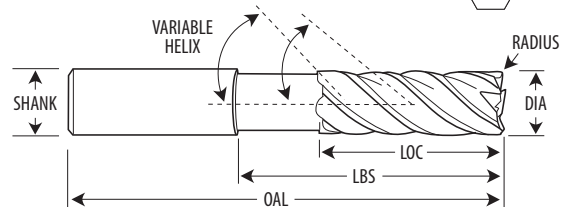
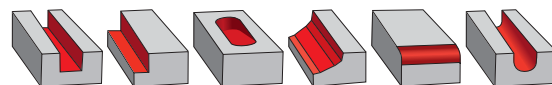
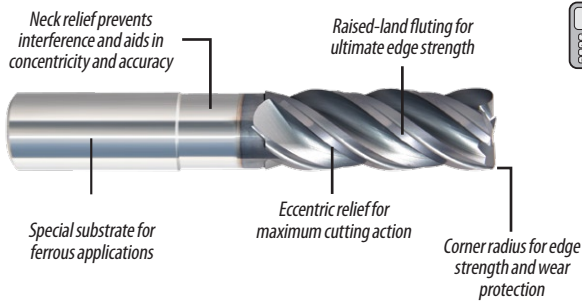
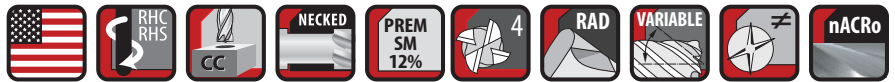




DIA	DEC IN	LOC	SHANK	OAL	LENGTH	RADIUS	NACRO®
1/2	0.5000	2	1/2	4	Long	0.030	294-003061
						0.030	294-001069
						0.045	294-001071
5/8	0.6250	3/4	5/8	3	Stub	0.060	294-001072
						0.090	294-001073
						0.120	294-001074
						0.030	294-002069
						0.045	294-002071
5/8	0.6250	1-1/4	5/8	3-1/2	Regular	0.060	294-002072
						0.090	294-002073
						0.120	294-002074
						0.045	294-003071
5/8	0.6250	2-1/4	5/8	5	Long	0.030	294-001079
						0.045	294-001081
3/4	0.7500	1	3/4	3	Stub	0.060	294-001082
						0.090	294-001083
						0.120	294-001084
						0.030	294-002079
						0.045	294-002081
3/4	0.7500	1-1/2	3/4	4	Regular	0.060	294-002082
						0.090	294-002083
						0.120	294-002084
						0.045	294-003081
3/4	0.7500	2-1/4	3/4	5	Long	0.045	294-003083
3/4	0.7500	3-1/4	3/4	6	X/Long	0.030	294-002089
						0.060	294-002091
						0.090	294-002092
1	1.0000	1-1/2	1	4	Regular	0.120	294-002093
						0.060	294-003091
1	1.0000	2-1/4	1	5	Long	0.060	294-003091
1	1.0000	3	1	6	X/Long	0.060	294-003093
1	1.0000	4	1	7	XX/Long	0.060	294-003095



DIA TOLERANCE: +0.000 / -0.002" SHANK TOLERANCE: +0.0000 / -0.0004"

DIA	DEC IN	LOC	SHANK	OAL	LBS	LENGTH	RADIUS	NACRO®
1/8	0.1250	1/4	1/8	3	1-3/8	Long	0.010	294-004001
							0.015	294-004002
							0.030	294-004003
3/16	0.1875	5/16	3/16	3	1-3/8	Long	0.015	294-004011
							0.030	294-004012



