Recommended Cutting Conditions

Cutting Speed

(inch)

	Work Material		Grade	Breaker	vc (SFM)
P	Mild Steel	≤180HB	**MP6120**	**GM**	655 (490—720)
P	Carbon Steel Alloy Steel	180—280HB	**MP6120**	**GM**	655 (490—720)
N	Aluminum Alloy	Si<5%	**TF15 LC15TF**	**GL**	3280 (655—9840)
N	Aluminum Alloy	Si<5%	**TF15 MP9120**	**GM**	3280 (655—9840)
N	Aluminum Alloy	5%≤Si≤10% Si>10%	**MP9120**	**GM**	3280 (655—9840)
S	Titanium Alloy	—	**MP9120**	**GM**	130 (100—195)

Feed per Tooth

(inch)

	Work Material		Breaker	ae	ap	Feed per Tooth (IPT) Cutting Edge Diameter **DC**					
						— 20mm	1.000" 25,28mm	1.250" 32,35mm	1.500" 40mm	2.000"—3.000" 50—80mm	4.000",5.000" 100,125mm
P	Mild Steel	≤180HB	**GM**	≤ .25 DC	≤ .197	≤ .002	≤ .006	≤ .006	≤ .007	≤ .007	≤ .007
					≤ .394	≤ .002	≤ .005	≤ .005	≤ .006	≤ .006	≤ .006
					≤ .571	≤ .002	≤ .004	≤ .004	≤ .005	≤ .005	—
				≤ .5 DC	≤ .197	≤ .002	≤ .005	≤ .006	≤ .006	≤ .007	≤ .007
					≤ .394	—	≤ .004	≤ .005	≤ .005	≤ .006	≤ .006
					≤ .571	—	≤ .003	≤ .004	≤ .004	≤ .005	—
				≤ .75 DC	≤ .197	≤ .002	≤ .005	≤ .005	≤ .006	≤ .006	≤ .006
					≤ .394	—	≤ .004	≤ .004	≤ .005	≤ .005	≤ .005
				DC (Slot)	≤ .197	≤ .002	≤ .004	≤ .005	≤ .005	≤ .006	≤ .006
	Carbon Steel Alloy Steel	180—280HB	**GM**	≤ .25 DC	≤ .197	≤ .002	≤ .006	≤ .006	≤ .007	≤ .007	≤ .007
					≤ .394	≤ .002	≤ .005	≤ .005	≤ .006	≤ .006	≤ .006
					≤ .571	≤ .002	≤ .004	≤ .004	≤ .005	≤ .005	—
				≤ .5 DC	≤ .197	≤ .002	≤ .005	≤ .006	≤ .006	≤ .007	≤ .007
					≤ .394	—	≤ .004	≤ .005	≤ .005	≤ .006	≤ .006
					≤ .571	—	≤ .003	≤ .004	≤ .004	≤ .005	—
				≤ .75 DC	≤ .197	≤ .002	≤ .005	≤ .005	≤ .006	≤ .006	≤ .006
					≤ .394	—	≤ .004	≤ .004	≤ .005	≤ .005	≤ .005
				DC (Slot)	≤ .197	≤ .002	≤ .004	≤ .005	≤ .005	≤ .006	≤ .006

(Note 1) The above cutting conditions are determined based on high workpiece and machine rigidity, where no vibration occurred.
If vibrations occur make adjustments according to the machining conditions.

(Note 2) Note, vibrations may occur in the following conditions.

- When using long tool overhang.
- When pocket machining corner radii.
- When the workpiece has poor clamping rigidity or when the machine rigidity or workpiece rigidity is low, vibrations can occur easily, if so, reduce cutting conditions such as width and depth of cut and feed per tooth.

