KYOCERA

SGS
Solid Carbide Tools

Z5 High Performance Roughers

CARB-HPR
HIGH PERFORMANCE ROUGHER

New Expanded Offering

www.kyocera-sgstool.com

ISO 9001 Certified

Z-CARB-HPR

HIGH PERFORMANCE ROUGHER

INTRODUCING 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.

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

EXPANSIVE OFFERING

- Over 700 items in portfolio
- Available in stub and regular lengths
- Full complement of corner radii available
- Central coolant hole option 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
- Available coatings are suitable for dry machining in ferrous based materials such as cast irons and many carbon steels

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
Oxidation Temperature: 1150°C / 2100°F
Coefficient of Friction: 0.45
Thickness: 1 – 4 Microns (based on tool diameter)

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
Oxidation Temperature: 1100°C / 2010°F
Coefficient of Friction: 0.30
Thickness: 1 – 4 Microns (based on tool diameter)

FEATURES

RADIAL RAKE

- Specially designed radial rake balances positive cutting action and edge strength
- 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

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

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

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

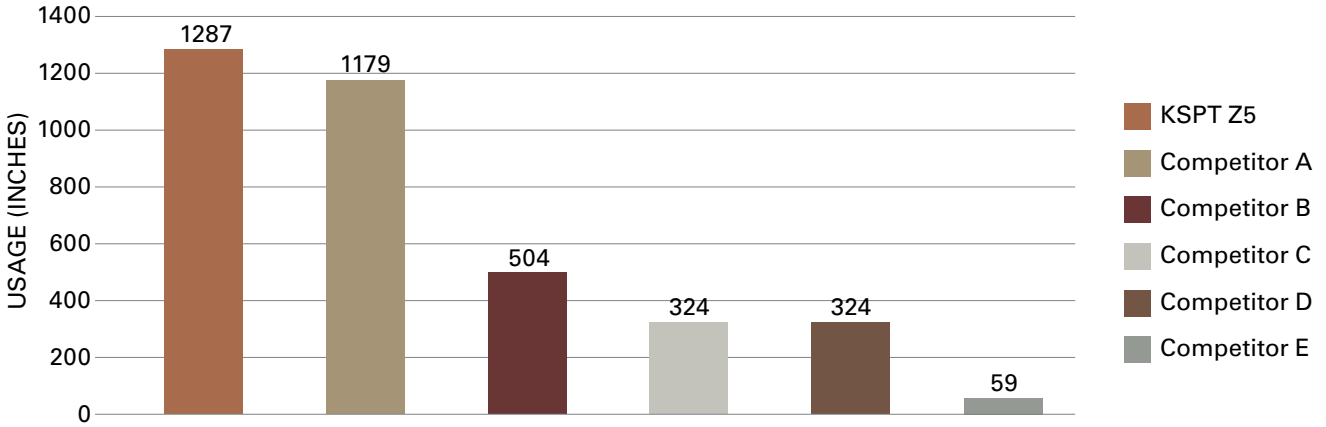
FINISHING

- 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

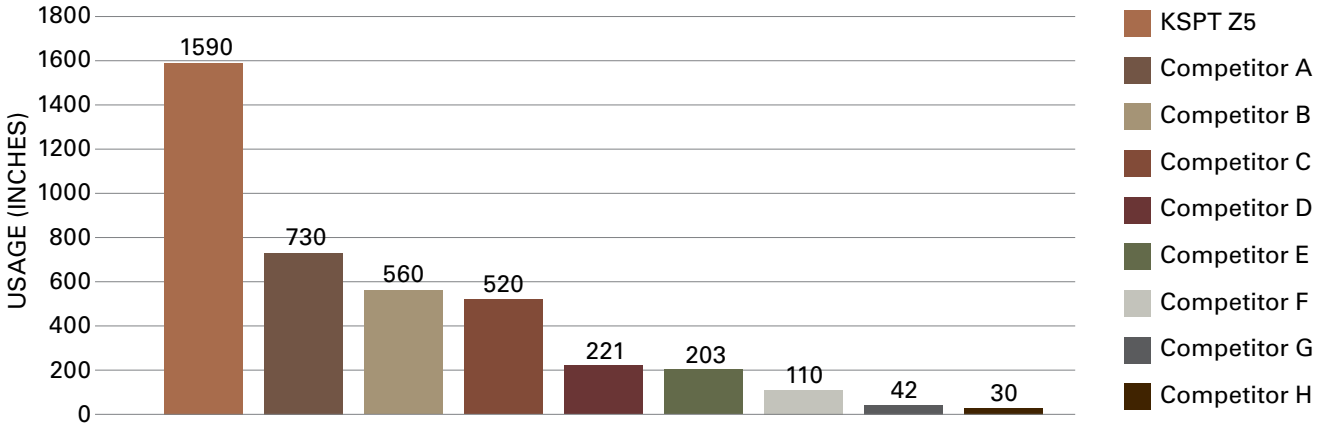
LAB TESTING RESULTS – HEAVY PROFILING IN TITANIUM



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
304LP Stainless Steel

PRODUCT
KSPT Z-CARB HPR

APPLICATION
MILLING

COMPETITOR
INSERT CUTTER

COOLANT
FLOOD

TOOL INFORMATION
.625 DIA / 1.25" LOC / 3.5" OAL

GOALS

The goals of this study were to significantly reduce job cost through increasing tool life, reducing cycle time and improving manufacturing efficiency.

