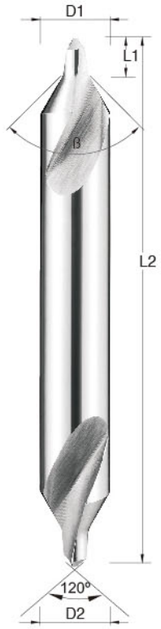
MG

CCD

超微粒中心鑽
Center Drills

60° ß | 55° | FINISHING SEMI-FINISHING



型號 / Order No.	直徑 Diameter D1	刃長 Flute Length L1	全長 O.A.L. L2	柄徑 Shank Dia D2
CCD **0050**	0.50	0.8	38	3
CCD **0080**	0.80	1.1	38	3
CCD **0100**	1.00	1.3	38	3
CCD **0125**	1.25	1.6	38	3
CCD **0160**	1.60	2.0	38	4
CCD **0200**	2.00	2.5	50	5
CCD **0250**	2.50	3.1	50	6
CCD **0315**	3.15	3.9	60	8
CCD **0400**	4.00	5.0	75	10
CCD **0500**	5.00	6.3	75	12

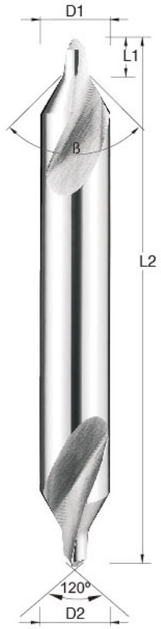
unit: mm

MG

CCDA

超微粒中心鑽
Center Drills

90° ß | 55° | FINISHING SEMI-FINISHING



型號 / Order No.	直徑 Diameter D1	刃長 Flute Length L1	全長 O.A.L. L2	柄徑 Shank Dia D2
CCDA **0050**	0.50	0.8	38	3
CCDA **0080**	0.80	1.1	38	3
CCDA **0100**	1.00	1.3	38	3
CCDA **0125**	1.25	1.6	38	3
CCDA **0160**	1.60	2.0	38	4
CCDA **0200**	2.00	2.5	50	5
CCDA **0250**	2.50	3.1	50	6
CCDA **0315**	3.15	3.9	60	8
CCDA **0400**	4.00	5.0	75	10
CCDA **0500**	5.00	6.3	75	12

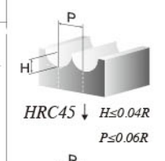
unit: mm

建議加工數據 Recommended cutting condition

高速高硬度加工系列（奈米微粒系列）
High Speed Cutting and High Hard Cutting Series （Nano Micro Grain Carbide Series）

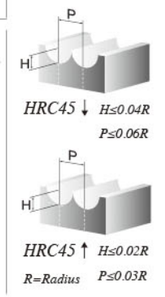
建議加工數據 Recommended cutting condition • NBN . NBX

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Radius	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
R1	23000	2000	22000	1800	16000	900	
R1.5	16000	2000	15000	1800	11000	900	
R2	15000	2400	14000	2000	10000	1300	
R3	17000	5500	14000	5000	9000	1500	
R4	12000	4000	9000	3000	6200	1400	
R5	9000	3500	7000	2800	5200	900	
R6	8000	2800	6500	1800	4300	800	
R8	7000	2000	5000	1500	3300	700	



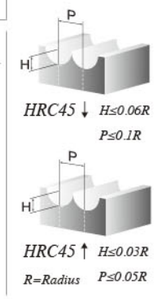
建議加工數據 Recommended cutting condition • NBL(S/M/L)N . NBL(S/M/L)X

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Radius	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
R1	23000	2000	22000	1800	16000	900	
R1.5	16000	2000	15000	1800	11000	900	
R2	15000	2400	14000	2000	10000	1300	
R3	13000	3200	11000	2000	9000	1500	
R4	9000	2300	8000	1500	6200	1400	
R5	7500	1900	6500	1200	5200	900	
R6	6300	1600	5500	1000	4300	800	



建議加工數據 Recommended cutting condition • NBM

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Radius	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
R0.1	32000	500 - 600	32000	400 - 500	25000	300 - 400	
R0.15	32000	500 - 600	32000	400 - 500	25000	300 - 400	
R0.2	32000	500 - 600	32000	400 - 500	25000	300 - 400	
R0.25	32000	600 - 700	32000	500 - 600	25000	400 - 500	
R0.3	32000	600 - 700	32000	500 - 600	25000	400 - 500	
R0.35	32000	700 - 800	32000	600 - 700	25000	500 - 600	
R0.4	32000	900 - 1000	32000	800 - 900	25000	600 - 700	
R0.45	32000	1000 - 1100	32000	900 - 1000	25000	600 - 700	



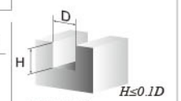
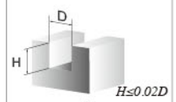
建議加工數據 Recommended cutting condition • NSN . NSX

	Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
	Hardness	~HRC30		~HRC50		~HRC60		
	Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
Side Milling	3	20000	2000	16000	1000	9000	500	HRC45 ↓ D 6mm ↓ H=1.5D W=0.02D D 6mm ↑ H=1.5D W=0.05D
	4	19000	2000	12000	1300	6000	550	
	5	13000	1800	10000	1400	5000	500	
	6	10000	3000	8000	1500	4500	700	
	8	8000	3200	5000	1300	3500	600	HRC45 ↑ D 6mm ↓ H=1.5D W=0.01D D 6mm ↑ H=1.5D W=0.02D
	10	7000	3000	4500	1200	3000	500	
	12	5000	2000	4000	1100	2000	500	
	16	4000	1800	3500	1000	1800	450	
	20	3500	1600	3000	1000	1300	450	
Grooving	3	20000	2000	20000	1200	16000	1200	H≤0.2D HRC45 ↓ D=Diameter
	4	16000	2000	16000	1200	12000	1300	
	5	13000	1800	13000	1100	10000	1400	
	6	10000	3000	10000	2100	8000	1500	
	8	8000	2900	8000	1800	6000	1400	
	10	7000	2800	6000	1700	5000	1300	
	12	5000	2300	5500	1700	4500	1200	
	16	3500	1800	4500	1800	3500	1200	
	20	3000	1400	3000	1500	2600	1100	

建議加工數據 Recommended cutting condition • NSL(S/M/L)N. NSL(S/M/L)X

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
6	4500	5800	3800	420	1600	300	H≤1.5D HRC45 ↓ W≤0.1D
8	3500	820	2800	420	1000	300	
10	3000	820	1800	420	900	300	H≤1D HRC45 ↑ W≤0.05D D=Diameter
12	2000	820	1600	350	800	300	
16	1500	650	1000	300	500	150	

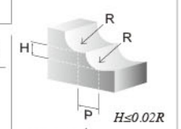
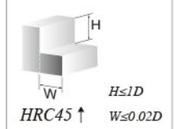
建議加工數據 Recommended cutting condition • NSM

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
0.2	40000	100 - 300	30000	80 - 250	15000	50 - 150	 H≤0.1D HRC45 ↓ D≤1D
0.3	40000	100 - 350	30000	80 - 300	15000	50 - 200	
0.4	40000	100 - 400	25000	80 - 350	10000	50 - 250	
0.5	40000	100 - 500	25000	80 - 400	10000	50 - 250	 H≤0.02D HRC45 ↑ D≤1D D=Diameter
0.6	38000	100 - 600	25000	80 - 500	8000	50 - 250	
0.7	36000	100 - 700	20000	80 - 600	8000	50 - 250	
0.8	34000	100 - 800	20000	80 - 700	8000	50 - 250	
0.9	32000	100 - 1000	20000	80 - 800	8000	50 - 250	

建議加工數據 Recommended cutting condition • NRN . NRX

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
2	26000	1600	16500	1000	7500	300	H≤0.02R P≤0.02R HRC45 ↓
3	19000	1800	12000	1200	5400	360	
4	16000	3200	10000	1900	4800	480	
5	14000	3300	8000	2000	3800	500	
6	12000	3600	7200	2200	3500	650	H≤1D W≤0.02D HRC45 ↑ D=Diameter R=Corner R
8	9600	4000	5600	2200	2700	750	
10	7000	3400	4400	1700	2100	650	
12	6000	2800	3600	1400	1800	600	

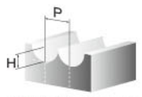
建議加工數據 Recommended cutting condition • NRL(S/M/L)N . NRL(S/M/L)X

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
6	12000	3600	7200	2200	3500	650	 H≤0.02R P≤0.02R HRC45 ↓
8	9600	4000	5600	2200	2700	750	
10	7000	3400	4400	1700	2100	650	
12	6000	2800	3600	1400	1800	600	 H≤1D W≤0.02D HRC45 ↑ D=Diameter R=Corner R

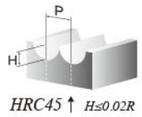
泛用鋼材加工系列（極細微粒系列）
Universal metal materials cutting series（Ultra Fine Micro Grain Carbide Series）

