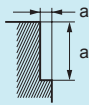
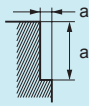


# RECOMMENDED CUTTING CONDITIONS

## Shoulder milling

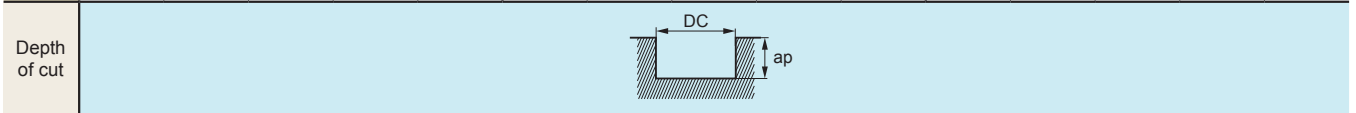
Work material	Carbon steel (–30HRC)						Alloy steel, Pre-hardened steel						Austenitic stainless steel, Titanium alloy					
	AISI 1035, AISI 1050, ASTM 283						AISI H13, AISI 4140, AISI P21						AISI 304, AISI 306, AISI 316L, Ti-6Al-4V etc.					
	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)
Revolution (min <sup>-1</sup> )	Feed rate (IPM)	Revolution (min <sup>-1</sup> )	Feed rate (IPM)	Revolution (min <sup>-1</sup> )			Feed rate (IPM)	Revolution (min <sup>-1</sup> )	Feed rate (IPM)	Revolution (min <sup>-1</sup> )			Feed rate (IPM)	Revolution (min <sup>-1</sup> )	Feed rate (IPM)	Revolution (min <sup>-1</sup> )		
<b>1/16</b>	26000	55.3	24000	33.9	.094	.013	20000	26.0	20000	17.3	.094	.013	18000	23.4	16000	13.8	.094	.013
<b>5/64</b>	24000	70.9	19000	37.0	.12	.023	19000	33.7	16000	18.9	.12	.023	16000	24.6	13000	13.0	.12	.023
<b>3/32</b>	20000	70.9	16000	37.4	.14	.028	16000	34.0	13000	18.1	.14	.028	13000	24.6	11000	13.8	.14	.028
<b>7/64</b>	17000	72.3	14000	39.4	.16	.033	14000	34.7	11000	18.1	.16	.033	11000	24.7	9200	13.8	.16	.033
<b>1/8</b>	15000	76.2	12000	39.4	.19	.038	12000	36.9	10000	20.1	.19	.038	10000	26.0	8000	13.8	.19	.038
<b>5/32</b>	12000	78.0	9600	39.4	.23	.047	9600	37.4	8000	20.5	.23	.047	8000	26.5	6400	13.8	.23	.047
<b>3/16</b>	10000	74.4	8000	39.4	.28	.056	8000	37.8	6700	20.9	.28	.056	6700	26.5	5300	13.8	.28	.056
<b>1/4</b>	7500	74.4	6000	39.4	.38	.075	6000	39.0	5000	21.3	.38	.075	5000	35.4	4000	18.9	.38	.075
<b>5/16</b>	6000	74.4	4800	39.4	.47	.094	4800	39.7	4000	21.7	.47	.094	4000	35.4	3200	18.9	.47	.094
<b>11/32</b>	5500	71.5	4400	37.8	.52	.10	4400	37.9	3600	20.5	.52	.10	3600	36.1	2900	19.3	.52	.10
<b>3/8</b>	5000	67.9	4000	35.8	.56	.11	4000	36.9	3300	20.1	.56	.11	3300	37.0	2700	20.1	.56	.11
<b>1/2</b>	3800	56.1	3000	29.1	.75	.15	3000	32.6	2500	18.1	.75	.15	2500	32.5	2000	17.3	.75	.15
Depth of cut																		

