Vol 2

End Mills Designed for

Additive Manufacturing

AM-EBT • AM-CRE • AM-HFC • PXHF-AM

For more information
scan the QR code to visit:
osgtool.com/am-ebt

EXOCARB® AM-EBT

End Mills Designed for Additive Manufacturing

Reinforced Cutting Edge

Large Chip Pockets

Can handle large variations in chipload

Large Relief

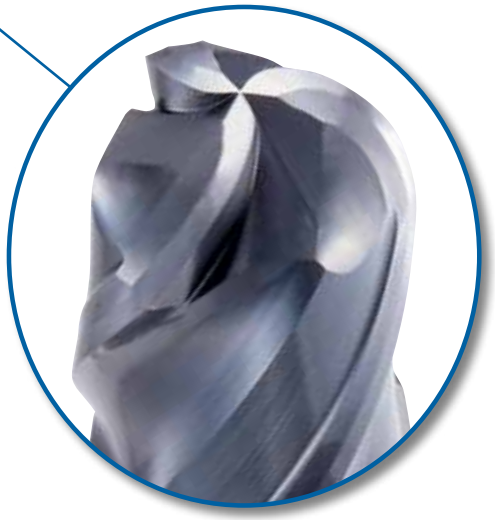
to prevent recutting and enable polishing

DUROREY Coating

Optimized for high hardness steel machining

Extremely Negative Rake Angle

for superior performance in high hardness and welded materials

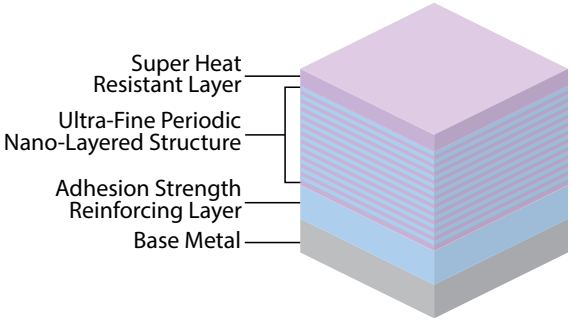


DUROREY Coating

Superior Heat Resistance and Toughness

OSG's newly developed DUROREY coating, with its unique coating structure, provides superior heat resistance and toughness for high-hardness steel milling. DUROREY coating also suppresses chipping and achieves longer tool life.

Coating Structure



DUROREY is a registered trademark of OSG Corporation.

Coating Color	Coating Structure	Hardness (GPa)	Oxidation Temperature (°C)	Heat Resistance
Black Gray	Ultra-Fine Periodic Nano-Layered	41	1,300	◎
Adhesion Strength	**Surface Roughness**	**Wear Resistance**	**Welding Resistance**	**Toughness**
○	Fair	◎	○	○

○ good ◎ best

AM-EBT: Additively Manufactured Propeller

High Efficiency Milling in SUS630 (34HRC)

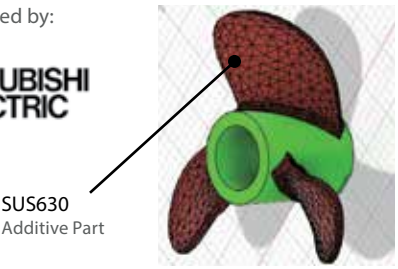
High efficiency milling by the AM-EBT in additive manufacturing part with high-hardness and unequal cutting allowance.

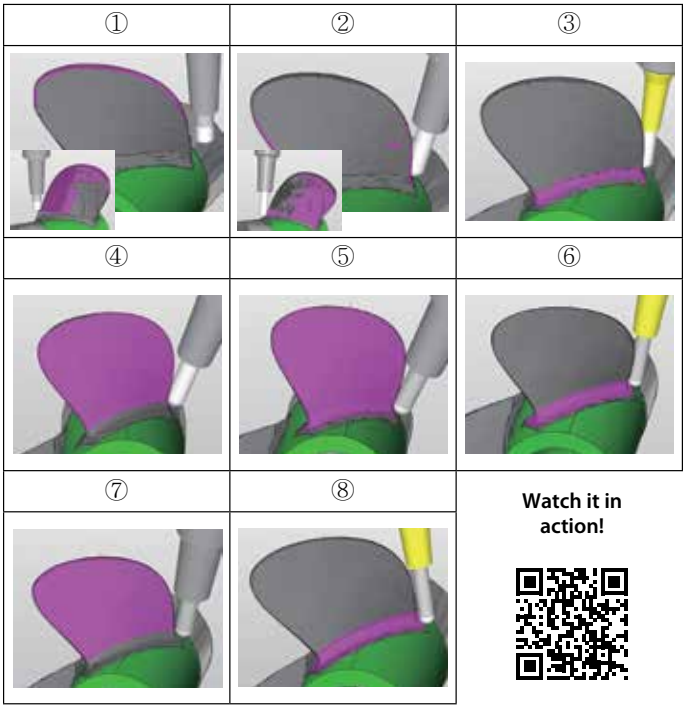
Application Details	
Workpiece	Additively Manufactured Propeller
Material	SUS630 (34HRC)
Machine	5-axis HSK-A63
Holder	Shrink Fit
Coolant	MQL

MQL was used to obtian footage and images.

Workpiece provided by:

MITSUBISHI ELECTRIC





Watch it in action!

Process	Milling Application	Milling Process	Tool	Cutting Speed (SFM)	Feed (IPM)	ap (in)	ae (in)	Machining Time
①	Overall	Roughing	NEO-CR-PHS φ16×R2	196	9.4 (0.0019 IPT)	0.039"	0.118"	1:40
②	Wing Surface	Roughing	AM-EBT R8×16	196	7 (0.0019 IPT)	0.039"	0.138"	2:30
③	Wingspan Root	Roughing	AM-EBT R8×16	196	9.4 (0.0019 IPT)	0.02"	0.079"	0:20
④	Wing Surface	Semi-roughing	AM-EBT R6×12	196	7 (0.0019 IPT)	0.039"	0.039"	2:30
⑤	Wing Surface	Semi-roughing	WXL-EBD R8×30	230	13.1 (0.0047 IPT)	0.02"	0.039"	2:20
⑥	Wingspan Root	Semi-roughing	WXL-EBD R6×18	196	15 (0.0047 IPT)	0.02"	0.02"	0:10
⑦	Wing Surface	Finishing	WXL-EBD R8×30	230	13.1 (0.0047 IPT)	0.02"	0.02"	2:20
⑧	Wingspan Root	Finishing	WXL-EBD R6×18	230	17.6 (0.0047 IPT)	0.02"	0.02"	0:10

Total machining time including tool changes: 12hrs.

AM-EBT: Additively Manufactured Inconel Wing

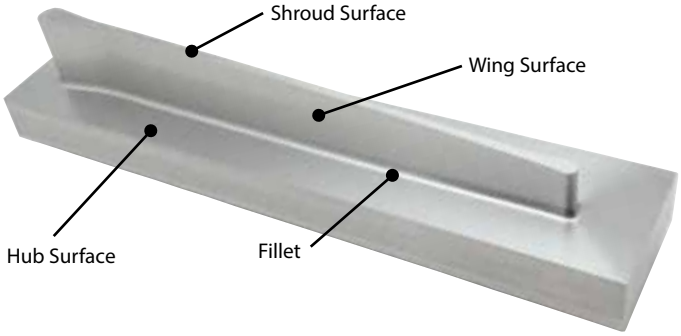
High Effeciency Surface Milling in Layered Inconel 718

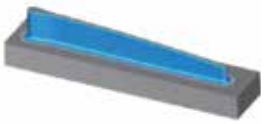
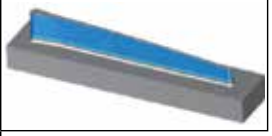
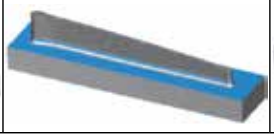
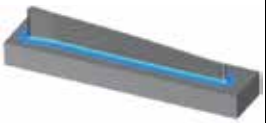
Application Details	
Workpiece	Inconel Wing
Material	Layered Inconel 718
Machine	5-axis BT50
Holder	Shrink Fit
Coolant	Water Soluble

Workpiece provided by: Hitachi Metals, Ltd. Global Research & Innovative Technology Center (GRIT)

Shape of Work Material Before Machining

After Machining



①	②	③	④	⑤
				
⑥	⑦	⑧	⑨	
				

Watch it in action!

Process	Milling Application	Milling Process	Tool	Cutting Speeed (SFM)	Feed (IPM)	ap (in)	ae(in)	Cutting Time
①	Shroud Surface	Roughing	AM-HFC 12xR1.5	196	45.12 (0.0047 IPT)	0.012"	0.177"	0:46
②	Hub Surface	Roughing		196	45.12 (0.0047 IPT)	0.012"	0.177"	0:24
③	Win Surface	Roughing		196	45.12 (0.0047 IPT)	0.012"	0.177"	0:54
④	Hub Surface	Semi-roughing	AM-HFC 12xR1.5	196	45.12 (0.0047 IPT)	0.012"	0.177"	0:04
⑤	Wing Surface	Finishing	AM-EBT R5x10	148	16.93 (0.0039 IPT)	0.004"	0.018"	1:37
⑥	Shroud Surface	Finishing		148	16.93 (0.0039 IPT)	0.004"	0.018"	1:16
⑦	Hub Surface	Finishing	AM-EBT R3x6	131	24.41 (0.0039 IPT)	0.004"	0.018"	0:15
⑧	Fillet	Finishing		131	24.41 (0.0039 IPT)	0.004"	0.018"	0:12
⑨	Fillet	Finishing		131	24.41 (0.0039 IPT)	0.004"	0.018"	0:25

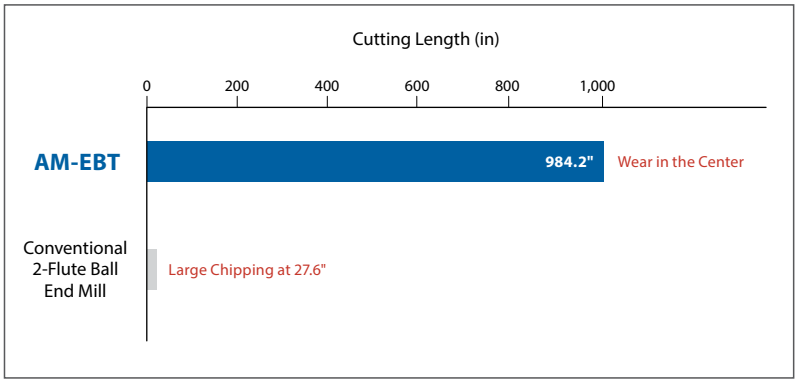
Total processing time: 6 hours

Long Tool Life Milling Built-up Welding Parts

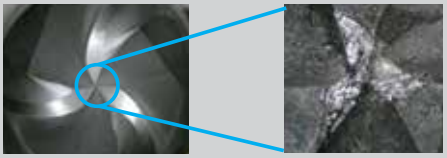
BK-660R

The AM-EBT performed exceptionally well, even when milling built-up welding parts with large depth of cut.

