INFORMATION

Technical Information

- Speeds & feeds charts
- Troubleshooting charts
- General
- Drills
- Taps
- Endmills
- Reamers

Sutton Tools

Contents — Page

General

Drills

Taps

Contents — Page

Endmills

Reamers

Carbide Burs

Enquiry forms for special tools

Literature Black Books

Catalogue Code | Size Ref.
L100 V2EN
Item #

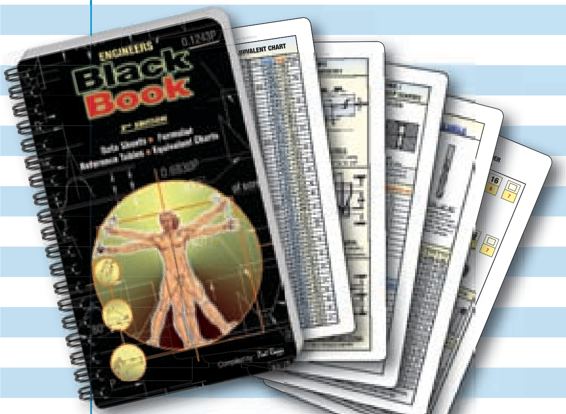
Sutton Tools

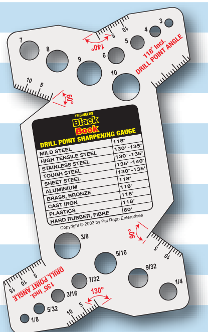
The ultimate reference book:
- Matt laminated grease proof pages
- Wire bound to stay flat on workbench when reading
- Ideal for engineers, trades people, apprentices, machine shops, tool rooms, technical colleges

Engineers Black Book
• Tables • Standards • Illustrations • Grinding wheels • Conversion factors • Tapers
• Lubricants-coolants • Spur gear calculations • Hardening & tempering • G Codes
• Geometrical construction • Formulae • Engineering drawing standards • Plastics • Tolerances
• Bolts & nuts • Tungsten carbide • Keys & keyways • Weights of metal • Tapping drill sizes
• Speeds & feeds • Equivalent charts • Sharpening information

Fastener Black Book
• Screw thread fundamentals • Standards • Thread classes • Thread terminology • Grades
• Heat treatment • Materials & coatings • Failures & corrosion • Fastener strengths & markings
• Tolerances • Material selection • Hydrogen embrittlement • Screw thread profiles
• Torque control • Galling • Dimensional Specifications DIN / ISO / ANSI • Platings
• Elevated temperature effects

					Discount Group	Z0502	Z0502
Size Ref.	**Description**	**Edition**	**Pages**	**Language**	**Merchandiser**	**Item #** **L100**	**Item #** **L200**
V2EN	Engineers Black Book	#2	164	English	499999803	L100 V2EN	
V2DK	Engineers Black Book	#2	164	Danish		•	
V2NL	Engineers Black Book	#2	164	Dutch	499999798	L100 V2NL	
V2FI	Engineers Black Book	#2	164	Finnish		•	
V2FR	Engineers Black Book	#2	164	French	499999797	L100 V2FR	
V2DE	Engineers Black Book	#2	164	German	499999797	L100 V2DE	
V2IT	Engineers Black Book	#2	164	Italian		L100 V2IT	
V2ES	Engineers Black Book	#2	164	Spanish	499999795	L100 V2ES	
V2SE	Engineers Black Book	#2	164	Swedish	499999799	L100 V2SE	
V1EN	Fastener Black Book	#1	248	English	499999803		L200 V1EN





BONUS:
Drill point sharpening gauge

BONUS:
Thread pitch identification gauge

499999803 - Merchandiser
(books sold seprerately)

• Available on request. Subject to lead time.

Sutton Tools

Sutton Tools have made the tool selection for cutting different materials easy by applying colour coded bands to the shanks of the tools which relates to the material it is best suited to.

Why Colour Band?

- Each colour gives clear assignment of materials, different choice of tools and applications
- Internationally recognised
- All suitable standard tools are identified at a glance
- A simplified tool selection lends itself to rationalisation
- Rejects are reduced due to correct tool choice.

Selection Made Easy!

Type UNI Universal use for a wide range of material, preferred application: steels up to 1200 N/mm²

Type VA Use in stainless steels, high-strength steels up to 900 N/mm²

Type H Use in hard materials up to 1400 N/mm²

Type AI Use in wrought Al alloys, pure-copper and thermoplastics.

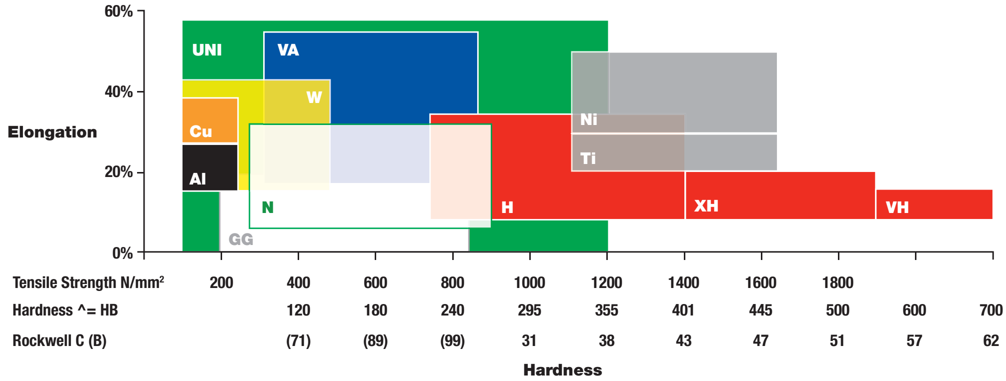
Type W Use in soft materials, free-cutting steels, AlSi alloys.

Type Cu Use in wrought Al alloys and coppers.

Type GG Use in grey cast iron GG, brittle plastics, hard bronzes.

Materials	HB	N/mm²	% Elong.	Material Examples			
1.0 Steels				**ANSI / USA**	**JIS**	**DIN**	**Material #**
1.1 Mild steels, magnetic soft steel	<200	>200 <400	10			RFe100	1.1013
1.2 Free cutting, structural, unalloyed	<200	>350 <700	30	1010, 1015, 1020	S10C, 515C, 520C	C10, C15, ST37, ST52	1.0301, 1.0401, 1.0044
1.3 Plain carbon, low alloyed	<300	>350 <850	20	1045, 1095	545C, 55BC	C45, C92D, D95-S	1.0503, 1.0618
1.4 Alloy steels harden. / tempered	<250	>500 <850	30	4140, 4340, D2, 02, H13	SCM440, SKD6, SKD11	41CrMo4, 36CrNiMo4, X155CrVMo12-1, 90MnV8	1.7223, 1.6511, 1.2343, 1.2379, 1.2344, 1.2842
1.5 Alloy steels harden. / tempered	<350	>850 <1200	30				
1.6 Hardened, heat treated, high tensile alloy	<420	<1500	12				
1.7 High tensile 45-50 Rc	<550		<12				
1.8 High Tensile 50-62 Rc	<700		<12	M2, M42	SKH59	HS2-10-1-8	1.3247
2.0 Stainless Steels							
2.1 Free machining	<250	<850	25	303, 430F	SUS303, SUS430F	X8CrNiS18-9	1.4305, 1.4104
2.2 Austenitic	<250	<850	20	304, 316	SUS304, SUS316	X5CrNi18-10	1.4301, 1.4401, 1.4571
2.3 Ferritic + martensitic	<250	<850	20	403, 420, 440F	SUS420, SUS403	X20Cr13	1.4021
3.0 Cast Irons							
3.1 Lamellar graphite (Grey soft)	<150	<500	10	A48-20B, A48-60B	FC10, FC20	GG10, GG40	0.6010, 0.6040
3.2 Lamellar graphite (Grey hard)	<300	<1000	10	120-90-02 80-55-06	FCD40, FCD60, FCD70	GGG40, GGG80	0.7080, 0.7040, 0.7060
3.3 Nodular (spheroidal) graphite & malleable	<200	<700	10				
4.0 Titaniums							
4.1 Pure Titanium	<250	<850	20	4902, 4941		Ti99.7, Ti99.8	3.7024, 3.7034
4.2 Titanium alloys	>250	>850	20	4911, 4928, 4965		TiCu2, TiAl6V4	3.7164, 3.7124
5.0 Nickels							
5.1 Nickel alloys	<250	<850	25	INCONEL 600 HASTELLOY, INCONEL 718		Ni38, Ni54, NiCr16FeTi	1.3913, 2.4816, 2.4669, 2.4665
5.2 Nickel alloys	>250	>850	25				
6.0 Coppers							
6.1 Pure Copper (electrolytic copper)	<120	<400	12	C10200, C12200		SF-Cu	2.0090
6.2 Short chip Brass, Phosphor Bronze, gun metal	<200	<700	12	C3800, C91700		G-CuSn12Ni	2.1060
6.3 Long chip Brass, Bronze	<200	<700	12	C17000, C94100		G-CuPb20Sn	2.1188
7.0 Aluminiums							
7.1 Aluminium unalloyed	<100	<350	15	1050A	A1050	Al99.5	3.0255
7.2 Magnesium unalloyed	<150	<350	15	6463		Al99.85Mg0.5	3.3307, 3.2307, 3.3211
7.3 Al Alloyed Si < 1.5 %	<120	<500	15	5050B, 7075, 6061	A6061	AlMg1.5	3.3316
7.4 Al Alloyed 1.5 % < Si < 10%	<120	<400	10	380	A380, ADC10	AlSi10Mg	3.2161
7.5 Al Alloyed > 10% Si	-	<400	N	390, 393		AlSi17Cu4	
7.6 Magnesium alloys	-	<400	N	SAE52		MgAl3Zn	3.5312
8.0 Plastics							
8.1 Plastics, Thermoplastics, Polyethylene	<340	<50	N	ABS, PVC, Polycarbonate, Polypropylene			

Sutton Tools



N for general purpose	UNI for universal materials	Al for aluminiums	W for soft materials	Cu for copper materials	VA for tough materials	GG for cast iron materials	H for hard materials	XH for extra hard materials	VH for very hard materials	Ti for titaniums	Ni for nickels
O	O		O		O						
O	O		O		O						
O	O		O		O						
	O		O		O		O				
	O						O				
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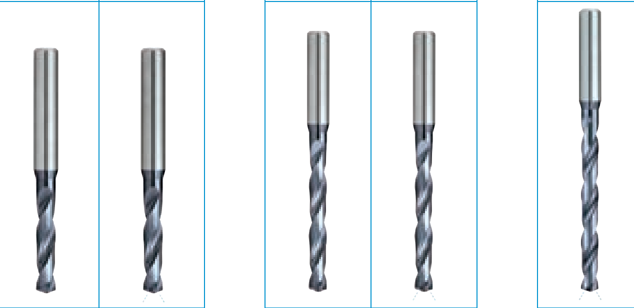
O		O	O	O							
O			O	O							
			O	O							
		O									

Sutton Tools

	3xD		5xD		8xD
Drilling Depth	≤ 3xØ		≤ 5xØ		≤ 8xØ
Catalogue Code	D323	D329	D326	D332	D335
Material	VHM		VHM		VHM
Surface Finish	AlCrN	AlCrN	AlCrN		AlCrN
Colour Ring & Application	Up to 1400N/mm²		Up to 1400N/mm²		Up to 1400N/mm²
Geometry	R30	R30 - IK	R30	R30 - IK	R30 - IK



Materials	HB	N/mm²	% Elong.	Material eg.	D323 Vc (m/min)	D323 Feed No.	D329 Vc (m/min)	D329 Feed No.	D326 Vc (m/min)	D326 Feed No.	D332 Vc (m/min)	D332 Feed No.	D335 Vc (m/min)	D335 Feed No.
1.0 Steels														
1.1 Mild steels, magnetic soft steel	<200	>200 <400	10	RFe100	90	8	130	8	90	8	130	8	100	6
1.2 Free cutting, structural, unalloyed	<200	>350 <700	30	C10, C15, ST37, ST52	90	8	130	8	90	8	130	8	100	6
1.3 Plain carbon, low alloyed	<300	>350 <850	20	C45, C92D, D95-S	85	8	110	8	85	8	110	8	85	6
1.4 Alloy steels harden. / tempered	<250	>500 <850	30		65	7	80	7	65	7	80	7	85	6
1.5 Alloy steels harden. / tempered	<350	>850 <1200	30	41CrMo4, 36CrNiMo4, X155CrVMo12-1, 90MnV8	50	6	70	6	50	6	70	6	60	5
1.6 Hardened, heat treated, high tensile alloy	<420	>1500	12		25	4	40	4	25	4	40	4	30	3
1.7 Hardened Steel 45-50 Rc	<550		<12		16	3	25	3	-	-	-	-	-	-
1.8 Hardened Steel 50-62 Rc	<700		<12	HS2-10-1-8	-	-	-	-	-	-	-	-	-	-
2.0 Stainless Steels														
2.1 Free machining	<250	<850	25	X8CrNiS18-9	-	-	40	3	-	-	40	3	-	-
2.2 Austenitic	<250	<850	20	X5CrNi18-10	-	-	35	3	-	-	35	3	-	-
2.3 Ferritic + martensitic	<250	<850	20	X20Cr13	-	-	25	3	-	-	25	3	-	-
3.0 Cast Irons														
3.1 Lamellar graphite (Grey soft)	<150	<500	10	GG10, GG40	75	6	150	9	75	6	150	9	70	7
3.2 Lamellar graphite (Grey hard)	<300	<1000	10	GGG40, GGG80	65	6	120	8	65	6	120	8	100	7
3.3 Nodular (spheroidal) graphite & malleable	<200	<700	10		65	5	100	8	65	5	100	8	90	7
4.0 Titaniums														
4.1 Pure Titanium	<250	<850	20	Ti99.7, Ti99.8	40	4	45	5	-	-	45	5	-	-
4.2 Titanium alloys	>250	>850	20	TiCu2, TiAl6V4	35	3	40	4	-	-	40	4	-	-
5.0 Nickels														
5.1 Nickel alloys	<250	<850	25	Ni38, Ni54, NiCr16FeTi	25	4	35	4	-	-	35	4	-	-
5.2 Nickel alloys	>250	>850	25		20	4	30	4	-	-	30	4	-	-
6.0 Coppers														
6.1 Pure Copper (electrolytic copper)	<120	<400	12	SF-Cu	-	-	-	-	-	-	-	-	-	-
6.2 Short chip Brass, Phosphor Bronze, gun metal	<200	<700	12	G-CuSn12Ni	-	-	-	-	-	-	-	-	-	-
6.3 Long chip Brass, Bronze	<200	<700	12	G-CuPb20Sn	-	-	-	-	-	-	-	-	-	-
7.0 Aluminiums														
7.1 Aluminium unalloyed	<100	<350	15	Al99.5	-	-	-	-	-	-	-	-	-	-
7.2 Magnesium unalloyed	<150	<350	15	Al99.85Mg0.5	-	-	-	-	-	-	-	-	-	-
7.3 Al Alloyed Si < 1.5 %	<120	<500	15	AlMg1.5	-	-	-	-	-	-	-	-	-	-
7.4 Al Alloyed 1.5 % < Si < 10%	<120	<400	10	AlSi10Mg	-	-	-	-	-	-	-	-	-	-
7.5 Al Alloyed > 10% Si	-	<400	N	AlSi17Cu4	-	-	-	-	-	-	-	-	-	-
7.6 Magnesium alloys	-	<400	N	MgAl3Zn	-	-	-	-	-	-	-	-	-	-
8.0 Plastics														
8.1 Plastics, Thermoplastics, Polyethylene	<340	<50	N	ABS, PVC, Polycarbonate	-	-	-	-	-	-	-	-	-	-

Feed Table (f) (mm/rev)

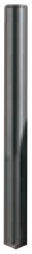
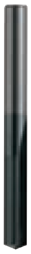
Ø	Feed No. 1	2	3	4	5	6	7	8	9
2.0	0.020	0.025	0.030	0.040	0.050	0.060	0.080	0.100	0.120
3.0	0.030	0.040	0.050	0.060	0.080	0.100	0.120	0.150	0.180
4.0	0.040	0.050	0.060	0.080	0.100	0.120	0.150	0.180	0.200
5.0	0.045	0.055	0.065	0.085	0.110	0.135	0.165	0.190	0.220
6.0	0.050	0.060	0.080	0.100	0.120	0.150	0.180	0.200	0.250
8.0	0.060	0.080	0.100	0.120	0.150	0.200	0.250	0.300	0.350
10.0	0.080	0.100	0.120	0.150	0.200	0.250	0.300	0.350	0.400
12.0	0.080	0.100	0.120	0.150	0.200	0.250	0.300	0.400	0.500
16.0	0.100	0.120	0.150	0.200	0.250	0.300	0.400	0.500	0.600
20.0	0.150	0.200	0.250	0.300	0.400	0.500	0.600	0.700	0.800

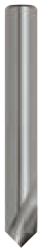
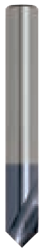
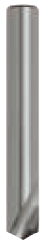
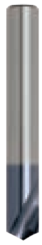
LEGEND

n = rev. per minute
v_c = cutting speed (m/min)
f = feed (mm/rev)
v_f = feed rate (mm/min)

FORMULAS

$n = (v_c \times 1000) / (Ø \times \pi)$
$v_c = (Ø \times \pi \times n) / 1000$
$v_f = f \times n$

3xD			
≤ 3xØ			
D300		D306	
VHM			
Brt		TiCN	
Up to 1400N/mm²			
Straight			
			
Vc (m/min)	Feed No.	Vc (m/min)	Feed No.
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
20	1	25	2
15	1	20	1
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
80	4	100	5
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
80	4	100	5
80	4	100	5
-	-	-	-

SPOTTING							
-							
D355		D364		D365		D366	
VHM							
Brt		AlCrN		Brt		AlCrN	
N							
90		90		142		142	
							
Vc (m/min)	Feed No.	Vc (m/min)	Feed No.	Vc (m/min)	Feed No.	Vc (m/min)	Feed No.
80	5	96	6	80	5	96	6
80	5	96	6	80	5	96	6
65	5	78	6	65	5	78	6
60	5	72	6	60	5	72	6
50	4	60	5	50	4	60	5
50	4	60	5	50	4	60	5
40	4	48	5	40	4	48	5
30	3	36	4	30	3	36	4
25	3	30	4	25	3	30	4
20	2	24	3	20	2	24	3
25	2	30	3	25	2	30	3
70	5	84	6	70	5	84	6
70	4	84	5	70	4	84	5
70	4	84	5	70	4	84	5
40	5	48	6	40	5	48	6
40	5	48	6	40	5	48	6
25	4	30	5	25	4	30	5
25	4	30	5	25	4	30	5
200	4	240	5	200	4	240	5
150	4	180	5	150	4	180	5
130	4	156	5	130	4	156	5
200	5	240	6	200	5	240	6
200	4	240	5	200	4	240	5
200	4	240	5	200	4	240	5
180	4	216	5	180	4	216	5
180	4	216	5	180	4	216	5
140	4	168	5	140	4	168	5
60	4	72	5	60	4	72	5

Sutton Tools

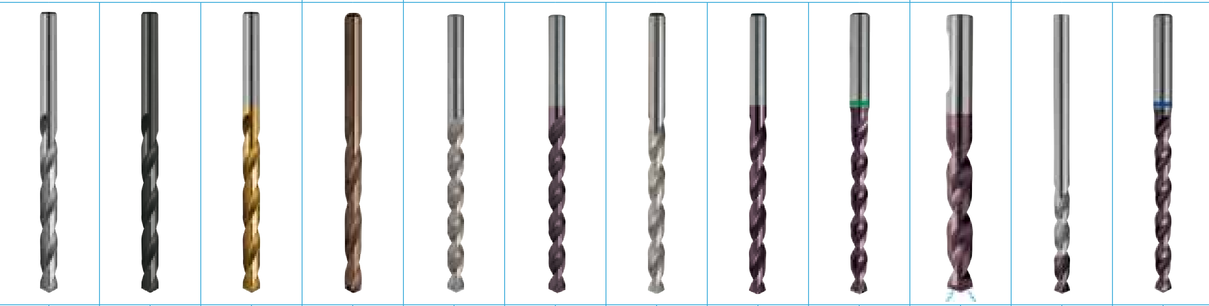
STUB

Drilling Depth	≤ 3xØ						
Catalogue Code	**D186**	**D146**	**D151**	**D190**	**D177**	**D155**	**D153**
Material	HSS	HSS Co				SPM	HSS Co
Surface Finish	Blu	Brt	TiAlN	Brt	TiAlN		
Colour Ring & Application	Ferrous Materials	**N → H**		**W → N**		**UNI**	**VA**
Geometry	R30	R40		R35°		R40	

Materials	HB	N/mm²	% Elong.	Material eg.	D186 Vc (m/min)	D186 Feed No.	D146 Vc (m/min)	D146 Feed No.	D151 Vc (m/min)	D151 Feed No.	D190 Vc (m/min)	D190 Feed No.	D177 Vc (m/min)	D177 Feed No.	D155 Vc (m/min)	D155 Feed No.	D153 Vc (m/min)	D153 Feed No.
1.0 Steels																		
1.1 Mild steels, magnetic soft steel	<200	>200 <400	10	RFe100	25	5	20	5	40	6	23	4	35	4	65	6	64	6
1.2 Free cutting, structural, unalloyed	<200	>350 <700	30	C10, C15, ST37, ST52	20	5	17	5	30	6	20	4	30	4	55	6	64	6
1.3 Plain carbon, low alloyed	<300	>350 <850	20	C45, C92D, D95-S	15	4	12	5	30	6	20	4	30	4	50	6	62	5
1.4 Alloy steels harden. / tempered	<250	>500 <850	30	41CrMo4, 36CrNiMo4, X155CrVMo12-1, 90MnV8	15	4	12	4	20	5	8	4	20	4	35	6	30	4
1.5 Alloy steels harden. / tempered	<350	>850 <1200	30		10	4	10	4	15	4	-	-	12	4	25	6	-	-
1.6 Hardened, heat treated, high tensile alloy	<420	>1500	12		-	-	8	4	12	4	-	-	-	-	15	5	-	-
1.7 Hardened Steel 45-50 Rc	<550		<12		-	-	-	-	-	-	-	-	-	-	10	4	-	-
1.8 Hardened Steel 50-62 Rc	<700		<12	HS2-10-1-8	-		-	-	-	-	-	-	-	-		-	-	-
2.0 Stainless Steels																		
2.1 Free machining	<250	<850	25	X8CrNiS18-9	10	4	10	4	20	5	10	3	15	3	16	5	30	6
2.2 Austenitic	<250	<850	20	X5CrNi18-10	8	4	7	4	15	5	-	-	10	4	12	5	20	5
2.3 Ferritic + martensitic	<250	<850	20	X20Cr13	-	-	11	4	20	4	-	-	15	4	14	4	12	4
3.0 Cast Irons																		
3.1 Lamellar graphite (Grey soft)	<150	<500	10	GG10, GG40	25	6	20	6	30	6	23	5	35	5	44	6	-	-
3.2 Lamellar graphite (Grey hard)	<300	<1000	10	GGG40, GGG80	20	5	15	5	25	6	-	-	-	-	39	6	-	-
3.3 Nodular (spheroidal) graphite & malleable	<200	<700	10		20	6	18	6	25	6	-	-	-	-	44	5	-	-
4.0 Titaniums																		
4.1 Pure Titanium	<250	<850	20	Ti99.7, Ti99.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.2 Titanium alloys	>250	>850	20	TiCu2, TiAl6V4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.0 Nickels																		
5.1 Nickel alloys	<250	<850	25	Ni38, Ni54, NiCr16FeTi	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.2 Nickel alloys	>250	>850	25		-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.0 Coppers																		
6.1 Pure Copper (electrolytic copper)	<120	<400	12	SF-Cu	-	-	30	5	30	5	45	5	45	5	33	4	80	3
6.2 Short chip Brass, Phosphor Bronze, gun metal	<200	<700	12	G-CuSn12Ni	-	-	28	5	40	5	30	5	35	5	44	5	-	-
6.3 Long chip Brass, Bronze	<200	<700	12	G-CuPb20Sn	-	-	25	5	60	5	40	5	50	5	39	4	50	5
7.0 Aluminiums																		
7.1 Aluminium unalloyed	<100	<350	15	Al99.5	-	-	42	6	-	-	50	6	60	6	88	5	112	6
7.2 Magnesium unalloyed	<150	<350	15	Al99.85Mg0.5	-	-	35	6	-	-	45	6	50	6	70	6	80	7
7.3 Al Alloyed Si < 1.5 %	<120	<500	15	AlMg1.5	-	-	35	6	50	6	45	6	50	6	70	6	50	7
7.4 Al Alloyed 1.5 % < Si < 10%	<120	<400	10	AlSi10Mg	-	-	28	5	40	5	30	5	40	5	53	5	70	7
7.5 Al Alloyed > 10% Si	-	<400	N	AlSi17Cu4	-	-	-	-	30	7	25	8	30	8	-	-	-	-
7.6 Magnesium alloys	-	<400	N	MgAl3Zn	-	-	-	-	-	-	25	8	30	8	-	-	-	-
8.0 Plastics																		
8.1 Plastics, Thermoplastics, Polyethylene	<340	<50	N	ABS, PVC, Polycarbonate	30	4	50	4	50	4	70	5	70	5	70	5	50	4

Notes on Drilling

1. Step feeding or pecking is required for drilling greater than 3 x Ø.
2. When drilling cast surface & black (ie.not machined surface), reduce drilling speed by 20%.
3. For optimal positional accuracy and hole size, the use of spot drills is recommended prior to drilling desired hole, refer to our standard range (D175).
4. For hole depths greater than 7 x Ø, pre-drill initially to pilot start for more accurate hole position and eliminate drill wandering. The pilot can be drilled with short rigid drill, approx. 3 x Ø in depth and reduced feed to ensure accurate pilot hole.

