

Cutting Conditions (Guide) :

● : Stable Cutting ● : General Cutting ✖ : Unstable Cutting

Chip Breaker Recommendation

Chip Breaker Selection Table

Workpiece Material	Properties	Cutting Conditions	Chip Breaker		Grade		
			1st Recommended	2nd Recommended	1st Recommended	2nd Recommended	
P	Mild Steels	Hardness ≤180HB	● ●	L	M	MP6120	VP15TF
			● ✖	M	L	MP6130	—
	Carbon Steels Alloy Steels Alloy Tool Steels	Hardness 180-350HB ≤350HB (Annealing)	● ●	L	M	MP6120	VP15TF
			● ●	M	L	MP6120	VP15TF
			● ✖	M	L	MP6130	—
	Pre-hardened Steels	Hardness 35-45HRC	● ●	M	L	MP6120	VP15TF
● ✖			M	L	MP6130	—	
M	Austenitic Stainless Steels	Hardness ≤280HB	● ●	L	M	MP7130	VP15TF
			● ✖	M	L	MP7130	—
		Hardness >200HB	● ●	L	M	MP7130	VP15TF
			● ✖	M	L	MP7130	—
	Duplex Stainless Steels	Hardness ≤280HB	● ●	L	M	MP7130	VP15TF
			● ✖	M	L	MP7130	—
	Ferritic and Martensitic Stainless Steels	—	● ●	L	M	MP7130	VP15TF
			● ✖	M	L	MP7130	—
	Precipitation Hardening Stainless Steels	Hardness <450HB	● ●	L	M	MP7130	VP15TF
			● ✖	M	L	MP7130	—
K	Gray Cast Irons	Tensile Strength ≤350MPa	● ●	M	L	MC5020	VP15TF
			● ✖	M	L	VP15TF	—
	Ductile Cast Irons	Tensile Strength ≤800MPa	● ●	M	L	MC5020	VP15TF
			● ✖	M	L	VP15TF	—
N	Aluminium Alloys	Content Si <5%	● ●	L	M	TF15	—
			● ✖	M	L	TF15	—
S	Titanium Alloys (Ti-6Al-4V, etc.)	—	● ●	L	M	MP9120	VP15TF
			● ✖	M	L	MP9130	—
	Titanium Alloys (Ti-5Al-5V-5Mo-3Cr, etc.)	—	● ●	L	M	MP9120	VP15TF
			● ✖	M	L	MP9130	—
	Heat Resistant Alloys	—	● ●	M	L	MP9120	VP15TF
			● ✖	M	L	MP9130	—
H	Hardened Steels	Hardness 40-55HRC	● ● ✖	M	—	VP15TF	—

Recommended Cutting Conditions

■ Dry Cutting Cutting Speed

(mm)

Workpiece Material	Properties	Cutting Conditions	Grade	ae				
				≤0.25DC	0.25—0.5DC	0.5—0.75DC	DC(Slot)	
				vc (m/min)				
P Mild Steels	Hardness ≤180HB	● ●	MP6120,VP15TF	230 (180—270)	220 (170—260)	180 (140—210)	180 (140—210)	
		● ● ✦	MP6130	200 (150—240)	190 (140—230)	150 (110—180)	150 (110—180)	
Carbon Steels Alloy Steels Alloy Tool Steels	Hardness 180—350HB ≤350HB (Annealing)	● ●	MP6120,VP15TF	180 (140—210)	170 (130—200)	140 (110—160)	140 (110—160)	
		● ● ✦	MP6130	150 (110—180)	140 (100—170)	110 (80—130)	110 (80—130)	
Pre-hardened Steels	Hardness 35—45HRC	● ●	MP6120,VP15TF	120 (90—140)	110 (80—130)	100 (70—120)	100 (70—120)	
		● ● ✦	MP6130	100 (80—120)	90 (70—110)	80 (60—100)	80 (60—100)	
M Austenitic Stainless Steels	Hardness ≤200HB	● ● ✦	MP7130,VP15TF	180 (140—210)	170 (130—200)	140 (110—160)	140 (110—160)	
	Hardness >200HB	● ● ✦	MP7130,VP15TF	150 (110—180)	140 (100—160)	110 (80—130)	110 (80—130)	
	Duplex Stainless Steels	Hardness ≤280HB	● ● ✦	MP7130,VP15TF	140 (110—170)	130 (90—150)	100 (70—120)	100 (70—120)
			● ● ✦	MP7130,VP15TF	180 (140—210)	170 (130—200)	140 (110—160)	140 (110—160)
			● ● ✦	MP7130,VP15TF	130 (100—160)	120 (80—140)	90 (60—110)	90 (60—110)
Ferritic and Martensitic Stainless Steels	—	● ● ✦	MP7130,VP15TF	180 (140—210)	170 (130—200)	140 (110—160)	140 (110—160)	
K Gray Cast Irons	Tensile Strength ≤350MPa	● ●	MC5020	250 (200—300)	240 (190—290)	210 (160—260)	210 (160—260)	
		● ● ✦	VP15TF	200 (150—250)	190 (140—240)	160 (110—210)	160 (110—210)	
Ductile Cast Irons	Tensile Strength ≤800MPa	● ●	MC5020	180 (150—200)	170 (140—190)	150 (120—170)	150 (120—170)	
		● ● ✦	VP15TF	130 (100—150)	120 (90—140)	100 (80—120)	100 (80—120)	
N Aluminium Alloys	Content Si<5%	● ● ✦	TF15	600 (400—1000)	600 (400—1000)	600 (400—1000)	600 (400—1000)	
H Hardened Steels	Hardness 40—55HRC	● ● ✦	VP15TF	90 (70—100)	85 (60—100)	70 (50—80)	70 (50—80)	

Note 1) These cutting conditions should be referenced for standard shank types (last letter in designation is S) and arbor shank types. If there is chatter, insert chipping, etc. during machining, alter conditions accordingly.