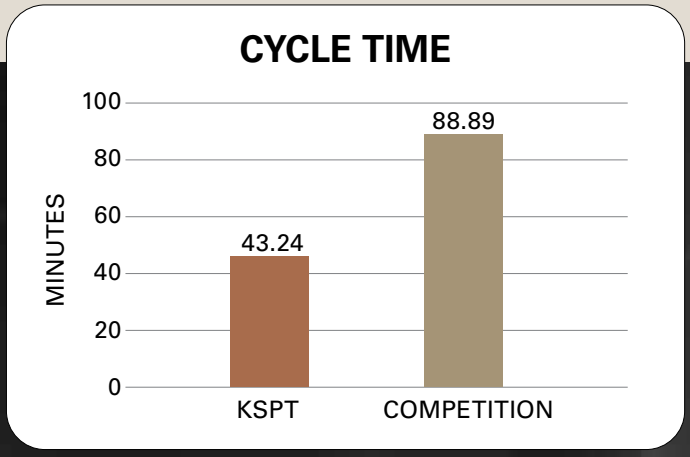
STRATEGY

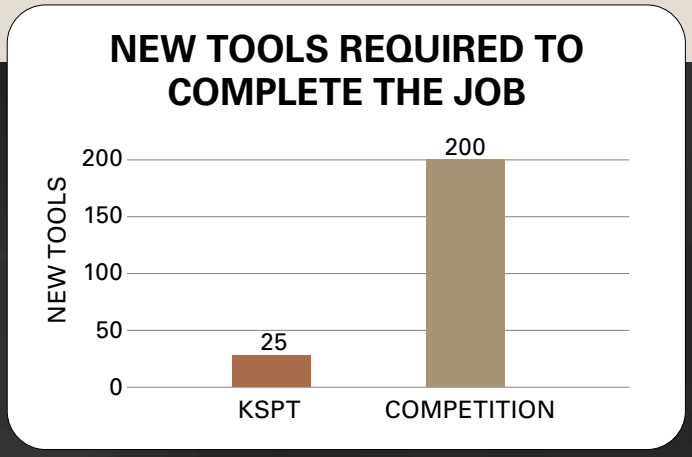
KSPT approached this job with a 5 flute Z-Carb high performance rougher (HPR) end mill. KSPT's Z-Carb HPR is ideal for achieving high metal removal rates, while at the same time achieving an optimal surface finish. The Ti-Namite M coating was selected for its outstanding performance in Titanium.

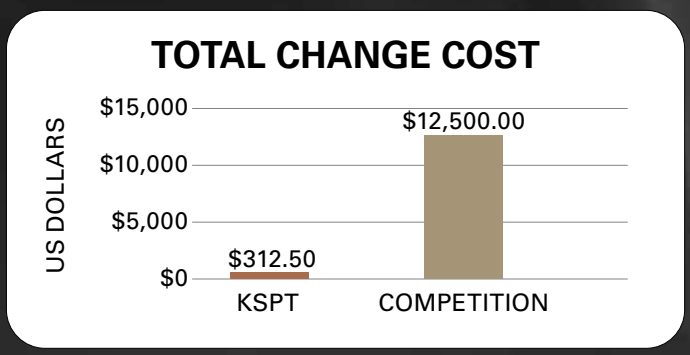
	KSPT	COMPETITOR
TOOL DIAMETER	.6250"	2" (INDEXABLE)
SPEED	1850 RPM	1200 RPM
FEED	18.5 IPM	9.0 IPM
RADIAL CUT (AE)	.1250"	.0500"
AXIAL CUT (AP)	1.4000"	.3000"
TOTAL MACHINING HOURS	72.07 HOURS	148.15 HOURS

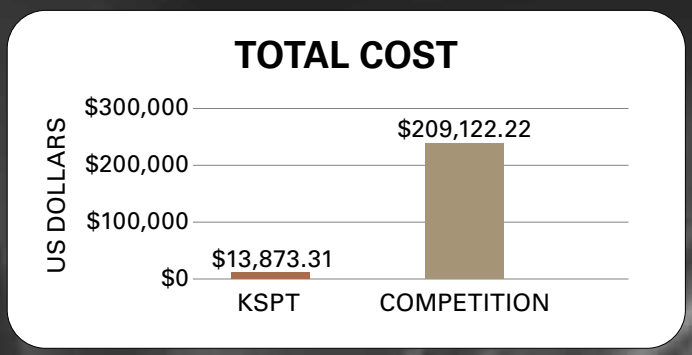
RESULTS

The overall findings of this study indicate that **KSPT's Z-Carb HPR outperformed the competition in every statistical category.** The HPR was able to be run more than **35% faster than the competition,** while maintaining a **feed rate that was double the competition.** Given those increased efficiencies, the HPR was able to **produce 8 times as many parts with 8 times less new tools.** With the limited number of new tools necessary to complete the job, the **tool change cost savings was over $12,000.** Additionally, the smaller number of new tools lead to a **total new tool cost more than $171,000 less than the competition.** The HPR outperformed the competition so impressively that the **total machining cost savings for the job was $11,411 and the total cost savings was $195,248.91!**





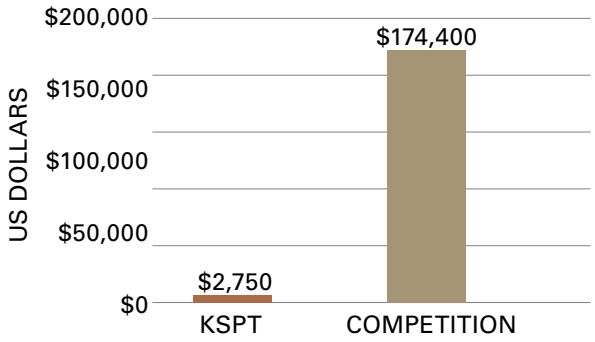




CARB-HPR

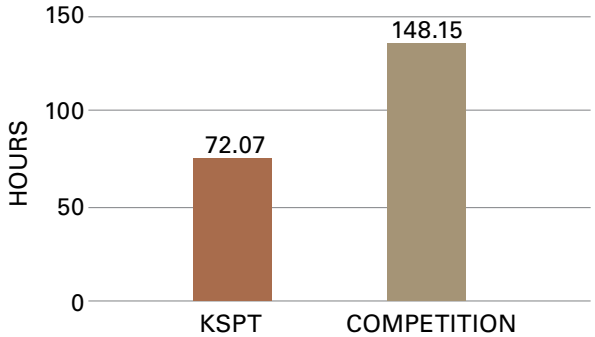
HIGH PERFORMANCE ROUGHER

TOTAL NEW TOOL COST



TOTAL MACHINING COST

TOTAL MACHINING HOURS



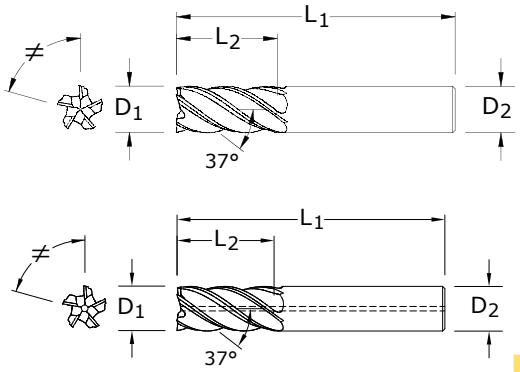
DESIGN AND ENGINEERING
ENSURE UNPARALLELED PERFORMANCE
IN A VARIETY OF DIFFICULT TO MACHINE MATERIALS.