JOBBER																							
≤ 5xØ																							
D101		D102		D103		D109		D158		D163		D200		D165		D168		D182		D180		D169	
HSS						HSS Co										SPM		HSS Co		HSS		HSS Co	
Brt		Blu		TiN		Colour Tempered		Brt		TiAlN		Brt		TiAlN						TiAlN Tip		TiAlN	
N						Tough Materials		N → H				W → N				UNI		N → H		VA		VA	
R30						R25°		R40										R40 - IK		R40			
																							
Vc	Feed No.	Vc	Feed No.	Vc	Feed No.	Vc	Feed No.	Vc	Feed No.	Vc	Feed No.	Vc	Feed No.	Vc	Feed No.	Vc	Feed No.	Vc	Feed No.	Vc	Feed No.	Vc	Feed No.
12	5	20	5	24	5	20	5	20	5	24	5	20	4	29	4	60	7	65	7	20	4	58	6
10	5	16	5	20	5	20	5	17	5	20	5	18	4	25	4	45	7	55	7	16	4	58	6
8	5	12	5	18	5	15	5	12	5	20	5	18	4	25	4	45	7	50	7	12	4	58	5
8	4	12	4	18	4	15	4	12	4	20	4	7	4	20	4	30	7	40	7	12	3	25	4
-	-	10	4	12	4	12	4	10	4	12	4	-	-	10	4	20	6	25	5	-	-	-	-
-	-	8	3	10	3	10	4	8	4	10	4	-	-	-	-	12	6	15	5	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	4	10	4	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-
-	-	8	4	10	4	10	4	10	4	12	4	8	3	12	3	10	4	16	4	12	4	25	6
-	-	6	4	8	4	8	4	-	-	10	10	-	-	10	4	8	4	12	4	10	4	14	5
-	-	-	-	10	3	-	-	-	-	12	4	-	-	-	-	10	3	14	3	7	3	12	4
12	6	20	6	25	6	25	6	20	6	24	6	20	5	29	5	40	6	40	6	-	-	-	-
10	5	16	5	20	5	20	5	20	5	20	5	-	-	20	5	35	6	35	6	-	-	-	-
-	-	16	6	18	6	20	6	20	6	20	6	-	-	-	-	40	5	40	5	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	3	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	3	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	3	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	4	-	-	25	4	-	-	-	-	-	-	40	5	40	5	30	5	45	5	30	5	70	3
15	4	-	-	25	4	25	6	32	5	32	5	24	5	32	5	40	5	36	5	-	-	-	-
20	4	-	-	30	4	-	-	48	5	48	5	36	5	48	5	35	4	50	5	50	5	40	5
25	5	-	-	-	-	-	-	48	6	-	-	36	6	48	6	80	5	60	6	50	6	112	8
20	5	-	-	-	-	-	-	40	6	-	-	30	6	40	6	64	6	50	6	50	6	80	7
20	5	-	-	-	-	-	-	40	6	40	6	30	6	40	6	64	6	50	6	50	6	50	7
18	4	-	-	30	4	-	-	32	5	32	5	24	5	32	5	48	5	40	5	40	5	70	6
12	6	-	-	20	6	-	-	-	-	25	6	20	7	25	7	30	6	40	5	30	5	-	-
12	6	-	-	20	6	-	-	-	-	-	-	20	7	25	7	30	6	40	5	30	5	-	-
25	3	30	4	35	4	-	-	50	4	50	4	50	4	60	5	60	4	70	5	50	4	50	4

Feed Table (f) (mm/rev)									
Ø	Feed No.								
	1	2	3	4	5	6	7	8	9
2.0	0.020	0.025	0.030	0.040	0.050	0.060	0.080	0.100	0.120
3.0	0.030	0.040	0.050	0.060	0.080	0.100	0.120	0.150	0.180
4.0	0.040	0.050	0.060	0.080	0.100	0.120	0.150	0.180	0.200
5.0	0.045	0.055	0.065	0.085	0.110	0.135	0.165	0.190	0.220
6.0	0.050	0.060	0.080	0.100	0.120	0.150	0.180	0.200	0.250
8.0	0.060	0.080	0.100	0.120	0.150	0.200	0.250	0.300	0.350
10.0	0.080	0.100	0.120	0.150	0.200	0.250	0.300	0.350	0.400
12.0	0.080	0.100	0.120	0.150	0.200	0.250	0.300	0.400	0.500
16.0	0.100	0.120	0.150	0.200	0.250	0.300	0.400	0.500	0.600
20.0	0.150	0.200	0.250	0.300	0.400	0.500	0.600	0.700	0.800

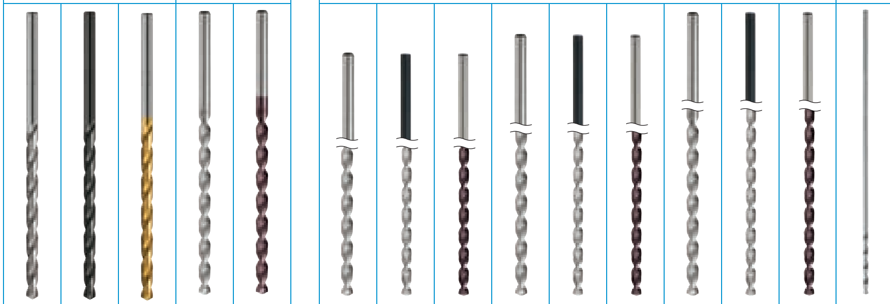
LEGEND

n = rev. per minute
v_c = cutting speed (m/min)
f = feed (mm/rev)
v_f = feed rate (mm/min)

FORMULAS

$n = (v_c \times 1000) / (Ø \times \pi)$
$v_c = (Ø \times \pi \times n) / 1000$
$v_f = f \times n$

	LONG SERIES					EXTRA LENGTH									
Drilling Depth	≤ 7xØ					≤ 10xØ			≤ 12xØ			≤ 14xØ			-
Catalogue Code	D112	D113	D111	D170	D171	D197	D191	D194	D198	D192	D195	D199	D193	D196	D187
Material	HSS			HSS Co		HSS		HSS Co	HSS		HSS Co	HSS		HSS Co	HSS
Surface Finish	Brt	Blu	TiN	TiAlN		Brt	Ni+Blu	TiAlN	Brt	Ni+Blu	TiAlN	Brt	Ni+Blu	TiAlN	Brt
Colour Ring & Application	N			N → H		N	N → H		N	N → H		N	N → H		N
Geometry	R30			R40		R40									R30



LONG SERIES

Materials	HB	N/mm²	% Elong.	Material eg.	D112 Vc	D112 Feed No.	D113 Vc	D113 Feed No.	D111 Vc	D111 Feed No.	D170 Vc	D170 Feed No.	D171 Vc	D171 Feed No.
1.0 Steels														
1.1 Mild steels, magnetic soft steel	<200	>200 <400	10	RFe100	16	5	16	5	19	5	25	5	30	5
1.2 Free cutting, structural, unalloyed	<200	>350 <700	30	C10, C15, ST37, ST52	13	5	13	5	15	5	13	5	16	5
1.3 Plain carbon, low alloyed	<300	>350 <850	20	C45, C92D, D95-S	10	5	10	5	12	5	13	5	16	5
1.4 Alloy steels harden. / tempered	<250	>500 <850	30	41CrMo4, 36CrNiMo4, X155CrVMo12-1, 90MnV8	10	4	10	4	12	4	13	4	16	4
1.5 Alloy steels harden. / tempered	<350	>850 <1200	30		-	-	-	-	-	-	8	4	10	4
1.6 Hardened, heat treated, high tensile alloy	<420	>1500	12		-	-	-	-	-	-	-	-	8	4
1.7 Hardened Steel 45-50 Rc	<550		<12		-	-	-	-	-	-	-	-	-	-
1.8 Hardened Steel 50-62 Rc	<700		<12	HS2-10-1-8	-	-	-	-	-	-	-	-	-	-
2.0 Stainless Steels														
2.1 Free machining	<250	<850	25	X8CrNiS18-9	7	4	7	4	5	4	8	4	10	4
2.2 Austenitic	<250	<850	20	X5CrNi18-10	-	-	-	-	-	-	-	-	-	-
2.3 Ferritic + martensitic	<250	<850	20	X20Cr13	-	-	-	-	-	-	8	4	10	4
3.0 Cast Irons														
3.1 Lamellar graphite (Grey soft)	<150	<500	10	GG10, GG40	16	6	16	6	7	6	16	6	19	6
3.2 Lamellar graphite (Grey hard)	<300	<1000	10	GGG40, GGG80	13	5	13	5	6	5	13	5	16	5
3.3 Nodular (spheroidal) graphite & malleable	<200	<700	10		13	6	13	6	7	6	13	6	16	6
4.0 Titaniums														
4.1 Pure Titanium	<250	<850	20	Ti99.7, Ti99.8	-	-	-	-	-	-	-	-	-	-
4.2 Titanium alloys	>250	>850	20	TiCu2, TiAl6V4	-	-	-	-	-	-	-	-	-	-
5.0 Nickels														
5.1 Nickel alloys	<250	<850	25	Ni38, Ni54, NiCr16FeTi	-	-	-	-	-	-	-	-	-	-
5.2 Nickel alloys	>250	>850	25		-	-	-	-	-	-	-	-	-	-
6.0 Coppers														
6.1 Pure Copper (electrolytic copper)	<120	<400	12	SF-Cu	30	5	-	-	-	-	-	-	-	-
6.2 Short chip Brass, Phosphor Bronze, gun metal	<200	<700	12	G-CuSn12Ni	-	-	-	-	-	-	22	5	26	5
6.3 Long chip Brass, Bronze	<200	<700	12	G-CuPb20Sn	20	5	-	-	-	-	31	5	38	5
7.0 Aluminiums														
7.1 Aluminium unalloyed	<100	<350	15	Al99.5	20	5	-	-	-	-	41	6	-	-
7.2 Magnesium unalloyed	<150	<350	15	Al99.85Mg0.5	15	5	-	-	-	-	26	6	-	-
7.3 Al Alloyed Si < 1.5 %	<120	<500	15	AlMg1.5	15	5	-	-	-	-	26	6	32	6
7.4 Al Alloyed 1.5 % < Si < 10%	<120	<400	10	AlSi10Mg	10	4	-	-	-	-	22	5	26	5
7.5 Al Alloyed > 10% Si	-	<400	N	AlSi17Cu4	-	-	-	-	-	-	-	-	18	5
7.6 Magnesium alloys	-	<400	N	MgAl3Zn	-	-	-	-	-	-	-	-	-	-
8.0 Plastics														
8.1 Plastics, Thermoplastics, Polyethylene	<340	<50	N	ABS, PVC, Polycarbonate	20	3	-	-	-	-	30	4	40	4

EXTRA LENGTH

Materials	D197 Vc	D197 Feed No.	D191 Vc	D191 Feed No.	D194 Vc	D194 Feed No.	D198 Vc	D198 Feed No.	D192 Vc	D192 Feed No.	D195 Vc	D195 Feed No.	D199 Vc	D199 Feed No.	D193 Vc	D193 Feed No.	D196 Vc	D196 Feed No.	D187 Vc	D187 Feed No.
1.0 Steels																				
1.1 Mild steels, magnetic soft steel	21	5	21	5	25	5	16	5	16	5	20	5	16	5	16	5	20	5	16	5
1.2 Free cutting, structural, unalloyed	11	5	11	5	13	5	8	5	8	5	10	5	8	5	8	5	10	5	8	5
1.3 Plain carbon, low alloyed	11	5	11	5	13	5	8	5	8	5	10	5	8	5	8	5	10	5	8	5
1.4 Alloy steels harden. / tempered	11	4	11	4	13	4	8	4	8	4	10	4	8	4	8	4	10	4	8	4
1.5 Alloy steels harden. / tempered	-	-	8	4	10	4	-	-	8	4	10	4	-	-	8	4	10	4	8	4
1.6 Hardened, heat treated, high tensile alloy	-	-	-	-	8	4	-	-	-	-	10	4	-	-	-	-	10	4	-	-
1.7 Hardened Steel 45-50 Rc	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.8 Hardened Steel 50-62 Rc	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.0 Stainless Steels																				
2.1 Free machining	8	4	8	4	10	4	8	4	8	4	10	4	8	4	8	4	10	4	8	4
2.2 Austenitic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.3 Ferritic + martensitic	8	4	8	4	10	4	8	4	8	4	10	4	8	4	8	4	10	4	-	-
3.0 Cast Irons																				
3.1 Lamellar graphite (Grey soft)	12	6	12	6	15	6	10	6	10	6	12	6	10	6	10	6	12	6	10	6
3.2 Lamellar graphite (Grey hard)	11	5	11	5	13	5	8	5	8	5	10	5	8	5	8	5	10	5	8	5
3.3 Nodular (spheroidal) graphite & malleable	11	6	11	6	13	6	8	6	8	6	10	6	8	6	8	6	10	6	8	6
4.0 Titaniums																				
4.1 Pure Titanium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.2 Titanium alloys	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.0 Nickels																				
5.1 Nickel alloys	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.2 Nickel alloys	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.0 Coppers																				
6.1 Pure Copper (electrolytic copper)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.2 Short chip Brass, Phosphor Bronze, gun metal	16	5	16	5	20	5	13	5	13	5	16	5	13	5	13	5	16	5	13	5
6.3 Long chip Brass, Bronze	26	5	26	5	31	5	21	5	21	5	25	5	21	5	21	5	25	5	21	5
7.0 Aluminiums																				
7.1 Aluminium unalloyed	26	6	26	6	-	-	21	6	21	6	-	-	21	6	21	6	-	-	21	6
7.2 Magnesium unalloyed	22	6	22	6	-	-	16	6	16	6	-	-	16	6	16	6	-	-	16	6
7.3 Al Alloyed Si < 1.5 %	22	6	22	6	26	6	16	6	16	6	20	6	16	6	16	6	20	6	16	6
7.4 Al Alloyed 1.5 % < Si < 10%	16	5	16	5	20	5	13	5	13	5	16	5	13	5	13	5	16	5	13	5
7.5 Al Alloyed > 10% Si	-	-	-	-	18	5	-	-	-	-	16	5	-	-	-	-	16	5	-	-
7.6 Magnesium alloys	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8.0 Plastics																				
8.1 Plastics, Thermoplastics, Polyethylene	30	4	30	4	40	4	30	4	30	4	40	4	30	4	30	4	40	4	30	4

Notes on Drilling

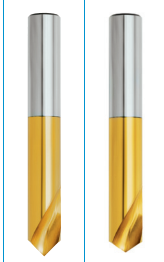
1. Step feeding or pecking is required for drilling greater than 3 x Ø.
2. When drilling cast surface & black (ie. not machined surface), reduce drilling speed by 20%.
3. For optimal positional accuracy and hole size, the use of spot drills is recommended prior to drilling desired hole, refer to our standard range (D175).
4. For hole depths greater than 7 x Ø, pre-drill initially to pilot start for more accurate hole position and eliminate drill wandering. The pilot can be drilled with short rigid drill, approx. 3 x Ø in depth and reduced feed to ensure accurate pilot hole.

LEGEND

n = rev. per minute
v_c = cutting speed (m/min)
f = feed (mm/rev)
v_f = feed rate (mm/min)

FORMULAS

$n = (v_c \times 1000) / (Ø \times \pi)$
$v_c = (Ø \times \pi \times n) / 1000$
$v_f = f \times n$

TAPER SHANK										REDUCED SHANK				SPOTTING				COUNTERBORES & COUNTERSINKS									
≤ 5xØ						Long Reach				≤ 5xØ								-									
D115		D139		D141		D140		D189		D120		D188		D175		D176		C107		C108		C105		C106		C100	
HSS				HSS Co		HSS				HSS				HSS Co				HSS Co				HSS				HSS Co	
Blu		TiAlN		Colour Tempered		Blu				Blu				TiN				Brt		TiAlN		Brt		TiN		Brt	
N				Tough Mat.		N				N				N				N		UNI		Machine Use				N	
R30										R30				90º		120º		90º								-	
																											
Vc	Feed No.	Vc	Feed No.	Vc	Feed No.	Vc	Feed No.	Vc	Feed No.	Vc	Feed No.	Vc	Feed No.	Vc	Feed No.	Vc	Feed No.	Vc	Feed No.	Vc	Feed No.	Vc	Feed No.	Vc	Feed No.	Vc	Feed No.
32	5	38	5	38	5	32	5	32	5	32	5	32	5	35	4	35	4	36	3	44	3	25	3	31	3	30	3
32	5	38	5	38	5	32	5	32	5	32	5	32	5	25	4	25	4	30	3	36	3	21	3	25	3	30	3
25	5	30	5	30	5	25	5	25	5	25	5	25	5	20	4	20	4	30	2	36	2	21	2	25	2	30	3
25	4	30	4	30	4	25	4	25	4	25	4	25	4	15	4	15	4	18	2	22	2	12	2	15	2	15	2
15	4	18	4	18	4	15	4	15	4	15	4	15	4	15	3	15	3	14	1	16	1	10	1	11	1	12	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	3	12	3	-	-	10	1	-	-	-	-	10	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	3	10	3	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	4	12	4	12	4	8	4	8	4	8	4	8	4	10	3	10	3	12	2	14	2	8	2	10	2	16	2
6	4	10	4	10	4	6	4	6	4	6	4	6	4	15	2	15	2	10	1	12	1	7	1	8	1	12	1
-	-	-	-	10	4	-	-	-	-	-	-	-	-	10	2	10	2	10	1	12	1	-	-	-	-	14	1
32	5	38	5	38	5	32	5	32	5	32	5	32	5	30	5	30	5	24	2	28	2	17	2	20	2	25	2
25	5	30	5	30	5	25	5	25	5	25	5	25	5	20	4	20	4	24	2	28	2	17	2	20	2	16	2
20	5	25	5	25	5	-	-	-	-	-	-	-	-	20	4	20	4	-	-	25	2	-	-	-	-	20	2
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	3	18	3	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	3	18	3	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	1	12	1	8	1	10	1	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	1	10	1	-	-	-	-	-	-
-	-	38	6	38	6	-	-	-	-	32	6	32	6	50	4	50	4	60	2	72	2	42	2	50	2	-	-
-	-	19	3	19	3	-	-	-	-	16	3	16	3	30	4	30	4	48	2	58	2	34	2	40	2	-	-
-	-	30	6	30	6	-	-	-	-	25	6	25	6	40	4	40	4	78	2	94	2	55	2	66	2	-	-
-	-	96	6	96	6	-	-	-	-	80	6	80	6	50	5	50	5	48	4	58	4	34	4	41	4	80	4
-	-	96	6	96	6	-	-	-	-	80	6	80	6	50	4	50	4	48	4	58	4	34	4	41	4	80	4
-	-	84	5	84	5	-	-	-	-	70	5	70	5	50	4	50	4	48	4	58	4	34	4	41	4	70	4
-	-	72	5	72	5	-	-	-	-	60	5	60	5	35	4	35	4	36	4	44	4	25	3	31	3	60	3
-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	4	30	4	30	4	44	4	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	4	30	4	30	4	44	4	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	4	30	4	30	4	44	4	-	-	-	-	30	2

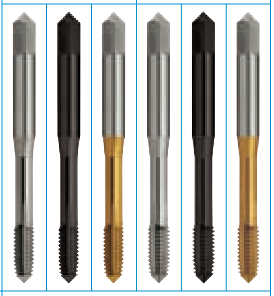
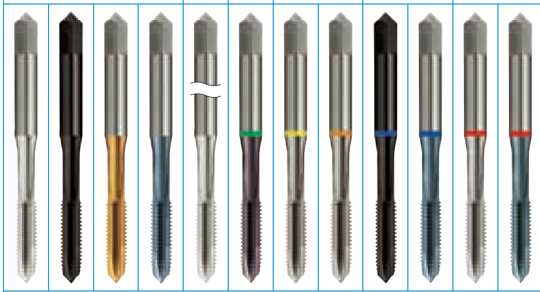
Feed Table (f) (mm/rev)

Ø	Feed No. 1	2	3	4	5	6	7	8	9
2.0	0.020	0.025	0.030	0.040	0.050	0.060	0.080	0.100	0.120
3.0	0.030	0.040	0.050	0.060	0.080	0.100	0.120	0.150	0.180
4.0	0.040	0.050	0.060	0.080	0.100	0.120	0.150	0.180	0.200
5.0	0.045	0.055	0.065	0.085	0.110	0.135	0.165	0.190	0.220
6.0	0.050	0.060	0.080	0.100	0.120	0.150	0.180	0.200	0.250
8.0	0.060	0.080	0.100	0.120	0.150	0.200	0.250	0.300	0.350
10.0	0.080	0.100	0.120	0.150	0.200	0.250	0.300	0.350	0.400
12.0	0.080	0.100	0.120	0.150	0.200	0.250	0.300	0.400	0.500

Feed Table (f) (mm/rev)

Ø	Feed No. 1	2	3	4	5	6	7	8	9
16.0	0.100	0.120	0.150	0.200	0.250	0.300	0.400	0.500	0.600
20.0	0.150	0.200	0.250	0.300	0.400	0.500	0.600	0.700	0.800
25.0	0.160	0.200	0.250	0.315	0.400	0.500	0.630	0.800	0.800
31.5	0.160	0.200	0.250	0.315	0.400	0.500	0.630	0.800	0.800
40.0	0.200	0.250	0.315	0.400	0.500	0.630	0.800	1.000	1.250
50.0	0.250	0.310	0.400	0.500	0.630	0.800	1.000	1.250	1.250
63.0	0.315	0.400	0.500	0.630	0.800	1.000	1.250	1.600	1.600

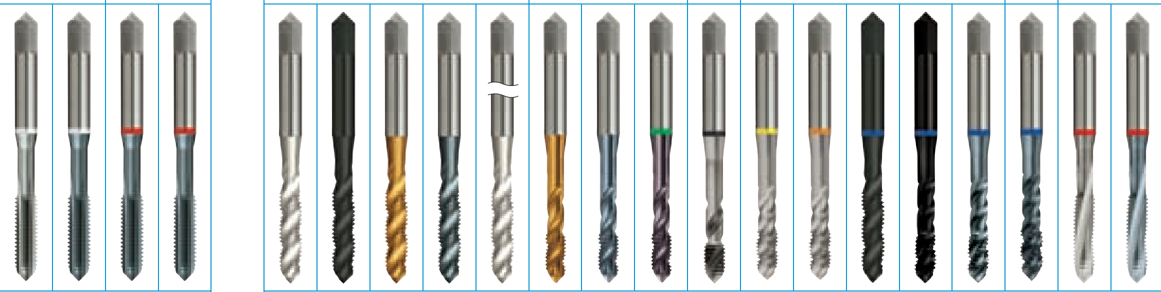
Sutton Tools

					THREAD FORMING						FOR TAPPING THROUGH HOLES											
Thread Depth					≤ 3xØ						≤ 3xØ											
Catalogue Code M					T510	T512	T514	T516	T518	T520	T499	T500	T502	T633	T501	T605	T546	T553	T548	T549	T550	T552
UNC					T522		T526	T528		T662	T615	T616	T617									
UNF					T534		T538	T540		T544	T621	T622	T623									
BSW											T491	T492	T494	T635	T493							
Material					HSS Co.8			HSS Co.8			HSSE V3					PM-HSSE V3	HSSE V3				PM-HSS Co	
Surface Finish					Ni	Blu	TiN	Ni	Blu	TiN	Brt	Blu	TiN	TiCN	Brt	TiAlN	Ni	CrN	Blu	TiCN	Brt	TiCN
Colour Ring & Application											N					UNI	W	Cu	VA		H	
Geometry					Single-Coolant Groove			Multi-Coolant Groove									High Rake		Special Relief		Low Relief	
																						
Materials	**HB**	**N/mm²**	**% Elong.**	**Material eg.**	**Vc (m/min)**						**Vc (m/min)**											
1.0 Steels																						
1.1 Mild steels, magnetic soft steel	<200	>200 <400	10	RFe100	-	15	18	-	15	18	15	15	20	22	8	20	15	-	15	15	-	-
1.2 Free cutting, structural, unalloyed	<200	>350 <700	30	C10, C15, ST37, ST52	-	15	18	-	15	18	15	15	12	14	8	18	18	-	15	15	-	-
1.3 Plain carbon, low alloyed	<300	>350 <850	20	C45, C92D, D95-S	-	10	14	-	10	14	12	12	20	22	9	20	12	-	12	12	12	15
1.4 Alloy steels harden. / tempered	<250	>500 <850	30		-	-	-	-	-	-	8	8	10	12	6	15	8	-	8	10	12	15
1.5 Alloy steels harden. / tempered	<350	>850 <1200	30	41CrMo4, 36CrNiMo4, X155CrVMo12-1, 90MnV8	-	-	-	-	-	-	-	-	-	5	-	10	-	-	-	8	6	8
1.6 Hardened, heat treated, high tensile alloy	<420	>1500	12		-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	4	5
1.7 Hardened Steel 45-50 Rc	<550		<12		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.8 Hardened Steel 50-62 Rc	<700		<12	HS2-10-1-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.0 Stainless Steels																						
2.1 Free machining	<250	<850	25	X8CrNiS18-9	-	8	12	-	8	12	-	5	7	9	-	12	-	-	12	16	-	-
2.2 Austenitic	<250	<850	20	X5CrNi18-10	-	5	10	-	5	10	-	3	5	7	-	10	-	-	10	14	-	-
2.3 Ferritic + martensitic	<250	<850	20	X20Cr13	-	-	-	-	-	-	-	2	3	4	-	8	-	-	-	-	6	8
3.0 Cast Irons																						
3.1 Lamellar graphite (Grey soft)	<150	<500	10	GG10, GG40	-	-	-	-	-	-	15	15	18	20	12	25	-	-	-	-	25	30
3.2 Lamellar graphite (Grey hard)	<300	<1000	10	GGG40, GGG80	-	-	-	-	-	-	10	10	12	14	8	18	-	-	-	-	15	20
3.3 Nodular (spheroidal) graphite & malleable	<200	<700	10		-	-	-	-	-	-	10	10	12	14	8	18	-	-	-	-	13	18
4.0 Titaniums																						
4.1 Pure Titanium	<250	<850	20	Ti99.7, Ti99.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	8
4.2 Titanium alloys	>250	>850	20	TiCu2, TiAl6V4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	6
5.0 Nickels																						
5.1 Nickel alloys	<250	<850	25	Ni38, Ni54, NiCr16FeTi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3
5.2 Nickel alloys	>250	>850	25		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.0 Coppers																						
6.1 Pure Copper (electrolytic copper)	<120	<400	12	SF-Cu	25	-	30	20	-	30	-	-	-	-	-	-	8	15	-	-	-	-
6.2 Short chip Brass, Phosphor Bronze, gun metal	<200	<700	12	G-CuSn12Ni	-	-	-	-	-	-	12	-	15	18	10	15	-	-	-	-	14	18
6.3 Long chip Brass, Bronze	<200	<700	12	G-CuPb20Sn	10	-	25	15	-	25	15	-	18	20	12	18	18	20	-	-	-	-
7.0 Aluminiums																						
7.1 Aluminium unalloyed	<100	<350	15	Al99.5	25	-	30	30	-	30	18	-	20	25	15	30	30	30	-	20	-	-
7.2 Magnesium unalloyed	<150	<350	15	Al99.85Mg0.5	25	-	30	30	-	30	18	-	20	25	15	30	30	30	-	20	-	-
7.3 Al Alloyed Si < 1.5 %	<120	<500	15	AlMg1.5	20	-	30	30	-	30	18	-	20	25	15	30	30	30	-	20	-	-
7.4 Al Alloyed 1.5 % < Si < 10%	<120	<400	10	AlSi10Mg	15	-	20	15	-	20	15	-	18	20	12	25	25	25	-	18	-	-
7.5 Al Alloyed > 10% Si	-	<400	N	AlSi17Cu4	-	-	-	-	-	-	-	-	-	-	-	15	-	15	-	20	-	-
7.6 Magnesium alloys	-	<400	N	MgAl3Zn	-	-	-	-	-	-	-	-	-	-	-	25	-	25	-	20	-	-
8.0 Plastics																						
8.1 Plastics, Thermoplastics, Polyethylene	<340	<50	N	ABS, PVC, Polycarbonate	-	-	-	-	-	-	20	-	30	30	18	30	-	30	-	30	-	-

Notes on Tapping

1. The speeds listed above are a recommendation only, and are based on depth of thread listed, speeds can be be adjusted on application. As a general rule;
   -If hole depth required is less than above mentioned = increase speed
   -If hole depth required is more than above mentioned = reduce speed
2. Taps must be driven by the square to eliminate slippage, eg, ER-GB collets (square drive)
3. When using spiral flute taps with length compensation tapping attachment, it is recommended to short pitch the feed 95%, to eliminate tap cutting oversize, eg. M6x1 @ 1000RPM, Feedrate= 950mm/min

FOR TAPPING BLIND / THROUGH HOLES			
≤ 3xØ		≤ 1.5xØ	
T599	T600	T294	T296
HSSE V3		SPM	VHM
Ni	TiCN		
GG		H	
Low Rake		Special Relief	
Vc (m/min)			
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	10	10
-	-	8	8
-	-	5	5
-	-	-	3
-	-	-	-
-	-	-	-
-	-	-	-
15	15	-	-
10	10	-	-
10	10	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	10	10
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	20	-	-
-	25	-	-
-	-	-	-



FOR TAPPING BLIND HOLES																
≤ 2.5xØ					≤ 3xØ										≤ 1.5xØ	
T503	T504	T508	T634	T507	T509	T568	T576	T573	T567	T583	T690	T570	T571	T566	T577	T578
T618	T619	T620														
T625	T626	T627														
T495	T496	T498	T636	T497												
HSSE V3							PM-HSSE V3	HSSE V3						PM-HSSE V3	PM-HSS Co	
Brt	Blu	TiN	TiCN	Brt	TiN	TiCN	TiAlN	Brt	Ni	CrN	Blu		TiCN		Brt	TiCN
N							UNI	Al	W	Cu	VA	VADH		VA PM	H	
R40								R45 2 Flute	R45					R50	R15	
Vc (m/min)																
12	12	15	15	8	10	10	18	-	18	-	12	18	20	25	-	-
12	12	15	15	8	10	10	15	-	15	-	12	15	18	20	-	-
10	10	12	12	8	10	10	18	-	15	-	10	12	15	20	8	10
4	4	6	8	4	8	8	12	-	10	-	10	10	10	12	6	8
-	-	4	5	-	5	5	10	-	-	-	-	-	10	12	5	6
-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	4	8
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	5	7	9	-	7	8	8	-	-	-	8	8	10	12	-	-
-	3	5	7	-	5	7	6	-	-	-	5	5	8	10	-	-
-	3	3	4	-	3	4	3	-	-	-	4	4	6	8	4	5
10	10	15	18	8	15	18	20	-	-	-	-	-	-	-	20	25
8	8	10	12	6	10	12	15	-	-	-	-	-	-	-	15	20
8	8	10	12	6	10	12	15	-	-	-	-	-	-	-	14	18
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	8
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	6
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	8	5	15	-	-	8	8	-	-
8	-	10	12	6	10	12	10	-	-	-	-	-	-	-	14	18
10	-	15	18	8	15	18	12	15	15	20	-	-	15	15	-	-
15	-	15	18	12	15	18	18	40	25	30	-	-	30	30	-	-
15	-	15	18	12	15	18	18	40	25	30	-	-	30	30	-	-
15	-	15	18	12	15	18	18	30	25	30	-	-	30	30	-	-
10	-	10	12	8	10	12	12	10	20	25	-	-	25	25	-	-
-	-	-	-	-	-	-	10	-	-	-	-	-	-	15	-	-
-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-
20	-	15	18	15	15	18	30	30	-	-	-	-	-	-	-	-

LEGEND

n = rev. per minute

V_c = cutting speed (m/min)

f = pitch (mm)

V_f = feed rate (mm/min)

