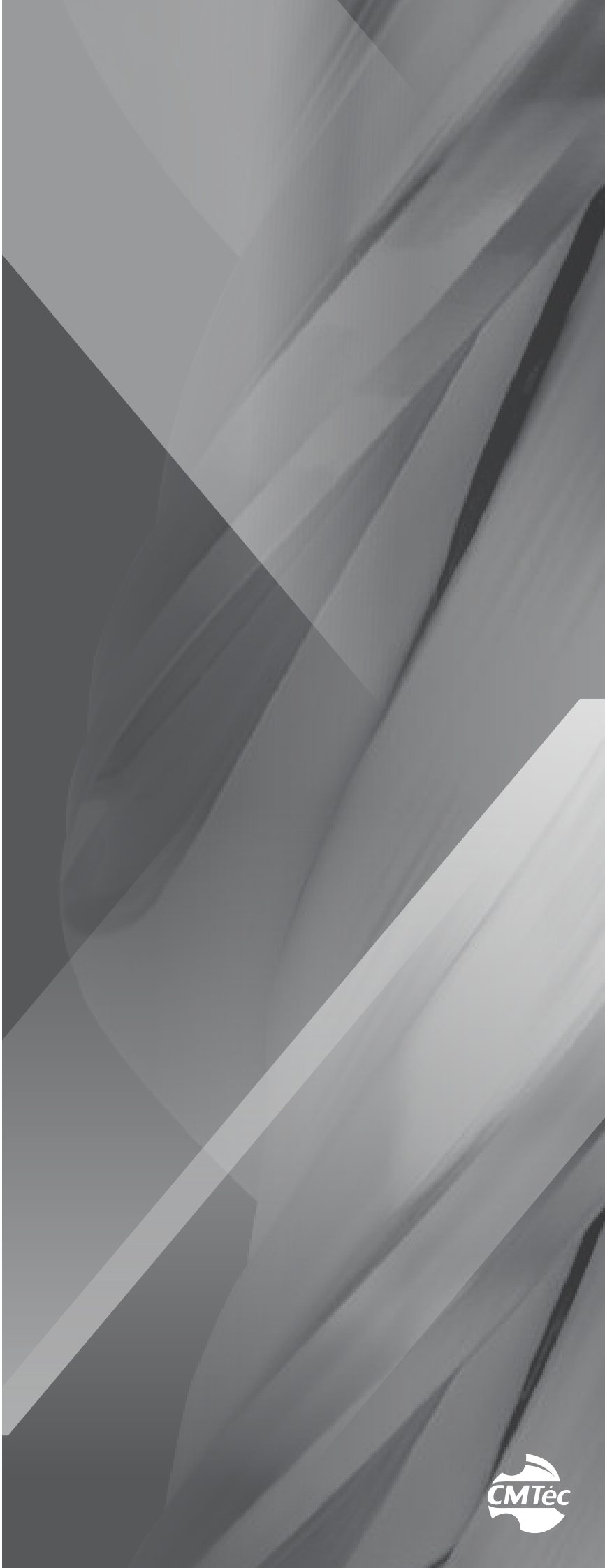
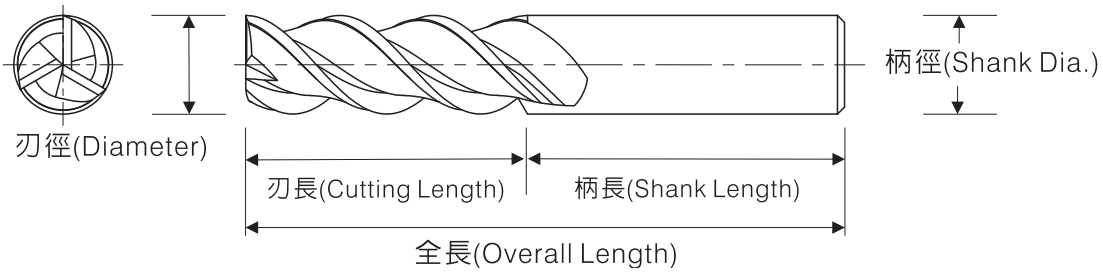
技術資料

Technical Data

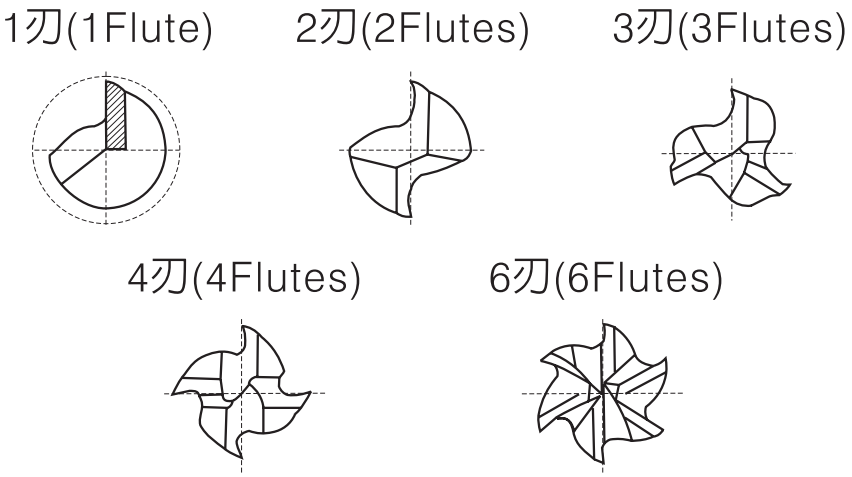


銑刀篇之技術資料
Technical Data for Solid Carbide End mills

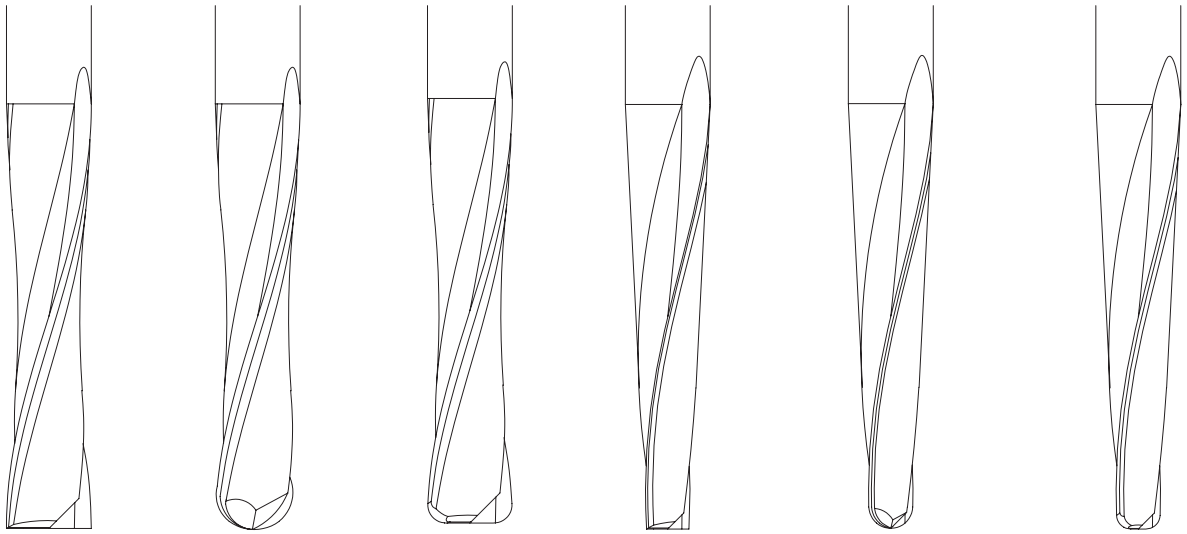
1. 尺寸名稱介紹
Nomenclature & Size



2. 刃數
Flutes



3. 類型
Types



平銑刀
Square
End Mill

球型銑刀
Ball Nosed
End Mill

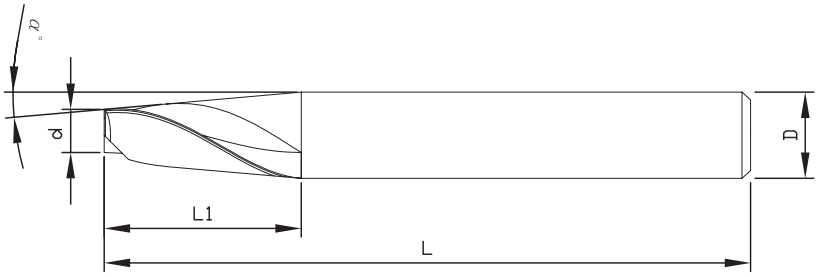
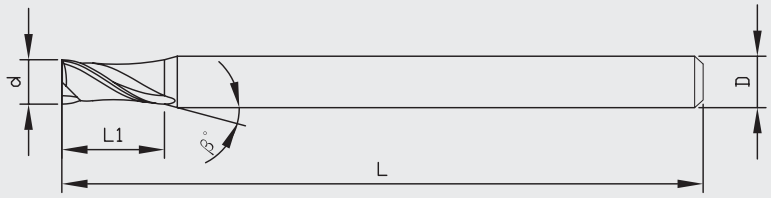
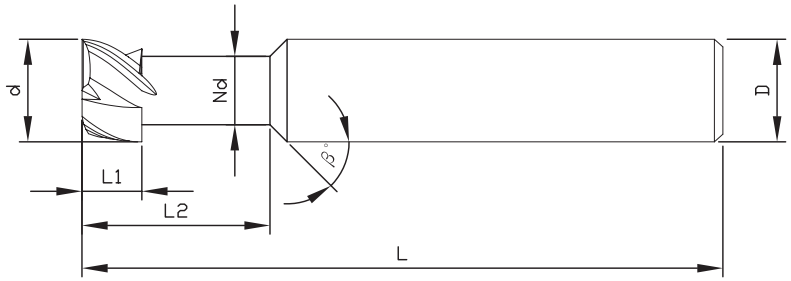
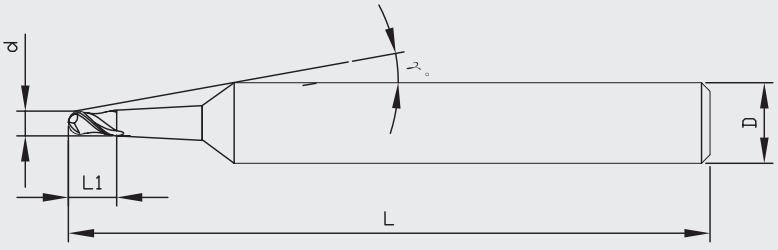
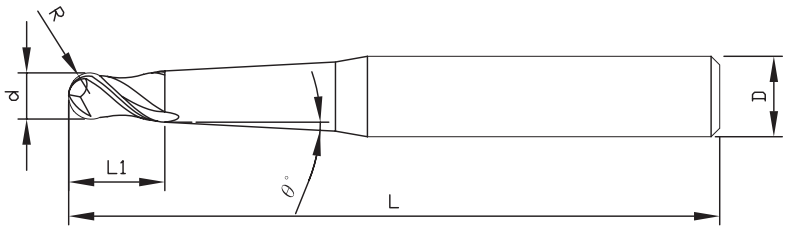
圓鼻銑刀
Corner
Radius
End Mill

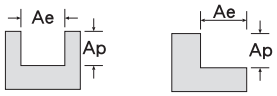
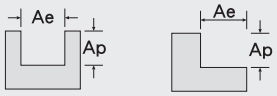
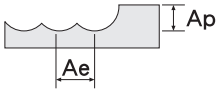
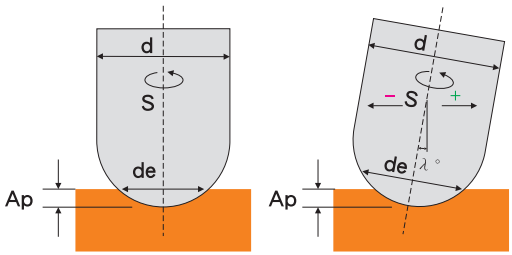
斜度銑刀
Taper
End Mill

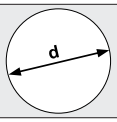
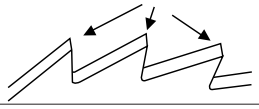
斜度球型銑刀
Taper
Ball Nosed
End Mill

斜度圓鼻銑刀
Taper
Corner
Radius
End Mill

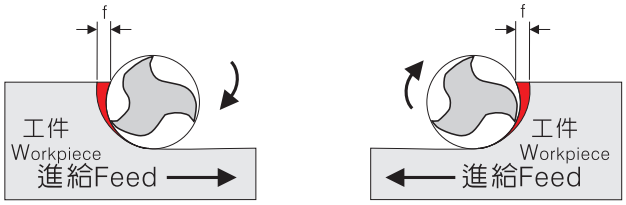
4. 符號說明
Symbol Guide

符號 Symbols	描述 Description
α	
β	
β	
γ	
θ	

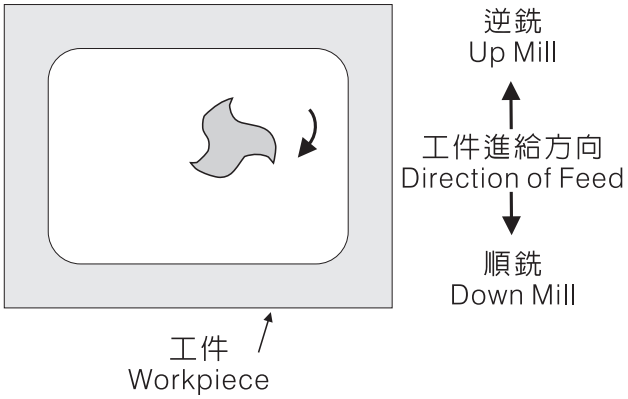
符號 Symbols	描述 Description	公式&標記 Formula&Icon
Ap	加工深度（mm） Axial depth of cutting	
Ae	加工寬度（mm） Radial depth of cutting	
Ae	步距（mm） Axial Pitch of cutting depth or width	
Vc	切削速度（m/min） Cutting speed	$Vc=d\times S\times\pi\ /\ 1000$
S	主軸轉速（rpm） Spindle speed	$S=Vc\times 1000\ /\ d\ /\ \pi$
F	進給速度（mm/min） Feed rate	$F=fz\times S\times Z$
fz	每刃進給量（mm） Feed per tooth	$fz=F\ /\ S\ /\ Z$
f	每轉進給量（mm/rev） Feed per revolution	$f=fz\times Z$
Q	切削移除率（mm^3/min） Removal rate	$Q=Ap\times Ae\times F$
λ	刃傾角（°） Angle of inclination	如下圖所示： To see the picture below：
de	球刀有效直徑（mm） Working diameter of ball nosed end mills 	當 λ =0時 When λ =0 $de=2\sqrt{Ap\times(d\text{-}Ap)}$ 當 λ ≠0時 When λ ≠0 $de=d\times sin\left[\lambda\pm arccos\left(\frac{d-2Ap}{d}\right)\right]$

符號 Symbols	描述 Description	公式&標記 Formula&Icon
Ve	銑刀的有效切削速度（m/min） Effective cutting speed of mills	$Ve=d\times S\times\pi / 1000$
d	銑刀直徑（mm） Diameter of End mill	
F / Z	刃數 / 齒數 Number of teeth	

側面切削Side Milling



槽穴切削Slotting



逆銑vs.順銑：

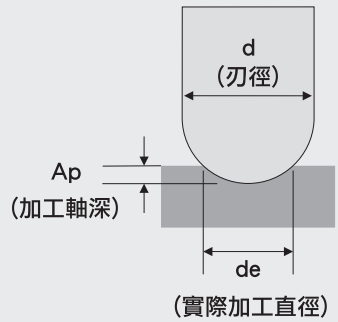
一般而言，要使刀具壽命長及得到好的表面粗糙度，推薦用「順銑」；若工件表面很粗糙不平整且夾砂，推薦用「逆銑」。

Up Mill vs. Down Mill：

We recommend 'down mill' to get long tool life and good finishing of workpiece. If the surface roughness of workpiece is poor,e.g.having sand,we would recommend you 'up mill'.

