Greenleaf®

Sustainable Productivity

PRODUCT CATALOG

Issue No. 7

At Greenleaf, we use our expertise in advanced materials technology to develop products of superior quality and performance, and we work with our customers to help them use those products in the most efficient manner. It's our technology and our willingness to work closely with our customers that make us a world leader in cutting tools.

Our customers mean a lot to us, and we give them our personal attention. If you have the opportunity to visit us, we'll be glad to show you through our facilities. We're here to serve you, and we never lose sight of that fact.

Our goal is to help our customers become more successful by solving their productivity problems. We do this in several ways – by developing a better tool design, by producing superior tool materials, or just by offering some good shop-floor advice. Whatever it takes, we'll solve your toughest application problems. While other companies are selling commodities, we're offering technical ability, service, and excellent products.

James M. Greenleaf
President, Greenleaf Corporation
jgreenleaf@greenleafcorporation.com

Greenleaf Corporation is a leading developer of cutting tool technology, specializing in the manufacturing of high-performance tungsten carbide and ceramic inserts as well as innovative tool-holding systems. Greenleaf continues to build on nearly 80 years of innovation, which centers on supplying customers with productive solutions to every metalcutting situation.

Greenleaf Corporation is positioned to serve the evolving needs of companies in all major segments of the metalcutting industry including aerospace, gas turbine, energy, oil and gas, steel, medical, roll turning, automotive, machine tool and rail. Greenleaf's products are engineered to provide optimal performance against a wide range of materials under the most rigorous metalcutting conditions. In addition to specially engineered tool-holding systems and a comprehensive line of carbide inserts, Greenleaf offers high-quality ceramic and ceramic composite materials, which can be custom designed for specific machining applications.

From its headquarters in Saegertown, Pennsylvania, a facility in North Carolina, and sales offices in Europe and China, Greenleaf maintains its commitment to pioneering breakthroughs in cutting tool technology and delivering productivity solutions to customers around the world.

Greenleaf Corporation
18695 Greenleaf Drive
Saegertown, PA 16433 USA
800-458-1850 • 814-763-2915
sales@greenleafcorporation.com

Greenleaf Europe BV
De Steeg 2
6333 AP Schimmert
The Netherlands
+31-45-404-1774
eurooffice@greenleafcorporation.com

Greenleaf (Hunan) High-Tech Materials Co., Ltd.
Changsha, Hunan 410205, China
+86-731-89954796
info@greenleafcorporation.com.cn

MADE IN THE USA
Greenleaf Corporation is ISO 9001 Certified.

Sustainable Productivity

It's who we are... and our promise to you.

Greenleaf's commitment to our customers is simple: Sustainable productivity.

Greenleaf works tirelessly to offer our customers value-added metal-cutting process solutions that continuously improve overall part quality and long-term production rates and efficiency levels. The economic and environmental benefits of improving and sustaining optimal parameters in machining operations are clear: Reduced machining time requires less power, which means lower production costs and a reduced impact on our environment. Using fewer resources to get more quality parts out the door: It's simple, it's clear, it's sustainable.

Greenleaf is in it for the long haul. Our commitment to sustainable productivity in our own corporate operations benefits both the bottom line and the planet, and it is an approach we want to support with every customer in our daily work. We look forward to working closely with you toward this operational goal.

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Phone: 814-763-2915 • 800-458-1850 • Fax: 814-763-4423 • sales@greenleafcorporation.com • www. greenleafcorporation.com

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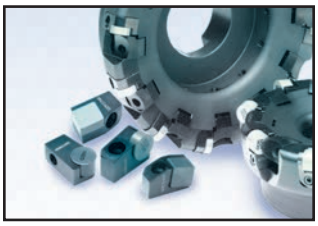
Product Guide

Milling Cutters

Hushcut® Series II Screw-on-Insert Cutter ..... *M 04*
Quiet and free-cutting mills with screw-on insert designs to make the most out of the available horsepower. The free cutting action results in longer tool life and improved surface finishes. Available in end mills and face mills in a wide range of small-to-large diameters.

Index-O-Cut™ ..... *M 08*
The Index-O-Cut™ is a high-performance milling system for all materials thanks to its high shear cutting action and the 45˚ lead angle on the octagon-style insert. These mills are designed to run at higher speeds and feeds than the competition with low horsepower consumption..



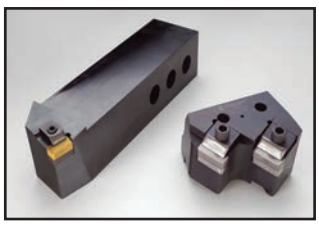
C-4 Series Face Mills..... *M 14*
High-speed ceramic or standard-speed carbide milling for use in high-temp alloys, hard metals, and cast irons at high speeds and accelerated feed rates. Precision nests provide multiple insert configurations and body protection.

Multi-Purpose End Mills..... *M 18*
High-speed ceramic or standard-speed carbide milling with positive and negative designs for a broad range of materials.

Ball Nose End Mills..... *M 30*
Our ball nose end mills are the only ball nose cutters designed to use ceramic and carbide inserts in the same qualified cutter bodies. Combined with our G-925 carbide and WG-600® and XSYTIN®-1 ceramic inserts, the unique cutter geometry offers better performance, longer tool life and superior cutting action over competitors' mills across a wider spectrum of materials. U.S. Patent No. 8,177,459 B2

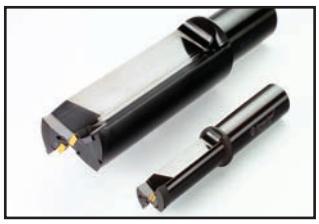
Powermill® Cutters ..... *M 32*
Ideal for heavy-duty cutting in severe interruptions and uneven surfaces. Replaceable components maximize cutter life while providing deep depths of cut.

Heavy Turning



Roll Lathe Tooling..... *HT 28, SE 03*
Greenleaf has extensive experience in the design and manufacture of heavy-turning tooling systems. These systems are extremely productive in heavy-turning applications with both carbide and ceramic inserts..

Indexable Drilling

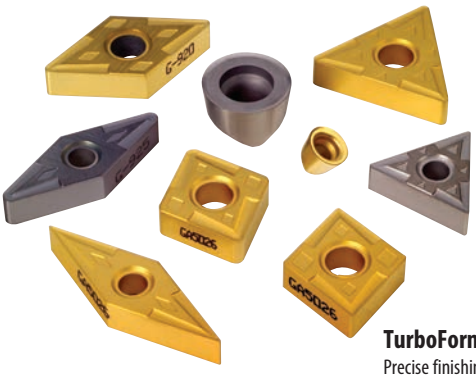


Holemill™ System ..... *ID 01*
Indexable drill utilizing Greenleaf's advanced coated carbide grades for higher speeds, quieter cutting, longer tool life and reduced horsepower consumption. Inserts are positive squares (SPMT) for 4 indexes per insert. 1" to 3" diameter range.

Tube Scarfing

Tube Scarfing..... *TS 01*
Tube scarfing systems from Greenleaf using our indexable inserts offer decreased downtime, longer tool life, faster tool change time, decreased tool costs and elimination of regrinding problems. Superior seams can be achieved since an accurate radius form is always available on each side of the insert..

Greenleaf Surfaces/Geometries



TurboForm® Inserts ..... *TB 07*
Precise finishing with excellent chip control in nickel-based alloys. Very effective for machining wall sections as thin as .050".

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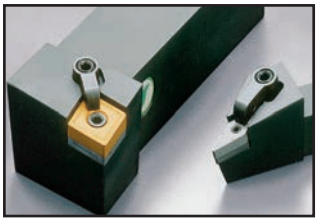
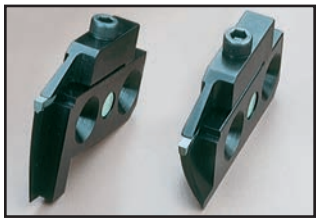
Grooving, Turning, and Boring Systems



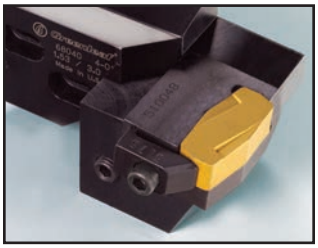
ANSI Toolholders..... *TB 61*
Greenleaf manufactures a complete line of industry-standard toolholders in conformance with ANSI specifications in 4140 and 4150 alloy steel, hardened up to 42 Rc and oxide coated.

GTS – Groove Turn System..... *GP 09*
GTS inserts offer high-speed performance in a chipform geometry specifically designed to allow the Greenleaf carbide grooving insert to double as a turning tool when the application dictates. GTS carbide inserts are qualified to fit into the same pocket as its standard ceramic groover counterpart.

Quick-Change Toolholders..... *TB 83*
The Greenleaf Quick-Change Toolholders conform to ISO 26623, utilize standard components, and are designed to maximize tool life in carbide and ceramic turning applications. All holders are designed with additional axial and radial clearance to allow for use in both external and internal turning applications.



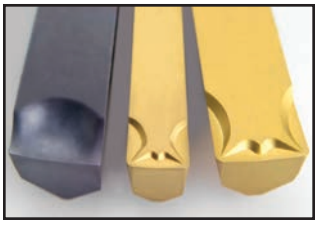
Face Grooving / Support Blades... *GP 47*
A selection of 248 width and face grooving diameter combinations to fit our standard advanced ceramic tooling offering. Support blades accept GTS carbide groovers as well as Greenleaf standard ceramic grooving inserts.



Bar Turning Tools..... *SE 02*
Complete systems are available – heads, cartridges and inserts for Kieserling*, Medart/BlawKnox*, Daisho* and Hetran* bar turning machines.

* *These trademarks or registered trademarks are the property of the respective companies.*

Advanced Tooling..... *TB 87*
Greenleaf ceramic insert tool-holders feature a geometry and pocket depth that maximizes ceramic performance.



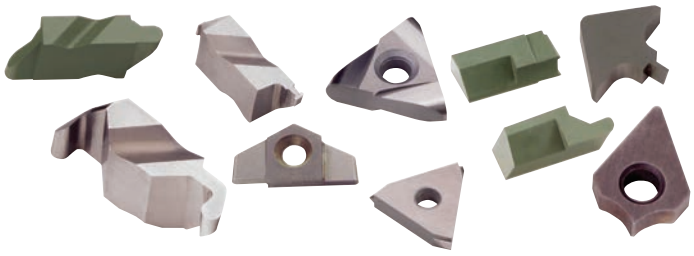
COS – Cut-Off System..... *GP 08*
Greenleaf's advanced Cut-Off System features inserts that are qualified to fit into the standard Greenleaf grooving tools while maintaining superior performance.

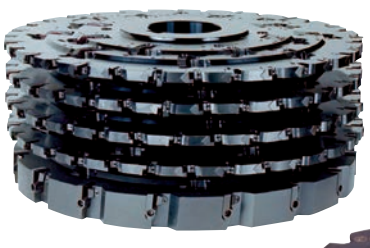
Trigon Inserts.. *TB 31, TB 32, TB 39, TB 56*
Ceramic and carbide. Flexibility of a triangle with the corner strength of an 80° diamond.

Specially Engineered Products

Specially Engineered Products..... *SE 01*
Greenleaf engineers have designed custom operation-specific metal-cutting tools for thousands of customers. Sometimes starting with a concept as simple as a paper sketch, they are able to implement their experience in materials and processes to devise a practical custom application.

From individual inserts making special cuts to ganged cutters providing special cutting paths, Greenleaf CAD engineering services can provide a prompt solution for your special metalcutting needs.





Insert Grades

Carbide

Greenleaf offers a comprehensive line of carbide inserts in grades ranging from sub-micron C-1 through C-8 classifications. An industry pioneer in coated carbide, Greenleaf offers a variety of uncoated, MT-CVD coated and PVD-coated grades. Carbide inserts are available in ANSI standard geometries with multi-purpose chipbreakers for heavy roughing through finishing.

Coated

G5125+ A tough, Co-enriched, CVD-coated grade that is ideally suited for the roughing and semi-finishing of steels in turning. Intended applications range from clean and continuous to heavily interrupted cuts in steels of various hardness and composition, at medium to high speeds and moderate feed rates.

GA5023 A high-performance grade designed for the turning and milling of various grades of cast iron, GA5023 features an advanced MT-CVD coating specifically developed to withstand the abrasiveness of cast iron in machining. Applications range from roughing to finishing in most grades of cast iron, including gray, nodular, and others. The high wear resistance and toughness of GA5023 enable high-speed machining in a wide range of feed rates.

GA5025 A high-speed MT-CVD coated grade developed primarily for turning, GA5025 excels in light roughing and finishing applications of carbon and alloy steels, including select stainless steels. GA5025 is preferred when tool life and wear resistance are essential in steel turning.

GA5026 A high-performance grade specifically developed for finish-turning in nickel- and cobalt-based super-alloys, stainless steels, hardened steels, and refractory metals. The advanced MT-CVD coating over a micro-grain substrate offers outstanding wear resistance while maintaining exceptional resistance to notching and deformation common in turning of high-strength materials. GA5026 is best applied at high speeds and low feed rates.

GA5035 A high-performance MT-CVD coated grade for turning all types of steels, GA5035 can be used for heavy roughing to finish-turning applications requiring resistance to heat deformation, thermal shock from interrupted cuts, and abrasion. GA5035 should be applied at high speeds and a moderate range of feeds. GA5035 is the primary choice for steel turning.

GA5036 A high-speed MT-CVD coated milling grade, GA5036 should be used when milling forged and cast steels and select ductile irons. GA5036 constitutes a unique combination of toughness and heat resistance, making it suitable for heavy and light-duty milling at high cutting speeds. It is a great first choice for all steel milling.

GA5125 A high-performance MT-CVD coated carbide used primarily for the milling and turning of manganese steel. GA5125 can also be applied in Cr-Mo steels, tool steels, and other alloyed steels in continuous and interrupted turning. GA5125 provides excellent resistance to abrasion, crater wear, thermal shock, deformation, and built-up edge. It performs best when applied at high speeds and moderate feed rates.

G-5135 A coarse-grain MT-CVD coated carbide, G-5135 is ideal for rough steel turning operations, including scale and moderate-to-heavy interruptions, as well as select steel milling applications. G-5135 is also applicable in the roughing of cast irons and stainless steels. Apply at moderate speeds and high feed rates.

G-915 A multi-layer PVD-coated grade, G-915 is exceptional for milling and interrupted turning of heat-resistant alloys, stainless steels, and low-carbon steels. The coating adds heat and abrasion resistance to the tough substrate. G-915 should be used at moderate speeds and moderate to high feeds. It is a versatile grade that performs well in a variety of materials and operations outside its primary application range, making it a great choice for general machining.

G-9120 This multi-layer PVD-coated carbide grade excels at milling and turning steel castings and forgings. G-9120 was engineered specifically to maximize productivity at moderate to heavy feed rates and high depths of cut, making it ideal for heavy-turning applications in steel.

G-920 A PVD-coated grade for light-to-medium turning of heat-resistant alloys and some stainless steels. It is also an excellent grade for aluminum and refractory metals. Given its resistance to deformation and notching, G-920 should be applied at higher speeds and is well-suited for grooving and finish-turning of HRSA.

G-9230 A PVD-coated grade designed for the machining of heat-resistant alloys, titanium, hardened steels and stainless steels. G-9230 works particularly well in stainless steel turning, interrupted turning of HRSA, and interrupted turning of titanium. G-9230 has superior wear resistance and toughness and is excellent for casting and forging scale conditions.

G-925 A high-performance multi-layer PVD-coated grade, G-925 is specifically designed for turning abrasive and difficult-to-machine materials. Typical applications include turning of HRSA, titanium and other refractory metals, stainless steels, and ductile cast irons. G-925 exhibits excellent resistance to notching and deformation. Apply at moderate to high speeds and moderate feeds.

G-935 A multi-layer PVD-coated grade for steel milling and turning applications requiring additional resistance to mechanical and thermal shock. The multi-layered PVD coating raises the speed envelope and wear resistance in tough milling, indexable drilling, and interrupted turning applications.

G-9610 A PVD-coated grade, G-9610 is designed for turning titanium-based alloys. The high-tech, wear-resistant, chemically stable, and very smooth and lubricious coating protects the heat-resistant, sub-micron substrate and allows for higher speeds and extended tool life in continuous cuts in non-ferrous alloys.

Uncoated

G-01 Developed for milling heat-resistant alloys, stainless steel, and low-carbon steels at low speeds and moderate to high feeds, G-01 can also be used for turning in the same range of materials with severe interruption or old machinery.

G-01M A tough sub-micron grade, G-01M is used for milling and rough turning stainless steels– even when rolling or casting skin is present. The edge strength of G-01M allows the use of sharp edges and high positive rakes in continuous or interrupted cuts.

G-10 Used for roughing all cast irons in severe conditions, including broaching. The edge strength of G-10 makes it a great choice for roughing Ni-, Co-, and Ti-based alloys with positive rakes, and any machining of non-ferrous materials when toughness is of prime importance. Apply at moderate speeds and feeds.

G-02 An excellent general-purpose cast-iron grade, G-02 can be used for milling and turning cast iron at moderately high speeds and medium feeds. G-02 is also a good choice for machining aluminum with positive rakes and light roughing of some heat-resistant alloys and stainless steels..

G-20M A sub-micron C-2 carbide grade suited for use in light-to-medium turning of titanium and heat-resistant super alloys, G-20M has the strength and edge wear characteristics to resist notching when turning high-strength materials.

G-23 G-23 is a finishing grade for all cast irons, and other short-chipping non-ferrous materials, such as brass and bronze. Apply G-23 at moderately high speeds and moderate feed rates.

G-40 Used for finish turning of cast iron and other hard-wearing materials at high speeds and light feeds in stable conditions.

G-50 A grade used for the heavy roughing of steel and steel castings in unstable conditions, and ferritic stainless steels in most applications, G-50 is tough enough to enable the use of positive rakes in turning.

G-53 An excellent general-purpose milling grade for steels at moderate speeds and feeds. G-53 has a good combination of toughness and wear resistance for milling, or can be used as an all-around grade for mixed-production applications.

G-60 Used for the heavy rough turning of steel, steel castings, and steel forgings. Apply G-60 at moderate speeds and heavy feed rates and depths of cut. G-60 is more wear-resistant than G-50 but is lower in toughness.

G-74 A roughing and finishing grade for steel and steel castings, G-74 should be applied at high speeds and moderate to heavy feeds. It is well-suited for the turning of steel rolls.

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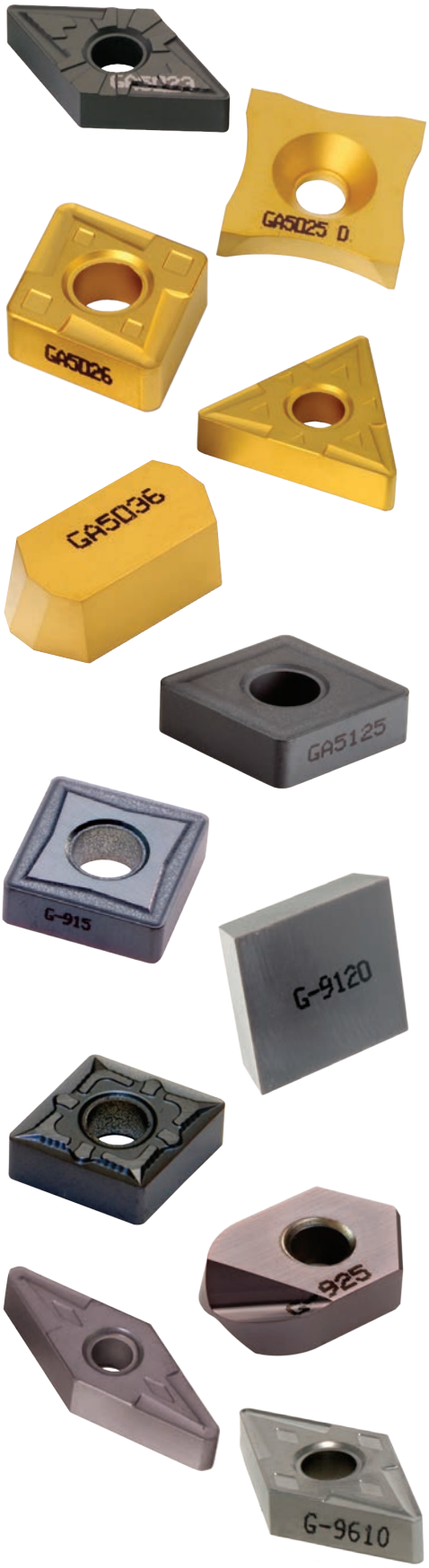


Ceramic

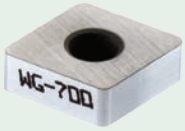
Greenleaf is the industry leader in the development and manufacture of ceramic and coated ceramic inserts in ANSI standard and special geometries. Some of the most prominent include:

WG-300®

A SiC whisker-reinforced Al_2O_3 ceramic that is very effective at machining nickel- and cobalt-based super alloys, alloyed cast iron, and hardened steels at metal removal rates up to 10 times higher than carbide. Excellent chemical stability and wear resistance at very high cutting speeds make WG-300® the first choice worldwide for grooving and turning difficult materials.

WG-600®

A coated SiC whisker-reinforced Al_2O_3 ceramic that offers higher tool life and speed capabilities than uncoated whisker-reinforced ceramics due to the additional barrier to heat and mechanical abrasion. Application areas for WG-600® include rough and finish turning of alloys in the M, K, S, and H ISO material classes, as well as milling of hardened steels and select stainless steels. WG-600® is particularly well-suited for finish-turning and grooving of heat-resistant super alloys and is unmatched in both turning and milling of steels with a hardness above 60 HRc.



WG-700™

A SiC whisker-reinforced Al_2O_3 ceramic featuring improved toughness and a unique low-friction coating. WG-700™ is ideal for turning, grooving, and profiling nickel- and cobalt-based super alloys that other ceramics may struggle in. WG-700™ exhibits exceptional tool life and productivity in next-generation formulations or novel heat treatments of heat-resistant super alloys, and long-reach or thin-walled applications with lower rigidity.

XSYTIN®-1

A phase-toughened ceramic grade capable of sustaining extreme cutting forces. The unprecedented strength, impact toughness, and resistance to thermal shock of XSYTIN®-1 make it ideal for use in interrupted cuts, forging scale removal, and milling. In continuous cuts, the strength of XSYTIN®-1 allows the use of significantly higher feed rates or depths of cut. In machining environments with severe interruptions and scale, the edge strength of XSYTIN®-1 allows the use of very light edge preparations, minimizing the force of impact and making for a much smoother cut.

GSN100™

An engineered blend of hot-pressed silicon nitride and proprietary toughening agents that excels in the machining of cast iron. GSN100™ delivers superior wear and toughness for turning, grooving, and milling applications. It is available in all standard geometries and engineered specials.

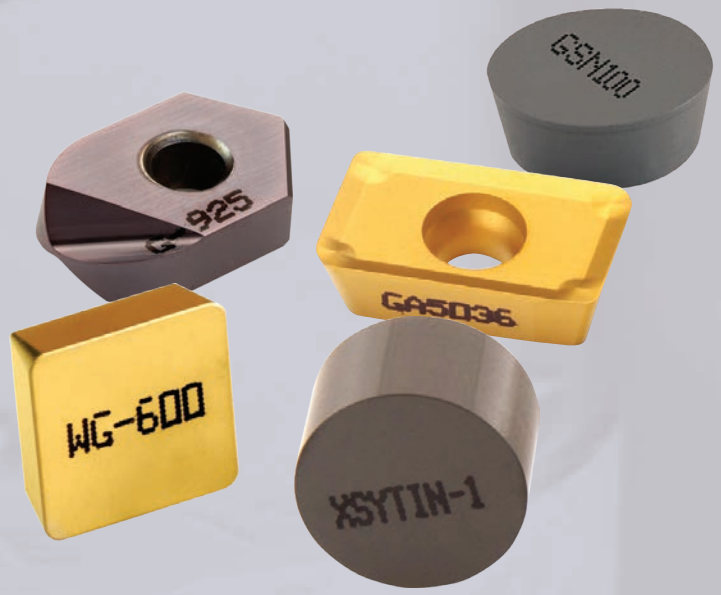
GEM-8™

An Al_2O_3 + TiC composite ceramic exhibiting excellent hardness and strength at elevated temperatures. GEM-8™ offers a high degree of predictability in roll turning and continuous cuts in ferrous alloys.


Greenleaf®

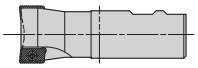

Greenleaf
1-800-458-1850
432458 .625 DIA. TUNE-UP KIT
Greenleaf
1-800-458-1850
432663 .375 DIA. TUNE-UP KIT

Milling

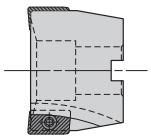


Pictorial Index

Hushcut® Series II Milling System



EM90
0° Lead End Mill
.375"-2.0" Diameter
page: M 06



FM90
0° Lead Face Mill
1.5"-6.0" Diameter
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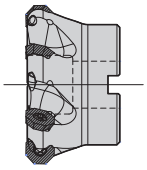
Index-O-Cut™ Milling System



G-OFHP
High Positive Face Mill
Octagon/Round Inserts
2.0"-8.0" Diameter
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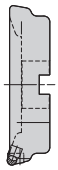
Excelerator Milling Cutters and Inserts



CP4 Series
Face Mill
Positive Rake Inserts, Cutters and Nests
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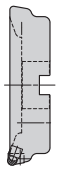

C4 Series
Face Mill
Negative Rake Inserts, Cutters and Nests
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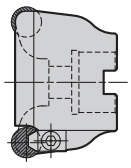

FMRP
Face Mill
Round Positive Inserts
2.0"-4.0" Dia.
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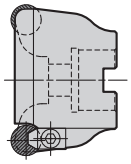
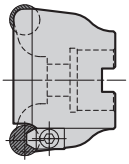
Excelerator Milling Cutters and Inserts *continued*



FMRPF
Face Mill (Fine Pitch)
Coolant Fed
Round Positive Inserts
1.50"-4.0" Dia.
page: M 18



FMRN
Face Mill
Round Negative Inserts
2.0"-4.0" Dia.
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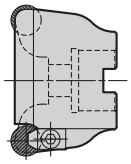
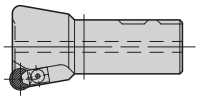
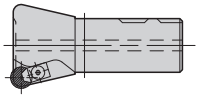


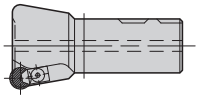
FMRNF
Face Mill (Fine Pitch)
Coolant Fed
Round Negative Inserts
1.50"-4.0" Dia.
page: M 19



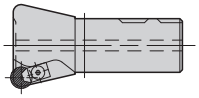
WSRP
End Mill
Round Positive Inserts
.625"-2.50" Dia.
page: M 20



WSRPF
End Mill (Fine Pitch)
Round Positive Inserts
Coolant Fed
.750"-2.0" Dia.
page: M 20

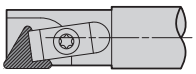


WSRN
End Mill
Round Negative Inserts
Inserts 1.0"-2.5" Dia.
page: M 22

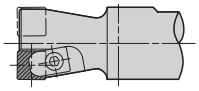


WSRNF
End Mill (Fine Pitch)
Coolant Fed
Round Negative Inserts
Inserts 1.0"-2.5" Dia.
page: M 22

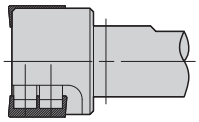
Excelerator Milling Cutters and Inserts *continued*



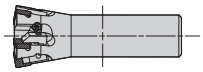
WSTP
End Mill
Positive Triangle Inserts
.5"-.625" Dia.
page: M 24



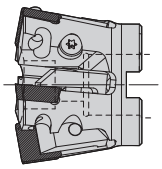
WSSP
End Mill
Positive Square Inserts
.375"-1.5" Dia.
page: M 25



WSAN
End Mill
Parallelogram Inserts
1.0"-2.50" Dia
page: M 26



XFSP
High-Feed Face Mill
Square Positive Inserts
1.0" – 1.5" Diameter
page: M 27



XFSP
High-Feed Face Mill
Square Positive Inserts
2" Diameter
page: M 27

SSBN
Ball Nose End Mill
Ball Nose Inserts
.375" – 1" Diameter
page: M 30

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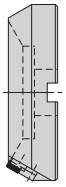
Powermill® Cutters



M430LNP-A
30° Lead Face Mill
Negative Radial
Positive Axial
4"-12" Diameter.
page: M 34

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Hushcut® Series II Milling Cutters

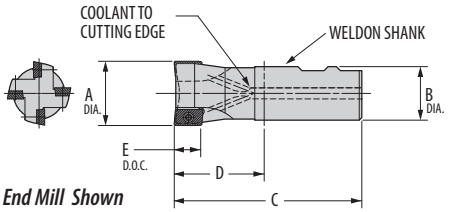
Quiet and free-cutting mills with screw-on insert designs to make the most out of the available power. The free-cutting action results in longer tool life and improved surface finishes. Available in end mills and face mills in a wide range of small to large diameters.

Greenleaf Tune-Up Kits

A Tune-Up Kit consists of all the standard hardware to refurbish a particular toolholder, boring bar, or milling cutter. A toolholder will have a readily visible, laser-inscribed Tune-Up Kit number on it for ease in ordering. This number will prevent any confusion created by searching a catalog for hardware, and it will help reduce downtime.

EM90S/L

0° Lead End Mill



Right-Hand End Mill Shown

Part Number	Gage Insert	Dimensions (inches)					No. of Inserts	Standard Components	*Tune-Up Kit
		A	B	C	D	E			
EM90S-050R-62W	ADGT-16222DFR5LD	0.500	0.625	2.910	1	0.350	1	PT-589T	TK-01002
EM90S-062R-75W	ADGT-16222DFR5LD	0.625	0.750	3.030	1	0.350	2	PT-589T	TK-01003
EM90S-075R-75W	ADGT-16222DFR5LD	0.750	0.750	3.280	1.25	0.350	3	PT-589T	TK-02696
EM90S-088R-100W	ADGT-16222DFR5LD	0.875	1.000	3.530	1.25	0.350	3	313631	TK-02379
EM90S-100R-75W	ADGT-16222DFR5LD	1.000	0.750	3.530	1.5	0.350	4	PT-542T	TK-00860
EM90S-100R-100W	ADGT-16222DFR5LD	1.000	1.000	3.780	1.5	0.350	4	PT-542T	TK-00860
EM90S-125R-125W	ADGT-16222DFR5LD	1.250	1.250	3.780	1.5	0.350	5	PT-542T	TK-00861
EM90S-150R-125W	ADGT-16222DFR5LD	1.500	1.250	3.780	1.5	0.350	5	PT-542T	TK-00861
EM90L-075R-75W	APHT-32.73PD2R**	0.750	0.750	3.380	1.35	0.530	1	PT-559T	TK-00758
EM90L-100R-75W	APHT-32.73PD2R**	1.000	0.750	3.880	1.85	0.530	2	312679	TK-00780
EM90L-100R-100W	APHT-32.73PD2R**	1.000	1.000	4.130	1.85	0.530	2	312679	TK-00780
EM90L-100R-100WL	APHT-32.73PD2R**	1.000	1.000	6.000	3.75	0.530	2	312679	TK-00780
EM90L-125R-75W	APHT-32.73PD2R**	1.250	0.750	4.130	2.1	0.530	3	312679	TK-00781
EM90L-125R-125W	APHT-32.73PD2R**	1.250	1.250	4.380	2.1	0.530	3	312679	TK-00781
EM90L-125R-125WM	APHT-32.73PD2R**	1.250	1.250	5.250	3	0.530	3	312679	TK-00781
EM90L-125R-125WL	APHT-32.73PD2R**	1.250	1.250	6.500	4.25	0.530	3	312679	TK-00781
EM90L-150R-75W	APHT-32.73PD2R**	1.500	0.750	4.130	2.1	0.530	4	312679	TK-00782
EM90L-150R-100W	APHT-32.73PD2R**	1.500	1.000	4.380	2.1	0.530	4	312679	TK-00782
EM90L-150R-125W	APHT-32.73PD2R**	1.500	1.250	4.380	2.1	0.530	4	312679	TK-00782
EM90L-150R-125W3	APHT-32.73PD2R**	1.500	1.250	4.380	2.1	0.530	3	312679	TK-00781
EM90L-150R-125WL	APHT-32.73PD2R**	1.500	1.250	6.500	4.25	0.530	3	312679	TK-00781
EM90L-200R-125W	APHT-32.73PD2R**	2.000	1.250	4.380	2.100	0.530	5	312679	TK-00783

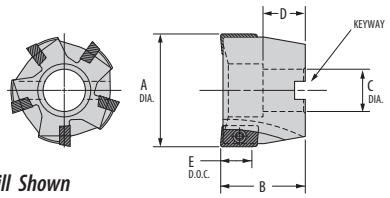
NOTE: For information on screw torque settings, please refer to the chart on page M38.

** Tune-Up Kits include all standard components and necessary wrenches to allow you to completely refurbish cutter.*

*** APET can be used in place of APHT.*

FM90S/L

0° Lead Face Mill



Right-Hand Face Mill Shown

Part Number	Gage Insert	Dimensions (inches)					No. of Inserts	Keyway	Standard Components	*Tune-Up Kit
		A	B	C	D	E				
FM90S-15R	ADGT-16222DFR5LD	1.500	1.500	0.500	0.620	0.350	6	1/4 x 5/32	PT-542T	TK-00862
FM90S-20R	ADGT-16222DFR5LD	2.000	1.500	0.750	0.750	0.350	7	5/16 x 3/16	PT-542T	TK-00863
FM90S-25R	ADGT-16222DFR5LD	2.500	1.500	1.000	0.750	0.350	8	3/8 x 1/4	PT-542T	TK-00864
FM90S-30R	ADGT-16222DFR5LD	3.000	2.000	1.000	0.750	0.350	9	3/8 x 1/4	PT-542T	TK-00913
FM90L-20R	APHT-32.73PD2R**	2.000	1.500	0.750	0.750	0.530	5	5/16 x 3/16	312679	TK-00783
FM90L-25R	APHT-32.73PD2R**	2.500	1.500	1.000	0.750	0.530	6	3/8 x 1/4	312679	TK-00784
FM90L-30R	APHT-32.73PD2R**	3.000	2.000	1.000	0.750	0.530	7	3/8 x 1/4	312679	TK-00785
FM90L-40R	APHT-32.73PD2R**	4.000	2.000	1.500	1.060	0.530	8	5/8 x 3/8	312679	TK-00786
FM90L-50R	APHT-32.73PD2R**	5.000	2.500	1.500	1.060	0.530	10	5/8 x 3/8	312679	TK-01249
FM90L-60R	APHT-32.73PD2R**	6.000	2.500	1.500	1.060	0.530	12	5/8 x 3/8	312679	TK-00787

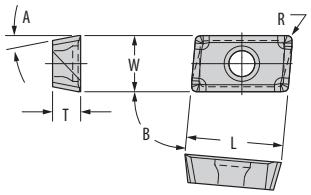
NOTE: For information on screw torque settings, please refer to the chart on page M38.

** Tune-Up Kits include all standard components and necessary wrenches to allow you to completely refurbish cutter.*

*** APET can be used in place of APHT.*

Hushcut Inserts

ADGT, APHT, and APET



Inserts	Part Number ANSI	Steel P			Stainless Steel M		Cast Iron K		Heat-Resistant Super Alloys S		Part Number ISO	Dimensions (inches)					
		GA5036	G-915	G-9120	G-915	G-9230	G-915	GA5023	G-915	G-9230		L	W	T	R	A	B
	ADGT-16222DFR5LD	◆	▲	●	◆	▲	◆	▲	◆	▲	ADGT-100308DFRLD	0.394	0.264	0.138	0.031	16°	84°
	ADGT-16224DFR5LD	◆	▲	●	◆	▲	◆	▲	◆	▲	ADGT-100316DFRLD	0.394	0.264	0.138	0.063	16°	84°
	APHT-32.73PD2R	◆	▲	●	◆	▲	◆	▲	◆	▲	APHT-160408PDR	0.647	0.375	0.187	0.031	11°	85°
	APHT-32.73PD4R	◆	▲	●	◆	▲	◆	▲	◆	▲	APHT-160416PDR	0.647	0.375	0.187	0.063	11°	85°
	APHT-32.73PD8R	◆	▲	●	◆	▲	◆	▲	◆	▲	APHT-160432PDR	0.647	0.375	0.187	0.125	11°	85°
	APET-32.73XD2R	◆	▲	●	◆	▲	◆	▲	◆	▲	APET-160408PDR	0.660	0.375	0.188	0.031	11°	85°
	APET-32.73XD4R	◆	▲	●	◆	▲	◆	▲	◆	▲	APET-160416PDR	0.653	0.375	0.188	0.063	11°	85°
	APET-32.73XD6R	◆	▲	●	◆	▲	◆	▲	◆	▲	APET-160432PDR	0.653	0.375	0.188	0.094	11°	85°

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages M 36–37

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Index-O-Cut™ Milling Cutters

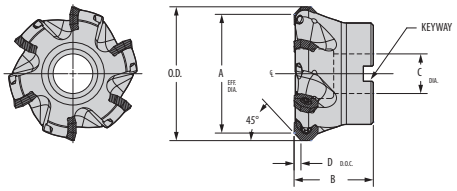
The Index-O-Cut™ is a high-performance milling system for all materials thanks to its high-shear cutting action and the 45° lead angle on the octagon-style insert. These mills are capable of running at higher speeds and feeds than the competition with low power consumption.

Greenleaf Tune-Up Kits

A Tune-Up Kit consists of all the standard hardware to refurbish a particular toolholder, boring bar, or milling cutter. A toolholder will have a readily visible, laser-inscribed Tune-Up Kit number on it for ease in ordering. This number will prevent any confusion created by searching a catalog for hardware, and it will help reduce downtime.

Index-O-Cut™

G-OFHP Face Mill



Part Number	Gage Insert	Dimensions (inches)					No. of Inserts	Keyway	Standard Components	*Tune-Up Kit
		A	O.D.	B	C	D**				
G-OFHP-0545E200	00EW-534	2.000	2.381	1.500	0.750	0.173	4	5/16	PT-546-T	TK-03249
G-OFHP-0545E250	00EW-534	2.500	2.879	1.750	1.000	0.173	5	3/8	PT-546-T	TK-03165
G-OFHP-0545E300	00EW-534	3.000	3.378	2.000	1.000	0.173	6	3/8	PT-546-T	TK-03250
G-OFHP-0545E400	00EW-534	4.000	4.375	2.000	1.500	0.173	7	5/8	PT-546-T	TK-03444
G-OFHP-0545E500	00EW-534	5.000	5.374	2.000	1.500	0.173	8	5/8	PT-546-T	TK-03445
G-OFHP-0545E600	00EW-534	6.000	6.373	2.000	1.500	0.173	9	5/8	PT-546-T	TK-03651
G-OFHP-0545E800	00EW-534	8.000	8.372	2.000	2.500	0.173	10	1	PT-546-T	TK-03437

** Tune-Up Kits include all standard components and necessary wrenches to allow you to completely refurbish cutter.*

*** Maximum depth of cut is 0.173". Maximum depth of cut for R0EW inserts will be half of IC. (0.3125")*

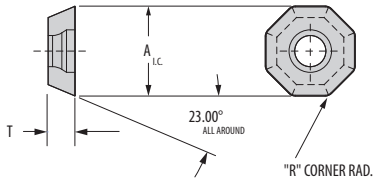
NOTE: For information on screw torque settings, please refer to the chart on page M38.

NOTE: Index-O-Cut milling cutters can be ordered in differential pitch for all diameters.

NOTE: All Index-O-Cut milling cutters contain coolant/air thru capabilities except G-OFHP-0545E800

Index-O-Cut™ Inserts

00EW



Inserts	Part Number ANSI	Steel			Stainless Steel		Cast Iron		Heat-Resistant Super Alloys		Part Number ISO	Dimensions (inches)		
		P			M		K		S					
		G-915	G-9120	G-9230	G-915	G-9230	G-915	GA5023	G-915	G-9230		A	T	R
	00EW-534	●	◆	▲	◆	▲	▲	◆	◆	▲	00EW-060416	0.625	0.188	0.063

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages M 36–37

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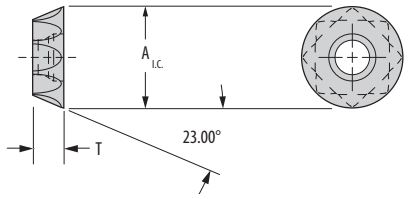
Index-O-Cut™ Inserts

ROEW



Inserts	Part Number ANSI	Steel P		Stainless Steel M		Cast Iron K		Heat-Resistant Super Alloys S		Part Number ISO	Dimensions (inches)	
		G-915	G-9120	G-915	G-9230	G-915	GA5023	G-915	G-9230		A	T
	ROEW-534	●	◆	◆	▲	▲	◆	◆	▲	ROEW-060416	0.625	0.188

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages M 36–37

Performance Calculations

Starting Speeds and Feeds for Index-O-Cut™

Work Material	Insert Grades	Hardness (HRc)	Cutting Speed (SFM)	Maximum Feed per Tooth (IPT)
Low-Carbon Steel / Free Machining	G-9120	<25	1200-1600	0.005-0.010
Alloy Steel (4140, 4130, 6150, 8620)	G-9120	15-30	900-1400	0.004-0.007
High-Carbon Steel (1080,1541, Nitralloy, 52100)	G-9120	25-40	600-1000	0.003-0.006
Tool Steel (A6, D2, P-20, H-13)	G-9120	<30	800-1200	0.004-0.008
HRSA (Inconel, Hastelloy, Waspaloy)	G-915	<35	150-300	0.003-0.007
Stainless Steel (304, 316, 17-4 PH)	G-915	<32	900-1500	0.004-0.009
Cast Iron	GA5023	<32	400-1000	0.005-0.010

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Excelerator® Milling Cutters

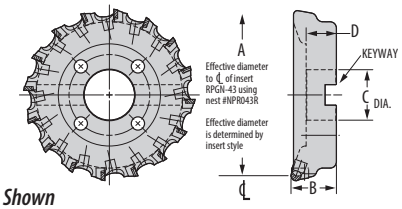
High-speed ceramic or standard-speed carbide milling for use in high-temp alloys, hard metals, and cast irons at high speeds and accelerated feed rates. Precision nests provide multiple insert configurations and body protection.

Greenleaf Tune-Up Kits

A Tune-Up Kit consists of all the standard hardware to refurbish a particular toolholder, boring bar, or milling cutter. A toolholder will have a readily visible, laser-inscribed Tune-Up Kit number on it for ease in ordering. This number will prevent any confusion created by searching a catalog for hardware, and it will help reduce downtime.

CP4 Series

Positive Rake Face Mill



Right-Hand End Mill Shown

Part Number		Dimensions (inches)				Keyway	Bolt Circle	No. of Inserts	Standard Components			*Tune-Up Kit
Right Hand	Left Hand	A	B	C	D				Wedge	Wedge Screw	Nest Screw	
CP-403R	–	3.000	2.000	1.250	0.750	1/2 x 9/32	–	6	425605	430578	SE03-02	TK-01141
–	CP-403L	3.000	2.000	1.250	0.750	1/2 x 9/32	–	6	425605	430578	SE03-02	TK-01141
CP-404R	–	4.000	2.250	1.500	1.000	5/8 x 3/8	–	8	425605	425606	SE03-02	TK-00841
–	CP-404L	4.000	2.250	1.500	1.000	5/8 x 3/8	–	8	425605	425606	SE03-02	TK-00841
CP-405R	–	5.000	2.250	1.500	1.000	5/8 x 3/8	–	10	425605	425606	SE03-02	TK-00845
–	CP-405L	5.000	2.250	1.500	1.000	5/8 x 3/8	–	10	425605	425606	SE03-02	TK-00845
CP-406R	–	6.000	2.250	2.000	1.000	3/4 x 7/16	–	12	425605	425606	SE03-02	TK-00842
–	CP-406L	6.000	2.250	2.000	1.000	3/4 x 7/16	–	12	425605	425606	SE03-02	TK-00842
CP-408R	–	8.000	2.250	2.500	1.500	1 x 9/16	4	16	425605	425606	SE03-02	TK-00843
–	CP-408L	8.000	2.250	2.500	1.500	1 x 9/16	4	16	425605	425606	SE03-02	TK-00843
CP-410R	–	10.000	2.750	2.500	1.500	1 x 9/16	4, 4-3/4	20	425605	425606	SE03-02	TK-00846
–	CP-410L	10.000	2.750	2.500	1.500	1 x 9/16	4, 4-3/4	20	425605	425606	SE03-02	TK-00846
CP-412R	–	12.000	2.750	2.500	1.500	1 x 9/16	4, 4-3/4, 7	24	425605	425606	SE03-02	TK-00847
–	CP-412L	12.000	2.750	2.500	1.500	1 x 9/16	4, 4-3/4, 7	24	425605	425606	SE03-02	TK-00847

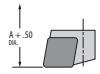
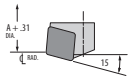
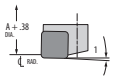
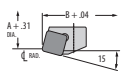
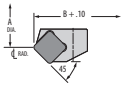
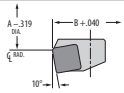
** Tune-Up Kits include all standard components and necessary wrenches to allow you to completely refurbish cutter.*

NOTE: For information on screw torque settings, please refer to the chart on page M38.

NOTE: Cutters are supplied less insert and nest. Nest must be purchased separately. Insert shape, size and quantity must be determined after choosing cutter and nest. Left-hand cutters can be built to order.

CP4 Series

Nests

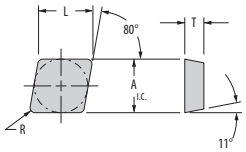
Nests	Nest Part Number		Gage Insert
	Right Hand	Left Hand	
	NPC043R	—	CPGN-433
	—	NPC043L	
	NPC1543R	—	CPGN-433
	—	NPC1543L	
	NPR043R	—	RPGN-43
	—	NPR043L	
	NPS143R	—	SPGN-434
	—	NPS143L	
	NPS1543R		SPGN-434
	—	NPS1543L	
	NPS4543R	—	SPGN-434
	—	NPS4543L	
	XFNPS8043R	—	SPGN-433
	—	XFNPS8043L	

NOTE: For applications which will not require the maximum number of inserts, the filler block nest NPB, will act as a replacement for the inserts and insert nests
The filler block nest must be locked securely in place with the wedge to insure cutter integrity.

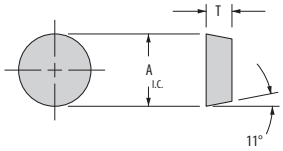
CP4 Inserts

CPGN, RPGN and SPGN

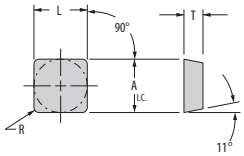
CPGN



RPGN



SPGN



Inserts	Part Number ANSI	Steel P			Stainless Steel M			Cast Iron K				Heat-Resistant Super Alloys S					Hardened Steel H			Part Number ISO	Dimensions (inches)			
		GA5036	G-915	G-9120	G-915	G-9230	WG-600®	G-9230	G-915	GSN100™	XSYTIN®-1	G-915	G-9230	WG-600®	WG-300®	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1		A	T	F	R
	CPGN-433	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	CPGN-120412	0.500	0.507	0.187	0.047
	CPGN-434	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	CPGN-120416	0.500	0.507	0.187	0.062
	RPGN-43	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RPGN-120400	0.500	N/A	0.187	N/A
	SPGN-433	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SPGN-120412	0.500	0.500	0.187	0.047
	SPGN-434	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SPGN-120416	0.500	0.500	0.187	0.062

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

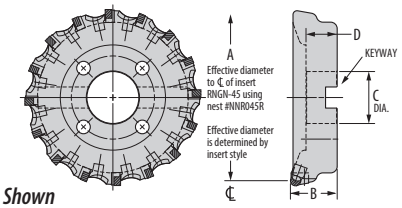
Grade descriptions — pages M 36–37

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

NOTE: For additional nose radii and available edge preps, please contact Greenleaf Tech Team.

C4 Series

Negative Rake Face Mill



Right-Hand End Mill Shown

Part Number		Dimensions (inches)				Keyway	Bolt Circle	No. of Inserts	Standard Components			*Tune-Up Kit
Right Hand	Left Hand	A	B	C	D				Wedge	Wedge Screw	Nest Screw	
C-403R	–	3.000	2.000	1.250	0.750	1/2 x 9/32	–	6	425605	430578	SE03-02	TK-00851
–	C-403L	3.000	2.000	1.250	0.750	1/2 x 9/32	–	6	425605	430578	SE03-02	TK-00851
C-404R	–	4.000	2.250	1.500	1.000	5/8 x 3/8	–	8	425605	425606	SE03-02	TK-00841
–	C-404L	4.000	2.250	1.500	1.000	5/8 x 3/8	–	8	425605	425606	SE03-02	TK-00841
C-405R	–	5.000	2.250	1.500	1.000	5/8 x 3/8	–	10	425605	425606	SE03-02	TK-00845
–	C-405L	5.000	2.250	1.500	1.000	5/8 x 3/8	–	10	425605	425606	SE03-02	TK-00845
C-406R	–	6.000	2.250	2.000	1.000	3/4 x 7/16	–	12	425605	425606	SE03-02	TK-00842
–	C-406L	6.000	2.250	2.000	1.000	3/4 x 7/16	–	12	425605	425606	SE03-02	TK-00842
C-408R	–	8.000	2.250	2.500	1.500	1 x 9/16	4	16	425605	425606	SE03-02	TK-00843
–	C-408L	8.000	2.250	2.500	1.500	1 x 9/16	4	16	425605	425606	SE03-02	TK-00843
C-410R	–	10.000	2.750	2.500	1.500	1 x 9/16	4, 4-3/4	20	425605	425606	SE03-02	TK-00846
–	C-410L	10.000	2.750	2.500	1.500	1 x 9/16	4, 4-3/4	20	425605	425606	SE03-02	TK-00846
C-412R	–	12.000	2.750	2.500	1.500	1 x 9/16	4, 4-3/4, 7	24	425605	425606	SE03-02	TK-00847
–	C-412L	12.000	2.750	2.500	1.500	1 x 9/16	4, 4-3/4, 7	24	425605	425606	SE03-02	TK-00847

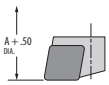
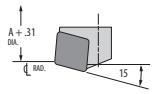
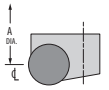
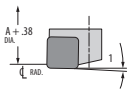
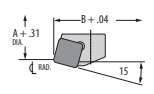
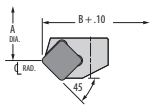
** Tune-Up Kits include all standard components and necessary wrenches to allow you to completely refurbish cutter.*

NOTE: For information on screw torque settings, please refer to the chart on page M38.

NOTE: Cutters are supplied less insert and nest. Nest must be purchased separately. Insert shape, size and quantity must be determined after choosing cutter and nest. Left-hand cutters can be built to order.

C4 Series

Nests

Nests	Nest Part Number		Gage Insert
	Right Hand	Left Hand	
	NNC043R	—	CNGN-433
	—	NNC043L	
	NNC045R	—	CNGN-453
	—	NNC045L	
	NNC1543R	—	CNGN-433
	—	NNC1543L	
	NNC1545R	—	CNGN-453
	—	NNC1545L	
	NNR043R	—	RNGN-43
	—	NNR043L	
	NNR045R	—	RNGN-45
	—	NNR045L	
	NNS143R	—	SNGN-434
	—	NNS143L	
	NNS145R	—	SNGN-454
	—	NNS145L	
	NNS1543R	—	SNGN-434
	—	NNS1543L	
	NNS1545R	—	SNGN-454
	—	NNS1545L	
	NNS4543R	—	SNGN-434
	—	NNS4543L	
	NNS4545R	—	SNGN-454
	—	NNS4545L	

NOTE: For applications which will not require the maximum number of inserts, the filler block nest NNB, will act as a replacement for the inserts and insert nests
The filler block nest must be locked securely in place with the wedge to insure cutter integrity.

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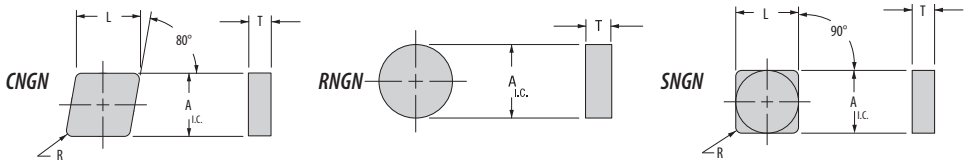
C4 Inserts

CNGN, RNGN, and SNGN



Inserts	Part Number ANSI	Steel P			Stainless Steel M			Cast Iron K				Heat-Resistant Super Alloys S					Hardened Steel H			Part Number ISO	Dimensions (inches)			
		GA5036	G-915	G-9120	G-915	G-9230	WG-600®	G-9230	G-915	GSN100™	XSYTIN®-1	G-915	G-9230	WG-600®	WG-300®	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1		A	T	F	R
	CNGN-433	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	CNGN-120412	0.500	0.508	0.187	0.047
	CNGN-434	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	CNGN-120416	0.500	0.508	0.187	0.062
	CNGN-453	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	CNGN-120712	0.500	0.508	0.312	0.047
	CNGN-454	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	CNGN-120716	0.500	0.508	0.312	0.062
	RNGN-43	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RNGN-120400	0.500	–	0.187	–
	RNGN-45	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RNGN-120700	0.500	–	0.312	–
	SNGN-433	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SNGN-120412	0.500	0.500	0.187	0.047
	SNGN-434	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SNGN-120416	0.500	0.500	0.187	0.062
	SNGN-453	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SNGN-120712	0.500	0.500	0.312	0.046
	SNGN-454	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SNGN-120716	0.500	0.500	0.312	0.062

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages M 36–37

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

NOTE: For additional nose radii and available edge preps, please contact Greenleaf Tech Team.

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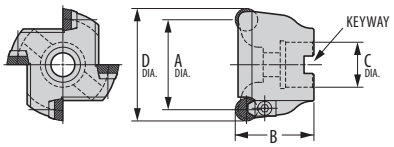
FMRP–FMRPF

Round Positive Face Mill



Right-Hand Face Mill Shown

Part Number		Gage Inserts	Dimensions (inches)				No. of Inserts	Mounting Screw	Keyway	Standard Components				*Tune-Up Kit
Right Hand	Left Hand**		A	B	C	D				Anvil	Anvil Screw	Clamp	Clamp Screw	
FMRP-200R		RPGN-43	2.000	1.750	0.750	2.500	4	3/8 SHCS	5/16x3/16	308341	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-00649
	FMRP-200L	RPGN-43	2.000	1.750	0.750	2.500	4	3/8 SHCS	5/16x3/16	308341	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-00649
FMRP-250R		RPGN-43	2.500	1.750	1.000	3.000	4	1/2 SHCS	3/8x1/4	308341	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-00814
	FMRP-250L	RPGN-43	2.500	1.750	1.000	3.000	4	1/2 SHCS	3/8x1/4	308341	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-00814
FMRP-300R		RPGN-43	3.000	2.000	1.250	3.500	5	5/8 SHCS	1/2x 5/16	308341	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-00815
	FMRP-300L	RPGN-43	3.000	2.000	1.250	3.500	5	5/8 SHCS	1/2x5/16	308341	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-00815
FMRP-400R		RPGN-43	4.000	2.250	1.500	4.500	6	15LS	5/8x3/8	308341	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-00816
	FMRP-400L	RPGN-43	4.000	2.250	1.500	4.500	6	15LS	5/8x3/8	308341	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-00816
FMRPF-150R		RPGN-43	1.500	1.750	0.750	2.000	5	3/8 SHCS	5/16x3/16	-	-	3025-1	438919	TK-03861
	FMRPF-150L	RPGN-43	1.500	1.750	0.750	2.000	5	3/8 SHCS	5/16x3/16	-	-	3025-1	438919	TK-03861
FMRPF-200R		RPGN-43	2.000	1.750	0.750	2.500	6	3/8 SHCS	5/16x3/16	308341	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-04689
	FMRPF-200L	RPGN-43	2.000	1.750	0.750	2.500	6	3/8 SHCS	5/16x3/16	308341	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-04689
FMRPF-250R		RPGN-43	2.500	1.750	1.000	3.000	7	1/2 SHCS	3/8x1/4	308341	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-04195
	FMRPF-250L	RPGN-43	2.500	1.750	1.000	3.000	7	1/2 SHCS	3/8x1/4	308341	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-04195
FMRPF-300R		RPGN-43	3.000	2.000	1.250	3.500	7	5/8 SHCS	1/2x 5/16	308341	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-00816
	FMRPF-300L	RPGN-43	3.000	2.000	1.250	3.500	7	5/8 SHCS	1/2x 5/16	308341	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-00816
FMRPF-400R		RPGN-43	4.000	2.250	1.500	4.500	10	15LS	5/8x3/8	308341	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-04425
	FMRPF-400L	RPGN-43	4.000	2.250	1.500	4.500	10	15LS	5/8x3/8	308341	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-04425

* *Tune-Up Kits include all standard components and necessary wrenches to allow you to completely refurbish cutter.*

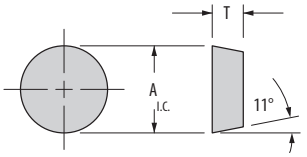
** *Left-Hand cutters are made to order only.*

NOTE: For information on screw torque settings, please refer to the chart on page M38.

NOTE: FMRPF milling cutters contain coolant/air thru capabilities.

FMRP–FMRPF Inserts

RPGN



Inserts	Part Number ANSI	Steel			Stainless Steel			Cast Iron				Heat-Resistant Super Alloys					Hardened Steel			Part Number ISO	Dimensions (inches)	
		P			M			K				S					H				A	T
		GA5036	G-915	G-9120	G-915	G-9230	WG-600®	G-9230	G-915	GSN100™	XSYTIN®-1	G-915	G-9230	WG-600®	WG-300®	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1			
	RPGN-43	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RPGN-120400	0.500	0.187

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages M 36–37

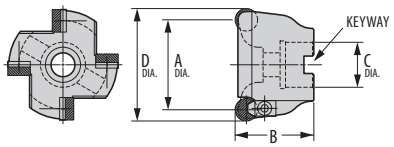
CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

NOTE: For additional nose radii and available edge preps, please contact Greenleaf Tech Team.

Phone: 814-763-2915 • 800-458-1850 • Fax: 814-763-4423 • sales@greenleafcorporation.com • www. greenleafcorporation.com

FMRN–FMRNF

Round Negative Face Mill



Right-Hand Face Mill Shown

Part Number		Gage Inserts	Dimensions (inches)				No. of Inserts	Mounting Screw	Keyway	Standard Components				*Tune-Up Kit
Right Hand	Left Hand**		A	B	C	D				Anvil	Anvil Screw	Clamp	Clamp Screw	
FMRN-200R		RNGN-43	2.000	1.750	0.750	2.500	4	3/8 SHCS	5/16x3/16	313572	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-02695
	FMRN-200L	RNGN-43	2.000	1.750	0.750	2.500	4	3/8 SHCS	5/16x3/16	313572	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-02695
FMRN-250R		RNGN-43	2.500	1.750	1.000	3.000	4	1/2 SHCS	3/8x1/4	313572	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-02695
	FMRN-250L	RNGN-43	2.500	1.750	1.000	3.000	4	1/2 SHCS	3/8x1/4	313572	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-02695
FMRN-300R		RNGN-43	3.000	2.000	1.250	3.500	5	5/8 SHCS	1/2x 5/16	313572	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-02697
	FMRN-300L	RNGN-43	3.000	2.000	1.250	3.500	5	5/8 SHCS	1/2x5/16	313572	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-02697
FMRN-400R		RNGN-43	4.000	2.250	1.500	4.500	6	15LS	5/8x3/8	313572	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-02698
	FMRN-400L	RNGN-43	4.000	2.250	1.500	4.500	6	15LS	5/8x3/8	313572	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-02698
FMRNF-150R†		RNGN-43	1.500	1.750	0.750	2.000	5	3/8 SHCS	5/16x3/16	-	-	3025-1	438919	TK-03861
	FMRNF-150L†	RNGN-43	1.500	1.750	0.750	2.000	5	3/8 SHCS	5/16x3/16	-	-	3025-1	438919	TK-03861
FMRNF-200R		RNGN-43	2.000	1.750	0.750	2.500	6	3/8 SHCS	5/16x3/16	313572	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-02698
	FMRNF-200L	RNGN-43	2.000	1.750	0.750	2.500	6	3/8 SHCS	5/16x3/16	313572	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-02698
FMRNF-250R		RNGN-43	2.500	1.750	1.000	3.000	7	1/2 SHCS	3/8x1/4	313572	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-04195
	FMRNF-250L	RNGN-43	2.500	1.750	1.000	3.000	7	1/2 SHCS	3/8x1/4	313572	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-04195
FMRNF-300R		RNGN-43	3.000	2.000	1.250	3.500	8	5/8 SHCS	1/2x 5/16	313572	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-04415
	FMRNF-300L	RNGN-43	3.000	2.000	1.250	3.500	8	5/8 SHCS	1/2x 5/16	313572	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-04415
FMRNF-400R		RNGN-43	4.000	2.250	1.500	4.500	10	15LS	5/8x3/8	313572	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-04407
	FMRNF-400L	RNGN-43	4.000	2.250	1.500	4.500	10	15LS	5/8x3/8	313572	#4-40x1/4 FHCS	3025-1	#10-32x1/2 SHCS	TK-04407

** Tune-Up Kits include all standard components and necessary wrenches to allow you to completely refurbish cutter.*

*** Left-Hand cutters are made to order only.*

† FMRNF-150 will not accept RNGN-42 or RNGN-45.

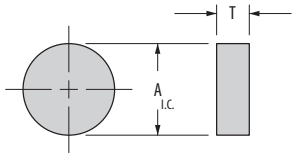
NOTE: For information on screw torque settings, please refer to the chart on page M38.

NOTE: FMRNF milling cutters contain coolant/air thru capabilities.

NOTE: For Insert RNGN-42, use anvil 312780. For insert RNGN-45, use no anvil.

FMRN–FMRNF Inserts

RNGN



Inserts	Part Number ANSI	Steel P			Stainless Steel M			Cast Iron K				Heat-Resistant Super Alloys S					Hardened Steel H			Part Number ISO	Dimensions (inches)	
		GA5036	G-915	G-9120	G-915	G-9230	WG-600®	G-9230	G-915	GSN100™	XSYTIN®-1	G-915	G-9230	WG-600®	WG-300®	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1		A	T
	RNGN-42	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RNGN-120300	0.500	0.125
	RNGN-43	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RNGN-120400	0.500	0.187
	RNGN-45	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RNGN-120700	0.500	0.312

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

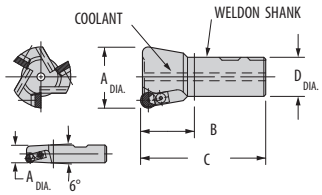
Grade descriptions — pages M 36–37

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

NOTE: For additional nose radii and available edge preps, please contact Greenleaf Tech Team.

WSRP-WSRPF

Round Positive End Mill



Right-Hand Cutter Shown

Part Number		Gage Inserts	Dimensions (inches)				No. of Inserts	Standard Components				*Tune-Up Kit
Right Hand	Left Hand**		A	B	C	D		Anvil	Anvil Screw	Clamp	Clamp Screw	
WSRP-60000.6-RH †		RPGN-21.5	0.625	1.250	3.160	0.625	2	–	–	423978	#3-48 x 1/4 SHCS	TK-00879
	WSRP-60000.6-LH †	RPGN-21.5	0.625	1.250	3.160	0.625	2	–	–	423978	#3-48 x 1/4 SHCS	TK-00879
WSRP-60000.7-RH †		RPGN-2.52	0.750	1.250	3.280	0.750	2	–	–	429323	SE02-01	TK-00880
	WSRP-60000.7-LH †	RPGN-2.52	0.750	1.250	3.280	0.750	2	–	–	429323	SE02-01	TK-00880
WSRP-60001A-RH		RPGN-2.52	1.000	1.250	3.280	0.750	3	–	–	429323	SE02-01	TK-00917
	WSRP-60001A-LH	RPGN-2.52	1.000	1.250	3.280	0.750	3	–	–	429323	SE02-01	TK-00917
WSRP-60001-RH		RPGN-32	1.000	1.250	3.280	0.750	3	–	–	425716	SE02-01	TK-00852
	WSRP-60001-LH	RPGN-32	1.000	1.250	3.280	0.750	3	–	–	425716	SE02-01	TK-00852
WSRP-60001.2-RH		RPGN-32	1.250	1.250	3.530	1.000	3	–	–	425716	SE02-01	TK-00852
	WSRP-60001.2-LH	RPGN-32	1.250	1.250	3.530	1.000	3	–	–	425716	SE02-01	TK-00852
WSRP-60001.5-RH		RPGN-43	1.500	1.720	4.000	1.250	3	–	–	3025-1	438919	TK-00645
	WSRP-60001.5-LH	RPGN-43	1.500	1.720	4.000	1.250	3	–	–	3025-1	438919	TK-00645
WSRP-60002-RH		RPGN-43	2.000	1.720	4.000	1.250	3	308341	#4-40 x 1/4 FHCS	3025-1	438919	TK-00648
	WSRP-60002-LH	RPGN-43	2.000	1.720	4.000	1.250	3	308341	#4-40 x 1/4 FHCS	3025-1	438919	TK-00648
WSRP-60002.5-RH		RPGN-43	2.500	1.750	4.000	1.250	4	308341	#4-40 x 1/4 FHCS	3025-1	#10-32 x 1/2 SHCS	TK-00649
	WSRP-60002.5-LH	RPGN-43	2.500	1.750	4.000	1.250	4	308341	#4-40 x 1/4 FHCS	3025-1	#10-32 x 1/2 SHCS	TK-00649
WSRPF-60000.7-RH †		RPGN-21.5	0.750	1.250	3.260	0.750	3	–	–	423978	#3-48 x 1/4 SHCS	TK-00879
	WSRPF-60000.7-LH †	RPGN-21.5	0.750	1.250	3.260	0.750	3	–	–	423978	#3-48 x 1/4 SHCS	TK-00879
WSRPF-60001A-RH		RPGN-2.52	1.000	1.250	3.280	0.750	4	–	–	429323	SE02-04	TK-00880
	WSRPF-60001A-LH	RPGN-2.52	1.000	1.250	3.280	0.750	4	–	–	429323	SE02-04	TK-00880
WSRPF-60001-RH		RPGN-32	1.000	1.250	3.280	0.750	4	–	–	429323	SE02-04	TK-00852
	WSRPF-60001-LH	RPGN-32	1.000	1.250	3.280	0.750	4	–	–	429323	SE02-04	TK-00852
WSRPF-60001.2-RH		RPGN-32	1.250	1.250	3.530	1.000	5	–	–	425716	SE02-04	TK-00852
	WSRPF-60001.2-LH	RPGN-32	1.250	1.250	3.530	1.000	5	–	–	425716	SE02-04	TK-00852
WSRPF-60001.5-RH		RPGN-43	1.500	1.720	4.000	1.250	4	–	–	3025	438919	TK-00645
	WSRPF-60001.5-LH	RPGN-43	1.500	1.720	4.000	1.250	4	–	–	3025	438919	TK-00645
WSRPF-60002-RH		RPGN-43	2.000	1.720	4.000	1.250	4	308341	#4-40 x 1/4 FHCS	3025	438919	TK-00648
	WSRPF-60002-LH	RPGN-43	2.000	1.720	4.000	1.250	4	308341	#4-40 x 1/4 FHCS	3025	438919	TK-00648
WSRPF-60002.5-RH		RPGN-43	2.500	1.750	4.000	1.250	5	308341	#4-40 x 1/4 FHCS	3025	438919	TK-00649
	WSRPF-60002.5-LH	RPGN-43	2.500	1.750	4.000	1.250	5	308341	#4-40 x 1/4 FHCS	3025	438919	TK-00649

** Tune-Up Kits include all standard components and necessary wrenches to allow you to completely refurbish cutter.*

*** Left-Hand cutters are made to order only.*

† No thru-tool coolant available

NOTE: For information on screw torque settings, please refer to the chart on page M38.

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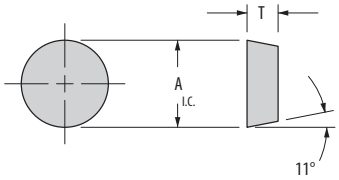
WSRP-WSRPF Inserts

RPGN



Inserts	Part Number ANSI	Steel P			Stainless Steel M			Cast Iron K				Heat-Resistant Super Alloys S					Hardened Steel H			Part Number ISO	Dimensions (inches)	
		GA5036	G-915	G-9120	G-915	G-9230	WG-600®	G-9230	G-915	GSN100™	XSYTIN®-1	G-915	G-9230	WG-600®	WG-300®	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1		A	T
	RPGN-21.5	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RPGN-060200	0.250	0.094
	RPGN-2.52	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RPGN-070300	0.312	0.125
	RPGN-32	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RPGN-090300	0.375	0.125
	RPGN-43	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RPGN-120400	0.500	0.187

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

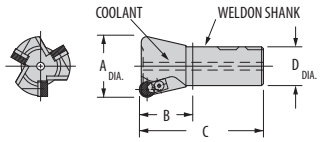
Grade descriptions — pages M 36–37

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

NOTE: For additional nose radii and available edge preps, please contact the Greenleaf Tech Team.

Maximum RPM

Cutter Part Number	Max RPM Carbide	Max RPM Ceramic
WSRP-60000.6	15,000	40,000
WSRP-60000.7	12,500	35,000
WSRP-60001A	9,500	26,000
WSRP-60001	9,500	26,000
WSRP-60001.2	7,500	21,000
WSRP-60001.5	6,200	19,500
WSRP-60002	4,600	13,000
WSRP-60002.5	3,800	10,000
WSRPF-60000.7	12,500	35,000
WSRPF-60001A	9,500	26,000
WSRPF-60001	9,500	26,000
WSRPF-60001.2	7,500	21,000
WSRPF-60001.5	6,200	19,500
WSRPF-60002	4,600	13,000
WSRPF-60002.5	3,800	10,000



WSRN-WSRNF

Round Negative End Mill

Right-Hand Cutter Shown

Part Number		Gage Inserts	Dimensions (inches)				No. of Inserts	Standard Components				*Tune-Up Kit
Right Hand	Left Hand**		A	B	C	D		Anvil	Anvil Screw	Clamp	Clamp Screw	
WSRN-60001-RH		RNGN-32	1.000	1.250	3.280	0.750	2	–	–	425716	SE02-01	TK-00853
	WSRN-60001-LH	RNGN-32	1.000	1.250	3.280	0.750	2	–	–	425716	SE02-01	TK-00853
WSRN-60001.2-RH		RNGN-32	1.250	1.250	3.530	1.000	3	–	–	425716	SE02-01	TK-00852
	WSRN-60001.2-LH	RNGN-32	1.250	1.250	3.530	1.000	3	–	–	425716	SE02-01	TK-00852
WSRN-60001.5-RH		RNGN-43	1.500	1.720	4.000	1.250	3	–	–	3025-1	438919	TK-00645
	WSRN-60001.5-LH	RNGN-43	1.500	1.720	4.000	1.250	3	–	–	3025-1	438919	TK-00645
WSRN-60002-RH ††		RNGN-43	2.000	1.720	4.000	1.250	3	313572	#4-40x1/4 FHCS	3025-1	#10-32 x 1/2 SHCS	TK-02703
	WSRN-60002-LH ††	RNGN-43	2.000	1.720	4.000	1.250	3	313572	#4-40x1/4 FHCS	3025-1	#10-32 x 1/2 SHCS	TK-02703
WSRN-60002.5-RH ††		RNGN-43	2.500	1.750	4.000	1.250	4	313572	#4-40x1/4 FHCS	3025-1	#10-32 x 1/2 SHCS	TK-02695
	WSRN-60002.5-LH ††	RNGN-43	2.500	1.750	4.000	1.250	4	313572	#4-40x1/4 FHCS	3025-1	#10-32 x 1/2 SHCS	TK-02695
WSRNF-600001-RH		RNGN-32	1.000	1.250	3.280	0.750	3	–	–	425716	SE02-01	TK-00853
	WSRNF-600001-LH	RNGN-32	1.000	1.250	3.280	0.750	3	–	–	425716	SE02-01	TK-00853
WSRNF-60001.2-RH		RNGN-32	1.250	1.250	3.530	1.000	4	–	–	425716	SE02-01	TK-00853
	WSRNF-60001.2-LH	RNGN-32	1.250	1.250	3.530	1.000	4	–	–	425716	SE02-01	TK-00853
WSRNF-60001.5-RH		RNGN-43	1.500	1.720	4.000	1.250	4	–	–	3025-1	438919	TK-00645
	WSRNF-60001.5-LH	RNGN-43	1.500	1.720	4.000	1.250	4	–	–	3025-1	438919	TK-00645
WSRNF-60002-RH ††		RNGN-43	2.000	1.720	4.000	1.250	4	313572	#4-40x1/4 FHCS	3025-1	#10-32 x 1/2 SHCS	TK-02703
	WSRNF-60002-LH ††	RNGN-43	2.000	1.720	4.000	1.250	4	313572	#4-40x1/4 FHCS	3025-1	#10-32 x 1/2 SHCS	TK-02703
WSRNF-60002.5-RH ††		RNGN-43	2.500	1.750	4.000	1.250	6	313572	#4-40x1/4 FHCS	3025-1	#10-32 x 1/2 SHCS	TK-02703
	WSRNF-60002.5-LH ††	RNGN-43	2.500	1.750	4.000	1.250	6	313572	#4-40x1/4 FHCS	3025-1	#10-32 x 1/2 SHCS	TK-02703

* *Tune-Up Kits include all standard components and necessary wrenches to allow you to completely refurbish cutter.*

** *Left-Hand cutters are made to order only.*

†† *For Insert RNGN-42, use anvil 313596. For insert RNGN-45, use no anvil.*

NOTE: For information on screw torque settings, please refer to the chart on page M38.

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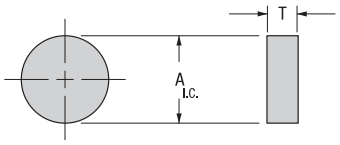
WSRN-WSRNF Inserts

RNGN



Inserts	Part Number ANSI	Steel P			Stainless Steel M			Cast Iron K				Heat-Resistant Super Alloys S					Hardened Steel H			Part Number ISO	Dimensions (inches)	
		GA5036	G-915	G-9120	G-915	G-9230	WG-600®	G-9230	G-915	GSN100™	XSYTIN®-1	G-915	G-9230	WG-600®	WG-300®	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1		A	T
	RNGN-32	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RNGN-090300	0.375	0.125
	RNGN-42	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RNGN-120300	0.500	0.125
	RNGN-43	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RNGN-120400	0.500	0.187
	RNGN-45	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RNGN-120700	0.500	0.313

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages M 36–37

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

NOTE: For additional nose radii and available edge preps, please contact Greenleaf Tech Team.

Maximum RPM

Cutter Part Number	Max RPM Carbide	Max RPM Ceramic
WSRN-60001	9,500	26,000
WSRN-60001.2	7,500	21,000
WSRN-60001.5	6,200	19,500
WSRN-60002	4,600	13,000
WSRN-60002.5	3,800	10,000
WSRNF-60001	9,500	26,000
WSRNF-60001.2	7,500	21,000
WSRNF-60001.5	6,200	19,500
WSRNF-60002	4,600	13,000
WSRNF-60002.5	3,800	10,000

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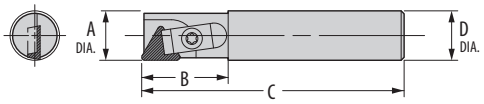
WSTP

Triangle Positive End Mill



Right-Hand Cutter Shown

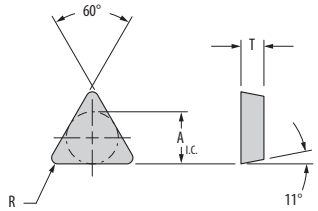
Part Number		Gage Inserts	Dimensions (inches)				No. of Inserts	Standard Components		*Tune-Up Kit
Right Hand	Left Hand		A	B	C	D		Clamp	Clamp Screw	
WSTP-70.50-RH		TPGN-222	0.500	0.875	2.66	0.500	1	429871	PT-317T	TK-00897
	WSTP-70.50-LH	TPGN-222	0.500	0.875	2.66	0.500	1	429871	PT-317T	TK-00897
WSTP-70.56-RH		TPGN-222	0.562	1.000	2.78	0.500	1	429871	PT-317T	TK-00897
	WSTP-70.56-LH	TPGN-222	0.562	1.000	2.78	0.500	1	429871	PT-317T	TK-00897
WSTP-70.62-RH		TPGN-222	0.625	1.000	2.91	0.625	1	429871	PT-317T	TK-00897
	WSTP-70.62-LH	TPGN-222	0.625	1.000	2.91	0.625	1	429871	PT-317T	TK-00897

* *Tune-Up Kits include all standard components and necessary wrenches to allow you to completely refurbish cutter.*

NOTE: For information on screw torque settings, please refer to the chart on page M38.

WSTP Inserts

TPGN



Inserts	Part Number ANSI	Steel P			Stainless Steel M			Cast Iron K				Heat-Resistant Super Alloys S					Hardened Steel H			Part Number ISO	Dimensions (inches)		
		GA5036	G-915	G-9120	G-915	G-9230	WG-600®	GA5023	G-915	GSN100™	XSYTIN®-1	G-915	G-9230	WG-600®	WG-300®	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1		A	T	R
	TPGN-222	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	TPGN-110308	0.250	0.125	0.031

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages M 36–37

NOTE: For additional nose radii and available edge preps, please contact Greenleaf Tech Team.

Maximum RPM

Cutter Part Number	Max RPM Carbide	Max RPM Ceramic
WSTP-70.50	19,000	35,000
WSTP-70.56	17,000	35,000
WSTP-70.62	15,000	35,000

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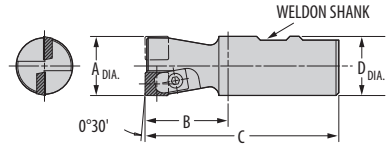
WSSP

Square Positive End Mill



Right-Hand Cutter Shown

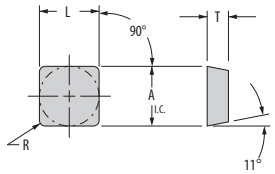
Part Number		Gage Inserts	Dimensions (inches)				No. of Inserts	Standard Components		*Tune-Up Kit
Right Hand	Left Hand		A	B	C	D		Clamp	Screw	
WSSP-70000.3-RH		SPGN-21.52	0.375	0.750	2.310	0.375	1	429871	PT-317T	TK-00897
	WSSP-70000.3-LH	SPGN-21.52	0.375	0.750	2.310	0.375	1	429871	PT-317T	TK-00897
WSSP-70000.5-RH		SPGN-21.52	0.500	0.875	2.660	0.500	1	429871	PT-317T	TK-00897
	WSSP-70000.5-LH	SPGN-21.52	0.500	0.875	2.660	0.500	1	429871	PT-317T	TK-00897
WSSP-70000.6-RH		SPGN-222	0.625	1.000	2.910	0.625	2	423978	#3-48x3/16SHCS	TK-00850
	WSSP-70000.6-LH	SPGN-222	0.625	1.000	2.910	0.625	2	423978	#3-48x3/16SHCS	TK-00850
WSSP-70000.7-RH		SPGN-222	0.75	1.000	3.030	0.750	2	423978	#3-48x1/4SHCS	TK-00879
	WSSP-70000.7-LH	SPGN-222	0.75	1.000	3.030	0.750	2	423978	#3-48x1/4SHCS	TK-00879
WSSP-70001-RH		SPGN-322	1.000	1.250	3.280	0.750	2	429706	SE02-01	TK-00854
	WSSP-70001-LH	SPGN-322	1.000	1.250	3.280	0.750	2	429706	SE02-01	TK-00854
WSSP-70001.2-RH		SPGN-322	1.250	1.750	4.030	1.000	3	429706	SE02-01	TK-00855
	WSSP-70001.2-LH	SPGN-322	1.250	1.750	4.030	1.000	3	429706	SE02-01	TK-00855
WSSP-70001.5-RH		SPGN-432	1.500	1.750	4.030	1.250	3	3127-C	#10-32x1/2SHCS	TK-00856
	WSSP-70001.5-LH	SPGN-432	1.500	1.750	4.030	1.250	3	3127-C	#10-32x1/2SHCS	TK-00856

** Tune-Up Kits include all standard components and necessary wrenches to allow you to completely refurbish cutter.*

NOTE: For information on screw torque settings, please refer to the chart on page M38.

WSSP Inserts

SPGN



Inserts	Part Number ANSI	Steel P			Stainless Steel M			Cast Iron K				Heat-Resistant Super Alloys S					Hardened Steel H			Part Number ISO	Dimensions (inches)			
		GA5036	G-915	G-9120	G-915	G-9230	WG-600®	GA5023	G-915	GSN100™	XSYTIN®-1	G-915	G-9230	WG-600®	WG-300®	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1		A	L	T	R
	SPGN-21.52	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SPGN-060208	0.250	0.250	0.093	0.031
	SPGN-222	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SPGN-060308	0.250	0.250	0.125	0.031
	SPGN-322	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SPGN-090308	0.375	0.375	0.125	0.031
	SPGN-432	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SPGN-120408	0.500	0.500	0.187	0.031
	SPGN-433	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SPGN-120412	0.500	0.500	0.187	0.047

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages M 36–37

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

NOTE: For additional nose radii and available edge preps, please contact Greenleaf Tech Team.

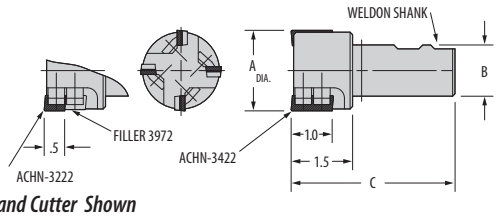
Maximum RPM

Cutter Part Number	Max RPM Carbide	Max RPM Ceramic
WSSP-70000.3	25,000	40,000
WSSP-70000.5	19,000	40,000
WSSP-70000.6	15,000	40,000
WSSP-70000.7	12,500	35,000
WSSP-70001	9,500	26,000
WSSP-70001.2	7,500	21,000
WSSP-70001.5	6,200	16,500

NOTE: For information on screw torque settings, please refer to the chart on page M38.

WSAN

Parallelogram Positive End Mill



Right-Hand Cutter Shown

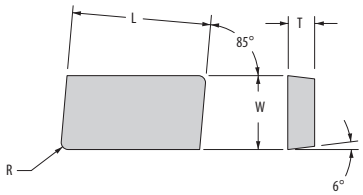
Part Number		Gage Inserts	Dimensions (inches)			No. of Inserts	Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand		A	B	C		Anvil	Anvil Screw	Clamp	Clamp Screw		Max. 1/2" D.O.C. Insert	Filler
WSAN-1-RH		ACHN-3422	0.985	0.750	3.750	2	–	#4-40x1/4 FHCS	410756	#8-32x9/32 IPBHCS	TK-00642	ACHN-3222	3972
	WSAN-1-LH	ACHN-3422-LH	0.985	0.750	3.750	2	–	#4-40x1/4 FHCS	410756	#8-32x9/32 IPBHCS	TK-00642	ACHN-3222-LH	3972
WSAN-1A-RH		ACHN-3422	0.985	1.000	4.000	2	–	#4-40x1/4 FHCS	410756	#8-32x9/32 IPBHCS	TK-00642	ACHN-3222	3972
	WSAN-1A-LH	ACHN-3422-LH	0.985	1.000	4.000	2	–	#4-40x1/4 FHCS	410756	#8-32x9/32 IPBHCS	TK-00642	ACHN-3222-LH	3972
WSAN-1 1/4-RH		ACHN-3422	1.215	1.000	4.000	2	–	#4-40x1/4 FHCS	410756	#8-32x9/32 IPBHCS	TK-00642	ACHN-3222	3972
	WSAN-1 1/4-LH	ACHN-3422-LH	1.215	1.000	4.000	2	–	#4-40x1/4 FHCS	410756	#8-32x9/32 IPBHCS	TK-00642	ACHN-3222-LH	3972
WSAN-1 1/2-RH		ACHN-3422	1.465	1.000	4.000	3	AAP-3224	#4-40x1/4 FHCS	410756	#8-32x9/32 IPBHCS	TK-00643	ACHN-3222	3972
	WSAN-1 1/2-LH	ACHN-3422-LH	1.465	1.000	4.000	3	AAP-3224-LH	#4-40x1/4 FHCS	410756	#8-32x9/32 IPBHCS	TK-00713	ACHN-3222-LH	3972
WSAN-2-RH		ACHN-3422	1.965	1.250	4.000	4	AAP-3224	#4-40x1/4 FHCS	410756	#8-32x3/8 IPBHCS	TK-00644	ACHN-3222	3972
	WSAN-2-LH	ACHN-3422-LH	1.965	1.250	4.000	4	AAP-3224-LH	#4-40x1/4 FHCS	410756	#8-32x3/8 IPBHCS	TK-00821	ACHN-3222-LH	3972
WSAN-2 1/2-RH		ACHN-3422	2.465	1.250	4.000	4	AAP-3224	#4-40x1/4 FHCS	410756	#8-32x3/8 IPBHCS	TK-00644	ACHN-3222	3972
	WSAN-2 1/2-LH	ACHN-3422-LH	2.465	1.250	4.000	4	AAP-3224-LH	#4-40x1/4 FHCS	410756	#8-32x3/8 IPBHCS	TK-00821	ACHN-3222-LH	3972

* *Tune-Up Kits include all standard components and necessary wrenches to allow you to completely refurbish cutter.*

NOTE: For information on screw torque settings, please refer to the chart on page M38.

WSAN Inserts

ACHN



Inserts	Part Number ANSI	Steel P			Stainless Steel M			Cast Iron K				Heat-Resistant Super Alloys S					Hardened Steel H			Part Number ISO	Dimensions (inches)			
		GA5036	G-915	G-9120	G-915	G-9230	WG-600®	GA5023	G-915	GSN100™	XSYTIN®-1	G-915	G-9230	WG-600®	WG-300®	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1		T	W	L	R
	ACHN-3422	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	ACHN-250308	0.125	0.375	1.000	0.031
	ACHN-3222	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	ACHN-120308	0.125	0.375	0.500	0.031
	ACHN-3422LH	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	ACHN-250308LH	0.125	0.375	1.000	0.031
	ACHN-3222LH	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	ACHN-120308LH	0.125	0.375	0.500	0.031

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages M 36–37

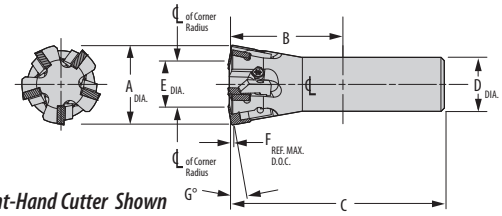
CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

NOTE: For additional nose radii and available edge preps, please contact Greenleaf Tech Team.

Excelerator® XF

Positive High-Feed Mills

1" and 1-1/2" High-Feed End Mill / Square Positive Inserts



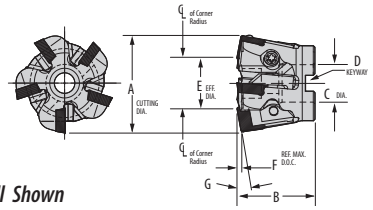
Right-Hand Cutter Shown

Cutter Order Number	Insert	Dimensions (inches)							No. of Inserts	Standard Components		*Tune-Up Kit	Max RPM Carbide	Max RPM Ceramic
		A	B	C	D	E	F	G		Clamp	Clamp Screw			
XFSP-010-EM	SPGN-222	1.000	1.250	3.280	0.750	0.568	0.031	10°	4	431402	PT-542T	TK-01868	9,500	26,000
XFSP-015-EM	SPGN-322	1.500	1.720	4.000	1.000	0.822	0.052	10°	5	313256	SE02-01	TK-01905	6,200	16,500

* *Tune-Up Kits include all standard components and necessary wrenches to allow you to completely refurbish cutter.*

NOTE: For information on screw torque settings, please refer to the chart on page M38.

2" High-Feed Face Mill / Square Positive Inserts



Right-Hand Face Mill Shown

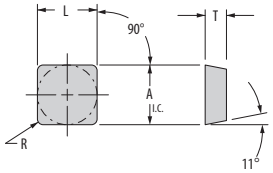
Cutter Order Number	Insert	Dimensions (inches)							No. of Inserts	Standard Components		*Tune-Up Kit	Max RPM Carbide	Max RPM Ceramic
		A	B	C	D	E	F	G		Clamp	Clamp Screw			
XFSP-020-FM	SPGN-432	2.000	1.560	0 .750	0.313	1.056	0.076	10°	5	431628	SE03-72	TK-02167	4,600	13,300

* *Tune-Up Kits include all standard components and necessary wrenches to allow you to completely refurbish cutter.*

NOTE: For information on screw torque settings, please refer to the chart on page M38.

Excelerator XF Inserts

SPGN



Inserts	Part Number ANSI	Steel P			Stainless Steel M			Cast Iron K				Heat-Resistant Super Alloys S					Hardened Steel H			Part Number ISO	Dimensions (inches)			
		GA5036	G-915	G-9120	G-915	G-9230	WG-600®	GA5023	G-915	GSN100™	XSYTIN®-1	G-915	G-9230	WG-600®	WG-300®	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1		A	L	T	R
	SPGN-222	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SPGN-060308	0.250	0.250	0.125	0.031
	SPGN-322	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SPGN-090308	0.375	0.375	0.125	0.031
	SPGN-432	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SPGN-120408	0.500	0.500	0.187	0.031

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages M 36–37

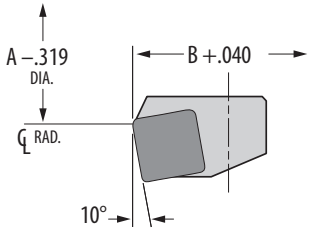
NOTE: For additional nose radii and available edge preps, please contact Greenleaf Tech Team.

XFNPS

Nest for CP4 Series

Nest Part Number		Gage Inserts
Right Hand	Left Hand	
XFNPS8043R	—	SPGN-433
—	XFNPS8043L	SPGN-433

NOTE: For information on CP4-series nests, please refer to the chart on page M14.



Performance Calculations

Starting Speeds and Feeds for Excelerator XF®

Material	Hardness	Insert Grades	Cutting Speed (SFM)	Target Chip Thickness (inches)	Recommended Feed per Tooth (IPT) Width of Cut (%) of Effective Diameter		
					15%	30%	45%+
Steel	60-65 HRC	WG-600®	500	0.0015	0.0121	0.0094	0.0087
	50-59 HRC	WG-600®	800	0.002	0.0162	0.0126	0.0116
	40-49 HRC	WG-600®	1300	0.0027	0.0218	0.017	0.0156
	40-49 HRC	GA5036	405	0.0017	0.0137	0.0107	0.0098
	30-39 HRC	GA5036	600	0.003	0.0242	0.0189	0.0174
	≤ 30 HRC	GA5036	800	0.0041	0.033	0.026	0.024

DOC vs. Effective Diameter for Excelerator® XF

	XFSP-010-EM	XFSP-015-EM	XFSP-020-EM	CP4 Series Face Mills: XFNPS8043 Nest						
Depth of Cut	1"	1.5"	2"	3"	4"	5"	6"	8"	10"	12"
0.01	0.6875	0.9413	1.1832	2.8031	3.8031	4.8031	5.8031	7.8031	9.8031	11.8031
0.02	0.8014	1.0552	1.2954	2.9170	3.9170	4.9170	5.9170	7.9170	9.9170	11.9170
0.03	0.9152	1.1690	1.4076	3.0308	4.0308	5.0308	6.0308	8.0308	10.0308	12.0308
0.04	X	1.2829	1.5498	3.1447	4.1447	5.1447	6.1447	8.1447	10.1447	12.1447
0.05	X	1.3968	1.6320	3.2586	4.2586	5.2586	6.2586	8.2586	10.2586	12.2586
0.06	X	1.4742	1.7441	3.3724	4.3724	5.3724	6.3724	8.3724	10.3724	12.3724
0.07	X	X	1.8563	3.4863	4.4863	5.4863	6.4863	8.4863	10.4863	12.4863
0.08	X	X	1.9459	3.5385	4.5385	5.5385	6.5385	8.5385	10.5385	12.5385
DIA OVER INSERT	1	1.5	1.9755	3.575	4.575	5.575	6.575	8.575	10.575	12.575

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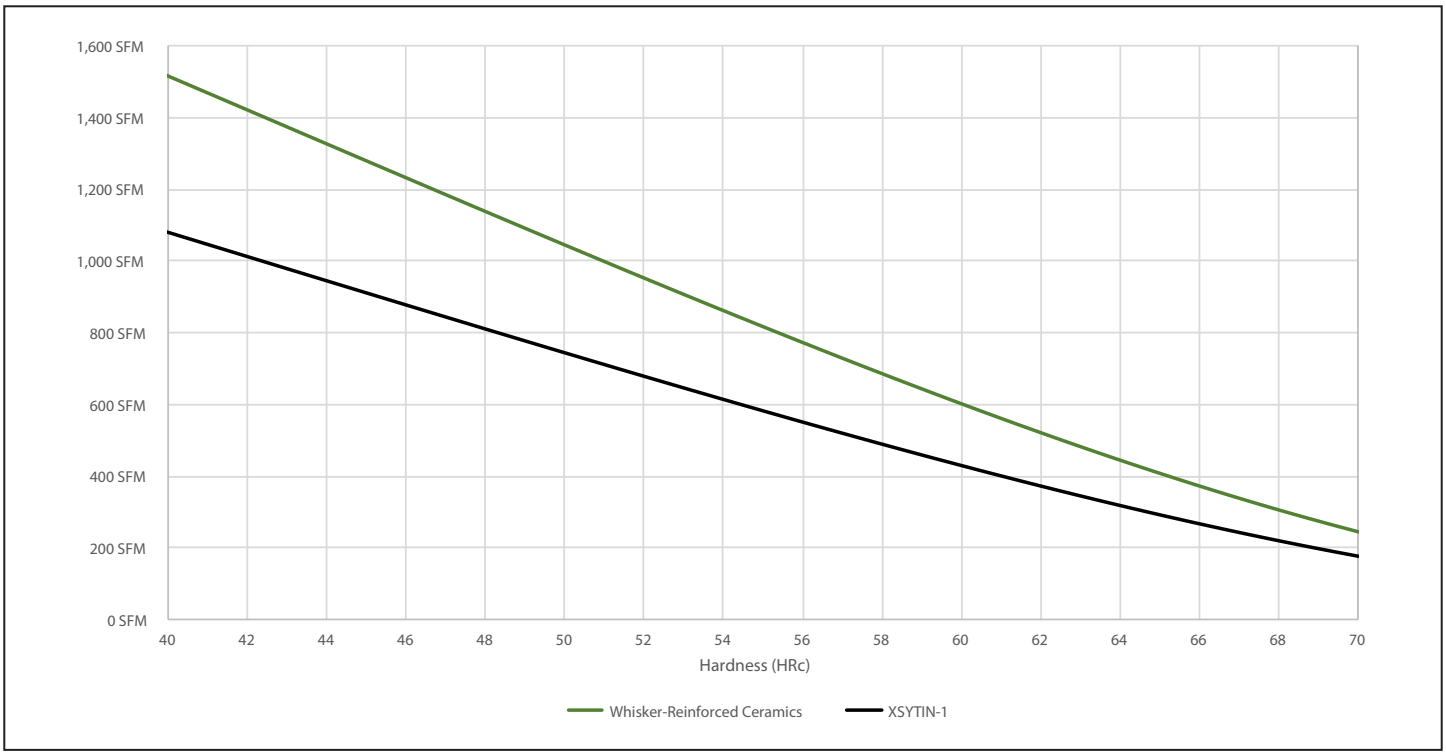
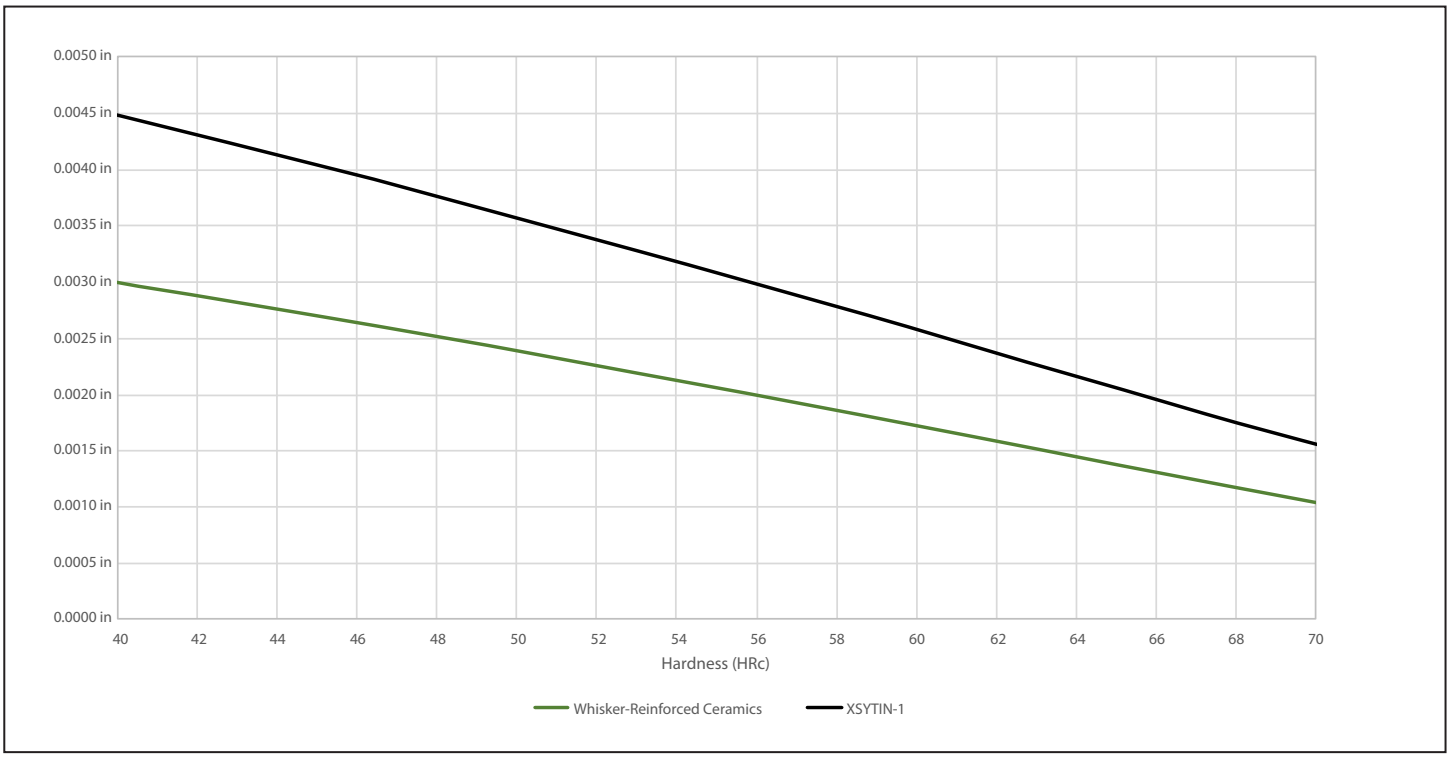
Milling Hardened Steel, Cutting Speed (Vc)



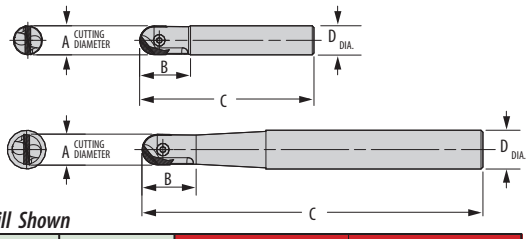
Milling Hardened Steel, Average Chip Thickness (Hm)



Ball Nose

End Mill

U.S. Patent No. 8,177,459 B2



Right-Hand End Mill Shown

Part Number		Gage Insert	Dimensions (inches)				Standard Components	*Tune-Up Kit Includes All Standard Components	Max RPM Carbide	Max RPM Ceramic
Short Series	Extended Series		A	B	C	D	Insert Screw			
SSBN-0375X	—	GBN-0375	0.375	0.75	4	0.625	SM30-083	TK-03466	40,000	40,000
—	SSBN-0375EX	GBN-0375	0.375	0.75	6	0.75	SM30-083	TK-03466	40,000	40,000
SSBN-0500X	—	GBN-0500	0.5	1.25	4	0.625	SM40-106	TK-03461	40,000	40,000
—	SSBN-0500EX	GBN-0500	0.5	1.25	7.5	0.75	SM40-106	TK-03461	40,000	40,000
SSBN-0625X	—	GBN-0625	0.625	1.375	5	0.625	SM50-139	TK-03175	40,000	40,000
—	SSBN-0625EX	GBN-0625	0.625	1.375	7.5	0.75	SM50-139	TK-03175	40,000	40,000
SSBN-0750X	—	GBN-0750	0.75	1.75	5.5	0.75	SM60-167	TK-04138	40,000	40,000
—	SSBN-0750EX	GBN-0750	0.75	1.75	10	1	SM60-167	TK-04138	40,000	40,000
SSBN-1000X	—	GBN-1000	1	1.75	6	1	SM70-210	TK-04142	40,000	40,000
—	SSBN-1000EX	GBN-1000	1	1.75	11	1.25	SM70-210	TK-04142	40,000	40,000

NOTE: Add L to part number for left-hand cutter.

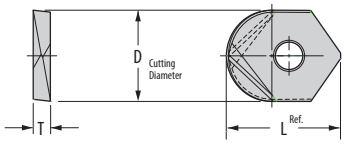
NOTE: For information on screw torque settings, please refer to the chart on page M38.

* *Tune-Up Kits include all standard components and necessary wrenches to allow you to completely refurbish cutter.*

Ball Nose Inserts

GBN

U.S. Patent No. 8,177,459 B2



Inserts	Part Number ANSI	Steel	S Steel	Cast Iron			Heat-Resistant Super Alloys			Hardened Steel			Dimensions (inches)		
		P	M	K			S			H					
		G-925	G-925	G-925	WG-600®	XSYTIN®-1	G-925	WG-600®	XSYTIN®-1	G-925	WG-600®	XSYTIN®-1	L	T	D
	GBN-0375	◆	◆	◆	▲	◆	◆	▲	◆	◆	◆	▲	0.500	0.125	0.375
	GBN-0500	◆	◆	◆	▲	◆	◆	▲	◆	◆	◆	▲	0.670	0.188	0.500
	GBN-0625	◆	◆	◆	▲	◆	◆	▲	◆	◆	◆	▲	0.800	0.188	0.625
	GBN-0750	◆	◆	◆	▲	◆	◆	▲	◆	◆	◆	▲	0.900	0.188	0.750
	GBN-1000	◆	◆	◆	▲	◆	◆	▲	◆	◆	◆	▲	1.230	0.188	1.000

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages M 36–37

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Performance Calculations

Starting Speeds and Feeds for Ball Nose

Work Material	Hardness (HRc)	Insert Grades	Cutting Speed (SFM)	Target Chip Thickness (in.)	Recommended Feed per Tooth (IPT) Depth of Cut to Radius Ratio (Ap/r)		
					0–13.4%	13.4–29.3%	29.3–50%
Steel	40 HRC	G-925	500	0.0019	0.0085	0.0049	0.0038
		XSYTIN®-1	1050	0.0031	0.0144	0.0081	0.0062
		WG-600®	1500	0.0022	0.0100	0.0057	0.0044
	50 HRC	G-925	350	0.0013	0.0042	0.0024	0.0019
		XSYTIN®-1	720	0.0025	0.0114	0.0065	0.0050
		WG-600®	1020	0.0019	0.0085	0.0049	0.0038
	60 HRC	G-925	300	0.0006	0.0028	0.0016	0.0013
		XSYTIN®-1	430	0.0019	0.0071	0.0041	0.0031
		WG-600®	610	0.0013	0.0042	0.0024	0.0019
Tool Steel	65 HRC	G-925	275	0.0006	0.0028	0.0016	0.0013
		XSYTIN®-1	280	0.0016	0.0071	0.0041	0.0031
		WG-600®	400	0.0010	0.0042	0.0024	0.0019
HRSA	20-25 HRC	G-925	550	0.0025	0.0114	0.0065	0.0050
		XSYTIN®-1	3000	0.0025	0.0114	0.0065	0.0050
		WG-600®	3950	0.0016	0.0071	0.0041	0.0031
	40-45 HRC	G-925	350	0.0016	0.0071	0.0041	0.0031
		XSYTIN®-1	2600	0.0016	0.0071	0.0041	0.0031
		WG-600®	3450	0.0010	0.0042	0.0024	0.0019
Graphitic Cast Iron	<40 HRC	G-925	850	0.0034	0.0156	0.0088	0.0067
		XSYTIN®-1	2300	0.0028	0.0129	0.0073	0.0056
		WG-600®	2950	0.0019	0.0085	0.0049	0.0038
Stainless Steel	≤40 HRC	G-925	450	0.0025	0.0114	0.0065	0.0050
		XSYTIN®-1	2400	0.0025	0.0114	0.0065	0.0050
		WG-600®	3480	0.0016	0.0071	0.0041	0.0031
Titanium 6Al4V	35-40 HRC	G-925	250	0.0010	0.0042	0.0024	0.0019
Aluminum		G-925	950	0.0038	0.0174	0.0097	0.0075

* *Recommended Feed per Tooth values are for full slotting situations to maintain the target chip thickness value. When 3D/Profile milling, please use the Greenleaf Ball Nose Calculator to determine the appropriate cutting parameters to achieve the target chip thickness listed. For questions regarding applications and additional materials, please contact your local sales and service engineer or the Greenleaf Technical Service department.*

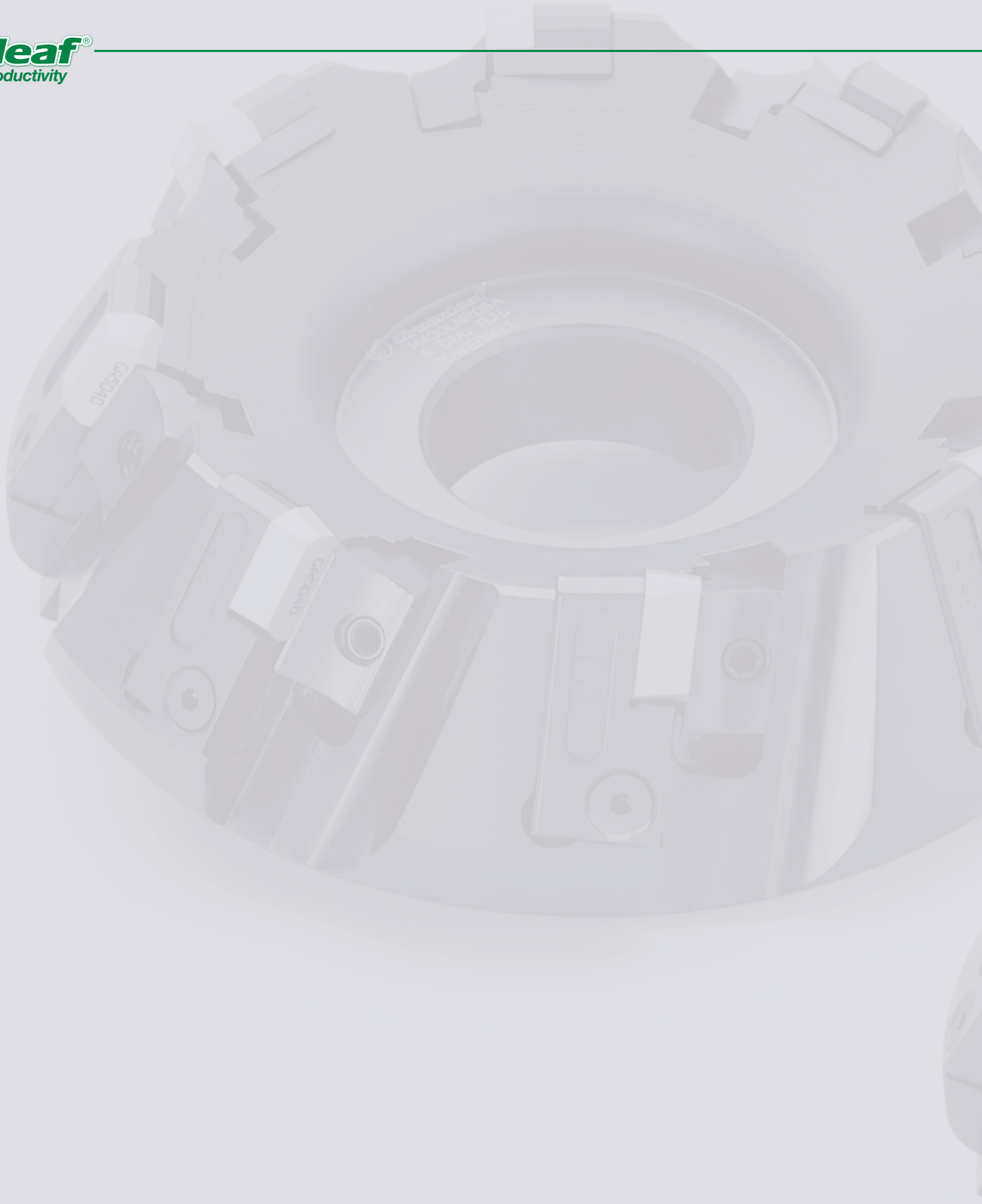
** *Maximum recommended depth of cut (DOC) when using XSYTIN-1 & G-925 is 20% of the insert diameter, and 15% of the insert diameter when using WG-600.*

Effective Cutting Diameter

Insert Diameter (in.) \ DOC	0.005	0.010	0.015	0.025	0.035	0.055	0.075	0.095	0.100	0.115	0.125	0.150	0.200
	Effective Diameter D_{eff} (in.) for a given Depth of Cut												
0.375	0.086	0.121	0.147	0.187	0.218	0.265	0.300	0.326	0.320	0.346	0.354	0.367	—
0.500	0.099	0.140	0.171	0.218	0.255	0.313	0.357	0.392	0.400	0.421	0.433	0.458	0.490
0.625	0.111	0.157	0.191	0.245	0.287	0.354	0.406	0.449	0.458	0.484	0.500	0.534	0.583
0.750	0.122	0.172	0.210	0.269	0.316	0.391	0.450	0.499	0.510	0.540	0.559	0.600	0.663
1.000	0.141	0.199	0.243	0.312	0.368	0.456	0.527	0.586	0.600	0.638	0.661	0.714	0.800

Maximum recommended DOC for WG-600®

Maximum recommended DOC for G-925 and XSYTIN®-1



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Powermill Milling Cutters

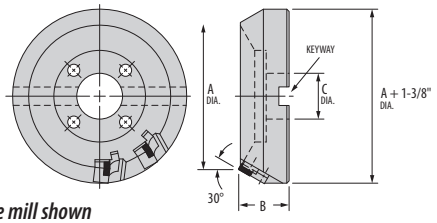
Ideal for heavy-duty cutting in severe interruptions and uneven surfaces. Replaceable components maximize cutter life while providing deep depths of cut.

Greenleaf Tune-Up Kits

A Tune-Up Kit consists of all the standard hardware to refurbish a particular toolholder, boring bar, or milling cutter. A toolholder will have a readily visible, laser-inscribed Tune-Up Kit number on it for ease in ordering. This number will prevent any confusion created by searching a catalog for hardware, and it will help reduce downtime.

Powermill M430LNP-A

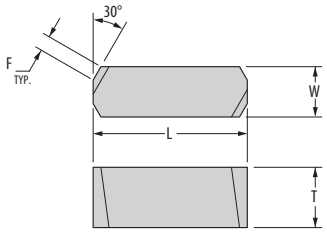
30º Lead, Neg-Pos

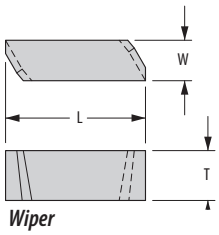


Right-hand face mill shown

Part Number		Gage Insert	No. of Inserts	Wiper Insert	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional †Anvil
Right Hand	Left Hand**				A	B	C	Keyway	Bolt Circle	Anvil	Wedge Screw	Anvil	Back-Up Plate		
M430LNP04A		LNP-335R	6	LNP-335RW	4	2.250	1.500	5/8 x 3/8	–	412151	XNS-58	S-21	303414	TK-00729	S-2
	M430LNP04A-LH	LNP-335L	6	LNP-335LW	4	2.250	1.500	5/8 x 3/8	–	412151	XNS-58	S-21	303414	TK-00729	S-2
M430LNP06A		LNP-335R	8	LNP-335RW	6	2.250	2.000	3/4 x 7/16	–	412151	XNS-58	S-21	303414	TK-00633	S-2
	M430LNP06A-LH	LNP-335L	8	LNP-335LW	6	2.250	2.000	3/4 x 7/16	–	412151	XNS-58	S-21	303414	TK-00633	S-2
M430LNP08A		LNP-335R	10	LNP-335RW	8	2.750	2.500	1 x 17/32	4	412151	XNS-58	S-21	303414	TK-00730	S-2
	M430LNP08A-LH	LNP-335L	10	LNP-335LW	8	2.750	2.500	1 x 17/32	4	412151	XNS-58	S-21	303414	TK-00730	S-2
M430LNP10A		LNP-335R	12	LNP-335RW	10	2.750	2.500	1 x 17/32	4, 4-3/4	412151	XNS-58	S-21	303414	TK-00634	S-2
	M430LNP10A-LH	LNP-335L	12	LNP-335LW	10	2.750	2.500	1 x 17/32	4, 4-3/4	412151	XNS-58	S-21	303414	TK-00634	S-2
M430LNP12A		LNP-335R	16	LNP-335RW	12	2.750	2.500	1 x 17/32	4, 4-3/4, 7	412151	XNS-58	S-21	303414	TK-00717	S-2
	M430LNP12A-LH	LNP-335L	16	LNP-335LW	12	2.750	2.500	1 x 17/32	4, 4-3/4, 7	412151	XNS-58	S-21	303414	TK-00717	S-2

NOTE: Maximum depth of cut is .500". When using optional insert and anvil, maximum depth of cut is .880"
NOTE: The Standard and Optional Anvil both use the same Anvil Screw: #10-32 x 1 FHCS.
NOTE: For information on screw torque settings, please refer to the chart on page M38.
** Tune-Up Kits include all standard components and necessary wrenches to allow you to completely refurbish cutter.*
*** Left-Hand cutters are made to order only.*

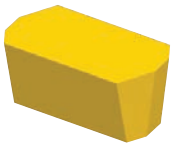




Wiper

Powermill Inserts

LNP

Inserts	Part Number ANSI	Steel P			Stainless Steel M		Part Number ISO	Dimensions (inches)			
		GA5036	G-915	G-9120	G-910	G-9230		W	T	L	F
	LNP-335R	◆	▲	●	●	◆	LNP-335R	0.312	0.375	0.750	0.100
	LNP-335L	◆	▲	●	●	◆	LNP-335L	0.312	0.375	0.750	0.100
	LNP-335RW	◆	▲	●	●	◆	LNP-335RW	0.312	0.355	0.850	N/A
	LNP-335LW	◆	▲	●	●	◆	LNP-335LW	0.312	0.355	0.850	N/A
	LNP-34.57R	◆	▲	●	●	◆	LNP-34.57R	0.437	0.375	1.125	0.100
	LNP-34.57L	◆	▲	●	●	◆	LNP-34.57L	0.437	0.375	1.125	0.100
	LNP-34.57RW	◆	▲	●	●	◆	LNP-34.57RW	0.437	0.355	1.228	N/A
	LNP-34.57LW	◆	▲	●	●	◆	LNP-34.57LW	0.437	0.355	1.228	N/A

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated
CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages M 36–37

Wiper Inserts (LNP-RW/LW)

A wiper insert is designed to be higher above the face of the cutter compared to standard inserts and has a broader wiping flat or radius to effectively wipe out any tool marks produced by the tolerance differences in the standard inserts.

Wiper inserts can be used effectively in a single pocket in smaller diameter cutters and in multiples of two or three in larger cutters to produce a superior finish.

The grades selected for wiper inserts will generally be harder (higher 'C' classification) to combat the trend toward more rapid wear caused by the increased surface contact. Wiper inserts should only be a used when the required RMS value is very low.

Always bear in mind that the majority of finish problems in milling come from lack of rigidity of the set-up, deflection of the part piece or machine spindle, excessive overhangs, and poor cleanliness and assembly practices in the cutter body. Wiper inserts cannot be expected to resolve these problems.

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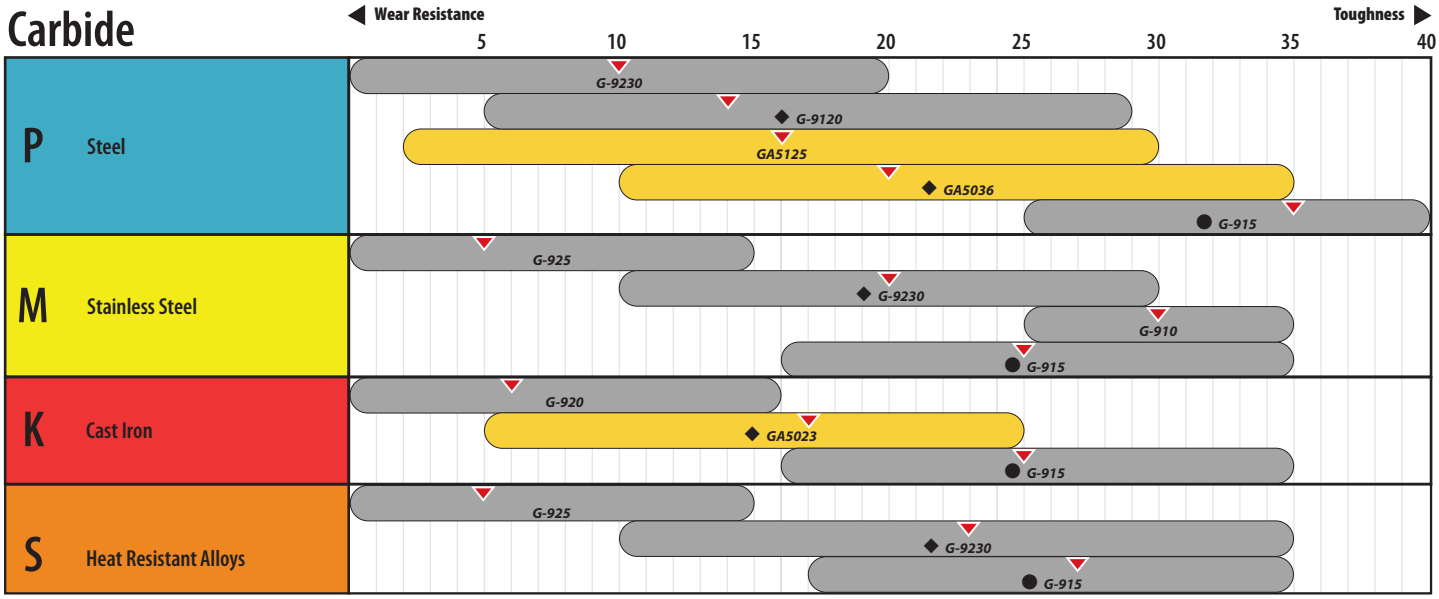
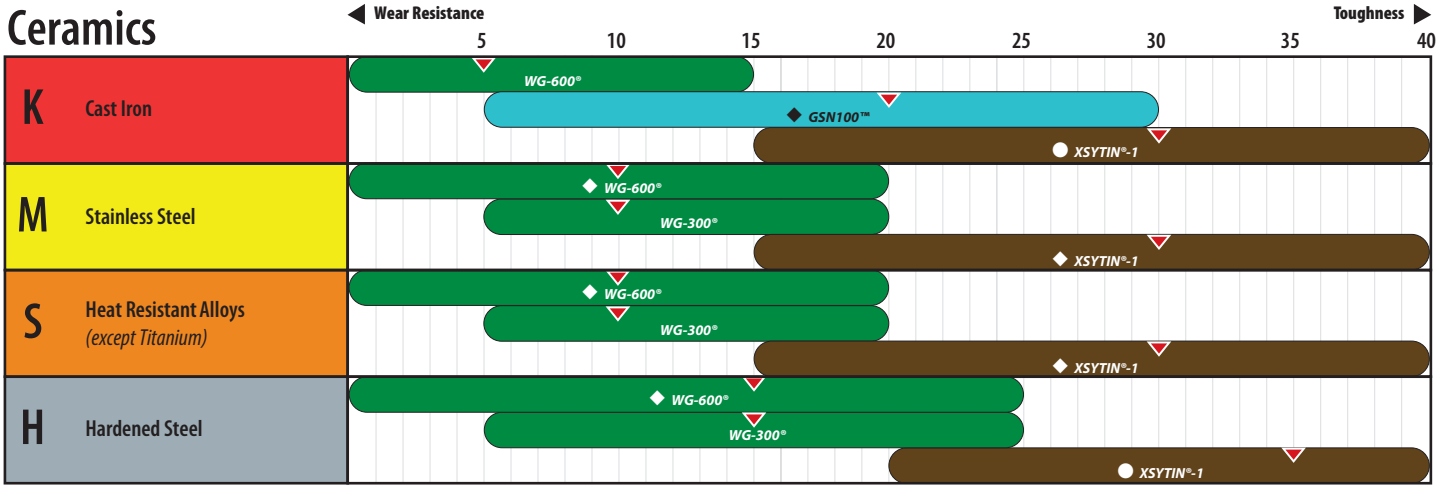
Insert Grade Reference for Milling

Carbide



CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated — First Choice ◆ Second Choice ●

Ceramics



CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC — First Choice ◆ Second Choice ●

Insert Grades

Carbide

Greenleaf offers a comprehensive line of carbide inserts ranging from sub-micron C-1 through C-8 classifications in uncoated, MT-CVD coated and PVD coated options. Carbide inserts are available in ANSI standard geometries that support the various milling products that are offered.

CVD Coated

GA5023
A high-performance grade designed for the turning and milling of various grades of cast iron, GA5023 features an advanced MT-CVD coating specifically developed to withstand the abrasiveness of cast iron in machining. Applications range from roughing to finishing in most grades of cast iron, including gray, nodular, and others. The high wear resistance and toughness of GA5023 enable high-speed machining in a wide range of feed rates.

GA5036
A high-speed MT-CVD coated milling grade, GA5036 should be used when milling forged and cast steels and select ductile irons. GA5036 constitutes a unique combination of toughness and heat resistance, making it suitable for heavy and light-duty milling at high cutting speeds. It is a great first choice for all steel milling.

GA5125
A high-performance MT-CVD coated carbide used primarily for the milling and turning of manganese steel. GA5125 can also be applied in Cr-Mo steels, tool steels, and other alloyed steels in continuous and interrupted turning. GA5125 provides excellent resistance to abrasion, crater wear, thermal shock, deformation, and built-up edge. It performs best when applied at high speeds and moderate feed rates.

PVD Coated

G-910
A PVD-coated grade for milling high-temp alloys, stainless steel, and low carbon steels, G-910 is a medium-speed grade and should be applied at moderate to high feed rates.

PVD Coated *continued*

G-915
A multi-layer PVD-coated grade, G-915 is exceptional for milling and interrupted turning of heat-resistant alloys, stainless steels, and low-carbon steels. The coating adds heat and abrasion resistance to the tough substrate. G-915 should be used at moderate speeds and moderate to high feeds. It is a versatile grade that performs well in a variety of materials and operations outside its primary application range, making it a great choice for general machining.

G-9120
This multi-layer PVD-coated carbide grade excels at milling and turning steel castings and forgings. G-9120 was engineered specifically to maximize productivity at moderate to heavy feed rates and high depths of cut, making it ideal for heavy-turning applications in steel.

G-9230
A PVD-coated grade designed for the machining of heat-resistant alloys, titanium, and hardened and stainless steels. G-9230 works particularly well in stainless steel turning, interrupted turning of HRSA, and interrupted turning of titanium. G-9230 has superior wear resistance and toughness and is excellent for casting and forging scale conditions.

G-925
A high-performance multi-layer PVD-coated grade, G-925 is specifically designed for turning abrasive and difficult-to-machine materials. Typical applications include turning of HRSA, titanium and other refractory metals, stainless steels, and ductile cast irons. G-925 exhibits excellent resistance to notching and deformation. Apply at moderate to high speeds and moderate feeds.

G-935
A multi-layer PVD-coated grade for steel milling and turning applications requiring additional resistance to mechanical and thermal shock. The multi-layered PVD coating raises the speed envelope and wear resistance in tough milling, indexable drilling, and interrupted turning applications.

Uncoated

G-01
Developed for milling heat-resistant alloys, stainless steel, and low-carbon steels at low speeds and moderate to high feeds, G-01 can also be used for turning in the same range of materials with severe interruption or old machinery.

G-01M
A tough sub-micron grade, G01M is used for milling and rough turning stainless steels– even when rolling or casting skin is present. The edge strength of G-01M allows the use of sharp edges and high positive rakes in continuous or interrupted cuts.

G-02
An excellent general-purpose cast-iron grade, G-02 can be used for milling and turning cast iron at moderately high speeds and medium feeds. G-02 is also a good choice for machining aluminum with positive rakes and light roughing of some heat-resistant alloys and stainless steels.

G-53
An excellent general-purpose milling grade for steels at moderate speeds and feeds. G-53 has a good combination of toughness and wear resistance for milling, or can be used as an all-around grade for mixed-production applications.

G-60
Used for the milling of steel, steel castings, and steel forgings. Apply G-60 at moderate speeds and heavy feed rates and depths of cut. G-60 is more wear-resistant than G-50 but is lower in toughness.

Ceramic

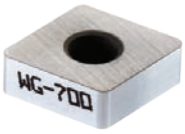
Greenleaf is the leader in the development and manufacture of ceramic and coated ceramic inserts. ANSI standard geometries are offered to fit in many of the milling lines offered.

WG-300®

A SiC whisker-reinforced Al_2O_3 ceramic that is very effective at machining nickel- and cobalt-based super alloys, alloyed cast iron, and hardened steels at metal removal rates up to 10 times higher than carbide. Excellent chemical stability and wear resistance at very high cutting speeds make WG-300® the first choice worldwide for grooving and turning difficult materials.

WG-600®

A coated SiC whisker-reinforced Al_2O_3 ceramic that offers higher tool life and speed capabilities than uncoated whisker-reinforced ceramics due to the additional barrier to heat and mechanical abrasion. Application areas for WG-600® include rough and finish turning of alloys in the M, K, S, and H ISO material classes, as well as milling of hardened steels and select stainless steels. WG-600® is particularly well-suited for finish-turning and grooving of heat-resistant super alloys and is unmatched in both turning and milling of steels with a hardness above 60 HRc.



WG-700™

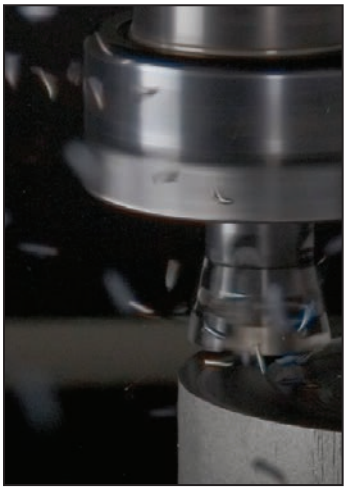
A SiC whisker-reinforced Al_2O_3 ceramic featuring improved toughness and a unique low-friction coating. WG-700™ is ideal for turning, grooving, and profiling nickel- and cobalt-based super alloys that other ceramics may struggle in. WG-700™ exhibits exceptional tool life and productivity in next-generation formulations or novel heat treatments of heat-resistant super alloys, and long-reach or thin-walled applications with lower rigidity.

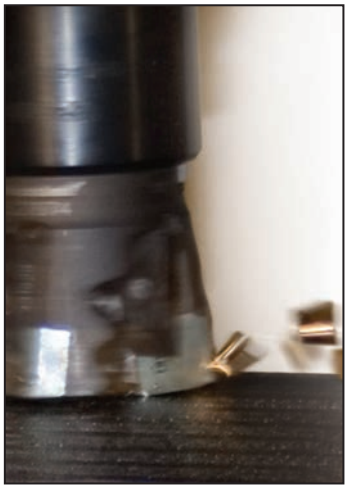
XSYTIN®-1

A phase-toughened ceramic grade capable of sustaining extreme cutting forces. The unprecedented strength, impact toughness, and resistance to thermal shock of XSYTIN®-1 make it ideal for use in interrupted cuts, forging scale removal, and milling. In continuous cuts, the strength of XSYTIN®-1 allows the use of significantly higher feed rates or depths of cut. In machining environments with severe interruptions and scale, the edge strength of XSYTIN®-1 allows the use of very light edge preparations, minimizing the force of impact and making for a much smoother cut.

GSN100™

An engineered blend of hot-pressed silicon nitride and proprietary toughening agents that excels in the machining of cast iron. GSN100™ delivers superior wear and toughness for turning, grooving, and milling applications. It is available in all standard geometries and engineered specials.





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Screw Torque Settings

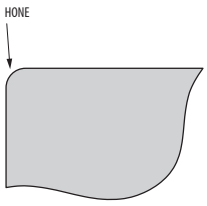
Screw Type	Part Number	Screw Torque (in-lbs)	Wrench
Insert Screw	PT-589T	8	T7
	313631	8	T7
	PT-542T	8	T7
	PT-559T	23	T15
	312679	23	T15
	PT-546T	45	T20
	SM30-083	17	T10+
	SM40-106	26	T15+
	SM50-1139	52	T20
	SM60-167	77	T25
	SM70-210	95	T20
Wedge Screw	430578	85	3/16
	425606	85	3/16
	XNS-58	95	5/32
Nest Screw	SE03-02	70	T15
Anvil Screw	#4-40x1/4 FHCS	9	1/16
	#10-32x7/8 FHCS	60	1/8
Clamp Screw	#10-32x1/2 SHCS	68	5/32
	438919	68	T25
	#3-48x1/4 SHCS	9	5/64
	SE02-01	22	T15
	SE02-04	22	T15
	PT-317T	15	T10
	#3-48x3/16 SHCS	9	5/64
	#8-32x9/32 IPBHCCS	30	T15
	#8-32x3/8 IPBHCS	30	T15
	PT-542T	8	T7
	SE03-72	70	T20
Back-Up Plate Screw	#5-40x3/8 FHCS	13	5/64

Excelerator® Mills

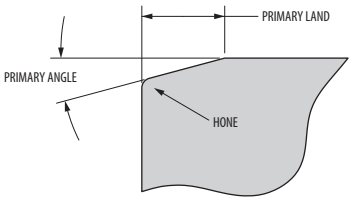
Setup and Operational Procedures

1. Thoroughly clean all insert pockets.
2. Install the inserts, making sure that they are properly seated in the pocket, and torque the insert clamp screws to the correct torque as indicated on the body of the Excelerator Milling Cutter.
3. Use Greenleaf Excelerator Mills only on machines that have adequate shield guards.
4. Run the Greenleaf Excelerator Mills using cutting parameters as recommended by Greenleaf Tech Team. Contact the Greenleaf Tech Team at: 814-763-2915 or by email: techteam@greenleafcorporation.com
5. For safety purposes, do not exceed the maximum RPMs etched on the Excelerator Mill. Note: There are two max RPM numbers. One (the lower RPM number) is for using the mill with carbide inserts and the other is for usage with ceramic inserts.

