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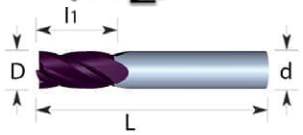

P	●	Steel
M	◒	Stainless Steel
K	●	Cast Iron
N	○	Non-Ferrous
S	○	High Temp. Alloys
H		Hardened Steel

●BETTER ◒OK ○NOT OPTIMAL

HIGH PERFORMANCE

- Special Helix Design with honed edges
- 10% Micrograin Carbide
- Variable Pitch to reduce chatter with special core design
- 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 l_1	O.A.L. L	Corner Radius	TiALN Coated: 4 Flute - ROUND Shank Part#	TiALN Coated: 4 Flute - WELDON Shank Part#
3/16	3/16	3/8	2	SQ	190-188-4	--
3/16	3/16	3/8	2	.015CR	190-188-4-015R	--
1/4	1/4	3/8	2	SQ	190-250-4	--
1/4	1/4	3/8	2	.015CR	190-250-4-015R	--
5/16	5/16	3/8	2	SQ	190-312-4	--
5/16	5/16	3/8	2	.020CR	190-312-4-020R	--
3/8	3/8	1/2	2	SQ	190-375-4	--
3/8	3/8	1/2	2	.020CR	190-375-4-020R	--
1/2	1/2	5/8	2-1/2	SQ	190-500-4	191-500-4
1/2	1/2	5/8	2-1/2	.030CR	190-500-4-030R	191-500-4-030R
5/8	5/8	3/4	3	SQ	190-625-4	191-625-4
5/8	5/8	3/4	3	.030CR	190-625-4-030R	191-625-4-030R
3/4	3/4	1	3	SQ	190-750-4	191-750-4
3/4	3/4	1	3	.030CR	190-750-4-030R	191-750-4-030R

HIGH PERFORMANCE Variable Pitch Carbide, Regular Length, Single End

Cutter Diam. D	Shank Diam. d	Length Of Cut l_1	O.A.L. L	Corner Radius	TiALN Coated: 4 Flute - ROUND Shank Part#	TiALN Coated: 4 Flute - WELDON Shank Part#	TiALN Coated: 5 Flute - ROUND Shank Part#
1/8	1/8	1/2	1-1/2	SQ	090-125-4		
1/8	1/8	1/2	1-1/2	.010CR	090-125-4-010R		
3/16	3/16	5/8	2	SQ	090-188-4	--	
3/16	3/16	5/8	2	.015CR	090-188-4-015R	--	
1/4	1/4	3/4	2-1/2	SQ	090-250-4	091-250-4	090-250-5
1/4	1/4	3/4	2-1/2	.020CR	090-250-4-020R	091-250-4-020R	090-250-5-020R
5/16	5/16	13/16	2-1/2	SQ	090-312-4	091-312-4	090-312-5
5/16	5/16	13/16	2-1/2	.020CR	090-312-4-020R	091-312-4-020R	090-312-5-020R
3/8	3/8	7/8	2-1/2	SQ	090-375-4	091-375-4	090-375-5
3/8	3/8	7/8	2-1/2	.020CR	090-375-4-020R	091-375-4-020R	090-375-5-020R
7/16	7/16	1	2-3/4	SQ	090-437-4	091-437-4	
1/2	1/2	1-1/4	3	SQ	090-500-4	091-500-4	090-500-5
1/2	1/2	1-1/4	3	.015CR	090-500-4-015R	091-500-4-015R	
1/2	1/2	1-1/4	3	.030CR	090-500-4-030R	091-500-4-030R	090-500-5-030R
1/2	1/2	1-1/4	3	.060CR	090-500-4-060R	091-500-4-060R	
5/8	5/8	1-1/4	3-1/2	SQ	090-625-4	091-625-4	090-625-5
5/8	5/8	1-1/4	3-1/2	.030CR	090-625-4-030R	091-625-4-030R	090-625-5-030R
5/8	5/8	1-1/4	3-1/2	.060CR	090-625-4-060R	091-625-4-060R	
5/8	5/8	1-1/4	3-1/2	.125CR	090-625-4-125R	091-625-4-125R	
3/4	3/4	1-1/2	4	SQ	090-750-4	091-750-4	090-750-5
3/4	3/4	1-1/2	4	.030CR	090-750-4-030R	091-750-4-030R	090-750-5-030R
3/4	3/4	1-1/2	4	.060CR	090-750-4-060R	091-750-4-060R	
3/4	3/4	1-1/2	4	.125CR	090-750-4-125R	091-750-4-125R	
1	1	1-1/2	4	SQ	090-100-4	091-100-4	090-100-5
1	1	1-1/2	4	.030CR	090-100-4-030R	091-100-4-030R	090-100-5-030R
1	1	1-1/2	4	.060CR	090-100-4-060R	091-100-4-060R	
1	1	1-1/2	4	.125CR	090-100-4-125R	091-100-4-125R	

