

Cutting Conditions (Guide) :

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

CHIPBREAKER RECOMMENDATION

Chipbreaker Selection Table

Work Material	Properties	Cutting Conditions	Chipbreaker		Grade		
			1st Recommendation	2nd Recommendation	1st Recommendation	2nd Recommendation	
P	Mild Steel	● ●	L	M	MP6120	VP15TF	
		✖	M	L	MP6130	—	
	Carbon Steel Alloy Steel Alloy Tool Steel	● ●	L	M	MP6120	VP15TF	
		● ●	M	L	MP6120	VP15TF	
	Pre-hardened Steel	● ●	M	L	MP6120	VP15TF	
		✖	M	L	MP6130	—	
M	Austenitic Stainless Steel	● ●	L	M	MP7130	VP15TF	
		✖	M	L	MP7130	—	
		● ●	L	M	MP7130	VP15TF	
		✖	M	L	MP7130	—	
	Duplex Stainless Steel	● ●	L	M	MP7130	VP15TF	
		✖	M	L	MP7130	—	
	Ferritic and Martensitic Stainless Steel	● ●	L	M	MP7130	VP15TF	
		✖	M	L	MP7130	—	
	Precipitation Hardening Stainless Steel	● ●	L	M	MP7130	VP15TF	
		✖	M	L	MP7130	—	
	K	Gray Cast Iron	● ●	M	L	MC5020	VP15TF
			✖	M	L	VP15TF	—
Ductile Cast Iron		● ●	M	L	MC5020	VP15TF	
		✖	M	L	VP15TF	—	
N	Aluminium Alloy	● ●	L	M	TF15	—	
		✖	M	L	TF15	—	
S	Titanium Alloy (Ti-6Al-4V, etc.)	● ●	L	M	MP9120	VP15TF	
		✖	M	L	MP9130	—	
	Titanium Alloy (Ti-5Al-5V-5Mo-3Cr, etc.)	● ●	L	M	MP9120	VP15TF	
		✖	M	L	MP9130	—	
	Heat Resistant Alloy	● ●	M	L	MP9120	VP15TF	
		✖	M	L	MP9130	—	
H	Hardened Steel	● ● ✖	M	—	VP15TF	—	

RECOMMENDED CUTTING CONDITIONS

■ Dry Cutting Cutting Speed

Work Material	Properties	Cutting Conditions	Insert Grade	ae (mm)			
				≤0.25DC	0.25-0.5DC	0.5-0.75DC	DC(Slot)
				Vc (m/min)			
P Mild Steel	Hardness ≤180HB	● ●	MP6120, VP15TF	230 (180-270)	220 (170-260)	180 (140-210)	180 (140-210)
		● ●	MP6130	200 (150-240)	190 (170-260)	150 (110-180)	150 (110-180)
	Hardness 180-350HB ≤350HB (Annealing)	● ●	MP6120, VP15TF	180 (140-210)	170 (130-200)	140 (110-160)	140 (110-180)
		● ●	MP6130	150 (110-180)	140 (100-170)	110 (80-130)	110 (80-130)
Pre-hardened Steel	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 Steel	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 Steel	Hardness ≤280HB ● ● ●	MP7130, VP15TF	140 (110-170)	130 (90-150)	100 (70-120)	100 (70-120)
	Ferritic and Martensitic Stainless Steel	— ● ● ●	MP7130, VP15TF	180 (140-210)	170 (130-200)	140 (110-160)	140 (110-160)
	Precipitation Hardening Stainless Steel	Hardness <450HB ● ● ●	MP7130, VP15TF	130 (100-160)	120 (80-140)	90 (60-110)	90 (60-110)
K	Gray Cast Iron	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 Iron	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 Alloy	Content Si <5% ● ● ●	TF15	600 (400-1000)	600 (400-1000)	600 (400-1000)	600 (400-1000)
H	Hardened Steel	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 and vibrations are 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, work material or attachment of work material is low
- At a corner radius during pocket milling

Note 3) A type with fewer teeth is recommended when the depth of cut in the radial 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 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

