Ingersoll

TECHNICAL INFORMATION.

Cutting Tools

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Ingersoll
Cutting Tools

GOING BACK TO THE BASICS OF FACE MILL DESIGN TO SELECT A TOOL TO MATCH YOUR APPLICATION

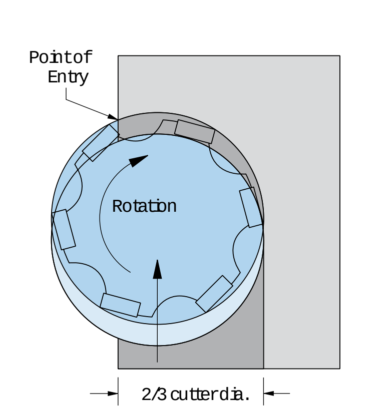
When milling with an indexable face mill, the workpiece, machine, and fixturing must all be as rigid as possible. This will help ensure efficient use of this type of tool and produce the results required. Only cutters using indexable carbide inserts will be discussed here.

Proper cutter diameter. For maximum efficiency, two-thirds of the cutter diameter should engage the workpiece. In other words, the cutter diameter should be 1-1/2 times the width of cut desired.

Climb milling using this cutter diameter to width of cut ratio will ensure a favorable entry angle into the workpiece (Fig. 1).

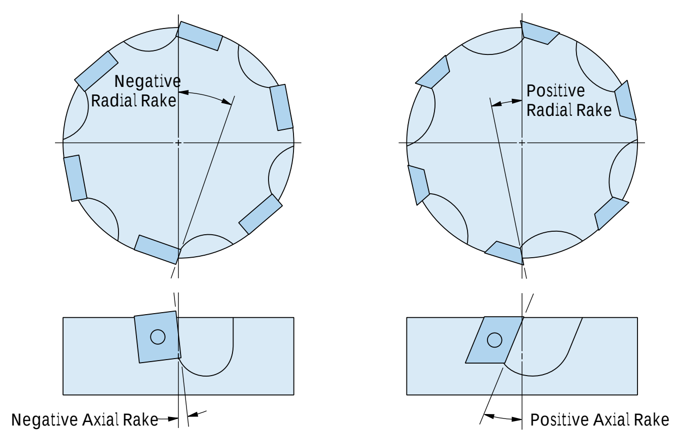
If uncertain as to whether the machine has enough horsepower to operate the cutter under this ratio, it may be best to divide the axial depth of cut into two passes (or more) to maintain as closely as possible this cutter diameter to width of cut ratio.

Fig. 1



Climb Milling

Fig. 2 Fig. 3



Negative Geometry **Positive Geometry**

Applying cutter geometry. Insert cutting edges may be positioned relative to both radial and axial planes in positive, neutral, or negative rakes. Neutral rake is generally not used due to the shock of the entire cutting edge impacting the workpiece simultaneously.

The combination of radial and axial rakes determines the shear angle. Three basic combinations are available: negative radial and axial, positive radial and axial, negative radial/positive axial, and positive radial/negative axial.

Double negative geometry is the traditional starting point for rough milling cast iron and steels when horsepower and rigidity are adequate. The double negative insert design provides the strongest possible cutting edge and can withstand heavier chip loads and considerable cutting forces (Fig. 2).

The increased cutting forces generated by this geometry will consume more horsepower. Double negative cutters also require greater machine, workpiece, and fixture rigidity.

Double positive geometry provides the most efficient cutting action due to its increased shearing angle. Although not as strong as double negative, entry impact and cutting forces are greatly reduced, making it a good choice for older, less rigid machines or where horsepower is limited.

With double positive geometry, the peripheral edge, in both the radial and axial planes, leads the insert through the workpiece creating a true shearing action. This makes it the best choice for non-ferrous materials and many soft, gummy stainless steels (Fig. 3).

Negative radial/positive axial geometry combines some of the advantages of both double negative and double positive. Negative radial rake provides strong cutting edges, while positive axial rake creates a shearing action. A positive axial rake directs chips up and away from the workpiece. This prevents chip recutting and takes heat away from the work surface and the cutting edge.

Positive radial/negative axial geometry reduces power consumption while still providing a strong corner cross-section.

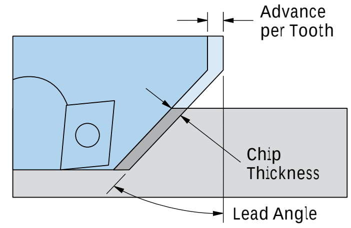
Effective lead angles. Cutter lead angles also affect performance. A 45° lead tool reduces chip thickness about 30 percent as compared to a 0° lead tool (Fig. 4). This allows you to maintain a given chip load at a higher feed rate, increasing the metal removal rate.

A proper lead angle allows a cutter to enter and exit the cut more smoothly, minimizing shock to the cutting edges. Workpiece edge breakout, a common problem when machining cast iron, can be significantly reduced or eliminated by use of increased lead angle. The lead angle allows the cutting edge to exit the workpiece gradually. This reduces radial pressure and minimizes breakout.

Remember that increasing the lead angle to reduce radial pressure does increase axial pressure. This can cause deflection of the machined surface when the workpiece has a thin cross-section.

Choosing cutter density. The cutter density must allow chips to form properly and clear the cut. Inadequate chip space can cause chips to plug the gullet, breaking the cutting edge and possibly damaging the workpiece.

Fig. 4



Lead Angles

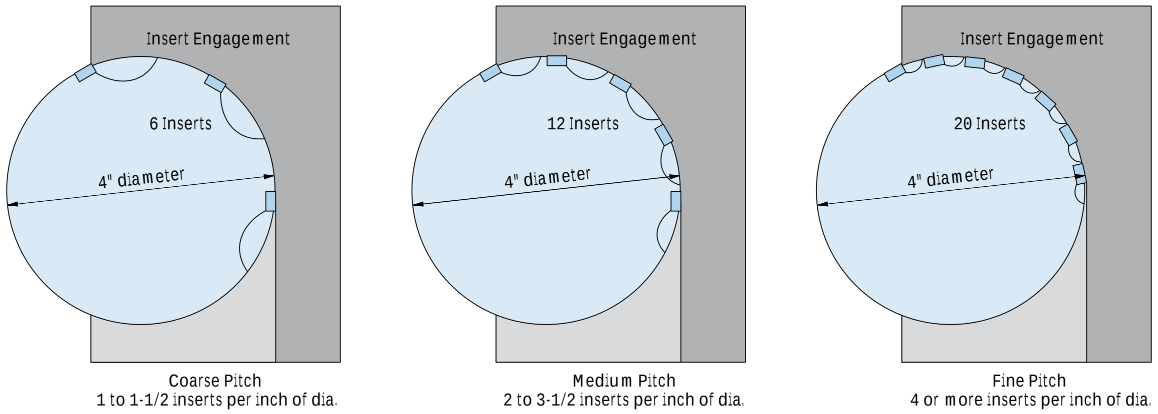
However, the cutter must have sufficient density to keep at least one insert in the cut at all times. Failure to do this could cause severe pounding which can lead to chipped cutting edges, a damaged cutter, and excess wear to the machine (Fig. 5).

Coarse pitch tools, with 1 to 1-1/2 inserts per inch of diameter, allow for greater chip gullet space. These tools are recommended for soft materials that produce continuous chips, and in wide cuts with a long insert engagement.

It is desirable to have at least one insert in contact with the workpiece at all times. Fine pitch tools, though primarily for cast iron, are also good for shallow or narrow cuts in high-temperature alloys where light chip loads are taken. Small chips require less gullet, allowing more inserts per inch.

Although selecting a face mill can be a complicated and somewhat subjective process, these guidelines can give you a good starting point. By using and expanding on these principles, you will be able to select a face mill for any operation in your plant.

Fig. 5



Cutter Density

APPLYING BASIC PRINCIPLES OF MACHINING WITH INDEXABLES CAN IMPROVE PERFORMANCE

The following information is directed toward indexable carbide tools but it can be applied to many other cutting tools, as well. It provides some basic guidelines designed to serve as a starting point for safe and reliable performance. Contact your Ingersoll Cutting Tool Company sales engineer for specific application assistance.

Rigidity. Use the most rigid cutter possible. This usually means the cutter with the largest diameter and shortest length. Use the best adaption possible. Integral tapers, such as a 50 V-flange, are better than straight shanks. When selecting straight shank tools, use a cutter with the largest diameter shank possible and a holder with the shortest length possible. For a more complete review, see "Rigidity Analysis" on page M460.

Effective cutting edges. When calculating feed rate, use the effective number of inserts. In extended flute cutters, the effective number of inserts is not the number of rows. Use the effective number listed with the specifications for each series of tools.

Chip load. Carbide cutting tools have to take a "bite" to cut. Be sure to cut with an adequate chip load. Light chip loads can contribute to chatter, causing a cutter to "rub" instead of "bite." This can also result in poor tool life. As a general rule, chip loads should not be less than .004". Also, be sure to use Radial Chip Thinning Factors (RCTF) when calculating feed rates. Refer to "Radial Chip Thinning" located on page M462.

Chip recutting. Unlike HSS, carbide cutting tools cannot recut chips. Recutting chips will damage carbide. To evacuate chips, use air or coolant depending on the material being cut. Refer to "General Operating Guidelines" on pages M472-M509 for coolant or air chip evacuation recommendations.

Coolant. Generous amounts of coolant are required when low thermal conductivity, work hardening, and chip welding tendencies are evident.

Use coolant only when necessary. Some materials cut better dry. In some applications, coolant causes thermal cracking of inserts and poor tool life.

Refer to "General Operating Guidelines" on pages M472-M509 to find coolant requirements.

Feed rates. Reduce feed rates by 50 percent when entering or exiting a cut. Since fewer inserts are engaged in the work, pounding can occur. Reducing feed rates will reduce the shock of the interrupted cut and contribute to longer tool life.

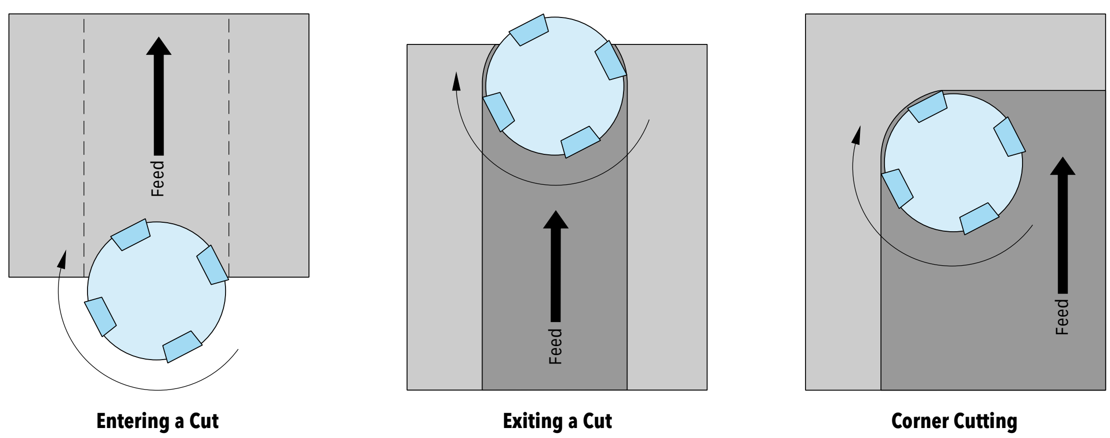
When entering a corner during pocket milling, a larger portion of the cutter's diameter is engaged. Power requirements and tool deflection increase. To compensate, program a reduced interpolated feed rate. Alternately, drill or plunge the corner prior to milling.

Cutter rotation. Climb cut whenever possible. Carbide is designed for climb milling and will not generally perform as well when conventional cutting.

Conventional cutting may be employed on older machines to minimize backlash. It can also extend tool life in sandy, scaly, or torch-cut surfaces as the cutting edge enters into cleaner, softer material.

Hardness. generally, harder materials should be machined at the lowest speed in Surface

Fig. 1



Reduce feed rates by 50% when entering a cut, exiting a cut, or entering a corner. This reduces pounding and cutting forces and can extend the life of your indexable carbide tool.

Feet per Minute (SFM) in the recommended range and softer materials at the higher recommended speed.

At 375 Brinell hardness, steel becomes very difficult to machine. Use the slowest recommended speed and the toughest carbide insert available. An edge hone may also be necessary to machine such hard material effectively.

Chip color. The color of the chips can also indicate how well your operation is performing. For example, carbon steel chips are blue. Stainless steel chips should be silver to straw colored, not blue. Titanium and nickel-based material chips should never change color.

Indexing Ingersoll inserts. Ingersoll's bent screw design used with on-edge inserts forces the insert into the corner of the pocket. The screw actually bends, locking the insert in place.

Conventional insert mounting is also common on Ingersoll products. In this case, the screw does not force the insert toward the corner of the pocket. Be sure to apply pressure into the pocket while tightening the insert screws.

Care should always be taken not to over-tighten insert screws. Over-tightened screws can become difficult to remove. Torque requirements are given for each cutter.

Indexing Ingersoll cutters is simple due to their design. However, care must be taken to make sure that the insert pocket is clean and the insert is properly seated.

After the used insert has been removed, clean the pocket. Visually inspect the cutter to see that no damage has been sustained from use. Place the insert into the pocket and start the screw. While tightening the screw, apply downward pressure on the insert toward the corner of the pocket.

A snugness will be felt on the screw as the insert seats. Do not over-tighten the insert screw. Be sure to apply the proper amount of torque listed in Ingersoll's catalogs.

If there is any doubt about the insert seating, check the seating surfaces with a .001" feeler gauge.

If the feeler gauge fits between the insert and the wall of the cutter pocket, the insert is not properly seated. Inspect the pocket for cleanliness or burrs and repeat the seating procedure. Cutters that have been damaged may have insert pockets that will no longer allow proper seating. Such tools should be replaced or returned to Ingersoll for repair.

GOING BEYOND THE BASICS OF FINISH MILLING TO HELP YOU ATTAIN BETTER SURFACE FINISHES

Surface finish is the result of tool marks or irregularities left by the cutting edges of a milling cutter. These irregularities are:

Roughness: the measurement of tool marks in terms of RMS (Root Mean Square); measured with a relatively short sampling length and suppresses waviness.

Waviness: widely spaced irregularities that underlie the roughness (Fig. 1).

Flatness: the overall condition of the entire milled plane; measured by large straightedges or feelers.

Laps: blending of successive passes; normally a function of how well the milling head is squared to the table and how rigidly it is held in position.

Bearing: the supporting quality of a milled surface; a combination of all these irregularities.

How the machine affects finish. The entire machine setup must be rigid since any type of looseness or lack of rigidity will affect a milled surface finish. The "heel" or trailing edge of the cutter should clear the workpiece. Therefore, the spindle should be tilted very slightly in the direction of feed.

If the cutter is flat to the workpiece, (1) the finished surface is recut by the back side of the cutter, (2) the cutting edges can carry small chips that scratch the surface, (3) more friction creates heat build-up in the workpiece and cutting edges, and (4) increased cutter contact can induce chatter.

Too much spindle tilt creates excessive "dish" or scallops. The effect is magnified as cutter diameter increases (Fig. 2).

Cutter geometry. Axial rake has a significant effect on axial force and the thrust applied to the spindle and the workpiece. The more positive the axial rake, the less axial force. Negative axial rake increases axial force. Positive axial rake lifts the chip away from the milled surface while a negative rake forces the chip back toward the surface.

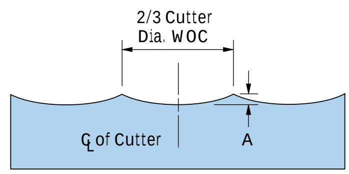
Radial rake has a major effect on tangential and radial forces. Positive axial rake reduces these forces, minimizing burrs and break-out.

Double negative cutters provide economy and the edge strength required for hard materials and interrupted cuts. But strength is often not required on light finishing cuts and economic gains may be offset by the time spent trying to attain a desired finish. Double negative geometry "pushes" rather than cuts. These higher forces consume more horsepower and create more pressure and heat.

Double positive cutters offer freer cutting action and consume less horsepower but have weaker cutting edges. Lower cutting forces direct less force against the workpiece and machine, so there is less tendency to chatter or deflect. Remember, however, that too high a positive angle can tend to reverse the force and lift the workpiece into the cutter.

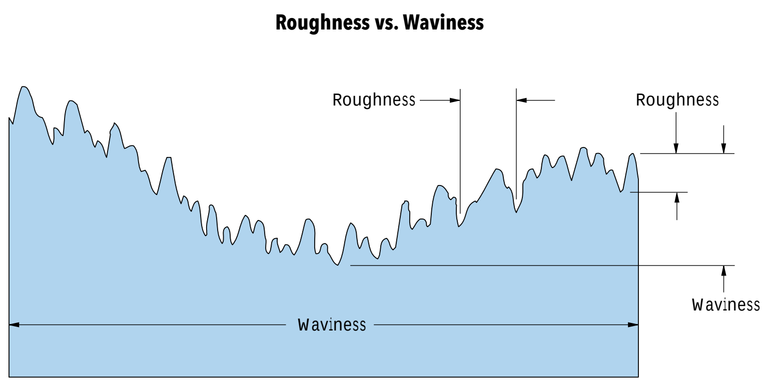
Negative/positive cutters provide the best cutting geometry for finish milling. Positive axial rake, negative radial rake, and the proper lead angle cause chips to be lifted up and out from the finished surface to clear the cutter and workpiece. This type of cutter combines the best aspects of negative and positive

Fig. 2: Effect of Spindle Tilt on Various Cutter Diameters



Spindle Tilt	Cutter Dia.	A
.001" per foot	6"	.00006"
	12"	.00013"
	18"	.00019"
.003" per foot	6"	.00019"
	12"	.00038"
	18"	.00057"
.005" per foot	6"	.00032"
	12"	.00064"
	18"	.00095"
.008" per foot	6"	.00051"
	12"	.00102"
	18"	.00153"

Fig. 1



geometries and provide extremely free cutting action. Excellent chip evacuation leaves the finish-milled surface free of scratches and scoring.

Lead angle also affects cutting forces. Increasing the lead angle from 0° lessens radial force slightly and increases axial force significantly. Generally, chip evacuation is easier with a higher lead angle.

Insert design. One common insert design has a wiping flat on the face of the insert. The width of this flat must be greater than the advance per revolution to allow the cutting edges to overlap. Spindle tilt is critical when using wipers. Due to the sharp ends on the insert, excessive spindle tilt can cause dig-in (Fig. 3).

The MICRO MILL insert has four radiused cutting edges which project a very shallow ellipse in the plane of the cut. The large elliptical radius aligns to the surface regardless of spindle tilt. This ensures that the ends of the cutting edge do not dig-in the surface as can occur when inserts with conventional flats are used.

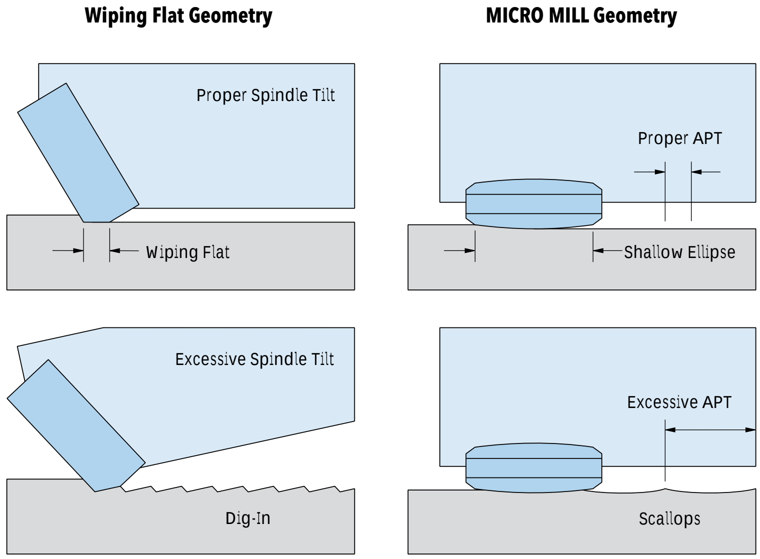
The cutting edge is ground with a hook as well as a radius so that the axial rake is positive. This creates a shearing action which eases entry into the cut and directs chips up and away so they do not cause scratches. With this type of insert, however, if the advance per revolution is too great, the elliptical cutting edges will not overlap enough to form a smooth surface finish.

Other recommendations. Climb milling is generally best for finish milling because the cutter takes the thick part of the chip when it enters the cut. In conventional milling, the chip thickness starts at zero, causing rubbing or burnishing before the chip can reach its full thickness. Pressure and heat build up at the finished surface. The thin section will then weld to the cutting edge and be carried around to scratch the surface.

Avoid cutting with the full diameter of the tool. This also results in zero chip thickness at the point of cutting edge entry just as in conventional milling. Two-thirds of the tool diameter is best when finish milling. It is also important to cut in the same direction when consecutive passes are required.

Finish milling depths are usually light (.003"-.010"). Greater Advance Per Tooth (APT) can be used, sometimes as high as .125". Finish milling cutters should be less dense than rough or semi-finish cutters, although high-density cutters may be required for some high production cast iron applications.

Fig. 3



Avoid too much spindle tilt, otherwise scratches may be created on the workpiece surface.

If advance per tooth is too great, the elliptical cutting edges will not overlap enough to form a smooth surface finish.

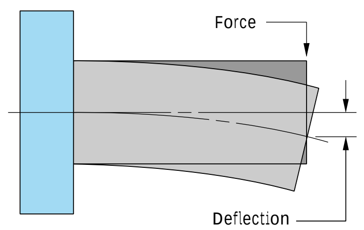
MAXIMIZING RIGIDITY WILL IMPROVE END MILL PERFORMANCE

Rigidity
Among the many variables in milling, rigidity is one of the most important. Quite often, it is the primary factor determining end mill performance. Due to their length-to-diameter ratio, end mills are the least rigid of all cutting tools. Understanding rigidity and maximizing it can dramatically increase end milling productivity.

Some of the primary factors that affect rigidity are basic machine design, drive mechanism, bearing placement, spindle size, tool diameter and length, overhang, workpiece, and fixturing. This discussion will focus on how end mill selection affects rigidity.

Rigidity: is affected by cutting force. Cutting force produces deflection.

Force: is produced by a combination of cutting speed in Surface Feet per Minute (SFM) and power. Power is a function of the width and depth of cut, feed rate, and the material being cut. Soft materials require less power and hard materials require more.
Deflection: is produced by the cutting force on the tool. The tool's length-to-diameter ratio determines the degree of effect cutting force has on the tool.



Deflection is directly proportional to L^3 (length to the third power) and inversely proportional to D^4 (diameter to the fourth power). In other words, deflection is radically reduced as diameter is increased and/or length is reduced.

Ingersoll has designed computer software to perform the many calculations required to determine the amount of deflection on the tool. Using Ingersoll's "Rigidity Analysis" software, deflection for the following example can easily be determined:

Cutter: 2.000" diameter, 4.00" flute length, No. 50 V-Flange adaption
Material: Low carbon steel
Speed: 400 SFM
Radial DOC: 1.00"
Axial DOC: 2.00"
Feed 12 IPM (.008 IPT)

The calculated theoretical deflection is .007".

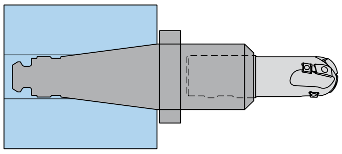
Deflection of .001" or less is recommended for end milling operations. This example exceeds the desired maximum deflection of .001". A cutter running under these conditions is likely to chatter, produce a poor surface finish, and exhibit reduced tool life.

The same example was recalculated after reducing the flute length from 4.00" to 3.00". Without making any other changes, the rigidity of the end mill improved dramatically. The theoretical deflection was reduced to .0009".

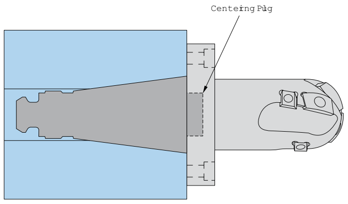
By reducing the overall length-to-diameter ratio by 25 percent, deflection was reduced to less than half of the original example.

Many operational variables require additional rigidity. Among these are brittle cutting edge materials and any factor causing an increase in cutting forces such as negative cutting angles or tougher workpiece materials.

Tool Adaption
Rotary Toolholder: Most end mills are run in rotary toolholders which connect the tool to the spindle. Ironically, due to the added length and extra joint, this is the least rigid of all end mill adaptions. To maximize rigidity with this adaption, an end mill with the largest diameter shank and the shortest adaptor possible should be used.



Poor: Straight shank end mill and rotary toolholder



Better: Integral Shank

Integral Shank: An improvement over the straight shank adaption is an integral shank. This eliminates the joints required with rotary tool holders and greatly improves length-to-diameter ratios. Many standard Ingersoll end mills are available with No. 50 taper adaptors. Other tapers are available upon request.

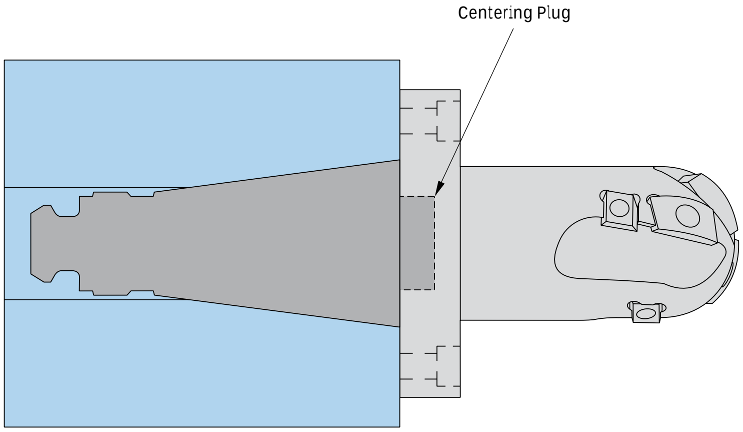
No. 50 tapers have a standard .125" gap between the flange and spindle face. To eliminate the gap, many Ingersoll machines have a simultaneous fit adaptor designed to be used in conjunction with a precision spindle face. Because the adaptor flange has bearing on the spindle face, the joint is more rigid.

Flat Back Drive: Another way to eliminate the .125" gap is to use a flat back drive system. It consists of a centering plug with a pilot diameter on the spindle. The end mill is bolted directly to the spindle face. This adaption is often used for large, heavy-duty end mill operations requiring maximum rigidity.

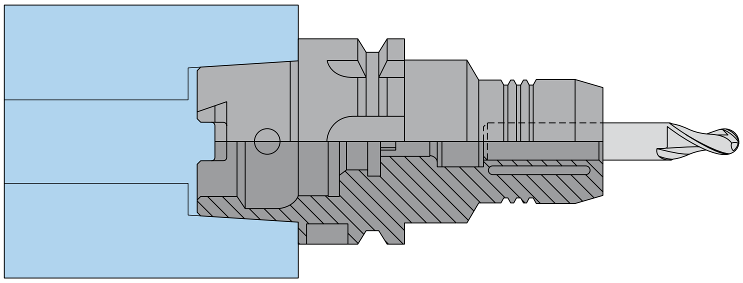
HSK Adaption: The HSK tool holder is designed to provide simultaneous fit on both the spindle face and the spindle taper.

At high speeds, centrifugal force causes the spindle to grow slightly. The face contact prevents the tool from moving up the bore. The hollow shank design is also susceptible to centrifugal force but is designed to grow with the spindle bore at very high speeds. I.D. clamping actually tightens its grip as spindle speed increases.

Supporting the cutting tool and holder in both the axial and radial planes creates a significantly more rigid connection between the tool and spindle.



Best: Flat Back Drive



Best: HSK Adaption

Moreover, HSK end mill holders are available in a variety of clamping styles including shrink fit for solid carbide shanks; hydraulic for steel shanks, collet, and Weldon styles. Choose the most rigid and accurate assembly possible.

Other HSK advantages include lighter weight, lower deflection under load, extremely accurate repeatability, increased torque transfer capabilities, and significantly improved dynamic runout over 50-taper adaptions at high speeds.

