



®

**SOLID
CARBIDE
END MILLS**

2024-2025

www.onlinesupply.ca



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
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N	○	Non-Ferrous
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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

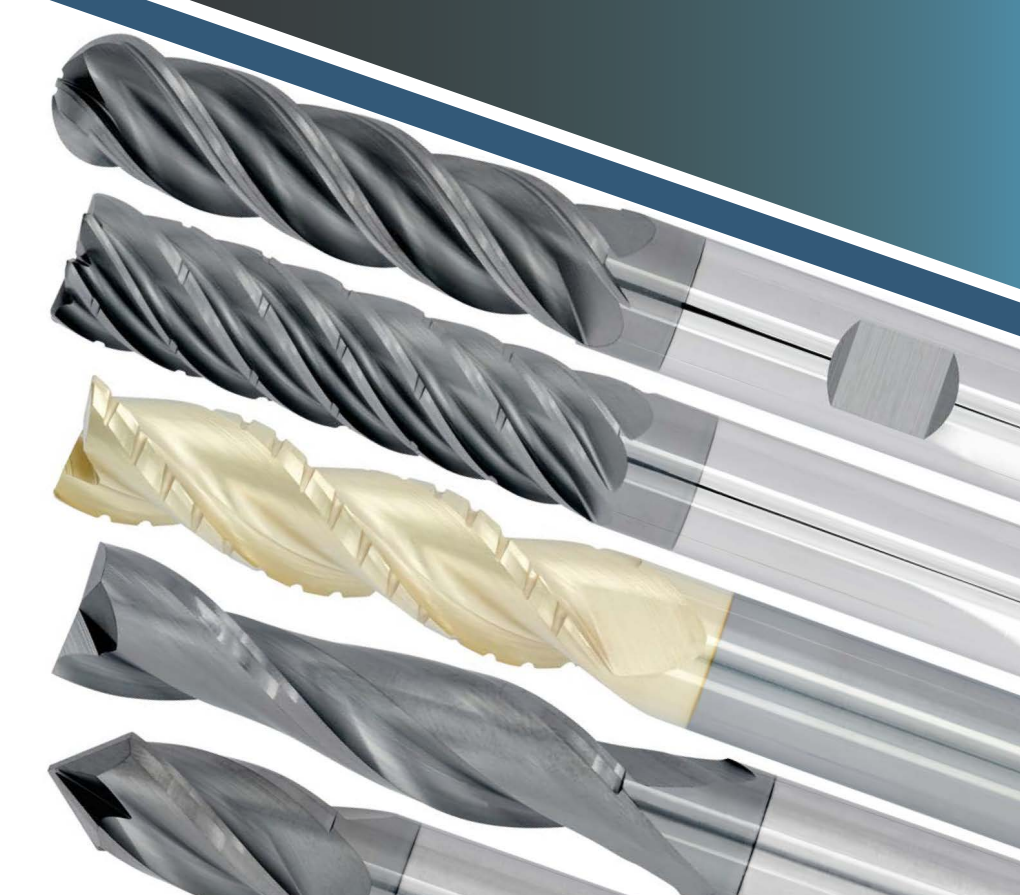
- Special Helix Design with Cylindrical Margin for improved stability in Aluminum & Non-Ferrous materials
- Variable Pitch to reduce chatter with special core design & chip breaker flute geometry
- Ultra High Performance Micrograin Carbide with special High Polished Finish to prevent built up edge
- 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 ○ OK ○ NOT OPTIMAL		
























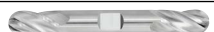












COATINGS:

- **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
GP	Standard Carbide, Stub Length , Square, Single End Uncoated	2,3,4		1
	Standard Carbide, Stub Length , Square, Single End, TiALN coated	2,3,4		1
	Standard Carbide, Regular Length , Square, Single End Uncoated	2,3,4		1,2
	Standard Carbide, Regular Length , Square, Single End, TiALN coated	2,3,4		1,2
	Standard Carbide, Long Length , Square, Single End Uncoated	2,4		3
	Standard Carbide, Long Length , Square, Single End, TiALN coated	2,4		3
	Standard Carbide, Extra Long Length , Square, Single End Uncoated	2,4		3
	Standard Carbide, Extra Long Length , Square, Single End, TiALN coated	2,4		3
	Standard Carbide, Stub Length , Ball Nose, Single End Uncoated	2,3,4		5
	Standard Carbide, Stub Length , Ball Nose, Single End, TiALN coated	2,3,4		5
	Standard Carbide, Regular Length , Ball Nose, Single End Uncoated	2,3,4		5,6
	Standard Carbide, Regular Length , Ball Nose, Single End, TiALN coated	2,3,4		5,6
	Standard Carbide, Long Length , Ball Nose, Single End Uncoated	2,4		7
	Standard Carbide, Long Length , Ball Nose, Single End, TiALN coated	2,4		7
	Standard Carbide, Extra Long Length , Ball Nose, Single End Uncoated	2,4		7
	Standard Carbide, Extra Long Length , Ball Nose, Single End, TiALN coated	2,4		7
	Standard Carbide, Stub Length , Square, Double End Uncoated	2,4		8
	Standard Carbide, Stub Length , Square, Double End, TiALN coated	2,4		8
	Standard Carbide, Stub Length , Ball Nose, Double End Uncoated	2,4		9
	Standard Carbide, Stub Length , Ball Nose, Double End, TiALN coated	2,4		9
	Standard Carbide, Regular Length , Square, Double End Uncoated	2,4		8
	Standard Carbide, Regular Length , Square, Double End, TiALN coated	2,4		8
	Standard Carbide, Regular Length , Ball Nose, Double End Uncoated	2,4		9
	Standard Carbide, Regular Length , Ball Nose, Double End, TiALN coated	2,4		9
	METRIC - Standard Carbide, Regular Length , Square, Single End Uncoated	2,3,4		4
	METRIC - Standard Carbide, Regular Length , Square, Single End, TiALN coated	2,3,4		4
	METRIC - Standard Carbide, Long Length , Square, Single End Uncoated	2,4		4
	METRIC - Standard Carbide, Long Length , Square, Single End, TiALN coated	2,4		4
	METRIC - Standard Carbide, Extra Long Length , Square, Single End Uncoated	2,4		4
	METRIC - Standard Carbide, Extra Long Length , Square, Single End, TiALN coated	2,4		4
	METRIC - Standard Carbide, Regular Length , Ball Nose, Single End Uncoated	2,3,4		7
	METRIC - Standard Carbide, Regular Length , Ball Nose, Single End, TiALN coated	2,3,4		7
Drill/Mill 90 Degree - Standard Carbide Uncoated	2,4		3	
Drill/Mill 90 Degree - Standard Carbide TiALN coated	2,4		3	
Engraving Tool - Standard Carbide TiALN coated, 30 Degree	1		8	
Spot Drill - Standard Carbide TiALN coated, 145 Degree Point	2		9	

GOOD

Speeds & Feed Chart - GENERAL PURPOSE

10

HP	High Performance Variable Pitch, Stub Length , Round Shk- TiALN	4		11
	High Performance Variable Pitch, Stub Length , Weldon Shk- TiALN	4		11
	High Performance Variable Pitch, Regular Length , Round Shk- TiALN NEW	4,5		11
	High Performance Variable Pitch, Regular Length , Weldon Shk- TiALN	4		11
	High Performance Variable Pitch, Long Length , Round Shk- TiALN NEW	4,5		12
	High Performance Variable Pitch, Long Length , Weldon Shk- TiALN	4		12
	High Performance Variable Pitch, Extra Long Length , Round Shk- TiALN NEW	4,5		12
	High Performance Variable Pitch, Regular Length , Ball Nose, Round Shk- TiALN	4		13
	High Performance Variable Pitch, Regular Length , Ball Nose, Weldon Shk- TiALN	4		13

BETTER

END MILL SERIES LISTING

Series	Description	Flutes		Pages
HP	High Performance Variable Pitch, Long Length , Ball Nose, Round Shk- TiALN	4		13
	High Performance Variable Pitch, Long Length , Ball Nose, Weldon Shk- TiALN	4		13
	High Performance Variable Pitch, Extra Long Length , Ball Nose, Round Shk- TiALN	4		13
	High Performance Variable Pitch, Long Reach Neck Relief , Round Shk- TiALN	4		14
	High Performance Variable Pitch, Long Reach Neck Relief , Ball Nose, Round Shk- TiALN	4		14
Speeds & Feed Chart - HIGH PERFORMANCE				15
UHP	ULTRA High Performance Variable Pitch, Stub Length , Round Shk- TiALN	4		17
	ULTRA High Performance Variable Pitch, Stub Length , Weldon Shk- TiALN	4		17
	ULTRA High Performance Variable Pitch, Regular Length , Round Shk- TiALN	4,5		17
	ULTRA High Performance Variable Pitch, Regular Length , Weldon Shk- TiALN	4		17
	ULTRA High Performance Variable Pitch, Long Length , Round Shk- TiALN	4,5		18
	ULTRA High Performance Variable Pitch, Long Length , Weldon Shk- TiALN	4		18
	ULTRA High Performance Variable Pitch, Extra Long Length , Round Shk- TiALN	4,5		18
	ULTRA High Performance Variable Pitch, Regular Length , Ball Nose, Round Shk- TiALN	4		19
	ULTRA High Performance Variable Pitch, Regular Length , Ball Nose, Weldon Shk- TiALN	4		19
	ULTRA High Performance Variable Pitch, Long Length , Ball Nose, Round Shk- TiALN	4		19
	ULTRA High Performance Variable Pitch, Long Length , Ball Nose, Weldon Shk- TiALN	4		19
	ULTRA High Performance Variable Pitch, Extra Long Length , Ball Nose, Round Shk- TiALN	4		19
UHP HEM	ULTRA High Performance Variable Pitch, Regular Length HEM , Round Shk- ALL4	5,6,7		21
	ULTRA High Performance Variable Pitch, Long Length HEM , Round Shk- ALL4	5,7		22
	ULTRA High Performance Variable Pitch, Extra Long Length HEM , Round Shk- ALL4	5,7		22
	ULTRA High Performance Variable Pitch, Regular Length HEM , Round Shk- ALL4 Chipbreaker	5,7		21
	ULTRA High Performance Variable Pitch, Long Length HEM , Round Shk- ALL4 Chipbreaker	5,7		22
	ULTRA High Performance Variable Pitch, Extra Long Length HEM , Round Shk- ALL4 Chipbreaker	5,7		22
Speeds & Feed Chart - ULTRA HIGH PERFORMANCE				20 & 24
ALU	Medium/Finishing Variable Pitch & Helix, Regular Length , Uncoated - ALUMINUM	2,3		26
	Medium/Finishing Variable Pitch & Helix, Regular Length , ZrN Coated - ALUMINUM	2,3		26
	Medium/Finishing Variable Pitch & Helix, Regular Length , DLC Coated - ALUMINUM	2,3		26
	Medium/Finishing Variable Pitch & Helix, Long Length , Uncoated - ALUMINUM	2,3		26
	Medium/Finishing Variable Pitch & Helix, Long Length , ZrN Coated - ALUMINUM	2,3		26
	Medium/Finishing Variable Pitch & Helix, Extra Long Length , Uncoated - ALUMINUM	2,3		26
	Medium/Finishing Variable Pitch & Helix, Extra Long Length , ZrN Coated - ALUMINUM	2,3		26
	Medium/Finishing Variable Pitch & Helix, Regular Length , Ball Nose Uncoated - ALUMINUM	2,3		27
	Medium/Finishing Variable Pitch & Helix, Regular Length , Ball Nose ZrN Coated - ALUMINUM	2,3		27
	Medium/Finishing Variable Pitch & Helix, Long Length , Ball Nose Uncoated - ALUMINUM	2,3		27
	Medium/Finishing Variable Pitch & Helix, Long Length , Ball Nose ZrN Coated - ALUMINUM	2,3		27
	Medium/Finishing Variable Pitch & Helix, Extra Long Length , Ball Nose Uncoated - ALUMINUM	2,3		27
	Medium/Finishing Variable Pitch & Helix, Extra Long Length , Ball Nose ZrN Coated - ALUMINUM	2,3		27
	Medium/Roughing Variable Pitch, Regular Length , Uncoated - ALUMINUM	3		25
	Medium/Roughing Variable Pitch, Regular Length , ZrN Coated - ALUMINUM	3		25
	Medium/Roughing Variable Pitch, Long Length , Uncoated - ALUMINUM	3		25
	Medium/Roughing Variable Pitch, Long Length , ZrN Coated - ALUMINUM	3		25
	Medium/Roughing Variable Pitch, Regular Length , Uncoated Chipbreaker - ALUMINUM	3		25
	Medium/Roughing Variable Pitch, Regular Length , ZrN Coated Chipbreaker - ALUMINUM	3		25
	Medium/Roughing Variable Pitch, Long Length , Uncoated Chipbreaker - ALUMINUM	3		25
Medium/Roughing Variable Pitch, Long Length , ZrN Coated Chipbreaker - ALUMINUM	3		25	
Speeds & Feed Chart - ULTRA HIGH PERFORMANCE - Aluminum				28

BETTER

BEST

BEST-Aluminum

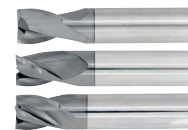
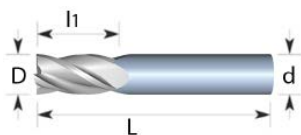


P	●	Steel
M	◐	Stainless Steel
K	●	Cast Iron
N	○	Non-Ferrous
S	●	High Temp. Alloys
H	●	Hardened Steel

