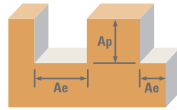


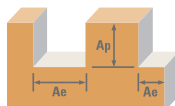
FRACTIONAL Series 33



Series 33CR Fractional	Hardness		Ae x DC	Ap x DC	Vc (sfm)		DC • in						
							1/8	1/4	3/8	1/2	5/8	3/4	1
P	CARBON STEELS 1018, 1040, 1080, 1090, 10L50, 1140, 1212, 12L15, 1525, 1536		≤ 0.5	≤ 1.5	550	RPM	16808	8404	5603	4202	3362	2801	2101
					(440-660)	Fz	0.0005	0.0012	0.0023	0.0031	0.0039	0.0040	0.0043
					Feed (ipm)	25.2	30.3	38.7	39.1	39.3	33.6	27.1	
			1	≤ 1	440	RPM	13446	6723	4482	3362	2689	2241	1681
					(352-528)	Fz	0.0005	0.0012	0.0023	0.0031	0.0039	0.0040	0.0043
					Feed (ipm)	20.2	24.2	30.9	31.3	31.5	26.9	21.7	
	ALLOY STEELS 4140, 4150, 4320, 5120, 5150, 8630, 86L20, 50100		≤ 0.5	≤ 1.5	315	RPM	9626	4813	3209	2407	1925	1604	1203
					(252-378)	Fz	0.0004	0.0009	0.0017	0.0023	0.0029	0.0030	0.0032
					Feed (ipm)	11.6	13.0	16.4	16.6	16.7	14.4	11.6	
			1	≤ 1	250	RPM	7640	3820	2547	1910	1528	1273	955
					(200-300)	Fz	0.0004	0.0009	0.0017	0.0023	0.0029	0.0030	0.0032
					Feed (ipm)	9.2	10.3	13.0	13.2	13.3	11.5	9.2	
	TOOL STEELS A2, D2, H13, L2, M2, P20, S7, T15, W2		≤ 0.5	≤ 1.5	185	RPM	5654	2827	1885	1413	1131	942	707
					(148-222)	Fz	0.0003	0.0007	0.0014	0.0018	0.0023	0.0024	0.0025
					Feed (ipm)	5.1	5.9	7.9	7.6	7.8	6.8	5.3	
			1	≤ 1	145	RPM	4431	2216	1477	1108	886	739	554
					(116-174)	Fz	0.0003	0.0007	0.0014	0.0018	0.0023	0.0024	0.0025
					Feed (ipm)	4.0	4.7	6.2	6.0	6.1	5.3	4.2	
M	STAINLESS STEELS (FREE MACHINING) 303, 416, 420F, 430F, 440F		≤ 0.5	≤ 1.5	490	RPM	14974	7487	4991	3744	2995	2496	1872
					(392-588)	Fz	0.0004	0.0010	0.0019	0.0025	0.0031	0.0032	0.0035
					Feed (ipm)	17.1	22.5	28.5	28.1	27.9	24.0	19.7	
			1	≤ 1	390	RPM	11918	5959	3973	2980	2384	1986	1490
					(312-468)	Fz	0.0004	0.0010	0.0019	0.0025	0.0031	0.0032	0.0035
					Feed (ipm)	13.6	17.9	22.6	22.3	22.2	19.1	15.6	
	STAINLESS STEELS (DIFFICULT) 304, 304L, 316, 316L		≤ 0.5	≤ 1.5	340	RPM	10390	5195	3463	2598	2078	1732	1299
					(272-408)	Fz	0.0003	0.0008	0.0015	0.0020	0.0025	0.0026	0.0028
					Feed (ipm)	9.4	12.5	15.6	15.6	15.6	13.5	10.9	
			1	≤ 1	270	RPM	8251	4126	2750	2063	1650	1375	1031
					(216-324)	Fz	0.0003	0.0008	0.0015	0.0020	0.0025	0.0026	0.0028
					Feed (ipm)	7.4	9.9	12.4	12.4	12.4	10.7	8.7	
	STAINLESS STEELS (PH) 13-8 PH, 15-5 PH, 17-4 PH, Custom 450		≤ 0.5	≤ 1.5	310	RPM	9474	4737	3158	2368	1895	1579	1184
					(248-372)	Fz	0.0003	0.0008	0.0015	0.0020	0.0025	0.0026	0.0028
					Feed (ipm)	8.5	11.4	14.2	14.2	14.2	12.3	9.9	
			1	≤ 1	250	RPM	7640	3820	2547	1910	1528	1273	955
					(200-300)	Fz	0.0003	0.0008	0.0015	0.0020	0.0025	0.0026	0.0028
					Feed (ipm)	6.9	9.2	11.5	11.5	11.5	9.9	8.0	

