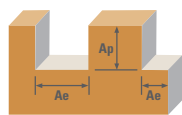


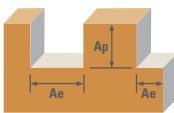
4 Flute, 12xD Overall Reach: Square, Ball



M4, M4B 12xD Fractional	Hardness	Ae x D ₁	Ap x D ₁	Vc (SFM)		Diameter (D ₁) (inch)								
						0.0100	0.0156	0.0312	0.0625	0.0938	0.1200			
P	CARBON STEELS 1018, 1040, 1080, 1090, 10L50, 1140, 1212, 12L15, 1525, 1536	Profile 	≤ .22	≤ .45	≤ .25	365	RPM	139430	89378	44689	22309	14865	11619	
						(292-438)	Fz	0.000016	0.00003	0.00005	0.00010	0.00015	0.00019	
							Feed (ipm)	9.03	9.03	9.03	9.03	9.03	9.03	
		Slot 	1	≤ .06	≤ .15	290	RPM	110780	71013	35506	17725	11810	9232	
						(232-348)	Fz	0.000016	0.00003	0.00005	0.00010	0.00015	0.00019	
							Feed (ipm)	7.18	7.18	7.18	7.18	7.18	7.18	
	ALLOY STEELS 4140, 4150, 4320, 5120, 5150, 8630, 86L20, 50100	≤ 375 Bhn or ≤ 40 HRc	Profile 	≤ .22	≤ .45	≤ .25	210	RPM	80220	51423	25712	12835	8552	6685
							(168-252)	Fz	0.000014	0.00002	0.00004	0.00009	0.00014	0.00017
								Feed (ipm)	4.62	4.62	4.62	4.62	4.62	4.62
		Slot 	1	≤ .06	≤ .15	165	RPM	63030	40404	20202	10085	6720	5253	
						(132-198)	Fz	0.000014	0.00002	0.00004	0.00009	0.00014	0.00017	
							Feed (ipm)	3.63	3.63	3.63	3.63	3.63	3.63	
H	≤ 375 Bhn or ≤ 40 HRc	Profile 	≤ .22	≤ .45	≤ .25	175	RPM	66850	42853	21426	10696	7127	5571	
						(140-210)	Fz	0.000012	0.00002	0.00004	0.00007	0.00011	0.00014	
							Feed (ipm)	3.21	3.21	3.21	3.21	3.21	3.21	
	Slot 	1	≤ .06	≤ .15	140	RPM	53480	34282	17141	8557	5701	4457		
					(112-168)	Fz	0.000012	0.00002	0.00004	0.00007	0.00011	0.00014		
						Feed (ipm)	2.57	2.57	2.57	2.57	2.57	2.57		
K	≤ 220 Bhn or ≤ 19 HRc	Profile 	≤ .22	≤ .45	≤ .25	305	RPM	116510	74686	37343	18642	12421	9709	
						(244-366)	Fz	0.000016	0.00003	0.00005	0.00010	0.00015	0.00019	
							Feed (ipm)	7.56	7.56	7.56	7.56	7.56	7.56	
	Slot 	1	≤ .06	≤ .15	245	RPM	93590	59994	29997	14974	9978	7799		
					(196-294)	Fz	0.000016	0.00003	0.00005	0.00010	0.00015	0.00019		
						Feed (ipm)	6.08	6.08	6.08	6.08	6.08	6.08		
M	STAINLESS STEELS (FREE MACHINING) 303, 416, 420F, 430F, 440F	≤ 275 Bhn or ≤ 28 HRc	Profile 	≤ .22	≤ .45	≤ .25	340	RPM	129880	83256	41628	20781	13846	10823
							(272-408)	Fz	0.000016	0.00003	0.00005	0.00010	0.00015	0.00019
								Feed (ipm)	8.42	8.42	8.42	8.42	8.42	8.42
		Slot 	1	≤ .06	≤ .15	270	RPM	103140	66115	33058	16502	10996	8595	
						(216-324)	Fz	0.000016	0.00003	0.00005	0.00010	0.00015	0.00019	
							Feed (ipm)	6.68	6.68	6.68	6.68	6.68	6.68	
	STAINLESS STEELS (DIFFICULT) 304, 304L, 316, 316L	≤ 275 Bhn or ≤ 28 HRc	Profile 	≤ .22	≤ .45	≤ .25	235	RPM	89770	57545	28772	14363	9570	7481
							(188-282)	Fz	0.000014	0.00002	0.00004	0.00009	0.00014	0.00017
								Feed (ipm)	5.17	5.17	5.17	5.17	5.17	5.17
		Slot 	1	≤ .06	≤ .15	185	RPM	70670	45301	22651	11307	7534	5889	
						(148-222)	Fz	0.000014	0.00002	0.00004	0.00009	0.00014	0.00017	
							Feed (ipm)	4.07	4.07	4.07	4.07	4.07	4.07	
STAINLESS STEELS (PH) 13-8 PH, 15-5PH, 17-4 PH, CUSTOM 450	≤ 325 Bhn or ≤ 35 HRc	Profile 	≤ .22	≤ .45	≤ .25	215	RPM	82130	52647	26324	13141	8756	6844	
						(172-258)	Fz	0.000010	0.00002	0.00003	0.00006	0.00010	0.00012	
							Feed (ipm)	3.35	3.35	3.35	3.35	3.35	3.35	
	Slot 	1	≤ .06	≤ .15	170	RPM	64940	41628	20814	10390	6923	5412		
					(136-204)	Fz	0.000010	0.00002	0.00003	0.00006	0.00010	0.00012		
						Feed (ipm)	2.65	2.65	2.65	2.65	2.65	2.65		