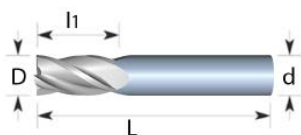
● GOOD ◐ OK ○ NOT OPTIMAL

- 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 l1	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	4321000	4321001	4321002	4321096	4321097	4321098
3/64	1/8	3/32	1-1/2	4321003	4321004	4321005	4321099	4321100	4321101
1/16	1/8	1/8	1-1/2	4321006	4321007	4321008	4321102	4321103	4321104
3/32	1/8	3/16	1-1/2	4321009	4321010	4321011	4321105	4321106	4321107
1/8	1/8	1/4	1-1/2	4321015	4321016	4321017	4321111	4321112	4321113
5/32	3/16	5/16	2	4321018	4321019	4321020	4321114	4321115	4321116
3/16	3/16	3/8	2	4321021	4321022	4321023	4321117	4321118	4321119
7/32	1/4	7/16	2	4321024	4321025	4321026	4321120	4321121	4321122
1/4	1/4	1/2	2	4321027	4321028	4321029	4321123	4321124	4321125
5/16	5/16	1/2	2	4321030	4321031	4321032	4321126	4321127	4321128
3/8	3/8	5/8	2	4321033	4321034	4321035	4321129	4321130	4321131
7/16	7/16	5/8	2-1/2	4321036	4321037	4321038	4321132	4321133	4321134
1/2	1/2	5/8	2-1/2	4321039	4321040	4321041	4321135	4321136	4321137
5/8	5/8	3/4	3	4321042	4321043	4321044	4321138	4321139	4321140
3/4	3/4	1	3	4321045	4321046	4321047	4321141	4321142	4321143
1	1	1	3	4321012	4321013	4321014	4321108	4321109	_____



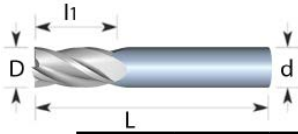
Square End, Standard Carbide, Regular Length, Single End									
Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Uncoated			TiAlN Coated		
				2 Flute Part#	3 Flute Part#	4 Flute Part#	2 Flute Part#	3 Flute Part#	4 Flute Part#
1/32	1/8	3/32	1-1/2	4321147	4321148	4321149	4321543	4321544	4321545
3/64	1/8	1/8	1-1/2	4321150	4321151	4321152	4321546	4321547	4321548
1/16	1/8	3/16	1-1/2	4321153	4321154	4321155	4321549	4321550	4321551
5/64	1/8	1/4	1-1/2	4321156	4321157	4321158	4321552	4321553	4321554
3/32	1/8	3/8	1-1/2	4321159	4321160	4321161	4321555	4321556	4321557
7/64	1/8	3/8	1-1/2	4321166	4321167	4321168	4321562	4321563	4321564
1/8	1/8	1/2	1-1/2	4321169	4321170	4321171	4321565	4321566	4321567
9/64	3/16	9/16	2	4321173	4321174	4321175	4321569	4321570	4321571
5/32	3/16	9/16	2	4321176	4321177	4321178	4321572	4321573	4321574
11/64	3/16	9/16	2	4321179	4321180	4321181	4321575	4321576	4321577
3/16	3/16	5/8	2	4321182	4321183	4321184	4321578	4321579	4321580
13/64	1/4	5/8	2-1/2	4321186	4321187	4321188	4321582	4321583	4321584
7/32	1/4	5/8	2-1/2	4321189	4321190	4321191	4321585	4321586	4321587
15/64	1/4	3/4	2-1/2	4321192	4321193	4321194	4321588	4321589	4321590
1/4	1/4	3/4	2-1/2	4321195	4321196	4321197	4321591	4321592	4321593



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 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#
17/64	5/16	7/8	2-1/2	4321199	4321200	4321201	4321595	4321596	4321597
9/32	5/16	7/8	2-1/2	4321202	4321203	4321204	4321598	4321599	4321600
19/64	5/16	7/8	2-1/2	4321205	4321206	4321207	4321601	4321602	4321603
5/16	5/16	7/8	2-1/2	4321208	4321209	4321210	4321604	4321605	4321606
21/64	3/8	7/8	2-1/2	4321212	4321213	4321214	4321608	4321609	4321610
11/32	3/8	7/8	2-1/2	4321215	4321216	4321217	4321611	4321612	4321613
23/64	3/8	7/8	2-1/2	4321218	4321219	4321220	4321614	4321615	4321616
3/8	3/8	1	2-1/2	4321221	4321222	4321223	4321617	4321618	4321619
25/64	7/16	1	2-1/2	4321225	4321226	4321227	4321621	4321622	4321623
13/32	7/16	1	2-1/2	4321228	4321229	4321230	4321624	4321625	4321626
27/64	7/16	1	2-1/2	4321231	4321232	4321233	4321627	4321628	4321629
7/16	7/16	1	2-1/2	4321234	4321235	4321236	4321630	4321631	4321632
29/64	1/2	1	3	4321238	4321239	4321240	4321634	4321635	4321636
15/32	1/2	1	3	4321241	4321242	4321243	4321637	4321638	4321639
31/64	1/2	1	3	4321244	4321245	4321246	4321640	4321641	4321642
1/2	1/2	1	3	4321247	4321248	4321249	4321643	4321644	4321645
1/2	1/2	1-1/4	3			4324001			4324000
33/64	9/16	1-1/4	3-1/2	4321251	4321252	4321253	4321647	4321648	4321649
17/32	9/16	1-1/4	3-1/2	4321254	4321255	4321256	4321650	4321651	4321652
35/64	9/16	1-1/4	3-1/2	4321257	4321258	4321260	4321653	4321654	4321655
9/16	9/16	1-1/4	3-1/2	4321261	4321262	4321263	4321656	4321657	4321658
37/64	5/8	1-1/4	3-1/2	4321265	4321266	4321267	4321660	4321661	4321662
19/32	5/8	1-1/4	3-1/2	4321268	4321269	4321270	4321663	4321664	4321665
39/64	5/8	1-1/4	3-1/2	4321271	4321272	4321273	4321666	4321667	4321668
5/8	5/8	1-1/4	3-1/2	4321274	4321275	4321276	4321669	4321670	4321671
41/64	3/4	1-1/2	4	4321278	4321279	4321280	4321673	4321674	4321675
21/32	3/4	1-1/2	4	4321281	4321282	4321283	4321676	4321677	4321678
43/64	3/4	1-1/2	4	4321284	4321285	4321286	4321679	4321680	4321681
11/16	3/4	1-1/2	4	4321287	4321288	4321289	4321682	4321683	4321684
45/64	3/4	1-1/2	4	4321290	4321291	4321292	4321685	4321686	4321687
23/32	3/4	1-1/2	4	4321293	4321294	4321295	4321688	4321689	4321690
47/64	3/4	1-1/2	4	4321296	4321297	4321298	4321691	4321692	4321693
3/4	3/4	1-1/2	4	4321299	4321300	4321301	4321694	4321695	4321696
49/64	7/8	1-1/2	4	4321303	4321304	4321305	4321698	4321699	4321700
25/32	7/8	1-1/2	4	4321306	4321307	4321308	4321701	4321702	4321703
51/64	7/8	1-1/2	4	4321309	4321310	4321311	4321704	4321705	4321706
13/16	7/8	1-1/2	4	4321312	4321313	4321314	4321707	4321708	4321709
53/64	7/8	1-1/2	4	4321315	4321316	4321317	4321710	4321711	4321712
27/32	7/8	1-1/2	4	4321318	4321319	4321320	4321713	4321714	4321715
55/64	7/8	1-1/2	4	4321321	4321322	4321323	4321716	4321717	4321718
7/8	7/8	1-1/2	4	4321324	4321325	4321326	4321719	4321720	4321721
57/64	1	1-1/2	4	4321328	4321329	4321330	4321723	4321724	4321725
29/32	1	1-1/2	4	4321331	4321332	4321333	4321726	4321727	4321728
59/64	1	1-1/2	4	4321334	4321335	4321336	4321729	4321730	4321731
15/16	1	1-1/2	4	4321337	4321338	4321339	4321732	4321733	4321734
61/64	1	1-1/2	4	4321340	4321341	4321342	4321735	4321736	4321737
31/32	1	1-1/2	4	4321343	4321344	4321345	4321738	4321739	4321740
63/64	1	1-1/2	4	4321346	4321347	4321348	4321741	4321742	4321743
1	1	1-1/2	4	4321162	4321163	4321164	4321558	4321559	4321560

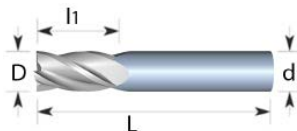


P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
H	Hardened Steel

● 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"

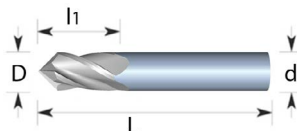
GENERAL PURPOSE



Square End, Standard Carbide, Long 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#
1/8	1/8	3/4	2-1/2	4321746	--	4321747	4321790	--	4321791
3/16	3/16	3/4	2-1/2	4321748	--	4321749	4321792	--	4321793
1/4	1/4	1-1/8	3	4321750	--	4321751	4321794	--	4321795
5/16	5/16	1-1/8	3	4321752	--	4321753	4321796	--	4321797
3/8	3/8	1-1/8	3	4321754	--	4321755	4321798	--	4321799
7/16	7/16	2	4	4321756	--	4321757	4321800	--	4321801
1/2	1/2	2	4	4321758	--	4321759	4321802	--	4321803
5/8	5/8	2-1/4	5	4321762	--	4321763	4321806	--	4321807
3/4	3/4	2-1/4	5	4321764	--	4321765	4321808	--	4321809
1	1	2-1/4	5	4321744	--	4321745	4321788	--	4321789



Square End, Standard Carbide, Extra Long 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#
1/8	1/8	1	3	4321815	--	4321816	4321879	--	4321880
3/16	3/16	1-1/8	3	4321817	--	4321818	4321881	--	4321882
1/4	1/4	1-1/2	4	4321819	--	4321820	4321883	--	4321884
5/16	5/16	1-5/8	4	4321823	--	4321824	4321887	--	4321888
3/8	3/8	1-3/4	4	4321829	--	4321830	4321893	--	4321894
1/2	1/2	3	6	4321833	--	4321834	4321897	--	4321898
5/8	5/8	3	6	4321837	--	4321838	4321901	--	4321902
3/4	3/4	3	6	4321839	--	4321840	4321903	--	4321904
1	1	3	6	4321810	--	4321812	4321875	--	4321876



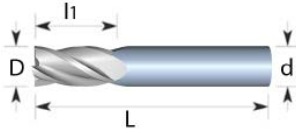
Drill/Mill 90 Degree, Standard Carbide, Regular Length									
Cutter Diam. D	Shank Diam. d	Length Of Cut Li	O.A.L. L	Uncoated			TiAlN Coated		
				2 Flute Part#	3 Flute Part#	4 Flute Part#	2 Flute Part#	3 Flute Part#	4 Flute Part#
1/8	1/8	1/2	1-1/2	4323545	--	4323546	4323563	--	4323564
3/16	3/16	5/8	2	4323547	--	4323548	4323565	--	4323566
1/4	1/4	3/4	2-1/2	4323549	--	4323550	4323567	--	4323568
5/16	5/16	7/8	2-1/2	4323551	--	4323552	4323569	--	4323570
3/8	3/8	1	2-1/2	4323553	--	4323554	4323571	--	4323572
7/16	7/16	1	2-3/4	4323555	--	4323556	4323573	--	4323574
1/2	1/2	1	3	4323557	--	4323558	4323575	--	4323576
5/8	5/8	1-1/4	3-1/2	4323559	--	4323560	4323577	--	4323578
3/4	3/4	1-1/2	4	4323561	--	4323562	4323579	--	4323580



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



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	4323245	4323246	4323247	4323311	4323312	4323313
1.5	2	5	38	4323248	4323249	4323250	4323314	4323315	4323316
2	2	6	38	4323251	4323252	4323253	4323317	4323318	4323319
3	3	12	38	4323257	4323258	4323259	4323323	4323324	4323325
3.5	4	12	50	4323260	4323261	4323262	4323326	4323327	4323328
4	4	14	50	4323263	4323264	4323265	4323329	4323330	4323331
4.5	5	14	50	4323266	4323267	4323268	4323332	4323333	4323334
5	5	16	50	4323269	4323270	4323271	4323335	4323336	4323337
6	6	19	63	4323272	4323273	4323274	4323338	4323339	4323340
7	8	19	63	4323275	4323276	4323277	4323341	4323342	4323343
8	8	19	63	4323278	4323279	4323280	4323344	4323345	4323346
9	10	22	70	4323281	4323282	4323283	4323347	4323348	4323349
10	10	22	70	4323284	4323285	4323286	4323350	4323351	4323352
11	12	25	70	4323287	4323288	4323289	4323353	4323354	4323355
12	12	25	75	4323290	4323291	4323292	4323356	4323357	4323358
14	14	30	88	4323293	4323294	4323295	4323359	4323360	4323361
16	16	32	88	4323296	4323297	4323298	4323362	4323363	4323364
18	18	36	100	4323299	4323300	4323301	4323365	4323366	4323367
20	20	38	100	4323302	4323303	4323304	4323368	4323369	4323370
22	25	38	100	4323305	4323306	4323307	4323371	4323372	4323373
25	25	38	100	4323308	4323309	4323310	4323374	4323375	4323376