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FRACTIONAL Series 33



Series 33CR Fractional	Hardness	Ae Ae		Vc (sfm)	DC • in							
		Ae x DC	Ap x DC		1/8	1/4	3/8	1/2	5/8	3/4	1	
K	CAST IRONS (LOW & MEDIUM ALLOY) Gray, Malleable, Ductile	Profile  ≤ 0.5	≤ 1.5	445	RPM	13599	6800	4533	3400	2720	2267	1700
				(356-534)	Fz	0.0004	0.0011	0.0021	0.0028	0.0035	0.0036	0.0039
				Feed (ipm)	14.3	22.4	28.6	28.6	28.6	24.5	19.9	
		Slot  1	≤ 1	355	RPM	10849	5424	3616	2712	2170	1808	1356
				(284-426)	Fz	0.0004	0.0011	0.0021	0.0028	0.0035	0.0036	0.0039
				Feed (ipm)	11.4	17.9	22.8	22.8	22.8	19.5	15.9	
	CAST IRONS (HIGH ALLOY) Gray, Malleable, Ductile	Profile  ≤ 0.5	≤ 1.5	340	RPM	10390	5195	3463	2598	2078	1732	1299
				(272-408)	Fz	0.0003	0.0008	0.0016	0.0021	0.0026	0.0027	0.0029
				Feed (ipm)	9.4	12.5	16.6	16.4	16.2	14.0	11.3	
		Slot  1	≤ 1	270	RPM	8251	4126	2750	2063	1650	1375	1031
				(216-324)	Fz	0.0003	0.0008	0.0016	0.0021	0.0026	0.0027	0.0029
				Feed (ipm)	7.4	9.9	13.2	13.0	12.9	11.1	9.0	
S	HIGH TEMP ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 601, 617, 625, Incoloy, Monel 400	Profile  ≤ 0.5	≤ 1.5	80	RPM	2445	1222	815	611	489	407	306
				(64-96)	Fz	0.0003	0.0007	0.0013	0.0017	0.0021	0.0022	0.0024
				Feed (ipm)	1.9	2.6	3.2	3.1	3.1	2.7	2.2	
		Slot  1	≤ 1	65	RPM	1986	993	662	497	397	331	248
				(52-78)	Fz	0.0003	0.0007	0.0013	0.0017	0.0021	0.0022	0.0024
				Feed (ipm)	1.5	2.1	2.6	2.5	2.5	2.2	1.8	
	HIGH TEMP ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 718, X-750, Incoloy, Waspaloy, Hastelloy, Rene	Profile  ≤ 0.5	≤ 1.5	62	RPM	1895	947	632	474	379	316	237
				(50-74)	Fz	0.0002	0.0005	0.0009	0.0012	0.0015	0.0016	0.0017
				Feed (ipm)	1.1	1.4	1.7	1.7	1.7	1.5	1.2	
		Slot  1	≤ 1	49	RPM	1497	749	499	374	299	250	187
				(39-59)	Fz	0.0002	0.0005	0.0009	0.0012	0.0015	0.0016	0.0017
				Feed (ipm)	0.9	1.1	1.3	1.3	1.3	1.2	1.0	
	TITANIUM ALLOYS Pure Titanium, Ti6Al4V, Ti6Al2Sn4Zr2Mo, Ti4Al4Mo2Sn0.5Si	Profile  ≤ 0.5	≤ 1.5	215	RPM	6570	3285	2190	1643	1314	1095	821
				(172-258)	Fz	0.0003	0.0008	0.0015	0.0020	0.0025	0.0026	0.0028
				Feed (ipm)	5.9	7.9	9.9	9.9	9.9	8.5	6.9	
		Slot  1	≤ 1	170	RPM	5195	2598	1732	1299	1039	866	649
				(136-204)	Fz	0.0003	0.0008	0.0015	0.0020	0.0025	0.0026	0.0028
				Feed (ipm)	4.7	6.2	7.8	7.8	7.8	6.8	5.5	
	TITANIUM ALLOYS (DIFFICULT) Ti10V2Fe3Al, Ti5Al5V5Mo3Cr, Ti7Al4Mo, Ti3Al8V6Cr4Zr4Mo, Ti6Al6V6Sn, Ti15V3 Cr3Sn3Al	Profile  ≤ 0.5	≤ 1.5	75	RPM	2292	1146	764	573	458	382	287
				(60-90)	Fz	0.0003	0.0008	0.0015	0.0020	0.0025	0.0026	0.0028
				Feed (ipm)	2.1	2.8	3.4	3.4	3.4	3.0	2.4	
		Slot  1	≤ 1	60	RPM	1834	917	611	458	367	306	229
				(48-72)	Fz	0.0003	0.0008	0.0015	0.0020	0.0025	0.0026	0.0028
				Feed (ipm)	1.7	2.2	2.8	2.8	2.8	2.4	1.9	