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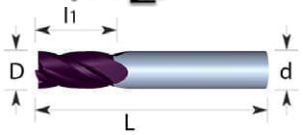

P	●	Steel
M	◒	Stainless Steel
K	●	Cast Iron
N	○	Non-Ferrous
S	○	High Temp. Alloys
H		Hardened Steel

● BETTER ◒ OK ○ NOT OPTIMAL

HIGH PERFORMANCE

- Special Helix Design with honed edges
- 10% Micrograin Carbide
- Variable Pitch to reduce chatter with special core design
- 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	092-188-4	--	
3/16	3/16	3/4	2-1/2	.015CR	092-188-4-015R	--	
1/4	1/4	1-1/8	3	SQ	092-250-4	093-250-4	092-250-5
1/4	1/4	1-1/8	3	.020CR	092-250-4-020R	093-250-4-020R	092-250-5-020R
5/16	5/16	1-1/8	3	SQ	092-312-4	093-312-4	092-312-5
5/16	5/16	1-1/8	3	.020CR	092-312-4-020R	093-312-4-020R	092-312-5-020R
3/8	3/8	1-1/8	3	SQ	092-375-4	093-375-4	092-375-5
3/8	3/8	1-1/8	3	.020CR	092-375-4-020R	093-375-4-020R	092-375-5-020R
7/16	7/16	2	4	SQ	092-437-4	093-437-4	
1/2	1/2	2	4	SQ	092-500-4	093-500-4	092-500-5
1/2	1/2	2	4	.015CR	092-500-4-015R	093-500-4-015R	
1/2	1/2	2	4	.030CR	092-500-4-030R	093-500-4-030R	092-500-5-030R
1/2	1/2	2	4	.060CR	092-500-4-060R	093-500-4-060R	
5/8	5/8	2-1/4	5	SQ	092-625-4	093-625-4	092-625-5
5/8	5/8	2-1/4	5	.030CR	092-625-4-030R	093-625-4-030R	092-625-5-030R
5/8	5/8	2-1/4	5	.060CR	092-625-4-060R	093-625-4-060R	
5/8	5/8	2-1/4	5	.125CR	092-625-4-125R	093-625-4-125R	
3/4	3/4	2-1/4	5	SQ	092-750-4	093-750-4	092-750-5
3/4	3/4	2-1/4	5	.030CR	092-750-4-030R	093-750-4-030R	092-750-5-030R
3/4	3/4	2-1/4	5	.060CR	092-750-4-060R	093-750-4-060R	
3/4	3/4	2-1/4	5	.125CR	092-750-4-125R	093-750-4-125R	
1	1	2-1/4	5	SQ	092-100-4	093-100-4	092-100-5
1	1	2-1/4	5	.030CR	092-100-4-030R	093-100-4-030R	092-100-5-030R
1	1	2-1/4	5	.060CR	092-100-4-060R	093-100-4-060R	
1	1	2-1/4	5	.125CR	092-100-4-125R	093-100-4-125R	

