END MILL SPEED AND FEED RECOMMENDATIONS

Maximizing Performance and Tool Life

Materials		Speed SFM	Feed per Tooth (FPT) 1/8"	1/4"	1/2"	3/4"	1"
Non-Ferrous	Aluminum / Aluminum Alloy	1000-2000	0.001	0.002	0.004	0.006	0.008
	Aluminum Alloy +10%	700-1200	0.001	0.002	0.004	0.006	0.008
	Brass	300-450	0.001	0.002	0.003	0.004	0.005
	Bronze	250-350	0.001	0.002	0.003	0.004	0.005
	Copper / Copper Alloys	500-900	0.001	0.002	0.003	0.005	0.007
	Composites: Fiberglass	200-600	0.001	0.002	0.003	0.004	0.005
	Graphites	200-400	0.001	0.006	0.010	0.015	0.020
	Graphite / Epoxy	200-400	0.001	0.002	0.003	0.004	0.005
	Magnesium	1000 min	0.001	0.002	0.004	0.006	0.008
Stainless Steel	Free Machine	300-400	0.0005	0.001	0.002	0.004	0.006
	Work Hardening	150-300	0.0005	0.0005	0.001	0.003	0.005
High Temp Alloys	Nickel Base	200-300	0.0005	0.001	0.002	0.003	0.004
Cast Iron	Ductile	250-400	0.0005	0.0015	0.002	0.004	0.006
	Gray	350-500	0.0005	0.002	0.004	0.006	0.008
	Malleable	200-350	0.0005	0.002	0.004	0.006	0.008
Steels	Low Alloy	350-600	0.0005	0.001	0.002	0.004	0.006
	Medium Alloy	200-400	0.0005	0.001	0.002	0.004	0.006
	High Alloy Mold-Die	175-250	0.0005	0.001	0.002	0.004	0.006
	High Strength	75-150	0.0005	0.0005	0.001	0.003	0.004
Titanium	Soft	150-300	0.0005	0.001	0.002	0.004	0.006
	Hard	50-150	0.0005	0.0005	0.001	0.002	0.004

All speed and feed recommendations should be considered only as a starting point. Start with conservative speeds and feeds while analyzing the rigidity of the process. Then cautiously progress incrementally to achieve optimum performance. Contact Fullerton Tool directly for any additional support.

General Recommendations

The above suggested parameters are recommended for uncoated tools only. When various coatings are applied, SFM may be increased accordingly. These general percentages are as follows under optimal conditions:

TiN = +15% • TiCN = +25% • TiAlN = +40%

Rigidity
Maximize rigidity to reduce chatter and increase tool life. Ways to improve rigidity include, choosing the largest diameter possible to perform your milling task, use the shortest LOC (Length of Cut) available, and always use the tool holder which offers the shortest gage line (Shortest Tool Holder Length).

Chatter
If chatter is present increase feed or reduce speed.

Extra Long End Mills
For extra long end mills the SFM should be reduced by 25%.

Cutter Direction
Cutter direction should be in a climb milling direction whenever possible. Conventional tool paths may be employed when the tool is in use on older manual equipment to minimize backlash or to remove scale to reach the softer parent material underneath.

TIR or Total Indicator Runout
This condition should be held to a minimum at all times. As this value increases, the effectiveness of the tool's performance decreases thus reducing tool life.

Recutting Chips
Use a coolant or air blast to evacuate chips to avoid premature damage to your carbide cutting tool, which may occur if chips are recut.

Formulas to determine speed, feed & chip load after the type and diameter of the cutting tool is determined.

US Customary Units
D = cutter diameter (in) | T = tooth count (flute)
IPT chip load (in/flute) = IPM ÷ RPM ÷ T
IPR feed per revolution (in/rev) = IPM ÷ RPM
SFM surface speed (ft/min) = 0.2618 x RPM x D
RPM spindle speed (rev/min) = 3.82 x SFM ÷ D
IPM feed rate (in/min) = RPM x IPT x T

SI Units
D = cutter diameter (mm) | T = tooth count (flute)
MMPT chip load (mm/flute)
MMPR feed per revolution (mm/rev) = MMPM ÷ RPM
SMPM surface speed (m/min) = 0.00314 x RPM x D
RPM spindle speed (rev/min) = 318.3 x SMPM ÷ D
MMPM feed rate (mm/min) = RPM x MMPT x T

Feed Rate Conversion
MMPM (mm/min) = IPM (in/min) x 25.4 (mm/in)
IPM (in/min) = MMPM (mm/min) x 0.0394 (in/mm)

Surface Speed Conversion
SMPM (m/min) = SFM (ft/min) x 0.3048 (m/ft)
SFM (ft/min) = SMPM (m/min) x 3.2808 (ft/m)

Unit Conversion
1 in = 25.4 mm | 1 ft = 304.8 mm = 0.3048 m
1 mm = .03937 in | 1 m = 3.2808 ft = 39.370 in

For the very best selection of an end mill and how to apply it for your particular application, we suggest that you call our technical support staff. They will advise you in what end mill to use, the correct speeds and feeds and if a particular coating would be beneficial. You may also visit our web site (http://www.fullertontool.com) for the latest information regarding particular tools.

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