variFLUTE™
Variable Flute ALTiN Coated HPE High Performance Solid Carbide Single End Mills

Fraise à queue à rainurer à haut rendement au carbure

Cortador vertical de carburo de alto rendimiento

Center Cutting
10% Cobalt Micrograin Carbide

HIGH PERFORMANCE MILLING: Carbon Steels, Alloy Steels, Stainless Steels, Mold & Die Steels, High Temperature Alloys, Titanium Alloys, Cast Iron and many other materials.

Variable Flute design reduces chatter, harmonics and cutting forces for increased feed rates, greater depths of cut, improved surface finish and accuracy, minimal tool deflection, reduced machine vibration and increased tool life.

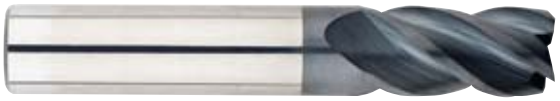
TOLERANCES

Diameter	+.000/ - .002
Shank Dia.	-.0001/ - .0004

ALTiN – Aluminum Titanium Nitride Coating is an excellent all-around coating that increases surface hardness, wear resistance, heat resistance, chip flow and resists chip welding. Especially recommended for abrasive and hard-to-machine materials that generate higher cutting temperatures.

List No. 5985 3-Flute – Corner Radius

List No. 5988 3-Flute – Ball Nose



List No. 5994 4-Flute – Corner Radius
List No. 5995 4-Flute – Square End

List No. 5996 4-Flute – Ball Nose

List No. 5986 5-Flute – Corner Radius
List No. 5987 5-Flute – Square End

List No. 5985 – 3-Flute – Corner Radius

ALTiN COATED

3-Flute variFLUTE end mills feature tool geometry for high chip evacuation in slotting and roughing applications.

Corner Radius strengthens the end mill to minimize chipping and reduce corner wear. Also used when the finished part requires a radius.

DIA.	SHANK DIA.	LENGTH OF CUT	OAL	CORNER RADIUS	EDP NO.
		STUB LENGTH			
¼	¼	⅜	2	.015-.020	56270
⅜	⅜	½	2	.015-.020	56271
½	½	⅝	2½	.025-.030	56272
⅝	⅝	¾	3	.030-.035	56273
¾	¾	⅞	3	.030-.035	56274
		REGULAR LENGTH			
⅛	⅛	⅜	1½	.010-.015	56275
5/32	3/16	7/16	2	.010-.015	56276
3/16	3/16	7/16	2	.010-.015	56277
7/32	¼	7/16	2½	.015-.020	56278
¼	¼	⅝	2½	.015-.020	56279
9/32	5/16	⅝	2½	.015-.020	56280
5/16	5/16	¾	2½	.015-.020	56281
⅜	⅜	⅞	2½	.015-.020	56282
7/16	7/16	1	2¾	.015-.020	56283
½	½	1	3	.025-.030	56284
⅝	⅝	1¼	3½	.030-.035	56285
¾	¾	1½	4	.030-.035	56286
1	1	1½	4	.030-.035	56287

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variFLUTE™ Solid Carbide Single End Mills

Fraise à queue à rainurer à haut rendement au carbure

Cortador vertical de carburo de alto rendimiento

List No. 5988 – 3-Flute – Ball Nose

ALTiN COATED

3-Flute variFLUTE end mills feature tool geometry for high chip evacuation in slotting and roughing applications.

Ball Nose for surfacing applications, fillets, radius bottom slots and die cavities.

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DIA.	SHANK DIA.	LENGTH OF CUT	OAL	EDP NO.
		REGULAR LENGTH		
1/8	1/8	3/8	1 1/2	56320
5/32	3/16	7/16	2	56321
3/16	3/16	7/16	2	56322
7/32	1/4	7/16	2 1/2	56323
1/4	1/4	5/8	2 1/2	56324
9/32	5/16	5/8	2 1/2	56325
5/16	5/16	3/4	2 1/2	56326
3/8	3/8	7/8	2 1/2	56327
7/16	7/16	1	2 3/4	56328
1/2	1/2	1	3	56329

Fraise à queue à rainurer à haut rendement au carbure

Cortador vertical de carburo de alto rendimiento

List No. 5996 – 4-Flute – Ball Nose

ALTiN COATED

4-Flute variFLUTE end mills feature versatile tool geometry for high chip evacuation in slotting applications while providing high surface finish and rapid feed rates in profiling applications.

