Cutting Tools for Modern Composite Applications

Vol 4

Composite Solutions

Composite Solutions

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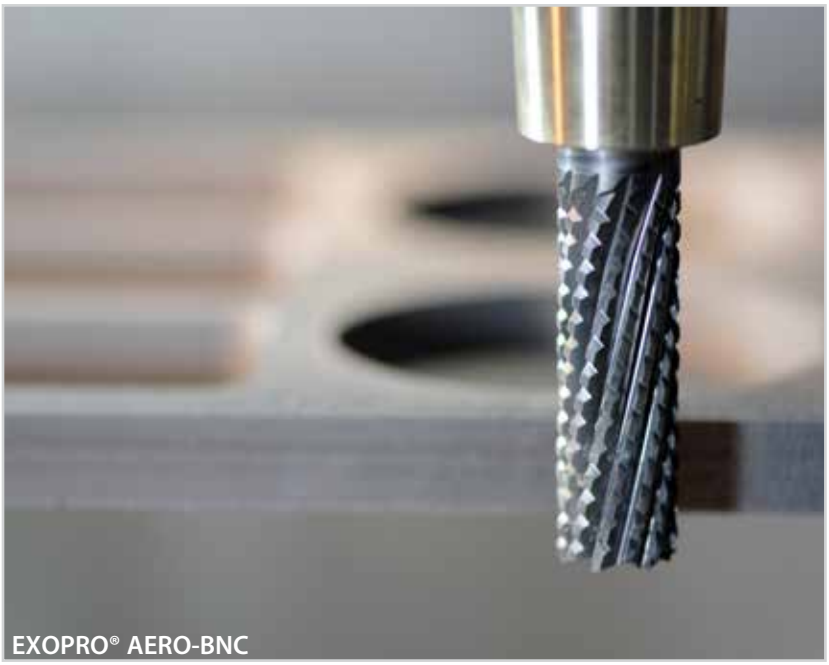

EXOPRO® AERO-BNC

Introduction

Composite Drills

Composite Routers


EXOPRO® AERO-LHX

Composite Routers (Continued)

OSG PHOENIX® PFB

Special Tooling

OSG's Ultra-Fine Diamond Coating

The Patented Ultra-Fine Grain Size

Competitor Comparison

OSG's patented ultra-fine diamond coating has a maximum diamond grain size diameter of 2µm. This strictly controlled diameter allows our coating to be super smooth and extremely sharp, which is visually distinguishable from our competition.


OSG Ultra-Fine Diamond Coating

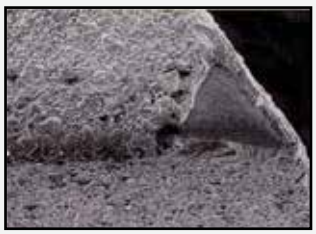

Competitor Diamond Coating
(Industry Standard)

Elimination of Diamond Delamination

Competitor Comparison

Unlike our competition, OSG manufactures all diamond products in-house. This includes using our grinding techniques on our special carbide substrate. The end result is a diamond coated product in which tool life can be consistently predicted, rather than having to endure premature diamond delamination like most of our competition.


OSG Ultra-Fine Diamond Coating


Diamond Delamination
(Note: Large Grain Size)

Illustrated Index

Composite Drills

List	Item	Brand/Series	Inch/ Metric	Material	Coating	Size Range	Features	Page	Tech Page
7501		EXOPRO® AERO-STAD	Inch	Carbide	**Diamond**	#40 - 1/2"	Triple Angle	6	22
7520		EXOPRO® AERO-LHX	Inch	Carbide	**Diamond**	#40 - 1/2"	Low Helix	8	22
7500		EXOPRO® AERO-D-REAM	Inch	Carbide	**Diamond**	#40 - 1/2"	Tapered Reamer	10	22
7530		EXOPRO® AERO-S	Inch	Carbide	**Diamond**	#40 - 1/2"	High Helix, Stack Drill	12	22
7532		EXOPRO® AERO-H	Inch	Carbide	**Diamond**	#40 - 1/2"	Stack Drill for All Stacks	14	23
5732		EXOCARB® AERO-H	Inch	Carbide	TiAlN	#11 - 1/2"	Stack Drill for All Stacks	16	23
HP700		HY-PRO CARB® NEPTUNE®	Inch	Carbide	TiAlN	#40 - 1/4"	Hand Drill	18	23
257		AERO-D-REAM	Inch	Carbide	Bright	#40 - 1/2"	Tapered Drill/Reamer	20	22

Composite Routers

List	Item	Brand/Series	Inch/ Metric	Material	Coating	Size Range	Features	Page	Tech Page
2061		EXOPRO® AERO-BNC	Inch	Carbide	**Diamond**	1/8 - 1/2"	Nick Router	24	40
2066		EXOPRO® AERO-HBC	Inch	Carbide	**Diamond**	1/8 - 1/2"	Compression Router, 30° Helix	26	40
2064		EXOPRO® AERO-HBC 45	Inch	Carbide	**Diamond**	1/4 - 1/2"	Compression Router, 45° Helix	28	40
2068		EXOPRO® AERO-HBC 60	Inch	Carbide	**Diamond**	1/4 - 1/2"	Compression Router, 60° Helix	30	41
2680		EXOPRO® AERO-REC	Inch	Carbide	**Diamond**	15/64 - 1/2"	Rougher Router	32	42
2650		EXOPRO® AERO-MFR	Inch	Carbide	**Diamond**	1/4 - 1/2"	Finishing Router	34	43
668		AERO-HBC 60	Inch	Carbide	Bright	1/4 - 1/2"	Compression Router, 60° Helix	36	41
641R		AERO-HFR	Inch	Carbide	Bright	3/16 - 1/2"	Hand Router	38	43

Indexable

List	Item	Brand/Series	Inch/ Metric	Material	Coating	Features	Page	Tech Page
52100 78014		PHOENIX® PFB	Inch/ Metric	Carbide/ Steel	**Diamond**	Finishing Ball End Mill	46-48	53

Composite Drills

List No.	Machine Type			Composite Type				
	Hand	Pneumatic	CNC	CFRP	Honeycomb	CFRP/ Al Stack	CFRP/ Ti Stack	CFRP/ CRES Stack
7501	◎	◎	◎	◎	○	△	X	X
7520	X	○	◎	◎	○	X	X	X
7500	◎	◎	◎	◎	○	X	X	X
7530	X	◎	◎	◎	○	◎	○	X
7532	X	○	◎	X	X	◎	◎	◎
5732	X	○	◎	X	X	◎	◎	◎
HP700	◎	○	◎	○	○	○	○	○
257	◎	◎	◎	◎	◎			

X Not Recommended △ OK ○ Good ◎ Best

Composite Routers

List No.	Machine Style				Machining Efficiency	Machine Type			Composite Type	
	Slotting	Side Milling	Roughing	Finishing		Hand	CNC	5-Axis or Robot	Thin	Thick
2061	◎	◎	○	○	◎	△	◎	◎	◎	◎
2066	◎	◎	○	○	◎	△	◎	○	◎	◎
2064	◎	◎	○	◎	◎	△	◎	○	◎	◎
2068	◎	◎	○	◎	◎	△	◎	○	◎	◎
2680	◎	◎	◎	X	◎	◎	◎	◎	△	◎
2650	X	○	X	◎	△	X	◎	◎	◎	◎
668	◎	◎	○	○	○	○	◎	◎	◎	◎
641R	◎	◎	○	○	△	◎	◎	◎	◎	◎

Thin ≤ 0.100" and 0.2xD

X Not Recommended △ OK ○ Good ◎ Best

EXOPRO® AERO-STAD

Diamond Coated Triple Angle Drill for Composites

ULTRA FINE

The AERO-STAD is a diamond coated drill specifically designed to eliminate fiber breakout and delamination issues on both entry and exit of drilled holes. The drill features a patent pending triple angle geometry with OSG's patented diamond coating.

Applications

- Excels in carbon/glass composites and honeycombs
- Excellent in CFRP and Al stack applications

Features

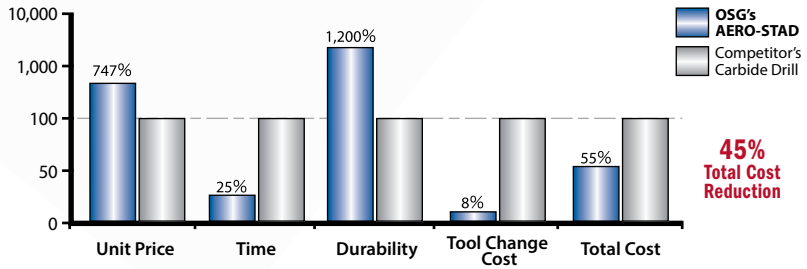
- Patent pending triple angle geometry to reduce push-out exit delamination
- Straight-fluted to eliminate the pull-up entrance delamination

Performance Highlights

OSG's AERO-STAD vs. Competitor's Carbide Tapered Drill

Overall Cost for the AERO-STAD is Less than the Competitor

Although the initial unit cost of the AERO-STAD is more than some competitors, a substantial savings can be seen after taking durability, tool change costs and reduced machining time into consideration. The graphs below illustrate the overall savings made with an investment into the AERO-STAD. ***A 45% total cost savings!***

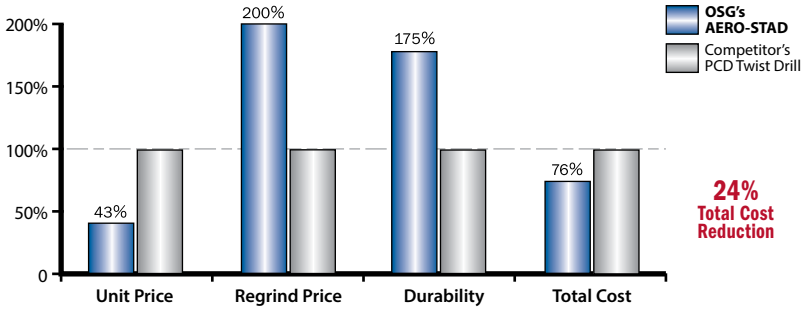


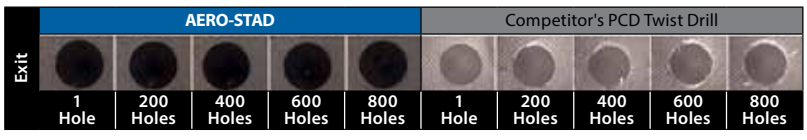
OSG's AERO-STAD vs. Competitor's PCD Twist Drill

EXOPRO® AERO-STAD Demonstrates Greater Tool Life than Competitor's Twist Drill

With a significantly greater tool life over the competitor's twist drill, the overall cost for machining with the AERO-STAD is ***24% less*** than using the competitor's drill.

Diameter: 0.251 • **Speed:** V=330 SFM • **Feed:** f=0.0025 IPR • **Thickness:** 0.750"





List 7501

Triple Angle

SPEED FEED	CARBIDE	DIA	0°
P22			

Tolerance
+0/-0.001"

EDP Number	Approximate Hole Size			Drill Size		Flute Length	Taper Length	Overall Length	Shank Diameter
	Fractional Size	Wire Gage	Letter Size	mm	Inch	FL	l	L	d
750109816	-	#40	-	2.50	0.0985	15.2	3.8	50.8	2.50
750112916	-	#30	-	3.28	0.1290	20.3	4.8		3.27
750116116	-	#20	-	4.10	0.1615	25.4	5.9	76.2	4.10
750119116	-	#11	-	4.86	0.1915	27.9	7.0		4.86
750119216	-	#11	-			48.2		101.6	
750122116	-	#2	-	5.63	0.2215	33.0	8.0	88.9	5.62
750125116	1/4	-	-	6.38	0.2510	38.1	9.0		6.37
750125216	1/4	-	-			63.5		139.7	
750131316	5/16	-	-	7.96	0.3135	48.2	11.2	101.6	7.96
750137616	3/8	-	-	9.55	0.3760	58.4	13.4		9.55
750137716	3/8	-	-			96.5		152.4	
750143816	7/16	-	-	11.14	0.4385	66.0	15.5	101.6	11.13
750150116	1/2	-	-	12.73	0.5010	76.2	17.7	127.0	12.72

Packed: 1 pc.
Available Diamond coating only.
Drills are oversize over nominal.
Tri-Flat shank available upon request.

EP

Tri-Flat Shank

Work Material												
List No.	Carbon Fiber (CFRP)	Glass Fiber (GFRP)	Aramid Fiber (AFRP)	Honeycomb					Carbon/ Carbon	Carbon Fiber/ Aluminum Stack	Carbon Fiber/ Titanium Stack	Carbon Fiber/ Al/ Ti/CRES Stack
				CFRP/Nomex	GFRP/Nomex	AFRP	CFRP/Al	Al/Al				
7501	◎	○		◎	◎		◎	○	◎	○		

○ Good ◎ Best

EXOPRO® AERO-LHX

Diamond Coated Low Helix Drill for Composites

ULTRA FINE

The AERO-LHX is a diamond coated drill specifically designed for tough laminates. It eliminates uncut fibers and delamination when other drills are unable to properly cut fibers. The drill features unique geometries combined with OSG's patented diamond coating.

Applications

- Excels in tough carbon fiber composites
- Excellent performance in unidirectional composites

Features

- Patent pending triple angle geometry to reduce push-out exit delamination
- Low helix providing a sharper cutting edge to help shear tough fibers

Performance Highlights

EXOPRO® AERO-LHX Provides a Quality Cut

Performance Analysis

When drilling carbon fiber composites with OSG's AERO-LHX, the hole quality can easily be seen from the first few drilled holes. The pictures below show the first hole drilled by AERO-LHX and several competitor drills. The AERO-LHX showed the cleanest cut when drilling this carbon fiber laminate.

Tool	EXOPRO® AERO-LHX
Size	0.2510"
Work Material	Carbon Fiber Composite
Drilling Speed	197 SFM (3,000 RPM)
Feed Rate	31 IPM (0.001 IPR)
Depth of Hole	0.25"
Coolant	Dry
Machine	Vertical Machining Center

	OSG AERO-LHX	Competitor A	Competitor B	Competitor C	Competitor D	Competitor E
Entrance						
Exit						

List 7520

Low Helix

SPEED FEED	CARBIDE	DIA	5°
P22			

Tolerance
+0/-0.001"

EDP Number	Approximate Hole Size			Drill Size		Flute Length	Taper Length	Overall Length	Shank Diameter
	Fractional Size	Wire Gage	Letter Size	mm	Inch	FL	l	L	d
752009816	-	#40	-	2.50	0.0985	15.2	7.0	50.8	2.50
752012916	-	#30	-	3.28	0.1290	20.3	9.0		3.27
752016116	-	#20	-	4.10	0.1615	25.4	11.2	76.2	4.10
752019216	-	#11	-	4.86	0.1915	27.9	13.2		4.86
752022116	-	#2	-	5.63	0.2215	33.0	15.2	88.9	5.62
752025116	1/4	-	-	6.38	0.2510	38.1	17.2		6.37
752031316	5/16	-	-	7.96	0.3135	48.2	21.4	101.6	7.96
752037616	3/8	-	-	9.55	0.3760	58.4	25.6		9.55
752043816	7/16	-	-	11.14	0.4385	66.0	29.8		11.13
752050116	1/2	-	-	12.73	0.5010	76.2	34.0	127.0	12.72

Packed: 1 pc.
Available Diamond coating only.
Drills are oversize over nominal.

EP

Work Material													
List No.	Carbon Fiber (CFRP)	Glass Fiber (GFRP)	Aramid Fiber (AFRP)	Honeycomb					Carbon/ Carbon	Carbon Fiber/ Aluminum Stack	Carbon Fiber/ Titanium Stack	Carbon Fiber/ Al/ Ti/CRES Stack
				CFRP/Nomex	GFRP/Nomex	AFRP	CFRP/Al	Al/Al				
7520	◎	○		◎	◎		◎		◎			

○ Good ◎ Best

EXOPRO® AERO-D-REAM

Diamond Coated Carbide Tapered Reamer for Composites

ULTRA FINE

The AERO-D-REAM is a diamond coated tapered drill/reamer for composites. The tool features a tapered 4-flute design and OSG's patented diamond coating.

Applications

- Excels in carbon and glass fiber composites

Features

- Straight flute to limit peel-up at hole entrance
- Elongated double-angle geometry to reduce thrust and limit exit delamination
- Patented OSG diamond coating

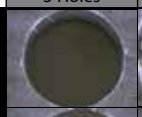
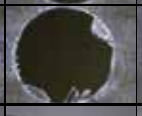
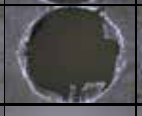
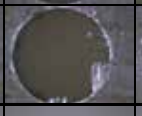
Performance Highlights

EXOPRO® AERO-D-REAM

Performance Analysis

Diamond coating significantly improves tool life and hole quality. When compared to the AERO-REAM (List 257), the EXOPRO® AERO-D-REAM was able to drill ***14 times more holes***, and at better quality, than its uncoated counterpart.

