

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
- Variable Pitch to reduce chatter with special core design

## HIGH PERFORMANCE

- 10% Micro Grain Carbide
- Diameter Tolerances: +0.0000"/-0.0020"



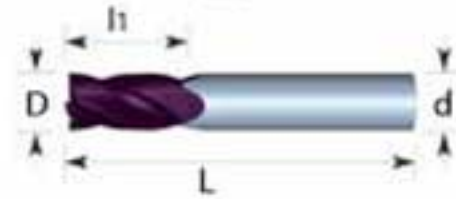
HIGH PERFORMANCE Variable Pitch Carbide, Stub Length, Single End								
Cutter Diam. D	Shank Diam. d	Length Of Cut l1	O.A.L. L	Corner Radius	TiAlN Coated		TiAlN Coated	
					4 Flute - ROUND Shank Part#	Price	4 Flute - WELDON Shank Part#	Price
3/16	3/16	3/8	2	SQ	190-188-4	\$13.06	--	
3/16	3/16	3/8	2	.015CR	190-188-4-015R	\$13.06	--	
1/4	1/4	3/8	2	SQ	190-250-4	\$16.53	--	
1/4	1/4	3/8	2	.015CR	190-250-4-015R	\$16.53	--	
5/16	5/16	3/8	2	SQ	190-312-4	\$22.82	--	
5/16	5/16	3/8	2	.020CR	190-312-4-020R	\$22.82	--	
3/8	3/8	1/2	2	SQ	190-375-4	\$27.26	--	
3/8	3/8	1/2	2	.020CR	190-375-4-020R	\$27.26	--	
1/2	1/2	5/8	2-1/2	SQ	190-500-4	\$40.11	191-500-4	\$40.11
1/2	1/2	5/8	2-1/2	.030CR	190-500-4-030R	\$40.11	191-500-4-030R	\$40.11
5/8	5/8	3/4	3	SQ	190-625-4	\$71.20	191-625-4	\$71.20
5/8	5/8	3/4	3	.030CR	190-625-4-030R	\$71.20	191-625-4-030R	\$71.20
3/4	3/4	1	3	SQ	190-750-4	\$100.61	191-750-4	\$100.61
3/4	3/4	1	3	.030CR	190-750-4-030R	\$100.61	191-750-4-030R	\$100.61



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		TiAlN Coated	
					4 Flute - ROUND Shank Part#	Price	4 Flute - WELDON Shank Part#	Price
3/16	3/16	5/8	2	SQ	090-188-4	\$14.51	--	
3/16	3/16	5/8	2	.015CR	090-188-4-015R	\$14.51	--	
1/4	1/4	3/4	2-1/2	SQ	090-250-4	\$18.36	091-250-4	\$18.36
1/4	1/4	3/4	2-1/2	.020CR	090-250-4-020R	\$18.36	091-250-4-020R	\$18.36
5/16	5/16	13/16	2-1/2	SQ	090-312-4	\$25.34	091-312-4	\$25.34
5/16	5/16	13/16	2-1/2	.020CR	090-312-4-020R	\$25.34	091-312-4-020R	\$25.34
3/8	3/8	7/8	2-1/2	SQ	090-375-4	\$29.64	091-375-4	\$29.64
3/8	3/8	7/8	2-1/2	.020CR	090-375-4-020R	\$29.64	091-375-4-020R	\$29.64
7/16	7/16	1	2-3/4	SQ	090-437-4	\$38.94	091-437-4	\$38.94
1/2	1/2	1-1/4	3	SQ	090-500-4	\$44.58	091-500-4	\$44.58
1/2	1/2	1-1/4	3	.015CR	090-500-4-015R	\$44.58	091-500-4-015R	\$44.58
1/2	1/2	1-1/4	3	.030CR	090-500-4-030R	\$44.58	091-500-4-030R	\$44.58
1/2	1/2	1-1/4	3	.060CR	090-500-4-060R	\$44.58	091-500-4-060R	\$44.58
5/8	5/8	1-1/4	3-1/2	SQ	090-625-4	\$73.40	091-625-4	\$73.40
5/8	5/8	1-1/4	3-1/2	.030CR	090-625-4-030R	\$73.40	091-625-4-030R	\$73.40
5/8	5/8	1-1/4	3-1/2	.060CR	090-625-4-060R	\$73.40	091-625-4-060R	\$73.40
5/8	5/8	1-1/4	3-1/2	.125CR	090-625-4-125R	\$73.40	091-625-4-125R	\$73.40
3/4	3/4	1-1/2	4	SQ	090-750-4	\$106.77	091-750-4	\$106.77
3/4	3/4	1-1/2	4	.030CR	090-750-4-030R	\$106.77	091-750-4-030R	\$106.77
3/4	3/4	1-1/2	4	.060CR	090-750-4-060R	\$106.77	091-750-4-060R	\$106.77
3/4	3/4	1-1/2	4	.125CR	090-750-4-125R	\$106.77	091-750-4-125R	\$106.77
1	1	1-1/2	4	SQ	090-100-4	\$173.84	091-100-4	\$173.84
1	1	1-1/2	4	.030CR	090-100-4-030R	\$173.84	091-100-4-030R	\$173.84
1	1	1-1/2	4	.060CR	090-100-4-060R	\$173.84	091-100-4-060R	\$173.84
1	1	1-1/2	4	.125CR	090-100-4-125R	\$173.84	091-100-4-125R	\$173.84

