



VALUE AT THE SPINDLE®

Z5 High Performance Roughers



New Expanded Offering

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.



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

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

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

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

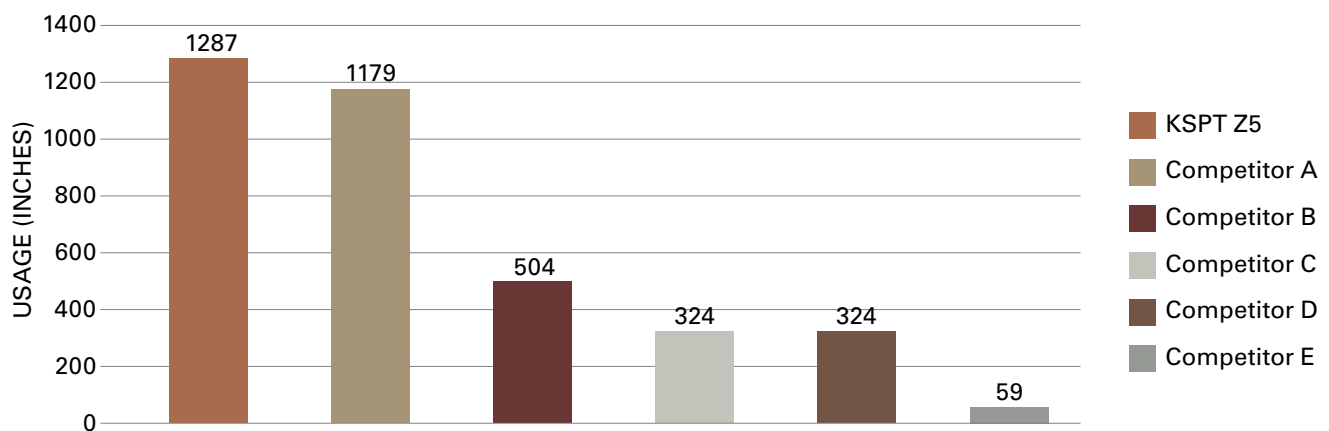
FINISHING

- 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

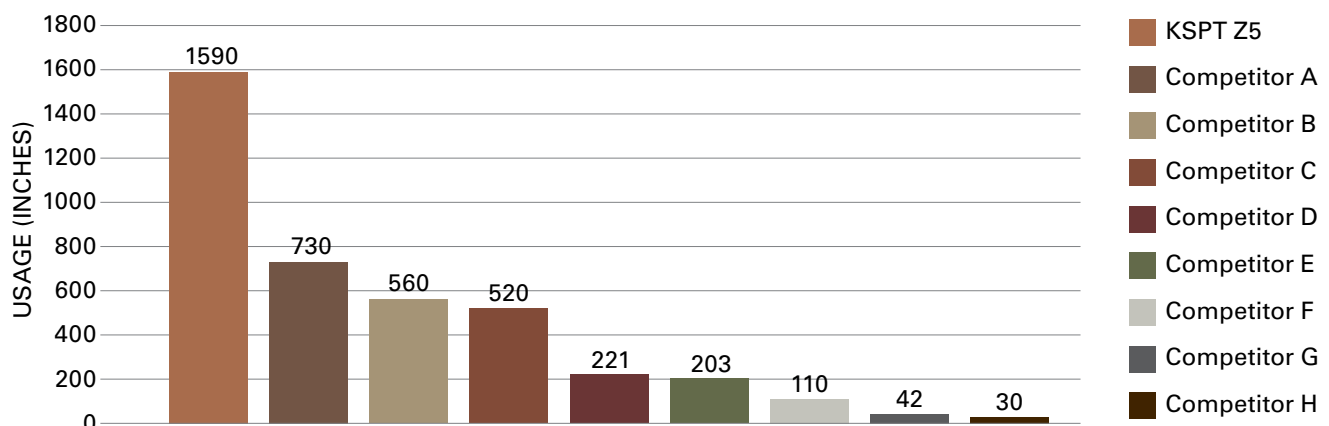
LAB TESTING RESULTS – HEAVY PROFILING IN TITANIUM



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

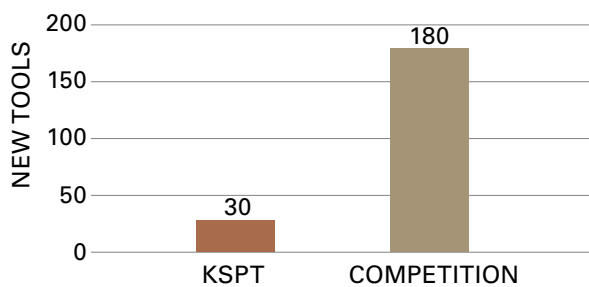
KSPT approached this job with a 5 flute Z-Carb high performance rougher (HPR) end mill. KSPT's Z-Carb HPR is ideal for achieving high metal removal rates, while achieving optimal surface finishes. The specialized five flute design is engineered for increased productivity over three and four flute end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

