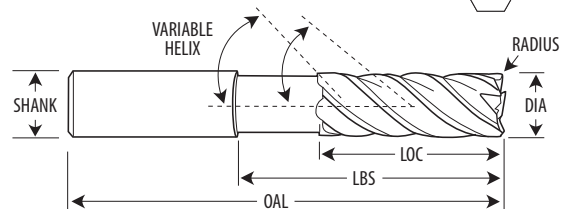
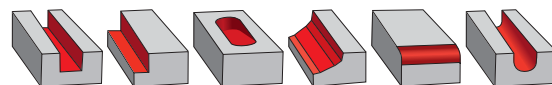
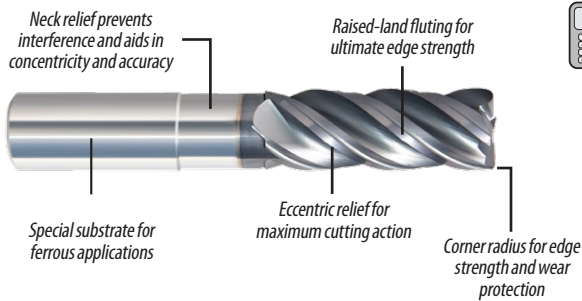
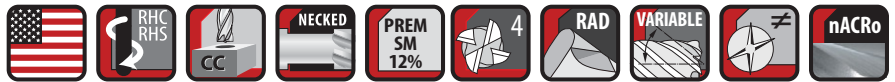


DIA TOLERANCE: +0.000 / -0.002" SHANK TOLERANCE: +0.0000 / -0.0004"

DIA	DEC IN	LOC	SHANK	OAL	LENGTH	RADIUS	NACRo®						
1/8	0.1250	1/4	1/8	1-1/2	Stub	0.015	294-001011						
						0.020	294-001012						
						0.030	294-001013						
1/8	0.1250	1/2	1/8	1-1/2	Regular	0.015	294-002011						
						0.020	294-002012						
						0.030	294-002013						
3/16	0.1875	3/8	3/16	2	Stub	0.015	294-001021						
						0.020	294-001022						
						0.030	294-001023						
3/16	0.1875	5/8	3/16	2	Regular	0.015	294-002021						
						0.020	294-002022						
						0.030	294-002023						
1/4	0.2500	1/2	1/4	2	Stub	0.015	294-001029						
						0.020	294-001031						
						0.030	294-001032						
1/4	0.2500	3/4	1/4	2-1/2	Regular	0.060	294-001033						
						0.015	294-002029						
						0.020	294-002031						
1/4	0.2500	1-1/8	1/4	4	Long	0.030	294-002032						
						0.060	294-002033						
						0.020	294-003031						
5/16	0.3125	5/8	5/16	2	Stub	0.015	294-001039						
						0.030	294-001041						
						0.060	294-001042						
5/16	0.3125	3/4	5/16	2-1/2	Regular	0.015	294-002039						
						0.030	294-002041						
						0.060	294-002042						
3/8	0.3750	5/8	3/8	2	Stub	0.015	294-001049						
						0.030	294-001051						
						0.060	294-001052						
3/8	0.3750	1	3/8	2-1/2	Regular	0.015	294-002049						
						0.030	294-002051						
						0.060	294-002052						
3/8	0.3750	1-1/2	3/8	4	Long	0.030	294-003051						
						7/16	0.4375	1	7/16	2-3/4	Regular	0.030	294-002056
												0.015	294-001059
0.030	294-001061												
1/2	0.5000	5/8	1/2	2-1/2	Stub	0.060	294-001062						
						0.090	294-001063						
						0.120	294-001064						
						0.015	294-002059						
1/2	0.5000	1-1/4	1/2	3	Regular	0.030	294-002061						
						0.045	294-002062						
						0.060	294-002063						
						0.090	294-002064						
						0.120	294-002065						



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
						0.120	294-002093
1	1.0000	1-1/2	1	4	Regular	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



MILLING RECOMMENDATIONS



PROFILING

Workpiece Material Group		Hardness	Surface Feet Per Minute (SFM)				Inches Per Tooth (IPT)									
			Radial Depth of Cut (RDOC)				IPT* (BASELINE)									
			SFM based on RDOC				Cutting Diameter									
			5%	10%	25%	50%	1/8 [†]	3/16 [†]	1/4 [†]	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										
	Alloy, 41XX	28-44 Rc	1035	840	765		0.0012	0.0020	0.0024	0.0031	0.0039	0.0047	0.0060	0.0078	0.0100	
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	K ≤ 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)			Inches Per Tooth (IPT)									
			Radial Depth of Cut (RDOC)			IPT									
			SFM based on RDOC			Cutting Diameter									
			25%	50%	100%	1/8 [†]	3/16 [†]	1/4 [†]	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										
	Alloy, 41XX	28-44 Rc	225	200	175	0.0004	0.0010	0.0012	0.0016	0.0020	0.0025	0.0031	0.0040	0.0050	
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													
	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	K ≤ 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										