Tool	List 257 (Uncoated)	EXOPRO® AERO-D-REAM (Test 1)	EXOPRO® AERO-D-REAM (Test 2)
Size	0.251"		
Speed	250 SFM (3,800 RPM)		
Feed Rate	7.6 IPM (0.002 IPR)		**11.5 IPM (0.003 IPR)**
Depth of Hole	0.450" (Through)		
Coolant	Dry		
Quality Holes	~20	~90	~180

	List 257 (Uncoated)		EXOPRO® AERO-D-REAM (Test 1)		EXOPRO® AERO-D-REAM (Test 2)	
	3 Holes	30 Holes	30 Holes	180 Holes	30 Holes	420 Holes
Entrance						
Exit						
Tool						
	At 30 holes the tool showed extreme margin wear.		At 180 holes the AERO-D-REAM showed virtually no margin wear.		At 420 holes, running at a faster feed rate, the AERO-D-REAM showed some slight margin wear.	

List 7500

Tapered Drill/Reamer

SPEED FEED	CARBIDE	DIA	0°
P22			

Tolerance
+0/-0.001"

EDP Number	Approximate Hole Size			Drill Size		Flute Length	Taper Length	Overall Length	Shank Diameter
	Fractional Size	Wire Gage	Letter Size	mm	Inch	FL	l	L	d
750009816	-	#40	-	2.50	0.0985	14.5	5.0	76.2	2.50
750012816	-	#30	-	3.26	0.1285	18.9	6.5		3.26
750012916	-		-			31.9		152.4	
750016116	-	#20	-	4.10	0.1615	23.8	8.1	76.2	4.10
750016216	-		-			40.1		152.4	
750018716	3/16	-	-	4.76	0.1875	46.7	9.4		4.76
750019016	-	#11	-	4.83	0.1900	47.3	9.5	101.6	4.82
750019116	-		-					152.4	
750019216	-		-	4.85	0.1910		9.6	101.6	4.85
750019316	-		-					152.4	
750019416	-		-	4.86	0.1920	28.3		76.2	4.87
750019516	-		-			47.7		101.6	
750019716	-		-					152.4	
750021816	7/32	-	-	5.54	0.2180	54.3	10.9		5.53
750022116	-	#2	-	5.63	0.2215	55.2	11.1	101.6	5.62
750025016	1/4	-	-	6.35	0.2500	62.3	12.5		6.35
750025116		-	-					152.4	
750025316		-	-	6.38	0.2510	37.1		76.2	6.37
750025416		-	-			62.6		101.6	
750025516		-	-					152.4	
750031216	5/16	-	-	7.94	0.3125	46.2	15.5	101.6	7.93
750031316		-	-			62.0		152.4	
750031416		-	-	7.96	0.3135	46.3	15.6	101.6	7.96
750031516		-	-			62.2		152.4	
750037516	3/8	-	-	9.53	0.3750	55.4	18.6	101.6	9.52
750037616		-	-			74.4		152.4	
750037716		-	-	9.55	0.3760	55.5	18.7	101.6	9.55
750037816		-	-			74.6		152.4	
750043816	7/16	-	-	11.14	0.4385	64.8	21.7	101.6	11.13
750050116	1/2	-	-	12.73	0.5010	99.5	24.8	152.4	12.72

Packed: 1 pc.
Available Diamond coating only.
Drills are oversize over nominal.
Tri-Flat shank available upon request.

EP

Tri-Flat Shank

Work Material												
List No.	Carbon Fiber (CFRP)	Glass Fiber (GFRP)	Aramid Fiber (AFRP)	Honeycomb					Carbon/ Carbon	Carbon Fiber/ Aluminum Stack	Carbon Fiber/ Titanium Stack	Carbon Fiber/ Al/ Ti/CRES Stack
				CFRP/Nomex	GFRP/Nomex	AFRP	CFRP/Al	Al/Al				
7500	◎	○		◎	◎		◎		◎			

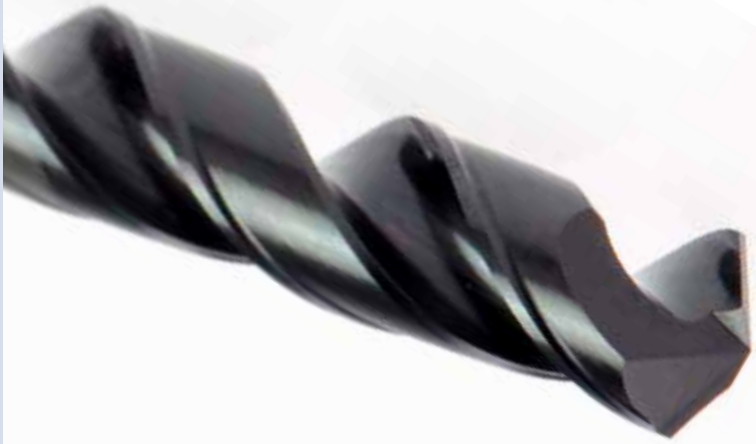
○ Good ◎ Best

EXOPRO® AERO-S

Diamond Coated High Helix Drill for Composites

ULTRA FINE

The AERO-S is a high helix diamond coated drill designed for composites and metal stack materials. It features OSG's patented diamond coating and unique geometries such as a high helix to assist in chip evacuation.



Applications

- Designed to shear through tough fibers
- Excellent for CFRP/Al stack applications

Features

- High helix angles for shearing fibers
- Drill point designed for cutting stacks
- Thin web and wide flutes to reduce thrust and improve chip evacuation

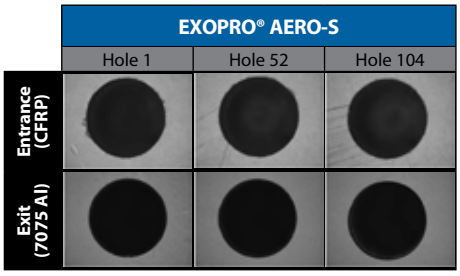
Performance Highlights

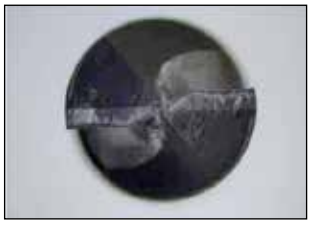
EXOPRO® AERO-S in CFRP/Al Stack Applications

Performance Analysis

Positive geometry and diamond coating allow for high quality holes in CFRP/Al stacks.

Tool	EXOPRO® AERO-S
Size	0.251"
Work Material	CFRP/Al
Drilling Speed	197 SFM (3,000 RPM)
Feed Rate	0.003 IPR • 0.015 Peck
Depth of Hole	0.25" (CFRP) 0.25" (Al)
Coolant	Dry
Machine	Vertical Machining Center





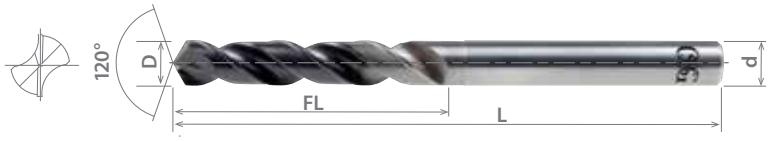
Drill wear after 104 holes.

List 7530

High Helix

SPEED FEED	CARBIDE	DIA	40°
P22			

Tolerance
+0/-0.001"



EDP Number	Approximate Hole Size			Drill Size		Flute Length	Overall Length	Shank Diameter
	Fractional Size	Wire Gage	Letter Size	mm	Inch	FL	L	d
753009816	-	#40	-	2.50	0.0985	15.2	50.8	2.50
753012916	-	#30	-	3.28	0.1290	20.3	76.2	3.27
753016116	-	#20	-	4.10	0.1615	25.4	101.6	4.10
753019116	-	#11	-	4.86	0.1915	27.9		4.86
753022116	-	#2	-	5.63	0.2215	33.0		5.62
753025116	1/4	-	-	6.38	0.2510	38.1		6.37
753031316	5/16	-	-	7.96	0.3135	48.2		7.96
753037616	3/8	-	-	9.55	0.3760	58.4	152.4	9.55
753043816	7/16	-	-	11.14	0.4385	66.0		11.13
753050116	1/2	-	-	12.73	0.5010	76.2		12.72

Packed: 1 pc.
Available Diamond coating only.
Drills are oversize over nominal.

EP

Work Material												
List No.	Carbon Fiber (CFRP)	Glass Fiber (GFRP)	Aramid Fiber (AFRP)	Honeycomb					Carbon/ Carbon	Carbon Fiber/ Aluminum Stack	Carbon Fiber/ Titanium Stack	Carbon Fiber/ Al/ Ti/CRES Stack
				CFRP/Nomex	GFRP/Nomex	AFRP	CFRP/Al	Al/Al				
7530	◎	◎		○	○		◎	◎		◎		

○ Good ◎ Best

EXOPRO® AERO-H

Diamond Coated Stack Drill for All Stack Applications

The EXOPRO® AERO-H is a diamond coated carbide drill specifically designed for drilling composite/metal stack applications. It features a high helix and parabolic flute form for improved chip evacuation as well as corner radius and end gash to resist chipping.

Applications

- Designed for difficult metal alloys such as Titanium, PH Stainless and Nickel Alloys
- For general purpose stacks

Features

- Parabolic flute form for improved chip evacuation
- Corner radius and end gash to resist chipping
- OSG's diamond coating makes it suitable for all materials and longer tool life

Performance Highlights

EXOPRO® AERO-H

Performance Analysis

The AERO-H is designed to excel in difficult metal alloys such as Titanium, PH Stainless and Nickel Alloys with a cutting edge gash to reduce chipping and burr height. The AERO-H comes standard with either OSG's diamond coating (EXOPRO® AERO-H) or TiAlN coating (EXOCARB® AERO-H - Page 16). Diamond coating makes the AERO-H suitable for all materials.

The Patented Ultra-Fine Grain Size

Competitor Comparison

OSG's patented ultra-fine diamond coating has a maximum diamond grain size diameter of 2µm. This strictly controlled diamter allows our coating to be super smooth and extremely sharp, which visually is distinguishable from our competition.

OSG Ultra-Fine Diamond Coating

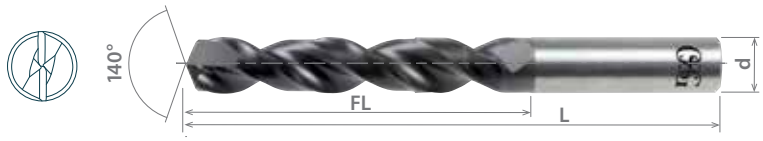
Competitor Diamond Coating
(Industry Standard)

List 7532

Stack Drill

SPEED FEED	CARBIDE	DIA	40°
P23			

Tolerance
+0/-0.001"



EDP Number	Approximate Hole Size			Drill Size		Flute Length	Overall Length	Shank Diameter
	Fractional Size	Wire Gage	Letter Size	mm	Inch	FL	L	d
753209816	-	#40	-	2.50	0.0985	15.2	50.8	2.50
753212916	-	#30	-	3.28	0.1290	20.3	76.2	3.27
753216116	-	#20	-	4.10	0.1615	25.4	101.6	4.10
753219116	-	#11	-	4.86	0.1915	27.9		4.86
753222116	-	#2	-	5.63	0.2215	33.0		5.62
753225116	1/4	-	-	6.38	0.2510	38.1		6.37
753231316	5/16	-	-	7.96	0.3135	48.2		7.96
753237616	3/8	-	-	9.55	0.3760	58.4	152.4	9.55
753243816	7/16	-	-	11.14	0.4385	66.0		11.13
753250116	1/2	-	-	12.73	0.5010	76.2		12.72

Packed: 1 pc.
Available Diamond coating only.
Drills are oversize over nominal.

EP

Work Material												
List No.	Carbon Fiber (CFRP)	Glass Fiber (GFRP)	Aramid Fiber (AFRP)	Honeycomb					Carbon/ Carbon	Carbon Fiber/ Aluminum Stack	Carbon Fiber/ Titanium Stack	Carbon Fiber/ Al/ Ti/CRES Stack
				CFRP/Nomex	GFRP/Nomex	AFRP	CFRP/Al	Al/Al				
7532	◎									○	◎	◎

○ Good ◎ Best

EXOCARB® AERO-H

TiAlN Coated Stack Drill for All Stack Applications

The EXOCARB® AERO-H is a TiAlN coated carbide drill designed for composite/metal stacks. It features a high helix and parabolic flute form for improved chip evacuation as well as corner radius and end gash to resist chipping.

Applications

- Designed for difficult metal alloys such as Titanium, PH Stainless and Nickel Alloys

Features

- Parabolic flute form for improved chip evacuation
- Corner radius and end gash to resist chipping
- TiAlN coating for a sharper cutting edge to reduce burr height

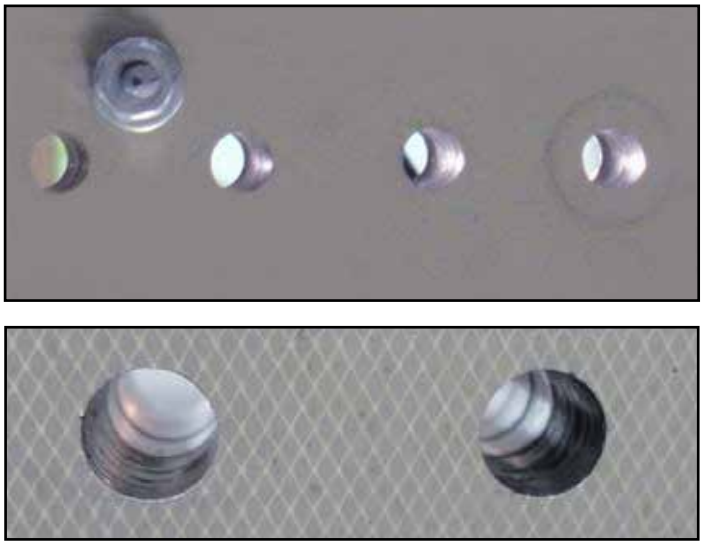
Performance Highlights

EXOCARB® AERO-H

Performance Analysis

The AERO-H is designed to excel in difficult metal alloys such as Titanium, PH Stainless and Nickel Alloys with a cutting edge gash to reduce chipping and burr height. The AERO-H comes standard with either OSG's diamond coating (EXOPRO® AERO-H - Page 14) or TiAlN coating (EXOCARB® AERO-H). TiAlN coating creates a sharper cutting edge to reduce burr height.

In the below example of CFRP/Ai/CFRP/Ti, the EXOCARB® AERO-H was able to successfully make over 120 quality holes.



List 5732

Stack Drill

SPEED FEED	CARBIDE	TiAlN	40°
P23			

Tolerance
+0/-0.0011"

EDP Number	Approximate Hole Size			Drill Size		Flute Length	Overall Length	Shank Diameter
	Fractional Size	Wire Gage	Letter Size	mm	Inch	FL	L	d
573219111	-	#11	-	4.86	0.1915	50.8	101.6	4.86
573225111	1/4	-	-	6.38	0.2510			6.37
573237611	3/8	-	-	9.55	0.3760			9.55
573250111	1/2	-	-	12.73	0.5010	101.6	152.4	12.72

Packed: 1 pc.
Available TiAlN coating only.
Drills are oversize over nominal.

HTE

Work Material												
List No.	Carbon Fiber (CFRP)	Glass Fiber (GFRP)	Aramid Fiber (AFRP)	Honeycomb					Carbon/ Carbon	Carbon Fiber/ Aluminum Stack	Carbon Fiber/ Titanium Stack	Carbon Fiber/ Al/ Ti/CRES Stack
				CFRP/Nomex	GFRP/Nomex	AFRP	CFRP/Al	Al/Al				
5732	◎									○	◎	◎

○ Good ◎ Best

HY-PRO® CARB NEPTUNE®

Three Flute Drill for Hand Drilling Tough Materials

The HY-PRO® CARB NEPTUNE® is an innovative hand drill designed for a wide variety of tough to machine alloys and specifically engineered for efficient hand drilling. The NEPTUNE® features a 3-flute design which improves stability and productivity.

Applications

- Designed for Inconel, titanium alloys, stainless steel and aluminum applications
- Excellent in hand drilling applications

Features

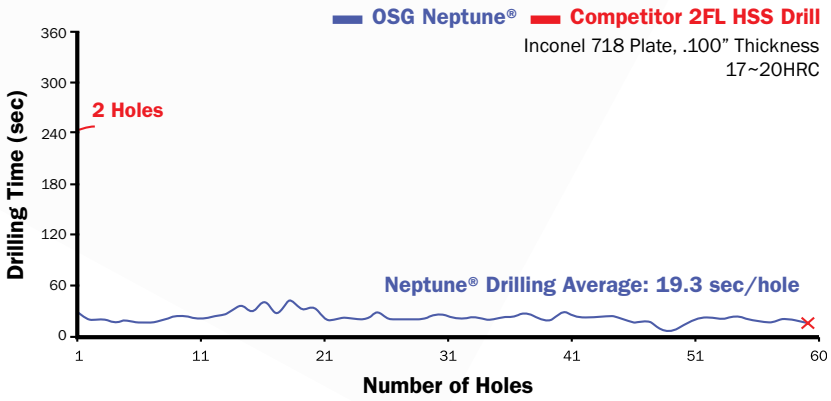
- 3 flutes for improved stability and increased productivity
- TiAlN coating for a sharper cutting edge

Performance Highlights

HY-PRO® CARB NEPTUNE®

Performance Analysis

During a customer test in Inconel, the HY-PRO® CARB NEPTUNE® reduced cycle time by 12.5% and increased tool life by 60 times!