	適用性 Application
逆銑 Up cut (Up mill)	粗銑、中銑 Roughing , Semi-finishing
順銑 Down cut (Down mill)	精銑、超精銑 Finishing, Bright Finishing

球刀實際加工直徑計算式
Calculation of Virtual Diameter



$$de=2\sqrt{Ap\times(d-Ap)}$$

5. 球刀實際加工直徑速查表
Simplified Virtual Diameter of Ball Nosed End Mill Table

R	刃徑	切削量(加工深度) Depth of Cutting (Ap)							
Radius	Diameter	0.01	0.02	0.03	0.04	0.05	0.08	0.1	0.15
0.1	0.2	0.087	0.120	0.143	0.160	0.173	0.196	0.20	–
0.2	0.4	0.125	0.174	0.211	0.240	0.265	0.320	0.35	0.39
0.3	0.6	0.154	0.215	0.262	0.299	0.332	0.410	0.45	0.52
0.4	0.8	0.178	0.250	0.304	0.349	0.387	0.480	0.53	0.62
0.5	1.0	0.199	0.280	0.341	0.392	0.436	0.540	0.60	0.71
1.0	2.0	0.282	0.398	0.486	0.560	0.624	0.780	0.87	1.05
1.5	3.0	0.346	0.488	0.597	0.688	0.768	0.970	1.08	1.31
2.0	4.0	0.399	0.564	0.690	0.796	0.889	1.120	1.25	1.52
2.5	5.0	0.447	0.631	0.722	0.891	0.995	1.250	1.40	1.71
3.0	6.0	0.489	0.692	0.846	0.977	1.091	1.380	1.54	1.87
4.0	8.0	0.565	0.799	0.978	1.129	1.261	1.590	1.78	2.17
5.0	10.0	0.632	0.894	1.094	1.262	1.411	1.780	1.99	2.43
6.0	12.0	0.693	0.979	1.198	1.383	1.546	1.950	2.18	2.67
7.0	14.0	0.748	1.058	1.295	1.495	1.670	2.110	2.36	2.88
8.0	16.0	0.800	1.131	1.384	1.598	1.786	2.260	2.52	3.08
9.0	18.0	0.848	1.199	1.468	1.695	1.895	2.390	2.68	3.27
10.0	20.0	0.894	1.264	1.548	1.787	1.997	2.520	2.82	3.45

R	刃徑	切削量(加工深度) Depth of Cutting (Ap)							
Radius	Diameter	0.2	0.3	0.5	0.8	1	2	3	
0.1	0.2								
0.2	0.4	0.40							
0.3	0.6	0.57	0.60						
0.4	0.8	0.69	0.77						
0.5	1.0	0.80	0.92						
1.0	2.0	1.20	1.43	1.73	1.96	2.00			
1.5	3.0	1.50	1.80	2.24	2.65	2.83			
2.0	4.0	1.74	2.11	2.65	3.20	3.46	4.00		
2.5	5.0	1.96	2.37	3.00	3.67	4.00	4.90		
3.0	6.0	2.15	2.62	3.32	4.08	4.47	5.66	6.00	
4.0	8.0	2.50	3.04	3.87	4.80	5.29	6.93	7.75	
5.0	10.0	2.80	3.41	4.36	5.43	6.00	8.00	9.17	
6.0	12.0	3.07	3.75	4.80	5.99	6.63	8.94	10.39	
7.0	14.0	3.32	4.05	5.20	6.50	7.21	9.80	11.49	
8.0	16.0	3.56	4.34	5.57	6.97	7.75	10.58	12.49	
9.0	18.0	3.77	4.61	5.92	7.42	8.25	11.31	13.42	
10.0	20.0	3.98	4.86	6.24	7.84	8.72	12.00	14.28	

6. 轉速度速查表(1)
Simplified Spindle Speed Table (1)

刃徑 d	切削速度(Vc) Cutting Speed (m/min)						
Diameter	20	30	40	50	60	70	80
0.2	31,850	47,770	63,690	79,620	95,540	111,460	127,390
0.3	21,230	31,850	42,460	53,080	63,690	74,310	84,930
0.4	15,920	23,890	31,850	39,810	47,770	55,730	63,690
0.5	12,740	19,110	25,480	31,850	38,220	44,590	50,960
0.6	10,620	15,920	21,230	26,540	31,850	37,150	42,460
0.7	9,100	13,650	18,200	22,750	27,300	31,850	36,400
0.8	7,960	11,940	15,920	19,900	23,890	27,870	31,850
0.9	7,080	10,620	14,150	17,690	21,230	24,770	28,310
1.0	6,370	9,550	12,740	15,920	19,110	22,290	25,480
1.4	4,550	6,820	9,100	11,370	13,650	15,920	18,200
1.6	3,980	5,970	7,960	9,950	11,940	13,390	15,920
1.8	3,540	5,310	7,080	8,850	10,620	12,380	14,150
2.0	3,180	4,780	6,370	7,960	9,550	11,150	12,740
2.2	2,900	4,340	5,790	7,240	8,690	10,130	11,580
2.4	2,650	3,980	5,310	6,630	7,960	9,290	10,620
2.6	2,450	3,670	4,900	6,120	7,350	8,570	9,800
2.8	2,270	3,410	4,550	5,690	6,820	7,960	9,100
3.0	2,120	3,180	4,250	5,310	6,370	7,430	8,490
4.0	1,590	2,390	3,180	3,980	4,780	5,570	6,370
5.0	1,270	1,910	2,550	3,180	3,820	4,460	5,100
6.0	1,060	1,590	2,120	2,650	3,180	3,720	4,250
7.0	910	1,360	1,820	2,270	2,730	3,180	3,640
8.0	800	1,190	1,590	1,990	2,390	2,790	3,180
9.0	710	1,060	1,420	1,770	2,120	2,480	2,830
10.0	640	960	1,270	1,590	1,910	2,230	2,550
11.0	580	870	1,160	1,450	1,740	2,030	2,320
12.0	530	800	1,060	1,330	1,590	1,860	2,120
13.0	490	730	980	1,220	1,470	1,710	1,960
14.0	450	680	910	1,140	1,360	1,590	1,820
15.0	420	640	850	1,060	1,270	1,490	1,700
16.0	400	600	800	1,000	1,190	1,390	1,590
17.0	370	560	750	940	1,120	1,310	1,500
18.0	350	530	710	880	1,060	1,240	1,420
19.0	340	500	670	840	1,010	1,170	1,340
20.0	320	480	640	800	960	1,110	1,270
21.0	300	450	610	760	910	1,060	1,210
22.0	290	430	580	720	870	1,010	1,160
23.0	280	420	550	690	830	970	1,100
24.0	270	400	530	660	800	930	1,060
25.0	250	380	510	640	760	890	1,020

7. 轉速度速查表(2)
Simplified Spindle Speed Table (2)

刃徑 d	切削速度(Vc) Cutting Speed (m/min)						
Diameter	90	100	120	140	150	180	200
0.2	143,310	159,240	191,080	222,930	238,850	286,620	318,470
0.3	95,540	106,160	127,390	148,620	159,240	191,080	212,310
0.4	71,660	79,620	95,540	111,460	119,430	143,310	159,240
0.5	57,320	63,690	76,430	89,170	95,540	114,650	127,390
0.6	47,770	53,080	63,690	74,310	79,620	95,540	106,160
0.7	40,950	45,500	54,590	63,690	68,240	81,890	90,990
0.8	35,830	39,810	47,770	55,730	59,710	71,660	79,620
0.9	31,850	35,390	42,640	49,540	53,080	63,690	70,770
1.0	28,660	31,850	38,220	44,590	47,770	57,320	63,390
1.4	20,470	22,750	27,300	31,850	34,120	40,950	45,500
1.6	17,910	19,900	23,890	27,870	29,860	35,830	39,810
1.8	15,920	17,690	21,230	24,770	26,540	31,850	35,390
2.0	14,330	15,920	19,110	22,290	23,890	28,660	31,850
2.2	13,030	14,480	17,370	20,270	21,710	26,060	28,950
2.4	11,940	13,270	15,920	18,580	19,900	23,890	26,540
2.6	11,020	12,250	14,700	17,150	18,370	22,050	24,500
2.8	10,240	11,370	13,650	15,920	17,060	20,470	22,750
3.0	9,550	10,620	12,740	14,860	15,920	19,110	21,230
4.0	7,170	7,960	9,550	11,150	11,940	14,330	15,920
5.0	5,730	6,370	7,640	8,920	9,550	11,460	12,740
6.0	4,780	5,310	6,370	7,430	7,960	9,550	10,620
7.0	4,090	4,550	5,460	6,370	6,820	8,190	9,100
8.0	3,580	3,980	4,780	5,570	5,970	7,170	7,960
9.0	3,180	3,540	4,250	4,950	5,310	6,370	7,080
10.0	2,870	3,180	3,820	4,460	4,780	5,730	6,370
11.0	2,610	2,900	3,470	4,050	4,340	5,210	5,790
12.0	2,390	2,650	3,180	3,720	3,980	4,780	5,310
13.0	2,200	2,450	2,940	3,430	3,670	4,410	4,900
14.0	2,050	2,270	2,730	3,180	3,410	4,090	4,550
15.0	1,910	2,120	2,550	2,970	3,180	3,820	4,250
16.0	1,790	1,990	2,390	2,790	2,990	3,580	3,980
17.0	1,690	1,870	2,250	2,620	2,810	3,370	3,750
18.0	1,590	1,770	2,120	2,480	2,650	3,180	3,540
19.0	1,510	1,680	2,020	2,350	2,510	3,020	3,350
20.0	1,430	1,590	1,910	2,230	2,390	2,870	3,180
21.0	1,360	1,520	1,820	2,120	2,270	2,730	3,030
22.0	1,300	1,450	1,740	2,030	2,170	2,610	2,900
23.0	1,250	1,380	1,660	1,940	2,080	2,490	2,770
24.0	1,190	1,330	1,590	1,860	1,990	2,390	2,650
25.0	1,150	1,270	1,530	1,780	1,910	2,290	2,550

8. 銑刀加工異常原因及對策
Troubleshooting in Milling

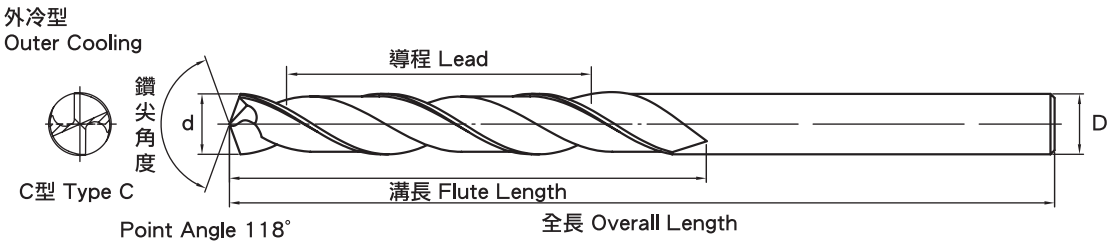
情況 Trouble	原因 Occurrences	對策 Countermeasures
崩刃 Chipping	進給速度(F)過高 High feed rate.	降低進給速度(F) Reduce feed rate.
	逆銑(向上切削) Up milling.	順銑(向下切削) Change down milling.
	切削刃太鋒利 Sharp cutting edge.	修磨切削刃-必要時倒角或倒圓 Honing at the cutting edge-chamfering or rounding if needed.
	加工震動 Chattering.	降低主軸轉速(S) Reduce spindle speed.
	刀具突出量太長 Too much overhang.	將刀具突出量調整為最小 Adjust to minimize overhang.
	銑刀末牢固夾緊 Unfixed chucking of end mill.	調整夾治具精度 Check the precision of chuck and collet.
磨損 Wear	切削速度(Vc)過高 High cutting speed.	降低切削速度(Vc) Reduce cutting speed.
	進給速度(F)過低 Low feed rate.	提高進給速度(F) Increase feed rate.
	逆銑(向上切削) Up milling.	順銑(向下切削) Down milling.
	材質硬度過高 High-hardened work piece.	選用特殊鍍膜的銑刀 Choosing special coating end mill.
刀具折斷 Tool breakage	切削量過大 Too much cutting amount.	降低切削量 Reduce cutting amount.
	切削力過大 High cutting force.	降低進給速度(F)，提高主軸轉速(S) Reduce feed rate, Increase spindle speed.
	刀具突出量太長 Too much overhang.	將刀具突出量調整為最小 Adjust to minimize overhang.
表面粗糙度 Surface roughness	加工震動 Chattering.	改變切削條件 Change the cutting condition.
	排屑不良 Generation of built-up edge.	提高切削速度(Vc)，進給速度(F)或順銑 Increasing cutting speed, feed rate or down milling.
	高進給速度(F)，低切削速度(Vc) High feed rate, low spindle speed.	降低進給速度(F)，提高切削速度(Vc) Reduce feed rate, Increase spindle speed.
加工精度 Accuracy of finished work piece	刃數不夠 Incorrect numbers of flute.	更換多刃銑刀 Replace more flutes end mill.
	刀具偏差 Deflection of tool.	使用大刃徑和突出量減至最小 Using big diameter tool & minimize the overhang.

鑽頭篇之技術資料
Technical Data for Drills

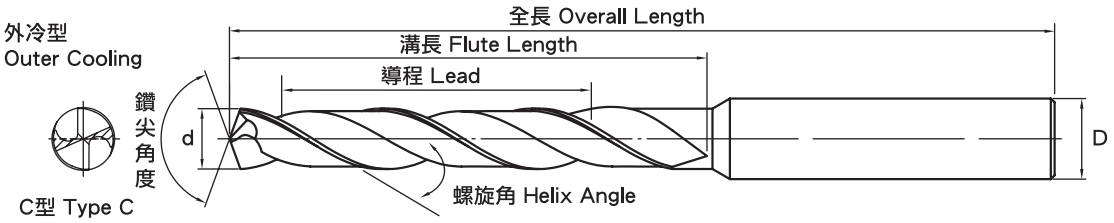
1. 鑽頭尺寸名稱介紹
Nomenclature & Size of Drill

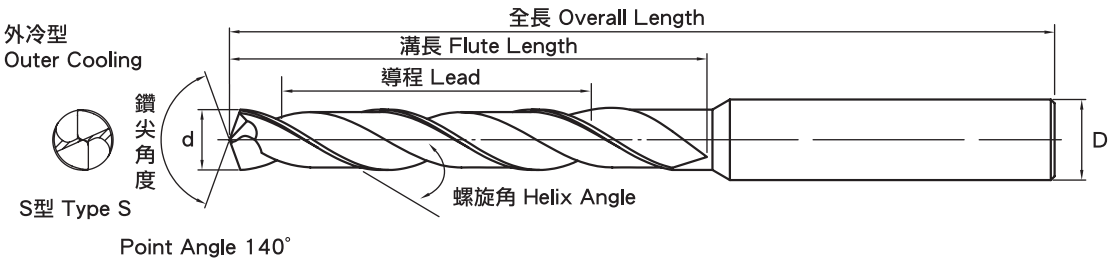
A. 螺旋刃鑽頭
Twist Drill

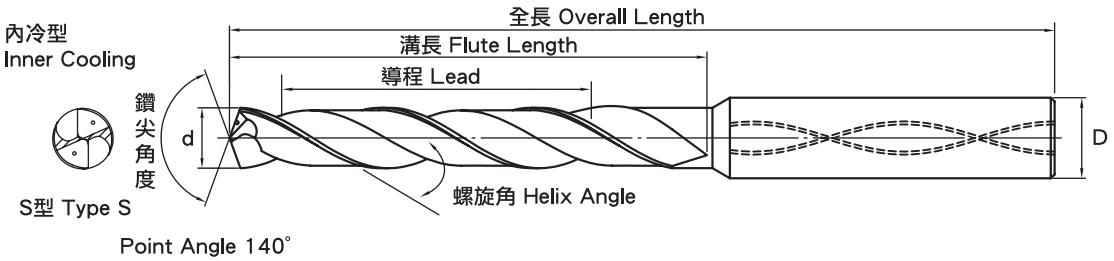
同柄徑Straight Shank



不同柄徑 End Mill Shank

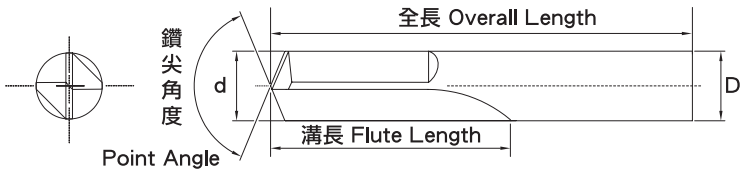




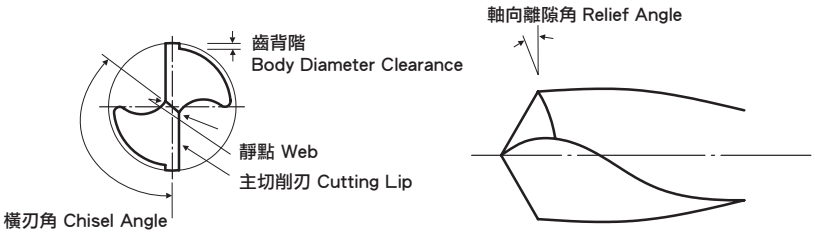


B. 直刃鑽鉸刀
Straight Flute Drill

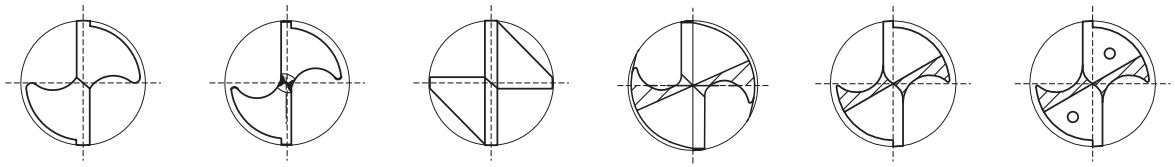
同柄徑 Straighi Shank



刀底圖解
Drill Point Geometry



刀底形式
Drill Point Style

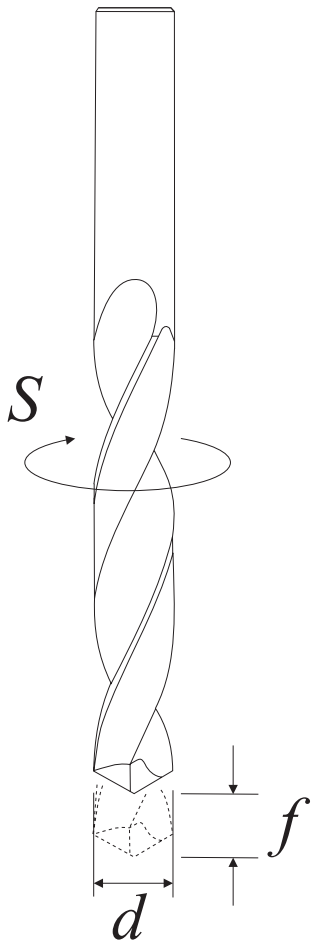


標準型 (Standard)	E型 (Type E)	2刃直刃 (Straight Flute) 2F	C型(平面型) Type C (Flat Relief)	S型(偏心型) Type S (Eccentric Relief)	S型(偏心型) 含出水孔 Type S (Eccentric Relief) with oil holes

