

MADE IN CANADA



**EVOLUTION**  
Solid Carbide Endmills 

**SOLID  
CARBIDE  
END MILLS**

**2023-2024**

# EVOLUTION

Solid Carbide Endmills

Carbide End Mills engineered to the highest quality with the best raw material & coatings for demanding applications. High tech geometries manufactured on the most state of the art 5 Axis CNC Grinders in the world. Extremely rigid quality control to assure the tightest tolerances & consistency.

## GOOD GENERAL PURPOSE

- General Purpose
- 30 deg Helix Carbide with honed edges
- 10% Micrograin Carbide
- Diameter Tolerances: +0.0000"/-0.0020"

P	●	Steel
M	○	Stainless Steel
K	●	Cast Iron
N	○	Non-Ferrous
S	○	High Temp. Alloys
H	○	Hardened Steel
● GOOD ○ OK ○ NOT OPTIMAL		



## BETTER HIGH PERFORMANCE

- Special Helix Design with honed edges
- Variable Pitch to reduce chatter with special core design
- 10% Micrograin Carbide
- Diameter Tolerances: +0.0000"/-0.0020"

P	●	Steel
M	○	Stainless Steel
K	●	Cast Iron
N	○	Non-Ferrous
S	○	High Temp. Alloys
H	○	Hardened Steel
● BETTER ○ OK ○ NOT OPTIMAL		

## BEST ULTRA HIGH PERFORMANCE

- Special Helix Design with honed edges
- Variable Pitch to reduce chatter with special core design
- 10% Ultra High Performance Micrograin Carbide with extremely high Transverse Rupture strength
- Diameter Tolerances: +0.0000"/-0.0015"

P	●	Steel
M	●	Stainless Steel
K	●	Cast Iron
N	○	Non-Ferrous
S	●	High Temp. Alloys
H	○	Hardened Steel
● BEST ○ OK ○ NOT OPTIMAL		

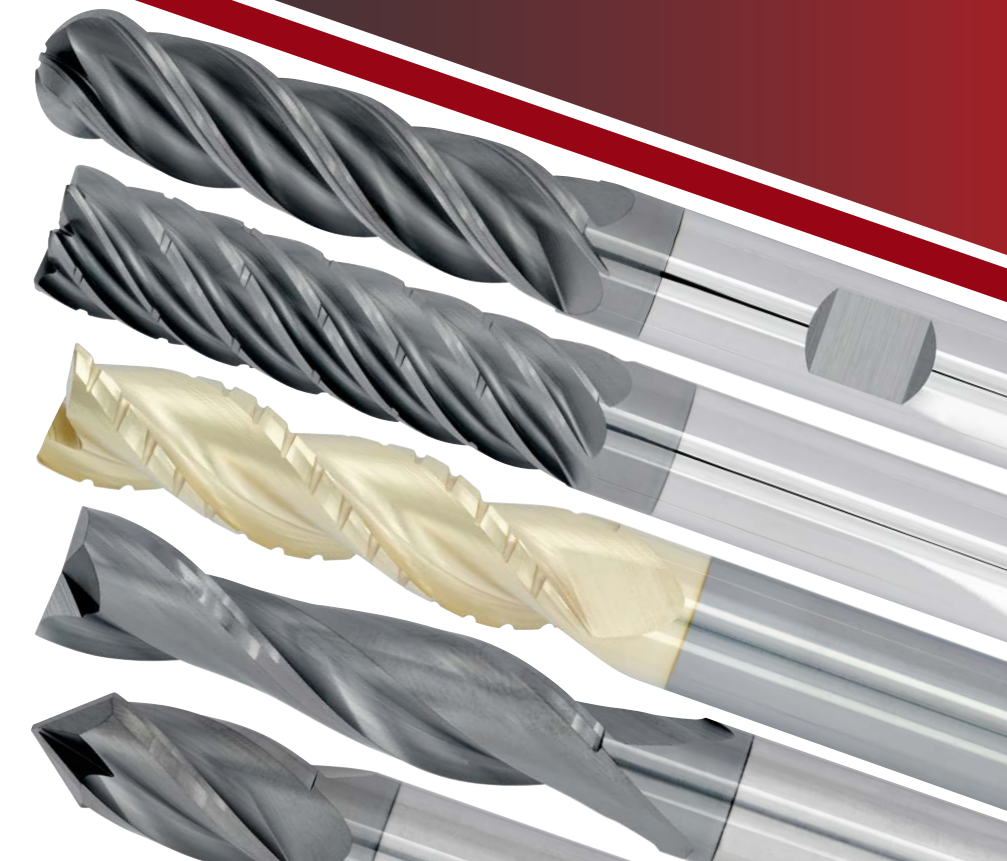
## BEST ULTRA HIGH PERFORMANCE - Aluminum

- Special Helix Design with Cylindrical Margin for improved stability in Aluminum & Non-Ferrous materials
- Variable Pitch to reduce chatter with special core design & chip breaker flute geometry
- Ultra High Performance Micrograin Carbide with special High Polished Finish to prevent built up edge
- Diameter Tolerances: +0.0000"/-0.0004"




























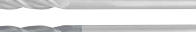















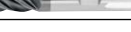

P	●	Steel
M	●	Stainless Steel
K	●	Cast Iron
N	○	Non-Ferrous
S	●	High Temp. Alloys
H	○	Hardened Steel
● BEST		

## COATINGS:

- **TiALN** (Titanium Aluminum Nitride) - Violet Color; Provides the benefits of high abrasion & heat resistance to improve tool life
- **ALL4** (Aluminum Chromium Titanium Nitride) - Grey Color; Ultra High Performance coating with extreme heat, abrasion & wear resistance in ferrous applications
- **ZrN** (Zirconium Nitride) - Pale Gold Color; Provides high lubricity for machining aluminum & non-ferrous materials
- **DLC** (Diamond Like Carbon) - Black Color; Extremely hard with very high wear resistance for finish machining aluminum, non-ferrous & composite materials





















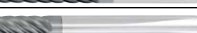













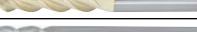











## END MILL SERIES LISTING

Series	Description	Flutes		Pages
001	Standard Carbide, <b>Stub Length</b> , Square, Single End Uncoated	2,3,4		1
003	Standard Carbide, <b>Stub Length</b> , Square, Single End, TiALN coated	2,3,4		1
004	Standard Carbide, <b>Regular Length</b> , Square, Single End Uncoated	2,3,4		1,2
006	Standard Carbide, <b>Regular Length</b> , Square, Single End, TiALN coated	2,3,4		1,2
007	Standard Carbide, <b>Long Length</b> , Square, Single End Uncoated	2,4		3
009	Standard Carbide, <b>Long Length</b> , Square, Single End, TiALN coated	2,4		3
010	Standard Carbide, <b>Extra Long Length</b> , Square, Single End Uncoated	2,4		3
012	Standard Carbide, <b>Extra Long Length</b> , Square, Single End, TiALN coated	2,4		3
013	Standard Carbide, <b>Stub Length</b> , Ball Nose, Single End Uncoated	2,3,4		5
015	Standard Carbide, <b>Stub Length</b> , Ball Nose, Single End, TiALN coated	2,3,4		5
016	Standard Carbide, <b>Regular Length</b> , Ball Nose, Single End Uncoated	2,3,4		5,6
018	Standard Carbide, <b>Regular Length</b> , Ball Nose, Single End, TiALN coated	2,3,4		5,6
019	Standard Carbide, <b>Long Length</b> , Ball Nose, Single End Uncoated	2,4		7
021	Standard Carbide, <b>Long Length</b> , Ball Nose, Single End, TiALN coated	2,4		7
022	Standard Carbide, <b>Extra Long Length</b> , Ball Nose, Single End Uncoated	2,4		7
024	Standard Carbide, <b>Extra Long Length</b> , Ball Nose, Single End, TiALN coated	2,4		7
025	Standard Carbide, <b>Stub Length</b> , Square, Double End Uncoated	2,4		8
027	Standard Carbide, <b>Stub Length</b> , Square, Double End, TiALN coated	2,4		8
028	Standard Carbide, <b>Stub Length</b> , Ball Nose, Double End Uncoated	2,4		9
030	Standard Carbide, <b>Stub Length</b> , Ball Nose, Double End, TiALN coated	2,4		9
031	Standard Carbide, <b>Regular Length</b> , Square, Double End Uncoated	2,4		8
032	Standard Carbide, <b>Regular Length</b> , Square, Double End, TiALN coated	2,4		8
033	Standard Carbide, <b>Regular Length</b> , Ball Nose, Double End Uncoated	2,4		9
034	Standard Carbide, <b>Regular Length</b> , Ball Nose, Double End, TiALN coated	2,4		9
041	<b>METRIC</b> - Standard Carbide, <b>Regular Length</b> , Square, Single End Uncoated	2,3,4		4
042	<b>METRIC</b> - Standard Carbide, <b>Regular Length</b> , Square, Single End, TiALN coated	2,3,4		4
045	<b>METRIC</b> - Standard Carbide, <b>Long Length</b> , Square, Single End Uncoated	2,4		4
046	<b>METRIC</b> - Standard Carbide, <b>Long Length</b> , Square, Single End, TiALN coated	2,4		4
047	<b>METRIC</b> - Standard Carbide, <b>Extra Long Length</b> , Square, Single End Uncoated	2,4		4
048	<b>METRIC</b> - Standard Carbide, <b>Extra Long Length</b> , Square, Single End, TiALN coated	2,4		4
043	<b>METRIC</b> - Standard Carbide, <b>Regular Length</b> , Ball Nose, Single End Uncoated	2,3,4		7
044	<b>METRIC</b> - Standard Carbide, <b>Regular Length</b> , Ball Nose, Single End, TiALN coated	2,3,4		7
104	Drill/Mill 90 Degree - Standard Carbide Uncoated	2,4		3
106	Drill/Mill 90 Degree - Standard Carbide TiALN coated	2,4		3
108	Engraving Tool - Standard Carbide TiALN coated, 30 Degree	1		8
110	Spot Drill - Standard Carbide TiALN coated, 145 Degree Point	2		9
<b>Speeds &amp; Feed Chart - GENERAL PURPOSE</b>				10
190	High Performance Variable Pitch, <b>Stub Length</b> , Round Shk- TiALN	4		11
191	High Performance Variable Pitch, <b>Stub Length</b> , Weldon Shk- TiALN	4		11
090	High Performance Variable Pitch, <b>Regular Length</b> , Round Shk- TiALN <i>NEW</i>	4,5		11
091	High Performance Variable Pitch, <b>Regular Length</b> , Weldon Shk- TiALN	4		11
092	High Performance Variable Pitch, <b>Long Length</b> , Round Shk- TiALN <i>NEW</i>	4,5		12
093	High Performance Variable Pitch, <b>Long Length</b> , Weldon Shk- TiALN	4		12
098	High Performance Variable Pitch, <b>Extra Long Length</b> , Round Shk- TiALN <i>NEW</i>	4,5		12
094	High Performance Variable Pitch, <b>Regular Length</b> , Ball Nose, Round Shk- TiALN	4		13
095	High Performance Variable Pitch, <b>Regular Length</b> , Ball Nose, Weldon Shk- TiALN	4		13

GOOD

BETTER

## END MILL SERIES LISTING

Series	Description	Flutes		Pages
096	High Performance Variable Pitch, <b>Long Length</b> , Ball Nose, Round Shk- TiALN	4		13
097	High Performance Variable Pitch, <b>Long Length</b> , Ball Nose, Weldon Shk- TiALN	4		13
099	High Performance Variable Pitch, <b>Extra Long Length</b> , Ball Nose, Round Shk- TiALN	4		13
290	High Performance Variable Pitch, <b>Long Reach Neck Relief</b> , Round Shk- TiALN	4		14
294	High Performance Variable Pitch, <b>Long Reach Neck Relief</b> , Ball Nose, Round Shk- TiALN	4		14
<b>Speeds &amp; Feed Chart - HIGH PERFORMANCE</b>				15
180	ULTRA High Performance Variable Pitch, <b>Stub Length</b> , Round Shk- TiALN	4		17
181	ULTRA High Performance Variable Pitch, <b>Stub Length</b> , Weldon Shk- TiALN	4		17
080	ULTRA High Performance Variable Pitch, <b>Regular Length</b> , Round Shk- TiALN <i>NEW</i>	4,5		17
081	ULTRA High Performance Variable Pitch, <b>Regular Length</b> , Weldon Shk- TiALN	4		17
082	ULTRA High Performance Variable Pitch, <b>Long Length</b> , Round Shk- TiALN <i>NEW</i>	4,5		18
083	ULTRA High Performance Variable Pitch, <b>Long Length</b> , Weldon Shk- TiALN	4		18
088	ULTRA High Performance Variable Pitch, <b>Extra Long Length</b> , Round Shk- TiALN <i>NEW</i>	4,5		18
084	ULTRA High Performance Variable Pitch, <b>Regular Length</b> , Ball Nose, Round Shk- TiALN	4		19
085	ULTRA High Performance Variable Pitch, <b>Regular Length</b> , Ball Nose, Weldon Shk- TiALN	4		19
086	ULTRA High Performance Variable Pitch, <b>Long Length</b> , Ball Nose, Round Shk- TiALN	4		19
087	ULTRA High Performance Variable Pitch, <b>Long Length</b> , Ball Nose, Weldon Shk- TiALN	4		19
089	ULTRA High Performance Variable Pitch, <b>Extra Long Length</b> , Ball Nose, Round Shk- TiALN	4		19
380	ULTRA High Performance Variable Pitch, <b>Regular Length HEM</b> , Round Shk- ALL4 <i>NEW</i>	5,6,7		21
382	ULTRA High Performance Variable Pitch, <b>Long Length HEM</b> , Round Shk- ALL4 <i>NEW</i>	5,7		22
388	ULTRA High Performance Variable Pitch, <b>Extra Long Length HEM</b> , Round Shk- ALL4 <i>NEW</i>	5,7		22
480	ULTRA High Performance Variable Pitch, <b>Regular Length HEM</b> , Round Shk- ALL4 Chipbreaker <i>NEW</i>	5,7		21
482	ULTRA High Performance Variable Pitch, <b>Long Length HEM</b> , Round Shk- ALL4 Chipbreaker <i>NEW</i>	5,7		22
488	ULTRA High Performance Variable Pitch, <b>Extra Long Length HEM</b> , Round Shk- ALL4 Chipbreaker <i>NEW</i>	5,7		22
<b>Speeds &amp; Feed Chart - ULTRA HIGH PERFORMANCE</b>				20 & 24
170	Medium/Finishing Variable Pitch & Helix, <b>Regular Length</b> , Uncoated - ALUMINUM	2,3		26
070	Medium/Finishing Variable Pitch & Helix, <b>Regular Length</b> , ZrN Coated - ALUMINUM	2,3		26
270	Medium/Finishing Variable Pitch & Helix, <b>Regular Length</b> , DLC Coated - ALUMINUM	2,3		26
172	Medium/Finishing Variable Pitch & Helix, <b>Long Length</b> , Uncoated - ALUMINUM	2,3		26
072	Medium/Finishing Variable Pitch & Helix, <b>Long Length</b> , ZrN Coated - ALUMINUM	2,3		26
178	Medium/Finishing Variable Pitch & Helix, <b>Extra Long Length</b> , Uncoated - ALUMINUM	2,3		26
078	Medium/Finishing Variable Pitch & Helix, <b>Extra Long Length</b> , ZrN Coated - ALUMINUM	2,3		26
174	Medium/Finishing Variable Pitch & Helix, <b>Regular Length</b> , Ball Nose Uncoated - ALUMINUM	2,3		27
074	Medium/Finishing Variable Pitch & Helix, <b>Regular Length</b> , Ball Nose ZrN Coated - ALUMINUM	2,3		27
176	Medium/Finishing Variable Pitch & Helix, <b>Long Length</b> , Ball Nose Uncoated - ALUMINUM	2,3		27
076	Medium/Finishing Variable Pitch & Helix, <b>Long Length</b> , Ball Nose ZrN Coated - ALUMINUM	2,3		27
179	Medium/Finishing Variable Pitch & Helix, <b>Extra Long Length</b> , Ball Nose Uncoated - ALUMINUM	2,3		27
079	Medium/Finishing Variable Pitch & Helix, <b>Extra Long Length</b> , Ball Nose ZrN Coated - ALUMINUM	2,3		27
370	Medium/Roughing Variable Pitch, <b>Regular Length</b> , Uncoated - ALUMINUM	3		25
470	Medium/Roughing Variable Pitch, <b>Regular Length</b> , ZrN Coated - ALUMINUM	3		25
372	Medium/Roughing Variable Pitch, <b>Long Length</b> , Uncoated - ALUMINUM	3		25
472	Medium/Roughing Variable Pitch, <b>Long Length</b> , ZrN Coated - ALUMINUM	3		25
570	Medium/Roughing Variable Pitch, <b>Regular Length</b> , Uncoated Chipbreaker - ALUMINUM	3		25
670	Medium/Roughing Variable Pitch, <b>Regular Length</b> , ZrN Coated Chipbreaker - ALUMINUM	3		25
572	Medium/Roughing Variable Pitch, <b>Long Length</b> , Uncoated Chipbreaker - ALUMINUM	3		25
672	Medium/Roughing Variable Pitch, <b>Long Length</b> , ZrN Coated Chipbreaker - ALUMINUM	3		25
<b>Speeds &amp; Feed Chart - ULTRA HIGH PERFORMANCE - Aluminum</b>				28

BETTER

BEST

BEST-Aluminum

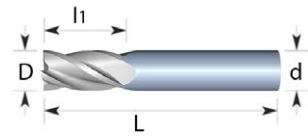


P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
H	Hardened Steel

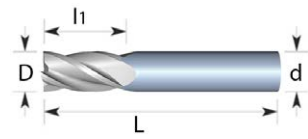
● GOOD ○ OK ○ NOT OPTIMAL

- 30 deg Helix Carbide with honed edges
- 10% Micrograin Carbide
- Diameter (D) Tolerance: +0.0000"/-0.0020"
- Shank (d) Tolerance: +0.0000"/-0.0004"

## GENERAL PURPOSE



Square End, Standard Carbide, Stub Length, Single End									
Cutter Diam. D	Shank Diam. d	Length Of Cut li	O.A.L. L	Uncoated			TiAlN Coated		
				2 Flute Part#	3 Flute Part#	4 Flute Part#	2 Flute Part#	3 Flute Part#	4 Flute Part#
1/32	1/8	1/16	1-1/2	001-031-2	001-031-3	001-031-4	003-031-2	003-031-3	003-031-4
3/64	1/8	3/32	1-1/2	001-046-2	001-046-3	001-046-4	003-046-2	003-046-3	003-046-4
1/16	1/8	1/8	1-1/2	001-062-2	001-062-3	001-062-4	003-062-2	003-062-3	003-062-4
3/32	1/8	3/16	1-1/2	001-093-2	001-093-3	001-093-4	003-093-2	003-093-3	003-093-4
1/8	1/8	1/4	1-1/2	001-125-2	001-125-3	001-125-4	003-125-2	003-125-3	003-125-4
5/32	3/16	5/16	2	001-156-2	001-156-3	001-156-4	003-156-2	003-156-3	003-156-4
3/16	3/16	3/8	2	001-187-2	001-187-3	001-187-4	003-187-2	003-187-3	003-187-4
7/32	1/4	7/16	2	001-218-2	001-218-3	001-218-4	003-218-2	003-218-3	003-218-4
1/4	1/4	1/2	2	001-250-2	001-250-3	001-250-4	003-250-2	003-250-3	003-250-4
5/16	5/16	1/2	2	001-312-2	001-312-3	001-312-4	003-312-2	003-312-3	003-312-4
3/8	3/8	5/8	2	001-375-2	001-375-3	001-375-4	003-375-2	003-375-3	003-375-4
7/16	7/16	5/8	2-1/2	001-437-2	001-437-3	001-437-4	003-437-2	003-437-3	003-437-4
1/2	1/2	5/8	2-1/2	001-500-2	001-500-3	001-500-4	003-500-2	003-500-3	003-500-4
5/8	5/8	3/4	3	001-625-2	001-625-3	001-625-4	003-625-2	003-625-3	003-625-4
3/4	3/4	1	3	001-750-2	001-750-3	001-750-4	003-750-2	003-750-3	003-750-4
1	1	1	3	001-100-2	001-100-3	001-100-4	003-100-2	003-100-3	003-100-4