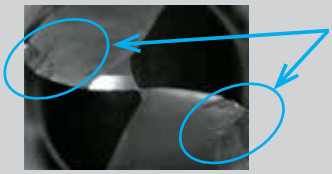
Tool	AM-EBT (R6x12)	Conventional (2-Flute Ball End Mill)
Work Material	BK-660R	
Milling Method	Linear Machining	
Cutting Speed	122 SFM (1,000 RPM)	
Feed	39.3 IPM (0.013 IPT)	
Depth of Cut	Aa = 0.12", Ar = 0.20"	
Coolant	Air Blow	
Machine	Vertical Machining Center	



AM-EBT (After Milling 984.2")



Conventional 2-flute Ball End Mill (After milling 27.6")



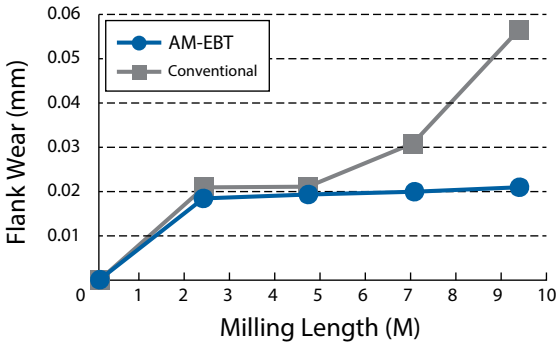
High Hardness Milling

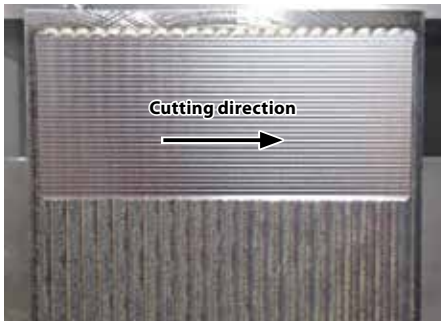
Stable Machining and Steady Wear Progression (66HRC)

AM-EBT achieved stable wear transition and excellent machined surface without peeling.

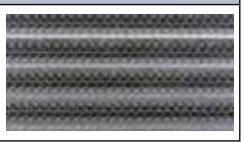
Tool	AM-EBT (R3x6)
Work Material	Additive High-Speed Steel (~66 HRC)
Milling Method	Pick Milling (Direction perpendicular to the deposited direction)
Cutting Speed	90 m/min (4,800 mim-1)
Feed	1,340 mm/min (0.093 mm/t)
Depth of Cut	Aa = 0.3mm, Ar = 0.9mm
Coolant	Air Blow
Machine	Horizontal Machining Center

Okuma Corporation: Wear Progression Testing





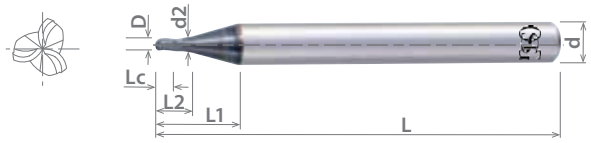
Molded with LASER-EX manufactured by Bear Corporation

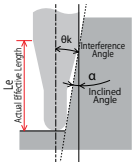
	Tool Condition After Machining 9.38m		Machined Surface
	Flank	Rake Face	
AM-EBT			
Conventional			

List 4730

AM-EBT, 3-Flute, Stub Length, Ball End

SPEED FEED P8 | CARBIDE | DUROREY | R ± 0.01 | STUB | 30° | SHANK h4





Milling Diameter Tolerance	
2 ≤ D ≤ 20	+/- 0.03mm

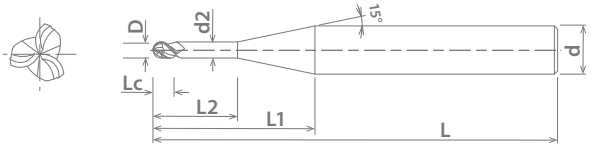
Units: mm

EDP	Mill Dia.	OAL	Length of Cut	Neck Length	Non-Tapered Neck Length	Neck Dia	Interference Angle	Effective Neck Length (Le) by Incline Angle (α)					Shank Dia.	Type
	D	L	Lc	L1	L2	d2	θk	0.5°	1.0°	1.5°	2.0°	3.0°	d	
3187240	2	60	2	11.9	4	1.95	10.64	4.19	4.33	4.42	4.55	4.85	6	1
3187280				15.9	8	1.95	7.79	8.33	5.58	8.86	9.15	9.82		
3187360	3		3	11.8	6	2.85	8.15	6.44	6.61	6.79	7.00	7.45		
3187392				17.8	12	2.85	5.22	12.64	13.03	13.44	13.89	14.91		
3187408	4		4	12	8	3.85	5.65	8.49	8.71	8.96	9.22	9.81		
3187416				20	16	3.85	3.17	16.76	17.27	17.82	18.42	19.76		
3187510	5		5	12.1	10	4.85	2.95	10.54	10.82	11.12	11.45	-		
3187520				22.1	20	4.85	1.46	20.87	21.52	-	-	-		
3188060	6		9	-	-	-	-	-	-	-	-	-		2
3188080	8	70	12	-	-	-	-	-	-	-	-	-	8	
3188100	10	80	15	-	-	-	-	-	-	-	-	-	10	
3188120	12	90	18	-	-	-	-	-	-	-	-	-	12	
3188160	16	105	24	-	-	-	-	-	-	-	-	-	16	
3188200	20	110	30	-	-	-	-	-	-	-	-	-	20	

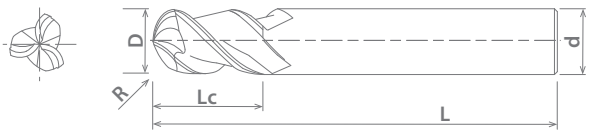
Packed: 1 pc.
Available DUROREY coating only.

HTE

Type1



Type2



Work Material

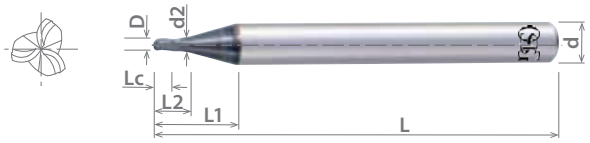
List No.	P					M			K	N		S		H			
	Carbon Steels			Alloy Steels	Die Steels	Stainless Steels ≤200HB			Cast Iron	Aluminum		Nickel Alloy	Titanium	Hardened Steels			
	Low	Med.	High														
	1010 1018	1035 1045	1065	4140 4340		300	400	17-4 PH		6061 7075	Casting	Inconel	6Al4V (30 HRC)	~35 HRC	35-45 HRC	45-50 HRC	50-70 HRC
4730						○	○	○				◎	◎		◎	◎	○

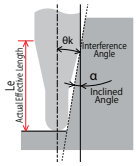
○ good ◎ best

List 4630

AM-EBT, 3-Flute, Stub Length, Ball End

NEW | SPEED FEED P8 | CARBIDE | DUROREY | R ± 0.0002 | STUB | 30° | SHANK h4





Milling Diameter Tolerance	
3/32 ≤ D ≤ 1/2	+/- 0.0012"

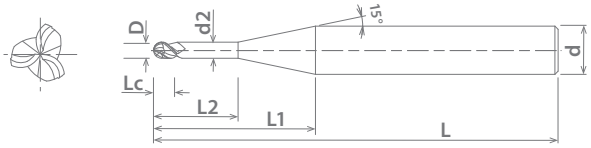
Units: Inch

EDP	Mill Dia.	OAL	Length of Cut	Neck Length	Non-Tapered Neck Length	Neck Dia	Interference Angle	Effective Neck Length (Le) by Incline Angle (α)					Shank Dia.	Type
	D	L	Lc	L1	L2	d2	Θk	0.5°	1.0°	1.5°	2.0°	3.0°	d	
46300023	3/32	2	3/32	0.4961	3/16	0.0905	10.33	0.192	0.197	0.203	0.209	0.222	1/4	1
46300123				0.6850	3/8	0.0905	7.382	0.386	0.398	0.411	0.424	0.455		
46300223	1/8		1/8	0.4921	1/4	0.1181	8.496	0.256	0.263	0.27	0.278	0.296		
46300323				0.7402	1/2	0.1181	5.399	0.515	0.531	0.547	0.566	0.607		
46300423	3/16	2.5	3/16	0.5039	3/8	0.1811	4.768	0.384	0.395	0.406	0.417	0.444		
46300523				0.8780	3/4	0.1811	2.498	0.772	0.796	0.821	0.849	-		
46300623	1/4	3	1/4					-	-	-	-	-		2
46300723	5/16	3.5	5/16					-	-	-	-	-	5/16	
46300823	3/8		9/16					-	-	-	-	-	3/8	
46300923	1/2	4	3/4					-	-	-	-	-	1/2	

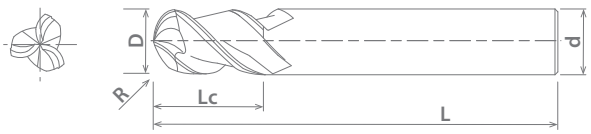
Packed: 1 pc.
Available DUROREY coating only.