Note 2) Chattering vibration is more likely under the following circumstances. Use a cut and feed per tooth that are at minimum recommended conditions or below.

- When tool overhang is long (using a long shank, screw-in type, etc.)
- Rigidity of machine, workpiece material or attachment of workpiece material is low
- Corner radius during pocket milling

Note 3) A type with fewer teeth is recommended when the depth of cut in the radius direction (ae) is 0.5 DC or more.

Note 4) Wet cutting is recommended, when focusing on the surface finish. (Service life is shorter than for dry cutting.)

Note 5) When using under higher than recommended cutting conditions, or for long periods of time, the clamp screw may become fatigued and break during machining. Please change out the clamp screw periodically.

Depth of Cut / Feed per Tooth

(mm)

Workpiece Material	Properties	ae	Cutting Conditions	DC					
				ø16—ø18		ø20—ø25		ø28—ø63	
				ap	fz (mm/t.)	ap	fz (mm/t.)	ap	fz (mm/t.)
P Mild Steels	Hardness ≤180HB	≤0.25DC	● ● ✦	≤6	0.10—0.15	≤8	0.10—0.20	≤8	0.10—0.25
		0.25—0.5DC	● ● ✦	≤5	0.08—0.12	≤8	0.10—0.15	≤8	0.10—0.20
		0.5—0.75DC	● ● ✦	≤4	0.08—0.12	≤6	0.08—0.12	≤6	0.10—0.15
		DC(Slot)	● ● ✦	≤2	0.06—0.10	≤4	0.06—0.10	≤4	0.08—0.12
Carbon Steels Alloy Steels Alloy Tool Steels	Hardness 180—280HB	≤0.25DC	● ● ✦	≤6	0.10—0.15	≤8	0.10—0.20	≤8	0.10—0.25
		0.25—0.5DC	● ● ✦	≤5	0.08—0.12	≤8	0.10—0.15	≤8	0.10—0.20
		0.5—0.75DC	● ● ✦	≤4	0.08—0.12	≤6	0.08—0.12	≤6	0.10—0.15
		DC(Slot)	● ● ✦	≤2	0.06—0.10	≤4	0.06—0.10	≤4	0.08—0.12
Carbon Steels Alloy Steels Alloy Tool Steels	Hardness 280—350HB ≤350HB (Annealing)	≤0.25DC	● ● ✦	≤6	0.10—0.15	≤8	0.10—0.15	≤8	0.10—0.20
		0.25—0.5DC	● ● ✦	≤5	0.08—0.12	≤8	0.08—0.12	≤8	0.10—0.15
		0.5—0.75DC	● ● ✦	≤4	0.08—0.12	≤6	0.06—0.10	≤6	0.08—0.12
		DC(Slot)	● ● ✦	≤2	0.06—0.10	≤4	0.06—0.10	≤4	0.05—0.10
Pre-hardened Steels	Hardness 35—45HRC	≤0.25DC	● ● ✦	≤6	0.10—0.15	≤8	0.10—0.15	≤8	0.10—0.20
		0.25—0.5DC	● ● ✦	≤5	0.08—0.12	≤8	0.08—0.12	≤8	0.10—0.15
		0.5—0.75DC	● ● ✦	≤4	0.08—0.12	≤6	0.06—0.10	≤6	0.08—0.12
		DC(Slot)	● ● ✦	≤2	0.06—0.10	≤4	0.06—0.10	≤4	0.06—0.10

Cutting Conditions (Guide) :

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Depth of Cut / Feed per Tooth

(mm)