建議加工數據 Recommended cutting condition • UBA-2F

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Radius	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
R0.5	45000	2000	45000	1800	28000	1000	
R1	23000	2000	22000	1800	16000	900	
R1.5	16000	2000	15000	1800	11000	900	
R2	15000	2400	14000	2000	10000	1300	
R3	13000	3200	11000	2000	9000	1500	
R4	9000	2300	8000	1500	6200	1400	
R5	7500	1900	6500	1200	5200	900	
R6	6300	1600	5500	1000	4300	800	
R8	4500	1200	3800	800	3300	700	



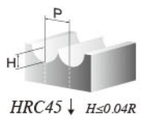
HRC45 ↓ H≤0.04R P≤0.06R



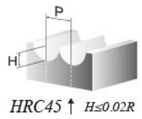
HRC45 ↑ H≤0.02R P≤0.03R
R=Radius

建議加工數據 Recommended cutting condition • UBA-4F

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Radius	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
R2	15000	3000	14000	2600	10000	1700	
R3	13000	4000	11000	2600	9000	1900	
R4	9000	2900	8000	1900	6200	1800	
R5	7500	2400	6500	1500	5200	1100	
R6	6300	2100	5500	1300	4300	1000	
R8	4500	1500	3800	1000	3300	900	
R10	3700	1200	3200	750	2600	600	



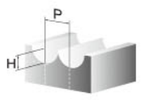
HRC45 ↓ H≤0.04R P≤0.06R



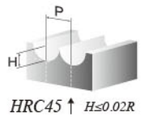
HRC45 ↑ H≤0.02R P≤0.03R
R=Radius

建議加工數據 Recommended cutting condition • UBLS(LM.LL)

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Radius	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
R0.5	45000	2000	45000	1800	28000	1000	
R1	23000	2000	22000	1800	16000	900	
R1.5	16000	2000	15000	1800	11000	900	
R2	15000	2400	14000	2000	10000	1300	
R3	13000	3200	11000	2000	9000	1500	
R4	9000	2300	8000	1500	6200	1400	
R5	7500	1900	6500	1200	5200	900	
R6	6300	1600	5500	1000	4300	800	
R8	4500	1200	3800	800	3300	700	



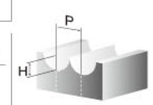
HRC45 ↓ H≤0.04R P≤0.06R



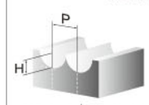
HRC45 ↑ H≤0.02R P≤0.03R
R=Radius

建議加工數據 Recommended cutting condition • UBTN

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Radius	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
R1	23000	2000	22000	1800	16000	900	
R1.5	16000	2000	15000	1800	11000	900	
R2	15000	2400	14000	2000	10000	1300	
R3	13000	3200	11000	2000	9000	1500	



HRC45 ↓ H≤0.04R P≤0.06R

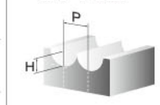


HRC45 ↑ H≤0.02R P≤0.03R
R=Radius

建議加工數據 Recommended cutting condition • UBLN

Material		Alloy Steels . Tool Steels . Hardened Steels S45C , SCM , S50C , SKS , SCr , SNCM , SKD11 , SKD61 , NAK80			Depth Of Cut
Radius	Effective Length	speed (min^{-1})	feed (mm / min)	depth of cut H (mm)	
R0.25	4	30000 - 40000	200 - 650	0.015	
	6	30000 - 40000	200 - 650	0.013	
R0.3	4	27000 - 40000	180 - 650	0.025	
	6	27000 - 40000	180 - 650	0.015	
R0.4	6	25000 - 40000	400 - 750	0.025	
	8	25000 - 40000	400 - 750	0.025	
R0.5	6	20000 - 32000	300 - 750	0.04	
	8	20000 - 32000	300 - 750	0.03	
	10	20000 - 32000	300 - 750	0.025	
	12	20000 - 32000	300 - 750	0.015	
R0.6	8	22000 - 25000	500 - 600	0.05	
	12	22000 - 25000	500 - 600	0.03	
R0.75	8	18000 - 20000	350 - 550	0.07	
	12	18000 - 20000	350 - 550	0.04	
	16	18000 - 20000	350 - 550	0.03	
	20	18000 - 20000	350 - 550	0.02	
R0.8	8	13000 - 18000	350 - 800	0.08	
	12	13000 - 18000	350 - 800	0.06	
	16	13000 - 18000	350 - 800	0.05	
R1.0	8	12000 - 17000	500 - 900	0.1	
	12	12000 - 17000	500 - 900	0.1	
	16	12000 - 17000	500 - 900	0.07	
	20	12000 - 17000	500 - 900	0.04	
R1.5	8	8000 - 11000	500 - 700	0.17	
	10	8000 - 11000	500 - 700	0.15	
	16	8000 - 11000	500 - 700	0.14	
	20	8000 - 11000	500 - 700	0.12	
	25	8000 - 11000	500 - 700	0.1	
R2.0	10	5000 - 8000	400 - 600	0.18	
	15	5000 - 8000	400 - 600	0.17	
	20	5000 - 8000	400 - 600	0.16	
	25	5000 - 8000	400 - 600	0.15	
	30	5000 - 8000	400 - 600	0.14	

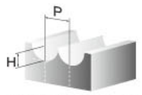
R<1 P<0.1R
R>1 P<0.2R



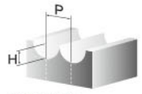
R=Radius

建議加工數據 Recommended cutting condition • UBM

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Radius	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
R0.10	32000	500 - 600	32000	400 - 500	25000	300 - 400	
R0.15	32000	500 - 600	32000	400 - 500	25000	300 - 400	
R0.20	32000	500 - 600	32000	400 - 500	25000	300 - 400	
R0.25	32000	600 - 700	32000	500 - 600	25000	400 - 500	
R0.30	32000	600 - 700	32000	500 - 600	25000	400 - 500	
R0.35	32000	700 - 800	32000	600 - 700	25000	500 - 600	
R0.40	32000	900 - 1000	32000	800 - 900	25000	600 - 700	
R0.45	32000	1000 - 1100	32000	900 - 1000	25000	600 - 700	



HRC45 ↓ *H≤0.06R*
P≤0.1R

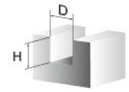


HRC45 ↑ *H≤0.03R*
R=Radius *P≤0.05R*

建議加工數據 Recommended cutting condition • USA-2F

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
1	20000	80	15000	45	11000	30	
1.5	13600	135	10000	60	9000	40	
2	9600	150	8500	50	6000	45	
3	6500	200	5800	75	4000	60	
4	5500	250	4000	80	3200	60	
5	4500	300	3000	80	2500	70	
6	4000	300	2500	80	2200	70	
8	3500	350	2200	90	1700	70	
10	3000	400	2000	90	1500	70	
12	2500	400	1500	100	1000	70	
16	2000	400	1200	100	800	70	

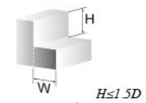
HRC45 ↓
D<3 H=0.15D
D>3 H=0.25D



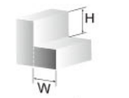
HRC45 ↑
D<3 H=0.05D
D>3 H=0.1D
D=Diameter

建議加工數據 Recommended cutting condition • USA-4F

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
1	22000	400	18000	200	9000	140	
1.5	12000	500	11000	280	5200	150	
2	10000	550	10000	280	4600	170	
3	9000	600	5500	310	3500	220	
4	6000	600	5000	400	2200	220	
5	4800	750	4000	400	1700	240	
6	4500	800	3800	420	1600	300	
8	3500	820	2800	420	1000	300	
10	3000	820	1800	420	900	300	
12	2000	820	1600	350	800	300	
16	1500	650	1000	300	500	150	
20	1200	600	900	300	400	150	



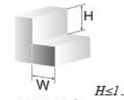
HRC45 ↓ *H≤1.5D*
W≤0.1D



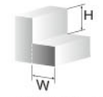
HRC45 ↑ *H≤1D*
D=Diameter *W≤0.05D*

建議加工數據 Recommended cutting condition • USK

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
1	22000	400	18000	200	9000	140	
1.5	12000	500	11000	280	5200	150	
2	10000	550	10000	280	4600	170	
3	9000	600	5500	310	3500	220	
4	6000	600	5000	400	2200	220	
5	4800	750	4000	400	1700	240	
6	4500	800	3800	420	1600	300	
8	3500	820	2800	420	1000	300	
10	3000	820	1800	420	900	300	
12	2000	820	1600	350	800	300	
16	1500	650	1000	300	500	150	
20	1200	600	900	300	400	150	



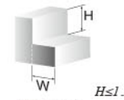
HRC45 ↓ *H≤1.5D*
W≤0.1D



HRC45 ↑ *H≤1D*
D=Diameter *W≤0.05D*

建議加工數據 Recommended cutting condition • USQ

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
1	22000	400	18000	200	9000	140	
1.5	12000	500	11000	280	5200	150	
2	10000	550	10000	280	4600	170	
3	9000	600	5500	310	3500	220	
4	6000	600	5000	400	2200	220	
5	4800	750	4000	400	1700	240	
6	4500	800	3800	420	1600	300	
8	3500	820	2800	420	1000	300	
10	3000	820	1800	420	900	300	
12	2000	820	1600	350	800	300	
16	1500	650	1000	300	500	150	
20	1200	600	900	300	400	150	