HTE

Type1



Type2



Work Material

List No.	P					M			K	N		S		H			
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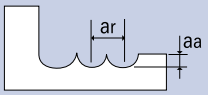
	Low	Med.	High														
	1010 1018	1035 1045	1065	4140 4340		300	400	17-4 PH		6061 7075	Casting	Inconel	6Al4V (30 HRC)	~35 HRC	35-45 HRC	45-50 HRC	50-70 HRC
4630						○	○	○				◎	◎		◎	◎	○

○ good ◎ best

List 4730 & 4630: 3-Flute, Stub Length, Ball End

Hardness		-	-	-	-	45 HRC	65 HRC	70 HRC
Work Material		Stainless Steel	Colbalt-Chromium Alloys (Stellite)	Titanium Alloy	Ni-Based Alloy (Inconel 718)	Hardened Steel		
SFM		195-260	165-230	135-190	70-130	165-230	135-190	70-130
Depth of Cut								

Dia	aa	ar
R≤6	Max: 0.15D	0.5D
R>6	Max: 3mm	

Mill Dia.		Non-Tapered Neck Length	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min
-	2	4	11100	43.3	9500	37.0	8000	31.1	4800	18.9	9500	37.0	8000	31.1	4800	18.9
-		8	5600	19.7	4800	16.9	4300	15.4	2600	9.1	4800	16.9	4300	15.4	2600	9.1
3/32	-	3/16	9371	36.6	8020	31.2	6754	26.3	4052	16.0	8020	31.2	6754	26.3	4052	16.0
		3/8	4728	16.6	4052	14.3	3630	13.0	2195	7.7	4052	14.3	3630	13.0	2195	7.7
-	3	6	7400	43.3	6400	37.8	5300	31.5	3200	18.9	6400	37.8	5300	31.5	3200	18.9
-		12	4400	23.2	3800	20.1	3300	17.7	2000	10.6	3800	20.1	3300	17.7	2000	10.6
1/8	-	1/4	7028	41.1	6078	35.9	5034	29.9	3039	17.9	6078	35.9	5034	29.9	3039	17.9
		1/2	4179	22.0	3609	19.1	3134	16.8	1899	10.1	3609	19.1	3134	16.8	1899	10.1
-	4	8	5600	42.5	4800	36.6	4000	30.3	2400	18.5	4800	36.6	4000	30.3	2400	18.5
-		16	3400	22.4	2900	19.3	2500	16.5	1500	9.8	2900	19.3	2500	16.5	1500	9.8
3/16	-	3/8	4685	35.6	3956	30.2	3332	25.2	1978	15.2	3956	30.2	3332	25.2	1978	15.2
	-	3/4	2844	18.7	2438	16.2	2032	13.4	1219	8.0	2438	16.2	2032	13.4	1219	8.0
-	5	10	4500	42.5	3800	35.8	3200	30.3	1900	18.1	3800	35.8	3200	30.3	1900	18.1
-		20	2800	23.6	2400	20.5	2000	16.9	1200	11.0	2400	21.7	2000	16.9	1200	11.0
-	6	-	3700	44.1	3200	37.8	2700	31.5	1600	18.9	3200	37.8	2700	31.5	1600	18.9
1/4	-	-	3514	41.9	3012	35.6	2510	29.3	1506	17.8	3012	35.6	2510	29.3	1506	17.8
5/16	-	-	2811	39.6	2431	34.3	2051	29.0	1216	17.1	2431	34.3	2051	29.0	1216	17.1
-	8	-	2800	39.4	2400	33.9	2000	28.3	1200	16.9	2400	33.9	2000	28.3	1200	16.9
-	10	-	2200	39.4	1900	33.9	1600	28.3	960	16.9	1900	33.9	1600	28.3	960	16.9
-	12	-	1900	44.1	1600	37.8	1300	31.5	800	18.9	1600	37.8	1300	31.5	800	18.9
9/16	-	-	1562	36.3	1325	31.3	1089	26.4	663	15.7	1325	31.3	1089	26.4	663	15.7
-	16	-	1400	36.2	1200	31.1	1000	26.0	600	15.4	1200	31.1	1000	26.0	600	15.4
3/4	-	-	1171	30.3	1030	26.7	843	21.9	506	13.0	1030	26.7	843	21.9	506	13.0
-	20	-	1100	33.1	1000	28.3	800	23.6	480	14.2	1000	28.3	800	23.6	480	14.2

1. This tool is recommended for the roughing of additive manufacturing and mold overlay surfaces.
2. Please use machines and holders that are rigid and highly accurate.
3. The values listed above are for reference. Please set the cutting condition in accordance with the actual machining environment.
4.Please reduce the feed rate when the depth of cut is greater than specified.
5. Please adjust the speed, feed and depth of cut accordingly when the overhang length is longer than specified.
6. Please use a suitable fluid with high smoke retardant properties.
7. During dry (no fluid) milling, please use air blow to remove disposable chips from the milling area and to eliminate chip packing.
8. Please use water-soluble coolant when machining stainless steel, cobalt-chromium based alloy, titanium alloy, and Ni-based alloy.
9. Tool runout should be kept to a minimum for maximum accuracy.
10. When the cutting load fluctuates in areas such as the corners, please reduce the rotational speed.

Multifluted Geometry

High Efficiency Multiflute Machining

Multifluted geometry promotes greater toolife and high efficiency milling.

< 10mm: 6 flutes

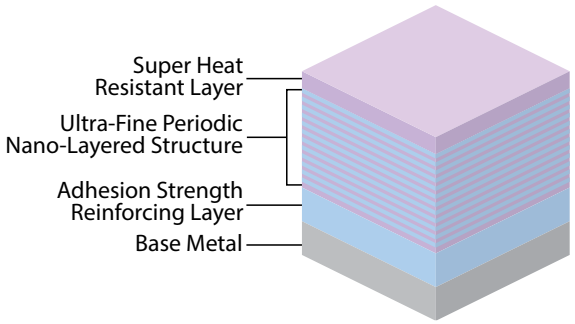
≥ 12 mm: 8 flutes

DUROREY Coating

Superior Heat Resistance and Toughness

OSG's newly developed DUROREY coating, with its unique coating structure, provides superior heat resistance and toughness for high-hardness steel milling. DUROREY coating also suppresses chipping and achieves longer tool life.

Coating Structure



DUROREY is a registered trademark of OSG Corporation.

Coating Color	Coating Structure	Hardness (GPa)	Oxidation Temperature (°C)	Heat Resistance
Black Gray	Ultra-Fine Periodic Nano-Layered	41	1,300	◎
Adhesion Strength	**Surface Roughness**	**Wear Resistance**	**Welding Resistance**	**Toughness**
○	Fair	◎	○	○

○ good ◎ best

Extremely Negative Rake Angle
Corner radius offers greater protection in high hardness multilayered parts

Large Chip Pockets
Enables cutting with large allowances in chipload

Unique Geometry
enables smooth cutting and polished surface finish

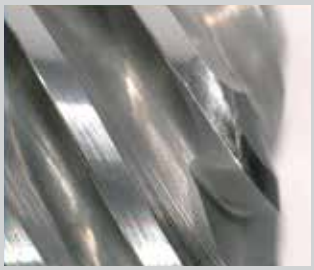
DUROREY Coating
Optimized for high hardness steel machining

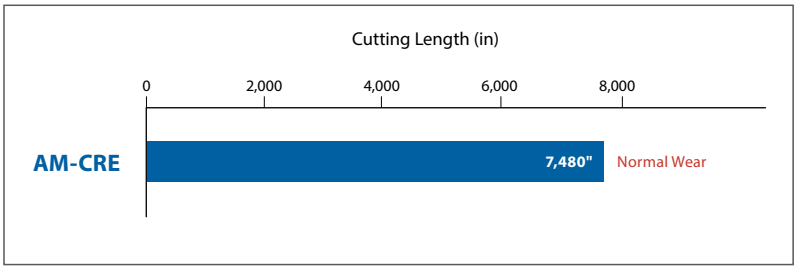
Milling Example in Stellite Alloys

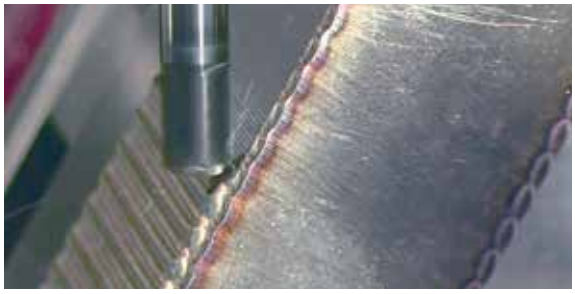
Stellite Alloys (48HRC)

Tool	AM-CRE (Ø8xR2 - 6-Flute)
Work Material	Stellite (48HRC)
Milling Method	Contour Line Operation
Cutting Speed	164 SFM (2,000 RPM)
Feed	23.6 IPM (0.002 IPT)
Depth of Cut	Aa = 0.002", Ar = 0.002"
Coolant	Air Blow
Machine	Vertical Machining Center

AM-CRE (After Milling 7,480")



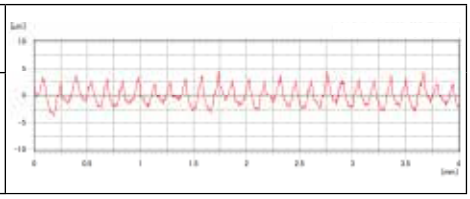




Layered Hardened Stainless Steel

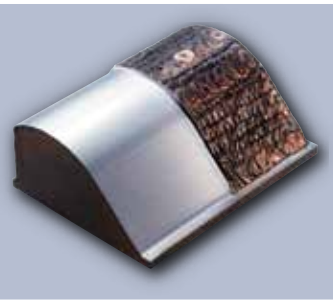
Precipitation Hardening Stainless Steel Additive Material (45HRC)

Tool	AM-CRE (Ø8xR2 - 6-Flute)
Work Material	SUS630 (45HRC)
Milling Method	Contour Line Operation
Cutting Speed	63m/min (2,500 mim-1)
Feed	869 mm/min (0.058 mm/t)
Depth of Cut	Aa = 0.1mm, Ar = 1.0mm
Coolant	Water-Soluble
Machine	Five-Axis Machining Center

Surface Roughness	
Ra1.3627µm Rz6.9465µm	

Mold Application:
Additive manufacturing end mills in welded applications

Welded material covers the majority of the part in a mold repair application. In addition to the high hardness of the material, there is a change in the cutting allowance making the part difficult to process. The AM series end mills make it possible to cope with the large varience in these welded parts through a exceptionally strong cutting edge.

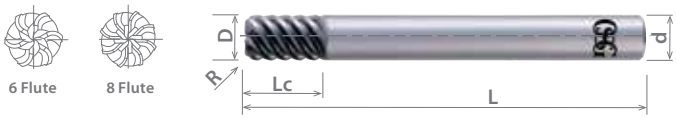


List 4770

AM-CRE, Multi-Flute, Stub Length, Corner Radius

SPEED FEED P12 | CARBIDE | DURAREY | R ± 0.03 | STUB | 60° | SHANK h4

Milling Diameter Tolerance	
6 ≤ D ≤ 20	+/- 0.01mm



Units: mm

EDP	Mill Diameter	Corner Radius	OAL	Length of Cut	Shank Diameter	No. of Flutes
	D	R	L	Lc	d	
3183010	6	1	60	9	6	6
3183015		1.5				
3183018	8	1	70	12	8	
3183020		2				
3183110	10	1	80	15	10	
3183120		2				
3183210	12	1	90	18	12	8
3183220		2				
3183226	16	1	105	24	16	
3183230		3				
3183310	20	1	110	30	20	
3183330		3				

Packed: 1 pc.
Available DURAREY coating only.

