SGS®
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Z5 High Performance Roughers

Z CARB-HPR
HIGH PERFORMANCE ROUGHER

New Expanded Offering

KYOCERA

www.kyocera-sgstool.com
ISO 9001:2015 Certified

DISCOVER THE NEXT GENERATION Z-CARB

The Z-Carb HPR Five Flute Roughing End Mills are ideal for achieving high material removal rates (MRR) and superior finishes. The specialized five flute design is engineered for increased productivity over three and four flute end mills. The variable indexing geometry allows for improved chatter suppression over symmetrical designs. The series is offered in a variety of length, square, and corner radius options and is coated with Ti-NAMITE®-M and Ti-NAMITE®-A for superior performance in difficult to machine materials like Titanium and Stainless Steel.

Z-CARB-HPR
HIGH PERFORMANCE ROUGHER

EXPANSIVE OFFERING

- Over 1,700 items in portfolio
- Available in stub and regular lengths
- Full complement of corner radii available
- Central coolant hole and chip breaker options available on select diameters
- Plain and Weldon Flat options available for diameters ½" and 12mm and above (other retention methods available upon request)
- Special tooling design attributes available upon request
- Available in Ti-NAMITE®-A coating ideal for Stainless Steel applications and in Ti-NAMITE®-M coating ideal in difficult to machine materials like Titanium
- The Z-Carb HPR expansion includes 908 tools in a variety of end configurations, coatings, and reach options

Ti-NAMITE®-M

Features of Ti-NAMITE®-M include high wear resistance, reduced friction, and excellent prevention of cutting edge build up. This coating provides superior material removal rates and tool life when used in high performance operations in Cast Iron and Steel and with difficult to machine materials like Titanium.

Hardness (HV): 3600
Coefficient of Friction: 0.45
Oxidation Temp.: 1150°C / 2100°F
Thickness: 1–5 Microns (based on tool dia.)

Ti-NAMITE®-A

The Z-Carb HPR is available with an abrasive resistant and hard coating, Aluminum Titanium Nitride (AlTiN) or Ti-NAMITE®-A. The coating has a high hardness giving ultimate protection against abrasive wear and erosion. Ideal for high temperature alloys and stainless steel applications.

Hardness (HV): 3700
Coefficient of Friction: 0.30
Oxidation Temp.: 1100°C/2010°F
Thickness: 1–5 Microns (based on tool dia.)

THE Z-CARB HPR MATERIAL REMOVAL RATES (MRR) MAKE THIS TOOL IDEAL FOR THE FOLLOWING TARGET MARKETS:

- Aerospace Structural Components
- Medical Implants
- Automotive & Heavy Transportation
- Energy & Power Generation
- Castings & Forgings
- General Engineering

FEATURES

THROUGH COOLANT

- Central hole delivers coolant effectively to the cutting zone
- Enhances chip removal when pocketing or slotting
- Select fractional and metric diameters in stock

RAKE

- End grind features include: (1) Positive axial rake for high performance shearing and lifting of material; and (2) Increased clearances to eliminate edge build-up during ramping
- Specially designed radial rake balances positive cutting action and edge strength

FLUTING & HELIX ANGLE

- Specialized five flute design is engineered for strength, chip evacuation, and increased productivity over three and four flute end mills by 20–40%
- The variable flute pattern provides excellent chatter suppression over a range of spindle speeds
- Open center design delivers efficiency during entry movements into the work-piece
- Helix angle engineered for balance between positive cutting action and reduced contact area to control tool pressure and spindle load

CHIP BREAKER

- Breaks up the chips formed by the long flute length allowing for better chip flow and evacuation in deep pocketing operations
- Specialized design enhances edge strength and reduces load

CAPABILITIES

RAMPING

- Typical ramp angles of 5 degrees are common; greater than 5 degree ramp angles are obtainable with reduced feed rates
- Entry feed rates can achieve 100% of the slotting value
- The open center provides an ideal exit for central coolant and chip flushing while maintaining the 5 degree ramp angle

ROUGHING

- One times diameter slotting capability is typical
- 50% radial by 150% axial heavy profiling capability is common

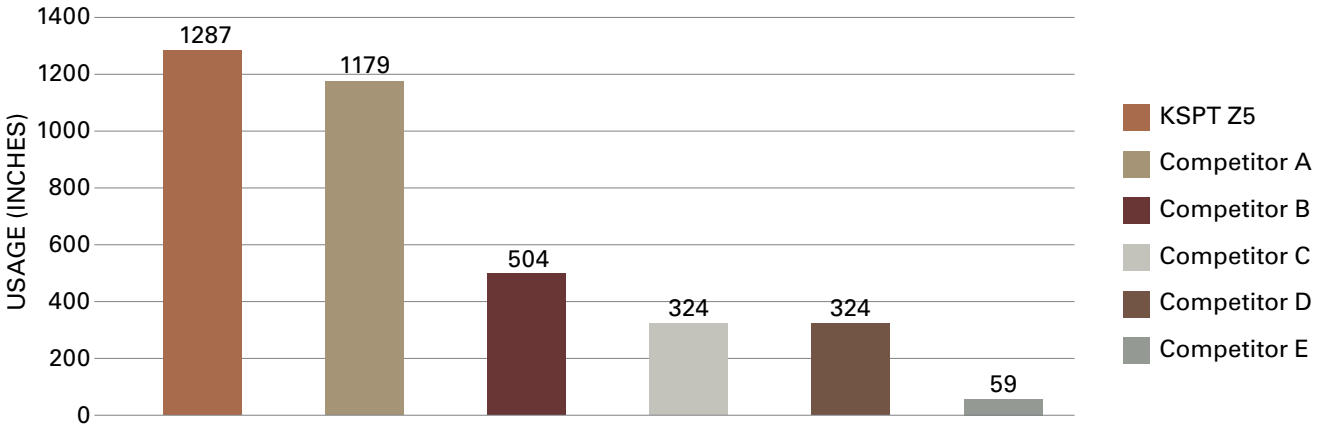
FINISHING

- Variable geometry contributes to exceptional finishing capabilities
- 10 µin. Ra possible

HIGH-SPEED MACHINING

- Variable geometry design and open fluting eliminate vibration to enable increased rates for High Speed Machining
- Exclusive Ti-NAMITE®-M coating for higher heat resistance to enhance tool life in difficult to machine materials like Titanium
- Available with Ti-NAMITE®-A coating for superior wear, edge build-up resistance and extended tool life in difficult to machine materials like Stainless Steel

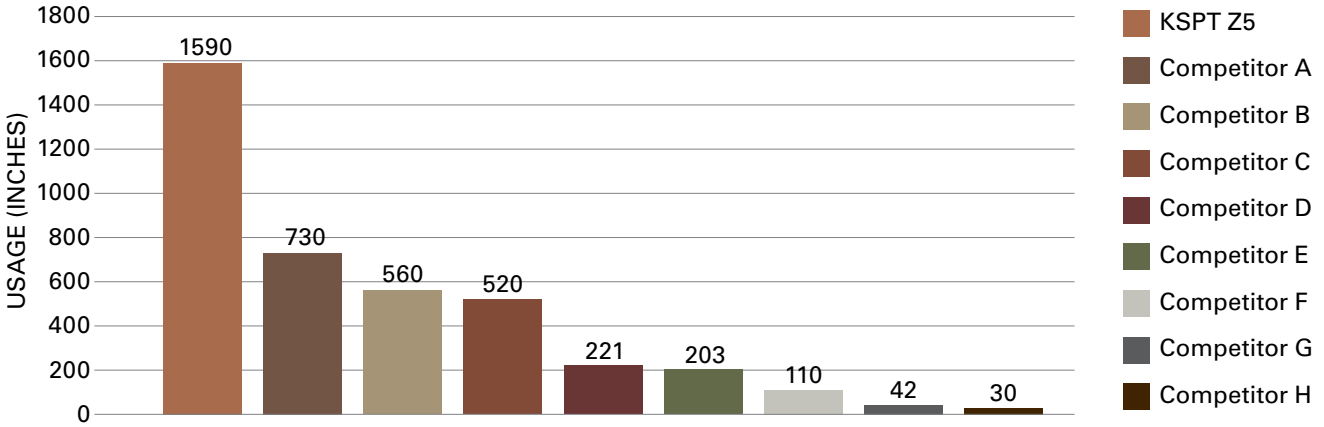
LAB TESTING RESULTS – HEAVY PROFILING IN TITANIUM



RESULTS IN TITANIUM 6AL4V @ 32HRC Z5CR 1/2″ TESTED AT 1643 RPM X 16.4 IPM
.250″ RADIAL WIDTH OF CUT X .750″ AXIAL DEPTH OF CUT

Ti-NAMITE®-M

LAB TESTING RESULTS – HEAVY PROFILING IN STAINLESS STEEL



RESULTS IN STAINLESS STEEL 316 @ 160HB Z5CR 1/2″ TESTED AT 2540 RPM X 31.7 IPM
.250″ RADIAL WIDTH OF CUT X .750″ AXIAL DEPTH OF CUT

Ti-NAMITE®-A

CASE STUDY

INDUSTRY
GENERAL ENGINEERING

MATERIAL
6AL4V TITANIUM (HRc 33-38)

PRODUCT
KSPT Z-CARB HPR

APPLICATION
80% AXIAL PROFILE

COMPETITOR
HIGH FEED FACEMILL

COOLANT
FLOOD

TOOL INFORMATION
3/4" DIA / 1-1/2" LOC / 4" OAL

GOALS

The goals of this study were to significantly reduce job cost through the use of a higher quality end mill and to maximize tool life.

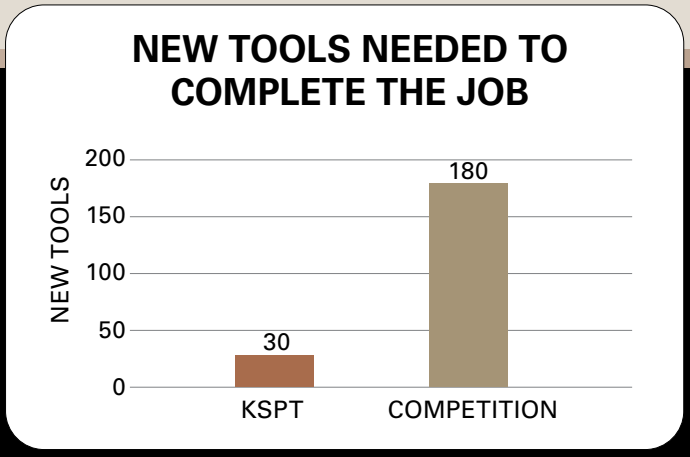
STRATEGY

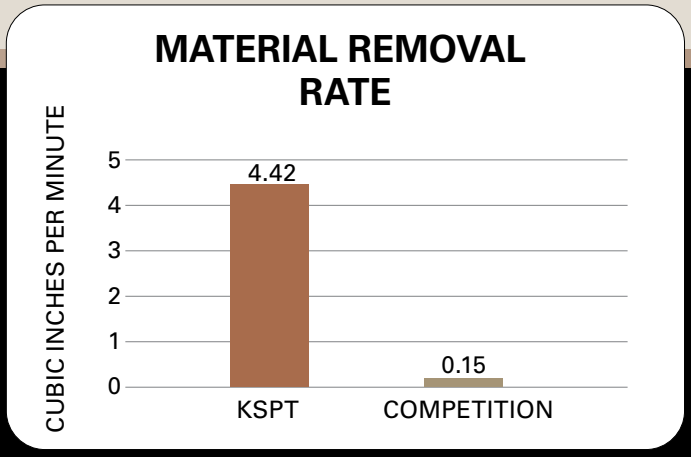
KSPT approached this job with a 5 flute Z-Carb high performance rougher (HPR) end mill. KSPT's Z-Carb HPR is ideal for achieving high metal removal rates, while achieving optimal surface finishes. The specialized five flute design is engineered for increased productivity over three and four flute end mills.

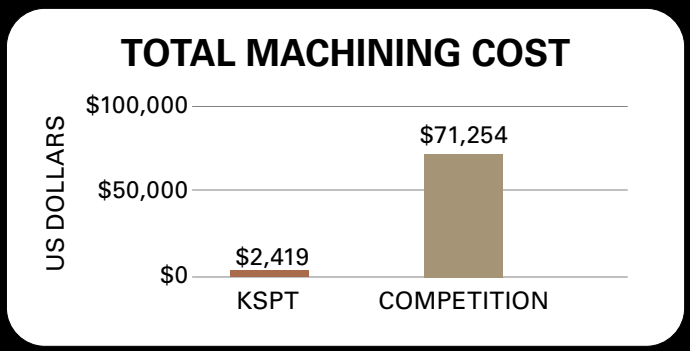
	KSPT	COMPETITOR
TOOL DIAMETER	3/4"	High Feed Facemill
SPEED	1192 RPM	350 RPM
FEED	14.9 IN/MIN	19.9 IN/MIN
RADIAL CUT (AE)	.25"	.25"
AXIAL CUT (AP)	1.25"	.03"
TOTAL MACHINING HOURS	4.42 IN^3/MINUTE	.15 IN^3/MINUTE

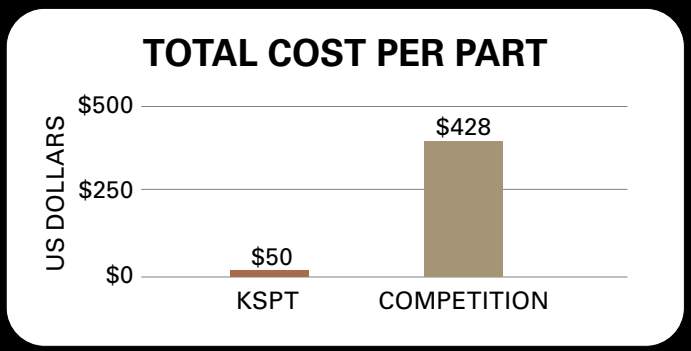
RESULTS

6AL4V titanium is corrosion resistant and has excellent strength to weight ratio, which makes it an ideal material for the aerospace industry. Unfortunately, it is relatively difficult to machine and tends to cause shorter tool life because tools are ran at lower speeds. A Ti-NAMITE®-M coated Z-Carb High Performance Rougher (HPR) was the optimal tool for this application. The HPR was ran at an RPM more than **3 times faster than the competitor's tool**. Even at a lower feed rate, the HPR had a material removal rate **almost 30 times higher than the competitor's tool!** Due to the overwhelming disparity in material removal rate, **the HPR produced 6 parts for every one of the competitors.** The manufacturing efficiencies were more dramatic when considering the SGS total new tool cost was more than twice the competitors tool, because **the HPR saved the customer over $65,655 in manufacturing cost. Combined with over $2,400 saved in tool change cost, the customer experienced total savings of $68,000!**