HRC45 ↓ *H≤1.5D*
W≤0.1D

HRC45 ↑ *H≤1D*
D=Diameter *W≤0.05D*

建議加工數據 Recommended cutting condition • USM

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
0.2	40000	100 - 300	30000	80 - 250	15000	50 - 150	
0.3	40000	100 - 350	30000	80 - 300	15000	50 - 200	
0.4	40000	100 - 400	25000	80 - 350	10000	50 - 250	
0.5	40000	100 - 500	25000	80 - 400	10000	50 - 250	
0.6	38000	100 - 600	25000	80 - 500	8000	50 - 250	
0.7	36000	100 - 700	20000	80 - 600	8000	50 - 250	
0.8	34000	100 - 800	20000	80 - 700	8000	50 - 250	
0.9	32000	100 - 1000	20000	80 - 800	8000	50 - 250	

HRC45 ↓ *H≤0.1D*
D≤1D

HRC45 ↑ *H≤0.02D*
D=Diameter *D≤1D*

建議加工數據 Recommended cutting condition • USP . USSP

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11	
Hardness	~HRC30		~HRC50		~HRC60	
	Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)
Side Milling	3	20000	2000	16000	1000	9000	500
	4	19000	2000	12000	1300	6000	550
	5	13000	1800	10000	1400	5000	500
	6	10000	3000	8000	1500	4500	700
	8	8000	3200	5000	1300	3500	600
	10	7000	3000	4500	1200	3000	500
	12	5000	2000	4000	1100	2000	500
	16	4000	1800	3500	1000	1800	450
	20	3500	1600	3000	1000	1300	450
Grooving	3	20000	2000	20000	1200	16000	1200
	4	16000	2000	16000	1200	12000	1300
	5	13000	1800	13000	1100	10000	1400
	6	10000	3000	10000	2100	8000	1500
	8	8000	2900	8000	1800	6000	1400
	10	7000	2800	6000	1700	5000	1300
	12	5000	2300	5500	1700	4500	1200
	16	3500	1800	4500	1800	3500	1200
	20	3000	1400	3000	1500	2600	1100

Depth Of Cut

HRC45 ↓
D 6mm ↓ H=1.5D W=0.02D
D 6mm ↑ H=1.5D W=0.05D

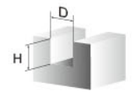
HRC45 ↑
D 6mm ↓ H=1.5D W=0.01D
D 6mm ↑ H=1.5D W=0.02D

H≤0.2D
HRC45 ↓ D=Diameter

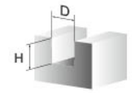
建議加工數據 Recommended cutting condition • USL(S.M.L)-2F

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11	
Hardness	~HRC30		~HRC50		~HRC60	
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)
6	4000	300	2500	80	2200	70
8	3500	350	2200	90	1700	70
10	3000	400	2000	90	1500	70
12	2500	400	1500	100	1000	70

Depth Of Cut



HRC45 ↓
D<3 H=0.15D
D>3 H=0.25D

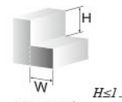


HRC45 ↑
D<3 H=0.05D
D>3 H=0.1D
D=Diameter

建議加工數據 Recommended cutting condition • USL(S.M.L)-4F

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11	
Hardness	~HRC30		~HRC50		~HRC60	
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)
6	4500	800	3800	420	1600	300
8	3500	820	2800	420	1000	300
10	3000	820	1800	420	900	300
12	2000	820	1600	350	800	300
16	1500	650	1000	300	500	150

Depth Of Cut



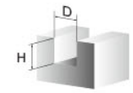
H≤1.5D
HRC45 ↓ W≤0.1D

HRC45 ↑ H≤1D
D=Diameter W≤0.05D

建議加工數據 Recommended cutting condition • USLN

Material		Alloy Steels . Tool Steels . Hardened Steels S45C , SCM , S50C , SKS , SCr , SNCM , SKD11 , SKD61 , NAK80		
Diameter	Effective Length	speed (min^{-1})	feed (mm / min)	depth of cut H (mm)
1	4	25000	1500	0.05
	6	25000	1500	0.03
	10	25000	1500	0.01
1.5	4	15000	1200	0.1
	8	15000	1200	0.05
	10	15000	1200	0.025
	12	15000	1200	0.018
2	8	12000	900	0.2
	10	8800	700	0.12
	12	7500	600	0.05
	16	7000	500	0.02
3	8	8000	600	0.5
	12	8000	600	0.45
	16	5500	450	0.18
	20	4000	300	0.15
	10	6000	400	0.7
	16	6000	400	0.4

Depth Of Cut

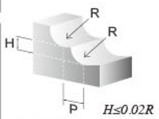


D=Diameter

建議加工數據 Recommended cutting condition • URA-4F

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11	
Hardness	~HRC30		~HRC50		~HRC60	
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)
2	26000	1600	16500	1000	7500	300
3	19000	1800	12000	1200	5400	360
4	16000	3200	10000	1900	4800	480
5	14000	3300	8000	2000	3800	500
6	12000	3600	7200	2200	3500	650
8	9600	4000	5600	2200	2700	750
10	7000	3400	4400	1700	2100	650
12	6000	2800	3600	1400	1800	600
16	4500	2000	2800	1000	1400	450

Depth Of Cut



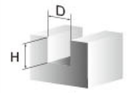
H≤0.02R
HRC45 ↓ P≤0.02R

H≤1D
HRC45 ↑ W≤0.02D
D=Diameter R=Corner R

建議加工數據 Recommended cutting condition • URA-2F

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
3	7600	180	4800	120	2900	50	
4	6500	260	4000	160	2500	55	
5	5500	270	3200	160	2000	60	
6	4800	300	2900	170	1800	70	
8	3700	325	2200	170	1500	85	
10	2900	280	1700	140	1100	70	
12	2400	230	1400	120	1000	65	
16	1800	170	1100	90	700	45	

HRC45 ↓ H≤0.3D

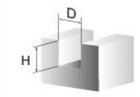


HRC45 ↑ H≤0.15D

D=Diameter

建議加工數據 Recommended cutting condition • URLN

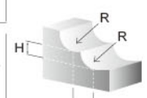
Material		Alloy Steels . Tool Steels . Hardened Steels S45C , SCM , S50C , SKS , SCr , SNCM , SKD11 , SKD61 , NAK80			Depth Of Cut
Diameter	Effective Length	speed (min^{-1})	feed (mm / min)	depth of cut H (mm)	
1	4	30000	2200	0.15	
	6	30000	2200	0.12	
	8	30000	2200	0.12	
	10	30000	2200	0.12	
1.5	4	25000	1800	0.20	
	6	25000	1800	0.18	
	8	25000	1800	0.15	
	10	25000	1800	0.15	
	12	25000	1800	0.15	
2	8	20000	1500	0.30	
	10	20000	1500	0.30	
	12	20000	1500	0.25	
	16	20000	1500	0.25	
3	8	12000	900	0.40	
	12	12000	900	0.40	
	16	12000	900	0.30	
	20	12000	900	0.30	



D=Diameter

建議加工數據 Recommended cutting condition • URL(S.M.L)

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
6	12000	3600	7200	2200	3500	650	
8	9600	4000	5600	2200	2700	750	
10	7000	3400	4400	1700	2100	650	
12	6000	2800	3600	1400	1800	600	



HRC45 ↓ H≤0.02R P≤0.02R

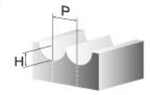
HRC45 ↑ H≤1D W≤0.02D

D=Diameter R=Corner R

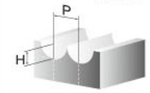
一般鋼材加工系列（超微粒系列） General metal materials cutting series（Micro Grain Carbide Series）

建議加工數據 Recommended cutting condition • BA-2F

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
RADIUS	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
R0.5	45000	800	35000	600	20000	200	
R1	23000	800	18000	600	10000	200	
R1.5	16000	1000	12000	600	6500	200	
R2	12000	1000	9500	700	5000	300	
R3	8000	1100	6000	700	3500	300	
R4	6000	1200	5000	800	2500	350	
R5	5000	1100	4000	800	2000	350	
R6	4000	1000	3000	700	1500	300	
R8	3000	1000	2000	700	1000	300	



HRC45 ↓ H≤0.05R P≤0.1R

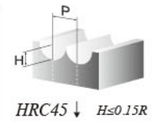


HRC45 ↑ H≤0.04R P≤0.06R

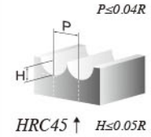
R=Radius

建議加工數據 Recommended cutting condition • BA-4F

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
RADIUS	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
R2	12000	1200	9500	900	5000	400	
R3	8000	1400	6000	900	3500	500	
R4	6000	1600	5000	1000	2500	600	
R5	5000	1400	4000	1000	2000	600	
R6	4000	1200	3000	900	1500	500	
R8	3000	1200	2500	900	1000	500	
R10	2500	1000	2000	600	900	300	