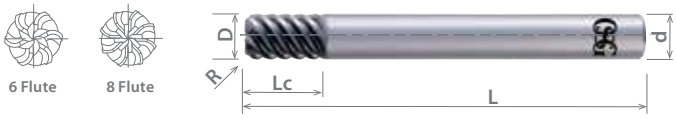
HTE

List 4670

AM-CRE, Multi-Flute, Stub Length, Corner Radius

NEW | SPEED FEED P12 | CARBIDE | DURAREY | R ±0.0012 | STUB | 60° | SHANK h4

Milling Diameter Tolerance	
1/4 ≤ D ≤ 1/2	+/- 0.0004"



Units: Inch

EDP	Mill Diameter	Corner Radius	OAL	Length of Cut	Shank Diameter	No. of Flutes
	D	R	L	Lc	d	
46700023	1/4	1/32	3	3/8	1/4	6
46700123		1/16				
46700223	5/16	3/64	3.5	15/32	5/16	
46700323		3/32				
46700423	3/8	3/64		9/16	3/8	
46700523		3/32				
46700623	1/2	1/16	4	3/4	1/2	8
46700723		1/8				

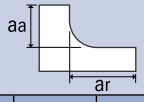
Packed: 1 pc.
Available DURAREY coating only.

HTE

Work Material																		
	P					M			K	N		S		H				
List No.	Carbon Steels			Alloy Steels	Die Steels	Stainless Steels ≤200HB			Cast Iron	Aluminum		Nickel Alloy	Titanium	Hardened Steels				
	Low	Med.	High															
	1010 1018	1035 1045	1065	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
4770						○	○	○				◎	◎		◎	◎	○
4670						○	○	○				◎	◎		◎	◎	○

○ good ◎ best

List 4770 & 4670: Multi-Flute, Stub Length, Corner Radius

Hardness			-		-		-		-		45 HRC		65 HRC		70 HRC	
Work Material			Stainless Steel		Colbalt-Chromium Alloys (Stellite)		Titanium Alloy		Ni-Based Alloy (Inconel 718)		Hardened Steel					
Cutting Speed			195-260 SFM		165-230 SFM		135-190 SFM		70-130 SFM		165-230 SFM		135-190 SFM		70-130 SFM	
Depth of Cut																
Diameter		Radius	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min
-	6	1	4240	60.2	3700	52.4	3200	45.3	1910	27.2	3700	52.4	3200	45.3	1910	27.2
-		1.5	3700	44.1	3200	37.8	2700	31.5	1600	18.9	3200	37.8	2700	31.5	1600	18.9
1/4	-	1/32	3972	56.4	3514	49.8	3025	42.8	1820	25.9	3514	49.8	3025	42.8	1820	25.9
	-	1/16	3514	41.9	3025	35.7	2536	29.6	1497	17.7	3025	35.7	2536	29.6	1466	17.3
5/16	-	3/64	3178	56.3	2811	49.7	2420	42.9	1442	25.4	2811	49.7	2420	42.9	1442	25.4
	-	3/32	2811	33.2	2420	28.5	2029	23.9	1197	14.2	2420	28.5	2029	23.9	1173	13.9
-	8	1	3180	56.3	2780	49.2	2400	42.5	1430	25.2	2780	49.2	2400	42.5	1430	25.2
-		2	2800	33.1	2400	28.3	2000	23.6	1200	14.2	2400	28.3	2000	23.6	1200	14.2
3/8	-	3/64	2648	67.6	2358	60.2	2030	51.8	1201	30.7	2342	59.8	2016	51.5	1201	30.7
	-	3/32	2342	40.3	2030	34.8	1690	28.4	998	16.9	2016	34.6	1690	28.4	977	16.6
-	10	1	2540	72.0	2220	63	1900	53.9	1150	32.7	2220	63	1900	53.9	1150	32.7
-		2	2200	42.1	1900	36.2	1600	29.9	960	18.1	1900	36.2	1600	29.9	960	18.1
-	12	1	2120	100.0	1850	87.4	1600	75.6	960	45.3	1850	87.4	1600	75.6	960	45.3
-		2	1900	58.7	1600	50	1300	41.7	800	25.2	1600	50	1300	41.7	800	25.2
1/2	-	1/16	1986	93.7	1757	83.0	1512	71.4	901	42.5	1757	83.0	1521	71.9	901	42.5
	-	1/8	1757	54.3	1512	47.3	1268	40.7	748	23.6	1521	47.5	1268	40.7	733	23.1
-	16	1	1590	110.2	1380	95.7	1200	83.1	720	50	1380	95.7	1200	83.1	720	50
-		3	1400	65.7	1200	56.3	1000	46.9	600	28.3	1200	56.3	1000	46.9	600	28.3
-	20	1	1270	111.8	1110	98	1000	88.2	570	50.4	1110	98	1000	88.2	570	50.4
-		3	1100	70.1	1000	60.2	800	50	480	29.9	1000	60.2	800	50	480	29.9

Dia	aa	ar
R≤6	Max: 0.2 x CR	0.5D
R>6	Max: 0.5 x D	

1. This tool is recommended for the roughing of additive manufacturing and mold overlay surfaces.
2. Please use machines and holders that are rigid and highly accurate.
3. The values listed above are for reference. Please set the cutting condition in accordance with the actual machining environment.
4.Please reduce the feed rate when the depth of cut is greater than specified.
5. Please adjust the speed, feed and depth of cut accordingly when the overhang length is longer than specified.
6. Please use a suitable fluid with high smoke retardant properties.
7. During dry (no fluid) milling, please use air blow to remove disposable chips from the milling area and to eliminate chip packing.
8. Please use water-soluble coolant when machining stainless steel, cobalt-chromium based alloy, titanium alloy, and Ni-based alloy.
9. Tool runout should be kept to a minimum for maximum accuracy.
10. When the cutting load fluctuates in areas such as the corners, please reduce the rotational speed.

Coolant-Through
Improves chip evacuation & prevents chip packing

Flat Cutting Edge
Suppresses chipping and improves surface quality

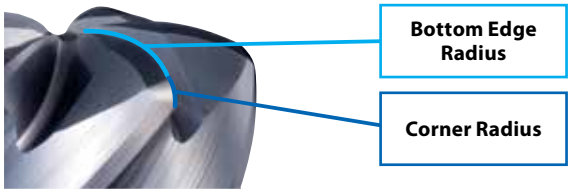
Composite Radius
Optimized for flat surface machining

DUROREY Coating
Optimized for high hardness steel machining

Composite Radius Shape

Optimized for Flat Surface Machining

Strong cutting edge can withstand unstable depths of cut.



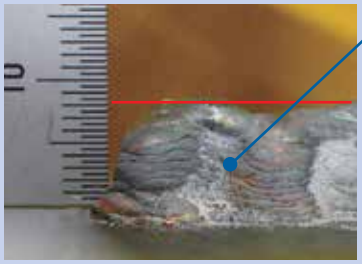
Flat Cutting Edge

For Improved Surface Quality

- Suppresses chipping of the end cutting edge.
- Achieves good machined surface quality.

Additive Manufacturing

Typical Part Surface



Challenge:
Welded material; large variations in the amount of material to be removed.

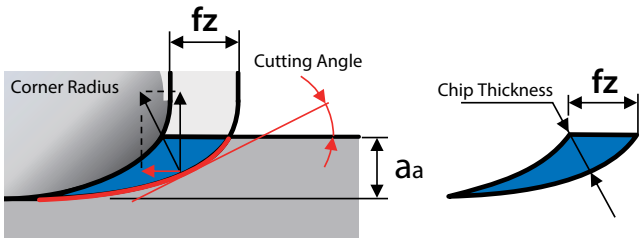
Requirement:
Cutting edge resistant to chipping, even in varying depths of cut.

Benefit:
Stable machining & reduced processing time.

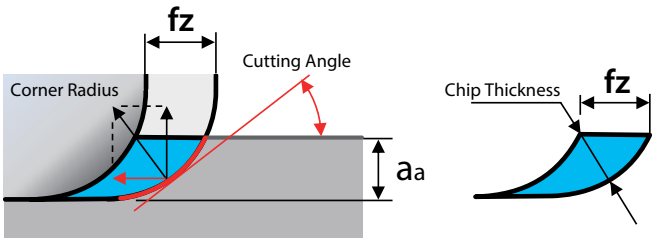
High Efficiency Machining

Composite Radius Shape for Flat Surface Machining

Since the depth of cut is small, cutting resistance in the feed direction is reduced, and vibration & deflection of the tool are suppressed. By reducing the chip thickness, cutting heat is easily transferred to the chip and it is difficult for heat to remain on the tool edge and work material.



Composite Radius Shape



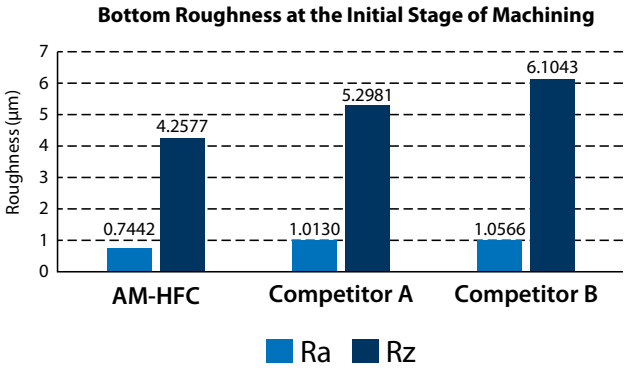
Conventional Radius Shape

AM-HFC: Flat Cutting Edge

SKD61 (50HRC)

Achieved a good, flat machined surface with Composite Radius

Tool	AM-HFC	Competitor A	Competitor B
Size	Ø4 x R0.5	6FL	4FL
Work Material	SKD61 (50 HRC), welded		
Milling Method	Facing (perpendicular to welding direction)		
Cutting Speed	196 SFM (4775 RPM)		
Feed	169.3 IPM		
Feed per Tooth	0.006 IPT	0.006 IPT	0.009 IPT
Depth of Cut	Aa = 0.006 in, Ar = 0.079 in		
Coolant	Air		
Machine	Vertical Machining Center		



AM-HFC: Excellent Durability in Nickel-Alloys

Inconel 718 - Welded

AM-HFC was able to process up to 8 workpieces, with a total cutting amount of 11.5 in^3.

