Icon Glossary

Z3	Number of Flutes
	Center Cutting
	Lengths

Coatings

ALtima®	TiAlN	TiCN
TiN	Fordlube	

30°	Helix Angle
	Ball Nose
N	Neck Relief
	Corner Radius
	Shank
HB DIN6535	Shank/DIN
Chipbreaker	Chipbreaker

Workpiece Material Group

Blue	Steels
Yellow	Stainless Steels
Red	Cast Iron
Orange	Special Alloys
Gray	Hardened Steels (35-65Rc)
Green	Non-Ferrous

End Mill Troubleshooting

Problem	Possible Solutions: Rigidity	Increase Inches/tooth	Reduce Inches/tooth	Material	Recutting Chips	Increase Rake Angle	Handling	Runout	Reduce Speed	Increase Speed	Depth of Cut	Fixturing	Coolant	Finish	Dull Tool	Chip Evacuation	Inadequate Number of Flutes	Insufficient Coolant	Plunge Cutting	Reduce Feed	Increase Feed	Tool Holder	Balance Holder & Tool
Chipping	x		x	x	x		x	x														x	
Chatter	x	x							x		x	x										x	
Built Up Edge		x				x				x			x	x									
Breakage	x		x								x				x	x						x	
Chip Packing																	x	x	x				
Poor Slotting	x	x	x						x		x	x								x			
Premature Wear				x					x	x			x							x	x	x	
Chip Welding			x			x			x				x	x									
Cratering																							x

Formulas

Inch

RPM=SFM x 3.82/Tool Diameter
IPM=RPM x number of teeth x (inches/tooth)

Metric

RPM=SMM x 318.057/Tool Diameter
mm/min.=RPM x number of teeth x (mm/tooth)

Conversion Inch to Metric

SMM=SFM x .3048
mm/min.= IPM x 25.4

Conversion Metric to Inch

SFM=SMM/.3048
IPM= (mm/min.)/25.4

Safety Note

Always wear the appropriate personal protective equipment such as safety glasses and protective clothing when using solid carbide or HSS cutting tools. Machines should be fully guarded. Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

Series 177/179 Inch

Workpiece Material Group		Examples	Coolant: Max	Coolant: Air	Coolant: MMS	Slotting: 25% Axial	Slotting: 50% Axial	Profiling 1% of Dia.	5% of Dia.	10% of Dia.	15% of Dia.	20% of Dia.	30% of Dia.	50% of Dia.
			Type			SFM								
Steels	P	Free Machining	●	●	●	500	500	2400	2250	2050	1850	1660	1260	500
		Low Carbon	●	●	●	500	500	2400	2250	2050	1850	1660	1260	500
		Medium Carbon	●	●	●	300	300	1100	1030	950	875	790	620	300
		Alloy Steels	●	●	●	250	250	500	480	450	430	400	350	250
		High Strength Alloys	●	●	●	250	250	500	480	450	430	400	350	250
		Structural Steels	●	●	●	500	500	2400	2250	2050	1850	1660	1260	500
		Die/Tool Steels	●	●	●	200	200	400	390	380	370	360	300	200
Stainless Steels	M	Free Machining	●	x	○	300	300	500	485	460	450	430	380	300
		Moderate Stainless	●	x	○	250	250	500	390	380	370	360	320	250
		Difficult Stainless	●	x	○	200	200	350	330	320	300	295	260	200
		PH Stainless	●	x	○	125	125	250	245	240	235	230	195	125
		Cobalt Chrome Alloys	●	x	○	150	150	250	245	230	225	215	190	150
		Duplex (22%)	●	x	○	125	125	250	245	230	225	215	185	125
		Super Duplex (25%)	●	x	○	100	100	200	195	180	180	170	140	100
Special Alloys	S	High Temp Alloys	●	x	x	150	150	250	240	220	215	200	180	150
		Titanium Alloys	●	x	x	175	175	425	400	380	350	325	275	175
Cast Irons	K	Gray Cast Iron	●	○	○	400	400	1500	1420	1315	1210	1100	860	400
		SG Iron	●	○	○	350	350	1200	1130	1050	980	900	710	350
		Ductile Cast Iron	●	○	○	300	300	500	485	460	450	430	380	300
		Malleable Iron	●	○	○	300	300	400	385	375	360	345	330	300

Profiling: 1 x Diameter Axial Depth — Small Radial Depth ===========> Largest Radial Depth

● Preferred
○ Possible
x Not Possible

If axial depth is less than the ball diameter, the speed is figured using the effective cutting diameter.