FORMULAS

$n = (V_c \times 1000) / (Ø \times \pi)$

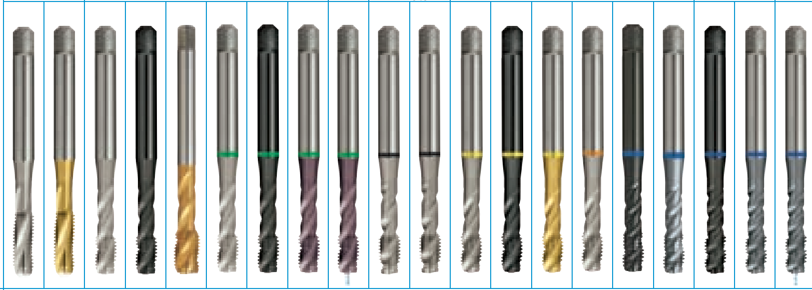
$V_c = (Ø \times \pi \times n) / 1000$

$V_f = f \times n$

Sutton Tools

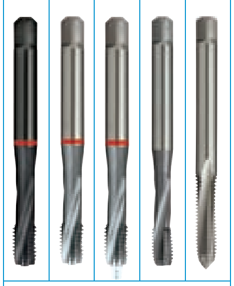
FOR TAPPING BLIND HOLES

					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Thread Depth					≤ 1.5xØ		≤ 3xØ																	
Catalogue Code M					T183	T185	T187	T189		T219	T221	T227	T229	T231	T233	T235	T237	T241	T239	T197	T201	T203	T205	T207
MF					T243	T244	T245	T247	T248	T253		T254								T249	T251	T250	T252	
UNC							T258	T260	T273		T266	T267								T261	T262			
UNF							T275													T276	T277			
G (BSPF)					T278	T279	T281	T282	T283											T284	T285	T351	T352	
Material					HSSE V3					PM-HSSE V3				HSSE V3								PM-HSSE V3		
Surface Finish					Brt	TiN	Brt	Blu	TiN	Brt	Blu	TiAlN		Brt	CrN	Brt	Blu	TiN	CrN	Blu	TiCN	Blu	TiCN	
Colour Ring & Application					N					UNI				Al		W			Cu	VADH		VA PM		
Geometry					R15		R40						IK	R45 2 Flute		R45						R50		IK
Materials	**HB**	**N/mm²**	**% Elong.**	**Material eg.**	**Vc (m/min)**																			
1.0 Steels																								
1.1 Mild steels, magnetic soft steel	<200	>200 <400	10	RFe100	6	8	8	8	8	10	10	18	15	-	-	18	20	20	-	18	12	10	25	15
1.2 Free cutting, structural, unalloyed	<200	>350 <700	30	C10, C15, ST37, ST52	6	8	8	8	8	10	10	15	15	-	-	15	20	18	-	15	12	10	20	15
1.3 Plain carbon, low alloyed	<300	>350 <850	20	C45, C92D, D95-S	6	8	10	10	8	10	10	18	15	-	-	18	20	20	-	18	12	10	20	15
1.4 Alloy steels harden. / tempered	<250	>500 <850	30	41CrMo4, 36CrNiMo4, X155CrVMo12-1, 90MnV8	5	7	4	4	6	8	8	12	12	-	-	10	10	12	-	10	10	8	12	12
1.5 Alloy steels harden. / tempered	<350	>850 <1200	30		4	4	-	-	4	8	8	10	10	-	-	-	-	-	-	-	10	8	12	12
1.6 Hardened, heat treated, high tensile alloy	<420	>1500	12		-	-	-	-	-	-	-	6	6	-	-	-	-	-	-	-	-	-	-	-
1.7 Hardened Steel 45-50 Rc	<550		<12		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.8 Hardened Steel 50-62 Rc	<700		<12	HS2-10-1-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.0 Stainless Steels																								
2.1 Free machining	<250	<850	25	X8CrNiS18-9	-	7	-	5	7	7	4	8	8	-	-	-	-	-	-	8	10	8	12	12
2.2 Austenitic	<250	<850	20	X5CrNi18-10	-	5	-	3	5	5	3	6	6	-	-	-	-	-	-	5	8	5	10	10
2.3 Ferritic + martensitic	<250	<850	20	X20Cr13	-	3	-	3	3	3	2	3	4	-	-	-	-	-	-	4	6	4	8	8
3.0 Cast Irons																								
3.1 Lamellar graphite (Grey soft)	<150	<500	10	GG10, GG40	10	12	10	10	15	15	15	20	20	-	-	-	-	-	-	-	-	-	-	-
3.2 Lamellar graphite (Grey hard)	<300	<1000	10	GGG40, GGG80	8	10	8	8	10	10	10	15	15	-	-	-	-	-	-	-	-	-	-	-
3.3 Nodular (spheroidal) graphite & malleable	<200	<700	10		8	10	8	8	10	10	10	15	15	-	-	-	-	-	-	-	-	-	-	-
4.0 Titaniums																								
4.1 Pure Titanium	<250	<850	20	Ti99.7, Ti99.8	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.2 Titanium alloys	>250	>850	20	TiCu2, TiAl6V4	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.0 Nickels																								
5.1 Nickel alloys	<250	<850	25	Ni38, Ni54, NiCr16FeTi	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.2 Nickel alloys	>250	>850	25		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.0 Coppers																								
6.1 Pure Copper (electrolytic copper)	<120	<400	12	SF-Cu	-	-	-	-	-	-	-	8	10	8	10	5	-	8	15	-	8	-	8	10
6.2 Short chip Brass, Phosphor Bronze, gun metal	<200	<700	12	G-CuSn12Ni	8	10	8	-	10	10	-	10	12	-	-	-	-	-	-	-	-	-	-	-
6.3 Long chip Brass, Bronze	<200	<700	12	G-CuPb20Sn	10	15	10	-	15	12	-	12	15	15	20	15	-	25	20	-	15	-	15	20
7.0 Aluminiums																								
7.1 Aluminium unalloyed	<100	<350	15	Al99.5	10	15	15	-	15	15	-	18	25	40	40	25	-	40	30	-	30	-	30	30
7.2 Magnesium unalloyed	<150	<350	15	Al99.85Mg0.5	10	15	15	-	15	15	-	18	25	40	40	25	-	40	30	-	30	-	30	30
7.3 Al Alloyed Si < 1.5 %	<120	<500	15	AlMg1.5	10	15	15	-	15	15	-	18	25	30	30	25	-	30	30	-	30	-	30	30
7.4 Al Alloyed 1.5 % < Si < 10%	<120	<400	10	AlSi10Mg	8	12	10	-	10	10	-	12	20	10	10	20	-	25	25	-	25	-	25	25
7.5 Al Alloyed > 10% Si	-	<400	N	AlSi17Cu4	-	-	-	-	-	-	-	10	12	-	-	-	-	-	-	-	-	-	15	20
7.6 Magnesium alloys	-	<400	N	MgAl3Zn	-	-	-	-	-	-	-	10	12	-	-	-	-	-	-	-	-	-	-	-
8.0 Plastics																								
8.1 Plastics, Thermoplastics, Polyethylene	<340	<50	N	ABS, PVC, Polycarbonate	10	15	20	-	15	15	-	30	40	30	40	-	-	-	-	-	-	-	-	-

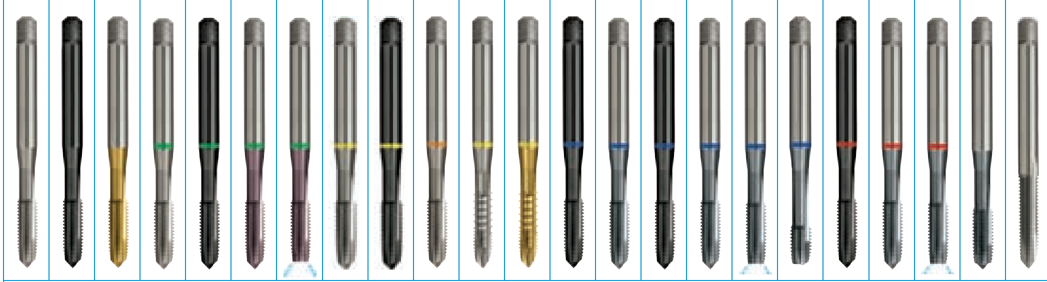


Notes on Tapping

1. The speeds listed above are a recommendation only, and are based on depth of thread listed, speeds can be adjusted on application. As a general rule;
   -If hole depth required is less than above mentioned = increase speed
   -If hole depth required is more than above mentioned = reduce speed
2. Taps must be driven by the square to eliminate slippage, eg, ER-GB collets (square drive).
3. When using spiral flute taps with length compensation tapping attachment, it is recommended to short pitch the feed 95%, to eliminate tap cutting oversize, eg. M6x1 @ 1000RPM, Feedrate= 950mm/min.

≤ 1.5xØ			≤ 1.5xØ	
T209	T211	T213	T215	T217
T265	T667			
PM-HSS Co				
Blu	TiCN			Brt
H			Ti	Ni
R15º		IK	R15º	R10º
				
Vc (m/min)				
-	-	-	-	-
-	-	-	-	-
8	10	12	-	-
6	8	10	-	-
5	6	8	-	-
6	8	6	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
4	5	5	-	-
20	25	25	-	-
15	20	20	-	-
12	18	18	-	-
6	8	8	10	-
5	6	6	8	-
-	-	-	-	8
-	-	-	-	5
-	-	-	-	-
10	12	12	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-

FOR TAPPING THROUGH HOLES

≤ 3xØ																						
T100	T102	T104	T132	T134	T140	T142	T122	T124	T126	T128	T130	T110	T112	T114	T116	T118	T120	T144	T146	T148	T152	T150
T154	T156	T157	T162		T163							T158	T161	T159	T160							
T164	T166	T167		T168	T169							T170	T171					T172	T666			
T173		T175										T176	T177									
T178	T179	T180										T181	T182	T349	T350							
HSSE V3			PM-HSSE V3				HSSE V3							PM-HSSE V3							PM-HSS Co	
Brt	Blu	TiN	Brt	Blu	TiAlN		Ni	Blu	CrN	Brt	TiN	Blu	TiCN	Blu	TiCN			Blu	TiCN			Brt
N			UNI				W		Cu	W		VA		VA PM			VADH	H			Ti	Ni
						IK				Interrupted Threads						IK				IK		
																						
Vc (m/min)																						
10	10	20	15	15	20	25	15	15	-	20	25	15	12	12	20	25	20	-	-	-	-	-
10	10	12	15	15	18	25	18	18	-	20	25	12	12	12	15	25	20	-	-	-	-	-
11	11	20	15	15	20	25	15	15	-	20	25	15	12	12	20	25	20	10	15	12	-	-
8	8	10	12	12	15	20	15	15	-	15	20	10	10	10	20	20	15	8	15	10	-	-
-	-	-	12	12	10	20	-	-	-	-	20	-	10	10	15	20	15	6	8	10	-	-
-	-	-	4	4	6	10	-	-	-	-	-	-	-	-	-	-	-	8	10	8	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	8	8	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	5	7	5	10	12	12	-	-	-	8	10	10	10	10	12	12	12	-	-	-	-	-
-	3	5	4	8	10	10	-	-	-	8	10	8	8	8	10	10	10	-	-	-	-	-
-	2	3	3	6	8	8	-	-	-	5	7	10	10	10	10	10	10	6	8	8	-	-
15	15	18	20	20	25	20	-	-	-	-	-	-	-	-	-	-	-	25	30	35	-	-
10	10	12	15	15	18	15	-	-	-	-	-	-	-	-	-	-	-	18	20	25	-	-
10	10	12	15	15	18	15	-	-	-	-	-	-	-	-	-	-	-	15	18	20	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	8	8	10	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	6	6	8	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	7	8	8	-	5	-	-	8
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	5
-	-	-	10	-	15	15	8	-	15	10	12	-	10	-	18	20	18	-	-	-	-	-
12	-	15	15	-	15	18	12	-	15	-	-	-	-	-	-	-	-	-	18	18	-	-
15	-	18	18	-	18	20	18	-	20	20	20	-	15	-	22	25	22	-	-	-	-	-
18	-	20	20	-	30	30	30	-	30	35	40	-	20	-	30	35	35	-	-	-	-	-
18	-	20	20	-	30	30	30	-	30	35	40	-	20	-	30	35	35	-	-	-	-	-
18	-	20	20	-	30	30	30	-	30	35	40	-	20	-	30	35	35	-	-	-	-	-
15	-	18	18	-	25	25	25	-	25	30	35	-	18	-	25	30	30	-	-	-	-	-
-	-	-	-	-	15	15	15	-	15	20	20	-	20	-	15	15	15	-	20	20	-	-
-	-	-	-	-	25	25	25	-	25	20	20	-	20	-	20	20	20	-	25	25	-	-
20	-	30	-	-	30	40	30	30	30	30	30	-	30	-	30	30	30	-	-	-	-	-

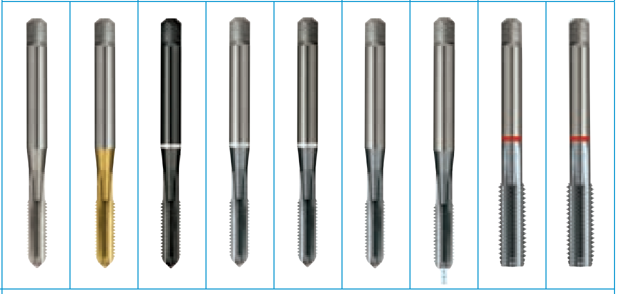
LEGEND

n = rev. per minute
v_c = cutting speed (m/min)
f = pitch (mm)
v_f = feed rate (mm/min)

FORMULAS

$n = (v_c \times 1000) / (Ø \times \pi)$
$v_c = (Ø \times \pi \times n) / 1000$
$v_f = f \times n$

Sutton Tools

					FOR TAPPING BLIND / THROUGH HOLES								
				Thread Depth	≤ 1.5xØ		≤ 3xØ			≤ 3xØ		≤ 1.5xØ	
				Catalogue Code M	T286	T288	T290	T292	T670	T335	T357	T294	T296
				MF	T298	T299	T300	T301		T668	T669		
				UNC			T302						
				UNF									
				G (BSPF)	T304	T305		T307					
				Material	HSSE V3				VHM	HSSE V3		SPM	VHM
				Surface Finish	Brt	TiN	Blu	TiCN					
				Colour Ring & Application	N		GG			DC		XH	VH
				Geometry			Low Relief				IK	Special Relief	
													
Materials	**HB**	**N/mm²**	**% Elong.**	**Material eg.**	**Vc (m/min)**								
1.0 Steels													
1.1 Mild steels, magnetic soft steel	<200	>200 <400	10	RFe100	6	8	-	-	-	-	-	-	-
1.2 Free cutting, structural, unalloyed	<200	>350 <700	30	C10, C15, ST37, ST52	6	8	-	-	-	-	-	-	-
1.3 Plain carbon, low alloyed	<300	>350 <850	20	C45, C92D, D95-S	6	8	-	-	-	-	-	-	-
1.4 Alloy steels harden. / tempered	<250	>500 <850	30		5	7	-	-	-	-	-	-	-
1.5 Alloy steels harden. / tempered	<350	>850 <1200	30	41CrMo4, 36CrNiMo4, X155CrVMo12-1, 90MnV8	4	5	-	-	-	-	-	10	10
1.6 Hardened, heat treated, high tensile alloy	<420	>1500	12		-	-	-	-	-	-	-	8	8
1.7 Hardened Steel 45-50 Rc	<550		<12		-	-	-	-	-	-	-	5	5
1.8 Hardened Steel 50-62 Rc	<700		<12	HS2-10-1-8	-	-	-	-	-	-	-	-	3
2.0 Stainless Steels													
2.1 Free machining	<250	<850	25	X8CrNiS18-9	-	-	-	-	-	-	-	-	-
2.2 Austenitic	<250	<850	20	X5CrNi18-10	-	-	-	-	-	-	-	-	-
2.3 Ferritic + martensitic	<250	<850	20	X20Cr13	-	-	-	-	-	-	-	-	-
3.0 Cast Irons													
3.1 Lamellar graphite (Grey soft)	<150	<500	10	GG10, GG40	15	15	15	20	60	12	12	-	-
3.2 Lamellar graphite (Grey hard)	<300	<1000	10	GGG40, GGG80	10	10	10	15	30	8	8	-	-
3.3 Nodular (spheroidal) graphite & malleable	<200	<700	10		10	10	10	12	30	8	8	-	-
4.0 Titaniums													
4.1 Pure Titanium	<250	<850	20	Ti99.7, Ti99.8	-	-	-	-	-	-	-	-	-
4.2 Titanium alloys	>250	>850	20	TiCu2, TiAl6V4	-	-	-	-	-	-	-	-	-
5.0 Nickels													
5.1 Nickel alloys	<250	<850	25	Ni38, Ni54, NiCr16FeTi	-	-	-	-	-	-	-	-	-
5.2 Nickel alloys	>250	>850	25		-	-	-	-	-	-	-	-	-
6.0 Coppers													
6.1 Pure Copper (electrolytic copper)	<120	<400	12	SF-Cu	8	8	-	-	-	-	-	-	-
6.2 Short chip Brass, Phosphor Bronze, gun metal	<200	<700	12	G-CuSn12Ni	6	6	-	-	20	10	10	10	10
6.3 Long chip Brass, Bronze	<200	<700	12	G-CuPb20Sn	6	6	-	-	-	-	-	-	-
7.0 Aluminiums													
7.1 Aluminium unalloyed	<100	<350	15	Al99.5	10	10	-	-	-	-	-	-	-
7.2 Magnesium unalloyed	<150	<350	15	Al99.85Mg0.5	10	10	-	-	-	-	-	-	-
7.3 Al Alloyed Si < 1.5 %	<120	<500	15	AlMg1.5	40	40	-	-	-	15	20	-	-
7.4 Al Alloyed 1.5 % < Si < 10%	<120	<400	10	AlSi10Mg	7	7	-	-	-	9	16	-	-
7.5 Al Alloyed > 10% Si	-	<400	N	AlSi17Cu4	-	-	-	20	40	5	10	-	-
7.6 Magnesium alloys	-	<400	N	MgAl3Zn	-	-	-	25	60	5	10	-	-
8.0 Plastics													
8.1 Plastics, Thermoplastics, Polyethylene	<340	<50	N	ABS, PVC, Polycarbonate	10	10	-	-	40	20	20	-	-

Notes on Tapping

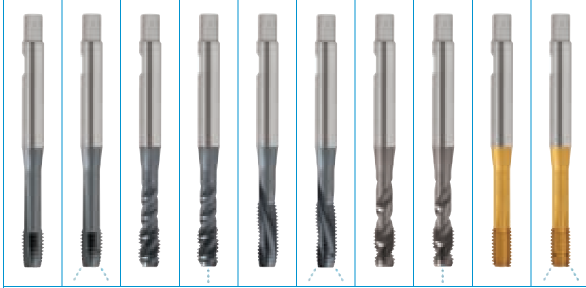
1. The speeds listed above are a recommendation only, and are based on depth of thread listed, speeds can be adjusted on application. As a general rule;
   -If hole depth required is less than above mentioned = increase speed
   -If hole depth required is more than above mentioned = reduce speed
2. Taps must be driven by the square to eliminate slippage, eg, ER-GB collets (square drive).
3. When using spiral flute taps with length compensation tapping attachment, it is recommended to short pitch the feed 95%, to eliminate tap cutting oversize, eg. M6x1 @ 1000RPM, Feedrate= 950mm/min.

THREAD FORMING

≤ 3xØ						
T309	T313		T319	T325	T327	T329
		T361	T363			
HSSE V3				SPM		HSSE V3
Brt	TiN	Brt	TiCN	TiAlN		CrN
N				UNI		Cu
No Groove		Multi-Coolant Groove			IK	Multi-Coolant Groove
Vc (m/min)						
5	8	8	12	10	12	-
5	5	5	10	10	12	-
-	5	5	8	8	10	-
-	-	-	-	5	8	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	10	-	10	10	12	-
-	8	-	8	8	10	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
20	20	20	20	20	20	40
-	-	-	-	-	-	-
15	15	15	15	15	15	20
30	30	30	30	30	30	40
30	30	30	30	30	30	40
30	30	30	30	30	30	40
15	15	15	15	15	15	20
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-

SYNCHRO TAPPING

≤ 3xØ									
T377	T379	T373	T375	T365	T367	T369	T371	T381	T383
PM-HSSE V3									
TiCN						CrN		TiN	
High Speed Cutting									
	IK	R50	R50 IK	L20°	L20° IK	R45	R45 IK	Multi-Coolant Groove	IK
Vc (m/min)									
50-60	50-60	40-50	40-50	50-60	50-60	-	-	20-30	20-30
40-50	40-50	30-40	30-40	40-50	40-50	-	-	20-30	20-30
30-40	30-40	20-30	20-30	30-40	30-40	-	-	20-30	20-30
20-35	20-35	15-25	15-25	20-35	20-35	-	-	10-20	10-20
20-35	20-35	15-25	15-25	20-35	20-35	-	-	10-20	10-20
12-20	12-20	8-15	8-15	12-20	12-20	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
15-25	15-25	20-35	20-35	15-25	15-25	-	-	10-20	10-20
12-20	12-20	15-25	15-25	12-20	12-20	-	-	10-20	10-20
10-15	10-15	8-15	8-15	10-15	10-15	-	-	-	-
30-40	30-40	20-25	20-25	30-40	30-40	-	-	-	-
30-40	30-40	20-25	20-25	30-40	30-40	-	-	-	-
20-25	20-25	12-20	12-20	20-25	20-25	-	-	-	-
15-25	15-25	10-20	10-20	15-25	15-25	-	-	-	-
10-15	10-15	5-10	5-10	10-15	10-15	-	-	-	-
10-15	10-15	5-10	5-10	10-15	10-15	-	-	-	-
-	-	-	-	-	-	-	-	-	-
25-35	25-35	20-30	20-30	25-35	25-35	25-35	25-35	20-30	20-30
20-30	20-30	20-30	20-30	20-30	20-30	40-50	40-50	-	-
25-35	25-35	20-30	20-30	25-35	25-35	25-35	25-35	-	-
60-80	60-80	50-60	50-60	60-80	60-80	60-80	60-80	80-100	80-100
60-80	60-80	50-60	50-60	60-80	60-80	60-80	60-80	80-100	80-100
40-50	40-50	30-40	30-40	40-50	40-50	40-50	40-50	60-80	60-80
30-40	30-40	20-30	20-30	30-40	30-40	30-40	30-40	50-60	50-60
20-30	20-30	20-30	20-30	20-30	20-30	-	-	-	-
20-30	20-30	20-30	20-30	20-30	20-30	-	-	-	-
50-60	50-60	50-60	50-60	50-60	50-60	60-80	60-80	-	-



LEGEND

n = rev. per minute
v_c = cutting speed (m/min)
f = pitch (mm)
v_f = feed rate (mm/min)

FORMULAS

$n = (v_c \times 1000) / (Ø \times \pi)$
$v_c = (Ø \times \pi \times n) / 1000$
$v_f = f \times n$

Sutton Tools

SLOTTING

ae = 1.0 x D
ap = 0.5 x D

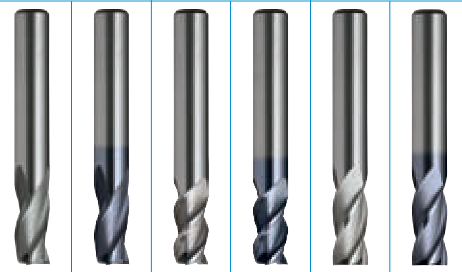
Catalogue Code	E600 / E504	E603 / E506	E310	E545
Material	VHM			VHM-ULTRA
Surface Finish	Brt	TiAlN AlCrN	Brt	AlCrN
Colour Ring & Application	<1600N/mm²		Al	UNI
Geometry	R30		R40	R45 STF (Uneq. Flute)

Materials	HB	N/mm²	% Elong.	Material eg.	E600 / E504 Vc (m/min)	Feed #	E603 / E506 Vc (m/min)	Feed #	E310 Vc (m/min)	Feed #	E545 Vc (m/min)	Feed #
1.0 Steels												
1.1 Mild steels, magnetic soft steel	<200	>200 <400	10	RFe100	80-100	10	100-120	10	-	-	250-320	9
1.2 Free cutting, structural, unalloyed	<200	>350 <700	30	C10, C15, ST37, ST52	80-100	10	100-120	10	-	-	250-320	9
1.3 Plain carbon, low alloyed	<300	>350 <850	20	C45, C92D, D95-S	70-90	10	90-110	10	-	-	210-300	9
1.4 Alloy steels harden. / tempered	<250	>500 <850	30	41CrMo4, 36CrNiMo4, X155CrVMo12-1, 90MnV8	65-80	8	80-100	8	-	-	170-250	6
1.5 Alloy steels harden. / tempered	<350	>850 <1200	30		50-65	6	60-80	6	-	-	130-200	4
1.6 Hardened, heat treated, high tensile alloy	<420	>1500	12		40-55	6	50-70	6	-	-	60-70	3
1.7 Hardened Steel 45-50 Rc	<550		<12		30-45	6	35-55	6	-	-	-	-
1.8 Hardened Steel 50-62 Rc	<700		<12	HS2-10-1-8	-	-	-	-	-	-	-	-
2.0 Stainless Steels												
2.1 Free machining	<250	<850	25	X8CrNiS18-9	55-70	9	70-90	9	-	-	110-140	5
2.2 Austenitic	<250	<850	20	X5CrNi18-10	50-65	9	60-80	9	-	-	80-120	5
2.3 Ferritic + martensitic	<250	<850	20	X20Cr13	40-55	8	50-70	8	-	-	60-80	3
3.0 Cast Irons												
3.1 Lamellar graphite (Grey soft)	<150	<500	10	GG10, GG40	80-100	10	100-120	10	-	-	210-250	8
3.2 Lamellar graphite (Grey hard)	<300	<1000	10	GGG40, GGG80	65-80	10	80-100	10	-	-	140-170	8
3.3 Nodular (spheroidal) graphite & malleable	<200	<700	10		50-65	10	60-80	10	-	-	100-150	8
4.0 Titaniums												
4.1 Pure Titanium	<250	<850	20	Ti99.7, Ti99.8	35-50	5	45-65	5	-	-	50-70	5
4.2 Titanium alloys	>250	>850	20	TiCu2, TiAl6V4	30-50	5	40-60	5	-	-	40-60	5
5.0 Nickels												
5.1 Nickel alloys	<250	<850	25	Ni38, Ni54, NiCr16FeTi	35-50	5	45-65	5	-	-	50-70	5
5.2 Nickel alloys	>250	>850	25		30-50	5	40-60	5	-	-	40-60	5
6.0 Coppers												
6.1 Pure Copper (electrolytic copper)	<120	<400	12	SF-Cu	80-100	8	100-120	8	110-130	14	300-350	4
6.2 Short chip Brass, Phosphor Bronze, gun metal	<200	<700	12	G-CuSn12Ni	65-80	8	80-100	8	-	-	200-250	4
6.3 Long chip Brass, Bronze	<200	<700	12	G-CuPb20Sn	70-90	8	90-110	8	90-110	13	200-250	4
7.0 Aluminiums												
7.1 Aluminium unalloyed	<100	<350	15	Al99.5	80-90	8	100-110	8	110-130	14	-	-
7.2 Magnesium unalloyed	<150	<350	15	Al99.85Mg0.5	80-90	8	100-110	8	110-130	14	-	-
7.3 Al Alloyed Si < 1.5 %	<120	<500	15	AlMg1.5	65-70	8	80-90	8	100-120	14	-	-
7.4 Al Alloyed 1.5 % < Si < 10%	<120	<400	10	AlSi10Mg	55-65	8	70-80	8	90-110	13	-	-
7.5 Al Alloyed > 10% Si	-	<400	N	AlSi17Cu4	50-55	8	60-70	8	70-90	13	-	-
7.6 Magnesium alloys	-	<400	N	MgAl3Zn	50-55	8	60-70	8	70-90	13	-	-
8.0 Plastics												
8.1 Plastics, Thermoplastics, Polyethylene	<340	<50	N	ABS, PV C, Polycarbonate	145-160	8	180-200	8	250-270	8	-	-

FINISHING

ae = 0.1 x D
ap = 1.5 x D

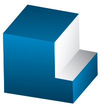
Catalogue Code	E513	E515	E521	E523	E601 / E529	E604 / E531
Material	VHM					
Surface Finish	Brt	AlCrN	Brt	AlCrN	Brt	TiAlN AlCrN
Colour Ring & Application	<1600N/mm²		W		<1600N/mm²	
Geometry	R30		R45			

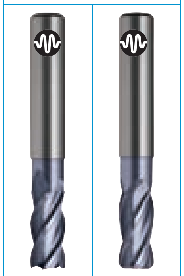
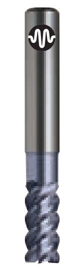


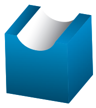
Materials	E513 Vc (m/min)	Feed #	E515 Vc (m/min)	Feed #	E521 Vc (m/min)	Feed #	E523 Vc (m/min)	Feed #	E601 / E529 Vc (m/min)	Feed #	E604 / E531 Vc (m/min)	Feed #
1.0 Steels												
1.1 Mild steels, magnetic soft steel	150-170	13	185-210	13	160-175	13	200-220	13	160-175	9	200-220	9
1.2 Free cutting, structural, unalloyed	130-150	13	160-185	13	135-160	13	170-200	13	160-175	9	200-220	9
1.3 Plain carbon, low alloyed	120-140	13	150-175	13	120-145	13	150-180	13	135-150	9	170-190	9
1.4 Alloy steels harden. / tempered	100-120	11	125-150	11	105-120	11	130-150	11	120-135	7	150-170	7
1.5 Alloy steels harden. / tempered	85-105	8	105-130	8	-	-	-	-	80-95	5	100-120	5
1.6 Hardened, heat treated, high tensile alloy	70-90	8	90-110	8	-	-	-	-	65-80	4	80-100	4
1.7 Hardened Steel 45-50 Rc	55-75	8	70-95	8	-	-	-	-	50-65	4	60-80	4
1.8 Hardened Steel 50-62 Rc	40-60	7	50-75	7	-	-	-	-	-	-	-	-
2.0 Stainless Steels												
2.1 Free machining	90-110	11	110-140	11	95-105	11	120-130	11	70-90	8	90-110	8
2.2 Austenitic	80-100	11	100-125	11	-	-	-	-	55-70	8	70-90	8
2.3 Ferritic + martensitic	60-80	9	75-100	9	-	-	-	-	50-65	7	60-80	7
3.0 Cast Irons												
3.1 Lamellar graphite (Grey soft)	130-150	13	160-185	13	-	-	-	-	120-135	15	150-170	15
3.2 Lamellar graphite (Grey hard)	100-120	13	125-150	13	-	-	-	-	95-110	11	120-140	11
3.3 Nodular (spheroidal) graphite & malleable	80-100	13	100-125	13	-	-	-	-	65-80	9	80-100	9
4.0 Titaniums												
4.1 Pure Titanium	55-75	6	70-95	6	-	-	-	-	55-70	7	70-90	7
4.2 Titanium alloys	45-65	6	55-80	6	-	-	-	-	40-55	5	50-70	5
5.0 Nickels												
5.1 Nickel alloys	45-65	6	55-80	6	-	-	-	-	55-70	7	70-90	7
5.2 Nickel alloys	40-60	6	50-75	6	-	-	-	-	40-55	5	50-70	5
6.0 Coppers												
6.1 Pure Copper (electrolytic copper)	300-320	10	375-400	10	280-320	10	350-400	10	90-105	11	110-130	11
6.2 Short chip Brass, Phosphor Bronze, gun metal	220-240	10	275-300	10	200-240	10	250-300	10	90-105	10	110-130	10
6.3 Long chip Brass, Bronze	200-220	10	250-275	10	200-240	10	250-300	10	70-90	11	90-110	11
7.0 Aluminiums												
7.1 Aluminium unalloyed	300-320	10	375-400	10	280-320	10	350-400	10	90-105	11	110-130	11
7.2 Magnesium unalloyed	300-320	10	375-400	10	280-320	10	350-400	10	90-105	11	110-130	11
7.3 Al Alloyed Si < 1.5 %	300-320	10	375-400	10	280-320	10	350-400	10	80-95	11	100-120	11
7.4 Al Alloyed 1.5 % < Si < 10%	250-270	10	310-335	10	240-280	10	300-350	10	70-90	11	90-110	11
7.5 Al Alloyed > 10% Si	200-220	10	250-275	10	240-280	10	300-350	10	55-70	11	70-90	11
7.6 Magnesium alloys	250-270	10	310-335	10	240-280	10	300-350	10	55-70	11	70-90	11
8.0 Plastics												
8.1 Plastics, Thermoplastics, Polyethylene	250-280	10	310-350	10	240-280	10	300-350	10	200-215	10	250-270	10

