

NEWLY EXPANDED

Vol. 4.5



OSG
CANADA, LTD.

HY-PRO® CARB 
VARIABLE GEOMETRY END MILLS





END MILLS

Chatter free, high performance machining!

The VGx® End Mill Series from OSG is a field proven milling tool with the capability of chatter free, high performance machining in a wide range of materials and milling applications.

ADVANTAGES

1. Center cutting; can be used in all milling operations - slotting, side milling and pocketing - in both roughing and finishing operations.
2. Capable of machining a wide range of materials including carbon steels, alloy steels, cast irons, stainless steels, titanium and nickel alloys.
3. Excels in difficult to machine materials and applications while maintaining high metal removal rates.



VGx® end mills feature these innovative characteristics:

Variable Index: An unequal index with equal flute spacing allows the VGx® end mills to eliminate chatter by breaking up the harmonics produced during normal milling operations.

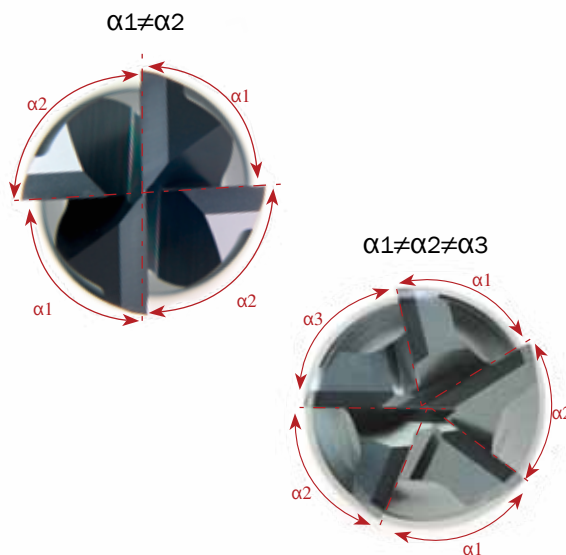
Raised Land: The raised land feature allows for stable constant milling in mild to severe milling operations.

Eccentric Relief: The unique eccentric relief grind keeps the tool sharp while minimizing friction.

Special Cutting Geometries: The cutting geometries incorporated on the VGx® end mills allow for free cutting in a wide range of materials while inhibiting premature chipping and wear.

TiAIN: OSG's TiAIN coating allows the end mill to cut at accelerated speeds and feeds while minimizing tool wear.

Variable Index

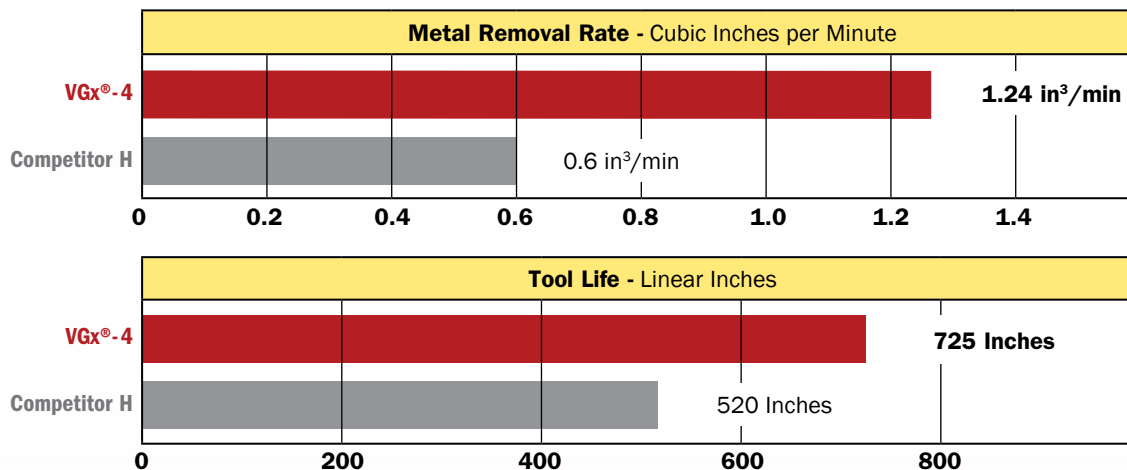


High Efficiency Milling in Stainless Steels

High metal removal rates, smooth surface finish and long tool life in both side and slot milling applications.

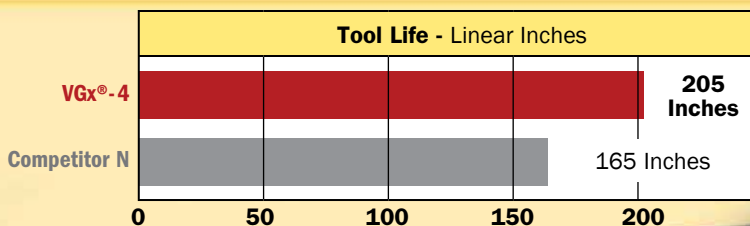
VGx® - 4 Flute End Mill Performance	
Tool	1/2" VGx®-4 with 0.030 CR
Material	304L Stainless Steel
Speed	3,500 RPM
Feed	19 IPM
Metal Removal Rate	1.24 in³/min
Milling Method	Side Milling
Depth of Cut	Aa=.650" Ar=.100"
Coolant	Water Soluble
Machine	Vertical Machining Center

Competitor H End Mill Performance	
Tool	1/2" with 0.030 CR
Material	304L Stainless Steel
Speed	2,300 RPM
Feed	9.2 IPM
Metal Removal Rate	0.60 in³/min
Milling Method	Side Milling
Depth of Cut	Aa=.650" Ar=.100"
Coolant	Water Soluble
Machine	Vertical Machining Center



Superior Tool Life in Heat Resistant Alloys

Tool Performance	
Tool	1/2" VGx®-4 with 0.100 CR
Material	RENE 220 (45 HRC)
Speed	560 RPM
Feed	3.1 IPM
Milling Method	Side Milling
Depth of Cut	Aa=0.5" Ar=0.1"
Coolant	Water Soluble
Machine	Horizontal Machining Center

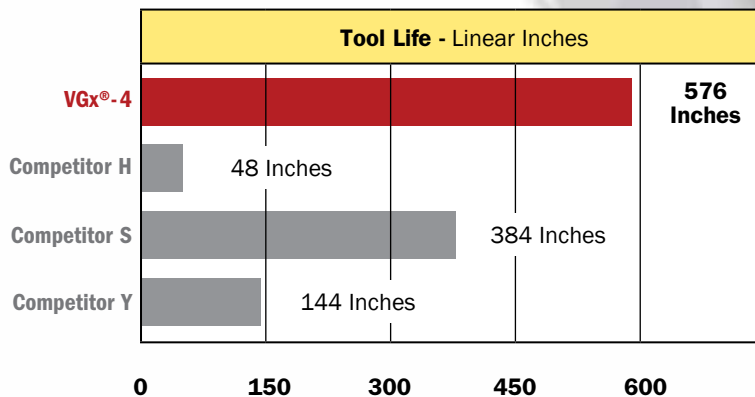


Cutting Data

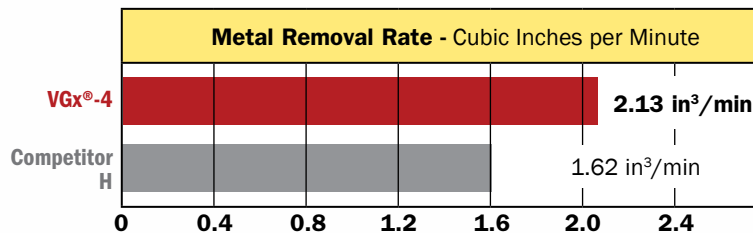
High Efficiency Milling and Superior Tool Life in Heat Resistant Alloys

High metal removal rates, good surface finish and long tool life in both side and slot milling applications.