HRC45 ↓ H≤0.15R P≤0.04R

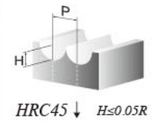


HRC45 ↑ H≤0.05R P≤0.02R

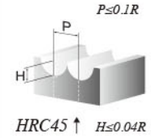
R=Radius

建議加工數據 Recommended cutting condition • BLS.BLM.BLL

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
RADIUS	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
R0.5	45000	800	35000	600	20000	200	
R1	23000	800	18000	600	10000	200	
R1.5	16000	1000	12000	600	6500	200	
R2	12000	1000	9500	700	5000	300	
R3	8000	1100	6000	700	3500	300	
R4	6000	1200	5000	800	2500	350	
R5	5000	1100	4000	800	2000	350	
R6	4000	1000	3000	700	1500	300	
R8	3000	1000	2000	700	1000	300	



HRC45 ↓ H≤0.05R P≤0.1R

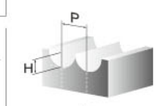


HRC45 ↑ H≤0.04R P≤0.06R

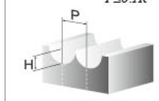
R=Radius

建議加工數據 Recommended cutting condition • BM

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Radius	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
R0.10	32000	500 - 600	32000	400 - 500	25000	300 - 400	
R0.15	32000	500 - 600	32000	400 - 500	25000	300 - 400	
R0.20	32000	500 - 600	32000	400 - 500	25000	300 - 400	
R0.25	32000	600 - 700	32000	500 - 600	25000	400 - 500	
R0.30	32000	600 - 700	32000	500 - 600	25000	400 - 500	
R0.35	32000	700 - 800	32000	600 - 700	25000	500 - 600	
R0.40	32000	900 - 1000	32000	800 - 900	25000	600 - 700	
R0.45	32000	1000 - 1100	32000	900 - 1000	25000	600 - 700	



HRC45 ↓ *H≤0.06R* *P≤0.1R*

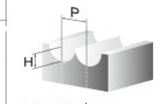


HRC45 ↑ *H≤0.03R* *P≤0.05R*

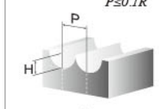
R=Radius

建議加工數據 Recommended cutting condition • BS

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Radius	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
R0.5	45000	800	35000	600	20000	200	
R1	23000	800	18000	600	10000	200	
R1.5	16000	1000	12000	600	6500	200	
R2	12000	1000	9500	700	5000	300	



HRC45 ↓ *H≤0.05R* *P≤0.1R*



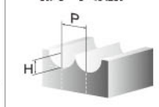
HRC45 ↑ *H≤0.04R* *P≤0.06R*

R=Radius

建議加工數據 Recommended cutting condition • BLN

Material		Alloy Steels . Tool Steels . Hardened Steels S45C , SCM , S50C , SKS , SCr , SNCM , SKD11 , SKD61 , NAK80			Depth Of Cut
Radius	Effective Length	speed (min^{-1})	feed (mm / min)	depth of cut H (mm)	
R0.5	6	20000 - 32000	300 - 750	0.04	
	8	20000 - 32000	300 - 750	0.03	
	10	20000 - 32000	300 - 750	0.025	
	12	20000 - 32000	300 - 750	0.015	
R0.75	8	18000 - 20000	350 - 550	0.07	
	12	18000 - 20000	350 - 550	0.04	
	16	18000 - 20000	350 - 550	0.03	
	20	18000 - 20000	350 - 550	0.02	
R1.0	8	12000 - 17000	500 - 900	0.1	
	12	12000 - 17000	500 - 900	0.1	
	16	12000 - 17000	500 - 900	0.07	
	20	12000 - 17000	500 - 900	0.04	
R1.5	8	8000 - 11000	500 - 700	0.17	
	10	8000 - 11000	500 - 700	0.15	
	16	8000 - 11000	500 - 700	0.14	
	20	8000 - 11000	500 - 700	0.12	
	25	8000 - 11000	500 - 700	0.1	
R2.0	10	5000 - 8000	400 - 600	0.18	
	15	5000 - 8000	400 - 600	0.17	
	20	5000 - 8000	400 - 600	0.16	
	25	5000 - 8000	400 - 600	0.15	
	30	5000 - 8000	400 - 600	0.14	

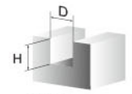
R<1 P<0.1R
R>1 P<0.2R



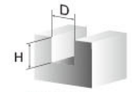
R=Radius

建議加工數據 Recommended cutting condition • SA-2F

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
1	20000	80	15000	45	11000	30	
1.5	13600	135	10000	60	9000	40	
2	9600	150	8500	50	6000	45	
3	6500	200	5800	75	4000	60	
4	5500	250	4000	80	3200	60	
5	4500	300	3000	80	2500	70	
6	4000	300	2500	80	2200	70	
8	3500	350	2200	90	1700	70	
10	3000	400	2000	90	1500	70	
12	2500	400	1500	100	1000	70	
16	2000	400	1200	100	800	70	



HRC45 ↓
D<3 H=0.15D
D>3 H=0.25D

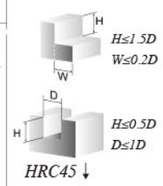


HRC45 ↑
D<3 H=0.05D
D>3 H=0.1D
D=Diameter

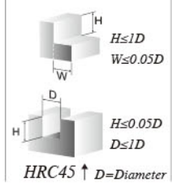
建議加工數據 Recommended cutting condition • SA-3F . SB-3F . SB-4F

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
3	8000	550(300)	5500	300(100)	3500	200(95)	
4	6500	550(300)	4500	300(100)	2200	200(95)	
5	5000	800(400)	3600	350(120)	1800	210(100)	
6	4000	800(400)	2800	350(120)	1500	210(110)	
8	3500	800(400)	2600	350(120)	1300	210(100)	
10	2500	800(400)	2000	350(120)	1100	210(100)	
12	1800	750(350)	1500	350(120)	700	210(100)	
16	1400	700(300)	1000	300(100)	500	170(70)	

( ):Grooving



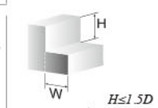
H≤1.5D W≤0.2D
H≤0.5D D≤1D
HRC45 ↓



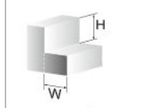
H≤1D W≤0.05D
H≤0.05D D≤1D
HRC45 ↑ D=Diameter

建議加工數據 Recommended cutting condition • SA-4F

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
1	22000	400	18000	200	9000	140	
1.5	12000	500	11000	280	5200	150	
2	10000	550	10000	280	4600	170	
3	9000	600	5500	310	3500	220	
4	6000	600	5000	400	2200	220	
5	4800	750	4000	400	1700	240	
6	4500	800	3800	420	1600	300	
8	3500	820	2800	420	1000	300	
10	3000	820	1800	420	900	300	
12	2000	820	1600	350	800	300	
16	1500	650	1000	300	500	150	
20	1200	600	900	300	400	150	



HRC45 ↓ *H≤1.5D W≤0.1D*

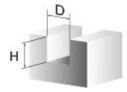


HRC45 ↑ *H≤1D*
D=Diameter *W≤0.05D*

建議加工數據 Recommended cutting condition • SL(S/M/L)-2F

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
6	4000	300	2500	80	2200	70	
8	3500	350	2200	90	1700	70	
10	3000	400	2000	90	1500	70	
12	2500	400	1500	100	1000	70	
16	2000	400	1200	100	800	70	

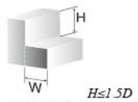
HRC45 ↓
D<3 H=0.15D
D>3 H=0.25D



HRC45 ↑
D<3 H=0.05D
D>3 H=0.1D
D=Diameter

建議加工數據 Recommended cutting condition • SL(S/M/L)-4F

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
6	4500	800	3800	420	1600	300	
8	3500	820	2800	420	1000	300	
10	3000	820	1800	420	900	300	
12	2000	820	1600	350	800	300	
16	1500	650	1000	300	500	150	
20	1200	600	900	300	400	150	

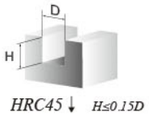


HRC45 ↓ *H≤1.5D W≤0.1D*

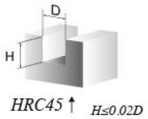
HRC45 ↑ *H≤1D W≤0.05D*
D=Diameter

建議加工數據 Recommended cutting condition • SLF-2F

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
2	3000	25	1700	20	1000	15	
3	2300	35	1900	25	800	10	
4	2000	45	1600	35	650	15	
5	1800	40	1400	40	600	20	
6	1700	60	1300	50	550	25	
8	1300	60	1000	50	450	25	
10	1000	60	800	50	350	25	
12	800	60	700	50	300	25	



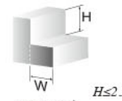
HRC45 ↓ *H≤0.15D*



HRC45 ↑ *H≤0.02D*
D=Diameter

建議加工數據 Recommended cutting condition • SLF-4F

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
2	3000	50	2500	40	1000	15	
3	2500	60	2000	50	800	20	
4	2000	80	1700	70	700	30	
5	1800	110	1500	85	600	40	
6	1500	110	1400	75	550	50	
8	1300	110	1100	75	450	50	
10	1000	110	800	75	300	50	
12	900	110	700	75	250	40	
16	800	95	500	70	150	20	
20	500	80	400	60	120	20	