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● BETTER ○ OK ○ NOT OPTIMAL



## HIGH PERFORMANCE

- Special Helix Design with honed edges
- Variable Pitch to reduce chatter with special core design

- 10% Micro Grain Carbide
- Diameter Tolerances: +0.0000"/-0.0020"



### 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		TiAlN Coated	
					4 Flute - ROUND Shank Part#	Price	4 Flute - WELDON Shank Part#	Price
3/16	3/16	3/4	2-1/2	SQ	092-188-4	\$29.64	--	
3/16	3/16	3/4	2-1/2	.015CR	092-188-4-015R	\$29.64	--	
1/4	1/4	1-1/8	3	SQ	092-250-4	\$31.24	093-250-4	\$31.24
1/4	1/4	1-1/8	3	.020CR	092-250-4-020R	\$31.24	093-250-4-020R	\$31.24
5/16	5/16	1-1/8	3	SQ	092-312-4	\$43.09	093-312-4	\$43.09
5/16	5/16	1-1/8	3	.020CR	092-312-4-020R	\$43.09	093-312-4-020R	\$43.09
3/8	3/8	1-1/8	3	SQ	092-375-4	\$50.36	093-375-4	\$50.36
3/8	3/8	1-1/8	3	.020CR	092-375-4-020R	\$50.36	093-375-4-020R	\$50.36
7/16	7/16	2	4	SQ	092-437-4	\$66.19	093-437-4	\$66.19
1/2	1/2	2	4	SQ	092-500-4	\$75.79	093-500-4	\$75.79
1/2	1/2	2	4	.015CR	092-500-4-015R	\$75.79	093-500-4-015R	\$75.79
1/2	1/2	2	4	.030CR	092-500-4-030R	\$75.79	093-500-4-030R	\$75.79
1/2	1/2	2	4	.060CR	092-500-4-060R	\$75.79	093-500-4-060R	\$75.79
5/8	5/8	2-1/4	5	SQ	092-625-4	\$110.11	093-625-4	\$110.11
5/8	5/8	2-1/4	5	.030CR	092-625-4-030R	\$110.11	093-625-4-030R	\$110.11
5/8	5/8	2-1/4	5	.060CR	092-625-4-060R	\$110.11	093-625-4-060R	\$110.11
5/8	5/8	2-1/4	5	.125CR	092-625-4-125R	\$110.11	093-625-4-125R	\$110.11
3/4	3/4	2-1/4	5	SQ	092-750-4	\$155.60	093-750-4	\$155.60
3/4	3/4	2-1/4	5	.030CR	092-750-4-030R	\$155.60	093-750-4-030R	\$155.60
3/4	3/4	2-1/4	5	.060CR	092-750-4-060R	\$155.60	093-750-4-060R	\$155.60
3/4	3/4	2-1/4	5	.125CR	092-750-4-125R	\$155.60	093-750-4-125R	\$155.60
1	1	2-1/4	5	SQ	092-100-4	\$225.97	093-100-4	\$225.97
1	1	2-1/4	5	.030CR	092-100-4-030R	\$225.97	093-100-4-030R	\$225.97
1	1	2-1/4	5	.060CR	092-100-4-060R	\$225.97	093-100-4-060R	\$225.97
1	1	2-1/4	5	.125CR	092-100-4-125R	\$225.97	093-100-4-125R	\$225.97