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	4323465	--	4323466	4323489	--	4323490
4	4	25	75	4323467	--	4323468	4323491	--	4323492
5	5	25	75	4323469	--	4323470	4323493	--	4323494
6	6	25	75	4323471	--	4323472	4323495	--	4323496
8	8	30	100	4323473	--	4323474	4323497	--	4323498
10	10	38	100	4323475	--	4323476	4323499	--	4323500
12	12	50	100	4323477	--	4323478	4323501	--	4323502
14	14	50	125	4323479	--	4323480	4323503	--	4323504
16	16	75	150	4323481	--	4323482	4323505	--	4323506
18	18	75	150	4323483	--	4323484	4323507	--	4323508
20	20	75	150	4323485	--	4323486	4323509	--	4323510
25	25	75	150	4323487	--	4323488	4323511	--	4323512



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	4323513	--	4323514	4323529	--	4323530
4	4	50	100	4323515	--	4323516	4323531	--	4323532
5	5	30	100	4323517	--	4323518	4323533	--	4323534
6	6	50	100	4323519	--	4323520	4323535	--	4323536
8	8	50	150	4323521	--	4323522	4323537	--	4323538
10	10	75	150	4323523	--	4323524	4323539	--	4323540
12	12	75	150	4323525	--	4323526	4323541	--	4323542
14	14	75	150	4323527	--	4323528	4323543	--	4323544

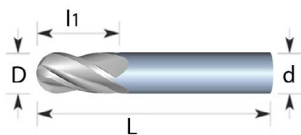


P	●	Steel
M	◐	Stainless Steel
K	●	Cast Iron
N	○	Non-Ferrous
S	●	High Temp. Alloys
H	●	Hardened Steel

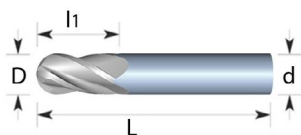
● GOOD ◐ OK ○ NOT OPTIMAL

- 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. 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	4321907	4321908	4321909	4322003	4322004	4322005
3/64	1/8	3/32	1-1/2	4321910	4321911	4321912	4322006	4322007	4322008
1/16	1/8	1/8	1-1/2	4321913	4321914	4321915	4322009	4322010	4322011
3/32	1/8	3/16	1-1/2	4321916	4321917	4321918	4322012	4322013	4322014
1/8	1/8	1/4	1-1/2	4321922	4321923	4321924	4322018	4322019	4322020
5/32	3/16	5/16	2	4321925	4321926	4321927	4322021	4322022	4322023
3/16	3/16	3/8	2	4321928	4321929	4321930	4322024	4322025	4322026
7/32	1/4	7/16	2	4321931	4321932	4321933	4322027	4322028	4322029
1/4	1/4	1/2	2	4321934	4321935	4321936	4322030	4322031	4322032
5/16	5/16	1/2	2	4321937	4321938	4321939	4322033	4322034	4322035
3/8	3/8	5/8	2	4321940	4321941	4321942	4322036	4322037	4322038
7/16	7/16	5/8	2-1/2	4321943	4321944	4321945	4322039	4322040	4322041
1/2	1/2	5/8	2-1/2	4321946	4321947	4321948	4322042	4322043	4322044
5/8	5/8	3/4	3	4321949	4321950	4321951	4322045	4322046	4322047
3/4	3/4	1	3	4321952	4321953	4321954	4322048	4322049	4322050
1	1	1	3	4321919	4321920	4321921	4322015	4322016	4322017



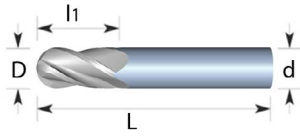
Ball Nose, Standard Carbide, Regular Length, Single End									
Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Uncoated			TiAlN Coated		
				2 Flute	3 Flute	4 Flute	2 Flute	3 Flute	4 Flute
				Part#	Part#	Part#	Part#	Part#	Part#
1/32	1/8	3/32	1-1/2	4322054	4322055	4322056	4322438	4322439	4322440
3/64	1/8	1/8	1-1/2	4322057	4322058	4322059	4322441	4322442	4322443
1/16	1/8	3/16	1-1/2	4322060	4322061	4322062	4322444	4322445	4322446
5/64	1/8	1/4	1-1/2	4322063	4322064	4322065	4322447	4322448	4322449
3/32	1/8	3/8	1-1/2	4322066	4322067	4322068	4322450	4322451	4322452
7/64	1/8	3/8	1-1/2	4322072	4322073	4322074	4322456	4322457	4322458
1/8	1/8	1/2	1-1/2	4322075	4322076	4322077	4322459	4322460	4322461
9/64	3/16	9/16	2	4322078	4322079	4322080	4322462	4322463	4322464
5/32	3/16	9/16	2	4322081	4322082	4322083	4322465	4322466	4322467
11/64	3/16	9/16	2	4322084	4322085	4322086	4322468	4322469	4322470
3/16	3/16	5/8	2	4322087	4322088	4322089	4322471	4322472	4322473
13/64	1/4	5/8	2-1/2	4322090	4322091	4322092	4322474	4322475	4322476
7/32	1/4	5/8	2-1/2	4322093	4322094	4322095	4322477	4322478	4322479
15/64	1/4	3/4	2-1/2	4322096	4322097	4322098	4322480	4322481	4322482
1/4	1/4	3/4	2-1/2	4322099	4322100	4322101	4322483	4322484	4322485



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. 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#
17/64	5/16	7/8	2-1/2	4322102	4322103	4322104	4322486	4322487	4322488
9/32	5/16	7/8	2-1/2	4322105	4322106	4322107	4322489	4322490	4322491
19/64	5/16	7/8	2-1/2	4322108	4322109	4322110	4322492	4322493	4322494
5/16	5/16	7/8	2-1/2	4322111	4322112	4322113	4322495	4322496	4322497
21/64	3/8	7/8	2-1/2	4322114	4322115	4322116	4322498	4322499	4322500
11/32	3/8	7/8	2-1/2	4322117	4322118	4322119	4322501	4322502	4322503
23/64	3/8	7/8	2-1/2	4322120	4322121	4322122	4322504	4322505	4322506
3/8	3/8	1	2-1/2	4322123	4322124	4322125	4322507	4322508	4322509
25/64	7/16	1	2-1/2	4322126	4322127	4322128	4322510	4322511	4322512
13/32	7/16	1	2-1/2	4322129	4322130	4322131	4322513	4322514	4322515
27/64	7/16	1	2-1/2	4322132	4322133	4322134	4322516	4322517	4322518
7/16	7/16	1	2-1/2	4322135	4322136	4322137	4322519	4322520	4322521
29/64	1/2	1	3	4322138	4322139	4322140	4322522	4322523	4322524
15/32	1/2	1	3	4322141	4322142	4322143	4322525	4322526	4322527
31/64	1/2	1	3	4322144	4322145	4322146	4322528	4322529	4322530
1/2	1/2	1	3	4322147	4322148	4322149	4322531	4322532	4322533
33/64	9/16	1-1/4	3-1/2	4322150	4322151	4322152	4322534	4322535	4322536
17/32	9/16	1-1/4	3-1/2	4322153	4322154	4322155	4322537	4322538	4322539
35/64	9/16	1-1/4	3-1/2	4322156	4322157	4322158	4322540	4322541	4322542
9/16	9/16	1-1/4	3-1/2	4322159	4322160	4322161	4322543	4322544	4322545
37/64	5/8	1-1/4	3-1/2	4322162	4322163	4322164	4322546	4322547	4322548
19/32	5/8	1-1/4	3-1/2	4322165	4322166	4322167	4322549	4322550	4322551
39/64	5/8	1-1/4	3-1/2	4322168	4322169	4322170	4322552	4322553	4322554
5/8	5/8	1-1/4	3-1/2	4322171	4322172	4322173	4322555	4322556	4322557
41/64	3/4	1-1/2	4	4322174	4322175	4322176	4322558	4322559	4322560
21/32	3/4	1-1/2	4	4322177	4322178	4322179	4322561	4322562	4322563
43/64	3/4	1-1/2	4	4322180	4322181	4322182	4322564	4322565	4322566
11/16	3/4	1-1/2	4	4322183	4322184	4322185	4322567	4322568	4322569
45/64	3/4	1-1/2	4	4322186	4322187	4322188	4322570	4322571	4322572
23/32	3/4	1-1/2	4	4322189	4322190	4322191	4322573	4322574	4322575
47/64	3/4	1-1/2	4	4322192	4322193	4322194	4322576	4322577	4322578
3/4	3/4	1-1/2	4	4322195	4322196	4322197	4322579	4322580	4322581
49/64	7/8	1-1/2	4	4322198	4322199	4322200	4322582	4322583	4322584
25/32	7/8	1-1/2	4	4322201	4322202	4322203	4322585	4322586	4322587
51/64	7/8	1-1/2	4	4322204	4322205	4322206	4322588	4322589	4322590
13/16	7/8	1-1/2	4	4322207	4322208	4322209	4322591	4322592	4322593
53/64	7/8	1-1/2	4	4322210	4322211	4322212	4322594	4322595	4322596
27/32	7/8	1-1/2	4	4322213	4322214	4322215	4322597	4322598	4322599
55/64	7/8	1-1/2	4	4322216	4322217	4322218	4322600	4322601	4322602
7/8	7/8	1-1/2	4	4322219	4322220	4322221	4322603	4322604	4322605
57/64	1	1-1/2	4	4322222	4322223	4322224	4322606	4322607	4322608
29/32	1	1-1/2	4	4322225	4322226	4322227	4322609	4322610	4322611
59/64	1	1-1/2	4	4322228	4322229	4322230	4322612	4322613	4322614
15/16	1	1-1/2	4	4322231	4322232	4322233	4322615	4322616	4322617
61/64	1	1-1/2	4	4322234	4322235	4322236	4322618	4322619	4322620
31/32	1	1-1/2	4	4322237	4322238	4322239	4322621	4322622	4322623
63/64	1	1-1/2	4	4322240	4322241	4322242	4322624	4322625	4322626
1	1	1-1/2	4	4322069	4322070	4322071	4322453	4322454	4322455

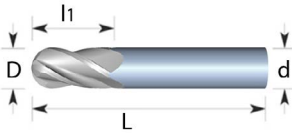


P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
H	Hardened Steel

● 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



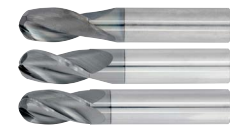
Ball Nose, Standard Carbide, Long Length, Single End

Cutter Diam. D	Shank Diam. d	Length Of Cut l1	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#
1/8	1/8	3/4	2-1/2	4322629	--	4322630	4322673	--	4322674
3/16	3/16	3/4	2-1/2	4322631	--	4322632	4322675	--	4322676
1/4	1/4	1-1/8	3	4322633	--	4322634	4322677	--	4322678
5/16	5/16	1-1/8	3	4322635	--	4322636	4322679	--	4322680
3/8	3/8	1-1/8	3	4322637	--	4322638	4322681	--	4322682
7/16	7/16	2	4	4322639	--	4322640	4322683	--	4322684
1/2	1/2	2	4	4322641	--	4322642	4322685	--	4322686
5/8	5/8	2-1/4	5	4322645	--	4322646	4322689	--	4322690
3/4	3/4	2-1/4	5	4322647	--	4322648	4322691	--	4322692
1	1	2-1/4	5	4322627	--	4322628	4322671	--	4322672



Ball Nose, Standard Carbide, Extra Long Length, Single End

Cutter Diam. D	Shank Diam. d	Length Of Cut l1	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#
1/8	1/8	1	3	4322697	--	4322698	4322761	--	4322762
3/16	3/16	1-1/8	3	4322699	--	4322700	4322763	--	4322764
1/4	1/4	1-1/2	4	4322701	--	4322702	4322765	--	4322766
5/16	5/16	1-5/8	4	4322705	--	4322706	4322769	--	4322770
3/8	3/8	1-3/4	4	4322711	--	4322712	4322775	--	4322776
1/2	1/2	3	6	4322715	--	4322716	4322779	--	4322780
5/8	5/8	3	6	4322719	--	4322720	4322783	--	4322784
3/4	3/4	3	6	4322721	--	4322722	4322785	--	4322786
1	1	3	6	4322693	--	4322694	4322757	--	4322758



METRIC - Ball Nose, Standard Carbide, Regular Length, Single End

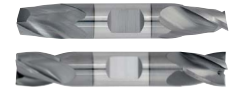
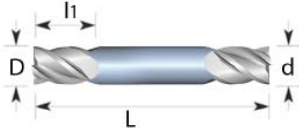
Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Uncoated			TiAlN Coated		
				2 Flute Part#	3 Flute Part#	4 Flute Part#	2 Flute Part#	3 Flute Part#	4 Flute Part#
1	1	3	38	4323377	--	4323378	4323421	--	4323422
1.5	2	5	38	4323379	--	4323380	4323423	--	4323424
2	2	6	38	4323381	--	4323382	4323425	--	4323426
3	3	12	38	4323385	--	4323386	4323429	--	4323430
3.5	4	12	50	4323387	--	4323388	4323431	--	4323432
4	4	14	50	4323389	--	4323390	4323433	--	4323434
4.5	5	14	50	4323391	--	4323392	4323435	--	4323436
5	5	16	50	4323393	--	4323394	4323437	--	4323438
6	6	19	63	4323395	--	4323396	4323439	--	4323440
7	8	19	63	4323397	--	4323398	4323441	--	4323442
8	8	19	63	4323399	--	4323400	4323443	--	4323444
9	10	22	70	4323401	--	4323402	4323445	--	4323446
10	10	22	70	4323403	--	4323404	4323447	--	4323448
11	12	25	70	4323405	--	4323406	4323449	--	4323450
12	12	25	75	4323407	--	4323408	4323451	--	4323452
14	14	30	88	4323409	--	4323410	4323453	--	4323454
16	16	32	88	4323411	--	4323412	4323455	--	4323456
18	18	36	100	4323413	--	4323414	4323457	--	4323458
20	20	38	100	4323415	--	4323416	4323459	--	4323460
22	25	38	100	4323417	--	4323418	4323461	--	4323462
25	25	38	100	4323419	--	4323420	4323463	--	4323464



