

Multi-purpose 3-flute ball end mill

# *EMB(P)E-ATH*

Epoch Mega Feed Ball (Pencil) Evolution-ATH



**Cutting Conditions**

**MOLDINO Tool Engineering Europe GmbH**



## EMBE-ATH Roughing

Work Material	DC	1	2	3	4	5	6	8	10	12
<b>1</b> Carbon Steel Alloy Steel (180-250HB)	V <sub>c</sub> (m/min)	130	260	250	250	250	250	250	250	250
	n (rpm)	41380	41380	26530	19890	15920	13260	9950	7960	6630
	f <sub>z</sub> (mm/t)	0.018	0.038	0.060	0.082	0.110	0.137	0.192	0.260	0.285
	V <sub>f</sub> (mm/min)	2230	4720	4780	4890	5250	5450	5730	6210	5670
	a <sub>p</sub> (mm)	0.09	0.18	0.27	0.36	0.45	0.54	0.72	0.90	1.08
	a <sub>e</sub> (mm)	0.36	0.72	1.08	1.44	1.80	2.16	2.88	3.60	4.32
	Q (cm <sup>3</sup> /min)	0.0723	0.6117	1.3938	2.5350	4.2525	6.3569	11.8817	20.1204	26.4544
<b>2</b> Alloy Steel Tool Steel (25-35HRC)	V <sub>c</sub> (m/min)	130	260	230	230	230	230	230	230	230
	n (rpm)	41380	41380	24400	18300	14640	12200	9150	7320	6100
	f <sub>z</sub> (mm/t)	0.018	0.038	0.060	0.082	0.110	0.137	0.192	0.260	0.285
	V <sub>f</sub> (mm/min)	2230	4720	4390	4500	4830	5010	5270	5710	5220
	a <sub>p</sub> (mm)	0.09	0.18	0.27	0.36	0.45	0.54	0.72	0.90	1.08
	a <sub>e</sub> (mm)	0.36	0.72	1.08	1.44	1.80	2.16	2.88	3.60	4.32
	Q (cm <sup>3</sup> /min)	0.0723	0.6117	1.2801	2.3328	3.9123	5.8437	10.9279	18.5004	24.3544
<b>3</b> Pre-hardened Steel (35-45HRC)	V <sub>c</sub> (m/min)	130	205	205	205	205	205	205	205	205
	n (rpm)	41380	32630	21750	16310	13050	10880	8160	6530	5440
	f <sub>z</sub> (mm/t)	0.017	0.036	0.057	0.078	0.105	0.130	0.182	0.247	0.271
	V <sub>f</sub> (mm/min)	2110	3520	3720	3820	4110	4240	4460	4840	4420
	a <sub>p</sub> (mm)	0.09	0.18	0.27	0.36	0.45	0.54	0.72	0.90	1.08
	a <sub>e</sub> (mm)	0.36	0.72	1.08	1.44	1.80	2.16	2.88	3.60	4.32
	Q (cm <sup>3</sup> /min)	0.0684	0.4562	1.0848	1.9803	3.3291	4.9455	9.2483	15.6816	20.6220
<b>4</b> Hardened Steel (45-55HRC)	V <sub>c</sub> (m/min)	130	175	175	175	175	175	175	175	175
	n (rpm)	41380	27850	18570	13930	11140	9280	6960	5570	4640
	f <sub>z</sub> (mm/t)	0.014	0.030	0.048	0.066	0.088	0.110	0.154	0.208	0.228
	V <sub>f</sub> (mm/min)	1740	2510	2670	2760	2940	3060	3220	3480	3170
	a <sub>p</sub> (mm)	0.06	0.12	0.18	0.24	0.30	0.36	0.48	0.60	0.72
	a <sub>e</sub> (mm)	0.24	0.48	0.72	0.96	1.20	1.44	1.92	2.40	2.88
	Q (cm <sup>3</sup> /min)	0.0251	0.1446	0.3460	0.6359	1.0584	1.5863	2.9676	5.0112	6.5733
<b>5</b> Hardened Steel (55-65HRC)	V <sub>c</sub> (m/min)	130	155	155	155	155	155	155	155	155
	n (rpm)	41380	24670	16450	12330	9870	8220	6170	4930	4110
	f <sub>z</sub> (mm/t)	0.011	0.023	0.036	0.049	0.066	0.082	0.115	0.156	0.171
	V <sub>f</sub> (mm/min)	1370	1700	1780	1810	1950	2020	2130	2310	2110
	a <sub>p</sub> (mm)	0.04	0.08	0.12	0.16	0.20	0.24	0.32	0.40	0.48
	a <sub>e</sub> (mm)	0.16	0.32	0.48	0.64	0.80	0.96	1.28	1.60	1.92
	Q (cm <sup>3</sup> /min)	0.0088	0.0435	0.1025	0.1853	0.3120	0.4654	0.8724	1.4784	1.9446