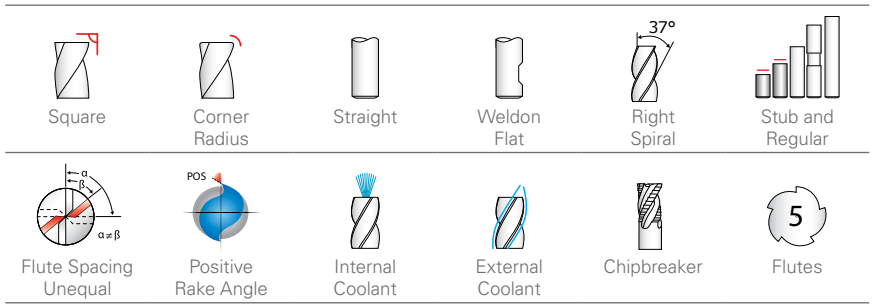








CARB-HPR
HIGH PERFORMANCE ROUGHER

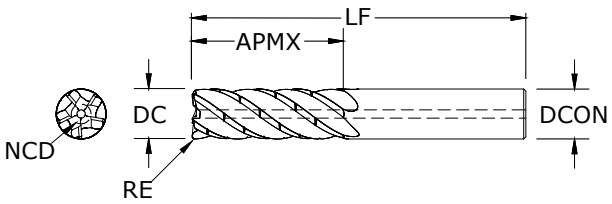


TOLERANCES (inch)

DIAMETER	DC	DCON
1/8 - 1/4	+0.0000 / –0.0012	h6
> 1/4 - 3/8	+0.0000 / –0.0016	h6
> 3/8 - 1	+0.0000 / –0.0020	h6

CORNER RADIUS TOLERANCES (inch)

RE = +0.0000 / –0.0020



New Expanded Tools

Cutting Diameter DC	Length of Cut APMX	Overall Length LF	Shank Diameter DCON	Corner Radius RE	Non-Cutting Center Diameter NCD	Ti-Namite®-A (TA) EDP No.	Ti-Namite®-A (TA) EDP No. w/Chipbreaker	Ti-Namite®-A (TA) EDP No. w/Internal Coolant	Ti-Namite®-A (TA) EDP No. w/Chipbreaker & Internal Coolant	Ti-Namite®-A (TA) EDP No. w/Flat	Ti-Namite®-M (TM) EDP No.	Ti-Namite®-M (TM) EDP No. w/Chipbreaker	Ti-Namite®-M (TM) EDP No. w/Internal Coolant	Ti-Namite®-M (TM) EDP No. w/Chipbreaker & Internal Coolant	Ti-Namite®-M (TM) EDP No. w/ Flat
1/8	1/4	1-1/2	1/8	–	0.044	38500	–	–	–	–	37000	–	–	–	–
1/8	1/4	1-1/2	1/8	0.010	0.044	38771	–	–	–	–	38770	–	–	–	–
1/8	1/4	1-1/2	1/8	0.015	0.044	38525	–	–	–	–	37001	–	–	–	–
1/8	1/4	1-1/2	1/8	0.030	0.044	38773	–	–	–	–	38772	–	–	–	–
1/8	3/8	1-1/2	1/8	–	0.044	37180	–	–	–	–	37002	–	–	–	–
1/8	3/8	1-1/2	1/8	0.010	0.044	38775	–	–	–	–	38774	–	–	–	–
1/8	3/8	1-1/2	1/8	0.015	0.029	37181	–	–	–	–	37003	–	–	–	–
1/8	3/8	1-1/2	1/8	0.030	0.029	38777	–	–	–	–	38776	–	–	–	–
1/8	3/8	2	1/8	–	0.044	37394	37395	–	–	–	37396	37397	–	–	–
1/8	3/8	2	1/8	0.010	0.044	37986	37987	–	–	–	37988	37989	–	–	–
1/8	3/8	2	1/8	0.015	0.044	37398	37399	–	–	–	37400	37401	–	–	–
1/8	3/8	2	1/8	0.030	0.029	37402	37403	–	–	–	37404	37405	–	–	–
3/16	5/16	2	3/16	–	0.066	38501	–	–	–	–	37004	–	–	–	–
3/16	5/16	2	3/16	0.010	0.066	38779	–	–	–	–	38778	–	–	–	–
3/16	5/16	2	3/16	0.015	0.066	38526	–	–	–	–	37005	–	–	–	–
3/16	5/16	2	3/16	0.030	0.066	38781	–	–	–	–	38780	–	–	–	–
3/16	1/2	2	3/16	–	0.066	37182	–	–	–	–	37006	–	–	–	–
3/16	1/2	2	3/16	0.010	0.066	38783	–	–	–	–	38782	–	–	–	–
3/16	1/2	2	3/16	0.015	0.066	37183	–	–	–	–	37007	–	–	–	–
3/16	1/2	2	3/16	0.030	0.066	38785	–	–	–	–	38784	–	–	–	–
3/16	9/16	2-1/2	3/16	–	0.066	37406	37407	–	–	–	37408	37409	–	–	–
3/16	9/16	2-1/2	3/16	0.010	0.066	37410	37411	–	–	–	37412	37413	–	–	–
3/16	9/16	2-1/2	3/16	0.015	0.066	37414	37415	–	–	–	37416	37417	–	–	–
3/16	9/16	2-1/2	3/16	0.030	0.066	37418	37419	–	–	–	37420	37421		–	–
1/4	3/8	2-1/2	1/4	–	0.088	38502	–	–	–	–	37008	–	–	–	–
1/4	3/8	2-1/2	1/4	0.010	0.088	38787	–	–	–	–	38786	–	–	–	–
1/4	3/8	2-1/2	1/4	0.015	0.088	38527	–	–	–	–	37009	–	–	–	–
1/4	3/8	2-1/2	1/4	0.030	0.088	38528	–	–	–	–	37010	–	–	–	–
1/4	3/8	2-1/2	1/4	0.060	0.075	38789	–	–	–	–	38788	–	–	–	–
1/4	1/2	2-1/2	1/4	–	0.088	37184	–	–	–	–	37011	–	–	–	–

(continued on next page)


Square


Corner Radius


Straight


Weldon Flat

Right Spiral


Stub and Regular

Flute Spacing Unequal

Positive Rake Angle


Internal Coolant


External Coolant


Chipbreaker

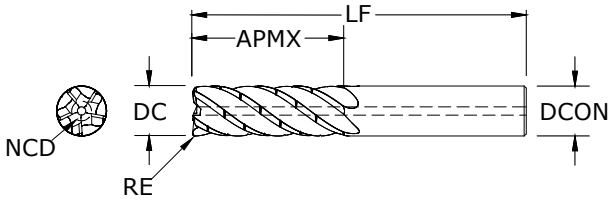
Flutes

TOLERANCES (inch)

DIAMETER	DC	DCON
1/8 - 1/4	+0.0000 / –0.0012	h6
> 1/4 - 3/8	+0.0000 / –0.0016	h6
> 3/8 - 1	+0.0000 / –0.0020	h6

CORNER RADIUS TOLERANCES (inch)

RE = +0.0000 / –0.0020



New Expanded Tools

Cutting Diameter DC	Length of Cut APMX	Overall Length LF	Shank Diameter DCON	Corner Radius RE	Non-Cutting Center Diameter NCD	Ti-Namite®-A (TA) EDP No.	Ti-Namite®-A (TA) EDP No. w/Chipbreaker	Ti-Namite®-A (TA) EDP No. w/Internal Coolant	Ti-Namite®-A (TA) EDP No. w/Chipbreaker & Internal Coolant	Ti-Namite®-A (TA) EDP No. w/Flat	Ti-Namite®-M (TM) EDP No.	Ti-Namite®-M (TM) EDP No. w/Chipbreaker	Ti-Namite®-M (TM) EDP No. w/Internal Coolant	Ti-Namite®-M (TM) EDP No. w/Chipbreaker & Internal Coolant	Ti-Namite®-M (TM) EDP No. w/ Flat
1/4	1/2	2-1/2	1/4	0.010	0.088	38793	–	–	–	–	38792	–	–	–	–
1/4	1/2	2-1/2	1/4	0.015	0.088	37185	–	–	–	–	37012	–	–	–	–
1/4	1/2	2-1/2	1/4	0.030	0.088	37186	–	–	–	–	37013	–	–	–	–
1/4	1/2	2-1/2	1/4	0.060	0.075	38795	–	–	–	–	38794	–	–	–	–
1/4	3/4	2-1/2	1/4	–	0.088	37422	37423	–	–	–	37424	37425	–	–	–
1/4	3/4	2-1/2	1/4	0.010	0.088	37426	37427	–	–	–	37428	37429	–	–	–
1/4	3/4	2-1/2	1/4	0.015	0.088	37430	37431	–	–	–	37432	37433	–	–	–
1/4	3/4	2-1/2	1/4	0.030	0.088	37434	37435	–	–	–	37436	37437	–	–	–
1/4	3/4	2-1/2	1/4	0.060	0.088	37438	37439	–	–	–	37440	37441	–	–	–
5/16	7/16	2-1/2	5/16	–	0.109	38503	–	–	–	–	37014	–	–	–	–
5/16	7/16	2-1/2	5/16	0.010	0.109	38799	–	–	–	–	38798	–	–	–	–
5/16	7/16	2-1/2	5/16	0.015	0.109	38529	–	–	–	–	37015	–	–	–	–
5/16	7/16	2-1/2	5/16	0.030	0.109	38801	–	–	–	–	38800	–	–	–	–
5/16	7/16	2-1/2	5/16	0.060	0.109	38803	–	–	–	–	38802	–	–	–	–
5/16	7/16	2-1/2	5/16	0.090	0.064	38805	–	–	–	–	38804	–	–	–	–
5/16	5/8	2-1/2	5/16	–	0.109	38504	–	–	–	–	37016	–	–	–	–
5/16	5/8	2-1/2	5/16	0.010	0.064	38807	–	–	–	–	38806	–	–	–	–
5/16	5/8	2-1/2	5/16	0.015	0.109	38530	–	–	–	–	37017	–	–	–	–
5/16	5/8	2-1/2	5/16	0.030	0.109	38809	–	–	–	–	38808	–	–	–	–
5/16	5/8	2-1/2	5/16	0.060	0.109	38811	–	–	–	–	38810	–	–	–	–
5/16	5/8	2-1/2	5/16	0.090	0.064	38813	–	–	–	–	38812	–	–	–	–
5/16	15/16	3	5/16	–	0.109	37446	37447	–	–	–	37448	37449	–	–	–
5/16	15/16	3	5/16	0.010	0.109	37451	37450	–	–	–	37452	37453	–	–	–
5/16	15/16	3	5/16	0.015	0.109	37454	37455	–	–	–	37456	37457	–	–	–
5/16	15/16	3	5/16	0.030	0.109	37458	37459	–	–	–	37460	37461	–	–	–
5/16	15/16	3	5/16	0.060	0.109	37462	37463	–	–	–	37464	37465	–	–	–
5/16	15/16	3	5/16	0.090	0.064	37466	37467	–	–	–	37468	37469	–	–	–
3/8	1/2	2-1/2	3/8	–	0.131	38505	–	–	–	–	37018	–	–	–	–
3/8	1/2	2-1/2	3/8	0.010	0.131	38815	–	–	–	–	38814	–	–	–	–
3/8	1/2	2-1/2	3/8	0.015	0.131	38531	–	–	–	–	37019	–	–	–	–

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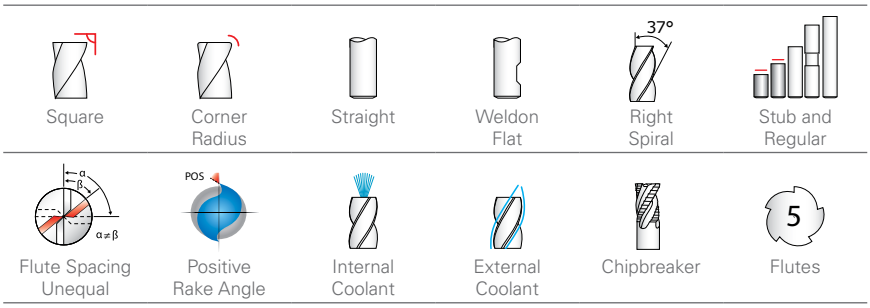
CARB-HPR
HIGH PERFORMANCE ROUGHER

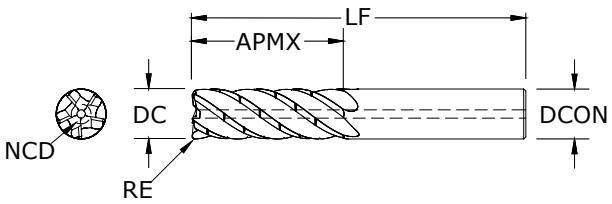


TOLERANCES (inch)

DIAMETER	DC	DCON
1/8 - 1/4	+0.0000 / –0.0012	h6
> 1/4 - 3/8	+0.0000 / –0.0016	h6
> 3/8 - 1	+0.0000 / –0.0020	h6

CORNER RADIUS TOLERANCES (inch)

