

Cutting Conditions (Guide) :

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

RECOMMENDED CUTTING CONDITIONS

Cutting Speed

(mm)

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

Note 1) 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
- 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.

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ROTATING TOOLS

RECOMMENDED CUTTING CONDITIONS

■ Depth of Cut / Feed per Tooth

(mm)

Work Material	Properties	ae	Cutting Conditions	DC				
				ø20—ø28		ø32—ø50		
				ap	fz (mm/t.)	ap	fz (mm/t.)	
P	Mild Steel	Hardness ≤180HB	≤0.25DC	● ● ● ●	≤14	0.13(0.10—0.15)	≤APMX	0.15(0.10—0.20)
			0.25—0.5DC	● ● ● ●	≤8	0.10(0.08—0.12)	≤28	0.13(0.10—0.15)
			0.5—0.75DC	● ● ● ●	≤6	0.10(0.08—0.12)	≤14	0.10(0.08—0.12)
			DC(Slot)	● ● ● ●	≤4	0.08(0.06—0.10)	≤4	0.08(0.06—0.10)
	Carbon Steel Alloy Steel	Hardness 180—280HB	≤0.25DC	● ● ● ●	≤14	0.13(0.10—0.15)	≤APMX	0.15(0.10—0.20)
			0.25—0.5DC	● ● ● ●	≤8	0.10(0.08—0.12)	≤28	0.13(0.10—0.15)
			0.5—0.75DC	● ● ● ●	≤6	0.10(0.08—0.12)	≤14	0.10(0.08—0.12)
			DC(Slot)	● ● ● ●	≤4	0.08(0.06—0.10)	≤4	0.08(0.06—0.10)
	Carbon Steel Alloy Steel	Hardness 280—350HB	≤0.25DC	● ● ● ●	≤14	0.13(0.10—0.15)	≤APMX	0.13(0.10—0.15)
			0.25—0.5DC	● ● ● ●	≤8	0.10(0.08—0.12)	≤28	0.10(0.08—0.12)
			0.5—0.75DC	● ● ● ●	≤6	0.10(0.08—0.12)	≤14	0.08(0.06—0.10)
			DC(Slot)	● ● ● ●	≤4	0.08(0.06—0.10)	≤4	0.08(0.06—0.10)
	Pre-hardened Steel	Hardness 35—45HRC	≤0.25DC	● ● ● ●	≤14	0.13(0.10—0.15)	≤APMX	0.13(0.10—0.15)
			0.25—0.5DC	● ● ● ●	≤8	0.10(0.08—0.12)	≤28	0.10(0.08—0.12)
			0.5—0.75DC	● ● ● ●	≤6	0.10(0.08—0.12)	≤14	0.08(0.06—0.10)
			DC(Slot)	● ● ● ●	≤4	0.08(0.06—0.10)	≤4	0.08(0.06—0.10)
M	Austenitic Stainless Steel	—	≤0.25DC	● ● ● ●	≤14	0.13(0.10—0.15)	≤APMX	0.15(0.10—0.20)
				● ● ● ●	≤14	0.10(0.08—0.12)	≤APMX	0.12(0.08—0.15)