HIGH PERFORMANCE END MILLS - 4 FLUTE



DIA	DEC IN	LOC	SHANK	OAL	LBS	LENGTH	RADIUS	NACRO®
1/4	0.2500	3/8	1/4	4	2-1/8	Long	0.015	294-004021
							0.030	294-004022
							0.060	294-004023
3/8	0.3750	1/2	3/8	3	1-1/2	Medium	0.015	294-004033
							0.030	294-004034
							0.060	294-004035
							0.090	294-004036
							0.120	294-004037
3/8	0.3750	1/2	3/8	4	2-1/8	Long	0.015	294-004038
							0.030	294-004039
							0.060	294-004040
							0.090	294-004041
1/2	0.5000	5/8	1/2	4	2-3/8	Medium	0.120	294-004042
							0.030	294-004051
							0.060	294-004052
							0.090	294-004053
1/2	0.5000	5/8	1/2	6	3-3/8	Long	0.120	294-004054
							0.030	294-004055
							0.060	294-004056
							0.090	294-004057
5/8	0.6250	3/4	5/8	5	2-3/8	Long	0.120	294-004058
							0.030	294-004071
							0.060	294-004072
							0.090	294-004073
5/8	0.6250	3/4	5/8	6	3-3/8	X/Long	0.120	294-004074
							0.030	294-004075
							0.060	294-004076
3/4	0.7500	1	3/4	6	3-1/2	X/Long	0.090	294-004077
							0.120	294-004078
							0.030	294-004091
							0.060	294-004092
3/4	0.7500	1	3/4	7	4-1/2	XX/Long	0.090	294-004093
							0.120	294-004094
							0.030	294-004095
1	1.0000	1-1/4	1	6	3-1/2	Long	0.060	294-004096
							0.090	294-004097
							0.120	294-004098
							0.030	294-004111
1	1.0000	1-1/4	1	7	4-1/2	X/Long	0.060	294-004112
							0.090	294-004113
							0.120	294-004114
							0.030	294-004115
1	1.0000	1-1/4	1	7	4-1/2	X/Long	0.060	294-004116
							0.090	294-004117
							0.120	294-004118



MILLING RECOMMENDATIONS



PROFILING

Workpiece Material Group		Hardness	Surface Feet Per Minute (SFM)				Radial Depth of Cut (RDOC)											
			SFM based on RDOC				Inches Per Tooth (IPT)											
			Cutting Diameter Engaged				IPT* (BASELINE)											
			5%	10%	25%	50%	1/8 <sup>†</sup>	3/16 <sup>†</sup>	1/4 <sup>†</sup>	Cutting Diameter								
			5/16	3/8	1/2	5/8	1/4	1										
Steels	Free Machining & Low Carbon, 10XX, 11XX, 12XX 12LXX, ASTM A27 ASTM A36	≤ 28 Rc	1475	1150	980	500												
	Medium Carbon Steels, 1140, 1145	P 28-38 Rc	1130	900	840	250	0.0012	0.0020	0.0024	0.0031	0.0039	0.0047	0.0060	0.0078	0.0100			
	Alloy, 41XX	28-44 Rc	1035	840	765													
Tool & Die Steels	A2, D2, H13, L6, P20, S7	P 28-44 Rc	900	725	615	200												
Stainless Steels	Easy to Machine, 430F, 301, 303, 410, 416 Annealed, 420F, 430, 430F	≤ 28 Rc	675	545	425	360												
	Austenitic, 301, 302, 303 High Tensile, 304, 304L, 305, 420, 15-5PH, 17-4PH, 17-7PH	M ≤ 28 Rc	525	430	400	210	0.0012	0.0020	0.0024	0.0031	0.0039	0.0047	0.0060	0.0078	0.0100			
	Difficult to Machine, 302B, 304B, 309, 310, 316, 316B, 316L, 316Ti, 317, 317L, 321	M ≤ 28 Rc	410	330	295													
	Difficult to Machine, 17-4 PH, PH13-8Mo, Nitronics	> 28 Rc	525	430	395	110												
	Cobalt Chrome Alloys, ASTM F75, ASTM F562, ASTM, F90:		410	325	295	130	0.0006	0.0010	0.0012	0.0016	0.0020	0.0024	0.0030	0.0040	0.0050			
	22% Duplex	M > 28 Rc	245	195	180													
25% Super Duplex		245	195	180	110													
Super Alloys	High Temp, Nimonic, Inconel, Monel, Hastelloy	S ≤ 42 Rc	180	150	130	85	0.0003	0.0005	0.0006	0.0008	0.0010	0.0012	0.0016	0.0020	0.0024			
	Titanium: Ti 3Al-2.5V, Ti 6Al-4V Ti 10V-2Fe-3Al	S ≤ 42 Rc	525	425	330	175												
Hardened Materials		H 45-50 Rc	610	495	325	250	0.0006	0.0010	0.0012	0.0016	0.0020	0.0024	0.0030	0.0040	0.0050			
		H 50-55 Rc	510	410	280	200	0.0003	0.0005	0.0006	0.0008	0.0010	0.0012	0.0016	0.0020	0.0024			
Cast-Iron	Gray, SAE J431, ASTM A48	≤ 240 HB	1625	1295	870	350	0.0012	0.0020	0.0024	0.0031	0.0039	0.0047	0.0060	0.0078	0.0100			
	Ductile & Malleable, ASTM A536, ASTM 897, ASTM A47, ASTM A220 ASTM A602	K > 240 HB	675	540	510	260												