INCREASE FEED RATES BY UNDERSTANDING AND APPLYING RADIAL CHIP THINNING FACTORS

Radial Chip Thickness
Limitations on a cutting tool's performance are generally established in terms of maximum chip load. Since commonly used speed and feed calculators show only Advance Per Tooth (APT), chip load and APT tend to be used interchangeably. This is an area of misunderstanding which can be significant. Chip load actually refers to chip thickness, not APT.

APT is defined as the increment of feed that takes place in the time necessary for the cutter to rotate the distance between cutting edges. Mathematically, it is:

$$APT = \frac{IPM}{RPM \times T}$$

where:
IPM = Feed rate (inches/min)
RPM = Spindle speed (rev/min)
T = Teeth

The chip thickness is the "bite" taken by each cutting edge as it performs its work. For a typical end mill in a radial Depth Of Cut (DOC) exceeding two-thirds the diameter of the cutter, the chip thickness increases until it equals the APT at the centerline of the cutter. The chip thickness then decreases to nothing as the cutting edge exits the cut (Figure 1).

Thus, APT is a constant for a given operation and the chip thickness is variable, changing cyclically.

Peripheral cutting: When end mill cuts are shallow in relation to the cutter diameter, the Actual Chip Thickness (ACT) is less than the APT. This chip thinning effect allows much higher feed rates (Figure 2).

For example, assume the following parameters:
- 2.000" diameter end mill
- Two-effective
- 500 Surface Feet per Minute (SFM)
- .12" radial Width Of Cut (WOC)
- .005" chip thickness
- 955 effective RPM

Even though the APT in this case is .0105", the ACT (or chip load) is only .005".

A two-effective, 2.000" diameter end mill had an APT of .0105" and a chip thickness of only .005". The Radial Chip Thinning Factor (RCTF) is the ratio of chip thickness to APT or, in this example, .48.

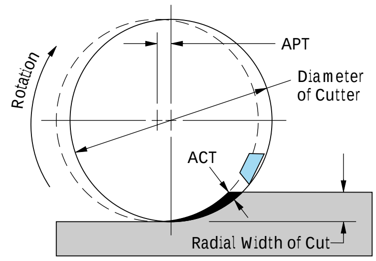
Mathematically, the RCTF can be expressed as:
where:

$$RCTF = \sqrt{1 - \left[1 - \frac{2 \times WOC}{Eff. Dia.}\right]^2}$$

D = Diameter of cutter
WOC = Radial Width Of Cut

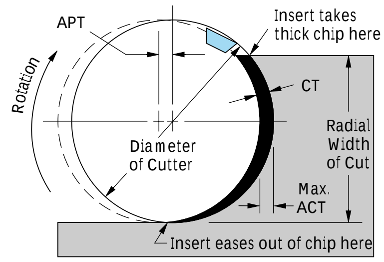
Whenever the radial DOC is equal to or greater than the effective cutter radius, the RCTF is equal to 1.

Fig. 1



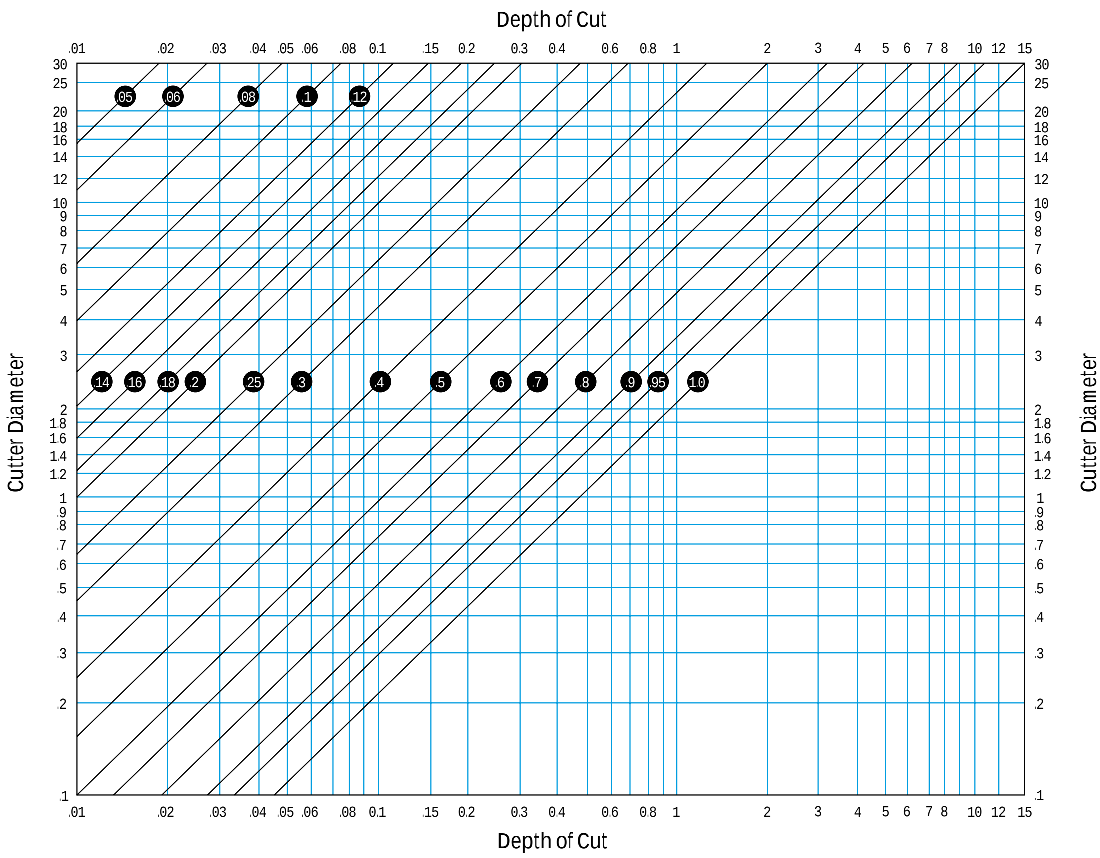
Chip thickness equals the Advance Per Tooth at the centerline of the cutter.

Fig. 2



Chip thickness is less than the Advance Per Tooth.

Fig. 3: Radial Chip Thinning Factors for Peripheral Milling



To find the Radial Chip Thinning Factor for a slabbing cut:

1. Find the Depth of Cut on the horizontal scale.
2. Locate the nominal diameter of the cutter on the vertical axis.
3. Cross-reference the two figures.
4. Locate the diagonal line closest to the intersection of the vertical and horizontal axes. The value of this diagonal is the Radial Chip Thinning Factor for your specific application.

The RCTF can also be found with the help of the graph in Figure 3.

A thorough understanding of the relationship between APT and chip thickness enables the tool engineer to establish optimum feed rates for a cutting tool. After determining the RCTF, the maximum permissible chip load is divided by the RCTF to arrive at the optimum APT.

Again, referring to the example, the chip load of .005″ is divided by the RCTF of .48 to arrive at the optimum APT of .0105″. This APT should be used in calculating the feed rate, in this case, 20.1 IPM.

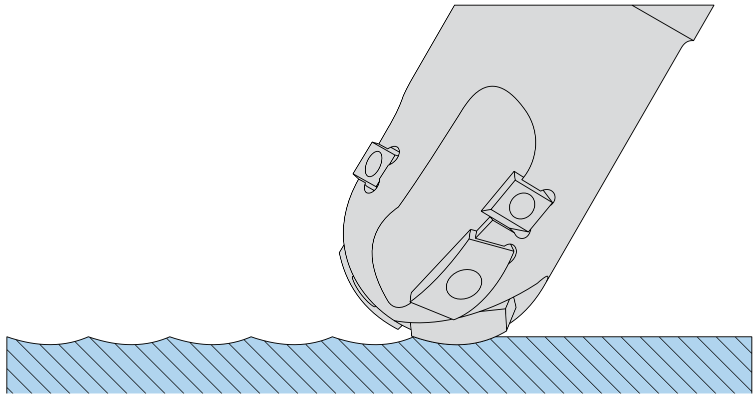
In addition to increasing productivity, applying the RCTF can improve a cutter's performance. At the higher feed rate, the insert will be taking a true bite. At lower feed rates without applying the RCTF, the insert may rub instead of cut and produce chatter, building heat and compromising tool life.

Ball Nose Milling. Ball nose end milling is a unique application that presents unique challenges. The nose inserts on a ball nose end mill are subjected to extreme abnormal and inconsistent work stresses. This is due, in part, to the wide variance in SFM and chip load from the radial to the axial end of the insert.

In order to minimize the stresses generated by this condition, the spindle axis can be tilted to raise the center point of the tool out of the cut (Figure 2). This "sturz" milling greatly reduces the force variance on the insert and helps to equalize the chip load.

To utilize this technique in optimizing your ball nose milling application, you must be able to tilt your machine spindle relative to the workpiece

Fig. 2



"Sturz" milling, or tilting the axis of the spindle to move the axial center of a ball nose end mill out of the cut, greatly reduces the cutting forces inflicted on the nose insert.

Axial Chip Thickness

Effective Diameter: When applying ball nose end mills, quite often the full diameter of the cutter is not engaged in the work. Since ball nose end mills cut to center, the speed in SFM is reduced to 0 as the centerline of the cutter is reached (see Figure 1 below).

To determine the Axial Chip Thinning Factor (ACTF), first determine the effective cutting diameter.

As the DOC varies, so does the effective cutting diameter. Since SFM calculations are based on the diameter of the cutter engaged in the cut, they must be made at the effective cutting diameter, not the nominal diameter of the tool.

The effective cutting diameter can be found in Chart A on pages M466-M467 by using the nominal tool diameter at the top and the DOC on the side. The SFM is calculated using the resulting effective cutting diameter at DOC.

The effective cutting diameter can also be calculated by using the following formula: Where:

$$D_t = 2 \times \sqrt{R^2 - (R - D)^2}$$

D_t = True cutting Diameter (in.)
R = Radius (in.)
D = Depth of cut (in.)

In order to achieve the best productivity possible, be sure to consider the effective cutting diameter when setting RPM for a profiling ball nose application.

Chip Thickness

Due to the spherical form presented to the workpiece, axial chip thinning can affect chip thickness the same way as a lead angle on a face mill. This can have an adverse effect on the performance of a ball nose end mill. The ACTF must be applied when calculating the desired chip thickness and resulting feed rate.

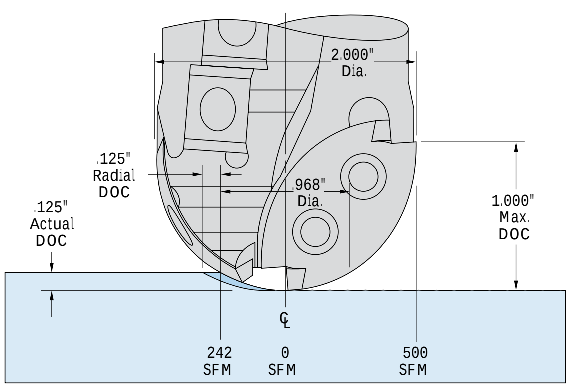
The ACTF is determined by the radius of the ball nose at a given DOC. Figure 2 illustrates the concept of axial chip thinning. Notice as the axial DOC increases, so does the axial chip thickness. To calculate axial chip thickness:

$$ACTF = \sqrt{1 - \left(1 - \left[\frac{2 \times DOC}{Ctr.\ Dia.}\right]\right)^2}$$

Whenever the axial DOC is equal to or greater than the radius of the ball nose, the ACTF is equal to 1.

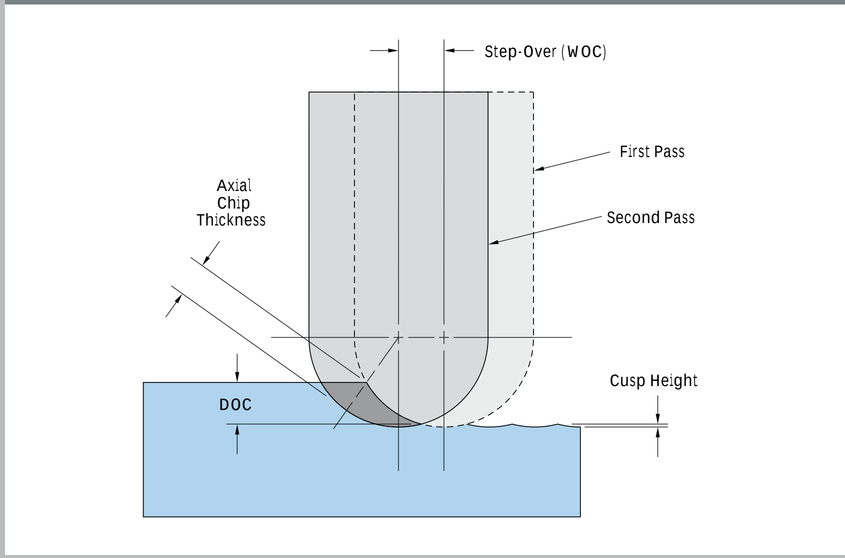
Next, determine the RCTF by the chart on pages M466-M467 or the formula. As Figure 3 shows, the RCTF is determined by the radius of the cutter at a given radial DOC. When determining the RCTF, use the effective diameter of the ball nose rather than the cutter diameter. Radial DOC is the same as the radial "step over." The formula used to calculate axial chip thinning is the same as that used for radial chip thinning. Ultimately, the purpose of determining the chip thinning factor is to optimize the feed rate.

Fig. 1: Effective Diameter



In this example, the SFM is 500 at a 2.000" diameter. The effective cutting diameter is .968", at which point, the SFM is 242. The RPM must be increased to 1973 in order to achieve 500 SFM at the .968" effective cutting diameter.

Fig. 2: Axial Chip Thinning



To calculate the proper feed rate, first multiply the ACTF by the RCTF. This result is the Feed Correction Factor (FCF):

$$FCF = RCTF \times ACTF$$

Divide the desired chip thickness by the FCF. This result is the desired APT to maintain proper chip thickness:

$$APT = \frac{CT}{FCF}$$

Finally, to arrive at the feed rate in Inches Per Minute (IPM), multiply the APT by the number of effective flutes and the RPM:

$$IPM = RPM \times (\text{No. of Flutes})$$

Overall performance would also improve since the cutter would be taking a true "bite" at the new feed rate. At the lower feed rate, the carbide may rub rather than cut.

Example

Figure 1 shows a 2.000" diameter ball nose end mill running at .125" DOC and a .125" radial DOC (step over). the effective diameter at this DOC is .968" (see chart on page M463). If the desired SFM is 500, the RPM would normally be set at 955 RPM for a 2.000" diameter cutter. However, since the effective diameter is .968", the RPM should be set at 1973 to achieve 500 SFM. This is an increase of more than 100 percent.

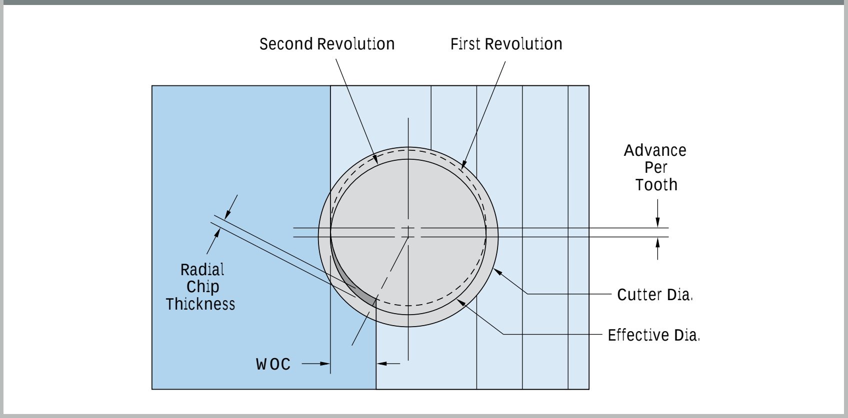
The DOC also affects the feed rate due to axial chip thinning. At .125" DOC, a 2.000" diameter has a chip thinning factor of .48 (see chart on M463). If the desired chip thickness is .010", the feed rate will need to be increased more than 100 percent. Without chip thinning, the feed rate would be set at 19.7 IPM (1973 x .010"). However, at this DOC, the ACT would be only .0048" (.010 x .48). To achieve the proper chip thickness (APT or ACT), divide the desired chip thickness by the chip thinning factor.

$$\frac{.010''}{.48} = .021'' \text{ APT}$$

The feed rate would be:

$$1973 \text{ RPM} \times .021 = 41.4 \text{ IPM}$$

Fig. 3: Radial Chip Thinning at Effective Diameter



In the same manner, the radial DOC (step over) has the same effect on feed rate. The radial DOC on a ball nose end mill is the same as the

radial WOC on an end mill or face mill. In this example, the radial DOC of .125" has an RCTF of .67 (see chart on page M463).

To achieve the desired chip thickness of .010", multiply the ACTF by the RCTF resulting in the FCF.

$$.48 \text{ ACTF} \times .67 \text{ RCTF} = .32 \text{ FCF}$$

The APT is:

$$\frac{.010''}{.32} = .021'' \text{ APT}$$

Productivity in this example is three times greater by using the correct chip thinning factors. On a single flute, one-effective tool using this example, the feed rate should be set at:

$$1973 \text{ RPM} \times .031'' \text{ APT} = 61.3 \text{ IPM}$$

At this feed rate, productivity is increased over 200 percent by using the proper chip thinning factors.

Ingersoll Cutting Tool Company provides speed and feed selectors which are designed to help obtain optimum speed, feed, and ACT multipliers. Ask your Ingersoll sales engineer for a complimentary selector.

BALL NOSE CHIP THINNING

This chart provides information on effective cutting diameter, ACTFs, and cusp height for a ball nose cutter at a given DOC or step over.

Effective Diameter and Axial Chip Thinning Factor. Axial DOC will affect the effective cutting diameter and, consequently, the ACTF. Note that as the axial DOC increases, the effective diameter and ACTF also increase. A lower DOC results in a smaller effective diameter and, therefore, a lower ACTF; i.e., the spindle RPM and feed rate need to be increased to maintain a proper surface speed and chip load.

Cusp Height. Step over, or radial DOC, affects the cusp height. Cusp height is the theoretical surface finish produced by successive tool paths made by a radius tool. Larger step over or a smaller cutter diameter produces a larger cusp height; i.e. a rougher finish.

For the best surface finish, use the largest diameter tool possible at the lowest practical radial DOC.

CHART A – EFFECTIVE BALL NOSE CUTTING DIAMETER, AXIAL CHIP THINNING FACTORS, AND CUSP HEIGHT (.375"–1.000" DIA.)

DOC/ Step Over	Cutter Diameter														
	0.375			0.500			0.625			0.750			1.000		
	Dia.	ACTF	Cusp	Dia.	ACTF	Cusp	Dia.	ACTF	Cusp	Dia.	ACTF	Cusp	Dia.	ACTF	Cusp
0.004	0.08	0.21	0.0000107	0.09	0.18	0.0000080	0.10	0.16	0.0000064	0.11	0.15	0.0000053	0.13	0.13	0.0000040
0.008	0.11	0.29	0.0000427	0.13	0.25	0.0000320	0.14	0.22	0.0000256	0.15	0.21	0.0000213	0.18	0.18	0.0000160
0.016	0.15	0.40	0.0001707	0.18	0.35	0.0001280	0.20	0.32	0.0001024	0.22	0.29	0.0000853	0.25	0.25	0.0000640
0.031	0.21	0.55	0.0006522	0.24	0.48	0.0004888	0.27	0.44	0.0003909	0.30	0.40	0.0003257	0.35	0.35	0.0002442
0.063	0.28	0.75	0.0026225	0.33	0.66	0.0019608	0.38	0.60	0.0015664	0.41	0.55	0.0013044	0.48	0.48	0.0009775
0.094	0.32	0.87	0.0059539	0.39	0.78	0.0044338	0.45	0.71	0.0035356	0.50	0.66	0.0029412	0.58	0.58	0.0022021
0.125	0.35	0.94	0.0107233	0.43	0.87	0.0079385	0.50	0.80	0.0063138	0.56	0.75	0.0052450	0.66	0.66	0.0039216
0.156	0.35	0.99	0.0170514	0.46	0.93	0.0125206	0.54	0.87	0.0099232	0.61	0.81	0.0082283	0.73	0.73	0.0061412
0.188	0.38	1.00	0.0251202	0.48	0.97	0.0182438	0.57	0.92	0.0143940	0.65	0.87	0.0119078	0.78	0.78	0.0088677
0.219				0.50	0.99	0.0251954	0.60	0.95	0.0197657	0.68	0.91	0.0163050	0.83	0.83	0.0121095
0.250							0.61	0.98	0.0260890	0.71	0.94	0.0214466	0.87	0.87	0.0158771
0.281							0.62	0.99	0.0334286	0.73	0.97	0.0273657	0.90	0.90	0.0201827
0.313							0.63	1.00	0.0418671	0.74	0.99	0.0341027	0.93	0.93	0.0250411
0.344										0.75	1.00	0.0417074	0.95	0.95	0.0304694
0.375										0.75	1.00	0.0502405	0.97	0.97	0.0364876
0.406													0.98	0.98	0.0431190
0.438													0.99	0.99	0.0503908
0.469													1.00	1.00	0.0583346
0.500													1.00	1.00	0.0669873

CHART A – EFFECTIVE BALL NOSE CUTTING DIAMETER, AXIAL CHIP THINNING FACTORS, AND CUSP HEIGHT (1.250"–3.000" DIA.)

DOC/ Step Over	Cutter Diameter														
	1.250			1.500			2.000			2.500			3.000		
	Dia.	ACTF	Cusp	Dia.	ACTF	Cusp	Dia.	ACTF	Cusp	Dia.	ACTF	Cusp	Dia.	ACTF	Cusp
0.004	0.14	0.11	0.0000032	0.15	0.10	0.0000027	0.18	0.09	0.0000020	0.20	0.08	0.0000016	0.22	0.07	0.0000013
0.008	0.20	0.16	0.0000128	0.22	0.15	0.0000107	0.25	0.13	0.0000080	0.28	0.11	0.0000064	0.31	0.10	0.0000053
0.016	0.28	0.22	0.0000512	0.31	0.21	0.0000427	0.36	0.18	0.0000320	0.40	0.16	0.0000256	0.44	0.15	0.0000213
0.031	0.39	0.31	0.0001953	0.43	0.29	0.0001628	0.50	0.25	0.0001221	0.56	0.22	0.0000977	0.61	0.20	0.0000814
0.063	0.54	0.44	0.0007817	0.60	0.40	0.0006513	0.70	0.35	0.0004884	0.78	0.31	0.0003907	0.86	0.29	0.0003256
0.094	0.66	0.53	0.0017603	0.73	0.48	0.0014663	0.85	0.42	0.0010992	0.95	0.38	0.0008792	1.04	0.35	0.0007326
0.125	0.75	0.60	0.0031329	0.83	0.55	0.0026087	0.97	0.48	0.0019550	1.09	0.44	0.0015635	1.20	0.40	0.0013026
0.156	0.83	0.66	0.0049020	0.92	0.61	0.0040801	1.07	0.54	0.0030564	1.21	0.48	0.0024438	1.33	0.44	0.0020359
0.188	0.89	0.71	0.0070713	0.99	0.66	0.0058824	1.17	0.58	0.0044042	1.32	0.53	0.0035206	1.45	0.48	0.0029326
0.219	0.95	0.76	0.0096447	1.06	0.71	0.0080181	1.25	0.62	0.0059994	1.41	0.57	0.0047944	1.56	0.52	0.0039929
0.250	1.00	0.80	0.0126276	1.12	0.75	0.0104900	1.32	0.66	0.0078433	1.50	0.60	0.0062657	1.66	0.55	0.0052174
0.281	1.04	0.84	0.0160258	1.17	0.78	0.0133015	1.39	0.70	0.0099371	1.58	0.63	0.0079353	1.75	0.58	0.0066063
0.313	1.08	0.87	0.0198464	1.22	0.81	0.0164566	1.45	0.73	0.0122825	1.65	0.66	0.0098041	1.83	0.61	0.0081602
0.344	1.12	0.89	0.0240974	1.26	0.84	0.0199596	1.51	0.75	0.0148812	1.72	0.69	0.0118728	1.91	0.64	0.0098795
0.375	1.15	0.92	0.0287880	1.30	0.87	0.0238156	1.56	0.78	0.0177354	1.79	0.71	0.0141425	1.98	0.66	0.0117649
0.406	1.17	0.94	0.0339287	1.33	0.89	0.0280303	1.61	0.80	0.0208472	1.84	0.74	0.0166143	2.05	0.68	0.0138169
0.438	1.19	0.95	0.0395314	1.36	0.91	0.0326100	1.65	0.83	0.0242191	1.90	0.76	0.0192895	2.12	0.71	0.0160362
0.469	1.21	0.97	0.0456095	1.39	0.93	0.0375617	1.69	0.85	0.0278537	1.95	0.78	0.0221692	2.18	0.73	0.0184237
0.500	1.22	0.98	0.0521780	1.41	0.94	0.0428932	1.73	0.87	0.0317542	2.00	0.80	0.0252551	2.24	0.75	0.0209801
0.531	1.24	0.99	0.0592542	1.43	0.96	0.0486133	1.77	0.88	0.0359236	2.05	0.82	0.0285487	2.29	0.76	0.0237062
0.563	1.24	0.99	0.0668572	1.45	0.97	0.0547314	1.80	0.90	0.0403655	2.09	0.84	0.0320515	2.34	0.78	0.0266031
0.594	1.25	1.00	0.0750089	1.47	0.98	0.0612582	1.83	0.91	0.0450837	2.13	0.85	0.0357656	2.39	0.80	0.0296717
0.625	1.25	1.00	0.0837341	1.48	0.99	0.0682055	1.85	0.93	0.0500822	2.17	0.87	0.0396927	2.44	0.81	0.0329132
0.656				1.49	0.99	0.0755862	1.88	0.94	0.0553657	2.20	0.88	0.0438350	2.48	0.83	0.0363286
0.688				1.49	1.00	0.0834147	1.90	0.95	0.0609388	2.23	0.89	0.0481947	2.52	0.84	0.0399192
0.719				1.50	1.00	0.0917070	1.92	0.96	0.0668068	2.26	0.91	0.0527742	2.56	0.85	0.0436863
0.750				1.50	1.00	0.1004809	1.94	0.97	0.0729752	2.29	0.92	0.0575760	2.60	0.87	0.0476312
0.781							1.95	0.98	0.0794501	2.32	0.93	0.0626028	2.63	0.88	0.0517555
0.813							1.96	0.98	0.0862380	2.34	0.94	0.0678575	2.67	0.89	0.0560606
0.844							1.98	0.99	0.0933460	2.36	0.95	0.0733431	2.70	0.90	0.0605482
0.875							1.98	0.99	0.1007816	2.38	0.95	0.0790629	2.73	0.91	0.0652200
0.906							1.99	1.00	0.1085530	2.40	0.96	0.0850203	2.75	0.92	0.0700777
0.938							2.00	1.00	0.1166691	2.42	0.97	0.0912190	2.78	0.93	0.0751234
0.969							2.00	1.00	0.1251395	2.44	0.97	0.0976629	2.81	0.94	0.0803589
1.000							2.00	1.00	0.1339746	2.45	0.98	0.1043561	2.83	0.94	0.0857864
1.031										2.46	0.98	0.1113030	2.85	0.95	0.0914082
1.063										2.47	0.99	0.1185083	2.87	0.96	0.0972265
1.094										2.48	0.99	0.1259770	2.89	0.96	0.1032439
1.125										2.49	0.99	0.1337143	2.90	0.97	0.1094628
1.156										2.49	1.00	0.1417259	2.92	0.97	0.1158860
1.188										2.50	1.00	0.1500178	2.93	0.98	0.1225164
1.219										2.50	1.00	0.1585963	2.95	0.98	0.1293570
1.250										2.50	1.00	0.1674682	2.96	0.99	0.1364110
1.281													2.97	0.99	0.1436816
1.313													2.98	0.99	0.1511724
1.344													2.98	0.99	0.1588870
1.375													2.99	1.00	0.1668294
1.406													2.99	1.00	0.1750037
1.438													3.00	1.00	0.1834141
1.469													3.00	1.00	0.1920652
1.500													3.00	1.00	0.2009619

FORMMASTER SPEED OPERATING GUIDELINES SERIES 15V1E, 15VIH

EXAMPLE CALCULATION

GIVEN	STEP 1	STEP 2	STEP 3	STEP 4	OPERATING PARAMETERS
▪ CUTTER = 5V6E-20R01 ▪ INSERT = UHLD08T310R-M ▪ NUMBER OF INSERTS = 5 ▪ MATERIAL = H13 PRE-HARD ▪ HARDNESS = 38-42 HRC ▪ EXTENSION LENGTH = 6.00"	CONVERT 38-42 HRC TO BRINELL THEN SELECT SURFACE FEET PER MINUTE (SFM). CALCULATE RPM FOR A 2.00" DIA. CUTTER	SELECT DEPTH OF CUT AND FEEDRATE MULTIPLIER FROM THE APPLICATION TABLE FOR RATIO OF 3:1	SELECT CHIP THICKNESS (CT) FOR THE UHLD08T310R-M INSERT IN H13	CALCULATE FEEDRATE (FULL WIDTH OF CUTTER)	▪ RPM - 860 ▪ DEPTH OF CUT = .04" ▪ FEEDRATE = 172 IPM ▪ WIDTH OF CUT = 2.00"
	*RPM = 860 (450 SFM)	DOC = .04" FRM MULTIPLIER = 4	0.010"	**FEEDRATE = 172 IPM	

*RPM = SFM x 3.82 / Cutter Diameter **Feedrate = RPM x # of inserts x CT x FRM

APPLICATION TABLE

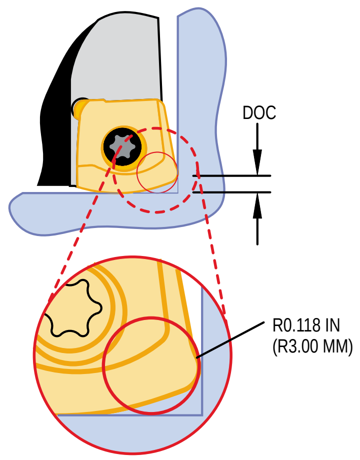
	GREATER THAN 8:1	FROM 3:1 TO 8:1	LESS THAN 3:1
	FROM .01" TO .03"	FROM .02" TO .06"	FROM .04" TO .08"
	3	4	5

MATERIAL HARDNESS

BRINELL (HB)	ROCKWELL (HRC)
200	15
225	20
250	24
275	29
300	32
325	34
350	38
375	40
400	43
425	46

FIGURE 1

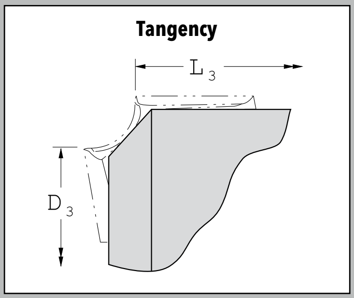
PROGRAM ALL FORMMASTERSPEED CUTTERS AS THOUGH THEY ARE BULLNOSE CUTTERS WITH .118"/ 3.0MM CORNER RADII. THIS METHOD WILL BOTH ENSURE AND MINIMIZE REMAINING STOCK FOR SECONDARY PASSES.