RE = +0.0000 / –0.0020



New Expanded Tools

Cutting Diameter DC	Length of Cut APMX	Overall Length LF	Shank Diameter DCON	Corner Radius RE	Non-Cutting Center Diameter NCD	Ti-Namite®-A (TA)					Ti-Namite®-M (TM)				
						EDP No.	EDP No. w/Chipbreaker	EDP No. w/Internal Coolant	EDP No. w/Chipbreaker & Internal Coolant	EDP No. w/Flat	EDP No.	EDP No. w/Chipbreaker	EDP No. w/Internal Coolant	EDP No. w/Chipbreaker & Internal Coolant	EDP No. w/ Flat
3/8	1/2	2-1/2	3/8	0.030	0.131	38532	–	–	–	–	37020	–	–	–	–
3/8	1/2	2-1/2	3/8	0.060	0.131	38817	–	–	–	–	38816	–	–	–	–
3/8	1/2	2-1/2	3/8	0.090	0.083	38819	–	–	–	–	38818	–	–	–	–
3/8	3/4	2-1/2	3/8	–	0.131	37187	–	–	–	–	37021	–	–	–	–
3/8	3/4	2-1/2	3/8	0.010	0.131	38821	–	–	–	–	38820	–	–	–	–
3/8	3/4	2-1/2	3/8	0.015	0.131	37188	–	–	–	–	37022	–	–	–	–
3/8	3/4	2-1/2	3/8	0.030	0.131	37189	–	–	–	37174	37023	–	–	–	37175
3/8	3/4	2-1/2	3/8	0.060	0.131	38823	–	–	–	–	38822	–	–	–	–
3/8	3/4	2-1/2	3/8	0.090	0.083	38825	–	–	–	–	38824	–	–	–	–
3/8	1-1/8	3	3/8	–	0.131	37470	37471	–	–	–	37472	37473	–	–	–
3/8	1-1/8	3	3/8	0.010	0.131	37474	37475	–	–	–	37476	37477	–	–	–
3/8	1-1/8	3	3/8	0.015	0.131	37478	37479	–	–	–	37480	37481	–	–	–
3/8	1-1/8	3	3/8	0.030	0.131	37482	37483	–	–	–	37484	37485	–	–	–
3/8	1-1/8	3	3/8	0.060	0.131	37486	37487	–	–	–	37488	37489	–	–	–
3/8	1-1/8	3	3/8	0.090	0.083	37490	37491	–	–	–	37492	37493	–	–	–
7/16	5/8	2-1/2	7/16	0.015	0.153	37164	–	–	–	–	37160	–	–	–	–
7/16	5/8	2-1/2	7/16	0.030	0.153	37165	–	–	–	–	37161	–	–	–	–
7/16	7/8	2-3/4	7/16	0.015	0.153	37166	–	–	–	–	37162	–	–	–	–
7/16	7/8	2-3/4	7/16	0.030	0.153	37167	–	–	–	–	37163	–	–	–	–
7/16	1-5/16	3	7/16	–	0.153	37494	37495	–	–	–	37496	37497	–	–	–
7/16	1-5/16	3	7/16	0.015	0.153	37498	37499	–	–	–	37500	37501	–	–	–
7/16	1-5/16	3	7/16	0.030	0.153	37502	37503	–	–	–	37504	37505	–	–	–
1/2	5/8	3	1/2	–	0.175	38506	–	37320	–	38512	37024	–	37321	–	37030
1/2	5/8	3	1/2	0.010	0.175	38827	–	38831	–	38829	38826	–	38830	–	38828
1/2	5/8	3	1/2	0.015	0.175	38533	–	37330	–	38578	37025	–	37331	–	37031
1/2	5/8	3	1/2	0.030	0.175	38534	–	37332	–	38579	37026	–	37333	–	37032
1/2	5/8	3	1/2	0.060	0.175	38535	–	37334	–	38580	37027	–	37335	–	37033
1/2	5/8	3	1/2	0.090	0.175	38536	–	37337	–	38581	37028	–	37338	–	37034
1/2	5/8	3	1/2	0.120	0.175	38537	–	37339	–	38582	37029	–	37340	–	37035
1/2	1	3	1/2	–	0.175	38507	–	37322	–	38513	37036	–	37323	–	37042

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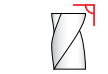

Square


Corner Radius


Straight


Weldon Flat

Right Spiral


Stub and Regular

Flute Spacing Unequal

Positive Rake Angle


Internal Coolant


External Coolant


Chipbreaker

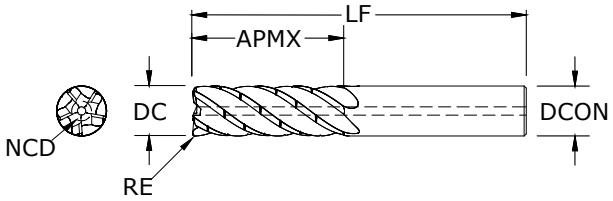
Flutes

TOLERANCES (inch)

DIAMETER	DC	DCON
1/8 - 1/4	+0.0000 / –0.0012	h6
> 1/4 - 3/8	+0.0000 / –0.0016	h6
> 3/8 - 1	+0.0000 / –0.0020	h6

CORNER RADIUS TOLERANCES (inch)

RE = +0.0000 / –0.0020



New Expanded Tools

Cutting Diameter DC	Length of Cut APMX	Overall Length LF	Shank Diameter DCON	Corner Radius RE	Non-Cutting Center Diameter NCD	Ti-Namite®-A (TA)					Ti-Namite®-M (TM)				
						EDP No.	EDP No. w/Chipbreaker	EDP No. w/Internal Coolant	EDP No. w/Chipbreaker & Internal Coolant	EDP No. w/Flat	EDP No.	EDP No. w/Chipbreaker	EDP No. w/Internal Coolant	EDP No. w/Chipbreaker & Internal Coolant	EDP No. w/ Flat
1/2	1	3	1/2	0.010	0.175	38833	–	38837	–	38835	38832	–	38836	–	38834
1/2	1	3	1/2	0.015	0.175	38538	–	37341	–	38583	37037	–	37342	–	37043
1/2	1	3	1/2	0.030	0.175	38539	–	37343	–	38584	37038	–	37344	–	37044
1/2	1	3	1/2	0.060	0.175	38540	–	37345	–	38585	37039	–	37346	–	37045
1/2	1	3	1/2	0.090	0.175	38541	–	37348	–	38586	37040	–	37349	–	37046
1/2	1	3	1/2	0.120	0.175	38542	–	37350	–	38587	37041	–	37351	–	37047
1/2	1-1/4	3-1/4	1/2	–	0.175	37190	–	37325	–	37194	37048	–	37324	–	37054
1/2	1-1/4	3-1/4	1/2	0.010	0.175	38839	–	38843	–	38841	38838	–	38842	–	38840
1/2	1-1/4	3-1/4	1/2	0.015	0.175	37191	–	37352	–	37195	37049	–	37353	–	37055
1/2	1-1/4	3-1/4	1/2	0.030	0.175	37192	–	37354	–	37196	37050	–	37355	–	37056
1/2	1-1/4	3-1/4	1/2	0.060	0.175	37193	–	37356	–	37197	37051	–	37357	–	37057
1/2	1-1/4	3-1/4	1/2	0.090	0.175	38543	–	37359	–	38588	37052	–	37360	–	37058
1/2	1-1/4	3-1/4	1/2	0.120	0.175	38544	–	37361	–	38589	37053	–	37362	–	37059
1/2	1-1/2	3-1/2	1/2	–	0.175	37506	37508	37507	37509	–	37510	37512	37511	37513	–
1/2	1-1/2	3-1/2	1/2	0.010	0.175	37514	37516	37515	37517	–	37518	37520	37519	37521	–
1/2	1-1/2	3-1/2	1/2	0.015	0.175	37522	37524	37523	37525	–	37526	37528	37527	37529	–
1/2	1-1/2	3-1/2	1/2	0.030	0.175	37530	37532	37531	37533	–	37534	37536	37535	37537	–
1/2	1-1/2	3-1/2	1/2	0.060	0.175	37538	37540	37539	37541	–	37542	37544	37543	37545	–
1/2	1-1/2	3-1/2	1/2	0.090	0.175	37546	37548	37547	37549	–	37550	37552	37551	37553	–
1/2	1-1/2	3-1/2	1/2	0.120	0.175	37554	37556	37555	37557	–	37558	37560	37559	37561	–
5/8	3/4	3-1/2	5/8	–	0.263	38508	–	38518	–	38514	37060	–	37260	–	37067
5/8	3/4	3-1/2	5/8	0.010	0.219	38845	–	38849	–	38847	38844	–	38848	–	38846
5/8	3/4	3-1/2	5/8	0.015	0.219	38545	–	38623	–	38590	37061	–	37261	–	37068
5/8	3/4	3-1/2	5/8	0.030	0.219	38546	–	38624	–	38591	37062	–	37262	–	37069
5/8	3/4	3-1/2	5/8	0.060	0.219	38547	–	38625	–	38592	37063	–	37263	–	37070
5/8	3/4	3-1/2	5/8	0.090	0.219	38548	–	38626	–	38593	37064	–	37264	–	37071
5/8	3/4	3-1/2	5/8	0.120	0.219	38549	–	38627	–	38594	37065	–	37265	–	37072
5/8	3/4	3-1/2	5/8	0.190	0.219	38550	–	38628	–	38595	37066	–	37266	–	37073
5/8	1-1/4	3-1/2	5/8	–	0.219	37198	–	38519	–	37202	37074	–	37267	–	37081
5/8	1-1/4	3-1/2	5/8	0.010	0.219	38851	–	38855	–	38853	38850	–	38854	–	38852

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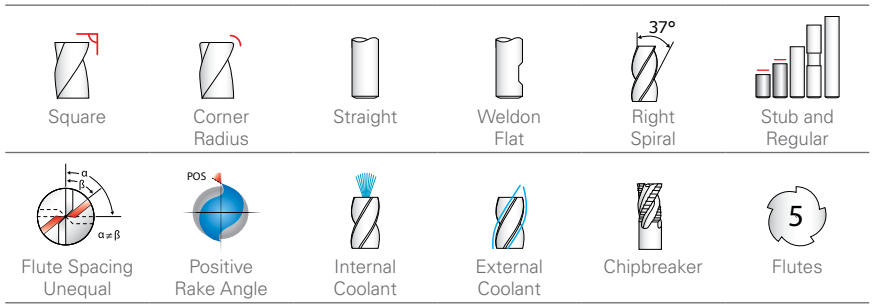
CARB-HPR
HIGH PERFORMANCE ROUGHER

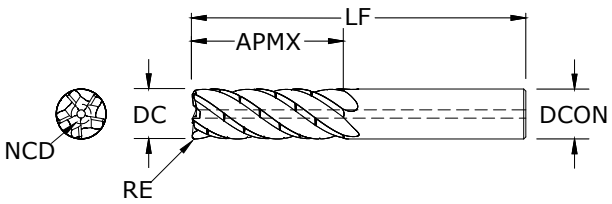


TOLERANCES (inch)

DIAMETER	DC	DCON
1/8 - 1/4	+0.0000 / –0.0012	h6
> 1/4 - 3/8	+0.0000 / –0.0016	h6
> 3/8 - 1	+0.0000 / –0.0020	h6

CORNER RADIUS TOLERANCES (inch)

RE = +0.0000 / –0.0020



New Expanded Tools

Cutting Diameter DC	Length of Cut APMX	Overall Length LF	Shank Diameter DCON	Corner Radius RE	Non-Cutting Center Diameter NCD	Ti-Namite®-A (TA) EDP No.	Ti-Namite®-A (TA) EDP No. w/Chipbreaker	Ti-Namite®-A (TA) EDP No. w/Internal Coolant	Ti-Namite®-A (TA) EDP No. w/Chipbreaker & Internal Coolant	Ti-Namite®-A (TA) EDP No. w/Flat	Ti-Namite®-M (TM) EDP No.	Ti-Namite®-M (TM) EDP No. w/Chipbreaker	Ti-Namite®-M (TM) EDP No. w/Internal Coolant	Ti-Namite®-M (TM) EDP No. w/Chipbreaker & Internal Coolant	Ti-Namite®-M (TM) EDP No. w/ Flat
5/8	1-1/4	3-1/2	5/8	0.015	0.219	37199	–	38629	–	37203	37075	–	37268	–	37082
5/8	1-1/4	3-1/2	5/8	0.030	0.219	37200	–	38630	–	37204	37076	–	37269	–	37083
5/8	1-1/4	3-1/2	5/8	0.060	0.219	37201	–	38631	–	37205	37077	–	37270	–	37084
5/8	1-1/4	3-1/2	5/8	0.090	0.219	38551	–	38632	–	38596	37078	–	37271	–	37085
5/8	1-1/4	3-1/2	5/8	0.120	0.219	38552	–	38633	–	38597	37079	–	37272	–	37086
5/8	1-1/4	3-1/2	5/8	0.190	0.219	38553	–	38634	–	38598	37080	–	37273	–	37087
5/8	1-7/8	4	5/8	–	0.219	37562	37564	37563	37565	–	37566	37568	37567	37569	–
5/8	1-7/8	4	5/8	0.010	0.219	37570	37572	37571	37573	–	37574	37576	37575	37577	–
5/8	1-7/8	4	5/8	0.015	0.219	37578	37580	37579	37581	–	37582	37584	37583	37585	–
5/8	1-7/8	4	5/8	0.030	0.219	37586	37588	37587	37589	–	37590	37592	37591	37593	–
5/8	1-7/8	4	5/8	0.060	0.219	37594	37596	37595	37597	–	37598	37600	37599	37601	–
5/8	1-7/8	4	5/8	0.090	0.219	37602	37604	37603	37605	–	37606	37608	37607	37609	–
5/8	1-7/8	4	5/8	0.120	0.219	37610	37612	37611	37613	–	37614	37616	37615	37617	–
5/8	1-7/8	4	5/8	0.190	0.219	37618	37620	37619	37621	–	37622	37624	37623	37625	–
3/4	7/8	4	3/4	–	0.263	38509	–	38520	–	38515	37088	–	37274	–	37095
3/4	7/8	4	3/4	0.010	0.263	38857	–	38861	–	38859	38856	–	38860	–	38858
3/4	7/8	4	3/4	0.030	0.263	38554	–	38635	–	38599	37089	–	37275	–	37096
3/4	7/8	4	3/4	0.060	0.263	38555	–	38636	–	38600	37090	–	37276	–	37097
3/4	7/8	4	3/4	0.090	0.263	38556	–	38637	–	38601	37091	–	37277	–	37098
3/4	7/8	4	3/4	0.120	0.263	38557	–	38638	–	38602	37092	–	37278	–	37099
3/4	7/8	4	3/4	0.190	0.263	38558	–	38639	–	38603	37093	–	37279	–	37100
3/4	7/8	4	3/4	0.250	0.263	38559	–	38640	–	38604	37094	–	37280	–	37101
3/4	1-1/2	4	3/4	–	0.263	37206	–	38521	–	37210	37102	–	37281	–	37109
3/4	1-1/2	4	3/4	0.010	0.263	38863	–	38867	–	38865	38862	–	38866	–	38864
3/4	1-1/2	4	3/4	0.030	0.263	37207	–	38641	–	37211	37103	–	37282	–	37110
3/4	1-1/2	4	3/4	0.060	0.263	37208	–	38642	–	37212	37104	–	37283	–	37111
3/4	1-1/2	4	3/4	0.090	0.263	38560	–	38643	–	38605	37105	–	37284	–	37112
3/4	1-1/2	4	3/4	0.120	0.263	37209	–	38644	–	37213	37106	–	37285	–	37113
3/4	1-1/2	4	3/4	0.190	0.263	38561	–	38645	–	38606	37107	–	37286	–	37114
3/4	1-1/2	4	3/4	0.250	0.263	38562	–	38646	–	38607	37108	–	37287	–	37115