Tool Performance	
Tool	1/2" VGx®-4 with 0.030 CR
Material	Inconel 718 (45 HRC)
Speed	993 RPM
Feed	9.9 IPM
Milling Method	Side Milling
Depth of Cut	Aa=0.75" Ar=0.025"
Coolant	Water Soluble
Machine	Vertical Machining Center



Tool Performance	
Tool	1/2" VGx®-4 with 0.030 CR
Material	Titanium 6Al4V
Speed	1,337 RPM
Feed	8.5 IPM
Milling Method	Slotting
Depth of Cut	Aa=0.5" Ar=0.5"
Coolant	Water Soluble
Machine	Vertical Machining Center

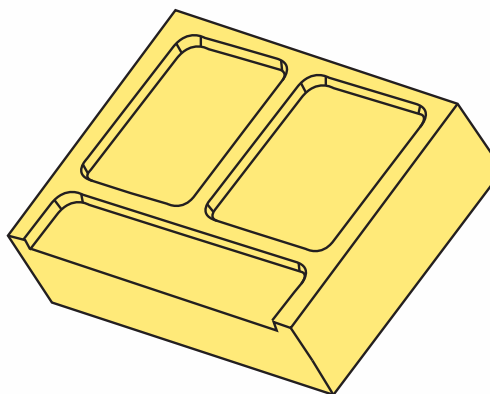




Excellent Performance in a Variety of Machining Scenarios

Pocketing and 1D Slotting in Hardened Stainless

Tool Performance	
Tool	3/8" VGx®-5 with 0.030 CR
Material	17-4 PH H925 (42 HRC)
Speed	2,505 RPM (246 SFM)
Feed	29 IPM (0.0023 IPT)
Milling Method	Pocketing & Slotting
Depth of Cut	Pocketing: Aa: 0.375" / Ar: 0.1875" Slotting: Aa: 0.375" / 0.375"
Coolant	Water Soluble
Machine	Vertical Machining Center



Tool Life									
VGx®-5	192 Inches			224 Inches			Still Running!		
Competitor	192 Inches			208 Inches			Chipping		
Pocketing Sequence				Slotting Sequence					

The VGx® end mill shows excellent performance in a variety of machining applications. A study was conducted machining pockets and slotting in hardened stainless steel. The results showed both tools performed the same in pocketing, but the VGx® tool machined twice the distance when slotting.



Competitor: Extreme Chipping



OSG's VGx®-5: Good Wear

VGx® Showed Greater Durability Versus the Competition

Tool Life Comparison in Hardened Stainless

Tool Performance	
Tool	1/2" VGx®-5 with 0.030 CR
Material	17-4 PH H925 (42 HRC)
Speed	1,566 RPM (205 SFM)
Feed	15.55 IPM (0.002 IPT)
Milling Method	Side Milling
Depth of Cut	Aa: 0.5" / Ar: 0.25"
Coolant	Water Soluble
Machine	Vertical Machining Center

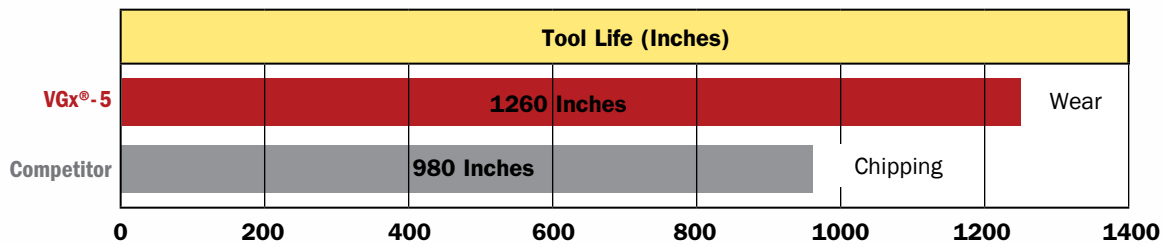
Tool Comparison After 1,200 Inches



OSG's VGx®-5: Mild Chipping;
Good Wear



Competitor: Severe Chipping;
Large Wear

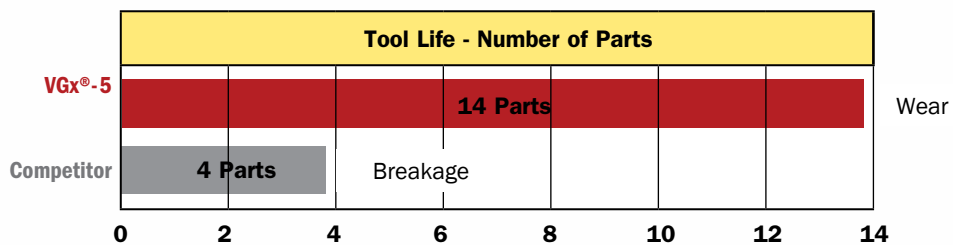


VGx® Increases Productivity and Lowers Cost Per Unit

OSG Reduced Cycle Time by 4 Minutes and Extended Tool Life by 10 Parts.



Tool Performance		
	OSG	Competitor
Tool	1/2" VGx®-5 with 0.030 CR	1/2" 5 Flute End Mill with 0.030 CR
Material	316 Stainless Steel	
Speed	2,300 RPM (300 SFM)	2,600 RPM (340 SFM)
Feed	30 IPM (0.0026 IPT)	24 IPM (0.0018 IPT)
Milling Method	Side Milling	
Depth of Cut	Aa: 0.075" / Ar: 0.225"	
Coolant	Water Soluble	
Machine	Vertical Machining Center	