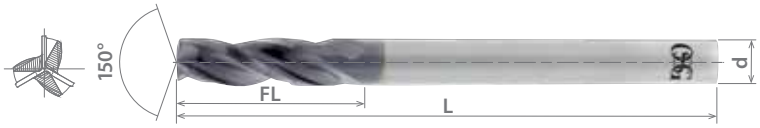


List HP700

Three Flute Drill

SPEED FEED	CARBIDE	TiAlN	30°
P23			

Tolerance
+0/-0.001"



EDP Number	Approximate Hole Size			Drill Size		Flute Length	Overall Length	Shank Diameter
	Fractional Size	Wire Gage	Letter Size	mm	Inch	FL	L	d
HP700-0980	-	#40	-	2.49	0.0980	12.7	38.1	2.48
HP700-1285	-	#30	-	3.26	0.1285			3.26
HP700-1610	-	#20	-	4.09	0.1610			4.08
HP700-1910	-	#11	-	4.85	0.1910			4.85
HP700-2500	1/4	-	-	6.35	0.2500			6.35
HP700-2512	1/4	-	-	4.09 x 6.35	#20 x 0.250 Step	15.8		

Packed: 1 pc.
Available TiAlN coating only.
Tri-Flat shank available upon request.

HPC

Tri-Flat Shank

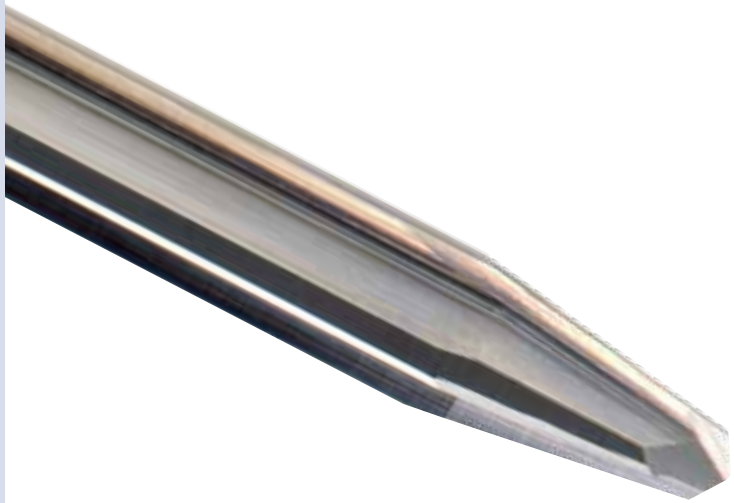
Work Material												
List No.	Carbon Fiber (CFRP)	Glass Fiber (GFRP)	Aramid Fiber (AFRP)	Honeycomb					Carbon/ Carbon	Carbon Fiber/ Aluminum Stack	Carbon Fiber/ Titanium Stack	Carbon Fiber/ Al/ Ti/CRES Stack
				CFRP/Nomex	GFRP/Nomex	AFRP	CFRP/Al	Al/Al				
HP700	◎									◎	◎	◎

○ Good ◎ Best

CARBIDE AERO-D-REAM

Carbide Drill/Reamer for Composites

The Carbide AERO-D-REAM is a non-coated tapered drill/reamer for composites. The tool features a tapered 4-flute design.

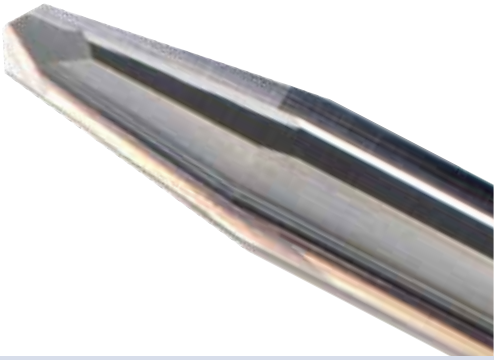


Applications

- Excels in carbon and glass fiber composites

Features

- Straight flute to limit peel-up at hole entrance
- Elongated double-angle geometry to reduce thrust and limit exit delamination



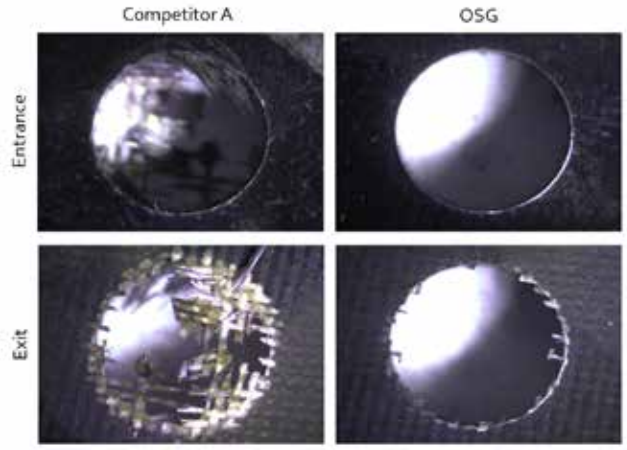
Performance Highlights

OSG's CARBIDE AERO-D-REAM

Performance Analysis

The bright carbide AERO-D-REAM provides substantial tool life in composite materials without sacrificing the cutting edge sharpness required for efficient machining of aluminum. Suitable for a variety of materials from CFRP to aluminum honeycomb, the AERO-D-REAM comes in a wide range of sizes for general machining of composites.

In carbon fiber, the long taper prevents fiber pullout and uncut fibers, allowing the AERO-D-REAM to provide a better quality hole than competitor tools.

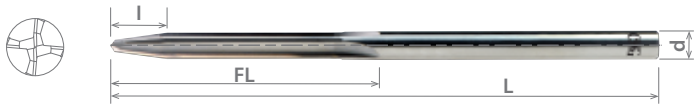


List 257

Tapered Drill/Reamer

SPEED FEED	CARBIDE	BR	0°
P22			

Tolerance
+0.0005"/-0



EDP Number	Size					Flute Length	Taper Length	Overall Length	Shank Diameter
	Fractional Size	Wire Gage	Letter Size	mm	Inch	FL	l	L	d
257-0980	-	#40	-	2.49	0.0980	14.4	5.1		2.48
257-1094	7/64	-	-	2.78	0.1094	16.1	5.6	76.2	2.77
257-1250	1/8	-	-	3.18	0.1250	18.4	6.4		3.17
257-1280	-	-	-	3.25	0.1280	31.9	6.5	152.4	3.25
257-1285	-	#30	-	3.26	0.1285	18.9	6.6	76.2	3.26
257-1286	-	-	-			32.0		152.4	
257-1299	-	-	-	3.30	0.1299	19.2			3.29
257-1406	9/64	-	-	3.57	0.1406	20.7	7.2		3.57
257-1440	-	#27	-	3.66	0.1440	21.2	7.3	76.2	3.65
257-1562	5/32	-	-	3.97	0.1562	23.0	7.9		3.96
257-1570	-	#22	-	3.99	0.1570	23.2	8.0		3.98
257-1610	-	#20	-	4.09	0.1610	23.7	8.2		4.08
257-1616	-	#20	-			40.1		152.4	
257-1630	-	-	-	4.14	0.1630	24.1	8.3		4.14
257-1719	11/64	-	-	4.37	0.1719	25.4	8.7	76.2	4.36
257-1870	-	-	-	4.75	0.1870	27.6	9.4		4.74
257-1875	3/16	-	-	4.76	0.1875	27.7	9.5		4.76
257-1900	-	-	-	4.83	0.1900	47.3	9.6	101.6	4.82
257-1906	-	-	-					152.4	
257-1910	-	#11	-	4.85	0.1910	47.6		76.2	4.85
257-1916	-	#11	-						
257-1920	-	-	-	4.88	0.1920	47.8	9.7		4.87
257-1930	-	-	-	4.90	0.1930	48.1			4.90
257-1935	-	#10	-	4.91	0.1935	48.2	9.8		4.91
257-1940	-	-	-	4.93	0.1940	48.3			4.92
257-2010	-	#7	-	5.11	0.2010	50.1	10.1	101.6	5.10
257-2031	13/64	-	-	5.16	0.2031	50.6	10.2		5.15
257-2040	-	#6	-	5.18	0.2040	50.8	10.3		5.18
257-2055	-	#5	-	5.22	0.2055	51.2	10.4		5.21
257-2180	-	-	-	5.54	0.2180	54.3	11.0		5.53
257-2188	7/32	-	-	5.56	0.2188	54.5			5.55
257-2186	7/32	-	-			54.3		152.4	
257-2210	-	#2	-	5.61	0.2210	55.1	11.1		5.61
257-2280	-	#1	-	5.79	0.2280	56.8	11.5	101.6	5.79
257-2344	15/64	-	-	5.95	0.2344	58.4	11.8		5.95
257-2500	1/4	-	-	6.35	0.2500	54.3	12.5		6.35
257-2506	1/4	-	-			62.3	12.6	152.4	
257-2510	-	-	-	6.38	0.2510	62.6		101.6	6.37
257-2516	-	-	-					152.4	
257-2520	-	-	-	6.40	0.2520	62.8			6.40
257-2530	-	-	-	6.43	0.2530	63.0	12.7		6.42
257-2656	17/64	-	-	6.75	0.2656	66.2	13.3		6.74
257-2812	9/32	-	-	7.14	0.2812	70.1	14.1		7.14
257-2969	19/64	-	-	7.54	0.2969	74.0	14.9		7.54
257-3120	-	-	-	7.92	0.3120	46.1	15.6	101.6	7.92
257-3125	5/16	-	-	7.94	0.3125	46.2			7.93
257-3135		-	-	7.96	0.3135	46.3	15.7		7.96
257-3280	21/64	-	-	8.33	0.3280	48.4	16.4		8.33
257-3438	11/32	-	-	8.73	0.3438	50.8	17.2		8.73
257-3500	-	-	-	8.89	0.3500	51.7	17.5		8.89
257-3594	23/64	-	-	9.13	0.3594	53.1	17.9		9.12
257-3750	3/8	-	-	9.53	0.3750	55.4	18.7	101.6	9.52
257-3756	3/8	-	-			74.4			
257-3906	25/64	-	-	9.91	0.3900	77.4	19.4		9.90
257-4066	13/32	-	-	10.31	0.4060	80.6	20.2	152.4	10.31
257-4376	7/16	-	-	11.11	0.4375	86.8	21.8		11.11
257-5006	1/2	-	-	12.70	0.5000	99.3	24.9		12.70

Packed: 1 pc.
Brazed shanks available on request: Threaded, Quick Change and Tri-Flat.

HYE

Work Material

List No.	Carbon Fiber (CFRP)	Glass Fiber (GFRP)	Aramid Fiber (AFRP)	Honeycomb					Carbon/ Carbon	Carbon Fiber/ Aluminum Stack	Carbon Fiber/ Titanium Stack	Carbon Fiber/ Al/ Ti/CRES Stack
				CFRP/Nomex	GFRP/Nomex	AFRP	CFRP/Al	Al/Al				
257	◎	○		◎	◎		◎	◎	◎			

○ good ◎ best

List 7500: EXOPRO® AERO-D-REAM
List 7501: EXOPRO® AERO-STAD
List 7520: EXOPRO® AERO-LHX
List 257: CARBIDE AERO-D-REAM

Work Material	Carbon & Glass Fiber Reinforced Plastics	
Cutting Speed	165 - 260 SFM	
Drill Diameter (in)	Speed RPM	Feed IPR
#40	8,000	0.0008 - 0.002
#30	6,100	0.0008 - 0.003
#20	4,900	0.0012 - 0.003
#11	4,100	0.0012 - 0.003
#2	3,550	0.0014 - 0.004
1/4	3,100	0.0016 - 0.004
5/16	3,170	0.0016 - 0.004
3/8	2,100	0.002 - 0.004
7/16	1,790	0.002 - 0.004
1/2	1,570	0.002 - 0.004

1. Coolant is not needed, however, make sure dust is efficiently collected.
2. Peck drilling is not needed if drilling depth is less than 3D.
3. The machinability of CFRP depends on physical makeup and percentage of contents, both speed & feed may need adjustments depending on material.
4. Feed rate can be and should be adjusted depending on surface layer makeup.
5. Feed rates can be increased when an approved coolant is utilized.
6. Please contact OSG for specific application questions.

List 7530: EXOPRO® AERO-S

Work Material	Carbon & Glass Fiber Reinforced Plastics		CFRP + Aluminum Stack	
Cutting Speed	165 - 260 SFM		200-400 SFM	
Drill Diameter (in)	Speed RPM	Feed IPR	Speed RPM	Feed IPR
#40	8,000	0.0008 - 0.002	10,135	0.001 - 0.003
#30	6,100	0.0008 - 0.003	8,110	0.003 - 0.004
#20	4,900	0.0012 - 0.003	6,310	0.004 - 0.005
#11	4,100	0.0012 - 0.003	5,410	0.004 - 0.005
#2	3,550	0.0014 - 0.004	4,730	0.005 - 0.006
1/4	3,100	0.0016 - 0.004	4,060	0.006 - 0.007
5/16	3,170	0.0016 - 0.004	3,380	0.007 - 0.008
3/8	2,100	0.002 - 0.004	2,710	0.009 - 0.010
7/16	1,790	0.002 - 0.004	2,370	0.010 - 0.011
1/2	1,570	0.002 - 0.004	2,030	0.012 - 0.013

1. Feed rates can and should be adjusted depending on stack makeup, with higher feed rates in the composite portion and lower feeds in the metal portion.
2. Peck drilling may be necessary for enhanced quality and proper chip evacuation.
3. There are many factors that can effect successful stack drilling; please contact OSG about your specific application for best recommendation.

List 7532: EXOPRO® AERO-H
List 5732: EXOCARB® AERO-H

Work Material	Carbon & Glass Fiber Reinforced Plastics		CFRP + Aluminum Stack		CFRP + Titanium Stack		CFRP + CRES Stack	
Cutting Speed	165 - 260 SFM		200-400 SFM		40-60 SFM		30-50 SFM	
Drill Dia. (in)	Speed RPM	Feed IPR	Speed RPM	Feed IPR	Speed RPM	Feed IPR	Speed RPM	Feed IPR
#40	8,000	0.0008 - 0.002	10,135	0.001 - 0.003	1,900	0.0002 - 0.0007	1,550	0.0002 - 0.0007
#30	6,100	0.0008 - 0.003	8,110	0.003 - 0.004	1,500	0.0004 - 0.0009	1,150	0.0004 - 0.0009
#20	4,900	0.0012 - 0.003	6,310	0.004 - 0.005	1,225	0.0006 - 0.0011	950	0.0006 - 0.0011
#11	4,100	0.0012 - 0.003	5,410	0.004 - 0.005	1,000	0.0007 - 0.0012	800	0.0007 - 0.0012
#2	3,550	0.0014 - 0.004	4,730	0.005 - 0.006	875	0.0009 - 0.0014	675	0.0009 - 0.0014
1/4	3,100	0.0016 - 0.004	4,060	0.006 - 0.007	750	0.001 - 0.0015	600	0.0010 - 0.0015
5/16	3,170	0.0016 - 0.004	3,380	0.007 - 0.008	625	0.0013 - 0.0018	475	0.0013 - 0.0018
3/8	2,100	0.002 - 0.004	2,710	0.009 - 0.010	500	0.0016 - 0.0021	400	0.0016 - 0.0021
7/16	1,790	0.002 - 0.004	2,370	0.010 - 0.011	425	0.0019 - 0.0024	350	0.0019 - 0.0024
1/2	1,570	0.002 - 0.004	2,030	0.012 - 0.013	375	0.0023 - 0.0028	275	0.0023 - 0.0028

1. Feed rates can and should be adjusted depending on stack makeup, with higher feed rates in the composite portion and lower feeds in the metal portion.
2. Peck drilling may be necessary for enhanced quality and proper chip evacuation.
3. There are many factors that can effect successful stack drilling; please contact OSG about your specific application for best recommendation.