KYOCERA SGS Precision Tools (KSPT) actively maintains a serious commitment to research and development. Our reputation for quality and ever increasing Value at the Spindle® pushes us to continually innovate and discover the next best thing in cutting tool technology. The Z-Carb HPR is a product of this passionate pursuit.

Field testing demonstrates the KSPT design achieved higher material removal rates while meeting or exceeding expected tool life. The specialized geometry allows for aggressive feed rates to increase productivity and enables exceptional finishes.

TOLERANCES (inch)

DIAMETER	D_1	D_2
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



CARB-HPR
HIGH PERFORMANCE ROUGHER

New Expanded Tools

Square
Straight
Weldon Flat
Right Spiral
Stub and Regular
Flute Spacing Unequal
Positive Rake Angle
Internal Coolant
External Coolant
5 Flutes

Cutting Diameter D_1	Length of Cut L_2	Overall Length L_1	Shank Diameter D_2	Ti-Namite-A (TA) EDP No.	Ti-Namite-A (TA) EDP No. w/Flat	Ti-Namite-A (TA) w/Internal Coolant	Ti-Namite-M (TM) EDP No.	Ti-Namite-M (TM) EDP No. w/ Flat	Ti-Namite-M (TM) EDP No. w/Internal Coolant
1/8	1/4	1-1/2	1/8	38500	–	–	37000	–	–
1/8	3/8	1-1/2	1/8	37180	–	–	37002	–	–
3/16	5/16	2	3/16	38501	–	–	37004	–	–
3/16	1/2	2	3/16	37182	–	–	37006	–	–
1/4	3/8	2-1/2	1/4	38502	–	–	37008	–	–
1/4	1/2	2-1/2	1/4	37184	–	–	37011	–	–
5/16	7/16	2-1/2	5/16	38503	–	–	37014	–	–
5/16	5/8	2-1/2	5/16	38504	–	–	37016	–	–
3/8	1/2	2-1/2	3/8	38505	–	–	37018	–	–
3/8	3/4	2-1/2	3/8	37187	–	–	37021	–	–
1/2	5/8	3	1/2	38506	38512	37320	37024	37030	37321
1/2	1	3	1/2	38507	38513	37322	37036	37042	37323
1/2	1-1/4	3-1/4	1/2	37190	37194	37325	37048	37054	37324
5/8	3/4	3-1/2	5/8	38508	38514	38518	37060	37067	37260
5/8	1-1/4	3-1/2	5/8	37198	37202	38519	37074	37081	37267
3/4	7/8	4	3/4	38509	38515	38520	37088	37095	37274
3/4	1-1/2	4	3/4	37206	37210	38521	37102	37109	37281
1	1-1/8	4	1	38510	38516	38522	37116	37123	37288
1	1-1/2	4	1	37214	37218	38523	37130	37137	37295
1	2	4-1/2	1	38511	38517	38524	37144	37151	37302

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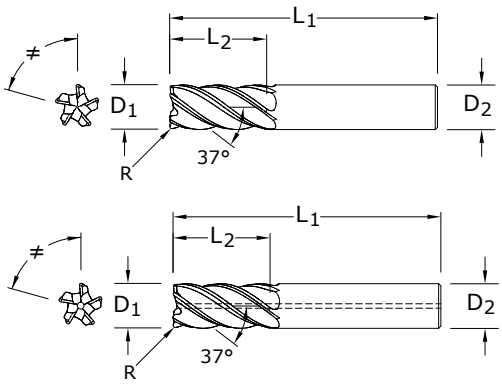


TOLERANCES (inch)

DIAMETER	D_1	D_2
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)

R = +0.0000 / –0.0020

New Expanded Tools

Cutting Diameter D_1	Length of Cut L_2	Overall Length L_1	Shank Diameter D_2	Corner Radius R	Ti-Namite-A (TA) EDP No.	Ti-Namite-A (TA) EDP No. w/Flat	Ti-Namite-A (TA) EDP No. w/Internal Coolant	Ti-Namite-M (TM) EDP No.	Ti-Namite-M (TM) EDP No. w/ Flat	Ti-Namite-M (TM) EDP No. w/Internal Coolant
1/8	1/4	1-1/2	1/8	0.010	38771	–	–	38770	–	–
1/8	1/4	1-1/2	1/8	0.015	38525	–	–	37001	–	–
1/8	1/4	1-1/2	1/8	0.030	38773	–	–	38772	–	–
1/8	3/8	1-1/2	1/8	0.010	38775	–	–	38774	–	–
1/8	3/8	1-1/2	1/8	0.015	37181	–	–	37003	–	–
1/8	3/8	1-1/2	1/8	0.030	38777	–	–	38776	–	–
3/16	5/16	2	3/16	0.010	38779	–	–	38778	–	–
3/16	5/16	2	3/16	0.015	38526	–	–	37005	–	–
3/16	5/16	2	3/16	0.030	38781	–	–	38780	–	–
3/16	1/2	2	3/16	0.010	38783	–	–	38782	–	–
3/16	1/2	2	3/16	0.015	37183	–	–	37007	–	–
3/16	1/2	2	3/16	0.030	38785	–	–	38784	–	–
1/4	3/8	2-1/2	1/4	0.010	38787	–	–	38786	–	–
1/4	3/8	2-1/2	1/4	0.015	38527	–	–	37009	–	–
1/4	3/8	2-1/2	1/4	0.030	38528	–	–	37010	–	–
1/4	3/8	2-1/2	1/4	0.060	38789	–	–	38788	–	–
1/4	3/8	2-1/2	1/4	0.090	38791	–	–	38790	–	–
1/4	1/2	2-1/2	1/4	0.010	38793	–	–	38792	–	–
1/4	1/2	2-1/2	1/4	0.015	37185	–	–	37012	–	–
1/4	1/2	2-1/2	1/4	0.030	37186	–	–	37013	–	–
1/4	1/2	2-1/2	1/4	0.060	38795	–	–	38794	–	–
1/4	1/2	2-1/2	1/4	0.090	38797	–	–	38796	–	–
5/16	7/16	2-1/2	5/16	0.010	38799	–	–	38798	–	–
5/16	7/16	2-1/2	5/16	0.015	38529	–	–	37015	–	–
5/16	7/16	2-1/2	5/16	0.030	38801	–	–	38800	–	–
5/16	7/16	2-1/2	5/16	0.060	38803	–	–	38802	–	–
5/16	7/16	2-1/2	5/16	0.090	38805	–	–	38804	–	–
5/16	5/8	2-1/2	5/16	0.010	38807	–	–	38806	–	–
5/16	5/8	2-1/2	5/16	0.015	38530	–	–	37017	–	–
5/16	5/8	2-1/2	5/16	0.030	38809	–	–	38808	–	–
5/16	5/8	2-1/2	5/16	0.060	38811	–	–	38810	–	–
5/16	5/8	2-1/2	5/16	0.090	38813	–	–	38812	–	–
3/8	1/2	2-1/2	3/8	0.010	38815	–	–	38814	–	–
3/8	1/2	2-1/2	3/8	0.015	38531	–	–	37019	–	–