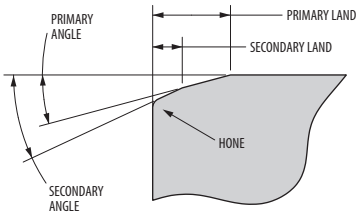
Ceramic Edge Preparations



HONE



PRIMARY ANGLE



SECONDARY ANGLE

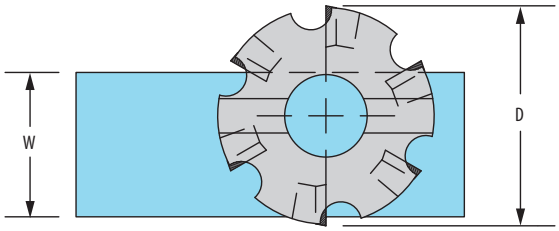
Edge Prep	Hone	Primary Land	Primary Angle	Application
A	.0005 - .001" R.			Light hone added to designated lands and chipforms • **XSYTIN®-1** – General-purpose milling of HRSA, hardened steel, and maraging steel
T1		.002 - .004"	20°	• **XSYTIN®-1** – General-purpose milling of high-hardness HRSA, and hardened steel
T1A	.0005 - .001" R.	.002 - .004"	20°	• **WG-300®/600/700** – Light-medium milling of hardened steel, milling HRSA, general-purpose turning and milling of stainless steel • **XSYTIN®-1** – Same applications as T1 where the interruption or hardness gradient and size of hard particles are greater - particularly in HRSA forging scale
T2		.006 - .008"	20°	Used in the same applications as T1 but at heavier depths of cut and/or heavier feed rates • **GSN100™** – General purpose grey, nodular, and CGI cast iron milling • **XSYTIN®-1** – General purpose grey, nodular, and CGI cast iron milling
T2A	.0005 - .001" R.	.006 - .008"	20°	• **WG-300®/600/700** – Milling of grey and nodular cast iron, and hardened steel • **GSN100™** – Same applications as T2 where more edge strength and protection from irregular wear is required • **XSYTIN®-1** – General-purpose cast iron (including white cast iron, ADI, CGI) milling

Technical Data

Selection of Correct Cutter Diameter

Select a cutter diameter greater than the workpiece width by a ratio of approximately 1.5 to 1. This will ensure that each insert enters the cut without the frictional, no-chip phase which occurs when attempting to cut the full cutter diameter. Also, the insert leaves the part without reducing the chip down to zero. These benefits can greatly extend the insert life.

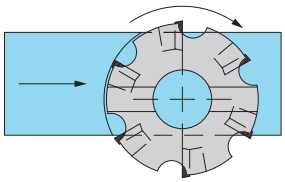
With smaller, low horsepower machines it will be better to select a smaller cutter and take two passes rather than a large diameter cutter forced to operate at low tooth loads (feed rates) to avoid stalling of the spindle.



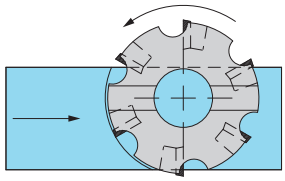
W = Width of work
D = Cutter diameter

Choose a cutter diameter approximately 1.5 times the workpiece width.

Hand of Cutters



Right-hand cutter



Left-hand cutter

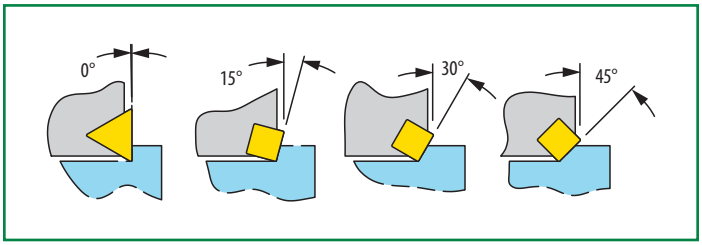
A *right-hand cutter* is one which, when viewed from above, rotates clockwise relative to the workpiece.

A *left-hand cutter* is one which, when viewed from above, rotates counterclockwise relative to the workpiece.

Lead Angles

The lead angle of a milling cutter is not intended for producing a specific angle on the work. In fact, because of compound angles, a given lead angle will not produce that angle exactly.

The purpose of lead angle is to thin the chip while absorbing a given depth of cut over a greater portion of the insert edge. This results in improved tool life and, for a given horsepower, a greater depth potential.



For example, 30° lead angle is a good choice for face milling in general purpose applications.

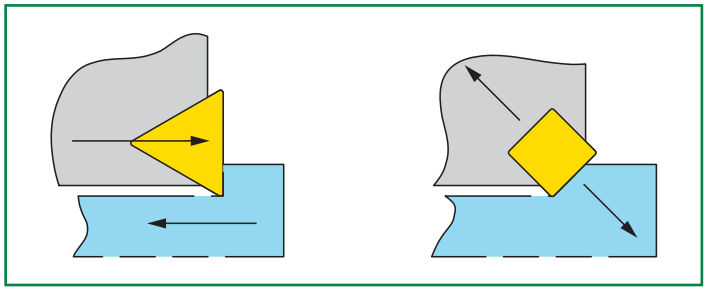
The exception to the previous statement is the 0° lead cutter, sometimes called a 90° cutter, which is designed for milling to square shoulders and producing a 90° corner.

Lead Angles and Cutting Forces

The lead angle of a milling cutter has a direct effect upon the cutting forces being presented to the workpiece, cutting tool, and machine.

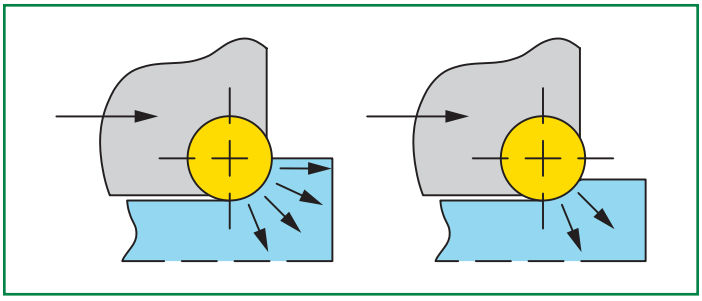
The resultant force is always directly perpendicular to the cutting edge. A lead angle may, therefore, be a major consideration in how we want to direct the forces.

For example, in a thin section workpiece, a high lead angle may cause deflection since there is more tendency to "push" the part away from the cutter. On the other hand, a 0° lead cutter has more deflective force on the machine spindle.



The Round Insert Cutter

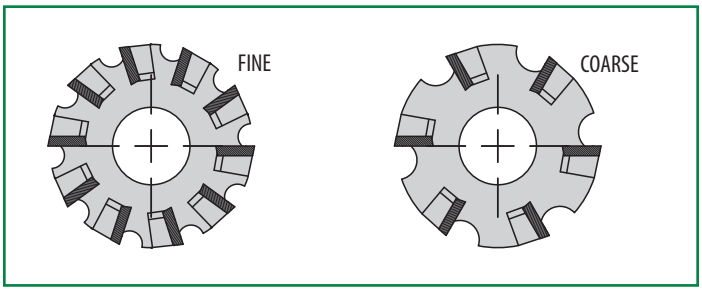
The exception to the rule in lead angle cutting forces is the round insert. With a round insert, the lead angle is entirely dependent upon the depth of cut. As the depth increases, the lead angle decreases. If cutting half the diameter deep, there is effectively 0° lead angle.



In the milling of work hardening materials such as Inconel, and using a round insert cutter, there will be a direct relationship between depth of cut and speed of development of notch wear. The shallower the cut, the slower the notch wear.

Pitch

The pitch of a milling cutter refers to the numbers of inserts placed into a given diameter.



Cutters for cast iron are often closer pitch to allow the maximum number of teeth to be engaged at one time for smoother cutting, and because cast iron does not need large gullet for the discontinuous chips produced.

For general use, choose a fairly coarse pitch. A guide would be diameter plus 2, i.e., a 6" cutter with 8 inserts, etc.

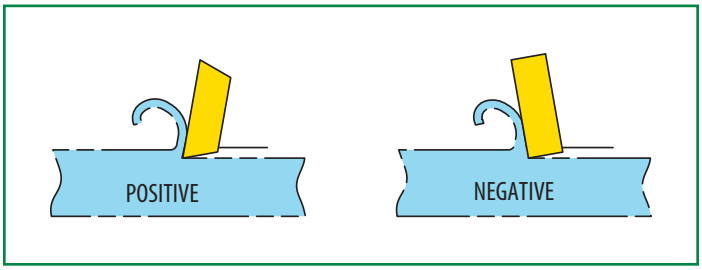
Negative Versus Positive Geometry

In an indexable cutter, the negative insert is the only one which permits the insert to be turned over and used on both sides. It is the most economical style. Also, it is the strongest insert because all edges are 90° to the faces.

On the minus side, the negative rake tool produces higher cutting forces when compared to the positive rake.

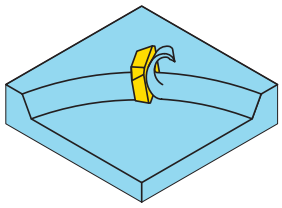
In general, use negative rakes for cast iron, interrupted cuts, and on rigid high horsepower machining for steels.

Use positive rakes for aluminum, titanium, copper, most stainless steels, thin or easily deflected parts, steels, and nickel alloys.



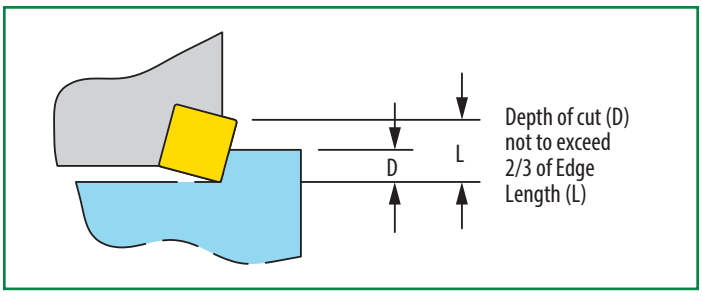
There are many milling cutters with a combination of positive and negative rakes often called shear-angle design. These cutters offer some of both worlds, although inserts are essentially like positive inserts and cannot be turned over. Shear angle cutters do provide continuous chip ejection since the axial rake behaves much like a helix in a flute and takes the chip up and away from the finished surface.

These cutters work well in heavy duty operations with wide widths of cut —especially if combined with a 30° lead angle.



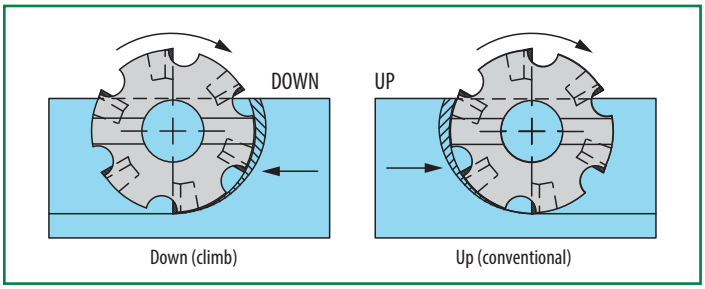
Depth of Cut

It is a good general rule not to allow depth of cut to exceed 2/3 of the cutting edge length. Remember that in lead angle cutters the cutting edge length in use is not the same as the depth of cut.



Up Milling and Down Milling

This refers to direction of rotation relative to the feed.

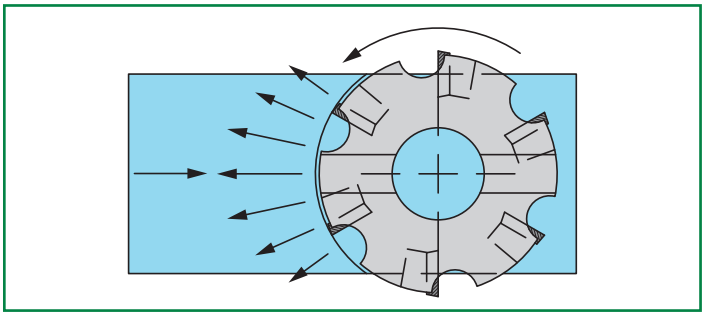


With a modern machine in good condition, down milling will give the best results. This is because the thickest section of the chip is against the insert to avoid welding, and pressure is progressively relieved towards the finished surface.

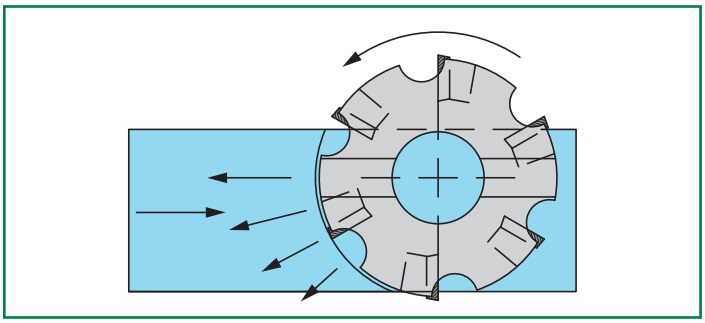
In up milling, friction and pressure build up before the chip starts to form, causing premature edge wear. It should be in rare cases that up milling is needed. This could be, for example, on an older machine with backlash in the table feed.

Cutter Positioning

Central positioning of the cutter can give rise to vibration if any spindle play is present. This is because of an alternating radial force pushing against the spindle.



Placing the cutter off center will always be a better situation to avoid chatter and vibration and also to improve tool life.

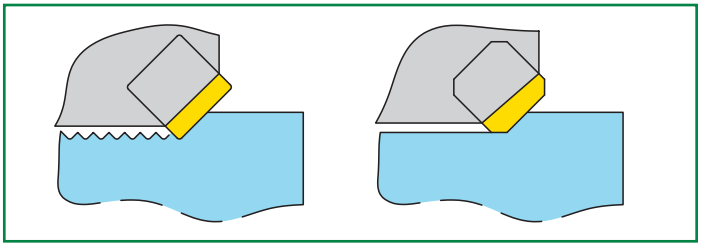


When moving off center, the path of cut is longer since each insert now sweeps a longer arc with each revolution. This may have a measureable impact on tool life, and cutting temperature will tend to increase.

Seek a happy medium by moving off center in small increments until vibration is controlled.

Surface Finish

In a milling cutter the finish is produced by the highest insert. Since variations exist in the body and the inserts, it is inevitable that some inserts will be higher than others. If the inserts have small corner radii, for example, the highest insert will cut the track and this will determine the finish.



For this reason, most inserts designed especially for milling, use flats on the insert rather than a radius. In this way, the highest insert produces a wiping effect removing the variances of the other inserts and leaving a much improved finish. "Wiper" inserts installed in a few stations can be used for this purpose as well as "finishing" inserts which are available for certain cutters in the Greenleaf line.

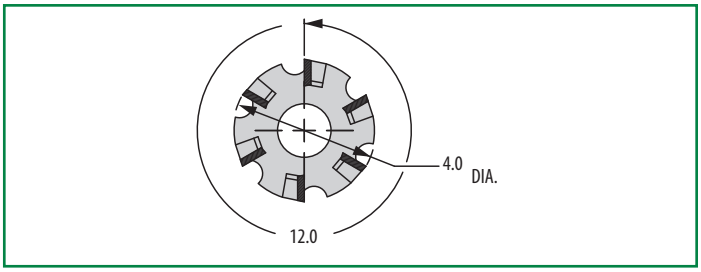
The 4" Reference for Speed Calculations

Recommended cutting speeds are usually given in surface feet per minute (SFM). Sometimes a problem exists in converting SFM to the correct RPM (revolutions per minute) for a given cutter diameter.

A very easy way to make a quick approximate calculation is to use a 4" cutter as a base of reference. Since a 4" cutter has a circumference of approximately 12" or 1 foot

$$\frac{(\pi \times D")}{12} = Cft$$

the correct RPM for a 4" cutter is the same as required speed in SFM, i.e,100 RPM = 100 SFM.



This makes it easy to make a mental calculation for most popular cutter diameters

For Example:

An 8" cutter has 2x the circumference. Therefore, 100 RPM=200 SFM.
A 2" cutter has half the circumference. Therefore, 100 RPM=50 SFM and so forth.

If you want to make an accurate calculation, the formula is:

$$SFM = \frac{(\pi \times d \times RPM)}{12}$$

Speed rate recommendations are based upon the material to be machined and the cutting tool material which will be used, i.e., carbide, coated carbide, ceramic, silicon nitride, etc.

Feed Rate Calculation

One problem encountered in milling cutter feed rate considerations is that while most milling cutter manufacturers make recommendations in load per tooth or feed per tooth, the machine is calibrated in inches per minute. It is, therefore, necessary to do a little simple math to get the answers required.

In turning, these problems do not exist since only one insert is involved, and the machine is calibrated in feed per revolution. Feed per revolution is the same as feed per tooth when there is only one insert, so we simply plug in the recommended feed.

With a milling cutter, the feed per tooth is controlled by three factors. These are:

1. The feed rate or table advance in inches per minute.
2. The spindle speed in revolutions per minute.
3. The number of inserts in the milling cutter.

We must make a calculation in order to find out the really critical information needed, i.e., what is the feed per tooth or how much work are we asking each insert to perform? Too little work is more often a problem than too much.

If the feed per tooth is very small, let us say less than .003", then abrasive wear is accelerated. No real chip is produced to take away the heat.

On the other hand, if high feed rates are used and the cutter has many teeth, then horsepower available may be insufficient. This is an important consideration in selecting a cutter, specially larger diameter cutters with fine pitch.

Here are the equations you will need to make your calculations:

T = Number of teeth
FPT = Feed per tooth
IPM = Inches per minute
RPM = Revolutions per minute
π = 3.1416

$$\text{Feed per tooth} = \frac{\text{IPM}}{\text{T x RPM}}$$

$$\text{Feed per revolution} = \frac{\text{IPM}}{\text{RPM}}$$

$$\text{Inches per minute} = \text{FPT x T x RPM}$$

$$\text{Revolutions per minute} = \frac{12 \times \text{SFM}}{\pi \times d}$$

These calculations can also be readily made using the Greenleaf milling calculator available free of charge upon request from your local representative or directly from Greenleaf Corporation (800-458-1850). This calculator also displays horsepower needed at the spindle for a given cut. This takes into account width and depth as well as speed and feed for a given cutter together with the machinability of the material to be machined, often referred to as the "K" factor.

It is a good starting point to know that a mild steel (150BHN) requires about 1 HP per cubic inch of material to be removed per minute.

The formula for cubic inches removed is:

Cu. ins. = D x W x IPM

Depth = .060

Width = 6 inches

IPM = 22 inches per minute

.060 x 6 x 22 = 7.92 cubic inches per minute
(or)
Approximately 8HP needed for steel 150 BHN

For any other material we can divide our answer by the "K" factor which is a machinability rating relative to 150BHN steel.

"K" Factors

Material	"K" Factor
Aluminum	4.00
Brass–soft	3.00
Brass–hard	2.00
Bronze–hard	1.40
Cast iron to 200 BHN	1.75
Cast iron to over 200 BHN	1.20
Malleable iron	1.50
Steel–100 BHN	1.40
Steel–150 BHN	1.00
Steel–200 BHN	0.85
Steel–250 BHN	0.83
Steel–300 BHN	0.80
Steel–400 BHN	0.65

HPc = Horsepower needed at spindle

D = Depth of cut

W = Width of cut

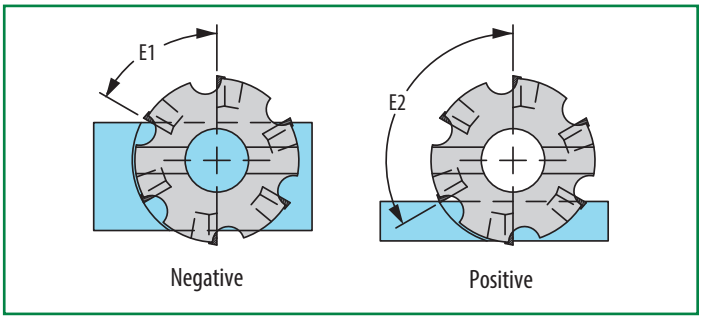
IPM = Inches per minute feed rate

K = K Factor

$$\text{HPc} = \frac{D \times W \times IPM}{K}$$

Angle of Entry

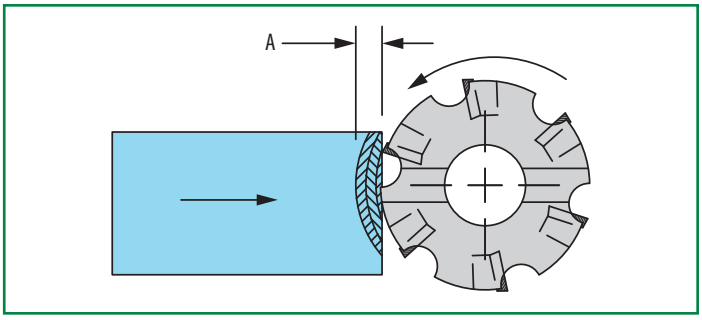
In face milling operations, the angle of entry can have a significant impact upon insert performance. A positive angle of entry can cause breakage or chipping, especially when using positive inserts. Positive angle of entry will occur when the path of cut is narrow relative to cutter diameter.



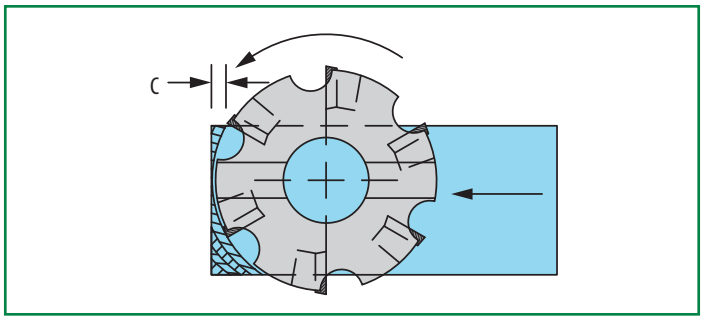
1. When the angle of entry (E1) is less than 90°, the initial impact occurs at a position behind the point of the tool. The insert has a greater section and is stronger here and better able to withstand the impacts.

2. When the angle of entry (E2) is greater than 90°, the initial impact between the insert and the part piece occurs at the point of the tool, which, especially in a positive rake milling cutter, is the weakest section of the insert. This can lead to insert failure.

Entering and Exiting the Cut



The angle of entry is always adverse as the cut commences. In the illustration, we can see that as the cutter travels through zone A, the angle of entry is changing. It starts out positive as the inserts first start to cut. As the cut progresses, it becomes less and less positive and eventually negative.



With a CNC machine, it is a worthwhile exercise to slow down the feed rate in zone A, especially with positive rake tools and hard to cut materials. As the cutter starts to break through at the end of the cut, another problem area is created in zone C.

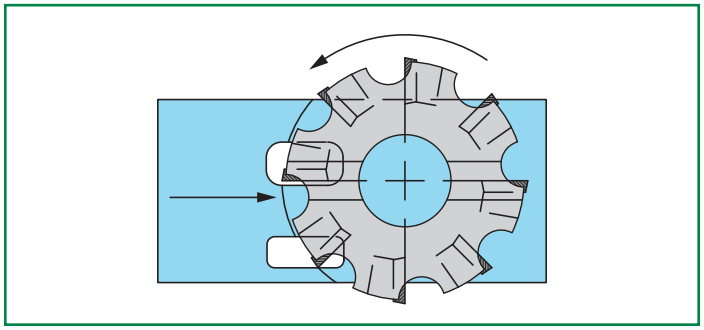
At this point, the cutter breaks through in the center, leaving two islands of material. Changes of entry angle occur which can result in insert problems. As in entry into the part, a reduction of feed rate can help alleviate chipping or breakage problems if they arise.

Interruptions

Milling is by definition an interrupted operation. In addition, as the cutter crosses voids in the part, changes of entry angle occur. This situation is usually too complex to define in absolute terms relative to a targeted solution.

Recognizing this in interrupted parts, try to include some of the following features in the set-up to reduce impact:

1. Negative or negative/positive geometry
2. Use a lead-angle cutter (30° or 45°) if possible
3. Use an impact-resistant carbide grade
4. Use a cutter with medium or fine pitch
5. Keep the load per tooth on the low end.



A Milling Cutter is a Series of Single-Point Tools

It is easy to lose sight of the fact that a milling cutter is nothing more than a series of single-point tools clamped into a rotating holder. If you always keep this in mind, you will be constantly reminded that what is most important to know is what is happening to each tool or insert.

The feed rate in inches per minute of machine table travel does not tell you anything important unless or until you
calculate the feed per tooth. You cannot calculate the feed per tooth until you know the speed in revolutions per minute and how many teeth are in the cutter. Therefore, it should become second nature to ask, know, and consider the three "golden" variables:

1. **How many inserts?**
2. **How many RPM?**
3. **What feed in inches per minute?**

Use this formula to find feed per tooth:

$$\text{FPT} = \frac{\text{IPM}}{\text{No. of Teeth x RPM}}$$

Once you know the feed per tooth, as a very broad general guide, try to keep the feed above .003" per tooth and remember that horsepower limitations usually come into play long before most cutters reach the upper limit.

Some heavy-duty cutters can be used as high as .030" or more per tooth, but this will need a machine in the 50+ horsepower class – and a larger cutter could well use over 100 horsepower!

For Additional Information about Milling with Ceramics

For additional information about milling with ceramics, go to the Application and Technical Information (ATI) section of the catalog.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CRGPR-204V
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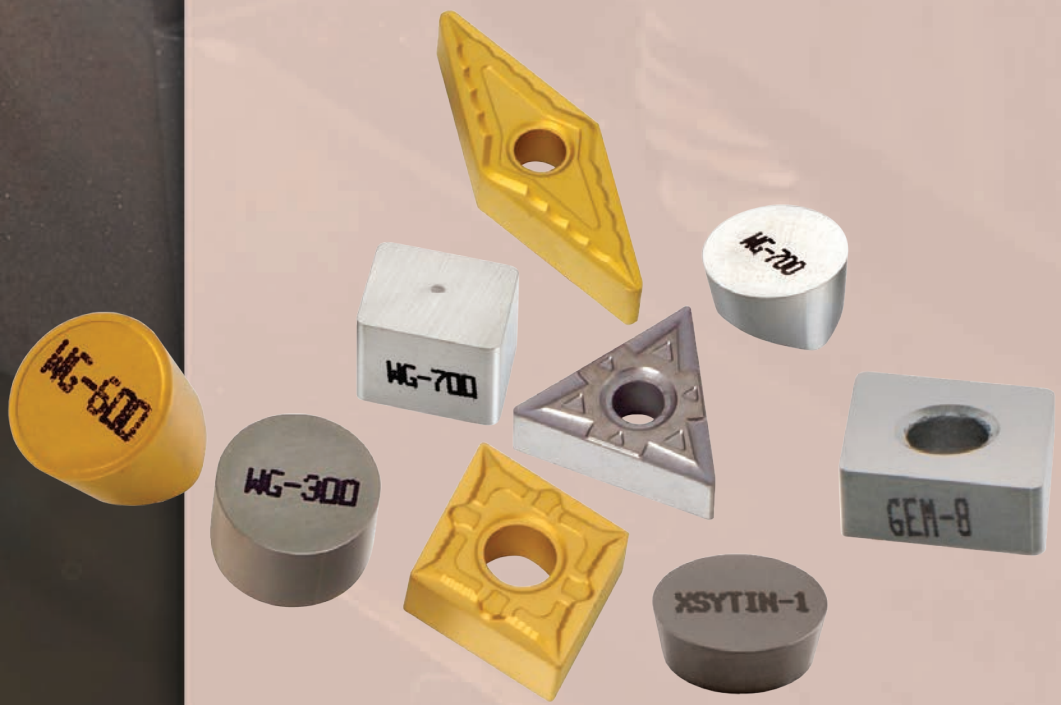
536834

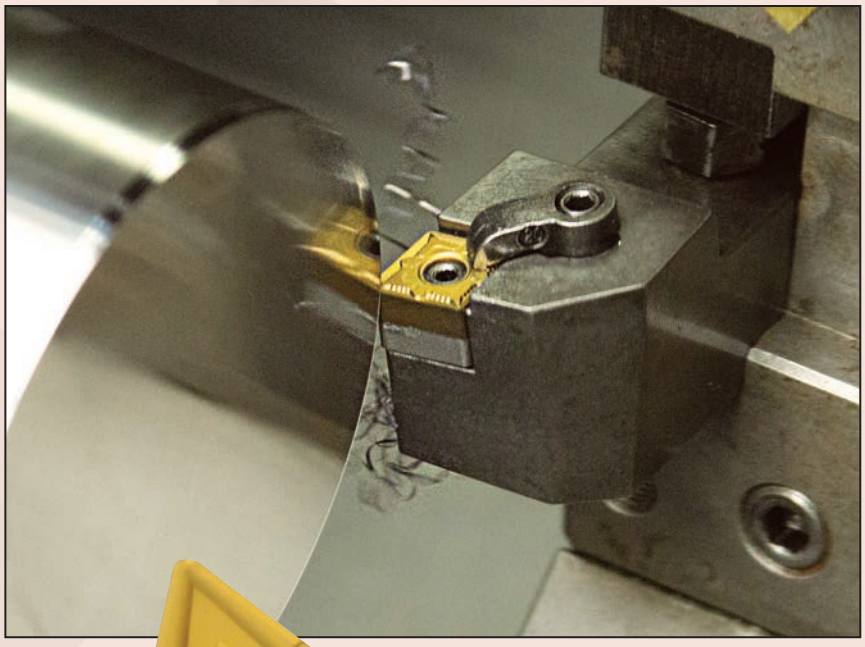
Turning and Boring

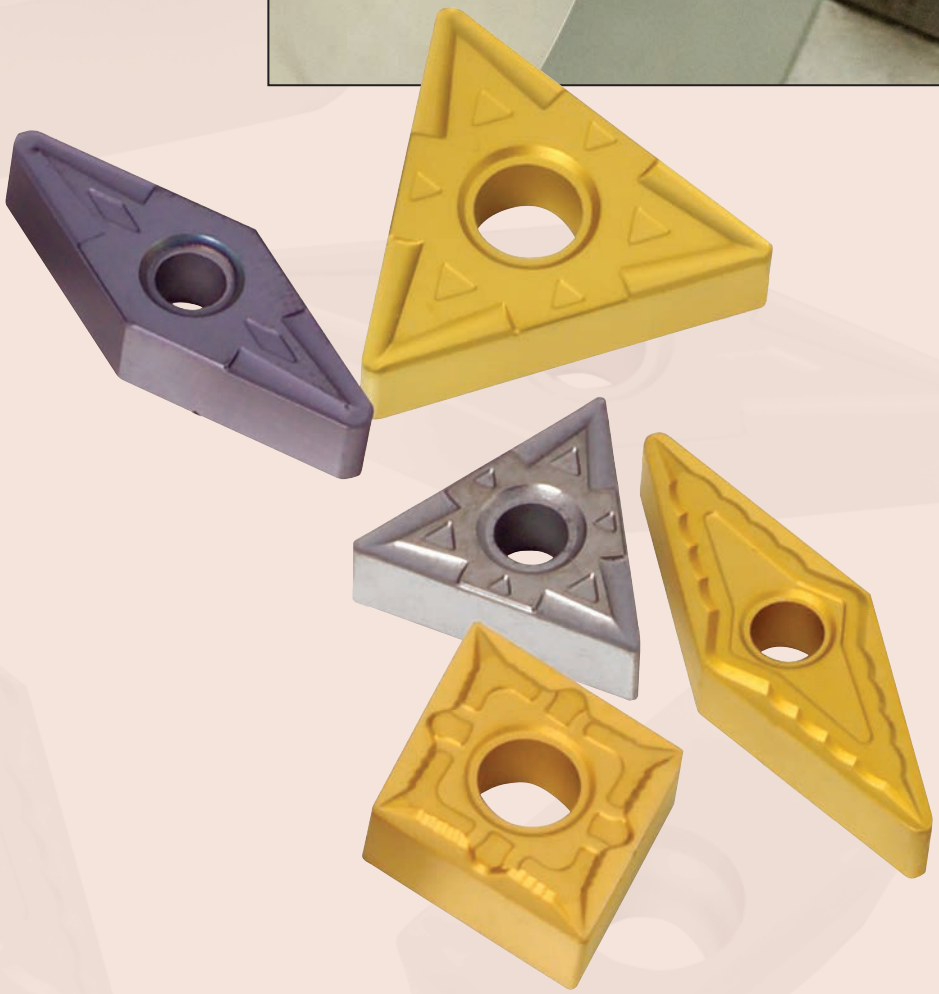


Phone: 814-763-2915 • 800-458-1850 • Fax: 814-763-4423 • sales@greenleafcorporation.com • www. greenleafcorporation.com

Advanced Carbide Inserts

Greenleaf offers a comprehensive line of carbide inserts in grades for all materials. Carbide inserts are available in ANSI standard geometries with multi-purpose chipbreakers for heavy roughing through finishing.





Phone: 814-763-2915 • 800-458-1850 • Fax: 814-763-4423 • sales@greenleafcorporation.com • www. greenleafcorporation.com

Insert Grades

Carbide

Greenleaf offers a comprehensive line of carbide inserts in grades ranging from sub-micron C-1 through C-8 classifications. An industry pioneer in coated carbide, Greenleaf offers a variety of uncoated, MT-CVD coated and PVD-coated grades. Carbide inserts are available in ANSI standard geometries with multi-purpose chipbreakers for heavy roughing through finishing.

CVD Coated

G5125+ A tough, Co-enriched, CVD-coated grade that is ideally suited for the roughing and semi-finishing of steels in turning. Intended applications range from clean and continuous to heavily nterrupted cuts in steels of various hardness and composition, at medium to high speeds and moderate feed rates.

GA5023 A high-performance grade designed for the turning and milling of various grades of cast iron, GA5023 features an advanced MT-CVD coating specifically developed to withstand the abrasiveness of cast iron in machining. Applications range from roughing to finishing in most grades of cast iron, including gray, nodular, and others. The high wear resistance and toughness of GA5023 enable high-speed machining in a wide range of feed rates.

GA5025 A high-speed MT-CVD coated grade developed primarily for turning, GA5025 excels in light roughing and finishing applications of carbon and alloy steels, including select stainless steels. GA5025 is preferred when tool life and wear resistance are essential in steel turning.

GA5026 A high-performance grade specifically developed for finish-turning in nickel- and cobalt-based super-alloys, stainless steels, hardened steels, and refractory metals. The advanced MT-CVD coating over a micro-grain substrate offers outstanding wear resistance while maintaining exceptional resistance to notching and deformation common in turning of high-strength materials. GA5026 is best applied at high speeds and low feed rates.

CVD Coated *continued*

GA5035 A high-performance MT-CVD coated grade for turning all types of steels, GA5035 can be used for heavy roughing to finish-turning applications requiring resistance to heat deformation, thermal shock from interrupted cuts, and abrasion. GA5035 should be applied at high speeds and a moderate range of feeds. GA5035 is the primary choice for steel turning.

GA5125 A high-performance MT-CVD coated carbide used primarily for the milling and turning of manganese steel. GA5125 can also be applied in Cr-Mo steels, tool steels, and other alloyed steels in continuous and interrupted turning. GA5125 provides excellent resistance to abrasion, crater wear, thermal shock, deformation, and built-up edge. It performs best when applied at high speeds and moderate feed rates.

G-5135 A coarse-grain MT-CVD coated carbide, G-5135 is ideal for rough steel turning operations, including scale and moderate-to-heavy interruptions, as well as select steel milling applications. G-5135 is also applicable in the roughing of cast irons and stainless steels. Apply at moderate speeds and high feed rates.

PVD Coated

G-915 A multi-layer PVD-coated grade, G-915 is exceptional for milling and interrupted turning of heat-resistant alloys, stainless steels, and low-carbon steels. The coating adds heat and abrasion resistance to the tough substrate. G-915 should be used at moderate speeds and moderate to high feeds. It is a versatile grade that performs well in a variety of materials and operations outside its primary application range, making it a great choice for general machining.

PVD Coated *continued*

G-9120 This multi-layer PVD-coated carbide grade excels at milling and turning steel castings and forgings. G-9120 was engineered specifically to maximize productivity at moderate to heavy feed rates and high depths of cut, making it ideal for heavy-turning applications in steel.

G-920 A PVD-coated grade for light-to-medium turning of heat-resistant alloys and some stainless steels. It is also an excellent grade for aluminum and refractory metals. Given its resistance to deformation and notching, G-920 should be applied at higher speeds and is well-suited for grooving and finish-turning of HRSA.

G-9230 A PVD-coated grade designed for the machining of heat-resistant alloys, titanium, and hardened and stainless steels. G-9230 works particularly well in stainless steel turning, interrupted turning of HRSA, and interrupted turning of titanium. G-9230 has superior wear resistance and toughness and is excellent for casting and forging scale conditions.

G-925 A high-performance multi-layer PVD-coated grade, G-925 is specifically designed for turning abrasive and difficult-to-machine materials. Typical applications include turning of HRSA, titanium and other refractory metals, stainless steels, and ductile cast irons. G-925 exhibits excellent resistance to notching and deformation. Apply at moderate to high speeds and moderate feeds.

G-9610 A PVD-coated grade, G-9610 is designed for turning titanium-based alloys. The high-tech, wear-resistant, chemically stable, and very smooth and lubricious coating protects the heat-resistant, sub-micron substrate and allows for higher speeds and extended tool life in continuous cuts in non-ferrous alloys.

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Uncoated

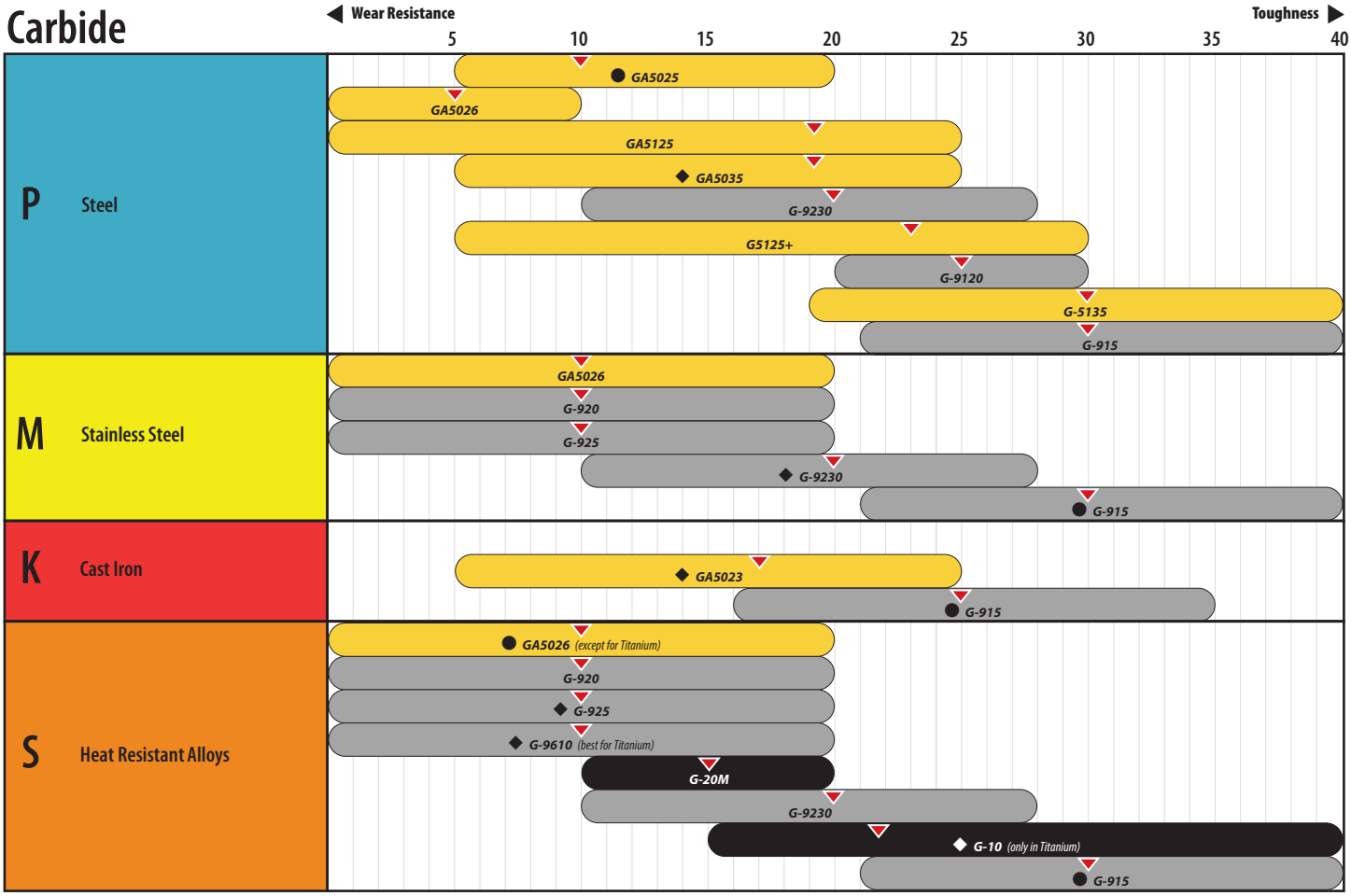
G-10 Used for roughing all cast irons in severe conditions, including broaching. The edge strength of G-10 makes it a great choice for roughing Ni-, Co-, and Ti-based alloys with positive rakes, and any machining of non-ferrous materials when toughness is of prime importance. Apply at moderate speeds and feeds.

G-02 An excellent general-purpose cast-iron grade, G-02 can be used for milling and turning cast iron at moderately high speeds and medium feeds. G-02 is also a good choice for machining aluminum with positive rakes and light roughing of some heat-resistant alloys and stainless steels.

G-20M A sub-micron C-2 carbide grade suited for use in light-to-medium turning of titanium and heat-resistant super alloys, G-20M has the strength and edge wear characteristics to resist notching when turning high-strength materials.edge wear characteristics to resist notching when turning high-strength materials.

Insert Grade Reference for Turning

Carbide



CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated First Choice ◆ Second Choice ●

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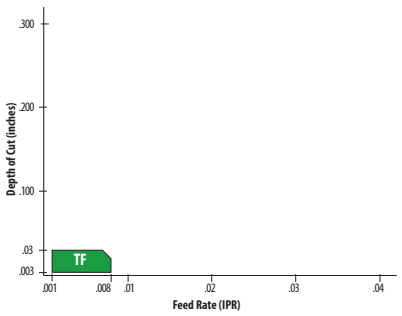
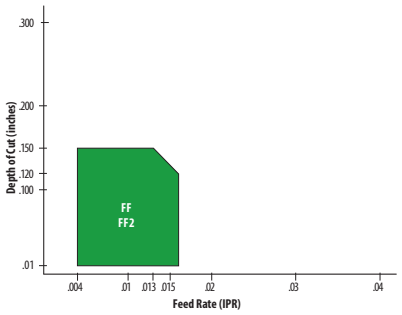
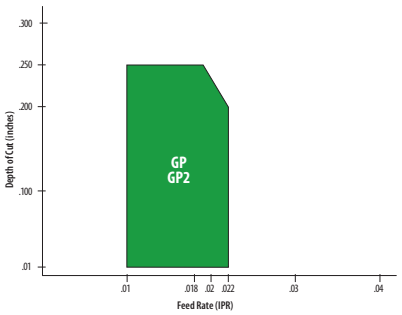
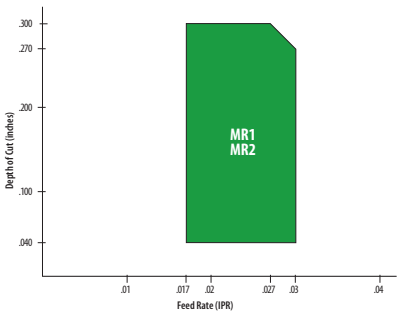
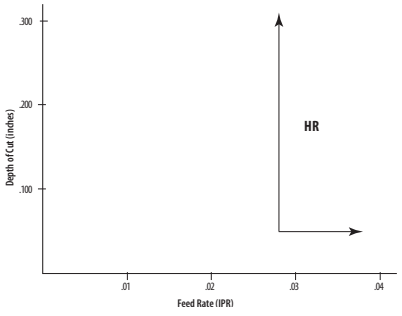
Chipform Application Range

PRECISION FINISHING	TF	Precision ground chipbreaker for nickel alloys. Good for feeds up to 0.009"/rev and depths to 0.03".	
FINISHING	FF and FF2	For finishing all types of material. Designed for feeds up to 0.0185"/rev and 0.15" depth of cut.	
GENERAL PURPOSE	GP and GP2	General purpose chipbreaker. Feed rates up to 0.02"/rev and 0.25" depth of cut.	
MEDIUM ROUGHING	MR and MR2	Used for medium roughing of all material. Feeds up to 0.028"/rev and depths up to 0.30".	
HEAVY ROUGHING	HR	Heavy roughing for all materials. Feeds above 0.023"/rev. One-sided chipbreaker for heaviest feeds (MM). *Example: CNMM 644 HR*	

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A.N.S.I. Identification for Turning and Boring Inserts

Tolerance Class [1]

	Roll Dim. B	I.C. A	Thickness T
A	0.0002 [2]	0.001	0.001
B	0.0002	0.001	0.005
C	0.0005	0.001	0.001
D	0.0005	0.001	0.005
E	0.001	0.001	0.001
F	0.0002 [2]	0.0005	0.001
G	0.001	0.001	0.005
H	0.0005	0.0005	0.001
J	0.0002 [2]	0.002-0.005	0.001
K	0.0005	0.002-0.005	0.001
L	0.001	0.002-0.005	0.001
M	0.002-0.010 [3]	0.002-0.004 [3]	0.005
U	0.005-0.012 [3]	0.005-0.010 [3]	0.005
N	0.002-0.010 [3]	0.002-0.004 [3]	0.001

Size (I.C.)

Regular polygons and diamonds

Number of 1/8ths of an inch in the inscribed circle as per table below:

Example:

5/32" I.C.	1.2
3/16" I.C.	1.5
7/32" I.C.	1.8
1/4" I.C.	2
5/16" I.C.	2.5
3/8" I.C.	3
1/2" I.C.	4
5/8" I.C.	5
3/4" I.C.	6
7/8" I.C.	7
1" I.C.	8
1-1/4" I.C.	10

Rectangles and parallelograms

Use two digits to size

1st digit: Number of 1/8ths of an inch in width

2nd digit: Number of 1/4ths of an inch in length

S P G A 6

Shape

- **V** 35° diamond
- **D** 55° diamond
- **K** 55° parallelogram
- **T** 60° triangle
- **E** 75° diamond
- **C** 80° diamond
- **W** 80° Trigon
- **B** 82° parallelogram
- **A** 85° parallelogram
- **M** 86° diamond
- **S** 90° square
- **L** 90° rectangle
- **P** 108° pentagon
- **H** 120° hexagon
- **O** 135° octagon
- **R** round

Clearances

- **N** 0°
- **A** 3°
- **B** 5°
- **C** 7°
- **P** 11°
- **D** 15°
- **E** 20°
- **F** 25°
- **G** 30°
- **H** 0°-11° [4]
- **J** 0°-14° [4]
- **K** 0°-17° [4]
- **L** 0°-20° [4]
- **M** 11°-14° [4]
- **R** 11°-17° [4]
- **S** 11°-20° [4]

Type

- **N** Without hole
- **R** Without hole with chip groove on one rake face
- **F** Without hole with chip grooves on two rake faces
- **A** With hole
- **B** With hole and one countersink (80°-90°)
- **C** With hole and two countersinks (80°-90°)
- **W** With hole and one countersink (40°-60°)
- **Q** With hole and two countersinks (40°-60°)
- **M** With hole and chip groove on one rake face
- **G** With hole and chip grooves on two rake faces
- **H** With hole, one countersink (80°-90°) and chip groove on one rake face
- **J** With hole, two countersinks (80°-90°) and chip grooves on two rake faces
- **T** With hole, one countersink (40°-60°) and chip groove on one rake face
- **U** With hole, two countersinks (40°-60°) and chip grooves on two rake faces

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Thickness

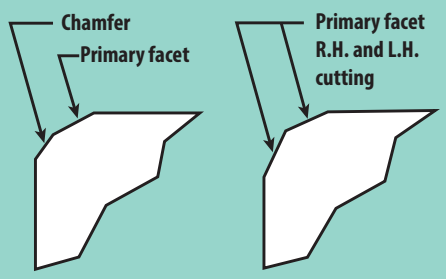
Regular polygons, diamonds, rectangles and parallelograms:
Number of 1/16ths of an inch in thickness as per table below:

Example:

3/32"	1.5
1/8"	2
5/32"	2.5
3/16"	3
7/32"	3.5
1/4"	4
5/16"	5
3/8"	6
7/16"	7
1/2"	8

Special Cutting Point Definition (5)

Only used following a letter in the seventh position.
Number of 1/64ths of an inch in the primary facet length.



Hand (5)

R	*Right*
L	*Left*

3 **3** [ ] [ ] **A**

Cutting Point Configuration

0	*Sharp Corner*
1	*1/64" radius*
2	*1/32" radius*
3	*3/64" radius*
4	*1/16" radius*
5	*5/64" radius*
6	*3/32" radius*
7	*7/64" radius*
8	*1/8" radius*
A	*Square insert with 45° chamfer*
D	*Square insert with 30° chamfer*
E	*Square insert with 15° chamfer*
F	*Square insert with 3° chamfer*
K	*Square insert with 30° double chamfer*
L	*Square insert with 15° double chamfer*
M	*Square insert with 3° double chamfer*
N	*Truncated triangular insert*
P	*Flatted corner triangle – 90°*

Other Conditions (5)

A	*Honed (0.0005 to 0.001")*
B	*Honed (0.001 to 0.002")*
C	*Honed (0.005 to less than 0.007")*
D	*Honed (0.007" and over)*
J	*Polished to 4 microinch AA (rake face only)*
T	*Chamfered – manufacturer's standard (negative land – rake face only)*

(1) Tolerances given are plus and minus from nominal.

(2) These tolerances normally apply to indexable inserts with facets (secondary cutting edges).

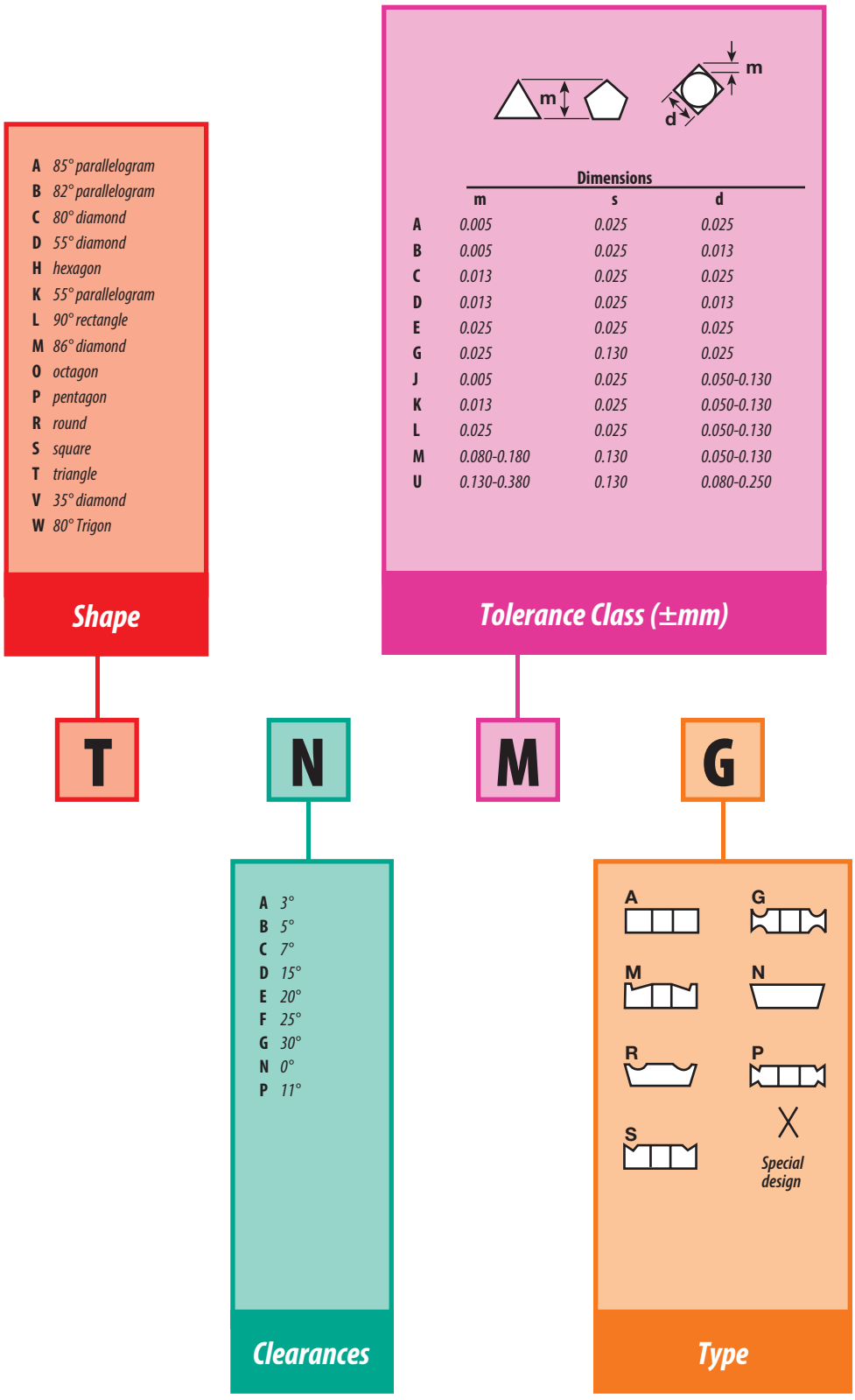
(3) The tolerance depends on the size and shape of the insert and should be shown in the standards for the corresponding shapes and sizes (see ANSI B94.25).

(4) Secondary facet angle may vary by +1°.

(5) Shall only be used when required.

(6) Dimensions are established prior to supplemental edge or coating modification.

I.S.O. Identification for Turning and Boring Inserts



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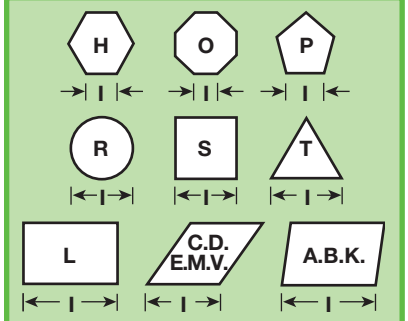
Comparison cutting edge length in mm – IC in inches

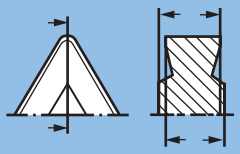
△	06	09	11	16	22	27	33	44
□ ○				09	12	15	19	25
55°					15	19		
80°					12	16	19	25
35°				16	22			
IC = d	5/32"	7/32"	1/4"	3/8"	1/2"	5/8"	3/4"	1"



Integers to be preceded by a 0.
Example: 9,52 mm indicated by 09.

Cutting Edge Length

22



01	s=	1,59
T1	s=	1,98
02	s=	2,38
03	s=	3,18
T3	s=	3,97
04	s=	4,76
05	s=	5,56
06	s=	6,35
07	s=	7,94
09	s=	9,52
10	s=	10,00
12	s=	12,00

04

Unhoned	F
Honed	E
Chamfered	T
Chamfered and Honed	S

Cutting Edge

E

Radius in terms of 0.1 mm

00	Round insert sharp point
00	0.2
02	0.4
04	0.5
05	0.8
08	1.0
10	1.2
12	1.5
15	1.6
16	2.4
24	3.2
32	4.0
40	

08

Cutting Point Configuration

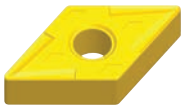
Pictorial Index

Negative Inserts

80° Diamond
Chip Control
page: T 14

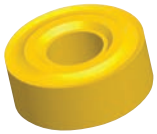
80° Diamond
Flat Top
page: T 15

80° Diamond
Flat Top
page: T 15



55° Diamond
Chip Control
page: T 16

55° Diamond
Flat Top
page: T 17



Round
Chip Control
page: T 18

Round
Flat Top
page: T 19

Round
Flat Top
page: T 19

Negative Inserts *continued*

Square
Chip Control
page: T 20

Square
Flat Top
page: T 21

Square
Flat Top
page: T 22-23

Triangle
Chip Control
page: T 24-25

Triangle
Flat Top
page: T 26

Triangle
Flat Top
page: T 27-28

35° Diamond
Chip Control
page: T 29

35° Diamond
Flat Top
page: T 30

Negative Inserts *continued*

80° Trigon
Chip Control
page: T 31

80° Trigon
Flat Top
page: T 32

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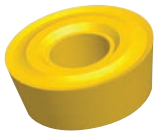
Positive Inserts

80° Diamond
Positive Flat Top
page: T33

Round
Positive Flat Top
page: T33



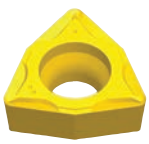
Round
Chip Control
page: T34

Round
Chip Control
page: T34

Square
Positive Flat Top
page: T35

Triangle
Positive Flat Top
page: T36-37

Triangle
Positive Flat Top
page: T38

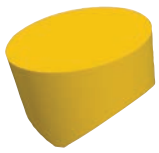


80° Trigon
Chip Control: Screw-On
page: T39

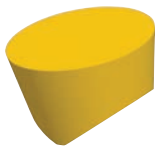
Radius Forming Insert

SNMA-IR
Insert and Toolholder
page: T40

V-Bottom Round Inserts

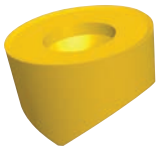


RCGN
Positive: Carbide
page: GP 14



RPGN
Positive: Ceramic
page: GP 15

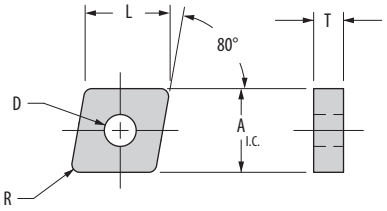
RCGR/RPGR
Positive Chipform
V-Bottom
page: GP 16

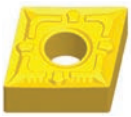


RCGT/RPGT
Positive Chipform
V-Bottom
page: GP 17

80° Diamond Inserts

Negative Chip Control (CNGG-CNMG-CNMM)



	Shape: 80° Diamond	Part Number ANSI	Steel P					Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S						Titanium S			Part Number ISO	Dimensions (inches)				
			GA5025	GA5035	GA5125	G-5125+	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-9610	G-20M	G-925	G-9610	G-10		$A_{I.C.}$	L	T	D	R
PRECISION FINISHING	TurboForm® 	CNGG-430.3-TF						●	▲	●	◆			●	◆	●	▲			●	◆		CNGG-120401.3-TF	0.500	0.507	0.187	0.203	0.005
		CNGG-430.6-TF						●	▲	●	◆			●	◆	●	▲			●	◆		CNGG-120402.6-TF	0.500	0.507	0.187	0.203	0.010
		CNGG-431-TF						●	▲	●	◆			●	◆	●	▲			●	◆		CNGG-120404-TF	0.500	0.507	0.187	0.203	0.015
		CNGG-432-TF						●	▲	●	◆			●	◆	●	▲			●	◆		CNGG-120408-TF	0.500	0.507	0.187	0.203	0.031
		CNGG-433-TF						●	▲	●	◆			●	◆	●	▲			●	◆		CNGG-120412-TF	0.500	0.507	0.187	0.203	0.047
FINISHING	FF2 	CNMG-431-FF2	▲	◆		●		●	▲	●	◆		◆	●	◆	●	▲			●	◆	▲	CNMG-120404-FF2	0.500	0.507	0.187	0.203	0.015
		CNMG-432-FF2	▲	◆		●		●	▲		◆		◆	●	◆		▲			●	◆	▲	CNMG-120408-FF2	0.500	0.507	0.187	0.203	0.031
		CNMG-433-FF2	▲	◆		●		●	▲		◆		◆	●	◆		▲			●	◆	▲	CNMG-120412-FF2	0.500	0.507	0.187	0.203	0.047
		CNMG-434-FF2	▲	◆		●		●	▲		◆		◆	●	◆		▲			●	◆	▲	CNMG-120416-FF2	0.500	0.507	0.187	0.203	0.062
		CNMG-542-FF	▲	◆		●		●	▲		◆		◆	●	◆		▲			●	◆	▲	CNMG-160608-FF	0.625	0.635	0.250	0.250	0.031
		CNMG-543-FF	▲	◆		●		●	▲		◆		◆	●	◆		▲			●	◆	▲	CNMG-160612-FF	0.625	0.635	0.250	0.250	0.047
		CNMG-643-FF	▲	◆		●		●	▲		◆		◆	●	◆		▲			●	◆	▲	CNMG-190612-FF	0.750	0.761	0.250	0.312	0.047
GENERAL PURPOSE	GP2 	CNMG-432-GP2	●	◆	▲	▲		●	▲		◆		◆	●	◆		▲			▲	●	◆	CNMG-120408-GP2	0.500	0.507	0.187	0.203	0.031
		CNMG-433-GP2	●	◆	▲	▲		●	▲		◆		◆	●	◆		▲			▲	●	◆	CNMG-120412-GP2	0.500	0.507	0.187	0.203	0.047
		CNMG-434-GP2	●	◆	▲	▲		●	▲		◆		◆	●	◆		▲			▲	●	◆	CNMG-120416-GP2	0.500	0.507	0.187	0.203	0.062
		CNMG-542-GP2	●	◆	▲	▲			▲		◆	●	◆		◆		▲		●	▲	●	◆	CNMG-160608-GP2	0.625	0.635	0.250	0.250	0.031
		CNMG-543-GP2	●	◆	▲	▲			▲		◆	●	◆		◆		▲		●	▲	●	◆	CNMG-160612-GP2	0.625	0.635	0.250	0.250	0.047
		CNMG-643-GP	●	◆	▲	▲			▲		◆	●	◆		◆		▲		●	▲	●	◆	CNMG-190612-GP	0.750	0.761	0.250	0.312	0.047
MEDIUM ROUGHING	MR2 	CNMG-432-MR2		◆	▲	▲	●		▲		◆	●	◆		◆		▲		●	●	▲	◆	CNMG-120408-MR2	0.500	0.507	0.187	0.203	0.031
		CNMG-433-MR2		◆	▲	▲	●		▲		◆	●	◆		◆		▲		●	●	▲	◆	CNMG-120412-MR2	0.500	0.507	0.187	0.203	0.047
		CNMG-434-MR2		◆	▲	▲	●		▲		◆	●	◆		◆		▲		●	●	▲	◆	CNMG-120416-MR2	0.500	0.507	0.187	0.203	0.062
		CNMG-542-MR2		◆	▲	▲	●		▲		◆	●	◆		◆		▲		●	●	▲	◆	CNMG-160608-MR2	0.625	0.635	0.250	0.250	0.031
		CNMG-543-MR2		◆	▲	▲	●		▲		◆	●	◆		◆		▲		●	●	▲	◆	CNMG-160612-MR2	0.625	0.635	0.250	0.250	0.047
		CNMG-642-MR		◆	▲	▲	●		▲		◆	●	◆		◆		▲		●	●	▲	◆	CNMG-190608-MR	0.750	0.761	0.250	0.312	0.031
		CNMG-643-MR		◆	▲	▲	●		▲		◆	●	◆		◆		▲		●	●	▲	◆	CNMG-190612-MR	0.750	0.761	0.250	0.312	0.047
		CNMG-644-MR		◆	▲	▲	●		▲		◆	●	◆		◆		▲		●	●	▲	◆	CNMG-190616-MR	0.750	0.761	0.250	0.312	0.062
HEAVY ROUGHING	HR – single sided 	CNMM-643-HR		◆		▲	●		▲		◆	●	◆		◆				●				CNMM-190612-HR	0.750	0.761	0.250	0.312	0.047
		CNMM-866-HR		◆			●		▲		◆	●	◆		◆				●				CNMM-250924-HR	1.000	1.015	0.375	0.359	0.094

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

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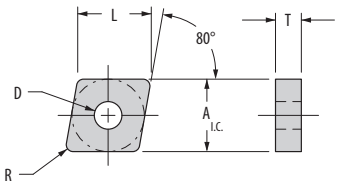
80° Diamond Inserts

Negative Flat Top (CNMA)



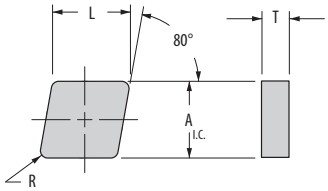
Shape: 80° Diamond	Part Number ANSI	Cast Iron K GA5023	Cast Iron K G-02	Part Number ISO	Dimensions (inches) $A_{I.C.}$	L	T	D	R
	CNMA-431	◆	▲	CNMA-120404	0.500	0.507	0.187	0.203	0.015
	CNMA-432	◆	▲	CNMA-120408	0.500	0.507	0.187	0.203	0.031
	CNMA-433	◆	▲	CNMA-120412	0.500	0.507	0.187	0.203	0.047
	CNMA-434	◆	▲	CNMA-120416	0.500	0.507	0.187	0.203	0.062
	CNMA-542	◆	▲	CNMA-160608	0.625	0.635	0.250	0.250	0.031
	CNMA-543	◆	▲	CNMA-160612	0.625	0.635	0.250	0.250	0.047
	CNMA-642	◆	▲	CNMA-190608	0.750	0.761	0.250	0.312	0.031
	CNMA-643	◆	▲	CNMA-190612	0.750	0.761	0.250	0.312	0.047
	CNMA-644	◆	▲	CNMA-190616	0.750	0.761	0.250	0.312	0.062
	CNMA-866	◆	▲	CNMA-250924	1.000	1.015	0.375	0.359	0.094

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated First Choice ◆ Second Choice ● Alternative ▲ *Grade descriptions — pages T 4*

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

80° Diamond Inserts

Negative Flat Top (CNGN)



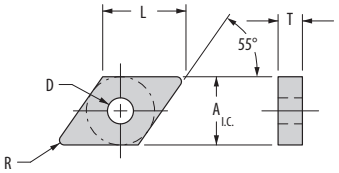
Shape: 80° Diamond	Part Number ANSI	Cast Iron K GA5023	Cast Iron K G-02	Part Number ISO	Dimensions (inches) $A_{I.C.}$	L	T	R
	CNGN-422	◆	▲	CNGN-120308	0.500	0.507	0.125	0.031
	CNGN-432	◆	▲	CNGN-120408	0.500	0.507	0.187	0.031
	CNGN-632	◆	▲	CNGN-190408	0.750	0.761	0.187	0.031
	CNGN-633	◆	▲	CNGN-190412	0.750	0.761	0.187	0.047
	CNGN-634	◆	▲	CNGN-190416	0.750	0.761	0.187	0.062
	CNGN-643	◆	▲	CNGN-190612	0.750	0.761	0.250	0.047
	CNGN-644	◆	▲	CNGN-190616	0.750	0.761	0.250	0.062

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated First Choice ◆ Second Choice ● Alternative ▲ *Grade descriptions — pages T 4*

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

55° Diamond Inserts

Negative Chip Control (DNGG-DNMG)



	Shape: 55° Diamond	Part Number ANSI	Steel P					Stainless Steel M						Cast Iron K	Heat-Resistant Super Alloys S						Titanium S			Part Number ISO	Dimensions (inches)				
			GA5025	GA5035	GA5125	G-5125+	G-9120	GA5026	G-5125+	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-9610	G-20M	G-925	G-9610	G-10		$A_{I.C.}$	L	T	D	R
PRECISION FINISHING	TurboForm®	DNGG-430.3-TF						▲		●		◆			▲	◆		●			●	◆		DNGG-150401.3-TF	0.500	0.610	0.187	0.203	0.005
		DNGG-430.6-TF						▲		●		◆			▲	◆		●			●	◆		DNGG-150402.6-TF	0.500	0.610	0.187	0.203	0.010
		DNGG-431-TF						▲		●		◆			▲	◆		●			●	◆		DNGG-150404-TF	0.500	0.610	0.187	0.203	0.015
		DNGG-432-TF						▲		●		◆			▲	◆		●			●	◆		DNGG-150408-TF	0.500	0.610	0.187	0.203	0.031
		DNGG-433-TF						▲		●		◆			▲	◆		●			●	◆		DNGG-150412-TF	0.500	0.610	0.187	0.203	0.047
		DNGG-542-TF						▲		●		◆			▲	◆		●			●	◆		DNGG-190608-TF	0.625	0.763	0.250	0.250	0.031
		DNGG-543-TF						▲		●		◆			▲	◆		●			●	◆		DNGG-190612-TF	0.625	0.763	0.250	0.250	0.047
FINISHING	FF2	DNMG-431-FF2	▲	◆				●	▲	▲		◆		◆	●	◆		▲			●	◆		DNMG-150404-FF2	0.500	0.610	0.187	0.203	0.015
		DNMG-432-FF2	▲	◆				●	▲	▲		◆		◆	●	◆		▲			●	◆		DNMG-150408-FF2	0.500	0.610	0.187	0.203	0.031
		DNMG-433-FF2	▲	◆				●	▲	▲		◆		◆	●	◆		▲			●	◆		DNMG-150412-FF2	0.500	0.610	0.187	0.203	0.047
		DNMG-441-FF2	▲	◆				●	▲	▲		◆		◆	●	◆		▲			●	◆		DNMG-150604-FF2	0.500	0.610	0.250	0.203	0.015
		DNMG-442-FF2	▲	◆				●	▲	▲		◆		◆	●	◆		▲			●	◆		DNMG-150608-FF2	0.500	0.610	0.250	0.203	0.031
		DNMG-443-FF2	▲	◆				●	▲	▲		◆		◆	●	◆		▲			●	◆		DNMG-150612-FF2	0.500	0.610	0.250	0.203	0.047
		DNMG-542-FF2	▲	◆				●	▲	▲		◆		◆	●	◆		▲			●	◆		DNMG-190608-FF2	0.625	0.763	0.250	0.250	0.031
		DNMG-543-FF2	▲	◆				●	▲	▲		◆		◆	●	◆		▲			●	◆		DNMG-190612-FF2	0.625	0.763	0.250	0.250	0.047
GENERAL PURPOSE	GP2	DNMG-432-GP2	●	◆	▲			●	▲	▲		◆		◆	●	◆		▲			▲	●	◆	DNMG-150408-GP2	0.500	0.610	0.187	0.203	0.031
		DNMG-433-GP2	●	◆	▲			●	▲		◆		◆		◆		▲	●		▲	●	◆		DNMG-150412-GP2	0.500	0.610	0.187	0.203	0.047
		DNMG-442-GP2	●	◆	▲				▲	▲		◆	●	◆		◆		▲	●		▲	●	◆	DNMG-150608-GP2	0.500	0.610	0.250	0.203	0.031
		DNMG-443-GP2	●	◆	▲				▲	▲		◆	●	◆		◆		▲	●		▲	●	◆	DNMG-150612-GP2	0.500	0.610	0.250	0.203	0.047
		DNMG-542-GP2	●	◆	▲				▲	▲		◆	●	◆		◆		▲	●		▲	●	◆	DNMG-190608-GP2	0.625	0.763	0.250	0.250	0.031
		DNMG-543-GP2	●	◆	▲				▲	▲		◆	●	◆		◆		▲	●		▲	●	◆	DNMG-190612-GP2	0.625	0.763	0.250	0.250	0.047
MEDIUM ROUGHING	MR2	DNMG-432-MR		◆	▲		●		▲	▲		◆	●	◆		◆		▲	●		●	▲	◆	DNMG-150408-MR	0.500	0.610	0.187	0.203	0.031
		DNMG-442-MR		◆	▲		●		▲	▲		◆	●	◆		◆		▲	●		●	▲	◆	DNMG-150608-MR	0.500	0.610	0.250	0.203	0.031
		DNMG-542-MR		◆	▲		●		▲	▲		◆	●	◆		◆		▲	●		●	▲	◆	DNMG-190608-MR2	0.625	0.763	0.250	0.250	0.031
		DNMG-543-MR2		◆	▲		●		▲	▲		◆	●	◆		◆		▲	●		●	▲	◆	DNMG-190612-MR2	0.625	0.763	0.250	0.250	0.047

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

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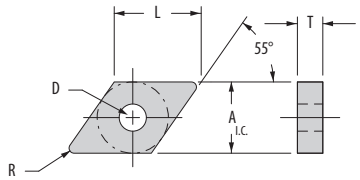
55° Diamond Inserts

Negative Flat Top (DNMA)



Shape: 55° Diamond	Part Number ANSI	Cast Iron K GA5023	Cast Iron K G-02	Part Number ISO	Dimensions (inches) $A_{I.C.}$	L	T	D	R
	DNMA-431	◆	▲	DNMA-150404	0.500	0.610	0.187	0.203	0.015
	DNMA-432	◆	▲	DNMA-150408	0.500	0.610	0.187	0.203	0.031
	DNMA-433	◆	▲	DNMA-150412	0.500	0.610	0.187	0.203	0.047
	DNMA-434	◆	▲	DNMA-150416	0.500	0.610	0.187	0.203	0.062
	DNMA-533	◆	▲	DNMA-190412	0.625	0.763	0.187	0.250	0.047
	DNMA-542	◆	▲	DNMA-190608	0.625	0.763	0.250	0.250	0.031
	DNMA-543	◆	▲	DNMA-190612	0.625	0.763	0.250	0.250	0.047
	DNMA-544	◆	▲	DNMA-190616	0.625	0.763	0.250	0.250	0.062

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

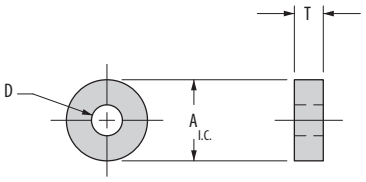
First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

Round Inserts

Negative Chip Control (RNGG-RNMG-RNMM)



	Shape: Round	Part Number ANSI	Steel P					Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S						Titanium S			Part Number ISO	Dimensions (inches)		
			GA5025	GA5035	GA5125	G-5125+	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-9610	G-20M	G-925	G-9610	G-10		$A_{I.C.}$	T	D
PRECISION FINISHING	TurboForm®	RNGG-43-TF						●	▲		◆			●	◆		▲			●	◆		RNGG-120400-TF	0.500	0.187	0.203
GENERAL PURPOSE	GP2	RNMG-32-GP	▲	◆				●	▲		◆		◆	●	◆		▲			▲	●	◆	RNMG-090300-GP	0.375	0.125	0.150
		RNMG-33-GP	▲	◆				●	▲		◆		◆	●	◆		▲			▲	●	◆	RNMG-090400-GP	0.375	0.187	0.150
		RNMG-43-GP	▲	◆				●	▲		◆		◆	●	◆		▲			▲	●	◆	RNMG-120400-GP	0.500	0.187	0.203
MEDIUM ROUGHING	MR2	RNMG-64-MR	●	◆	▲			●	▲		◆		◆	●	◆		▲			●	▲	◆	RNMG-190600-MR	0.750	0.250	0.312
		RNMG-86-MR	●	◆	▲			●	▲		◆		◆	●	◆		▲			●	▲	◆	RNMG-250900-MR	1.000	0.375	0.359
HEAVY ROUGHING	HR – single sided	RNMM-84 MR	●	◆	▲			●	▲		◆		◆	●	◆		▲						RNMM-250600-MR	1.000	0.250	0.359

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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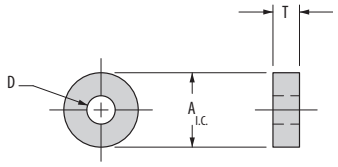
Round Inserts

Negative Flat Top (RNMA)



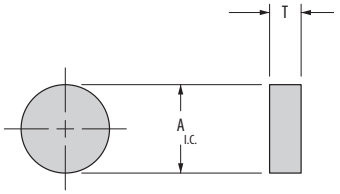
Shape: Round	Part Number ANSI	Cast Iron K GA5023	Cast Iron K G-02	Part Number ISO	Dimensions (inches) $A_{I.C.}$	T	D
	RNMA-32	◆	▲	RNMA-090300	0.375	0.125	0.150
	RNMA-33	◆	▲	RNMA-090400	0.375	0.187	0.150
	RNMA-43	◆	▲	RNMA-120400	0.500	0.187	0.203
	RNMA-54	◆	▲	RNMA-150600	0.625	0.250	0.250
	RNMA-64	◆	▲	RNMA-190600	0.750	0.250	0.312
	RNMA-86	◆	▲	RNMA-250900	1.000	0.375	0.359
	RNMA-106	◆	▲	RNMA-310900	1.250	0.375	0.500

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated First Choice ◆ Second Choice ● Alternative ▲ *Grade descriptions — pages T 4*

For additional grades, please contact Greenleaf Technical Service.

Round Inserts

Negative Flat Top (RNGN)



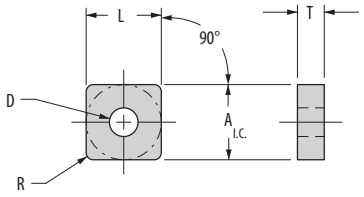
Shape: Round	Part Number ANSI	Cast Iron K GA5023	Cast Iron K G-02	Part Number ISO	Dimensions (inches) $A_{I.C.}$	T
	RNGN-32	◆	▲	RNGN-090300	0.375	0.125
	RNGN-42	◆	▲	RNGN-120300	0.500	0.125
	RNGN-43	◆	▲	RNGN-120400	0.500	0.187
	RNGN-45	◆	▲	RNGN-120700	0.500	0.312
	RNGN-53	◆	▲	RNGN-150400	0.625	0.187
	RNGN-63	◆	▲	RNGN-190400	0.750	0.187
	RNGN-84	◆	▲	RNGN-250600	1.000	0.250

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated First Choice ◆ Second Choice ● Alternative ▲ *Grade descriptions — pages T 4*

For additional grades, please contact Greenleaf Technical Service.

Square Inserts

Negative Chip Control (SNMG-SNMM)



	Shape: Square	Part Number ANSI	Steel P					Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S						Titanium S			Part Number ISO	Dimensions (inches)				
			GA5025	GA5035	GA5125	G-5125+	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-9610	G-20M	G-925	G-9610	G-10		$A_{I.C.}$	L	T	D	R
FINISHING	FF2 	SNMG-322-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	SNMG-090308-FF2	0.375	0.375	0.125	0.150	0.031
		SNMG-432-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	SNMG-120408-FF2	0.500	0.500	0.187	0.203	0.031
		SNMG-433-FF	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	SNMG-120412-FF	0.500	0.500	0.187	0.203	0.047
		SNMG-543-FF	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	SNMG-150612-FF	0.625	0.625	0.250	0.250	0.047
GENERAL PURPOSE	GP2 	SNMG-322-GP	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	SNMG-090308-GP	0.375	0.375	0.125	0.150	0.031
		SNMG-432-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	SNMG-120408-GP2	0.500	0.500	0.187	0.203	0.031
		SNMG-433-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	SNMG-120412-GP2	0.500	0.500	0.187	0.203	0.047
		SNMG-434-GP	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	SNMG-120416-GP	0.500	0.500	0.187	0.203	0.062
		SNMG-543-GP2	●	◆	▲				▲		◆	●	◆		◆		▲	●		▲	●	◆	SNMG-150612-GP2	0.625	0.625	0.250	0.250	0.047
		SNMG-643-GP2	●	◆	▲				▲		◆	●	◆		◆		▲	●		▲	●	◆	SNMG-190612-GP2	0.750	0.750	0.250	0.312	0.047
		SNMG-644-GP2	●	◆	▲				▲		◆	●	◆		◆		▲	●		▲	●	◆	SNMG-190616-GP2	0.750	0.750	0.250	0.312	0.062
MEDIUM ROUGHING	MR2 	SNMG-432-MR2	●	◆	▲				▲		◆	●	◆		◆		▲	●		●	▲	◆	SNMG-120408-MR2	0.500	0.500	0.187	0.203	0.031
		SNMG-442-MR	●	◆	▲				▲		◆	●	◆		◆		▲	●		●	▲	◆	SNMG-120608-MR	0.500	0.500	0.250	0.203	0.031
		SNMG-543-MR2		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	SNMG-150612-MR2	0.625	0.625	0.250	0.250	0.047
		SNMG-643-MR		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	SNMG-190612-MR	0.750	0.750	0.250	0.312	0.047
		SNMG-644-MR		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	SNMG-190616-MR	0.750	0.750	0.250	0.312	0.062
		SNMG-866-MR		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	SNMG-250924-MR	1.000	1.000	0.375	0.359	0.094
HEAVY ROUGHING	HR – single sided 	SNMM-643-HR		◆			●		▲				◆		◆								SNMM-190612-HR	0.750	0.750	0.250	0.312	0.047
		SNMM-644-HR		◆			●		▲				◆		◆								SNMM-190616-HR	0.750	0.750	0.250	0.312	0.062

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

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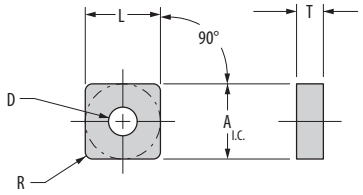
Square Inserts

Negative Flat Top (SNMA)



Shape: Square	Part Number ANSI	Cast Iron K GA5023	Cast Iron K G-02	Part Number ISO	Dimensions (inches) $A_{I.C.}$	L	T	D	R
	SNMA-321	◆	▲	SNMA-090304	0.375	0.375	0.125	0.150	0.015
	SNMA-322	◆	▲	SNMA-090308	0.375	0.375	0.125	0.150	0.031
	SNMA-323	◆	▲	SNMA-090312	0.375	0.375	0.125	0.150	0.047
	SNMA-431	◆	▲	SNMA-120404	0.500	0.500	0.187	0.203	0.015
	SNMA-432	◆	▲	SNMA-120408	0.500	0.500	0.187	0.203	0.031
	SNMA-433	◆	▲	SNMA-120412	0.500	0.500	0.187	0.203	0.047
	SNMA-434	◆	▲	SNMA-120416	0.500	0.500	0.187	0.203	0.062
	SNMA-542	◆	▲	SNMA-150608	0.625	0.625	0.250	0.250	0.031
	SNMA-543	◆	▲	SNMA-150612	0.625	0.625	0.250	0.250	0.047
	SNMA-544	◆	▲	SNMA-150616	0.625	0.625	0.250	0.250	0.062
	SNMA-643	◆	▲	SNMA-190612	0.750	0.750	0.250	0.312	0.047
	SNMA-644	◆	▲	SNMA-190616	0.750	0.750	0.250	0.312	0.062
	SNMA-864	◆	▲	SNMA-250916	1.000	1.000	0.375	0.359	0.062
	SNMA-866	◆	▲	SNMA-250924	1.000	1.000	0.375	0.359	0.094

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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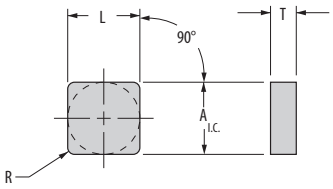
Square Inserts

Negative Flat Top (SNGN)



Shape: Square	Part Number ANSI	Cast Iron K GA5023	Cast Iron K G-02	Part Number ISO	Dimensions (inches) $A_{I.C.}$	L	T	R
	SNGN-321	◆	▲	SNGN-090304	0.375	0.375	0.125	0.015
	SNGN-322	◆	▲	SNGN-090308	0.375	0.375	0.125	0.031
	SNGN-422	◆	▲	SNGN-120308	0.500	0.500	0.125	0.031
	SNGN-423	◆	▲	SNGN-120312	0.500	0.500	0.125	0.047
	SNGN-430	◆	▲	SNGN-120400	0.500	0.500	0.187	0.005
	SNGN-431	◆	▲	SNGN-120404	0.500	0.500	0.187	0.015
	SNGN-432	◆	▲	SNGN-120408	0.500	0.500	0.187	0.031
	SNGN-433	◆	▲	SNGN-120412	0.500	0.500	0.187	0.047
	SNGN-434	◆	▲	SNGN-120416	0.500	0.500	0.187	0.062
	SNGN-533	◆	▲	SNGN-150412	0.625	0.625	0.187	0.047
	SNGN-534	◆	▲	SNGN-150416	0.625	0.625	0.187	0.062
	SNGN-543	◆	▲	SNGN-150612	0.625	0.625	0.250	0.047
	SNGN-631	◆	▲	SNGN-190404	0.750	0.750	0.187	0.015
	SNGN-632	◆	▲	SNGN-190408	0.750	0.750	0.187	0.031
	SNGN-633	◆	▲	SNGN-190412	0.750	0.750	0.187	0.047
	SNGN-634	◆	▲	SNGN-190416	0.750	0.750	0.187	0.062
	SNGN-638	◆	▲	SNGN-190432	0.750	0.750	0.187	0.125
	SNGN-643	◆	▲	SNGN-190612	0.750	0.750	0.250	0.047
	SNGN-644	◆	▲	SNGN-190616	0.750	0.750	0.250	0.062
	SNGN-646	◆	▲	SNGN-190624	0.750	0.750	0.250	0.094
	SNGN-844	◆	▲	SNGN-250616	1.000	1.000	0.250	0.062
	SNGN-854	◆	▲	SNGN-250716	1.000	1.000	0.312	0.062
	SNGN-10412	◆	▲	SNGN-310648	1.250	1.250	0.250	0.187
	SNGN-1066	◆	▲	SNGN-310924	1.250	1.250	0.375	0.094
	SNGN-1068	◆	▲	SNGN-310932	1.250	1.250	0.375	0.125
	SNGN-1288	◆	▲	SNGN-381232	1.500	1.500	0.500	0.125

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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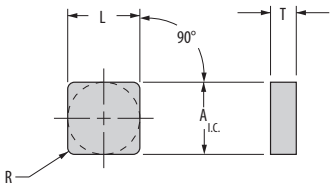
Square Inserts

Negative Flat Top (SNUN)



Shape: Square	Part Number ANSI	Cast Iron K GA5023	Cast Iron K G-02	Part Number ISO	Dimensions (inches) $A_{I.C.}$	L	T	R
	SNUN-322	◆	▲	SNUN-090308	0.375	0.375	0.125	0.031
	SNUN-323	◆	▲	SNUN-090312	0.375	0.375	0.125	0.047
	SNUN-422	◆	▲	SNUN-120308	0.500	0.500	0.125	0.031
	SNUN-423	◆	▲	SNUN-120312	0.500	0.500	0.125	0.047
	SNUN-424	◆	▲	SNUN-120316	0.500	0.500	0.125	0.062
	SNUN-432	◆	▲	SNUN-120408	0.500	0.500	0.187	0.031
	SNUN-433	◆	▲	SNUN-120412	0.500	0.500	0.187	0.047
	SNUN-434	◆	▲	SNUN-120416	0.500	0.500	0.187	0.062
	SNUN-533	◆	▲	SNUN-150412	0.625	0.625	0.187	0.047
	SNUN-632	◆	▲	SNUN-190408	0.750	0.750	0.187	0.031
	SNUN-633	◆	▲	SNUN-190412	0.750	0.750	0.187	0.047
	SNUN-634	◆	▲	SNUN-190416	0.750	0.750	0.187	0.062
	SNUN-844	◆	▲	SNUN-250616	1.000	1.000	0.250	0.062
	SNUN-848	◆	▲	SNUN-250632	1.000	1.000	0.250	0.125
	SNUN-854	◆	▲	SNUN-250716	1.000	1.000	0.312	0.062
	SNUN-1066	◆	▲	SNUN-310924	1.250	1.250	0.375	0.094
	SNUN-1068	◆	▲	SNUN-310932	1.250	1.250	0.375	0.125
	SNUN-1288	◆	▲	SNUN-381232	1.500	1.500	0.500	0.125

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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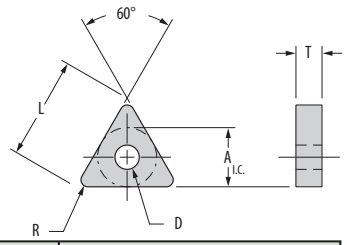
Triangle Inserts

Negative Chip Control (TNGG-TNMG-TNMM)



	Shape: Triangle	Part Number ANSI	Steel P					Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S						Titanium S			Part Number ISO	Dimensions (inches)				
			GA5025	GA5035	GA5125	G-5125+	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-9610	G-20M	G-925	G-9610	G-10		$A_{I.C.}$	L	T	D	R
PRECISION FINISHING	TurboForm® 	TNGG-330.3-TF						●	▲	●	◆			●	◆	●	▲			●	◆		TNGG-160401.3-TF	0.375	0.650	0.187	0.150	0.005
		TNGG-330.6-TF						●	▲	●	◆			●	◆	●	▲			●	◆		TNGG-160402.6-TF	0.375	0.650	0.187	0.150	0.010
		TNGG-331-TF						●	▲	●	◆			●	◆	●	▲			●	◆		TNGG-160404-TF	0.375	0.650	0.187	0.150	0.015
		TNGG-332-TF						●	▲	●	◆			●	◆	●	▲			●	◆		TNGG-160408-TF	0.375	0.650	0.187	0.150	0.031
		TNGG-430.3-TF						●	▲	●	◆			●	◆	●	▲			●	◆		TNGG-220401.3-TF	0.500	0.866	0.187	0.203	0.005
		TNGG-430.6-TF						●	▲	●	◆			●	◆	●	▲			●	◆		TNGG-220402.6-TF	0.500	0.866	0.187	0.203	0.010
		TNGG-431-TF						●	▲	●	◆			●	◆	●	▲			●	◆		TNGG-220404-TF	0.500	0.866	0.187	0.203	0.015
		TNGG-432-TF						●	▲	●	◆			●	◆	●	▲			●	◆		TNGG-220408-TF	0.500	0.866	0.187	0.203	0.031
FINISHING	FF2 	TNMG-321-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-160304-FF2	0.375	0.650	0.125	0.150	0.015
		TNMG-322-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-160308-FF2	0.375	0.650	0.125	0.150	0.031
		TNMG-323-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-160312-FF2	0.375	0.650	0.125	0.150	0.047
		TNMG-324-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-160316-FF2	0.375	0.650	0.125	0.150	0.062
		TNMG-331-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-160404-FF2	0.375	0.650	0.187	0.150	0.015
		TNMG-332-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-160408-FF2	0.375	0.650	0.187	0.150	0.031
		TNMG-334-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-160416-FF2	0.375	0.650	0.187	0.150	0.062
		TNMG-431-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG- 220404-FF2	0.500	0.866	0.187	0.203	0.015
		TNMG-432-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-220408-FF2	0.500	0.866	0.187	0.203	0.031
		TNMG-433-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-220412-FF2	0.500	0.866	0.187	0.203	0.047
		TNMG-434-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-220416-FF2	0.500	0.866	0.187	0.203	0.062
		TNMG-542-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-270608-FF2	0.625	1.083	0.250	0.250	0.031
		TNMG-543-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-270612-FF2	0.625	1.083	0.250	0.250	0.047
GENERAL PURPOSE	GP2 	TNMG-321-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	TNMG-160304-GP2	0.375	0.650	0.125	0.150	0.015
		TNMG-322-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	TNMG-160308-GP2	0.375	0.650	0.125	0.150	0.031
		TNMG-323-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	TNMG-160312-GP2	0.375	0.650	0.125	0.150	0.047
		TNMG-324-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	TNMG-160316-GP2	0.375	0.650	0.125	0.150	0.062
		TNMG-333-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	TNMG-160412-GP2	0.375	0.650	0.187	0.150	0.047
		TNMG-432-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	TNMG-220408-GP2	0.500	0.866	0.187	0.203	0.031
		TNMG-433-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	TNMG-220412-GP2	0.500	0.866	0.187	0.203	0.047
		TNMG-434-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	TNMG-220416-GP2	0.500	0.866	0.187	0.203	0.062
		TNMG-542-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	TNMG-270608-GP2	0.625	1.083	0.250	0.250	0.031

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

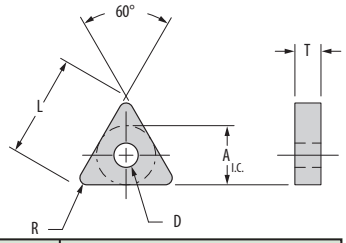
Grade descriptions — pages T 4

Continued on next page.

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

Triangle Inserts

Negative Chip Control (TNGG-TNMG-TNMM) Continued



	Shape: Triangle	Part Number ANSI	Steel P					Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S						Titanium S			Part Number ISO	Dimensions (inches)				
			GA5025	GA5035	GA5125	G-5125+	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-9610	G-20M	G-925	G-9610	G-10		$A_{I.C.}$	L	T	D	R
MEDIUM ROUGHING	MR2 	TNMG-222-MR2		◆	▲		●	●	▲		◆		◆	●	◆		▲			●	▲	◆	TNMG-110308-MR2	0.250	0.433	0.125	0.093	0.031
		TNMG-433-MR2		◆	▲		●	●	▲		◆		◆	●	◆		▲			●	▲	◆	TNMG-220412-MR2	0.500	0.866	0.187	0.203	0.047
		TNMG-434-MR2		◆	▲		●	●	▲		◆		◆	●	◆		▲			●	▲	◆	TNMG-220416-MR2	0.500	0.866	0.187	0.203	0.062
		TNMG-438-MR2		◆	▲		●	●	▲		◆		◆	●	◆		▲			●	▲	◆	TNMG-220432-MR2	0.500	0.866	0.187	0.203	0.125
		TNMG-542-MR2		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	TNMG-270608-MR2	0.625	1.083	0.250	0.250	0.031
		TNMG-543-MR2		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	TNMG-270612-MR2	0.625	1.083	0.250	0.250	0.047
		TNMG-544-MR2		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	TNMG-270616-MR2	0.625	1.083	0.250	0.250	0.062
		TNMG-546-MR2		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	TNMG-270624-MR2	0.625	1.083	0.250	0.250	0.094
		TNMG-666-MR		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	TNMG-330924-MR	0.750	1.299	0.375	0.312	0.094
HEAVY ROUGHING	HR – single sided 	TNMM-433-HR		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	TNMM-220412-HR	0.500	0.866	0.187	0.203	0.047
		TNMM-544-HR		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	TNMM-270616-HR	0.625	1.083	0.250	0.250	0.062

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

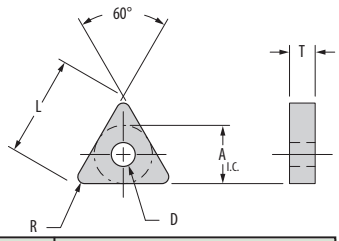
First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

Triangle Inserts

Negative Flat Top (TNMA)



Shape: Triangle	Part Number ANSI	Cast Iron K GA5023	Cast Iron K G-02	Part Number ISO	Dimensions (inches) $A_{I.C.}$	L	T	D	R
	TNMA-222	◆	▲	TNMA-110308	0.250	0.433	0.125	0.093	0.031
	TNMA-321	◆	▲	TNMA-160304	0.375	0.650	0.125	0.150	0.015
	TNMA-322	◆	▲	TNMA-160308	0.375	0.650	0.125	0.150	0.031
	TNMA-323	◆	▲	TNMA-160312	0.375	0.650	0.125	0.150	0.047
	TNMA-324	◆	▲	TNMA-160316	0.375	0.650	0.125	0.150	0.062
	TNMA-332	◆	▲	TNMA-160408	0.375	0.650	0.187	0.150	0.031
	TNMA-333	◆	▲	TNMA-160412	0.375	0.650	0.187	0.150	0.047
	TNMA-431	◆	▲	TNMA-220404	0.500	0.866	0.187	0.203	0.015
	TNMA-432	◆	▲	TNMA-220408	0.500	0.866	0.187	0.203	0.031
	TNMA-433	◆	▲	TNMA-220412	0.500	0.866	0.187	0.203	0.047
	TNMA-434	◆	▲	TNMA-220416	0.500	0.866	0.187	0.203	0.062
	TNMA-542	◆	▲	TNMA-270608	0.625	1.083	0.250	0.250	0.031
	TNMA-543	◆	▲	TNMA-270612	0.625	1.083	0.250	0.250	0.047
	TNMA-544	◆	▲	TNMA-270616	0.625	1.083	0.250	0.250	0.062
	TNMA-548	◆	▲	TNMA-270632	0.625	1.083	0.250	0.250	0.125
	TNMA-556	◆	▲	TNMA-270724	0.625	1.083	0.312	0.250	0.094
	TNMA-566	◆	▲	TNMA-270924	0.625	1.083	0.375	0.250	0.094
	TNMA-642	◆	▲	TNMA-330608	0.750	1.299	0.250	0.312	0.031
	TNMA-643	◆	▲	TNMA-330612	0.750	1.299	0.250	0.312	0.047
	TNMA-644	◆	▲	TNMA-330616	0.750	1.299	0.250	0.312	0.062
	TNMA-664	◆	▲	TNMA-330916	0.750	1.299	0.375	0.312	0.062
	TNMA-666	◆	▲	TNMA-330924	0.750	1.299	0.375	0.312	0.094
	TNMA-668	◆	▲	TNMA-330932	0.750	1.299	0.375	0.312	0.125

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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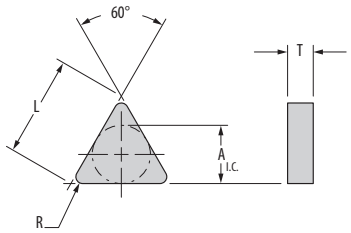
Triangle Inserts

Negative Flat Top (TNGN)



Shape: Triangle	Part Number ANSI	Cast Iron K GA5023	Cast Iron K G-02	Part Number ISO	Dimensions (inches) $A_{I.C.}$	L	T	R
	TNGN-222	◆	▲	TNGN-110308	0.250	0.433	0.125	0.031
	TNGN-223	◆	▲	TNGN-110312	0.250	0.433	0.125	0.047
	TNGN-320	◆	▲	TNGN-160300	0.375	0.650	0.125	0.005
	TNGN-321	◆	▲	TNGN-160304	0.375	0.650	0.125	0.015
	TNGN-322	◆	▲	TNGN-160308	0.375	0.650	0.125	0.031
	TNGN-323	◆	▲	TNGN-160312	0.375	0.650	0.125	0.047
	TNGN-324	◆	▲	TNGN-160316	0.375	0.650	0.125	0.062
	TNGN-331	◆	▲	TNGN-160404	0.375	0.650	0.187	0.015
	TNGN-332	◆	▲	TNGN-160408	0.375	0.650	0.187	0.031
	TNGN-333	◆	▲	TNGN-160412	0.375	0.650	0.187	0.047
	TNGN-334	◆	▲	TNGN-160416	0.375	0.650	0.187	0.062
	TNGN-431	◆	▲	TNGN-220404	0.500	0.866	0.187	0.015
	TNGN-432	◆	▲	TNGN-220408	0.500	0.866	0.187	0.031
	TNGN-433	◆	▲	TNGN-220412	0.500	0.866	0.187	0.047
	TNGN-434	◆	▲	TNGN-220416	0.500	0.866	0.187	0.062
	TNGN-438	◆	▲	TNGN-220432	0.500	0.866	0.187	0.125
	TNGN-442	◆	▲	TNGN-220608	0.500	0.866	0.250	0.031
	TNGN-443	◆	▲	TNGN-220612	0.500	0.866	0.250	0.047
	TNGN-444	◆	▲	TNGN-220616	0.500	0.866	0.250	0.062
	TNGN-532	◆	▲	TNGN-270408	0.625	1.083	0.187	0.031
	TNGN-538	◆	▲	TNGN-270432	0.625	1.083	0.187	0.125
	TNGN-541	◆	▲	TNGN-270604	0.625	1.083	0.250	0.015
	TNGN-542	◆	▲	TNGN-270608	0.625	1.083	0.250	0.031
	TNGN-543	◆	▲	TNGN-270612	0.625	1.083	0.250	0.047
	TNGN-544	◆	▲	TNGN-270616	0.625	1.083	0.250	0.062
	TNGN-554	◆	▲	TNGN-270716	0.625	1.083	0.312	0.062
	TNGN-556	◆	▲	TNGN-270724	0.625	1.083	0.312	0.094
	TNGN-654	◆	▲	TNGN-330716	0.750	1.299	0.312	0.062
	TNGN-656	◆	▲	TNGN-330724	0.750	1.299	0.312	0.094
	TNGN-664	◆	▲	TNGN-330916	0.750	1.299	0.375	0.062
	TNGN-666	◆	▲	TNGN-330924	0.750	1.299	0.375	0.094
	TNGN-668	◆	▲	TNGN-330932	0.750	1.299	0.375	0.125
	TNGN-776	◆	▲	TNGN-381124	0.875	1.516	0.437	0.094
	TNGN-778	◆	▲	TNGN-381132	0.875	1.516	0.437	0.125
	TNGN-7710	◆	▲	TNGN-381140	0.875	1.516	0.437	0.156
	TNGN-878	◆	▲	TNGN-441132	1.000	1.732	0.437	0.125

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

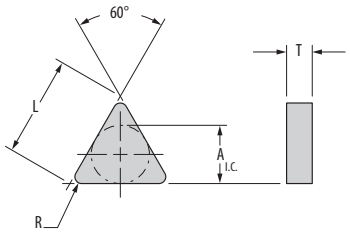
First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

Triangle Inserts

Negative Flat Top (TNUN)



Shape: Triangle	Part Number ANSI	Cast Iron K GA5023	Cast Iron K G-02	Part Number ISO	Dimensions (inches) $A_{I.C.}$	L	T	R
	TNUN-321	◆	▲	TNUN-160304	0.375	0.650	0.125	0.015
	TNUN-322	◆	▲	TNUN-160308	0.375	0.650	0.125	0.031
	TNUN-323	◆	▲	TNUN-160312	0.375	0.650	0.125	0.047
	TNUN-332	◆	▲	TNUN-160408	0.375	0.650	0.187	0.031
	TNUN-333	◆	▲	TNUN-160412	0.375	0.650	0.187	0.047
	TNUN-334	◆	▲	TNUN-160416	0.375	0.650	0.187	0.062
	TNUN-432	◆	▲	TNUN-220408	0.500	0.866	0.187	0.031
	TNUN-433	◆	▲	TNUN-220412	0.500	0.866	0.187	0.047
	TNUN-434	◆	▲	TNUN-220416	0.500	0.866	0.187	0.062
	TNUN-438	◆	▲	TNUN-220432	0.500	0.866	0.187	0.125
	TNUN-441	◆	▲	TNUN-220604	0.500	0.866	0.250	0.015
	TNUN-442	◆	▲	TNUN-220608	0.500	0.866	0.250	0.031
	TNUN-443	◆	▲	TNUN-220612	0.500	0.866	0.250	0.047
	TNUN-444	◆	▲	TNUN-220616	0.500	0.866	0.250	0.062
	TNUN-448	◆	▲	TNUN-220632	0.500	0.866	0.250	0.125
	TNUN-542	◆	▲	TNUN-270608	0.625	1.083	0.250	0.031
	TNUN-543	◆	▲	TNUN-270612	0.625	1.083	0.250	0.047
	TNUN-544	◆	▲	TNUN-270616	0.625	1.083	0.250	0.062
	TNUN-546	◆	▲	TNUN-270624	0.625	1.083	0.250	0.094
	TNUN-552	◆	▲	TNUN-270708	0.625	1.083	0.312	0.031
	TNUN-553	◆	▲	TNUN-270712	0.625	1.083	0.312	0.047
	TNUN-554	◆	▲	TNUN-270716	0.625	1.083	0.312	0.062
	TNUN-556	◆	▲	TNUN-270724	0.625	1.083	0.312	0.094
	TNUN-654	◆	▲	TNUN-330716	0.750	1.299	0.312	0.062
	TNUN-656	◆	▲	TNUN-330724	0.750	1.299	0.312	0.094
	TNUN-664	◆	▲	TNUN-330916	0.750	1.299	0.375	0.062
	TNUN-666	◆	▲	TNUN-330924	0.750	1.299	0.375	0.094
	TNUN-668	◆	▲	TNUN-330932	0.750	1.299	0.375	0.125
	TNUN-776	◆	▲	TNUN-381124	0.875	1.516	0.437	0.094
	TNUN-778	◆	▲	TNUN-381132	0.875	1.516	0.437	0.125
	TNUN-7710	◆	▲	TNUN-381140	0.875	1.516	0.437	0.156

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

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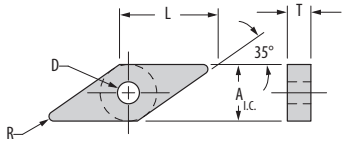
35° Diamond Inserts

Negative Chip Control (VNGG-VNMG)



	Shape: 35° Diamond	Part Number ANSI	Steel P					Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S						Titanium S			Part Number ISO	Dimensions (inches)				
			GA5025	GA5035	GA5125	G-5125+	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-9610	G-20M	G-925	G-9610	G-10		$A_{I.C.}$	L	T	D	R
PRECISION FINISHING	TurboForm®	VNGG-330.3-TF						●	▲	●	◆			●	◆		▲			●	◆		VNGG-160401.3-TF	0.375	0.654	0.187	0.150	0.005
		VNGG-330.6-TF						●	▲	●	◆			●	◆		▲			●	◆		VNGG-160402.6-TF	0.375	0.654	0.187	0.150	0.010
		VNGG-331-TF						●	▲	●	◆			●	◆		▲			●	◆		VNGG-160404-TF	0.375	0.654	0.187	0.150	0.015
		VNGG-332-TF						●	▲	●	◆			●	◆		▲			●	◆		VNGG-160408-TF	0.375	0.654	0.187	0.150	0.031
		VNGG-333-TF						●	▲	●	◆			●	◆		▲			●	◆		VNGG-160412-TF	0.375	0.654	0.187	0.150	0.047
FINISHING	FF2	VNMG-331-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	VNMG-160404-FF2	0.375	0.654	0.187	0.150	0.015
		VNMG-332-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	VNMG-160408-FF2	0.375	0.654	0.187	0.150	0.031
		VNMG-333-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	VNMG-160412-FF2	0.375	0.654	0.187	0.150	0.047
		VNMG-432-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	VNMG-220408-FF2	0.500	0.872	0.187	0.203	0.031
GENERAL PURPOSE	GP2	VNMG-332-GP2	●	◆	▲				▲		◆	●	◆		◆		▲	●		▲	●	◆	VNMG-160408-GP2	0.375	0.654	0.187	0.150	0.031
		VNMG-333-GP2	●	◆	▲				▲		◆	●	◆		◆		▲	●		▲	●	◆	VNMG-160412-GP2	0.375	0.654	0.187	0.150	0.047
		VNMG-432-GP2	●	◆	▲				▲		◆	●	◆		◆		▲	●		▲	●	◆	VNMG-220408-GP2	0.500	0.872	0.187	0.203	0.031

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

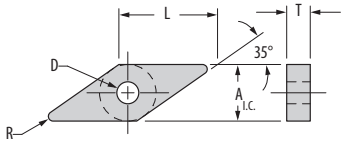
First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

35° Diamond Inserts

Negative Flat Top (VNMA)



Shape: 35° Diamond	Part Number ANSI	Cast Iron K GA5023	Cast Iron K G-02	Part Number ISO	Dimensions (inches) $A_{I.C.}$	L	T	D	R
	VNMA-331	◆	▲	VNMA-160404	0.375	0.654	0.187	0.150	0.015
	VNMA-332	◆	▲	VNMA-160408	0.375	0.654	0.187	0.150	0.031
	VNMA-431	◆	▲	VNMA-220404	0.500	0.872	0.187	0.203	0.015
	VNMA-432	◆	▲	VNMA-220408	0.500	0.872	0.187	0.203	0.031

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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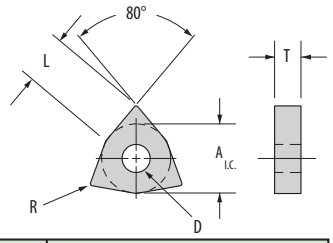
80° Trigon Inserts

Negative Chip Control (WNMG)



	Shape: 80° Trigon	Part Number ANSI	Steel P					Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S						Titanium S			Part Number ISO	Dimensions (inches)				
			GA5025	GA5035	GA5125	G-5125+	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-9610	G-20M	G-925	G-9610	G-10		$A_{I.C.}$	L	T	D	R
PRECISION FINISHING	FF 	WNMG-331-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	WNMG-060404-FF2	0.375	0.257	0.187	0.150	0.015
		WNMG-332-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	WNMG-060408-FF2	0.375	0.257	0.187	0.150	0.031
		WNMG-431-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	WNMG-080404-FF2	0.500	0.342	0.187	0.203	0.015
		WNMG-432-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	WNMG-080408-FF2	0.500	0.342	0.187	0.203	0.031
FINISHING	GP2 	WNMG-331-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	WNMG-060404-GP2	0.375	0.257	0.187	0.150	0.015
		WNMG-332-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	WNMG-060408-GP2	0.375	0.257	0.187	0.150	0.031
		WNMG-431-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	WNMG-080404-GP2	0.500	0.342	0.187	0.203	0.015
		WNMG-432-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	WNMG-080408-GP2	0.500	0.342	0.187	0.203	0.031
		WNMG-433-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	WNMG-080412-GP2	0.500	0.342	0.187	0.203	0.047
		WNMG-434-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	WNMG-080416-GP2	0.500	0.342	0.187	0.203	0.062
GENERAL PURPOSE	MR2 	WNMG-432-MR2		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	WNMG-080408-MR2	0.500	0.342	0.187	0.203	0.031
		WNMG-433-MR2		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	WNMG-080412-MR2	0.500	0.342	0.187	0.203	0.047

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

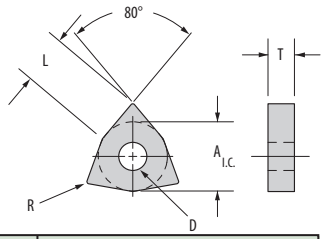
First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

80° Trigon Inserts

Negative Flat Top (WNMA)



Shape: 80° Trigon	Part Number ANSI	Cast Iron K GA5023	Cast Iron K G-02	Part Number ISO	Dimensions (inches) A I.C.	L	T	D	R
	WNMA-331	◆	▲	WNMA-060404	0.375	0.257	0.187	0.150	0.015
	WNMA-332	◆	▲	WNMA-060408	0.375	0.257	0.187	0.150	0.031
	WNMA-333	◆	▲	WNMA-060412	0.375	0.257	0.187	0.150	0.047
	WNMA-431	◆	▲	WNMA-080404	0.500	0.342	0.187	0.203	0.015
	WNMA-432	◆	▲	WNMA-080408	0.500	0.342	0.187	0.203	0.031
	WNMA-433	◆	▲	WNMA-080412	0.500	0.342	0.187	0.203	0.047
	WNMA-434	◆	▲	WNMA-080416	0.500	0.342	0.187	0.203	0.062

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

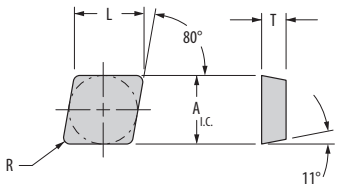
Grade descriptions — pages T 4

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

Phone: 814-763-2915 • 800-458-1850 • Fax: 814-763-4423 • sales@greenleafcorporation.com • www. greenleafcorporation.com

80° Diamond Inserts

Positive Flat Top (CPGN)



Shape: 80° Diamond	Part Number ANSI	Steel P				Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S					Part Number ISO	Dimensions (inches)			
		GA5025	GA5035	GA5125	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-20M		$A_{I.C.}$	L	T	R
	CPGN-422	●	◆	▲		●	▲		◆		◆	●	◆		▲		CPGN-120308	0.500	0.507	0.125	0.031
	CPGN-424	●	◆	▲		●	▲		◆		◆	●	◆		▲		CPGN-120316	0.500	0.507	0.125	0.062
	CPGN-426	●	◆	▲		●	▲		◆		◆	●	◆		▲		CPGN-120324	0.500	0.507	0.125	0.094
	CPGN-433	●	◆	▲		●	▲		◆		◆	●	◆		▲		CPGN-120412	0.500	0.507	0.187	0.047
	CPGN-434	●	◆	▲		●	▲		◆		◆	●	◆		▲		CPGN-120416	0.500	0.507	0.187	0.062
	CPGN-632		◆	▲	●		▲		◆	●	◆		◆		▲	●	CPGN-190408	0.750	0.761	0.187	0.031
	CPGN-633		◆	▲	●		▲		◆	●	◆		◆		▲	●	CPGN-190412	0.750	0.761	0.187	0.047

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

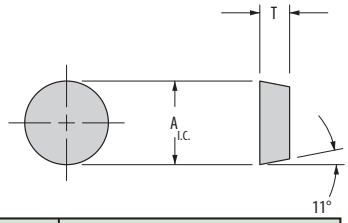
First Choice ◆ Second Choice ● Alternative ▲

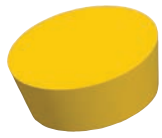
Grade descriptions — pages T 4

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

Round Inserts

Positive Flat Top (RPGN)



Shape: Round	Part Number ANSI	Steel P				Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S					Part Number ISO	Dimensions (inches)	
		GA5025	GA5035	GA5125	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-20M		$A_{I.C.}$	T
	RPGN-32	●	◆	▲		●	▲		◆		◆	●	◆		▲		RPGN-090300	0.375	0.125
	RPGN-43	●	◆	▲		●	▲		◆		◆	●	◆		▲		RPGN-120400	0.500	0.187

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

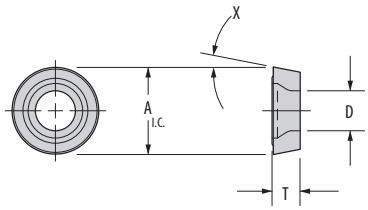
First Choice ◆ Second Choice ● Alternative ▲

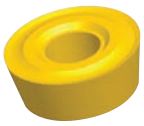
Grade descriptions — pages T 4

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

Round Inserts

Positive Chip Control (RCGT-RPGT-RCMT)



Shape: Round	Part Number ANSI	Steel P					Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S						Titanium S			Part Number ISO	Dimensions (inches)			
		GA5025	GA5035	GA5125	G-5125+	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-9610	G-20M	G-925	G-9610	G-10		$A_{I.C.}$	T	D	X
TurboForm® 	RCGT-22-TF						●	▲		◆			●	◆		▲			●	◆		RCGT-060300-TF	0.250	0.125	0.134	7°
	RCGT-32.5-TF						●	▲		◆			●	◆		▲			●	◆		RCGT-09T300-TF	0.375	0.156	0.173	7°
	RCGT-43-TF						●	▲		◆			●	◆		▲			●	◆		RCGT-120400-TF	0.500	0.187	0.217	7°
	RPGT-22-TF						●	▲		◆			●	◆		▲			●	◆		RPGT-060300-TF	0.250	0.125	0.134	11°
	RPGT-32.5-TF						●	▲		◆			●	◆		▲			●	◆		RPGT-09T300-TF	0.375	0.156	0.173	11°
	RPGT-43-TF						●	▲		◆			●	◆		▲			●	◆		RPGT-120400-TF	0.500	0.187	0.217	11°
	RCMT-10T3-TF						●	▲		◆			●	◆		▲			●	◆		RCMT-10T3-TF	0.394	0.156	0.173	7°
	RCMT-1204-TF						●	▲		◆			●	◆		▲			●	◆		RCMT-1204-TF	0.472	0.187	0.173	7°
	RCMT-1606-TF						●	▲		◆			●	◆		▲			●	◆		RCMT-1606-TF	0.630	0.250	0.217	7°
	RCMT-10T3-MR						●	▲		◆			●	◆		▲			◆			RCMT-10T3-MR	0.394	0.156	0.173	7°
	RCMT-1204-MR						●	▲		◆			●	◆		▲			◆			RCMT-1204-MR	0.472	0.187	0.173	7°
	RCMT-1606-MR						●	▲		◆			●	◆		▲			◆			RCMT-1606-MR	0.630	0.250	0.217	7°

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

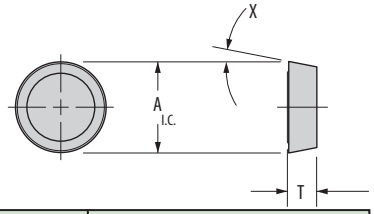
First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

Round Inserts

Positive Chip Control (RCGR-RPGR)



Shape: Round	Part Number ANSI	Steel P					Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S						Titanium S			Part Number ISO	Dimensions (inches)		
		GA5025	GA5035	GA5125	G-5125+	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-9610	G-20M	G-925	G-9610	G-10		$A_{I.C.}$	T	X
TurboForm® 	RCGR-22-TF						●	▲		◆			●	◆		▲			●	◆		RCGR-060300-TF	0.250	0.125	7°
	RCGR-32.5-TF						●	▲		◆			●	◆		▲			●	◆		RCGR-09T300-TF	0.375	0.156	7°
	RCGR-43-TF						●	▲		◆			●	◆		▲			●	◆		RCGR-120400-TF	0.500	0.187	7°
	RPGR-22-TF						●	▲		◆			●	◆		▲			●	◆		RPGR-060300-TF	0.250	0.125	11°
	RPGR-32.5-TF						●	▲		◆			●	◆		▲			●	◆		RPGR-09T300-TF	0.375	0.156	11°
	RPGR-43-TF						●	▲		◆			●	◆		▲			●	◆		RPGR-120400-TF	0.500	0.187	11°

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

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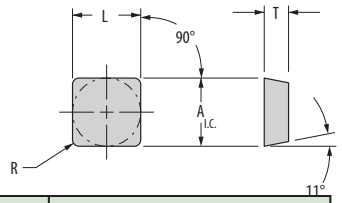
Square Inserts

Positive Flat Top (SPGN-SPUN)



Shape: Square	Part Number ANSI	Steel P				Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S					Part Number ISO	Dimensions (inches)			
		GA5025	GA5035	GA5125	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-20M		$A_{I.C.}$	L	T	R
	SPGN-322	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPGN-090308	0.375	0.375	0.125	0.031
	SPGN-323	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPGN-090312	0.375	0.375	0.125	0.047
	SPGN-422	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPGN-120308	0.500	0.500	0.125	0.031
	SPGN-423	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPGN-120312	0.500	0.500	0.125	0.047
	SPGN-424	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPGN-120316	0.500	0.500	0.125	0.062
	SPGN-432	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPGN-120408	0.500	0.500	0.187	0.031
	SPGN-433	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPGN-120412	0.500	0.500	0.187	0.047
	SPGN-434	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPGN-120416	0.500	0.500	0.187	0.062
	SPGN-532	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPGN-150408	0.625	0.625	0.187	0.031
	SPGN-534	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPGN-150416	0.625	0.625	0.187	0.062
	SPGN-631		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPGN-190404	0.750	0.750	0.187	0.015
	SPGN-632		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPGN-190408	0.750	0.750	0.187	0.031
	SPGN-633		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPGN-190412	0.750	0.750	0.187	0.047
	SPGN-634		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPGN-190416	0.750	0.750	0.187	0.062
	SPGN-636		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPGN-190424	0.750	0.750	0.187	0.094
	SPGN-638		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPGN-190432	0.750	0.750	0.187	0.125
	SPUN-422	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPUN-120308	0.500	0.500	0.125	0.031
	SPUN-423	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPUN-120312	0.500	0.500	0.125	0.047
	SPUN-424	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPUN-120316	0.500	0.500	0.125	0.062
	SPUN-432	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPUN-120408	0.500	0.500	0.187	0.031
	SPUN-433	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPUN-120412	0.500	0.500	0.187	0.047
	SPUN-633		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPUN-190412	0.750	0.750	0.187	0.047
	SPUN-634		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPUN-190416	0.750	0.750	0.187	0.062
	SPUN-643		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPUN-190612	0.750	0.750	0.250	0.047
	SPUN-644		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPUN-190616	0.750	0.750	0.250	0.062
	SPUN-864		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPUN-250916	1.000	1.000	0.375	0.062
	SPUN-866		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPUN-250924	1.000	1.000	0.375	0.094
	SPUN-868		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPUN-250932	1.000	1.000	0.375	0.125
	SPUN-1068		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPUN-310932	1.250	1.250	0.375	0.125
	SPUN-1288		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPUN-381232	1.500	1.500	0.500	0.125

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

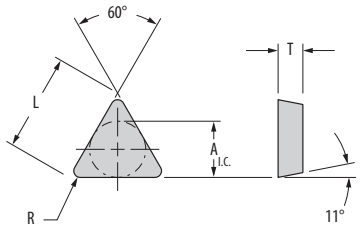
First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

Triangle Inserts

Positive Flat Top (TPGN)



Shape: Triangle	Part Number ANSI	Steel P				Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S					Part Number ISO	Dimensions (inches)			
		GA5025	GA5035	GA5125	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-20M		$A_{I.C.}$	T	D	R
	TPGN-221	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-110304	0.250	0.433	0.125	0.015
	TPGN-222	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-110308	0.250	0.433	0.125	0.031
	TPGN-223	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-110312	0.250	0.433	0.125	0.047
	TPGN-224	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-110316	0.250	0.433	0.125	0.062
	TPGN-320	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-160300	0.375	0.650	0.125	0.005
	TPGN-321	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-160304	0.375	0.650	0.125	0.015
	TPGN-322	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-160308	0.375	0.650	0.125	0.031
	TPGN-323	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-160312	0.375	0.650	0.125	0.047
	TPGN-324	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-160316	0.375	0.650	0.125	0.062
	TPGN-334	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-160416	0.375	0.650	0.187	0.062
	TPGN-336	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-160424	0.375	0.650	0.187	0.094
	TPGN-431	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-220404	0.500	0.866	0.187	0.015
	TPGN-432	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-220408	0.500	0.866	0.187	0.031
	TPGN-433	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-220412	0.500	0.866	0.187	0.047
	TPGN-434	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-220416	0.500	0.866	0.187	0.062
	TPGN-436	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-220424	0.500	0.866	0.187	0.094
	TPGN-532	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-270408	0.625	1.083	0.187	0.031
	TPGN-533	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-270412	0.625	1.083	0.187	0.047
	TPGN-534	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-270416	0.625	1.083	0.187	0.062
	TPGN-541	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-270604	0.625	1.083	0.250	0.015
	TPGN-542	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-270608	0.625	1.083	0.250	0.031
	TPGN-543	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-270612	0.625	1.083	0.250	0.047
	TPGN-544	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-270616	0.625	1.083	0.250	0.062
	TPGN-548	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-270632	0.625	1.083	0.250	0.125
	TPGN-554	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-270716	0.625	1.083	0.312	0.062
	TPGN-556	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-270724	0.625	1.083	0.312	0.094
	TPGN-666	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-330924	0.750	1.299	0.375	0.094

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

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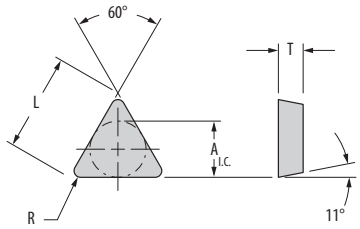
Triangle Inserts

Positive Flat Top (TPUN)



Shape: Triangle	Part Number ANSI	Steel P				Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S					Part Number ISO	Dimensions (inches)			
		GA5025	GA5035	GA5125	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-20M		$A_{I.C.}$	L	T	R
	TPUN-321	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-160304	0.375	0.650	0.125	0.015
	TPUN-322	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-160308	0.375	0.650	0.125	0.031
	TPUN-323	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-160312	0.375	0.650	0.125	0.047
	TPUN-431	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-220404	0.500	0.866	0.187	0.015
	TPUN-432	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-220408	0.500	0.866	0.187	0.031
	TPUN-433	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-220412	0.500	0.866	0.187	0.047
	TPUN-434	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-220416	0.500	0.866	0.187	0.062
	TPUN-542	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-270608	0.625	1.083	0.250	0.031
	TPUN-543	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-270612	0.625	1.083	0.250	0.047
	TPUN-544	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-270616	0.625	1.083	0.250	0.062
	TPUN-552	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-270708	0.625	1.083	0.312	0.031
	TPUN-553	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-270712	0.625	1.083	0.312	0.047
	TPUN-554	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-270716	0.625	1.083	0.312	0.062
	TPUN-556	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-270724	0.625	1.083	0.312	0.094
	TPUN-664		◆	▲	●		▲		◆	●	◆		◆		▲	●	TPUN-330916	0.750	1.299	0.375	0.062
	TPUN-666		◆	▲	●		▲		◆	●	◆		◆		▲	●	TPUN-330924	0.750	1.299	0.375	0.094

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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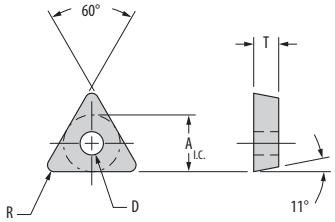
Triangle Inserts

Positive Flat Top (TP-TPGA)



Shape: Triangle	Part Number ANSI	Steel P				Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S					Part Number ISO	Dimensions (inches)			
		GA5025	GA5035	GA5125	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-20M		$A_{I.C.}$	T	D	X
	TP-41	●	◆	▲		●	▲		◆		◆	●	◆		▲		TP-41	0.250	0.093	0.137	0.015
	TP-42	●	◆	▲		●	▲		◆		◆	●	◆		▲		TP-42	0.250	0.093	0.137	0.031
	TP-62	●	◆	▲		●	▲		◆		◆	●	◆		▲		TP-62	0.375	0.125	0.163	0.031
	TP-64	●	◆	▲		●	▲		◆		◆	●	◆		▲		TP-64	0.375	0.125	0.163	0.062
	TP-82	●	◆	▲		●	▲		◆		◆	●	◆		▲		TP-82	0.500	0.187	0.203	0.031
	TPGA-321	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGA-160304	0.375	0.125	0.150	0.015
	TPGA-322	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGA-160308	0.375	0.125	0.150	0.031
	TPGA-323	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGA-160312	0.375	0.125	0.150	0.047

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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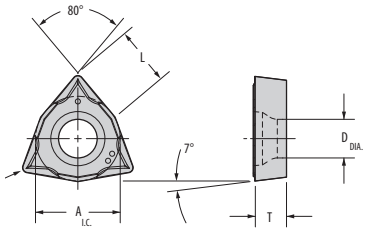
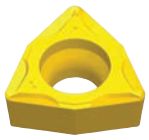
80° Trigon Inserts

Chip Control: Screw On (WCMT)



Shape: 80° Trigon	Part Number ANSI	Steel P				Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S					Part Number ISO	Dimensions (inches)				
		GA5025	GA5035	GA5125	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-20M		$A_{I.C.}$	L	T	D	R
	WCMT-21.5.5-X3	●	◆	▲		●	▲		◆		◆	●	◆		▲		WCMT-060202-X3	0.250	0.171	0.093	0.110	0.008
	WCMT-21.51-X3	●	◆	▲		●	▲		◆		◆	●	◆		▲		WCMT-060204-X3	0.250	0.171	0.093	0.110	0.015
	WCMT-32.51-X3	●	◆	▲		●	▲		◆		◆	●	◆		▲		WCMT-09T304-X3	0.375	0.256	0.156	0.173	0.015
	WCMT-32.52-X3	●	◆	▲		●	▲		◆		◆	●	◆		▲		WCMT-09T308-X3	0.375	0.256	0.156	0.173	0.031

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

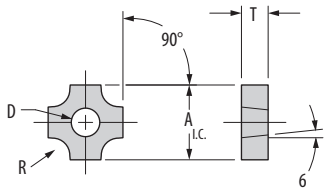
First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

Radius Forming Inserts

Flat Top (SNMA)

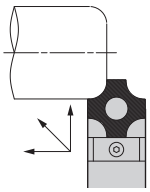


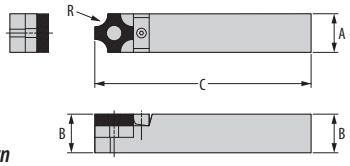
Shape: Square	Part Number ANSI	G-02	G-60	GA5035	Part Number ISO	Dimensions (inches) $A_{I.C.}$	L	T	R
	SNMA-64IR4		●	◆	SNMA-64IR4	0.750	0.250	0.312	0.062
	SNMA-64IR6		●	◆	SNMA-64IR6	0.750	0.250	0.312	0.093
	SNMA-64IR8		●	◆	SNMA-64IR8	0.750	0.250	0.312	0.125
	SNMA-64IR10		●	◆	SNMA-64IR10	0.750	0.250	0.312	0.156
	SNMA-84IR12		●	◆	SNMA-84IR12	1.000	0.250	0.359	0.187
	SNMA-84IR14		●	◆	SNMA-84IR14	1.000	0.250	0.359	0.218
	SNMA-84IR16		●	◆	SNMA-84IR16	1.000	0.250	0.359	0.250
	SNMA-106IR20		●	◆	SNMA-106IR20	1.250	0.375	0.500	0.312
	SNMA-106IR24		●	◆	SNMA-106IR24	1.250	0.375	0.500	0.375
	SNMA-126IR28		●	◆	SNMA-126IR28	1.500	0.375	0.500	0.437
	SNMA-126IR32		●	◆	SNMA-126IR32	1.500	0.375	0.500	0.500

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated First Choice ◆ Second Choice ● Alternative ▲ *Grade descriptions — pages T 4*

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

Style GSRN





Neutral Toolholder Shown

Part Number Neutral	Dimensions (inches) A	B	C	Standard Components Shim	Center Pin	Clamp	Clamp Screw	Tune-Up Kit	Insert Options Insert	R
GSRN-646	0.750	1.000	6.000	SR6	30309	30308-2	30301-1	TK-01117	SNMA-64IR4	0.062
GSRN-656	0.750	1.250	6.000	SR6	30309	30308-2	30301-1	TK-01117	SNMA-64IR6	0.093
GSRN-666	0.750	1.500	7.000	SR6	30309	30308-2	30301-1	TK-01117	SNMA-64IR8	0.125
									SNMA-64IR10	0.156
GSRN-168	1.000	1.000	6.000	SR8	30327-1	30308-2	30301-1	TK-00572	SNMA-84IR12	0.187
GSRN-858	1.000	1.250	7.000	SR8	30327-1	30308-2	30301-1	TK-00572	SNMA-84IR14	0.218
GSRN-868	1.000	1.500	8.000	SR8	30327-1	30308-2	30301-1	TK-00572	SNMA-84IR16	0.250
GSRN-2010	1.250	1.250	7.000	SR10	30454	30319-2	30320	TK-00573	SNMA-106IR20	0.312
GSRN-2410	1.500	1.500	8.000	SR10	30454	30319-2	30320	TK-00573	SNMA-106IR24	0.375
GSRN-2412	1.500	1.500	8.000	SR12	30545	30319-2	30320	TK-00574	SNMA-126IR28	0.437
									SNMA-126IR32	0.500

These toolholders are Greenleaf standards and do not conform to the ANSI identification system.

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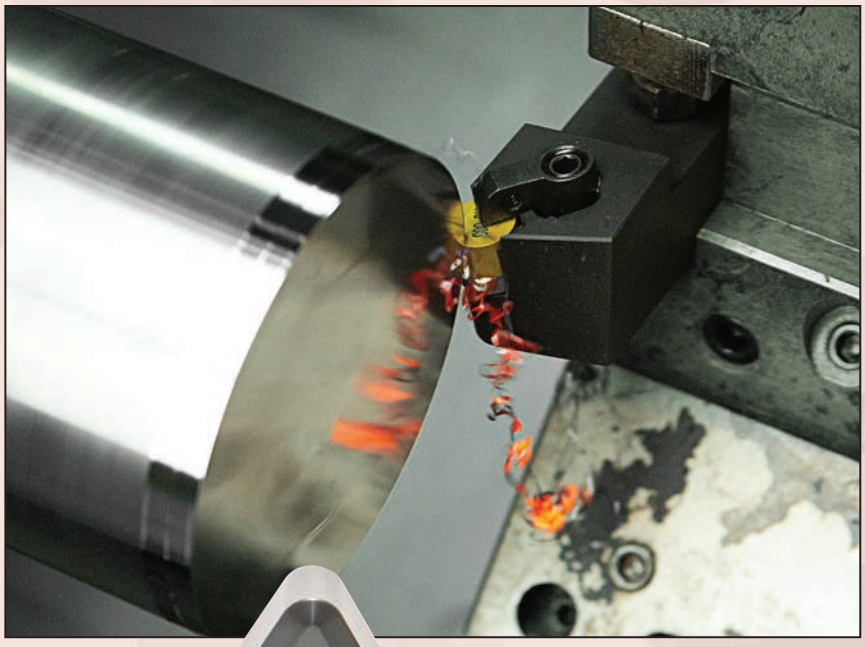
Ceramic Inserts

Greenleaf is the industry leader in the development and manufacturing of ceramic and coated ceramic inserts in ANSI standard and special geometries.