(inch)

Work Material			Breaker	ae	ap	Feed per Tooth (IPT)					
						Cutting Edge Diameter **DC**					
							1.000"	**1.250"**	**1.500"**	**2.000"−3.000"**	**4.000",5.000"**
						20mm	**25,28mm**	**32,35mm**	**40mm**	**50−80mm**	**100,125mm**
N	Aluminum Alloy	**Si<5%**	**GL**	≤ .25 DC	≤ .197	≤ .002	≤ .010	≤ .010	≤ .010	≤ .010	≤ .010
					≤ .394	≤ .002	≤ .008	≤ .008	≤ .008	≤ .008	≤ .008
					≤ .571	≤ .002	≤ .006	≤ .006	≤ .006	≤ .006	≤ .006
				≤ .5 DC	≤ .197	≤ .002	≤ .010	≤ .010	≤ .010	≤ .010	≤ .010
					≤ .394	—	≤ .008	≤ .008	≤ .008	≤ .008	≤ .008
					≤ .571	—	≤ .006	≤ .006	≤ .006	≤ .006	≤ .006
				≤ .75 DC	≤ .197	≤ .002	≤ .010	≤ .010	≤ .010	≤ .010	≤ .010
					≤ .394	—	≤ .008	≤ .008	≤ .008	≤ .008	≤ .008
					≤ .571	—	≤ .006	≤ .006	≤ .006	≤ .006	≤ .006
				DC (Slot)	≤ .197	≤ .002	≤ .010	≤ .010	≤ .010	≤ .010	≤ .010
		Si<5%	**GM**	≤ .25 DC	≤ .197	≤ .002	≤ .014	≤ .014	≤ .016	≤ .016	≤ .016
					≤ .394	≤ .002	≤ .012	≤ .012	≤ .014	≤ .014	≤ .014
					≤ .571	≤ .002	≤ .010	≤ .010	≤ .012	≤ .012	≤ .012
				≤ .5 DC	≤ .197	≤ .002	≤ .014	≤ .014	≤ .014	≤ .016	≤ .016
					≤ .394	—	≤ .012	≤ .012	≤ .012	≤ .014	≤ .014
					≤ .571	—	≤ .008	≤ .010	≤ .010	≤ .012	≤ .012
				≤ .75 DC	≤ .197	≤ .002	≤ .012	≤ .012	≤ .012	≤ .014	≤ .014
					≤ .394	—	≤ .010	≤ .010	≤ .010	≤ .012	≤ .012
					≤ .571	—	≤ .008	≤ .008	≤ .008	≤ .010	≤ .010
				DC (Slot)	≤ .197	≤ .002	≤ .010	≤ .010	≤ .012	≤ .014	≤ .014
		5%≤Si≤10% Si>10%	**GM**	≤ .25 DC	≤ .197	≤ .002	≤ .014	≤ .014	≤ .016	≤ .016	≤ .016
					≤ .394	≤ .002	≤ .012	≤ .012	≤ .014	≤ .014	≤ .014
					≤ .571	≤ .002	≤ .010	≤ .010	≤ .012	≤ .012	≤ .012
				≤ .5 DC	≤ .197	≤ .002	≤ .014	≤ .014	≤ .014	≤ .016	≤ .016
					≤ .394	—	≤ .012	≤ .012	≤ .012	≤ .014	≤ .014
					≤ .571	—	≤ .008	≤ .010	≤ .010	≤ .012	≤ .012
				≤ .75 DC	≤ .197	≤ .002	≤ .012	≤ .012	≤ .012	≤ .014	≤ .014
					≤ .394	—	≤ .010	≤ .010	≤ .010	≤ .012	≤ .012
					≤ .571	—	≤ .008	≤ .008	≤ .008	≤ .010	≤ .010
				DC (Slot)	≤ .197	≤ .002	≤ .010	≤ .010	≤ .012	≤ .014	≤ .014
S	Titanium Alloy	—	**GM**	≤ .25 DC	≤ .197	≤ .002	≤ .004	≤ .004	≤ .004	≤ .004	≤ .004
					≤ .394	≤ .002	≤ .004	≤ .004	≤ .004	≤ .004	≤ .004
					≤ .571	≤ .002	≤ .004	≤ .004	≤ .004	≤ .004	≤ .004
				≤ .5 DC	≤ .197	≤ .002	≤ .003	≤ .004	≤ .004	≤ .004	≤ .004
					≤ .394	—	≤ .003	≤ .004	≤ .004	≤ .004	≤ .004
					≤ .571	—	≤ .003	≤ .004	≤ .004	≤ .004	≤ .004
				≤ .75 DC	≤ .197	≤ .002	≤ .002	≤ .003	≤ .004	≤ .004	≤ .004
					≤ .394	—	≤ .002	≤ .003	≤ .004	≤ .004	≤ .004
					≤ .571	—	≤ .002	≤ .003	≤ .004	≤ .004	≤ .004
				DC (Slot)	≤ .197	≤ .002	≤ .002	≤ .002	≤ .002	≤ .002	≤ .002