Ball Nose for surfacing applications, fillets, radius bottom slots and die cavities.

DIA.	SHANK DIA.	LENGTH OF CUT	OAL	EDP NO.
		REGULAR LENGTH		
1/8	1/8	3/8	1 1/2	56373
5/32	3/16	7/16	2	56374
3/16	3/16	7/16	2	56375
7/32	1/4	7/16	2 1/2	56376
1/4	1/4	5/8	2 1/2	56377
9/32	5/16	5/8	2 1/2	56378
5/16	5/16	3/4	2 1/2	56379
3/8	3/8	7/8	2 1/2	56380
7/16	7/16	1	2 3/4	56381
1/2	1/2	1	3	56382
5/8	5/8	1 1/4	3 1/2	56383
3/4	3/4	1 1/2	4	56384
1	1	1 1/2	4	56385

ALTiN – Aluminum Titanium Nitride Coating is an excellent all-around coating that increases surface hardness, wear resistance, heat resistance, chip flow and resists chip welding. Especially recommended for abrasive and hard-to-machine materials that generate higher cutting temperatures.

variFLUTE™ Solid Carbide Single End Mills

Fraise à queue à rainurer à haut rendement au carbure

Cortador vertical de carburo de alto rendimiento

List No. 5994 – 4-Flute – Corner Radius

ALTiN COATED

4-Flute variFLUTE end mills feature versatile tool geometry for high chip evacuation in slotting applications while providing high surface finish and rapid feed rates in profiling applications.

Corner Radius strengthens the end mill to minimize chipping and reduce corner wear. Also used when the finished part requires a radius.

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DIA.	SHANK DIA.	LENGTH OF CUT	OAL	CORNER RADIUS	EDP NO.
		STUB LENGTH			
1/4	1/4	3/8	2	.015 - .020	56335
5/16	5/16	3/8	2	.015 - .020	56336
3/8	3/8	1/2	2	.015 - .020	56337
1/2	1/2	5/8	2 1/2	.025 - .030	56338
5/8	5/8	3/4	3	.030 - .035	56339
3/4	3/4	7/8	3	.030 - .035	56340
1	1	1	4	.030 - .035	56341
		REGULAR LENGTH			
1/8	1/8	3/8	1 1/2	.010 - .015	56342
5/32	3/16	7/16	2	.010 - .015	56343
3/16	3/16	7/16	2	.010 - .015	56344
7/32	1/4	7/16	2 1/2	.015 - .020	56345
1/4	1/4	5/8	2 1/2	.015 - .020	56346
9/32	5/16	5/8	2 1/2	.015 - .020	56347
5/16	5/16	3/4	2 1/2	.015 - .020	56348
3/8	3/8	7/8	2 1/2	.015 - .020	56349
7/16	7/16	1	2 3/4	.015 - .020	56350
1/2	1/2	1	3	.025 - .030	56351
5/8	5/8	1 1/4	3 1/2	.030 - .035	56352
3/4	3/4	1 1/2	4	.030 - .035	56353
1	1	1 1/2	4	.030 - .035	56354
		LONG LENGTH			
1/4	1/4	1 1/4	3	.015 - .020	56355
3/8	3/8	1 1/4	3	.015 - .020	56356
1/2	1/2	2	4	.025 - .030	56357
5/8	5/8	2 1/4	5	.030 - .035	56358
3/4	3/4	2 1/4	5	.030 - .035	56359
		EXTENDED LENGTH			
1/4	1/4	5/8	4	.015 - .020	56360
3/8	3/8	7/8	4	.015 - .020	56361
1/2	1/2	1	6	.025 - .030	56362
5/8	5/8	1 1/4	6	.030 - .035	56363
3/4	3/4	1 1/2	6	.030 - .035	56364