This standard cutting condition table is intended as reference cutting conditions. The conditions should be adjusted as necessary according to the actual conditions of machined shape, purpose, machine used, etc..



**EMBE-ATH Finishing**

Work Material	DC	1	2	3	4	5	6	8	10	12
<b>1</b> Carbon Steel Alloy Steel (180-250HB)	V <sub>c</sub> (m/min)	130	260	330	330	330	330	330	330	330
	n (rpm)	41380	41380	35010	26260	21010	17510	13130	10500	8750
	f <sub>z</sub> (mm/t)	0.012	0.026	0.042	0.057	0.073	0.092	0.125	0.160	0.190
	V <sub>f</sub> (mm/min)	1490	3230	4410	4490	4600	4830	4920	5040	4990
	Step (mm)	0.06	0.08	0.10	0.11	0.13	0.14	0.16	0.18	0.20
	Step Max (mm)	0.08	0.11	0.13	0.16	0.17	0.19	0.22	0.25	0.27
	<b>2</b> Alloy Steel Tool Steel (25-35HRC)	V <sub>c</sub> (m/min)	130	260	310	310	310	310	310	310
n (rpm)		41380	41380	32890	24670	19740	16450	12330	9870	8220
f <sub>z</sub> (mm/t)		0.012	0.026	0.042	0.057	0.073	0.092	0.125	0.160	0.190
V <sub>f</sub> (mm/min)		1490	3230	4140	4220	4320	4540	4620	4740	4690
Step (mm)		0.06	0.08	0.10	0.11	0.13	0.14	0.16	0.18	0.20
Step Max (mm)		0.08	0.11	0.13	0.16	0.17	0.19	0.22	0.25	0.27
<b>3</b> Pre-hardened Steel (35-45HRC)		V <sub>c</sub> (m/min)	130	260	285	285	285	285	285	285
	n (rpm)	41380	41380	30240	22680	18140	15120	11340	9070	7560
	f <sub>z</sub> (mm/t)	0.012	0.025	0.040	0.054	0.069	0.088	0.119	0.152	0.181
	V <sub>f</sub> (mm/min)	1490	3100	3630	3670	3750	3990	4050	4140	4110
	Step (mm)	0.06	0.08	0.10	0.11	0.13	0.14	0.16	0.18	0.20
	Step Max (mm)	0.08	0.11	0.13	0.16	0.17	0.19	0.22	0.25	0.27
	<b>4</b> Hardened Steel (45-55HRC)	V <sub>c</sub> (m/min)	130	260	230	230	230	230	230	230
n (rpm)		41380	41380	24400	18300	14640	12200	9150	7320	6100
f <sub>z</sub> (mm/t)		0.010	0.021	0.034	0.046	0.058	0.074	0.100	0.128	0.152
V <sub>f</sub> (mm/min)		1240	2610	2490	2530	2550	2710	2750	2810	2780
Step (mm)		0.06	0.08	0.10	0.11	0.13	0.14	0.16	0.18	0.20
Step Max (mm)		0.08	0.11	0.13	0.16	0.17	0.19	0.22	0.25	0.27
<b>5</b> Hardened Steel (55-65HRC)		V <sub>c</sub> (m/min)	130	200	200	200	200	200	200	200
	n (rpm)	41380	31830	21220	15920	12730	10610	7960	6370	5310
	f <sub>z</sub> (mm/t)	0.008	0.016	0.025	0.034	0.044	0.055	0.075	0.096	0.114
	V <sub>f</sub> (mm/min)	990	1530	1590	1620	1680	1750	1790	1830	1820
	Step (mm)	0.06	0.08	0.10	0.11	0.13	0.14	0.16	0.18	0.20
	Step Max (mm)	0.08	0.11	0.13	0.16	0.17	0.19	0.22	0.25	0.27



