 +18	30	+48 +35	+61 +48
	1.6	+20 +14	+24 +18	40	+59 +43	+76 +60
	2	+20 +14	+24 +18	50	+59 +43	+86 +70
	2.5	+20 +14	+24 +18	60	+72 +53	+106 +87
	3	+20 +14	+24 +18	80	+78 +59	+121 +102
	4	+27 +19	+31 +23	100	+93 +71	+146 +124
	5	+27 +19	+31 +23	120	+101 +79	+166 +144
	6	+27 +19	+31 +23	160	+125 +100	+215 +190
	8	+32 +23	+37 +28	200	+151 +122	+265 +236
	10	+32 +23	+37 +28	250	+169 +140	+313 +284
	12	+39 +28	+44 +33	300	+202 +170	+382 +350
	16	+39 +28	+44 +33	400	+244 +208	+471 +435
	20	+48 +35	+54 +41	500	+292 +252	+580 +540