Recommended Cutting Conditions

Dry Cutting

Cutting Speed

(inch)

	Workpiece Material	Properties	Cutting Conditions	Insert		Cutting Width **ae**			
				Grade	Chip Breaker	≤.25DC	.25—.5DC	.5—.75DC	DC(Slot)
						Cutting Speed **vc** (SFM)			
P	Mild Steels	≤180HB	● ◐	MP6120	M	755 (590—885)	720 (560—850)	590 (460—690)	590 (460—690)
			● ◐	VP15TF	M	755 (590—885)	720 (560—850)	590 (460—690)	590 (460—690)
			✲	MP6130	M	655 (490—785)	620 (560—850)	490 (360—590)	490 (360—590)
	Carbon Steels Alloy Steels Alloy Tool Steels	180—350HB ≤350HB (Annealing)	● ◐	MP6120	M	590 (460—690)	560 (425—655)	460 (360—525)	460 (360—590)
			● ◐	VP15TF	M	590 (460—690)	560 (425—655)	460 (360—525)	460 (360—590)
			✲	MP6130	M	490 (360—590)	460 (330—560)	360 (260—425)	360 (260—425)
	Pre-hardened Steels	35—45HRC	● ◐	MP6120	M	395 (295—460)	360 (260—425)	330 (230—395)	330 (230—395)
			● ◐	VP15TF	M	395 (295—460)	360 (260—425)	330 (230—395)	330 (230—395)
			✲	MP6130	M	330 (260—395)	295 (230—360)	260 (195—330)	260 (195—330)
M	Austenitic Stainless Steels	≤200HB	● ◐ ✲	MP7130	M	590 (460—690)	560 (425—655)	460 (360—525)	460 (360—525)
			● ◐	VP15TF	M	590 (460—690)	560 (425—655)	460 (360—525)	460 (360—525)
		>200HB	● ◐ ✲	MP7130	M	490 (360—590)	460 (330—525)	360 (260—425)	360 (260—425)
			● ◐	VP15TF	M	490 (360—590)	460 (330—525)	360 (260—425)	360 (260—425)
	Duplex Stainless Steels	≤280HB	● ◐ ✲	MP7130	M	460 (360—560)	425 (295—490)	330 (230—395)	330 (230—395)
			● ◐	VP15TF	M	460 (360—560)	425 (295—490)	330 (230—395)	330 (230—395)
	Ferritic and Martensitic Stainless Steels	—	● ◐ ✲	MP7130	M	590 (460—690)	560 (425—655)	460 (360—525)	460 (360—525)
			● ◐	VP15TF	M	590 (460—690)	560 (425—655)	460 (360—525)	460 (360—525)
	Precipitation Hardening Stainless Steels	<450HB	● ◐ ✲	MP7130	M	425 (330—525)	395 (260—460)	295 (195—360)	295 (195—360)
			● ◐	VP15TF	M	425 (330—525)	395 (260—460)	295 (195—360)	295 (195—360)
K	Gray Cast Irons	Tensile Strength ≤350MPa	● ◐	MC5020	M	820 (655—985)	785 (620—950)	690 (525—850)	690 (525—850)
			● ◐ ✲	VP15TF	M	655 (490—820)	620 (460—785)	525 (360—690)	525 (360—690)
	Ductile Cast Irons	Tensile Strength ≤800MPa	● ◐	MC5020	M	590 (490—655)	560 (460—620)	490 (395—560)	490 (395—560)
			● ◐ ✲	VP15TF	M	425 (330—490)	395 (295—460)	330 (260—395)	330 (260—395)
N	Aluminum Alloys	Si<5%	● ◐ ✲	TF15	M	1970 (1310—3280)	1970 (1310—3280)	1970 (1310—3280)	1970 (1310—3280)
H	Hardened Steels	40—55HRC	● ◐ ✲	VP15TF	M	295 (230—330)	280 (195—330)	230 (165—260)	230 (165—260)

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 .5 DC or more.

Note 4) Wet cutting is recommended, when focusing on the surface finish. (Tool 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) :
● : Stable Cutting ◔ : General Cutting ✲ : Unstable Cutting

Depth of Cut / Feed per Tooth

(inch)