Work Material	Properties	ae (mm)	Cutting Conditions	DC (mm)			
				ø25		ø28-ø80	
				ap (mm)	fz (mm/t.)	ap (mm)	fz (mm/t.)
P Mild Steel	Hardness ≤180HB	≤0.25DC	● ● ●	≤11	0.10 - 0.20	≤11	0.10 - 0.30
		0.25-0.5DC	● ● ●	≤11	0.10 - 0.15	≤11	0.10 - 0.25
		0.5-0.75DC	● ● ●	≤8	0.08 - 0.12	≤8	0.10 - 0.20
		DC(Slot)	● ● ●	≤5	0.06 - 0.10	≤5	0.08 - 0.15
Carbon Steel Alloy Steel Alloy Tool Steel	Hardness 180-280HB	≤0.25DC	● ● ●	≤11	0.10 - 0.20	≤11	0.10 - 0.30
		0.25-0.5DC	● ● ●	≤11	0.10 - 0.15	≤11	0.10 - 0.25
		0.5-0.75DC	● ● ●	≤8	0.08 - 0.12	≤8	0.10 - 0.20
		DC(Slot)	● ● ●	≤5	0.06 - 0.10	≤5	0.08 - 0.15
Carbon Steel Alloy Steel Alloy Tool Steel	Hardness 280-350HB ≤350HB (Annealing)	≤0.25DC	● ● ●	≤11	0.10 - 0.15	≤11	0.10 - 0.25
		0.25-0.5DC	● ● ●	≤11	0.08 - 0.12	≤11	0.10 - 0.20
		0.5-0.75DC	● ● ●	≤8	0.06 - 0.10	≤8	0.10 - 0.15
		DC(Slot)	● ● ●	≤5	0.06 - 0.10	≤5	0.08 - 0.12
Pre-hardened Steel	Hardness 35-45HRC	≤0.25DC	● ● ●	≤11	0.10 - 0.15	≤11	0.10 - 0.25
		0.25-0.5DC	● ● ●	≤11	0.08 - 0.12	≤11	0.10 - 0.20
		0.5-0.75DC	● ● ●	≤8	0.06 - 0.10	≤8	0.10 - 0.15
		DC(Slot)	● ● ●	≤5	0.06 - 0.10	≤5	0.08 - 0.12

Cutting Conditions (Guide) :

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Depth of Cut / Feed per Tooth

Work Material	Properties	ae (mm)	Cutting Conditions	DC (mm)				
				ø25		ø28-ø80		
				ap (mm)	fz (mm/t.)	ap (mm)	fz (mm/t.)	
M	Austenitic Stainless Steel	≤0.25DC	● ● ✖	≤11	0.10-0.20	≤11	0.10-0.20	
			● ● ✖	≤11	0.08-0.15	≤11	0.08-0.15	
		0.25-0.5DC	● ● ✖	≤11	0.08-0.15	≤11	0.08-0.15	
			● ● ✖	≤11	0.08-0.12	≤11	0.08-0.12	
	0.5-0.75DC	● ● ✖	≤8	0.08-0.12	≤8	0.08-0.12		
		● ● ✖	≤8	0.06-0.10	≤8	0.06-0.10		
	DC(Slot)	● ● ✖	≤5	0.06-0.10	≤5	0.06-0.10		
		● ● ✖	≤5	0.06-0.08	≤5	0.06-0.08		
	Duplex Stainless Steel	Hardness ≤280HB	≤0.25DC	● ● ✖	≤11	0.10-0.20	≤11	0.10-0.20
				● ● ✖	≤11	0.08-0.15	≤11	0.08-0.15
			0.25-0.5DC	● ● ✖	≤11	0.08-0.15	≤11	0.08-0.15
				● ● ✖	≤11	0.08-0.12	≤11	0.08-0.12
	0.5-0.75DC	● ● ✖	≤8	0.08-0.12	≤8	0.08-0.12		
		● ● ✖	≤8	0.06-0.10	≤8	0.06-0.10		
	DC(Slot)	● ● ✖	≤5	0.06-0.10	≤5	0.06-0.10		
		● ● ✖	≤5	0.06-0.08	≤5	0.06-0.08		
Ferritic and Martensitic Stainless Steel	-	≤0.25DC	● ● ✖	≤11	0.10-0.20	≤11	0.10-0.20	
			● ● ✖	≤11	0.08-0.15	≤11	0.08-0.15	
		0.25-0.5DC	● ● ✖	≤11	0.08-0.15	≤11	0.08-0.15	
			● ● ✖	≤11	0.08-0.12	≤11	0.08-0.12	
0.5-0.75DC	● ● ✖	≤8	0.08-0.12	≤8	0.08-0.12			
	● ● ✖	≤8	0.06-0.10	≤8	0.06-0.10			
DC(Slot)	● ● ✖	≤5	0.06-0.10	≤5	0.06-0.10			
	● ● ✖	≤5	0.06-0.08	≤5	0.06-0.08			
Precipitation Hardening Stainless Steel	Hardness <450HB	≤0.25DC	● ● ✖	≤11	0.10-0.15	≤11	0.10-0.15	
			● ● ✖	≤11	0.08-0.12	≤11	0.08-0.12	
		0.25-0.5DC	● ● ✖	≤11	0.08-0.12	≤11	0.08-0.12	
			● ● ✖	≤11	0.08-0.12	≤11	0.06-0.10	
0.5-0.75DC	● ● ✖	≤8	0.06-0.10	≤8	0.06-0.10			
	● ● ✖	≤8	0.06-0.08	≤8	0.06-0.08			
DC(Slot)	● ● ✖	≤5	0.06-0.10	≤5	0.06-0.10			
	● ● ✖	≤5	0.06-0.08	≤5	0.06-0.08			
K	Gray Cast Iron	≤0.25DC	● ● ✖	≤11	0.10-0.20	≤11	0.10-0.30	
			● ● ✖	≤11	0.08-0.15	≤11	0.10-0.25	
		0.25-0.5DC	● ● ✖	≤11	0.08-0.15	≤11	0.10-0.25	
			● ● ✖	≤11	0.08-0.12	≤11	0.10-0.20	
	0.5-0.75DC	● ● ✖	≤8	0.08-0.12	≤8	0.10-0.20		
		● ● ✖	≤8	0.06-0.10	≤8	0.08-0.15		
	DC(Slot)	● ● ✖	≤5	0.06-0.10	≤5	0.08-0.15		
		● ● ✖	≤5	0.06-0.08	≤5	0.08-0.12		
Ductile Cast Iron	Tensile Strength ≤800MPa	≤0.25DC	● ● ✖	≤11	0.10-0.20	≤11	0.10-0.25	
			● ● ✖	≤11	0.10-0.15	≤11	0.10-0.20	
		0.25-0.5DC	● ● ✖	≤11	0.10-0.15	≤11	0.10-0.20	
			● ● ✖	≤11	0.08-0.12	≤11	0.10-0.15	
0.5-0.75DC	● ● ✖	≤8	0.08-0.12	≤8	0.10-0.15			
	● ● ✖	≤8	0.08-0.12	≤8	0.08-0.12			
DC(Slot)	● ● ✖	≤5	0.06-0.10	≤5	0.08-0.12			
	● ● ✖	≤5	0.06-0.08	≤5	0.06-0.10			
N	Aluminium Alloy	≤0.25DC	● ● ✖	≤11	0.10-0.25	≤11	0.10-0.25	
			● ● ✖	≤11	0.10-0.20	≤11	0.10-0.20	
		0.25-0.5DC	● ● ✖	≤11	0.10-0.20	≤11	0.10-0.20	
			● ● ✖	≤11	0.10-0.15	≤11	0.10-0.15	
	0.5-0.75DC	● ● ✖	≤8	0.06-0.15	≤8	0.08-0.15		
		● ● ✖	≤8	0.06-0.15	≤8	0.08-0.15		
	DC(Slot)	● ● ✖	≤5	0.06-0.15	≤5	0.08-0.15		
		● ● ✖	≤5	0.06-0.15	≤5	0.08-0.12		
H	Hardened Steel	≤0.25DC	● ● ✖	≤5	0.08-0.15	≤5	0.08-0.15	
			● ● ✖	≤5	0.08-0.12	≤5	0.08-0.12	
		0.25-0.5DC	● ● ✖	≤4	0.08-0.12	≤4	0.08-0.12	
			● ● ✖	≤4	0.06-0.10	≤4	0.06-0.10	
0.5-0.75DC	● ● ✖	≤3	0.06-0.10	≤3	0.06-0.10			
	● ● ✖	≤3	0.06-0.08	≤3	0.06-0.08			
DC(Slot)	● ● ✖	≤2	0.06-0.10	≤2	0.06-0.10			
	● ● ✖	≤2	0.06-0.08	≤2	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 and vibrations are 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, work material or attachment of work material is low
- At a corner radius during pocket milling