List HP700: HY-PRO® CARB NEPTUNE®

Work Material	Carbon & Glass Fiber Reinforced Plastics		CFRP + Aluminum Stack		CFRP + Titanium Stack		CFRP + CRES Stack	
Cutting Speed	150-300 SFM		200-400 SFM		40-60 SFM		30-50 SFM	
Drill Diameter (in)	Speed RPM	Feed IPR	Speed RPM	Feed IPR	Speed RPM	Feed IPR	Speed RPM	Feed IPR
#40	8,900	0.001-0.002	11,250	0.001-0.003	1,900	0.0002-0.0007	1,550	0.0002-0.0007
#30	6,700	0.001-0.002	9,000	0.003-0.004	1,500	0.0004-0.0009	1,150	0.0004-0.0009
#20	5,250	0.001-0.002	7,000	0.004-0.005	1,225	0.0006-0.0011	950	0.0006-0.0011
#11	4,500	0.001-0.002	6,000	0.004-0.005	1,000	0.0007-0.0012	800	0.0007-0.0012
1/4	3,350	0.0015-0.003	4,500	0.006-0.007	750	0.001-0.0015	675	0.0009-0.0014

EXOPRO® AERO-BNC

Diamond Coated Routers for Milling CFRP and Other Composites

ULTRA FINE

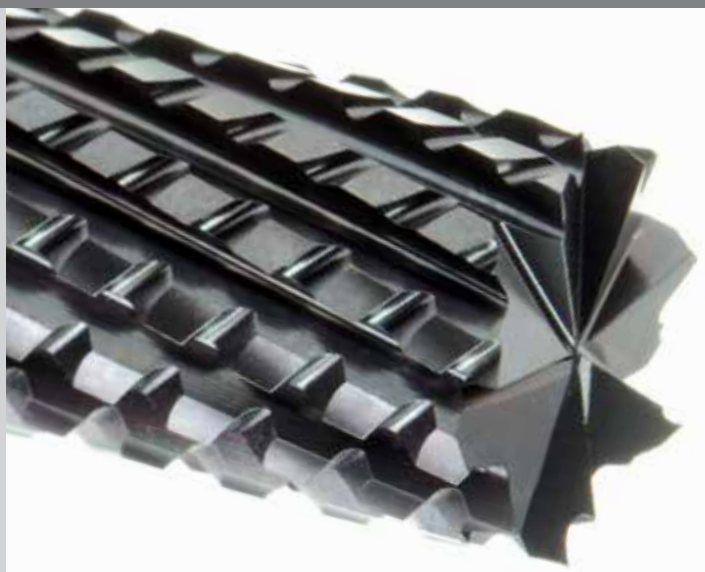
The EXOPRO® AERO-BNC is a fine nicked router specifically designed for carbon fiber composite trimming. This router features a patented cutting geometry coupled with OSG's patented diamond coating.

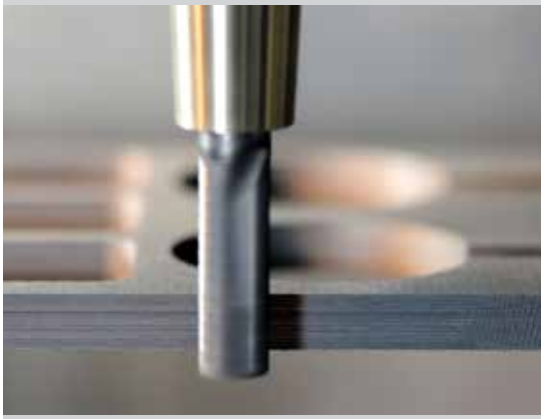
Applications

- Best in carbon fiber, also good for carbon/carbon and honeycombs
- High feed roughing and finishing
- Applied in both thick and thin laminates
- ***Type 1*** - Non end cutting
  Type 2 - for ramping and helical interpolation
  Type 3 - for plunging and helical interpolation
  Type 4 - for drilling

Features

- Patented nick and flute form to eliminate uncut fibers and delamination
- Extremely low cutting forces for long tool life
- Flute management can be applied by changing the milling position at the flute to increase tool life



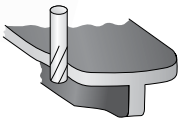


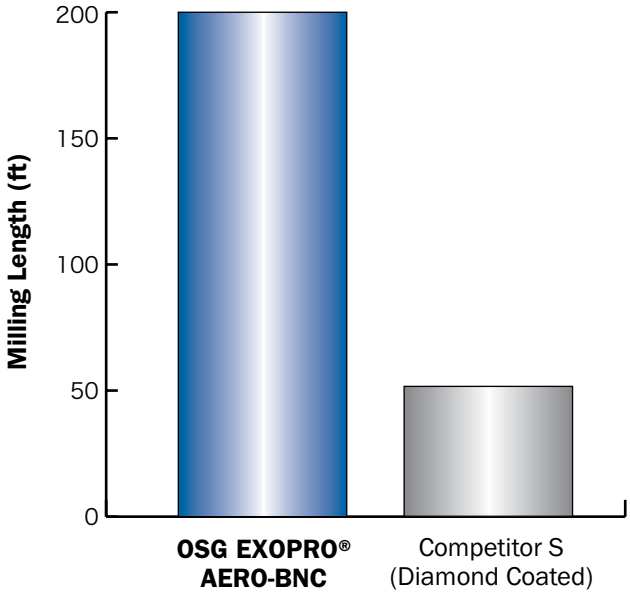
Performance Highlights

OSG's EXOPRO® AERO-BNC End Trimming of a CFRP Stringer

Performance Analysis

Achieve exceptional tool life with EXOPRO® AERO-BNC. Although the details of the machining conditions cannot be disclosed, OSG's AERO-BNC achieved approximately ***4 times the tool life*** versus the competitor product when performing end trimming of a CFRP stringer.



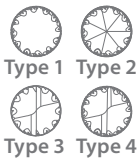


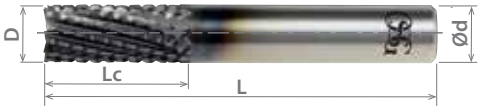
List 2061

Multiple Flutes, Regular Length, Nicked Router

SPEED FEED P40 | CARBIDE | DIA | 15° | SHANK h6

Tolerance
+0/-0.002"





EDP Number	Mill Diameter	Length of Cut	OAL	Shank Diameter	Number of Flutes	Type	Corner Radius
	D	Lc	L	d			
20610116	1/8	1/4	1-1/2	1/8	6	2	-
20611116	1/8	3/8	1-1/2	1/8	6	3	-
20612116	1/8	1/2	1-1/2	1/8	8	3	-
20610216	3/16	3/8	2	3/16	6	2	-
20611216	3/16	9/16	2	3/16	6	3	-
20612216	3/16	3/4	2	3/16	8	3	-
20610316	1/4	1/2	2-1/2	1/4	8	2	-
20613416	1/4	3/4	2-1/2	1/4	8	2	-
20612316	1/4	3/4	2-1/2	1/4	10	2	-
20612416	1/4	3/4	2-1/2	1/4	12	2	-
20611316	1/4	3/4	2-1/2	1/4	10	3	-
20613216	1/4	1	3	1/4	8	2	-
20614316	1/4	1	3	1/4	10	2	-
20614400	1/4	1	3	1/4	12	2	-
20614416	1/4	1	3	1/4	12	2	-
20617316	1/4	1	3	1/4	12	2	0.030
20613316	1/4	1	3	1/4	10	3	-
20616316	1/4	1	3	1/4	8	4	-
20616416	1/4	1	3	1/4	12	4	-
20615316	1/4	1-1/4	4	1/4	12	1	-
20615216	1/4	1-1/4	4	1/4	8	2	-
20610416	5/16	1	2-1/2	5/16	10	3	-
20610516	3/8	3/4	2-1/2	3/8	12	2	-
20612516	3/8	1-1/8	3	3/8	12	2	-
20616816	3/8	1-1/8	3	3/8	12	2	0.030
20611516	3/8	1-1/8	3	3/8	12	3	-
20616516	3/8	1-1/4	3	3/8	12	4	-
20614516	3/8	1-1/2	4	3/8	12	2	-
20613516	3/8	1-1/2	4	3/8	12	3	-
20615516	3/8	2	4	3/8	12	1	-
20616716	1/2	7/8	2-7/8	1/2	14	1	-
20611716	1/2	1	3	1/2	14	2	-
20613716	1/2	1	3	1/2	14	2	0.030
20610716	1/2	1	3	1/2	14	3	-
20615716	1/2	1	3	1/2	14	4	-
20612716	1/2	2	4	1/2	16	2	-

Packed: 1 pc.
Available Diamond coating only.
Red EDP numbers indicate the item is uncoated.

EP

Type 1 - Non End Cutting
Type 2 - Burr End
Type 3 - End Mill Cut
Type 4 - Drill Point

Work Material												
List No.	Carbon Fiber (CFRP)	Glass Fiber (GFRP)	Aramid Fiber (AFRP)	Honeycomb					Carbon/ Carbon	Carbon Fiber/ Aluminum Stack	Carbon Fiber/ Titanium Stack	Carbon Fiber/ Al/ Ti/CRES Stack
				CFRP/Nomex	GFRP/Nomex	AFRP	CFRP/Al	Al/Al				
2061	◎	○		○	○		○	○	◎			

○ Good ◎ Best

EXOPRO® AERO-HBC

Diamond Coated Routers for Milling CFRP and Other Composites

ULTRA FINE

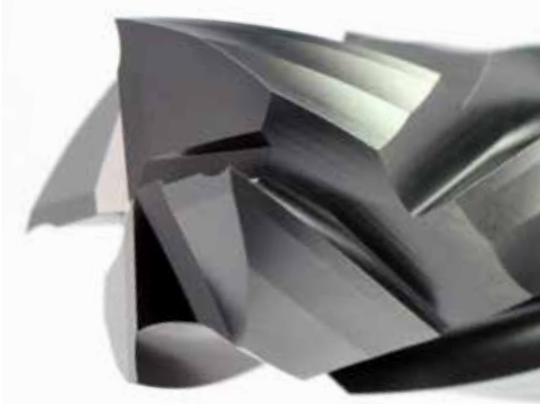
The EXOPRO® AERO-HBC is a diamond coated herringbone style router for high feed rates and excellent surface finishes. This router features a compression cutting mechanism along with OSG's patented diamond coating.

Applications

- Excels in carbon and glass composites and honeycombs
- High feed routing and finishing
- Best in thick laminates (Ref. L2 length on next page)
- Excellent in thermoplastic matrix

Features

- Compression mechanism to neutralize cutting forces to prevent delamination on both top and bottom laminates
- Low cutting forces for longer tool life



Performance Highlights

OSG's EXOPRO® AERO-HBC in Carbon Fiber Composite

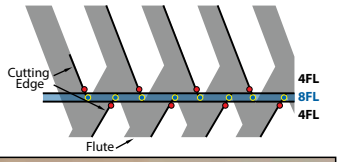
Performance Analysis

The EXOPRO® AERO-HBC showed excellent performance and surface finish at high feed rates. The 4-flute herringbone design was able to mill up to 480 IPM without leaving streak marks on the composite.

Tool	EXOPRO® AERO-HBC	Competitor
	4 Flutes	6 Flutes
	Herringbone Router - Diamond Coated	
Size	0.500"	
Work Material	Carbon Fiber Composite	
Drilling Speed	786 SFM (6,000 RPM)	
Feed Rate	24 to 480 IPM (Various)	
Depth of Cut	Aa: 0.250" • Ar: 0.125"	
Coolant	Dry	
Machine	Vertical Machining Center	

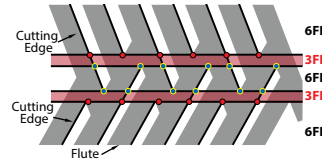
OSG EXOPRO® AERO-HBC
(List 2066)

Clean milling at 480 IPM



Competitor

Streaking and Torn/Uncut Fibers



List 2066

4 Flute, Regular Length, 30° Compression Router

SPEED FEED P40 | CARBIDE | DIA | 30° | SHANK h6

Tolerance
+0/-0.002"

EDP Number	Mill Diameter	Compression Length	Length of Cut	OAL	Shank Diameter
	D	L2	Lc	L	d
20660116	1/8	1/8	0.560	1-1/2	1/8
20660316	1/4	1/4	0.750	2-1/2	1/4
20660516	3/8	3/8	0.875	3	3/8
20660716	1/2	1/2	1.500	3	1/2

Packed: 1 pc. Available Diamond coating only.

EP

Work Material												
List No.	Carbon Fiber (CFRP)	Glass Fiber (GFRP)	Aramid Fiber (AFRP)	Honeycomb					Carbon/ Carbon	Carbon Fiber/ Aluminum Stack	Carbon Fiber/ Titanium Stack	Carbon Fiber/ Al/ Ti/CRES Stack
				CFRP/Nomex	GFRP/Nomex	AFRP	CFRP/Al	Al/Al				
2066	◎	◎	○	○	○	○	○	○				

○ Good ◎ Best

EXOPRO® AERO-HBC 45

Diamond Coated Routers for Milling CFRP and Other Composites

ULTRA FINE

The EXOPRO® AERO-HBC 45 is a diamond coated compression router with a higher helix angle to shear tougher materials. It features compression cutting and OSG's patented diamond coating.

Applications

- Designed for tough carbon fibers and honeycomb applications

Features

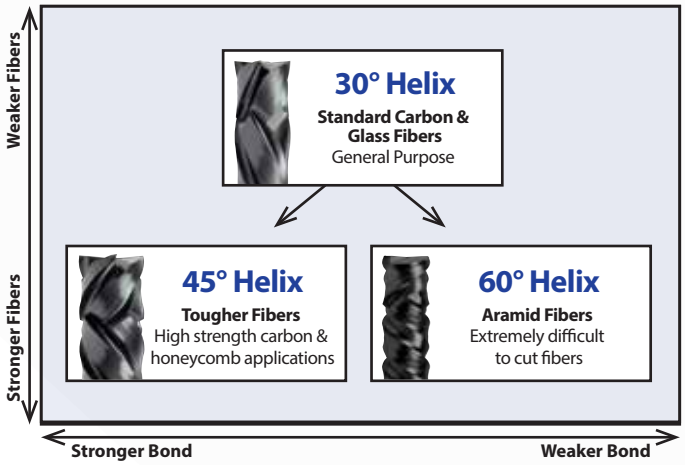
- 45° helix angle to shear tougher fibers
- Compressive geometry to prevent pullout
- OSG's patented diamond coating

Performance Highlights

OSG's AERO-HBC 45 Angle Comparison Chart

Performance Analysis

While similar to the AERO-HBC, the AERO-HBC 45's higher helix angle is able to shear tougher fibers like high strength carbon and honeycomb materials. If you are machining aramid fibers, try OSG's EXOPRO® AERO-HBC 60 (Page 30).



List 2064

4 Flute, Regular Length, 45° Compression Router

SPEED FEED P40 | CARBIDE | DIA | 45° | SHANK h6

Tolerance
+0/-0.002"

EDP Number	Mill Diameter	Compression Length	Length of Cut	OAL	Shank Diameter
	D	L2	Lc	L	d
20642516	1/4	1/4	3/4	3	1/4
20643516	3/8	3/8	3/4	3	3/8
20643616	3/8	3/8	2	4	3/8
20645016	1/2	1/2	1	3	1/2
20645116	1/2	1/2	2	4	1/2

Packed: 1 pc. Available Diamond coating only.

EP

Work Material												
List No.	Carbon Fiber (CFRP)	Glass Fiber (GFRP)	Aramid Fiber (AFRP)	Honeycomb					Carbon/ Carbon	Carbon Fiber/ Aluminum Stack	Carbon Fiber/ Titanium Stack	Carbon Fiber/ Al/ Ti/CRES Stack
				CFRP/Nomex	GFRP/Nomex	AFRP	CFRP/Al	Al/Al				
2064	◎	◎	○	○	○	○	○	○				

○ Good ◎ Best

EXOPRO® AERO-HBC 60

Diamond Coated Routers for Milling CFRP and Other Composites

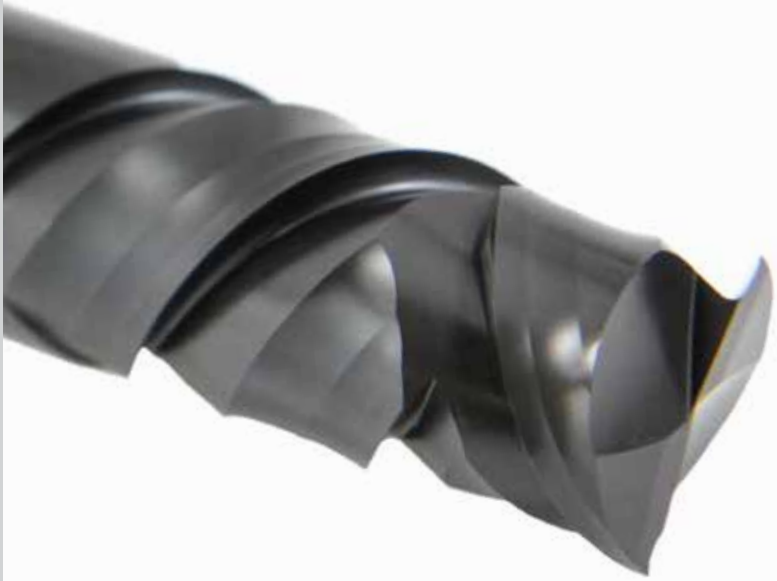
The EXOPRO® AERO-HBC 60 is a compression router featuring a 60° helix angle designed to shear fibers in aramid fiber applications and OSG's patented diamond coating for longer tool life.