ALTiN – Aluminum Titanium Nitride Coating is an excellent all-around coating that increases surface hardness, wear resistance, heat resistance, chip flow and resists chip welding. Especially recommended for abrasive and hard-to-machine materials that generate higher cutting temperatures.

variFLUTE™ Solid Carbide Single End Mills

Fraise à queue à rainurer à haut rendement au carbure

Cortador vertical de carburo de alto rendimiento

List No. 5995 – 4-Flute – Square End

ALTiN COATED

4-Flute variFLUTE end mills feature versatile tool geometry for high chip evacuation in slotting applications while providing high surface finish and rapid feed rates in profiling applications.

Square End for peripheral milling and finishing applications requiring machining to a sharp corner.

DIA.	SHANK DIA.	LENGTH OF CUT	OAL	EDP NO.
		REGULAR LENGTH		
1/4	1/4	5/8	2 1/2	56365
5/16	5/16	3/4	2 1/2	56366
3/8	3/8	7/8	2 1/2	56367
7/16	7/16	1	2 3/4	56368
1/2	1/2	1	3	56369
5/8	5/8	1 1/4	3 1/2	56370
3/4	3/4	1 1/2	4	56371
1	1	1 1/2	4	56372

Fraise à queue à rainurer à haut rendement au carbure

Cortador vertical de carburo de alto rendimiento

List No. 5986 – 5-Flute – Corner Radius

ALTiN COATED

5-Flute variFLUTE end mills with increased core thickness and five flutes provide higher feed rates in profiling and finishing applications and enhanced surface finish.

Corner Radius strengthens the end mill to minimize chipping and reduce corner wear. Also used when the finished part requires a radius.

DIA.	SHANK DIA.	LENGTH OF CUT	OAL	CORNER RADIUS	EDP NO.
		STUB LENGTH			
1/4	1/4	3/8	2	.015-.020	56290
3/8	3/8	1/2	2	.015-.020	56291
1/2	1/2	5/8	2 1/2	.025-.030	56292
5/8	5/8	3/4	3	.030-.035	56293
3/4	3/4	7/8	3	.030-.035	56294
		REGULAR LENGTH			
1/4	1/4	5/8	2 1/2	.015-.020	56295
5/16	5/16	3/4	2 1/2	.015-.020	56296
3/8	3/8	7/8	2 1/2	.015-.020	56297
7/16	7/16	1	2 3/4	.015-.020	56298
1/2	1/2	1	3	.025-.030	56299
5/8	5/8	1 1/4	3 1/2	.030-.035	56300
3/4	3/4	1 1/2	4	.030-.035	56301
1	1	1 1/2	4	.030-.035	56302
		LONG LENGTH			
1/4	1/4	1 1/4	3	.015-.020	56330
3/8	3/8	1 1/4	3	.015-.020	56331
1/2	1/2	2	4	.025-.030	56332
5/8	5/8	2 1/4	5	.030-.035	56333
3/4	3/4	2 1/4	5	.030-.035	56334
		EXTENDED LENGTH			
1/4	1/4	5/8	4	.015-.020	56303
3/8	3/8	7/8	4	.015-.020	56304
1/2	1/2	1	6	.025-.030	56305
5/8	5/8	1 1/4	6	.030-.035	56306
3/4	3/4	1 1/2	6	.030-.035	56307

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variFLUTE™ Solid Carbide Single End Mills

Fraise à queue à rainurer à haut rendement au carbure

Cortador vertical de carburo de alto rendimiento

List No. 5987 – 5-Flute – Square End

ALTiN COATED

5-Flute variFLUTE end mills with increased core thickness and five flutes provide higher feed rates in profiling and finishing applications and enhanced surface finish.

Square End for peripheral milling and finishing applications requiring machining to a sharp corner.

