RECOMMENDED CUTTING CONDITIONS

■ Dry Cutting

Cutting Speed

(mm)

	Work Material	Properties	Cutting Conditions	Grade	ae 0.5DC≥	ae 0.8DC≥	ae DC(Slot)
					Vc (m/min)		
P	Mild Steel	Hardness ≤180HB	●	MP6120	240(200—280)	220(180—260)	200(160—240)
			●	MP6130	230(190—270)	210(170—250)	190(150—230)
			●	MP6130,VP15TF	210(170—250)	190(150—230)	170(130—210)
	Carbon Steel Alloy Steel	Hardness 180—280HB	●	MP6120	210(170—250)	190(150—230)	170(130—210)
			●	MP6130	200(160—240)	180(140—220)	160(120—200)
			●	MP6130,VP15TF	180(140—220)	160(120—200)	140(100—180)
	Carbon Steel Alloy Steel Alloy Tool Steel	Hardness 280—350HB ≤350HB (Annealing)	●	MP6120	200(160—240)	180(140—220)	160(120—200)
			●	MP6130	190(150—230)	170(130—210)	150(110—190)
			●	MP6130,VP15TF	170(130—210)	150(110—190)	130(90—170)
	Pre-hardened Steel	Hardness 35—45HRC	●	MP6120	140(120—160)	—	—
			●	MP6130	120(100—140)	—	—
			●	MP6130,VP15TF	110(90—130)	—	—
M	Austenitic Stainless Steel	Hardness ≤200HB	●	MP7130	180(160—200)	160(140—180)	—
			●	MP7130,VP15TF	170(150—190)	150(130—170)	—
			●	MP7130,VP15TF	150(130—170)	130(110—150)	—
	Austenitic Stainless Steel	Hardness >200HB	●	MP7130	170(150—190)	150(130—170)	—
			●	MP7130,VP15TF	160(140—180)	140(120—160)	—
			●	MP7130,VP15TF	140(120—160)	120(100—140)	—
	Ferritic and Martensitic Stainless Steel	Hardness ≤200HB	●	MP7130	180(160—200)	160(140—180)	—
			●	MP7130,VP15TF	170(150—190)	150(130—170)	—
			●	MP7130,VP15TF	150(130—170)	130(110—150)	—
	Duplex Stainless Steel	Hardness ≤280HB	●	MP7130	160(140—180)	140(120—160)	—
			●	MP7130,VP15TF	150(130—170)	130(110—150)	—
			●	MP7130,VP15TF	130(110—150)	110(90—130)	—
	Precipitation Hardening Stainless Steel	Hardness <450HB	●	MP7130	140(120—160)	—	—
			●	MP7130,VP15TF	130(110—150)	—	—
			●	MP7130,VP15TF	110(90—130)	—	—
K	Gray Cast Iron	Tensile Strength ≤350MPa	●	MC5020	250(210—290)	230(190—270)	210(170—250)
			●	MC5020	240(200—280)	220(180—260)	200(160—240)
			●	VP15TF	240(200—280)	220(180—260)	—
			●	MC5020,VP15TF	220(180—260)	200(160—240)	180(140—220)
	Ductile Cast Iron	Tensile Strength ≤450MPa	●	MC5020	220(180—160)	200(160—240)	180(140—220)
			●	MC5020	210(170—250)	190(150—230)	170(130—210)
			●	VP15TF	210(170—250)	190(150—230)	—
			●	MC5020,VP15TF	190(150—230)	170(130—210)	150(110—190)
	Ductile Cast Iron	Tensile Strength ≤800MPa	●	MC5020	180(140—220)	160(120—200)	140(100—180)
			●	MC5020	170(130—210)	150(110—190)	130(90—170)
			●	VP15TF	170(130—210)	150(110—190)	—
			●	MC5020,VP15TF	150(110—190)	130(90—170)	110(70—150)
H	Hardened Steel	Hardness 40—55HRC	●	VP15TF	50(30—70)	—	—
			●	VP15TF	50(30—70)	—	—

Note 1) The recommended cutting speed has been calculated for a depth of cut of 2mm. Please reduce the cutting speed by an appropriate amount corresponding to the increase in cutting depth.

