



Industry Solutions for Nickel Alloy Materials & Hardened Steels

Vol 3

Nickel Alloy Solutions



Nickel Alloy Solutions

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EXOPRO® UVX-Ni



EXOPRO® UVX-Ni



EXOTAP® VC-10

With more demand to machine nickel-based alloys, OSG has developed the EXOPRO[®] WHO-Ni 3D & 5D carbide drill series. A total solution for drilling nickel-based heat-resistant alloys.



Sharp Cutting Edge

Suppresses Heat Generation



The EXOPRO[®] WHO-Ni 3D & 5D Carbide Drills are engineered with sharper cutting edges for drilling nickel-based alloys. The sharp cutting edges are designed to suppress the generation of heat during machining and promotes the stable creation of cutting chips.

High Rigidity

A Low Helix Angle Results in High Precision Drilling

A low helix angle has been used for the flutes to attain high tool rigidity and to make the machining of high precision holes possible.

Great Chip Evacuation

For Stable Drilling

The WHO-Ni 3D & 5D Carbide Drills are able to produce small cutting chips to enable trouble-free chip evacuation and stable drilling.



Excellent Wear Resistance

WXS[®] Coating Provides Long and Stable Tool Life

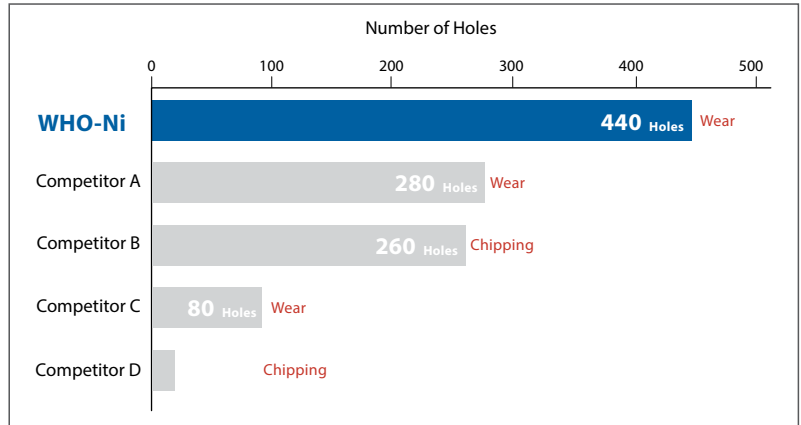
The incredible high hardness and heat resistance of OSG's WXS[®] coating, coupled with internally-fed coolant, ensures long, stable tool life.

1.5 Times Longer Tool Life vs. Competitors

Inconel 718

The highly rigid body and sharp cutting edge are coated with OSG's WXS[®] coating and achieved 40% more life versus the closest competitor.

Tool	WHO-Ni 3D	Competitors
Drill Size	Ø6mm	
Work Material	Inconel 718 (43 HRC)	
Cutting Speed	98 SFM (1,592 RPM)	
Feed Rate	5.63 IPM (0.0035 IPR)	
Depth of Hole	18 mm (Blind, No Step)	
Coolant	Water Soluble (Internal)	
Machine	Vertical Machining Center	



Wear after drilling 440 holes.

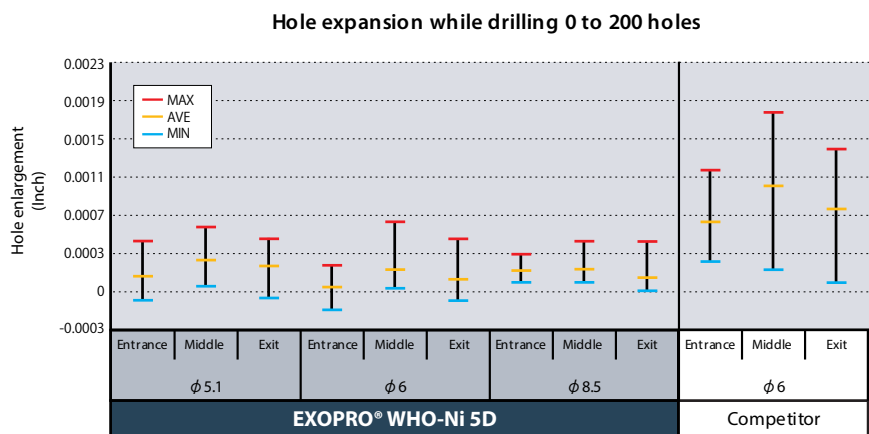


Suppression of Hole Enlargement

Inconel 718

With a highly rigid flute form, the WHO-Ni is able to suppress the enlargement of holes of every size in a stable manner. This allows these tools to be used for machining precision holes.

Tool	WHO-Ni 5D	Competitor
Drill Size	ØVar	
Work Material	Inconel 718 (43 HRC)	
Cutting Speed	98 SFM	
Feed Rate	1.5% D = IPR	
Depth of Hole	3D (Blind)	
Coolant	Water Soluble (Internal)	
Machine	Vertical Machining Center	



List 5950Ni

WHO55-3D, Coolant-Through



SPEED FEED P10	CARBIDE	WXS		12-20°	SHANK h6
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Cutting Diameter Tolerance (h8)		
Size	mm	inch
D=3	+0 / -0.014	+0 / -0.0006
3<D≤6	+0 / -0.018	+0 / -0.0007
6<D≤10	+0 / -0.022	+0 / -0.0009
10<D≤12.7	+0 / -0.027	+0 / -0.0011

EDP Number	Diameter					Flute Length FL	Overall Length L	Shank Diameter d
	Fractional Size	Wire Gage	Letter Size	mm	Inch			
595011811	-	-	-	3.00	0.1181	20	62	6
595012511	1/8	-	-	3.18	0.1250			
595013011	-	-	-	3.30	0.1299			
595013411	-	-	-	3.40	0.1339			
595013711	-	-	-	3.49	0.1374			
595013811	-	-	-	3.50	0.1378			
595013911	-	-	-	3.51	0.1382			
595014211	-	-	-	3.60	0.1417			
595014611	-	-	-	3.70	0.1457			
595015011	-	25	-	3.80	0.1496			
595015411	-	-	-	3.90	0.1535			
595015611	5/32	-	-	3.97	0.1563			
595015711	-	-	-	4.00	0.1575			
595016111	-	-	-	4.10	0.1614			
595016311	-	-	-	4.15	0.1634			
595016511	-	-	-	4.20	0.1654			
595016911	-	-	-	4.30	0.1693			
595017111	11/64	-	-	4.37	0.1719			
595017311	-	-	-	4.40	0.1732			
595017711	-	16	-	4.50	0.1772			
595018111	-	-	-	4.60	0.1811			
595018511	-	13	-	4.70	0.1850			
595018711	3/16	-	-	4.76	0.1875			
595018911	-	12	-	4.80	0.1890			
595019311	-	-	-	4.90	0.1929			
595019711	-	-	-	5.00	0.1969			
595020111	-	-	-	5.10	0.2008			
595020311	13/64	-	-	5.16	0.2031			
595020511	-	-	-	5.20	0.2047			
595020611	-	-	-	5.22	0.2055			
595020911	-	-	-	5.30	0.2087			
595021311	-	-	-	5.40	0.2126			
595021711	-	-	-	5.50	0.2165			
595021611	-	-	-	5.53	0.2177			
595021811	7/32	-	-	5.56	0.2188			
595021911	-	-	-	5.56	0.2189			
595022011	-	-	-	5.60	0.2205			
595022411	-	-	-	5.70	0.2244			
595022811	-	-	-	5.80	0.2283			
595023211	-	-	-	5.90	0.2323			
595023411	15/64	-	-	5.95	0.2344			
595023611	-	-	-	6.00	0.2362			
595025011	1/4	-	-	6.35	0.2500			
595025611	-	-	-	6.50	0.2559			
595026211	-	-	-	6.65	0.2618			
595026511	17/64	-	-	6.75	0.2656			
595026811	-	-	-	6.80	0.2677			
595027411	-	-	-	6.96	0.2740			
595027611	-	-	-	7.00	0.2756			
595028111	9/32	-	-	7.15	0.2813			
595029511	-	-	-	7.50	0.2953			
595029611	19/64	-	-	7.54	0.2969			
595030711	-	-	-	7.80	0.3071			
595031211	5/16	-	-	7.94	0.3125			
595031511	-	-	-	8.00	0.3150			

Packed: 1 pc.
Available WXS[®] Coating Only.



List 5950Ni (Continued)

WHO55-3D, Coolant-Through



EDP Number	Diameter					Flute Length FL	Overall Length L	Shank Diameter d
	Fractional Size	Wire Gage	Letter Size	mm	Inch			
595031711	-	-	-	8.04	0.3165	41	101	10
595032811	21/64	-	-	8.33	0.3281	43		
595033411	-	-	-	8.50	0.3346	44		
595033511	-	-	-	8.52	0.3354			
595033811	-	-	-	8.58	0.3378			
595034211	-	-	-	8.70	0.3425			
595034311	11/32	-	-	8.73	0.3438	45		
595034611	-	-	-	8.80	0.3465			
595035411	-	-	-	9.00	0.3543	46		
595035911	23/64	-	-	9.13	0.3594			
595037011	-	-	-	9.39	0.3697	48		
595037411	-	-	-	9.50	0.3740			
595037511	3/8	-	-	9.53	0.3750	49		
595038611	-	-	W	9.80	0.3858		106	12
595038911	-	-	-	9.90	0.3898			
595039011	25/64	-	-	9.92	0.3906	50		
595039311	-	-	-	9.97	0.3925			
595039411	-	-	-	10.00	0.3937	53		
595040511	-	-	-	10.30	0.4055			
595040611	13/32	-	-	10.32	0.4063	55		
595041311	-	-	-	10.50	0.4134			
595042211	27/64	-	-	10.72	0.4219	56		
595042511	-	-	-	10.80	0.4252			
595042611	-	-	-	10.83	0.4264			
595043311	-	-	-	11.00	0.4331	58		
595043711	7/16	-	-	11.11	0.4375			
595045211	-	-	-	11.47	0.4516	59		
595045411	-	-	-	11.50	0.4528			
595045311	29/64	-	-	11.51	0.4531	60		
595045511	-	-	-	11.56	0.4551			
595046511	-	-	-	11.80	0.4646	63		
595046811	15/32	-	-	11.91	0.4688			
595047211	-	-	-	12.00	0.4724	65		
595048411	31/64	-	-	12.30	0.4844			
595050011	1/2	-	-	12.70	0.5000			

Packed: 1 pc.
Available WXS[®] Coating Only.