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Square


Corner Radius


Straight


Weldon Flat

Right Spiral


Stub and Regular

Flute Spacing Unequal

Positive Rake Angle


Internal Coolant


External Coolant


Chipbreaker

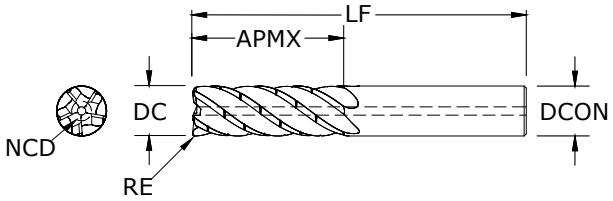
Flutes

TOLERANCES (inch)

DIAMETER	DC	DCON
1/8 - 1/4	+0.0000 / –0.0012	h6
> 1/4 - 3/8	+0.0000 / –0.0016	h6
> 3/8 - 1	+0.0000 / –0.0020	h6

CORNER RADIUS TOLERANCES (inch)

RE = +0.0000 / –0.0020



New Expanded Tools

Cutting Diameter DC	Length of Cut APMX	Overall Length LF	Shank Diameter DCON	Corner Radius RE	Non-Cutting Center Diameter NCD	Ti-Namite®-A (TA)					Ti-Namite®-M (TM)				
						EDP No.	EDP No. w/Chipbreaker	EDP No. w/Internal Coolant	EDP No. w/Chipbreaker & Internal Coolant	EDP No. w/Flat	EDP No.	EDP No. w/Chipbreaker	EDP No. w/Internal Coolant	EDP No. w/Chipbreaker & Internal Coolant	EDP No. w/ Flat
3/4	1-5/8	4	3/4	0.030	0.263	37222	–	–	–	–	37223	–	–	–	–
3/4	1-5/8	4	3/4	0.060	0.263	37224	–	–	–	–	37225	–	–	–	–
3/4	1-5/8	4	3/4	0.090	0.263	37226	–	–	–	–	37227	–	–	–	–
3/4	1-5/8	4	3/4	0.120	0.263	37228	–	–	–	–	37229	–	–	–	–
3/4	2	4-1/2	3/4	0.030	0.263	37230	–	–	–	–	37231	–	–	–	–
3/4	2	4-1/2	3/4	0.060	0.263	37232	–	–	–	–	37233	–	–	–	–
3/4	2	4-1/2	3/4	0.090	0.263	37234	–	–	–	–	37235	–	–	–	–
3/4	2	4-1/2	3/4	0.120	0.263	37236	–	–	–	–	37237	–	–	–	–
3/4	2-1/4	5	3/4	–	0.263	37626	37628	37627	37629	–	37630	37632	37631	37633	–
3/4	2-1/4	5	3/4	0.010	0.263	37634	37636	37635	37637	–	37638	37640	37639	37641	–
3/4	2-1/4	5	3/4	0.030	0.263	37642	37644	37643	37645	–	37646	37648	37647	37649	–
3/4	2-1/4	5	3/4	0.060	0.263	37650	37652	37651	37653	–	37654	37656	37655	37657	–
3/4	2-1/4	5	3/4	0.090	0.263	37658	37660	37659	37661	–	37662	37664	37663	37665	–
3/4	2-1/4	5	3/4	0.120	0.263	37666	37668	37667	37669	–	37670	37672	37671	37673	–
3/4	2-1/4	5	3/4	0.190	0.263	37674	37676	37675	37677	–	37678	37680	37679	37681	–
3/4	2-1/4	5	3/4	0.250	0.263	37682	37684	37683	37685	–	37686	37688	37687	37689	–
1	1-1/8	4	1	–	0.350	38510	–	38522	–	38516	37116	–	37288	–	37123
1	1-1/8	4	1	0.010	0.350	38869	–	38873	–	38871	38868	–	38872	–	38870
1	1-1/8	4	1	0.030	0.350	38563	–	38647	–	38608	37117	–	37289	–	37124
1	1-1/8	4	1	0.060	0.350	38564	–	38648	–	38609	37118	–	37290	–	37125
1	1-1/8	4	1	0.090	0.350	38565	–	38649	–	38610	37119	–	37291	–	37126
1	1-1/8	4	1	0.120	0.350	38566	–	38650	–	38611	37120	–	37292	–	37127
1	1-1/8	4	1	0.190	0.350	38567	–	38651	–	38612	37121	–	37293	–	37128
1	1-1/8	4	1	0.250	0.350	38568	–	38652	–	38613	37122	–	37294	–	37129
1	1-1/2	4	1	–	0.350	37214	–	38523	–	37218	37130	–	37295	–	37137
1	1-1/2	4	1	0.010	0.350	38875	–	38879	–	38877	38874	–	38878	–	38876
1	1-1/2	4	1	0.030	0.350	37215	–	38653	–	37219	37131	–	37296	–	37138
1	1-1/2	4	1	0.060	0.350	37216	–	38654	–	37220	37132	–	37297	–	37139
1	1-1/2	4	1	0.090	0.350	38569	–	38655	–	38614	37133	–	37298	–	37140
1	1-1/2	4	1	0.120	0.350	37217	–	38656	–	37221	37134	–	37299	–	37141

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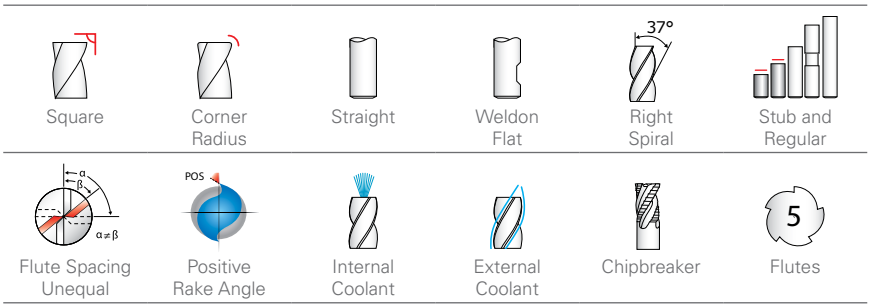
CARB-HPR
HIGH PERFORMANCE ROUGHER

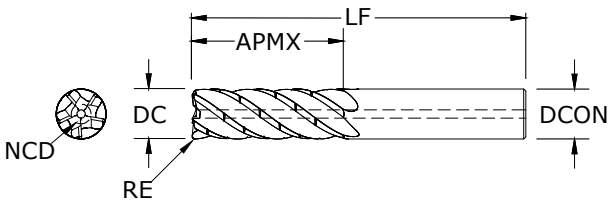


TOLERANCES (inch)

DIAMETER	DC	DCON
1/8 - 1/4	+0.0000 / –0.0012	h6
> 1/4 - 3/8	+0.0000 / –0.0016	h6
> 3/8 - 1	+0.0000 / –0.0020	h6

CORNER RADIUS TOLERANCES (inch)

RE = +0.0000 / –0.0020



New Expanded Tools

Cutting Diameter DC	Length of Cut APMX	Overall Length LF	Shank Diameter DCON	Corner Radius RE	Non-Cutting Center Diameter NCD	Ti-Namite®-A (TA) EDP No.	Ti-Namite®-A (TA) EDP No. w/Chipbreaker	Ti-Namite®-A (TA) EDP No. w/Internal Coolant	Ti-Namite®-A (TA) EDP No. w/Chipbreaker & Internal Coolant	Ti-Namite®-A (TA) EDP No. w/Flat	Ti-Namite®-M (TM) EDP No.	Ti-Namite®-M (TM) EDP No. w/Chipbreaker	Ti-Namite®-M (TM) EDP No. w/Internal Coolant	Ti-Namite®-M (TM) EDP No. w/Chipbreaker & Internal Coolant	Ti-Namite®-M (TM) EDP No. w/ Flat
1	1-1/2	4	1	0.190	0.350	38570	–	38657	–	38615	37135	–	37300	–	37142
1	1-1/2	4	1	0.250	0.350	38571	–	38658	–	38616	37136	–	37301	–	37143
1	2	4-1/2	1	–	0.350	38511	–	38524	–	38517	37144	–	37302	–	37151
1	2	4-1/2	1	0.010	0.350	38881	–	38885	–	38883	38880	–	38884	–	38882
1	2	4-1/2	1	0.030	0.350	38572	–	38659	–	38617	37145	–	37303	–	37152
1	2	4-1/2	1	0.060	0.350	38573	–	38660	–	38618	37146	–	37304	–	37153
1	2	4-1/2	1	0.090	0.350	38574	–	38661	–	38619	37147	–	37305	–	37154
1	2	4-1/2	1	0.120	0.350	38575	–	38662	–	38620	37148	–	37306	–	37155
1	2	4-1/2	1	0.190	0.350	38576	–	38663	–	38621	37149	–	37307	–	37156
1	2	4-1/2	1	0.250	0.350	38577	–	38664	–	38622	37150	–	37308	–	37157
1	1-1/2	4	1	0.090	0.350	38569	–	38655	–	38614	37133	–	37298	–	37140
1	1-1/2	4	1	0.120	0.350	37217	–	38656	–	37221	37134	–	37299	–	37141
1	1-1/2	4	1	0.190	0.350	38570	–	38657	–	38615	37135	–	37300	–	37142
1	1-1/2	4	1	0.250	0.350	38571	–	38658	–	38616	37136	–	37301	–	37143
1	2	4-1/2	1	–	0.350	38511	–	38524	–	38517	37144	–	37302	–	37151
1	2	4-1/2	1	0.010	0.350	38881	–	38885	–	38883	38880	–	38884	–	38882
1	2	4-1/2	1	0.030	0.350	38572	–	38659	–	38617	37145	–	37303	–	37152
1	2	4-1/2	1	0.060	0.350	38573	–	38660	–	38618	37146	–	37304	–	37153
1	2	4-1/2	1	0.090	0.350	38574	–	38661	–	38619	37147	–	37305	–	37154
1	2	4-1/2	1	0.120	0.350	38575	–	38662	–	38620	37148	–	37306	–	37155
1	2	4-1/2	1	0.190	0.350	38576	–	38663	–	38621	37149	–	37307	–	37156
1	2	4-1/2	1	0.250	0.350	38577	–	38664	–	38622	37150	–	37308	–	37157
1	3	6	1	–	0.350	37690	37692	37691	37693	–	37694	37696	37695	37697	–
1	3	6	1	0.010	0.350	37698	37700	37699	37701	–	37702	37704	37703	37705	–
1	3	6	1	0.030	0.350	37706	37708	37707	37709	–	37710	37712	37711	37713	–
1	3	6	1	0.060	0.350	37714	37716	37715	37717	–	37718	37720	37719	37721	–
1	3	6	1	0.090	0.350	37722	37724	37723	37725	–	37726	37728	37727	37729	–
1	3	6	1	0.120	0.350	37730	37732	37731	37733	–	37734	37736	37735	37737	–
1	3	6	1	0.190	0.350	37738	37740	37739	37741	–	37742	37744	37743	37745	–
1	3	6	1	0.250	0.350	37746	37748	37747	37749	–	37750	37752	37751	37753	–


Square


Corner Radius


Straight

Right Spiral


Long Reach Neck

Flute Spacing Unequal

Positive Rake Angle


External Coolant


Chipbreaker

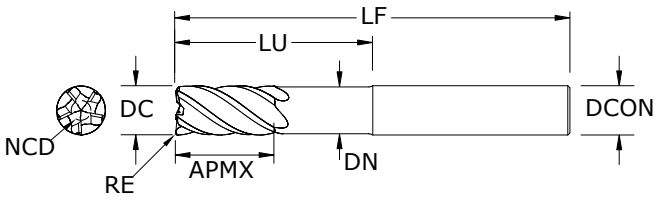
Flutes

TOLERANCES (inch)

DIAMETER	DC	DCON
1/8 - 1/4	+0.0000 / –0.0012	h6
> 1/4 - 3/8	+0.0000 / –0.0016	h6
> 3/8 - 1	+0.0000 / –0.0020	h6

CORNER RADIUS TOLERANCES (inch)