DIA.	SHANK DIA.	LENGTH OF CUT	OAL	EDP NO.
		REGULAR LENGTH		
¼	¼	⅝	2½	56310
5⁄16	5⁄16	¾	2½	56311
⅜	⅜	⅞	2½	56312
7⁄16	7⁄16	1	2¾	56313
½	½	1	3	56314
⅝	⅝	1¼	3½	56315
¾	¾	1½	4	56316
1	1	1½	4	56317

variFLUTE™ SPEEDS & FEEDS

Workpiece Material	Hardness BHN	Type of Cut	Surface Speed (SFM)	FEED PER TOOTH BY END MILL DIAMETER 1/8"	1/4"	1/2"	3/4"	1"
Plain Steels -Low & Medium Carbon 1008, 1010, 1020	175	Profile	500	0.0004	0.0013	0.0030	0.0038	0.0042
		Slot	400	0.0003	0.0010	0.0024	0.0030	0.0034
Plain Steels -Low & Medium Carbon 1008, 1010, 1020	275	Profile	400	0.0004	0.0013	0.0030	0.0038	0.0042
		Slot	320	0.0003	0.0010	0.0024	0.0030	0.0034
Alloy Steels - Medium Carbon 4140, 4150, 4340	275	Profile	400	0.0003	0.0010	0.0025	0.0035	0.0040
		Slot	320	0.0002	0.0008	0.0020	0.0028	0.0032
Alloy Steels - Medium Carbon 4140, 4150, 4340	375	Profile	300	0.0003	0.0010	0.0025	0.0035	0.0040
		Slot	240	0.0002	0.0008	0.0020	0.0028	0.0032
Mold & Die Steels O1, A2, D2, H13, P20	275	Profile	180	0.0002	0.0010	0.0025	0.0035	0.0040
		Slot	145	0.0002	0.0008	0.0020	0.0028	0.0032
Stainless Steels 300 Series 304, 310, 316	275	Profile	300	0.0003	0.0010	0.0025	0.0035	0.0042
		Slot	240	0.0002	0.0008	0.0020	0.0028	0.0034
Stainless Steels 400 Series 409, 430, 436	325	Profile	250	0.0003	0.0010	0.0025	0.0035	0.0042
		Slot	200	0.0002	0.0008	0.0020	0.0028	0.0034
Stainless Steels Precipitation Hardened 15-5PH, 17-4PH	325	Profile	250	0.0002	0.0010	0.0022	0.0030	0.0040
		Slot	200	0.0002	0.0008	0.0018	0.0024	0.0032
High Temperature Alloys Inconel, Hastelloy, Waspaloy	300	Profile	75	0.0002	0.0007	0.0020	0.0025	0.0032
		Slot	60	0.0002	0.0006	0.0016	0.0020	0.0026
Titanium Alloys Ti-6Al-4V, ASTM B367 Grades C-3, C-4	300	Profile	300	0.0003	0.0010	0.0025	0.0027	0.0035
		Slot	240	0.0002	0.0008	0.0020	0.0022	0.0028
Cast Iron Grey	200	Profile	550	0.0004	0.0012	0.0030	0.0038	0.0042
		Slot	440	0.0003	0.0010	0.0024	0.0030	0.0034
Cast Iron Ductile	300	Profile	250	0.0003	0.0010	0.0030	0.0033	0.0042
		Slot	200	0.0002	0.0008	0.0024	0.0026	0.0034

SPEEDS and FEEDS are suggested starting points and may be increased or decreased depending on actual material and machining conditions. In pocketing operations ramping and spiral plunging are the preferred methods of entry. A 5° ramp angle at about 50% feed are suggested.

RECOMMENDED MAXIMUM DEPTHS OF CUT	PROFILING Radial Depth = .5XD Axial Depth = 1.5XD	SLOTTING Axial Depth = 1XD

May be increased or decreased depending on actual material and machining conditions.

variFLUTE™ NF
Solid Carbide Variable Flute HPE Ultra-High Performance Single End Mills For Aluminum and Non-Ferrous Materials

Fraise à queue à rainurer à haut rendement au carbure

Cortador vertical de carburo de alto rendimiento

Center Cutting
Premium Micrograin Carbide
10% Cobalt Content

High Performance Milling in Aluminum and Non-Ferrous Materials, Copper Alloys, Bronze/Brass

The Variable Flute Design reduces chatter and improves tool life. The high shear flute designed for rapid chip removal combined with an ultra high polish enable extremely high cutting rates and long tool life.