2. 計算公式
Formula

切削速度	$Vc = d \times S \times \pi / 1000$
進給速度	$F = fz \times S \times Z$
每轉進給量	$f = fz \times Z$
螺旋角度	$\delta = \tan^{-1}(\pi \times d / L)$
鑽削時間	$Tc = Ap \times i / S / f$
鑽削移除量	$Q = \pi \times d^2 / 4 \times S \times f$

Ap (加工深度)	mm
Tc (鑽削時間)	min
Vc (切削速度)	m/min
d (外徑)	mm
S (轉速)	rpm
π (圓周率)	3.14
F (進給速度)	mm/min
f (每轉進給量)	mm/rev
δ (螺旋角)	°
L (導程)	mm
i (孔數)	pcs



3. 鑽頭加工異常原因及對策
Troubleshooting in Drilling

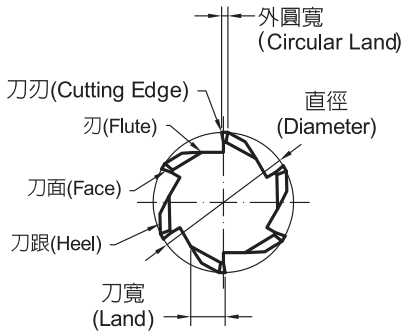
情況 Trouble	原因 Occurrences	對策 Countermeasures
鑽孔成橢圓 Deformation of hole	形成螺紋刮痕 Becoming thread scratch in the hole.	1.使用適合之鑽套 Check for suitable guide-bush. 2.減少間隙角度 Reduce relief angle. 3.檢查鑽頭尖端角度和兩邊長度是否對稱 Check for proper point angle & length of lips.
	產生顫動、振動 Generation of chattering & vibration.	1.減少間隙角度 Reduce relief angle. 2.腹板削薄 Grind web thinning. 3.縮短鑽頭長度，增加剛性 Shortening length of drill. 4.檢查鑽頭角度研磨是否正確 Check for proper drill. 5.檢查夾具與鑽頭接觸情形 Check for chuck & collet & socket. 6.預先鑽好中心孔 Pre-centering. 7.提高工作機械的剛性 Inspect rigidity of the drill machine.
	切屑排出不易 Poor chip evacuation.	1.提高每轉進給量(f) Increase feed per revolution. 2.選擇正確螺旋角 Check for proper helix angle. 3.加大槽寬比 Check for proper chip space. 4.採用間歇式進給 Using step feed.

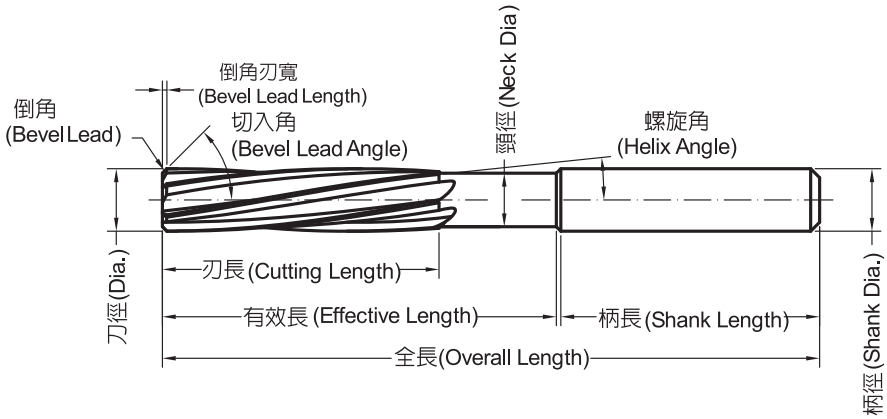
情況 Trouble	原因 Occurrences	對策 Countermeasures
鑽孔傾斜 Deflection of hole	剛進刀時不良 Drill won't enter work.	1.使用適合的鑽套 Check for suitable guide-bush. 2.降低進刀時的每轉進給量(f) Reduce feed per revolution. 3.預先鑽好中心孔 Pre-centering.
	鑽頭剛性不良 Insufficient rigidity of drill.	縮短鑽頭長度，提高剛性 Shortening length of drill.
	鑽頭角度不對 Unsuitable angle.	再研磨 Regrinding.
外角磨損 Excessive wear of cutting edge	切削速度(Vc)過高 High cutting speed.	1.降低切削速度(Vc) Reduce cutting speed. 2.加大間隙角 Check lip relief. 3.充分供給切削液 Increase coolant flow. 4.提高鑽頭之材質 Check for proper material.
孔壁粗糙 Poor surface conditions of work piece	刀刃磨損太大 Excessive wear of cutting edge.	再研磨 Regrinding.
	進給速度(F)過高 High feed rate.	降低進給速度(F) Reduce feed rate.
	切削阻塞 Chips clog in hole.	增加退刀次數 Add number of exit.
	其他 the others.	1.腹板削薄 Thin web. 2.使用適合導套 Check for proper guide- bush. 3.採用高剛性主軸 Use the highly rigid spindle.

情況 Trouble	原因 Occurrences	對策 Countermeasures
切削中鑽頭折斷 Breakage	每轉進給量(f)過高 High feed per revolution.	降低每轉進給量(f) Reduce feed per revolution.
	切削阻塞 Chips clog in hole.	1.加大槽寬比 Check for proper chip space. 2.選擇適當之螺旋角度 Check for proper helix angle.
	鑽頭剛性不足 Insufficient rigidity of drill.	1.降低每轉進給量(f) Reduce feed per revolution. 2.縮短鑽頭長度，增加剛性 Shortening length of drill. 3.腹板厚度加大 Increasing web thickness.
	貫穿時安定性不夠 (工件不完全被夾住) Unstable in throughout hole drilling.	1.降低貫穿時的每轉進給量(f) Reduce feed per revolution while throughout drilling. 2.工作保持固定 Check set up rigidity. 3.採用高剛性主軸 Use the highly rigid spindle.
切唇崩刃 Chipping	進給速度(F)過高 High feed rate.	降低每轉進給量(f) Reduce feed per revolution.
	切刃強度不足 (過度的間隙角度) Too high lip relief angle.	1.減少間隙角度 Reduce lip relief angle. 2.降低貫空時的每轉進給量(f) Reduce feed per revolution in drilling. 3.工作保持固定 Check set up rigidity.
	使用在擴孔作業時 During oversize operation.	1.加大鑽尖角度 Properly grind point angle. 2.降低切削速度(Vc) Reduce cutting speed.
孔徑擴大 Hole oversize	尖端角度末對稱或刃大小不一 Point angle is not properly, large chip of one flute; small chip of other flute.	1.再研磨 Regrinding. 2.腹板削薄 Thin web. 3.減少尖端角度 Properly grind point angle. 4.使用鑽套 Guide-bush.

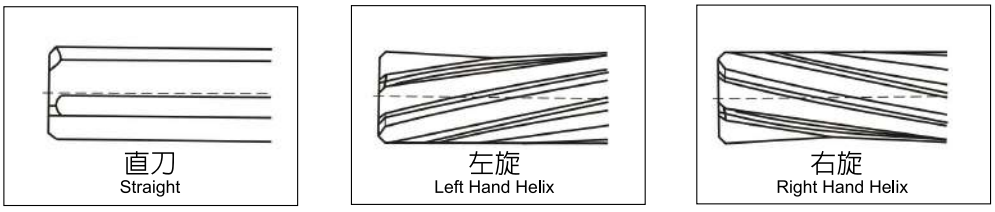
鉸刀篇之技術資料
Technical Data for Reamers

1. 鉸刀名稱介紹
Nomenclature & Size of Reamer





2. 螺旋形式
Helix Type



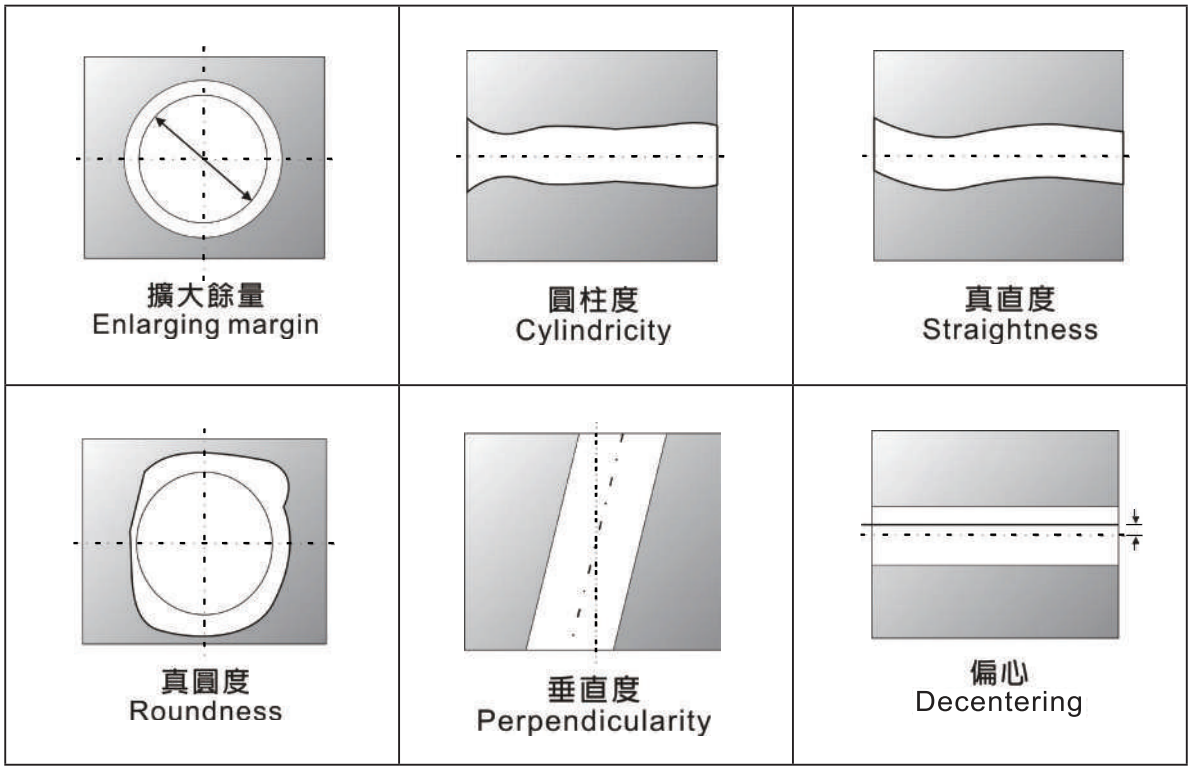
目的：鑽好孔穴後再做鉸孔以得到下列的效果：

1. 正確之孔直徑
2. 平順光滑的加工面
3. 精準的真直度
4. 準確的圓柱度

The reaming work means to enlarge drilled hole to get the following hole finishing：

1. The hole bearing correct diameter.
2. The hole having good finish surface roughness.
3. The hole having correct roundness.
4. The hole free from shape (Cylindricity) deviation.

3. 孔穴的形狀誤差
Hole Shape Deviation



4. 鉸刀加工異常原因及對策
Troubleshooting in Reaming

情況 Trouble	原因 Occurrences	對策 Countermeasures
外徑異常磨耗 Serious wear on outside diameter	1. 倒角過小 Bevel lead angle is insufficient. 2. 切削速度(Vc)過高 High cutting speed. 3. 冷卻不足 Insufficient cooling. 4. 工件過硬 Work piece is too hard.	1. 加大倒角 Increase bevel lead angle. 2. 降低切削速度(Vc) Reduce cutting speed. 3. 供給充分的切削油量 使用適當的切削油 Increase coolant flow and use proper cutting fluid. 4. 增加鉸刀刃部硬度，改變鉸刀材質 Increase hardness of reamer cutting edge and change the material.
孔徑擴大 Hole size gets larger	1. 機械主軸、夾持部或鉸刀偏擺 Check for any run out at machine spindle, sleeve and reamer. 2. 工具夾持部損傷 Damaging on the sleeve.	1. 檢查鉸刀外徑，咬入部是否偏擺。 Check for any run out of reamer diameter and biting section.

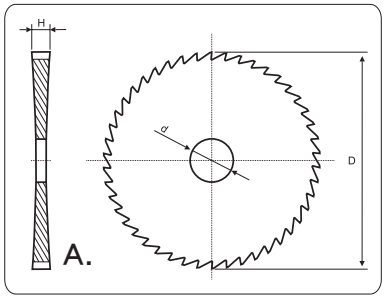
情況 Trouble	原因 Occurrences	對策 Countermeasures
孔徑擴大 Hole size gets larger	3. 預留量過大 Stock amount is too big. 4. 中心未對正 Is the drilled hole eccentric to the reamer. 5. 進給速度(F)過高 High feed rate.	2. 鉸刀柄部、套管、承套有無損傷 Check for any damage on the shank , sleeve and socket. 3. 減少預留量 Reduce stock amount. 4. 確認鉸刀中心與工件中心是否對正 Confirm to see if the reamer and workpiece are concentric. 5. 降低進給速度(F) Reduce feed rate.
孔徑縮小 Hole size gets smaller	1. 使用大尺寸的鉸刀 Use the reamer of larger diameter. 2. 預留量過小 Stock amount is too small. 3. 刀緣面寬度變大 Margin becomes larger. 4. 鉸刀切刃鈍化 Cutting edge is worn.	1. 檢查鉸刀刃徑 Check for diameter of cutting edge. 1.1工件之熱膨脹係數大，加工後會收縮 Check to see if heat expansion ratio of workpiece is too high. 2. 增加預留量 Increase stock amount. 3. 縮小刀緣面寬度 Make the margin narrower. 4. 再次研磨成形面 Regrinding the scooping surface.
切削中折損 Breakage during cutting	1. 進給速度(F)過高 High feed rate. 2. 切削堵塞 Chips clogging. 3. 主軸轉速(S)過高 High spindle speed. 4. 預留量過大 Stock amount is too large. 5. 切削液不足 Lack of cutting fluid. 6. 絞刀切刃純化 Cutting edge of reamer is worn. 7. 刀緣寬度過大 Margin width of cutting edge is too wide. 8. 下孔歪曲或中心未對正 Is the hole reaming drilled through straight or eccentric.	1. 降低進給速度(F) Reduce feed rate. 2. 改變鉸刀溝槽深度或排屑槽底部Adjust the teeth groove depth or teeth bottom due to too shallow or sharp edge. 3. 降低主軸轉速(S) Reduce spindle speed. 4. 減少預留量 Reduce stock amount. 5. 適當增加切削液量 Increase cutting fluid supply. 6. 再研磨 Re-grinding. 7. 減少刀緣寬度 Reduce the width of cutting edge. 8. 確認下孔正直或中心對正 Before reaming, check the drilled hole straightness and concentricity.

情況 Trouble	原因 Occurrences	對策 Countermeasures
	9. 工件過硬 Work piece is too hard.	9. 確認被削材硬度和鉸刀硬度 Confirm hardness of work piece and reamer.
鉸刀壽命短 Poor tool life of reamer	1. 切削條件過快 Cutting condition too high. 2. 切削液不足 Lack of cutting fluid. 3. 刀具材質不對 Choose the wrong material. 4. 刀具選擇錯誤 Use the wrong reamer.	1. 放慢切削條件 Slow down the cutting conditions. 2. 適當增加切削液量 Increase cutting fluid. 3. 改變鉸刀材質或鍍膜處理 Change reamer material or apply coating process. 4. 由直刃改用螺旋刃 Exchange straight flute to helix one.
加工面不良 Surface roughness of a hole is not sufficient	1. 咬入部和刀緣面之熔著 Check biting section and cutting edge. Are they clogged with metal chips. 2. 咬入部之離隙角過小 Is the relieving angel of biting section of the reamer too small. 3. 預留量是否適當 Is the stock amount adequate. 4. 切削堵塞 Chips clog on the cutting edge. 5. 加工件夾持不穩 Is the workpiece tightly clamped. 6. 切刃之傾斜角成為負角 Is the scooping angle in minus range.	1. 供給充分之切削油量 Full of supply cutting oil. 2. 加大咬入部之離隙角 Increase relief angle of biting section. 3. 預留量過多或過少均會造成加工面不良 Either too large or too small size of stock amount lowers the quality of surface roughness. 4. 改變鉸刀刃溝深度和排屑槽深度 Adjust the teeth groove depth and chip pocket depth. 5. 加強固定加工件 Fix the workpiece firmly. 6. 檢查傾斜角與背推拔 Check to see the scooping angel and back taper.
孔之入口徑變大 Diameter at hole inlet becomes larger	1. 鉸刀產生振動 Reamer causes vibration. 2. 加工件夾持不穩 Is the workpiece mounted correctly without any run-out. 3. 孔未對正鉸刀中心 Axis of predrilled hole and reamer are not in line.	1. 改善外徑和咬入部之振動 Improving the outside diameter and biting section vibration. 2. 加強固定加工件 Fix the workpiece firmly. 3. 預先使用中心鑽 Use center drill before reaming.