(continued on next page)

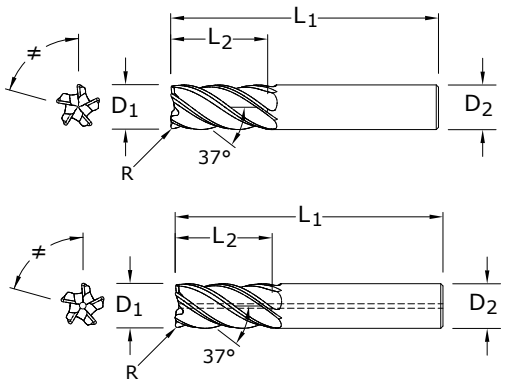
Corner
Straight
Weldon Flat
Right Spiral
Stub and Regular
Flute Spacing Unequal
Positive Rake Angle
Internal Coolant
External Coolant
5 Flutes

TOLERANCES (inch)

DIAMETER	D_1	D_2
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)

R = +0.0000 / –0.0020



CARB-HPR
HIGH PERFORMANCE ROUGHER

New Expanded Tools

Corner
Straight
Weldon Flat
Right Spiral
Stub and Regular
Flute Spacing Unequal
Positive Rake Angle
Internal Coolant
External Coolant
5 Flutes

Cutting Diameter D_1	Length of Cut L_2	Overall Length L_1	Shank Diameter D_2	Corner Radius R	Ti-Namite-A (TA) EDP No.	Ti-Namite-A (TA) EDP No. w/Flat	Ti-Namite-A (TA) w/Internal Coolant	Ti-Namite-M (TM) EDP No.	Ti-Namite-M (TM) EDP No. w/ Flat	Ti-Namite-M (TM) EDP No. w/Internal Coolant
3/8	1/2	2-1/2	3/8	0.030	38532	–	–	37020	–	–
3/8	1/2	2-1/2	3/8	0.060	38817	–	–	38816	–	–
3/8	1/2	2-1/2	3/8	0.090	38819	–	–	38818	–	–
3/8	3/4	2-1/2	3/8	0.010	38821	–	–	38820	–	–
3/8	3/4	2-1/2	3/8	0.015	37188	–	–	37022	–	–
3/8	3/4	2-1/2	3/8	0.030	37189	37174	–	37023	–	–
3/8	3/4	2-1/2	3/8	0.060	38823	–	–	38822	–	–
3/8	3/4	2-1/2	3/8	0.090	38825	–	–	38824	–	–
7/16	5/8	2-1/2	7/16	0.015	37164	–	–	37160	–	–
7/16	5/8	2-1/2	7/16	0.030	37165	–	–	37161	–	–
7/16	7/8	2-3/4	7/16	0.015	37166	–	–	37162	–	–
7/16	7/8	2-3/4	7/16	0.030	37167	–	–	37163	–	–
1/2	5/8	3	1/2	0.010	38827	38829	38831	38826	38828	38830
1/2	5/8	3	1/2	0.015	38533	38578	37330	37025	37031	37331
1/2	5/8	3	1/2	0.030	38534	38579	37332	37026	37032	37333
1/2	5/8	3	1/2	0.060	38535	38580	37334	37027	37033	37335
1/2	5/8	3	1/2	0.090	38536	38581	37337	37028	37034	37338
1/2	5/8	3	1/2	0.120	38537	38582	37339	37029	37035	37340
1/2	1	3	1/2	0.010	38833	38835	38837	38832	38834	38836
1/2	1	3	1/2	0.015	38538	38583	37341	37037	37043	37342
1/2	1	3	1/2	0.030	38539	38584	37343	37038	37044	37344
1/2	1	3	1/2	0.060	38540	38585	37345	37039	37045	37346
1/2	1	3	1/2	0.090	38541	38586	37348	37040	37046	37349
1/2	1	3	1/2	0.120	38542	38587	37350	37041	37047	37351
1/2	1-1/4	3-1/4	1/2	0.010	38839	38841	38843	38838	38840	38842
1/2	1-1/4	3-1/4	1/2	0.015	37191	37195	37352	37049	37055	37353
1/2	1-1/4	3-1/4	1/2	0.030	37192	37196	37354	37050	37056	37355
1/2	1-1/4	3-1/4	1/2	0.060	37193	37197	37356	37051	37057	37357
1/2	1-1/4	3-1/4	1/2	0.090	38543	38588	37359	37052	37058	37360
1/2	1-1/4	3-1/4	1/2	0.120	38544	38589	37361	37053	37059	37362
5/8	3/4	3-1/2	5/8	0.010	38845	38847	38849	38844	38846	38848
5/8	3/4	3-1/2	5/8	0.015	38545	38590	38623	37061	37068	37261
5/8	3/4	3-1/2	5/8	0.030	38546	38591	38624	37062	37069	37262
5/8	3/4	3-1/2	5/8	0.060	38547	38592	38625	37063	37070	37263