Square End, Standard Carbide, Regular Length, Single End									
Cutter Diam. D	Shank Diam. d	Length Of Cut li	O.A.L. L	Uncoated			TiAlN Coated		
				2 Flute Part#	3 Flute Part#	4 Flute Part#	2 Flute Part#	3 Flute Part#	4 Flute Part#
1/32	1/8	3/32	1-1/2	004-031-2	004-031-3	004-031-4	006-031-2	006-031-3	006-031-4
3/64	1/8	1/8	1-1/2	004-046-2	004-046-3	004-046-4	006-046-2	006-046-3	006-046-4
1/16	1/8	3/16	1-1/2	004-062-2	004-062-3	004-062-4	006-062-2	006-062-3	006-062-4
5/64	1/8	1/4	1-1/2	004-078-2	004-078-3	004-078-4	006-078-2	006-078-3	006-078-4
3/32	1/8	3/8	1-1/2	004-093-2	004-093-3	004-093-4	006-093-2	006-093-3	006-093-4
7/64	1/8	3/8	1-1/2	004-109-2	004-109-3	004-109-4	006-109-2	006-109-3	006-109-4
1/8	1/8	1/2	1-1/2	004-125-2	004-125-3	004-125-4	006-125-2	006-125-3	006-125-4
9/64	3/16	9/16	2	004-140-2	004-140-3	004-140-4	006-140-2	006-140-3	006-140-4
5/32	3/16	9/16	2	004-156-2	004-156-3	004-156-4	006-156-2	006-156-3	006-156-4
11/64	3/16	9/16	2	004-171-2	004-171-3	004-171-4	006-171-2	006-171-3	006-171-4
3/16	3/16	5/8	2	004-187-2	004-187-3	004-187-4	006-187-2	006-187-3	006-187-4
13/64	1/4	5/8	2-1/2	004-203-2	004-203-3	004-203-4	006-203-2	006-203-3	006-203-4
7/32	1/4	5/8	2-1/2	004-218-2	004-218-3	004-218-4	006-218-2	006-218-3	006-218-4
15/64	1/4	3/4	2-1/2	004-234-2	004-234-3	004-234-4	006-234-2	006-234-3	006-234-4
1/4	1/4	3/4	2-1/2	004-250-2	004-250-3	004-250-4	006-250-2	006-250-3	006-250-4

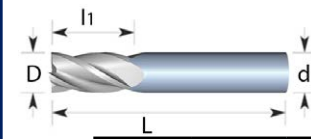


P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
H	Hardened Steel

● GOOD ○ OK ○ NOT OPTIMAL

- 30 deg Helix Carbide with honed edges
- 10% Micrograin Carbide
- Diameter (D) Tolerance: +0.0000"/-0.0020"
- Shank (d) Tolerance: +0.0000"/-0.0004"

## GENERAL PURPOSE



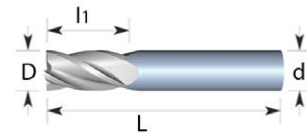
Square End, Standard Carbide, Regular Length, Single End									
Cutter Diam. D	Shank Diam. d	Length Of Cut li	O.A.L. L	Uncoated			TiAlN Coated		
				2 Flute Part#	3 Flute Part#	4 Flute Part#	2 Flute Part#	3 Flute Part#	4 Flute Part#
17/64	5/16	7/8	2-1/2	004-265-2	004-265-3	004-265-4	006-265-2	006-265-3	006-265-4
9/32	5/16	7/8	2-1/2	004-281-2	004-281-3	004-281-4	006-281-2	006-281-3	006-281-4
19/64	5/16	7/8	2-1/2	004-296-2	004-296-3	004-296-4	006-296-2	006-296-3	006-296-4
5/16	5/16	7/8	2-1/2	004-312-2	004-312-3	004-312-4	006-312-2	006-312-3	006-312-4
21/64	3/8	7/8	2-1/2	004-328-2	004-328-3	004-328-4	006-328-2	006-328-3	006-328-4
11/32	3/8	7/8	2-1/2	004-343-2	004-343-3	004-343-4	006-343-2	006-343-3	006-343-4
23/64	3/8	7/8	2-1/2	004-359-2	004-359-3	004-359-4	006-359-2	006-359-3	006-359-4
3/8	3/8	1	2-1/2	004-375-2	004-375-3	004-375-4	006-375-2	006-375-3	006-375-4
25/64	7/16	1	2-1/2	004-390-2	004-390-3	004-390-4	006-390-2	006-390-3	006-390-4
13/32	7/16	1	2-1/2	004-406-2	004-406-3	004-406-4	006-406-2	006-406-3	006-406-4
27/64	7/16	1	2-1/2	004-421-2	004-421-3	004-421-4	006-421-2	006-421-3	006-421-4
7/16	7/16	1	2-1/2	004-437-2	004-437-3	004-437-4	006-437-2	006-437-3	006-437-4
29/64	1/2	1	3	004-453-2	004-453-3	004-453-4	006-453-2	006-453-3	006-453-4
15/32	1/2	1	3	004-468-2	004-468-3	004-468-4	006-468-2	006-468-3	006-468-4
31/64	1/2	1	3	004-484-2	004-484-3	004-484-4	006-484-2	006-484-3	006-484-4
1/2	1/2	1	3	004-500-2	004-500-3	004-500-4	006-500-2	006-500-3	006-500-4
1/2	1/2	1-1/4	3			004-500-4-L			006-500-4-L
33/64	9/16	1-1/4	3-1/2	004-515-2	004-515-3	004-515-4	006-515-2	006-515-3	006-515-4
17/32	9/16	1-1/4	3-1/2	004-531-2	004-531-3	004-531-4	006-531-2	006-531-3	006-531-4
35/64	9/16	1-1/4	3-1/2	004-546-2	004-546-3	004-546-4	006-546-2	006-546-3	006-546-4
9/16	9/16	1-1/4	3-1/2	004-562-2	004-562-3	004-562-4	006-562-2	006-562-3	006-562-4
37/64	5/8	1-1/4	3-1/2	004-578-2	004-578-3	004-578-4	006-578-2	006-578-3	006-578-4
19/32	5/8	1-1/4	3-1/2	004-593-2	004-593-3	004-593-4	006-593-2	006-593-3	006-593-4
39/64	5/8	1-1/4	3-1/2	004-609-2	004-609-3	004-609-4	006-609-2	006-609-3	006-609-4
5/8	5/8	1-1/4	3-1/2	004-625-2	004-625-3	004-625-4	006-625-2	006-625-3	006-625-4
41/64	3/4	1-1/2	4	004-640-2	004-640-3	004-640-4	006-640-2	006-640-3	006-640-4
21/32	3/4	1-1/2	4	004-656-2	004-656-3	004-656-4	006-656-2	006-656-3	006-656-4
43/64	3/4	1-1/2	4	004-671-2	004-671-3	004-671-4	006-671-2	006-671-3	006-671-4
11/16	3/4	1-1/2	4	004-687-2	004-687-3	004-687-4	006-687-2	006-687-3	006-687-4
45/64	3/4	1-1/2	4	004-703-2	004-703-3	004-703-4	006-703-2	006-703-3	006-703-4
23/32	3/4	1-1/2	4	004-718-2	004-718-3	004-718-4	006-718-2	006-718-3	006-718-4
47/64	3/4	1-1/2	4	004-734-2	004-734-3	004-734-4	006-734-2	006-734-3	006-734-4
3/4	3/4	1-1/2	4	004-750-2	004-750-3	004-750-4	006-750-2	006-750-3	006-750-4
49/64	7/8	1-1/2	4	004-765-2	004-765-3	004-765-4	006-765-2	006-765-3	006-765-4
25/32	7/8	1-1/2	4	004-781-2	004-781-3	004-781-4	006-781-2	006-781-3	006-781-4
51/64	7/8	1-1/2	4	004-796-2	004-796-3	004-796-4	006-796-2	006-796-3	006-796-4
13/16	7/8	1-1/2	4	004-812-2	004-812-3	004-812-4	006-812-2	006-812-3	006-812-4
53/64	7/8	1-1/2	4	004-828-2	004-828-3	004-828-4	006-828-2	006-828-3	006-828-4
27/32	7/8	1-1/2	4	004-843-2	004-843-3	004-843-4	006-843-2	006-843-3	006-843-4
55/64	7/8	1-1/2	4	004-859-2	004-859-3	004-859-4	006-859-2	006-859-3	006-859-4
7/8	7/8	1-1/2	4	004-875-2	004-875-3	004-875-4	006-875-2	006-875-3	006-875-4
57/64	1	1-1/2	4	004-890-2	004-890-3	004-890-4	006-890-2	006-890-3	006-890-4
29/32	1	1-1/2	4	004-906-2	004-906-3	004-906-4	006-906-2	006-906-3	006-906-4
59/64	1	1-1/2	4	004-921-2	004-921-3	004-921-4	006-921-2	006-921-3	006-921-4
15/16	1	1-1/2	4	004-937-2	004-937-3	004-937-4	006-937-2	006-937-3	006-937-4
61/64	1	1-1/2	4	004-953-2	004-953-3	004-953-4	006-953-2	006-953-3	006-953-4
31/32	1	1-1/2	4	004-968-2	004-968-3	004-968-4	006-968-2	006-968-3	006-968-4
63/64	1	1-1/2	4	004-984-2	004-984-3	004-984-4	006-984-2	006-984-3	006-984-4
1	1	1-1/2	4	004-100-2	004-100-3	004-100-4	006-100-2	006-100-3	006-100-4



P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
H	Hardened Steel

- 30 deg Helix Carbide with honed edges
- 10% Micrograin Carbide
- Diameter (D) Tolerance: +0.0000"/-0.0020"
- Shank (d) Tolerance: +0.0000"/-0.0004"

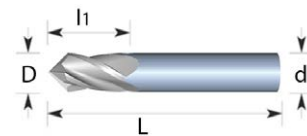
### GENERAL PURPOSE



Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Uncoated			TiAlN Coated		
				2 Flute	3 Flute	4 Flute	2 Flute	3 Flute	4 Flute
				Part#	Part#	Part#	Part#	Part#	Part#
1/8	1/8	3/4	2-1/2	007-125-2	--	007-125-4	009-125-2	--	009-125-4
3/16	3/16	3/4	2-1/2	007-187-2	--	007-187-4	009-187-2	--	009-187-4
1/4	1/4	1-1/8	3	007-250-2	--	007-250-4	009-250-2	--	009-250-4
5/16	5/16	1-1/8	3	007-312-2	--	007-312-4	009-312-2	--	009-312-4
3/8	3/8	1-1/8	3	007-375-2	--	007-375-4	009-375-2	--	009-375-4
7/16	7/16	2	4	007-437-2	--	007-437-4	009-437-2	--	009-437-4
1/2	1/2	2	4	007-500-2	--	007-500-4	009-500-2	--	009-500-4
5/8	5/8	2-1/4	5	007-625-2	--	007-625-4	009-625-2	--	009-625-4
3/4	3/4	2-1/4	5	007-750-2	--	007-750-4	009-750-2	--	009-750-4
1	1	2-1/4	5	007-100-2	--	007-100-4	009-100-2	--	009-100-4



Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Uncoated			TiAlN Coated		
				2 Flute	3 Flute	4 Flute	2 Flute	3 Flute	4 Flute
				Part#	Part#	Part#	Part#	Part#	Part#
1/8	1/8	1	3	010-125-2	--	010-125-4	012-125-2	--	012-125-4
3/16	3/16	1-1/8	3	010-187-2	--	010-187-4	012-187-2	--	012-187-4
1/4	1/4	1-1/2	4	010-250-2	--	010-250-4	012-250-2	--	012-250-4
5/16	5/16	1-5/8	4	010-312-2	--	010-312-4	012-312-2	--	012-312-4
3/8	3/8	1-3/4	4	010-375-2	--	010-375-4	012-375-2	--	012-375-4
1/2	1/2	3	6	010-500-2	--	010-500-4	012-500-2	--	012-500-4
5/8	5/8	3	6	010-625-2	--	010-625-4	012-625-2	--	012-625-4
3/4	3/4	3	6	010-750-2	--	010-750-4	012-750-2	--	012-750-4
1	1	3	6	010-100-2	--	010-100-4	012-100-2	--	012-100-4



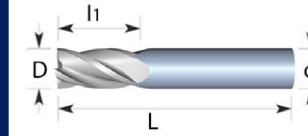
Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Uncoated			TiAlN Coated		
				2 Flute	3 Flute	4 Flute	2 Flute	3 Flute	4 Flute
				Part#	Part#	Part#	Part#	Part#	Part#
1/8	1/8	1/2	1-1/2	104-125-2	--	104-125-4	106-125-2	--	106-125-4
3/16	3/16	5/8	2	104-187-2	--	104-187-4	106-187-2	--	106-187-4
1/4	1/4	3/4	2-1/2	104-250-2	--	104-250-4	106-250-2	--	106-250-4
5/16	5/16	7/8	2-1/2	104-312-2	--	104-312-4	106-312-2	--	106-312-4
3/8	3/8	1	2-1/2	104-375-2	--	104-375-4	106-375-2	--	106-375-4
7/16	7/16	1	2-3/4	104-437-2	--	104-437-4	106-437-2	--	106-437-4
1/2	1/2	1	3	104-500-2	--	104-500-4	106-500-2	--	106-500-4
5/8	5/8	1-1/4	3-1/2	104-625-2	--	104-625-4	106-625-2	--	106-625-4
3/4	3/4	1-1/2	4	104-750-2	--	104-750-4	106-750-2	--	106-750-4



P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
H	Hardened Steel

- 30 deg Helix Carbide with honed edges
- 10% Micrograin Carbide
- Diameter (D) Tolerance: +0.0000"/-0.0020"
- Shank (d) Tolerance: +0.0000"/-0.0004"

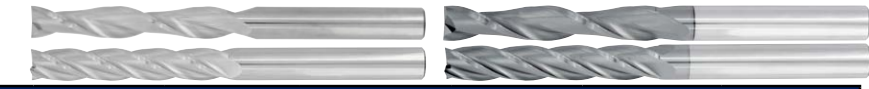
### GENERAL PURPOSE



Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Uncoated			TiAlN Coated		
				2 Flute	3 Flute	4 Flute	2 Flute	3 Flute	4 Flute
				Part#	Part#	Part#	Part#	Part#	Part#
1	1	3	38	041-010-2	041-010-3	041-010-4	042-010-2	042-010-3	042-010-4
1.5	2	5	38	041-015-2	041-015-3	041-015-4	042-015-2	042-015-3	042-015-4
2	2	6	38	041-020-2	041-020-3	041-020-4	042-020-2	042-020-3	042-020-4
3	3	12	38	041-030-2	041-030-3	041-030-4	042-030-2	042-030-3	042-030-4
3.5	4	12	50	041-035-2	041-035-3	041-035-4	042-035-2	042-035-3	042-035-4
4	4	14	50	041-040-2	041-040-3	041-040-4	042-040-2	042-040-3	042-040-4
4.5	5	14	50	041-045-2	041-045-3	041-045-4	042-045-2	042-045-3	042-045-4
5	5	16	50	041-050-2	041-050-3	041-050-4	042-050-2	042-050-3	042-050-4
6	6	19	63	041-060-2	041-060-3	041-060-4	042-060-2	042-060-3	042-060-4
7	8	19	63	041-070-2	041-070-3	041-070-4	042-070-2	042-070-3	042-070-4
8	8	19	63	041-080-2	041-080-3	041-080-4	042-080-2	042-080-3	042-080-4
9	10	22	70	041-090-2	041-090-3	041-090-4	042-090-2	042-090-3	042-090-4
10	10	22	70	041-100-2	041-100-3	041-100-4	042-100-2	042-100-3	042-100-4
11	12	25	70	041-110-2	041-110-3	041-110-4	042-110-2	042-110-3	042-110-4
12	12	25	75	041-120-2	041-120-3	041-120-4	042-120-2	042-120-3	042-120-4
14	14	30	88	041-140-2	041-140-3	041-140-4	042-140-2	042-140-3	042-140-4
16	16	32	88	041-160-2	041-160-3	041-160-4	042-160-2	042-160-3	042-160-4
18	18	36	100	041-180-2	041-180-3	041-180-4	042-180-2	042-180-3	042-180-4
20	20	38	100	041-200-2	041-200-3	041-200-4	042-200-2	042-200-3	042-200-4
22	25	38	100	041-220-2	041-220-3	041-220-4	042-220-2	042-220-3	042-220-4
25	25	38	100	041-250-2	041-250-3	041-250-4	042-250-2	042-250-3	042-250-4



Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Uncoated			TiAlN Coated		
				2 Flute	3 Flute	4 Flute	2 Flute	3 Flute	4 Flute
				Part#	Part#	Part#	Part#	Part#	Part#
3	3	25	75	045-030-2	--	045-030-4	046-030-2	--	046-030-4
4	4	25	75	045-040-2	--	045-040-4	046-040-2	--	046-040-4
5	5	25	75	045-050-2	--	045-050-4	046-050-2	--	046-050-4
6	6	25	75	045-060-2	--	045-060-4	046-060-2	--	046-060-4
8	8	30	100	045-080-2	--	045-080-4	046-080-2	--	046-080-4
10	10	38	100	045-100-2	--	045-100-4	046-100-2	--	046-100-4
12	12	50	100	045-120-2	--	045-120-4	046-120-2	--	046-120-4
14	14	50	125	045-140-2	--	045-140-4	046-140-2	--	046-140-4
16	16	75	150	045-160-2	--	045-160-4	046-160-2	--	046-160-4
18	18	75	150	045-180-2	--	045-180-4	046-180-2	--	046-180-4
20	20	75	150	045-200-2	--	045-200-4	046-200-2	--	046-200-4
25	25	75	150	045-250-2	--	045-250-4	046-250-2	--	046-250-4



Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Uncoated			TiAlN Coated		
				2 Flute	3 Flute	4 Flute	2 Flute	3 Flute	4 Flute
				Part#	Part#	Part#	Part#	Part#	Part#
3	3	25	100	047-030-2	--	047-030-4	048-030-2	--	048-030-4
4	4	50	100	047-040-2	--	047-040-4	048-040-2	--	048-040-4
5	5	30	100	047-050-2	--	047-050-4	048-050-2	--	048-050-4
6	6	50	100	047-060-2	--	047-060-4	048-060-2	--	048-060-4
8	8	50	150	047-080-2	--	047-080-4	048-080-2	--	048-080-4
10	10	75	150	047-100-2	--	047-100-4	048-100-2	--	048-100-4
12	12	75	150	047-120-2	--	047-120-4	048-120-2	--	048-120-4
14	14	75	150	047-140-2	--	047-140-4	048-140-2	--	048-140-4

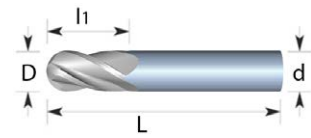


P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
H	Hardened Steel

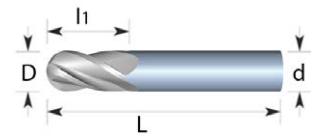
● GOOD ○ OK ○ NOT OPTIMAL

- 30 deg Helix Carbide with honed edges
- 10% Micrograin Carbide
- Diameter (D) Tolerance: +0.0000"/-0.0020"
- Shank (d) Tolerance: +0.0000"/-0.0004"

