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	Hardness ≤180HB	● ◔	L	M	MP6120	VP15TF
			✣	M	L	MP6130	—
	Carbon Steel Alloy Steel Alloy Tool Steel	Hardness 180-350HB ≤350HB (Annealing)	●	L	M	MP6120	VP15TF
			◔	M	L	MP6120	VP15TF
			✣	M	L	MP6130	—
	Pre-hardened Steel	Hardness 35—45HRC	● ◔	M	L	MP6120	VP15TF
			✣	M	L	MP6130	—
M	Austenitic Stainless Steel	Hardness ≤280HB	● ◔	L	M	MP7130	VP15TF
			✣	M	L	MP7130	—
		Hardness >200HB	● ◔	L	M	MP7130	VP15TF
			✣	M	L	MP7130	—
	Duplex Stainless Steel	Hardness ≤280HB	● ◔	L	M	MP7130	VP15TF
			✣	M	L	MP7130	—
	Ferritic and Martensitic Stainless Steel	—	● ◔	L	M	MP7130	VP15TF
			✣	M	L	MP7130	—
	Precipitation Hardening Stainless Steel	Hardness <450HB	● ◔	L	M	MP7130	VP15TF
			✣	M	L	MP7130	—
K	Gray Cast Iron	Tensile Strength ≤350MPa	● ◔	M	L	MC5020	VP15TF
			✣	M	L	VP15TF	—
	Ductile Cast Iron	Tensile Strength ≤800MPa	● ◔	M	L	MC5020	VP15TF
			✣	M	L	VP15TF	—
N	Aluminium Alloy	Content Si<5%	● ◔	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	Hardness 40—55HRC	● ◔ ✣	M	—	VP15TF	—

RECOMMENDED CUTTING CONDITIONS

■ Dry Cutting

Cutting Speed

	Work Material	Properties	Cutting Conditions	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 (140—230)	150 (110—180)	150 (110—180)
	Carbon Steel Alloy Steel Alloy Tool Steel	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 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**	Cutting Conditions	**DC** (mm) ø16—ø18 **ap**	ø16—ø18 **fz** (mm/t.)	ø20—ø25 **ap**	ø20—ø25 **fz** (mm/t.)	ø28—ø63 **ap**	ø28—ø63 **fz** (mm/t.)
P	Mild Steel	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 Steel Alloy Steel Alloy Tool Steel	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 Steel Alloy Steel Alloy Tool Steel	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 Steel	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) :
● : Stable Cutting ◕ : General Cutting ✣ : Unstable Cutting

Depth of Cut / Feed per Tooth

	Work Material	Properties	ae	Cutting Conditions	DC (mm) ø16—ø18 ap	ø16—ø18 fz (mm/t.)	ø20—ø25 ap	ø20—ø25 fz (mm/t.)	ø28—ø63 ap	ø28—ø63 fz (mm/t.)
M	Austenitic Stainless Steel	—	≤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 Steel	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 Steel	—	≤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 Steel	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 Iron	Tensile Strength ≤350MPa	≤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 Iron	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 Alloy	Content Si<5%	≤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 Steel	Hardness 40—55HRC	≤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 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	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—110)	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 MP9130 VP15TF	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)

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.

Cutting Conditions (Guide) :
● : Stable Cutting ◐ : General Cutting ✣ : Unstable Cutting

Depth of Cut / Feed per Tooth

	Work Material	Properties	ae	Cutting Conditions	DC (mm) ø16—ø18 ap	ø16—ø18 fz (mm/t.)	ø20—ø25 ap	ø20—ø25 fz (mm/t.)	ø28—ø63 ap	ø28—ø63 fz (mm/t.)
P	Mild Steel	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 Steel Alloy Steel Alloy Tool Steel	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 Steel Alloy Steel Alloy Tool Steel	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 Steel	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 Steel	—	≤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 Steel	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—0.12
				✣	≤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	0.08—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 Steel	—	≤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	0.05—0.10
			DC(Slot)	● ◐	≤2	0.06—0.10	≤4	0.06—0.10	≤4	0.05—0.10
				✣	≤2	0.06—0.08	≤4	0.06—0.08	≤4	0.05—0.08
	Precipitation Hardening Stainless Steel	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	0.05—0.10
				✣	≤4	0.06—0.08	≤6	0.06—0.08	≤6	0.05—0.08
			DC(Slot)	● ◐	≤2	0.06—0.10	≤4	0.06—0.10	≤4	0.05—0.10
				✣	≤2	0.06—0.08	≤4	0.06—0.08	≤4	0.05—0.08
K	Gray Cast Iron	Tensile Strength ≤350MPa	≤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	0.06—0.10	≤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	0.06—0.10
	Ductile Cast Iron	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	0.08—0.12	≤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

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.