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## EMBPE-ATH Roughing

Work Material	DC	4				5		6			
	LN	30	40	50	60	40	60	50	60	70	80
<b>1</b> Carbon Steel Alloy Steel (180-250HB)	V <sub>c</sub> (m/min)	205	185	145	105	205	165	205	185	165	145
	n (rpm)	16400	14800	11500	8300	13200	10600	10900	9900	8700	7700
	f <sub>z</sub> (mm/t)	0.077	0.077	0.066	0.055	0.099	0.088	0.132	0.132	0.121	0.110
	V <sub>f</sub> (mm/min)	3790	3420	2280	1370	3920	2800	4320	3920	3160	2540
	ap (mm)	0.28	0.28	0.28	0.28	0.35	0.35	0.42	0.42	0.42	0.42
	ae (mm)	1.12	1.12	1.12	1.12	1.40	1.40	1.68	1.68	1.68	1.68
	Q (cm <sup>3</sup> /min)	1.1885	1.0725	0.7150	0.4296	1.9208	1.3720	3.0482	2.7660	2.2297	1.7922
<b>2</b> Alloy Steel Tool Steel (25-35HRC)	V <sub>c</sub> (m/min)	185	165	130	95	185	145	185	165	145	130
	n (rpm)	16400	14800	11500	8300	13200	10600	10900	9900	8700	7700
	f <sub>z</sub> (mm/t)	0.077	0.077	0.066	0.055	0.099	0.088	0.132	0.132	0.121	0.110
	V <sub>f</sub> (mm/min)	3790	3420	2280	1370	3920	2800	4320	3920	3160	2540
	ap (mm)	0.24	0.24	0.24	0.24	0.30	0.30	0.36	0.36	0.36	0.36
	ae (mm)	0.96	0.96	0.96	0.96	1.20	1.20	1.44	1.44	1.44	1.44
	Q (cm <sup>3</sup> /min)	0.8732	0.7880	0.5253	0.3156	1.4112	1.0080	2.2395	2.0321	1.6381	1.3167
<b>3</b> Pre-hardened Steel (35-45HRC)	V <sub>c</sub> (m/min)	160	145	115	80	160	130	160	145	130	115
	n (rpm)	16400	14800	11500	8300	13200	10600	10900	9900	8700	7700
	f <sub>z</sub> (mm/t)	0.073	0.073	0.063	0.052	0.094	0.084	0.125	0.125	0.115	0.104
	V <sub>f</sub> (mm/min)	3590	3240	2170	1290	3720	2670	4090	3710	3000	2400
	ap (mm)	0.20	0.20	0.20	0.20	0.25	0.25	0.30	0.30	0.30	0.30
	ae (mm)	0.80	0.80	0.80	0.80	1.00	1.00	1.20	1.20	1.20	1.20
	Q (cm <sup>3</sup> /min)	0.5744	0.5184	0.3472	0.2064	0.9300	0.6675	1.4724	1.3356	1.0800	0.8640
<b>4</b> Hardened Steel (45-55HRC)	V <sub>c</sub> (m/min)	130	120	95	65	130	105	130	120	105	95
	n (rpm)	16400	14800	11500	8300	13200	10600	10900	9900	8700	7700
	f <sub>z</sub> (mm/t)	0.062	0.061	0.053	0.044	0.079	0.070	0.105	0.105	0.097	0.094
	V <sub>f</sub> (mm/min)	3050	2710	1830	1100	3130	2230	3430	3120	2530	2170
	ap (mm)	0.12	0.12	0.12	0.12	0.15	0.15	0.18	0.18	0.18	0.18
	ae (mm)	0.48	0.48	0.48	0.48	0.60	0.60	0.72	0.72	0.72	0.72
	Q (cm <sup>3</sup> /min)	0.1757	0.1561	0.1054	0.0634	0.2817	0.2007	0.4445	0.4044	0.3279	0.2812
<b>5</b> Hardened Steel (55-65HRC)	V <sub>c</sub> (m/min)	110	100	80	55	110	90	110	100	85	75
	n (rpm)	16400	14800	11500	8300	13200	10600	10900	9900	8700	7700
	f <sub>z</sub> (mm/t)	0.046	0.046	0.039	0.033	0.060	0.052	0.079	0.079	0.072	0.066
	V <sub>f</sub> (mm/min)	2260	2040	1350	820	2380	1650	2580	2350	1880	1520
	ap (mm)	0.08	0.08	0.08	0.08	0.10	0.10	0.12	0.12	0.12	0.12
	ae (mm)	0.32	0.32	0.32	0.32	0.40	0.40	0.48	0.48	0.48	0.48
	Q (cm <sup>3</sup> /min)	0.0579	0.0522	0.0346	0.0210	0.0952	0.0660	0.1486	0.1354	0.1083	0.0876