Workpiece Material	Properties	ae	Cutting Conditions	DC						
				ø16-ø18		ø20-ø25		ø28-ø63		
				ap	fz (mm/t.)	ap	fz (mm/t.)	ap	fz (mm/t.)	
M	Austenitic Stainless Steels	≤0.25DC	● ●	≤6	0.10-0.15	≤8	0.10-0.20	≤8	0.10-0.20	
			● ● ✖	≤6	0.08-0.12	≤8	0.08-0.15	≤8	0.08-0.15	
		0.25-0.5DC	● ●	≤5	0.08-0.12	≤8	0.08-0.15	≤8	0.08-0.15	
			● ● ✖	≤5	0.06-0.10	≤8	0.08-0.12	≤8	0.08-0.12	
	0.5-0.75DC	● ●	≤4	0.06-0.10	≤6	0.08-0.12	≤6	0.08-0.12		
		● ● ✖	≤4	0.06-0.08	≤6	0.06-0.10	≤6	0.06-0.10		
	DC(Slot)	● ●	≤2	0.06-0.10	≤4	0.06-0.10	≤4	0.06-0.10		
		● ● ✖	≤2	0.06-0.08	≤4	0.06-0.08	≤4	0.06-0.08		
	Duplex Stainless Steels	Hardness ≤280HB	≤0.25DC	● ●	≤6	0.10-0.15	≤8	0.10-0.20	≤8	0.10-0.20
				● ● ✖	≤6	0.08-0.12	≤8	0.08-0.15	≤8	0.08-0.15
			0.25-0.5DC	● ●	≤5	0.08-0.12	≤8	0.08-0.15	≤8	0.08-0.15
				● ● ✖	≤5	0.06-0.10	≤8	0.08-0.12	≤8	0.08-0.12
0.5-0.75DC	● ●	≤4	0.06-0.10	≤6	0.08-0.12	≤6	0.08-0.12			
	● ● ✖	≤4	0.06-0.08	≤6	0.06-0.10	≤6	0.06-0.10			
DC(Slot)	● ●	≤2	0.06-0.10	≤4	0.06-0.10	≤4	0.06-0.10			
	● ● ✖	≤2	0.06-0.08	≤4	0.06-0.08	≤4	0.06-0.08			
Ferritic and Martensitic Stainless Steels	-	≤0.25DC	● ●	≤6	0.10-0.15	≤8	0.10-0.20	≤8	0.10-0.20	
			● ● ✖	≤6	0.08-0.12	≤8	0.08-0.15	≤8	0.08-0.15	
		0.25-0.5DC	● ●	≤5	0.08-0.12	≤8	0.08-0.15	≤8	0.08-0.15	
			● ● ✖	≤5	0.06-0.10	≤8	0.08-0.12	≤8	0.08-0.12	
0.5-0.75DC	● ●	≤4	0.06-0.10	≤6	0.08-0.12	≤6	0.08-0.12			
	● ● ✖	≤4	0.06-0.08	≤6	0.06-0.10	≤6	0.06-0.10			
DC(Slot)	● ●	≤2	0.06-0.10	≤4	0.06-0.10	≤4	0.06-0.10			
	● ● ✖	≤2	0.06-0.08	≤4	0.06-0.08	≤4	0.06-0.08			
Precipitation Hardening Stainless Steels	Hardness <450HB	≤0.25DC	● ●	≤6	0.10-0.15	≤8	0.10-0.15	≤8	0.10-0.15	
			● ● ✖	≤6	0.08-0.12	≤8	0.08-0.12	≤8	0.08-0.12	
		0.25-0.5DC	● ●	≤5	0.08-0.12	≤8	0.08-0.12	≤8	0.08-0.12	
			● ● ✖	≤5	0.06-0.10	≤8	0.08-0.12	≤8	0.08-0.12	
0.5-0.75DC	● ●	≤4	0.06-0.10	≤6	0.06-0.10	≤6	0.06-0.10			
	● ● ✖	≤4	0.06-0.08	≤6	0.06-0.08	≤6	0.06-0.08			
DC(Slot)	● ●	≤2	0.06-0.10	≤4	0.06-0.10	≤4	0.06-0.10			
	● ● ✖	≤2	0.06-0.08	≤4	0.06-0.08	≤4	0.06-0.08			
K	Gray Cast Irons	≤0.25DC	● ●	≤6	0.10-0.15	≤8	0.10-0.20	≤8	0.10-0.25	
			● ● ✖	≤6	0.08-0.12	≤8	0.08-0.15	≤8	0.10-0.20	
		0.25-0.5DC	● ●	≤5	0.08-0.12	≤8	0.08-0.15	≤8	0.10-0.20	
			● ● ✖	≤5	0.06-0.10	≤8	0.08-0.12	≤8	0.10-0.15	
	0.5-0.75DC	● ●	≤4	0.08-0.12	≤6	0.08-0.12	≤6	0.10-0.15		
		● ● ✖	≤4	0.08-0.12	≤6	0.06-0.10	≤6	0.08-0.12		
	DC(Slot)	● ●	≤2	0.06-0.10	≤4	0.06-0.10	≤4	0.08-0.15		
		● ● ✖	≤2	0.06-0.08	≤4	0.06-0.08	≤4	0.08-0.10		
Ductile Cast Irons	Tensile Strength ≤800MPa	≤0.25DC	● ●	≤6	0.10-0.15	≤8	0.10-0.20	≤8	0.10-0.20	
			● ● ✖	≤6	0.08-0.12	≤8	0.10-0.15	≤8	0.10-0.15	
		0.25-0.5DC	● ●	≤5	0.08-0.12	≤8	0.10-0.15	≤8	0.10-0.15	
			● ● ✖	≤5	0.06-0.10	≤8	0.08-0.12	≤8	0.08-0.12	
0.5-0.75DC	● ●	≤4	0.08-0.12	≤6	0.08-0.12	≤6	0.08-0.12			
	● ● ✖	≤4	0.08-0.12	≤6	0.06-0.10	≤6	0.06-0.10			
DC(Slot)	● ●	≤2	0.06-0.10	≤4	0.06-0.10	≤4	0.06-0.10			
	● ● ✖	≤2	0.06-0.08	≤4	0.06-0.08	≤4	0.06-0.08			
N	Aluminium Alloys	≤0.25DC	● ●	≤6	0.10-0.20	≤8	0.10-0.25	≤8	0.10-0.25	
			● ● ✖	≤6	0.10-0.15	≤8	0.10-0.20	≤8	0.10-0.20	
		0.25-0.5DC	● ●	≤5	0.10-0.15	≤8	0.10-0.20	≤8	0.10-0.20	
			● ● ✖	≤5	0.08-0.12	≤8	0.10-0.15	≤8	0.10-0.15	
0.5-0.75DC	● ●	≤4	0.08-0.12	≤6	0.06-0.15	≤6	0.08-0.15			
	● ● ✖	≤4	0.06-0.10	≤6	0.06-0.15	≤6	0.08-0.15			
DC(Slot)	● ●	≤2	0.06-0.10	≤4	0.06-0.15	≤4	0.08-0.15			
	● ● ✖	≤2	0.06-0.08	≤4	0.06-0.12	≤4	0.08-0.12			
H	Hardened Steels	≤0.25DC	● ●	≤4	0.08-0.15	≤4	0.08-0.15	≤4	0.08-0.15	
			● ● ✖	≤4	0.08-0.12	≤4	0.08-0.12	≤4	0.08-0.12	
		0.25-0.5DC	● ●	≤3	0.08-0.12	≤3	0.08-0.12	≤3	0.08-0.12	
			● ● ✖	≤3	0.06-0.10	≤3	0.08-0.10	≤3	0.06-0.10	
0.5-0.75DC	● ●	≤2	0.06-0.10	≤2	0.08-0.10	≤2	0.06-0.10			
	● ● ✖	≤2	0.06-0.08	≤2	0.06-0.08	≤2	0.06-0.08			
DC(Slot)	● ●	≤1	0.06-0.10	≤1	0.06-0.10	≤1	0.06-0.10			
	● ● ✖	≤1	0.06-0.08	≤1	0.06-0.08	≤1	0.06-0.08			

Note 1) These cutting conditions should be referenced for standard shank types (last letter in designation is S) and arbor shank types. If there is chatter, insert chipping, etc. during machining, alter conditions accordingly.