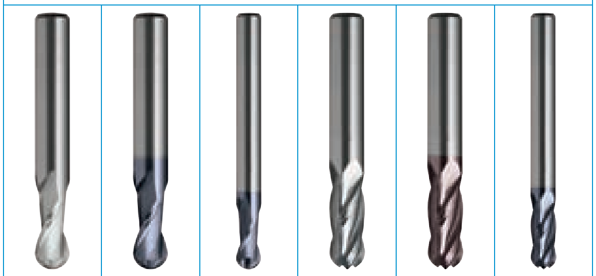
Notes on Milling

1. Above values are guidelines for the size and type of cut nominated.



FINISHING				FINISHING		ROUGHING					
ae = 0.1 x D ap = 1.5 x D				ae = 0.02 x D ap = 1 x D		ae = 0.5 x D ap = 1.5 x D					
E535		E559		E543		E545		E547		E549	
VHM-ULTRA				VHM-ULTRA		VHM-ULTRA		VHM		VHM-ULTRA	
AlCrN				AlCrN		AlCrN					
UNI				VH		UNI		<1600N/mm^2		UNI	
R35/38				R45		R45 STF (Uneq. Flute)		R30 NR		R45 HRS	
											
Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #
200-240	15	200-240	15	-	-	250-320	12	160-180	12	140-160	12
200-240	15	200-240	15	-	-	250-320	12	160-180	12	120-140	12
180-220	15	180-220	15	-	-	210-300	12	110-130	12	110-130	12
140-160	13	140-160	13	-	-	170-250	9	60-80	6	85-105	7
95-115	10	95-115	10	90-100	10	130-200	7	50-70	5	70-90	6
80-100	10	80-100	10	80-90	10	70-80	6	-	-	60-80	6
65-85	10	65-85	10	60-70	10	-	-	-	-	45-65	6
50-70	8	50-70	8	40-50	8	-	-	-	-	-	-
90-100	12	90-100	12	-	-	120-150	8	-	-	90-110	8
80-90	12	80-90	12	-	-	90-130	8	-	-	80-100	8
90-100	12	90-100	12	-	-	70-100	6	-	-	65-85	6
150-170	15	150-170	15	-	-	210-250	11	100-120	10	130-150	11
120-140	15	120-140	15	100-120	10	140-170	11	-	-	100-120	11
100-120	15	100-120	15	80-90	9	100-150	11	-	-	80-100	11
70-90	8	70-90	8	-	-	50-70	8	-	-	50-70	8
60-80	8	60-80	8	-	-	40-60	8	-	-	45-65	8
60-80	8	60-80	8	-	-	50-70	8	-	-	50-70	8
50-70	8	50-70	8	-	-	40-60	8	-	-	40-60	8
-	-	-	-	-	-	400-450	7	-	-	300-320	7
280-300	12	280-300	12	120-150	11	200-250	7	-	-	240-260	7
-	-	-	-	-	-	200-250	7	-	-	200-220	7
300-400	15	300-400	15	-	-	-	-	300-320	8	300-320	7
300-400	15	300-400	15	-	-	-	-	300-320	8	300-320	7
300-400	15	300-400	15	-	-	-	-	300-320	8	300-320	7
250-300	15	250-300	15	-	-	-	-	250-270	6	250-270	7
200-250	15	200-250	15	-	-	-	-	220-240	6	220-240	7
200-250	15	200-250	15	-	-	-	-	250-270	6	250-270	7
150-170	7	150-170	7	-	-	-	-	240-260	-	240-260	7



PROFILING											
ae = 0.02-0.05 x D ap = 0.05 x D											
E551 / E602		E605 / E553		E555		E606		E607		E557	
VHM				VHM-ULTRA		VHM				VHM-ULTRA	
Brt		TiAlN / AlCrN		AlCrN		Brt		TiAlN		AlCrN	
<1600N/mm^2											
R30											
											
Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #
130-145	10	160-180	10	90-110	9	130-145	10	160-180	10	90-110	9
130-145	10	160-180	10	90-110	9	130-145	10	160-180	10	90-110	9
110-130	10	140-160	10	80-100	9	110-130	10	140-160	10	85-95	9
80-100	9	100-120	9	50-60	8	80-100	9	100-120	9	50-60	8
35-45	9	45-55	9	25-35	8	35-45	9	45-55	9	25-35	8
35-45	9	45-55	9	25-35	8	35-45	9	45-55	9	25-35	8
30-40	8	40-50	8	-	-	30-40	8	40-50	8	-	-
-	-	-	-	-	-	-	-	-	-	-	-
50-60	5	65-75	5	35-45	4	50-60	5	65-75	5	35-45	4
45-50	5	55-65	5	30-40	4	45-50	5	55-65	5	30-40	4
35-45	5	45-55	5	25-35	4	35-45	5	45-55	5	25-35	4
120-135	14	150-170	14	90-110	13	120-135	14	150-170	14	90-110	13
70-90	12	90-110	12	50-70	11	70-90	12	90-110	12	50-70	11
135-150	13	170-190	13	100-120	12	135-150	13	170-190	13	100-120	12
60-70	7	75-85	7	45-55	6	60-70	7	75-85	7	45-55	6
50-55	4	60-70	4	35-45	3	50-55	4	60-70	4	35-45	3
45-50	5	55-65	5	30-40	4	45-50	5	55-65	5	30-40	4
-	-	-	-	-	-	-	-	-	-	-	-
175-215	12	220-270	12	130-150	11	175-215	12	220-270	12	130-150	11
110-150	10	140-190	10	90-110	9	110-150	10	140-190	10	90-110	9
145-185	12	180-230	12	110-130	11	145-185	12	180-230	12	110-130	11
175-215	13	220-270	13	130-150	12	175-215	13	220-270	13	130-150	12
175-215	13	220-270	13	130-150	12	175-215	13	220-270	13	130-150	12
160-200	13	200-250	13	120-140	12	160-200	13	200-250	13	120-140	12
145-185	12	180-230	12	110-130	11	145-185	12	180-230	12	110-130	11
110-150	11	140-190	11	90-110	10	110-150	11	140-190	11	90-110	10
110-150	11	140-190	11	90-110	10	110-150	11	140-190	11	90-110	10
145-1600	8	180-200	8	180-200	8	145-1600	8	180-200	8	180-200	8

Feed Table (f) (mm/tooth)

Ø	Feed No. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2.0	0.001	0.001	0.001	0.002	0.002	0.004	0.005	0.006	0.007	0.008	0.010	0.012	0.014	0.016	0.018	0.020
3.0	0.002	0.002	0.003	0.003	0.004	0.007	0.010	0.010	0.010	0.012	0.015	0.017	0.019	0.022	0.024	0.027
5.0	0.005	0.006	0.007	0.009	0.010	0.014	0.020	0.020	0.022	0.025	0.026	0.026	0.028	0.030	0.032	0.038
6.0	0.006	0.008	0.009	0.011	0.013	0.017	0.020	0.024	0.027	0.029	0.031	0.033	0.035	0.036	0.039	0.043
8.0	0.010	0.012	0.014	0.016	0.019	0.024	0.029	0.032	0.034	0.036	0.038	0.041	0.045	0.048	0.052	0.063
10.0	0.013	0.015	0.018	0.021	0.024	0.030	0.036	0.039	0.044	0.049	0.053	0.058	0.063	0.067	0.071	0.075
12.0	0.016	0.018	0.022	0.026	0.030	0.036	0.046	0.048	0.052	0.059	0.063	0.072	0.079	0.085	0.090	0.100
16.0	0.020	0.023	0.027	0.031	0.038	0.045	0.052	0.059	0.063	0.071	0.079	0.087	0.095	0.100	0.110	0.120
20.0	0.022	0.028	0.033	0.038	0.045	0.056	0.065	0.073	0.080	0.090	0.096	0.100	0.110	0.120	0.130	0.140

LEGEND

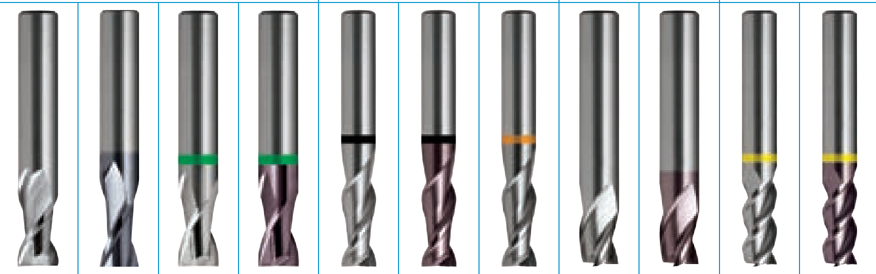
n = rev. per minute
vc = m/min
fz = mm/tooth
vf = mm/min
z = no. cutting edges
Q = metal removal rate (cm^3/min)

FORMULAS

$n = vc \times 1000 / Ø \times \pi$
$vc = Ø \times \pi \times n / 1000$
$fz = vf / z \times n$
$vf = fz \times z \times n$
$Q = ae \times ap \times vf / 1000$

Sutton Tools

SLOTTING

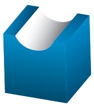


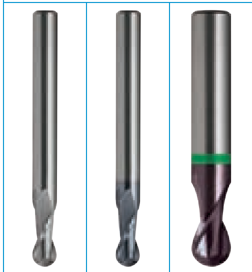
Catalogue Code					E100		E101		E108		E109		E110		E111		E112		E187		E188		E121		E122	
Material					HSS Co.8		HSS Co.8		SPM		SPM		HSS Co.8		HSS Co.8		HSS Co.8		HSS Co.8		HSS Co.8		SPM		SPM	
Surface Finish					Brt		TiCN		Brt		TiAlN		Brt		TiAlN		CrN		Brt		TiAlN		Brt		TiAlN	
Colour Ring & Application					N		N		UNI		UNI		Al		Al		Cu		N		N		W		W	
Geometry					R30		R30		R30		R30		R40		R40		R40		R30		R30		R45		R45	
Materials	**HB**	**N/mm²**	**% Elong.**	**Material eg.**	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #
1.0 Steels																										
1.1 Mild steels, magnetic soft steel	<200	>200 <400	10	RFe100	30	6	36	6	40	6	48	6	-	-	-	-	-	-	30	6	36	6	-	-	-	-
1.2 Free cutting, structural, unalloyed	<200	>350 <700	30	C10, C15, ST37, ST52	30	6	36	6	40	6	48	6	-	-	-	-	-	-	30	6	36	6	-	-	-	-
1.3 Plain carbon, low alloyed	<300	>350 <850	20	C45, C92D, D95-S	30	6	36	6	35	5	42	5	-	-	-	-	-	-	30	6	36	6	-	-	-	-
1.4 Alloy steels harden. / tempered	<250	>500 <850	30		25	5	30	5	25	5	30	5	-	-	-	-	-	-	25	5	30	5	-	-	-	-
1.5 Alloy steels harden. / tempered	<350	>850 <1200	30	41CrMo4, 36CrNiMo4, X155CrVMo12-1, 90MnV8	20	5	25	5	25	5	30	5	-	-	-	-	-	-	20	5	25	5	-	-	-	-
1.6 Hardened, heat treated, high tensile alloy	<420	>1500	12		15	4	18	4	20	4	24	4	-	-	-	-	-	-	15	4	18	4	-	-	-	-
1.7 Hardened Steel 45-50 Rc	<550		<12		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.8 Hardened Steel 50-62 Rc	<700		<12	HS2-10-1-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.0 Stainless Steels																										
2.1 Free machining	<250	<850	25	X8CrNiS18-9	15	5	18	5	20	5	24	5	-	-	-	-	-	-	15	5	18	5	-	-	-	-
2.2 Austenitic	<250	<850	20	X5CrNi18-10	12	3	15	3	15	3	18	3	-	-	-	-	-	-	12	3	15	3	-	-	-	-
2.3 Ferritic + martensitic	<250	<850	20	X20Cr13	-	-	-	-	12	4	15	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3.0 Cast Irons																										
3.1 Lamellar graphite (Grey soft)	<150	<500	10	GG10, GG40	30	5	35	5	40	5	48	5	-	-	-	-	-	-	30	5	35	-	-	-	-	-
3.2 Lamellar graphite (Grey hard)	<300	<1000	10	GGG40, GGG80	25	4	30	4	30	4	36	4	-	-	-	-	-	-	25	4	30	-	-	-	-	-
3.3 Nodular (spheroidal) graphite & malleable	<200	<700	10		20	3	25	3	25	3	30	3	-	-	-	-	-	-	20	3	25	-	-	-	-	-
4.0 Titaniums																										
4.1 Pure Titanium	<250	<850	20	Ti99.7, Ti99.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.2 Titanium alloys	>250	>850	20	TiCu2, TiAl6V4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.0 Nickels																										
5.1 Nickel alloys	<250	<850	25	Ni38, Ni54, NiCr16FeTi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.2 Nickel alloys	>250	>850	25		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.0 Coppers																										
6.1 Pure Copper (electrolytic copper)	<120	<400	12	SF-Cu	50	6	55	6	60	6	72	6	72	6	80	6	86	6	50	6	55	6	100	10	130	10
6.2 Short chip Brass, Phosphor Bronze, gun metal	<200	<700	12	G-CuSn12Ni	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.3 Long chip Brass, Bronze	<200	<700	12	G-CuPb20Sn	25	5	30	5	30	5	36	5	48	5	55	5	58	5	25	5	30	5	-	-	-	-
7.0 Aluminiums																										
7.1 Aluminium unalloyed	<100	<350	15	Al99.5	70	6	85	6	80	6	85	6	96	6	110	6	100	6	70	6	85	6	150	10	200	10
7.2 Magnesium unalloyed	<150	<350	15	Al99.85Mg0.5	70	6	85	6	80	6	85	6	96	6	110	6	100	6	70	6	85	6	150	10	200	10
7.3 Al Alloyed Si < 1.5 %	<120	<500	15	AlMg1.5	60	5	70	5	70	5	75	5	84	5	90	5	84	5	60	5	70	5	130	10	180	10
7.4 Al Alloyed 1.5 % < Si < 10%	<120	<400	10	AlSi10Mg	50	5	55	5	60	5	65	5	72	5	80	5	72	5	50	5	55	5	100	10	150	10
7.5 Al Alloyed > 10% Si	-	<400	N	AlSi17Cu4	30	6	35	6	40	6	45	5	48	6	60	6	48	6	30	6	35	6	-	-	-	-
7.6 Magnesium alloys	-	<400	N	MgAl3Zn	25	6	30	6	40	6	45	6	48	6	60	6	48	6	25	6	30	6	-	-	-	-
8.0 Plastics																										
8.1 Plastics, Thermoplastics, Polyethylene	<340	<50	N	ABS, PV C, Polycarbonate	60	5	100	5	90	5	120	5	130	6	150	6	150	5	80	5	100	5	150	10	200	10

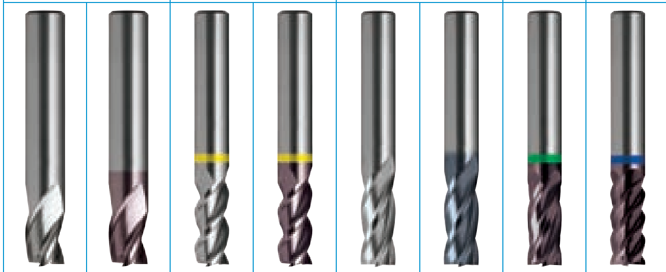
Notes on Milling

1. Above values are guidelines for the size and type of cut nominated.
2. For long series tools, reduce speed by 40% and feed by 20%.

PROFILING						FINISHING															
ae = 0.02-0.05 x D ap = 0.05 x D						ae = 0.1 x D ap = 1.5 x D															
E113		E114		E118		E187		E188		E121		E122		E125		E126		E134		E137	
HSS Co.8				SPM		HSS Co.8				SPM				HSS Co.8				SPM			
Brt		TiCN		TiAlN		Brt		TiAlN		Brt		TiAlN		Brt		TiCN		TiAlN			
N				UNI		N				W				N				UNI		VA	
R30						R30				R45				R30				30 / 32		R50	
Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #
45	5	50	5	90	6	40	5	50	5	-	-	-	-	40	5	50	5	70	8	70	7
45	5	50	5	90	6	40	5	50	5	-	-	-	-	40	5	50	5	70	8	70	7
45	5	50	5	90	6	40	5	50	5	-	-	-	-	40	5	50	5	70	7	70	6
40	4	45	4	80	5	30	5	40	5	-	-	-	-	30	4	40	5	60	7	40	6
30	4	40	4	55	5	25	4	30	4	-	-	-	-	25	4	30	4	50	7	40	6
20	4	25	4	45	5	20	4	25	4	-	-	-	-	22	4	25	4	40	5	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	4	25	4	40	5	20	4	25	4	-	-	-	-	17	4	20	4	30	5	30	6
17	2	20	2	35	3	15	2	18	2	-	-	-	-	13	2	15	2	22	3	25	4
14	4	18	4	30	4	-	-	-	-	-	-	-	-	10	3	12	3	18	4	20	5
40	4	50	4	80	5	-	-	-	-	-	-	-	-	35	4	40	4	60	5	-	-
28	3	35	3	60	4	-	-	-	-	-	-	-	-	25	3	30	3	50	4	-	-
23	2	30	2	50	3	-	-	-	-	-	-	-	-	22	2	5	2	40	3	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50	6	60	6	70	6	80	6	90	6	130	12	150	12	70	6	75	6	100	6	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	5	30	5	40	5	50	5	60	5	-	-	-	-	40	5	40	5	70	5	-	-
85	6	100	6	180	6	80	6	90	6	250	12	300	12	70	6	75	6	100	6	100	7
85	6	100	6	180	6	80	6	90	6	250	12	300	12	70	6	75	6	100	6	100	7
70	6	80	6	150	6	70	6	80	6	200	12	250	12	60	6	65	6	80	6	90	7
60	5	70	5	120	5	60	5	70	5	150	12	180	12	55	5	60	5	70	5	80	6
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	5	70	5	150	5	60	5	70	5	-	-	-	-	55	5	60	6	100	5	55	4







Feed Table (f) (mm/tooth)

Ø	Feed No. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2.0	0.001	0.001	0.001	0.002	0.002	0.004	0.005	0.006	0.007	0.008	0.010	0.012	0.014	0.016	0.018	0.020
3.0	0.002	0.002	0.003	0.003	0.004	0.007	0.010	0.010	0.010	0.012	0.015	0.017	0.019	0.022	0.024	0.027
5.0	0.005	0.006	0.007	0.009	0.010	0.014	0.020	0.020	0.022	0.025	0.026	0.026	0.028	0.030	0.032	0.038
6.0	0.006	0.008	0.009	0.011	0.013	0.017	0.020	0.024	0.027	0.029	0.031	0.033	0.035	0.036	0.039	0.043
8.0	0.010	0.012	0.014	0.016	0.019	0.024	0.029	0.032	0.034	0.036	0.038	0.041	0.045	0.048	0.052	0.063
10.0	0.013	0.015	0.018	0.021	0.024	0.030	0.036	0.039	0.044	0.049	0.053	0.058	0.063	0.067	0.071	0.075
12.0	0.016	0.018	0.022	0.026	0.030	0.036	0.046	0.048	0.052	0.059	0.063	0.072	0.079	0.085	0.090	0.100
16.0	0.020	0.023	0.027	0.031	0.038	0.045	0.052	0.059	0.063	0.071	0.079	0.087	0.095	0.100	0.110	0.120
20.0	0.022	0.028	0.033	0.038	0.045	0.056	0.065	0.073	0.080	0.090	0.096	0.100	0.110	0.120	0.130	0.140

LEGEND

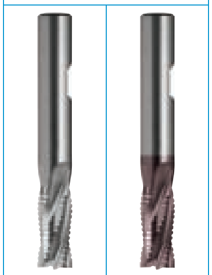
n = rev. per minute
vc = m/min
fz = mm/tooth
vf = mm/min
z = no. cutting edges
Q = metal removal rate (cm^3/min)

FORMULAS

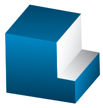
n = vc × 1000 / Ø × π
vc = Ø × π × n / 1000
fz = vf / z × n
vf = fz × z × n
Q = ae × ap × vf / 1000

SEMI FINISHING

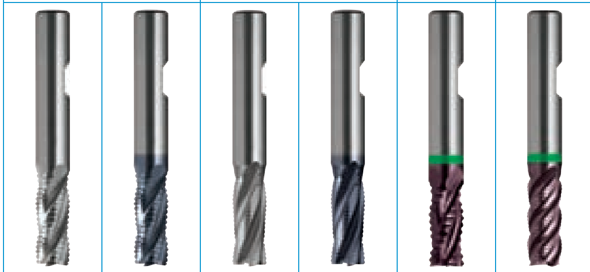
ae = 0.25 x D
ap = 1.5 x D



ROUGHING



ae = 0.5 x D
ap = 1.0 x D

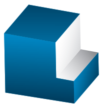


					SEMI FINISHING				ROUGHING											
				Catalogue Code	E201		E202		E140		E141		E166		E167		E150		E151	
				Material	HSS Co.8				HSS Co.8								SPM			
				Surface Finish	Brt		TiAlN		Brt		TiCN		Brt		TiCN		TiAlN			
				Colour Ring & Application	N				Soft-Med <22HRc				Med-Hard 22-40HRc				UNI			
				Geometry	R30 NF				R30 NR				R30 HR				R30 NR		R45 HRS	
Materials	**HB**	**N/mm²**	**% Elong.**	**Material eg.**	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #
1.0 Steels																				
1.1 Mild steels, magnetic soft steel	<200	>200 <400	10	RFe100	45	9	50	9	36	5	40	5	-	-	-	-	40	5	70	6
1.2 Free cutting, structural, unalloyed	<200	>350 <700	30	C10, C15, ST37, ST52	45	9	50	9	36	5	40	5	-	-	-	-	40	5	70	6
1.3 Plain carbon, low alloyed	<300	>350 <850	20	C45, C92D, D95-S	45	9	50	9	36	5	40	5	-	-	-	-	40	5	60	6
1.4 Alloy steels harden. / tempered	<250	>500 <850	30		45	9	50	9	-	-	-	-	38	3	40	3	35	4	40	5
1.5 Alloy steels harden. / tempered	<350	>850 <1200	30	41CrMo4, 36CrNiMo4, X155CrVMo12-1, 90MnV8	30	7	40	7	-	-	-	-	30	3	35	3	30	4	40	4
1.6 Hardened, heat treated, high tensile alloy	<420	>1500	12		18	6	25	6	-	-	-	-	25	3	30	3	30	4	30	4
1.7 Hardened Steel 45-50 Rc	<550		<12		-	-	-	-	-	-	-	-	25	2	30	2	25	2	-	-
1.8 Hardened Steel 50-62 Rc	<700		<12	HS2-10-1-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.0 Stainless Steels																				
2.1 Free machining	<250	<850	25	X8CrNiS18-9	20	5	25	5	-	-	-	-	30	4	35	4	-	-	25	4
2.2 Austenitic	<250	<850	20	X5CrNi18-10	18	5	20	5	-	-	-	-	20	2	25	2	-	-	15	2
2.3 Ferritic + martensitic	<250	<850	20	X20Cr13	11	4	15	4	-	-	-	-	15	3	20	3	-	-	15	3
3.0 Cast Irons																				
3.1 Lamellar graphite (Grey soft)	<150	<500	10	GG10, GG40	25	9	30	9	45	8	50	8	50	8	60	8	50	8	60	8
3.2 Lamellar graphite (Grey hard)	<300	<1000	10	GGG40, GGG80	25	9	30	9	25	8	30	8	30	8	40	8	-	-	40	8
3.3 Nodular (spheroidal) graphite & malleable	<200	<700	10		25	8	30	9	18	8	20	8	20	8	30	8	-	-	25	8
4.0 Titaniums																				
4.1 Pure Titanium	<250	<850	20	Ti99.7, Ti99.8	18	10	22	10	-	-	-	-	-	-	-	-	-	-	-	-
4.2 Titanium alloys	>250	>850	20	TiCu2, TiAl6V4	23	8	28	8	-	-	-	-	-	-	-	-	-	-	-	-
5.0 Nickels																				
5.1 Nickel alloys	<250	<850	25	Ni38, Ni54, NiCr16FeTi	18	5	20	5	-	-	-	-	-	-	-	-	-	-	-	-
5.2 Nickel alloys	>250	>850	25		8	5	10	5	-	-	-	-	-	-	-	-	-	-	-	-
6.0 Coppers																				
6.1 Pure Copper (electrolytic copper)	<120	<400	12	SF-Cu	60	15	70	15	-	-	-	-	-	-	-	-	55	7	-	-
6.2 Short chip Brass, Phosphor Bronze, gun metal	<200	<700	12	G-CuSn12Ni	71	11	80	11	-	-	-	-	25	5	30	5	-	-	-	-
6.3 Long chip Brass, Bronze	<200	<700	12	G-CuPb20Sn	60	15	60	15	-	-	-	-	-	-	-	-	37	7	-	-
7.0 Aluminiums																				
7.1 Aluminium unalloyed	<100	<350	15	Al99.5	80	16	90	16	80	9	90	9	-	-	-	-	70	5	120	9
7.2 Magnesium unalloyed	<150	<350	15	Al99.85Mg0.5	80	16	90	16	80	9	90	9	-	-	-	-	70	5	120	9
7.3 Al Alloyed Si < 1.5 %	<120	<500	15	AlMg1.5	70	16	80	16	80	9	90	9	-	-	-	-	65	5	120	9
7.4 Al Alloyed 1.5 % < Si < 10%	<120	<400	10	AlSi10Mg	50	16	60	16	55	8	65	8	-	-	-	-	55	4	80	8
7.5 Al Alloyed > 10% Si	-	<400	N	AlSi17Cu4	-	-	-	-	-	-	-	-	-	-	-	-	38	6	-	-
7.6 Magnesium alloys	-	<400	N	MgAl3Zn	-	-	-	-	-	-	-	-	-	-	-	-	38	6	-	-
8.0 Plastics																				
8.1 Plastics, Thermoplastics, Polyethylene	<340	<50	N	ABS, PV C, Polycarbonate	-	-	-	-	45	4	50	4	-	-	-	-	55	4	-	-

Notes on Milling

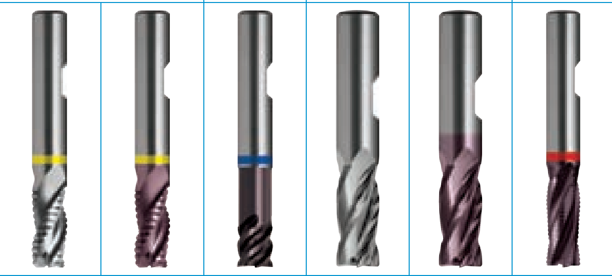
1. Above values are guidelines for the size and type of cut nominated.
2. For long series tools, reduce speed by 40% and feed by 20%.

ROUGHING



ae = 0.5 x D
ap = 1.0 x D

E152		E153		E157		E158		E159		E176	
SPM											
Brt		TiAlN				Brt		TiAlN			
W				VA		Ti				H	
R30 WR				R55°		R30				R30 HR	
Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #	Vc (m/min)	Feed #
-	-	-	-	35	6	-	-	-	-	-	-
-	-	-	-	35	6	-	-	-	-	-	-
-	-	-	-	25	6	-	-	-	-	-	-
-	-	-	-	15	4	-	-	-	-	40	4
-	-	-	-	15	4	-	-	-	-	40	4
-	-	-	-	-	-	-	-	-	-	30	2
-	-	-	-	-	-	-	-	-	-	20	2
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	30	6	-	-	-	-	-	-
-	-	-	-	20	6	-	-	-	-	-	-
-	-	-	-	20	6	-	-	-	-	25	6
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	60	6
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	20	9	32	9	40	9	30	5
-	-	-	-	15	9	20	9	30	9	15	4
-	-	-	-	-	-	-	-	-	-	25	4
-	-	-	-	7	15	-	-	-	-	15	4
58	8	70	8	49	7	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	30	6
38	8	45	8	33	7	-	-	-	-	-	-
77	6	90	6	52	5	-	-	-	-	-	-
77	6	90	6	52	5	-	-	-	-	-	-
67	6	75	6	48	5	-	-	-	-	-	-
58	5	65	5	40	4	-	-	-	-	-	-
40	7	50	7	-	-	-	-	-	-	-	-
40	7	50	7	-	-	-	-	-	-	-	-
-	-	-	-	55	4	-	-	-	-	-	-



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Feed Table (f) (mm/tooth)

Ø	Feed No. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2.0	0.001	0.001	0.001	0.002	0.002	0.004	0.005	0.006	0.007	0.008	0.010	0.012	0.014	0.016	0.018	0.020
3.0	0.002	0.002	0.003	0.003	0.004	0.007	0.010	0.010	0.010	0.012	0.015	0.017	0.019	0.022	0.024	0.027
5.0	0.005	0.006	0.007	0.009	0.010	0.014	0.020	0.020	0.022	0.025	0.026	0.026	0.028	0.030	0.032	0.038
6.0	0.006	0.008	0.009	0.011	0.013	0.017	0.020	0.024	0.027	0.029	0.031	0.033	0.035	0.036	0.039	0.043
8.0	0.010	0.012	0.014	0.016	0.019	0.024	0.029	0.032	0.034	0.036	0.038	0.041	0.045	0.048	0.052	0.063
10.0	0.013	0.015	0.018	0.021	0.024	0.030	0.036	0.039	0.044	0.049	0.053	0.058	0.063	0.067	0.071	0.075
12.0	0.016	0.018	0.022	0.026	0.030	0.036	0.046	0.048	0.052	0.059	0.063	0.072	0.079	0.085	0.090	0.100
16.0	0.020	0.023	0.027	0.031	0.038	0.045	0.052	0.059	0.063	0.071	0.079	0.087	0.095	0.100	0.110	0.120
20.0	0.022	0.028	0.033	0.038	0.045	0.056	0.065	0.073	0.080	0.090	0.096	0.100	0.110	0.120	0.130	0.140

LEGEND

n = rev. per minute
vc = m/min
fz = mm/tooth
vf = mm/min
z = no. cutting edges
Q = metal removal rate (cm^3/min)

FORMULAS

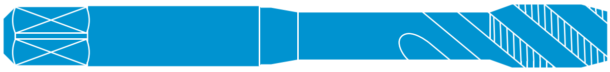
$n = vc \times 1000 / Ø \times \pi$
$vc = Ø \times \pi \times n / 1000$
$fz = vf / z \times n$
$vf = fz \times z \times n$
$Q = ae \times ap \times vf / 1000$

Sutton Tools

Code	Problem
1	Breaking of drill
2	Outer corner breaks down
3	Cutting edges chip
4	Lands chip
5	Drill splits up centre
6	Drill will not enter work
7	Hole rough
8	Hole oversize
9	Tang Breaks

1	2	3	4	5	6	7	8	9	Solution
●					●	●			Dull point
●									Drill has front taper due to wearing
●				●	●				Insufficient lip clearance on point
●		●							Lip clearance too great
●									Drill in incorrectly point ground
●	●								Flutes clogged with chips
●									Spring or backlash in drill press, fixture or work
●		●		●		●			Feed too heavy
	●								Cutting speed too high
	●					●			Dry cutting, no lubricant at cutting edges
	●								Hard spots in workpiece material
			●						Oversize jig bushing
					●				Drill web (core) diameter too big
						●			Fixture/Clamping not rigid
							●		Unequal angle or Uneven length of cutting edges
							●		Spindle run-out/Loose spindle
								●	Bad fit between shank taper & socket. The drive & alignment is controlled by the taper fit.