Workpiece Material		Properties	Cutting Width **ae**	Cutting Conditions	Cutter Diameter **DC** ø1.000 (ø25mm) Depth of Cut **ap**	ø1.000 (ø25mm) Feed per Tooth. **fz** (IPT)	ø1.125—ø3.000 (ø28mm-ø80mm) Depth of Cut **ap**	ø1.125—ø3.000 (ø28mm-ø80mm) Feed per Tooth. **fz** (IPT)
P	Mild Steels	≤180HB	≤.25DC	● ◔ ✲	≤.433	.004—.008	≤.433	.004—.012
			.25—.5DC	● ◔ ✲	≤.433	.004—.006	≤.433	.004—.010
			.5—.75DC	● ◔ ✲	≤.315	.003—.005	≤.315	.004—.008
			DC(Slot)	● ◔ ✲	≤.197	.002—.004	≤.197	.003—.006
	Carbon Steels Alloy Steels Alloy Tool Steels	180—280HB	≤.25DC	● ◔ ✲	≤.433	.004—.008	≤.433	.004—.012
			.25—.5DC	● ◔ ✲	≤.433	.004—.006	≤.433	.004—.010
			.5—.75DC	● ◔ ✲	≤.315	.003—.005	≤.315	.004—.008
			DC(Slot)	● ◔ ✲	≤.197	.002—.004	≤.197	.003—.006
	Carbon Steels Alloy Steels Alloy Tool Steels	280—350HB ≤350HB (Annealing)	≤.25DC	● ◔ ✲	≤.433	.004—.006	≤.433	.004—.010
			.25—.5DC	● ◔ ✲	≤.433	.003—.005	≤.433	.004—.008
			.5—.75DC	● ◔ ✲	≤.315	.002—.004	≤.315	.004—.006
			DC(Slot)	● ◔ ✲	≤.197	.002—.004	≤.197	.003—.005
	Pre-hardened Steels	35—45HRC	≤.25DC	● ◔ ✲	≤.433	.004—.006	≤.433	.004—.010
			.25—.5DC	● ◔ ✲	≤.433	.003—.005	≤.433	.004—.008
			.5—.75DC	● ◔ ✲	≤.315	.002—.004	≤.315	.004—.006
			DC(Slot)	● ◔ ✲	≤.197	.002—.004	≤.197	.003—.005
M	Austenitic Stainless Steels	—	≤.25DC	○ ◔	≤.433	.004—.008	≤.433	.004—.008
				✲	≤.433	.003—.006	≤.433	.003—.006
			.25—.5DC	○ ◔	≤.433	.003—.006	≤.433	.003—.006
				✲	≤.433	.003—.005	≤.433	.003—.005
			.5—.75DC	○ ◔	≤.315	.003—.005	≤.315	.003—.005
				✲	≤.315	.002—.004	≤.315	.002—.004
			DC(Slot)	○ ◔	≤.197	.002—.004	≤.197	.002—.004
				✲	≤.197	.002—.003	≤.197	.002—.003
	Duplex Stainless Steels	≤280HB	≤.25DC	○ ◔	≤.433	.004—.008	≤.433	.004—.008
				✲	≤.433	.003—.006	≤.433	.003—.006
			.25—.5DC	○ ◔	≤.433	.003—.006	≤.433	.003—.006
				✲	≤.433	.003—.005	≤.433	.003—.005
			.5—.75DC	○ ◔	≤.315	.003—.005	≤.315	.003—.005
				✲	≤.315	.002—.004	≤.315	.002—.004
			DC(Slot)	○ ◔	≤.197	.002—.004	≤.197	.002—.004
				✲	≤.197	.002—.003	≤.197	.002—.003
	Ferritic and Martensitic Stainless Steels	—	≤.25DC	○ ◔	≤.433	.004—.008	≤.433	.004—.008
				✲	≤.433	.003—.006	≤.433	.003—.006
			.25—.5DC	○ ◔	≤.433	.003—.006	≤.433	.003—.006
				✲	≤.433	.003—.005	≤.433	.003—.005
			.5—.75DC	○ ◔	≤.315	.003—.005	≤.315	.003—.005
				✲	≤.315	.002—.004	≤.315	.002—.004
			DC(Slot)	○ ◔	≤.197	.002—.004	≤.197	.002—.004
				✲	≤.197	.002—.003	≤.197	.002—.003
	Precipitation Hardening Stainless Steels	<450HB	≤.25DC	○ ◔	≤.433	.004—.006	≤.433	.004—.006
				✲	≤.433	.003—.005	≤.433	.003—.005
			.25—.5DC	○ ◔	≤.433	.003—.005	≤.433	.003—.005
				✲	≤.433	.003—.005	≤.433	.002—.004
			.5—.75DC	○ ◔	≤.315	.002—.004	≤.315	.002—.004
				✲	≤.315	.002—.003	≤.315	.002—.003
			DC(Slot)	○ ◔	≤.197	.002—.004	≤.197	.002—.004
				✲	≤.197	.002—.003	≤.197	.002—.003

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 .5 DC or more.
Note 4) Wet cutting is recommended, when focusing on the surface finish. (Tool 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

Dry Cutting

Depth of Cut / Feed per Tooth

(inch)

	Workpiece Material	Properties	Cutting Width **ae**	Cutting Conditions	Cutter Diameter **DC**			
					ø1.000 (ø25mm)		**ø1.125—ø3.000 (ø28mm-ø80mm)**	
					Depth of Cut **ap**	Feed per Tooth. **fz** (IPT)	Depth of Cut **ap**	Feed per Tooth. **fz** (IPT)
K	Gray Cast Irons	Tensile Strength ≤350MPa	≤.25DC	● ◐	≤.433	.004—.008	≤.433	.004—.012
				✲	≤.433	.003—.006	≤.433	.004—.010
			.25—.5DC	● ◐	≤.433	.003—.006	≤.433	.004—.010
				✲	≤.433	.003—.005	≤.433	.004—.008
			.5—.75DC	● ◐	≤.315	.003—.005	≤.315	.004—.008
				✲	≤.315	.002—.004	≤.315	.003—.006
			DC(Slot)	● ◐	≤.197	.002—.004	≤.197	.003—.006
				✲	≤.197	.002—.003	≤.197	.003—.005
	Ductile Cast Irons	Tensile Strength ≤800MPa	≤.25DC	● ◐	≤.433	.004—.008	≤.433	.004—.010
				✲	≤.433	.004—.006	≤.433	.004—.008
			.25—.5DC	● ◐	≤.433	.004—.006	≤.433	.004—.008
				✲	≤.433	.003—.005	≤.433	.004—.006
			.5—.75DC	● ◐	≤.315	.003—.005	≤.315	.004—.006
				✲	≤.315	.003—.005	≤.315	.003—.005
			DC(Slot)	● ◐	≤.197	.002—.004	≤.197	.003—.005
				✲	≤.197	.002—.003	≤.197	.002—.004
N	Aluminum Alloys	Si< 5%	≤.25DC	● ◐	≤.433	.004—.010	≤.433	.004—.010
				✲	≤.433	.004—.008	≤.433	.004—.008
			.25—.5DC	● ◐	≤.433	.004—.008	≤.433	.004—.008
				✲	≤.433	.004—.006	≤.433	.004—.006
			.5—.75DC	● ◐	≤.315	.002—.006	≤.315	.003—.006
				✲	≤.315	.002—.006	≤.315	.003—.006
			DC(Slot)	● ◐	≤.197	.002—.006	≤.197	.003—.006
				✲	≤.197	.002—.006	≤.197	.003—.005
H	Hardened Steels	40—55HRC	≤.25DC	● ◐	≤.197	.003—.006	≤.197	.003—.006
				✲	≤.197	.003—.005	≤.197	.003—.005
			.25—.5DC	● ◐	≤.157	.003—.005	≤.157	.003—.005
				✲	≤.157	.002—.004	≤.157	.002—.004
			.5—.75DC	● ◐	≤.118	.002—.004	≤.118	.002—.004
				✲	≤.118	.002—.003	≤.118	.002—.003
			DC(Slot)	● ◐	≤.079	.002—.004	≤.079	.002—.004
				✲	≤.079	.002—.003	≤.079	.002—.003