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## EMBPE-ATH Roughing

Work Material	DC	8			10	
	LN	60	70	80	60	75
<b>1</b> Carbon Steel Alloy Steel (180-250HB)	V <sub>c</sub> (m/min)	210	195	185	225	205
	n (rpm)	8300	7800	7400	7200	6600
	f <sub>z</sub> (mm/t)	0.176	0.176	0.154	0.220	0.220
	V <sub>f</sub> (mm/min)	4380	4120	3420	4750	4360
	a <sub>p</sub> (mm)	0.56	0.56	0.56	0.70	0.70
	a <sub>e</sub> (mm)	2.24	2.24	2.24	2.80	2.80
	Q (cm <sup>3</sup> /min)	5.4943	5.1681	4.2900	9.3100	8.5456
<b>2</b> Alloy Steel Tool Steel (25-35HRC)	V <sub>c</sub> (m/min)	185	175	165	200	185
	n (rpm)	8300	7800	7400	7200	6600
	f <sub>z</sub> (mm/t)	0.176	0.176	0.154	0.220	0.220
	V <sub>f</sub> (mm/min)	4380	4120	3420	4750	4360
	a <sub>p</sub> (mm)	0.48	0.48	0.48	0.60	0.60
	a <sub>e</sub> (mm)	1.92	1.92	1.92	2.40	2.40
	Q (cm <sup>3</sup> /min)	4.0366	3.7970	3.1519	6.8400	6.2784
<b>3</b> Pre-hardened Steel (35-45HRC)	V <sub>c</sub> (m/min)	160	155	145	175	165
	n (rpm)	8300	7800	7400	7200	6600
	f <sub>z</sub> (mm/t)	0.167	0.167	0.147	0.209	0.209
	V <sub>f</sub> (mm/min)	4160	3910	3260	4510	4140
	a <sub>p</sub> (mm)	0.40	0.40	0.40	0.50	0.50
	a <sub>e</sub> (mm)	1.60	1.60	1.60	2.00	2.00
	Q (cm <sup>3</sup> /min)	2.6624	2.5024	2.0864	4.5100	4.1400
<b>4</b> Hardened Steel (45-55HRC)	V <sub>c</sub> (m/min)	135	125	120	145	130
	n (rpm)	8300	7800	7400	7200	6600
	f <sub>z</sub> (mm/t)	0.141	0.141	0.123	0.176	0.176
	V <sub>f</sub> (mm/min)	3510	3300	2730	3800	3480
	a <sub>p</sub> (mm)	0.24	0.24	0.24	0.30	0.30
	a <sub>e</sub> (mm)	0.96	0.96	0.96	1.20	1.20
	Q (cm <sup>3</sup> /min)	0.8087	0.7603	0.6290	1.3680	1.2528
<b>5</b> Hardened Steel (55-65HRC)	V <sub>c</sub> (m/min)	110	105	100	125	110
	n (rpm)	8300	7800	7400	7200	6600
	f <sub>z</sub> (mm/t)	0.105	0.105	0.093	0.132	0.132
	V <sub>f</sub> (mm/min)	2610	2460	2060	2850	2610
	a <sub>p</sub> (mm)	0.16	0.16	0.16	0.20	0.20
	a <sub>e</sub> (mm)	0.64	0.64	0.64	0.80	0.80
	Q (cm <sup>3</sup> /min)	0.2673	0.2519	0.2109	0.4560	0.4176