List No.	Work Material																
	P					M			K	N		S		H			
	Carbon Steels			Alloy Steels	Die Steels	Stainless Steels			Cast Iron	Aluminum		Nickel Alloy	Titanium	Hardened Steels			
	Low	Med.	High				300	400		17-4 PH				6061	Casting	Inconel	6Al4V (30 HRC)
5950Ni	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>				<input type="checkbox"/>			<input checked="" type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

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List 5955Ni

WHO55-5D, Coolant-Through



SPEED FEED	CARBIDE	WXS	12-20°	SHANK h6
P10				

Cutting Diameter Tolerance (h8)		
Size	mm	inch
D=3	+0 / -0.014	+0 / -0.0006
3<D≤6	+0 / -0.018	+0 / -0.0007
6<D≤10	+0 / -0.022	+0 / -0.0009
10<D≤12.7	+0 / -0.027	+0 / -0.0011

EDP Number	Diameter					Flute Length FL	Overall Length L	Shank Diameter d
	Fractional Size	Wire Gage	Letter Size	mm	Inch			
595511811	-	-	-	3.00	0.1181	29	78	6
595512511	1/8	-	-	3.18	0.1250			
3316330	-	-	-	3.30	0.1299			
3316340	-	-	-	3.40	0.1339			
3316349	-	-	-	3.49	0.1374			
3316350	-	-	-	3.50	0.1378			
595513911	-	-	-	3.51	0.1382			
3316360	-	-	-	3.60	0.1417			
3316370	-	-	-	3.70	0.1457			
3316380	-	25	-	3.80	0.1496			
3316390	-	-	-	3.90	0.1535			
595515611	5/32	-	-	3.97	0.1563			
3316400	-	-	-	4.00	0.1575			
3316410	-	-	-	4.10	0.1614			
3316415	-	-	-	4.15	0.1634			
3316420	-	-	-	4.20	0.1654			
3316430	-	-	-	4.30	0.1693			
595517111	11/64	-	-	4.37	0.1719			
3316440	-	-	-	4.40	0.1732			
3316450	-	16	-	4.50	0.1772			
3316460	-	-	-	4.60	0.1811			
3316470	-	13	-	4.70	0.1850			
595518711	3/16	-	-	4.76	0.1875			
3316480	-	12	-	4.80	0.1890			
3316490	-	-	-	4.90	0.1929			
3316500	-	-	-	5.00	0.1969			
3316510	-	-	-	5.10	0.2008			
595520311	13/64	-	-	5.16	0.2031			
3316520	-	-	-	5.20	0.2047			
595520611	-	-	-	5.22	0.2055			
3316530	-	-	-	5.30	0.2087			
3316540	-	-	-	5.40	0.2126			
3316550	-	-	-	5.50	0.2165			
595521611	-	-	-	5.53	0.2177			
595521811	7/32	-	-	5.56	0.2188			
3316556	-	-	-		0.2189			
3316560	-	-	-	5.60	0.2205			
3316570	-	-	-	5.70	0.2244			
3316580	-	-	-	5.80	0.2283			
3316590	-	-	-	5.90	0.2323			
595523411	15/64	-	-	5.95	0.2344			
3316600	-	-	-	6.00	0.2362			
595525011	1/4	-	-	6.35	0.2500			
3316650	-	-	-	6.50	0.2559			
595526211	-	-	-	6.65	0.2618			
595526511	17/64	-	-	6.75	0.2656			
3316680	-	-	-	6.80	0.2677			
595527411	-	-	-	6.96	0.2740			
3316700	-	-	-	7.00	0.2756			
595528111	9/32	-	-	7.14	0.2813			
3316750	-	-	-	7.50	0.2953			
595529611	19/64	-	-	7.54	0.2969			
3316780	-	-	-	7.80	0.3071			
595531211	5/16	-	-	7.94	0.3125			
3316800	-	-	-	8.00	0.3150			

Packed: 1 pc.
Available WXS® Coating Only.



List 5955Ni (Continued)

WHO55-5D, Coolant-Through



EDP Number	Diameter					Flute Length FL	Overall Length L	Shank Diameter d
	Fractional Size	Wire Gage	Letter Size	mm	Inch			
595531711	-	-	-	8.04	0.3165	66	128	10
595532811	21/64	-	-	8.33	0.3281	68		
3316850	-	-	-	8.50	0.3346	70		
595533511	-	-	-	8.52	0.3354			
3316858	-	-	-	8.58	0.3378			
3316870	-	-	-	8.70	0.3425			
595534311	11/32	-	-	8.73	0.3438			
3316880	-	-	-	8.80	0.3465	72		
3316900	-	-	-	9.00	0.3543	74		
595535911	23/64	-	-	9.13	0.3594			
595537011	-	-	-	9.39	0.3697	76		
3316950	-	-	-	9.50	0.3740	78		
595537511	3/8	-	-	9.53	0.3750			
3316980	-	-	W	9.80	0.3858	80		
595538911	-	-	-	9.90	0.3898			
595539011	25/64	-	-	9.92	0.3906			
3316997	-	-	-	9.97	0.3925	84		
3317000	-	-	-	10.00	0.3937			
3317030	-	-	-	10.30	0.4055	88		
595540611	13/32	-	-	10.32	0.4063			
3317050	-	-	-	10.50	0.4134	90		
595542211	27/64	-	-	10.72	0.4219			
3317080	-	-	-	10.80	0.4252	92		
595542611	-	-	-	10.83	0.4264			
3317100	-	-	-	11.00	0.4331	94		
595543711	7/16	-	-	11.11	0.4375			
595545211	-	-	-	11.47	0.4516	96		
3317150	-	-	-	11.50	0.4528			
595545311	29/64	-	-	11.51	0.4531	100		
3317156	-	-	-	11.56	0.4551			
3317180	-	-	-	11.80	0.4646	104		
595546811	15/32	-	-	11.91	0.4688			
3317200	-	-	-	12.00	0.4724	167		
595548411	31/64	-	-	12.30	0.4844			
595550011	1/2	-	-	12.70	0.5000	14		

Packed: 1 pc.
Available WXS[®] Coating Only.



List No.	Work Material																
	P					M			K	N		S		H			
	Carbon Steels			Alloy Steels	Die Steels	Stainless Steels			Cast Iron	Aluminum		Nickel Alloy	Titanium	Hardened Steels			
	Low	Med.	High				300	400		17-4 PH		6061	Casting	Inconel	6Al4V (30 HRC)	~35 HRC	35-45 HRC
5955Ni	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>				<input type="checkbox"/>			<input checked="" type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

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List 5950Ni-EXOPRO® WHO-Ni: 3D

List 5955Ni-EXOPRO® WHO-Ni: 5D

General Drilling Operations

Work Material		Carbon Steels, Mild Steels 1010, 1050, 12L14		Alloy Steels 4140, 4130		Cast Iron		Ductile Cast Iron		Ni-Base Material, Inconel 38-43 HRC	
Drilling Speed		260-395 SFM		260-395 SFM		260-395 SFM		195-330 SFM		35-100 SFM	
Drill Dia.		Speed RPM	Feed IPR	Speed RPM	Feed IPR	Speed RPM	Feed IPR	Speed RPM	Feed IPR	Speed RPM	Feed IPR
mm	Inch										
3	-	10,600	0.002-0.005	10,600	0.002-0.005	10,600	0.002-0.005	8,500	0.002-0.005	2,100	0.001-0.002
-	1/8	10,000	0.002-0.005	10,000	0.002-0.005	10,000	0.002-0.005	8,000	0.002-0.005	1,900	0.001-0.002
4	-	8,000	0.003-0.006	8,000	0.003-0.006	8,000	0.003-0.006	6,400	0.003-0.006	1,600	0.001-0.003
-	3/16	6,400	0.004-0.008	6,400	0.004-0.008	6,400	0.004-0.008	5,100	0.004-0.008	1,300	0.002-0.004
6	-	5,300	0.005-0.009	5,300	0.005-0.009	5,300	0.005-0.009	4,200	0.005-0.009	1,100	0.002-0.005
-	1/4	5,100	0.005-0.009	5,100	0.005-0.009	5,100	0.005-0.009	4,000	0.005-0.009	1,100	0.002-0.005
8	-	4,000	0.006-0.011	4,000	0.006-0.011	4,000	0.006-0.011	3,200	0.006-0.011	800	0.003-0.006
-	3/8	3,400	0.007-0.012	3,400	0.007-0.012	3,400	0.007-0.012	2,700	0.007-0.012	650	0.003-0.007
10	-	3,200	0.008-0.012	3,200	0.008-0.012	3,200	0.008-0.012	2,500	0.008-0.012	600	0.004-0.008
-	7/16	2,900	0.008-0.012	2,900	0.008-0.012	2,900	0.008-0.012	2,300	0.008-0.012	600	0.004-0.009
12	-	2,700	0.008-0.012	2,700	0.008-0.012	2,700	0.008-0.012	2,100	0.008-0.012	500	0.005-0.009
-	1/2	2,400	0.008-0.012	2,400	0.008-0.012	2,400	0.008-0.012	2,000	0.008-0.012	500	0.005-0.010

