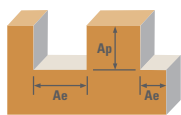


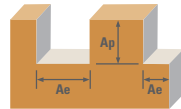
# 2 Flute: Square, Ball



M2M, M2MB 3xD Metric	Hardness	Ae x D <sub>1</sub>	Ap x D <sub>1</sub>	Vc (m/min)	Diameter (D <sub>1</sub> ) (mm)									
					0.1	0.5	1	1.5	2	2.5	3			
<b>P</b>	<b>CARBON STEELS</b> 1018, 1040, 1080, 1090, 10L50, 1140, 1212, 12L15, 1525, 1536	Profile 	≤ .10	≤ .25	≤ 2	111	RPM	353837	70767	35384	23589	17692	14153	11795
						(89-134)	Fz	0.00039	0.00194	0.00389	0.00583	0.00778	0.00972	0.01168
		Slot 	1	≤ .15	≤ .35	88	RPM	281131	56226	28113	18742	14057	11245	9371
						(71-106)	Fz	0.00039	0.00194	0.00389	0.00583	0.00778	0.00972	0.01168
	<b>ALLOY STEELS</b> 4140, 4150, 4320, 5120, 5150, 8630, 86L20, 50100	Profile 	≤ .10	≤ .25	≤ 2	64	RPM	203577	40715	20358	13572	10179	8143	6786
						(51-77)	Fz	0.00035	0.00173	0.00346	0.00519	0.00692	0.00865	0.01041
		Slot 	1	≤ .15	≤ .35	50	RPM	159954	31991	15995	10664	7998	6398	5332
						(40-60)	Fz	0.00035	0.00173	0.00346	0.00519	0.00692	0.00865	0.01041
<b>H</b>	Profile 	≤ .10	≤ .25	≤ 2	53	RPM	169648	33930	16965	11310	8482	6786	5655	
					(43-64)	Fz	0.00028	0.00140	0.00281	0.00421	0.00561	0.00702	0.00840	
	Slot 	1	≤ .15	≤ .35	43	RPM	135718	27144	13572	9048	6786	5429	4524	
					(34-51)	Fz	0.00028	0.00140	0.00281	0.00421	0.00561	0.00702	0.00840	
<b>K</b>	Profile 	≤ .10	≤ .25	≤ 2	93	RPM	295672	59134	29567	19711	14784	11827	9856	
					(74-112)	Fz	0.00039	0.00195	0.00390	0.00586	0.00781	0.00976	0.01168	
	Slot 	1	≤ .15	≤ .35	75	RPM	237507	47501	23751	15834	11875	9500	7917	
					(60-90)	Fz	0.00039	0.00195	0.00390	0.00586	0.00781	0.00976	0.01168	
<b>M</b>	<b>STAINLESS STEELS (FREE MACHINING)</b> 303, 416, 420F, 430F, 440F	Profile 	≤ .10	≤ .25	≤ 2	104	RPM	329602	65920	32960	21973	16480	13184	10987
						(83-124)	Fz	0.00039	0.00194	0.00388	0.00582	0.00776	0.00970	0.01163
		Slot 	1	≤ .15	≤ .35	82	RPM	261742	52348	26174	17449	13087	10470	8725
						(66-99)	Fz	0.00039	0.00194	0.00388	0.00582	0.00776	0.00970	0.01163
	<b>STAINLESS STEELS (DIFFICULT)</b> 304, 304L, 316, 316L	Profile 	≤ .10	≤ .25	≤ 2	72	RPM	227813	45563	22781	15188	11391	9113	7594
						(57-86)	Fz	0.00035	0.00173	0.00346	0.00519	0.00693	0.00866	0.01037
		Slot 	1	≤ .15	≤ .35	56	RPM	179342	35868	17934	11956	8967	7174	5978
						(45-68)	Fz	0.00035	0.00173	0.00346	0.00519	0.00693	0.00866	0.01037
	<b>STAINLESS STEELS (PH)</b> 13-8 PH, 15-5PH, 17-4 PH, CUSTOM 450	Profile 	≤ .10	≤ .25	≤ 2	66	RPM	208425	41685	20842	13895	10421	8337	6947
						(52-79)	Fz	0.00025	0.00123	0.00245	0.00368	0.00490	0.00613	0.00737
		Slot 	1	≤ .15	≤ .35	52	RPM	164801	32960	16480	10987	8240	6592	5493
						(41-62)	Fz	0.00025	0.00123	0.00245	0.00368	0.00490	0.00613	0.00737