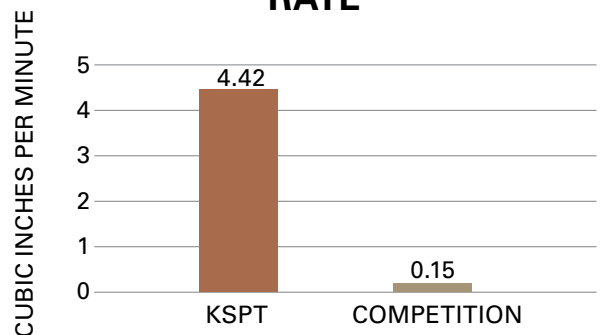
RESULTS

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!**

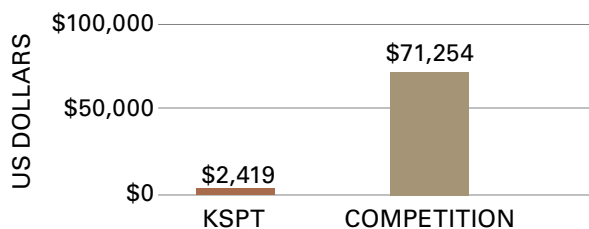
NEW TOOLS NEEDED TO COMPLETE THE JOB



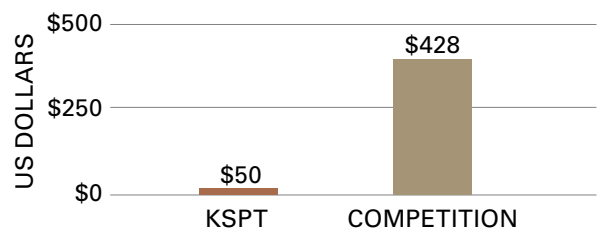
MATERIAL REMOVAL RATE

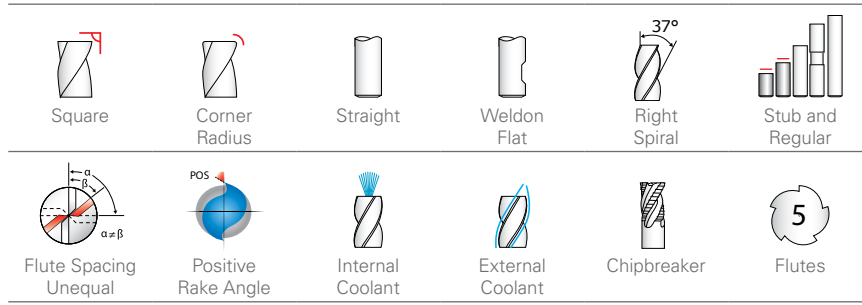


TOTAL MACHINING COST



TOTAL COST PER PART



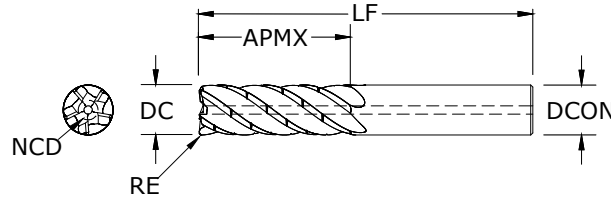


TOLERANCES (inch)

