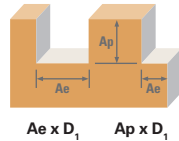


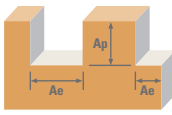









Series  
51, 51CR,  
51L, 51LC  
Fractional



Diameter (D<sub>1</sub>)  
(inch)

Material	Hardness	Profile Ae x D <sub>1</sub>	HSM Ap x D <sub>1</sub>	Vc (sfm)	Diameter (D <sub>1</sub> ) (inch)						
					1/4	3/8	1/2	5/8	3/4	1	
<b>P</b> <b>CARBON STEELS</b> 1018, 1040, 1080, 1090, 10L50, 1140, 1212, 12L15, 1525, 1536	≤ 275 Bhn or ≤ 28 HRc	Profile ≤ 0.1	≤ 1	720	RPM	11002	7334	5501	4401	3667	2750
				(576-864)	Fz	0.0020	0.0035	0.0050	0.0055	0.0061	0.0071
				Feed (ipm)	132	154	165	145	134	117	
	≤ 275 Bhn or ≤ 28 HRc	HSM ≤ 0.05	≤ 2	915	RPM	13981	9321	6991	5592	4660	3495
				(732-1098)	Fz	0.0028	0.0053	0.0070	0.0077	0.0085	0.0100
				Feed (ipm)	235	296	294	258	238	210	
<b>H</b> <b>ALLOY STEELS</b> 4140, 4150, 4320, 5120, 5150, 8630, 86L20, 50100	≤ 375 Bhn or ≤ 40 HRc	Profile ≤ 0.1	≤ 1	490	RPM	7487	4991	3744	2995	2496	1872
				(392-588)	Fz	0.0015	0.0029	0.0038	0.0042	0.0046	0.0054
				Feed (ipm)	67	87	85	75	69	61	
	≤ 375 Bhn or ≤ 40 HRc	HSM ≤ 0.05	≤ 2	620	RPM	9474	6316	4737	3789	3158	2368
				(496-744)	Fz	0.0021	0.0039	0.0052	0.0057	0.0062	0.0073
				Feed (ipm)	119	148	148	130	117	104	
<b>H</b> <b>TOOL STEELS</b> A2, D2, H13, L2, M2, P20, S7, T15, W2	≤ 375 Bhn or ≤ 40 HRc	Profile ≤ 0.1	≤ 1	240	RPM	3667	2445	1834	1467	1222	917
				(192-288)	Fz	0.0012	0.0023	0.0030	0.0034	0.0037	0.0043
				Feed (ipm)	26	34	33	30	27	24	
	≤ 375 Bhn or ≤ 40 HRc	HSM ≤ 0.05	≤ 2	305	RPM	4660	3107	2330	1864	1553	1165
				(244-366)	Fz	0.0017	0.0032	0.0042	0.0046	0.0050	0.0059
				Feed (ipm)	48	60	59	51	47	41	
<b>M</b> <b>STAINLESS STEELS (FREE MACHINING)</b> 303, 416, 420F, 430F, 440F	≤ 275 Bhn or ≤ 28 HRc	Profile ≤ 0.1	≤ 1	510	RPM	7793	5195	3896	3117	2598	1948
				(459-561)	Fz	0.0015	0.0028	0.0038	0.0041	0.0045	0.0053
				Feed (ipm)	70	87	89	77	70	62	
	≤ 275 Bhn or ≤ 28 HRc	HSM ≤ 0.05	≤ 2	650	RPM	9932	6621	4966	3973	3311	2483
				(585-715)	Fz	0.0021	0.0038	0.0051	0.0056	0.0061	0.0072
				Feed (ipm)	125	151	152	133	121	107	
<b>M</b> <b>STAINLESS STEELS (DIFFICULT)</b> 304, 304L, 316, 316L	≤ 275 Bhn or ≤ 28 HRc	Profile ≤ 0.1	≤ 1	350	RPM	5348	3565	2674	2139	1783	1337
				(315-385)	Fz	0.0012	0.0023	0.0030	0.0033	0.0036	0.0042
				Feed (ipm)	39	49	48	42	39	34	
	≤ 275 Bhn or ≤ 28 HRc	HSM ≤ 0.05	≤ 2	450	RPM	6876	4584	3438	2750	2292	1719
				(405-495)	Fz	0.0017	0.0032	0.0042	0.0046	0.0050	0.0059
				Feed (ipm)	70	88	87	76	69	61	
<b>M</b> <b>STAINLESS STEELS (PH)</b> 13-8 PH, 15-5 PH, 17-4 PH, Custom 450	≤ 325 Bhn or ≤ 35 HRc	Profile ≤ 0.1	≤ 1	325	RPM	4966	3311	2483	1986	1655	1242
				(293-358)	Fz	0.0012	0.0023	0.0030	0.0033	0.0036	0.0042
				Feed (ipm)	36	46	45	39	36	31	
	≤ 325 Bhn or ≤ 35 HRc	HSM ≤ 0.05	≤ 2	410	RPM	6265	4177	3132	2506	2088	1566
				(369-451)	Fz	0.0017	0.0032	0.0042	0.0046	0.0050	0.0059
				Feed (ipm)	64	80	79	69	63	55	

