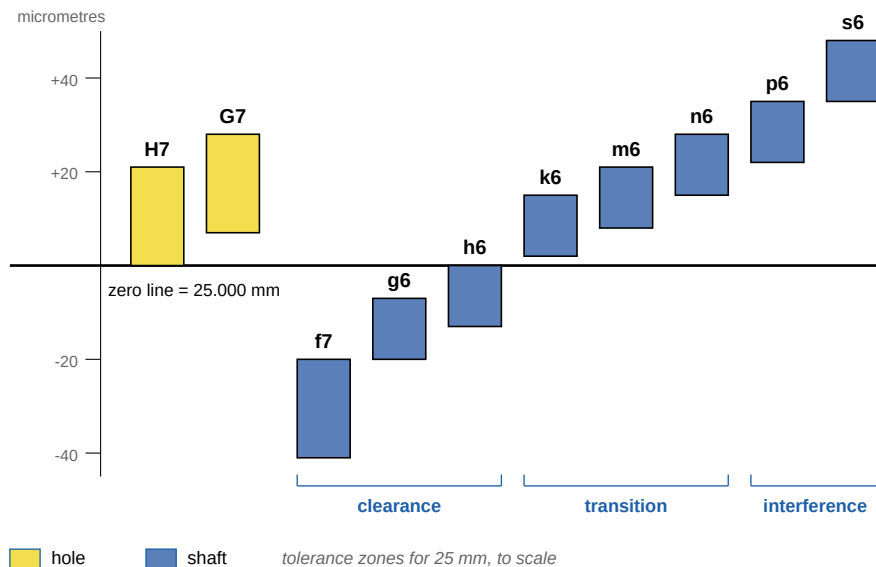


Reaming, Fits & Tolerances Chart

Choosing a fit - ISO hole basis system, what each fit feels like and where to use it.



Reading a fit: the capital letter is the hole, small letters the shaft; the number is the IT grade (the width of the band). H holes start at the nominal size and go up only.

Hole basis: ream or bore the hole to H7, then turn or grind the shaft to suit the fit you want - reamers and plug gauges come in H7, so this is the usual system.

Example - 25 H7/g6:

Hole 25.000 to 25.021 mm

Shaft 24.980 to 24.993 mm

Clearance 0.007 to 0.041 mm - a sliding fit.

Example - 25 H7/p6: shaft 25.022 to 25.035 mm,

interference 0.001 to 0.035 mm - press it in.

A tolerance on a drawing like 25 +0.021/0 is the same H7 written out.

Choosing a fit (hole basis)

Fit	Type	Assembly	Typical use
H11/c11	Loose running	Falls together, lots of play	Agricultural and crude pivots, pins in dirty conditions
H9/d9	Free running	Easy by hand, visible play	Loose pulleys, idlers, large plain bearings, gland sleeves
H8/f7	Close running	By hand, turns freely when oiled	Shafts in plain bushes, gearbox and pump shafts, levers
H7/g6	Sliding	By hand, slides with no shake	Locating spigots, sliding gears and clutches, jig bushes, pistons
H7/h6	Locating clearance	By hand, snug - may need a push	Spigots and registers, parts that must locate and come apart
H7/k6	Transition	Light mallet	Pulleys, gears and couplings on keyed shafts, bearing inner rings (k5 / k6)
H7/n6	Transition, tight	Mallet or light press	Gears and couplings that must not move, armatures, bushes for good location
H7/p6	Interference, light	Press (or warm the hole)	Bronze bushes in housings, dowels in soft material, gears on shafts with no key
H7/s6	Interference, heavy	Hydraulic press or shrink	Permanent assemblies - valve seats, couplings, crank pins, bushes in cast iron

What each process will hold

Process	Usual IT grade	Typical Ra μm
Drilling (twist drill)	IT11 - IT13	3.2 - 12.5
Reaming	IT7 - IT8 (IT6 with care)	0.8 - 3.2
Boring	IT7 - IT9	0.8 - 6.3
Turning	IT7 - IT10	0.8 - 6.3
Milling	IT8 - IT11	1.6 - 6.3
Broaching	IT7 - IT8	0.8 - 3.2
Cylindrical grinding	IT5 - IT7	0.2 - 1.6
Honing and lapping	IT4 - IT6	0.05 - 0.4
Sawing, flame or plasma cutting	IT14 and coarser	12.5 - 50

Size mm	IT5	IT6	IT7	IT8	IT9	IT11
up to 3	4	6	10	14	25	60
3 - 6	5	8	12	18	30	75
6 - 10	6	9	15	22	36	90
10 - 18	8	11	18	27	43	110
18 - 30	9	13	21	33	52	130
30 - 50	11	16	25	39	62	160
50 - 80	13	19	30	46	74	190
80 - 120	15	22	35	54	87	220
120 - 180	18	25	40	63	100	250
180 - 250	20	29	46	72	115	290
250 - 315	23	32	52	81	130	320
315 - 400	25	36	57	89	140	360
400 - 500	27	40	63	97	155	400