RAMP ANGLES

INCHES	.750"	1.000"	1.250"	1.500"	2.000"	NA	3.000"	4.000"
MM	20.00 MM	25.00 MM	32.00 MM	42.00 MM	52.00 MM	66.00 MM	80.00 MM	NA
	3.5 DEG	3.0 DEG	2.5 DEG	1.6 DEG	1.2 DEG	0.7 DEG	0.5 DEG	0.2 DEG

FAST BREAK PROGRAMMING DIMENSIONS



D1 Nominal Diameter	Cutter Body	Insert Corner	Inserts	D3 Program Diameter	L3 Program Length
0.750	15R1V-0702084R01	0.031"	BEEW120308R-CR	0.684	1.985
		0.062"	BEEW120316R-CR	0.623	1.949
		0.094"	BEEW120325R-CR	0.552	1.909
		0.125"	BEEW120332R-CR	0.495	1.876
		1.0 mm	BEEW120310R-CR	0.670	1.976
		2.0 mm	BEEW120320R-CR	0.589	1.930
		3.0 mm	BEEW120330R-CR	0.512	1.885
1.000	15R1V-1002080R01	0.031"	BEEW120308R-CR	0.934	1.984
		0.062"	BEEW120316R-CR	0.873	1.949
		0.094"	BEEW120325R-CR	0.802	1.909
		0.125"	BEEW120332R-CR	0.745	1.875
		1.0 mm	BEEW120310R-CR	0.920	1.976
		2.0 mm	BEEW120320R-CR	0.839	1.930
		3.0 mm	BEEW120330R-CR	0.762	1.885
1.000	15R1V-10015X7R01	0.031"	BEEW120308R-CR	0.934	1.484
		0.062"	BEEW120316R-CR	0.873	1.449
		0.094"	BEEW120325R-CR	0.802	1.409
		0.125"	BEEW120332R-CR	0.745	1.375
		1.0 mm	BEEW120310R-CR	0.920	1.476
		2.0 mm	BEEW120320R-CR	0.839	1.430
		3.0 mm	BEEW120330R-CR	0.762	1.385
1.000	15R4H-1002080R01	.156"	FEEW250340R-CR	0.697	1.881
		.187"	FEEW250348R-CR	0.644	1.846
		.250"	FEEW250364R-CR	0.500	1.750
		4.0 mm	FEEW250340R-CR	0.697	1.881
		5.0 mm	FEEW250350R-CR	0.611	1.825
		6.0 mm	FEEW250360R-CR	0.530	1.771
1.000	15R4H-10015X7R01	.156"	FEEW250340R-CR	0.697	1.631
		.187"	FEEW250348R-CR	0.644	1.596
		.250"	FEEW250364R-CR	0.500	1.500
		4.0 mm	FEEW250340R-CR	0.697	1.631
		5.0 mm	FEEW250350R-CR	0.611	1.575
		6.0 mm	FEEW250360R-CR	0.530	1.521

TROUBLESHOOTING CHART

Solution / Problem	Chipping Fracturing	Excessive Abrassive Fank Wear	Cratering Chemical Wear	Built Up Edge	Deformation	Thermal Cracking	"Bad Surface Finish"	Vibration/Chatter	"Chip Built Up (Chip Tangled Up"	"Edge of Material Breaks"	"Cutting Forces too high". Machine overload
Cutting Speed	1	2	2	1	2		1	3			2
APT	2	1	2	1	2	2	2	3		2	2
Toughness of Cutting Material	1					1					
Wear Resistance		1	1		1, 3						
Entering Angle				3				2	3	2	2
Rake Angle	2			1, 3	1, 3	3		1	3		
Chamfer	1			3			2			2	
Stabilize Fixture/Part	1					1	1	1			
Tool Position						3	3	3		3	
Coolant, Chip Removal			1	1	3		3		3		
DOC	3					3	3	3		2	2
Runout/Concentricity							1	1		3	

1-Increase
2-Decrease
3-Optimize

SYMBOLS DEFINED

Explanation of catalog parameters and formula symbols		
Symbol	**Unit**	**Designation**
D	Inch	Nominal diameter
n	min^{-1}	RPM
a_e	Inch	Width of cut
a_p	Inch	Cutting depth
f_z	Inch	Feed per tooth
f	Inch/U	Feed per revolution
h_m	Inch	Average chip thickness
Q	ft^3/min	Chip removal rate
v_c	Inch/min	Feed rate
C	x 45°	Chamfer
R	–	Radius

GENERAL FORMULI FOR MILLING OPERATIONS

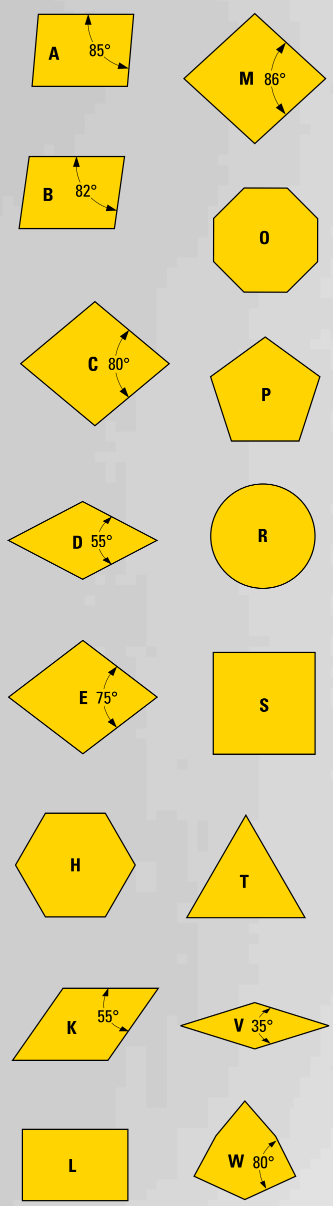
Value	Unit	Formula
RPM	min^{-1}	$n = \frac{v_c \times 1000}{D \cdot \pi}$
Cutting speed	ft/min	$v_c = \frac{D \cdot \pi \cdot n}{1000}$
Feed rate	in/min	$v_f = f_z \cdot Z_{eff} \cdot n$
Feed per tooth	in	$f_z = \frac{v_f}{Z_{eff} \cdot n}$
Chip removal rate	in^3/min	$Q = \frac{a_e \cdot a_p \cdot v_f}{1000}$
Average chip thickness	in	$h_m = f_z \cdot \sqrt{a_e/D}$

MILLING GRADES

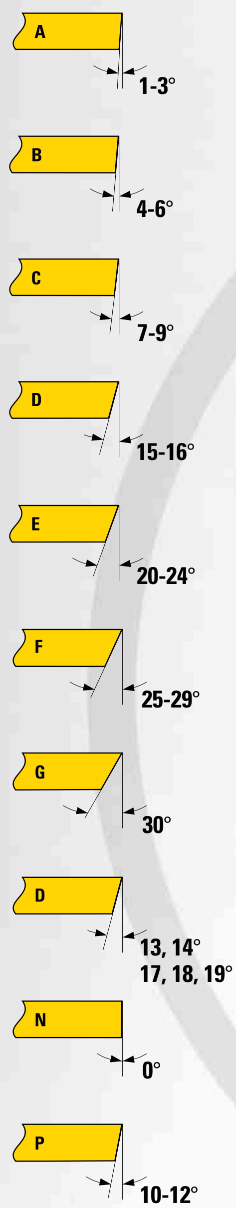
New Grade	Coating	OLD GRADE	Cast Iron	Stainless Steel	Steel	Non-Ferrous Alloys	Hi-Temp. Alloys	Hardened Steel	U.S. Industry Code	ISO Code	Mech. Shock	Thermal Shock	Wear Resistance	Crater Resistance	Grain
IN04S	None	110, 103				•			C-3	K10-K20	L	L	H	VL	Micro
IN05S	None					•			C-1	M10-M20	M	L	H	VL	Micro
IN10K	None	111				•			C-1/C-2	K20-K40	L	L	H	VL	Fin.- Med.
IN15K	None	205H				•			C-1/C-2	K20-K40	H	L	M	VL	Micro
IN30M	None	205S, 131				•	•		C-1/C-2	M20-M40, K20-K50	EH	L	M	VL	Coarse
IN5015	CVD, TiN-TiCN	R47	•	•	•			•	C-2/C-6	P10-P30, K10-K30	M	M	M	M	Micro
IN5515	MT-CVD, TiCN, TiN				•				C-2/C-6	K10-K30 P15-P30	M	M	H	M	Micro
IN6510	MT-CVD, Al2O3	711, 714	•						C-2	K15-K20	L	H	EH	M	Fin.- Med.
IN6515	MT-CVD, Al2O3	722, 723	•		•				C-2/C-3/C-6	K15-K35, P20-P30	M	H	H	M	Micro
IN6530	MT-CVD, Al2O3	708, 731	•	•	•		•		C-1/C-5/C-6	P25-P45, M25-M40	EH	M-H	M-H	M-H	Coarse
IN6542	MT-CVD, Al2O3	732, 757, 762, 767	•	•		•	•		C-1/C-2	M20-M40, K20-K30	H	L	H	L	Medium
INDD15	MT-CVD + PVD		•		•				C-1/C-2	K20-K40	M	H	H	H	Medium
IN1030	PVD, TiCN	J05	•	•	•	•	•		C-1/C-2	M20-M40, K20-K30	H	L	H	L	Coarse
IN1040	PVD, TiCN	J47		•	•				C-5/C-6	P20-P40	H	H	H	H	Fin.- Med.
IN1510	PVD, TiCN-TiN	561	•			•			C-1/C-2/C-3	K20-K40	L	L	EH	L	Fin.- Med.
IN1515	PVD, TiCN-TiN	555H	•	•		•	•		C-1/C-2	M20-M40, K20-K30	H	L	M-H	L	Micro
IN1530	PVD, TiCN-TiN	555S, 581		•	•		•		C-1/C-5	M30, K25-K40	EH	M	M	M	Coarse
IN1540	PVD, TiCN-TiN	557, 563, 570, 585, 597		•	•				C-5/C-6	P20-P40	H	H	H	H	Fin.- Med.
IN2004	PVD, TiAlN	803	•		•			•	C-3/C-7	P15, K10	L	H	H	H	Micro
IN2005	PVD, TiAlN	804	•	•	•	•	•		C-2	M20-M40	H	M	H	M	Micro
IN2006	PVD, TiAlN			•	•		•	•	C7/C8	P05-P20 M10-M20	H	M	M	M	Micro
IN2010	PVD, TiAlN	811, B11	•						C-1/C-2	K10-K40	L	L-M	EH	L-M	Fin.- Med.
IN2510	PVD, TiAlN, TiN		•						C-1/C-2	K10-K40	L	L-M	EH	L-M	Fin.- Med.
IN2015	PVD, TiAlN	805H, 823	•	•	•		•		C-1/C-2	K10-K40	H	M	H	M	Micro
IN2030	PVD, TiAlN	805S, 831		•	•		•		C-1/C-5	K25-K40, M30-M40	EH	H	M	M-H	Coarse
IN2040	PVD, TiAlN	835, 847, B35			•				C-5/C-6	P20-P40	H	H-EH	H	H-EH	Fin.- Med.
IN2505	PVD, TiAlN, TiN		•	•	•	•	•	•	C1/C2	P15-P35 M10-M30 K10-K30	H	M	H	M	Micro
IN2540	PVD, TiAlN, TiN				•				C5/C6	P10-P40	H	H-EH	H	H-EH	Fin. - Med.
IN60C	None	406, 430			•			•	C-7/C-8	P05-P15	VL	EH	H	EH	Cermet
IN62C	None	NA			•			•	C-7/C-8	P10-P30	L	EH	H	EH	Cermet
IN70N	None	405				•			C-1/C-2	K10-K25	VL	VL	EH	EH	SiN
IN72N	None	NA		•	•				C-1/C-2	S01-S10	L	VL	EH	EH	SiN
IN80B	None	421		•	•				CBN	K01-K20	VL	EH	EH	EH	CBN
IN90D	None	411				•			PCD	PCD	VL	H	EH	VL	PCD

INSERT NOMENCLATURE ISO STANDARD INSERTS

INSERT SHAPE

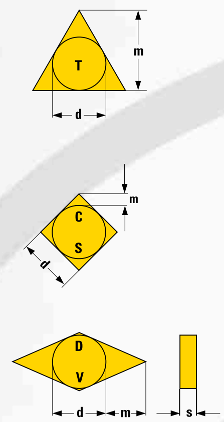


RELIEF ANGLE



O = other angle

TOLERANCE

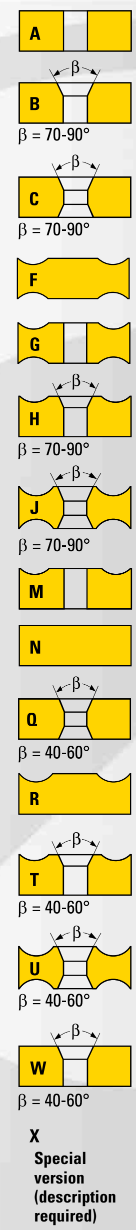


Allowable tolerance in mm:

	d	m	s
A	± 0,025	± 0,005	± 0,025
C	± 0,025	± 0,013	± 0,025
E	± 0,025	± 0,025	± 0,025
F	± 0,013	± 0,005	± 0,025
G	± 0,025	± 0,025	± 0,05-0,13
H	± 0,013	± 0,013	± 0,025
J[1]	± 0,05-0,15[2]	± 0,005	± 0,025
K[1]	± 0,05-0,15[2]	± 0,013	± 0,025
L[1]	± 0,05-0,15[2]	± 0,013	± 0,025
M	± 0,05-0,15[2]	± 0,08-0,20[2]	± 0,013
N	± 0,05-0,15[2]	± 0,08-0,20[2]	± 0,025
U	± 0,05-0,25[2]	± 0,13-0,38[2]	± 0,05-0,13

[1] Inserts with ground surfaces
[2] Dependant on insert size (see ISO standard 132)

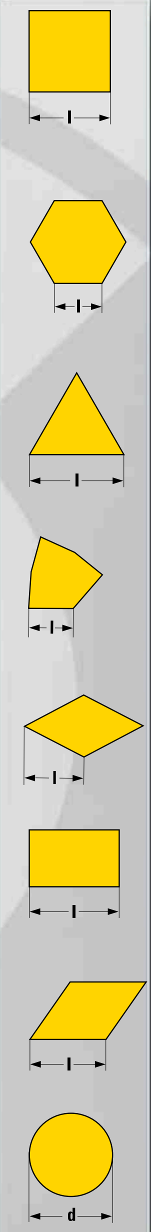
INSERT TYPE



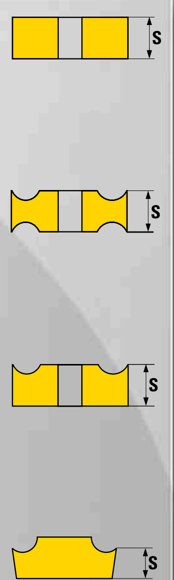
X
Special version (description required)

08 03 04 F R - P

CUTTING LENGTH

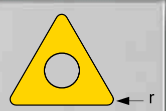


THICKNESS

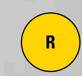


01 s = .062
T1 s = .078
02 s = .093
T2 s = .109
03 s = .125
T3 s = .156
04 s = .187
05 s = .219
06 s = .250
07 s = .312
09 s = .375

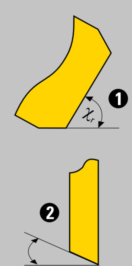
RADIUS



04 r = .015
08 r = .031
16 r = .062
24 r = .093
32 r = .125
48 r = .187
64 r = .250



"00" for diameters converted from inch to mm. "M0" for diameters in metric dimensions.



❶ Bevel Angle
A = 45°
D = 60°
E = 75°
F = 85°
P = 90°
Z = other
M = multiple

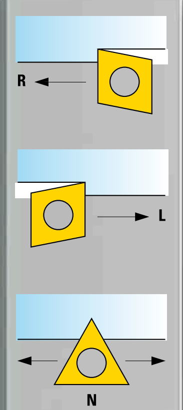
❷ Clearance Angle
A = 3°
B = 5°
C = 7°
D = 15°
E = 20°
F = 25°
G = 30°
J = 23°
N = 0°
P = 11°
Z = other clearance angle

HONE

F sharp

T K-Land

HAND



MODIFIER

- P = Polished
- W = Wiper
- PW = Polished Wiper
- VL = Variable Land
- FS = Flat Step Chip Breaker
- PS = Hooked Step Chip Breaker
- DM = Dimpled Chip Breaker
- DK = Double Wave Breaker with K-Land
- SK = Single Wave Breaker with K-Land
- DW = Double Wave Breaker, no K-Land
- SW = Single Wave Breaker, no K-Land
- HS = High Shear Geometry
- HR = "Rill"-Type Chip Breaker
- GB = Groove-Type Chip Breaker
- PH = Positive Hook
- RW = "Rills" and Wiper
- CR = Corner Rounding

INSERTS

Insert Number	Corner Radius	New Grade	Cutter Series
ANHU160704FR-P	0.015 R	IN10K	1TJ1N, 1TJ1N (TOP-ON STYLE), 2TJ3N, 2TJ3N (SHELL MILL), TJ6N
ANHU160704R	0.015 R	IN2030	1TJ1N, 1TJ1N (TOP-ON STYLE), 2TJ3N, 2TJ3N (SHELL MILL), TJ6N
ANHU160708FR	0.031 R	IN2030	1TJ1N, 1TJ1N (TOP-ON STYLE), 2TJ3N, 2TJ3N (SHELL MILL), TJ6N
ANHU160708FR-P	0.031 R	IN10K	1TJ1N, 1TJ1N (TOP-ON STYLE), 2TJ3N, 2TJ3N (SHELL MILL), TJ6N
ANHU160708R	0.031 R	INDD15, IN2010, IN2030, IN2505, IN2540	1TJ1N, 1TJ1N (TOP-ON STYLE), 2TJ3N, 2TJ3N (SHELL MILL), TJ6N
ANHU160716R	0.062 R	IN2010, IN2030, IN2505, IN2540	1TJ1N, 1TJ1N (TOP-ON STYLE), 2TJ3N, 2TJ3N (SHELL MILL), TJ6N
ANHU1607ANR	0.015 R	IN2010, IN2030, IN2540	TN1N
AOCT060204FR-P	0.015 R	IN05S	12J1D, 12J1D (CHIP-SURFER STYLE), 12J1D (STRAIGHT SHANK), 12J1D (TOP-ON STYLE), 12P1D, 12N1D, 12M1D, 22J3D, 2J1D
AOCT120408FR-P	0.031 R	IN10K	12J1X, 12J1X (TOP-ON STYLE), 12R1X, 12V1X (TOP-ON STYLE), 22J3X, 22J3X (INNO-FIT STYLE), 22J3X (SHELL MILL), 22N3X, 2J1X, 2L1X
AOCT170508FR-P	0.031 R	K10	12J1G, 12J1G (TOP-ON STYLE), 22J3G, 2J1G
AOMT060202R	0.008 R	IN1030, IN2005, IN2030	12J1D, 12J1D (CHIP-SURFER STYLE), 12J1D (STRAIGHT SHANK), 12J1D (TOP-ON STYLE), 12P1D, 12N1D, 12M1D, 22J3D, 2J1D
AOMT060204R	0.015 R	IN2005, IN2030, IN2505	12J1D, 12J1D (CHIP-SURFER STYLE), 12J1D (STRAIGHT SHANK), 12J1D (TOP-ON STYLE), 12P1D, 12N1D, 12M1D, 22J3D, 2J1D
AOMT060208R	0.031 R	IN2005, IN2030, IN2505	12J1D, 12J1D (CHIP-SURFER STYLE), 12J1D (STRAIGHT SHANK), 12J1D (TOP-ON STYLE), 12P1D, 12N1D, 12M1D, 22J3D, 2J1D
AOMT060216R	0.062 R	IN2005, IN2030	12J1D, 12J1D (CHIP-SURFER STYLE), 12J1D (STRAIGHT SHANK), 12J1D (TOP-ON STYLE), 12P1D, 12N1D, 12M1D, 22J3D, 2J1D
AOMT120404R	0.015 R	IN1030, IN2005	12J1X, 12J1X (TOP-ON STYLE), 12R1X, 12V1X (TOP-ON STYLE), 22J3X, 22J3X (INNO-FIT STYLE), 22J3X (SHELL MILL), 22N3X, 2J1X, 2L1X
AOMT120408FR	0.031 R	IN2005, IN2030	12J1X, 12J1X (TOP-ON STYLE), 12R1X, 12V1X (TOP-ON STYLE), 22J3X, 22J3X (INNO-FIT STYLE), 22J3X (SHELL MILL), 22N3X, 2J1X, 2L1X
AOMT120408R	0.031 R	IN1030, IN2005, IN2010, IN2030, IN2040, IN2505	12J1X, 12J1X (TOP-ON STYLE), 12R1X, 12V1X (TOP-ON STYLE), 22J3X, 22J3X (INNO-FIT STYLE), 22J3X (SHELL MILL), 22N3X, 2J1X, 2L1X
AOMT120416R	0.062 R	IN1030, IN2005, IN2030, IN2510	12J1X, 12J1X (TOP-ON STYLE), 12R1X, 12V1X (TOP-ON STYLE), 22J3X, 22J3X (INNO-FIT STYLE), 22J3X (SHELL MILL), 22N3X, 2J1X, 2L1X
AOMT120424R	0.093 R	IN2005, IN2030	12J1X, 12J1X (TOP-ON STYLE), 12R1X, 12V1X (TOP-ON STYLE), 22J3X, 22J3X (INNO-FIT STYLE), 22J3X (SHELL MILL), 22N3X, 2J1X, 2L1X
AOMT120430FR	3.0 R	IN2005	12J1X, 12J1X (TOP-ON STYLE), 12R1X, 12V1X (TOP-ON STYLE), 22J3X, 22J3X (INNO-FIT STYLE), 22J3X (SHELL MILL), 22N3X, 2J1X, 2L1X
AOMT120432R	0.125 R	IN1030, IN2005, IN2010, IN2030, IN2040	12J1X, 12J1X (TOP-ON STYLE), 12R1X, 12V1X (TOP-ON STYLE), 22J3X, 22J3X (INNO-FIT STYLE), 22J3X (SHELL MILL), 22N3X, 2J1X, 2L1X
AOMT120440R	4.0 R	IN2505	12J1X, 12J1X (TOP-ON STYLE), 12R1X, 12V1X (TOP-ON STYLE), 22J3X, 22J3X (INNO-FIT STYLE), 22J3X (SHELL MILL), 22N3X, 2J1X, 2L1X
AOMT170504R	0.015 R	IN1030, IN2040	12J1G, 12J1G (TOP-ON STYLE), 22J3G, 2J1G
AOMT170508R	0.031 R	INDD15, IN1030, IN2005, IN2030, IN2040, IN2505, IN2510	12J1G, 12J1G (TOP-ON STYLE), 22J3G, 2J1G
AOMT170508R-HS	0.031 R	IN1030, IN2005, IN2010, IN2030, IN6530	12J1G, 12J1G (TOP-ON STYLE), 22J3G, 2J1G
AOMT170516R	0.062 R	IN1030, IN2005, IN2030, IN2510	12J1G, 12J1G (TOP-ON STYLE), 22J3G, 2J1G
AOMT170524R	0.093 R	IN1030, IN2005, IN2010	12J1G, 12J1G (TOP-ON STYLE), 22J3G, 2J1G
AOMT170532R	0.125 R	IN1030, IN2005, IN2040	12J1G, 12J1G (TOP-ON STYLE), 22J3G, 2J1G