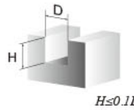


HRC45 ↓ *H≤2.5D W≤0.05D*

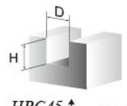
HRC45 ↑ *H≤2D W≤0.02D*
D=Diameter

建議加工數據 Recommended cutting condition • SM

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
0.4	40000	100 - 400	25000	80 - 350	10000	50 - 250	
0.5	40000	100 - 500	25000	80 - 400	10000	50 - 250	
0.6	38000	100 - 600	25000	80 - 500	8000	50 - 250	
0.7	36000	100 - 700	20000	80 - 600	8000	50 - 250	
0.8	34000	100 - 800	20000	80 - 700	8000	50 - 250	
0.9	32000	100 - 1000	20000	80 - 800	8000	50 - 250	



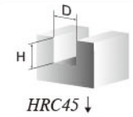
HRC45 ↓ *H≤0.1D D≤1D*



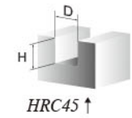
HRC45 ↑ *H≤0.02D D≤1D*
D=Diameter

建議加工數據 Recommended cutting condition • SS

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
1	20000	80	15000	45	11000	30	
1.5	13600	135	10000	60	9000	40	
2	9600	150	8500	50	6000	45	
3	6500	200	5800	75	4000	60	
4	5500	250	4000	80	3200	60	

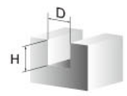


HRC45 ↓
D<3 H=0.15D
D>3 H=0.25D



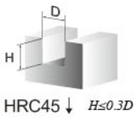
HRC45 ↑
D<3 H=0.05D
D>3 H=0.1D
D=Diameter

建議加工數據 Recommended cutting condition • SLN

Material		Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...	Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...	Hardened Steels SKD11	Depth Of Cut
Diameter	Effective Length	speed (mim^{-1})	feed (mm / min)	depth of cut H (mm)	
1	4	25000	1500	0.05	
	6	25000	1500	0.03	
	10	25000	1500	0.01	
1.5	4	15000	1200	0.1	
	8	15000	1200	0.05	
	10	15000	1200	0.025	
	12	15000	1200	0.018	
2	8	12000	900	0.2	
	10	8800	700	0.12	
	12	7500	600	0.05	
	16	7000	500	0.02	
3	8	8000	600	0.5	
	12	8000	600	0.45	
	16	5500	450	0.18	
	20	4000	300	0.15	
4	10	6000	400	0.7	
	16	6000	400	0.4	

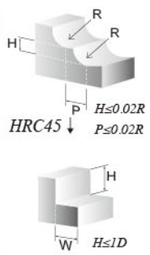
D=Diameter

建議加工數據 Recommended cutting condition • RA-2F

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	
3	7600	180	4800	120	2900	50	
4	6500	260	4000	160	2500	55	
5	5500	270	3200	160	2000	60	
6	4800	300	2900	170	1800	70	
8	3700	325	2200	170	1500	85	
10	2900	280	1700	140	1100	70	
12	2400	230	1400	120	1000	65	
16	1800	170	1100	90	700	45	

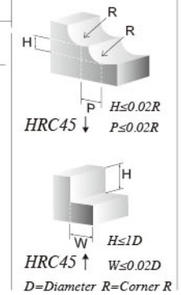
D=Diameter

建議加工數據 Recommended cutting condition • RA-4F

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	
3	9500	450	6000	290	3600	120	
4	8000	800	5000	480	3200	160	
5	6800	820	4000	500	2500	170	
6	6000	900	3600	530	2300	220	
8	4600	1000	2800	530	1800	250	
10	3500	850	2200	420	1400	220	
12	3000	720	1800	350	1200	200	
16	2300	520	1400	250	900	150	

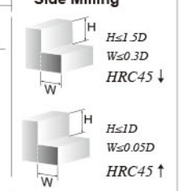
D=Diameter R=Corner R

建議加工數據 Recommended cutting condition • RLS . RLM

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	
6	4800	2560	2900	330	1800	140	
8	3700	620	2200	330	1500	160	
10	2900	530	1700	260	1100	140	
12	2400	450	1400	220	1000	125	

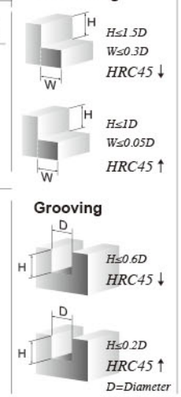
D=Diameter R=Corner R

建議加工數據 Recommended cutting condition • SR-3F

Material		Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness		~HRC30		~HRC50		~HRC60		
	Diameter	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	Side Milling
Side Milling	6	5500	550	3000	310	1150	120	
	8	4600	550	2500	310	920	120	
	10	3700	550	2000	310	730	120	
	12	3000	500	1700	310	600	120	
	16	2300	520	1200	310	460	120	
Grooving	6	4400	440	2400	250	920	100	Grooving
	8	3600	440	2000	250	730	100	
	10	3000	440	1600	250	580	100	
	12	2400	440	1350	250	480	100	
	16	1800	440	960	250	370	100	

D=Diameter

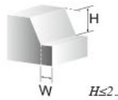
建議加工數據 Recommended cutting condition • SR-4F

Material		Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness		~HRC30		~HRC50		~HRC60		
	Diameter	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	Side Milling
Side Milling	6	5500	550	3000	310	1150	120	
	8	4600	550	2500	310	920	120	
	10	3700	550	2000	310	730	120	
	12	3000	500	1700	310	600	120	
	16	2300	520	1200	310	460	120	
Grooving	6	4400	440	2400	250	920	100	Grooving
	8	3600	440	2000	250	730	100	
	10	3000	440	1600	250	580	100	
	12	2400	440	1350	250	480	100	
	16	1800	440	960	250	370	100	

D=Diameter

建議加工數據 Recommended cutting condition • SLT

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	
1	12000	65	6800	40	2500	15	
1.5	9600	70	5200	45	2000	15	
2	7500	85	4000	48	1500	18	
2.5	6800	100	3700	60	1700	20	
4	3500	120	1800	60	600	20	



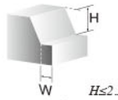
HRC45 ↓ *H≤2.5D* *W≤0.02D*

HRC45 ↑ *H≤2.5D* *W≤0.01D*

D=Diameter

建議加工數據 Recommended cutting condition • ST

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	
1	12000	65	6800	40	2500	15	
1.5	9600	70	5200	45	2000	15	
2	7500	85	4000	48	1500	18	
2.5	6800	100	3700	60	1700	20	
4	3500	120	1800	60	600	20	
6	2500	150	1600	80	550	25	
8	2000	150	1200	80	450	25	
10	1500	150	1000	80	350	25	



HRC45 ↓ *H≤2.5D* *W≤0.02D*

HRC45 ↑ *H≤2.5D* *W≤0.01D*

D=Diameter

特殊金屬材料加工系列
Special metal materials cutting series

建議加工數據 Recommended cutting condition • USV . USTA .USTB

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	
3	22000	1800	16000	1300	10000	800	
4	15000	1400	12000	1250	7000	700	
5	13000	1600	10000	1400	6000	650	
6	11500	1650	8500	1300	5000	800	
8	8000	1800	6500	1350	3500	700	
10	7000	1800	5000	1400	2800	750	
12	6000	1700	4000	1300	2300	650	
16	3560	1500	3000	1250	1800	700	
20	3000	1450	2500	1250	1500	780	

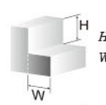
HRC45 ↓ *H≤1.5D* *W≤0.4D*

HRC45 ↑ *H≤1.5D* *W≤0.2D*

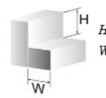
D=Diameter

建議加工數據 Recommended cutting condition • USSI

Material	Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness	~HRC30		~HRC50		~HRC60		
Diameter	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	
3	9000	600	5500	310	3500	220	
4	6000	600	5000	400	2200	220	
5	4800	750	4000	400	1700	240	
6	4500	800	3800	420	1600	300	
8	3500	820	2800	420	1000	300	
10	3000	820	1800	420	900	300	
12	2000	820	1600	350	800	300	
16	1500	650	1000	300	500	150	
20	1200	600	900	300	400	150	



HRC45 ↓ *H≤1.5D* *W≤0.1D*



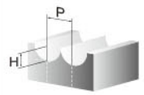
HRC45 ↑ *H≤1D* *W≤0.05D*

D=Diameter

鋁合金材料加工系列
Aluminum alloy cutting series

建議加工數據 Recommended cutting condition • AB

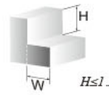
Material	Aluminum 1070		Aluminum alloy 2014 / 4032 / 5052 / 6061 / 7075		Aluminum alloy AC85		Depth Of Cut
Radius	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	
R0.5	50000	2300	37000	2000	50000	1400	
R0.75	50000	3000	28000	2000	50000	1800	
R1	44000	4000	18500	2000	44000	2500	
R1.5	28000	4000	11500	2000	28000	2500	
R2	22000	4000	8800	2000	22000	2500	
R3	16000	4000	6400	2000	16000	2500	
R4	12000	4000	4800	2000	12000	2500	
R5	10000	4000	4000	2000	10000	2500	
R6	8000	4000	3200	2000	8000	2500	