Note 3) A type with fewer teeth is recommended when the depth of cut in the radial 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 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

Work Material	Properties	Cutting Conditions	Insert Grade	ae (mm)				
				≤0.25DC	0.25—0.5DC	0.5—0.75DC	DC(Slot)	
				Vc (m/min)				
P	Mild Steel	Hardness ≤180HB	● ● ✖	MP6120 MP6130 VP15TF	140 (100—190)	130 (90—180)	100 (70—120)	100 (70—120)
	Carbon Steel Alloy Steel Alloy Tool Steel	Hardness 180—350HB ≤350HB (Annealing)	● ● ✖	MP6120 MP6130 VP15TF	120 (90—140)	110 (80—130)	100 (70—120)	100 (70—120)
	Pre-hardened Steel	Hardness 35—45HRC	● ● ✖	MP6120 MP6130 VP15TF	100 (80—120)	90 (70—110)	80 (60—100)	80 (60—100)
M	Austenitic Stainless Steel	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—120)	70 (50—100)	70 (50—100)
	Duplex Stainless Steel	Hardness ≤280HB	● ● ✖	MP7130, VP15TF	100 (80—130)	90 (70—120)	70 (50—100)	70 (50—100)
	Ferritic and Martensitic Stainless Steel	—	● ● ✖	MP7130, VP15TF	120 (100—150)	110 (90—140)	90 (70—120)	90 (70—120)
	Precipitation Hardening Stainless Steel	Hardness <450HB	● ● ✖	MP7130, VP15TF	90 (70—120)	80 (60—110)	60 (40—90)	60 (40—90)
K	Gray Cast Iron	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 Iron	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 Alloy	Content Si <5%	● ● ✖	TF15	600 (400—1000)	600 (400—1000)	600 (400—1000)	600 (400—1000)
S	Titanium Alloy (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 Alloy (Ti-5Al-5V-5Mo-3Cr, etc.)	—	● ● ✖	MP9120, VP15TF	30 (20—40)	30 (20—40)	30 (20—40)	30 (20—40)
			● ✖	MP9130	30 (20—40)	30 (20—40)	30 (20—40)	30 (20—40)
	Heat Resistant Alloy	—	● ● ✖	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 Steel	Hardness 40—55HRC	● ● ✖	VP15TF	90 (70—100)	85 (60—100)	70 (50—80)	70 (50—80)