			0.25—0.5DC	● ● ● ●	≤8	0.10(0.08—0.12)	≤28	0.12(0.08—0.15)
				● ● ● ●	≤8	0.08(0.06—0.10)	≤28	0.10(0.08—0.12)
			0.5—0.75DC	● ● ● ●	≤6	0.08(0.06—0.10)	≤14	0.10(0.08—0.12)
				● ● ● ●	≤6	0.07(0.06—0.08)	≤14	0.08(0.06—0.10)
			DC(Slot)	● ● ● ●	≤4	0.08(0.06—0.10)	≤4	0.08(0.06—0.10)
				● ● ● ●	≤4	0.07(0.06—0.08)	≤4	0.07(0.06—0.08)
	Ferritic and Martensitic Stainless Steel	Hardness ≤200HB	≤0.25DC	● ● ● ●	≤14	0.13(0.10—0.15)	≤APMX	0.15(0.10—0.20)
				● ● ● ●	≤14	0.10(0.08—0.12)	≤APMX	0.12(0.08—0.15)
			0.25—0.5DC	● ● ● ●	≤8	0.10(0.08—0.12)	≤28	0.12(0.08—0.15)
				● ● ● ●	≤8	0.08(0.06—0.10)	≤28	0.10(0.08—0.12)
			0.5—0.75DC	● ● ● ●	≤6	0.08(0.06—0.10)	≤14	0.10(0.08—0.12)
				● ● ● ●	≤6	0.07(0.06—0.08)	≤14	0.08(0.06—0.10)
			DC(Slot)	● ● ● ●	≤4	0.08(0.06—0.10)	≤4	0.08(0.06—0.10)
				● ● ● ●	≤4	0.07(0.06—0.08)	≤4	0.07(0.06—0.08)
	Duplex Stainless Steel	Hardness ≤280HB	≤0.25DC	● ● ● ●	≤14	0.13(0.10—0.15)	≤APMX	0.15(0.10—0.20)
				● ● ● ●	≤14	0.10(0.08—0.12)	≤APMX	0.12(0.08—0.15)
			0.25—0.5DC	● ● ● ●	≤8	0.10(0.08—0.12)	≤28	0.12(0.08—0.15)
				● ● ● ●	≤8	0.08(0.06—0.10)	≤28	0.10(0.08—0.12)
			0.5—0.75DC	● ● ● ●	≤6	0.08(0.06—0.10)	≤14	0.10(0.08—0.12)
				● ● ● ●	≤6	0.07(0.06—0.08)	≤14	0.08(0.06—0.10)
			DC(Slot)	● ● ● ●	≤4	0.08(0.06—0.10)	≤4	0.08(0.06—0.10)
				● ● ● ●	≤4	0.07(0.06—0.08)	≤4	0.07(0.06—0.08)
Precipitation Hardening Stainless Steel	Hardness <450HB	≤0.25DC	● ● ● ●	≤14	0.13(0.10—0.15)	≤APMX	0.13(0.10—0.15)	
			● ● ● ●	≤14	0.10(0.08—0.12)	≤APMX	0.10(0.08—0.12)	
		0.25—0.5DC	● ● ● ●	≤8	0.10(0.08—0.12)	≤28	0.10(0.08—0.12)	
			● ● ● ●	≤8	0.08(0.06—0.10)	≤28	0.10(0.08—0.12)	
		0.5—0.75DC	● ● ● ●	≤6	0.08(0.06—0.10)	≤14	0.08(0.06—0.10)	
			● ● ● ●	≤6	0.07(0.06—0.08)	≤14	0.07(0.06—0.08)	
		DC(Slot)	● ● ● ●	≤4	0.08(0.06—0.10)	≤4	0.08(0.06—0.10)	
			● ● ● ●	≤4	0.07(0.06—0.08)	≤4	0.07(0.06—0.08)	

