

INDEXING **CHIP SURFER**™ TIP GUIDELINES

- Step 1: Screw tip into shank until finger tight (Figure 1a). Note a .010" gap (Figure 1b).
- Step 2: Use wrench to torque approximately 1/4 turn, creating a simultaneous fit (Figure 2).
- Step 3: Use .001" shim stock to check the simultaneous fit at the intersection of the tip and the shank. The shim should not be able to enter the intersection (Figure 3a). If it does, tighten further with the wrench until there is no gap (Figure 3b).

Note: Pre-set torque wrenches (series DT-. . .) can be purchased.

Figure 1a. Finger tight



Figure 1b. .010" gap



Figure 2. 1/4 turn



Figure 3a. Shim should NOT enter intersection



Figure 3b. Proper fit



Series DT-. . . Optional Torque Wrench



MILLING TIP OPERATING GUIDELINES



Material	Specifications	Hardness Brinell	Coolant?	SFM	Diameter	IPT Based on Diameter
Aluminum Alloys	7075 - T6 6061 - T6 2024	-	Yes	1000-5000	0.312	.003
					0.375	.004
					0.500	.005
					0.625	.006
					0.750-1.000	.008
Magnesium	Die Cast, Extruded	-	?	800-1500	0.312	.002
					0.375	.003
					0.500	.004
					0.625	.006
					0.750-1.000	.008
Copper	Yellow Brass, High Lead Brass, Red Brass	-	?	800-1000	0.312	.002
					0.375	.0025
					0.500	.003
					0.625	.004
					0.750-1.000	.004
Copper Alloys	Aluminum/Bronze, Low Silicon Bronze	-	?	750-1000	0.312	.002
					0.375	.0025
					0.500	.003
					0.625	.004
					0.750-1.000	.004
Plastics, Acrylics, Phenolics	Polysulfone, G10, G11	-	?	200-500	0.312	.003
					0.375	.004
					0.500	.006
					0.625	.008
					0.750-1.000	.010
Cast Iron	Ductile Cast Iron	150-250	No	600-650	0.312	.0015
					0.375	.002
					0.500	.0022
					0.625	.003
					0.750-1.000	.004
Cast Iron	Gray Cast Iron	150-250	No	600-650	0.312	.002
					0.375	.003
					0.500	.004
					0.625	.005
					0.750-1.000	.006
Steel	Low Alloy Steels 10xx, 11xx, 13xx	100-250	No	600-800	0.312	.0012
					0.375	.002
					0.500	.003
					0.625	.004
					0.750-1.000	.005
Steel	High Strength Steels 4140, 4340, 6150, H13	150-300	No	400-800	0.312	.001
					0.375	.0015
					0.500	.002
					0.625	.0025
					0.750-1.000	.003
Steel	High Alloy Steels A2, A6, P20	Up to 300	No	500-650	0.312	.001
					0.375	.0015
					0.500	.0015
					0.625	.0025
					0.750-1.000	.003



■ MILLING TIP OPERATING GUIDELINES



Material	Specifications	Hardness Brinell	Coolant?	SFM	Diameter	IPT Based on Diameter
Steel	Medium Alloy Steels 200, 250, 300	250-400	No	500-750	0.312	.001
					0.375	.002
					0.500	.0025
					0.625	.0035
Stainless Steel	13/8, 15/5, AM-350/355	-	Yes*	200-275	0.750-1.000	.004
					0.312	.001
					0.375	.0015
					0.500	.002
Stainless Steel	200 Series, 302, 303, 304L, 316L	-	Yes*	225-300	0.625	.003
					0.750-1.000	.004
					0.312	.002
					0.375	.0025
Stainless Steel	403, 410, 416	-	Yes*	250-325	0.500	.003
					0.625	.0035
					0.750-1.000	.0035
					0.312	.0005
High Temperature Alloys	Nickel Base: Inconel, Hastelloy, Waspalloy	-	Yes	100-200	0.375	.001
					0.500	.002
					0.625	.0025
					0.750-1.000	.003
High Temperature Alloys	Cobalt Base: Stellite, Haynes, X-40, L-605	-	Yes	100-200	0.312	.001
					0.375	.001
					0.500	.0012
					0.625	.0015
High Temperature Alloys	Iron Base: Incoloy, Multimet, Timken	-	Yes	125-225	0.750-1.000	.002
					0.312	.001
					0.375	.0015
					0.500	.002
Titanium	Titanium Alloys: 6AL-4V, etc.	-	Yes	100-250	0.625	.0025
					0.750-1.000	.003
					0.312	.0005
					0.375	.001
Carbon, Graphites	Carbon, Graphites	-	?	200-500	0.500	.010
					0.625	.010
					0.750-1.000	.015
					0.312	.006