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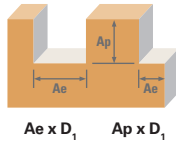
Series 51, 51CR, 51L, 51LC Fractional	Hardness			Vc (sfm)	Diameter (D <sub>1</sub> ) (inch)									
		Profile 	Ae x D <sub>1</sub>		Ap x D <sub>1</sub>									
						1/4	3/8	1/2	5/8	3/4	1			
<b>SUPER ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 601, 617, 625, Incoloy, Monel 400</b>	≤ 300 Bhn or ≤ 32 HRc	Profile 	≤ 0.1	≤ 1	105	RPM	1604	1070	802	642	535	401		
					(84-126)	Fz	0.0014	0.0027	0.0036	0.0039	0.0043	0.0050		
		HSM 	≤ 0.05	≤ 2	130	RPM	1986	1324	993	795	662	497		
					(104-156)	Fz	0.0016	0.0036	0.0048	0.0053	0.0058	0.0067		
		Feed (ipm)							13	17	17	15	14	12
									19	29	29	25	23	20
<b>SUPER ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 718, X-750, Incoloy, Waspaloy, Hastelloy, Rene</b>	≤ 400 Bhn or ≤ 43 HRc	Profile 	≤ 0.1	≤ 1	80	RPM	1222	815	611	489	407	306		
					(64-96)	Fz	0.0010	0.0018	0.0025	0.0027	0.0029	0.0034		
		HSM 	≤ 0.05	≤ 2	100	RPM	1528	1019	764	611	509	382		
					(80-120)	Fz	0.0013	0.0025	0.0034	0.0037	0.0041	0.0047		
		Feed (ipm)							7	9	9	8	7	6
									12	15	16	14	13	11
<b>TITANIUM ALLOYS Pure Titanium, Ti6Al4V, Ti6Al2Sn4Zr2Mo, Ti4Al4Mo2Sn0.5Si</b>	≤ 350 Bhn or ≤ 38 HRc	Profile 	≤ 0.1	≤ 1	280	RPM	4278	2852	2139	1711	1426	1070		
					(224-336)	Fz	0.0010	0.0018	0.0025	0.0027	0.0029	0.0034		
		HSM 	≤ 0.05	≤ 2	355	RPM	5424	3616	2712	2170	1808	1356		
					(284-426)	Fz	0.0013	0.0025	0.0034	0.0037	0.0041	0.0047		
		Feed (ipm)							26	31	32	28	25	22
									42	54	55	48	44	38
<b>TITANIUM ALLOYS (DIFFICULT) Ti10Al2Fe3Al, Ti5Al5V5Mo3Cr, Ti7Al4Mo, Ti3Al8V6Cr4Zr4Mo, Ti6Al6V6Sn, Ti15V3 Cr3Sn3Al</b>	≤ 440 Bhn or ≤ 47 HRc	Profile 	≤ 0.1	≤ 1	155	RPM	2368	1579	1184	947	789	592		
					(124-186)	Fz	0.0010	0.0018	0.0025	0.0027	0.0029	0.0034		
		HSM 	≤ 0.05	≤ 2	200	RPM	3056	2037	1528	1222	1019	764		
					(160-240)	Fz	0.0013	0.0025	0.0034	0.0037	0.0041	0.0047		
		Feed (ipm)							14	17	18	15	14	12
									24	31	31	27	25	22

- Note:**
- Bhn (Brinell)    HRc (Rockwell C)    HSM (High Speed Machining)
  - rpm = Vc x 3.82 / D<sub>1</sub>
  - ipm = Fz x 6 x rpm
  - 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)