Cutting Conditions (Guide) :
● : Stable Cutting ◕ : General Cutting ✣ : Unstable Cutting

RECOMMENDED CUTTING CONDITIONS

■ Wet Cutting

Depth of Cut / Feed per Tooth

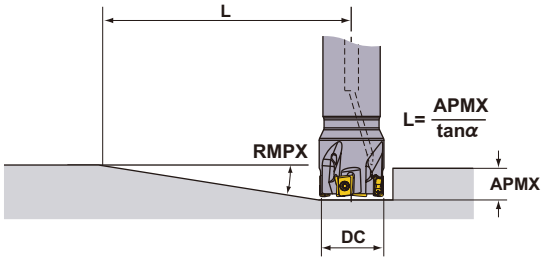
	Work Material	Properties	ae	Cutting Conditions	DC (mm) ø16—ø18 ap	ø16—ø18 fz (mm/t.)	ø20—ø25 ap	ø20—ø25 fz (mm/t.)	ø28—ø63 ap	ø28—ø63 fz (mm/t.)
N	Aluminium Alloy	Content Si＜5%	≤0.25DC	● ◕	≤6	0.10—0.20	≤8	0.10—0.25	≤8	0.10—0.25
				✣	≤6	0.10—0.15	≤8	0.10—0.20	≤8	0.10—0.20
			0.25—0.5DC	● ◕	≤5	0.10—0.15	≤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
S	Titanium Alloy (Ti-6Al-4V,etc.)	—	≤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
	Titanium Alloy (Ti-5Al-5V-5Mo-3Cr,etc.)	—	≤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
	Heat Resistant Alloy	—	≤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 Steel	Hardness 40—55HRC	≤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	0.06—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
				✣	≤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
				✣	≤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 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

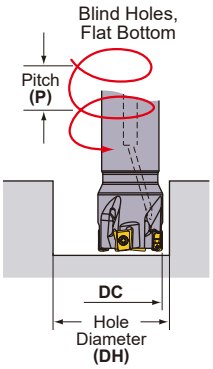
Note 3) A type with fewer teeth is recommended when the depth of cut in the radial direction (ae) is 0.5 DC or more.
Note 4) Wet cutting is recommended, when focusing on the surface finish. (Service life is shorter than for dry cutting.)
Note 5) When using higher than recommended cutting conditions, or for long periods of time, the clamp screw may become fatigued and break during machining. Please change out the clamp screw periodically.

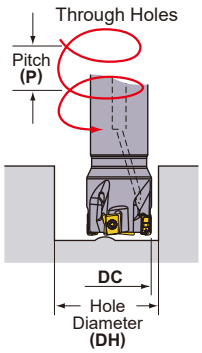
■ Ramping / Helical Cutting

● Ramping



● Helical Cutting





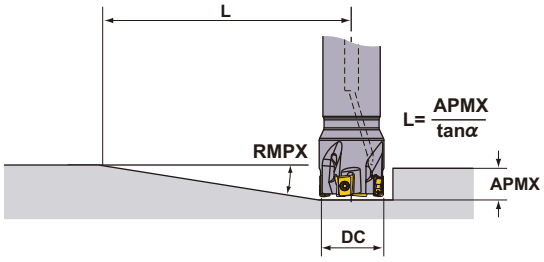
Refer to the table below for cutting conditions. For feed per tooth and cutting speed, follow the cutting conditions for slot milling.

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)
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
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

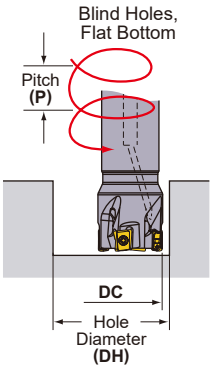
Note 1) When machining a highly ductile work material with the ramping angles in the table above, chips may be elongated.
* Shows the distance until a maximum depth of cut of 8 mm is achieved at the maximum ramping angle L (= 8/tan α).

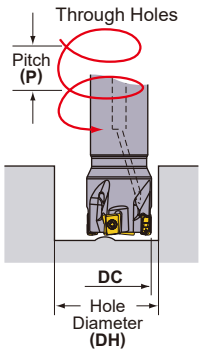
■ Ramping / Helical Cutting

● **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.

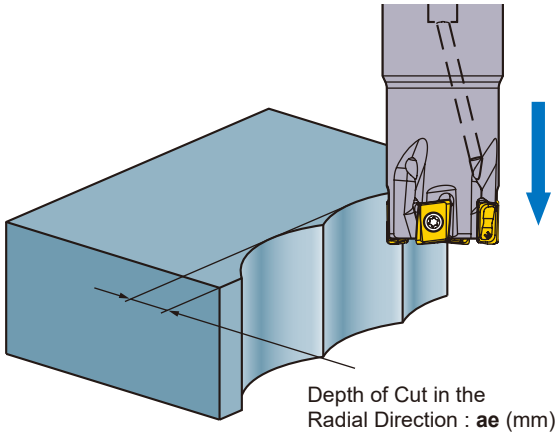
DC (mm)	RE (mm)	Ramping		Helical Cutting (Blind Hole, Flat Bottom)				Helical Cutting (Through Hole)	
		RMPX	L (mm) *	DH max. (mm)	P max. (mm)	DH min. (mm)	P max. (mm)	DH min. (mm)	P max. (mm)
35	0.2	0.63°	728	69.0	1.2	65.5	1.1	62.0	0.9
	0.4	0.63°	728	68.6	1.2	65.5	1.1	62.0	0.9
	0.8	0.63°	728	67.8	1.1	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 work 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 α).

■ 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.

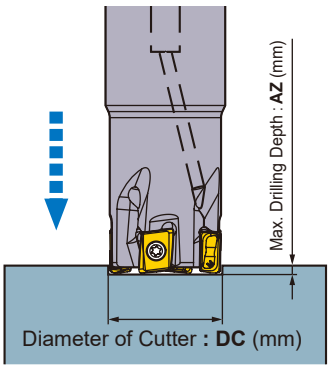
● Plunging



DC (mm)	**ae max.** (mm)
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

Note 1) No step feed necessary.

● Drilling



DC (mm)	**AZ max.** (mm)
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

Note 1) Exercise due caution as chips scatter easily.
Note 2) Use compressed air to eliminate chips (or coolant for when machining aluminium alloy).