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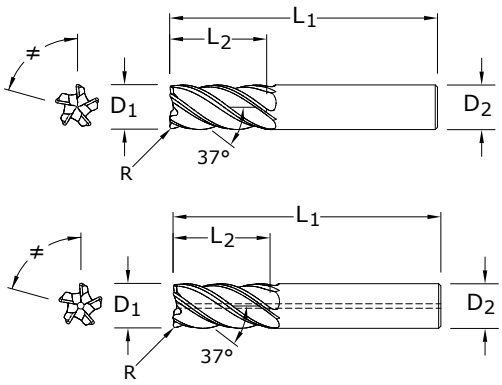
CARB-HPR
HIGH PERFORMANCE ROUGHER



TOLERANCES (inch)

DIAMETER	D_1	D_2
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)

R = +0.0000 / –0.0020

New Expanded Tools

Cutting Diameter D_1	Length of Cut L_2	Overall Length L_1	Shank Diameter D_2	Corner Radius R	Ti-Namite-A (TA) EDP No.	Ti-Namite-A (TA) EDP No. w/Flat	Ti-Namite-A (TA) EDP No. w/Internal Coolant	Ti-Namite-M (TM) EDP No.	Ti-Namite-M (TM) EDP No. w/ Flat	Ti-Namite-M (TM) EDP No. w/Internal Coolant
5/8	3/4	3-1/2	5/8	0.090	38548	38593	38626	37064	37071	37264
5/8	3/4	3-1/2	5/8	0.120	38549	38594	38627	37065	37072	37265
5/8	3/4	3-1/2	5/8	0.190	38550	38595	38628	37066	37073	37266
5/8	1-1/4	3-1/2	5/8	0.010	38851	38853	38855	38850	38852	38854
5/8	1-1/4	3-1/2	5/8	0.015	37199	37203	38629	37075	37082	37268
5/8	1-1/4	3-1/2	5/8	0.030	37200	37204	38630	37076	37083	37269
5/8	1-1/4	3-1/2	5/8	0.060	37201	37205	38631	37077	37084	37270
5/8	1-1/4	3-1/2	5/8	0.090	38551	38596	38632	37078	37085	37271
5/8	1-1/4	3-1/2	5/8	0.120	38552	38597	38633	37079	37086	37272
5/8	1-1/4	3-1/2	5/8	0.190	38553	38598	38634	37080	37087	37273
3/4	7/8	4	3/4	0.010	38857	38859	38861	38856	38858	38860
3/4	7/8	4	3/4	0.030	38554	38599	38635	37089	37096	37275
3/4	7/8	4	3/4	0.060	38555	38600	38636	37090	37097	37276
3/4	7/8	4	3/4	0.090	38556	38601	38637	37091	37098	37277
3/4	7/8	4	3/4	0.120	38557	38602	38638	37092	37099	37278
3/4	7/8	4	3/4	0.190	38558	38603	38639	37093	37100	37279
3/4	7/8	4	3/4	0.250	38559	38604	38640	37094	37101	37280
3/4	1-1/2	4	3/4	0.010	38863	38865	38867	38862	38864	38866
3/4	1-1/2	4	3/4	0.030	37207	37211	38641	37103	37110	37282
3/4	1-1/2	4	3/4	0.060	37208	37212	38642	37104	37111	37283
3/4	1-1/2	4	3/4	0.090	38560	38605	38643	37105	37112	37284
3/4	1-1/2	4	3/4	0.120	37209	37213	38644	37106	37113	37285
3/4	1-1/2	4	3/4	0.190	38561	38606	38645	37107	37114	37286
3/4	1-1/2	4	3/4	0.250	38562	38607	38646	37108	37115	37287
1	1-1/8	4	1	0.010	38869	38871	38873	38868	38870	38872
1	1-1/8	4	1	0.030	38563	38608	38647	37117	37124	37289
1	1-1/8	4	1	0.060	38564	38609	38648	37118	37125	37290
1	1-1/8	4	1	0.090	38565	38610	38649	37119	37126	37291
1	1-1/8	4	1	0.120	38566	38611	38650	37120	37127	37292
1	1-1/8	4	1	0.190	38567	38612	38651	37121	37128	37293
1	1-1/8	4	1	0.250	38568	38613	38652	37122	37129	37294
1	1-1/2	4	1	0.010	38875	38877	38879	38874	38876	38878
1	1-1/2	4	1	0.030	37215	37219	38653	37131	37138	37296
1	1-1/2	4	1	0.060	37216	37220	38654	37132	37139	37297

(continued on next page)

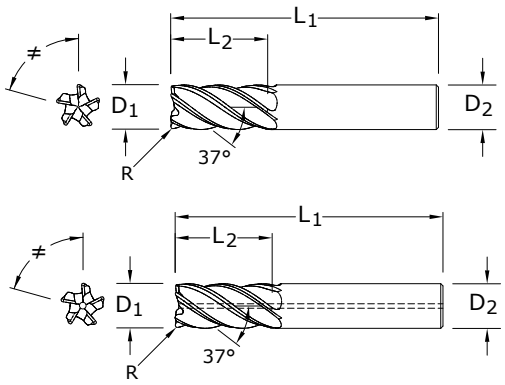
Corner
Straight
Weldon Flat
Right Spiral
Stub and Regular
Flute Spacing Unequal
Positive Rake Angle
Internal Coolant
External Coolant
5 Flutes

TOLERANCES (inch)

DIAMETER	D_1	D_2
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)