Workpiece Material Group		Examples	1/16	1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1.0
			Inches/Tooth									
Steels	P	Free Machining Low Carbon Medium Carbon Alloy Steels High Strength Alloys Structural Steels Die/Tool Steels	.0002	.0004	.0007	.0010-.0016	.0013-.0021	.0016-.0026	.0020-.0031	.0026-.0033	.0031-.0035	.0035-.0051
Stainless Steels	M	Free Machining Moderate Stainless Difficult Stainless PH Stainless Cobalt Chrome Alloys Duplex (22%) Super Duplex (25%)	.0002	.0004	.0007	.0010-.0016	.0012-.0021	.0012-.0026	.0020-.0031	.0020-.0033	.0022-.0035	.0024-.0039
Special Alloys	S	Titanium Alloys										
		High Temp Alloys	.0001	.0002	.0008	.0005-.0008	.0007-.0011	.0007-.0013	.0010-.0016	.0010-.0017	.0011-.0018	.0012-.0020
Cast Irons	K	Gray Cast Iron SG Iron Ductile Cast Iron Malleable Iron	.0002	.0004	.0007	.0007-.0016	.0010-.0022	.0015-.0028	.0018-.0033	.0024-.0035	.0028-.0039	.0024-.0050

Tool Diameter

Spindle Max.

Should the Calculated Spindle Speed be more than your actual Spindle Max., Use Formula Below:

Calculated Feed x Spindle Max.
Calculated Speed

During Profile Milling less than 50% of the cutter diameter radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1.00
30%	1.10
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

Example: Profile Milling
1) Select Material from chart.
2) Select Tool Size.
3) Select feed per tooth.
4) Figure percentage of clutter Diameter Radial Cut Depth.
5) Select Chip Load Factor for Radial Depth.
6) Multiply Chip Load Factor x Feed per Tooth.
7) Answer: New Feed per Tooth.
8) New Feed per Tooth x Number of Teeth x RPM = IPM (Inches per Minute)

Example:Slotting
1) Select Material from chart.
2) Select Tool Size.
3) Select feed per tooth from chart.
4) Multiply Feed per Tooth x Number of Teeth x RPM.
5) Answer: IPM (Inches per Minute)

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

Series 177/179 Metric

Workpiece Material Group		Examples	Coolant Type: Max	Air	MMS	Slotting 25% Axial	Slotting 50% Axial	1 x Diameter Axial Depth – Profiling (Small Radial Depth ===========> Largest Radial Depth): 1% of Dia.	5% of Dia.	10% of Dia.	15% of Dia.	20% of Dia.	30% of Dia.	50% of Dia.
						SMM								
Steels	P	Free Machining	●	●	●	150	150	730	685	620	565	500	380	150
		Low Carbon	●	●	●	150	150	730	685	620	565	500	380	150
		Medium Carbon	●	●	●	90	90	335	310	290	260	240	180	90
		Alloy Steels	●	●	●	75	75	150	140	130	130	120	105	75
		High Strength Alloys	●	●	●	75	75	150	140	130	130	120	105	75
		Structural Steels	●	●	●	150	150	730	685	620	565	500	380	150
		Die/Tool Steels	●	●	●	60	60	120	115	115	110	110	90	60
Stainless Steels	M	Free Machining	●	x	○	90	90	150	145	140	135	130	115	90
		Moderate Stainless	●	x	○	75	75	150	115	115	110	105	95	75
		Difficult Stainless	●	x	○	60	60	105	100	95	90	90	75	60
		PH Stainless	●	x	○	40	40	75	75	75	70	70	60	40
		Cobalt Chrome Alloys	●	x	○	45	45	75	75	75	70	70	60	45
		Duplex (22%)	●	x	○	40	40	75	75	75	70	70	60	40
		Super Duplex (25%)	●	x	○	30	30	60	60	55	55	50	45	30
Special Alloys	S	High Temp Alloys	●	x	x	45	45	75	75	75	70	60	55	45
		Titanium Alloys	●	x	x	55	55	125	120	115	105	100	80	55
Cast Irons	K	Gray Cast Iron	●	○	○	120	120	450	430	400	360	335	250	120
		SG Iron	●	○	○	105	105	365	345	320	295	275	215	105
		Ductile Cast Iron	●	○	○	90	90	150	145	140	130	130	115	90
		Malleable Iron	●	○	○	90	90	120	115	110	105	105	100	90