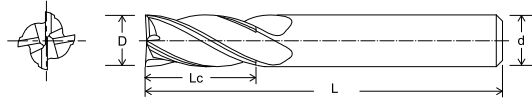


HY-PRO® CARB

Variable Geometry End Mills

List VG441

Multiple Lengths, 4 Flute, Square End, for Difficult to Machine Materials



EDP Number	EDP Number w/ Weldon Flat	Milling Diameter	Overall Length	Length of Cut	Shank Diameter
		D	L	Lc	d
VG441-1250	-	1/8	1 1/2	3/8	1/8
VG441-1875	-	3/16	2	7/16	3/16
VG441-2500	-	1/4	2 1/2	7/16	1/4
VG441-2501	-	1/4	2 1/2	3/4	1/4
VG441-2502	-	1/4	3 1/4	1 1/4	1/4
VG441-3125	-	5/16	2 1/2	13/16	5/16
VG441-3126	-	5/16	3 1/4	1 1/4	5/16
VG441-3127	-	5/16	4	1 5/8	5/16
VG441-3750	VG441-3752	3/8	2 1/2	1/2	3/8
VG441-3751	VG441-3753	3/8	2 1/2	7/8	3/8
VG441-3754	VG441-3755	3/8	4	1 1/2	3/8
VG441-3756	VG441-3757	3/8	4	2 1/2	3/8
VG441-4375	VG441-4376	7/16	2 3/4	1	7/16
VG441-5007	VG441-5000	1/2	2 1/2	5/8	1/2
VG441-5008	VG441-5001	1/2	3	1	1/2
VG441-5009	VG441-5002	1/2	3 1/2	1 1/4	1/2
VG441-5010	VG441-5003	1/2	4	1 1/2	1/2
VG441-5011	VG441-5004	1/2	4	2	1/2
VG441-5012	VG441-5005	1/2	4	2 1/2	1/2
VG441-5013	VG441-5006	1/2	5	3	1/2
VG441-6255	VG441-6250	5/8	3	3/4	5/8
VG441-6256	VG441-6251	5/8	3 1/2	1 1/4	5/8
VG441-6257	VG441-6252	5/8	5	1 5/8	5/8
VG441-6258	VG441-6253	5/8	5	2 1/4	5/8
VG441-6259	VG441-6254	5/8	6	3	5/8
VG441-7506	VG441-7500	3/4	3 1/2	7/8	3/4
VG441-7507	VG441-7501	3/4	4	1 1/2	3/4
VG441-7508	VG441-7502	3/4	4	1 5/8	3/4
VG441-7509	VG441-7503	3/4	5	2 1/4	3/4
VG441-7510	VG441-7504	3/4	6	3	3/4
VG441-7511	VG441-7505	3/4	6 1/4	4	3/4
VG441-1005	VG441-1000	1	4	1 1/2	1
VG441-1006	VG441-1001	1	5	2	1
VG441-1007	VG441-1002	1	5	2 1/2	1
VG441-1008	VG441-1003	1	6	3	1
VG441-1009	VG441-1004	1	7	4	1

Packed: 1 pc. Available TiAlN coating only.



Work Material															
List No.	Aluminum		Cast Iron	Carbon Steel	Alloy/Die Steel	Stainless Steels			Hardened Steels			High Heat Materials		MMC	Copper Alloy
	6061 7075	Casting				300	400	17-4PH	~35 HRC	35-45 HRC	45-50 HRC	Ti-Alloy	Inconel & Waspaloy		
VG441			⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	○	⊙	⊙		

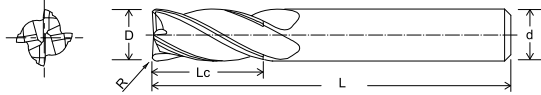
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List VG434

Multiple Lengths, 4 Flute, Corner Radius, for Difficult to Machine Materials



EDP Number	EDP Number w/ Weldon Flat	Milling Diameter	Overall Length	Corner Radius	Length of Cut	Shank Diameter
		D	L	R	Lc	d
VG434-1250	-	1/8	1 1/2	0.010	3/8	1/8
VG434-1251	-	1/8	1 1/2	0.015	3/8	1/8
VG434-1875	-	3/16	2	0.015	7/16	3/16
VG434-1876	-	3/16	2	0.030	7/16	3/16
VG434-2500	-	1/4	2 1/2	0.015	7/16	1/4
VG434-2501	-	1/4	2 1/2	0.030	7/16	1/4
VG434-2502	-	1/4	2 1/2	0.015	3/4	1/4
VG434-2503	-	1/4	2 1/2	0.030	3/4	1/4
VG434-2504	-	1/4	2 1/2	0.060	3/4	1/4
VG434-3125	-	5/16	2 1/2	0.015	13/16	5/16
VG434-3126	-	5/16	2 1/2	0.030	13/16	5/16
VG434-3750	VG434-3754	3/8	2 1/2	0.030	1/2	3/8
VG434-3751	VG434-3755	3/8	2 1/2	0.030	7/8	3/8
VG434-3752	VG434-3756	3/8	2 1/2	0.045	7/8	3/8
VG434-3753	VG434-3757	3/8	2 1/2	0.060	7/8	3/8
VG434-3759	VG434-3758	3/8	2 1/2	0.015	7/8	3/8
VG434-4375	VG434-4377	7/16	2 3/4	0.015	1	7/16
VG434-4376	VG434-4378	7/16	2 3/4	0.030	1	7/16
VG434-5021	VG434-5020	1/2	2 1/2	0.015	5/8	1/2
VG434-5009	VG434-5000	1/2	2 1/2	0.030	5/8	1/2
VG434-5010	VG434-5001	1/2	3	0.030	1	1/2
VG434-5011	VG434-5002	1/2	3	0.060	1	1/2
VG434-5012	VG434-5003	1/2	3 1/2	0.015	1 1/4	1/2
VG434-5013	VG434-5004	1/2	3 1/2	0.030	1 1/4	1/2
VG434-5014	VG434-5005	1/2	3 1/2	0.045	1 1/4	1/2
VG434-5015	VG434-5006	1/2	3 1/2	0.060	1 1/4	1/2
VG434-5016	VG434-5007	1/2	3 1/2	0.090	1 1/4	1/2
VG434-5017	VG434-5008	1/2	3 1/2	0.125	1 1/4	1/2
VG434-5019	VG434-5018	1/2	4	0.020	1 1/2	1/2
VG434-6254	VG434-6250	5/8	3 1/2	0.030	1 1/4	5/8
VG434-6255	VG434-6251	5/8	3 1/2	0.060	1 1/4	5/8
VG434-6256	VG434-6252	5/8	3 1/2	0.090	1 1/4	5/8
VG434-6257	VG434-6253	5/8	3 1/2	0.125	1 1/4	5/8
VG434-7504	VG434-7500	3/4	4	0.030	1 1/2	3/4
VG434-7505	VG434-7501	3/4	4	0.060	1 1/2	3/4
VG434-7506	VG434-7502	3/4	4	0.090	1 1/2	3/4
VG434-7507	VG434-7503	3/4	4	0.125	1 1/2	3/4
VG434-7510	VG434-7508	3/4	4	0.020	1 5/8	3/4
VG434-7511	VG434-7509	3/4	5	0.060	2 1/4	3/4
VG434-1004	VG434-1000	1	4	0.030	1 1/2	1
VG434-1005	VG434-1001	1	4	0.060	1 1/2	1
VG434-1006	VG434-1002	1	4	0.090	1 1/2	1
VG434-1007	VG434-1003	1	4	0.125	1 1/2	1

Packed: 1 pc. Available TiAlN coating only.