Insert Number	Corner Radius	New Grade	Cutter Series
AOMT170540R-EM	0.156 R	IN1030	12J1G, 12J1G (TOP-ON STYLE), 2J1G
AOMT170548R	0.187 R	IN1030, IN2005, IN2040	12J1G, 12J1G (TOP-ON STYLE), 22J3G, 2J1G
AOMT170564R	0.250 R	IN1030, IN2005, IN2510, IN2540	12J1G, 12J1G (TOP-ON STYLE), 22J3G, 2J1G
AOMT180504FR-P	0.015 R	IN05S	12J1E (TOP-ON STYLE), 12J1E (V-FLANGE), 12J1E, 12J4E, 22J3E, 22J3E (INNO-FIT STYLE), 22J3E (Shell Mill), 2J1E, 2J4E, 2L1E
AOMT180504R-HS	0.015 R	IN2030	12J1E (TOP-ON STYLE), 12J1E (V-FLANGE), 12J1E, 12J4E, 22J3E, 22J3E (INNO-FIT STYLE), 22J3E (Shell Mill), 25J3H, 25J3H (Shell Mill), 2J1E, 2J4E, 2L1E
AOMT180508FR-P	0.031 R	IN30M	12J1E (TOP-ON STYLE), 12J1E (V-FLANGE), 12J1E, 12J4E, 22J3E, 22J3E (INNO-FIT STYLE), 22J3E (Shell Mill), 2J1E, 2J4E, 2L1E
AOMT180508R	0.031 R	IN1030, IN2005, IN2015, IN2030, IN2040	12J1E (TOP-ON STYLE), 12J1E (V-FLANGE), 12J1E, 12J4E, 22J3E, 22J3E (INNO-FIT STYLE), 22J3E (Shell Mill), 23J2G (END CAP STYLE), 23J2G ASSEMBLY, 23J6G, 25J3H, 25J3H (Shell Mill), 2J1E, 2J4E, 2L1E
AOMT180508R-HS	0.031 R	IN2005, IN2030, IN30M	12J1E (TOP-ON STYLE), 12J1E (V-FLANGE), 12J1E, 12J4E, 22J3E, 22J3E (INNO-FIT STYLE), 22J3E (Shell Mill), 25J3H, 25J3H (Shell Mill), 2J1E, 2J4E, 2L1E
AOMT180516FR-P	0.062 R	IN30M	12J1E (TOP-ON STYLE), 12J1E (V-FLANGE), 12J1E, 12J4E, 22J3E, 22J3E (INNO-FIT STYLE), 22J3E (Shell Mill), 2J1E, 2J4E, 2L1E
AOMT180516R	0.062 R	IN1030, IN2005, IN2015, IN2030, IN2040	12J1E (TOP-ON STYLE), 12J1E (V-FLANGE), 12J1E, 12J4E, 22J3E, 22J3E (INNO-FIT STYLE), 22J3E (Shell Mill), 23J2G (END CAP STYLE), 23J2G ASSEMBLY, 23J6G, 25J3H, 25J3H (Shell Mill), 2J1E, 2J4E, 2L1E
AOMT180516R-HS	0.062 R	IN2005	12J1E (TOP-ON STYLE), 12J1E (V-FLANGE), 12J1E, 12J4E, 22J3E, 22J3E (INNO-FIT STYLE), 22J3E (Shell Mill), 25J3E, 25J3H, 25J3H (Shell Mill), 2J1E, 2J4E, 2L1E
AOMT180524FR-P	0.093 R	IN30M	12J1E (TOP-ON STYLE), 12J1E (V-FLANGE), 12J1E, 12J4E, 22J3E, 22J3E (INNO-FIT STYLE), 22J3E (Shell Mill), 2J1E, 2J4E, 2L1E
AOMT180524R	0.093 R	IN1030, IN2005, IN2040	12J1E (TOP-ON STYLE), 12J1E (V-FLANGE), 12J1E, 12J4E, 22J3E, 22J3E (INNO-FIT STYLE), 22J3E (Shell Mill), 23J2G (END CAP STYLE), 23J2G ASSEMBLY, 23J6G, 25J3H, 25J3H (Shell Mill), 2J1E, 2J4E, 2L1E
AOMT180532FR-P	0.125 R	IN30M	12J1E (TOP-ON STYLE), 12J1E (V-FLANGE), 12J1E, 12J4E, 22J3E, 22J3E (INNO-FIT STYLE), 22J3E (Shell Mill), 2J1E, 2J4E, 2L1E
AOMT180532R	0.125 R	IN1030, IN2005, IN2015, IN2030, IN2040	12J1E (TOP-ON STYLE), 12J1E (V-FLANGE), 12J1E, 12J4E, 22J3E, 22J3E (INNO-FIT STYLE), 22J3E (Shell Mill), 23J2G (END CAP STYLE), 23J2G ASSEMBLY, 23J6G, 25J3H, 25J3H (Shell Mill), 2J1E, 2J4E, 2L1E
AOMT180548R	0.187 R	IN2005	12J1E, 12J4E, 22J3E (V-FLANGE), 2J1E, 2J4E
AOMT180564R	0.250 R	IN1030, IN2005, IN2040	12J1E, 12J4E, 22J3E (V-FLANGE), 2J1E, 2J4E
APKT160408L	0.031 R	IN1030, IN5015	15T, 12T
APKT160408R	0.031 R	IN1030, IN1540, IN2005, IN2015, IN2030, IN2040, IN40P, IN5015, IN6530	12J1B (TOP-ON STYLE), 12J1B (V-FLANGE), 12J1B, 12J4B, 12M1Q, 12N1Q, 12P1Q, 12N1B, 12R1B, 12S1Q, 12S1B, 12V1B (TOP-ON STYLE), 15T, 12T, 22J3Q (SHELL MILL STYLE), 22J5B, 22J3B, 2J1B, 2J4B, 2L1B
BEEW120308R-CR	0.031 Corner rounding	IN2030	15R1V, 15R1V (TOP-ON STYLE)
BEEW120310R-CR	1.0 Corner rounding	IN2030	15R1V, 15R1V (TOP-ON STYLE)
BEEW120316R-CR	0.062 Corner rounding	IN2030, IN2040	15R1V, 15R1V (TOP-ON STYLE)
BEEW120320R-CR	2.0 Corner rounding	IN2030	15R1V, 15R1V (TOP-ON STYLE)
BEEW120325R-CR	0.094 Corner rounding	IN2030	15R1V, 15R1V (TOP-ON STYLE)
BEEW120330R-CR	3.0 Corner rounding	IN2030	15R1V, 15R1V (TOP-ON STYLE)
BEEW120332R-CR	0.125 Corner rounding	IN2030, IN2040	15R1V, 15R1V (TOP-ON STYLE)

INSERTS

Insert Number	Corner Radius	New Grade	Cutter Series
BEHW250304R	0.015 R	IN1540	15J1H, 15M1H, 15N1H
BEHW250304R-P	0.015 R	IN15K	15J1H, 15M1H, 15N1H
BEHW250308R	0.031 R	IN1540	15J1H, 15M1H, 15N1H
BEHW250308R-P	0.031 R	IN15K	15J1H, 15M1H, 15N1H
BEHW250316R	0.062 R	IN1540	15J1H, 15M1H, 15N1H
BEHW250316R-P	0.062 R	IN15K	15J1H, 15M1H, 15N1H
BOCT09T304FR-P	0.015 R	IN10K	12J1P, 12J1P (TOP-ON STYLE), 22J3P, 2J1P
BOCT09T308FR-P	0.031 R	IN10K	12J1P, 12J1P (TOP-ON STYLE), 22J3P, 2J1P
BOCT130404FR-P	0.015 R	IN10K	12J1R
BOMT09T304R	0.015 R	IN2030, IN2505	12J1P, 12J1P (TOP-ON STYLE), 22J3P, 2J1P
BOMT09T308R	0.031 R	IN2030, IN2505	12J1P, 12J1P (TOP-ON STYLE), 22J3P, 2J1P
BOMT09T316R	0.062 R	IN2030, IN2505	12J1P, 12J1P (TOP-ON STYLE), 22J3P, 2J1P
BOMT130404R	0.015 R	IN2030, IN2505	12J1R
BOMT130408R	0.031 R	IN2030, , IN2505	12J1R
BOMT130416R	0.062 R	IN2030, IN2505	12J1R
BOMT130420R	0.078 R	IN2030, IN2505	12J1R
BOMT130424R	0.093 R	IN2030, IN2505	12J1R
BOMT130431R	0.125 R	IN2030, IN2505	12J1R
BOMT130440R	0.156 R	IN2030, IN2505	12J1R
CNHU060310N	1.0 R	IN1030, IN2005, IN2006, IN2040, IN3005	15V, 15V (TOP-ON STYLE)
CNHU110420N	2.0 R	IN1030, IN2005, IN2006, IN2040	15V, 15V (TOP-ON STYLE), 5V6G (SHELL MILL)
DGE314R001	0.031 R	IN2030	1SJ1F, 1SJ1F (TOP-ON STYLE), 2SJ3F, 2SJ3F (Shell Mill), SJ6F, SJ5F
DGE314R002	0.062 R	IN2030	1SJ1F, 1SJ1F (TOP-ON STYLE), 2SJ3F, 2SJ3F (Shell Mill), SJ6F, SJ5F
DGE314R004	0.125 R	IN2030	1SJ1F, 1SJ1F (TOP-ON STYLE), 2SJ3F, 2SJ3F (Shell Mill), SJ6F, SJ5F
DGE324R001	0.031 R	IN2030	2SJ3J (Shell Mill), SJ2J, SJ5J, SJ6J
DGE324R002	0.062 R	IN2030	2SJ3J (Shell Mill), SJ2J, SJ5J, SJ6J
DGE324R004	0.125 R	IN2030	SJ2J, SJ5J, SJ6J
DGE324R045	0.010 R	IN2030	SN6J, SN2J
DGM212R100	0.015 R	IN2005, IN2015, IN2030	1SJ1Y, 1SJ1Y (CHIP SURFER STYLE), 1SJ1Y (TOP-ON STYLE), 2SJ3Y, SJ_Y
DGM212R101	0.031 R	IN2005, IN2015, IN2030	1SJ1Y, 1SJ1Y (CHIP SURFER STYLE), 1SJ1Y (TOP-ON STYLE), 2SJ3Y, SJ_Y
DGM212R103	0.062 R	IN2005, IN2015, IN2030	1SJ1Y, 1SJ1Y (CHIP SURFER STYLE), 1SJ1Y (TOP-ON STYLE), 2SJ3Y, SJ_Y
DGM314R001	0.031 R	IN2005, IN2015, IN2030, IN2040, IN6515	1BW / 2BW, 1SJ1F, 1SJ1F (TOP-ON STYLE), 2SJ3F, 2SJ3F (Shell Mill), SJ6F, SJ5F
DGM314R002	0.062 R	IN2005, IN2015, IN2030, IN2040, IN6515	1SJ1F, 1SJ1F (TOP-ON STYLE), 2SJ3F, 2SJ3F (Shell Mill), SJ6F, SJ5F
DGM314R003	0.093 R	IN2005	1SJ1F, 1SJ1F (TOP-ON STYLE), 2SJ3F, 2SJ3F (Shell Mill), SJ6F, SJ5F
DGM314R004	0.125 R	IN2005, IN2015, IN2030, IN2040, IN6515	1SJ1F, 1SJ1F (TOP-ON STYLE), 2SJ3F, 2SJ3F (Shell Mill), SJ6F, SJ5F
DGM324R001	0.031 R	IN2005, IN2015, IN2030, IN2040, IN6515	1BW / 2BW, 2SJ3J (Shell Mill), SJ2J, SJ5J, SJ6J

Insert Number	Corner Radius	New Grade	Cutter Series
DGM324R002	0.062 R	IN2005, IN2015, IN2030, IN2040, IN6515	2SJ3J (Shell Mill), SJ2J, SJ5J, SJ6J
DGM324R003	0.093 R	IN2005	2SJ3J (Shell Mill), SJ2J, SJ5J, SJ6J
DGM324R004	0.125 R	IN2005, IN2015, IN2030, IN2040, IN6515	SJ2J, SJ5J, SJ6J
DGM324R045	0.010 R	IN2005, IN2015, IN2030, IN2040, IN6515	SN6J, SN2J
DGM324R201	0.031 R	IN2005, IN2015, IN2030, IN2040, IN6515	2SJ3J (Shell Mill), SJ2J, SJ5J, SJ6J
DGM324R202	0.062 R	IN2005, IN2015, IN2030, IN2040, IN6515	2SJ3J (Shell Mill), SJ2J, SJ5J, SJ6J
DNM434L201	0.031 R	IN2005	2SJ1N
DNM434L202	0.062 R	IN2005, IN2030	2SJ1N
DNM434R201	0.031 R	IN2005, IN2015, IN2030, IN2040	2SJ1N, SJ2N
DNM434R202	0.062 R	IN2005, IN2030, IN2040	2SJ1N, SJ2N
DNM434R203	0.093 R	IN2005	2SJ1N, SJ2N
DNM434R204	0.125 R	IN2005	2SJ1N, SJ2N
DNM434R245	-	IN2005, IN2015, IN2030	SN2N
DPM314-001	0.031 R	IN1530, IN2005, IN2015	3SJ6 (AXIAL DRIVE), 3SJ6 (RADIAL DRIVE)
DPM314-002	0.062 R	IN1530, IN2005, IN2015	3SJ6 (AXIAL DRIVE), 3SJ6 (RADIAL DRIVE)
DPM314-003	0.094 R	IN2005	3SJ6 (AXIAL DRIVE), 3SJ6 (RADIAL DRIVE)
DPM314-004	0.125 R	IN1530, IN2005, IN2015	3SJ6 (AXIAL DRIVE), 3SJ6 (RADIAL DRIVE)
DPM324-001	0.031 R	IN1530, IN2005, IN2015	3SJ6 (AXIAL DRIVE), 3SJ6 (RADIAL DRIVE)
DPM324-002	0.062 R	IN2005, IN2015	3SJ6 (AXIAL DRIVE), 3SJ6 (RADIAL DRIVE)
DPM324-003	0.094 R	IN1530, IN2005	3SJ6 (AXIAL DRIVE), 3SJ6 (RADIAL DRIVE)
DPM324-004	0.125 R	IN1530, IN2005, IN2015	3SJ6 (AXIAL DRIVE), 3SJ6 (RADIAL DRIVE)
DPM324L050	0.062 R	IN1530, IN2005	SHU
DPM324L051	0.062 R	IN1530, IN2005, IN2015, IN2030	SP6H, SP6N
DPM324L101	0.125 R	IN1530, IN2005, IN2030	SP6H, SP6N
DPM324R001	0.031 R	IN1530, IN2005, IN2015	2SJ1H, 2SJ1L (SHELL MILL), SJ6H
DPM324R002	0.062 R	IN1530, IN2005	2SJ1H, 2SJ1L (SHELL MILL), SJ6H
DPM424-001	0.031 R	IN2005, IN2015, IN2040	3SJ6 (AXIAL DRIVE), 3SJ6 (RADIAL DRIVE)
DPM424-002	0.062 R	IN2005, IN2015, IN2040	3SJ6 (AXIAL DRIVE), 3SJ6 (RADIAL DRIVE)
DPM424-003	0.094 R	IN2005, IN2015, IN2040	3SJ6 (AXIAL DRIVE), 3SJ6 (RADIAL DRIVE)

INSERTS

Insert Number	Corner Radius	New Grade	Cutter Series
DPM424-004	0.125 R	IN2005, IN2015, IN2040	3SJ6 (AXIAL DRIVE), 3SJ6 (RADIAL DRIVE)
DPM424R001	0.031 R	IN2005, IN2015, IN2040	2SJ1H, 2SJ1L (SHELL MILL)
DPM434L050	0.062 R	IN1530, IN2005	SHU
DPM434L051	0.062 R	IN1530, IN2005, IN2015, IN2030	SP6H, SP6N
DPM434L101	0.200 R	IN1530, IN2005, IN2030	SP6H, SP6N
DPM434R001	0.031 R	IN1530, IN2005, IN2015, IN2030, IN2040	SJ2N, SJ6N
DPM434R002	0.062 R	IN2005, IN2015, IN2040, IN6515, IN1530	SJ2N, SJ6N
DPM434R003	0.093 R	IN1530	SJ2N, SJ6N
DPM434R004	0.125 R	IN1530, IN2005	SJ2N, SJ6N
DPM434R045	-	IN1530, IN2005, IN2015, IN2030, IN2040	SN2N, SN6N
DPM435R045	0.010 R	IN2005, IN2015	SN2N, SN6N
DPM436R001	0.031 R	IN1530, IN2005, IN2015, IN2030, IN2040, IN6515, IN6530	SJ2R
DPM436R002	0.062 R	IN1530, IN2005, IN2015, IN2030, IN2040, IN6515, IN6530	SJ2R
DPM436R003	0.093 R	IN1530, IN2005	SJ2R
DPM436R004	0.125 R	IN1530, IN2005, IN2015, IN2030, IN2040, IN6515, IN6530	SJ2R
DPM436R045	0.010 R	IN1530, IN2005, IN2015, IN2030, IN2040	SN2R
DTM324R001	0.031 R	IN1530, IN2005, IN2015	2SJ1H, 2SJ1L (SHELL MILL)
FEEW250340R-CR	4.0 Corner rounding	IN2030	15R4H, 15R4H (TOP-ON STYLE)
FEEW250348R-CR	0.187 Corner rounding	IN2030	15R4H, 15R4H (TOP-ON STYLE)
FEEW250350R-CR	5.0 Corner rounding	IN2030	15R4H, 15R4H (TOP-ON STYLE)
FEEW250360R-CR	6.0 Corner rounding	IN2030	15R4H, 15R4H (TOP-ON STYLE)
FEEW250364R-CR	0.250 Corner rounding	IN2030	15R4H, 15R4H (TOP-ON STYLE)
GEKT12T3AFTR-WC	0.047 R	IN1030, IN2040, IN2510	15N1H, 5N2H
GOMT060230R	Chamfer 30 deg.	IN1505	MHK SLIP FIT CHAMFER SHANKS
GOMT060245R	Chamfer	IN1505	MHK SLIP FIT CHAMFER SHANKS
GOMT060260R	Chamfer 60 deg.	IN1505	MHK SLIP FIT CHAMFER SHANKS
GOMT080330R	Chamfer 30 deg.	IN1505	MHK SLIP FIT CHAMFER SHANKS

Insert Number	Corner Radius	New Grade	Cutter Series
GOMT080345R	Chamfer	IN1505	MHK SLIP FIT CHAMFER SHANKS
GOMT080360R	Chamfer 60 deg.	IN1505	MHK SLIP FIT CHAMFER SHANKS
GPHG091208R01	0.031 R	IN2005	12W5 (Solid Carbide), 12W9, 12W9 (TOP-ON STYLE)
GPHG121708R01	0.031 R	IN2005	12W5 (Solid Carbide), 12W9, 12W9 (TOP-ON STYLE)
GPHG121716R01	0.062 R	IN2005	12W5 (Solid Carbide), 12W9, 12W9 (TOP-ON STYLE)
GPHG121732R01	0.125 R	IN2005	12W5 (Solid Carbide), 12W9, 12W9 (TOP-ON STYLE)
GPHG152208R01	0.031 R	IN2005	12W5 (Solid Carbide), 12W9, 12W9 (TOP-ON STYLE)
GPHG152216R01	0.062 R	IN2005	12W5 (Solid Carbide), 12W9, 12W9 (TOP-ON STYLE)
GPHG152232R01	0.125 R	IN2005	12W5 (Solid Carbide), 12W9, 12W9 (TOP-ON STYLE)
GPHG192508R01	0.031 R	IN2005	12W5 (Solid Carbide), 12W9, 12W9 (TOP-ON STYLE)
GPHG192516R01	0.062 R	IN2005	12W5 (Solid Carbide), 12W9, 12W9 (TOP-ON STYLE)
GPHG192532R01	0.125 R	IN2005	12W5 (Solid Carbide), 12W9, 12W9 (TOP-ON STYLE)
GPHG252608R01	0.031 R	IN2005	12W9, 12W9 (TOP-ON STYLE)
GPHG252616R01	0.062 R	IN2005	12W9, 12W9 (TOP-ON STYLE)
GPHG252632R01	0.125 R	IN2005	12W9, 12W9 (TOP-ON STYLE)
KOMT050104R	Chamfer	IN2005	YC TAP DRILL/CHAMFER BODIES
NCE324-100	0.031 R	IN70N	5VK6V, VK5V (HI DENSITY), VK6V (COARSE-DENSITY), VK6V (MEDIUM-DENSITY)
NCE324R107	0.031 R	IN70N	VL6V
NCET250400R	0.500 R	IN2005, IN2030	1BW (TOP-ON STYLE), 1BW / 2BW
NDET380700R	0.750 R	IN2005	1BW / 2BW
NDET500800R	1.000 R	IN2005	1BW, 1BW / 2BW
NJE324-100-P	0.031 R	IN15K	5VK6V, VK6V (COARSE-DENSITY), VK6V (MEDIUM-DENSITY)
NKET120200R	0.250 R	IN2005, IN2030	1BW (CHIP-SURFER STYLE), 1BW (TOP-ON STYLE), 1BW / 2BW
NKET180300R	0.375 R	IN2005	1BW (CHIP-SURFER STYLE), 1BW (TOP-ON STYLE), 1BW / 2BW
NNE324-100	0.031 R	IN1530, IN2010, IN2015, IN2030, IN2040, IN6515	5VK6V, VHU, VK5V (HI DENSITY), VK6V (COARSE-DENSITY), VK6V (MEDIUM-DENSITY)
NNE324-102	0.062 R	IN1530, IN2015, IN2030, IN2040, IN6515	5VK6V, VHU, VK5V (HI DENSITY), VK6V (COARSE-DENSITY), VK6V (MEDIUM-DENSITY)
NNE324-104	0.031 Chamfer	IN1530, IN2010, IN2015, IN2040, IN6515	5VK6V, VK5V (HI DENSITY), VK6V (COARSE-DENSITY), VK6V (MEDIUM-DENSITY)
NNE324-108	0.031 R	IN2030, IN2040, IN6515	3VL5V (AXIAL DRIVE), 3VL5V (RADIAL DRIVE)
NNE324-110	-	IN2015, IN2030, IN2040, IN6515	VM6V
NNE324-125	0.125 R	IN2010, IN2030	5VK6V, VHU, VK5V (HI DENSITY), VK6V (COARSE-DENSITY), VK6V (MEDIUM-DENSITY)
NNE324L109	0.031 R	IN2005, IN2015, IN2030, IN2040, IN6515	5VK6V, VK5V (HI DENSITY), VK6V (COARSE-DENSITY), VK6V (MEDIUM-DENSITY)
NNE324R107	0.031 R	IN2005, IN2015, IN2030, IN2030, IN2040, IN6515	VL6V
NNE324R109	0.031 R	IN2005, IN2010, IN2015, IN2030, IN2040, IN6515	5VK6V, VK5V (HI DENSITY), VK6V (COARSE-DENSITY), VK6V (MEDIUM-DENSITY)
NNE425-030	0.005 R	IN2005, IN6510	VM2N
NNET310500R	0.625 R	IN2005	1BW / 2BW
NPHG090300R	0.187 R	IN2005, IN2006	12W5 (Solid Carbide), 12W9, 12W9 (TOP-ON STYLE)
NPHG120400R	0.250 R	IN05S, IN2005, IN2006	12W5 (Solid Carbide), 12W9, 12W9 (TOP-ON STYLE)

INSERTS

Insert Number	Corner Radius	New Grade	Cutter Series
NPHG150400R	0.312 R	IN2005, IN2006	12W5 (Solid Carbide), 12W9, 12W9 (TOP-ON STYLE)
NPHG190400R	0.375 R	IN05S, IN2005, IN2006	12W5 (Solid Carbide), 12W9, 12W9 (TOP-ON STYLE)
NPHG250600R	0.500 R	IN05S, IN2005, IN2006	12W9, 12W9 (TOP-ON STYLE)
NPHG310700R	0.625 R	IN2005	12W9
OELB060416FN	0.060 R	IN2030, IN2040	5N6K
OELB060416N	0.060 R	IN1530, IN1540, IN2030	5N6K
OELH060416N	0.060 R	IN1530, IN2005, IN2030	5N6K
OELH060416-P	0.060 R	IN30M	5N6K
OFCT05T3AFFN-P	0.024 R	K10, IN30M	5N6H
OFCT05T3TN	0.024 R	IN1030, IN2005, IN2040	5N6H
OFCT0705AFFN-P	0.031 R	IN30M	5N6L
OFCT0705AFFR-W	0.031 R	IN1030	5N6L
OFMT05T3AFN-HR	0.024 R	IN1030, IN2005, IN2040, IN30M	5N6H
OFMT0705AFR-HR	0.031 R	IN2030, IN2040, IN30M	5N6L
OFMT0705AFTN	0.031 R	IN1030, IN2005, IN2015	5N6L
OFMW0705AFTN	0.031 R		5N6L
ONCU0505ANEN	0.031 R	, IN2010	ON5H ON6H
ONCU0505ANFN-P	0.031 R	IN10K	ON5H ON6H
ONCU0505ANTN-HR	0.031 R	IN2005, IN2030, IN2505	ON5H ON6H
ONCU0505ANTN-W	0.031 R	IN2505	ON5H ON6H
ONCU090612FN-P	0.047 R	IN10K	OP1N, OP6N
ONCU090612TN-HR	0.047 R	IN2005, IN2030, IN2040	OP1N, OP6N
ONCU090612TN-W	0.047 R	IN2505	OP1N, OP6N
ONCU0906ANFN-WE	0.031 Faceted	IN2004, IN2510, IN6515, IN6515	OP1N, OP6N
OPEN050608TR	0.031 R	IN72N	5J2H
PNCQ0804GNTN	0.030 R	IN2005, IN2030	DM6G, DM5G
PNCQ0804ZNTN	0.180 R	IN2005, IN2030	1DP1G, 1DP1G (TOP ON STYLE), DP5G
PNCT0804ZNN-HR	0.180 R	IN2030, IN2505	1DP1G, 1DP1G (TOP ON STYLE), DP5G
PNCU0805GNFR-HS	0.030 R	IN2030, IN2505	DM6G, DM5G
PNCU0805GNFR-P	0.030 R	IN05S	DM6G, DM5G
PNCU0805GNR	0.030 R	IN70N	DM6G, DM5G
PNCU0805GNTR	0.030 R	INDD15, IN1030, IN2005, IN2015, IN2030	DM6G, DM5G
PNCU0805GNTR-W	0.030 R	INDD15, IN2005, IN2030, IN2505	DM6G, DM5G
PNCU1708GNTR	0.060 R	INDD15, INDD15, IN2005, IN2005, IN2030, IN2030, IN2040, IN2040	DM2Q, DM6Q, DM5Q

Insert Number	Corner Radius	New Grade	Cutter Series
PNCU1708GNTR	0.060 R	INDD15, INDD15, IN2005, IN2005, IN2030, IN2030, IN2040, IN2040	DM2Q, DM6Q, DM5Q
RCHX120400FN-P	0.250 R	IN10K	15B4H, 15B4J (TOP-ON STYLE), 5W6J
RCKX120400TN-M	0.250 R	IN2005, IN2030, IN2505, IN5515	15B4H, 15B4J (TOP-ON STYLE), 5W6J
RCLB120500TN-VL	0.250 R	IN2005, IN2040, IN6530	15B4H, 15B4J (TOP-ON STYLE), 5W6J
RCLB19T600TN-VL	0.375 R	IN2005, IN2040, IN6530	15B4M (Toroid TOP-ON STYLE), 5W6N
RCLT1204M0N-CC1	6.0 R	IN2005, IN2015, IN2030	15E1H, 15E1K (TOP-ON STYLE), 5E6K / 5E6H
RCLT1204M0N-CC2	6.0 R	IN2005, IN2015, IN2030	15E1H, 15E1K (TOP-ON STYLE), 5E6K / 5E6H
RCLT1204M0N-CP	6.0 R	IN05S	15E1H, 15E1K (TOP-ON STYLE), 5E6K / 5E6H
RCLT1204M0TN-PH2	6.0 R	IN2005, IN2015, IN2030, IN2040	15E1H, 15E1K (TOP-ON STYLE), 5E6K / 5E6H
RCLT1606M0N-CC	8.0 R	IN2005, IN2015, IN2030	15E1K (TOP-ON STYLE), 5E6K / 5E6H
RCLT1606M0N-CC1	8.0 R	IN2005, IN2015, IN2030	15E1K (TOP-ON STYLE), 5E6K / 5E6H
RCLT1606M0N-CC2	8.0 R	IN2005, IN2030	15E1K (TOP-ON STYLE), 5E6K / 5E6H
RCLT1606M0N-CP	8.0 R	IN05S	15E1K (TOP-ON STYLE), 5E6K / 5E6H
RCLT1606M0TN-PH	8.0 R	IN2005, IN2015, IN2030	15E1K (TOP-ON STYLE), 5E6K / 5E6H
RCLT1606M0TN-PH2	8.0 R	IN2005, IN2015, IN2040	15E1K (TOP-ON STYLE), 5E6K / 5E6H
RCLT190600N-HR	0.375 R	IN2005, IN2030, IN2040	15B4M (Toroid TOP-ON STYLE), 5W6N
RFMT1404M0N-F	0.275 R	IN1030, IN2040	5N6H
RHHT1003M0FN-P	5.0 R	IN05S	15B1 (TOP-ON STYLE), 5W7
RHHT1204M0FN-P	6.0 R	IN05S	15B1 (TOP-ON STYLE), 5W7
RHHW0602M0TN	3.0 R	IN2004, IN2005, IN2006	15B1 (TOP-ON STYLE)
RHHW0802M0TN	4.0 R	IN2004, IN2005, IN2015	15B1 (TOP-ON STYLE)
RHHW1003M0TN	5.0 R	IN2004, IN2005, IN2006, IN2015, IN2040	15B1 (TOP-ON STYLE), 5W7
RHHW1204M0TN	6.0 R	IN2004, IN2005, IN2006, IN2015, IN2040	15B1 (TOP-ON STYLE), 5W7
RHHW1605M0TN	8.0 R	IN2004, IN2005, IN2015, IN2040	15B1 (TOP-ON STYLE), 5W7
RHKW1003M0TN	5.0 R	IN2005, IN2015, , IN2040	15B1 (TOP-ON STYLE), 5W7
RHKW1204M0TN	6.0 R	IN2004, IN2005, IN2015, IN2040	15B1 (TOP-ON STYLE), 5W7
RHKW1605M0TN	8.0 R	IN2004, IN2005, IN2015, IN2030, IN2040	15B1 (TOP-ON STYLE), 5W7
RHKW2006M0TN	10.0 R	IN2015, IN2030, IN2040	5W7
RNGX45CH	0.250 R	IN72N	DW*H

