

## Fractional

Material	Rc	SFM (Vc)	CHIPLOAD PER FLUTE Recommendations (Fz)									*Profiling	Slotting
			1/8"	3/16"	1/4"	5/16"	3/8"	1/2"	5/8"	3/4"	1"	Radial	Axial
Stainless Steel: 303		290-375	.0004"-.0008"	.0008"-.0010"	.0010"-.0015"	.0013"-.0020"	.0015"-.0020"	.0020"-.0030"	.0025"-.0035"	.0030"-.0040"	.0035"-.0045"	1 x D	1 x D
Stainless Steel: 304, 316, 400 Series, Kovar, Invar		250-300	.0003"-.0006"	.0006"-.0010"	.0008"-.0015"	.0010"-.0020"	.0012"-.0020"	.0015"-.0020"	.0020"-.0025"	.0025"-.0030"	.0025"-.0035"	1 x D	1 x D
Stainless Steel: 304L, 316L, 8620, 17/4, 15/5, 13/8, PH Mat'l	< 35	250-300	.0003"-.0006"	.0006"-.0008"	.0007"-.0010"	.0010"-.0015"	.0015"-.0020"	.0015"-.0025"	.0020"-.0030"	.0025"-.0035"	.0030"-.0040"	1 x D	1 x D
	> 35	200-250	.0003"-.0006"	.0006"-.0008"	.0007"-.0010"	.0008"-.0010"	.0010"-.0015"	.0010"-.0020"	.0015"-.0025"	.0020"-.0030"	.0020"-.0030"	0.5 x D	0.5 x D
High Temperature Alloys: Inconel 625/718, A286	< 35	125-175	.0004"-.0008"	.0008"-.0010"	.0010"-.0015"	.0012"-.0020"	.0020"-.0025"	.0025"-.0030"	.0030"-.0035"	.0030"-.0035"	.0030"-.0040"	0.5 x D	0.3 x D
	> 35	80-100	.0003"-.0006"	.0007"-.0010"	.0008"-.0010"	.0010"-.0015"	.0010"-.0015"	.0010"-.0015"	.0012"-.0020"	.0015"-.0025"	.0015"-.0025"	0.2 x D	0.2 x D
Titanium: 6AL4V, CP		150-200	.0004"-.0008"	.0008"-.0010"	.0010"-.0015"	.0010"-.0020"	.0015"-.0020"	.0020"-.0030"	.0025"-.0030"	.0030"-.0035"	.0030"-.0040"	1 x D	1 x D
Carbon Steels: 1000 Series	< 35	400-600	.0004"-.0008"	.0008"-.0010"	.0010"-.0015"	.0010"-.0020"	.0015"-.0020"	.0020"-.0030"	.0025"-.0035"	.0030"-.0040"	.0035"-.0045"	0.3 x D	0.5 x D
	> 35	275-425	.0003"-.0006"	.0006"-.0008"	.0008"-.0012"	.0010"-.0015"	.0010"-.0020"	.0015"-.0025"	.0020"-.0025"	.0020"-.0030"	.0025"-.0035"	0.3 x D	0.5 x D
High Strength Tool Steel: 4130, 4140, A2, D2, P20, H13	< 30	250-400	.0003"-.0006"	.0006"-.0010"	.0008"-.0015"	.0010"-.0020"	.0012"-.0020"	.0015"-.0022"	.0020"-.0025"	.0025"-.0030"	.0025"-.0035"	0.5 x D	0.5 x D
	30-38	250-400	.0003"-.0006"	.0006"-.0008"	.0007"-.0010"	.0008"-.0010"	.0010"-.0015"	.0010"-.0020"	.0015"-.0025"	.0020"-.0030"	.0020"-.0030"	0.3 x D	0.5 x D
	> 38	(SEE HIGH ROCKWELL CHART - PAGE 280)											
Gray Cast Iron		400-500	.0005"-.0010"	.0010"-.0020"	.0010"-.0020"	.0015"-.0020"	.0015"-.0025"	.0020"-.0035"	.0025"-.0035"	.0030"-.0040"	.0040"-.0050"	1 x D	1 x D