INDERSOLL

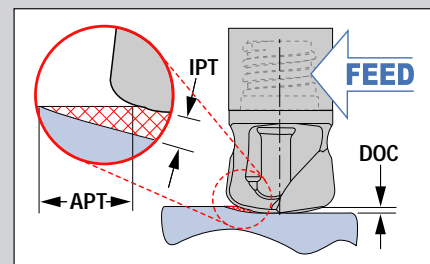
ULTRA HIGH FEED OPERATING GUIDELINES



Material	Spec	Hardness Brinell	SFM	IPT	Coolant
Steel	Hi Strength Steel 4140, 4340, 6150, H13	150-300	600-800	.008-.018	No
	High Alloy Tool Steel	Up to 300	500-650	.008-.018	
	Medium Alloy 200, 250, 300	250-400	500-750	.008-.018	
	Low Alloy 1018, 1045	100-250	600-800	.010-.020	
	Hardened Steel	Rc 42-52	300-450	.002-.004	
	Hardened Steel	Rc 52-58	200-350	.001-.003	
	Hardened Steel	Rc 58-62	100-200	.001-.003	
Stainless Steel	Precipitation 13/8, 15/5, AM350/355	-	200-275	.003-.013	Yes
	Austenitic 200 series, 302, 303, 304L, 316L	-	225-300	.008-.018	
	Martensitic 403, 410, 416	Up to 320	250-325	.008-.018	
Cast Iron	Ductile Iron	150-250	600-650	.005-.015	No
	Gray Cast Iron	150-250	600-650	.006-.016	
Hi Temp Alloys	Cobalt Based - Stellite, HS-21, X-40, L-605	-	100-200	.002-.004	Yes
	Nickel Base - Inconel, Monel, Incoly 600-800	-	100-200	.003-.005	
	Iron Base - Incoloy 800-802, Multimet N-155, Timken 16-26-6	-	125-225	.003-.005	
Titanium	Titanium Alloys - 6AL4V	-	100-250	.003-.005	Yes

FEED RATE CALCULATION

Hardened Steel Applications	Extended Cutter Applications (Length/Dia > 8:1)	Typical Applications (Length/Dia < 8:1)
.005 < DOC < .010 APT = 3 X IPT	.005 < DOC < .015 APT = 3 X IPT	.015 < DOC < .030 APT = 4 X IPT



EXAMPLE CALCULATION

Given	Step 1	Step 2	Step 3	Step 4	Operating Parameters
<ul style="list-style-type: none"> Tip = 45A12001T8RA25 Number of Flutes = 2 Material = H13 Pre Hard Hardness = 38-42 Extension = 2.0 	Convert 38-42 HRC to Brinell & then select SFM. Calculate RPM for .472" diameter tip *RPM = 4855	Select DOC and FeedRate Multiplier from the application table for a ratio of < 8:1 DOC = .025	Select appropriate Chip Thickness CT = .010"	Calculate FeedRate (full width) **FeedRate = 388 IPM	<ul style="list-style-type: none"> RPM = 4855 DOC = .025 Feed Rate = 388 IPM WOC = .472