Note 2) Chattering vibration is more likely under the following circumstances. Use a cut and feed per tooth that are at minimum recommended conditions or below.

- When tool overhang is long (using a long shank, screw-in type, etc.)
- Rigidity of machine, workpiece material or attachment of workpiece material is low
- Corner radius during pocket milling

Note 3) A type with fewer teeth is recommended when the depth of cut in the radius direction (ae) is 0.5 DC or more.

Note 4) Wet cutting is recommended, when focusing on the surface finish. (Service life is shorter than for dry cutting.)

Note 5) When using under higher than recommended cutting conditions, or for long periods of time, the clamp screw may become fatigued and break during machining. Please change out the clamp screw periodically.

Recommended Cutting Conditions

Wet Cutting Cutting Speed

(mm)

Workpiece Material	Properties	Cutting Conditions	Grade	ae				
				≤0.25DC	0.25—0.5DC	0.5—0.75DC	DC(Slot)	
				vc (m/min)				
P	Mild Steels	Hardness ≤180HB	● ● ✖	MP6120 MP6130 VP15TF	140 (100—190)	130 (90—180)	100 (70—120)	100 (70—120)
	Carbon Steels Alloy Steels Alloy Tool Steels	Hardness 180—350HB ≤350HB (Annealing)	● ● ✖	MP6120 MP6130 VP15TF	120 (90—140)	110 (80—130)	100 (70—120)	100 (70—120)
	Pre-hardened Steels	Hardness 35—45HRC	● ● ✖	MP6120 MP6130 VP15TF	100 (80—120)	90 (70—110)	80 (60—100)	80 (60—100)
M	Austenitic Stainless Steels	Hardness ≤200HB	● ● ✖	MP7130,VP15TF	120 (100—150)	110 (90—140)	90 (70—120)	90 (70—120)
		Hardness >200HB	● ● ✖	MP7130,VP15TF	100 (80—130)	90 (70—110)	70 (50—100)	70 (50—100)
	Duplex Stainless Steels	Hardness ≤280HB	● ● ✖	MP7130,VP15TF	100 (80—130)	90 (70—120)	70 (50—100)	70 (50—100)
	Ferritic and Martensitic Stainless Steels	—	● ● ✖	MP7130,VP15TF	120 (100—150)	110 (90—140)	90 (70—120)	90 (70—120)
	Precipitation Hardening Stainless Steels	Hardness <450HB	● ● ✖	MP7130,VP15TF	90 (70—120)	80 (60—110)	60 (40—90)	60 (40—90)
K	Gray Cast Irons	Tensile Strength ≤350MPa	● ● ✖	MC5020	180 (160—220)	170 (150—210)	150 (130—190)	150 (130—190)
			● ● ✖	VP15TF	130 (100—150)	120 (90—140)	100 (80—120)	100 (80—120)
	Ductile Cast Irons	Tensile Strength ≤800MPa	● ● ✖	MC5020	160 (140—180)	150 (130—170)	130 (110—150)	130 (110—150)
			● ● ✖	VP15TF	110 (80—140)	100 (70—130)	80 (60—120)	80 (60—120)
N	Aluminium Alloys	Content Si <5%	● ● ✖	TF15	600 (400—1000)	600 (400—1000)	600 (400—1000)	600 (400—1000)
S	Titanium Alloys (Ti-6Al-4V, etc.)	—	● ● ✖	MP9120,VP15TF	50 (40—70)	50 (40—70)	50 (40—70)	50 (40—70)
			● ● ✖	MP9130	40 (30—60)	40 (30—60)	40 (30—60)	40 (30—60)
	Titanium Alloys (Ti-5Al-5V-5Mo-3Cr, etc.)	—	● ● ✖	MP9120 MP9130 VP15TF	30 (20—40)	30 (20—40)	30 (20—40)	30 (20—40)
	Heat Resistant Alloys	—	● ● ✖	MP9120,VP15TF	40 (30—60)	40 (30—60)	40 (30—60)	40 (30—60)
		● ● ✖	MP9130	30 (20—40)	30 (20—40)	30 (20—40)	30 (20—40)	
H	Hardened Steels	Hardness 40—55HRC	● ● ✖	VP15TF	90 (70—100)	85 (60—100)	70 (50—80)	70 (50—80)

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- Rigidity of machine, workpiece material or attachment of workpiece material is low
- Corner radius during pocket milling

Note 3) A type with fewer teeth is recommended when the depth of cut in the radius direction (ae) is 0.5 DC or more.

Note 4) Wet cutting is recommended, when focusing on the surface finish. (Service life is shorter than for dry cutting.)

Note 5) When using under higher than recommended cutting conditions, or for long periods of time, the clamp screw may become fatigued and break during machining. Please change out the clamp screw periodically.