R = +0.0000 / –0.0020



CARB-HPR
HIGH PERFORMANCE ROUGHER

New Expanded Tools

Corner
Straight
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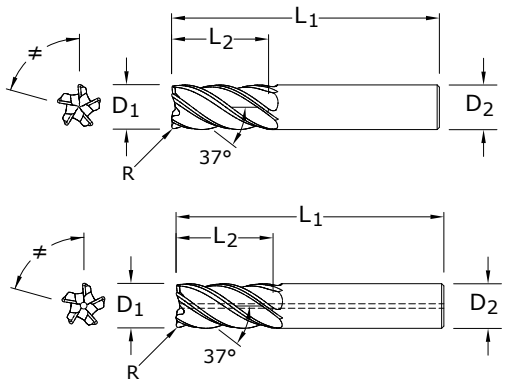
Internal Coolant
External Coolant
5 Flutes

Cutting Diameter D_1	Length of Cut L_2	Overall Length L_1	Shank Diameter D_2	Corner Radius R	Ti-Namite-A (TA) EDP No.	Ti-Namite-A (TA) EDP No. w/Flat	Ti-Namite-A (TA) w/Internal Coolant	Ti-Namite-M (TM) EDP No.	Ti-Namite-M (TM) EDP No. w/ Flat	Ti-Namite-M (TM) EDP No. w/Internal Coolant
1	1-1/2	4	1	0.090	38569	38614	38655	37133	37140	37298
1	1-1/2	4	1	0.120	37217	37221	38656	37134	37141	37299
1	1-1/2	4	1	0.190	38570	38615	38657	37135	37142	37300
1	1-1/2	4	1	0.250	38571	38616	38658	37136	37143	37301
1	2	4-1/2	1	0.010	38881	38883	38885	38880	38882	38884
1	2	4-1/2	1	0.030	38572	38617	38659	37145	37152	37303
1	2	4-1/2	1	0.060	38573	38618	38660	37146	37153	37304
1	2	4-1/2	1	0.090	38574	38619	38661	37147	37154	37305
1	2	4-1/2	1	0.120	38575	38620	38662	37148	37155	37306
1	2	4-1/2	1	0.190	38576	38621	38663	37149	37156	37307
1	2	4-1/2	1	0.250	38577	38622	38664	37150	37157	37308

CARB-HPR
HIGH PERFORMANCE ROUGHER



TOLERANCES (mm)

DIAMETER	D_1	D_2
6	+0,000 / –0,030	h6
> 6 - 10	+0,000 / –0,040	h6
> 10 - 25	+0,000 / –0,050	h6

CORNER RADIUS TOLERANCES (mm)

R = +0,000 / –0,050

New Expanded Tools

Cutting Diameter D_1	Length of Cut L_2	Overall Length L_1	Shank Diameter D_2	Corner Radius R	Ti-Namite-A (TA) EDP No.	Ti-Namite-A (TA) EDP No. w/Flat	Ti-Namite-A (TA) EDP No. w/Internal Coolant	Ti-Namite-M (TM) EDP No.	Ti-Namite-M (TM) EDP No. w/ Flat	Ti-Namite-M (TM) EDP No. w/Internal Coolant
6,0	9,0	54,0	6,0	0,5	48000	–	–	47000	–	–
6,0	13,0	57,0	6,0	0,3	48001	–	–	47001	–	–
6,0	13,0	57,0	6,0	0,5	47120	–	–	47002	–	–
6,0	13,0	57,0	6,0	1,0	48002	–	–	47003	–	–
6,0	13,0	57,0	6,0	1,5	48003	–	–	47004	–	–
8,0	11,0	58,0	8,0	0,5	48004	–	–	47005	–	–
8,0	18,0	63,0	8,0	0,5	47121	–	–	47006	–	–
8,0	18,0	63,0	8,0	1,0	47122	–	–	47007	–	–
8,0	18,0	63,0	8,0	1,5	48005	–	–	47008	–	–
8,0	18,0	63,0	8,0	2,0	48006	–	–	47009	–	–
10,0	13,0	66,0	10,0	1,0	48007	–	–	47010	–	–
10,0	22,0	72,0	10,0	0,5	47123	–	–	47011	–	–
10,0	22,0	72,0	10,0	1,0	47124	–	–	47012	–	–
10,0	22,0	72,0	10,0	1,5	48008	–	–	47013	–	–
10,0	22,0	72,0	10,0	2,0	48009	–	–	47014	–	–
10,0	22,0	72,0	10,0	2,5	48010	–	–	47015	–	–
12,0	15,0	73,0	12,0	1,0	48011	48029	–	47016	47024	–
12,0	26,0	83,0	12,0	0,5	47125	47128	47160	47017	47025	47161
12,0	26,0	83,0	12,0	0,76	47126	47129	47162	47018	47026	47163
12,0	26,0	83,0	12,0	1,0	47127	47130	47164	47019	47027	47165
12,0	26,0	83,0	12,0	1,5	48012	48030	47166	47020	47028	47167
12,0	26,0	83,0	12,0	2,0	48013	48031	47168	47021	47029	47169
12,0	26,0	83,0	12,0	2,5	48014	48032	47170	47022	47030	47171
12,0	26,0	83,0	12,0	3,0	48015	48033	47172	47023	47031	47173
16,0	19,0	82,0	16,0	1,0	48016	48034	48056	47032	47039	47046
16,0	19,0	82,0	16,0	1,5	48070	–	–	48071	–	–
16,0	35,0	92,0	16,0	1,0	47131	48035	47134	47033	47040	47047
16,0	35,0	92,0	16,0	1,5	48017	48036	48057	47034	47041	47048
16,0	35,0	92,0	16,0	2,0	47132	48037	47135	47035	47042	47049
16,0	35,0	92,0	16,0	2,5	48018	48038	48058	47036	47043	47050
16,0	35,0	92,0	16,0	3,0	47133	48039	47136	47037	47044	47051
16,0	35,0	92,0	16,0	4,0	48019	48040	48059	47038	47045	47052
20,0	23,0	92,0	20,0	1,0	48020	48041	48060	47053	47061	47069
20,0	43,0	104,0	20,0	1,0	47137	48042	47140	47054	47062	47070

(continued on next page)