Sutton Tools



Code	Problem
1	Thread is oversize
2	Axial miscutting of thread
3	Thread is undersize
4	Thread has bellmouthed entry
5	Thread surface is rough and unclean
6	Low tool life
7	Partial or complete tap breakage on FORWARD or BACKWARD movement

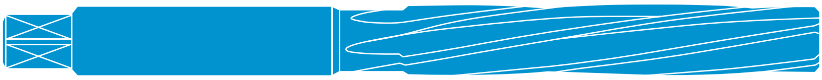
1	2	3	4	5	6	7	Possible reason	Solution
●		●	●	●	●	●	Wrong tap, cutting geometry of the tap is not suitable for this operation	Use correct tap for the material group (see Expert Tool System, at www.sutton.com.au)
●				●	●		Tap hole diameter is undersize	Tap hole diameter should be in accordance to DIN336 or respective standard. For cold forming taps, a special hole diameter is needed.
●			●			●	Misalignment - tap hole position, or angle is not correct	a) check workpiece clamping b) check machine settings
●							The axial machine spindle movement is not free and easy	a) use mechanical feed b) use tap holder with length compensation
●							Cold welding on the thread flanks of the tap	a) use a new tap b) improve and check lubrication c) remove cold welding area from tap d) use tap with surface treatment or coatings
●							Poor guidance of the tap because of little thread depth	a) use mechanical feed b) use tap that has better guiding characteristics
●				●	●		Speed is too high	a) improve lubrication b) lower speed
●				●	●		Chip clogging	a) use tap with different flute form b) use coated taps c) use tap set
●				●	●		The lubrication wrong, additives or the coolant supply is not sufficient	Make sure that the coolant is correct and that the supply is sufficient
	●						Spiral fluted taps are over pressured in the initial cutting phase (retracting pulling force)	Spiral fluted taps should only be lightly pushed into the tap hole until it begins to cut. The tap holder should immediately begin to apply tension to the tap.
	●						Spiral pointed taps (gun taps) are not receiving enough pressure in the initial cutting phase	Spiral pointed taps and even left hand spiral flute taps must have a stronger pressure until they begin to cut. The tap holder should immediately begin to apply pressure to the tap (pushing force)
●		●					Tolerance on the tap is not identical to the tolerance on the drawing or on the gauge	Use a tap which has a correct tolerance
			●				Wrong initial cutting pressure has been used or the machine spindle is not moving along its axis free and easy	a) use mechanical feed b) use tap holder with length compensation
				●	●		Tap is over loaded, either from coarse pitch and/or tough material	Use set of taps
					●		Cold welding, material build-up (pick-up)	a) improve coolant supply, use taps with surface treatments or coatings b) check if surface treatment is correct for this application
					●	●	Hardened walls in drilled hole	a) use drill best suited to material being drilled b) use new drill or boring tool c) resharpen drilling or boring tools d) if possible, heat treatment and coatings should only be made after threading
						●	Over loading of teeth in the chamfer area	a) use a longer chamfer (check if the tap hole is blind hole or through) b) use increased number of teeth in the chamfer area by selecting tap with increased number of flutes
						●	Tap hole chamfer is missing or wrong	Countersink tap hole chamfer with correct angle
						●	Tap crashed against the bottom of tap hole	Use tap holder with length compensation and over load clutch

Sutton Tools

Code	Problem	Possible reason
1	Poor Workpiece Finish	Cutting edge wear, cutter radial run-out
2	Splintering of workpiece edge	Unsuitable cutting conditions, unsuitable shape of cutting edge
3	Non-parallel or uneven surface	Low stiffness of the cutter or of the workpiece (loose)
4	Extreme flank wear	Unsuitable cutting conditions, unsuitable shape of cutting edge
5	Extreme crater wear	
6	Breaks and shelling due to thermal shock	
7	Formation of built-up edges	
8	Poor chip clearance, chip blockage	
9	Lack of Rigidity	Difficult cutting conditions, clamping of the workpiece
10	End mill cutter breaks	Unsuitable cutting conditions, flute length of the cutter

1	2	3	4	5	6	7	8	9	10	Solution
●						●	●			increase cutting speed
			●	●				●		reduce cutting speed
						●	●			increase feed rate
●	●	●		●	●		●	●	●	reduce feed rate
●	●	●		●	●			●	●	reduce cutting depth
							●	●	●	change cutter diameter and cut width
●			●	●		●	●			check use of cooling lubricant, flush swarf away
	●	●	●	●	●	●	●	●		increase clearance angle (Radial relief)
	●			●	●					increase wedge angle (Rake angle)
	●									increase number of teeth
		●					●	●	●	reduce number of teeth
							●			select larger chip space (Cutter)
●	●	●	●		●					change shape of minor cutting edge
		●			●					cutter - change radial run-out
	●	●			●			●	●	change cutter stiffness, flue length (l/D ratio)
	●	●			●			●		select machine with higher power and stiffness

Sutton Tools



Code	Problem
1	Breakage
2	Excessive wear
3	Chattering
4	Poor surface Finish

1	2	3	4	Possible reason	Solution
●		●		Dirt or burrs in spindle or socket in which reamer is held	clean spindle
●	●			Misalignment of two or more parts of the set-up. This condition can cause a bell-mouthed hole	align holes or use bridge style reamer
●	●	●	●	Too fast or too slow speeds	adjust
●	●	●	●	Too much or too little feed	adjust
	●			Wrong type of coolant	refer to lubricant supplier's literature
●				No lubricant between guide bushing and reamer	apply
	●		●	Lack of lubricant	increase
●				Bottoming in blind holes	reduce depth travel of reamer
		●		Lack of sufficient stock to ream	drill smaller hole
●	●		●	Too much stock to ream	drill larger hole
●		●		Entering work too fast	slow down the approach feed, until all cutting edges are located in the hole
●	●	●	●	Badly drilled holes – too rough, tapered or bell-mouthed. Bell-mouthed holes may cause the reamer to wedge rather than cut	replace drill
●		●		Oversize or undersize bushings	use suitable bush
●		●		Lack of rigidity in machine or work holder	improve rigidity
●	●		●	Improperly designed reamer for the job	

Sutton Tools

Trade Name	Coating	Coating Structure	Micro-hardness	Coeff. of Friction vs Steel	Thermal Stability	Colour	Application & Benefits
Brt	-	-	-	0.8 - 1.0	-	-	• For non-ferrous metals and plastics
Blu	Steam Oxide	-	-	0.8 - 1.0	-	Blue - Black	• For ferrous metals • Prevents chip build-up on the cutting edges, especially in low carbon steels • Oxide layer protects surface • Good carrier of lubricants
Ni	Plasma Nitride	-	-	0.8 - 1.0	-	-	• Increases surface hardness • Better lubricant carrying properties • Abrasive materials - cast iron and aluminium alloys
Futura Nano (TiAlN)	Titanium Aluminium Nitride	Nano Layer	3300 HV	0.3 - 0.35	up to 900ºC	Violet - Grey	• Abrasive materials - cast iron and heat treated steel • Difficult to machine materials, such as stainless steel • Higher speeds and feeds • Reduces or eliminates use of coolants
Hardlube	TiAlN + WC/C	Nano Layer	3000 HV	0.15-0.20	up to 800ºC	Dark Grey	• Excellent friction and lubricating properties of the coating provide optimal chip flow • Tapping and drilling of hard to machine materials • Suitable for minimum quantity lubrication (MQL) and dry machining
Alcrona (AlCrN)	Aluminium Chromium Nitride	Mono Layer	3200 HV	0.35	up to 1,100ºC	Blue - Grey	• Low alloy steels and high tensile steels • Hardened steels up to 54 HRC • Ideal for carbide tools
Helica	Alcrona based	Multi Layer	3000 HV	0.25	up to 1100ºC	Copper	• Longer tool life • Higher cutting speeds and feeds • Superb chip evacuation • Greater number of regrinds • Improved drill hole quality • Excellent performance in abrasive material
TiCN	Titanium Carbonitride	Gradient Coating	3000 HV	0.4	up to 400ºC	Blue - Grey	• High performance applications • Difficult to machine materials • Abrasive materials - cast iron and aluminium alloys • Adhesive materials - copper and copper based alloys
TiN	Titanium Nitride	Mono Layer	2300 HV	0.4	up to 600ºC	Gold - Yellow	• General purpose use • Wide range of materials • 3 to 8 times longer tool life than uncoated tools • Higher tool speeds and feeds than uncoated tools
CrN	Chromium Nitride	Gradient Coating	1750 HV	0.5	up to 700ºC	Silver - Grey	• Cutting and forming of copper, nickel, & monel metal • Enhanced thermal stability and oxidation resistance • Excellent corrosion resistance • Low internal stress of coating results in excellent adhesion under high loads

Latest advances in thin film coatings to optimise your machining application

Abbreviations	Type	Application	Description
HSS	Conventional high speed steel	Standard tool material for most common applications	Used for the manufacturing of cutting tools such as twist drills, end mills and taps. Yields consistent hardness levels following heat treatment providing for a reputable tool life.
HSS Co	5% cobalt grade of high speed steel	High-heat resistance, especially suited for roughing or when coolant insufficient	Cobalt alloyed, tungsten-molybdenum high speed steel possessing high hardness, excellent cutting properties, high-red hardness and good toughness.
HSSE Co8%	8% cobalt grade of high speed steel	Increased heat resistance & hardness, suitable for difficult-to-machine materials	Available for applications that require a strong resistance to softening at elevated cutting temperatures. The ability of the steel to maintain its “red-hot hardness” is provided by the addition of cobalt. The high hot hardness is required for machining difficult materials such as nickel-base, titanium and highly alloyed steel.
HSSE V3	Premium grade of high speed steel	Wide range of machine taps.	Vanadium grade gives high wear resistance and toughness for most tapping applications.
PM-HSSE V3	Powdered metallurgy - vanadium grade of high speed steel	Materials with hardness up to $40HR_c$ Difficult to machine materials eg. stainless steels.	PM-HSS V3 for higher performance tools, incorporates very fine and uniform grain structure allowing a high hardness to be achieved, whilst maintaining good toughness.
PM-HSS Co	Powdered metallurgy - 8% Cobalt grade of high speed steel	Materials with hardness up to $45HR_c$	The addition of cobalt provides this material with the ability to maintain its strength and hardness level when exposed to extremely high cutting temperatures. This makes PM-HSS Co suitable for heavy duty tapping, in materials such as high alloyed steels to non-ferrous metals like Ni-base alloys & Ti-alloys.
SPM	Powdered metallurgy - 11% Cobalt grade of high speed steel	Special applications, requiring very high edge hardness. Cutting tools with the appropriate geometry can be applied to workpiece materials with hardness up to $55HR_c$	An excellent bridge material between high speed steel and carbide. SPM offers very high red hardness, wear resistance and the highest compressive strength of any high speed steel.
VHM	Sub-micron grade of solid Carbide (ISO K15-K30)	Tapping hardened steel	Ultra fine grain type (0.8µm) with maximum toughness & high hardness, therefore especially recommended for rotating tools to machine hardened parts.
VHM	Sub-micron grade of solid Carbide (ISO K40)	Sutton standard grade for endmills & drills	Ultra fine grain type (0.6µm) offers the ideal combination of hardness & toughness for high performance drilling & general milling applications
VHM-ULTRA	Sub-micron grade of solid Carbide (ISO K40-K50)	High performance grade for endmills	Ultra fine grain type (0.5µm) offers the best wear resistance for high performance milling applications.

Computer controlled vacuum heat treatment ensures consistent high quality

Sutton Tools

Metric	Imperial	Inch	Gauge
0.010		0.0004	
0.100		0.0039	
0.150		0.0059	**97**
0.160		0.0063	**96**
0.170		0.0067	**95**
0.180		0.0071	**94**
0.190		0.0075	**93**
0.200		0.0079	**92**
0.210		0.0083	**91**
0.220		0.0087	**90**
0.230		0.0091	**89**
0.240		0.0094	**88**
0.254		0.0100	**87**
0.270		0.0106	**86**
0.280		0.0110	**85**
0.290		0.0114	**84**
0.300		0.0118	
0.305		0.0120	**83**
0.317		0.0125	**82**
0.330		0.0130	**81**
0.343		0.0135	**80**
0.368		0.0145	**79**
0.397	**1/64**	0.0156	
0.400		0.0157	
0.406		0.0160	**78**
0.457		0.0180	**77**
0.500		0.0197	
0.508		0.0200	**76**
0.533		0.0210	**75**
0.572		0.0225	**74**
0.600		0.0236	
0.610		0.0240	**73**
0.635		0.0250	**72**
0.660		0.0260	**71**
0.700		0.0276	
0.711		0.0280	**70**
0.742		0.0292	**69**
0.787		0.0310	**68**
0.794	**1/32**	0.0313	
0.800		0.0315	
0.813		0.0320	**67**
0.838		0.0330	**66**
0.889		0.0350	**65**
0.900		0.0354	
0.914		0.0360	**64**
0.940		0.0370	**63**
0.965		0.0380	**62**
0.991		0.0390	**61**
1.000		0.0394	
1.016		0.0400	**60**
1.041		0.0410	**59**

Metric	Imperial	Inch	Gauge
1.067		0.0420	**58**
1.092		0.0430	**57**
1.181		0.0465	**56**
1.191	**3/64**	0.0469	
1.321		0.0520	**55**
1.397		0.0550	**54**
1.511		0.0595	**53**
1.588	**1/16**	0.0625	
1.613		0.0635	**52**
1.702		0.0670	**51**
1.778		0.0700	**50**
1.854		0.0730	**49**
1.900		0.0748	
1.930		0.0760	**48**
1.984	**5/64**	0.0781	
1.994		0.0785	**47**
2.000		0.0787	
2.057		0.0810	**46**
2.083		0.0820	**45**
2.184		0.0860	**44**
2.261		0.0890	**43**
2.375		0.0935	**42**
2.381	**3/32**	0.0938	
2.438		0.0960	**41**
2.489		0.0980	**40**
2.527		0.0995	**39**
2.578		0.1015	**38**
2.642		0.1040	**37**
2.705		0.1065	**36**
2.778	**7/64**	0.1094	
2.794		0.1100	**35**
2.819		0.1110	**34**
2.870		0.1130	**33**
2.946		0.1160	**32**
3.000		0.1181	
3.048		0.1200	**31**
3.100		0.1220	
3.175	**1/8**	0.1250	
3.200		0.1260	
3.264		0.1285	**30**
3.300		0.1299	
3.400		0.1339	
3.454		0.1360	**29**
3.500		0.1378	
3.569		0.1405	**28**
3.572	**9/64**	0.1406	
3.600		0.1417	
3.658		0.1440	**27**
3.700		0.1457	
3.734		0.1470	**26**
3.797		0.1495	**25**

Metric	Imperial	Inch	Gauge
3.800		0.1496	
3.861		0.1520	**24**
3.900		0.1535	
3.912		0.1540	**23**
3.969	**5/32**	0.1563	
3.988		0.1570	**22**
4.000		0.1575	
4.039		0.1590	**21**
4.089		0.1610	**20**
4.100		0.1614	
4.200		0.1654	
4.216		0.1660	**19**
4.300		0.1693	
4.305		0.1695	**18**
4.366	**11/64**	0.1719	
4.394		0.1730	**17**
4.400		0.1732	
4.496		0.1770	**16**
4.500		0.1772	
4.572		0.1800	**15**
4.600		0.1811	
4.623		0.1820	**14**
4.700		0.1850	**13**
4.762	**3/16**	0.1875	
4.800		0.1890	**12**
4.851		0.1910	**11**
4.900		0.1929	
4.915		0.1935	**10**
4.978		0.1960	**9**
5.000		0.1969	
5.055		0.1990	**8**
5.100		0.2008	
5.105		0.2010	**7**
5.159	**13/64**	0.2031	
5.182		0.2040	**6**
5.200		0.2047	
5.220		0.2055	**5**
5.300		0.2087	
5.309		0.2090	**4**
5.400		0.2126	
5.410		0.2130	**3**
5.500		0.2165	
5.556	**7/32**	0.2188	
5.600		0.2205	
5.613		0.2210	**2**
5.700		0.2244	
5.791		0.2280	**1**
5.800		0.2283	
5.900		0.2323	
5.944		0.2340	**A**
5.953	**15/64**	0.2344	

Sutton Tools

Metric	Imperial	Inch	Gauge
6.000		0.2362	
6.045		0.2380	**B**
6.100		0.2402	
6.147		0.2420	**C**
6.200		0.2441	
6.248		0.2460	**D**
6.300		0.2480	
6.350	**1/4**	0.2500	**E**
6.400		0.2520	
6.500		0.2559	
6.528		0.2570	**F**
6.600		0.2598	
6.629		0.2610	**G**
6.700		0.2638	
6.747	**17/64**	0.2656	
6.756		0.2660	**H**
6.800		0.2677	
6.900		0.2717	
6.909		0.2720	**I**
7.000		0.2756	
7.036		0.2770	**J**
7.100		0.2795	
7.137		0.2810	**K**
7.144	**9/32**	0.2813	
7.200		0.2835	
7.300		0.2874	
7.366		0.2900	**L**
7.400		0.2913	
7.493		0.2950	**M**
7.500		0.2953	
7.541	**19/64**	0.2969	
7.600		0.2992	
7.671		0.3020	**N**
7.700		0.3031	
7.800		0.3071	
7.900		0.3110	
7.938	**5/16**	0.3125	
8.000		0.3150	
8.026		0.3160	**O**
8.100		0.3189	
8.200		0.3228	
8.204		0.3230	**P**
8.300		0.3268	
8.334	**21/64**	0.3281	
8.400		0.3307	
8.433		0.3320	**Q**
8.500		0.3346	
8.600		0.3386	
8.611		0.3390	**R**
8.700		0.3425	
8.731	**11/32**	0.3438	

Metric	Imperial	Inch	Gauge
8.800		0.3465	
8.839		0.3480	**S**
8.900		0.3504	
9.000		0.3543	
9.093		0.3580	**T**
9.100		0.3583	
9.128	**23/64**	0.3594	
9.200		0.3622	
9.300		0.3661	
9.347		0.3680	**U**
9.400		0.3701	
9.500		0.3740	
9.525	**3/8**	0.3750	
9.576		0.3770	**V**
9.600		0.3780	
9.700		0.3819	
9.800		0.3858	
9.804		0.3860	**W**
9.900		0.3898	
9.922	**25/64**	0.3906	
10.000		0.3937	
10.084		0.3970	**X**
10.200		0.4016	
10.262		0.4040	**Y**
10.319	**13/32**	0.4063	
10.490		0.4130	**Z**
10.500		0.4134	
10.716	**27/64**	0.4219	
10.800		0.4252	
11.000		0.4331	
11.112	**7/16**	0.4375	
11.200		0.4409	
11.500		0.4528	
11.509	**29/64**	0.4531	
11.800		0.4646	
11.906	**15/32**	0.4688	
12.000		0.4724	
12.200		0.4803	
12.303	**31/64**	0.4844	
12.500		0.4921	
12.700	**1/2**	0.5000	
12.800		0.5039	
13.000		0.5118	
13.097	**33/64**	0.5156	
13.494	**17/32**	0.5313	
13.500		0.5315	
13.891	**35/64**	0.5469	
14.000		0.5512	
14.288	**9/16**	0.5625	
14.500		0.5709	
14.684	**37/64**	0.5781	

Metric	Imperial	Inch	Gauge
15.000		0.5906	
15.081	**19/32**	0.5938	
15.478	**39/64**	0.6094	
15.500		0.6102	
15.875	**5/8**	0.6250	
16.000		0.6299	
16.272	**41/64**	0.6406	
16.500		0.6496	
16.669	**21/32**	0.6563	
17.000		0.6693	
17.066	**43/64**	0.6719	
17.462	**11/16**	0.6875	
17.500		0.6890	
17.859	**45/64**	0.7031	
18.000		0.7087	
18.256	**23/32**	0.7188	
18.500		0.7283	
18.653	**47/64**	0.7344	
19.000		0.7480	
19.050	**3/4**	0.7500	
19.447	**49/64**	0.7656	
19.500		0.7677	
19.844	**25/32**	0.7813	
20.000		0.7874	
20.241	**51/64**	0.7969	
20.500		0.8071	
20.638	**13/16**	0.8125	
21.000		0.8268	
21.034	**53/64**	0.8281	
21.431	**27/32**	0.8438	
21.500		0.8465	
21.828	**55/64**	0.8594	
22.000		0.8661	
22.225	**7/8**	0.8750	
22.500		0.8858	
22.622	**57/64**	0.8906	
23.000		0.9055	
23.019	**29/32**	0.9063	
23.416	**59/64**	0.9219	
23.500		0.9252	
23.812	**15/16**	0.9375	
24.000		0.9449	
24.209	**61/64**	0.9531	
24.500		0.9646	
24.606	**31/32**	0.9688	
25.000		0.9843	
25.003	**63/64**	0.9844	
25.400	**1**	1.0000	

Sutton Tools

Approx Tensile Strength vs Hardness

Tensile Strength			Hardness	
N/mm²	Kg/mm²	Tons/Inch²	Brinell Hb	Rockwell HR
400	40.8	26.0	119	69 HR_B
450	45.9	29.0	133	75 HR_B
500	50.1	32.4	149	81 HR_B
550	56.0	35.6	163	85.5 HR_B
600	61.0	38.9	178	89 HR_B
650	66.2	42.1	193	92 HR_B
700	71.4	45.3	208	95 HR_B
750	76.5	48.5	221	97 HR_B
800	81.6	51.8	238	22 HR_C
850	86.7	55.1	252	25 HR_C
900	91.8	58.3	266	27 HR_C
1000	102.0	64.7	296	31 HR_C
1100	112.2	71.2	325	35 HR_C
1200	122.4	77.7	354	38 HR_C
1300	132.6	84.1	383	41 HR_C
1400	142.8	90.5	408	44 HR_C
1500	152.9	97.0	444	47 HR_C
1600	163.1	103.5	461	49 HR_C
1700	173.3	109.9	477	50 HR_C
1800	183.5	116.4	514	52 HR_C
1900	193.7	122.9	549	54 HR_C
2000	203.9	129.3	584	56 HR_C
2100	214.1	135.8	607	57 HR_C
2200	224.3	142.2	622	58 HR_C
2300	233.1	148.7	653	60 HR_C

Manufacturing Tolerances

Nominal Diameter in mm above	up to and including	Tolerance Grade in Microns								1 Micron = 0.001mm	
		e6	h6	h7	h8	h9	h10	js10	js12	k9	k10
0	3	-14 -18	0 -6	0 -10	0 -14	0 -25	0 -40	+20 -20	+50 -50	+25 0	+40 0
3	6	-20 -38	0 -8	0 -12	0 -18	0 -30	0 -48	+24 -24	+60 -60	+30 0	+48 0
6	10	-25 -47	0 -9	0 -15	0 -22	0 -36	0 -58	+29 -29	+75 -75	+36 0	+58 0
10	18	-32 -59	0 -11	0 -18	0 -27	0 -43	0 -70	+35 -35	+90 -90	+43 0	+70 0
18	30	-40 -73	0 -13	0 -21	0 -33	0 -52	0 -84	+42 -42	+105 -105	+52 0	+84 0
30	50	-50 -89	0 -16	0 -25	0 -39	0 -62	0 -100	+50 -50	+125 -125	+62 0	+100 0
50	80	-60 -106	0 -19	0 -30	0 -46	0 -74	0 -120	+60 -60	+150 -150	+74 0	+120 0
80	120	-72 -126	0 -22	0 -35	0 -54	0 -87	0 -140	+70 -70	+175 -175	+87 0	+140 0

Sutton Tools

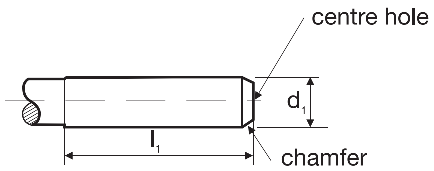
High Speed Steel Straight Shanks

DIN 1835

Form A (plain)

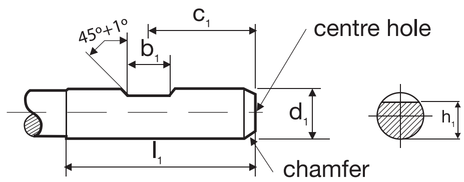
d_1 h6	l_1 +2 -0
3	28
4	28
5	28
6	36
8	36
10	40
12	45

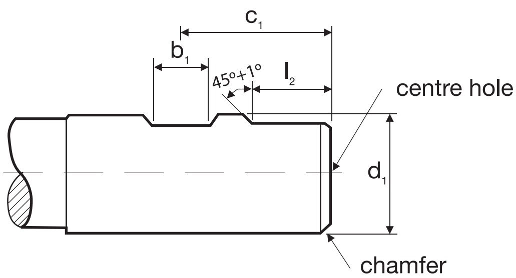
d_1 h6	l_1 +2 -0
16	48
20	50
25	56
32	60
40	70
50	80
63	90



Form B (with drive flat)

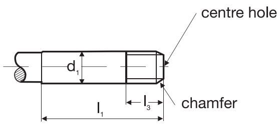
d_1 h6	b_1 +0.05 -0	c_1 0 -1	h_1 h13	l_1 +2 -0	l_2 +1 -0	centre hole form R DIN 332 part b
6	4.2	18	4.8	36	-	1.6 x 2.5
8	5.5	18	6.6	36	-	1.6 x 3.35
10	7	20	8.4	40	-	1.6 x 3.35
12	8	22.5	10.4	45	-	1.6 x 3.35
16	10	24	14.2	48	-	2.0 x 4.25
20	11	25	18.2	50	-	2.5 x 5.3
25	12	32	23	56	17	2.5 x 5.3
32	14	36	30	60	19	3.15 x 6.7
40	14	40	38	70	19	3.15 x 6.7
50	18	45	47.8	80	23	3.15 x 6.7
63	18	50	60.8	90	23	3.15 x 6.7

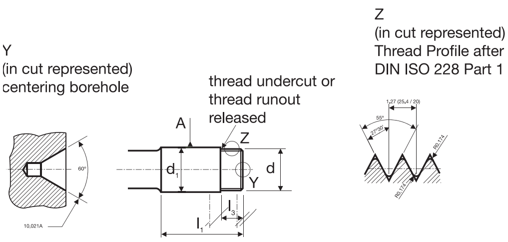




Form D (screwed shank)

d_1	l_1 +2 -0	l_3 +1 -0
6	36	10
10	40	10
12	45	10
16	48	10
20	50	15
25	56	15
32	60	15





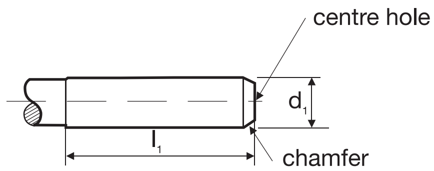
Sutton Tools

Carbide Straight Shanks

Form HA (plain)

d_1 h6	l_1 +2 -0
2	28
3	28
4	28
5	28
6	36
8	36
10	40

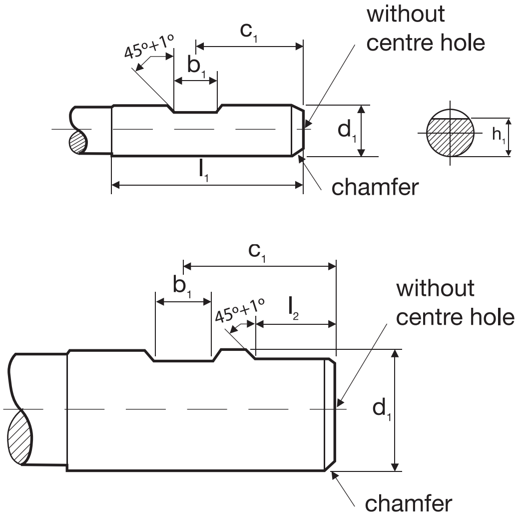
d_1 h6	l_1 +2 -0
12	45
14	45
16	48
18	48
20	50
25	56
32	60



Form HB (with drive flat)

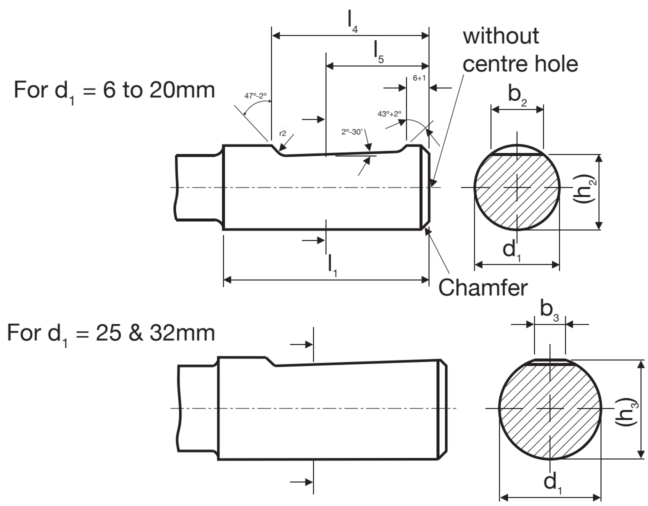
d_1 h6	b_1 +0.05 -0	c_1 0 -1	h_1 h11	l_1 +2 -0	l_2 +1 -0
6	4.2	18	4.8	36	-
8	5.5	18	6.6	36	-
10	7	20	8.4	40	-
12	8	22.5	10.4	45	-
14	8	22.5	12.7	45	-
16	10	24	14.2	48	-
18	10	24	16.2	48	-
20	11	25	18.2	50	-
25	12	32	23	56	17
32	14	36	30	60	19

6mm to 20mm = One Drive Flat
25mm & 32mm = Two Drive Flats



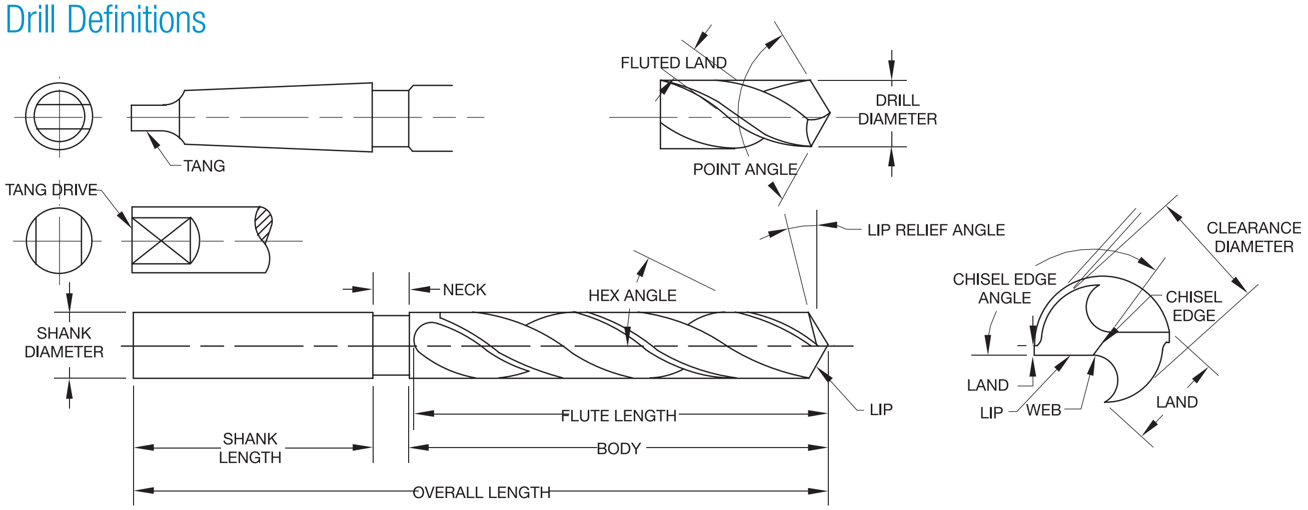
Form HE (with whistle notch flat)

d_1 h6	b_1 +0.05 -0	c_1 0 -1	h_1 h11	l_1 +2 -0	l_2 +1 -0
6	4.2	18	4.8	36	-
8	5.5	18	6.6	36	-
10	7	20	8.4	40	-
12	8	22.5	10.4	45	-
14	8	22.5	12.7	45	-
16	10	24	14.2	48	-
18	10	24	16.2	48	-
20	11	25	18.2	50	-
25	12	32	23	56	17
32	14	36	30	60	19



Sutton Tools

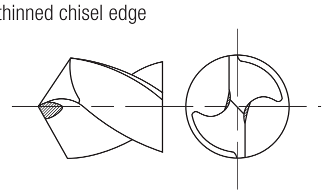
Drill Definitions



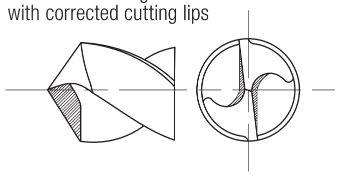
*Drills manufactured to ANSI B94-11. The overall length and flute length are measured to the corner of the outer lip.