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Insert Number	Corner Radius	New Grade	Cutter Series
RNLM250600TN	0.500 R	IN1530, IN1540, IN2030, IN40P, IN6530	5W6
RNMA250600N	0.500 R	IN1540, IN40P	5W6
RPCW120400N	0.250 R	IN1530, IN2030	15B1H, 5W6
RPGX43CH	0.250 R	IN72N	1DB1H
RPLB190500FN	0.375 R	IN2030	5W6
RPLB190500TN	0.375 R	IN1530, IN2030, IN6530	5W6
RPLB250700FN	0.500 R	IN2030, IN2040	5W6S
RPLB250700TN-VL	0.500 R	IN2030, IN2040, IN6530	5W6S
RPLB250700TN-VL1	0.500 R	IN2030, IN2040	15W4S (Toroid), 5W6 (Toroid)
RPLH190500TN	0.375 R	IN1530, IN1540, IN2030, IN2040, IN40P, IN6530	5W6
RPLT090400N	0.187 R	IN1530, IN1540, IN2030, IN6530	15B1F
RPLT120400TN	0.250 R	IN1530, IN1540, IN2030, IN2040, IN40P, IN6530	15B1H, 5W6
RPLW120400FN	0.250 R	IN2030	15B1H, 5W6
RPLW120400TN	0.250 R	IN1530, IN2030, IN6530	15B1H, 5W6
SCLT050204N	0.016 R	IN2010	INDEXABLE DRILLS 5
SCLT050204N-PH	0.015 R	IN1030, IN2005, IN6520	INDEXABLE DRILLS 5
SDCT080305FN-P	0.020 R	IN30M	15J1E, 15N1E (TOP-ON STYLE), 15N1E, 15P1E, 25J3E, 25J3E (INNO-FIT), 35J6E, 5J1E
SDE-31-001	0.006 Chamfer 20 deg.	IN1030, IN30M	38L5 (AXIAL DRIVE), 38L5 (RADIAL DRIVE)
SDE-31-002	0.006 Chamfer 20 deg.	IN1030, IN2040	38L5 (AXIAL DRIVE), 38L5 (RADIAL DRIVE)
SDE-42-001	0.012 Chamfer 17 deg.	IN1030, IN15K	38L5 (AXIAL DRIVE), 38L5 (RADIAL DRIVE)
SDE-42-002	0.012 Chamfer 17 deg.	IN1030	38L5 (AXIAL DRIVE), 38L5 (RADIAL DRIVE)
SDE-42-003	0.012 Chamfer 17 deg.	IN1030	38L5 (AXIAL DRIVE), 38L5 (RADIAL DRIVE)
SDGT07T308-HP	0.030 R	IN10K	INDEXABLE DRILLS 2
SDGT140512-HP	0.047 R	IN10K	INDEXABLE DRILLS 2
SDLT07T308N-PH	0.030 R	IN2005	15C
SDLT07T308N-PS	0.030 R	IN1030, IN2005, IN6515	15C
SDMT080305N	0.020 R	IN1030, IN2005, IN2015, IN2030, IN2040	15J1E, 15N1E (TOP-ON STYLE), 15N1E, 15P1E, 25J3E, 25J3E (INNO-FIT), 35J6E, 5J1E
SDMT080308N	0.031 R	IN1530	15J1E, 15N1E (TOP-ON STYLE), 15N1E, 15P1E, 25J3E, 25J3E (INNO-FIT), 35J6E, 5J1E
SDMT080316N	0.062 R	IN1530	15J1E, 15N1E (TOP-ON STYLE), 15N1E, 15P1E, 25J3E, 25J3E (INNO-FIT), 35J6E, 5J1E
SDMT120608R	0.031 R	IN1030, IN2005, IN2015, IN5015	25J3H, 25J3H (Shell Mill), 5J1H
SDMT120608R-HS	0.031 R	IN2005, IN2030	25J3H, 25J3H (Shell Mill), 5J1H
SDMW080305TN	0.020 R	IN1030, IN2005, IN2015, IN2030	15J1E, 15N1E (TOP-ON STYLE), 15N1E, 15P1E, 25J3E, 25J3E (INNO-FIT), 35J6E, 5J1E

Insert Number	Corner Radius	New Grade	Cutter Series
SDMW080305TN-W	0.020 R	IN2005, IN2015	15J1E, 5J1E
SDMW080308TN	0.031 R	IN1530	15J1E, 15N1E (TOP-ON STYLE), 15N1E, 15P1E, 25J3E, 25J3E (INNO-FIT), 35J6E, 5J1E
SECT09T3AFFN-P	0.015 R	IN30M	15N1F_R00, 5N6F
SEKT09T3AFN	0.015 R	IN1030, IN2005, IN2030, IN2040	15N1F_R00, 5N6F
SEKT12T3AFTN-M	0.043 R	IN1030, IN2005, IN2510, IN2540, IN40P	15N1H, 5N2H
SELW100403N	0.010 R	IN1530	FAK (QUAD INSERT)
SHEH1504AEN-P	0.020 R	IN15K	5N6R
SHEH1504AETN1-P	0.020 R	IN2005	5N6R
SHET110502FR-P	0.008 R	IN15K	15U1G, 15U1G (TOP-ON STYLE), 5H6G
SHET110505FR-P	0.020 R	IN15K	15U1G, 15U1G (TOP-ON STYLE), 5H6G
SHET110508FR-P	0.031 R	IN15K	15U1G, 15U1G (TOP-ON STYLE), 5H6G
SHET110516FR-P	0.062 R	IN15K	15U1G, 15U1G (TOP-ON STYLE), 5H6G
SHET110524FN-P	0.093 R	IN15K	15U1G, 15U1G (TOP-ON STYLE), 5H6G
SHET110532FN-P	0.125 R	IN15K	15U1G, 15U1G (TOP-ON STYLE), 5H6G
SHET1504AJTN	0.031 R	IN1530, IN2005, IN2010, IN2040	5N6R
SHEW1504AJTN	0.031 R	IN2040, IN2015	5N6R
SHLT090308N-HR	0.031 R	IN1030, IN2005, IN30M	15L1G, 15M1G, 15N1F, 15N1G, 15W7V, 25W1V, 25J3F, 25J3G
SHLT090408N-FS	0.031 R	IN1030, IN2005, IN6515	15S, 15T, 12T, DHU (TOP-ON STYLE)
SHLT090416N-FS	0.062 R	IN1530	15S, DHU (TOP-ON STYLE)
SHLT110408N-FS	0.031 R	IN1030, IN2005, IN6515	15C, 15S, DHU (TOP-ON STYLE)
SHLT110408N-PH	0.030 R	IN2005	15C, 15S
SHLT110408TN-HR	0.031 R	IN1030, IN2005, IN30M, IN40P, IN6530	15C, 15L1G, 15M1G, 15N1F, 15N1G, 15S, 15W7V, 25W1V, 23J2G (END CAP STYLE), 23J2G ASSEMBLY, 23J2G BODY, 23J6G, 25J3F, 25J3G, 25J3G, 25J3J (SHELL MILL), DHU (TOP-ON STYLE)
SHLT110416N-FS	0.062 R	IN1030	15C, 15S, DHU (TOP-ON STYLE)
SHLT140508N-FS	0.031 R	IN1030, IN2005, IN6515	15C, 15S, DHU
SHLT140508N-PH	0.030 R	IN2005	15C, 15S
SHLT140508TN-HR	0.031 R	IN1030, IN2005, IN30M, IN40P, IN6530	15C, 15S, 25J3G, 25J3J (SHELL MILL), 25J3J (END CAP STYLE), 25J3J BODY, 25J3J END CAP, DHU
SHLT140516N-FS	0.062 R	IN1030, IN2005, IN6515	15C, 15S, DHU
SHLT140516TN-HR	0.062 R	IN1530, IN2005	25J3G, 25J3J (SHELL MILL), DHU
SHLT140532N-FS	0.125 R	IN2005	DHU
SHLT1405APTN-HR	0.010 R	IN1030, IN40P, IN6530	5N6J
SNED120420	0.078 R	IN2010	DJ1H
SNED1204ANR-DT	0.040 Chamfer	IN80B	DJ1H
SNES1204ANN	0.080 Chamfer	IN2010	DJ1H
SNEV1204ANN-PH	0.080 Chamfer	IN2505	DJ1H
SNGS1205ANN-W	0.015 R	IN2010, IN2505, IN62C	DN6H DN5H
SNGU1205EFN-P	0.093 R	IN10K	DL6H DL5H, DN6H DN5H
SNGU1205ENN	0.093 R	INDD15, IN2030, , IN2505, IN2510	DL6H DL5H, DN6H DN5H

INSERTS

Insert Number	Corner Radius	New Grade	Cutter Series
SNGU130604N	0.015 R	IN2010, IN2030, IN2505	DJ6T, DJ5T
SNGU130608TN	0.031 R	INDD15, IN2010, IN2030, IN2505, IN2540	DJ6T, DJ5T
SNGU130616N	0.062 R	INDD15, IN2030, IN2505, IN2540	DJ6T, DJ5T
SNGU1306ANTN	0.031 Chamfer 45 deg.	INDD15, IN2010	DJ6T, DJ5T
SPEN120608TN	0.031 R	IN70N	5J2H
SPEN120611TR-W	0.031 R	IN70N	5J2H
SPEN1206MPTN	0.096 Faceted	IN70N	5J2H
SPEN1206MPTR-W	0.096 Faceted	IN70N	5J2H
SPLT060204R	0.015 R	IN1030, IN1040, IN30M	15C, 15S, 15T, 12T
SPLT060204R-DM04	0.015 R	IN1030	15C, 15S
SPLT07T308N-PH	0.030 R	IN1030, IN2005, IN6520	DHU (TOP-ON STYLE), INDEXABLE DRILLS 2
TNGU2207PNTN	0.093 R	IN2030, IN2505, IN2510	DJ6H, DJ5H
UHLD08T310R-M	0.118 R	IN2005, IN2030, IN2505	15V1E, 15V1H, 5V6E, 5V6H
UHLD130515R-MM	0.118 R	IN2005, IN2030, IN2040, IN2505, IN2540	15V1E, 15V1H, 5V6E, 5V6H
UNEU1205R	0.118 R	IN2030, IN2505, IN2540, IN6530	1DG1H, DG6H
UNEU1205R	0.118 R	IN2030, IN2505, IN2540, IN6530	1DG1H (TOP-ON STYLE), 4W2A
UNLU0603M0TR	0.078 R	IN2030, , IN2505, IN6530	1TG1F, 1TG1F (TOP-ON STYLE), TG1F
UOMT0602TR	0.040 R	IN2030, IN2505	12J1D, 12J1D (CHIP-SURFER STYLE), 12J1D (STRAIGHT SHANK), 12J1D (TOP-ON STYLE), 2J1D
XEET250408R-P	0.031 R	IN15K	15X1X, 15X1X (TOP-ON STYLE), 5X6X
XEET250408R-PWRWK	0.031 R	IN15K	15X1X, 15X1X (TOP-ON STYLE), 5X6X
XEET25040XR-P	0.031 R	IN15K	15X1X
XEET250416R-P	0.062 R	IN15K	15X1X, 15X1X (TOP-ON STYLE), 5X6X
XEET250424R-P	0.093 R	IN15K	15X1X, 15X1X (TOP-ON STYLE), 5X6X
XEET250432R-P	0.125 R	IN15K	15X1X, 15X1X (TOP-ON STYLE), 5X6X
XEEW250308R-P	0.031 R		15X1W_XEET2503
XEEW250332R-P	0.125 R	IN15K	15X1W_XEET2503
XFEB330504R-P	0.020 (.5mm) R	IN15K	15X1Z, 5X6Z
XFEB330508R-P	0.031 R	IN15K	15X1Z, 5X6Z
XFEB330508R-PW	0.031 R	IN15K	15X1Z, 5X6Z
XFEB330516R-P	0.062 R	IN15K	15X1Z, 5X6Z
XFEB330516R-PW	0.062 R	IN15K	15X1Z, 5X6Z
XFEB330532R-P	0.125 R	IN15K	15X1Z, 5X6Z
XFEB330550L-P	0.197 (5mm) R	IN15K	15X1Z, 5X6Z
XFEB330550R-P	0.197 (5mm) R	IN15K	15X1Z, 5X6Z
XFEB330564R-P	0.250 R	IN15K	15X1Z, 5X6Z
XPET140405FR-P	0.020 R	IN15K	15X1W, 15X1W (HSK ADAPTION), 15X1W (TOP-ON STYLE), 5X6W
XPET140408FR-P	0.031 R	IN15K	15X1W, 15X1W (HSK ADAPTION), 15X1W (TOP-ON STYLE), 5X6W

Insert Number	Corner Radius	New Grade	Cutter Series
XPET140408FR-PW	0.031 Wiper w/ Radius	IN15K	15X1W, 15X1W (HSK ADAPTION), 15X1W (TOP-ON STYLE), 5X6W
XPET140416FR-P	0.062 R	IN15K	15X1W, 15X1W (HSK ADAPTION), 15X1W (TOP-ON STYLE), 5X6W
XPET140424FR-P	0.093 R	IN15K	15X1W, 15X1W (HSK ADAPTION), 15X1W (TOP-ON STYLE), 5X6W
XPET140432FR-P	0.125 R	IN15K	15X1W, 15X1W (HSK ADAPTION), 15X1W (TOP-ON STYLE), 5X6W
YNE324-100	0.031 R	IN2015, IN2030, IN2040, IN6515	5VK6V, VK5V (HI DENSITY), VK6V (COARSE-DENSITY), VK6V (MEDIUM-DENSITY)
YXM324L001	0.031 R	IN1505, IN1510, IN1540	SF6H, SF6N
YXM434L001	0.031 R	IN1505, IN1510, IN1540	SF6H, SF6N

INSERT SCREW DATA

New Screw Number	Old Screw Number	Drive Size/Style	Thread	Torque			Torx¨ Drivers/w Interchangeable Bits		
				Overall Length	Setting in. lbs.	Standard Driver	Manual Handle	Preset Torque	Torx Bit
SA060-01	SA04-42	3mm hex	M6 x 1.0	.394	n/a	DS-H03T			
SA-06-37	SA06-37	3/16 hex	3/8-24 UNF	.500	n/a				
SB080-01	WS8	5mm hex			n/a	DS-H05T			
SB080-02	WS8S	5mm hex			n/a	DS-H05T			
SB080-03	D-M8	8mm hex			n/a				
SC-04-17	SC04-17	1/8 hex	1/4-28 UNF	.875	40-45				
SE-03-26	SE03-26	1/8 hex	10-32 UNF	.625	n/a				
SE-03-65	SE03-65	3mm hex	M5 x .8	.630	n/a	DS-H03T			
SE-04-09	SE04-09	5/32 hex	1/4-28 UNF	1.000	n/a				
SE05-031-00	SE02-45	Tx-10	5-40 UNC	.322	20-25	DS-T10T	DS-A00S	DTQ-27W	DS-T10QB
SE06-024-00	SE02-05	Tx-15	6-32 UNC	.241	25-30	DS-T15T	DS-A00S	DT-29-01	DS-T15B
SE06-028-00	SE02-02	Tx-15	6-32 UNC	.280	25-30	DS-T15T	DS-A00S	DT-29-01	DS-T15B
SE06-030-00	SE02-18	Tx-15	6-32 UNC	.300	25-30	DS-T15T	DS-A00S	DT-29-01	DS-T15B
SE06-037-00	SE02-04	Tx-15	6-32 UNC	.360	25-30	DS-T15T	DS-A00S	DT-29-01	DS-T15B
SE06-038-10	SE02-23	3/32 hex	6-32 UNC	.375	n/a				
SE06-042-00	SE02-11	Tx-15	6-32 UNC	.430	25-30	DS-T15T	DS-A00S	DT-29-01	DS-T15B
SE08-051-00	SE02-65	Tx-15	8-32 UNC	.522	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SE10-061-00	SE03-10	Tx-15	10-32 UNF	.610	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SE10-046-00	SE03-12	Tx-15	10-32 UNF	.460	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SE10-049-00	SE03-23	Tx-15	10-32 UNF	.500	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SE25-063-10	SE04-13	Tx-25	1/4 x 28 NF	.610	40-45	DS-T25T	DS-A00S	DT-40-01	DS-T25B
SF050-01	SF03-11	Tx-15	M5 x .8	.417	53-58	DS-T15T	DS-A00S		DS-T15B
SF060-01	SF03-12	Tx-20	M6 x 1.0	.535	65-70	DS-T20T	DS-A00S		DS-T20B
SF080-01	SF05-15	Tx-25	M8 x 1.25	.661	105-110	DS-T25T	DS-A00S		DS-T25B
SF080-02	SF05-16	Tx-25	M8 x 1.25	.820	105-110	DS-T25T	DS-A00S		DS-T25B
SM18-041-00	SM18-041-00	Tx-6IP	M1.8 x .35	.161	5	DS-TP06S		DTN005S	DS-TP06TB
SM22-052-00	SE01-16	Tx-07	M2.2 x .45	.205	7.5-8.5	DS-T07F	DS-A00S	DTQ-08W	DS-T07QB
SM25-049-00	SM25-05	Tx-08	M2.5 x .45	.191	9-11.5	DS-T08W	DS-A00S	DTQ-11W	DS-T08QB
SM25-052-80		Tx-06	M2.5 x 45	.204	5	DS-T06F		DTQ-05W	DS-T06QB
SM25-054-00	SE01-17	Tx-08	M2.5 x .45	.211	9-11.5	DS-T08W	DS-A00S	DTQ-11W	DS-T08QB
SM25-055-10	SE01-18	Tx-08	M2.5 x .45	.217	9-11.5	DS-T08W	DS-A00S	DTQ-11W	DS-T08QB
SM25-064-00	HZT.0001	Tx-08	M2.5 x .45	.250	9-11.5	DS-T08W	DS-A00S	DTQ-11W	DS-T08QB
SM25-072-30	SE01-21	Tx-07	M2.5 x .45	.287	7.5-8.5	DS-T07F	DS-A00S	DTQ-08W	DS-T07QB
SM25-075-20	TS25075I/HG	Tx-08	M2.5 x .45	.295	9-11.5	DS-T08W	DS-A00S	DTQ-11W	DS-T08QB
SM25-075-60	TS25A075I/HG	Tx-08	M2.5 x .45	.295	9-11.5	DS-T08W	DS-A00S	DTQ-11W	DS-T08QB
SM30-053-00	SM31-06	Tx-09	M3 x .5	.209	13-18	DS-T09W	DS-A00S	DTQ-18W	DS-T09QB
SM30-065-00	SE02-79	Tx-09	M3 x .5	.256	13-18	DS-T09W	DS-A00S	DTQ-18W	DS-T09QB
SM30-074-21		Tx-08	M3 x .5	.293	13-18	DS-T08W	DS-A00S	DTQ-18W	DS-T08QB
SM30-080-10		Tx-09	M3 x .5	.315	13-18	DS-T09W	DS-A00S	DTQ-18W	DS-T09QB
SM30-082-00	HZT.0028	Tx-09	M3 x .5	.323	13-18	DS-T09W	DS-A00S	DTQ-18W	DS-T09QB
SM30-082-B0	TS30F100	Tx-10IP	M3 x .5	.327	13-18	TD-10P			
SM30-082-21		Tx-08	M3 x .5	.323	13-18	DS-T08W	DS-A00S	DTQ-18W	DS-T08QB
SM35-034-50	HZT.0021	Tx-09	M3.5 x .6	.134	13-18	DS-T09W	DS-A00S	DTQ-18W	DS-T09QB
SM35-042-50	HZT.0022	Tx-09	M3.5 x .6	.165	13-18	DS-T09W	DS-A00S	DTQ-18W	DS-T09QB
SM35-076-10		Tx 10	M3.5 x .6	.300	25-30	DS-T10T	DS-A00S	DTQ-27W	DS-T10QB
SM35-088-10	HZT.0003	Tx-10	M3.5 x .6	.346	25-30	DS-T10T	DS-A00S	DTQ-27W	DS-T10QB
SM35-089-00	SE02-B2	Tx-15	M3.5 x .6	.350	25-30	DS-T15T	DS-A00S	DTQ-27W	DS-T15B
SM35-090-40	SE02-A8	Tx-10	M3.5 x .6	.354	18-22	DS-T10T	DS-A00S	DTQ-18W	DS-T10QB

INSERT SCREW DATA

New Screw Number	Old Screw Number	Drive Size/Style	Thread	Overall Length	Torque Setting in. lbs.	Standard Driver	Torx™ Drivers/w Interchangeable Bits Manual Handle	Preset Torque	Torx Bit
SM35-097-00	SE02-C3	Tx-15	M3.5 x .6	.380	25-30	DS-T15T	DS-A00S	DTQ-27W	DS-T15B
SM35-110-00	SE02-63	Tx-15	M3.5 x .6	.433	25-30	DS-T15T	DS-A00S	DTQ-27W	DS-T15B
SM35-114-H0		Tx-15	M3.5 x .6	.449	25-30	DS-T15T	DS-A00S	DTQ-27W	DS-T15B
SM40-050-50	HZT.0023	Tx-15	M4 x .7	.197	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SM40-060-50	HZT.0024	Tx-15	M4 x .7	.236	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SM40-070-00	SM40-07	Tx-15	M4 x .7	.276	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SM40-080-00	SM40-08D	Tx-15	M4 x .7	.315	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SM40-080-10	SM41-09	Tx-15	M4 x .7	.315	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SM40-080-30	SE02-B3	Tx-15	M4 x .7	.315	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SM40-084-20	SE02-B7	Tx-15	M4 x .7	.337	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SM40-090-00	SE02-55	Tx-15	M4 x .7	.354	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SM40-093-20	SE02-82	Tx-15	M4 x .7	.354	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SM40-100-10		Tx-15	M4 x .7	.394	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SM40-100-R0		Tx-15	M4 x .7	.394	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SM40-106-B0	TS40F120	Tx-15IP	M4 x .7	.470	25-30	TD-15P		DT-35-02	
SM40-110-00	SE02-78	Tx-15	M4 x .7	.433	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SM40-120-00	SE02-75	Tx-15	M4 x 7	.472	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SM40-120-20	SE02-81	Tx-15	M4 x 7	.472	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SM40-120-40	SE02-A9	Tx-15	M4 x .7	.472	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SM40-130-00	SE02-83	Tx-15	M4 x .7	.512	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SM40-143-H0		Tx-15	M4 x .7	.561	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SM45-120-R0	TS45120I	Tx-20	M4.5 x .75	.472	35-40	DS-T20T	DS-A00S	DT-40-01	DS-T20B
SM50-096-20	SE03-68	Tx-20	M5 x .8	.377	40-45	DS-T20T	DS-A00S	DT-40-01	DS-T20B
SM50-100-00	SM50-10B	Tx-20	M5 x .8	.393	35-40	DS-T20T	DS-A00S	DT-40-01	DS-T20B
SM50-100-10	SE03-79	Tx-20	M5 x .8	.393	40-45	DS-T20T	DS-A00S	DT-40-01	DS-T20B
SM50-105-10	SM52-10	Tx-20	M5 x .8	.240	40-45	DS-T20T	DS-A00S	DT-40-01	DS-T20B
SM50-120-00	SE03-58	Tx-15	M5 x .8	.472	30-35	DS-T15T	DS-A00S	DT-35-02	DS-T15B
SM50-120-10	SM52-12	Tx-20	M5 x .8	.472	40-45	DS-T20T	DS-A00S	DT-40-01	DS-T20B
SM50-120-30	HZT.0026	Tx-20	M5 x .8	.472	40-45	DS-T20T	DS-A00S	DT-40-01	DS-T20B
SM50-127-10	SE03-72	Tx-20	M5 x .8	.500	40-45	DS-T20T	DS-A00S	DT-40-01	DS-T20B
SM50-130-R0		Tx-20	M5 x .8	.512	40-45	DS-T20T	DS-A00S	DT-40-01	DS-T20B
SM50-138-B0	TS50F160	3mm hex	M5 x .8	.630	40-45	L-W3		DT-40-01	
SM50-150-40	SE03-80	Tx-20	M5 x .8	.591	40-45	DS-T20T	DS-A00S	DT-40-01	DS-T20B
SM50-160-10	SE03-70	Tx-20	M5 x .8	.625	40-45	DS-T20T	DS-A00S	DT-40-01	DS-T20B
SM50-190-00	SM50-19	Tx-20	M5 x .8	.748	40-45	DS-T20T	DS-A00S	DT-40-01	DS-T20B
SM50-190-10	SM52-19	Tx-20	M5 x .8	.748	40-45	DS-T20T	DS-A00S	DT-40-01	DS-T20B
SM50-200-40	SE03-81	Tx-20	M5 x .8	.787	40-45	DS-T20T	DS-A00S	DT-40-01	DS-T20B
SM60-093-S0	TS6040093S	4mm hex	M6 x 1.0	.366	40-45	DS-H40T		DT-40-01	
SM60-150-00	-	Tx-25	M6 x 1.0	.591	72-77	DS-T25T	DS-A00S		DS-T25B
SM60-127-00		Tx-25	M6 x 1.0	.500	72-77	DS-T25T	DS-A00S		DS-T25B
SM60-165-B0	TS60F200	4mm hex	M6 x 1.0		50-55	L-W4			
SM60-180-00		Tx-25	M6 x 1.0	.709	50-55	DS-T25T	DS-A00S		DS-T25B
SM60-220-40	SE03-88	4mm hex	M6 x 1.0	.866	72-77	DS-H04T			
SM70-210-B0	TS70F250	4mm hex	M7	.827	80-85	L-W4			
SM80-250-B0	TS80F300	4mm hex	M8 x 1.25	.985	95-100	L-W4			
STC-35	STC-35	1/8 hex	(2) 1/4-28 UNF	.781	75				

STANDARD RETENTION BOLT DATA CHART

New Bolt Number	Old Bolt Number	Drive Size/Style	Thread	Head Diameter	Standard Length
SD-04-85	SD04-85	3/16 hex	1/4-28 UNF	3/8	.875
SD-06-46	SD06-46	5/16 hex	3/8-24 UNF	9/16	1.00
SD-06-47	SD06-47	5/16 hex	3/8-24 UNF	9/16	1.25
SD-06-48	SD06-48	5/16 hex	3/8-24 UNF	9/16	1.50
SD-06-49	SD06-49	5/16 hex	3/8-24 UNF	9/16	1.75
***SD-06-89**	SD06-89-	5/16 hex	3/8-24 UNF	9/16	1.00
SD-07-13	SD07-13	10mm hex	M12 x 1.75	18mm	2.17
SD012-40	SD08-21	10mm hex	M12 x 1.75	18mm	1.57
SD-08-46	SD08-46	3/8 hex	1/2-20 UNF	3/4	1.00
SD-08-47	SD08-47	3/8 hex	1/2-20 UNF	3/4	1.25
SD-08-48	SD08-48	3/8 hex	1/2-20 UNF	3/4	1.50
SD-08-52	SD08-52	3/8 hex	1/2-20 UNF	3/4	2.50
***SD-08-92**	SD08-92-	3/8 hex	1/2-20 UNF	3/4	1.00
SD-08LA2	SD08LA2	1/2 hex	1/2-13 UNC-LH	3/4	5.75
SD-10-46	SD10-46	1/2 hex	5/8-18 UNF	15/16	1.00
SD-10-47	SD10-47	1/2 hex	5/8-18 UNF	15/16	1.25
SD10-48	SD10-48	1/2 hex	5/8-18 UNF	15/16	1.50
SD-10-51	SD10-51	1/2 hex	5/8-18 UNF	15/16	2.25
SD-10-54	SD10-54	1/2 hex	5/8-18 UNF	15/16	3.00
***SD-10-99**	SD10-99-	1/2 hex	5/8-18 UNF	15/16	1.25
SD-12-82	SD12-82-	5/8 hex	3/4-16 UNF	1-1/8	1.50
***SD-12-99**	SD12-99-	5/8 hex	3/4-16 UNF	1-1/8	1.50
***CZ-0097**		1/2 hex	3/4-16 UNF	2-1/4	2.00

***Equipped with coolant through.**

STANDARD SCREW DRIVER CHART

Drive Size/Style	Standard Driver		Manual Handle		Torx Bit	
	New Part No.	Old Part No.	NewPart No.	Old Part No.	New Part No.	Old Part No.
Tx-61P	DS-TP06	-	-	-	–	–
Tx-06	DS-T06F	DS-0038	DS-A00S	DS-0017	–	–
Tx-07	DS-T07F	DS-0036	DS-A00S	DS-0017	DS-T07B	DS-0028
Tx-08	DS-T08W	DS-0020	DS-A00S	DS-0017	DS-T08B	DS-0021
Tx-09	DS-T09W	DS-0022	DS-A00S	DS-0017	DS-T09B	DS-0029
Tx-10	DS-T10T	DS-0013	DS-A00S	DS-0017	DS-T10B	DS-0004
Tx-101P	TD-10P	-	-	-	-	-
Tx-15	DS-T15T	DS-0010	DS-A00S	DS-0017	DS-T15B	DS-0003
Tx-20	DS-T20T	DS-0034	DS-A00S	DS-0017	DS-T20B	DS-0035
Tx-25	DS-T25T	DS-0037	DS-A00S	DS-0017	DS-T25B	DS-0030
Tx-30	DS-T30T	–	–	–	DS-T30B	–
Tx-40	DS-T40T	–	–	–	DS-T40B	–
Tx-50	DS-T50L	–	–	–	DS-T50B	–
2mm hex	–	WS-0014	–	–	–	–
3mm hex	DS-H03T	DS-0033	–	–	–	–
4mm hex	DS-H04T	DS-0039	–	–	–	–
5mm hex	DS-H05T	WS-0023	–	–	–	–
6mm hex	–	WS-0024	–	–	–	–
1/8 hex	–	WS-0022	–	–	–	–

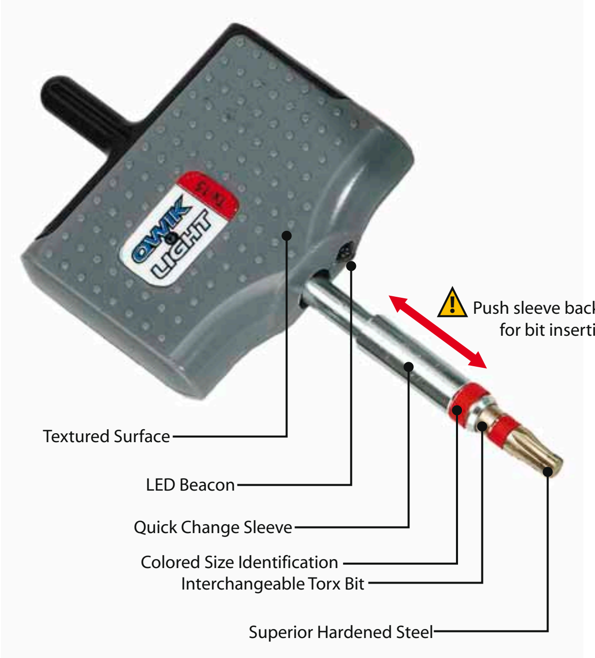
QWIKLIGHT™

QUICK CHANGE TORQUE DRIVER SYSTEM WITH BRIGHT LED DISPLAY.