*RPM = SFM x 3.82 / Diameter

** FeedRate = RPM x Number of Flutes x CT x Multiplier

T-SLOTTER TIP OPERATING GUIDELINES



Material	Spec	Brinell	SFM	Hardness IPT	Coolant
Aluminum	7075 - T6, 6061 - T6, 2024	-	1650-2500	.0025-.0035	Yes
Cast Iron	Gray	150-250	350-550	.0025-.0035	No
	Nodular	150-250	425-650	.0030-.0040	
Steel	Low Carbon 1018, 8620	150-250	450-750	.0025-.0035	No
	High Carbon F-6180	250-400	250-450	.0030-.0040	
	Alloyed Steel 4140, 4340	150-300	350-550		
	Tool Steel A-6, D-1, D-2	Up to 300	350-450		
Stainless Steel	300 Series, 304, 316	-	300-500	.0025-.0035	may not be required at high speeds
	400 Series 15-5 PH	Up to 320	250-400	.0030-.0040	may not be required at high speeds
	13-8 PH	-	200-350		Yes
Nickel Alloys	Inconel, Hastelloy, Waspalloy	-	100-200	.0025-.0035	Yes
Titanium	6AL-4V	-	150-200	.0025-.0035	Yes

Please see Ingersoll's Milling Products Catalog (CAT-001) for chip thinning factor application at various depths of cut.

45Z THREAD MILL OPERATING GUIDELINES



Material	Speed (FPM)	Feed (Inches per Tooth) Cutter Diameter (Inch)		
		.250 - .350	.500	.750
Aluminum & Magnesium	800 - Up	.001 - .004	.003 - .006	.004 - .008
Brass	500 - 800	.001 - .003	.003 - .005	.004 - .008
Bronze	400 - 600	.001 - .003	.003 - .006	.005 - .007
Hard Bronze	220 - 280	.0005 - .002	.002 - .003	.004 - .006
Cast Iron - Soft	200 - 280	.0005 - .002	.002 - .004	.003 - .006
Cast Iron - Hard	180 - 250	.0005 - .002	.002 - .003	.003 - .004
Steel - Soft	230 - 400	.001 - .003	.002 - .004	.003 - .005
Steel - Medium	200 - 350	.0005 - .003	.001 - .003	.002 - .004
Steel - Hard	120 - 220	.0005 - .002	.001 - .003	.002 - .004
Stainless Steel	120 - 220	.0005 - .002	.001 - .003	.002 - .004

12J1D OPERATING GUIDELINES



12J1D

Material	Spec	Brinell	SFM	Hardness IPT	Coolant
Aluminum	7075 - T6, 6061 - T6, 2024	-	1000-8000	.003-.008	Yes
Cast Iron	Gray	150-250	500-1200	.002-.004	No
	Nodular	150-250	400-800	.002-.004	No
Steel	Low Carbon 1018, 8620	150-250	600-1200	.002-.004	No
	High Carbon F-6180, Nitralloy 52100	250-400	400-600	.002-.004	No
	Alloyed Steel 4140, 4340, 6150	150-300	400-800	.002-.004	No
	Tool Steel A-6, D-1, D-2, P-20	Up to 300	400-800	.002-.004	No
Stainless Steel	300 Series, 304, 316	-	400-800	.002-.004	May not be required at high speeds.
	400 Series 15-5 PH, 17-4 PH	Up to 320	500-1000	.002-.004	Yes
	13-8 PH	-	200-400	.002-.004	Yes
Nickel Alloys	Inconel, Hastelloy, Waspalloy	-	75-120	.002-.003	Yes
Titanium	6AL-4V	-	80-150	.002-.0032	Yes

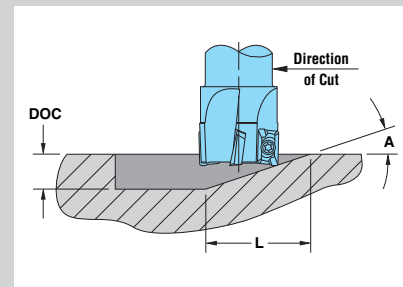
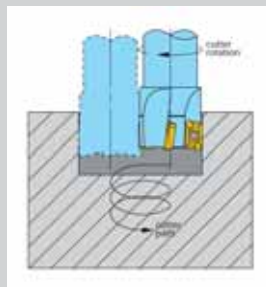
Please see Ingersoll's Milling Products Catalog (CAT-001) for chip thinning factor application at various depths of cut.