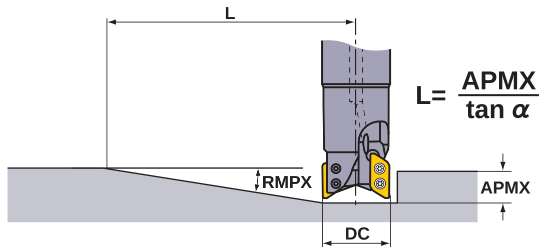
(Note 1) The above cutting conditions are determined based on high workpiece and machine rigidity, where no vibration occurred. If vibrations occur make adjustments according to the machining conditions.

(Note 2) Note, vibrations may occur in the following conditions.

- When using long tool overhang.
- When pocket machining corner radii.
- When the workpiece has poor clamping rigidity or when the machine rigidity or workpiece rigidity is low, vibrations can occur easily, if so, reduce cutting conditions such as width and depth of cut and feed per tooth.

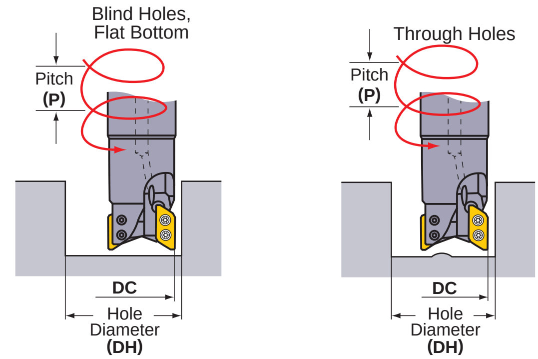
Ramping / Helical Cutting (Aluminum Alloy)

Ramping



$$L = \frac{APMX}{\tan \alpha}$$

Helical Cutting



(inch)

Type	DC	RE	Ramping		Helical Cutting (Blind Hole, Flat Bottom)				Helical Cutting (Through Hole)	
			RMPX	L *1	DH max.	P max.	DH min.	P max.	DH min.	P max.
A Type	.787 [20mm]	.016—.047	20.7°	1.65	1.524 *2	.551	1.421	.551	.866	.079
		.063—.094	19.9°	1.69	1.429 *3	.512	1.362	.512	.866	.079
		.118—.125	18.9°	1.81	1.319 *4	.472	1.311	.472	.866	.039
	1.000	.016—.047	22.6°	1.50	1.949 *2	.551	1.832	.551	1.267	.315
		.063—.094	22.1°	1.54	1.854 *3	.512	1.766	.512	1.267	.315
		.118—.125	20.7°	1.65	1.728 *4	.472	1.707	.472	1.267	.315
	1.102 [28mm]	.016—.047	19.2°	1.77	2.154 *2	.551	2.047	.551	1.417	.315
		.063—.094	18.5°	1.85	2.059 *3	.512	1.984	.512	1.417	.315
		.118—.125	16.7°	2.05	1.949 *4	.472	1.925	.472	1.417	.276
	1.250	.016—.047	15.6°	2.20	2.449 *2	.551	2.331	.551	1.762	.433
		.063—.094	14.9°	2.32	2.354 *3	.512	2.264	.512	1.762	.394
		.118—.125	14.0°	2.48	2.244 *4	.472	2.203	.472	1.762	.394
	1.378 [35mm]	.016—.047	13.4°	2.60	2.705 *2	.551	2.591	.551	1.969	.433
		.063—.094	12.7°	2.71	2.610 *3	.512	2.531	.512	1.969	.394
		.118—.125	11.8°	2.95	2.500 *4	.472	2.472	.472	1.969	.354
	1.500	.016—.047	13.0°	2.68	2.933 *2	.551	2.827	.551	2.262	.512
		.063—.094	12.3°	2.83	2.839 *3	.512	2.760	.512	2.262	.512
		.118—.125	11.6°	2.99	2.728 *4	.472	2.701	.472	2.262	.472
	2.000	.016—.047	8.7°	4.02	3.933 *2	.551	3.827	.551	3.258	.551
		.063—.094	8.2°	4.25	3.839 *3	.512	3.757	.512	3.257	.512
		.118—.125	7.6°	4.61	3.728 *4	.472	3.696	.472	3.257	.472
	2.500	.016—.047	6.6°	5.28	4.933 *2	.551	4.824	.551	4.259	.551
		.063—.094	6.1°	5.75	4.839 *3	.512	4.756	.512	4.259	.512
		.118—.125	5.7°	6.14	4.728 *4	.472	4.695	.472	4.258	.472
	3.000	.016—.047	5.3°	6.61	5.933 *2	.551	5.824	.551	5.260	.551
		.063—.094	4.9°	7.13	5.839 *3	.512	5.756	.512	5.260	.512
		.118—.125	4.5°	7.76	5.728 *4	.472	5.746	.472	5.259	.472
	4.000	.016—.047	3.8°	9.21	7.933 *2	.551	7.824	.551	7.261	.551
		.063—.094	3.5°	10.00	7.839 *3	.512	7.755	.512	7.261	.512
		.118—.125	3.2°	10.94	7.728 *4	.472	7.694	.472	7.260	.472
	5.000	.016—.047	2.9°	12.05	9.933 *2	.551	9.823	.551	9.261	.551
		.063—.094	2.7°	12.95	9.839 *3	.512	9.755	.512	9.261	.512
		.118—.125	2.5°	14.02	9.728 *4	.472	9.693	.472	9.260	.472