General Drilling Operations

Work Material		Special Alloy Steels, Hardened Steels					
Hardness		35-40 HRC		40-45 HRC		45-56 HRC	
Drilling Speed		130-160 SFM		115-150 SFM		65-100 SFM	
Drill Dia.		Speed RPM	Feed IPR	Speed RPM	Feed IPR	Speed RPM	Feed IPR
mm	Inch						
3	-	4,700	0.002-0.003	4,200	0.001-0.002	2,675	0.001-0.002
-	1/8	4,000	0.002-0.003	3,900	0.001-0.002	2,400	0.001-0.002
4	-	3,600	0.003-0.004	3,200	0.001-0.003	2,000	0.001-0.003
-	3/16	2,900	0.004-0.005	2,500	0.002-0.004	1,600	0.002-0.004
6	-	2,400	0.005-0.006	2,100	0.002-0.005	1,300	0.002-0.005
-	1/4	2,300	0.005-0.006	2,000	0.002-0.005	1,200	0.002-0.005
8	-	1,800	0.006-0.008	1,600	0.003-0.006	1,000	0.003-0.006
-	3/8	1,550	0.007-0.009	1,350	0.003-0.007	850	0.003-0.007
10	-	1,400	0.008-0.010	1,300	0.004-0.008	800	0.004-0.008
-	7/16	1,300	0.009-0.011	1,150	0.004-0.009	720	0.004-0.009
12	-	1,200	0.009-0.012	1,100	0.005-0.009	700	0.005-0.009
-	1/2	1,100	0.010-0.013	1,100	0.005-0.010	625	0.005-0.010

Common Issues

Common Issues when Tapping Nickel-Based Alloys

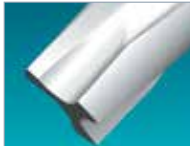
- Short Tool Life
- Tap Breaking Off Inside Workpiece
- Sudden Tool Wear
- Chipping of Cutting Edge
- High Probability of Breakage



Edge chipping and wear at the chamfer.

OSG Solution: New Design

OSG's Newly Designed Point Flute Prevents Chipping



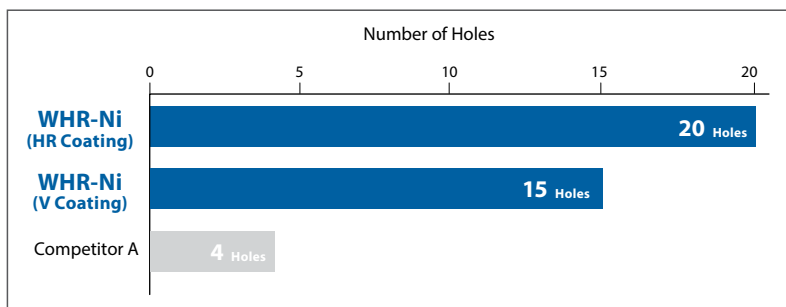
The newly designed point flute improves cutting edge rigidity to prevent edge chipping and makes it effective even in blind holes.

OSG Solution: HR Coating

OSG's HR Coating Improves Wear Resistance

This chart illustrates the wear resistance comparison among OSG's HR coating, OSG's V coating and a competitor TiCN coating. In this example, the average tapping speed was 7 SFM. By adopting OSG's HR coating, the tapping speed can be accelerated 1.4 times versus OSG's V coating and the competitor's!

Tool	WHR-Ni HR Coating	WHR-Ni V Coating	Competitor
Thread Size	3/8-16 UNC		
Thread Length	0.750"		
Material	Inconel 718 (43 HRC)		
Drill Depth	Ø0.319" x 1.38" (Blind)		
Cutting Speed	7 SFM (71 RPM)		
Coolant	Non-Water Soluble		
Machine	Vertical Machining Center		

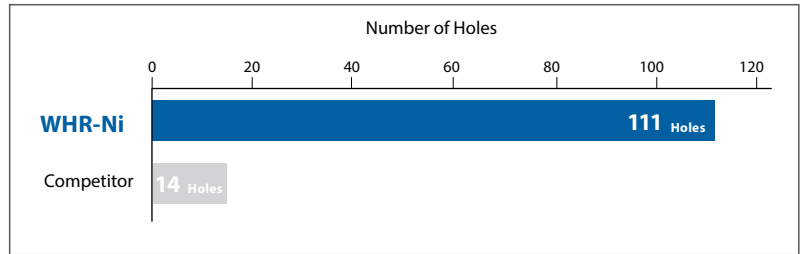


8 Times the Tool Life

Inconel 718

Under identical conditions, the WHR-Ni tap achieved **8 times the tool life** versus the competitor's tap in 718 Inconel (43 HRC).

Tool	WHR-Ni	Competitor
Thread Size	1/4-28 UNJF	
Work Material	Inconel 718 (43 HRC)	
Hole Size	Ø0.217" x 0.866" (Blind)	
Thread Length	0.500" (2D)	
Tapping Speed	6.56 SFM (100 RPM)	
Coolant	Non-Water Soluble	
Machine	Vertical Machining Center	

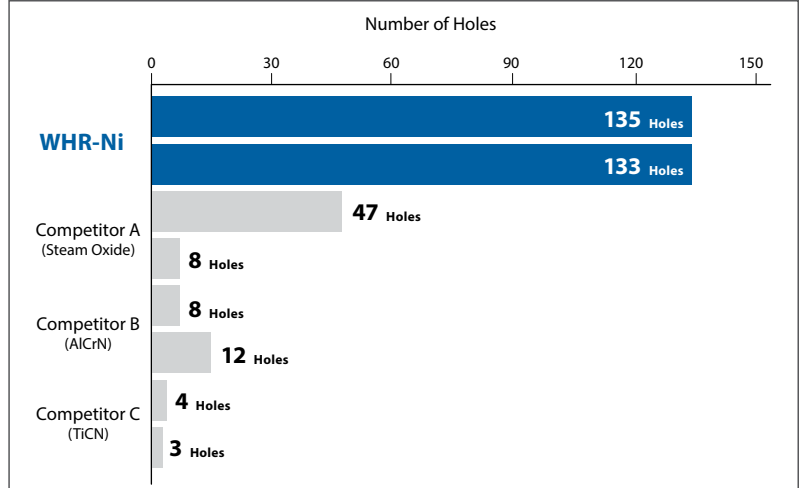


Stable Long Tool Life

Inconel 718

Not only did the WHR-Ni tap achieve substantially longer tool life than the competition in 718 Inconel (43 HRC), but it also achieved more consistent tool life.

Tool	WHR-Ni	Competitors
Thread Size	M4 x 0.7	
Work Material	Inconel 718 (43 HRC)	
Hole Size	Ø3.3 x 9.5mm (Through)	
Thread Length	9.5mm (2.4D)	
Tapping Speed	9.84 SFM (2,356 RPM)	
Coolant	Non-Water Soluble	
Machine	Vertical Machining Center	



List 335Ni

WHR-Ni-SFT, DIN Overall Length, Modified Bottom (2.5P-3P)



Tap Size	Thread Limit	No. of Flutes	EDP Number	DIN Overall Length	Thread Length	Neck Length	Shank Dia.	Square Width	Square Length
			Modified Bottom (2.5P-3P)						
			HR						
			L	Lc	Ln	d	k	lk	
2 - 56 UNC	H2	2	3350002562	1.77	0.437	0.476	0.140	0.109	0.188
4 - 40 UNC			3350004402	2.20	0.563	0.602			
6 - 32 UNC	H2	3	3350006322	2.48	0.689	-	0.167	0.131	0.251
8 - 32 UNC	H3		3350008322						
10 - 24 UNC	H2	3	3350010243	2.76	0.870	-	0.194	0.151	0.287
10 - 32 UNF	H3		3350010245						
1/4 - 20 UNC	H5	3	3350014203	3.14	1.000	-	0.255	0.190	0.287
1/4 - 28 UNF	H3		3350014205						
5/16 - 18 UNC	H3	3	3350014283	3.54	0.665	1.377	0.317	0.238	0.374
5/16 - 24 UNF	H5		3350014284						
3/8 - 16 UNC	H3	3	3350516183	3.94	0.752	1.535	0.380	0.285	0.437
3/8 - 24 UNF	H5		3350516185						
7/16 - 14 UNC	H3	3	3350038243	3.54	0.858	1.712	0.322	0.242	0.405
7/16 - 20 UNF	H4		3350038244						
1/2 - 13 UNC	H3	3	3350716143	3.94	0.921	1.933	0.367	0.274	0.437
1/2 - 20 UNF	H5		3350716145						
9/16 - 18 UNF	H3	3	3350012133	4.33	1.000	1.972	0.429	0.322	0.500
5/8 - 11 UNC	H5		3350012135						
5/8 - 18 UNF	H3	3	3350012203	3.94	1.090	2.125	0.480	0.359	0.562
3/4 - 10 UNC	H5		3350012205						
3/4 - 16 UNF	H3	3	3350096183	4.92	1.200	2.433	0.590	0.442	0.688
7/8 - 9 UNC	H5		3350096185						
7/8 - 14 UNF	H3	3	3350058113	5.51	1.334	2.653	0.697	0.522	0.751
1 - 8 UNC	H5		3350058115						
1 - 12 UNF	H3	3	3350058183	4.92	1.500	3.011	0.800	0.600	0.811
	H5		3350058185						
	H3	4	3350034103	6.30	1.500	3.011	0.800	0.600	0.811
	H5		3350034105						
	H3	4	3350034163	5.51	1.334	2.653	0.697	0.522	0.751
	H5		3350034165						
	H3	4	3350078093	4.92	1.334	2.653	0.697	0.522	0.751
	H5		3350078095						
	H3	4	3350078143	6.30	1.500	3.011	0.800	0.600	0.811
	H5		3350078145						
	H3	4	3350001083	5.51	1.500	3.011	0.800	0.600	0.811
	H5		3350001085						
	H3	4	3350001123	5.51	1.500	3.011	0.800	0.600	0.811
	H5		3350001125						

Packed: 1 pc.
Available HR coating only.