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Insert Grades

Ceramic

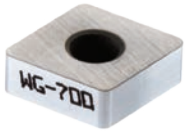
Greenleaf is the industry leader in the development and manufacturing of ceramic and coated ceramic inserts in ANSI standard and special geometries. Some of the most prominent include:

WG-300®

A SiC whisker-reinforced Al_2O_3 ceramic that is very effective at machining nickel- and cobalt-based super alloys, alloyed cast iron, and hardened steels at metal removal rates up to 10 times higher than carbide. Excellent chemical stability and wear resistance at very high cutting speeds make WG-300® the first choice worldwide for grooving and turning difficult materials.

WG-600®

A coated SiC whisker-reinforced Al_2O_3 ceramic that offers higher tool life and speed capabilities than uncoated whisker-reinforced ceramics due to the additional barrier to heat and mechanical abrasion. Application areas for WG-600® include rough and finish turning of alloys in the M, K, S, and H ISO material classes, as well as milling of hardened steels and select stainless steels. WG-600® is particularly well-suited for finish-turning and grooving of Heat-Resistant Super Alloys and is unmatched in both turning and milling of steels with a hardness above 60 HRc.



WG-700™

A SiC whisker-reinforced Al_2O_3 ceramic featuring improved toughness and a unique low-friction coating. WG-700™ is ideal for turning, grooving, and profiling nickel- and cobalt-based super alloys that other ceramics may struggle in. WG-700™ exhibits exceptional tool life and productivity in next-generation formulations or novel heat treatments of Heat-Resistant Super Alloys, and long-reach or thin-walled applications with lower rigidity.

XSYTIN®-1

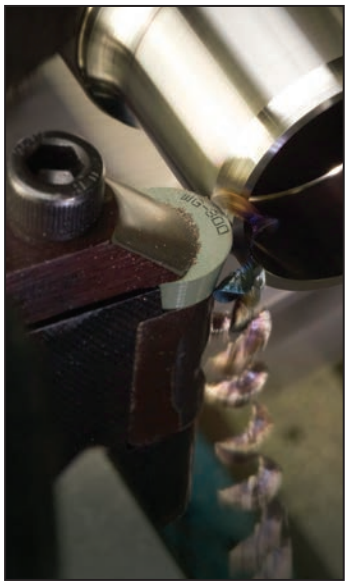
A phase-toughened ceramic grade capable of sustaining extreme cutting forces. The unprecedented strength, impact toughness, and resistance to thermal shock of XSYTIN®-1 make it ideal for use in interrupted cuts, forging scale removal, and milling. In continuous cuts, the strength of XSYTIN®-1 allows the use of significantly higher feed rates or depths of cut. In machining environments with severe interruptions and scale, the edge strength of XSYTIN®-1 allows the use of very light edge preparations, minimizing the force of impact and making for a much smoother cut.

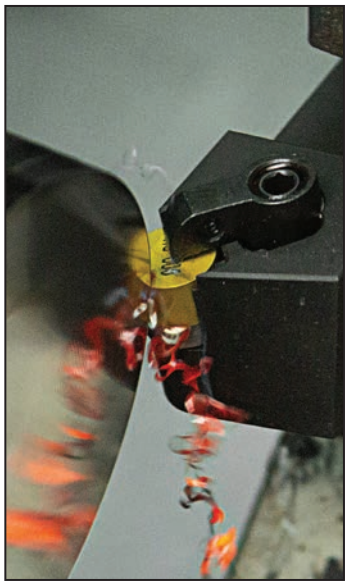
GSN100™

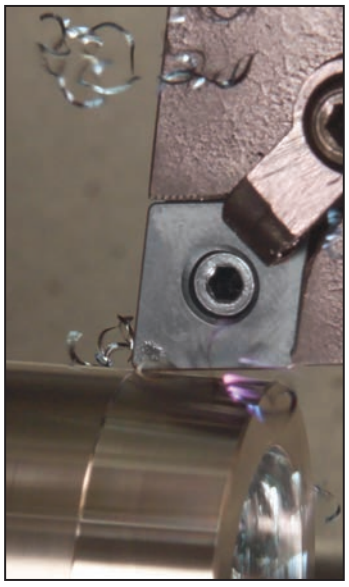
An engineered blend of hot-pressed silicon nitride and proprietary toughening agents that excels in the machining of cast iron. GSN100™ delivers superior wear and toughness for turning, grooving, and milling applications. It is available in all standard geometries and engineered specials.

GEM-8™

An Al_2O_3 + TiC composite ceramic exhibiting excellent hardness and strength at elevated temperatures. GEM-8™ offers a high degree of predictability in roll turning and continuous cuts in ferrous alloys.







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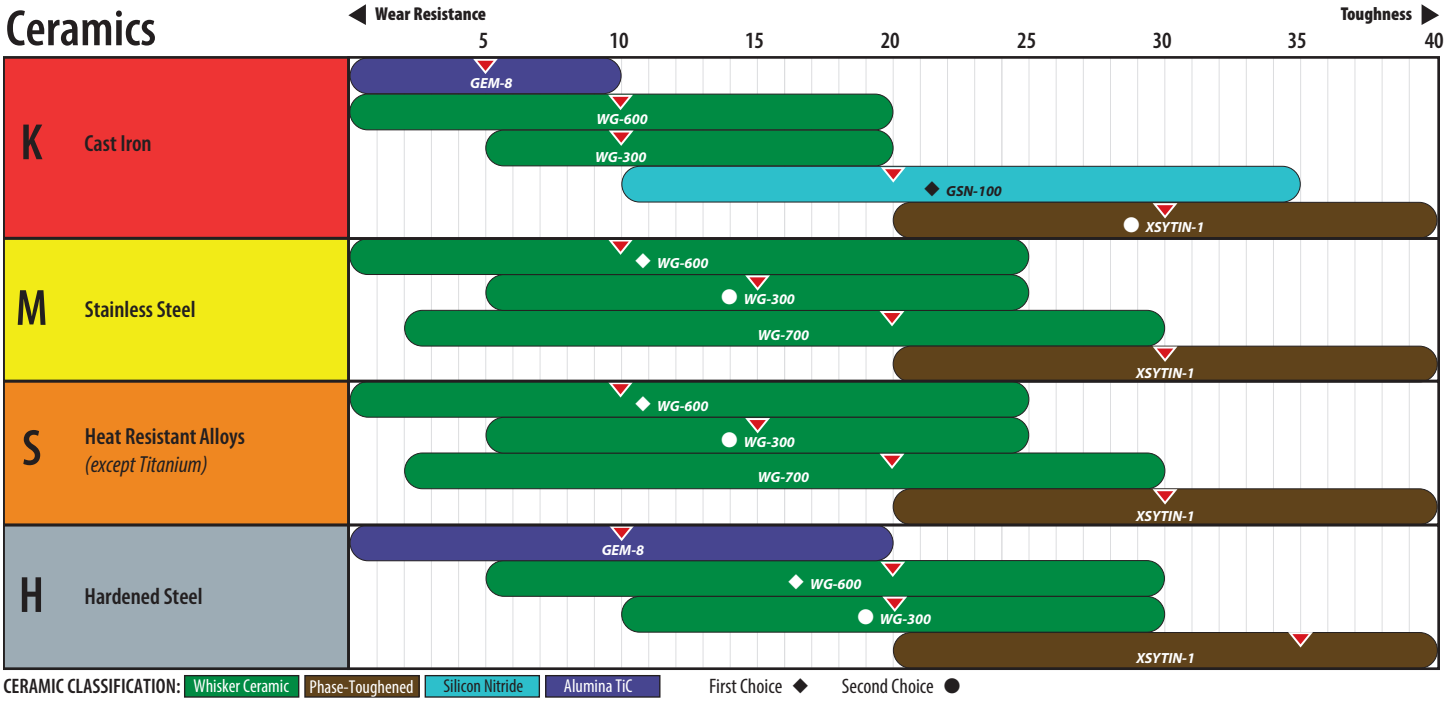
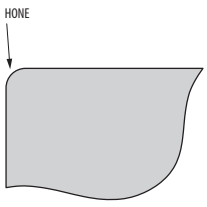
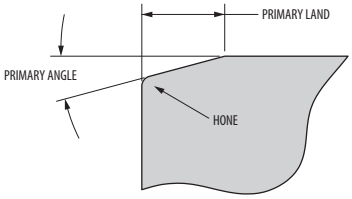
Insert Grade Reference for Turning



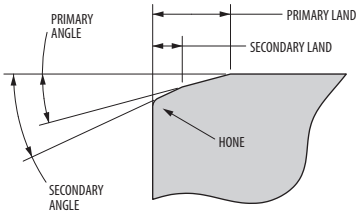
Edge Preparations



HONE



PRIMARY ANGLE



SECONDARY ANGLE

Edge Prep	Hone	Primary Land	Primary Angle	Application
A	.0005 - .001″ R.	–	–	For light finishing and grooving, also added to designated negative lands (i.e. T1, T2, T9).
T1	–	.002 - .004″	20°	General purpose for turning and light milling in clean high-temp. alloys and materials <50HRc.
T1A	.0005 - .001″ R.	.002 - .004″	20°	Used where more protection is needed than T1 such as in scale and light interruptions, hard turning.
T2	–	.006 - .008″	20°	General purpose chamfer for light to medium feed rates, cast-iron machining.
T2A	.0005 - .001″ R.	.006 - .008″	20°	Scale applications, light interruptions, weld overlays, finish turning and milling of hardened materials.

See pages ATI 22-23 for other Greenleaf edge preps or call Greenleaf Technical Service for application concerns.

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A.N.S.I. Identification for Turning and Boring Inserts

Tolerance Class [1]

	Roll Dim. B	I.C. A	Thickness T
A	0.0002 [2]	0.001	0.001
B	0.0002	0.001	0.005
C	0.0005	0.001	0.001
D	0.0005	0.001	0.005
E	0.001	0.001	0.001
F	0.0002 [2]	0.0005	0.001
G	0.001	0.001	0.005
H	0.0005	0.0005	0.001
J	0.0002 [2]	0.002-0.005	0.001
K	0.0005	0.002-0.005	0.001
L	0.001	0.002-0.005	0.001
M	0.002-0.010 [3]	0.002-0.004 [3]	0.005
U	0.005-0.012 [3]	0.005-0.010 [3]	0.005
N	0.002-0.010 [3]	0.002-0.004 [3]	0.001

Size (I.C.)

Regular polygons and diamonds

Number of 1/8ths of an inch in the inscribed circle as per table below:

Example:

5/32" I.C.	1.2
3/16" I.C.	1.5
7/32" I.C.	1.8
1/4" I.C.	2
5/16" I.C.	2.5
3/8" I.C.	3
1/2" I.C.	4
5/8" I.C.	5
3/4" I.C.	6
7/8" I.C.	7
1" I.C.	8
1-1/4" I.C.	10

Rectangles and parallelograms

Use two digits to size

1st digit: Number of 1/8ths of an inch in width

2nd digit: Number of 1/4ths of an inch in length

S P G A 6

Shape

- **V** 35° diamond
- **D** 55° diamond
- **K** 55° parallelogram
- **T** 60° triangle
- **E** 75° diamond
- **C** 80° diamond
- **W** 80° Trigon
- **B** 82° parallelogram
- **A** 85° parallelogram
- **M** 86° diamond
- **S** 90° square
- **L** 90° rectangle
- **P** 108° pentagon
- **H** 120° hexagon
- **O** 135° octagon
- **R** round

Clearances

- **N** 0°
- **A** 3°
- **B** 5°
- **C** 7°
- **P** 11°
- **D** 15°
- **E** 20°
- **F** 25°
- **G** 30°
- **H** 0°-11° [4]
- **J** 0°-14° [4]
- **K** 0°-17° [4]
- **L** 0°-20° [4]
- **M** 11°-14° [4]
- **R** 11°-17° [4]
- **S** 11°-20° [4]

Type

- **N** Without hole
- **R** Without hole with chip groove on one rake face
- **F** Without hole with chip grooves on two rake faces
- **A** With hole
- **B** With hole and one countersink (80°-90°)
- **C** With hole and two countersinks (80°-90°)
- **W** With hole and one countersink (40°-60°)
- **Q** With hole and two countersinks (40°-60°)
- **M** With hole and chip groove on one rake face
- **G** With hole and chip grooves on two rake faces
- **H** With hole, one countersink (80°-90°) and chip groove on one rake face
- **J** With hole, two countersinks (80°-90°) and chip grooves on two rake faces
- **T** With hole, one countersink (40°-60°) and chip groove on one rake face
- **U** With hole, two countersinks (40°-60°) and chip grooves on two rake faces

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Thickness

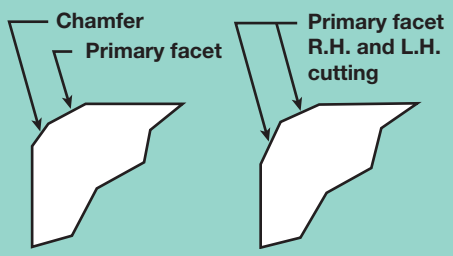
Regular polygons, diamonds, rectangles and parallelograms:
Number of 1/16ths of an inch in thickness as per table below:

Example:

3/32"	1.5
1/8"	2
5/32"	2.5
3/16"	3
7/32"	3.5
1/4"	4
5/16"	5
3/8"	6
7/16"	7
1/2"	8

Special Cutting Point Definition (5)

Only used following a letter in the seventh position.
Number of 1/64ths of an inch in the primary facet length.



Hand (5)

R *Right*
L *Left*

3 **3** [ ] [ ] **A**

Cutting Point Configuration

0 *Sharp Corner*
1 *1/64" radius*
2 *1/32" radius*
3 *3/64" radius*
4 *1/16" radius*
5 *5/64" radius*
6 *3/32" radius*
7 *7/64" radius*
8 *1/8" radius*

A *Square insert with 45° chamfer*
D *Square insert with 30° chamfer*
E *Square insert with 15° chamfer*
F *Square insert with 3° chamfer*
K *Square insert with 30° double chamfer*
L *Square insert with 15° double chamfer*
M *Square insert with 3° double chamfer*
N *Truncated triangular insert*
P *Flatted corner triangle – 90°*

Other Conditions (5)

A *Honed (0.0005 to 0.001")*
B *Honed (0.001 to 0.002")*
C *Honed (0.005 to less than 0.007")*
D *Honed (0.007" and over)*
J *Polished to 4 microinch AA (rake face only)*
T *Chamfered – manufacturer's standard (negative land – rake face only)*

(1) Tolerances given are plus and minus from nominal.

(2) These tolerances normally apply to indexable inserts with facets (secondary cutting edges).

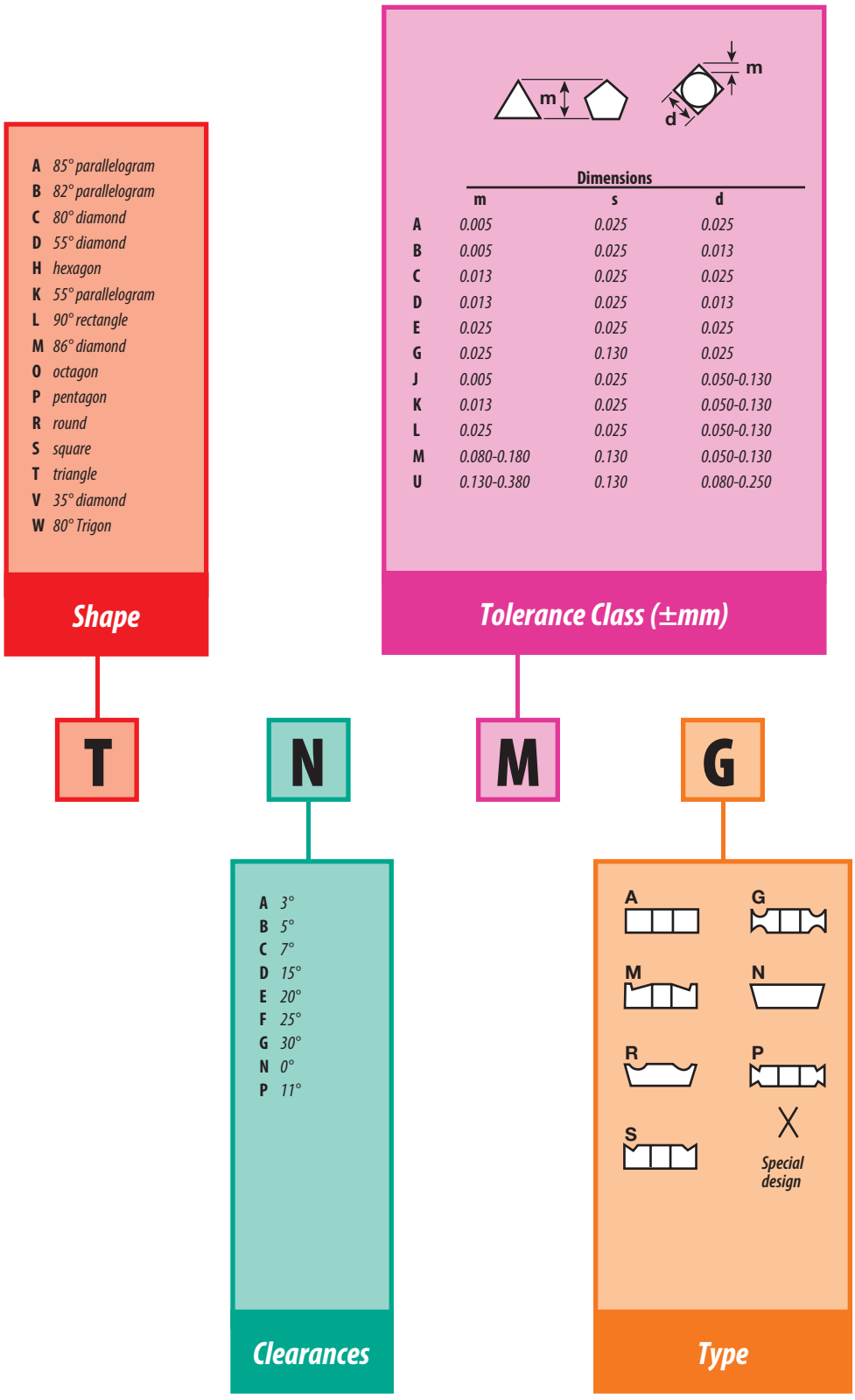
(3) The tolerance depends on the size and shape of the insert and should be shown in the standards for the corresponding shapes and sizes (see ANSI B94.25).

(4) Secondary facet angle may vary by +1°.

(5) Shall only be used when required.

(6) Dimensions are established prior to supplemental edge or coating modification.

I.S.O. Identification for Turning and Boring Inserts



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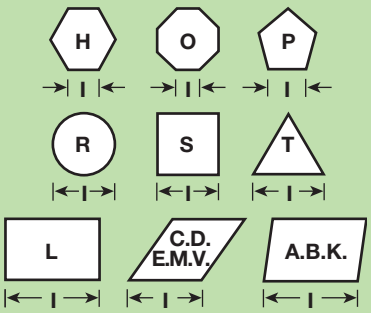
Comparison cutting edge length in mm – IC in inches

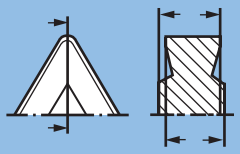
△	06	09	11	16	22	27	33	44
□ ○				09	12	15	19	25
55°					15	19		
80°					12	16	19	25
35°				16	22			
IC = d	5/32"	7/32"	1/4"	3/8"	1/2"	5/8"	3/4"	1"



Integers to be preceded by a 0.
Example: 9,52 mm indicated by 09.

Cutting Edge Length

22



01	s=	1,59
T1	s=	1,98
02	s=	2,38
03	s=	3,18
T3	s=	3,97
04	s=	4,76
05	s=	5,56
06	s=	6,35
07	s=	7,94
09	s=	9,52
10	s=	10,00
12	s=	12,00

04

Unhoned	F
Honed	E
Chamfered	T
Chamfered and Honed	S

Cutting Edge

E

Radius in terms of 0.1 mm

00	**Round insert sharp point**
00	0.2
02	0.4
04	0.5
05	0.8
08	1.0
10	1.2
12	1.5
15	1.6
16	2.4
24	3.2
32	4.0
40	

08

Cutting Point Configuration

Pictorial Index

Negative Inserts

80° Diamond
page: T49

80° Diamond
page: T49

55° Diamond
page: T50

55° Diamond
page: T50

Round
page: T51

Round
page: T51

Square
page: T52

Square
page: T53

Triangle
page: T54

Negative Inserts *continued*

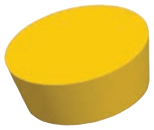
Triangle
page: T54

35° Diamond
page: T55

Trigon
page: T56

Positive Inserts

80° Diamond
Positive Flat Top
page: T57



Round
Positive Flat Top
page: T58

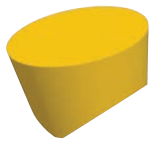
Square
Positive Flat Top
page: T59

Triangle
Positive Flat Top
page: T60

Triangle
page: T60

V-Bottom Round Inserts

RCGN
Positive: Ceramic
page: GP 14



RPGN
Positive: Ceramic
page: GP 15

RCGR/RPGR
Positive Chipform
V-Bottom
page: GP 16

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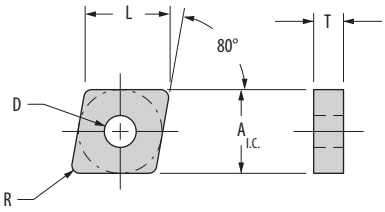
80° Diamond Inserts

Negative (CNGA)



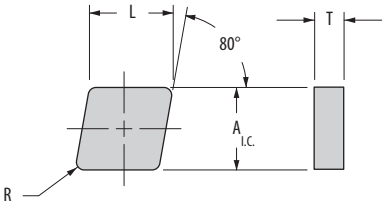
Shape: 80° Diamond	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)				
		M	K			S				H									
		WG-600	WG-600	GSN100	XSYTIN-1	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		$A_{I.C.}$	L	T	D	R
	CNGA-431	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-120404	0.500	0.508	0.187	0.203	0.015
	CNGA-432	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-120408	0.500	0.508	0.187	0.203	0.031
	CNGA-433	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-120412	0.500	0.508	0.187	0.203	0.047
	CNGA-434	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-120416	0.500	0.508	0.187	0.203	0.062
	CNGA-453	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-120712	0.500	0.508	0.312	0.203	0.047
	CNGA-454	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-120716	0.500	0.508	0.312	0.203	0.062
	CNGA-542	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-160608	0.625	0.635	0.250	0.250	0.031
	CNGA-543	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-160612	0.625	0.635	0.250	0.250	0.047
	CNGA-544	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-160616	0.625	0.635	0.250	0.250	0.062
	CNGA-643	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-190612	0.750	0.762	0.250	0.312	0.047
	CNGA-644	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-190616	0.750	0.762	0.250	0.312	0.062
	CNGA-652	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-190708	0.750	0.762	0.312	0.312	0.031
	CNGA-653	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-190712	0.750	0.762	0.312	0.312	0.047
	CNGA-654	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-190716	0.750	0.762	0.312	0.312	0.062

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC — First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖ — *Grade descriptions — pages T 42*

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.
See pages ATI 22-23 for information on edge preps. For availability and any application concerns, please contact Greenleaf Technical Service.

80° Diamond Inserts

Negative (CNGN)



Shape: 80° Diamond	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)			
		M	K			S				H								
		WG-600	WG-600	GSN100	XSYTIN-1	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		$A_{I.C.}$	L	T	R
	CNGN-431	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-120404	0.500	0.508	0.187	0.015
	CNGN-432	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-120408	0.500	0.508	0.187	0.031
	CNGN-433	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-120412	0.500	0.508	0.187	0.047
	CNGN-434	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-120416	0.500	0.508	0.187	0.062
	CNGN-451	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-120704	0.500	0.508	0.312	0.015
	CNGN-452	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-120708	0.500	0.508	0.312	0.031
	CNGN-453	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-120712	0.500	0.508	0.312	0.047
	CNGN-454	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-120716	0.500	0.508	0.312	0.062
	CNGN-542	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-160608	0.625	0.635	0.250	0.031
	CNGN-543	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-160612	0.625	0.635	0.250	0.047
	CNGN-642	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-190608	0.750	0.762	0.250	0.031
	CNGN-643	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-190612	0.750	0.762	0.250	0.047
	CNGN-644	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-190616	0.750	0.762	0.250	0.062
	CNGN-658	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-190732	0.750	0.762	0.312	0.125

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC — First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖ — *Grade descriptions — pages T 42*

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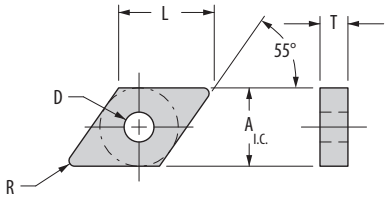
55° Diamond Inserts

Negative (DNGA)



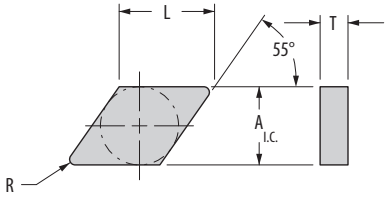
Shape: 55° Diamond	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)				
		M	K			S				H									
		WG-600	WG-600	GSN100	XSYTIN-1	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		$A_{I.C.}$	L	T	D	R
	DNGA-322	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGA-110308	0.375	0.458	0.125	0.150	0.031
	DNGA-323	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGA-110312	0.375	0.458	0.125	0.150	0.047
	DNGA-324	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGA-110316	0.375	0.458	0.125	0.150	0.062
	DNGA-332	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGA-110408	0.375	0.458	0.187	0.150	0.031
	DNGA-431	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGA-150404	0.500	0.610	0.187	0.203	0.015
	DNGA-432	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGA-150408	0.500	0.610	0.187	0.203	0.031
	DNGA-433	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGA-150412	0.500	0.610	0.187	0.203	0.047
	DNGA-434	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGA-150416	0.500	0.610	0.187	0.203	0.062
	DNGA-443	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGA-150612	0.500	0.610	0.250	0.203	0.047
	DNGA-543	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGA-190612	0.625	0.763	0.250	0.250	0.047

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖ *Grade descriptions — pages T 42*

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.
See pages ATI 22-23 for information on edge preps. For availability and any application concerns, please contact Greenleaf Technical Service.

55° Diamond Inserts

Negative (DNGN)



Shape: 55° Diamond	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)			
		M	K			S				H								
		WG-600	WG-600	GSN100	XSYTIN-1	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		$A_{I.C.}$	L	T	R
	DNGN-322	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGN-110308	0.375	0.458	0.125	0.031
	DNGN-323	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGN-110312	0.375	0.458	0.125	0.047
	DNGN-324	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGN-110316	0.375	0.458	0.125	0.062
	DNGN-432	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGN-150408	0.500	0.610	0.187	0.031
	DNGN-433	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGN-150412	0.500	0.610	0.187	0.047
	DNGN-434	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGN-150416	0.500	0.610	0.187	0.062

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖ *Grade descriptions — pages T 42*

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.
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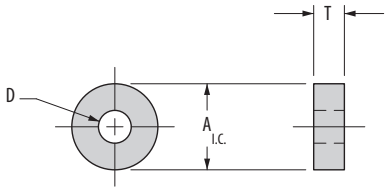
Round Inserts

Negative (RNGA)



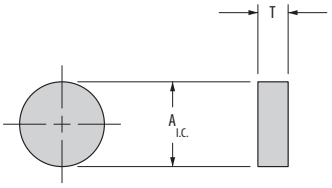
Shape: Round	Part Number ANSI	S Steel M	Cast Iron K			Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ISO	Dimensions (inches)		
		WG-600	WG-600	GSN100	XSYTIN-1	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		$A_{I.C.}$	T	D
	RNGA-32	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGA-090300	0.375	0.125	0.150
	RNGA-33	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGA-090400	0.375	0.187	0.150
	RNGA-43	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGA-120400	0.500	0.187	0.203
	RNGA-45	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGA-120700	0.500	0.312	0.203
	RNGA-55	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGA-150700	0.625	0.312	0.250
	RNGA-65	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGA-190700	0.750	0.312	0.312
	RNGA-85	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGA-250700	1.000	0.312	0.359

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖ *Grade descriptions — pages T 42*

See pages ATI 22-23 for information on edge preps. For availability and any application concerns, please contact Greenleaf Technical Service.

Round Inserts

Negative (RNGN)



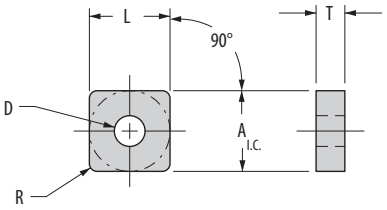
Shape: Round	Part Number ANSI	S Steel M	Cast Iron K			Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ISO	Dimensions (inches)	
		WG-600	WG-600	GSN100	XSYTIN-1	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		$A_{I.C.}$	T
	RNGN-32	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-090300	0.375	0.125
	RNGN-33	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-090400	0.375	0.187
	RNGN-42	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-120300	0.500	0.125
	RNGN-43	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-120400	0.500	0.187
	RNGN-45	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-120700	0.500	0.312
	RNGN-55	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-150700	0.625	0.312
	RNGN-64	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-190600	0.750	0.250
	RNGN-65	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-190700	0.750	0.312
	RNGN-84	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-250600	1.000	0.250
	RNGN-85	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-250700	1.000	0.312
	RNGN-86	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-250900	1.000	0.375
	RNGN-106	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-310900	1.250	0.375

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖ *Grade descriptions — pages T 42*

See pages ATI 22-23 for information on edge preps. For availability and any application concerns, please contact Greenleaf Technical Service.

Square Inserts

Negative (SNGA)



Shape: Square	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)				
		M	K			S				H									
		WG-600	WG-600	GSN100	XSYTIN-1	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		$A_{I.C.}$	L	T	D	R
	SNGA-432	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-120408	0.500	0.500	0.187	0.203	0.031
	SNGA-433	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-120412	0.500	0.500	0.187	0.203	0.047
	SNGA-434	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-120416	0.500	0.500	0.187	0.203	0.062
	SNGA-452	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-120708	0.500	0.500	0.312	0.203	0.031
	SNGA-453	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-120712	0.500	0.500	0.312	0.203	0.047
	SNGA-454	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-120716	0.500	0.500	0.312	0.203	0.062
	SNGA-542	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-150608	0.625	0.625	0.250	0.250	0.031
	SNGA-543	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-150612	0.625	0.625	0.250	0.250	0.047
	SNGA-544	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-150616	0.625	0.625	0.250	0.250	0.062
	SNGA-642	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-190608	0.750	0.750	0.250	0.312	0.031
	SNGA-643	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-190612	0.750	0.750	0.250	0.312	0.047
	SNGA-644	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-190616	0.750	0.750	0.250	0.312	0.062

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages T 42

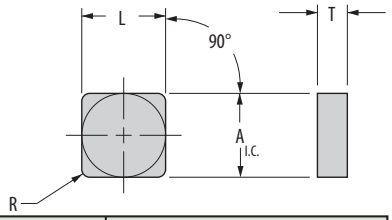
For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

See pages ATI 22-23 for information on edge preps. For availability and any application concerns, please contact Greenleaf Technical Service.

Phone: 814-763-2915 • 800-458-1850 • Fax: 814-763-4423 • sales@greenleafcorporation.com • www. greenleafcorporation.com

Square Inserts

Negative (SNGN)



Shape: Square	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)			
		M	K			S				H								
		WG-600	WG-600	GSN100	XSYTIN-1	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		$A_{I.C.}$	L	T	R
	SNGN-322	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-090308	0.375	0.375	0.125	0.031
	SNGN-333	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-090412	0.375	0.375	0.187	0.047
	SNGN-432	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-120408	0.500	0.500	0.187	0.031
	SNGN-433	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-120412	0.500	0.500	0.187	0.047
	SNGN-434	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-120416	0.500	0.500	0.187	0.062
	SNGN-452	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-120708	0.500	0.500	0.312	0.031
	SNGN-453	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-120712	0.500	0.500	0.312	0.047
	SNGN-454	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-120716	0.500	0.500	0.312	0.062
	SNGN-542	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-150608	0.625	0.625	0.250	0.031
	SNGN-543	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-150612	0.625	0.625	0.250	0.047
	SNGN-544	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-150616	0.625	0.625	0.250	0.062
	SNGN-6416	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-190663	0.750	0.750	0.250	0.250
	SNGN-642	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-190608	0.750	0.750	0.250	0.031
	SNGN-643	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-190612	0.750	0.750	0.250	0.047
	SNGN-644	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-190616	0.750	0.750	0.250	0.062
	SNGN-652	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-190708	0.750	0.750	0.312	0.031
	SNGN-653	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-190712	0.750	0.750	0.312	0.047
	SNGN-654	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-190716	0.750	0.750	0.312	0.062
	SNGN-655	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-190720	0.750	0.750	0.312	0.078
	SNGN-656	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-190723	0.750	0.750	0.312	0.094
	SNGN-866	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-250924	1.000	1.000	0.375	0.094

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

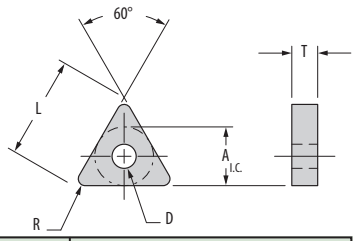
Grade descriptions — pages T 42

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

See pages ATI 22-23 for information on edge preps. For availability and any application concerns, please contact Greenleaf Technical Service.

Triangle Inserts

Negative (TNGA)



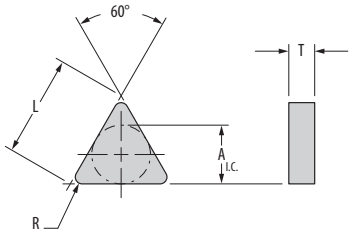
Shape: Triangle	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)				
		M	K			S				H									
		WG-600	WG-600	GSN100	XSYTIN-1	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		$A_{I.C.}$	L	T	D	R
	TNGA-331	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGA-160404	0.375	0.650	0.187	0.150	0.015
	TNGA-332	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGA-160408	0.375	0.650	0.187	0.150	0.031
	TNGA-333	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGA-160412	0.375	0.650	0.187	0.150	0.047
	TNGA-334	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGA-160416	0.375	0.650	0.187	0.150	0.062
	TNGA-432	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGA-220408	0.500	0.866	0.187	0.203	0.031
	TNGA-433	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGA-220412	0.500	0.866	0.187	0.203	0.047
	TNGA-434	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGA-220416	0.500	0.866	0.187	0.203	0.062
	TNGA-454	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGA-220716	0.500	0.866	0.312	0.203	0.062

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖ *Grade descriptions — pages T 42*

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.
See pages ATI 22-23 for information on edge preps. For availability and any application concerns, please contact Greenleaf Technical Service.

Triangle Inserts

Negative (TNGN)



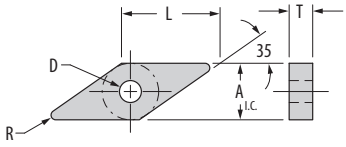
Shape: Triangle	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)			
		M	K			S				H								
		WG-600	WG-600	GSN100	XSYTIN-1	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		$A_{I.C.}$	L	T	R
	TNGN-222	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-110308	0.250	0.433	0.125	0.031
	TNGN-321	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-160304	0.375	0.650	0.125	0.015
	TNGN-322	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-160308	0.375	0.650	0.125	0.031
	TNGN-331	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-160404	0.375	0.650	0.187	0.015
	TNGN-332	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-160408	0.375	0.650	0.187	0.031
	TNGN-333	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-160412	0.375	0.650	0.187	0.047
	TNGN-334	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-160416	0.375	0.650	0.187	0.062
	TNGN-431	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-220404	0.500	0.866	0.187	0.015
	TNGN-432	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-220408	0.500	0.866	0.187	0.031
	TNGN-433	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-220412	0.500	0.866	0.187	0.047
	TNGN-434	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-220416	0.500	0.866	0.187	0.062
	TNGN-438	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-220432	0.500	0.866	0.187	0.125
	TNGN-452	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-220708	0.500	0.866	0.312	0.031
	TNGN-453	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-220712	0.500	0.866	0.312	0.047
	TNGN-454	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-220716	0.500	0.866	0.312	0.062
	TNGN-543	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-270612	0.625	1.083	0.250	0.047
	TNGN-544	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-270616	0.625	1.083	0.250	0.062
	TNGN-548	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-270632	0.625	1.083	0.250	0.125
	TNGN-666	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-330924	0.750	1.299	0.375	0.094
	TNGN-868	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-440932	1.000	1.732	0.375	0.125

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖ *Grade descriptions — pages T 42*

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.
See pages ATI 22-23 for information on edge preps. For availability and any application concerns, please contact Greenleaf Technical Service.

35° Diamond Inserts

Negative (VNGA)



Shape: 35° Diamond	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)				
		M	K			S				H									
		WG-600	WG-600	GSN100	XSYTIN-1	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		$A_{I.C.}$	L	T	D	R
	VNGA-332	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	VNGA-160408	0.375	0.654	0.187	0.150	0.031
	VNGA-333	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	VNGA-160412	0.375	0.654	0.187	0.150	0.047
	VNGA-432	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	VNGA-220408	0.500	0.872	0.187	0.203	0.031
	VNGA-436	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	VNGA-220424	0.500	0.872	0.187	0.203	0.094

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

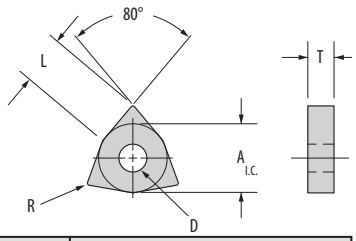
Grade descriptions — pages T 42

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

See pages ATI 22-23 for information on edge preps. For availability and any application concerns, please contact Greenleaf Technical Service.

Trigon Inserts

Negative (WNGA)



Shape: Trigon	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)				
		M	K			S				H									
		WG-600	WG-600	GSN100	XSYTIN-1	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		$A_{I.C.}$	L	T	D	R
	WNGA-331	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	WNGA-060404	0.375	0.257	0.187	0.152	0.015
	WNGA-332	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	WNGA-060408	0.375	0.257	0.187	0.152	0.031
	WNGA-333	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	WNGA-060412	0.375	0.257	0.187	0.152	0.047
	WNGA-431	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	WNGA-080404	0.500	0.342	0.187	0.203	0.015
	WNGA-432	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	WNGA-080408	0.500	0.342	0.187	0.203	0.031
	WNGA-433	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	WNGA-080412	0.500	0.342	0.187	0.203	0.047

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages T 42

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

See pages ATI 22-23 for information on edge preps. For availability and any application concerns, please contact Greenleaf Technical Service.

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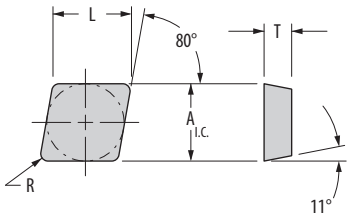
80° Diamond Inserts

Positive (CPGN)



Shape: 80° Diamond	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)			
		M	K			S				H								
		WG-600	WG-600	GSN100	XSYTIN-1	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		$A_{I.C.}$	L	T	R
	CPGN-321	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CPGN-090304	0.375	0.380	0.125	0.015
	CPGN-322	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CPGN-090308	0.375	0.380	0.125	0.031
	CPGN-323	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CPGN-090312	0.375	0.380	0.125	0.047
	CPGN-422	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CPGN-120308	0.500	0.508	0.125	0.031
	CPGN-424	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CPGN-120316	0.500	0.508	0.125	0.062
	CPGN-432	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CPGN-120408	0.500	0.508	0.187	0.031
	CPGN-433	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CPGN-120412	0.500	0.508	0.187	0.047
	CPGN-434	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CPGN-120416	0.500	0.508	0.187	0.062

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

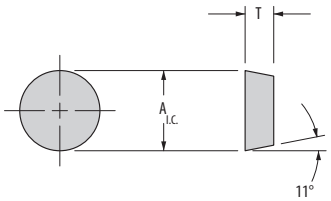
Grade descriptions — pages T 42

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

See pages ATI 22-23 for information on edge preps. For availability and any application concerns, please contact Greenleaf Technical Service.

Round Inserts

Positive Flat Top (RPGN)



Shape: Round	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)	
		M	K			S				H						
		WG-600	WG-600	GSN100	XSYTIN-1	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		$A_{I.C.}$	T
	RPGN-32	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RPGN-090300	0.375	0.125
	RPGN-43	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RPGN-120400	0.500	0.187

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages T 42

See pages ATI 22-23 for information on edge preps. For availability and any application concerns, please contact Greenleaf Technical Service.

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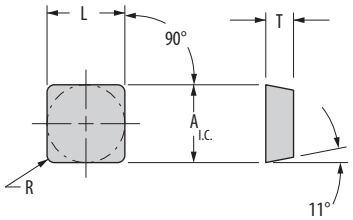
Square Inserts

Positive Flat Top (SPGN)



Shape: Square	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)			
		M	K			S				H								
		WG-600	WG-600	GSN100	XSYTIN-1	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		$A_{I.C.}$	L	T	R
	SPGN-322	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SPGN-090308	0.375	0.375	0.125	0.031
	SPGN-422	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SPGN-120308	0.500	0.500	0.125	0.031
	SPGN-423	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SPGN-120312	0.500	0.500	0.125	0.047
	SPGN-432	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SPGN-120408	0.500	0.500	0.187	0.031
	SPGN-433	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SPGN-120412	0.500	0.500	0.187	0.047
	SPGN-434	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SPGN-120416	0.500	0.500	0.187	0.062
	SPGN-632	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SPGN-190408	0.750	0.750	0.187	0.031
	SPGN-633	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SPGN-190412	0.750	0.750	0.187	0.047
	SPGN-634	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SPGN-190416	0.750	0.750	0.187	0.062
	SPGN-642	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SPGN-190608	0.750	0.750	0.250	0.031

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

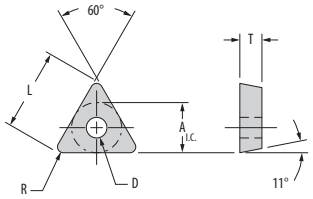
Grade descriptions — pages T 42

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.

See pages ATI 22-23 for information on edge preps. For availability and any application concerns, please contact Greenleaf Technical Service.

Triangle Inserts

Positive Flat Top (TP)



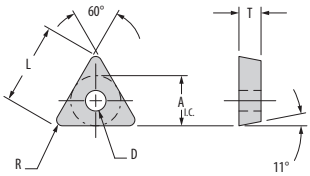
Shape: Triangle	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)				
		M	K			S				H									
		WG-600	WG-600	GSN100	XSYTIN-1	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		$A_{I.C.}$	L	T	D	R
	TP-41	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TP-41	0.250	0.433	0.093	0.137	0.015
	TP-42	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TP-42	0.250	0.433	0.093	0.137	0.031
	TP-62	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TP-62	0.375	0.650	0.125	0.163	0.031
	TP-64	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TP-64	0.375	0.650	0.125	0.163	0.062
	TP-82	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TP-82	0.500	0.866	0.187	0.203	0.031

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC — First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖ *Grade descriptions — pages T 42*

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.
See pages ATI 22-23 for information on edge preps. For availability and any application concerns, please contact Greenleaf Technical Service.

Triangle Inserts

Positive Flat Top (TPGA)



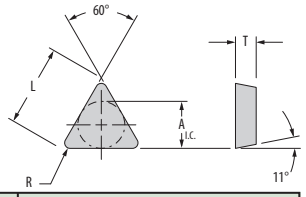
Shape: Triangle	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)				
		M	K			S				H									
		WG-600	WG-600	GSN100	XSYTIN-1	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		$A_{I.C.}$	L	T	D	R
	TPGA-321	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGA-160304	0.375	0.650	0.125	0.150	0.015
	TPGA-322	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGA-160308	0.375	0.650	0.125	0.150	0.031

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC — First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖ *Grade descriptions — pages T 42*

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.
See pages ATI 22-23 for information on edge preps. For availability and any application concerns, please contact Greenleaf Technical Service.

Triangle Inserts

Positive Flat Top (TPGN)



Shape: Triangle	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)			
		M	K			S				H								
		WG-600	WG-600	GSN100	XSYTIN-1	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		$A_{I.C.}$	L	T	R
	TPGN-221	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGN-110304	0.250	0.433	0.125	0.015
	TPGN-222	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGN-110308	0.250	0.433	0.125	0.031
	TPGN-321	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGN-160304	0.375	0.650	0.125	0.015
	TPGN-322	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGN-160308	0.375	0.650	0.125	0.031
	TPGN-323	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGN-160312	0.375	0.650	0.125	0.047
	TPGN-324	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGN-160316	0.375	0.650	0.125	0.062
	TPGN-431	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGN-220404	0.500	0.866	0.187	0.015
	TPGN-432	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGN-220408	0.500	0.866	0.187	0.031
	TPGN-433	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGN-220412	0.500	0.866	0.187	0.047
	TPGN-434	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGN-220416	0.500	0.866	0.187	0.062

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC — First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖ *Grade descriptions — pages T 42*

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.
See pages ATI 22-23 for information on edge preps. For availability and any application concerns, please contact Greenleaf Technical Service.

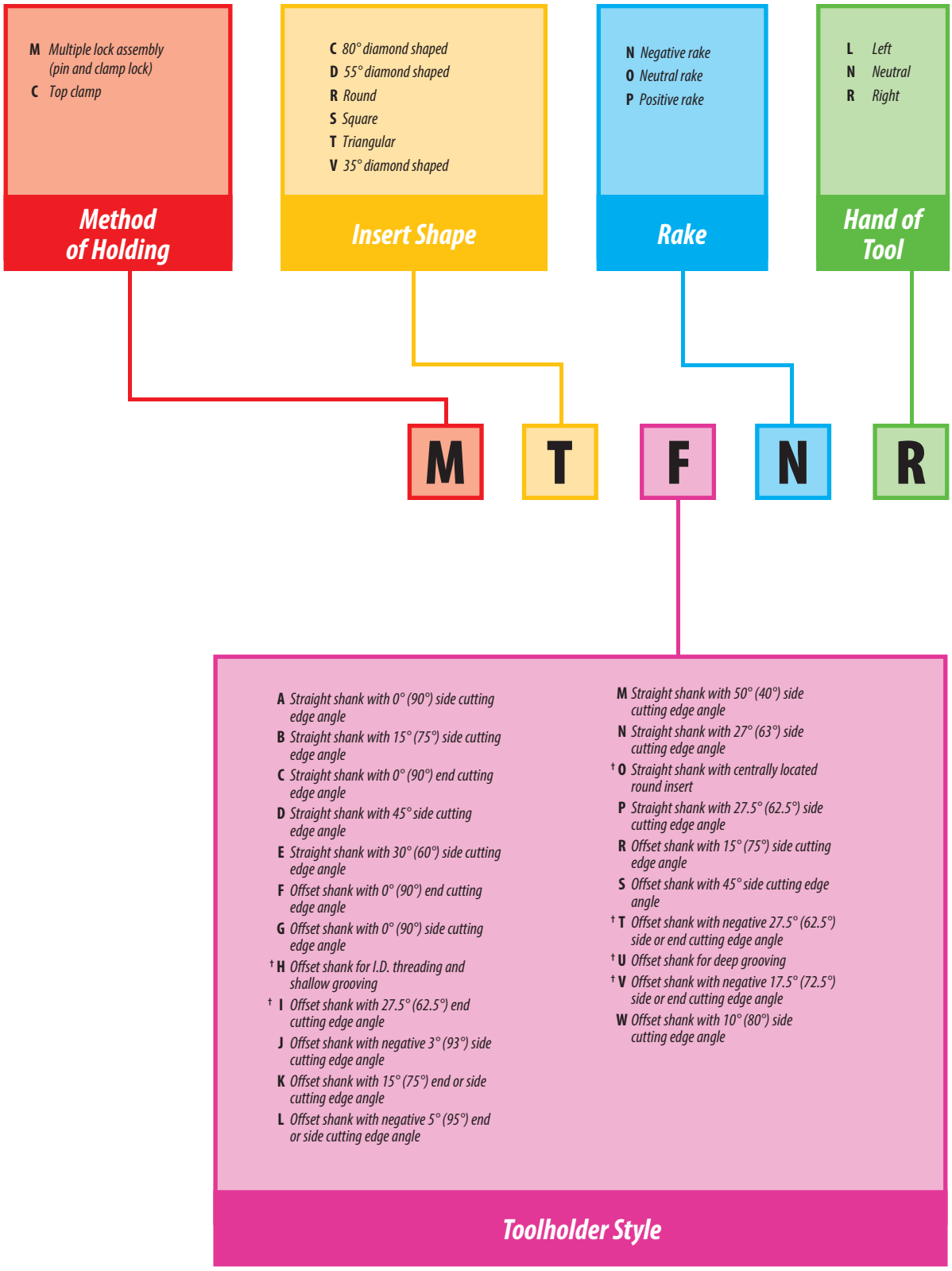
Industry-Standard Toolholders for Carbide Inserts

Greenleaf manufactures a complete line of industry-standard toolholders in conformance with ANSI specifications in 4140 and 4150 alloy steel, hardened up to 42 HRc and oxide coated.

Greenleaf Tune-Up Kits

A Tune-Up Kit consists of all the standard hardware to refurbish a particular toolholder, boring bar, or milling cutter. A toolholder will have a readily visible, laser-inscribed Tune-Up Kit number on it for ease in ordering. This number will prevent any confusion created by searching a catalog for hardware, and it will help reduce downtime.

Industry-Standard Toolholder Identification System



NOTE:
The angles shown in parentheses are the angles as shown in the ANSI standard.

†Greenleaf standard.

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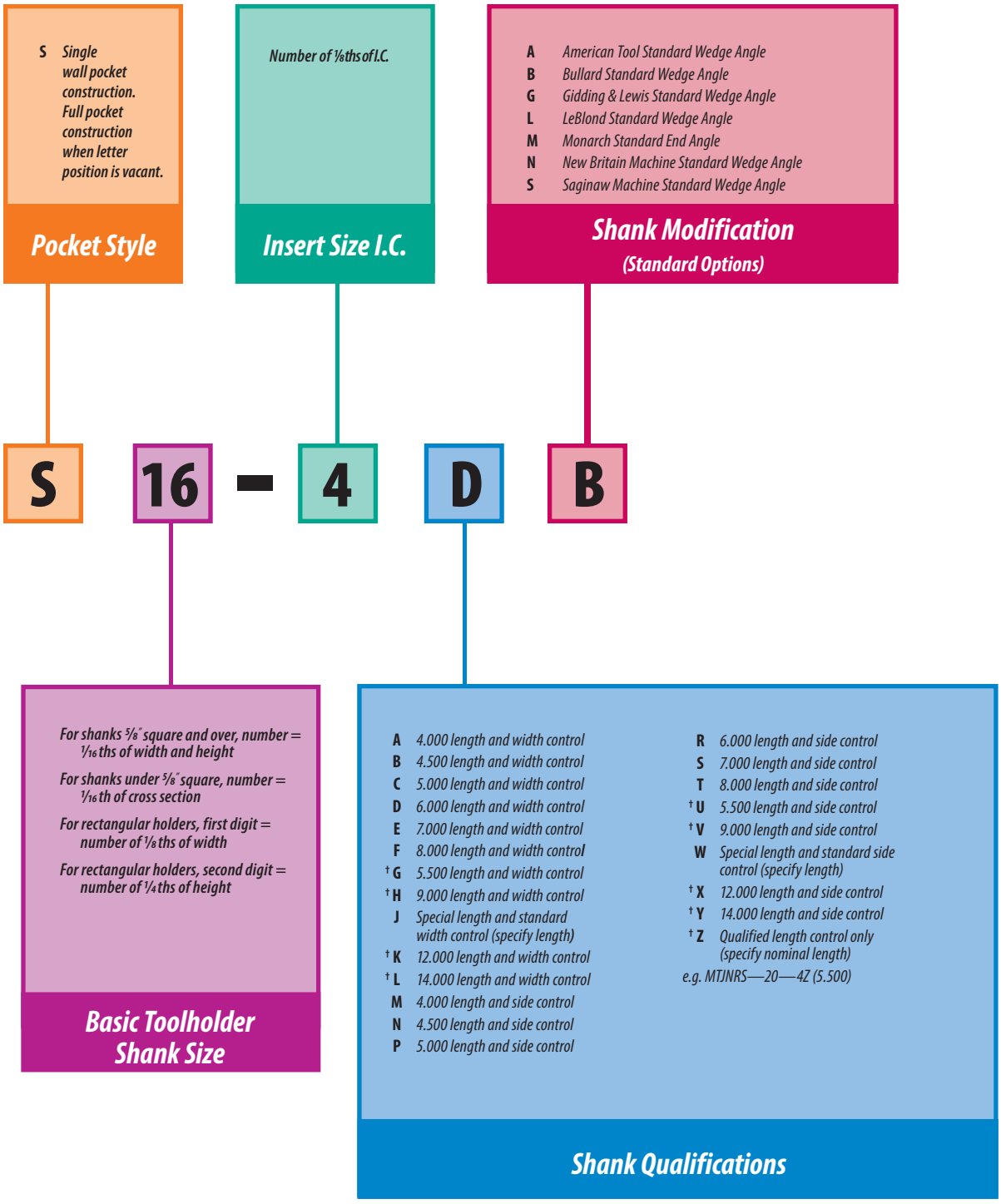


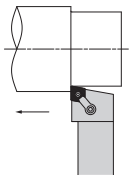
NOTE:
All toolholders are shipped qualified over insert gage radius to ±.003" on C and F dimensions as standard. Some toolholders are qualifiable on length only (C dimension).

All toolholders to be qualified other than above should be designated with the appropriate letter under heading "Shank Qualifications."

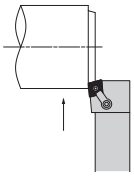
†Greenleaf standard.

Pictorial Index

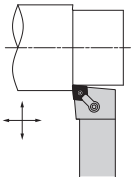
80° Diamond – Negative



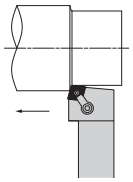
G-MCGNR/L
Style G
80° Diamond
Negative Rake
0° Lead
page: T66



G-MCKNR/L
Style K
80° Diamond
(Using 100° Corner)
Negative Rake
15° Lead
page: T66

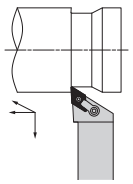


G-MCLNR/L
Style L
80° Diamond
Negative Rake
5° Reverse Lead
page: T67

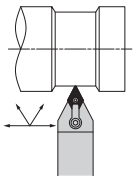


G-MCRNR/L
Style R
80° Diamond
(Using 100° Corner)
Negative Rake
15° Lead
page: T67

55° Diamond – Negative

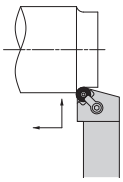


G-MDJNR/L
Style J
55° Diamond
Negative Rake
3° Reverse Lead
page: T68



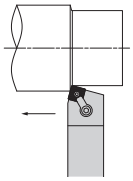
G-MDPNN
Style P
55° Diamond
Negative Rake
27° 30' Lead
page: T68

Round – Negative

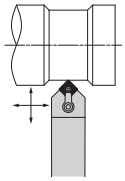


G-MRGNR/L
Style G
Round
Negative Rake
page: T69

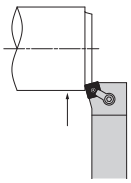
Square – Negative



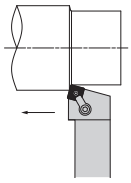
G-MSBNR/L
Style B
Square
Negative Rake
15° Lead
page: T70



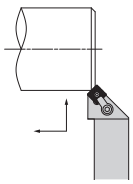
G-MSDNN
Style D
Square
Negative Rake
45° Lead
page: T71



G-MSKNR/L
Style K
Square
Negative Rake
15° Lead
page: T71

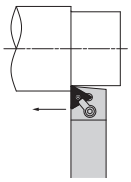


G-MSRNR/L
Style R
Square
Negative Rake
15° Lead
page: T72

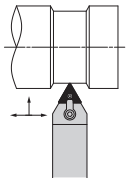


G-MSSNR/L
Style S
Square
Negative Rake
45° Lead
page: T72

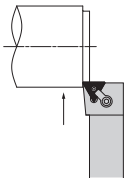
Triangle – Negative



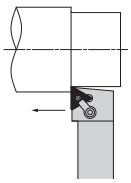
G-MTANR/L
Style A
Triangle
Negative Rake
0° Lead
page: T73



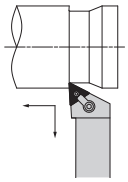
G-MTENNS
Style E
Triangle
Negative Rake
30° Lead
page: T73



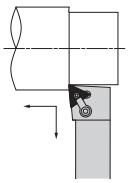
G-MTFNR/L
Style F
Triangle
Negative Rake
0° Lead
page: T74



G-MTGNR/L
Style G
Triangle
Negative Rake
0° Lead
page: T75



G-MTJNRS
Style J
Triangle
Negative Rake
3° Reverse Lead
page: T75



G-MTLNR/L
Style L
Triangle
Negative Rake
5° Reverse Lead
page: T76

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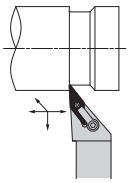
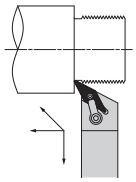
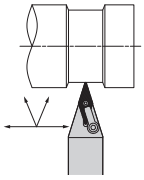
35° Diamond – Negative



G-MVJNR/L
Style J
35° Diamond
Negative Rake
3° Reverse Lead
page: T77

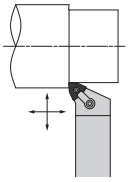


G-MVTNR/L
Style T
35° Diamond
Negative Rake
27° 30' Lead
page: T77



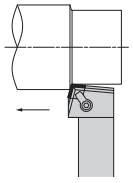
G-MVVNN
Style V
35° Diamond
Negative Rake
1°30' Reverse Lead
page: T78

Trigon – Negative



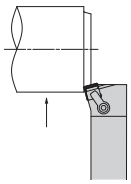
G-MWLNR/L
Style L
Trigon
Negative Rake
5° Reverse Lead
page: T78

80° Diamond – Positive



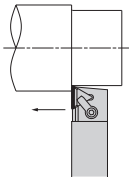
G-CCRPR/L
Style R
80° Diamond
(Using 100° Corner)
Positive Rake
15° Lead
page: T79

Square – Positive

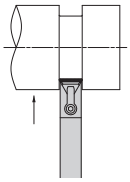


G-CSKPR/L
Style K
Square
Positive Rake
15° Lead
page: T80

Triangle – Positive

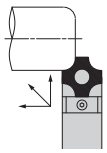


G-CTAPR/L
Style A
Triangle
Positive Rake
0° Lead
page: T81



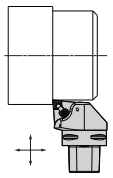
G-CTCPN
Style C
Triangle
Positive Rake
0° Lead
page: T81

Radius Forming

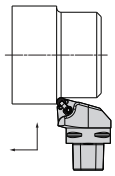


GSRN
Style GSRN
page: T82

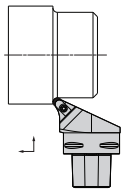
Quick-Change Toolholders



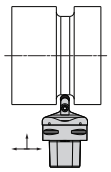
MCLNR/L
80° Diamond
Negative Rake
5° Reverse Lead
C6 & C8 Tool Heads
page: T84



MRGNR/L
Round Negative Rake
C6 & C8 Tool Heads
page: T84



CRGPR/L
45° Grooving/Profiling
Replaceable Nest
page: T85



CRDPN
Neutral
Replaceable Nest
page: T85

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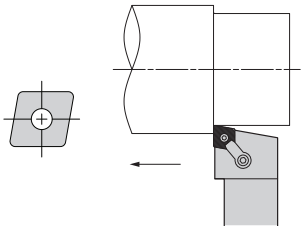
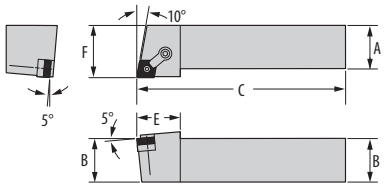
G-MCGNR/L

Style G / 80° Diamond / Negative Rake / 0° Lead





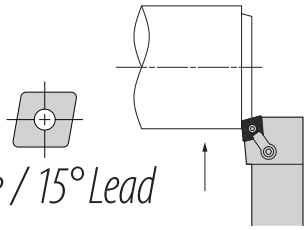
Right-Hand Toolholder Shown

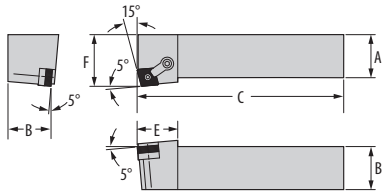
Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Seat
G-MCGNR-12-4C	G-MCGNL-12-4C	CNMG-432	0.750	0.750	5.000	1.250	1.000	CSN-433	NL-46	CL-20	XNS-48	TK-00545	S-46	–
G-MCGNR-16-4D	G-MCGNL-16-4D	CNMG-432	1.000	1.000	6.000	1.250	1.250	CSN-433	NL-46	CL-20	XNS-48	TK-00545	S-46	–
G-MCGNR-85-4D	G-MCGNL-85-4D	CNMG-432	1.000	1.250	6.000	1.250	1.250	CSN-433	NL-46	CL-20	XNS-48	TK-00545	S-46	–
G-MCGNR-20-4D	G-MCGNL-20-4D	CNMG-432	1.250	1.250	6.000	1.250	1.500	CSN-433	NL-46	CL-20	XNS-48	TK-00545	S-46	–
G-MCGNR-24-4D	G-MCGNL-24-4D	CNMG-432	1.500	1.500	6.000	1.250	2.000	CSN-433	NL-46	CL-20	XNS-48	TK-00545	S-46	–
G-MCGNR-16-5D	G-MCGNL-16-5D	CNMG-543	1.000	1.000	6.000	1.500	1.250	CSN-533	NL-58	CL-12	XNS-510	TK-00547	S-58	CSN-543
G-MCGNR-85-5D	G-MCGNL-85-5D	CNMG-543	1.000	1.250	6.000	1.500	1.250	CSN-533	NL-58	CL-12	XNS-510	TK-00547	S-58	CSN-543
G-MCGNR-20-5D	G-MCGNL-20-5D	CNMG-543	1.250	1.250	6.000	1.500	1.500	CSN-533	NL-58	CL-12	XNS-510	TK-00547	S-58	CSN-543
G-MCGNR-24-5D	G-MCGNL-24-5D	CNMG-543	1.500	1.500	6.000	1.500	2.000	CSN-533	NL-58	CL-12	XNS-510	TK-00547	S-58	CSN-543
G-MCGNR-16-6D	G-MCGNL-16-6D	CNMG-643	1.000	1.000	6.000	1.500	1.250	CSN-633	NL-68	CL-12	XNS-510	TK-00546	S-68	CSN-643
G-MCGNR-85-6D	G-MCGNL-85-6D	CNMG-643	1.000	1.250	6.000	1.500	1.250	CSN-633	NL-68	CL-12	XNS-510	TK-00546	S-68	CSN-643
G-MCGNR-86-6D	G-MCGNL-86-6D	CNMG-643	1.000	1.500	6.000	1.500	1.250	CSN-633	NL-68	CL-12	XNS-510	TK-00546	S-68	CSN-643
G-MCGNR-20-6D	G-MCGNL-20-6D	CNMG-643	1.250	1.250	6.000	1.500	1.500	CSN-633	NL-68	CL-12	XNS-510	TK-00546	S-68	CSN-643
G-MCGNR-24-6D	G-MCGNL-24-6D	CNMG-643	1.500	1.500	6.000	1.500	2.000	CSN-633	NL-68	CL-12	XNS-510	TK-00546	S-68	CSN-643
G-MCGNR-24-8D	G-MCGNL-24-8D	CNMG-866	1.500	1.500	6.000	1.630	2.000	CSN-846	NL-810	CL-24	XNS-610	TK-00718	S-810	–

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

G-MCKNR/L

Style K / 80° Diamond (Using 100° Corner) / Negative Rake / 15° Lead





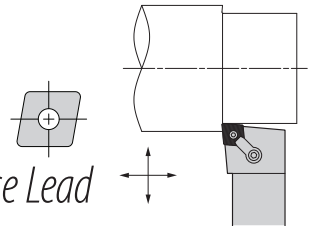
Neutral Toolholder Shown

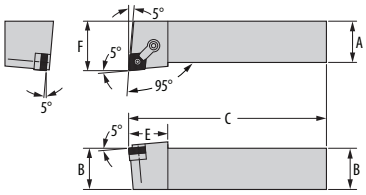
Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Seat
G-MCKNR-12-4C	G-MCKNL-12-4C	CNMG-432	0.750	0.750	5.000	1.190	1.000	CSN-433	NL-46	CL-20	XNS-48	TK-00545	S-46	–
G-MCKNR-16-4D	G-MCKNL-16-4D	CNMG-432	1.000	1.000	6.000	1.190	1.250	CSN-433	NL-46	CL-20	XNS-48	TK-00545	S-46	–
G-MCKNR-20-4D	G-MCKNL-20-4D	CNMG-432	1.250	1.250	6.000	1.190	1.500	CSN-433	NL-46	CL-20	XNS-48	TK-00545	S-46	–
G-MCKNR-24-4D	G-MCKNL-24-4D	CNMG-432	1.500	1.500	6.000	1.190	2.000	CSN-433	NL-46	CL-20	XNS-48	TK-00545	S-46	–
G-MCKNR-16-5D	G-MCKNL-16-5D	CNMG-543	1.000	1.000	6.000	1.440	1.250	CSN-533	NL-58	CL-9	XNS-59	TK-00548	S-58	CSN-543
G-MCKNR-85-5D	G-MCKNL-85-5D	CNMG-543	1.000	1.250	6.000	1.440	1.250	CSN-533	NL-58	CL-9	XNS-59	TK-00548	S-58	CSN-543
G-MCKNR-86-5D	G-MCKNL-86-5D	CNMG-543	1.000	1.500	6.000	1.440	1.250	CSN-533	NL-58	CL-9	XNS-59	TK-00548	S-58	CSN-543
G-MCKNR-20-5D	G-MCKNL-20-5D	CNMG-543	1.250	1.250	6.000	1.440	1.500	CSN-533	NL-58	CL-9	XNS-59	TK-00548	S-58	CSN-543
G-MCKNR-16-6D	G-MCKNL-16-6D	CNMG-643	1.000	1.000	6.000	1.440	1.250	CSN-633	NL-68	CL-12	XNS-510	TK-00546	S-68	CSN-643
G-MCKNR-85-6D	G-MCKNL-85-6D	CNMG-643	1.000	1.250	6.000	1.440	1.250	CSN-633	NL-68	CL-12	XNS-510	TK-00546	S-68	CSN-643
G-MCKNR-86-6D	G-MCKNL-86-6D	CNMG-643	1.000	1.500	6.000	1.440	1.250	CSN-633	NL-68	CL-12	XNS-510	TK-00546	S-68	CSN-643
G-MCKNR-20-6D	G-MCKNL-20-6D	CNMG-643	1.250	1.250	6.000	1.440	1.500	CSN-633	NL-68	CL-12	XNS-510	TK-00546	S-68	CSN-643
G-MCKNR-24-6D	G-MCKNL-24-6D	CNMG-643	1.500	1.500	6.000	1.440	2.000	CSN-633	NL-68	CL-12	XNS-510	TK-00546	S-68	CSN-643
G-MCKNR-24-8D	G-MCKNL-24-8D	CNMG-866	1.500	1.500	6.000	1.940	2.000	CSN-846	NL-810	CL-24	XNS-610	TK-00718	S-810	–

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

G-MCLNR/L

Style L / 80° Diamond / Negative Rake / 5° Reverse Lead





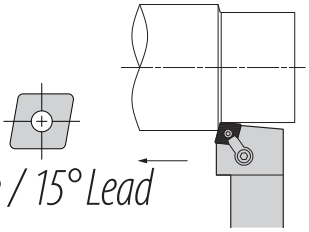
Right-Hand Toolholder Shown

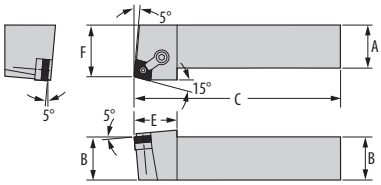
Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Seat
G-MCLNR-12-4C	G-MCLNL-12-4C	CNMG-432	0.750	0.750	5.000	1.190	1.000	CSN-433	NL-46	CL-20	XNS-48	TK-00545	S-46	–
G-MCLNR-16-4D	G-MCLNL-16-4D	CNMG-432	1.000	1.000	6.000	1.190	1.250	CSN-433	NL-46	CL-20	XNS-48	TK-00545	S-46	–
G-MCLNR-85-4D	G-MCLNL-85-4D	CNMG-432	1.000	1.250	6.000	1.190	1.250	CSN-433	NL-46	CL-20	XNS-48	TK-00545	S-46	–
G-MCLNR-20-4D	G-MCLNL-20-4D	CNMG-432	1.250	1.250	6.000	1.190	1.500	CSN-433	NL-46	CL-20	XNS-48	TK-00545	S-46	–
G-MCLNR-24-4D	G-MCLNL-24-4D	CNMG-432	1.500	1.500	6.000	1.190	2.000	CSN-433	NL-46	CL-20	XNS-48	TK-00545	S-46	–
G-MCLNR-16-5D	G-MCLNL-16-5D	CNMG-543	1.000	1.000	6.000	1.380	1.250	CSN-533	NL-58	CL-12	XNS-510	TK-00547	S-58	CSN-543
G-MCLNR-85-5D	G-MCLNL-85-5D	CNMG-543	1.000	1.250	6.000	1.380	1.250	CSN-533	NL-58	CL-12	XNS-510	TK-00547	S-58	CSN-543
G-MCLNR-86-5D	G-MCLNL-86-5D	CNMG-543	1.000	1.500	6.000	1.380	1.250	CSN-533	NL-58	CL-12	XNS-510	TK-00547	S-58	CSN-543
G-MCLNR-20-5D	G-MCLNL-20-5D	CNMG-543	1.250	1.250	6.000	1.380	1.500	CSN-533	NL-58	CL-12	XNS-510	TK-00547	S-58	CSN-543
G-MCLNR-24-5D	G-MCLNL-24-5D	CNMG-543	1.500	1.500	6.000	1.380	2.000	CSN-533	NL-58	CL-12	XNS-510	TK-00547	S-58	CSN-543
G-MCLNR-16-6D	G-MCLNL-16-6D	CNMG-643	1.000	1.000	6.000	1.380	1.250	CSN-633	NL-68	CL-12	XNS-510	TK-00546	S-68	CSN-643
G-MCLNR-85-6D	G-MCLNL-85-6D	CNMG-643	1.000	1.250	6.000	1.380	1.250	CSN-633	NL-68	CL-12	XNS-510	TK-00546	S-68	CSN-643
G-MCLNR-86-6D	G-MCLNL-86-6D	CNMG-643	1.000	1.500	6.000	1.380	1.250	CSN-633	NL-68	CL-12	XNS-510	TK-00546	S-68	CSN-643
G-MCLNR-20-6D	G-MCLNL-20-6D	CNMG-643	1.250	1.250	6.000	1.380	1.500	CSN-633	NL-68	CL-12	XNS-510	TK-00546	S-68	CSN-643
G-MCLNR-24-6D	G-MCLNL-24-6D	CNMG-643	1.500	1.500	6.000	1.380	2.000	CSN-633	NL-68	CL-12	XNS-510	TK-00546	S-68	CSN-643
G-MCLNR-24-8D	G-MCLNL-24-8D	CNMG-866	1.500	1.500	6.000	1.500	2.000	CSN-846	NL-810	CL-24	XNS-610	TK-00718	S-810	–

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

G-MCRNR/L

Style R / 80° Diamond (Using 100° Corner) / Negative Rake / 15° Lead





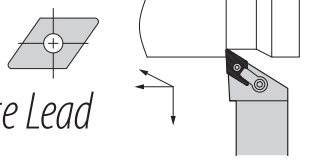
Right-Hand Toolholder Shown

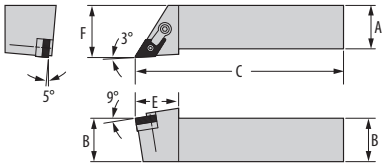
Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Seat
G-MCRNR-12-4C	G-MCRNL-12-4C	CNMG-432	0.750	0.750	5.000	1.250	1.000	CSN-433	NL-46	CL-9	XNS-59	TK-00549	S-46	–
G-MCRNR-16-4D	G-MCRNL-16-4D	CNMG-432	1.000	1.000	6.000	1.250	1.250	CSN-433	NL-46	CL-9	XNS-59	TK-00549	S-46	–
G-MCRNR-20-4D	G-MCRNL-20-4D	CNMG-432	1.250	1.250	6.000	1.250	1.500	CSN-433	NL-46	CL-9	XNS-59	TK-00549	S-46	–
G-MCRNR-24-4D	G-MCRNL-24-4D	CNMG-432	1.500	1.500	6.000	1.250	2.000	CSN-433	NL-46	CL-9	XNS-59	TK-00549	S-46	–
G-MCRNR-16-5D	G-MCRNL-16-5D	CNMG-543	1.000	1.000	6.000	1.340	1.250	CSN-533	NL-58	CL-9	XNS-510	TK-00550	S-58	CSN-543
G-MCRNR-85-5D	G-MCRNL-85-5D	CNMG-543	1.000	1.250	6.000	1.340	1.250	CSN-533	NL-58	CL-9	XNS-510	TK-00550	S-58	CSN-543
G-MCRNR-86-5D	G-MCRNL-86-5D	CNMG-543	1.000	1.500	6.000	1.340	1.250	CSN-533	NL-58	CL-9	XNS-510	TK-00550	S-58	CSN-543
G-MCRNR-20-5D	G-MCRNL-20-5D	CNMG-543	1.250	1.250	6.000	1.340	1.500	CSN-533	NL-58	CL-9	XNS-510	TK-00550	S-58	CSN-543
G-MCRNR-85-6D	G-MCRNL-85-6D	CNMG-643	1.000	1.250	6.000	1.480	1.250	CSN-633	NL-68	CL-12	XNS-510	TK-00546	S-68	CSN-643
G-MCRNR-86-6D	G-MCRNL-86-6D	CNMG-643	1.000	1.500	6.000	1.480	1.250	CSN-633	NL-68	CL-12	XNS-510	TK-00546	S-68	CSN-643
G-MCRNR-20-6D	G-MCRNL-20-6D	CNMG-643	1.250	1.250	6.000	1.480	1.500	CSN-633	NL-68	CL-12	XNS-510	TK-00546	S-68	CSN-643
G-MCRNR-24-6D	G-MCRNL-24-6D	CNMG-643	1.500	1.500	6.000	1.480	2.000	CSN-633	NL-68	CL-12	XNS-510	TK-00546	S-68	CSN-643
G-MCRNR-24-8D	G-MCRNL-24-8D	CNMG-866	1.500	1.500	6.000	1.620	2.000	CSN-846	NL-810	CL-24	XNS-610	TK-00718	S-810	–

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

G-MDJNR/L

Style J / 55° Diamond / Negative Rake / 3° Reverse Lead





Right-Hand Toolholder Shown

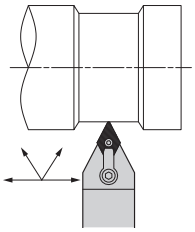
Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Seat
G-MDJNR-12-4C	G-MDJNL-12-4C	DNMG-432	0.750	0.750	5.000	1.380	1.000	DSN-433	NL-46	CL-20	XNS-48	TK-00551	S-46	DSN-423**
G-MDJNR-16-4D	G-MDJNL-16-4D	DNMG-432	1.000	1.000	6.000	1.250	1.250	DSN-433	NL-46	CL-20	XNS-48	TK-00551	S-46	DSN-423**
G-MDJNR-85-4D	G-MDJNL-85-4D	DNMG-432	1.000	1.250	6.000	1.250	1.250	DSN-433	NL-46	CL-20	XNS-48	TK-00551	S-46	DSN-423**
G-MDJNR-20-4D	G-MDJNL-20-4D	DNMG-432	1.250	1.250	6.000	1.250	1.500	DSN-433	NL-46	CL-20	XNS-48	TK-00551	S-46	DSN-423**
G-MDJNR-24-4D	G-MDJNL-24-4D	DNMG-432	1.500	1.500	6.000	1.250	2.000	DSN-433	NL-46	CL-20	XNS-48	TK-00551	S-46	DSN-423**
G-MDJNR-16-5D	G-MDJNL-16-5D	DNMG-543	1.000	1.000	6.000	1.470	1.250	DSN-533	NL-58	CL-12	XNS-510	TK-00552	S-58	DSN-543
G-MDJNR-85-5D	G-MDJNL-85-5D	DNMG-543	1.000	1.250	6.000	1.470	1.250	DSN-533	NL-58	CL-12	XNS-510	TK-00552	S-58	DSN-543
G-MDJNR-86-5D	G-MDJNL-86-5D	DNMG-543	1.000	1.500	6.000	1.470	1.250	DSN-533	NL-58	CL-12	XNS-510	TK-00552	S-58	DSN-543
G-MDJNR-20-5D	G-MDJNL-20-5D	DNMG-543	1.250	1.250	6.000	1.470	1.500	DSN-533	NL-58	CL-12	XNS-510	TK-00552	S-58	DSN-543
G-MDJNR-24-5D	G-MDJNL-24-5D	DNMG-543	1.500	1.500	6.000	1.470	2.000	DSN-533	NL-58	CL-12	XNS-510	TK-00552	S-58	DSN-543

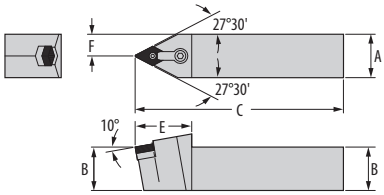
* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

** *Cannot be used with lock pin.*

G-MDPNN

Style P / 55° Diamond / Negative Rake / 27° 30' Lead





Neutral Toolholder Shown

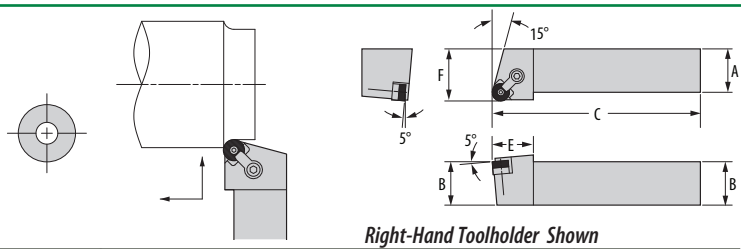
Part Number	Gage	Dimensions (inches)					Standard Components				*Tune-Up	Optional Components	
Neutral	Inserts	B	C	E	F		Seat	Lock Pin	Clamp	Kit Clamp Screw		Seat Screw	Seat
G-MDPNN-12-4C	DNMG-432	0.750	0.750	5.000	1.620	0.375	DSN-433	NL-46	CL-12	XNS-510	TK-00553	S-46	DSN-423**
G-MDPNN-16-4D	DNMG-432	1.000	1.000	6.000	1.620	0.500	DSN-433	NL-46	CL-12	XNS-510	TK-00553	S-46	DSN-423**
G-MDPNN-85-4D	DNMG-432	1.000	1.250	6.000	1.620	0.500	DSN-433	NL-46	CL-12	XNS-510	TK-00553	S-46	DSN-423**
G-MDPNN-20-4D	DNMG-432	1.250	1.250	6.000	1.620	0.625	DSN-433	NL-46	CL-12	XNS-510	TK-00553	S-46	DSN-423**
G-MDPNN-24-4D	DNMG-432	1.500	1.500	6.000	1.620	0.750	DSN-433	NL-46	CL-12	XNS-510	TK-00553	S-46	DSN-423**
G-MDPNN-16-5D	DNMG-543	1.000	1.000	6.000	1.920	0.500	DSN-533	NL-58	CL-12	XNS-510	TK-00552	S-58	DSN-543
G-MDPNN-85-5D	DNMG-543	1.000	1.250	6.000	1.920	0.500	DSN-533	NL-58	CL-12	XNS-510	TK-00552	S-58	DSN-543
G-MDPNN-86-5D	DNMG-543	1.000	1.500	6.000	1.920	0.500	DSN-533	NL-58	CL-12	XNS-510	TK-00552	S-58	DSN-543
G-MDPNN-20-5D	DNMG-543	1.250	1.250	6.000	1.920	0.625	DSN-533	NL-58	CL-12	XNS-510	TK-00552	S-58	DSN-543
G-MDPNN-24-5D	DNMG-543	1.500	1.500	6.000	1.920	0.750	DSN-533	NL-58	CL-12	XNS-510	TK-00552	S-58	DSN-543

* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

** *Cannot be used with lock pin.*

G-MRGNR/L

Style G / Round / Negative Rake



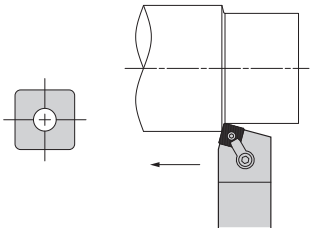
Right-Hand Toolholder Shown

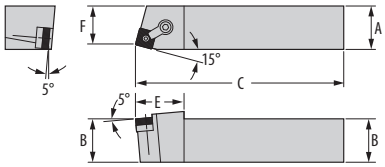
Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Seat
G-MRGNR-12-3C	G-MRGNL-12-3C	RNMG-32	0.750	0.750	5.000	1.000	1.000	–	NL-33	CL-6	XNS-36	R TK-00740	–	–
G-MRGNR-12-4C	G-MRGNL-12-4C	RNMG-43	0.750	0.750	5.000	1.190	1.000	IRSN-43	NL-46	CL-9	XNS-59	TK-00554	S-46	IRSN-44
G-MRGNR-16-4D	G-MRGNL-16-4D	RNMG-43	1.000	1.000	6.000	1.190	1.250	IRSN-43	NL-46	CL-9	XNS-59	TK-00554	S-46	IRSN-44
G-MRGNR-85-4D	G-MRGNL-85-4D	RNMG-43	1.000	1.250	6.000	1.190	1.250	IRSN-43	NL-46	CL-9	XNS-59	TK-00554	S-46	IRSN-44
G-MRGNR-86-4D	G-MRGNL-86-4D	RNMG-43	1.000	1.500	6.000	1.190	1.250	IRSN-43	NL-46	CL-9	XNS-59	TK-00554	S-46	IRSN-44
G-MRGNR-20-4D	G-MRGNL-20-4D	RNMG-43	1.250	1.250	6.000	1.190	1.500	IRSN-43	NL-46	CL-9	XNS-59	TK-00554	S-46	IRSN-44
G-MRGNR-16-5D	G-MRGNL-16-5D	RNMG-54	1.000	1.000	6.000	1.380	1.250	RSN-53	NL-58	CL-9	XNS-59	TK-00555	S-58	–
G-MRGNR-85-5D	G-MRGNL-85-5D	RNMG-54	1.000	1.250	6.000	1.380	1.250	RSN-53	NL-58	CL-9	XNS-59	TK-00555	S-58	–
G-MRGNR-20-5D	G-MRGNL-20-5D	RNMG-54	1.250	1.250	6.000	1.380	1.500	RSN-53	NL-58	CL-9	XNS-59	TK-00555	S-58	–
G-MRGNR-16-6D	G-MRGNL-16-6D	RNMG-64	1.000	1.000	6.000	1.520	1.250	RSN-63	NL-68	CL-12	XNS-59	TK-00556	S-68	–
G-MRGNR-85-6D	G-MRGNL-85-6D	RNMG-64	1.000	1.250	6.000	1.520	1.250	RSN-63	NL-68	CL-12	XNS-59	TK-00556	S-68	–
G-MRGNR-20-6D	G-MRGNL-20-6D	RNMG-64	1.250	1.250	6.000	1.520	1.500	RSN-63	NL-68	CL-12	XNS-59	TK-00556	S-68	–
G-MRGNR-24-8D	G-MRGNL-24-8D	RNMG-86	1.500	1.500	6.000	1.700	2.000	RSN-84	NL-810	CL-24	XNS-610	TK-00557	S-810	–

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

G-MSBNR/L

Style B / Square / Negative Rake / 15° Lead





Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Seat
G-MSBNR-8-3C	G-MSBNL 8-3C	SNMG-322	0.500	0.500	5.000	1.060	0.500	ISSN-322	NL-34	CL-6	XNS-36	TK-00561	S-34	–
G-MSBNR-10-3C	G-MSBNL-10-3C	SNMG-322	0.625	0.625	5.000	1.060	0.500	ISSN-322	NL-34	CL-6	XNS-36	TK-00561	S-34	–
G-MSBNR-12-3C	G-MSBNL-12-3C	SNMG-322	0.750	0.750	5.000	1.060	0.625	ISSN-322	NL-34	CL-6	XNS-36	TK-00561	S-34	–
G-MSBNR-16-3D	G-MSBNL-16-3D	SNMG-322	1.000	1.000	6.000	1.060	0.875	ISSN-322	NL-34	CL-6	XNS-36	TK-00561	S-34	–
G-MSBNR-12-4C	G-MSBNL-12-4C	SNMG-432	0.750	0.750	5.000	1.410	0.750	ISSN-433	NL-46	CL-9	XNS-59	TK-00558	S-46	ISSN-443
G-MSBNR-16-4D	G-MSBNL-16-4D	SNMG-432	1.000	1.000	6.000	1.410	0.843	ISSN-433	NL-46	CL-9	XNS-59	TK-00558	S-46	ISSN-443
G-MSBNR-85-4D	G-MSBNL-85-4D	SNMG-432	1.000	1.250	6.000	1.410	0.843	ISSN-433	NL-46	CL-9	XNS-59	TK-00558	S-46	ISSN-443
G-MSBNR-20-4D	G-MSBNL-20-4D	SNMG-432	1.250	1.250	6.000	1.410	1.093	ISSN-433	NL-46	CL-9	XNS-59	TK-00558	S-46	ISSN-443
G-MSBNR-16-5D	G-MSBNL-16-5D	SNMG-543	1.000	1.000	6.000	1.560	0.828	SSN-533	NL-58	CL-12	XNS-510	TK-00559	S-58	ISSN-543
G-MSBNR-85-5D	G-MSBNL-85-5D	SNMG-543	1.000	1.250	6.000	1.560	0.828	SSN-533	NL-58	CL-12	XNS-510	TK-00559	S-58	ISSN-543
G-MSBNR-20-5D	G-MSBNL-20-5D	SNMG-543	1.250	1.250	6.000	1.560	1.078	SSN-533	NL-58	CL-12	XNS-510	TK-00559	S-58	ISSN-543
G-MSBNR-24-5D	G-MSBNL-24-5D	SNMG-543	1.500	1.500	6.000	1.560	1.328	SSN-533	NL-58	CL-12	XNS-510	TK-00559	S-58	ISSN-543
G-MSBNR-20-6D	G-MSBNL-20-6D	SNMG-643	1.250	1.250	6.000	1.590	1.031	ISSN-633	NL-68	CL-12	XNS-510	TK-00560	S-68	ISSN-643
G-MSBNR-24-6D	G-MSBNL-24-6D	SNMG-643	1.500	1.500	6.000	1.590	1.281	ISSN-633	NL-68	CL-12	XNS-510	TK-00560	S-68	ISSN-643
G-MSBNR-24-8D	G-MSBNL-24-8D	SNMG-866	1.500	1.500	6.000	1.970	1.250	SSN-844	NL-810	CL-24	XNS-610	TK-00714	S-810	–

* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

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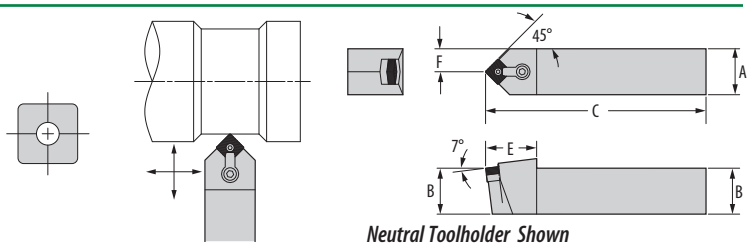
G-MSDNN

Style D / Square / Negative Rake / 45° Lead



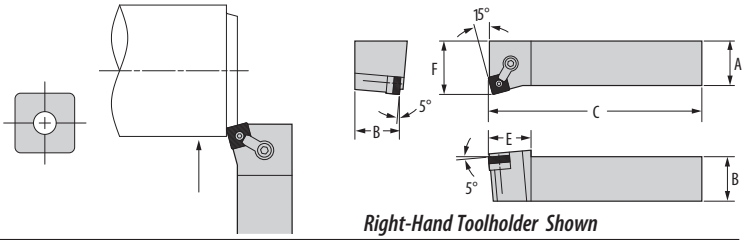
Neutral Toolholder Shown

Part Number	Gage Inserts	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components	
		A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Seat
G-MSDNN-8-3C	SNMG-322	0.500	0.500	5.000	1.140	0.250	ISSN-322	NL-34	CL-6	XNS-36	TK-00561	S-34	–
G-MSDNN-10-3C	SNMG-322	0.625	0.625	5.000	1.140	0.312	ISSN-322	NL-34	CL-6	XNS-36	TK-00561	S-34	–
G-MSDNN-12-3C	SNMG-322	0.750	0.750	5.000	1.140	0.375	ISSN-322	NL-34L	CL-6	XNS-36	TK-00761	S-34	–
G-MSDNN-12-4C	SNMG-432	0.750	0.750	5.000	1.390	0.375	ISSN-433	NL-46	CL-9	XNS-59	TK-00558	S-46	ISSN-443
G-MSDNN-16-4D	SNMG-432	1.000	1.000	6.000	1.390	0.500	ISSN-433	NL-46	CL-9	XNS-59	TK-00558	S-46	ISSN-443
G-MSDNN-85-4D	SNMG-432	1.000	1.250	6.000	1.390	0.500	ISSN-433	NL-46	CL-9	XNS-59	TK-00558	S-46	ISSN-443
G-MSDNN-20-4D	SNMG-432	1.250	1.250	6.000	1.390	0.625	ISSN-433	NL-46	CL-9	XNS-59	TK-00558	S-46	ISSN-443
G-MSDNN-16-5D	SNMG-543	1.000	1.000	6.000	1.610	0.500	SSN-533	NL-58	CL-12	XNS-510	TK-00559	S-58	ISSN-543
G-MSDNN-85-5D	SNMG-543	1.000	1.250	6.000	1.610	0.500	SSN-533	NL-58	CL-12	XNS-510	TK-00559	S-58	ISSN-543
G-MSDNN-86-5D	SNMG-543	1.000	1.500	6.000	1.610	0.500	SSN-533	NL-58	CL-12	XNS-510	TK-00559	S-58	ISSN-543
G-MSDNN-20-5D	SNMG-543	1.250	1.250	6.000	1.610	0.625	SSN-533	NL-58	CL-12	XNS-510	TK-00559	S-58	ISSN-543
G-MSDNN-24-5D	SNMG-543	1.500	1.500	6.000	1.610	0.750	SSN-533	NL-58	CL-12	XNS-510	TK-00559	S-58	ISSN-543
G-MSDNN-85-6D	SNMG-643	1.000	1.250	6.000	1.730	0.500	ISSN-633	NL-68	CL-12	XNS-510	TK-00560	S-68	ISSN-643
G-MSDNN-20-6D	SNMG-643	1.250	1.250	6.000	1.730	0.625	ISSN-633	NL-68	CL-12	XNS-510	TK-00560	S-68	ISSN-643
G-MSDNN-24-6D	SNMG-643	1.500	1.500	6.000	1.730	0.750	ISSN-633	NL-68	CL-12	XNS-510	TK-00560	S-68	ISSN-643
G-MSDNN-24-8D	SNMG-866	1.500	1.500	6.000	2.230	0.750	SSN-844	NL-810	CL-24	XNS-610	TK-00714	S-810	–

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

G-MSKNR/L

Style K / Square / Negative Rake / 15° Lead



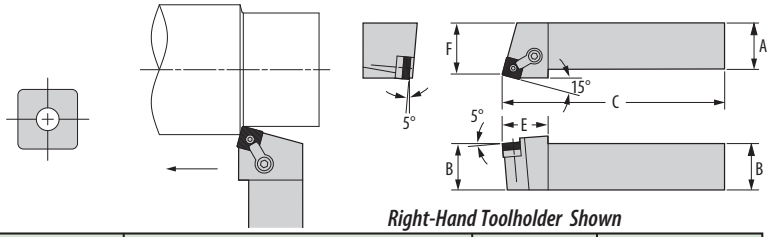
Right-Hand Toolholder Shown

Part Number		Gage Inserts	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand		A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Seat
G-MSKNR-8-3C	G-MSKNL-8-3C	SNMG-322	0.500	0.500	5.000	1.000	0.625	ISSN-322	NL-34	CL-6	XNS-36	TK-00561	S-34	–
G-MSKNR-10-3C	G-MSKNL-10-3C	SNMG-322	0.625	0.625	5.000	1.000	0.750	ISSN-322	NL-34	CL-6	XNS-36	TK-00561	S-34	–
G-MSKNR-12-3C	G-MSKNL-12-3C	SNMG-322	0.750	0.750	5.000	1.000	0.875	ISSN-322	NL-34	CL-6	XNS-36	TK-00561	S-34	–
G-MSKNR-16-3D	G-MSKNL-16-3D	SNMG-322	1.000	1.000	6.000	1.000	1.125	ISSN-322	NL-34	CL-6	XNS-36	TK-00561	S-34	–
G-MSKNR-12-4C	G-MSKNL-12-4C	SNMG-432	0.750	0.750	5.000	1.220	1.000	ISSN-433	NL-46	CL-9	XNS-59	TK-00558	S-46	ISSN-443
G-MSKNR-16-4D	G-MSKNL-16-4D	SNMG-432	1.000	1.000	6.000	1.220	1.250	ISSN-433	NL-46	CL-9	XNS-59	TK-00558	S-46	ISSN-443
G-MSKNR-85-4D	G-MSKNL-85-4D	SNMG-432	1.000	1.250	6.000	1.220	1.250	ISSN-433	NL-46	CL-9	XNS-59	TK-00558	S-46	ISSN-443
G-MSKNR-20-4D	G-MSKNL-20-4D	SNMG-432	1.250	1.250	6.000	1.220	1.500	ISSN-433	NL-46	CL-9	XNS-59	TK-00558	S-46	ISSN-443
G-MSKNR-16-5D	G-MSKNL-16-5D	SNMG-543	1.000	1.000	6.000	1.440	1.250	SSN-533	NL-58	CL-12	XNS-510	TK-00559	S-58	ISSN-543
G-MSKNR-85-5D	G-MSKNL-85-5D	SNMG-543	1.000	1.250	6.000	1.440	1.250	SSN-533	NL-58	CL-12	XNS-510	TK-00559	S-58	ISSN-543
G-MSKNR-20-5D	G-MSKNL-20-5D	SNMG-543	1.250	1.250	6.000	1.440	1.500	SSN-533	NL-58	CL-12	XNS-510	TK-00559	S-58	ISSN-543
G-MSKNR-85-6D	G-MSKNL-85-6D	SNMG-643	1.000	1.250	6.000	1.550	1.250	ISSN-633	NL-68	CL-12	XNS-510	TK-00560	S-68	ISSN-643
G-MSKNR-20-6D	G-MSKNL-20-6D	SNMG-643	1.250	1.250	6.000	1.550	1.500	ISSN-633	NL-68	CL-12	XNS-510	TK-00560	S-68	ISSN-643
G-MSKNR-24-6D	G-MSKNL-24-6D	SNMG-643	1.500	1.500	6.000	1.550	2.000	ISSN-633	NL-68	CL-12	XNS-510	TK-00560	S-68	ISSN-643
G-MSKNR-24-8D	G-MSKNL-24-8D	SNMG-866	1.500	1.500	6.000	1.970	2.000	SSN-844	NL-810	CL-24	XNS-610	TK-00714	S-810	–

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

G-MSRNR/L

Style R / Square / Negative Rake / 15° Lead



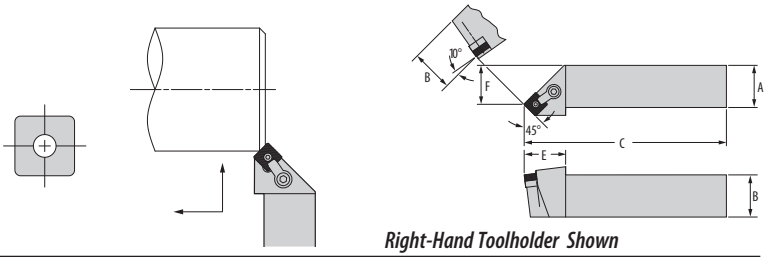
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Filler
G-MSRNR-8-3C	G-MSRNL-8-3C	SNMG-322	0.500	0.500	5.000	1.060	0.656	ISSN-322	NL-34	CL-6	XNS-36	TK-00561	S-34	–
G-MSRNR-10-3C	G-MSRNL-10-3C	SNMG-322	0.625	0.625	5.000	1.060	0.781	ISSN-322	NL-34	CL-6	XNS-36	TK-00561	S-34	–
G-MSRNR-12-3C	G-MSRNL-12-3C	SNMG-322	0.750	0.750	5.000	1.060	0.906	ISSN-322	NL-34L	CL-6	XNS-36	TK-00761	S-34	–
G-MSRNR-12-4C	G-MSRNL-12-4C	SNMG-432	0.750	0.750	5.000	1.240	0.875	ISSN-433	NL-46	CL-9	XNS-59	TK-00558	S-46	ISSN-443
G-MSRNR-16-4D	G-MSRNL-16-4D	SNMG-432	1.000	1.000	6.000	1.240	1.125	ISSN-433	NL-46	CL-9	XNS-59	TK-00558	S-46	ISSN-443
G-MSRNR-85-4D	G-MSRNL-85-4D	SNMG-432	1.000	1.250	6.000	1.240	1.125	ISSN-433	NL-46	CL-9	XNS-59	TK-00558	S-46	ISSN-443
G-MSRNR-20-4D	G-MSRNL-20-4D	SNMG-432	1.250	1.250	6.000	1.240	1.375	ISSN-433	NL-46	CL-9	XNS-59	TK-00558	S-46	ISSN-443
G-MSRNR-16-5D	G-MSRNL-16-5D	SNMG-543	1.000	1.000	6.000	1.470	1.093	SSN-533	NL-58	CL-12	XNS-510	TK-00559	S-58	ISSN-543
G-MSRNR-85-5D	G-MSRNL-85-5D	SNMG-543	1.000	1.250	6.000	1.470	1.093	SSN-533	NL-58	CL-12	XNS-510	TK-00559	S-58	ISSN-543
G-MSRN-20-5D	G-MSRNL-20-5D	SNMG-543	1.250	1.250	6.000	1.470	1.343	SSN-533	NL-58	CL-12	XNS-510	TK-00559	S-58	ISSN-543
G-MSRNR-24-5D	G-MSRNL-24-5D	SNMG-543	1.500	1.500	6.000	1.470	1.843	SSN-533	NL-58	CL-12	XNS-510	TK-00559	S-58	ISSN-543
G-MSRNR-85-6D	G-MSRNL-85-6D	SNMG-643	1.000	1.250	6.000	1.500	1.062	ISSN-633	NL-68	CL-12	XNS-510	TK-00560	S-68	ISSN-643
G-MSRNR-86-6D	G-MSRNL-86-6D	SNMG-643	1.000	1.500	6.000	1.500	1.062	ISSN-633	NL-68	CL-12	XNS-510	TK-00560	S-68	ISSN-643
G-MSRNR-20-6D	G-MSRNL-20-6D	SNMG-643	1.250	1.250	6.000	1.500	1.312	ISSN-633	NL-68	CL-12	XNS-510	TK-00560	S-68	ISSN-643
G-MSRNR-24-6D	G-MSRNL-24-6D	SNMG-643	1.500	1.500	6.000	1.500	1.812	ISSN-633	NL-68	CL-12	XNS-510	TK-00560	S-68	ISSN-643
G-MSRNR-24-8D	G-MSRNL-24-8D	SNMG-866	1.500	1.500	6.000	1.630	1.765	SSN-844	NL-810	CL-24	XNS-610	TK-00714	S-810	–

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

G-MSSNR/L

Style S / Square / Negative Rake / 45° Lead



Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Filler
G-MSSNR-12-4C	G-MSSNL-12-4C	SNMG-432	0.750	0.750	5.000	1.230	0.656	ISSN-433	NL-46	CL-9	XNS-59	TK-00558	S-46	ISSN-443
G-MSSNR-16-4D	G-MSSNL-16-4D	SNMG-432	1.000	1.000	6.000	1.230	0.906	ISSN-433	NL-46	CL-9	XNS-59	TK-00558	S-46	ISSN-443
G-MSSNR-85-4D	G-MSSNL-85-4D	SNMG-432	1.000	1.250	6.000	1.230	0.906	ISSN-433	NL-46	CL-9	XNS-59	TK-00558	S-46	ISSN-443
G-MSSNR-20-4D	G-MSSNL-20-4D	SNMG-432	1.250	1.250	6.000	1.230	1.156	ISSN-433	NL-46	CL-9	XNS-59	TK-00558	S-46	ISSN-443
G-MSSNR-16-5D	G-MSSNL-16-5D	SNMG-543	1.000	1.000	6.000	1.380	0.828	SSN-533	NL-58	CL-9	XNS-510	TK-00562	S-58	ISSN-543
G-MSSNR-85-5D	G-MSSNL-85-5D	SNMG-543	1.000	1.250	6.000	1.380	0.828	SSN-533	NL-58	CL-9	XNS-510	TK-00562	S-58	ISSN-543
G-MSSNR-86-5D	G-MSSNL-86-5D	SNMG-543	1.000	1.500	6.000	1.380	0.828	SSN-533	NL-58	CL-9	XNS-510	TK-00562	S-58	ISSN-543
G-MSSNR-20-5D	G-MSSNL-20-5D	SNMG-543	1.250	1.250	6.000	1.380	1.078	SSN-533	NL-58	CL-9	XNS-510	TK-00562	S-58	ISSN-543
G-MSSNR-24-5D	G-MSSNL-24-5D	SNMG-543	1.500	1.500	6.000	1.380	1.328	SSN-533	NL-58	CL-9	XNS-510	TK-00562	S-58	ISSN-543
G-MSSNR-85-6D	G-MSSNL-85-6D	SNMG-643	1.000	1.250	6.000	1.480	0.750	ISSN-633	NL-68	CL-9	XNS-510	TK-00563	S-68	ISSN-643
G-MSSNR-86-6D	G-MSSNL-86-6D	SNMG-643	1.000	1.500	6.000	1.480	0.750	ISSN-633	NL-68	CL-9	XNS-510	TK-00563	S-68	ISSN-643
G-MSSNR-20-6D	G-MSSNL-20-6D	SNMG-643	1.250	1.250	6.000	1.480	1.000	ISSN-633	NL-68	CL-9	XNS-510	TK-00563	S-68	ISSN-643
G-MSSNR-24-6D	G-MSSNL-24-6D	SNMG-643	1.500	1.500	6.000	1.480	1.500	ISSN-633	NL-68	CL-9	XNS-510	TK-00563	S-68	ISSN-643

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

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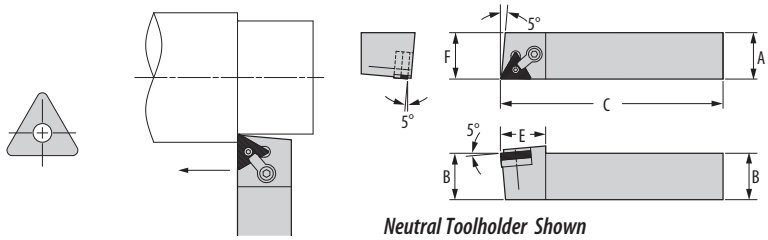
G-MTANR/L

Style A / Triangle / Negative Rake / 0° Lead



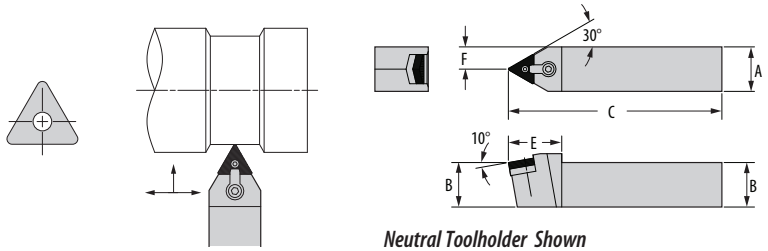
Neutral Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Filler
G-MTANR-8-2C	G-MTANL-8-2C	TNMG-221	0.500	0.500	5.000	0.970	0.500	–	NL-23	CL-19	XNS-36	TK-00742	–	–
G-MTANR-10-2C	G-MTANL-10-2C	TNMG-221	0.625	0.625	5.000	0.970	0.625	–	NL-23	CL-19	XNS-36	TK-00742	–	–
G-MTANR-10-3C	G-MTANL-10-3C	TNMG-322	0.625	0.625	5.000	1.120	0.625	ITSN-333	NL-34L	CL-6	XNS-36	TK-00564	S-34	ITSN-323
G-MTANR-12-3C	G-MTANL-12-3C	TNMG-322	0.750	0.750	5.000	1.120	0.750	ITSN-333	NL-34L	CL-6	XNS-36	TK-00564	S-34	ITSN-323
G-MTANR-16-3D	G-MTANL-16-3D	TNMG-322	1.000	1.000	6.000	1.120	1.000	ITSN-333	NL-34L	CL-6	XNS-36	TK-00564	S-34	ITSN-323
G-MTANR-85-3D	G-MTANL-85-3D	TNMG-322	1.000	1.250	6.000	1.120	1.000	ITSN-333	NL-34L	CL-6	XNS-36	TK-00564	S-34	ITSN-323
G-MTANR-16-4D	G-MTANL-16-4D	TNMG-432	1.000	1.000	6.000	1.220	1.000	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	TS-424**
G-MTANR-85-4D	G-MTANL-85-4D	TNMG-432	1.000	1.250	6.000	1.220	1.000	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	TS-424**
G-MTANR-20-4D	G-MTANL-20-4D	TNMG-432	1.250	1.250	6.000	1.220	1.250	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	TS-424**
G-MTANR-24-4D	G-MTANL-24-4D	TNMG-432	1.500	1.500	6.000	1.220	1.500	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	TS-424**
G-MTANR-16-5D	G-MTANL-16-5D	TNMG-543	1.000	1.000	6.000	1.450	1.000	ITSN-533	NL-58	CL-9	XNS-510	TK-00566	S-58	ITSN-543
G-MTANR-85-5D	G-MTANL-85-5D	TNMG-543	1.000	1.250	6.000	1.450	1.000	ITSN-533	NL-58	CL-9	XNS-510	TK-00566	S-58	ITSN-543
G-MTANR-86-5D	G-MTANL-86-5D	TNMG-543	1.000	1.500	6.000	1.450	1.000	ITSN-533	NL-58	CL-9	XNS-510	TK-00566	S-58	ITSN-543
G-MTANR-20-5D	G-MTANL-20-5D	TNMG-543	1.250	1.250	6.000	1.450	1.250	ITSN-533	NL-58	CL-9	XNS-510	TK-00566	S-58	ITSN-543
G-MTANR-24-5D	G-MTANL-24-5D	TNMG-543	1.500	1.500	6.000	1.450	1.500	ITSN-533	NL-58	CL-9	XNS-510	TK-00566	S-58	ITSN-543
G-MTANR-24-6D	G-MTANL-24-6D	TNMG-663	1.500	1.500	6.000	1.480	1.500	TSN-637	NL-68L	CL-12	XNS-510	TK-00567	S-68	TSN-657

* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*
** *Cannot be used with lock pin.*

G-MTENNS

Style E / Triangle / Negative Rake / 30° Lead



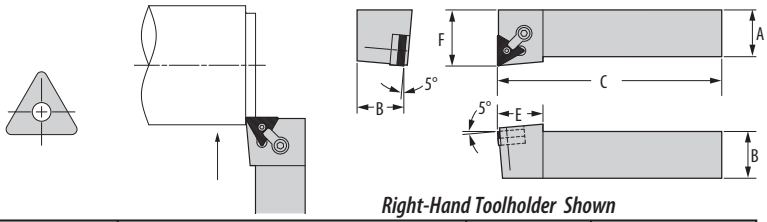
Neutral Toolholder Shown

Part Number	Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components	
	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Filler
G-MTENNS-8-2C	TNMG-221	0.500	0.500	5.000	1.000	0.250	–	NL-23	CL-6	XNS-36	TK-00716	–	–
G-MTENNS-10-2C	TNMG-221	0.625	0.625	5.000	1.000	0.312	–	NL-23	CL-6	XNS-36	TK-00716	–	–
G-MTENNS-10-3C	TNMG-322	0.625	0.625	5.000	1.160	0.312	ITSN-333	NL-34L	CL-6	XNS-36	TK-00564	S-34	ITSN-323
G-MTENNS-12-3C	TNMG-322	0.750	0.750	5.000	1.160	0.375	ITSN-333	NL-34L	CL-6	XNS-36	TK-00564	S-34	ITSN-323
G-MTENNS-16-3D	TNMG-322	1.000	1.000	6.000	1.160	0.500	ITSN-333	NL-34L	CL-6	XNS-36	TK-00564	S-34	ITSN-323
G-MTENNS-85-3D	TNMG-322	1.000	1.250	6.000	1.160	0.500	ITSN-333	NL-34L	CL-6	XNS-36	TK-00564	S-34	ITSN-323
G-MTENNS-12-4C	TNMG-432	0.750	0.750	5.000	1.500	0.375	ITSN-433	NL-46	CL-9	XNS-59	TK-00725	S-46	–
G-MTENNS-16-4D	TNMG-432	1.000	1.000	6.000	1.500	0.500	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	–
G-MTENNS-85-4D	TNMG-432	1.000	1.250	6.000	1.500	0.500	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	–
G-MTENNS-86-4D	TNMG-432	1.000	1.500	6.000	1.500	0.500	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	–
G-MTENNS-20-4D	TNMG-432	1.250	1.250	6.000	1.500	0.625	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	–
G-MTENNS-20-5D	TNMG-543	1.250	1.250	6.000	1.640	0.625	ITSN-533	NL-58	CL-9	XNS-510	TK-00566	S-58	–
G-MTENNS-24-5D	TNMG-543	1.500	1.500	6.000	1.640	0.750	ITSN-533	NL-58	CL-9	XNS-510	TK-00566	S-58	–
G-MTENNS-24-6D	TNMG-663	1.500	1.500	6.000	1.950	0.750	TSN-637	NL-68L	CL-12	XNS-510	TK-00567	S-68	–

* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

G-MTFNR/L

Style F / Triangle / Negative Rake / 0° Lead



Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Filler
G-MTFNR-8-2C	G-MTFNL-8-2C	TNMG-221	0.500	0.500	5.000	0.810	0.750	–	NL-23	CL-19	XNS-36	TK-00742	–	–
G-MTFNR-10-2C	G-MTFNL-10-2C	TNMG-221	0.625	0.625	5.000	0.810	0.875	–	NL-23	CL-19	XNS-36	TK-00742	–	–
G-MTFNR-10-3C	G-MTFNL-10-3C	TNMG-322	0.625	0.625	5.000	0.940	0.875	ITSN-333	NL-34L	CL-6	XNS-36	TK-00564	S-34	ITSN-323
G-MTFNR-12-3C	G-MTFNL-12-3C	TNMG-322	0.750	0.750	5.000	0.940	1.000	ITSN-333	NL-34L	CL-6	XNS-36	TK-00564	S-34	ITSN-323
G-MTFNR-16-3D	G-MTFNL-16-3D	TNMG-322	1.000	1.000	6.000	0.940	1.250	ITSN-333	NL-34L	CL-6	XNS-36	TK-00564	S-34	ITSN-323
G-MTFNR-85-3D	G-MTFNL-85-3D	TNMG-322	1.000	1.250	6.000	0.940	1.250	ITSN-333	NL-34L	CL-6	XNS-36	TK-00564	S-34	ITSN-323
G-MTFNR-20-3D	G-MTFNL-20-3D	TNMG-322	1.250	1.250	6.000	0.940	1.500	ITSN-333	NL-34L	CL-6	XNS-36	TK-00564	S-34	ITSN-323
G-MTFNR-16-4D	G-MTFNL-16-4D	TNMG-432	1.000	1.000	6.000	1.220	1.250	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	TS-424**
G-MTFNR-85-4D	G-MTFNL-85-4D	TNMG-432	1.000	1.250	6.000	1.220	1.250	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	TS-424**
G-MTFNR-86-4D	G-MTFNL-86-4D	TNMG-432	1.000	1.500	6.000	1.220	1.250	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	TS-424**
G-MTFNR-20-4D	G-MTFNL-20-4D	TNMG-432	1.250	1.250	6.000	1.220	1.500	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	TS-424**
G-MTFNR-24-4D	G-MTFNL-24-4D	TNMG-432	1.500	1.500	6.000	1.220	2.000	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	TS-424**
G-MTFNR-16-5D	G-MTFNL-16-5D	TNMG-543	1.000	1.000	6.000	1.440	1.250	ITSN-533	NL-58	CL-12	XNS-510	TK-00569	S-58	ITSN-543
G-MTFNR-85-5D	G-MTFNL-85-5D	TNMG-543	1.000	1.250	6.000	1.440	1.250	ITSN-533	NL-58	CL-12	XNS-510	TK-00569	S-58	ITSN-543
G-MTFNR-86-5D	G-MTFNL-86-5D	TNMG-543	1.000	1.500	6.000	1.440	1.250	ITSN-533	NL-58	CL-12	XNS-510	TK-00569	S-58	ITSN-543
G-MTFNR-20-5D	G-MTFNL-20-5D	TNMG-543	1.250	1.250	6.000	1.440	1.500	ITSN-533	NL-58	CL-12	XNS-510	TK-00569	S-58	ITSN-543
G-MTFNR-24-5D	G-MTFNL-24-5D	TNMG-543	1.500	1.500	6.000	1.440	2.000	ITSN-533	NL-58	CL-12	XNS-510	TK-00569	S-58	ITSN-543
G-MTFNR-24-6D	G-MTFNL-24-6D	TNMG-663	1.500	1.500	6.000	1.500	2.000	TSN-637	NL-68L	CL-12	XNS-510	TK-00567	S-68	TSN-657

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

*** Cannot be used with lock pin.*

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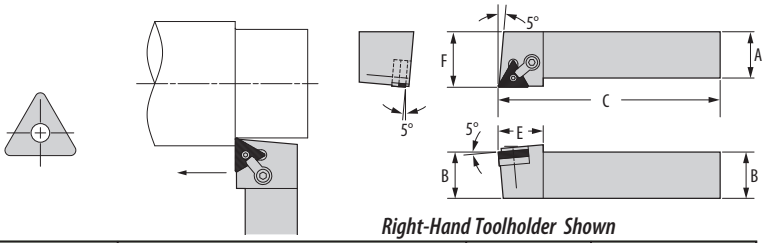
G-MTGNR/L

Style G / Triangle / Negative Rake / 0° Lead



Right-Hand Toolholder Shown

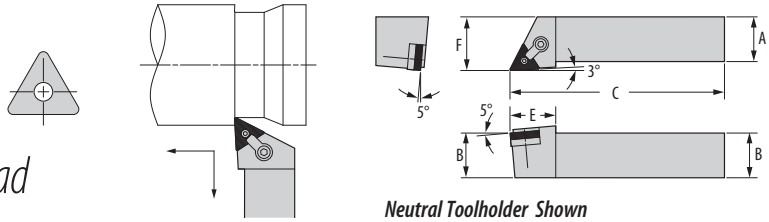
Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Filler
G-MTGNR-8-2C	G-MTGNL-8-2C	TNMG-221	0.500	0.500	5.000	0.970	0.625	–	NL-23	CL-19	XNS-36	TK-00742	–	–
G-MTGNR-10-2C	G-MTGNL-10-2C	TNMG-221	0.625	0.625	5.000	0.970	0.750	–	NL-23	CL-19	XNS-36	TK-00742	–	–
G-MTGNR-10-3C	G-MTGNL-10-3C	TNMG-322	0.625	0.625	5.000	1.110	0.875	ITSN-333	NL-34L	CL-6	XNS-36	TK-00564	S-34	ITSN-323
G-MTGNR-12-3C	G-MTGNL-12-3C	TNMG-322	0.750	0.750	5.000	1.110	1.000	ITSN-333	NL-34L	CL-6	XNS-36	TK-00564	S-34	ITSN-323
G-MTGNR-16-3D	G-MTGNL-16-3D	TNMG-322	1.000	1.000	6.000	1.110	1.250	ITSN-333	NL-34L	CL-6	XNS-36	TK-00564	S-34	ITSN-323
G-MTGNR-85-3D	G-MTGNL-85-3D	TNMG-322	1.000	1.250	6.000	1.110	1.250	ITSN-333	NL-34L	CL-6	XNS-36	TK-00564	S-34	ITSN-323
G-MTGNR-20-3D	G-MTGNL-20-3D	TNMG-322	1.250	1.250	6.000	1.110	1.500	ITSN-333	NL-34L	CL-6	XNS-36	TK-00564	S-34	ITSN-323
G-MTGNR-12-4C	G-MTGNL-12-4C	TNMG-432	0.750	0.750	5.000	1.220	1.000	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	TS-424**
G-MTGNR-16-4D	G-MTGNL-16-4D	TNMG-432	1.000	1.000	6.000	1.220	1.250	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	TS-424**
G-MTGNR-85-4D	G-MTGNL-85-4D	TNMG-432	1.000	1.250	6.000	1.220	1.250	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	TS-424**
G-MTGNR-86-4D	G-MTGNL-86-4D	TNMG-432	1.000	1.500	6.000	1.220	1.250	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	TS-424**
G-MTGNR-20-4D	G-MTGNL-20-4D	TNMG-432	1.250	1.250	6.000	1.220	1.500	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	TS-424**
G-MTGNR-24-4D	G-MTGNL-24-4D	TNMG-432	1.500	1.500	6.000	1.220	2.000	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	TS-424**
G-MTGNR-16-5D	G-MTGNL-16-5D	TNMG-543	1.000	1.000	6.000	1.440	1.250	ITSN-533	NL-58	CL-9	XNS-510	TK-00566	S-58	ITSN-543
G-MTGNR-85-5D	G-MTGNL-85-5D	TNMG-543	1.000	1.250	6.000	1.440	1.250	ITSN-533	NL-58	CL-9	XNS-510	TK-00566	S-58	ITSN-543
G-MTGNR-86-5D	G-MTGNL-86-5D	TNMG-543	1.000	1.500	6.000	1.440	1.250	ITSN-533	NL-58	CL-9	XNS-510	TK-00566	S-58	ITSN-543
G-MTGNR-20-5D	G-MTGNL-20-5D	TNMG-543	1.250	1.250	6.000	1.440	1.500	ITSN-533	NL-58	CL-9	XNS-510	TK-00566	S-58	ITSN-543
G-MTGNR-24-5D	G-MTGNL-24-5D	TNMG-543	1.500	1.500	6.000	1.440	2.000	ITSN-533	NL-58	CL-9	XNS-510	TK-00566	S-58	ITSN-543
G-MTGNR-24-6D	G-MTGNL-24-6D	TNMG-663	1.500	1.500	6.000	1.500	2.000	TSN-637	NL-68L	CL-12	XNS-510	TK-00567	S-68	TSN-657

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

*** Cannot be used with lock pin.*

G-MTJNRS

Style J / Triangle / Negative Rake / 3° Reverse Lead



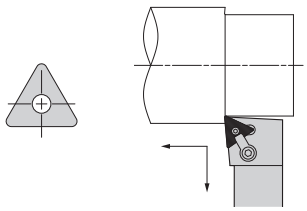
Neutral Toolholder Shown

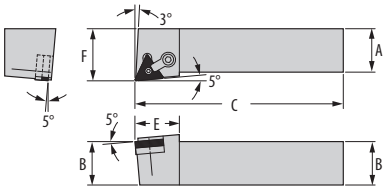
Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Filler
G-MTJNRS-12-3C	G-MTJNLS-12-3C	TNMG-322	0.750	0.750	5.000	1.120	1.000	ITSN-333	NL-34L	CL-6	XNS-36	TK-00564	S-34	ITSN-323
G-MTJNRS-16-3D	G-MTJNLS-16-3D	TNMG-322	1.000	1.000	6.000	1.120	1.250	ITSN-333	NL-34L	CL-6	XNS-36	TK-00564	S-34	ITSN-323
G-MTJNRS-16-4D	G-MTJNLS-16-4D	TNMG-432	1.000	1.000	6.000	1.190	1.250	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	–
G-MTJNRS-85-4D	G-MTJNLS-85-4D	TNMG-432	1.000	1.250	6.000	1.190	1.250	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	–
G-MTJNRS-86-4D	G-MTJNLS-86-4D	TNMG-432	1.000	1.500	6.000	1.190	1.250	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	–
G-MTJNRS-20-4D	G-MTJNLS-20-4D	TNMG-432	1.250	1.250	6.000	1.190	1.500	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	–
G-MTJNRS-86-5D	G-MTJNLS-86-5D	TNMG-543	1.000	1.500	6.000	1.440	1.250	ITSN-533	NL-58	CL-9	XNS-510	TK-00566	S-58	–
G-MTJNRS-20-5D	G-MTJNLS-20-5D	TNMG-543	1.250	1.250	6.000	1.440	1.500	ITSN-533	NL-58	CL-9	XNS-510	TK-00566	S-58	–
G-MTJNRS-24-5D	G-MTJNLS-24-5D	TNMG-543	1.500	1.500	6.000	1.440	2.000	ITSN-533	NL-58	CL-9	XNS-510	TK-00566	S-58	–
G-MTJNRS-24-6D	G-MTJNLS-24-6D	TNMG-663	1.500	1.500	6.000	1.670	2.000	TSN-637	NL-68L	CL-12	XNS-510	TK-00567	S-68	–

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

G-MTLNR/L

Style L / Triangle / Negative Rake / 5° Lead





Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Filler
G-MTLNR 16-4D	G-MTLNL 16-4D	TNMG-432	1.000	1.000	6	1.280	1.250	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	TS-424**
G-MTLNR 85-4D	G-MTLNL 85-4D	TNMG-432	1.000	1.250	6	1.280	1.250	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	TS-424**
G-MTLNR 20-4D	G-MTLNL 20-4D	TNMG-432	1.250	1.250	6	1.280	1.500	ITSN-433	NL-46	CL-9	XNS-510	TK-00565	S-46	TS-424**
G-MTLNR 20-5D	G-MTLNL 20-5D	TNMG-543	1.250	1.250	6	1.410	1.500	ITSN-533	NL-58	CL-9	XNS-510	TK-00566	S-58	ITSN-543
G-MTLNR 24-5D	G-MTLNL 24-5D	TNMG-543	1.500	1.500	6	1.410	2.000	ITSN-533	NL-58	CL-9	XNS-510	TK-00566	S-58	ITSN-543
G-MTLNR 24-6D	G-MTLNL 24-6D	TNMG-663	1.500	1.500	6	1.530	2.000	TSN-637	NL-68L	CL-12	XNS-510	TK-00567	S-68	TSN-657

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

*** Cannot be used with lock pin.*

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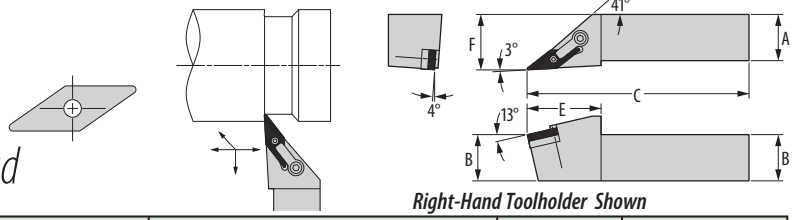
G-MVJNR/L

Style J / 35° Diamond / Negative Rake / 3° Lead



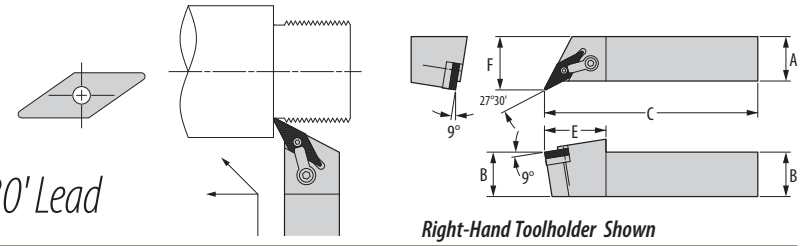
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Component
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw
G-MVJNR-12-3C	G-MVJNL-12-3C	VNMG-332	0.750	0.750	5.000	1.680	1.000	IVSN-322	NL-34L	CL-30	XNS-510	TK-00570	S-34
G-MVJNR-16-3D	G-MVJNL-16-3D	VNMG-332	1.000	1.000	6.000	1.680	1.250	IVSN-322	NL-34L	CL-30	XNS-510	TK-00570	S-34
G-MVJNR-85-3D	G-MVJNL-85-3D	VNMG-332	1.000	1.250	6.000	1.680	1.250	IVSN-322	NL-34L	CL-30	XNS-510	TK-00570	S-34
G-MVJNR-86-3D	G-MVJNL-86-3D	VNMG-332	1.000	1.500	6.000	1.680	1.250	IVSN-322	NL-34L	CL-30	XNS-510	TK-00570	S-34
G-MVJNR-20-3D	G-MVJNL-20-3D	VNMG-332	1.250	1.250	6.000	1.680	1.500	IVSN-322	NL-34L	CL-30	XNS-510	TK-00570	S-34
G-MVJNR-24-3D	G-MVJNL-24-3D	VNMG-332	1.500	1.500	6.000	1.680	2.000	IVSN-322	NL-34L	CL-30	XNS-510	TK-00570	S-34
G-MVJNR-16-4D	G-MVJNL-16-4D	VNMG-432	1.000	1.000	6.000	2.000	1.250	IVSN-433	NL-46	CL-30	XNS-510	TK-00571	S-46
G-MVJNR-86-4D	G-MVJNL-86-4D	VNMG-432	1.000	1.500	6.000	2.000	1.250	IVSN-433	NL-46	CL-30	XNS-510	TK-00570	S-46
G-MVJNR-20-4D	G-MVJNL-20-4D	VNMG-432	1.250	1.250	6.000	2.000	1.500	IVSN-433	NL-46	CL-30	XNS-510	TK-00569	S-46
G-MVJNR-24-4D	G-MVJNL-24-4D	VNMG-432	1.500	1.500	6.000	2.000	2.000	IVSN-433	NL-46	CL-30	XNS-510	TK-00568	S-46

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

G-MVTNR/L

Style T / 35° Diamond / Negative Rake / 27° 30' Lead



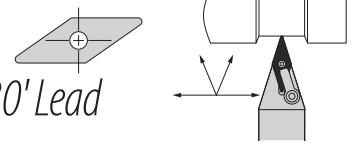
Right-Hand Toolholder Shown

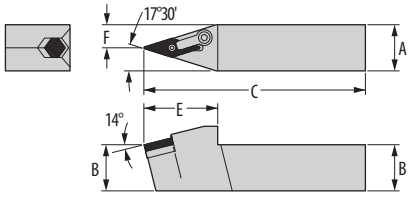
Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Component
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw
G-MVTNR-12-3C	G-MVTNL-12-3C	VNMG-332	0.750	0.750	5.000	1.730	1.000	IVSN-322	NL-34L	CL-30	XNS-510	TK-00570	S-34
G-MVTNR-16-3D	G-MVTNL-16-3D	VNMG-332	1.000	1.000	6.000	1.730	1.250	IVSN-322	NL-34L	CL-30	XNS-510	TK-00570	S-34
G-MVTNR-85-3D	G-MVTNL-85-3D	VNMG-332	1.000	1.250	6.000	1.730	1.250	IVSN-322	NL-34L	CL-30	XNS-510	TK-00570	S-34
G-MVTNR-86-3D	G-MVTNL-86-3D	VNMG-332	1.000	1.500	6.000	1.730	1.250	IVSN-322	NL-34L	CL-30	XNS-510	TK-00570	S-34
G-MVTNR-20-3D	G-MVTNL-20-3D	VNMG-332	1.250	1.250	6.000	1.730	1.500	IVSN-322	NL-34L	CL-30	XNS-510	TK-00570	S-34
G-MVTNR-24-3D	G-MVTNL-24-3D	VNMG-332	1.500	1.500	6.000	1.730	1.750	IVSN-322	NL-34L	CL-30	XNS-510	TK-00570	S-34

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

G-MVVNN

Style V / 35° Diamond / Negative Rake / 17° 30' Lead





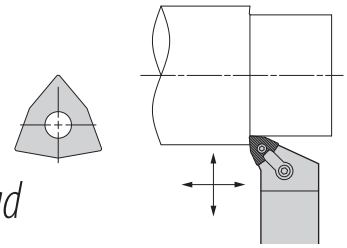
Neutral Toolholder Shown

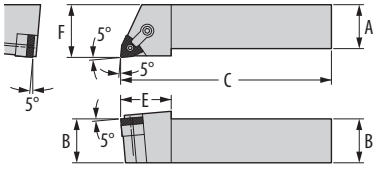
Part Number	Gage Inserts	Dimensions (inches) A	B	C	E	F	Standard Components Seat	Lock Pin	Clamp	Clamp Screw	*Tune-Up Kit	Optional Component Seat Screw
G-MVVNN-12-3C	VNMG-332	0.750	0.750	5.000	1.750	0.375	IVSN-322	NL-34L	CL-30	XNS-510	TK-00570	S-34
G-MVVNN-16-3D	VNMG-332	1.000	1.000	6.000	1.750	0.500	IVSN-322	NL-34L	CL-30	XNS-510	TK-00570	S-34
G-MVVNN-85-3D	VNMG-332	1.000	1.250	6.000	1.750	0.500	IVSN-322	NL-34L	CL-30	XNS-510	TK-00570	S-34
G-MVVNN-86-3D	VNMG-332	1.000	1.500	6.000	1.750	0.500	IVSN-322	NL-34L	CL-30	XNS-510	TK-00570	S-34
G-MVVNN-20-3D	VNMG-332	1.250	1.250	6.000	1.750	0.625	IVSN-322	NL-34L	CL-30	XNS-510	TK-00570	S-34
G-MVVNN-24-3D	VNMG-332	1.500	1.500	6.000	1.750	0.750	IVSN-322	NL-34L	CL-30	XNS-510	TK-00570	S-34
G-MVVNN-16-4D	VNMG-432	1.000	1.000	6.000	2.120	0.500	IVSN-433	NL-46	CL-30	XNS-510	TK-00571	S-46
G-MVVNN-20-4D	VNMG-432	1.250	1.250	6.000	2.120	0.625	IVSN-433	NL-46	CL-30	XNS-510	TK-00571	S-46
G-MVVNN-24-4D	VNMG-432	1.500	1.500	6.000	2.120	0.750	IVSN-433	NL-46	CL-30	XNS-510	TK-00571	S-46

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

G-MWLNR/L

Style L / Trigon / Negative Rake / 5° Reverse Lead





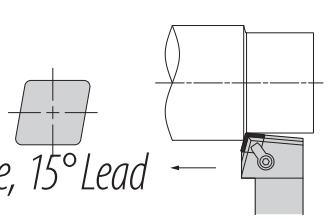
Right-Hand Toolholder Shown

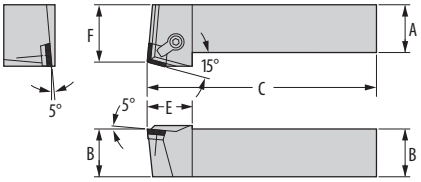
Part Number Right Hand	Part Number Left Hand	Gage Inserts	Dimensions (inches) A	B	C	E	F	Standard Components Seat	Lock Pin	Clamp	Clamp Screw	*Tune-Up Kit	Optional Component Seat Screw
G-MWLNR-12-3C	G-MWLNL-12-3C	WNMG-332	0.750	0.750	5.000	1.000	1.000	IWSN-323	NL-34L	CL-6	XNS-36	TK-00775	IWSN-332
G-MWLNR-16-3D	G-MWLNL-16-3D	WNMG-332	1.000	1.000	6.000	1.000	1.250	IWSN-323	NL-34L	CL-6	XNS-36	TK-00775	IWSN-332
G-MWLNR-20-3D	G-MWLNL-20-3D	WNMG-332	1.250	1.250	6.000	1.000	1.500	IWSN-323	NL-34L	CL-6	XNS-36	TK-00775	IWSN-332
G-MWLNR-24-3D	G-MWLNL-24-3D	WNMG-332	1.500	1.500	6.000	1.000	2.000	IWSN-323	NL-34L	CL-6	XNS-36	TK-00775	IWSN-332
G-MWLNR-12-4C	G-MWLNL-12-4C	WNMG-432	0.750	0.750	5.000	1.188	1.000	IWSN-433	NL-46	CL-20	XNS-48	TK-00759	–
G-MWLNR-16-4D	G-MWLNL-16-4D	WNMG-432	1.000	1.000	6.000	1.188	1.250	IWSN-433	NL-46	CL-20	XNS-48	TK-00759	–
G-MWLNR-20-4D	G-MWLNL-20-4D	WNMG-432	1.250	1.250	6.000	1.188	1.500	IWSN-433	NL-46	CL-20	XNS-48	TK-00759	–
G-MWLNR-24-4D	G-MWLNL-24-4D	WNMG-432	1.500	1.500	6.000	1.188	2.000	IWSN-433	NL-46	CL-20	XNS-48	TK-00759	–

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

G-CCRPR/L

Style R / 80° Diamond (Using 100° Corner) / Positive Rake, 15° Lead





Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components					*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Seat Screw	Clamp	Clamp Screw	Chip Breaker	Includes all Standard Components
G-CCRPR-12-4C	G-CCRPL-12-4C	CPGN-422	0.750	0.750	5.000	1.220	1.000	CSP-422	#4-40 x 3/8 FHCS	CL-9	XNS-59	CBDC-415L	TK-00720
G-CCRPR-16-4D	G-CCRPL-16-4D	CPGN-422	1.000	1.000	6.000	1.220	1.250	CSP-422	#4-40 x 3/8 FHCS	CL-9	XNS-59	CBDC-415L	TK-00720
G-CCRPR-85-4D	G-CCRPL-85-4D	CPGN-422	1.000	1.250	6.000	1.220	1.250	CSP-422	#4-40 x 3/8 FHCS	CL-9	XNS-59	CBDC-415L	TK-00720
G-CCRPR-20-4D	G-CCRPL-20-4D	CPGN-422	1.250	1.250	6.000	1.220	1.500	CSP-422	#4-40 x 3/8 FHCS	CL-9	XNS-59	CBDC-415L	TK-00720
G-CCRPR-24-4D	G-CCRPL-24-4D	CPGN-422	1.500	1.500	6.000	1.220	2.000	CSP-422	#4-40 x 3/8 FHCS	CL-9	XNS-59	CBDC-415L	TK-00720
G-CCRPR-16-6D	G-CCRPL-16-6D	CPGN-633	1.000	1.000	6.000	1.310	1.250	CSP-632	#5-40 x 3/8 FHCS	CL-12	XNS-510	CBDC-615G	TK-00533
G-CCRPR-85-6D	G-CCRPL-85-6D	CPGN-633	1.000	1.250	6.000	1.310	1.250	CSP-632	#5-40 x 3/8 FHCS	CL-12	XNS-510	CBDC-615G	TK-00533
G-CCRPR-86-6D	G-CCRPL-86-6D	CPGN-633	1.000	1.500	6.000	1.310	1.250	CSP-632	#5-40 x 3/8 FHCS	CL-12	XNS-510	CBDC-615G	TK-00533
G-CCRPR-20-6D	G-CCRPL-20-6D	CPGN-633	1.250	1.250	6.000	1.310	1.500	CSP-632	#5-40 x 3/8 FHCS	CL-12	XNS-510	CBDC-615G	TK-00533
G-CCRPR-24-6D	G-CCRPL-24-6D	CPGN-633	1.500	1.500	6.000	1.310	2.000	CSP-632	#5-40 x 3/8 FHCS	CL-12	XNS-510	CBDC-615G	TK-00533

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

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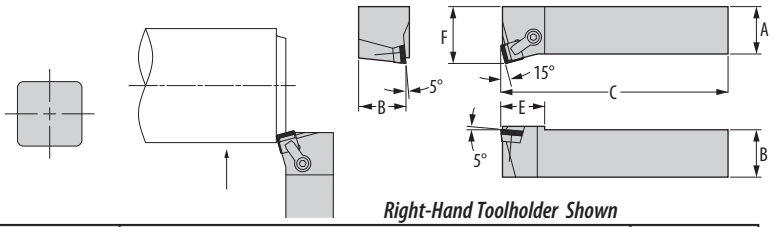
G-CSKPR/L

Style K / Square / Positive Rake / 15° Lead



Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components					*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Seat Screw	Clamp	Clamp Screw	Chip Breaker	Includes all Standard Components
G-CSKPR-12-4C	G-CSKPL-12-4C	SPGN-422	0.750	0.750	5.000	1.120	1.000	SP-40	#6-32 x 1/2 FHCS	CL-12	XNS-58	CBS-4G	TK-00712
G-CSKPR-16-4D	G-CSKPL-16-4D	SPGN-422	1.000	1.000	6.000	1.120	1.250	SP-40	#6-32 x 1/2 FHCS	CL-12	XNS-58	CBS-4G	TK-00712
G-CSKPR-85-4D	G-CSKPL-85-4D	SPGN-422	1.000	1.250	6.000	1.120	1.250	SP-40	#6-32 x 1/2 FHCS	CL-12	XNS-510	CBS-4G	TK-00753
G-CSKPR-20-4D	G-CSKPL-20-4D	SPGN-422	1.250	1.250	6.000	1.120	1.500	SP-40	#6-32 x 1/2 FHCS	CL-12	XNS-510	CBS-4G	TK-00753
G-CSKPR-24-4D	G-CSKPL-24-4D	SPGN-422	1.500	1.500	6.000	1.120	2.000	SP-40	#6-32 x 1/2 FHCS	CL-12	XNS-510	CBS-4G	TK-00753
G-CSKPR-16-6D	G-CSKPL-16-6D	SPGN 633	1.000	1.000	6.000	1.500	1.250	SP-60	#10-32 x 1/2 FHCS	CL-30	XNS-510	CBS-6G	TK-00534
G-CSKPR-85-6D	G-CSKPL-85-6D	SPGN 633	1.000	1.250	6.000	1.500	1.250	SP-60	#10-32 x 1/2 FHCS	CL-30	XNS-510	CBS-6G	TK-00534
G-CSKPR-86-6D	G-CSKPL-86-6D	SPGN 633	1.000	1.500	6.000	1.500	1.250	SP-60	#10-32 x 1/2 FHCS	CL-30	XNS-510	CBS-6G	TK-00534
G-CSKPR-20-6D	G-CSKPL-20-6D	SPGN 633	1.250	1.250	6.000	1.500	1.500	SP-60	#10-32 x 1/2 FHCS	CL-30	XNS-510	CBS-6G	TK-00534
G-CSKPR-24-6D	G-CSKPL-24-6D	SPGN 633	1.500	1.500	6.000	1.500	2.000	SP-60	#10-32 x 1/2 FHCS	CL-30	XNS-510	CBS-6G	TK-00534

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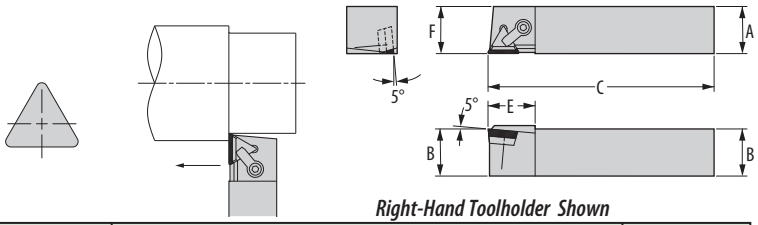
G-CTAPR/L

Style A / Triangle / Positive Rake / 0° Lead



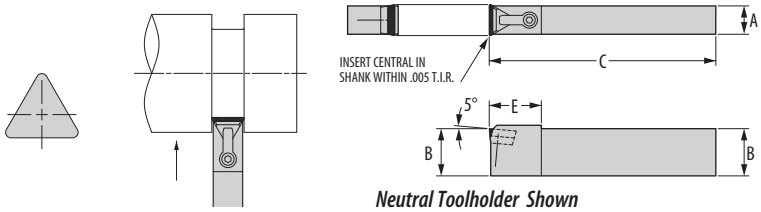
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components					*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Seat Screw	Clamp	Clamp Screw	Chip Breaker	Includes all Standard Components
G-CTAPR-12-3C	G-CTAPL-12-3C	TPGN-322	0.750	0.750	5.000	1.000	0.750	TSP-321	#4-40 x 3/8 FHCS	CL-7	XNS-36	CBT-3G	TK-00538
G-CTAPR-16-3D	G-CTAPL-16-3D	TPGN-322	1.000	1.000	6.000	1.000	1.000	TSP-321	#4-40 x 3/8 FHCS	CL-7	XNS-36	CBT-3G	TK-00538
G-CTAPR-85-3D	G-CTAPL-85-3D	TPGN-322	1.000	1.250	6.000	1.000	1.000	TSP-321	#4-40 x 3/8 FHCS	CL-7	XNS-36	CBT-3G	TK-00538
G-CTAPR-16-4D	G-CTAPL-16-4D	TPGN-432	1.000	1.000	6.000	1.250	1.000	SP-4	#6-32 x 1/2 FHCS	CL-12	XNS-59	CBT-4G	TK-00537
G-CTAPR-85-4D	G-CTAPL-85-4D	TPGN-432	1.000	1.250	6.000	1.250	1.000	SP-4	#6-32 x 1/2 FHCS	CL-12	XNS-510	CBT-4G	TK-00539
G-CTAPR-20-4D	G-CTAPL-20-4D	TPGN-432	1.250	1.250	6.000	1.250	1.250	SP-4	#6-32 x 1/2 FHCS	CL-12	XNS-510	CBT-4G	TK-00539
G-CTAPR-24-4D	G-CTAPL-24-4D	TPGN-432	1.500	1.500	6.000	1.250	1.500	SP-4	#6-32 x 1/2 FHCS	CL-12	XNS-510	CBT-4G	TK-00539
G-CTAPR-16-5D	G-CTAPL-16-5D	TPGN-543	1.000	1.000	6.000	1.380	1.000	SP-5	#8-32 x 1/2 FHCS	CL-12	XNS-59	CBT-5G	TK-00745
G-CTAPR-20-5D	G-CTAPL-20-5D	TPGN-543	1.250	1.250	6.000	1.380	1.250	SP-5	#8-32 x 1/2 FHCS	CL-12	XNS-510	CBT-5G	TK-00544
G-CTAPR-24-5D	G-CTAPL-24-5D	TPGN-543	1.500	1.500	6.000	1.380	1.500	SP-5	#8-32 x 1/2 FHCS	CL-12	XNS-510	CBT-5G	TK-00544
G-CTAPR-24-6D	G-CTAPL-24-6D	TPGN-666	1.500	1.500	6.000	1.500	1.500	SP-6	#10-32 x 1/2 FHCS	CL-12	XNS-510	CBT-6G	TK-007459

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

G-CTCPN

Style C / Triangle / Positive Rake / 0° Lead



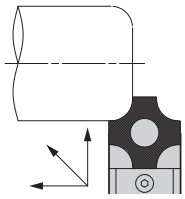
Neutral Toolholder Shown

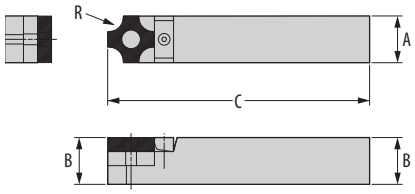
Part Number	Gage	Dimensions (inches)				Standard Components					*Tune-Up Kit
Neutral	Inserts	A	B	C	E	Seat	Seat Screw	Clamp	Clamp Screw	Chip Breaker	Includes all Standard Components
G-CTCPN-44-3D	TPGN-322	0.500	1.000	6.000	1.250	TSP-321	#4-40 x 3/8 FHCS	CL-22	XNS-48	CBT-3G	TK-00540
G-CTCPN-64-4D	TPGN-432	0.750	1.000	6.000	1.380	SP-4	#6-32 x 1/2 FHCS	CL-30	XNS-59	CBT-4G	TK-00541
G-CTCPN-65-4D	TPGN-432	0.750	1.250	6.000	1.380	SP-4	#6-32 x 1/2 FHCS	CL-30	XNS-59	CBT-4G	TK-00541
G-CTCPN-66-4D	TPGN-432	0.750	1.500	6.000	1.380	SP-4	#6-32 x 1/2 FHCS	CL-30	XNS-59	CBT-4G	TK-00541
G-CTCPN-76-5D	TPGN-543	0.875	1.500	6.000	1.500	SP-5	#8-32 x 1/2 FHCS	CL-30	XNS-510	CBT-5G	TK-00542

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

GSRN

Style GSRN





Neutral Toolholder Shown

Part Number	Dimensions (inches)			Standard Components				*Tune-Up Kit	Insert Options	
Neutral	A	B	C	Shim	Center Pin	Clamp	Clamp Screw	Includes all Standard Components	Inserts	R
GSRN-646	0.750	1.000	6.000	SR6	30309	30308-2	30301-1	TK-01117	SNMA-64IR4	0.062
GSRN-656	0.750	1.250	6.000	SR6	30309	30308-2	30301-1	TK-01117	SNMA-64IR6	0.093
GSRN-666	0.750	1.500	7.000	SR6	30309	30308-2	30301-1	TK-01117	SNMA-64IR8	0.125
									SNMA-64IR10	0.156
GSRN-168	1.000	1.000	6.000	SR8	30327-1	30308-2	30301-1	TK-00572	SNMA-84IR12	0.187
GSRN-858	1.000	1.250	7.000	SR8	30327-1	30308-2	30301-1	TK-00572	SNMA-84IR14	0.218
GSRN-868	1.000	1.500	8.000	SR8	30327-1	30308-2	30301-1	TK-00572	SNMA-84IR16	0.250
GSRN-2010	1.250	1.250	7.000	SR10	30454	30319-2	30320	TK-00573	SNMA-106IR20	0.312
GSRN-2410	1.500	1.500	8.000	SR10	30454	30319-2	30320	TK-00573	SNMA-106IR24	0.375
GSRN-2412	1.500	1.500	8.000	SR12	30454	30319-2	30320	TK-00574	SNMA-126IR28	0.437
									SNMA-126IR32	0.500

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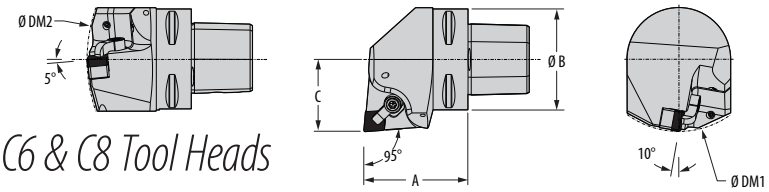
Quick-Change Toolholders

The Greenleaf Quick-Change Toolholders conform to ISO 26623, utilize standard components, and are designed to maximize tool life in carbide and ceramic turning applications.