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# 2 Flute: Square, Ball

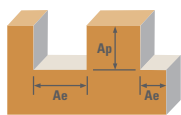


M2M, M2MB 3xD Metric	Hardness	Profile Ae x D <sub>1</sub>	Slot Ap x D <sub>1</sub>	Vc (m/min)	Diameter (D <sub>1</sub> ) (mm)							
					0.1	0.5	1	1.5	2	2.5	3	
S  <b>SUPER ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 601, 617, 625, Incoloy, Monel 400</b>	≤ 300 Bhn or ≤ 32 HRc	Profile ≤ .10 ≤ .25	≤ 2	18	RPM	58165	11633	5816	3878	2908	2327	1939
				(15-22)	Fz	0.00022	0.00109	0.00218	0.00328	0.00437	0.00546	0.00653
				Feed (mm/min)	25	25	25	25	25	25		
		Slot 1 ≤ .15 ≤ .35	14	RPM	43624	8725	4362	2908	2181	1745	1454	
			(11-16)	Fz	0.00022	0.00109	0.00218	0.00328	0.00437	0.00546	0.00653	
			Feed (mm/min)	19	19	19	19	19	19			
	≤ 400 Bhn or ≤ 43 HRc	Profile ≤ .10 ≤ .25	≤ 2	14	RPM	43624	8725	4362	2908	2181	1745	1454
				(11-16)	Fz	0.00015	0.00073	0.00146	0.00219	0.00292	0.00365	0.00442
				Feed (mm/min)	13	13	13	13	13	13		
		Slot 1 ≤ .15 ≤ .35	11	RPM	33930	6786	3393	2262	1696	1357	1131	
			(9-13)	Fz	0.00015	0.00073	0.00146	0.00219	0.00292	0.00365	0.00442	
			Feed (mm/min)	10	10	10	10	10	10			
S  <b>TITANIUM ALLOYS Pure Titanium, Ti6Al4V, Ti6Al2Sn4Zr2Mo, Ti4Al4Mo2Sn0.5Si</b>	≤ 350 Bhn or ≤ 38 HRc	Profile ≤ .10 ≤ .25	≤ 2	49	RPM	155107	31021	15511	10340	7755	6204	5170
				(39-59)	Fz	0.00024	0.00122	0.00245	0.00367	0.00490	0.00612	0.00738
				Feed (mm/min)	76	76	76	76	76	76		
		Slot 1 ≤ .15 ≤ .35	40	RPM	126024	25205	12602	8402	6301	5041	4201	
			(32-48)	Fz	0.00024	0.00122	0.00245	0.00367	0.00490	0.00612	0.00738	
			Feed (mm/min)	62	62	62	62	62	62			
	≤ 440 Bhn or ≤ 47 HRc	Profile ≤ .10 ≤ .25	≤ 2	18	RPM	58165	11633	5816	3878	2908	2327	1939
				(15-22)	Fz	0.00017	0.00086	0.00172	0.00258	0.00344	0.00429	0.00516
				Feed (mm/min)	20	20	20	20	20	20		
		Slot 1 ≤ .15 ≤ .35	14	RPM	43624	8725	4362	2908	2181	1745	1454	
			(11-16)	Fz	0.00017	0.00086	0.00172	0.00258	0.00344	0.00429	0.00516	
			Feed (mm/min)	15	15	15	15	15	15			
N  <b>ALUMINUM ALLOYS 2017, 2024, 356, 6061, 7075</b>	≤ 150 Bhn or ≤ 7 HRc	Profile ≤ .10 ≤ .25	≤ 2	305	RPM	969416	193883	96942	64628	48471	38777	32314
				(244-366)	Fz	0.00115	0.00573	0.01146	0.01719	0.02293	0.02866	0.03439
				Feed (mm/min)	2223	2223	2223	2223	2223	2223		
		Slot 1 ≤ .15 ≤ .35	244	RPM	775533	155107	77553	51702	38777	31021	25851	
			(195-293)	Fz	0.00115	0.00573	0.01146	0.01719	0.02293	0.02866	0.03439	
			Feed (mm/min)	1778	1778	1778	1778	1778	1778			
	≤ 140 Bhn or ≤ 3 HRc	Profile ≤ .10 ≤ .25	≤ 2	157	RPM	499249	99850	49925	33283	24962	19970	16642
				(126-188)	Fz	0.00086	0.00431	0.00863	0.01294	0.01725	0.02157	0.02589
				Feed (mm/min)	861	861	861	861	861	861		
		Slot 1 ≤ .15 ≤ .35	125	RPM	397461	79492	39746	26497	19873	15898	13249	
			(100-150)	Fz	0.00086	0.00431	0.00863	0.01294	0.01725	0.02157	0.02589	
			Feed (mm/min)	686	686	686	686	686	686			
<b>PLASTICS Polycarbonate, PVC, Polypropylene</b>	Profile ≤ .10 ≤ .25	≤ 2	305	RPM	969416	193883	96942	64628	48471	38777	32314	
			(244-366)	Fz	0.00115	0.00573	0.01146	0.01719	0.02293	0.02866	0.03439	
			Feed (mm/min)	2223	2223	2223	2223	2223	2223			
	Slot 1 ≤ .15 ≤ .35	244	RPM	775533	155107	77553	51702	38777	31021	25851		
		(195-293)	Fz	0.00115	0.00573	0.01146	0.01719	0.02293	0.02866	0.03439		
		Feed (mm/min)	1778	1778	1778	1778	1778	1778				