ZrN - Zirconium Nitride coating is a pale gold hard thin high-lubricity coating particularly well suited to machining non-ferrous materials including aluminum, copper alloys and brass.

DLC, CrN, and other high performance coatings also available.

TOLERANCES:
Diameter -.0001 / -.0003
Shank -.0001/ -.0003
Runout Less Than 0.0001 TIR

List No. 5990 & 5990Z 2-Flute — Standard Corner Radius

List No. 5991 & 5991Z 2-Flute — Square End

List No. 5992 & 5992Z 3-Flute — Standard Corner Radius

List No. 5993 & 5993Z 2-Flute — Ball End

2-Flute mills have greater chip capacity and are recommended for slotting and roughing operations.

3-Flute mills offer greater feed rates than two flute mills while still offering high chip capacity, recommended for profile applications.

Corner Radius strengthens the endmill and improves wear characteristics. Small .007- .010 radius enables use in most applications.

List No. 5990 & 5990Z 2-Flute Standard Corner Radius

Dia.	Shank Dia.	Length Of Cut	OAL	Corner Radius	List No. 5990 Bright Finish EDP No.	List No. 5990Z ZrN Coated EDP No.
			STANDARD LENGTH			
1/4	1/4	3/4	2-1/2	.007 - .010	52900	92600
5/16	5/16	3/4	2-1/2	.007 - .010	52901	92601
3/8	3/8	1	2-1/2	.007 - .010	52902	92602
1/2	1/2	1-1/4	3	.007 - .010	52903	92603
5/8	5/8	1-5/8	3-1/2	.007 - .010	52904	92604
3/4	3/4	1-3/4	4	.007 - .010	52905	92605
1	1	1-3/4	4	.007 - .010	52906	92606
			LONG LENGTH			
1/4	1/4	1-1/4	3	.007 - .010	52910	92610
5/16	5/16	1-3/8	3	.007 - .010	52911	92611
3/8	3/8	1-1/2	3-1/2	.007 - .010	52912	92612
1/2	1/2	2	4	.007 - .010	52913	92613
5/8	5/8	2-3/8	5	.007 - .010	52914	92614
3/4	3/4	2-1/2	5	.007 - .010	52915	92615
1	1	3	6	.007 - .010	52916	92616

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variFLUTE™ NF
Solid Carbide High Performance End Mills for Aluminum and Non Ferrous Materials

Fraise à queue à rainurer à haut rendement au carbure

Cortador vertical de carburo de alto rendimiento

Corner Radius strengthens the end mill and improves wear characteristics. Small .007- .010 radius enables use in most applications.

ZrN - Zirconium Nitride coating is a pale gold hard thin high-lubricity coating particularly well suited to machining non-ferrous materials including aluminum, copper alloys and brass.

DLC, CrN, and other high performance coatings also available.

List No. 5992 & 5992Z 3-Flute Standard Corner Radius

DIA.	SHANK DIA.	LENGTH OF CUT	OAL	CORNER RADIUS	LIST NO. 5992 BRIGHT FINISH EDP NO.	LIST NO. 5992Z ZrN COATED EDP NO.
			STANDARD LENGTH			
1/4	1/4	3/4	2-1/2	.007 - .010	52930	92630
5/16	5/16	3/4	2-1/2	.007 - .010	52931	92631
3/8	3/8	1	2-1/2	.007 - .010	52932	92632
1/2	1/2	1-1/4	3	.007 - .010	52933	92633
5/8	5/8	1-5/8	3-1/2	.007 - .010	52934	92634
3/4	3/4	1-3/4	4	.007 - .010	52935	92635
1	1	1-3/4	4	.007 - .010	52936	92636
			LONG LENGTH			
1/4	1/4	1-1/4	3	.007 - .010	52940	92940
5/16	5/16	1-3/8	3	.007 - .010	52941	92941
3/8	3/8	1-1/2	3-1/2	.007 - .010	52942	92942
1/2	1/2	2	4	.007 - .010	52943	92943
5/8	5/8	2-3/8	5	.007 - .010	52944	92944
3/4	3/4	2-1/2	5	.007 - .010	52945	92945
1	1	3	6	.007 - .010	52946	92946

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Square End for milling and finishing where a sharp corner is required

ZrN - Zirconium Nitride coating is a pale gold hard thin high-lubricity coating particularly well suited to machining non-ferrous materials including aluminum, copper alloys and brass.