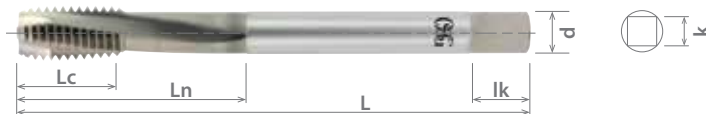
Work Material																			
List No.	P					M			K	N		S		H					
	Carbon Steels			Alloy Steels	Die Steels	Stainless Steels			Cast Iron	Aluminum		Nickel Alloy	Titanium	Hardened Steels					
	Low	Med.	High			300	400	17-4 PH		6061 7075	Casting	Inconel	6Al4V (30 HRC)	~35 HRC	35-45 HRC	45-50 HRC	50-70 HRC		
335Ni																			
SFM								8-20				8-15							8-12

good best



List 336Ni

WHR-Ni-SFT, DIN Overall Length, Modified Bottom (2.5P-3P)



Tap Size	Thread Limit	No. of Flutes	EDP Number	DIN Overall Length	Thread Length	Neck Length	Shank Dia.	Square Width	Square Length	
			Modified Bottom (2.5P-3P)							
			HR							
M2.5 x 0.45	D3	3	3360250453	50	12	13.7	3.58	2.79	4.8	
M3 x 0.5			3360003053	56	15	20.9				
M4 x 0.7			3360004074	63	19	25.4				
M5 x 0.8	D4		3360005084	70	22	-	4.92	3.86	6.4	
M6 x 1.0			3360006105	80	25	33.9	6.47	4.85		7.3
M6 x 0.75	D5		3360006755		25	33.8				
M8 x 1.25			3360008255	90	15	35	8.07	6.05	9.5	
M8 x 1.0			3360008105							
M10 x 1.5	D6		3360010156	100	18	39	9.67	7.26	11.1	
M10 x 1.25	D5		3360010255							
M12 x 1.75	D6		3360012756	110	21	49.1	9.32	6.98		
M12 x 1.5			3360012156	100						
M14 x 2.0	D7		3360014207	110	24	50.1	10.89	8.18	12.7	
M14 x 1.5	D6		3360014156	100						
M16 x 2.0	D7		3360016207	110						
M16 x 1.5	D6		3360016156	100						
M18 x 2.5	D7		3360018257	125			54	13.76	10.31	15.9
M18 x 1.5	D6		3360018156	110						
M20 x 2.5	D8		3360020258	140	30	61.8	16.56	12.42	17.5	
M20 x 1.5	D6		3360020156	125						
M22 x 2.5	D8		3360022258	140						
M22 x 1.5	D6		3360022156	125	36	67.4	17.70	13.28	19.1	
M24 x 3.0	D8		3360024308	160						
M24 x 1.5	D6		3360024156	140						

Packed: 1 pc.
Available HR coating only.



Work Material																		
List No.	P					M			K	N		S		H				
	Carbon Steels			Alloy Steels	Die Steels	Stainless Steels			Cast Iron	Aluminum		Nickel Alloy	Titanium	Hardened Steels				
	Low	Med.	High			300	400	17-4 PH		6061	Casting	Inconel	6Al4V (30 HRC)	~35 HRC	35-45 HRC	45-50 HRC	50-70 HRC	
336Ni	1010	1035	1065	4140	4340													
SFM	1018	1045																

good best



VC10
HR

List 337Ni

WHR-Ni-POT, DIN Overall Length, Plug (5P)



Tap Size	Thread Limit	No. of Flutes	EDP Number	DIN Overall Length	Thread Length	Neck Length	Shank Dia.	Square Width	Square Length
			Plug (5P)						
			HR	L	Lc	Ln	d	k	lk
2 - 56 UNC	H2	2	3370002562	1.77	0.437	0.476			
4 - 40 UNC	H3		3370004402 3370004403						
4 - 48 UNF	H2	3	3370004482	2.2	0.562	0.602	0.140	0.109	0.188
6 - 32 UNC	H3		3370006322 3370006323						
8 - 32 UNC	H2	3	3370008322	2.48	0.751		0.167	0.131	
	H3		3370008323						
10 - 24 UNC	H2	3	3370010242	2.75	0.874		0.194	0.151	0.251
	H3		3370010243						
10 - 32 UNF	H2	3	3370010322	2.75	0.870				
	H3		3370010323						
1/4 - 20 UNC	H5	3	3370014203	3.14	1.000		0.255	0.190	0.287
1/4 - 28 UNF	H3		3370014205						
	H4	3	3370014283	3.14	0.992				
	H5		3370014284						
5/16 - 18 UNC	H3	3	3370516183	3.54	0.665	1.377	0.317	0.238	0.342
	H5		3370516185						
5/16 - 24 UNF	H3	3	3370516243	3.54	0.657	1.370			
	H5		3370516245						
3/8 - 16 UNC	H3	3	3370038163	3.93	0.751	1.535	0.380	0.285	0.397
	H5		3370038165						
3/8 - 24 UNF	H3	3	3370038243	3.54	0.740	1.377			
	H5		3370038245						
7/16 - 14 UNC	H3	3	3370716143	3.93	0.858	1.291	0.322	0.242	0.405
	H5		3370716145						
7/16 - 20 UNF	H3	3	3370716203	3.93	0.921	1.354	0.367	0.274	0.437
	H5		3370716205						
1/2 - 13 UNC	H3	3	3370012133	4.33	0.921	1.354	0.367	0.274	0.437
	H5		3370012135						
1/2 - 20 UNF	H3	3	3370012203	3.93	1.000	1.472	0.429	0.322	0.500
	H5		3370012205						
9/16 - 18 UNF	H3	3	3370916183	4.33	1.090	1.562	0.480	0.359	0.562
	H5		3370916185						
5/8 - 11 UNC	H3	3	3370058113	3.93	1.200	1.712	0.590	0.442	0.688
	H5		3370058115						
5/8 - 18 UNF	H3	3	3370058183	4.92	1.334	1.885	0.697	0.522	0.751
	H5		3370058185						
3/4 - 10 UNC	H3	3	3370034103	4.33	1.334	1.885	0.697	0.522	0.751
	H5		3370034105						
3/4 - 16 UNF	H3	3	3370034163	5.51	1.500	2.090	0.800	0.600	0.811
	H5		3370034165						
7/8 - 9 UNC	H3	3	3370078093	4.92	1.500	2.090	0.800	0.600	0.811
	H5		3370078095						
7/8 - 14 UNF	H3	3	3370078143	6.29	1.500	2.090	0.800	0.600	0.811
	H5		3370078145						
1 - 8 UNC	H3	3	3370001083	5.51	1.500	2.090	0.800	0.600	0.811
	H5		3370001085						
1 - 12 UNF	H3	3	3370001123	5.51	1.500	2.090	0.800	0.600	0.811
	H5		3370001125						

Packed: 1 pc.
Available HR coating only.



Work Material																			
List No.	P					M			K	N		S		H					
	Carbon Steels			Alloy Steels	Die Steels	Stainless Steels			Cast Iron	Aluminum		Nickel Alloy	Titanium	Hardened Steels					
	Low	Med.	High			300	400	17-4 PH		6061 7075	Casting	Inconel	6Al4V (30 HRC)	~35 HRC	35-45 HRC	45-50 HRC	50-70 HRC		
337Ni																			
SFM								8-20				8-15							8-12

good best



List 338Ni

VC10

HR

WHR-Ni-POT, DIN Overall Length, Plug (5P)



Tap Size	Thread Limit	No. of Flutes	EDP Number	DIN Overall Length	Thread Length	Neck Length	Shank Dia.	Square Width	Square Length
			Plug (5P)						
			HR	L	Lc	Ln	d	k	Ik
M2.5 x 0.45	D3	2	3380250453	50	12	13.8	3.58	2.79	4.8
M3 x 0.5			3380003053	56	16	21.0			
M4 x 0.7	D4		3380004074	63	19	25.5	4.26	3.33	6.4
M5 x 0.8			3380005084	70	22	-			
M6 x 1.0	D5		3380006105	80	25	33.9	6.47	4.85	7.3
M6 x 0.75			3380006755						
M8 x 1.25			3380008255						
M8 x 1.0	D6		3380008105	90	15	35.0	8.07	6.05	8.7
M10 x 1.5			3380010156						
M10 x 1.25	D5		3380010255	100	22	43.5	9.67	7.26	10.1
M12 x 1.75			3380012756						
M12 x 1.5	D6	3	3380012156	100	21	32.0	9.32	6.98	11.1
M14 x 2.0			3380014207	110	24	36.0			
M14 x 1.5	D6		3380014156	100			24	36.0	10.89
M16 x 2.0			D7		3380016207	110			
M16 x 1.5	D6		3380016156	100	24	36.0	12.19	9.14	14.3
M18 x 2.5			D7						
M18 x 1.5	D6		3380018156	110	30	43.0	13.76	10.31	15.9
M20 x 2.5			D8						
M20 x 1.5	D6		3380020156	125	30	44.0	16.56	12.42	17.5
M22 x 2.5			D8						
M22 x 1.5	D6		3380022156	125	30	44.0	16.56	12.42	17.5
M24 x 3.0			D8	4					
M24 x 1.5	D6	3380024156	140						

Packed: 1 pc.
Available HR coating only.



Work Material																			
List No.	P					M			K	N		S		H					
	Carbon Steels			Alloy Steels	Die Steels	Stainless Steels			Cast Iron	Aluminum		Nickel Alloy	Titanium	Hardened Steels					
	Low	Med.	High			300	400	17-4 PH		6061 7075	Casting	Inconel	6Al4V (30 HRC)	~35 HRC	35-45 HRC	45-50 HRC	50-70 HRC		
338Ni																			
SFM																			

good best



Common Issues

Common Issues when Threading Nickel-Based Alloys

- **Diversification of Work Materials**

Due to the high-hardness materials exceeding 50HRC, heat-resistant steels and even brittle materials, small diameter internal threads are becoming increasingly difficult to machine.