Cutting Conditions (Guide) :

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Depth of Cut / Feed per Tooth

(mm)

Workpiece Material	Properties	ae	Cutting Conditions	DC						
				ø16-ø18		ø20-ø25		ø28-ø63		
				ap	fz (mm/t.)	ap	fz (mm/t.)	ap	fz (mm/t.)	
P	Mild Steels	≤0.25DC	● ● ✖	≤6	0.10-0.15	≤8	0.10-0.20	≤8	0.10-0.25	
		0.25-0.5DC	● ● ✖	≤5	0.10-0.15	≤8	0.10-0.15	≤8	0.10-0.20	
		0.5-0.75DC	● ● ✖	≤4	0.08-0.12	≤6	0.08-0.12	≤6	0.10-0.15	
		DC(Slot)	● ● ✖	≤2	0.06-0.10	≤4	0.06-0.10	≤4	0.08-0.12	
	Carbon Steels Alloy Steels Alloy Tool Steels	Hardness 180-280HB	≤0.25DC	● ● ✖	≤6	0.10-0.15	≤8	0.10-0.20	≤8	0.10-0.25
			0.25-0.5DC	● ● ✖	≤5	0.08-0.12	≤8	0.10-0.15	≤8	0.10-0.20
			0.5-0.75DC	● ● ✖	≤4	0.08-0.12	≤6	0.08-0.12	≤6	0.10-0.15
			DC(Slot)	● ● ✖	≤2	0.06-0.10	≤4	0.06-0.10	≤4	0.08-0.12
	Carbon Steels Alloy Steels Alloy Tool Steels	Hardness 280-350HB ≤350HB (Annealing)	≤0.25DC	● ● ✖	≤6	0.10-0.15	≤8	0.10-0.15	≤8	0.10-0.20
			0.25-0.5DC	● ● ✖	≤5	0.08-0.12	≤8	0.08-0.12	≤8	0.10-0.15
			0.5-0.75DC	● ● ✖	≤4	0.08-0.12	≤6	0.06-0.10	≤6	0.08-0.12
			DC(Slot)	● ● ✖	≤2	0.06-0.10	≤4	0.06-0.10	≤4	0.06-0.10
Pre-hardened Steels	Hardness 35-45HRC	≤0.25DC	● ● ✖	≤6	0.10-0.15	≤8	0.10-0.15	≤8	0.10-0.20	
		0.25-0.5DC	● ● ✖	≤5	0.08-0.12	≤8	0.08-0.12	≤8	0.10-0.15	
		0.5-0.75DC	● ● ✖	≤4	0.08-0.12	≤6	0.06-0.10	≤6	0.08-0.12	
		DC(Slot)	● ● ✖	≤2	0.06-0.10	≤4	0.06-0.10	≤4	0.06-0.10	
M	Austenitic Stainless Steels	-	≤0.25DC	● ● ✖	≤6	0.10-0.15	≤8	0.10-0.20	≤8	0.10-0.20
			0.25-0.5DC	● ● ✖	≤5	0.08-0.12	≤8	0.08-0.15	≤8	0.08-0.15
			0.5-0.75DC	● ● ✖	≤4	0.06-0.10	≤6	0.08-0.12	≤6	0.08-0.12
			DC(Slot)	● ● ✖	≤2	0.06-0.10	≤4	0.06-0.10	≤4	0.06-0.10
	Duplex Stainless Steels	Hardness ≤280HB	≤0.25DC	● ● ✖	≤6	0.10-0.15	≤8	0.10-0.20	≤8	0.10-0.20
			0.25-0.5DC	● ● ✖	≤5	0.08-0.12	≤8	0.08-0.15	≤8	0.08-0.12
			0.5-0.75DC	● ● ✖	≤4	0.06-0.10	≤6	0.08-0.12	≤6	0.08-0.12
			DC(Slot)	● ● ✖	≤2	0.06-0.10	≤4	0.06-0.10	≤4	0.06-0.10
	Ferritic and Martensitic Stainless Steels	-	≤0.25DC	● ● ✖	≤6	0.10-0.15	≤8	0.10-0.20	≤8	0.10-0.20
			0.25-0.5DC	● ● ✖	≤5	0.08-0.12	≤8	0.08-0.15	≤8	0.08-0.15
			0.5-0.75DC	● ● ✖	≤4	0.06-0.10	≤6	0.08-0.12	≤6	0.08-0.12
			DC(Slot)	● ● ✖	≤2	0.06-0.10	≤4	0.06-0.10	≤4	0.05-0.10
Precipitation Hardening Stainless Steels	Hardness <450HB	≤0.25DC	● ● ✖	≤6	0.10-0.15	≤8	0.10-0.15	≤8	0.10-0.15	
		0.25-0.5DC	● ● ✖	≤5	0.08-0.12	≤8	0.08-0.12	≤8	0.08-0.12	
		0.5-0.75DC	● ● ✖	≤4	0.06-0.10	≤6	0.06-0.10	≤6	0.05-0.10	
		DC(Slot)	● ● ✖	≤2	0.06-0.10	≤4	0.06-0.10	≤4	0.05-0.10	
K	Gray Cast Irons	Tensile Strength ≤350MPa	≤0.25DC	● ● ✖	≤6	0.10-0.15	≤8	0.10-0.20	≤8	0.10-0.25
			0.25-0.5DC	● ● ✖	≤5	0.08-0.12	≤8	0.08-0.15	≤8	0.10-0.20
			0.5-0.75DC	● ● ✖	≤4	0.08-0.12	≤6	0.06-0.10	≤6	0.10-0.15
			DC(Slot)	● ● ✖	≤2	0.06-0.10	≤4	0.06-0.10	≤4	0.08-0.15
	Ductile Cast Irons	Tensile Strength ≤800MPa	≤0.25DC	● ● ✖	≤6	0.10-0.15	≤8	0.10-0.20	≤8	0.10-0.20
			0.25-0.5DC	● ● ✖	≤5	0.08-0.12	≤8	0.10-0.15	≤8	0.10-0.15
			0.5-0.75DC	● ● ✖	≤4	0.08-0.12	≤6	0.08-0.12	≤6	0.08-0.12
			DC(Slot)	● ● ✖	≤2	0.06-0.10	≤4	0.06-0.10	≤4	0.06-0.10

Note 1) These cutting conditions should be referenced for standard shank types (last letter in designation is S) and arbor shank types. If there is chatter, insert chipping, etc. during machining, alter conditions accordingly.

Note 2) Chattering vibration is more likely under the following circumstances. Use a cut and feed per tooth that are at minimum recommended conditions or below.