Cutting Conditions (Guide) :

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

								(mm)
Work Material	Properties	ae	Cutting Conditions	DC				
				ø20—ø28		ø32—ø50		
				ap	fz (mm/t.)	ap	fz (mm/t.)	
K	Gray Cast Iron	Tensile Strength ≤350MPa	≤0.25DC	● ●	≤14	0.13(0.10—0.15)	≤APMX	0.15(0.10—0.20)
				● ✖	≤14	0.10(0.08—0.12)	≤APMX	0.12(0.08—0.15)
			0.25—0.5DC	● ●	≤8	0.10(0.08—0.12)	≤28	0.12(0.08—0.15)
				● ✖	≤8	0.08(0.06—0.10)	≤28	0.10(0.08—0.12)
			0.5—0.75DC	● ●	≤6	0.10(0.08—0.12)	≤14	0.10(0.08—0.12)
				● ✖	≤6	0.08(0.06—0.10)	≤14	0.08(0.06—0.10)
		DC(Slot)	● ●	≤4	0.08(0.06—0.10)	≤4	0.08(0.06—0.10)	
		● ✖	≤4	0.07(0.06—0.08)	≤4	0.07(0.06—0.08)		
	Ductile Cast Iron	—	≤0.25DC	● ●	≤14	0.13(0.10—0.15)	≤APMX	0.15(0.10—0.20)
				● ✖	≤14	0.10(0.08—0.12)	≤APMX	0.13(0.10—0.15)
			0.25—0.5DC	● ●	≤8	0.10(0.08—0.12)	≤28	0.13(0.10—0.15)
				● ✖	≤8	0.08(0.06—0.10)	≤28	0.10(0.08—0.12)
0.5—0.75DC			● ●	≤6	0.10(0.08—0.12)	≤14	0.10(0.08—0.12)	
			● ✖	≤6	0.08(0.06—0.10)	≤14	0.08(0.06—0.10)	
	DC(Slot)	● ●	≤4	0.08(0.06—0.10)	≤4	0.08(0.06—0.10)		
	● ✖	≤4	0.07(0.06—0.08)	≤4	0.07(0.06—0.08)			
N	Aluminium Alloy	Content Si<5%	≤0.25DC	● ●	≤14	0.15(0.10—0.20)	≤APMX	0.18(0.10—0.25)
				● ✖	≤14	0.13(0.10—0.15)	≤APMX	0.15(0.10—0.20)
			0.25—0.5DC	● ●	≤8	0.13(0.10—0.15)	≤28	0.15(0.10—0.20)
				● ✖	≤8	0.10(0.08—0.12)	≤28	0.13(0.10—0.15)
			0.5—0.75DC	● ●	≤6	0.10(0.08—0.12)	≤14	0.11(0.06—0.15)
				● ✖	≤6	0.08(0.06—0.10)	≤14	0.11(0.06—0.15)
		DC(Slot)	● ●	≤4	0.08(0.06—0.10)	≤4	0.11(0.06—0.15)	
		● ✖	≤4	0.07(0.06—0.08)	≤4	0.09(0.06—0.12)		
S	Titanium Alloy (Ti-6Al-4V etc.)	—	≤0.25DC	● ● ✖	≤14	0.12(0.08—0.15)	≤APMX	0.12(0.08—0.15)
			0.25—0.5DC	● ● ✖	≤8	0.10(0.08—0.12)	≤28	0.10(0.08—0.12)
			0.5—0.75DC	● ● ✖	≤6	0.08(0.06—0.10)	≤14	0.08(0.06—0.10)
			DC(Slot)	● ● ✖	≤4	0.08(0.06—0.10)	≤4	0.08(0.06—0.10)
	Titanium Alloy (Ti-5Al-5V-5Mo-3Cr etc.)	—	≤0.25DC	● ● ✖	≤14	0.10(0.08—0.12)	≤APMX	0.10(0.08—0.12)
			0.25—0.5DC	● ● ✖	≤8	0.10(0.08—0.12)	≤28	0.10(0.08—0.12)
			0.5—0.75DC	● ● ✖	≤6	0.08(0.06—0.10)	≤14	0.08(0.06—0.10)
			DC(Slot)	● ● ✖	≤4	0.08(0.06—0.10)	≤4	0.08(0.06—0.10)
	Heat Resistant Alloy	—	≤0.25DC	● ● ✖	≤14	0.10(0.08—0.12)	≤APMX	0.10(0.08—0.12)
			0.25—0.5DC	● ● ✖	≤8	0.10(0.08—0.12)	≤28	0.10(0.08—0.12)
			0.5—0.75DC	● ● ✖	≤6	0.08(0.06—0.10)	≤14	0.08(0.06—0.10)
			DC(Slot)	● ● ✖	≤4	0.08(0.06—0.10)	≤4	0.08(0.06—0.10)

Note 1) 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
- 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.)

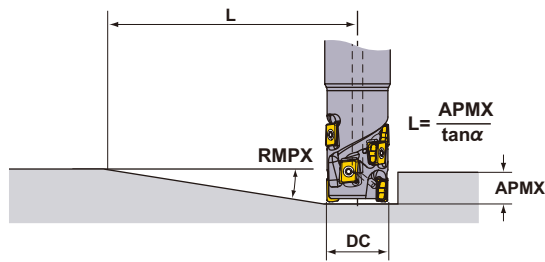
Note 5) When using higher than recommended cutting conditions, or for long periods of time, the clamp screw may become fatigued and break during machining. Please change out the clamp screw periodically.