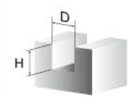
H≤0.1R
R=Radius P≤0.2R

建議加工數據 Recommended cutting condition • ASA-2F

Material	Aluminum 1070		Aluminum alloy 2014 / 4032 / 5052 / 6061 / 7075		Aluminum alloy AC85		Depth Of Cut
Diameter	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	
2	37000	2000(800)	16000	850(350)	20000	1100(450)	
3	35000	2000(900)	14000	850(450)	18000	1100(550)	
4	26000	2000(1100)	11000	850(550)	13000	1100(660)	
5	21000	2000(1100)	9000	850(550)	10000	1100(660)	
6	17000	2000(1100)	7000	850(550)	9000	1100(660)	
8	13000	2000(1100)	5500	850(650)	7000	1100(800)	
10	11000	2000(1300)	7000	850(650)	5500	1100(800)	
12	8800	2000(1300)	3600	850(800)	4500	1100(800)	
16	6500	2000(1100)	3000	850(550)	3500	1100(900)	
20	5300	2000(1100)	2200	850(550)	2500	1100(650)	



H≤1.5D
W≤0.1D

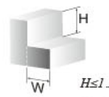


D=Diameter H≤0.1D

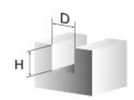
( ):Grooving

建議加工數據 Recommended cutting condition • ASA-3F

Material	Aluminum 1070		Aluminum alloy 2014 / 4032 / 5052 / 6061 / 7075		Aluminum alloy AC85		Depth Of Cut
Diameter	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	
2	37000	2400(950)	16000	1000(380)	20000	1300(500)	
3	35000	2400(1050)	14000	1000(500)	18000	1300(600)	
4	26000	2400(1200)	11000	1000(600)	13000	1300(720)	
5	21000	2400(1200)	9000	1000(600)	10000	1300(720)	
6	17000	2400(1200)	7000	1000(600)	9000	1300(720)	
8	13000	2400(1200)	5500	1000(700)	7000	1300(880)	
10	11000	2400(1400)	7000	1000(700)	5500	1300(880)	
12	8800	2400(1400)	3600	1000(880)	4500	1300(880)	
16	6500	2400(1200)	3000	1000(600)	3500	1300(1000)	
20	5300	2400(1200)	2200	1000(600)	2500	1300(700)	



H≤1.5D
W≤0.2D



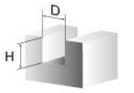
D=Diameter H≤1D

( ):Grooving

建議加工數據 Recommended cutting condition • ASB-2F

Material	Aluminum 1070		Aluminum alloy 2014 / 4032 / 5052 / 6061 / 7075		Aluminum alloy AC85		Depth Of Cut
Diameter	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	
2	37000	2000(800)	16000	850(350)	20000	1100(450)	
3	35000	2000(900)	14000	850(450)	18000	1100(550)	
4	26000	2000(1100)	11000	850(550)	13000	1100(660)	
5	21000	2000(1100)	9000	850(550)	10000	1100(660)	
6	17000	2000(1100)	7000	850(550)	9000	1100(660)	
8	13000	2000(1100)	5500	850(650)	7000	1100(800)	
10	11000	2000(1300)	7000	850(650)	5500	1100(800)	
12	8800	2000(1300)	3600	850(800)	4500	1100(800)	
16	6500	2000(1100)	3000	850(550)	3500	1100(900)	
20	5300	2000(1100)	2200	850(550)	2500	1100(650)	

H≤1.5D
W≤0.1D

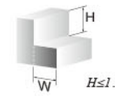


D=Diameter H≤0.1D

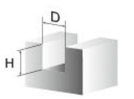
( ):Grooving

建議加工數據 Recommended cutting condition • ASB-3F

Material	Aluminum 1070		Aluminum alloy 2014 / 4032 / 5052 / 6061 / 7075		Aluminum alloy AC85		Depth Of Cut
Diameter	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	
2	37000	2400(950)	16000	1000(380)	20000	1300(500)	
3	35000	2400(1050)	14000	1000(500)	18000	1300(600)	
4	26000	2400(1200)	11000	1000(600)	13000	1300(720)	
5	21000	2400(1200)	9000	1000(600)	10000	1300(720)	
6	17000	2400(1200)	7000	1000(600)	9000	1300(720)	
8	13000	2400(1200)	5500	1000(700)	7000	1300(880)	
10	11000	2400(1400)	7000	1000(700)	5500	1300(880)	
12	8800	2400(1400)	3600	1000(880)	4500	1300(880)	
16	6500	2400(1200)	3000	1000(600)	3500	1300(1000)	
20	5300	2400(1200)	2200	1000(600)	2500	1300(700)	



H≤1.5D
W≤0.2D

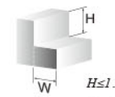


D=Diameter H≤1D

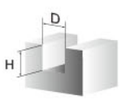
( ):Grooving

建議加工數據 Recommended cutting condition • ASC-3F

Material	Aluminum 1070		Aluminum alloy 2014 / 4032 / 5052 / 6061 / 7075		Aluminum alloy AC85		Depth Of Cut
Diameter	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	speed (mim^{-1})	feed (mm / min)	
2	37000	2400(950)	16000	1000(380)	20000	1300(500)	
3	35000	2400(1050)	14000	1000(500)	18000	1300(600)	
4	26000	2400(1200)	11000	1000(600)	13000	1300(720)	
5	21000	2400(1200)	9000	1000(600)	10000	1300(720)	
6	17000	2400(1200)	7000	1000(600)	9000	1300(720)	
8	13000	2400(1200)	5500	1000(700)	7000	1300(880)	
10	11000	2400(1400)	7000	1000(700)	5500	1300(880)	
12	8800	2400(1400)	3600	1000(880)	4500	1300(880)	
16	6500	2400(1200)	3000	1000(600)	3500	1300(1000)	
20	5300	2400(1200)	2200	1000(600)	2500	1300(700)	



H≤1.5D
W≤0.2D



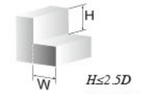
D=Diameter H≤1D

( ):Grooving

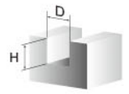
鋁合金材料加工系列
Aluminum alloy cutting series

建議加工數據 Recommended cutting condition • ASL

Material	Aluminum 1070		Aluminum alloy 2014 / 4032 / 5052 / 6061 / 7075		Aluminum alloy AC85		Depth Of Cut
Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
2	30000	600(500)	15000	250(250)	18000	300(300)	
3	26000	600(500)	11000	250(250)	13500	300(350)	
4	20000	600(550)	8500	250(250)	10000	300(350)	
5	15600	600(550)	6700	250(200)	8000	300(350)	
6	13500	600(550)	5500	250(200)	6700	300(350)	
8	10000	600(600)	4200	250(200)	5000	300(350)	
10	7500	600(600)	3300	250(200)	4000	300(350)	
12	6700	600(600)	2700	250(200)	3400	300(350)	
16	5000	600(500)	2300	250(200)	2500	300(350)	
20	4000	600(500)	1700	250(200)	2000	300(350)	



H≤2.5D
W≤0.15D

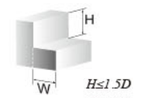


D=Diameter H≤0.6D

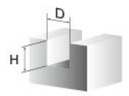
( ):Grooving

建議加工數據 Recommended cutting condition • AR

Material		Carbon Steels . Alloy Steels S45C , FC , FCD , SCM , S50C , SKS...		Alloy Steels . Tool Steels SCr , SNCM , SKD11 , SKD61 , NAK80...		Hardened Steels SKD11		Depth Of Cut
Hardness		~HRC30		~HRC50		~HRC60		
	Diameter	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	speed (min^{-1})	feed (mm / min)	
Side Milling	3	25000	1000	25000	1000	9000	350	
	4	18000	1200	18000	1200	7000	400	
	5	15000	1300	15000	1300	6000	450	
	6	12000	1400	12000	1400	5000	500	
	8	9000	1500	9000	1500	4000	550	
	10	7000	1800	7000	1800	3000	600	
	12	6000	1900	6000	1900	2500	650	
	16	4500	1900	4500	1900	1500	650	
Grooving	3	25000	800	25000	800	9000	350	
	4	18000	800	18000	800	7000	400	
	5	15000	900	15000	900	6000	450	
	6	12000	1000	12000	1000	5000	500	
	8	9000	1000	9000	1000	4000	550	
	10	7000	1200	7000	1200	3000	600	
	12	6000	1300	6000	1300	2500	650	
	16	4500	1300	4500	1300	1500	650	