Bhn (Brinell) HRc (Rockwell C)

rpm = Vc x 3.82 / DC

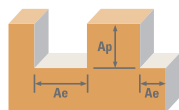
ipm = Fz x 3 x rpm

reduce speed and feed for materials harder than listed

reduce feed and Ae when finish milling (.02 x DC maximum)

feed rates listed have chip thinning adjustments included where applicable

refer to the SGS Tool Wizard® for complete technical information (www.kyocera-sgstool.com)

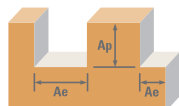


Series 33MCR Metric		Hardness	Ae Ae x DC Ae Ap x DC		Vc (m/min)		DC • mm							
			3	6			8	10	12	16	20			
P	CARBON STEELS 1018, 1040, 1080, 1090, 10L50, 1140, 1212, 12L15, 1525, 1536	≤ 275 Bhn or ≤ 28 HRC	Profile	≤ 0.5	≤ 1.5	168	RPM	17773	8886	6665	5332	4443	3332	2666
						(134-201)	Fz	0.012	0.029	0.049	0.061	0.074	0.100	0.107
						Feed (mm/min)	640	768	981	981	992	998	853	
			Slot	1	≤ 1	134	RPM	14218	7109	5332	4265	3555	2666	2133
						(107-161)	Fz	0.012	0.029	0.049	0.061	0.074	0.100	0.107
						Feed (mm/min)	512	614	785	785	793	798	682	
	ALLOY STEELS 4140, 4150, 4320, 5120, 5150, 8630, 86L20, 50100	≤ 375 Bhn or ≤ 40 HRC	Profile	≤ 0.5	≤ 1.5	96	RPM	10179	5089	3817	3054	2545	1909	1527
						(77-115)	Fz	0.010	0.022	0.036	0.045	0.055	0.074	0.080
						Feed (mm/min)	293	330	415	415	421	425	366	
			Slot	1	≤ 1	76	RPM	8078	4039	3029	2424	2020	1515	1212
						(61-91)	Fz	0.010	0.022	0.036	0.045	0.055	0.074	0.080
						Feed (mm/min)	233	262	330	330	334	337	291	
	TOOL STEELS A2, D2, H13, L2, M2, P20, S7, T15, W2	≤ 375 Bhn or ≤ 40 HRC	Profile	≤ 0.5	≤ 1.5	56	RPM	5978	2989	2242	1793	1495	1121	897
						(45-68)	Fz	0.007	0.017	0.030	0.037	0.043	0.059	0.064
						Feed (mm/min)	129	151	201	201	194	198	172	
			Slot	1	≤ 1	44	RPM	4686	2343	1757	1406	1171	879	703
						(35-53)	Fz	0.007	0.017	0.030	0.037	0.043	0.059	0.064
						Feed (mm/min)	101	118	157	157	152	155	135	
M	STAINLESS STEELS (FREE MACHINING) 303, 416, 420F, 430F, 440F	≤ 275 Bhn or ≤ 28 HRC	Profile	≤ 0.5	≤ 1.5	149	RPM	15834	7917	5938	4750	3958	2969	2375
						(119-179)	Fz	0.009	0.024	0.041	0.051	0.060	0.079	0.085
						Feed (mm/min)	433	570	722	722	712	707	608	
			Slot	1	≤ 1	119	RPM	12602	6301	4726	3781	3151	2363	1890
						(95-143)	Fz	0.009	0.024	0.041	0.051	0.060	0.079	0.085
						Feed (mm/min)	345	454	575	575	567	563	484	
	STAINLESS STEELS (DIFFICULT) 304, 304L, 316, 316L	≤ 275 Bhn or ≤ 28 HRC	Profile	≤ 0.5	≤ 1.5	104	RPM	10987	5493	4120	3296	2747	2060	1648
						(83-124)	Fz	0.007	0.019	0.032	0.040	0.048	0.064	0.069
						Feed (mm/min)	237	316	396	396	395	396	343	
			Slot	1	≤ 1	82	RPM	8725	4362	3272	2617	2181	1636	1309
						(66-99)	Fz	0.007	0.019	0.032	0.040	0.048	0.064	0.069
						Feed (mm/min)	188	251	314	314	314	314	272	
	STAINLESS STEELS (PH) 13-8 PH, 15-5 PH, 17-4 PH, Custom 450	≤ 325 Bhn or ≤ 35 HRC	Profile	≤ 0.5	≤ 1.5	94	RPM	10017	5009	3756	3005	2504	1878	1503
						(76-113)	Fz	0.007	0.019	0.032	0.040	0.048	0.064	0.069
						Feed (mm/min)	216	288	361	361	361	361	313	
			Slot	1	≤ 1	76	RPM	8078	4039	3029	2424	2020	1515	1212
						(61-91)	Fz	0.007	0.019	0.032	0.040	0.048	0.064	0.069
						Feed (mm/min)	174	233	291	291	291	291	252	