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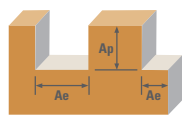
4 Flute, 12xD Overall Reach: Square, Ball



M4, M4B 12xD Fractional	Hardness	Profile	Ae x D ₁		Ap x D ₁	Vc (SFM)		Diameter (D ₁) (inch)					
			≤ .22	≤ .45				≤ .25	0.0100	0.0156	0.0312	0.0625	0.0938
S	SUPER ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 601, 617, 625, Incoloy, Monel 400	Profile	≤ .22	≤ .45	≤ .25	60	RPM	22920	14692	7346	3667	2443	1910
						(48-72)	Fz	0.000009	0.00001	0.00003	0.00006	0.00008	0.00011
							Feed (ipm)	0.83	0.83	0.83	0.83	0.83	0.83
		Slot	1	≤ .06	≤ .15	45	RPM	17190	11019	5510	2750	1833	1433
						(36-54)	Fz	0.000009	0.00001	0.00003	0.00006	0.00008	0.00011
							Feed (ipm)	0.62	0.62	0.62	0.62	0.62	0.62
	SUPER ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 718, X-750, Incoloy, Waspaloy, Hastelloy, Rene	Profile	≤ .22	≤ .45	≤ .25	45	RPM	17190	11019	5510	2750	1833	1433
						(36-54)	Fz	0.000006	0.00001	0.00002	0.00004	0.00006	0.00007
							Feed (ipm)	0.41	0.41	0.41	0.41	0.41	0.41
		Slot	1	≤ .06	≤ .15	35	RPM	13370	8571	4285	2139	1425	1114
						(28-42)	Fz	0.000006	0.00001	0.00002	0.00004	0.00006	0.00007
							Feed (ipm)	0.32	0.32	0.32	0.32	0.32	0.32
TITANIUM ALLOYS Pure Titanium, Ti6Al4V, Ti6Al2Sn4Zr2Mo, Ti4Al4Mo2Sn0.5Si	Profile	≤ .22	≤ .45	≤ .25	160	RPM	61120	39179	19590	9779	6516	5093	
					(128-192)	Fz	0.000010	0.00002	0.00003	0.00006	0.00010	0.00012	
						Feed (ipm)	2.49	2.49	2.49	2.49	2.49	2.49	
	Slot	1	≤ .06	≤ .15	130	RPM	49660	31833	15917	7946	5294	4138	
					(104-156)	Fz	0.000010	0.00002	0.00003	0.00006	0.00010	0.00012	
						Feed (ipm)	2.03	2.03	2.03	2.03	2.03	2.03	
TITANIUM ALLOYS (DIFFICULT) Ti10Al2Fe3Al, Ti5Al5V5Mo3Cr, Ti7Al4Mo, Ti3Al8V6Cr4Zr4Mo, Ti6Al6V6Sn, Ti15V3 Cr3Sn3Al	Profile	≤ .22	≤ .45	≤ .25	60	RPM	22920	14692	7346	3667	2443	1910	
					(48-72)	Fz	0.000007	0.00001	0.00002	0.00004	0.00007	0.00009	
						Feed (ipm)	0.66	0.66	0.66	0.66	0.66	0.66	