Greenleaf's special design capabilities offer customers unique solutions to further increase productivity.

MCLNR/L

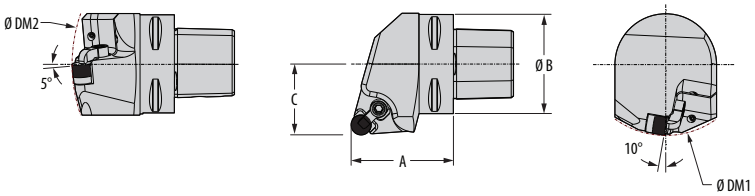
80° Diamond Negative Rake / 5º Reverse Lead / C6 & C8 Tool Heads



Part Number		Gage	Dimensions (inches)					Standard Components					Optional Components		
Right Hand	Left Hand	Inserts	A	B	C	DM1	DM2	Shim Seat	Seat Screw	Clamp	Clamp Screw	Coolant Nozzle	Lock Pin	Clamp	5/16" Insert Shim Seat
GC6-MCLNR-45065-12	GC6-MCLNL-45065-12	CNGN-432	2.56	2.48	1.77	4.33	7.68	CSN-453	S-46M	CLM-12	STCM-4	5691 026-03	NLM-46L	CLM9	CSN-433
GC8-MCLNR-55080-12	GC8-MCLNL-55080-12	CNGN-432	3.15	3.15	2.17	9.25	11.81	CSN-453	S-46M	CLM-12	STCM-4	5691 026-03	NLM-46L	CLM9	CSN-433

MRGNR/L

Round Negative Rake / C6 & C8 Tool Heads



Part Number		Gage	Dimensions (inches)					Standard Components					Optional Components		
Right Hand	Left Hand	Inserts	A	B	C	DM1	DM2	Shim Seat	Seat Screw	Clamp	Clamp Screw	Coolant Nozzle	Lock Pin	Clamp	3/16" Insert Shim Seat
GC6-MRGNR-45065-12	GC6-MRGNL-45065-12	RNGN-45	2.56	2.48	1.77	4.33	7.68	IRSN-43	S-46M	CLM-12	STCM-4	5691 026-03	NLM-46L	CLM9	IRSN-45
GC8-MRGNR-55080-12	GC8-MRGNL-55080-12	RNGN-45	3.15	3.15	2.17	9.25	11.81	IRSN-43	S-46M	CLM-12	STCM-4	5691 026-03	NLM-46L	CLM9	IRSN-45

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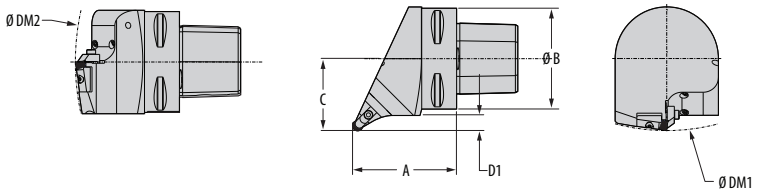
CRGPR/L

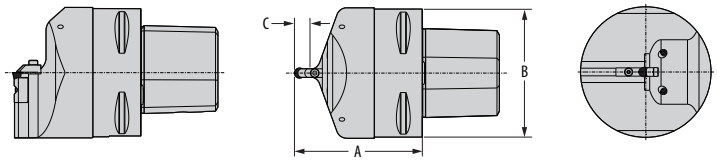
45° Grooving/Profiling / Replaceable Nest



Part Number		Gage Insert	Dimensions (inches)						Standard Components				
Right Hand	Left Hand		A	B	C	D	DM1	DM2	Nest	Nest Screw	Clamp	Clamp Screw	Coolant Nozzle
GC6-CRGPR-45065-06V	GC6-CRGPL-45065-06V	RPGN-2V	2.56	2.48	0.18	0.38	9.84	11.81	411108	M2.5-.45 x 10mm BHCS	308618	M3-0.5 x 12mm SHCS	5691 026-03
GC8-CRGPR-55080-06V	GC8-CRGPL-55080-06V	RCGN-2V	3.15	3.15	0.38	0.38	11.81	13.78	411108	M2.5-.45 x 10mm BHCS	308618	M3-0.5 x 12mm SHCS	5691 026-03
GC6-CRGPR-45065-09V	GC6-CRGPL-45065-09V	RPGN-3V	2.56	2.48	0.56	0.38	9.84	11.81	414009	M3-0.5 x 12mm TBHCS	308063	M5-.8 x 12mm TSHCS	5691 026-03
GC8-CRGPR-55080-09V	GC8-CRGPL-55080-09V	RCGN-3V	3.15	3.15	0.56	0.38	11.81	13.78	414009	M3-0.5 x 12mm TBHCS	308063	M5-.8 x 12mm TSHCS	5691 026-03
GC6-CRGPR-45065-12V	GC6-CRGPL-45065-12V	RPGN-4V	2.56	2.48	0.75	0.38	9.84	11.81	414008	M5-.8 x 16mm TBHCS	308136	434258 (M6-1.0 x 19mm TSHCS)	5691 026-03
GC8-CRGPR-55080-12V	GC8-CRGPR-55080-12V	RCGN-4V	3.15	3.15	0.75	0.38	11.81	13.78	414008	M5-.8 x 16mm TBHCS	308136	434258 (M6-1.0 x 19mm TSHCS)	5691 026-03

CRDPN

Neutral / Replaceable Nest



Part Number	Gage Insert	Dimensions (inches)			Standard Components				
		A	B	C	Nest	Nest Screw	Clamp	Clamp Screw	Coolant Nozzle
GC6-CRDPN-03065-06V	RPGN-2V	2.56	2.48	0.38	410631	M2.5-.45 x 10mm BHCS	308618	M3-0.5 x 12mm SHCS	5691 026-03
GC8-CRDPN-03080-06V	RCGN-2V	3.15	3.15	0.38	410631	M2.5-.45 x 10mm BHCS	308618	M3-0.5 x 12mm SHCS	5691 026-03
GC6-CRDPN-05065-09V	RPGN-3V	2.56	2.48	0.56	413970	M3-0.5 x 12mm TBHCS	308063	M5-.8 x 12mm TSHCS	5691 026-03
GC8-CRDPN-05080-09V	RCGN-3V	3.15	3.15	0.56	413970	M3-0.5 x 12mm TBHCS	308063	M5-.8 x 12mm TSHCS	5691 026-03
GC6-CRDPN-06065-12V	RPGN-4V	2.56	2.48	0.75	414007	M5-.8 x 16mm TBHCS	308136	434258 (M6-1.0 x 19mm TSHCS)	5691 026-03
GC8-CRDPN-06080-12V	RCGN-4V	3.15	3.15	0.75	414007	M5-.8 x 16mm TBHCS	308136	434258 (M6-1.0 x 19mm TSHCS)	5691 026-03

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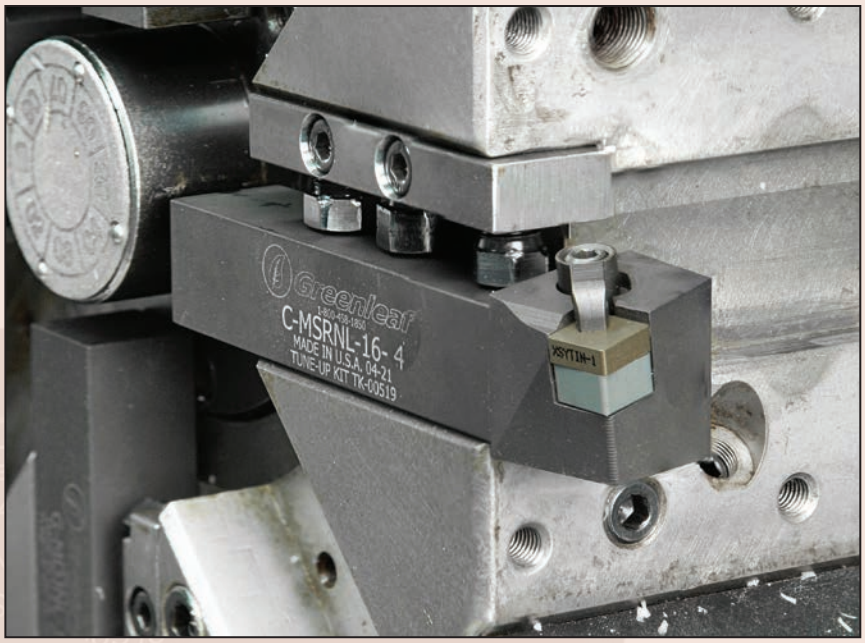
Toolholders for Ceramic Inserts

Greenleaf toolholder systems for use with ceramic inserts are based upon industry standard hardware. However, geometry and pocket depth are designed to maximize ceramic performance. Negative tools have a 10° negative side rake rather than the 5° usually found in tools for carbide inserts. This will increase clearance and, in turn, tool life. The additional pocket depth allows for thicker inserts with shims available to adjust the thickness stack-up for thinner tools if necessary.

The standard clamp is the long series to secure the inserts without a hole which is a stronger setup. Short clamps are an optional item.

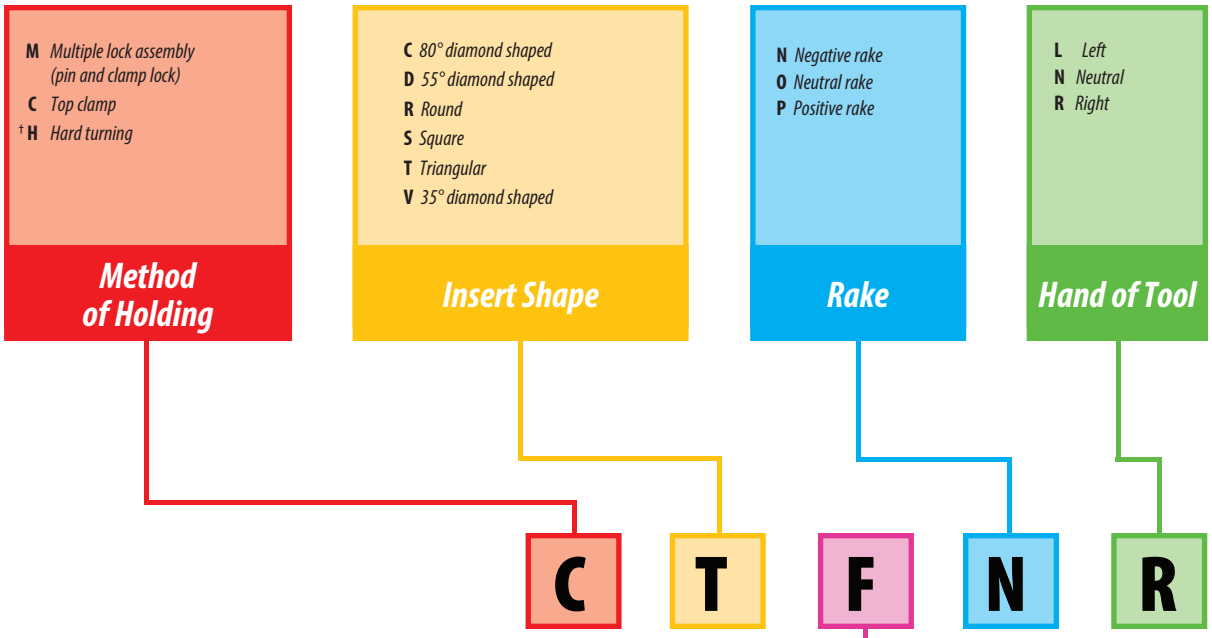
Greenleaf has designated a "C" prefix for a ceramic insert toolholder and an "H" prefix for ceramic insert toolholder for hard material machining.



Greenleaf Tune-Up Kits

A Tune-Up Kit consists of all the standard hardware to refurbish a particular toolholder, boring bar, or milling cutter. A toolholder will have a readily visible, laser-inscribed Tune-Up Kit number on it for ease in ordering. This number will prevent any confusion created by searching a catalog for hardware, and it will help reduce downtime.

Advanced Ceramic Toolholder Identification System



Toolholder Style

- **A** *Straight shank with 0° (90°) side cutting edge angle*
- **B** *Straight shank with 15° (75°) side cutting edge angle*
- **C** *Straight shank with 0° (90°) end cutting edge angle*
- **D** *Straight shank with 45° side cutting edge angle*
- **E** *Straight shank with 30° (60°) side cutting edge angle*
- **F** *Offset shank with 0° (90°) end cutting edge angle*
- **G** *Offset shank with 0° (90°) side cutting edge angle*
- **H** *Offset shank for I.D. threading and shallow grooving*
- **I** *Offset shank with 27.5° (62.5°) end cutting edge angle*
- **J** *Offset shank with negative 3° (93°) side cutting edge angle*
- **K** *Offset shank with 15° (75°) end or side cutting edge angle*
- **L** *Offset shank with negative 5° (95°) end or side cutting edge angle*
- **M** *Straight shank with 50° (40°) side cutting edge angle*
- **N** *Straight shank with 27° (63°) side cutting edge angle*
- **O** *Straight shank with centrally located round insert*
- **P** *Straight shank with 27.5° (62.5°) side cutting edge angle*
- **R** *Offset shank with 15° (75°) side cutting edge angle*
- **S** *Offset shank with 45° side cutting edge angle*
- **T** *Offset shank with negative 27.5° (62.5°) side or end cutting edge angle*
- **U** *Offset shank for deep grooving*
- **V** *Offset shank with negative 17.5° (72.5°) side or end cutting edge angle*
- **W** *Offset shank with 10° (80°) side cutting edge angle*

NOTE:
The angles shown in parentheses are the angles as shown in the ANSI standard.

† Greenleaf standard.

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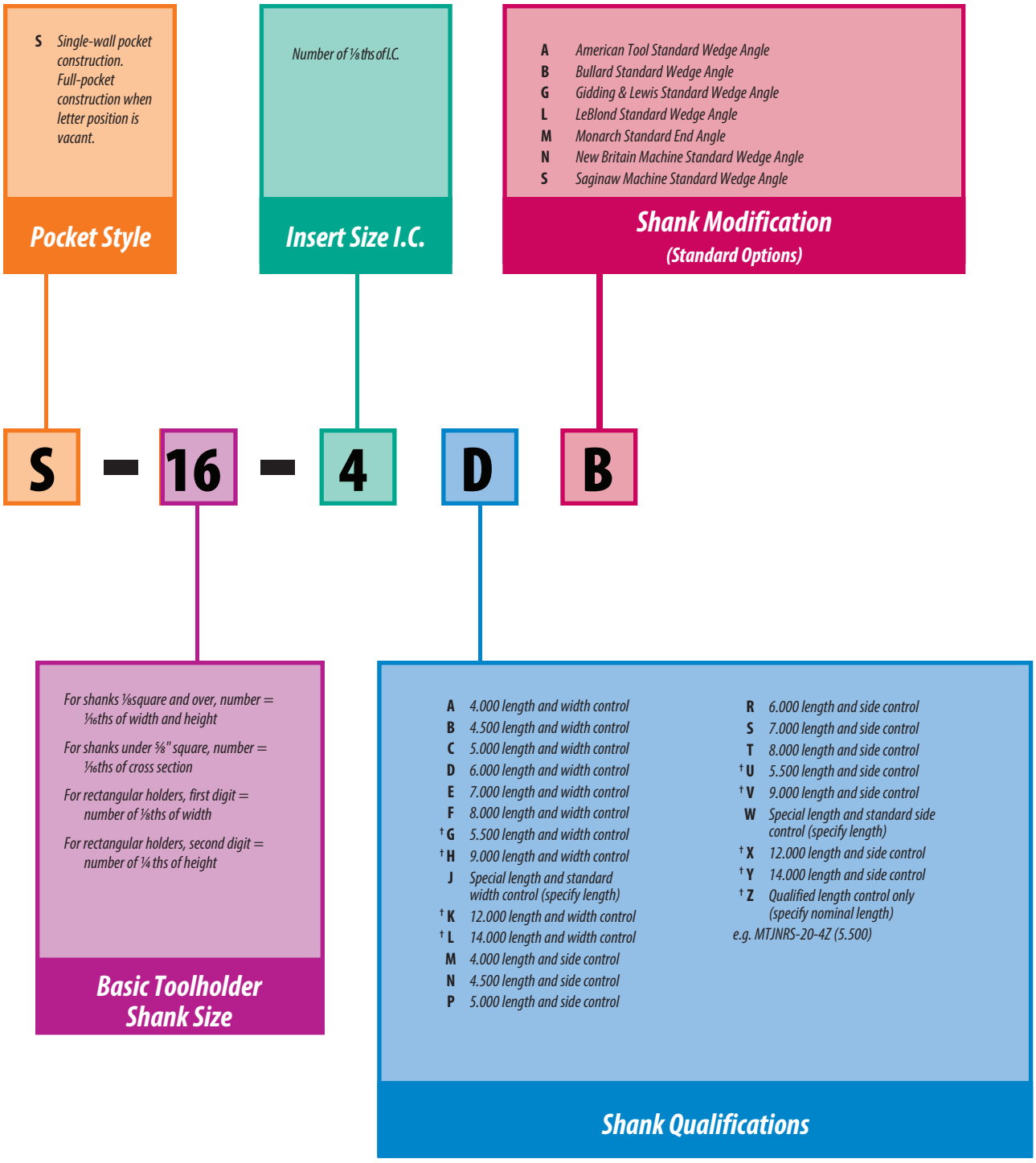


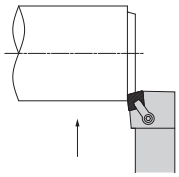
NOTE:
All toolholders are shipped qualified over insert gage radius to ±.003" on C and F dimensions as standard. Some toolholders are qualifiable on length only (C dimension).

All toolholders to be qualified other than above should be designated with the appropriate letter under heading "Shank Qualifications."

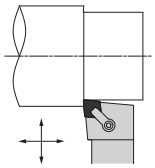
† Greenleaf standard.

Pictorial Index

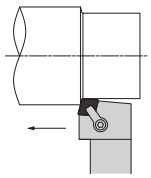
80° Diamond – Negative



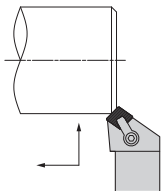
C-MCKNR/L
Style K
80° Diamond
(Using 100° Corner)
Negative Rake
15° Lead
page: T 92



C-MCLNR/L
Style L
80° Diamond
Negative Rake
5° Reverse Lead
page: T 92

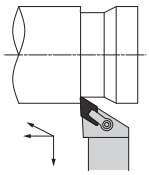


C-MCRNR/L
Style R
80° Diamond
(Using 100° Corner)
Negative Rake
15° Reverse Lead
page: T 93

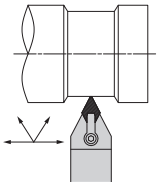


C-MCSNR/L
Style S
80° Diamond
(Using 100° Corner)
Negative Rake
45° Lead
page: T 93

55° Diamond – Negative

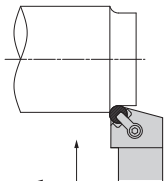


C-MDJNR/L
Style J
55° Diamond
Negative Rake
3° Reverse Lead
page: T 94

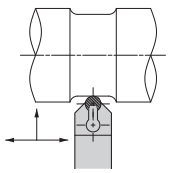


C-MDPNN
Style P
55° Diamond
Negative Rake
27°30' Lead
page: T 94

Round – Negative

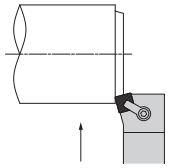


C-MRGNR/L
Style G
Round
Negative Rake
page: T 95

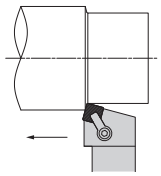


C-MRDNN
Style D
Round
Negative Rake
page: T 95

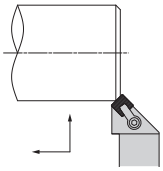
Square – Negative



C-MSKNR/L
Style K
Square
Negative Rake
15° Lead
page: T 96

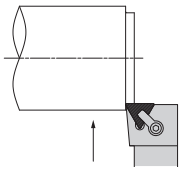


C-MSRNR/L
Style R
Square
Negative Rake
15° Lead
page: T 96

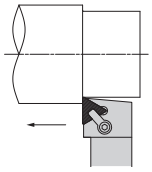


C-MSSNR/L
Style S
Square
Negative Rake
45° Lead
page: T 97

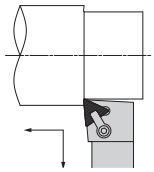
Triangle – Negative



C-MTFNR/L
Style F
Triangle
Negative Rake
0° Lead
page: T 98

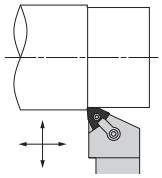


C-MTGNR/L
Style G
Triangle
Negative Rake
0° Lead
page: T 98



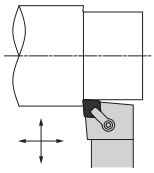
C-MTLNR/L
Style L
Triangle
Negative Rake
5° Reverse Lead
page: T 99

Trigon – Negative

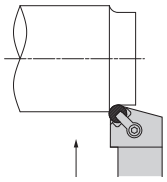


C-MWLNR/L
Style L
Trigon
Negative Rake
5° Reverse Lead
page: T 99

Hard-Turning – Negative



H-MCLNR/L
Style L
80° Diamond
Negative Rake
5° Reverse Lead
page: T 100



H-MRGNR/L
Style G
Round
Negative Rake
page: T 100

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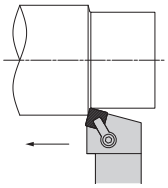
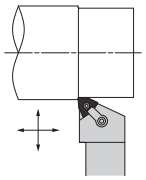
Hard-Turning – Negative *continued*

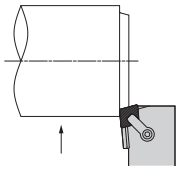


H-MSRNR/L
Style R
Square
Negative Rake
15° Lead
page: T 101

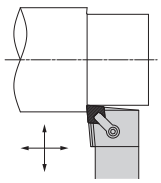


H-MWLNR/L
Style L
Trigon
Negative Rake
5° Reverse Lead
page: T 101

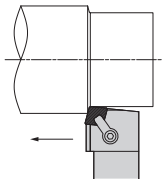
80°/100° Diamond – Positive



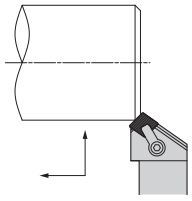
C-CCKPR/L
Style K
80° Diamond
(Using 100° Corner)
Positive Rake
15° Lead
page: T 102



C-CCLPR/L
Style L
80° Diamond
Positive Rake
5° Reverse Lead
page: T 102

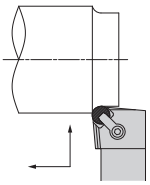


C-CCRPR/L
Style R
80° Diamond
(Using 100° Corner)
Positive Rake
15° Lead
page: T 102



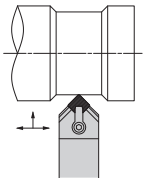
C-CCSPR/L
Style S
80° Diamond
(Using 100° Corner)
Positive Rake
45° Lead
page: T 103

Round – Positive

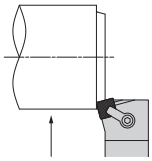


C-CRGPR/L
Style G
Round
Positive Rake
page: T 103

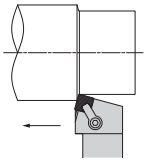
Square – Positive



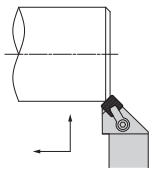
C-CSDPN
Style D
Square
Positive Rake
45° Lead
page: T 104



C-CSKPR/L
Style K
Square
Positive Rake
15° Lead
page: T 104

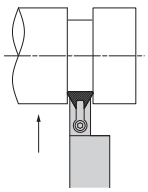


C-CSRPR/L
Style R
Square
Positive Rake
15° Lead
page: T 105



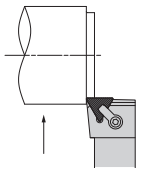
C-CSSPR/L
Style S
Square
Positive Rake
45° Lead
page: T 105

Triangle – Positive

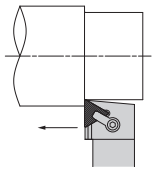


C-CTCPR/L
Style C
Triangle
Positive Rake
0° Lead
page: T 106

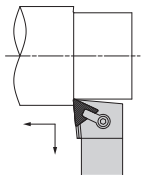
Triangle – Positive *continued*



C-CTFPR/L
Style F
Triangle
Positive Rake
0° Lead
page: T 106

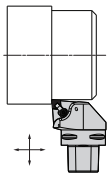


C-CTGPR/L
Style G
Triangle
Positive Rake
0° Lead
page: T 107

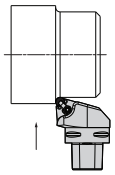


C-CTLPR/L
Style F
Triangle
Positive Rake
5° Reverse Lead
page: T 107

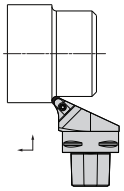
Quick-Change Toolholders



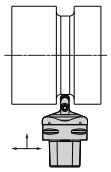
MCLNR/L
80° Diamond
Negative Rake
5° Reverse Lead
C6 & C8 Tool Heads
page: T 84



MRGNR/L
Round Negative Rake
C6 & C8 Tool Heads
page: T 84



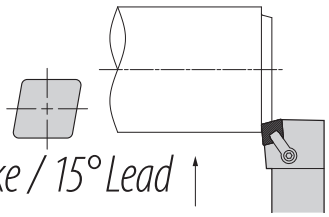
CRGPR/L
45° Grooving/Profiling
Replaceable Nest
page: T 85

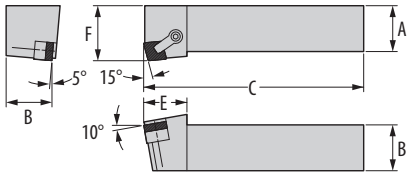


CRDPN
Neutral
Replaceable Nest
page: T 85

C-MCKNR/L

Style K / 80° Diamond *(Using 100° Corner)* / Negative Rake / 15° Lead





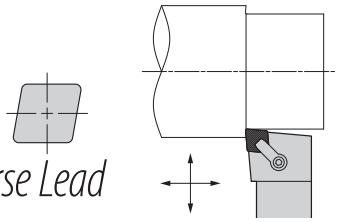
Right-Hand Toolholder Shown

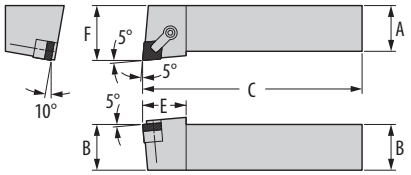
Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components		
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp	5/16" Insert Shim Seat
C-MCKNR-16-4C	C-MCKNL-16-4C	CNGN-432	1.000	1.000	5.000	1.190	1.250	CSN-453	S-46	CL-12	XNS-59	TK-00509	NL-46L	CL-9	CSN-433
C-MCKNR-16-4	C-MCKNL-16-4	CNGN-432	1.000	1.000	6.000	1.190	1.250	CSN-453	S-46	CL-12	XNS-59	TK-00509	NL-46L	CL-9	CSN-433
C-MCKNR-20-4	C-MCKNL-20-4	CNGN-432	1.250	1.250	6.000	1.190	1.500	CSN-453	S-46	CL-12	XNS-59	TK-00509	NL-46L	CL-9	CSN-433
C-MCKNR-20-6	C-MCKNL-20-6	CNGN-643	1.250	1.250	6.000	1.438	1.500	CSN-643	S-68	CL-30	XNS-59	TK-00510	NL-68L	CL-12	CSN-633
C-MCKNR-24-6	C-MCKNL-24-6	CNGN-643	1.500	1.500	8.000	1.438	2.000	CSN-643	S-68	CL-30	XNS-59	TK-00510	NL-68L	CL-12	CSN-633

* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

C-MCLNR/L

Style L / 80° Diamond / Negative Rake / 5° Reverse Lead





Right-Hand Toolhodler Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components		
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp	5/16" Insert Shim Seat
C-MCLNR-16-4C	C-MCLNL-16-4C	CNGN-432	1.000	1.000	5.000	1.190	1.250	CSN-453	S-46	CL-12	XNS-59	TK-00509	NL-46L	CL-9	CSN-433
C-MCLNR-16-4	C-MCLNL-16-4	CNGN-432	1.000	1.000	6.000	1.190	1.250	CSN-453	S-46	CL-12	XNS-59	TK-00509	NL-46L	CL-9	CSN-433
C-MCLNR-20-4	C-MCLNL-20-4	CNGN-432	1.250	1.250	6.000	1.190	1.500	CSN-453	S-46	CL-12	XNS-59	TK-00509	NL-46L	CL-9	CSN-433
C-MCLNR-20-6	C-MCLNL-20-6	CNGN-643	1.250	1.250	6.000	1.500	1.500	CSN-643	S-68	CL-30	XNS-59	TK-00510	NL-68L	CL-12	CSN-633
C-MCLNR-24-6	C-MCLNL-24-6	CNGN-643	1.500	1.500	8.000	1.500	2.000	CSN-643	S-68	CL-30	XNS-59	TK-00510	NL-68L	CL-12	CSN-633

* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

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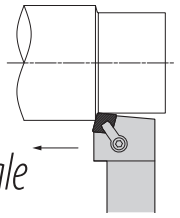
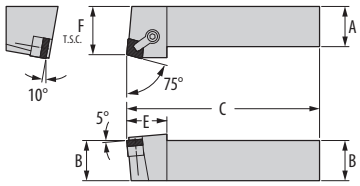
C-MCRNR/L

Style R / 80° Diamond (Using 100° Corner) / Negative Rake / 75° Lead Angle





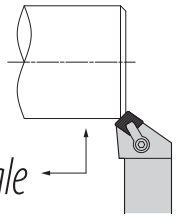
Right-Hand Toolholder Shown

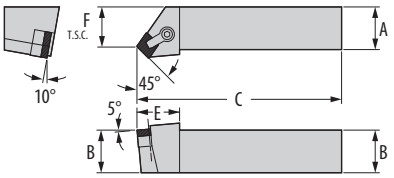
Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Components		
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp	5/16" Insert Shim Seat
C-MCRNR-2525M12	C-MCRNL-2525M12	CNGN-120408	25	25	150	32	32	CSN-453	S-46M	CLM-12	STCM-4	TK-02750	NLM-46L	CLM-9	CSN-433
C-MCRNR-2525P12	C-MCRNL-2525P12	CNGN-120408	25	25	170	32	32	CSN-453	S-46M	CLM-12	STCM-4	TK-02750	NLM-46L	CLM-9	CSN-433
C-MCRNR-3232P12	C-MCRNL-3232P12	CNGN-120408	32	32	170	32	40	CSN-453	S-46M	CLM-12	STCM-4	TK-02750	NLM-46L	CLM-9	CSN-433
C-MCRNR-3232P19	C-MCRNL-3232P19	CNGN-190612	32	32	170	38	40	CSN-643	S-68M	CLM-30	STCM-4	TK-02751	NLM-68L	CLM-12	CSN-633
C-MCRNR-4040R19	C-MCRNL-4040R19	CNGN-190612	40	40	200	38	50	CSN-643	S-68M	CLM-30	STCM-4	TK-02751	NLM-68L	CLM-12	CSN-633

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

C-MCSNR/L

Style S / 80° Diamond (Using 100° Corner) / Negative Rake, 45° Lead Angle





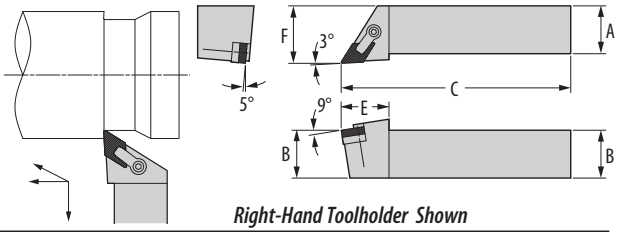
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Components		
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp	5/16" Insert Shim Seat
C-MCSNR-2525M12	C-MCSNL-2525M12	CNGN-120408	25	25	150	32	23	CSN-453	S-46M	CLM-12	STCM-4	TK-02750	NLM-46L	CLM-9	CSN-433
C-MCSNR-2525P12	C-MCSNL-2525P12	CNGN-120408	25	25	170	32	23	CSN-453	S-46M	CLM-12	STCM-4	TK-02750	NLM-46L	CLM-9	CSN-433
C-MCSNR-3232P12	C-MCSNL-3232P12	CNGN-120408	32	32	170	32	29	CSN-453	S-46M	CLM-12	STCM-4	TK-02750	NLM-46L	CLM-9	CSN-433
C-MCSNR-3232P19	C-MCSNL-3232P19	CNGN-190612	32	32	170	38	25	CSN-643	S-68M	CLM-30	STCM-4	TK-02751	NLM-68L	CLM-12	CSN-633
C-MCSNR-4040R19	C-MCSNL-4040R19	CNGN-190612	40	40	200	38	38	CSN-643	S-68M	CLM-30	STCM-4	TK-02751	NLM-68L	CLM-12	CSN-633

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

C-MDJNR/L

Style J / 55° Diamond / Negative Rake / 3° Reverse Lead



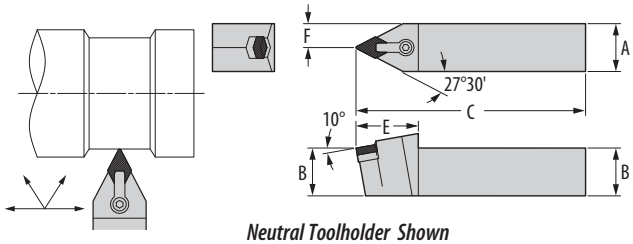
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp
C-MDJNR-16-3C	C-MDJNL-16-3C	DNGN-322	1.000	1.000	5.000	1.000	1.250	DSN-333	S-34	CL-7	XNS-36	TK-00511	NL-34L	CL-6
C-MDJNR-16-3	C-MDJNL-16-3	DNGN-322	1.000	1.000	6.000	1.000	1.250	DSN-333	S-34	CL-7	XNS-36	TK-00511	NL-34L	CL-6
C-MDJNR-20-3	C-MDJNL-20-3	DNGN-322	1.250	1.250	6.000	1.000	1.500	DSN-333	S-34	CL-7	XNS-36	TK-00511	NL-34L	CL-6
C-MDJNR-16-4C	C-MDJNL-16-4C	DNGN-432	1.000	1.000	5.000	1.250	1.250	DSN-433	S-46	CL-22	XNS-48	TK-00512	NL-46	CL-20
C-MDJNR-16-4	C-MDJNL-16-4	DNGN-432	1.000	1.000	6.000	1.250	1.250	DSN-433	S-46	CL-22	XNS-48	TK-00512	NL-46	CL-20
C-MDJNR-20-4	C-MDJNL-20-4	DNGN-432	1.250	1.250	6.000	1.250	1.500	DSN-433	S-46	CL-22	XNS-48	TK-00512	NL-46	CL-20
C-MDJNR-24-4	C-MDJNL-24-4	DNGN-432	1.500	1.500	8.000	1.250	2.000	DSN-433	S-46	CL-22	XNS-48	TK-00512	NL-46	CL-20

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

C-MDPNN

Style P / 55° Diamond / Negative Rake / 27° 30' Lead



Neutral Toolholder Shown

Part Number	Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components	
Neutral	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp
C-MDPNN-16-3C	DNGN-322	1.000	1.000	5.000	1.500	0.500	DSN-333	S-34	CL-12	XNS-59	TK-00513	NL-34L	CL-9
C-MDPNN-16-3	DNGN-322	1.000	1.000	6.000	1.500	0.500	DSN-333	S-34	CL-12	XNS-59	TK-00513	NL-34L	CL-9
C-MDPNN-20-3	DNGN-322	1.250	1.250	6.000	1.500	0.625	DSN-333	S-34	CL-12	XNS-59	TK-00513	NL-34L	CL-9
C-MDPNN-16-4C	DNGN-432	1.000	1.000	5.000	1.625	0.500	DSN-433	S-46	CL-30	XNS-59	TK-00514	NL-46	CL-12
C-MDPNN-16-4	DNGN-432	1.000	1.000	6.000	1.625	0.500	DSN-433	S-46	CL-30	XNS-59	TK-00514	NL-46	CL-12
C-MDPNN-20-4	DNGN-432	1.250	1.250	6.000	1.625	0.625	DSN-433	S-46	CL-30	XNS-59	TK-00514	NL-46	CL-12
C-MDPNN-24-4	DNGN-432	1.500	1.500	8.000	1.625	0.750	DSN-433	S-46	CL-30	XNS-59	TK-00514	NL-46	CL-12

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

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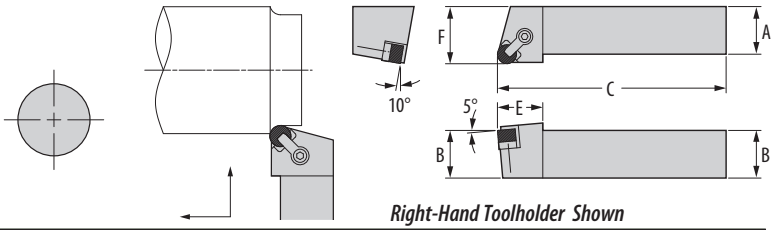
C-MRGNR/L

Style G / Round / Negative Rake



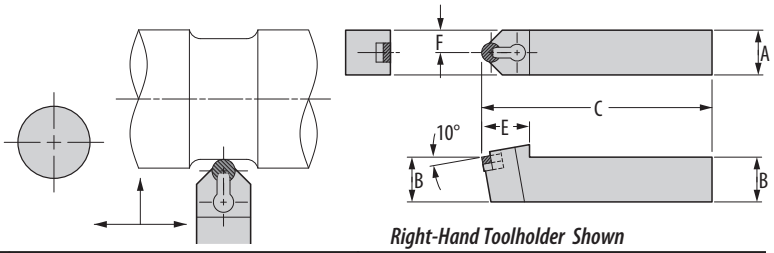
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Opt. Components #1		Opt. Components #2	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp	Insert Thickness	Shim Seat
C-MRGNR-16-3C	C-MRGNL-16-3C	RNGN-33	1.000	1.000	5.000	1.000	1.250	RSN-32	S-34	CL-7	XNS-36	TK-00515	NL-34L	CL-6	1 / 8 ″	RSN-33
C-MRGNR-16-3	C-MRGNL-16-3	RNGN-33	1.000	1.000	6.000	1.000	1.250	RSN-32	S-34	CL-7	XNS-36	TK-00515	NL-34L	CL-6	1 / 8 ″	RSN-33
C-MRGNR-20-3	C-MRGNL-20-3	RNGN-33	1.250	1.250	6.000	1.000	1.500	RSN-32	S-34	CL-7	XNS-36	TK-00515	NL-34L	CL-6	1 / 8 ″	RSN-33
C-MRGNR-16-4C	C-MRGNL-16-4C	RNGN-45	1.000	1.000	5.000	1.190	1.250	IRSN-43	S-46	CL-12	XNS-59	TK-00516	NL-46L	CL-9	3 / 16 ″	IRSN-45
C-MRGNR-16-4	C-MRGNL-16-4	RNGN-45	1.000	1.000	6.000	1.190	1.250	IRSN-43	S-46	CL-12	XNS-59	TK-00516	NL-46L	CL-9	3 / 16 ″	IRSN-45
C-MRGNR-20-4	C-MRGNL-20-4	RNGN-45	1.250	1.250	6.000	1.190	1.500	IRSN-43	S-46	CL-12	XNS-59	TK-00516	NL-46L	CL-9	3 / 16 ″	IRSN-45
C-MRGNR-24-4	C-MRGNL-24-4	RNGN-45	1.500	1.500	8.000	1.190	2.000	IRSN-43	S-46	CL-12	XNS-59	TK-00516	NL-46L	CL-9	3 / 16 ″	IRSN-45
C-MRGNR-16-5C	C-MRGNL-16-5C	RNGN-55	1.000	1.000	5.000	1.380	1.250	RSN-53	S-58	CL-12	XNS-59	TK-00517	NSP-5	CL-9	–	–
C-MRGNR-16-5	C-MRGNL-16-5	RNGN-55	1.000	1.000	6.000	1.380	1.250	RSN-53	S-58	CL-12	XNS-59	TK-00517	NSP-5	CL-9	–	–
C-MRGNR-20-5	C-MRGNL-20-5	RNGN-55	1.250	1.250	6.000	1.380	1.500	RSN-53	S-58	CL-12	XNS-59	TK-00517	NSP-5	CL-9	–	–
C-MRGNR-24-5	C-MRGNL-24-5	RNGN-55	1.500	1.500	8.000	1.380	2.000	RSN-53	S-58	CL-12	XNS-59	TK-00517	NSP-5	CL-9	–	–
C-MRGNR-16-6C	C-MRGNL-16-6C	RNGN-65	1.000	1.000	5.000	1.500	1.250	RSN-63	S-68	CL-30	XNS-59	TK-00518	NL-68L	CL-12	–	–
C-MRGNR-16-6	C-MRGNL-16-6	RNGN-65	1.000	1.000	6.000	1.500	1.250	RSN-63	S-68	CL-30	XNS-59	TK-00518	NL-68L	CL-12	–	–
C-MRGNR-20-6	C-MRGNL-20-6	RNGN-65	1.250	1.250	6.000	1.500	1.500	RSN-63	S-68	CL-30	XNS-59	TK-00518	NL-68L	CL-12	–	–
C-MRGNR-24-6	C-MRGNL-24-6	RNGN-65	1.500	1.500	8.000	1.500	2.000	RSN-63	S-68	CL-30	XNS-59	TK-00518	NL-68L	CL-12	–	–

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

C-MRDNN

Style D / Round / Negative Rake



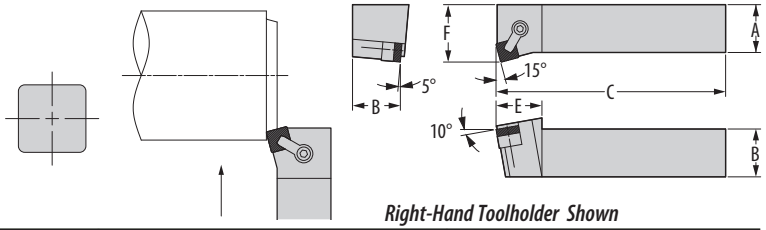
Right-Hand Toolholder Shown

Part Number	Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Opt. Components #1		Opt. Components #2	
Neutral	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp	Insert Thickness	Shim Seat
C-MRDNN-16-3C	RNGN-33	1.000	1.000	5.000	1.000	0.500	RSN-32	S-34	CL-7	XNS-36	TK-00515	NL-34L	CL-6	1/8″	RSN-33
C-MRDNN-16-3	RNGN-33	1.000	1.000	6.000	1.000	0.500	RSN-32	S-34	CL-7	XNS-36	TK-00515	NL-34L	CL-6	1/8″	RSN-33
C-MRDNN-20-3	RNGN-33	1.250	1.250	6.000	1.000	0.625	RSN-32	S-34	CL-7	XNS-36	TK-00515	NL-34L	CL-6	1/8″	RSN-33
C-MRDNN-16-4C	RNGN-45	1.000	1.000	5.000	1.375	0.500	IRSN-43	S-46	CL-12	XNS-59	TK-00516	NL-46L	CL-9	3/16″	IRSN-45
C-MRDNN-16-4	RNGN-45	1.000	1.000	6.000	1.375	0.500	IRSN-43	S-46	CL-12	XNS-59	TK-00516	NL-46L	CL-9	3/16″	IRSN-45
C-MRDNN-20-4	RNGN-45	1.250	1.250	6.000	1.375	0.625	IRSN-43	S-46	CL-12	XNS-59	TK-00516	NL-46L	CL-9	3/16″	IRSN-45
C-MRDNN-24-4	RNGN-45	1.500	1.500	8.000	1.375	0.750	IRSN-43	S-46	CL-12	XNS-59	TK-00516	NL-46L	CL-9	3/16″	IRSN-45
C-MRDNN-16-5C	RNGN-55	1.000	1.000	5.000	1.375	0.500	RSN-53	S-58	CL-12	XNS-59	TK-00517	NSP-5	CL-9	–	–
C-MRDNN-16-5	RNGN-55	1.000	1.000	6.000	1.375	0.500	RSN-53	S-58	CL-12	XNS-59	TK-00517	NSP-5	CL-9	–	–
C-MRDNN-20-5	RNGN-55	1.250	1.250	6.000	1.375	0.625	RSN-53	S-58	CL-12	XNS-59	TK-00517	NSP-5	CL-9	–	–
C-MRDNN-24-5	RNGN-55	1.500	1.500	8.000	1.375	0.750	RSN-53	S-58	CL-12	XNS-59	TK-00517	NSP-5	CL-9	–	–
C-MRDNN-16-6C	RNGN-65	1.000	1.000	5.000	1.562	0.500	RSN-63	S-68	CL-30	XNS-59	TK-00518	NL-68L	CL-12	–	–
C-MRDNN-16-6	RNGN-65	1.000	1.000	6.000	1.562	0.500	RSN-63	S-68	CL-30	XNS-59	TK-00518	NL-68L	CL-12	–	–
C-MRDNN-20-6	RNGN-65	1.250	1.250	6.000	1.562	0.625	RSN-63	S-68	CL-30	XNS-59	TK-00518	NL-68L	CL-12	–	–
C-MRDNN-24-6	RNGN-65	1.500	1.500	8.000	1.562	0.750	RSN-63	S-68	CL-30	XNS-59	TK-00518	NL-68L	CL-12	–	–

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

C-MSKNR/L

Style K / Square / Negative Rake / 15° Lead



Right-Hand Toolholder Shown

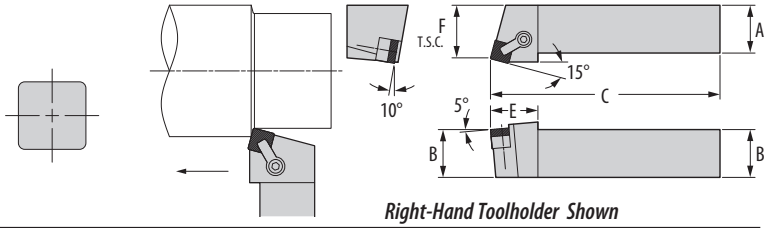
Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components		
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp	5/16" Insert Shim Seat
C-MSKNR-16-4C	C-MSKNL-16-4C	SNGN-432	1.000	1.000	5.000	1.219	1.250	ISSN-453	S-46	CL-12	XNS-59	TK-00519	NL-46L	CL-9	ISSN-433
C-MSKNR-16-4	C-MSKNL-16-4	SNGN-432	1.000	1.000	6.000	1.219	1.250	ISSN-453	S-46	CL-12	XNS-59	TK-00519	NL-46L	CL-9	ISSN-433
C-MSKNR-20-4	C-MSKNL-20-4	SNGN-432	1.250	1.250	6.000	1.219	1.500	ISSN-453	S-46	CL-12	XNS-59	TK-00519	NL-46L	CL-9	ISSN-433
C-MSKNR-20-5	C-MSKNL-20-5	SNGN-543	1.250	1.250	6.000	1.438	1.500	SSN-533	S-58	CL-12	XNS-59	TK-00520	NL-58	CL-9	–
C-MSKNR-24-5	C-MSKNL-24-5	SNGN-543	1.500	1.500	8.000	1.438	2.000	SSN-533	S-58	CL-12	XNS-59	TK-00520	NL-58	CL-9	–
C-MSKNR-20-6	C-MSKNL-20-6	SNGN-643	1.250	1.250	6.000	1.547	1.500	ISSN-633	S-68	CL-30	XNS-59	TK-00521	NL-68	CL-12	**ISSN-623
C-MSKNR-24-6	C-MSKNL-24-6	SNGN-643	1.500	1.500	8.000	1.547	2.000	ISSN-633	S-68	CL-30	XNS-59	TK-00521	NL-68	CL-12	**ISSN-623

* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

** *The lock pin option can NOT be used with this shim.*

C-MSRNR/L

Style R / Square / Negative Rake / 15° Lead



Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components		
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp	5/16" Insert Shim Seat
C-MSRNR-16-4C	C-MSRNL-16-4C	SNGN-432	1.000	1.000	5.000	1.234	1.125	ISSN-453	S-46	CL-12	XNS-59	TK-00519	NL-46L	CL-9	ISSN-433
C-MSRNR-16-4	C-MSRNL-16-4	SNGN-432	1.000	1.000	6.000	1.234	1.125	ISSN-453	S-46	CL-12	XNS-59	TK-00519	NL-46L	CL-9	ISSN-433
C-MSRNR-20-4	C-MSRNL-20-4	SNGN-432	1.250	1.250	6.000	1.234	1.375	ISSN-453	S-46	CL-12	XNS-59	TK-00519	NL-46L	CL-9	ISSN-433
C-MSRNR-20-5	C-MSRNL-20-5	SNGN-543	1.250	1.250	6.000	1.469	1.343	SSN-533	S-58	CL-12	XNS-59	TK-00520	NL-58	CL-9	–
C-MSRNR-24-5	C-MSRNL-24-5	SNGN-543	1.500	1.500	8.000	1.469	1.843	SSN-533	S-58	CL-12	XNS-59	TK-00520	NL-58	CL-9	–
C-MSRNR-20-6	C-MSRNL-20-6	SNGN-643	1.250	1.250	6.000	1.500	1.312	ISSN-633	S-68	CL-30	XNS-59	TK-00521	NL-68	CL-12	**ISSN-623
C-MSRNR-24-6	C-MSRNL-24-6	SNGN-643	1.500	1.500	8.000	1.500	1.812	ISSN-633	S-68	CL-30	XNS-59	TK-00521	NL-68	CL-12	**ISSN-623

* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

** *The lock pin option can NOT be used with this shim.*

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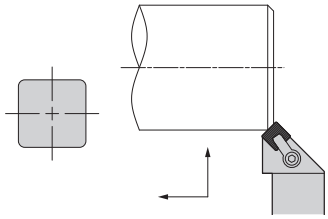
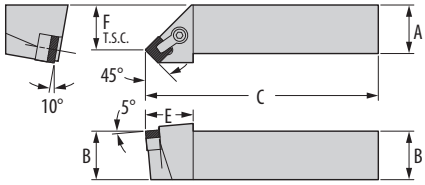
C-MSSNR/L

Style S / Square / Negative Rake / 45° Lead





Right-Hand Toolholder Shown

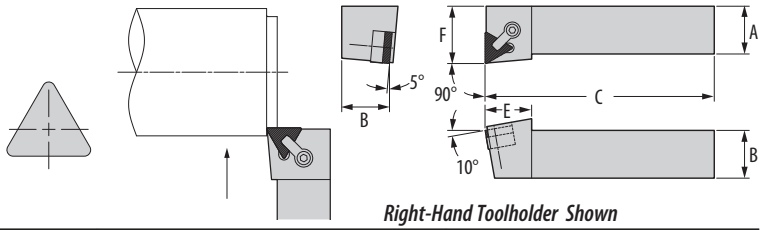
Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components		
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp	5/16" Insert Shim Seat
C-MSKNR-16-4C	C-MSKNL-16-4C	SNGN-432	1.000	1.000	5.000	1.234	0.906	ISSN-453	S-46	CL-12	XNS-59	TK-00519	NL-46L	CL-9	ISSN-433
C-MSKNR-16-4	C-MSKNL-16-4	SNGN-432	1.000	1.000	6.000	1.234	0.906	ISSN-453	S-46	CL-12	XNS-59	TK-00519	NL-46L	CL-9	ISSN-433
C-MSKNR-20-4	C-MSKNL-20-4	SNGN-432	1.250	1.250	6.000	1.234	1.156	ISSN-453	S-46	CL-12	XNS-59	TK-00519	NL-46L	CL-9	ISSN-433
C-MSKNR-20-5	C-MSKNL-20-5	SNGN-543	1.250	1.250	6.000	1.375	1.078	SSN-533	S-58	CL-12	XNS-59	TK-00520	NL-58	CL-9	–
C-MSKNR-24-5	C-MSKNL-24-5	SNGN-543	1.500	1.500	8.000	1.375	1.578	SSN-533	S-58	CL-12	XNS-59	TK-00520	NL-58	CL-9	–
C-MSKNR-20-6	C-MSKNL-20-6	SNGN-643	1.250	1.250	6.000	1.484	1.000	ISSN-633	S-68	CL-30	XNS-59	TK-00521	NL-68	CL-12	**ISSN-623
C-MSKNR-24-6	C-MSKNL-24-6	SNGN-643	1.500	1.500	8.000	1.484	1.500	ISSN-633	S-68	CL-30	XNS-59	TK-00521	NL-68	CL-12	**ISSN-623

* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

** *The lock pin option can NOT be used with this shim.*

C-MTFNR/L

Style F / Triangle / Negative Rake / 0° Lead



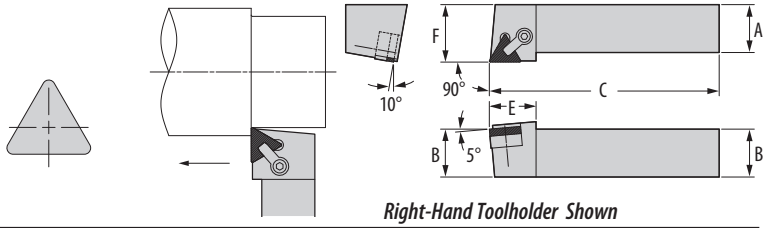
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components		
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp	5/16" Insert Shim Seat
C-MTFNR-16-3C	C-MTFNL-16-3C	TNGN-332	1.000	1.000	5.000	0.938	1.250	ITSN-322	S-34	CL-7	XNS-36	TK-00522	NL-34L	CL-6	–
C-MTFNR-16-3	C-MTFNL-16-3	TNGN-332	1.000	1.000	6.000	0.938	1.250	ITSN-322	S-34	CL-7	XNS-36	TK-00522	NL-34L	CL-6	–
C-MTFNR-20-3	C-MTFNL-20-3	TNGN-332	1.250	1.250	6.000	0.938	1.500	ITSN-322	S-34	CL-7	XNS-36	TK-00522	NL-34L	CL-6	–
C-MTFNR-16-4C	C-MTFNL-16-4C	TNGN-432	1.000	1.000	5.000	1.219	1.250	ITSN-453	S-46	CL-12	XNS-59	TK-00523	NL-46L	CL-9	ITSN-433
C-MTFNR-16-4	C-MTFNL-16-4	TNGN-432	1.000	1.000	6.000	1.219	1.250	ITSN-453	S-46	CL-12	XNS-59	TK-00523	NL-46L	CL-9	ITSN-433
C-MTFNR-20-4	C-MTFNL-20-4	TNGN-432	1.250	1.250	6.000	1.219	1.500	ITSN-453	S-46	CL-12	XNS-59	TK-00523	NL-46L	CL-9	ITSN-433
C-MTFNR-24-4	C-MTFNL-24-4	TNGN-432	1.500	1.500	8.000	1.219	2.000	ITSN-453	S-46	CL-12	XNS-59	TK-00523	NL-46L	CL-9	ITSN-433

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

C-MTGNR/L

Style G / Triangle / Negative Rake / 0° Lead



Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components		
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp	5/16" Insert Shim Seat
C-MTGNR-16-3C	C-MTGNL-16-3C	TNGN-332	1.000	1.000	5.000	1.109	1.250	ITSN-322	S-34	CL-7	XNS-36	TK-00522	NL-34L	CL-6	–
C-MTGNR-16-3	C-MTGNL-16-3	TNGN-332	1.000	1.000	6.000	1.109	1.250	ITSN-322	S-34	CL-7	XNS-36	TK-00522	NL-34L	CL-6	–
C-MTGNR-20-3	C-MTGNL-20-3	TNGN-332	1.250	1.250	6.000	1.109	1.500	ITSN-322	S-34	CL-7	XNS-36	TK-00522	NL-34L	CL-6	–
C-MTGNR-16-4C	C-MTGNL-16-4C	TNGN-432	1.000	1.000	5.000	1.188	1.250	ITSN-453	S-46	CL-12	XNS-59	TK-00523	NL-46L	CL-9	ITSN-433
C-MTGNR-16-4	C-MTGNL-16-4	TNGN-432	1.000	1.000	6.000	1.188	1.250	ITSN-453	S-46	CL-12	XNS-59	TK-00523	NL-46L	CL-9	ITSN-433
C-MTGNR-20-4	C-MTGNL-20-4	TNGN-432	1.250	1.250	6.000	1.188	1.500	ITSN-453	S-46	CL-12	XNS-59	TK-00523	NL-46L	CL-9	ITSN-433
C-MTGNR-24-4	C-MTGNL-24-4	TNGN-432	1.500	1.500	8.000	1.188	2.000	ITSN-453	S-46	CL-12	XNS-59	TK-00523	NL-46L	CL-9	ITSN-433

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

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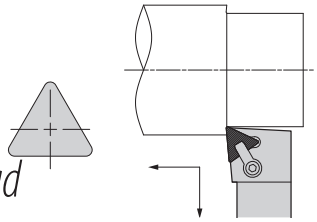
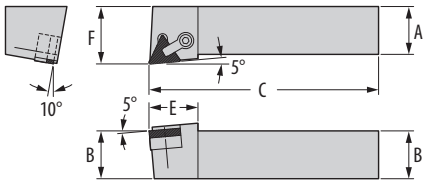
C-MTLNR/L

Style L / Triangle / Negative Rake / 5° Reverse Lead





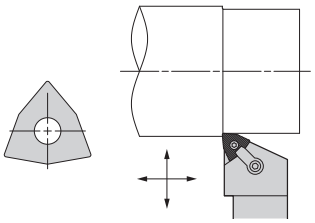
Right-Hand Toolholder Shown

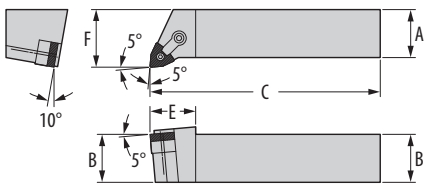
Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components		
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp	5/16" Insert Shim Seat
C-MTLNR-16-3C	C-MTLNL-16-3C	TNGN-332	1.000	1.000	5.000	1.109	1.250	ITSN-322	S-34	CL-7	XNS-36	TK-00522	NL-34L	CL-6	–
C-MTLNR-16-3	C-MTLNL-16-3	TNGN-332	1.000	1.000	6.000	1.109	1.250	ITSN-322	S-34	CL-7	XNS-36	TK-00522	NL-34L	CL-6	–
C-MTLNR-20-3	C-MTLNL-20-3	TNGN-332	1.250	1.250	6.000	1.109	1.500	ITSN-322	S-34	CL-7	XNS-36	TK-00522	NL-34L	CL-6	–
C-MTLNR-16-4C	C-MTLNL-16-4C	TNGN-432	1.000	1.000	5.000	1.188	1.250	ITSN-453	S-46	CL-12	XNS-59	TK-00523	NL-46L	CL-9	ITSN-433
C-MTLNR-16-4	C-MTLNL-16-4	TNGN-432	1.000	1.000	6.000	1.188	1.250	ITSN-453	S-46	CL-12	XNS-59	TK-00523	NL-46L	CL-9	ITSN-433
C-MTLNR-20-4	C-MTLNL-20-4	TNGN-432	1.250	1.250	6.000	1.188	1.500	ITSN-453	S-46	CL-12	XNS-59	TK-00523	NL-46L	CL-9	ITSN-433
C-MTLNR-24-4	C-MTLNL-24-4	TNGN-432	1.500	1.500	8.000	1.188	2.000	ITSN-453	S-46	CL-12	XNS-59	TK-00523	NL-46L	CL-9	ITSN-433

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

C-MWLNR/L

Style L / Trigon / Negative Rake / 5° Reverse Lead





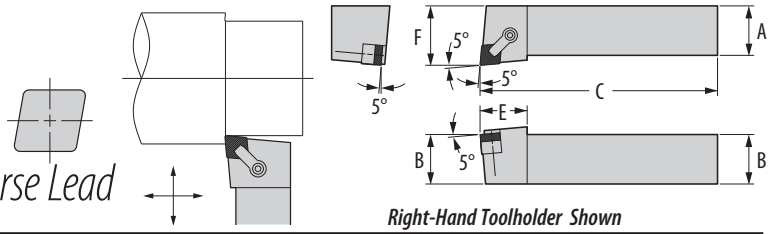
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-MWLNR-12-3B	C-MWLNL-12-3B	WNGA-332	0.750	0.750	4.500	1.000	1.000	IWSN-322	NL-34L	CL-6	XNS-36	TK-00777
C-MWLNR-16-3	C-MWLNL-16-3	WNGA-332	1.000	1.000	6.000	1.000	1.250	IWSN-322	NL-34L	CL-6	XNS-36	TK-00777
C-MWLNR-20-3	C-MWLNL-20-3	WNGA-332	1.250	1.250	6.000	1.000	1.500	IWSN-322	NL-34L	CL-6	XNS-36	TK-00777
C-MWLNR-24-3	C-MWLNL-24-3	WNGA-332	1.500	1.500	8.000	1.000	2.000	IWSN-322	NL-34L	CL-6	XNS-36	TK-00777
C-MWLNR-12-4B	C-MWLNL-12-4B	WNGA-432	0.750	0.750	4.500	1.078	1.000	IWSN-453	NL-46L	CL-20	XNS-48	TK-00766
C-MWLNR-16-4	C-MWLNL-16-4	WNGA-432	1.000	1.000	6.000	1.078	1.250	IWSN-453	NL-46L	CL-20	XNS-48	TK-00766
C-MWLNR-20-4	C-MWLNL-20-4	WNGA-432	1.250	1.250	6.000	1.078	1.500	IWSN-453	NL-46L	CL-20	XNS-48	TK-00766
C-MWLNR-24-4	C-MWLNL-24-4	WNGA-432	1.500	1.500	8.000	1.078	2.000	IWSN-453	NL-46L	CL-20	XNS-48	TK-00766

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

H-MCLNR/L

Style L / 80° Diamond / Negative Rake / 5° Reverse Lead



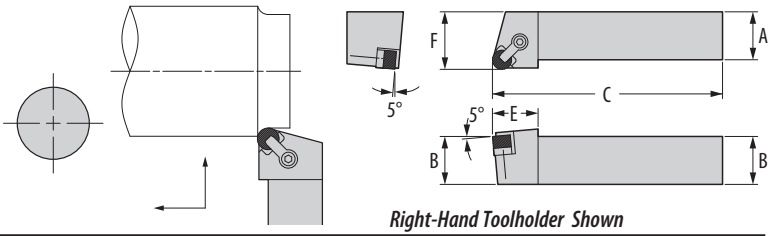
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components		
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp	5/16" Insert Shim Seat
H-MCLNR-16-4C	H-MCLNL-16-4C	CNGN-432	1.000	1.000	5.000	1.190	1.250	CSN-453	S-46	CL-12	XNS-59	TK-00509	NL-46L	CL-9	CSN-433
H-MCLNR-16-4	H-MCLNL-16-4	CNGN-432	1.000	1.000	6.000	1.190	1.250	CSN-453	S-46	CL-12	XNS-59	TK-00509	NL-46L	CL-9	CSN-433
H-MCLNR-20-4	H-MCLNL-20-4	CNGN-432	1.250	1.250	6.000	1.190	1.500	CSN-453	S-46	CL-12	XNS-59	TK-00509	NL-46L	CL-9	CSN-433

* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

H-MRGNR/L

Style G / Round / Negative Rake



Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components		
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp	3/16" Insert Shim Seat
H-MRGNR-16-4C	H-MRGNL-16-4C	RNGN-45	1.000	1.000	5.000	1.190	1.250	IRSN-43	S-46	CL-12	XNS-59	TK-00516	NL-46L	CL-9	IRSN-45
H-MRGNR-16-4	H-MRGNL-16-4	RNGN-45	1.000	1.000	6.000	1.190	1.250	IRSN-43	S-46	CL-12	XNS-59	TK-00516	NL-46L	CL-9	IRSN-45
H-MRGNR-20-4	H-MRGNL-20-4	RNGN-45	1.250	1.250	6.000	1.190	1.500	IRSN-43	S-46	CL-12	XNS-59	TK-00516	NL-46L	CL-9	IRSN-45
H-MRGNR-24-4	H-MRGNL-24-4	RNGN-45	1.500	1.500	8.000	1.190	2.000	IRSN-43	S-46	CL-12	XNS-59	TK-00516	NL-46L	CL-9	IRSN-45

* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

These toolholders are for hard turning with ceramic inserts using industry standard components.

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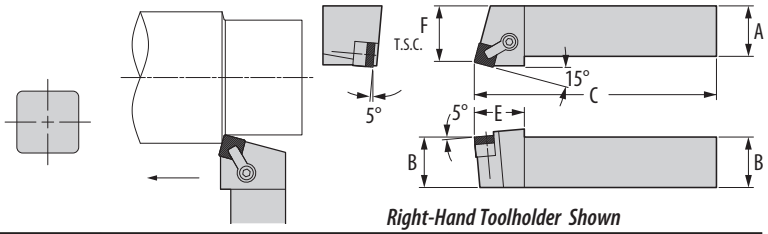
H-MSRNR/L

Style R / Square / Negative Rake / 15° Lead



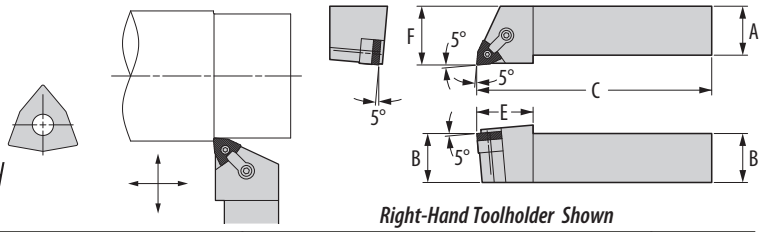
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit	Optional Components		
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp	5/16" Insert Shim Seat
H-MSRNR-16-4C	H-MSRNL-16-4C	SNGN-432	1.000	1.000	5.000	1.234	1.125	ISSN-453	S-46	CL-12	XNS-59	TK-00519	NL-46L	CL-9	ISSN-433
H-MSRNR-16-4	H-MSRNL-16-4	SNGN-432	1.000	1.000	6.000	1.234	1.125	ISSN-453	S-46	CL-12	XNS-59	TK-00519	NL-46L	CL-9	ISSN-433
H-MSRNR-20-4	H-MSRNL-20-4	SNGN-432	1.250	1.250	6.000	1.234	1.375	ISSN-453	S-46	CL-12	XNS-59	TK-00519	NL-46L	CL-9	ISSN-433

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

H-MWLNR/L

Style L / Trigon / Negative Rake / 5° Reverse Lead



Right-Hand Toolholder Shown

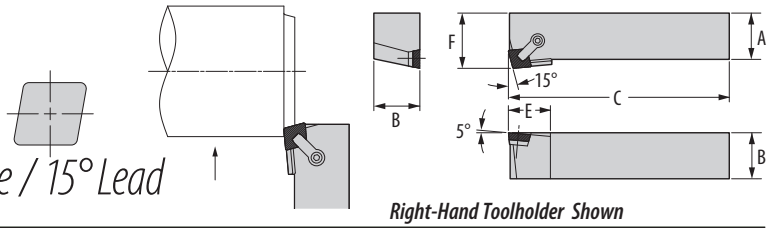
Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
H-MWLNR-12-3B	H-MWLNL-12-3B	WNGA-332	0.750	0.750	4.500	1.000	1.000	IWSN-322	NL-34L	CL-6	XNS-36	TK-00777
H-MWLNR-16-3	H-MWLNL-16-3	WNGA-332	1.000	1.000	6.000	1.000	1.250	IWSN-322	NL-34L	CL-6	XNS-36	TK-00777
H-MWLNR-20-3	H-MWLNL-20-3	WNGA-332	1.250	1.250	6.000	1.000	1.500	IWSN-322	NL-34L	CL-6	XNS-36	TK-00777
H-MWLNR-24-3	H-MWLNL-24-3	WNGA-332	1.500	1.500	8.000	1.000	2.000	IWSN-322	NL-34L	CL-6	XNS-36	TK-00777
H-MWLNR-12-4B	H-MWLNL-12-4B	WNGA-432	0.750	0.750	4.500	1.078	1.000	IWSN-453	NL-46L	CL-20	XNS-48	TK-00766
H-MWLNR-16-4	H-MWLNL-16-4	WNGA-432	1.000	1.000	6.000	1.078	1.250	IWSN-453	NL-46L	CL-20	XNS-48	TK-00766
H-MWLNR-20-4	H-MWLNL-20-4	WNGA-432	1.250	1.250	6.000	1.078	1.500	IWSN-453	NL-46L	CL-20	XNS-48	TK-00766
H-MWLNR-24-4	H-MWLNL-24-4	WNGA-432	1.500	1.500	8.000	1.078	2.000	IWSN-453	NL-46L	CL-20	XNS-48	TK-00766

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

These toolholders are for hard turning with ceramic inserts using industry standard components.

C-CCKPR/L

Style K / 80° Diamond *(Using 100° Corner)* / Positive Rake / 15° Lead



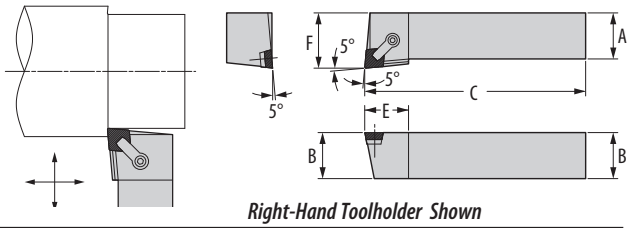
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CCKPR-16-4C	C-CCKPL-16-4C	CPGN-432	1.000	1.000	5.000	1.188	1.250	SP-49	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00501
C-CCKPR-16-4	C-CCKPL-16-4	CPGN-432	1.000	1.000	6.000	1.188	1.250	SP-49	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00501
C-CCKPR-20-4	C-CCKPL-20-4	CPGN-432	1.250	1.250	6.000	1.188	1.500	SP-49	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00501

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

C-CCLPR/L

Style L / 80° Diamond / Positive Rake / 5° Reverse Lead



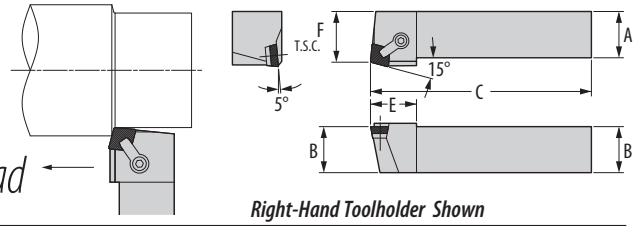
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CCLPR-16-4C	C-CCLPL-16-4C	CPGN-432	1.000	1.000	5.000	1.188	1.250	SP-49	#4-40x 3/8 F.C.H.S.	CL-12	XNS-59	TK-00501
C-CCLPR-16-4	C-CCLPL-16-4	CPGN-432	1.000	1.000	6.000	1.188	1.250	SP-49	#4-40x 3/8 F.C.H.S.	CL-12	XNS-59	TK-00501
C-CCLPR-20-4	C-CCLPL-20-4	CPGN-432	1.250	1.250	6.000	1.188	1.500	SP-49	#4-40x 3/8 F.C.H.S.	CL-12	XNS-59	TK-00501

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

C-CCRPR/L

Style R / 80° Diamond *(Using 100° Corner)* / Positive Rake / 15° Lead



Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CCRPR-16-4C	C-CCRPL-16-4C	CPGN-432	1.000	1.000	5.000	1.250	1.250	SP-49	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00501
C-CCRPR-16-4	C-CCRPL-16-4	CPGN-432	1.000	1.000	6.000	1.250	1.250	SP-49	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00501
C-CCRPR-20-4	C-CCRPL-20-4	CPGN-432	1.250	1.250	6.000	1.250	1.500	SP-49	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00501

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

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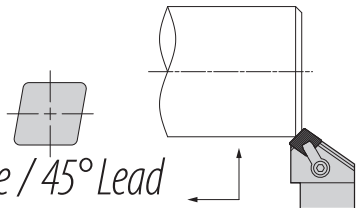
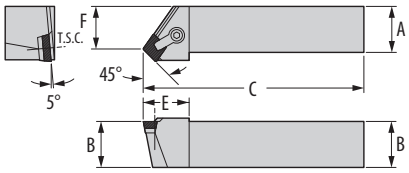
C-CCSPR/L

Style S / 80° Diamond (Using 100° Corner) / Positive Rake / 45° Lead





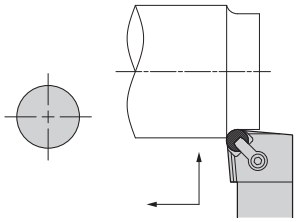
Right-Hand Toolholder Shown

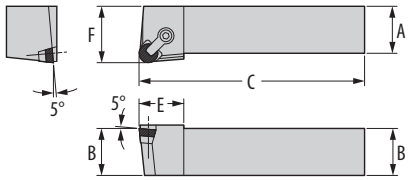
Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CCSPR-16-4C	C-CCSPL-16-4C	CPGN-432	1.000	1.000	5.000	1.250	1.250	SP-49	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00501
C-CCSPR-16-4	C-CCSPL-16-4	CPGN-432	1.000	1.000	6.000	1.250	1.250	SP-49	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00501
C-CCSPR-20-4	C-CCSPL-20-4	CPGN-432	1.250	1.250	6.000	1.250	1.500	SP-49	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00501

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

C-CRGPR/L

Style G / Round / Positive Rake





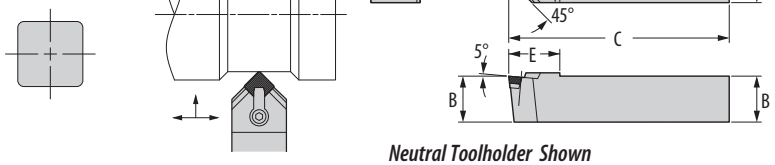
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CRGPR-16-3C	C-CRGPL-16-3C	RPGN-32	1.000	1.000	5.000	1.000	1.250	SP-34	#2-56x 1/4 S.H.C.S.	CL-7	XNS-36	TK-00502
C-CRGPR-16-3	C-CRGPL-16-3	RPGN-32	1.000	1.000	6.000	1.000	1.250	SP-34	#2-56x 1/4 S.H.C.S.	CL-7	XNS-36	TK-00502
C-CRGPR-20-3	C-CRGPL-20-3	RPGN-32	1.250	1.250	6.000	1.000	1.500	SP-34	#2-56x 1/4 S.H.C.S.	CL-7	XNS-36	TK-00502
C-CRGPR-16-4C	C-CRGPL-16-4C	RPGN-43	1.000	1.000	5.000	1.188	1.250	SP-44	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00503
C-CRGPR-16-4	C-CRGPL-16-4	RPGN-43	1.000	1.000	6.000	1.188	1.250	SP-44	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00503
C-CRGPR-20-4	C-CRGPL-20-4	RPGN-43	1.250	1.250	6.000	1.188	1.500	SP-44	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00503
C-CRGPR-24-4	C-CRGPL-24-4	RPGN-43	1.500	1.500	8.000	1.188	2.000	SP-44	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00503

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

C-CSDPN

Style D / Square / Positive Rake / 45° Lead



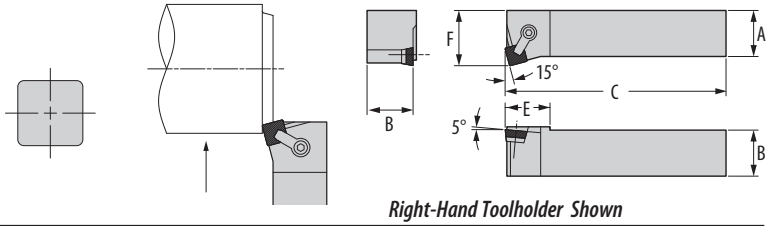
Neutral Toolholder Shown

Part Number	Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit
Neutral	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CSDPN-16-4C	SPGN-432	1.000	1.000	5.000	1.391	0.500	SP-41	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00504
C-CSDPN-16-4	SPGN-432	1.000	1.000	6.000	1.391	0.500	SP-41	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00504
C-CSDPN-20-4	SPGN-432	1.250	1.250	6.000	1.391	0.625	SP-41	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00504

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

C-CSKPR/L

Style K / Square / Positive Rake / 15° Lead



Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CSKPR-16-4C	C-CSKPL-16-4C	SPGN-432	1.000	1.000	5.000	1.219	1.250	SP-41	#4-40X 3/8 F.H.C.S.	CL-12	XNS-59	TK-00504
C-CSKPR-16-4	C-CSKPL-16-4	SPGN-432	1.000	1.000	6.000	1.219	1.250	SP-41	#4-40X 3/8 F.H.C.S.	CL-12	XNS-59	TK-00504
C-CSKPR-20-4	C-CSKPL-20-4	SPGN-432	1.250	1.250	6.000	1.219	1.500	SP-41	#4-40X 3/8 F.H.C.S.	CL-12	XNS-59	TK-00504

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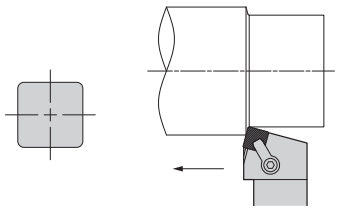
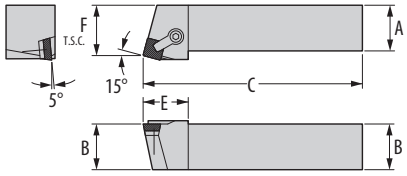
C-CSRPR/L

Style R / Square / Positive Rake / 15° Lead





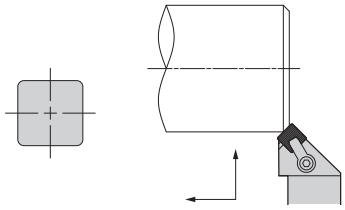
Right-Hand Toolholder Shown

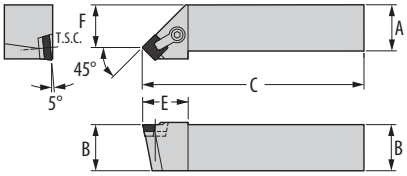
Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CSRPR-16-4C	C-CSRPL-16-4C	SPGN-432	1.000	1.000	5.000	1.234	1.125	SP-41	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00504
C-CSRPR-16-4	C-CSRPL-16-4	SPGN-432	1.000	1.000	6.000	1.234	1.125	SP-41	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00504
C-CSRPR-20-4	C-CSRPL-20-4	SPGN-432	1.250	1.250	6.000	1.234	1.375	SP-41	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00504

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

C-CSSPR/L

Style S / Square / Positive Rake / 45° Lead





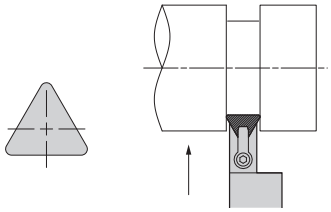
Right-Hand Toolholder Shown

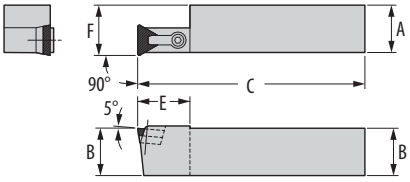
Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CSSPR-16-4C	C-CSSPL-16-4C	SPGN-432	1.000	1.000	5.000	1.234	0.906	SP-41	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00504
C-CSSPR-16-4	C-CSSPL-16-4	SPGN-432	1.000	1.000	6.000	1.234	0.906	SP-41	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00504
C-CSSPR-20-4	C-CSSPL-20-4	SPGN-432	1.250	1.250	6.000	1.234	1.156	SP-41	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00504

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

C-CTCPR/L

Style C / Triangle / Positive Rake / 0° Lead





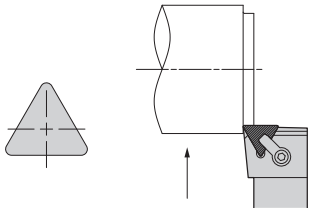
Right-Hand Toolholder Shown

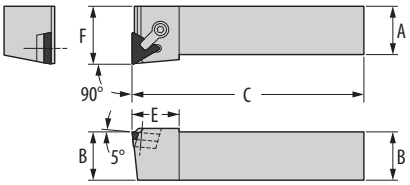
Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CTCPR-16-3C	C-CTCPL-16-3C	TPGN-322	1.000	1.000	5.000	1.125	1.047	SP3A	#4-40x 3/8 F.H.C.S.	CL-22	XNS-48	TK-00505
C-CTCPR-16-3	C-CTCPL-16-3	TPGN-322	1.000	1.000	6.000	1.125	1.047	SP3A	#4-40x 3/8 F.H.C.S.	CL-22	XNS-48	TK-00505
C-CTCPR-20-3	C-CTCPL-20-3	TPGN-322	1.250	1.250	6.000	1.125	1.297	SP3A	#4-40x 3/8 F.H.C.S.	CL-22	XNS-48	TK-00505
C-CTCPR-16-4C	C-CTCPL-16-4C	TPGN-432	1.000	1.000	5.000	1.375	1.078	SP-4	#6-32x 1/2 F.H.C.S.	CL-30	XNS-59	TK-00506
C-CTCPR-16-4	C-CTCPL-16-4	TPGN-432	1.000	1.000	6.000	1.375	1.078	SP-4	#6-32x 1/2 F.H.C.S.	CL-30	XNS-59	TK-00506
C-CTCPR-20-4	C-CTCPL-20-4	TPGN-432	1.250	1.250	6.000	1.375	1.328	SP-4	#6-32x 1/2 F.H.C.S.	CL-30	XNS-59	TK-00506
C-CTCPR-24-4	C-CTCPL-24-4	TPGN-432	1.500	1.500	8.000	1.375	1.578	SP-4	#6-32x 1/2 F.H.C.S.	CL-30	XNS-59	TK-00506

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

C-CTFPR/L

Style F / Triangle / Positive Rake / 0° Lead





Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CTFPR-16-3C	C-CTFPL-16-3C	TPGN-322	1.000	1.000	5.000	0.938	1.250	SP3A	#4-40x 3/8 F.H.C.S.	CL-7	XNS-36	TK-00507
C-CTFPR-16-3	C-CTFPL-16-3	TPGN-322	1.000	1.000	6.000	0.938	1.250	SP3A	#4-40x 3/8 F.H.C.S.	CL-7	XNS-36	TK-00507
C-CTFPR-20-3	C-CTFPL-20-3	TPGN-322	1.250	1.250	6.000	0.938	1.500	SP3A	#4-40x 3/8 F.H.C.S.	CL-7	XNS-36	TK-00507
C-CTFPR-16-4C	C-CTFPL-16-4C	TPGN-432	1.000	1.000	5.000	1.219	1.250	SP4	#6-32x 1/2 F.H.C.S.	CL-12	XNS-59	TK-00508
C-CTFPR-16-4	C-CTFPL-16-4	TPGN-432	1.000	1.000	6.000	1.219	1.250	SP4	#6-32x 1/2 F.H.C.S.	CL-12	XNS-59	TK-00508
C-CTFPR-20-4	C-CTFPL-20-4	TPGN-432	1.250	1.250	6.000	1.219	1.500	SP4	6-32x 1/2 F.H.C.S.	CL-12	XNS-59	TK-00508
C-CTFPR-24-4	C-CTFPL-24-4	TPGN-432	1.500	1.500	8.000	1.219	2.000	SP4	#6-32x 1/2 F.H.C.S.	CL-12	XNS-59	TK-00508

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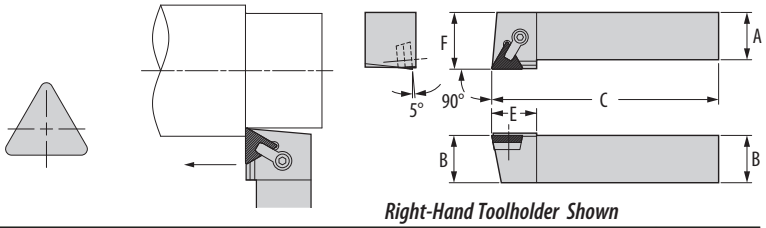
C-CTGPR/L

Style G / Triangle / Positive Rake / 0° Lead



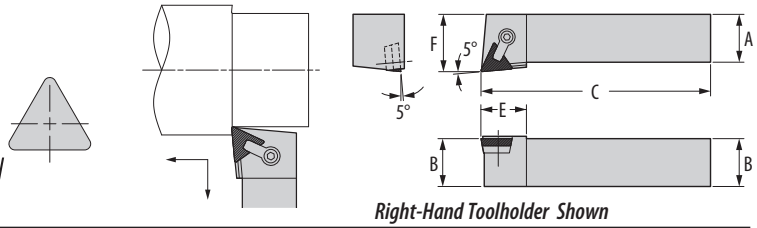
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CTGPR-16-3C	C-CTGPL-16-3C	TPGN-322	1.000	1.000	5.000	1.109	1.250	SP3A	#4-40x 3/8 F.H.C.S.	CL-7	XNS-36	TK-00507
C-CTGPR-16-3	C-CTGPL-16-3	TPGN-322	1.000	1.000	6.000	1.109	1.250	SP3A	#4-40x 3/8 F.H.C.S.	CL-7	XNS-36	TK-00507
C-CTGPR-20-3	C-CTGPL-20-3	TPGN-322	1.250	1.250	6.000	1.109	1.500	SP3A	#4-40x 3/8 F.H.C.S.	CL-7	XNS-36	TK-00507
C-CTGPR-16-4C	C-CTGPL-16-4C	TPGN-432	1.000	1.000	5.000	1.188	1.250	SP-4	#6-32x 1/2 F.H.C.S.	CL-12	XNS-59	TK-00508
C-CTGPR-16-4	C-CTGPL-16-4	TPGN-432	1.000	1.000	6.000	1.188	1.250	SP-4	#6-32x 1/2 F.H.C.S.	CL-12	XNS-59	TK-00508
C-CTGPR-20-4	C-CTGPL-20-4	TPGN-432	1.250	1.250	6.000	1.188	1.500	SP-4	#6-32x 1/2 F.H.C.S.	CL-12	XNS-59	TK-00508
C-CTGPR-24-4	C-CTGPL-24-4	TPGN-432	1.500	1.500	8.000	1.188	2.000	SP-4	#6-32x 1/2 F.H.C.S.	CL-12	XNS-59	TK-00508

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

C-CTLPR/L

Style F / Triangle / Positive Rake / 5° Reverse Lead



Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CTLPR-16-3C	C-CTLPL-16-3C	TPGN-322	1.000	1.000	5.000	1.109	1.250	SP3A	#4-40x 3/8 F.H.C.S.	CL-7	XNS-36	TK-00507
C-CTLPR-16-3	C-CTLPL-16-3	TPGN-322	1.000	1.000	6.000	1.109	1.250	SP3A	#4-40x 3/8 F.H.C.S.	CL-7	XNS-36	TK-00507
C-CTLPR-20-3	C-CTLPL-20-3	TPGN-322	1.250	1.250	6.000	1.109	1.500	SP3A	#4-40x 3/8 F.H.C.S.	CL-7	XNS-36	TK-00507
C-CTLPR-16-4C	C-CTLPL-16-4C	TPGN-432	1.000	1.000	5.000	1.188	1.250	SP4	#6-32x 1/2 F.H.C.S.	CL-12	XNS-59	TK-00508
C-CTLPR-16-4	C-CTLPL-16-4	TPGN-432	1.000	1.000	6.000	1.188	1.250	SP4	#6-32x 1/2 F.H.C.S.	CL-12	XNS-59	TK-00508
C-CTLPR-20-4	C-CTLPL-20-4	TPGN-432	1.250	1.250	6.000	1.188	1.500	SP4	#6-32x 1/2 F.H.C.S.	CL-12	XNS-59	TK-00508
C-CTLPR-24-4	C-CTLPL-24-4	TPGN-432	1.500	1.500	8.000	1.188	2.000	SP4	#6-32x 1/2 F.H.C.S.	CL-12	XNS-59	TK-00508

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

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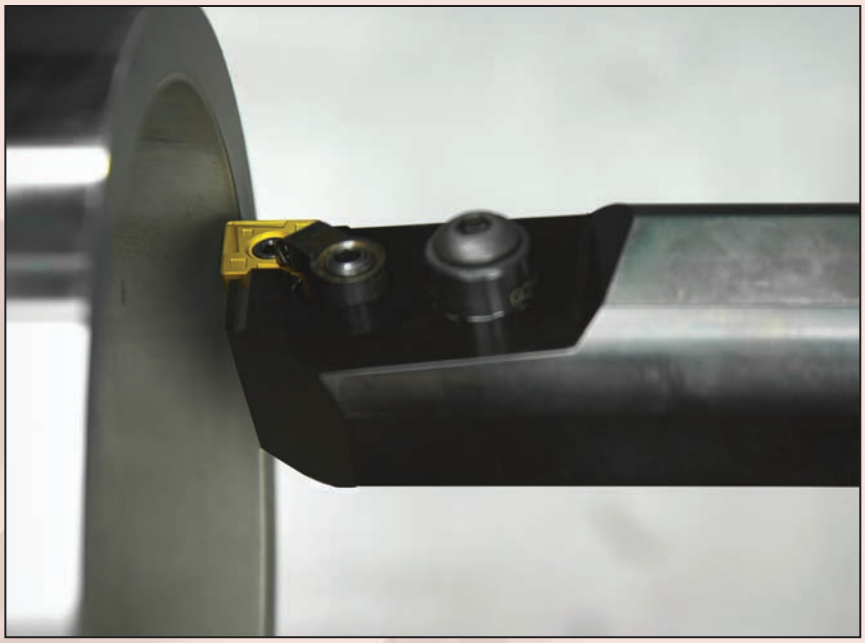
Industry-Standard Boring Bars for Carbide Inserts

The boring bar systems and cartridges in this catalog are designed around industry standard hardware. This gives complete interchangeability with other tooling components and minimizes spare parts inventories.

Most bars incorporate "through the bar" coolant feed with directable outlet nozzle.

Greenleaf uses heat-treated alloy steel to ensure a consistent, high-quality product for maximum life performance.

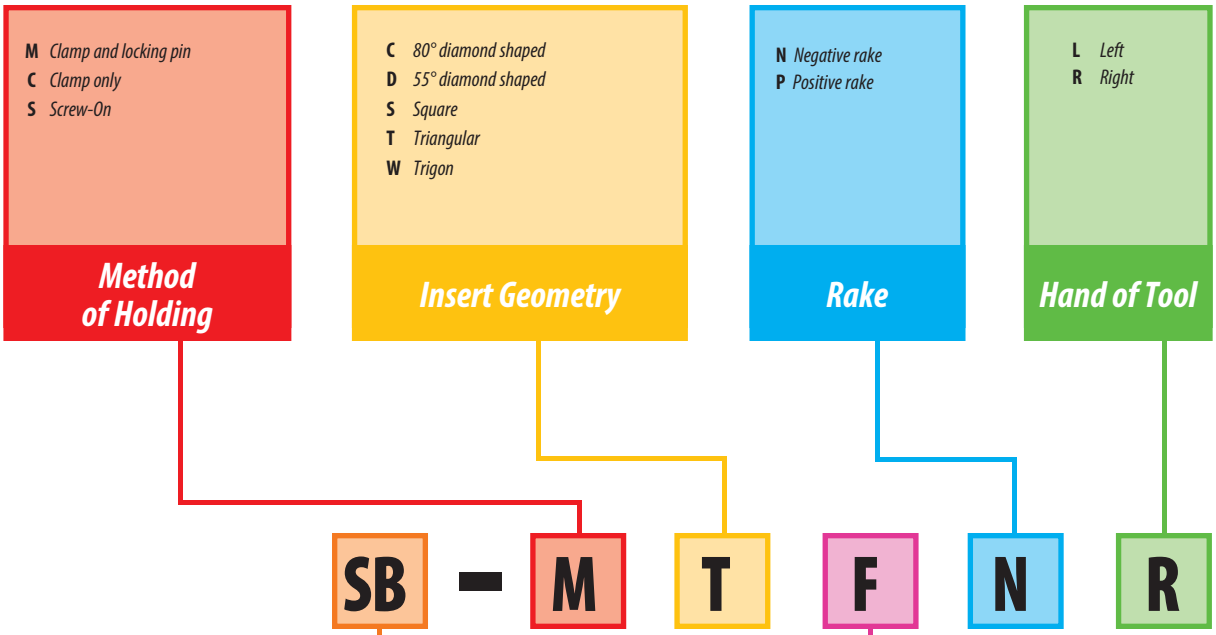
Custom engineered tooling is a Greenleaf specialty and we will be pleased to quote your special requirements for boring. Additionally, Greenleaf has the capability to quote boring bars made of heavy metal shanks or "No-Chat" material.



Greenleaf Tune-Up Kits

A Tune-Up Kit consists of all the standard hardware to refurbish a particular toolholder, boring bar, or milling cutter. A toolholder will have a readily visible, laser-inscribed Tune-Up Kit number on it for ease in ordering. This number will prevent any confusion created by searching a catalog for hardware, and it will help reduce downtime.

Boring Bar Identification System



NOTE:
The angles shown in parentheses are the angles as shown in the ANSI standard.

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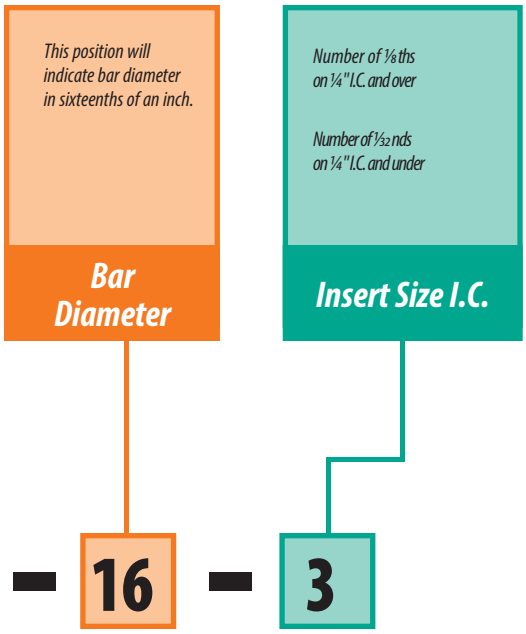

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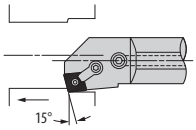
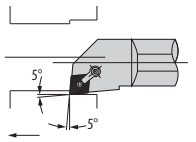
Pictorial Index

80° Diamond – Negative

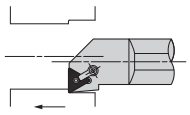


SB-MCKNR/L
Style K
80° Diamond
(Using 100° Corner)
Negative Rake
15° Lead
page: T 114

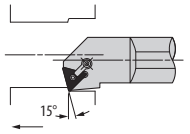


SB-MCLNR/L
Style L
80° Diamond
Negative Rake
5° Reverse Lead
page: T 114

Triangle – Negative

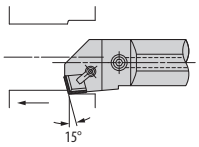


SB-MTFNR/L
Style F
Triangle
Negative Rake
0° Lead
page: T 117

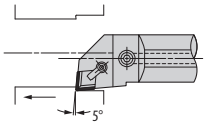


SB-MTKNR/L
Style K
Triangle
Negative Rake
15° Lead
page: T 117

80° Diamond – Positive

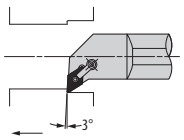


SB-CCKPR/L
Style K
80° Diamond
(Using 100° Corner)
Positive Rake
15° Lead
page: T 119



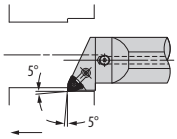
SB-CCLPR/L
Style L
80° Diamond
Positive Rake
5° Reverse Lead
page: T 119

55° Diamond – Negative



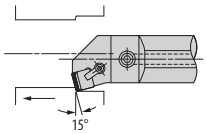
SB-MDUNR/L
Style U
55° Diamond
Negative Rake
3° Reverse Lead
page: T 115

Trigon – Negative



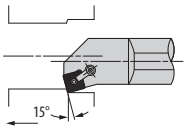
SB-MWLNR/L
Style L
80° Trigon
Negative Rake
5° Reverse Lead
page: T 118

Square – Positive



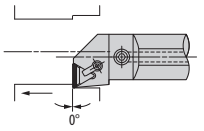
SB-CSKPR/L
Style K
Square
Positive Rake
15° Lead
page: T 120

Square – Negative



SB-MSKNR/L
Style K
Square
Negative Rake
15° Lead
page: T 116

Triangle – Positive



SB-CTFPR/L
Style F
Triangle
Positive Rake
0° Lead
page: T 121

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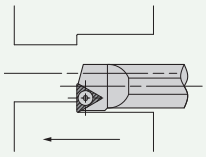
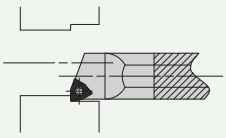
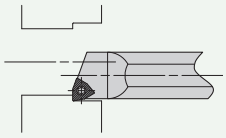
Screw-On



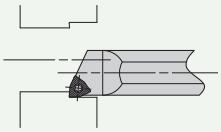
S-STFNR/L
Style F
Triangle
Positive Rake
0° Lead
page: T 121



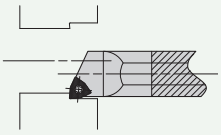
S-SWFCR/L
Style F
Screw-On Trigon
Heavy Metal
Fixed Steel Head
0° Lead
page: T 122



C-SWFCR/L
Style F
Screw-On Trigon
Solid Steel
0° Lead
page: T 122



S-SWLCR/L
Style L
Screw-On Trigon
Solid Steel
5° Reverse Lead
page: T 123

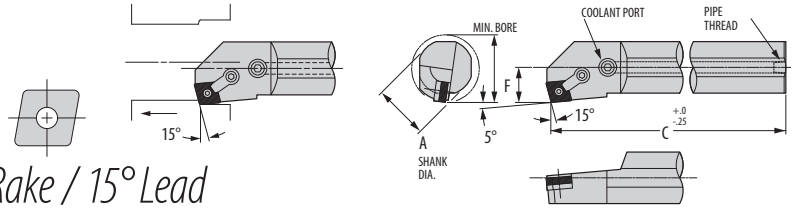


C-SWLCR/L
Style L
Screw-On Trigon
Heavy Metal
Fixed Steel Head
5° Reverse Lead
page: T 123

These Boring Bars do not follow the Boring Bar Identification System.

SB-MCKNR/L

Style K / 80° Diamond (Using 100° Corner) / Negative Rake / 15° Lead



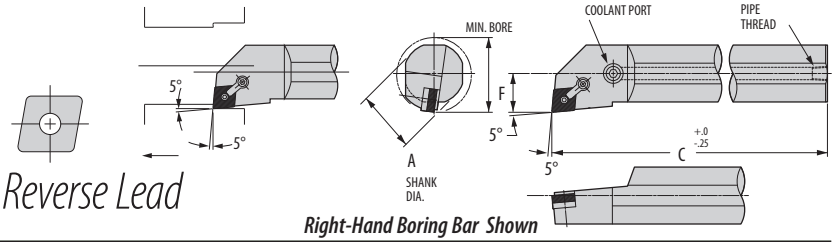
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Clamp Screw	Shim	Lock Pin		Shim Screw	Shim
SB-MCKNR-16-4	SB-MCKNL-16-4	CNGA-432	1.250	1.000	12.000	0.640	CL-20	XNS-47	–	NL-44	TK-00657	–	–
SB-MCKNR-20-4	SB-MCKNL-20-4	CNGA-432	1.468	1.250	13.750	0.765	CL-20	XNS-47	CSNB-433	NL-46A	TK-00658	S-46S	–
SB-MCKNR-24-4	SB-MCKNL-24-4	CNGA-432	1.718	1.500	13.750	0.890	CL-20	XNS-47	CSN-432	NL-46	TK-00659	S-46S	–
SB-MCKNR-28-4	SB-MCKNL-28-4	CNGA-432	1.968	1.750	13.750	1.015	CL-20	XNS-47	CSN-432	NL-46	TK-00659	S-46S	–
SB-MCKNR-32-6	SB-MCKNL-32-6	CNGA-643	2.468	2.000	16.000	1.281	CL-12	XNS-510	CSN-633	NL-68	TK-00546	S-68S	CSN-642
SB-MCKNR-36-6	SB-MCKNL-36-6	CNGA-643	2.718	2.250	16.000	1.406	CL-12	XNS-510	CSN-633	NL-68	TK-00546	S-68S	CSN-642
SB-MCKNR-40-6	SB-MCKNL-40-6	CNGA-643	2.968	2.500	16.000	1.531	CL-12	XNS-510	CSN-633	NL-68	TK-00546	S-68S	CSN-642

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

SB-MCLNR/L

Style L / 80° Diamond / Negative Rake / 5° Reverse Lead



Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Clamp Screw	Shim	Lock Pin		Shim Screw	Shim
SB-MCLNR-16-4	SB-MCLNL-16-4	CNGA-432	1.375	1.000	12.000	0.640	CL-20	XNS-47	–	NL-44	TK-00657	–	–
SB-MCLNR-20-4	SB-MCLNL-20-4	CNGA-432	1.600	1.250	13.750	0.765	CL-20	XNS-47	CSNB-433	NL-46A	TK-00658	S-46S	–
SB-MCLNR-24-4	SB-MCLNL-24-4	CNGA-432	1.800	1.500	13.750	0.890	CL-20	XNS-47	CSN-432	NL-46	TK-00659	S-46S	–
SB-MCLNR-28-4	SB-MCLNL-28-4	CNGA-432	1.925	1.750	13.750	1.015	CL-20	XNS-47	CSN-432	NL-46	TK-00659	S-46S	–
SB-MCLNR-32-6	SB-MCLNL-32-6	CNGA-643	2.475	2.000	16.000	1.281	CL-12	XNS-510	CSN-633	NL-68	TK-00546	S-68S	CSN-642
SB-MCLNR-36-6	SB-MCLNL-36-6	CNGA-643	2.718	2.250	16.000	1.406	CL-12	XNS-510	CSN-633	NL-68	TK-00546	S-68S	CSN-642
SB-MCLNR-40-6	SB-MCLNL-40-6	CNGA-643	2.968	2.500	16.000	1.531	CL-12	XNS-510	CSN-633	NL-68	TK-00546	S-68S	CSN-642

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

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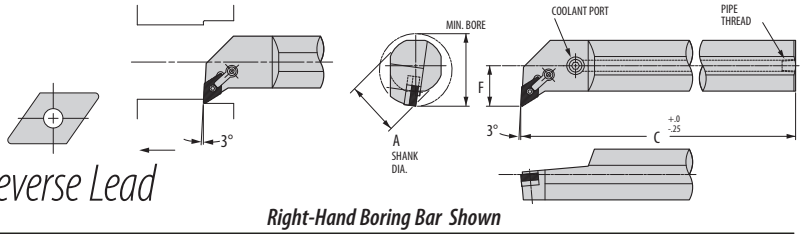
SB-MDUNR/L

Style U / 55° Diamond / Negative Rake / 3° Reverse Lead



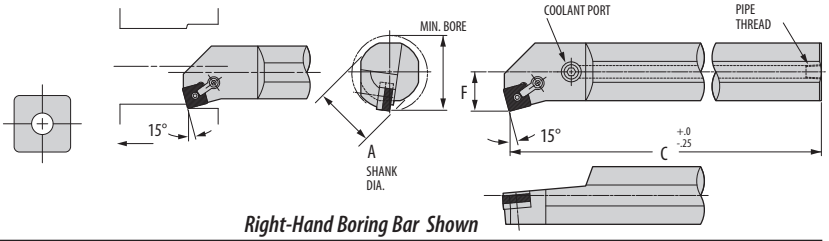
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit	Optional Components
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Clamp Screw	Shim	Lock Pin		Shim Screw
SB-MDUNR-20-4	SB-MDUNL-20-4	DNGA-432	2.000	1.250	13.750	1.000	CL-12	XNS-59	DSN-433	NL-46	TK-00660	S-46S
SB-MDUNR-24-4	SB-MDUNL-24-4	DNGA-432	2.250	1.500	13.750	1.125	CL-12	XNS-59	DSN-433	NL-46	TK-00660	S-46S
SB-MDUNR-28-4	SB-MDUNL-28-4	DNGA-432	2.500	1.750	13.750	1.250	CL-12	XNS-59	DSN-433	NL-46	TK-00660	S-46S
SB-MDUNR-28-5	SB-MDUNL-28-5	DNGA-543	2.750	1.750	13.750	1.375	CL-30	XNS-510	DSN-533	NL-58	TK-00722	S-58S
SB-MDUNR-32-5	SB-MDUNL-32-5	DNGA-543	3.000	2.000	16.000	1.500	CL-30	XNS-510	DSN-533	NL-58	TK-00722	S-58S
SB-MDUNR-36-5	SB-MDUNL-36-5	DNGA-543	3.250	2.250	16.000	1.625	CL-30	XNS-510	DSN-533	NL-58	TK-00722	S-58S
SB-MDUNR-40-5	SB-MDUNL-40-5	DNGA-543	3.500	2.500	16.000	1.750	CL-30	XNS-510	DSN-533	NL-58	TK-00722	S-58S

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

SB-MSKNR/L

Style K / Square / Negative Rake / 15° Lead



Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Clamp Screw	Shim	Lock Pin		Shim Screw	Shim
SB-MSKNR-16-4	SB-MSKNL-16-4	SNGA-432	1.350	1.000	12.000	0.640	CL-6	XNS-36	–	NL-44	TK-00661	–	–
SB-MSKNR-20-4	SB-MSKNL-20-4	SNGA-432	1.600	1.250	13.750	0.765	CL-9	XNS-59	ISSNB-433	NL-46	TK-00662	S-46S	–
SB-MSKNR-24-4	SB-MSKNL-24-4	SNGA-432	1.718	1.500	13.750	0.890	CL-9	XNS-59	ISSN-433	NL-46	TK-00558	S-46S	–
SB-MSKNR-28-4	SB-MSKNL-28-4	SNGA-432	1.968	1.750	13.750	1.015	CL-9	XNS-59	ISSN-433	NL-46	TK-00558	S-46S	–
SB-MSKNR-32-5	SB-MSKNL-32-5	SNGA-543	2.468	2.000	16.000	1.281	CL-12	XNS-510	SSN-533	NL-58	TK-00559	S-58S	ISSN-543
SB-MSKNR-36-5	SB-MSKNL-36-5	SNGA-543	2.718	2.250	16.000	1.406	CL-12	XNS-510	SSN-533	NL-58	TK-00559	S-58S	ISSN-543
SB-MSKNR-32-6	SB-MSKNL-32-6	SNGA-643	2.468	2.000	16.000	1.281	CL-12	XNS-510	ISSN-633	NL-68	TK-00560	S-68S	ISSN-643
SB-MSKNR-36-6	SB-MSKNL-36-6	SNGA-643	2.718	2.250	16.000	1.406	CL-12	XNS-510	ISSN-633	NL-68	TK-00560	S-68S	ISSN-643
SB-MSKNR-40-6	SB-MSKNL-40-6	SNGA-643	2.968	2.500	16.000	1.531	CL-12	XNS-510	ISSN-633	NL-68	TK-00560	S-68S	ISSN-643

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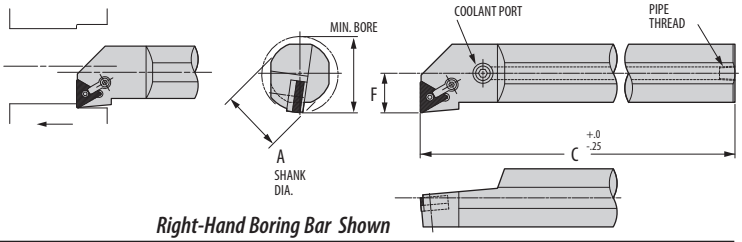
SB-MTFNR/L

Style F / Triangle / Negative Rake / 0° Lead



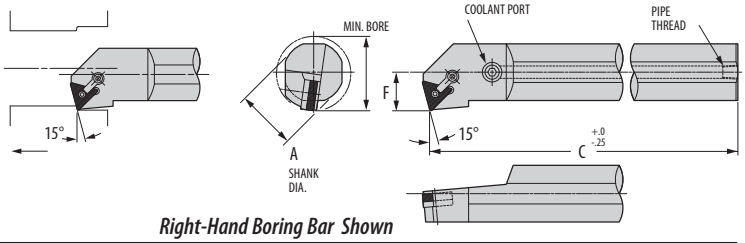
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Clamp Screw	Shim	Lock Pin		Shim Screw	Shim
SB-MTFNR-16-3	SB-MTFNL-16-3	TNGA-332	1.325	1.000	12.000	0.640	CL-6	XNS-35	–	NL-33L	TK-00663	–	–
SB-MTFNR-20-3	SB-MTFNL-20-3	TNGA-332	1.550	1.250	13.750	0.765	CL-6	XNS-35	ITSN-322	NL-34L	TK-00664	S-34S	–
SB-MTFNR-24-3	SB-MTFNL-24-3	TNGA-332	1.825	1.500	13.750	0.890	CL-6	XNS-35	ITSN-322	NL-34L	TK-00664	S-34S	–
SB-MTFNR-28-3	SB-MTFNL-28-3	TNGA-332	1.968	1.750	13.750	1.015	CL-6	XNS-35	ITSN-322	NL-34L	TK-00664	S-34S	–
SB-MTFNR-24-4	SB-MTFNL-24-4	TNGA-432	1.968	1.500	13.750	1.031	CL-9	XNS-59	ITSN-432	NL-46	TK-00665	S-46S	TS-424
SB-MTFNR-28-4	SB-MTFNL-28-4	TNGA-432	2.218	1.750	13.750	1.156	CL-9	XNS-59	ITSN-432	NL-46	TK-00665	S-46S	TS-424
SB-MTFNR-32-5	SB-MTFNL-32-5	TNGA-543	2.468	2.000	16.000	1.281	CL-12	XNS-510	ITSN-533	NL-58	TK-00569	S-58S	–
SB-MTFNR-36-5	SB-MTFNL-36-5	TNGA-543	2.718	2.250	16.000	1.406	CL-12	XNS-510	ITSN-533	NL-58	TK-00569	S-58S	–
SB-MTFNR-40-5	SB-MTFNL-40-5	TNGA-543	2.968	2.500	16.000	1.531	CL-12	XNS-510	ITSN-533	NL-58	TK-00569	S-58S	–

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

SB-MTKNR/L

Style K / Triangle / Negative Rake / 15° Lead



Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Clamp Screw	Shim	Lock Pin		Shim Screw	Shim
SB-MTKNR-16-3	SB-MTKNL-16-3	TNGA-332	1.325	1.000	12.000	0.640	CL-6	XNS-35	–	NL-33L	TK-00663	–	–
SB-MTKNR-20-3	SB-MTKNL-20-3	TNGA-332	1.550	1.250	13.750	0.765	CL-6	XNS-35	ITSN-322	NL-34L	TK-00664	S-34S	–
SB-MTKNR-24-3	SB-MTKNL-24-3	TNGA-332	1825	1.500	13.750	0.890	CL-6	XNS-35	ITSN-322	NL-34L	TK-00664	S-34S	–
SB-MTKNR-28-3	SB-MTKNL-28-3	TNGA-332	1.968	1.750	13.750	1.015	CL-6	XNS-35	ITSN-322	NL-34L	TK-00664	S-34S	–
SB-MTKNR-24-4	SB-MTKNL-24-4	TNGA-432	1.968	1.500	13.750	1.031	CL-9	XNS-59	ITSN-432	NL-46	TK-00665	S-46S	TS-424
SB-MTKNR-28-4	SB-MTKNL-28-4	TNGA-432	2.218	1.750	13.750	1.156	CL-9	XNS-59	ITSN-432	NL-46	TK-00665	S-46S	TS-424
SB-MTKNR-32-5	SB-MTKNL-32-5	TNGA-543	2.468	2.000	16.000	1.281	CL-12	XNS-510	ITSN-533	NL-58	TK-00569	S-58S	–
SB-MTKNR-36-5	SB-MTKNL-36-5	TNGA-543	2.718	2.250	16.000	1.406	CL-12	XNS-510	ITSN-533	NL-58	TK-00569	S-58S	–
SB-MTKNR-40-5	SB-MTKNL-40-5	TNGA-543	2.968	2.500	16.000	1.531	CL-12	XNS-510	ITSN-533	NL-58	TK-00569	S-58S	–

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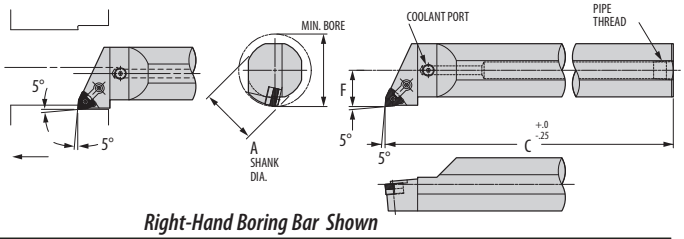
SB-MWLNR/L

Style L / 80° Trigon / Negative Rake / 5° Reverse Lead



Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit	Optional Components
Right Hand	Left Hand	Inserts		A	C	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat
† SB-MWLNR-12-3	SB-MWLNL-12-3†	WNMA-332	1.025	0.750	10.000	0.515	–	NL-33L	CL-6	XNS-36	TK-00796	–
SB-MWLNR-16-3	SB-MWLNL-16-3	WNMA-332	1.200	1.000	12.000	0.640	–	NL-33L	CL-6	XNS-36	TK-00796	–
SB-MWLNR-20-3	SB-MWLNL-20-3	WNMA-332	1.470	1.250	13.750	0.765	IWSN-322	NL-34L	CL-6	XNS-36	TK-00777	IWSN-332
SB-MWLNR-24-3	SB-MWLNL-24-3	WNMA-332	1.780	1.500	13.750	0.890	IWSN-322	NL-34L	CL-6	XNS-36	TK-00777	IWSN-332
SB-MWLNR-16-4	SB-MWLNL-16-4	WNMA-432	1.280	1.000	12.000	0.640	–	NL-44	CL-20	XNS-47	TK-00657	–
SB-MWLNR-20-4	SB-MWLNL-20-4	WNMA-432	1.530	1.250	13.750	0.765	IWSN-433	NL-46	CL-20	XNS-48	TK-00759	–
SB-MWLNR-24-4	SB-MWLNL-24-4	WNMA-432	1.780	1.500	13.750	0.890	IWSN-433	NL-46	CL-20	XNS-48	TK-00759	–

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† Coolant port not available.