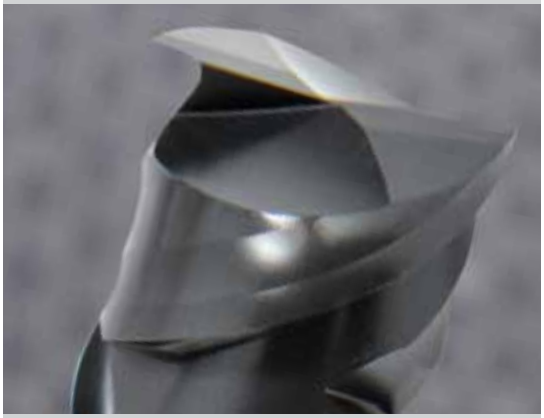
Applications

- Excels in Aramid fiber applications

Features

- 60° helix angle for even sharper cutting edges for shearing fibers
- OSG's patented diamond coating



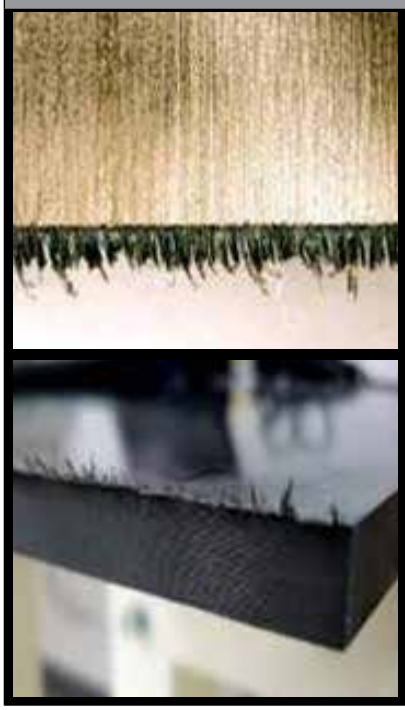
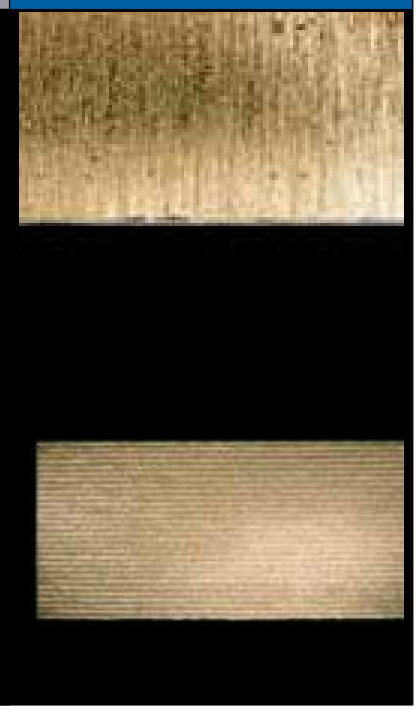


Performance Highlights

OSG's AERO-HBC 60 in Aramid Fiber

Performance Analysis

The AERO-HBC 60's high helix angle shears fibers in Aramid applications and prevents tearout.

Conventional End Mill	EXOPRO® AERO-HBC 60
	

List 2068

2 Flute, Regular Length, 60° Compression Router

SPEED FEED P41 | CARBIDE | DIA | 60° | SHANK h6

Tolerance
+0/-0.002"

EDP Number	Mill Diameter	Compression Length	Length of Cut	OAL	Shank Diameter
	D	L2	Lc	L	d
20682516	1/4	0.188	3/4	3	1/4
20683516	3/8	0.281	3/4	3	3/8
20683616	3/8	0.281	2	4	3/8
20685016	1/2	0.375	1	3	1/2
20685116	1/2	0.375	2	4	1/2

Packed: 1 pc. Available Diamond coating only.

EP

Work Material												
List No.	Carbon Fiber (CFRP)	Glass Fiber (GFRP)	Aramid Fiber (AFRP)	Honeycomb					Carbon/ Carbon	Carbon Fiber/ Aluminum Stack	Carbon Fiber/ Titanium Stack	Carbon Fiber/ Al/ Ti/CRES Stack
				CFRP/Nomex	GFRP/Nomex	AFRP	CFRP/Al	Al/Al				
2068	◎	◎	○	◎	◎	◎	◎	◎				

○ Good ◎ Best

EXOPRO® AERO-REC

Diamond Coated Routers for Milling CFRP and Other Composites

The EXOPRO® AERO-REC is a diamond coated router for roughing and semi-finishing composites. The AERO-REC uses extremely low cutting forces for low rigid fixtures and weak spindles.

Applications

- Low rigid fixtures, setups and weak spindles
- Can be used in combination with the AERO-MFR for finishing

Features

- Roughing nicks for efficient milling providing extremely low cutting forces
- Flute management can be applied by changing the milling position at the flute to increase tool life

Performance Highlights

OSG's AERO-REC Demonstrates Extremely Low Cutting Forces

Performance Analysis

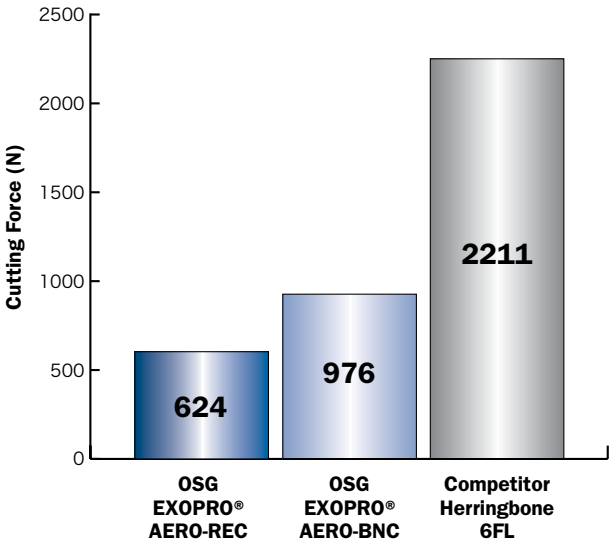
Due to the roughing nick profile, the AERO-REC can significantly reduce cutting force when compared to our herringbone 6-flute competitor.

Tool	EXOPRO® AERO-REC	EXOPRO® AERO-BNC	Competitor
Size	0.3937"		
Work Material	CFRP		
Drilling Speed	656 SFM (6,365 RPM)		
Feed Rate	15.7 IPM		
Depth of Cut	Aa: 1" • Ar: 0.3937"		
Coolant	Dry		

OSG EXOPRO® AERO-REC

OSG EXOPRO® AERO-BNC

Competitor Herringbone 6FL



List 2680

Multiple Flute, Regular Length, Roughing Router

SPEED FEED P42 | CARBIDE | DIA | 15° | SHANK h6

Tolerance
+0/-0.002"

EDP Number	Mill Diameter	Length of Cut	OAL	Shank Diameter	Number of Flutes
	D	Lc	L	d	
26809316	15/64	3/4	2-1/2	1/4	4
26805316	1/4	1/2	2-1/2	1/4	4
26800316	1/4	3/4	2-1/2	1/4	4
26806316	1/4	1	3	1/4	4
26809416	5/16	15/16	3	3/8	6
26809516	23/64	1-1/8	3	3/8	6
26805516	3/8	3/4	3	3/8	6
26800516	3/8	1-1/8	3	3/8	6
26809616	7/16	1-5/16	3	1/2	8
26809716	31/64	1-1/2	3	1/2	8
26805716	1/2	1	3	1/2	8
26800716	1/2	1-1/2	3	1/2	8

Packed: 1 pc. Available Diamond coating only.

EP

Work Material												
List No.	Carbon Fiber (CFRP)	Glass Fiber (GFRP)	Aramid Fiber (AFRP)	Honeycomb					Carbon/ Carbon	Carbon Fiber/ Aluminum Stack	Carbon Fiber/ Titanium Stack	Carbon Fiber/ Al/ Ti/CRES Stack
				CFRP/Nomex	GFRP/Nomex	AFRP	CFRP/Al	Al/Al				
2680	◎	◎		○	○		○	○	◎			

○ Good ◎ Best

EXOPRO® AERO-MFR

Diamond Coated Routers for Milling CFRP and Other Composites

The EXOPRO® AERO-MFR is a highly rigid multi-fluted finishing router designed for high precision and accuracy requirements. This router features a large core and OSG's patented diamond coating.

Applications

- Excellent for tight tolerances and high precision applications
- Can be used in combination with the AERO-REC for roughing

Features

- Multi-fluted for superior finishes
- Large core for ultra rigidity
- Flute management can be applied by changing the milling position at the flute to increase tool life

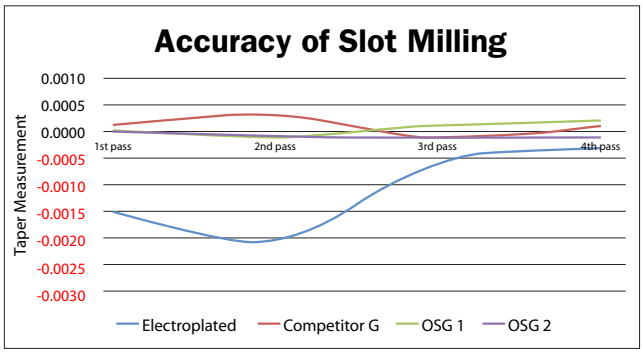
Performance Highlights

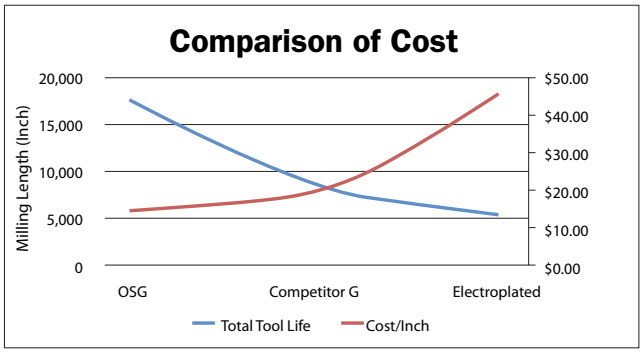
OSG's AERO-MFR Holds Highest Accuracy vs Competition

Performance Analysis

The EXOPRO® AERO-MFR showed exceptional accuracy when compared against its diamond coated and electroplated competition.

Tool	OSG AERO-MFR	Competitor G	Electroplated
Material	Carbon / Carbon		
Diameter	5/16"		
Milling Method	Slotting		
Speed	221 SFM (2,700 RPM)	801 SFM (9,795 RPM)	
Feed	50 IPM		
DOC	Aa: 0.400"		
Coolant	Dry		





List 2650

Multiple Flute, Regular Length, Non End Cutting, Finishing Router

SPEED FEED	CARBIDE	DIA	15°	SHANK
P43				h6

Tolerance
+0/-0.002"

EDP Number	Mill Diameter	Length of Cut	OAL	Shank Diameter	Number of Flutes
	D	Lc	L	d	
26500316	1/4	3/4	2-1/2	1/4	8
26501316	1/4	1	3	1/4	8
26500616	3/8	1-1/8	3	3/8	12
26501516	3/8	1-1/2	3	3/8	12
26500716	1/2	1-1/2	4	1/2	14
26501716	1/2	2	4	1/2	14

Packed: 1 pc. Available Diamond coating only.

EP

Work Material												
List No.	Carbon Fiber (CFRP)	Glass Fiber (GFRP)	Aramid Fiber (AFRP)	Honeycomb					Carbon/ Carbon	Carbon Fiber/ Aluminum Stack	Carbon Fiber/ Titanium Stack	Carbon Fiber/ Al/ Ti/CRES Stack
				CFRP/Nomex	GFRP/Nomex	AFRP	CFRP/Al	Al/Al				
2650	◎	◎		○	○		○	○	◎			

○ Good ◎ Best

CARBIDE AERO-HBC 60

Carbide Router for Honeycomb & Other Composites

The Carbide AERO-HBC 60 is a compression router featuring a 60° helix angle designed to shear off fibers in aramid fiber applications.

Applications

- Excels in Aramid fiber materials

Features

- 60° helix angle for even sharper cutting edges for shearing fibers

Performance Highlights

OSG's AERO-HBC 60 Eliminates Tearout

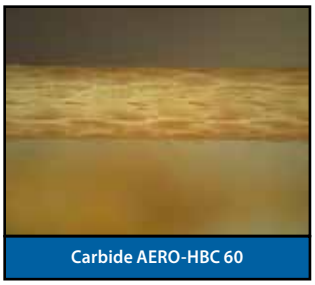
Performance Analysis

The AERO-HBC 60's high helix angle successfully shears fibers and prevents tearout.

Kevlar material has been generally accepted to require a second or third processing to achieve a clean cut. In the test shown below, the HBC 60 demonstrates that a clean edge can be cut with no secondary processing.

OSG's EXOPRO® AERO-HBC 60 (page 30) features the same capabilities as the CARBIDE AERO-HBC 60 but features OSG's patented diamond coating for longer tool life.

Tool	Carbide AERO-HBC 60	Competitor FG Router
Size	1/4"	
Work Material	Aramid Fiber Laminate (0.250" Thickness)	
Speed	949 SFM (14,500 RPM)	
Feed Rate	10 IPM	
Depth of Cut	Ar: 0.050	
Milling Method	Conventional (Up) Milling	
Coolant	Dry	
Machine	VMC	



Carbide AERO-HBC 60

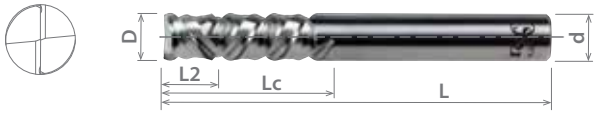
Competitor FG Router

List 668

2 Flute, Regular Length, 60° Compression Router

SPEED FEED P41 | CARBIDE | BR | 60° | SHANK h6

Tolerance
+0/-0.0015"



EDP Number	Mill Diameter	Compression Length	Length of Cut	OAL	Shank Diameter
	D	L2	Lc	L	d
668-2501	1/4	0.188	3/4	2 1/2	1/4
668-3751	3/8	0.281	3/4	3	3/8
668-3752	3/8	0.281	2	4	3/8
668-5001	1/2	0.375	1	3	1/2
668-5002	1/2	0.375	2	4	1/2

Packed: 1 pc.

HYE

Work Material												
List No.	Carbon Fiber (CFRP)	Glass Fiber (GFRP)	Aramid Fiber (AFRP)	Honeycomb					Carbon/ Carbon	Carbon Fiber/ Aluminum Stack	Carbon Fiber/ Titanium Stack	Carbon Fiber/ Al/ Ti/CRES Stack
				CFRP/Nomex	GFRP/Nomex	AFRP	CFRP/Al	Al/Al				
668			◎	◎	◎	◎	◎	◎				

○ Good ◎ Best

CARBIDE AERO-HFR

Carbide Router for CFRP & Composites

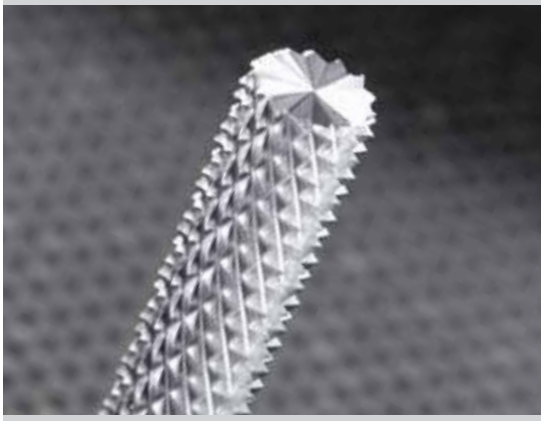
The AERO-HFR is a nicked router featuring a trapezoidal nicked geometry that reduces heat and friction with very low cutting forces. The AERO-HFR can be successfully used in hand routers or machines to provide excellent surface finish and good tool life.