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 .5 DC or more.

Note 4) Wet cutting is recommended, when focusing on the surface finish. (Tool 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) :
● : Stable Cutting ◐ : General Cutting ✣ : Unstable Cutting

Wet Cutting
Cutting Speed

(inch)

	Workpiece Material	Properties	Cutting Conditions	Insert Grade	Insert Chip Breaker	Cutting Width **ae** ≤.25DC	.25—.5DC	.5—.75DC	DC(Slot)
						Cutting Speed **vc** (SFM)			
P	Mild Steels	≤180HB	● ◐	MP6120	M	460 (330—620)	425 (295—590)	330 (230—395)	330 (230—395)
			● ◐	VP15TF	M	460 (330—620)	425 (295—590)	330 (230—395)	330 (230—395)
			✣	MP6130	M	460 (330—620)	425 (295—590)	330 (230—395)	330 (230—395)
	Carbon Steels Alloy Steels Alloy Tool Steels	180—350HB ≤350HB (Annealing)	● ◐	MP6120	M	395 (295—460)	360 (260—425)	330 (230—395)	330 (230—395)
			● ◐	VP15TF	M	395 (295—460)	360 (260—425)	330 (230—395)	330 (230—395)
			✣	MP6130	M	395 (295—460)	360 (260—425)	330 (230—395)	330 (230—395)
	Pre-hardened Steels	35—45HRC	● ◐	MP6120	M	330 (260—395)	295 (230—360)	260 (195—330)	260 (195—330)
			● ◐	VP15TF	M	330 (260—395)	295 (230—360)	260 (195—330)	260 (195—330)
			✣	MP6130	M	330 (260—395)	295 (230—360)	260 (195—330)	260 (195—330)
M	Austenitic Stainless Steels	≤200HB	○ ◐ ✣	MP7130	M	395 (330—490)	360 (295—460)	295 (230—395)	295 (230—395)
			○ ◐	VP15TF	M	395 (330—490)	360 (295—460)	295 (230—395)	295 (230—395)
		>200HB	○ ◐ ✣	MP7130	M	330 (260—425)	295 (230—395)	230 (165—330)	230 (165—330)
			○ ◐	VP15TF	M	330 (260—425)	295 (230—395)	230 (165—330)	230 (165—330)
	Duplex Stainless Steels	≤280HB	○ ◐ ✣	MP7130	M	330 (260—425)	295 (230—395)	230 (165—330)	230 (165—330)
			○ ◐	VP15TF	M	330 (260—425)	295 (230—395)	230 (165—330)	230 (165—330)
	Ferritic and Martensitic Stainless Steels	—	○ ◐ ✣	MP7130	M	395 (330—490)	360 (295—460)	295 (230—395)	295 (230—395)
			○ ◐	VP15TF	M	395 (330—490)	360 (295—460)	295 (230—395)	295 (230—395)
	Precipitation Hardening Stainless Steels	<450HB	○ ◐ ✣	MP7130	M	295 (230—395)	260 (195—360)	195 (130—295)	195 (130—295)
			○ ◐	VP15TF	M	295 (230—395)	260 (195—360)	195 (130—295)	195 (130—295)
K	Gray Cast Irons	Tensile Strength ≤350MPa	● ◐	MC5020	M	590 (525—720)	560 (490—690)	490 (425—620)	490 (425—620)
			● ◐ ✣	VP15TF	M	425 (330—490)	395 (295—460)	330 (260—395)	330 (260—395)
	Ductile Cast Irons	Tensile Strength ≤800MPa	● ◐	MC5020	M	525 (460—590)	490 (425—560)	425 (360—490)	425 (360—490)
			● ◐ ✣	VP15TF	M	360 (260—460)	330 (230—425)	260 (195—395)	260 (195—395)
N	Aluminum Alloys	Si<5%	● ◐ ✣	TF15	M	1970 (1310—3280)	1970 (1310—3280)	1970 (1310—3280)	1970 (1310—3280)
S	Titanium Alloys (Ti-6Al-4V,etc.)	—	● ◐	MP9120	M	165 (130—230)	165 (130—230)	165 (130—230)	165 (130—230)
			● ◐	VP15TF	M	165 (130—230)	165 (130—230)	165 (130—230)	165 (130—230)
			✣	MP9130	M	130 (100—195)	130 (100—195)	130 (100—195)	130 (100—195)
	Titanium Alloys (Ti-5Al-5V-5Mo-3Cr,etc.)	—	● ◐	MP9120	M	100 (65—130)	100 (65—130)	100 (65—130)	100 (65—130)
			● ◐	VP15TF	M	100 (65—130)	100 (65—130)	100 (65—130)	100 (65—130)
			✣	MP9130	M	100 (65—130)	100 (65—130)	100 (65—130)	100 (65—130)
	Heat Resistant Alloys	—	● ◐	MP9120	M	130 (100—195)	130 (100—195)	130 (100—195)	130 (100—195)
			● ◐	VP15TF	M	130 (100—195)	130 (100—195)	130 (100—195)	130 (100—195)
			✣	MP9130	M	100 (65—130)	100 (65—130)	100 (65—130)	100 (65—130)
H	Hardened Steels	40—55HRC	● ◐ ✣	VP15TF	M	295 (230—330)	280 (195—330)	230 (165—260)	230 (165—260)