H≤1.5D
W≤0.1D



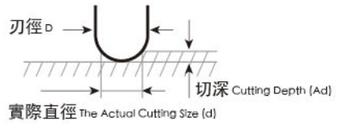
D=Diameter H≤0.2D

球刀實際切削直徑
Ball Nose End Milling Real Diameter

半徑 (R)	直徑 (Dia)	切削深度 Depth of Cut Ad (mm)														
		0.01	0.02	0.03	0.04	0.05	0.08	0.1	0.15	0.2	0.3	0.5	0.8	1.0	2.0	3.0
0.1	0.2	0.087	0.12	0.143	0.16	0.173	0.196	0.2	------	------	------	------	------	------	------	------
0.2	0.4	0.125	0.174	0.211	0.24	0.265	0.32	0.35	0.39	0.4	------	------	------	------	------	------
0.3	0.6	0.154	0.215	0.262	0.299	0.332	0.41	0.45	0.52	0.57	0.6	------	------	------	------	------
0.4	0.8	0.178	0.25	0.304	0.349	0.387	0.48	0.53	0.62	0.69	0.77	0.77	------	------	------	------
0.5	1	0.199	0.28	0.341	0.392	0.436	0.54	0.6	0.71	0.8	0.92	1	------	------	------	------
1	2	0.282	0.398	0.486	0.56	0.624	0.78	0.87	1.05	1.2	1.43	1.73	1.96	2	------	------
1.5	3	0.346	0.488	0.597	0.688	0.768	0.97	1.08	1.31	1.5	1.8	2.24	2.65	2.83	2.83	------
2	4	0.399	0.564	0.69	0.796	0.889	1.12	1.25	1.52	1.74	2.11	2.65	3.2	3.46	4	------
2.5	5	0.447	0.631	0.772	0.891	0.995	1.25	1.4	1.71	1.96	2.37	3	3.67	4	4.9	4.9
3	6	0.489	0.692	0.846	0.977	1.091	1.38	1.54	1.87	2.15	2.62	3.32	4.08	4.47	5.66	6
4	8	0.565	0.799	0.978	1.129	1.261	1.59	1.78	2.17	2.5	3.04	3.87	4.8	5.29	6.93	7.75
5	10	0.632	0.894	1.094	1.262	1.411	1.78	1.99	2.43	2.8	3.41	4.36	5.43	6	8	9.17
6	12	0.693	0.979	1.198	1.383	1.546	1.95	2.18	2.67	3.07	3.75	4.8	5.99	6.63	8.94	10.39
7	14	0.748	1.058	1.295	1.495	1.67	2.11	2.36	2.88	3.32	4.05	5.2	6.5	7.21	9.8	11.49
8	16	0.8	1.131	1.384	1.598	1.786	2.26	2.52	3.08	3.56	4.34	5.57	6.97	7.75	10.58	12.49
9	18	0.848	1.199	1.468	1.695	1.895	2.39	2.68	3.27	3.77	4.61	5.92	7.42	8.25	11.31	13.42
10	20	0.894	1.264	1.548	1.787	1.997	2.52	2.82	3.45	3.98	4.86	6.24	7.84	8.72	12	14.28

實際直徑計算公式 **Calculation of Real Dia.**

$$d=2\sqrt{Ad\,(D-Ad)}$$



主軸轉速表
Spindle Speed Table

直徑 (Dia)	切削速度 Cutting Speed V (m/min)														
ø	20	30	40	50	60	70	80	90	100	120	150	180	200	250	300
0.5	12740	19110	25480	31850	38220	44590	50960	57320	63690	76430	95540	114650	127390	159240	191080
0.6	10620	15920	21230	26540	31850	37150	42460	47770	53080	63690	79620	95540	106160	132700	159240
0.7	9100	13650	18200	22750	27300	31850	36400	40950	45500	54590	68240	81890	90990	113740	136490
0.8	7960	11940	15920	19900	23890	27870	31850	35830	39810	47770	59710	71660	79620	99520	119430
0.9	7080	10620	14150	17690	21230	24770	28310	31850	35390	42640	53080	63690	70770	88460	106160
1	6370	9550	12740	15920	19110	22290	25480	28660	31850	38220	47770	57320	63390	79620	95540
2	3180	4780	6370	7960	9550	11150	12740	14330	15920	19110	23890	28660	31850	39810	47770
3	2120	3180	4250	5310	6370	7430	8490	9550	10620	12740	15920	19110	21230	26540	31850
4	1590	2390	3180	3980	4780	5570	6370	7170	7960	9550	11940	14330	15920	19900	23890
5	1270	1910	2550	3180	3820	4460	5100	5730	6370	7640	9550	11460	12740	15920	19110
6	1060	1590	2120	2650	3180	3720	4250	4780	5310	6370	7960	9550	10620	13270	15920
8	800	1190	1590	1990	2390	2790	3180	3580	3980	4780	5970	7170	7960	9950	11940
10	640	960	1270	1590	1910	2230	2550	2870	3180	3820	4780	5730	6370	7960	9550
12	530	800	1060	1330	1590	1860	2120	2390	2650	3180	3980	4780	5310	6630	7960
14	450	680	910	1140	1360	1590	1820	2050	2270	2730	3410	4090	4550	5690	6820
15	420	640	850	1060	1270	1490	1700	1910	2120	2550	3180	3820	4250	5310	6370
16	400	600	800	1000	1190	1390	1590	1790	1990	2390	2990	3580	3980	4980	5970
20	320	480	640	800	960	1110	1270	1430	1590	1910	2390	2870	3180	3980	4780
25	250	380	510	640	760	890	1020	1150	1270	1530	1910	2290	2550	3180	3820

加工數據計算公式
Calculation for Cutting Speed, Spindle Speed and Feed

$$\text{Cutting Speed (V)} = \frac{\pi \times D \times N}{1{,}000}$$

$$\text{Spindle Speed (N)} = \frac{V \times \pi \times 1{,}000}{D}$$

$$\text{Feed (F)} = N \times fz \times Z$$

$$\text{Feed per Tooth (fz)} = \frac{F}{N \times Z}$$

切削速度 V = Cutting Speed (m/min)
圓周率 π = 3.14 The circular Constant
直徑 D = Diameter (mm)
主軸轉速 N = Spindle Speed (min^{-1})
進給 F = Feed (mm/min)
單刃進給量 fz = Feed per Tooh (mm/tooth)
刃數 Z = Number of Flutes

選擇刀具刃數
Selection of Number of Flute

	2刃 *2-Flutes*	3刃 *3-Flutes*	4刃 *4-Flutes*	6刃 *6-Flutes*
溝銑 *Slotting*	◎	◎	○	×
側銑 *Side Milling*	○	◎	◎	◎

通常兩刃和三刃的刀會被選擇用在插槽的加工,因為他們有比較大的容屑槽。
四刃和六刃因切屑處理佳,建議用在側銑的部份。
Generally 2-flutes and 3-flutes are selected for slotting because of the larger chip pocket.
4-flutes and 6-flutes are recommended for side milling as no promble of chip disposal.

切削速度
Cutting Speed (V)

決定切削速度的因素有：刀具的材質,刀具直徑,刃長,加工材質,切削機器,夾持的剛性,機器的結構,精準度,切削液...等等。一般刀具材質和加工材質是決定切削速度主要因素。

Appropriate Cutting Speed should be decided by parameters such as tool material, diameter, length of cut, work material, cutting machine, rigidity of tool holder, machining configuration, accuracy, cutting fluid, and etc.
Generally tool material and work material are main factors to determine the Cutting Speed.

工件 *Work Materials*	切削速度 V *Cutting Speed (m/min)*	
	鎢鋼 *Carbide*	塗層鎢鋼 *Coated Carbide*
碳鋼 *Carbon Steels (S50C)*	*20~40*	*40~80*
合金鋼 *Alloy Steels (SCM.SKD)*	*20~35*	*35~60*
調質鋼 *Prehardened Steels (NAK.HPM)*	*15~30*	*30~50*
不鏽鋼 *Stainless Steels (SUS304)*	*5~20*	*10~30*
熱處理鋼 *Hardened Steels (SKD61.HRC60)*	-	*20~40*

單刃進給量
Feed per Tooth (fz)

刀具每刃進給速率 是影響加工的重要因素,決定它的因素有:刀具的直徑,類型,加工材質,切削機器,夾持的剛性,機器的結構,精準度,和切削深度。

Feed per Tooth is an important element for efficient machining which should be determined by parameters such as tool diameter,type, work material, cutting machine, rigidity of tool holder, machining configuration, accuracy and cutting depth.

刃徑 *Diameter(mm)*	單刃進給量 *Feed per tooth (mm/tooth)*	
	2刃 *2-Flutes*	4刃 *4-Flutes*
1	*0.001~0.005*	
6	*0.02~0.04*	*0.01~0.03*
10	*0.04~0.08*	*0.03~0.06*
20	*0.08~0.12*	*0.06~0.1*