Work Material															
List No.	Aluminum		Cast Iron	Carbon Steel	Alloy/Die Steel	Stainless Steels			Hardened Steels			High Heat Materials		MMC	Copper Alloy
	6061 7075	Casting				300	400	17-4PH	~35 HRC	35-45 HRC	45-50 HRC	Ti-Alloy	Inconel & Waspaloy		
VG434			⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	○	⊙	⊙		

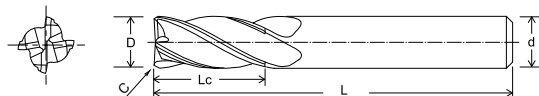
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List VG436

Multiple Lengths, 4 Flute, Corner Chamfer, for Difficult to Machine Materials



EDP Number	EDP Number w/ Weldon Flat	Milling Diameter	Overall Length	Corner Chamfer	Length of Cut	Shank Diameter
		D	L	C	Lc	d
VG436-1252	-	1/8	1 1/2	0.010	1/8	1/8
VG436-1250	-	1/8	1 1/2	0.010	1/4	1/8
VG436-1251	-	1/8	1 1/2	0.010	1/2	1/8
VG436-1875	-	3/16	2	0.010	5/16	3/16
VG436-1876	-	3/16	2 1/4	0.010	5/8	3/16
VG436-2500	-	1/4	2	0.016	3/8	1/4
VG436-2501	-	1/4	2 1/2	0.016	3/4	1/4
VG436-3125	-	5/16	2	0.016	1/2	5/16
VG436-3126	-	5/16	2 1/2	0.016	3/4	5/16
-	VG436-3750	3/8	2	0.020	1/2	3/8
-	VG436-3751	3/8	2 1/2	0.020	7/8	3/8
-	VG436-4375	7/16	2 1/2	0.020	5/8	7/16
-	VG436-4376	7/16	2 3/4	0.020	7/8	7/16
-	VG436-5000	1/2	2 1/2	0.020	5/8	1/2
-	VG436-5001	1/2	3	0.020	1	1/2
-	VG436-5002	1/2	3 1/2	0.020	1 1/4	1/2
-	VG436-5003	1/2	4	0.020	1 1/2	1/2
-	VG436-6250	5/8	3	0.020	3/4	3/4
-	VG436-6251	5/8	3 1/2	0.020	1 1/4	3/4
-	VG436-6252	5/8	4 1/8	0.020	1 5/8	3/4
-	VG436-7500	3/4	3 1/2	0.020	7/8	3/4
-	VG436-7501	3/4	4	0.020	1 1/2	3/4
-	VG436-7502	3/4	4	0.020	1 5/8	3/4
-	VG436-1000	1	4	0.020	1 1/2	1
-	VG436-1001	1	5	0.020	2	1

Packed: 1 pc. Available TiAlN coating only.



Work Material															
List No.	Aluminum		Cast Iron	Carbon Steel	Alloy/Die Steel	Stainless Steels			Hardened Steels			High Heat Materials		MMC	Copper Alloy
	6061 7075	Casting				300	400	17-4PH	~35 HRC	35-45 HRC	45-50 HRC	Ti-Alloy	Inconel & Waspaloy		
VG436			⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	○	⊙	⊙		

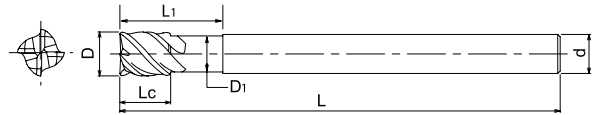
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List VG446 **NEW!**

Multiple Lengths, 4 Flute, Reduced Neck, Corner Radius/Corner Chamfer, for Difficult to Machine Materials



EDP Number	EDP Number w/ Weldon Flat	Milling Diameter	Overall Length	Corner Radius	Corner Chamfer	Length of Cut	Neck Diameter	Neck Length	Shank Diameter
		D	L	R	C	Lc	d1	L1	d
VG446-2500	-	1/4	4	0.015	-	3/8	0.235	1 1/4	1/4
VG446-2501	-	1/4	4	0.030	-	3/8	0.235	1 1/4	1/4
VG446-2502	-	1/4	4	-	0.016	3/8	0.235	1 1/4	1/4
-	VG446-3750	3/8	4	0.030	-	1/2	0.353	1 7/8	3/8
-	VG446-3751	3/8	4	0.060	-	1/2	0.353	1 7/8	3/8
-	VG446-3752	3/8	4	-	0.020	1/2	0.353	1 7/8	3/8
-	VG446-5000	1/2	4	0.030	-	5/8	0.470	2 1/4	1/2
-	VG446-5001	1/2	4	0.060	-	5/8	0.470	2 1/4	1/2
-	VG446-5002	1/2	4	0.120	-	5/8	0.470	2 1/4	1/2
-	VG446-5003	1/2	4	-	0.020	5/8	0.470	2 1/4	1/2
-	VG446-6250	5/8	4 1/8	0.060	-	3/4	0.588	2 1/4	5/8
-	VG446-6251	5/8	4 1/8	0.120	-	3/4	0.588	2 1/4	5/8
-	VG446-6252	5/8	4 1/8	-	0.020	3/4	0.588	2 1/4	5/8
-	VG446-6253	5/8	5	-	0.020	3/4	0.588	3 1/8	5/8
-	VG446-7500	3/4	4 1/4	-	0.020	1	0.705	2 1/4	3/4
-	VG446-7501	3/4	5 1/4	0.030	-	1	0.705	3 1/4	3/4
-	VG446-7502	3/4	5 1/4	0.060	-	1	0.705	3 1/4	3/4
-	VG446-7503	3/4	5 1/4	0.120	-	1	0.705	3 1/4	3/4
-	VG446-7504	3/4	5 1/4	-	0.020	1	0.705	3 1/4	3/4
-	VG446-1000	1	4 1/2	-	0.020	1 1/8	0.940	2 1/4	1
-	VG446-1001	1	5 1/2	0.030	-	1 1/8	0.940	3 1/4	1
-	VG446-1002	1	5 1/2	0.060	-	1 1/8	0.940	3 1/4	1
-	VG446-1003	1	5 1/2	0.120	-	1 1/8	0.940	3 1/4	1
-	VG446-1004	1	5 1/2	-	0.020	1 1/8	0.940	3 1/4	1
-	VG446-1005	1	6 1/2	-	0.020	1 1/8	0.940	4 1/4	1

Packed: 1 pc. Available TiAlN coating only.



Work Material															
List No.	Aluminum		Cast Iron	Carbon Steel	Alloy/Die Steel	Stainless Steels			Hardened Steels			High Heat Materials		MMC	Copper Alloy
	6061 7075	Casting				300	400	17-4PH	~35 HRC	35-45 HRC	45-50 HRC	Ti-Alloy	Inconel & Waspaloy		
VG446			⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	○	⊙	⊙		

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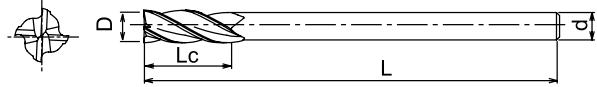
HY-PRO® CARB

Variable Geometry End Mills

List VG464 **NEW!**



Multiple Lengths, 4 Flute, Extended Length, Corner Radius/Corner Chamfer, for Difficult to Machine Materials