### 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		TiAlN Coated	
					4 Flute - ROUND Shank Part#	Price	4 Flute - WELDON Shank Part#	Price
3/16	3/16	1-1/8	3	SQ	098-188-4	\$32.59	--	
1/4	1/4	1-1/2	4	SQ	098-250-4	\$37.15	--	
5/16	5/16	1-5/8	4	SQ	098-312-4	\$49.55	--	
3/8	3/8	1-3/4	4	SQ	098-375-4	\$55.41	--	
1/2	1/2	3	6	SQ	098-500-4	\$115.20	--	
5/8	5/8	3	6	SQ	098-625-4	\$127.73	--	
3/4	3/4	3	6	SQ	098-750-4	\$177.39	--	
1	1	3	6	SQ	098-100-4	\$302.11	--	

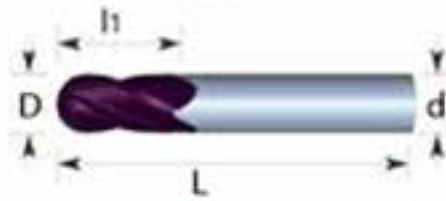
P	●	Steel
M	○	Stainless Steel
K	●	Cast Iron
N	○	Non-Ferrous
S	○	High Temp. Alloys
H	○	Hardened Steel

● BETTER ○ OK ○ NOT OPTIMAL

## HIGH PERFORMANCE

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HIGH PERFORMANCE Variable Pitch Carbide, Ball Regular Length, Single End							
Cutter Diam. D	Shank Diam. d	Length Of Cut l <sub>1</sub>	O.A.L. L	TiALN Coated		TiALN Coated	
				4 Flute - ROUND Shank Part#	Price	4 Flute - WELDON Shank Part#	Price
3/16	3/16	5/8	2	094-188-4	\$20.92	--	
1/4	1/4	3/4	2-1/2	094-250-4	\$22.04	095-250-4	\$22.04
5/16	5/16	13/16	2-1/2	094-312-4	\$30.41	095-312-4	\$30.41
3/8	3/8	7/8	2-1/2	094-375-4	\$35.56	095-375-4	\$35.56
7/16	7/16	1	2-3/4	094-437-4	\$46.72	095-437-4	\$46.72
1/2	1/2	1	3	094-500-4	\$53.50	095-500-4	\$53.50
5/8	5/8	1-1/4	3-1/2	094-625-4	\$88.09	095-625-4	\$88.09
3/4	3/4	1-1/2	4	094-750-4	\$124.48	095-750-4	\$124.48
1	1	1-1/2	4	094-100-4	\$208.59	095-100-4	\$208.59