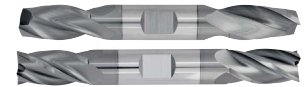
P	●	Steel
M	◐	Stainless Steel
K	●	Cast Iron
N	○	Non-Ferrous
S	◐	High Temp. Alloys
H	◐	Hardened Steel
●	GOOD	◐ OK ○ NOT OPTIMAL

- 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

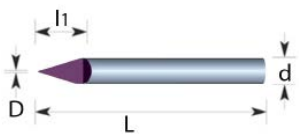


Square End, Standard Carbide, Stub Length, Double End									
Cutter Diam. D	Shank Diam. d	Length Of Cut Li	O.A.L. L	Uncoated			TiAlN Coated		
				2 Flute Part#	3 Flute Part#	4 Flute Part#	2 Flute Part#	3 Flute Part#	4 Flute Part#
1/32	1/8*	1/16	1-1/2	4322789	--	4322790	4322861	--	4322862
3/64	1/8*	3/32	1-1/2	4322791	--	4322792	4322863	--	4322864
1/16	1/8*	1/8	1-1/2	4322793	--	4322794	4322865	--	4322866
3/32	1/8*	3/16	1-1/2	4322795	--	4322796	4322867	--	4322868
7/64	1/8*	7/32	1-1/2	4322797	--	4322798	4322869	--	4322870
1/8	1/8*	1/4	1-1/2	4322799	--	4322800	4322871	--	4322872
5/32	3/16*	5/16	2	4322801	--	4322802	4322873	--	4322874
3/16	3/16*	5/16	2	4322803	--	4322804	4322875	--	4322876
7/32	1/4	3/8	2-1/2	4322805	--	4322806	4322877	--	4322878
1/4	1/4	1/2	2-1/2	4322807	--	4322808	4322879	--	4322880
9/32	5/16	1/2	2-1/2	4322809	--	4322810	4322881	--	4322882
5/16	5/16	1/2	2-1/2	4322811	--	4322812	4322883	--	4322884
3/8	3/8	9/16	2-1/2	4322813	--	4322814	4322885	--	4322886
7/16	1/2	9/16	2-3/4	4322815	--	4322816	4322887	--	4322888
1/2	1/2	5/8	3	4322817	--	4322818	4322889	--	4322890
9/16	5/8	11/16	3-1/2	4322819	--	4322820	4322891	--	4322892
5/8	5/8	11/16	3-1/2	4322821	--	4322822	4322893	--	4322894
3/4	3/4	7/8	4	4322823	--	4322824	4322895	--	4322896



Square End, Standard Carbide, Regular Length, Double 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#
5/32	3/16*	7/16	3	4323009	--	4323010	4323037	--	4323038
3/16	3/16*	1/2	3	4323011	--	4323012	4323039	--	4323040
7/32	1/4	9/16	4	4323013	--	4323014	4323041	--	4323042
1/4	1/4	5/8	4	4323015	--	4323016	4323043	--	4323044
5/16	5/16	3/4	4	4323017	--	4323018	4323045	--	4323046
3/8	3/8	3/4	4	4323021	--	4323022	4323049	--	4323050
7/16	1/2	7/8	4	4323023	--	4323024	4323051	--	4323052
1/2	1/2	1	4	4323025	--	4323026	4323053	--	4323054
5/8	5/8	1-1/2	6	4323029	--	4323030	4323057	--	4323058
3/4	3/4	1-1/2	6	4323031	--	4323032	4323059	--	4323060

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



NEW

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



Single Flute Engraving Tools 30 Degree Tip				
Tip Diam. D	Shank Diam. d	Length Of Cut Li	O.A.L. L	TiAlN Coated Part#
.005	1/4	1/2	2-1/2	4323581
.010	1/4	1/2	2-1/2	4323582
.020	1/4	1/2	2-1/2	4323583

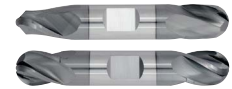
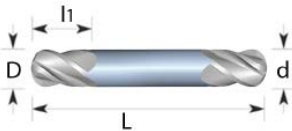


P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
H	Hardened Steel

● 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

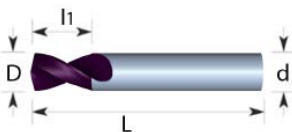


Ball Nose, Standard Carbide, Stub Length, Double End									
Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Uncoated			TiAlN Coated		
				2 Flute Part#	3 Flute Part#	4 Flute Part#	2 Flute Part#	3 Flute Part#	4 Flute Part#
1/32	1/8*	1/16	1-1/2	4322897	--	4322898	4322969	--	4322970
3/64	1/8*	3/32	1-1/2	4322899	--	4322900	4322971	--	4322972
1/16	1/8*	1/8	1-1/2	4322901	--	4322902	4322973	--	4322974
3/32	1/8*	3/16	1-1/2	4322903	--	4322904	4322975	--	4322976
7/64	1/8*	7/32	1-1/2	4322905	--	4322906	4322977	--	4322978
1/8	1/8*	1/4	1-1/2	4322907	--	4322908	4322979	--	4322980
5/32	3/16*	5/16	2	4322909	--	4322910	4322981	--	4322982
3/16	3/16*	5/16	2	4322911	--	4322912	4322983	--	4322984
7/32	1/4	3/8	2-1/2	4322913	--	4322914	4322985	--	4322986
1/4	1/4	1/2	2-1/2	4322915	--	4322916	4322987	--	4322988
9/32	5/16	1/2	2-1/2	4322917	--	4322918	4322989	--	4322990
5/16	5/16	1/2	2-1/2	4322919	--	4322920	4322991	--	4322992
3/8	3/8	9/16	2-1/2	4322921	--	4322922	4322993	--	4322994
7/16	1/2	9/16	2-3/4	4322923	--	4322924	4322995	--	4322996
1/2	1/2	5/8	3	4322925	--	4322926	4322997	--	4322998
9/16	5/8	11/16	3-1/2	4322927	--	4322928	4322999	--	4323000
5/8	5/8	11/16	3-1/2	4322929	--	4322930	4323001	--	4323002
3/4	3/4	7/8	4	4322931	--	4322932	4323003	--	4323004



Ball Nose, Standard Carbide, Regular Length, Double End									
Cutter Diam. D	Shank Diam. d	Length Of Cut l1	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#
5/32	3/16*	7/16	3	4323065	--	4323066	4323093	--	4323094
3/16	3/16*	1/2	3	4323067	--	4323068	4323095	--	4323096
7/32	1/4	9/16	4	4323069	--	4323070	4323097	--	4323098
1/4	1/4	5/8	4	4323071	--	4323072	4323099	--	4323100
5/16	5/16	3/4	4	4323073	--	4323074	4323101	--	4323102
3/8	3/8	3/4	4	4323077	--	4323078	4323105	--	4323106
7/16	1/2	7/8	4	4323079	--	4323080	4323107	--	4323108
1/2	1/2	1	4	4323081	--	4323082	4323109	--	4323110
5/8	5/8	1-1/2	6	4323085	--	4323086	4323113	--	4323114
3/4	3/4	1-1/2	6	4323087	--	4323088	4323115	--	4323116

* 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 l1	O.A.L. L	TiAlN Coated Part#
1/4	1/4	1/2	3	4323584
3/8	3/8	3/4	3	4323585
1/2	1/2	1	4	4323586
5/8	5/8	1	4	4323587
3/4	3/4	1-1/8	4	4323588

GENERAL PURPOSE

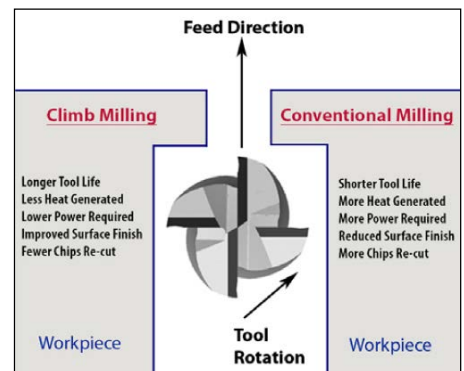
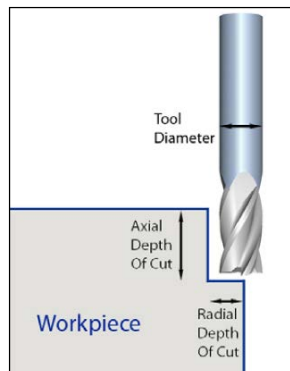
Material	Speed (SFM)		Feed Per Tooth By End Mill Diameter							
	Uncoated	TiALN Coated	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"	1"
Aluminum & Aluminum Alloys	600-1200	900-1800	.0020	.0025	.0030	.0035	.0040	.0050	.0060	.0080
Copper & Copper Alloys	350-850	525-1275	.0020	.0025	.0025	.0030	.0030	.0035	.0040	.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	.0012	.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.
- 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.
- 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)





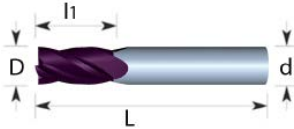
P	●	Steel
M	◐	Stainless Steel
K	●	Cast Iron
N	○	Non-Ferrous
S	○	High Temp. Alloys
H	●	Hardened Steel

● 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. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Corner Radius	TiAlN Coated	
					4 Flute - ROUND Shank Part#	4 Flute - WELDON Shank Part#
3/16	3/16	3/8	2	SQ	3321147	--
3/16	3/16	3/8	2	.015CR	3321148	--
1/4	1/4	3/8	2	SQ	3321149	--
1/4	1/4	3/8	2	.015CR	3321150	--
5/16	5/16	3/8	2	SQ	3321151	--
5/16	5/16	3/8	2	.020CR	3321152	--
3/8	3/8	1/2	2	SQ	3321153	--
3/8	3/8	1/2	2	.020CR	3321154	--
1/2	1/2	5/8	2-1/2	SQ	3321155	3321161
1/2	1/2	5/8	2-1/2	.030CR	3321156	3321162
5/8	5/8	3/4	3	SQ	3321157	3321163
5/8	5/8	3/4	3	.030CR	3321158	3321164
3/4	3/4	1	3	SQ	3321159	3321165
3/4	3/4	1	3	.030CR	3321160	3321166



HIGH PERFORMANCE Variable Pitch Carbide, Regular Length, Single End							
Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Corner Radius	TiAlN Coated		
					4 Flute - ROUND Shank Part#	4 Flute - WELDON Shank Part#	5 Flute - ROUND Shank Part#
1/8	1/8	1/2	1-1/2	SQ	3324000		
1/8	1/8	1/2	1-1/2	.010CR	3324001		
3/16	3/16	5/8	2	SQ	3321004	--	
3/16	3/16	5/8	2	.015CR	3321005	--	
1/4	1/4	3/4	2-1/2	SQ	3321006	3321030	3324012
1/4	1/4	3/4	2-1/2	.020CR	3321007	3321031	3324013
5/16	5/16	13/16	2-1/2	SQ	3321008	3321032	3324014
5/16	5/16	13/16	2-1/2	.020CR	3321009	3321033	3324015
3/8	3/8	7/8	2-1/2	SQ	3321010	3321034	3324016
3/8	3/8	7/8	2-1/2	.020CR	3321011	3321035	3324017
7/16	7/16	1	2-3/4	SQ	3321013	3321036	--
1/2	1/2	1-1/4	3	SQ	3321014	3321037	3324018
1/2	1/2	1-1/4	3	.015CR	3321015	3321038	--
1/2	1/2	1-1/4	3	.030CR	3321016	3321039	3324019
1/2	1/2	1-1/4	3	.060CR	3321017	3321040	--
5/8	5/8	1-1/4	3-1/2	SQ	3321018	3321041	3324020
5/8	5/8	1-1/4	3-1/2	.030CR	3321019	3321042	3324021
5/8	5/8	1-1/4	3-1/2	.060CR	3321020	3321043	--
5/8	5/8	1-1/4	3-1/2	.125CR	3321021	3321044	--
3/4	3/4	1-1/2	4	SQ	3321022	3321045	3324022
3/4	3/4	1-1/2	4	.030CR	3321023	3321046	3324023
3/4	3/4	1-1/2	4	.060CR	3321024	3321047	--
3/4	3/4	1-1/2	4	.125CR	3321025	3321048	--
1	1	1-1/2	4	SQ	3321000	3321026	3324010
1	1	1-1/2	4	.030CR	3321001	3321027	3324011
1	1	1-1/2	4	.060CR	3321002	3321028	--
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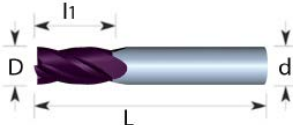
P	●	Steel
M	⊖	Stainless Steel
K	●	Cast Iron
N	○	Non-Ferrous
S	○	High Temp. Alloys
H	○	Hardened Steel