Work material	Precipitation hardening martensitic stainless steel, Co-Cr-Mo alloy						Copper, Copper alloy						Heat resistant alloy					
	ASTM S 17400, ASTM S 17700, 17-4PH, 15-5PH etc.												Inconel718 etc.					
	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	Width of cut ae (inch)
Revolution (min <sup>-1</sup> )	Feed rate (IPM)	Revolution (min <sup>-1</sup> )	Feed rate (IPM)	Revolution (min <sup>-1</sup> )			Feed rate (IPM)	Revolution (min <sup>-1</sup> )	Feed rate (IPM)	Revolution (min <sup>-1</sup> )			Feed rate (IPM)	Revolution (min <sup>-1</sup> )	Feed rate (IPM)	Revolution (min <sup>-1</sup> )		
<b>1/16</b>	13000	16.9	13000	11.0	.094	.0063	30000	63.8	28000	39.4	.094	.013	8000	3.3	6000	13.8	.094	.0031
<b>5/64</b>	12000	21.3	11000	13.0	.12	.016	29000	85.6	22000	43.3	.12	.023	6400	3.4	4800	13.0	.12	.0078
<b>3/32</b>	10000	21.3	9400	13.4	.14	.019	24000	85.0	19000	43.3	.14	.028	5300	3.4	4000	13.8	.14	.0094
<b>7/64</b>	8600	21.3	8000	13.0	.16	.022	21000	89.3	16000	43.3	.16	.033	4600	3.5	3400	13.8	.16	.011
<b>1/8</b>	7500	23.0	7000	14.2	.19	.025	18000	91.4	14000	47.2	.19	.038	4000	3.5	3000	13.8	.19	.013
<b>5/32</b>	6000	23.4	5600	14.6	.23	.031	14000	90.9	11000	47.2	.23	.047	3200	3.5	2400	13.8	.23	.016
<b>3/16</b>	5000	23.6	4700	14.6	.28	.038	12000	89.3	9400	47.2	.28	.056	2700	3.6	2000	13.8	.28	.019
<b>1/4</b>	3800	24.7	3500	15.0	.38	.050	9000	89.3	7000	47.2	.38	.075	2000	3.7	1500	18.9	.38	.025
<b>5/16</b>	3000	24.8	2800	15.4	.47	.063	7200	89.3	5600	47.2	.47	.094	1600	3.7	1200	18.9	.47	.031
<b>11/32</b>	2700	23.3	2600	15.0	.52	.069	6600	85.7	5100	43.3	.52	.10	1500	3.9	1100	19.3	.52	.034
<b>3/8</b>	2500	23.0	2300	14.2	.56	.075	6000	81.5	4700	43.3	.56	.11	1300	3.9	1000	20.1	.56	.038
<b>1/2</b>	1900	20.6	1800	13.0	.75	.10	4500	66.4	3500	34.3	.75	.15	1000	3.7	750	17.3	.75	.050
Depth of cut																		

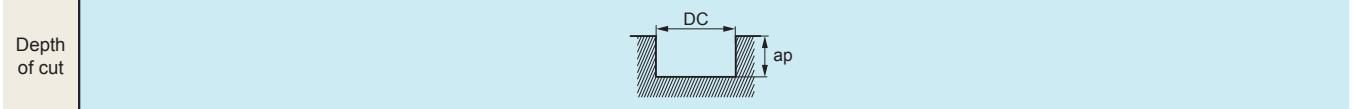
- 1) SMART MIRACLE coating has reduced electric conductivity; therefore an external contact type (electric transmitted) tool setter may not work. When measuring the tool length, please use an internal contact type (non-electricity type) tool setter or a laser type tool setter.
- 2) Effective cutting of stainless steel, and titanium alloy can be achieved with the use of water-soluble cutting fluid.
- 3) Higher feeds and speeds can be used for smaller depth of cut.
- 4) Vibration can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed etc. should be reduced proportionately.

## Slotting

Work material	Carbon steel (—30HRC)					Alloy steel, Pre-hardened steel					Austenitic stainless steel, Titanium alloy				
	AISI 1035, AISI 1050, ASTM 283					AISI H13, AISI 4140, AISI P21					AISI 304, AISI 306, AISI 316L, Ti-6Al-4V etc.				
	High speed cutting		General purpose cutting		Depth of cut ap (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)
Revolution (min <sup>-1</sup> )	Feed rate (IPM)	Revolution (min <sup>-1</sup> )	Feed rate (IPM)	Revolution (min <sup>-1</sup> )		Feed rate (IPM)	Revolution (min <sup>-1</sup> )	Feed rate (IPM)	Revolution (min <sup>-1</sup> )		Feed rate (IPM)	Revolution (min <sup>-1</sup> )	Feed rate (IPM)		
<b>1/16</b>	26000	27.6	20000	14.2	.031	20000	11.8	16000	6.3	.031	18000	10.6	12000	4.7	.031
<b>5/64</b>	24000	36.9	16000	16.1	.078	19000	18.0	13000	8.3	.078	16000	18.9	9600	7.5	.078
<b>3/32</b>	20000	37.8	13000	16.1	.094	16000	18.9	11000	8.7	.094	13000	19.2	8000	7.9	.094
<b>7/64</b>	17000	40.2	11000	17.3	.11	14000	19.8	9200	8.7	.11	11000	19.5	6900	7.9	.11
<b>1/8</b>	15000	44.3	10000	19.7	.13	12000	22.7	8000	9.8	.13	10000	20.1	6000	7.9	.13
<b>5/32</b>	12000	56.7	8000	24.8	.16	9600	26.1	6400	11.4	.16	8000	20.8	4800	8.3	.16
<b>3/16</b>	10000	56.7	6700	25.2	.19	8000	26.9	5300	11.8	.19	6700	21.4	4000	8.3	.19
<b>1/4</b>	7500	55.8	5000	24.4	.25	6000	29.8	4000	13.0	.25	5000	21.9	3000	8.7	.25
<b>5/16</b>	6000	49.6	4000	21.7	.31	4800	28.3	3200	12.6	.31	4000	23.6	2400	9.4	.31
<b>11/32</b>	5500	48.7	3600	20.9	.34	4400	27.0	2900	11.8	.34	3600	24.2	2200	9.8	.34
<b>3/8</b>	5000	46.1	3300	20.1	.38	4000	25.5	2700	11.4	.38	3300	25.3	2000	10.2	.38
<b>1/2</b>	3800	35.9	2500	15.7	.50	3000	22.3	2000	9.8	.50	2500	23.6	1500	9.4	.50