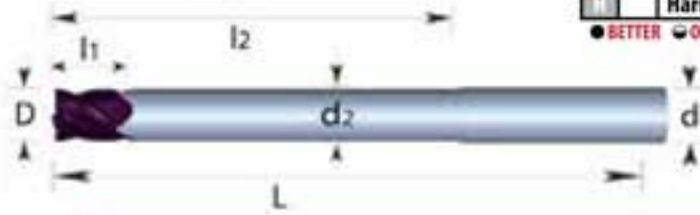
HIGH PERFORMANCE Variable Pitch Carbide, Ball Long Length, Single End							
Cutter Diam. D	Shank Diam. d	Length Of Cut l <sub>1</sub>	O.A.L. L	TiALN Coated		TiALN Coated	
				4 Flute - ROUND Shank Part#	Price	4 Flute - WELDON Shank Part#	Price
3/16	3/16	3/4	2-1/2	096-188-4	\$35.56	--	
1/4	1/4	1-1/8	3	096-250-4	\$37.48	097-250-4	\$37.48
5/16	5/16	1-1/8	3	096-312-4	\$51.69	097-312-4	\$51.69
3/8	3/8	1-1/8	3	096-375-4	\$60.44	097-375-4	\$60.44
7/16	7/16	2	4	096-437-4	\$79.42	097-437-4	\$79.42
1/2	1/2	2	4	096-500-4	\$90.96	097-500-4	\$90.96
5/8	5/8	2-1/4	5	096-625-4	\$132.12	097-625-4	\$132.12
3/4	3/4	2-1/4	5	096-750-4	\$186.71	097-750-4	\$186.71
1	1	2-1/4	5	096-100-4	\$271.18	097-100-4	\$271.18



HIGH PERFORMANCE Variable Pitch Carbide, Ball Extra Long Length, Single End							
Cutter Diam. D	Shank Diam. d	Length Of Cut l <sub>1</sub>	O.A.L. L	TiALN Coated		TiALN Coated	
				4 Flute - ROUND Shank Part#	Price	4 Flute - WELDON Shank Part#	Price
3/16	3/16	1-1/8	3	099-188-4	\$40.88	--	
1/4	1/4	1-1/2	4	099-250-4	\$43.09	--	
5/16	5/16	1-5/8	4	099-312-4	\$58.93	--	
3/8	3/8	1-3/4	4	099-375-4	\$84.62	--	
1/2	1/2	3	6	099-500-4	\$138.26	--	
5/8	5/8	3	6	099-625-4	\$147.95	--	
3/4	3/4	3	6	099-750-4	\$212.86	--	
1	1	3	6	099-100-4	\$360.66	--	