HIGH PERFORMANCE Variable Pitch Carbide,Extra Long Length, Single End

Cutter Diam. 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	098-188-4	--
3/16	3/16	1-1/8	3	.015CR	098-188-4-015R	--
1/4	1/4	1-1/2	4	SQ	098-250-4	098-250-5
1/4	1/4	1-1/2	4	.020CR	098-250-4-020R	098-250-5-020R
5/16	5/16	1-5/8	4	SQ	098-312-4	098-312-5
5/16	5/16	1-5/8	4	.020CR	098-312-4-020R	098-312-5-020R
3/8	3/8	1-3/4	4	SQ	098-375-4	098-375-5
3/8	3/8	1-3/4	4	.020CR	098-375-4-020R	098-375-5-020R
1/2	1/2	3	6	SQ	098-500-4	098-500-5
1/2	1/2	3	6	.030CR	098-500-4-030R	098-500-5-030R
5/8	5/8	3	6	SQ	098-625-4	098-625-5
5/8	5/8	3	6	.030CR	098-625-4-030R	098-625-5-030R
3/4	3/4	3	6	SQ	098-750-4	098-750-5
3/4	3/4	3	6	.030CR	098-750-4-030R	098-750-5-030R
1	1	3	6	SQ	098-100-4	098-100-5
1	1	3	6	.030CR	098-100-4-030R	098-100-5-030R

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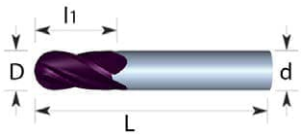

P	●	Steel
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- Variable Pitch to reduce chatter with special core design
- Diameter (D) Tolerance: +0.0000"/-0.0020"
- Shank (d) Tolerance: +0.0000"/-0.0004"

HIGH PERFORMANCE Variable Pitch Carbide, Ball Nose, Regular Length, Single End

Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	TiALN Coated 4 Flute - ROUND Shank Part#	TiALN Coated 4 Flute - WELDON Shank Part#
3/16	3/16	5/8	2	094-188-4	--
1/4	1/4	3/4	2-1/2	094-250-4	095-250-4
5/16	5/16	13/16	2-1/2	094-312-4	095-312-4
3/8	3/8	7/8	2-1/2	094-375-4	095-375-4
7/16	7/16	1	2-3/4	094-437-4	095-437-4
1/2	1/2	1	3	094-500-4	095-500-4
5/8	5/8	1-1/4	3-1/2	094-625-4	095-625-4
3/4	3/4	1-1/2	4	094-750-4	095-750-4
1	1	1-1/2	4	094-100-4	095-100-4

HIGH PERFORMANCE Variable Pitch Carbide, Ball Nose, Long Length, Single End

Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	TiALN Coated 4 Flute - ROUND Shank Part#	TiALN Coated 4 Flute - WELDON Shank Part#
3/16	3/16	3/4	2-1/2	096-188-4	--
1/4	1/4	1-1/8	3	096-250-4	097-250-4
5/16	5/16	1-1/8	3	096-312-4	097-312-4
3/8	3/8	1-1/8	3	096-375-4	097-375-4
7/16	7/16	2	4	096-437-4	097-437-4
1/2	1/2	2	4	096-500-4	097-500-4
5/8	5/8	2-1/4	5	096-625-4	097-625-4
3/4	3/4	2-1/4	5	096-750-4	097-750-4
1	1	2-1/4	5	096-100-4	097-100-4

HIGH PERFORMANCE Variable Pitch Carbide, Ball Nose, Extra Long Length, Single End

Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	TiALN Coated 4 Flute - ROUND Shank Part#	TiALN Coated 4 Flute - WELDON Shank Part#
3/16	3/16	1-1/8	3	099-188-4	--
1/4	1/4	1-1/2	4	099-250-4	--
5/16	5/16	1-5/8	4	099-312-4	--
3/8	3/8	1-3/4	4	099-375-4	--
1/2	1/2	3	6	099-500-4	--
5/8	5/8	3	6	099-625-4	--
3/4	3/4	3	6	099-750-4	--
1	1	3	6	099-100-4	--