- When tool overhang is long (using a long shank, screw-in type, etc.)
- Rigidity of machine, workpiece material or attachment of workpiece material is low
- Corner radius during pocket milling

Note 3) A type with fewer teeth is recommended when the depth of cut in the radius direction (ae) is 0.5 DC or more.

Note 4) Wet cutting is recommended, when focusing on the surface finish. (Service life is shorter than for dry cutting.)

Note 5) When using under higher than recommended cutting conditions, or for long periods of time, the clamp screw may become fatigued and break during machining. Please change out the clamp screw periodically.

Recommended Cutting Conditions

Cutting Conditions (Guide) :

● : Stable Cutting ● : General Cutting ✖ : Unstable Cutting

Wet Cutting

Depth of Cut / Feed per Tooth

(mm)

Workpiece Material	Properties	ae	Cutting Conditions	DC						
				ø16-ø18		ø20-ø25		ø28-ø63		
				ap	fz (mm/t.)	ap	fz (mm/t.)	ap	fz (mm/t.)	
N Aluminium Alloys	Content Si < 5%	≤ 0.25DC	● ● ✖	≤ 6	0.10-0.20	≤ 8	0.10-0.25	≤ 8	0.10-0.25	
		0.25-0.5DC	● ● ✖	≤ 6	0.10-0.15	≤ 8	0.10-0.20	≤ 8	0.10-0.20	
		0.25-0.5DC	● ● ✖	≤ 5	0.10-0.15	≤ 8	0.10-0.20	≤ 8	0.10-0.20	
		0.5-0.75DC	● ● ✖	≤ 5	0.08-0.12	≤ 8	0.10-0.15	≤ 8	0.10-0.15	
		0.5-0.75DC	● ● ✖	≤ 4	0.08-0.12	≤ 6	0.06-0.15	≤ 6	0.08-0.15	
		DC(Slot)	● ● ✖	≤ 4	0.06-0.10	≤ 6	0.06-0.15	≤ 6	0.08-0.15	
		DC(Slot)	● ● ✖	≤ 2	0.06-0.10	≤ 4	0.06-0.15	≤ 4	0.08-0.15	
		DC(Slot)	● ● ✖	≤ 2	0.06-0.08	≤ 4	0.06-0.12	≤ 4	0.08-0.12	
S Titanium Alloys (Ti-6Al-4V, etc.) Titanium Alloys (Ti-5Al-5V-5Mo-3Cr, etc.) Heat Resistant Alloys	-	≤ 0.25DC	● ● ✖	≤ 6	0.08-0.15	≤ 8	0.08-0.15	≤ 8	0.08-0.15	
		0.25-0.5DC	● ● ✖	≤ 5	0.08-0.12	≤ 8	0.08-0.12	≤ 8	0.08-0.12	
		0.5-0.75DC	● ● ✖	≤ 4	0.06-0.10	≤ 6	0.06-0.10	≤ 6	0.06-0.10	
		DC(Slot)	● ● ✖	≤ 2	0.06-0.10	≤ 4	0.06-0.10	≤ 4	0.06-0.10	
	-	≤ 0.25DC	● ● ✖	≤ 6	0.08-0.12	≤ 8	0.08-0.12	≤ 8	0.08-0.12	
		0.25-0.5DC	● ● ✖	≤ 5	0.08-0.12	≤ 8	0.08-0.12	≤ 8	0.08-0.12	
		0.5-0.75DC	● ● ✖	≤ 4	0.06-0.10	≤ 6	0.06-0.10	≤ 6	0.06-0.10	
		DC(Slot)	● ● ✖	≤ 2	0.06-0.10	≤ 4	0.06-0.10	≤ 4	0.06-0.10	
	-	≤ 0.25DC	● ● ✖	≤ 6	0.08-0.12	≤ 8	0.08-0.12	≤ 8	0.08-0.12	
		0.25-0.5DC	● ● ✖	≤ 5	0.08-0.12	≤ 8	0.08-0.12	≤ 8	0.08-0.12	
		0.5-0.75DC	● ● ✖	≤ 4	0.06-0.10	≤ 6	0.06-0.10	≤ 6	0.06-0.10	
		DC(Slot)	● ● ✖	≤ 2	0.06-0.10	≤ 4	0.06-0.10	≤ 4	0.06-0.10	
H Hardened Steels	Hardness 40-55HRC	≤ 0.25DC	● ● ✖	≤ 4	0.08-0.15	≤ 4	0.08-0.15	≤ 4	0.08-0.15	
		0.25-0.5DC	● ● ✖	≤ 4	0.08-0.12	≤ 4	0.08-0.12	≤ 4	0.08-0.12	
		0.25-0.5DC	● ● ✖	≤ 3	0.08-0.12	≤ 3	0.08-0.12	≤ 3	0.08-0.12	
		0.25-0.5DC	● ● ✖	≤ 3	0.06-0.10	≤ 3	0.06-0.10	≤ 3	0.06-0.10	
		0.5-0.75DC	● ● ✖	≤ 2	0.06-0.10	≤ 2	0.06-0.10	≤ 2	0.06-0.10	
		0.5-0.75DC	● ● ✖	≤ 2	0.06-0.10	≤ 2	0.06-0.10	≤ 2	0.06-0.10	
		0.5-0.75DC	● ● ✖	≤ 2	0.06-0.10	≤ 2	0.06-0.10	≤ 2	0.06-0.10	
		DC(Slot)	● ● ✖	≤ 1	0.06-0.10	≤ 1	0.06-0.10	≤ 1	0.06-0.10	
			DC(Slot)	● ● ✖	≤ 1	0.06-0.10	≤ 1	0.06-0.10	≤ 1	0.06-0.10
			DC(Slot)	● ● ✖	≤ 1	0.06-0.10	≤ 1	0.06-0.10	≤ 1	0.06-0.10
			DC(Slot)	● ● ✖	≤ 1	0.06-0.10	≤ 1	0.06-0.10	≤ 1	0.06-0.10

Note 1) These cutting conditions should be referenced for standard shank types (last letter in designation is S) and arbor shank types. If there is chatter, insert chipping, etc. during machining, alter conditions accordingly.