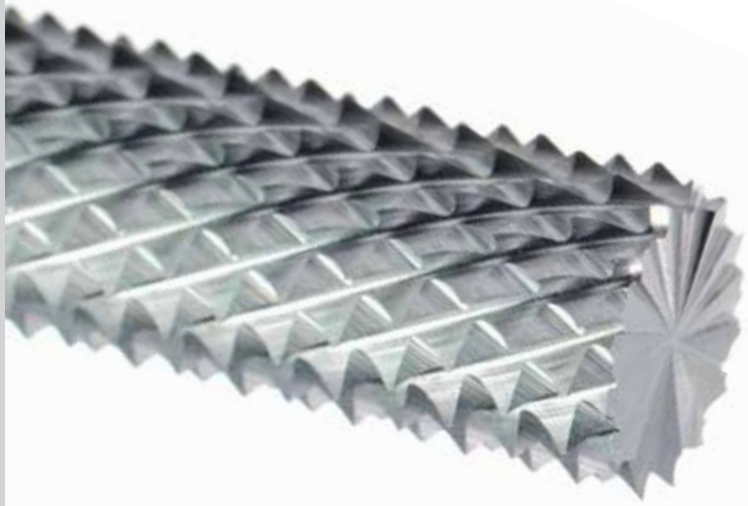
Applications

- Designed for hand trimming
- Used for roughing

Features

- Sharp cutting edges
- Low cutting forces
- Trapezoidal cutting edges reduce friction
- Variety of end cut options for different applications



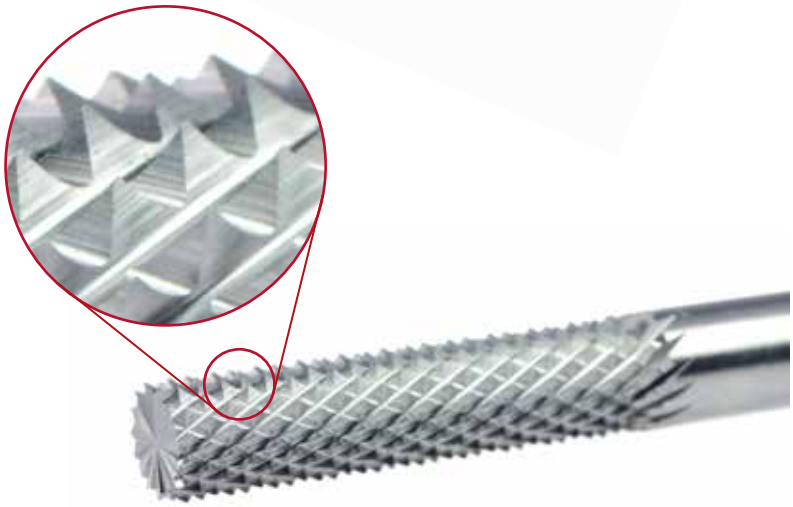


Performance Highlights

OSG's AERO-HFR Performs in a Variety of Applications

Performance Analysis

The AERO-HFR's trapezoidal cutting edge works well in many hand applications.

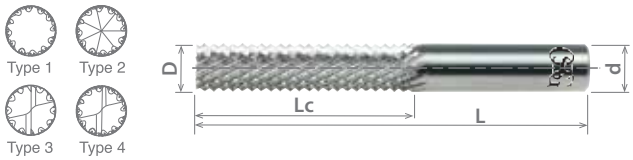


List 641R

Regular Length, General Purpose Router

SPEED FEED P43 | CARBIDE | BR | 30° | SHANK h6

Tolerance
+0/-0.003"



EDP Number	Mill Diameter	Length of Cut	OAL	Shank Diameter	Type
	D	Lc	L	d	
641-1871	3/16	1	3	1/4	1
641-1872	3/16	1	3	1/4	2
641-1873	3/16	1	3	1/4	3
641-1874	3/16	1	3	1/4	4
641-2501	1/4	1	3	1/4	1
641-2502	1/4	1	3	1/4	2
641-2503	1/4	1	3	1/4	3
641-2504	1/4	1	3	1/4	4
641-3751	3/8	1	3	3/8	1
641-3752	3/8	1	3	3/8	2
641-3753	3/8	1	3	3/8	3
641-3754	3/8	1	3	3/8	4
641-5001	1/2	1	3	1/2	1
641-5002	1/2	1	3	1/2	2
641-5003	1/2	1	3	1/2	3
641-5004	1/2	1	3	1/2	4

Packed: 1 pc.

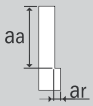
Type #1 - Non End Cutting
Type #2 - Burr End
Type #3 - End Mill Cut
Type #4 - Drill Point

Work Material												
List No.	Carbon Fiber (CFRP)	Glass Fiber (GFRP)	Aramid Fiber (AFRP)	Honeycomb					Carbon/ Carbon	Carbon Fiber/ Aluminum Stack	Carbon Fiber/ Titanium Stack	Carbon Fiber/ Al/ Ti/CRES Stack
				CFRP/Nomex	GFRP/Nomex	AFRP	CFRP/Al	Al/Al				
641R	◎	◎		○	○		○	○	○			

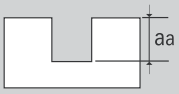
○ Good ◎ Best

List 2061: EXOPRO® AERO BNC, Nick Router
List 2066: EXOPRO® AERO HBC, Compression Router, 30° Helix
List 2064: EXOPRO® AERO HBC 45, Compression Router, 45° Helix

Side Milling

Work Material	Carbon & Glass Fiber Reinforced Plastics	
Cutting Speed	400-800 SFM	
Depth of Cut	**a**a: Up to 1.5D **a**r: Up to 1D 	
Drill Diameter (Inch)	Speed RPM	Feed IPR
1/8	12,000 - 24,000	0.0011 - 0.0022
3/16	8,000 - 16,000	0.0021 - 0.0042
1/4	6,000 - 12,000	0.0033 - 0.0067
5/16	5,000 - 10,000	0.0047 - 0.0093
3/8	4,000 - 8,000	0.0067 - 0.0133
1/2	3,000 - 6,000	0.0111 - 0.0222

Slotting

Work Material	Carbon & Glass Fiber Reinforced Plastics	
Cutting Speed	300-600 SFM	
Depth of Cut	**a**a: Up to 1D 	
Drill Diameter (Inch)	Speed RPM	Feed IPR
1/8	10,000 - 18,000	0.0016 - 0.0020
3/16	6,700 - 12,000	0.0020 - 0.0024
1/4	5,000 - 9,000	0.004 - 0.005
5/16	4,000 - 7,200	0.006 - 0.008
3/8	3,300 - 6,000	0.009 - 0.012
1/2	2,500 - 4,500	0.012 - 0.020

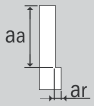
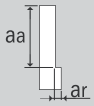
1. The conditions listed above are based on approximately 1xDc thickness of part with rigid work holding.
2. Conventional cut is recommended at part side for good surface finish.
3. Milling speed can be increased by 20-50% with the use of appropriate cutting oil.
4. Please provide appropriate measures against dust (Such as vacuum dust collection).
5. Depending on the workpiece thickness and form as well as work holding, vibration may occur. When it occurs, please adjust RPM and feed rate.

Feed Reduction

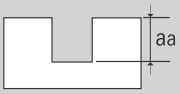
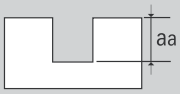
Material Thickness	Feed Reduction
≤0.25Dc	x80%
0.25Dc ~ 0.5Dc	x150%
0.5Dc ~ 1Dc	x120%
1Dc ~ 2Dc	x80%
2Dc ~ 3Dc	x50%

List 2068: EXOPRO® AERO HBC 60, Compression Router, 60° Helix
List 668: CARBIDE AERO HBC 60, Compression Router, 60° Helix, Bright

Side Milling

Work Material	Carbon & Glass Fiber Reinforced Plastics		Honeycomb Structures & Aramid Fiber Reinforced Plastics	
Cutting Speed	400-800 SFM		1000-2600 SFM	
Depth of Cut	**a**a: Up to 1.5D **a**r: Up to 1D 		**a**a: Up to 1.5D **a**r: Up to 1D 	
Drill Diameter (Inch)	Speed RPM	Feed IPR	Speed RPM	Feed IPR
1/4	6,000 - 12,000	0.0033 - 0.0067	15,000 - 40,000	0.0003 - 0.0007
3/8	4,000 - 8,000	0.0067 - 0.0133	10,000 - 25,000	0.0006 - 0.0009
1/2	3,000 - 6,000	0.0111 - 0.0222	8,000 - 20,000	0.0011 - 0.0014

Slotting

Work Material	Carbon & Glass Fiber Reinforced Plastics		Honeycomb Structures & Aramid Fiber Reinforced Plastics	
Cutting Speed	300-600 SFM		750-1900 SFM	
Depth of Cut	**a**a: Up to 1D 		**a**a: Up to 1D 	
Drill Diameter (Inch)	Speed RPM	Feed IPR	Speed RPM	Feed IPR
1/4	5,000 - 9,000	0.0021 - 0.0043	12,000 - 30,000	0.0002 - 0.0005
3/8	3,000 - 6,000	0.0044 - 0.0089	8,000 - 20,000	0.0007 - 0.0011
1/2	2,000 - 5,000	0.0071 - 0.0143	6,000 - 15,000	0.0013 - 0.0017

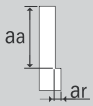
1. The conditions listed above are based on approximately 1xDc thickness of part with rigid work holding.
2. Conventional cut is recommended at part side for good surface finish.
3. Milling speed can be increased by 20-50% with the use of appropriate cutting oil.
4. Please provide appropriate measures against dust (Such as vacuum dust collection).
5. Depending on the workpiece thickness and form as well as work holding, vibration may occur. When it occurs, please adjust RPM and feed rate.
6. Kevlar laminate machinability can vary greatly by fiber and resin. If surface quality is not achieved with the feed rates provided above, reducing the feed rates may produce better quality surfaces.

Feed Reduction

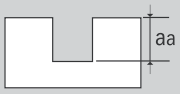
Material Thickness	Feed Reduction
≤0.25Dc	x80%
0.25Dc ~ 0.5Dc	x150%
0.5Dc ~ 1Dc	x120%
1Dc ~ 2Dc	x80%
2Dc ~ 3Dc	x50%

List 2680: EXOPRO® AERO REC, Rougher Router

Side Milling

Work Material	Carbon & Glass Fiber Reinforced Plastics	
Cutting Speed	400-800 SFM	
Depth of Cut	**a**a: Up to 1.5D **a**r: Up to 1D 	
Drill Diameter (Inch)	Speed RPM	Feed IPR
1/4	6,000 - 12,000	0.0067 - 0.0200
3/8	4,000 - 8,000	0.0200 - 0.0400
1/2	3,000 - 6,000	0.0333 - 0.0667

Slotting

Work Material	Carbon & Glass Fiber Reinforced Plastics	
Cutting Speed	300-600 SFM	
Depth of Cut	**a**a: Up to 1D 	
Drill Diameter (Inch)	Speed RPM	Feed IPR
1/4	5,000 - 9,000	0.0064 - 0.0129
3/8	3,000 - 6,000	0.0133 - 0.0267
1/2	2,000 - 5,000	0.0214 - 0.0429

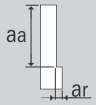
1. The conditions listed above are based on approximately 1xDc thickness of part with rigid work holding.
2. Conventional cut is recommended at part side for good surface finish.
3. Milling speed can be increased by 20-50% with the use of appropriate cutting oil.
4. Please provide appropriate measures against dust (Such as vacuum dust collection).
5. Depending on the workpiece thickness and form as well as work holding, vibration may occur. When it occurs, please adjust RPM and feed rate.

Feed Reduction

Material Thickness	Feed Reduction
≤0.25Dc	x80%
0.25Dc ~ 0.5Dc	x150%
0.5Dc ~ 1Dc	x120%
1Dc ~ 2Dc	x80%
2Dc ~ 3Dc	x50%

List 2650: EXOPRO® AERO MFR, Finishing Router

Side Milling

Work Material	Carbon & Glass Fiber Reinforced Plastics	
Cutting Speed	400-800 SFM	
Depth of Cut	**a**a: Up to 1.0D **a**r≤0.2D 	
Drill Diameter (Inch)	Speed RPM	Feed IPR
1/4	5,000 - 9,000	0.009 - 0.016
3/8	3,300 - 6,000	0.019 - 0.047
1/2	2,500 - 4,000	0.028 - 0.055

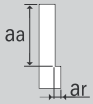
1. The conditions listed above are based on approximately 1xDc thickness of part with rigid work holding.
2. Conventional cut is recommended at part side for good surface finish.
3. Milling speed can be increased by 20-50% with the use of appropriate cutting oil.
4. Please provide appropriate measures against dust (Such as vacuum dust collection).
5. Depending on the workpiece thickness and form as well as work holding, vibration may occur. When it occurs, please adjust RPM and feed rate.

Feed Reduction

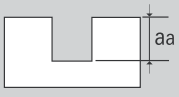
Material Thickness	Feed Reduction
≤0.25Dc	x80%
0.25Dc ~ 0.5Dc	x150%
0.5Dc ~ 1Dc	x120%
1Dc ~ 2Dc	x80%
2Dc ~ 3Dc	x50%

List 641R: CARBIDE AERO HFR, Hand Router

Side Milling

Work Material	Carbon & Glass Fiber Reinforced Plastics	
Cutting Speed	400-800 SFM	
Depth of Cut	**a**a: Up to 1.5D **a**r: Up to 1D 	
Drill Diameter (Inch)	Speed RPM	Feed IPR
3/16	8,000 - 18,000	0.0015 - 0.0027
1/4	6,000 - 12,000	0.0033 - 0.0067
3/8	4,000 - 8,000	0.0067 - 0.0117
1/2	3,000 - 6,000	0.0111 - 0.0222

Slotting

Work Material	Carbon & Glass Fiber Reinforced Plastics	
Cutting Speed	300-600 SFM	
Depth of Cut	**a**a: Up to 1D 	
Drill Diameter (Inch)	Speed RPM	Feed IPR
3/16	7,000 - 13,000	0.0010 - 0.0020
1/4	5,000 - 9,000	0.0021 - 0.0043
3/8	3,000 - 6,000	0.0044 - 0.0078
1/2	2,000 - 5,000	0.0071 - 0.0143

OSG PHOENIX® PFB

Finishing Ball End Mill

The PHOENIX® PFB is a high precision indexable finish ballnose end mill designed for superior surface finish and tool life. The PFB features a high insert radius of ±6µm!

Applications

- Ideal for 3-D finishing operations where precision and surface finish are critical
- PVD & CVD coated grades for milling mold materials for composites
- 3-D machining operations in composites utilizing OSG's XC4505 grade diamond-coated insert

Features

- Very high insert radius precision (±6µm) provides superior milling surface finish
- Spiral cutting edge for excellent strength and sharpness
- Carbide shank to inhibit chattering and to increase both precision and tool life
- Steel shank for superior cost performance when working with shorter projection lengths

Performance Highlights

OSG's PHOENIX® PFB High Wear Resistance in CFRP

Performance Analysis

In addition to the exceptional insert radius precision, the PHOENIX® PFB showed high wear resistance while machining the CFRP propeller shown below.

Tool	PFB
Insert (Grade)	PFB300-D (XC4505)
Workpiece	Propeller
Work Material	CFRP-Unidirectional
Tool Overhang	4.7"
Cutting Speed	670 SFM (6000 RPM)
Feed	78 IPM (0.0065 IPT)
Milling Method	3D Milling
Depth of Cut	Aa = 0.040 in • Ar = 0.236 in
Coolant	Air Blow
Machine	Vertical Machining Center

Total Cutting Length: 120"
Flank Wear Amount: 0.005"

Features & Benefits

The steel shank achieves superior cost performance when working with relatively short projection lengths.

The high precision mounting of the insert into the body enables a superior milling surface and long tool life.

The carbide shank inhibits chattering and produces a favorable milling surface even when machining with a long projection length. High precision and long tool life are possible even when milling at high speeds.

±6µm Precision

The PFB features an exceptionally high insert radius precision of ±6µm.

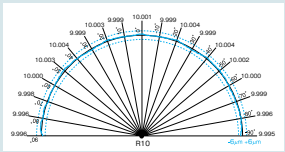
Inserts & Grades

PFB-Q

- The effective cutting edge has a 220˚ angle, applicable for undercut milling.
- The 220˚ cutting edge reduces chatter on vertical walls and produces improved surface finishes.
- High insert radius precision (±6µm).

PFB-SP

- Spiral edge form handles a wide range of work materials.
- High insert radius precision (±6µm).



PFB-SH

- Specialized cutting edge shape for cast iron, ductile cast iron, and hardened steel.
- Improved resistance to chipping and breakage by special edge treatment.
- High insert radius precision (±6µm).

PFB-D

- Employs a spiral edge form for outstanding sharpness.
- Amazing durability when machining graphite, copper, aluminum, MMC, and carbon fiber composite material!
- High insert radius precision (±6µm).

XP3225 Grade

- Stable machining is possible in a wide range of cutting conditions.
- Especially good performance in stainless steel and carbon steel.

XP3320 Grade

- Utilizes a carbide substrate with a superior balance of wear resistance and anti-chipping properties.
- Oxidation temperature 1300˚C
- Surface hardness 3500 HV
- Capable of long tool life during high speed, high-efficiency machining.

XP3310 Grade

- Highly wear resistant carbide substrate.
- Utilizes a coating with excellent heat resistance and wear resistance.

XC4505 Grade

- Utilizes a special carbide substrate for diamond coating.
- A sharp edge is attained through the combination of our high-level grinding techniques and leading diamond coating technology.