EDP Number	EDP Number w/ Weldon Flat	Milling Diameter	Overall Length	Corner Chamfer	Length of Cut	Shank Diameter
		D	L	C	Lc	d
VG464-2500	-	1/4	4	-	3/8	1/4
VG464-2501	-	1/4	4	0.016	3/8	1/4
-	VG464-3750	3/8	4	-	1/2	3/8
-	VG464-3751	3/8	4	0.020	1/2	3/8
-	VG464-5000	1/2	5	-	5/8	1/2
-	VG464-5001	1/2	5	0.020	5/8	1/2
-	VG464-5002	1/2	6	-	5/8	1/2
-	VG464-5003	1/2	6	0.020	5/8	1/2
-	VG464-6250	5/8	6	-	3/4	5/8
-	VG464-6251	5/8	6	0.020	3/4	5/8
-	VG464-6252	5/8	7	-	3/4	5/8
-	VG464-6253	5/8	7	0.020	3/4	5/8
-	VG464-7500	3/4	6	-	1	3/4
-	VG464-7501	3/4	6	0.020	1	3/4
-	VG464-7502	3/4	7	-	1	3/4
-	VG464-7503	3/4	7	0.020	1	3/4
-	VG464-1000	1	6	-	1 1/8	1
-	VG464-1001	1	6	0.020	1 1/8	1
-	VG464-1002	1	7	-	1 1/8	1
-	VG464-1003	1	7	0.020	1 1/8	1

Packed: 1 pc. Available TiAlN coating only.



Work Material															
List No.	Aluminum		Cast Iron	Carbon Steel	Alloy/Die Steel	Stainless Steels			Hardened Steels			High Heat Materials		MMC	Copper Alloy
	6061 7075	Casting				300	400	17-4PH	~35 HRC	35-45 HRC	45-50 HRC	Ti-Alloy	Inconel & Waspaloy		
VG464			⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	○	⊙	⊙		

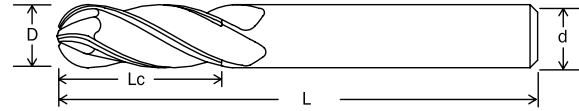
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List VG441BN **NEW!**

Multiple Lengths, 4 Flute, Ball Nose, for Difficult to Machine Materials



EDP Number	EDP Number w/ Weldon Flat	Milling Diameter	Overall Length	Length of Cut	Shank Diameter
		D	L	Lc	d
VG441-1250-BN	-	1/8	2	1/2	1/8
VG441-1875-BN	-	3/16	2 1/4	5/8	3/16
VG441-2500-BN	-	1/4	2 1/2	3/4	1/4
VG441-3125-BN	-	5/16	2 1/2	3/4	5/16
-	VG441-3750-BN	3/8	2 1/2	7/8	3/8
-	VG441-4375-BN	7/16	2 1/2	7/8	7/16
-	VG441-5000-BN	1/2	3	1	1/2
-	VG441-5010-BN	1/2	3	1 1/4	1/2
-	VG441-6250-BN	5/8	3 1/2	1 1/4	5/8
-	VG441-7500-BN	3/4	4	1 1/2	3/4
-	VG441-1000-BN	1	4	1 1/2	1
-	VG441-1010-BN	1 1/4	5	2 1/4	1 1/4

Packed: 1 pc. Available TiAlN coating only.



Work Material															
List No.	Aluminum		Cast Iron	Carbon Steel	Alloy/Die Steel	Stainless Steels			Hardened Steels			High Heat Materials		MMC	Copper Alloy
	6061 7075	Casting				300	400	17-4PH	~35 HRC	35-45 HRC	45-50 HRC	Ti-Alloy	Inconel & Waspaloy		
VG441BN			⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	○	⊙	⊙		

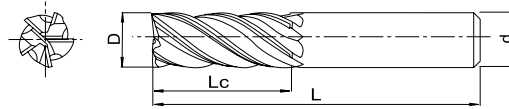
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List VG541 **NEW!**

Multiple Lengths, 5 Flute, Square End, for Difficult to Machine Materials



EDP Number	EDP Number w/ Weldon Flat	Milling Diameter	Overall Length	Length of Cut	Shank Diameter
		D	L	Lc	d
VG541-1249	-	1/8	1 1/2	9/32	1/8
VG541-1250	-	1/8	1 1/2	3/8	1/8
VG541-1875	-	3/16	2	7/16	3/16
VG541-1874	-	3/16	2 1/4	5/8	3/16
VG541-2500	-	1/4	2	3/8	1/4
VG541-2501	-	1/4	2 1/2	3/4	1/4
VG541-3125	-	5/16	2	15/32	5/16
VG541-3124	-	5/16	2 1/2	3/4	5/16
VG541-3750	VG541-3752	3/8	2	1/2	3/8
VG541-3751	VG441-3753	3/8	2 1/2	7/8	3/8
VG541-5007	VG541-5000	1/2	2 1/2	5/8	1/2
VG541-5009	VG541-5002	1/2	3 1/2	1 1/4	1/2
VG541-6255	VG541-6250	5/8	3	3/4	5/8
VG541-6256	VG541-6251	5/8	3 1/2	1 1/4	5/8
VG541-7512	VG541-7513	3/4	4	1 1/8	3/4
VG541-7507	VG541-7501	3/4	4	1 1/2	3/4
VG541-1010	VG541-1011	1	4	1 1/4	1
VG541-1005	VG541-1000	1	4	1 1/2	1

Packed: 1 pc. Available TiAlN coating only.



Work Material															
List No.	Aluminum		Cast Iron	Carbon Steel	Alloy/Die Steel	Stainless Steels			Hardened Steels			High Heat Materials		MMC	Copper Alloy
	6061 7075	Casting				300	400	17-4PH	~35 HRC	35-45 HRC	45-50 HRC	Ti-Alloy	Inconel & Waspaloy		
VG541			⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	○	⊙	⊙		

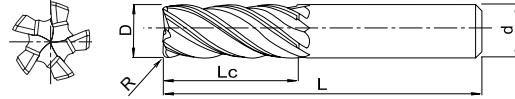
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List VG534 **NEW!**