● 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. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Corner Radius	TiAlN Coated		
					4 Flute - ROUND Shank Part#	4 Flute - WELDON Shank Part#	5 Flute - ROUND Shank Part#
3/16	3/16	3/4	2-1/2	SQ	3321053	--	
3/16	3/16	3/4	2-1/2	.015CR	3321054	--	
1/4	1/4	1-1/8	3	SQ	3321055	3321078	3324026
1/4	1/4	1-1/8	3	.020CR	3321056	3321079	3324027
5/16	5/16	1-1/8	3	SQ	3321057	3321080	3324028
5/16	5/16	1-1/8	3	.020CR	3321058	3321081	3324029
3/8	3/8	1-1/8	3	SQ	3321059	3321082	3324030
3/8	3/8	1-1/8	3	.020CR	3321060	3321083	3324031
7/16	7/16	2	4	SQ	3321061	3321084	--
1/2	1/2	2	4	SQ	3321062	3321085	3324032
1/2	1/2	2	4	.015CR	3321063	3321086	--
1/2	1/2	2	4	.030CR	3321064	3321087	3324033
1/2	1/2	2	4	.060CR	3321065	3321088	--
5/8	5/8	2-1/4	5	SQ	3321066	3321089	3324034
5/8	5/8	2-1/4	5	.030CR	3321067	3321090	3324035
5/8	5/8	2-1/4	5	.060CR	3321068	3321091	--
5/8	5/8	2-1/4	5	.125CR	3321069	3321092	--
3/4	3/4	2-1/4	5	SQ	3321070	3321093	3324036
3/4	3/4	2-1/4	5	.030CR	3321071	3321094	3324037
3/4	3/4	2-1/4	5	.060CR	3321072	3321095	--
3/4	3/4	2-1/4	5	.125CR	3321073	3321096	--
1	1	2-1/4	5	SQ	3321049	3321074	3324024
1	1	2-1/4	5	.030CR	3321050	3321075	3324025
1	1	2-1/4	5	.060CR	3321051	3321076	--
1	1	2-1/4	5	.125CR	3321052	3321077	--



HIGH PERFORMANCE Variable Pitch Carbide, Extra Long Length, Single End							
Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Corner Radius	TiAlN Coated		
					4 Flute - ROUND Shank Part#	5 Flute - ROUND Shank Part#	5 Flute - ROUND Shank Part#
3/16	3/16	1-1/8	3	SQ	3321132	--	
3/16	3/16	1-1/8	3	.015CR	3324003	--	
1/4	1/4	1-1/2	4	SQ	3321133		3324040
1/4	1/4	1-1/2	4	.020CR	3324004		3324041
5/16	5/16	1-5/8	4	SQ	3321134		3324042
5/16	5/16	1-5/8	4	.020CR	3324005		3324043
3/8	3/8	1-3/4	4	SQ	3321135		3324044
3/8	3/8	1-3/4	4	.020CR	3324006		3324045
1/2	1/2	3	6	SQ	3321136		3324046
1/2	1/2	3	6	.030CR	3324007		3324047
5/8	5/8	3	6	SQ	3321137		3324048
5/8	5/8	3	6	.030CR	3324008		3324049
3/4	3/4	3	6	SQ	3321138		3324050
3/4	3/4	3	6	.030CR	3324009		3324051
1	1	3	6	SQ	3321131		3324038
1	1	3	6	.030CR	3324002		3324039

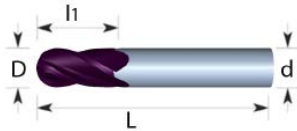


P	●	Steel
M	○	Stainless Steel
K	●	Cast Iron
N	○	Non-Ferrous
S	○	High Temp. Alloys
H	●	Hardened Steel
● BETTER ○ OK ○ NOT OPTIMAL		

- 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, 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 ₁	L	Part#	Part#
3/16	3/16	5/8	2	3321098	--
1/4	1/4	3/4	2-1/2	3321099	3321107
5/16	5/16	13/16	2-1/2	3321100	3321108
3/8	3/8	7/8	2-1/2	3321101	3321109
7/16	7/16	1	2-3/4	3321102	3321110
1/2	1/2	1	3	3321103	3321111
5/8	5/8	1-1/4	3-1/2	3321104	3321112
3/4	3/4	1-1/2	4	3321105	3321113
1	1	1-1/2	4	3321097	3321106



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 ₁	L	Part#	Part#
3/16	3/16	3/4	2-1/2	3321115	--
1/4	1/4	1-1/8	3	3321116	3321124
5/16	5/16	1-1/8	3	3321117	3321125
3/8	3/8	1-1/8	3	3321118	3321126
7/16	7/16	2	4	3321119	3321127
1/2	1/2	2	4	3321120	3321128
5/8	5/8	2-1/4	5	3321121	3321129
3/4	3/4	2-1/4	5	3321122	3321130
1	1	2-1/4	5	3321114	3321123

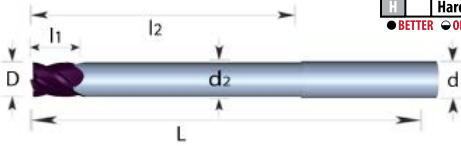


HIGH PERFORMANCE Variable Pitch Carbide, Ball Nose, Extra Long Length, Single End					
Cutter Diam.	Shank Diam.	Length Of Cut	O.A.L.	TiALN Coated	
				4 Flute - ROUND Shank	4 Flute - WELDON Shank
D	d	l ₁	L	Part#	Part#
3/16	3/16	1-1/8	3	3321140	--
1/4	1/4	1-1/2	4	3321141	--
5/16	5/16	1-5/8	4	3321142	--
3/8	3/8	1-3/4	4	3321143	--
1/2	1/2	3	6	3321144	--
5/8	5/8	3	6	3321145	--
3/4	3/4	3	6	3321146	--
1	1	3	6	3321139	--



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

● BETTER ◐ OK ○ NOT OPTIMAL



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- 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. D	Shank Diam. d	Necked Diam. d2	Length Of Cut l1	Length Below Shk. l2	O.A.L. L	Corner Radius	TiAlN Coated			
							4 Flute - ROUND Shank		4 Flute - WELDON Shank	
							Part#		Part#	
3/16	3/16	.1775	3/8	2-1/2	4	SQ	3321173		--	--
3/16	3/16	.1775	3/8	2-1/2	4	.015CR	3321174		--	--
1/4	1/4	.2400	3/8	2-1/2	4	SQ	3321175		--	--
1/4	1/4	.2400	3/8	2-1/2	4	.015CR	3321176		--	--
5/16	5/16	.3025	7/16	2-1/2	4	SQ	3321177		--	--
5/16	5/16	.3025	7/16	2-1/2	4	.015CR	3321178		--	--
3/8	3/8	.3650	1/2	2-1/2	4	SQ	3321179		--	--
3/8	3/8	.3650	1/2	2-1/2	4	.015CR	3321180		--	--
1/2	1/2	.4800	5/8	3	5	SQ	3321181		--	--
1/2	1/2	.4800	5/8	3	5	.020CR	3321182		--	--
1/2	1/2	.4800	5/8	4	6	SQ	3321184		--	--
1/2	1/2	.4800	5/8	4	6	.020CR	3321183		--	--
5/8	5/8	.6050	3/4	3	5	SQ	3321185		--	--
5/8	5/8	.6050	3/4	3	5	.020CR	3321186		--	--
5/8	5/8	.6050	3/4	4	6	SQ	3321188		--	--
5/8	5/8	.6050	3/4	4	6	.020CR	3321187		--	--
3/4	3/4	.7300	1	3	5	SQ	3321189		--	--
3/4	3/4	.7300	1	3	5	.020CR	3321190		--	--
3/4	3/4	.7300	1	4	6	SQ	3321193		--	--
3/4	3/4	.7300	1	4	6	.020CR	3321191		--	--
3/4	3/4	.7300	1	5	7	SQ	3321194		--	--
3/4	3/4	.7300	1	5	7	.020CR	3321192		--	--
1	1	.9800	1-1/4	3	5	SQ	3321167		--	--
1	1	.9800	1-1/4	3	5	.020CR	3321168		--	--
1	1	.9800	1-1/4	4	6	SQ	3321171		--	--
1	1	.9800	1-1/4	4	6	.020CR	3321169		--	--
1	1	.9800	1-1/4	5	7	SQ	3321172		--	--
1	1	.9800	1-1/4	5	7	.020CR	3321170		--	--



HIGH PERFORMANCE Variable Pitch Carbide, Ball Long Reach Neck Relief, Single End									
Cutter Diam. D	Shank Diam. d	Necked Diam. d2	Length Of Cut l1	Length Below Shk. l2	O.A.L. L	TiAlN Coated			
						4 Flute - ROUND Shank		4 Flute - WELDON Shank	
						Part#		Part#	
3/16	3/16	.1775	3/8	2-1/2	4	3321198		--	--
1/4	1/4	.2400	3/8	2-1/2	4	3321199		--	--
5/16	5/16	.3025	7/16	2-1/2	4	3321200		--	--
3/8	3/8	.3650	1/2	2-1/2	4	3321201		--	--
1/2	1/2	.4800	5/8	3	5	3321202		--	--
1/2	1/2	.4800	5/8	4	6	3321203		--	--
5/8	5/8	.6050	3/4	3	5	3321204		--	--
5/8	5/8	.6050	3/4	4	6	3321205		--	--
3/4	3/4	.7300	1	3	5	3321206		--	--
3/4	3/4	.7300	1	4	6	3321207		--	--
3/4	3/4	.7300	1	5	7	3321208		--	--
1	1	.9800	1-1/4	3	5	3321195		--	--
1	1	.9800	1-1/4	4	6	3321196		--	--
1	1	.9800	1-1/4	5	7	3321197		--	--

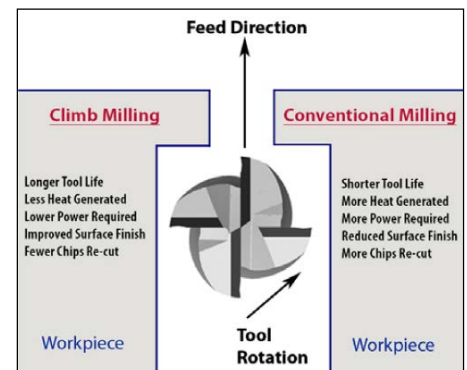
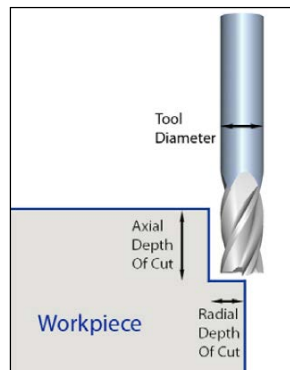
HIGH PERFORMANCE										
Material	Speed (SFM)	Feed Per Tooth By End Mill Diameter								
		TiAlN Coated	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"	1"
Aluminum & Aluminum Alloys	900-1800		.0025	.0030	.0035	.0040	.0045	.0055	.0065	.0085
Copper & Copper Alloys	525-1275		.0025	.0030	.0030	.0035	.0035	.0040	.0045	.0065
Brass & Bronze	375-600	N	.0025	.0030	.0030	.0035	.0035	.0040	.0045	.0055
Graphite	--		--	--	--	--	--	--	--	--
Plastics	--		--	--	--	--	--	--	--	--
Iron, Cast (soft)	375-650	K	.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	P	.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	M	.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	S	.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)





OVER 300 NEW ITEMS IN THE 2024 CATALOG

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.





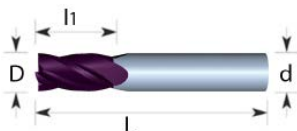
P	●	Steel
M	○	Stainless Steel
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- Variable Pitch to reduce chatter with special core design

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- Diameter (D) Tolerances: +0.0000"/-0.0015"
- Shank (d) Tolerance: +0.0000"/-0.0004"



Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Corner Radius	TiAlN Coated			
					4 Flute - ROUND Shank		4 Flute - WELDON Shank	
					Part#		Part#	
3/16	3/16	3/8	2	SQ	2321179		--	--
3/16	3/16	3/8	2	.015CR	2321180		--	--
1/4	1/4	3/8	2	SQ	2321181		--	--
1/4	1/4	3/8	2	.015CR	2321182		--	--
5/16	5/16	3/8	2	SQ	2321183		--	--
5/16	5/16	3/8	2	.020CR	2321184		--	--
3/8	3/8	1/2	2	SQ	2321185		--	--
3/8	3/8	1/2	2	.020CR	2321186		--	--
1/2	1/2	5/8	2-1/2	SQ	2321187		2321193	
1/2	1/2	5/8	2-1/2	.030CR	2321188		2321194	
5/8	5/8	3/4	3	SQ	2321189		2321195	
5/8	5/8	3/4	3	.030CR	2321190		2321196	
3/4	3/4	1	3	SQ	2321191		2321197	
3/4	3/4	1	3	.030CR	2321192		2321198	



Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Corner Radius	TiAlN Coated					
					4 Flute - ROUND Shank		4 Flute - WELDON Shank		5 Flute - ROUND Shank	
					Part#		Part#		Part#	
1/8	1/8	1/2	1-1/2	SQ	2321006		--		--	
1/8	1/8	1/2	1-1/2	.010CR	2321007		--		--	
3/16	3/16	5/8	2	SQ	2321008		--		--	
3/16	3/16	5/8	2	.015CR	2321009		--		--	
1/4	1/4	3/4	2-1/2	SQ	2321010		2321053		2321013	
1/4	1/4	3/4	2-1/2	.020CR	2321012		2321055		2321014	
5/16	5/16	13/16	2-1/2	SQ	2321015		2321056		2321017	
5/16	5/16	13/16	2-1/2	.020CR	2321016		2321057		2321018	
3/8	3/8	7/8	2-1/2	SQ	2321019		2321058		2321023	
3/8	3/8	7/8	2-1/2	.020CR	2321021		2321060		2321024	
3/8	3/8	7/8	2-1/2	.030CR	2321022		2321061		2321025	
7/16	7/16	1	2-3/4	SQ	2321026		2321062		--	
1/2	1/2	1-1/4	3	SQ	2321027		2321063		2321033	
1/2	1/2	1-1/4	3	.015CR	2321028		2321064		--	
1/2	1/2	1-1/4	3	.030CR	2321029		2321065		2321034	
1/2	1/2	1-1/4	3	.060CR	2321031		2321067		--	
5/8	5/8	1-1/4	3-1/2	SQ	2321035		2321069		2321039	
5/8	5/8	1-1/4	3-1/2	.030CR	2321036		2321070		2321040	
5/8	5/8	1-1/4	3-1/2	.060CR	2321037		2321071		--	
5/8	5/8	1-1/4	3-1/2	.125CR	2321038		2321072		--	
3/4	3/4	1-1/2	4	SQ	2321041		2321073		2321045	
3/4	3/4	1-1/2	4	.030CR	2321042		2321075		2321046	
3/4	3/4	1-1/2	4	.060CR	2321043		2321076		--	
3/4	3/4	1-1/2	4	.125CR	2321044		2321077		--	
1	1	1-1/2	4	SQ	2321000		2321047		2321004	
1	1	1-1/2	4	.030CR	2321001		2321048		2321005	
1	1	1-1/2	4	.060CR	2321002		2321049		--	
1	1	1-1/2	4	.125CR	2321003		2321050		--	

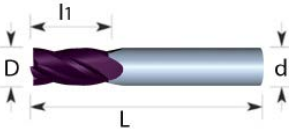


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ULTRA HIGH PERFORMANCE Variable Pitch Carbide, Long Length, Single End						TiAlN Coated		
Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Corner Radius	TiAlN Coated			
					4 Flute - ROUND Shank Part#	4 Flute - WELDON Shank Part#	5 Flute - ROUND Shank Part#	
3/16	3/16	3/4	2-1/2	SQ	2321083	--	--	
3/16	3/16	3/4	2-1/2	.015CR	2321084	--	--	
1/4	1/4	1-1/8	3	SQ	2321085	2321108	2324010	
1/4	1/4	1-1/8	3	.020CR	2321086	2321109	2324011	
5/16	5/16	1-1/8	3	SQ	2321087	2321110	2324012	
5/16	5/16	1-1/8	3	.020CR	2321088	2321111	2324013	
3/8	3/8	1-1/8	3	SQ	2321089	2321112	2324014	
3/8	3/8	1-1/8	3	.020CR	2321090	2321113	2324015	
7/16	7/16	2	4	SQ	2321091	2321114	--	
1/2	1/2	2	4	SQ	2321092	2321115	2324016	
1/2	1/2	2	4	.015CR	2321093	2321116	--	
1/2	1/2	2	4	.030CR	2321094	2321117	2324017	
1/2	1/2	2	4	.060CR	2321095	2321118	--	
5/8	5/8	2-1/4	5	SQ	2321096	2321119	2324018	
5/8	5/8	2-1/4	5	.030CR	2321097	2321120	2324019	
5/8	5/8	2-1/4	5	.060CR	2321098	2321121	--	
5/8	5/8	2-1/4	5	.125CR	2321099	2321122	--	
3/4	3/4	2-1/4	5	SQ	2321100	2321123	2324020	
3/4	3/4	2-1/4	5	.030CR	2321101	2321124	2324021	
3/4	3/4	2-1/4	5	.060CR	2321102	2321125	--	
3/4	3/4	2-1/4	5	.125CR	2321103	2321126	--	
1	1	2-1/4	5	SQ	2321078	2321104	2324008	
1	1	2-1/4	5	.030CR	2321079	2321105	2324009	
1	1	2-1/4	5	.060CR	2321080	2321106	--	
1	1	2-1/4	5	.125CR	2321081	2321107	--	



ULTRA HIGH PERFORMANCE Variable Pitch Carbide, Extra Long Length, Single End						TiAlN Coated	
Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Corner Radius	TiAlN Coated		
					4 Flute - ROUND Shank Part#	5 Flute - ROUND Shank Part#	
3/16	3/16	1-1/8	3	SQ	2321163	--	
3/16	3/16	1-1/8	3	.015CR	2324001	--	
1/4	1/4	1-1/2	4	SQ	2321164	2324024	
1/4	1/4	1-1/2	4	.020CR	2324002	2324025	
5/16	5/16	1-5/8	4	SQ	2321165	2324026	
5/16	5/16	1-5/8	4	.020CR	2324003	2324027	
3/8	3/8	1-3/4	4	SQ	2321166	2324028	
3/8	3/8	1-3/4	4	.020CR	2324004	2324029	
1/2	1/2	3	6	SQ	2321167	2324030	
1/2	1/2	3	6	.030CR	2324005	2324031	
5/8	5/8	3	6	SQ	2321168	2324032	
5/8	5/8	3	6	.030CR	2324006	2324033	
3/4	3/4	3	6	SQ	2321169	2324034	
3/4	3/4	3	6	.030CR	2324007	2324035	
1	1	3	6	SQ	2321162	2324022	
1	1	3	6	.030CR	2324000	2324023	



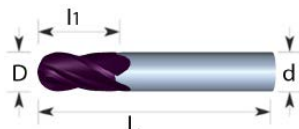
P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
H	Hardened Steel

● BEST ○ OK ○ NOT OPTIMAL

ULTRA HIGH PERFORMANCE

- 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. D	Shank Diam. d	Length Of Cut l ₁	O.A.L. L	4 Flute - ROUND Shank		4 Flute - WELDON Shank	
				Part#		Part#	
3/16	3/16	5/8	2	2321129		--	
1/4	1/4	3/4	2-1/2	2321130		2321138	
5/16	5/16	13/16	2-1/2	2321131		2321139	
3/8	3/8	7/8	2-1/2	2321132		2321140	
7/16	7/16	1	2-3/4	2321133		2321141	
1/2	1/2	1	3	2321134		2321142	
5/8	5/8	1-1/4	3-1/2	2321135		2321143	
3/4	3/4	1-1/2	4	2321136		2321144	
1	1	1-1/2	4	2321127		2321137	



ULTRA HIGH PERFORMANCE Variable Pitch Carbide, Ball Nose, Long Length, Single End				TiAlN Coated			
Cutter Diam. D	Shank Diam. d	Length Of Cut l ₁	O.A.L. L	4 Flute - ROUND Shank		4 Flute - WELDON Shank	
				Part#		Part#	
3/16	3/16	3/4	2-1/2	2321146		--	
1/4	1/4	1-1/8	3	2321147		2321155	
5/16	5/16	1-1/8	3	2321148		2321156	
3/8	3/8	1-1/8	3	2321149		2321157	
7/16	7/16	2	4	2321150		2321158	
1/2	1/2	2	4	2321151		2321159	
5/8	5/8	2-1/4	5	2321152		2321160	
3/4	3/4	2-1/4	5	2321153		2321161	
1	1	2-1/4	5	2321145		2321154	



ULTRA HIGH PERFORMANCE Variable Pitch Carbide, Ball Nose, Extra Long Length, Single End				TiAlN Coated			
Cutter Diam. D	Shank Diam. d	Length Of Cut l ₁	O.A.L. L	4 Flute - ROUND Shank		4 Flute - WELDON Shank	
				Part#		Part#	
3/16	3/16	1-1/8	3	2321172		--	
1/4	1/4	1-1/2	4	2321173		--	
5/16	5/16	1-5/8	4	2321174		--	
3/8	3/8	1-3/4	4	2321175		--	
1/2	1/2	3	6	2321176		--	
5/8	5/8	3	6	2321177		--	
3/4	3/4	3	6	2321178		--	
1	1	3	6	2321170		--	

ULTRA HIGH PERFORMANCE

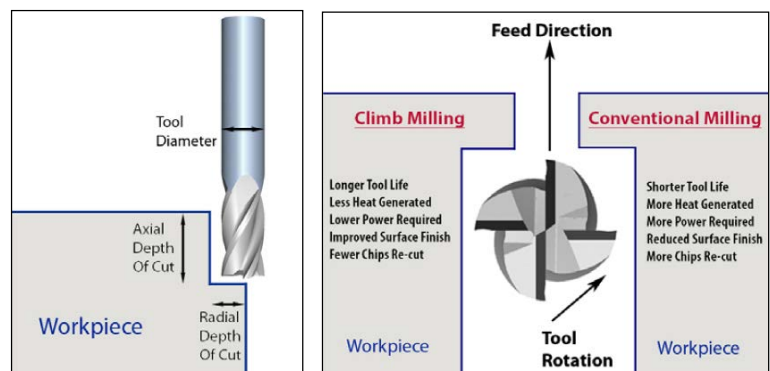
Material	Speed (SFM)	Feed Per Tooth By End Mill Diameter								
		TiAlN Coated	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"	1"
Aluminum & Aluminum Alloys	900-1800		.0025	.0030	.0035	.0040	.0045	.0055	.0065	.0085
Copper & Copper Alloys	525-1275		.0025	.0030	.0030	.0035	.0035	.0040	.0045	.0065
Brass & Bronze	375-600	N	.0025	.0030	.0030	.0035	.0035	.0040	.0045	.0055
Graphite	--		--	--	--	--	--	--	--	--
Plastics	--		--	--	--	--	--	--	--	--
Iron, Cast (soft)	375-650	K	.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	P	.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	M	.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	S	.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.
- 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

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

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

(Inches Per Minute)



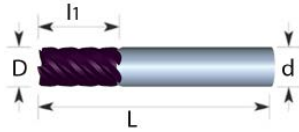


P	●	Steel
M	●	Stainless Steel
K	●	Cast Iron
N	○	Non-Ferrous
S	●	High Temp. Alloys
H	●	Hardened Steel
●	BEST	○ OK ○ NOT OPTIMAL

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"

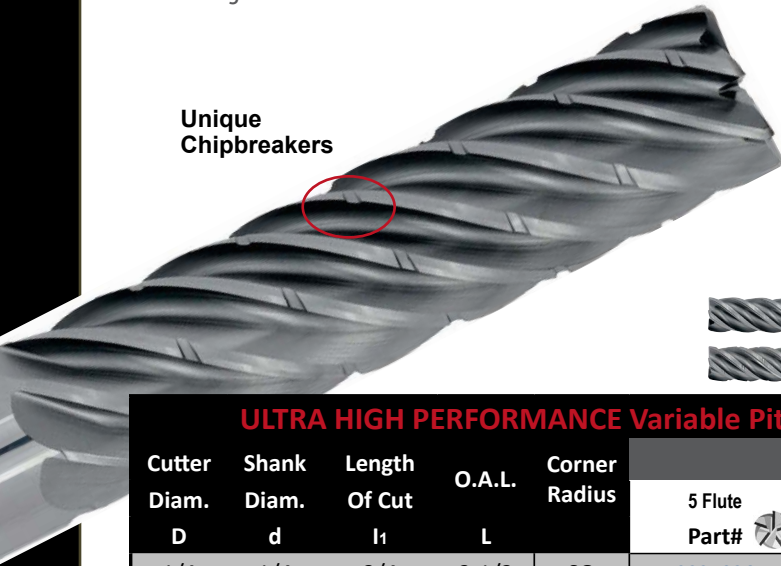


5, 6 & 7 Flute Specially for HEM (High Efficiency Machining)

- 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^d



Unique
Chipbreakers



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

Cutter Diam. D	Shank Diam. d	Length Of Cut Li	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	2324036	--	2321202	--	--
1/4	1/4	3/4	2-1/2	.015CR	2324037	--	--	--	--
1/4	1/4	3/4	2-1/2	.030CR	2324038	--	2321203	--	--
5/16	5/16	13/16	2-1/2	SQ	2324042	--	--	--	--
5/16	5/16	13/16	2-1/2	.015CR	2324043	--	--	--	--
5/16	5/16	13/16	2-1/2	.030CR	2324044	--	--	--	--
3/8	3/8	1	2-1/2	SQ	2324051	2324066	2321204	2324060	2324075
3/8	3/8	1	2-1/2	.015CR	2324052	2324067	--	2324061	2324076
3/8	3/8	1	2-1/2	.030CR	2324053	2324068	2321205	2324062	2324077
1/2	1/2	1-1/4	3	SQ	2324081	2324113	2321206	2324097	2324129
1/2	1/2	1-1/4	3	.015CR	2324082	2324114	--	2324098	2324130
1/2	1/2	1-1/4	3	.030CR	2324083	2324115	2321207	2324099	2324131
1/2	1/2	1-1/4	3	.060CR	2324084	2324116	--	2324100	--
5/8	5/8	1-1/2	3-1/2	SQ	2324141	2324159	2321209	2324150	2324168
5/8	5/8	1-1/2	3-1/2	.030CR	2324142	2324160	2321210	2324151	2324169
5/8	5/8	1-1/2	3-1/2	.060CR	2324143	2324161	--	2324152	--
3/4	3/4	1-1/2	4	SQ	2324174	2324192	2321212	2324183	2324198
3/4	3/4	1-1/2	4	.030CR	2324175	2324193	2321213	2324184	2324199
3/4	3/4	1-1/2	4	.060CR	2324176	--	--	2324185	--
1	1	1-1/2	4	SQ	2324204	2324222	2321199	2324213	2324228
1	1	1-1/2	4	.030CR	2324205	2324223	2321200	2324214	2324229
1	1	1-1/2	4	.060CR	2324206	--	--	2324215	--