硬度對照表
Comparison Table of Hardness

洛氏硬度 C級150kg鑽石圓錐 Rockwell Hardness C Scale 150kg Brale (HRC)	維克氏硬度 Diamond Pyramid Hardness Number, Vickers (HV)	布氏硬度 標準球 Brinell Hardness Standard 10mm Ball 29.42kN (HB)	洛氏硬度 A級60kg鑽石圓錐 Rockwell Hardness A Scale 60kg Brale (HRA)	蕭氏硬度 Shore Scleroscope Hardness Number (HS)	抗拉強度 (近似值) Approx Tensile Strength N/mm^2
68	940	-	85.6	97	-
67	900	-	85.5	95	-
66	865	-	84.5	92	-
65	832	-	83.9	91	-
64	800	-	83.4	88	-
63	772	-	82.8	87	-
62	746	-	82.3	85	-
61	720	-	81.8	83	-
60	697	-	81.2	81	-
59	674	-	80.7	80	-
58	653	-	80.1	78	-
57	633	-	79.6	76	-
56	613	-	79.0	75	-
55	595	-	78.5	74	2079
54	577	-	78.0	72	2010
53	560	-	77.4	71	1952
52	544	500	76.8	69	1883
51	528	487	76.3	68	1824
50	513	475	75.9	67	1755
49	498	464	75.2	66	1687
48	484	451	74.7	64	1639
47	471	442	74.1	63	1578
46	458	432	73.6	62	1530
45	446	421	73.1	60	1481
44	434	409	72.5	58	1432
43	423	400	72.0	57	1383
42	412	390	71.5	56	1334
41	402	381	70.9	55	1294
40	392	371	70.4	54	1245
39	382	362	69.9	52	1216
38	372	353	69.4	51	1177
37	363	344	68.9	50	1157
36	354	336	68.4	49	1118
35	345	327	67.9	48	1079
34	336	319	67.4	47	1059
33	327	311	66.8	46	1030
32	318	301	66.3	44	1000
31	310	294	65.8	43	981
30	302	286	65.3	42	952
29	294	279	64.7	41	932
28	285	271	64.3	41	912
27	279	264	63.8	40	883
26	272	258	63.3	38	863
25	266	253	62.8	38	843
24	260	247	62.4	37	824
23	254	243	62.0	36	804
22	248	237	61.5	35	785
21	243	231	61.0	35	775
20	238	226	60.5	34	755
(18)	230	219	-	33	736
(16)	222	212	-	32	706
(14)	213	203	-	31	677
(12)	204	194	-	29	647
(10)	196	187	-	28	618
(8)	188	179	-	27	598
(6)	180	171	-	26	579
(4)	173	165	-	25	549
(2)	166	158	-	24	530
(0)	160	152	-	24	520

影響刀具操作的因素
Factors for End Mill Operation

因素 FACTOR	說明& 建議 INSTRUCTION AND ADVICE
機器的剛性 Rigidity of Machine	1. 使用對的機器 Use a right machine. 2. 根據機器的剛性去調整適合的切削數據 Adjust cutting conditions according to the rigidity of machine.
銑刀和筒夾的偏擺值 Collet Chuck and Run out of End Mill	1. 使用適合且準確的夾頭 Use a right and precise collet chuck. 2. 刀的偏擺值降到最低 Minimize the run out of end mill.
工作夾頭 Work Clamp	1. 需夾緊工件 Work piece must be firmly clamped. 2. 萬一工件沒夾緊,降低切削數據 In case work piece cannot be firmly clamped, relieve cutting condition.
切削液和排屑 Cutting Fluid and Chips	1. 足夠的切削液 Give a sufficient cutting fluid. 2. 建議在大量切削時要用水基性的切削液 Recommend water-base cutting fluid for heavy cutting. 3. 有些銑刀適用於乾式切削 Some end mills apply dry cutting only. 4. 在乾式切削時用吹風的方式 Use air blow for dry cutting. 5. 移除加工區的切屑 Remove chips from working area.
選刀 Selection of End Mill	1. 根據加工材質和大小選擇最適合的刀 Select most suitable end mills according to work material and dimension. 2. 參考前面的索引表 Refer to the index table on front page.
切削數據 Cutting Conditions	1. 參考切削數據表 Refer to recommend milling condition table. 2. 根據工件.機器剛性和夾具去做數據的調整 It is necessary to adjust conditions according to the machine rigidity and clamping condition of work piece.
刀具伸長量 Overhang of End Mill from tool holder	1. 刀柄夾持盡量越多好,刀具露出的部份盡可能少一點 Overhang of end mill must be as short as possible from tool holder. 2. 當刀柄夾持無法太深時,那就要放慢切削的速度 In case overhang cannot be shorten, relieve cutting condition.

銑刀操作故障排除
Troubleshooting for End Mill Operation

故障 SYMPTOMS OF TROUBLES	原因 CAUSE	解決 SOLUTION
加工時不正常異音 Chattering	· 主軸轉速過高 · 進給過多 · 有效長或銑刀過長 · 工件沒夾緊 · 切削刃磨損 · 筒夾偏擺過度	· 減少主軸速度 · 減少進給 · 調整有效長和刀具伸長量縮短 · 夾緊工件 · 換新刀具或修磨 · 調整夾具
刀具破損 Breakage of end mill	· 切深過深 · 容屑槽堵塞 · 每一刃進給過多 · 切削刃磨損	· 減少切深 · 調整冷卻液噴嘴到正確位置 · 減少每一刃進給 · 使用新刀具或修磨
刀具崩刃 Chipping of cutting edge	· 切深過深 · 進給過多 · 工件沒夾緊 · 主軸轉速過高 · 有效長或銑刀過長 · 切削刃磨損 · 切刃切屑溶融 · 過多切削液	· 減少切深 · 減少進給 · 夾緊工件 · 減少主軸速度 · 調整有效長和刀具伸長量縮短 · 使用新刀具或修磨 · 選擇適當鍍層 · 使用氣冷或是油霧
異常耗損 Abnormal wear	· 主軸轉速過高 · 刀具速度太低	· 減少主軸速度 · 增加速度
切屑堵塞 Clogging and Depositing	· 容屑槽堵塞 · 進給過多 · 切深過深 · 不對的刀刃數 · 刀具加工磨耗	· 調整冷卻液噴嘴到正確位置 · 減少進給 · 減少切深 · 使用刀刃數較少的刀具 · 使用新刀具或修磨
刀具偏轉 Deflection of end mill	· 進給過多 · 切深過深 · 有效長或銑刀過長 · 大螺旋角刀刃	· 減少進給 · 減少切深 · 調整有效長和刀具伸長量縮短 · 使用小螺旋角刀刃
表面有毛刺 Burr on finished surface	· 刀具加工磨損 · 刀具螺旋角太小 · 切深過深	· 使用新刀具或修磨 · 使用更小螺旋角的刀具 · 減少切深
表面粗糙度差 Poor surface roughness	· 刀具加工磨損 · 切屑咬勾 · 進給過多 · 有效長或銑刀過長 · 主軸轉速太慢 · 表面切削不一 · 筒夾偏擺過度	· 使用新刀具或修磨 · 使用冷卻液 · 減少進給 · 調整有效長和刀具伸長量縮短 · 增加速度 · 改善中胚加工 · 調整筒夾偏擺
加工精度差 Poor machining accuracy	· 過熱主軸不穩定 · 表面切削不一 · 進給過多 · 筒夾偏擺過度	· 生產前先暖機 · 改善中胚加工 · 減少進給 · 調整筒夾偏擺

TROUBLESHOOTING FOR END MILL OPERATION

Symptoms of troubles	Cause	Solution
Chattering	· Excessive spindle speed · Excessive feed · Excessive long of effective length or overhang of end mill · Work piece is not firmly clamped · Wear of cutting edge progressed · Excessive chucking runout	· Reduce spindle speed · Reduce feed · Adjust effective length and overhang as short as possible · Clamped work piece firmly · Use new end mill or regrind · Adjust chucking runout
Breakage of end mill	· Excessive depth of cut · Chips clogged · Excessive feed per tooth · Wear of cutting edge progressed	· Reduce depth of cut · Adjust coolant nozzle to right direction to disposed · Reduce feed per tooth · Use new end mill or regrind
Chipping of cutting edge	· Excessive depth of cut · Excessive feed · Work piece is not firmly clamped · Excessive spindle speed · Excessive long of effective length or overhang of end mill · Wear of cutting edge progressed · Bulit up edge · Excessive cooling	· Reduce depth of cut · Reduce feed · Clamped work piece firmly · Reduce spindle speed · Adjust effective length and overhang as short as possible · Use new end mill or regrind · Choose appropriate coating · Use air blow or oil mist
Abnormal wear	· Excessive spindle speed · Tool of low feed	· Reduce spindle speed · Increase feed
Clogging and Depositing	· Chips are not well disposed · Excessive feed · Excessive depth of cut · Inappropriate number of flutes · Wear of cutting edge progressed	· Adjust coolant nozzle to right direction to dispose chips · Reduce feed · Reduce depth of cut · Use fewer flutes end mill · Use new end mill or regrind
Deflection of end mill	· Excessive feed · Excessive depth of cut · Excessive long of effective length or overhang of end mill · Large helix angle of flutes	· Reduce feed · Reduce depth of cut · Adjust effective length and overhang as short as possible · Use smaller helix angle
Burr on finished surface	· Wear of cutting edge progressed · Small helix angle of flutes · Excessive depth of cut	· Use new end mill or regrind · Use smaller helix angle · Reduce depth of cut
Poor surface roughness	· Wear of cutting edge progressed · Chips bite · Excessive feed · Excessive long of effective length or overhang of end mill · Too low spindle speed · Stock removals vary for finishing · Excessive chucking runout	· Use new end mill or regrind · Use coolant to remove chips · Reduce feed · Adjust effective length and overhang as short as possible · Increase spindle speed · Improve semi-finishing process · Adjust chucking runout
Poor machining accuracy	· Inconsistent thermal extention of spindle · Stock removals vary for finishing · Excessive feed · Excessive chucking runout	· Warm up spindle by idling before staring operation · Improve semi-finishing process · Reduce feed · Adjust chucking runout