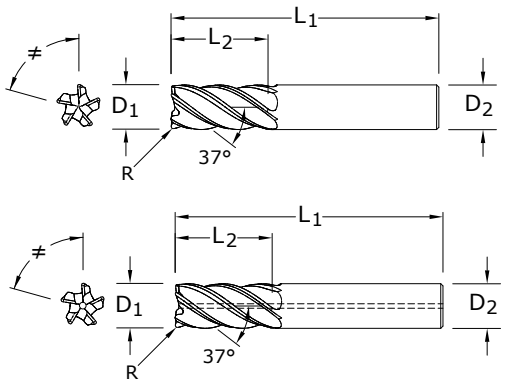
Corner
Straight
Weldon Flat
Right Spiral
Stub and Regular
Flute Spacing Unequal
Positive Rake Angle
Internal Coolant
External Coolant
5 Flutes

TOLERANCES (mm)

DIAMETER	D_1	D_2
6	+0,000 / –0,030	h6
> 6 - 10	+0,000 / –0,040	h6
> 10 - 25	+0,000 / –0,050	h6

CORNER RADIUS TOLERANCES (mm)

R = +0,000 / –0,050



CARB-HPR
HIGH PERFORMANCE ROUGHER

New Expanded Tools

Corner
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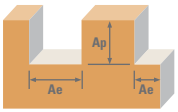
5 Flutes

Cutting Diameter D_1	Length of Cut L_2	Overall Length L_1	Shank Diameter D_2	Corner Radius R	Ti-Namite-A (TA) EDP No.	Ti-Namite-A (TA) EDP No. w/Flat	Ti-Namite-A (TA) EDP No. w/Internal Coolant	Ti-Namite-M (TM) EDP No.	Ti-Namite-M (TM) EDP No. w/ Flat	Ti-Namite-M (TM) EDP No. w/Internal Coolant
20,0	43,0	104,0	20,0	1,5	48021	48043	48061	47055	47063	47071
20,0	43,0	104,0	20,0	2,0	47138	48044	47141	47056	47064	47072
20,0	43,0	104,0	20,0	2,5	48022	48045	48062	47057	47065	47073
20,0	43,0	104,0	20,0	3,0	47139	48046	47142	47058	47066	47074
20,0	43,0	104,0	20,0	4,0	48023	48047	48063	47059	47067	47075
20,0	43,0	104,0	20,0	5,0	48024	48048	48064	47060	47068	47076
25,0	28,0	100,0	25,0	1,0	48025	48049	48065	47077	47084	47091
25,0	53,0	121,0	25,0	1,0	47143	48050	47146	47078	47085	47092
25,0	53,0	121,0	25,0	2,0	47144	48051	47147	47079	47086	47093
25,0	53,0	121,0	25,0	2,5	48026	48052	48066	47080	47087	47094
25,0	53,0	121,0	25,0	3,0	47145	48053	47148	47081	47088	47095
25,0	53,0	121,0	25,0	4,0	48027	48054	48067	47082	47089	47096
25,0	53,0	121,0	25,0	5,0	48028	48055	48068	47083	47090	47097

CARB-HPR
HIGH PERFORMANCE ROUGHER



	Series Z5, Z5CR Fractional	Hardness		Ae x D_1	Ap x D_1	Vc (sfm)		Diameter (D_1) (inch) 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	Profile	≤ 0.5	≤ 1.5	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)	39.0	50.9	65.0	65.7	57.7	52.3	45.6
			Slot	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	Profile	≤ 0.5	≤ 1.5	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	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
H	**TOOL STEELS A2, D2, H13, L2, M2, P20, S7, T15, W2**	≤ 375 Bhn or ≤ 40 HRc	Profile	≤ 0.5	≤ 1.5	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	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
K	**CAST IRONS (LOW & MEDIUM ALLOY) Gray, Malleable, Ductile**	≤ 220 Bhn or ≤ 19 HRc	Profile	≤ 0.5	≤ 1.5	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	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	Profile	≤ 0.5	≤ 1.5	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	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
M	**STAINLESS STEELS (FREE MACHINING) 303, 416, 420F, 430F, 440F**	≤ 275 Bhn or ≤ 28 HRc	Profile	≤ 0.5	≤ 1.5	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	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	Profile	≤ 0.5	≤ 1.5	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	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	Profile	≤ 0.5	≤ 1.5	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	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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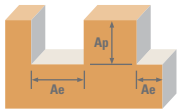
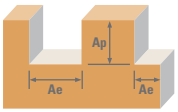


	Series Z5, Z5CR Fractional	Hardness		Ae x D_1	Ap x D_1	Vc (sfm)		Diameter (D_1) (inch) 1/8	1/4	3/8	1/2	5/8	3/4	1
S	**SUPER ALLOYS (NICKEL , COBALT, IRON BASE) Inconel 601, 617, 625, Incoloy, Monel 400**	≤ 300 Bhn or ≤ 32 HRc	Profile	≤ 0.5	≤ 1.5	80	RPM	2445	1222	815	611	489	407	306
						(64-96)	Fz	0.00025	0.00068	0.00128	0.00170	0.00187	0.00204	0.00238
							Feed (ipm)	3.1	4.2	5.2	5.2	4.6	4.2	3.6
			Slot	1	≤ 1	65	RPM	1986	993	662	497	397	331	248
						(52-78)	Fz	0.00025	0.00068	0.00128	0.00170	0.00187	0.00204	0.00238
							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	Profile	≤ 0.5	≤ 1.5	62	RPM	1895	947	632	474	379	316	237
						(50-74)	Fz	0.00018	0.00048	0.00090	0.00120	0.00130	0.00140	0.00170
							Feed (ipm)	1.7	2.3	2.8	2.8	2.5	2.2	2.0
			Slot	1	≤ 1	50	RPM	1528	764	509	382	306	255	191
						(40-60)	Fz	0.00018	0.00048	0.00090	0.00120	0.00130	0.00140	0.00170
							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	Profile	≤ 0.5	≤ 1.5	215	RPM	6570	3285	2190	1643	1314	1095	821
						(172-258)	Fz	0.0003	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	1	≤ 1	170	RPM	5195	2598	1732	1299	1039	866	649
						(136-204)	Fz	0.0003	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	Profile	≤ 0.5	≤ 1.5	75	RPM	2292	1146	764	573	458	382	287
						(60-90)	Fz	0.0003	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	1	≤ 1	60	RPM	1834	917	611	458	367	306	229
						(48-72)	Fz	0.0003	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)
- rpm = Vc x 3.82 / D_1
- ipm = Fz x 5 x rpm
- 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 D_1 maximum)
- refer to the KYOCERA SGS Tool Wizard® for complete technical information (www.kyocera-sgstool.com)