DLC, CrN, and other high performance coatings also available.

List No. 5991 & 5991Z 2-Flute Square End

DIA.	SHANK DIA.	LENGTH OF CUT	OAL	LIST NO. 5991 BRIGHT FINISH EDP NO.	LIST NO. 5991Z ZRN COATED EDP NO.
			STANDARD LENGTH		
1/4	1/4	3/4	2-1/2	52920	92920
5/16	5/16	3/4	2-1/2	52921	92921
3/8	3/8	1	2-1/2	52922	92922
1/2	1/2	1-1/4	3	52923	92923
5/8	5/8	1-5/8	3-1/2	52924	92924
3/4	3/4	1-3/4	4	52925	92925
1	1	1-3/4	4	52926	92926

variFLUTE™ NF
Solid Carbide High Performance End Mills for Aluminum and Non Ferrous Materials

Fraise à queue à rainurer à haut rendement au carbure

Cortador vertical de carburo de alto rendimiento

Ball End for use in contour milling, radius bottom slots, fillets, and cavity milling.

ZrN - Zirconium Nitride coating is a pale gold hard thin high-lubricity coating particularly well suited to machining non-ferrous materials including aluminum, copper alloys and brass.

DLC, CrN, and other high performance coatings also available.

List No. 5993 & 5993Z 2-Flute Ball End

DIA.	SHANK DIA.	LENGTH OF CUT	OAL	LIST NO. 5993 BRIGHT FINISH EDP NO.	LIST NO. 5993Z ZrN COATED EDP NO.
		STANDARD LENGTH			
1/4	1/4	3/4	2-1/2	52950	92650
5/16	5/16	3/4	2-1/2	52951	92651
3/8	3/8	1	2-1/2	52952	92652
1/2	1/2	1-1/4	3	52953	92653
5/8	5/8	1-5/8	3-1/2	52954	92654
3/4	3/4	1-3/4	4	52955	92655
1	1	1-3/4	4	52956	92656

variFLUTE™ NF SPEEDS & FEEDS

MATERIAL	CUTTING SPEED SFM M/MIN	CHIP LOAD PER TOOTH IN / MM						
		1/4"	5/16"	3/8"	1/2"	5/8"	3/4"	1"
Aluminum	1500 - 2000 460 - 610	.0030 0.076	.0041 0.104	.0049 0.124	.0060 0.152	.0071 0.180	.0082 0.208	.0102 0.259
Copper Alloys	750 - 1200 230 - 370	.0030 0.076	.0041 0.104	.0049 0.124	.0060 0.152	.0071 0.180	.0082 0.208	.0102 0.259
Brass/Bronze	750 - 1550 230 - 470	.0030 0.076	.0041 0.104	.0049 0.124	.0060 0.152	.0071 0.180	.0082 0.208	.0102 0.259
Plastics	1200 - 1650 370 - 505	.0063 0.152	.0078 0.203	.0095 0.254	.0125 0.305	0.0148 0.358	.0168 0.406	.0212 0.508

Morse variFLUTE NF mills are capable of very high removal rates
- Use adequate coolant.
- High quality balanced tool holding is recommended
- Increase chip load based on available machine capability

RECOMMENDED MAXIMUM DEPTHS OF CUT	PROFILING Radial Depth = .5XD Axial Depth = 1.5XD	SLOTTING Axial Depth = 1XD

SPEEDS and FEEDS are suggested starting points and may be increased or decreased depending on actual material and machining conditions. The speeds and feed values listed are conservative in most cases.