RE = +0.0000 / –0.0020



New Expanded Tools

Cutting Diameter DC	Length of Cut APMX	Overall Length LF	Shank Diameter DCON	Corner Radius RE	Non-Cutting Center Diameter NCD	Reach LU	Neck Diameter DN	Ti-Namite®-A (TA)		Ti-Namite®-M (TM)	
								EDP No.	EDP No. w/Chipbreaker	EDP No.	EDP No. w/Chipbreaker
1/8	1/4	2	1/8	–	0.044	1/2	0.119	37754	37755	37756	37757
1/8	1/4	2	1/8	0.010	0.044	1/2	0.119	37990	37991	37992	37993
1/8	1/4	2	1/8	0.015	0.044	1/2	0.119	37758	37759	37760	37761
1/8	1/4	2	1/8	0.030	0.029	1/2	0.119	37762	37763	37764	37765
3/16	3/8	2-1/2	3/16	–	0.066	3/4	0.178	37766	37767	37768	37769
3/16	3/8	2-1/2	3/16	0.010	0.066	3/4	0.178	37770	37771	37772	37773
3/16	3/8	2-1/2	3/16	0.015	0.066	3/4	0.178	37774	37775	37776	37777
3/16	3/8	2-1/2	3/16	0.030	0.066	3/4	0.178	37778	37779	37780	37781
1/4	1/2	3	1/4	–	0.088	1	0.238	37782	37783	37784	37785
1/4	1/2	3	1/4	0.010	0.088	1	0.238	37786	37787	37788	37789
1/4	1/2	3	1/4	0.015	0.088	1	0.238	37790	37791	37792	37793
1/4	1/2	3	1/4	0.030	0.088	1	0.238	37794	37795	37796	37797
1/4	1/2	3	1/4	0.060	0.088	1	0.238	37798	37799	37800	37801
5/16	5/8	3	5/16	–	0.109	1-1/4	0.297	37806	37807	37808	37809
5/16	5/8	3	5/16	0.010	0.109	1-1/4	0.297	37810	37811	37812	37813
5/16	5/8	3	5/16	0.015	0.109	1-1/4	0.297	37814	37815	37816	37817
5/16	5/8	3	5/16	0.030	0.109	1-1/4	0.297	37818	37819	37820	37821
5/16	5/8	3	5/16	0.060	0.109	1-1/4	0.297	37822	37823	37824	37825
5/16	5/8	3	5/16	0.090	0.109	1-1/4	0.297	37826	37827	37828	37829
3/8	3/4	4	3/8	–	0.109	1-1/2	0.356	37830	37831	37832	37833
3/8	3/4	4	3/8	0.010	0.131	1-1/2	0.356	37834	37835	37836	37837
3/8	3/4	4	3/8	0.015	0.131	1-1/2	0.356	37838	37839	37840	37841
3/8	3/4	4	3/8	0.030	0.131	1-1/2	0.356	37842	37843	37844	37845
3/8	3/4	4	3/8	0.060	0.131	1-1/2	0.356	37846	37847	37848	37849
3/8	3/4	4	3/8	0.090	0.083	1-1/2	0.356	37850	37851	37852	37853
7/16	7/8	4	7/16	–	0.153	1-3/4	0.416	37854	37855	37856	37857
7/16	7/8	4	7/16	0.015	0.153	1-3/4	0.416	37858	37859	37860	37861
7/16	7/8	4	7/16	0.030	0.153	1-3/4	0.416	37862	37863	37864	37865
1/2	1	4	1/2	–	0.175	2	0.475	37866	37867	37868	37869
1/2	1	4	1/2	0.010	0.175	2	0.475	37870	37871	37872	37873
1/2	1	4	1/2	0.015	0.175	2	0.475	37874	37875	37876	37877
1/2	1	4	1/2	0.030	0.175	2	0.475	37878	37879	37880	37881

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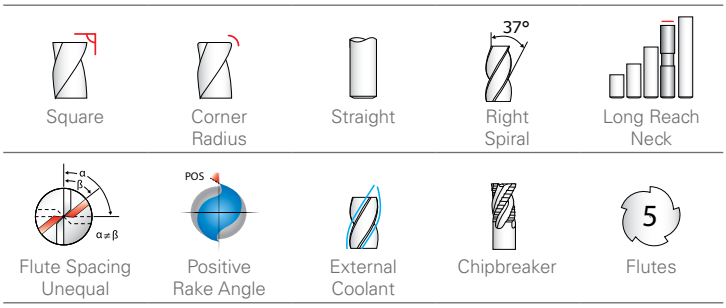
CARB-HPR
HIGH PERFORMANCE ROUGHER

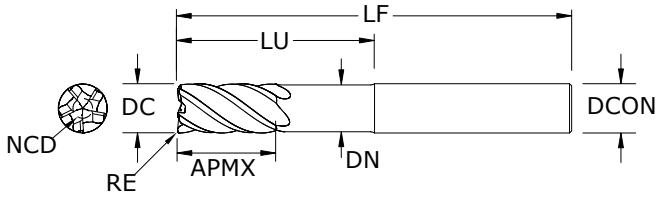


TOLERANCES (inch)

DIAMETER	DC	DCON
1/8 - 1/4	+0.0000 / –0.0012	h6
> 1/4 - 3/8	+0.0000 / –0.0016	h6
> 3/8 - 1	+0.0000 / –0.0020	h6

CORNER RADIUS TOLERANCES (inch)

RE = +0.0000 / –0.0020



New Expanded Tools

Cutting Diameter DC	Length of Cut APMX	Overall Length LF	Shank Diameter DCON	Corner Radius RE	Non-Cutting Center Diameter NCD	Reach LU	Neck Diameter DN	Ti-Namite®-A (TA)		Ti-Namite®-M (TM)	
								EDP No.	EDP No. w/Chipbreaker	EDP No.	EDP No. w/Chipbreaker
1/2	1	4	1/2	0.060	0.175	2	0.475	37882	37883	37884	37885
1/2	1	4	1/2	0.090	0.175	2	0.475	37886	37887	37888	37889
1/2	1	4	1/2	0.120	0.175	2	0.475	37890	37891	37892	37893
5/8	1-1/4	5	5/8	–	0.219	2-1/2	0.594	37894	37895	37896	37897
5/8	1-1/4	5	5/8	0.010	0.219	2-1/2	0.594	37994	37995	37996	37997
5/8	1-1/4	5	5/8	0.015	0.219	2-1/2	0.594	37898	37899	37900	37901
5/8	1-1/4	5	5/8	0.030	0.219	2-1/2	0.594	37902	37903	37904	37905
5/8	1-1/4	5	5/8	0.060	0.219	2-1/2	0.594	37906	37907	37908	37909
5/8	1-1/4	5	5/8	0.090	0.219	2-1/2	0.594	37910	37911	37912	37913
5/8	1-1/4	5	5/8	0.120	0.219	2-1/2	0.594	37914	37915	37916	37917
5/8	1-1/4	5	5/8	0.190	0.219	2-1/2	0.594	37918	37919	37920	37921
3/4	1-1/2	6	3/4	–	0.263	3	0.713	37922	37923	37924	37925
3/4	1-1/2	6	3/4	0.010	0.263	3	0.713	37926	37927	37928	37929
3/4	1-1/2	6	3/4	0.030	0.263	3	0.713	37930	37931	37932	37933
3/4	1-1/2	6	3/4	0.060	0.263	3	0.713	37934	37935	37936	37937
3/4	1-1/2	6	3/4	0.090	0.263	3	0.713	37938	37939	37940	37941
3/4	1-1/2	6	3/4	0.120	0.263	3	0.713	37942	37943	37944	37945
3/4	1-1/2	6	3/4	0.190	0.263	3	0.713	37946	37947	37948	37949
3/4	1-1/2	6	3/4	0.250	0.263	3	0.713	37950	37951	37952	37953
1	2	7	1	–	0.350	4	0.950	37954	37955	37956	37957
1	2	7	1	0.010	0.350	4	0.950	37958	37959	37960	37961
1	2	7	1	0.030	0.350	4	0.950	37962	37963	37964	37965
1	2	7	1	0.060	0.350	4	0.950	37966	37967	37968	37969
1	2	7	1	0.090	0.350	4	0.950	37970	37971	37972	37973
1	2	7	1	0.120	0.350	4	0.950	37974	37975	37976	37977
1	2	7	1	0.190	0.350	4	0.950	37978	37979	37980	37981
1	2	7	1	0.250	0.350	4	0.950	37982	37983	37984	37985


Corner Radius


Straight


Weldon Flat

Right Spiral


Stub and Regular

Flute Spacing Unequal

Positive Rake Angle


Internal Coolant


External Coolant


Chipbreaker

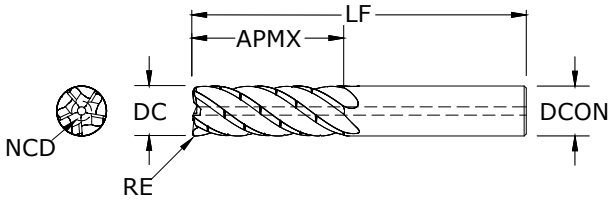
Flutes

TOLERANCES (mm)

DIAMETER	DC	DCON
6	+0,000 / –0,030	h6
> 6 - 10	+0,000 / –0,040	h6
> 10 - 25	+0,000 / –0,050	h6

CORNER RADIUS TOLERANCES (mm)

RE = +0,000 / –0,050



New Expanded Tools

Cutting Diameter DC	Length of Cut APMX	Overall Length LF	Shank Diameter DCON	Corner Radius RE	Non-Cutting Center Diameter NCD	Ti-Namite®-A (TA) EDP No.	Ti-Namite®-A (TA) EDP No. w/Chipbreaker	Ti-Namite®-A (TA) EDP No. w/Internal Coolant	Ti-Namite®-A (TA) EDP No. w/Flat	Ti-Namite®-M (TM) EDP No.	Ti-Namite®-M (TM) EDP No. w/Chipbreaker	Ti-Namite®-M (TM) EDP No. w/Internal Coolant	Ti-Namite®-M (TM) EDP No. w/ Flat
6,0	9,0	54,0	6,0	0,5	2,11	48000	–	–	–	47000	–	–	–
6,0	13,0	57,0	6,0	0,3	2,11	48001	–	–	–	47001	–	–	–
6,0	13,0	57,0	6,0	0,5	2,11	47120	–	–	–	47002	–	–	–
6,0	13,0	57,0	6,0	1,0	2,11	48002	–	–	–	47003	–	–	–
6,0	13,0	57,0	6,0	1,5	2,11	48003	–	–	–	47004	–	–	–
6,0	18,0	63,0	6,0	0,3	2,11	47480	47481	–	–	47482	47483	–	–
6,0	18,0	63,0	6,0	0,5	2,11	47484	47485	–	–	47486	47487	–	–
6,0	18,0	63,0	6,0	1,0	2,11	47488	47489	–	–	47490	47491	–	–
6,0	18,0	63,0	6,0	1,5	2,11	47492	47493	–	–	47494	47495	–	–
8,0	11,0	58,0	8,0	0,5	2,79	48004	–	–	–	47005	–	–	–
8,0	18,0	63,0	8,0	0,5	2,79	47121	–	–	–	47006	–	–	–
8,0	18,0	63,0	8,0	1,0	2,79	47122	–	–	–	47007	–	–	–
8,0	18,0	63,0	8,0	1,5	2,79	48005	–	–	–	47008	–	–	–
8,0	18,0	63,0	8,0	2,0	2,79	48006	–	–	–	47009	–	–	–
8,0	24,0	75,0	8,0	0,5	2,79	47496	47497	–	–	47498	47499	–	–
8,0	24,0	75,0	8,0	1,0	2,79	47500	47501	–	–	47502	47503	–	–
8,0	24,0	75,0	8,0	1,5	2,79	47504	47505	–	–	47506	47507	–	–
8,0	24,0	75,0	8,0	2,0	2,79	47508	47509	–	–	47510	47511	–	–
10,0	13,0	66,0	10,0	1,0	2,79	48007	–	–	–	47010	–	–	–
10,0	22,0	72,0	10,0	0,5	3,51	47123	–	–	–	47011	–	–	–
10,0	22,0	72,0	10,0	1,0	3,51	47124	–	–	–	47012	–	–	–
10,0	22,0	72,0	10,0	1,5	3,51	48008	–	–	–	47013	–	–	–
10,0	22,0	72,0	10,0	2,0	3,51	48009	–	–	–	47014	–	–	–
10,0	22,0	72,0	10,0	2,5	3,51	48010	–	–	–	47015	–	–	–
10,0	30,0	75,0	10,0	0,5	3,51	47512	47513	–	–	47514	47515	–	–
10,0	30,0	75,0	10,0	1,0	3,51	47516	47517	–	–	47518	47519	–	–
10,0	30,0	75,0	10,0	1,5	3,51	47520	47521	–	–	47522	47523	–	–
10,0	30,0	75,0	10,0	2,0	3,51	47524	47525	–	–	47526	47527	–	–
10,0	30,0	75,0	10,0	2,5	3,51	47528	47529	–	–	47530	47531	–	–
12,0	15,0	73,0	12,0	1,0	4,19	48011	–	–	48029	47016	–	–	47024
12,0	26,0	83,0	12,0	0,5	4,19	47125	–	47160	47128	47017	–	47161	47025
12,0	26,0	83,0	12,0	0,76	4,19	47126	–	47162	47129	47018	–	47163	47026

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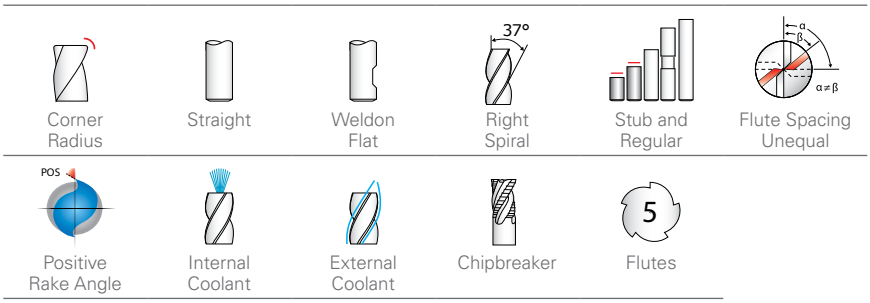
Z-CARB-HPR
HIGH PERFORMANCE ROUGHER

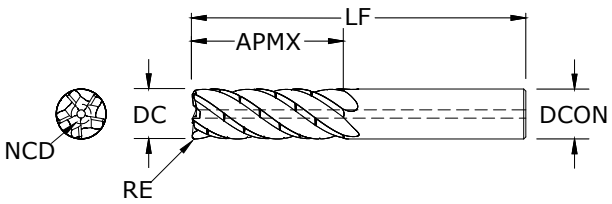


TOLERANCES (mm)

DIAMETER	DC	DCON
6	+0,000 / –0,030	h6
> 6 - 10	+0,000 / –0,040	h6
> 10 - 25	+0,000 / –0,050	h6

CORNER RADIUS TOLERANCES (mm)