Tool	AM-HFC
Size	Ø10 x R1.2
Work Material	Inconel 718, welded
Milling Method	Facing
Cutting Speed	164 SFM (1592 RPM)
Feed	18.8 IPM (0.0019 ipt)
Depth of Cut	Aa = 0.020 in, Ar = 0.079 in
Coolant	Air
Machine	5-Axis Machining Center

Molded and machined with the LASER EX manufactured by Okuma Corporation.

Cooperation: Okuma Corporation

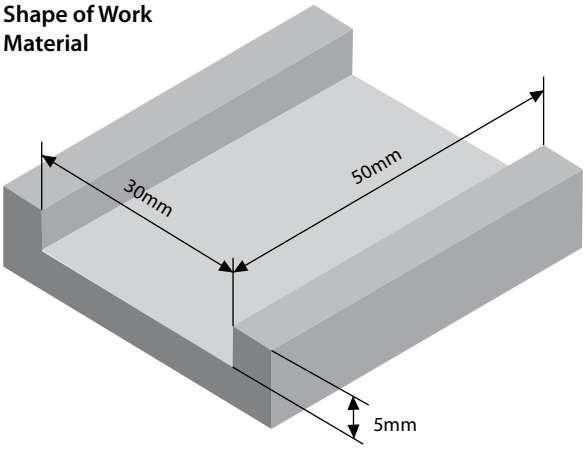
AM-HFC: Excellent Surface Quality

SKH51 (65 HRC)

Stable machining with no chipping on both the end cutting edge and outer peripheral cutting edge.

Tool	AM-HFC	
Size	Ø10 x R1.2	
Work Material	SKH51 (65 HRC)	
Milling Method	Facing	Trochoidal Milling
Cutting Speed	328 SFM (3200 RPM)	
Feed	60.5 IPM (0.0031 ipt)	35.4 IPM (0.0018 ipt)
Depth of Cut	Aa = 0.004 in, Ar = 0.157 in	Aa = 0.197 in, Ar = 0.008 in
Coolant	Air	
Machine	Vertical Machining Center	

Shape of Work Material

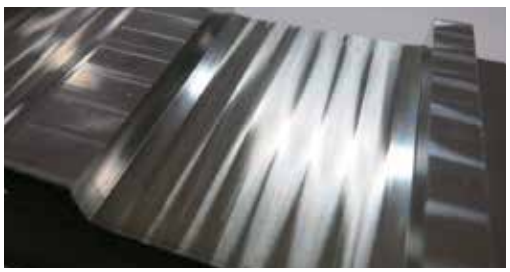
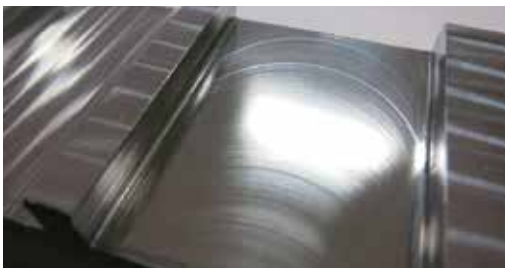


Worn State After Frontal Milling 3 Slots and Trochoidal Milling 2 Slots

The AM-HFC exhibits no chipping on the end cutting edge and outer peripheral cutting edge, and can continued to be used.

End cutting edge		Peripheral cutting edge	
AM-HFC	Competitor	AM-HFC	Competitor
			

Condition of the Bottom Surface Machined by AM-HFC

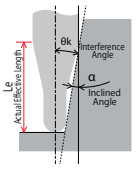
Frontal Milling	Trochoidal Milling
	

List 4970

AM-HFC, High Feed Radius Type

NEW | SPEED FEED P18 | CARBIDE | DUROREY | R ± 0.03 | 45° | SHRINK FIT

Milling Diameter Tolerance	
1/4 ≤ D ≤ 1/2	+/- 0.0004"



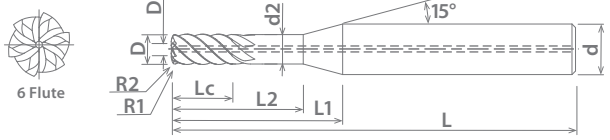
Units: mm

EDP	Mill Dia. X Effetive Corner Radius	Effective Diameter	Overall Length	Length of Cut	Corner Radius	Endcut Radius	Neck Length	Non-Tapered Neck Length	Neck Dia	Interference Angle	Effective Neck Length (Le) by Incline Angle (α)					Shank Diameter	
	DxRt	D1	OAL	Lc	R1	R2	L1	L2	d2	Θk	0.5°	1.0°	1.5°	2.0°	3.0°	d	TYPE
3188204	4XR0.5	2	50	8	0.4	2.5	15.9	12	3.8	3.73°	12.53	12.98	13.43	13.91	15	6	1
3188205	5XR0.6	2.5	60	10	0.5	3	17	15	4.8	1.76°	15.64	16.18	16.74	-	-	6	
3188206	6XR0.8	3	60	12	0.6	3.5	-	18	5.8	-	-	-	-	-	-	6	2
3188208	8XR1	4	70	16	0.8	5	-	24	7.7	-	-	-	-	-	-	8	
3188210	10XR1.2	5	80	20	1	6	-	30	9.7	-	-	-	-	-	-	10	
3188212	12XR1.5	6	90	24	1.2	7	-	36	11.7	-	-	-	-	-	-	12	

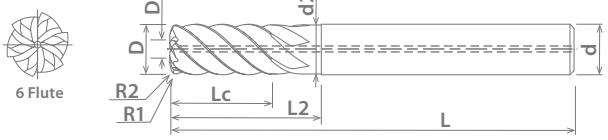
Packed: 1 pc.
Available DUROREY coating only.

HTE

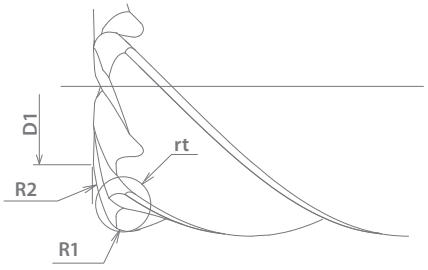
Type1



Type2



Details of Corner Radius



Work Material

List No.	P					M			K	N		S		H			
	Carbon Steels			Alloy Steels	Die Steels	Stainless Steels ≤200HB			Cast Iron	Aluminum		Nickel Alloy	Titanium	Hardened Steels			
	Low	Med.	High														
	1010 1018	1035 1045	1065	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
4970						◎	◎	◎				◎	◎		○	◎	◎

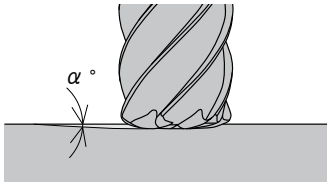
○ good ◎ best

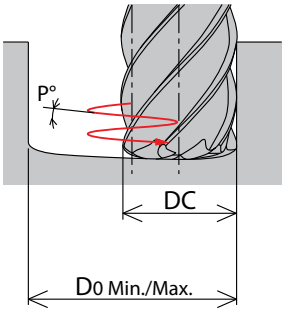
AM-HFC

Ramping Angles & Flute Shape Definitions

AM-HFC Maximum Ramping Angle (α) & Maximum Helical Angle (P)

DC×rt	Ramping Angle	Helical Milling (mm)		Helical Angle
	α	D0 Min.	D0 Max.	P°
4 × R0.5	3°	6	7	1.5°
5 × R0.6		7.5	9	
6 × R0.8		9	11	
8 × R1		12	15	
10 × R1.2		15	19	
12 × R1.5		18	23	

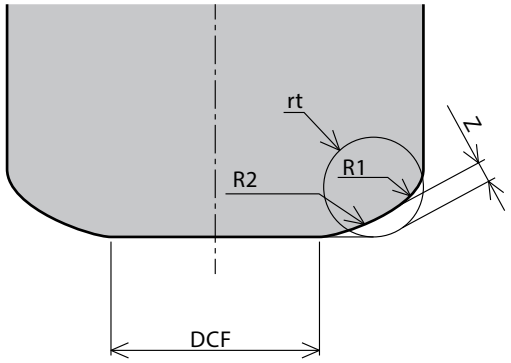




Edge shape definitions for the purpose of creating a program.

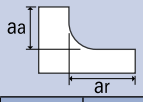
DC	rt	Remainder
		Z
4	R0.5	0.11
5	R0.6	0.15
6	R0.8	0.17
8	R1	0.22
10	R1.2	0.31
12	R1.5	0.36

During machining, please program the milling paths according to the recommended simulated R (rt) respective to the individual end mill diameter.



List 4970: High Feed Radius Type

Facing

Hardness	-		-		-		-		45 HRC		65 HRC		70 HRC	
Work Material	Stainless Steel		Colbalt-Chromium Alloys (Stellite)		Titanium Alloy		Ni-Based Alloy (Inconel 718)		Hardened Steel					
SFM	330-395		295-360		230-295		100-165		295-360		230-295		165-230	
Depth of Cut									aa Max: 0.04D	ar Max: 0.5D				
Mill Dia. X Effetive Corner Radius (DxRt)	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min
4XR0.5	8760	248.4	7960	225.6	6370	180.7	3180	29.9	7960	225.6	6370	180.7	4780	67.7
5XR0.6	7010	248.4	6370	225.6	5100	180.7	2550	30.3	6370	225.6	5100	180.7	3820	67.7
6XR0.8	5840	248.4	5310	225.6	4250	180.7	2120	29.9	5310	225.6	4250	180.7	3180	67.7
8XR1	4380	248.4	3980	225.6	3180	180.3	1590	29.9	3980	225.6	3180	180.3	2390	67.7
10XR1.2	3500	248	3180	225.2	2550	180.7	1270	29.9	3180	225.2	2550	180.7	1910	67.7
12XR1.5	2920	248.4	2650	225.2	2120	180.3	1060	29.9	2650	225.2	2120	180.3	1590	67.7