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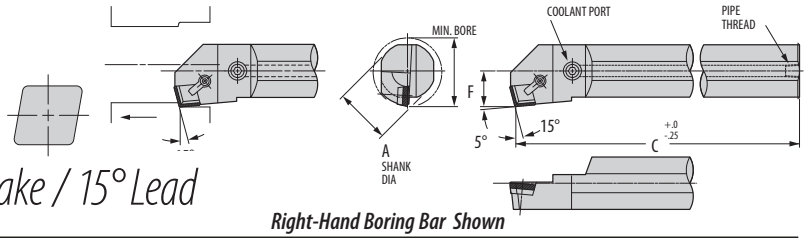
SB-CCKPR/L

Style K / 80° Diamond (Using 100° Corner) / Positive Rake / 15° Lead



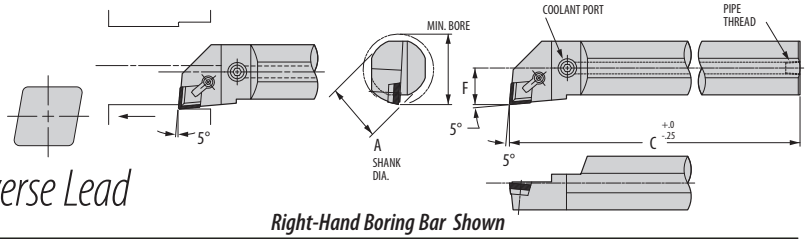
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components					*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Clamp Screw	Shim	Shim Screw	Chipbreaker	
SB-CCKPR-16-4	SB-CCKPL-16-4	CPGN-422	1.250	1.000	12.000	0.640	CL-7	XNS-35	–	–	CBDC-415L	TK-00820
SB-CCKPR-20-4	SB-CCKPL-20-4	CPGN-422	1.468	1.250	13.750	0.765	CL-20	XNS-47	CSP-422	#4-40 x 1/4 F.H.C.S.	CBDC-415L	TK-00921
SB-CCKPR-24-4	SB-CCKPL-24-4	CPGN-422	1.718	1.500	13.750	0.890	CL-20	XNS-47	CSP-422	#4-40 x 1/4 F.H.C.S.	CBDC-415L	TK-00921
SB-CCKPR-28-4	SB-CCKPL-28-4	CPGN-422	1.968	1.750	13.750	1.015	CL-20	XNS-47	CSP-422	#4-40 x 1/4 F.H.C.S.	CBDC-415L	TK-00921
SB-CCKPR-32-6	SB-CCKPL-32-6	CPGN-633	2.468	2.000	16.000	1.281	CL-30	XNS-59	CSP-632	#5-40 x 3/8 F.H.C.S.	CBDC-615G	TK-00920
SB-CCKPR-36-6	SB-CCKPL-36-6	CPGN-633	2.718	2.250	16.000	1.406	CL-30	XNS-59	CSP-632	#5-40 x 3/8 F.H.C.S.	CBDC-615G	TK-00920
SB-CCKPR-40-6	SB-CCKPL-40-6	CPGN-633	2.968	2.500	16.000	1.531	CL-30	XNS-59	CSP-632	#5-40 x 3/8 F.H.C.S.	CBDC-615G	TK-00920

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

SB-CCLPR/L

Style L / 80° Diamond / Positive Rake / 5° Reverse Lead



Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components					*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Clamp Screw	Shim	Shim Screw	Chipbreaker	
SB-CCKPR-16-4	SB-CCKPL-16-4	CPGN-422	1.250	1.000	12.000	0.640	CL-7	XNS-35	–	–	CBDC-4L	TK-00705
SB-CCKPR-20-4	SB-CCKPL-20-4	CPGN-422	1.468	1.250	13.750	0.765	CL-20	XNS-47	CSP-422	#4-40 x 1/4 F.H.C.S.	CBDC-4L	TK-00746
SB-CCKPR-24-4	SB-CCKPL-24-4	CPGN-422	1.718	1.500	13.750	0.890	CL-20	XNS-47	CSP-422	#4-40 x 1/4 F.H.C.S.	CBDC-4L	TK-00746
SB-CCKPR-28-4	SB-CCKPL-28-4	CPGN-422	1.968	1.750	13.750	1.015	CL-20	XNS-47	CSP-422	#4-40 x 1/4 F.H.C.S.	CBDC-4L	TK-00746
SB-CCKPR-32-6	SB-CCKPL-32-6	CPGN-633	2.468	2.000	16.000	1.281	CL-30	XNS-59	CSP-632	#5-40 x 3/8 F.H.C.S.	CBDC-6G	TK-00532
SB-CCKPR-36-6	SB-CCKPL-36-6	CPGN-633	2.718	2.250	16.000	1.406	CL-30	XNS-59	CSP-632	#5-40 x 3/8 F.H.C.S.	CBDC-6G	TK-00532
SB-CCKPR-40-6	SB-CCKPL-40-6	CPGN-633	2.968	2.500	16.000	1.531	CL-30	XNS-59	CSP-632	#5-40 x 3/8 F.H.C.S.	CBDC-6G	TK-00532

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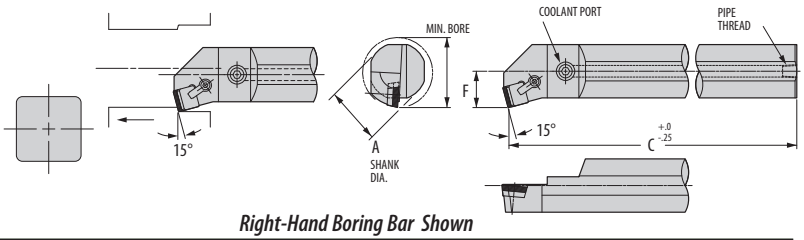
SB-CSKPR/L

Style K / Square / Positive Rake / 15° Lead



Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components					*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Clamp Screw	Shim	Shim Screw	Chipbreaker	
SB-CSKPR-16-4	**SB-CSKPL-16-4**	SPGN-422	1.250	1.000	12.000	0.640	CL-7	XNS-35	–	–	CBS-4G	TK-00757
SB-CSKPR-20-4	**SB-CSKPL-20-4**	SPGN-422	1.468	1.250	13.750	0.765	CL-20	XNS-47	–	–	CBS-4G	TK-00776
SB-CSKPR-24-4	**SB-CSKPL-24-4**	SPGN-422	1.718	1.500	13.750	0.890	CL-20	XNS-47	SP-40	#6-32 x 1/2 F.H.C.S.	CBS-4G	TK-02168
SB-CSKPR-28-4	**SB-CSKPL-28-4**	SPGN-422	1.968	1.750	13.750	1.015	CL-20	XNS-47	SP-40	#6-32 x 1/2 F.H.C.S.	CBS-4G	TK-02168
SB-CSKPR-32-6	**SB-CSKPL-32-6**	SPGN-633	2.468	2.000	16.000	1.281	CL-30	XNS-59	SP-60	#8-32 x 1/2 F.H.C.S.	CBS-6G	TK-00825
SB-CSKPR-36-6	**SB-CSKPL-36-6**	SPGN-633	2.718	2.250	16.000	1.406	CL-30	XNS-59	SP-60	#8-32 x 1/2 F.H.C.S.	CBS-6G	TK-00825
SB-CSKPR-40-6	**SB-CSKPL-40-6**	SPGN-633	2.968	2.500	16.000	1.531	CL-30	XNS-59	SP-60	#8-32 x 1/2 F.H.C.S.	CBS-6G	TK-00825

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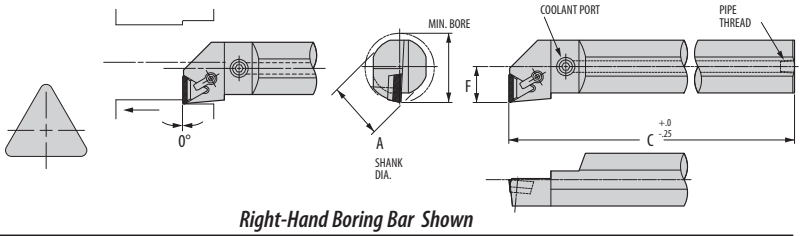
SB-CTFPR/L

Style F / Triangle / Positive Rake / 0° Lead



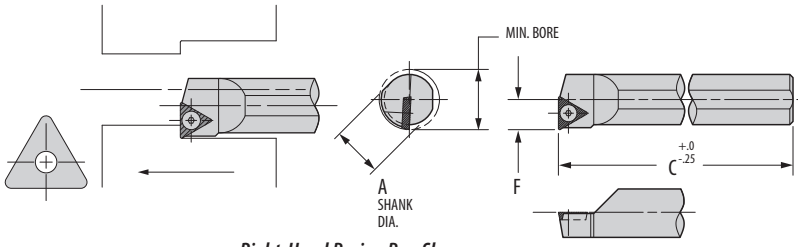
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components					*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Clamp Screw	Shim	Shim Screw	Chipbreaker	
SB-CTFPR-16-3	SB-CTFPL-16-3	TPGN-322	1.250	1.000	12.000	0.640	CL-7	XNS-35	–	–	CBT-3G	TK-00655
SB-CTFPR-20-3	SB-CTFPL-20-3	TPGN-322	1.468	1.250	13.750	0.765	CL-6	XNS-35	TSP-321	#4-40 x 3/8 F.H.C.S.	CBT-3G	TK-00653
SB-CTFPR-24-3	SB-CTFPL-24-3	TPGN-322	1.718	1.500	13.750	0.890	CL-6	XNS-35	TSP-321	#4-40 x 3/8 F.H.C.S.	CBT-3G	TK-00653
SB-CTFPR-28-3	SB-CTFPL-28-3	TPGN-322	1.968	1.750	13.750	1.015	CL-6	XNS-35	TSP-321	#4-40 x 3/8 F.H.C.S.	CBT-3G	TK-00653
SB-CTFPR-24-4	SB-CTFPL-24-4	TPGN-432	1.968	1.500	13.750	1.031	CL-12	XNS-58	SP-4	#6-32 x 1/2 F.H.C.S.	CBT-4G	TK-00654
SB-CTFPR-28-4	SB-CTFPL-28-4	TPGN-432	2.218	1.750	13.750	1.156	CL-12	XNS-58	SP-4	#6-32 x 1/2 F.H.C.S.	CBT-4G	TK-00654
SB-CTFPR-32-5	SB-CTFPL-32-5	TPGN-543	2.468	2.000	16.000	1.281	CL-12	XNS-510	SP-5	#8-32 x 1/2 F.H.C.S.	CBT-5G	TK-00656
SB-CTFPR-36-5	SB-CTFPL-36-5	TPGN-543	2.718	2.250	16.000	1.406	CL-12	XNS-510	SP-5	#8-32 x 1/2 F.H.C.S.	CBT-5G	TK-00656
SB-CTFPR-40-5	SB-CTFPL-40-5	TPGN-543	2.968	2.500	16.000	1.531	CL-12	XNS-510	SP-5	#8-32 x 1/2 F.H.C.S.	CBT-5G	TK-00656

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

S-STFNR/L

Style F / Triangle / Positive Rake / 0° Lead



Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Std Components	*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Insert Screw	
S-STFNR-6-2	S-STFNL-6-2	TP-41	0.500	0.375	6.000	0.250	#4-40 x 1/4 BHCS	TK-00922
S-STFNR-8-2	S-STFNL-8-2	TP-41	0.625	0.500	8.000	0.312	#4-40 x ¼ BHCS	TK-00922
S-STFNR-10-2	S-STFNL-10-2	TP-41	0.750	0.625	10.000	0.375	#4-40 x 1/4 BHCS	TK-00922
S-STFNR-12-3	S-STFNL-12-3	TPGA-322	1.000	0.750	10.000	0.500	#6-32 x 3/8 BHCS	TK-00923

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

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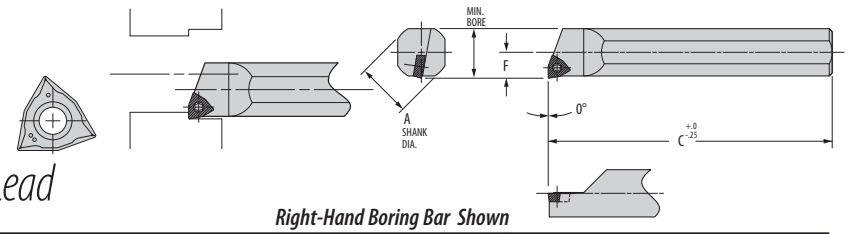
S-SWFCR/L

Style F / Screw-On Trigon / Solid Steel / 0° Lead



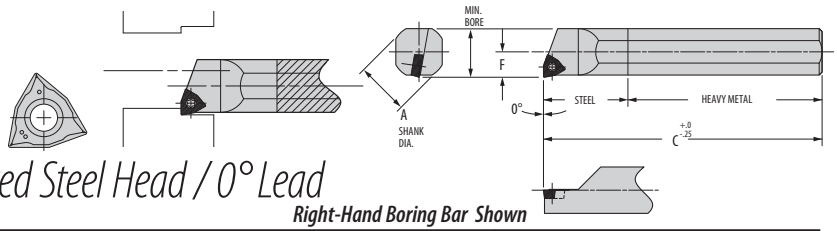
Right-Hand Boring Bar Shown

Part Number		Gage		Dimensions (inches)			Std Components	
Right Hand	Left Hand	Inserts	Minimum Bore	A	F	C	Insert Screw	*Tune-Up Kit
S06-SWFCR-2-050	S06-SWFCL-2-050	WCMT-21.51	0.438	0.375	0.219	5	PT-589T	TK-00804
S08-SWFCR-2-060	S08-SWFCL-2-060	WCMT-21.51	0.563	0.500	0.281	6	PT-589T	TK-00804
S08-SWFCR-3-025	S08-SWFCL-3-025	WCMT-32.51	0.625	0.500	0.312	2.5	PT-559T	TK-00807
S08-SWFCR-3-060	S08-SWFCL-3-060	WCMT-32.51	0.625	0.500	0.312	6	PT-559T	TK-00807
S10-SWFCR-3-040	S10-SWFCL-3-040	WCMT-32.51	0.719	0.625	0.359	4	PT-559T	TK-00807
S10-SWFCR-3-070	S10-SWFCL-3-070	WCMT-32.51	0.719	0.625	0.359	7	PT-559T	TK-00807
S12-SWFCR-3-040	S12-SWFCL-3-040	WCMT-32.51	0.844	0.750	0.422	4	PT-559T	TK-00807
S12-SWFCR-3-080	S12-SWFCL-3-080	WCMT-32.51	0.844	0.750	0.422	8	PT-559T	TK-00807
S16-SWFCR-3-050	S16-SWFCL-3-050	WCMT-32.51	1.094	1.000	0.547	5	PT-559T	TK-00807
S16-SWFCR-3-100	S16-SWFCL-3-100	WCMT-32.51	1.094	1.000	0.547	10	PT-559T	TK-00807
S20-SWFCR-3-120	S20-SWFCL-3-120	WCMT-32.51	1.344	1.250	0.672	12	PT-559T	TK-00807

* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

C-SWFCR/L

Style F / Screw-On Trigon / Heavy Metal, Fixed Steel Head / 0° Lead



Right-Hand Boring Bar Shown

Part Number		Gage		Dimensions (inches)			Std Components	
Right Hand	Left Hand	Inserts	Minimum Bore	A	F	C	Insert Screw	*Tune-Up Kit
C06-SWFCR-2-060	C06-SWFCL-2-060	WCMT-21.51	0.438	0.375	0.219	6.000	PT-589T	TK-00804
C06-SWFCR-2-080	C06-SWFCL-2-080	WCMT-21.51	0.438	0.375	0.219	8.000	PT-589T	TK-00804
C08-SWFCR-2-060	C08-SWFCL-2-060	WCMT-21.51	0.563	0.500	0.281	6.000	PT-589T	TK-00804
C08-SWFCR-2-080	C08-SWFCL-2-080	WCMT-21.51	0.563	0.500	0.281	8.000	PT-589T	TK-00804
C10-SWFCR-3-060	C10-SWFCL-3-060	WCMT-32.51	0.719	0.625	0.359	6.000	PT-559T	TK-00807
C10-SWFCR-3-100	C10-SWFCL-3-100	WCMT-32.51	0.719	0.625	0.359	10.000	PT-559T	TK-00807
C12-SWFCR-3-060	C12-SWFCL-3-060	WCMT-32.51	0.844	0.750	0.422	6.000	PT-559T	TK-00807
C12-SWFCR-3-100	C12-SWFCL-3-100	WCMT-32.51	0.844	0.750	0.422	10.000	PT-559T	TK-00807
C16-SWFCR-3-060	C16-SWFCL-3-060	WCMT-32.51	1.094	1.000	0.547	6.000	PT-559T	TK-00807
C16-SWFCR-3-120	C16-SWFCL-3-120	WCMT-32.51	1.094	1.000	0.547	12.000	PT-559T	TK-00807

* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

These boring bars do not use coolant.

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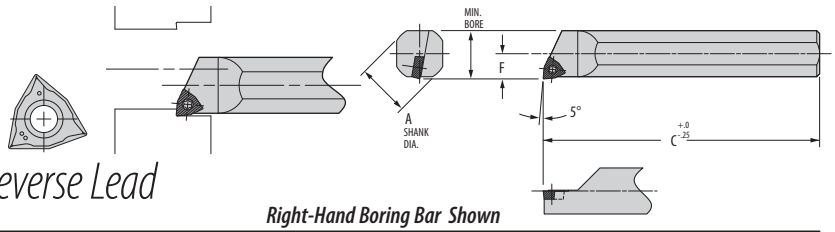
S-SWLCR/L

Style L / Screw-On Trigon / Solid Steel / 5° Reverse Lead



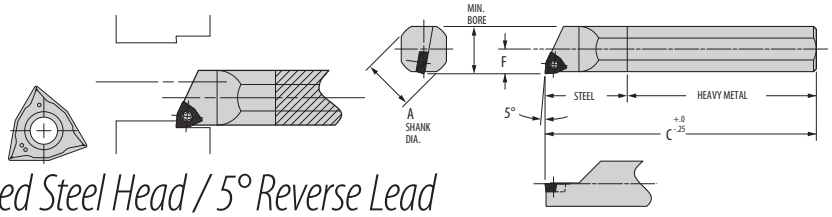
Right-Hand Boring Bar Shown

Part Number		Gage		Dimensions (inches)			Std Components	
Right Hand	Left Hand	Inserts	Minimum Bore	A	F	C	Insert Screw	*Tune-Up Kit
S06-SWLCR-2-050	S06-SWLCL-2-050	WCMT-21.51	0.438	0.375	0.219	5.000	PT-589T	TK-00804
S08-SWLCR-2-060	S08-SWLCL-2-060	WCMT-21.51	0.563	0.500	0.281	6.000	PT-589T	TK-00804
S08-SWLCR-3-025	S08-SWLCL-3-025	WCMT-32.51	0.625	0.500	0.312	2.500	PT-559T	TK-00807
S08-SWLCR-3-060	S08-SWLCL-3-060	WCMT-32.51	0.625	0.500	0.312	6.000	PT-559T	TK-00807
S10-SWLCR-3-040	S10-SWLCL-3-040	WCMT-32.51	0.719	0.625	0.359	4.000	PT-559T	TK-00807
S10-SWLCR-3-070	S10-SWLCL-3-070	WCMT-32.51	0.719	0.625	0.359	7.000	PT-559T	TK-00807
S12-SWLCR-3-040	S12-SWLCL-3-040	WCMT-32.51	0.844	0.750	0.422	4.000	PT-559T	TK-00807
S12-SWLCR-3-080	S12-SWLCL-3-080	WCMT-32.51	0.844	0.750	0.422	8.000	PT-559T	TK-00807
S16-SWLCR-3-050	S16-SWLCL-3-050	WCMT-32.51	1.094	1.000	0.547	5.000	PT-559T	TK-00807
S16-SWLCR-3-100	S16-SWLCL-3-100	WCMT-32.51	1.094	1.000	0.547	10.000	PT-559T	TK-00807
S20-SWLCR-3-120	S20-SWLCL-3-120	WCMT-32.51	1.344	1.250	0.672	12.000	PT-559T	TK-00807

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

C-SWLCR/L

Style L / Screw-On Trigon / Heavy Metal, Fixed Steel Head / 5° Reverse Lead



Right-Hand Boring Bar Shown

Part Number		Gage		Dimensions (inches)			Std Components	
Right Hand	Left Hand	Inserts	Minimum Bore	A	F	C	Insert Screw	*Tune-Up Kit
C06-SWLCR-2-060	C06-SWLCL-2-060	WCMT-21.51	0.438	0.375	0.219	6.000	PT-589T	TK-00804
C06-SWLCR-2-080	C06-SWLCL-2-080	WCMT-21.51	0.438	0.375	0.219	8.000	PT-589T	TK-00804
C08-SWLCR-2-060	C08-SWLCL-2-060	WCMT-21.51	0.563	0.500	0.281	6.000	PT-589T	TK-00804
C08-SWLCR-2-080	C08-SWLCL-2-080	WCMT-21.51	0.563	0.500	0.281	8.000	PT-589T	TK-00804
C10-SWLCR-3-060	C10-SWLCL-3-060	WCMT-32.51	0.719	0.625	0.359	6.000	PT-559T	TK-00807
C10-SWLCR-3-100	C10-SWLCL-3-100	WCMT-32.51	0.719	0.625	0.359	10.000	PT-559T	TK-00807
C12-SWLCR-3-060	C12-SWLCL-3-060	WCMT-32.51	0.844	0.750	0.422	6.000	PT-559T	TK-00807
C12-SWLCR-3-100	C12-SWLCL-3-100	WCMT-32.51	0.844	0.750	0.422	10.000	PT-559T	TK-00807
C16-SWLCR-3-060	C16-SWLCL-3-060	WCMT-32.51	1.094	1.000	0.547	6.000	PT-559T	TK-00807
C16-SWLCR-3-120	C16-SWLCL-3-120	WCMT-32.51	1.094	1.000	0.547	12.000	PT-559T	TK-00807

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

These boring bars do not use coolant.

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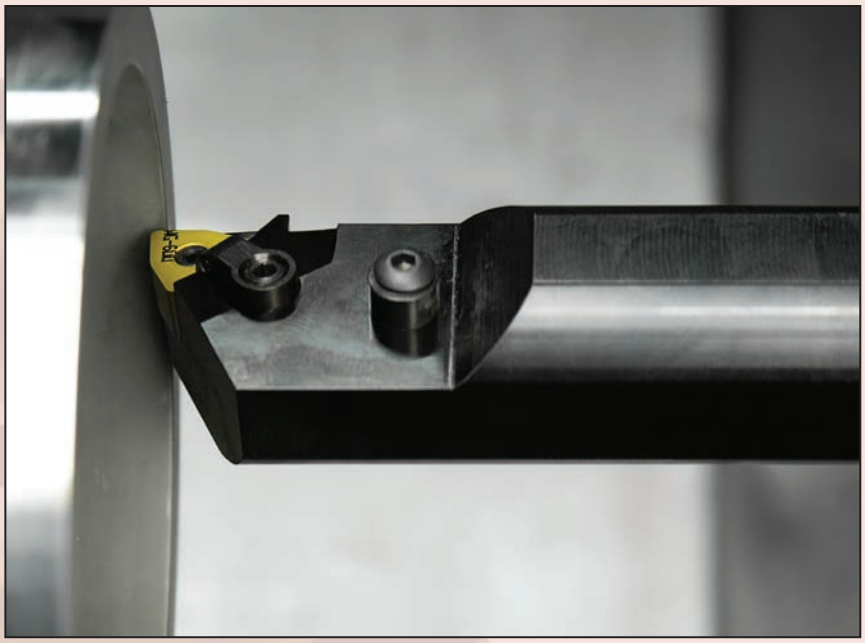
Boring Bars for Ceramic Inserts

This section contains boring bars using the ceramic inserts most often used by industry.

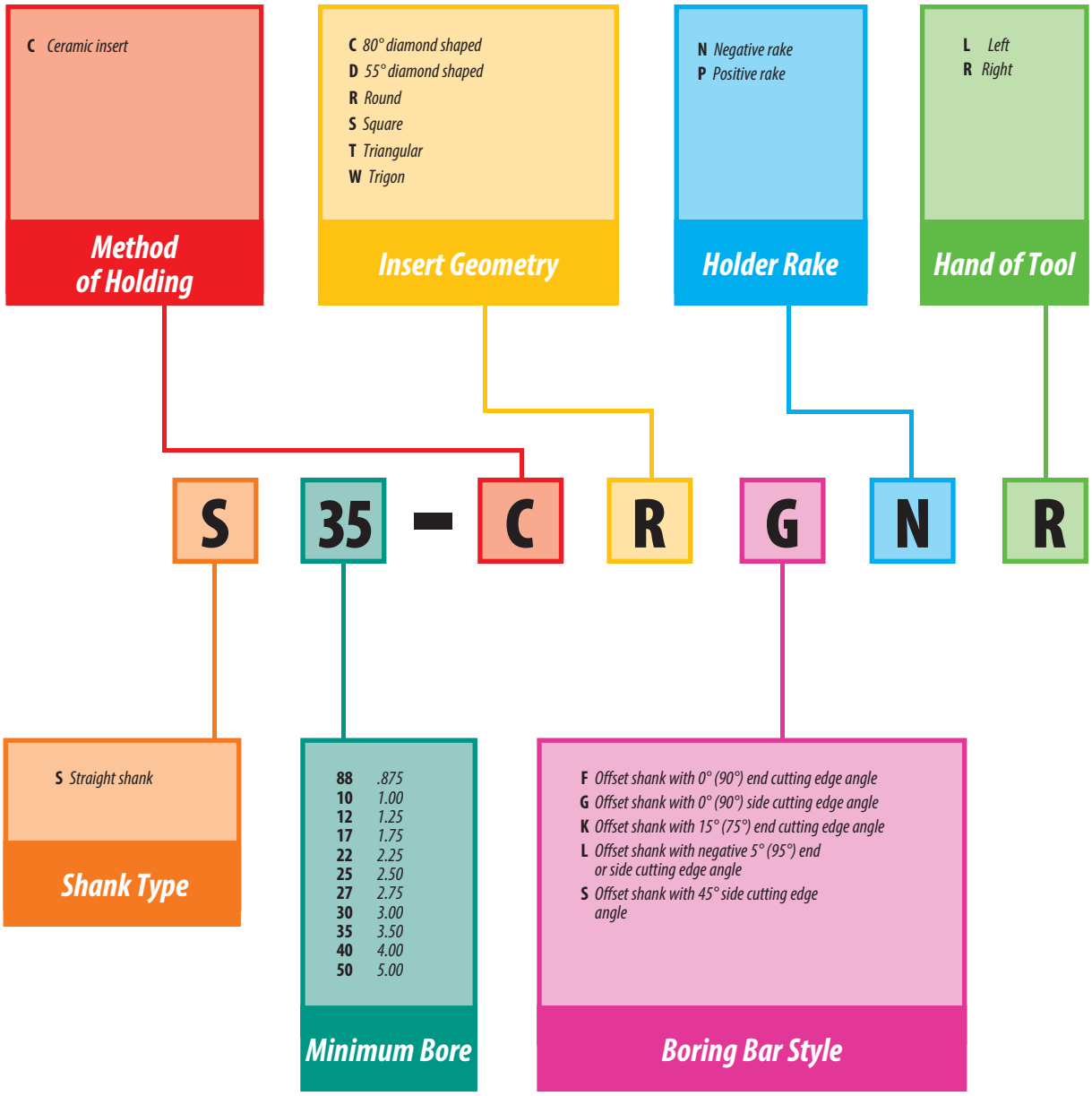
In addition to tempered-steel bars, Greenleaf also can supply Heavy Metal or "No Chat" high-density steel bars that can reduce, and sometimes eliminate, "chatter" for those applications that require a longer reach.

Greenleaf's boring bar capability includes numerous additional styles not shown in this catalog. Contact us if you do not see the bar you need. Our special design and build services can be counted on to meet your individual needs.



Greenleaf Tune-Up Kits
A Tune-Up Kit consists of all the standard hardware to refurbish a particular toolholder, boring bar, or milling cutter. A toolholder will have a readily visible, laser-inscribed Tune-Up Kit number on it for ease in ordering. This number will prevent any confusion created by searching a catalog for hardware, and it will help reduce downtime.

Ceramic-Insert Boring Bar Identification System



NOTE:
The angles shown in parentheses are the angles as shown in the ANSI standard.

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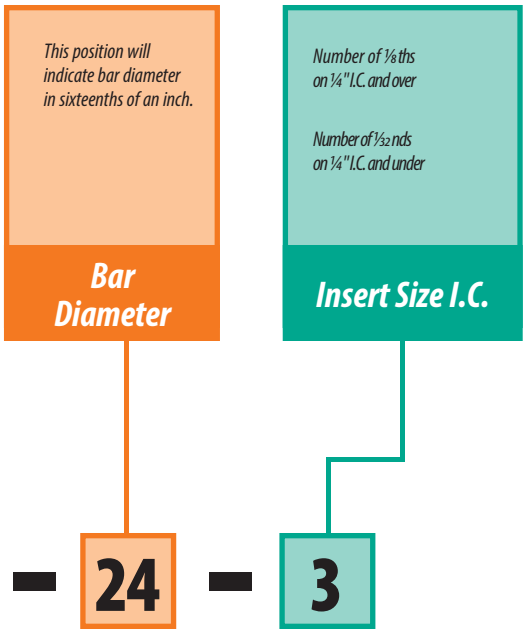

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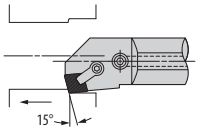
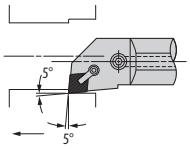
Pictorial Index

80°/100° Diamond – Negative

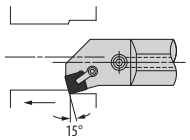


S-CCKNR/L
Style K
80° Diamond
(Using 100° Corner)
Negative Rake
15° Lead
page: T 130

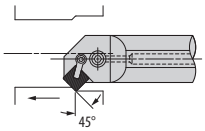


S-CCLNR/L
Style L
80° Diamond
Negative Rake
5° Reverse Lead
page: T 130

Square – Negative

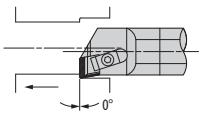


S-CSKNR/L
Style K
Square
Negative Rake
15° Lead
page: T 132

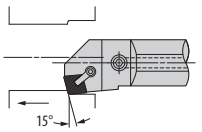


S-CSSNR/L
Style S
Square
Negative Rake
45° Lead
page: T 132

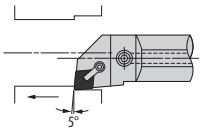
80° Diamond – Positive



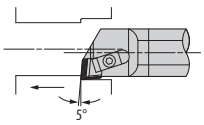
S-CCFPR/L
Style F
Heavy Metal Shank
80° Diamond
Positive Rake
0° Lead
page: T 134



S-CCKPR/L
Style K
80° Diamond
(Using 100° Corner)
Positive Rake
15° Lead
page: T 134

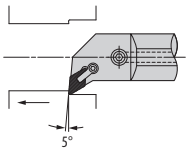


S-CCLPR/L
Style L
80° Diamond
Positive Rake
5° Reverse Lead
page: T 134



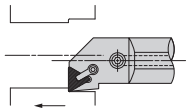
S-CCLPR/L
Style L
Heavy Metal Shank
80° Diamond
Positive Rake
5° Reverse Lead
page: T 135

55° Diamond – Negative



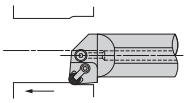
S-CDLNR/L
Style L
55° Diamond
Negative Rake
5° Reverse Lead
page: T 131

Triangle – Negative



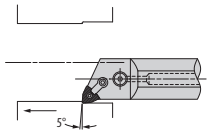
S-CTFNR/L
Style F
Triangle
Negative Rake
0° Lead
page: T 133

Round – Negative



S-CRGNR/L
Style G
Round
Negative Rake
page: T 131

Trigon – Negative



S-CWLNR/L
Style L
Trigon
Negative Rake
5° Reverse Lead
page: T 133

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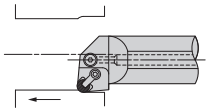
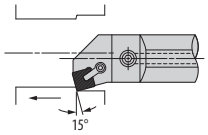
Round – Positive

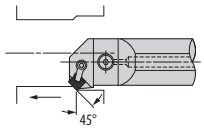


S-CRGPR/L
Style G
Round
Positive Rake
page: T 135

Square – Positive

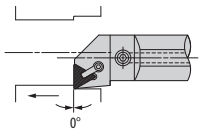


S-CSKPR/L
Style K
Square
Positive Rake
15° Lead
page: T 136

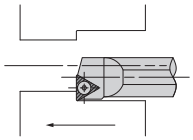


S-CSSPR/L
Style S
Square
Positive Rake
45° Lead
page: T 136

Triangle – Positive



S-CTFPR/L
Style F
Triangle
Positive Rake
0° Lead
page: T 137



S-STFNR/L
Style F
Triangle
Positive Rake
0° Lead
page: T 137

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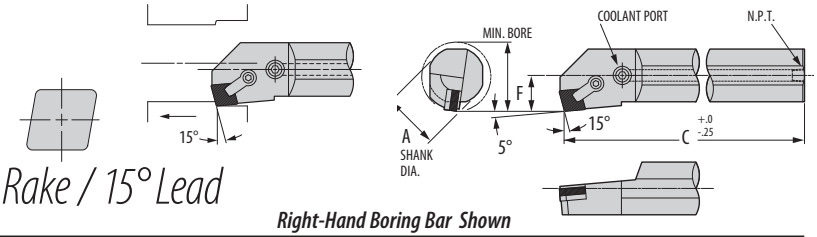
S-CCKNR/L

Style K / 80° Diamond (Using 100° Corner) / Negative Rake / 15° Lead



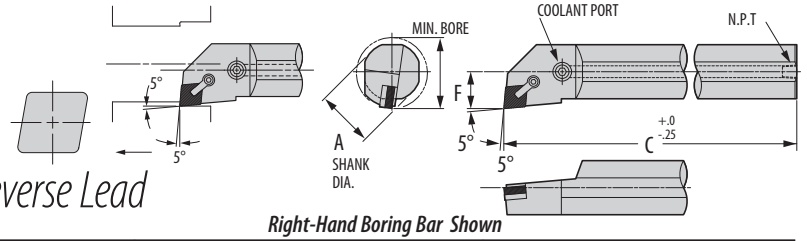
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp
S30-CCKNR-16-4	S30-CCKNL-16-4	CNGN-432	1.250	1.000	12.000	0.640	–	–	CL-12	XNS-58	TK-00670	NL-44	CL-9
S40-CCKNR-24-4	S40-CCKNL-24-4	CNGN-432	1.718	1.500	13.750	0.890	CSN-433	S-46S	CL-12	XNS-59	TK-00677	NL-46	CL-9
S40-CCKNR-32-4	S40-CCKNL-32-4	CNGN-432	2.468	2.000	16.000	1.140	CSN-433	S-46	CL-12	XNS-59	TK-00678	NL-46	CL-9
S50-CCKNR-32-6	S50-CCKNL-32-6	CNGN-643	2.468	2.000	16.000	1.281	CSN-633	S-68	CL-30	XNS-59	TK-00711	NL-68	CL-12
S50-CCKNR-40-6	S50-CCKNL-40-6	CNGN-643	2.968	2.500	16.000	1.781	CSN-633	S-68	CL-30	XNS-59	TK-00711	NL-68	CL-12

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

S-CCLNR/L

Style L / 80° Diamond / Negative Rake / 5° Reverse Lead



Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp
S30-CCLNR-16-4	S30-CCLNL-16-4	CNGN-432	1.375	1.000	12.000	0.640	–	–	CL-12	XNS-58	TK-00670	NL-44	CL-9
S40-CCLNR-24-4	S40-CCLNL-24-4	CNGN-432	1.800	1.500	13.750	0.890	CSN-433	S-46	CL-12	XNS-59	TK-00678	NL-46	CL-9
S40-CCLNR-32-4	S40-CCLNL-32-4	CNGN-432	2.475	2.000	16.000	1.140	CSN-433	S-46	CL-12	XNS-59	TK-00678	NL-46	CL-9
S50-CCLNR-32-6	S50-CCLNL-32-6	CNGN-643	2.475	2.000	16.000	1.281	CSN-633	S-68	CL-30	XNS-59	TK-00711	NL-68	CL-12
S50-CCLNR-40-6	S50-CCLNL-40-6	CNGN-643	2.968	2.500	16.000	1.781	CSN-633	S-68	CL-30	XNS-59	TK-00711	NL-68	CL-12

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

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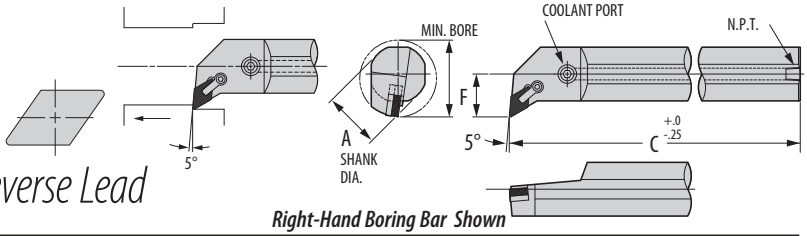
S-CDLNR/L

Style L / 55° Diamond / Negative Rake / 5° Reverse Lead



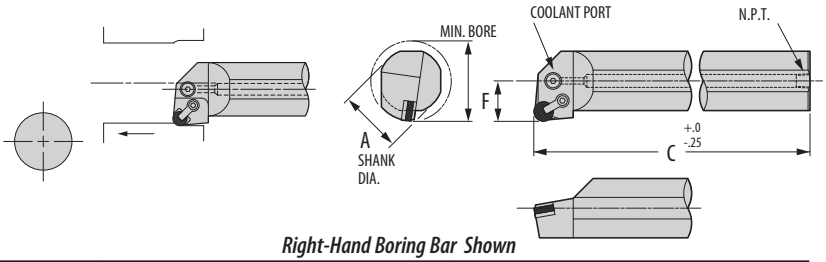
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp
S35-CDLNR-24-3	S35-CDLNL-24-3	DNGN-322	2.250	1.500	13.750	1.000	DSN-333	S-34	CL-12	XNS-59	TK-00513	NL-34L	–
S35-CDLNR-32-3	S35-CDLNL-32-3	DNGN-322	2.500	2.000	16.000	1.250	DSN-333	S-34	CL-12	XNS-59	TK-00513	NL-34L	–
S40-CDLNR-32-4	S40-CDLNL-32-4	DNGN-432	2.750	2.000	16.000	1.375	DSN-433	S-46	CL-30	XNS-59	TK-00514	NL-46	CL-12
S40-CDLNR-40-4	S40-CDLNL-40-4	DNGN-432	3.250	2.500	16.000	1.625	DSN-433	S-46	CL-30	XNS-59	TK-00514	NL-46	CL-12

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

S-CRGNR/L

Style G / Round / Negative Rake



Right-Hand Boring Bar Shown

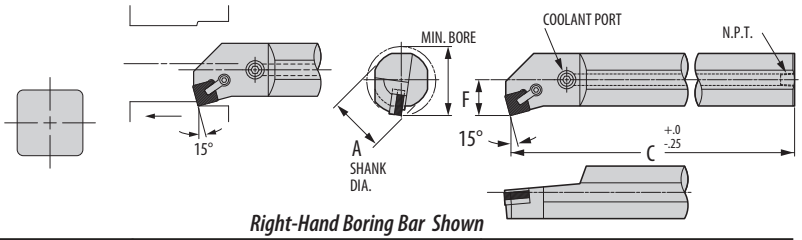
Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit	Optional Components		
Right Hand	Left Hand	Inserts		A	C	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Clamp	Combination	
													Insert Thick.	Shim Seat
S30-CRGNR-24-3	S30-CRGNL-24-3	RNGN-33	3.000	1.500	13.750	1.015	–	–	CL-6	XNS-36	TK-00671	CL-6	–	–
S30-CRGNR-32-3	S30-CRGNL-32-3	RNGN-33	3.000	2.000	16.000	1.265	–	–	CL-6	XNS-36	TK-00671	CL-6	–	–
S35-CRGNR-32-4	S35-CRGNL-32-4	RNGN-43	3.500	2.000	16.000	1.281	IRSN-42	S-46	CL-12	XNS-59	TK-00674	CL-9	5/16	No shim
S35-CRGNR-40-4	S35-CRGNL-40-4	RNGN-43	3.500	2.500	16.000	1.531	IRSN-42	S-46	CL-12	XNS-59	TK-00674	CL-9	5/16	No shim
S50-CRGNR-32-4	S50-CRGNL-32-4	RNGN-45	5.000	2.000	16.000	1.281	IRSN-43	S-46	CL-12	XNS-59	TK-00516	CL-9	3/16 †or	IRSN-45
S50-CRGNR-40-4	S50-CRGNL-40-4	RNGN-45	5.000	2.500	16.000	1.531	IRSN-43	S-46	CL-12	XNS-59	TK-00516	CL-9	1/4	IRSN-44
S35-CRGNR-32-5	S35-CRGNL-32-5	RNGN-55	3.500	2.000	16.000	1.281	–	–	CL-12	XNS-59	TK-00675	CL-9	3/16	RSN-52
S35-CRGNR-40-5	S35-CRGNL-40-5	RNGN-55	3.500	2.500	16.000	1.531	–	–	CL-12	XNS-59	TK-00675	CL-9	3/16	RSN-52
S50-CRGNR-32-5	S50-CRGNL-32-5	RNGN-55	5.000	2.000	16.000	1.281	RSN-53	S-58	CL-12	XNS-59	TK-00517	CL-9	3/16 †or	RSN-55
S50-CRGNR-40-5	S50-CRGNL-40-5	RNGN-55	5.000	2.500	16.000	1.531	RSN-53	S-58	CL-12	XNS-59	TK-00517	CL-9	¼	RSN-54
S35-CRGNR-32-6	S35-CRGNL-32-6	RNGN-65	3.500	2.000	16.000	1.281	–	–	CL-30	XNS-59	TK-00676	CL-12	3/16	RSN-62
S35-CRGNR-40-6	S35-CRGNL-40-6	RNGN-65	3.500	2.500	16.000	1.531	–	–	CL-30	XNS-59	TK-00676	CL-12	3/16	RSN-62
S50-CRGNR-32-6	S50-CRGNL-32-6	RNGN-65	5.000	2.000	16.000	1.281	RSN-63	S-68	CL-30	XNS-59	TK-00518	CL-12	3/16 †or	RSN-65
S50-CRGNR-40-6	S50-CRGNL-40-6	RNGN-65	5.000	2.500	16.000	1.531	RSN-63	S-68	CL-30	XNS-59	TK-00518	CL-12	1/4	RSN-64

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

† Insert thickness will need to correspond with the proper shim seat thickness.

S-CSKNR/L

Style K / Square / Negative Rake / 15° Lead



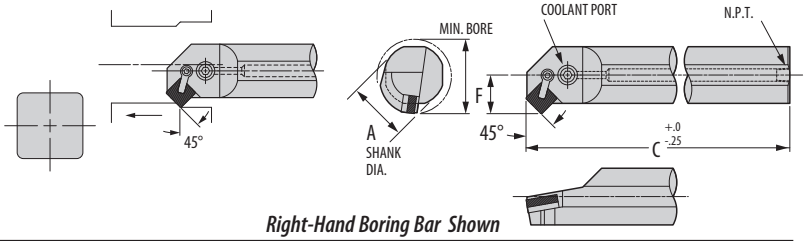
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp
S30-CSKNR-16-4	S30-CSKNL-16-4	SNGN-432	3.000	1.000	12.000	0.640	–	–	CL-12	XNS-58	TK-00672	NL-44	CL-9
S40-CSKNR-24-4	S40-CSKNL-24-4	SNGN-432	4.000	1.500	13.750	0.890	ISSN-433	S-46	CL-12	XNS-59	TK-00723	NL-46	CL-9
S40-CSKNR-32-4	S40-CSKNL-32-4	SNGN-432	4.000	2.000	16.000	1.140	ISSN-433	S-46	CL-12	XNS-59	TK-00679	NL-46	CL-9
S50-CSKNR-32-5	S50-CSKNL-32-5	SNGN-543	5.000	2.000	16.000	1.281	SSN-533	S-58	CL-12	XNS-59	TK-00520	NL-58	CL-9
S50-CSKNR-40-5	S50-CSKNL-40-5	SNGN-543	5.000	2.500	16.000	1.531	SSN-533	S-58	CL-12	XNS-59	TK-00520	NL-58	CL-9
S50-CSKNR-32-6	S50-CSKNL-32-6	SNGN-643	5.000	2.000	16.000	1.281	ISSN-633	S-68	CL-30	XNS-59	TK-00521	NL-68	CL-12
S50-CSKNR-40-6	S50-CSKNL-40-6	SNGN-643	5.000	2.500	16.000	1.531	ISSN-633	S-68	CL-30	XNS-59	TK-00521	NL-68	CL-12

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

S-CSSNR/L

Style S / Square / Negative Rake / 45° Lead



Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp
S30-CSSNR-16-4	S30-CSSNL-16-4	SNGN-432	3.000	1.000	12.000	0.640	–	–	CL-12	XNS-59	TK-00675	NL-44	CL-9
S40-CSSNR-24-4	S40-CSSNL-24-4	SNGN-432	4.000	1.500	13.750	0.890	ISSN-433	S-46	CL-12	XNS-59	TK-00679	NL-46	CL-9
S40-CSSNR-32-4	S40-CSSNL-32-4	SNGN-432	4.000	2.000	16.000	1.140	ISSN-433	S-46	CL-12	XNS-59	TK-00679	NL-46	CL-9
S50-CSSNR-32-5	S50-CSSNL-32-5	SNGN-543	5.000	2.000	16.000	1.281	SSN-533	S-58	CL-12	XNS-59	TK-00520	NL-58	CL-9
S50-CSSNR-40-5	S50-CSSNL-40-5	SNGN-543	5.000	2.500	16.000	1.531	SSN-533	S-58	CL-12	XNS-59	TK-00520	NL-58	CL-9
S50-CSSNR-32-6	S50-CSSNL-32-6	SNGN-643	5.000	2.000	16.000	1.281	ISSN-633	S-68	CL-30	XNS-59	TK-00521	NL-68	CL-12
S50-CSSNR-40-6	S50-CSSNL-40-6	SNGN-643	5.000	2.500	16.000	1.531	ISSN-633	S-68	CL-30	XNS-59	TK-00521	NL-68	CL-12

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

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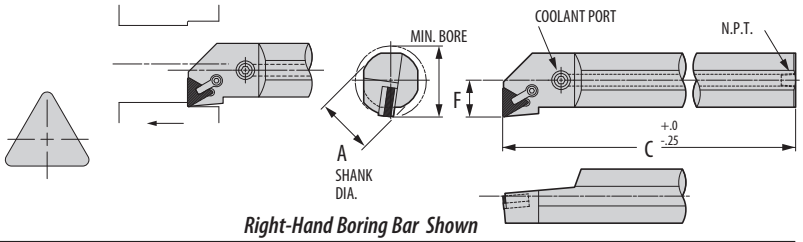
S-CTFNR/L

Style F / Triangle / Negative Rake / 0° Lead



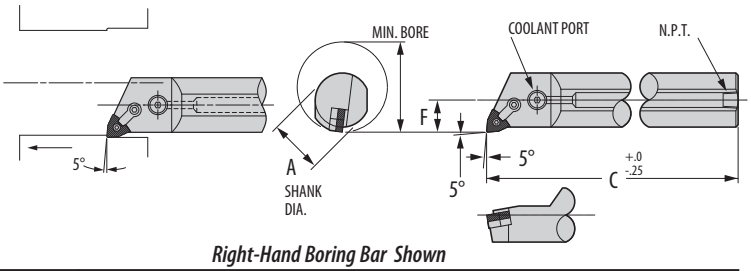
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp
S30-CTFNR-16-3	S30-CTFNL-16-3	TNGN-332	3.000	1.000	12.000	0.640	–	–	CL-7	XNS-36	TK-00719	NL-33L	CL-6
S35-CTFNR-24-3	S35-CTFNL-24-3	TNGN-332	3.500	1.500	13.750	0.890	ITSN-322	S-34	CL-7	XNS-36	TK-00522	NL-34L	CL-6
S40-CTFNR-24-4	S40-CTFNL-24-4	TNGN-432	4.000	1.500	13.750	1.031	ITSN-432	S-46	CL-12	XNS-59	TK-00680	NL-46	CL-9
S40-CTFNR-32-4	S40-CTFNL-32-4	TNGN-432	4.000	2.000	16.000	1.281	ITSN-432	S-46	CL-12	XNS-59	TK-00680	NL-46	CL-9
S40-CTFNR-40-4	S40-CTFNL-40-4	TNGN-432	4.000	2.500	16.000	1.531	ITSN-432	S-46	CL-12	XNS-59	TK-00680	NL-46	CL-9

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

S-CWLNR/L

Style L / Trigon / Negative Rake / 5° Reverse Lead



Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Shim Seat	Lock Pin	Clamp	Clamp Screw	
S30-CWLNR-16-3	S30-CWLNL-16-3	WNGA-332	3.000	1.000	12.000	0.640	–	NL-33L	CL-6	XNS-36	TK-00740
S35-CWLNR-24-3	S35-CWLNL-24-3	WNGA-332	3.500	1.500	13.750	0.890	IWSN-322	NL-34L	CL-6	XNS-36	TK-00777
S30-CWLNR-16-4	S30-CWLNL-16-4	WNGA-432	3.000	1.000	12.000	0.640	–	NL-44	CL-20	XNS-48	TK-00887
S40-CWLNR-24-4	S40-CWLNL-24-4	WNGA-432	4.000	1.500	13.750	0.890	IWSN-433	NL-46	CL-20	XNS-48	TK-00759
S40-CWLNR-32-4	S40-CWLNL-32-4	WNGA-432	4.000	2.000	16.000	1.281	IWSN-433	NL-46	CL-20	XNS-48	TK-00759

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

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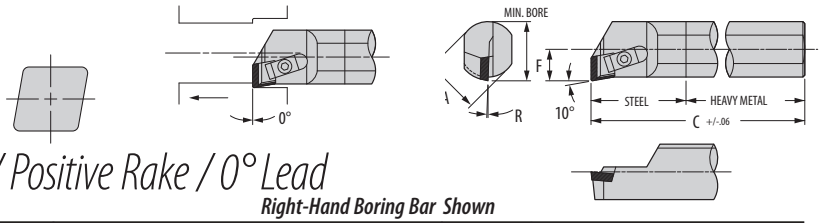
S-CCFPR/L

Style F / Heavy Metal Shank / 80° Diamond / Positive Rake / 0° Lead



Right-Hand Boring Bar Shown

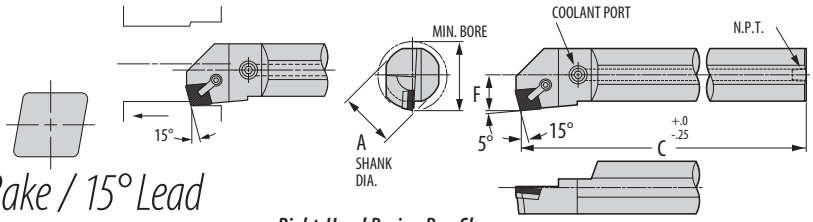
Part Number		Gage	Min. Bore	Dimensions (inches)				Standard Components				Eff. Width	*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	R	Clamp	Clamp Screw	Chipbreaker	Chipbreaker			Chip-breaker†	Eff. Width
S88-CCFPR-12-3	—	CPGN-321	0.875	0.750	10.000	0.437	3°	33704	#6-32 x 1/2 B.H.C.S.	307378-R	—	.093"	TK-00682	307377-R	0.062
—	S88-CCFPL-12-3	CPGN-321	0.875	0.750	10.000	0.437	3°	33704	#6-32 x 1/2 B.H.C.S.	—	307378-L	.093"	TK-00681	307377-L	0.062
S10-CCFPR-14-3	—	CPGN-321	1.000	0.875	10.000	0.500	2°	33704	#6-32 x 1/2 B.H.C.S.	307378-R	—	.093"	TK-00682	307379-R	0.125
—	S10-CCFPL-14-3	CPGN-321	1.000	0.875	10.000	0.500	2°	33704	#6-32 x 1/2 B.H.C.S.	—	307378-L	.093"	TK-00681	307379-L	0.125

* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

† *Specifiy left or right chipbreaker when ordering. (example: 307377-R for right)*

S-CCKPR/L

Style K / 80° Diamond *(Using 100° Corner)* / Positive Rake / 15° Lead



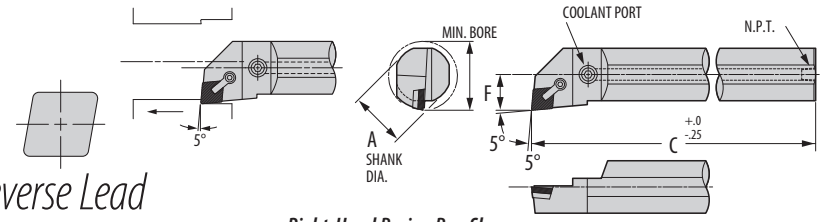
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
S12-CCKPR-16-4	S12-CCKPL-16-4	CPGN-432	1.250	1.000	12.000	0.640	–	–	CL-22	XNS-46	TK-00666
S17-CCKPR-24-4	S17-CCKPL-24-4	CPGN-432	1.718	1.500	13.750	0.890	SP-49	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00501
S22-CCKPR-32-4	S22-CCKPL-32-4	CPGN-432	2.218	2.000	16.000	1.140	SP-49	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00501
S27-CCKPR-40-4	S27-CCKPL-40-4	CPGN-432	2.718	2.500	16.000	1.390	SP-49	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00501

* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

S-CCLPR/L

Style L / 80° Diamond / Positive Rake / 5° Reverse Lead



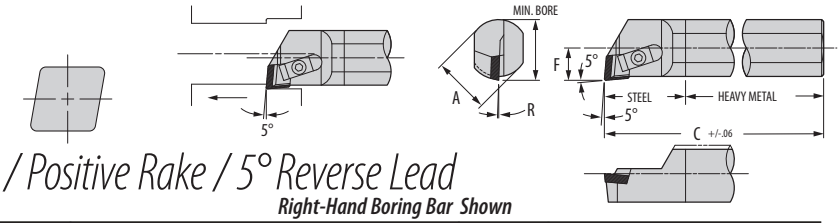
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
S12-CCLPR-16-4	S12-CCLPL-16-4	CPGN-432	1.250	1.000	12.000	0.640	–	–	CL-22	XNS-46	TK-00666
S17-CCLPR-24-4	S17-CCLPL-24-4	CPGN-432	1.718	1.500	13.750	0.890	SP-49	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00501
S22-CCLPR-32-4	S22-CCLPL-32-4	CPGN-432	2.218	2.000	16.000	1.140	SP-49	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00669
S27-CCLPR-40-4	S27-CCLPL-40-4	CPGN-432	2.718	2.500	16.000	1.390	SP-49	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00501

* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

S-CCLPR/L

Style L / Heavy Metal Shank / 80° Diamond / Positive Rake / 5° Reverse Lead



Right-Hand Boring Bar Shown

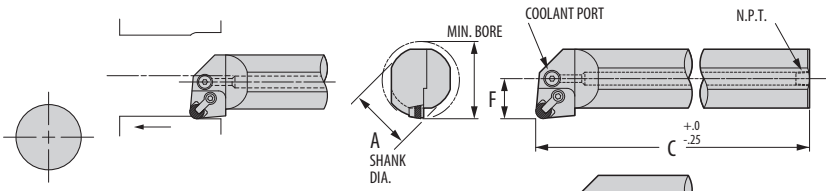
Part Number		Gage	Min. Bore	Dimensions (inches)				Standard Components				Eff. Width	*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	R	Clamp	Clamp Screw	Chipbreaker	Chipbreaker			Chip-breaker†	Eff. Width
S88-CCLPR-12-3	—	CPGN-321	0.875	0.750	10.000	0.437	3°	33704	#6-32 x 1/2 B.H.C.S.	307378-R	—	.093″	TK-00682	307377-R	0.062
—	S88-CCLPL-12-3	CPGN-321	0.875	0.750	10.000	0.437	3°	33704	#6-32 x 1/2 B.H.C.S.	—	307378-L	.093″	TK-00681	307377-L	0.062
S10-CCLPR-14-3	—	CPGN-321	1.000	0.875	10.000	0.500	2°	33704	#6-32 x 1/2 B.H.C.S.	307378-R	—	.093″	TK-00682	307379-R	0.125
—	S10-CCLPL-14-3	CPGN-321	1.000	0.875	10.000	0.500	2°	33704	#6-32 x 1/2 B.H.C.S.	—	307378-L	.093″	TK-00681	307379-R	0.125

* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

† *Specifiy left or right chipbreaker when ordering. (example: 307377-R for right)*

S-CRGPR/L

Style G / Round / Positive Rake



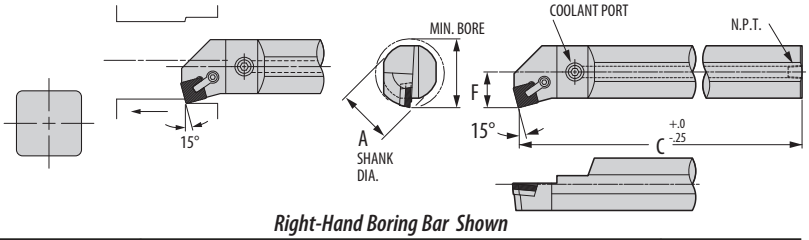
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
S12-CRGPR-16-3	S12-CRGPL-16-3	RPGN-32	1.250	1.000	12.000	0.640	–	–	CL-7	XNS-36	TK-00667
S17-CRGPR-24-3	S17-CRGPL-24-3	RPGN-32	1.718	1.500	13.750	0.890	SP-34	#2-56x 1/4 S.H.C.S.	CL-7	XNS-36	TK-00502
S22-CRGPR-32-3	S22-CRGPL-32-3	RPGN-32	2.218	2.000	16.000	1.140	SP-34	#2-56x 1/4 S.H.C.S.	CL-7	XNS-36	TK-00502
S25-CRGPR-32-4	S25-CRGPL-32-4	RPGN-43	2.468	2.000	16.000	1.281	SP-44	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00503
S30-CRGPR-40-4	S30-CRGPL-40-4	RPGN-43	2.968	2.500	16.000	1.531	SP-44	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00503

* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

S-CSKPR/L

Style K / Square / Positive Rake / 15° Lead



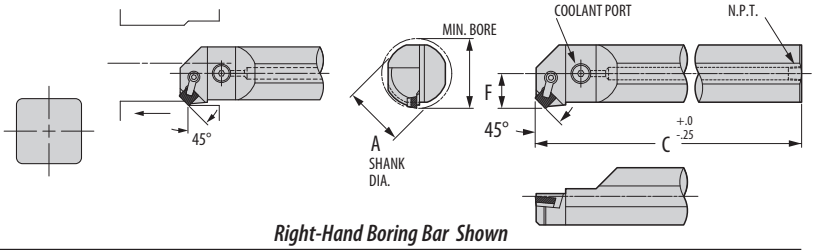
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
S12-CSKPR-16-4	**S12-CSKPL-16-4**	SPGN-432	1.250	1.000	12.000	0.640	–	–	CL-7	XNS-36	TK-00667
S17-CSKPR-24-4	**S17-CSKPL-24-4**	SPGN-432	1.718	1.500	13.750	0.890	SP-41	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00504
S22-CSKPR-32-4	**S22-CSKPL-32-4**	SPGN-432	2.218	2.000	16.000	1.140	SP-41	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00504
S27-CSKPR-40-4	**S27-CSKPL-40-4**	SPGN-432	2.718	2.500	16.000	1.390	SP-41	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00504

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

S-CSSPR/L

Style S / Square / Positive Rake / 45° Lead



Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
S12-CSSPR-16-4	**S12-CSSPL-16-4**	SPGN-432	1.250	1.000	12.000	0.640	–	–	CL-7	XNS-36	TK-00667
S17-CSSPR-24-4	**S17-CSSPL-24-4**	SPGN-432	1.718	1.500	13.750	0.890	SP-41	#4-40x 3/8 F.H.C.S.	CL-12	XNS-58	TK-03027
S22-CSSPR-32-4	**S22-CSSPL-32-4**	SPGN-432	2.218	2.000	16.000	1.140	SP-41	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00504
S27-CSSPR-40-4	**S27-CSSPL-40-4**	SPGN-432	2.718	2.500	16.000	1.390	SP-41	#4-40x 3/8 F.H.C.S.	CL-12	XNS-59	TK-00504

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

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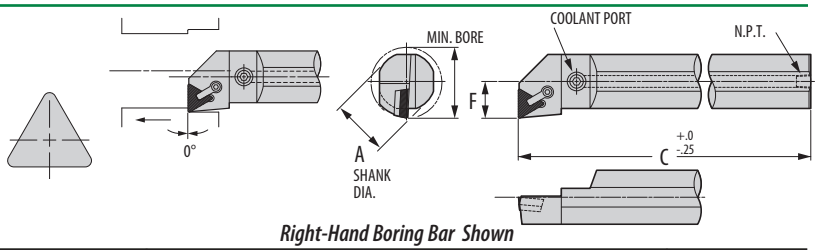
S-CTFPR/L

Style F / Triangle / Positive Rake / 0° Lead



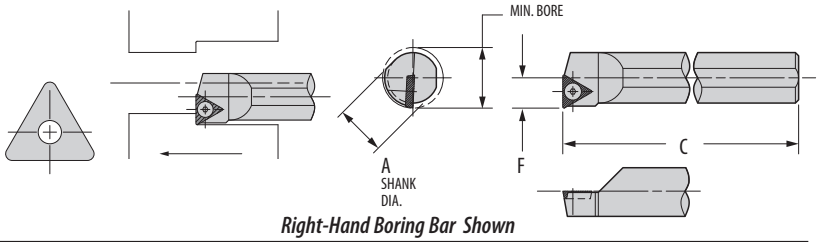
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
S12-CTFPR-16-3	S12-CTFPL-16-3	TPGN-322	1.250	1.000	12.000	0.640	–	–	CL-7	XNS-35	TK-00668
S17-CTFPR-24-3	S17-CTFPL-24-3	TPGN-322	1.718	1.500	13.750	0.890	SP3A	#4-40x 3/8 F.H.C.S.	CL-7	XNS-36	TK-00507
S20-CTFPR-24-4	S20-CTFPL-24-4	TPGN-432	1.968	1.500	13.750	1.031	SP-4	#6-32x 1/2 F.H.C.S.	CL-12	XNS-59	TK-00508
S25-CTFPR-32-4	S25-CTFPL-32-4	TPGN-432	2.468	2.000	16.000	1.281	SP-4	#6-32x 1/2 F.H.C.S.	CL-12	XNS-59	TK-00508
S30-CTFPR-40-4	S30-CTFPL-40-4	TPGN-432	2.968	2.500	16.000	1.531	SP-4	#6-32x 1/2 F.H.C.S.	CL-12	XNS-59	TK-00508

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

S-STFNR/L

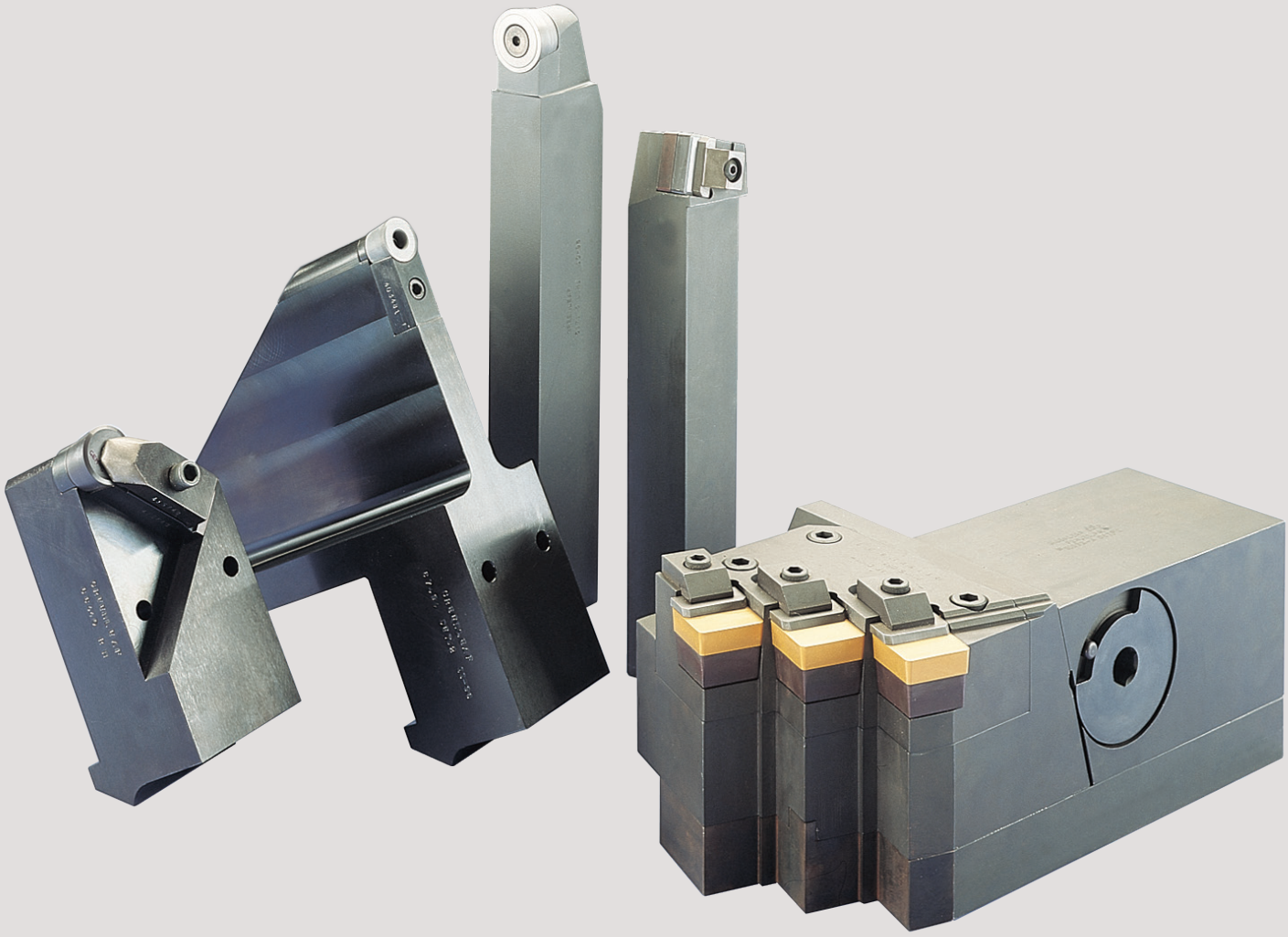
Style F / Triangle / Positive Rake / 0° Lead



Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (inches)			Standard Components	*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Insert Screw	
S-STFNR-6-2	S-STFNL-6-2	TP-41	0.500	0.375	6.000	0.250	#4-40x1/4BHCS	TK-00922
S-STFNR-8-2	S-STFNL-8-2	TP-41	0.625	0.500	8.000	0.312	#4-40x1/4BHCS	TK-00922
S-STFNR-10-2	S-STFNL-10-2	TP-41	0.750	0.625	10.000	0.375	#4-40x1/4BHCS	TK-00922
S-STFNR-12-3	S-STFNL-12-3	TPGA322	1.000	0.750	10.000	0.500	#6-32x3/8BHCS	TK-00923

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*



Heavy Turning

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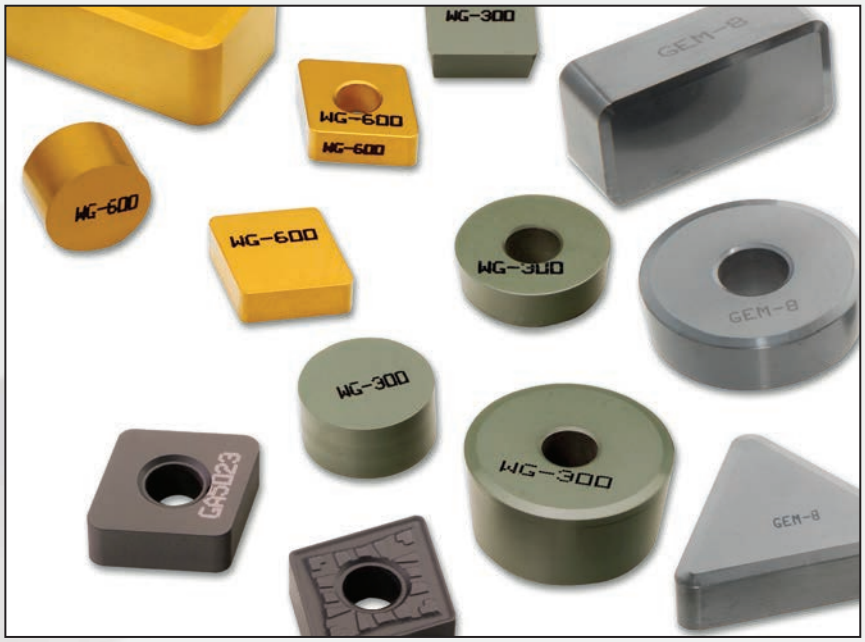
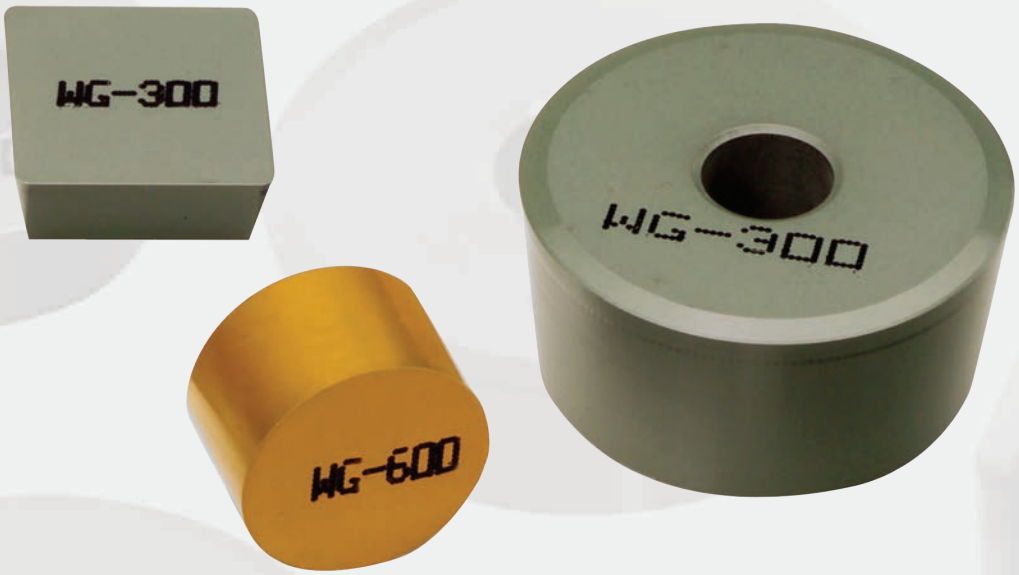
Heavy Turning

The manufacture of rolls for use in steel making is an area where machinability has been decreased significantly by the introduction of alloyed materials, especially chromium content. In addition, the use of forged rolls is increasing, and centrifugally cast products with high hardness levels and surface contamination are another challenge.

Ceramic cutting tools such as Greenleaf GEM-8™ composite material and WG-300® whiskered material are finding an important place in heavy turning when combined with rigid, well-designed holding systems. Greenleaf has extensive experience in the design and manufacture of heavy-turning tooling systems. For more than thirty years, we have supplied O.E.M. packages to many of the largest lathe manufacturers – both domestic and overseas. We will be pleased to quote tooling systems for any type of machine to effectively use ceramic or carbide inserts. Most of the options regularly manufactured are outlined on page HT 28.

Call a Greenleaf heavy-turning specialist at 800-458-1850 to discuss your particular needs.





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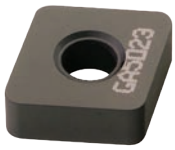
Insert Grades

Carbide

Greenleaf offers a comprehensive line of carbide inserts ranging from sub-micron C-1 through C-8 classifications. Carbide inserts are available in ANSI standard geometries with multi-purpose chipbreakers for heavy roughing through finishing.





CVD Coated

GA5023

A high-performance grade designed for the turning and milling of various grades of cast iron, GA5023 features an advanced MT-CVD coating specifically developed to withstand the abrasiveness of cast iron in machining. Applications range from roughing to finishing in most grades of cast iron, including gray, nodular, and others. The high wear resistance and toughness of GA5023 enable high-speed machining in a wide range of feed rates.

GA5035

A high-performance MT-CVD coated grade for turning all types of steels, GA5035 can be used for heavy roughing to finish-turning applications requiring resistance to heat deformation, thermal shock from interrupted cuts, and abrasion. GA5035 should be applied at high speeds and a moderate range of feeds. GA5035 is the primary choice for steel turning.

GA5036

A high-speed MT-CVD coated milling grade, GA5036 should be used when milling forged and cast steels and select ductile irons. GA5036 constitutes a unique combination of toughness and heat resistance, making it suitable for heavy and light-duty milling at high cutting speeds. It is a great first choice for all steel milling.

GA5125

A high-performance MT-CVD coated carbide used primarily for the milling and turning of manganese steel. GA5125 can also be applied in Cr-Mo steels, tool steels, and other alloyed steels in continuous and interrupted turning. GA5125 provides excellent resistance to abrasion, crater wear, thermal shock, deformation, and built-up edge. It performs best when applied at high speeds and moderate feed rates.

PVD Coated

G-915

A multi-layer PVD-coated grade, G-915 is exceptional for milling and interrupted turning of heat-resistant alloys, stainless steels, and low-carbon steels. The coating adds heat and abrasion resistance to the tough substrate. G-915 should be used at moderate speeds and moderate to high feeds. It is a versatile grade that performs well in a variety of materials and operations outside its primary application range, making it a great choice for general machining.

G-935

A multi-layer PVD-coated grade for steel milling and turning applications requiring additional resistance to mechanical and thermal shock. The multi-layered PVD coating raises the speed envelope and wear resistance in tough milling, indexable drilling, and interrupted turning applications.

Uncoated

G-02

An excellent general-purpose cast-iron grade, G-02 can be used for milling and turning cast iron at moderately high speeds and medium feeds. G-02 is also a good choice for machining aluminum with positive rakes and light roughing of some heat-resistant alloys and stainless steels.

G-20M

A sub-micron C-2 carbide grade suited for use in light-to-medium turning of titanium and heat-resistant super alloys, G-20M has the strength and edge wear characteristics to resist notching when turning high-strength materials.

G-50

A grade used for the heavy roughing of steel and steel castings in unstable conditions, and ferritic stainless steels in most applications, G-50 is tough enough to enable the use of positive rakes in turning.

G-60

Used for the heavy rough turning of steel, steel castings, and steel forgings. Apply G-60 at moderate speeds and heavy feed rates and depths of cut. G-60 is more wear-resistant than G-50 but is lower in toughness.

G-74

A roughing and finishing grade for steel and steel castings, G-74 should be applied at high speeds and moderate to heavy feeds. It is well-suited for the turning of steel rolls.

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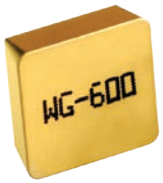
Ceramic

Greenleaf is the industry leader in the development and manufacture of ceramic and coated ceramic inserts in ANSI standard and special geometries. Some of the most prominent include:

WG-300®

A SiC whisker-reinforced Al_2O_3 ceramic that is very effective at machining nickel- and cobalt-based super alloys, alloyed cast iron, and hardened steels at metal removal rates up to 10 times higher than carbide. Excellent chemical stability and wear resistance at very high cutting speeds make WG-300® the first choice worldwide for grooving and turning difficult materials.



WG-600®

A coated SiC whisker-reinforced Al_2O_3 ceramic that offers higher tool life and speed capabilities than uncoated whisker-reinforced ceramics due to the additional barrier to heat and mechanical abrasion. Application areas for WG-600® include rough and finish turning of alloys in the M, K, S, and H ISO material classes, as well as milling of hardened steels and select stainless steels. WG-600® is particularly well-suited for finish-turning and grooving of heat-resistant super alloys and is unmatched in both turning and milling of steels with a hardness above 60 HRc.

XSYTIN®-1

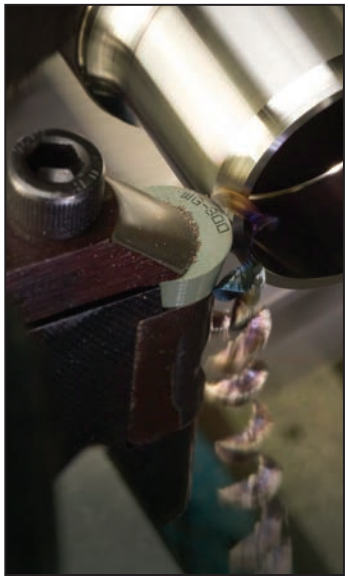
A phase-toughened ceramic grade capable of sustaining extreme cutting forces. The unprecedented strength, impact toughness, and resistance to thermal shock of XSYTIN®-1 make it ideal for use in interrupted cuts, forging scale removal, and milling. In continuous cuts, the strength of XSYTIN®-1 allows the use of significantly higher feed rates or depths of cut. In machining environments with severe interruptions and scale, the edge strength of XSYTIN®-1 allows the use of very light edge preparations, minimizing the force of impact and making for a much smoother cut.

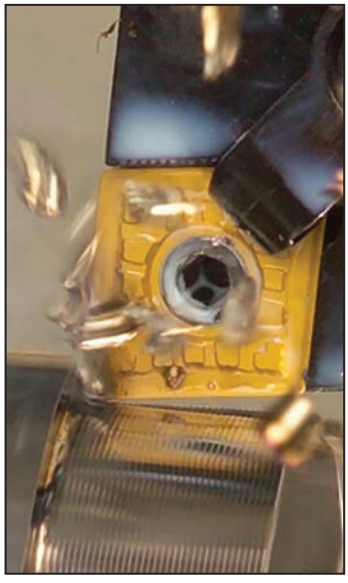
GSN100™

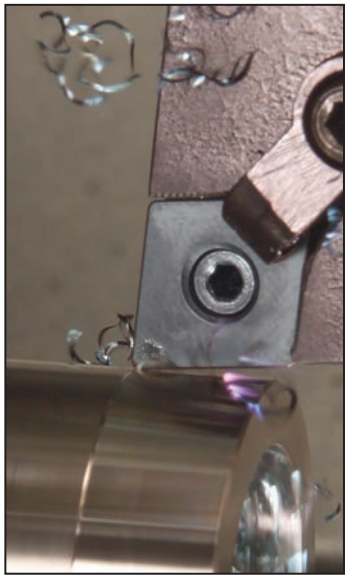
An engineered blend of hot-pressed silicon nitride and proprietary toughening agents that excels in the machining of cast iron. GSN100™ delivers superior wear and toughness for turning, grooving, and milling applications. It is available in all standard geometries and engineered specials.

GEM-8™

An Al_2O_3 + TiC composite ceramic exhibiting excellent hardness and strength at elevated temperatures. GEM-8™ offers a high degree of predictability in roll turning and continuous cuts in ferrous alloys.







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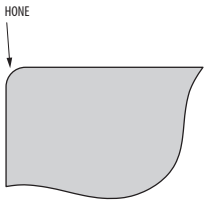
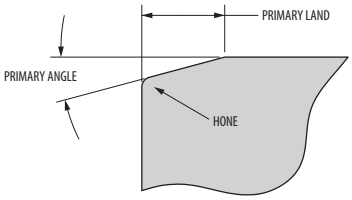
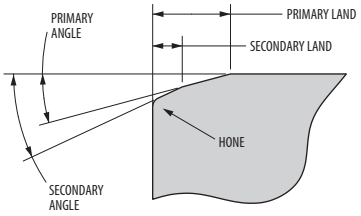
Edge Preparations



HONE



PRIMARY ANGLE



SECONDARY ANGLE

Edge Prep	Hone	Primary Land	Primary Angle	Secondary Land	Secondary Angle	Application
T2A	.0005 - .001" R.	.006 - .008"	20°			Scale applications, light interruptions, weld overlays, finish turning and milling of hardened materials.
T4A	.0005 - .001" R.	.065-.075"	10°	.006 - .008"	25°	Heavy machining <3/4"IC - Roll turning, 3V, 4V, CDH-22, CDH-33.
T4B	.001 - .002" R.	.065-.075"	10°	.006 - .008"	25°	Heavy machining <3/4"IC - Roll turning, 3V, 4V, CDH-22, CDH-33.
T10B	.001 - .002" R.	.090 - .100"	15°	.006 - .008"	30°	Heavy machining, iron and steel roll turning >3/4"IC, CDH-43, CDH-53.

NOTE: For additional edge preparations see page ATI 22-23.

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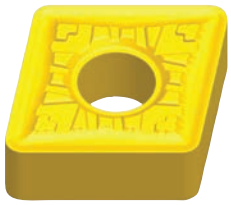
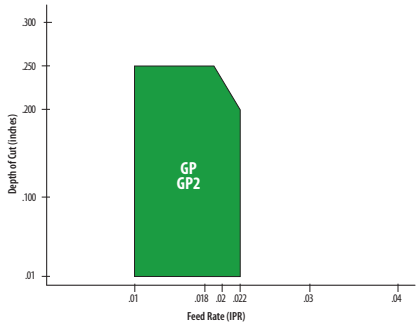
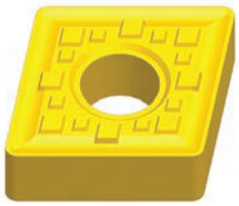
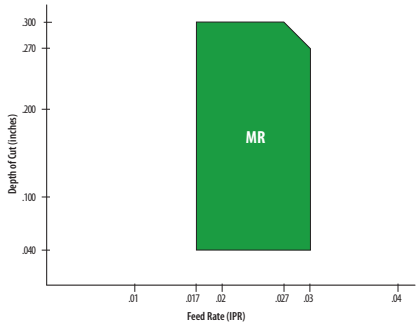
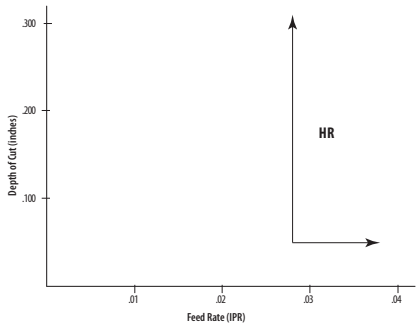
Chipform Application Range

GENERAL PURPOSE	GP and GP2 	General purpose chipbreaker. Feed rates up to 0.02"/rev and 0.25" depth of cut.	
MEDIUM ROUGHING	MR and MR2 	Used for medium roughing of all material. Feeds up to 0.028"/rev and depths up to 0.30".	
HEAVY ROUGHING	HR *single sided* 	Heavy roughing for all materials. Feeds above 0.023"/rev. One-sided chipbreaker for heaviest feeds (MM). *Example: CNMM 644 HR*	

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Pictorial Index

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GP2, MR, HR – single sided
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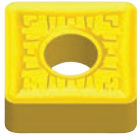
Flat Top
page: HT 10

80° Diamond
Flat Top
page: HT 11

Round
Chip Control
MR, HR – single sided
page: HT 12

Round
Flat Top
page: HT 12

Round
Flat Top
page: HT 12



Square
Chip Control
GP2, MR,
HR – single sided
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Carbide Inserts – Negative *continued*

Square
Flat Top
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Square
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MR
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Triangle
Flat Top
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Flat Top
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Carbide Inserts – Positive

Triangle
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Radius Forming

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Roll Turning

Roll Turning
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Roll Turning
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Roll Turning
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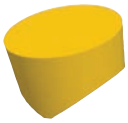
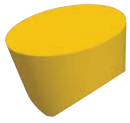


Round
V-Bottom
page: HT 25



Round
V-Bottom
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Square
Negative
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Heavy Turning Toolholder

H-SROON
Style K
Neutral
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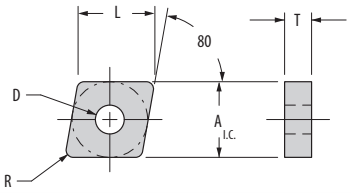
80° Diamond Inserts

Chip Control — CNMG, CNMM



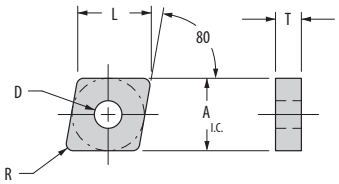
Shape: 80° Diamond	Part Number ANSI	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ISO	Dimensions (inches)				
		GA5035	GA5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		A	L	T	D	R
General Purpose 	CNMG-643-GP	▲	●	◆	◆	▲	◆	▲		CNMG-190612-GP	0.750	0.761	0.250	0.312	0.047
Medium Roughing 	CNMG-642-MR	▲	●	◆	◆	▲	◆	▲		CNMG-190608-MR	0.750	0.761	0.250	0.312	0.031
	CNMG-643-MR	▲	●	◆	◆	▲	◆	▲		CNMG-190612-MR	0.750	0.761	0.250	0.312	0.047
	CNMG-644-MR									CNMG-190616-MR	0.750	0.761	0.250	0.312	0.062
Heavy Roughing 	CNMG-643-HR	▲	●	◆	◆	▲	◆	▲		CNMM-190612-HR	0.750	0.761	0.250	0.312	0.047

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5



Flat Top — CNMA

Shape: 80° Diamond	Part Number ANSI	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ISO	Dimensions (inches)				
		GA5035	GA5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		A	L	T	D	R
	CNMA-642	◆	●			◆	◆	●	◆	CNMA-190608	0.750	0.761	0.250	0.312	0.031
	CNMA-643	◆	●			◆	◆	●	◆	CNMA-190612	0.750	0.761	0.250	0.312	0.047
	CNMA-644	◆	●			◆	◆	●	◆	CNMA-190616	0.750	0.761	0.250	0.312	0.062
	CNMA-866	◆	●			◆	◆	●	◆	CNMA-250924	1.000	1.015	0.375	0.359	0.093

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5

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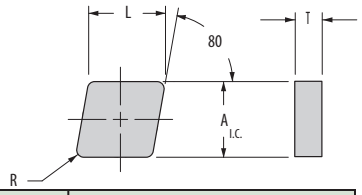
80° Diamond Inserts

Flat Top — CNGN



Shape: 80° Diamond	Part Number ANSI	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ISO	Dimensions (inches)			
		GA5035	GA5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		A	L	T	R
	CNGN-632	◆	●			◆	◆	●	◆	CNGN-190408	0.750	0.761	0.187	0.031
	CNGN-633	◆	●			◆	◆	●	◆	CNGN-190412	0.750	0.761	0.187	0.047
	CNGN-634	◆	●			◆	◆	●	◆	CNGN-190416	0.750	0.761	0.187	0.062
	CNGN-643	◆	●			◆	◆	●	◆	CNGN-190612	0.750	0.761	0.250	0.047
	CNGN-644	◆	●			◆	◆	●	◆	CNGN-190616	0.750	0.761	0.250	0.062

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

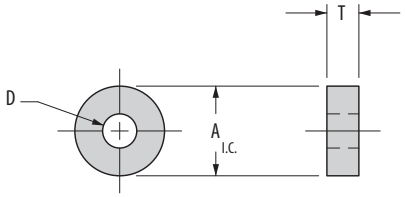
CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions *— pages HT 4–5*

Round Inserts

Chip Control — RNMG, RNMM



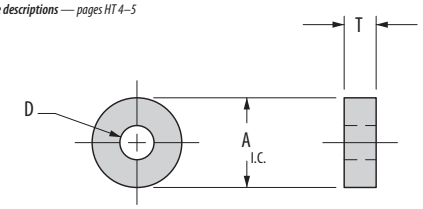
Shape: Round		Part Number ANSI	Steel P GA5035	Steel P GA5125	Steel P GA5036	Stainless Steel M GA5023	Stainless Steel M G-915	Cast Iron K GA5023	Heat-Resistant Super Alloys S G-915	Heat-Resistant Super Alloys S G-20M	Part Number ISO	Dimensions (inches) A	Dimensions (inches) T	Dimensions (inches) D
Medium Roughing		RNMG-64-MR	◆	●			◆	◆	●	◆	RNMG-190600-MR	0.750	0.250	0.312
		RNMG-86-MR	◆	●			◆	◆	●	◆	RNMG-250900-MR	1.000	0.375	0.359
Heavy Roughing		RNMM-84-HR	◆	●			◆	◆	●	◆	RNMM-250600-MR	1.000	0.250	0.359

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated
CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5

Flat Top — RNMA



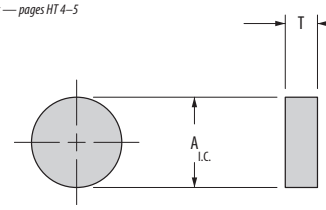
Shape: Round		Part Number ANSI	Steel P GA5035	Steel P GA5125	Steel P GA5036	Stainless Steel M GA5023	Stainless Steel M G-915	Cast Iron K GA5023	Heat-Resistant Super Alloys S G-915	Heat-Resistant Super Alloys S G-20M	Part Number ISO	Dimensions (inches) A	Dimensions (inches) T	Dimensions (inches) D
		RNMA-64	◆	●			◆	◆	●	◆	RNMA-190600	0.750	0.250	0.312
		RNMA-86	◆	●			◆	◆	●	◆	RNMA-250900	1.000	0.375	0.359

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated
CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5

Flat Top — RNGN



Shape: Round		Part Number ANSI	Steel P GA5035	Steel P GA5125	Steel P GA5036	Stainless Steel M GA5023	Stainless Steel M G-915	Cast Iron K GA5023	Heat-Resistant Super Alloys S G-915	Heat-Resistant Super Alloys S G-20M	Part Number ISO	Dimensions (inches) A	Dimensions (inches) T
		RNGN-63	◆	●			◆	◆	●	◆	RNGN-190400	0.750	0.187
		RNGN-84	◆	●			◆	◆	●	◆	RNGN-250600	1.000	0.250

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated
CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5

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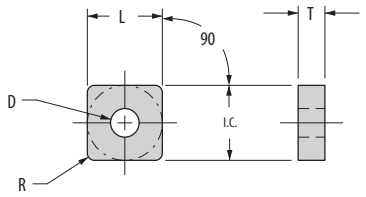
Square Inserts

Chip Control — SNMG, SNMM



Shape: Square		Part Number ANSI	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ISO	Dimensions (inches)				
			GA5035	GA5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		A	L	T	D	R
General Purpose		SNMG-643-GP2	▲	●			◆	◆	●	◆	SNMG-190612-GP2	0.750	0.750	0.250	0.312	0.047
		SNMG-644-GP2	▲	●			◆	◆	●	◆	SNMG-190616-GP2	0.750	0.750	0.250	0.312	0.062
Medium Roughing		SNMG-643-MR	▲	●			◆	◆	●	◆	SNMG-190612-MR	0.750	0.750	0.250	0.312	0.047
		SNMG-644-MR	▲	●			◆	◆	●	◆	SNMG-190616-MR	0.750	0.750	0.250	0.312	0.062
		SNMG-866-MR	▲	●			◆	◆	●	◆	SNMG-250924-MR	1.000	1.000	0.375	0.359	0.093
Heavy Roughing		SNMM-643-HR	▲	●			◆	◆	●	◆	SNMM-190612-HR	0.750	0.750	0.250	0.312	0.047
		SNMM-644-HR	▲	●			◆	◆	●	◆	SNMM-190616-HR	0.750	0.750	0.250	0.312	0.062

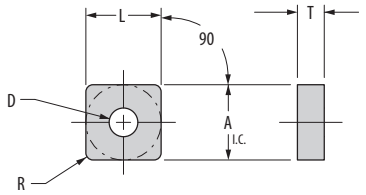
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5

Flat Top — SNMA



Shape: Square		Part Number ANSI	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ISO	Dimensions (inches)				
			GA5035	GA5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		A	L	T	D	R
		SNMA-643	▲	●			◆	◆	●	◆	SNMA-190612	0.750	0.750	0.250	0.312	0.047
		SNMA-644	▲	●			◆	◆	●	◆	SNMA-190616	0.750	0.750	0.250	0.312	0.062
		SNMA-864	▲	●			◆	◆	●	◆	SNMA-250916	1.000	1.000	0.375	0.359	0.062
		SNMA-866	▲	●			◆	◆	●	◆	SNMA-250924	1.000	1.000	0.375	0.359	0.093

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5

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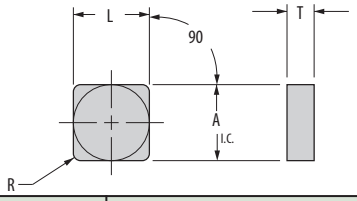
Square Inserts

Flat Top — SNGN / SNUN



Shape: Square	Part Number ANSI	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ISO	Dimensions (inches)			
		GA5035	GA5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		A	L	T	R
	SNGN-633	▲	●			◆	◆	●	◆	SNGN-190412	0.750	0.750	0.187	0.047
	SNGN-634	▲	●			◆	◆	●	◆	SNGN-190416	0.750	0.750	0.187	0.062
	SNGN-638	▲	●			◆	◆	●	◆	SNGN-190432	0.750	0.750	0.187	0.125
	SNGN-643	▲	●			◆	◆	●	◆	SNGN-190612	0.750	0.750	0.250	0.047
	SNGN-644	▲	●			◆	◆	●	◆	SNGN-190616	0.750	0.750	0.250	0.062
	SNGN-646	▲	●			◆	◆	●	◆	SNGN-190624	0.750	0.750	0.250	0.093
	SNGN-844	▲	●			◆	◆	●	◆	SNGN-250616	1.000	1.000	0.250	0.062
	SNGN-854	▲	●			◆	◆	●	◆	SNGN-250716	1.000	1.000	0.312	0.062
	SNGN-10412	▲	●			◆	◆	●	◆	SNGN-310648	1.250	1.250	0.250	0.187
	SNGN-1066	▲	●			◆	◆	●	◆	SNGN-310924	1.250	1.250	0.375	0.093
	SNGN-1068	▲	●			◆	◆	●	◆	SNGN-310932	1.250	1.250	0.375	0.125
	SNGN-1288	▲	●			◆	◆	●	◆	SNGN-381232	1.500	1.500	0.500	0.125
	SNUN-633	▲	●			◆	◆	●	◆	SNUN-190412	0.750	0.750	0.187	0.047
	SNUN-634	▲	●			◆	◆	●	◆	SNUN-190416	0.750	0.750	0.187	0.062
	SNUN-844	▲	●			◆	◆	●	◆	SNUN-250616	1.000	1.000	0.250	0.062
	SNUN-848	▲	●			◆	◆	●	◆	SNUN-250632	1.000	1.000	0.250	0.125
	SNUN-854	▲	●			◆	◆	●	◆	SNUN-250716	1.000	1.000	0.312	0.062
	SNUN-1066	▲	●			◆	◆	●	◆	SNUN-310924	1.250	1.250	0.375	0.093
	SNUN-1068	▲	●			◆	◆	●	◆	SNUN-310932	1.250	1.250	0.375	0.125
	SNUN-1288	▲	●			◆	◆	●	◆	SNUN-381232	1.500	1.500	0.500	0.125

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5

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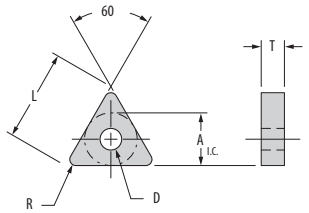
Triangle Inserts

Chip Control — TNMG



Shape: Triangle		Part Number ANSI	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ISO	Dimensions (inches)				
			GA5035	GA5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		A	L	T	D	R
Medium Roughing		TNMG-666-MR	▲	●			◆	◆	●	◆	TNMG-330924-MR	0.750	1.299	0.375	0.312	0.094

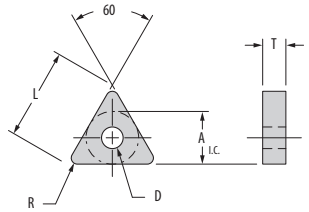
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5

Flat Top — TNMA



Shape: Triangle	Part Number ANSI	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ISO	Dimensions (inches)				
		GA5035	GA5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		A	L	T	D	R
	TNMA-642	▲	●			◆	◆	●	◆	TNMA-330608	0.750	1.299	0.250	0.312	0.031
	TNMA-643	▲	●			◆	◆	●	◆	TNMA-330612	0.750	1.299	0.250	0.312	0.047
	TNMA-644	▲	●			◆	◆	●	◆	TNMA-330616	0.750	1.299	0.250	0.312	0.062
	TNMA-664	▲	●			◆	◆	●	◆	TNMA-330916	0.750	1.299	0.375	0.312	0.062
	TNMA-666	▲	●			◆	◆	●	◆	TNMA-330924	0.750	1.299	0.375	0.312	0.093
	TNMA-668	▲	●			◆	◆	●	◆	TNMA-330932	0.750	1.299	0.375	0.312	0.125

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

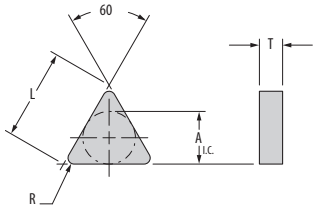
CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5

Triangle Inserts

Flat Top — TNGN



Shape: Triangle	Part Number ANSI	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ISO	Dimensions (inches)			
		GA5035	GA5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		A	L	T	R
	TNGN-654	◆	●			◆	◆	●	◆	TNGN-330716	0.750	1.299	0.312	0.062
	TNGN-656	◆	●			◆	◆	●	◆	TNGN-330724	0.750	1.299	0.312	0.093
	TNGN-664	◆	●			◆	◆	●	◆	TNGN-330916	0.750	1.299	0.375	0.062
	TNGN-666	◆	●			◆	◆	●	◆	TNGN-330924	0.750	1.299	0.375	0.093
	TNGN-668	◆	●			◆	◆	●	◆	TNGN-330932	0.750	1.299	0.375	0.125
	TNGN-776	◆	●			◆	◆	●	◆	TNGN-381124	0.875	1.516	0.437	0.093
	TNGN-778	◆	●			◆	◆	●	◆	TNGN-381132	0.875	1.516	0.437	0.125
	TNGN-7710	◆	●			◆	◆	●	◆	TNGN-381140	0.875	1.516	0.437	0.156
	TNGN-878	◆	●			◆	◆	●	◆	TNGN-441132	1.000	1.732	0.437	0.125

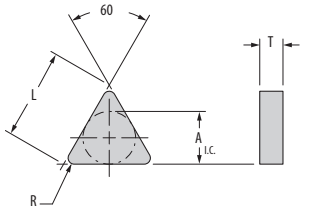
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5

Flat Top — TNUN



Shape: Triangle	Part Number ANSI	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ISO	Dimensions (inches)			
		GA5035	GA5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		A	L	T	R
	TNUN-654	◆	●			◆	◆	●	◆	TNUN-330716	0.750	1.299	0.312	0.062
	TNUN-656	◆	●			◆	◆	●	◆	TNUN-330724	0.750	1.299	0.312	0.093
	TNUN-664	◆	●			◆	◆	●	◆	TNUN-330916	0.750	1.299	0.375	0.062
	TNUN-666	◆	●			◆	◆	●	◆	TNUN-330924	0.750	1.299	0.375	0.093
	TNUN-668	◆	●			◆	◆	●	◆	TNUN-330932	0.750	1.299	0.375	0.125
	TNUN-776	◆	●			◆	◆	●	◆	TNUN-381124	0.875	1.516	0.437	0.093
	TNUN-778	◆	●			◆	◆	●	◆	TNUN-381132	0.875	1.516	0.437	0.125
	TNUN-7710	◆	●			◆	◆	●	◆	TNUN-381140	0.875	1.516	0.437	0.156
	TNUN-878	◆	●			◆	◆	●	◆	TNUN-441132	1.000	1.732	0.437	0.125

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5

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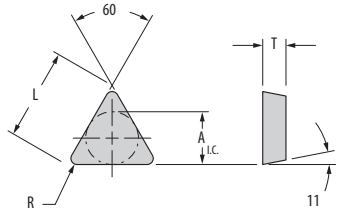
Triangle Inserts

Flat Top — TPGN/TPUN



Shape: Triangle	Part Number ANSI	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ISO	Dimensions (inches)			
		GA5035	GA5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		A	L	T	R
	TPGN-666	◆	●			◆	◆	●	◆	TPGN-330924	0.750	1.299	0.375	0.093
	TPUN-664	◆	●			◆	◆	●	◆	TPUN-330916	0.750	1.299	0.375	0.062
	TPUN-666	◆	●			◆	◆	●	◆	TPUN-330924	0.750	1.299	0.375	0.093

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

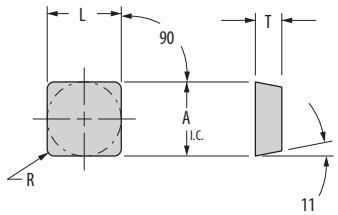
CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5

Square Inserts

Flat Top — SPGN / SPUN



Shape: Square	Part Number ANSI	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ISO	Dimensions (inches)			
		GA5035	GA5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		A	L	T	R
	SPGN-633	◆	●			◆	◆	●	◆	SPGN-190412	0.750	0.750	0.187	0.047
	SPGN-634	◆	●			◆	◆	●	◆	SPGN-190416	0.750	0.750	0.187	0.062
	SPGN-636	◆	●			◆	◆	●	◆	SPGN-190424	0.750	0.750	0.187	0.093
	SPGN-638	◆	●			◆	◆	●	◆	SPGN-190432	0.750	0.750	0.187	0.125
	SPUN-633	◆	●			◆	◆	●	◆	SPUN-190412	0.750	0.750	0.187	0.047
	SPUN-634	◆	●			◆	◆	●	◆	SPUN-190416	0.750	0.750	0.187	0.062
	SPUN-643	◆	●			◆	◆	●	◆	SPUN-190612	0.750	0.750	0.250	0.047
	SPUN-644	◆	●			◆	◆	●	◆	SPUN-190616	0.750	0.750	0.250	0.062
	SPUN-864	◆	●			◆	◆	●	◆	SPUN-250916	1.000	1.000	0.375	0.062
	SPUN-866	◆	●			◆	◆	●	◆	SPUN-250924	1.000	1.000	0.375	0.093
	SPUN-868	◆	●			◆	◆	●	◆	SPUN-250932	1.000	1.000	0.375	0.125
	SPUN-1068	◆	●			◆	◆	●	◆	SPUN-310932	1.250	1.250	0.375	0.125
	SPUN-1288	◆	●			◆	◆	●	◆	SPUN-381232	1.500	1.500	0.500	0.125

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5

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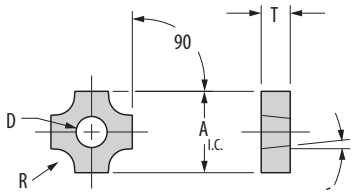
Radius Forming Inserts

SNMA



Shape: Square	Part Number ANSI	GA5035	GA5036	G-02	G-60	Part Number ISO	Dimensions (inches) A	D	T	R
	SNMA-64IR4	◆	●			SNMA-64IR4	0.750	0.250	0.312	0.062
	SNMA-64IR6	◆	●			SNMA-64IR6	0.750	0.250	0.312	0.093
	SNMA-64IR8	◆	●			SNMA-64IR8	0.750	0.250	0.312	0.125
	SNMA-64IR10	◆	●			SNMA-64IR10	0.750	0.250	0.312	0.156
	SNMA-84IR12	◆	●			SNMA-84IR12	1.000	0.250	0.359	0.187
	SNMA-84IR14	◆	●			SNMA-84IR14	1.000	0.250	0.359	0.218
	SNMA-84IR16	◆	●			SNMA-84IR16	1.000	0.250	0.359	0.250
	SNMA-106IR20	◆	●			SNMA-106IR20	1.250	0.375	0.500	0.312
	SNMA-106IR24	◆	●			SNMA-106IR24	1.250	0.375	0.500	0.375
	SNMA-126IR28	◆	●			SNMA-126IR28	1.500	0.375	0.500	0.437
	SNMA-126IR32	◆	●			SNMA-126IR32	1.500	0.375	0.500	0.500

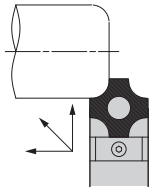
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

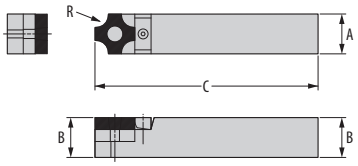
First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5

Style GSRN



Neutral toolhoder shown



Part Number Neutral	Dimensions (inches) A	B	C	Standard Components Shim	Center Pin	Clamp	Clamp Screw	Tune-Up Kit	Insert Options Insert	R
GSRN-646	0.750	1.000	6.000	SR6	30309	30308-2	30301-1	TK-01117	SNMA-64IR4	0.062
GSRN-656	0.750	1.250	6.000	SR6	30309	30308-2	30301-1	TK-01117	SNMA-64IR6	0.093
GSRN-666	0.750	1.500	7.000	SR6	30309	30308-2	30301-1	TK-01117	SNMA-64IR8	0.125
									SNMA-64IR10	0.156
GSRN-168	1.000	1.000	6.000	SR8	30327-1	30308-2	30301-1	TK-00572	SNMA-84IR12	0.187
GSRN-858	1.000	1.250	7.000	SR8	30327-1	30308-2	30301-1	TK-00572	SNMA-84IR14	0.218
GSRN-868	1.000	1.500	8.000	SR8	30327-1	30308-2	30301-1	TK-00572	SNMA-84IR16	0.250
GSRN-2010	1.250	1.250	7.000	SR10	30454	30319-2	30320	TK-00573	SNMA-106IR20	0.312
GSRN-2410	1.500	1.500	8.000	SR10	30454	30319-2	30320	TK-00573	SNMA-106IR24	0.375
GSRN-2412	1.500	1.500	8.000	SR12	30545	30319-2	30320	TK-00574	SNMA-126IR28	0.437
									SNMA-126IR32	0.500

These toolholders are Greenleaf standard and do not conform to the ANSI identification system.

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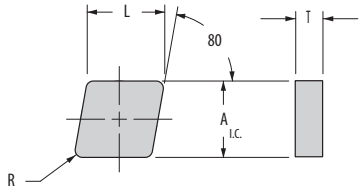
80° Diamond Inserts

CNGN



Shape: Diamond	Part Number ANSI	Steel P				S Steel M	Cast Iron K				Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ISO	Dimensions (inches)			
		WG-300	WG-600	XSYTIN-1	GEM-8	WG-600	WG-600	GSN100	XSYTIN-1	GEM-8	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		A	L	T	R
	CNGN-642	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	CNGN-190608	0.750	0.761	0.250	0.031
	CNGN-643	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	CNGN-190612	0.750	0.761	0.250	0.047
	CNGN-644	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	CNGN-190616	0.750	0.761	0.250	0.062

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

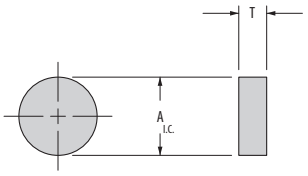
CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5

Round Inserts

RNGN



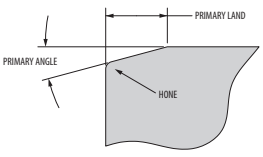
Shape: Round	Part Number ANSI	Steel P				S Steel M	Cast Iron K				Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ISO	Dimensions (inches)	
		WG-300	WG-600	XSYTIN-1	GEM-8	WG-600	WG-600	GSN100	XSYTIN-1	GEM-8	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		A	T
	RNGN-64	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RNGN-190600	0.750	0.250
	RNGN-65	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RNGN-190700	0.750	0.312
	RNGN-84	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RNGN-250600	1.000	0.250
	RNGN-85	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RNGN-250700	1.000	0.312
	RNGN-86	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RNGN-250900	1.000	0.375
	RNGN-106	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RNGN-310900	1.250	0.375

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5



Edge preparations — page HT 06

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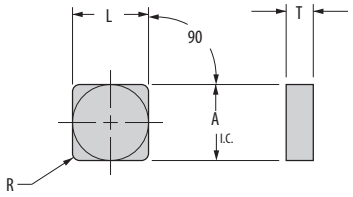
Square Inserts

SNGN



Shape: Square	Part Number ANSI	Steel P				S Steel M	Cast Iron K				Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ISO	Dimensions (inches)			
		WG-300	WG-600	XSYTIN-1	GEM-8	WG-600	WG-600	GSN100	XSYTIN-1	GEM-8	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		A	L	T	R
	SNGN-642	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SNGN-190608	0.750	0.750	0.250	0.031
	SNGN-643	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SNGN-190612	0.750	0.750	0.250	0.047
	SNGN-644	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SNGN-190616	0.750	0.750	0.250	0.062
	SNGN-653	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SNGN-190712	0.750	0.750	0.312	0.047
	SNGN-654	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SNGN-190716	0.750	0.750	0.312	0.062
	SNGN-655	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SNGN-190720	0.750	0.750	0.312	0.078
	SNGN-866	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SNGN-250924	1.000	1.000	0.375	0.094

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

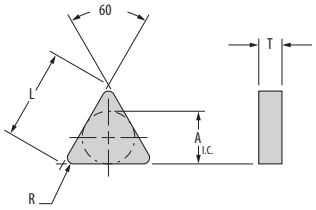
CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5

Triangle Inserts

TNGN



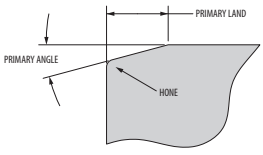
Shape: Triangle	Part Number ANSI	Steel P				S Steel M	Cast Iron K				Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ISO	Dimensions (inches)			
		WG-300	WG-600	XSYTIN-1	GEM-8	WG-600	WG-600	GSN100	XSYTIN-1	GEM-8	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		A	L	T	R
	TNGN-666	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	TNGN-330924	0.750	1.299	0.375	0.094
	TNGN-868	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	TNGN-440932	1.000	1.732	0.375	0.125

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5



Edge preparations — page HT 06

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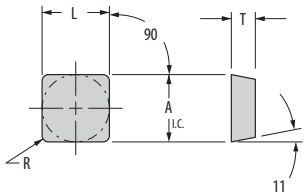
Square Inserts

SPGN



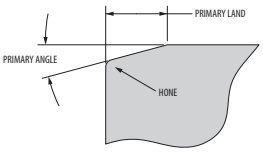
Shape: Square	Part Number ANSI	Steel P				S Steel M	Cast Iron K				Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ISO	Dimensions (inches)			
		WG-300	WG-600	XSYTIN-1	GEM-8	WG-600	WG-600	GSN100	XSYTIN-1	GEM-8	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		A	L	T	R
	SPGN-633	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SPGN-190412	0.750	0.750	0.187	0.047
	SPGN-634	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SPGN-190416	0.750	0.750	0.187	0.062
	SPGN-642	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SPGN-190608	0.750	0.750	0.250	0.031

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5



Edge preparations — page HT 06

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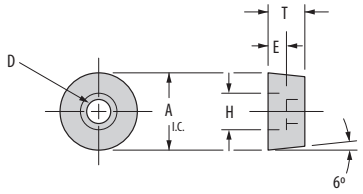
Roll Turning Inserts

Carbide — CDH



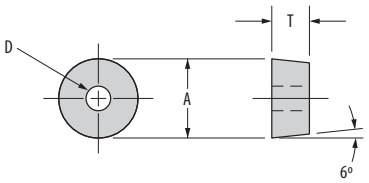
Shape: CDH	Part Number ANSI	GA5035	GA5036	G-02	G-60	Part Number ISO	Dimensions (inches) A	T	H	D	E
	CDH-42	▲	▲	▲	▲	CDH-42	1.000	0.500	0.406	0.265	0.250
	CDH-43	▲	▲	▲	▲	CDH-43	1.000	0.750	0.406	0.265	0.500
	CDH-51.5	▲	▲	▲	▲	CDH-51.5	1.250	0.375	0.593	0.390	0.375
	CDH-53	▲	▲	▲	▲	CDH-53	1.250	0.750	0.593	0.390	0.375

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC



Ceramic — C-CDH

Shape: C-CDH	Part Number ANSI	Steel P				S Steel M	Cast Iron K				Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ISO	Dimensions (inches) A	T	D
		WG-300	WG-600	XSYTIN-1	GEM-8	WG-600	WG-600	GSN100	XSYTIN-1	GEM-8	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8				
	C-CDH-21	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	C-CDH-21	0.500	0.250	0.125
	C-CDH-22	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	C-CDH-22	0.500	0.500	0.125
	C-CDH-31	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	C-CDH-31	0.750	0.250	0.265
	C-CDH-31.5	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	C-CDH-31.5	0.750	0.375	0.265
	C-CDH-42	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	C-CDH-42	1.000	0.500	0.265
	C-CDH-43	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	C-CDH-43	1.000	0.750	0.265
	C-CDH-51.5	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	C-CDH-51.5	1.250	0.375	0.390
	C-CDH-53	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	C-CDH-53	1.250	0.750	0.390

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

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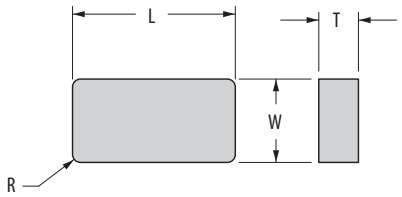
Roll Turning Inserts

LNUN



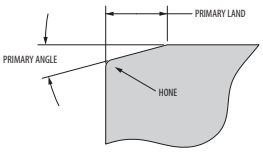
Shape: LNUN	Part Number ANSI	GA5035	G-935	G-50	G-74	Part Number ISO	Dimensions (inches) W	L	T	R
	LNUN-4442	▲	▲	▲	▲	LNUN-4442	0.500	1.000	0.250	0.031
	LNUN-4444	▲	▲	▲	▲	LNUN-4444	0.500	1.000	0.250	0.062
	LNUN-4452	▲	▲	▲	▲	LNUN-4452	0.500	1.000	0.312	0.031
	LNUN-4454	▲	▲	▲	▲	LNUN-4454	0.500	1.000	0.312	0.062
	LNUN-5444	▲	▲	▲	▲	LNUN-5444	0.625	1.000	0.250	0.062
	LNUN-5464	▲	▲	▲	▲	LNUN-5464	0.625	1.000	0.375	0.062
	LNUN-5564	▲	▲	▲	▲	LNUN-5564	0.625	1.250	0.375	0.062
	LNUN-6568	▲	▲	▲	▲	LNUN-6568	0.750	1.250	0.375	0.125
	LNUN-6684	▲	▲	▲	▲	LNUN-6684	0.750	1.500	0.500	0.062
	LNUN-6688	▲	▲	▲	▲	LNUN-6688	0.750	1.500	0.500	0.125
	LNUN-66812	▲	▲	▲	▲	LNUN-66812	0.750	1.500	0.500	0.187
	LNUN-68812	▲	▲	▲	▲	LNUN-68812	0.750	2.000	0.500	0.187

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

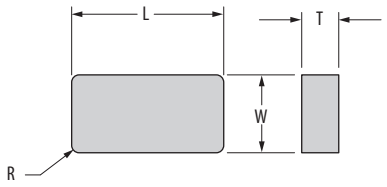
Grade descriptions *— pages HT 4–5*



Edge preparations *— page HT 06*

Roll Turning Inserts

LNMN



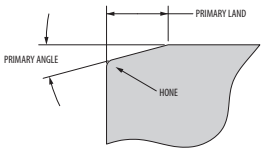
Shape: LNMN	Part Number ANSI	Steel P				S Steel M	Cast Iron K				Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ISO	Dimensions (inches)			
		WG-300	WG-600	XSYTIN-1	GEM-8	WG-600	WG-600	GSN100	XSYTIN-1	GEM-8	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		W	L	T	R
	LNMN-4442	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-4442	0.500	1.000	0.250	0.031
	LNMN-4444	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-4444	0.500	1.000	0.250	0.062
	LNMN-4452	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-4452	0.500	1.000	0.312	0.031
	LNMN-4454	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-4454	0.500	1.000	0.312	0.062
	LNMN-5444	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-5444	0.625	1.000	0.250	0.062
	LNMN-5464	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-5464	0.625	1.000	0.375	0.062
	LNMN-5564	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-5564	0.625	1.250	0.375	0.062
	LNMN-6568	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-6568	0.750	1.250	0.375	0.125
	LNMN-6684	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-6684	0.750	1.500	0.500	0.062
	LNMN-6688	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-6688	0.750	1.500	0.500	0.125
	LNMN-66812	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-66812	0.750	1.500	0.500	0.187

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions *— pages HT 4–5*



Edge preparations *— page HT 06*

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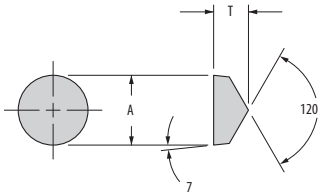
Round V-Bottom Inserts

RCGN-V



Shape: Round V-Bottom	Part Number ANSI	Steel P				S Steel M	Cast Iron K				Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ISO	Dimensions (inches)	
		WG-300	WG-600	XSYTIN-1	GEM-8	WG-600	WG-600	GSN100	XSYTIN-1	GEM-8	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		A	T
	RCGN-2V	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RCGX-060400	0.250	0.187
	RCGN-3V	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RCGX-090700	0.375	0.312
	RCGN-4V	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RCGX-120700	0.500	0.312
	RCGN-5V	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RCGX-151000	0.625	0.394
	RCGX-106	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RCGX-191000	0.750	0.394
	RCGN-6V	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RCGX-191200	0.750	0.500

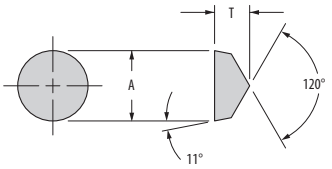
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5

RPGN-V



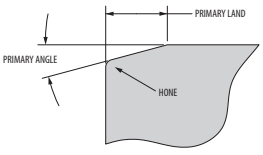
Shape: Round V-Bottom	Part Number ANSI	Steel P				S Steel M	Cast Iron K				Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ISO	Dimensions (inches)	
		WG-300	WG-600	XSYTIN-1	GEM-8	WG-600	WG-600	GSN100	XSYTIN-1	GEM-8	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		A	T
	RPGN-2V	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RPGX-060400	0.250	0.187
	RPGN-3V	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RPGX-090700	0.375	0.312
	RPGN-4V	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RPGX-120700	0.500	0.312

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5



Edge preparations — page HT 06

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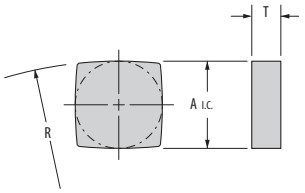
Square Inserts

SNGN



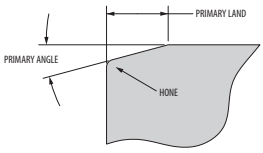
Shape: Square	Part Number ANSI	Steel P				S Steel M	Cast Iron K				Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ISO	Dimensions (inches)		
		WG-300	WG-600	XSYTIN-1	GEM-8	WG-600	WG-600	GSN100	XSYTIN-1	GEM-8	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		A	T	R
	SNGN-128-R4.5	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SNGN-128-R4.5	1.500	0.500	4.500

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages HT 4–5



Edge preparations — page HT 06

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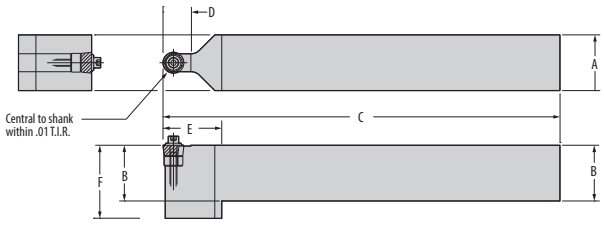
H-SROON

Neutral Carbide and Ceramic Inserts



Part Number	Gage Insert	Dimensions (inches)						Standard Components		
		A	B	C	D	E	F	Shim	Shim Thickness	Insert Screw
H-SROON-24-3-1	C-CDH-31	1.500	1.500	12.000	1.500	2.250	2.000	313665	0.125	SHCS 1/4-20 x 1.25 Long
H-SROON-32-3-1	CDH-31	2.000	2.000	12.000	1.500	N/A	N/A			
H-SROON-24-4-2	C-CDH-42	1.500	1.500	12.000	1.500	2.250	2.250	3291	0.250	SHCS 1/4-20 x 1.50 Long
H-SROON-32-4-2	CDH-42	2.000	2.000	12.000	1.500	2.250	2.250			
H-SROON-32-5-1.5	C-CDH-51.5	2.000	2.000	12.000	2.000	2.500	2.500	313690	0.375	SHCS 3/8-16 x 2.00 Long
	CDH-51.5	2.000	2.000	12.000	2.000	2.500	2.500			

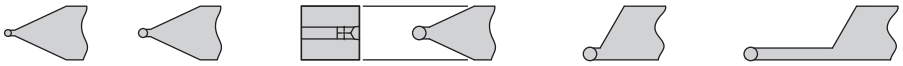
C-CDH and CDH inserts can be found on page HT 23.

Optional

Part Number	Gage Insert	Optional Inserts and Components			
		Shim	Shim Thickness	Insert Screw	Chip Breaker
H-SROON-24-3-1	C-CDH-31.5	N/A	N/A	SHCS 1/4-20 x 1.25 Long	306727
H-SROON-32-3-1	CDH-31.5				
H-SROON-24-4-2	C-CDH-43	N/A	N/A	SHCS 1/4-20 x 1.50 Long	304736
H-SROON-32-4-2	CDH-43				
H-SROON-32-5-1.5	C-CDH-53	N/A	N/A	SHCS 3/8-16 x 2.00 Long	313602
	CDH-53				

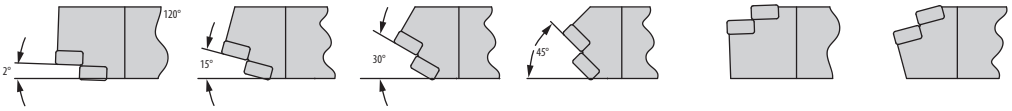
Inserts

Round V-Bottom
RPGN , RCGN STYLES



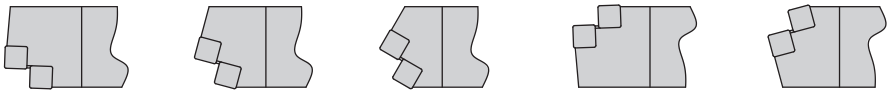
Single Rectangle
LNU STYLE

Double Rectangle
LNU STYLE

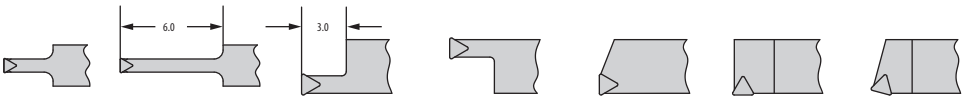


Single Square
NEGATIVE OR POSITIVE
SNUN , SPUN STYLES

Double Square
NEGATIVE OR POSITIVE
SNUN , SPUN STYLES

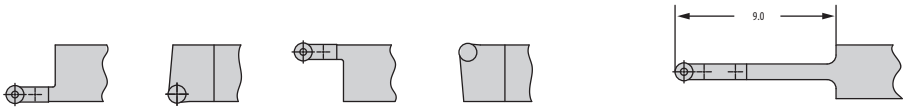


Triangular Insert
NEGATIVE OR POSITIVE
TPGN, TNUN STYLES

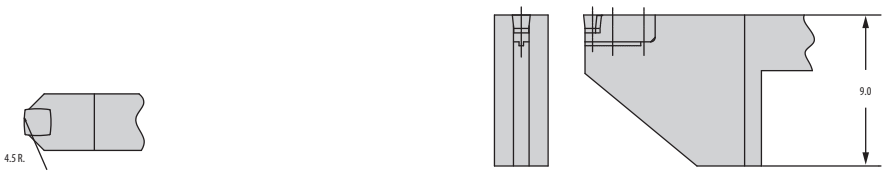


Diamond Insert
NEGATIVE OR POSITIVE
CNGN , CPGN STYLES

Round Insert
NEGATIVE OR POSITIVE
RNGN , RCGN STYLES
CDH STYLES



1½ I.C.
Finishing Insert
SNGN-128R4.5



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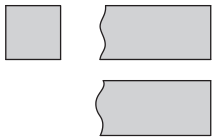
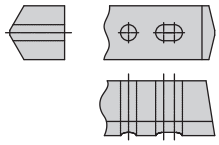
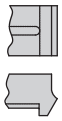
Shank Options



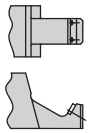
Straight Shank



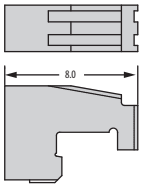
Customized V-Bottom Shank



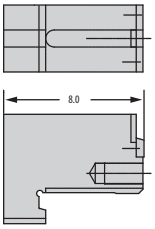
Farrel Quick Change



Greenleaf Cam Lock



Customized Shank for Herkules Lathes



Customized Shank for Waldrich Siegen Lathes

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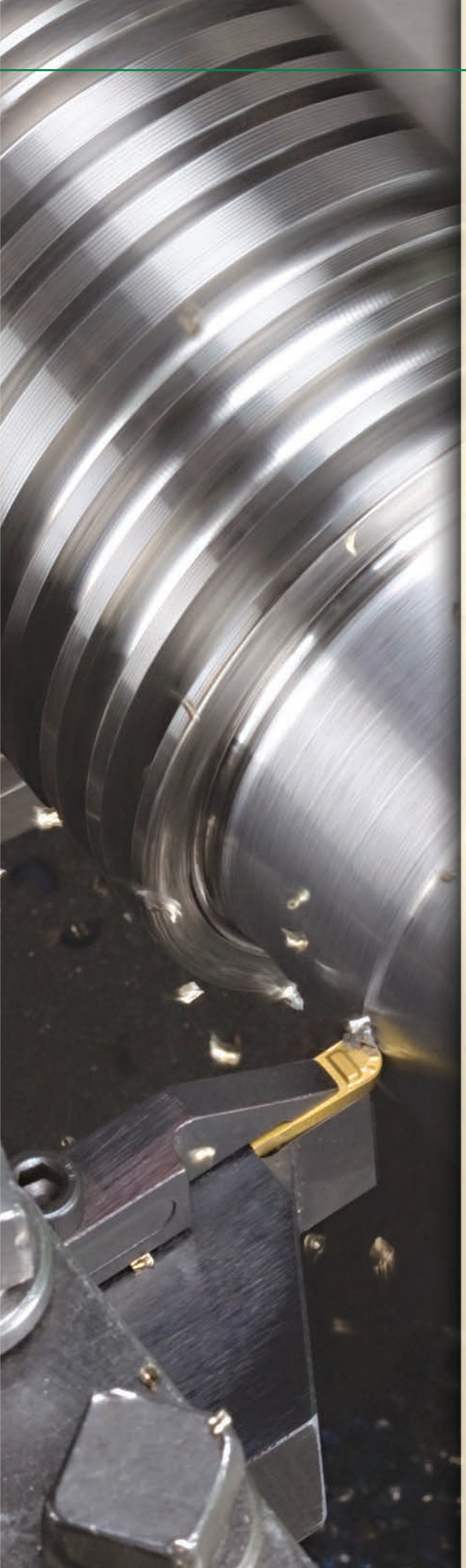

Grooving, Profiling, and Cut-Off

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Grooving, Profiling and Cut-Off Inserts

Greenleaf offers one of the most comprehensive lines of grooving, profiling, and cut-off inserts in the industry. The single-ended V-bottom grooving systems allow greater depth of cut and optimal transfer of cutting forces for carbide and ceramic inserts.

Our advanced MT-CVD-coated and PVD-coated grades have the strength and wear resistance needed for higher cutting speeds and tool life.

Greenleaf is the industry leader in the development and manufacture of ceramic and coated ceramic inserts, including WG-600® and WG-700™ – second-generation, coated ceramic-composite cutting tools using whisker reinforcement. The coatings protect the already heat-resistant substrate from additional heat encountered in grooving applications and appreciably extend tool life.

Insert Grades

Carbide

CVD Coated

GA5025
A high-speed MT-CVD coated grade developed primarily for turning, GA5025 excels in light roughing and finishing applications of carbon and alloy steels, including select stainless steels. GA5025 is preferred in grooving and profiling applications where tool life and wear resistance are essential.

GA5026
A high-performance grade specifically developed for finish-turning in nickel- and cobalt-based super-alloys, stainless steels, hardened steels, and refractory metals. The combination of an advanced MT-CVD coating over a hard, sub-micron grain carbide offers outstanding wear resistance while maintaining exceptional resistance to notching and deformation common in turning of high-strength materials. GA5026 is best applied at high speeds and low feed rates.

GA5035
A high-performance MT-CVD coated grade for turning in all types of steels, GA5035 can be used from rough to finish-turning applications that require resistance to heat deformation and abrasion. GA5035 is the primary choice for steel grooving and profiling applications, and should be applied at high speeds and moderate feed rates.

GA5036
A high-speed MT-CVD coated grade developed primarily for milling, GA5036 excels in grooving and profiling applications of forged and cast steels, as well as select stainless steels where toughness and heat resistance are required. GA5036 is best applied at high cutting speeds and moderate feed rates.

GA5125
A high-performance MT-CVD coated carbide grade developed specifically for milling manganese steel, GA5125 can also be applied to interrupted and continuous grooving and profiling applications in chrome-moly steel, tool steel and similar high alloy steels. GA5125 offers excellent wear, built-up edge, thermal shock and deformation resistance, and is best applied at high cutting speeds with moderate feed rates.

PVD Coated

G-915
A tough PVD-coated grade, G-915 is exceptional for milling and interrupted turning of heat-resistant alloys, stainless steels and low-carbon steels. The multi-layer PVD coating provides heat and abrasion resistance to the tough substrate, making G-915 a versatile grade choice that performs well in a variety of materials and grooving, profiling and cut-off applications. G-915 is best applied at moderate speeds and moderate-to-high feed rates.

G-920
A high-speed PVD-coated grade for light-to-medium turning applications of heat-resistant alloys and select stainless steels, G-920 is also an excellent grade option for machining aluminum and refractory metals. The resistance to deformation and notching which allows the use of high cutting speeds makes G-920 well-suited to grooving and finish profiling applications in heat-resistant alloys.

G-925
A high-performance multi-layered PVD-coated grade, G-925 is specifically designed for machining abrasive and difficult-to-machine materials. Typical applications include grooving and profiling of heat-resistant alloys, titanium, and other refractory metals, stainless steels, and ductile cast irons. G-925 exhibits excellent resistance to notching and deformation, and should be applied at moderate-to-high speeds and moderate feed rates.

G-935
A multi-layer PVD-coated grade primarily for steel milling and turning applications requiring additional resistance to mechanical and thermal shock. These properties make G-935 an ideal choice in grooving and profiling applications where toughness is essential. G-935 is best applied at high cutting speeds and moderate feed rates.

G-9610
An advanced PVD-coated grade, G-9610 is specifically designed for turning, grooving and profiling applications in all grades of titanium. The high-tech coating provides wear-resistance, chemical stability and a smooth, lubricious outer layer which protects the hard, sub-micron grain substrate and enables high cutting speeds and extended tool life for continuous cuts in non-ferrous alloys.

Uncoated

G-10
A medium grain carbide grade suited for the medium-to-heavy roughing of titanium and Heat-Resistant Super Alloys.

G-20M
A sub-micron C-2 carbide grade suited for use in light-to-medium turning, grooving and profiling of titanium and heat-resistant super alloys. G-20M has the edge strength and edge wear characteristics necessary to resist notching when grooving high-strength materials.

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Ceramic

WG-300®

A SiC whisker-reinforced Al_2O_3 ceramic that is very effective at machining nickel- and cobalt-based super alloys, alloyed cast iron, and hardened steels at metal removal rates up to 10 times higher than carbide. Excellent chemical stability and wear resistance at very high cutting speeds make WG-300® the first choice worldwide for grooving difficult materials.

WG-600®

A coated SiC whisker-reinforced Al_2O_3 ceramic that offers higher tool life and speed capabilities than uncoated whisker-reinforced ceramics due to the additional barrier to heat and mechanical abrasion. Application areas for WG-600® include rough and finish turning of alloys in the M, K, S, and H ISO material classes, as well as grooving of hardened steels and select stainless steels. WG-600® is particularly well-suited for finish-turning and grooving of Heat-Resistant Super Alloys and is unmatched in both grooving and milling of steels with a hardness above 60 HRc.

WG-700™

A SiC whisker-reinforced Al_2O_3 ceramic featuring improved toughness and a unique low-friction coating. WG-700™ is ideal for turning, grooving, and profiling nickel- and cobalt-based super alloys that other ceramics may struggle in. WG-700™ exhibits exceptional tool life and productivity in next-generation formulations or novel heat treatments of heat-resistant super alloys lower, and long-reach or thin-walled applications with lower rigidity.