Holes

Size mm (over - to)	H7	H8	H9	H11	G7	JS7
up to 3	+10 / 0	+14 / 0	+25 / 0	+60 / 0	+12 / +2	+5 / -5
3 - 6	+12 / 0	+18 / 0	+30 / 0	+75 / 0	+16 / +4	+6 / -6
6 - 10	+15 / 0	+22 / 0	+36 / 0	+90 / 0	+20 / +5	+7.5 / -7.5
10 - 18	+18 / 0	+27 / 0	+43 / 0	+110 / 0	+24 / +6	+9 / -9
18 - 30	+21 / 0	+33 / 0	+52 / 0	+130 / 0	+28 / +7	+10.5 / -10.5
30 - 50	+25 / 0	+39 / 0	+62 / 0	+160 / 0	+34 / +9	+12.5 / -12.5
50 - 80	+30 / 0	+46 / 0	+74 / 0	+190 / 0	+40 / +10	+15 / -15
80 - 120	+35 / 0	+54 / 0	+87 / 0	+220 / 0	+47 / +12	+17.5 / -17.5
120 - 180	+40 / 0	+63 / 0	+100 / 0	+250 / 0	+54 / +14	+20 / -20
180 - 250	+46 / 0	+72 / 0	+115 / 0	+290 / 0	+61 / +15	+23 / -23
250 - 315	+52 / 0	+81 / 0	+130 / 0	+320 / 0	+69 / +17	+26 / -26
315 - 400	+57 / 0	+89 / 0	+140 / 0	+360 / 0	+75 / +18	+28.5 / -28.5
400 - 500	+63 / 0	+97 / 0	+155 / 0	+400 / 0	+83 / +20	+31.5 / -31.5

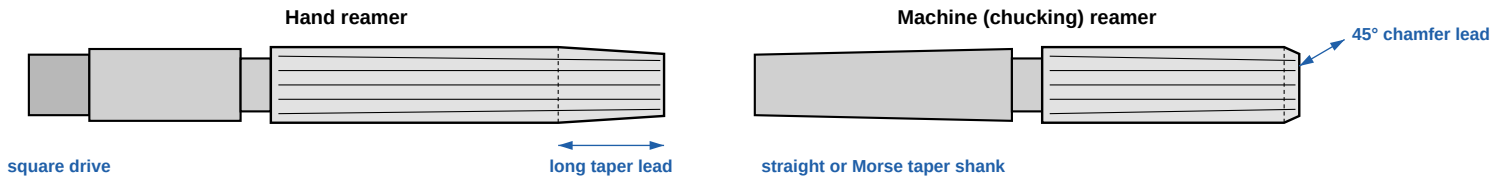
Shafts

Size mm (over - to)	f7	g6	h6	k6	m6	n6	p6
up to 3	-6 / -16	-2 / -8	0 / -6	+6 / 0	+8 / +2	+10 / +4	+12 / +6
3 - 6	-10 / -22	-4 / -12	0 / -8	+9 / +1	+12 / +4	+16 / +8	+20 / +12
6 - 10	-13 / -28	-5 / -14	0 / -9	+10 / +1	+15 / +6	+19 / +10	+24 / +15
10 - 18	-16 / -34	-6 / -17	0 / -11	+12 / +1	+18 / +7	+23 / +12	+29 / +18
18 - 30	-20 / -41	-7 / -20	0 / -13	+15 / +2	+21 / +8	+28 / +15	+35 / +22
30 - 50	-25 / -50	-9 / -25	0 / -16	+18 / +2	+25 / +9	+33 / +17	+42 / +26
50 - 80	-30 / -60	-10 / -29	0 / -19	+21 / +2	+30 / +11	+39 / +20	+51 / +32
80 - 120	-36 / -71	-12 / -34	0 / -22	+25 / +3	+35 / +13	+45 / +23	+59 / +37
120 - 180	-43 / -83	-14 / -39	0 / -25	+28 / +3	+40 / +15	+52 / +27	+68 / +43
180 - 250	-50 / -96	-15 / -44	0 / -29	+33 / +4	+46 / +17	+60 / +31	+79 / +50
250 - 315	-56 / -108	-17 / -49	0 / -32	+36 / +4	+52 / +20	+66 / +34	+88 / +56
315 - 400	-62 / -119	-18 / -54	0 / -36	+40 / +4	+57 / +21	+73 / +37	+98 / +62
400 - 500	-68 / -131	-20 / -60	0 / -40	+45 / +5	+63 / +23	+80 / +40	+108 / +68

How to use: find the size range, read upper / lower deviation in micrometres and add it to the nominal size. 40 k6 = +18 / +2 = 40.018 / 40.002 mm. Clearance or interference = hole limit minus shaft limit, both ways.
Ball bearings: rotating shaft k5 / k6 (small) or m6 (larger and heavier loads); housing H7, or J7 / JS7 when the outer ring must not creep. Dowel pins (ISO 8734 hardened, m6): ream H7 for a light press.