**Note:**

- Bhn (Brinell)      HRc (Rockwell C)
- when recommended speed exceeds your capability, use maximum available and recalculate ipm
- rpm = (Vc x 1000) / (D<sub>1</sub> x 3.14)
- mm/min = Fz x 2 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 D<sub>1</sub> maximum)
- refer to the KYOCERA SGS Tool Wizard® for complete technical information (www.kyocera-sgstool.com)

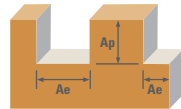
# 4 Flute: Ball



M4MB 1.5xD Metric	Hardness	Ae x D <sub>1</sub>	Ap x D <sub>1</sub>	Vc (m/min)	Diameter (D <sub>1</sub> ) (mm)										
					0.1	0.5	1	1.5	2	2.5	3				
<b>P</b>	<b>CARBON STEELS</b> 1018, 1040, 1080, 1090, 10L50, 1140, 1212, 12L15, 1525, 1536	Profile 	≤ .30	≤ .50	≤ 1	111	RPM	353837	70767	35384	23589	17692	14153	11795	
						(89-134)	Fz	0.00034	0.00169	0.00339	0.00508	0.00678	0.00847	0.01016	
						Feed (mm/min)	480	480	480	480	480	480	480		
		Slot 	1	≤ .20	≤ .50	88	RPM	281131	56226	28113	18742	14057	11245	9371	
						(71-106)	Fz	0.00034	0.00169	0.00339	0.00508	0.00678	0.00847	0.01016	
						Feed (mm/min)	381	381	381	381	381	381	381		
	<b>H</b>	<b>ALLOY STEELS</b> 4140, 4150, 4320, 5120, 5150, 8630, 86L20, 50100	Profile 	≤ .30	≤ .50	≤ 1	64	RPM	203577	40715	20358	13572	10179	8143	6786
							(51-77)	Fz	0.00031	0.00153	0.00306	0.00459	0.00611	0.00764	0.00919
							Feed (mm/min)	249	249	249	249	249	249	249	
			Slot 	1	≤ .20	≤ .50	50	RPM	159954	31991	15995	10664	7998	6398	5332
(40-60)							Fz	0.00031	0.00153	0.00306	0.00459	0.00611	0.00764	0.00919	
Feed (mm/min)							196	196	196	196	196	196	196		
<b>K</b>		<b>TOOL STEELS</b> A2, D2, H13, L2, M2, P20, S7, T15, W2	Profile 	≤ .30	≤ .50	≤ 1	53	RPM	169648	33930	16965	11310	8482	6786	5655
							(43-64)	Fz	0.00025	0.00126	0.00253	0.00379	0.00505	0.00632	0.00757
							Feed (mm/min)	171	171	171	171	171	171	171	
			Slot 	1	≤ .20	≤ .50	43	RPM	135718	27144	13572	9048	6786	5429	4524
	(34-51)						Fz	0.00025	0.00126	0.00253	0.00379	0.00505	0.00632	0.00757	
	Feed (mm/min)						137	137	137	137	137	137	137		
	<b>M</b>	<b>CAST IRONS (LOW &amp; MEDIUM ALLOY) Gray, Malleable, Ductile</b>	Profile 	≤ .30	≤ .50	≤ 1	93	RPM	295672	59134	29567	19711	14784	11827	9856
							(74-112)	Fz	0.00034	0.00170	0.00340	0.00509	0.00679	0.00849	0.01020
							Feed (mm/min)	402	402	402	402	402	402	402	
			Slot 	1	≤ .20	≤ .50	75	RPM	237507	47501	23751	15834	11875	9500	7917
(60-90)							Fz	0.00034	0.00170	0.00340	0.00509	0.00679	0.00849	0.01020	
Feed (mm/min)							323	323	323	323	323	323	323		
<b>N</b>		<b>STAINLESS STEELS (FREE MACHINING) 303, 416, 420F, 430F, 440F</b>	Profile 	≤ .30	≤ .50	≤ 1	104	RPM	329602	65920	32960	21973	16480	13184	10987
							(83-124)	Fz	0.00033	0.00167	0.00335	0.00502	0.00670	0.00837	0.01006
							Feed (mm/min)	441	441	441	441	441	441	441	
			Slot 	1	≤ .20	≤ .50	82	RPM	261742	52348	26174	17449	13087	10470	8725
	(66-99)						Fz	0.00033	0.00167	0.00335	0.00502	0.00670	0.00837	0.01006	
	Feed (mm/min)						351	351	351	351	351	351	351		
	<b>O</b>	<b>STAINLESS STEELS (DIFFICULT) 304, 304L, 316, 316L</b>	Profile 	≤ .30	≤ .50	≤ 1	72	RPM	227813	45563	22781	15188	11391	9113	7594
							(57-86)	Fz	0.00030	0.00152	0.00305	0.00457	0.00609	0.00761	0.00912
							Feed (mm/min)	277	277	277	277	277	277	277	
			Slot 	1	≤ .20	≤ .50	56	RPM	179342	35868	17934	11956	8967	7174	5978
(45-68)							Fz	0.00030	0.00152	0.00305	0.00457	0.00609	0.00761	0.00912	
Feed (mm/min)							218	218	218	218	218	218	218		
<b>P</b>		<b>STAINLESS STEELS (PH) 13-8 PH, 15-5PH, 17-4 PH, CUSTOM 450</b>	Profile 	≤ .30	≤ .50	≤ 1	66	RPM	208425	41685	20842	13895	10421	8337	6947
							(52-79)	Fz	0.00022	0.00108	0.00216	0.00324	0.00432	0.00539	0.00646
			Slot 	1	≤ .20	≤ .50	52	RPM	164801	32960	16480	10987	8240	6592	5493
							(41-62)	Fz	0.00022	0.00108	0.00216	0.00324	0.00432	0.00539	0.00646