XSYTIN®-1

A phase-toughened ceramic grade capable of sustaining extreme cutting forces. The unprecedented strength, impact toughness, and resistance to thermal shock of XSYTIN®-1 make it ideal for use in interrupted turning, forging scale removal and milling. In continuous cuts, the strength of XSYTIN®-1 allows the use of significantly higher feed rates or depths of cut. In machining environments with severe interruptions and scale, the edge strength of XSYTIN®-1 allows the use of very light edge preparations, minimizing the force of impact and making for a much smoother cut.

GSN100™

An engineered blend of hot-pressed silicon nitride and proprietary toughening agents that excels in the machining of cast iron. GSN100™ delivers superior wear and toughness for turning, grooving, and milling applications. It is available in all standard geometries and engineered specials.

GEM-8™

An Al_2O_3 + TiC composite ceramic exhibiting excellent hardness and strength at elevated temperatures. GEM-8™ offers a high degree of predictability in roll turning and continuous cuts in ferrous alloys.

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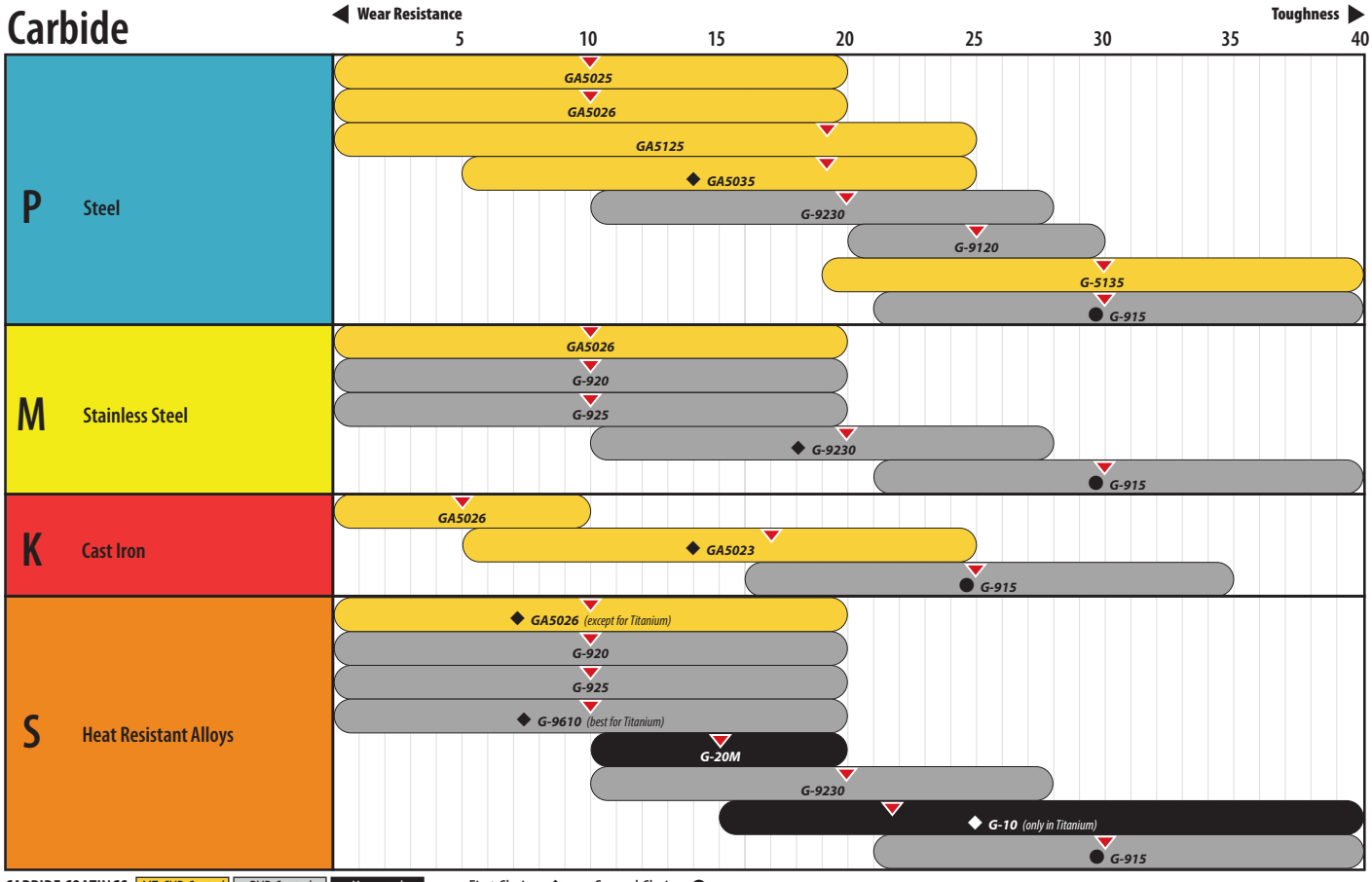
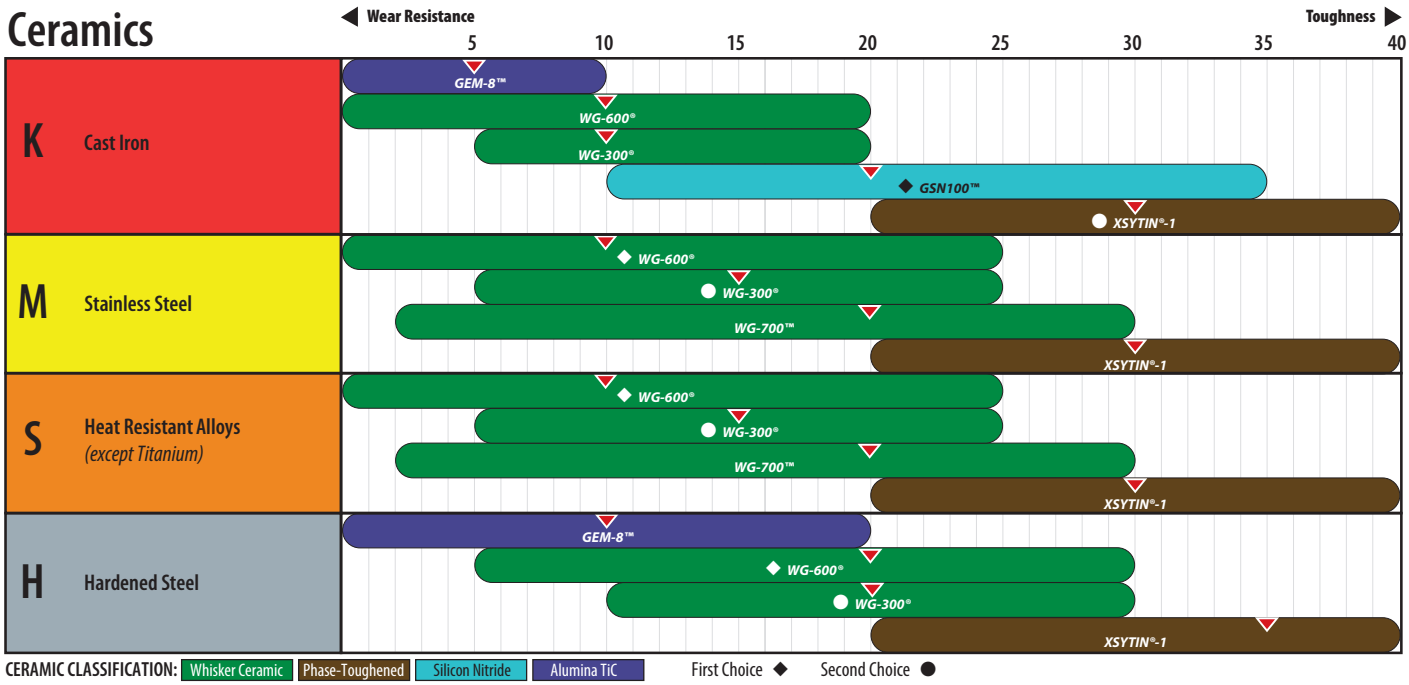
Insert Grade Reference for Grooving, Profiling, and Cut-Off

Carbide



CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated First Choice ◆ Second Choice ●

Ceramics



CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC First Choice ◆ Second Choice ●

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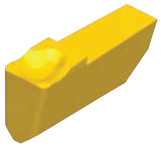
Pictorial Index

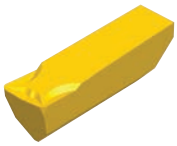
Greenleaf Cut-Off System



COS
page: GP 08

Single-Ended Groovers

GTS Style
Full Nose
page: GP 09



GTS Style
Flat Nose
page: GP 09

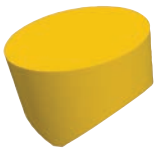
WG-Style
Full Nose
page: GP 10

WG-Style
Flat Nose
page: GP 11

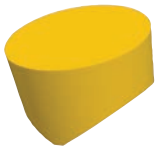
WGC
Full Nose
page: GP 12

WGC
Flat Nose
page: GP 13

V-Bottom Round Inserts



RCGN
Positive: Carbide
page: GP 14



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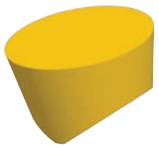
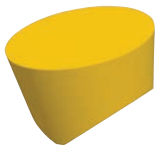
Positive: Ceramic
page: GP 14

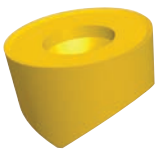


RPGN
Positive: Carbide
page: GP 15



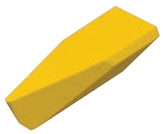
RPGN
Positive: Ceramic
page: GP 15

RCGR/RPGR
Positive Chipform
V-Bottom
page: GP 16



RCGT/RPGT
Positive Chipform
V-Bottom
page: GP 17

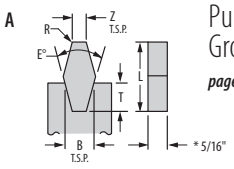
35° and 55° V-Bottom Diamond Inserts



VPG
35°
page: GP 18

VCGN
35°
page: GP 18

DPGN
55°
page: GP 19



Pulley and Poly
Groove Inserts
page: GP 20

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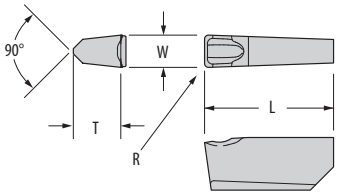
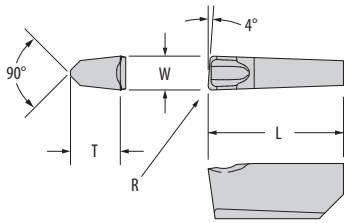
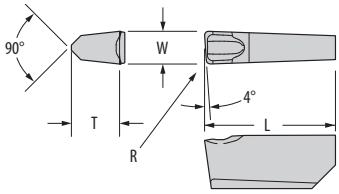
Greenleaf Cut-Off System



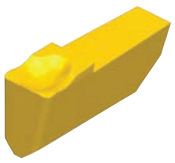
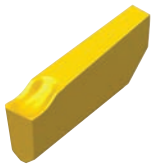
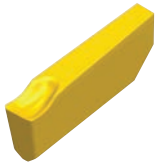
0° Lead



4° Left Hand



4° Right Hand

Shape: Groove/Turn	Part Number ANSI	G-915	Part Number ISO	Dimensions (inches)			
				W	L	T	R
	COS-4094-0	◆	COS-4094-0	0.094	0.500	0.187	0.010
	COS-4125-0	◆	COS-4125-0	0.125	0.500	0.187	0.010
	COS-4187-0	◆	COS-4187-0	0.187	0.500	0.187	0.010
	COS-4094-4L	◆	COS-4094-4L	0.094	0.500	0.187	0.010
	COS-4125-4L	◆	COS-4125-4L	0.125	0.500	0.187	0.010
	COS-4187-4L	◆	COS-4187-4L	0.187	0.500	0.187	0.010
	COS-4094-4R	◆	COS-4094-4R	0.094	0.500	0.187	0.010
	COS-4125-4R	◆	COS-4125-4R	0.125	0.500	0.187	0.010
	COS-4187-4R	◆	COS-4187-4R	0.187	0.500	0.187	0.010

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages GP 04

See pages GP 31, GP 34 and GP 39 for toolholders.

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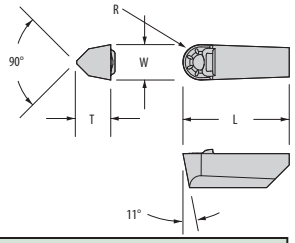
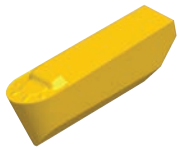
GTS Style, Full Nose Grooving Inserts



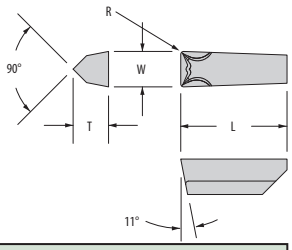
Shape: Groove/Turn	Part Number ANSI	Steel P			Stainless Steel M		Cast Iron K	Heat Resistant Super Alloys S		Part Number ISO	Dimensions (inches)			
		GA5035	G-915	G-935	GA5026	G-915	G-915	GA5026	G-925		W	L	T	R
	GTS-4125	▲	◆	●	◆	●	◆	●	◆	GTS-4125	0.125	0.500	0.187	Full
	GTS-4187	▲	◆	●	◆	●	◆	●	◆	GTS-4187	0.187	0.500	0.187	Full
	GTS-6250	▲	◆	●	◆	●	◆	●	◆	GTS-6250	0.250	0.750	0.250	Full

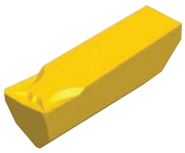
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages GP 04

GTS Style, Flat Nose Grooving Inserts



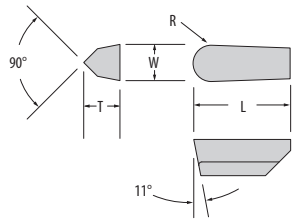
Shape: Groove/Turn	Part Number ANSI	Steel P			Stainless Steel M		Cast Iron K	Heat Resistant Super Alloys S		Part Number ISO	Dimensions (inches)			
		GA5035	G-915	G-935	GA5026	G-915	G-915	GA5026	G-925		W	L	T	R
	GTS-4125-1	▲	◆	●	◆	●	◆	●	◆	GTS-4125-1	0.125	0.500	0.187	0.015
	GTS-4125-2	▲	◆	●	◆	●	◆	●	◆	GTS-4125-2	0.125	0.500	0.187	0.031
	GTS-4187-1	▲	◆	●	◆	●	◆	●	◆	GTS-4187-1	0.187	0.500	0.187	0.015
	GTS-4187-2	▲	◆	●	◆	●	◆	●	◆	GTS-4187-2	0.187	0.500	0.187	0.031
	GTS-6250-1	▲	◆	●	◆	●	◆	●	◆	GTS-6250-1	0.250	0.750	0.250	0.015
	GTS-6250-2	▲	◆	●	◆	●	◆	●	◆	GTS-6250-2	0.250	0.750	0.250	0.031

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages GP 04

WG-Style, Full Nose Grooving Inserts



Shape: Groover	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)			
		M	K			S				H								
		WG-600	GSN100	XSYTIN-1	WG-600	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		W	L	T	R
	WG-4094	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4094	0.094	0.500	0.187	Full
	WG-4125	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4125	0.125	0.500	0.187	Full
	WG-4156	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4156	0.156	0.500	0.187	Full
	WG-4187	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4187	0.187	0.500	0.187	Full
	WG-6218	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6218	0.218	0.750	0.250	Full
	WG-6250	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6250	0.250	0.750	0.250	Full
	WG-6281	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6281	0.281	0.750	0.250	Full
	WG-8312	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8312	0.312	1.000	0.337	Full
	WG-8344	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8344	0.344	1.000	0.337	Full
	WG-8375	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8375	0.375	1.000	0.337	Full

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages GP 05

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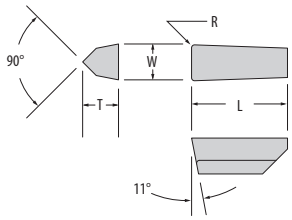
WG-Style, Flat Nose Grooving Inserts



Shape: Groover	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)			
		M	K			S				H								
		WG-600	GSN100	XSYTIN-1	WG-600	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		W	L	T	R
	WG-4094-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4094-1	0.094	0.500	0.187	0.015
	WG-4094-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4094-2	0.094	0.500	0.187	0.031
	WG-4125-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4125-1	0.125	0.500	0.187	0.015
	WG-4125-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4125-2	0.125	0.500	0.187	0.031
	WG-4156-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4156-1	0.156	0.500	0.187	0.015
	WG-4156-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4156-2	0.156	0.500	0.187	0.031
	WG-4156-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4156-3	0.156	0.500	0.187	0.046
	WG-4187-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4187-1	0.187	0.500	0.187	0.015
	WG-4187-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4187-2	0.187	0.500	0.187	0.031
	WG-6218-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6218-1	0.218	0.750	0.250	0.015
	WG-6218-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6218-2	0.218	0.750	0.250	0.031
	WG-6250-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6250-1	0.250	0.750	0.250	0.015
	WG-6250-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6250-2	0.250	0.750	0.250	0.031
	WG-6250-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6250-3	0.250	0.750	0.250	0.046
	WG-6250-4	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6250-4	0.250	0.750	0.250	0.062
	WG-6281-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6281-1	0.281	0.750	0.250	0.015
	WG-6281-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6281-2	0.281	0.750	0.250	0.031
	WG-6281-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6281-3	0.281	0.750	0.250	0.046
	WG-8312-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8312-1	0.312	1.000	0.337	0.015
	WG-8312-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8312-2	0.312	1.000	0.337	0.031
	WG-8312-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8312-3	0.312	1.000	0.337	0.046
	WG-8312-4	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8312-4	0.312	1.000	0.337	0.062
	WG-8344-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8344-1	0.344	1.000	0.337	0.015
	WG-8344-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8344-2	0.344	1.000	0.337	0.031
	WG-8344-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8344-3	0.344	1.000	0.337	0.046
	WG-8344-4	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8344-4	0.344	1.000	0.337	0.062
	WG-8375-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8375-1	0.375	1.000	0.337	0.015
	WG-8375-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8375-2	0.375	1.000	0.337	0.031
	WG-8375-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8375-3	0.375	1.000	0.337	0.046
	WG-8375-4	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8375-4	0.375	1.000	0.337	0.062

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages GP 05

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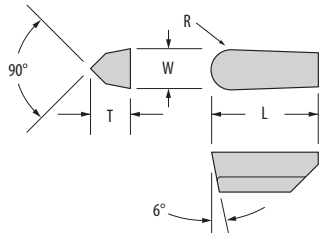
WGC, Full Nose Grooving Inserts



Shape: Groover	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)			
		M	K			S				H								
		WG-600	GSN100	XSYTIN-1	WG-600	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		W	L	T	R
	WGC-4094	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4094	0.094	0.500	0.187	Full
	WGC-4125	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4125	0.125	0.500	0.187	Full
	WGC-4156	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4156	0.156	0.500	0.187	Full
	WGC-4187	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4187	0.187	0.500	0.187	Full
	WGC-6218	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6218	0.218	0.750	0.250	Full
	WGC-6250	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6250	0.250	0.750	0.250	Full
	WGC-6281	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6281	0.281	0.750	0.250	Full
	WGC-8312	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8312	0.312	1.000	0.337	Full
	WGC-8344	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8344	0.344	1.000	0.337	Full
	WGC-8375	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8375	0.375	1.000	0.337	Full

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages GP 05

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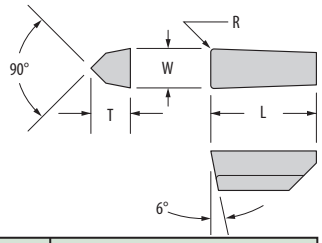
WGC, Flat Nose Grooving Inserts



Shape: Groover	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)			
		M	K			S				H								
		WG-600	GSN100	XSYTIN-1	WG-600	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		W	L	T	R
	WGC-4094-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4094-1	0.094	0.500	0.187	0.015
	WGC-4094-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4094-2	0.094	0.500	0.187	0.031
	WGC-4125-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4125-1	0.125	0.500	0.187	0.015
	WGC-4125-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4125-2	0.125	0.500	0.187	0.031
	WGC-4156-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4156-1	0.156	0.500	0.187	0.015
	WGC-4156-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4156-2	0.156	0.500	0.187	0.031
	WGC-4187-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4187-1	0.187	0.500	0.187	0.015
	WGC-4187-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4187-2	0.187	0.500	0.187	0.031
	WGC-6218-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6218-1	0.218	0.750	0.250	0.015
	WGC-6218-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6218-2	0.218	0.750	0.250	0.031
	WGC-6250-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6250-1	0.250	0.750	0.250	0.015
	WGC-6250-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6250-2	0.250	0.750	0.250	0.031
	WGC-6250-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6250-3	0.250	0.750	0.250	0.046
	WGC-6281-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6281-1	0.281	0.750	0.250	0.015
	WGC-6281-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6281-2	0.281	0.750	0.250	0.031
	WGC-6281-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6281-3	0.281	0.750	0.250	0.046
	WGC-8312-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8312-1	0.312	1.000	0.337	0.015
	WGC-8312-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8312-2	0.312	1.000	0.337	0.031
	WGC-8312-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8312-3	0.312	1.000	0.337	0.046
	WGC-8312-4	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8312-4	0.312	1.000	0.337	0.062
	WGC-8344-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8344-1	0.344	1.000	0.337	0.015
	WGC-8344-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8344-2	0.344	1.000	0.337	0.031
	WGC-8344-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8344-3	0.344	1.000	0.337	0.046
	WGC-8344-4	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8344-4	0.344	1.000	0.337	0.062
	WGC-8375-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8375-1	0.375	1.000	0.337	0.015
	WGC-8375-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8375-2	0.375	1.000	0.337	0.031
	WGC-8375-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8375-3	0.375	1.000	0.337	0.046
	WGC-8375-4	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8375-4	0.375	1.000	0.337	0.062

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages GP 05

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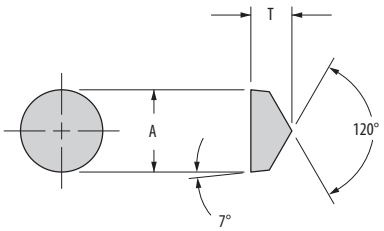
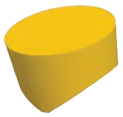
Round Positive V-Bottom Inserts

RCGN-V — Carbide



Shape: Round V-Bottom	Part Number ANSI	Steel P				Stainless Steel M			Cast Iron K	Heat-Resistant Super Alloys S							Part Number ISO	Dimensions (inches)	
		GA5025	GA5035	GA5125	GA5036	GA5026	G-925	G-915	GA5023	G-915	G-10	GA5026	G-9610	G-925	G-920	G-20M		A	T
	RCGN-2V	●	◆	▲	❖	●	◆	❖	◆	❖	❖	●	▲	◆	▲	▲	RCGX-060400	0.250	0.187
	RCGX-102	●	◆	▲	❖	●	◆	❖	◆	❖	❖	●	▲	◆	▲	▲	RCGX-060600	0.250	0.250
	RCGN-3V	●	◆	▲	❖	●	◆	❖	◆	❖	❖	●	▲	◆	▲	▲	RCGX-090700	0.375	0.312
	RCGN-4V	●	◆	▲	❖	●	◆	❖	◆	❖	❖	●	▲	◆	▲	▲	RCGX-120700	0.500	0.312

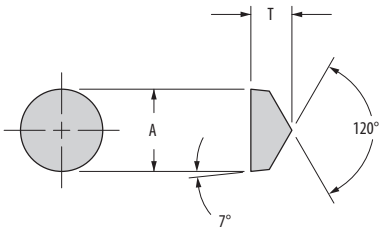
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

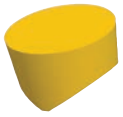
First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages GP 04

Round Positive V-Bottom Inserts

RCGN-V — Ceramic



Shape: Round V-Bottom	Part Number ANSI	S Steel M	Cast Iron K			Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ISO	Dimensions (inches)	
		WG-600	GSN100	XSYTIN-1	WG-600	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		A	T
	RCGN-2V	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	RCGX-060400	0.250	0.187
	RCGX-102	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	RCGX-060600	0.250	0.250
	RCGN-3V	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	RCGX-090700	0.375	0.312
	RCGN-4V	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	RCGX-120700	0.500	0.312

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages GP 05

See pages ATI 22-23 for information on edge preps. For availability and any application concerns, please contact Greenleaf Technical Service.

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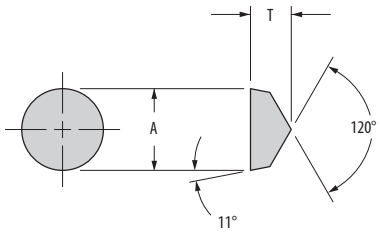
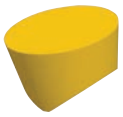
Round Positive V-Bottom Inserts

RPGN-V — Carbide



Shape: Round V-Bottom	Part Number ANSI	Steel P				Stainless Steel M			Cast Iron K	Heat-Resistant Super Alloys S							Part Number ISO	Dimensions (inches)	
		GA5025	GA5035	GA5125	GA5036	GA5026	G-925	G-915	GA5023	G-915	G-10	GA5026	G-9610	G-925	G-920	G-20M		A	T
	RPGN-2V	●	◆	▲	❖	●	◆	❖	◆	❖	❖	●	▲	◆	▲	▲	RPGX-060400	0.250	0.187
	RPGN-3V	●	◆	▲	❖	●	◆	❖	◆	❖	❖	●	▲	◆	▲	▲	RPGX-090700	0.375	0.312
	RPGN-4V	●	◆	▲	❖	●	◆	❖	◆	❖	❖	●	▲	◆	▲	▲	RPGX-120700	0.500	0.312

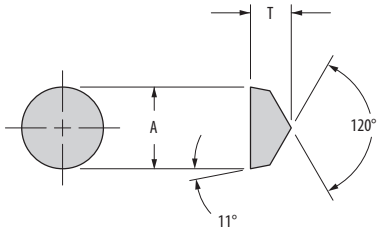
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

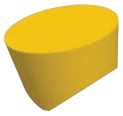
First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages GP 04

Round Positive V-Bottom Inserts

RPGN-V — Ceramic



Shape: Round V-Bottom	Part Number ANSI	S Steel M	Cast Iron K			Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ISO	Dimensions (inches)	
		WG-600	GSN100	XSYTIN-1	WG-600	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		A	T
	RPGN-2V	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	RPGX-060400	0.250	0.187
	RPGN-3V	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	RPGX-090700	0.375	0.312
	RPGN-4V	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	RPGX-120700	0.500	0.312

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

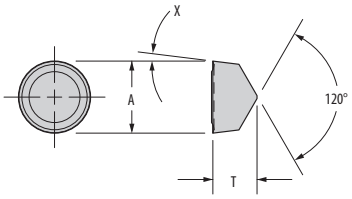
First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages GP 05

See pages ATI 22-23 for information on edge preps. For availability and any application concerns, please contact Greenleaf Technical Service.

Round Positive Chipform V-Bottom Inserts

RCGR-V/RPGR-V — Carbide



Shape: Round V-Bottom	Part Number ANSI	Steel P				Stainless Steel M			Cast Iron K	Heat-Resistant Super Alloys S							Part Number ISO	Dimensions (inches)		
		GA5025	GA5035	GA5125	GA5036	GA5026	G-925	G-915	GA5023	G-915	G-10	GA5026	G-9610	G-925	G-920	G-20M		A	T	X
	RCGR-2V-TF					●	◆					●	▲	◆	▲	▲	RCGR-060400V-TF	0.250	0.187	7°
	RCGR-3V-TF					●	◆					●	▲	◆	▲	▲	RCGR-090700V-TF	0.375	0.312	7°
	RCGR-4V-TF					●	◆					●	▲	◆	▲	▲	RCGR-120700V-TF	0.500	0.312	7°
	RPGR-2V-TF					●	◆					●	▲	◆	▲	▲	RPGX-060400V-TF	0.250	0.187	11°
	RPGR-3V-TF					●	◆					●	▲	◆	▲	▲	RPGX-090700V-TF	0.375	0.312	11°
	RPGR-4V-TF					●	◆					●	▲	◆	▲	▲	RPGX-120700V-TF	0.500	0.312	11°

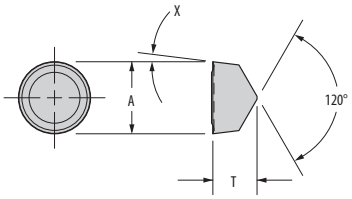
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages GP 04

Round Positive Chipform V-Bottom Inserts

RCGR-V/RPGR-V — Ceramic



Shape: Round V-Bottom	Part Number ANSI	S Steel M	Cast Iron K			Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ISO	Dimensions (inches)		
		WG-600	GSN100	XSYTIN-1	WG-600	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		A	T	X
	RCGR-2V-GF1	◆		▲	●	●	◆	▲	▲	●	●	❖		RCGR-060400V-GF1	0.250	0.187	7°
	RCGR-3V-GF1	◆		▲	●	●	◆	▲	▲	●	●	❖		RCGR-090700V-GF1	0.375	0.312	7°
	RCGR-4V-GF1	◆		▲	●	●	◆	▲	▲	●	●	❖		RCGR-120700V-GF1	0.500	0.312	7°
	RPGR-2V-GF1	◆		▲	●	●	◆	▲	▲	●	●	❖		RPGR-060400V-GF1	0.250	0.187	11°
	RPGR-3V-GF1	◆		▲	●	●	◆	▲	▲	●	●	❖		RPGR-090700V-GF1	0.375	0.312	11°

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages GP 05

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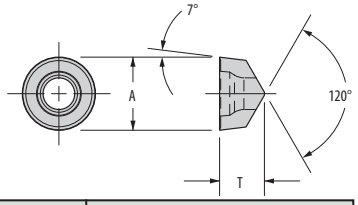
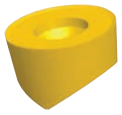
Round Positive Chipform V-Bottom Inserts

RCGT-V — Carbide



Shape: Round V-Bottom	Part Number ANSI	Steel P				Stainless Steel M			Cast Iron K	Heat-Resistant Super Alloys S							Part Number ISO	Dimensions (inches)	
		GA5025	GA5035	GA5125	GA5036	GA5026	G-925	G-915	GA5023	G-915	G-10	GA5026	G-9610	G-925	G-920	G-20M		A I.C.	T
	RCGT-2V-TF					●	◆					●	▲	◆	▲	▲	RCGT-060400V-TF	0.250	0.187
	RCGT-3V-TF					●	◆					●	▲	◆	▲	▲	RCGT-090700V-TF	0.375	0.312
	RCGT-4V-TF					●	◆					●	▲	◆	▲	▲	RCGT-120700V-TF	0.500	0.312

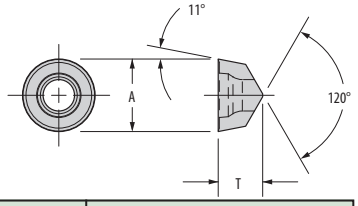
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

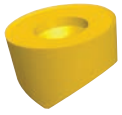
First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages GP 04

Round Positive Chipform V-Bottom Inserts

RPGT-V — Carbide



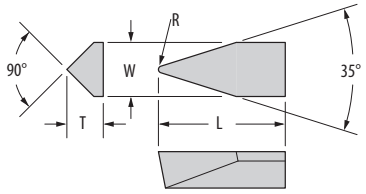
Shape: Round V-Bottom	Part Number ANSI	Steel P				Stainless Steel M			Cast Iron K	Heat-Resistant Super Alloys S							Part Number ISO	Dimensions (inches)	
		GA5025	GA5035	GA5125	GA5036	GA5026	G-925	G-915	GA5023	G-915	G-10	GA5026	G-9610	G-925	G-920	G-20M		A I.C.	T
	RPGT-2V-TF					●	◆					●	▲	◆	▲	▲	RPGT-060400V-TF	0.250	0.187
	RPGT-3V-TF					●	◆					●	▲	◆	▲	▲	RPGT-090700V-TF	0.375	0.312
	RPGT-4V-TF					●	◆					●	▲	◆	▲	▲	RPGT-120700V-TF	0.500	0.312

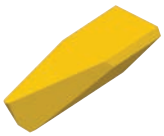
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages GP 04

35° V-Bottom Inserts
(VPG-V)

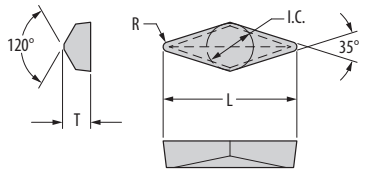


Shape: 35° V-Bottom	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)			
		M	K			S				H								
		WG-600	GSN100	XSYTIN-1	WG-600	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		W	L	T	R
	VPG-33.542V	◆		▲	●	●	◆	▲	▲	●	●	❖		VPG-33.542V	0.375	0.875	0.250	0.031
	VPG-33.543V	◆		▲	●	●	◆	▲	▲	●	●	❖		VPG-33.543V	0.375	0.875	0.250	0.046

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖ *Grade descriptions — pages GP 05*

See pages ATI 22-23 for information on edge preps. For availability and any application concerns, please contact Greenleaf Technical Service.

35° V-Bottom Inserts
(VCGN-V)



Shape: 35° V-Bottom	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)			
		M	K			S				H								
		WG-600	GSN100	XSYTIN-1	WG-600	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		I.C.	L	T	R
	VCGN-2.532V	◆		▲	●	●	◆	▲	▲	●	●	❖		VCGN-2.532V	0.312	0.892	0.187	0.031
	VCGN-2.533V	◆		▲	●	●	◆	▲	▲	●	●	❖		VCGN-2.533V	0.312	0.819	0.187	0.047

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖ *Grade descriptions — pages GP 05*

See pages ATI 22-23 for information on edge preps. For availability and any application concerns, please contact Greenleaf Technical Service.

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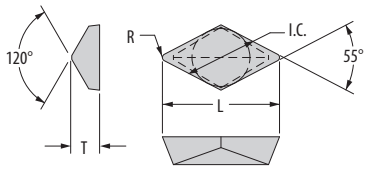
55° V-Bottom Inserts

(DPGN-V)



Shape: 55° V-Bottom	Part Number ANSI	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ISO	Dimensions (inches)			
		M	K			S				H								
		WG-600	GSN100	XSYTIN-1	WG-600	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		I.C.	L	T	R
	DPGN-442V	◆		▲	●	●	◆	▲	▲	●	●	❖		DPGN-442V	0.500	1.010	0.250	0.031
	DPGN-443V	◆		▲	●	●	◆	▲	▲	●	●	❖		DPGN-443V	0.500	0.973	0.250	0.047

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages GP 05

See pages ATI 22-23 for information on edge preps. For availability and any application concerns, please contact Greenleaf Technical Service.

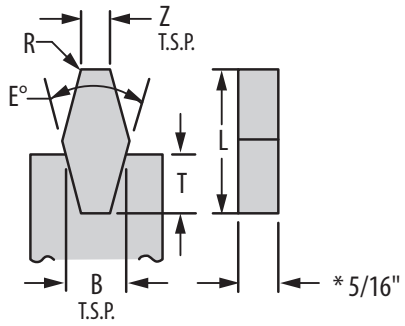
Pulley and Poly Grooving Inserts

When ordering or requesting quotations, you should provide a part print and a sketch with dimensions as indicated in the following format:

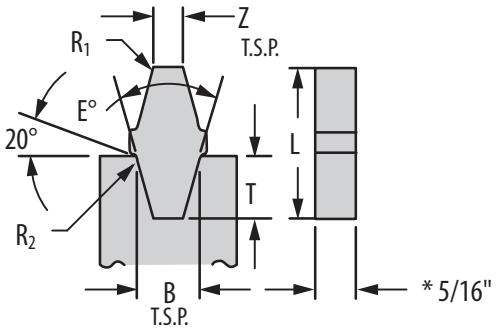
Insert Style	B	E°	L
R_1	R_2	T	Z

* Recommended – other specifications available upon request.

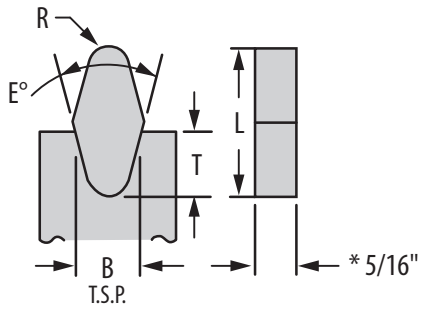
A



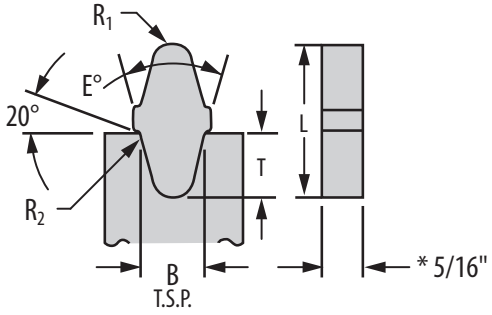
B



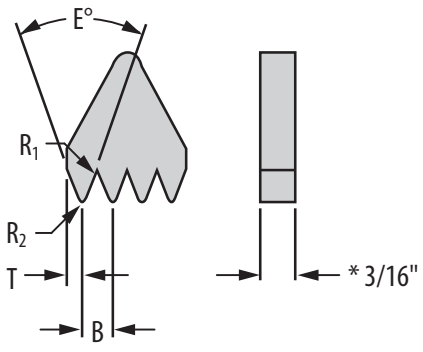
C



D



E



Z NUMBER OF TEETH REQUIRED ON INSERT

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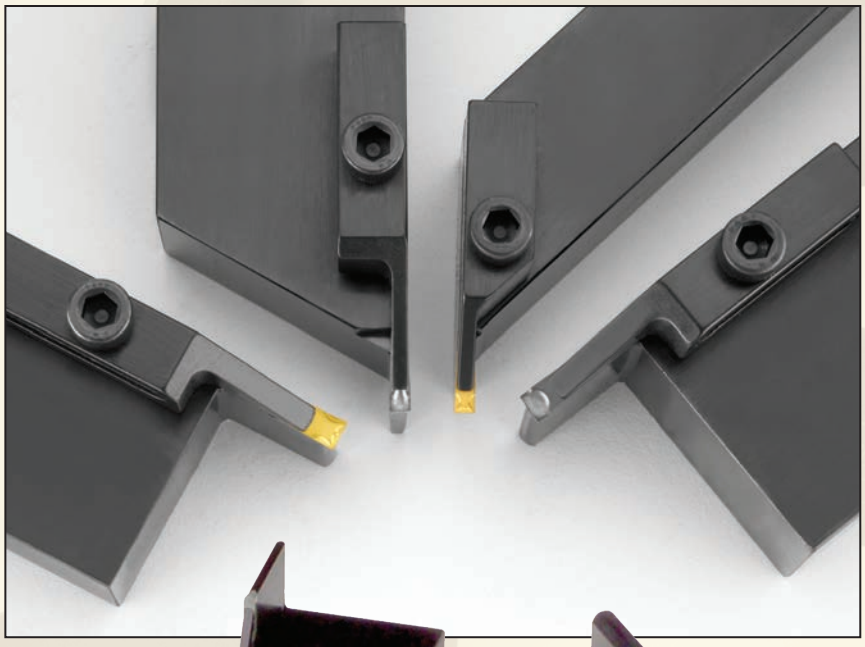
Grooving, Profiling and Cut-Off Toolholders

The Greenleaf tooling system for grooving, profiling, and cut-off provides every specific application with unsurpassed support to ensure the greatest tool life and highest material-removal rates with both carbide and ceramic inserts. All the tools in this system are designed to use Greenleaf carbide or ceramic inserts interchangeably for maximum versatility.

Toolholders are offered with both milled-nest and replaceable-nest designs to provide further options for your tooling requirements.

Using the most rigid holder that fits the application will make the process more reliable and repeatable, reducing the likelihood of irregular wear.

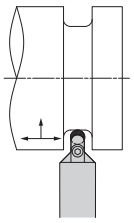


Greenleaf Tune-Up Kits

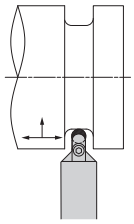
A Tune-Up Kit consists of all the standard hardware to refurbish a particular toolholder, boring bar, or milling cutter. A toolholder will have a readily visible, laser-inscribed Tune-Up Kit number on it for ease in ordering. This number will prevent any confusion created by searching a catalog for hardware, and it will help reduce downtime.

Pictorial Index

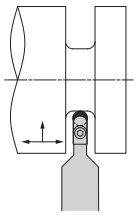
V-Bottom Round Toolholders



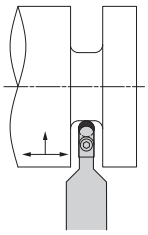
CRDPN-VS
Replaceable Nest
Shallow D.O.C.
page: GP 24



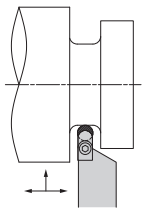
CRDPN-V
Replaceable Nest
Deep D.O.C.
page: GP 24



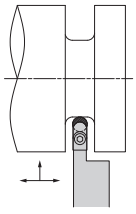
CRDPN-VMS
Milled Nest
Shallow D.O.C.
page: GP 25



CRDPN-VM
Milled Nest
Deep D.O.C.
page: GP 25

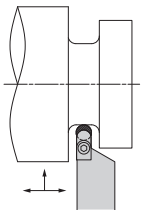


O.D. G/P Toolholder
Replaceable Nest
Shallow D.O.C.
page: GP 26

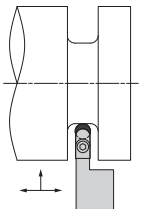


O.D. G/P Toolholder
Replaceable Nest
Deep D.O.C.
page: GP 26

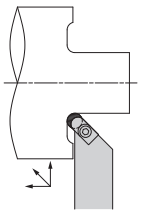
V-Bottom Round Toolholders *continued*



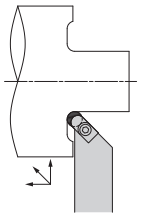
O.D. G/P Toolholder
Milled Nest
Shallow D.O.C.
page: GP 27



O.D. G/P Toolholder
Milled Nest
Deep D.O.C.
page: GP 27

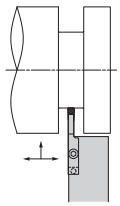


CRGPR-V
CRGPL-V
45°
Replaceable Nest
page: GP 28

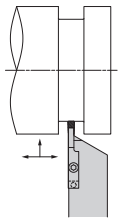


CRGPR-VM
CRGPL-VM
45°
Milled Nest
page: GP 28

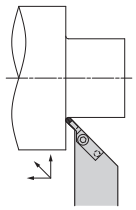
Single-Ended Groovers



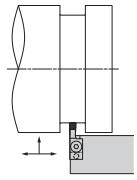
Deep D.O.C.
page: GP 29-30



Shallow D.O.C.
page: GP 31-32



45° G/P Toolholder
page: GP 33



90° G/P Toolholder
page: GP 34-35

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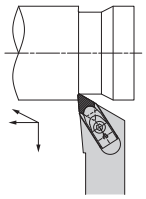
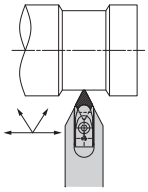
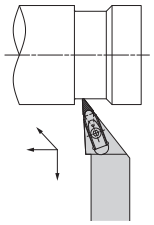
35° and 55° V-Bottom



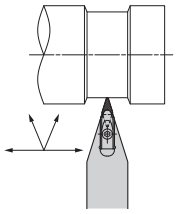
CDJOR-V
CDJOL-V
Double Ended
55° Diamond
page: GP 36



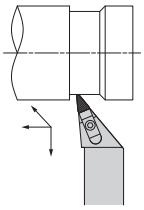
CDPON-V
Double Ended
55° Diamond
page: GP 36



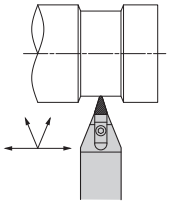
CVJOR-V
CVJOL-V
Double Ended
35° Diamond
page: GP 37



CVVON-V
Double Ended
35° Diamond
page: GP 37

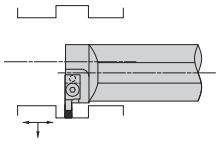


VJOR-V
VJOL-V
Single Ended
35° Diamond
page: GP 38

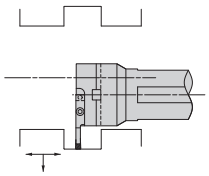


VVON-V
Single Ended
35° Diamond
page: GP 38

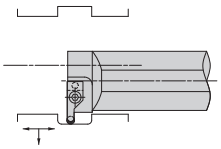
Grooving, Profiling, and Cut-Off Bars



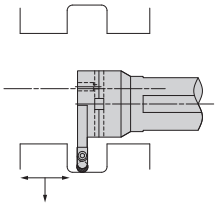
Cut-Off
Grooving Bar
page: GP 39



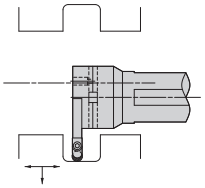
Cut-Off
Grooving
Support Blade
For Single-Ended,
V-Bottom Inserts
page: GP 40



Profiling Bar
Round V-Bottom Insert
Milled Nest
page: GP 41

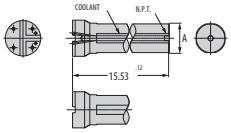


Profiling Support
Blade
Round V-Bottom Insert
Milled Nest
page: GP 42

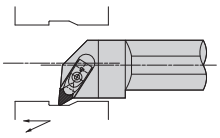


Profiling Support
Blade
Round V-Bottom Insert
Replaceable Nest
page: GP 43

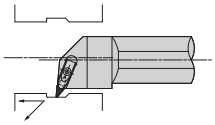
Grooving, Profiling, and Cut-Off Bars *continued*



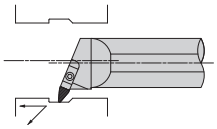
Shank Options
For Bolt-On
Support Blades
page: GP 44



Profiling Bar
Double Ended
55° Diamond
page: GP 45



Profiling Bar
Double Ended
35° Diamond
page: GP 45



Profiling Bar
Single Ended
35° Diamond
page: GP 46

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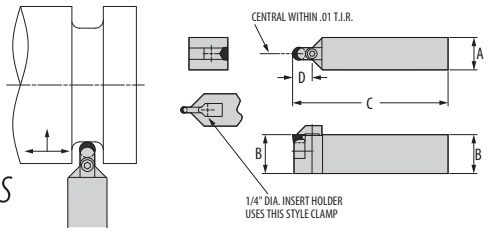
CRDPN-VS Toolholder

Round V-Bottom Insert / Replaceable Nest / Shallow D.O.C. (D) Series



Part Number	Gage Inserts	D.O.C. D	Dimensions (inches) A	B	C	Standard Components Nest	Nest Screw	Clamp	Clamp Screw	*Tune-Up Kit Includes all Standard Components
CRDPN-162VS	** RPGN-2V	0.375	1.000	1.000	6.000	410631	#3-48 x 3/8 B.H.C.S	411910-250VRC	1/4-20 x 3/4 B.H.C.S.	TK-00524
CRDPN-202VS	** RPGN-2V	0.375	1.250	1.250	6.000	410631	#3-48 x 3/8 B.H.C.S	411910-250VRC	1/4-20 x 3/4 B.H.C.S.	TK-00524
CRDPN-242VS	** RPGN-2V	0.375	1.500	1.500	8.000	410631	#3-48 x 3/8 B.H.C.S	411910-250VRC	1/4-20 x 3/4 B.H.C.S.	TK-00524
CRDPN-163VS	** RPGN-3V	0.562	1.000	1.000	6.000	413970	#6-32 x 1/2 B.H.C.S.	308063	#10-32 x 1/2 S.H.C.S.	TK-00525
CRDPN-203VS	** RPGN-3V	0.562	1.250	1.250	6.000	413970	#6-32 x 1/2 B.H.C.S.	308063	#10-32 x 1/2 S.H.C.S.	TK-00525
CRDPN-243VS	** RPGN-3V	0.562	1.500	1.500	8.000	413970	#6-32 x 1/2 B.H.C.S.	308063	#10-32 x 1/2 S.H.C.S.	TK-00525
CRDPN-164VS	** RPGN-4V	0.750	1.000	1.000	6.000	414007	#10-32 x 5/8 B.H.C.S.	308136	1/4-20 x 5/8 S.H.C.S.	TK-00526
CRDPN-204VS	** RPGN-4V	0.750	1.250	1.250	6.000	414007	#10-32 x 5/8 B.H.C.S.	308136	1/4-20 x 5/8 S.H.C.S.	TK-00526
CRDPN-244VS	** RPGN-4V	0.750	1.500	1.500	8.000	414007	#10-32 x 5/8 B.H.C.S.	308136	1/4-20 x 5/8 S.H.C.S.	TK-00526

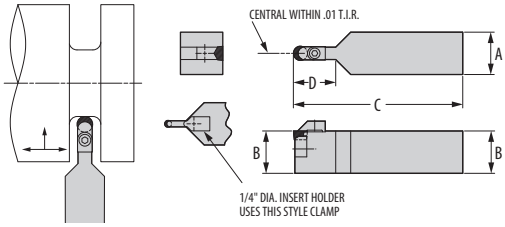
NOTE: See page GP 14 for ceramic and carbide inserts.

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

*** RCGN can be used in place of RPGN.*

CRDPN-V Toolholder

Round V-Bottom Insert / Replaceable Nest / Deep D.O.C. (D) Series



Part Number	Gage Inserts	D.O.C. D	Dimensions (inches) A	B	C	Standard Components Nest	Nest Screw	Clamp	Clamp Screw	*Tune-Up Kit Includes all Standard Components
CRDPN-162V	** RPGN-2V	0.750	1.000	1.000	6.000	410631	#3-48 x 3/8 B.H.C.S.	411910-250VRC	1/4-20 x 3/4 B.H.C.S.	TK-00524
CRDPN-202V	** RPGN-2V	0.750	1.250	1.250	6.000	410631	#3-48 x 3/8 B.H.C.S.	411910-250VRC	1/4-20 x 3/4 B.H.C.S.	TK-00524
CRDPN-242V	** RPGN-2V	0.750	1.500	1.500	8.000	410631	#3-48 x 3/8 B.H.C.S.	411910-250VRC	1/4-20 x 3/4 B.H.C.S.	TK-00524
CRDPN-163V	** RPGN-3V	1.125	1.000	1.000	6.000	413970	#6-32 x 1/2 B.H.C.S.	308063	#10-32 x 1/2 S.H.C.S.	TK-00525
CRDPN-203V	** RPGN-3V	1.125	1.250	1.250	6.000	413970	#6-32 x 1/2 B.H.C.S.	308063	#10-32 x 1/2 S.H.C.S.	TK-00525
CRDPN-243V	** RPGN-3V	1.125	1.500	1.500	8.000	413970	#6-32 x 1/2 B.H.C.S.	308063	#10-32 x 1/2 S.H.C.S.	TK-00525
CRDPN-164V	** RPGN-4V	1.500	1.000	1.000	6.000	414007	#10-32 x 5/8 B.H.C.S.	308136	1/4-20 x 5/8 S.H.C.S.	TK-00526
CRDPN-204V	** RPGN-4V	1.500	1.250	1.250	6.000	414007	#10-32 x 5/8 B.H.C.S.	308136	1/4-20 x 5/8 S.H.C.S.	TK-00526
CRDPN-244V	** RPGN-4V	1.500	1.500	1.500	8.000	414007	#10-32 x 5/8 B.H.C.S.	308136	1/4-20 x 5/8 S.H.C.S.	TK-00526

NOTE: See page GP 14 for ceramic and carbide inserts.

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

*** RCGN can be used in place of RPGN.*

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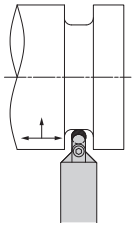
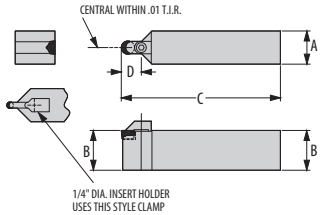
CRDPN-VMS Toolholder

Round V-Bottom Insert / Milled Nest / Shallow D.O.C. (D) Series



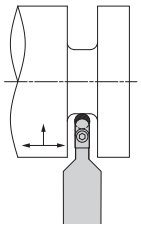


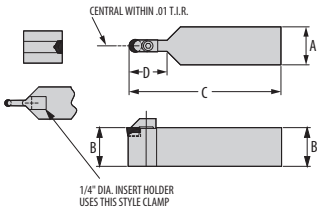
Part Number	Gage Inserts	D.O.C. D	Dimensions (inches) A	B	C	Standard Components Clamp	Clamp Screw	*Tune-Up Kit Includes all Standard Components	Opt. Component Insert Screw
CRDPN-162VMS	** RPGN-2V	0.375	1.000	1.000	6.000	411910-250VRC	1/4-20 x 3/4 B.H.C.S.	TK-00803	PT-542T
CRDPN-202VMS	** RPGN-2V	0.375	1.250	1.250	6.000	411910-250VRC	1/4-20 x 3/4 B.H.C.S.	TK-00803	PT-542T
CRDPN-242VMS	** RPGN-2V	0.375	1.500	1.500	8.000	411910-250VRC	1/4-20 x 3/4 B.H.C.S.	TK-00803	PT-542T
CRDPN-163VMS	** RPGN-3V	0.562	1.000	1.000	6.000	308063	#10-32 x 1/2 S.H.C.S.	TK-00764	PT-545T
CRDPN-203VMS	** RPGN-3V	0.562	1.250	1.250	6.000	308063	#10-32 x 1/2 S.H.C.S.	TK-00764	PT-545T
CRDPN-243VMS	** RPGN-3V	0.562	1.500	1.500	8.000	308063	#10-32 x 1/2 S.H.C.S.	TK-00764	PT-545T
CRDPN-164VMS	** RPGN-4V	0.750	1.000	1.000	6.000	308136	1/4-20 x 3/4 S.H.C.S.	TK-00763	CO-5018
CRDPN-204VMS	** RPGN-4V	0.750	1.250	1.250	6.000	308136	1/4-20 x 3/4 S.H.C.S.	TK-00763	CO-5018
CRDPN-244VMS	** RPGN-4V	0.750	1.500	1.500	8.000	308136	1/4-20 x 3/4 S.H.C.S.	TK-00763	CO-5018

NOTE: See page GP 14 for ceramic and carbide inserts.
NOTE: Use carbide inserts RCGT and RPGT with optional insert screw for finishing.
** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*
*** RCGN can be used in place of RPGN.*

CRDPN-VM Toolholder

Round V-Bottom Insert / Milled Nest / Deep D.O.C. (D) Series



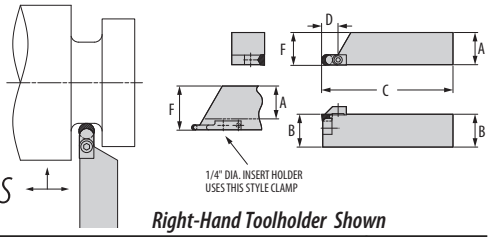


Part Number	Gage Inserts	D.O.C. D	Dimensions (inches) A	B	C	Standard Components Clamp	Clamp Screw	*Tune-Up Kit Includes all Standard Components	Opt. Component Insert Screw
CRDPN-162VM	** RPGN-2V	0.750	1.000	1.000	6.000	411910-250VRC	1/4-20 x 3/4 B.H.C.S.	TK-00803	PT-542T
CRDPN-202VM	** RPGN-2V	0.750	1.250	1.250	6.000	411910-250VRC	1/4-20 x 3/4 B.H.C.S.	TK-00803	PT-542T
CRDPN-242VM	** RPGN-2V	0.750	1.500	1.500	8.000	411910-250VRC	1/4-20 x 3/4 B.H.C.S.	TK-00803	PT-542T
CRDPN-163VM	** RPGN-3V	1.125	1.000	1.000	6.000	308063	#10-32 x 1/2 S.H.C.S.	TK-00764	PT-545T
CRDPN-203VM	** RPGN-3V	1.125	1.250	1.250	6.000	308063	#10-32 x 1/2 S.H.C.S.	TK-00764	PT-545T
CRDPN-243VM	** RPGN-3V	1.125	1.500	1.500	8.000	308063	#10-32 x 1/2 S.H.C.S.	TK-00764	PT-545T
CRDPN-164VM	** RPGN-4V	1.500	1.000	1.000	6.000	308136	1/4-20 x 3/4 S.H.C.S.	TK-00763	CO-5018
CRDPN-204VM	** RPGN-4V	1.500	1.250	1.250	6.000	308136	1/4-20 x 3/4 S.H.C.S.	TK-00763	CO-5018
CRDPN-244VM	** RPGN-4V	1.500	1.500	1.500	8.000	308136	1/4-20 x 3/4 S.H.C.S.	TK-00763	CO-5018

NOTE: See page GP 14 for ceramic and carbide inserts.
NOTE: Use carbide inserts RCGT and RPGT with optional insert screw for finishing.
** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*
*** RCGN can be used in place of RPGN.*

O.D. Grooving/Profiling Toolholder

Round V-Bottom Insert / Replaceable Nest / Shallow D.O.C. (D) Series



Right-Hand Toolholder Shown

Part Number		Gage	D.O.C.	Dimensions (inches)				Standard Components				*Tune-Up Kit
Right	Left	Inserts	D	A†	B	C	F	Nest	Nest Screw	Clamp	Clamp Screw	Includes all Standard Components
415419-2VRS	–	** RPGN-2V	0.375	1.000	1.000	6.000	1.500	410631	#3-48 x 3/8 B.H.C.S.	411905-250VRC	1/4-20 x 1 S.H.C.S.	TK-00590
–	415420-2VRS	** RPGN-2V	0.375	1.000	1.000	6.000	1.500	410631	#3-48 x 3/8 B.H.C.S.	411906-250VRC	1/4-20 x 1 S.H.C.S.	TK-00591
415421-2VRS	–	** RPGN-2V	0.375	1.250	1.250	6.000	1.750	410631	#3-48 x 3/8 B.H.C.S.	411905-250VRC	1/4-20 x 1 S.H.C.S.	TK-00590
–	415422-2VRS	** RPGN-2V	0.375	1.250	1.250	6.000	1.750	410631	#3-48 x 3/8 B.H.C.S.	411906-250VRC	1/4-20 x 1 S.H.C.S.	TK-00591
415423-2VRS	–	** RPGN-2V	0.375	1.500	1.500	8.000	2.000	410631	#3-48 x 3/8 B.H.C.S.	411905-250VRC	1/4-20 x 1 S.H.C.S.	TK-00590
–	415424-2VRS	** RPGN-2V	0.375	1.500	1.500	8.000	2.000	410631	#3-48 x 3/8 B.H.C.S.	411906-250VRC	1/4-20 x 1 S.H.C.S.	TK-00591
415427-3VRS	415428-3VRS	** RPGN-3V	0.562	1.000	1.000	6.000	1.000	413970	#6-32 x 1/2 B.H.C.S.	308063	#10-32 x 1/2 S.H.C.S.	TK-00525
415429-3VRS	415430-3VRS	** RPGN-3V	0.562	1.250	1.250	6.000	1.250	413970	#6-32 x 1/2 B.H.C.S.	308063	#10-32 x 1/2 S.H.C.S.	TK-00525
415431-3VRS	415432-3VRS	** RPGN-3V	0.562	1.500	1.500	8.000	1.500	413970	#6-32 x 1/2 B.H.C.S.	308063	#10-32 x 1/2 S.H.C.S.	TK-00525
415435-4VRS	415436-4VRS	** RPGN-4V	0.750	1.000	1.000	6.000	1.000	414007	#10-32 x 5/8 B.H.C.S.	308136	1/4-20 x 5/8 S.H.C.S.	TK-00526
415437-4VRS	415438-4VRS	** RPGN-4V	0.750	1.250	1.250	6.000	1.250	414007	#10-32 x 5/8 B.H.C.S.	308136	1/4-20 x 5/8 S.H.C.S.	TK-00526
415439-4VRS	415440-4VRS	** RPGN-4V	0.750	1.500	1.500	8.000	1.500	414007	#10-32 x 5/8 B.H.C.S.	308136	1/4-20 x 5/8 S.H.C.S.	TK-00526

NOTE: See page GP 14 for ceramic and carbide inserts.

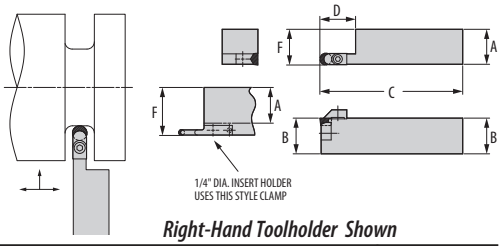
† *"A" indicates width of shank available for clamping, (not necessarily overall shank width).*

* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

** *RCGN can be used in place of RPGN.*

O.D. Grooving/Profiling Toolholder

Round V-Bottom Insert / Replaceable Nest / Deep D.O.C. (D) Series



Right-Hand Toolholder Shown

Part Number		Gage	D.O.C.	Dimensions (inches)				Standard Components				*Tune-Up Kit
Right	Left	Inserts	D	A†	B	C	F	Nest	Nest Screw	Clamp	Clamp Screw	Includes all Standard Components
411149-2VRS	–	** RPGN-2V	0.750	1.000	1.000	6.000	1.500	410631	#3-48 x 3/8 B.H.C.S	411905-250VRC.	1/4-20 x 1 S.H.C.S.	TK-00590
–	411150-2VRS	** RPGN-2V	0.750	1.000	1.000	6.000	1.500	410631	#3-48 x 3/8 B.H.C.S.	411905-250VRC	1/4-20 x 1 S.H.C.S.	TK-00591
411151-2VRS	–	** RPGN-2V	0.750	1.250	1.250	6.000	1.750	410631	#3-48 x 3/8 B.H.C.S.	411905-250VRC	1/4-20 x 1 S.H.C.S.	TK-00590
–	411956-2VRS	** RPGN-2V	0.750	1.250	1.250	6.000	1.750	410631	#3-48 x 3/8 B.H.C.S.	411905-250VRC	1/4-20 x 1 S.H.C.S.	TK-00591
411957-2VRS	–	** RPGN-2V	0.750	1.500	1.500	8.000	2.000	410631	#3-48 x 3/8 B.H.C.S.	411905-250VRC	1/4-20 x 1 S.H.C.S.	TK-00590
–	411958-2VRS	** RPGN-2V	0.750	1.500	1.500	8.000	2.000	410631	#3-48 x 3/8 B.H.C.S.	411905-250VRC	1/4-20 x 1 S.H.C.S.	TK-00591
411157-3VRS	411158-3VRS	** RPGN-3V	1.125	1.000	1.000	6.000	1.000	413970	#6-32 x 1/2 B.H.C.S.	308063	#10-32 x 1/2 S.H.C.S.	TK-00525
411159-3VRS	411160-3VRS	** RPGN-3V	1.125	1.250	1.250	6.000	1.250	413970	#6-32 x 1/2 B.H.C.S.	308063	#10-32 x 1/2 S.H.C.S.	TK-00525
411161-3VRS	411162-3VRS	** RPGN-3V	1.125	1.500	1.500	8.000	1.500	413970	#6-32 x 1/2 B.H.C.S.	308063	#10-32 x 1/2 S.H.C.S.	TK-00525
411165-4VRS	411166-4VRS	** RPGN-4V	1.500	1.000	1.000	6.000	1.000	414007	#10-32 x 5/8 B.H.C.S.	308136	1/4-20 x 5/8 S.H.C.S.	TK-00526
411167-4VRS	411168-4VRS	** RPGN-4V	1.500	1.250	1.250	6.000	1.250	414007	#10-32 x 5/8 B.H.C.S.	308136	1/4-20 x 5/8 S.H.C.S.	TK-00526
411169-4VRS	411170-4VRS	** RPGN-4V	1.500	1.500	1.500	8.000	1.500	414007	#10-32 x 5/8 B.H.C.S.	308136	1/4-20 x 5/8 S.H.C.S.	TK-00526

NOTE: See page GP 14 for ceramic and carbide inserts.

† *"A" indicates width of shank available for clamping, (not necessarily overall shank width).*

* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

** *RCGN can be used in place of RPGN.*

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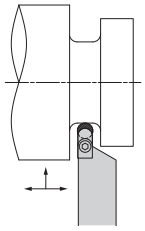
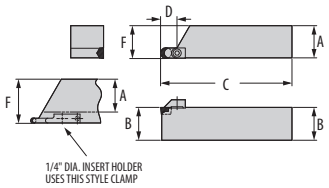
O.D. Grooving/Profiling Toolholder

Round V-Bottom Insert / Milled Nest / Shallow D.O.C. (D) Series





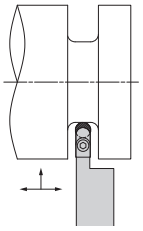
Right-Hand Toolholder Shown

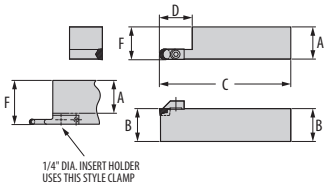
Part Number		Gage	D.O.C.	Dimensions (inches)				Standard Components		*Tune-Up Kit	Opt. Component
Right	Left	Inserts	D	A†	B	C	F	Clamp	Clamp Screw	Includes all Standard Components	Insert Screw
421450-2VMRS	–	** RPGN-2V	0.375	1.000	1.000	6.000	1.500	411905-250VRC	1/4-20 x 1 S.H.C.S.	TK-00765	PT-542T
–	421451-2VMRS	** RPGN-2V	0.375	1.000	1.000	6.000	1.500	411906-250VRC	1/4-20 x 1 S.H.C.S.	TK-00799	PT-542T
421452-2VMRS	–	** RPGN-2V	0.375	1.250	1.250	6.000	1.750	411905-250VRC	1/4-20 x 1 S.H.C.S.	TK-00765	PT-542T
–	421453-2VMRS	** RPGN-2V	0.375	1.250	1.250	6.000	1.750	411906-250VRC	1/4-20 x 1 S.H.C.S.	TK-00799	PT-542T
421454-2VMRS	–	** RPGN-2V	0.375	1.500	1.500	8.000	2.000	411905-250VRC	1/4-20 x 1 S.H.C.S.	TK-00765	PT-542T
–	421455-2VMRS	** RPGN-2V	0.375	1.500	1.500	8.000	2.000	411906-250VRC	1/4-20 x 1 S.H.C.S.	TK-00799	PT-542T
421458-3VMRS	421459-3VMRS	** RPGN-3V	0.562	1.000	1.000	6.000	1.000	308063	#10-32 x 1/2 S.H.C.S.	TK-00764	PT-545T
421460-3VMRS	421461-3VMRS	** RPGN-3V	0.562	1.250	1.250	6.000	1.250	308063	#10-32 x 1/2 S.H.C.S.	TK-00764	PT-545T
421462-3VMRS	421463-3VMRS	** RPGN-3V	0.562	1.500	1.500	8.000	1.500	308063	#10-32 x 1/2 S.H.C.S.	TK-00764	PT-545T
421466-4VMRS	421467-4VMRS	** RPGN-4V	0.750	1.000	1.000	6.000	1.000	308136	1/4-20 x 3/4 S.H.C.S.	TK-00763	CO-5018
421468-4VMRS	421469-4VMRS	** RPGN-4V	0.750	1.250	1.250	6.000	1.250	308136	1/4-20 x 3/4 S.H.C.S.	TK-00763	CO-5018
421470-4VMRS	421471-4VMRS	** RPGN-4V	0.750	1.500	1.500	8.000	1.500	308136	1/4-20 x 3/4 S.H.C.S	TK-00763	CO-5018

NOTE: See page GP 14 for ceramic and carbide inserts.
NOTE: Use carbide inserts RCGT and RPGT with optional insert screw for finishing.
† *"A" indicates width of shank available for clamping, (not necessarily overall shank width).*
* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*
** *RCGN can be used in place of RPGN.*

O.D. Grooving/Profiling Toolholder

Round V-Bottom Insert / Milled Nest / Deep D.O.C. (D) Series





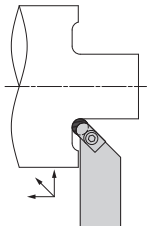
Right-Hand Toolholder Shown

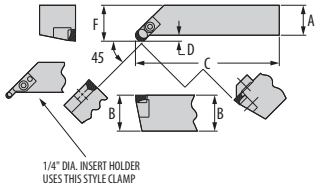
Part Number		Gage	D.O.C.	Dimensions (inches)				Standard Components		*Tune-Up Kit	Opt. Component
Right	Left	Inserts	D	A†	B	C	F	Clamp	Clamp Screw	Includes all Standard Components	Insert Screw
421498-2VMRS	–	** RPGN-2V	0.750	1.000	1.000	6.000	1.500	411905-250VRC	1/4-20 x 1 S.H.C.S.	TK-00765	PT-542T
–	421499-2VMRS	** RPGN-2V	0.750	1.000	1.000	6.000	1.500	411906-250VRC	1/4-20 x 1 S.H.C.S.	TK-00799	PT-542T
421500-2VMRS	–	** RPGN-2V	0.750	1.250	1.250	6.000	1.750	411905-250VRC	1/4-20 x 1 S.H.C.S.	TK-00765	PT-542T
–	421501-2VMRS	** RPGN-2V	0.750	1.250	1.250	6.000	1.750	411906-250VRC	1/4-20 x 1 S.H.C.S.	TK-00799	PT-542T
421502-2VMRS	–	** RPGN-2V	0.750	1.500	1.500	8.000	2.000	411905-250VRC	1/4-20 x 1 S.H.C.S.	TK-00765	PT-542T
–	421503-2VMRS	** RPGN-2V	0.750	1.500	1.500	8.000	2.000	411906-250VRC	1/4-20 x 1 S.H.C.S.	TK-00799	PT-542T
421504-3VMRS	421505-3VMRS	** RPGN-3V	1.125	1.000	1.000	6.000	1.000	308063	#10-32 x 1/2 S.H.C.S.	TK-00764	PT-545T
421506-3VMRS	421507-3VMRS	** RPGN-3V	1.125	1.250	1.250	6.000	1.250	308063	#10-32 x 1/2 S.H.C.S.	TK-00764	PT-545T
421508-3VMRS	421509-3VMRS	** RPGN-3V	1.125	1.500	1.500	8.000	1.500	308063	#10-32 x 1/2 S.H.C.S.	TK-00764	PT-545T
421510-4VMRS	421511-4VMRS	** RPGN-4V	1.500	1.000	1.000	6.000	1.000	308136	1/4-20 x 3/4 S.H.C.S.	TK-00763	CO-5018
421512-4VMRS	421513-4VMRS	** RPGN-4V	1.500	1.250	1.250	6.000	1.250	308136	1/4-20 x 3/4 S.H.C.S.	TK-00763	CO-5018
421514-4VMRS	421515-4VMRS	** RPGN-4V	1.500	1.500	1.500	8.000	1.500	308136	1/4-20 x 3/4 S.H.C.S.	TK-00763	CO-5018

NOTE: See page GP 14 for ceramic and carbide inserts.
NOTE: Use carbide inserts RCGT and RPGT with optional insert screw for finishing.
† *"A" indicates width of shank available for clamping, (not necessarily overall shank width).*
* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*
** *RCGN can be used in place of RPGN.*

CRGPR-V/CRGPL-V

45° Grooving/Profiling Toolholder
Round V-Bottom Insert; Replaceable Nest





Right-Hand Toolholder Shown

Part Number		Gage	D.O.C.	Dimensions (inches)				Standard Components				*Tune-Up Kit
Right	Left	Inserts	D	A†	B	C	F	Nest	Nest Screw	Clamp	Clamp Screw	Includes all Standard Components
CRGPR-162V	–	** RPGN-2V	0.250	1.000	1.000	6.000	1.250	411108	#3-48 x 3/8 B.H.C.S.	412131-250GC	1/4-20 x 3/4 S.H.C.S.	TK-00530
–	CRGPL-162V	** RPGN-2V	0.250	1.000	1.000	6.000	1.250	411108	#3-48 x 3/8 B.H.C.S.	412132-250GC	1/4-20 x 3/4 S.H.C.S.	TK-00527
CRGPR-202V	–	** RPGN-2V	0.250	1.250	1.250	6.000	1.500	411108	#3-48 x 3/8 B.H.C.S.	412131-250GC	1/4-20 x 3/4 S.H.C.S.	TK-00530
–	CRGPL-202V	** RPGN-2V	0.250	1.250	1.250	6.000	1.500	411108	#3-48 x 3/8 B.H.C.S.	412132-250GC	1/4-20 x 3/4 S.H.C.S.	TK-00527
CRGPR-242V	–	** RPGN-2V	0.250	1.500	1.500	8.000	1.750	411108	#3-48 x 3/8 B.H.C.S.	412131-250GC	1/4-20 x 3/4 S.H.C.S.	TK-00530
–	CRGPL-242V	** RPGN-2V	0.250	1.500	1.500	8.000	1.750	411108	#3-48 x 3/8 B.H.C.S.	412132-250GC	1/4-20 x 3/4 S.H.C.S.	TK-00527
CRGPR-163V	CRGPL-163V	** RPGN-3V	0.250	1.000	1.000	6.000	1.250	414009	#6-32 x 1/2 B.H.C.S.	308063	#10-32 x 1/2 S.H.C.S.	TK-00528
CRGPR-203V	CRGPL-203V	** RPGN-3V	0.250	1.250	1.250	6.000	1.500	414009	#6-32 x 1/2 B.H.C.S.	308063	#10-32 x 1/2 S.H.C.S.	TK-00528
CRGPR-243V	CRGPL-243V	** RPGN-3V	0.250	1.500	1.500	8.000	1.750	414009	#6-32 x 1/2 B.H.C.S.	308063	#10-32 x 1/2 S.H.C.S.	TK-00528
CRGPR-164V	CRGPL-164V	** RPGN-4V	0.250	1.000	1.000	6.000	1.250	414008	#10-32 x 5/8 B.H.C.S.	308136	1/4-20 x 5/8 S.H.C.S.	TK-00529
CRGPR-204V	CRGPL-204V	** RPGN-4V	0.250	1.250	1.250	6.000	1.500	414008	#10-32 x 5/8 B.H.C.S.	308136	1/4-20 x 5/8 S.H.C.S.	TK-00529
CRGPR-244V	CRGPL-244V	** RPGN-4V	0.250	1.500	1.500	8.000	1.750	414008	#10-32 x 5/8 B.H.C.S.	308136	1/4-20 x 5/8 S.H.C.S.	TK-00529

NOTE: See page GP 14 for ceramic and carbide inserts.

† *"A" indicates width of shank available for clamping, (not necessarily overall shank width).*

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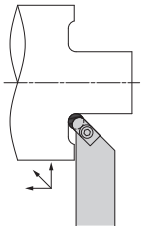
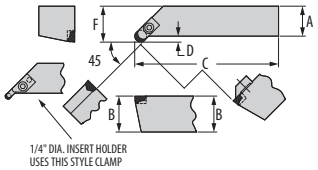
** *RCGN can be used in place of RPGN.*

CRGPR-VM/CRGPL-VM

45° Grooving/Profiling Toolholder
Round V-Bottom Insert; Milled Nest





Right-Hand Toolholder Shown

Part Number		Gage	D.O.C.	Dimensions (inches)				Standard Components		*Tune-Up Kit	Optional Component
Right	Left	Inserts	D	A†	B	C	F	Clamp	Clamp Screw	Includes all Standard Components	Insert Screw
CRGPR-162VM	–	** RPGN-2V	0.250	1.000	1.000	6.000	1.250	412131-250GC	1/4-20 x 3/4 S.H.C.S.	TK-00795	PT-542T
–	CRGPL-162VM	** RPGN-2V	0.250	1.000	1.000	6.000	1.250	412132-250GC	1/4-20 x 3/4 S.H.C.S.	TK-00836	PT-542T
CRGPR-202VM	–	** RPGN-2V	0.250	1.250	1.250	6.000	1.500	412131-250GC	1/4-20 x 3/4 S.H.C.S.	TK-00795	PT-542T
–	CRGPL-202VM	** RPGN-2V	0.250	1.250	1.250	6.000	1.500	412132-250GC	1/4-20 x 3/4 S.H.C.S.	TK-00836	PT-542T
CRGPR-242VM	–	** RPGN-2V	0.250	1.500	1.500	8.000	1.750	412131-250GC	1/4-20 x 3/4 S.H.C.S.	TK-00795	PT-542T
–	CRGPL-242VM	** RPGN-2V	0.250	1.500	1.500	8.000	1.750	412132-250GC	1/4-20 x 3/4 S.H.C.S.	TK-00836	PT-542T
CRGPR-163VM	CRGPL-163VM	** RPGN-3V	0.250	1.000	1.000	6.000	1.250	308063	#10-32 x 1/2 S.H.C.S.	TK-00764	PT-545T
CRGPR-203VM	CRGPL-203VM	** RPGN-3V	0.250	1.250	1.250	6.000	1.500	308063	#10-32 x 1/2 S.H.C.S.	TK-00764	PT-545T
CRGPR-243VM	CRGPL-243VM	** RPGN-3V	0.250	1.500	1.500	8.000	1.750	308063	#10-32 x 1/2 S.H.C.S.	TK-00764	PT-545T
CRGPR-164VM	CRGPL-164VM	** RPGN-4V	0.250	1.000	1.000	6.000	1.250	308136	1/4-20 x 3/4 S.H.C.S.	TK-00763	CO-5018
CRGPR-204VM	CRGPL-204VM	** RPGN-4V	0.250	1.250	1.250	6.000	1.500	308136	1/4-20 x 3/4 S.H.C.S.	TK-00763	CO-5018
CRGPR-244VM	CRGPL-244VM	** RPGN-4V	0.250	1.500	1.500	8.000	1.750	308136	1/4-20 x 3/4 S.H.C.S.	TK-00763	CO-5018

NOTE: See page GP 14 for ceramic and carbide inserts.

NOTE: Use carbide inserts RCGT and RPGT with optional insert screw for finishing.

† *"A" indicates width of shank available for clamping, (not necessarily overall shank width).*

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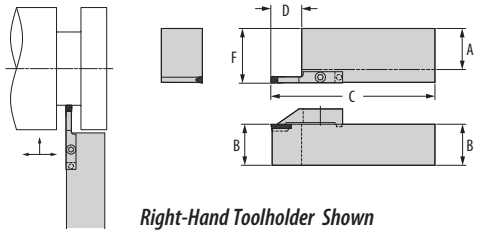
** *RCGN can be used in place of RPGN.*

Grooving/Profiling/Cut-Off Toolholder

Deep D.O.C. Series



Right-Hand Toolholder Shown

Part Number			D.O.C.	Dimensions (inches)				Standard Components		*Tune-Up Kit	Optional Components	
Right	Left	Groove Width	D	A†	B	C	F	Insert	Clamp	Includes all Standard Components	Insert	Clamp
427635-094VGS	–	0.094	0.750	1.000	1.000	6.000	1.500		427651-094GC	TK-00881		429524-094GC
–	**427636-094VGS**	0.094	0.750	1.000	1.000	6.000	1.500		427652-094GC	TK-00882		429525-094GC
427637-094VGS	–	0.094	0.750	1.250	1.250	6.000	1.750	WGC-4094	427651-094GC	TK-00881	COS-4094-0	429524-094GC
–	**427638-094VGS**	0.094	0.750	1.250	1.250	6.000	1.750	WG-4094	427652-094GC	TK-00882	COS-4094-4L	429525-094GC
427639-094VGS	–	0.094	0.750	1.500	1.500	8.000	2.000		427651-094GC	TK-00881	COS-4094-4R	429524-094GC
–	**427640-094VGS**	0.094	0.750	1.500	1.500	8.000	2.000		427652-094GC	TK-00882		429525-094GC
411173-125VGS	–	0.125	0.750	1.000	1.000	6.000	1.500		411966-125GC	TK-00592		429512-125GC
–	**411961-125VGS**	0.125	0.750	1.000	1.000	6.000	1.500	WGC-4125	411967-125GC	TK-00596	GTS-4125	429513-125GC
411250-125VGS	–	0.125	0.750	1.250	1.250	6.000	1.750	WG-4125	411966-125GC	TK-00592	COS-4125-0	429512-125GC
–	**411251-125VGS**	0.125	0.750	1.250	1.250	6.000	1.750	GTS-4125-1	411967-125GC	TK-00596	COS-4125-4L	429513-125GC
411962-125VGS	–	0.125	0.750	1.500	1.500	8.000	2.000	GTS-4125-2	411966-125GC	TK-00592	COS-4125-4R	429512-125GC
–	**411963-125VGS**	0.125	0.750	1.500	1.500	8.000	2.000		411967-125GC	TK-00596		429513-125GC
411964-156VGS	–	0.156	0.750	1.000	1.000	6.000	1.500		411968-156GC	TK-00580		436373-156GC
–	**411965-156VGS**	0.156	0.750	1.000	1.000	6.000	1.500		411969-156GC	TK-00597		436374-156GC
411256-156VGS	–	0.156	0.750	1.250	1.250	6.000	1.750	WGC-4156	411968-156GC	TK-00580	GTS-4156	436373-156GC
–	**411257-156VGS**	0.156	0.750	1.250	1.250	6.000	1.750	WG-4156	411969-156GC	TK-00597		436374-156GC
411258-156VGS	–	0.156	0.750	1.500	1.500	8.000	2.000		411968-156GC	TK-00580		436373-156GC
–	**411259-156VGS**	0.156	0.750	1.500	1.500	8.000	2.000		411969-156GC	TK-00597		436374-156GC
411970-187VGS	–	0.187	0.750	1.000	1.000	6.000	1.500		411977-187GC	TK-00581		429518-187GC
–	**411178-187VGS**	0.187	0.750	1.000	1.000	6.000	1.500	WGC-4187	411978-187GC	TK-00593	GTS-4187	429519-187GC
411262-187VGS	–	0.187	0.750	1.250	1.250	6.000	1.750	WG-4187	411977-187GC	TK-00581	COS-4187-0	429518-187GC
–	**411263-187VGS**	0.187	0.750	1.250	1.250	6.000	1.750	GTS-4187-1	411978-187GC	TK-00593	COS-4187-4L	429519-187GC
411971-187VGS	–	0.187	0.750	1.500	1.500	8.000	2.000	GTS-4187-2	411977-187GC	TK-00581	COS-4187-4R	429518-187GC
–	**411972-187VGS**	0.187	0.750	1.500	1.500	8.000	2.000		411978-187GC	TK-00593		429519-187GC
411179-218VGS	–	0.218	1.125	1.000	1.000	6.000	1.500		411979-218GC	TK-00582	–	–
–	**411180-218VGS**	0.218	1.125	1.000	1.000	6.000	1.500		411130-218GC	TK-00583	–	–
411268-218VGS	–	0.218	1.125	1.250	1.250	6.000	1.750	WGC-6218	411979-218GC	TK-00582	–	–
–	**411269-218VGS**	0.218	1.125	1.250	1.250	6.000	1.750	WG-6218	411130-218GC	TK-00583	–	–
411270-218VGS	–	0.218	1.125	1.500	1.500	8.000	2.000		411979-218GC	TK-00582	–	–
–	**411271-218VGS**	0.218	1.125	1.500	1.500	8.000	2.000		411130-218GC	TK-00583	–	–

† *"A" indicates width of shank available for clamping, (not necessarily overall shank width).*

Continued on next page.

* *All toolholders include standard clamp and 1/4-20 x 1 SHCS clamp screw.*

GTS is Greenleaf's groove/turn system insert with chip control. Page GP 09.

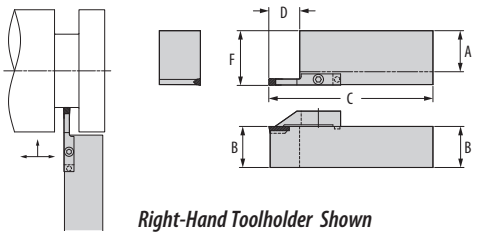
COS is Greenleaf's cut-off system insert. Page GP 08.

WG is Greenleaf flat-top groover with an 11° nose clearance. Pages GP 10 and GP 11.

WGC is Greenleaf's flat-top groover with a 6° nose clearance. Pages GP 12 and GP 13.

Grooving/Profiling/Cut-Off Toolholder

Deep D.O.C. Series *(Continued)*



Right-Hand Toolholder Shown

Part Number		Groove Width	D.O.C.	Dimensions (inches)				Standard Components		*Tune-Up Kit	Optional Components	
Right	Left		D	A†	B	C	F	Insert	Clamp	Includes all Standard Components	Insert	Clamp
411973-250VGS	–	0.250	1.125	1.000	1.000	6.000	1.500	WGC-6250	411980-250GC	TK-00617	–	–
–	**411974-250VGS**	0.250	1.125	1.000	1.000	6.000	1.500	WG-6250	411981-250GC	TK-00598	–	–
411975-250VGS	–	0.250	1.125	1.250	1.250	6.000	1.750	GTS-6250	411980-250GC	TK-00617	–	–
–	**411275-250VGS**	0.250	1.125	1.250	1.250	6.000	1.750	GTS-6250-1	411981-250GC	TK-00598	–	–
411276-250VGS	–	0.250	1.125	1.500	1.500	8.000	2.000	GTS-6250-2	411980-250GC	TK-00617	–	–
–	**411277-250VGS**	0.250	1.125	1.500	1.500	8.000	2.000		411981-250GC	TK-00598	–	–
411183-281VGS	–	0.281	1.125	1.000	1.000	6.000	1.500		411133-281GC	TK-00584	–	–
–	**411184-281VGS**	0.281	1.125	1.000	1.000	6.000	1.500		411134-281GC	TK-00585	–	–
411280-281VGS	–	0.281	1.125	1.250	1.250	6.000	1.750	WGC-6281	411133-281GC	TK-00584	–	–
–	**411281-281VGS**	0.281	1.125	1.250	1.250	6.000	1.750	WG-6281	411134-281GC	TK-00585	–	–
411282-281VGS	–	0.281	1.125	1.500	1.500	8.000	2.000		411133-281GC	TK-00584	–	–
–	**411283-281VGS**	0.281	1.125	1.500	1.500	8.000	2.000		411134-281GC	TK-00585	–	–
411982-312VGS	–	0.312	1.500	1.000	1.000	6.000	1.500		411985-312GC	TK-00586	–	–
–	**411186-312VGS**	0.312	1.500	1.000	1.000	6.000	1.500		411136-312GC	TK-00587	–	–
411286-312VGS	–	0.312	1.500	1.250	1.250	6.000	1.750	WGC-8312	411985-312GC	TK-00586	–	–
–	**411287-312VGS**	0.312	1.500	1.250	1.250	6.000	1.750	WG-8312	411136-312GC	TK-00587	–	–
411288-312VGS	–	0.312	1.500	1.500	1.500	8.000	2.000		411985-312GC	TK-00586	–	–
–	**411289-312VGS**	0.312	1.500	1.500	1.500	8.000	2.000		411136-312GC	TK-00587	–	–
411187-344VGS	–	0.344	1.500	1.000	1.000	6.000	1.500		411137-344GC	TK-00594	–	–
–	**411188-344VGS**	0.344	1.500	1.000	1.000	6.000	1.500		411138-344GC	TK-00588	–	–
411292-344VGS	–	0.344	1.500	1.250	1.250	6.000	1.750	WGC-8344	411137-344GC	TK-00594	–	–
–	**411293-344VGS**	0.344	1.500	1.250	1.250	6.000	1.750	WG-8344	411138-344GC	TK-00588	–	–
411294-344VGS	–	0.344	1.500	1.500	1.500	8.000	2.000		411137-344GC	TK-00594	–	–
–	**411295-344VGS**	0.344	1.500	1.500	1.500	8.000	2.000		411138-344GC	TK-00588	–	–
411189-375VGS	–	0.375	1.500	1.000	1.000	6.000	1.500		411986-375GC	TK-00595	–	–
–	**411190-375VGS**	0.375	1.500	1.000	1.000	6.000	1.500		411987-375GC	TK-00589	–	–
411983-375VGS	–	0.375	1.500	1.250	1.250	6.000	1.750	WGC-8375	411986-375GC	TK-00595	–	–
–	**411984-375VGS**	0.375	1.500	1.250	1.250	6.000	1.750	WG-8375	411987-375GC	TK-00589	–	–
411300-375VGS	–	0.375	1.500	1.500	1.500	8.000	2.000		411986-375GC	TK-00595	–	–
–	**411301-375VGS**	0.375	1.500	1.500	1.500	8.000	2.000		411987-375GC	TK-00589	–	–

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* *All toolholders include standard clamp and 1/4-20 x 1 SHCS clamp screw.*

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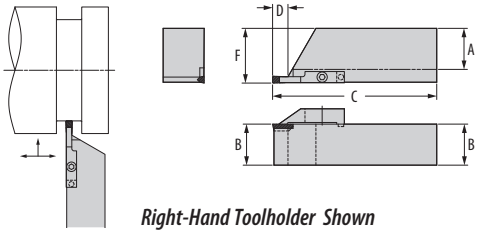
Grooving/Profiling/Cut-Off Toolholder

Shallow D.O.C. Series



Right-Hand Toolholder Shown

Part Number		Groove Width	D.O.C.	Dimensions (inches)				Standard Components		*Tune-Up Kit	Optional Components	
Right	Left		D	A†	B	C	F	Insert	Clamp	Includes all Standard Components	Insert	Clamp
427641-094VGS	–	0.094	0.375	1.000	1.000	6.000	1.500		427651-094GC	TK-00881		429524-094GC
–	**427642-094VGS**	0.094	0.375	1.000	1.000	6.000	1.500		427652-094GC	TK-00882	COS-4094-0	429525-094GC
427643-094VGS	–	0.094	0.375	1.250	1.250	6.000	1.750	WG-4094	427651-094GC	TK-00881	COS-4094-4L	429524-094GC
–	**427644-094VGS**	0.094	0.375	1.250	1.250	6.000	1.750	WGC-4094	427652-094GC	TK-00882	COS-4094-4R	429525-094GC
427645-094VGS	–	0.094	0.375	1.500	1.500	8.000	2.000		427651-094GC	TK-00881		429524-094GC
–	**427646-094VGS**	0.094	0.375	1.500	1.500	8.000	2.000		427652-094GC	TK-00882		429525-094GC
415316-125VGS	–	0.125	0.375	1.000	1.000	6.000	1.500		411966-125GC	TK-00592		429512-125GC
–	**415317-125VGS**	0.125	0.375	1.000	1.000	6.000	1.500	GTS-4125-1	411967-125GC	TK-00596	GTS-4125	429513-125GC
415318-125VGS	–	0.125	0.375	1.250	1.250	6.000	1.750	GTS-4125-2	411966-125GC	TK-00592	COS-4125-0	429512-125GC
–	**415319-125VGS**	0.125	0.375	1.250	1.250	6.000	1.750	WG-4125	411967-125GC	TK-00592	COS-4125-4L	429513-125GC
415320-125VGS	–	0.125	0.375	1.500	1.500	8.000	2.000	WGC-4125	411966-125GC	TK-00596	COS-4125-4R	429512-125GC
–	**415321-125VGS**	0.125	0.375	1.500	1.500	8.000	2.000		411967-125GC	TK-00596		429513-125GC
415324-156VGS	–	0.156	0.375	1.000	1.000	6.000	1.500		411968-156GC	TK-00580		436373-156GC
–	**415325-156VGS**	0.156	0.375	1.000	1.000	6.000	1.500		411969-156GC	TK-00597		436374-156GC
415326-156VGS	–	0.156	0.375	1.250	1.250	6.000	1.750	WG-4156	411968-156GC	TK-00580	GTS-4156	436373-156GC
–	**415327-156VGS**	0.156	0.375	1.250	1.250	6.000	1.750	WGC-4156	411969-156GC	TK-00597		436374-156GC
415328-156VGS	–	0.156	0.375	1.500	1.500	8.000	2.000		411968-156GC	TK-00580		436373-156GC
–	**415329-156VGS**	0.156	0.375	1.500	1.500	8.000	2.000		411969-156GC	TK-00597		436374-156GC
415332-187VGS	–	0.187	0.375	1.000	1.000	6.000	1.500		411977-187GC	TK-00581		429518-187GC
–	**415333-187VGS**	0.187	0.375	1.000	1.000	6.000	1.500	GTS-4187-1	411978-187GC	TK-00593	GTS-4187	429519-187GC
415334-187VGS	–	0.187	0.375	1.250	1.250	6.000	1.750	GTS-4187-2	411977-187GC	TK-00581	COS-4187-0	429519-187GC
–	**415335-187VGS**	0.187	0.375	1.250	1.250	6.000	1.750	WG-4187	411978-187GC	TK-00593	COS-4187-4L	429518-187GC
415336-187VGS	–	0.187	0.375	1.500	1.500	8.000	2.000	WGC-4187	411977-187GC	TK-00581	COS-4187-4R	429519-187GC
–	**415337-187VGS**	0.187	0.375	1.500	1.500	8.000	2.000		411978-187GC	TK-00593		429518-187GC
415340-218VGS	–	0.218	0.562	1.000	1.000	6.000	1.500		411979-218GC	TK-00582	–	–
–	**415341-218VGS**	0.218	0.562	1.000	1.000	6.000	1.500		411130-218GC	TK-00583	–	–
415342-218VGS	–	0.218	0.562	1.250	1.250	6.000	1.750	WG-6218	411979-218GC	TK-00582	–	–
–	**415343-218VGS**	0.218	0.562	1.250	1.250	6.000	1.750	WGC-6218	411130-218GC	TK-00583	–	–
415344-218VGS	–	0.218	0.562	1.500	1.500	8.000	2.000		411979-218GC	TK-00582	–	–
–	**415345-218VGS**	0.218	0.562	1.500	1.500	8.000	2.000		411130-218GC	TK-00583	–	–

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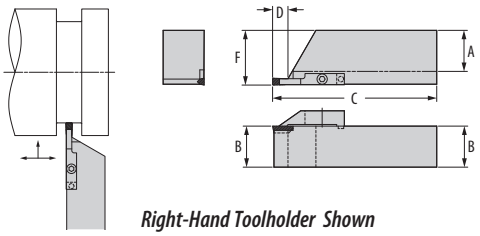
Continued on next page.

Grooving/Profiling/Cut-Off Toolholder

Shallow D.O.C. Series *(Continued)*



Right-Hand Toolholder Shown

Part Number		Groove Width	D.O.C.	Dimensions (inches)				Standard Components		*Tune-Up Kit	Optional Components	
Right	Left		D	A†	B	C	F	Insert	Clamp	Includes all Standard Components	Insert	Clamp
415348-250VGS	–	0.25	0.562	1.000	1.000	6.000	1.500	GTS-6250	411980-250GC	TK-00617	–	–
–	415349-250VGS	0.25	0.562	1.000	1.000	6.000	1.500	GTS-6250-1	411981-250GC	TK-00598	–	–
415350-250VGS	–	0.25	0.562	1.250	1.250	6.000	1.750	GTS-6250-2	411980-250GC	TK-00617	–	–
–	415351-250VGS	0.25	0.562	1.250	1.250	6.000	1.750	WG-6250	411981-250GC	TK-00598	–	–
415352-250VGS	–	0.25	0.562	1.500	1.500	8.000	2.000	WGC-6250	411980-250GC	TK-00617	–	–
–	415353-250VGS	0.25	0.562	1.500	1.500	8.000	2.000		411981-250GC	TK-00598	–	–
415356-281VGS	–	0.281	0.562	1.000	1.000	6.000	1.500		411133-281GC	TK-00584	–	–
–	415357-281VGS	0.281	0.562	1.000	1.000	6.000	1.500		411134-281GC	TK-00585	–	–
415358-281VGS	–	0.281	0.562	1.250	1.250	6.000	1.750	WG-6281	411133-281GC	TK-00584	–	–
–	415359-281VGS	0.281	0.562	1.250	1.250	6.000	1.750	WGC-6281	411134-281GC	TK-00585	–	–
415360-281VGS	–	0.281	0.562	1.500	1.500	8.000	2.000		411133-281GC	TK-00584	–	–
–	415361-281VGS	0.281	0.562	1.500	1.500	8.000	2.000		411134-281GC	TK-00585	–	–
415364-312VGS	–	0.312	0.750	1.000	1.000	6.000	1.500		411985-312GC	TK-00586	–	–
–	415365-312VGS	0.312	0.750	1.000	1.000	6.000	1.500		411136-312GC	TK-00587	–	–
415366-312VGS	–	0.312	0.750	1.250	1.250	6.000	1.750	WG-8312	411985-312GC	TK-00586	–	–
–	415367-312VGS	0.312	0.750	1.250	1.250	6.000	1.750	WGC-8312	411136-312GC	TK-00587	–	–
415368-312VGS	–	0.312	0.750	1.500	1.500	8.000	2.000		411985-312GC	TK-00586	–	–
–	415369-312VGS	0.312	0.750	1.500	1.500	8.000	2.000		411136-312GC	TK-00587	–	–
415372-344VGS	–	0.344	0.750	1.000	1.000	6.000	1.500		411137-344GC	TK-00594	–	–
–	415373-344VGS	0.344	0.750	1.000	1.000	6.000	1.500		411138-344GC	TK-00588	–	–
415374-344VGS	–	0.344	0.750	1.250	1.250	6.000	1.750	WG-8344	411137-344GC	TK-00594	–	–
–	415375-344VGS	0.344	0.750	1.250	1.250	6.000	1.750	WGC-8344	411138-344GC	TK-00588	–	–
415376-344VGS	–	0.344	0.750	1.500	1.500	8.000	2.000		411137-344GC	TK-00594	–	–
–	415377-344VGS	0.344	0.750	1.500	1.500	8.000	2.000		411138-344GC	TK-00588	–	–
415380-375VGS	–	0.375	0.750	1.000	1.000	6.000	1.500		411986-375GC	TK-00595	–	–
–	415381-375VGS	0.375	0.750	1.000	1.000	6.000	1.500		411987-375GC	TK-00589	–	–
415382-375VGS	–	0.375	0.750	1.250	1.250	6.000	1.750	WGC-8375	411986-375GC	TK-00595	–	–
–	415383-375VGS	0.375	0.750	1.250	1.250	6.000	1.750		411987-375GC	TK-00589	–	–
415384-375VGS	–	0.375	0.750	1.500	1.500	8.000	2.000		411986-375GC	TK-00595	–	–
–	415385-375VGS	0.375	0.750	1.500	1.500	8.000	2.000		411987-375GC	TK-00589	–	–

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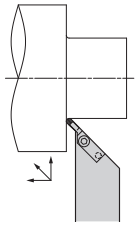
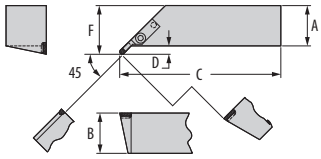
45° Grooving/Profiling Toolholder





Right-Hand Toolholder Shown

Part Number		Gage	D.O.C.	Dimensions (inches)				Std Component	*Tune-Up Kit	Optional Components	
Right	Left	Insert	D	A	B	C	F	Clamp	Includes all Standard Components	Insert	Clamp
415293-45VGS	415294-45VGS	GTS-4125-1	0.313	1.000	1.000	6.020	1.332	415305-GC 415306-GC	TK-00618 TK-00709	GTS-4125	429514-GC 429515-GC
		GTS-4125-2	0.313	1.000	1.000	6.013	1.325				
		WG-4125	0.313	1.000	1.000	6.000	1.312				
		WG-4125-1	0.313	1.000	1.000	6.020	1.332				
		WG-4125-2	0.313	1.000	1.000	6.013	1.325				
		WG-4156	0.313	1.000	1.000	6.005	1.317				
		WG-4156-1	0.313	1.000	1.000	6.031	1.343				
		WG-4156-2	0.313	1.000	1.000	6.024	1.336				
415295-45VGS	415296-45VGS	GTS-4125-1	0.313	1.250	1.250	6.020	1.582	415305-GC 415306-GC	TK-00618 TK-00709	GTS-4125	429514-GC 429515-GC
		GTS-4125-2	0.313	1.250	1.250	6.013	1.575				
		WG-4125	0.313	1.250	1.250	6.000	1.562				
		WG-4125-1	0.313	1.250	1.250	6.020	1.582				
		WG-4125-2	0.313	1.250	1.250	6.013	1.575				
		WG-4156	0.313	1.250	1.250	6.005	1.567				
		WG-4156-1	0.313	1.250	1.250	6.031	1.593				
		WG-4156-2	0.313	1.250	1.250	6.024	1.586				
415297-45VGS	415298-45VGS	GTS-4125-1	0.313	1.500	1.500	8.020	1.832	415305-GC 415306-GC	TK-00618 TK-00709	GTS-4125	429514-GC 429515-GC
		GTS-4125-2	0.313	1.500	1.500	8.013	1.825				
		WG-4125	0.313	1.500	1.500	8.000	1.812				
		WG-4125-1	0.313	1.500	1.500	8.020	1.832				
		WG-4125-2	0.313	1.500	1.500	8.013	1.825				
		WG-4156	0.313	1.500	1.500	8.005	1.817				
		WG-4156-1	0.313	1.500	1.500	8.031	1.843				
		WG-4156-2	0.313	1.500	1.500	8.024	1.836				
415299-45VGS	415300-45VGS	GTS-4187-1	0.313	1.000	1.000	6.033	1.345	415307-GC 415308-GC	TK-00619 TK-00708	GTS-4187	429520-GC 429521-GC
		GTS-4187-2	0.313	1.000	1.000	6.026	1.338				
		WG-4187	0.313	1.000	1.000	6.000	1.312				
		WG-4187-1	0.313	1.000	1.000	6.033	1.345				
		WG-4187-2	0.313	1.000	1.000	6.026	1.338				
415301-45VGS	415302-45VGS	GTS-4187-1	0.313	1.250	1.250	6.033	1.595	415307-GC 415308-GC	TK-00619 TK-00708	GTS-4187	429520-GC 429521-GC
		GTS-4187-2	0.313	1.250	1.250	6.026	1.588				
		WG-4187	0.313	1.250	1.250	6.000	1.562				
		WG-4187-1	0.313	1.250	1.250	6.033	1.595				
		WG-4187-2	0.313	1.250	1.250	6.026	1.588				
415303-45VGS	415304-45VGS	GTS-4187-1	0.313	1.500	1.500	8.033	1.845	415307-GC 415308-GC	TK-00619 TK-00708	GTS-4187	429520-GC 429521-GC
		GTS-4187-2	0.313	1.500	1.500	8.026	1.838				
		WG-4187	0.313	1.500	1.500	8.000	1.812				
		WG-4187-1	0.313	1.500	1.500	8.033	1.845				
		WG-4187-2	0.313	1.500	1.500	8.026	1.838				

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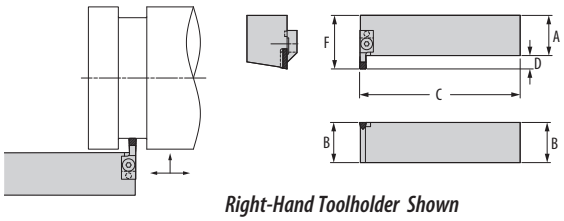
90° Grooving/Profiling Toolholder



Right-Hand Toolholder Shown

Part Number		Groove Width	D.O.C.	Dimensions (inches)				Standard Components		*Tune-Up Kit	Optional Components	
Right	Left		D	A	B	C	F	Insert	Clamp	Includes all Standard Components	Insert	Clamp
411693-125VGS	–	0.125	0.375	1.000	1.000	6.000	1.375		411765-125GC	TK-00599		429516-125GC
–	**411694-125VGS**	0.125	0.375	1.000	1.000	6.000	1.375	GTS-4125-1	411766-125GC	TK-00600	GTS-4125	429517-125GC
411695-125VGS	–	0.125	0.375	1.250	1.250	6.000	1.625	GTS-4125-2	411765-125GC	TK-00599	COS-4125-0	429516-125GC
–	**411696-125VGS**	0.125	0.375	1.250	1.250	6.000	1.625	WG-4125	411766-125GC	TK-00600	COS-4125-4R	429517-125GC
411697-125VGS	–	0.125	0.375	1.500	1.500	8.000	1.875	WGC-4125	411765-125GC	TK-00599	COS-4125-4L	429516-125GC
–	**411698-125VGS**	0.125	0.375	1.500	1.500	8.000	1.875		411766-125GC	TK-00600		429517-125GC
411701-156VGS	–	0.156	0.375	1.000	1.000	6.000	1.375		411767-156GC	TK-00601	–	–
–	**411702-156VGS**	0.156	0.375	1.000	1.000	6.000	1.375		411768-156GC	TK-00602	–	–
411703-156VGS	–	0.156	0.375	1.250	1.250	6.000	1.625	WG-4156	411767-156GC	TK-00601	–	–
–	**411704-156VGS**	0.156	0.375	1.250	1.250	6.000	1.625	WGC-4156	411768-156GC	TK-00602	–	–
411705-156VGS	–	0.156	0.375	1.500	1.500	8.000	1.875		411767-156GC	TK-00601	–	–
–	**411706-156VGS**	0.156	0.375	1.500	1.500	8.000	1.875		411768-156GC	TK-00602	–	–
411709-187VGS	–	0.187	0.375	1.000	1.000	6.000	1.375		411769-187GC	TK-00603		429522-187GC
–	**411710-187VGS**	0.187	0.375	1.000	1.000	6.000	1.375	GTS-4187-1	411770-187GC	TK-00604	GTS-4187	429523-187GC
411711-187VGS	–	0.187	0.375	1.250	1.250	6.000	1.625	GTS-4187-2	411769-187GC	TK-00603	COS-4187-0	429522-187GC
–	**411712-187VGS**	0.187	0.375	1.250	1.250	6.000	1.625	WG-4187	411770-187GC	TK-00604	COS-4187-4R	429523-187GC
411713-187VGS	–	0.187	0.375	1.500	1.500	8.000	1.875	WGC-4187	411769-187GC	TK-00603	COS-4187-4L	429522-187GC
–	**411714-187VGS**	0.187	0.375	1.500	1.500	8.000	1.875		411770-187GC	TK-00604		429523-187GC
411717-218VGS	–	0.218	0.500	1.000	1.000	6.000	1.500		411771-218GC	TK-00605	–	–
–	**411718-218VGS**	0.218	0.500	1.000	1.000	6.000	1.500		411772-218GC	TK-00606	–	–
411719-218VGS	–	0.218	0.500	1.250	1.250	6.000	1.750	WG-6218	411771-218GC	TK-00605	–	–
–	**411720-218VGS**	0.218	0.500	1.250	1.250	6.000	1.750	WGC-6218	411772-218GC	TK-00606	–	–
411721-218VGS	–	0.218	0.500	1.500	1.500	8.000	2.000		411771-218GC	TK-00605	–	–
–	**411722-218VGS**	0.218	0.500	1.500	1.500	8.000	2.000		411772-218GC	TK-00606	–	–
411725-250VGS	–	0.250	0.500	1.000	1.000	6.000	1.500	GTS-6250	411773-250GC	TK-00608	–	–
–	**411726-250VGS**	0.250	0.500	1.000	1.000	6.000	1.500	GTS-6250-1	411774-250GC	TK-00607	–	–
411727-250VGS	–	0.250	0.500	1.250	1.250	6.000	1.750	GTS-6250-2	411773-250GC	TK-00608	–	–
–	**411728-250VGS**	0.250	0.500	1.250	1.250	6.000	1.750	WG-6250	411774-250GC	TK-00607	–	–
411729-250VGS	–	0.250	0.500	1.500	1.500	8.000	2.000	WGC-6250	411773-250GC	TK-00608	–	–
–	**411730-250VGS**	0.250	0.500	1.500	1.500	8.000	2.000		411774-250GC	TK-00607	–	–

** All toolholders include standard clamp and 1/4-20 x 1 SHCS clamp screw.*

Continued on next page.

GTS is Greenleaf's groove/turn system insert with chip control. Page GP 09.
COS is Greenleaf's cut-off system insert. Page GP 08.
WG is Greenleaf flat-top groover with an 11° nose clearance. Pages GP 10 and GP 11.
WGC is Greenleaf's flat-top groover with a 6° nose clearance. Pages GP 12 and GP 13.

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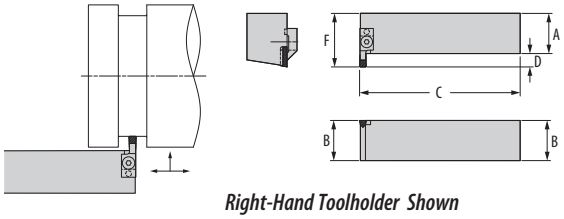
90° Grooving/Profiling Toolholder

(Continued)



Right-Hand Toolholder Shown

Part Number		Groove Width	D.O.C.	Dimensions (inches)				Standard Components		*Tune-Up Kit	Optional Components	
Right	Left		D	A	B	C	F	Insert	Clamp	Includes all Standard Components	Insert	Clamp
411733-281VGS	–	0.281	0.500	1.000	1.000	6.000	1.500		411775-281GC	TK-00609	–	–
–	**411734-281VGS**	0.281	0.500	1.000	1.000	6.000	1.500		411776-281GC	TK-00610	–	–
411735-281VGS	–	0.281	0.500	1.250	1.250	6.000	1.750	WG-6281	411775-281GC	TK-00609	–	–
–	**411736-281VGS**	0.281	0.500	1.250	1.250	6.000	1.750	WGC-6281	411776-281GC	TK-00610	–	–
411737-281VGS	–	0.281	0.500	1.500	1.500	8.000	2.000		411775-281GC	TK-00609	–	–
–	**411738-281VGS**	0.281	0.500	1.500	1.500	8.000	2.000		411776-281GC	TK-00610	–	–
411743-312VGS	–	0.312	0.625	1.250	1.250	6.000	1.875		411777-312GC	TK-00611	–	–
–	**411744-312VGS**	0.312	0.625	1.250	1.250	6.000	1.875	WG-8312	411778-312GC	TK-00612	–	–
411745-312VGS	–	0.312	0.625	1.500	1.500	8.000	2.125	WGC-8312	411777-312GC	TK-00611	–	–
–	**411746-312VGS**	0.312	0.625	1.500	1.500	8.000	2.125		411778-312GC	TK-00612	–	–
411751-344VGS	–	0.344	0.625	1.250	1.250	6.000	1.875		411779-344GC	TK-00613	–	–
–	**411752-344VGS**	0.344	0.625	1.250	1.250	6.000	1.875	WG-8344	411780-344GC	TK-00614	–	–
411753-344VGS	–	0.344	0.625	1.500	1.500	8.000	2.125	WGC-8344	411779-344GC	TK-00613	–	–
–	**411754-344VGS**	0.344	0.625	1.500	1.500	8.000	2.125		411780-344GC	TK-00614	–	–
411759-375VGS	–	0.375	0.625	1.250	1.250	6.000	1.875		411781-375GC	TK-00615	–	–
–	**411760-375VGS**	0.375	0.625	1.250	1.250	6.000	1.875	WG-8375	411782-375GC	TK-00616	–	–
411761-375VGS	–	0.375	0.625	1.500	1.500	8.000	2.125	WGC-8375	411781-375GC	TK-00615	–	–
–	**411762-375VGS**	0.375	0.625	1.500	1.500	8.000	2.125		411782-375GC	TK-00616	–	–

** All toolholders include standard clamp and 1/4-20 x 1 SHCS clamp screw.*
GTS is Greenleaf's groove/turn system insert with chip control. Page GP 09.
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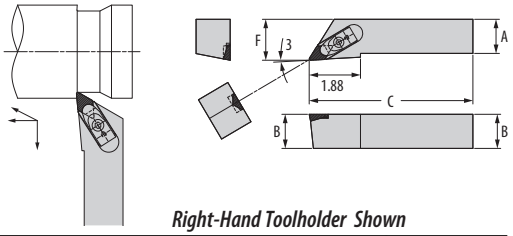
CDJOR-V/CDJOL-V

Double Ended / 55° Diamond Insert



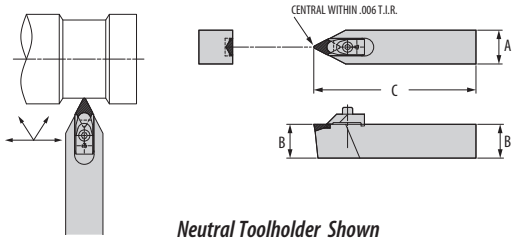
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)				Standard Components				*Tune-Up Kit
Right	Left	Inserts	A	B	C	F	Back-Up Plate	Plate Screw	Clamp	Clamp Screw	Includes all Standard Components
CDJOR-164V	CDJOL-164V	DPGN-443V	1.000	1.000	6.000	1.250	418101	#6-32x3/8S.H.C.S.	418100	1/4-20x1S.H.C.S.	TK-00754
CDJOR-204V	CDJOL-204V	DPGN-443V	1.250	1.250	6.000	1.500	418101	#6-32x3/8S.H.C.S.	418100	1/4-20x1S.H.C.S.	TK-00754
CDJOR-244V	CDJOL-244V	DPGN-443V	1.500	1.500	8.000	2.000	418101	#6-32x3/8S.H.C.S.	418100	1/4-20x1S.H.C.S.	TK-00754

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

CDPON-V

Double Ended / 55° Diamond Insert



Neutral Toolholder Shown

Part Number	Gage	Dimensions (inches)			Standard Components				*Tune-Up Kit
	Inserts	A	B	C	Back-Up Plate	Plate Screw	Clamp	Clamp Screw	Includes all Standard Components
CDPON-164V	DPGN-443V	1.000	1.000	6.000	418101	#6-32 x 3/8 S.H.C.S.	418100	1/4-20 x 1 S.H.C.S.	TK-00754
CDPON-204V	DPGN-443V	1.250	1.250	6.000	418101	#6-32 x 3/8 S.H.C.S.	418100	1/4-20 x 1 S.H.C.S.	TK-00754
CDPON-244V	DPGN-443V	1.500	1.500	8.000	418101	#6-32 x 3/8 S.H.C.S.	418100	1/4-20 x 1 S.H.C.S.	TK-00754

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

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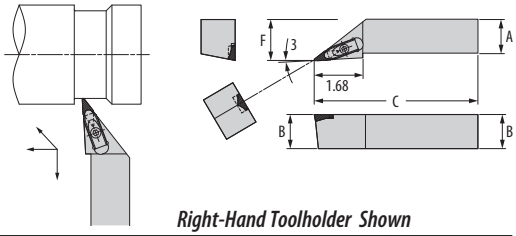
CVJOR-V/CVJOL-V

Double Ended / 35° Diamond Insert



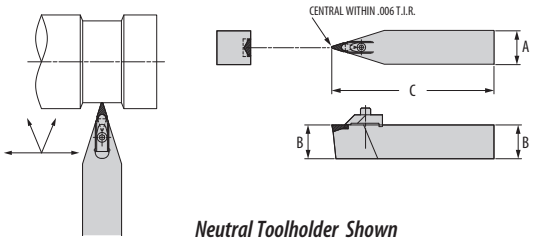
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)				Standard Components				*Tune-Up Kit
Right	Left	Inserts	A	B	C	F	Back-Up Plate	Plate Screw	Clamp	Clamp Screw	Includes all Standard Components
CVJOR-122.5VC	CVJOL-122.5VC	VCGN-2.532V	0.750	0.750	5.000	1.000	418525	#4-40x1/4S.H.C.S.	418524	#10-32x3/4S.H.C.S.	TK-00756
CVJOR-162.5V	CVJOL-162.5V	VCGN-2.532V	1.000	1.000	6.000	1.250	418525	#4-40x1/4S.H.C.S.	418524	#10-32x3/4S.H.C.S.	TK-00756
CVJOR-202.5V	CVJOL-202.5V	VCGN-2.532V	1.250	1.250	6.000	1.500	418525	#4-40x1/4S.H.C.S.	418524	#10-32x3/4S.H.C.S.	TK-00756
CVJOR-242.5V	CVJOL-242.5V	VCGN-2.532V	1.500	1.500	8.000	2.000	418525	#4-40x1/4S.H.C.S.	418524	#10-32x3/4S.H.C.S.	TK-00756

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

CVVON-V

Double Ended / 35° Diamond Insert



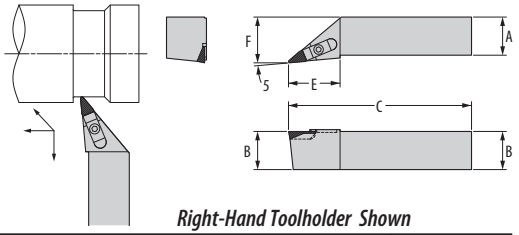
Neutral Toolholder Shown

Part Number	Gage	Dimensions (inches)			Standard Components				*Tune-Up Kit
	Inserts	A	B	C	Back-Up Plate	Plate Screw	Clamp	Clamp Screw	Includes all Standard Components
CVVON-122.5VC	VCGN-2.532V	0.750	0.750	5.000	418525	#4-40x1/4S.H.C.S.	418524	#10-32x3/4S.H.C.S.	TK-00756
CVVON-162.5V	VCGN-2.532V	1.000	1.000	6.000	418525	#4-40x1/4S.H.C.S.	418524	#10-32x3/4S.H.C.S.	TK-00756
CVVON-202.5V	VCGN-2.532V	1.250	1.250	6.000	418525	#4-40x1/4S.H.C.S.	418524	#10-32x3/4S.H.C.S.	TK-00756
CVVON-242.5V	VCGN-2.532V	1.500	1.500	8.000	418525	#4-40x1/4S.H.C.S.	418524	#10-32x3/4S.H.C.S	TK-00756

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

VJOR-V/VJOL-V

Single Ended / 35° Diamond Insert



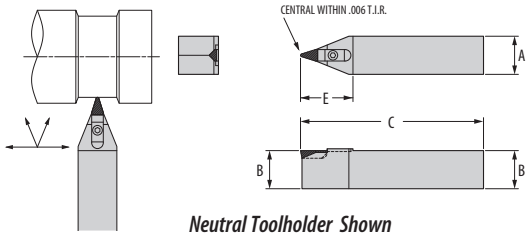
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (inches)					Standard Components		*Tune-Up Kit
Right	Left	Inserts	A	B	C	E	F	Clamp	Clamp Screw	Includes all Standard Components
VJOR-164V	VJOL-164V	VPG-33.543V	1.000	1.000	6.000	1.688	1.250	3386	#10-32 x 5/8 S.H.C.S.	TK-00578
VJOR-204V	VJOL-204V	VPG-33.543V	1.250	1.250	6.000	1.688	1.500	3386	#10-32 x 5/8 S.H.C.S.	TK-00578
VJOR-244V	VJOL-244V	VPG-33.543V	1.500	1.500	8.000	1.688	2.000	3386	#10-32 x 5/8 S.H.C.S.	TK-00578

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

VVON-V

Single Ended / 35° Diamond Insert



Neutral Toolholder Shown

Part Number	Gage	Dimensions (inches)				Standard Components		*Tune-Up Kit
	Inserts	A	B	C	E	Clamp	Clamp Screw	Includes all Standard Components
VVON-164V	VPG-33.543V	1.000	1.000	6.000	1.719	3386	#10-32 x 5/8 S.H.C.S.	TK-00578
VVON-204V	VPG-33.543V	1.250	1.250	6.000	1.719	3386	#10-32 x 5/8 S.H.C.S.	TK-00578
VVON-244V	VPG-33.543V	1.500	1.500	8.000	1.719	3386	#10-32 x 5/8 S.H.C.S.	TK-00578

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

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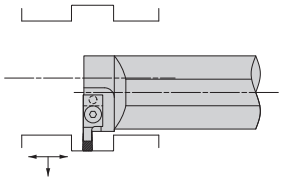
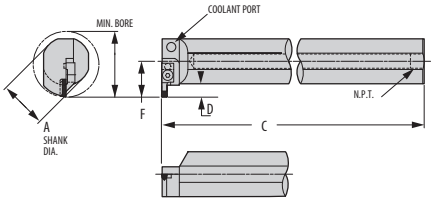
Cut-Off Grooving Bar





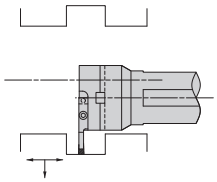
Right-Hand Grooving Bar Shown

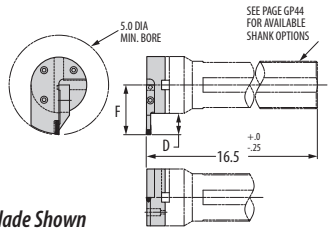
Part Number		Groove Width	D.O.C.	Min. Bore	Dimensions (inches)			Standard Components		*Tune-Up Kit	Optional Components	
Right	Left		D		A	C	F	Insert	Clamp	Includes all Standard Components	Insert	Clamp
512074-125VGS	–	0.125	0.375	2.500	2.000	16.000	1.375	GTS-4125-1	411765-125GC	TK-00599	GTS-4125	429516-125GC
–	**512075-125VGS**	0.125	0.375	2.500	2.000	16.000	1.375	GTS-4125-2	411766-125GC	TK-00600	COS-4125-0	429517-125GC
								WG-4125			COS-4125-4R	
								WGC-4125			COS-4125-4L	
512086-156VGS	–	0.156	0.375	2.500	2.000	16.000	1.375	WG-4156	411767-156GC	TK-00601	–	–
–	**512087-156VGS**	0.156	0.375	2.500	2.000	16.000	1.375	WGC-4156	411768-156GC	TK-00602	–	–
512098-187VGS	–	0.187	0.375	2.500	2.000	16.000	1.375	GTS-4187-1	411769-187GC	TK-00603	GTS-4187	429522-187GC
–	**512099-187VGS**	0.187	0.375	2.500	2.000	16.000	1.375	GTS-4187-2	411770-187GC	TK-00604	COS-4187-0	429523-187GC
								WG-4187			COS-4187-4R	
								WGC-4187			COS-4187-4L	
512106-218VGS	–	0.218	0.500	2.750	2.000	16.000	1.500	WG-6218	411771-218GC	TK-00605	–	–
–	**512107-218VGS**	0.218	0.500	2.750	2.000	16.000	1.500	WGC-6218	411772-218GC	TK-00606	–	–
512116-250VGS	–	0.250	0.500	2.750	2.000	16.000	1.500	GTS-6250	411773-250GC	TK-00608	–	–
–	**512117-250VGS**	0.250	0.500	2.750	2.000	16.000	1.500	GTS-6250-1	411774-250GC	TK-00607	–	–
								GTS-6250-2				
								WG-6250				
								WGC-6250				
512126-281VGS	–	0.281	0.500	2.750	2.000	16.000	1.500	WG-6281	411775-281GC	TK-00609	–	–
–	**512127-281VGS**	0.281	0.500	2.750	2.000	16.000	1.500	WGC-6281	411776-281GC	TK-00610	–	–
512132-312VGS	–	0.312	0.625	3.000	2.000	16.000	1.625	WG-8312	411777-312GC	TK-00611	–	–
–	**512133-312VGS**	0.312	0.625	3.000	2.000	16.000	1.625	WGC-8312	411778-312GC	TK-00612	–	–
512138-344VGS	–	0.344	0.625	3.000	2.000	16.000	1.625	WG-8344	411779-344GC	TK-00613	–	–
–	**512139-344VGS**	0.344	0.625	3.000	2.000	16.000	1.625	WGC-8344	411780-344GC	TK-00614	–	–
512144-375VGS	–	0.375	0.625	3.000	2.000	16.000	1.625	WG-8375	411781-375GC	TK-00615	–	–
–	**512145-375VGS**	0.375	0.625	3.000	2.000	16.000	1.625	WGC-8375	411782-375GC	TK-00616	–	–

** All toolholders include standard clamp and 1/4-20 x 1 SHCS clamp screw.*
GTS is Greenleaf's groove/turn system insert with chip control. Page GP 09.
COS is Greenleaf's cut-off system insert. Page GP 08.
WG is Greenleaf flat-top groover with an 11° nose clearance. Pages GP 10 and GP 11.
WGC is Greenleaf's flat-top groover with a 6° nose clearance. Pages GP 12 and GP 13.

Cut-Off Grooving Support Blade

For Single-Ended V-Bottom Inserts





Right-Hand Support Blade Shown

Part Number			D.O.C.	Dimensions (inches)	Standard Components		*Tune-Up Kit	Optional Components	
Right	Left	Groove Width	D	F	Insert	Clamp	Includes all Std Components and *Clamp Screw	Insert	Clamp
511309-125VGB	–	0.125	0.750	2.250	GTS-4125-1	411967-125GC	TK-00596	GTS-4125	429513-125GC
–	**512228-125VGB**	0.125	0.750	2.250	GTS-4125-2	411966-125GC	TK-00592	COS-4125-0	429512-125GC
					WG-4125			COS-4125-4R	
					WGC-4125			COS-4125-4L	
511311-156VGB	–	0.156	0.750	2.250	WG-4156	411969-156GC	TK-00597	–	–
–	**511312-156VGB**	0.156	0.750	2.250	WGC-4156	411968-156GC	TK-00580	–	–
511313-187VGB	–	0.187	0.750	2.250	GTS-4187-1	411978-187GC	TK-00593	GTS-4187	429519-187GC
–	**511314-187VGB**	0.187	0.750	2.250	GTS-4187-2	411977-187GC	TK-00581	COS-4187-0	429518-187GC
					WG-4187			COS-4187-4R	
					WGC-4187			COS-4187-4L	
511315-218VGB	–	0.218	1.125	2.625	WG-6218	411130-218GC	TK-00583	–	–
–	**512229-218VGB**	0.218	1.125	2.625	WGC-6218	411979-218GC	TK-00582	–	–
512230-250VGB	–	0.250	1.125	2.625	GTS-6250	411981-250GC	TK-00598	–	–
–	**511318-250VGB**	0.250	1.125	2.625	GTS-6250-1	411980-250GC	TK-00617	–	–
					GTS-6250-2				
					WG-6250				
					WGC-6250				
511319-281VGB	–	0.281	1.125	2.625	WG-6281	411134-281GC	TK-00585	–	–
–	**511320-281VGB**	0.281	1.125	2.625	WGC-6281	411133-281GC	TK-00584	–	–
511321-312-VGB	–	0.312	1.500	3.000	WG-8312	411136-312GC	TK-00587	–	–
–	**511322-312VGB**	0.312	1.500	3.000	WGC-8312	411985-312GC	TK-00586	–	–
511323-344VGB	–	0.344	1.500	3.000	WG-8344	411138-344GC	TK-00588	–	–
–	**511324-344VGB**	0.344	1.500	3.000	WGC-8344	411137-344GC	TK-00594	–	–
511325-375VGB	–	0.375	1.500	3.000	WG-8375	411987-375GC	TK-00589	–	–
–	**511326-375VGB**	0.375	1.500	3.000	WGC-8375	411986-375GC	TK-00595	–	–

NOTE: See page GP 44 for available shank options

** All toolholders include standard clamp and 1/4-20 x 1 SHCS.*

GTS is Greenleaf's groove/turn system insert with chip control. Page GP 09.

COS is Greenleaf's cut-off system insert. Page GP 08.

WG is Greenleaf flat-top groover with an 11° nose clearance. Pages GP 10 and GP 11.

WGC is Greenleaf's flat-top groover with a 6° nose clearance. Pages GP 12 and GP 13.

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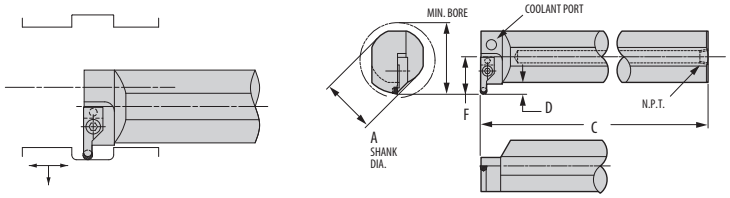
Profiling Bar

Round V-Bottom Insert / Milled Nest



Right-Hand Profiling Bar Shown

Part Number		Gage - Opt 1		Gage - Opt 2		D.O.C.	Dimensions (inches)			Standard Components		*Tune-Up Kit	Opt. Component
Right	Left	Insert	Min. Bore	Insert	Min. Bore	D	A	C	F	Clamp	Clamp Screw	Includes all Standard Components	Insert Screw
519700-2VMRB	–	RPGN-2V	1.500	RCGN-2V	3.500	3/8	1.000	12.00	0.875	412131-250GC	1/4-20x3/4S.H.C.S.	TK-00795	PT-542T
–	**519701-2VMRB**	RPGN-2V	1.500	RCGN-2V	3.500	3/8	1.000	12.00	0.875	412132-250GC	1/4-20x3/4S.H.C.S.	TK-00836	PT-542T
519702-2VMRB	–	RPGN-2V	1.750	RCGN-2V	3.500	3/8	1.250	13.75	1.000	412131-250GC	1/4-20x1S.H.C.S.	TK-00798	PT-542T
–	**519703-2VMRB**	RPGN-2V	1.750	RCGN-2V	3.500	3/8	1.250	13.75	1.000	412132-250GC	1/4-20x1S.H.C.S.	TK-00848	PT-542T
519704-2VMRB	–	RPGN-2V	2.000	RCGN-2V	3.500	3/8	1.500	13.75	1.125	412131-250GC	1/4-20x1S.H.C.S.	TK-00798	PT-542T
–	**519705-2VMRB**	RPGN-2V	2.000	RCGN-2V	3.500	3/8	1.500	13.75	1.125	412132-250GC	1/4-20x1S.H.C.S.	TK-00848	PT-542T
519706-2VMRB	–	RPGN-2V	2.500	RCGN-2V	3.500	3/8	2.000	16.00	1.375	412131-250GC	1/4-20x1S.H.C.S.	TK-00798	PT-542T
–	**519707-2VMRB**	RPGN-2V	2.500	RCGN-2V	3.500	3/8	2.000	16.00	1.375	412132-250GC	1/4-20x1S.H.C.S.	TK-00848	PT-542T
519708-3VMRB	**519709-3VMRB**	RPGN-3V	2.250	RCGN-3V	4.500	1/2	1.250	13.75	1.125	308063	#10-32x1/2S.H.C.S.	TK-00764	PT-545T
519710-3VMRB	**519711-3VMRB**	RPGN-3V	2.500	RCGN-3V	4.500	1/2	1.500	13.75	1.250	308063	#10-32x1/2S.H.C.S.	TK-00764	PT-545T
519712-3VMRB	**519713-3VMRB**	RPGN-3V	2.750	RCGN-3V	4.500	1/2	2.000	16.00	1.500	308063	#10-32x1/2S.H.C.S.	TK-00764	PT-545T
519714-4VMRB	**519715-4VMRB**	RPGN-4V	2.250	RCGN-4V	4.500	5/8	1.250	13.75	1.250	308136	1/4-20x3/4S.H.C.S.	TK-00763	CO-5018
519716-4VMRB	**519717-4VMRB**	RPGN-4V	2.500	RCGN-4V	4.500	5/8	1.500	13.75	1.375	308136	1/4-20x3/4S.H.C.S.	TK-00763	CO-5018
519718-4VMRB	**519719-4VMRB**	RPGN-4V	2.750	RCGN-4V	4.500	5/8	2.000	16.00	1.625	308136	1/4-20x3/4S.H.C.S.	TK-00763	CO-5018

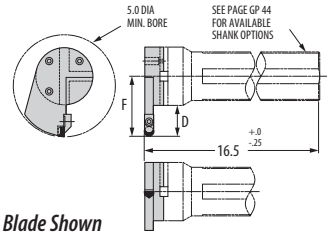
NOTE: See page GP 14 for ceramic and carbide inserts.

NOTE: Use carbide inserts RCGT and RPGT with optional insert screw for finishing.