**TOOLWIZARD® 2.1**  
www.sgstoolwizard.com

Series 51 | Speed & Feed Recommendations

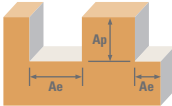








Series  
51M, 51MCR,  
51ML, 51MLC  
Metric



Diameter (D<sub>1</sub>)  
(mm)

Material	Hardness	Profile	Ae x D <sub>1</sub>	Ap x D <sub>1</sub>	Vc (m/min)	Diameter (D <sub>1</sub> ) (mm)							
						6	8	10	12	16	20		
<b>P</b>  <b>CARBON STEELS</b> 1018, 1040, 1080, 1090, 10L50, 1140, 1212, 12L15, 1525, 1536	≤ 275 Bhn or ≤ 28 HRc	Profile	≤ 0.1	≤ 1	219	RPM	11633	8725	6980	5816	4362	3490	
					(176-263)	Fz	0.048	0.081	0.101	0.121	0.142	0.158	
					Feed (mm/min)	3350	4240	4230	4223	3717	3308		
		HSM	≤ 0.05	≤ 2	279	RPM	14784	11088	8870	7392	5544	4435	
					(223-335)	Fz	0.066	0.113	0.141	0.169	0.197	0.220	
					Feed (mm/min)	5854	7517	7504	7495	6553	5854		
	≤ 375 Bhn or ≤ 40 HRc	Profile	≤ 0.1	≤ 1	149	RPM	7917	5938	4750	3958	2969	2375	
					(119-179)	Fz	0.036	0.061	0.077	0.092	0.107	0.119	
					Feed (mm/min)	1710	2173	2195	2185	1906	1696		
		HSM	≤ 0.05	≤ 2	189	RPM	10017	7513	6010	5009	3756	3005	
					(151-227)	Fz	0.049	0.083	0.104	0.125	0.146	0.163	
					Feed (mm/min)	2945	3741	3750	3756	3291	2939		
<b>H</b>  <b>TOOL STEELS</b> A2, D2, H13, L2, M2, P20, S7, T15, W2	≤ 375 Bhn or ≤ 40 HRc	Profile	≤ 0.1	≤ 1	73	RPM	3878	2908	2327	1939	1454	1163	
					(59-88)	Fz	0.029	0.049	0.061	0.073	0.086	0.096	
					Feed (mm/min)	675	855	852	849	750	670		
		HSM	≤ 0.05	≤ 2	93	RPM	4928	3696	2957	2464	1848	1478	
					(74-112)	Fz	0.040	0.069	0.086	0.103	0.120	0.134	
					Feed (mm/min)	1183	1530	1526	1523	1331	1189		
	<b>M</b>  <b>STAINLESS STEELS (FREE MACHINING)</b> 303, 416, 420F, 430F, 440F	≤ 275 Bhn or ≤ 28 HRc	Profile	≤ 0.1	≤ 1	155	RPM	8240	6180	4944	4120	3090	2472
						(140-171)	Fz	0.035	0.060	0.075	0.090	0.105	0.117
						Feed (mm/min)	1730	2225	2225	2225	1947	1735	
			HSM	≤ 0.05	≤ 2	198	RPM	10502	7877	6301	5251	3938	3151
						(178-218)	Fz	0.048	0.082	0.102	0.122	0.143	0.159
						Feed (mm/min)	3025	3875	3856	3844	3379	3006	
≤ 275 Bhn or ≤ 28 HRc		Profile	≤ 0.1	≤ 1	107	RPM	5655	4241	3393	2827	2121	1696	
					(96-117)	Fz	0.029	0.049	0.061	0.073	0.086	0.096	
					Feed (mm/min)	984	1247	1242	1238	1094	977		
		HSM	≤ 0.05	≤ 2	137	RPM	7271	5453	4362	3635	2726	2181	
					(123-151)	Fz	0.040	0.069	0.086	0.103	0.120	0.134	
					Feed (mm/min)	1745	2258	2251	2247	1963	1754		
≤ 325 Bhn or ≤ 35 HRc	Profile	≤ 0.1	≤ 1	99	RPM	5251	3938	3151	2626	1969	1575		
				(89-109)	Fz	0.029	0.049	0.061	0.073	0.086	0.096		
				Feed (mm/min)	914	1158	1153	1150	1016	907			
	HSM	≤ 0.05	≤ 2	125	RPM	6624	4968	3975	3312	2484	1987		
				(112-137)	Fz	0.040	0.069	0.086	0.103	0.120	0.134		
				Feed (mm/min)	1590	2057	2051	2047	1789	1598			
<b>STAINLESS STEELS (PH)</b> 13-8 PH, 15-5 PH, 17-4 PH, Custom 450	≤ 325 Bhn or ≤ 35 HRc	Profile	≤ 0.1	≤ 1	99	RPM	5251	3938	3151	2626	1969	1575	
					(89-109)	Fz	0.029	0.049	0.061	0.073	0.086	0.096	
					Feed (mm/min)	914	1158	1153	1150	1016	907		
		HSM	≤ 0.05	≤ 2	125	RPM	6624	4968	3975	3312	2484	1987	
					(112-137)	Fz	0.040	0.069	0.086	0.103	0.120	0.134	
					Feed (mm/min)	1590	2057	2051	2047	1789	1598		