Note 2) Chattering vibration is more likely under the following circumstances. Use a cut and feed per tooth that are at minimum recommended conditions or below.

- When tool overhang is long (using a long shank, screw-in type, etc.)
- Rigidity of machine, workpiece material or attachment of workpiece material is low
- Corner radius during pocket milling

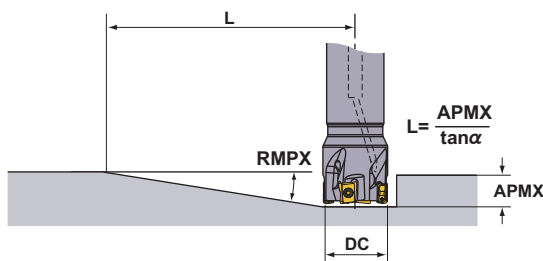
Note 3) A type with fewer teeth is recommended when the depth of cut in the radius direction (ae) is 0.5 DC or more.

Note 4) Wet cutting is recommended, when focusing on the surface finish. (Service life is shorter than for dry cutting.)

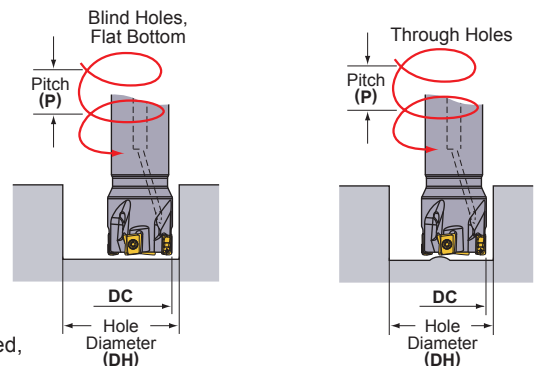
Note 5) When using under higher than recommended cutting conditions, or for long periods of time, the clamp screw may become fatigued and break during machining. Please change out the clamp screw periodically.

Ramping / Helical Milling

● Ramping



● Helical Milling



Refer to the table below for cutting conditions. For feed per tooth and cutting speed, follow the cutting conditions for slot milling.

(mm)

DC	RE	Ramping		Helical Milling (Blind Hole, Flat Bottom)				Helical Milling (Through Hole)	
		RMPX	L *	DH max.	P max.	DH min.	P max.	DH min.	P max.
16	0.2	1.85°	248	31.0	1.5	27.5	1.2	24.2	0.8
	0.4	1.85°	248	30.6	1.5	27.5	1.2	24.2	0.8
	0.8	1.85°	248	29.8	1.4	27.5	1.2	24.2	0.8
	1.0	1.85°	248	29.4	1.4	27.5	1.2	24.2	0.8
	1.2	1.85°	248	29.0	1.3	27.5	1.2	24.2	0.8
	1.6	1.85°	248	28.2	1.2	27.5	1.2	24.2	0.8

(mm)