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the profiling bar.*

Profiling Support Blade

Round V-Bottom Insert / Milled Nest



Right-Hand Support Blade Shown

Part Number		Gage	D.O.C.	Dimensions (inches)	Standard Components		*Tune-Up Kit	Opt. Component
Right	Left	Insert	D	F	Clamp	Clamp Screw	Includes all Standard Components	Insert Screw
519740-2VMRB	–	**RPGN-2V	0.750	2.375	411906-250VRC	1/4-20x1S.H.C.S.	TK-00799	PT-542T
–	**519741-2VMRB**	**RPGN-2V	0.750	2.375	411905-250VRC	1/4-20x1S.H.C.S.	TK-00765	PT-542T
519742-3VMRB	–	**RPGN-3V	1.125	2.750	308063	#10-32x1/2S.H.C.S.	TK-00764	PT-545T
–	**519743-3VMRB**	**RPGN-3V	1.125	2.750	308063	#10-32x1/2S.H.C.S.	TK-00764	PT-545T
519744-4VMRB	–	**RPGN-4V	1.500	3.125	308136	1/4-20x3/4S.H.C.S.	TK-00763	CO-5018
–	**519745-4VMRB**	**RPGN-4V	1.500	3.125	308136	1/4-20x3/4S.H.C.S.	TK-00763	CO-5018

NOTE: See page GP 14 for ceramic and carbide inserts.
NOTE: See page GP 44 for available shank options.
NOTE: Use carbide inserts RCGT and RPGT with optional insert screw for finishing.
** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the support blade.*
*** RCGN can be used in place of RPGN.*

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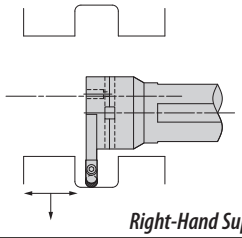
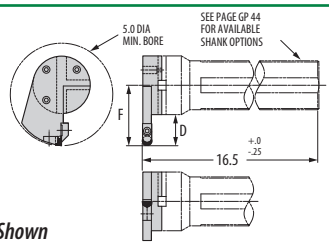
Profiling Support Blade

Round V-Bottom Insert / Replaceable Nest





Right-Hand Support Blade Shown

Part Number		Gage	D.O.C.	Dimensions (inches)	Standard Components				*Tune-Up Kit
Right	Left	Insert	D	F	Nest	Nest Screw	Clamp	Clamp Screw	Includes all Standard Components
512227-2VRB	–	**RPGN-2V	0.750	2.375	411108	#3-48x3/8B.H.C.S.	411906-250VRC	1/4-20x1S.H.C.S.	TK-00685
–	**511287-2VRB**	**RPGN-2V	0.750	2.375	411108	#3-48x3/8B.H.C.S.	411905-250VRC	1/4-20x1S.H.C.S.	TK-00683
511288-3VRB	–	**RPGN-3V	1.125	2.750	414009	#6-32x1/2B.H.C.S.	308063	#10-32x1/2S.H.C.S.	TK-00528
–	**511289-3VRB**	**RPGN-3V	1.125	2.750	414009	#6-32x1/2B.H.C.S.	308063	#10-32x1/2S.H.C.S.	TK-00528
511290-4VRB	–	**RPGN-4V	1.500	3.125	414008	#10-32x5/8B.H.C.S.	308136	1/4-20x5/8S.H.C.S.	TK-00529
–	**511291-4VRB**	**RPGN-4V	1.500	3.125	414008	#10-32x5/8B.H.C.S.	308136	1/4-20x5/8S.H.C.S.	TK-00529

NOTE: See page GP 14 for ceramic and carbide inserts.

NOTE: See page GP 44 for available shank options.

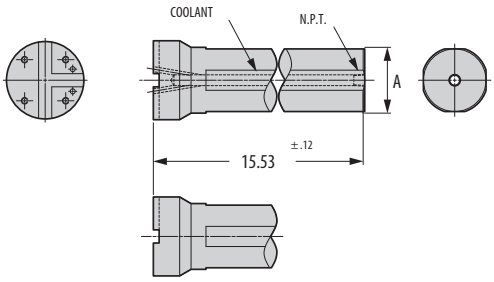
* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the support blade.*

** *RCGN can be used in place of RPGN.*

Shank Options

For Bolt-On Support Blades

Part Number	Dimensions (inches)
511296	2.000
511297	2.250
511292	2.500
511298	3.000



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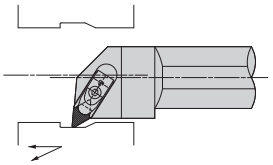
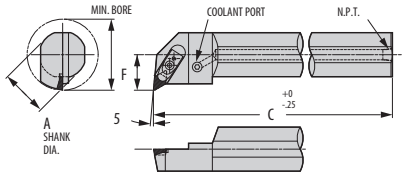
Profiling Bar

Double-Ended 55° Diamond





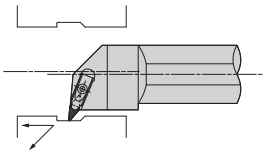
Right-Hand Profiling Bar Shown

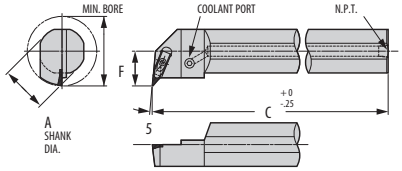
Part Number		Gage	Min. Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit
Right	Left	Insert		A	C	F	Back-Up Plate	Plate Screw	Clamp	Clamp Screw	Includes all Standard Components
518560-32-5 5VR	518561-32-55VL	DPGN-443V	2-3/4	2.000	16.000	1.500	418101	#6-32 x 3/8 S.H.C.S.	418100	1/4-20 x 1 S.H.C.S.	TK-00754
518562-40-55VR	518563-40-55VL	DPGN-443V	3-1/4	2.500	16.000	2.000	418101	#6-32 x 3/8 S.H.C.S.	418100	1/4-20 x 1 S.H.C.S.	TK-00754

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the support blade profiling bar.*

Profiling Bar

Double-Ended 35° Diamond





Right-Hand Profiling Bar Shown

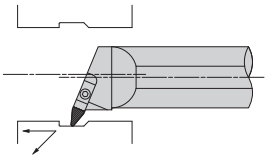
Part Number		Gage	Min. Bore	Dimensions (inches)			Standard Components				*Tune-Up Kit
Right	Left	Insert		A	C	F	Back-Up Plate	Plate Screw	Clamp	Clamp Screw	Includes all Standard Components
518554-24-35VR	518555-24-35VL	VCGN-2.532V	2	1.500	14.000	1.000	418525	#4-40 x 1/4 S.H.C.S.	418524	#10-32 x 3/4 S.H.C.S.	TK-00756
518556-32-35VR	518557-32-35VL	VCGN-2.532V	2-3/4	2.000	16.000	1.500	418525	#4-40 x 1/4 S.H.C.S.	418524	#10-32 x 3/4 S.H.C.S.	TK-00756
518558-40-35VR	518559-40-35VL	VCGN-2.532V	3-1/4	2.500	16.000	2.000	418525	#4-40 x 1/4 S.H.C.S.	418524	#10-32 x 3/4 S.H.C.S.	TK-00756

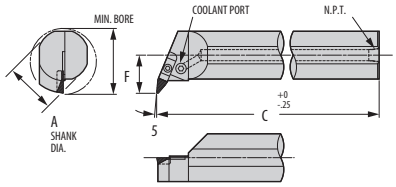
NOTE: See page GP 18 for inserts

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the support blade profiling bar.*

Profiling Bar

Single-Ended 35° Diamond





Right-Hand Profiling Bar Shown

Part Number		Gage		Dimensions (inches)			Standard Components		*Tune-Up Kit
Right	Left	Insert	Min. Bore	A	C	F	Clamp	Clamp Screw	Includes all Standard Components
511339-B244VR	**511340-B244VL**	VPG-33.543V	2	1.500	14.000	1.000	3386	#10-32 x 5/8 S.H.C.S.	TK-00578
511343-B324VR	**511344-B324VL**	VPG-33.543V	2-3/4	2.000	16.000	1.500	3386	#10-32 x 5/8 S.H.C.S.	TK-00578
511347-B404VR	**511348-B404VL**	VPG-33.543V	3-1/4	2.500	16.000	2.000	3386	#10-32 x 5/8 S.H.C.S.	TK-00578

NOTE: See page GP 18 for inserts

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the support blade profiling bar.*

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Grooving, Profiling and Cut-Off Support Blades

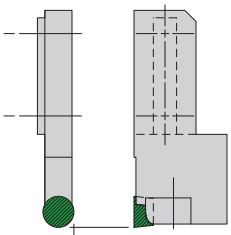
The Greenleaf tooling system for grooving, profiling, and cut-off is complemented by a support blade system that combines qualified shanks and support blades to expand the application range of each toolholder or bar. Greenleaf tools can be coupled with 248 support blades holding cut-off, V-bottom round profilers, and grooving inserts to meet your every need.

Quick-change shanks such as CAPTO or KM, as well as straight shank holders and bars, are all part of this tooling system. Custom solutions for particular features not addressable with standard tools can be readily designed with your input and Greenleaf's extensive experience.

Greenleaf Tune-Up Kits

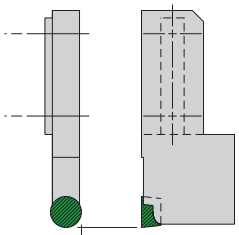
A Tune-Up Kit consists of all the standard hardware to refurbish a particular toolholder, boring bar, or milling cutter. A toolholder will have a readily visible, laser-inscribed Tune-Up Kit number on it for ease in ordering. This number will prevent any confusion created by searching a catalog for hardware, and it will help reduce downtime.

Support Blade Overview



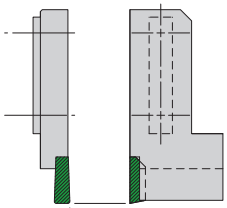
Round V-Bottom Insert with Replaceable Nest
3 sizes available using 12 insert combinations

page GP 50



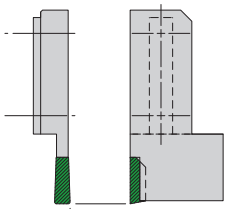
Round V-Bottom Insert with Milled Nest
3 sizes available using 18 insert combinations

page GP 50



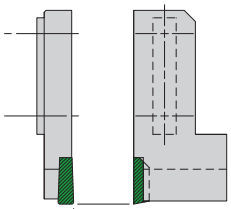
O.D. Grooving/Profiling Shallow Series
10 sizes available using 56 insert combinations

page GP 51



O.D. Grooving/Profiling Deep Series
10 sizes available using 56 insert combinations

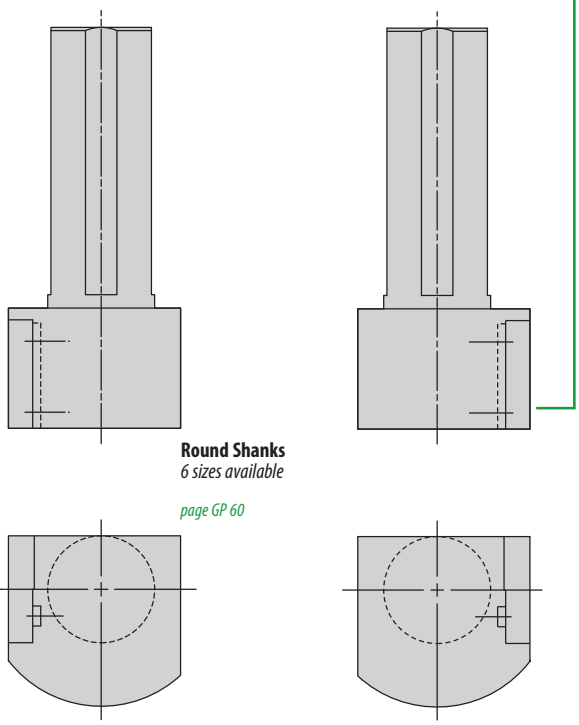
page GP 51



Face Grooving B Shallow Series
25 sizes available using 47 insert combinations

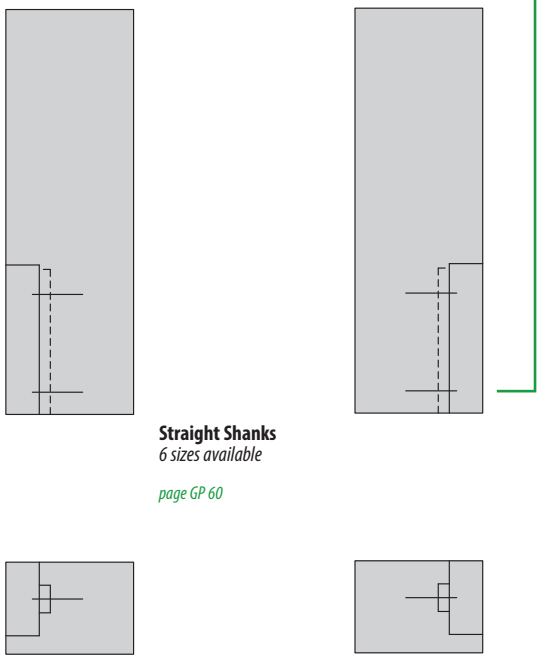
page GP 54

RIGHT HAND



Round Shanks
6 sizes available

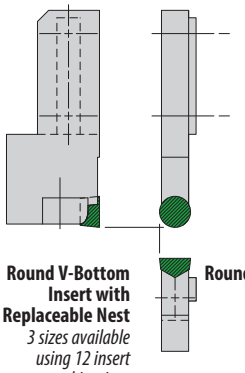
page GP 60



Straight Shanks
6 sizes available

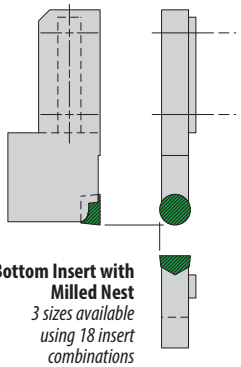
page GP 60

LEFT HAND



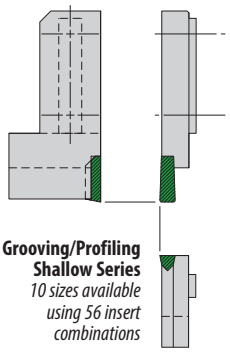
Round V-Bottom Insert with Replaceable Nest
3 sizes available using 12 insert combinations

page GP 50



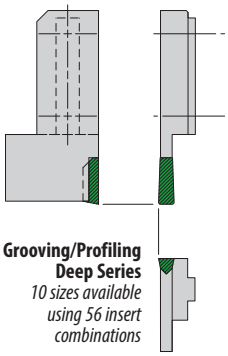
Round V-Bottom Insert with Milled Nest
3 sizes available using 18 insert combinations

page GP 50



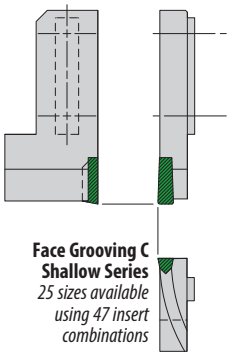
O.D. Grooving/Profiling Shallow Series
10 sizes available using 56 insert combinations

page GP 52



O.D. Grooving/Profiling Deep Series
10 sizes available using 56 insert combinations

page GP 52



Face Grooving C Shallow Series
25 sizes available using 47 insert combinations

page GP 55

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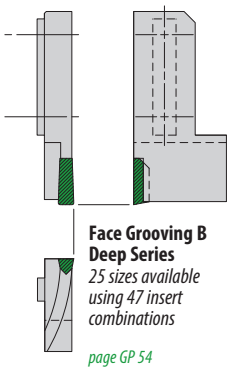
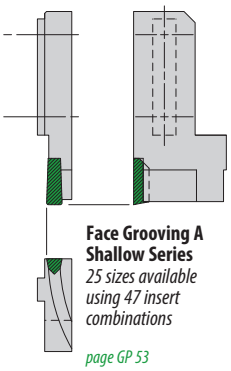


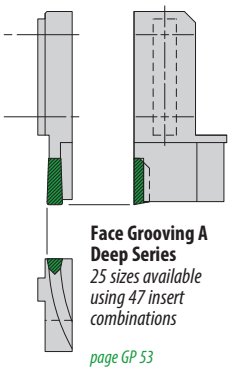
Face Grooving B Deep Series
25 sizes available using 47 insert combinations

page GP 54



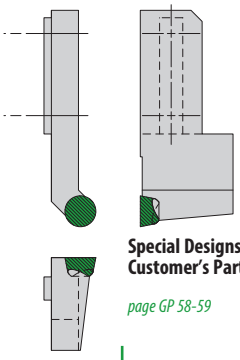
Face Grooving A Shallow Series
25 sizes available using 47 insert combinations

page GP 53



Face Grooving A Deep Series
25 sizes available using 47 insert combinations

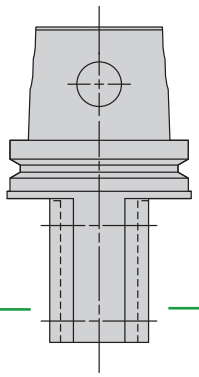
page GP 53

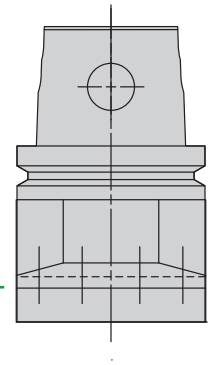


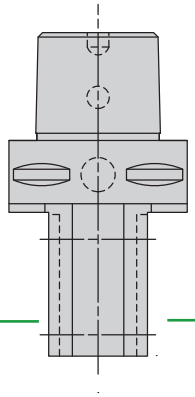
Special Designs to Fit Customer's Parts

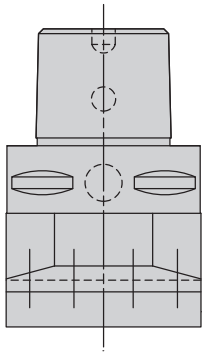
page GP 58-59

RIGHT HAND



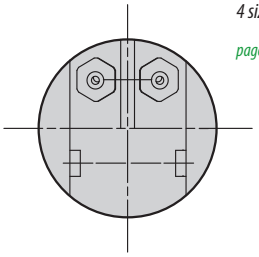


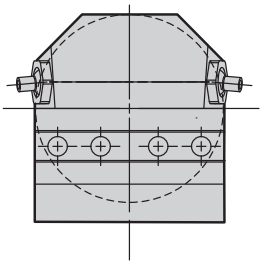




KM Tool Shanks
4 sizes available

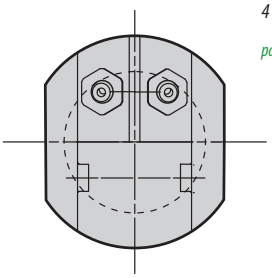
page GP 61

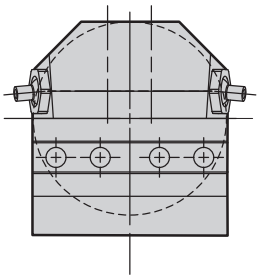




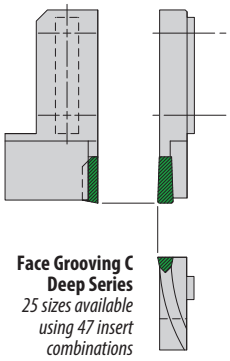
ISO 26623 Shanks
4 sizes available

page GP 61



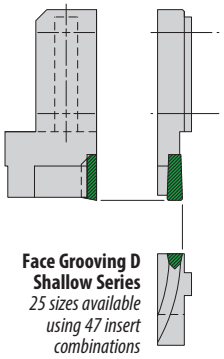


LEFT HAND



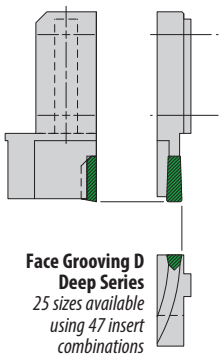
Face Grooving C Deep Series
25 sizes available using 47 insert combinations

page GP 55



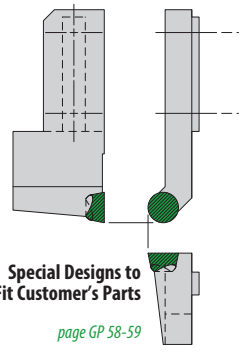
Face Grooving D Shallow Series
25 sizes available using 47 insert combinations

page GP 56



Face Grooving D Deep Series
25 sizes available using 47 insert combinations

page GP 56

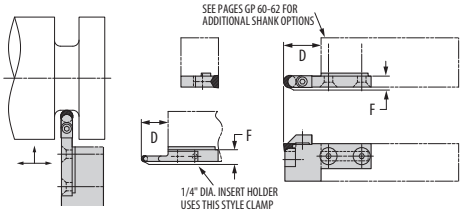


Special Designs to Fit Customer's Parts

page GP 58-59

O.D. Grooving/Profiling Support Blade

Round V-Bottom Insert Replaceable Nest



Right-Hand Support Blade Shown

Part Number		Gage	D.O.C.	Dimensions (inches)	Standard Components				*Tune-Up Kit
Right	Left	Insert	D	F	Back-Up Plate	Plate Screw	Clamp	Clamp Screw	Includes all Standard Components
411959-2VR	–	**RPGN-2V	0.750	0.469	410631	#3-48x3/8B.H.C.S.	411905-250VRC	1/4-20x1S.H.C.S.	TK-00590
–	411960-2VR	**RPGN-2V	0.750	0.469	410631	#3-48x3/8B.H.C.S.	411906-250VRC	1/4-20x1S.H.C.S.	TK-00591
411011-3VR	411012-3VR	**RPGN-3V	1.125	0.469	413970	#6-32x1/2B.H.C.S.	308063	#10-32x1/2S.H.C.S.	TK-00525
411009-4VR	411010-4VR	**RPGN-4V	1.500	0.469	414007	#10-32x5/8B.H.C.S.	308136	1/4-20x5/8S.H.C.S.	TK-00526

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the support blade.*

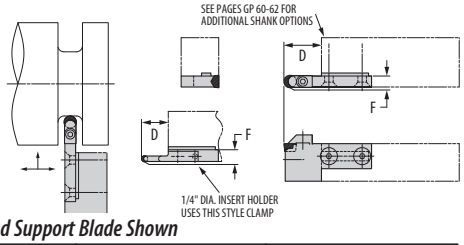
*** RCGN can be used in place of RPGN.*

See pages GP 60-62 for additional shank options.

See page GP 14 for ceramic and carbide insert.

O.D. Grooving/Profiling Support Blade

Round V-Bottom Insert Milled Nest



Right-Hand Support Blade Shown

Part Number		Gage	D.O.C.	Dimensions (inches)	Standard Components		*Tune-Up Kit	Optional Component
Right	Left	Insert	D	F	Clamp	Clamp Screw	Includes all Standard Components	Insert Screw
421534-2VMR	–	**RPGN-2V	0.750	0.469	411905-250VRC	1/4-20x1S.H.C.S.	TK-00765	PT-542T
–	421535-2VMR	**RPGN-2V	0.750	0.469	411906-250VRC	1/4-20x1S.H.C.S.	TK-00799	PT-542T
421536-3VMR	421537-3VMR	**RPGN-3V	1.125	0.469	308063	#10-32x1/2S.H.C.S.	TK-00764	PT-545T
421538-4VMR	421539-4VMR	**RPGN-4V	1.500	0.469	308136	1/4-20x3/4S.H.C.S.	TK-00763	CO-5018

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the support blade.*

*** RCGN can be used in place of RPGN.*

See pages GP 60-62 for additional shank options.

See page GP 14 for ceramic and carbide insert.

NOTE: Use carbide inserts RCGT and RPGT with optional insert screw for finishing.

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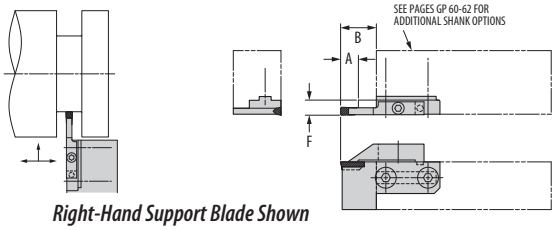
O.D. Grooving/Profiling/ Cut-Off Support Blade *Right Hand*

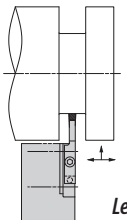


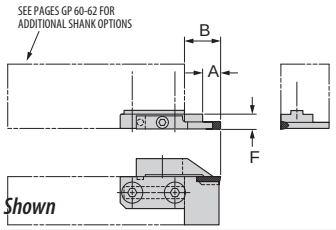
Right-Hand Support Blade Shown

Part Number		Groove Width	Dimensions (inches)			Standard Components		*Tune-Up Kit	Optional Components	
Shallow Series	Deep Series		A	B	F	Insert	Clamp	Includes all Std Components and *Clamp Screw	Insert	Clamp
427647-094VG		0.094	0.380	–	0.469	WG-4094	427651-094GC	TK-00881	COS-4094-0	429524-094GC
	427648-094VG	0.094	–	0.750	0.469	WGC-4094	427651-094GC	TK-00881	COS-4094-4L COS-4094-4R	429524-094GC
421109-125VG		0.125	0.380	–	0.469	GTS-4125-1	411966-125GC	TK-00592	GTS-4125	429512-125GC
	411988-125VG	0.125	–	0.750	0.469	GTS-4125-2 WG-4125 WGC-4125	411966-125GC	TK-00592	COS-4125-0 COS-4125-4R COS-4125-4L	429512-125GC
421110-156VG		0.156	0.380	–	0.469	WG-4156		TK-00580	–	–
	411066-156VG	0.156	–	0.750	0.469	WGC-4156	411968-156GC	TK-00580		-
421111-187VG		0.187	0.380	–	0.469	GTS-4187-1	411977-187GC	TK-00581	GTS-4187	429518-187GC
	411068-187VG	0.187	–	0.750	0.469	GTS-4187-2 WG-4187 WGC-4187	411977-187GC	TK-00581	COS-4187-0 COS-4187-4R COS-4187-4L	429518-187GC
421112-218VG		0.218	0.560	–	0.469	WG-6218	411979-218GC	TK-00582	–	–
	411081-218VG	0.218	–	1.130	0.469	WGC-6218	411979-218GC	TK-00582		-
421113-250VG		0.250	0.560	–	0.469	WG-6250	411980-250GC	TK-00617	–	–
	411992-250VG	0.250	–	1.130	0.469	WGC-6250 GTS-6250 GTS-6250-1 GTS-6250-2	411980-250GC	TK-00617		-
421114-281VG		0.281	0.560	–	0.469	WG-6281	411133-281GC	TK-00584	–	–
	411085-281VG	0.281	–	1.130	0.469	WGC-6281	411133-281GC	TK-00584		-
421115-312VG		0.312	0.750	–	0.469	WG-8312	411985-312GC	TK-00586	–	–
	411087-312VG	0.312	–	1.500	0.469	WGC-8312	411985-312GC	TK-00586		-
421116-344VG		0.344	0.750	–	0.469	WG-8344	411137-344GC	TK-00594	–	–
	411089-344VG	0.344	–	1.500	0.469	WGC-8344	411137-344GC	TK-00594		-
421117-375VG		0.375	0.750	–	0.469	WG-8375	411986-375GC	TK-00595	–	–
411994-375VG		0.375	–	1.500	0.469	WGC-8375	411986-375GC	TK-00595		

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the support blade.*
All support blades include Standard Clamp and 1/4-20 x 1 SHCS.
GTS is Greenleaf's groove/turn system insert with chip control. Page GP 09.
COS is Greenleaf's cut-off system insert. Page GP 08.
WG is Greenleaf flat-top groover with an 11° nose clearance. See pages GP 10 and GP 11.
WGC is Greenleaf's flat-top groover with a 6° nose clearance. See pages GP 12 and GP 13.
See pages GP 60-62 for additional shank options.

O.D. Grooving/Profiling/ Cut-Off Support Blade *Left Hand*





Left-Hand Support Blade Shown

Part Number			Dimensions (inches)			Standard Components		*Tune-Up Kit	Optional Components	
Shallow Series	Deep Series	Groove Width	A	B	F	Insert	Clamp	Includes all Std Components and *Clamp Screw	Insert	Clamp
427649-094VG		0.094	0.380	–	0.469	WG-4094	427652-094GC	TK-00882	COS-4094-0	429525-094GC
	427650-094VG	0.094	–	0.750	0.469	WGC-4094	427652-094GC	TK-00882	COS-4094-4L COS-4094-4R	429525-094GC
421100-125VG		0.125	0.380	–	0.469	GTS-4125-1	411967-125GC	TK-00596	GTS-4125	429513-125GC
	411989-125VG	0.125	–	0.750	0.469	GTS-4125-2 WG-4125 WGC-4125	411967-125GC	TK-00596	COS-4125-0 COS-4125-4R COS-4125-4L	429513-125GC
421101-156VG		0.156	0.380	–	0.469	WG-4156	411969-156GC	TK-00597	–	–
	411990-156VG	0.156	–	0.750	0.469	WGC-4156	411969-156GC	TK-00597		
421102-187VG		0.187	0.380	–	0.469	GTS-4187-1	411978-187GC	TK-00593	GTS-4187	429519-187GC
	411991-187VG	0.187	–	0.750	0.469	GTS-4187-2 WG-4187 WGC-4187	411978-187GC	TK-00593	COS-4187-0 COS-4187-4R COS-4187-4L	429519-187GC
421103-218VG		0.218	0.560	–	0.469	WG-6218	411130-218GC	TK-00583	–	–
	411082-218VG	0.218	–	1.130	0.469	WGC-6218	411130-218GC	TK-00583		-
421104-250VG		0.250	0.560	–	0.469	WG-6250	411981-250GC	TK-00598	–	–
	411993-250VG	0.250	–	1.130	0.469	WGC-6250 GTS-6250 GTS-6250-1 GTS-6250-2	411981-250GC	TK-00598		-
421105-281VG		0.281	0.560	–	0.469	WG-6281	411134-281GC	TK-00585	–	–
	411086-281VG	0.281	–	1.130	0.469	WGC-6281	411134-281GC	TK-00585		-
421106-312VG		0.312	0.750	–	0.469	WG-8312	411136-312GC	TK-00587	–	–
	411088-312VG	0.312	–	1.500	0.469	WGC-8312	411136-312GC	TK-00587		-
421107-344VG		0.344	0.750	–	0.469	WG-8344	411138-344GC	TK-00588	–	–
	411090-344VG	0.344	–	1.500	0.469	WGC-8344	411138-344GC	TK-00588		-
421108-375VG		0.375	0.750	–	0.469	WG-8375	411987-375GC	TK-00589	–	–
	411122-375VG	0.375	–	1.500	0.469	WGC-8375	411987-375GC	TK-00589		-

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the support blade.*
All support blades include Standard Clamp and 1/4-20 x 1 SHCS.
GTS is Greenleaf's groove/turn system insert with chip control. Page GP 09.
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WG is Greenleaf flat-top groover with an 11° nose clearance. Pages GP 10 and GP 11.
WGC is Greenleaf's flat-top groover with a 6° nose clearance. Pages GP 12 and GP 13.
See pages GP 60-62 for additional shank options.

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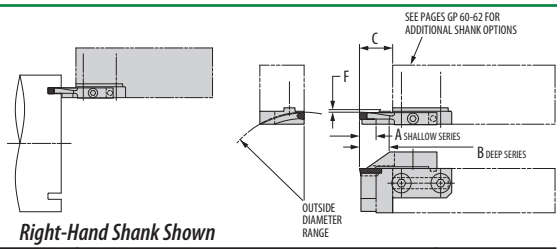
Face Grooving Support Blade A



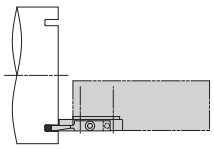
Right-Hand Shank Shown

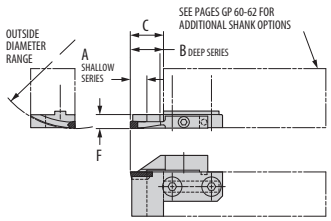
Part Number		Gage		Dimensions (inches)				Standard Components		*Tune-Up Kit
Shallow Series	Deep Series	Insert	Outside Diameter Range	A	B	C	F	Clamp	Clamp Screw	Includes all Standard Components
421218-125S-030	421243-125L-030	WG-4125	3.00 / 3.50	0.380	0.630	0.750	0.031	421323-125GC	1/4-20 x 1 S.H.C.S.	TK-00801
421219-125S-035	421244-125L-035	WG-4125	3.50 / 4.25	0.380	0.630	0.750	0.031	421323-125GC	1/4-20 x 1 S.H.C.S.	TK-00801
421220-125S-0425	421245-125L-0425	WG-4125	4.25 / 5.50	0.380	0.630	0.750	0.031	421323-125GC	1/4-20 x 1 S.H.C.S.	TK-00801
421221-125S-055	421246-125L-055	WG-4125	5.50 / 7.50	0.380	0.630	0.750	0.031	421323-125GC	1/4-20 x 1 S.H.C.S.	TK-00801
421222-125S-075	421247-125L-075	WG-4125	7.50 / 12.50	0.380	0.630	0.750	0.031	421323-125GC	1/4-20 x 1 S.H.C.S.	TK-00801
421223-125S-125	421248-125L-125	WG-4125	12.50 / 40.00	0.380	0.630	0.750	0.031	421323-125GC	1/4-20 x 1 S.H.C.S.	TK-00801
421224-187S-030	421249-187L-030	WG-4187	3.00 / 3.50	0.380	0.630	0.750	0.031	421324-187GC	1/4-20 x 1 S.H.C.S.	TK-00762
421225-187S-035	421250-187L-035	WG-4187	3.50 / 4.25	0.380	0.630	0.750	0.031	421324-187GC	1/4-20 x 1 S.H.C.S.	TK-00762
421226-187S-0425	421251-187L-0425	WG-4187	4.25 / 5.50	0.380	0.630	0.750	0.031	421324-187GC	1/4-20 x 1 S.H.C.S.	TK-00762
421227-187S-055	421252-187L-055	WG-4187	5.50 / 7.50	0.380	0.630	0.750	0.031	421324-187GC	1/4-20 x 1 S.H.C.S.	TK-00762
421228-187S-075	421253-187L-075	WG-4187	7.50 / 12.50	0.380	0.630	0.750	0.031	421324-187GC	1/4-20 x 1 S.H.C.S.	TK-00762
421229-187S-125	421254-187L-125	WG-4187	12.50 / 40.00	0.380	0.630	0.750	0.031	421324-187GC	1/4-20 x 1 S.H.C.S.	TK-00762
421230-250S-030	421255-250L-030	WG-6250	3.00 / 4.25	0.560	1.000	1.125	0.031	421325-250GC	1/4-20 x 1 S.H.C.S.	TK-00808
421231-250S-0425	421256-250L-0425	WG-6250	4.25 / 6.00	0.560	1.000	1.125	0.031	421325-250GC	1/4-20 x 1 S.H.C.S.	TK-00808
421232-250S-060	421257-250L-060	WG-6250	6.00 / 8.50	0.560	1.000	1.125	0.031	421325-250GC	1/4-20 x 1 S.H.C.S.	TK-00808
421233-250S-085	421258-250L-085	WG-6250	8.50 / 15.50	0.560	1.000	1.125	0.031	421325-250GC	1/4-20 x 1 S.H.C.S.	TK-00808
421234-250S-155	421259-250L-155	WG-6250	15.50 / 40.00	0.560	1.000	1.125	0.031	421325-250GC	1/4-20 x 1 S.H.C.S.	TK-00808
421235-312S-030	421260-312L-030	WG-8312	3.00 / 5.00	0.750	1.310	1.500	0.031	421326-312GC	1/4-20 x 1 S.H.C.S.	TK-00823
421236-312S-050	421261-312L-050	WG-8312	5.00 / 9.00	0.750	1.310	1.500	0.031	421326-312GC	1/4-20 x 1 S.H.C.S.	TK-00823
421237-312S-090	421262-312L-090	WG-8312	9.00 / 19.00	0.750	1.310	1.500	0.031	421326-312GC	1/4-20 x 1 S.H.C.S.	TK-00823
421238-312S-190	421263-312L-190	WG-8312	19.00 and up	0.750	1.310	1.500	0.031	421326-312GC	1/4-20 x 1 S.H.C.S.	TK-00823
421239-375S-030	421264-375L-030	WG-8375	3.00 / 5.00	0.750	1.310	1.500	0.031	421327-375GC	1/4-20 x 1 S.H.C.S.	TK-00839
421240-375S-050	421265-375L-050	WG-8375	5.00 / 9.00	0.750	1.310	1.500	0.031	421327-375GC	1/4-20 x 1 S.H.C.S.	TK-00839
421241-375S-090	421266-375L-090	WG-8375	9.00 / 19.00	0.750	1.310	1.500	0.031	421327-375GC	1/4-20 x 1 S.H.C.S.	TK-00839
421242-375S-190	421267-375L-190	WG-8375	19.00 and up	0.750	1.310	1.500	0.031	421327-375GC	1/4-20 x 1 S.H.C.S.	TK-00839

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the support blade.*

See pages GP 60-62 for additional shank options.
See pages GP 10 and GP 11 for inserts.

Face Grooving Support Blade B





Right-Hand Shank Shown

Part Number		Gage		Dimensions (inches)				Standard Components		*Tune-Up Kit
Shallow Series	Deep Series	Insert	Outside Diameter Range	A	B	C	F	Clamp	Clamp Screw	Includes all Standard Components
421118-125S-030	421143-125L-030	WG-4125	3.00 / 3.50	0.380	0.630	0.750	0.469	421318-125GC	1/4-20 x 1 S.H.C.S.	TK-00800
421119-125S-035	421144-125L-035	WG-4125	3.50 / 4.25	0.380	0.630	0.750	0.469	421318-125GC	1/4-20 x 1 S.H.C.S.	TK-00800
421120-125S-0425	421145-125L-0425	WG-4125	4.25 / 5.50	0.380	0.630	0.750	0.469	421318-125GC	1/4-20 x 1 S.H.C.S.	TK-00800
421121-125S-055	421146-125L-055	WG-4125	5.50 / 7.50	0.380	0.630	0.750	0.469	421318-125GC	1/4-20 x 1 S.H.C.S.	TK-00800
421122-125S-075	421147-125L-075	WG-4125	7.50 / 12.50	0.380	0.630	0.750	0.469	421318-125GC	1/4-20 x 1 S.H.C.S.	TK-00800
421123-125S-125	421148-125L-125	WG-4125	12.50 / 40.00	0.380	0.630	0.750	0.469	421318-125GC	1/4-20 x 1 S.H.C.S.	TK-00800
421124-187S-030	421149-187L-030	WG-4187	3.00 / 3.50	0.380	0.630	0.750	0.469	421319-187GC	1/4-20 x 1 S.H.C.S.	TK-00794
421125-187S-035	421150-187L-035	WG-4187	3.50 / 4.25	0.380	0.630	0.750	0.469	421319-187GC	1/4-20 x 1 S.H.C.S.	TK-00794
421126-187S-0425	421151-187L-0425	WG-4187	4.25 / 5.50	0.380	0.630	0.750	0.469	421319-187GC	1/4-20 x 1 S.H.C.S.	TK-00794
421127-187S-055	421152-187L-055	WG-4187	5.50 / 7.50	0.380	0.630	0.750	0.469	421319-187GC	1/4-20 x 1 S.H.C.S.	TK-00794
421128-187S-075	421153-187L-075	WG-4187	7.50 / 12.50	0.380	0.630	0.750	0.469	421319-187GC	1/4-20 x 1 S.H.C.S.	TK-00794
421129-187S-125	421154-187L-125	WG-4187	12.50 / 40.00	0.380	0.630	0.750	0.469	421319-187GC	1/4-20 x 1 S.H.C.S.	TK-00794
421130-250S-030	421155-250L-030	WG-6250	3.00 / 4.25	0.560	1.000	1.125	0.469	421320-250GC	1/4-20 x 1 S.H.C.S.	TK-00802
421131-250S-0425	421156-250L-0425	WG-6250	4.25 / 6.00	0.560	1.000	1.125	0.469	421320-250GC	1/4-20 x 1 S.H.C.S.	TK-00802
421132-250S-060	421157-250L-060	WG-6250	6.00 / 8.50	0.560	1.000	1.125	0.469	421320-250GC	1/4-20 x 1 S.H.C.S.	TK-00802
421133-250S-085	421158-250L-085	WG-6250	8.50 / 15.50	0.560	1.000	1.125	0.469	421320-250GC	1/4-20 x 1 S.H.C.S.	TK-00802
421134-250S-155	421159-250L-155	WG-6250	15.50 / 40.00	0.560	1.000	1.125	0.469	421320-250GC	1/4-20 x 1 S.H.C.S.	TK-00802
421135-312S-030	421160-312L-030	WG-8312	3.00 / 5.00	0.750	1.310	1.500	0.469	421321-312GC	1/4-20 x 1 S.H.C.S.	TK-00849
421136-312S-050	421161-312L-050	WG-8312	5.00 / 9.00	0.750	1.310	1.500	0.469	421321-312GC	1/4-20 x 1 S.H.C.S.	TK-00849
421137-312S-090	421162-312L-090	WG-8312	9.00 / 19.00	0.750	1.310	1.500	0.469	421321-312GC	1/4-20 x 1 S.H.C.S.	TK-00849
421138-312S-190	421163-312L-190	WG-8312	19.00 and up	0.750	1.310	1.500	0.469	421321-312GC	1/4-20 x 1 S.H.C.S.	TK-00849
421139-375S-030	421164-375L-030	WG-8375	3.00 / 5.00	0.750	1.310	1.500	0.469	421322-375GC	1/4-20 x 1 S.H.C.S.	TK-00797
421140-375S-050	421165-375L-050	WG-8375	5.00 / 9.00	0.750	1.310	1.500	0.469	421322-375GC	1/4-20 x 1 S.H.C.S.	TK-00797
421141-375S-090	421166-375L-090	WG-8375	9.00 / 19.00	0.750	1.310	1.500	0.469	421322-375GC	1/4-20 x 1 S.H.C.S.	TK-00797
421142-375S-190	421167-375L-190	WG-8375	19.00 and up	0.750	1.310	1.500	0.469	421322-375GC	1/4-20 x 1 S.H.C.S.	TK-00797

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the support blade.*

See pages GP 60-62 for additional shank options.
See pages GP 10 and GP 11 for inserts.

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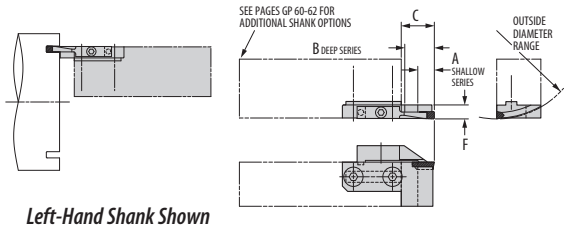
Face Grooving Support Blade C



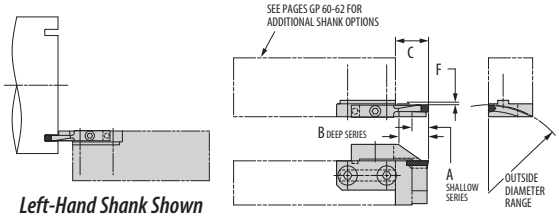
Left-Hand Shank Shown

Part Number		Gage		Dimensions (inches)				Standard Components		*Tune-Up Kit
Shallow Series	Deep Series	Insert	Outside Diameter Range	A	B	C	F	Clamp	Clamp Screw	Includes all Standard Components
421168-125S-030	421193-125L-030	WG-4125	3.00 / 3.50	0.380	0.630	0.750	0.469	421323-125GC	1/4-20 x 1 S.H.C.S.	TK-00801
421169-125S-035	421194-125L-035	WG-4125	3.50 / 4.25	0.380	0.630	0.750	0.469	421323-125GC	1/4-20 x 1 S.H.C.S.	TK-00801
421170-125S-0425	421195-125L-0425	WG-4125	4.25 / 5.50	0.380	0.630	0.750	0.469	421323-125GC	1/4-20 x 1 S.H.C.S.	TK-00801
421171-125S-055	421196-125L-055	WG-4125	5.50 / 7.50	0.380	0.630	0.750	0.469	421323-125GC	1/4-20 x 1 S.H.C.S.	TK-00801
421172-125S-075	421197-125L-075	WG-4125	7.50 / 12.50	0.380	0.630	0.750	0.469	421323-125GC	1/4-20 x 1 S.H.C.S.	TK-00801
421173-125S-125	421198-125L-125	WG-4125	12.50 / 40.00	0.380	0.630	0.750	0.469	421323-125GC	1/4-20 x 1 S.H.C.S.	TK-00801
421174-187S-030	421199-187L-030	WG-4187	3.00 / 3.50	0.380	0.630	0.750	0.469	421324-187GC	1/4-20 x 1 S.H.C.S.	TK-00762
421175-187S-035	421200-187L-035	WG-4187	3.50 / 4.25	0.380	0.630	0.750	0.469	421324-187GC	1/4-20 x 1 S.H.C.S.	TK-00762
421176-187S-0425	421201-187L-0425	WG-4187	4.25 / 5.50	0.380	0.630	0.750	0.469	421324-187GC	1/4-20 x 1 S.H.C.S.	TK-00762
421177-187S-055	421202-187L-055	WG-4187	5.50 / 7.50	0.380	0.630	0.750	0.469	421324-187GC	1/4-20 x 1 S.H.C.S.	TK-00762
421178-187S-075	421203-187L-075	WG-4187	7.50 / 12.50	0.380	0.630	0.750	0.469	421324-187GC	1/4-20 x 1 S.H.C.S.	TK-00762
421179-187S-125	421204-187L-125	WG-4187	12.50 / 40.00	0.380	0.630	0.750	0.469	421324-187GC	1/4-20 x 1 S.H.C.S.	TK-00762
421180-250S-030	421205-250L-030	WG-6250	3.00 / 4.25	0.560	1.000	1.125	0.469	421325-250GC	1/4-20 x 1 S.H.C.S.	TK-00808
421181-250S-0425	421206-250L-0425	WG-6250	4.25 / 6.00	0.560	1.000	1.125	0.469	421325-250GC	1/4-20 x 1 S.H.C.S.	TK-00808
421182-250S-060	421207-250L-060	WG-6250	6.00 / 8.50	0.560	1.000	1.125	0.469	421325-250GC	1/4-20 x 1 S.H.C.S.	TK-00808
421183-250S-085	421208-250L-085	WG-6250	8.50 / 15.50	0.560	1.000	1.125	0.469	421325-250GC	1/4-20 x 1 S.H.C.S.	TK-00808
421184-250S-155	421209-250L-155	WG-6250	15.50 / 40.00	0.560	1.000	1.125	0.469	421325-250GC	1/4-20 x 1 S.H.C.S.	TK-00808
421185-312S-030	421210-312L-030	WG-8312	3.00 / 5.00	0.750	1.310	1.500	0.469	421326-312GC	1/4-20 x 1 S.H.C.S.	TK-00823
421186-312S-050	421211-312L-050	WG-8312	5.00 / 9.00	0.750	1.310	1.500	0.469	421326-312GC	1/4-20 x 1 S.H.C.S.	TK-00823
421187-312S-090	421212-312L-090	WG-8312	9.00 / 19.00	0.750	1.310	1.500	0.469	421326-312GC	1/4-20 x 1 S.H.C.S.	TK-00823
421188-312S-190	421213-312L-190	WG-8312	19.00 and up	0.750	1.310	1.500	0.469	421326-312GC	1/4-20 x 1 S.H.C.S.	TK-00823
421189-375S-030	421214-375L-030	WG-8375	3.00 / 5.00	0.750	1.310	1.500	0.469	421327-375GC	1/4-20 x 1 S.H.C.S.	TK-00839
421190-375S-050	421215-375L-050	WG-8375	5.00 / 9.00	0.750	1.310	1.500	0.469	421327-375GC	1/4-20 x 1 S.H.C.S.	TK-00839
421191-375S-090	421216-375L-090	WG-8375	9.00 / 19.00	0.750	1.310	1.500	0.469	421327-375GC	1/4-20 x 1 S.H.C.S.	TK-00839
421192-375S-190	421217-375L-190	WG-8375	19.00 and up	0.750	1.310	1.500	0.469	421327-375GC	1/4-20 x 1 S.H.C.S.	TK-00839

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the support blade.*

See pages GP 60-62 for additional shank options.
See pages GP 10 and GP 11 for inserts.

Face Grooving Support Blade D



Left-Hand Shank Shown

Part Number		Gage		Dimensions (inches)				Standard Components		*Tune-Up Kit
Shallow Series	Deep Series	Insert	Outside Diameter Range	A	B	C	F	Clamp	Clamp Screw	Includes all Standard Components
421268-125S-030	**421293-125L-030**	WG-4125	3.00 / 3.50	0.380	0.630	0.750	0.031	421318-125GC	1/4-20 x 1 S.H.C.S.	TK-00800
421269-125S-035	**421294-125L-035**	WG-4125	3.50 / 4.25	0.380	0.630	0.750	0.031	421318-125GC	1/4-20 x 1 S.H.C.S.	TK-00800
421270-125S-0425	**421295-125L-0425**	WG-4125	4.25 / 5.50	0.380	0.630	0.750	0.031	421318-125GC	1/4-20 x 1 S.H.C.S.	TK-00800
421271-125S-055	**421296-125L-055**	WG-4125	5.50 / 7.50	0.380	0.630	0.750	0.031	421318-125GC	1/4-20 x 1 S.H.C.S.	TK-00800
421272-125S-075	**421297-125L-075**	WG-4125	7.50 / 12.50	0.380	0.630	0.750	0.031	421318-125GC	1/4-20 x 1 S.H.C.S.	TK-00800
421273-125S-125	**421298-125L-125**	WG-4125	12.50 / 40.00	0.380	0.630	0.750	0.031	421318-125GC	1/4-20 x 1 S.H.C.S.	TK-00800
421274-187S-030	**421299-187L-030**	WG-4187	3.00 / 3.50	0.380	0.630	0.750	0.031	421319-187GC	1/4-20 x 1 S.H.C.S.	TK-00794
421275-187S-035	**421300-187L-035**	WG-4187	3.50 / 4.25	0.380	0.630	0.750	0.031	421319-187GC	1/4-20 x 1 S.H.C.S.	TK-00794
421276-187S-0425	**421301-187L-0425**	WG-4187	4.25 / 5.50	0.380	0.630	0.750	0.031	421319-187GC	1/4-20 x 1 S.H.C.S.	TK-00794
421277-187S-055	**421302-187L-055**	WG-4187	5.50 / 7.50	0.380	0.630	0.750	0.031	421319-187GC	1/4-20 x 1 S.H.C.S.	TK-00794
421278-187S-075	**421303-187L-075**	WG-4187	7.50 / 12.50	0.380	0.630	0.750	0.031	421319-187GC	1/4-20 x 1 S.H.C.S.	TK-00794
421279-187S-125	**421304-187L-125**	WG-4187	12.50 / 40.00	0.380	0.630	0.750	0.031	421319-187GC	1/4-20 x 1 S.H.C.S.	TK-00794
421280-250S-030	**421305-250L-030**	WG-6250	3.00 / 4.25	0.560	1.000	1.125	0.031	421320-250GC	1/4-20 x 1 S.H.C.S.	TK-00802
421281-250S-0425	**421306-250L-0425**	WG-6250	4.25 / 6.00	0.560	1.000	1.125	0.031	421320-250GC	1/4-20 x 1 S.H.C.S.	TK-00802
421282-250S-060	**421307-250L-060**	WG-6250	6.00 / 8.50	0.560	1.000	1.125	0.031	421320-250GC	1/4-20 x 1 S.H.C.S.	TK-00802
421283-250S-085	**421308-250L-085**	WG-6250	8.50 / 15.50	0.560	1.000	1.125	0.031	421320-250GC	1/4-20 x 1 S.H.C.S.	TK-00802
421284-250S-155	**421309-250L-155**	WG-6250	15.50 / 40.00	0.560	1.000	1.125	0.031	421320-250GC	1/4-20 x 1 S.H.C.S.	TK-00802
421285-312S-030	**421310-312L-030**	WG-8312	3.00 / 5.00	0.750	1.310	1.500	0.031	421321-312GC	1/4-20 x 1 S.H.C.S.	TK-00849
421286-312S-050	**421311-312L-050**	WG-8312	5.00 / 9.00	0.750	1.310	1.500	0.031	421321-312GC	1/4-20 x 1 S.H.C.S.	TK-00849
421287-312S-090	**421312-312L-090**	WG-8312	9.00 / 19.00	0.750	1.310	1.500	0.031	421321-312GC	1/4-20 x 1 S.H.C.S.	TK-00849
421288-312S-190	**421313-312L-190**	WG-8312	19.00 and up	0.750	1.310	1.500	0.031	421321-312GC	1/4-20 x 1 S.H.C.S.	TK-00849
421289-375S-030	**421314-375L-030**	WG-8375	3.00 / 5.00	0.750	1.310	1.500	0.031	421322-375GC	1/4-20 x 1 S.H.C.S.	TK-00797
421290-375S-050	**421315-375L-050**	WG-8375	5.00 / 9.00	0.750	1.310	1.500	0.031	421322-375GC	1/4-20 x 1 S.H.C.S.	TK-00797
421291-375S-090	**421316-375L-090**	WG-8375	9.00 / 19.00	0.750	1.310	1.500	0.031	421322-375GC	1/4-20 x 1 S.H.C.S.	TK-00797
421292-375S-190	**421317-375L-190**	WG-8375	19.00 and up	0.750	1.310	1.500	0.031	421322-375GC	1/4-20 x 1 S.H.C.S.	TK-00797

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the support blade.*

See pages GP 60-62 for additional shank options.
See pages GP 10 and GP 11 for inserts.

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Notes:

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Technical Data

Face Grooving Tools - Ordering Instructions

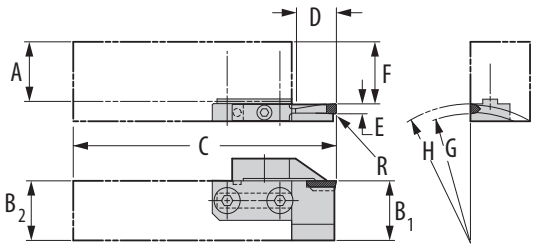
Face grooving tools must be matched to a specific radius and are, therefore, manufactured to order for your particular application.

We offer tools either with integral support blades (SFG) or with separate replaceable blades (AFG). Four combinations are available relative to hand of tool and hand of radius.

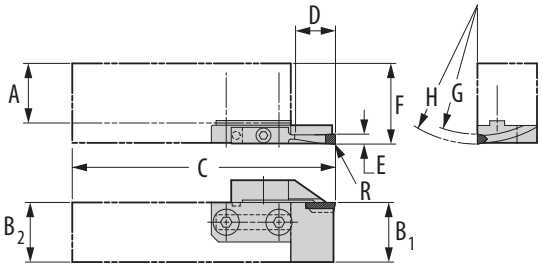
When ordering replaceable blade styles, we suggest the purchase of additional back-up blades at time of original order.

For your convenience in ordering or request for quotation, we have published sample blank engineering data forms. You must provide ALL of the dimensional data listed to ensure the correct tool being manufactured.

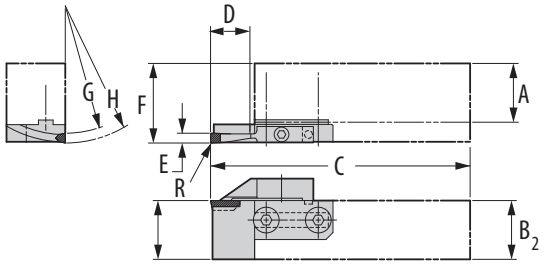
Note: *Tools will be quoted either with radius relieved blades or angular relieved blades, according to groove diameter. Radius relieved blades are illustrated.*



AFGVLL



AFGVLR



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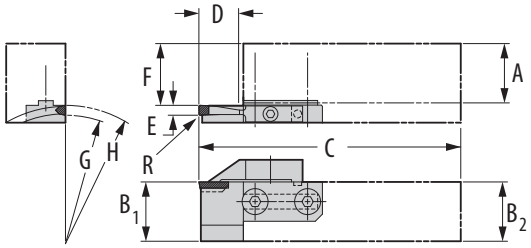

AFGVRR

AFGV_ _	A	C	F
Drawing #	B_1	D (depth of cut)	G (radius)
R (radius)	B_2	E	H (radius)

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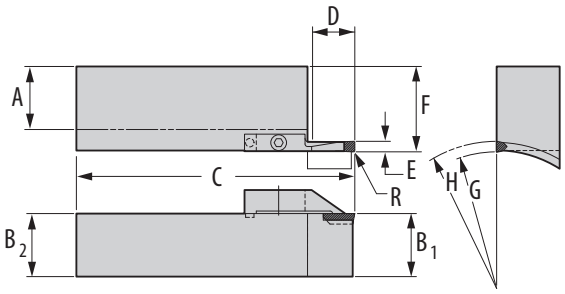
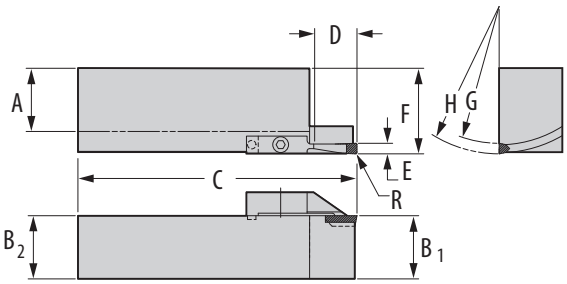


SFGVLL



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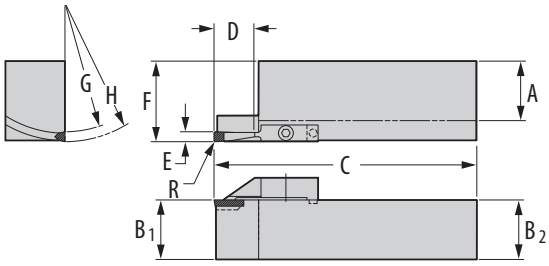
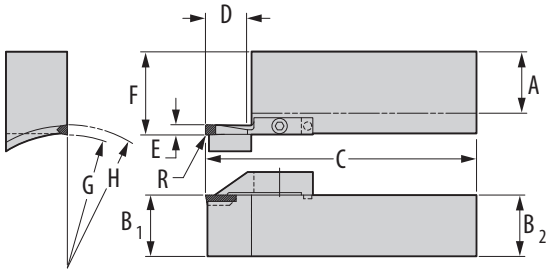


SFGVRL

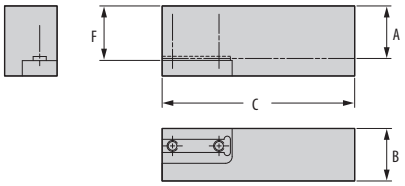


SFGVRR

SFGV_ _	A	C	F
Drawing #	B_1	D (depth of cut)	G (radius)
R (radius)	B_2	E	H (radius)

Straight Shank Holder

For Support Blades

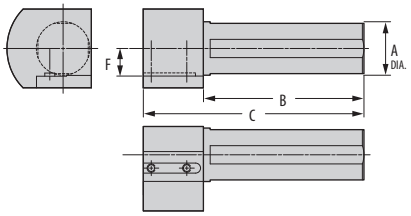


Part Number		Dimensions (inches)				Standard Components	*Tune-Up Kit
Right	Left	A	B	C	F	Mounting Screw	Includes all Standard Components
411055	**411056**	1.000	1.000	4.500	1.031	5/16-18 x 1 F.H.C.S.	TK-00579
411059	**411449**	1.250	1.250	5.500	1.281	5/16-18 x 1 F.H.C.S.	TK-00579
411015	**411016**	1.500	1.500	7.500	1.531	5/16-18 x 1 F.H.C.S.	TK-00579

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

Round Shank Holder

For Support Blades



Part Number		Dimensions (inches)				Standard Components	*Tune-Up Kit
Right	Left	A	B	C	F	Mounting Screw	Includes all Standard Components
519600	**519601**	1.500	6.000	8.250	1.031	5/16-18 X 1 F.H.C.S.	TK-00579
519602	**519603**	2.000	6.000	8.250	1.281	5/16-18 X 1 F.H.C.S.	TK-00579
519604	**519605**	2.500	6.000	8.250	1.531	5/16-18 X 1 F.H.C.S.	TK-00579

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

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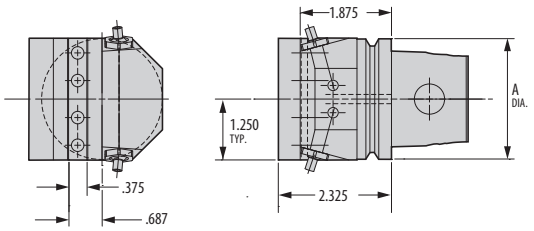
KM Shank
Face Mount



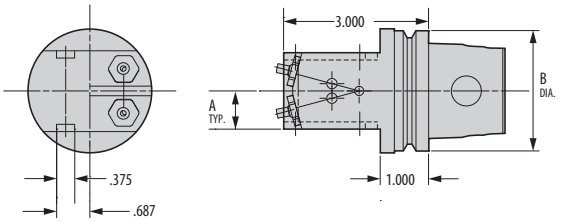
Part Number	Dimensions (inches)	Standard Components	*Tune-Up Kit
Face Mount †	A	Mounting Screw	Includes all Standard Components
SBH-KM50-F	1.969	5/16-18 X 1 F.H.C.S.	TK-00579
SBH-KM63-F	2.480	5/16-18 X 1 F.H.C.S.	TK-00579

High-pressure coolant – 1,500 PSI Max (100 bar)

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

† These tools based on KM63UT shank.

KM Shank
Side Mount



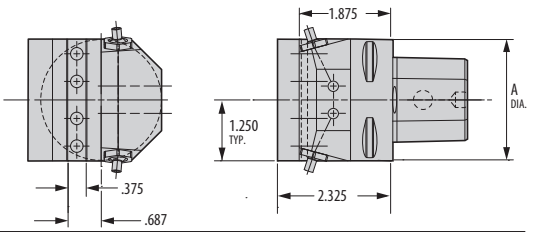
Part Number	Dimensions (inches)		Standard Components	*Tune-Up Kit
Face Mount †	A	B	Mounting Screw	Includes all Standard Components
SBH-KM50-S	0.687	1.969	5/16-18 X 1 F.H.C.S.	TK-00579
SBH-KM63-S	0.790	2.480	5/16-18 X 1 F.H.C.S.	TK-00579

High-pressure coolant – 1,500 PSI Max (100 bar)

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

† These tools based on KM63UT shank.

ISO 26623 Shank
Face Mount

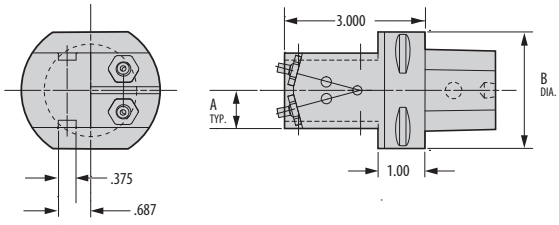


Part Number	Dimensions (inches)	Standard Components	*Tune-Up Kit
Face Mount	A	Mounting Screw	Includes all Standard Components
SBH-C5-F	1.969	5/16-18 X 1 F.H.C.S.	TK-00579
SBH-C6-F	2.480	5/16-18 X 1 F.H.C.S	TK-00579

High-pressure coolant – 1,500 PSI Max (100 bar)

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

ISO 26623 Shank
Side Mount



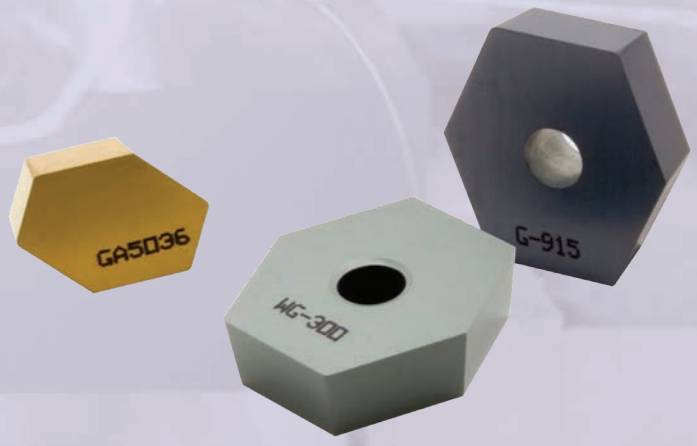
Part Number	Dimensions (inches)		Standard Components	*Tune-Up Kit
Face Mount	A	B	Mounting Screw	Includes all Standard Components
SBH-C5-S	0.687	1.969	5/16-18 X 1 F.H.C.S.	TK-00579
SBH-C6-S	0.790	2.480	5/16-18 X 1 F.H.C.S.	TK-00579

High-pressure coolant – 1,500 PSI Max (100 bar)

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*


RINGMAX™
434608
435966
RING MAX™ GRM-GC-BX-150

API Ring Groove



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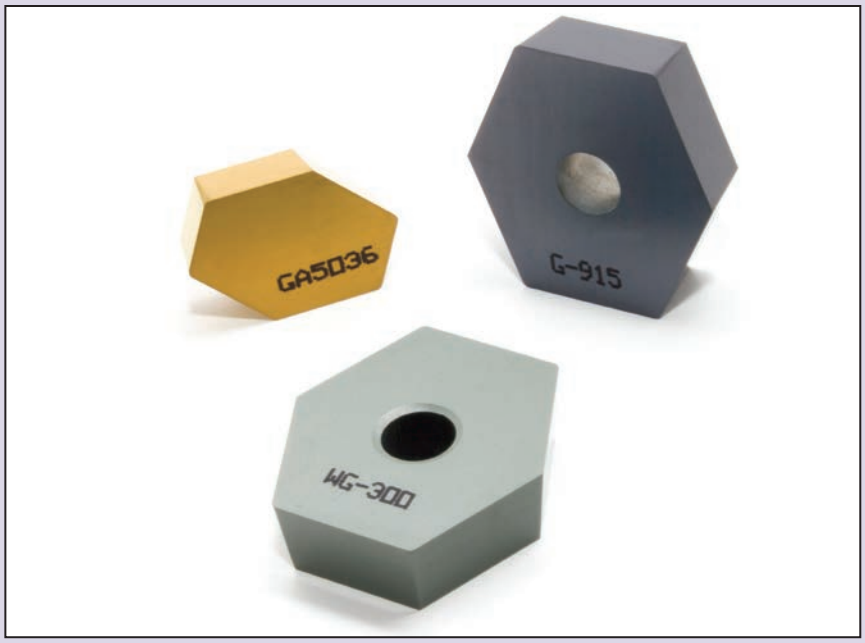
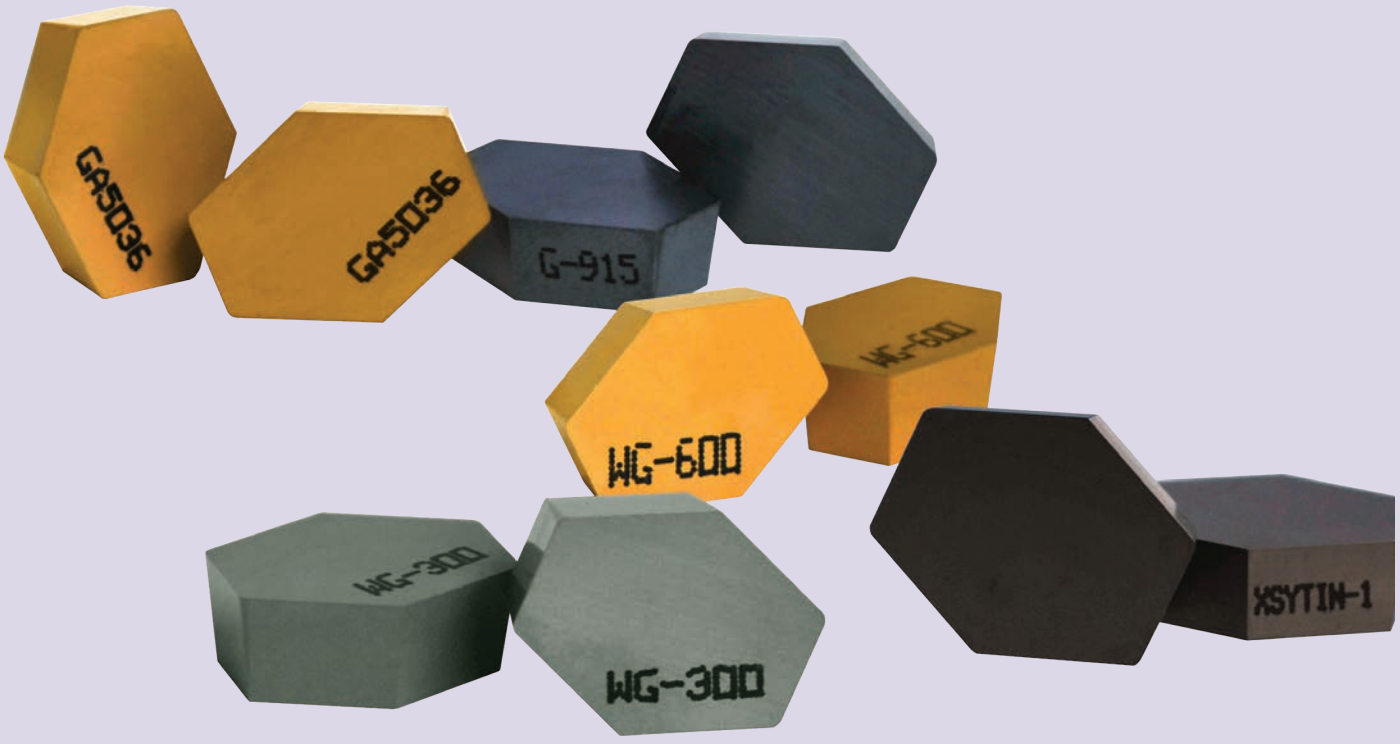
Ring Max™ Grooving Inserts

Greenleaf's Ring Max Grooving Inserts are a unique solution for machining API ring grooves and provide the capability of roughing and finishing in various materials. These inserts are specifically designed for use in Ring Max and will significantly increase productivity and savings.

Please contact Greenleaf Corporation for any questions or assistance.





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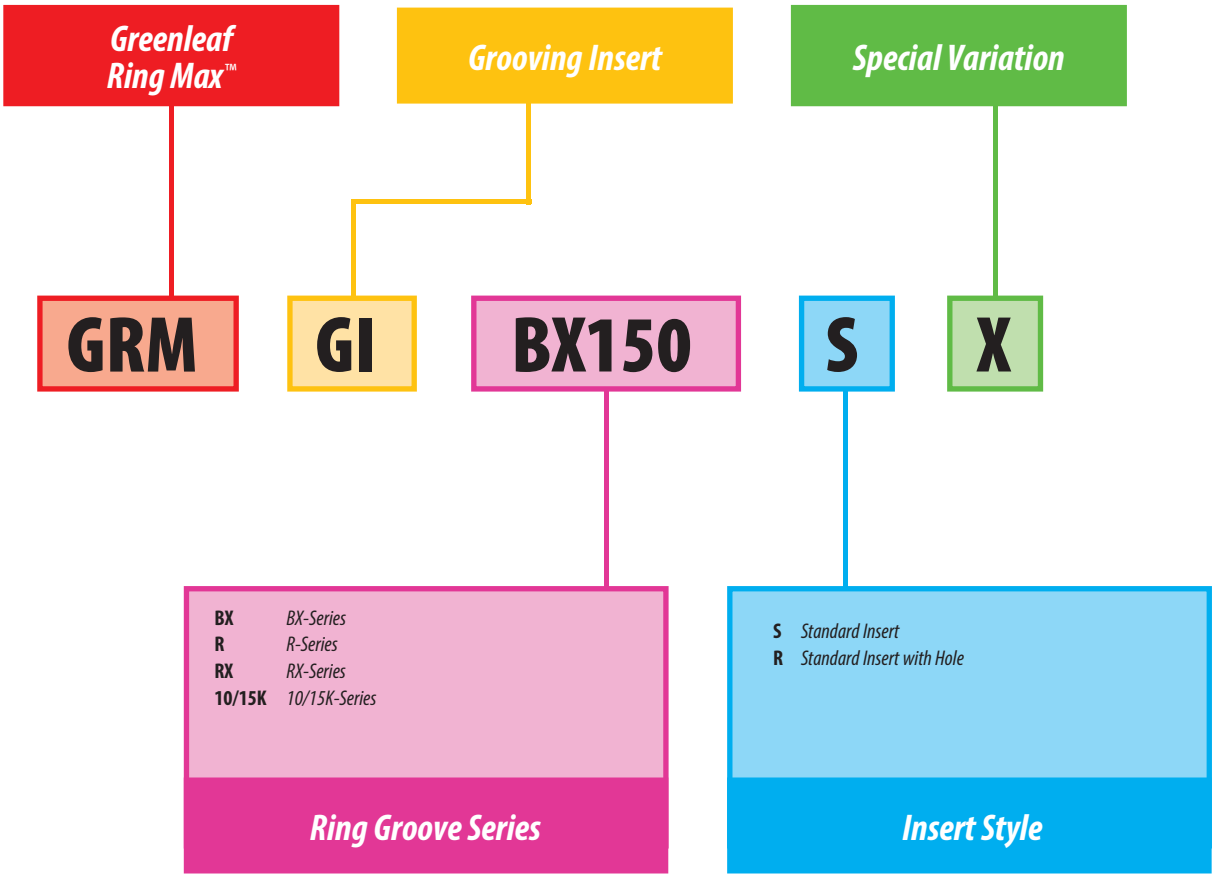
Ring Max™

Grooving Insert Identification System



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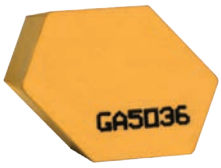
Insert Grades

Carbide



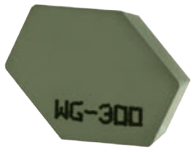
GA5036

A carbide grade that is best combined with the Ring Max for use in cast-steel applications, GA5036 has an advanced MT-CVD coating that promotes long tool life at high speeds.

G-915

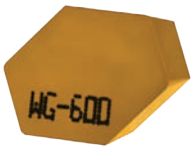
Greenleaf's most versatile grade for machining API ring grooves, G-915 can easily machine most materials and works well on machines with low RPMs.

Ceramic



WG-300®

A whisker-reinforced Al_2O_3 ceramic that is very effective at machining high-temp alloy ring grooves, WG-300® offers increased removal rates up to 10 times higher than carbide.



WG-600®

A coated whisker-reinforced Al_2O_3 ceramic that offers longer tool life and better performance over uncoated ceramics due to excellent thermal and wear resistance at very high surface speeds.

XSYTIN®-1

A phase-toughened ceramic for your most demanding applications, XSYTIN®-1 can run at lower RPMs and higher feed rates than any other ceramic grade and should be considered a first choice when machining rough weld overlay for API ring grooves.

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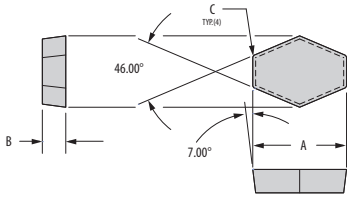
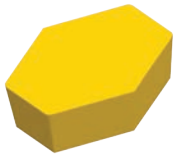
Ring Max™ Inserts

GRM-GI



Insert	Part Number	Steel		Stainless Steel		Heat-Resistant Super Alloys				Dimensions (inches)		
		P		M		S						
		G-915	GA5036	WG-300	G-915	WG-300	WG-600	XSYLIN-1	G-915	A	B	C
	GRM-GI-BX150S	●	▲	◆	◆	●	◆	▲	▲	0.625	0.250	0.031
	GRM-GI-BX151S	●	▲	◆	◆	●	◆	▲	▲	0.625	0.250	0.031
	GRM-GI-BX152S	●	▲	◆	◆	●	◆	▲	▲	0.750	0.250	0.031
	GRM-GI-BX153S	●	▲	◆	◆	●	◆	▲	▲	0.750	0.250	0.031
	GRM-GI-BX154S	●	▲	◆	◆	●	◆	▲	▲	0.750	0.250	0.031
	GRM-GI-BX155R	●	▲	◆	◆	●	◆	▲	▲	0.875	0.250	0.031
	GRM-GI-BX156R	●	▲	◆	◆	●	◆	▲	▲	1.013	0.312	0.031
	GRM-GI-BX169R	●	▲	◆	◆	●	◆	▲	▲	1.000	0.250	0.031
	GRM-GI-RSET1-SX*	●	▲	◆	◆	●	◆	▲	▲	1.000	0.250	0.031
	GRM-GI-R46R	●	▲	◆	◆	●	◆	▲	▲	1.000	0.250	0.060
	GRM-GI-RSET2-SX*	●	▲	◆	◆	●	◆	▲	▲	0.625	0.156	0.031
	GRM-GI-RX201/5SX*	●	▲	◆	◆	●	◆	▲	▲	0.604	0.188	0.015
	GRM-GI-10K/15KSX*	●	▲	◆	◆	●	◆	▲	▲	0.625	0.250	0.030

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages RM 05

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

** Denotes multiple groove sizes (See chart to below)*

NOTE: Depending on groove size, some Ring Max™ inserts may have a hole. All pre-clad groove inserts are designed and built to suit customer specifications.

NOTE: API groove specification GA/ISO-10423 is used for all finish inserts.

Group	Groove Size
R-SET1SX	R-21, R-23, R-24, R-26, R-27, R-30, R-31, R-34, R-35,R-37, R-39, R-41, R-44, R-45, R-49, R-53, R-57, R-61,R-65, R-69, R-82, R-84, R-99
R-SET2SX	R-12, R-13, R-14, R-15, R-16, R-17, R-18, R-19, R-20, R-22, R-25, R-29, R-33, R-36, R-40, R-43, R-48, R-52
10K/15KSX	10K-2 1/16", 10K-3 1/16", 15K-3 1/16"

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Ring Max™ II Ring Groove Tooling

The Ring Max™ II cutters are designed to use fewer components for even greater dimensional accuracy and repeatability from groove to groove. Their unique design ensures accurate seating and secure locking of the insert cartridge into the cutter body.

Standard features and benefits include:

- Cutting of BX, R, and RX API ring grooves in Inconel 625 clad overlay in less than one minute!
- Machines the groove and chamfers in one operation.
- Adjustable and replaceable cartridge design for easy maintenance.

Please contact Greenleaf Corporation for any questions or assistance.

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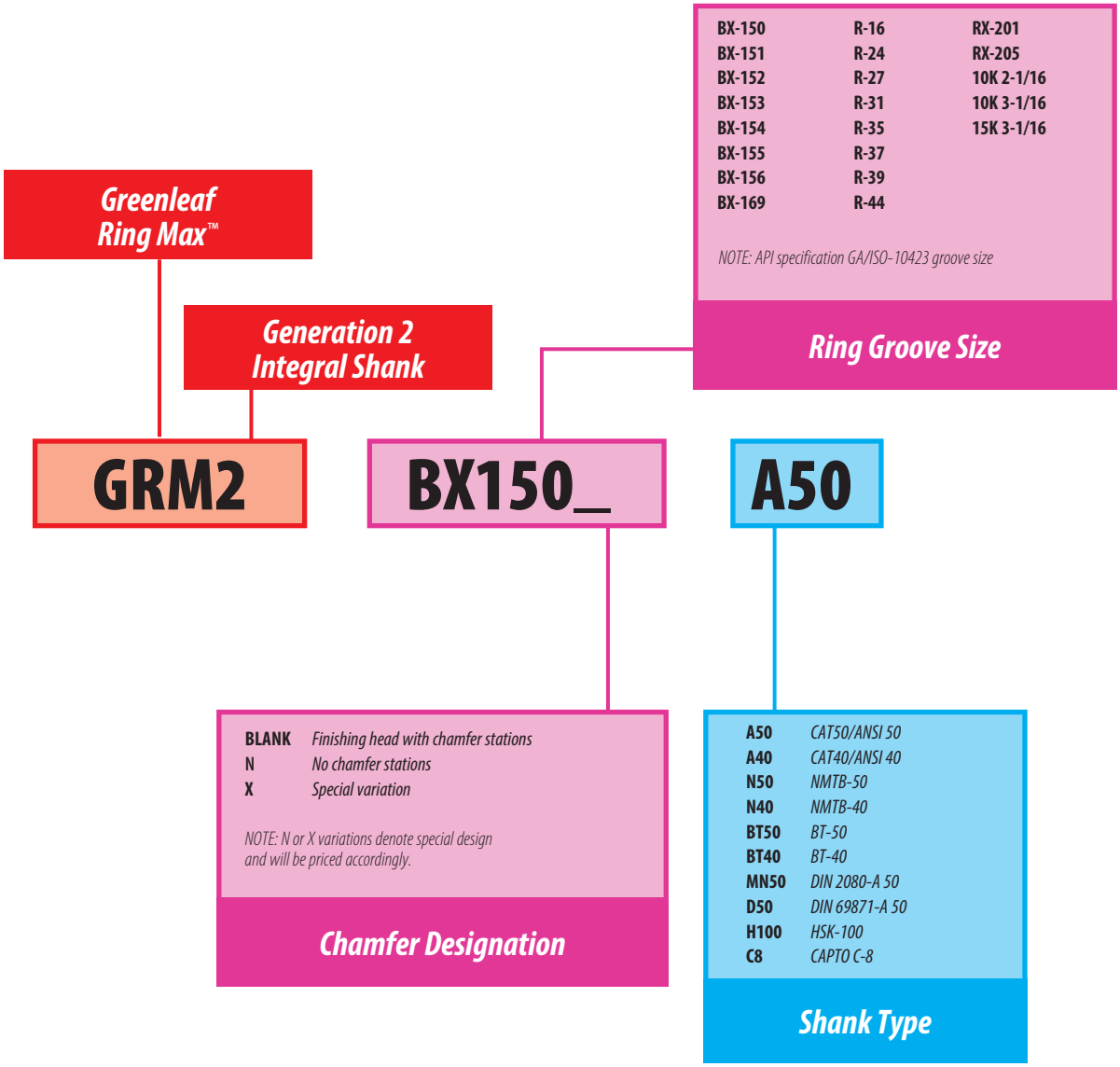
Ring Max™ II

Finishing Head Identification System



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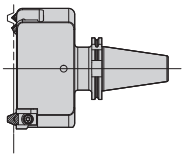
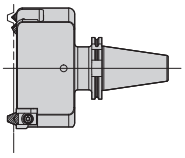
Pictorial & Reference Index

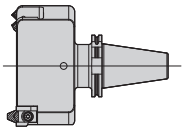
Ring Max™ II Tooling



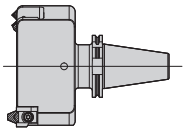
BX Series
page: RM 10



R Series
page: RM 11



RX Series
page: RM 12



10K and 15K Series
page: RM 12

Reference

Ring Max™ II
Models
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Ring Max™ II Pre-Clad
Models
page: RM 14

Machining Methods
Reference Guide
page: RM 30

Special Toolchanger Clearance
Request Form
page: RM 31

Pre-Clad Head
Quote Request Form
page: RM 31

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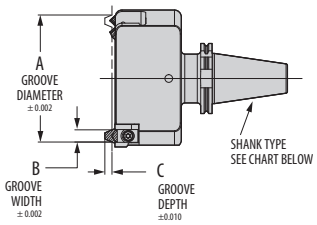
Ring Max™ II

BX Series



Part Number		Dimensions (inches)			Standard Components		Inserts	
Groove Series - Shank Type*	Stock	A	B	C	Grooving Cartidge	Chamfer Cartidge	Grooving Insert	Chamfer Insert
GRM2-BX150-_ _ _ _	See chart below for stocked sizes.	2.895	0.452	0.230	GRM-GC-BX-150	GRMCC01	GRM-GI-BX150S	SPGN-322
GRM2-BX151-_ _ _ _		3.064	0.468	0.230	GRM-GC-BX-151	GRMCC01	GRM-GI-BX151S	SPGN-322
GRM2-BX152-_ _ _ _		3.397	0.500	0.240	GRM-GC-BX-152	GRMCC01	GRM-GI-BX152S	SPGN-322
GRM2-BX153-_ _ _ _		4.048	0.556	0.280	GRM-GC-BX-153	GRMCC01	GRM-GI-BX153S	SPGN-322
GRM2-BX154-_ _ _ _		4.687	0.608	0.310	GRM-GC-BX-154	GRMCC01	GRM-GI-BX154S	SPGN-322
GRM2-BX155-_ _ _ _		5.932	0.700	0.340	GRM-GC-BX-155	GRMCC01	GRM-GI-BX155R	SPGN-322
GRM2-BX156-_ _ _ _		9.523	0.923	0.450	GRM-GC-BX-156	GRMCC01	GRM-GI-BX156R	SPGN-322
GRM2-BX169-_ _ _ _		6.957	0.668	0.390	GRM-GC-BX-169	GRMCC01	GRM-GI-BX169R	SPGN-322

** See chart to below*

Shank Description	Ordering Code
CAT50/ANSI 50	A50
CAT40/ANSI 40	A40
NMTB-50	N50
NMTB-40	N40
BT-50	BT50
BT-40	BT40
DIN 2080-A 50	MN50
DIN 69871-A 50	D50
HSK-100	H100
CAPTO C-8	C8

Stocked Sizes	
GRM2-BX150-A50	GRM2-BX154-A40
GRM2-BX150-BT50	GRM2-BX154-A50
GRM2-BX150-D50	GRM2-BX154-BT50
GRM2-BX151-A50	GRM2-BX154-D50
GRM2-BX151-BT50	GRM2-BX155-A40
GRM2-BX151-D50	GRM2-BX155-A50
GRM2-BX152-A40	GRM2-BX155-BT50
GRM2-BX152-A50	GRM2-BX155-D50
GRM2-BX152-BT50	GRM2-BX156-A50
GRM2-BX152-D50	GRM2-BX169-A50

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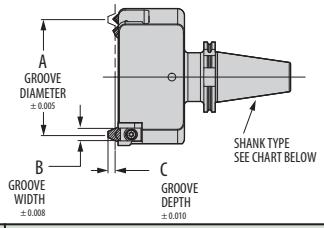
Ring Max™ II

R Series



Part Number		Dimensions (inches)			Standard Components		Inserts	
Groove Series - Shank Type*	Stock	A	B	C	Grooving Cartidge	Chamfer Cartidge	Grooving Insert	Chamfer Insert
GRM2-R16-_ _ _ _	See chart	2.000	0.344	0.250	GRM-GC-RSET 2 AX	GRMCC01	GRM-GI-RSET 2 SX	SPGN-322
GRM2-R24-_ _ _ _	below	3.750	0.469	0.320	GRM-GC-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
GRM2-R27-_ _ _ _	for	4.250	0.469	0.320	GRM-GC-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
GRM2-R31-_ _ _ _	stocked	4.875	0.469	0.320	GRM-GC-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
GRM2-R35-_ _ _ _	sizes.	5.375	0.469	0.320	GRM-GC-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
GRM2-R37-_ _ _ _		5.875	0.469	0.320	GRM-GC-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
GRM2-R39-_ _ _ _		6.375	0.469	0.320	GRM-GC-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
GRM2-R44-_ _ _ _		7.625	0.469	0.320	GRM-GC-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
GRM2-R46-_ _ _ _		8.313	0.531	0.390	GRM-GC-R46	GRMCC01	GRM-GI-R46R	SPGN-322

** See chart to below*

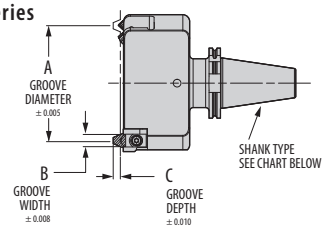
Shank Description	Ordering Code
CAT50/ANSI 50	A50
CAT40/ANSI 40	A40
NMTB-50	N50
NMTB-40	N40
BT-50	BT50
BT-40	BT40
DIN 2080-A 50	MN50
DIN 69871-A 50	D50
HSK-100	H100
CAPTO C-8	C8

Stocked Sizes
GRM2-R24-A50
GRM2-R24-D50
GRM2-R24N-A50
GRM2-R24N-D50

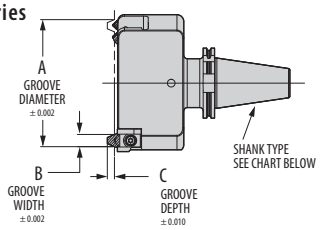
Ring Max™ II

RX Series / 10K and 15K Series

RX Series



10/15K Series



Part Number	Stock	Dimensions (inches)			Standard Components		Inserts	
Groove Series - Shank Type*		A	B	C	Grooving Cartidge	Chamfer Cartidge	Grooving Insert	Chamfer Insert
GRM2-RX201N-_ _ _ _	See chart	1.813	0.219	0.160	GRM-GCRX201/5-X	N/A	GRM-GI-RX201/5SX	N/A
GRM2-RX205N-_ _ _ _	below	2.250	0.219	0.160	GRM-GCRX201/5-X	N/A	GRM-GI-RX201/5SX	N/A
GRM2-10K2-_ _ _ _	for	4.623	0.377	0.258	GRM-GC10/15K-X	GRMCC01	GRM-GI-10/15KSX	SPGN-322
GRM2-10K3N-_ _ _ _	stocked	5.748	0.377	0.258	GRM-GC10/15K-X	N/A	GRM-GI-10/15KSX	N/A
GRM2-10K5-_ _ _ _	sizes.	8.748	0.377	0.258	GRM-GC10/15K-X	GRMCC01	GRM-GI-10/15KSX	SPGN-322
GRM2-15K3-_ _ _ _		6.623	0.377	0.258	GRM-GC10/15K-X	GRMCC01	GRM-GI-10/15KSX	SPGN-322

** See chart to below*

Shank Description	Ordering Code
CAT50/ANSI 50	A50
CAT40/ANSI 40	A40
NMTB-50	N50
NMTB-40	N40
BT-50	BT50
BT-40	BT40
DIN 2080-A 50	MN50
DIN 69871-A 50	D50
HSK-100	H100
CAPTO C-8	C8

Stocked Sizes
Ring Max™ II RX and 10/15K Series are not standard stocked items.

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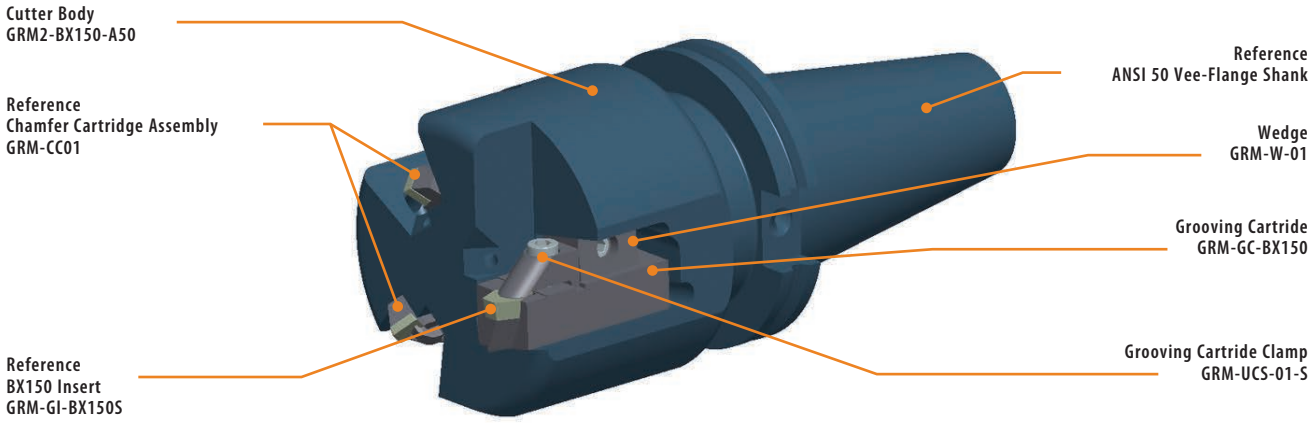
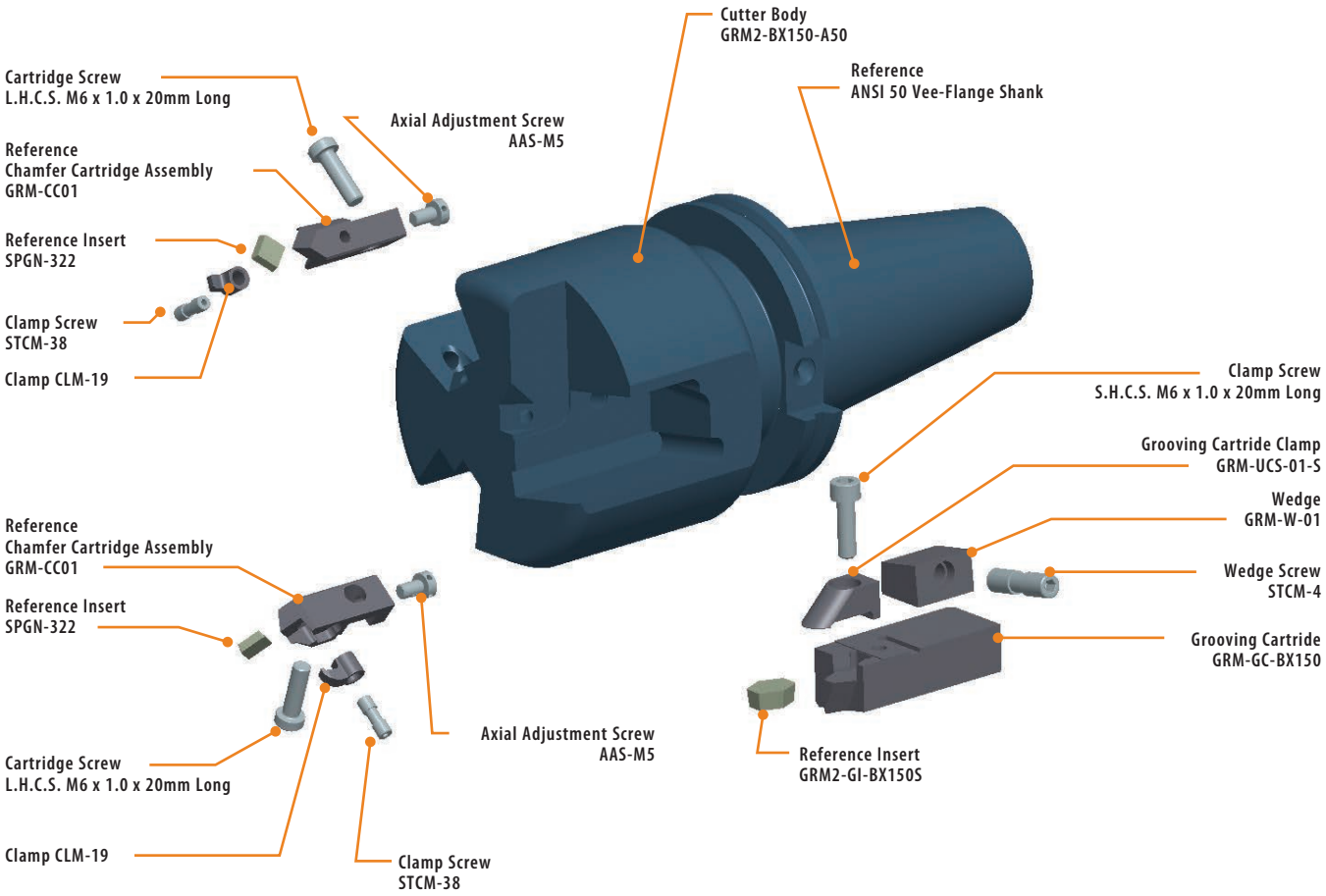
Ring Max™ II

Assembled and Exploded Views Reference Guide

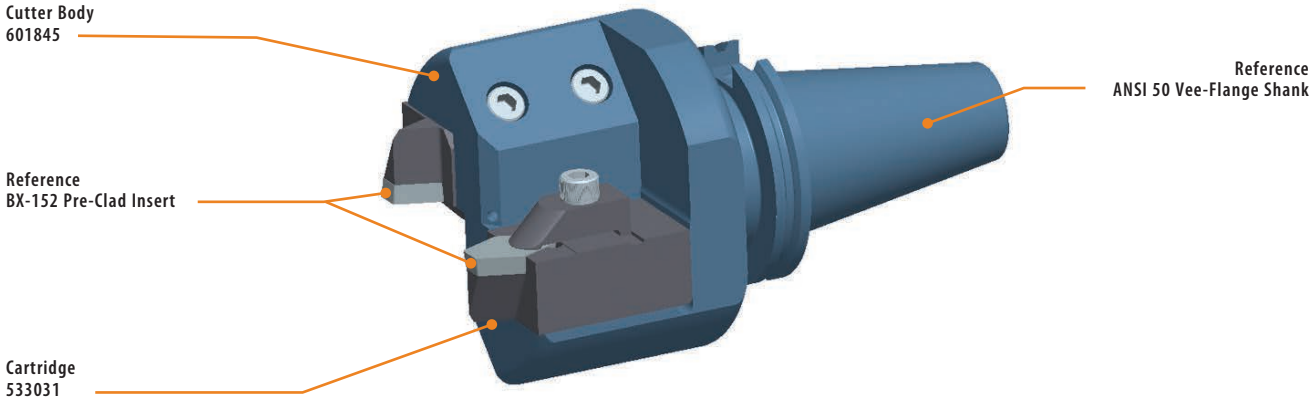


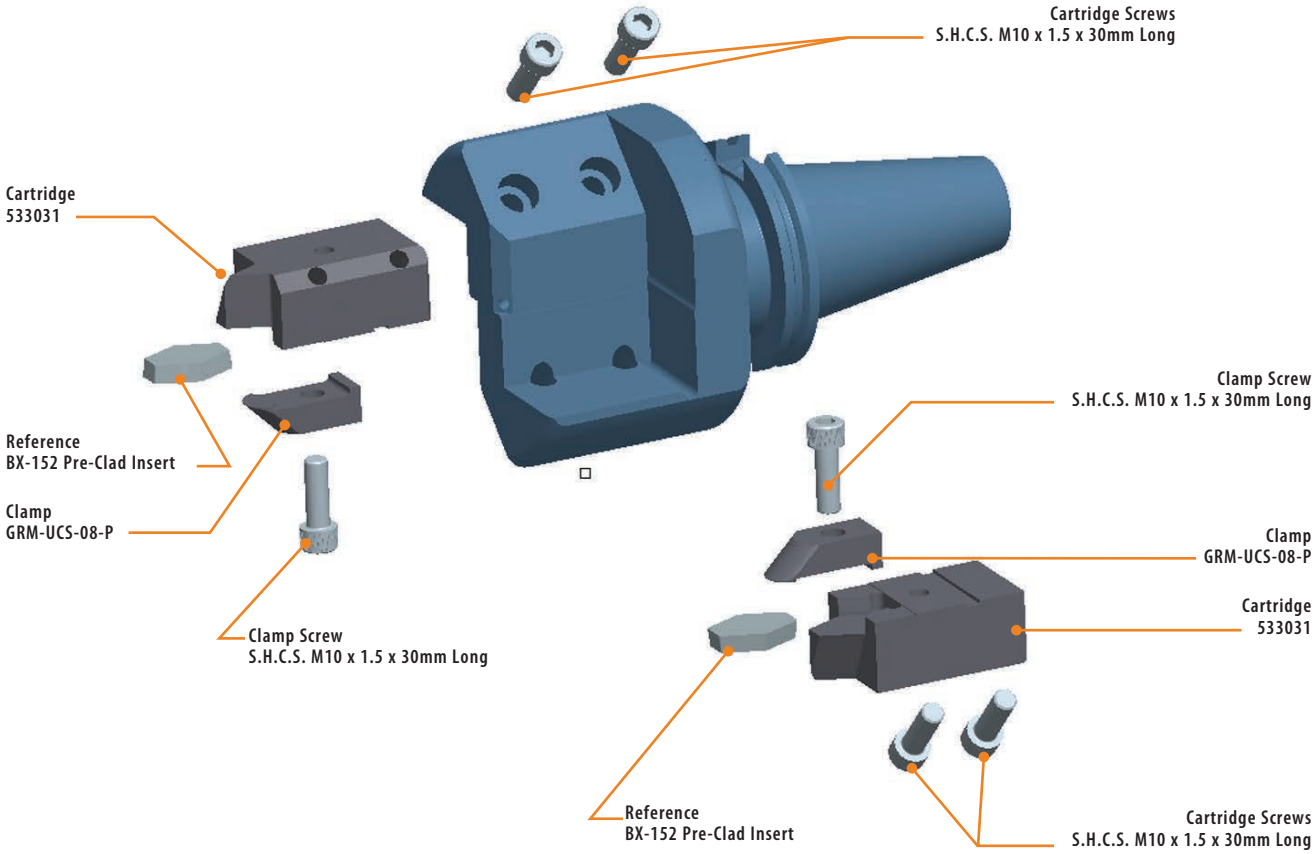


Ring Max™ II Quote Request Form For information for a quote form you can download, see page RM 31.

Ring Max™ BX-152 Pre-Clad

Assembled and Exploded Views Reference Guide





Special Toolchanger Clearance Request Form For information for a quote form you can download, see page RM 31.

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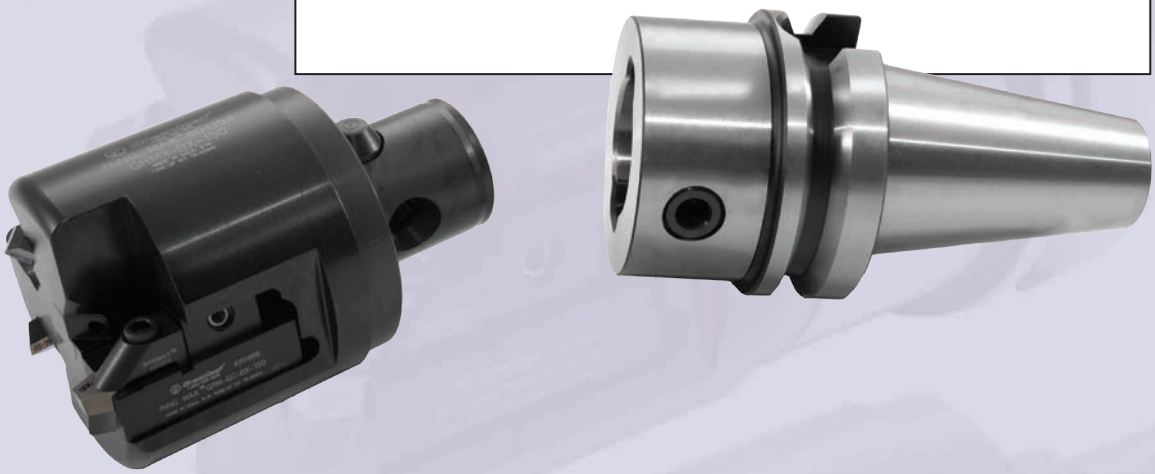
Ring Max™ III Ring Groove Tooling

The Ring Max™ III is a high-precision, two-piece modular system for shop versatility. This system offers many head and shank configurations, including adaptability to Greenleaf's Excelerator® face mills. The Ring Max™ III line delivers the ultimate economical and flexible solution for any shop machining multiple API ring groove sizes.

Standard features and benefits include:

- Cutting of BX, R, and RX API ring grooves in Inconel 625 clad overlay in less than one minute.
- Machines the groove and chamfers in one operation.
- Adjustable and replaceable cartridge design for easy maintenance.

Please contact Greenleaf Corporation for any questions or assistance.



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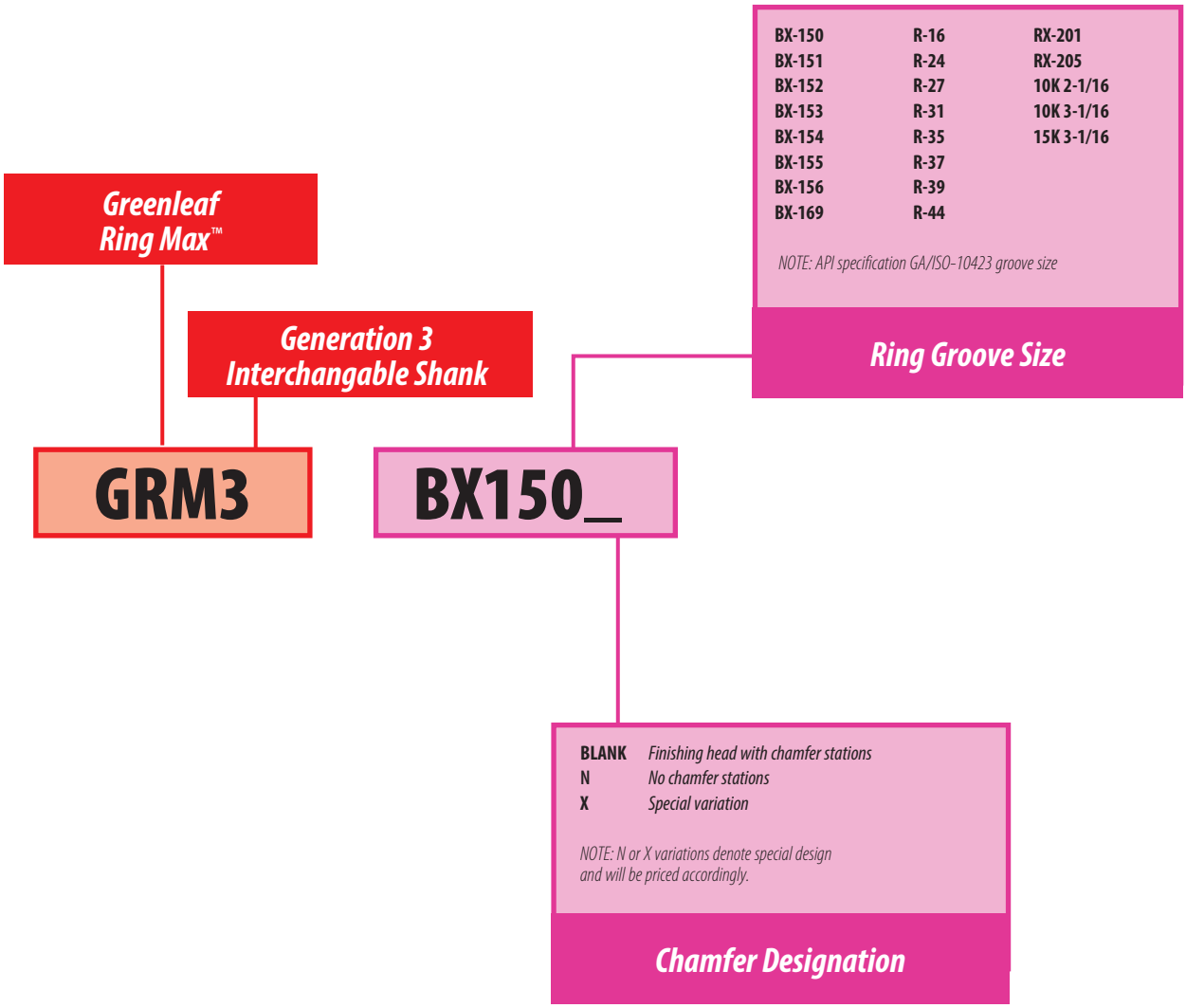
Ring Max™ III

Finishing Head Identification System



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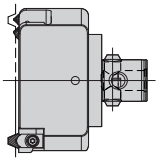
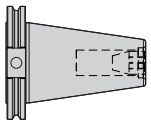
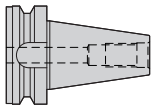
Pictorial & Reference Index

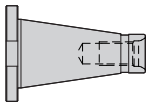
Ring Max™ III Tooling

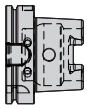


BX Series
R Series
RX Series
10/15K Series
page: RM 18









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Shank Options
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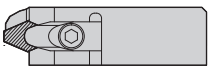

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Grooving Cartridge
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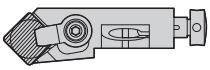

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Machining Methods
Reference Guide
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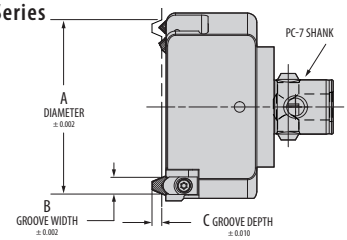
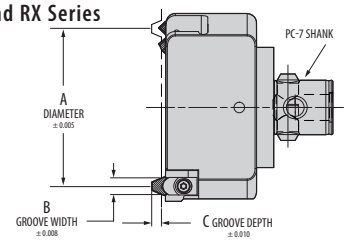
Ring Max™ III

BX Series / R Series / RX and 10/15K Series

BX and 10/15K Series



R and RX Series



	Part Number	Dimensions (inches)			Standard Components		Inserts	
	Groove Series - Shank Type*	A	B	C	Grooving Cartidge	Chamfer Cartidge	Grooving Insert	Chamfer Insert
BX Series	**GRM3-BX150**	2.895	0.452	0.230	GRM-GC-BX-150	GRMCC01	GRM-GI-BX150S	SPGN-322
	GRM3-BX151	3.064	0.468	0.230	GRM-GC-BX-151	GRMCC01	GRM-GI-BX151S	SPGN-322
	GRM3-BX152	3.397	0.500	0.240	GRM-GC-BX-152	GRMCC01	GRM-GI-BX152S	SPGN-322
	GRM3-BX153	4.048	0.556	0.280	GRM-GC-BX-153	GRMCC01	GRM-GI-BX153S	SPGN-322
	GRM3-BX154	4.687	0.608	0.310	GRM-GC-BX-154	GRMCC01	GRM-GI-BX154S	SPGN-322
	GRM3-BX155	5.932	0.700	0.340	GRM-GC-BX-155	GRMCC01	GRM-GI-BX155R	SPGN-322
	GRM3-BX169	6.957	0.668	0.390	GRM-GC-BX-169	GRMCC01	GRM-GI-BX169R	SPGN-322
R Series	**GRM3-R16**	2.000	0.344	0.250	GRM-GC-RSET 2 AX	GRMCC01	GRM-GI-RSET 2 SX	SPGN-322
	GRM3-R24	3.750	0.469	0.320	GRM-GC-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
	GRM3-R27	4.250	0.469	0.320	GRM-GC-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
	GRM3-R31	4.875	0.469	0.320	GRM-GC-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
	GRM3-R35	5.375	0.469	0.320	GRM-GC-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
	GRM3-R37	5.875	0.469	0.320	GRM-GC-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
	GRM3-R39	6.375	0.469	0.320	GRM-GC-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
	GRM3-R44	7.625	0.469	0.320	GRM-GC-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
RX and 10/15K Series	**GRM3-RX201N**	1.813	0.219	0.160	GRM-GCRX201/5-X	N/A	GRM-GI-RX201/5SX	N/A
	GRM3-RX205N	2.250	0.219	0.160	GRM-GCRX201/5-X	N/A	GRM-GI-RX201/5SX	N/A
	GRM3-10K2	4.623	0.377	0.258	GRM-GC10/15K-X	GRMCC01	GRM-GI-10/15KSX	SPGN-322
	GRM3-10K3N	5.748	0.377	0.258	GRM-GC10/15K-X	N/A	GRM-GI-10/15KSX	N/A
	GRM3-15K3	6.623	0.377	0.258	GRM-GC10/15K-X	GRMCC01	GRM-GI-10/15KSX	SPGN-322

NOTE: Due to blank availability, special designs may need to be a two-piece weld construction or no quote.

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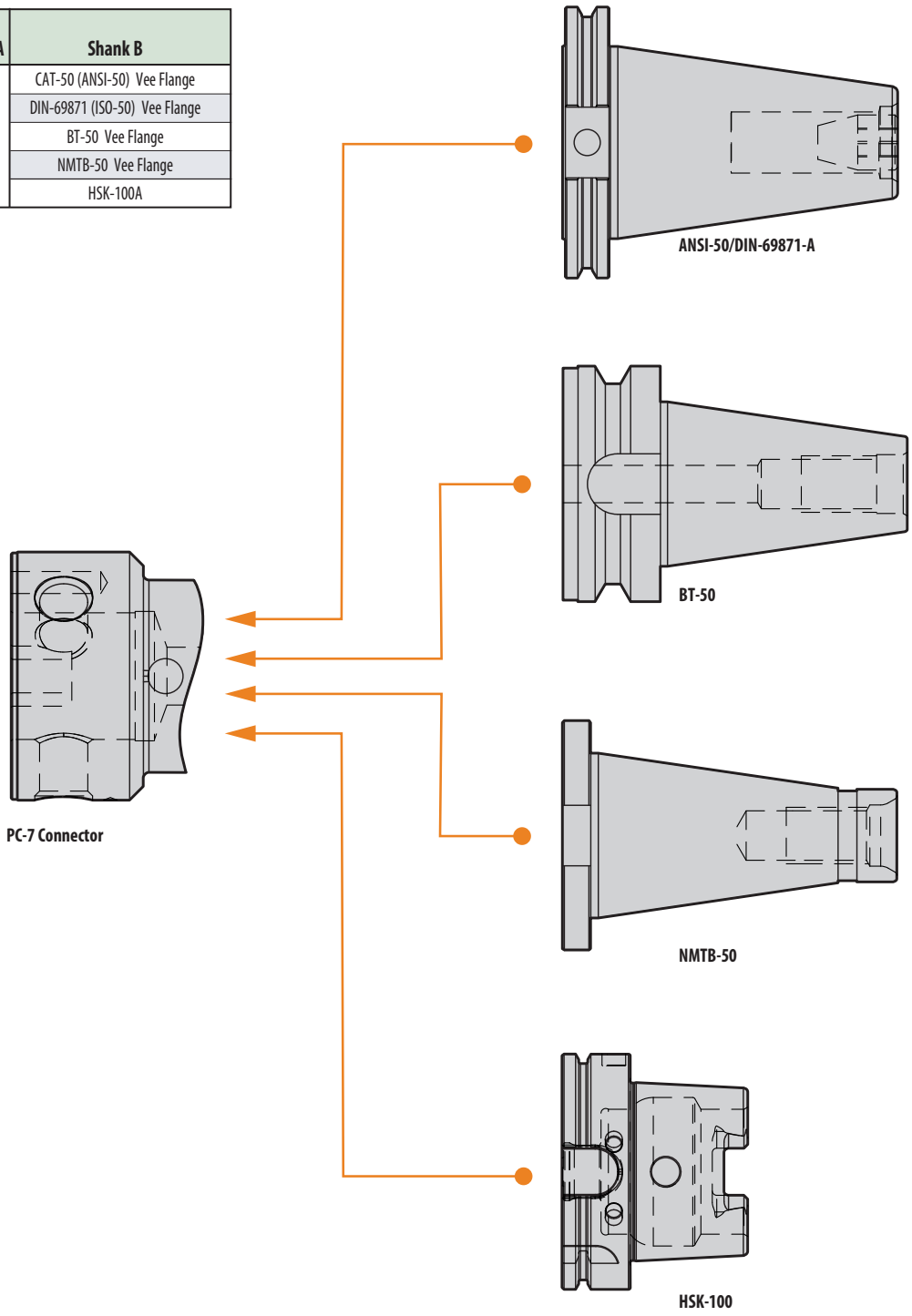
Ring Max™ III

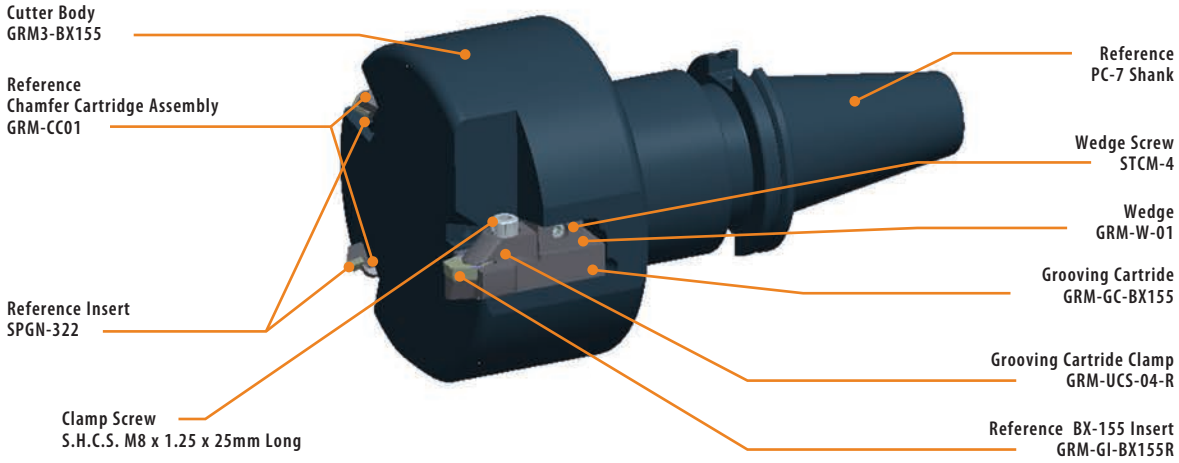
Shank Options

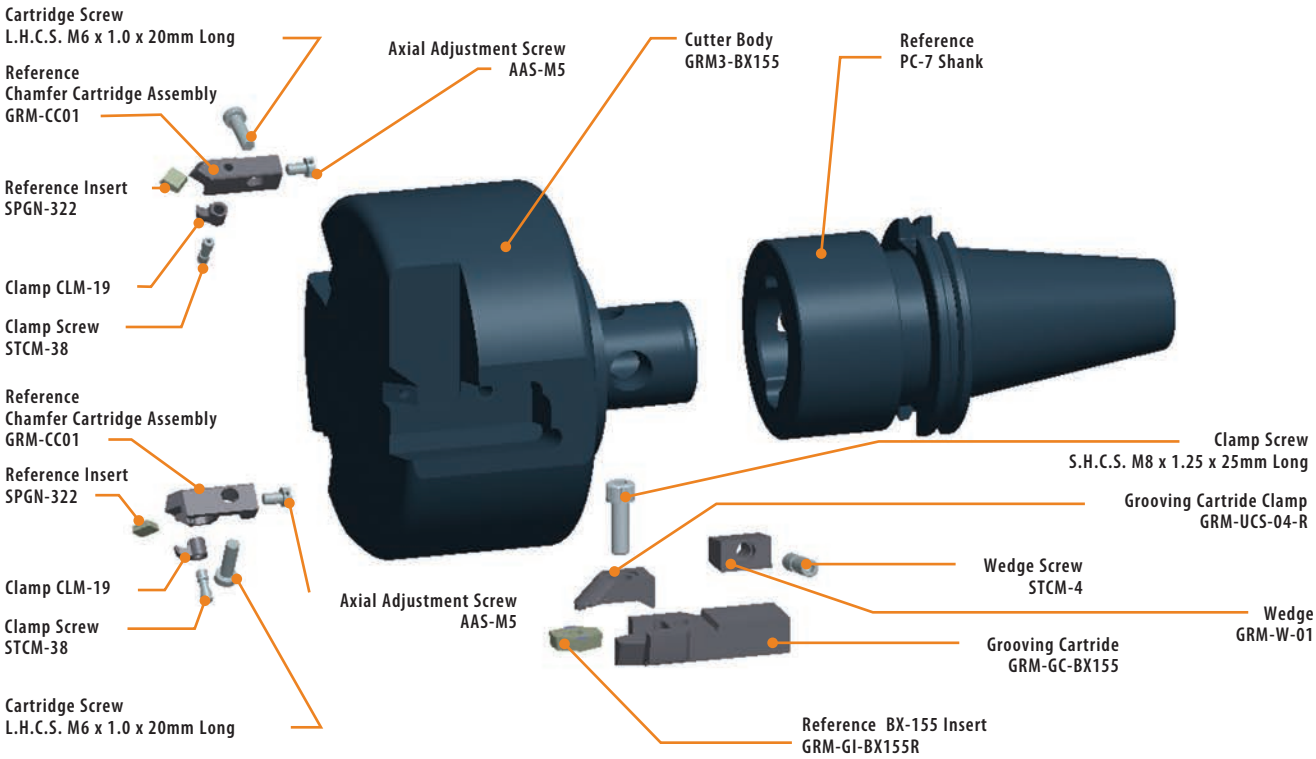
Adapter Designation	Shank A	Shank B
04-GRMA50-000	PC-7	CAT-50 (ANSI-50) Vee Flange
04-GRMA50-000		DIN-69871 (ISO-50) Vee Flange
04-GRMBT50-000		BT-50 Vee Flange
04-GRMNMTB50-000		NMTB-50 Vee Flange
04-GRMHSK100-000		HSK-100A



Ring Max™ GRM3-BX155

Assembled and Exploded Views Reference Guide





Special Toolchanger Clearance Request Form For information for a quote form you can download, see page RM 31.

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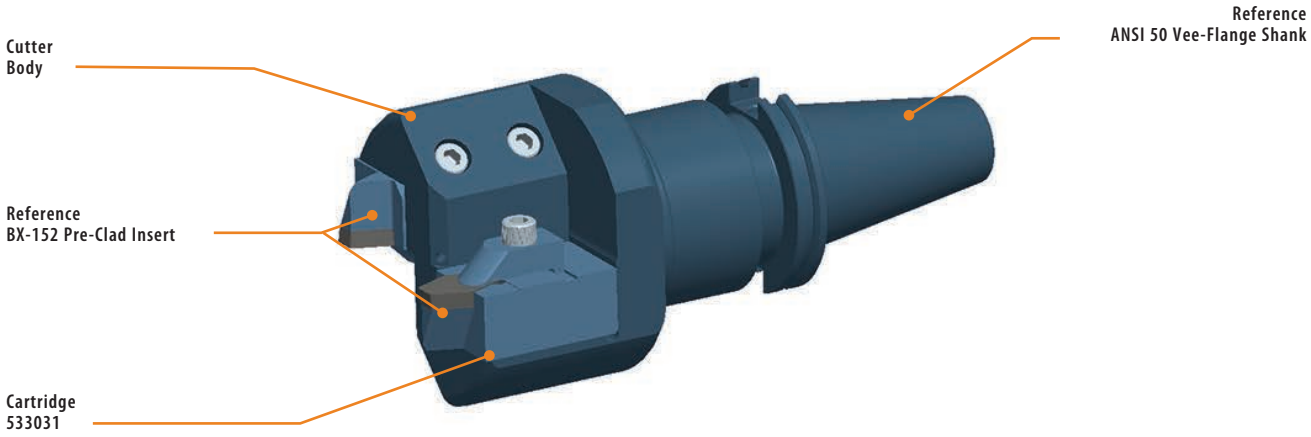
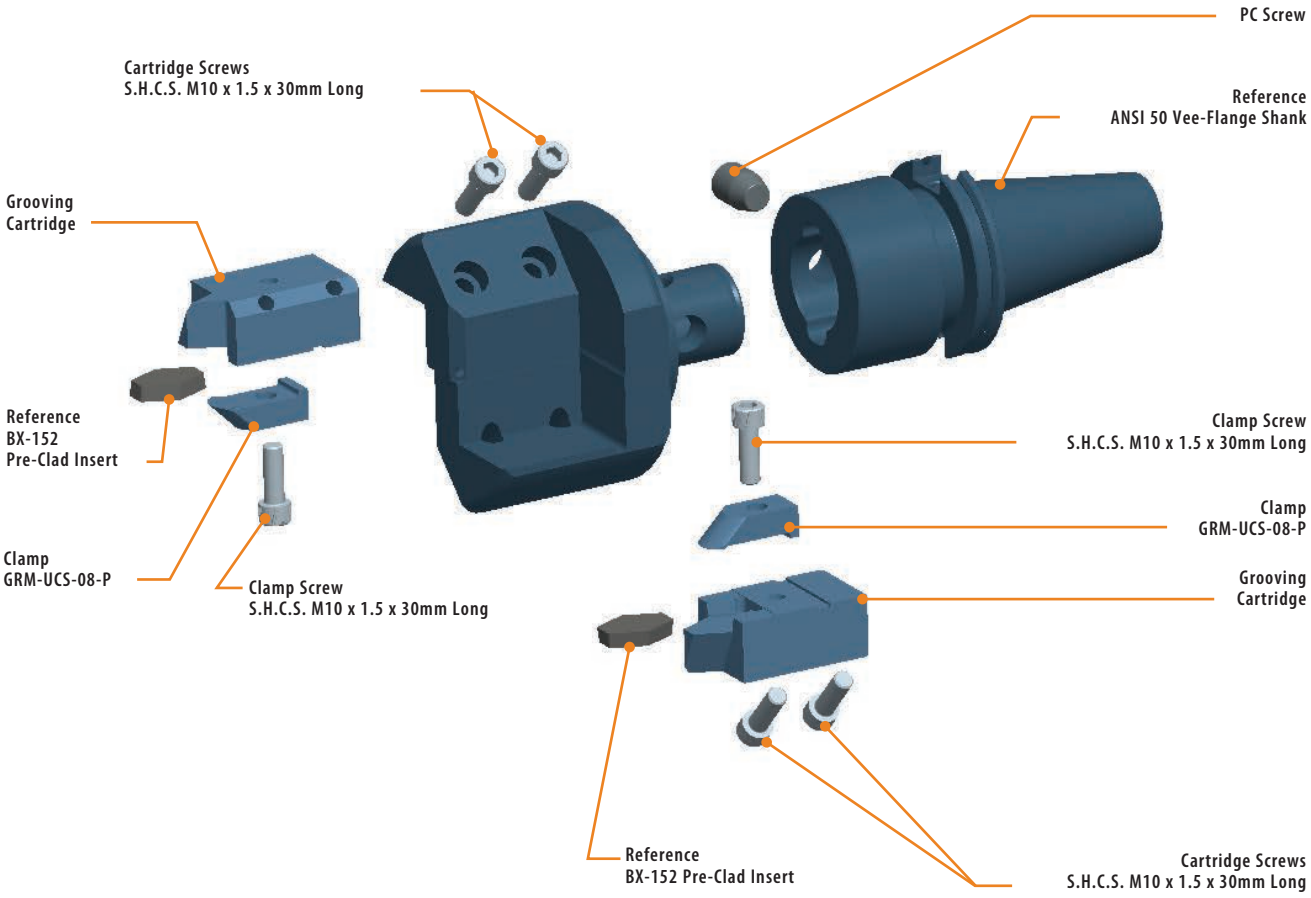
Ring Max™ III Pre-Clad

Assembled and Exploded Views Reference Guide

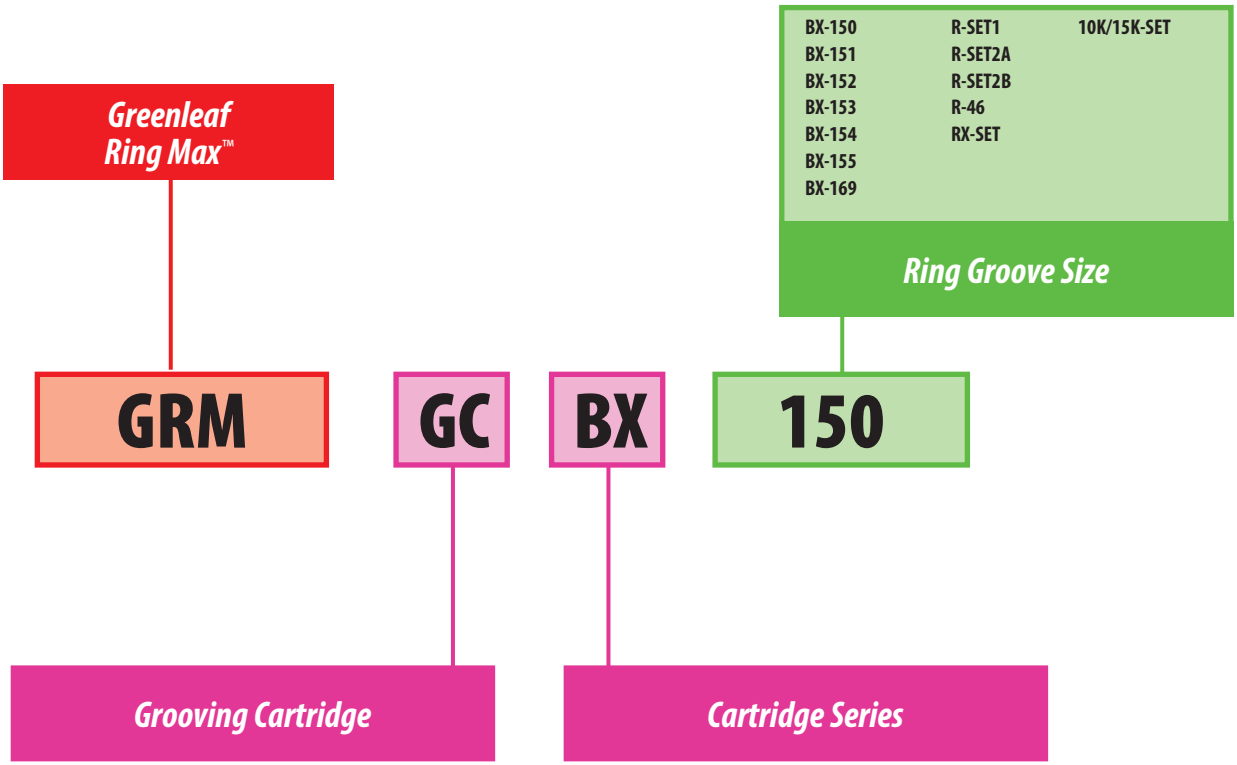




Ring Max™ III Pre-Clad Head Quote Request Form For information for a quote form you can download, see page RM 31.

Ring Max™

Grooving Cartridge Identification System



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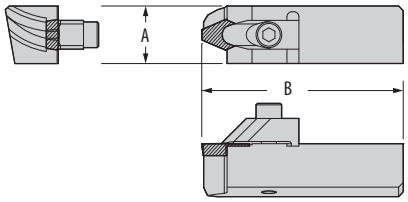


Ring Max™

Grooving Cartridge

Cartridge		Dimensions (inches)		Standard Components		Inserts
Groove Size	**Part Number**	**A**	**B**	**Clamp**	**Clamp Screw**	**Purchased Seperately**
BX-150	**GRM-GC-BX-150**	1.000	2.625	GRMUCS01S	M6-1.0 SHCS	GRM-GI-BX150S
BX-151	**GRM-GC-BX-151**	1.000	2.625	GRMUCS01S	M6-1.0 SHCS	GRM-GI-BX151S
BX-152	**GRM-GC-BX-152**	1.000	2.625	GRMUCS01S	M6-1.0 SHCS	GRM-GI-BX152S
BX-153	**GRM-GC-BX-153**	1.000	2.625	GRMUCS01S	M6-1.0 SHCS	GRM-GI-BX153S
BX-154	**GRM-GC-BX-154**	1.117	2.625	GRMUCS01S	M6-1.0 SHCS	GRM-GI-BX154S
BX-155	**GRM-GC-BX-155**	1.259	3.125	GRMUCS04R	M8-1.25 SHCS	GRM-GI-BX155R
BX-156	**GRM-GC-BX-156**	1.188	3.125	GRMUCS04R	M8-1.25 SHCS	GRM-GI-BX156R
BX-169	**GRM-GC-BX-169**	1.000	3.125	GRMUCS04R	M8-1.25 SHCS	GRM-GI-BX169R
R-SET1*	**GRM-GCRSET1-X**	1.000	3.125	GRMUCS03S	M6-1.0 SHCS	GRM-GI-RSET1SX
R-SET2A*	**GRM-GCRSET2A-X**	0.750	2.625	GRMUCS05S	M5-0.8 SHCS	GRM-GI-RSET2SX
R-SET2B*	**GRM-GCRSET2B-X**	1.000	2.625	GRMUCS03S	M5-0.8 SHCS	GRM-GI-RSET2SX
R-46	**GRM-GCR46**	1.000	3.125	GRMUCS04R	M8-1.25 SHCS	GRM-GI-R46R
RX-SET*	**GRM-GCRX201/5-X**	0.750	2.625	GRMUCS05S	M5-0.8 SHCS	GRM-GI-RX201/5SX
10/15K-SET*	**GRM-GC10/15-X**	1.000	2.625	GRMUCS05S	M5-0.8 SHCS	GRM-GI-10/15KSX

**** Denotes multiple groove sizes (See chart below.)***

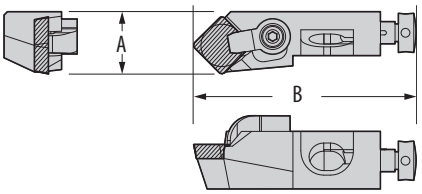
Multiple-Groove Compatibility

Single cartridges can produce multiple grooves when used in the proper gage diameter Ring Max™ grooving head.
Use this chart for compatibility.