●	Preferred
○	Possible
x	Not Possible

If axial depth is less than the ball diameter, the speed is figured using the effective cutting diameter.

Workpiece Material Group		Examples	Tool Diameter (mm): 1	3	4	6	8	10	12	16	18	25
			mm/Tooth									
Steels	P	Free Machining Low Carbon Medium Carbon Alloy Steels High Strength Alloys Structural Steels Die/Tool Steels	.005	.010	.017	.025-.040	.033-.053	.040	.066	.066-.083	.078-.088	.088-.129
Stainless Steels	M	Free Machining Moderate Stainless Difficult Stainless PH Stainless Cobalt Chrome Alloys Duplex (22%) Super Duplex (25%)	.005	.010	.017	.025-.040	.033-.053	.040	.066	.066-.083	.078-.088	.088-.129
Special Alloys	S	Titanium Alloys										
		High Temp Alloys	.002	.005	.020	.012-.020	.017-.027	.017-.033	.025-.040	.025-.043	.027-.045	.030-.050
Cast Irons	K	Gray Cast Iron SG Iron Ductile Cast Iron Malleable Iron	.005	.010	.017	.017-.040	.025-.055	.038-.071	.045-.083	.060-.088	.071-.099	.060-.127

Spindle Max.

Should the Calculated Spindle Speed be more than your actual Spindle Max., Use Formula Below:

$$\frac{\text{Calculated Feed x Spindle Max.}}{\text{Calculated Speed}}$$

During Profile Milling less than 50% of the cutter diameter radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1.00
30%	1.10
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

Example: Profile Milling
1) Select Material from chart.
2) Select Tool Size.
3) Select feed per tooth.
4) Figure percentage of clutter Diameter Radial Cut Depth.
5) Select Chip Load Factor for Radial Depth.
6) Multiply Chip Load Factor x Feed per Tooth.
7) Answer: New Feed per Tooth.
8) RPM x New Feed per Tooth x number of Teeth = mm/min (Millimeters per Minute)

Example:Slotting
1) Select Material from chart.
2) Select Tool Size.
3) Select feed per tooth from chart.
4) Multiply Feed per Tooth x Number of Teeth x RPM.
5) Answer: mm/min (Millimeters per Minute)

Series 178 Inch

Workpiece Material Group		Examples	Coolant Max	Coolant Air	Coolant MMS	1% of Dia.	5% of Dia.	10% of Dia.	15% of Dia.	20% of Dia.	30% of Dia.	50% of Dia.
			Type			SFM (1 x Diameter Axial Depth — Profiling — Small Radial Depth ===========> Large Radial Depth)						
Steels	P	Free Machining	●	●	●	2400	2250	2050	1850	1660	1260	500
		Low Carbon	●	●	●	2400	2250	2050	1850	1660	1260	500
		Medium Carbon	●	●	●	1100	1030	950	875	790	620	300
		Alloy Steels	●	●	●	500	480	450	430	400	350	250
		High Strength Alloys	●	●	●	500	480	450	430	400	350	250
		Structural Steels	●	●	●	2400	2250	2050	1850	1660	1260	500
		Die/Tool Steels	●	●	●	400	390	380	370	360	300	200
Stainless Steels	M	Free Machining	●	x	○	500	485	460	450	430	380	300
		Moderate Stainless	●	x	○	500	390	380	370	360	320	250
		Difficult Stainless	●	x	○	350	330	320	300	295	260	200
		PH Stainless	●	x	○	250	245	240	235	230	195	125
		Cobalt Chrome Alloys	●	x	○	250	245	230	225	215	190	150
		Duplex (22%)	●	x	○	250	245	230	225	215	185	125
		Super Duplex (25%)	●	x	○	200	195	180	180	170	140	100
Special Alloys	S	High Temp Alloys	●	x	x	250	240	220	215	200	180	150
		Titanium Alloys	●	x	x	425	400	380	350	325	275	175
Cast Irons	K	Gray Cast Iron	●	○	○	1500	1420	1315	1210	1100	860	400
		SG Iron	●	○	○	1200	1130	1050	980	900	710	350
		Ductile Cast Iron	●	○	○	500	485	460	450	430	380	300
		Malleable Iron	●	○	○	400	385	375	360	345	330	300