*CHIP THINNING Adjustments	
RDOC	Increase IPT
50%	None
30%	1.1 x
25%	1.2 x
20%	1.3 x
15%	1.4 x
10%	1.8 x
7%	2.0 x
5%	2.3 x
3%	3.0 x
2%	3.5 x
1%	5.0 x

**†1/4" AND SMALLER DIAMETERS: Use caution when Profiling more than 50% or Slotting more than 25%**



SLOTTING

Workpiece Material Group		Hardness	Surface Feet Per Minute (SFM)			Radial Depth of Cut (RDOC)									
			SFM based on RDOC			Inches Per Tooth (IPT)									
			Cutting Diameter Engaged			Cutting Diameter									
			25%	50%	100%	1/8 <sup>†</sup>	3/16 <sup>†</sup>	1/4 <sup>†</sup>	5/16	3/8	1/2	5/8	3/4	1	
Steels	Free Machining & Low Carbon, 10XX, 11XX, 12XX 12LXX, ASTM A27 ASTM A36	≤ 28 Rc	550	500	475										
	Medium Carbon Steels, 1140, 1145	P 28-38 Rc	275	250	225	0.0004	0.0010	0.0012	0.0016	0.0020	0.0025	0.0031	0.0040	0.0050	
	Alloy, 41XX	28-44 Rc	225	200	175										
Tool & Die Steels	A2, D2, H13, L6, P20, S7	P 28-44 Rc	225	200	175										
Stainless Steels	Easy to Machine, 430F, 301, 303, 410, 416 Annealed, 420F, 430, 430F	≤ 28 Rc	385	360	350										
	Austenitic, 301, 302, 303 High Tensile, 304, 304L, 305, 420, 15-5PH, 17-4PH, 17-7PH	M ≤ 28 Rc	225	210	200	0.0004	0.0010	0.0012	0.0016	0.0020	0.0024	0.0031	0.0040	0.0050	
	Difficult to Machine, 302B, 304B, 309, 310, 316, 316B, 316L, 316Ti, 317, 317L, 321	M ≤ 28 Rc	225	210	200										
	Difficult to Machine, 17-4 PH, PH13-8Mo, Nitronics	> 28 Rc	125	110	100										
Super Alloys	Cobalt Chrome Alloys, ASTM F75, ASTM F562, ASTM, F90:		150	130	120	0.0003	0.0005	0.0006	0.0008	0.0010	0.0012	0.0016	0.0020	0.0024	
	22% Duplex	M > 28 Rc	120	110	100										
	25% Super Duplex		120	110	100										
Hardened Materials	High Temp, Nimonic, Inconel, Monel, Hastelloy	S ≤ 42 Rc	100	85	75	0.0003	0.0005	0.0006	0.0008	0.0010	0.0012	0.0016	0.0020	0.0024	
	Titanium: Ti 3Al-2.5V, Ti 6Al-4V Ti 10V-2Fe-3Al	S ≤ 42 Rc	180	175	160										
Cast-Iron		H 45-50 Rc	275	250	225	0.0003	0.0005	0.0006	0.0008	0.0010	0.0012	0.0016	0.0020	0.0024	
		H 50-55 Rc	225	200	175	0.0001	0.0002	0.0003	0.0004	0.0005	0.0006	0.0008	0.0010	0.0015	
	Gray, SAE J431, ASTM A48	≤ 240 HB	375	350	325	0.0004	0.0010	0.0012	0.0016	0.0020	0.0024	0.0031	0.0040	0.0050	
	Ductile & Malleable, ASTM A536, ASTM 897, ASTM A47, ASTM A220 ASTM A602	K > 240 HB	275	260	250										