- **Machining Equipment Constraints**

Along with the need for ultra-high speed and high precision operations, small machining centers without reverse function (tap cycles) have emerged.

- **Coolant Constraints**

Standard taps have difficulty machining nickel-based alloys with water-soluble coolant.

OSG Solution 1: *Advanced Coatings*

OSG's EXO®, WXS®, & SS Coatings

OSG's EXO®, WXS®, and SS coatings provide extreme temperature and wear resistance.

OSG Solution 2: *Premium Substrate*

Premium Carbide Substrate

OSG's Carbide Substrate provides superior wear resistance and long tool life at high cutting speeds.

OSG Solution 3: *Optimized Design*

Optimized Flute Geometry & Thread Form

OSG's specially designed helical flute geometry reduces cutting forces, while the thread form minimizes cutting load on both the machine and tool.



Machining Small Diameter Internal Threads

Inconel 718

Compared to taps, thread mills have fewer cutting condition limitations. There is no concern with chip management or coolant lubricity, and stable threading is possible. In this example, we were able to improve the yield rate of small diameter internal threads in a high value workpiece. More durability improvements and cost reductions can be expected by adjusting the feed rate and number of passes and changing the cutting fluid.

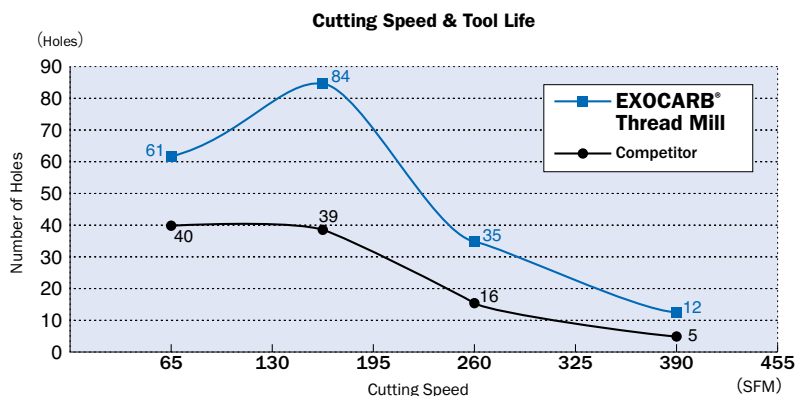
Tool	EXOCARB® Thread Mill		Cutting Speed	Passes	Tool life holes
Tool Size	3.2 x 2.4 U32				
Work Material	Inconel 718 (43 HRC)				
Cutting Speed	130 SFM (3,980 RPM)	195 SFM (5,970 RPM)			
Feed	4.72 IPM (0.001 ipt)	7.07 IPM (0.001 ipt)			
Internal Thread	No. 10-32 UNF				
Drill Hole Size	Ø0.161" x 0.551 (Blind)				
Tapping Length	0.354" (1.9D)				
Machining Method	Down Cut, 2/4 Passes				
Coolant	Water Soluble				
Machine	Vertical Machining Center				
			130 SFM	4	50 Holes
			195 SFM	4	60 Holes
			195 SFM	2	40 Holes

Double the Tool Life at Any Cutting Speed

Inconel 718

At various cutting speeds under 165 SFM, better durability is achieved. The EXOCARB® Thread Mill achieves **2 times the tool life** versus the competitor, regardless of the cutting speed.

Tool	EXOCARB® Thread Mill
Tool Size	4.55 x 10.8 U20
Work Material	Inconel 718 (43 HRC)
Internal Thread	1/4-20 UNC
Tapping Length	0.354"
Feed Per Tooth	0.001 ipt
Coolant	Water Soluble (10%)
Machine	Horizontal Machining Center



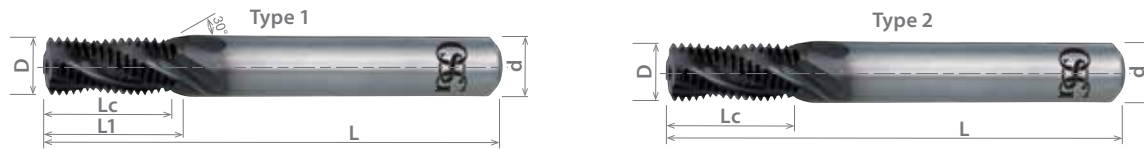
EXOCARB® Thread Mill

Ideal for Steels, Exotics and Difficult to Machine Materials

List 41100

OT-SFT-PNGT & WX-PNC, Regular & Long Length, Helical Flute

SPEED FEED P21	CARBIDE	EXO®	11-30°	SHANK h6
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Size	Threads Per Inch	Cutter Diameter	Overall Length	Length of Cut	Neck Length	Shank Diameter	No. of Flutes	Type	EDP Number
		D	L	Lc	L1	d			
M6	1.00	4.5	60	10.00	15	6	3	1	411000111
				13.00					3900001
M8	1.25	6.0	65	13.80	-	8	3	2	411000311
				17.50					3900012
	1.00			13.00	-			411000211	
				17.00	-			3900011	
M10	1.50	7.5	70	16.50	-	10	3	1	411000611
				22.50					3900023
	1.25			16.25	-			411000511	
				16.00	-			411000411	
M12	1.75	9.5	85	21.00	-	12	3	1	3900021
				26.30					411000811
	1.25			20.00	-			3900034	
				26.30	-			411000711	
M14	2.00	10.0	85	24.00	-	16	3	2	3900032
				30.00					4110001011
	1.50			22.50	-			3900044	
				30.00	-			411000911	
M16	2.00	12.0	95	34.00	-	20	3	1	3900043
				25.50					3900054
	1.50			34.50	-			4110001111	
				42.50	-			3900053	
M20	2.50	16.0	105	42.50	-	24	3	2	3900075
				31.50					4110001211
	1.50			42.00	-			3900073	
				51.00	-			41100086	
M24	3.00	20.0	120	50.00	-	28	3	1	3900084
	2.00			50.00	-				3900084

Packed: 1 pc.
Available EXO® coating only.
For internal threads only.



For more information on thread mill applications, including ThreadPro software, visit: www.osgtool.com/ThreadPro.

List No.	Work Material																
	P					M			K	N		S	H				
	Carbon Steels			Alloy Steels	Die Steels	Stainless Steels			Cast Iron	Aluminum		Nickel Alloy	Titanium	Hardened Steels			
	Low	Med.	High	4140 4340		300	400	17-4 PH		6061 7075	Casting	Inconel	6Al4V (30 HRC)	~35 HRC	35-45 HRC	45-50 HRC	50-70 HRC
41100	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

good best



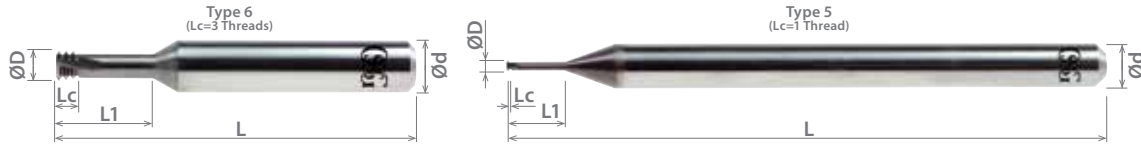
EXOCARB® Thread Mill

Ideal for Steels, Exotics and Difficult to Machine Materials

List 41200

WH-VM-PNC, Miniature, Helical Flute

SPEED FEED P22	CARBIDE	SS	WXS	11°	SHANK h6
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Size	Threads Per Inch	Cutter Diameter D	Overall Length L	Length of Cut Lc	Neck Length L1	Shank Diameter d	No. of Flutes	Type	EDP Number	
									SS	WXS®
0	80	0.045	1.625	0.013	0.162	1/8	5	4120000115	-	
1	64	0.055		0.016	0.198			-	4120000315	
1	72			0.014	0.196			-	4120000215	
2	64	0.064	1.661	0.047	0.189	1/4	3	6	-	4120000513
2, 3	56			0.054					-	4120000413
3, 4	48	0.074		0.063	0.220				-	4120000613
4, 5, 6	40	0.083	0.075	0.248	-	4120000713				
5	44	0.096	0.068	0.272	-	4120000813				
6, 8	32	0.103	0.094	0.307	-	4120000913				
8	36	0.129	0.083	0.354	-	4120001013				

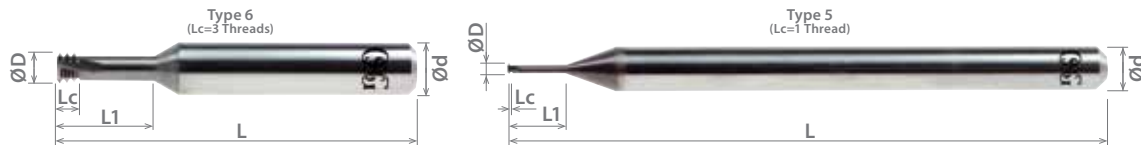
Packed: 1 pc.
Available in Super Smooth or WXS® coatings as shown above.
For internal threads only.



List 41300

WH-VM-PNC, Miniature, Helical Flute

SPEED FEED P22	CARBIDE	SS	WXS	11°	SHANK h6
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Size	Threads Per Inch	Cutter Diameter D	Overall Length L	Length of Cut Lc	Neck Length L1	Shank Diameter d	No. of Flutes	Type	EDP Number	
									SS	WXS®
M1	0.25	0.72	40	0.26	2.75	3	3	5	3900495	-
M1.2		0.91			3.25				-	3900496
M1.4		1.05			3.80				-	3900497
M1.6	0.35	1.20	41	0.36	4.35	6	6	3900498	-	
M1.7, M1.8		1.30			4.85			-	3900499	
M2	0.40	1.50			1.20			4.40	-	3900500
M2.5, M2.6	0.45	1.90	1.35	5.60	-	3900501				
M3	0.50	2.40	1.50	6.50	-	3900502				
M4	0.70	3.10	2.10	8.70	-	3900503				
M5	0.80	4.00	2.40	10.80	-	3900504				

Packed: 1 pc.
Available in Super Smooth or WXS® coatings as shown above.
For internal threads only.