### GENERAL PURPOSE



Ball Nose, Standard Carbide, Stub Length, Single End									
Cutter Diam.	Shank Diam.	Length Of Cut	O.A.L.	Uncoated			TiAlN Coated		
				2 Flute	3 Flute	4 Flute	2 Flute	3 Flute	4 Flute
D	d	l <sub>1</sub>	L	Part#	Part#	Part#	Part#	Part#	Part#
1/32	1/8	1/16	1-1/2	013-031-2	013-031-3	013-031-4	015-031-2	015-031-3	015-031-4
3/64	1/8	3/32	1-1/2	013-046-2	013-046-3	013-046-4	015-046-2	015-046-3	015-046-4
1/16	1/8	1/8	1-1/2	013-062-2	013-062-3	013-062-4	015-062-2	015-062-3	015-062-4
3/32	1/8	3/16	1-1/2	013-093-2	013-093-3	013-093-4	015-093-2	015-093-3	015-093-4
1/8	1/8	1/4	1-1/2	013-125-2	013-125-3	013-125-4	015-125-2	015-125-3	015-125-4
5/32	3/16	5/16	2	013-156-2	013-156-3	013-156-4	015-156-2	015-156-3	015-156-4
3/16	3/16	3/8	2	013-187-2	013-187-3	013-187-4	015-187-2	015-187-3	015-187-4
7/32	1/4	7/16	2	013-218-2	013-218-3	013-218-4	015-218-2	015-218-3	015-218-4
1/4	1/4	1/2	2	013-250-2	013-250-3	013-250-4	015-250-2	015-250-3	015-250-4
5/16	5/16	1/2	2	013-312-2	013-312-3	013-312-4	015-312-2	015-312-3	015-312-4
3/8	3/8	5/8	2	013-375-2	013-375-3	013-375-4	015-375-2	015-375-3	015-375-4
7/16	7/16	5/8	2-1/2	013-437-2	013-437-3	013-437-4	015-437-2	015-437-3	015-437-4
1/2	1/2	5/8	2-1/2	013-500-2	013-500-3	013-500-4	015-500-2	015-500-3	015-500-4
5/8	5/8	3/4	3	013-625-2	013-625-3	013-625-4	015-625-2	015-625-3	015-625-4
3/4	3/4	1	3	013-750-2	013-750-3	013-750-4	015-750-2	015-750-3	015-750-4
1	1	1	3	013-100-2	013-100-3	013-100-4	015-100-2	015-100-3	015-100-4



Ball Nose, Standard Carbide, Regular Length, Single End									
Cutter Diam.	Shank Diam.	Length Of Cut	O.A.L.	Uncoated			TiAlN Coated		
				2 Flute	3 Flute	4 Flute	2 Flute	3 Flute	4 Flute
D	d	l <sub>1</sub>	L	Part#	Part#	Part#	Part#	Part#	Part#
1/32	1/8	3/32	1-1/2	016-031-2	016-031-3	016-031-4	018-031-2	018-031-3	018-031-4
3/64	1/8	1/8	1-1/2	016-046-2	016-046-3	016-046-4	018-046-2	018-046-3	018-046-4
1/16	1/8	3/16	1-1/2	016-062-2	016-062-3	016-062-4	018-062-2	018-062-3	018-062-4
5/64	1/8	1/4	1-1/2	016-078-2	016-078-3	016-078-4	018-078-2	018-078-3	018-078-4
3/32	1/8	3/8	1-1/2	016-093-2	016-093-3	016-093-4	018-093-2	018-093-3	018-093-4
7/64	1/8	3/8	1-1/2	016-109-2	016-109-3	016-109-4	018-109-2	018-109-3	018-109-4
1/8	1/8	1/2	1-1/2	016-125-2	016-125-3	016-125-4	018-125-2	018-125-3	018-125-4
9/64	3/16	9/16	2	016-140-2	016-140-3	016-140-4	018-140-2	018-140-3	018-140-4
5/32	3/16	9/16	2	016-156-2	016-156-3	016-156-4	018-156-2	018-156-3	018-156-4
11/64	3/16	9/16	2	016-171-2	016-171-3	016-171-4	018-171-2	018-171-3	018-171-4
3/16	3/16	5/8	2	016-187-2	016-187-3	016-187-4	018-187-2	018-187-3	018-187-4
13/64	1/4	5/8	2-1/2	016-203-2	016-203-3	016-203-4	018-203-2	018-203-3	018-203-4
7/32	1/4	5/8	2-1/2	016-218-2	016-218-3	016-218-4	018-218-2	018-218-3	018-218-4
15/64	1/4	3/4	2-1/2	016-234-2	016-234-3	016-234-4	018-234-2	018-234-3	018-234-4
1/4	1/4	3/4	2-1/2	016-250-2	016-250-3	016-250-4	018-250-2	018-250-3	018-250-4

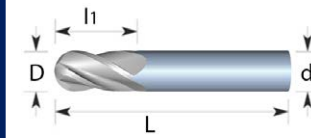


P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
H	Hardened Steel

● GOOD ○ OK ○ NOT OPTIMAL

- 30 deg Helix Carbide with honed edges
- 10% Micrograin Carbide
- Diameter (D) Tolerance: +0.0000"/-0.0020"
- Shank (d) Tolerance: +0.0000"/-0.0004"

### GENERAL PURPOSE



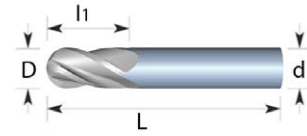
Ball Nose, Standard Carbide, Regular Length, Single End									
Cutter Diam.	Shank Diam.	Length Of Cut	O.A.L.	Uncoated			TiAlN Coated		
				2 Flute	3 Flute	4 Flute	2 Flute	3 Flute	4 Flute
D	d	l <sub>1</sub>	L	Part#	Part#	Part#	Part#	Part#	Part#
17/64	5/16	7/8	2-1/2	016-265-2	016-265-3	016-265-4	018-265-2	018-265-3	018-265-4
9/32	5/16	7/8	2-1/2	016-281-2	016-281-3	016-281-4	018-281-2	018-281-3	018-281-4
19/64	5/16	7/8	2-1/2	016-296-2	016-296-3	016-296-4	018-296-2	018-296-3	018-296-4
5/16	5/16	7/8	2-1/2	016-312-2	016-312-3	016-312-4	018-312-2	018-312-3	018-312-4
21/64	3/8	7/8	2-1/2	016-328-2	016-328-3	016-328-4	018-328-2	018-328-3	018-328-4
11/32	3/8	7/8	2-1/2	016-343-2	016-343-3	016-343-4	018-343-2	018-343-3	018-343-4
23/64	3/8	7/8	2-1/2	016-359-2	016-359-3	016-359-4	018-359-2	018-359-3	018-359-4
3/8	3/8	1	2-1/2	016-375-2	016-375-3	016-375-4	018-375-2	018-375-3	018-375-4
25/64	7/16	1	2-1/2	016-390-2	016-390-3	016-390-4	018-390-2	018-390-3	018-390-4
13/32	7/16	1	2-1/2	016-406-2	016-406-3	016-406-4	018-406-2	018-406-3	018-406-4
27/64	7/16	1	2-1/2	016-421-2	016-421-3	016-421-4	018-421-2	018-421-3	018-421-4
7/16	7/16	1	2-1/2	016-437-2	016-437-3	016-437-4	018-437-2	018-437-3	018-437-4
29/64	1/2	1	3	016-453-2	016-453-3	016-453-4	018-453-2	018-453-3	018-453-4
15/32	1/2	1	3	016-468-2	016-468-3	016-468-4	018-468-2	018-468-3	018-468-4
31/64	1/2	1	3	016-484-2	016-484-3	016-484-4	018-484-2	018-484-3	018-484-4
1/2	1/2	1	3	016-500-2	016-500-3	016-500-4	018-500-2	018-500-3	018-500-4
33/64	9/16	1-1/4	3-1/2	016-515-2	016-515-3	016-515-4	018-515-2	018-515-3	018-515-4
17/32	9/16	1-1/4	3-1/2	016-531-2	016-531-3	016-531-4	018-531-2	018-531-3	018-531-4
35/64	9/16	1-1/4	3-1/2	016-546-2	016-546-3	016-546-4	018-546-2	018-546-3	018-546-4
9/16	9/16	1-1/4	3-1/2	016-562-2	016-562-3	016-562-4	018-562-2	018-562-3	018-562-4
37/64	5/8	1-1/4	3-1/2	016-578-2	016-578-3	016-578-4	018-578-2	018-578-3	018-578-4
19/32	5/8	1-1/4	3-1/2	016-593-2	016-593-3	016-593-4	018-593-2	018-593-3	018-593-4
39/64	5/8	1-1/4	3-1/2	016-609-2	016-609-3	016-609-4	018-609-2	018-609-3	018-609-4
5/8	5/8	1-1/4	3-1/2	016-625-2	016-625-3	016-625-4	018-625-2	018-625-3	018-625-4
41/64	3/4	1-1/2	4	016-640-2	016-640-3	016-640-4	018-640-2	018-640-3	018-640-4
21/32	3/4	1-1/2	4	016-656-2	016-656-3	016-656-4	018-656-2	018-656-3	018-656-4
43/64	3/4	1-1/2	4	016-671-2	016-671-3	016-671-4	018-671-2	018-671-3	018-671-4
11/16	3/4	1-1/2	4	016-687-2	016-687-3	016-687-4	018-687-2	018-687-3	018-687-4
45/64	3/4	1-1/2	4	016-703-2	016-703-3	016-703-4	018-703-2	018-703-3	018-703-4
23/32	3/4	1-1/2	4	016-718-2	016-718-3	016-718-4	018-718-2	018-718-3	018-718-4
47/64	3/4	1-1/2	4	016-734-2	016-734-3	016-734-4	018-734-2	018-734-3	018-734-4
3/4	3/4	1-1/2	4	016-750-2	016-750-3	016-750-4	018-750-2	018-750-3	018-750-4
49/64	7/8	1-1/2	4	016-765-2	016-765-3	016-765-4	018-765-2	018-765-3	018-765-4
25/32	7/8	1-1/2	4	016-781-2	016-781-3	016-781-4	018-781-2	018-781-3	018-781-4
51/64	7/8	1-1/2	4	016-796-2	016-796-3	016-796-4	018-796-2	018-796-3	018-796-4
13/16	7/8	1-1/2	4	016-812-2	016-812-3	016-812-4	018-812-2	018-812-3	018-812-4
53/64	7/8	1-1/2	4	016-828-2	016-828-3	016-828-4	018-828-2	018-828-3	018-828-4
27/32	7/8	1-1/2	4	016-843-2	016-843-3	016-843-4	018-843-2	018-843-3	018-843-4
55/64	7/8	1-1/2	4	016-859-2	016-859-3	016-859-4	018-859-2	018-859-3	018-859-4
7/8	7/8	1-1/2	4	016-875-2	016-875-3	016-875-4	018-875-2	018-875-3	018-875-4
57/64	1	1-1/2	4	016-890-2	016-890-3	016-890-4	018-890-2	018-890-3	018-890-4
29/32	1	1-1/2	4	016-906-2	016-906-3	016-906-4	018-906-2	018-906-3	018-906-4
59/64	1	1-1/2	4	016-921-2	016-921-3	016-921-4	018-921-2	018-921-3	018-921-4
15/16	1	1-1/2	4	016-937-2	016-937-3	016-937-4	018-937-2	018-937-3	018-937-4
61/64	1	1-1/2	4	016-953-2	016-953-3	016-953-4	018-953-2	018-953-3	018-953-4
31/32	1	1-1/2	4	016-968-2	016-968-3	016-968-4	018-968-2	018-968-3	018-968-4
63/64	1	1-1/2	4	016-984-2	016-984-3	016-984-4	018-984-2	018-984-3	018-984-4
1	1	1-1/2	4	016-100-2	016-100-3	016-100-4	018-100-2	018-100-3	018-100-4



P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
H	Hardened Steel

- 30 deg Helix Carbide with honed edges
- 10% Micrograin Carbide
- Diameter (D) Tolerance: +0.0000"/-0.0020"
- Shank (d) Tolerance: +0.0000"/-0.0004"

### GENERAL PURPOSE



Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Uncoated			TiAlN Coated		
				2 Flute	3 Flute	4 Flute	2 Flute	3 Flute	4 Flute
				Part#	Part#	Part#	Part#	Part#	Part#
1/8	1/8	3/4	2-1/2	019-125-2	--	019-125-4	021-125-2	--	021-125-4
3/16	3/16	3/4	2-1/2	019-187-2	--	019-187-4	021-187-2	--	021-187-4
1/4	1/4	1-1/8	3	019-250-2	--	019-250-4	021-250-2	--	021-250-4
5/16	5/16	1-1/8	3	019-312-2	--	019-312-4	021-312-2	--	021-312-4
3/8	3/8	1-1/8	3	019-375-2	--	019-375-4	021-375-2	--	021-375-4
7/16	7/16	2	4	019-437-2	--	019-437-4	021-437-2	--	021-437-4
1/2	1/2	2	4	019-500-2	--	019-500-4	021-500-2	--	021-500-4
5/8	5/8	2-1/4	5	019-625-2	--	019-625-4	021-625-2	--	021-625-4
3/4	3/4	2-1/4	5	019-750-2	--	019-750-4	021-750-2	--	021-750-4
1	1	2-1/4	5	019-100-2	--	019-100-4	021-100-2	--	021-100-4



Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Uncoated			TiAlN Coated		
				2 Flute	3 Flute	4 Flute	2 Flute	3 Flute	4 Flute
				Part#	Part#	Part#	Part#	Part#	Part#
1/8	1/8	1	3	022-125-2	--	022-125-4	024-125-2	--	024-125-4
3/16	3/16	1-1/8	3	022-187-2	--	022-187-4	024-187-2	--	024-187-4
1/4	1/4	1-1/2	4	022-250-2	--	022-250-4	024-250-2	--	024-250-4
5/16	5/16	1-5/8	4	022-312-2	--	022-312-4	024-312-2	--	024-312-4
3/8	3/8	1-3/4	4	022-375-2	--	022-375-4	024-375-2	--	024-375-4
1/2	1/2	3	6	022-500-2	--	022-500-4	024-500-2	--	024-500-4
5/8	5/8	3	6	022-625-2	--	022-625-4	024-625-2	--	024-625-4
3/4	3/4	3	6	022-750-2	--	022-750-4	024-750-2	--	024-750-4
1	1	3	6	022-100-2	--	022-100-4	024-100-2	--	024-100-4



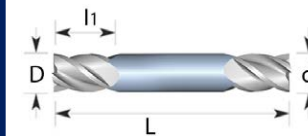
Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Uncoated			TiAlN Coated		
				2 Flute	3 Flute	4 Flute	2 Flute	3 Flute	4 Flute
				Part#	Part#	Part#	Part#	Part#	Part#
1	1	3	38	043-010-2	043-010-3	043-010-4	044-010-2	044-010-3	044-010-4
1.5	2	5	38	043-015-2	043-015-3	043-015-4	044-015-2	044-015-3	044-015-4
2	2	6	38	043-020-2	043-020-3	043-020-4	044-020-2	044-020-3	044-020-4
3	3	12	38	043-030-2	043-030-3	043-030-4	044-030-2	044-030-3	044-030-4
3.5	4	12	50	043-035-2	043-035-3	043-035-4	044-035-2	044-035-3	044-035-4
4	4	14	50	043-040-2	043-040-3	043-040-4	044-040-2	044-040-3	044-040-4
4.5	5	14	50	043-045-2	043-045-3	043-045-4	044-045-2	044-045-3	044-045-4
5	5	16	50	043-050-2	043-050-3	043-050-4	044-050-2	044-050-3	044-050-4
6	6	19	63	043-060-2	043-060-3	043-060-4	044-060-2	044-060-3	044-060-4
7	8	19	63	043-070-2	043-070-3	043-070-4	044-070-2	044-070-3	044-070-4
8	8	19	63	043-080-2	043-080-3	043-080-4	044-080-2	044-080-3	044-080-4
9	10	22	70	043-090-2	043-090-3	043-090-4	044-090-2	044-090-3	044-090-4
10	10	22	70	043-100-2	043-100-3	043-100-4	044-100-2	044-100-3	044-100-4
11	12	25	70	043-110-2	043-110-3	043-110-4	044-110-2	044-110-3	044-110-4
12	12	25	75	043-120-2	043-120-3	043-120-4	044-120-2	044-120-3	044-120-4
14	14	30	88	043-140-2	043-140-3	043-140-4	044-140-2	044-140-3	044-140-4
16	16	32	88	043-160-2	043-160-3	043-160-4	044-160-2	044-160-3	044-160-4
18	18	36	100	043-180-2	043-180-3	043-180-4	044-180-2	044-180-3	044-180-4
20	20	38	100	043-200-2	043-200-3	043-200-4	044-200-2	044-200-3	044-200-4
22	25	38	100	043-220-2	043-220-3	043-220-4	044-220-2	044-220-3	044-220-4
25	25	38	100	043-250-2	043-250-3	043-250-4	044-250-2	044-250-3	044-250-4



P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
H	Hardened Steel

- 30 deg Helix Carbide with honed edges
- 10% Micrograin Carbide
- Diameter (D) Tolerance: +0.0000"/-0.0020"
- Shank (d) Tolerance: +0.0000"/-0.0004"

### GENERAL PURPOSE

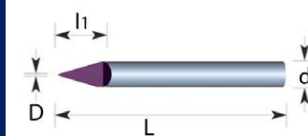


Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Uncoated			TiAlN Coated		
				2 Flute	3 Flute	4 Flute	2 Flute	3 Flute	4 Flute
				Part#	Part#	Part#	Part#	Part#	Part#
1/32	1/8*	1/16	1-1/2	025-031-2	--	025-031-4	027-031-2	--	027-031-4
3/64	1/8*	3/32	1-1/2	025-046-2	--	025-046-4	027-046-2	--	027-046-4
1/16	1/8*	1/8	1-1/2	025-062-2	--	025-062-4	027-062-2	--	027-062-4
3/32	1/8*	3/16	1-1/2	025-093-2	--	025-093-4	027-093-2	--	027-093-4
7/64	1/8*	7/32	1-1/2	025-109-2	--	025-109-4	027-109-2	--	027-109-4
1/8	1/8*	1/4	1-1/2	025-125-2	--	025-125-4	027-125-2	--	027-125-4
5/32	3/16*	5/16	2	025-156-2	--	025-156-4	027-156-2	--	027-156-4
3/16	3/16*	5/16	2	025-187-2	--	025-187-4	027-187-2	--	027-187-4
7/32	1/4	3/8	2-1/2	025-218-2	--	025-218-4	027-218-2	--	027-218-4
1/4	1/4	1/2	2-1/2	025-250-2	--	025-250-4	027-250-2	--	027-250-4
9/32	5/16	1/2	2-1/2	025-281-2	--	025-281-4	027-281-2	--	027-281-4
5/16	5/16	1/2	2-1/2	025-312-2	--	025-312-4	027-312-2	--	027-312-4
3/8	3/8	9/16	2-1/2	025-375-2	--	025-375-4	027-375-2	--	027-375-4
7/16	1/2	9/16	2-3/4	025-437-2	--	025-437-4	027-437-2	--	027-437-4
1/2	1/2	5/8	3	025-500-2	--	025-500-4	027-500-2	--	027-500-4
9/16	5/8	11/16	3-1/2	025-562-2	--	025-562-4	027-562-2	--	027-562-4
5/8	5/8	11/16	3-1/2	025-625-2	--	025-625-4	027-625-2	--	027-625-4
3/4	3/4	7/8	4	025-750-2	--	025-750-4	027-750-2	--	027-750-4



Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Uncoated			TiAlN Coated		
				2 Flute	3 Flute	4 Flute	2 Flute	3 Flute	4 Flute
				Part#	Part#	Part#	Part#	Part#	Part#
5/32	3/16*	7/16	3	031-156-2	--	031-156-4	032-156-2	--	032-156-4
3/16	3/16*	1/2	3	031-187-2	--	031-187-4	032-187-2	--	032-187-4
7/32	1/4	9/16	4	031-218-2	--	031-218-4	032-218-2	--	032-218-4
1/4	1/4	5/8	4	031-250-2	--	031-250-4	032-250-2	--	032-250-4
5/16	5/16	3/4	4	031-312-2	--	031-312-4	032-312-2	--	032-312-4
3/8	3/8	3/4	4	031-375-2	--	031-375-4	032-375-2	--	032-375-4
7/16	1/2	7/8	4	031-437-2	--	031-437-4	032-437-2	--	032-437-4
1/2	1/2	1	4	031-500-2	--	031-500-4	032-500-2	--	032-500-4
5/8	5/8	1-1/2	6	031-625-2	--	031-625-4	032-625-2	--	032-625-4
3/4	3/4	1-1/2	6	031-750-2	--	031-750-4	032-750-2	--	032-750-4

\* Double Ended tools under 1/4" Diameter have Round Shanks. 1/4" diameter & larger have Weldon Shanks.