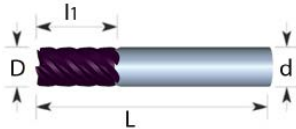


P	●	Steel	
M	●	Stainless Steel	
K	●	Cast Iron	
N	○	Non-Ferrous	
S	●	High Temp. Alloys	
H	●	Hardened Steel	
● BEST		○ OK	○ NOT OPTIMAL

ULTRA HIGH PERFORMANCE HEM

- Special Helix Design with honed edges
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- Diameter (D) Tolerances: +0.0000"/-0.0015"
- Shank (d) Tolerance: +0.0000"/-0.0004"



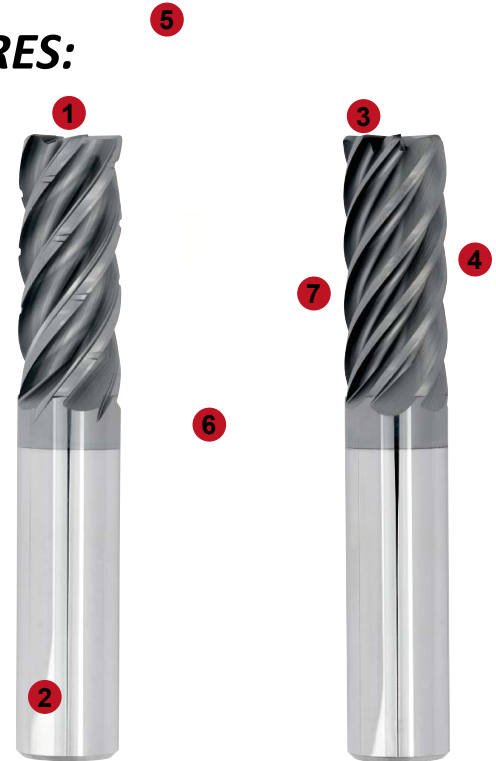
Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Corner Radius	ALL4 Coated				
					5 Flute Part#	5 Flute Chipbreaker Part#	6 Flute Part#	7 Flute Part#	7 Flute Chipbreaker Part#
					1/4	1/4	1-1/8	3	SQ
1/4	1/4	1-1/8	3	.015CR	2324040	--	--	--	--
1/4	1/4	1-1/8	3	.030CR	2324041	--	--	--	--
5/16	5/16	1-1/4	3	SQ	2324045	--	--	--	--
5/16	5/16	1-1/4	3	.015CR	2324046	--	--	--	--
5/16	5/16	1-1/4	3	.030CR	2324047	--	--	--	--
3/8	3/8	1-1/4	3	SQ	2324054	2324069	--	2324063	2324078
3/8	3/8	1-1/4	3	.015CR	2324055	2324070	--	2324064	2324079
3/8	3/8	1-1/4	3	.030CR	2324056	2324071	--	2324065	2324080
1/2	1/2	2-1/8	4	SQ	2324085	2324117	--	2324101	2324132
1/2	1/2	2-1/8	4	.015CR	2324086	2324118	--	2324102	2324133
1/2	1/2	2-1/8	4	.030CR	2324087	2324119	--	2324103	2324134
1/2	1/2	2-1/8	4	.060CR	2324088	2324120	--	2324104	--
1/2	1/2	2-5/8	5	SQ	2324089	2324121	--	2324105	2324135
1/2	1/2	2-5/8	5	.015CR	2324090	2324122	--	2324106	2324136
1/2	1/2	2-5/8	5	.030CR	2324091	2324123	--	2324107	2324137
1/2	1/2	2-5/8	5	.060CR	2324092	2324124	--	2324108	--
5/8	5/8	2-1/2	5	SQ	2324144	2324162	--	2324153	2324170
5/8	5/8	2-1/2	5	.030CR	2324145	2324163	--	2324154	2324171
5/8	5/8	2-1/2	5	.060CR	2324146	2324164	--	2324155	--
3/4	3/4	2-1/2	5	SQ	2324177	2324194	--	2324186	2324200
3/4	3/4	2-1/2	5	.030CR	2324178	2324195	--	2324187	2324201
3/4	3/4	2-1/2	5	.060CR	2324179	--	--	2324188	--
1	1	2-5/8	5	SQ	2324207	2324224	--	2324216	2324230
1	1	2-5/8	5	.030CR	2324208	2324225	--	2324217	2324231
1	1	2-5/8	5	.060CR	2324209	--	--	2324218	--



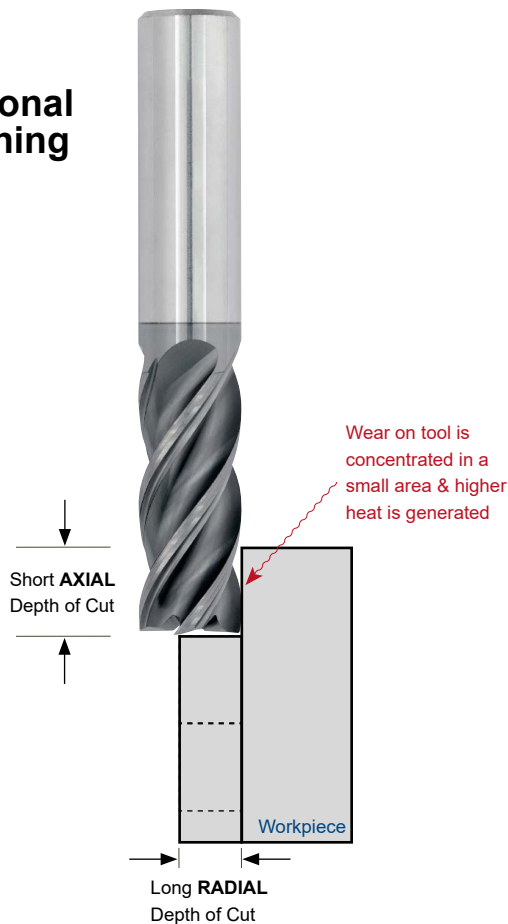
Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Corner Radius	ALL4 Coated				
					5 Flute Part#	5 Flute Chipbreaker Part#	6 Flute Part#	7 Flute Part#	7 Flute Chipbreaker Part#
					5/16	5/16	2-1/8	4	SQ
5/16	5/16	2-1/8	4	.015CR	2324049	--	--	--	--
5/16	5/16	2-1/8	4	.030CR	2324050	--	--	--	--
3/8	3/8	2-1/8	4	SQ	2324057	2324072	--	--	--
3/8	3/8	2-1/8	4	.015CR	2324058	2324073	--	--	--
3/8	3/8	2-1/8	4	.030CR	2324059	2324074	--	--	--
1/2	1/2	3-1/4	6	SQ	2324093	2324125	--	2324109	2324138
1/2	1/2	3-1/4	6	.015CR	2324094	2324126	--	2324110	2324139
1/2	1/2	3-1/4	6	.030CR	2324095	2324127	--	2324111	2324140
1/2	1/2	3-1/4	6	.060CR	2324096	2324128	--	2324112	--
5/8	5/8	3-1/4	6	SQ	2324147	2324165	--	2324156	2324172
5/8	5/8	3-1/4	6	.030CR	2324148	2324166	--	2324157	2324173
5/8	5/8	3-1/4	6	.060CR	2324149	2324167	--	2324158	--
3/4	3/4	3-1/4	6	SQ	2324180	2324196	--	2324189	2324202
3/4	3/4	3-1/4	6	.030CR	2324181	2324197	--	2324190	2324203
3/4	3/4	3-1/4	6	.060CR	2324182	--	--	2324191	--
1	1	3-1/4	6	SQ	2324210	2324226	--	2324219	2324232
1	1	3-1/4	6	.030CR	2324211	2324227	--	2324220	2324233
1	1	3-1/4	6	.060CR	2324212	--	--	2324221	--

ULTRA HIGH PERFORMANCE **HEM** FEATURES:

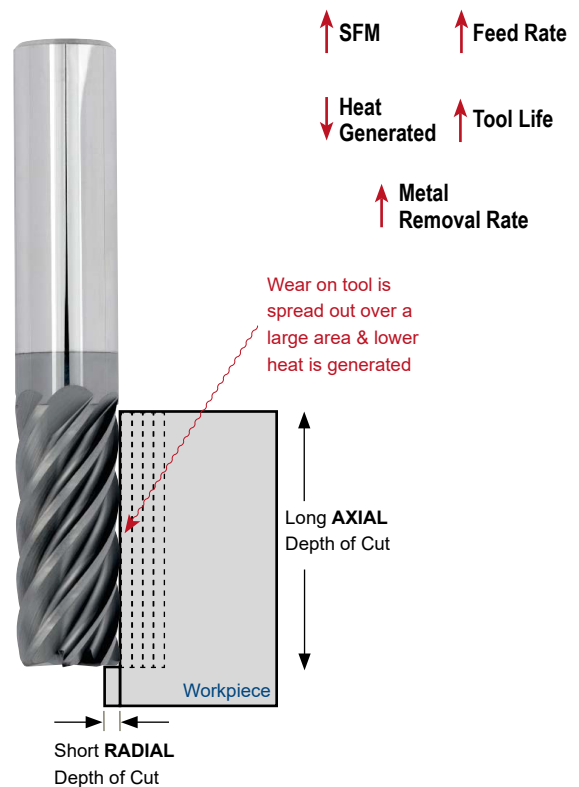
- 1** **Special Tapered Core** - Increases tool stiffness
- 2** **Ultra High Performance Micrograin Carbide** - Exceptional tool life
- 3** **Variable Pitch** - Reduces harmonic vibration & increases tool life & surface finish
- 4** **Finishers** - When exceptional finishes are required and chip lengths 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**)



ULTRA HIGH PERFORMANCE HEM

Material	ALL4 Coated	Feed Per Tooth By End Mill Diameter*								
		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		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	M	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	S	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

1:56

BACK RPM & IPM

DIA .5 RPM 3820 IPM 76.4

FLUTES 5

SFM 500

FPT .004 Calculate

High Efficiency Machining (HEM)
Result = 175.3 IPM

8:48

BACK IPM Radial Chip Thinning

DIA .5 RPM 3820 ADJ IPM 175.3

FLUTES 5

SFM 500 REGULAR IPM 76.4

FPT .004

* WOC .025 Calculate

* WOC not to exceed 1/2 of Diameter

Less Than 1/2 Diameter Engagement

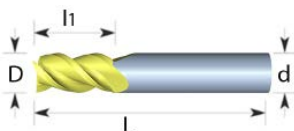
Something Less Than The Calculated FPT



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



ULTRA HIGH PERFORMANCE 3Flute Medium/Roughing - ALUMINUM

Cutter Diam.	Shank Diam.	Length Of Cut	O.A.L.	Corner Radius	Uncoated		ZrN Coated	
					3 Flute	3 Flute Chipbreaker	3 Flute	3 Flute Chipbreaker
					Part#	Part#	Part#	Part#
1/4	1/4	3/4	2-1/2	SQ	1321344	--	1321395	--
1/4	1/4	3/4	2-1/2	.015CR	1321345	--	1321396	--
1/4	1/4	3/4	2-1/2	.030CR	1321347	--	--	--
1/4	1/4	3/4	2-1/2	.060CR	1321348	--	--	--
5/16	5/16	13/16	2-1/2	SQ	1321350	--	1321399	--
5/16	5/16	13/16	2-1/2	.030CR	1321351	--	1321400	--
5/16	5/16	13/16	2-1/2	.060CR	1321352	--	--	--
3/8	3/8	1	2-1/2	SQ	1321353	--	1321401	--
3/8	3/8	1	2-1/2	.030CR	1321354	1321356	1321402	1321403
3/8	3/8	1	2-1/2	.060CR	1321355	--	--	--
3/8	3/8	1-1/8	3	SQ	1321357	--	1321404	--
3/8	3/8	1-1/8	3	.030CR	1321358	1321359	1321405	1321406
1/2	1/2	1-1/4	3	SQ	1321360	--	1321407	--
1/2	1/2	1-1/4	3	.030CR	1321361	1321365	1321408	1321409
1/2	1/2	1-1/4	3	.060CR	1321362	--	--	--
1/2	1/2	1-1/4	3	.090CR	1321363	--	--	--
1/2	1/2	1-1/4	3	.120CR	1321364	--	--	--
1/2	1/2	2	4	SQ	1321366	--	1321410	--
1/2	1/2	2	4	.030CR	1321367	1321368	1321411	1321412
5/8	5/8	1-1/4	3-1/2	SQ	1321369	--	1321413	--
5/8	5/8	1-1/4	3-1/2	.030CR	1321370	1321374	1321414	1321415
5/8	5/8	1-1/4	3-1/2	.060CR	1321371	--	--	--
5/8	5/8	1-1/4	3-1/2	.090CR	1321372	--	--	--
5/8	5/8	1-1/4	3-1/2	.120CR	1321373	--	--	--
5/8	5/8	2-1/4	5	SQ	1321375	--	1321416	--
5/8	5/8	2-1/4	5	.030CR	1321376	1321377	1321417	1321418
3/4	3/4	1-5/8	4	SQ	1321378	--	1321419	--
3/4	3/4	1-5/8	4	.030CR	1321379	1321383	1321420	1321421
3/4	3/4	1-5/8	4	.060CR	1321380	--	--	--
3/4	3/4	1-5/8	4	.090CR	1321381	--	--	--
3/4	3/4	1-5/8	4	.120CR	1321382	--	--	--
3/4	3/4	2-1/4	5	SQ	1321384	--	1321422	--
3/4	3/4	2-1/4	5	.030CR	1321385	1321386	1321423	1321424
1	1	1-1/2	4	SQ	1321387	--	1321425	--
1	1	1-1/2	4	.030CR	1321388	1321391	1321426	1321427
1	1	1-1/2	4	.060CR	1321389	--	--	--
1	1	1-1/2	4	.120CR	1321390	--	--	--
1	1	2-1/4	5	SQ	1321392	--	1321428	--
1	1	2-1/4	5	.030CR	1321393	1321394	1321429	1321430