Drill Point Types (DIN1412)

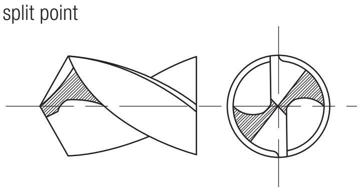
Type A
thinned chisel edge



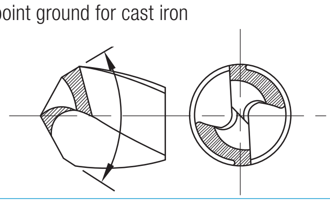
Type B
thinned chisel edge
with corrected cutting lips



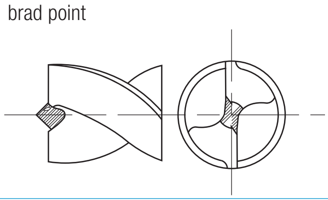
Type C
split point



Type D
point ground for cast iron



Type E
brad point



Drill Tolerances DIN / ISO 286, Part 2

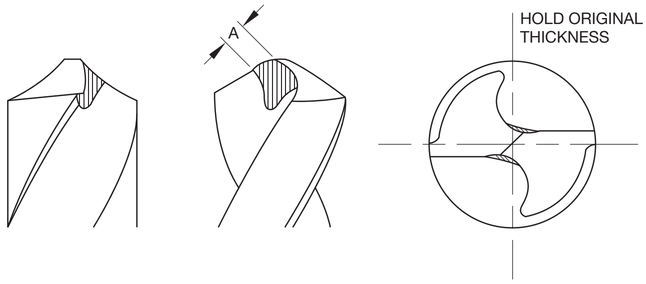
Drill Diameter at Point (mm)		Diameter Tolerance h8 (mm)		Back Taper (mm) (Tapering of Diameter)†		
Over	Inclusive	Plus (+)	Minus (-)			
0.20	3.00	0.000	0.014	0.000	to	0.008
3.00	6.00	0.000	0.018	0.002	to	0.008
6.00	10.00	0.000	0.022	0.002	to	0.009
10.00	18.00	0.000	0.027	0.003	to	0.011
18.00	30.00	0.000	0.033	0.004	to	0.015
30.00	50.00	0.000	0.039	0.004	to	0.015

† The Drill diameter usually reduces towards the shank end; tolerance per 10mm of flute length.

Sutton Tools

Web Thinning

On most drills the web increases in thickness towards the shank with the result that, as the drill is shortened by repeated sharpening, the chisel edge will become wider. As the chisel edge does not cut but forces the metal out of the way, too wide a chisel edge will result in more pressure required for penetration, leading to greater heat generation and a resultant loss of life.



Cutting Fluids

The use of cutting fluids is an advantage in most drilling operations and an essential in some.
The two main functions of the cutting fluid are lubrication and cooling.
The purpose of lubrication is to reduce friction by lubricating the surfaces tool and work, to facilitate easier sliding of the chips up the flute and to prevent the chips welding to the cutting edges.
In production work, particularly when drilling deep holes, the cooling action of the fluid is often more important than the lubrication. Overheating will shorten the life of the drill. Intermittent feed on deep holes, where possible, not only clears the chips but permits more effective cooling.

Speeds

The speed of a drill is the rate at which the periphery of the drill moves in relation to the work being drilled.
As a rule, with a drill working within its speed range for a specific material, more holes between sharpenings will be achieved if the speed is reduced and less holes if the speed is increased. Thus, for each production run, a speed must be established which will result in the highest rate of production without excessive breakdown time or drill usage.
The factors governing speed are: Component material, hardness of material, depth of hole, quality required, condition of drilling machine, efficiency of cutting fluid.

Feeds

The feed of the drill is governed by the drill size and the component material.
As with speeds, an increase in feed will lessen the number of holes produced sharpening but it is essential that a constant feed be maintained. If a drill is allowed to dwell, breakdown of the cutting edges will result.

Small Drill Feeds and Speeds

Breakdown of small drills can most often be attributed to two faults: speed too high and feed too low.
A feed which will produce CHIPS not POWDER, coupled with a speed compatible with the strength of the drill is essential for small hole drilling.
Feeds must be based on thickness of chip, not mm/min, and speeds adjusted accordingly. EXAMPLE: A 1mm drill is to operate at a feed of 0.013mm /rev, drilling steel.
While the material may permit a speed of 30m/min or 9,500 RPM it is obvious that the drill could not withstand a load of 0.013mm feed at this speed; a penetration rate of 124mm/min.
The correct procedure is to retain the feed but reduce the speed to obtain a penetration within the capacity of the strength of the drill.

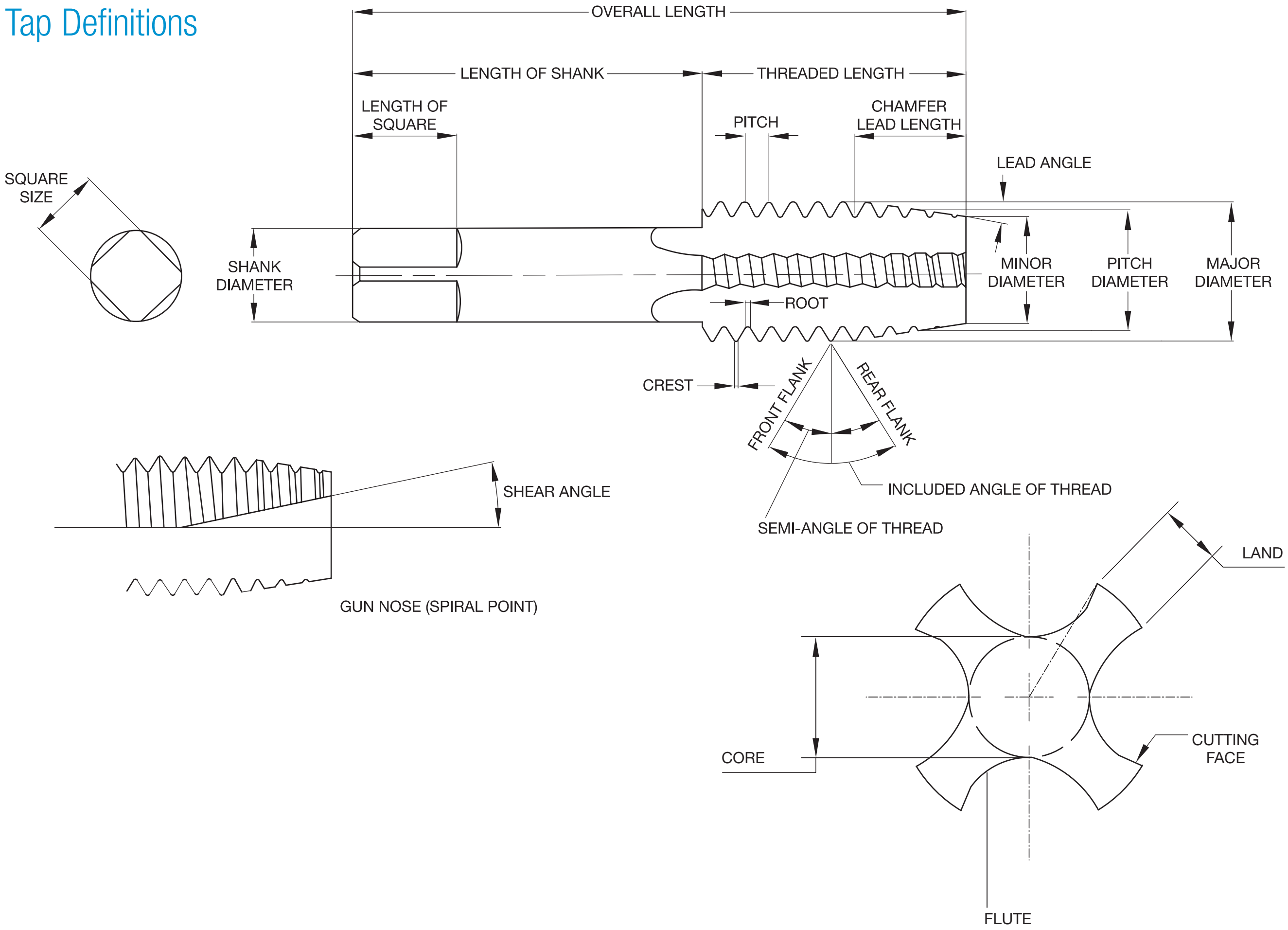
Deep Hole Drilling

When drilling deep holes, speeds and feeds should be reduced as follows:

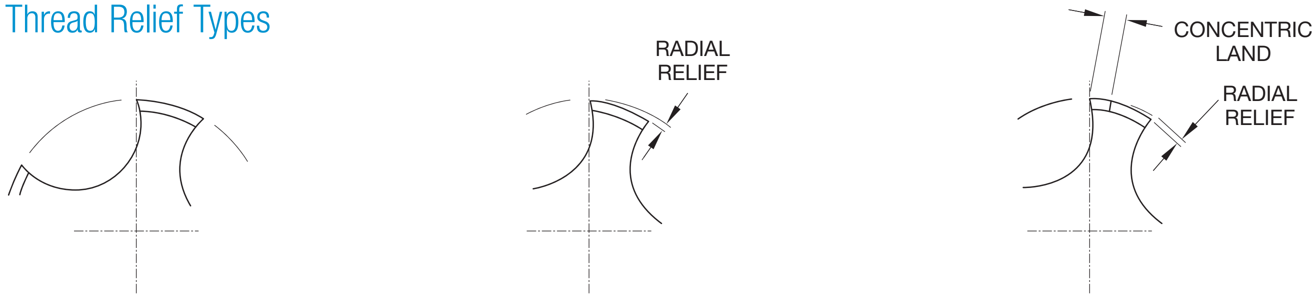
Depth of hole	Reduction per cent %	
	Speed	**Feed**
3 times drill diameter	10	10
4 times drill diameter	30	10
5 times drill diameter	30	20
6 to 8 times drill diameter	35 to 40	20

Sutton Tools

Tap Definitions



Thread Relief Types

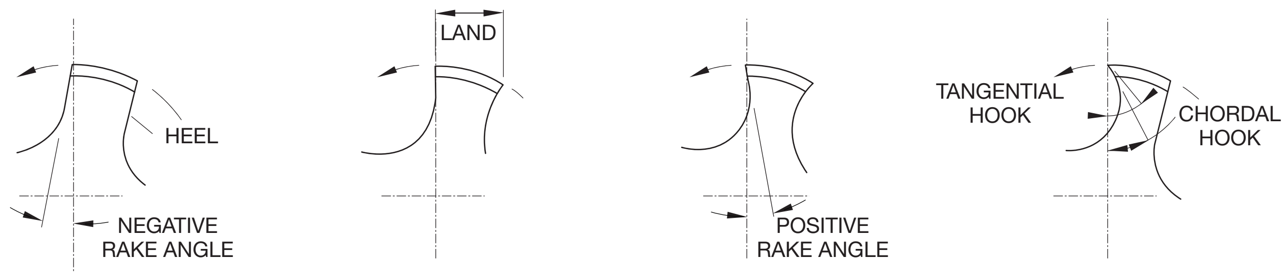


CONCENTRIC THREADS (No radial relief)

ECCENTRIC THREADS (Relieved to cutting edge)

CON-ECCENTRIC THREADS (Relieved to a land)

Cutting Faces



NEGATIVE RAKE

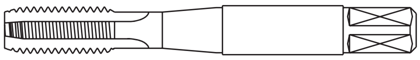
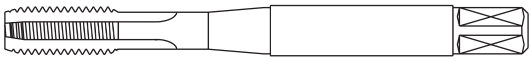
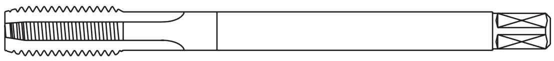
RADIAL RAKE

POSITIVE RAKE

HOOK

Construction dimensions / designs

The construction dimensions & designs of our taps, are manufactured in accordance to the various international standards listed below. The dimensions can be found in our catalogues, respective leaflets & our Expert Tool System situated on our website.

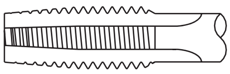
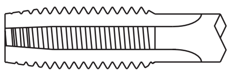
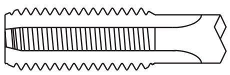
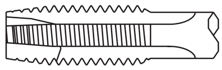
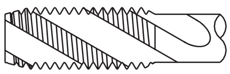
Style	Standard	Illustration
Short Machine & Hand Taps	ISO 529 JIS (J TYPE)	
Reinforced Shank Taps	DIN371	
Reduced Shank Taps	DIN374 / DIN376	

Exceptions are:

Pipe taps - Rc (BSPT), G (BSPF), Rp (BSPPL)	ISO2284 Standard
Pipe taps - NPT, NPTF, NPSF	ANSI B949 Standard
Machine Nut Taps	ANSI B949 Standard

Chamfer Type / Length

Table below is in accordance with ISO8830 / DIN2197

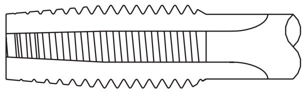
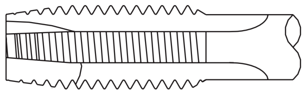
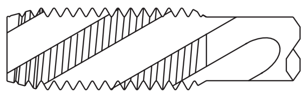
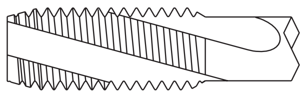
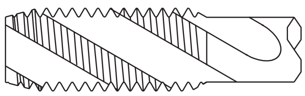
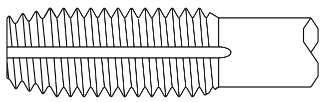
Terminology	Form	Number of threads on lead	Approx. chamfer angle	Type of flute	Main area of application	Illustration
TAPER	**A**	6 to 8	5°	Hand or straight flutes	Short through holes	
INTERMEDIATE	**D**	3.5 to 5	8°	Hand or straight	Generally for Through holes	
BOTTOMING	**E***	1.5 to 2	23°	Hand or straight flutes	Blind holes with very short thread runout	
INTERMEDIATE	**B**	3.5 to 5	10°	Straight, with spiral point	Through holes in medium & long chipping materials	
BOTTOMING	**C**	2 to 3	15°	Spiral fluted	Generally for blind holes	

* Use of this type is not recommended

Sutton Tools

Tap Types - Helix direction/ Helical pitch / Fluteless

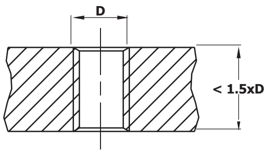
The helix angle depends primarily upon the hole form, eg. Through hole , blind hole, deep blind hole, etc., but the material, eg short chips, long chips, also has a strong influence on the direction of the helix. The following basic forms have derived during the development of taps:

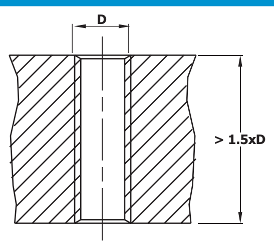
Description	Illustration
Straight Flutes (Hand) - Suitable for through or blind holes. The flutes only have room for a small amount of chips. The chips are not transported axially. Therefore, it is not advisable to cut deep through or blind holes (except in short chipping materials), with this type.	
Straight Flutes with (Gun) – Suitable for through holes, the gun point curls the chip forward ahead of the tap & out of the hole. Therefore, chip clogging is avoided and coolant can flow without problems.	
Spiral Flutes (LH Spiral) – Suitable for interrupted through holes, where cross-holes exist. The direction of the flutes, curls & transports the chips forward of the tap, similar to Gun taps (also, opposite to RH spiral flutes). However, in applications where another hole intersects with the tapped hole, the helical flutes maintain the pitching of the thread.	
15º Spiral Flutes (RH Spiral) – Suitable for blind holes, best suited to tough short chipping materials, up to 1.5 x D in depth. This particular tap design has no advantages for soft, and long chipping materials, especially over 1.5 x d_1 in depth. Due to the slow helix angle not transporting the chips well, clogging is possible.	
40º to 50º Spiral Flutes (RH Spiral) – Suitable for blind holes, best suited to long chipping materials, the high helix angle & the direction of the flutes, curls & transports the chips back out of the hole. This particular tap style is required to cut on reversal; therefore flute rake is required on the both front & back flute faces.	
Thredflo/Roll taps (fluteless) - Suitable for blind & through holes. This type of tap internally rolls a thread, therefore displacing the metal rather than cutting, like the above mentioned styles. Due to torque generated when producing roll threads, much higher machine power is required. Roll threads also produce much stronger threads than cut threads, as the grain structure of the thread remains uniform through the thread form profile. Note! Tapping drill size is not the same as a cut thread tap.	

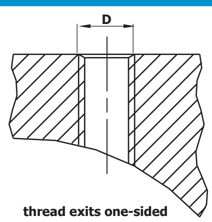
The above basic tool types are available in different variations, which have been designed & developed in respect to the specific materials and working conditions.

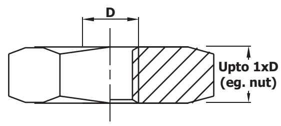
Tap Hole Type

Through Holes

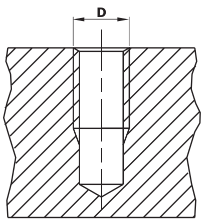


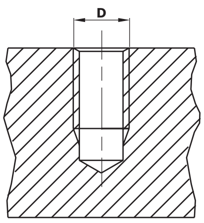


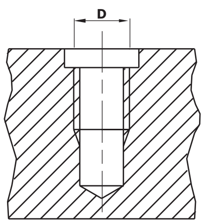


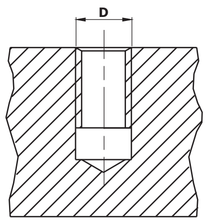


Blind Holes









For blind holes, there are generally two thread runout forms used at the bottom of the tap hole. One form has a recessed diameter at the bottom of the hole, and the other form has a standard runout. Other types of holes are respective to construction designs, eg.

a) The bore is smaller than the tap hole diameter (typical for pipes)
b) As step hole, where the following diameter (second step), is smaller than the tap hole diameter.

Sutton Tools

Geometry

Abbrev.	Description	Tap geometry	Surface
GG	For cast iron – iron is a very abrasive material, therefore to increase tool life the taps are always surface treated or coated to resist the abrasion. The thread limit for this range is 6HX, which is high limit of the 6H tolerance allowing for longer wear life.	Straight flutes with low rake angle	TiCN Plasma Nitride Ni
N	For normal, general purpose type materials – suited to a wide range of materials, with normal rakes & relief's. This is existing geometry that Sutton has historically manufactured.	Normal rake angle & Normal thread relief	Bright Blu TiN
UNI	For normal, general purpose type materials – suited to a wide range of materials, with normal rakes & high relief's. However tap material is powder metal high speed steel (PMHSS), which due to its finer grain structure than that of conventional HSS, higher hardness can be achieved with excellent toughness, along with TiAlN surface coating allowing for better tool life than normal taps.	Normal rake angle & High thread relief	Bright TiAlN
VA	For stainless and tough steels – to avoid clogging in tough, long chipping materials such as stainless steel, it is essential that the chip flows continuously in an axial direction. Best suited to rigid tapping applications due to high thread relief. TiCN & TiN coating has proven to be best suited for these materials.	High rake angle & thread relief	TiCN Blu
VAPM	For stainless and tough steels – geometry similar to VA range, however tap material is powder metal high speed steel (PMHSS), which due to its finer grain structure than that of conventional HSS, higher hardness can be achieved with excellent toughness, allowing for better tool life than VA taps.	High rake angle & thread relief	TiCN
H	For hard materials forming short chips – the low rakes & relief's combined with a hard surface coating, allow excellent tool life.	Low rake angle & thread relief	TiCN
W	For soft materials – due to the very high rake angle with a low thread relief, allows for excellent chip flow & gauging in soft materials.	High rake angle & Low thread relief	Bright CrN
Al	For malleable aluminium with long chips – to avoid clogging when threading in aluminium which forms long chips, it is essential that the chip flows continuously in an axial direction. Generally these taps have 1 less flute than normal taps & therefore have larger flute space, which more adequate for large volumes of chips to help avoid clogging.	High rake angle High helix, 2 Flutes Low thread relief	Bright Plasma Nitride

Use
Use of a suitable lubricant or cutting compound is necessary on most tapping operations. The type of lubricant as well as the method of application is often of extreme importance and can be responsible for the success or failure of a tapping operation.

Recommendation
Better results can sometimes be obtained by the use of one of the many modified or specialised lubricants recommended by cutting oil specialists.
The general principle is to have more EP (Extreme Pressure) additives added with the degree of difficulty, usually hardness increase. Oils stick, and improve frictional properties essential in tapping tough applications.

Application
Proper application of the lubricant is just as important as the type used. To be effective, ample quantities of lubricant must reach the chamfer or cutting portion of the tap during the entire tapping operation. In many cases, the lubricant must also aid in controlling or disposing of the chips.

Flow
The flow of lubricant should be directed into the hole rather than at the tap and should have sufficient pressure to wash the chips away from the hole as much as possible. Also, if the flow is not continuous, it should start before the tap enters the hole and continue until the tap is completely reversed out of the hole. In this way, ample oil is provided at the start of the cut and loose chips will be suspended in the oil so that they do not interfere with the tap backing out of the hole. On machines where the work revolves and the tap is stationary, it is desirable to use several streams of lubricant on opposite sides of the tap, especially on horizontal tapping.

Cleanliness
Tapping lubricants must always be clean. If filter equipment is not used, the lubricant must be replaced periodically to eliminate fine chips, grit and foreign matter that accumulate in the tank. Also, it is very important that the piping and tank are thoroughly flushed and cleaned before filling with new lubricant. The dilution of lubricants often changes during use so that additions may be necessary to maintain the recommended proportion of active materials.

Tapping drill
The tapping drill hole diameter should be drilled as large as possible, within the respective fitting just under the upper permissible dimension of the tolerance.
If the tapping drill hole diameter is too small, then this will cause the thread root diameter (minor diameter) to cut the material. This should be avoided, because the small chips which derive from the root of thread, clog the normal chip flow and rip pieces of material out of the finished thread. Consequently, the tap is overloaded and often breaks because of the high torque.
Another problem which occurs in certain materials due to thread root diameter cutting, is when a chip-bulge has been formed around the root radius. The minor diameter of the tap is clogged with small chips, which leads to a clamping of the tool teeth are ripped out, which leads to tool breakage. It is therefore, necessary that the material which is to be tapped, be taken into account when determining the tap hole diameter. Typical materials which do not squeeze or clamp are iron, brass and bronze and materials which squeeze are steels, steel castings and malleable steels. The tap cuts more economically, when the tap drill hole diameter is within the upper range of the permissible tolerance.

Warning: When drilling holes in materials which tend to work harden, care is needed to ensure the drills are sharp otherwise tap life is decreased.