For more information on thread mill applications, including ThreadPro software, visit: www.osgtool.com/ThreadPro.

Work Material																	
Chart applies to all list numbers above	P					M			K	N		S		H			
	Carbon Steels			Alloy Steels 4140 4340	Die Steels	Stainless Steels			Cast Iron	Aluminum		Nickel Alloy Inconel	Titanium 6Al4V (30 HRC)	Hardened Steels			
	Low 1010 1018	Med. 1035 1045	High 1065			300	400	17-4 PH		6061 7075	Casting			~35 HRC	35-45 HRC	45-50 HRC	50-70 HRC
-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

good best



List 41100 - EXOCARB® Thread Mill

Work Material	SFM	Feed Rate (Inch/Tooth)	No. of Passes
Low Carbon Steel	300 - 420	0.0016 - 0.0050	1
Medium Carbon Steel	300 - 420	0.0016 - 0.0050	1
High Carbon Steel	250 - 420	0.0016 - 0.0050	1
Alloy Steel	180 - 350	0.0008 - 0.0040	1-2
Heat Treated Steel (28-34HRC)	160 - 300	0.0008 - 0.0040	1
Heat Treated Steel (34-40HRC)	130 - 260	0.0004 - 0.0040	1-2
Heat Treated Steel (40-50HRC)	65 - 250	0.0004 - 0.0040	2-4
Stainless Steel (SUS3**,SUS2**)	200 - 450	0.0016 - 0.0060	1-2
Stainless Steel (SUS405,410L,430)	165 - 400	0.0016 - 0.0060	1-2
Stainless Steel (15-5, 17-4PH)	130 - 350	0.0016 - 0.0060	2
Cast Iron	300 - 450	0.0012 - 0.0040	1
Cast Iron	250 - 400	0.0008 - 0.0035	1
Ductile Cast Iron	210 - 310	0.0012 - 0.0040	1
Ductile Cast Iron	210 - 280	0.0012 - 0.0040	1
Aluminum Alloy	300 - 500	0.0012 - 0.0040	1
Aluminum Alloy Casting Si [12]%	280 - 550	0.0012 - 0.0050	1
Aluminum Alloy Casting Si [12-16]%	250 - 460	0.0012 - 0.0040	1
Aluminum Alloy Casting with Si [16-20]%	210 - 400	0.0012 - 0.0040	1
Aluminum Alloy Casting with Si [20-25]%	200 - 350	0.0012 - 0.0040	1
Copper,Copper Casting	300 - 510	0.0012 - 0.0040	1
Brass, Brass Casting	300 - 510	0.0012 - 0.0040	1
Bronze,Bronze Casting (C6***,PB,PBC)	300 - 500	0.0012 - 0.0040	1
Magnesium Alloy Casting	210 - 410	0.0012 - 0.0050	1
Zinc Alloy Casting	180 - 380	0.0012 - 0.0050	1
Titanium Alloy (Ti-6Al-4V)	100 - 330	0.0012 - 0.0025	2
High Heat Resistance Alloy (Inconel)	65 - 260	0.0008 - 0.0020	2
High Heat Resistance Alloy (Inconel >40HRC)	65 - 200	0.0008 - 0.0020	4
Thermoplastic	220 - 510	0.0012 - 0.0050	1
Cobalt/Chrome Alloy (Stellite)	65 - 200	0.0016 - 0.0060	3

For chip loads, the smaller cutter diameters use a smaller chip load per tooth within a given range.

Larger cutter diameters use the larger chip load per tooth within the given range.

For programming help or other information, please contact our Engineering Department at 800-837-2223.

List 41200/41300 - EXOCARB® Thread Mill Mini

Work Material	Thread Sizes Under #2/M2			Thread Sizes #2/M2 & Larger		
	SFM	Feed Rate (Inch/Tooth)	No. of Passes	SFM	Feed Rate (Inch/Tooth)	No. of Passes
Low Carbon Steel	200 - 300	0.0008 - 0.0020	2	200 - 300	0.0008 - 0.0030	1
Medium Carbon Steel	200 - 300	0.0008 - 0.0020	2	200 - 300	0.0008 - 0.0030	1
High Carbon Steel	200 - 300	0.0008 - 0.0020	2	200 - 300	0.0008 - 0.0030	1
Alloy Steel	—	—	—	100 - 200	0.0004 - 0.0012	1-2
Heat Treated Steel (28-34HRC)	—	—	—	100 - 200	0.0004 - 0.0012	1
Heat Treated Steel (34-40HRC)	—	—	—	100 - 200	0.0004 - 0.0012	1-2
Heat Treated Steel (40-50HRC)	—	—	—	100 - 200	0.0004 - 0.0012	2-4
Stainless Steel (SUS3**,SUS2**)	200 - 300	0.0008 - 0.0020	2-3	200 - 300	0.0008 - 0.0030	1-2
Stainless Steel (SUS405,410L,430)	200 - 300	0.0008 - 0.0020	2-3	200 - 300	0.0008 - 0.0030	1-2
Stainless Steel (15-5, 17-4PH)	200 - 300	0.0008 - 0.0020	3	200 - 300	0.0008 - 0.0030	2
Cast Iron	130 - 200	0.0008 - 0.0020	2	165 - 330	0.0012 - 0.0040	1
Cast Iron	130 - 200	0.0008 - 0.0020	2	165 - 330	0.0012 - 0.0040	1
Ductile Cast Iron	130 - 200	0.0008 - 0.0020	2	165 - 230	0.0012 - 0.0040	1
Ductile Cast Iron	130 - 300	0.0008 - 0.0020	2	165 - 230	0.0012 - 0.0040	1
Aluminum Alloy	230 - 330	0.0015 - 0.0030	2	165 - 330	0.0008 - 0.0025	1
Aluminum Alloy Casting	230 - 330	0.0015 - 0.0030	2	165 - 330	0.0008 - 0.0025	1
Copper,Copper Casting	—	—	—	—	—	—
Brass, Brass Casting	200 - 330	0.0015 - 0.0030	2	165 - 330	0.0008 - 0.0025	1
Bronze,Bronze Casting	—	—	—	165 - 330	0.0008 - 0.0025	1
Magnesium Alloy Casting	230 - 330	0.0015 - 0.0030	2	165 - 330	0.0008 - 0.0025	1
Zinc Alloy Casting	230 - 330	0.0015 - 0.0030	2	165 - 330	0.0008 - 0.0025	1
Titanium Alloy (Ti-6Al-4V)	65 - 130	0.0004 - 0.0012	3	65 - 200	0.0004 - 0.0012	2
High Heat Resistance Alloy (Inconel)	—	—	—	65 - 200	0.0004 - 0.0012	2
High Heat Resistance Alloy (Inconel >40HRC)	—	—	—	65 - 200	0.0004 - 0.0012	4
Thermoplastic	165 - 330	0.0015 - 0.0030	2	165 - 330	0.0008 - 0.0025	1
Cobalt/Chrome Alloy (Stellite)	—	—	—	—	—	—

For chip loads, the smaller cutter diameters use a smaller chip load per tooth within a given range.

Larger cutter diameters use the larger chip load per tooth within the given range.

For programming help or other information, please contact our Engineering Department at 800-837-2223.



Corner Protection

Radius with Variable negative rake angle for strong cutting corners.

Variable Helix/Variable Index

Vibration absorption enables stable machining.

Proprietary Cutting Edge Geometry

Reduction of cutting heat and forces.

Unique Flute Form

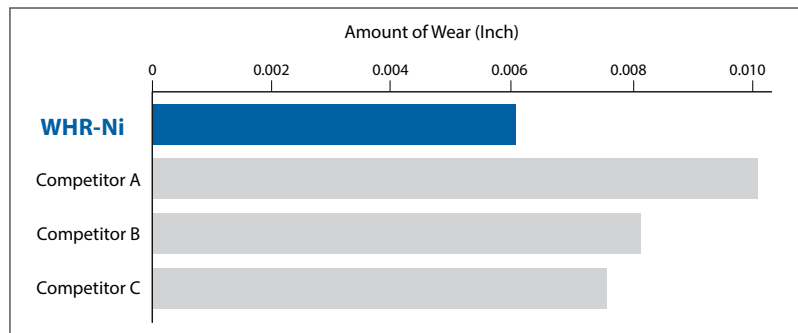
For excellent chip shape and evacuation.

Side Milling in 718 Inconel

Inconel 718

Stable performance in Nickel Alloys can be achieved with UVX-Ni's unique cutting geometry and flute design.