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

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Depth of Cut / Feed per Tooth

Work Material	Properties	ae (mm)	Cutting Conditions	DC (mm)				
				ø25		ø28-ø80		
				ap (mm)	fz (mm/t.)	ap (mm)	fz (mm/t.)	
P	Mild Steel	Hardness ≤180HB	≤0.25DC	● ● ✖	≤11	0.10-0.20	≤11	0.10-0.30
			0.25-0.5DC	● ● ✖	≤11	0.10-0.15	≤11	0.10-0.25
			0.5-0.75DC	● ● ✖	≤8	0.08-0.12	≤8	0.10-0.20
			DC(Slot)	● ● ✖	≤5	0.06-0.10	≤5	0.08-0.15
	Carbon Steel Alloy Steel Alloy Tool Steel	Hardness 180-280HB	≤0.25DC	● ● ✖	≤11	0.10-0.20	≤11	0.10-0.30
			0.25-0.5DC	● ● ✖	≤11	0.10-0.15	≤11	0.10-0.25
			0.5-0.75DC	● ● ✖	≤8	0.08-0.12	≤8	0.10-0.20
			DC(Slot)	● ● ✖	≤5	0.06-0.10	≤5	0.08-0.15
	Carbon Steel Alloy Steel Alloy Tool Steel	Hardness 280-350HB ≤350HB (Annealing)	≤0.25DC	● ● ✖	≤11	0.10-0.15	≤11	0.10-0.25
			0.25-0.5DC	● ● ✖	≤11	0.08-0.12	≤11	0.10-0.20
			0.5-0.75DC	● ● ✖	≤8	0.06-0.10	≤8	0.10-0.15
			DC(Slot)	● ● ✖	≤5	0.06-0.10	≤5	0.08-0.12
	Pre-hardened Steel	Hardness 35-45HRC	≤0.25DC	● ● ✖	≤11	0.10-0.15	≤11	0.10-0.25
			0.25-0.5DC	● ● ✖	≤11	0.08-0.12	≤11	0.10-0.20
			0.5-0.75DC	● ● ✖	≤8	0.06-0.10	≤8	0.10-0.15
			DC(Slot)	● ● ✖	≤5	0.06-0.10	≤5	0.08-0.12
M	Austenitic Stainless Steel	-	≤0.25DC	● ● ✖	≤11	0.10-0.20	≤11	0.10-0.20
				● ● ✖	≤11	0.08-0.15	≤11	0.08-0.15
			0.25-0.5DC	● ● ✖	≤11	0.08-0.12	≤11	0.08-0.15
				● ● ✖	≤11	0.06-0.10	≤11	0.08-0.12
		0.5-0.75DC	● ● ✖	≤8	0.06-0.10	≤8	0.08-0.12	
			● ● ✖	≤8	0.06-0.10	≤8	0.06-0.10	
		DC(Slot)	● ● ✖	≤5	0.06-0.10	≤5	0.06-0.10	
			● ● ✖	≤5	0.06-0.08	≤5	0.06-0.08	
	Duplex Stainless Steel	Hardness ≤280HB	≤0.25DC	● ● ✖	≤11	0.10-0.20	≤11	0.10-0.20
				● ● ✖	≤11	0.08-0.15	≤11	0.08-0.15
			0.25-0.5DC	● ● ✖	≤11	0.08-0.15	≤11	0.08-0.15
				● ● ✖	≤11	0.08-0.12	≤11	0.08-0.12
		0.5-0.75DC	● ● ✖	≤8	0.08-0.12	≤8	0.08-0.12	
			● ● ✖	≤8	0.06-0.10	≤8	0.06-0.10	
		DC(Slot)	● ● ✖	≤5	0.06-0.10	≤5	0.06-0.10	
			● ● ✖	≤5	0.06-0.08	≤5	0.06-0.08	
	Ferritic and Martensitic Stainless Steel	-	≤0.25DC	● ● ✖	≤11	0.10-0.20	≤11	0.10-0.20
				● ● ✖	≤11	0.08-0.15	≤11	0.08-0.15
			0.25-0.5DC	● ● ✖	≤11	0.08-0.15	≤11	0.08-0.15
				● ● ✖	≤11	0.08-0.12	≤11	0.08-0.12
		0.5-0.75DC	● ● ✖	≤8	0.08-0.12	≤8	0.08-0.12	
			● ● ✖	≤8	0.06-0.10	≤8	0.06-0.10	
		DC(Slot)	● ● ✖	≤5	0.06-0.10	≤5	0.06-0.10	
			● ● ✖	≤5	0.06-0.08	≤5	0.06-0.08	
Precipitation Hardening Stainless Steel	Hardness <450HB	≤0.25DC	● ● ✖	≤11	0.10-0.15	≤11	0.10-0.15	
			● ● ✖	≤11	0.08-0.12	≤11	0.08-0.12	
		0.25-0.5DC	● ● ✖	≤11	0.08-0.12	≤11	0.08-0.12	
			● ● ✖	≤11	0.08-0.12	≤11	0.08-0.12	
	0.5-0.75DC	● ● ✖	≤8	0.06-0.10	≤8	0.06-0.10		
		● ● ✖	≤8	0.06-0.08	≤8	0.06-0.08		
	DC(Slot)	● ● ✖	≤5	0.06-0.10	≤5	0.06-0.10		
		● ● ✖	≤5	0.06-0.08	≤5	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 and vibrations are 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, work material or attachment of work material is low
- At corner radius during pocket milling