- Engraving Tools with 30 Degree angle
- 3 tip sizes to choose from
- 10% Micrograin Carbide
- Diameter Tolerance: +0.0000"/-0.0020"

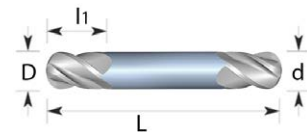
Tip Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	TiAlN Coated
				Part#
.005	1/4	1/2	2-1/2	108-250-005
.010	1/4	1/2	2-1/2	108-250-010
.020	1/4	1/2	2-1/2	108-250-020

P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
H	Hardened Steel

● GOOD    ◐ OK    ○ NOT OPTIMAL

- 30 deg Helix Carbide with honed edges
- 10% Micrograin Carbide
- Diameter (D) Tolerance: +0.0000"/-0.0020"
- Shank (d) Tolerance: +0.0000"/-0.0004"

**GENERAL PURPOSE**

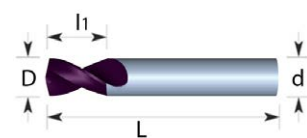


Ball Nose, Standard Carbide, Stub Length, Double End										
Cutter Diam. D	Shank Diam. d	Length Of Cut L	O.A.L. L	Uncoated			TiAlN Coated			
				2 Flute	3 Flute	4 Flute	2 Flute	3 Flute	4 Flute	
				Part#	Part#	Part#	Part#	Part#	Part#	
1/32	1/8*	1/16	1-1/2	028-031-2	--	028-031-4	030-031-2	--	030-031-4	
3/64	1/8*	3/32	1-1/2	028-046-2	--	028-046-4	030-046-2	--	030-046-4	
1/16	1/8*	1/8	1-1/2	028-062-2	--	028-062-4	030-062-2	--	030-062-4	
3/32	1/8*	3/16	1-1/2	028-093-2	--	028-093-4	030-093-2	--	030-093-4	
7/64	1/8*	7/32	1-1/2	028-109-2	--	028-109-4	030-109-2	--	030-109-4	
1/8	1/8*	1/4	1-1/2	028-125-2	--	028-125-4	030-125-2	--	030-125-4	
5/32	3/16*	5/16	2	028-156-2	--	028-156-4	030-156-2	--	030-156-4	
3/16	3/16*	5/16	2	028-187-2	--	028-187-4	030-187-2	--	030-187-4	
7/32	1/4	3/8	2-1/2	028-218-2	--	028-218-4	030-218-2	--	030-218-4	
1/4	1/4	1/2	2-1/2	028-250-2	--	028-250-4	030-250-2	--	030-250-4	
9/32	5/16	1/2	2-1/2	028-281-2	--	028-281-4	030-281-2	--	030-281-4	
5/16	5/16	1/2	2-1/2	028-312-2	--	028-312-4	030-312-2	--	030-312-4	
3/8	3/8	9/16	2-1/2	028-375-2	--	028-375-4	030-375-2	--	030-375-4	
7/16	1/2	9/16	2-3/4	028-437-2	--	028-437-4	030-437-2	--	030-437-4	
1/2	1/2	5/8	3	028-500-2	--	028-500-4	030-500-2	--	030-500-4	
9/16	5/8	11/16	3-1/2	028-562-2	--	028-562-4	030-562-2	--	030-562-4	
5/8	5/8	11/16	3-1/2	028-625-2	--	028-625-4	030-625-2	--	030-625-4	
3/4	3/4	7/8	4	028-750-2	--	028-750-4	030-750-2	--	030-750-4	



Ball Nose, Standard Carbide, Regular Length, Double End										
Cutter Diam. D	Shank Diam. d	Length Of Cut L	O.A.L. L	Uncoated			TiAlN Coated			
				2 Flute	3 Flute	4 Flute	2 Flute	3 Flute	4 Flute	
				Part#	Part#	Part#	Part#	Part#	Part#	
5/32	3/16*	7/16	3	033-156-2	--	033-156-4	034-156-2	--	034-156-4	
3/16	3/16*	1/2	3	033-187-2	--	033-187-4	034-187-2	--	034-187-4	
7/32	1/4	9/16	4	033-218-2	--	033-218-4	034-218-2	--	034-218-4	
1/4	1/4	5/8	4	033-250-2	--	033-250-4	034-250-2	--	034-250-4	
5/16	5/16	3/4	4	033-312-2	--	033-312-4	034-312-2	--	034-312-4	
3/8	3/8	3/4	4	033-375-2	--	033-375-4	034-375-2	--	034-375-4	
7/16	1/2	7/8	4	033-437-2	--	033-437-4	034-437-2	--	034-437-4	
1/2	1/2	1	4	033-500-2	--	033-500-4	034-500-2	--	034-500-4	
5/8	5/8	1-1/2	6	033-625-2	--	033-625-4	034-625-2	--	034-625-4	
3/4	3/4	1-1/2	6	033-750-2	--	033-750-4	034-750-2	--	034-750-4	

\* Double Ended tools under 1/4" Diameter have Round Shanks. 1/4" diameter & larger have Weldon Shanks.



**NEW**

- Allows High Performance drills to center properly without damaging their outside edge
- 145 Degree Point Carbide with honed edges
- 10% Micrograin Carbide
- Diameter Tolerance: +0.0000"/-0.0004"



Spot Drills 145 Degree Point				
Drill Diam. D	Shank Diam. d	Length Of Cut L	O.A.L. L	TiAlN Coated Part#
1/4	1/4	1/2	3	110-250-2
3/8	3/8	3/4	3	110-375-2
1/2	1/2	1	4	110-500-2
5/8	5/8	1	4	110-625-2
3/4	3/4	1-1/8	4	110-750-2

**SPEED & FEED RECOMMENDATIONS**

Material	Speed (SFM)		Feed Per Tooth By End Mill Diameter							
	Uncoated	TiAlN Coated	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"	1"
	Aluminum & Aluminum Alloys	600-1200	900-1800	.0020	.0025	.0030	.0035	.0040	.0050	.0060
Copper & Copper Alloys	350-850	525-1275	.0020	.0025	.0025	.0030	.0030	.0035	.0040	.0060
Brass & Bronze	250-400	375-600	.0020	.0025	.0025	.0030	.0030	.0035	.0040	.0050
Graphite	500-800	500-1200	.0030	.0035	.0025	.0030	.0030	.0040	.0050	.0070
Plastics	600-1100	600-1650	.0030	.0035	.0040	.0050	.0060	.0080	.0100	.0150
Iron, Cast (soft)	250-450	375-650	.0020	.0022	.0025	.0027	.0030	.0045	.0060	.0080
Iron, Cast (hard)	100-250	100-375	.0008	.0010	.0015	.0017	.0020	.0025	.0030	.0040
Iron, Ductile	80-400	100-600	.0010	.0012	.0015	.0017	.0020	.0030	.0040	.0060
Iron, Malleable	150-500	225-650	.0010	.0015	.0020	.0025	.0030	.0040	.0050	.0070
Carbon Steels, Low	200-400	300-600	.0010	.0015	.0020	.0025	.0030	.0040	.0050	.0070
Carbon Steels, Medium	100-250	150-375	.0015	.0016	.0017	.0018	.0020	.0030	.0040	.0050
Carbon Steels Hardened to 35 Rc	130-230	130-345	.0010	.0011	.0012	.0013	.0015	.0017	.0020	.0030
Carbon Steels Hardened to 50 Rc	70-130	70-160	.0007	.0007	.0008	.0009	.0010	.0015	.0020	.0030
Carbon Steels Hardened to 60 Rc	30-70	30-90	.0005	.0006	.0007	.0009	.0010	.0012	.0015	.0020
Steels, Mold	200-350	300-525	.0010	.0012	.0015	.0017	.0020	.0025	.0030	.0040
Steels, Tool	100-250	150-375	.0010	.0012	.0015	.0017	.0020	.0025	.0030	.0040
Stainless Steels, Soft	200-350	300-450	.0010	.0012	.0015	.0017	.0020	.0030	.0040	.0060
Stainless Steels, Hard	100-200	150-300	.0005	.0006	.0007	.0008	.0010	.0020	.0030	.0050
Monel & High Nickel Steel	75-175	75-200	.0010	.0012	.0015	.0017	.0020	.0025	.0030	.0040
Titanium, Soft	125-300	125-375	.0010	.0012	.0015	.0017	.0020	.0030	.0040	.0060
Titanium, Hard	50-150	50-175	.0005	.0006	.0007	.0008	.0010	.0015	.0020	.0020
Nickel Based High Temp Alloys	50-100	50-125	.0008	.0008	.0009	.0009	.0010	.0012	.0015	.0020

• Higher Feed Per Tooth should be used to start for radial depths of cut less than 25% of the tool diameter. Lower Feed Per Tooth should be used to start for radial depths of cut greater than 25% of the tool diameter.

$$RPM = \frac{SFM}{(3.146 * Cutter Diam.) / 12}$$

• The above recommendations are for axial lengths of cut not to exceed 1 times the tool diameter for profiling and .5 times the diameter for full slotting.

$$IPM = RPM * Feed Per Tooth * \# of Teeth$$

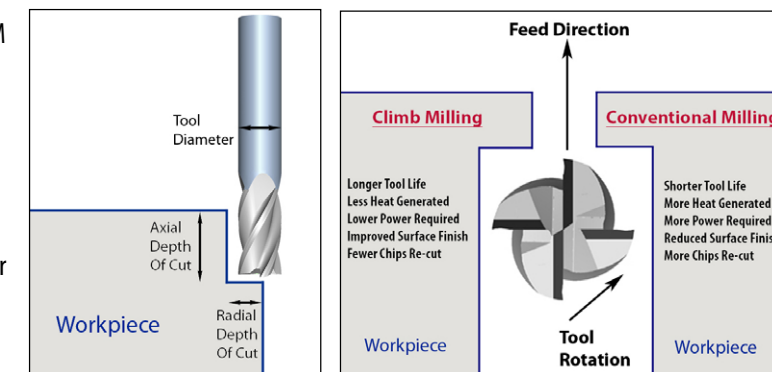
(Inches Per Minute)

• The above parameters are recommended starting points only. If the tool is working well, without vibrations or significant noise, increase the SFM and/or Feed Per Tooth in 5-10% increments.

• Optimum speeds & feeds will depend upon material, setup, machine conditions & tool deflection. Higher or lower parameters may be required to achieve optimum machining conditions.

• For Light Radial Depths of cut, make certain to increase the feed rate to compensate for Radial Chip Thinning Factor (RCTF). Consult a formula or app to calculate.

• Climb Milling is preferred to Conventional Milling





**EVOLUTION**  
Solid Carbide Endmills

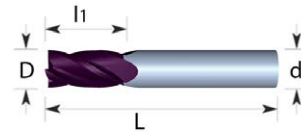
P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
H	Hardened Steel

● BETTER ◐ OK ○ NOT OPTIMAL

- Special Helix Design with honed edges
- 10% Micrograin Carbide
- Variable Pitch to reduce chatter with special core design

### HIGH PERFORMANCE

- Diameter (D) Tolerance: +0.0000"/-0.0020"
- Shank (d) Tolerance: +0.0000"/-0.0004"



HIGH PERFORMANCE Variable Pitch Carbide, Stub Length, Single End							
Cutter Diam.	Shank Diam.	Length Of Cut	O.A.L.	Corner Radius	TiAlN Coated		
					4 Flute - ROUND Shank	4 Flute - WELDON Shank	5 Flute - ROUND Shank
D	d	l <sub>1</sub>	L		Part#	Part#	Part#
3/16	3/16	3/8	2	SQ	190-188-4	--	
3/16	3/16	3/8	2	.015CR	190-188-4-015R	--	
1/4	1/4	3/8	2	SQ	190-250-4	--	
1/4	1/4	3/8	2	.015CR	190-250-4-015R	--	
5/16	5/16	3/8	2	SQ	190-312-4	--	
5/16	5/16	3/8	2	.020CR	190-312-4-020R	--	
3/8	3/8	1/2	2	SQ	190-375-4	--	
3/8	3/8	1/2	2	.020CR	190-375-4-020R	--	
1/2	1/2	5/8	2-1/2	SQ	190-500-4	191-500-4	
1/2	1/2	5/8	2-1/2	.030CR	190-500-4-030R	191-500-4-030R	
5/8	5/8	3/4	3	SQ	190-625-4	191-625-4	
5/8	5/8	3/4	3	.030CR	190-625-4-030R	191-625-4-030R	
3/4	3/4	1	3	SQ	190-750-4	191-750-4	
3/4	3/4	1	3	.030CR	190-750-4-030R	191-750-4-030R	



HIGH PERFORMANCE Variable Pitch Carbide, Regular Length, Single End							
Cutter Diam.	Shank Diam.	Length Of Cut	O.A.L.	Corner Radius	TiAlN Coated		
					4 Flute - ROUND Shank	4 Flute - WELDON Shank	5 Flute - ROUND Shank
D	d	l <sub>1</sub>	L		Part#	Part#	Part#
1/8	1/8	1/2	1-1/2	SQ	090-125-4		
1/8	1/8	1/2	1-1/2	.010CR	090-125-4-010R		
3/16	3/16	5/8	2	SQ	090-188-4	--	
3/16	3/16	5/8	2	.015CR	090-188-4-015R	--	
1/4	1/4	3/4	2-1/2	SQ	090-250-4	091-250-4	090-250-5
1/4	1/4	3/4	2-1/2	.020CR	090-250-4-020R	091-250-4-020R	090-250-5-020R
5/16	5/16	13/16	2-1/2	SQ	090-312-4	091-312-4	090-312-5
5/16	5/16	13/16	2-1/2	.020CR	090-312-4-020R	091-312-4-020R	090-312-5-020R
3/8	3/8	7/8	2-1/2	SQ	090-375-4	091-375-4	090-375-5
3/8	3/8	7/8	2-1/2	.020CR	090-375-4-020R	091-375-4-020R	090-375-5-020R
7/16	7/16	1	2-3/4	SQ	090-437-4	091-437-4	
1/2	1/2	1-1/4	3	SQ	090-500-4	091-500-4	090-500-5
1/2	1/2	1-1/4	3	.015CR	090-500-4-015R	091-500-4-015R	
1/2	1/2	1-1/4	3	.030CR	090-500-4-030R	091-500-4-030R	090-500-5-030R
1/2	1/2	1-1/4	3	.060CR	090-500-4-060R	091-500-4-060R	
5/8	5/8	1-1/4	3-1/2	SQ	090-625-4	091-625-4	090-625-5
5/8	5/8	1-1/4	3-1/2	.030CR	090-625-4-030R	091-625-4-030R	090-625-5-030R
5/8	5/8	1-1/4	3-1/2	.060CR	090-625-4-060R	091-625-4-060R	
5/8	5/8	1-1/4	3-1/2	.125CR	090-625-4-125R	091-625-4-125R	
3/4	3/4	1-1/2	4	SQ	090-750-4	091-750-4	090-750-5
3/4	3/4	1-1/2	4	.030CR	090-750-4-030R	091-750-4-030R	090-750-5-030R
3/4	3/4	1-1/2	4	.060CR	090-750-4-060R	091-750-4-060R	
3/4	3/4	1-1/2	4	.125CR	090-750-4-125R	091-750-4-125R	
1	1	1-1/2	4	SQ	090-100-4	091-100-4	090-100-5
1	1	1-1/2	4	.030CR	090-100-4-030R	091-100-4-030R	090-100-5-030R
1	1	1-1/2	4	.060CR	090-100-4-060R	091-100-4-060R	
1	1	1-1/2	4	.125CR	090-100-4-125R	091-100-4-125R	

**EVOLUTION**  
Solid Carbide Endmills

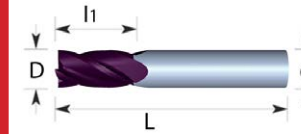
P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
H	Hardened Steel

● BETTER ◐ OK ○ NOT OPTIMAL

- Special Helix Design with honed edges
- 10% Micrograin Carbide
- Variable Pitch to reduce chatter with special core design

### HIGH PERFORMANCE

- Diameter (D) Tolerance: +0.0000"/-0.0020"
- Shank (d) Tolerance: +0.0000"/-0.0004"



HIGH PERFORMANCE Variable Pitch Carbide, Long Length, Single End							
Cutter Diam.	Shank Diam.	Length Of Cut	O.A.L.	Corner Radius	TiAlN Coated		
					4 Flute - ROUND Shank	4 Flute - WELDON Shank	5 Flute - ROUND Shank
D	d	l <sub>1</sub>	L		Part#	Part#	Part#
3/16	3/16	3/4	2-1/2	SQ	092-188-4	--	
3/16	3/16	3/4	2-1/2	.015CR	092-188-4-015R	--	
1/4	1/4	1-1/8	3	SQ	092-250-4	093-250-4	092-250-5
1/4	1/4	1-1/8	3	.020CR	092-250-4-020R	093-250-4-020R	092-250-5-020R
5/16	5/16	1-1/8	3	SQ	092-312-4	093-312-4	092-312-5
5/16	5/16	1-1/8	3	.020CR	092-312-4-020R	093-312-4-020R	092-312-5-020R
3/8	3/8	1-1/8	3	SQ	092-375-4	093-375-4	092-375-5
3/8	3/8	1-1/8	3	.020CR	092-375-4-020R	093-375-4-020R	092-375-5-020R
7/16	7/16	2	4	SQ	092-437-4	093-437-4	
1/2	1/2	2	4	SQ	092-500-4	093-500-4	092-500-5
1/2	1/2	2	4	.015CR	092-500-4-015R	093-500-4-015R	
1/2	1/2	2	4	.030CR	092-500-4-030R	093-500-4-030R	092-500-5-030R
1/2	1/2	2	4	.060CR	092-500-4-060R	093-500-4-060R	
5/8	5/8	2-1/4	5	SQ	092-625-4	093-625-4	092-625-5
5/8	5/8	2-1/4	5	.030CR	092-625-4-030R	093-625-4-030R	092-625-5-030R
5/8	5/8	2-1/4	5	.060CR	092-625-4-060R	093-625-4-060R	
5/8	5/8	2-1/4	5	.125CR	092-625-4-125R	093-625-4-125R	
3/4	3/4	2-1/4	5	SQ	092-750-4	093-750-4	092-750-5
3/4	3/4	2-1/4	5	.030CR	092-750-4-030R	093-750-4-030R	092-750-5-030R
3/4	3/4	2-1/4	5	.060CR	092-750-4-060R	093-750-4-060R	
3/4	3/4	2-1/4	5	.125CR	092-750-4-125R	093-750-4-125R	
1	1	2-1/4	5	SQ	092-100-4	093-100-4	092-100-5
1	1	2-1/4	5	.030CR	092-100-4-030R	093-100-4-030R	092-100-5-030R
1	1	2-1/4	5	.060CR	092-100-4-060R	093-100-4-060R	
1	1	2-1/4	5	.125CR	092-100-4-125R	093-100-4-125R	