鋸片與圓刀之技術資料
Technical Data for Saws & Knives

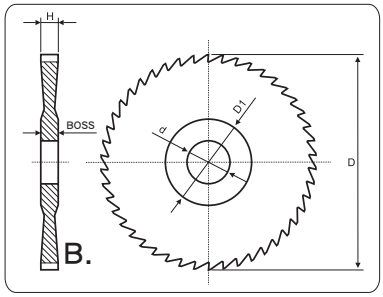
1. 鋸片之選用
Selecting of Slitting Saws

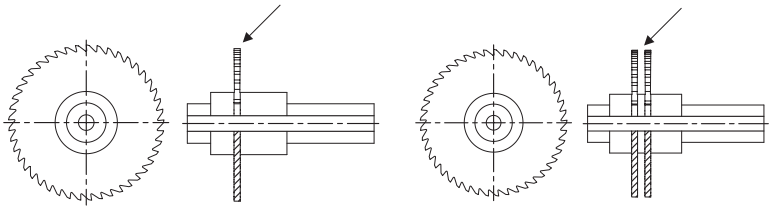
A. 厚度的2種型式
Two Types of Thickness



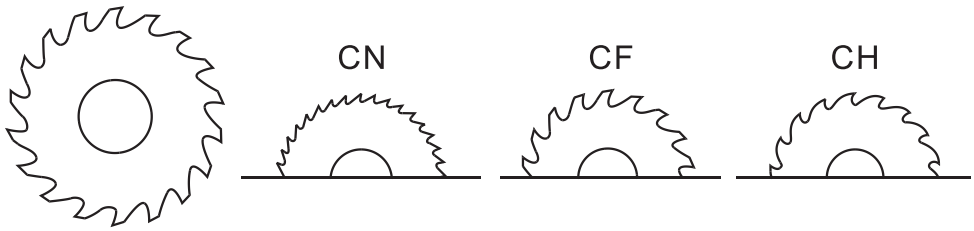
A.無Boss(墊部) Without Boss
(用於切斷或溝槽加工，一般採單片使用)
For cutting off or slot making, single usage is recommended.

B.有Boss(墊部) With Boss
(用於多槽等距加工，一般採多片使用)
For multiple groove & equidistance tooling; multi- usage is recommended.





B. 齒型之選用：
Selection of Tooth Type



CN型（尖齒）：銅、鋁合金之加工適用。
CF型（平齒）：一般鋼材、不銹鋼、鈦合金之加工適用。
CH型（鉤齒）：一般鋼材、不銹鋼、鈦合金之加工適用(高效率)。
CN-Type：To be suitable to work Copper Alloys & Aluminum Alloys.
CF-Type：To be suitable to work Normal Steel or Stainless Steel, Titanium Alloys.
CH-Type：To be suitable to work Normal Steel or Stainless Steel, Titanium Alloys (high efficiency).

C. 加工的選擇：
Selection of Application

1.對於較深或較寬溝槽之加工應選擇較粗刃之鋸片，以利排屑。
2.對於較淺或較窄溝槽之加工應選擇較細刃之鋸片，以提高工件精緻度。
3.對於較難加工材質先降低進給速度，再視狀況逐漸提高進給速度。
4.對於要求表面較光滑之加工，提高鋸片之轉速，亦可改善工件精緻度。

1.Using big teeth for deep or wide slot making, in order to be good at chip removal.
2.Using small teeth for shallow or narrow slot making, in order to get high-level accuracy of finishing,
3.For hardened material, feed may be decreased first, then increases it step by step.
4.Increasing the spindle speed of saws may get high-level surface roughness for finishing.

◎圓鋸片規格總覽（生產範圍）：
外徑：10mm ~ 150mm
厚度：0.1mm ~ 20mm

※齒形依上述為主，其他的規格，請附上圖面(檔案如DWG，PDF)，以利後續作業。
◎Saw range in production
Diameter：10mm ~ 150mm
Thickness：0.1mm ~ 20mm

※The above-mentioned range is mainly composed of our standard tooth type.

※For special tooth form is subject to quotation indicating：clear drawing file (DWG, PDF).

D. 計算公式 Formula

齒距	P = D× π / Z
切削速度	Vc = D×S× π / 1000
進給速度	F = fz×S×Z

P (齒距)	mm
Z (齒數)	(Number of Teeth)
Vc (切削速度)	m/min
D (外徑)	mm
S (轉速)	rpm
π (圓周率)	3.14
F (進給速度)	mm/min
f (每轉進給量)	mm/rev

2. 圓刀之選用 Selecting of Circular Knife

A. 應用：

加工材質：非金屬→斜角小；金屬→斜角大
※ 依加工需求，可另訂特殊規格及切入角設計

Applications：

Applicable Work Material：
Non-material→ small bevel angle; Material→ big bevel angle
※ Due to special working, special design for angle is produced for requirement.

B. 型式 Type

項次 Index	型式 Type	圖式 Drawing	材質 Material	外徑 Diameter	厚度 Thickness
1	單斜單角 Single bevel		鎢鋼 (Carbide)	Φ50 ~ 125mm	0.2 ~ 5.0mm
			高速鋼 (HSS)	Φ50 ~ 250mm	0.2 ~ 5.0mm
2	單斜雙角 Single bevel with top bevel		鎢鋼 (Carbide)	Φ50 ~ 125mm	0.2 ~ 5.0mm
			高速鋼 (HSS)	Φ50 ~ 250mm	0.2 ~ 5.0mm
3	雙斜單角 Double bevel		鎢鋼 (Carbide)	Φ50 ~ 125mm	0.2 ~ 5.0mm
			高速鋼 (HSS)	Φ50 ~ 250mm	0.2 ~ 5.0mm
4	雙斜雙角 Double bevel with top bevel on both sides		鎢鋼 (Carbide)	Φ50 ~ 125mm	0.2 ~ 5.0mm
			高速鋼 (HSS)	Φ50 ~ 250mm	0.2 ~ 5.0mm

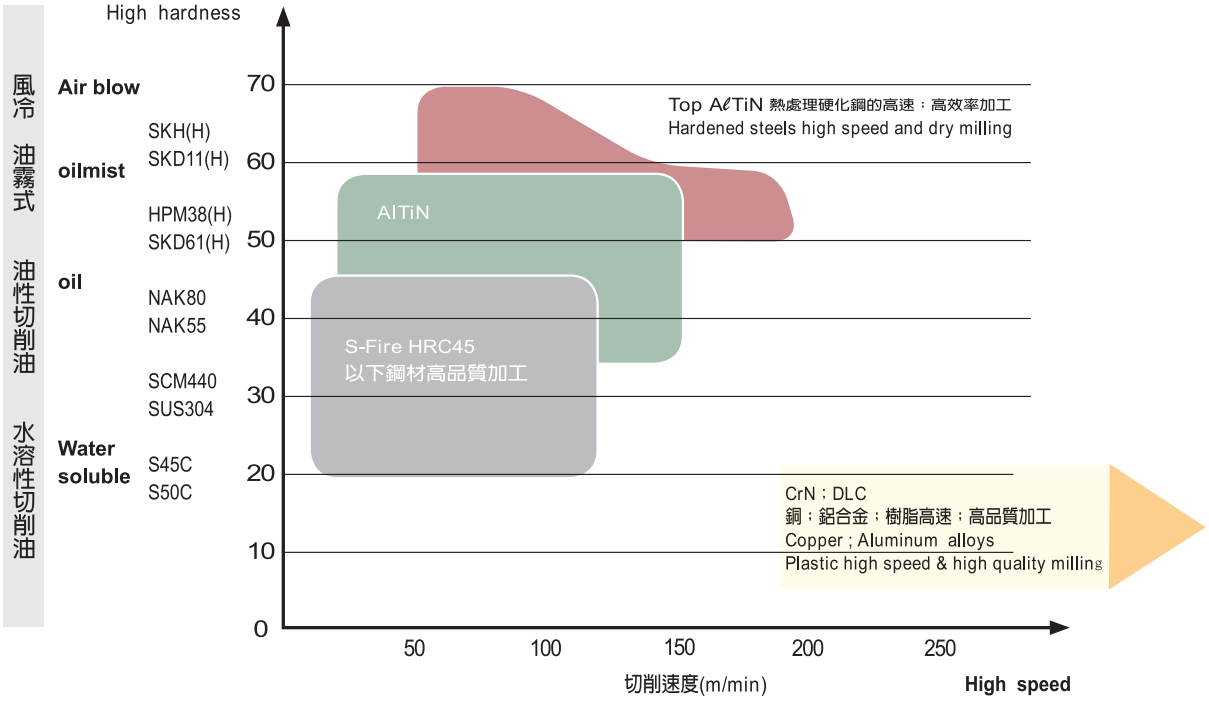
4. 鋸片加工異常原因及對策
Troubleshooting for Sawing

情況 Trouble	原因 Occurrences	對策 Countermeasures
尺寸精度不良 Poor dimensional precision	進給速度(F)過高 High feed speed.	降低進給速度(F) Reduce feed rate.
	外徑過大(超過厚度) Outside diameter is larger than width.	選擇適當的外徑 Use a slitting saw with proper outside diameter.
	切削量過大 Too large depth of cut.	減少切削量 Make small depth of cut.
	機台和軸心剛性不足 Insufficient stiffness of machine and arbor.	更換適當型式的機台和軸心 Replace the machine and arbor with proper types.
	刀刃磨損大 Excessively worn-out cutting edge.	再研磨 Re-grinding.
磨損燒焦 Serious wear and burning	主軸轉速(S)過高 High spindle speed.	降低主軸轉速(S) Reduce spindle speed.
	外部離隙角過小 Excessively small outside relief angle.	修正外部離隙角 Modify the outside relief angle properly.
	被削材硬度過高 Hardness of the workpiece material is too high.	刀具做表面處理 Apply the surface coated slitting saw.
表面不佳 Insufficient roughness of finished surface	側面離隙(內凹)過小 Too small medium to low gradient of side relief.	加大側面離隙(內凹) Make the medium to low gradient greater.
	排屑不良 Chips clog on the workpiece.	降低切削量 Make small cutting depth.
	刀刃磨耗大 Excessively worn-out cutting edge.	再研磨 Re-grinding.
	進給速度(F)過高 High feed rate.	降低進給速度(F) Reduce feed rate.
	主軸轉速(S)過低 Low spindle speed.	提高切削速度(Vc)、主軸轉速(S) Increase cutting speeds and pindle speed.
顫動和振動 Chattering during cutting	工件未固定好 Workpiece is not attached securely.	加強固定 Fix the workpiece firmly.
	主軸轉速(S)、進給速度(F)過高 High spindle speed and feed speed.	降低主軸轉速(S)、進給速度(F) Reduce spindle speed and feed speed.
	機台剛性不足 Insufficient rigidity of machine.	提昇機台剛性 Replace machine rigidity with properly.
	沒有切削角或過小 Too small rake angle, or no rake angle.	採用適當之切削角 Use the slitting saw with proper rake angle.
	由於直刃而咬入不易 Poor bite due to straight tooth.	改用千鳥刃 Use the slitting saw with staggered tooth.
切削阻塞 Chip clogging	切削量過大 Too large amount of cutting.	調整進給速度(F)與切削量 Adjust the feed speed and depth of cut.
	切削油不足 Insufficient application of cutting fluid.	增加切削油 Apply a large amount of cutting fluid to workpiece.
	屑袋過小 Small chip pocket.	採用刃數較少刀具 Use a tool with less number of teeth.

情況 Trouble	原因 Occurrences	對策 Countermeasures
切削阻塞 Chip clogging	屑袋形狀不良 Improper shape of chip pocket.	修改屑袋形狀 Modify the chip pocket to have a proper shape.
切感不良 Poor cutting quality	切刃磨耗較大 Excessively worn-out cutting edge.	再研磨 Re-grinding.
	加工工件與刀具不匹配 A tool to be used is not suited to the workpiece.	建議使用專用刀具 Use a tool specially designed for the work.
	切削角過小或無 Too small rake angle.	採用適當之切削角 Modify the rake angle properly.
於切削中產生之刃部缺損 Breakage during cutting	工件之固定不夠 The workpiece is not fixed properly.	加強固定 Fix the workpiece firmly.
	進給速度(F)過高 High feed speed.	降低進給速度(F) Reduce feed rate.
	切削角磨損 Worn-out cutting edge.	適當研磨切削刃 Perform re-grinding in early stage of wear.
	夾軸振動或彎曲過大 Too large deflection or bend of arbor.	採用精度良好的夾軸 Use the high-precision arbor.
	切削量過大 Too large cutting depth.	減少切削量 Make small cutting depth.
	機台剛性不足 Insufficient rigidity of machine.	提高機台剛性 Replace the machine a proper one.

The Application of Solid Carbide Cutting Tool's Coating
鎢鋼刀具薄膜銑削加工的適用範疇

加工冷卻方式	被加工鋼材 硬度(HRC)



金屬材質料號對照表
Metal Material Code

材質 Material	日本 JIS	美國 AISI / SAE	大陸 GB	英國 BS	德國 DIN	法國 NF	俄羅斯 ГОСТ
機械構造用碳鋼鋼材	S10C	1010	08 10	040A10 045A10 045M10	C10E C10R	XC10	—
	S12C	1012	—	040A12	—	XC12	—
	S15C	1015	15	055M15	C15E C15R	—	—
	S17C	1017	—	—	—	XC18	—
	S20C	1020	20	070M20 C22 C22E C22R	C22 C22E C22R	C22 C22E C22R	—
	S22C	1023	—	—	—	—	—
	S25C	1025	25	C25 C25E C22R	C25 C25E C25R	C25 C25E C25R	—
	S28C	1029	—	—	—	—	25Γ
	S30C	1030	30	080A30 080M30 C30 C30E C30R	C30 C30E C30R	C30 C30E C30R	30Γ
	S33C	—	—	—	—	—	30Γ
	S35C	1035	35	C35 C35E C35R	C35 C35E C35R	C35 C35E C35R	35Γ
	S38C	1038	—	—	—	—	35Γ
	S40C	1039 1040	40	080M40 C40 C40E C40R	C40 C40E C40R	C40 C40E C40R	40Γ
	S43C	1042 1043	—	080A42	—	—	40Γ
	S45C	1045 1046	45	C45 C45E C45R	C45 C45E C45R	C45 C45E C45R	45Γ
	S48C	—	—	080A47	—	—	45Γ
	S50C	1049	50	080M50 C50 C50E C50R	C50 C50E C50R	C50 C50E C50R	50Γ
	S53C	1050 1053	—	—	—	—	50Γ
	S55C	1055	55	070M55 C55 C55E C55R	C55 C55E C55R	C55 C55E C55R	—
	S58C	1059 1060	60	C60 C60E C60R	C60 C60E C60R	C60 C60E C60R	60Γ
	S09CK	—	—	045A10 045M10	C10E	XC10	—
	S15CK	—	15F	—	C15E	XC12	—
	S20CK	—	—	—	—	XC18	—

金屬材質料號對照表
Metal Material Code

材質 Material	日本 JIS	美國 AISI / SAE	大陸 GB	英國 BS	德國 DIN	法國 NF	俄羅斯 ГОСТ
鎳鉻鋼鋼材	SNC236	—	—	—	36NiCr6	—	40XH
	SNC415	—	12CrNi2	—	14NiCr10	—	—
	SNC631	—	30CrNi3	—	36NiCr10	—	30XH3A
	SNC815	—	12Cr2Ni4	655M13	15NiCr13	—	—
	SNC836	—	37CrNi3	—	31NiCr14	—	—
鎳鉻鉬鋼鋼材	SNCM220	8615 8617 8620 8622	20CrNiMo	805A20 805M20 805A22 805M22	20NiCrMo2 20NiCrMoS2	20NCD2	—
	SNCM240	8637 8640	—	—	40NiCrMo2-2	—	—
	SNCM415	—	—	—	—	—	—
	SNCM420	4320	18CrNiMnMoA	—	17NiCrMo6-4	—	20XH2M (20XHM)
	SNCM431	—	—	—	30CrNiMo8	—	—
	SNCM439	4340	40CrNiMoA	—	40NiCrMo6	—	—
	SNCM447	—	—	—	34CrNiMo6	—	—
	SNCM616	—	—	—	—	—	—
	SNCM625	—	—	—	—	—	—
	SNCM630	—	—	—	—	—	—
	SNCM815	—	—	—	—	—	—
鉻鋼鋼材	SCr415	—	15Cr 15CrA	—	17Cr3 17CrS3	—	15X 15XA
	SCr420	5120	20Cr	—	—	—	20X
	SCr430	5130 5132	30Cr	34Cr4 34CrS4	34Cr4 34CrS4	34Cr4 34CrS4	30X
	SCr435	5132	35Cr	37Cr4 37CrS4	37Cr4 37CrS4	37Cr4 37CrS4	35X
	SCr440	5140	40Cr	530M40 41Cr4 41CrS4	41Cr4 41CrS4	41Cr4 41CrS4	40X
	SCr445	—	45Cr 50Cr	—	—	—	45X
鉻鉬鋼鋼材	SCM415	—	15CrMo	—	15CrMo4	—	—
	SCM418	—	20CrMo	—	18CrMo4 18CrMoS4	—	20XM
	SCM420	—	—	708M20	20CrMo5	—	20XM
	SCM421	—	—	—	—	—	—
	SCM430	4130	30CrMo 30CrMoA	—	—	—	30XM 30XMA
	SCM432	—	—	—	—	—	—
	SCM435	4137	35CrMo	34CrMo4 34CrMoS4	34CrMo4 34CrMoS4	34CrMo4 34CrMoS4	35XM
	SCM440	4140 4142	42CrMo	708M40 709M40 42CrMo4 42CrMoS4	42CrMo4 42CrMoS4	42CrMo4 42CrMoS4	—
	SCM445	4145 4147	—	—	—	—	—
	SCM822	—	—	—	—	—	—