List 52100

PFB SA (Inch)

SPEED FEED P53

Recommended Materials: p53
Accessories & Inserts: p49-51
Effective Cutting Diameter & Recommended Width of Cut: p52

Steel Shank

Carbide Shank

EDP No.	Body Type	Designation	Type	Tool Dia. (inch)	Tool Radius (inch)	Overall Length (inch)	Neck Length (inch)	Taper	L/D Ratio	No. of Teeth	Shank Dia. (inch)	Shank Length (inch)	Neck Dia. (inch)
				D	R	L	l1	α°			d	l2	d2
52100000	Cylindrical Shank Steel	PFB-R0250SA0250-S325	1	0.250	0.1250	3.250	0.625	0	2.5	2	0.250	2.625	0.226
52100026		PFB-R0250SA0250-S375	1	0.250	0.1250	3.750	1.125	0	4.5	2	0.250	2.625	0.226
52100027		PFB-R0250TPA0375-S375	2	0.250	0.1250	3.750	1.125	2	4.5	2	0.375	2.581	0.226
52100028		PFB-R0250TPA0375-S425	2	0.250	0.1250	4.250	1.500	1	6	2	0.375	2.697	0.226
52100029		PFB-R0375SA0375-S400	1	0.375	0.1875	4.000	0.937	0	2.5	2	0.375	3.063	0.336
52100001		PFB-R0375SA0375-S550	1	0.375	0.1875	5.500	1.687	0	4.5	2	0.375	3.813	0.336
52100030		PFB-R0375TPA0500-S500	2	0.375	0.1875	5.000	1.687	2	4.5	2	0.500	3.276	0.336
52100031		PFB-R0375TPA0500-S550	2	0.375	0.1875	5.500	2.250	1	6	2	0.500	3.200	0.336
52100032		PFB-R0500SA0500-S450	1	0.500	0.2500	4.500	1.250	0	2.5	2	0.500	3.250	0.461
52100002		PFB-R0500SA0500-S550	1	0.500	0.2500	5.500	2.250	0	4.5	2	0.500	3.250	0.461
52100033		PFB-R0500TPA0625-S550	2	0.500	0.2500	5.500	2.250	2	4.5	2	0.625	3.229	0.461
52100034		PFB-R0500TPA0625-S650	2	0.500	0.2500	6.500	3.000	1	6	2	0.625	3.461	0.461
52100035		PFB-R0625SA0625-S500	1	0.625	0.3125	5.000	1.562	0	2.5	2	0.625	3.438	0.546
52100003		PFB-R0625SA0625-S550	1	0.625	0.3125	5.500	2.500	0	4	2	0.625	3.000	0.546
52100036		PFB-R0625TPA0750-S600	2	0.625	0.3125	6.000	2.812	2	4.5	2	0.750	3.181	0.546
52100037		PFB-R0625TPA0750-S700	2	0.625	0.3125	7.000	3.750	1	6	2	0.750	3.222	0.546
52100038		PFB-R0750SA0750-S550	1	0.750	0.3750	5.500	1.875	0	2.5	2	0.750	3.625	0.671
52100004		PFB-R0750SA0750-S600	1	0.750	0.3750	6.000	3.000	0	4	2	0.750	3.000	0.671
52100039		PFB-R0750TPA1000-S650	2	0.750	0.3750	6.500	3.375	2	4.5	2	1.000	3.072	0.671
52100040		PFB-R0750TPA1000-S800	2	0.750	0.3750	8.000	4.500	1	6	2	1.000	3.420	0.671
52100005		PFB-R1000SA1000-S650	1	1.000	0.5000	6.500	3.000	0	3	2	1.000	3.500	0.882
52100041		PFB-R1000SA1000-S750	1	1.000	0.5000	7.500	4.000	0	4	2	1.000	3.500	0.882
52100042		PFB-R1000TPA1250-S800	2	1.000	0.5000	8.000	4.500	2	4.5	2	1.250	3.477	0.882
52100043		PFB-R1000TPA1250-S950	2	1.000	0.5000	9.500	6.000	1	6	2	1.250	3.442	0.882
52100016		PFB-R1250SA1250-S700	1	1.250	0.6250	7.000	3.750	0	3	2	1.250	3.250	1.132
52100044		PFB-R1250SA1250-S850	1	1.250	0.6250	8.500	5.000	0	4	2	1.250	3.500	1.132
52100045		PFB-R1250TPA1500-S900	2	1.250	0.6250	9.000	5.625	2	4.5	2	1.500	3.344	1.132
52100046		PFB-R1250TPA1500-S1100	2	1.250	0.6250	11.000	7.500	1	6	2	1.500	3.425	1.132
52100020	Cylindrical Shank Short Carbide	PFB-R0250SA0250-S325CS	1	0.250	0.1250	3.250	0.625	0	2.5	2	0.250	2.625	0.226
52100021		PFB-R0375SA0375-S400CS	1	0.375	0.1875	4.000	0.937	0	2.5	2	0.375	3.063	0.336
52100022		PFB-R0500SA0500-S450CS	1	0.500	0.2500	4.500	1.250	0	2.5	2	0.500	3.250	0.461
52100023		PFB-R0625SA0625-S550CS	1	0.625	0.3125	5.500	1.562	0	2.5	2	0.625	3.938	0.546
52100024		PFB-R0750SA0750-S600CS	1	0.750	0.3750	6.000	1.875	0	2.5	2	0.750	4.125	0.671
52100025		PFB-R1000SA1000-S650CS	1	1.000	0.5000	6.500	2.500	0	2.5	2	1.000	4.000	0.882
52100017		PFB-R1250SA1250-S700CS	1	1.250	0.6250	7.000	3.125	0	2.5	2	1.250	3.875	1.132
52100047	Cylindrical Shank Long Carbide	PFB-R0250SA0250-L400CS	1	0.250	0.1250	4.000	1.250	0	5	2	0.250	2.750	0.226
52100048		PFB-R0250TPA0375-L425CS	2	0.250	0.1250	4.250	1.500	1	6	2	0.375	2.697	0.226
52100006		PFB-R0375SA0375-L550CS	1	0.375	0.1875	5.500	1.875	0	5	2	0.375	3.625	0.336
52100049		PFB-R0375TPA0500-L550CS	2	0.375	0.1875	5.500	2.250	1	6	2	0.500	3.200	0.336
52100007		PFB-R0500SA0500-L550CS	1	0.500	0.2500	5.500	2.500	0	5	2	0.500	3.000	0.461
52100050		PFB-R0500TPA0625-L650CS	2	0.500	0.2500	6.500	3.000	1	6	2	0.625	3.461	0.461
52100008		PFB-R0625SA0625-L650CS	1	0.625	0.3125	6.500	3.125	0	5	2	0.625	3.375	0.546
52100051		PFB-R0625TPA0750-L700CS	2	0.625	0.3125	7.000	3.750	1	6	2	0.750	3.222	0.546
52100009		PFB-R0750SA0750-L700CS	1	0.750	0.3750	7.000	3.750	0	5	2	0.750	3.250	0.671
52100052		PFB-R0750TPA1000-L800CS	2	0.750	0.3750	8.000	4.500	1	6	2	1.000	3.420	0.671
52100010		PFB-R1000SA1000-L800CS	1	1.000	0.5000	8.000	4.500	0	4.5	2	1.000	3.500	0.882
52100053		PFB-R1000TPA1250-L950CS	2	1.000	0.5000	9.500	6.000	1	6	2	1.250	3.442	0.882
52100018		PFB-R1250SA1250-L900CS	1	1.250	0.6250	9.000	5.625	0	4.5	2	1.250	3.375	1.132
52100054		PFB-R1250TPA1500-L1100CS	2	1.250	0.6250	11.000	7.500	1	6	2	1.500	3.425	1.132

Packed: 1 pc.

PXT

List 52100 (Continued)

SPEED FEED P53

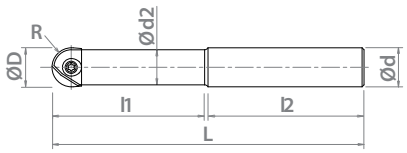
PFB SA (Inch)

EDP No.	Body Type	Designation	Type	Tool Dia. (inch)	Tool Radius (inch)	Overall Length (inch)	Neck Length (inch)	Taper	L/D Ratio	No. of Teeth	Shank Dia. (inch)	Shank Length (inch)	Neck Dia. (inch)
				D	R	L	l1	α°			d	l2	d2
52100055	Cylindrical Shank Extra-Long Carbide	PFB-R0250SA0250-LL450CS	1	0.250	0.1250	4.500	1.750	0	7	2	0.250	2.750	0.226
52100056		PFB-R0250TPA0375-LL475CS	2	0.250	0.1250	4.750	2.000	0.5	8	2	0.375	2.690	0.226
52100011		PFB-R0375SA0375-LL650CS	1	0.375	0.1875	6.500	2.625	0	7	2	0.375	3.875	0.336
52100057		PFB-R0375TPA0500-LL650CS	2	0.375	0.1875	6.500	3.000	0.5	8	2	0.500	3.440	0.336
52100012		PFB-R0500SA0500-LL700CS	1	0.500	0.2500	7.000	3.500	0	7	2	0.500	3.500	0.461
52100058		PFB-R0500TPA0625-LL750CS	2	0.500	0.2500	7.500	4.000	0.5	8	2	0.625	3.448	0.461
52100013		PFB-R0625SA0625-LL750CS	1	0.625	0.3125	7.500	3.750	0	6	2	0.625	3.750	0.546
52100059		PFB-R0625TPA0750-LL825CS	2	0.625	0.3125	8.250	5.000	0.5	8	2	0.750	3.206	0.546
52100014		PFB-R0750SA0750-LL900CS	1	0.750	0.3750	9.000	4.500	0	6	2	0.750	4.500	0.671
52100060		PFB-R0750TPA1000-LL950CS	2	0.750	0.3750	9.500	6.000	0.5	8	2	1.000	3.401	0.671
52100015		PFB-R1000SA1000-LL1050CS	1	1.000	0.5000	10.500	5.500	0	5.5	2	1.000	5.000	0.882
52100061		PFB-R1000TPA1250-LL1150CS	2	1.000	0.5000	11.500	8.000	0.5	8	2	1.250	3.416	0.882
52100019		PFB-R1250SA1250-LL1200CS	1	1.250	0.6250	12.000	6.875	0	5.5	2	1.250	5.125	1.132
52100062		PFB-R1250TPA1500-LL1350CS	2	1.250	0.6250	13.500	10.000	0.5	8	2	1.500	3.392	1.132

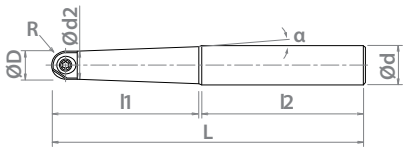
Packed: 1 pc.

PXT

Type 1



Type 2



List 78014

PFB SS (Metric)

SPEED FEED P53

Recommended Materials: p53
Accessories & Inserts: p49-51
Effective Cutting Diameter & Recommended Width of Cut: p52

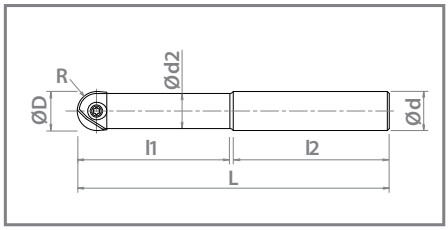
Steel Shank

Carbide Shank

EDP No.	Body Type	Designation	Tool Dia. (mm)	Tool Radius (mm)	Overall Length (mm)	Neck Length (mm)	L/D Ratio	No. of Teeth	Shank Dia. (mm)	Shank Length (mm)	Neck Dia. (mm)
			D	R	L	l1			d	l2	d2
7801400	Cylindrical Shank Steel	PFB-R080SS08-S120	8	4	120	36	4.5	2	8	84	7
7801401		PFB-R100SS10-S130	10	5	130	45	4.5	2	10	85	9
7801402		PFB-R120SS12-S130	12	6	130	54	4.5	2	12	76	11
7801403		PFB-R160SS16-S140	16	8	140	65	4	2	16	76	14
7801404		PFB-R200SS20-S160	20	10	160	80	4	2	20	80	18
7801405		PFB-R250SS25-S160	25	12.5	160	75	3	2	25	85	22
7801406		PFB-R300SS32-S170	30	15	170	90	3	2	32	80	27
7801407		PFB-R320SS32-S180	32	16	180	96	3	2	32	84	29
7801429	Cylindrical Shank Short Carbide	PFB-R060SS06-S80CS	6	3	80	15	2.5	2	6	65	5.4
7801430		PFB-R080SS08-S100CS	8	4	100	20	2.5	2	8	80	7
7801431		PFB-R100SS10-S100CS	10	5	100	25	2.5	2	10	75	9
7801432		PFB-R120SS12-S110CS	12	6	110	30	2.5	2	12	80	11
7801433		PFB-R160SS16-S140CS	16	8	140	40	2.5	2	16	100	14
7801434		PFB-R200SS20-S160CS	20	10	160	50	2.5	2	20	110	18
7801435		PFB-R250SS25-S160CS	25	12.5	160	62.5	2.5	2	25	97.5	22
7801436		PFB-R300SS32-S170CS	30	15	170	75	2.5	2	32	95	27
7801437		PFB-R320SS32-S180CS	32	16	180	80	2.5	2	32	100	29
7801439	Cylindrical Shank Long Carbide	PFB-R060SS06-L100CS	6	3	100	30	5.0	2	6	70	5.4
7801440		PFB-R080SS08-L120CS	8	4	120	40	5.0	2	8	80	7
7801441		PFB-R100SS10-L130CS	10	5	130	50	5.0	2	10	80	9
7801442		PFB-R120SS12-L140CS	12	6	140	60	5.0	2	12	80	11
7801443		PFB-R160SS16-L160CS	16	8	160	72	4.5	2	16	88	14
7801444		PFB-R200SS20-L180CS	20	10	180	90	4.5	2	20	90	18
7801445		PFB-R250SS25-L200CS	25	12.5	200	100	4	2	25	100	22
7801446		PFB-R300SS32-L220CS	30	15	220	120	4	2	32	100	27
7801447		PFB-R320SS32-L230CS	32	16	230	128	4	2	32	102	29
7801419	Cylindrical Shank Extra-Long Carbide	PFB-R060SS06-LL120CS	6	3	120	42	7	2	6	78	5.4
7801420		PFB-R080SS08-LL140CS	8	4	140	56	7	2	8	84	7
7801421		PFB-R100SS10-LL150CS	10	5	150	70	7	2	10	80	9
7801422		PFB-R120SS12-LL160CS	12	6	160	84	7	2	12	76	11
7801423		PFB-R160SS16-LL200CS	16	8	200	96	6	2	16	104	14
7801424		PFB-R200SS20-LL240CS	20	10	240	120	6	2	20	120	18
7801425		PFB-R250SS25-LL260CS	25	12.5	260	137.5	5.5	2	25	122.5	22
7801426		PFB-R300SS32-LL290CS	30	15	290	165	5.5	2	32	125	27
7801427		PFB-R320SS32-LL300CS	32	16	300	176	5.5	2	32	124	29

Packed: 1 pc.

PXT

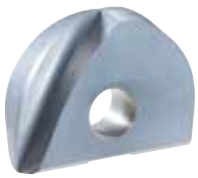


List 78PFB

PFB Inserts (Inch)

Spiral

Spiral (Full Radius)



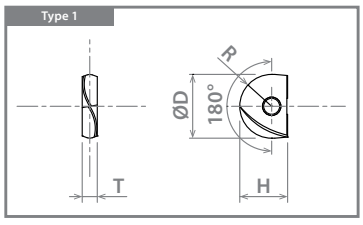
Spiral (Strengthened Edge)

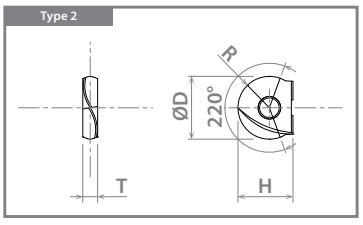
Spiral (Diamond Coated)

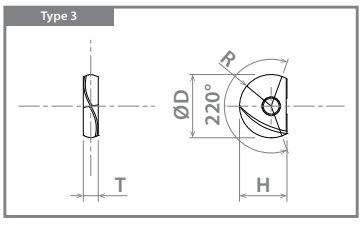
Designation	Type	Specification	No. of Cutting Edges	Range	Insert Size				EDP Number			
					D (inch)	R (inch)	T (mm)	H (mm)	XP3225	XP3310	XP3320	XC4505
PFB0250A-SP	1	Spiral	2	180°	0.250	0.125	2	5.175	52101020	-	52101010	-
PFB0375A-SP					0.375	0.1875	2.6	8.5	52101021	-	52101011	-
PFB0500A-SP					0.500	0.2500	3	10	52101022	-	52101012	-
PFB0625A-SP					0.625	0.3125	4	12	52101023	-	52101013	-
PFB0750A-SP					0.750	0.3750	5	15	52101024	-	52101014	-
PFB1000A-SP					1.000	0.5000	6	18.5	52101025	-	52101015	-
PFB1250A-SP					1.250	0.6250	7	23.5	52101026	-	52101016	-
PFB0250A-Q	2	Spiral (Full Radius)	2	220°	0.250	0.125	2	5.175	52101040	-	-	-
PFB0375A-Q					0.375	0.1875	2.6	8.5	52101041	-	-	-
PFB0500A-Q					0.500	0.2500	3	10	52101042	-	-	-
PFB0625A-Q	3				0.625	0.3125	4	12	52101043	-	-	-
PFB0750A-Q					0.750	0.3750	5	15	52101044	-	-	-
PFB1000A-Q					1.000	0.5000	6	18.5	52101045	-	-	-
PFB1250A-Q					1.250	0.6250	7	23.5	52101046	-	-	-
PFB0250A-SH	2	Spiral (Strengthened Edge)	2	220°	0.250	0.125	2	5.175	-	52101030	-	-
PFB0375A-SH	1			180°	0.375	0.1875	2.6	8.5	-	52101031	-	-
PFB0500A-SH					0.500	0.2500	3	10	-	52101032	-	-
PFB0625A-SH					0.625	0.3125	4	12	-	52101033	-	-
PFB0750A-SH					0.750	0.3750	5	15	-	52101034	-	-
PFB1000A-SH					1.000	0.5000	6	18.5	-	52101035	-	-
PFB1250A-SH					1.250	0.6250	7	23.5	-	52101036	-	-
PFB0250A-D	2	Spiral (Diamond Coated)	2	220°	0.250	1.250	2	5.175	-	-	-	52101000
PFB0375A-D	1			180°	0.375	0.1875	2.6	8.5	-	-	-	52101001
PFB0500A-D					0.500	0.2500	3	10	-	-	-	52101002
PFB0625A-D					0.625	0.3125	4	12	-	-	-	52101003
PFB0750A-D					0.750	0.3750	5	15	-	-	-	52101004
PFB1000A-D					1.000	0.5000	6	18.5	-	-	-	52101005
PFB1250A-D					1.250	0.6250	7	23.5	-	-	-	52101006

Packed: 1 pc.