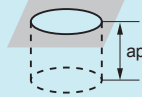
Work material	Precipitation hardening martensitic stainless steel, Co-Cr-Mo alloy					Copper, Copper alloy					Heat resistant alloy				
	ASTM S 17400, ASTM S 17700, 17-4PH, 15-5PH etc.										Inconel718 etc.				
	High speed cutting		General purpose cutting		Depth of cut ap (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)	High speed cutting		General purpose cutting		Depth of cut ap (inch)
Revolution (min <sup>-1</sup> )	Feed rate (IPM)	Revolution (min <sup>-1</sup> )	Feed rate (IPM)	Revolution (min <sup>-1</sup> )		Feed rate (IPM)	Revolution (min <sup>-1</sup> )	Feed rate (IPM)	Revolution (min <sup>-1</sup> )		Feed rate (IPM)	Revolution (min <sup>-1</sup> )	Feed rate (IPM)		
<b>1/16</b>	11000	6.5	10000	3.9	.019	30000	31.9	24000	16.9	.031	6000	3.5	5000	2.0	.013
<b>5/64</b>	9600	9.1	8000	5.1	.039	29000	44.5	19000	19.3	.078	4800	4.0	4000	2.2	.023
<b>3/32</b>	8000	9.5	6700	5.1	.047	24000	45.4	16000	20.1	.094	4000	4.3	3300	2.3	.028
<b>7/64</b>	6900	9.8	5700	5.5	.055	21000	49.6	14000	21.7	.11	3400	4.4	2900	2.5	.033
<b>1/8</b>	6000	11.3	5000	6.3	.063	18000	53.1	12000	23.2	.13	3000	4.6	2500	2.5	.038
<b>5/32</b>	4800	13.0	4000	7.1	.078	14000	66.1	9600	29.9	.16	2400	5.0	2000	2.8	.047
<b>3/16</b>	4000	13.7	3300	7.5	.094	12000	68.0	8000	29.9	.19	2000	5.1	1700	2.9	.056
<b>1/4</b>	3000	14.9	2500	8.3	.13	9000	67.0	6000	29.5	.25	1500	5.3	1300	3.0	.075
<b>5/16</b>	2400	14.2	2000	7.9	.16	7200	59.5	4800	26.4	.31	1200	5.7	1000	3.1	.094
<b>11/32</b>	2200	13.5	1800	7.5	.17	6600	58.5	4400	25.6	.34	1100	5.9	910	3.2	.10
<b>3/8</b>	2000	12.8	1700	7.1	.19	6000	55.3	4000	24.4	.38	1000	6.1	840	3.4	.11
<b>1/2</b>	1500	11.2	1300	6.3	.25	4500	42.5	3000	18.9	.50	750	5.7	630	3.1	.15



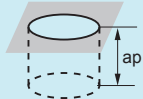
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- 2) Effective cutting of stainless steel, titanium alloy, and heat-resistant alloy can be achieved with the use of water-soluble cutting fluid.
- 3) Higher feeds and speeds can be used for smaller depth of cut.
- 4) Vibration can still occur if the machine rigidity and clamping method are insufficient. In these cases the feed and speed should be reduced proportionately.