Note 3) A type with fewer teeth is recommended when the depth of cut in the radial 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 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) :

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

RECOMMENDED CUTTING CONDITIONS

Wet Cutting

Depth of Cut / Feed per Tooth

Work Material	Properties	ae (mm)	Cutting Conditions	DC (mm)					
				ø25		ø28—ø80			
				ap (mm)	fz (mm/t.)	ap (mm)	fz (mm/t.)		
K	Gray Cast Iron	Tensile Strength ≤350MPa	● ● ✖	≤11	0.10—0.20	≤11	0.10—0.30		
				≤11	0.08—0.15	≤11	0.10—0.25		
			● ● ✖	≤11	0.08—0.15	≤11	0.10—0.25		
				≤11	0.08—0.12	≤11	0.10—0.20		
			● ● ✖	≤8	0.08—0.12	≤8	0.10—0.20		
		≤8		0.06—0.10	≤8	0.08—0.15			
		DC(Slot)	● ● ✖	≤5	0.06—0.10	≤5	0.08—0.15		
			● ● ✖	≤5	0.06—0.08	≤5	0.08—0.12		
			Ductile Cast Iron	Tensile Strength ≤800MPa	● ● ✖	≤11	0.10—0.20	≤11	0.10—0.25
						≤11	0.10—0.15	≤11	0.10—0.20
● ● ✖	≤11				0.10—0.15	≤11	0.10—0.20		
	≤11	0.08—0.12			≤11	0.10—0.15			
● ● ✖	≤8	0.08—0.12			≤8	0.10—0.15			
	≤8	0.06—0.10	≤8	0.08—0.12					
DC(Slot)	● ● ✖	≤5	0.06—0.10	≤5	0.08—0.12				
	● ● ✖	≤5	0.06—0.08	≤5	0.06—0.10				
	N	Aluminium Alloy	Content Si <5%	● ● ✖	≤11	0.10—0.25	≤11	0.10—0.25	
					≤11	0.10—0.20	≤11	0.10—0.20	
				● ● ✖	≤11	0.10—0.20	≤11	0.10—0.20	
≤11					0.10—0.15	≤11	0.10—0.15		
● ● ✖				≤8	0.06—0.15	≤8	0.08—0.15		
	≤8	0.06—0.15	≤8	0.08—0.15					
DC(Slot)	● ● ✖	≤5	0.06—0.15	≤5	0.08—0.15				
	● ● ✖	≤5	0.06—0.15	≤5	0.08—0.12				
	S	Titanium Alloy (Ti-6Al-4V, etc.)	—	● ● ✖	≤11	0.08—0.15	≤11	0.08—0.15	
					≤11	0.08—0.12	≤11	0.08—0.12	
				● ● ✖	≤8	0.06—0.10	≤8	0.06—0.10	
≤5					0.06—0.10	≤5	0.06—0.10		
Titanium Alloy (Ti-5Al-5V-5Mo-3Cr, etc.)		—	—	● ● ✖	≤11	0.08—0.12	≤11	0.08—0.12	
	≤11				0.08—0.12	≤11	0.08—0.12		
	● ● ✖			≤8	0.06—0.10	≤8	0.06—0.10		
				≤5	0.06—0.10	≤5	0.06—0.10		
Heat Resistant Alloy	—	—	● ● ✖	≤11	0.08—0.12	≤11	0.08—0.12		
				≤11	0.08—0.12	≤11	0.08—0.12		
			● ● ✖	≤8	0.06—0.10	≤8	0.06—0.10		
				≤5	0.06—0.10	≤5	0.06—0.10		
H	Hardened Steel	Hardness 40—55HRC	● ● ✖	≤5	0.08—0.15	≤5	0.08—0.15		
				≤5	0.08—0.12	≤5	0.08—0.12		
			● ● ✖	≤4	0.08—0.12	≤4	0.08—0.12		
				≤4	0.06—0.10	≤4	0.06—0.10		
			● ● ✖	≤3	0.06—0.10	≤3	0.06—0.10		
		≤3		0.06—0.10	≤3	0.06—0.08			
		DC(Slot)	● ● ✖	≤2	0.06—0.10	≤2	0.06—0.10		
			● ● ✖	≤2	0.06—0.10	≤2	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 and vibrations are 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, work material or attachment of work material is low
- At a corner radius during pocket milling