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Series 51M, 51MCR, 51ML, 51MLC Metric	Hardness			Vc (m/min)	Diameter (D <sub>1</sub> ) (mm)							
		Ae x D <sub>1</sub>	Ap x D <sub>1</sub>		6	8	10	12	16	20		
<b>SUPER ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 601, 617, 625, Incoloy, Monel 400</b>	≤ 300 Bhn or ≤ 32 HRc	Profile 	≤ 0.1	≤ 1	32	RPM	1696	1272	1018	848	636	509
					(26-38)	Fz	0.034	0.057	0.071	0.085	0.100	0.110
					Feed (mm/min)	346	435	434	433	382	336	
	HSM 	≤ 0.05	≤ 2	40	RPM	2100	1575	1260	1050	788	630	
				(32-48)	Fz	0.046	0.077	0.097	0.120	0.140	0.150	
				Feed (mm/min)	580	728	733	756	662	567		
<b>SUPER ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 718, X-750, Incoloy, Waspaloy, Hastelloy, Rene</b>	≤ 400 Bhn or ≤ 43 HRc	Profile 	≤ 0.1	≤ 1	24	RPM	1293	969	776	646	485	388
					(20-29)	Fz	0.023	0.039	0.049	0.059	0.068	0.077
					Feed (mm/min)	178	227	228	229	198	179	
	HSM 	≤ 0.05	≤ 2	30	RPM	1616	1212	969	808	606	485	
				(24-37)	Fz	0.032	0.054	0.068	0.081	0.095	0.110	
				Feed (mm/min)	310	393	396	393	345	320		
<b>TITANIUM ALLOYS Pure Titanium, Ti6Al4V, Ti6Al2Sn4Zr2Mo, Ti4Al4Mo2Sn0.5Si</b>	≤ 350 Bhn or ≤ 38 HRc	Profile 	≤ 0.1	≤ 1	85	RPM	4524	3393	2714	2262	1696	1357
					(68-102)	Fz	0.023	0.039	0.049	0.059	0.068	0.077
					Feed (mm/min)	624	794	798	801	692	627	
	HSM 	≤ 0.05	≤ 2	108	RPM	5736	4302	3441	2868	2151	1721	
				(87-130)	Fz	0.032	0.054	0.068	0.081	0.095	0.110	
				Feed (mm/min)	1101	1394	1404	1394	1226	1136		
<b>TITANIUM ALLOYS (DIFFICULT) Ti10Al2Fe3Al, Ti5Al5V5Mo3Cr, Ti7Al4Mo, Ti3Al8V6Cr4Zr4Mo, Ti6Al6V6Sn, Ti15V3 Cr3Sn3Al</b>	≤ 440 Bhn or ≤ 47 HRc	Profile 	≤ 0.1	≤ 1	47	RPM	2504	1878	1503	1252	939	751
					(38-57)	Fz	0.023	0.039	0.049	0.059	0.068	0.077
					Feed (mm/min)	346	440	442	443	383	347	
	HSM 	≤ 0.05	≤ 2	61	RPM	3231	2424	1939	1616	1212	969	
				(49-73)	Fz	0.032	0.054	0.068	0.081	0.095	0.110	
				Feed (mm/min)	620	785	791	785	691	640		

**Note:**

- Bhn (Brinell)      HRc (Rockwell C)      HSM (High Speed Machining)
- rpm = (Vc x 1000) / (D<sub>1</sub> x 3.14)
- mm/min = Fz x 6 x rpm
- 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)

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