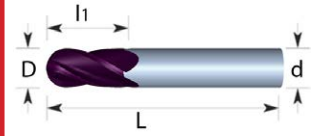
HIGH PERFORMANCE Variable Pitch Carbide, Extra Long Length, Single End							
Cutter Diam.	Shank Diam.	Length Of Cut	O.A.L.	Corner Radius	TiAlN Coated		
					4 Flute - ROUND Shank	5 Flute - ROUND Shank	
D	d	l <sub>1</sub>	L		Part#	Part#	
3/16	3/16	1-1/8	3	SQ	098-188-4	--	
3/16	3/16	1-1/8	3	.015CR	098-188-4-015R	--	
1/4	1/4	1-1/2	4	SQ	098-250-4	098-250-5	
1/4	1/4	1-1/2	4	.020CR	098-250-4-020R	098-250-5-020R	
5/16	5/16	1-5/8	4	SQ	098-312-4	098-312-5	
5/16	5/16	1-5/8	4	.020CR	098-312-4-020R	098-312-5-020R	
3/8	3/8	1-3/4	4	SQ	098-375-4	098-375-5	
3/8	3/8	1-3/4	4	.020CR	098-375-4-020R	098-375-5-020R	
1/2	1/2	3	6	SQ	098-500-4	098-500-5	
1/2	1/2	3	6	.030CR	098-500-4-030R	098-500-5-030R	
5/8	5/8	3	6	SQ	098-625-4	098-625-5	
5/8	5/8	3	6	.030CR	098-625-4-030R	098-625-5-030R	
3/4	3/4	3	6	SQ	098-750-4	098-750-5	
3/4	3/4	3	6	.030CR	098-750-4-030R	098-750-5-030R	
1	1	3	6	SQ	098-100-4	098-100-5	
1	1	3	6	.030CR	098-100-4-030R	098-100-5-030R	



- Special Helix Design with honed edges
- 10% Micrograin Carbide
- Variable Pitch to reduce chatter with special core design

### HIGH PERFORMANCE

- Diameter (D) Tolerance: +0.0000"/-0.0020"
- Shank (d) Tolerance: +0.0000"/-0.0004"



HIGH PERFORMANCE Variable Pitch Carbide, Ball Nose, Regular Length, Single End							
Cutter Diam.	Shank Diam.	Length Of Cut	O.A.L.	TiAlN Coated			
				4 Flute - ROUND Shank		4 Flute - WELDON Shank	
D	d	l <sub>1</sub>	L	Part#		Part#	
3/16	3/16	5/8	2	094-188-4		--	
1/4	1/4	3/4	2-1/2	094-250-4		095-250-4	
5/16	5/16	13/16	2-1/2	094-312-4		095-312-4	
3/8	3/8	7/8	2-1/2	094-375-4		095-375-4	
7/16	7/16	1	2-3/4	094-437-4		095-437-4	
1/2	1/2	1	3	094-500-4		095-500-4	
5/8	5/8	1-1/4	3-1/2	094-625-4		095-625-4	
3/4	3/4	1-1/2	4	094-750-4		095-750-4	
1	1	1-1/2	4	094-100-4		095-100-4	



HIGH PERFORMANCE Variable Pitch Carbide, Ball Nose, Long Length, Single End							
Cutter Diam.	Shank Diam.	Length Of Cut	O.A.L.	TiAlN Coated			
				4 Flute - ROUND Shank		4 Flute - WELDON Shank	
D	d	l <sub>1</sub>	L	Part#		Part#	
3/16	3/16	3/4	2-1/2	096-188-4		--	
1/4	1/4	1-1/8	3	096-250-4		097-250-4	
5/16	5/16	1-1/8	3	096-312-4		097-312-4	
3/8	3/8	1-1/8	3	096-375-4		097-375-4	
7/16	7/16	2	4	096-437-4		097-437-4	
1/2	1/2	2	4	096-500-4		097-500-4	
5/8	5/8	2-1/4	5	096-625-4		097-625-4	
3/4	3/4	2-1/4	5	096-750-4		097-750-4	
1	1	2-1/4	5	096-100-4		097-100-4	



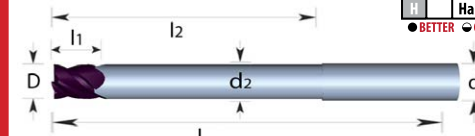
HIGH PERFORMANCE Variable Pitch Carbide, Ball Nose, Extra Long Length, Single End							
Cutter Diam.	Shank Diam.	Length Of Cut	O.A.L.	TiAlN Coated			
				4 Flute - ROUND Shank		4 Flute - WELDON Shank	
D	d	l <sub>1</sub>	L	Part#		Part#	
3/16	3/16	1-1/8	3	099-188-4		--	
1/4	1/4	1-1/2	4	099-250-4		--	
5/16	5/16	1-5/8	4	099-312-4		--	
3/8	3/8	1-3/4	4	099-375-4		--	
1/2	1/2	3	6	099-500-4		--	
5/8	5/8	3	6	099-625-4		--	
3/4	3/4	3	6	099-750-4		--	
1	1	3	6	099-100-4		--	



- Special Helix Design with honed edges
- 10% Micrograin Carbide
- Variable Pitch to reduce chatter with special core design

### HIGH PERFORMANCE

- Diameter (D) Tolerance: +0.0000"/-0.0020"
- Shank (d) Tolerance: +0.0000"/-0.0004"



HIGH PERFORMANCE Variable Pitch Carbide, Long Reach Neck Relief, Single End									
Cutter Diam.	Shank Diam.	Necked Diam.	Length Of Cut	Length Below Shk.	O.A.L.	Corner Radius	TiAlN Coated		
							4 Flute - ROUND Shank		4 Flute - WELDON Shank
D	d	d <sub>2</sub>	l <sub>1</sub>	l <sub>2</sub>	L		Part#		Part#
3/16	3/16	.1775	3/8	2-1/2	4	SQ	290-188-4		--
3/16	3/16	.1775	3/8	2-1/2	4	.015CR	290-188-4-015R		--
1/4	1/4	.2400	3/8	2-1/2	4	SQ	290-250-4		--
1/4	1/4	.2400	3/8	2-1/2	4	.015CR	290-250-4-015R		--
5/16	5/16	.3025	7/16	2-1/2	4	SQ	290-312-4		--
5/16	5/16	.3025	7/16	2-1/2	4	.015CR	290-312-4-015R		--
3/8	3/8	.3650	1/2	2-1/2	4	SQ	290-375-4		--
3/8	3/8	.3650	1/2	2-1/2	4	.015CR	290-375-4-015R		--
1/2	1/2	.4800	5/8	3	5	SQ	290-500-4		--
1/2	1/2	.4800	5/8	3	5	.020CR	290-500-4-020R		--
1/2	1/2	.4800	5/8	4	6	SQ	290-500-4-L		--
1/2	1/2	.4800	5/8	4	6	.020CR	290-500-4-020R-L		--
5/8	5/8	.6050	3/4	3	5	SQ	290-625-4		--
5/8	5/8	.6050	3/4	3	5	.020CR	290-625-4-020R		--
5/8	5/8	.6050	3/4	4	6	SQ	290-625-4-L		--
5/8	5/8	.6050	3/4	4	6	.020CR	290-625-4-020R-L		--
3/4	3/4	.7300	1	3	5	SQ	290-750-4		--
3/4	3/4	.7300	1	3	5	.020CR	290-750-4-020R		--
3/4	3/4	.7300	1	4	6	SQ	290-750-4-L		--
3/4	3/4	.7300	1	4	6	.020CR	290-750-4-020R-L		--
3/4	3/4	.7300	1	5	7	SQ	290-750-4-LL		--
3/4	3/4	.7300	1	5	7	.020CR	290-750-4-020R-LL		--
1	1	.9800	1-1/4	3	5	SQ	290-100-4		--
1	1	.9800	1-1/4	3	5	.020CR	290-100-4-020R		--
1	1	.9800	1-1/4	4	6	SQ	290-100-4-L		--
1	1	.9800	1-1/4	4	6	.020CR	290-100-4-020R-L		--
1	1	.9800	1-1/4	5	7	SQ	290-100-4-LL		--
1	1	.9800	1-1/4	5	7	.020CR	290-100-4-020R-LL		--



HIGH PERFORMANCE Variable Pitch Carbide, Ball Long Reach Neck Relief, Single End									
Cutter Diam.	Shank Diam.	Necked Diam.	Length Of Cut	Length Below Shk.	O.A.L.	TiAlN Coated			
						4 Flute - ROUND Shank		4 Flute - WELDON Shank	
D	d	d <sub>2</sub>	l <sub>1</sub>	l <sub>2</sub>	L		Part#		Part#
3/16	3/16	.1775	3/8	2-1/2	4		294-188-4		--
1/4	1/4	.2400	3/8	2-1/2	4		294-250-4		--
5/16	5/16	.3025	7/16	2-1/2	4		294-312-4		--
3/8	3/8	.3650	1/2	2-1/2	4		294-375-4		--
1/2	1/2	.4800	5/8	3	5		294-500-4		--
1/2	1/2	.4800	5/8	4	6		294-500-4-L		--
5/8	5/8	.6050	3/4	3	5		294-625-4		--
5/8	5/8	.6050	3/4	4	6		294-625-4-L		--
3/4	3/4	.7300	1	3	5		294-750-4		--
3/4	3/4	.7300	1	4	6		294-750-4-L		--
3/4	3/4	.7300	1	5	7		294-750-4-LL		--
1	1	.9800	1-1/4	3	5		294-100-4		--
1	1	.9800	1-1/4	4	6		294-100-4-L		--
1	1	.9800	1-1/4	5	7		294-100-4-LL		--

**HIGH PERFORMANCE**

Material	Speed (SFM)	Feed Per Tooth By End Mill Diameter							
		TiAlN Coated	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"
Aluminum & Aluminum Alloys	900-1800	.0025	.0030	.0035	.0040	.0045	.0055	.0065	.0085
Copper & Copper Alloys	525-1275	.0025	.0030	.0030	.0035	.0035	.0040	.0045	.0065
Brass & Bronze	375-600	.0025	.0030	.0030	.0035	.0035	.0040	.0045	.0055
Graphite	--	--	--	--	--	--	--	--	--
Plastics	--	--	--	--	--	--	--	--	--
Iron, Cast (soft)	375-650	.0025	.0027	.0030	.0032	.0035	.0040	.0065	.0085
Iron, Cast (hard)	100-375	.0013	.0015	.0020	.0022	.0025	.0030	.0035	.0045
Iron, Ductile	100-600	.0015	.0017	.0020	.0022	.0025	.0035	.0045	.0065
Iron, Malleable	225-650	.0015	.0020	.0025	.0030	.0035	.0045	.0055	.0075
Carbon Steels, Low	300-600	.0015	.0020	.0025	.0030	.0035	.0045	.0055	.0075
Carbon Steels, Medium	150-375	.0020	.0021	.0022	.0023	.0025	.0035	.0045	.0055
Carbon Steels Hardened to 35 Rc	130-345	.0015	.0016	.0017	.0018	.0020	.0022	.0025	.0035
Carbon Steels Hardened to 50 Rc	70-160	.0012	.0012	.0013	.0014	.0015	.0020	.0025	.0035
Carbon Steels Hardened to 60 Rc	--	--	--	--	--	--	--	--	--
Steels, Mold	300-525	.0015	.0017	.0020	.0022	.0025	.0030	.0035	.0045
Steels, Tool	150-375	.0015	.0017	.0020	.0022	.0025	.0030	.0035	.0045
Stainless Steels, Soft	300-450	.0015	.0017	.0020	.0017	.0025	.0035	.0045	.0065
Stainless Steels, Hard	150-300	.0010	.0011	.0012	.0013	.0015	.0025	.0035	.0055
Monel & High Nickel Steel	75-200	.0015	.0017	.0020	.0021	.0025	.0030	.0035	.0045
Titanium, Soft	125-375	.0015	.0017	.0020	.0021	.0025	.0035	.0045	.0065
Titanium, Hard	50-175	.0010	.0011	.0012	.0012	.0014	.0017	.0022	.0023
Nickel Based High Temp Alloys	50-125	.0013	.0012	.0011	.0011	.0014	.0015	.0017	.0023

• Higher Feed Per Tooth should be used to start for radial depths of cut less than 25% of the tool diameter. Lower Feed Per Tooth should be used to start for radial depths of cut greater than 25% of the tool diameter.

• The above recommendations are for axial lengths of cut not to exceed 1.25 times the tool diameter for profiling and .75 times the diameter for full slotting.

• The above parameters are recommended starting points only. If the tool is working well, without vibrations or significant noise, increase the SFM and/or Feed Per Tooth in 5-10% increments.

• Optimum speeds & feeds will depend upon material, setup, machine conditions & tool deflection. Higher or lower parameters may be required to achieve optimum machining conditions.

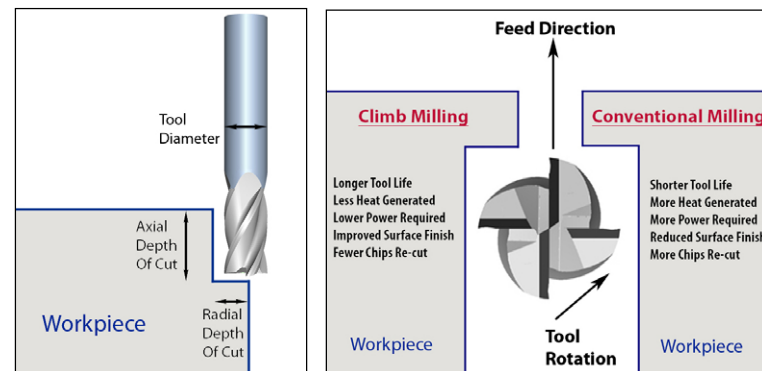
• For Light Radial Depths of cut, make certain to increase the feed rate to compensate for Radial Chip Thinning Factor (RCTF). Consult a formula or app to calculate.

• Climb Milling is preferred to Conventional Milling

$$RPM = \frac{SFM}{(3.146 * \text{Cutter Diam.}) / 12}$$

$$IPM = RPM * \text{Feed Per Tooth} * \# \text{ of Teeth}$$

(Inches Per Minute)



**WHAT'S NEW IN THE 2023 CATALOG...  
ABOUT 300 NEW ITEMS!**

**GENERAL PURPOSE**

- **004 & 006 Series** - 1/2" 4 Flute Regular Length end mills in Coated and Uncoated are now available in a 1-1/4" LOC in addition to the standard 1" LOC



**HIGH PERFORMANCE**

- **098 Series** - Extra Long Length series now have corner radius options (previously only square were available)
- **090 Series** - 1/8" square & corner radius now available
- **090, 092 & 098 Series** - 5 Flute Square & Corner Radius in Regular, Long & Extra Long series are now available



**ULTRA HIGH PERFORMANCE**

- **088 Series** - Extra Long Length series now have corner radius options (previously only square were available)
- **080, 082 & 088 Series** - 5 Flute Square & Corner Radius in Regular, Long & Extra Long series are now available



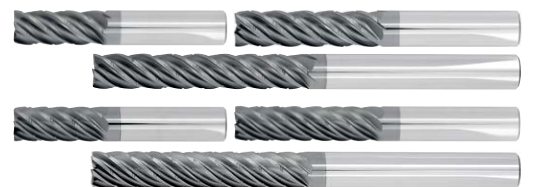
**ULTRA HIGH PERFORMANCE HEM**

New Series specially designed for High Efficiency Machining (HEM), Dynamic & Trochoidal Milling

- **380, 382, 388 Series** - 5 Flute & 7 Flute Regular, Long & Extra Long Series Square & Corner Radius



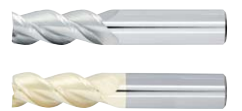
- **480, 482, 488 Series** - 5 Flute & 7 Flute Regular, Long & Extra Long Series Square & Corner Radius With Chip Breakers



**ULTRA HIGH PERFORMANCE - Aluminum**

**NEW Improved design for all tools to increase performance... for the same price!**

- All tools now have a special high polished, mirror like finish to prevent built up edge. This dramatically increases tool life & performance.

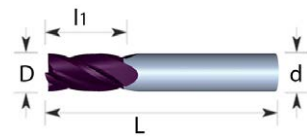




P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
H	Hardened Steel

### ULTRA HIGH PERFORMANCE

- Special Helix Design with honed edges
- Variable Pitch to reduce chatter with special core design
- 10% Ultra High Performance Micrograin Carbide
- Diameter (D) Tolerances: +0.0000"/-0.0015"
- Shank (d) Tolerance: +0.0000"/-0.0004"



Cutter Diam.	Shank Diam.	Length Of Cut	O.A.L.	Corner Radius	TiAlN Coated				
					4 Flute - ROUND Shank		4 Flute - WELDON Shank		
					D	d	l1	Part#	Part#
3/16	3/16	3/8	2	SQ			180-188-4	--	--
3/16	3/16	3/8	2	.015CR			180-188-4-015R	--	--
1/4	1/4	3/8	2	SQ			180-250-4	--	--
1/4	1/4	3/8	2	.015CR			180-250-4-015R	--	--
5/16	5/16	3/8	2	SQ			180-312-4	--	--
5/16	5/16	3/8	2	.020CR			180-312-4-020R	--	--
3/8	3/8	1/2	2	SQ			180-375-4	--	--
3/8	3/8	1/2	2	.020CR			180-375-4-020R	--	--
1/2	1/2	5/8	2-1/2	SQ			180-500-4		181-500-4
1/2	1/2	5/8	2-1/2	.030CR			180-500-4-030R		181-500-4-030R
5/8	5/8	3/4	3	SQ			180-625-4		181-625-4
5/8	5/8	3/4	3	.030CR			180-625-4-030R		181-625-4-030R
3/4	3/4	1	3	SQ			180-750-4		181-750-4
3/4	3/4	1	3	.030CR			180-750-4-030R		181-750-4-030R



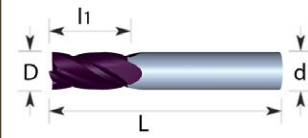
Cutter Diam.	Shank Diam.	Length Of Cut	O.A.L.	Corner Radius	TiAlN Coated				
					4 Flute - ROUND Shank		4 Flute - WELDON Shank	5 Flute - ROUND Shank	
					D	d	l1	L	Part#
1/8	1/8	1/2	1-1/2	SQ			080-125-4		
1/8	1/8	1/2	1-1/2	.010CR			080-125-4-010R	--	--
3/16	3/16	5/8	2	SQ			080-188-4	--	--
3/16	3/16	5/8	2	.015CR			080-188-4-015R	--	--
1/4	1/4	3/4	2-1/2	SQ			080-250-4	081-250-4	080-250-5
1/4	1/4	3/4	2-1/2	.020CR			080-250-4-020R	081-250-4-020R	080-250-5-020R
5/16	5/16	13/16	2-1/2	SQ			080-312-4	081-312-4	080-312-5
5/16	5/16	13/16	2-1/2	.020CR			080-312-4-020R	081-312-4-020R	080-312-5-020R
3/8	3/8	7/8	2-1/2	SQ			080-375-4	081-375-4	080-375-5
3/8	3/8	7/8	2-1/2	.020CR			080-375-4-020R	081-375-4-020R	080-375-5-020R
3/8	3/8	7/8	2-1/2	.030CR			080-375-4-030R	081-375-4-030R	080-375-5-030R
7/16	7/16	1	2-3/4	SQ			080-437-4	081-437-4	--
1/2	1/2	1-1/4	3	SQ			080-500-4	081-500-4	080-500-5
1/2	1/2	1-1/4	3	.015CR			080-500-4-015R	081-500-4-015R	--
1/2	1/2	1-1/4	3	.030CR			080-500-4-030R	081-500-4-030R	080-500-5-030R
1/2	1/2	1-1/4	3	.060CR			080-500-4-060R	081-500-4-060R	--
5/8	5/8	1-1/4	3-1/2	SQ			080-625-4	081-625-4	080-625-5
5/8	5/8	1-1/4	3-1/2	.030CR			080-625-4-030R	081-625-4-030R	080-625-5-030R
5/8	5/8	1-1/4	3-1/2	.060CR			080-625-4-060R	081-625-4-060R	--
5/8	5/8	1-1/4	3-1/2	.125CR			080-625-4-125R	081-625-4-125R	--
3/4	3/4	1-1/2	4	SQ			080-750-4	081-750-4	080-750-5
3/4	3/4	1-1/2	4	.030CR			080-750-4-030R	081-750-4-030R	080-750-5-030R
3/4	3/4	1-1/2	4	.060CR			080-750-4-060R	081-750-4-060R	--
3/4	3/4	1-1/2	4	.125CR			080-750-4-125R	081-750-4-125R	--
1	1	1-1/2	4	SQ			080-100-4	081-100-4	080-100-5
1	1	1-1/2	4	.030CR			080-100-4-030R	081-100-4-030R	080-100-5-030R
1	1	1-1/2	4	.060CR			080-100-4-060R	081-100-4-060R	--
1	1	1-1/2	4	.125CR			080-100-4-125R	081-100-4-125R	--