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

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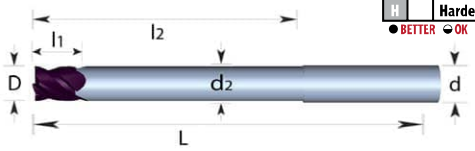


HIGH PERFORMANCE

- Special Helix Design with honed edges
- 10% Micrograin Carbide
- Variable Pitch to reduce chatter with special core design
- 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. d_2	Length Of Cut l_1	Length Below Shk. l_2	O.A.L. L	Corner Radius	TiALN Coated: 4 Flute - ROUND Shank Part#	TiALN Coated: 4 Flute - WELDON Shank Part#
3/16	3/16	.1775	3/8	2-1/2	4	SQ	290-188-4	--
3/16	3/16	.1775	3/8	2-1/2	4	.015CR	290-188-4-015R	--
1/4	1/4	.2400	3/8	2-1/2	4	SQ	290-250-4	--
1/4	1/4	.2400	3/8	2-1/2	4	.015CR	290-250-4-015R	--
5/16	5/16	.3025	7/16	2-1/2	4	SQ	290-312-4	--
5/16	5/16	.3025	7/16	2-1/2	4	.015CR	290-312-4-015R	--
3/8	3/8	.3650	1/2	2-1/2	4	SQ	290-375-4	--
3/8	3/8	.3650	1/2	2-1/2	4	.015CR	290-375-4-015R	--
1/2	1/2	.4800	5/8	3	5	SQ	290-500-4	--
1/2	1/2	.4800	5/8	3	5	.020CR	290-500-4-020R	--
1/2	1/2	.4800	5/8	4	6	SQ	290-500-4-L	--
1/2	1/2	.4800	5/8	4	6	.020CR	290-500-4-020R-L	--
5/8	5/8	.6050	3/4	3	5	SQ	290-625-4	--
5/8	5/8	.6050	3/4	3	5	.020CR	290-625-4-020R	--
5/8	5/8	.6050	3/4	4	6	SQ	290-625-4-L	--
5/8	5/8	.6050	3/4	4	6	.020CR	290-625-4-020R-L	--
3/4	3/4	.7300	1	3	5	SQ	290-750-4	--
3/4	3/4	.7300	1	3	5	.020CR	290-750-4-020R	--
3/4	3/4	.7300	1	4	6	SQ	290-750-4-L	--
3/4	3/4	.7300	1	4	6	.020CR	290-750-4-020R-L	--
3/4	3/4	.7300	1	5	7	SQ	290-750-4-LL	--
3/4	3/4	.7300	1	5	7	.020CR	290-750-4-020R-LL	--
1	1	.9800	1-1/4	3	5	SQ	290-100-4	--
1	1	.9800	1-1/4	3	5	.020CR	290-100-4-020R	--
1	1	.9800	1-1/4	4	6	SQ	290-100-4-L	--
1	1	.9800	1-1/4	4	6	.020CR	290-100-4-020R-L	--
1	1	.9800	1-1/4	5	7	SQ	290-100-4-LL	--
1	1	.9800	1-1/4	5	7	.020CR	290-100-4-020R-LL	--

HIGH PERFORMANCE Variable Pitch Carbide, Ball Long Reach Neck Relief, Single End

Cutter Diam. D	Shank Diam. d	Necked Diam. d_2	Length Of Cut l_1	Length Below Shk. l_2	O.A.L. L	TiALN Coated: 4 Flute - ROUND Shank Part#	TiALN Coated: 4 Flute - WELDON Shank Part#
3/16	3/16	.1775	3/8	2-1/2	4	294-188-4	--
1/4	1/4	.2400	3/8	2-1/2	4	294-250-4	--
5/16	5/16	.3025	7/16	2-1/2	4	294-312-4	--
3/8	3/8	.3650	1/2	2-1/2	4	294-375-4	--
1/2	1/2	.4800	5/8	3	5	294-500-4	--
1/2	1/2	.4800	5/8	4	6	294-500-4-L	--
5/8	5/8	.6050	3/4	3	5	294-625-4	--
5/8	5/8	.6050	3/4	4	6	294-625-4-L	--
3/4	3/4	.7300	1	3	5	294-750-4	--
3/4	3/4	.7300	1	4	6	294-750-4-L	--
3/4	3/4	.7300	1	5	7	294-750-4-LL	--
1	1	.9800	1-1/4	3	5	294-100-4	--
1	1	.9800	1-1/4	4	6	294-100-4-L	--
1	1	.9800	1-1/4	5	7	294-100-4-LL	--