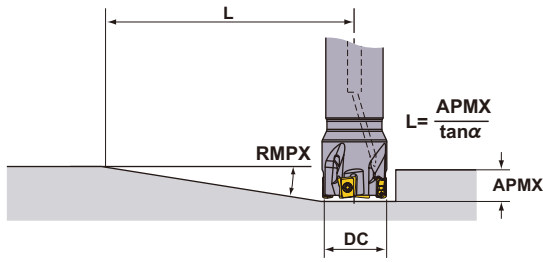
Note 3) A type with fewer teeth is recommended when the depth of cut in the radial direction (ae) is 0.5 DC or more.

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

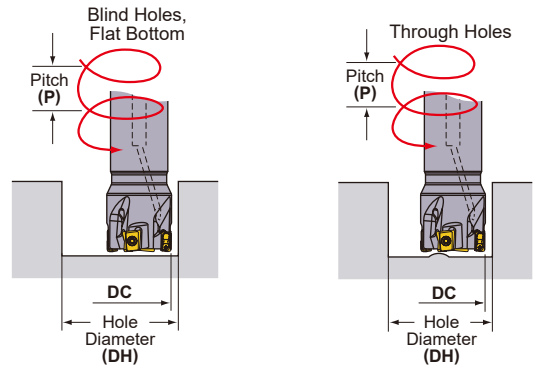
Note 5) When using higher than recommended cutting conditions, or for long periods of time, the clamp screw may become fatigued and break during machining. Please change out the clamp screw periodically.