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# 4 Flute: Ball



M4MB 1.5xD Metric	Hardness	Profile Ae x D <sub>1</sub>	Slot Ap x D <sub>1</sub>	Vc (m/min)	Diameter (D <sub>1</sub> ) (mm)							
					0.1	0.5	1	1.5	2	2.5	3	
S	SUPER ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 601, 617, 625, Incoloy, Monel 400	Profile ≤ .30 ≤ .50	≤ 1	18	RPM	58165	11633	5816	3878	2908	2327	1939
				(15-22)	Fz	0.00019	0.00095	0.00189	0.00284	0.00378	0.00473	0.00567
				Feed (mm/min)	44	44	44	44	44	44	44	
		Slot 1 ≤ .20 ≤ .50	14	RPM	43624	8725	4362	2908	2181	1745	1454	
			(11-16)	Fz	0.00019	0.00095	0.00189	0.00284	0.00378	0.00473	0.00567	
			Feed (mm/min)	33	33	33	33	33	33	33		
	SUPER ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 718, X-750, Incoloy, Waspaloy, Hastelloy, Rene	Profile ≤ .30 ≤ .50	≤ 1	14	RPM	43624	8725	4362	2908	2181	1745	1454
				(11-16)	Fz	0.00013	0.00064	0.00127	0.00191	0.00255	0.00318	0.00376
				Feed (mm/min)	22	22	22	22	22	22	22	
		Slot 1 ≤ .20 ≤ .50	11	RPM	33930	6786	3393	2262	1696	1357	1131	
			(9-13)	Fz	0.00013	0.00064	0.00127	0.00191	0.00255	0.00318	0.00376	
			Feed (mm/min)	17	17	17	17	17	17	17		
TITANIUM ALLOYS Pure Titanium, Ti6Al4V, Ti6Al2Sn4Zr2Mo, Ti4Al4Mo2Sn0.5Si	Profile ≤ .30 ≤ .50	≤ 1	49	RPM	155107	31021	15511	10340	7755	6204	5170	
			(39-59)	Fz	0.00021	0.00106	0.00212	0.00317	0.00423	0.00529	0.00637	
			Feed (mm/min)	131	131	131	131	131	131	131		
	Slot 1 ≤ .20 ≤ .50	40	RPM	126024	25205	12602	8402	6301	5041	4201		
		(32-48)	Fz	0.00021	0.00106	0.00212	0.00317	0.00423	0.00529	0.00637		
		Feed (mm/min)	107	107	107	107	107	107	107			
TITANIUM ALLOYS (DIFFICULT) Ti10Al2Fe3Al, Ti5Al5V5Mo3Cr, Ti7Al4Mo, Ti3Al8V6Cr4Zr4Mo, Ti6Al6V6Sn, Ti15V3 Cr3Sn3Al	Profile ≤ .30 ≤ .50	≤ 1	18	RPM	58165	11633	5816	3878	2908	2327	1939	
			(15-22)	Fz	0.00015	0.00073	0.00146	0.00218	0.00291	0.00364	0.00430	
			Feed (mm/min)	34	34	34	34	34	34	34		