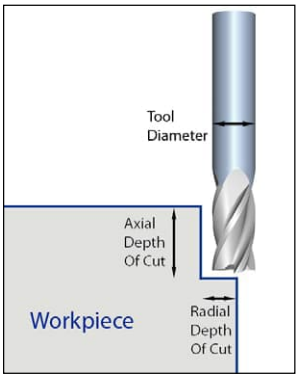
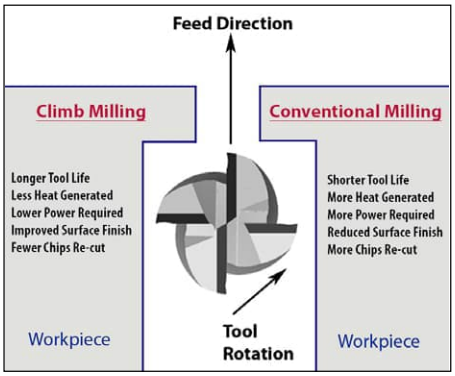
SPEED & FEED RECOMMENDATIONS

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	N	900-1800	.0025	.0030	.0035	.0040	.0045	.0055	.0065	.0085
Copper & Copper Alloys	N	525-1275	.0025	.0030	.0030	.0035	.0035	.0040	.0045	.0065
Brass & Bronze	N	375-600	.0025	.0030	.0030	.0035	.0035	.0040	.0045	.0055
Graphite	N	--	--	--	--	--	--	--	--	--
Plastics	N	--	--	--	--	--	--	--	--	--
Iron, Cast (soft)	K	375-650	.0025	.0027	.0030	.0032	.0035	.0040	.0065	.0085
Iron, Cast (hard)	K	100-375	.0013	.0015	.0020	.0022	.0025	.0030	.0035	.0045
Iron, Ductile	K	100-600	.0015	.0017	.0020	.0022	.0025	.0035	.0045	.0065
Iron, Malleable	K	225-650	.0015	.0020	.0025	.0030	.0035	.0045	.0055	.0075
Carbon Steels, Low	P	300-600	.0015	.0020	.0025	.0030	.0035	.0045	.0055	.0075
Carbon Steels, Medium	P	150-375	.0020	.0021	.0022	.0023	.0025	.0035	.0045	.0055
Carbon Steels Hardened to 35 Rc	P	130-345	.0015	.0016	.0017	.0018	.0020	.0022	.0025	.0035
Carbon Steels Hardened to 50 Rc	P	70-160	.0012	.0012	.0013	.0014	.0015	.0020	.0025	.0035
Carbon Steels Hardened to 60 Rc	P	--	--	--	--	--	--	--	--	--
Steels, Mold	P	300-525	.0015	.0017	.0020	.0022	.0025	.0030	.0035	.0045
Steels, Tool	P	150-375	.0015	.0017	.0020	.0022	.0025	.0030	.0035	.0045
Stainless Steels, Soft	M	300-450	.0015	.0017	.0020	.0017	.0025	.0035	.0045	.0065
Stainless Steels, Hard	M	150-300	.0010	.0011	.0012	.0013	.0015	.0025	.0035	.0055
Monel & High Nickel Steel	S	75-200	.0015	.0017	.0020	.0021	.0025	.0030	.0035	.0045
Titanium, Soft	S	125-375	.0015	.0017	.0020	.0021	.0025	.0035	.0045	.0065
Titanium, Hard	S	50-175	.0010	.0011	.0012	.0012	.0014	.0017	.0022	.0023
Nickel Based High Temp Alloys	S	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

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

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

(Inches Per Minute)