■ Ramping / Helical Cutting

● Ramping



● Helical Cutting



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

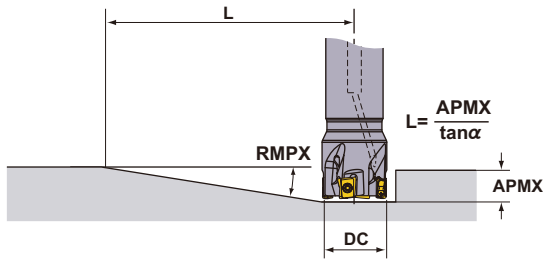
DC (mm)	RE (mm)	Ramping		Helical Cutting (Blind Hole, Flat Bottom)				Helical Cutting (Through Hole)	
		RMPX	L (mm) *	DH max. (mm)	P max. (mm)	DH min. (mm)	P max. (mm)	DH min. (mm)	P max. (mm)
25	0.2	2.13°	296	49.0	2.8	42.7	2.1	36.9	1.4
	0.4	2.13°	296	48.6	2.8	42.7	2.1	36.9	1.4
	0.8	2.13°	296	47.8	2.7	42.7	2.1	36.9	1.4
	1.0	2.13°	296	47.4	2.6	42.7	2.1	36.9	1.4
	1.2	2.13°	296	47.0	2.6	42.7	2.1	36.9	1.4
	1.6	2.13°	296	46.2	2.5	42.7	2.1	36.9	1.4
	2.0	2.13°	296	45.4	2.4	42.7	2.1	36.9	1.4
	2.4	2.13°	296	44.6	2.3	42.7	2.1	36.9	1.4
	3.0	2.13°	296	43.4	2.2	42.7	2.1	36.9	1.4
3.2	2.13°	296	43.0	2.1	42.7	2.1	36.9	1.4	
28	0.2	1.77°	356	55.0	2.6	48.7	2.0	42.7	1.4
	0.4	1.77°	356	54.6	2.6	48.7	2.0	42.7	1.4
	0.8	1.77°	356	53.8	2.5	48.7	2.0	42.7	1.4
	1.0	1.77°	356	53.4	2.5	48.7	2.0	42.7	1.4
	1.2	1.77°	356	53.0	2.4	48.7	2.0	42.7	1.4
	1.6	1.77°	356	52.2	2.4	48.7	2.0	42.7	1.4
	2.0	1.77°	356	51.4	2.3	48.7	2.0	42.7	1.4
	2.4	1.77°	356	50.6	2.2	48.7	2.0	42.7	1.4
	3.0	1.77°	356	49.4	2.1	48.7	2.0	42.7	1.4
3.2	1.77°	356	49.0	2.0	48.7	2.0	42.7	1.4	
30	0.2	1.61°	392	59.0	2.6	52.7	2.0	46.6	1.5
	0.4	1.61°	392	58.6	2.5	52.7	2.0	46.6	1.5
	0.8	1.61°	392	57.8	2.5	52.7	2.0	46.6	1.5
	1.0	1.61°	392	57.4	2.4	52.7	2.0	46.6	1.5
	1.2	1.61°	392	57.0	2.4	52.7	2.0	46.6	1.5
	1.6	1.61°	392	56.2	2.3	52.7	2.0	46.6	1.5
	2.0	1.61°	392	55.4	2.2	52.7	2.0	46.6	1.5
	2.4	1.61°	392	54.6	2.2	52.7	2.0	46.6	1.5
	3.0	1.61°	392	53.4	2.1	52.7	2.0	46.6	1.5
3.2	1.61°	392	53.0	2.0	52.7	2.0	46.6	1.5	
32	0.2	1.47°	429	63.0	2.5	56.7	2.0	50.6	1.5
	0.4	1.47°	429	62.6	2.5	56.7	2.0	50.6	1.5
	0.8	1.47°	429	61.8	2.4	56.7	2.0	50.6	1.5
	1.0	1.47°	429	61.4	2.4	56.7	2.0	50.6	1.5
	1.2	1.47°	429	61.0	2.3	56.7	2.0	50.6	1.5
	1.6	1.47°	429	60.2	2.3	56.7	2.0	50.6	1.5
	2.0	1.47°	429	59.4	2.2	56.7	2.0	50.6	1.5
	2.4	1.47°	429	58.6	2.1	56.7	2.0	50.6	1.5
	3.0	1.47°	429	57.4	2.1	56.7	2.0	50.6	1.5
3.2	1.47°	429	57.0	2.0	56.7	2.0	50.6	1.5	
35	0.2	1.28°	493	69.0	2.4	62.8	1.9	56.6	1.5
	0.4	1.28°	493	68.6	2.4	62.8	1.9	56.6	1.5
	0.8	1.28°	493	67.8	2.3	62.8	1.9	56.6	1.5
	1.0	1.28°	493	67.4	2.3	62.8	1.9	56.6	1.5
	1.2	1.28°	493	67.0	2.2	62.8	1.9	56.6	1.5
	1.6	1.28°	493	66.2	2.2	62.8	1.9	56.6	1.5
	2.0	1.28°	493	65.4	2.1	62.8	1.9	56.6	1.5
	2.4	1.28°	493	64.6	2.1	62.8	1.9	56.6	1.5
	3.0	1.28°	493	63.4	2.0	62.8	1.9	56.6	1.5
3.2	1.28°	493	63.0	2.0	62.8	1.9	56.6	1.5	

Note 1) When machining a highly ductile work material with the ramping angles in the table above, chips may be elongated.

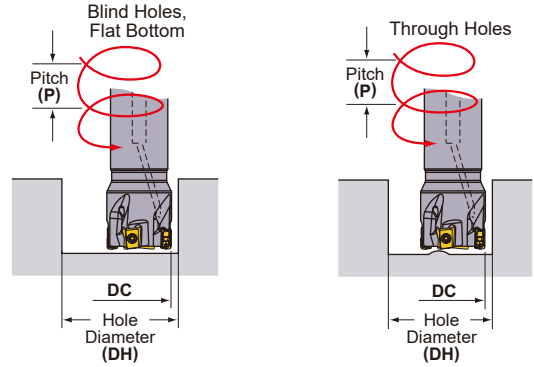
* Shows the distance until a maximum depth of cut of 11 mm is achieved at the maximum ramping angle $L (= 11/\tan \alpha)$.