金屬材質料號對照表
Metal Material Code

材質 Material	日本 JIS	美國 AISI / SAE	大陸 GB	英國 BS	德國 DIN	法國 NF	俄羅斯 ГОСТ
錳鉻鋼/錳鋼鋼材	SMn420	1522	20Mn2	150M19	20Mn5	—	—
	SMn433	1536	30Mn2 35Mn2	150M36	34Mn5	—	30Г2 35Г2
	SMn438	1541	40Mn2	150M36	36Mn5	—	35Г2 40Г2
	SMn443	1541	45Mn2	—	—	—	40Г2 45Г2
	SMnC420	5115	15CrMn	—	16MnCr5	—	—
	SMnC443	5140	40CrMn	—	—	—	—
保證硬化能構造用鋼材(H鋼)	SMn420H	1522H	—	—	—	—	—
	SMn433H	—	—	—	—	—	—
	SMn438H	1541H	—	—	—	—	—
	SMn443H	1541H	—	—	—	—	—
	SMnC420H	—	—	—	—	—	—
	SMnC443H	—	—	—	—	—	—
	SCr415H	—	15CrH	—	17Cr3 17CrS3	—	15X
	SCr420H	5120H	20Cr1H	—	17Cr3	—	20X
	SCr430H	5130H 5132H	—	34Cr4 34CrS4	34Cr4 34CrS3	34Cr4 34CrS4	30X
	SCr435H	5135H	—	37Cr4 37CrS4	37Cr4 34CrS4	37Cr4 37CrS4	35X
	SCr440H	5140H	40CrH	41Cr4 41CrS4	41Cr4 41CrS4	41Cr4 41CrS4	40X
	SCM415H	4118H	15CrMoH	—	15CrMo5	—	—
	SCM418H	—	—	—	18CrMo4 18CrMoS4	—	—
	SCM420H	4118H	20CrMoH	708H20	18CrMo4	—	—
	SCM435H	4135H 4137H	—	34CrMo4 34CrMoS4	34CrMo4 34CrMoS4	34CrMo4 34CrMoS4	—
	SCM440H	4140H 4142H	42CrMoH	42CrMo4 42CrMoS4	42CrMo4 42CrMoS4	42CrMo4 42CrMoS4	—
	SCM445H	4145H 4147H	—	—	—	—	—
	SCM822H	—	—	—	—	—	—
	SNC415H	—	—	—	—	—	—
	SNC631H	—	—	—	—	—	—
	SNC815H	—	12Cr2Ni4H	655H13	15NiCr13	—	—
	SNCM220H	8617H 8620H 8622H	20CrNiMoH	805H17 805H20 805H22	21NiCrMo2	20N CD 2	—
	SNCM420H	4320H	20CrNi2MoH	—	20NiCrMoS6-4	—	—

金屬材質料號對照表
Metal Material Code

材質 Material	日本 JIS	美國 AISI / ASTM	大陸 GB	英國 BS	德國 DIN	法國 NF	俄羅斯 ГОСТ
碳工具鋼鋼材	SK140 (SK1)	—	T13	—	—	C140E3U	Y13
	SK120 (SK2)	W1-11 1/2	T12	—	—	C120E3U	Y12
	SK105 (SK3)	W1-10	T11	—	C105W1	C105E2U	Y11
	SK95 (SK4)	W1-9	T10	—	—	C90E2U	Y10
	SK85 (SK5)	W1-8	T8Mn T9	—	C80W1	C90E2U C80E2U	Y8Г Y9
	SK75 (SK6)	—	T8	—	C80W1	C80E2U C70E2U	Y8
	SK65 (SK7)	—	T7	—	C70W2	C70E2U	Y7
高速工具鋼鋼材	SKH2	T1	W18Cr4V	BT1	—	HS18-0-1	P18
	SKH3	T4	W18Cr4VCo5	BT4	S18-1-2-5	HS18-1-1-5	P18K5Φ2
	SKH4	T5	W18Cr4V2Co8	BT5	—	HS18-0-2-9	P18K5Φ
	SKH10	T15	W12Cr4V5Co5	BT15	S12-1-4-5	HS12-1-5-5	—
	SKH51	M2	W6Mo5Cr4V2	BM2	S6-5-2	HS6-5-2	P6M5
	SKH52	M3-1	CW6Mo5Cr4V2 W6Mo5Cr4V3	—	—	—	P6M5Φ3
	SKH53	M3-2	CW6Mo5Cr4V3	—	S6-5-3	HS6-5-3	P6M5Φ3
	SKH54	M4	—	BM4	—	HS6-5-4	—
	SKH55	M35 M41	W6Mo5Cr4V2Co5 W7Mo5Cr4V2Co5	BM35	S6-5-2-5	HS6-5-2-5HC	P6M5K5
	SKH56	M36	—	—	—	—	—
	SKH57	—	—	BT42	S10-4-3-10	HS10-4-3-10	—
	SKH58	M7	W2Mo9Cr4V2	—	—	HS2-9-2	—
	SKH59	M42	W2Mo9Cr4VCo8	BM42	S2-10-1-8	HS2-9-1-8	—
合金工具鋼鋼材	SKS11	F2	—	—	—	—	XB4
	SKS2	—	—	—	105WCr6	105WCr5	XBГ
	SKS21	—	W	—	—	—	—
	SKS5	—	—	—	—	—	—
	SKS51	L6	—	—	—	—	—
	SKS7	—	—	—	—	—	—
	SKS8	—	Cr06	—	—	C140E3UCr4	13X
	SKS4	S1	5CrW2Si 6CrW2Si	—	—	—	6XB2C 5XB2CΦ
	SKS41	S1	4CrW2Si	—	—	—	4XB2C
	SKS43	W2-9 1/2	—	BW2	—	100V2	—
	SKS44	W2-8	—	—	—	—	—
	SKS3	—	9CrWMn	—	—	—	9XBГ
	SKS31	—	CrWMn	—	105WCr6	105WCr5	XBГ
	SKS93	—	—	—	—	—	—
	SKS94	—	—	—	—	—	—
	SKS95	—	8MnSi	—	—	—	—
	SKD1	D3	Cr12	BD3	X210Cr12	X200Cr12	X12
	SKD10	D2	Cr12Mo1V1	—	X153CrMoV12	—	X12MΦ
	SKD11	D2	Cr12MoV	BD2	X153CrMoV12	X160CrMoV12	—
	SKD12	A2	Cr5Mo1V	BA2	—	X100CrMoV5	—
	SKD4	—	—	—	—	X32WCrV3	—

金屬材質料號對照表
Metal Material Code

材質 Material	日本 JIS	美國 AISI / ASTM	大陸 GB	英國 BS	德國 DIN	法國 NF	俄羅斯 ГОСТ
合金工具鋼鋼材	SKD5	H21	3Cr2W8V	BH21	X30WCrV9-3	X30WCrV9	—
	SKD6	H11	4Cr5MoSiV	BH11	X38CrMoV51	X38CrMoV5	4X5MΦC
	SKD61	H13	4Cr5MoSiV1	BH13	X40CrMoV51	X40CrMoV5	4X5MΦ1C
	SKD62	H12	—	BH12	—	X35CrWMoV5	3X3M3Φ
	SKD7	H10	4Cr3Mo3SiV	BH10	X32CrMoV33	32CrMoV12-18	—
	SKD8	H19	—	BH19	—	—	—
	SKT3	—	—	—	—	55CrNiMoV4	—
	SKT4	—	5CrNiMo	BH224 / 5	55NiCrMoV6	55NiCrMoV7	5XHM
彈簧鋼鋼材	SUP3	1075 1078	—	—	—	—	75 80 85
	SUP6	—	55Si2Mn	—	56SiCr7	60Si7	60C2
	SUP7	9260	60Si2Mn 60Si2MnA	—	61SiCr7	60Si7	60C2Г
	SUP9	5155	55CrMnA	—	55Cr3	55Cr3	—
	SUP9A	5160	60CrMnA	—	55Cr3	60Cr3	—
	SUP10	6150	50CrVA	735A51, 735H51	50CrV4	51CrV4	XΦA50XГΦA
	SUP11A	51B60	60CrMnBA	—	51CrV4	—	50XГР
	SUP12	9254	—	685A57, 685H57	54SiCr6	54SiCr6	—
	SUP13	4161	60CrMnMoA	705A60, 705H60	60CrMn3-2	60CrMo4	—
硫磺及硫磺複合快削鋼材	SUM11	1110	—	—	—	—	—
	SUM12	1108	Y12	—	—	—	—
	SUM21	1212	—	—	—	—	—
	SUM22	1213	Y15	(203M07)	9SMn28	S250	—
	SUM22L	12L13	Y12Pb	—	9SMnPb28	S250Pb	—
	SUM23	1215	—	—	—	—	—
	SUM23L	—	—	—	—	—	—
	SUM24L	12L14	Y15Pb	—	9SMnPb28	S250Pb	—
	SUM25	—	—	—	9SMn36	S300	—
	SUM31	1117	—	—	15S10	—	—
	SUM31L	—	—	—	—	—	—
	SUM32	—	Y20	210M15, 210A15	—	(13MF4)	—
	SUM41	1137	Y30 Y35	—	—	(35MF6)	—
	SUM42	1141	Y40Mn	—	—	(45MF6.1)	—
	SUM43	1144	—	(226M44)	—	(45MF6.3)	—
高碳鉻軸承鋼材	SUJ1	51100	GCr4	—	—	—	—
	SUJ2	52100	GCr5	—	100Cr6	100Cr6	Ш X15
	SUJ3	ASTM A 485 Grade 1	GCr15SiMn	—	—	—	—
	SUJ4	—	GCr15SiMo	—	—	—	—
	SUJ5	—	GCr18Mo	—	—	—	—

金屬材質料號對照表
Metal Material Code

材質 Material	日本 JIS	美國 UNS	美國 AISI	大陸 GB	英國 BS	德國 DIN	法國 NF	俄羅斯 ГОСТ
耐熱鋼	SUH31	—	—	—	331S42	—	Z35CNWS14-14	45X14H14B2M
	SUH35	—	—	—	349S52	—	Z52CMN21-09Az	—
	SUH36	S63008	—	5Cr21Mn9Ni4N	349S54	X53CrMnNi21 9	Z55CMN21-09Az	55X20Г9AH4
	SUH37	S63017	—	2Cr21Ni12N	381S34	—	—	—
	SUH38	—	—	—	—	—	—	—
	SUH309	S30900	309	2Cr23Ni13	309S24	—	Z15CN24-13	—
	SUH310	S31000	310	2Cr25Ni20	310S24	CrNi2520	Z15CN25-20	20X25H20C2
	SUH330	N08330	N08330	1Cr16Ni35	—	—	Z12NCS35-16	—
	SUH660	S66286	—	0Cr15Ni25Ti2MoAlVB	—	—	Z6NCTV25-20	—
	SUH661	R30155	—	—	—	—	—	—
	SUH21	—	—	—	—	CrAl1205	—	—
	SUH409	S40900	409	—	409S19	X6CrTi12	Z6CT12	—
	SUH409L	—	—	—	—	—	Z3CT12	—
	SUH446	S44600	446	2Cr25N	—	—	Z12C25	15X28
	SUH1	S65007	—	4Cr9Si2	401S45	X45CrSi9 3	Z45CS9	—
	SUH3	—	—	4Cr10Si2Mo	—	—	Z40CSD10	40X10C2M
	SUH4	—	—	8Cr20Si2Ni	443S65	—	Z80CSN20-02	—
	SUH11	—	—	—	—	—	—	40X9C2
	SUH600	—	—	2Cr12MoVNbN	—	—	—	20X12BHMБФР
	SUH616	S42200	—	2Cr12NiMoWV	—	—	—	—

材質 Material	日本 JIS 沃斯田鐵系	日本 JIS 肥粒鐵系	日本 JIS 麻田散鐵系
耐熱鋼 (代表性)	SUH31	SUH21	SUH1
	SUH35	SUH409	SUH3
	SUH36	SUH446	SUH4
	SUH37	—	SUH11
	SUH38	—	SUH600
	SUH309	—	SUH616
	SUH310	—	—
	SUH330	—	—
	SUH660	—	—
	SUH661	—	—

金屬材質料號對照表
Metal Material Code

材質 Material	日本 JIS	美國 UNS	美國 AISI	大陸 GB	英國 BS	德國 DIN	法國 NF	俄羅斯 ГОСТ
不銹鋼	SUS201	S20100	201	1Cr17Mn6Ni5N	—	—	Z12CMN17-07Az	—
	SUS202	S20200	202	1Cr18Mn8Ni5N	284S16	—	—	12X17Г9AH4
	SUS301	S30100	301	1Cr18Mn10Ni5 Mo3N1Cr17Ni7	301S21	X12CrNi17 7	Z11CN17-08	07X16H6
	SUS301L	S30153	—	—	—	X2CrNiN18-7	—	—
	SUS301J1	—	—	—	—	X12CrNi17 7	—	—
	SUS302	S30200	302	1Cr18Ni9	302S25	—	Z12CN18-09	12X18H9
	SUS302B	S30215	302B	—	—	—	—	—
	SUS303	S30300	303	Y1Cr18Ni9	303S21	X10CrNiS18 9	Z8CNF18-09	—
	SUS303Se	S30323	303Se	Y1Cr18Ni9Se	303S41	—	—	12X18H10E
	SUS304	S30400	304	0Cr18Ni9	304S31	X5CrNi18 10	Z7CN18-09	08X18H10
	SUS304L	S30403	304L	00Cr18Ni10	304S11	X2CrNi19 11	Z3CN19-11	03X18H11
	SUS304N1	S30451	304N	0Cr18Ni9N	—	—	Z6CN19-09Az	—
	SUS304N2	S30452	—	0Cr19Ni10NbN	—	—	—	—
	SUS304LN	S30453	304LN	00Cr18Ni10N	—	X2CrNiN18 10	Z3CN18-10Az	—
	SUS304J1	—	—	—	—	—	—	—
	SUS304J2	—	—	—	—	—	—	—
	SUS304J3	S30431	S30431	—	—	—	—	—
	SUS305	S30500	305	1Cr18Ni12	305S19	X5CrNi18 12	Z8CN18-12	06X18H11
	SUS305J1	—	—	—	—	—	—	—
	SUS309S	S30908	309S	0Cr23Ni13	—	—	Z10CN24-13	—
	SUS310S	S31008	310S	0Cr25Ni20	310S31	—	Z8CN25-20	10X23H18
	SUS316	S31600	316	0Cr17Ni12Mo2	316S31	X5CrNiMo17 12 2	Z7CND17-12-02	—
	SUS316F	—	—	—	—	X5CrNiMo17 13 3	Z6CND18-12-03	—
	SUS316L	S31603	316L	00Cr17Ni14Mo2	316S11	X2CrNiMo17 13 2	Z3CND17-12-02	—
	—	—	—	—	—	X2CrNiMo17 14 3	Z3CND17-13-03	03X17H14M3
	SUS316N	S31651	316N	0Cr17Ni12Mo2N	—	—	—	—
	SUS316LN	S31653	316LN	00Cr17Ni13Mo2N	—	X2CrNiMoN17122	Z3CND17-11Az	—
	—	—	—	—	—	X2CrNiMoN17133	Z3CND17-12Az	—
	SUS316Ti	S31635	—	—	—	X6CrNiMoTi17 12 2	Z6CNDT17-12	08X17H13M2T
	SUS316J1	—	—	0Cr18Ni12Mo2 Cu2	—	—	—	—
	SUS316J1L	—	—	00Cr18Ni14Mo2 Cu2	—	—	—	—
	SUS317	S31700	317	0Cr19Ni13Mo3	317S16	—	—	—
	SUS317L	S31703	317L	00Cr19Ni13Mo3	317S12	X2CrNiMo18 16 4	Z3CND19-15-04	—
	SUS317LN	S31753	—	—	—	—	Z3CND19-14Az	—
	SUS317J1	—	—	0Cr18Ni16Mo5	—	—	—	—
	SUS317J2	—	—	—	—	—	—	—
	SUS317J3L	—	—	—	—	—	—	—
	SUS836L	N08367	—	—	—	—	—	—
	SUS890L	N08904	N08904	—	904S14	—	Z2NCDU25-20	—
	SUS321	S32100	321	1Cr18Ni9Ti 0Cr18Ni10Ti	321S31	X6CrNiTi18 10	Z6CNT18-10	08X18H10T
	SUS347	S34700	347	0Cr18Ni11Nb	347S31	X6CrNiNb18 10	Z6CNNb18-10	08X18H12Б
	SUS384	S38400	384	—	—	—	Z6CN18-16	—