| 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

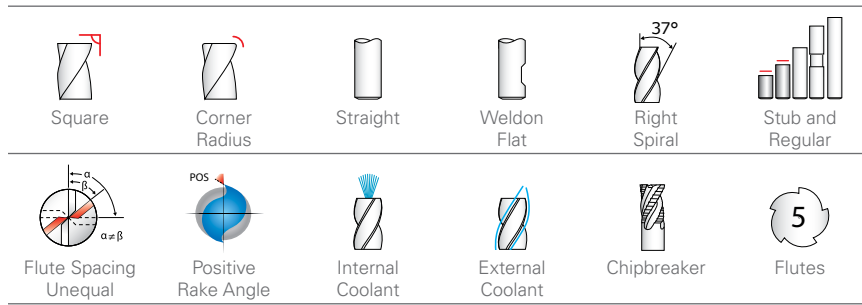


New Expanded Tools

Series Z5 • Z5CR Fractional

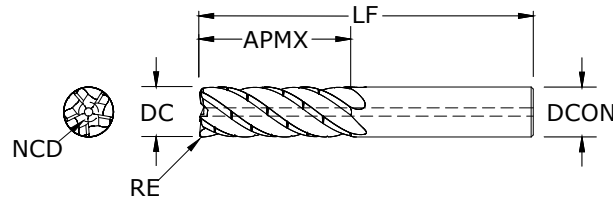
| Cutting Diameter DC | Length of Cut APMX | Overall Length LF | Shank Diameter DCON | Corner Radius RE | Non-Cutting Center Diameter NCD | Ti-Namite®-A (TA) | | | | | Ti-Namite®-M (TM) | | | | |
|---------------------|--------------------|-------------------|---------------------|------------------|---------------------------------|-------------------|-----------------------|----------------------------|--|----------------|-------------------|-----------------------|----------------------------|--|-----------------|
| | | | | | | 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 |
| 1/8 | 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 | - | - | - | - |

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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 |



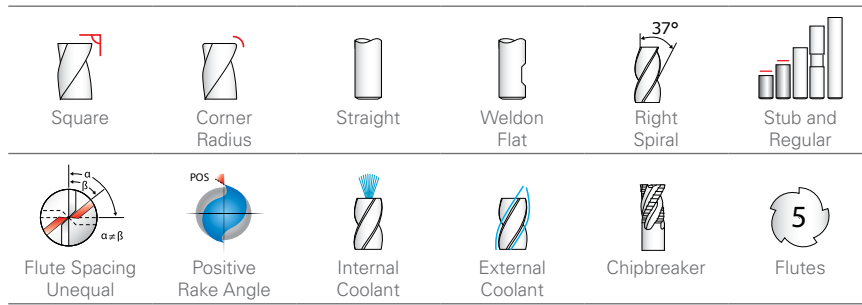
CORNER RADIUS TOLERANCES (inch)

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 |
| 1/4 | 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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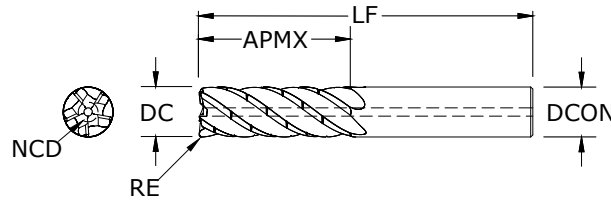


TOLERANCES (inch)

| 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

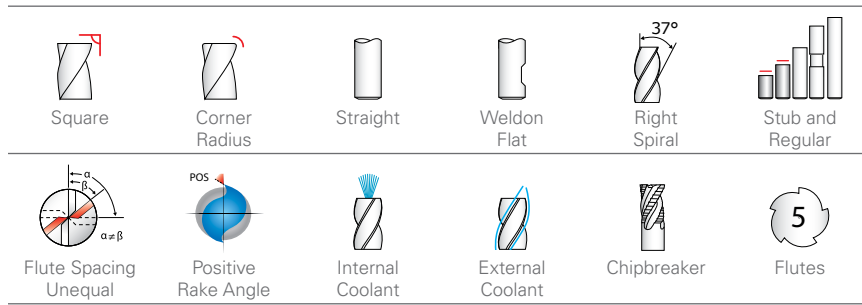


New Expanded Tools

Series Z5 • Z5CR Fractional

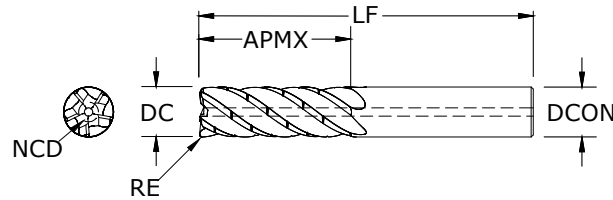
| Cutting Diameter DC | Length of Cut APMX | Overall Length LF | Shank Diameter DCON | Corner Radius RE | Non-Cutting Center Diameter NCD | Ti-Namite®-A (TA) | | | | | Ti-Namite®-M (TM) | | | | |
|---------------------|--------------------|-------------------|---------------------|------------------|---------------------------------|-------------------|-----------------------|----------------------------|--|----------------|-------------------|-----------------------|----------------------------|--|-----------------|
| | | | | | | 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 |