Side Milling

Hardness	-		-		-		-		45 HRC		65 HRC		70 HRC	
Work Material	Stainless Steel		Colbalt-Chromium Alloys (Stellite)		Titanium Alloy		Ni-Based Alloy (Inconel 718)		Hardened Steel					
SFM	330-395		265-330		165-230		100-165		265-330		195-230		100-165	
Depth of Cut	aa Max: 1.5D ar Max: 0.05D				aa Max: 1.5D ar Max: 0.02D				aa Max: 1.5D ar Max: 0.05D				aa Max: 1.0D ar Max: 0.02D	
Mill Dia. X Effetive Corner Radius (DxRt)	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min	Speed RPM	Feed in/min
4XR0.5	7960	52.8	7170	47.2	4780	22.4	2390	9.1	7960	47.2	6370	22.4	4780	9.1
5XR0.6	6370	52.8	5730	47.2	3820	22.4	1910	9.1	6370	47.2	5100	22.4	3820	9.1
6XR0.8	5310	52.8	4780	47.2	3180	22.4	1590	9.1	5310	47.2	4250	22.4	3180	9.1
8XR1	3980	75.2	3580	67.7	2390	31.5	1190	9.1	3980	67.7	3180	31.5	2390	15
10XR1.2	3180	75.2	2870	67.7	1910	31.5	960	9.1	3180	67.7	2550	31.5	1910	15
12XR1.5	2650	75.2	2390	67.7	1590	31.5	800	9.1	2650	67.7	2120	31.5	1590	15

Parameter Reduction Chart by Length to Diameter Ratio

Overhang Length	Cutting Speed	a_p	fz
L/D ≤ 4	100%	100%	100%
4 < L/D ≤ 5	90%	75%	80%
5 < L/D ≤ 6	80%	50%	60%

Coolant-Through
Improves chip evacuation & prevents chip packing

Flat Cutting Edge
Suppresses chipping and improves surface quality

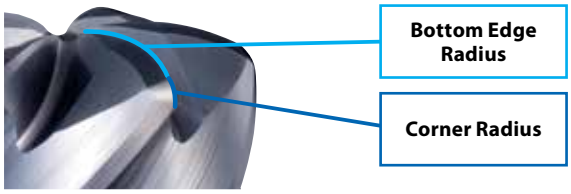
Composite Radius
Optimized for flat surface machining

DUROREY Coating
Optimized for high hardness steel machining

Composite Radius Shape

Optimized for Flat Surface Machining

Strong cutting edge can withstand unstable depths of cut.



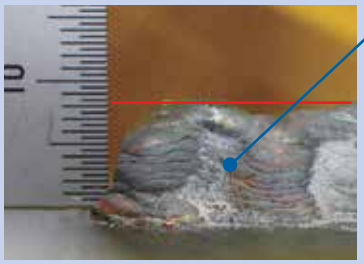
Flat Cutting Edge

For Improved Surface Quality

- Suppresses chipping of the end cutting edge.
- Achieves good machined surface quality.

Additive Manufacturing

Typical Part Surface



Challenge:
Welded material; large variations in the amount of material to be removed.

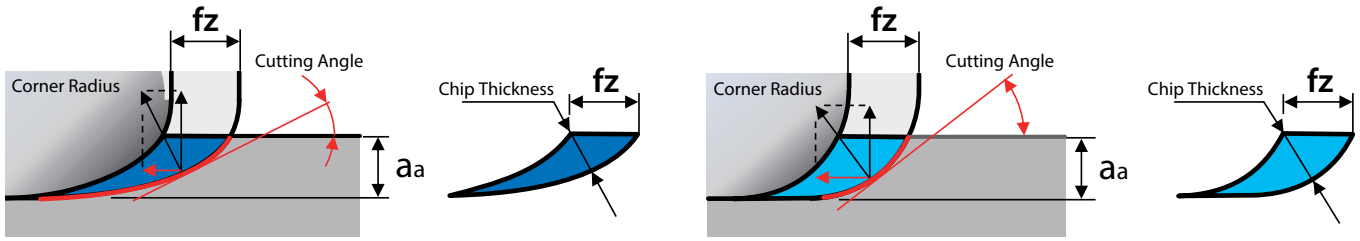
Requirement:
Cutting edge resistant to chipping, even in varying depths of cut.

Benefit:
Stable machining & reduced processing time.

High Efficiency Machining

Composite Radius Shape for Flat Surface Machining

Since the depth of cut is small, cutting resistance in the feed direction is reduced, and vibration & deflection of the tool are suppressed. By reducing the chip thickness, cutting heat is easily transferred to the chip and it is difficult for heat to remain on the tool edge and work material.

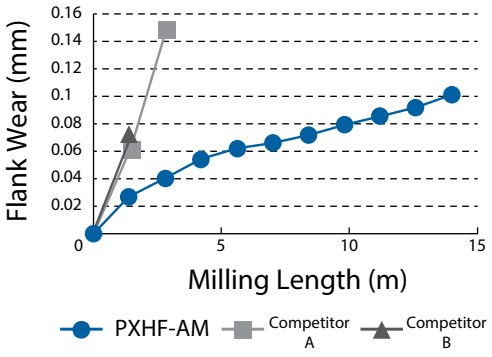


PXHF-AM: Excellent Tool Life in Hardened Steel

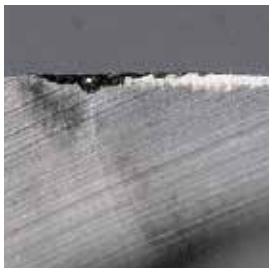
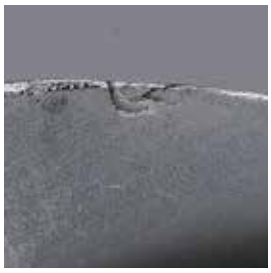
SKH51 (65 HRC)

In SKH51 (65 HRC), the durability of PXHF-AM was 4 times that of the competitor.

Tool	PXHF-AM	Competitors
Size	Ø16 (6FL)	Ø16 (4FL)
Work Material	SKH51 (65 HRC)	
Milling Method	Facing	
Cutting Speed	197 SFM (1200 RPM)	
Feed	56.7 IPM (0.0079 ipt)	56.7 IPM (0.0118 ipt)
Depth of Cut	Aa = 0.012 in, Ar = 0.315 in	
Coolant	Air	
Machine	Vertical Machining Center	



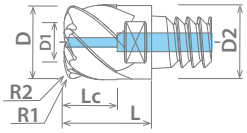
Cutting Edge Wear on Corner Radius

PXHF-AM (13.9m)	Competitor A (2m)	Competitor B (1.4m)
		

List 78PXHF-AM

NEW SPEED FEED P26-27

PXHF-AM Echangeable Heads (Inch & Metric), 6 Flutes, High Feed, Corner Radius, Coolant-Through

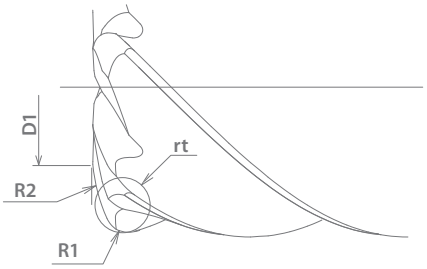


EDP#	Type	Designation	Head Dia.		Effective Dia.		Effective Radius		Corner Radius		Bottom Edge Radius		Length of Cut		Overall Length		Flange Dia.		Helix Angle	Grade
			D		D1		rt		R1		R2		Lc		L		D2			
			mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch		
52313000	PXHF-AM	PXHF-AM0500AC12-06R060-O	-	0.500	-	0.250	-	0.060	-	0.050	-	0.300	-	0.350	-	0.598	-	0.488	45°	XP6703
52313001		PXHF-AM0625AC16-06R080-O	-	0.625	-	0.313	-	0.080	-	0.063	-	0.375	-	0.438	-	0.732	-	0.613	45°	XP6703
52313002		PXHF-AM0750AC20-06R100-O	-	0.750	-	0.375	-	0.100	-	0.075	-	0.450	-	0.525	-	0.807	-	0.736	45°	XP6703
52313003		PXHF-AM1000AC25-06R120-O	-	1.000	-	0.500	-	0.120	-	0.100	-	0.600	-	0.700	-	1.098	-	0.960	45°	XP6703
7830377		PXHF-AM120C12-06R150-O	12	-	6	-	1.5	-	1.2	-	7	-	8.4	-	14.4	-	11.7	-	45°	XP6703
7830378		PXHF-AM160C16-06R200-O	16	-	8	-	2	-	1.6	-	9.5	-	11.2	-	18.7	-	15.7	-	45°	XP6703
7830379		PXHF-AM200C20-06R250-O	20	-	10	-	2.5	-	2	-	12	-	14	-	21.5	-	19.6	-	45°	XP6703

Packed: 1 pc.

PXI

Details of Corner Radius



List 52319

PXM SA/TPA (inch) - Coolant-Through


Straight Shank

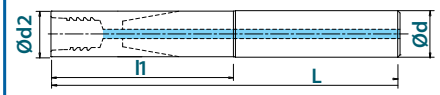

Tapered Shank

EDP No.	Body Type	Designation	Type	Neck Dia. (inch)	Shank Dia. (inch)	Taper	Overall Length (inch)	Neck Length (inch)	Applicable Head (Inch)
				d2	d	α°	L	l1	
52319000	Cylindrical Shank Steel	PXMZ-C12SA0500-S400-O	3	0.488	0.500	-	4.000	0.750	0.500
52319001		PXMZ-C16SA0625-S400-O	3	0.613	0.625	-	4.000	1.000	0.625
52319002		PXMZ-C20SA0750-S500-O	3	0.736	0.750	-	5.000	1.250	0.750
52319003		PXMZ-C25SA1000-S550-O	3	0.960	1.000	-	5.500	1.500	1.000
52319004	Cylindrical Shank Carbide	PXMZ-C12SA0500-S300CS-O	3	0.488	0.500	-	3.000	1.000	0.500
52319005		PXMZ-C12SA0500-L400CS-O	3	0.488	0.500	-	4.000	1.750	0.500
52319006		PXMZ-C12SA0500-L450CS-O	3	0.488	0.500	-	4.500	2.500	0.500
52319007		PXMZ-C12TPA0625-LL550CS-O	4	0.488	0.625	1.2°	5.500	3.250	0.500
52319008		PXMZ-C12TPA0625-LL600CS-O	4	0.488	0.625	1°	6.000	3.750	0.500
52319009		PXMZ-C16SA0625-S350CS-O	3	0.613	0.625	-	3.500	1.500	0.625
52319010		PXMZ-C16SA0625-L550CS-O	3	0.613	0.625	-	5.500	2.500	0.625
52319011		PXMZ-C16SA0625-L600CS-O	3	0.613	0.625	-	6.000	3.250	0.625
52319012		PXMZ-C16TPA0750-LL650CS-O	4	0.613	0.750	1°	6.500	4.500	0.625
52319013		PXMZ-C16TPA0750-LL700CS-O	4	0.613	0.750	1°	7.000	5.000	0.625
52319014		PXMZ-C20SA0750-S350CS-O	3	0.736	0.750	-	3.500	1.500	0.750
52319015		PXMZ-C20SA0750-L600CS-O	3	0.736	0.750	-	6.000	3.000	0.750
52319016		PXMZ-C20SA0750-L700CS-O	3	0.736	0.750	-	7.000	4.250	0.750
52319017		PXMZ-C20TPA1000-LL800CS-O	4	0.736	1.000	1.5°	8.000	5.500	0.750
52319018		PXMZ-C20TPA1000-LL850CS-O	4	0.736	1.000	1.2°	8.500	6.000	0.750
52319019		PXMZ-C25SA1000-L800CS-O	3	0.960	1.000	-	8.000	3.750	1.000

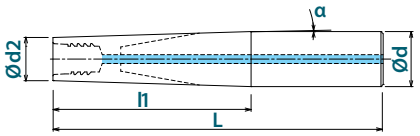
Packed: 1 pc.
Note: Wrench included with body.