PXI







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List 78PFB (Continued)

PFB Inserts (Metric)

Spiral

Spiral (Full Radius)

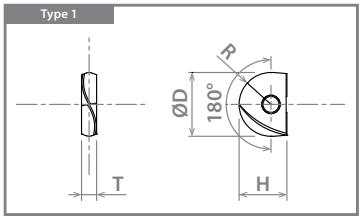
Spiral (Strengthened Edge)

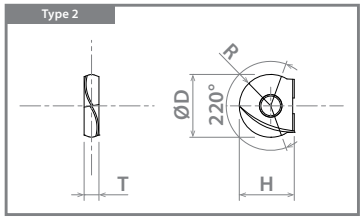
Spiral (Diamond Coated)

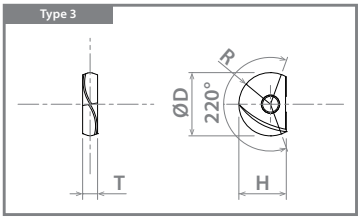
Designation	Type	Specification	No. of Cutting Edges	Range	Insert Size				EDP Number			
					D (mm)	R (mm)	T (mm)	H (mm)	XP3225	XP3310	XP3320	XC4505
PFB080-SP	1	Spiral	2	180°	8	4	2.4	7	7820030	-	7820010	-
PFB100-SP					10	5	2.6	8.5	7820031	-	7820011	-
PFB120-SP					12	6	3	10	7820032	-	7820012	-
PFB160-SP					16	8	4	12	7820033	-	7820013	-
PFB200-SP					20	10	5	15	7820034	-	7820014	-
PFB250-SP					25	12.5	6	18.5	7820035	-	7820015	-
PFB300-SP					30	15	7	22.5	7820036	-	7820016	-
PFB060-Q	2	Spiral (Full Radius)	2	220°	6	3	2	5	7820048	-	-	-
PFB070-Q					7	3.5	2	5.5	7820049	-	-	-
PFB080-Q					8	4	2.4	7	7820050	-	-	-
PFB100-Q					10	5	2.6	8.5	7820051	-	-	-
PFB120-Q					12	6	3	10	7820052	-	-	-
PFB160-Q	3				16	8	4	12	7820053	-	-	-
PFB200-Q					20	10	5	15	7820054	-	-	-
PFB250-Q					25	12.5	6	18.5	7820055	-	-	-
PFB300-Q					30	15	7	22.5	7820056	-	-	-
PFB060-SH	2	Spiral (Strengthened Edge)	2	220°	6	3	2	5	-	7820039	-	-
PFB080-SH	1			180°	8	4	2.4	7	-	7820040	-	-
PFB100-SH					10	5	2.6	8.5	-	7820041	-	-
PFB120-SH					12	6	3	10	-	7820042	-	-
PFB160-SH					16	8	4	12	-	7820043	-	-
PFB200-SH					20	10	5	15	-	7820044	-	-
PFB250-SH					25	12.5	6	18.5	-	7820045	-	-
PFB300-SH					30	15	7	22.5	-	7820046	-	-
PFB320-SH					32	16	7	23.5	-	7820047	-	-
PFB060-D	2	Spiral (Diamond Coated)	2	220°	6	3	2	5	-	-	-	7820018
PFB070-D					7	3.5	2	5.5	-	-	-	7820019
PFB080-D	1			180°	8	4	2.4	7	-	-	-	7820020
PFB100-D					10	5	2.6	8.5	-	-	-	7820021
PFB120-D					12	6	3	10	-	-	-	7820022
PFB160-D					16	8	4	12	-	-	-	7820023
PFB200-D					20	10	5	15	-	-	-	7820024
PFB250-D					25	12.5	6	18.5	-	-	-	7820025
PFB300-D					30	15	7	22.5	-	-	-	7820026

Packed: 1 pc.

PXI

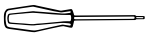






List 7808H

PFB Accessories

Appearance	EDP No.	Designation	Applicable Insert		Recommended Tightening Torque
			(inch)	(mm)	
 Clamping Screw	7808124	FS20652RB (Torx 6)	0.250	6-7	0.8 Nm
	7808123	FS25669RB (Torx 7)	-	8	1.0 Nm
	7808117	FS30686RB (Torx 8)	0.375	10	1.2 Nm
	7808118	FS35610RB (Torx 10)	0.500	12	2.0 Nm
	7808119	FS40613RB (Torx 15)	0.625	16	3.0 Nm
	7808120	FS50615RB (Torx 20)	0.750	20	5.0 Nm
	7808121	FS60620RB (Torx 20)	1.000	25	5.0 Nm
	7808122	FS80624RB (Torx 30)	1.250	30-32	6.0 Nm
 Wrench	7808203	T6-D (Torx 6)	0.250	6-7	
	7808204	T7-D (Torx 7)	-	8	
	7808205	T8-D (Torx 8)	0.375	10	
	7808207	T10-D (Torx 10)	0.500	12	
	7808208	T15-D (Torx 15)	0.625	16	
	7808209	T20-D (Torx 20)	0.750-1.000	20-25	
	7808212	T30-T (Torx 30)	1.250	30-32	

Packed: Clamping Screw = 1 pc.; Wrench = 1 pc.
Note: Wrench sold separately.

PXT

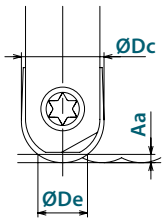
Effective Cutting Diameter

Depth of Cut Aa		Effective Cutting Diameter (ØDe)																			
		ØDc		ØDc		ØDc		ØDc		ØDc		ØDc		ØDc		ØDc		ØDc		ØDc	
(inch)	(mm)	0.250"	6mm	0.275"	7mm	0.315"	8 mm	0.375"	10 mm	0.500"	12 mm	0.625"	16 mm	0.750"	20 mm	1.000"	25 mm	1.181"	30 mm	1.250"	32mm
0.004	0.1	0.063	1.5	0.063	1.6	0.071	1.8	0.077	2.0	0.089	2.2	0.100	2.5	0.109	2.8	0.126	3.2	0.137	3.5	0.142	3.6
0.008	0.2	0.088	2.2	0.091	2.3	0.099	2.5	0.108	2.8	0.125	3.1	0.141	3.6	0.154	4.0	0.178	4.5	0.194	4.9	0.197	5.0
0.012	0.3	0.107	2.6	0.110	2.8	0.121	3.0	0.132	3.4	0.153	3.7	0.172	4.3	0.188	4.9	0.218	5.4	0.237	6.0	0.244	6.2
0.016	0.4	0.122	3.0	0.130	3.3	0.138	3.5	0.152	3.9	0.176	4.3	0.197	5.0	0.217	5.6	0.251	6.3	0.273	6.9	0.280	7.1
0.020	0.5	0.136	3.3	0.142	3.6	0.154	3.9	0.169	4.4	0.196	4.8	0.220	5.6	0.242	6.2	0.280	7.0	0.305	7.7	0.311	7.9
0.031	0.8	0.165	4.1	0.177	4.5	0.188	4.8	0.207	5.4	0.241	6.0	0.271	7.0	0.299	7.8	0.347	8.8	0.378	9.7	0.394	10.0
0.039	1.0	-	-	-	-	-	-	0.229	6.0	0.268	6.6	0.302	7.7	0.333	8.7	0.387	9.8	0.422	10.8	0.437	11.1
0.059	1.5	-	-	-	-	-	-	0.273	7.1	0.323	7.9	0.365	9.3	0.404	10.5	0.471	11.9	0.515	13.1	0.531	13.5
0.079	2.0	-	-	-	-	-	-	-	-	0.365	8.9	0.415	10.6	0.460	12.0	0.539	13.6	0.590	15.0	0.610	15.5
0.098	2.5	-	-	-	-	-	-	-	-	-	-	0.455	11.6	0.506	13.2	0.595	15.0	0.652	16.6	0.677	17.2
0.118	3.0	-	-	-	-	-	-	-	-	-	-	-	-	0.546	14.3	0.645	16.2	0.708	18.0	0.736	18.7
0.138	3.5	-	-	-	-	-	-	-	-	-	-	-	-	0.581	15.2	0.690	17.3	0.759	19.3	0.787	20.0
0.157	4.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.728	18.3	0.802	20.4	0.835	21.2
0.117	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.706	21.4	0.874	22.2
0.197	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.881	22.3	0.913	23.2

Note: Effective cutting diameter is based on cutting depth (Aa)

How to determine effective cutting diameter:

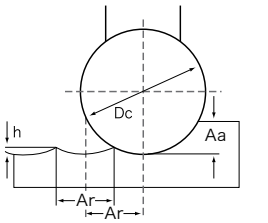
Ex: Dc = 0.500"
Aa = 0.020"
De = 2√0.020(0.500-0.020)
De = 0.196"



$$De=2\sqrt{a_a(D_c-a_a)}$$

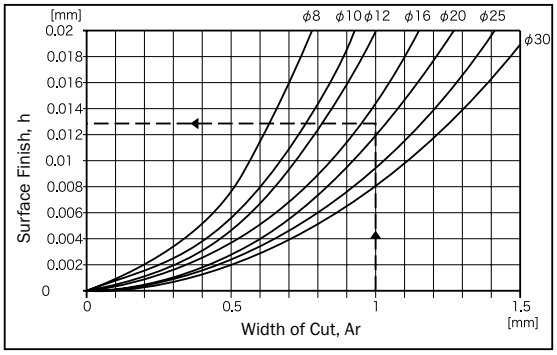
Recommended Width of Cut & Surface Roughness

Tool Dia ØDc		Width of Cut Ar		Surface Roughness h	
(inch)	(mm)	(inch)	(mm)	(inch)	(mm)
0.250	6	0.0157	0.4	0.00027	0.007
0.275	7	0.0177	0.45	0.00027	0.007
0.315	8	0.0197	0.5	0.00031	0.008
0.375	10	0.0236	0.6	0.00037	0.009
0.500	12	0.0275	0.7	0.00038	0.010
0.625	16	0.0315	0.8	0.00040	0.010
0.750	20	0.0394	1.0	0.00052	0.012
1.000	25	0.0472	1.2	0.00055	0.014
1.181	30	0.0512	1.3	0.00055	0.014
1.250	32	0.0551	1.4	0.00059	0.015



$$h=0.5\ (Dc-\sqrt{Dc^2-Ar^2})$$

Dc=20mm
Ar=1mm
->h=0.0125mm



Cutting Conditions

Work Material		Tensile Strength – Hardness	Milling Speed Vc (SFM)	Depth of Cut Aa (in)	Feed Per Tooth fz (in/t)			
					Ø0.236-0.312 (6-8mm)	Ø0.375-0.500 (10-12mm)	Ø0.625-0.750 (16-20mm)	Ø1.000-1.250 (25-32mm)
P	Mild Steels, Carbon Steels (1010, 1018)	~180 HB	985 (655-1310)	0.02Dc	0.0040	0.0047	0.0055	0.0071
	Carbon Steels, Alloy Steels (1050, 4140)	~280 HB	985 (655-1310)	0.02Dc	0.0028	0.0040	0.0047	0.0055
	Die Steels (H13, D2)	~280 HB	820 (495-1150)	0.02Dc	0.0028	0.0040	0.0047	0.0055
M	Stainless Steels (304SS, 420SS)	~250 HB	820 (495-1150)	0.02Dc	0.0028	0.0047	0.0055	0.0067
K	Cast Iron (FC250)	~350 N/mm²	1310 (985-1640)	0.02Dc	0.0047	0.0055	0.0071	0.0086
	Ductile Cast Iron (60-40-18)	~600 N/mm²	985 (655-1310)	0.02Dc	0.0040	0.0047	0.0055	0.0071
N	Aluminum Alloys (6061, 7075)	~13% Si	1640 (1310-1970)	0.03Dc	0.0047	0.0055	0.0071	0.0086
	Copper Alloys (C1100)	-	985 (655-1310)	0.03Dc	0.0043	0.0051	0.0067	0.0079
	Graphite	-	1640 (1310-1970)	0.03Dc	0.0055	0.0067	0.0083	0.0098
	CFRP	-	1310 (985-1640)	0.03Dc	0.0043	0.0051	0.0067	0.0079
S	Heat Resistant Alloys (Inconel 718)	-	165 (65-260)	0.015Dc	0.0016	0.0020	0.0024	0.0024
	Titanium Alloy (Ti-6Al-4V)	-	295 (130-395)	0.02Dc	0.0024	0.0031	0.0043	0.0051
H	Pre-hardened Steel (P20, Stavax)	40 - 43 HRC	655 (330-985)	0.015Dc	0.0024	0.0028	0.0031	0.0040
	Die Cast Steels (A2, S7)	43 - 48 HRC	590 (295-655)	0.015Dc	0.0020	0.0024	0.0028	0.0028
	Hardened Steels (D2)	50 - 55 HRC	490 (330-820)	0.01Dc	0.0020	0.0024	0.0028	0.0028

Recommended Materials by Application

Insert Grade	P	M	K	N	S	H
XP3225	◎	◎		◎*	○	
XP3310			◎			◎
XP3320	○	○	○		◎	○
XC4505				◎**		

*: Best recommended for aluminum & copper alloy applications.
**: Best recommended for graphite & CFRP applications.

○ good ◎ best

Special Drilling Tools

Spacematic Drill/Countersink

Carbide drill and countersink with internal thread and 60° cone seat straight shank style with pin spanner wrench holes or optional wrench flats for slotted type drill wrenches.
Application: Spacematic Drill motors with 1″ stroke.

Drivematic Drill/Countersink

Carbide drill and countersink with solid shank used in aerospace drivematic drill riveting machines.

Dagger Drill

Designed to produce holes in composite materials without delamination around the hole or fraying the composite materials.

Threaded Hex Shank Adapter Drill

Carbide adapter drill manufactured to NAS 907 construction with 135° split points. Used for general to medium duty drilling in low tensile strength materials in confined areas.

Jobbers Length Double Margin Step Drill

Carbide drill with 135° split point. Used for drilling close tolerance holes in low tensile strength materials. Can also be supplied in taper, screw machine lengths or special lengths.

Nutplate Drill/Countersink

Carbide drill and countersink with 135° split point. External thread and 60° cone seat straight shank style with pin spanner wrench holes.
Application: Nutplate and motors with nutplate pressure foot attachments.

Special Milling Tools

Circular Milling Tool

The circular milling tool excels in hole machining utilizing helical interpolation. This tool can produce excellent quality holes in CF/Ti and CF/AL stack materials with an extremely high level of hole circularity. Chipping and burr formation in both metallic and composite structures are also reduced.

Electroplated Diamond Drill/Mill

The electroplated diamond drill can be used in various applications ranging from drilling through and blind holes to side and contour grinding.

Special Threading Tools

Electroplated Thread Mill (Thermosetting Plastics)

The electroplated thread mill is for grinding internal threads and composites.

Thread Mill & Tap (Thermoplastics)

Tapping and thread milling of composites is uncommon. Some composites are capable of being tapped or thread milled. In such cases, OSG can offer special-made tooling for these applications.

shaping your dreams

Safe use of cutting tools

- Use safety cover, safety glasses and safety shoes during operation.
- Do not touch cutting edges with bare hands.
- Do not touch cutting chips with bare hands. Chips will be hot after cutting.
- Stop cutting when the tool becomes dull.
- Stop cutting operation immediately if you hear any abnormal cutting sounds.
- Do not modify tools.
- Please use appropriate tools for the operation. Check dimensions to ensure proper selection.

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