(continued on next page)



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 |



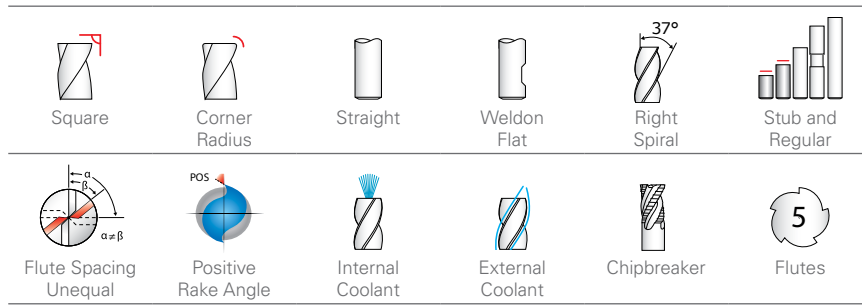
CORNER RADIUS TOLERANCES (inch)

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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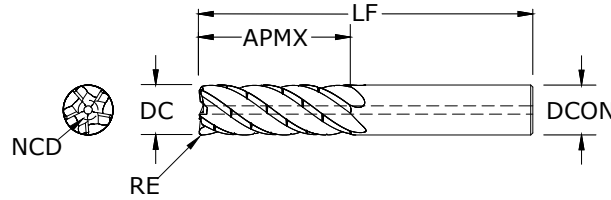


TOLERANCES (inch)

| 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

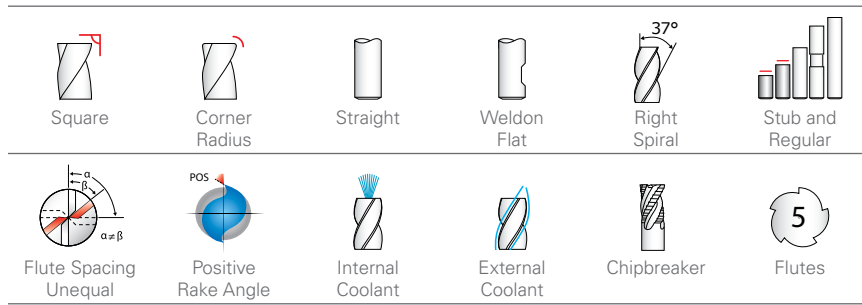


New Expanded Tools

Series Z5 • Z5CR Fractional

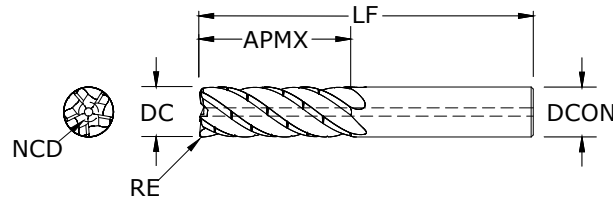
| Cutting Diameter DC | Length of Cut APMX | Overall Length LF | Shank Diameter DCON | Corner Radius RE | Non-Cutting Center Diameter NCD | Ti-Namite®-A (TA) | | | | | Ti-Namite®-M (TM) | | | | |
|---------------------|--------------------|-------------------|---------------------|------------------|---------------------------------|-------------------|-----------------------|----------------------------|--|----------------|-------------------|-----------------------|----------------------------|--|----------------|
| | | | | | | 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 |
| 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 |

(continued on next page)



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 |



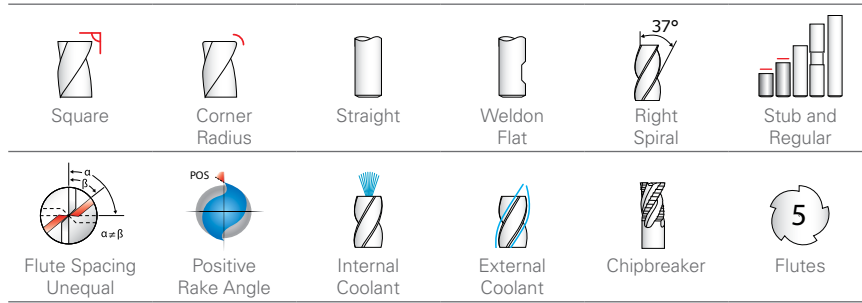
CORNER RADIUS TOLERANCES (inch)