PXT

Type 3



Type 4



List 78035

PXM SS/TP (metric) - Coolant-Through

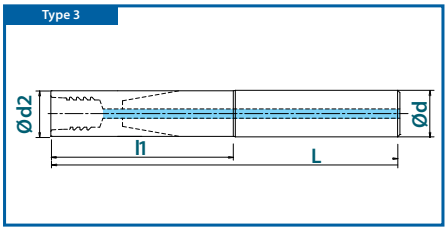
Straight Shank

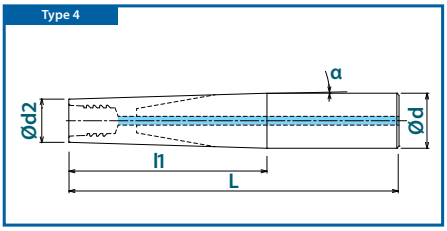
Tapered Shank

EDP No.	Body Type	Designation	Type	Neck Dia. (mm)	Shank Dia. (mm)	Taper	Overall Length (mm)	Neck Length (mm)	Applicable Head (mm)
				d2	d	α°	L	l1	
48309001	Cylindrical Shank Steel	PXMZ-C12SS12-S100-O	3	11.7	12	-	100	18	12
48309002		PXMZ-C16SS16-S100-O	3	15.7	16	-	100	23	16
48309003		PXMZ-C20SS20-S120-O	3	19.6	20	-	120	28	20
48309004		PXMZ-C25SS25-S140-O	3	24	25	-	140	34.5	25
48309005	Cylindrical Shank Carbide	PXMZ-C12SS12-S075CS-O	3	11.7	12	-	75	25	12
48309006		PXMZ-C12SS12-L100CS-O	3	11.7	12	-	100	46.3	12
48309007		PXMZ-C12SS12-L115CS-O	3	11.7	12	-	115	65	12
48309008		PXMZ-C12TP16-LL135CS-O	4	11.7	16	1.3°	135	85	12
48309009		PXMZ-C12TP16-LL150CS-O	4	11.7	16	1°	150	85.6	12
48309010		PXMZ-C16SS16-S090CS-O	3	15.7	16	-	90	40	16
48309011		PXMZ-C16SS16-L130CS-O	3	15.7	16	-	130	62	16
48309012		PXMZ-C16SS16-L135CS-O	3	15.7	16	-	135	85	16
48309013		PXMZ-C16TP20-LL165CS-O	4	15.7	20	1°	165	115	16
48309014		PXMZ-C16TP20-LL180CS-O	4	15.7	20	1°	180	116.6	16
48309015		PXMZ-C20SS20-S090CS-O	3	19.6	20	-	90	40	20
48309016		PXMZ-C20SS20-L150CS-O	3	19.6	20	-	150	79.3	20
48309017		PXMZ-C20SS20-L180CS-O	3	19.6	20	-	180	110	20
48309018		PXMZ-C20TP25-LL200CS-O	4	19.6	25	1°	200	140	20
48309019		PXMZ-C20TP25-LL210CS-O	4	19.6	25	1°	210	145	20
48309020		PXMZ-C25SS25-L200CS-O	3	24	25	-	200	98	25

Packed: 1 pc.
Note: Wrench included with body.

PXT





List 7808H

PXM Accessories

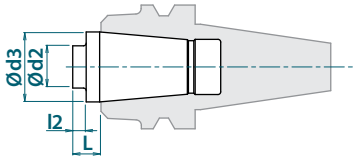
Appearance	EDP No.	Designation	Applicable Head (inch)	Applicable Head (mm)	Recommended Tightening
Spanner Wrench	7801890	PXMP8-10	0.375	10-12	10.0 Nm
			0.500	12-14	12.0 Nm
	7801891	PXMP13-16	0.625	16-18	30.0 Nm
			0.750	20-22	50.0 Nm
	7801892	PXMP21	1.000	25	60.0 Nm
	7801897	PXMP24	1.250	32	60.0 Nm

Packed: Wrench = 1 pc.

PXT

List 78340

PXMC (Metric)



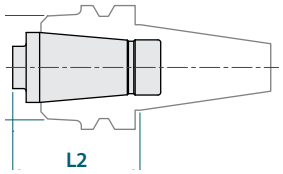
EDP No.	Body Type	Designation	Neck Dia. (mm)	Body Dia. (mm)	Projection Length (mm)	Neck Length (mm)	Applicable Head (mm)
			d2	d3	L	l2	
7834001	Extra-Short	PXMC-C1205	11.7	26	10.5	5	12
7834002		PXMC-C1605	15.7	26	10.5	5	16
7834003		PXMC-C2005	19.6	26	10.5	5	20
7834004		PXMC-C2505	24	26	10.5	5	25
7834011	Short	PXMC-C1230	11.7	26	35.5	30	12
7834012		PXMC-C1630	15.7	26	35.5	30	16
7834013		PXMC-C2030	19.6	26	35.5	30	20
7834014		PXMC-C2530	24	26	35.5	30	25

Packed: 1 pc.
Note: The PXMC collet is compatible with the HYPRO Shrink Collet System.
Note: Wrench sold seperately.

PXT

HY-PRO® Shrink

2 Piece Base Holders



EDP No.	Body Type	Designation	Nose Diameter (mm)	Gage Length (mm)	
			C	L2	
				Extra-Short	Short
9910002	CAT40	CT40-SLK12-45	40.9	45.5	70.5
8910000	BT30	BT30-SLK12-35 - 45 Deg.	38	45.5	70.5
8910001		BT30-SLK12-35 - 60 Deg.	38	45.5	70.5
8910002	BT40	BT40-SLK12-45	38	55.5	80.5
8910003		BT40-SLK12-75	38	85.5	110.5
9910005	HSK-E50	HSK-E50-SLK12-75	38	85.5	110.5
8910005	HSK-A63	HSK-A63-SLK12-75	38	85.5	110.5
8910006		HSK-A63-SLK12-135	38	145.5	170.5

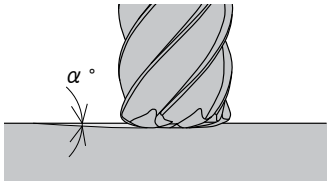
Packed: 1 pc.
Note: For more information, see p1523.

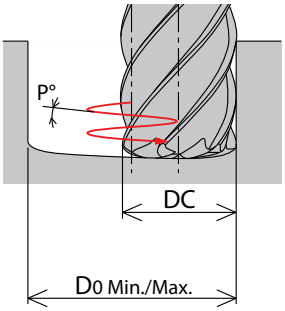
PXHF-AM

Ramping Angles & Flute Shape Definitions

PXHF-AM Maximum Ramping Angle (α°) & Maximum Helical Angle (P°)

PXHF-AM Head	Ramping Angle	Helical Milling		Helical Angle
	α°	D_0 min	D_0 max	P°
PXHF-AM0500AC12-06R060-O	3°	0.750	0.960	1.5°
PXHF-AM0625AC16-06R080-O		0.937	1.210	
PXHF-AM0750AC20-06R100-O		1.125	1.460	
PXHF-AM1000AC25-06R120-O		1.500	1.960	
PXHF-AM120C12-06R150-O		18mm	23mm	
PXHF-AM160C16-06R200-O		24mm	31mm	
PXHF-AM200C20-06R250-O		30mm	39mm	

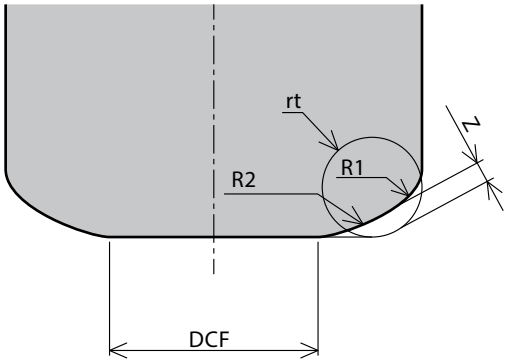




PXHF-AM Flute Shape Definitions for the Purpose of Creating a Program

PXHF-AM Head	Effective Radius	Uncut Amount
	rt	Z
PXHF-AM0500AC12-06R060-O	R0.060	0.015
PXHF-AM0625AC16-06R080-O	R0.080	0.018
PXHF-AM0750AC20-06R100-O	R0.100	0.020
PXHF-AM1000AC25-06R120-O	R0.120	0.031
PXHF-AM120C12-06R150-O	R1.5 mm	0.36 mm
PXHF-AM160C16-06R200-O	R2 mm	0.47 mm
PXHF-AM200C20-06R250-O	R2.5 mm	0.59mm

During machining, please program the milling paths according to the recommended Effective Radius (rt) for the corresponding end mill diameter.