Tool	UVX-Ni	Competitors
Tool Diameter	1/2" x 1-1/4" x 3-1/2" 0.030CR	
Work Material	Inconel 718 (45 HRC)	
Speed	764 RPM (100 SFM)	
Feed	6.02 IPM (0.0015 IPT)	
Depth of Cut	Aa: 0.250" / Ar: 0.150"	
Coolant	Water Soluble (External)	



Tool Wear After Milling 39 Inches:



List 2055

5 Flute, Multiple Lengths, Corner Radius

SPEED FEED	CARBIDE	EXO®		Var.°
P25				

Milling Diameter Tolerance	
1/4 ≤ D ≤ 1	+0/-0.0015"



EDP Number	EDP Number w/ Weldon Flat	Mill Diameter	Corner Radius	OAL	Length of Cut	Shank Diameter
		D	R	L	Lc	d
20552501	-	1/4	0.015	2-1/2	5/8	1/4
20552502	-	1/4	0.030	2-1/2	5/8	1/4
20552503	-	1/4	0.060	2-1/2	5/8	1/4
20553121	-	5/16	0.015	2-1/2	3/4	5/16
20553122	-	5/16	0.030	2-1/2	3/4	5/16
20553123	-	5/16	0.060	2-1/2	3/4	5/16
-	20553751	3/8	0.015	2-1/2	7/8	3/8
-	20553752	3/8	0.030	2-1/2	7/8	3/8
-	20553753	3/8	0.060	2-1/2	7/8	3/8
-	20555001	1/2	0.030	2-1/2	5/8	1/2
-	20555002	1/2	0.030	3	1	1/2
-	20555003	1/2	0.060	3	1	1/2
-	20555004	1/2	0.015	3-1/2	1-1/4	1/2
-	20555005	1/2	0.030	3-1/2	1-1/4	1/2
-	20555006	1/2	0.060	3-1/2	1-1/4	1/2
-	20555007	1/2	0.090	3-1/2	1-1/4	1/2
-	20555008	1/2	0.120	3-1/2	1-1/4	1/2
-	20556251	5/8	0.030	3-1/2	1-1/4	5/8
-	20556252	5/8	0.060	3-1/2	1-1/4	5/8
-	20556253	5/8	0.090	3-1/2	1-1/4	5/8
-	20556254	5/8	0.120	3-1/2	1-1/4	5/8
-	20557501	3/4	0.030	4	1-1/2	3/4
-	20557502	3/4	0.060	4	1-1/2	3/4
-	20557503	3/4	0.090	4	1-1/2	3/4
-	20557504	3/4	0.120	4	1-1/2	3/4
-	20551001	1	0.030	4	1-1/2	1
-	20551002	1	0.060	4	1-1/2	1
-	20551003	1	0.090	4	1-1/2	1
-	20551004	1	0.120	4	1-1/2	1

Packed: 1 pc. Available EXO® coating only.
Weldon Flat 3/8" and above.




Work Material																
List No.	P				Die Steels	M			K Cast Iron	N		S		H		
	Carbon Steels			Alloy Steels		Stainless Steels				Aluminum		Nickel Alloy Inconel	Titanium 6Al4V (30 HRC)	Hardened Steels		
	Low 1010 1018	Med. 1035 1045	High 1065			300	400	17-4 PH		6061 7075	Casting			~35 HRC	35-45 HRC	45-50 HRC
2055						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			<input checked="" type="checkbox"/>				<input type="checkbox"/>	

good best



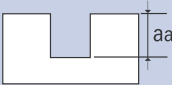
List 2055 - EXOPRO® UVX-Ni: 5 Flute, Corner Radius

Side Milling

Hardness		
Work Material	High Temp. Alloys Inconel Hastelloy	
Cutting Speed	125-150 SFM	
Depth of Cut	$a_a \leq 0.5D$ $a_r \leq 0.3D$ 	
Mill Dia.	Speed RPM	Feed in/min
1/4	2,100	11.0
5/16	1,600	10.0
3/8	1,400	10.0
1/2	1,100	9.5
5/8	800	9.0
3/4	650	8.0
1	500	7.0

1. Use a rigid and precise machine and holder.
2. When chattering occurs, reduce the speed and feed simultaneously.
3. Use a suitable cutting fluid with high smoke retardant.

Slotting

Hardness		
Work Material	High Temp. Alloys Inconel Hastelloy	
Cutting Speed	75-100 SFM	
Depth of Cut	$a_a \leq 0.5D$ 	
Mill Dia.	Speed RPM	Feed in/min
1/4	1,300	7.0
5/16	1,000	6.5
3/8	900	6.0
1/2	700	5.5
5/8	500	5.0
3/4	400	4.5
1	300	4.0

1. Use a rigid and precise machine and holder.
2. When chattering occurs, reduce the speed and feed simultaneously.
3. Use a suitable cutting fluid with high smoke retardant.

OSG PHOENIX® Indexable Tooling

Product Offering

OSG PHOENIX® Product Lineup

Drilling

OSG PHOENIX® PXD

Exchangeable head drill series for efficient, precise hole processing.

OSG PHOENIX® PD

Indexable drill series for efficient, stable hole processing.

OSG PHOENIX® PHP

High performance 3D indexable drill.

Milling

OSG PHOENIX® PAS

45° indexable facemills with 2-sided square insert.

OSG PHOENIX® PAO

45° indexable facemills with 2-sided octagon insert.

OSG PHOENIX® PSE

Multifunctional 90° indexable end mills and facemills.

OSG PHOENIX® PSEL

90° indexable roughing end mills and facemills.

OSG PHOENIX® PSF

90° indexable shoulder end mills and facemills.

OSG PHOENIX® PSFL

90° indexable roughing end mills & facemills.

OSG PHOENIX® PSTW

90° indexable shoulder facemills with 2-sided triangle insert.

OSG PHOENIX® PRC

Button insert end mills and facemills for contour milling applications.

OSG PHOENIX® PHC

High feed end mills and facemills for maximum metal removal rates in a variety of applications.

OSG PHOENIX® PDR

Deep feed radius end mills and facemills for deeper depths of cut versus conventional high feed cutters.

OSG PHOENIX® PFB

High precision indexable finish ballnose end mills for superior surface finish and tool life.

OSG PHOENIX® PFR

High precision indexable finish radius end mills for superior surface finish and tool life.

OSG PHOENIX® SF

Modular indexable end mills for a variety of applications.

OSG PHOENIX® PXM

Exchangeable head end mill series for superior surface finish and precision in a variety of applications.

OSG PHOENIX® PRC - Radius Cutter

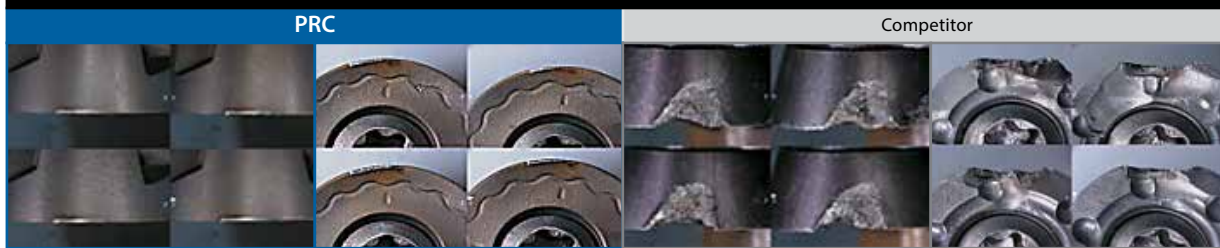
Inconel 718 (45 HRC)

The competitor tool chipped severely after milling 6.5 feet with damage extending to other corners, and made the tool unusable. In contrast, the PRC was able to mill 32.8 feet and resulted in considerably longer tool life.

Tool	PRC12R050M22-5	Competitor
Insert (grade)	RPHT1204MOEN-SM (XC5035)	Coated Carbide Chip
Work Material	Inconel 718 (45 HRC)	
Cutting Speed	131 SFM (255 RPM)	196 SFM (382 RPM)
Feed	10.63 IPM (0.008 in/t)	10.63 IPM (0.005 in/t)
Depth of Cut	Aa: 0.020" / Ar: 1.181"	
Coolant	Water Soluble	
Machine	Horizontal Machining Center	
Durability	32.8'	6.5'



Photo of Insert After Milling 2m



OSG PHOENIX® PSE - 90° Shoulder Cutter

Inconel 718 (45HRC)

OSG PHOENIX® PSE was able to mill at conditions that were 50% higher than those for conventional tools. It provided double the durability, wore normally and provided longer tool life.

Tool	PSE11R032SS32-5S	Competitor
Insert (grade)	ZDKT11T308ER-SM (XC5040)	Coated Carbide Chip
Work Material	Inconel 718 (45 HRC)	
Cutting Speed	98 SFM (298 RPM)	82 SFM (248 RPM)
Feed	4.72 IPM (0.003 in/t)	3.15 IPM (0.003 in/t)
Depth of Cut	Aa: 0.040" / Ar: 0.787"	
Coolant	Water Soluble	
Machine	Vertical Machining Center	

Photo of Tool After Milling 4.9'



OSG PHOENIX® Indexable Tooling

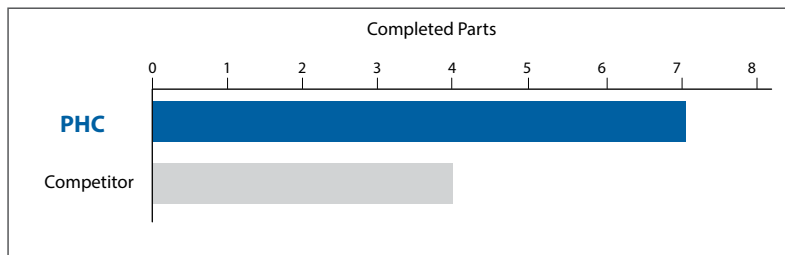
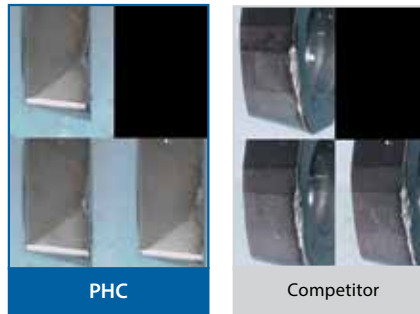
Cutting Data

OSG PHOENIX® PHC - High Feed Radius Cutter

630 Stainless Steel

A blade was rough-milled under the same conditions for comparison. The PHC provided 1.75 times the durability with more stable milling and with inserts exhibiting normal wear.