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## EMBPE-ATH Finishing

Work Material	DC	4				5		6			
	LN	30	40	50	60	40	60	50	60	70	80
<b>1</b> Carbon Steel Alloy Steel (180-250HB)	V <sub>c</sub> (m/min)	245	220	170	120	240	195	245	220	190	170
	n (rpm)	19300	17400	13500	9700	15400	12300	12900	11600	10200	9000
	f <sub>z</sub> (mm/t)	0.053	0.053	0.053	0.042	0.063	0.053	0.074	0.074	0.063	0.053
	V <sub>f</sub> (mm/min)	3070	2770	2150	1220	2910	1960	2860	2580	1930	1430
	Step (mm)	0.11	0.11	0.11	0.11	0.13	0.13	0.14	0.14	0.14	0.14
	Step Max (mm)	0.16	0.16	0.16	0.16	0.17	0.17	0.19	0.19	0.19	0.19
<b>2</b> Alloy Steel Tool Steel (25-35HRC)	V <sub>c</sub> (m/min)	220	195	155	110	220	175	2205	200	175	155
	n (rpm)	19300	17400	13500	9700	15400	12300	12900	11600	10200	9000
	f <sub>z</sub> (mm/t)	0.053	0.053	0.053	0.042	0.063	0.053	0.074	0.074	0.063	0.053
	V <sub>f</sub> (mm/min)	3070	2770	2150	1220	2910	1960	2860	2580	1930	1430
	Step (mm)	0.11	0.11	0.11	0.11	0.13	0.13	0.14	0.14	0.14	0.14
	Step Max (mm)	0.16	0.16	0.16	0.16	0.17	0.17	0.19	0.19	0.19	0.19
<b>3</b> Pre-hardened Steel (35-45HRC)	V <sub>c</sub> (m/min)	195	180	140	100	200	160	200	180	160	140
	n (rpm)	19300	17400	13500	9700	15400	12300	12900	11600	10200	9000
	f <sub>z</sub> (mm/t)	0.050	0.050	0.050	0.040	0.060	0.050	0.070	0.070	0.060	0.050
	V <sub>f</sub> (mm/min)	2900	2610	2030	1160	2770	1850	2710	2440	1840	1350
	Step (mm)	0.11	0.11	0.11	0.11	0.13	0.13	0.14	0.14	0.14	0.14
	Step Max (mm)	0.16	0.16	0.16	0.16	0.17	0.17	0.19	0.19	0.19	0.19
<b>4</b> Hardened Steel (45-55HRC)	V <sub>c</sub> (m/min)	175	160	125	90	175	140	175	160	140	125
	n (rpm)	19300	17400	13500	9700	15400	12300	12900	11600	10200	9000
	f <sub>z</sub> (mm/t)	0.042	0.042	0.042	0.033	0.050	0.042	0.059	0.059	0.050	0.044
	V <sub>f</sub> (mm/min)	2430	2190	1700	960	2310	1550	2280	2050	1530	1190
	Step (mm)	0.11	0.11	0.11	0.11	0.13	0.13	0.14	0.14	0.14	0.14
	Step Max (mm)	0.16	0.16	0.16	0.16	0.17	0.17	0.19	0.19	0.19	0.19
<b>5</b> Hardened Steel (55-65HRC)	V <sub>c</sub> (m/min)	155	140	110	80	155	125	155	140	125	105
	n (rpm)	19300	17400	13500	9700	15400	12300	12900	11600	10200	9000
	f <sub>z</sub> (mm/t)	0.032	0.032	0.031	0.025	0.038	0.032	0.044	0.044	0.038	0.023
	V <sub>f</sub> (mm/min)	1850	1670	1260	730	1760	1180	1700	1530	1160	620
	Step (mm)	0.11	0.11	0.11	0.11	0.13	0.13	0.14	0.14	0.14	0.14
	Step Max (mm)	0.16	0.16	0.16	0.16	0.17	0.17	0.19	0.19	0.19	0.19