Cutting Conditions: PXHF-AM

Slotting (L/D ≤ 4)

Hardness		< 45 HRC		< 62 HRC		< 70 HRC		–		–		–		–	
Work Material		Hardened Steel Prehardened Steel		Hardened Steel		Hardened Steel		Stainless Steel		Cobalt-Chrome Alloy Stellite		Titanium Alloy		Nickel-based Alloy Inconel 718	
Cutting Speed		360 - 425 SFM		295 - 360 SFM		215 - 280 SFM		410 - 475 SFM		360 - 425 SFM		295 - 360 SFM		100 - 165 SFM	
Depth of Cut		Aa=0.04Dc Max • Ar=0.5Dc Max													
Mill Dia.		Speed	Feed	Speed	Feed	Speed	Feed	Speed	Feed	Speed	Feed	Speed	Feed	Speed	Feed
(in)	(mm)	(RPM)	(in/min)	(RPM)	(in/min)	(RPM)	(in/min)	(RPM)	(in/min)	(RPM)	(in/min)	(RPM)	(in/min)	(RPM)	(in/min)
-	12	3180	207.87	2650	172.83	1990	62.20	3580	233.86	3180	207.48	2650	172.83	1060	30.31
1/2	-	3020	207.87	2520	172.83	1870	62.20	3400	233.86	3020	207.48	2520	172.83	990	30.31
5/8	-	2415	207.87	2015	172.83	1500	62.20	2720	233.86	2415	207.48	2015	172.83	800	30.31
-	16	2390	207.87	1990	172.83	1490	62.20	2690	233.86	2390	207.48	1990	172.83	800	30.31
3/4	-	2010	207.87	1680	172.83	1250	62.20	2265	233.86	2010	207.48	1680	172.83	660	30.31
-	20	1910	207.87	1590	172.83	1190	62.20	2150	233.86	1910	207.48	1590	172.83	640	30.31
1	-	1510	207.87	1260	172.83	935	62.20	1700	233.86	1510	207.48	1260	172.83	500	30.31

1. This tool is recommended for the roughing of additive manufacturing and mold overlay surfaces.
2.Please use machines and holders that are rigid and highly accurate.
3. The values listed above are for reference. Please set the cutting condition in accordance with the actual machining environment.
4.Please reduce the feed rate when the depth of cut is greater than specified.
5. Please adjust the cutting condition when the overhang length is longer.
6. Please use a suitable fluid with high smoke retardant properties.
7. During dry (no fluid) milling, please use air blow to remove disposable chips from the milling area and to eliminate chip packing.
8. Please use water-soluble coolant when machining stainless steel, cobalt-chromiumalloy, titanium alloy, and Ni-based alloy.
9.Tool runout should be kept to a minimum for maximum accuracy.
10. When the cutting load fluctuates in areas such as the corners, please reduce the rotational speed.
11. If Ar is greater than 0.5Dc, there may be a cusp in the machined surface.

Slotting (4 < L/D ≤ 5)

Hardness		< 45 HRC		< 62 HRC		< 70 HRC		–		–		–		–	
Work Material		Hardened Steel Prehardened Steel		Hardened Steel		Hardened Steel		Stainless Steel		Cobalt-Chrome Alloy Stellite		Titanium Alloy		Nickel-based Alloy Inconel 718	
Cutting Speed		330 - 395 SFM		265 - 330 SFM		195 - 265 SFM		380 - 450 SFM		330 - 400 SFM		265 - 330 SFM		80 - 150 SFM	
Depth of Cut		Aa=0.03Dc Max • Ar=0.5Dc Max													
Mill Dia.		Speed	Feed	Speed	Feed	Speed	Feed	Speed	Feed	Speed	Feed	Speed	Feed	Speed	Feed
(in)	(mm)	(RPM)	(in/min)	(RPM)	(in/min)	(RPM)	(in/min)	(RPM)	(in/min)	(RPM)	(in/min)	(RPM)	(in/min)	(RPM)	(in/min)
-	12	2920	148.80	2390	73.23	1860	47.64	3320	169.30	2920	148.80	2390	122.05	930	21.26
1/2	-	2750	148.80	2250	73.23	1560	47.64	3130	169.30	2750	148.80	2250	122.05	880	21.26
5/8	-	2200	148.80	1800	73.23	1400	47.64	2500	169.30	2200	148.80	1800	122.05	700	21.26
-	16	2190	148.80	1790	73.23	1390	47.64	2490	169.30	2190	148.80	1790	122.05	700	21.26
3/4	-	1830	148.80	1500	73.23	1170	47.64	2090	169.30	1830	148.80	1500	122.05	590	21.26
-	20	1750	148.80	1430	73.23	1110	47.64	1990	169.30	1750	148.80	1430	122.05	560	21.26
1	-	1380	148.80	1130	73.23	880	47.64	1570	169.30	1380	148.80	1130	122.05	440	21.26

1. This tool is recommended for the roughing of additive manufacturing and mold overlay surfaces.
2.Please use machines and holders that are rigid and highly accurate.
3. The values listed above are for reference. Please set the cutting condition in accordance with the actual machining environment.
4.Please reduce the feed rate when the depth of cut is greater than specified.
5. Please adjust the cutting condition when the overhang length is longer.
6. Please use a suitable fluid with high smoke retardant properties.
7. During dry (no fluid) milling, please use air blow to remove disposable chips from the milling area and to eliminate chip packing.
8. Please use water-soluble coolant when machining stainless steel, cobalt-chromiumalloy, titanium alloy, and Ni-based alloy.
9.Tool runout should be kept to a minimum for maximum accuracy.
10. When the cutting load fluctuates in areas such as the corners, please reduce the rotational speed.
11. If Ar is greater than 0.5Dc, there may be a cusp in the machined surface.

Cutting Conditions: PXHF-AM

Slotting (5 < L/D ≤ 6)

Hardness		< 45 HRC		< 62 HRC		< 70 HRC		–		–		–		–	
Work Material		Hardened Steel Prehardened Steel		Hardened Steel		Hardened Steel		Stainless Steel		Cobalt-Chrome Alloy Stellite		Titanium Alloy		Nickel-based Alloy Inconel 718	
Cutting Speed		295 - 360 SFM		230 - 295 SFM		165 - 230 SFM		330 - 395 SFM		295 - 360 SFM		230 - 295 SFM		65 - 130 SFM	
Depth of Cut		Aa=0.02Dc Max • Ar=0.5Dc Max													
Mill Dia.		Speed	Feed	Speed	Feed	Speed	Feed	Speed	Feed	Speed	Feed	Speed	Feed	Speed	Feed
(in)	(mm)	(RPM)	(in/min)	(RPM)	(in/min)	(RPM)	(in/min)	(RPM)	(in/min)	(RPM)	(in/min)	(RPM)	(in/min)	(RPM)	(in/min)
-	12	2650	105.12	2120	83.46	1590	31.50	2920	115.75	2650	105.12	2120	84.25	800	13.78
1/2	-	2520	105.12	2000	83.46	1500	31.50	2750	115.75	2520	105.12	2000	84.25	760	13.78
5/8	-	2010	105.12	1600	83.46	1200	31.50	2200	115.75	2010	105.12	1600	84.25	610	13.78
-	16	1990	105.12	1590	83.46	1190	31.50	2190	115.75	1990	105.12	1590	84.25	600	13.78
3/4	-	1680	105.12	1330	83.46	1000	31.50	1830	115.75	1680	105.12	1330	84.25	510	13.78
-	20	1590	105.12	1270	83.46	960	31.50	1750	115.75	1590	105.12	1270	84.25	480	13.78
1	-	1260	105.12	1000	83.46	750	31.50	1380	115.75	1260	105.12	1000	84.25	380	13.78

1. This tool is recommended for the roughing of additive manufacturing and mold overlay surfaces.
2.Please use machines and holders that are rigid and highly accurate.
3. The values listed above are for reference. Please set the cutting condition in accordance with the actual machining environment.
4.Please reduce the feed rate when the depth of cut is greater than specified.
5. Please adjust the cutting condition when the overhang length is longer.
6. Please use a suitable fluid with high smoke retardant properties.
7. During dry (no fluid) milling, please use air blow to remove disposable chips from the milling area and to eliminate chip packing.
8. Please use water-soluble coolant when machining stainless steel, cobalt-chromiumalloy, titanium alloy, and Ni-based alloy.
9.Tool runout should be kept to a minimum for maximum accuracy.
10. When the cutting load fluctuates in areas such as the corners, please reduce the rotational speed.
11. If Ar is greater than 0.5Dc, there may be a cusp in the machined surface.

Side Milling

Hardness		< 45 HRC		< 62 HRC		< 70 HRC		–		–		–		–	
Work Material		Hardened Steel Prehardened Steel		Hardened Steel		Hardened Steel		Stainless Steel		Cobalt-Chrome Alloy Stellite		Titanium Alloy		Nickel-based Alloy Inconel 718	
Cutting Speed		260 - 330 SFM		165 - 230 SFM		165 - 230 SFM		330 - 395 SFM		295 - 360 SFM		100 - 165 SFM			
Depth of Cut		Aa=0.5Dc Max • Ar=0.05Dc Max		Aa=0.5Dc Max • Ar=0.02Dc Max				Aa=0.5Dc Max • Ar=0.05Dc Max				Aa=0.5Dc Max • Ar=0.02Dc Max			
Mill Dia.		Speed	Feed	Speed	Feed	Speed	Feed	Speed	Feed	Speed	Feed	Speed	Feed	Speed	Feed
(in)	(mm)	(RPM)	(in/min)	(RPM)	(in/min)	(RPM)	(in/min)	(RPM)	(in/min)	(RPM)	(in/min)	(RPM)	(in/min)	(RPM)	(in/min)
-	12	2390	47.25	1590	22.83	1060	9.06	2650	52.75	2390	47.25	1590	22.83	800	9.06
1/2	-	2250	47.25	1490	22.83	990	9.06	2520	52.75	2250	47.25	1490	22.83	760	9.06
5/8	-	1800	47.25	1190	22.83	790	9.06	2010	52.75	1800	47.25	1190	22.83	610	9.06
-	16	1790	47.25	1190	22.83	800	9.06	1990	52.75	1790	47.25	1190	22.83	600	9.06
3/4	-	1500	47.25	990	22.83	660	9.06	1680	52.75	1500	47.25	990	22.83	510	9.06
-	20	1430	47.25	960	22.83	640	9.06	1590	52.75	1430	47.25	960	22.83	480	9.06
1	-	1120	47.25	740	22.83	500	9.06	1260	52.75	1120	47.25	740	22.83	380	9.06

1. This tool is recommended for the roughing of additive manufacturing and mold overlay surfaces.
2.Please use machines and holders that are rigid and highly accurate.
3. The values listed above are for reference. Please set the cutting condition in accordance with the actual machining environment.
4.Please reduce the feed rate when the depth of cut is greater than specified.
5. The above table is a guide when the amount of protrusion of the tool is 4D or less. If the amount of protrusion is large, chattering is likely to occur. Please adjust the rotation speed, feed speed, and depth of cut.
6. Please use a suitable fluid with high smoke retardant properties.
7. During dry (no fluid) milling, please use air blow to remove disposable chips from the milling area and to eliminate chip packing.
8. Please use water-soluble coolant when machining stainless steel, cobalt-chromiumalloy, titanium alloy, and Ni-based alloy.
9.Tool runout should be kept to a minimum for maximum accuracy.
10. When the cutting load fluctuates in areas such as the corners, please reduce the rotational speed.

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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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