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 .5 DC or more.
Note 4) Wet cutting is recommended, when focusing on the surface finish. (Tool 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

Depth of Cut / Feed per Tooth

(inch)

Workpiece Material		Properties	Cutting Width **ae**	Cutting Conditions	Cutter Diameter **DC** ø1.000 (ø25mm) Depth of Cut **ap**	ø1.000 (ø25mm) Feed per Tooth. **fz** (IPT)	ø1.125—ø3.000 (ø28mm-ø80mm) Depth of Cut **ap**	ø1.125—ø3.000 (ø28mm-ø80mm) Feed per Tooth. **fz** (IPT)
P	Mild Steels	≤180HB	≤.25DC	● ● ✲	≤.433	.004—.008	≤.433	.004—.012
			.25—.5DC	● ● ✲	≤.433	.004—.006	≤.433	.004—.010
			.5—.75DC	● ● ✲	≤.315	.003—.005	≤.315	.004—.008
			DC(Slot)	● ● ✲	≤.197	.002—.004	≤.197	.003—.006
	Carbon Steels Alloy Steels Alloy Tool Steels	180—280HB	≤.25DC	● ● ✲	≤.433	.004—.008	≤.433	.004—.012
			.25—.5DC	● ● ✲	≤.433	.004—.006	≤.433	.004—.010
			.5—.75DC	● ● ✲	≤.315	.003—.005	≤.315	.004—.008
			DC(Slot)	● ● ✲	≤.197	.002—.004	≤.197	.003—.006
	Carbon Steels Alloy Steels Alloy Tool Steels	280—350HB ≤350HB (Annealing)	≤.25DC	● ● ✲	≤.433	.004—.006	≤.433	.004—.010
			.25—.5DC	● ● ✲	≤.433	.003—.005	≤.433	.004—.008
			.5—.75DC	● ● ✲	≤.315	.002—.004	≤.315	.004—.006
			DC(Slot)	● ● ✲	≤.197	.002—.004	≤.197	.003—.005
	Pre-hardened Steels	35—45HRC	≤.25DC	● ● ✲	≤.433	.004—.006	≤.433	.004—.010
			.25—.5DC	● ● ✲	≤.433	.003—.005	≤.433	.004—.008
			.5—.75DC	● ● ✲	≤.315	.002—.004	≤.315	.004—.006
			DC(Slot)	● ● ✲	≤.197	.002—.004	≤.197	.003—.005
M	Austenitic Stainless Steels	—	≤.25DC	○ ◔	≤.433	.004—.008	≤.433	.004—.008
				✲	≤.433	.003—.006	≤.433	.003—.006
			.25—.5DC	○ ◔	≤.433	.003—.005	≤.433	.003—.006
				✲	≤.433	.002—.004	≤.433	.003—.005
			.5—.75DC	○ ◔	≤.315	.002—.004	≤.315	.003—.005
				✲	≤.315	.002—.004	≤.315	.002—.004
			DC(Slot)	○ ◔	≤.197	.002—.004	≤.197	.002—.004
				✲	≤.197	.002—.003	≤.197	.002—.003
	Duplex Stainless Steels	≤280HB	≤.25DC	○ ◔	≤.433	.004—.008	≤.433	.004—.008
				✲	≤.433	.003—.006	≤.433	.003—.006
			.25—.5DC	○ ◔	≤.433	.003—.006	≤.433	.003—.006
				✲	≤.433	.003—.005	≤.433	.003—.005
			.5—.75DC	○ ◔	≤.315	.003—.005	≤.315	.003—.005
				✲	≤.315	.002—.004	≤.315	.002—.004
			DC(Slot)	○ ◔	≤.197	.002—.004	≤.197	.002—.004
				✲	≤.197	.002—.003	≤.197	.002—.003
	Ferritic and Martensitic Stainless Steels	—	≤.25DC	○ ◔	≤.433	.004—.008	≤.433	.004—.008
				✲	≤.433	.003—.006	≤.433	.003—.006
			.25—.5DC	○ ◔	≤.433	.003—.006	≤.433	.003—.006
				✲	≤.433	.003—.005	≤.433	.003—.005
			.5—.75DC	○ ◔	≤.315	.003—.005	≤.315	.003—.005
				✲	≤.315	.002—.004	≤.315	.002—.004
			DC(Slot)	○ ◔	≤.197	.002—.004	≤.197	.002—.004
				✲	≤.197	.002—.003	≤.197	.002—.003
	Precipitation Hardening Stainless Steels	<450HB	≤.25DC	○ ◔	≤.433	.004—.006	≤.433	.004—.006
				✲	≤.433	.003—.005	≤.433	.003—.005
			.25—.5DC	○ ◔	≤.433	.003—.005	≤.433	.003—.005
				✲	≤.433	.003—.005	≤.433	.003—.005
			.5—.75DC	○ ◔	≤.315	.002—.004	≤.315	.002—.004
				✲	≤.315	.002—.003	≤.315	.002—.003
			DC(Slot)	○ ◔	≤.197	.002—.004	≤.197	.002—.004
				✲	≤.197	.002—.003	≤.197	.002—.003

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 .5 DC or more.