## Drilling

Work material	Carbon steel (—30HRC)							Alloy steel, Pre-hardened steel							Austenitic stainless steel, Titanium alloy							
	AISI 1035, AISI 1050, ASTM 283							AISI H13, AISI 4140, AISI P21							AISI 304, AISI 306, AISI 316L, Ti-6Al-4V etc.							
	DC (inch)	High speed cutting			General purpose cutting			Hole Depth ap (inch)	High speed cutting			General purpose cutting			Hole Depth ap (inch)	High speed cutting			General purpose cutting			Hole Depth ap (inch)
Revolution (min <sup>-1</sup> )		Feed rate (IPM)	Step (inch)	Revolution (min <sup>-1</sup> )	Feed rate (IPM)	Step (inch)	Revolution (min <sup>-1</sup> )		Feed rate (IPM)	Step (inch)	Revolution (min <sup>-1</sup> )	Feed rate (IPM)	Step (inch)	Revolution (min <sup>-1</sup> )		Feed rate (IPM)	Step (inch)	Revolution (min <sup>-1</sup> )	Feed rate (IPM)	Step (inch)		
	1/16	18000	12.8	.013	18000	12.6	.006	.031	12000	5.2	.013	12000	5.2	.006	.031	12000	3.3	.004	12000	3.3	.002	.031
	5/64	16000	18.9	.020	16000	18.9	.006	.078	11000	7.8	.016	11000	7.8	.006	.078	9600	3.5	.004	9600	3.5	.002	.039
	3/32	13000	20.5	.023	13000	20.5	.010	.094	9400	8.8	.019	9400	8.8	.010	.094	8000	3.5	.006	8000	3.5	.002	.047
	7/64	11000	21.7	.033	11000	21.7	.010	.11	8000	9.4	.022	8000	9.4	.010	.11	6900	3.5	.008	6900	3.5	.002	.055
	1/8	10000	27.6	.044	10000	27.6	.012	.13	7000	11.0	.025	7000	11.0	.012	.13	6000	4.0	.008	6000	4.0	.004	.063
	5/32	8000	31.5	.078	8000	31.5	.012	.16	5600	13.2	.031	5600	13.2	.012	.16	4800	3.8	.016	4800	3.8	.004	.078
	3/16	6700	34.3	.094	6700	34.3	.016	.19	4700	15.0	.038	4700	15.0	.016	.19	4000	3.8	.020	4000	3.8	.008	.094
	1/4	5000	35.4	.13	5000	35.4	.024	.25	3500	16.5	.050	3500	16.5	.024	.25	3000	3.5	.024	3000	3.5	.012	.13
	5/16	4000	28.3	.16	4000	28.3	.028	.31	2800	13.2	.063	2800	13.2	.028	.31	2400	2.8	.024	2400	2.8	.012	.16
	11/32	3600	25.5	.17	3600	25.5	.028	.34	2600	12.3	.069	2600	12.3	.028	.34	2200	2.6	.024	2200	2.6	.012	.17
	3/8	3300	23.4	.19	3300	23.4	.030	.38	2300	11.0	.094	2300	11.0	.030	.38	2000	2.3	.024	2000	2.3	.012	.19
	1/2	2500	17.7	.20	2500	17.7	.030	.50	1800	8.5	.13	1800	8.5	.030	.50	1500	2.0	.024	1500	2.0	.012	.25



Work material	Precipitation hardening martensitic stainless steel, Co-Cr-Mo alloy							Copper, Copper alloy							
	ASTM S 17400, ASTM S 17700, 17-4PH, 15-5PH etc.														
	DC (inch)	High speed cutting			General purpose cutting			Hole Depth ap (inch)	High speed cutting			General purpose cutting			Hole Depth ap (inch)
Revolution (min <sup>-1</sup> )		Feed rate (IPM)	Step (inch)	Revolution (min <sup>-1</sup> )	Feed rate (IPM)	Step (inch)	Revolution (min <sup>-1</sup> )		Feed rate (IPM)	Step (inch)	Revolution (min <sup>-1</sup> )	Feed rate (IPM)	Step (inch)		
	1/16	7000	2.0	.004	7000	2.0	.002	.031	22000	15.6	.013	22000	15.6	.006	.031
	5/64	6400	2.4	.004	6400	2.4	.002	.039	19000	22.4	.020	19000	22.4	.006	.039
	3/32	5300	2.4	.006	5300	2.4	.002	.047	16000	25.2	.023	16000	25.2	.010	.047
	7/64	4600	2.4	.008	4600	2.4	.002	.055	14000	27.6	.033	14000	27.6	.010	.055
	1/8	4000	2.8	.008	4000	2.8	.004	.063	12000	33.1	.044	12000	33.1	.012	.063
	5/32	3200	2.4	.016	3200	2.4	.004	.078	9600	37.8	.078	9600	37.8	.012	.078
	3/16	2700	2.4	.020	2700	2.4	.008	.094	8000	39.4	.094	8000	39.4	.016	.094
	1/4	2000	2.4	.024	2000	2.4	.012	.13	6000	43.3	.130	6000	43.3	.024	.13
	5/16	1600	2.0	.024	1600	2.0	.012	.16	4800	33.9	.160	4800	33.9	.028	.16
	11/32	1500	1.8	.024	1500	1.8	.012	.17	4400	31.1	.17	4400	31.1	.028	.17
	3/8	1300	1.5	.024	1300	1.5	.012	.19	4000	28.3	.19	4000	28.3	.030	.19
	1/2	1000	1.2	.024	1000	1.2	.012	.25	3000	21.3	.20	3000	21.3	.030	.25



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- 3) Higher feeds and speeds can be used for smaller depth of cut.
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