(inch)

Type	DC	RE	Ramping		Helical Cutting (Blind Hole, Flat Bottom)				Helical Cutting (Through Hole)	
			RMPX	L *1	DH max.	P max.	DH min.	P max.	DH min.	P max.
B Type	.787 [20mm]	.157	17.5°	1.850	1.240	.394	1.252	.394	.866	.039
		.197	16.6°	2.795	1.161	.236	1.224	.276	.866	.039
	1.000	.157	17.9°	1.81	1.665	.394	1.635	.394	1.269	.236
		.197	14.7°	2.24	1.587	.354	1.596	.354	1.269	.197
	1.102 [28mm]	.157	14.1°	2.323	1.870	.394	1.858	.394	1.417	.236
		.197	13°	2.559	1.791	.354	1.827	.354	1.417	.197
	1.250	.157	12.9°	2.56	2.165	.394	2.130	.394	1.762	.354
		.197	12.2°	2.72	2.087	.354	2.090	.354	1.762	.315
	1.378 [35mm]	.157	10.8°	3.071	2.421	.394	2.402	.394	1.969	.315
		.197	10.2°	3.268	2.343	.354	2.370	.354	1.969	.315
	1.500	.157	10.7°	3.11	2.650	.394	2.622	.394	2.261	.394
		.197	10.1°	3.31	2.571	.354	2.583	.354	2.261	.354
	2.000	.157	6.9°	4.84	3.650	.394	3.621	.394	3.257	.394
		.197	6.5°	5.12	3.571	.354	3.580	.354	3.256	.354
	2.500	.157	5.1°	6.54	4.650	.394	4.600	.394	4.258	.394
		.197	4.8°	6.97	4.571	.354	4.578	.354	4.257	.354
	3.000	.157	4.1°	8.15	5.650	.394	5.619	.394	5.258	.394
		.197	3.8°	8.78	5.571	.354	5.578	.354	5.258	.354
	4.000	.157	2.9°	11.54	7.650	.394	7.618	.394	7.259	.394
		.197	2.7°	12.36	7.571	.354	7.577	.354	7.258	.354
	5.000	.157	2.2°	15.20	9.650	.394	9.618	.394	9.260	.394
		.197	2.1°	15.91	9.571	.354	9.577	.354	9.259	.354

The recommended ramping or helical cutting feed is .002IPT or less.