Note 4) Wet cutting is recommended, when focusing on the surface finish. (Tool 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) :
● : Stable Cutting ◐ : General Cutting ✲ : Unstable Cutting

(inch)

Workpiece Material		Properties	Cutting Width **ae**	Cutting Conditions	Cutter Diameter **DC** ø1.000 (ø25mm) Depth of Cut **ap**	ø1.000 (ø25mm) Feed per Tooth. **fz** (IPT)	ø1.125—ø3.000 (ø28mm-ø80mm) Depth of Cut **ap**	ø1.125—ø3.000 (ø28mm-ø80mm) Feed per Tooth. **fz** (IPT)
K	Gray Cast Irons	Tensile Strength ≤350MPa	≤.25DC	● ◐	≤.433	.004—.008	≤.433	.004—.012
				✲	≤.433	.003—.006	≤.433	.004—.010
			.25—.5DC	● ◐	≤.433	.003—.006	≤.433	.004—.010
				✲	≤.433	.003—.005	≤.433	.004—.008
			.5—.75DC	● ◐	≤.315	.003—.005	≤.315	.004—.008
				✲	≤.315	.002—.004	≤.315	.003—.006
			DC(Slot)	● ◐	≤.197	.002—.004	≤.197	.003—.006
				✲	≤.197	.002—.003	≤.197	.003—.005
	Ductile Cast Irons	Tensile Strength ≤800MPa	≤.25DC	● ◐	≤.433	.004—.008	≤.433	.004—.010
				✲	≤.433	.004—.006	≤.433	.004—.008
			.25—.5DC	● ◐	≤.433	.004—.006	≤.433	.004—.008
				✲	≤.433	.003—.005	≤.433	.004—.006
			.5—.75DC	● ◐	≤.315	.003—.005	≤.315	.004—.006
				✲	≤.315	.002—.004	≤.315	.003—.005
			DC(Slot)	● ◐	≤.197	.002—.004	≤.197	.003—.005
				✲	≤.197	.002—.003	≤.197	.002—.004
N	Aluminum Alloys	Si<5%	≤.25DC	● ◐	≤.433	.004—.010	≤.433	.004—.010
				✲	≤.433	.004—.008	≤.433	.004—.008
			.25—.5DC	● ◐	≤.433	.004—.008	≤.433	.004—.008
				✲	≤.433	.004—.006	≤.433	.004—.006
			.5—.75DC	● ◐	≤.315	.002—.006	≤.315	.003—.006
				✲	≤.315	.002—.006	≤.315	.003—.006
			DC(Slot)	● ◐	≤.197	.002—.006	≤.197	.003—.006
				✲	≤.197	.002—.006	≤.197	.003—.005
S	Titanium Alloys (Ti-6Al-4V,etc.)	—	≤.25DC	● ◐ ✲	≤.433	.003—.006	≤.433	.003—.006
			.25—.5DC	● ◐ ✲	≤.433	.003—.005	≤.433	.003—.005
			.5—.75DC	● ◐ ✲	≤.315	.002—.004	≤.315	.002—.004
			DC(Slot)	● ◐ ✲	≤.197	.002—.004	≤.197	.002—.004
	Titanium Alloys (Ti-5Al-5V-5Mo-3Cr,etc.)	—	≤.25DC	● ◐ ✲	≤.433	.003—.005	≤.433	.003—.005
			.25—.5DC	● ◐ ✲	≤.433	.003—.005	≤.433	.003—.005
			.5—.75DC	● ◐ ✲	≤.315	.002—.004	≤.315	.002—.004
			DC(Slot)	● ◐ ✲	≤.197	.002—.004	≤.197	.002—.004
	Heat Resistant Alloys	—	≤.25DC	● ◐ ✲	≤.433	.003—.005	≤.433	.003—.005
			.25—.5DC	● ◐ ✲	≤.433	.003—.005	≤.433	.003—.005
			.5—.75DC	● ◐ ✲	≤.315	.002—.004	≤.315	.002—.004
			DC(Slot)	● ◐ ✲	≤.197	.002—.004	≤.197	.002—.004
H	Hardened Steels	40—55HRC	≤.25DC	● ◐	≤.197	.003—.006	≤.197	.003—.006
				✲	≤.197	.003—.005	≤.197	.003—.005
			.25—.5DC	● ◐	≤.157	.003—.005	≤.157	.003—.005
				✲	≤.157	.002—.004	≤.157	.002—.004
			.5—.75DC	● ◐	≤.118	.002—.004	≤.118	.002—.004
				✲	≤.118	.002—.004	≤.118	.002—.003
			DC(Slot)	● ◐	≤.079	.002—.004	≤.079	.002—.004
				✲	≤.079	.002—.004	≤.079	.002—.003

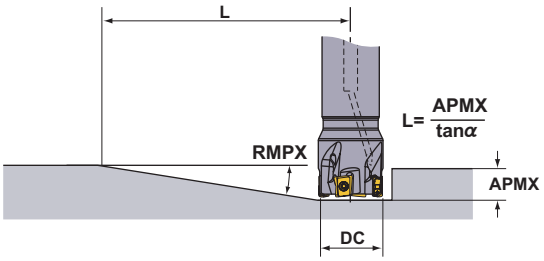
Note 1) These cutting conditions should be referenced for standard shank types (last letter in designation is S) and arbor shank types. If there is chatter, insert chipping, etc. during machining, alter conditions accordingly.
Note 2) Chattering vibration is more likely under the following circumstances. 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 .5 DC or more.
Note 4) Wet cutting is recommended, when focusing on the surface finish. (Tool 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.