Ingersoll brings a high tech and economical solution that will ensure your tooling screws are clamped to the correct torque value. An LED beacon shines brightly when the required clamping torque is reached.

FEATURES:

- Torque accuracy is +/- 6% to prolong the life of your locking screws.
- Interchangeable bit system for versatility of size/torque.
- Color coded Torx® driver and bit system.
- Long life battery needs no replacement.
- Hardened Steel Bits for long life.
- Qwik change bits.



Operating Instructions:
- Turn key clockwise. When reaching the required torque, the LED light will be activated.
- Operation temperature: 18-28°C, 64.4-82.4°F

Service:
- Keep the QwikLight clean and dry, without lubrication.

FULL RANGE OF COLOR CODED DRIVERS AND TIPS:

Torx® Size	Torque N•m	(Inch lbs.)	Torx® Size Color Identification
TX-06	0.60	(5.3)	White
TX-07	0.90	(8.0)	Black
TX-08	1.20	(10.6)	Green
TX-09	1.40	(12.4)	Blue
TX-10	2.00	(17.7)	Yellow
TX-15	3.00	(26.6)	Red

STOCK ITEMS:

Item Number	Description	Part Number	Torque	Color
7011852	Qwik-Light Driver	DTQ-05W	5.3 in. lbs.	White
7011853	Qwik-Light Driver	DTQ-08W	8.0 in. lbs.	Black
7011854	Qwik-Light Driver	DTQ-11W	10.6 in. lbs.	Green
7011855	Qwik-Light Driver	DTQ-13W	12.4 in. lbs.	Blue
7011856	Qwik-Light Driver	DTQ-18W	17.7 in. lbs.	Yellow
7011857	Qwik-Light Driver	DTQ-27W	26.6 in. lbs.	Red

Item Number	Description	Part Number	Torque	Color
7011858	Qwik-Light Driver w/ TX-6 Bit	DTQ-05WK	5.3 in. lbs.	White
7011859	Qwik-Light Driver w/ TX-7 Bit	DTQ-08WK	8.0 in. lbs.	Black
7011860	Qwik-Light Driver w/ TX-8 Bit	DTQ-11WK	10.6 in. lbs.	Green
7011861	Qwik-Light Driver w/ TX-9 Bit	DTQ-13WK	12.4 in. lbs.	Blue
7011862	Qwik-Light Driver w/ TX-10 Bit	DTQ-18WK	17.7 in. lbs.	Yellow
7011863	Qwik-Light Driver w/ TX-15 Bit	DTQ-27WK	26.6 in. lbs.	Red

Item Number	Description	Part Number	Color
7011870	5 PAK of Qwik-Light TX-6 Bits	DS-T06QB 5pc	White
7011872	5 PAK of Qwik-Light TX-7 Bits	DS-T07QB 5pc	Black
7011874	5 PAK of Qwik-Light TX-8 Bits	DS-T08QB 5pc	Green
7011876	5 PAK of Qwik-Light TX-9 Bits	DS-T09QB 5pc	Blue
7011878	5 PAK of Qwik-Light TX-10 Bits	DS-T10QB 5pc	Yellow
7011880	5 PAK of Qwik-Light TX-15 Bits	DS-T15QB 5pc	Red

Item Number	Description	Part Number	Color
7011871	10 PAK of Qwik-Light TX-6 Bits	DS-T06QB 10pc	White
7011873	10 PAK of Qwik-Light TX-7 Bits	DS-T07QB 10pc	Black
7011875	10 PAK of Qwik-Light TX-8 Bits	DS-T08QB 10pc	Green
7011877	10 PAK of Qwik-Light TX-9 Bits	DS-T09QB 10pc	Blue
7011879	10 PAK of Qwik-Light TX-10 Bits	DS-T10QB 10pc	Yellow
7011881	10 PAK of Qwik-Light TX-15 Bits	DS-T15QB 10pc	Red

QWIK TORQUE™

TORQUE DRIVERS THAT "CAM-OUT" FOR THE UTMOST IN ACCURACY AND PROTECTION.

FEATURES:

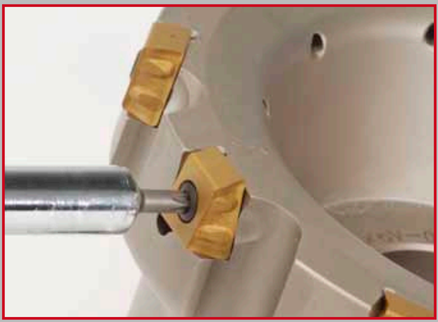
- Qwik Change Bits.
- Comfortable Grip Rubberized Handles.
- Steel Bits are Hardened for Long Life.
- DT-35 and DT-40 Drivers for higher torque requirements with TX-15 and TX-20 screws.

DRIVERS:

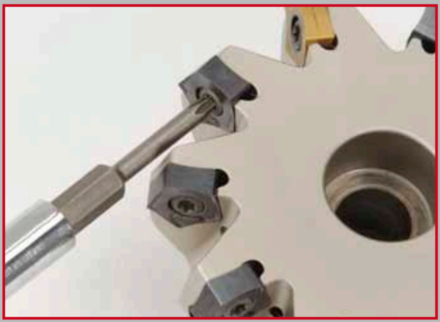
Item Number	Description	Part Number	Torque
7011223	Torque Driver Handle	DTN005S	5in. lbs
7018948	Torque Driver Handle	DT-35-02	35in. lbs.
7011847	Torque Driver Handle	DT-40-01	40in. lbs.

INTERCHANGEABLE BITS:

Item Number	Description	Part Number
7011224	TX Plus 06 Bit	DS-TP06TB
7000078	TX 15 Bit (1/4" Hex Shank)	DS-T15B
7011883	TX 15 Bit (1/4" Hex Shank) long	DS-T15B1
7001303	TX 20 Bit (1/4" Hex Shank)	DS-T20B
7018957	TX 20 Bit (1/4" Hex Shank) long	DS-T20B1



Short bit for "on-edge" product.



Long bit for traditional mounted inserts.

INDEX

End Mills, Angle Mills

Face Mills

Contour Milling

Slotters

Subject to technical changes.

GENERAL OPERATING GUIDELINES

THESE OPERATING GUIDELINES ARE RECOMMENDED STARTING POINTS FOR SAFE, EFFECTIVE PERFORMANCE IN A VARIETY OF MATERIALS

The parameters outlined on the following pages represent recommended general operating guidelines. They are intended to act as starting points as you look for the optimum operating parameters for a specific application.

Optimum parameters for any application are bound to vary according to the unique combination of variables which may be present in that particular application. Such variables might include the machine tool condition, rigidity of the workpiece and fixturing, the work material condition, the precise hardness and machinability of the material, and the shape and finish requirements of the workpiece, to name a few.

Once the application is operating reasonably well and safely, adjustments to these guidelines can be made based on variables present and the performance of the tool.

Extended length end mills require special operating parameters. They are NOT intended for channel cutting. Feed rates must generally be reduced due to their length-to-diameter ratios. Always use the shortest extension possible for best performance. Refer to "Rigidity Analysis" on page 310.

When ball nose end milling, two critical parameters are directly affected by the Depth of Cut (DOC): cutting speed in Surface Feet per Minute (SFM) and chip thickness. It is necessary to recognize these factors and to follow the guidelines relating to them. Refer to "Ball Nose Chip Thinning" on page 312.

For additional information regarding specific grades, refer to the grade chart on page 322. If you have questions regarding a specific application, contact your Ingersoll Cutting Tool Company sales engineer for assistance.

Series 12J1R, 12J1X, 12V1X, 12R1X, 22J3X, 22N3X, 12J1G, 12V1G, 12J1B, 12J4B, 12R1B, 12N1B, 12S1B, 22J5B, 22J3B, 22J3G, 22J3Q

Material		Brinell Hardness	SFM	Feed per Insert	Grades: IN10K	IN2005/IN2505	IN2010/IN2510	IN1030	IN2030	IN2040	INDD15	Coolant
Aluminum	7075-T6, 6061-T6, 2024	-	1500-8000	.004-.010	1	3	2				Yes	
Cast Iron	Gray	150-250	300-1000	.004-.010		3	1				2	No
	Nodular		300-600									
Steel	Low Carbon 1018-8620	100-250	400-1000	.004-.010		2		1	1*	3		
	High Carbon F-6180	250-400	350-500	.004-.008		3		1	1*	2		No
	Alloyed Steel 4140, 4340	150-300	300-700	.004-.010								
	Tool Steel A-6, D-1, D-2	Up to 300										
Stainless Steel	300 Series, 304, 316	-	300-700	.004-.010		2		1	1*	3		May not be required at high speeds
	400 Series 15-5 PH	-	400-900									
	13-8 PH	-	200-400									Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.003-.006		2	3	1	1*			Yes
Titanium	6AL-4V	-	100-150	.005-.008		2		1	1			Yes

*Preferred for higher SFM.

Series 15L1G, 15M1G, 15N1F, 15N1G

Material		Brinell Hardness	SFM	Feed per Insert	Grades: IN30M	IN40P	SHLT11: IN2005	SHLT11: IN1030	SHLT11: IN6530		SHLT09: IN2005	SHLT09: IN1030	SHLT09: IN6515	Coolant
Aluminum	7075-T6, 6061-T6, 2024	-	1000-8000	.010-.020	1			2				1		Yes
Cast Iron	Gray	150-250	250-400	.006-.010			2	1	1		2	3	1	No
	Nodular		200-350											
Steel	Low Carbon 1018, 8620	100-250	250-500	.006-.010		3	2	1	4		2	1		
	High Carbon F-6180	250-400	200-350	.005-.008		3	2	1	4		2	1		No
	Alloyed Steel 4140, 4340	150-300	250-400	.006-.010										
	Tool Steel A-6, D-1, D-2	Up to 300												
Stainless Steel	300 Series, 304, 316	-	250-400	.005-.008	3		2	1	3		2	1	3	May not be required at high speeds
	400 Series 15-5 PH	Up to 320	300-600											
	13-8 PH	-	200-250											Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.004-.006	3		2	1	3		2	1		Yes
Titanium	6AL-4V	-	100-150	.004-.006	3		2	1			2	1		Yes

The success of any cutter application is a function of many variables. Our initial preference of grade is based on applying a more tough grade.

Series 12J1D, 22J3D, 12P1D, 12N1D, 12M1D Material		Brinell Hardness	SFM	Feed per Insert	IN05S	IN2005/IN2505	IN1030	IN2030	Coolant
Aluminum	6061 T-6, 7075 T-6, 2024	-	1000-8000	.003-.008	1	2			Yes
Cast Iron	Gray	150-250	500-1200	.002-.004		1	2	1	No
	Nodular		400-800						
Steel	Low Carbon 1018-8620	150-250	600-1200	.002-.004		3	1	2	No
	High Carbon F-6180, Nitralloy 52100	250-400	400-600	.002-.004		3	2	1	
	Alloyed Steel 4140, 4340, 6150	150-300	400-800						
	Tool Steel A-6, D-1, D-2, P-20	Up to 300							
Stainless Steel	300 Series, 304, 316	-	400-800	.002-.004		2	1	1	May not be required at high speeds
	400 Series 15-5 PH, 17-4 PH	Up to 320	500-1000						
	13-8 PH	-	200-400						Yes
Nickel Alloys	Inconel, Hastelloy, Waspalloy	-	75-120	.002-.003		2	3	1	Yes
Titanium	6AL-4V	-	80-150	.002-.003		2	1	1	Yes

Series 15J1H Material		Brinell Hardness	SFM	Feed per Insert	IN15K	IN1540	Coolant
Aluminum	6061 T-6, 7075 T-6	-	1000-8000	.003-.005	1		Yes
Steel	Low Carbon 1018-8620	100-250	400-1000	.003-.006		1	Yes
	High Carbon F-6180, Nitralloy 52100	250-400	300-500				
	Alloyed Steel 4140, 4340, 6150	150-300	300-700				
	Tool Steel A-6, D-1, D-2, P-20	Up to 300					
Stainless Steel	300 Series, 304, 316	-	300-700	.003-.006		1	May not be required at high speeds
	400 Series 15-5 PH, 17-4 PH	-	400-900				
	13-8 PH	-	200-400				Yes

The success of any cutter application is a function of many variables. Our initial preference of grade is based on applying a more tough grade.

END MILL OPERATING GUIDELINES

Series 12J1Q, 12R1Q, 12M1Q, 12N1Q, 12P1Q, 12S1Q, 22J3Q, 22J7Q

Material		Brinell Hardness	SFM	Feed per Insert	IN30M	IN2005	IN2015	IN1030	IN2030	IN2040	IN5015	IN6530	Coolant
Aluminum	6061 T-6, 7075 T-6, 2024	-	1500-8000	.003-.008	1	3	2						Yes
Cast Iron	Gray	150-250	300-1000	.003-.008		3	1				2		No
	Nodular		300-600										
Steel	Low Carbon 1018-8620	100-250	400-1000	.003-.008		3		1	1*	2		4	No
	High Carbon F-6180, Nitralloy 52100	250-400	350-500	.003-.006									
	Alloyed Steel 4140, 4340, 6150	150-300	300-700	.003-.007									
	Tool Steel A-6, D-1, D-2, P-20	Up to 300											
Stainless Steel	300 Series, 304, 316	-	300-700	.003-.006		2	3	1	1*			4	May not be required at high speeds
	400 Series 15-5 PH, 17-4 PH	-	400-900										
	13-8 PH	-	200-400										Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.003-.006		2		1	3				Yes
Titanium	6AL-4V	-	100-150	.003-.006				2		1	1		Yes

*Preferred for higher SFM.

The success of any cutter application is a function of many variables. Our initial preference of grade is based on applying a more tough grade.

Series 15M1H, 15N1H

Material		Brinell Hardness	SFM	Feed per Insert	IN15K	IN1540	Coolant
Aluminum	6061 T-6, 7075-T6	-	1000-8000	.003-.006	1	2	Yes
Cast Iron	Gray	150-250	300-1000	.003-.006		1	No
	Nodular		300-600				
Steel	Low Carbon 1018-8620	100-250	400-1000	.003-.006		1	No
	High Carbon F-6180, Nitralloy 52100	250-400	300-500				
	Alloyed Steel 4140, 4340, 6150	150-300	300-700				
	Tool Steel A-6, D-1, D-2, P-20	Up to 300					
Stainless Steel	300 Series, 304, 316	-	300-700	.003-.006		1	May not be required at high speeds
	400 Series 15-5 PH, 17-4 PH	-	400-900				
	13-8 PH	-	200-400				Yes

Series 12J1P, 22J3P, 2J1P

Material		Brinell Hardness	SFM	Feed per Insert	IN10K	IN2505	IN2030	Coolant
Aluminum	6061 T-6, 7075 T-6, 2024	-	1000-8000	.003-.006	1			Yes
Cast Iron	Gray	150-250	500-1200	.002-.006		1	2	No
	Nodular		400-800					
Steel	Low Carbon 1018-8620	150-250	600-1200	.002-.006		2	1	No
	High Carbon F-6180, Nitralloy 52100	250-400	400-600	.002-.005		2	1	
	Alloyed Steel 4140, 4340, 6150	150-300	400-800					
	Tool Steel A-6, D-1, D-2, P-20	Up to 300						
Stainless Steel	300 Series, 304, 316	-	400-800	.002-.005		2	1	May not be required at high speeds
	400 Series 15-5 PH, 17-4 PH	Up to 320	500-1000					
	13-8 PH	-	200-400					Yes
Nickel Alloys	Inconel, Hastelloy, Waspalloy	-	75-120	.002-.004		2	1	Yes
Titanium	6AL-4V	-	80-150	.002-.005		2	1	Yes

The success of any cutter application is a function of many variables. Our initial preference of grade is based on applying a more tough grade.

END MILL OPERATING GUIDELINES

Series 15R1V, 15R4H

Material		Brinell Hardness	SFM	Feed per Insert	Grades: IN2030	Grades: IN2040	Coolant
Aluminum	7075-T6, 6061-T6, 2024	-	1500-8000	.004-.006	1		Yes
Cast Iron	Gray	150-250	700-1500	.004-.006	1		No
	Nodular						
Steel	Low Carbon 1018, 8620	100-250	600-1500	.004-.006	1	2	No
	High Carbon F-6180	250-400					
	Alloyed Steel 4140, 4340	150-300					
	Tool Steel A-6, D-1, D-2	Up to 300					
Stainless Steel	300 Series, 304, 316	-	350-1000	.004-.006	1	2	May not be required at high speeds
	400 Series, 15-5 PH, 17-4 PH	-					
	13-8 PH	-					Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.004-.006	1		Yes
Titanium	6AL-4V	-	100-150	.004-.006	1		Yes

Series 22J3F, 12J1F, 2J1F

Material		Brinell Hardness	SFM	Feed per Insert	Grades*: IN30M	IN2005	IN2015	IN1030	IN2030	IN2040	Coolant
Aluminum	6061 T-6, 7075 T-6, 2024	-	1500-8000	.004-.010	1	3	2				Yes
Cast Iron	Gray	150-250	300-1000	.004-.010		2	1	3	3		No
	Nodular		300-600								
Steel	Low Carbon 1018, 8620	100-250	400-1000	.004-.010		2		1	1*	3	No
	High Carbon F-6180, Nitralloy 52100	250-400	350-500	.004-.008		3		1	1*	2	
	Alloyed Steel 4140, 4340, 6150	150-300	300-700	.004-.010							
	Tool Steel A-6, D-1, D-2, P-20	Up to 300									
Stainless Steel	300 Series, 304, 316	-	300-700	.004-.010		2	3	1	1*		May not be required at high speeds
	400 Series 15-5 PH, 17-4 PH	Up to 320	400-900								
	13-8 PH	-	200-400	.004-.008							Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.003-.006		2	3	1	1		Yes
Titanium	6AL-4V	-	100-150	.003-.006		2		1	1		Yes

*Preferred for higher SFM.

The success of any cutter application is a function of many variables. Our initial preference of grade is based on applying a more tough grade.

Series 27E2V Material		Brinell Hardness	SFM	Feed per Insert	Grades IN30M	IN1530	IN5530	Coolant
Cast Iron	Gray	150-250	250-400	.006-.010	2	1	3	No
	Nodular		200-350					
Steel	Low Carbon 1018-8620	150-250	250-500	.006-.010	2	1	2	No
	High Carbon F-6180, Nitralloy 52100	250-400	200-350	.005-.008				
	Alloyed Steel 4140, 4340, 6150	150-300	250-400	.006-.010				
	Tool Steel A-6, D-1, D-2, P-20	Up to 300						
Stainless Steel	300 Series, 304, 316	-	250-400	.005-.008	2	1	2	May not be required at high speeds
	400 Series 15-5 PH, 17-4 PH	Up to 320	300-600					
	13-8 PH	-	200-250					Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.004-.006	2	1	2	Yes
Titanium	6AL-4V	-	100-150	.004-.006	2	1		Yes

Series 25J3F, 25J3G, 25J3H, 25J3J, 23J Material		Brinell Hardness	SFM	Feed per Insert SHLT, (SHLP-32, 33)	SHLH, (SHLP-44)	Grades Side IN2030	IN2015/IN5015	IN2040	IN2005	IN1030	IN6530	End† IN2005	IN1030	IN2030	IN2040	IN2015	Coolant
Aluminum	6061-T6, 7075 T-6	-	1000-8000	.003-.006	.004-.020		1		1	2		1	2			1	Yes
Cast Iron	Gray	150-250	250-400	.003-.006	.004-.010		1		2			2				1	No
	Nodular		200-350														
Steel	Low Carbon 1018-8620	150-250	250-500	.003-.006	.004-.010			3	2	1		2	1	1	2		No
	High Carbon F-6180, Nitralloy 52100	250-400	200-350	.003-.006	.004-.008			3	2	1							
	Alloyed Steel 4140, 4340, 6150	150-300	250-400	.003-.006	.004-.010			3	2	1							
	Tool Steel A-6, D-1, D-2, P-20	Up to 300	250-400														
		300 to 500	150-250					3	2	1							
Stainless Steel	300 Series, 304, 316	-	250-400	.003-.006	.004-.008	2	3		2	1	1	2	1	1			May not be required at high speeds
	400 Series 15-5 PH, 17-4 PH	Up to 320	300-600														
	13-8 PH	-	200-250														Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.003-.006	.004-.006	2				2	3	1	2	2			Yes
Titanium	6AL-4V	-	100-150	.003-.006	.003-.006	1			2	1		2	1	1			Yes

†For Series 23J6G and 23S2G only.

The success of any cutter application is a function of many variables. Our initial preference of grade is based on applying a more tough grade.

Series 15X1W, 15X1X, 15U1G Material		Brinell Hardness	SFM	Feed per Insert	Grade IN15K	Coolant
Aluminum	7075-T6, 6061-T6, 2024	-	1000-10000	.008-.020	1	Yes

Series 15X1Z Material		Brinell Hardness	SFM	Feed per Insert	Grade IN15K	Coolant
Aluminum	7075-T6, 6061-T2, 2024	-	1000-10000	.008-.020	1	Yes

Series 12J1E, 22J3E Material		Brinell Hardness	SFM	Feed per Insert	Grades IN30M/IN05S	IN2005	IN2015	IN1030	IN2030	IN2040	Coolant
Aluminum	7075-T6, 6061-T6, 2024	-	1500-8000	.004-.018	1	3	2				Yes
Cast Iron	Gray	150-250	300-1000	.004-.018		2	1				No
	Nodular		300-600								
Steel	Low Carbon 1018-8620	100-250	400-1000	.004-.018		2		1	1*	3	
	High Carbon F-6180	250-400	350-500	.004-.015		3		1	1*	2	No
	Alloyed Steel 4140, 4340	150-300	300-700	.004-.018							
	Tool Steel A-6, D-1, D-2	Up to 300									
Stainless Steel	300 Series, 304, 316	-	300-700	.004-.018		2	3	1	1*		May not be required at high speeds
	400 Series, 15-5 PH	-	400-900								
	13-8 PH	-	200-400								Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.003-.006		1	3	2	2		Yes
Titanium	6AL-4V	-	100-150	.005-.008		2		1	1		Yes

*Preferred for higher SFM.

The success of any cutter application is a function of many variables. Our initial preference of grade is based on applying a more tough grade.

Series 1TJ1N, 2TJ3N, TJ5N, TJ6N, TN1N Material		Brinell Hardness	SFM	Feed per Insert	IN10K	IN2030	IN2505	IN2540	INDD15/IN2010	Coolant
Aluminum	7075 - T6, 6061 - T6, 2024	-	1500-8000	.004-.018	1					Yes
Cast Iron	Gray	150-250	300-1000	.004-.010			2		1	No
	Nodular		300-600	.004-.010			2		1	No
Steel	Low Carbon 1018, 8620	100-250	400-1000	.004-.010		1	3	2		No
	High Carbon F-6180	250-400	350-500	.004-.008						No
	Alloyed Steel 4140, 4340	150-300	300-700	.004-.010						No
	Tool Steel A-6, D-1, D-2	Up to 300								
Stainless Steel	300 Series, 304, 316	-	300-550	.004-.010		1	2			May not be required at HighSpeed
	400 Series 15-5 PH	Up to 320	350-600							
	13-8 PH	-	200-400							Yes
Nickel Alloys	Inconel, Hastelloy, Waspalloy	-	75-120	.003-.006		2	1			Yes
Titanium	6AL-4V	-	100-150	.005-.008		1	2			Yes

Series 25J3E, 15N1E, 15P1E, 15J1E Material		Brinell Hardness	SFM	Feed per Insert	IN30M	IN2005	IN2015	IN1030/IN1530	IN2030	IN2040	Coolant
Aluminum	7075-T6, 6061-T6, 2024	-	1500-8000	.003-.008	1						Yes
Cast Iron	Gray	150-250	300-1000	.003-.008		2	1	3	3*		No
	Nodular		300-600								
Steel	Low Carbon	100-250	400-1000	.003-.008		2		1	1*	3	No
	High Carbon	250-400	350-500	.003-.006		3		1	1*	2	
	Alloyed Steel	150-300	300-700	.003-.007							
	Tool Steel	Up to 300									
Stainless Steel	300 Series, 304, 316	-	300-700	.003-.006		2		1	1*	3	May not be required at high speeds
	400 Series, 15-5 PH, 17-4 PH	-	400-900								
	13-8 PH	-	200-400							Yes	
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.003-.006		1		2	2		Yes
Titanium	6AL-4V	-	100-150	.003-.006		2		1	1*		Yes

*Preferred for higher SFM.

The success of any cutter application is a function of many variables. Our initial preference of grade is based on applying a more tough grade.