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

■ Wet Cutting
Cutting Speed

(mm)

	Work Material	Properties	Cutting Conditions	Grade	ae 0.5DC≥	ae 0.8DC≥	ae DC(Slot)
					Vc (m/min)		
P	Mild Steel	Hardness ≤180HB	●	MP6120	150(140—160)	130(120—140)	120(110—130)
			◐	MP6130	140(130—150)	120(110—130)	110(100—120)
			✣	MP6130,VP15TF	120(110—130)	100(90—110)	90(80—100)
	Carbon Steel Alloy Steel	Hardness 180—280HB	●	MP6120	150(140—160)	130(120—140)	120(110—130)
			◐	MP6130	140(130—150)	120(110—130)	110(100—120)
			✣	MP6130,VP15TF	120(110—130)	100(90—110)	90(80—100)
	Carbon Steel Alloy Steel Alloy Tool Steel	Hardness 280—350HB ≤350HB (Annealing)	●	MP6120	140(130—150)	120(110—130)	110(100—120)
			◐	MP6130	130(120—140)	110(100—120)	100(90—110)
			✣	MP6130,VP15TF	110(100—120)	90(80—100)	80(70—90)
	Pre-hardened Steel	Hardness 35—45HRC	●	MP6120	110(100—120)	—	—
			◐	MP6130	100(90—110)	—	—
			✣	MP6130,VP15TF	80(70—90)	—	—
M	Austenitic Stainless Steel	Hardness ≤200HB	●	MP7130	130(120—140)	110(100—120)	—
			◐	MP7130,VP15TF	120(110—130)	100(90—110)	—
			✣	MP7130,VP15TF	100(90—110)	80(70—90)	—
	Austenitic Stainless Steel	Hardness >200HB	●	MP7130	130(120—140)	110(100—120)	—
			◐	MP7130,VP15TF	120(110—130)	100(90—110)	—
			✣	MP7130,VP15TF	100(90—110)	80(70—90)	—
	Ferritic and Martensitic Stainless Steel	Hardness ≤200HB	●	MP7130	130(120—140)	110(100—120)	—
			◐	MP7130,VP15TF	120(110—130)	100(90—110)	—
			✣	MP7130,VP15TF	100(90—110)	80(70—90)	—
	Duplex Stainless Steel	Hardness ≤280HB	●	MP7130	120(110—130)	100(90—110)	—
			◐	MP7130,VP15TF	110(100—120)	90(80—100)	—
			✣	MP7130,VP15TF	90(80—100)	70(60—80)	—
	Precipitation Hardening Stainless Steel	Hardness <450HB	●	MP7130	120(110—130)	—	—
			◐	MP7130,VP15TF	110(100—120)	—	—
			✣	MP7130,VP15TF	90(80—100)	—	—
K	Gray Cast Iron	Tensile Strength ≤350MPa	●	MC5020	170(150—190)	150(130—170)	130(110—150)
			◐	MC5020	160(140—180)	140(120—160)	120(100—140)
			◐	VP15TF	160(140—180)	140(120—160)	—
			✣	MC5020,VP15TF	140(120—160)	120(100—140)	100(80—120)
	Ductile Cast Iron	Tensile Strength ≤450MPa	●	MC5020	170(150—190)	150(130—170)	130(110—150)
			◐	MC5020	160(140—180)	140(120—160)	120(100—140)
			◐	VP15TF	160(140—180)	140(120—160)	—
			✣	MC5020,VP15TF	140(120—160)	120(100—140)	100(80—120)
	Ductile Cast Iron	Tensile Strength ≤800MPa	●	MC5020	160(150—170)	140(130—150)	120(110—130)
			◐	MC5020	150(140—160)	130(120—140)	110(100—120)
			◐	VP15TF	150(140—160)	130(120—140)	—
			✣	MC5020,VP15TF	130(120—140)	110(100—120)	90(80—100)
N	Aluminium Alloy	Si<5%	●	TF15	500(300—900)	500(300—900)	500(300—900)
			◐	TF15	500(300—900)	500(300—900)	500(300—900)
			✣	TF15	400(200—800)	400(200—800)	400(200—800)
S	Titanium Alloy	—	●	MP9120	80(60—100)	—	—
			◐	MP9120	70(50—90)	—	—
			✣	MP9130	60(40—80)	—	—
	Heat Resistant Alloy	—	●	MP9120	60(50—70)	—	—
			◐	MP9120	50(30—60)	—	—
			✣	MP9130	40(20—40)	—	—
H	Hardened Steel	Hardness 40—55HRC	●	VP15TF	50(30—70)	—	—
			◐	VP15TF	50(30—70)	—	—

Note 1) Refer to the above table for cutting conditions according to the applications.