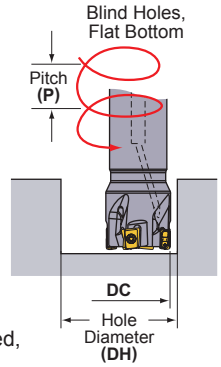
Recommended Cutting Conditions

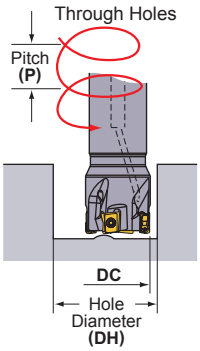
Ramping / Helical Milling

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.

(inch)

Cutting Edge Diameter DC	RE	Ramping		Helical Milling (Blind Hole, Flat Bottom)				Helical Milling (Through Hole)	
		Maximum Ramping Angle RMPX	Minimum * Distance L	Maximum Hole Diameter DH max.	Maximum Pitch P max.	Minimum Hole Diameter DH min.	Maximum Pitch P max.	Minimum Hole Diameter DH min.	Maximum Pitch P max.
1.000	.008	2.07°	12.0	1.963	.109	1.713	.081	1.483	.055
	.016	2.07°	12.0	1.947	.108	1.713	.081	1.483	.055
	.031	2.07°	12.0	1.915	.104	1.713	.081	1.483	.055
	.039	2.07°	12.0	1.900	.102	1.713	.081	1.483	.055
	.047	2.07°	12.0	1.884	.100	1.713	.081	1.483	.055
	.063	2.07°	12.0	1.852	.097	1.713	.081	1.483	.055
	.079	2.07°	12.0	1.821	.093	1.713	.081	1.483	.055
	.094	2.07°	12.0	1.789	.090	1.713	.081	1.483	.055
	.118	2.07°	12.0	1.742	.084	1.713	.081	1.483	.055
	.126	2.07°	12.0	1.726	.082	1.713	.081	1.483	.055
1.125	.008	1.73°	14.4	2.213	.103	1.963	.080	1.726	.057
	.016	1.73°	14.4	2.197	.102	1.963	.080	1.726	.057
	.031	1.73°	14.4	2.165	.099	1.963	.080	1.726	.057
	.039	1.73°	14.4	2.150	.097	1.963	.080	1.726	.057
	.047	1.73°	14.4	2.134	.096	1.963	.080	1.726	.057
	.063	1.73°	14.4	2.102	.093	1.963	.080	1.726	.057
	.079	1.73°	14.4	2.071	.090	1.963	.080	1.726	.057
	.094	1.73°	14.4	2.039	.087	1.963	.080	1.726	.057
	.118	1.73°	14.4	1.992	.082	1.963	.080	1.726	.057
	.126	1.73°	14.4	1.976	.081	1.963	.079	1.726	.057
1.250	.008	1.49°	16.7	2.463	.099	2.214	.079	1.973	.059
	.016	1.49°	16.7	2.447	.098	2.214	.079	1.973	.059
	.031	1.49°	16.7	2.415	.095	2.214	.079	1.973	.059
	.039	1.49°	16.7	2.400	.094	2.214	.079	1.973	.059
	.047	1.49°	16.7	2.384	.093	2.214	.079	1.973	.059
	.063	1.49°	16.7	2.352	.090	2.214	.079	1.973	.059
	.079	1.49°	16.7	2.321	.088	2.214	.079	1.973	.059
	.094	1.49°	16.7	2.289	.085	2.214	.079	1.973	.059
	.118	1.49°	16.7	2.242	.081	2.214	.079	1.973	.059
	.126	1.49°	16.7	2.226	.080	2.214	.079	1.973	.059
1.375	.008	1.28°	19.4	2.713	.094	2.465	.076	2.221	.059
	.016	1.28°	19.4	2.697	.093	2.465	.076	2.221	.059
	.031	1.28°	19.4	2.665	.091	2.465	.076	2.221	.059
	.039	1.28°	19.4	2.650	.089	2.465	.076	2.221	.059
	.047	1.28°	19.4	2.634	.088	2.465	.076	2.221	.059
	.063	1.28°	19.4	2.602	.086	2.465	.076	2.221	.059
	.079	1.28°	19.4	2.571	.084	2.465	.076	2.221	.059
	.094	1.28°	19.4	2.539	.082	2.465	.076	2.221	.059
	.118	1.28°	19.4	2.492	.078	2.465	.077	2.221	.059
	.126	1.28°	19.4	2.476	.077	2.465	.077	2.221	.059

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 .433" is achieved at the maximum ramping angle L (= .433"/tan α).