RE = +0,000 / –0,050



New Expanded Tools

Cutting Diameter DC	Length of Cut APMX	Overall Length LF	Shank Diameter DCON	Corner Radius RE	Non-Cutting Center Diameter NCD	Ti-Namite®-A (TA) EDP No.	Ti-Namite®-A (TA) EDP No. w/Chipbreaker	Ti-Namite®-A (TA) EDP No. w/Internal Coolant	Ti-Namite®-A (TA) EDP No. w/Flat	Ti-Namite®-M (TM) EDP No.	Ti-Namite®-M (TM) EDP No. w/Chipbreaker	Ti-Namite®-M (TM) EDP No. w/Internal Coolant	Ti-Namite®-M (TM) EDP No. w/ Flat
12,0	26,0	83,0	12,0	1,0	4,19	47127	–	47164	47130	47019	–	47165	47027
12,0	26,0	83,0	12,0	1,5	4,19	48012	–	47166	48030	47020	–	47167	47028
12,0	26,0	83,0	12,0	2,0	4,19	48013	–	47168	48031	47021	–	47169	47029
12,0	26,0	83,0	12,0	2,5	4,19	48014	–	47170	48032	47022	–	47171	47030
12,0	26,0	83,0	12,0	3,0	4,19	48015	–	47172	48033	47023	–	47173	47031
12,0	36,0	83,0	12,0	0,5	4,19	47532	47533	–	–	47534	47535	–	–
12,0	36,0	83,0	12,0	0,76	4,19	47536	47537	–	–	47538	47539	–	–
12,0	36,0	83,0	12,0	1,0	4,19	47540	47541	–	–	47542	47543	–	–
12,0	36,0	83,0	12,0	1,5	4,19	47544	47545	–	–	47546	47547	–	–
12,0	36,0	83,0	12,0	2,0	4,19	47548	47549	–	–	47550	47551	–	–
12,0	36,0	83,0	12,0	2,5	4,19	47552	47553	–	–	47554	47555	–	–
12,0	36,0	83,0	12,0	3,0	4,19	47556	47557	–	–	47558	47559	–	–
16,0	19,0	82,0	16,0	1,0	5,59	48016	–	48056	48034	47032	–	47046	47039
16,0	19,0	82,0	16,0	1,5	5,59	48070	–	–	–	48071	–	–	–
16,0	35,0	92,0	16,0	1,0	5,59	47131	–	47134	48035	47033	–	47047	47040
16,0	35,0	92,0	16,0	1,5	5,59	48017	–	48057	48036	47034	–	47048	47041
16,0	35,0	92,0	16,0	2,0	5,59	47132	–	47135	48037	47035	–	47049	47042
16,0	35,0	92,0	16,0	2,5	5,59	48018	–	48058	48038	47036	–	47050	47043
16,0	35,0	92,0	16,0	3,0	5,59	47133	–	47136	48039	47037	–	47051	47044
16,0	35,0	92,0	16,0	4,0	5,59	48019	–	48059	48040	47038	–	47052	47045
16,0	48,0	100,0	16,0	1,0	5,59	47560	47561	–	–	47562	47563	–	–
16,0	48,0	100,0	16,0	1,5	5,59	47564	47565	–	–	47566	47567	–	–
16,0	48,0	100,0	16,0	2,0	5,59	47568	47569	–	–	47570	47571	–	–
16,0	48,0	100,0	16,0	2,5	5,59	47572	47573	–	–	47574	47575	–	–
16,0	48,0	100,0	16,0	3,0	5,59	47576	47577	–	–	47578	47579	–	–
16,0	48,0	100,0	16,0	4,0	5,59	47580	47581	–	–	47582	47583	–	–
20,0	23,0	92,0	20,0	1,0	7,01	48020	–	48060	48041	47053	–	47069	47061
20,0	43,0	104,0	20,0	1,0	7,01	47137	–	47140	48042	47054	–	47070	47062
20,0	43,0	104,0	20,0	1,5	7,01	48021	–	48061	48043	47055	–	47071	47063
20,0	43,0	104,0	20,0	2,0	7,01	47138	–	47141	48044	47056	–	47072	47064
20,0	43,0	104,0	20,0	2,5	7,01	48022	–	48062	48045	47057	–	47073	47065
20,0	43,0	104,0	20,0	3,0	7,01	47139	–	47142	48046	47058	–	47074	47066

(continued on next page)


Corner Radius


Straight


Weldon Flat

Right Spiral


Stub and Regular

Flute Spacing Unequal

Positive Rake Angle


Internal Coolant


External Coolant


Chipbreaker

Flutes

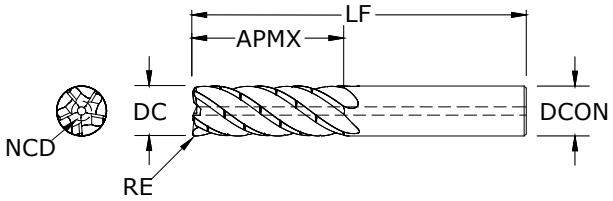
CARB-HPR
HIGH PERFORMANCE ROUGHER

TOLERANCES (mm)

DIAMETER	DC	DCON
6	+0,000 / –0,030	h6
> 6 - 10	+0,000 / –0,040	h6
> 10 - 25	+0,000 / –0,050	h6

CORNER RADIUS TOLERANCES (mm)

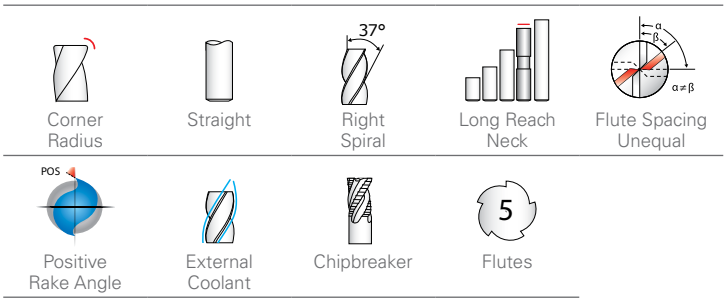
RE = +0,000 / –0,050



New Expanded Tools

Cutting Diameter DC	Length of Cut APMX	Overall Length LF	Shank Diameter DCON	Corner Radius RE	Non-Cutting Center Diameter NCD	Ti-Namite®-A (TA)				Ti-Namite®-M (TM)			
						EDP No.	EDP No. w/Chipbreaker	EDP No. w/Internal Coolant	EDP No. w/Flat	EDP No.	EDP No. w/Chipbreaker	EDP No. w/Internal Coolant	EDP No. w/ Flat
20,0	43,0	104,0	20,0	4,0	7,01	48023	–	48063	48047	47059	–	47075	47067
20,0	43,0	104,0	20,0	5,0	7,01	48024	–	48064	48048	47060	–	47076	47068
20,0	60,0	140,0	20,0	1,0	7,01	47584	47585	–	–	47586	47587	–	–
20,0	60,0	140,0	20,0	1,5	7,01	47588	47589	–	–	47590	47591	–	–
20,0	60,0	140,0	20,0	2,0	7,01	47592	47593	–	–	47594	47595	–	–
20,0	60,0	140,0	20,0	2,5	7,01	47596	47597	–	–	47598	47599	–	–
20,0	60,0	140,0	20,0	3,0	7,01	47600	47601	–	–	47602	47603	–	–
20,0	60,0	140,0	20,0	4,0	7,01	47604	47605	–	–	47606	47607	–	–
20,0	60,0	140,0	20,0	5,0	7,01	47608	47609	–	–	47610	47611	–	–
25,0	28,0	100,0	25,0	1,0	8,76	48025	–	48065	48049	47077	–	47091	47084
25,0	53,0	121,0	25,0	1,0	8,76	47143	–	47146	48050	47078	–	47092	47085
25,0	53,0	121,0	25,0	2,0	8,76	47144	–	47147	48051	47079	–	47093	47086
25,0	53,0	121,0	25,0	2,5	8,76	48026	–	48066	48052	47080	–	47094	47087
25,0	53,0	121,0	25,0	3,0	8,76	47145	–	47148	48053	47081	–	47095	47088
25,0	53,0	121,0	25,0	4,0	8,76	48027	–	48067	48054	47082	–	47096	47089
25,0	53,0	121,0	25,0	5,0	8,76	48028	–	48068	48055	47083	–	47097	47090
25,0	75,0	170,0	25,0	1,0	8,76	47612	47613	–	–	47614	47615	–	–
25,0	75,0	170,0	25,0	2,0	8,76	47616	47617	–	–	47618	47619	–	–
25,0	75,0	170,0	25,0	2,5	8,76	47620	47621	–	–	47622	47623	–	–
25,0	75,0	170,0	25,0	3,0	8,76	47624	47625	–	–	47626	47627	–	–
25,0	75,0	170,0	25,0	4,0	8,76	47628	47629	–	–	47630	47631	–	–
25,0	75,0	170,0	25,0	5,0	8,76	47632	47633	–	–	47634	47635	–	–

Z-CARB-HPR
HIGH PERFORMANCE ROUGHER

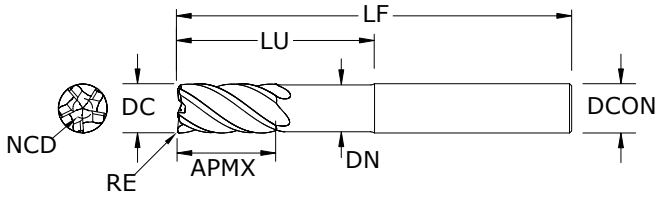


TOLERANCES (mm)

DIAMETER	DC	DCON
6	+0,000 / –0,030	h6
> 6 - 10	+0,000 / –0,040	h6
> 10 - 25	+0,000 / –0,050	h6

CORNER RADIUS TOLERANCES (mm)

RE = +0,000 / –0,050



New Expanded Tools

Cutting Diameter DC	Length of Cut APMX	Overall Length LF	Shank Diameter DCON	Corner Radius RE	Non-Cutting Center Diameter NCD	Reach LU	Neck Diameter DN	Ti-Namite®-A (TA)		Ti-Namite®-M (TM)	
								EDP No.	EDP No. w/Chipbreaker	EDP No.	EDP No. w/Chipbreaker
6,0	13,0	75,0	6,0	0,3	2,11	24,0	5,70	47636	47637	47638	47639
6,0	13,0	75,0	6,0	0,5	2,11	24,0	5,70	47640	47641	47642	47643
6,0	13,0	75,0	6,0	1,0	2,11	24,0	5,70	47644	47645	47646	47647
6,0	13,0	75,0	6,0	1,5	2,11	24,0	5,70	47648	47649	47650	47651
8,0	18,0	75,0	8,0	0,5	2,79	32,0	7,60	47652	47653	47654	47655
8,0	18,0	75,0	8,0	1,0	2,79	32,0	7,60	47656	47657	47658	47659
8,0	18,0	75,0	8,0	1,5	2,79	32,0	7,60	47660	47661	47662	47663
8,0	18,0	75,0	8,0	2,0	2,79	32,0	7,60	47664	47665	47666	47667
10,0	22,0	100,0	10,0	0,5	3,51	40,0	9,50	47668	47669	47670	47671
10,0	22,0	100,0	10,0	1,0	3,51	40,0	9,50	47672	47673	47674	47675
10,0	22,0	100,0	10,0	1,5	3,51	40,0	9,50	47676	47677	47678	47679
10,0	22,0	100,0	10,0	2,0	3,51	40,0	9,50	47680	47681	47682	47683
10,0	22,0	100,0	10,0	2,5	3,51	40,0	9,50	47684	47685	47686	47687
12,0	26,0	100,0	12,0	0,5	4,19	48,0	11,40	47688	47689	47690	47691
12,0	26,0	100,0	12,0	0,76	4,19	48,0	11,40	47692	47693	47694	47695
12,0	26,0	100,0	12,0	1,0	4,19	48,0	11,40	47696	47697	47698	47699
12,0	26,0	100,0	12,0	1,5	4,19	48,0	11,40	47700	47701	47702	47703
12,0	26,0	100,0	12,0	2,0	4,19	48,0	11,40	47704	47705	47706	47707
12,0	26,0	100,0	12,0	2,5	4,19	48,0	11,40	47708	47709	47710	47711
12,0	26,0	100,0	12,0	3,0	4,19	48,0	11,40	47712	47713	47714	47715
16,0	35,0	125,0	16,0	1,0	5,59	64,0	15,20	47716	47717	47718	47719
16,0	35,0	125,0	16,0	1,5	5,59	64,0	15,20	47720	47721	47722	47723
16,0	35,0	125,0	16,0	2,0	5,59	64,0	15,20	47724	47725	47726	47727
16,0	35,0	125,0	16,0	2,5	5,59	64,0	15,20	47728	47729	47730	47731
16,0	35,0	125,0	16,0	3,0	5,59	64,0	15,20	47732	47733	47734	47735
16,0	35,0	125,0	16,0	4,0	5,59	64,0	15,20	47736	47737	47738	47739
20,0	43,0	150,0	20,0	1,0	7,01	80,0	19,00	47740	47741	47742	47743
20,0	43,0	150,0	20,0	1,5	7,01	80,0	19,00	47744	47745	47746	47747
20,0	43,0	150,0	20,0	2,0	7,01	80,0	19,00	47748	47749	47750	47751
20,0	43,0	150,0	20,0	2,5	7,01	80,0	19,00	47752	47753	47754	47755
20,0	43,0	150,0	20,0	3,0	7,01	80,0	19,00	47756	47757	47758	47759
20,0	43,0	150,0	20,0	4,0	7,01	80,0	19,00	47760	47761	47762	47763

(continued on next page)


Corner Radius


Straight

Right Spiral


Long Reach Neck

Flute Spacing Unequal

Positive Rake Angle


External Coolant


Chipbreaker

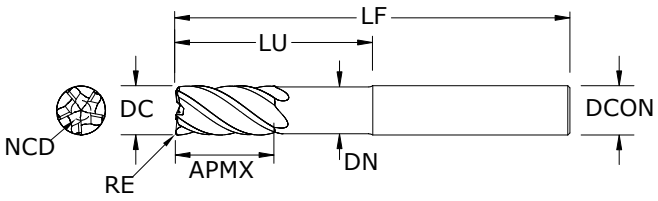
Flutes

TOLERANCES (mm)

DIAMETER	DC	DCON
6	+0,000 / –0,030	h6
> 6 - 10	+0,000 / –0,040	h6
> 10 - 25	+0,000 / –0,050	h6

CORNER RADIUS TOLERANCES (mm)