金屬材質料號對照表
Metal Material Code

材質 Material	日本 JIS	美國 UNS	美國 AISI	大陸 GB	英國 BS	德國 DIN	法國 NF	俄羅斯 ГОСТ
不銹鋼	SUSXM7	S30430	304Cu	0Cr18Ni9Cu3	394S17	—	Z2CNU18-10	—
	SUSXM15J1	S38100	—	0Cr18Ni13Si4	—	—	Z15CNS20-12	—
	SUS329J1	S32900	329	0Cr26Ni5Mo2	—	—	—	—
	SUS329J3L	S39240	S31803	—	—	—	Z3CNDU22-05Az	08X21H6M2T
	SUS329J4L	S39275	S31260	—	—	—	Z3CNDU25-07Az	—
	SUS405	S40500	405	0Cr13Al 0Cr13	405S17	X6CrAl13	Z8CA12	—
	SUS410L	—	—	00Cr12	—	—	Z3C14	—
	SUS429	S42900	429	—	—	—	—	—
	SUS430	S43000	430	1Cr17	430S17	X6Cr17	Z8C17	12X17
	SUS430F	S43020	430F	Y1Cr17	—	X7CrMoS18	Z8CF17	—
	SUS430LX	S43035	—	—	—	X6CrTi17	Z4CT17	—
	SUS430J1L	—	—	—	—	X6CrNb17	Z4CNb17	—
	SUS434	S43400	434	1Cr17Mo	434S17	X6CrMo17 1	Z8CD17-01	—
	SUS436L	S43600	436	—	—	—	—	—
	SUS436J1L	—	—	—	—	—	—	—
	SUS444	S44400	444	—	—	—	Z3CDT18-02	—
	SUS447J1	S44700	—	00Cr30Mo2	—	—	—	—
	SUS XM27	S44627	—	00Cr27Mo	—	—	Z1CD26-01	—
	SUS403	S40300	403	1Cr12	—	—	—	—
	SUS410	S41000	410	1Cr13	410S21	X10Cr13	Z13C13	—
	SUS410S	S41008	410S	—	403S17	X6Cr13	Z8C12	08X13
	SUS410F2	—	—	—	—	—	—	—
	SUS410J1	S41025	—	1Cr13Mo 1Cr12Mo	—	X12CrS13	—	—
	SUS416	S41600	416	Y1Cr13	416S21	—	Z11CF13	—
	SUS420J1	S42000	420	2Cr13	420S29	X20Cr13	Z20C13	20X13
	SUS420J2	S42000	420	3Cr13	420S37	X30Cr13	Z33C13	30X13
	SUS420F	S42020	420F	Y3Cr13	—	—	Z30CF13	—
	SUS420F2	—	—	—	—	—	—	—
	SUS429J1	—	—	—	—	—	—	—
	SUS431	S43100	431	1Cr17Ni2	431S29	X20CrNi17 2	Z15CN16-02	20X17H2
	SUS440A	S44002	440A	7Cr17	—	—	Z70C15	—
	SUS440B	S44003	440B	8Cr17	—	—	—	—
	SUS440C	S44004	440C	9Cr18 11Cr17 9Cr18Mo	—	—	Z100CD17	95X18
	SUS440F	S44020	S44020	Y11Cr17	—	—	—	—
	SUS630	S17400	S17400	0Cr17Ni4CuNb	—	X5CrNiCuNb16-4	Z6CNU17-04	—
	SUS631	S17700	S17700	0Cr17Ni7Al	—	X7CrNiAl17 7	Z9CNA17-07	09X17H7Ю
	SUS632J1	—	—	—	—	—	—	—

材質 Material	日本 JIS 奧氏體 (沃斯田鐵)				日本 JIS 肥粒鐵	日本 JIS 麻田散鐵		日本 JIS 析出硬化系
不銹鋼 (代表性)	SUS201	SUS304	SUS310S	SUS347	SUS405	SUS403	SUS440A	SUS630
	SUS202	SUS304L	SUS316	SUS384	SUS429	SUS410	SUS440B	SUS631
	SUS301	SUS304N1	SUS316L	SUSXM7	SUS430	SUS410S	SUS440C	—
	SUS302	SUS304N2	SUS316N	SUSXM15J1	SUS430F	SUS416	SUS440F	—
	SUS302B	SUS305	SUS317	—	SUS434	SUS420J1	—	—
	SUS303	SUS308	SUS317L	—	SUSXM27	SUS420F	—	—
	SUS303Se	SUS309S	SUS321	—	—	SUS431	—	—

金屬材質料號對照表
Metal Material Code

材質 Material	日本 JIS	美國 AISI / SAE	大陸 GB	英國 BS	德國 DIN	法國 NF	俄羅斯 ГОСТ
灰口鑄鐵	FC100	NO.20	HT100	100	GG10	—	Cy10
	FC150	NO.30	HT150	150	GG15	FGL150	Cy15
	FC200	NO.35	HT200	200	GG20	FGL200	Cy20
	FC250	NO.45	HT250	250	GG25	FGL250	Cy25
	FC300	NO.50	HT300	300	GG30	FGL300	Cy30
	FC350	NO.60	HT350	350	GG35	FGL350	Cy35
	—	—	—	—	GG40	FGL400	Cy40
球墨鑄鐵	FCD400	60-40-18	QT400-18	400 / 17	GGG40	FGS370-17	By40
	FCD450	65-45-12	QT450-10	420 /12	—	FGS400-12	By45
	FCD500	70-50-05	QT500-7	500 / 7	GGG50	FGS500-7	By50
	FCD600	80-60-03	QT600-3	600 / 7	GGG60	FGS600-2	By60
	FCD700	100-70-03	QT700-2	700 / 2	GGG70	FGS700-2	By70
	FCD800	120-90-02	QT800-2	800 / 2	GGG80	FGS800-2	By80
	—	—	QT900-2	900 / 2	—	—	By100

材質 Material	日本 JIS	美國 ASTM	大陸 GB	英國 BS	德國 DIN	法國 NF	俄羅斯 ГОСТ
鋁合金	—	1199	1A99	—	A199.99R	—	A99
	—	—	1A97	—	A199.98R	—	A97
	—	—	1A95	—	—	—	A95
	A1080	—	1A80	1080 (1A)	A199.90	1080A	A8
	A1050	1050	1A50	1050 (1B)	A199.50	1050A	A5
	A5052	5052	5A02	NS4	AlMg2.5	5052	Amg
	—	—	5A03	NS5	—	—	AMg3
	A5056	5056	5A05	NB6	AlMg5	—	AMg5V
	A5556	5456	5A30	NG61	—	5957	—
	A2117	2036	2A01	—	AlCu2.5Mg0.5	2117	D18
	A2017	—	2A11	HF15	AlCuMg1	2017S	D1
	A2024	2124	2A12	—	AlCuMg2	2024	D16AVTV
	—	2319	2B16	—	—	—	—
	A2N01	—	2A80	—	—	—	AK4
	A2018	2218	2A90	—	—	—	AK2
	A2014	2014	2A14	—	AlCuSiMn	2014	AK8
	A7075	7175	7A09	—	AlZnMgCu1.5	7075	V95P
鋁合金鑄件	AC4C	356.2	ZAlSi7Mn	LM25	G-AlSi7Mg	—	—
	AC3A	413.2	ZAlSi12	LM6	G-Al12	A-S12-Y4	AL2
	—	355.2	ZAlSi5Cu1Mg	—	—	—	AL5
	AC8A	413.0	ZAlSi2Cu2Mg1	—	G-Al12 (Cu)	—	—
	—	—	ZAlCu5Mn	—	—	—	AL19
	—	201.0	ZAlCu5MnCdVA	—	—	—	—
	—	520.2	ZAlMg10	LM10	G-AlMg10	AG11	AL8
	—	—	ZAlMg5Si	—	G-AlMg5Si	—	AL13

螺紋下孔徑建議表- ISO螺紋
Recommended Drill Hole Size- ISO Thread

ISO螺紋 Thread Size- ISO	建議下孔徑 Standard Drill hole dia.	最小下孔徑 Drill hole dia.- Min 各精度共用	最大下孔徑 Drill hole dia.- Max			
			舊JIS-2級用	4H用	5H用	6H用
M1.0×0.25	0.75	0.73	0.78	0.77	0.78	0.80
M1.0×0.20	0.80	0.79	—	0.82	0.83	0.84
M1.1×0.25	0.85	0.83	0.88	0.87	0.88	0.90
M1.1×0.20	0.90	0.89	—	0.92	0.93	0.94
M1.2×0.25	0.95	0.93	0.98	0.97	0.98	1.00
M1.2×0.20	1.00	0.99	—	1.02	1.03	1.04
M1.4×0.30	1.10	1.08	1.14	1.12	1.14	1.16
M1.4×0.20	1.20	1.19	—	1.22	1.23	1.24
M1.6×0.35	1.25	1.23	1.32	1.28	1.30	1.32
M1.6×0.20	1.40	1.39	—	1.42	1.43	1.44
M1.7×0.35	1.35	—	—	1.38	1.40	1.42
M1.7×0.30	1.40	—	—	1.42	1.44	1.46
M1.7×0.25	1.45	—	—	1.47	1.48	1.50
M1.7×0.20	1.50	—	—	1.52	1.53	1.54
M1.8×0.35	1.45	1.43	1.52	1.48	1.50	1.52
M1.8×0.20	1.60	1.59	—	1.62	1.63	1.64
M2.0×0.40	1.60	1.57	1.67	1.63	1.65	1.67
M2.0×0.25	1.75	1.73	—	1.77	1.78	1.80
M2.2×0.45	1.75	1.72	1.83	1.79	1.81	1.83
M2.2×0.25	1.95	1.93	—	1.97	1.98	2.00
M2.3×0.40	1.90	—	—	1.93	1.95	1.97
M2.3×0.35	1.95	—	—	1.98	2.00	2.02
M2.3×0.25	2.05	—	—	2.07	2.08	2.10
M2.5×0.45	2.05	2.02	2.13	2.09	2.11	2.13
M2.5×0.35	2.15	2.13	2.22	2.18	2.20	2.22
M2.6×0.45	2.15	—	—	2.19	2.22	2.23
M2.6×0.35	2.25	—	—	2.28	2.30	2.32
M3.0×0.60	2.40	2.35	2.42	2.45	2.47	2.51
M3.0×0.50	2.50	2.46	2.59	2.54	2.57	2.59
M3.0×0.35	2.65	2.63	2.72	2.68	2.70	2.72
M3.5×0.60	2.90	2.85	3.01	2.95	2.97	3.01
M3.5×0.50	3.00	2.96	—	3.04	3.07	3.09
M3.5×0.35	3.15	3.13	3.22	3.18	3.20	3.22
M4.0×0.75	3.25	3.19	3.32	3.30	3.33	3.37
M4.0×0.70	3.30	3.25	3.42	3.35	3.38	3.42
M4.0×0.50	3.50	3.46	3.59	3.54	3.57	3.59
M4.5×0.75	3.75	3.69	3.87	3.80	3.83	3.87
M4.5×0.50	4.00	3.96	4.09	4.04	4.07	4.09
M5.0×0.90	4.10	—	—	4.15	4.19	4.23
M5.0×0.80	4.20	4.14	4.33	4.25	4.29	4.33
M5.0×0.75	4.25	4.19	—	4.30	4.33	4.37
M5.0×0.50	4.50	4.46	4.59	4.54	4.57	4.59
M5.5×0.90	4.60	—	—	4.65	4.69	4.73
M5.5×0.75	4.75	—	—	4.80	4.83	4.87
M5.5×0.50	5.00	4.96	5.09	5.04	5.07	5.09
M6.0×1.00	5.00	4.92	5.15	5.06	5.10	5.15
M6.0×0.75	5.25	5.19	5.37	5.30	5.33	5.37
M6.0×0.50	5.50	—	—	5.54	5.57	5.59
M7.0×1.00	6.00	5.92	6.15	6.06	6.10	6.15
M7.0×0.75	6.25	6.19	6.37	6.30	6.33	6.37
M7.0×0.50	6.50	—	—	6.54	6.57	6.59
M8.0×1.25	6.75	6.65	6.91	6.81	6.85	6.91
M8.0×1.00	7.00	6.92	7.15	7.06	7.10	7.15
M8.0×0.75	7.25	7.19	7.37	7.30	7.33	7.37
M8.0×0.50	7.50	—	—	7.54	7.57	7.59
M9.0×1.25	7.75	7.65	7.91	7.81	7.85	7.91
M9.0×1.00	8.00	7.92	8.15	8.06	8.10	8.15
M9.0×0.75	8.25	8.19	8.37	8.30	8.33	8.37
M9.0×0.50	8.50	—	—	8.54	8.57	8.59
M10×1.50	8.50	8.38	8.67	8.52	8.61	8.67

※ 下孔徑 = 鑽頭刃徑　Drill hole dia. = Drill diameter

螺紋下孔徑建議表- ISO螺紋
Recommended Drill Hole Size- ISO Thread

ISO螺紋 Thread Size- ISO	建議下孔徑 Standard Drill hole dia.	最小下孔徑 Drill hole dia.- Min 各精度共用	最大下孔徑 Drill hole dia.- Max			
			舊JIS-2級用	4H用	5H用	6H用
M10×1.25	8.75	8.65	8.91	8.81	8.85	8.91
M10×1.00	9.00	8.92	9.15	9.06	9.10	9.15
M10×0.75	9.25	9.19	9.37	9.30	9.33	9.37
M10×0.50	9.50	—	—	9.54	9.57	9.59
M11×1.50	9.50	9.38	9.67	9.52	9.61	9.67
M11×1.25	9.75	9.65	9.80	9.81	9.85	9.91
M11×1.00	10.00	9.92	10.15	10.06	10.10	10.15
M11×0.75	10.25	10.19	10.37	10.30	10.33	10.37
M11×0.50	10.50	—	—	10.54	10.57	10.59
M12×1.75	10.25	10.11	10.44	10.31	10.37	10.44
M12×1.50	10.50	10.38	10.67	10.56	10.61	10.67
M12×1.25	10.75	10.65	10.91	10.81	10.85	10.91
M12×1.00	11.00	10.92	11.15	11.06	11.10	11.15
M12×0.75	11.25	—	—	11.30	11.33	11.37
M12×0.50	11.50	—	—	11.54	11.57	11.59
M13×1.75	11.25	—	—	11.31	11.37	11.44
M13×1.50	11.50	—	—	11.56	11.61	11.67
M13×1.25	11.75	—	—	11.81	11.85	11.91
M13×1.00	12.00	—	—	12.06	12.10	12.15
M13×0.75	12.30	—	—	12.30	12.33	12.37
M13×0.50	12.50	—	—	12.54	12.57	12.59
M14×2.00	12.00	11.84	12.21	12.07	12.13	12.21
M14×1.50	12.50	12.38	12.67	12.56	12.61	12.67
M14×1.25	12.75	12.65	—	—	—	12.91
M14×1.00	13.00	12.92	13.15	13.06	13.10	13.15
M14×0.75	13.30	—	—	13.30	13.33	13.37
M14×0.50	13.50	—	—	13.54	13.57	13.59
M15×2.00	13.00	—	—	13.07	13.13	13.21
M15×1.50	13.50	13.40	13.60	13.56	13.61	13.67
M15×1.25	13.80	13.70	13.90	13.81	13.85	13.91
M15×1.00	14.00	13.95	14.15	14.06	14.10	14.15
M15×0.75	14.30	—	—	14.30	14.33	14.37
M15×0.50	14.50	—	—	14.54	14.57	14.59
M16×2.00	14.00	13.90	14.20	14.07	14.13	14.21
M16×1.50	14.50	14.40	14.60	14.56	14.61	14.67
M16×1.25	14.75	14.65	—	14.81	14.85	14.91
M16×1.00	15.00	14.95	15.15	15.06	15.10	15.15
M16×0.75	15.25	15.19	—	15.30	15.33	15.37
M16×0.50	15.50	15.46	15.52	15.54	15.57	15.59
M17×2.00	15.00	—	—	15.07	15.13	15.21
M17×1.50	15.50	15.40	15.68	15.56	15.61	15.67
M17×1.25	15.80	—	—	15.81	15.85	15.91
M17×1.00	16.00	15.95	16.15	16.06	16.10	16.15
M17×0.75	16.30	—	—	16.30	16.33	16.37
M17×0.50	16.50	—	—	16.54	16.57	16.59
M18×2.50	15.50	15.30	15.70	15.57	15.64	15.74
M18×2.00	16.00	15.90	16.20	16.07	16.13	16.21
M18×1.50	16.50	16.40	16.60	16.56	16.61	16.67
M18×1.25	16.75	16.65	—	16.81	16.85	16.91
M18×1.00	17.00	16.95	17.15	17.06	17.10	17.15
M18×0.75	17.25	17.19	—	17.30	17.33	17.37
M18×0.50	17.50	17.46	17.52	17.54	17.57	17.59
M19×2.50	16.50	—	—	16.57	16.64	16.74
M19×2.00	17.00	—	—	17.07	17.13	17.21
M19×1.50	17.50	—	—	17.56	17.61	17.67
M19×1.25	17.80	—	—	17.81	17.85	17.91
M19×1.00	18.00	—	—	18.06	18.10	18.15
M19×0.75	18.30	—	—	18.30	18.33	18.37
M19×0.50	18.50	—	—	18.54	18.57	18.59
M20×2.50	17.50	17.30	17.70	17.57	17.64	17.74