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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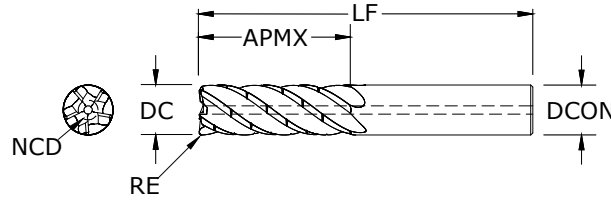


TOLERANCES (inch)

| 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)

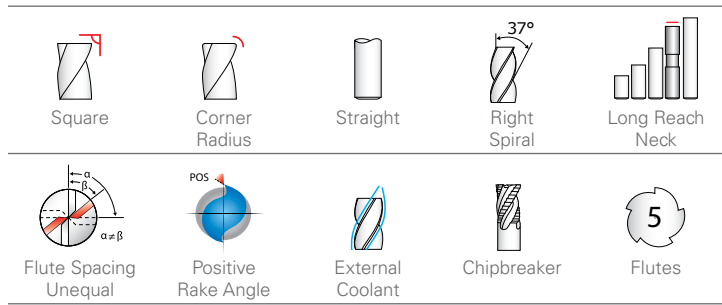
RE = +0.0000 / -0.0020



New Expanded Tools

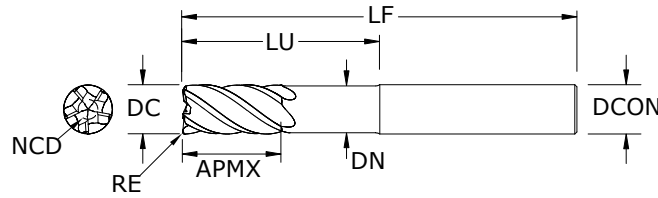
Series Z5 • Z5CR Fractional

| 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 | 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 | - |



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 |



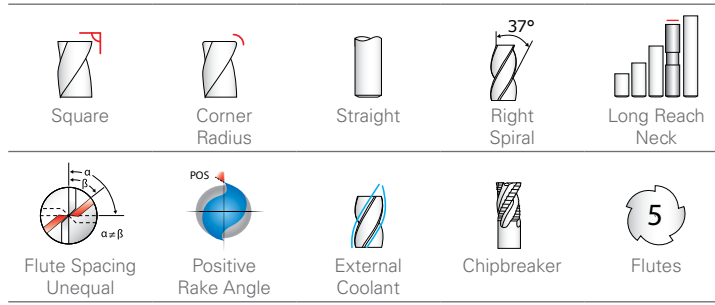
CORNER RADIUS TOLERANCES (inch)

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 |

(continued on next page)

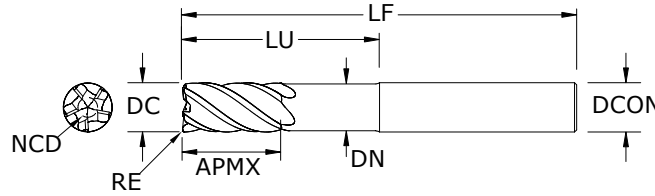


TOLERANCES (inch)

| 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)