RECOMMENDED CUTTING CONDITIONS

Depth of Cut / Feed per Tooth

	Work Material	Properties	Cutting Conditions	Grade	ae 0.5DC≥ Breaker	ap	fz (mm/t.)
P	Mild Steel	Hardness ≤180HB	●	MP6120	L,M	≤4.0	0.13(0.10—0.15)
			◐	MP6130	L,M	≤4.0	0.13(0.10—0.15)
			◐		M,R	≤4.0	0.16(0.10—0.20)
			✣	MP6130,VP15TF	M,R	≤4.0	0.13(0.10—0.15)
	Carbon Steel Alloy Steel	Hardness 180—280HB	●	MP6120	L,M	≤4.0	0.13(0.10—0.15)
			◐	MP6130	L,M	≤4.0	0.13(0.10—0.15)
			◐		M,R	≤4.0	0.16(0.10—0.20)
			✣	MP6130,VP15TF	M,R	≤4.0	0.13(0.10—0.15)
	Carbon Steel Alloy Steel Alloy Tool Steel	Hardness 280—350HB ≤350HB (Annealing)	●	MP6120	L,M	≤3.0	0.13(0.10—0.15)
			◐	MP6130	L,M	≤3.0	0.13(0.10—0.15)
			◐		M,R	≤3.0	0.16(0.10—0.20)
			✣	MP6130,VP15TF	M,R	≤3.0	0.13(0.10—0.15)
	Pre-hardened Steel	Hardness 35—45HRC	●	MP6120	L,M	≤2.0	0.13(0.10—0.15)
			◐	MP6130	L,M	≤2.0	0.13(0.10—0.15)
			◐		M,R	≤2.0	0.16(0.10—0.20)
			✣	MP6130,VP15TF	M,R	≤2.0	0.13(0.10—0.15)
M	Austenitic Stainless Steel	Hardness ≤200HB	● ◐	MP7130	L,M	≤4.0	0.13(0.10—0.15)
			◐	VP15TF	M	≤4.0	0.16(0.10—0.20)
			✣	MP7130,VP15TF	M	≤4.0	0.13(0.10—0.15)
	Austenitic Stainless Steel	Hardness >200HB	●	MP7130	L,M	≤4.0	0.13(0.10—0.15)
			◐	MP7130	L,M	≤3.0	0.13(0.10—0.15)
			◐	VP15TF	M	≤3.0	0.16(0.10—0.20)
			✣	MP7130,VP15TF	M	≤3.0	0.13(0.10—0.15)
	Ferritic and Martensitic Stainless Steel	Hardness ≤200HB	● ◐	MP7130	L,M	≤4.0	0.13(0.10—0.15)
			◐	VP15TF	M	≤4.0	0.16(0.10—0.20)
			✣	MP7130,VP15TF	M	≤3.0	0.13(0.10—0.15)
	Duplex Stainless Steel	Hardness ≤280HB	● ◐	MP7130	L,M	≤3.0	0.13(0.10—0.15)
			● ◐	MP7130	L,M	≤4.0	0.13(0.10—0.15)
			◐	VP15TF	M	≤3.0	0.16(0.10—0.20)
			◐	VP15TF	M	≤4.0	0.16(0.10—0.20)
			✣	MP7130,VP15TF	M	≤3.0	0.13(0.10—0.15)
			✣	MP7130,VP15TF	M	≤4.0	0.13(0.10—0.15)
	Precipitation Hardening Stainless Steel	Hardness <450HB	●	MP7130	L,M	≤2.0	0.13(0.10—0.15)
			◐	MP7130	L,M	≤2.0	0.13(0.10—0.15)
			◐	VP15TF	M	≤2.0	0.16(0.10—0.20)
			✣	MP7130,VP15TF	M	≤2.0	0.13(0.10—0.15)
K	Gray Cast Iron	Tensile Strength ≤350MPa	● ◐	MC5020	L,M	≤4.0	0.13(0.10—0.15)
			◐	VP15TF	M,R	≤4.0	0.16(0.10—0.20)
			✣	MC5020,VP15TF	M,R	≤4.0	0.13(0.10—0.15)
	Ductile Cast Iron	Tensile Strength ≤800MPa	● ◐	MC5020	L,M	≤4.0	0.13(0.10—0.15)
			◐	VP15TF	M,R	≤4.0	0.16(0.10—0.20)
			✣	MC5020,VP15TF	M,R	≤4.0	0.13(0.10—0.15)
N	Aluminium Alloy	Si<5%	● ◐ ✣	TF15	L	≤4.0	0.13(0.10—0.15)
S	Titanium Alloy	—	● ◐	MP9120	L,M	≤2.0	0.10(0.05—0.13)
			✣	MP9130	L,M	≤2.0	0.10(0.05—0.13)
	Heat Resistant Alloy	—	● ◐	MP9120	L,M	≤2.0	0.10(0.05—0.13)
			✣	MP9130	L,M	≤2.0	0.10(0.05—0.13)
H	Hardened Steel	Hardness 40—55HRC	●	VP15TF	M	≤2.0	0.05(0.05—0.10)
			◐	VP15TF	M,R	≤2.0	0.05(0.05—0.10)