Multiple Lengths, 5 Flute, Corner Radius, for Difficult to Machine Materials



EDP Number	EDP Number w/ Weldon Flat	Milling Diameter	Overall Length	Corner Radius	Length of Cut	Shank Diameter
		D	L	R	Lc	d
VG534-1875	-	3/16	2	0.015	7/16	3/16
VG534-1876	-	3/16	2	0.030	7/16	3/16
VG534-1877	-	3/16	2 1/4	0.015	5/8	3/16
VG534-1878	-	3/16	2 1/4	0.030	5/8	3/16
VG534-2505	-	1/4	2	0.015	3/8	1/4
VG534-2506	-	1/4	2	0.030	3/8	1/4
VG534-2507	-	1/4	2	0.060	3/8	1/4
VG534-2502	-	1/4	2 1/2	0.015	3/4	1/4
VG534-2503	-	1/4	2 1/2	0.030	3/4	1/4
VG534-2504	-	1/4	2 1/2	0.060	3/4	1/4
VG534-3122	-	5/16	2 1/2	0.015	3/4	5/16
VG534-3123	-	5/16	2 1/2	0.030	3/4	5/16
VG534-3124	-	5/16	2 1/2	0.060	3/4	5/16
VG534-3764	VG534-3758	3/8	2	0.015	1/2	3/8
VG534-3765	VG534-3759	3/8	2	0.030	1/2	3/8
VG534-3766	VG534-3760	3/8	2	0.060	1/2	3/8
VG534-3751	VG534-3755	3/8	2 1/2	0.015	7/8	3/8
VG534-3752	VG534-3756	3/8	2 1/2	0.030	7/8	3/8
VG534-3753	VG534-3757	3/8	2 1/2	0.060	7/8	3/8
VG534-5024	VG534-5018	1/2	2 1/2	0.015	5/8	1/2
VG534-5009	VG534-5000	1/2	2 1/2	0.030	5/8	1/2
VG534-5025	VG534-5019	1/2	2 1/2	0.060	5/8	1/2
VG534-5026	VG534-5020	1/2	2 1/2	0.090	5/8	1/2
VG534-5027	VG534-5021	1/2	2 1/2	0.120	5/8	1/2
VG534-5010	VG534-5001	1/2	3	0.030	1	1/2
VG534-5011	VG534-5002	1/2	3	0.060	1	1/2
VG534-5012	VG534-5003	1/2	3 1/2	0.015	1 1/4	1/2
VG534-5013	VG534-5004	1/2	3 1/2	0.030	1 1/4	1/2
VG534-5015	VG534-5006	1/2	3 1/2	0.060	1 1/4	1/2
VG534-5016	VG534-5007	1/2	3 1/2	0.090	1 1/4	1/2
VG534-5017	VG534-5008	1/2	3 1/2	0.120	1 1/4	1/2
VG534-6265	VG534-6258	5/8	3	0.030	3/4	5/8
VG534-6266	VG534-6259	5/8	3	0.060	3/4	5/8
VG534-6267	VG534-6260	5/8	3	0.090	3/4	5/8
VG534-6254	VG534-6250	5/8	3 1/2	0.030	1 1/4	5/8
VG534-6255	VG534-6251	5/8	3 1/2	0.060	1 1/4	5/8
VG534-6256	VG534-6252	5/8	3 1/2	0.090	1 1/4	5/8
VG534-7515	VG534-7508	3/4	4	0.030	1 1/8	3/4
VG534-7516	VG534-7509	3/4	4	0.060	1 1/8	3/4
VG534-7517	VG534-7510	3/4	4	0.090	1 1/8	3/4
VG534-7518	VG534-7511	3/4	4	0.120	1 1/8	3/4
VG534-7504	VG534-7500	3/4	4	0.030	1 1/2	3/4
VG534-7505	VG534-7501	3/4	4	0.060	1 1/2	3/4
VG534-7506	VG534-7502	3/4	4	0.090	1 1/2	3/4
VG534-7507	VG534-7503	3/4	4	0.120	1 1/2	3/4
VG534-1017	VG534-1010	1	4	0.030	1 1/4	1
VG534-1018	VG534-1011	1	4	0.060	1 1/4	1
VG534-1019	VG534-1012	1	4	0.090	1 1/4	1
VG534-1020	VG534-1013	1	4	0.120	1 1/4	1
VG534-1004	VG534-1000	1	4	0.030	1 1/2	1
VG534-1005	VG534-1001	1	4	0.060	1 1/2	1
VG534-1006	VG534-1002	1	4	0.090	1 1/2	1
VG534-1007	VG534-1003	1	4	0.120	1 1/2	1

Packed: 1 pc. Available TiAlN coating only.



Work Material															
List No.	Aluminum		Cast Iron	Carbon Steel	Alloy/Die Steel	Stainless Steels			Hardened Steels			High Heat Materials		MMC	Copper Alloy
	6061 7075	Casting				300	400	17-4PH	~35 HRC	35-45 HRC	45-50 HRC	Ti-Alloy	Inconel & Waspaloy		
VG534			⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	○	⊙	⊙		

○ good ⊙ best



Speeds & Feeds

List VG441 – HY-PRO® CARB VGx® 4 Flute

List VG434 – HY-PRO® CARB VGx® 4 Flute - Corner Radius

List VG436 – HY-PRO® CARB VGx® 4 Flute - Corner Chamfer

Side Milling (Inch)

Work Material	Mild Steels Carbon Steels Cast Iron		400 Stainless Steels Alloy Steels Tool Steels		300 Stainless Steels Hardened Steels Prehardened Steels		PH Stainless Steels Hardened Steels		Hardened Steels		Titanium Alloys		High Temp. Alloys Inconel Hastelloy	
Hardness	Up to 25 HRC		Up to 30 HRC		30 to 35 HRC		35 to 45 HRC		45 to 50 HRC		Less than 40 HRC		Less than 45 HRC	
Cutting Speed	400-500 SFM		300-400 SFM		200-350 SFM		200-250 SFM		175-225 SFM		150-250 SFM		100-135 SFM	
Depth of Cut	Aa=1.5D Ar=0.5D 						Aa=1.25D Ar=0.4D		Aa=1.25D Ar=0.2D		Aa=1.25D Ar=0.4D		Aa=1D Ar=0.2D	
Mill Dia.	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min
1/8	13750	44.0	10695	25.7	8400	18.6	6875	15.2	6110	14.5	6110	12.9	3665	9.5
3/16	9170	46.8	7130	28.8	5600	20.6	4585	16.9	4075	16.3	4075	13.7	2445	10.9
1/4	6875	46.8	5350	31.1	4200	20.3	3440	16.7	3050	16.8	3050	13.9	1835	11.2
5/16	5500	48.1	4210	31.8	3350	21.4	2750	17.6	2450	17.8	2450	15.1	1465	11.7
3/8	4585	47.1	3565	30.5	2800	20.6	2290	16.9	2040	16.3	2040	14.6	1220	11.1
7/16	3930	45.4	3055	30.2	2400	20.1	1965	16.5	1750	16.3	1750	14.0	1050	11.1
1/2	3440	45.4	2675	29.2	2100	19.5	1720	15.9	1525	15.7	1525	13.9	915	10.8
5/8	2750	40.6	2140	27.7	1700	19.0	1375	15.4	1225	14.7	1225	12.5	730	9.9
3/4	2290	37.3	1785	25.3	1400	16.8	1150	13.8	1025	13.5	1025	11.8	610	9.3
1	1720	33.0	1340	22.8	1050	14.9	860	12.2	765	12.2	765	10.6	460	8.4

Slotting (Inch)