■ Ramping / Helical Cutting

● Ramping



● Helical Cutting



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

DC (mm)	RE (mm)	Ramping		Helical Cutting (Blind Hole, Flat Bottom)				Helical Cutting (Through Hole)	
		RMPX	L (mm) *	DH max. (mm)	P max. (mm)	DH min. (mm)	P max. (mm)	DH min. (mm)	P max. (mm)
40	0.2	1.06°	595	78.8	2.3	72.7	1.9	66.5	1.5
	0.4	1.06°	595	78.4	2.2	72.7	1.9	66.5	1.5
	0.8	1.06°	595	77.6	2.2	72.7	1.9	66.5	1.5
	1.0	1.06°	595	77.2	2.2	72.7	1.9	66.5	1.5
	1.2	1.06°	595	76.8	2.1	72.7	1.9	66.5	1.5
	1.6	1.06°	595	76.0	2.1	72.7	1.9	66.5	1.5
	2.0	1.06°	595	75.2	2.0	72.7	1.9	66.5	1.5
	2.4	1.06°	595	74.4	2.0	72.7	1.9	66.5	1.5
	3.0	1.06°	595	73.2	1.9	72.7	1.9	66.5	1.5
3.2	1.06°	595	72.8	1.9	72.7	1.9	66.5	1.5	
50	0.2	0.79°	798	98.8	2.1	92.7	1.8	86.5	1.6
	0.4	0.79°	798	98.4	2.1	92.7	1.8	86.5	1.6
	0.8	0.79°	798	97.6	2.1	92.7	1.8	86.5	1.6
	1.0	0.79°	798	97.2	2.0	92.7	1.8	86.5	1.6
	1.2	0.79°	798	96.8	2.0	92.7	1.8	86.5	1.6
	1.6	0.79°	798	96.0	2.0	92.7	1.8	86.5	1.6
	2.0	0.79°	798	95.2	2.0	92.7	1.8	86.5	1.6
	2.4	0.79°	798	94.4	1.9	92.7	1.8	86.5	1.6
	3.0	0.79°	798	93.2	1.9	92.7	1.8	86.5	1.6
3.2	0.79°	798	92.8	1.9	92.7	1.8	86.5	1.6	
63	0.2	0.6°	1051	124.8	2.0	118.7	1.8	112.5	1.6
	0.4	0.6°	1051	124.4	2.0	118.7	1.8	112.5	1.6
	0.8	0.6°	1051	123.6	2.0	118.7	1.8	112.5	1.6
	1.0	0.6°	1051	123.2	2.0	118.7	1.8	112.5	1.6
	1.2	0.6°	1051	122.8	2.0	118.7	1.8	112.5	1.6
	1.6	0.6°	1051	122.0	1.9	118.7	1.8	112.5	1.6
	2.0	0.6°	1051	121.2	1.9	118.7	1.8	112.5	1.6
	2.4	0.6°	1051	120.4	1.9	118.7	1.8	112.5	1.6
	3.0	0.6°	1051	119.2	1.9	118.7	1.8	112.5	1.6
3.2	0.6°	1051	118.8	1.8	118.7	1.8	112.5	1.6	
80	0.2	0.45°	1401	158.8	1.9	152.6	1.8	146.5	1.6
	0.4	0.45°	1401	158.4	1.9	152.7	1.8	146.5	1.6
	0.8	0.45°	1401	157.6	1.9	152.7	1.8	146.5	1.6
	1.0	0.45°	1401	157.2	1.9	152.7	1.8	146.5	1.6
	1.2	0.45°	1401	156.8	1.9	152.7	1.8	146.5	1.6
	1.6	0.45°	1401	156.0	1.9	152.7	1.8	146.5	1.6
	2.0	0.45°	1401	155.2	1.9	152.7	1.8	146.5	1.6
	2.4	0.45°	1401	154.4	1.8	152.7	1.8	146.5	1.6
	3.0	0.45°	1401	153.2	1.8	152.7	1.8	146.5	1.6
3.2	0.45°	1401	152.8	1.8	152.7	1.8	146.5	1.6	

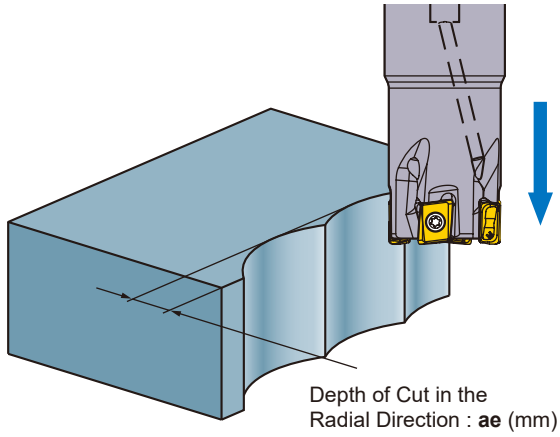
Note 1) When machining a highly ductile work material with the ramping angles in the table above, chips may be elongated.

* Shows the distance until a maximum depth of cut of 11 mm is achieved at the maximum ramping angle $L (= 11/\tan \alpha)$.

■ 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.

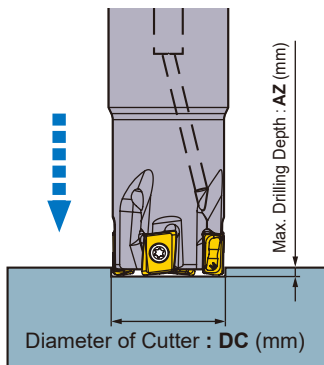
● Plunging



DC (mm)	ae max. (mm)
25	6.5
28	6.6
30	6.6
32	6.6
35	6.7
40	6.7
50	6.7
63	6.7
80	6.7

Note 1) No step feed necessary.

● Drilling



DC (mm)	AZ max. (mm)
25	0.55
28	0.55
30	0.55
32	0.55
35	0.55
40	0.55
50	0.55
63	0.55
80	0.55

Note 1) Exercise due caution as chips scatter easily.

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