Series 15N1F, 15N1H

Material		Brinell Hardness	SFM	Feed per Insert	IN30M/IN40P	IN2005	IN2510	IN1030	IN2030	IN2040/IN2540	Coolant
Aluminum	7075-T6, 6061-T6, 2024	-	1500-8000	.004-.010	1		2				Yes
Cast Iron	Gray	150-250	300-1000	.004-.010		2	1				No
	Nodular		300-600								
Steel	Low Carbon	100-250	400-1000	.004-.010		3		1	1*	2	No
	High Carbon	250-400	350-500	.004-.008		2		1	1*	3	
	Alloyed Steel	150-300	300-700	.004-.010							
	Tool Steel	Up to 300									
Stainless Steel	300 Series, 304, 316	-	300-700	.004-.010		2		1	1*		May not be required at high speeds
	400 Series, 15-5 PH, 17-4 PH	-	400-900								
	13-8 PH	-	200-400								Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.003-.006		1		2	2		Yes
Titanium	6AL-4V	-	100-150	.003-.006		2		1	1*		Yes

*Preferred for higher SFM.

Series 2SJ1L

Material		Brinell Hardness	SFM	Feed per Insert	IN2005	IN2015	IN1530	IN2040	Coolant
Cast Iron	Gray	150-280	400-750	.007-.018	2	1			No
	Nodular		300-650						
Steel	Low Carbon 1018, 8620	100-250	250-500	.005-.015	1		3	2	No
	High Carbon F-6180	250-400	200-350	.006-.013					
	Alloyed Steel 4140, 4340	150-300	250-400	.006-.015					
	Tool Steel A-6, D-1, D-2	Up to 300							
Stainless Steel	300 Series, 304, 316	-	250-400	.005-.010	2		1		May not be required at high speeds
	400 Series, 15-5 PH	Up to 300	300-600						
	13-8 PH	-	200-250	.006-.012					Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-150	.004-.007	1		2		Yes
Titanium	6AL-4V	-	100-150	.004-.007	2		1		Yes

The success of any cutter application is a function of many variables. Our initial preference of grade is based on applying a more tough grade.

Series 2SJ1H

Material		Brinell Hardness	SFM	Feed per Insert	IN2005	IN2015	IN1530	IN2040	Coolant
Cast Iron	Gray	150-280	400-750	.003-.006	2	1			No
	Nodular		300-650						
Steel	Low Carbon 1018, 8620	100-250	250-500	.003-.006	1		2	1	No
	High Carbon F-6180	250-400	200-350	.003-.005					
	Alloyed Steel 4140, 4340	150-300	250-400						
	Tool Steel A-6, D-1, D-2	Up to 300							
Stainless Steel	300 Series, 304, 316	-	400-600	.003-.006	1		2		May not be required at high speeds
	400 Series, 15-5 PH	Up to 320	300-600						
	13-8 PH	-	200-600						Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-150	.003-.005	1	2			Yes
Titanium	6AL-4V	-	100-200	.003-.005	2		1		Yes

Series 1SJ1Y, 2SJ3Y, SJ5Y, SJ6Y

Material		Brinell Hardness	SFM	Feed per Insert	IN2005	IN2015	IN2030	Coolant
Cast Iron	Gray	150-280	400-750	.003-.006	2	1		No
	Nodular		300-650					
Steel	Low Carbon 1018, 8620	100-250	250-500	.003-.006	1		2	No
	High Carbon F-6180	250-400	200-350					
	Alloyed Steel 4140, 4340	150-300	250-400	.003-.005				
	Tool Steel A-6, D-1, D-2	Up to 300						
Stainless Steel	300 Series, 304, 316	-	400-600	.003-.006	2		1	May not be required at high speeds
	400 Series, 15-5 PH	Up to 320	300-600					
	13-8 PH	-	200-600					Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-150	.003-.005	1		2	Yes
Titanium	6AL-4V	-	100-200	.003-.005	2		2	Yes

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Series 1SJ1F, SJ5F, SJ5H, SJ6F, 2SJ3F

Material		Brinell Hardness	SFM	Feed per Insert	IN2005	IN2015	IN2030	IN2040	IN6515	Coolant
Cast Iron	Gray	150-250	400-750	.005-.012	3	1			2	No
	Nodular		300-650							
Steel	Low Carbon 1018, 8620	100-250	400-850	.005-.012	1		3	2		No
	High Carbon F-6180	250-400	300-500	.005-.010						
	Alloyed Steel 4140, 4340	150-300	300-600							
	Tool Steel A-6, D-1, D-2	Up to 300								
Stainless Steel	300 Series, 304, 316	-	300-600	.005-.012	1		2			May not be required at high speeds
	400 Series 15-5 PH	-	350-700							
	13-8 PH	-	200-400							
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-150	.004-.008	1		2			Yes
Titanium	6AL-4V, TI-10-2-3, TI-5553	-	75-200	.004-.008	2		1			Yes

Series SJ2J, SJ5J, SJ6J, 2SJ3J, SN2J, SN6J

Material		Brinell Hardness	SFM	Feed per Insert	IN1530	IN2005	IN2015	IN2030	IN2040	IN6515	Coolant
Cast Iron	Gray	150-250	400-750	.005-.015		3	1			2	No
	Nodular		300-650								
Steel	Low Carbon 1018, 8620	100-250	400-850	.005-.014	1	1		2	3		No
	High Carbon F-6180	250-400	300-500	.005-.012							
	Alloyed Steel 4140, 4340	150-300	300-600								
	Tool Steel A-6, D-1, D-2	Up to 300									
Stainless Steel	300 Series, 304, 316	-	300-600	.005-.012	2	1		2			May not be required at high speeds
	400 Series 15-5 PH	-	350-700								
	13-8 PH	-	200-400								
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-150	.004-.008		1		2			Yes
Titanium	6AL-4V, TI-10-2-3, TI-5553	-	75-200	.004-.008		2		1			Yes

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STARTING FEED RATE GUIDELINES FOR EXTENDED FLUTE MILL BASED ON WIDTH OF CUT

Material	Material Specification	Radial WOC	Feed Rate (APT) 2.00 Diameter	2.50 Diameter	3.00 Diameter	4.00 Diameter
Aluminum	7075 - T6, 6061 - T6, 2024	0.02	0.050	0.060	0.070	0.080
		Diameter / 8	0.015	0.015	0.015	0.015
		Diameter / 4	0.012	0.012	0.012	0.012
		Diameter / 2	0.010	0.010	0.010	0.010
Cast Iron	Gray / Nodular	0.02	0.035	0.048	0.056	0.064
		Diameter / 8	0.009	0.011	0.011	0.011
		Diameter / 4	0.007	0.008	0.008	0.008
		Diameter / 2	0.006	0.006	0.006	0.006
Steel	Low / Med Carbon 1018, 1045, 8620	0.02	0.035	0.048	0.056	0.064
		Diameter / 8	0.009	0.011	0.011	0.011
		Diameter / 4	0.007	0.008	0.008	0.008
		Diameter / 2	0.006	0.006	0.006	0.006
	Alloyed Steel, 4140, 4340, Tool Steel A-6, D-1, D-2	0.02	0.030	0.042	0.049	0.056
		Diameter / 8	0.008	0.009	0.009	0.009
		Diameter / 4	0.006	0.007	0.007	0.007
		Diameter / 2	0.005	0.005	0.005	0.005
Stainless Steel	300 Series, 304, 316, 13-8PH	0.02	0.030	0.042	0.049	0.056
		Diameter / 8	0.008	0.009	0.009	0.009
		Diameter / 4	0.006	0.007	0.007	0.007
		Diameter / 2	0.005	0.005	0.005	0.005
	400 Series 15-5PH, 17-4PH	0.02	0.035	0.048	0.056	0.064
		Diameter / 8	0.009	0.011	0.011	0.011
		Diameter / 4	0.007	0.008	0.008	0.008
		Diameter / 2	0.006	0.006	0.006	0.006
Nickel Alloys & Titanium	Inconel, Hastelloy, Waspalloy, 6AL-4V	0.02	0.030	0.042	0.049	0.056
		Diameter / 8	0.008	0.009	0.009	0.009
		Diameter / 4	0.006	0.007	0.007	0.007
		Diameter / 2	0.005	0.005	0.005	0.005

The success of any cutter application is a function of many variables. Our initial preference of grade is based on applying a more tough grade.

Series 2L1Q, 2J1Q, 2J1D

Material		Brinell Hardness	SFM	Feed per Insert	IN30M/IN05S	IN2005/IN2505	IN1030	IN2030	Coolant
Aluminum	6061-T6, 7075-T6, 2024	-	1500-8000	.003-.008	1	2			Yes
Cast Iron	Gray	150-250	300-1000	.003-.008		1		2	No
	Nodular		300-600						
Steel	Low Carbon 1018, 8620	100-250	400-1000	.003-.008		2	1	1*	No
	High Carbon F-6180, Nitralloy 52100	250-400	350-500	.003-.006		2	1	1*	
	Alloyed Steel 4140, 4340, 6150	150-300	300-700	.003-.007					
	Tool Steel A-6, D-1, D-2, P-20	Up to 300							
Stainless Steel	300 Series, 304, 316	-	300-700	.003-.006		2	1	1*	May not be required at high speeds
	400 Series, 15-5 PH, 17-4 PH	-	400-900						
	13-8 PH	-	200-400						Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.003-.006		1	2	2	Yes
Titanium	6AL-4V	-	100-150	.003-.006		2	1	1	Yes

*Preferred for higher SFM.

Series 2J1E, 2J4E, 2L1E

Material		Brinell Hardness	SFM	Feed per Insert	IN30M/IN05S	IN2005	IN2015	IN1030	IN2030	IN2040	Coolant
Aluminum	7075-T6, 6061-T6, 2024	-	1500-8000	.004-.018	1	3	2				Yes
Cast Iron	Gray	150-250	300-1000	.004-.018		2	1				No
	Nodular		300-600								
Steel	Low Carbon 1018-8620	100-250	400-1000	.004-.018		3		1	1*	2	No
	High Carbon F-6180	250-400	350-500	.004-.015							
	Alloyed Steel 4140, 4340	150-300	300-700	.004-.018							
	Tool Steel A-6, D-1, D-2	Up to 300									
Stainless Steel	300 Series, 304, 316	-	300-700	.004-.018		2	3	1	1*		Yes
	400 Series, 15-5 PH	-	400-900								
	13-8 PH	-	200-400								
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.003-.006		1		2	2		Yes
Titanium	6AL-4V	-	100-150	.005-.008		2		1	1*		Yes

*Preferred for higher SFM.

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Series 2J1X, 2L1X, 2J1G, TFM90, 2J1B, 2J4B, 2L6B

Material		Brinell Hardness	SFM	Feed per Insert	IN10K	IN2005/IN2505	IN2010/IN2510	IN1030	IN2030	IN2040	INDD15	Coolant
Aluminum	6061-T6, 7075-T6, 2024	-	1500-8000	.004-.010	1	3	2					Yes
Cast Iron	Gray	150-250	300-1000	.004-.010		3	1				2	No
	Nodular		300-600									
Steel	Low Carbon 1018, 8620	100-250	400-1000	.004-.010		2		1	1*	3		No
	High Carbon F-6180, Nitralloy 52100	250-400	350-500	.004-.008		3		1	1*	2		
	Alloyed Steel 4140, 4340, 6150	150-300	300-700	.004-.010								
	Tool Steel A-6, D-1, D-2, P-20	Up to 300										
Stainless Steel	300 Series, 304, 316	-	300-700	.004-.010		2		1	1*	2		May not be required at high speeds
	400 Series, 15-5 PH, 17-4 PH	-	400-900									
	13-8 PH	-	200-400									Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.003-.006		1	3	2	2			Yes
Titanium	6AL-4V	-	100-150	.005-.008		2		1	1			Yes

*Preferred for higher SFM.

Series 5J1E, 2J1F

Material		Brinell Hardness	SFM	Feed per Insert	IN30M	IN2005	IN2015	IN1030/IN1530	IN2030	IN2040	Coolant
Aluminum	7075-T6, 6061-T6, 2024	-	1500-8000	.003-.008	1	3	2				Yes
Cast Iron	Gray	150-250	300-1000	.003-.008		2	1	3	3		No
	Nodular		300-600								
Steel	Low Carbon 1018-8620	100-250	400-1000	.003-.008		3		1	1*	2	No
	High Carbon F-6180	250-400	350-500	.003-.006		2		1	1*	3	
	Alloyed Steel 4140, 4340	150-300	300-700	.003-.007							
	Tool Steel A-6, D-1, D-2	Up to 300									
Stainless Steel	300 Series, 304, 316	-	300-700	.003-.006		2		1	1*		May not be required at high speeds
	400 Series, 15-5 PH	-	400-900								
	13-8 PH	-	200-400								Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.003-.006		2		1	1*		Yes
Titanium	6AL-4V	-	100-150	.003-.006		1		2	2		Yes

*Preferred for higher SFM.

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Series 5J1H

Material		Brinell Hardness	SFM	Feed per Insert	IN2005	IN1030	IN2015	IN2030	IN5015	Coolant
Aluminum	6061-T6, 7075-T6, 2024	-	1500-8000	.003-.008	2		1			Yes
Cast Iron	Gray	150-250	300-1000	.003-.008	2	3	1	3	1	No
	Nodular		300-600							
Steel	Low Carbon 1018, 8620	100-250	400-1000	.003-.008		1		1*		No
	High Carbon F-6180, Nitralloy 52100	250-400	350-500	.003-.006	2	1		1*		
	Alloyed Steel 4140, 4340, 6150	150-300	300-700	.003-.007						
	Tool Steel A-6, D-1, D-2, P-20	Up to 300								
Stainless Steel	300 Series, 304, 316	-	300-700	.003-.006	2	1		1*		May not be required at high speeds
	400 Series, 15-5 PH, 17-4 PH	-	400-900							
	13-8 PH	-	200-400							Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.003-.006	1	2		2*		Yes
Titanium	6AL-4V	-	100-150	.003-.006	2	1		1*		Yes

*Preferred for higher SFM.

The success of any cutter application is a function of many variables. Our initial preference of grade is based on applying a more tough grade.

Series 5N6F, 5N2H Material		Brinell Hardness	SFM	Feed per Insert	IN30M	IN2005	IN2510	IN1030	IN2030	IN2040/IN2540	Coolant
Aluminum	7075-T6, 6061-T6, 2024	-	1500-8000	.004-.010	1		2				Yes
Cast Iron	Gray	150-250	300-1000	.004-.010		2	1	3	3*		No
	Nodular		300-600								
Steel	Low Carbon 1018-8620	100-250	400-1000	.004-.010		3		1	1*	2	No
	High Carbon F-6180	250-400	350-500	.004-.008		2		1	1*	3	
	Alloyed Steel 4140, 4340	150-300	300-700	.004-.010							
	Tool Steel A-6, D-1, D-2	Up to 300									
Stainless Steel	300 Series, 304, 316	-	300-700	.004-.010		2		1	1*		May not be required at high speeds
	400 Series, 15-5 PH	-	400-900								
	13-8 PH	-	200-400								Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.003-.006		1		2	2		Yes
Titanium	6AL-4V	-	100-150	.003-.006		2		1	1*		Yes

*Preferred for higher SFM.

Series 5J2H Material		Brinell Hardness	SFM	Feed per Insert	IN70N	IN72N	Coolant
Cast Iron	Gray	150-250	1800+	.005-.008	1	1	No
	Nodular		1500+	.004-.007			

The success of any cutter application is a function of many variables. Our initial preference of grade is based on applying a more tough grade.

Series ON5H, ON6H, OP1N, OP6N

Material		Brinell Hardness	SFM	Feed per Insert	IN10K	IN2010/IN2510	IN2030	IN2505/IN2005	IN2040	IN2004**	IN6515	Coolant
Aluminum	6061 T-6, 7075 T-6, 2024	-	1500-8000	.006-.012	1							Yes
Cast Iron	Gray	150-250	500-1000	.008-.016		1				3	2	No
Cast Iron	Nodular	150-250	400-800	.007-.014		1				3	2	No
Steel	Low Carbon 1018, 8620	100-250	400-1000	.006-.015			1	2	3			No
Steel	High Carbon F-6180,	250-400	400-800	.006-.012			1	2	3			No
Steel	Alloyed Steel 4140, 4340	150-300	300-700	.006-.012			1	2	3			No
Steel	Tool Steel A-6, D-1, D-2	Up to 300	300-500	.006-.012			1	2	3			No
Stainless Steel	300 Series, 304, 316	-	300-700	.005-.009			1	2	1			May not be required at high speeds
Stainless Steel	400 Series 15-5 PH,	Up to 320	400-700	.005-.009			1	2	1			May not be required at high speeds
Stainless Steel	13-8 PH	-	200-400	.005-.009			1	2	1			Yes
Nickel Alloys	Inconel, Hastelloy, Waspalloy	-	75-120	.003-.006			2	1				Yes
Titanium	6AL-4V	-	100-150	.004-.007			1	2	2			Yes

Grades*

*Preferred for higher SFM.
**Preferred for CGI.

Series 5N6J, 5N6R

Material		Brinell Hardness	SFM	Feed per Insert	IN15K/IN30M	IN2005	IN2010/IN2015	IN1030/IN1530	IN2040	IN6530	Coolant
Aluminum	6061 T-6, 7075 T-6, 2024	-	1500-8000	.006-.020	1		2				Yes
Cast Iron	Gray	150-250	300-1000	.006-.015		2	1	3			No
Cast Iron	Nodular	150-250	300-600	.006-.015		2	1	3			No
Steel	Low Carbon 1018, 8620	100-250	400-1000			3		1	2		No
Steel	High Carbon F-6180, Nitralloy 52100	250-400	350-600	.006-.015		2		1	3	4	No
Steel	Alloyed Steel 4140, 4340, 6150	150-300	300-800	.006-.015		2		1	3	4	No
Steel	Tool Steel A-6, D-1, D-2, P-20	Up to 300	300-800	.006-.015		2		1	3	4	No
Stainless Steel	300 Series, 304, 316	-	300-700	.006-.015		2		1			Yes
Stainless Steel	400 Series, 15-5 PH, 17-4 PH	Up to 320	400-900	.006-.015		2		1			Yes
Stainless Steel	13-8 PH	-	200-400	.006-.015		2		1			Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.003-.010		1		2			Yes
Titanium	6AL-4V	-	100-150	.003-.010		2		1			Yes

Grades

The success of any cutter application is a function of many variables. Our initial preference of grade is based on applying a more tough grade.

Series 5N6H, 5N6K, 5N6L

Material		Brinell Hardness	SFM	Feed per Insert	IN10K	IN30M	IN2005	IN2015	IN1030	IN2030	IN2040	IN1530	IN1540	Coolant
Aluminum	6061-T6, 7075-T6, 2024	-	1500-8000	.003-.007	1	1								Yes
Cast Iron	Gray	150-250	400-600	.003-.006	4		2	1	3	3		3		No
	Nodular		300-500											
Steel	Low Carbon 1018, 8620	100-250	400-1000	.003-.008			3		1	1*	2*	1	2	No
	High Carbon F-6180, Nitralloy 52100	250-400	400-600	.003-.007			2		1	1*	3	1	3	
	Alloyed Steel 4140, 4340, 6150	150-300	350-600											
	Tool Steel A-6, D-1, D-2, P-20	Up to 300												
Stainless Steel	300 Series, 304, 316	-	300-600	.003-.006			2		1	1*		1		May not be required at high speeds
	400 Series, 15-5 PH, 17-4 PH	Up to 320												
	13-8 PH	-												Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	70-100	.002-.004			1		2	2		1		Yes
Titanium	6AL-4V	-	100-150	.003-.005			2		1	1*		2		Yes

The nine grade columns (IN10K to IN1540) are printed under a shared "Grades" heading.

*Preferred for higher SFM.

Series 5H6G, 5X6Z, 5X6X, 5X6W

Material		Brinell Hardness	SFM	Feed per Insert	IN15K	Coolant
Aluminum	7075-T6, 6061-T2, 2024	-	2000-15000	.008-.025	1	Yes

The IN15K column is printed under the heading "Grade".

The success of any cutter application is a function of many variables. Our initial preference of grade is based on applying a more tough grade.

Series DN5H/DN6H, DL5H/DL6H, DJ5H/DJ6H					Grades						
Material		Brinell Hardness	SFM	Feed per Insert	IN10K	IN2010/IN2510	IN2030	IN2505	IN62C	INDD15	Coolant
Aluminum	7075 - T6, 6061 - T6, 2024	-	1500-8000	.004-.020	1						Yes
Cast Iron	Gray	150-250	300-1000	.006-.018		1			W	2	No
	Nodular		300-600	.006-.018		1			W	2	No
Steel	Low Carbon 1018, 8620	100-250	400-1000	.006-.018							No
	High Carbon F-6180	250-400	350-500	.006-.015			1	2			No
	Alloyed Steel 4140, 4340	150-300	300-800	.006-.018							No
	Tool Steel A-6, D-1, D-2	Up to 300									
Stainless Steel	300 Series, 304, 316	-	300-700	.004-.008							May not be required at high speeds
	400 Series 15-5 PH	Up to 320	400-700				1	2			
	13-8 PH	-	200-400								Yes
Nickel Alloys	Inconel, Hastelloy, Waspalloy	-	75-120	.003-.006			2	1			Yes
Titanium	6AL-4V	-	100-150	.004-.006			1	2			Yes

W=WIPER

Series DJ6T, DJ5T					Grades					
Material		Brinell Hardness	SFM	Feed per Insert	IN2010	IN2030	IN2505	IN2540	INDD15	Coolant
Cast Iron	Gray	150-250	500-1000	.008-.010	2				1	No
	Nodular		400-800	.007-.009	1				2	
Steel	Low Carbon 1018, 8620	100-250	400-1000	.006-.012						No
	High Carbon F-6180	250-400	400-800	.006-.010		1	3	2		
	Alloyed Steel 4140, 4340	150-300	300-700							
	Tool Steel A-6, D-1, D-2	Up to 300	300-500							
Stainless Steel	300 Series, 304, 316	-	300-700	.005-.008						May not be required at high speeds
	400 Series, 15-5 PH	Up to 320	400-700			1	2			
	13-8 PH	-	200-400							Yes
Nickel	Inconel, Hastelloy, Waspalloy	-	75-120	.003-.006		2	1			Yes
Titanium	6AL-4V	-	100-150	.004-.007		1	2			Yes

*Preferred for higher SFM.

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Series 6X1V, 6X2V, 6X3V, 6X4V

Material		Brinell Hardness	SFM	Feed per Insert	IN10K	IN90D	Coolant
					Grades		
Aluminum	6061 T-6, 7075 T-6	-	1500-8000	.004-.015	2	1	Yes
Cast Iron	Gray	150-250	300-1000	.004-.012	1	2	Yes
	Nodular		300-600				

Series DM5G, DM6G

Material		Brinell Hardness	SFM	Feed per Insert	IN05S	IN1030	IN2005/IN2505	IN2015	IN2030	INDD15	IN70N	Coolant
					Grades							
Aluminum	7075-T6, 6061-T6, 2024	-	1000-8000	.005-.020	1		3	2				Yes
Cast Iron	Grey	150-250	300-1000	.008-.020			3	2		1		No
			1800+	.005-.008							1	
	Nodular	150-250	300-600	.008-.015			3	1		2		
			1500+	.004-.007							1	
Steel	Low Carbon 1018, 8620	150-250	400-1000	.008-.020		1	2		1*	2		No
	High Carbon F-6180	250-400	350-500	.008-.015								
	Alloyed Steel 4140, 4340	150-300	300-700	.008-.020								
	Tool Steel A-6, D-1, D-2	Up to 300										
Stainless Steel	300 Series, 304, 316	-	300-700	.007-.015		1	2		1*			May not be required at high speeds
	400 Series, 15-5 PH	Up to 320	400-900									
	13-8 PH	-	200-400									Yes
Nickel	Inconel, Hastelloy, Waspalloy	-	75-120	.004-.012			1		2			Yes
Titanium	6AL-4V	-	100-150	.005-.014			2		1			Yes

*Preferred for higher SFM.

Series SJ2R, SN2R

Material		Brinell Hardness	SFM	Feed per Insert	IN2030	IN2005	IN2015/IN6515	IN1530	IN2040	IN6530	Coolant
					Grades						
Cast Iron	Gray	150-280	400-750	.008-.030		2	1				No
	Nodular		300-650								
Steel	Low Carbon 1018, 8620	100-250	250-500	.008-.025	2	1		2	3	3	No
	High Carbon F-6180	250-400	200-350	.008-.020							
	Alloyed Steel 4140, 4340	150-300	250-400	.008-.025							
	Tool Steel A-6, D-1, D-2	Up to 300									
Stainless Steel	300 Series, 304, 316	-	250-400	.006-.014	1	2		1			May not be required at high speeds
	400 Series, 15-5 PH	Up to 300	300-600								
	13-8 PH	-	200-250								Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-150	.004-.007	2	1		2			Yes

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Series SF6H, SF6N

Material		Brinell Hardness	SFM	Feed per Insert	IN1505	IN1510	IN1540	Coolant
Aluminum	7075-T6, 6061-T6, 2024	-	1000-8000	.020-.050	1	2		Yes
Cast Iron	Gray	150-250	1000-1500	.010-.050		1		No
	Nodular							
Steel	Low Carbon 1018, 8620	100-250	800-1200	.010-.050	1	2	2	No
	High Carbon F-6180	250-400	500-800					
	Alloyed Steel 4140, 4340	150-300	600-1000					
	Tool Steel A-6, D-1, D-2	Up to 300						
Stainless Steel	300 Series, 304, 316	-	400-600	.010-.050	1		2	No
	400 Series, 15-5 PH	Up to 320	500-800					
	13-8 PH	-	400-600					
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-150	.010-.030	1			Yes
Titanium	6AL-4V	-	100-200	.010-.030	1			Yes

Series SJ2N, SJ6N, SN2N, SN6N, 2SJ1N, VM2N

Material		Brinell Hardness	SFM	Feed per Insert	IN2005	IN2015/IN6510	IN1530	IN2040	IN6515	IN2030	Coolant
Cast Iron	Gray	150-280	400-750	.007-.018	3	1			2		No
	Nodular		300-650								
Steel	Low Carbon 1018, 8620	100-250	250-500	.005-.015	1		3	2		2	No
	High Carbon F-6180	250-400	200-350	.006-.013							
	Alloyed Steel 4140, 4340	150-300	250-400	.006-.015							
	Tool Steel A-6, D-1, D-2	Up to 300									
Stainless Steel	300 Series, 304, 316	-	250-400	.005-.010	2		1			1	May not be required at high speeds
	400 Series, 15-5 PH	Up to 300	300-600								
	13-8 PH	-	200-250	.006-.012							Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-150	.004-.007	1		2			2	Yes
Titanium	6AL-4V	-	100-150	.004-.007	2		1			1	Yes

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Series DJ1H

Material		Brinell Hardness	SFM	Feed per Insert	IN2505	IN2010	IN80B	Coolant
Cast Iron	Gray	150-250	300-1000	.006-.012		1		No
			1800 +	.005-.008			1	No
	Nodular	150-250	300-600	.005-.011		1		No
			1500 +	.004-.007			1	No
Steel	-	-	500-1000	.004-.008	1			No
Stainless Steel	-	-	500-1000	.004-.008	1			No

Series SJ6H, SJ5E

Material		Brinell Hardness	SFM	Feed per Insert	IN2005	IN2015/IN2010	IN1530	IN2040	Coolant
Cast Iron	Gray	150-280	400-750	.003-.006			1		No
	Nodular		300-650						
Steel	Low Carbon 1018, 8620	100-250	250-500	.003-.006	1	3	2	2	No
	High Carbon F-6180	250-400	200-350	.003-.005					
	Alloyed Steel 4140, 4340	150-300	250-400						
	Tool Steel A-6, D-1, D-2	Up to 300							
Stainless Steel	300 Series, 304, 316	-	400-600	.003-.006	1	3	2		May not be required at high speeds
	400 Series, 15-5 PH	Up to 320	300-600						
	13-8 PH	-	200-600						Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-150	.003-.005	1		2		Yes
Titanium	6AL-4V	-	100-200	.003-.005	2		1		Yes

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FACE MILL OPERATING GUIDELINES

Series SJ5V, SJ6V

Material		Brinell Hardness	SFM	Feed per Insert	IN2005	IN2015	IN2030	Coolant
Aluminum	7075-T6, 6061-T6, 2024	-	1500-8000	.003-.007	1		2	Yes
Cast Iron	Gray	150-280	400-750	.003-.006	2	1		No
	Nodular		300-650					
Steel	Low Carbon 1018, 8620	100-250	250-500	.003-.006	1		2	No
	High Carbon F-6180	250-400	200-350	.003-.005				
	Alloyed Steel 4140, 4340	150-300	250-400					
	Tool Steel A-6, D-1, D-2	Up to 300						
Stainless Steel	300 Series, 304, 316	-	400-600	.003-.006	2		1	May not be required at high speeds
	400 Series, 15-5 PH	Up to 320	300-600					
	13-8 PH	-	200-600					Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-150	.003-.005	1		2	Yes
Titanium	6AL-4V	-	100-200	.003-.005	2		1	Yes

Series DM5Q, DM6Q, DM2Q

Material		Brinell Hardness	SFM	Feed per Insert	IN2005	IN2030	IN2040	INDD15	Coolant
Cast Iron	Gray	150-250	300-1000	.007-.025	2			1	No
	Nodular		300-600	.007-.020	2			1	
Steel	Low Carbon 1018-8620	150-250	400-1000	.008-.025	3	2	1		No
	High Carbon F-6180	250-400	350-500	.008-.020	3	1	2		
	Alloyed Steel 4140, 4340	150-300	300-700	.008-.020					
	Tool Steel A-6, D-1, D-2	Up to 300							
Stainless Steel	300 Series, 304, 316	-	250-600	.007-.018	2	1			May not be required at high speeds
	400 Series 15-5 PH	Up to 320	300-600						
	13-8 PH	-	200-550						Yes

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Series VM6V, VL6V, VK6V, VK5V

Material		Brinell Hardness	SFM	Feed per Insert	IN15K	IN2005	IN2015/IN2010	IN1530	IN2030	IN2040	IN6515	IN70N	Coolant
Aluminum	6061-T6, 7075-T6, 2024	-	1500-8000	.004-.015	1								Yes
Cast Iron	Gray	150-280	400-750	.005-.012		3	1				2		No
	Nodular		300-650										
			1500+	.004-.007								1	
Steel	Low Carbon 1018, 8620	100-250	250-500	.005-.010		2			2	1			No
	High Carbon F-6180, Nitralloy 52100	250-400	200-350	.005-.008									
	Alloyed Steel 4140, 4340, 6150	150-300	250-400	.005-.010									
	Tool Steel A-6, D-1, D-2, P-20	Up to 300											
Stainless Steel	300 Series, 304, 316	-	250-400	.003-.006		1		2	2				May not be required at high speeds
	400 Series, 15-5 PH, 17-4 PH	Up to 320	300-600										
	13-8 PH	-	200-250	.004-.008									Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.003-.006		1		1	2				Yes
Titanium	6AL-4V	-	100-150	.003-.006		2		1	1				Yes

*Preferred for higher SFM.