12J1D 0° END MILL RAMPING DATA SERIES 12J1D

End Mill Using AOMT0602 Insert w/ .008"R	Cutter Diameter	Min. Dia. Milled Hole	Min. Advance Per Cutter Path Rev. (APCPR)	Max. Dia. Milled Hole	Max Advance Per Cutter Path Rev. (APCPR)
12J1D	0.375	0.495	0.050	0.73	0.175
	0.500	0.735	0.063	0.98	0.150
	0.625	0.985	0.067	1.23	0.130
	0.750	1.220	0.059	1.47	0.102

12J1D End Mills Using AOMT0602 Insert

Cutter Diameter	A° Ramp Angle	L	DOC
0.375	9.6	1.3	0.22
0.500	6.0	2.1	0.22
0.625	4.0	3.1	0.22
0.750	2.6	4.8	0.22



CENTER DRILL OPERATING GUIDELINES FOR 45Z



ISO	Material Number	Cutting Speed (SFM)	Feed (in/rev) $\phi.118 - \phi.185$	Feed (in/rev) $\phi.189 - \phi.292$	Feed (in/rev) $\phi.295 - \phi.396$	Feed (in/rev) $\phi.397 - \phi.500$
P	1	250 - 450	.002" - .006"	.003" - .007"	.005" - .010"	.006" - .012"
	2	250 - 450	.002" - .006"	.003" - .007"	.005" - .010"	.006" - .012"
	3	150 - 400	.002" - .004"	.003" - .005"	.005" - .008"	.006" - .010"
	4	150 - 400	.002" - .004"	.003" - .005"	.005" - .008"	.006" - .010"
	5	150 - 400	.002" - .004"	.003" - .005"	.005" - .008"	.006" - .010"
	6	120 - 250	.002" - .004"	.002" - .005"	.004" - .007"	.005" - .009"
	7	120 - 250	.002" - .004"	.002" - .005"	.004" - .007"	.005" - .009"
	8	120 - 250	.002" - .004"	.002" - .005"	.004" - .007"	.005" - .009"
	9	120 - 250	.002" - .004"	.002" - .005"	.004" - .007"	.005" - .009"
	10	100 - 240	.002" - .004"	.002" - .004"	.004" - .006"	.005" - .009"
	11	100 - 240	.002" - .004"	.002" - .004"	.004" - .006"	.005" - .009"
M	12	190 - 230	.002" - .004"	.002" - .004"	.003" - .006"	.005" - .008"
	13	160 - 200	.002" - .004"	.002" - .005"	.004" - .007"	.006" - .009"
	14	110 - 200	.002" - .004"	.002" - .004"	.003" - .006"	.005" - .008"
K	15	230 - 300	.005" - .008"	.007" - .011"	.009" - .015"	.012" - .020"
	16	230 - 300	.005" - .008"	.007" - .011"	.009" - .015"	.012" - .020"
	17	260 - 330	.006" - .010"	.008" - .013"	.011" - .017"	.013" - .024"
	18	260 - 330	.006" - .010"	.008" - .013"	.011" - .017"	.013" - .024"
	19	260 - 330	.006" - .010"	.008" - .013"	.011" - .017"	.013" - .024"
	20	260 - 330	.006" - .010"	.008" - .013"	.011" - .017"	.013" - .024"
N	21	300 - 400	.004" - .010"	.007" - .014"	.009" - .017"	.012" - .020"
	22	300 - 400	.004" - .010"	.007" - .014"	.009" - .017"	.012" - .020"
	23	300 - 400	.004" - .010"	.007" - .014"	.009" - .017"	.012" - .020"
	24	300 - 400	.004" - .010"	.007" - .014"	.009" - .017"	.012" - .020"
	25	300 - 400	.004" - .010"	.007" - .014"	.009" - .017"	.012" - .020"
	26	300 - 400	.003" - .007"	.007" - .014"	.009" - .017"	.012" - .020"
	27	300 - 400	.003" - .007"	.007" - .014"	.009" - .017"	.012" - .020"
	28	300 - 400	.003" - .007"	.007" - .014"	.009" - .017"	.012" - .020"
	29					
	30					
S	31	30 - 80	.001" - .003"	.002" - .003"	.003" - .004"	.004" - .005"
	32	30 - 80	.001" - .003"	.002" - .003"	.003" - .004"	.004" - .005"
	33	30 - 80	.001" - .003"	.002" - .003"	.003" - .004"	.004" - .005"
	34	30 - 80	.001" - .003"	.002" - .003"	.003" - .004"	.004" - .005"
	35	30 - 80	.001" - .003"	.002" - .003"	.003" - .004"	.004" - .005"
	36	70 - 140	.001" - .003"	.002" - .004"	.003" - .006"	.004" - .008"
	37	70 - 140	.001" - .003"	.002" - .004"	.003" - .006"	.004" - .008"
H	38	50 - 100	.001" - .002"	.001" - .003"	.001" - .003"	.002" - .004"
	39	50 - 100	.001" - .002"	.001" - .003"	.001" - .003"	.002" - .004"
	40	50 - 100	.001" - .002"	.001" - .003"	.001" - .003"	.002" - .004"
	41	50 - 100	.001" - .002"	.001" - .003"	.001" - .003"	.002" - .004"