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## EMBPE-ATH Finishing

Work Material	DC	8			10	
	LN	60	70	80	60	75
<b>1</b> Carbon Steel Alloy Steel (180-250HB)	V <sub>c</sub> (m/min)	245	230	220	265	240
	n (rpm)	9700	9100	8700	8500	7700
	f <sub>z</sub> (mm/t)	0.098	0.105	0.094	0.126	0.126
	V <sub>f</sub> (mm/min)	2850	2870	2450	3210	2910
	Step (mm)	0.16	0.16	0.16	0.18	0.18
	Step Max (mm)	0.22	0.22	0.22	0.25	0.25
<b>2</b> Alloy Steel Tool Steel (25-35HRC)	V <sub>c</sub> (m/min)	220	210	200	240	220
	n (rpm)	9700	9100	8700	8500	7700
	f <sub>z</sub> (mm/t)	0.098	0.105	0.094	0.126	0.126
	V <sub>f</sub> (mm/min)	2850	2870	2450	3210	2910
	Step (mm)	0.16	0.16	0.16	0.18	0.18
	Step Max (mm)	0.22	0.22	0.22	0.25	0.25
<b>3</b> Pre-hardened Steel (35-45HRC)	V <sub>c</sub> (m/min)	200	190	175	215	200
	n (rpm)	9700	9100	8700	8500	7700
	f <sub>z</sub> (mm/t)	0.100	0.100	0.090	0.119	0.120
	V <sub>f</sub> (mm/min)	2910	2730	2350	3030	2770
	Step (mm)	0.16	0.16	0.16	0.18	0.18
	Step Max (mm)	0.22	0.22	0.22	0.25	0.25
<b>4</b> Hardened Steel (45-55HRC)	V <sub>c</sub> (m/min)	175	165	160	195	175
	n (rpm)	9700	9100	8700	8500	7700
	f <sub>z</sub> (mm/t)	0.084	0.084	0.076	0.101	0.101
	V <sub>f</sub> (mm/min)	2440	2290	1980	2580	2330
	Step (mm)	0.16	0.16	0.16	0.18	0.18
	Step Max (mm)	0.22	0.22	0.22	0.25	0.25
<b>5</b> Hardened Steel (55-65HRC)	V <sub>c</sub> (m/min)	155	145	140	170	155
	n (rpm)	9700	9100	8700	8500	7700
	f <sub>z</sub> (mm/t)	0.063	0.063	0.057	0.076	0.075
	V <sub>f</sub> (mm/min)	1830	1720	1490	1940	1730
	Step (mm)	0.16	0.16	0.16	0.18	0.18
	Step Max (mm)	0.22	0.22	0.22	0.25	0.25



This standard cutting condition table is intended as reference cutting conditions. The conditions should be adjusted as necessary according to the actual conditions of machined shape, purpose, machine used, etc..



## Attentions on Safety

### 1. Cautions regarding handling

- (a) When removing the tool from its case (packaging), be careful that the tool does not pop out or is dropped. Be particularly careful regarding contact with the tool flutes.
- (b) When handling tools with sharp cutting flutes, be careful not to touch the cutting flutes directly with your bare hands.

### 2. Cautions regarding mounting

- (a) Before use, check the outside appearance of the tool for scratches, cracks, etc. and that it is firmly mounted in the collet chuck, etc..
- (b) When preparing for use, be sure that the inserts are firmly mounted in place and that they are firmly mounted on the arbor, etc..
- (c) If abnormal chattering, etc. occurs during use, stop the machine immediately and remove the cause of the chattering.

### 3. Cautions during use

- (a) Before use, confirm the dimensions and direction of rotation of the tool and milling work material.
- (b) The numerical values in the standard cutting conditions table should be used as criteria when starting new work. The cutting conditions should be adjusted as appropriate when the cutting depth is large, the rigidity of the machine being used is low, or according to the conditions of the work material.
- (c) Cutting tools are made of a hard material. During use, they may break and fly off. In addition, cutting chips may also fly off. Since there is a danger of injury to workers, fire, or eye damage from such flying pieces, a safety cover should be attached when work is performed and safety equipment such as safety goggles should be worn to create a safe environment for work.
- (d) There is a risk of fire or inflammation due to sparks, heat due to breakage, and cutting chips. Do not use where there is a risk of fire or explosion. Please caution of fire while using oil base coolant, fire prevention is necessary.
- (e) Do not use the tool for any purpose other than that for which it is intended.

### 4. Cautions regarding regrinding

- (a) If regrinding is not performed at the proper time, there is a risk of the tool breaking. Replace the tool with one in good condition, or perform regrinding.
- (b) Grinding dust will be created when regrinding a tool. When regrinding, be sure to attach a safety cover over the work area and wear safety clothes such as safety goggles, etc.

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