Reaming, Fits & Tolerances Chart

Reaming - stock to leave, speeds and feeds, reamer types and problems.



The hand reamer only cuts on its taper lead and is guided by its long body; the machine reamer cuts on the short chamfer and needs a true, straight hole to follow.

Stock to leave and drill size

Reamer dia mm	Stock on dia - machine	Stock on dia - hand	Example: drill for H7
up to 5	0.10 - 0.20	0.05 - 0.10	3H7: 2.9 / 4H7: 3.9 / 5H7: 4.8
5 - 10	0.20	0.10 - 0.15	6H7: 5.8 / 8H7: 7.8 / 10H7: 9.8
10 - 20	0.20 - 0.30	0.15 - 0.20	12H7: 11.8 / 16H7: 15.75 / 20H7: 19.7
20 - 32	0.30	0.20	25H7: 24.7 / 30H7: 29.7
32 - 50	0.40 - 0.50	0.20 - 0.30	40H7: 39.5 (drill, bore or core drill first)
over 50	0.50 - 0.80	-	Bore it - leave 0.5 for the reamer

Speeds and feeds

Material	Vc HSS m/min	Vc carbide m/min	Coolant
Mild steel	8 - 12	20 - 40	Soluble oil or cutting oil
Alloy steel (EN19, EN24)	5 - 8	15 - 25	Cutting oil
Stainless steel	4 - 6	10 - 20	Cutting oil
Cast iron	8 - 12	30 - 50	Dry or air
Brass, bronze	15 - 25	40 - 60	Dry or soluble oil
Aluminium	20 - 30	60 - 100	Soluble oil, paraffin
Plastics	15 - 25	30 - 60	Air

Reamer dia mm	3	6	10	16	25	40
Feed mm/rev - steel	0.10	0.15	0.20	0.25	0.35	0.45
Feed mm/rev - cast iron, brass, aluminium	0.15	0.25	0.35	0.45	0.60	0.80
rpm - mild steel, HSS at 10 m/min	1060	530	320	200	130	80

Reamer types and problems

Reamer	Use it for
Hand reamer	Long taper lead, square drive - start square in a tap wrench; finishing by hand, fitting work
Machine (chucking) reamer	Short 45° lead, straight or Morse taper shank - lathe, drill press, mill
Left-hand spiral flute	Through holes - pushes chips ahead out of the hole; good on interrupted holes and keyways
Right-hand spiral flute	Blind holes - lifts the chips back out
Adjustable / expanding	Odd sizes and repair work - blades set by nuts; take light cuts
Taper pin reamer (1:50)	Holes for taper pins - drill the small end size, ream until the pin sits proud by 2 - 3 mm
Morse taper reamer	Cleaning up or making Morse tapered sockets - roughing and finishing pair
Bridge / construction reamer	Lining up holes in steelwork - long taper, used in a drill

Problem	Likely cause - fix
Hole oversize	Reamer running out or misaligned - use a floating holder or check the chuck; built-up edge - use oil, slow down; feed too light
Hole undersize	Worn reamer; hole hot when measured - let it cool; springy material - more stock or a sharper reamer
Poor finish, rubbing	Too little stock - the reamer rubs instead of cutting; speed too high; dry; chips packing
Bellmouth at the entry	Reamer not in line with the hole - ream in the same setting as the drill, float the reamer
Chatter, polygon hole	Too fast, too much overhang, not enough stock - slow down, feed harder, shorter reamer
Reamer seizes or breaks	Chips packing in a blind hole - clear chips, use a spiral flute; too much stock
Edges chipped	Turned backwards - never reverse a reamer; withdraw while still turning forwards

Reaming to size
Drill (or better, drill and bore) the hole first in the same setting so the reamer follows a straight, true hole.
Run at about half to a third of the drilling speed, and about twice the drilling feed - feed steadily, do not let it dwell.
Leave enough stock: too little and the reamer rubs and glazes; too much and it wanders and tears.
A new H7 reamer cuts in the upper part of the H7 band - measure the first hole with a plug gauge or bore gauge.
Never turn a reamer backwards. Keep it turning forwards as you take it out (machine: withdraw at feed, not rapid).
Use plenty of cutting oil on steel; ream cast iron dry. Store reamers in tubes - a chipped edge spoils every hole.