	Slot	1	≤ .06	≤ .15	45	RPM	17190	11019	5510	2750	1833	1433	
					(36-54)	Fz	0.000007	0.00001	0.00002	0.00004	0.00007	0.00009	
						Feed (ipm)	0.50	0.50	0.50	0.50	0.50	0.50	
ALUMINUM ALLOYS 2017, 2024, 356, 6061, 7075	Profile	≤ .28	≤ .55	≤ .30	1000	RPM	382000	244872	122436	61120	40725	31833	
					(800-1200)	Fz	0.000048	0.00007	0.00015	0.00030	0.00045	0.00057	
						Feed (ipm)	73.13	73.13	73.13	73.13	73.13	73.13	
	Slot	1	≤ .07	≤ .17	800	RPM	305600	195897	97949	48896	32580	25467	
					(640-960)	Fz	0.000048	0.00007	0.00015	0.00030	0.00045	0.00057	
						Feed (ipm)	58.50	58.50	58.50	58.50	58.50	58.50	
COPPER ALLOYS Alum Bronze, C110, Muntz Brass	Profile	≤ .22	≤ .45	≤ .25	515	RPM	196730	126109	63054	31477	20973	16394	
					(412-618)	Fz	0.000036	0.00006	0.00011	0.00022	0.00034	0.00043	
						Feed (ipm)	28.26	28.26	28.26	28.26	28.26	28.26	
	Slot	1	≤ .06	≤ .15	410	RPM	156620	100397	50199	25059	16697	13052	
					(328-492)	Fz	0.000036	0.00006	0.00011	0.00022	0.00034	0.00043	
						Feed (ipm)	22.50	22.50	22.50	22.50	22.50	22.50	
PLASTICS Polycarbonate, PVC, Polypropylene	Profile	≤ .22	≤ .45	≤ .25	1000	RPM	382000	244872	122436	61120	40725	31833	
					(800-1200)	Fz	0.000048	0.00007	0.00015	0.00030	0.00045	0.00057	
						Feed (ipm)	73.13	73.13	73.13	73.13	73.13	73.13	
	Slot	1	≤ .06	≤ .15	800	RPM	305600	195897	97949	48896	32580	25467	
					(640-960)	Fz	0.000048	0.00007	0.00015	0.00030	0.00045	0.00057	
						Feed (ipm)	58.50	58.50	58.50	58.50	58.50	58.50	

- Note:**
- Bhn (Brinell) HRc (Rockwell C)
 - when recommended speed exceeds your capability, use maximum available and recalculate ipm
 - rpm = Vc x 3.82 / D₁
 - ipm = Fz x 4 x rpm
 - helical ramp at 1 degrees or less, using slotting speed and feed rates (plunging is not recommended)
 - reduce speed and feed for materials harder than listed
 - reduce feed and Ae when finish milling (.02 x D₁ maximum)
 - refer to the KYOCERA SGS Tool Wizard® for complete technical information (www.kyocera-sgstool.com)