● = P ● = M ● = K ● = N ● = S ○ = H



INGERSOLL ISO MATERIAL GROUPS

ISO	Material	Condition	Tensile Strength (Kpsi)	Hardness HB	Material Number	
P	Non - Alloy Steels	<0.25% C	Annealed	61	125	1
	Steel Castings	=>0.25% C	Annealed	94	190	2
	Free Machining Steel	<0.55% C	Quenched & Tempered	123	250	3
			Annealed	109	220	4
			Quenched & Tempered	145	300	5
	Low - Alloy Steels and Steel Castings (less than 5% of alloying elements)	>0.55% C	Annealed	87	200	6
			Quenched & Tempered	135	275	7
				145	300	8
				174	350	9
	High - Alloy Steels, Steel Castings & Tool Steels		Annealed	99	200	10
			Quenched & Tempered	160	325	11
M	Stainless Steels and Stainless Steel Castings	Ferritic/Martensitic	99	200	12	
		Martensitic	119	240	13	
		Austenitic & P.H.	87	180	14	
K	Nodular Cast Iron (GGG)	Ferritic / Pearlitic		180	15	
		Pearlitic		260	16	
	Grey Cast Iron (GG)	Ferritic		160	17	
		Pearlitic		250	18	
	Malleable Cast Iron	Ferritic		130	19	
		Pearlitic		230	20	
N	Aluminum wrought alloy	As cast		60	21	
		Forged		100	22	
	Cast Aluminum alloyed	<=12% Si	As cast		75	23
			Forged		90	24
			High Temperature		130	25
	Copper Alloys	> 12% Si	Free Cutting		110	26
			Brass		90	27
			Electrolitic Copper		100	28
	Non Metallic		Duroplastics & Fiberplastics			29
			Hard Rubber			30
S	High Temp Alloys	Fe Based	Annealed	200	31	
			Cured	280	32	
		Ni or Co Based	Annealed	250	33	
			Cured	350	34	
			Cast	320	35	
	Titanium and Ti Alloys			58	36	
			Alpha+Beta alloys cured	152	37	
H	Hardened Steel			55 HRc	38	
				60 HRc	39	
	Chilled Cast Iron	Cast		400	40	
	Cast Iron	Hardened		55 HRc	41	

●=P ●=M ●=K ●=N ●=S ○=H

■ NOTES