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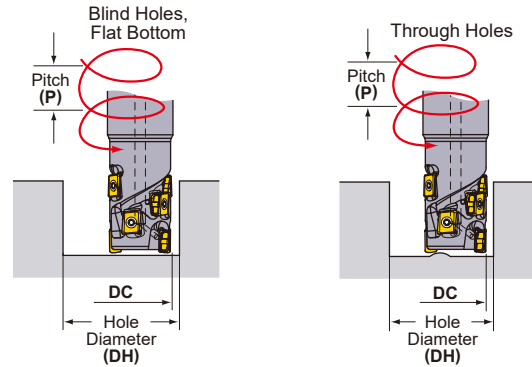
ROTATING TOOLS

■ 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)
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
32	0.2	0.71°	646	62.8	1.2	59.4	1.1	56.0	0.9
	0.4	0.71°	646	62.4	1.2	59.4	1.1	56.0	0.9
	0.8	0.71°	646	61.6	1.2	59.4	1.1	56.0	0.9
	1.0	0.71°	646	61.2	1.1	59.4	1.1	56.0	0.9
	1.2	0.71°	646	60.8	1.1	59.4	1.1	56.0	0.9
	1.6	0.71°	646	60.0	1.1	59.4	1.1	56.0	0.9
35	0.2	0.63°	728	69.0	1.2	65.5	1.1	62.0	0.9
	0.4	0.63°	728	68.6	1.2	65.5	1.1	62.0	0.9
	0.8	0.63°	728	67.8	1.1	65.5	1.1	62.0	0.9
	1.0	0.63°	728	67.4	1.1	65.5	1.1	62.0	0.9
	1.2	0.63°	728	67.0	1.1	65.5	1.1	62.0	0.9
	1.6	0.63°	728	66.2	1.1	65.5	1.1	62.0	0.9
40	0.2	0.54°	849	78.8	1.2	75.4	1.0	72.0	0.9
	0.4	0.54°	849	78.4	1.1	75.4	1.0	72.0	0.9
	0.8	0.54°	849	77.6	1.1	75.4	1.0	72.0	0.9
	1.0	0.54°	849	77.2	1.1	75.4	1.0	72.0	0.9
	1.2	0.54°	849	76.8	1.1	75.4	1.0	72.0	0.9
	1.6	0.54°	849	76.0	1.1	75.4	1.0	72.0	0.9
50	0.2	0.42°	1092	98.8	1.1	95.4	1.0	92.0	1.0
	0.4	0.42°	1092	98.4	1.1	95.4	1.0	92.0	1.0
	0.8	0.42°	1092	97.6	1.1	95.4	1.0	92.0	1.0
	1.0	0.42°	1092	97.2	1.1	95.4	1.0	92.0	1.0
	1.2	0.42°	1092	96.8	1.1	95.4	1.0	92.0	1.0
	1.6	0.42°	1092	96.0	1.1	95.4	1.0	92.0	1.0

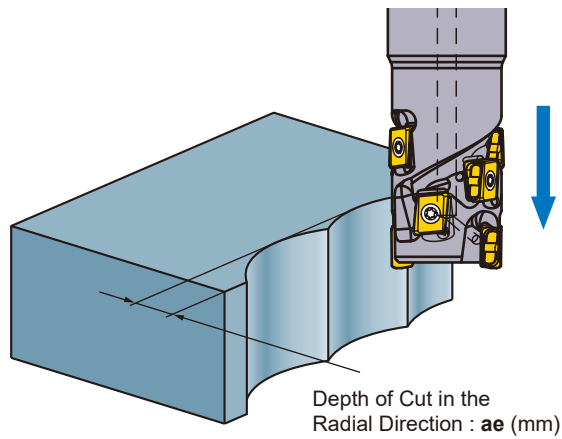
Note 1) When machining a highly ductile work material with the ramping angles in the table above, chips may be elongated.

* Shows the distance until a maximum depth of cut of 8 mm is achieved at the maximum ramping angle $L (= 8/\tan \alpha)$.

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.

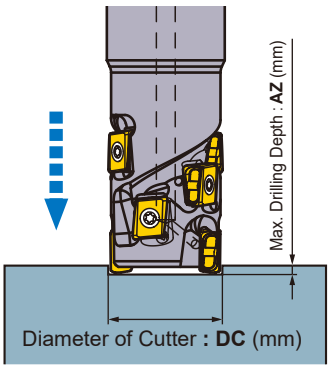
● Plunging



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

Note 1) No step feed necessary.

● Drilling



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