Work Material	Mild Steels Carbon Steels Cast Iron		400 Stainless Steels Alloy Steels Tool Steels		300 Stainless Steels Hardened Steels Prehardened Steels		PH Stainless Steels Hardened Steels		Hardened Steels		Titanium Alloys		High Temp. Alloys Inconel Hastelloy	
Hardness	Up to 25 HRC		Up to 30 HRC		30 to 35 HRC		35 to 45 HRC		45 to 50 HRC		Less than 40 HRC		Less than 45 HRC	
Cutting Speed	325-400 SFM		250-325 SFM		175-275 SFM		160-200 SFM		140-180 SFM		125-200 SFM		75-100 SFM	
Depth of Cut	Aa=1D						Aa=0.75D		Aa=0.5D		Aa=0.5D		Aa=0.2D	
Mill Dia.	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min
1/8	11240	35.8	8860	21.3	6900	15.4	5500	10.7	4890	11.6	5050	10.6	2750	7.3
3/16	7495	38.5	5910	23.9	4600	17.5	3670	11.5	3260	12.8	3350	11.5	1835	8.1
1/4	5620	37.9	4430	25.5	3450	17.2	2750	12.2	2445	14.0	2550	11.8	1375	8.1
5/16	4500	39.4	3545	26.8	2750	18.3	2200	12.9	1955	14.2	2000	11.8	1100	9.0
3/8	3750	38.2	2955	25.5	2300	17.5	1835	12.2	1630	12.8	1700	11.6	915	8.3
7/16	3210	37.1	2530	24.7	1950	16.7	1575	11.8	1395	12.8	1450	11.8	785	8.3
1/2	2810	37.2	2215	24.2	1700	16.1	1375	11.5	1225	12.8	1300	12.1	690	8.1
5/8	2250	33.1	1775	22.5	1400	15.9	1100	11.0	975	11.6	1000	10.0	550	7.6
3/4	1875	31.1	1480	20.9	1150	14.4	920	10.0	815	10.5	850	9.4	460	6.9
1	1405	26.7	1110	18.7	875	12.6	685	8.6	610	9.8	650	9.0	345	6.5

List VG446 – HY-PRO® CARB VGx® 4 Flute - Reduced Neck

List VG464 – HY-PRO® CARB VGx® 4 Flute - Extended Length

Side Milling (Inch)

Work Material	Mild Steels Carbon Steels Cast Iron		400 Stainless Steels Alloy Steels Tool Steels		300 Stainless Steels Hardened Steels Prehardened Steels		PH Stainless Steels Hardened Steels		Hardened Steels		Titanium Alloys		High Temp. Alloys Inconel Hastelloy	
Hardness	Up to 25 HRC		Up to 30 HRC		30 to 35 HRC		35 to 45 HRC		45 to 50 HRC		Less than 40 HRC		Less than 45 HRC	
Cutting Speed	400-500 SFM		300-400 SFM		200-350 SFM		200-250 SFM		175-225 SFM		150-250 SFM		100-135 SFM	
Depth of Cut	Aa=1D Ar=0.4D 						Aa=0.75D Ar=0.35D		Aa=0.75D Ar=0.15D		Aa=0.75D Ar=0.35D		Aa=0.75D Ar=0.15D	
Mill Dia.	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min
1/4	6875	46.8	5350	31.1	4200	20.3	3440	16.7	3050	16.8	3050	13.9	1835	11.2
3/8	4585	47.1	3565	30.5	2800	20.6	2290	16.9	2040	16.3	2040	14.6	1220	11.1
1/2	3440	45.4	2675	29.2	2100	19.5	1720	15.9	1525	15.7	1525	13.9	915	10.8
5/8	2750	40.6	2140	27.7	1700	19.0	1375	15.4	1225	14.7	1225	12.5	730	9.9
3/4	2290	37.3	1785	25.3	1400	16.8	1150	13.8	1025	13.5	1025	11.8	610	9.3
1	1720	33.0	1340	22.8	1050	14.9	860	12.2	765	12.2	765	10.6	460	8.4

Slotting (Inch)

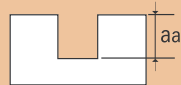
Work Material	Mild Steels Carbon Steels Cast Iron		400 Stainless Steels Alloy Steels Tool Steels		300 Stainless Steels Hardened Steels Prehardened Steels		PH Stainless Steels Hardened Steels		Hardened Steels		Titanium Alloys		High Temp. Alloys Inconel Hastelloy	
Hardness	Up to 25 HRC		Up to 30 HRC		30 to 35 HRC		35 to 45 HRC		45 to 50 HRC		Less than 40 HRC		Less than 45 HRC	
Cutting Speed	325-400 SFM		250-325 SFM		175-275 SFM		160-200 SFM		140-180 SFM		125-200 SFM		75-100 SFM	
Depth of Cut	Aa=0.6D						Aa=0.4D		Aa=0.25D		Aa=0.4D		Aa=0.15D	
Mill Dia.	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min
1/4	5620	37.9	4430	25.5	3450	17.2	2750	12.2	2445	14.0	2550	11.8	1375	8.1
3/8	3750	38.2	2955	25.5	2300	17.5	1835	12.2	1630	12.8	1700	11.6	915	8.3
1/2	2810	37.2	2215	24.2	1700	16.1	1375	11.5	1225	12.8	1300	12.1	690	8.1
5/8	2250	33.1	1775	22.5	1400	15.9	1100	11.0	975	11.6	1000	10.0	550	7.6
3/4	1875	31.1	1480	20.9	1150	14.4	920	10.0	815	10.5	850	9.4	460	6.9
1	1405	26.7	1110	18.7	875	12.6	685	8.6	610	9.8	650	9.0	345	6.5

List VG441BN – HY-PRO® CARB VGx® 4 Flute - Ball Nose

Side Milling (Inch)

Work Material	Mild Steels Carbon Steels Cast Iron		400 Stainless Steels Alloy Steels Tool Steels		300 Stainless Steels Hardened Steels Prehardened Steels		PH Stainless Steels Hardened Steels		Hardened Steels		Titanium Alloys		High Temp. Alloys Inconel Hastelloy	
Hardness	Up to 25 HRC		Up to 30 HRC		30 to 35 HRC		35 to 45 HRC		45 to 50 HRC		Less than 40 HRC		Less than 45 HRC	
Cutting Speed	400-500 SFM		300-400 SFM		200-350 SFM		200-250 SFM		175-225 SFM		150-250 SFM		100-135 SFM	
Depth of Cut	Aa=1.5D Ar=0.5D 						Aa=1.25D Ar=0.4D		Aa=1.25D Ar=0.2D		Aa=1.25D Ar=0.4D		Aa=1D Ar=0.2D	
Mill Dia.	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min
1/8	13750	44.0	10695	25.7	8400	18.6	6875	15.2	6110	14.5	6110	12.9	3665	9.5
3/16	9170	46.8	7130	28.8	5600	20.6	4585	16.9	4075	16.3	4075	13.7	2445	10.9
1/4	6875	46.8	5350	31.1	4200	20.3	3440	16.7	3050	16.8	3050	13.9	1835	11.2
5/16	5500	48.1	4210	31.8	3350	21.4	2750	17.6	2450	17.8	2450	15.1	1465	11.7
3/8	4585	47.1	3565	30.5	2800	20.6	2290	16.9	2040	16.3	2040	14.6	1220	11.1
7/16	3930	45.4	3055	30.2	2400	20.1	1965	16.5	1750	16.3	1750	14.0	1050	11.1
1/2	3440	45.4	2675	29.2	2100	19.5	1720	15.9	1525	15.7	1525	13.9	915	10.8
5/8	2750	40.6	2140	27.7	1700	19.0	1375	15.4	1225	14.7	1225	12.5	730	9.9
3/4	2290	37.3	1785	25.3	1400	16.8	1150	13.8	1025	13.5	1025	11.8	610	9.3
1	1720	33.0	1340	22.8	1050	14.9	860	12.2	765	12.2	765	10.6	460	8.4
1 1/4	1375	26.4	1070	18.2	850	12.1	690	9.8	610	9.7	610	8.3	365	6.7