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Series 12W9, 12W5

	Material	Brinell Hardness	SFM	Feed per Insert	IN2005 (Grades)	IN2006 (Grades)	IN05S (Grades)	Coolant
Aluminum	6061 T-6, 7075 T-6	-	1000-8000	.003-.006	2		1	Yes
Cast Iron	Gray	150-250	500-1200	.002-.006	1			No
	Nodular	150-250	400-800	.002-.006	1			
Steel	Low Carbon 1018-8620	150-250	600-1200	.002-.006	1			No
	High Carbon F-6180	250-400*	400-600	.002-.005	2	1		
	Alloyed Steel 4140	150-300	400-800	.002-.005	1	2		
	Tool Steel P-20-H13	Up to 460*	400-800	.002-.005	2	1		
Stainless Steel	300 Series, 304, 316	-	400-800	.002-.005	1	2		No
	400 Series, 15-5 PH, 17-4 PH	Up to 320	500-1000	.002-.005	1	2		
	13-8 PH	-	200-400	.002-.005	1	2		Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy	75-120	75-120	.002-.004	1	2		Yes
Titanium	6AL-4V	-	80-150	.002-.005	1	2		Yes

*58Rc & Above use IN2006.

Series 15V1E, 5V6E, 1TG1F, TG1F

	Material	Brinell Hardness	SFM	Feed per Insert	IN2005/IN2505 (Grades)	IN2030 (Grades)	IN2040/IN2540 (Grades)	IN6530 (Grades)	Coolant
Steel	Mild 1018-1045	125-425	500-1100	.010-.035		1	2	2	No
	Low Alloy 4140, 8620, 4340	150-425	400-1000	.008-.018	1	3	2	4	
	Med Alloy P20, S7, H13, O1, A2	150-425	300-900						
	High Alloy A7-D2	200-425	300-600	.005-.015	1	2		3	
Stainless Steel	Free Machining 303, 416	150-425	300-800	.010-.030	2	1		3	No
	300 Series 304, 310, 316	150-425	200-600	.005-.015					
	400 Series 410, 420, 15-5PH, 17-4 PH	150-425	200-600						
	PH Series 13-8	150-425	200-500						
Hardened Steel	ALL		200-400	.002-.010	1		2	3	No

The success of any cutter application is a function of many variables. Our initial preference of grade is based on applying a more tough grade.

Series 15V1H, 5V6H

Material		Brinell Hardness	SFM	Feed per Insert	IN2005	IN2030	IN2040	Coolant
Steel	Mild 1018-1045	125-425	500-1100	.015-.035				No
	Low Alloy 4140, 8620, 4340	150-425	400-1000	.010-.025	1	3	2	
	Med Alloy P20, S7, H13, O1, A2	150-425	300-900					
	High Alloy A7-D2	200-425	300-600	.005-.020	1	2		
Stainless Steel	Free Machining 303, 416	150-425	300-800	.010-.030	1	2		No
	300 Series 304, 310, 316	150-425	200-600	.005-.030				
	400 Series 410, 420, 15-5PH, 17-4 PH	150-425	200-600					
	PH Series 13-8	150-425	200-500					
Hardened Steel	ALL		200-400	.002-.010	1		2	No

Series 15V1Z, 5V6G, 15V1D, 15V1G

Material		Brinell Hardness	SFM	Feed per Insert	IN2006*	IN2005	IN1030	IN2040	IN3005**	
Steel	Alloyed Steel 4140, 4340	150-300	500-10000	.003-.006		1	3	2		No
	Tool Steel A-6, D-1, D-2	Up to 300								
Stainless Steel	300 Series, 304, 316	-	300-700	.003-.006		1	2	3		No
	400 Series, 15-5 PH	Up to 320	400-900	.003-.006		1	2	3		Yes
	13-8 PH	-	200-400	.003-.006		1	2	3		No

*Preferred for hardened steel RC58-62.
**Preferred for milling graphite.

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Series DG6H, 1DG1H, 1DP1G, DP5G

Material		Brinell Hardness	SFM	Feed per Insert	Grades: IN2005/IN2505	IN2030	IN6530	IN2540	Coolant
Steel	Mild 1018-1045	125-425	300-650	.035-.157	1				No
	Low Alloy 4140, 8620, 4340	150-425	300-650	.035-.157	2	1	3	4	No
	Med Alloy P20, S7, H13, O1, A2	150-425	300-700	.035-.157	2	1	3	4	No
Stainless Steel	Free Machining 303, 416	150-425	200-550	.030-.100	1	2	3	4	Yes
	300 Series 304, 310, 316								
	400 Series 410, 420, 15-5PH, 17-4 PH								
	PH Series 13-8								
Hardened Steel	ALL	-	200-400	.030-.075	1	2			No

Series SP6H/SP6N

Material		Brinell Hardness	SFM	Feed per Insert	DOC DPM324L	DOC DPM434L	Grades: IN2005	IN1530	IN2030	IN2015	Coolant
Steel	Low Carbon 1018, 8620	100-250	500-800	.035-.100	.040-.080	.060-.120	1	2	2		No
	High Carbon F-6180	250-400	400-700								
	Alloyed Steel 4140, 4340	150-300	300-600								
	Tool Steel A-6, D-1, D-2	Up to 300									
Stainless Steel	300 Series, 304, 316	-	300-600	.030-.080	.030-.080	.050-.100	1	2		3	May not be required at high speeds.
	400 Series 15-5 PH	Up to 320	300-500								
	13-8 PH	-	200-400								
Titanium	6AL-4V	-	100-200	.030-.060	.030-.070	.040-.100	2	1			Yes

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Series 15W7V, 25W1V Material		Brinell Hardness	SFM	Feed per Insert	IN30M	IN1030	Coolant
Aluminum	7075-T6, 6061-T2, 2024	-	1500-8000	.003-.008	2	1	Yes
Cast Iron	Gray	150-250	300-1000	.003-.008		1	No
	Nodular		300-600				
Steel	Low Carbon 1018, 8620	150-250	400-1000	.003-.008		1	No
	High Carbon F-6180	250-400	350-500	.003-.006		1	
	Alloyed Steel 4140, 4340	150-300	300-700	.003-.008		1	
	Tool Steel A-6, D-1, D-2, P-20	Up to 300					
Stainless Steel	300 Series, 304, 316	-	300-700	.003-.006		1	Yes
	400 Series 15-5 PH	Up to 320	400-900				
	13-8 PH	-	200-400				
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.003-.006	2	1	Yes
Titanium	6AL-4V	-	100-150	.003-.006	2	1	Yes

Series 13W7X, 23W1X Material		Brinell Hardness	SFM	Feed per Insert	IN40P	IN1530	IN1540	Coolant
Cast Iron	Gray GM-241M, M3A71-A G2500	150-250	600-900	.015-.025	3	1	2	No
	Nodular GM-245M		500-800					
Steel	Low Carbon 1018-8620	150-250	500-800	.010-.020	3	2	1	No
	Cast Steel GM-190M, M3A76-A							
	Alloyed Steel 4140, 4340, 6150	150-300						
	Tool Steel A-6, D-1, D-2, P-20, W2	Up to 300						
Stainless Steel	300 Series, 304, 316	-	300-500	.008-.015		1		Yes
	400 Series 15-5 PH, 17-4 PH	Up to 320						
	13-8 PH	-	250-350					

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Series 15B Material		Brinell Hardness	SFM	Feed per Insert RPLT, RPLH, (RPLP)	RPLW, (RPLB)	RPLW, RPLB, (RPLS)	RPCW, (RPCB)	Grades IN05S/IN10K	IN1530/IN6530	IN2030	IN2040	IN1540	IN2015/IN5515	IN2005/IN2505	IN2004*	IN2006**	Coolant
Aluminum	6061 T-6, 7075 T-6	-	1500-8000	.005-.015	-	-	.005-.015	1									Yes
Cast Iron	Gray	150-250	250-800	.005-.015	.008-.020	-	.005-.015		2	3			1		3		No
	Nodular		200-800														
Steel	Low Carbon 1018-8620	100-250	250-1000						1	1	3	5	4	2			No
	High Carbon F-6180, Nitralloy 52100	250-400	200-750	.005-.015	.008-.020	-	.005-.015			3	2	4		1			
	Alloyed Steel 4140, 4340, 6150	150-300	250-750														
	Tool Steel A-6, D-1, D-2, P-20	Up to 300	250-750													1	
Stainless Steel	300 Series, 304, 316	-	250-750	.005-.015	.005-.015	.005-.015	.005-.015		2	1	4		3	2			Yes
	400 Series 15-5 PH, 17-4 PH	Up to 320	300-800														
	13-8 PH	-	200-600														
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.005-.008	-	.003-.006	.003-.006		1	2							Yes
Titanium	6AL-4V	-	100-150	.005-.010	-	.005-.008	.005-.008		2	1			3	2			Yes

*Preferred for CGI
**Preferred for milling hardened steel RC58-62

Series 1DB1H, DW_H, TFMR, TBRP Material	SFM	Feed per Insert	Depth of Cut	Grade IN72N	Coolant
Inconel	985 - 2600	.002 - .004	.040 - .120	X	No
Ductile Cast Iron	1970 - 2600	.004 - .012	.040 - .157	X	No

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Series 5W7

Material		Brinell Hardness	SFM	Feed per Insert	IN05S	IN2004	IN2005	IN2015	IN2030	IN2040	IN2006*	Coolant
Aluminum	6061-T6, 7075-T6	-	1500-8000	.010-.025	1							Yes
Cast Iron	Gray	150-250	250-800	.008-.025			2	1	3			No
	Nodular		200-800									
Steel	Low Carbon 1018-8620	150-250	250-1000	.008-.025			3	1		2		No
	High Carbon F-6180	250-400	200-750	.008-.025			2		1	3	*	
	Alloyed Steel 4140	150-300	150-300									
	Tool Steel P20-H13	Up to 300	Up to 300									
Stainless Steel	300 Series, 304, 316	-	250-750	.007-.018			2	3	1	4		Yes
	400 Series 15-5 PH, 17-4 PH	Up to 320	300-800									
	13-8 PH	-	200-600									
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy	-	75-120	.005-.015			2		1			Yes
Titanium	6AL-4V	-	100-150	.004-.015			2		1			Yes

*Preferred for milling hardened steel RC58-62.

Series 5W

Material		Brinell Hardness	SFM	Feed per Insert RPLT, RPLH, (RNLM, RPLP)	Feed per Insert RPLW, (RPLB)	IN40P	IN1530	IN2030	IN2040	IN1540	IN6530	Coolant
Aluminum	6061 T-6, 7075 T-6	-	1500-8000	.005-.015	-		1				2	Yes
Cast Iron	Gray	150-250	250-800	.005-.015	.008-.020		2	3	4		1	No
	Nodular		200-800									
Steel	Low Carbon 1018, 8620	100-250	250-1000	.005-.015	.008-.020	6	1	2	3	5	4	No
	High Carbon F-6180, Nitralloy 52100	250-400	200-750	.005-.015	.008-.020	6	5	3	2	4	1	
	Alloyed Steel 4140, 4340, 6150	150-300	250-750									
	Tool Steel A-6, D-1, D-2, P-20	Up to 300										
Stainless Steel	300 Series, 304, 316	-	250-750	.005-.015	.005-.015		2	1	4		3	May not be required at high speeds
	400 Series, 15-5 PH, 17-4 PH	Up to 320	300-800									
	13-8 PH	-	200-600									Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.005-.008	-		1	2			3	Yes
Titanium	6AL-4V	-	100-150	.005-.010	-		2	1			3	Yes

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CONTOUR MILLING OPERATING GUIDELINES

Series 15W, 5W6

Material		Brinell Hardness	SFM	Feed per Insert	IN2030	IN2040	IN6530	Coolant
					Grades			
Aluminum	6061-T6, 7075-T6	-	1500-8000	.012-.035	1	3	2	Yes
Cast Iron	Gray	150-250	250-800	.010-.025	1	2	3	No
	Nodular		200-800					
Steel	Low Carbon 1018-8620	150-250	250-1000	.010-.025	3	2	1	No
	High Carbon F-6180	250-400	200-750					
	Alloyed Steel 4140	150-300	150-300					
	Tool Steel P20-H13	Up to 300	Up to 300					
Stainless Steel	300 Series, 304, 316	-	250-750	.005-.015	1		2	Yes
	400 Series 15-5 PH, 17-4 PH	Up to 320	300-800					
	13-8 PH	-	200-600					
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy	-	75-120	.005-.008	1		2	Yes
Titanium	6AL-4V	-	100-150	.005-.010	1			Yes

Series VHU

Material		Brinell Hardness	SFM	Feed per Insert	IN2015/IN2010	IN1530	IN2030	IN2040	IN6515/IN6510	Coolant
					Grades					
Aluminum	6061-T6, 7075-T6, 2024	-	1500-8000	.004-.015	1					Yes
Cast Iron	Gray	150-280	400-750	.005-.012	1				2	No
	Nodular		300-650							
			1500+	.004-.007						
Steel	Low Carbon 1018, 8620	100-250	250-500	.005-.010		3	2	1		No
	High Carbon F-6180, Nitralloy 52100	250-400	200-350	.005-.008						
	Alloyed Steel 4140, 4340, 6150	150-300	250-400	.005-.010						
	Tool Steel A-6, D-1, D-2, P-20	Up to 300								
Stainless Steel	300 Series, 304, 316	-	250-400	.003-.006		1	2			May not be required at high speeds
	400 Series, 15-5 PH, 17-4 PH	Up to 320	300-600							
	13-8 PH	-	200-250	.004-.008						Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.003-.006		1	2			Yes
Titanium	6AL-4V	-	100-150	.003-.006		2		2		Yes

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Series SHU

Material		Brinell Hardness	SFM	Feed per Insert	IN2005	IN1530	Coolant
Cast Iron	Gray	150-280	400-750	.007-.018	1		No
	Nodular		300-650				
Steel	Low Carbon 1018, 8620	100-250	250-500	.005-.015	1	2	No
	High Carbon F-6180	250-400	200-350	.006-.013			
	Alloyed Steel 4140, 4340	150-300	250-400	.006-.015			
	Tool Steel A-6, D-1, D-2	Up to 300					
Stainless Steel	300 Series, 304, 316	-	250-400	.005-.010	2	1	May not be required at high speeds
	400 Series, 15-5 PH	Up to 300	300-600				
	13-8 PH	-	200-250	.006-.012			Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-150	.004-.007	2	1	Yes
Titanium	6AL-4V	-	100-150	.004-.007	2	1	Yes

Grades: IN2005, IN1530

Series DHU

Material		Brinell Hardness	SFM	Feed per Insert	IN30M	IN1030/IN1530	IN2005	IN6515	IN6530	IN6520	Coolant
Aluminum	6061 T-6, 7075 T-6	-	1500-8000	.004-.010	1		2				No
Cast Iron	Gray	150-250	250-800	.005-.012			2	1	3	4	No
	Nodular		200-800								
Steel	Low Carbon 1018-8620	100-250	250-800	.004-.012		1	2				No
	High Carbon F-6180, Nitralloy 52100	250-400	200-700	.005-.012		1	2		2	3	
	Alloyed Steel 4140, 4340, 6150	150-300	250-700								
	Tool Steel A-6, D-1, D-2, P-20	Up to 300									
Stainless Steel	300 Series, 304, 316	-	250-600	.004-.008		1	2	1	3	4	Yes
	400 Series 15-5 PH, 17-4 PH	Up to 320	300-700	.005-.010							
	13-8 PH	Up to 320	200-250	.004-.008							
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.004-.008		1	2	1		3	Yes
Titanium	6AL-4V	-	100-150	.004-.008		1	2			3	Yes

Grades: IN30M, IN1030/IN1530, IN2005, IN6515, IN6530, IN6520

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Series 5E6, 15E1

Material		Brinell Hardness	SFM	Feed per Insert CC/CC1/CC2	Feed per Insert CP	Feed per Insert PH/PH2	Grades IN2005	Grades IN2015	Grades IN2030	Grades IN05S	Grades IN2040	Coolant
Aluminum	6061 T-6, 7075 T-6	-	1600-3300	-	.007-.012	-				1		Yes
Cast Iron	Gray	150-250	500-800	.007-.010	-	.015-.039	2	1				No
	Nodular		450-800									
Steel	Low Carbon 1018-8620	150-250	500-700	.007-.012	-	.015-.039	1	3	2			No
	High Carbon F-6180	250-400	450-500	.007-.010	-	.015-.039	1	3	2		3	
	Alloyed Steel 4140	150-300										
	Tool Steel P20-H13	up to 300										
Stainless Steel	300 Series, 304, 316	up to 320	250-500	.006-.010	-	.011-.023	2	3	1			Yes
	400 Series, 15-5 PH, 17-4 PH											
	13-8 PH											
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy	-	50-250	.006-.010	-	.011-.023	2	3	1			Yes
Titanium	6AL-4V	-	50-250	.006-.010	-	.009-.015	2		1			Yes

Recommended Starting Ranges

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Series 1BW, 2BW Material		Brinell Hardness	SFM	Feed per Insert	IN2005	IN2015/IN6515	IN2030	IN2040	Coolant
					Grades				
Aluminum	6061 T-6, 7075 T-6	-	1000-3000	.003-.008		1			Yes
Cast Iron	Gray	150-250	500-1200	.002-.008	2	1			No
	Nodular	150-250	400-800	.002-.008					
Steel	Low Carbon 1018-8620	150-250	600-1200	.005-.020	2		1	3	No
	High Carbon F-6180	250-400	400-600	.005-.020					
	Alloyed Steel 4140	150-300	400-800	.005-.025					
	Tool Steel P-20-H13	Up to 460	400-800	.005-.025					
Stainless Steel	300 Series, 304, 316	-	400-800	.003-.015	2		1	3	No
	400 Series 15-5 PH, 17-4 PH	Up to 320	500-1000	.003-.015					
	13-8 PH	-	200-400	.003-.015					Yes
Nickel Alloys	Inconel 600, 706, 718, 903 Hastelloy	75-120	75-120	.003-.010	2			1	Yes
Titanium	6AL-4V	-	80-150	.002-.006	2			1	Yes

Note: Feed and speed recommendations are starting operating parameters. They are only guidelines from which further optimization should take place. Operating parameters are influenced by many machining variables. These variables may cause for reductions in feeds and speed or dramatic increases. Additionally, DOC and WOC may need to be revised to optimize the tools performance.

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SLOTTER OPERATING GUIDELINES

Series 31J, TSC_K, TSC_A

Material		Brinell Hardness	SFM	Feed per Insert by Width .063	.122	.188	.250	G IN1030	Coolant
Aluminum	7075-T6, 6061-T2, 2024	-	1300-8000	.001-.004	.0015-.007	.0025-.009	.0025-.010	1	Yes
Cast Iron	Gray	150-250	200-400	.001-.004	.0015-.007	.0025-.009	.0025-.010	1	No
	Nodular		200-330						
Steel	Low Carbon 1018-8620	150-250	600-1200	.001-.004	.0015-.007	.0025-.009	.0025-.010	1	No
	High Carbon F-6180	250-400	400-600						
	Alloyed Steel 4140, 4340	150-300	350-800						
	Tool Steel A-6, D-1, D-2	Up to 300	350-800						
Stainless Steel	300 Series, 304, 316	-	400-850	.001-.004	.0015-.007	.0025-.009	.0025-.010	1	Yes
	400 Series, 15-5 PH	Up to 320	460-800						
	13-8 PH	-	115-330						
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	70-200	.001-.004	.0015-.007	.0025-.009	.0025-.010	1	Yes
Titanium	6AL-4V	-	115-200	.001-.004	.0015-.007	.0025-.009	.0025-.010	1	Yes

Series 35J, 38L

Material		Brinell Hardness	SFM	Feed per Insert	Grades IN30M	IN2005	IN2015	IN1030	IN2030	IN2040	Coolant
Aluminum	6061 T-6, 7075 T-6	-	1500-8000	.004-.015	1	3			2		Yes
Cast Iron	Gray	150-250	250-400	.003-.008			1	2	3		No
	Nodular		200-350								
Steel	Low Carbon 1018-8620	100-250	250-600	.003-.008		2		1	1	3	No
	High Carbon F-6180, Nitralloy 52100	250-400	200-350	.005-.010							
	Alloyed Steel 4140, 4340, 6150	150-320	250-400								
	Tool Steel A-6, D-1, D-2, P-20	Up to 320									
Stainless Steel	300 Series, 304, 316	Up to 320	200-350	.005-.010	3	2		1			Yes
	400 Series 15-5 PH, 17-4 PH	Up to 320	200-500								
	13-8 PH	Up to 320	120-250								
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	Up to 320	75-180	.003-.006		2		1	2		Yes
Titanium	6AL-4V	Up to 320	100-150	.004-.008		2		1	1		Yes

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Series 3SJ6E, 3SJ6H

Material		Brinell Hardness	SFM	Feed per Insert	IN2005	IN2015	IN1530	IN2040	Coolant
Cast Iron	Gray	150-280	400-750	.003-.006			1		No
	Nodular		300-650						
Steel	Low Carbon 1018, 8620	100-250	250-500	.003-.006	1			2	No
	High Carbon F-6180	250-400	200-350	.003-.005					
	Alloyed Steel 4140, 4340	150-300	250-400						
	Tool Steel A-6, D-1, D-2	Up to 300							
Stainless Steel	300 Series, 304, 316	-	400-600	.003-.006	2	2		1	May not be required at high speeds
	400 Series, 15-5 PH	Up to 320	300-600						
	13-8 PH	-	200-600						Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-150	.003-.005	1	2		3	Yes
Titanium	6AL-4V	-	100-200	.003-.005	2	2	1		Yes

Series 3SJ6L

Material		Brinell Hardness	SFM	Feed per Insert	IN2005	IN2015	IN1530	IN2040	IN6515	Coolant
Cast Iron	Gray	150-280	400-750	.007-.018	3	1			2	No
	Nodular		300-650							
Steel	Low Carbon 1018, 8620	100-250	250-500	.005-.015	1		3	2		No
	High Carbon F-6180	250-400	200-350	.006-.013						
	Alloyed Steel 4140, 4340	150-300	250-400	.006-.015						
	Tool Steel A-6, D-1, D-2	Up to 300								
Stainless Steel	300 Series, 304, 316	-	250-400	.005-.010	2		1			May not be required at high speeds
	400 Series, 15-5 PH	Up to 300	300-600							
	13-8 PH	-	200-250	.006-.012						Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-150	.004-.007	1		2			Yes
Titanium	6AL-4V	-	100-150	.004-.007	2		1			Yes

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SLOTTER OPERATING GUIDELINES

Series 15T, 12T

Material		Brinell Hardness	SFM	Feed per Insert SPLT06	Feed per Insert SHLT09, APKT	Grades IN2030	Grades IN2005	Grades IN1030	Grades IN2040/IN1040	Grades IN2015	Coolant 12T1B, 15T	Coolant 15T1D
Aluminum	6061 T-6, 7075 T-6	-	1000-8000	.003-.006	.004-.008					1	Yes	Yes
Cast Iron	Gray	150-250	350-1000	.002-.005	.003-.007		2			1	Optional	Yes
	Nodular											
Steel	Low Carbon 1018, 8620	100-250	450-800	.003-.008	.004-.009	1	2	1	3		Optional	Yes
	High Carbon F-6180, Nitralloy 52100	250-400	200-600	.003-.008	.004-.009	1	2	1	3			
	Alloyed Steel 4140, 4340, 6150	150-300	400-800	.003-.008	.004-.008							
	Tool Steel A-6, D-1, D-2, P-20	Up to 300	250-600	.002-.005	.003-.006							
Stainless Steel	300 Series, 304, 316	150-270	350-800	.003-.006	.004-.009	1	2	1			Yes	Yes
	400 Series 15-5 PH, 17-4 PH	Up to 320	275-600	.002-.005	.003-.006							
	13-8 PH	150-270										
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	180-475	150-475	.002-.004	.003-.005	3	2	1			Yes	Yes
Titanium	6AL-4V	110-400	90-250	.002-.005	.003-.006	1	2	1			Yes	Yes

Series 5VK6V, 3VL5V

Material		Brinell Hardness	SFM	Feed per Insert	Grades IN15K	Grades IN2005	Grades IN2015/IN2010	Grades IN1530	Grades IN2030	Grades IN2040	Grades IN6515/IN6510	Grades IN70N	Coolant
Aluminum	6061-T6, 7075-T6, 2024	-	1500-8000	.004-.015	1								Yes
Cast Iron	Gray	150-280	400-750	.005-.012			1				2		No
	Nodular		300-650										
			1500+	.004-.007								1	
Steel	Low Carbon 1018, 8620	100-250	250-500	.005-.010		3			2	1			No
	High Carbon F-6180, Nitralloy 52100	250-400	200-350	.005-.008									
	Alloyed Steel 4140, 4340, 6150	150-300	250-400	.005-.010									
	Tool Steel A-6, D-1, D-2, P-20	Up to 300											
Stainless Steel	300 Series, 304, 316	-	250-400	.003-.006		3		1	2				May not be required at high speeds
	400 Series, 15-5 PH, 17-4 PH	Up to 320	300-600										
	13-8 PH	-	200-250	.004-.008									Yes
Nickel Alloys	Inconel 600, 706, 718, 903, Hastelloy, Waspalloy	-	75-120	.003-.006		2		1	3				Yes
Titanium	6AL-4V	-	100-150	.003-.006		2		2	1				Yes

*Preferred for higher SFM.

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