DC	RE	Ramping		Helical Milling (Blind Hole, Flat Bottom)				Helical Milling (Through Hole)	
		RMPX	L *	DH max.	P max.	DH min.	P max.	DH min.	P max.
18	0.2	1.56°	294	35.0	1.5	31.5	1.2	28.1	0.9
	0.4	1.56°	294	34.6	1.4	31.5	1.2	28.1	0.9
	0.8	1.56°	294	33.8	1.4	31.5	1.2	28.1	0.9
	1.0	1.56°	294	33.4	1.3	31.5	1.2	28.1	0.9
	1.2	1.56°	294	33.0	1.3	31.5	1.2	28.1	0.9
	1.6	1.56°	294	32.2	1.2	31.5	1.2	28.1	0.9
20	0.2	1.35°	340	39.0	1.4	35.5	1.1	32.0	0.9
	0.4	1.35°	340	38.6	1.4	35.5	1.1	32.0	0.9
	0.8	1.35°	340	37.8	1.3	35.5	1.1	32.0	0.9
	1.0	1.35°	340	37.4	1.3	35.5	1.1	32.0	0.9
	1.2	1.35°	340	37.0	1.3	35.5	1.1	32.0	0.9
	1.6	1.35°	340	36.2	1.2	35.5	1.1	32.0	0.9
22	0.2	1.16°	396	43.0	1.3	39.5	1.1	36.0	0.9
	0.4	1.16°	396	42.6	1.3	39.5	1.1	36.0	0.9
	0.8	1.16°	396	41.8	1.3	39.5	1.1	36.0	0.9
	1.0	1.16°	396	41.4	1.2	39.5	1.1	36.0	0.9
	1.2	1.16°	396	41.0	1.2	39.5	1.1	36.0	0.9
	1.6	1.16°	396	40.2	1.2	39.5	1.1	36.0	0.9
25	0.2	0.97°	473	49.0	1.3	45.5	1.1	42.0	0.9
	0.4	0.97°	473	48.6	1.3	45.5	1.1	42.0	0.9
	0.8	0.97°	473	47.8	1.2	45.5	1.1	42.0	0.9
	1.0	0.97°	473	47.4	1.2	45.5	1.1	42.0	0.9
	1.2	0.97°	473	47.0	1.2	45.5	1.1	42.0	0.9
	1.6	0.97°	473	46.2	1.1	45.5	1.1	42.0	0.9
28	0.2	0.84°	546	55.0	1.2	51.5	1.1	48.0	0.9
	0.4	0.84°	546	54.6	1.2	51.5	1.1	48.0	0.9
	0.8	0.84°	546	53.8	1.2	51.5	1.1	48.0	0.9
	1.0	0.84°	546	53.4	1.2	51.5	1.1	48.0	0.9
	1.2	0.84°	546	53.0	1.2	51.5	1.1	48.0	0.9
	1.6	0.84°	546	52.2	1.1	51.5	1.1	48.0	0.9
30	0.2	0.77°	596	59.0	1.2	55.5	1.1	52.0	0.9
	0.4	0.77°	596	58.6	1.2	55.5	1.1	52.0	0.9
	0.8	0.77°	596	57.8	1.2	55.5	1.1	52.0	0.9
	1.0	0.77°	596	57.4	1.2	55.5	1.1	52.0	0.9
	1.2	0.77°	596	57.0	1.1	55.5	1.1	52.0	0.9
	1.6	0.77°	596	56.2	1.1	55.5	1.1	52.0	0.9
32	0.2	0.71°	646	62.8	1.2	59.4	1.1	56.0	0.9
	0.4	0.71°	646	62.4	1.2	59.4	1.1	56.0	0.9
	0.8	0.71°	646	61.6	1.2	59.4	1.1	56.0	0.9
	1.0	0.71°	646	61.2	1.1	59.4	1.1	56.0	0.9
	1.2	0.71°	646	60.8	1.1	59.4	1.1	56.0	0.9
	1.6	0.71°	646	60.0	1.1	59.4	1.1	56.0	0.9
35	0.2	0.63°	728	69.0	1.2	65.5	1.1	62.0	0.9
	0.4	0.63°	728	68.6	1.2	65.5	1.1	62.0	0.9
	0.8	0.63°	728	67.8	1.1	65.5	1.1	62.0	0.9
	1.0	0.63°	728	67.4	1.1	65.5	1.1	62.0	0.9
	1.2	0.63°	728	67.0	1.1	65.5	1.1	62.0	0.9
	1.6	0.63°	728	66.2	1.1	65.5	1.1	62.0	0.9
40	0.2	0.54°	849	78.8	1.2	75.4	1.0	72.0	0.9
	0.4	0.54°	849	78.4	1.1	75.4	1.0	72.0	0.9
	0.8	0.54°	849	77.6	1.1	75.4	1.0	72.0	0.9
	1.0	0.54°	849	77.2	1.1	75.4	1.0	72.0	0.9
	1.2	0.54°	849	76.8	1.1	75.4	1.0	72.0	0.9
	1.6	0.54°	849	76.0	1.1	75.4	1.0	72.0	0.9
50	0.2	0.42°	1092	98.8	1.1	95.4	1.0	92.0	1.0
	0.4	0.42°	1092	98.4	1.1	95.4	1.0	92.0	1.0
	0.8	0.42°	1092	97.6	1.1	95.4	1.0	92.0	1.0
	1.0	0.42°	1092	97.2	1.1	95.4	1.0	92.0	1.0
	1.2	0.42°	1092	96.8	1.1	95.4	1.0	92.0	1.0
	1.6	0.42°	1092	96.0	1.1	95.4	1.0	92.0	1.0
63	0.2	0.32°	1433	124.8	1.1	121.4	1.0	118.0	1.0
	0.4	0.32°	1433	124.4	1.1	121.4	1.0	118.0	1.0
	0.8	0.32°	1433	123.6	1.1	121.4	1.0	118.0	1.0
	1.0	0.32°	1433	123.2	1.1	121.4	1.0	118.0	1.0
	1.2	0.32°	1433	122.8	1.1	121.4	1.0	118.0	1.0
	1.6	0.32°	1433	122.0	1.0	121.4	1.0	118.0	1.0

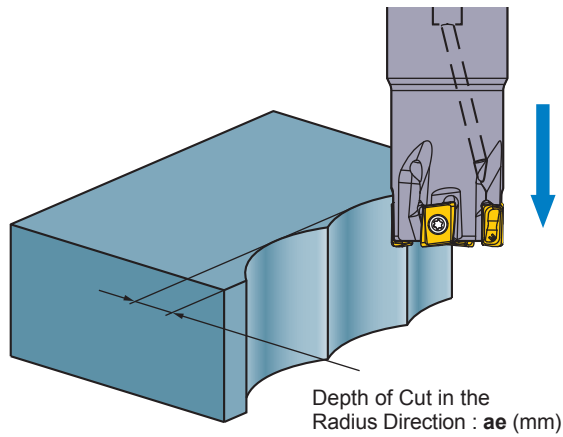
Note 1) When machining a highly ductile workpiece material with the ramping angles in the table above, chips may be elongated.
 * Shows the distance until a maximum depth of cut of 8 mm is achieved at the maximum ramping angle $L (= 8/\tan \alpha)$.

Recommended Cutting Conditions

For Plunging and Drilling

See the tables to the right for cutting conditions. Follow the cutting conditions for slot milling regarding feed per tooth and cutting speed.

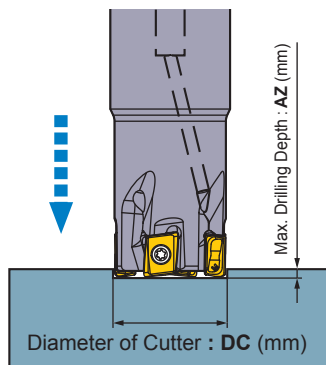
● Plunging



Note 1) No step feed necessary.

(mm)	
DC	ae max.
16	3.9
18	3.9
20	3.9
22	4.0
25	4.0
28	4.0
30	4.0
32	4.0
35	4.0
40	4.0
50	4.0
63	4.0

● Drilling



Note 1) Exercise due caution as chips scatter easily.

Note 2) Use compressed air to eliminate chips (or coolant for when machining aluminium alloy).

(mm)	
DC	AZ max.
16	0.3
18	0.3
20	0.3
22	0.3
25	0.3
28	0.3
30	0.3
32	0.3
35	0.3
40	0.3
50	0.3
63	0.3