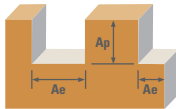
4 Flute: Square, Ball



M4, M4B 1.5xD Fractional	Hardness	Ae x D ₁	Ap x D ₁	Vc (SFM)		Diameter (D ₁) (inch)						
						0.005	0.015	0.031	0.062	0.093	0.120	
P	CARBON STEELS 1018, 1040, 1080, 1090, 10L50, 1140, 1212, 12L15, 1525, 1536 ≤ 275 Bhn or ≤ 28 HRc	Profile ≤ .30 ≤ .50 ≤ 1	365 (292-438)	RPM	278860	89378	44689	22309	14865	11619		
				Fz	0.000017	0.00005	0.00011	0.00021	0.00032	0.00041		
		Slot 1 ≤ .20 ≤ .50	290 (232-348)	RPM	221560	71013	35506	17725	11810	9232		
				Fz	0.000017	0.00005	0.00011	0.00021	0.00032	0.00041		
						RPM	160440	51423	25712	12835	8552	6685
						Fz	0.000015	0.00005	0.00010	0.00019	0.00029	0.00037
H	ALLOY STEELS 4140, 4150, 4320, 5120, 5150, 8630, 86L20, 50100 ≤ 375 Bhn or ≤ 40 HRc	Profile ≤ .30 ≤ .50 ≤ 1	210 (168-252)	RPM	160440	51423	25712	12835	8552	6685		
				Fz	0.000015	0.00005	0.00010	0.00019	0.00029	0.00037		
		Slot 1 ≤ .20 ≤ .50	165 (132-198)	RPM	126060	40404	20202	10085	6720	5253		
				Fz	0.000015	0.00005	0.00010	0.00019	0.00029	0.00037		
						RPM	133700	42853	21426	10696	7127	5571
						Fz	0.000013	0.00004	0.00008	0.00016	0.00024	0.00030
K	TOOL STEELS A2, D2, H13, L2, M2, P20, S7, T15, W2 ≤ 375 Bhn or ≤ 40 HRc	Profile ≤ .30 ≤ .50 ≤ 1	175 (140-210)	RPM	133700	42853	21426	10696	7127	5571		
				Fz	0.000013	0.00004	0.00008	0.00016	0.00024	0.00030		
		Slot 1 ≤ .20 ≤ .50	140 (112-168)	RPM	106960	34282	17141	8557	5701	4457		
				Fz	0.000013	0.00004	0.00008	0.00016	0.00024	0.00030		
						RPM	233020	74686	37343	18642	12421	9709
						Fz	0.000017	0.00005	0.00011	0.00021	0.00032	0.00041
M	CAST IRONS (LOW & MEDIUM ALLOY) Gray, Malleable, Ductile ≤ 220 Bhn or ≤ 19 HRc	Profile ≤ .30 ≤ .50 ≤ 1	305 (244-366)	RPM	233020	74686	37343	18642	12421	9709		
				Fz	0.000017	0.00005	0.00011	0.00021	0.00032	0.00041		
		Slot 1 ≤ .20 ≤ .50	245 (196-294)	RPM	187180	59994	29997	14974	9978	7799		
				Fz	0.000017	0.00005	0.00011	0.00021	0.00032	0.00041		
						RPM	259760	83256	41628	20781	13846	10823
						Fz	0.000017	0.00005	0.00010	0.00021	0.00031	0.00040
	STAINLESS STEELS (FREE MACHINING) 303, 416, 420F, 430F, 440F ≤ 275 Bhn or ≤ 28 HRc	Profile ≤ .30 ≤ .50 ≤ 1	340 (272-408)		RPM	259760	83256	41628	20781	13846	10823	
					Fz	0.000017	0.00005	0.00010	0.00021	0.00031	0.00040	
		Slot 1 ≤ .20 ≤ .50	270 (216-324)	RPM	206280	66115	33058	16502	10996	8595		
				Fz	0.000017	0.00005	0.00010	0.00021	0.00031	0.00040		
						RPM	179540	57545	28772	14363	9570	7481
						Fz	0.000015	0.00005	0.00009	0.00019	0.00029	0.00037
STAINLESS STEELS (DIFFICULT) 304, 304L, 316, 316L ≤ 275 Bhn or ≤ 28 HRc	Profile ≤ .30 ≤ .50 ≤ 1	235 (188-282)		RPM	179540	57545	28772	14363	9570	7481		
				Fz	0.000015	0.00005	0.00009	0.00019	0.00029	0.00037		
	Slot 1 ≤ .20 ≤ .50	185 (148-222)	RPM	141340	45301	22651	11307	7534	5889			
			Fz	0.000015	0.00005	0.00009	0.00019	0.00029	0.00037			
					RPM	164260	52647	26324	13141	8756	6844	
					Fz	0.000011	0.00003	0.00007	0.00013	0.00020	0.00026	
STAINLESS STEELS (PH) 13-8 PH, 15-5PH, 17-4 PH, CUSTOM 450 ≤ 325 Bhn or ≤ 35 HRc	Profile ≤ .30 ≤ .50 ≤ 1	215 (172-258)		RPM	164260	52647	26324	13141	8756	6844		
				Fz	0.000011	0.00003	0.00007	0.00013	0.00020	0.00026		
	Slot 1 ≤ .20 ≤ .50	170 (136-204)	RPM	129880	41628	20814	10390	6923	5412			
			Fz	0.000011	0.00003	0.00007	0.00013	0.00020	0.00026			
					RPM	164260	52647	26324	13141	8756	6844	
					Fz	0.000011	0.00003	0.00007	0.00013	0.00020	0.00026	