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H	■	Hardened Steel

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## HIGH PERFORMANCE

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- 10% Micro Grain Carbide
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### 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		TiAlN Coated	
							4 Flute - ROUND Shank Part#	Price	4 Flute - WELDON Shank Part#	Price
3/16	3/16	.1775	3/8	2-1/2	4	SQ	290-188-4	\$54.00	--	
3/16	3/16	.1775	3/8	2-1/2	4	.015CR	290-188-4-015R	\$54.00	--	
1/4	1/4	.2400	3/8	2-1/2	4	SQ	290-250-4	\$59.55	--	
1/4	1/4	.2400	3/8	2-1/2	4	.015CR	290-250-4-015R	\$59.55	--	
5/16	5/16	.3025	7/16	2-1/2	4	SQ	290-312-4	\$70.35	--	
5/16	5/16	.3025	7/16	2-1/2	4	.015CR	290-312-4-015R	\$70.35	--	
3/8	3/8	.3650	1/2	2-1/2	4	SQ	290-375-4	\$74.61	--	
3/8	3/8	.3650	1/2	2-1/2	4	.015CR	290-375-4-015R	\$74.61	--	
1/2	1/2	.4800	5/8	3	5	SQ	290-500-4	\$110.40	--	
1/2	1/2	.4800	5/8	3	5	.020CR	290-500-4-020R	\$110.40	--	
1/2	1/2	.4800	5/8	4	6	SQ	290-500-4-L	\$119.68	--	
1/2	1/2	.4800	5/8	4	6	.020CR	290-500-4-020R-L	\$119.68	--	
5/8	5/8	.6050	3/4	3	5	SQ	290-625-4	\$136.64	--	
5/8	5/8	.6050	3/4	3	5	.020CR	290-625-4-020R	\$136.64	--	
5/8	5/8	.6050	3/4	4	6	SQ	290-625-4-L	\$143.04	--	
5/8	5/8	.6050	3/4	4	6	.020CR	290-625-4-020R-L	\$143.04	--	
3/4	3/4	.7300	1	3	5	SQ	290-750-4	\$183.79	--	
3/4	3/4	.7300	1	3	5	.020CR	290-750-4-020R	\$183.79	--	
3/4	3/4	.7300	1	4	6	SQ	290-750-4-L	\$193.39	--	
3/4	3/4	.7300	1	4	6	.020CR	290-750-4-020R-L	\$193.39	--	
3/4	3/4	.7300	1	5	7	SQ	290-750-4-LL	\$220.59	--	
3/4	3/4	.7300	1	5	7	.020CR	290-750-4-020R-LL	\$220.59	--	
1	1	.9800	1-1/4	3	5	SQ	290-100-4	\$297.31	--	
1	1	.9800	1-1/4	3	5	.020CR	290-100-4-020R	\$297.31	--	
1	1	.9800	1-1/4	4	6	SQ	290-100-4-L	\$318.11	--	
1	1	.9800	1-1/4	4	6	.020CR	290-100-4-020R-L	\$318.11	--	
1	1	.9800	1-1/4	5	7	SQ	290-100-4-LL	\$367.71	--	
1	1	.9800	1-1/4	5	7	.020CR	290-100-4-020R-LL	\$367.71	--	



### 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		TiAlN Coated	
						4 Flute - ROUND Shank Part#	Price	4 Flute - WELDON Shank Part#	Price
3/16	3/16	.1775	3/8	2-1/2	4	294-188-4	\$61.49	--	
1/4	1/4	.2400	3/8	2-1/2	4	294-250-4	\$69.49	--	
5/16	5/16	.3025	7/16	2-1/2	4	294-312-4	\$78.13	--	
3/8	3/8	.3650	1/2	2-1/2	4	294-375-4	\$84.53	--	
1/2	1/2	.4800	5/8	3	5	294-500-4	\$121.28	--	
1/2	1/2	.4800	5/8	4	6	294-500-4-L	\$127.68	--	
5/8	5/8	.6050	3/4	3	5	294-625-4	\$161.55	--	
5/8	5/8	.6050	3/4	4	6	294-625-4-L	\$167.15	--	
3/4	3/4	.7300	1	3	5	294-750-4	\$222.46	--	
3/4	3/4	.7300	1	4	6	294-750-4-L	\$232.06	--	
3/4	3/4	.7300	1	5	7	294-750-4-LL	\$256.06	--	
1	1	.9800	1-1/4	3	5	294-100-4	\$359.06	--	
1	1	.9800	1-1/4	4	6	294-100-4-L	\$379.86	--	
1	1	.9800	1-1/4	5	7	294-100-4-LL	\$423.06	--	

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

- Higher Feed Per Tooth should be used to start for radial depths of cut less than 25% of the tool diameter. Lower Feed Per Tooth should be used to start for radial depths of cut greater than 25% of the tool diameter.
- The above recommendations are for axial lengths of cut not to exceed 1.25 times the tool diameter for profiling and .75 times the diameter for full slotting.
- The above parameters are recommended starting points only. If the tool is working well, without vibrations or significant noise, increase the SFM and/or Feed Per Tooth in 5-10% increments.
- Optimum speeds & feeds will depend upon material, setup, machine conditions & tool deflection. Higher or lower parameters may be required to achieve optimum machining conditions.
- For Light Radial Depths of cut, make certain to increase the feed rate to compensate for Radial Chip Thinning Factor (RCTF). Consult a formula or app to calculate.
- Climb Milling is preferred to Conventional Milling

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

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