CARB-HPR
HIGH PERFORMANCE ROUGHER



	Series Z5MCR Metric	Hardness		Ae x D_1	Ap x D_1	Vc (m/min)		Diameter (D_1) (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	Profile	≤ 0.5	≤ 1.5	169	RPM	8967	6725	5380	4484	3363	2690	2152
						(135-203)	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	1	≤ 1	134	RPM	7109	5332	4265	3555	2666	2133	1706
						(107-161)	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	Profile	≤ 0.5	≤ 1.5	96	RPM	5089	3817	3054	2545	1909	1527	1221
						(77-115)	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	1	≤ 1	76	RPM	4039	3029	2424	2020	1515	1212	969
						(61-91)	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
H	TOOL STEELS A2, D2, H13, L2, M2, P20, S7, T15, W2	≤ 375 Bhn or ≤ 40 HRc	Profile	≤ 0.5	≤ 1.5	56	RPM	2989	2242	1793	1495	1121	897	717
						(45-68)	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	1	≤ 1	44	RPM	2343	1757	1406	1171	879	703	562
						(35-53)	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
K	CAST IRONS (LOW & MEDIUM ALLOY) Gray, Malleable, Ductile	≤ 220 Bhn or ≤ 19 HRc	Profile	≤ 0.5	≤ 1.5	136	RPM	7190	5392	4314	3595	2696	2157	1726
						(109-163)	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	1	≤ 1	108	RPM	5736	4302	3441	2868	2151	1721	1377
						(87-130)	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	Profile	≤ 0.5	≤ 1.5	104	RPM	5493	4120	3296	2747	2060	1648	1318
						(83-124)	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	1	≤ 1	82	RPM	4362	3272	2617	2181	1636	1309	1047
						(66-99)	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
M	STAINLESS STEELS (FREE MACHINING) 303, 416, 420F, 430F, 440F	≤ 275 Bhn or ≤ 28 HRc	Profile	≤ 0.5	≤ 1.5	149	RPM	7917	5938	4750	3958	2969	2375	1900
						(119-179)	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	1	≤ 1	119	RPM	6301	4726	3781	3151	2363	1890	1512
						(95-143)	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	Profile	≤ 0.5	≤ 1.5	104	RPM	5493	4120	3296	2747	2060	1648	1318
						(83-124)	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	1	≤ 1	82	RPM	4362	3272	2617	2181	1636	1309	1047
						(66-99)	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	Profile	≤ 0.5	≤ 1.5	94	RPM	5009	3756	3005	2504	1878	1503	1202
						(76-113)	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	1	≤ 1	76	RPM	4039	3029	2424	2020	1515	1212	969
						(61-91)	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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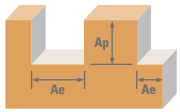

Series Z5MCR Metric	Hardness		Ae x D_1	Ap x D_1	Vc (m/min)		Diameter (D_1) (mm)						
S	**SUPER ALLOYS (NICKEL , COBALT, IRON BASE) Inconel 601, 617, 625, Incoloy, Monel 400**	≤ 300 Bhn or ≤ 32 HRc	Profile	≤ 0.5	≤ 1.5	24	RPM	1293	969	776	646	485	388	310
						(20-29)	Fz	0.0160	0.0272	0.0340	0.0409	0.0478	0.0531	0.0599
							Feed (mm/min)	103	132	132	132	116	103	93
			Slot	1	≤ 1	20	RPM	1050	788	630	525	394	315	252
						(16-24)	Fz	0.0160	0.0272	0.0340	0.0409	0.0478	0.0531	0.0599
							Feed (mm/min)	84	107	107	107	94	84	75
	SUPER ALLOYS (NICKEL, COBALT, IRON BASE) Inconel 718, X-750, Incoloy, Waspaloy, Hastelloy, Rene	≤ 400 Bhn or ≤ 43 HRc	Profile	≤ 0.5	≤ 1.5	19	RPM	1002	751	601	501	376	301	240
						(15-23)	Fz	0.0112	0.0192	0.0239	0.0284	0.0333	0.0371	0.0420
							Feed (mm/min)	56	72	72	71	63	56	50
			Slot	1	≤ 1	15	RPM	808	606	485	404	303	242	194
						(12-18)	Fz	0.0112	0.0192	0.0239	0.0284	0.0333	0.0371	0.0420
							Feed (mm/min)	45	58	58	57	50	45	41
	TITANIUM ALLOYS Pure Ttanium, Ti6Al4V, Ti6Al2Sn4Zr2Mo, Ti4Al4Mo2Sn0.5Si	≤ 350 Bhn or ≤ 38 HRc	Profile	≤ 0.5	≤ 1.5	66	RPM	3474	2605	2084	1737	1303	1042	834
						(52-79)	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	1	≤ 1	52	RPM	2747	2060	1648	1373	1030	824	659
						(41-62)	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	Profile	≤ 0.5	≤ 1.5	23	RPM	1212	909	727	606	454	364	291
						(18-27)	Fz	0.019	0.032	0.040	0.048	0.056	0.064	0.071
							Feed (mm/min)	116	145	145	145	128	116	103
			Slot	1	≤ 1	18	RPM	969	727	582	485	364	291	233
						(15-22)	Fz	0.019	0.032	0.040	0.048	0.056	0.064	0.071
							Feed (mm/min)	93	116	116	116	102	93	83

Note:
- Bhn (Brinell) HRc (Rockwell C)
- rpm = (Vc x 1000) / (D_1 x 3.14)
- mm/min = Fz x 5 x rpm
- 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 D_1 maximum)
- refer to the KYOCERA SGS Tool Wizard® for complete technical information (www.kyocera-sgstool.com)

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