Tool	PHC09R032SS32-3S	Competitor
Insert (grade)	SDMT09T308ER-SM (XC5040)	Coated Carbide Chip
Work Material	630 Stainless Steel	
Cutting Speed	262 SFM (796 RPM)	
Feed	31.5 IPM (0.013 in/t)	
Depth of Cut	Aa: 0.020" / Ar: 1.260"	
Coolant	Water Soluble	
Machine	Vertical Machining Center	

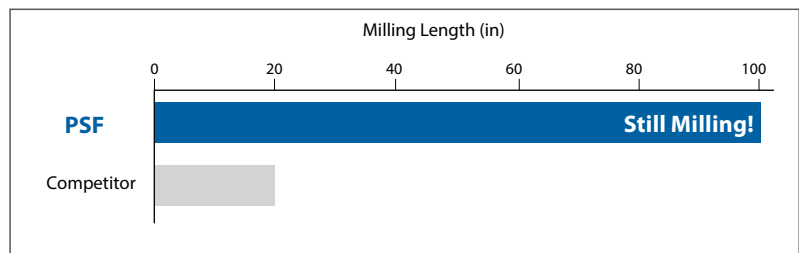


OSG PHOENIX® PSF - 90° Shoulder Cutter

Duplex Stainless Steel

The competitor tool chipped early on, however, the PHOENIX® PSF's stable milling resulted in **5 times the tool life!**

Tool	PSF09R025SS25-3S	Competitor
Insert (grade)	SDKT09T308SR-GL (XC5040)	Coated Carbide Chip
Work Material	Duplex Stainless Steel	
Cutting Speed	262 SFM (800 RPM)	
Feed	11.81 IPM (0.004 in/t)	
Depth of Cut	Aa: 0.079" / Ar: 0.591"	
Coolant	Water Soluble	
Machine	Vertical Machining Center	











OSG PHOENIX® PFB - Finishing Ball End Mill

Heat Resistant Steel (SUH600)

The OSG PHOENIX® PFB demonstrated exceptional wear resistance when machining SUH600 heat-resistant steel.

Tool	PFB-R200SS20-S160	Competitor
Insert (grade)	PFB200-SP (XP3320)	
Workpiece	Blade Sample Model	
Work Material	SUH600 Steel	
Overall Length	4.331 in	
Cutting Speed	308 SFM (1,500 RPM)	
Feed	78.74 IPM (0.026 in/t)	
Depth of Cut	Aa: 0.008" / Ar: 0.039"	
Coolant	Water Soluble	
Machine	Vertical Machining Center	

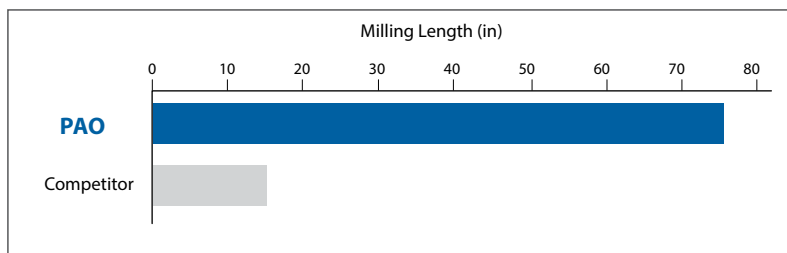
Time	70 minutes		140 minutes	
Milling Length	4,000 in		8,000 in	
PFB				
Wear Amount (in)	0.0012	0.0011	0.0016	0.0017
Competitor				
Wear Amount (in)	0.0012	0.0013	0.0027	0.0028

OSG PHOENIX® PAO - 45° Face Milling Cutter

Inconel 718

In Inconel 718, the PHOENIX® PAO demonstrated excellent wear resistance and achieved four times the durability versus the competitor.

Tool	PAO06R125M38.1-12	Competitor
Insert (grade)	OZKU060508SR-GM (XC5040)	Coated Carbide Chip
Work Material	Inconel 718	
Cutting Speed	131 SFM (100 RPM)	
Feed	4.72 IPM (0.004 in/t)	
Depth of Cut	Aa: 0.059" / Ar: 1.968"	
Coolant	Water Soluble	
Machine	Vertical Machining Center	



EXOTAP® VC-10 Taps

Product Offering

V Coating

for increased hardness, lubricity & wear resistance.

Coolant-Through

for smooth chip evacuation.

Premium Powdered Metal VC-10 Substrate

for increased hardness and longer tool life.

DIN Overall Length

for longer reach.



EXOTAP® VC-10 Lineup

Designed to Excel in Difficult to Machine Materials

The EXOTAP® VC-10 taps feature unique geometries to excel in Nickel or other difficult to machine materials.

Series	List Number	Style	Size Range	Features	P	M			S		H	
					Alloy Steels	Stainless Steels			Nickel Alloy	Titanium	Hardened Steels	
					4140 4340	300	400	17-4 PH	Inconel	6Al4V (30 HRC)	~35 HRC	35-45 HRC
EXOTAP® VC-10 Ti	313Ti	Spiral Flute	No. 2 - 1"	VC-10 Powdered Metal Tap, Steam-Oxide or V-coated Ideal for Ti-Alloys & Difficult to Machine Materials	○				○	○	○	○
	345Ti		M2.5 - M12									
	312Ti	Spiral Point	No. 2 - 1"									
	344Ti		M3 - M12									
	315Ti	STI, Spiral Fluted	No. 2 - 1/2"									
314Ti	STI, Spiral Pointed	No. 2 - 1/2"										
EXOTAP® VC-10 Ti Oil	317Ti	Spiral Flute, Coolant-Through, DIN OAL	1/4" - 1"	Coolant-Through VC-10 Powdered Metal Tap, Steam-Oxide or V-coated, Ideal for Ti-Alloys & Difficult to Machine Materials	○				○	○	○	○
	348Ti		M8 - M24									
	316Ti	Spiral Point, Coolant-Through, DIN OAL	1/4" - 1"									
	347Ti		M8 - M24									
EXOTAP® VC-10 Ni	313Ni	Spiral Flute	No. 2 - 1"	VC-10 Powdered Metal Tap, V-coated Ideal for Ni-Alloys & Difficult to Machine Materials					○	○	○	○
	345Ni		M2.5 - M12									
	312Ni	Spiral Point	No. 2 - 1"									
	344Ni		M2.5 - M12									
	315Ni	STI, Spiral Fluted	No. 2 - 1/2"									
314Ni	STI, Spiral Pointed	No. 2 - 1/2"										
EXOTAP® VC-10	313	Spiral Flute	No. 2 - 3/4"	VC-10 Powdered Metal Tap, Steam-Oxide or V-coated Ideal for Difficult to Machine Materials	○				○	○	○	○
	345		M3 - M12									
	312	Spiral Point	No. 2 - 3/4"									
	344		M3 - M12									
	315	STI, Spiral Fluted	No. 2 - 1"									
	345STI		M2 - M24									
	314	STI, Spiral Pointed	No. 2 - 1"									
344STI	M2 - M24											
EXOTAP® VC-10 Oil	317	Spiral Flute, Coolant-Through, DIN OAL	5/16" - 1"	Coolant-Through VC-10 Powdered Metal Tap, Steam-Oxide or V-coated, Ideal for Difficult to Machine Materials	○				○	○	○	○
	351		M8 - M24									
	316	Spiral Point, Coolant-Through, DIN OAL	1/4" - 1"									
	350		M6 - M24									



V-Series Drilling Lineup

VPH-GDS & VPH-GDR

V-coated, XPM powdered metal drills, are ideal for Nickel Alloys and other difficult to machine materials.

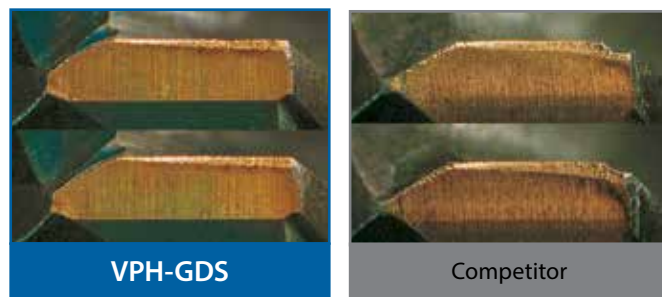
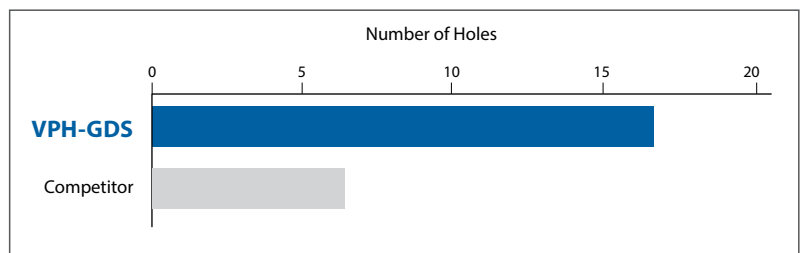
Series	List Number	Style	Size Range	P		M			S		H		
				Alloy Steels		Stainless Steels			Nickel Alloy	Titanium	Hardened Steels		
				4140	4340	300	400	17-4 PH	Inconel	6Al4V (30 HRC)	~35 HRC	35-45 HRC	45-50 HRC
VPH-GDS	1900	Stub	#73 - 3/4" (0.50 - 20mm)	☐	☐		☐	☐	☐	☐	☐	☐	☐
VPH-GDR	1950	Jobbers	#47 - 11/16" (1.99mm - 17.46mm)	☐	☐		☐	☐	☐	☐	☐	☐	☐

Performance of VPH-GDS

Inconel 718

Made of high-quality powdered HSS, the highly rigid body combined with a sharp cutting edge is able to surpass the competitor's durability when machining Inconel 718. In a general oil-based coolant environment, the VPH-GDS is also able to provide more stable machining.

Tool	VPH-GDS	Competitor
Tool Size	Ø5.9	
Work Material	Inconel 718 (43 HRC)	
Drilling Speed	20 SFM (329 RPM)	
Feed	0.0023 IPR	
Depth of Hole	12mm (Blind) 3mm Step	
Coolant	Water Soluble (External)	
Machine	Vertical Machining Center	





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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