(inch)

Cutting Edge Diameter **DC**	**RE**	Ramping		Helical Milling (Blind Hole, Flat Bottom)				Helical Milling (Through Hole)	
		Maximum Ramping Angle **RMPX**	Minimum * Distance **L**	Maximum Hole Diameter **DH max.**	Maximum Pitch **P max.**	Minimum Hole Diameter **DH min.**	Maximum Pitch **P max.**	Minimum Hole Diameter **DH min.**	Maximum Pitch **P max.**
1.500	.008	1.13°	22.0	2.963	.091	2.711	.075	2.469	.060
	.016	1.13°	22.0	2.947	.090	2.711	.075	2.469	.060
	.031	1.13°	22.0	2.915	.088	2.711	.075	2.469	.060
	.039	1.13°	22.0	2.900	.087	2.711	.075	2.469	.060
	.047	1.13°	22.0	2.884	.086	2.711	.075	2.469	.060
	.063	1.13°	22.0	2.852	.084	2.711	.075	2.469	.060
	.079	1.13°	22.0	2.821	.082	2.711	.075	2.469	.060
	.094	1.13°	22.0	2.789	.080	2.711	.075	2.469	.060
	.118	1.13°	22.0	2.742	.077	2.711	.075	2.469	.060
	.126	1.13°	22.0	2.726	.076	2.711	.075	2.469	.060
2.000	.008	.78°	31.8	3.963	.084	3.711	.073	3.469	.063
	.016	.78°	31.8	3.947	.083	3.711	.073	3.469	.063
	.031	.78°	31.8	3.915	.082	3.711	.073	3.469	.063
	.039	.78°	31.8	3.900	.081	3.711	.073	3.469	.063
	.047	.78°	31.8	3.884	.081	3.711	.073	3.469	.063
	.063	.78°	31.8	3.852	.079	3.711	.073	3.469	.063
	.079	.78°	31.8	3.821	.078	3.711	.073	3.469	.063
	.094	.78°	31.8	3.789	.077	3.711	.073	3.469	.063
	.118	.78°	31.8	3.742	.075	3.711	.073	3.469	.063
	.126	.78°	31.8	3.726	.074	3.711	.073	3.469	.063
2.500	.008	.59°	42.1	4.963	.080	4.711	.072	4.469	.064
	.016	.59°	42.1	4.947	.079	4.711	.072	4.469	.064
	.031	.59°	42.1	4.915	.078	4.711	.072	4.469	.064
	.039	.59°	42.1	4.900	.078	4.711	.072	4.469	.064
	.047	.59°	42.1	4.884	.077	4.711	.072	4.469	.064
	.063	.59°	42.1	4.852	.076	4.711	.072	4.469	.064
	.079	.59°	42.1	4.821	.075	4.711	.072	4.469	.064
	.094	.59°	42.1	4.789	.074	4.711	.072	4.469	.064
	.118	.59°	42.1	4.742	.073	4.711	.072	4.469	.064
	.126	.59°	42.1	4.726	.072	4.711	.072	4.469	.064
3.000	.008	.48°	51.7	5.955	.078	5.711	.071	5.469	.065
	.016	.48°	51.7	5.939	.077	5.711	.071	5.469	.065
	.031	.48°	51.7	5.907	.077	5.711	.071	5.469	.065
	.039	.48°	51.7	5.892	.076	5.711	.071	5.469	.065
	.047	.48°	51.7	5.876	.076	5.711	.071	5.469	.065
	.063	.48°	51.7	5.844	.075	5.711	.071	5.469	.065
	.079	.48°	51.7	5.813	.074	5.711	.071	5.469	.065
	.094	.48°	51.7	5.781	.073	5.711	.071	5.469	.065
	.118	.48°	51.7	5.734	.072	5.711	.071	5.469	.065
	.126	.48°	51.7	5.718	.072	5.711	.071	5.469	.065

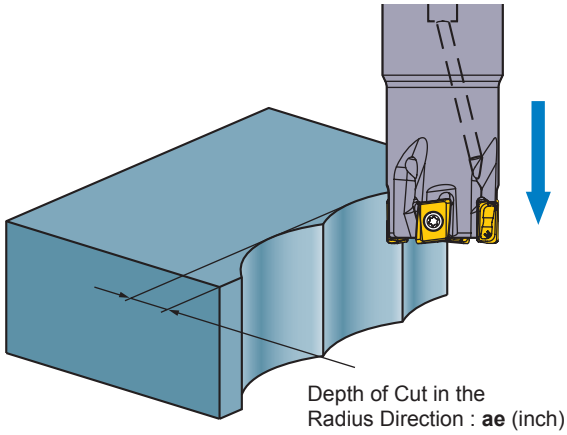
Note 1) When machining a highly ductile workpiece material with the ramping angles in the table above, chips may be elongated.
* Shows the distance until a maximum depth of cut of .433” is achieved at the maximum ramping angle L (= .433”/tan α).

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

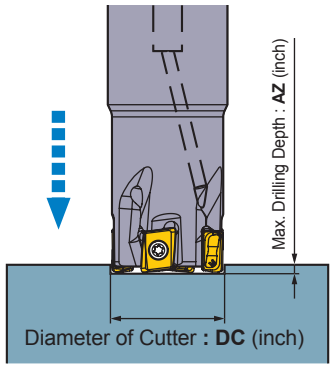


(inch)

DC	ae max.
1.000	.256
1.125	.260
1.250	.260
1.375	.260
1.500	.264
2.000	.264
2.500	.264
3.000	.264

Note 1) No step feed necessary.