Tapping drill formula
The correct size of drill to give the desired percentage of thread can be calculated by using the following formula:

Thread Type	Formula	Example
Metric (ISO)	Drill Size = Nom. Tap Dia. in mm – Pitch	M6 x 1 = 5.00mm drill
Whitworth Form Threads (inch calculation)	Drill Size = Nom. Tap Dia. – $\frac{1.28}{TPI}$ x % of thread depth	1/4 BSW 75% thread required: Drill Size = .250 – $\frac{1.28}{20}$ x $\frac{75}{100}$ = .250 – .048 Therefore Drill Size = .202 Nearest Standard Drill = 5.1mm = .2007 inch
Unified Form Threads (inch calculation)	Drill Size = Nom. Tap Dia. – $\frac{1.30}{TPI}$ x % of thread depth	1/4 UNC 75% thread required: Drill Size = .250 – $\frac{1.30}{20}$ x $\frac{75}{100}$ = .250 – .049 Therefore Drill Size = .201 Nearest Standard Drill = 5.1mm = .2007 inch

Sutton Tools

ALL SIZES ARE "SUGGESTED SIZES" ONLY AND MAY BE VARIED TO SUIT INDIVIDUAL REQUIREMENTS

M ISO Metric Coarse (60º)

Tap Size	Pitch mm	Tapping Drill mm
M1.6	0.35	1.25
M2	0.4	1.6
M2.5	0.45	2.05
M3	0.5	2.5
M3.5	0.6	2.9
M4	0.7	3.3
M4.5	0.75	3.7
M5	0.8	4.2
M6	1.0	5.0
M8	1.25	6.8
M10	1.5	8.5
M12	1.75	10.2
M14	2.0	12.0
M16	2.0	14.0
M18	2.5	15.5
M20	2.5	17.5
M22	2.5	19.5
M24	3.0	21.0
M27	3.0	24.0
M30	3.5	26.5
M33	3.5	29.5
M36	4.0	32.0
M42	4.5	37.5
M45	4.5	40.5
M48	5.0	43.0
M52	5.0	47.0
M56	5.5	50.5

MF ISO Metric Fine (60º)

Tap Size	Pitch mm	Tapping Drill mm
M4	0.5	3.5
M5	0.5	4.5
M6	0.75	5.3
M8	1.0	7.0
M10**	1.0	9.0
M10	1.25	8.8
M12**	1.25	10.8
M12	1.5	10.5
M14**	1.25	12.8
M14	1.5	12.5
M16*	1.5	14.5
M18**	1.5	16.5
M20*	1.5	18.5
M22	1.5	20.5
M24	2.0	22.0
M25*	1.5	23.5
M32*	1.5	30.5
M40*	1.5	38.5
M50*	1.5	48.5

*Metric Conduit **Spark Plug

8UN (8 TPI) Unified National Form (60º)

Tap Size	T.P.I.	Tapping Drill mm
1-1/8	8	25.5
1-1/4	8	28.5
1-3/8	8	31.75
1-1/2	8	35.0
1-5/8	8	38.0
1-3/4	8	41.5
1-7/8	8	44.5
2	8	47.5

UNC Unified National Coarse (60º)

Tap Size	T.P.I.	Tapping Drill mm
#2 (.086)	56	1.85
#3 (.099)	48	2.1
#4 (.112)	40	2.3
#5 (.125)	40	2.6
#6 (.138)	32	2.8
#8 (.164)	32	3.4
#10 (.190)	24	3.8
#12 (.216)	24	4.5
1/4	20	5.1
5/16	18	6.6
3/8	16	8.0
7/16	14	9.4
1/2	13	10.8
9/16	12	12.2
5/8	11	13.5
3/4	10	16.5
7/8	9	19.5
1	8	22.2
1-1/8	7	25.0
1-1/4	7	28.0
1-3/8	6	31.0
1-1/2	6	34.0
1-3/4	5	39.5
2	4.5	45.0

UNF Unified National Fine (60º)

Tap Size	T.P.I.	Tapping Drill mm
#3 (.099)	56	2.1
#4 (.112)	48	2.35
#5 (.125)	44	2.65
#6 (.138)	40	2.9
#8 (.164)	36	3.5
#10 (.190)	32	4.1
#12 (.216)	28	4.6
3/16*	32	4.0
1/4	28	5.5
5/16	24	6.9
3/8	24	8.5
7/16	20	9.8
1/2	20	11.5
9/16	18	12.8
5/8	18	14.5
3/4	16	17.5
7/8	14	20.5
1	12	23.5
1*	14	24.0
1-1/8	12	26.5
1-1/4	12	29.5
1-3/8	12	33.01
1-1/2	12	36.0

*UNS

UNEF Unified National Form (60º)

Tap Size	T.P.I.	Tapping Drill mm
1/4	32	5.6
5/16	32	7.2
3/8	32	8.8
1/2	28	11.8
5/8	24	14.75
3/4	20	18
1	20	24.2

BSW British Standard Whitworth (55º)

Tap Size	T.P.I.	Tapping Drill mm
1/16*	60	1.2
3/32*	48	1.85
1/8	40	2.55
5/32*	32	3.2
3/16	24	3.7
7/32*	24	4.5
1/4	20	5.1
5/16	18	6.5
3/8	16	7.9
7/16	14	9.3
1/2	12	10.5
9/16	12	12.1
5/8	11	13.5
3/4	10	16.25
7/8	9	19.25
1	8	22.0
1-1/8	7	24.75
1-1/4	7	28.0
1-1/2	6	33.5
1-3/4	5	39.0
2	4-1/2	44.5

*WHIT. Form

BSF British Standard Fine (55º)

Tap Size	T.P.I.	Tapping Drill mm
3/16	32	4.0
7/32	28	4.6
1/4	26	5.3
5/16	22	6.8
3/8	20	8.3
7/16	18	9.8
1/2	16	11.0
9/16	16	12.7
5/8	14	14.0
11/16	14	15.5
3/4	12	16.75
7/8	11	19.75
1	10	22.75
1-1/8	9	25.5
1-1/4	9	28.5
1-1/2	8	34.5
1-3/4	7	41.0

BSB British Standard Brass (55º)

Tap Size	T.P.I.	Tapping Drill mm
1/4	26	5.2
5/16	26	6.8
3/8	26	8.4
7/16	26	10.0
1/2	26	11.6
9/16	26	13.2
5/8	26	14.8
3/4	26	18.0
7/8	26	20.8
1	26	24.3

Rc (BSPT)* ISO Rc Taper Series 1:16 (55º)

Tap Size	T.P.I.	Drill Only*	Drill & Reamer
Rc 1/16	28	6.4	6.2
Rc 1/8	28	8.4	8.4
Rc 1/4	19	11.2	10.8
Rc 3/8	19	14.75	14.5
Rc 1/2	14	18.25	18.0
Rc 3/4	14	23.75	23.0
Rc 1	11	30.0	29.0
Rc 1-1/4	11	38.5	38.0
Rc 1-1/2	11	44.5	44.0
Rc 2	11	56.0	55.0

G (BSPF) ISO G Parallel Series (55º)

Tap Size	T.P.I.	Tapping Drill mm
G 1/16	28	6.8
G 1/8	28	8.8
G 1/4	19	11.8
G 3/8	19	15.3
G 1/2	14	19.0
G 5/8	14	21.0
G 3/4	14	24.5
G 7/8	14	28.5
G 1	11	31.0
G 1-1/4	11	39.5
G 1-1/2	11	45.5
G 1-3/4	11	51.5
G 2	11	57.5
G 2-1/2	11	72.5

Rp (BSPPL) Sealing pipe thread parallel (55º)

Tap Size	T.P.I.	Tapping Drill mm
Rp 1/8	28	8.6
Rp 1/4	19	11.5
Rp 3/8	19	15.0
Rp 1/2	14	18.5
Rp 3/4	14	24.0
Rp 1	11	30.2
Rp 1-1/4	11	39.0
Rp 1-1/2	11	45.0
Rp 2	11	56.4

Pg Steel conduit (80º)

Tap Size	T.P.I.	Tapping Drill mm
Pg7	20	11.3
Pg9	18	13.9
Pg11	18	17.3
Pg13.5	18	19.1
Pg16	18	21.2
Pg21	15	26.8

Thread forming (Fluteless taps)

Tap Size	T.P.I.	Tapping Drill mm
Metric coarse		
M1	0.25	0.9
M1.1	0.25	1.0
M1.2	0.25	1.1
M1.4	0.3	1.28
M1.6	0.35	1.45
M1.7	0.35	1.55
M1.8	0.35	1.65
M2.0	0.40	1.8
M2.2	0.45	2.0
M2.3	0.4	2.1
M2.5	0.45	2.3
M2.6	0.45	2.4
M3	0.5	2.8
M3.5	0.6	3.2
M4	0.7	3.7
M5	0.8	4.6
M6	1.0	5.5
M8	1.25	7.4
M10	1.5	9.3
M12	1.75	11.2
BSW		
1/8	40	2.9
5/32	32	3.6
3/16	24	4.3
1/4	20	5.8
5/16	18	7.3
3/8	16	8.8

NPT-NPTF* national pipe Taper 1:16 (60º)

Tap Size	T.P.I.	Drill Only*	Drill & Reamer
1/16	27	6.3	6.0
1/8	27	8.5	8.2
1/4	18	11.0	10.8
3/8	18	14.5	14.0
1/2	14	18.0	17.5
3/4	14	23.0	23.0
1	11-1/2	29.0	28.5
1-1/4	11-1/2	37.5	37.0
1-1/2	11-1/2	44	43.5
2	11-1/2	55.5	55.0

NPSF National pipe Straight (60º)

Tap Size	T.P.I.	Tapping Drill mm
1/8	27	8.6
1/4	18	11.3
3/8	18	14.5
1/2	14	18.0

*Taper pipe threads of improved quality are obtained when taper is pre-formed using Sutton Taper Pipe Reamers.

Thread forming (Fluteless taps)

Tap Size	T.P.I.	Tapping Drill mm
UNC		
#1 (.073)	64	1.7
#2 (.086)	56	2.0
#3 (.099)	48	2.3
#4 (.112)	40	2.6
#5 (.125)	40	2.9
#6 (.138)	32	3.2
#8 (.164)	32	3.8
#10 (.190)	24	4.4
#12 (.216)	24	5.0
1/4	20	5.8
5/16	18	7.3
3/8	16	8.8
7/16	14	10.2
1/2	13	11.7
UNF		
#1 (.073)	72	1.7
#2 (.086)	64	2.0
#3 (.099)	56	2.3
#4 (.112)	48	2.6
#5 (.125)	44	2.9
#6 (.138)	40	3.2
#8 (.164)	36	3.9
#10 (.190)	32	4.5
#12 (.216)	28	5.1
1/4	28	6.0
5/16	24	7.5
3/8	24	9.0
7/16	20	10.6
1/2	20	12.1
G (BSPF)		
1/8	28	9.25
1/4	19	12.5
3/8	19	16.0
1/2	14	20.0
5/8	14	22.0
3/4	14	25.5
7/8	14	29.25
1	11	32.0

BA (47.5º)

Tap Size	T.P.I.	Tapping Drill mm
0	1	5.1
1	0.9	4.5
2	0.81	4.0
3	0.73	3.4
4	0.66	3.0
5	0.59	2.65
6	0.53	2.3
7	0.48	2.05
8	0.43	1.8
9	0.39	1.55
10	0.35	1.4
11	0.31	1.2
12	0.28	1.05
13	0.25	0.98
14	0.23	0.8
15	0.21	0.7
16	0.19	0.6

Sutton Tools

Fluteless taps

Fluteless taps do not cut threads in the same manner as conventional taps – but actually FORM and FLOW the threads with an absence of chips. Used under suitable conditions, these taps produce threads with a high degree of finish not possible with ordinary taps. Ductile materials are most appropriate for forming of threads and must have a minimum 10% elongation.

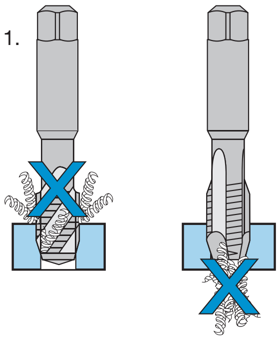
Benefits of thread forming

1. No chips produced
2. Higher tensile strength threads produced due to grain structure following the thread form
3. For use in through and blind holes applications
4. Higher speeds and tool life
5. Reduced possibility of breakage due to no cutting edges and robust tool construction

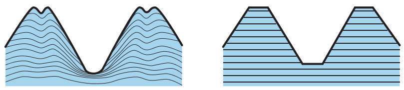
Suitable for wide range materials

-Low carbon steels
-Leaded steels
-Austenitic stainless steels
-Alloy steels; typically up to 1200 N/mm^2, (36 Rc) with a minimum 10% elongation
-Aluminium die castings alloys (low silicon, 10% max;)
-Wrought aluminium alloys (Ductile)
-Zinc die casting alloys
-Copper and copper alloys

1.



2. Formed Thread / Cut Thread



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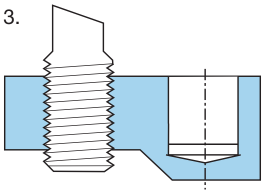
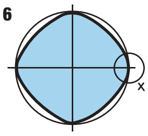


Whats New?

- New polygon profile 6
- New radiused blend on polygon profile 7
- Thread profile with radius crest 8
- Polished tool surface, surface finish 9

6



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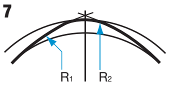

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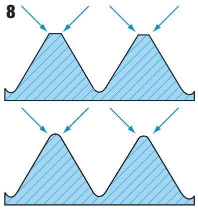

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Percentage of thread required

Because the thread produced by a fluteless tap is substantially stronger than a conventional thread, greater tool life and efficiency may be obtained when forming up to 65% thread. Threads may be formed up to 80% of depth, but tool life will be reduced and work clamping pressure necessarily increased. Greater tapping speeds allow the metal to flow far more readily, so 60 feet per minute minimum may be used as a guide, but this could increase with the type of material being tapped. A depth of 65% is recommended for the ductile materials mentioned, but this percentage will be reduced for less ductile materials to maintain all-round efficiency.

Tapping drill formula for fluteless taps

Refer Tapping Drill Size Chart for recommended sizes (Suitable for Unified, Whitworth and Metric sizes only).
The formula to calculate the theoretical hole size for a required percentage of thread is:

Formula	Example
Drill size = nominal thread dia. – inch $\frac{.007 \text{ x \% of thread}}{\text{TPI}}$	Drill size for 65% of thread in a M6 x 1.0 threaded hole would be: Drill size = 6 – (.007 x 65 x 1.0 (pitch)) = 5.54m (Use 5.50mm drill (Stockable drill) = 76%)

It is to be noted that the drill size for fluteless tapping is always larger than the P.D. of the thread. A drill size equal to the P.D. of the thread would produce 100% of thread, but this is NOT recommended.

As the additional driving torque is only up to 50% increase, any conventional driving equipment using the square as a drive is suitable for fluteless tapping.

Lubrication

In general it is best to use a good cutting oil or lubricant rather than a coolant for fluteless tapping. Sulphur base and mineral oils, along with most friction reducing lubricants recommended for use in cold extrusion or metal drawing, have proven best for this work. Make sure lubricant is clean, free from chips swarf and filings in suspension, which produce a poor finish and jamming, sometimes breakage – extra filtration may be required.

Countersinking

Because the fluteless tap displaces metal, some metal will be displaced above the mouth of the hole during tapping, countersink or chamfer the hole prior to tapping will reduce the extrusion within the countersink and not interfere with the mating part.

Sutton Tools

(Fluteless) Roll Taps:

Thread Size			ISO Coarse		UNC		BSW	
Metric	Fraction	M/C Screw Gauge	Pitch mm	Tapping Drill mm	T.P.I.	Tapping Drill mm	T.P.I.	Tapping Drill mm
M1.0			0.25	0.90				
M1.1			0.25	1.00				
M1.2			0.25	1.10				
M1.4			0.3	1.25				
M1.6			0.35	1.45				
M1.7			0.35	1.55				
M1.8			0.35	1.65				
M2.0			0.4	1.80				
M2.2			0.45	2.00				
M2.3			0.4	2.10				
M2.5			0.45	2.30				
M2.6			0.45	2.40				
M3.0			0.5	2.75				
	1/8						40	2.90
M3.5			0.6	3.20				
		#6			32	3.10		
	5/32						32	3.60
M4			0.7	3.70				
		#8			32	3.80		
	3/16						24	4.30
		#10			24	4.30		
M5			0.8	4.60				
M6			1.0	5.55				
	1/4				20	5.80	20	5.80
	5/16				18	7.30	18	7.30
M8			1.25	7.40				
	3/8				16	8.80	16	8.80
M10			1.50	9.30				

Sutton Tools

Thread Systems

The ISO standard is the international standard intended to be adopted throughout the world to unify and rationalise screw threads at an international level. The ISO standard recognises two groups of screw threads, (a) ISO metric, a complete thread system in metric units and (b) ISO inch Unified which is covered by British Standard BS 1580 and American Standard ANSI – B1-1 – Unified screw thread systems. The Whitworth and BA screw threads are obsolete but still widely used during the period of transition.
All measurements must have a controlling point or base from which to start. In the case of a screw thread, this control point is called BASIC or theoretically correct size, which is calculated on the basis of a full thread form. Thus, on a given screw thread, we have the Basic Major Diameter, the Basic Pitch Diameter, and the Basic Minor Diameter. The Basic Profile is the profile to which the deviations, which define the limits of the external and internal threads, are applied.
While it is impossible in practice to form screw threads to their precise theoretical or BASIC sizes, it is possible and practical to establish limits to which the deviation must not exceed. These are called the “Maximum” and “Minimum” Limits. If the product is no smaller than the “Minimum Limit” and no larger than the “Maximum Limit”, then it is within the size limits required. This difference between the Maximum and Minimum Limits is the TOLERANCE. In actual practice, the Basic size is not necessarily between Maximum and Minimum Limits. In most cases, the Basic Size is one of the Limits.
In general, tolerances for internal threads will be above Basic and for external threads, below Basic.

Basic Profile for ISO Inch (Unified) and ISO Metric

The basic form is derived from an equilateral triangle which is truncated 1/8 of the height at the major diameter and 1/4 of the height at the minor diameter. The corresponding flats have a width of P/8 and P/4 respectively. Fig. 1.
In practice major diameter clearance is provided by the tap beyond the P/8 flat on internal threads and beyond the P/4 flat on external threads. These clearances are usually rounded.

ISO Metric Tolerance Positions

Three tolerance positions are standardised for bolts and two for nuts. These are designated e, g and h for bolts and G and H for nuts. As in the ISO System for limits and fits, small letters are used to designate tolerance positions for bolts and capital letters are used for nut tolerance positions. Also the letters h and H are used for tolerance positions having the maximum metal limit coincided with the basic size, i.e., with a fundamental deviation of zero. Fig. 2.

ISO Metric Tolerance Grades

A series of tolerance grades designated 4, 5, 6, 7
and 8 for nut pitch diameters. An extended series of tolerance grades, designated 3, 4, 5, 6, 7,8 and 9, for bolt pitch diameters.
An important factor here is that for the same tolerance grade the nut pitch diameter tolerance is 1.32 x the corresponding bolt pitch diameter tolerance.
Size and recommendations of fits can be obtained from the Australian Standards AS 1275 or AS 1721.

Figure 1

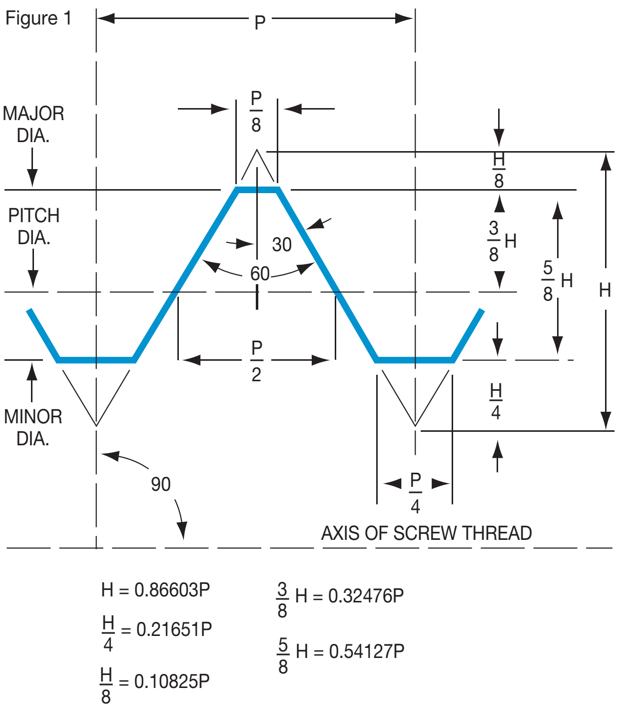
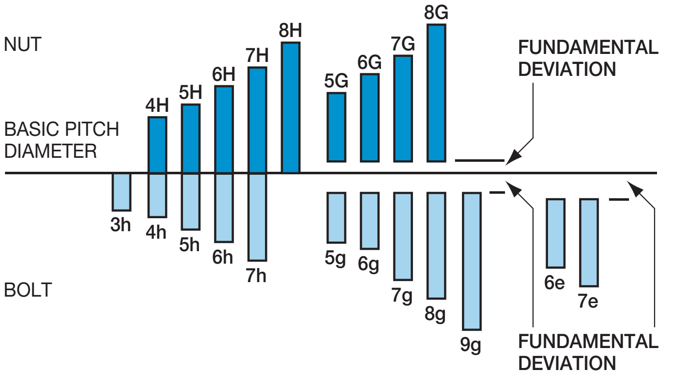


Figure 2



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The ISO metric system of tap tolerances comprises three classes of tap sizes which are calculated from the Grade 5 nut tolerance, irrespective of the nut grade to be cut as follows:

ISO, Class 1 – Class 2 – Class 3

The tolerances of these three classes are determined in terms of a tolerance unit t, the value of which is equal to the pitch tolerance value TD2 grade 5 of nut (extrapolated up to pitch 0.2mm):

t = TD_2 grade 5

The value of the tap pitch diameter tolerance is the same for all three classes 1, 2 and 3: it is equal to 20% of t.

The position of the tolerance of the tap with respect to the basic pitch diameter results from the lower deviation the values of which are (see figure 3):

for tap class 1: + 0.1 t

for tap class 2: + 0.3 t

for tap class 3: + 0.5 t

Choice of tolerance class of the tap with respect to the class of thread to be produced.

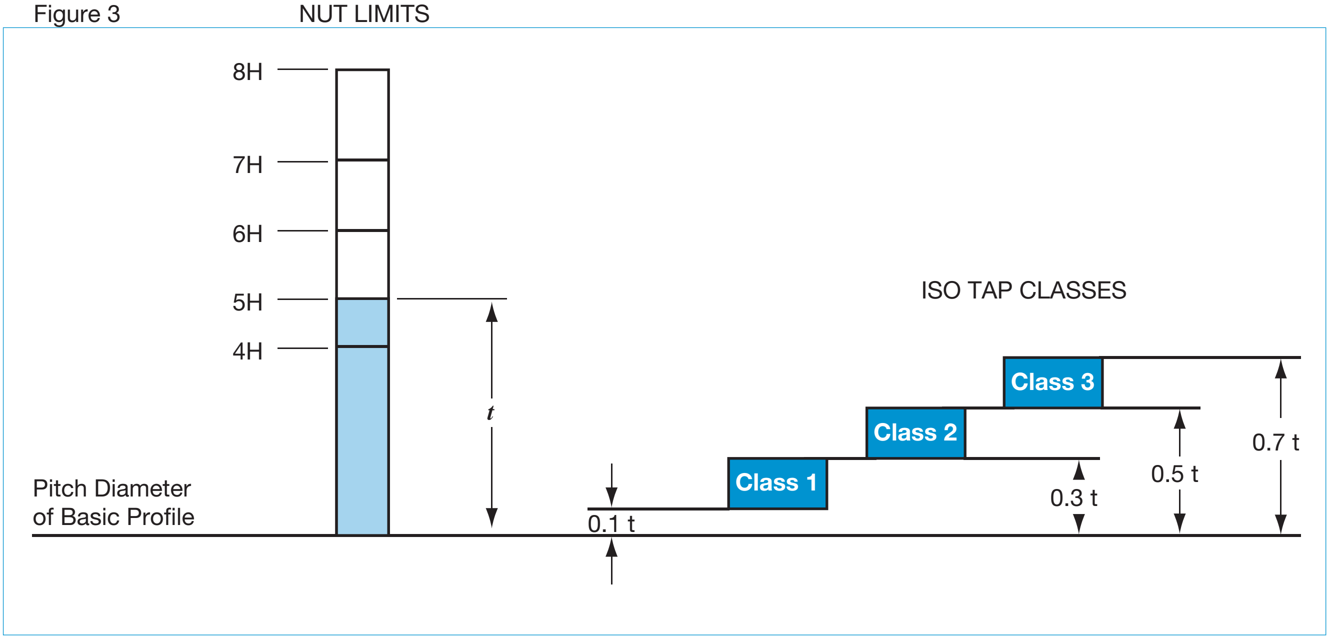
Unless otherwise specified, the taps of classes 1 to 3 will generally be used for the manufacture of nuts of the following classes:

ISO, Class 1: for nuts of limits 4H and 5H

ISO, Class 2: for nuts of limits 6H and 5G

ISO, Class 3: for nuts of limits 7H – 8H and 6G.

Figure 3



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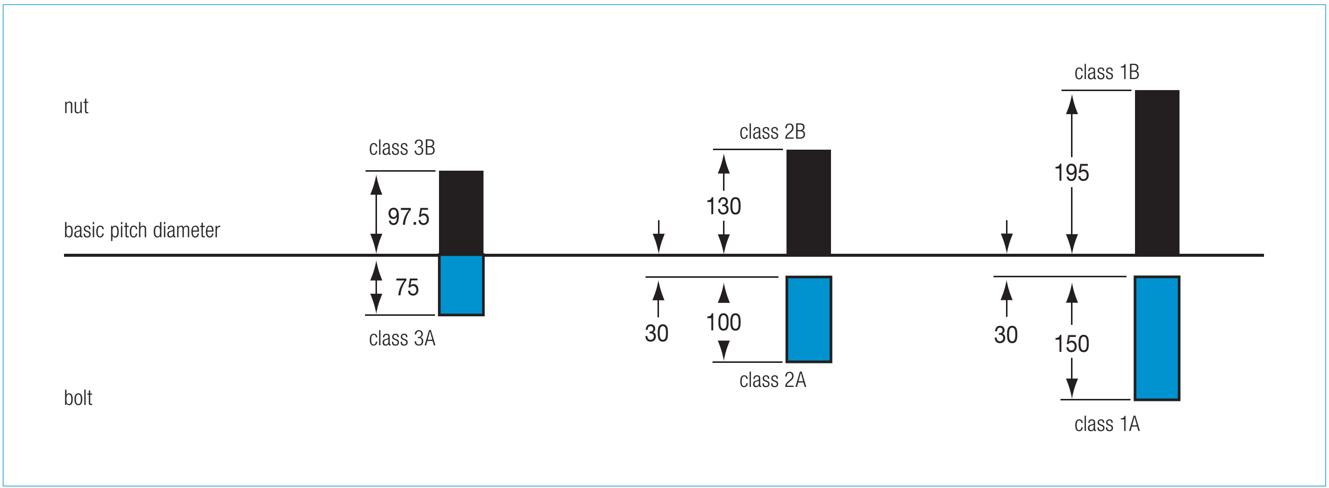
This system is well known. It has now been accepted by ISO as the recommended tolerance for ISO inch threads down to 0.06 inch nominal diameter. The arrangement of the allowance and the various classes of pitch diameter tolerance for a normal length of engagement of the mating threads is shown in this diagram.
The pitch diameter tolerance for Class 2A bolts is shown as 100 units, and the fundamental deviation and other tolerances are shown as percentages of the Class 2A tolerance. Fig. 4.

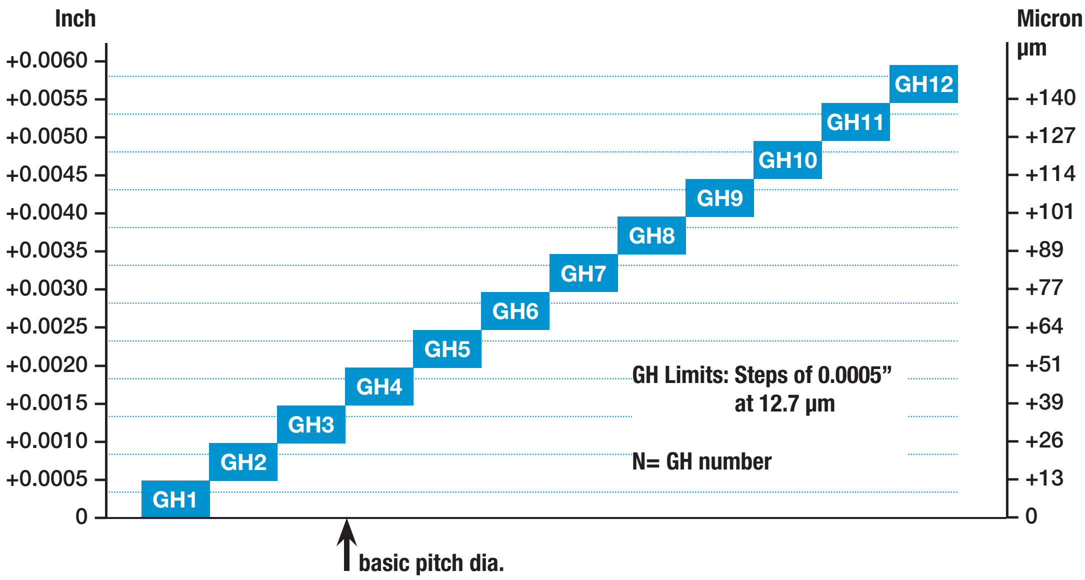


Unified Taps
The "GH" System

This system provides for a range of pitch diameters for each size of tap: the height limit of pitch diameters being the basic pitch diameter plus increments or units of .0005". It is designated by the letter "GH" followed by a numeral indicating the number or units applying to the particular "GH" size. The tap manufacturer's tolerance is applied as minus.
This is the limit which will normally be supplied. Alternative "GH" limits other than those shown in the price list can be made to special order.

GH Limits for JIS Roll Taps

GH Limits are applied to JIS Metric and Unified Thredflo Tap Threads due to market demands in the JIS standard.



For Sutton Tools Metric (mm) Roll / Fluteless Taps (Limit same as the "RH" & "G" Limits)
GH Limits: Steps of 0.0127 mm
N = GH number

GH LIMITS

Upper limit: 0.0005" x N
Lower limit: (0.0005" x N) – 0.0005

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Basic Profile for Whitworth (BSW, BSF and WHIT.) Thread forms

British Standard Whitworth Form

The sides of the thread form an angle of 55° with one another, and the top and bottom of the full triangle are truncated one-sixth of the height. The actual depth of the thread is equal to two-thirds of the height of the generating triangle and is equal to 0.6403 times the pitch. The crests and roots are rounded to a radius of 0.137329 times the pitch. Fig. 5.

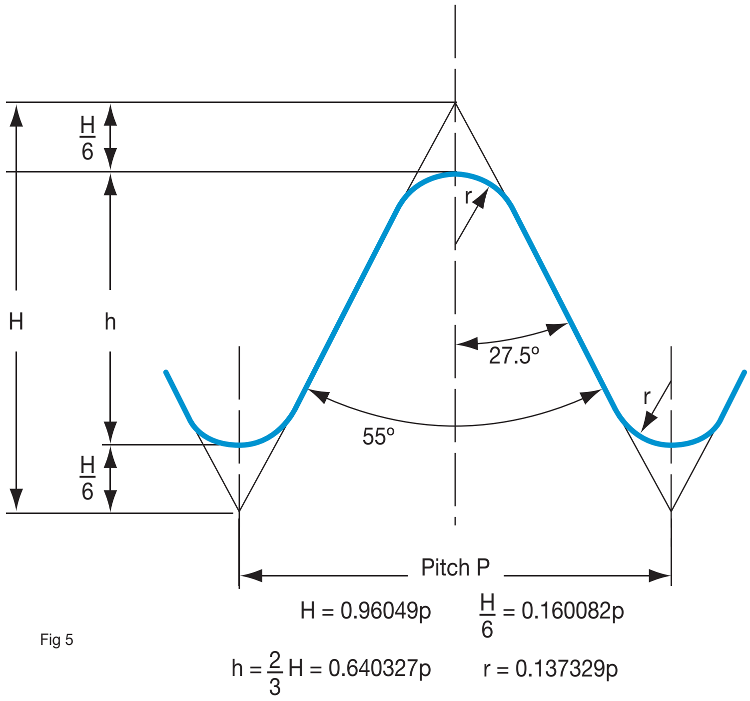
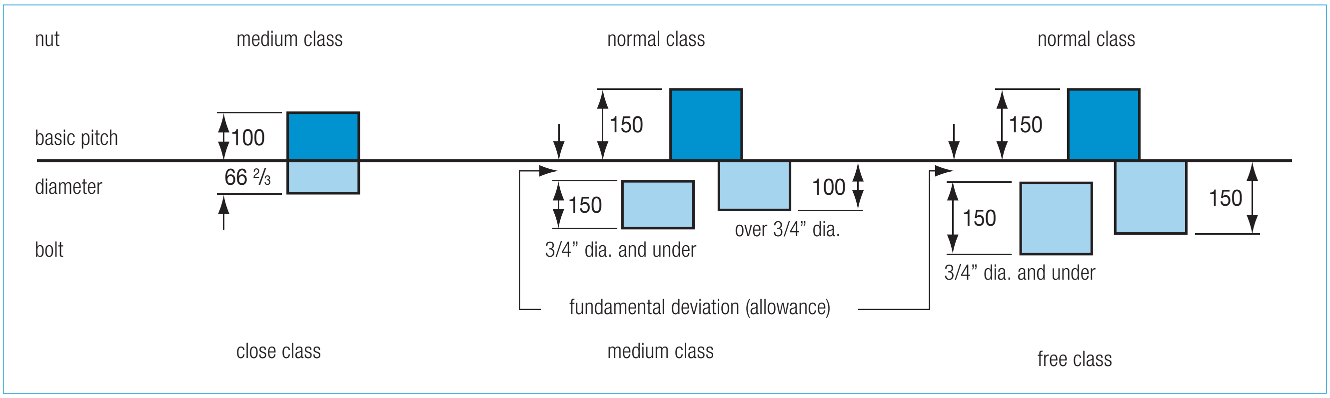


Fig 5

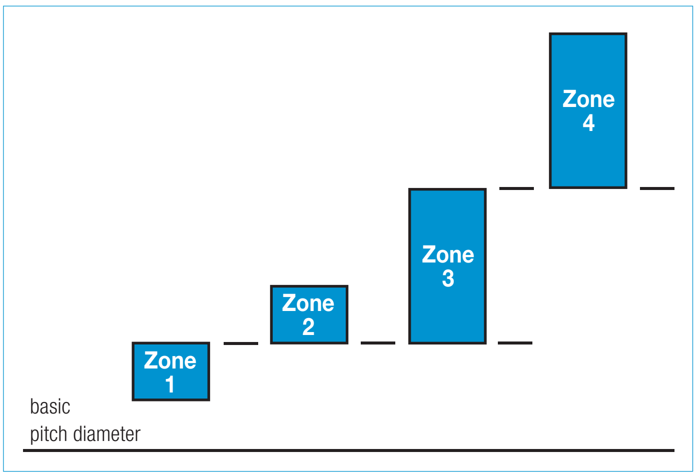
The Whitworth Screw Thread Tolerance System



Pitch diameter tolerance zones of recommended combinations of classes of bolts and nuts having Whitworth screw threads. Fig. 6

British Tap Size Zone Limits

British Standard Zone 3 and Zone 4 limits are normally applied to Whitworth and BA taps.
The values for position and tolerances are formulated and must be obtained from the standard's tables.
The accompanying chart shows the zone limits relationship for ground threads. Fig. 7.