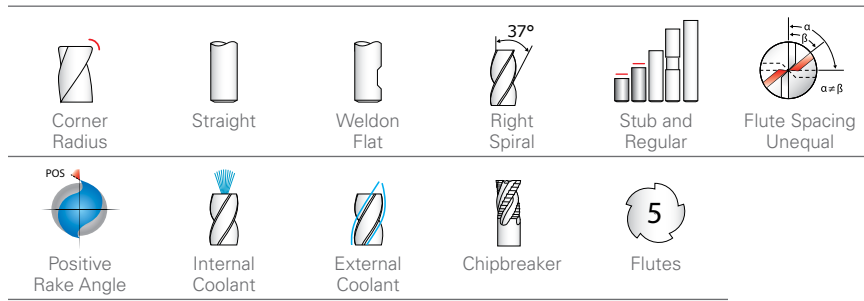
RE = +0.0000 / -0.0020



New Expanded Tools

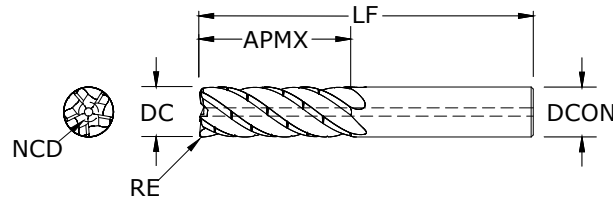
Series Z5L • Z5LC Fractional

| 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 |



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 |



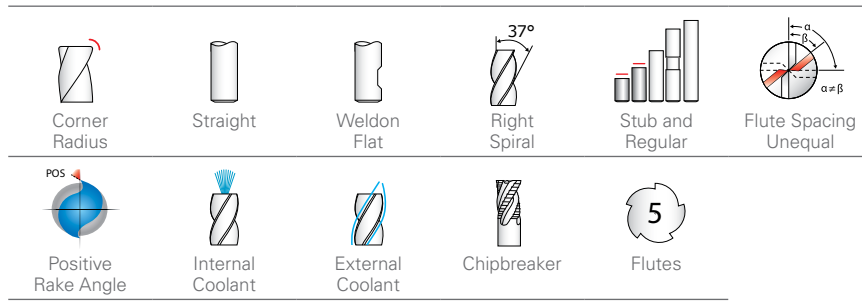
CORNER RADIUS TOLERANCES (mm)

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 |
| 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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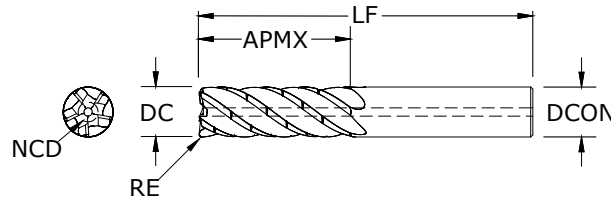


TOLERANCES (mm)

| 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)

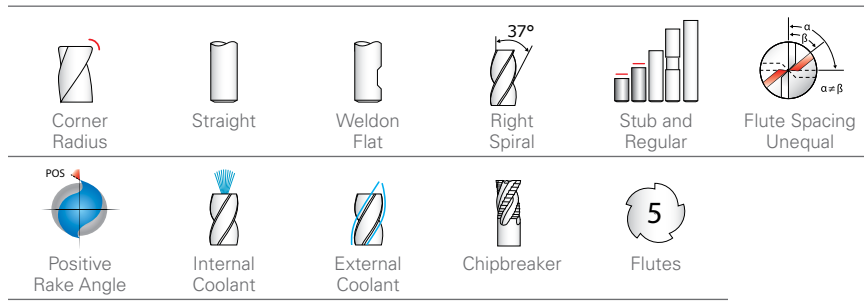
RE = +0,000 / -0,050



New Expanded Tools

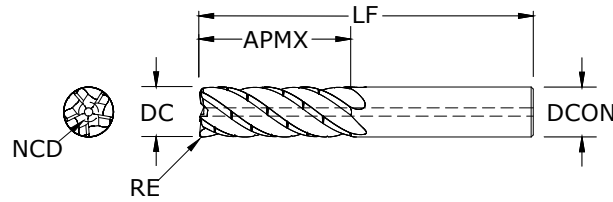
| Cutting Diameter DC | Length of Cut APMX | Overall Length LF | Shank Diameter DCON | Corner Radius RE | Non-Cutting Center Diameter NCD | Ti-Namite®-A (TA) | | | | Ti-Namite®-M (TM) | | | |
|---------------------|--------------------|-------------------|---------------------|------------------|---------------------------------|-------------------|-----------------------|----------------------------|----------------|-------------------|-----------------------|----------------------------|----------------|
| | | | | | | 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 |
| 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)



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 |



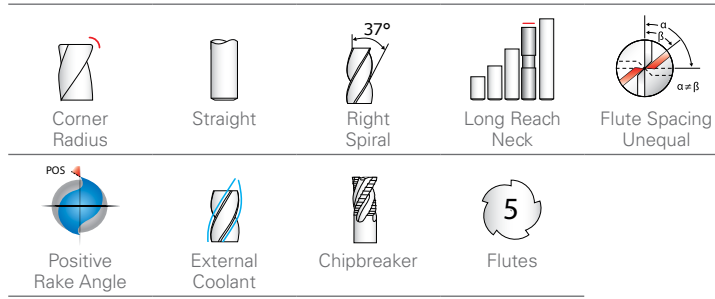
CORNER RADIUS TOLERANCES (mm)