●	Preferred
○	Possible
x	Not Possible

Spindle Max.

Should the Calculated Spindle Speed be more than your actual Spindle Max., Use Formula Below:

Calculated Feed x Spindle Max.

Calculated Speed

Workpiece Material Group		Examples	1/16	1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1.0
			Inches/Tooth (Tool Diameter)									
Steels	P	Free Machining Low Carbon Medium Carbon Alloy Steels High Strength Alloys Structural Steels Die/Tool Steels	.0002	.0004	.0007	.0010-.0016	.0013-.0021	.0016-.0026	.0020-.0031	.0026-.0033	.0031-.0035	.0035-.0051
Stainless Steels	M	Free Machining Moderate Stainless Difficult Stainless PH Stainless Cobalt Chrome Alloys Duplex (22%) Super Duplex (25%)	.0002	.0004	.0007	.0010-.0016	.0012-.0021	.0012-.0026	.0020-.0031	.0020-.0033	.0022-.0035	.0024-.0039
Special Alloys	S	Titanium Alloys										
		High Temp Alloys	.0001	.0002	.0008	.0005-.0008	.0007-.0011	.0007-.0013	.0010-.0016	.0010-.0017	.0011-.0018	.0012-.0020
Cast Irons	K	Gray Cast Iron SG Iron Ductile Cast Iron Malleable Iron	.0002	.0004	.0007	.0007-.0016	.0010-.0022	.0015-.0028	.0018-.0033	.0024-.0035	.0028-.0039	.0024-.0050

During Profile Milling less than 50% of the cutter diameter radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1.00
30%	1.10
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

Example: Profile Milling

1) Select Material from chart.

2) Select Tool Size.

3) Select feed per tooth.

4) Figure percentage of cutter Diameter Radial Cut Depth.

5) Select Chip Load Factor for Radial Depth.

6) Multiply Chip Load Factor x Feed per Tooth.

7) Answer: New Feed per Tooth.

8)New Feed per Tooth x Number of Teeth x RPM = IPM (Inches per Minute)

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

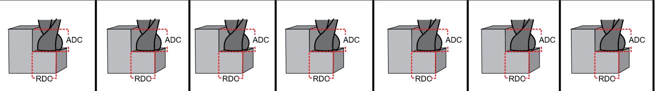
Series 178 Metric

Spindle Max.

Should the Calculated Spindle Speed be more than your actual Spindle Max., Use Formula Below:

$$\frac{\text{Calculated Feed} \times \text{Spindle Max.}}{\text{Calculated Speed}}$$

1 x Diameter Axial Depth — Profiling — Small Radial Depth ===========> Large Radial Depth