※ 下孔徑 = 鑽頭刃徑　Drill hole dia. = Drill diameter

螺紋下孔徑建議表- ISO螺紋
Recommended Drill Hole Size- ISO Thread

ISO螺紋 Thread Size- ISO	建議下孔徑 Standard Drill hole dia.	最小下孔徑 Drill hole dia.- Min 各精度共用	最大下孔徑 Drill hole dia.- Max			
			舊JIS-2級用	4H用	5H用	6H用
M20×2.00	18.00	17.90	18.20	18.07	18.13	18.21
M20×1.50	18.50	18.40	18.60	18.56	18.61	18.67
M20×1.25	18.75	18.65	—	18.81	18.85	18.91
M20×1.00	19.00	18.95	19.15	19.06	19.10	19.15
M20×0.50	19.50	19.46	19.52	19.54	19.57	19.59
M21×2.50	18.50	—	—	18.57	18.64	18.74
M21×1.50	19.50	—	—	19.56	19.61	19.67
M21×1.00	20.00	—	—	20.06	20.10	20.15
M22×2.50	19.50	19.30	19.70	19.57	19.64	19.74
M22×2.00	20.00	19.90	20.20	20.07	20.13	20.21
M22×1.50	20.50	20.40	20.60	20.56	20.61	20.67
M22×1.00	21.00	20.95	21.15	21.06	21.10	21.15
M22×0.50	21.50	21.46	21.52	21.54	21.57	21.59
M23×2.50	20.50	—	—	20.57	20.64	20.74
M23×2.00	21.00	—	—	21.07	21.13	21.21
M23×1.50	21.50	—	—	21.56	21.61	21.67
M23×1.00	22.00	—	—	22.06	22.10	22.15
M24×3.00	21.00	20.80	21.20	21.06	21.15	21.25
M24×2.50	21.50	21.29	—	21.57	21.64	21.74
M24×2.00	22.00	21.90	22.20	22.07	22.13	22.21
M24×1.50	22.50	22.40	22.60	22.56	22.61	22.67
M24×1.25	22.75	22.65	—	22.81	22.85	22.91
M24×1.00	23.00	22.95	23.15	23.06	23.10	23.15
M25×3.00	22.00	—	—	22.06	22.15	22.25
M25×2.00	23.00	22.90	23.20	23.07	23.13	23.21
M25×1.50	23.50	23.40	23.60	23.56	23.61	23.67
M25×1.00	24.00	23.95	24.15	24.06	24.10	24.15
M26×3.00	23.00	—	—	23.06	23.15	23.25
M26×2.00	24.00	—	—	24.07	24.13	24.21
M26×1.50	24.50	24.40	24.60	24.56	24.61	24.67
M26×1.00	25.00	24.95	25.15	25.06	25.10	25.15
M27×3.00	24.00	23.80	24.20	24.06	24.15	24.25
M27×2.50	24.50	—	—	24.57	24.64	24.74
M27×2.00	25.00	24.90	25.20	25.07	25.13	25.21
M27×1.50	25.50	25.40	25.60	25.56	25.61	25.67
M27×1.00	26.00	25.95	26.15	26.06	26.10	26.15
M28×3.00	25.00	—	—	25.06	25.15	25.25
M28×2.00	26.00	25.90	26.20	26.07	26.13	26.21
M28×1.50	26.50	26.40	26.60	26.56	26.61	26.67
M28×1.00	27.00	26.95	27.15	27.06	27.10	27.15
M30×3.50	26.50	26.30	26.70	26.56	26.66	26.77
M30×3.00	27.00	26.80	27.20	27.06	27.15	27.25
M30×2.00	28.00	27.90	28.20	28.07	28.13	28.21
M30×1.50	28.50	28.40	28.60	28.56	28.61	28.67
M30×1.00	29.00	28.95	29.15	29.06	29.10	29.15
M32×3.00	29.00	—	—	29.06	29.15	29.25
M32×2.00	30.00	29.90	30.20	30.07	30.13	30.21
M32×1.50	30.50	30.40	30.60	30.56	30.61	30.67
M32×1.00	31.00	30.95	31.15	31.06	31.10	—
M33×3.50	29.50	29.30	29.70	29.56	29.66	29.77
M33×3.00	30.00	29.80	30.20	30.06	30.15	30.25
M33×2.00	31.00	30.90	31.20	31.07	31.13	31.21
M33×1.50	31.50	31.40	31.60	31.56	31.61	31.67
M33×1.00	32.00	—	—	32.06	32.10	32.15
M34×3.00	31.00	—	—	31.06	31.15	31.25
M34×2.00	32.00	—	—	32.07	32.13	32.21
M34×1.50	32.50	—	—	32.56	32.61	32.67
M34×1.00	33.00	—	—	33.06	33.10	33.15
M35×3.00	32.00	—	—	32.06	32.15	32.25
M35×2.00	33.00	—	—	33.07	33.13	33.20

※ 下孔徑 = 鑽頭刃徑　Drill hole dia. = Drill diameter

螺紋下孔徑建議表- ISO螺紋
Recommended Drill Hole Size- ISO Thread

ISO螺紋 Thread Size- ISO	建議下孔徑 Standard Drill hole dia.	最小下孔徑 Drill hole dia.- Min 各精度共用	最大下孔徑 Drill hole dia.- Max			
			舊JIS-2級用	4H用	5H用	6H用
M35×1.50	33.50	33.40	33.60	33.56	33.61	33.67
M35×1.00	34.00	—	—	34.06	34.10	34.15
M36×4.00	32.00	31.70	32.20	32.04	32.14	32.27
M36×3.00	33.00	32.80	33.20	33.06	33.15	33.25
M36×2.00	34.00	33.90	34.20	34.07	34.13	34.21
M36×1.50	34.50	34.40	34.60	34.56	34.61	34.67
M36×1.00	35.00	—	—	35.06	35.10	35.15
M37×1.50	35.50	—	—	35.56	35.61	35.67
M37×1.00	36.00	—	—	36.06	36.10	36.15
M38×4.00	34.00	—	—	34.04	34.14	34.27
M38×3.00	35.00	—	—	35.06	35.15	35.25
M38×2.00	36.00	—	—	36.07	36.13	36.21
M38×1.50	36.50	36.40	36.60	36.56	36.61	36.67
M38×1.00	37.00	36.95	37.15	37.06	37.10	37.15
M39×4.00	35.00	34.70	35.20	35.04	35.14	35.27
M39×3.00	36.00	35.80	36.20	36.06	36.15	36.25
M39×2.00	37.00	36.90	37.20	37.07	37.13	37.21
M39×1.50	37.50	37.40	37.60	37.56	37.61	37.67
M39×1.00	38.00	—	—	38.06	38.10	38.15
M40×4.00	36.00	—	—	36.04	36.14	36.27
M40×3.00	37.00	36.80	37.20	37.06	37.15	37.25
M40×2.00	38.00	37.90	38.20	38.07	38.13	38.21
M40×1.50	38.50	38.40	38.60	38.56	38.61	38.67
M40×1.00	39.00	—	—	39.06	39.10	39.15
M42×4.50	37.50	37.20	37.70	37.55	37.65	37.79
M42×4.00	38.00	37.70	38.20	38.04	38.14	38.27
M42×3.00	39.00	38.80	39.20	39.06	39.15	39.25
M42×2.00	40.00	39.90	40.20	40.07	40.13	40.21
M42×1.50	40.50	40.40	40.60	40.56	40.61	40.67
M42×1.00	41.00	40.95	41.03	41.06	41.10	41.15
M45×4.50	40.50	40.20	40.70	40.55	40.65	40.79
M45×4.00	41.00	40.70	41.20	41.04	41.14	41.27
M45×3.00	42.00	41.80	42.20	42.06	42.15	42.25
M45×2.00	43.00	42.90	43.20	43.07	43.13	43.21
M45×1.50	43.50	43.40	43.60	43.56	43.61	43.67
M45×1.00	44.00	—	—	44.06	44.10	44.15
M46×1.50	44.50	—	—	44.56	44.61	44.67
M48×5.00	43.00	42.60	43.20	43.03	43.14	43.29
M48×4.00	44.00	43.70	44.20	44.04	44.14	44.27
M48×3.00	45.00	44.80	45.20	45.06	45.15	45.25
M48×2.00	46.00	45.90	46.20	46.07	46.13	46.21
M48×1.50	46.50	46.40	46.60	46.56	46.61	46.67
M48×1.00	47.00	—	—	47.06	47.10	47.15
M50×5.00	45.00	—	—	45.03	45.14	45.29
M50×4.00	46.00	45.70	—	46.00	46.10	46.20
M50×3.00	47.00	46.80	47.20	47.06	47.15	47.25
M50×2.00	48.00	47.90	48.20	48.07	48.13	48.21
M50×1.50	48.50	48.40	48.60	48.56	48.61	48.67
M50×1.00	49.00	—	—	49.10	49.10	49.15
M52×5.00	47.00	46.60	47.20	47.00	47.10	47.20
M52×4.00	48.00	47.70	48.20	48.00	48.10	48.20
M52×3.00	49.00	48.80	49.20	49.00	49.10	49.20
M52×2.00	50.00	49.90	50.20	50.00	50.10	50.20
M52×1.50	50.50	50.40	50.60	50.50	50.60	50.60
M55×4.00	51.00	50.70	51.20	51.00	51.10	51.20
M55×3.00	52.00	51.80	52.20	52.00	52.10	52.20
M55×2.00	53.00	52.90	53.20	53.00	53.10	53.20
M55×1.50	53.50	53.40	53.60	53.50	53.60	53.60
M56×5.50	50.50	50.10	50.70	50.50	50.60	50.70
M56×4.00	52.00	51.70	52.20	52.00	52.10	52.20

※ 下孔徑 = 鑽頭刃徑　Drill hole dia. = Drill diameter

螺紋下孔徑建議表- ISO螺紋
Recommended Drill Hole Size- ISO Thread

ISO螺紋 Thread Size- ISO	建議下孔徑 Standard Drill hole dia.	最小下孔徑 Drill hole dia.- Min 各精度共用	最大下孔徑 Drill hole dia.- Max			
			舊JIS-2級用	4H用	5H用	6H用
M56×3.00	53.00	52.80	53.20	53.00	53.10	53.20
M56×2.00	54.00	53.90	54.20	54.00	54.10	54.20
M56×1.50	54.50	54.40	54.60	54.50	54.60	54.60
M58×4.00	54.00	53.70	54.20	54.00	54.10	54.20
M58×3.00	55.00	54.80	55.20	55.00	55.10	55.20
M58×2.00	56.00	55.90	56.20	56.00	56.10	56.20
M58×1.50	56.50	56.40	56.60	56.50	56.60	56.60
M60×5.50	54.50	54.10	54.70	54.50	54.60	54.70
M60×4.00	56.00	55.70	56.20	56.00	56.10	56.20
M60×3.00	57.00	56.80	57.20	57.00	57.10	57.20
M60×2.00	58.00	57.90	58.20	58.00	58.10	58.20
M60×1.50	58.50	58.40	58.60	58.50	58.60	58.60
M62×4.00	58.00	57.70	58.20	58.00	58.10	58.20
M62×3.00	59.00	58.80	59.20	59.00	59.10	59.20
M62×2.00	60.00	59.90	60.20	60.00	60.10	60.20
M62×1.50	60.50	60.40	60.60	60.50	60.60	60.60
M64×6.00	58.00	57.60	58.30	58.00	58.10	58.20
M64×4.00	60.00	59.70	60.20	60.00	60.10	60.20
M64×3.00	61.00	60.80	61.20	61.00	61.10	61.20
M64×2.00	62.00	61.90	62.20	62.00	62.10	62.20
M64×1.50	62.50	62.40	62.60	62.50	62.60	62.60
M65×4.00	61.00	60.70	61.20	61.00	61.10	61.20
M65×3.00	62.00	61.80	62.20	62.00	62.10	62.20
M65×2.00	63.00	62.90	63.20	63.00	63.10	63.20
M65×1.50	63.50	63.40	63.60	63.50	63.60	63.60
M68×6.00	62.00	61.60	62.30	62.00	62.10	62.20
M68×4.00	64.00	63.70	64.20	64.00	64.10	64.20
M68×3.00	65.00	64.80	65.20	65.00	65.10	65.20
M68×2.00	66.00	65.90	66.20	66.00	66.10	66.20
M68×1.50	66.50	66.40	66.60	66.50	66.60	66.60
M70×6.00	64.00	63.60	64.30	64.00	64.10	64.30
M70×4.00	66.00	65.70	66.20	66.00	66.10	66.20
M70×3.00	67.00	66.80	67.20	67.00	67.10	67.20
M70×2.00	68.00	67.90	68.20	68.00	68.10	68.20
M72×6.00	66.00	65.60	66.30	66.00	66.10	66.30
M72×4.00	68.00	67.70	68.20	68.00	68.10	68.20
M72×3.00	69.00	68.80	69.20	69.00	69.10	69.20
M72×2.00	70.00	69.90	70.20	70.00	70.10	70.20
M75×4.00	71.00	70.70	71.20	71.00	71.10	71.20
M75×3.00	72.00	71.80	72.20	72.00	72.10	72.20
M75×2.00	73.00	72.90	73.20	73.00	73.10	73.20
M76×2.00	74.00	73.90	74.20	74.00	74.10	74.20
M80×6.00	74.00	73.60	74.30	74.00	74.10	74.30
M80×4.00	76.00	75.70	76.20	76.00	76.10	76.20
M80×3.00	77.00	76.80	77.20	77.00	77.10	77.20
M80×2.00	78.00	77.90	78.20	78.00	78.10	78.20
M85×6.00	79.00	78.60	79.30	79.00	79.10	79.30
M85×4.00	81.00	80.70	81.20	81.00	81.10	81.20
M85×3.00	82.00	81.80	82.20	82.00	82.10	82.20
M85×2.00	83.00	82.90	83.20	83.00	83.10	83.20
M90×6.00	84.00	83.60	84.30	84.00	84.10	84.30
M90×4.00	86.00	85.70	86.20	86.00	86.10	86.20
M90×2.00	88.00	87.90	88.20	88.00	88.10	88.20
M95×6.00	89.00	88.60	89.30	89.00	89.10	89.30
M95×4.00	91.00	90.70	91.20	91.00	91.10	91.20
M95×2.00	93.00	92.90	93.20	93.00	93.10	93.20
M100×6.00	94.00	93.60	94.30	94.00	94.10	94.30
M100×4.00	96.00	95.70	96.20	96.00	96.10	96.20
M100×2.00	98.00	97.90	98.20	98.00	98.10	98.20

※ 下孔徑 = 鑽頭刃徑　Drill hole dia. = Drill diameter

螺紋下孔徑建議表- UN美製螺紋
Recommended Drill Hole Size- UN Thread

UN螺紋 Thread Size- UN	建議下孔徑 Standard Drill hole dia.	JIS-2級用	
		最小下孔徑 Drill hole- Min	最大下孔徑 Drill hole- Max
No. 0- 80UNF	1.25	1.19	1.30
No. 1- 64UNC	1.50	1.43	1.57
No. 1- 72UNF	1.55	1.48	1.61
No. 2- 56UNC	1.79	1.70	1.87
No. 2- 64UNF	1.84	1.76	1.91
No. 3- 48UNC	2.05	1.95	2.14
No. 3- 56UNF	2.11	2.03	2.19
No. 4- 40UNC	2.27	2.16	2.38
No. 4- 48UNF	2.37	2.28	2.45
No. 5- 40UNC	2.59	2.49	2.69
No. 5- 44UNF	2.65	2.56	2.74
No. 6- 32UNC	2.77	2.65	2.89
No. 6- 40UNF	2.92	2.82	3.02
No. 8- 32UNC	3.42	3.31	3.53
No. 8- 36UNF	3.51	3.41	3.60
No.10- 24UNC	3.81	3.69	3.93
No.10- 32UNF	4.07	3.97	4.16
No.12- 24UNC	4.47	4.35	4.59
No.12- 28UNF	4.61	4.50	4.72
1/4- 20UNC	5.12	4.98	5.25
1/4- 28UNF	5.47	5.36	5.58
1/4- 32UNEF	5.59	5.49	5.68
5/16- 18UNC	6.57	6.41	6.73
5/16- 24UNF	6.91	6.79	7.03
5/16- 32UNEF	7.18	7.09	7.26
3/8- 16UNC	7.98	7.80	8.15
3/8- 20UN	8.30	8.16	8.43
3/8- 24UNF	8.51	8.39	8.63
3/8- 32UNEF	8.77	8.67	8.86
7/16- 14UNC	9.35	9.15	9.55
7/16- 20UNF	9.88	9.73	10.03
1/2- 13UNC	10.81	10.60	11.02
1/2- 20UNF	11.47	11.33	11.60
9/16- 12UNC	12.20	12.00	12.40
9/16- 18UNF	12.90	12.80	13.00
5/8- 11UNC	13.60	13.40	13.80
5/8- 18UNF	14.50	14.40	14.60
5/8- 24UNEF	14.90	14.80	14.90
3/4- 10UNC	16.60	16.40	16.80
3/4- 16UNF	17.50	17.40	17.60
3/4- 20UNEF	17.80	17.70	17.90
7/8- 9UNC	19.50	19.20	19.70
7/8- 14UNF	20.50	20.30	20.60
7/8- 20UNEF	21.00	20.90	21.10
1- 8UNC	22.30	22.00	22.60
1- 12UNF	23.40	23.20	23.50
1- 14UNS	23.70	23.50	23.80
1 1/16- 12UN	24.90	24.70	25.10
1 1/8- 7UNC	25.00	24.70	25.30
1 1/8- UN	25.50	25.20	25.70
1 1/8- 12UNF	26.50	26.30	26.70
1 1/4- 7UNC	28.20	27.90	28.50
1 1/4- 8UN	28.70	28.40	28.90
1 1/4- 12UNF	29.70	29.50	29.90