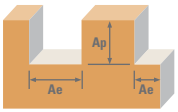
RE = +0,000 / –0,050



New Expanded Tools

Cutting Diameter DC	Length of Cut APMX	Overall Length LF	Shank Diameter DCON	Corner Radius RE	Non-Cutting Center Diameter NCD	Reach LU	Neck Diameter DN	Ti-Namite®-A (TA)		Ti-Namite®-M (TM)	
								EDP No.	EDP No. w/Chipbreaker	EDP No.	EDP No. w/Chipbreaker
20,0	43,0	150,0	20,0	5,0	7,01	80,0	19,00	47764	47765	47766	47767
25,0	53,0	170,0	25,0	1,0	8,76	100,0	23,75	47768	47769	47770	47771
25,0	53,0	170,0	25,0	2,0	8,76	100,0	23,75	47772	47773	47774	47775
25,0	53,0	170,0	25,0	2,5	8,76	100,0	23,75	47776	47777	47778	47779
25,0	53,0	170,0	25,0	3,0	8,76	100,0	23,75	47780	47781	47782	47783
25,0	53,0	170,0	25,0	4,0	8,76	100,0	23,75	47784	47785	47786	47787
25,0	53,0	170,0	25,0	5,0	8,76	100,0	23,75	47788	47789	47790	47791

CARB-HPR
HIGH PERFORMANCE ROUGHER



	Series Z5, Z5CR, Z5L, Z5LC Fractional	Hardness		Ae x DC	Ap x DC	Vc (sfm)		DC • in 1/8	1/4	3/8	1/2	5/8	3/4	1
P	**CARBON STEELS 1018, 1040, 1080, 1090, 10L50, 1140, 1212, 12L15, 1525, 1536**	≤ 275 Bhn or ≤ 28 HRc	HSM[1]	≤ 0.1	≤ APMX	720 (576-864)	RPM	22003	11002	7334	5501	4401	3667	2750
							Fz	0.00078	0.0021	0.0039	0.0052	0.0057	0.0062	0.0073
							Feed (ipm)	85.8	115.5	143.0	143.0	125.4	113.7	100.4
			Profile	≤ 0.4	≤ APMX	555 (444-666)	RPM	16961	8480	5654	4240	3392	2827	2120
							Fz	0.00046	0.0012	0.0023	0.0031	0.0034	0.0037	0.0043
							Feed (ipm)	50.6	66.0	84.3	85.3	74.8	67.8	59.1
			Slot[2]	1	≤ 1	440 (352-528)	RPM	13446	6723	4482	3362	2689	2241	1681
							Fz	0.00046	0.0012	0.0023	0.0031	0.0034	0.0037	0.0043
							Feed (ipm)	30.9	40.3	51.5	52.1	45.7	41.5	36.1
	ALLOY STEELS 4140, 4150, 4320, 5120, 5150, 8630, 86L20, 50100	≤ 375 Bhn or ≤ 40 HRc	HSM[1]	≤ 0.1	≤ APMX	410 (328-492)	RPM	12530	6265	4177	3132	2506	2088	1566
							Fz	0.00057	0.0015	0.0029	0.0038	0.0042	0.0046	0.0053
							Feed (ipm)	35.7	47.0	60.6	59.5	52.6	48.0	41.5
			Profile	≤ 0.5	≤ APMX	315 (252-378)	RPM	9626	4813	3209	2407	1925	1604	1203
							Fz	0.00034	0.0009	0.0017	0.0023	0.0026	0.0028	0.0032
							Feed (ipm)	16.4	21.7	27.3	27.7	25.0	22.5	19.3
			Slot[2]	1	≤ 1	250 (200-300)	RPM	7640	3820	2547	1910	1528	1273	955
							Fz	0.00034	0.0009	0.0017	0.0023	0.0026	0.0028	0.0032
							Feed (ipm)	13.0	17.2	21.6	22.0	19.9	17.8	15.3
	TOOL STEELS A2, D2, H13, L2, M2, P20, S7, T15, W2	≤ 375 Bhn or ≤ 40 HRc	HSM[1]	≤ 0.1	≤ APMX	240 (192-288)	RPM	7334	3667	2445	1834	1467	1222	917
							Fz	0.00045	0.0012	0.0023	0.0030	0.0033	0.0036	0.0042
							Feed (ipm)	16.5	22.0	28.1	27.5	24.2	22.0	19.3
			Profile	≤ 0.4	≤ APMX	185 (148-222)	RPM	5654	2827	1885	1413	1131	942	707
							Fz	0.00028	0.0007	0.0014	0.0018	0.0020	0.0022	0.0026
							Feed (ipm)	7.9	9.9	13.2	12.7	11.3	10.4	9.2
			Slot[2]	1	≤ 1	145 (116-174)	RPM	4431	2216	1477	1108	886	739	554
							Fz	0.00028	0.0007	0.0014	0.0018	0.0020	0.0022	0.0026
							Feed (ipm)	6.2	7.8	10.3	10.0	8.9	8.1	7.2
M	**STAINLESS STEELS (FREE MACHINING) 303, 416, 420F, 430F, 440F**	≤ 275 Bhn or ≤ 28 HRc	HSM[1]	≤ 0.1	≤ APMX	635 (508-762)	RPM	19406	9703	6469	4851	3881	3234	2426
							Fz	0.00057	0.0015	0.0029	0.0038	0.0042	0.0046	0.0053
							Feed (ipm)	55.3	72.8	93.8	92.2	81.5	74.4	64.3
			Profile	≤ 0.4	≤ APMX	490 (392-588)	RPM	14974	7487	4991	3744	2995	2496	1872
							Fz	0.00034	0.0009	0.0017	0.0023	0.0026	0.0028	0.0032
							Feed (ipm)	25.5	33.7	42.4	43.1	38.9	34.9	29.9
			Slot[2]	1	≤ 1	390 (312-468)	RPM	11918	5959	3973	2980	2384	1986	1490
							Fz	0.00034	0.0009	0.0017	0.0023	0.0026	0.0028	0.0032
							Feed (ipm)	20.3	26.8	33.8	34.3	31.0	27.8	23.8
	STAINLESS STEELS (DIFFICULT) 304, 304L, 316, 316L	≤ 275 Bhn or ≤ 28 HRc	HSM[1]	≤ 0.1	≤ APMX	440 (352-528)	RPM	13446	6723	4482	3362	2689	2241	1681
							Fz	0.00045	0.0012	0.0023	0.0030	0.0033	0.0036	0.0042
							Feed (ipm)	30.3	40.3	51.5	50.4	44.4	40.3	35.3
			Profile	≤ 0.4	≤ APMX	340 (272-408)	RPM	10390	5195	3463	2598	2078	1732	1299
							Fz	0.00027	0.0007	0.0014	0.0018	0.0020	0.0022	0.0025
							Feed (ipm)	14.0	18.2	24.2	23.4	20.8	19.0	16.2
			Slot[2]	1	≤ 1	270 (216-324)	RPM	8251	4126	2750	2063	1650	1375	1031
							Fz	0.00027	0.0007	0.0014	0.0018	0.0020	0.0022	0.0025
							Feed (ipm)	11.1	14.4	19.3	18.6	16.5	15.1	12.9
	STAINLESS STEELS (PH) 13-8 PH, 15-5PH, 17-4 PH, CUSTOM 450	≤ 325 Bhn or ≤ 35 HRc	HSM[1]	≤ 0.1	≤ APMX	410 (328-492)	RPM	12530	6265	4177	3132	2506	2088	1566
							Fz	0.00045	0.0012	0.0023	0.0030	0.0033	0.0036	0.0042
							Feed (ipm)	28.2	37.6	48.0	47.0	41.3	37.6	32.9
			Profile	≤ 0.4	≤ APMX	310 (248-372)	RPM	9474	4737	3158	2368	1895	1579	1184
							Fz	0.00027	0.0007	0.0014	0.0018	0.0020	0.0022	0.0025
							Feed (ipm)	12.8	16.6	22.1	21.3	18.9	17.4	14.8
			Slot[2]	1	≤ 1	250 (200-300)	RPM	7640	3820	2547	1910	1528	1273	955
							Fz	0.00027	0.0007	0.0014	0.0018	0.0020	0.0022	0.0025
							Feed (ipm)	10.3	13.4	17.8	17.2	15.3	14.0	11.9

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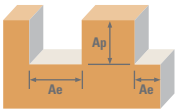
CARB-HPR
HIGH PERFORMANCE ROUGHER



	Series Z5, Z5CR, Z5L, Z5LC Fractional	Hardness		Ae x DC	Ap x DC	Vc (sfm)		DC • in 1/8	1/4	3/8	1/2	5/8	3/4	1
K	CAST IRONS (LOW & MEDIUM ALLOY) Gray, Malleable, Ductile	≤ 220 Bhn or ≤ 19 HRc	HSM[1]	≤ 0.1	≤ APMX	575 (460-690)	RPM	17572	8786	5857	4393	3514	2929	2197
							Fz	0.00071	0.0019	0.0035	0.0047	0.0052	0.0056	0.0066
							Feed (ipm)	62.4	83.5	102.5	103.2	91.4	82.0	72.5
			Profile	≤ 0.4	≤ APMX	445 (356-534)	RPM	13599	6800	4533	3400	2720	2267	1700
							Fz	0.00042	0.0011	0.0021	0.0028	0.0031	0.0034	0.0039
							Feed (ipm)	28.6	37.4	47.6	47.6	42.2	38.5	33.1
			Slot[2]	1	≤ 1	355 (284-426)	RPM	10849	5424	3616	2712	2170	1808	1356
							Fz	0.00042	0.0011	0.0021	0.0028	0.0031	0.0034	0.0039
							Feed (ipm)	22.8	29.8	38.0	38.0	33.6	30.7	26.4
	CAST IRONS (HIGH ALLOY) Gray, Malleable, Ductile	≤ 260 Bhn or ≤ 26 HRc	HSM[1]	≤ 0.1	≤ APMX	440 (352-528)	RPM	13446	6723	4482	3362	2689	2241	1681
							Fz	0.00053	0.0014	0.0026	0.0035	0.0039	0.0042	0.0049
							Feed (ipm)	35.6	47.1	58.3	58.8	52.4	47.1	41.2
			Profile	≤ 0.4	≤ APMX	340 (272-408)	RPM	10390	5195	3463	2598	2078	1732	1299
							Fz	0.00031	0.0008	0.0016	0.0021	0.0023	0.0025	0.0029
							Feed (ipm)	16.1	21.8	27.7	27.3	23.9	21.6	18.8
			Slot[2]	1	≤ 1	270 (216-324)	RPM	8251	4126	2750	2063	1650	1375	1031
							Fz	0.00031	0.0008	0.0016	0.0021	0.0023	0.0025	0.0029
							Feed (ipm)	12.8	17.3	22.0	21.7	19.0	17.2	15.0
S	SUPER ALLOYS (NICKEL , COBALT, IRON BASE) Inconel 601, 617, 625, Incoloy, Monel 400	≤ 300 Bhn or ≤ 32 HRc	HSM[1]	≤ 0.1	≤ APMX	115 (92-138)	RPM	3514	1757	1171	879	703	586	439
							Fz	0.00042	0.0011	0.0021	0.0028	0.0031	0.0034	0.0039
							Feed (ipm)	7.4	9.7	12.3	12.3	10.9	10.0	8.6
			Profile	≤ 0.4	≤ APMX	80 (64-96)	RPM	2445	1222	815	611	489	407	306
							Fz	0.00025	0.0007	0.0013	0.0017	0.0019	0.0020	0.0024
							Feed (ipm)	3.1	4.2	5.2	5.2	4.6	4.2	3.6
			Slot[2]	1	≤ 1	65 (52-78)	RPM	1986	993	662	497	397	331	248
							Fz	0.00025	0.0007	0.0013	0.0017	0.0019	0.0020	0.0024
							Feed (ipm)	2.5	3.4	4.2	4.2	3.7	3.4	3.0
	SUPER ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 718, X-750, Incoloy, Waspaloy, Hastelloy, Rene	≤ 400 Bhn or ≤ 43 HRc	HSM[1]	≤ 0.1	≤ APMX	100 (80-120)	RPM	3056	1528	1019	764	611	509	382
							Fz	0.00030	0.0008	0.0015	0.0020	0.0022	0.0024	0.0028
							Feed (ipm)	4.6	6.1	7.6	7.6	6.7	6.1	5.3
			Profile	≤ 0.4	≤ APMX	62 (50-74)	RPM	1895	947	632	474	379	316	237
							Fz	0.00018	0.0005	0.0009	0.0012	0.0013	0.0014	0.0017
							Feed (ipm)	1.7	2.3	2.8	2.8	2.5	2.2	2.0
			Slot[2]	1	≤ 1	50 (40-60)	RPM	1528	764	509	382	306	255	191
							Fz	0.00018	0.0005	0.0009	0.0012	0.0013	0.0014	0.0017
							Feed (ipm)	1.4	1.8	2.3	2.3	2.0	1.8	1.6
	TITANIUM ALLOYS Pure Ttanium, Ti6Al4V, Ti6Al2Sn4Zr2Mo, Ti4Al4Mo2Sn0.5Si	≤ 350 Bhn or ≤ 38 HRc	HSM[1]	≤ 0.1	≤ APMX	280 (224-336)	RPM	8557	4278	2852	2139	1711	1426	1070
							Fz	0.00050	0.0013	0.0025	0.0033	0.0036	0.0040	0.0046
							Feed (ipm)	21.4	27.8	35.7	35.3	30.8	28.5	24.6
			Profile	≤ 0.4	≤ APMX	215 (172-258)	RPM	6570	3285	2190	1643	1314	1095	821
							Fz	0.00030	0.0008	0.0015	0.0020	0.0022	0.0024	0.0028
							Feed (ipm)	9.9	13.1	16.4	16.4	14.5	13.1	11.5
			Slot[2]	1	≤ 1	170 (136-204)	RPM	5195	2598	1732	1299	1039	866	649
							Fz	0.00030	0.0008	0.0015	0.0020	0.0022	0.0024	0.0028
							Feed (ipm)	7.8	10.4	13.0	13.0	11.4	10.4	9.1
	TITANIUM ALLOYS (DIFFICULT) Ti10Al2Fe3Al, Ti5Al5V5Mo3Cr, Ti7Al4Mo, Ti3Al8V6Cr4Zr4Mo, Ti6Al6V6Sn, Ti15V3 Cr3Sn3Al	≤ 440 Bhn or ≤ 47 HRc	HSM[1]	≤ 0.1	≤ APMX	155 (124-186)	RPM	4737	2368	1579	1184	947	789	592
							Fz	0.00050	0.0013	0.0025	0.0033	0.0036	0.0040	0.0046
							Feed (ipm)	11.8	15.4	19.7	19.5	17.1	15.8	13.6
			Profile	≤ 0.4	≤ APMX	75 (60-90)	RPM	2292	1146	764	573	458	382	287
							Fz	0.00030	0.0008	0.0015	0.0020	0.0022	0.0024	0.0028
							Feed (ipm)	3.4	4.6	5.7	5.7	5.0	4.6	4.0
			Slot[2]	1	≤ 1	60 (48-72)	RPM	1834	917	611	458	367	306	229
							Fz	0.00030	0.0008	0.0015	0.0020	0.0022	0.0024	0.0028
							Feed (ipm)	2.8	3.7	4.6	4.6	4.0	3.7	3.2