P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
H	Hardened Steel

### ULTRA HIGH PERFORMANCE

- Special Helix Design with honed edges
- Variable Pitch to reduce chatter with special core design
- 10% Ultra High Performance Micrograin Carbide
- Diameter (D) Tolerances: +0.0000"/-0.0015"
- Shank (d) Tolerance: +0.0000"/-0.0004"



Cutter Diam.	Shank Diam.	Length Of Cut	O.A.L.	Corner Radius	TiAlN Coated				
					4 Flute - ROUND Shank		4 Flute - WELDON Shank	5 Flute - ROUND Shank	
					D	d	l1	L	Part#
3/16	3/16	3/4	2-1/2	SQ			082-188-4	--	--
3/16	3/16	3/4	2-1/2	.015CR			082-188-4-015R	--	--
1/4	1/4	1-1/8	3	SQ			082-250-4	083-250-4	082-250-5
1/4	1/4	1-1/8	3	.020CR			082-250-4-020R	083-250-4-020R	082-250-5-020R
5/16	5/16	1-1/8	3	SQ			082-312-4	083-312-4	082-312-5
5/16	5/16	1-1/8	3	.020CR			082-312-4-020R	083-312-4-020R	082-312-5-020R
3/8	3/8	1-1/8	3	SQ			082-375-4	083-375-4	082-375-5
3/8	3/8	1-1/8	3	.020CR			082-375-4-020R	083-375-4-020R	082-375-5-020R
7/16	7/16	2	4	SQ			082-437-4	083-437-4	--
1/2	1/2	2	4	SQ			082-500-4	083-500-4	082-500-5
1/2	1/2	2	4	.015CR			082-500-4-015R	083-500-4-015R	--
1/2	1/2	2	4	.030CR			082-500-4-030R	083-500-4-030R	082-500-5-030R
1/2	1/2	2	4	.060CR			082-500-4-060R	083-500-4-060R	--
5/8	5/8	2-1/4	5	SQ			082-625-4	083-625-4	082-625-5
5/8	5/8	2-1/4	5	.030CR			082-625-4-030R	083-625-4-030R	082-625-5-030R
5/8	5/8	2-1/4	5	.060CR			082-625-4-060R	083-625-4-060R	--
5/8	5/8	2-1/4	5	.125CR			082-625-4-125R	083-625-4-125R	--
3/4	3/4	2-1/4	5	SQ			082-750-4	083-750-4	082-750-5
3/4	3/4	2-1/4	5	.030CR			082-750-4-030R	083-750-4-030R	082-750-5-030R
3/4	3/4	2-1/4	5	.060CR			082-750-4-060R	083-750-4-060R	--
3/4	3/4	2-1/4	5	.125CR			082-750-4-125R	083-750-4-125R	--
1	1	2-1/4	5	SQ			082-100-4	083-100-4	082-100-5
1	1	2-1/4	5	.030CR			082-100-4-030R	083-100-4-030R	082-100-5-030R
1	1	2-1/4	5	.060CR			082-100-4-060R	083-100-4-060R	--
1	1	2-1/4	5	.125CR			082-100-4-125R	083-100-4-125R	--

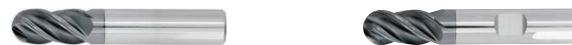
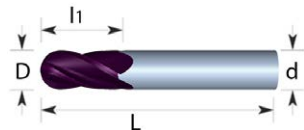


Cutter Diam.	Shank Diam.	Length Of Cut	O.A.L.	Corner Radius	TiAlN Coated		
					4 Flute - ROUND Shank	5 Flute - ROUND Shank	
					D	d	l1
3/16	3/16	1-1/8	3	SQ		088-188-4	--
3/16	3/16	1-1/8	3	.015CR		088-188-4-015R	--
1/4	1/4	1-1/2	4	SQ		088-250-4	088-250-5
1/4	1/4	1-1/2	4	.020CR		088-250-4-020R	088-250-5-020R
5/16	5/16	1-5/8	4	SQ		088-312-4	088-312-5
5/16	5/16	1-5/8	4	.020CR		088-312-4-020R	088-312-5-020R
3/8	3/8	1-3/4	4	SQ		088-375-4	088-375-5
3/8	3/8	1-3/4	4	.020CR		088-375-4-020R	088-375-5-020R
1/2	1/2	3	6	SQ		088-500-4	088-500-5
1/2	1/2	3	6	.030CR		088-500-4-030R	088-500-5-030R
5/8	5/8	3	6	SQ		088-625-4	088-625-5
5/8	5/8	3	6	.030CR		088-625-4-030R	088-625-5-030R
3/4	3/4	3	6	SQ		088-750-4	088-750-5
3/4	3/4	3	6	.030CR		088-750-4-030R	088-750-5-030R
1	1	3	6	SQ		088-100-4	088-100-5
1	1	3	6	.030CR		088-100-4-030R	088-100-5-030R

P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
	Hardened Steel

### ULTRA HIGH PERFORMANCE

- Special Helix Design with honed edges
- Variable Pitch to reduce chatter with special core design
- 10% Ultra High Performance Micrograin Carbide
- Diameter (D) Tolerances: +0.0000"/-0.0015"
- Shank (d) Tolerance: +0.0000"/-0.0004"



ULTRA HIGH PERFORMANCE Variable Pitch Carbide, Ball Nose, Regular Length, Single End				TiALN Coated	
Cutter Diam.	Shank Diam.	Length Of Cut	O.A.L.	4 Flute - ROUND Shank Part#	4 Flute - WELDON Shank Part#
D	d	l1	L		
3/16	3/16	5/8	2	084-188-4	--
1/4	1/4	3/4	2-1/2	084-250-4	085-250-4
5/16	5/16	13/16	2-1/2	084-312-4	085-312-4
3/8	3/8	7/8	2-1/2	084-375-4	085-375-4
7/16	7/16	1	2-3/4	084-437-4	085-437-4
1/2	1/2	1	3	084-500-4	085-500-4
5/8	5/8	1-1/4	3-1/2	084-625-4	085-625-4
3/4	3/4	1-1/2	4	084-750-4	085-750-4
1	1	1-1/2	4	084-100-4	085-100-4



ULTRA HIGH PERFORMANCE Variable Pitch Carbide, Ball Nose, Long Length, Single End				TiALN Coated	
Cutter Diam.	Shank Diam.	Length Of Cut	O.A.L.	4 Flute - ROUND Shank Part#	4 Flute - WELDON Shank Part#
D	d	l1	L		
3/16	3/16	3/4	2-1/2	086-188-4	--
1/4	1/4	1-1/8	3	086-250-4	087-250-4
5/16	5/16	1-1/8	3	086-312-4	087-312-4
3/8	3/8	1-1/8	3	086-375-4	087-375-4
7/16	7/16	2	4	086-437-4	087-437-4
1/2	1/2	2	4	086-500-4	087-500-4
5/8	5/8	2-1/4	5	086-625-4	087-625-4
3/4	3/4	2-1/4	5	086-750-4	087-750-4
1	1	2-1/4	5	086-100-4	087-100-4



ULTRA HIGH PERFORMANCE Variable Pitch Carbide, Ball Nose, Extra Long Length, Single End				TiALN Coated	
Cutter Diam.	Shank Diam.	Length Of Cut	O.A.L.	4 Flute - ROUND Shank Part#	4 Flute - WELDON Shank Part#
D	d	l1	L		
3/16	3/16	1-1/8	3	089-188-4	--
1/4	1/4	1-1/2	4	089-250-4	--
5/16	5/16	1-5/8	4	089-312-4	--
3/8	3/8	1-3/4	4	089-375-4	--
1/2	1/2	3	6	089-500-4	--
5/8	5/8	3	6	089-625-4	--
3/4	3/4	3	6	089-750-4	--
1	1	3	6	089-100-4	--

### SPEED & FEED RECOMMENDATIONS

#### ULTRA HIGH PERFORMANCE

Material	Speed (SFM)	Feed Per Tooth By End Mill Diameter							
		TiALN Coated	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"
Aluminum & Aluminum Alloys	900-1800	.0025	.0030	.0035	.0040	.0045	.0055	.0065	.0085
Copper & Copper Alloys	525-1275	.0025	.0030	.0030	.0035	.0035	.0040	.0045	.0065
Brass & Bronze	375-600	.0025	.0030	.0030	.0035	.0035	.0040	.0045	.0055
Graphite	--	--	--	--	--	--	--	--	--
Plastics	--	--	--	--	--	--	--	--	--
Iron, Cast (soft)	375-650	.0030	.0032	.0035	.0037	.0040	.0045	.0070	.0090
Iron, Cast (hard)	100-375	.0018	.0020	.0025	.0027	.0030	.0035	.0040	.0050
Iron, Ductile	100-600	.0020	.0022	.0025	.0027	.0030	.0040	.0050	.0070
Iron, Malleable	225-650	.0020	.0025	.0030	.0035	.0040	.0050	.0060	.0080
Carbon Steels, Low	300-600	.0020	.0025	.0030	.0035	.0040	.0050	.0060	.0080
Carbon Steels, Medium	150-375	.0025	.0026	.0027	.0028	.0030	.0040	.0050	.0060
Carbon Steels Hardened to 35 Rc	130-345	.0020	.0021	.0022	.0023	.0025	.0027	.0030	.0040
Carbon Steels Hardened to 50 Rc	70-160	.0012	.0012	.0013	.0014	.0015	.0026	.0030	.0035
Carbon Steels Hardened to 60 Rc	--	--	--	--	--	--	--	--	--
Steels, Mold	300-525	.0020	.0022	.0025	.0027	.0030	.0035	.0040	.0050
Steels, Tool	150-375	.0020	.0022	.0025	.0027	.0030	.0035	.0040	.0050
Stainless Steels, Soft	300-450	.0020	.0022	.0025	.0022	.0030	.0040	.0050	.0070
Stainless Steels, Hard	150-300	.0015	.0016	.0017	.0018	.0020	.0030	.0040	.0060
Monel & High Nickel Steel	75-200	.0015	.0022	.0025	.0027	.0030	.0035	.0040	.0050
Titanium, Soft	125-375	.0015	.0022	.0025	.0027	.0030	.0040	.0050	.0070
Titanium, Hard	50-175	.0010	.0016	.0017	.0018	.0020	.0022	.0026	.0030
Nickel Based High Temp Alloys	50-125	.0014	.0014	.0015	.0016	.0017	.0018	.0020	.0023

• Higher Feed Per Tooth should be used to start for radial depths of cut less than 25% of the tool diameter. Lower Feed Per Tooth should be used to start for radial depths of cut greater than 25% of the tool diameter.

$$RPM = \frac{SFM}{(3.146 * \text{Cutter Diam.}) / 12}$$

• The above recommendations are for axial lengths of cut not to exceed 1.5 times the tool diameter for profiling and 1 times the diameter for full slotting.

$$IPM = RPM * \text{Feed Per Tooth} * \# \text{ of Teeth}$$

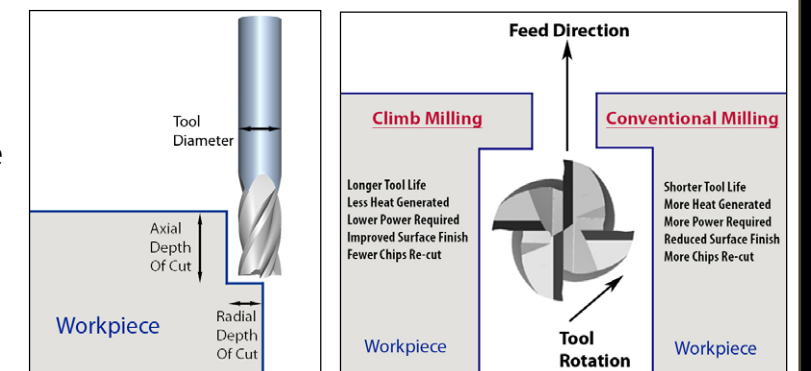
(Inches Per Minute)

• The above parameters are recommended starting points only. If the tool is working well, without vibrations or significant noise, increase the SFM and/or Feed Per Tooth in 5-10% increments.

• Optimum speeds & feeds will depend upon material, setup, machine conditions & tool deflection. Higher or lower parameters may be required to achieve optimum machining conditions.

• For Light Radial Depths of cut, make certain to increase the feed rate to compensate for Radial Chip Thinning Factor (RCTF). Consult a formula or app to calculate.

• Climb Milling is preferred to Conventional Milling





P	Steel	
M	Stainless Steel	
K	Cast Iron	
N	Non-Ferrous	
S	High Temp. Alloys	
H	Hardened Steel	
● BEST	○ OK	○ NOT OPTIMAL

## ULTRA HIGH PERFORMANCE HEM

- Special Helix Design with honed edges
- Variable Pitch to reduce chatter with special core design
- With & Without Chip Breakers
- 10% Ultra High Performance Micrograin Carbide
- Diameter (D) Tolerances: +0.0000"/-0.0015"
- Shank (d) Tolerance: +0.0000"/-0.0004"

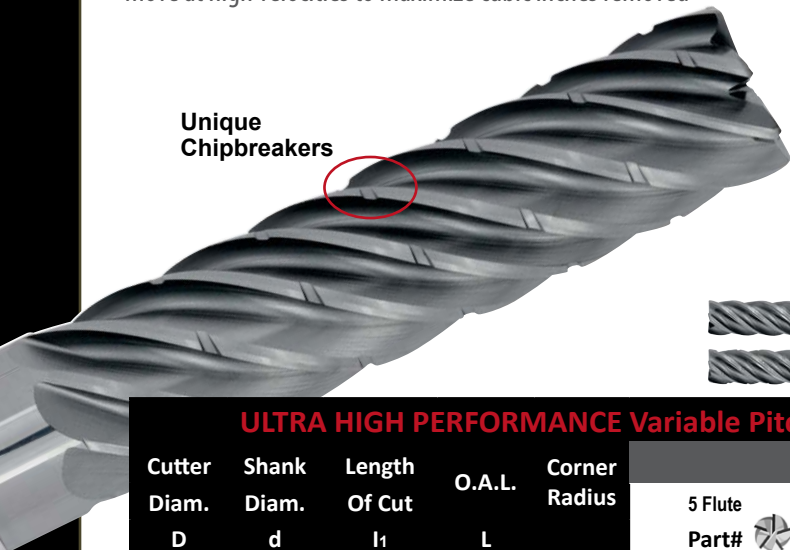


### 5, 6 & 7 Flute

### Specially for HEM (High Efficiency Machining)

- For long axial with low radial engagement at high speeds & feeds
- For Dynamic Milling, Trochoidal Milling, HEM (High Efficiency Milling)
- Take advantage of Radial Chip Thinning Factor compensation (RCTF) to move at high velocities to maximize cubic inches removed

Unique Chipbreakers



### ULTRA HIGH PERFORMANCE Variable Pitch Carbide, Regular Length, Single End - HEM

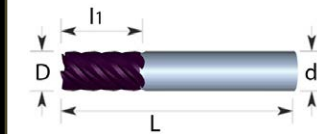
Cutter Diam. D	Shank Diam. d	Length Of Cut l <sub>i</sub>	O.A.L. L	Corner Radius	ALL4 Coated				
					5 Flute Part#	5 Flute Chipbreaker Part#	6 Flute Part#	7 Flute Part#	7 Flute Chipbreaker Part#
1/4	1/4	3/4	2-1/2	SQ	380-250-5	--	380-250-6	--	--
1/4	1/4	3/4	2-1/2	.015CR	380-250-5-015R	--	--	--	--
1/4	1/4	3/4	2-1/2	.030CR	380-250-5-030R	--	380-250-6-030R	--	--
5/16	5/16	13/16	2-1/2	SQ	380-312-5	--	--	--	--
5/16	5/16	13/16	2-1/2	.015CR	380-312-5-015R	--	--	--	--
5/16	5/16	13/16	2-1/2	.030CR	380-312-5-030R	--	--	--	--
3/8	3/8	1	2-1/2	SQ	380-375-5	480-375-5	380-375-6	380-375-7	480-375-7
3/8	3/8	1	2-1/2	.015CR	380-375-5-015R	480-375-5-015R	--	380-375-7-015R	480-375-7-015R
3/8	3/8	1	2-1/2	.030CR	380-375-5-030R	480-375-5-030R	380-375-6-030R	380-375-7-030R	480-375-7-030R
1/2	1/2	1-1/4	3	SQ	380-500-5	480-500-5	380-500-6	380-500-7	480-500-7
1/2	1/2	1-1/4	3	.015CR	380-500-5-015R	480-500-5-015R	--	380-500-7-015R	480-500-7-015R
1/2	1/2	1-1/4	3	.030CR	380-500-5-030R	480-500-5-030R	380-500-6-030R	380-500-7-030R	480-500-7-030R
1/2	1/2	1-1/4	3	.060CR	380-500-5-060R	480-500-5-060R	--	380-500-7-060R	--
5/8	5/8	1-1/2	3-1/2	SQ	380-625-5	480-625-5	380-625-6	380-625-7	480-625-7
5/8	5/8	1-1/2	3-1/2	.030CR	380-625-5-030R	480-625-5-030R	380-625-6-030R	380-625-7-030R	480-625-7-030R
5/8	5/8	1-1/2	3-1/2	.060CR	380-625-5-060R	480-625-5-060R	--	380-625-7-060R	--
3/4	3/4	1-1/2	4	SQ	380-750-5	480-750-5	380-750-6	380-750-7	480-750-7
3/4	3/4	1-1/2	4	.030CR	380-750-5-030R	480-750-5-030R	380-750-6-030R	380-750-7-030R	480-750-7-030R
3/4	3/4	1-1/2	4	.060CR	380-750-5-060R	--	--	380-750-7-060R	--
1	1	1-1/2	4	SQ	380-100-5	480-100-5	380-100-6	380-100-7	480-100-7
1	1	1-1/2	4	.030CR	380-100-5-030R	480-100-5-030R	380-100-6-030R	380-100-7-030R	480-100-7-030R
1	1	1-1/2	4	.060CR	380-100-5-060R	--	--	380-100-7-060R	--



P	Steel	
M	Stainless Steel	
K	Cast Iron	
N	Non-Ferrous	
S	High Temp. Alloys	
H	Hardened Steel	
● BEST	○ OK	○ NOT OPTIMAL

## ULTRA HIGH PERFORMANCE HEM

- Special Helix Design with honed edges
- Variable Pitch to reduce chatter with special core design
- With & Without Chip Breakers
- 10% Ultra High Performance Micrograin Carbide
- Diameter (D) Tolerances: +0.0000"/-0.0015"
- Shank (d) Tolerance: +0.0000"/-0.0004"