UN螺紋 Thread Size- UN	建議下孔徑 Standard Drill hole dia.	JIS-2級用	
		最小下孔徑 Drill hole- Min	最大下孔徑 Drill hole- Max
1 5/16- 12UN	31.30	31.10	31.40
1 3/8- 6UNC	30.80	30.40	31.10
1 3/8- 8UN	31.80	31.50	32.10
1 3/8- 12UNF	32.90	32.70	33.00
1 1/2- 6UNC	33.90	33.60	34.20
1 1/2- 8UN	35.00	34.70	35.30
1 1/2- 12UNF	36.10	35.90	36.20
1 5/8- 5UNS	36.20	35.80	36.60
1 5/8- 8UN	38.20	37.90	38.40
1 5/8- 12UN	39.20	39.00	39.40
1 3/4- 5UNC	39.40	39.00	39.80
1 3/4- 8UN	41.40	41.10	41.60
1 3/4- 12UN	42.40	42.20	42.60
1 7/8- 8UN	44.50	44.20	44.80
2- 4.5UNC	45.10	44.70	45.50
2- 8UN	47.70	47.40	48.00
2- 12UN	48.80	48.60	48.90
2 1/4- 4.5UNC	51.50	51.10	51.90
2 1/2- 4UNC	57.10	56.70	57.50
2 1/2- 8UN	60.40	60.10	60.70
2 3/4- 4UNC	63.50	63.00	63.90
2 3/4- 8UN	66.80	66.50	67.00
3- 4UNC	69.80	69.40	70.20
3- 8UN	73.10	72.80	73.40
3 1/4- 4UNC	76.20	75.70	76.60
3 1/2- 4UNC	82.50	82.10	82.90
3 1/2- 8UN	85.80	85.50	86.10
3 3/4- 4UNC	88.90	88.40	89.30
4- 4UNC	95.20	94.80	95.60
4- 8UN	98.50	98.20	98.80
4 1/4- 4UN	101.60	101.10	102.00
4 1/4- 6UN	103.80	103.40	104.10
4 1/4- 8UN	104.90	104.60	105.10
4 1/2- 4UN	107.90	107.50	108.30
4 1/2- 6UN	110.10	109.80	110.40
4 1/2- 8UN	111.20	110.90	111.50
4 3/4- 4UN	126.30	137.80	114.70
4 3/4- 6UN	116.50	116.10	116.80
4 3/4- 8UN	117.60	117.30	117.80
5- 4UN	120.60	120.20	121.00
5- 6UN	122.80	122.50	123.10
5- 8UN	123.90	123.60	124.20
5 1/4- 4UN	127.00	126.50	127.40
5 1/4- 6UN	129.20	128.80	129.50
5 1/4- 8UN	130.30	130.00	130.50
5 1/2- 4UN	133.30	132.90	133.70
5 1/2- 6UN	134.50	135.20	133.80
5 1/2- 8UN	136.60	136.30	136.90
5 3/4- 4UN	139.70	139.20	140.10
5 3/4- 6UN	141.90	141.50	142.20
5 3/4- 8UN	143.00	142.70	143.20
6- 4UN	146.00	145.60	146.40
6- 6UN	148.20	147.90	148.50
6- 8UN	149.30	149.00	149.60

※ 下孔徑 = 鑽頭刃徑 Drill hole dia. = Drill diameter

螺紋下孔徑建議表- NPT美製錐度管螺紋
Recommended Drill Hole Size- NPT Thread

NPT螺紋 Thread Size- NPT	下孔徑 Drill hole dia.	
	使用鉸刀 Where Reamer is used	不使用鉸刀 Where Reamer is not used
1/16"	5.94	6.15
1/8"	8.33	8.43
1/4"	10.72	11.13
3/8"	14.27	14.27
1/2"	17.48	17.86
3/4"	22.63	23.01
1"	28.58	28.98
1 1/4"	37.31	37.69
1 1/2"	43.26	43.66
2"	55.17	55.58
2 1/2"	65.48	66.27

螺紋下孔徑建議表- NPTF美製精密錐度管螺紋
Recommended Drill Hole Size- NPTF Thread

NPTF螺紋 Thread Size- NPTF	下孔徑 Drill hole dia.	
	使用鉸刀 Where Reamer is used	不使用鉸刀 Where Reamer is not used
1/16"	5.94	6.15
1/8"	8.33	8.43
1/4"	10.72	11.13
3/8"	14.30	14.27
1/2"	17.48	17.86
3/4"	22.63	23.01
1"	28.58	28.98
1 1/4"	37.31	37.69
1 1/2"	43.26	43.66
2"	55.17	55.58
2 1/2"	65.48	66.27

※ 下孔徑 = 鑽頭刃徑 Drill hole dia. = Drill diameter

螺紋下孔徑建議表- BSP(G)英製圓柱管螺紋
Recommended Drill Hole Size- BSP(G) Thread

BSP(G)螺紋 Thread Size- BSP(G)	螺紋外徑 Major dia.	最小下孔徑 Drill hole dia.- Min	最大下孔徑 Drill hole dia.- Max
G 1/16"	7.723	6.561	6.843
G 1/8"	9.728	8.566	8.848
G 1/4"	13.157	11.445	11.890
G 3/8"	16.662	14.950	15.395
G 1/2"	20.955	18.631	19.172
G 5/8"	22.911	20.587	21.128
G 3/4"	26.441	24.117	24.658
G 7/8"	30.201	27.877	28.418
G 1"	33.249	30.291	30.931
G 1 1/8"	37.897	34.939	35.579
G 1 1/4"	41.910	38.952	39.592
G 1 3/8"	44.323	41.365	42.005
G 1 1/2"	47.803	44.845	45.485
G 1 3/4"	53.746	50.788	51.428
G 2"	59.614	56.656	57.296
G 2 1/2"	75.184	72.226	72.866
G 3"	87.884	84.926	85.566
G 3 1/2"	100.330	97.300	98.000
G 4"	113.030	110.072	110.712

螺紋下孔徑建議表- BSPT(Rc/PT)英製圓錐管螺紋
Recommended Drill Hole Size- BSPT(Rc/PT) Thread

BSPT(Rc/PT)螺紋 Thread Size- BSPT(Rc/PT)	螺紋外徑 Major dia. (JIS B 0203)	下孔徑 Drill hole dia. (JIS B 0203)
1/16"	7.723	6.2
1/8"	9.728	8.2
1/4"	13.157	10.9
3/8"	16.662	14.4
1/2"	20.955	18.0
3/4"	26.441	23.0
1"	33.249	29.0
1 1/4"	41.910	38.0
1 1/2"	47.803	44.0
2"	59.614	55.0
2 1/2"	75.184	71.0
3"	87.884	83.0
3 1/2"	100.330	96.0
4"	113.030	108.0
5"	138.430	133.0
6"	163.830	159.0
7"	189.230	183.0
8"	214.630	209.0
9"	240.030	234.0
10"	265.430	259.0
12"	316.230	310.0

※ 下孔徑 = 鑽頭刃徑 Drill hole dia. = Drill diameter

硬度對照表
Comparison Table of Hardness
(HARDNESS CONVERSION TABLE)
(Approximate relationship between various hardness scales)

布氏硬度 Brinell hardness			維克氏硬度 Diamond Pyramid hardness number Vickers	洛氏硬度 Rockwell hardness				蕭氏硬度 Shore scleroscope hardness number	抗拒強度 (近似值) Approx. tensile strength
標準球 Standard 10mm ball	Halt- gren 10mm ball	鎢鋼球 Tungsten 10mm ball		鑽石圓錐 A Scale 60Kgf	球 1/16in B Scale 100Kgf	鑽石圓錐 C Scale 150Kgf	鑽石圓錐 D Scale 100Kgf		
	HB		HV	HRA	HRB	HRC	HRD	HS	N/mm^2
			940	85.6		68.0	76.9	97	
			920	85.3		67.5	76.5	96	
			900	85.0		67.0	76.1	95	
		767	880	84.7		66.4	75.7	93	
		757	860	84.4		65.9	75.3	92	
		745	840	84.1		65.3	74.8	91	
		733	820	83.8		64.7	74.3	90	
		722	800	83.4		64.0	73.8	88	
		712							
		710	780	83.0		63.3	73.3	87	
		698	760	82.6		62.5	72.6	86	
		684	740	82.2		61.8	72.1	84	
		682	737	82.2		61.7	72.0	83	
		670	720	81.8		61.0	71.5		
		656	700	81.3		60.1	70.8	81	
		653	697	81.2		60.0	70.7		
		647	690	81.1		59.7	70.5		
		638	680	80.8		59.2	70.1	80	
		630	670	80.6		58.8	69.8		
		627	667	80.5		58.7	69.7	79	
	601		677	80.7		59.1	70.0		
		601	640	79.8		57.3	68.7	77	
	578		640	79.8		57.3	68.7		
		578	615	79.1		56.0	67.7	75	
	555		607	78.8		55.6	67.4		
		555	591	78.4		54.7	66.7	73	2055
	534		579	78.0		54.0	66.1		2015
		534	569	77.8		53.5	65.8	71	1985
	514		533	77.1		52.5	65.0		1915
		514	547	76.9		52.1	64.7	70	1890
495			539	76.7		51.6	64.3		1855
	495		530	76.4		51.1	63.9		1825
		496	528	76.3		51.0	63.8	68	1820
477			516	75.9		50.3	63.2		1780
	477		508	75.6		49.6	62.7		1740
		477	508	75.6		49.6	62.7	66	1740
461			495	75.1		48.8	61.9		1680
	461		491	74.9		48.5	61.7		1670
		461	491	74.9		48.5	61.7	65	1670
444			474	74.3		47.2	61.0		1595
	444		472	74.2		47.1	60.8		1585
		444	472	74.2		47.1	60.8	63	1585

硬度對照表
Comparison Table of Hardness
(HARDNESS CONVERSION TABLE)
(Approximate relationship between various hardness scales)

布氏硬度 Brinell hardness			維克氏硬度 Diamond Pyramid hardness number Vickers	洛氏硬度 Rockwell hardness				蕭氏硬度 Shore scleroscope hardness number	抗拒強度 (近似值) Approx. tensile strength
標準球 Standard 10mm ball	Halt- gren 10mm ball	鎢鋼球 Tungsten 10mm ball		鑽石圓錐 A Scale 60Kgf	球 1/16in B Scale 100Kgf	鑽石圓錐 C Scale 150Kgf	鑽石圓錐 D Scale 100Kgf		
	HB		HV	HRA	HRB	HRC	HRD	HS	N/mm^2
429	429	429	455	73.4		45.7	59.7	61	1510
415	415	415	440	72.8		44.5	58.8	59	1460
401	401	401	425	72.0		43.1	57.8	58	1390
388	388	388	410	71.4		41.8	56.8	56	1330
375	375	375	396	70.6		40.4	55.7	54	1270
363	363	363	383	70.0		39.1	54.6	52	1220
352	352	352	372	69.3	110.0	37.9	53.8	51	1180
341	341	341	360	68.7	109.0	36.6	52.8	50	1130
331	331	331	350	68.1	108.5	35.5	51.9	48	1095
321	321	321	339	67.5	108.0	34.3	51.0	47	1060
311	311	311	328	66.9	107.5	33.1	50.0	46	1025
302	302	302	319	66.3	107.0	32.1	49.3	45	1005
293	293	293	309	65.7	106.0	30.9	48.3	43	970
285	285	285	301	65.3	105.5	29.9	47.6		950
277	277	277	292	64.6	104.5	28.8	46.7	41	925
269	269	269	284	64.1	104.0	27.8	45.9	40	895
262	262	262	276	63.6	103.0	26.6	45.0	39	875
255	255	255	269	63.0	102.0	25.4	44.2	38	850
248	248	248	261	62.5	101.0	24.2	43.2	37	825
241	241	241	253	61.8	100.0	22.8	42.0	36	800
235	235	235	247	61.4	99.0	21.7	41.4	35	785
229	229	229	241	60.8	98.2	20.5	40.5	34	765
223	223	223	234		97.3	18.8			
217	217	217	228		96.4	17.5		33	725
212	212	212	222		95.5	16.0			705
207	207	207	218		94.6	15.2		32	690
201	201	201	212		93.8	13.8		31	675
197	197	197	207		92.8	12.7		30	655
192	192	192	202		91.9	11.5		29	640
187	187	187	196		90.7	10.0			620
183	183	183	192		90.9	9.0		28	615
179	179	179	188		89.0	8.0		27	600
174	174	174	182		87.8	6.4			585
170	170	170	178		86.8	5.4		26	570
167	167	167	175		86.0	4.4			560
163	163	163	171		85.0	3.3		25	545
156	156	156	163		82.9	0.9			525
149	149	149	156		80.8			23	505
143	143	143	150		78.8			22	490
137	137	137	143		76.4			21	460
131	131	131	137		74.0				450
126	126	126	132		72.0			20	435
121	121	121	127		69.8			19	415
116	116	116	122		67.6			18	400
111	111	111	117		65.7			15	385

ISO常用公差表
Tolerance Table- ISO

公差 Tolerance Micrometers (μm)	Millimeters (mm)							
	Φ≦3	3<Φ≦6	6<Φ≦10	10<Φ≦18	18<Φ≦30	30<Φ≦50	50<Φ≦80	80<Φ≦120
h5	0 -4	0 -5	0 -6	0 -8	0 -9	0 -11	0 -13	0 -15
h6	0 -6	0 -8	0 -9	0 -11	0 -13	0 -16	0 -19	0 -22
h7	0 -10	0 -12	0 -15	0 -18	0 -21	0 -25	0 -30	0 -35
h8	0 -14	0 -18	0 -22	0 -27	0 -33	0 -39	0 -46	0 -54
h9	0 -25	0 -30	0 -36	0 -43	0 -52	0 -62	0 -74	0 -87
h10	0 -40	0 -48	0 -58	0 -70	0 -84	0 -100	0 -120	0 -140
h11	0 -60	0 -75	0 -90	0 -110	0 -130	0 -160	0 -190	0 -220
h12	0 -100	0 -120	0 -150	0 -180	0 -210	0 -250	0 -300	0 -350
h13	0 -140	0 -180	0 -220	0 -270	0 -330	0 -390	0 -460	0 -540
H13	+140 0	+180 0	+220 0	+270 0	+330 0	+390 0	+460 0	+540 0
H12	+100 0	+120 0	+150 0	+180 0	+210 0	+250 0	+300 0	+350 0
H11	+60 0	+75 0	+90 0	+110 0	+130 0	+160 0	+190 0	+220 0
H10	+40 0	+48 0	+58 0	+70 0	+84 0	+100 0	+120 0	+140 0
H9	+25 0	+30 0	+36 0	+43 0	+52 0	+62 0	+74 0	+87 0
H8	+14 0	+18 0	+22 0	+27 0	+33 0	+39 0	+46 0	+54 0
H7	+10 0	+12 0	+15 0	+18 0	+21 0	+25 0	+30 0	+35 0
H6	+6 0	+8 0	+9 0	+11 0	+13 0	+16 0	+19 0	+22 0
H5	+4 0	+5 0	+6 0	+8 0	+9 0	+11 0	+13 0	+15 0

ISO常用公差表
Tolerance Table- ISO

公差 Tolerance Micrometers (μm)	Millimeters (mm)							
	Φ≦3	3<Φ≦6	6<Φ≦10	10<Φ≦18	18<Φ≦30	30<Φ≦50	50<Φ≦80	80<Φ≦120
d8	-20 -34	-30 -48	-40 -62	-50 -77	-65 -98	-80 -119	-100 -146	-120 -174
d9	-20 -45	-30 -60	-40 -76	-50 -93	-65 -117	-80 -142	-100 -175	-120 -207
e7	-14 -24	-20 -32	-25 -40	-32 -50	-40 -61	-50 -75	-60 -90	-72 -107
e8	-14 -28	-20 -38	-25 -47	-32 -59	-40 -73	-50 -89	-60 -106	-72 -126
e9	-14 -39	-20 -50	-25 -61	-32 -75	-40 -92	-50 -112	-60 -134	-72 -159
f6	-6 -12	-10 -18	-13 -22	-16 -27	-20 -33	-25 -41	-30 -49	-36 -58
f7	-6 -16	-10 -22	-13 -28	-16 -34	-20 -41	-25 -50	-30 -60	-36 -71
f8	-6 -20	-10 -28	-13 -35	-16 -43	-20 -53	-25 -64	-30 -76	-36 -90
g6	-2 -8	-4 -12	-5 -14	-6 -17	-7 -20	-9 -25	-10 -29	-12 -34
G6	+8 +2	+12 +4	+14 +5	+17 +6	+20 +7	+25 +9	+29 +10	+34 +12
F8	+20 +6	+28 +10	+35 +13	+43 +16	+53 +20	+64 +25	+76 +30	+90 +36
F7	+16 +6	+22 +10	+28 +13	+34 +16	+41 +20	+50 +25	+60 +30	+71 +36
F6	+12 +6	+18 +10	+22 +13	+27 +16	+33 +20	+41 +25	+49 +30	+58 +36
E9	+39 +14	+50 +20	+61 +25	+75 +32	+92 +40	+112 +50	+134 +60	+159 +72
E8	+28 +14	+38 +20	+47 +25	+59 +32	+73 +40	+89 +50	+106 +60	+126 +72
E7	+24 +14	+32 +20	+40 +25	+50 +32	+61 +40	+75 +50	+90 +60	+107 +72
D9	+45 +20	+60 +30	+76 +40	+93 +50	+117 +65	+142 +80	+174 +100	+207 +120
D8	+34 +20	+48 +30	+62 +40	+77 +50	+98 +65	+119 +80	+146 +100	+174 +120

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