

**Updated Technical Data for
TuffCut[®] AL
High Performance End Mills
Series 134/135/136/137/138**

September 9, 2009

Series 134/135/137 Inch

Workpiece Material Group	Examples	Coolant	Slotting						
			Small Radial Depth ==> Large Radial Depth			1 x Diameter Axial Depth			
			Profile Milling						
			25% Axial	50% Axial	100% Axial	10% of Dia.	25% of Dia.	50% of Dia.	
			SFM						
Non-Ferrous	N	Aluminum < 10% Si	•	1000-2000			2000	1625	1000
		Aluminum > 10% Si	•	800-1500			1500	1230	800
		Brass	•	500-900			900	750	500
		Plastics	•	800-1200			1200	1050	800

Workpiece Material Group	Examples	Milling Type	Tool Diameter									
			1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1	
			Inches/Tooth									
Non-Ferrous	N	Aluminum Alloys < 10% Si	Slotting	.0012	.0018	.0025	.0032	.0037	.0050	.0065	.0075	.0100
		Aluminum / Aluminum Alloys > 10% Si		Profile Milling	.003-.004	.004-.006	.004-.008	.006-.009	.007-.012	.010-.045	.015-.040	.015-.040
	Brass											
		Plastic										

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)

Above 20,000 RPM, Tool Balancing Is Required.

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

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

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

Series 134/135/137 Metric

Workpiece Material Group	Examples	Coolant	Slotting				Small Radial Depth ==> Large Radial Depth	
							1 x Diameter Axial Depth	
							Profile Milling	
			Max.	25% Axial	50% Axial	100% Axial	10% of Dia.	25% of Dia.
	Type						SMM	
Non-Ferrous	N		Aluminum < 10% Si	•	305-610	610	495	305
			Aluminum > 10% Si	•	245-460	460	375	245
			Brass	•	150-275	900	230	155
			Plastics	•	245-365	365	320	245

Workpiece Material Group	Examples	Milling Type	Tool Diameter(mm)									
			3	5	6	8	10	14	16	18	25	
			mm/Tooth									
Non-Ferrous	N	Aluminum / Aluminum Alloys < 10% Si	Slotting	.030	.046	.064	.081	.094	.127	.165	.191	.254
		Aluminum / Aluminum Alloys > 10% Si Brass Plastics		Profile Milling	.076-.102	.102-.152	.102-.203	.152-.229	.178-.305	.254-1.143	.381-1.016	.381-1.016

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 = mm/min. (mm per Minute)

Above 20,000 RPM, Tool Balancing Is Required.

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

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

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

For product information, call your local distributor.

Series 136/138 Inch



Series 136/138 Inch

Workpiece Material Group	Examples	Coolant	Slotting				Small Radial Depth ==> Large Radial Depth	
			1 x Diameter Axial Depth					
			Profile Milling					
			25% Axial	50% Axial	100% Axial	10% of Dia.	25% of Dia.	50% of Dia.
			SFM					
Non-Ferrous	N		Aluminum < 10% Si					
			Aluminum > 10% Si					
			Brass					
			Plastics					

Workpiece Material Group	Examples	Milling Type	Tool Diameter									
			1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1	
			Inches/Tooth									
Non-Ferrous	N	Slotting	.0012	.0018	.0025	.0032	.0037	.0050	.0065	.0075	.0100	
		Profile Milling	.0024	.0036	.0050	.0064	.0074	.0100	.0120	.0140	.0200	

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)

Above 20,000 RPM, Tool Balancing Is Required.

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

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

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

Series 136/138 Metric

Workpiece Material Group	Examples	Coolant	Slotting					
			Small Radial Depth ==> Large Radial Depth					
			1 x Diameter Axial Depth					
			Profile Milling					
Max.	Type	25% Axial	50% Axial	100% Axial	10% of Dia.	25% of Dia.	50% of Dia.	
		SMM						
Non-Ferrous	N	Aluminum < 10% Si	425-610			610	540	425
		Aluminum > 10% Si	305-460			460	400	305
		Brass	150-275			275	230	150
		Plastics	245-365			365	320	245

Workpiece Material Group	Examples	Milling Type	Tool Diameter(mm)								
			3	5	6	8	10	14	16	18	25
			mm/Tooth								
Non-Ferrous	N	Aluminum / Aluminum Alloys < 10% Si	.030	.046	.064	.081	.094	.127	.165	.191	.254
		Aluminum / Aluminum Alloys > 10% Si Brass Plastics	.061	.091	.127	.163	.188	.254	.305	.356	.508

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 = mm/min. (mm per Minute)

Above 20,000 RPM, Tool Balancing Is Required.

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

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

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Series 135B/138B Inch

Workpiece Material Group	Examples	Coolant	Slotting						Contouring
			Small Radial Depth ==> Large Radial Depth			1 x Diameter Axial Depth			
			Profile Milling						
			25% Axial	50% Axial	100% Axial	10% of Dia.	25% of Dia.	50% of Dia.	
			SFM						
Non-Ferrous	N		1400-2000			2000	1775	1400	2000
			1000-1500			1500	1310	1000	1500
			500-900			900	750	500	900
			800-1200			1200	1050	800	1200

Workpiece Material Group	Examples	Milling Type	Tool Diameter									
			1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1	
			Inches/Tooth									
Non-Ferrous	N	Aluminum / Aluminum Alloys < 10% Si	Slotting	.0012	.0018	.0025	.0032	.0037	.0050	.0065	.0075	.0100
		Aluminum / Aluminum Alloys > 10% Si	Profile Milling	.0024	.0036	.0050	.0064	.0074	.0100	.0120	.0140	.0200
		Brass Plastics	Contouring	.0024	.0036	.0050	.0064	.0074	.0100	.0120	.0140	.0200

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)









Above 20,000 RPM, Tool Balancing Is Required.
If axial depth is less than the ball diameter, the speed is figured using the effective cutting diameter.

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

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

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

Series 135B/138B Metric

Workpiece Material Group	Examples	Coolant	Slotting			Small Radial Depth ==> Large Radial Depth			Contouring
			1 x Diameter Axial Depth						
			Profile Milling						
			25% Axial	50% Axial	100% Axial	10% of Dia.	25% of Dia.	50% of Dia.	
									
		Max.							
		Type	SMM						
Non-Ferrous	N	Aluminum < 10% Si	•	425-610	610	540	425	610	
		Aluminum > 10% Si	•	305-460	460	400	305	460	
		Brass	•	150-275	275	230	150	275	
		Plastics	•	245-365	365	320	245	365	

Workpiece Material Group	Examples	Milling Type	Tool Diameter(mm)									
			3	5	6	8	10	14	16	18	25	
			mm/Tooth									
Non-Ferrous	N	Aluminum / Aluminum Alloys < 10% Si	Slotting	.030	.046	.064	.081	.094	.127	.165	.191	.254
		Aluminum / Aluminum Alloys > 10% Si	Profile Milling	.061	.091	.127	.163	.188	.254	.305	.356	.508
		Brass Plastics	Contouring	.061	.091	.127	.163	.188	.254	.305	.356	.508

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 = mm/min. (mm per Minute)

Above 20,000 RPM, Tool Balancing Is Required.
If axial depth is less than the ball diameter, the speed is figured using the effective cutting 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

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