### ULTRA HIGH PERFORMANCE Variable Pitch Carbide, Long Length, Single End - HEM

Cutter Diam. D	Shank Diam. d	Length Of Cut l <sub>i</sub>	O.A.L. L	Corner Radius	ALL4 Coated				
					5 Flute Part#	5 Flute Chipbreaker Part#	6 Flute Part#	7 Flute Part#	7 Flute Chipbreaker Part#
1/4	1/4	1-1/8	3	SQ	382-250-5	--	--	--	--
1/4	1/4	1-1/8	3	.015CR	382-250-5-015R	--	--	--	--
1/4	1/4	1-1/8	3	.030CR	382-250-5-030R	--	--	--	--
5/16	5/16	1-1/4	3	SQ	382-312-5	--	--	--	--
5/16	5/16	1-1/4	3	.015CR	382-312-5-015R	--	--	--	--
5/16	5/16	1-1/4	3	.030CR	382-312-5-030R	--	--	--	--
3/8	3/8	1-1/4	3	SQ	382-375-5	482-375-5	--	382-375-7	482-375-7
3/8	3/8	1-1/4	3	.015CR	382-375-5-015R	482-375-5-015R	--	382-375-7-015R	482-375-7-015R
3/8	3/8	1-1/4	3	.030CR	382-375-5-030R	482-375-5-030R	--	382-375-7-030R	482-375-7-030R
1/2	1/2	2-1/8	4	SQ	382-500-5	482-500-5	--	382-500-7	482-500-7
1/2	1/2	2-1/8	4	.015CR	382-500-5-015R	482-500-5-015R	--	382-500-7-015R	482-500-7-015R
1/2	1/2	2-1/8	4	.030CR	382-500-5-030R	482-500-5-030R	--	382-500-7-030R	482-500-7-030R
1/2	1/2	2-1/8	4	.060CR	382-500-5-060R	482-500-5-060R	--	382-500-7-060R	--
1/2	1/2	2-5/8	5	SQ	382-500-5-L	482-500-5-L	--	382-500-7-L	482-500-7-L
1/2	1/2	2-5/8	5	.015CR	382-500-5-L-015R	482-500-5-L-015R	--	382-500-7-L-015R	482-500-7-L-015R
1/2	1/2	2-5/8	5	.030CR	382-500-5-L-030R	482-500-5-L-030R	--	382-500-7-L-030R	482-500-7-L-030R
1/2	1/2	2-5/8	5	.060CR	382-500-5-L-060R	482-500-5-L-060R	--	382-500-7-L-060R	--
5/8	5/8	2-1/2	5	SQ	382-625-5	482-625-5	--	382-625-7	482-625-7
5/8	5/8	2-1/2	5	.030CR	382-625-5-030R	482-625-5-030R	--	382-625-7-030R	482-625-7-030R
5/8	5/8	2-1/2	5	.060CR	382-625-5-060R	482-625-5-060R	--	382-625-7-060R	--
3/4	3/4	2-1/2	5	SQ	382-750-5	482-750-5	--	382-750-7	482-750-7
3/4	3/4	2-1/2	5	.030CR	382-750-5-030R	482-750-5-030R	--	382-750-7-030R	482-750-7-030R
3/4	3/4	2-1/2	5	.060CR	382-750-5-060R	--	--	382-750-7-060R	--
1	1	2-5/8	5	SQ	382-100-5	482-100-5	--	382-100-7	482-100-7
1	1	2-5/8	5	.030CR	382-100-5-030R	482-100-5-030R	--	382-100-7-030R	482-100-7-030R
1	1	2-5/8	5	.060CR	382-100-5-060R	--	--	382-100-7-060R	--



### ULTRA HIGH PERFORMANCE Variable Pitch Carbide, Extra Long Length, Single End - HEM

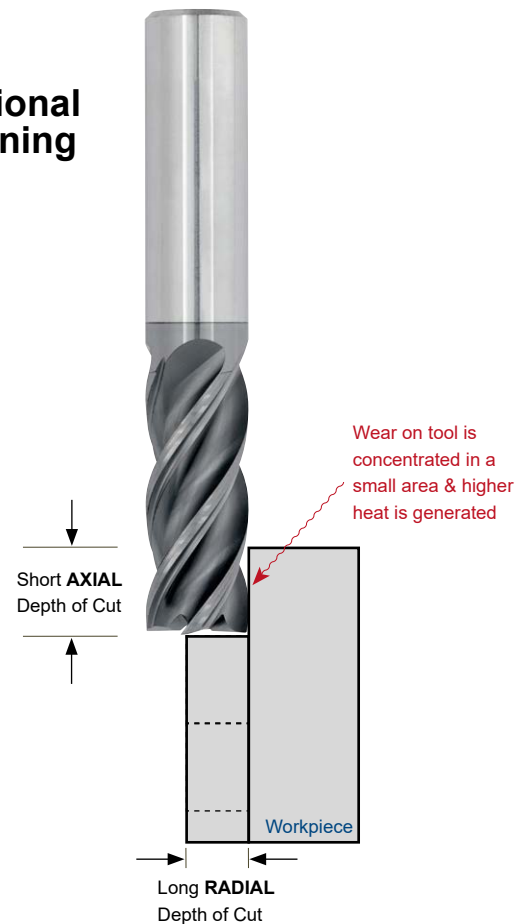
Cutter Diam. D	Shank Diam. d	Length Of Cut l <sub>i</sub>	O.A.L. L	Corner Radius	ALL4 Coated				
					5 Flute Part#	5 Flute Chipbreaker Part#	6 Flute Part#	7 Flute Part#	7 Flute Chipbreaker Part#
5/16	5/16	2-1/8	4	SQ	388-312-5	--	--	--	--
5/16	5/16	2-1/8	4	.015CR	388-312-5-015R	--	--	--	--
5/16	5/16	2-1/8	4	.030CR	388-312-5-030R	--	--	--	--
3/8	3/8	2-1/8	4	SQ	388-375-5	488-375-5	--	--	--
3/8	3/8	2-1/8	4	.015CR	388-375-5-015R	488-375-5-015R	--	--	--
3/8	3/8	2-1/8	4	.030CR	388-375-5-030R	488-375-5-030R	--	--	--
1/2	1/2	3-1/4	6	SQ	388-500-5	488-500-5	--	388-500-7	488-500-7
1/2	1/2	3-1/4	6	.015CR	388-500-5-015R	488-500-5-015R	--	388-500-7-015R	488-500-7-015R
1/2	1/2	3-1/4	6	.030CR	388-500-5-030R	488-500-5-030R	--	388-500-7-030R	488-500-7-030R
1/2	1/2	3-1/4	6	.060CR	388-500-5-060R	488-500-5-060R	--	388-500-7-060R	--
5/8	5/8	3-1/4	6	SQ	388-625-5	488-625-5	--	388-625-7	488-625-7
5/8	5/8	3-1/4	6	.030CR	388-625-5-030R	488-625-5-030R	--	388-625-7-030R	488-625-7-030R
5/8	5/8	3-1/4	6	.060CR	388-625-5-060R	488-625-5-060R	--	388-625-7-060R	--
3/4	3/4	3-1/4	6	SQ	388-750-5	488-750-5	--	388-750-7	488-750-7
3/4	3/4	3-1/4	6	.030CR	388-750-5-030R	488-750-5-030R	--	388-750-7-030R	488-750-7-030R
3/4	3/4	3-1/4	6	.060CR	388-750-5-060R	--	--	388-750-7-060R	--
1	1	3-1/4	6	SQ	388-100-5	488-100-5	--	388-100-7	488-100-7
1	1	3-1/4	6	.030CR	388-100-5-030R	488-100-5-030R	--	388-100-7-030R	488-100-7-030R
1	1	3-1/4	6	.060CR	388-100-5-060R	--	--	388-100-7-060R	--

**ULTRA HIGH PERFORMANCE HEM FEATURES:**

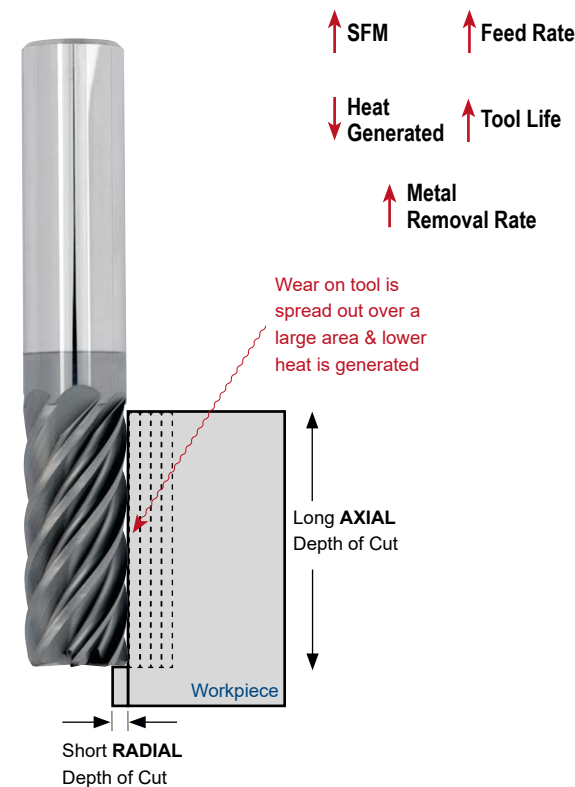
- 1 Special Tapered Core** - Increases tool stiffness
- 2 Ultra High Performance Micrograin Carbide** - Exceptional tool life
- 3 Variable Pitch** - Reduces harmonic vibration & increases tool life & surface finish
- 4 Finishers** - When exceptional finishes are required and chip lengths aren't an issue
- 5 Unique Chipbreakers** - A must in slotting & pocketing applications to clear chips. Keeps chip augers & conveyors from getting clogged too
- 6 ALL4 Coating** - Premium coating provides extremely high tool life
- 7 Proprietary Edge Honing** - Provides quiet cutting & long tool life



**Traditional Machining**



**High Efficiency Machining (HEM)**



**SPEED & FEED RECOMMENDATIONS**

**ULTRA HIGH PERFORMANCE HEM**

Material	Speed (SFM)	Feed Per Tooth By End Mill Diameter*								
	ALL4 Coated	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"	1"	
Iron, Cast (soft)	K	375-950	.0030	.0032	.0035	.0037	.0040	.0045	.0070	.0090
Iron, Cast (hard)		150-475	.0018	.0020	.0025	.0027	.0030	.0035	.0040	.0050
Iron, Ductile		200-900	.0020	.0022	.0025	.0027	.0030	.0040	.0050	.0070
Iron, Malleable		275-850	.0020	.0025	.0030	.0035	.0040	.0050	.0060	.0080
Carbon Steels, Low	P	350-900	.0020	.0025	.0030	.0035	.0040	.0050	.0060	.0080
Carbon Steels, Medium		200-675	.0025	.0026	.0027	.0028	.0030	.0040	.0050	.0060
Carbon Steels Hardened to 35 Rc		190-545	.0020	.0021	.0022	.0023	.0025	.0027	.0030	.0040
Carbon Steels Hardened to 50 Rc		90-275	.0012	.0012	.0013	.0014	.0015	.0026	.0030	.0035
Carbon Steels Hardened to 60 Rc		--	--	--	--	--	--	--	--	
Steels, Mold	M	300-725	.0020	.0022	.0025	.0027	.0030	.0035	.0040	.0050
Steels, Tool		175-525	.0020	.0022	.0025	.0027	.0030	.0035	.0040	.0050
Stainless Steels, Soft	S	300-525	.0020	.0022	.0025	.0022	.0030	.0040	.0050	.0070
Stainless Steels, Hard		150-475	.0015	.0016	.0017	.0018	.0020	.0030	.0040	.0060
Monel & High Nickel Steel		75-250	.0015	.0022	.0025	.0027	.0030	.0035	.0040	.0050
Titanium, Soft		125-425	.0015	.0022	.0025	.0027	.0030	.0040	.0050	.0070
Titanium, Hard		50-195	.0010	.0016	.0017	.0018	.0020	.0022	.0026	.0030
Nickel Based High Temp Alloys		50-175	.0014	.0014	.0015	.0016	.0017	.0018	.0020	.0023

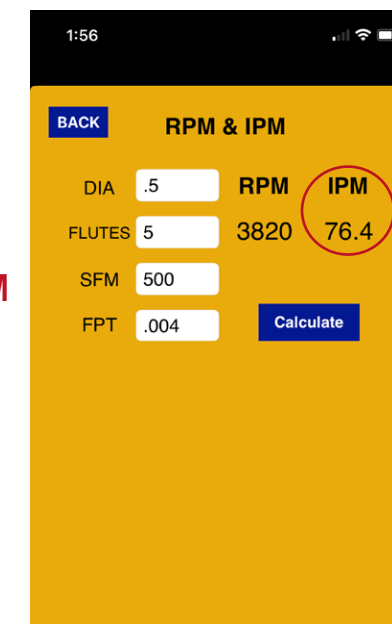
\* When using HEM techniques, the above feed per tooth must be used in a Radial Chip Thinning Factor (RCTF), formula to assure the proper programmed feed is calculated. Most machinist apps available online will have this.

Example below demonstrates the importance of RCTF calculations:

*1/2" Diameter 5 Flute Machining Low Carbon Steel using 500 SFM & .0040" feed per tooth from the chart above with Traditional & HEM techniques. The HEM application will use .025" Radial Depths of Cut*

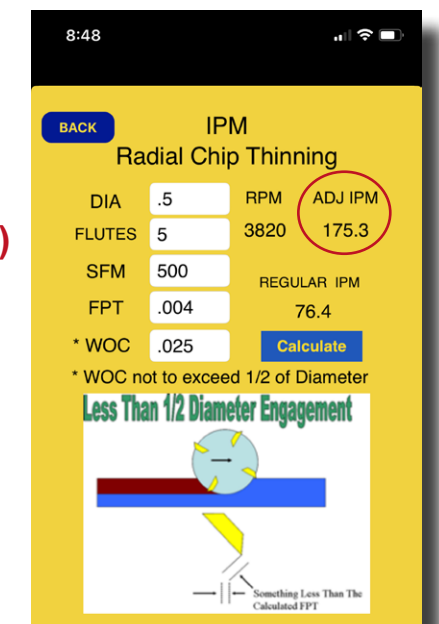
**Traditional Machining**

**Result = 76.4 IPM**



**High Efficiency Machining (HEM)**

**Result = 175.3 IPM**

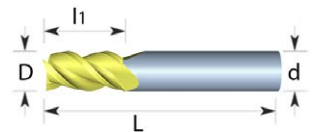




P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
H	Hardened Steel

### UHP - Aluminum Medium/Rougher

- Special 36 Degree Helix Design with Cylindrical Margin
- Ultra High Performance Micrograin Carbide
- 3 Flute Variable Pitch & Special Core Design with Chipbreaker
- Diameter (D) Tolerance: +0.0000"/-0.0004"
- Flute Geometries, with High Polished finish
- Shank (d) Tolerance: +0.0000"/-0.0004"



#### ULTRA HIGH PERFORMANCE 3Flute Medium/Roughing - ALUMINUM

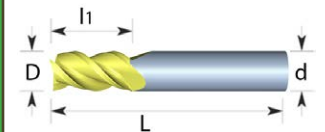
Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Corner Radius	Uncoated		ZrN Coated	
					3 Flute Part#	3 Flute Chipbreaker Part#	3 Flute Part#	3 Flute Chipbreaker Part#
1/4	1/4	3/4	2-1/2	SQ	370-250-3	--	470-250-3	--
1/4	1/4	3/4	2-1/2	.015CR	370-250-3-015R	--	470-250-3-015R	--
1/4	1/4	3/4	2-1/2	.030CR	370-250-3-030R	--	--	--
1/4	1/4	3/4	2-1/2	.060CR	370-250-3-060R	--	--	--
5/16	5/16	13/16	2-1/2	SQ	370-312-3	--	470-312-3	--
5/16	5/16	13/16	2-1/2	.030CR	370-312-3-030R	--	470-312-3-030R	--
5/16	5/16	13/16	2-1/2	.060CR	370-312-3-060R	--	--	--
3/8	3/8	1	2-1/2	SQ	370-375-3	--	470-375-3	--
3/8	3/8	1	2-1/2	.030CR	370-375-3-030R	570-375-3-030R	470-375-3-030R	670-375-3-030R
3/8	3/8	1	2-1/2	.060CR	370-375-3-060R	--	--	--
3/8	3/8	1-1/8	3	SQ	372-375-3	--	472-375-3	--
3/8	3/8	1-1/8	3	.030CR	372-375-3-030R	572-375-3-030R	472-375-3-030R	672-375-3-030R
1/2	1/2	1-1/4	3	SQ	370-500-3	--	470-500-3	--
1/2	1/2	1-1/4	3	.030CR	370-500-3-030R	570-500-3-030R	470-500-3-030R	670-500-3-030R
1/2	1/2	1-1/4	3	.060CR	370-500-3-060R	--	--	--
1/2	1/2	1-1/4	3	.090CR	370-500-3-090R	--	--	--
1/2	1/2	1-1/4	3	.120CR	370-500-3-120R	--	--	--
1/2	1/2	2	4	SQ	372-500-3	--	472-500-3	--
1/2	1/2	2	4	.030CR	372-500-3-030R	572-500-3-030R	472-500-3-030R	672-500-3-030R
5/8	5/8	1-1/4	3-1/2	SQ	370-625-3	--	470-625-3	--
5/8	5/8	1-1/4	3-1/2	.030CR	370-625-3-030R	570-625-3-030R	470-625-3-030R	670-625-3-030R
5/8	5/8	1-1/4	3-1/2	.060CR	370-625-3-060R	--	--	--
5/8	5/8	1-1/4	3-1/2	.090CR	370-625-3-090R	--	--	--
5/8	5/8	1-1/4	3-1/2	.120CR	370-625-3-120R	--	--	--
5/8	5/8	2-1/4	5	SQ	372-625-3	--	472-625-3	--
5/8	5/8	2-1/4	5	.030CR	372-625-3-030R	572-625-3-030R	472-625-3-030R	672-625-3-030R
3/4	3/4	1-5/8	4	SQ	370-750-3	--	470-750-3	--
3/4	3/4	1-5/8	4	.030CR	370-750-3-030R	570-750-3-030R	470-750-3-030R	670-750-3-030R
3/4	3/4	1-5/8	4	.060CR	370-750-3-060R	--	--	--
3/4	3/4	1-5/8	4	.090CR	370-750-3-090R	--	--	--
3/4	3/4	1-5/8	4	.120CR	370-750-3-120R	--	--	--
3/4	3/4	2-1/4	5	SQ	372-750-3	--	472-750-3	--
3/4	3/4	2-1/4	5	.030CR	372-750-3-030R	572-750-3-030R	472-750-3-030R	672-750-3-030R
1	1	1-1/2	4	SQ	370-100-3	--	470-100-3	--
1	1	1-1/2	4	.030CR	370-100-3-030R	570-100-3-030R	470-100-3-030R	670-100-3-030R
1	1	1-1/2	4	.060CR	370-100-3-060R	--	--	--
1	1	1-1/2	4	.120CR	370-100-3-120R	--	--	--
1	1	2-1/4	5	SQ	372-100-3	--	472-100-3	--
1	1	2-1/4	5	.030CR	372-100-3-030R	572-100-3-030R	472-100-3-030R	672-100-3-030R



P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
H	Hardened Steel

### UHP - Aluminum Medium/Finisher

- Special 45 Degree Helix Design with Cylindrical Margin
- Ultra High Performance Micrograin Carbide
- Variable Pitch & Special Core Design with Chipbreaker Flute
- Diameter (D) Tolerance: +0.0000"/-0.0004"
- Geometries, with High Polished finish
- Shank (d) Tolerance: +0.0000"/-0.0004"



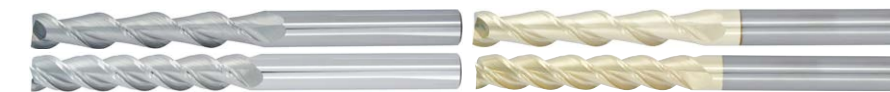
#### ULTRA HIGH PERFORMANCE Medium/Finishing, Regular Length, Single End - ALUMINUM

Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Corner Radius	Uncoated		ZrN Coated		DLC Coated	
					2 Flute Part#	3 Flute Part#	2 Flute Part#	3 Flute Part#	2 Flute Part#	3 Flute Part#
1/8	1/8	1/2	1-1/2	SQ	170-125-2	170-125-3	--	--	--	--
3/16	3/16	5/8	2	SQ	170-188-2	170-188-3	070-188-2	070-188-3	270-188-2	270-188-3
1/4	1/4	3/4	2-1/2	SQ	170-250-2	170-250-3	070-250-2	070-250-3	270-250-2	270-250-3
1/4	1/4	3/4	2-1/2	.020CR	170-250-2-020R	170-250-3-020R	070-250-2-020R	070-250-3-020R	270-250-2-020R	270-250-3-020R
5/16	5/16	13/16	2-1/2	SQ	170-312-2	170-312-3	070-312-2	070-312-3	270-312-2	270-312-3
5/16	5/16	13/16	2-1/2	.020CR	170-312-2-020R	170-312-3-020R	070-312-2-020R	070-312-3-020R	270-312-2-020R	270-312-3-020R
3/8	3/8	1	2-1/2	SQ	170-375-2	170-375-3	070-375-2	070-375-3	270-375-2	270-375-3
3/8	3/8	1	2-1/2	.020CR	170-375-2-020R	170-375-3-020R	070-375-2-020R	070-375-3-020R	270-375-2-020R	270-375-3-020R
1/2	1/2	1-1/4	3	SQ	170-500-2	170-500-3	070-500-2	070-500-3	270-500-2	270-500-3
1/2	1/2	1-1/4	3	.030CR	170-500-2-030R	170-500-3-030R	070-500-2-030R	070-500-3-030R	270-500-2-030R	270-500-3-030R
5/8	5/8	1-1/4	3-1/2	SQ	170-625-2	170-625-3	070-625-2	070-625-3	270-625-2	270-625-3
5/8	5/8	1-1/4	3-1/2	.030CR	170-625-2-030R	170-625-3-030R	070-625-2-030R	070-625-3-030R	270-625-2-030R	270-625-3-030R
3/4	3/4	1-1/2	4	SQ	170-750-2	170-750-3	070-750-2	070-750-3	270-750-2	270-750-3
3/4	3/4	1-1/2	4	.030CR	170-750-2-030R	170-750-3-030R	070-750-2-030R	070-750-3-030R	270-750-2-030R	270-750-3-030R
1	1	1-1/2	4	SQ	170-100-2	170-100-3	070-100-2	070-100-3	270-100-2	270-100-3
1	1	1-1/2	4	.030CR	170-100-2-030R	170-100-3-030R	070-100-2-030R	070-100-3-030R	270-100-2-030R	270-100-3-030R



#### ULTRA HIGH PERFORMANCE Medium/Finishing, Long Length, Single End - ALUMINUM

Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Corner Radius	Uncoated		ZrN Coated	
					2 Flute Part#	3 Flute Part#	2 Flute Part#	3 Flute Part#
3/16	3/16	3/4	2-1/2	SQ	172-188-2	172-188-3	072-188-2	072-188-3
1/4	1/4	1-1/8	3	SQ	172-250-2	172-250-3	072-250-2	072-250-3
5/16	5/16	1-1/8	3	SQ	172-312-2	172-312-3	072-312-2	072-312-3
3/8	3/8	1-1/8	3	SQ	172-375-2	172-375-3	072-375-2	072-375-3
1/2	1/2	2	4	SQ	172-500-2	172-500-3	072-500-2	072-500-3
5/8	5/8	2-1/4	5	SQ	172-625-2	172-625-3	072-625-2	072-625-3
3/4	3/4	2-1/4	5	SQ	172-750-2	172-750-3	072-750-2	072-750-3
1	1	2-1/4	5	SQ	172-100-2	172-100-3	072-100-2	072-100-3



#### ULTRA HIGH PERFORMANCE Medium/Finishing, Extra Long Length, Single End - ALUMINUM

Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Corner Radius	Uncoated		ZrN Coated	
					2 Flute Part#	3 Flute Part#	2 Flute Part#	3 Flute Part#
3/16	3/16	1-1/8	3	SQ	178-188-2	178-188-3	078-188-2	078-188-3
1/4	1/4	1-1/2	4	SQ	178-250-2	178-250-3	078-250-2	078-250-3
5/16	5/16	1-5/8	4	SQ	178-312-2	178-312-3	078-312-2	078-312-3
3/8	3/8	1-3/4	4	SQ	178-375-2	178-375-3	078-375-2	078-375-3
1/2	1/2	3	6	SQ	178-500-2	178-500-3	078-500-2	078-500-3
5/8	5/8	3	6	SQ	178-625-2	178-625-3	078-625-2	078-625-3
3/4	3/4	3	6	SQ	178-750-2	178-750-3	078-750-2	078-750-3
1	1	3	6	SQ	178-100-2	178-100-3	078-100-2	078-100-3

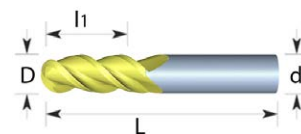


P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
H	Hardened Steel

• Special 45 Degree Helix Design with Cylindrical Margin  
 • Variable Pitch & Special Core Design with Chipbreaker Flute Geometries, with High Polished finish

### UHP- Aluminum

• Ultra High Performance Micrograin Carbide  
 • Diameter (D) Tolerance: +0.0000"/-0.0004"  
 • Shank (d) Tolerance: +0.0000"/-0.0004"



#### ULTRA HIGH PERFORMANCE Medium/Finishing, Ball Nose, Regular Length, Single End - ALUMINUM

Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Corner Radius BN	Uncoated		ZrN Coated	
					2 Flute	3 Flute	2 Flute	3 Flute
					Part#	Part#	Part#	Part#
3/16	3/16	5/8	2	BN	174-188-2	174-188-3	074-188-2	074-188-3
1/4	1/4	3/4	2-1/2	BN	174-250-2	174-250-3	074-250-2	074-250-3
5/16	5/16	13/16	2-1/2	BN	174-312-2	174-312-3	074-312-2	074-312-3
3/8	3/8	1	2-1/2	BN	174-375-2	174-375-3	074-375-2	074-375-3
1/2	1/2	1-1/4	3	BN	174-500-2	174-500-3	074-500-2	074-500-3
5/8	5/8	1-1/4	3-1/2	BN	174-625-2	174-625-3	074-625-2	074-625-3
3/4	3/4	1-1/2	4	BN	174-750-2	174-750-3	074-750-2	074-750-3
1	1	1-1/2	4	BN	174-100-2	174-100-3	074-100-2	074-100-3



#### ULTRA HIGH PERFORMANCE Medium/Finishing, Ball Nose, Long Length, Single End - ALUMINUM

Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Corner Radius BN	Uncoated		ZrN Coated	
					2 Flute	3 Flute	2 Flute	3 Flute
					Part#	Part#	Part#	Part#
3/16	3/16	3/4	2-1/2	BN	176-188-2	176-188-3	076-188-2	076-188-3
1/4	1/4	1-1/8	3	BN	176-250-2	176-250-3	076-250-2	076-250-3
5/16	5/16	1-1/8	3	BN	176-312-2	176-312-3	076-312-2	076-312-3
3/8	3/8	1-1/8	3	BN	176-375-2	176-375-3	076-375-2	076-375-3
1/2	1/2	2	4	BN	176-500-2	176-500-3	076-500-2	076-500-3
5/8	5/8	2-1/4	5	BN	176-625-2	176-625-3	076-625-2	076-625-3
3/4	3/4	2-1/4	5	BN	176-750-2	176-750-3	076-750-2	076-750-3
1	1	2-1/4	5	BN	176-100-2	176-100-3	076-100-2	076-100-3



#### ULTRA HIGH PERFORMANCE Medium/Finishing, Ball Nose, Extra Long Length, Single End - ALUMINUM

Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Corner Radius BN	Uncoated		ZrN Coated	
					2 Flute	3 Flute	2 Flute	3 Flute
					Part#	Part#	Part#	Part#
3/16	3/16	1-1/8	3	BN	179-188-2	179-188-3	079-188-2	079-188-3
1/4	1/4	1-1/2	4	BN	179-250-2	179-250-3	079-250-2	079-250-3
5/16	5/16	1-5/8	4	BN	179-312-2	179-312-3	079-312-2	079-312-3
3/8	3/8	1-3/4	4	BN	179-375-2	179-375-3	079-375-2	079-375-3
1/2	1/2	3	6	BN	179-500-2	179-500-3	079-500-2	079-500-3
5/8	5/8	3	6	BN	179-625-2	179-625-3	079-625-2	079-625-3
3/4	3/4	3	6	BN	179-750-2	179-750-3	079-750-2	079-750-3
1	1	3	6	BN	179-100-2	179-100-3	079-100-2	079-100-3

## SPEED & FEED RECOMMENDATIONS

### ULTRA HIGH PERFORMANCE - Aluminum

Material	Speed (SFM)	Feed Per Tooth By End Mill Diameter							
		ZrN Coated	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"
Aluminum & Aluminum Alloys	900-1800	.0030	.0035	.0040	.0045	.0050	.0060	.0070	.0090
Copper & Copper Alloys	525-1275	.0030	.0035	.0035	.0040	.0040	.0045	.0050	.0070
Brass & Bronze	375-600	.0030	.0035	.0035	.0040	.0040	.0045	.0050	.0060
Graphite	500-1200	.0040	.0045	.0045	.0045	.0045	.0050	.0060	.0080
Plastics	600-1650	.0040	.0045	.0050	.0060	.0070	.0090	.0110	.0160
Iron, Cast (soft)	--	--	--	--	--	--	--	--	--
Iron, Cast (hard)	--	--	--	--	--	--	--	--	--
Iron, Ductile	--	--	--	--	--	--	--	--	--
Iron, Malleable	--	--	--	--	--	--	--	--	--
Carbon Steels, Low	--	--	--	--	--	--	--	--	--
Carbon Steels, Medium	--	--	--	--	--	--	--	--	--
Carbon Steels Hardened to 35 Rc	--	--	--	--	--	--	--	--	--
Carbon Steels Hardened to 50 Rc	--	--	--	--	--	--	--	--	--
Carbon Steels Hardened to 60 Rc	--	--	--	--	--	--	--	--	--
Steels, Mold	--	--	--	--	--	--	--	--	--
Steels, Tool	--	--	--	--	--	--	--	--	--
Stainless Steels, Soft	--	--	--	--	--	--	--	--	--
Stainless Steels, Hard	--	--	--	--	--	--	--	--	--
Monel & High Nickel Steel	--	--	--	--	--	--	--	--	--
Titanium, Soft	--	--	--	--	--	--	--	--	--
Titanium, Hard	--	--	--	--	--	--	--	--	--
Nickel Based High Temp Alloys	--	--	--	--	--	--	--	--	--



• Higher Feed Per Tooth should be used to start for radial depths of cut less than 25% of the tool diameter. Lower Feed Per Tooth should be used to start for radial depths of cut greater than 25% of the tool diameter.

• The above recommendations are for axial lengths of cut not to exceed 1.5 times the tool diameter for profiling and 1 times the diameter for full slotting.

• The above parameters are recommended starting points only. If the tool is working well, without vibrations or significant noise, increase the SFM and/or Feed Per Tooth in 5-10% increments.

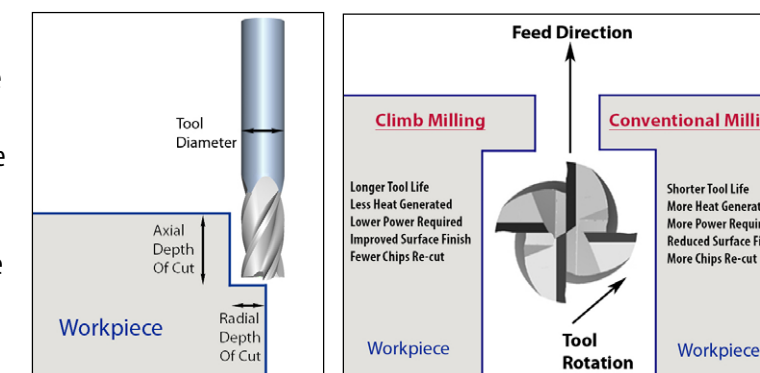
• Optimum speeds & feeds will depend upon material, setup, machine conditions & tool deflection. Higher or lower parameters may be required to achieve optimum machining conditions.

• For Light Radial Depths of cut, make certain to increase the feed rate to compensate for Radial Chip Thinning Factor (RCTF). Consult a formula or app to calculate.

• Climb Milling is preferred to Conventional Milling

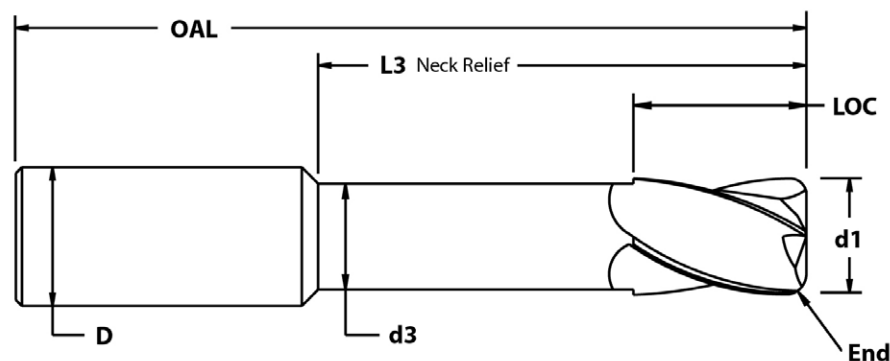
$$RPM = \frac{SFM}{(3.146 * \text{Cutter Diam.}) / 12}$$

$$IPM = RPM * \text{Feed Per Tooth} * \# \text{ of Teeth}$$





## CUSTOM CARBIDE END MILL FORM



### End:

- Square
- Ball Nose
- Corner Radius (Size: \_\_\_\_\_)
- Chamfer (Size: \_\_\_\_\_)

### Dimensions:

- OAL (Overall Length): \_\_\_\_\_
- D (Shank Diameter): \_\_\_\_\_
- LOC (Length of Cut): \_\_\_\_\_
- d1 (Tool Diameter): \_\_\_\_\_
- Number of Flutes: \_\_\_\_\_

### Series:

- GENERAL PURPOSE
- HIGH PERFORMANCE
- ULTRA HIGH PERFORMANCE
- ULTRA HIGH PERFORMANCE - Aluminum

### Special Minimum Order Quantities

Tool Diameter Range	Minimum Order Qty.
Under 3/16" (4mm)	Not Available
3/16"-1/4" (4mm-6mm)	20
5/16"-3/8" (7mm-10mm)	15
7/16"-1/2" (11mm-12mm)	10
9/16"-3/4" (13mm-20mm)	5
7/8"-1" (25mm)	3

## OPTIONAL:

### Neck Relief:

- No
- Yes
- d3 (Neck Relief Diameter): \_\_\_\_\_
- L3 (Length from Tip): \_\_\_\_\_



### Shank Type:

- Cylindrical
- Weldon Flat

### Tapered:

- No
- Yes
- Taper Angle (Indicate if angle is per side or included): \_\_\_\_\_
- d1 (Tip Diameter): \_\_\_\_\_

### Coating:

- Uncoated
- ALL4 (Aluminum Chromium Titanium Nitride)
- ZrN (Zirconium Nitride)
- DLC (Diamond Like Carbon)

## OTHER INFORMATION:

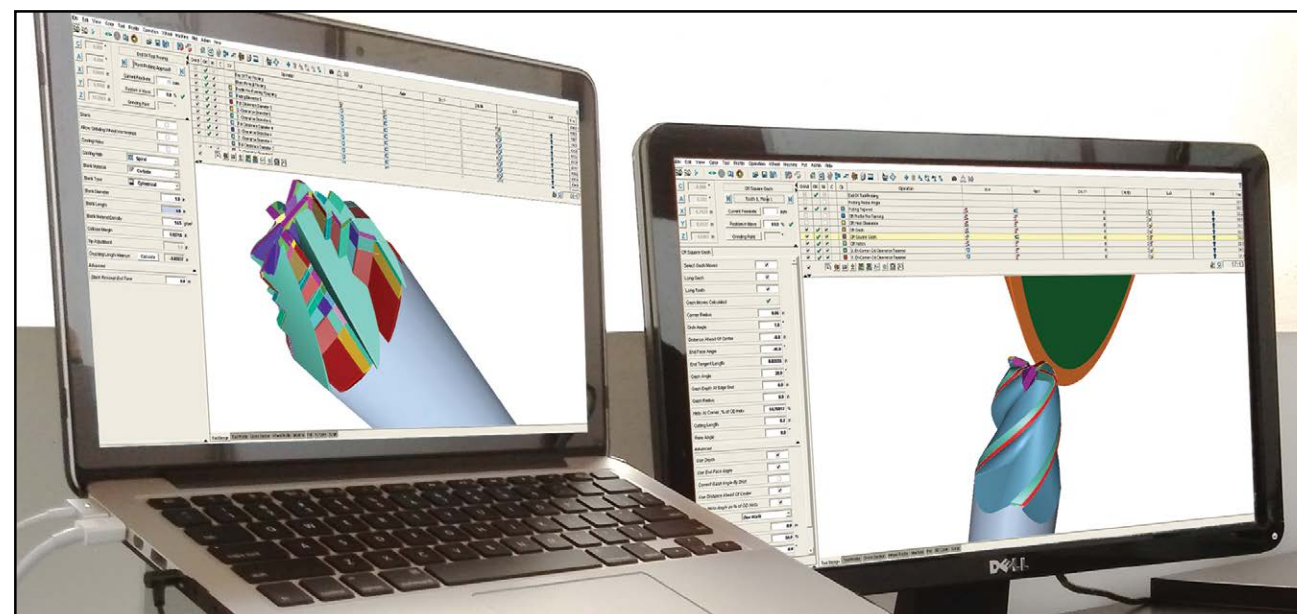
- Material(s) being machined: \_\_\_\_\_
- Current Speed: \_\_\_\_\_ Radial DOC.: \_\_\_\_\_
- Current Feed: \_\_\_\_\_ Axial DOC.: \_\_\_\_\_
- End User Company Name: \_\_\_\_\_
- End User Contact: \_\_\_\_\_
- Other Information: \_\_\_\_\_



## ADDITIONAL SERVICES

### SPECIALS & ENGINEERED SOLUTIONS

- Don't see what you need? Let us know what you would like and we would be happy to quote on it!
- Engineered solutions based on your applications. Allow our technical experience to design the tool that works best for your unique application.
- Quick turnaround time from concept to your spindle.



### REGRINDING SERVICES:

- Extremely high precision work on 5 Axis CNC Tool & Cutter Grinders, allowing your used tools to be brought back to better-than-new condition in many cases.
- Quick turnaround times.
- Tools are measured, labelled with new size, and repackaged in new plastic tubes.
- Tools reground include HSS & Carbide:
  - Endmills
  - HSS Drills
  - Reamers
  - Countersinks
  - Counterbores
  - High Performance Carbide Drills
  - Annular Cutters
  - Spot Drills

BEFORE



AFTER



Bring Them Back To Life At A Fraction Of The Price!

### COMPLETE COATING SERVICES:

- The most state of the art PVD coatings on the World's Leading Equipment
- Ultra High Performance Coatings on new tools & regrinds
- Extremely quick turn around times





# EVOLUTION

Solid Carbide Endmills 



Email: [sales@omnitool.ca](mailto:sales@omnitool.ca)  
Tel: (519) 622-3065 | Fax: (519) 622-3270  
[www.omnitool.ca](http://www.omnitool.ca)

284 Pinebush Rd, Unit 1, Cambridge ON N1T 1Z6

# DURAMILL

INDUSTRIAL SUPPLIES

Email: [sales@duramill.ca](mailto:sales@duramill.ca)  
Tel: (416) 661-7809 | Fax: (905) 738-4862  
[www.duramill.ca](http://www.duramill.ca)

6877 Edwards Blvd, Mississauga, ON L5T 2T9