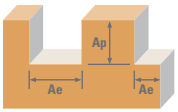
Note:

- Bhn (Brinell) HRc (Rockwell C) HSM (High Speed Machining)
- rpm = Vc x 3.82 / DC
- ipm = Fz x 5 x rpm

[1] HSM method strongly recommended, particularly when using 4 x DC tools
[2] reduce Ap to ≤.5 x DC when slotting with 4 x DC tools

- ramp at 5 degrees or less, using slotting speed and feed rates (do not plunge)
- reduce speed and feed for materials harder than listed
- reduce feed and Ae when finish milling (.02 x DC maximum)
- refer to the SGS Tool Wizard® for complete technical information (www.kyocera-sgstool.com)

CARB-HPR
HIGH PERFORMANCE ROUGHER



Series Z5M, Z5MCR, Z5ML, Z5MLC Metric		Hardness		Ae x DC	Ap x DC	Vc (m/min)		DC • mm 6	8	10	12	16	20	25
P	CARBON STEELS 1018, 1040, 1080, 1090, 10L50, 1140, 1212, 12L15, 1525, 1536	≤ 275 Bhn or ≤ 28 HRc	HSM[1]	≤ 0.1	≤ APMX	219 (176-263)	RPM	11633	8725	6980	5816	4362	3490	2792
							Fz	0.050	0.083	0.104	0.125	0.146	0.165	0.183
							Feed (mm/min)	2931	3630	3629	3629	3183	2885	2548
			Profile	≤ 0.4	≤ APMX	169 (135-203)	RPM	8967	6725	5380	4484	3363	2690	2152
							Fz	0.029	0.049	0.061	0.074	0.087	0.099	0.108
							Feed (mm/min)	1291	1650	1650	1668	1463	1327	1157
			Slot[2]	1	≤ 1	134 (107-161)	RPM	7109	5332	4265	3555	2666	2133	1706
							Fz	0.029	0.049	0.061	0.074	0.087	0.099	0.108
							Feed (mm/min)	1024	1308	1308	1322	1160	1052	917
	ALLOY STEELS 4140, 4150, 4320, 5120, 5150, 8630, 86L20, 50100	≤ 375 Bhn or ≤ 40 HRc	HSM[1]	≤ 0.1	≤ APMX	125 (100-150)	RPM	6624	4968	3975	3312	2484	1987	1590
							Fz	0.036	0.062	0.077	0.091	0.108	0.123	0.133
							Feed (mm/min)	1192	1537	1537	1510	1335	1219	1053
			Profile	≤ 0.5	≤ APMX	96 (77-115)	RPM	5089	3817	3054	2545	1909	1527	1221
							Fz	0.022	0.036	0.045	0.055	0.067	0.075	0.080
							Feed (mm/min)	550	692	692	702	635	570	489
			Slot[2]	1	≤ 1	76 (61-91)	RPM	4039	3029	2424	2020	1515	1212	969
							Fz	0.022	0.036	0.045	0.055	0.067	0.075	0.080
							Feed (mm/min)	436	549	549	557	504	452	388
	TOOL STEELS A2, D2, H13, L2, M2, P20, S7, T15, W2	≤ 375 Bhn or ≤ 40 HRc	HSM[1]	≤ 0.1	≤ APMX	73 (59-88)	RPM	3878	2908	2327	1939	1454	1163	931
							Fz	0.029	0.049	0.061	0.072	0.084	0.096	0.105
							Feed (mm/min)	558	714	713	698	614	558	489
			Profile	≤ 0.4	≤ APMX	56 (45-68)	RPM	2989	2242	1793	1495	1121	897	717
							Fz	0.017	0.030	0.037	0.043	0.051	0.059	0.065
							Feed (mm/min)	251	335	335	323	287	263	233
			Slot[2]	1	≤ 1	44 (35-53)	RPM	2343	1757	1406	1171	879	703	562
							Fz	0.017	0.030	0.037	0.043	0.051	0.059	0.065
							Feed (mm/min)	197	262	262	253	225	206	183
M	STAINLESS STEELS (FREE MACHINING) 303, 416, 420F, 430F, 440F	≤ 275 Bhn or ≤ 28 HRc	HSM[1]	≤ 0.1	≤ APMX	194 (155-232)	RPM	10260	7695	6156	5130	3847	3078	2462
							Fz	0.036	0.062	0.077	0.091	0.108	0.123	0.133
							Feed (mm/min)	1847	2381	2380	2339	2068	1888	1631
			Profile	≤ 0.4	≤ APMX	149 (119-179)	RPM	7917	5938	4750	3958	2969	2375	1900
							Fz	0.022	0.036	0.045	0.055	0.067	0.075	0.080
							Feed (mm/min)	855	1077	1077	1092	988	887	760
			Slot[2]	1	≤ 1	119 (95-143)	RPM	6301	4726	3781	3151	2363	1890	1512
							Fz	0.022	0.036	0.045	0.055	0.067	0.075	0.080
							Feed (mm/min)	680	857	857	869	786	706	605
	STAINLESS STEELS (DIFFICULT) 304, 304L, 316, 316L	≤ 275 Bhn or ≤ 28 HRc	HSM[1]	≤ 0.1	≤ APMX	134 (107-161)	RPM	7109	5332	4265	3555	2666	2133	1706
							Fz	0.029	0.049	0.061	0.072	0.084	0.096	0.105
							Feed (mm/min)	1024	1308	1308	1280	1126	1024	896
			Profile	≤ 0.4	≤ APMX	104 (83-124)	RPM	5493	4120	3296	2747	2060	1648	1318
							Fz	0.017	0.030	0.037	0.043	0.051	0.059	0.063
							Feed (mm/min)	461	615	615	593	527	483	412
			Slot[2]	1	≤ 1	82 (66-99)	RPM	4362	3272	2617	2181	1636	1309	1047
							Fz	0.017	0.030	0.037	0.043	0.051	0.059	0.063
							Feed (mm/min)	366	489	489	471	419	384	327
	STAINLESS STEELS (PH) 13-8 PH, 15-5PH, 17-4 PH, CUSTOM 450	≤ 325 Bhn or ≤ 35 HRc	HSM[1]	≤ 0.1	≤ APMX	125 (100-150)	RPM	6624	4968	3975	3312	2484	1987	1590
							Fz	0.029	0.049	0.061	0.072	0.084	0.096	0.105
							Feed (mm/min)	954	1219	1219	1192	1049	954	835
			Profile	≤ 0.4	≤ APMX	94 (76-113)	RPM	5009	3756	3005	2504	1878	1503	1202
							Fz	0.017	0.030	0.037	0.043	0.051	0.059	0.063
							Feed (mm/min)	421	561	561	541	481	441	376
			Slot[2]	1	≤ 1	76 (61-91)	RPM	4039	3029	2424	2020	1515	1212	969
							Fz	0.017	0.030	0.037	0.043	0.051	0.059	0.063
							Feed (mm/min)	339	452	452	436	388	355	303

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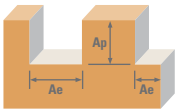
Z-CARB-HPR
HIGH PERFORMANCE ROUGHER



	Series Z5M, Z5MCR, Z5ML, Z5MLC Metric	Hardness		Ae x DC	Ap x DC	Vc (m/min)		DC • mm 6	8	10	12	16	20	25
K	CAST IRONS (LOW & MEDIUM ALLOY) Gray, Malleable, Ductile	≤ 220 Bhn or ≤ 19 HRc	HSM[1]	≤ 0.1	≤ APMX	175 (140-210)	RPM	9290	6968	5574	4645	3484	2787	2230
							Fz	0.046	0.075	0.093	0.113	0.133	0.149	0.165
							Feed (mm/min)	2118	2602	2601	2620	2319	2081	1840
			Profile	≤ 0.4	≤ APMX	136 (109-163)	RPM	7190	5392	4314	3595	2696	2157	1726
							Fz	0.026	0.045	0.056	0.067	0.079	0.091	0.098
							Feed (mm/min)	949	1208	1208	1208	1070	978	841
			Slot[2]	1	≤ 1	108 (87-130)	RPM	5736	4302	3441	2868	2151	1721	1377
							Fz	0.026	0.045	0.056	0.067	0.079	0.091	0.098
							Feed (mm/min)	757	964	964	964	853	780	671
	CAST IRONS (HIGH ALLOY) Gray, Malleable, Ductile	≤ 260 Bhn or ≤ 26 HRc	HSM[1]	≤ 0.1	≤ APMX	134 (107-161)	RPM	7109	5332	4265	3555	2666	2133	1706
							Fz	0.034	0.055	0.069	0.084	0.100	0.112	0.123
							Feed (mm/min)	1194	1479	1479	1493	1331	1194	1045
			Profile	≤ 0.4	≤ APMX	104 (83-124)	RPM	5493	4120	3296	2747	2060	1648	1318
							Fz	0.020	0.034	0.043	0.050	0.059	0.067	0.073
							Feed (mm/min)	554	703	703	692	606	549	478
			Slot[2]	1	≤ 1	82 (66-99)	RPM	4362	3272	2617	2181	1636	1309	1047
							Fz	0.020	0.034	0.043	0.050	0.059	0.067	0.073
							Feed (mm/min)	440	558	558	550	482	436	380
S	SUPER ALLOYS (NICKEL , COBALT, IRON BASE) Inconel 601, 617, 625, Incoloy, Monel 400	≤ 300 Bhn or ≤ 32 HRc	HSM[1]	≤ 0.1	≤ APMX	35 (28-42)	RPM	1858	1394	1115	929	697	557	446
							Fz	0.026	0.045	0.056	0.067	0.079	0.091	0.098
							Feed (mm/min)	245	312	312	312	276	253	217
			Profile	≤ 0.4	≤ APMX	24 (20-29)	RPM	1293	969	776	646	485	388	310
							Fz	0.016	0.027	0.034	0.041	0.048	0.054	0.060
							Feed (mm/min)	105	132	132	132	116	105	92
			Slot[2]	1	≤ 1	20 (16-24)	RPM	1050	788	630	525	394	315	252
							Fz	0.016	0.027	0.034	0.041	0.048	0.054	0.060
							Feed (mm/min)	86	108	108	107	94	86	75
	SUPER ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 718, X-750, Incoloy, Waspaloy, Hastelloy, Rene	≤ 400 Bhn or ≤ 43 HRc	HSM[1]	≤ 0.1	≤ APMX	30 (24-37)	RPM	1616	1212	969	808	606	485	388
							Fz	0.019	0.032	0.040	0.048	0.056	0.064	0.070
							Feed (mm/min)	155	194	194	194	171	155	136
			Profile	≤ 0.4	≤ APMX	19 (15-23)	RPM	1002	751	601	501	376	301	240
							Fz	0.012	0.019	0.024	0.029	0.033	0.037	0.043
							Feed (mm/min)	58	72	72	72	63	56	51
			Slot[2]	1	≤ 1	15 (12-18)	RPM	808	606	485	404	303	242	194
							Fz	0.012	0.019	0.024	0.029	0.033	0.037	0.043
							Feed (mm/min)	47	58	58	58	50	45	41
	TITANIUM ALLOYS Pure Ttanium, Ti6Al4V, Ti6Al2Sn4Zr2Mo, Ti4Al4Mo2Sn0.5Si	≤ 350 Bhn or ≤ 38 HRc	HSM[1]	≤ 0.1	≤ APMX	85 (68-102)	RPM	4524	3393	2714	2262	1696	1357	1086
							Fz	0.031	0.053	0.067	0.079	0.092	0.107	0.115
							Feed (mm/min)	706	905	905	896	782	724	624
			Profile	≤ 0.4	≤ APMX	66 (52-79)	RPM	3474	2605	2084	1737	1303	1042	834
							Fz	0.019	0.032	0.040	0.048	0.056	0.064	0.070
							Feed (mm/min)	333	417	417	417	367	333	292
			Slot[2]	1	≤ 1	52 (41-62)	RPM	2747	2060	1648	1373	1030	824	659
							Fz	0.019	0.032	0.040	0.048	0.056	0.064	0.070
							Feed (mm/min)	264	330	330	330	290	264	231
	TITANIUM ALLOYS (DIFFICULT) Ti10Al2Fe3Al, Ti5Al5V5Mo3Cr, Ti7Al4Mo, Ti3Al8V6Cr4Zr4Mo, Ti6Al6V6Sn, Ti15V3 Cr3Sn3Al	≤ 440 Bhn or ≤ 47 HRc	HSM[1]	≤ 0.1	≤ APMX	47 (38-57)	RPM	2504	1878	1503	1252	939	751	601
							Fz	0.031	0.053	0.067	0.079	0.092	0.107	0.115
							Feed (mm/min)	391	501	501	496	433	401	346
			Profile	≤ 0.4	≤ APMX	23 (18-27)	RPM	1212	909	727	606	454	364	291
							Fz	0.019	0.032	0.040	0.048	0.056	0.064	0.070
							Feed (mm/min)	116	145	145	145	128	116	102
			Slot[2]	1	≤ 1	18 (15-22)	RPM	969	727	582	485	364	291	233
							Fz	0.019	0.032	0.040	0.048	0.056	0.064	0.070
							Feed (mm/min)	93	116	116	116	102	93	81

Note:
- Bhn (Brinell) HRc (Rockwell C) HSM (High Speed Machining)
- rpm = (Vc x 1000) / (DC x 3.14)
- mm/min = Fz x 5 x rpm

[1] HSM method strongly recommended, particularly when using 4 x DC tools
[2] reduce Ap to ≤.5 x DC when slotting with 4 x DC tools

- ramp at 5 degrees or less, using slotting speed and feed rates (do not plunge)
- reduce speed and feed for materials harder than listed
- reduce feed and Ae when finish milling (.02 x DC maximum)
- refer to the SGS Tool Wizard® for complete technical information (www.kyocera-sgstool.com)

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