	Slot 1 ≤ .20 ≤ .50	14	RPM	43624	8725	4362	2908	2181	1745	1454		
		(11-16)	Fz	0.00015	0.00073	0.00146	0.00218	0.00291	0.00364	0.00430		
		Feed (mm/min)	25	25	25	25	25	25	25			
ALUMINUM ALLOYS 2017, 2024, 356, 6061, 7075	Profile ≤ .30 ≤ .50	≤ 1	305	RPM	969416	193883	96942	64628	48471	38777	32314	
			(244-366)	Fz	0.00102	0.00512	0.01023	0.01535	0.02047	0.02559	0.03070	
			Feed (mm/min)	3969	3969	3969	3969	3969	3969	3969		
	Slot 1 ≤ .20 ≤ .50	244	RPM	775533	155107	77553	51702	38777	31021	25851		
		(195-293)	Fz	0.00102	0.00512	0.01023	0.01535	0.02047	0.02559	0.03070		
		Feed (mm/min)	3175	3175	3175	3175	3175	3175	3175			
COPPER ALLOYS Alum Bronze, C110, Muntz Brass	Profile ≤ .30 ≤ .50	≤ 1	157	RPM	499249	99850	49925	33283	24962	19970	16642	
			(126-188)	Fz	0.00077	0.00383	0.00767	0.01150	0.01534	0.01917	0.02300	
			Feed (mm/min)	1531	1531	1531	1531	1531	1531	1531		
	Slot 1 ≤ .20 ≤ .50	125	RPM	397461	79492	39746	26497	19873	15898	13249		
		(100-150)	Fz	0.00077	0.00383	0.00767	0.01150	0.01534	0.01917	0.02300		
		Feed (mm/min)	1219	1219	1219	1219	1219	1219	1219			
PLASTICS Polycarbonate, PVC, Polypropylene	Profile ≤ .30 ≤ .50	≤ 1	305	RPM	969416	193883	96942	64628	48471	38777	32314	
			(244-366)	Fz	0.00102	0.00512	0.01023	0.01535	0.02047	0.02559	0.03070	
			Feed (mm/min)	3969	3969	3969	3969	3969	3969	3969		
	Slot 1 ≤ .20 ≤ .50	244	RPM	775533	155107	77553	51702	38777	31021	25851		
		(195-293)	Fz	0.00102	0.00512	0.01023	0.01535	0.02047	0.02559	0.03070		
		Feed (mm/min)	3175	3175	3175	3175	3175	3175	3175			

**Note:**

- Bhn (Brinell)      HRc (Rockwell C)
- when recommended speed exceeds your capability, use maximum available and recalculate ipm
- rpm = (Vc x 1000) / (D<sub>1</sub> x 3.14)
- mm/min = 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 D<sub>1</sub> maximum)
- refer to the KYOCERA SGS Tool Wizard® for complete technical information (www.kyocera-sgstool.com)