## Metric

Material	Rc	M/Min. (Vc)	CHIPLOAD PER FLUTE - Metric Recommendations (Fz)									*Profiling	Slotting
			3.0	5.0	6.0	8.0	10.0	12.0	16.0	20.0	25.0	Radial	Axial
Stainless Steel: 303		90-115	.010-.020	.020-.025	.025-.038	.033-.050	.038-.050	.050-.076	.063-.089	.076-.102	.089-.114	1 x D	1 x D
Stainless Steel: 304, 316, 400 Series, Kovar, Invar		75-90	.008-.015	.015-.025	.020-.038	.025-.050	.030-.050	.038-.050	.050-.063	.063-.076	.063-.089	1 x D	1 x D
Stainless Steel: 304L, 316L, 17/4, 15/5, 13/8, PH Materials	< 35	75-85	.008-.015	.015-.020	.018-.025	.025-.038	.038-.050	.038-.063	.050-.076	.063-.089	.076-.102	1 x D	1 x D
	> 35	60-75	.008-.015	.015-.020	.018-.025	.020-.025	.025-.038	.025-.050	.038-.063	.050-.076	.050-.076	0.5 x D	0.5 x D
High Temperature Alloys: Inconel 625/718, A286	< 35	40-55	.010-.020	.020-.025	.025-.038	.030-.050	.050-.063	.063-.076	.076-.089	.076-.089	.076-.102	0.5 x D	0.3 x D
	> 35	25-30	.008-.015	.018-.025	.020-.025	.025-.038	.025-.038	.025-.038	.030-.050	.038-.063	.038-.063	0.2 x D	0.2 x D
Titanium: 6AL4V, CP		45-60	.010-.020	.020-.025	.025-.038	.025-.050	.038-.050	.050-.076	.063-.076	.076-.089	.076-.102	1 x D	1 x D
Carbon Steels: 1000 Series	< 35	125-185	.010-.020	.020-.025	.025-.038	.025-.050	.038-.050	.050-.076	.063-.089	.076-.102	.089-.114	0.3 x D	0.5 x D
	> 35	85-130	.008-.015	.015-.020	.020-.030	.025-.038	.025-.050	.038-.063	.050-.063	.050-.076	.063-.089	0.3 x D	0.5 x D
High Strength Tool Steel: 4130, 4140, A2, D2, P20, H13	< 30	75-125	.008-.015	.015-.025	.020-.038	.025-.050	.030-.050	.038-.056	.050-.063	.063-.076	.063-.089	0.5 x D	0.5 x D
	30-38	75-125	.006-.015	.015-.020	.018-.025	.020-.025	.025-.038	.025-.050	.038-.063	.050-.076	.050-.076	0.3 x D	0.5 x D
	> 38	(SEE HIGH ROCKWELL CHART - PAGE 281)											
Gray Cast Iron		125-150	.013-.025	.025-.050	.025-.050	.038-.050	.038-.063	.050-.089	.063-.089	.076-.102	.102-.127	1 x D	1 x D

\* For profiling, axial = 1xD

**NOTE - ABOVE ARE STARTING PARAMETERS ONLY. HIGHER RESULTS MAY BE ACHIEVED WITH OPTIMUM CONDITIONS.**

# GARR TOOL Milling Guide for High Rc Finishers in Hardened Steel

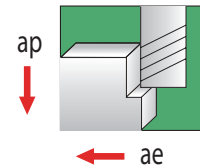
## Fractional

(Reference series: 545MA, 545BA, 545RA, VRX)

DIAMETER	38 - 45 HRc		45 - 50 HRc		50 - 55 HRc		55 - 60 HRc		60 - 65 HRc		65 - 70 HRc	
	RPM	CPT (Fz)	RPM	CPT (Fz)	RPM	CPT (Fz)	RPM	CPT (Fz)	RPM	CPT (Fz)	RPM	CPT (Fz)
1/8"	13750	.0009"	7650	.0008"	5350	.0006"	3820	.0005"	2300	.0004"	1850	.0003"
3/16"	9200	.0012"	5100	.0010"	3570	.0008"	2550	.0007"	1530	.0006"	1225	.0004"
1/4"	6900	.0015"	3850	.0012"	2675	.0010"	1910	.0008"	1150	.0007"	925	.0006"
3/8"	4600	.0018"	2550	.0015"	1800	.0012"	1275	.0010"	765	.0009"	615	.0008"
1/2"	3450	.0022"	1950	.0018"	1350	.0014"	955	.0012"	575	.0012"	460	.0010"
5/8"	2750	.0027"	1550	.0022"	1100	.0020"	765	.0018"	460	.0015"	370	.0013"
3/4"	2300	.0030"	1275	.0027"	900	.0025"	640	.0022"	390	.0017"	310	.0017"
1"	1720	.0033"	960	.0030"	675	.0027"	480	.0025"	290	.0023"	230	.0019"

Profiling / Side Cutting	
Axial (ap)	1xD
Radial (ae)	5% of Dia.

Slotting / Pocket Milling	
Axial (ap)	5% of Dia.
Radial (ae)	1xD



## High Speed Machining

DIAMETER	38 - 45 HRc		45 - 50 HRc		50 - 55 HRc		55 - 60 HRc		60 - 65 HRc		65 - 70 HRc	
	RPM	CPT (Fz)	RPM	CPT (Fz)	RPM	CPT (Fz)	RPM	CPT (Fz)	RPM	CPT (Fz)	RPM	CPT (Fz)
1/8"	36670	.0006"	30600	.0005"	24500	.0004"	18340	.0004"	13750	.0003"	11460	.0002"
3/16"	24450	.0009"	20400	.0008"	16300	.0006"	12230	.0005"	9200	.0004"	7650	.0003"
1/4"	18340	.0012"	15300	.0010"	12230	.0008"	9200	.0007"	6900	.0005"	5750	.0004"
3/8"	12225	.0015"	10200	.0012"	8150	.0010"	6100	.0008"	4600	.0007"	3850	.0006"
1/2"	9170	.0018"	7650	.0015"	6100	.0012"	4600	.0010"	3450	.0009"	2870	.0008"
5/8"	7335	.0022"	6100	.0018"	4900	.0014"	3700	.0012"	2750	.0011"	2300	.0010"
3/4"	6115	.0027"	5100	.0022"	4100	.0020"	3100	.0018"	2300	.0014"	1900	.0013"
1"	4585	.0030"	3820	.0027"	3100	.0025"	2300	.0022"	1720	.0019"	1450	.0017"

Profiling / Side Cutting	
Axial (ap)	1xD
Radial (ae)	2% of Dia.

Slotting / Pocket Milling	
Axial (ap)	2% of Dia.
Radial (ae)	1xD

**D = Tool Diameter**

**Example: 2% of Dia., when D = 1/2" (.02 x .500") = .010" per pass**

Preferable method is to run tools with air blast to keep chips away from the cutting edge.  
If air is not available, either coolant spray or dry machining is acceptable.

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