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METRIC

Series 33



Series 33MCR Metric	Hardness			Vc (m/min)	DC • mm								
		Ae x DC	Ap x DC		3	6	8	10	12	16	20		
K	CAST IRONS (LOW & MEDIUM ALLOY) Gray, Malleable, Ductile	 Profile	≤ 0.5	≤ 1.5	136	RPM	14380	7190	5392	4314	3595	2696	2157
					(109-163)	Fz	0.008	0.026	0.045	0.056	0.067	0.090	0.096
					Feed (mm/min)	362	569	725	725	725	725	621	
		 Slot	1	≤ 1	108	RPM	11471	5736	4302	3441	2868	2151	1721
					(87-130)	Fz	0.008	0.026	0.045	0.056	0.067	0.090	0.096
					Feed (mm/min)	289	454	578	578	578	578	496	
	CAST IRONS (HIGH ALLOY) Gray, Malleable, Ductile	 Profile	≤ 0.5	≤ 1.5	104	RPM	10987	5493	4120	3296	2747	2060	1648
					(83-124)	Fz	0.007	0.019	0.034	0.043	0.050	0.067	0.072
					Feed (mm/min)	237	316	422	422	415	411	356	
		 Slot	1	≤ 1	82	RPM	8725	4362	3272	2617	2181	1636	1309
					(66-99)	Fz	0.007	0.019	0.034	0.043	0.050	0.067	0.072
					Feed (mm/min)	188	251	335	335	330	327	283	
S	HIGH TEMP ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 601, 617, 625, Incoloy, Monel 400	 Profile	≤ 0.5	≤ 1.5	24	RPM	2585	1293	969	776	646	485	388
					(20-29)	Fz	0.006	0.017	0.028	0.035	0.041	0.054	0.059
					Feed (mm/min)	48	65	81	65	79	78	68	
		 Slot	1	≤ 1	20	RPM	2100	1050	788	630	525	394	315
					(16-24)	Fz	0.006	0.017	0.028	0.035	0.041	0.054	0.059
					Feed (mm/min)	39	53	66	66	64	64	55	
	HIGH TEMP ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 718, X-750, Incoloy, Waspaloy, Hastelloy, Rene	 Profile	≤ 0.5	≤ 1.5	19	RPM	2003	1002	751	601	501	376	301
					(15-23)	Fz	0.005	0.012	0.019	0.024	0.029	0.038	0.043
					Feed (mm/min)	29	36	43	43	43	43	38	
		 Slot	1	≤ 1	15	RPM	1583	792	594	475	396	297	238
					(12-18)	Fz	0.005	0.012	0.019	0.024	0.029	0.038	0.043
					Feed (mm/min)	23	28	34	34	34	34	30	
	TITANIUM ALLOYS Pure Titanium, Ti6Al4V, Ti6Al2Sn4Zr2Mo, Ti4Al4Mo2Sn0.5Si	 Profile	≤ 0.5	≤ 1.5	66	RPM	6947	3474	2605	2084	1737	1303	1042
					(52-79)	Fz	0.007	0.019	0.032	0.040	0.048	0.064	0.069
					Feed (mm/min)	150	200	250	250	250	250	217	
		 Slot	1	≤ 1	52	RPM	5493	2747	2060	1648	1373	1030	824
					(41-62)	Fz	0.007	0.019	0.032	0.040	0.048	0.064	0.069
					Feed (mm/min)	119	158	198	198	198	198	171	
	TITANIUM ALLOYS (DIFFICULT) Ti10V2Fe3Al, Ti5Al5V5Mo3Cr, Ti7Al4Mo, Ti3Al8V6Cr4Zr4Mo, Ti6Al6V6Sn, Ti15V3 Cr3Sn3Al	 Profile	≤ 0.5	≤ 1.5	23	RPM	2424	1212	909	727	606	454	364
					(18-27)	Fz	0.007	0.019	0.032	0.040	0.048	0.064	0.069
					Feed (mm/min)	52	70	87	87	87	87	76	
		 Slot	1	≤ 1	18	RPM	1939	969	727	582	485	364	291
					(15-22)	Fz	0.007	0.019	0.032	0.040	0.048	0.064	0.069
					Feed (mm/min)	42	56	70	70	70	70	60	

Bhn (Brinell) HRc (Rockwell C)

rpm = (Vc x 1000) / (DC x 3.14)

mm/min = Fz x 3 x rpm

reduce speed and feed for materials harder than listed

reduce feed and Ae when finish milling (.02 x DC maximum)

feed rates listed have chip thinning adjustments included where applicable

refer to the SGS Tool Wizard® for complete technical information (www.kyocera-sgstool.com)