Note 1) Refer to the above table and set up cutting conditions according to cutting applications.

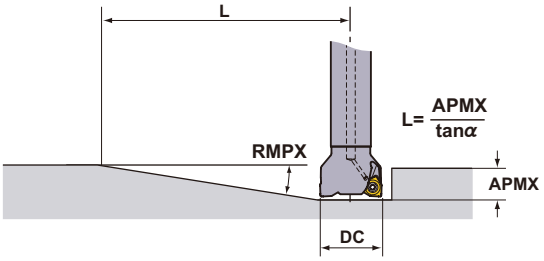
Cutting Conditions (Guide) :
● : Stable Cutting ◐ : General Cutting ✣ : Unstable Cutting

(mm)

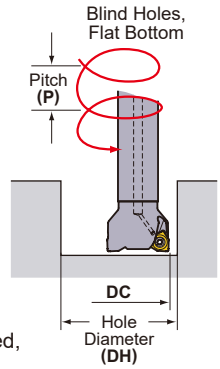
	ae						Cutting Mode
	0.8DC≥			DC(Slot)			
	Breaker	**ap**	**fz** (mm/t.)	Breaker	**ap**	**fz** (mm/t.)	
	L,M	≤3.0	0.13(0.10—0.15)	L,M	≤2.0	0.13(0.10—0.15)	Dry, Wet
	L,M	≤3.0	0.13(0.10—0.15)	L,M	≤2.0	0.13(0.10—0.15)	Dry, Wet
	M,R	≤3.0	0.16(0.10—0.20)	—	—	—	Dry, Wet
	M,R	≤3.0	0.13(0.10—0.15)	M	≤2.0	0.13(0.10—0.15)	Dry, Wet
	L,M	≤3.0	0.13(0.10—0.15)	L,M	≤2.0	0.13(0.10—0.15)	Dry, Wet
	L,M	≤3.0	0.13(0.10—0.15)	L,M	≤2.0	0.13(0.10—0.15)	Dry, Wet
	M,R	≤3.0	0.16(0.10—0.20)	—	—	—	Dry, Wet
	M,R	≤3.0	0.13(0.10—0.15)	M	≤2.0	0.13(0.10—0.15)	Dry, Wet
	L,M	≤3.0	0.13(0.10—0.15)	L,M	≤3.0	0.13(0.10—0.15)	Dry, Wet
	L,M	≤3.0	0.13(0.10—0.15)	L,M	≤2.0	0.13(0.10—0.15)	Dry, Wet
	M,R	≤3.0	0.16(0.10—0.20)	—	—	—	Dry, Wet
	M,R	≤3.0	0.13(0.10—0.15)	M	≤2.0	0.13(0.10—0.15)	Dry, Wet
	—	—	—	—	—	—	Dry, Wet
	—	—	—	—	—	—	Dry, Wet
	—	—	—	—	—	—	Dry, Wet
	—	—	—	—	—	—	Dry, Wet
	L,M	≤3.0	0.13(0.10—0.15)	—	—	—	Dry, Wet
	M	≤3.0	0.16(0.10—0.20)	—	—	—	Dry, Wet
	M	≤3.0	0.13(0.10—0.15)	—	—	—	Dry, Wet
	L,M	≤3.0	0.13(0.10—0.15)	—	—	—	Dry, Wet
	L,M	≤3.0	0.13(0.10—0.15)	—	—	—	Dry, Wet
	M	≤3.0	0.16(0.10—0.20)	—	—	—	Dry, Wet
	M	≤3.0	0.13(0.10—0.15)	—	—	—	Dry, Wet
	L,M	≤3.0	0.13(0.10—0.15)	—	—	—	Dry, Wet
	M	≤3.0	0.16(0.10—0.20)	—	—	—	Dry, Wet
	M	≤3.0	0.13(0.10—0.15)	—	—	—	Dry, Wet
	L,M	≤3.0	0.13(0.10—0.15)	—	—	—	Dry
	L,M	≤3.0	0.13(0.10—0.15)	—	—	—	Wet
	M	≤3.0	0.16(0.10—0.20)	—	—	—	Dry
	M	≤3.0	0.16(0.10—0.20)	—	—	—	Wet
	M	≤3.0	0.16(0.10—0.20)	—	—	—	Dry
	M	≤3.0	0.13(0.10—0.15)	—	—	—	Wet
	—	—	—	—	—	—	Dry, Wet
	—	—	—	—	—	—	Dry, Wet
	—	—	—	—	—	—	Dry, Wet
	—	—	—	—	—	—	Dry, Wet
	L,M	≤3.0	0.13(0.10—0.15)	L,M	≤2.0	0.13(0.10—0.15)	Dry, Wet
	M,R	≤3.0	0.16(0.10—0.20)	—	—	—	Dry, Wet
	M,R	≤3.0	0.13(0.10—0.15)	M,R	≤2.0	0.13(0.10—0.15)	Dry, Wet
	L,M	≤3.0	0.13(0.10—0.15)	L,M	≤2.0	0.13(0.10—0.15)	Dry, Wet
	M,R	≤3.0	0.16(0.10—0.20)	—	—	—	Dry, Wet
	M,R	≤3.0	0.13(0.10—0.15)	M,R	≤2.0	0.13(0.10—0.15)	Dry, Wet
	L	≤3.0	0.13(0.10—0.15)	L	≤2.0	0.13(0.10—0.15)	Wet
	—	—	—	—	—	0.10(0.05—0.13)	Wet
	—	—	—	—	—	0.10(0.05—0.13)	Wet
	—	—	—	—	—	0.10(0.05—0.13)	Wet
	—	—	—	—	—	0.10(0.05—0.13)	Wet
	—	—	—	—	—	0.05(0.05—0.10)	Dry, Wet
	—	—	—	—	—	0.05(0.05—0.10)	Dry, Wet