● Drilling



(inch)

DC	AZ max.
1.000	.022
1.125	.022
1.250	.022
1.375	.022
1.500	.022
2.000	.022
2.500	.022
3.000	.022

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

Recommended Cutting Conditions

■ VPX200/300 Cutting Speed

Dry Cutting

(inch)

Workpiece Material		Properties	Cutting Conditions	Recommended		Width of Cut **ae**							
						≤0.25DC		0.25-0.5DC		0.5-0.75DC		DC(Slot)	
				1st	2nd	**MV1020**	**MV1030**	**MV1020**	**MV1030**	**MV1020**	**MV1030**	**MV1020**	**MV1030**
P	Mild Steel	Hardness ≤180HB	● ●	L	M	920 (720–1080)	755 (590–885)	885 (690–1050)	720 (560–850)	720 (560–850)	590 (460–690)	720 (560–850)	590 (460–690)
	Carbon Steel Alloy Steel	Hardness 180–280HB	● ●	L	M	720 (560–850)	590 (460–690)	690 (525–785)	560 (425–655)	560 (425–655)	460 (360–525)	560 (425–655)	560 (425–655)
		Hardness 280–350HB	● ●	L	M	590 (460–690)	590 (460–690)	560 (425–655)	560 (425–655)	460 (360–525)	460 (360–525)	460 (360–525)	460 (360–525)
M	Stainless Steel	Hardness ≤200HB	○ ●	L	M	–	590 (460–690)	–	560 (425–655)	–	460 (360–525)	–	460 (360–525)
		Hardness >200HB	○ ●	L	M	–	490 (360–590)	–	460 (330–525)	–	360 (260–425)	–	360 (260–425)
K	Ductile Cast Iron	Tensile Strength ≤450MPa	● ●	M	L	655 (490–920)	490 (330–655)	620 (460–885)	460 (295–620)	560 (425–785)	410 (260–560)	560 (425–785)	330 (260–395)
		Tensile Strength ≤800MPa	● ●	M	L	590 (460–820)	490 (330–655)	560 (425–785)	460 (295–620)	490 (395–690)	410 (260–560)	490 (395–690)	490 (395–690)

Cutting Mode : Wet Cutting

(inch)

Workpiece Material		Properties	Cutting Conditions	Recommended		Width of Cut **ae**							
						≤0.25DC		0.25-0.5DC		0.5-0.75DC		DC(Slot)	
				1st	2nd	**MV1020**	**MV1030**	**MV1020**	**MV1030**	**MV1020**	**MV1030**	**MV1020**	**MV1030**
P	Mild Steel	Hardness ≤180HB	● ●	L	M	690 (490–950)	460 (330–620)	655 (460–885)	425 (295–590)	490 (360–590)	330 (230–395)	490 (360–590)	330 (230–395)
	Carbon Steel Alloy Steel	Hardness 180–280HB	● ●	L	M	590 (460–690)	395 (295–460)	560 (395–655)	360 (260–425)	490 (360–590)	330 (230–395)	490 (360–590)	330 (230–395)
		Hardness 280–350HB	● ●	L	M	460 (360–525)	395 (295–460)	425 (295–490)	360 (260–425)	395 (260–460)	330 (230–395)	395 (260–460)	395 (260–460)
K	Ductile Cast Iron	Tensile Strength ≤450MPa	● ●	M	L	590 (490–785)	425 (260–590)	560 (460–755)	395 (230–560)	490 (425–655)	345 (195–490)	490 (425–655)	345 (195–490)
		Tensile Strength ≤800MPa	● ●	M	L	525 (425–690)	425 (260–590)	490 (395–655)	395 (230–560)	425 (360–560)	345 (195–490)	425 (360–560)	345 (195–490)

Cutting Conditions (Guide) :
● : Stable Cutting ◔ : General Cutting ✤ : Unstable Cutting

■ VPX300 Depth of Cut / Feed per Tooth
Dry and Wet Cutting

(inch)

Workpiece Material		Properties	Width of Cut **ae**	Cutting Conditions	DC			
					ø1.000(ø25mm)		ø1.125—ø3.000(ø28mm—80mm)	
					Depth of Cut **ap**	Feed **fz** (IPT)	Depth of Cut **ap**	Feed **fz** (IPT)
P	Mild Steel	Hardness ≤180HB	≤0.25DC	● ◔	≤.433	.004—.008	≤.433	.004—.012
			0.25—0.5DC	● ◔	≤.433	.004—.006	≤.433	.004—.010
			0.5—0.75DC	● ◔	≤.315	.003—.005	≤.315	.004—.008
			DC(Slot)	● ◔	≤.197	.002—.004	≤.197	.003—.006
	Carbon Steel Alloy Steel	Hardness 180—280HB	≤0.25DC	● ◔	≤.433	.004—.008	≤.433	.004—.012
			0.25—0.5DC	● ◔	≤.433	.004—.006	≤.433	.004—.010
			0.5—0.75DC	● ◔	≤.315	.003—.005	≤.315	.004—.008
			DC(Slot)	● ◔	≤.197	.002—.004	≤.197	.003—.006
		Hardness 280—350HB	≤0.25DC	● ◔	≤.433	.004—.006	≤.433	.004—.010
			0.25—0.5DC	● ◔	≤.433	.003—.005	≤.433	.004—.008
			0.5—0.75DC	● ◔	≤.315	.002—.004	≤.315	.004—.006
			DC(Slot)	● ◔	≤.197	.002—.004	≤.197	.003—.005
M	Stainless Steel	—	≤0.25DC	○ ◔	≤.433	.004—.008	≤.433	.004—.008
			0.25—0.5DC	○ ◔	≤.433	.003—.006	≤.433	.003—.006
			0.5—0.75DC	○ ◔	≤.315	.003—.005	≤.315	.003—.005
			DC(Slot)	○ ◔	≤.197	.002—.004	≤.197	.002—.004
K	Ductile Cast Iron	Tensile Strength ≤800MPa	≤0.25DC	● ◔	≤.433	.004—.008	≤.433	.004—.010
			0.25—0.5DC	● ◔	≤.433	.004—.006	≤.433	.004—.008
			0.5—0.75DC	● ◔	≤.315	.003—.005	≤.315	.004—.006
			DC(Slot)	● ◔	≤.197	.002—.004	≤.197	.003—.005

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.