Workpiece Material Group		Examples	Coolant Type: Max	Air	MMS	1% of Dia. (SMM)	5% of Dia.	10% of Dia.	15% of Dia.	20% of Dia.	30% of Dia.	50% of Dia.
Steels	P	Free Machining	●	●	●	730	685	620	565	500	380	150
		Low Carbon	●	●	●	730	685	620	565	500	380	150
		Medium Carbon	●	●	●	335	310	290	260	240	180	90
		Alloy Steels	●	●	●	150	140	130	130	120	105	75
		High Strength Alloys	●	●	●	150	140	130	130	120	105	75
		Structural Steels	●	●	●	730	685	620	565	500	380	150
		Die/Tool Steels	●	●	●	120	115	115	110	110	90	60
Stainless Steels	M	Free Machining	●	x	○	150	145	140	135	130	115	90
		Moderate Stainless	●	x	○	150	115	115	110	105	95	75
		Difficult Stainless	●	x	○	105	100	95	90	90	75	60
		PH Stainless	●	x	○	75	75	75	70	70	60	40
		Cobalt Chrome Alloys	●	x	○	75	75	75	70	70	60	45
		Duplex (22%)	●	x	○	75	75	75	70	70	60	40
		Super Duplex (25%)	●	x	○	60	60	55	55	50	45	30
Special Alloys	S	High Temp Alloys	●	x	x	75	75	75	70	60	55	45
		Titanium Alloys	●	x	x	125	120	115	105	100	80	55
Cast Irons	K	Gray Cast Iron	●	○	○	450	430	400	360	335	250	120
		SG Iron	●	○	○	365	345	320	295	275	215	105
		Ductile Cast Iron	●	○	○	150	145	140	130	130	115	90
		Malleable Iron	●	○	○	120	115	110	105	105	100	90

● Preferred
○ Possible
x Not Possible

Workpiece Material Group		Examples	Tool Diameter (mm): 1	3	4	6	8	10	12	16	18	25
			mm/Tooth									
Steels	P	Free Machining Low Carbon Medium Carbon Alloy Steels High Strength Alloys Structural Steels Die/Tool Steels	.005	.010	.017	.025-.040	.033-.053	.040	.066	.066-.083	.078-.088	.088-.129
Stainless Steels	M	Free Machining Moderate Stainless Difficult Stainless PH Stainless Cobalt Chrome Alloys Duplex (22%) Super Duplex (25%)	.005	.010	.017	.025-.040	.033-.053	.040	.066	.066-.083	.078-.088	.088-.129
Special Alloys	S	Titanium Alloys										
		High Temp Alloys	.002	.005	.020	.012-.020	.017-.027	.017-.033	.025-.040	.025-.043	.027-.045	.030-.050
Cast Irons	K	Gray Cast Iron SG Iron Ductile Cast Iron Malleable Iron	.005	.010	.017	.017-.040	.025-.055	.038-.071	.045-.083	.060-.088	.071-.099	.060-.127

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

During Profile Milling less than 50% of the cutter diameter radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1.00
30%	1.10
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

Example: Profile Milling

1) Select Material from chart.
2) Select Tool Size.
3) Select feed per tooth.
4) Figure percentage of cutter Diameter Radial Cut Depth.
5) Select Chip Load Factor for Radial Depth.
6) Multiply Chip Load Factor x Feed per Tooth.
7) Answer: New Feed per Tooth.
8) RPM x New Feed per Tooth x number of Teeth = mm/min. (mm per Minute)

Series 180 Inch

Workpiece Material Group		Examples	Coolant: Max	Coolant: Air	Coolant: MMS	1 x Diameter Axial Depth — Profiling — Small Radial Depth ==========> Large Radial Depth: 1% of Dia.	5% of Dia.	10% of Dia.	15% of Dia.	20% of Dia.
			Type			SFM				
Steels	P	Free Machining	●	●	●	2400	2250	2050	1850	1660
		Low Carbon	●	●	●	2400	2250	2050	1850	1660
		Medium Carbon	●	●	●	1100	1030	950	875	790
		Alloy Steels	●	●	●	500	480	450	430	400
		High Strength Alloys	●	●	●	500	480	450	430	400
		Structural Steels	●	●	●	2400	2250	2050	1850	1660
		Die/Tool Steels	●	●	●	400	390	380	370	360
Stainless Steels	M	Free Machining	●	x	○	500	485	460	450	430
		Moderate Stainless	●	x	○	500	390	380	370	360
		Difficult Stainless	●	x	○	350	330	320	300	295
		PH Stainless	●	x	○	250	245	240	235	230
		Cobalt Chrome Alloys	●	x	○	250	245	230	225	215
		Duplex (22%)	●	x	○	250	245	230	225	215
		Super Duplex (25%)	●	x	○	200	195	180	180	170
Special Alloys	S	High Temp Alloys	●	x	x	250	240	220	215	200
		Titanium Alloys	●	x	x	425	400	380	350	325
Cast Irons	K	Gray Cast Iron	●	○	○	1500	1420	1315	1210	1100
		SG Iron	●	○	○	1200	1130	1050	980	900
		Ductile Cast Iron	●	○	○	500	485	460	450	430
		Malleable Iron	●	○	○	400	385	375	360	345

●	Preferred
○	Possible
x	Not Possible

Spindle Max.