Slotting (Inch)

Work Material	Mild Steels Carbon Steels Cast Iron		400 Stainless Steels Alloy Steels Tool Steels		300 Stainless Steels Hardened Steels Prehardened Steels		PH Stainless Steels Hardened Steels		Hardened Steels		Titanium Alloys		High Temp. Alloys Inconel Hastelloy	
Hardness	Up to 25 HRC		Up to 30 HRC		30 to 35 HRC		35 to 45 HRC		45 to 50 HRC		Less than 40 HRC		Less than 45 HRC	
Cutting Speed	325-400 SFM		250-325 SFM		175-275 SFM		160-200 SFM		140-180 SFM		125-200 SFM		75-100 SFM	
Depth of Cut	Aa=1.0D 						Aa=0.75D		Aa=0.5D		Aa=0.5D		Aa=0.2D	
Mill Dia.	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min
1/8	11240	35.8	8860	21.3	6900	15.4	5500	10.7	4890	11.6	5050	10.6	2750	7.3
3/16	7495	38.5	5910	23.9	4600	17.5	3670	11.5	3260	12.8	3350	11.5	1835	8.1
1/4	5620	37.9	4430	25.5	3450	17.2	2750	12.2	2445	14.0	2550	11.8	1375	8.1
5/16	4500	39.4	3545	26.8	2750	18.3	2200	12.9	1955	14.2	2000	11.8	1100	9.0
3/8	3750	38.2	2955	25.5	2300	17.5	1835	12.2	1630	12.8	1700	11.6	915	8.3
7/16	3210	37.1	2530	24.7	1950	16.7	1575	11.8	1395	12.8	1450	11.8	785	8.3
1/2	2810	37.2	2215	24.2	1700	16.1	1375	11.5	1225	12.8	1300	12.1	690	8.1
5/8	2250	33.1	1775	22.5	1400	15.9	1100	11.0	975	11.6	1000	10.0	550	7.6
3/4	1875	31.1	1480	20.9	1150	14.4	920	10.0	815	10.5	850	9.4	460	6.9
1	1405	26.7	1110	18.7	875	12.6	685	8.6	610	9.8	650	9.0	345	6.5
1 1/4	1115	21.2	885	14.9	700	10.1	550	6.9	490	7.8	500	6.9	275	5.1

List VG541 — HY-PRO® CARB VGx® 5 Flute

List VG534 — HY-PRO® CARB VGx® 5 Flute - Corner Radius

Side Milling (Inch)

Work Material	Mild Steels Carbon Steels Cast Iron		400 Stainless Steels Alloy Steels Tool Steels		300 Stainless Steels Hardened Steels Prehardened Steels		PH Stainless Steels Hardened Steels		Hardened Steels		Titanium Alloys		High Temp. Alloys Inconel Hastelloy	
Hardness	Up to 25 HRC		Up to 30 HRC		30 to 35 HRC		35 to 45 HRC		45 to 50 HRC		Less than 40 HRC		Less than 45 HRC	
Cutting Speed	400-500 SFM		300-400 SFM		200-350 SFM		200-250 SFM		175-225 SFM		150-250 SFM		100-135 SFM	
Depth of Cut	Aa=1.5D Ar=0.5D 						Aa=1.25D Ar=0.4D		Aa=1.25D Ar=0.2D		Aa=1.25D Ar=0.4D		Aa=1D Ar=0.2D	
Mill Dia.	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min
1/8	13750	55.0	10695	32.2	8400	23.2	6875	19.0	6110	18.2	6110	16.1	3665	11.8
3/16	9170	58.5	7130	36.1	5600	25.8	4585	21.1	4075	20.4	4075	17.2	2445	13.6
1/4	6875	58.4	5350	38.9	4200	25.4	3440	20.8	3050	21.1	3050	17.4	1835	14.1
5/16	5500	60.2	4210	39.7	3350	26.8	2750	22.0	2450	22.2	2450	18.9	1465	14.7
3/8	4585	58.8	3565	38.1	2800	25.8	2290	21.1	2040	20.4	2040	18.3	1220	13.9
7/16	3930	56.8	3055	37.8	2400	25.1	1965	20.6	1750	20.4	1750	17.5	1050	13.8
1/2	3440	56.8	2675	36.5	2100	24.3	1720	19.9	1525	19.6	1525	17.4	915	13.4
5/8	2750	50.7	2140	34.6	1700	23.8	1375	19.3	1225	18.4	1225	15.6	730	12.4
3/4	2290	46.7	1785	31.6	1400	21.0	1150	17.3	1025	16.8	1025	14.8	610	11.6
1	1720	41.3	1340	28.5	1050	18.7	860	15.3	765	15.3	765	13.2	460	10.5

Slotting (Inch)

Work Material	Mild Steels Carbon Steels Cast Iron		400 Stainless Steels Alloy Steels Tool Steels		300 Stainless Steels Hardened Steels Prehardened Steels		PH Stainless Steels Hardened Steels		Hardened Steels		Titanium Alloys		High Temp. Alloys Inconel Hastelloy	
Hardness	Up to 25 HRC		Up to 30 HRC		30 to 35 HRC		35 to 45 HRC		45 to 50 HRC		Less than 40 HRC		Less than 45 HRC	
Cutting Speed	325-400 SFM		250-325 SFM		175-275 SFM		160-200 SFM		140-180 SFM		125-200 SFM		75-100 SFM	
Depth of Cut	Aa=1D						Aa=0.75D		Aa=0.5D		Aa=0.5D		Aa=0.2D	
Mill Dia.	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min
1/8	11240	44.8	8860	26.6	6900	19.3	5500	13.4	4890	14.6	5050	13.3	2750	9.1
3/16	7495	48.2	5910	29.9	4600	21.9	3670	14.3	3260	16.0	3350	14.3	1835	10.2
1/4	5620	47.5	4430	31.9	3450	21.6	2750	15.3	2445	17.5	2550	14.8	1375	10.2
5/16	4500	49.2	3545	33.4	2750	22.9	2200	16.1	1955	17.8	2000	14.8	1100	11.2
3/8	3750	47.8	2955	31.9	2300	21.9	1835	15.3	1630	16.0	1700	14.5	915	10.4
7/16	3210	46.4	2530	30.8	1950	20.9	1575	14.8	1395	16.0	1450	14.7	785	10.3
1/2	2810	46.5	2215	30.2	1700	20.1	1375	14.3	1225	16.0	1300	15.1	690	10.2
5/8	2250	41.4	1775	28.2	1400	19.8	1100	13.8	975	14.5	1000	12.5	550	9.6
3/4	1875	38.8	1480	26.1	1150	18.0	920	12.5	815	13.1	850	11.8	460	8.7
1	1405	33.4	1110	23.4	875	15.8	685	10.7	610	12.2	650	11.3	345	8.0



- Use safety cover, safety glasses and safety shoes during operation.
- Do not touch cutting edges or chips with bare hands.
- Stop cutting when the tool becomes dull.
- Stop cutting operation immediately if you hear any strange sounds.
- Use correct tools for the operation. Check dimensions to ensure proper selection.
- Do not modify tools.



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