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FRACTIONAL 4 Flute: Square, Ball



M4, M4B 1.5xD Fractional	Hardness	Profile	Ae x D ₁		Ap x D ₁	Vc (SFM)	Diameter (D ₁) (inch)						
			≤ .30	≤ .50			0.005	0.015	0.031	0.062	0.093	0.120	
S	SUPER ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 601, 617, 625, Incoloy, Monel 400	Profile	≤ .30	≤ .50	≤ 1	60	RPM	45840	14692	7346	3667	2443	1910
						(48-72)	Fz	0.000009	0.00003	0.00006	0.00012	0.00018	0.00023
						Feed (ipm)	1.73	1.73	1.73	1.73	1.73	1.73	
		Slot	1	≤ .20	≤ .50	45	RPM	34380	11019	5510	2750	1833	1433
						(36-54)	Fz	0.000009	0.00003	0.00006	0.00012	0.00018	0.00023
						Feed (ipm)	1.30	1.30	1.30	1.30	1.30	1.30	
	SUPER ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 718, X-750, Incoloy, Waspaloy, Hastelloy, Rene	Profile	≤ .30	≤ .50	≤ 1	45	RPM	34380	11019	5510	2750	1833	1433
						(36-54)	Fz	0.000006	0.00002	0.00004	0.00008	0.00012	0.00015
						Feed (ipm)	0.87	0.87	0.87	0.87	0.87	0.87	
		Slot	1	≤ .20	≤ .50	35	RPM	26740	8571	4285	2139	1425	1114
						(28-42)	Fz	0.000006	0.00002	0.00004	0.00008	0.00012	0.00015
						Feed (ipm)	0.68	0.68	0.68	0.68	0.68	0.68	
TITANIUM ALLOYS Pure Titanium, Ti6Al4V, Ti6Al2Sn4Zr2Mo, Ti4Al4Mo2Sn0.5Si	Profile	≤ .30	≤ .50	≤ 1	160	RPM	122240	39179	19590	9779	6516	5093	
					(128-192)	Fz	0.000011	0.00003	0.00007	0.00013	0.00020	0.00025	
					Feed (ipm)	5.17	5.17	5.17	5.17	5.17	5.17		
	Slot	1	≤ .20	≤ .50	130	RPM	99320	31833	15917	7946	5294	4138	
					(104-156)	Fz	0.000011	0.00003	0.00007	0.00013	0.00020	0.00025	
					Feed (ipm)	4.20	4.20	4.20	4.20	4.20	4.20		
TITANIUM ALLOYS (DIFFICULT) Ti10Al2Fe3Al, Ti5Al5V5Mo3Cr, Ti7Al4Mo, Ti3Al8V6Cr4Zr4Mo, Ti6Al6V6Sn, Ti15V3 Cr3Sn3Al	Profile	≤ .30	≤ .50	≤ 1	60	RPM	45840	14692	7346	3667	2443	1910	
					(48-72)	Fz	0.000007	0.00002	0.00005	0.00009	0.00014	0.00017	
					Feed (ipm)	1.33	1.33	1.33	1.33	1.33	1.33		
	Slot	1	≤ .20	≤ .50	45	RPM	34380	11019	5510	2750	1833	1433	