*1. Using the maximum ramping angle, the distance to reach the maximum depth of cut is as follows: L=(maximum depth of cut APMX / tan α). Maximum depth of cut A type is .610", B type is .583".
*2. The maximum diameter when machining a blind hole with a flat face using a corner radius of .047".
*3. The maximum diameter when machining a blind hole with a flat face using a corner radius of .094".
*4. The maximum diameter when machining a blind hole with a flat face using a corner radius of .125".
For other corner radius, use to following formula. {(cutting edge diameter DC) - (corner radius RE) - β} ×2

DC	β
1.0–1.25"	.010"
1.5–5.0"	.018"

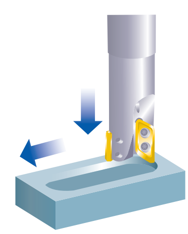
Max. Drilling Depth (Aluminum Alloy)

(inch)

Type	RE	Max. Drilling Depth			
		ϕ.787"	ϕ1.000"	ϕ1.250"	ϕ1.500"–ϕ5.000"
A Type	.016–.047	.209	.205	.205	.209
	.063–.094	.189	.181	.185	.189
	.118–.125	.169	.146	.165	.173
B Type	.157	.146	.106	.142	.150
	.197	.134	.091	.130	.138

The recommended drilling feed is .002 IPT or less.

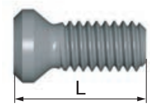
AXD4000 can be effectively used for pocket machining without the need for a prepared hole.



Operation Guidance

Only use the inserts and parts provided by Mitsubishi Materials with this tool. Use of the correct insert clamp screws is especially important to ensure overall tool safety. Do not use damaged or worn clamp screws.

Type	AXD4000		AXD7000	
Cutting Edge Diameter **DC**(inch)	ø.787"	ø1.000"–ø5.000"	ø1.250"	ø1.500"–ø5.000"
Clamp Screw Number	TS3SBS	TS3SB	TS4SB	TS4SBL
Overall Length **L**(inch)	.256	.315	.353	.413
Clamp Torque (lbf-in)	13	13	31	31



When tightening the clamp screws, follow the order in Figure 1.
The maximum allowable spindle speeds are shown in Table 1.
Ensure that the cutter operates under the maximum allowable spindle speed.
The maximum allowable spindle speeds for safety purposes are determined in accordance with ISO15641 (Milling Cutters for high speed machining–Safety requirements).

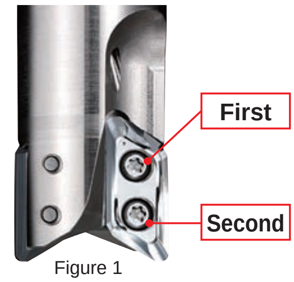


Figure 1

(Table 1) Maximum allowable spindle speed

AXD4000

Cutting Edge Diameter **DC**(inch)	ø.787"	ø1.000"	ø1.250"	ø1.500"	ø2.000"	ø2.500"	ø3.000"	ø4.000"	ø5.000"
Max. Allowable Spindle Speed (min^{-1})	15000	49000	48000	41000	35000	30000	27000	23000	20000

AXD7000

Cutting Edge Diameter **DC**(inch)	ø1.250"	ø1.500"	ø2.000"	ø2.500"	ø3.000"	ø4.000"	ø5.000"
Max. Allowable Spindle Speed (min^{-1})	41000	36000	30000	25000	23000	19000	16000

Even when operating under the maximum allowable spindle speed, if the spindle speed is equal to or higher than the values shown in table 2, it is recommended that the balance quality (with the arbor or milling chuck) conforms to G6.3 or better based on ISO1940. It is also recommended to replace the clamp screws with new ones when changing inserts. Furthermore, ensure to use machines that are provided with safety measures in case of cutter breakage.

* The balance quality of the holder (without inserts and clamp screws) is G6.3 or better at 10000min^{-1}.

(Table 2) Maximum spindle speed when balancing with the arbor or milling chuck has not been achieved

AXD4000

Cutting Edge Diameter **DC**(inch)	ø.787"	ø1.000"	ø1.250"	ø1.500"	ø2.000"	ø2.500"	ø3.000"	ø4.000"	ø5.000"
Max. Spindle Speed (min^{-1})	15000	12000	9500	7600	6000	4800	3800	3000	2400

AXD7000

Cutting Edge Diameter **DC**(inch)	ø1.250"	ø1.500"	ø2.000"	ø2.500"	ø3.000"	ø4.000"	ø5.000"
Max. Spindle Speed (min^{-1})	9500	7600	6000	4800	3800	3000	2400

When setting the spindle speed, take into consideration the maximum allowable spindle speed of the arbor or milling chuck.
Use the specified set bolt when using the arbor type with through coolant.
The inserts have sharp cutting edges and handling them with bare hands may cause injuries. Always wear safety gloves when handling the indexable inserts.