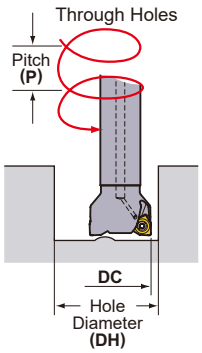
■ Ramping / Helical Milling

● 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)

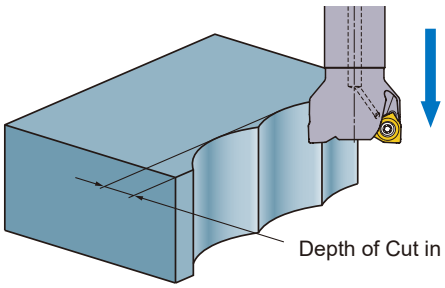
DC	RE	APMX	Ramping		Helical Milling (Blind Hole, Flat Bottom)				Helical Milling (Through Hole)	
			RMPX	L *	DH max.	P max.	DH min.	P max.	DH min.	P max.
50	0.4	8	0.40°	1175	98.5	1.06	95.2	0.99	82.5	0.7
50	0.8	8	0.40°	1175	97.7	1.05	95.2	0.99	82.5	0.7
63	0.4	8	0.26°	1807	124.5	0.88	121.2	0.83	108.6	0.6
63	0.8	8	0.26°	1807	123.7	0.87	121.2	0.83	108.6	0.6
80	0.4	8	0.16°	2936	158.5	0.69	155.2	0.66	142.6	0.5
80	0.8	8	0.16°	2936	157.7	0.68	155.3	0.66	142.6	0.5

DC = Cutting Diameter
APMX = Depth of Cut Max.
RMPX = Ramping Angle Max.
DH = Desired Hole Diameter
P = Pitch

Note 1) When ramping and helical milling, it is recommended to reduce the feed per tooth.
Note 2) When ramping and helical milling, long continuous chips may be dispersed, take cautionary measures.

<Helical Milling>
To obtain a flat bottom surface when helical milling, it is required to remove “the uncut part” in the centre of the work material during a final pass. When helical milling, make sure that the depth of cut per helical pass doesn’t exceed the maximum depth of cut (**APMX**).

● Plunging



Depth of Cut in the Radial Direction : **ae** = 8mm