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 | - | - |

Series Z5MCR | Metric

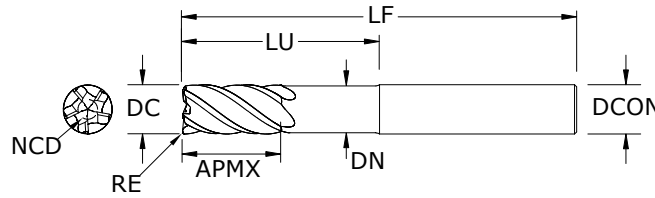


TOLERANCES (mm)

| 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

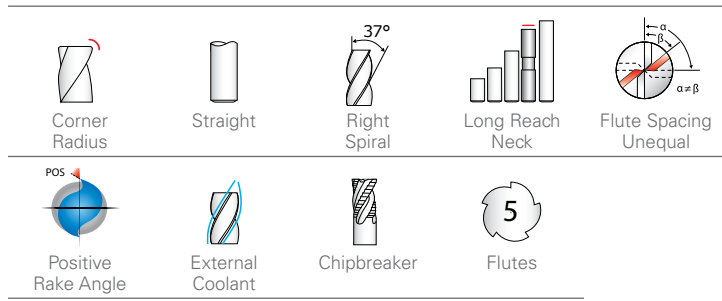


New Expanded Tools

Series Z5MLC Metric

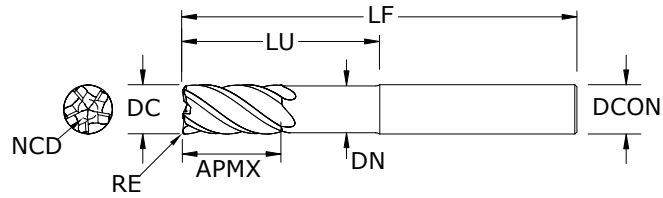
| Cutting Diameter DC | Length of Cut APMX | Overall Length LF | Shank Diameter DCON | Corner Radius RE | Non-Cutting Center Diameter NCD | Reach LU | Neck Diameter DN | Ti-Namite®-A (TA) | | Ti-Namite®-M (TM) | |
|---------------------|--------------------|-------------------|---------------------|------------------|---------------------------------|----------|------------------|-------------------|-----------------------|-------------------|-----------------------|
| | | | | | | | | 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)



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 |



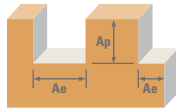
CORNER RADIUS TOLERANCES (mm)

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 |

Series Z5MLC | Metric



Series
Z5, Z5CR, Z5L, Z5LC
Fractional

Hardness

Ae x DC

Ap x DC

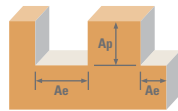
Vc
(sfm)

DC • in

1/8 1/4 3/8 1/2 5/8 3/4 1

| Material | 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 | HSM ¹ ≤ 275 Bhn or ≤ 28 HRc | ≤ 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 | HSM ¹ ≤ 375 Bhn or ≤ 40 HRc | ≤ 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 | | HSM ¹ ≤ 375 Bhn or ≤ 40 HRc | ≤ 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 | HSM ¹ ≤ 275 Bhn or ≤ 28 HRc | ≤ 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 | | HSM ¹ ≤ 275 Bhn or ≤ 28 HRc | ≤ 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 | HSM ¹ ≤ 325 Bhn or ≤ 35 HRc | ≤ 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 | |

continued on next page



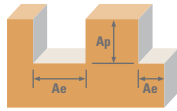
| Series | Hardness | Ae x DC | Ap x DC | Vc (sfm) | DC • in | | | | | | | | | |
|--|--|-----------------------------|------------------|---------------|---------------|---------------|------------|---------|--------|--------|--------|--------|--------|--------|
| | | | | | 1/8 | 1/4 | 3/8 | 1/2 | 5/8 | 3/4 | 1 | | | |
| Series Z5, Z5CR, Z5L, Z5LC Fractional 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 | | |
| 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 Titanium, 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)

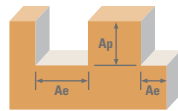
Z-Carb HPR — Speed & Feed Recommendations





















Series
Z5M, Z5MCR,
Z5ML, Z5MLC
Metric

| Series | 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 | 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 | 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 | 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 | 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 | 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 | 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 | | |

continued on next page



| 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 | 495 | 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 Titanium, 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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