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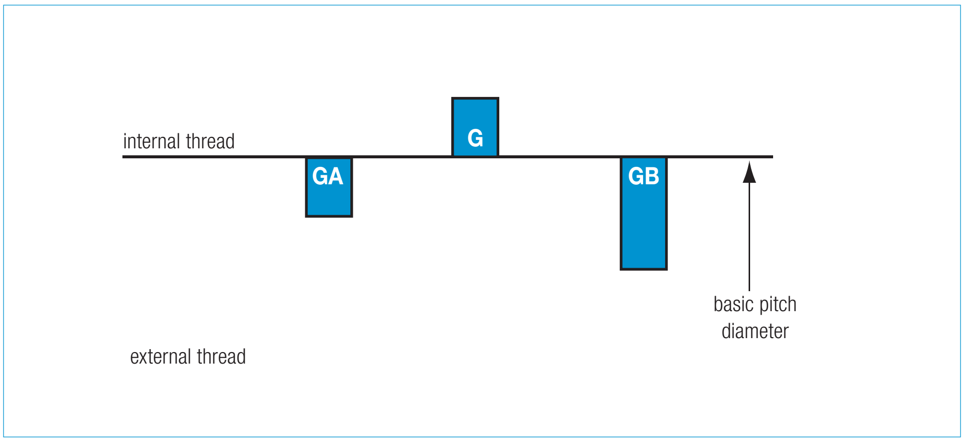
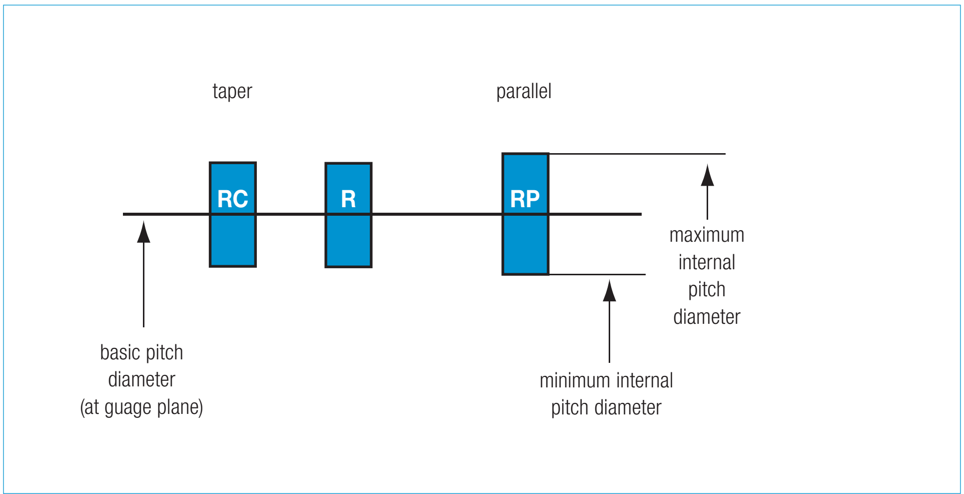
The International Standard Pipe Tap Thread System (ISO) has been derived from the original Whitworth gas and water pipe tap threads, formerly known as BSPF (Fastening) and BSPT (Taper), these systems have been so widely used throughout Europe and the United Kingdom that they have been metricated, whilst still retaining the whitworth thread form. These popular thread systems are the basis for the ISO parallel "G" series and the taper "R" series, these systems are endorsed and in agreement with the current British and Australian standards. For comparison, the pitch diameter tolerance zones are given for both the parallel and taper systems.

"G" Fastening Parallel Pipe Threads – ISO 228, AS1722 PT2 and BS2779.
This parallel thread system has only one positive internal thread tolerance and two classes of external tolerances. This series constitutes a fine series of fastening connecting pipe threads for general engineering purposes, the assembly tolerances on these threads are such as to make them unsuitable for pressure tight seal by the threads themselves. For the conveying of fluids, the seal may be produced by gaskets, flanges, or "O" rings etc.



"R" Sealing Taper Pipe Threads – ISO 7, AS1722 PT1 and BS21. The taper rate is 1-16 on diameter.
This series is for tubes and fittings where pressure tight joints are made by threads, these threads therefore must have a full form profile (no truncations). The series include a taper external thread (R) for assembly with either taper internal (Rc) or parallel internal (Rp) threads. The Rp series has a unilateral tolerance (+/–) which normally requires a special below basic low limit tap, to allow for sizing deviations at the start of the internal thread, the size is gauged at this position, with an Rc taper gauge. The low limit Rp tap size, allows a minimum accommodation length to be machined, with an equivalent material saving possible.



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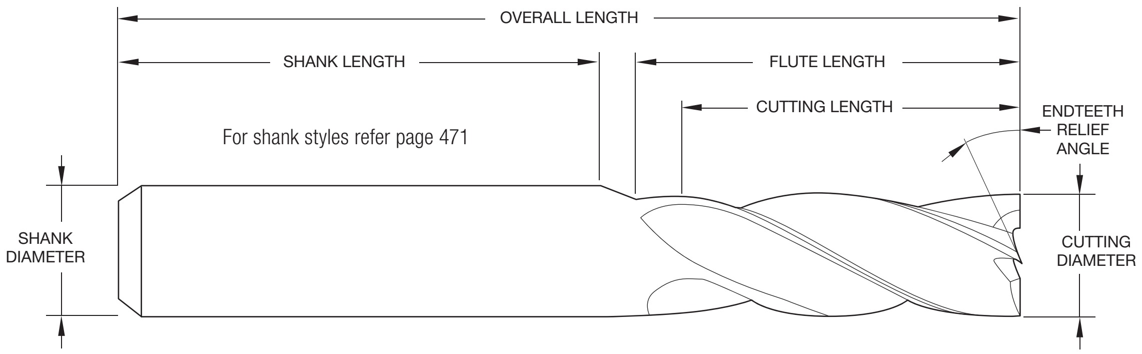
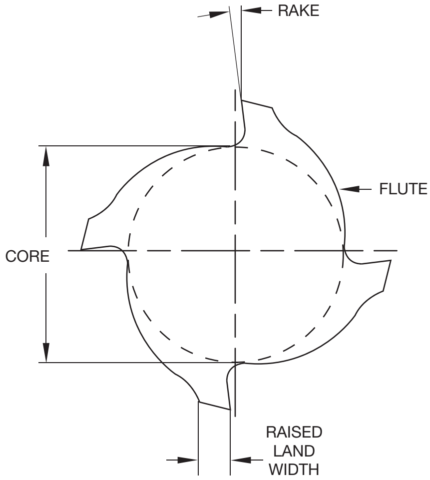
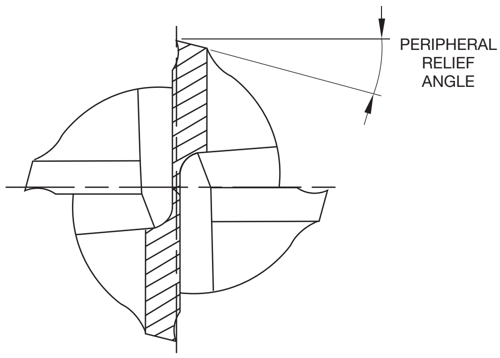
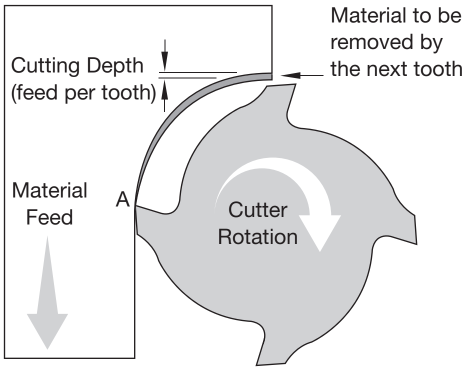
Endmill Definitions







Conventional milling. Point A may become work hardened

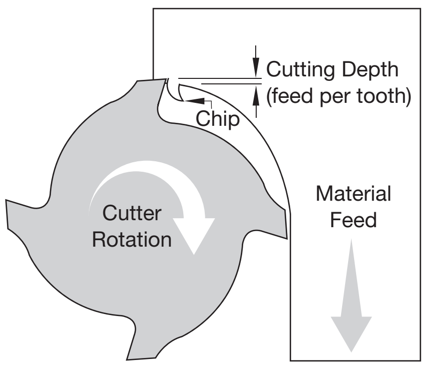


Conventional milling versus climb milling

A milling cutter can cut in two directions, sometimes known as climb or conventional.

Conventional milling: The depth of the cut starts at zero thickness, and increases up to the maximum. The cut is so light at the beginning that the tool does not cut, but slides across the surface of the material, until sufficient pressure is built up and the tooth suddenly bites and begins to cut. This deforms the material (at point A on the diagram, left), work hardening it, and dulling the tool. The sliding and biting behaviour leaves a poor finish on the material.

Chip formation during climb milling



Climb milling: Each tooth engages the material at a definite point, and the width of the cut starts at the maximum and decreases to zero. The chips are disposed behind the cutter, leading to easier swarf removal. The tooth does not rub on the material, and so tool life may be longer. However, climb milling can apply larger loads to the machine, and so is not recommended for older milling machines, or machines which are not in good condition. This type of milling is used predominantly on mills with a backlash eliminator.

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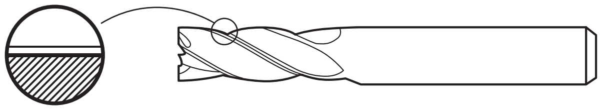
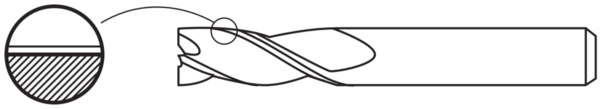
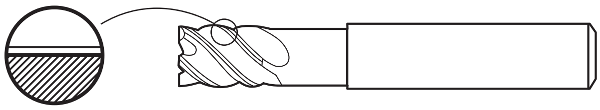
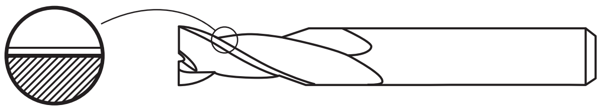
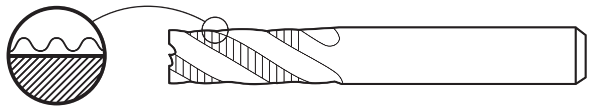
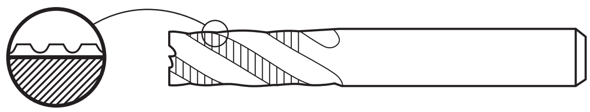
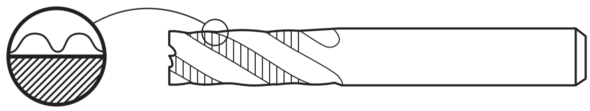
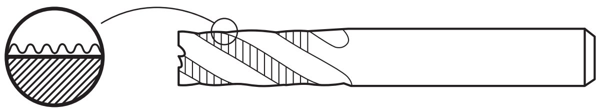
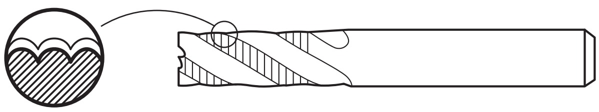
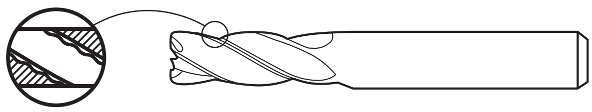
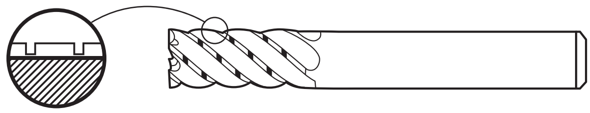
Type	Description	Application	Illustration
N	Finishing Form		
W	Slotting & Finishing - Use in soft materials, quick spiral 45° up to 600 N/mm^2		
VA	Optimised geometry for Austentic Stainless Steels & other long chipping materials up to 1000 N/mm^2		
Al & CU	For slotting wrought aluminium alloys with efficient chip evacuation, due to high relief angles and 40° spiral		
NR	Normal Roughing Form - general purpose		
NF	Semi Roughing Form - Ideally suited to soft, long chipping materials.		
WR	Coarse Form - ideally suited to soft, non-ferrous materials.		
HR	Fine Pitch Roughing Form - ideally suited to hard, short chipping materials		
HRS	Special Fine Pitch Roughing Form - Universal use		
Ti	Wave Form - ideally suited to titanium & nickel alloys		
STF	Special tooth form - Semi Roughing Form, ideally suited to materials up to 1400 N/mm^2		

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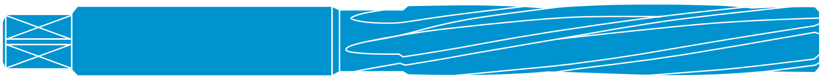

Feeds

In reaming, feeds are usually much higher than those used for drilling. The amount per feed may vary with the material, but a good starting point would be between 0.038mm and 0.10mm per flute per revolution. Too low a feed may result in glazing, excessive wear, and occasionally chatter. Too high a feed tends to reduce the accuracy of the hole and may lower the quality of the finish. The basic idea is to use as high a feed as possible and still produce the required accuracy and finish.

Stock to be removed

For the same reason, insufficient stock for reaming may result in a burnishing rather than a cutting action. It is very difficult to generalise on this phase as it is closely tied with the type of material the finish required, depth of hole, and chip capacity of the reamer. For machine reaming 0.20mm for a 6mm hole, 0.30mm for a 12mm hole, and 0.50mm for a 50mm hole, would be a typical starting point guide. For hand reaming, stock allowances are much smaller, partly because of the difficulty in hand forcing the reamer through greater stock.
A common allowance is 0.08mm to 0.13mm.

Speeds

The most efficient speed for machine reaming is closely tied in with the type of material being reamed, the rigidity of the set-up, and the tolerance or finish required. Quite often the best speed is found to lie around two-thirds the speed used for drilling the same material.
A lack of rigidity in the set-up may necessitate slower speeds, while occasionally a very compact, rigid operation may permit still higher speeds.
When close tolerances and fine finish are required it is usually found necessary to finish the reamer at considerably lower speeds.
In general, reamers do not work well when they chatter. Consequently, one primary consideration in selecting a speed is to stay low enough to eliminate chatter. Other ways of reducing chatter will be considered later, but this one rule holds: SPEEDS MUST NOT BE SO HIGH AS TO PERMIT CHATTER.

The following charts gives recommended surface feet per minute values which may be used as a basis from which to start.

	m/min
Aluminium and its alloys	20 – 35
Brass and Bronze, ordinary	20 – 35
Bronze, high tensile	18 – 22
Monel Metal	8 – 12
Cast Iron, soft	22 – 35
Cast iron, hard	18 – 22
Cast Iron, chilled	7 – 10
Malleable Iron	18 – 20
Steel, Annealed	13 – 18
Steel, Alloy	12 – 13
Steel, Alloy 300-400 Brinell	7 – 10
Stainless Steel	5 – 12

Chatter

The presence of chatter while reaming has a very bad effect on reamer life and on the finish of the hole. Chatter may be the result of several causes, some of which are listed:

1. Excessive speed.
2. Too much clearance on reamer.
3. Lack of rigidity in jig or machine.
4. Insecure holding of work.
5. Excessive overhang of reamer in spindle.
6. Excessive looseness in floating holder.
7. Too light a feed.

Correcting the cause can materially increase both reamer life and the quality of the reamed holes.

Coolants for Reaming

In reaming, the emphasis is usually on finish and a lubricant is normally chosen for this purpose rather than for cooling. Quite often this means a straight cutting oil.

Limit of tolerance on cutting diameter

The tolerance on the cutting diameter measured immediately behind the bevel or taper lead for parallel reamers listed is M6 as specified in BS122-PT2-1964. It is not practicable to standardise reamer limits to suit each grade of hole and the limits chosen are intended to produce H7 holes.

Nominal Diameter Range				Cutting Edge Diameter			
Inch		mm		Inch		mm	
Over	Up to and including	Over	Up to and including	High +	Low +	High +	Low +
0.0394	0.1181	1	3	0.0004	0.0001	0.009	0.002
0.1181	0.2362	3	6	0.0005	0.0002	0.012	0.004
0.2362	0.3937	6	10	0.0006	0.0002	0.015	0.006
0.3937	0.7087	10	18	0.0007	0.0003	0.018	0.007
0.7087	1.1181	18	30	0.0008	0.0003	0.021	0.008
1.1811	1.9085	30	50	0.0010	0.0004	0.025	0.009
1.9085	3.1496	50	80	0.0012	0.0004	0.030	0.011

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Recommended Cutting Speeds (RPM) - Standard Length Burs

Diameter	Double Cut		Aluminium Cut	Max RPM
	Steels, alloys & non-ferrous	Stainless Steel	Aluminium	
1/16	33,000	50,000	-	78,000
3/32	26,000	40,000	-	60,000
1/8	23,000	35,000	-	53,000
3/16	17,000	25,000	-	38,000
1/4	15,000	22,000	30,000	33,000
5/16	13,000	20,000	25,000	30,000
3/8	12,000	18,000	20,000	27,000
7/16	11,500	17,000	18,000	26,000
1/2	11,000	16,000	15,000	24,000
5/8	10,000	15,000	12,000	23,000
3/4	9,000	14,000	10,000	21,000
7/8	8,500	13,000	-	20,000
1	8,000	12,000	-	18,000

Note: Recommend reduce speeds by 50% when using long shank carbide burs.

Safety Tips

- Eye protection must be worn at and around bur application
- For use in air & electric die grinders, do not use in conventional electric drills as insufficient speed can cause breakage
- Chuck carbide bur to full capacity of machine chuck
- Do not use driving tool with worn bearings
- Endeavour to use double cut wherever possible as standard cut can produce harmful slivers

Hints for Use

- Position bur in drive as close as possible to head of collet
- Allow tool to do its own cutting – do not force the cut or use excessive pressure
- Allow tool to be running at full speed before making contact with the work piece.
- To prevent loading on aluminium burs – coat bur with bees wax or oven cleaner before use
- If sparks are evident in use, either bur is dull and should be replaced or material is too hard

SUTTON TOOLS 214 Coleraine Road, Hamilton, Victoria, Australia 3300
Ph. (61 3) 5571 1322 Fax. (61 3) 5572 2944 Email. specsales@sutton.com.au

Application TAP - Special Enquiry

Customer No.: ____________ **New Customer** ☐

Order No. | | | | | | | | | | | | |

Company:

Contact:

Address:

Phone:

State/Province:

Fax:

Country:

Email:

Tap Details

☐ Thread Cutting ☐ Thread Forming

Size:

Thread Limit:

Please Note: If special thread form, please supply details on separate drawing

d_1

d_2

l_1

l_2

l_3

l_4

sq a/f

Existing Method

Manufacturer:

Dimensions:

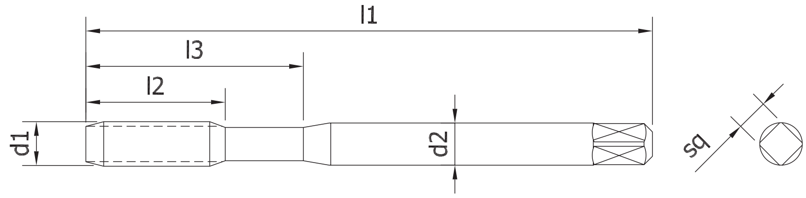
Tolerance:

Product No.:

Tool Material:

Coating: ☐ Uncoated ☐ Steam Oxide ☐ TiN ☐ TiAlN ☐ TiCN ☐ AlCrN

Speed:



Workpiece Details

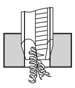
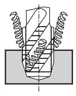
Component:

Material Group:

Material Grade:

Characteristics of Material: ☐ Short Chipping ☐ Long Chipping

Tapping Hole Size: ☐ Drilled ☐ Cast ☐ Punched

Hole Type:  ☐ Through Hole  ☐ Blind Hole

Hole Depth:

Drawing / Notes

Machine Details

Machine Type: ☐ CNC ☐ Semi Auto ☐ Manual

Machine Direction: ☐ Vertical ☐ Horizontal ☐ Oblique

Work Piece Holder: ☐ Stationary ☐ Rotating

Coolant: ☐ Neat Oil ☐ Mist / Dry ☐ Emulsion >5% ☐ Emulsion >10%

Feed: ☐ CNC ☐ Mechanical ☐ Pneumatic ☐ Hydraulic ☐ Manual

Tapping Attachment:

☐ Tapping Chuck ☐ Tension ☐ Compression

☐ Tapping Attachment

☐ Tapping Chuck (rigid)

☐ Collet Chuck (length compensating)

Please copy and fax to our Special Sales Dept. on (61 3) 5572 2944

Item No. 499980185B

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Application HSS Drills - Special Enquiry

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Order No.: | | | | | | | | | | | | |

Company: ____

Contact: ____

Address: ____

Phone: ____

State / Province: ____

Fax: ____

Country: ____

Email: ____

Drill Details

Tool Material:	☐ HSS ☐ HSS-E	☐ PM HSS-E	☐ Other
Tool Type:	☐ Drill	☐ Step Drill	☐ Subland Drills
	☐ Core Drills	☐ Countersinks	☐ Centre Drills
Internal Cooling:	☐ Without	☐ With	
Shank Design:	☐ Reinforced	☐ Without Flat	☐ With Flat
	☐ Parallel Straight Shank	☐ Morse Taper	☐ Other
Number of Steps:	☐ Without	☐ With________ Steps	
Total Length:	☐ ____________ mm		
Step Diameter:	☐ d_1__________ mm	☐ d_2__________ mm	☐ d_3__________ mm
	☐ d_4__________ mm	☐ d_5__________ mm	☐ d_6__________ mm
Point Geometry	☐ Relieved Cone	☐ For Grey Cast Iron	☐ Centre Point
	☐ Facet Point Grind	☐ Other	
Special Point Grind, Form:	☐ A	☐ B	☐ C
	☐ Without	☐ Other	
Coating:	☐ Uncoated	☐ TiN	☐ TiCN
	☐ TiAIN	☐ AlCrN	☐ Steam Oxide
	☐ Other		
Spiral:	☐ RH	☐ LH	
Quantity Required:	________________ Tools		

Drawing / Notes

Please copy and fax to our Special Sales Dept. on (61 3) 5572 2944

Item No. 499980185A

SUTTON TOOLS 214 Coleraine Road, Hamilton, Victoria, Australia 3300
Ph. (61 3) 5571 1322 Fax. (61 3) 5572 2944 Email. specsales@sutton.com.au

Application Twist Drill - Special Enquiry

Customer No.: New Customer ☐ | Order No. | | | | | | | | | | | |

Company: | Contact:

Address: | Phone:

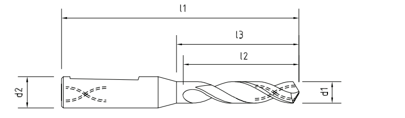
| Fax:

Date: | Signature:

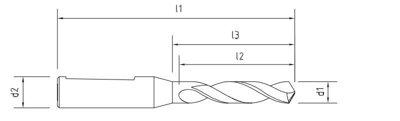
Solid Carbide Drill Without Step

Carbide grade
(specify if known)

With Internal Cooling



Without Internal Cooling

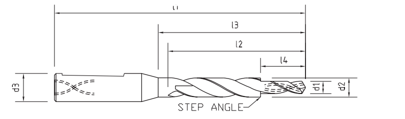


	With Internal Cooling: Range	Complete	Without Internal Cooling: Range	Complete
Norm-Ø d_2	4.0 - 20.0mm		3.0 - 20.0mm	
Shank-Ø d_2 to DIN 6535				
Shank length l to DIN 6535				
Shank form to DIN 6535	HA HE		HA HE	
Drilling depth l_3	Maximum 7 x D		Maximum 7 x D	
Flute length l_2	9.5 - 155mm		9.5 - 155mm	
Total length l_1	60 - 205mm		60 - 205mm	
Point angle	120º / 130 / 140º		120º / 130 / 140º	
Point geometry (specify if known)				
Surface finish/coating	Uncoated / TiN		Uncoated / TiN	
	/ TiCN / TiALN / AlCrN		/ TiCN / TiALN / AlCrN	
Quantity				
Cost per tool				

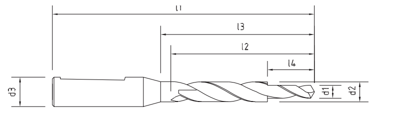
Solid Carbide Step Drill

Carbide grade
(specify if known)

With Internal Cooling



Without Internal Cooling



	With Internal Cooling: Range	Complete	Without Internal Cooling: Range	Complete
Step-Ø d_1	4.0 - 20.0mm		3.0 - 20.0mm	
Body-Ø d_2	4.0 - 20.0mm		3.0 - 20.0mm	
Shank-Ø d_3 to DIN 6535				
Shank length l_3 to DIN 6535				
Shank form to DIN 6535	HA HE		HA HE	
Step length l_4	3 - 100 mm		3 - 100 mm	
Drilling depth l_3	Maximum 7 x D		Maximum 7 x D	
Flute length l_2	9.5 - 155mm		9.5 - 155mm	
Total length l_1	60 - 205mm		60 - 205mm	
Point angle	120º / 130 / 140º		120º / 130 / 140º	
Step angle	60º / 90º / 120º		60º / 90º / 120º	
Point geometry (specify if known)				
Surface finish/coating	Uncoated / TiN		Uncoated / TiN	
	/ TiCN / TiALN / AlCrN		/ TiCN / TiALN / AlCrN	
Quantity				
Cost per tool				

Item No. 499980185 c

SUTTON TOOLS 214 Coleraine Road, Hamilton, Victoria, Australia 3300
Ph. (61 3) 5571 1322 Fax. (61 3) 5572 2944 Email. specsales@sutton.com.au

Application milling - Special Enquiry

Customer No.: New Customer ☐

Company:

Address:

Date:

Order No.

Contact:

Phone:

Fax:

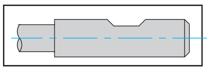
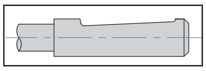
Signature:

Basic Geometry

	Range	Complete
Norm-Ø d_2	3.0 - 20.0mm	Ø mm
Shank-Ø d_2 to DIN 6535	4.0 - 20.0mm	Ø mm
Shank length l_3	to DIN 6535	mm
Total length l_1		
Ø 3.0 to 10.0	28.0 - 100mm	mm
from Ø 10.0 to 20.0	56.0 - 150mm	mm
Cutting length l_2		
Ø 3.0 to 10.0	3.0 - 40.0mm	mm
from Ø 10.0 to 20.0	10.0 - 65.0mm	mm
Helix angle w_1		
Ø 3.0 to 6.0	20° - 45°	
from Ø 6.0 to 20.0	20° - 55°	
No. of cutting edges		
Ø 3.0 to 6.0	2 - 4	
from Ø 6.0 to 20.0	2 - 6	
from Ø 16.0 to 20.0	2 - 8	

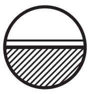
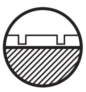
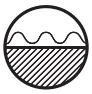
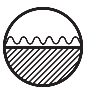
Shank Design

Straight Shank	Choice DIN 6535	☐ HA ☐ HB ☐ HE


HA

HB

HE

Peripheral Geometry

Finishing and Mills	Ø 3.0 - 20.0mm	☐ N ☐ Chip Breaker
Roughing and Mills	Ø 6.0 - 20.0mm	☐ Coarse ☐ Fine

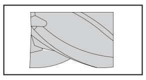
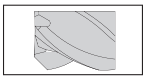
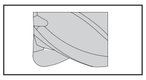
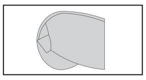

N

w chip breaker

Coarse

Fine

Face Geometry

Point angle w_s	180° + 5°		
Cutting to centre	Choice	☐ Yes	☐ No

Corner Prep/ ...

Sharp edge	Choice	☐ Yes	☐ No
Corner protection	Ø 0.03 - 1.5mm x 45°	mm x 45°	
Corner radius	Ø 0.3mm - 2/3 x d_1	mm	
Ball nosed	Choice	☐ Yes	☐ No


Sharp edge

Corner protection

Corner radius

Ball-nosed

Plus Internal Cooling

Diameter range	Ø 4.0 - 20.0mm	☐ Yes	☐ No

Plus Coating

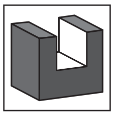
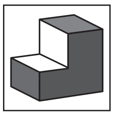
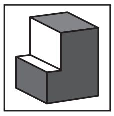
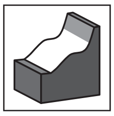
Coating	Ø 4.0 - 20.0mm	☐ TiN	☐ TiCN
	☐ Uncoated	☐ AlCrN	☐ TiAlN

Tool Material

Carbide (specify grade, if known)	
PM-HSSE (specify grade, if known)	
HSS-Co	
HSS	

Detail Regarding Application

Range of applications		
Material description		
Material hardness	(N/mm² or HR_c)	
Application Types	☐ Slotting	☐ Roughing op.
	☐ Finishing op.	☐ Copy


Slotting

Roughing op.

Finishing op.

Copy milling

Drawing / Notes

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Item No. 499980185 d