Should the Calculated Spindle Speed be more than your actual Spindle Max., Use Formula Below:

$$\frac{\text{Calculated Feed x Spindle Max.}}{\text{Calculated Speed}}$$

Workpiece Material Group		Examples	Tool Diameter 1/2	5/8	3/4	1.0
			Inches/Tooth			
Steels	P	Free Machining Low Carbon Medium Carbon Alloy Steels High Strength Alloys Structural Steels Die/Tool Steels	.0020-.0031	.0026-.0033	.0031-.0035	.0035-.0051
Stainless Steels	M	Free Machining Moderate Stainless Difficult Stainless PH Stainless Cobalt Chrome Alloys Duplex (22%) Super Duplex (25%)	.0020-.0031	.0020-.0033	.0022-.0035	.0024-.0039
Special Alloys	S	Titanium Alloys				
		High Temp Alloys	.0010-.0016	.0010-.0017	.0011-.0018	.0012-.0020
Cast Irons	K	Gray Cast Iron SG Iron Ductile Cast Iron Malleable Iron	.0018-.0033	.0024-.0035	.0028-.0039	.0024-.0050

During Profile Milling less than 50% of the cutter diameter radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

Example: Profile Milling

1) Select Material from chart.
2) Select Tool Size.
3) Select feed per tooth.
4) Figure percentage of cutter Diameter Radial Cut Depth.
5) Select Chip Load Factor for Radial Depth.
6) Multiply Chip Load Factor x Feed per Tooth.
7) Answer: New Feed per Tooth.
8) New Feed per Tooth x Number of Teeth x RPM = IPM (Inches per Minute)

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

Series 180 Metric

Workpiece Material Group		Examples	Coolant Type: Max	Coolant Type: Air	Coolant Type: MMS	1 x Diameter Axial Depth – Profiling (Small Radial Depth =========> Large Radial Depth): 1% of Dia.	5% of Dia.	10% of Dia.	15% of Dia.	20% of Dia.
						SMM				
Steels	P	Free Machining	•	•	•	730	685	625	565	505
		Low Carbon	•	•	•	730	685	625	565	505
		Medium Carbon	•	•	•	335	310	290	265	240
		Alloy Steels	•	•	•	150	145	135	130	120
		High Strength Alloys	•	•	•	150	145	135	130	120
		Structural Steels	•	•	•	730	685	625	565	505
		Die/Tool Steels	•	•	•	120	115	115	110	110
Stainless Steels	M	Free Machining	•	x	○	150	145	140	135	130
		Moderate Stainless	•	x	○	150	115	115	110	105
		Difficult Stainless	•	x	○	105	100	95	90	90
		PH Stainless	•	x	○	75	75	75	70	70
		Cobalt Chrome Alloys	•	x	○	75	75	70	65	65
		Duplex (22%)	•	x	○	75	75	70	65	65
		Super Duplex (25%)	•	x	○	60	60	55	55	50
Special Alloys	S	High Temp Alloys	•	x	x	75	75	70	65	60
		Titanium Alloys	•	x	x	130	120	115	105	100
Cast Irons	K	Gray Cast Iron	•	○	○	455	430	400	365	335
		SG Iron	•	○	○	365	345	320	295	275
		Ductile Cast Iron	•	○	○	150	145	140	135	130
		Malleable Iron	•	○	○	120	115	115	110	105

•	Preferred
○	Possible
x	Not Possible

Spindle Max.
Should the Calculated Spindle Speed be more than your actual Spindle Max., Use Formula Below:

Calculated Feed x Spindle Max.
Calculated Speed

Workpiece Material Group		Examples	Tool Diameter (mm): 12	16	18	25
			mm/Tooth			
Steels	P	Free Machining Low Carbon Medium Carbon Alloy Steels High Strength Alloys Structural Steels Die/Tool Steels	.050-.078	.066-.083	.078-.088	.088-.129
Stainless Steels	M	Free Machining Moderate Stainless Difficult Stainless PH Stainless Cobalt Chrome Alloys Duplex (22%) Super Duplex (25%)	.050-.078	.050-.083	.055-.088	.060-.099
Special Alloys	S	Titanium Alloys				
		High Temp Alloys	.025-.040	.025-.043	.027-.045	.030-.050
Cast Irons	K	Gray Cast Iron SG Iron Ductile Cast Iron Malleable Iron	.045-.083	.060-.088	.071-.099	.060-.127

During Profile Milling less than 50% of the cutter diameter radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

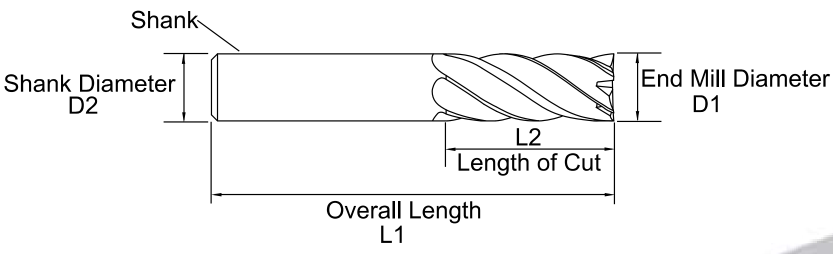
Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

Example: Profile Milling

1) Select Material from chart.
2) Select Tool Size.
3) Select feed per tooth.
4) Figure percentage of cutter Diameter Radial Cut Depth.
5) Select Chip Load Factor for Radial Depth.
6) Multiply Chip Load Factor x Feed per Tooth.
7) Answer: New Feed per Tooth.
8) RPM x New Feed per Tooth x number of Teeth = mm/min. (mm per Minute)

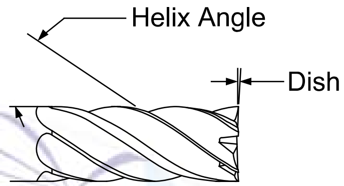
Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

End Mill Terminology

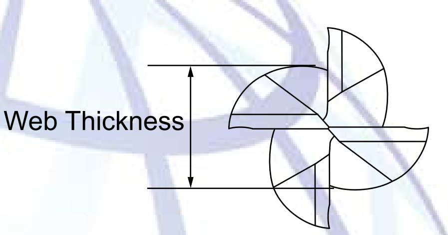


Length of Cut (Flute Length) – Always select the shortest Flute Length possible for your application. By selecting the shortest Flute Length, you can increase rigidity and allow for higher feed rates.

End Mill Diameter – Always select the largest diameter possible for your milling operation. Increasing your diameter by just 10%, can increase your rigidity by 25%.

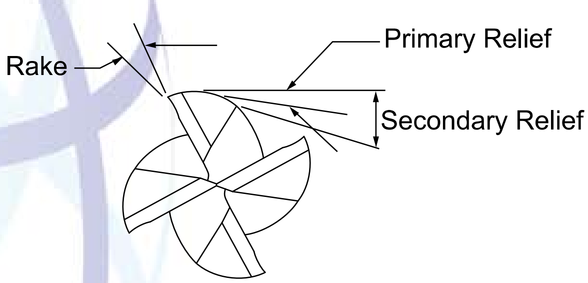


Helix Angle – Varies from 0 to 60 degrees. Higher helix angles can increase the number of teeth in a cut, and help in redirecting cutting forces. This is beneficial in harder to machine materials in particular. Changes in helix angle can also greatly affect the flute form of an end mill, and affect chip evacuation.



Web Thickness – The cross section of the fluting of the end mill. Larger webs allow for more rigidity, while smaller webs allow for better chip evacuation. This feature is highly dependent on the material being machined.

Rake Angle – The measurement of the curvature of the cutting edge in the face of the flute. A high rake angle will cut more aggressively, while a lower rake angle will increase the strength of the cutting edge.



Primary Relief – The clearance directly behind the cutting edge. High primary relief angles will allow for more aggressive milling, while lower relief angles will increase the strength of the cutting edge. The primary relief will also affect the wear on a cutting edge. Lower primary relief angles can tend to develop larger wear lands.