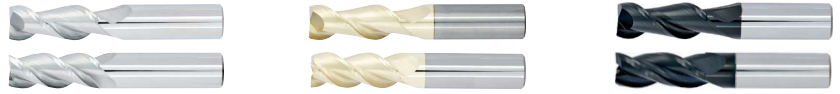
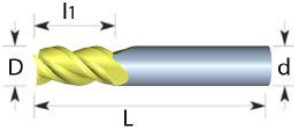


P	Steel
M	Stainless Steel
K	Cast Iron
N	Non-Ferrous
S	High Temp. Alloys
H	Hardened Steel
● BEST	

UHP - Aluminum Medium/Finisher

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

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



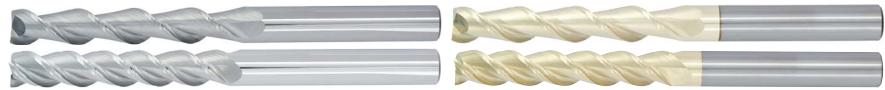
ULTRA HIGH PERFORMANCE Medium/Finishing, Regular Length, Single End - ALUMINUM

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	1321118	1321119	--	--	--	--
3/16	3/16	5/8	2	SQ	1321120	1321122	1321004	1321006	1321234	1321236
1/4	1/4	3/4	2-1/2	SQ	1321123	1321125	1321007	1321009	1321237	1321239
1/4	1/4	3/4	2-1/2	.020CR	1321124	1321126	1321008	1321010	1321238	1321240
5/16	5/16	13/16	2-1/2	SQ	1321128	1321130	1321012	1321014	1321242	1321244
5/16	5/16	13/16	2-1/2	.020CR	1321129	1321132	1321013	1321016	1321243	1321246
3/8	3/8	1	2-1/2	SQ	1321134	1321136	1321018	1321020	1321248	1321250
3/8	3/8	1	2-1/2	.020CR	1321135	1321137	1321019	1321021	1321249	1321251
1/2	1/2	1-1/4	3	SQ	1321138	1321140	1321022	1321024	1321252	1321254
1/2	1/2	1-1/4	3	.030CR	1321139	1321141	1321023	1321025	1321253	1321255
5/8	5/8	1-1/4	3-1/2	SQ	1321142	1321144	1321026	1321028	1321256	1321258
5/8	5/8	1-1/4	3-1/2	.030CR	1321143	1321145	1321027	1321029	1321257	1321259
3/4	3/4	1-1/2	4	SQ	1321146	1321148	1321030	1321032	1321260	1321262
3/4	3/4	1-1/2	4	.030CR	1321147	1321149	1321031	1321033	1321261	1321263
1	1	1-1/2	4	SQ	1321114	1321116	1321000	1321002	1321230	1321232
1	1	1-1/2	4	.030CR	1321115	1321117	1321001	1321003	1321231	1321233



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	1321152	1321153	1321036	1321037
1/4	1/4	1-1/8	3	SQ	1321154	1321155	1321038	1321039
5/16	5/16	1-1/8	3	SQ	1321156	1321157	1321040	1321041
3/8	3/8	1-1/8	3	SQ	1321158	1321159	1321042	1321043
1/2	1/2	2	4	SQ	1321160	1321161	1321044	1321045
5/8	5/8	2-1/4	5	SQ	1321162	1321163	1321046	1321047
3/4	3/4	2-1/4	5	SQ	1321164	1321165	1321048	1321049
1	1	2-1/4	5	SQ	1321150	1321151	1321034	1321035

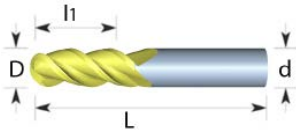


ULTRA HIGH PERFORMANCE Medium/Finishing, Extra Long Length, Single End - ALUMINUM

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	1321200	1321201	1321084	1321085
1/4	1/4	1-1/2	4	SQ	1321202	1321203	1321086	1321087
5/16	5/16	1-5/8	4	SQ	1321204	1321205	1321088	1321089
3/8	3/8	1-3/4	4	SQ	1321206	1321207	1321090	1321091
1/2	1/2	3	6	SQ	1321208	1321209	1321092	1321093
5/8	5/8	3	6	SQ	1321210	1321211	1321094	1321095
3/4	3/4	3	6	SQ	1321212	1321213	1321096	1321097
1	1	3	6	SQ	1321198	1321199	1321082	1321083



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



- 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 l ₁	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	5/8	2	BN	1321168	1321169	1321052	1321053
1/4	1/4	3/4	2-1/2	BN	1321170	1321171	1321054	1321055
5/16	5/16	13/16	2-1/2	BN	1321172	1321173	1321056	1321057
3/8	3/8	1	2-1/2	BN	1321174	1321175	1321058	1321059
1/2	1/2	1-1/4	3	BN	1321176	1321177	1321060	1321061
5/8	5/8	1-1/4	3-1/2	BN	1321178	1321179	1321062	1321063
3/4	3/4	1-1/2	4	BN	1321180	1321181	1321064	1321065
1	1	1-1/2	4	BN	1321166	1321167	1321050	1321051



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

Cutter Diam. D	Shank Diam. d	Length Of Cut l ₁	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	BN	1321184	1321185	1321068	1321069
1/4	1/4	1-1/8	3	BN	1321186	1321187	1321070	1321071
5/16	5/16	1-1/8	3	BN	1321188	1321189	1321072	1321073
3/8	3/8	1-1/8	3	BN	1321190	1321191	1321074	1321075
1/2	1/2	2	4	BN	1321192	1321193	1321076	1321077
5/8	5/8	2-1/4	5	BN	1321194	1321195	1321078	1321079
3/4	3/4	2-1/4	5	BN	1321196	1321197	1321080	1321081
1	1	2-1/4	5	BN	1321182	1321183	1321066	1321067



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

Cutter Diam. D	Shank Diam. d	Length Of Cut l ₁	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	BN	1321216	1321217	1321100	1321101
1/4	1/4	1-1/2	4	BN	1321218	1321219	1321102	1321103
5/16	5/16	1-5/8	4	BN	1321220	1321221	1321104	1321105
3/8	3/8	1-3/4	4	BN	1321222	1321223	1321106	1321107
1/2	1/2	3	6	BN	1321224	1321225	1321108	1321109
5/8	5/8	3	6	BN	1321226	1321227	1321110	1321111
3/4	3/4	3	6	BN	1321228	1321229	1321112	1321113
1	1	3	6	BN	1321214	1321215	1321098	1321099

ULTRA HIGH PERFORMANCE - Aluminum

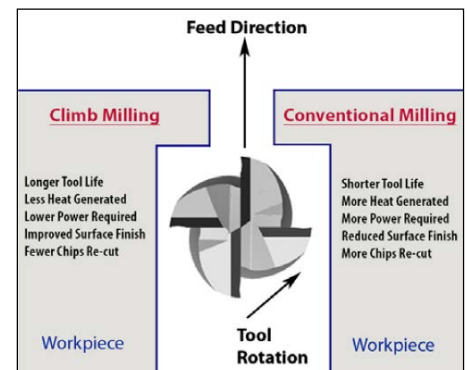
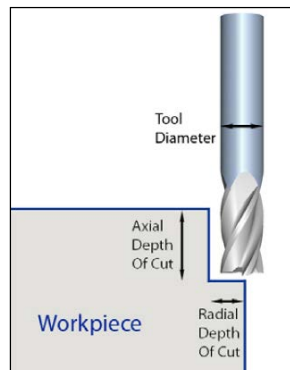
Material	Speed (SFM)	Feed Per Tooth By End Mill Diameter								
		ZrN Coated	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"	1"
Aluminum & Aluminum Alloys	900-1800		.0030	.0035	.0040	.0045	.0050	.0060	.0070	.0090
Copper & Copper Alloys	525-1275		.0030	.0035	.0035	.0040	.0040	.0045	.0050	.0070
Brass & Bronze	375-600	N	.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)	--	K	--	--	--	--	--	--	--	--
Iron, Cast (hard)	--		--	--	--	--	--	--	--	--
Iron, Ductile	--		--	--	--	--	--	--	--	--
Iron, Malleable	--		--	--	--	--	--	--	--	--
Carbon Steels, Low	--	P	--	--	--	--	--	--	--	--
Carbon Steels, Medium	--		--	--	--	--	--	--	--	--
Carbon Steels Hardened to 35 Rc	--		--	--	--	--	--	--	--	--
Carbon Steels Hardened to 50 Rc	--		--	--	--	--	--	--	--	--
Carbon Steels Hardened to 60 Rc	--		--	--	--	--	--	--	--	--
Steels, Mold	--	M	--	--	--	--	--	--	--	--
Steels, Tool	--		--	--	--	--	--	--	--	--
Stainless Steels, Soft	--	S	--	--	--	--	--	--	--	--
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

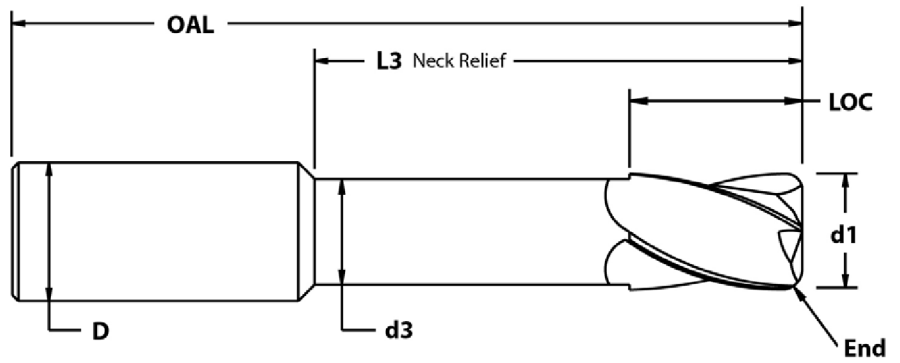
$$RPM = \frac{SFM}{(3.146 * \text{Cutter Diam.}) / 12}$$

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





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

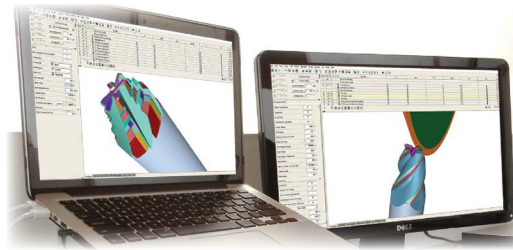
Special Minimum Order Quantities

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: _____

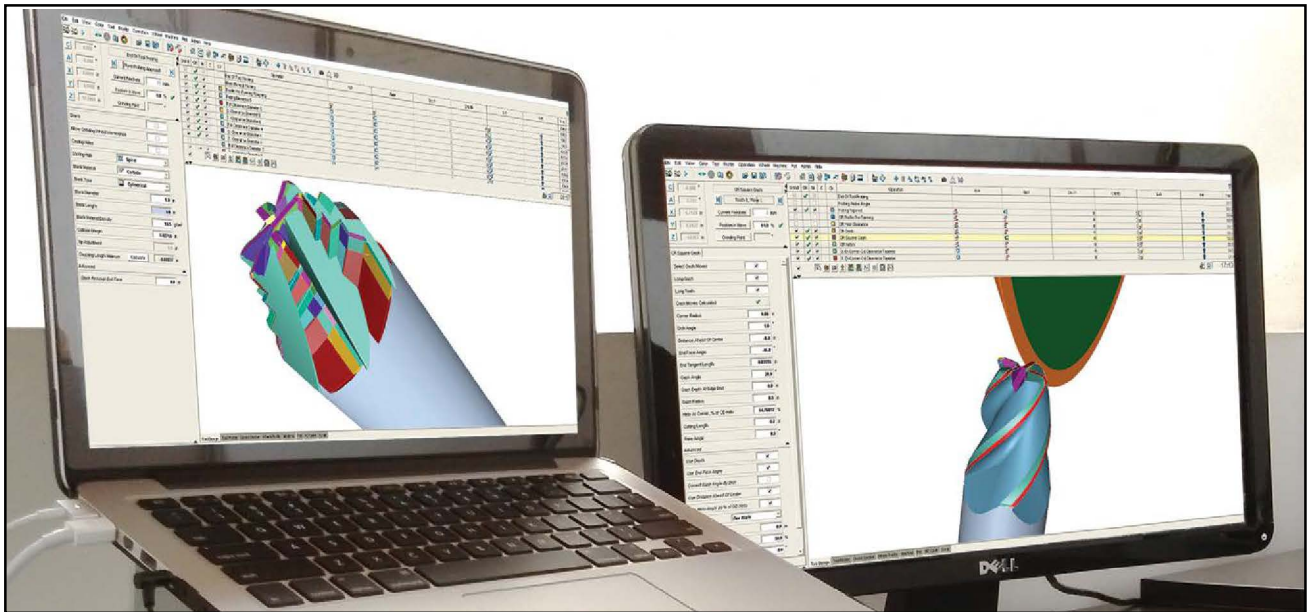
End User Contact: _____

Other Information: _____



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





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Langford, B.C. V9B 4G1
Ph. 1-888-665-6936
E. warehouse@onlinesupply.ca**

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