					(36-54)	Fz	0.000007	0.00002	0.00005	0.00009	0.00014	0.00017	
					Feed (ipm)	1.00	1.00	1.00	1.00	1.00	1.00		
N	ALUMINUM ALLOYS 2017, 2024, 356, 6061, 7075	Profile	≤ .30	≤ .50	≤ 1	1000	RPM	764000	244872	122436	61120	40725	31833
						(800-1200)	Fz	0.000051	0.00016	0.00032	0.00064	0.00096	0.00123
						Feed (ipm)	156.25	156.25	156.25	156.25	156.25	156.25	
		Slot	1	≤ .20	≤ .50	800	RPM	611200	195897	97949	48896	32580	25467
						(640-960)	Fz	0.000051	0.00016	0.00032	0.00064	0.00096	0.00123
						Feed (ipm)	125.00	125.00	125.00	125.00	125.00	125.00	
COPPER ALLOYS Alum Bronze, C110, Muntz Brass	Profile	≤ .30	≤ .50	≤ 1	515	RPM	393460	126109	63054	31477	20973	16394	
					(412-618)	Fz	0.000038	0.00012	0.00024	0.00048	0.00072	0.00092	
					Feed (ipm)	60.29	60.29	60.29	60.29	60.29	60.29		
	Slot	1	≤ .20	≤ .50	410	RPM	313240	100397	50199	25059	16697	13052	
					(328-492)	Fz	0.000038	0.00012	0.00024	0.00048	0.00072	0.00092	
					Feed (ipm)	48.00	48.00	48.00	48.00	48.00	48.00		
PLASTICS Polycarbonate, PVC, Polypropylene	Profile	≤ .30	≤ .50	≤ 1	1000	RPM	764000	244872	122436	61120	40725	31833	
					(800-1200)	Fz	0.000051	0.00016	0.00032	0.00064	0.00096	0.00123	
					Feed (ipm)	156.25	156.25	156.25	156.25	156.25	156.25		
	Slot	1	≤ .20	≤ .50	800	RPM	611200	195897	97949	48896	32580	25467	
					(640-960)	Fz	0.000051	0.00016	0.00032	0.00064	0.00096	0.00123	
					Feed (ipm)	125.00	125.00	125.00	125.00	125.00	125.00		

Note:

- Bhn (Brinell) HRC (Rockwell C)
- when recommended speed exceeds your capability, use maximum available and recalculate ipm
- rpm = Vc x 3.82 / D1
- ipm = Fz x 4 x rpm
- helical ramp at 2 degrees or less, using slotting speed and feed rates (plunging is not recommended)
- reduce speed and feed for materials harder than listed
- reduce feed and Ae when finish milling (.02 x D1 maximum)
- refer to the KYOCERA SGS Tool Wizard® for complete technical information (www.kyocera-sgstool.com)