Shank Description	Ordering Code
R-SET1	R-21, R-23, R-24, R-26, R-27, R-31, R-35, R-37, R-39, R-41, R-44, R-45, R-49, R-53, R-57, R-65, R-69, R-82, R-84
R-SET2A	R-12, R-13, R-14, R-15, R-16, R-17, R-18, R-19, R-20
R-SET2B	R-22, R-25, R-29, R-33, R-36, R-40, R-43, R-48, R-52
RX-SET	RX-201, RX-205
10/15K-SET	10K-$2^{1}/_{16}$", 10K-$3^{1}/_{16}$", 10K-$5^{1}/_{16}$", 15K-$3^{1}/_{16}$"

Ring Max™

Chamfer Cartridge



Cartridge	Dimension (inches)		Standard Components			Inserts	Mounting Screws
	A	B	Clamp	Clamp Screw	Adj. Screw	Purchased Seperately	Supplied with Grooving Head
GRM-CC01	0.551	1.971	CLM-19	STCM-38	AAS-M5	SPGN-322	M6-1.0 LHCS

All Ring Max™ heads for generation 2 and 3 use the same chamfer cartridges.

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Ring Max™ STX – Lathe Tooling

The Ring Max™ STX system provides the same productivity gains as the Ring Max™ II and Ring Max™ III systems in a square shank tool. Whether you are machining a large diameter groove, or a standard BX, R, or RX groove, the Ring Max™ STX system is your solution for maximizing productivity in multiple API ring groove sizes.

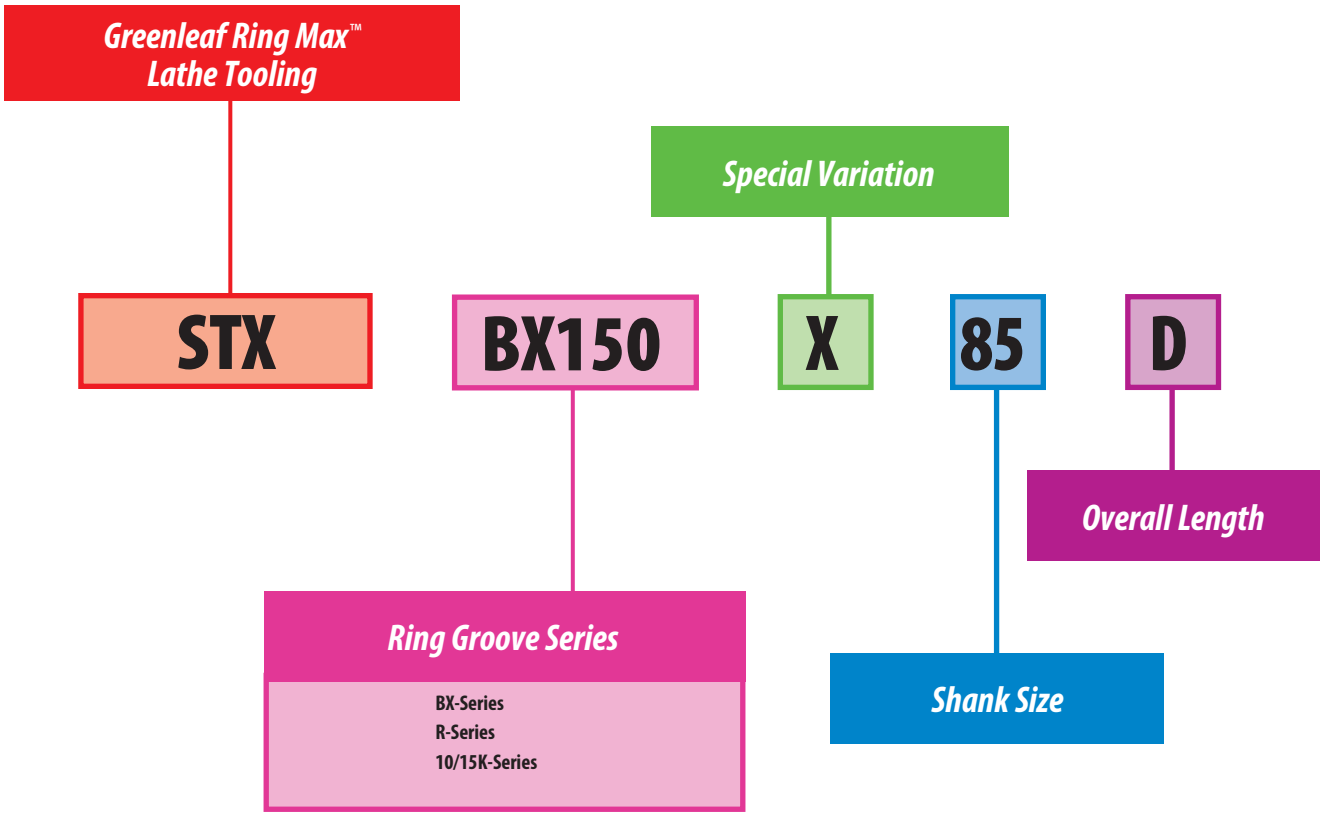
Standard features and benefits include:

- Roughing and finishing of BX, R, and RX API ring grooves in Inconel 625 clad overlay in less than one minute.
- Utilization of the same clamping system and inserts as the Ring Max™ II and Ring Max III™ cutter systems.
- Available in common standard inch and metric shank sizes.

Please contact Greenleaf Corporation for any questions or assistance.

Ring Max™ STX

Lathe Tooling Identification System



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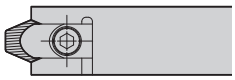
Pictorial & Reference Index

RING MAX™ Lathe Tooling



Reference

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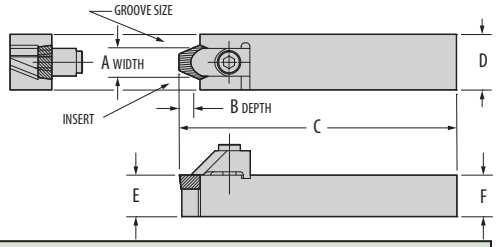
Ring Max™ STX

Lathe Tooling



Holder		Dimensions (inches)					
Groove Size	Part Number	A†	B†	C	D	E	F
BX-150	**STXBX15016D**	0.452	0.230	6.000	1.000	1.000	1.000
	STXBX15085D	0.452	0.230	6.000	1.000	1.250	1.250
BX-151	**STXBX15116D**	0.468	0.230	6.000	1.000	1.000	1.000
	STXBX15185D	0.468	0.230	6.000	1.000	1.250	1.250
BX-152	**STXBX15216D**	0.500	0.240	6.000	1.000	1.000	1.000
	STXBX15285D	0.500	0.240	6.000	1.000	1.250	1.250
BX-154	**STXBX15416D**	0.608	0.310	6.000	1.000	1.000	1.000
	STXBX15485D	0.608	0.310	6.000	1.000	1.250	1.250
BX-155	**STXBX15516D**	0.700	0.340	6.000	1.000	1.000	1.000
	STXBX15585D	0.700	0.340	6.000	1.000	1.250	1.250
BX-156	**STXBX15616D**	0.923	0.450	6.000	1.000	1.000	1.000
	STXBX15685D	0.923	0.450	6.000	1.000	1.250	1.250
BX-169	**STXBX16916D**	0.688	0.390	6.000	1.000	1.000	1.000
	STXBX16985D	0.688	0.390	6.000	1.000	1.250	1.250
R-SET1SX*	**STXRSET116D**	0.469	0.320	6.000	1.000	1.000	1.000
	STXRSET185D	0.469	0.320	6.000	1.000	1.250	1.250
R-SET2SX*	**STXRSET216D**	0.469	0.320	6.000	1.000	1.000	1.000
	STXRSET285D	0.469	0.320	6.000	1.000	1.250	1.250
R-46R	**STXR4616D**	0.531	0.390	6.000	1.000	1.000	1.000
	STXR4685D	0.531	0.390	6.000	1.000	1.250	1.250
10/15KSX*	**STX1015KX16D**	0.377	0.258	6.000	1.000	1.000	1.000
	STX1015KX85D	0.377	0.258	6.000	1.000	1.250	1.250

† Groove width and depth tolerances comply with API Standard 6A/ISO 10423.

** Denotes multiple groove sizes (See Multiple-Groove Compatibility chart below.)*

Groove Size	Standard Components		Inserts Purchased Seperately
	Clamp	Clamp Screw	
BX-150	GRMUCS01S	M6-1.0 SHCS	GRM-GI-BX150S
BX-151	GRMUCS01S	M6-1.0 SHCS	GRM-GI-BX151S
BX-152	GRMUCS01S	M6-1.0 SHCS	GRM-GI-BX152S
BX-154	GRMUCS01S	M6-1.0 SHCS	GRM-GI-BX154S
BX-155	GRMUCS04R	M8-1.25 SHCS	GRM-GI-BX155R
BX-156	GRMUCS04R	M8-1.25 SHCS	GRM-GI-BX156R
BX-169	GRMUCS04R	M8-1.25 SHCS	GRM-GI-BX169R
R-SET1SX*	GRMUCS03S	M6-1.0 SHCS	GRM-GI-RSET1SX
R-SET2SX*	GRMUCS05S	M5-0.8 SHCS	GRM-GI-RSET2SX
R-46R	GRMUCS04R	M8-1.25 SHCS	GRM-GI-R46R
10/15KSX*	GRMUCS05S	M5-0.8 SHCS	GRM-GI-10/15KSX

Multiple-Groove Compatibility

Single cartridges can produce multiple grooves. Use this chart for compatibility.

Shank Description	Ordering Code
R-SET1SX	R-21, R-23, R-24, R-26, R-27, R-31, R-35, R-37, R-39, R-41, R-44, R-45, R-49, R-53, R-57, R-65, R-69, R-82,R-84
R-SET2SX	R-12, R-13, R-14, R-15, R-16, R-17, R-18, R-19, R-20
10/15K-SET	10/15K, 10K-2$^{1}/_{16}$", 10K-3$^{1}/_{16}$"

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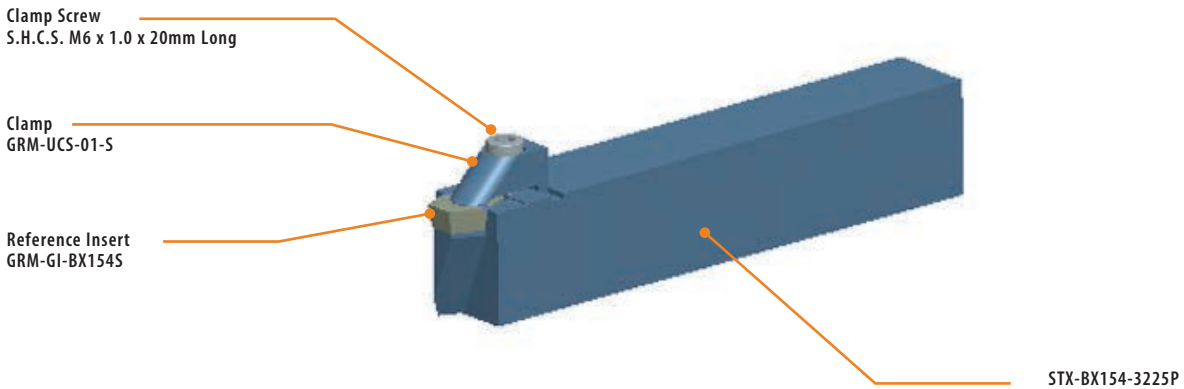
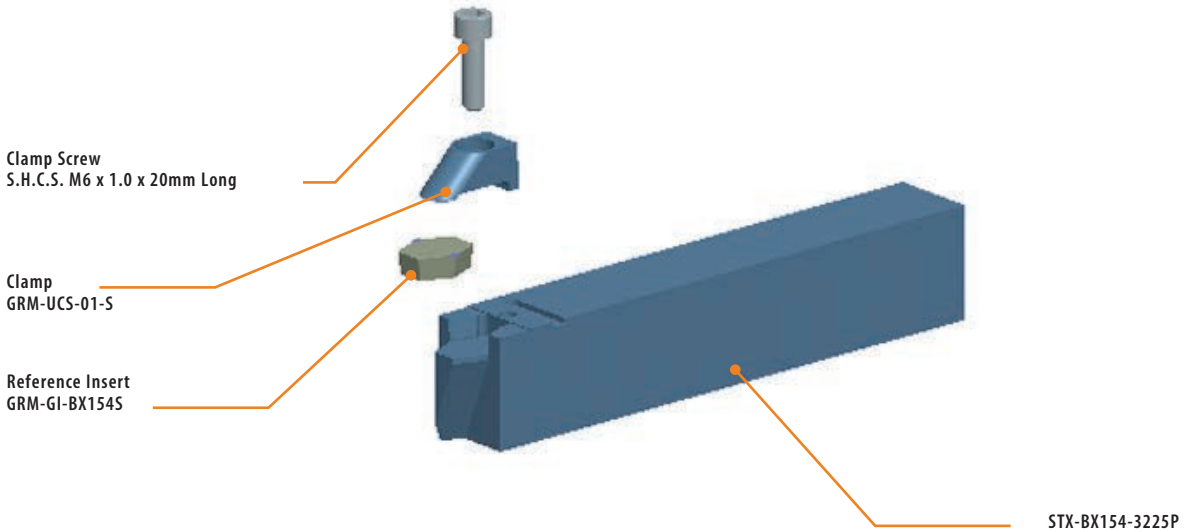
Ring Max™ STX

Assembled and Exploded Views Reference Guide





Ring Max™ Lathe Quote Request Form For information for a quote form you can download, see page RM 31.

Ring Max™

Machining Methods Reference Guide

Method One

Use these instructions for setting gage points and establishing target ring groove depths using an optical comparator.

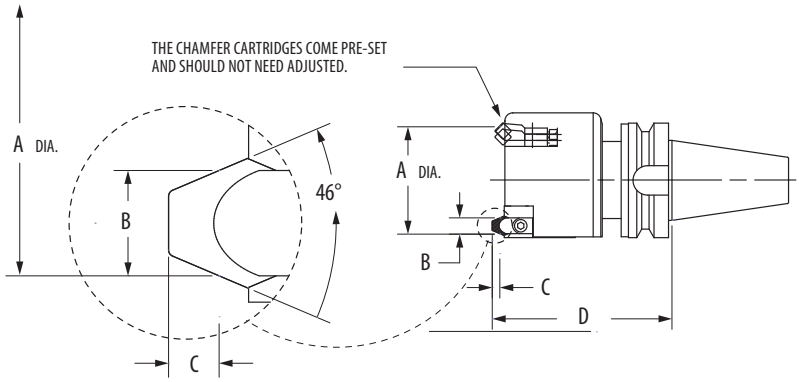
Step One:

Using an optical comparator, find and set the gage points at the groove's A diameter at mid-tolerance. The groove's B dimension will be within the allowable tolerance range.

Step Two:

Once the gage points in Step One have been determined, measure, and record the tool's Z length and the actual measured C dimension over the insert nose.

NOTE: The measured C dimension is the target machining depth and will be within the groove's allowable part tolerance.



Example for BX-152

A		B	C		Z
Part print dimension and tolerance	Target this diameter for gage points	Part print dimension and tolerance	Part print dimension and tolerance	Measure and target this depth for programming	Measure and target this depth for programming
3.395″ + 0.004 – 0.000	3.397″	0.498″ + 0.004 – 0.000	0.230″ + 0.020 – 0.000		

Method Two

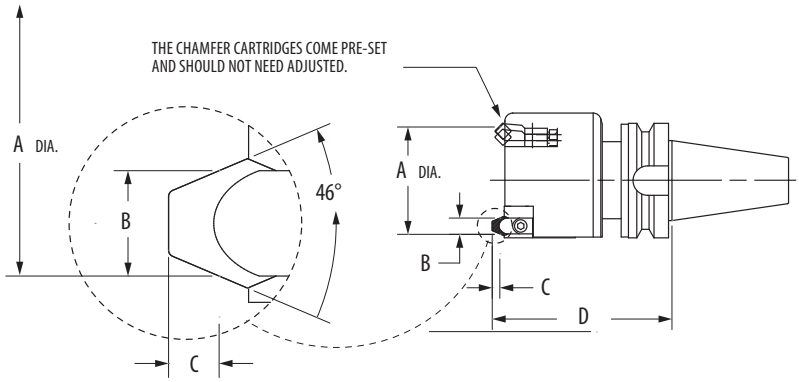
This method is used to machine ring grooves in a rough and finish pass.

Step One:

Machine the groove but reduce the groove depth to leave stock for the finish pass.

Step Two:

Measure the groove's A diameter and use the chart below to determine the additional D depth necessary to bring the A diameter into mid-tolerance.



If the A groove diameter is undersize by:	Increase the groove depth D by:
0.0010	0.0012
0.0020	0.0023
0.0030	0.0035
0.0040	0.0047
0.0050	0.0059
0.0060	0.0071
0.0070	0.0082
0.0080	0.0094
0.0090	0.0106
0.0100	0.0118
0.0110	0.0130
0.0120	0.0141

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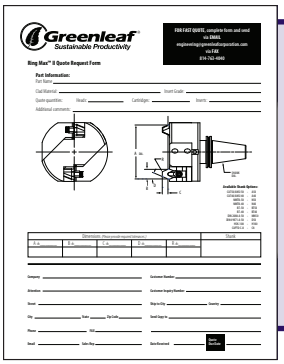
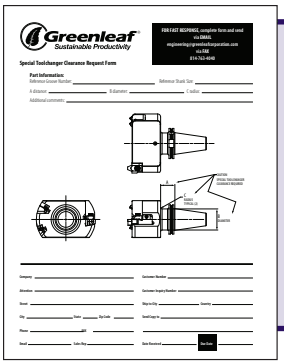


Ring Max™ II Quote Request Form

We have a Ring Max™ II Quote Request Form that you can download at —
https://www.greenleafcorporation.com/RingMax2QuoteRequest.pdf

If you have any questions, contact the Greenleaf Tech Team at 800-458-1850,
or email the engineering department at engineering@greenleafcorporation.com.



Special Toolchanger Clearance Request Form

We have a Special Toolchanger Clearance Request Form that you can download at —
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If you have any questions, contact the Greenleaf Tech Team at 800-458-1850,
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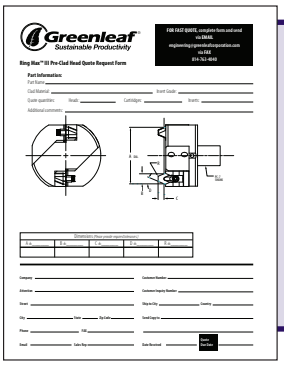
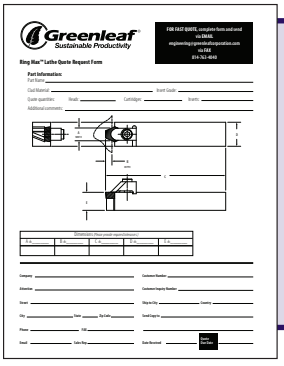


Ring Max™ III Pre-Clad Head Quote Request Form

We have a Ring Max™ III Pre-Clad Head Quote Request Form that you can download at —
https://www.greenleafcorporation.com/RingMax3QuoteRequest.pdf

If you have any questions, contact the Greenleaf Tech Team at 800-458-1850,
or email the engineering department at engineering@greenleafcorporation.com.

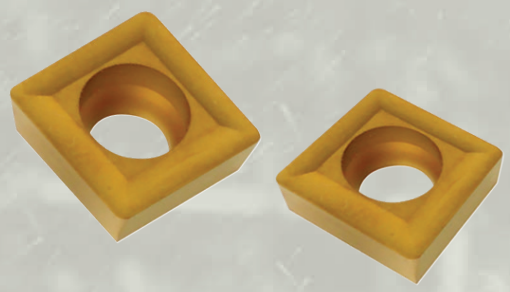


Ring Max™ Lathe Quote Request Form

We have a Ring Max™ III Pre-Clad Head Quote Request Form that you can download at —
https://www.greenleafcorporation.com/RingMax3QuoteRequest.pdf

If you have any questions, contact the Greenleaf Tech Team at 800-458-1850,
or email the engineering department at engineering@greenleafcorporation.com.

Indexable Drilling



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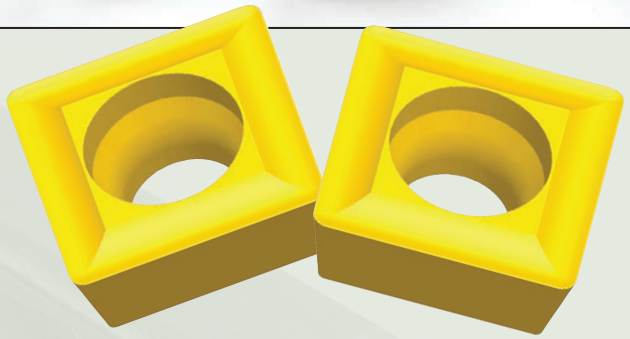
Indexable Drilling

The Holemill™ is an indexable drill utilizing Greenleaf's advanced coated-carbide grades for higher speeds, quieter cutting, longer tool life and reduced horsepower consumption. Inserts are positive squares (SPMT) for four indexes per insert. The Holemill is available in 1" to 3" diameters in 1/8" increments.



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Insert Grades

Carbide

Greenleaf offers a comprehensive line of carbide inserts in grades ranging from sub-micron C-1 through C-8 classifications. An industry pioneer in coated carbide, Greenleaf offers a variety of uncoated, MT-CVD coated and PVD-coated grades. Carbide inserts are available in ANSI standard geometries with multi-purpose chipbreakers for heavy roughing through finishing.

PVD Coated

G-915

A multi-layer PVD-coated grade, G-915 is excellent for heat-resistant alloys, stainless steels, and low-carbon steels. The multi-layer PVD coating adds heat and abrasion resistance to the tough, impact-resistant substrate. G-915 should be used at moderate speeds and moderate to high feeds.

G-935

G-935 is a multi-layer PVD-coated grade for applications requiring additional resistance to mechanical and thermal shock. The multilayered PVD coating raises the speed envelope and wear resistance, particularly in indexable drilling.

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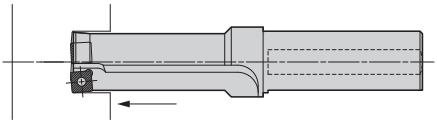
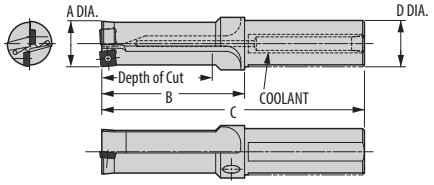
Holemill™ System



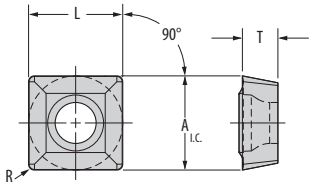


Part Number Right Hand	Gage				Dimensions (inches)					Standard Components	*Tune-Up Kit
	Insert Inboard	Qty	Insert Outboard	Qty	A	Depth of Cut	B	C	D	Insert Screw	
HM3X-094	SPMT-2.522-X2	1	SPMT-2.522-X2	1	0.937	3.000	4.130	8.000	1.250	PT-543-T	TK-00737
HM3X-100	SPMT-2.522-X2	1	SPMT-2.522-X2	1	1.000	3.000	4.130	8.000	1.250	PT-543-T	TK-00737
HM3X-112	SPMT-2.522-X2	1	SPMT-32.52-X2	1	1.125	3.375	4.380	8.250	1.250	PT-543-T & PT559-T	TK-02619
HM3X-125	SPMT-32.52-X2	1	SPMT-32.52-X2	1	1.250	3.750	4.880	8.750	1.250	PT-559-T	TK-00738
HM3X-138	SPMT-432-X2	1	SPMT-32.52-X2	1	1.375	4.500	5.880	9.750	1.500	PT-588-T & PT-559-T	TK-00936
HM3X-150	SPMT-432-X2	1	SPMT-432-X2	1	1.500	4.500	5.880	9.750	1.500	PT-588-T	TK-00739
HM3X-162	SPMT-432-X2	1	SPMT-432-X2	1	1.625	5.250	6.630	10.500	1.500	PT-588-T	TK-00739
HM3X-175	SPMT-432-X2	1	SPMT-432-X2	1	1.750	5.250	6.630	10.500	1.500	PT-588-T	TK-00739
HM3X-188	SPMT-32.52-X2	1	SPMT-32.52-X2	2	1.875	6.000	7.580	11.500	2.000	PT-559-T	TK-00734
HM3X-200	SPMT-32.52-X2	1	SPMT-432-X2	2	2.000	6.000	7.620	11.500	2.000	PT-588-T & PT-544-T	TK-01961
HM3X-225	SPMT-32.52-X2	1	SPMT-432-X2	2	2.250	6.750	8.380	12.250	2.000	PT-588-T & PT-544-T	TK-01961
HM3X-238	SPMT-432-X2	1	SPMT-432-X2	2	2.375	7.500	9.130	13.000	2.000	PT-588-T	TK-00751
HM3X-250	SPMT-432-X2	1	SPMT-432-X2	2	2.500	7.500	9.130	13.000	2.000	PT-588-T	TK-00751
HM3X-275	SPMT-32.52-X2	2	SPMT-432-X2	2	2.750	8.250	9.880	13.750	2.000	PT-588-T & PT-544-T	TK-02353
HM3X-288	SPMT-432-X2	2	SPMT-432-X2	2	2.875	9.000	10.630	14.500	2.000	PT-588-T	TK-00752
HM3X-300	SPMT-432-X2	2	SPMT-432-X2	2	3.000	9.000	10.630	14.500	2.000	PT-588-T	TK-00752

** Tune-Up Kits include one complete set of standard components to allow you to refurbish the Holemill.*

Holemill™ Inserts

SPMT-X2



Inserts	Part Number ANSI	Insert Position	Steel P		Stainless Steel M		Cast Iron K		Heat-Resistant Super Alloys S		Part Number ISO	Dimensions (inches)			
			G-935	G-915	G-915	G-935	G-915	G-935	G-935	G-915		A	L	T	R
	**SPMT-2.522-X2**	Inboard	◆	●	◆	●	◆	●	◆	●	**SPMT-070308-X2**	0.312	0.312	0.125	0.031
	SPMT-2.522-X2	Outboard	●	◆	●	◆	●	◆	●	◆	**SPMT-070308-X2**	0.312	0.312	0.125	0.031
	SPMT-32.52-X2	Inboard	◆	●	◆	●	◆	●	◆	●	**SPMT-09T308-X2**	0.375	0.375	0.156	0.031
	SPMT-32.52-X2	Outboard	●	◆	●	◆	●	◆	●	◆	**SPMT-09T308-X2**	0.375	0.375	0.156	0.031
	SPMT-432-X2	Inboard	◆	●	◆	●	◆	●	◆	●	**SPMT-120408-X2**	0.500	0.500	0.187	0.031
	SPMT-432-X2	Outboard	●	◆	●	◆	●	◆	●	◆	**SPMT-120408-X2**	0.500	0.500	0.187	0.031

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions — pages ID 7

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

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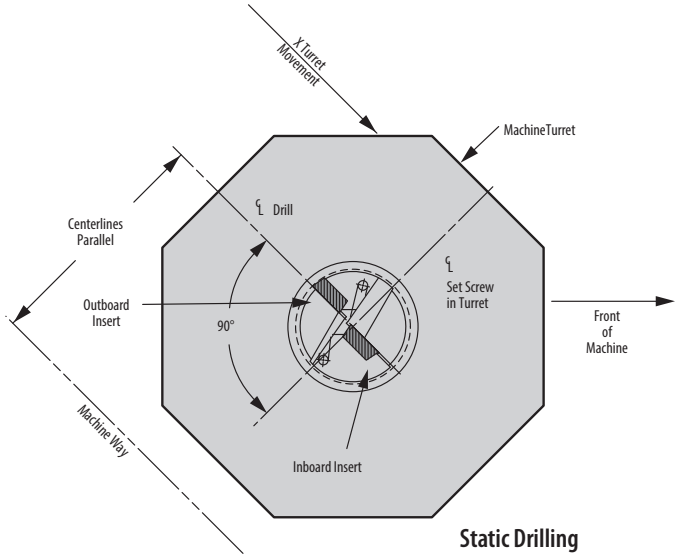
Feed and Speed for Greenleaf Holemill™

Material	Hardness (HRc)	SFM	Feed Rate (IPR)	
			1–1.75″ Dia.	1.75–3″ Dia.
Low Carbon Steel / Free Machining 1010, 1018, 12L14	up to 25	450-1000	.004-.008	.005-.010
High Carbon Steel 1080, 1541, Nitralloy, 52100	25-40	200-600	.004-.008	.005-.010
Alloy Steel 4140, 4340, 6150, 8620	15-30	400-900	.004-.008	.005-.010
Tool Steel A-6, D-2, P-20, H-13	up to 30	250-600	.004-.008	.005-.010
High-Temp Alloys Inconel, Hastelloy, Waspaloy, Stellite	up to 45	90-225	.003-.005	.003-.005
Stainless Steel 304, 316, 17-4PH	up to 32	250-550	.003-.007	.004-.008

Greenleaf Holemill™ Operational Information

For best results in static drilling, set up the Greenleaf Holemill with the drill in the turret in an attitude that puts the inserts parallel to the ways of the machine with the inboard insert located toward the operator as shown.



Static Drilling

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Notes:

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Greenleaf
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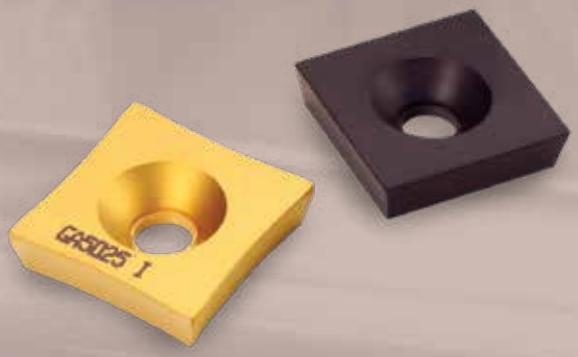
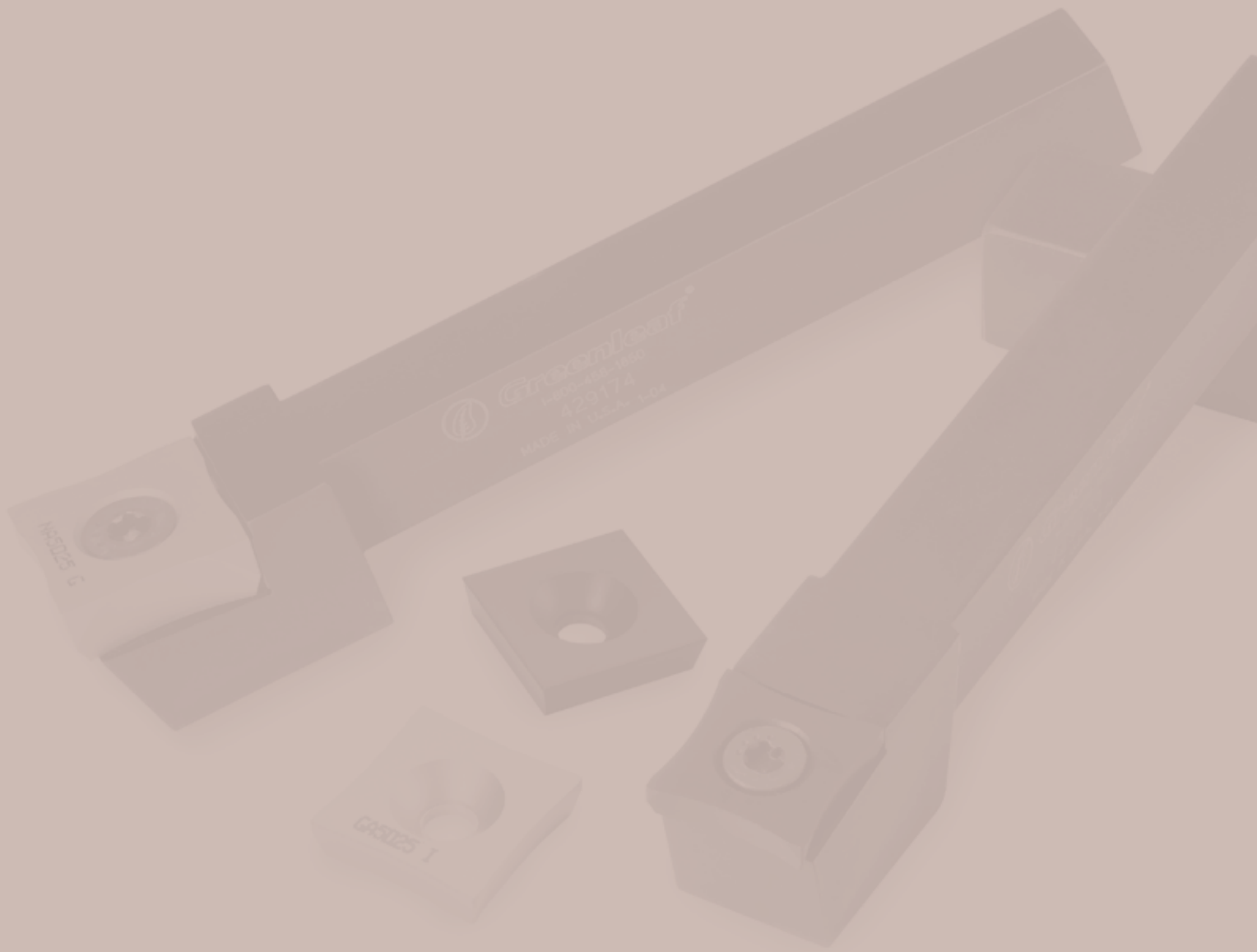
Greenleaf
428154

Tube Scarfing





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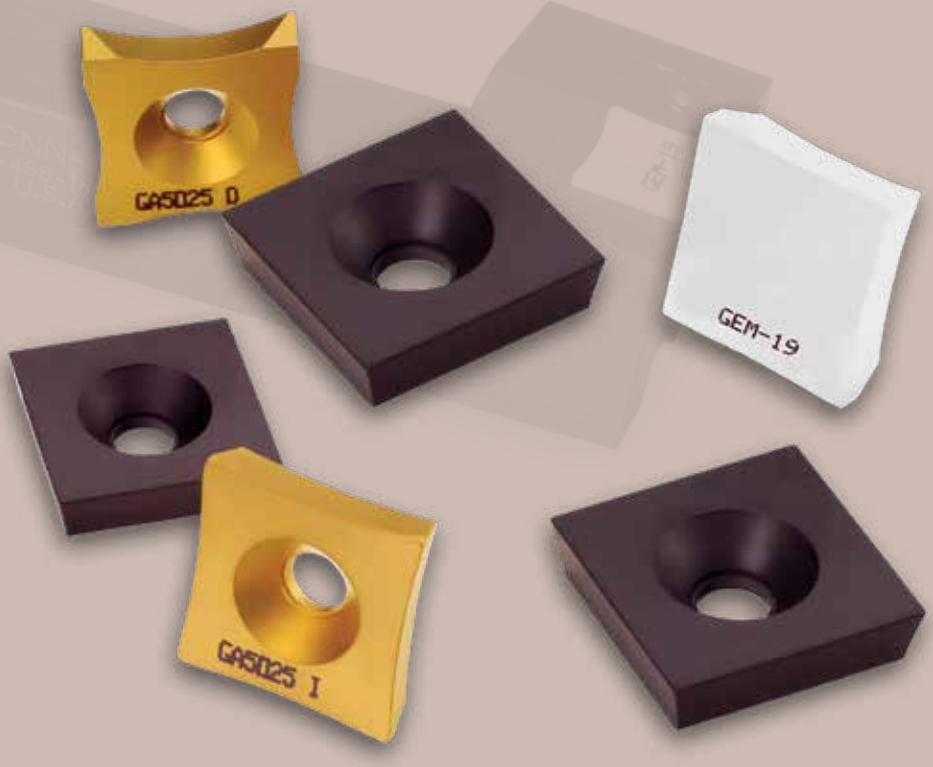
Tube Scarfing

Greenleaf's modern tube scarfing system using indexable inserts offers greatly increased productivity potential from decreased downtime, longer tool life, faster tool change time, decreased tool costs and elimination of regrinding problems. In addition, a superior seam can be expected since an accurate radius form is always available on each side of the insert.

Greenleaf Tune-Up Kits

A Tune-Up Kit consists of all the standard hardware to refurbish a particular toolholder, boring bar, or milling cutter. A toolholder will have a readily visible, laser-inscribed Tune-Up Kit number on it for ease in ordering. This number will prevent any confusion created by searching a catalog for hardware, and it will help reduce downtime.



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Insert Grades

Carbide

Greenleaf offers a comprehensive line of carbide inserts in grades ranging from sub-micron C-1 through C-8 classifications. An industry pioneer in coated carbide, Greenleaf offers a variety of uncoated, MT-CVD coated and PVD-coated grades. Carbide inserts are available in ANSI standard geometries with multi-purpose chipbreakers for heavy roughing through finishing.

GA5023

A combination of an advanced MT-CVD coating and medium-grain substrate makes GA5023 an excellent choice for tube scarfing applications where toughness and abrasive wear resistance are required. The GA5023 grade is a tougher alternative option to GA5025 for any tube scarfing application.

GA5025

Primarily developed for high-speed steel turning, GA5025 also excels as a grade for tube scarfing applications thanks to its thick MT-CVD coating and hard, heat-resistant substrate. GA5025 is a great first choice when tool life and superior heat resistance are top priorities.

Ceramic

Greenleaf is the industry leader in the development and manufacture of ceramic and coated ceramic inserts in ANSI standard and special geometries.

GEM-19™

A cold-pressed and sintered Al_2O_3 ceramic, GEM-19™ provides an economical tube scarfing solution for high-speed operations with demanding finish requirements.

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Pictorial & Reference Index

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page: TS 06

S-SGUB-63
page: TS 07

S-SNUN-46
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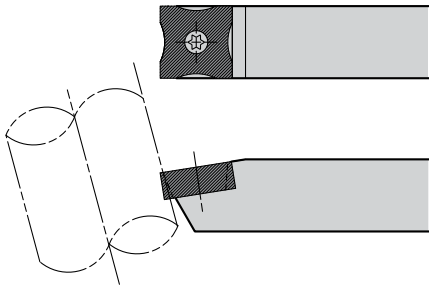
ID Scarfing
page: TS 08

Toolholders

N-SSCPS
page: TS 09



N-WSCNN
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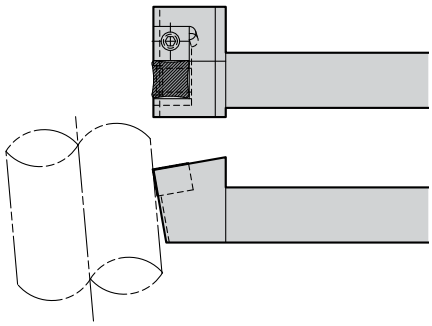

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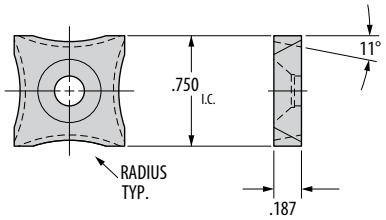
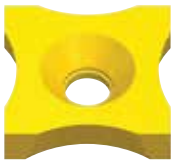
S-SPUB-63



Shape: Scarfing	Part Number	GA5023	GA5025	Dimensions (inches)	
				Tube Size	Radius
	S-SPUB-63-B	●	◆	Up to .875″	0.475
	S-SPUB-63-C	●	◆	.875-1.125″	0.590
	S-SPUB-63-D	●	◆	1.125-1.500″	0.785
	S-SPUB-63-R	●	◆	1.750″	0.875
	S-SPUB-63-E	●	◆	1.500-1.875″	0.985
	S-SPUB-63-F	●	◆	1.875-2.250″	1.180
	S-SPUB-63-G	●	◆	2.250-3.125″	1.575
	S-SPUB-63-H	●	◆	3.125-3.875″	1.970
	S-SPUB-63-I	●	◆	3.875-4.875″	2.470
	S-SPUB-63-J	●	◆	4.875″-5.875″	2.970
	S-SPUB-63-K	●	◆	5.875-6.875″	3.470
	S-SPUB-63-L	●	◆	6.875-7.875″	3.970
	* S-SPUB-63-M	●	◆	7.875″ and up	NONE
	S-SPUB-63-P	●	◆		6.000
	S-SPUB-63-S	●	◆		0.375

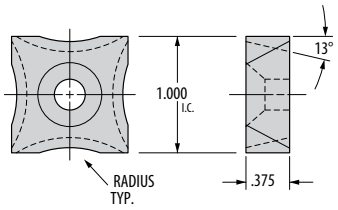
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated — First Choice ◆ Second Choice ● Alternative ▲ — *Grade descriptions — pages TS 04*

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC | Alumina

Note: Applicable for thin-wall pipe up to .250″ thick

** Note: This insert has 11° positive clearance all around.*

S-SPUB-86



Additional thickness and flank clearance for heavy-wall pipe and pipe diameters over 5″ are available.

Shape: Scarfing	Part Number	GA5023	GA5025	Dimensions (inches)	
				Tube Size	Radius
	S-SPUB-86-B	●	◆	Up to .875″	0.475
	S-SPUB-86-C	●	◆	.875-1.125″	0.590
	S-SPUB-86-D	●	◆	1.125-1.500″	0.785
	S-SPUB-86-E	●	◆	1.500-1.875″	0.985
	S-SPUB-86-F	●	◆	1.875-2.250″	1.180
	S-SPUB-86-G	●	◆	2.250-3.125″	1.575
	S-SPUB-86-H	●	◆	3.125-3.875″	1.970
	S-SPUB-86-I	●	◆	3.875-4.875″	2.470
	S-SPUB-86-J	●	◆	4.875″-5.875″	2.970
	S-SPUB-86-K	●	◆	5.875-6.875″	3.470
	S-SPUB-86-L	●	◆	6.875-7.875″	3.970
	* S-SPUB-86-M	●	◆	7.875″ and up	NONE
	S-SPUB-86-N	●	◆		5.000
	S-SPUB-86-S	●	◆		9.500
	S-SPUB-86-P	●	◆		6.250

CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated — First Choice ◆ Second Choice ● Alternative ▲ — *Grade descriptions — pages TS 04*

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC | Alumina

** Note: This insert has 13° positive clearance all around.*

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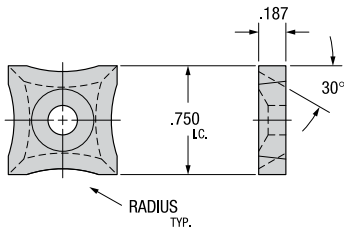
S-SGUB-63



Additional flank clearance for coated tube operations.

Shape: Scarfing	Part Number	GA5025	Dimensions (inches)	
			Tube Size	Radius
	S-SGUB-63-B	◆	Up to .875″	0.475
	S-SGUB-63-C	◆	.875-1.125″	0.590
	S-SGUB-63-D	◆	1.125-1.500″	0.785
	S-SGUB-63-E	◆	1.500-1.875″	0.985
	S-SGUB-63-F	◆	1.875-2.250″	1.180
	S-SGUB-63-G	◆	2.250-3.125″	1.575
	S-SGUB-63-H	◆	3.125-3.875″	1.970
	S-SGUB-63-I	◆	3.875-4.875″	2.470
	S-SGUB-63-J	◆	4.875″-5.875″	2.970
	S-SGUB-63-K	◆	5.875-6.875″	3.470
	S-SGUB-63-L	◆	6.875-7.875″	3.970
	* S-SGUB-63-M	◆	7.875″ and up	NONE
	S-SGUB-63-R	◆	1.750″ DIA	0.875
	S-SGUB-63-S	◆		0.375
	S-SGUB-63-P	◆		6.000

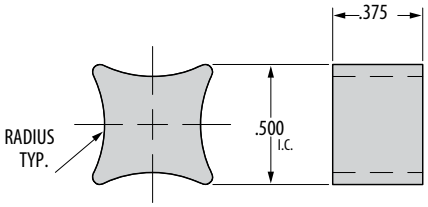
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated — First Choice ◆ Second Choice ● Alternative ▲ — *Grade descriptions — pages TS 04*

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC | Alumina

** Note: This insert has 30° positive clearance all around.*

S-SNUN-46

Ceramic-Style Insert



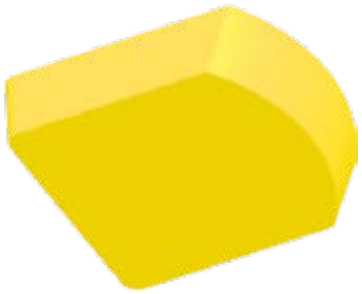
Shape: Scarfing	Part Number	GEM-19	Dimensions (inches)	
			Tube Size	Radius
	S-SNUN-46-B	◆	Up to .875″	0.475
	S-SNUN-46-C	◆	.875-1.125″	0.590
	S-SNUN-46-D	◆	1.125-1.500″	0.785
	S-SNUN-46-E	◆	1.500-1.875″	0.985
	S-SNUN-46-F	◆	1.875-2.250″	1.180
	S-SNUN-46-G	◆	2.250-3.125″	1.575
	S-SNUN-46-H	◆	3.125-3.875″	1.970

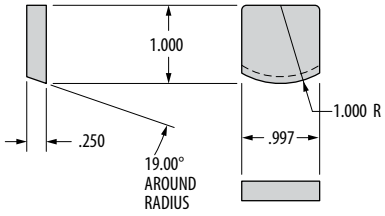
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated — First Choice ◆ Second Choice ● Alternative ▲ — *Grade descriptions — pages TS 04*

CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC | Alumina

ID Scarfing Insert

Other sizes available upon request.





NOTE: This illustration is for reference only

Greenleaf ID tube scarfing inserts are specially designed and manufactured to meet specific customer requirements for various tube scarfing applications.

For more information on Greenleaf's ID tube scarfing capabilities, please contact Greenleaf Technical Service at ***800-763-1820*** or ***techteam@greenleafcorporation.com.***

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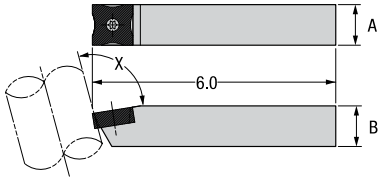
N-SSCPS

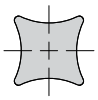


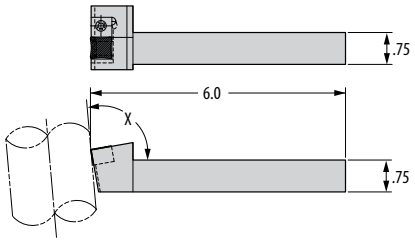
Part Number	Gage Insert	Angle X	Dimensions (inches) A	Dimensions (inches) B	Standard Component Insert Screw	Tune-Up Kit* Includes All Standard Components
N-SSCPS-12-90	S-SPUB-63	90°	0.750	0.750	10-32 x 1/2 IPFHCS	TK-00576
N-SSCPS-12-95	S-SPUB-63	95°	0.750	0.750	10-32 x 1/2 IPFHCS	TK-00576
N-SSCPS-12-100	S-SPUB-63	100°	0.750	0.750	10-32 x 1/2 IPFHCS	TK-00576
N-SSCPS-12-105	S-SPUB-63	105°	0.750	0.750	10-32 x 1/2 IPFHCS	TK-00576
N-SSCPS-16-8-90	S-SPUB-86	90°	1.000	1.000	1/4-20 x 3/4 IPFHCS	TK-00760
N-SSCPS-16-8-95	S-SPUB-86	95°	1.000	1.000	1/4-20 x 3/4 IPFHCS	TK-00760
N-SSCPS-16-8-100	S-SPUB-86	100°	1.000	1.000	1/4-20 x 3/4 IPFHCS	TK-00760
N-SSCPS-16-8-105	S-SPUB-86	105°	1.000	1.000	1/4-20 x 3/4 IPFHCS	TK-00760

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

N-WSCNN

Ceramic Insert Holder

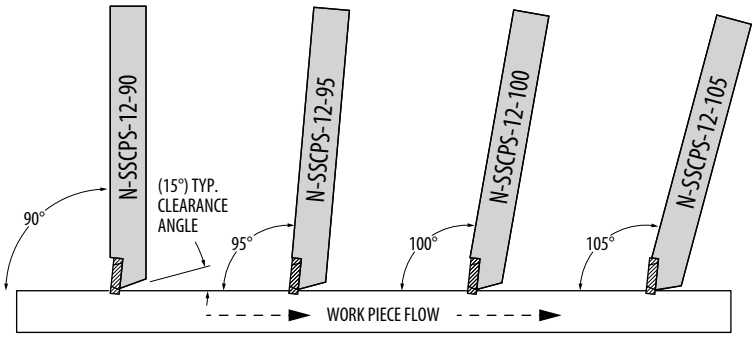




Part Number	Gage Insert	Angle X	Standard Component Wedge	Standard Component Wedge Screw	Tune-Up Kit* Includes All Standard Components
N-WSCNN-12-90	S-SNUN-46	90°	303996	38309	TK-00577
N-WSCNN-12-95	S-SNUN-46	95°	303996	38309	TK-00577
N-WSCNN-12-100	S-SNUN-46	100°	303996	38309	TK-00577
N-WSCNN-12-105	S-SNUN-46	105°	303996	38309	TK-00577

** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

Tool Holder Selection Guide



Notes:

1. *The tool holder angle (Angle X) should match the angle of the tube mill tool post.*
2. *The correct setup will allow for 15° of clearance between the tool holder body, and the top of the tube.*

Special Engineering

Aerospace Tools

Milling Cutters

Special Inserts

Special Designs/Layouts

Link to download Special Tool Design Information Checklist

Special Engineering

Greenleaf Corporation is a leading supplier of cutting-tool technology, specializing in the manufacture of high-performance tungsten carbide and ceramic inserts, as well as inventive tool-holding systems. Greenleaf continues to build on over 75 years of innovation which centers on supplying customers with productive solutions to their metalcutting needs.

Today, Greenleaf Corporation is positioned to serve the evolving needs of companies in all major segments of the metalcutting industry including gas turbine, steel, medical, roll turning, automotive, machine tools and rail. Greenleaf's products are engineered to provide optimal performance against a wide range of materials under the most rigorous metalcutting conditions.

Special engineered or custom engineered products is a visible strength of the Greenleaf product line. Customers from around the world utilize the Greenleaf engineering services to address their specific, and often complex, requirements. Ask us to determine if we can assist you in your cutting tool special requirements.

In addition to specially engineered tooling systems and a comprehensive line of carbide inserts, Greenleaf offers high-quality ceramic and ceramic-composite materials which can be custom designed for specific machining applications.

From its headquarters in Saegertown, Pennsylvania, and a facility in North Carolina, Greenleaf maintains its commitment to pioneering breakthroughs in cutting-tool technology and to delivering Excelerated solutions for customers around the world.

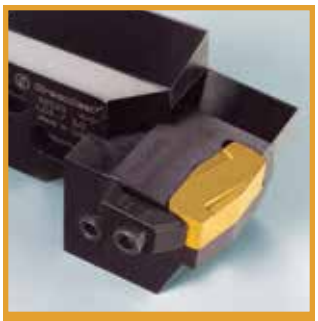
Special Tool Design Information Checklist

If you have a project that needs tooling designed for the needs and demands of that project, we're here to help.

We have a Special Tool Design Information Checklist form that you can download at —
https://www.greenleafcorporation.com/SpecialToolDesignChecklist.pdf

Fill it out and email it to engineering@greenleafcorporation.com.

If you have any questions, don't hesitate to contact the Greenleaf Tech Team at 800-458-1850, or email the engineering department at the above email.



Bar Peeler Cartridge

KM and Capto Shank

Heavy Metal Head

Keyslot

Quick Change Roll Tool

Race Track Groovers

Roll Turning

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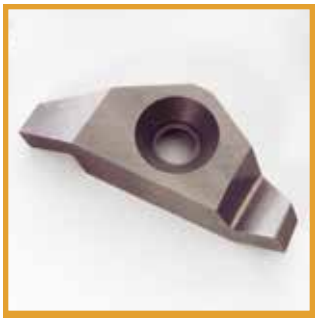
Dovetail Cutter



Heligroove Group

Hogmill

Hook Groove Holder

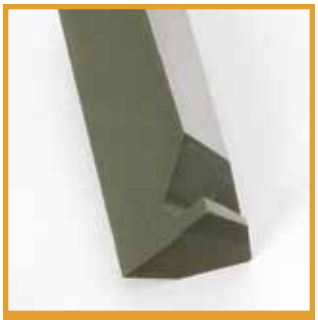
Long Shaft End Mill

Plungeface Cutter

Pod Bore Head

Special Form Insert

Roll Lathe Tool

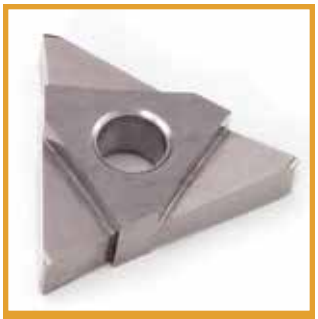


V-Bottom

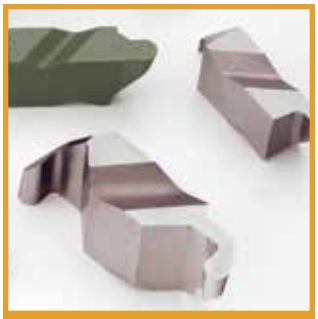
Aero Grooving Tools

Roll Turning Tool

Heavy Turning



Tri-Thread Groover



Powerlock® Grooving Inserts

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Application and Technical Information

Insert Grades

Carbide

Greenleaf offers a comprehensive line of carbide inserts in grades ranging from sub-micron C-1 through C-8 classifications. An industry pioneer in coated carbide, Greenleaf offers a variety of uncoated, MT-CVD coated and PVD-coated grades. Carbide inserts are available in ANSI standard geometries with multi-purpose chipbreakers for heavy roughing through finishing.

Coated

G5125+ A tough, Co-enriched, CVD-coated grade that is ideally suited for the roughing and semi-finishing of steels in turning. Intended applications range from clean and continuous to heavily interrupted cuts in steels of various hardness and composition, at medium to high speeds and moderate feed rates.

GA5023 A high-performance grade designed for the turning and milling of various grades of cast iron, GA5023 features an advanced MT-CVD coating specifically developed to withstand the abrasiveness of cast iron in machining. Applications range from roughing to finishing in most grades of cast iron, including gray, nodular, and others. The high wear resistance and toughness of GA5023 enable high-speed machining in a wide range of feed rates.

GA5025 A high-speed MT-CVD coated grade developed primarily for turning, GA5025 excels in light roughing and finishing applications of carbon and alloy steels, including select stainless steels. GA5025 is preferred when tool life and wear resistance are essential in steel turning.

GA5026 A high-performance grade specifically developed for finish-turning in nickel- and cobalt-based super-alloys, stainless steels, hardened steels, and refractory metals. The advanced MT-CVD coating over a micro-grain substrate offers outstanding wear resistance while maintaining exceptional resistance to notching and deformation common in turning of high-strength materials. GA5026 is best applied at high speeds and low feed rates.

GA5035 A high-performance MT-CVD coated grade for turning all types of steels, GA5035 can be used for heavy roughing to finish-turning applications requiring resistance to heat deformation, thermal shock from interrupted cuts, and abrasion. GA5035 should be applied at high speeds and a moderate range of feeds. GA5035 is the primary choice for steel turning.

GA5036 A high-speed MT-CVD coated milling grade, GA5036 should be used when milling forged and cast steels along with select ductile irons. GA5036 constitutes a unique combination of toughness and heat resistance, making it suitable for heavy and light-duty milling at high cutting speeds. It is a great first choice for all steel milling.

GA5125 A high-performance MT-CVD coated carbide used primarily for the milling and turning of manganese steel. GA-5125 can also be applied in Cr-Mo steels, tool steels, and other alloyed steels in continuous and interrupted turning. GA-5125 provides excellent resistance to abrasion, crater wear, thermal shock, deformation, and built-up edge. It performs best when applied at high speeds and moderate feed rates.

G-5135 A coarse-grain MT-CVD coated carbide, G-5135 is ideal for rough steel turning operations, including scale and moderate-to-heavy interruptions, as well as select steel milling applications. G-5135 is also applicable in the roughing of cast irons and stainless steels. Apply at moderate speeds and high feed rates.

G-910 A PVD-coated grade designed for milling heat-resistant alloys, stainless steel, and low-carbon steels. G-910 should be applied at moderate speeds and moderate to high feed rates.

G-915 A multi-layer PVD-coated grade, G-915 is exceptional for milling and interrupted turning of heat-resistant alloys, stainless steels, and low-carbon steels. The coating adds heat and abrasion resistance to the tough substrate. G-915 should be used at moderate speeds and moderate to high feeds. It is a versatile grade that performs well in a variety of materials and operations outside its primary application range, making it a great choice for general machining.

G-9120 This multi-layer PVD-coated carbide grade excels at milling and turning steel castings and forgings. G-9120 was engineered specifically to maximize productivity at moderate to heavy feed rates and high depths of cut, making it ideal for heavy-turning applications in steel.

G-920 A PVD-coated grade for light-to-medium turning of heat-resistant alloys and some stainless steels. It is also an excellent grade for aluminum and refractory metals. Given its resistance to deformation and notching, G-920 should be applied at higher speeds and is well-suited for grooving and finish-turning of HRSA.

G-9230 A PVD-coated grade designed for the machining of heat-resistant alloys, titanium, hardened steels and stainless steels. G-9230 works particularly well in stainless steel turning, interrupted turning of HRSA, and interrupted turning of titanium. G-9230 has superior wear resistance and toughness and is excellent for casting and forging scale conditions.

G-925 A high-performance multi-layer PVD-coated grade, G-925 is specifically designed for turning abrasive and difficult-to-machine materials. Typical applications include turning of HRSA, titanium and other refractory metals, stainless steels, and ductile cast irons. G-925 exhibits excellent resistance to notching and deformation. Apply at moderate to high speeds and moderate feeds.

G-935 A multi-layer PVD-coated grade for steel milling and turning applications requiring additional resistance to mechanical and thermal shock. The multi-layered PVD coating raises the speed envelope and wear resistance in tough milling, indexable drilling, and interrupted turning applications.

G-9610 A PVD-coated grade, G-9610 is designed for turning titanium-based alloys. The high-tech, wear-resistant, chemically stable, and very smooth and lubricious coating protects the heat-resistant, sub-micron substrate and allows for higher speeds and extended tool life in continuous cuts in non-ferrous alloys.

Uncoated

G-01 Developed for milling heat-resistant alloys, stainless steel, and low-carbon steels at low speeds and moderate to high feeds, G-01 can also be used for turning in the same range of materials with severe interruption or old machinery.

G-01M A tough sub-micron grade, G-01M is used for milling and rough turning stainless steels– even when rolling or casting skin is present. The edge strength of G-01M allows the use of sharp edges and high positive rakes in continuous or interrupted cuts.

G-10 Used for roughing all cast irons in severe conditions, including broaching. The edge strength of G-10 makes it a great choice for roughing Ni-, Co-, and Ti-based alloys with positive rakes, and any machining of non-ferrous materials when toughness is of prime importance. Apply at moderate speeds and feeds.

G-02 An excellent general-purpose cast-iron grade, G-02 can be used for milling and turning cast iron at moderately high speeds and medium feeds. G-02 is also a good choice for machining aluminum with positive rakes and light roughing of some heat-resistant alloys and stainless steels..

G-20M A sub-micron C-2 carbide grade suited for use in light-to-medium turning of titanium and heat-resistant super alloys, G-20M has the strength and edge wear characteristics to resist notching when turning high-strength materials.

G-23 G-23 is a finishing grade for all cast irons, and other short-chipping non-ferrous materials, such as brass and bronze. Apply G-23 at moderately high speeds and moderate feed rates.

G-40 Used for finish turning of cast iron and other hard-wearing materials at high speeds and light feeds in stable conditions.

G-50 Used for the heavy roughing of steel and steel castings in unstable conditions, and ferritic stainless steels in most applications, G-50 is tough enough to enable the use of positive rakes in turning.

G-53 An excellent general-purpose milling grade for steels at moderate speeds and feeds. G-53 has a good combination of toughness and wear resistance for milling, or can be used as an all-around grade for mixed-production applications.

G-60 Used for the heavy rough turning of steel, steel castings, and steel forgings. Apply G-60 at moderate speeds and heavy feed rates and depths of cut. G-60 is more wear-resistant than G-50 but is lower in toughness.

G-74 A roughing and finishing grade for steel and steel castings, G-74 should be applied at high speeds and moderate to heavy feeds. It is well-suited for the turning of steel rolls.

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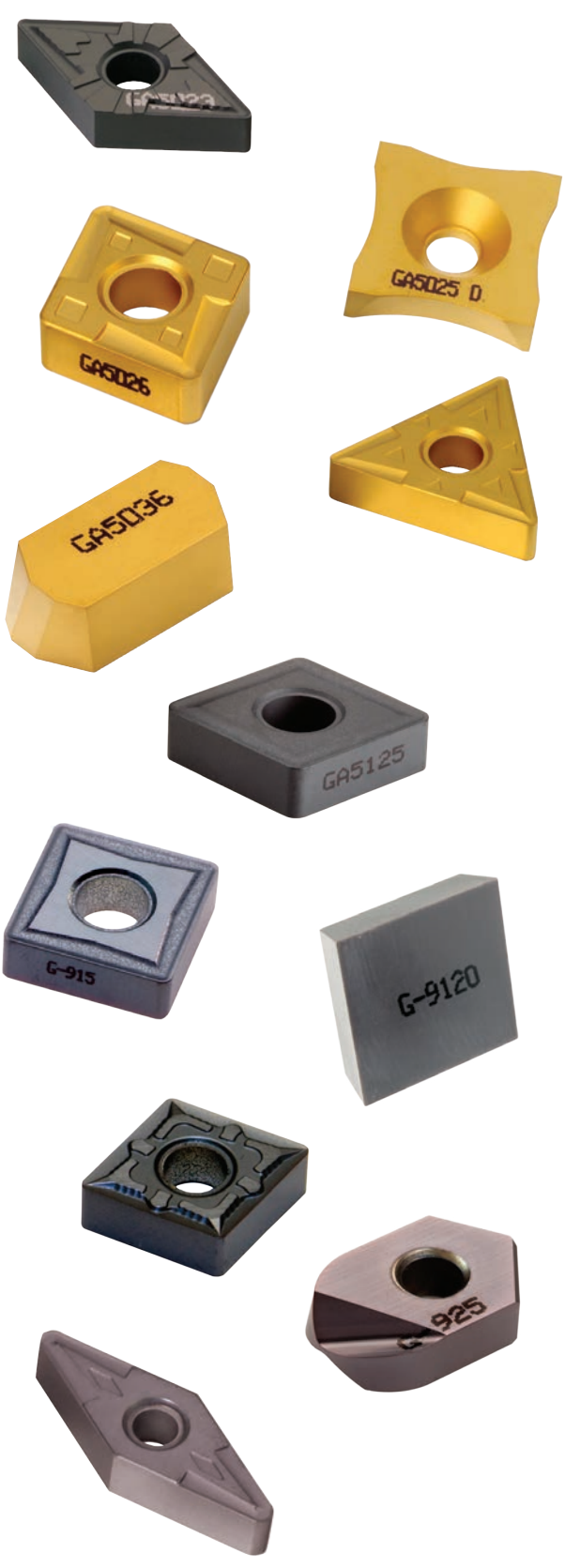
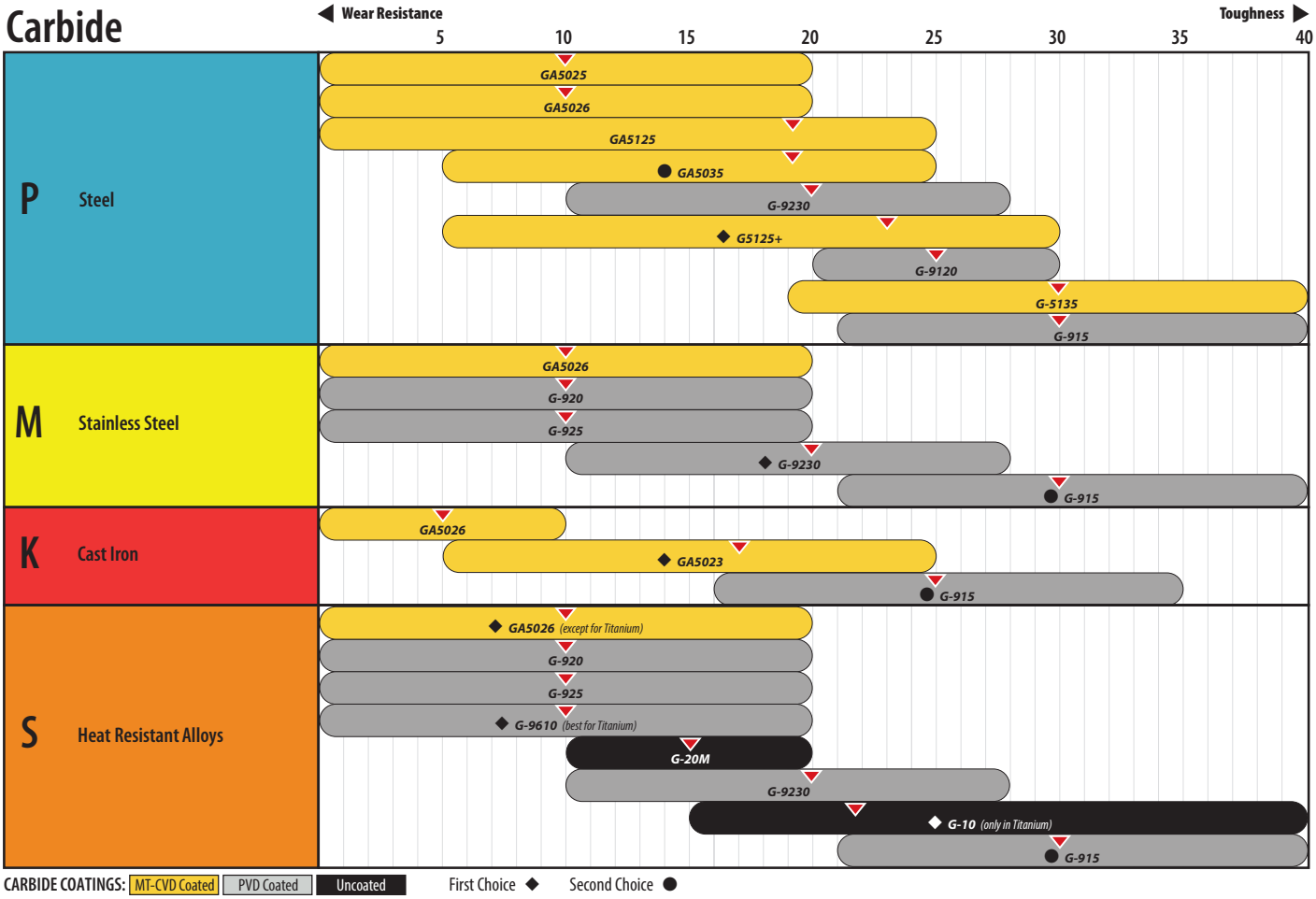

GA5025 D
GA5026
GA5036
GA5125
G-915
G-9120
G-925

Insert Grade Reference

Carbide for Turning, Grooving, and Profiling



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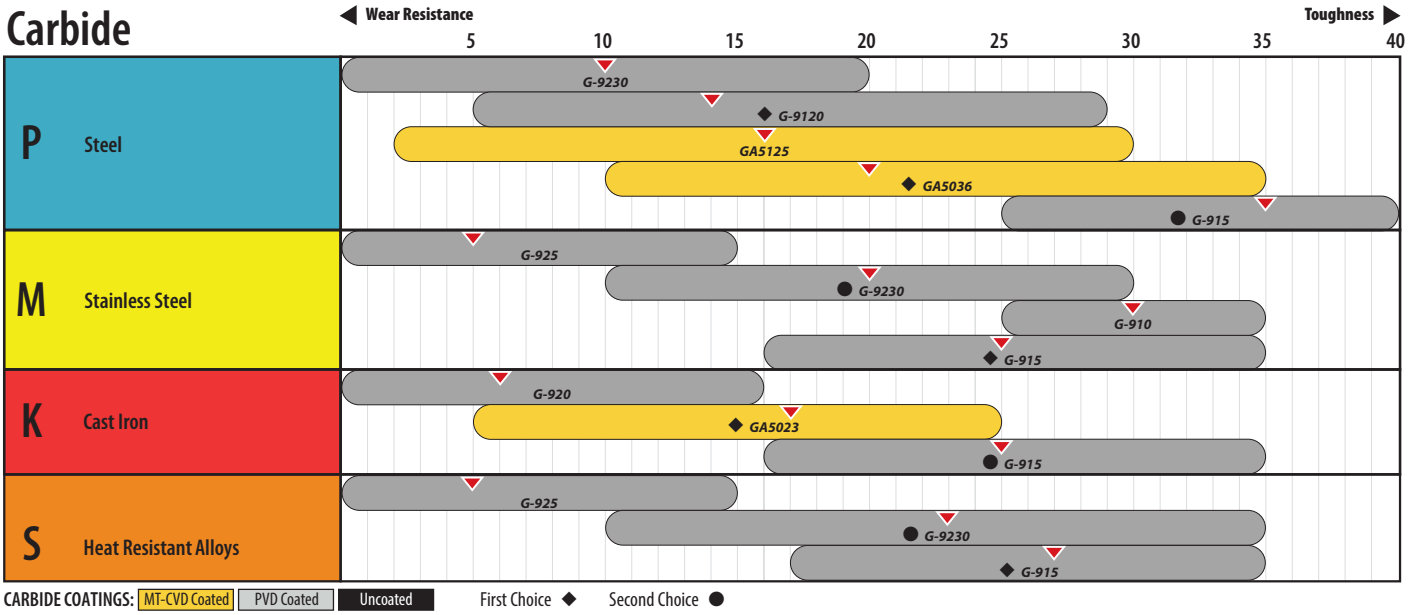
Insert Grade Reference

Carbide for Milling



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Carbide Grade Machining

Recommendations for Turning – Cutting Speed, SFM

	Type	Common Alloys	HRc	MT-CVD					PVD		
				< Wear Resistance				Toughness >	< Wear Resistance		Toughness >
				GA5026	GA5025	G5125+	GA5035	GA5125	G-9120	G-935	G-915
Steel (P)	**Soft Steel**	A36,1018, 8620,1045	< 25	1000	900	900	800	700	750	650	600
	Alloy Steels	4340, 4140	20-25	800	725	725	650	550	600	525	500
	Tool Steels	A2, D2, S7	< 25	650	600	600	525	475	500	450	450
	Die Steels	H13, P20	< 25	650	600	600	525	475	500	450	450

	Type	Matrix	Common Alloys	HRc	Uncoated				MT-CVD	PVD			
					< Wear Resistance			Toughness >		< Wear Resistance			Toughness >
					G-20M	G-23	G-01M	G-10, G-02	GA5026	G-925	G-920	G-9230	G-915
Stainless Steel (M)	**Ferritic**	*Ferrite*	Annealed 400 series (430, 409, 410, 439, 441, 434)	0-25	310	310	310	310	855	690	575	675	590
	Austenitic	*Austenite*	300 series (301, 303, 304, 304L, 309, 310, 316, 316L, 316Ti, 321), 200 series (201, 202, 204Cu, 205)	0-25	260	260	260	260	705	575	475	560	490
	Super-austenitic	*Austenite*	S31266, 904L, N08031, S34565, N08926, S31254, N0828, S32654, 1.4588	0-25	150	165	165	165	425	345	280	330	295
	Duplex	*Ferrite + Austenite*	F51 (1.4462), F53 (1.4410), F55 (1.4501), 255 (1.4507), CD3MN	0-25	180	180	180	180	490	410	330	395	345
	Martensitic	*Plate martensite (high-C)*	Quenched and tempered 400 series (416, 410, 420, 431)	30	295	295	295	295	770	640	525	605	540
				40	260	260	260	260	705	575	475	560	490
		Lath martensite (low-C)	Jethete M152	35	150	150	150	150	395	330	260	310	280
	PH	*Austenite and/or Lath Martensite*	A286, PH14-8Mo, PH15-7Mo, 15-5PH, 15-7PH, 17-4PH, 17-7PH	0-25	165	165	165	165	445	360	295	345	310
				35	150	150	150	150	395	330	260	310	280
				40-45	130	130	130	130	360	295	230	280	245

	Type	Common Alloys	HRc	Uncoated	MT-CVD		PVD
					< Wear Resistance	Toughness >	
				G-02	GA5026	GA5023	G-915
Cast Iron (K)	**Lamellar (Grey) Cast Iron**	GG15, GG25, GG35 (EN-GJL-150, EN-GJL-250, EN-GJL-350)	< 32	450	1150	1000	600
	Nodular (Ductile) Cast Iron	GGG40 (EN-GJS-400)	< 28	360	920	800	600
		GGG60 (EN-GJS-600)	< 28	305	780	680	510
		GGG80 (EN-GJS-800)	30-35	250	645	560	420
	Compacted Graphite Iron (CGI)	EN-GJV-300 -- EN-GJV-500	< 28	235	605	525	425
	Austempered Ductile Iron (ADI)	800 (EN-GJS-800-10	25-30	270	690	600	450
		1200 (EN-GS-1200-3)	35-40	205	520	450	337.5
		1600 (EN-GJS-HB450)	≥ 47	120	310	270	202.5

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Carbide Grade Machining

Recommendations for Turning – Cutting Speed, SFM

Non-Ferrous (N)

Type	Uncoated			MT-CVD		PVD			
	< Wear Resistance		Toughness >	< Wear Resistance	Toughness >	< Wear Resistance			Toughness >
	G-20M	G-02	G-01	GA5026	GA5023	G-9610	G-920	G-9230	G-915
Aluminum Alloys	1250	900	750	–	–	2000	1800	1650	1650
Brass, Copper, Bronze	400	300	250	650	500	650	600	550	550

Heat-Resistant Super Alloys (S)

Type	Matrix	Common Alloys	HRc	Uncoated				MT-CVD	PVD				
				< Wear Resistance			Toughness >		< Wear Resistance				Toughness >
				G-20M	G-23	G-01M	G-10, G-02	GA5026	G-9610	G-925	G-920	G-9230	G-915
Corrosion-Resistant	*Nickel or iron*	Inconel 625, Incoloy 825, Hastelloy, Monel	–	115	100	100	100	280	245	230	180	215	195
High-Strength	*Nickel or cobalt*	Inconel 718, Rene 220, C-263, Haynes 188, Haynes 282, FSX-414	0-25	115	100	100	100	280	245	230	180	215	195
			35	100	80	80	80	260	215	195	165	180	165
			40-45	80	65	65	65	215	195	180	150	165	150
			45-50	80	65	65	65	195	180	165	130	150	150
			50+	65	50	50	50	165	150	130	100	115	115
	Nickel	Waspaloy, RR1000, Rene 41-125, Udimet, GTD111-444, MM-247, C1023, IN100	0-25	100	80	80	80	260	215	195	165	180	165
			35	80	65	65	65	215	195	180	150	165	150
			40-45	80	65	65	65	165	180	165	130	150	150
			45-50	65	50	50	50	130	150	130	100	115	115
			50+	50	35	35	35	130	130	115	100	100	100
Wear-resistant	*Nickel or cobalt*	Stellite, Eutalloy, Metco, Wall Colmonoy, Weartech	20	100	80	80	80	280	245	230	180	215	195
			40	50	35	35	35	165	150	130	100	115	115
Titanium	*Alpha Ti*	Commercially pure, grades 1-4	–	165	130	130	130	–	330	295	230	280	260
		Ti-5Al2Sn, Ti-8Al1Mo1V	–	150	115	115	115	–	295	260	215	245	230
		Ti-5522, Ti-834, Ti-6242, Ti-6246, Ti 1100	–	130	100	100	100	–	260	230	180	215	195
	Alpha+Beta Ti	Ti-6Al4V, Ti-6Al6V2Sn, Ti-6Al7Nb	–	100	65	65	65	–	230	195	165	180	165
	Beta Ti	Ti-17, Ti-5553, Ti-10V2Fe3Al, Ti-8823	–	65	50	50	50	–	195	165	130	150	150

Hardened Steel (H)

Type	Common Alloys	HRc	MT-CVD						PVD	
			< Wear Resistance					Toughness >	< Wear Resistance	Toughness >
			GA5026	GA5025	G5125+	GA5035	GA5125	G-5135	G-9120	G-915
Alloy Steels	4340, 4140, 2550	45-50	405	360	405	360	360	315	315	270
		50-55	315	280	315	280	280	245	245	210
Tool Steels	D2, M4, S7, A2	45-50	315	270	315	270	270	225	225	180
		50-55	245	210	245	210	210	175	175	140
Die Steels	H13, P20	45-50	405	360	405	360	360	315	315	270
		50-55	315	280	315	280	280	245	245	210

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Carbide Grade Machining

Recommendations for Milling – Cutting Speed, SFM

	Type	Common Alloys	HRc	MT-CVD	PVD			
					< Wear Resistance			Toughness >
Steel (P)				GA5036	G-9120	G-925	G-935	G-915
	Soft Steel	A36,1018, 8620,1045	< 25	800	1000	825	825	750
	Alloy Steels	4340, 4140	20-25	650	850	700	700	625
	Tool Steels	A2, D2, S7	< 25	600	700	625	625	575
	Die Steels	H13, P20	< 25	600	700	625	625	575

	Type	Matrix	Common Alloys	HRc	Uncoated				MT-CVD	PVD			
					< Wear Resistance			Toughness >		< Wear Resistance			Toughness >
Stainless Steel (M)					G-20M	G-23	G-01M	G-10, G-02	GA5026	G-925	G-920	G-9230	G-915
	Ferritic	*Ferrite*	Annealed 400 series (430, 409, 410, 439, 441, 434)	0-25	410	360	360	360	1000	855	675	820	690
	Austenitic	*Austenite*	300 series (301, 303, 304, 304L, 309, 310, 316, 316L, 316Ti, 321), 200 series (201, 202, 204Cu, 205)	0-25	345	295	295	295	835	705	560	690	575
	Super-austenitic	*Austenite*	S31266, 904L, N08031, S34565, N08926, S31254, N0828, S32654, 1.4588	0-25	215	180	180	180	510	425	330	410	345
	Duplex	*Ferrite + Austenite*	F51 (1.4462), F53 (1.4410), F55 (1.4501), 255 (1.4507), CD3MN	0-25	245	215	215	215	590	490	395	475	410
	Martensitic	*Plate martensite (high-C)*	Quenched and tempered 400 series (416, 410, 420, 431)	30	375	330	330	330	920	770	605	755	640
				40	345	295	295	295	835	705	560	690	575
		Lath martensite (low-C)	Jethete M152	35	195	165	165	165	475	395	310	375	330
	PH	*Austenite and/or Lath Martensite*	A286, PH14-8Mo, PH15-7Mo, 15-5PH, 15-7PH, 17-4PH, 17-7PH	0-25	215	180	180	180	525	445	345	425	360
				35	195	165	165	165	475	395	310	375	330
				40-45	165	150	150	150	425	360	280	345	295

	Type	Common Alloys	HRc	MT-CVD	PVD
Cast Iron (K)				GA5023	G-915
	Lamellar (Grey) Cast Iron	GG15, GG25, GG35 (EN-GJL-150, EN-GJL-250, EN-GJL-350)	< 32	1250	750
	Nodular (Ductile) Cast Iron	GGG40 (EN-GJS-400)	< 28	1000	750
		GGG60 (EN-GJS-600)	< 28	850	640
		GGG80 (EN-GJS-800)	30-35	700	525
	Compacted Graphite Iron (CGI)	EN-GJV-300 -- EN-GJV-500	< 28	655	530
	Austempered Ductile Iron (ADI)	800 (EN-GJS-800-10	25-30	750	565
		1200 (EN-GS-1200-3)	35-40	565	420
		1600 (EN-GJS-HB450)	≥ 47	340	255

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Carbide Grade Machining

Recommendations for Milling – Cutting Speed, SFM

Non-Ferrous (N)

Type	Uncoated	PVD	
		< Wear Resistance	Toughness >
	G-01M	G-9230	G-915
Aluminum Alloys	1200	2000	2000
Brass, Copper, Bronze	400	650	665

Heat-Resistant Super Alloys (S)

Type	Matrix	Common Alloys	HRc	Uncoated				MT-CVD	PVD				
				< Wear Resistance			Toughness >		< Wear Resistance				Toughness >
				G-20M	G-23	G-01M	G-10, G-02	GA5026	G-9610	G-925	G-920	G-9230	G-915
Corrosion-Resistant	*Nickel or iron*	Inconel 625, Incoloy 825, Hastelloy, Monel	–	130	115	115	115	330	295	280	215	260	230
High-Strength	*Nickel or cobalt*	Inconel 718, Rene 220, C-263, Haynes 188, Haynes 282, FSX-414	0-25	130	115	115	115	330	295	280	215	260	230
			35	115	100	100	100	310	260	230	195	215	195
			40-45	100	80	80	80	260	230	215	180	195	180
			45-50	100	80	80	80	230	215	195	165	180	180
			50+	80	65	65	65	195	180	165	115	130	130
	Nickel	Waspaloy, RR1000, Rene 41-125, Udimet, GTD111-444, MM-247, C1023, IN100	0-25	115	100	100	100	310	260	230	195	215	195
			35	100	80	80	80	260	230	215	180	195	180
			40-45	100	80	80	80	195	215	195	165	180	180
			45-50	80	65	65	65	165	180	165	115	130	130
			50+	65	35	35	35	165	165	130	115	115	115
Wear-resistant	*Nickel or cobalt*	Stellite, Eutalloy, Metco, Wall Colmonoy, Weartech	20	115	100	100	100	330	295	280	215	260	230
			40	65	35	35	35	195	180	165	115	130	130
Titanium	*Alpha Ti*	Commercially pure, grades 1-4	–	195	165	165	165	–	395	360	280	330	310
		Ti-5Al2Sn, Ti-8Al1Mo1V	–	180	130	130	130	–	360	310	260	295	280
		Ti-5522, Ti-834, Ti-6242, Ti-6246, Ti 1100	–	165	115	115	115	–	310	280	215	260	230
	Alpha+Beta Ti	Ti-6Al4V, Ti-6Al6V2Sn, Ti-6Al7Nb	–	115	80	80	80	–	280	230	195	215	195
	Beta Ti	Ti-17, Ti-5553, Ti-10V2Fe3Al, Ti-8823	–	80	65	65	65	–	230	195	165	180	180

Hardened Steel (H)

Type	Common Alloys	HRc	MT-CVD		PVD		
			< Wear Resistance	Toughness >	< Wear Resistance		Toughness >
			GA5036	GA5125	G-9230	G-9120	G-915
Alloy Steels	4340, 4140, 2550	45-50	405	360	405	360	360
		50-55	315	280	315	280	280
Tool Steels	D2, M4, S7, A2	45-50	315	270	315	270	270
		50-55	245	210	245	210	210
Die Steels	H13, P20	45-50	405	360	405	360	360
		50-55	315	280	315	280	280

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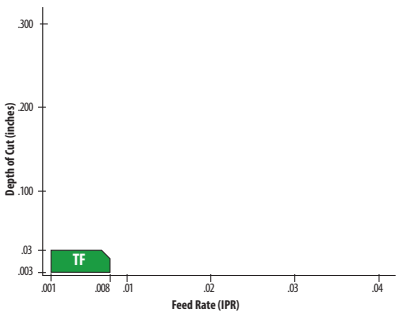
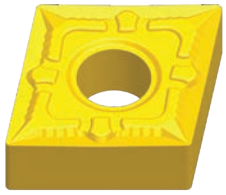
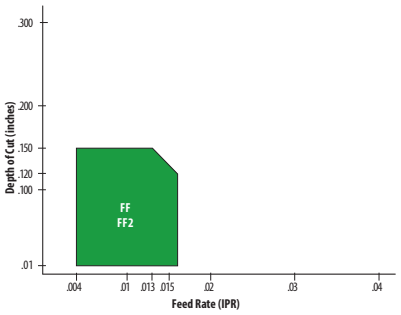
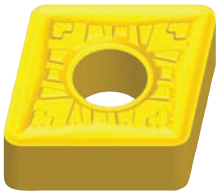
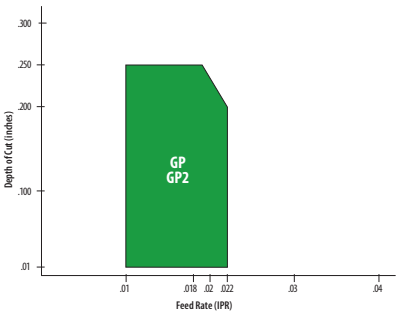
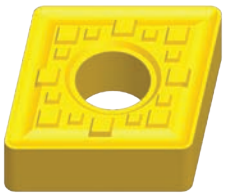
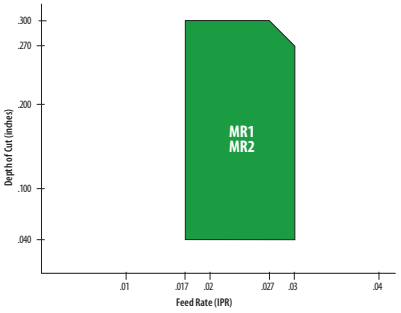
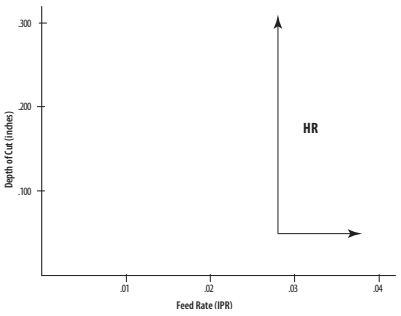
Chipform Application Range

PRECISION FINISHING	TF		Precision ground chipbreaker for nickel alloys. Good for feeds up to 0.009"/rev and depths to 0.03".	
FINISHING	FF and FF2		For finishing all types of material. Designed for feeds up to 0.0185"/rev and 0.15" depth of cut.	
GENERAL PURPOSE	GP and GP2		General purpose chipbreaker. Feed rates up to 0.02"/rev and 0.25" depth of cut.	
MEDIUM ROUGHING	MR and MR2		Used for medium roughing of all material. Feeds up to 0.028"/rev and depths up to 0.30".	
HEAVY ROUGHING	HR		Heavy roughing for all materials. Feeds above 0.023"/rev. One-sided chipbreaker for heaviest feeds (MM). *Example: CNMM 644 HR*	

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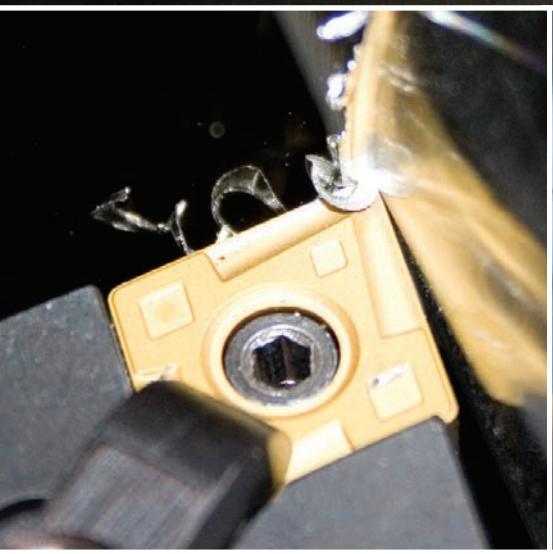
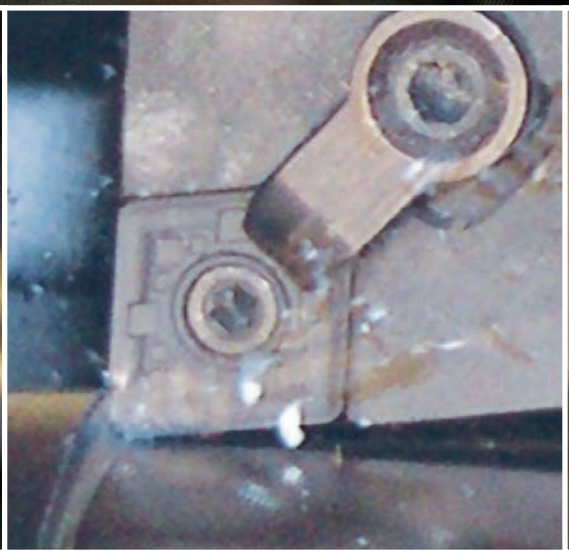
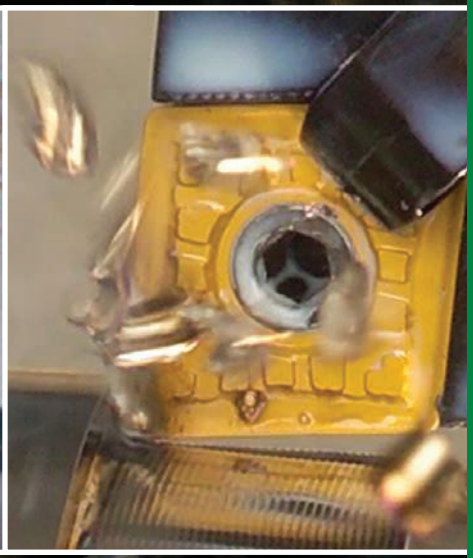
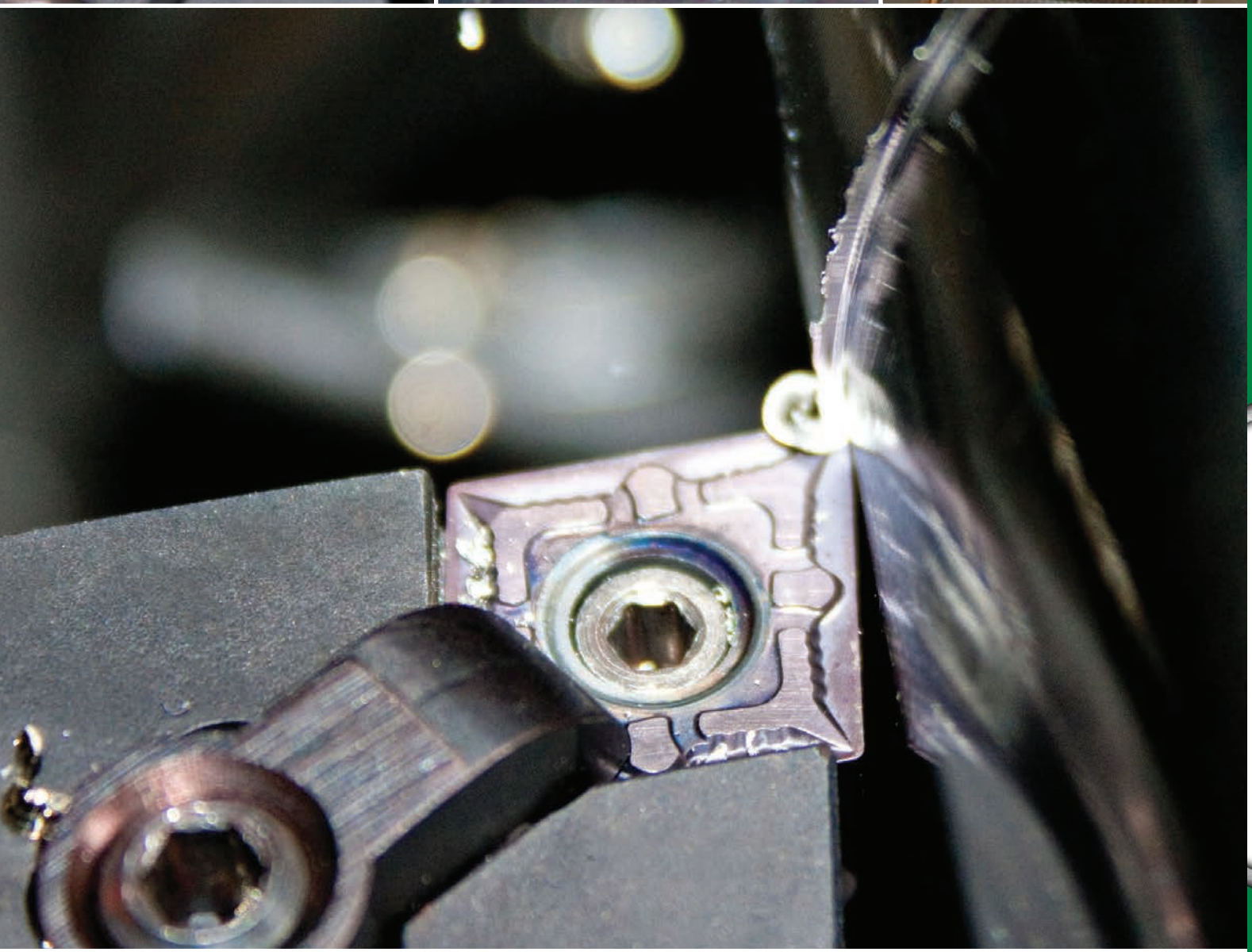
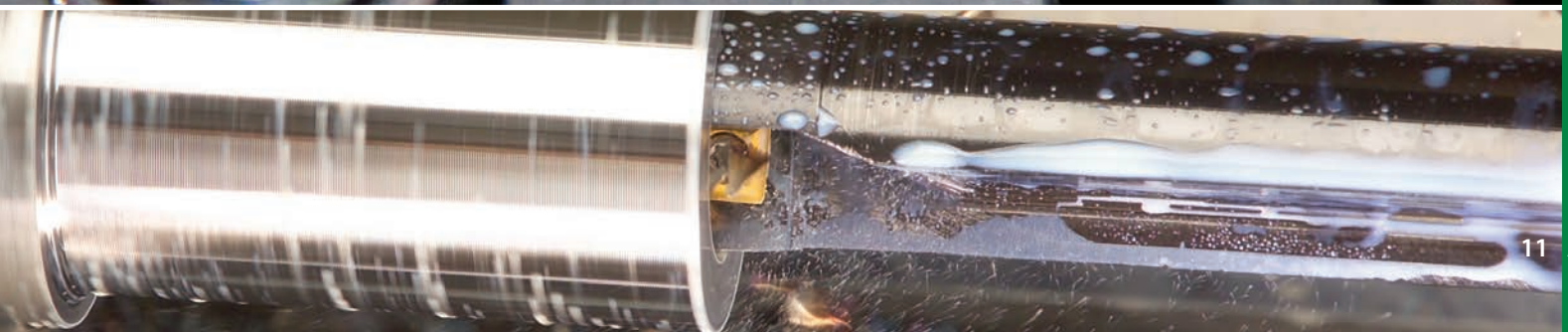










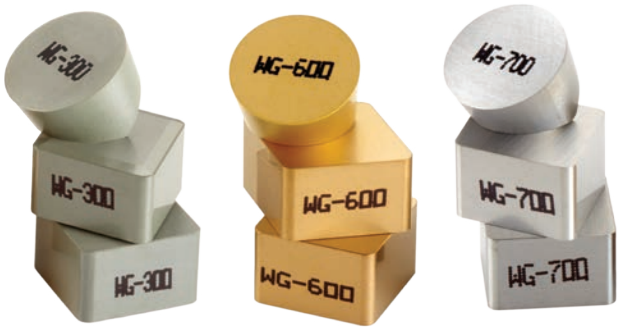
Insert Grades

Ceramic

Greenleaf is the industry leader in the development and manufacture of ceramic and coated ceramic inserts in ANSI standard and special geometries. Some of the most prominent include:

WG-300®

A SiC whisker-reinforced Al_2O_3 ceramic that is very effective at machining nickel- and cobalt-based super alloys, alloyed cast iron, and hardened steels at metal removal rates up to 10 times higher than carbide. Excellent chemical stability and wear resistance at very high cutting speeds make WG-300® the first choice worldwide for grooving and turning difficult materials.



WG-600®

A coated SiC whisker-reinforced Al_2O_3 ceramic that offers higher tool life and speed capabilities than uncoated whisker-reinforced ceramics due to the additional barrier to heat and mechanical abrasion. Application areas for WG-600® include rough and finish turning of alloys in the M, K, S, and H ISO material classes, as well as milling of hardened steels and select stainless steels. WG-600® is particularly well-suited for finish-turning and grooving of heat-resistant super alloys and is unmatched in both turning and milling of steels with a hardness above 60 HRc.

WG-700™

A SiC whisker-reinforced Al_2O_3 ceramic featuring improved toughness and a unique low-friction coating. WG-700™ is ideal for turning, grooving, and profiling nickel- and cobalt-based super alloys that other ceramics may struggle in. WG-700™ exhibits exceptional tool life and productivity in next-generation formulations or novel heat treatments of heat-resistant super alloys, and long-reach or thin-walled applications with lower rigidity.

XSYTIN®-1

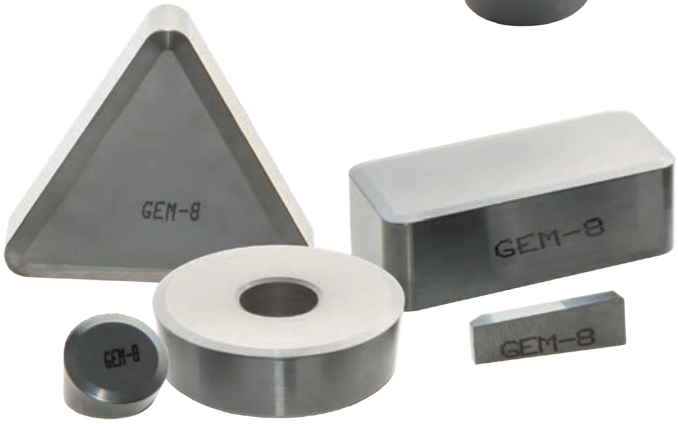
A phase-toughened ceramic grade capable of sustaining extreme cutting forces. The unprecedented strength, impact toughness, and resistance to thermal shock of XSYTIN®-1 make it ideal for use in interrupted cuts, forging scale removal, and milling. In continuous cuts, the strength of XSYTIN®-1 allows the use of significantly higher feed rates or depths of cut. In machining environments with severe interruptions and scale, the edge strength of XSYTIN®-1 allows the use of very light edge preparations, minimizing the force of impact and making for a much smoother cut.

GSN100™

An engineered blend of hot-pressed silicon nitride and proprietary toughening agents that excels in the machining of cast iron. GSN100™ delivers superior wear and toughness for turning, grooving, and milling applications. It is available in all standard geometries and engineered specials.

GEM-8™

An Al_2O_3 + TiC composite ceramic exhibiting excellent hardness and strength at elevated temperatures. GEM-8™ offers a high degree of predictability in roll turning and continuous cuts in ferrous alloys.



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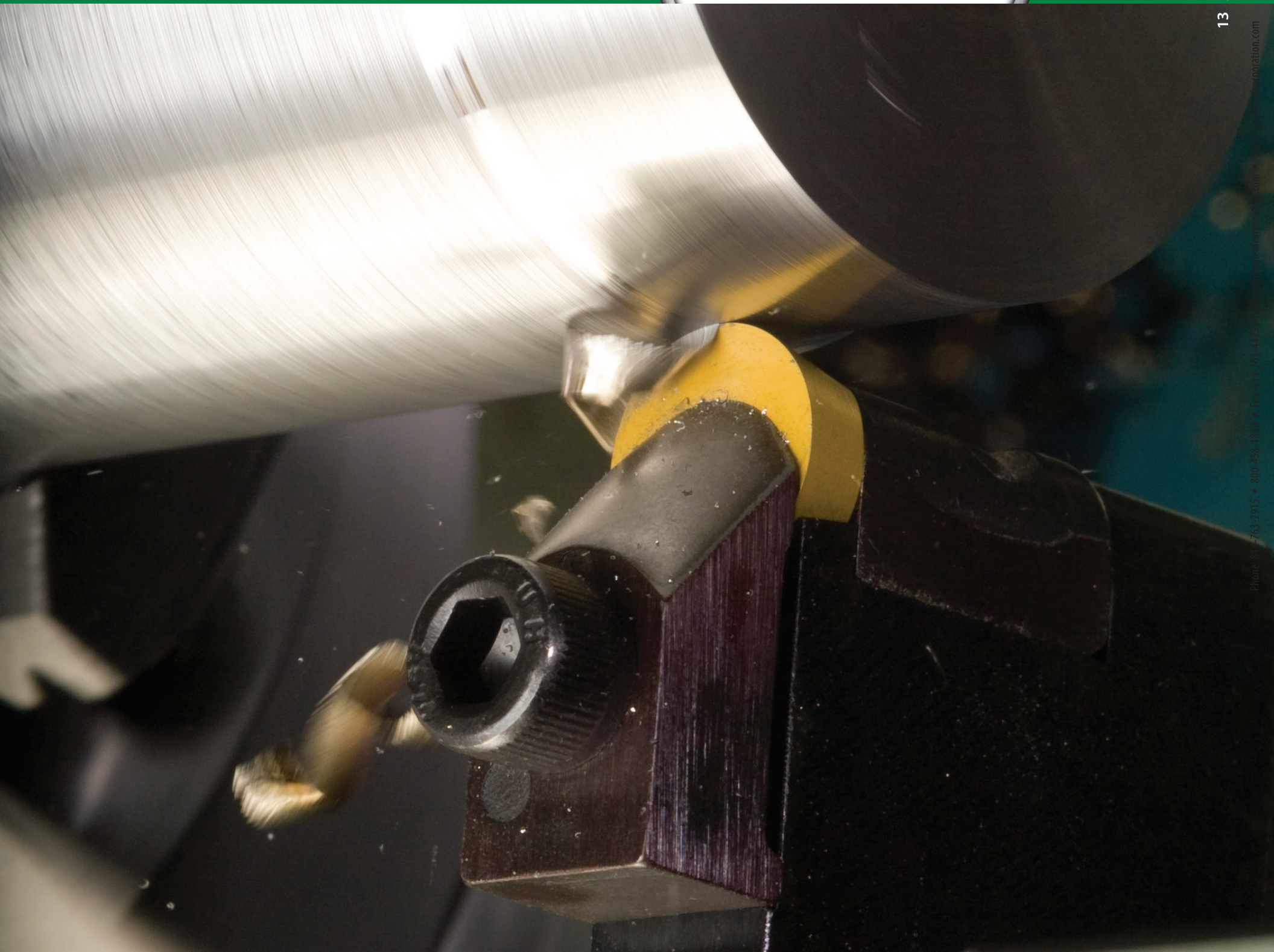

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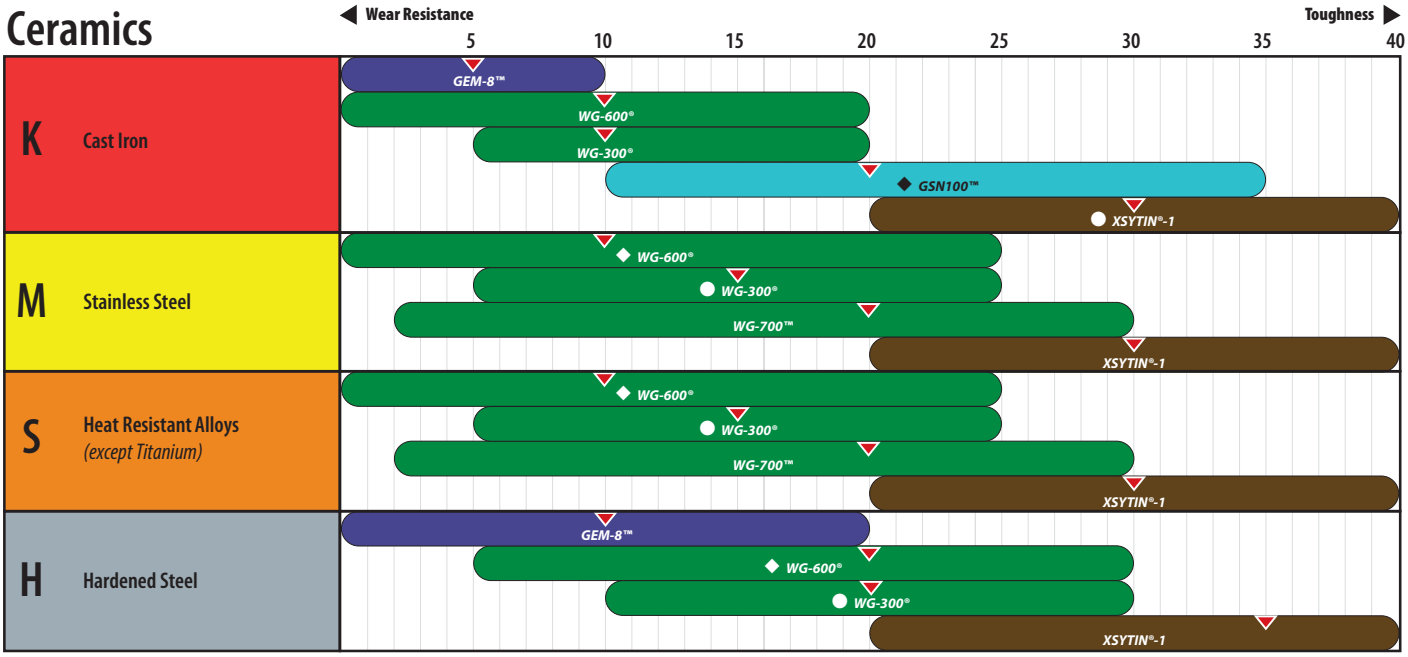
Insert Grade Reference

Ceramic for Turning, Grooving, and Profiling



CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC First Choice ◆ Second Choice ●

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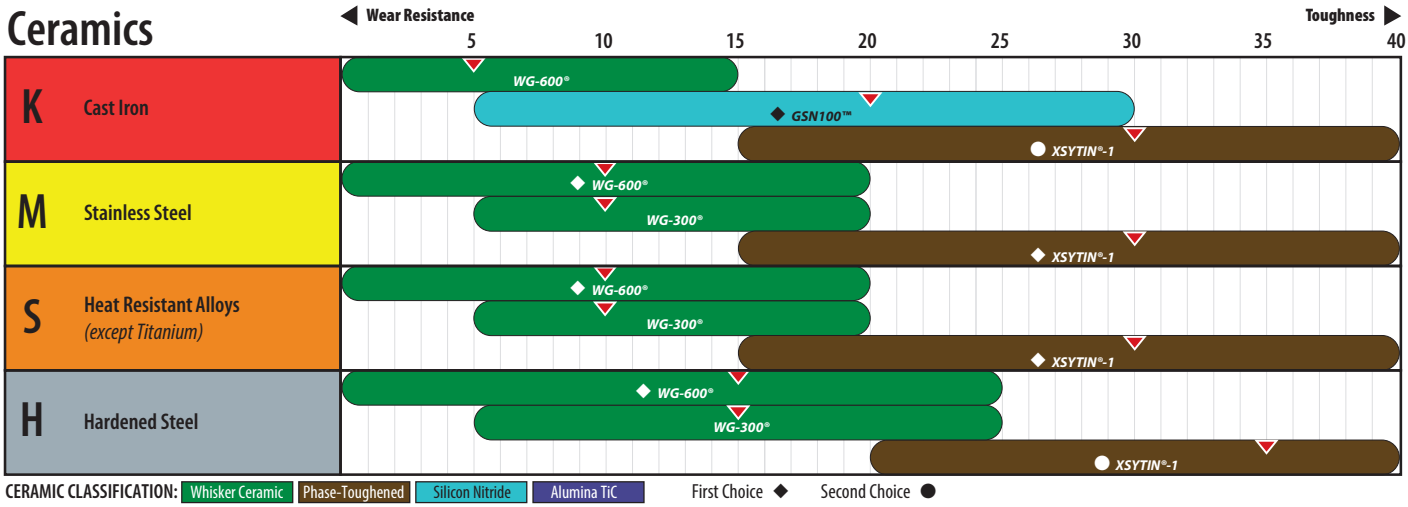
Insert Grade Reference

Ceramic for Milling



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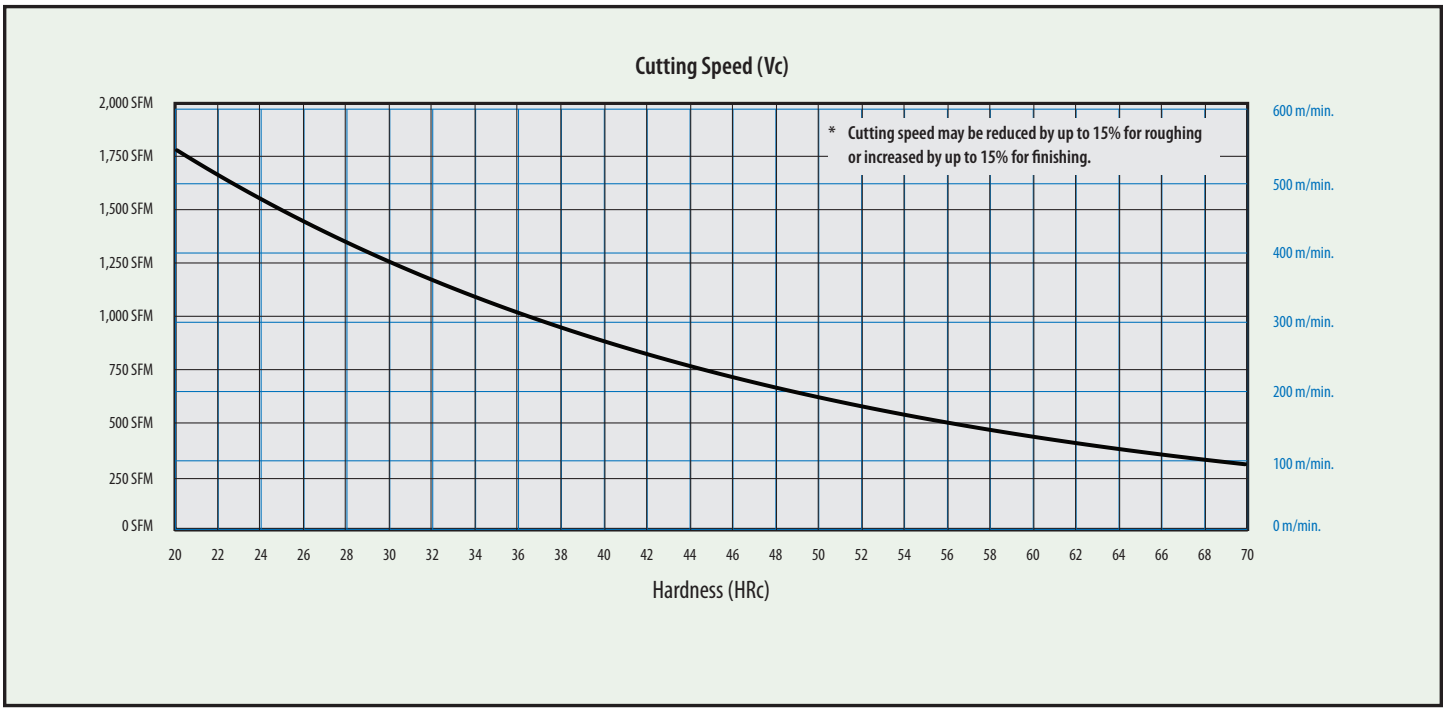
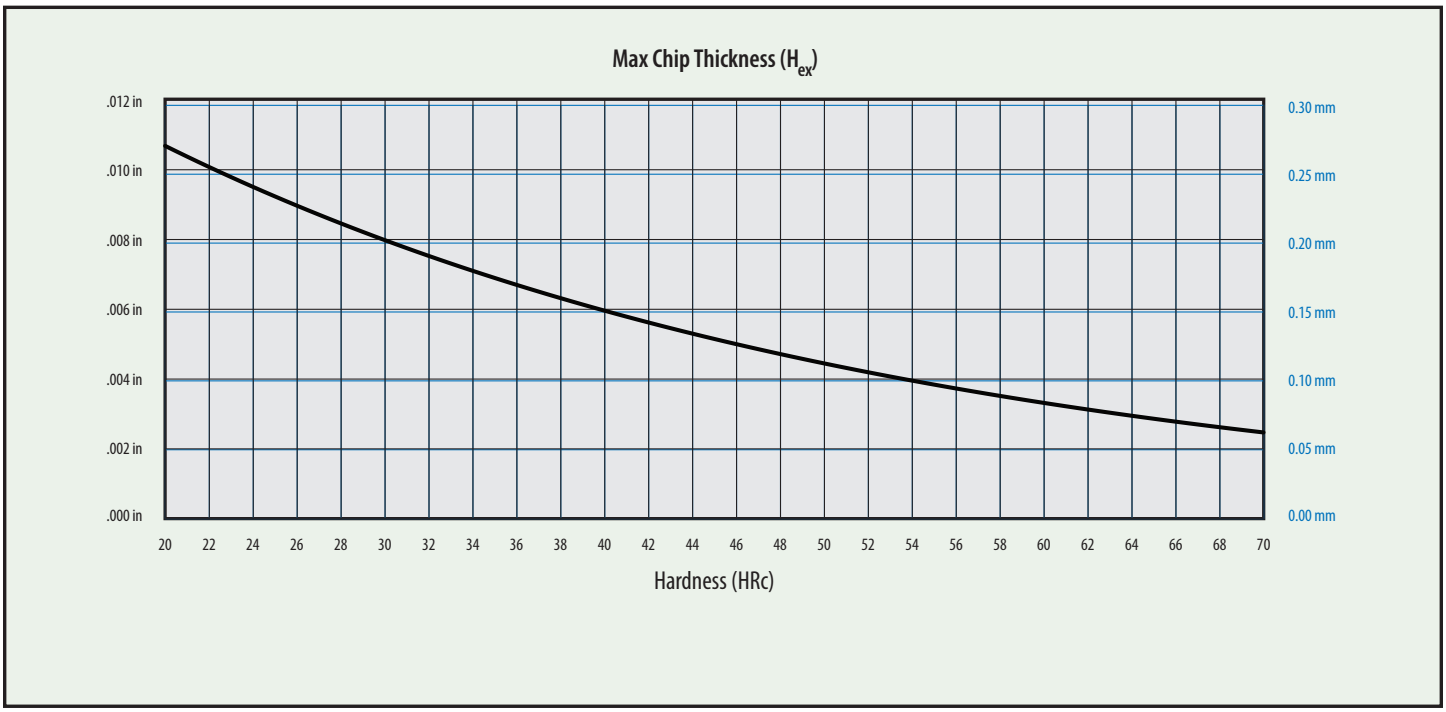
Steel Roll Turning

with GEM-8™





Note: for more recommendations on Cutting Speed and Chip Thickness in turning, see chart on ATI49.

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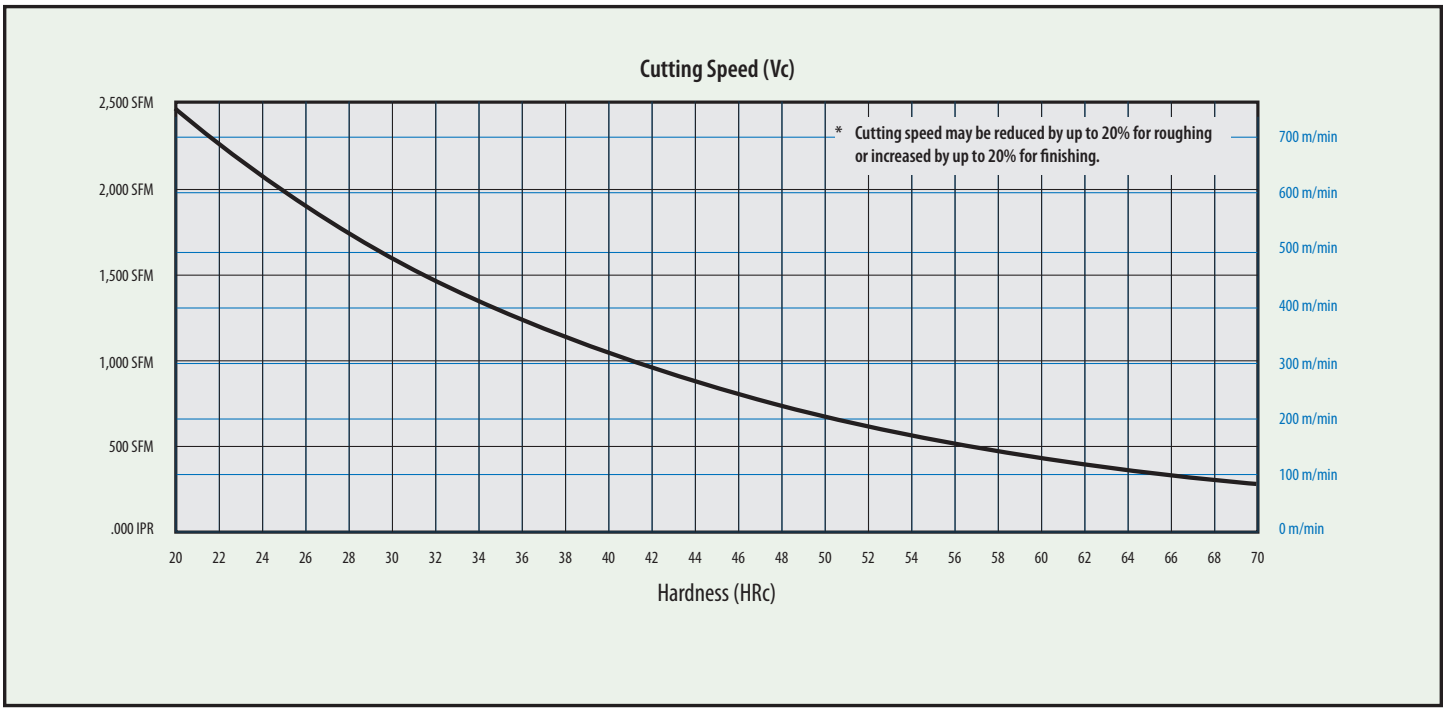
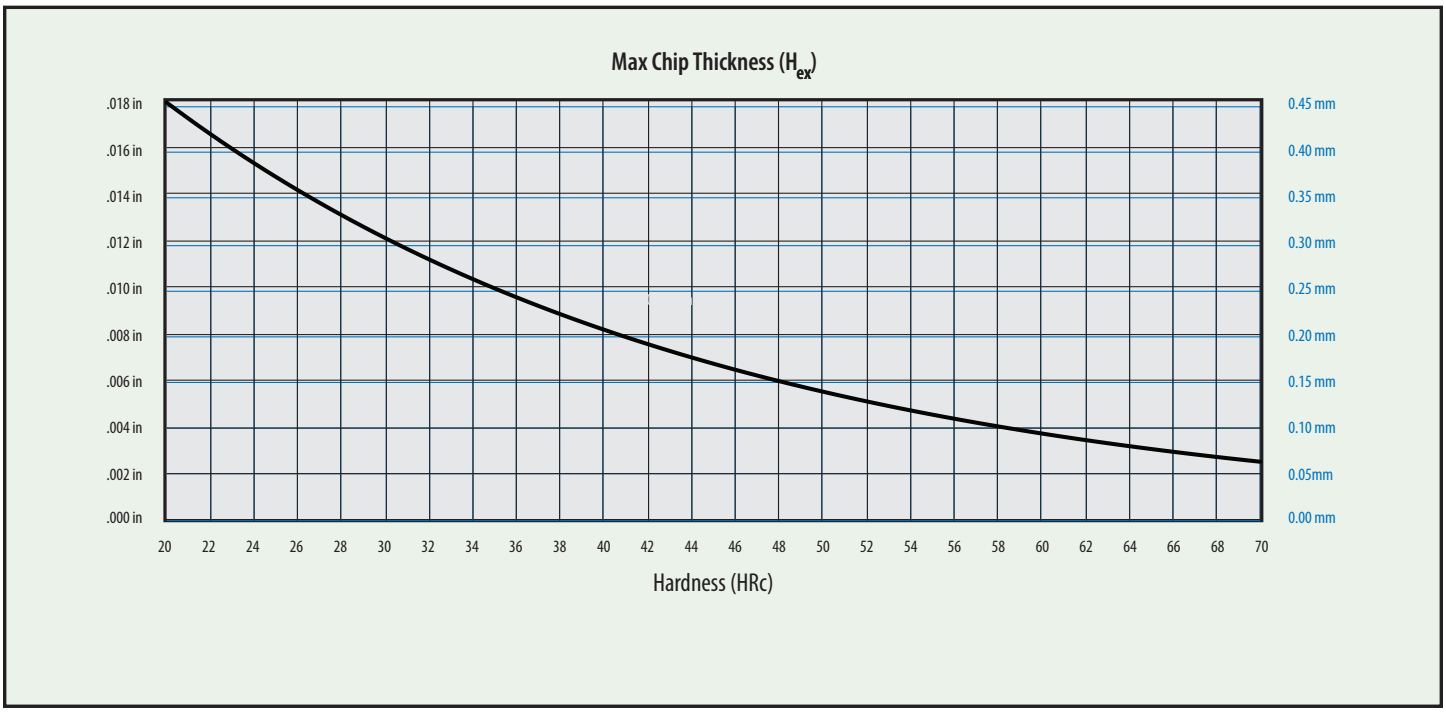
Cast Iron Roll Turning

with GEM-8™

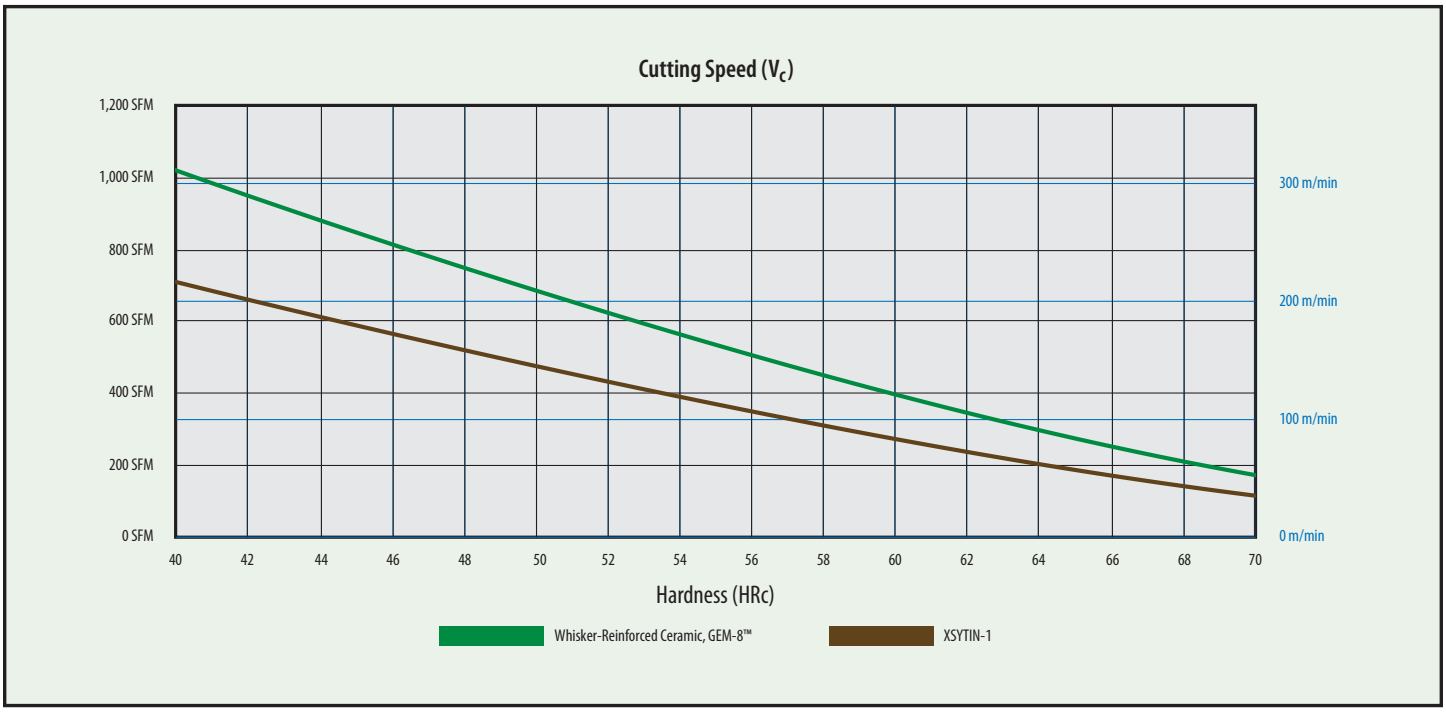


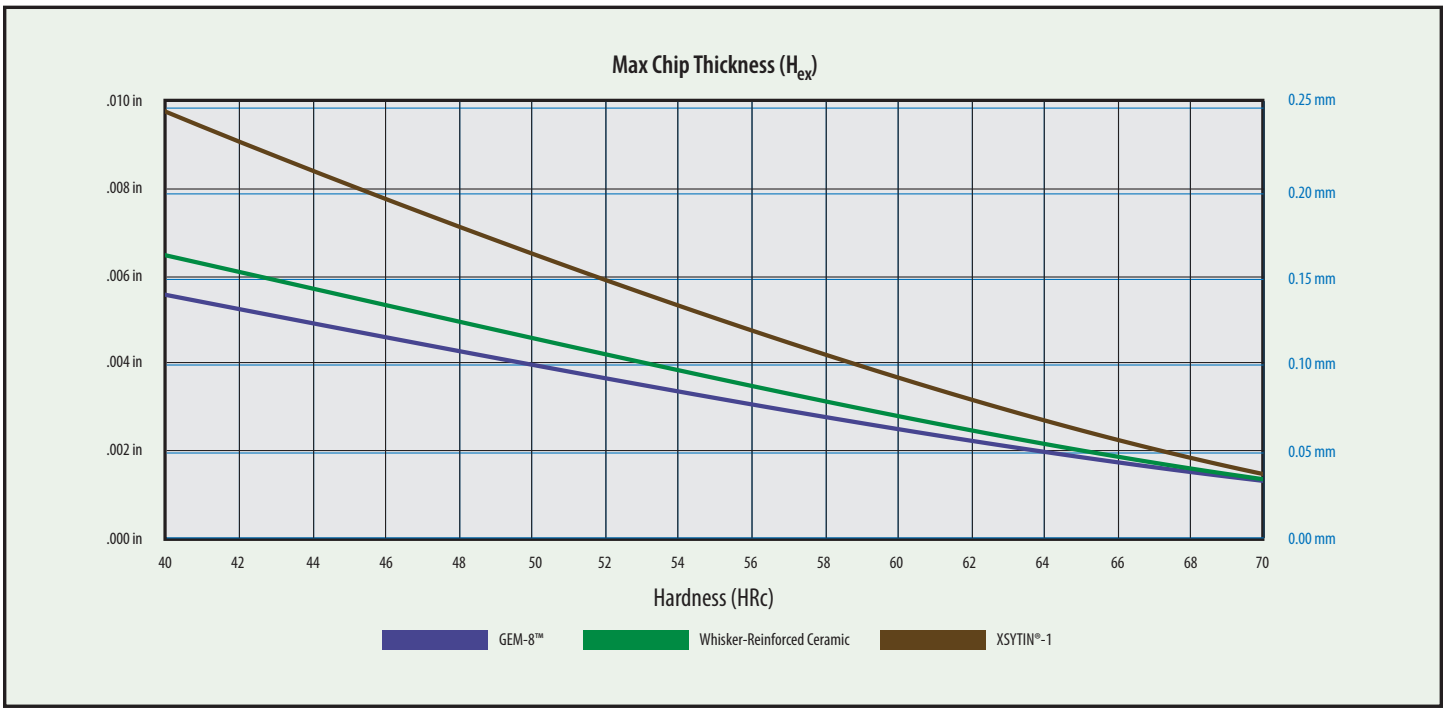


Note: for more recommendations on Cutting Speed and Chip Thickness in turning, see chart on ATI49.

Turning Hardened Steel

with GEM-8™/Whisker-Reinforced Ceramics/XSYTIN®-1





Note: for more recommendations on Cutting Speed and Chip Thickness in turning, see chart on ATI49.

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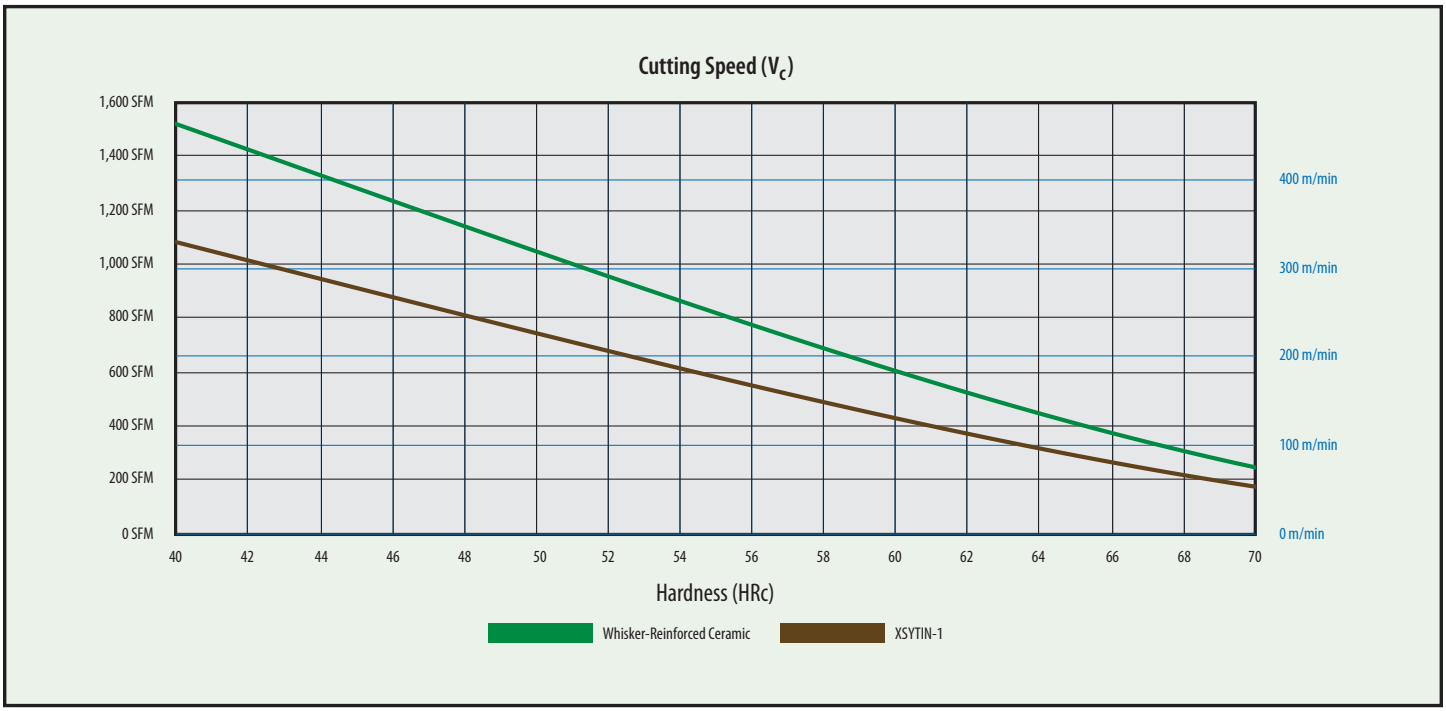
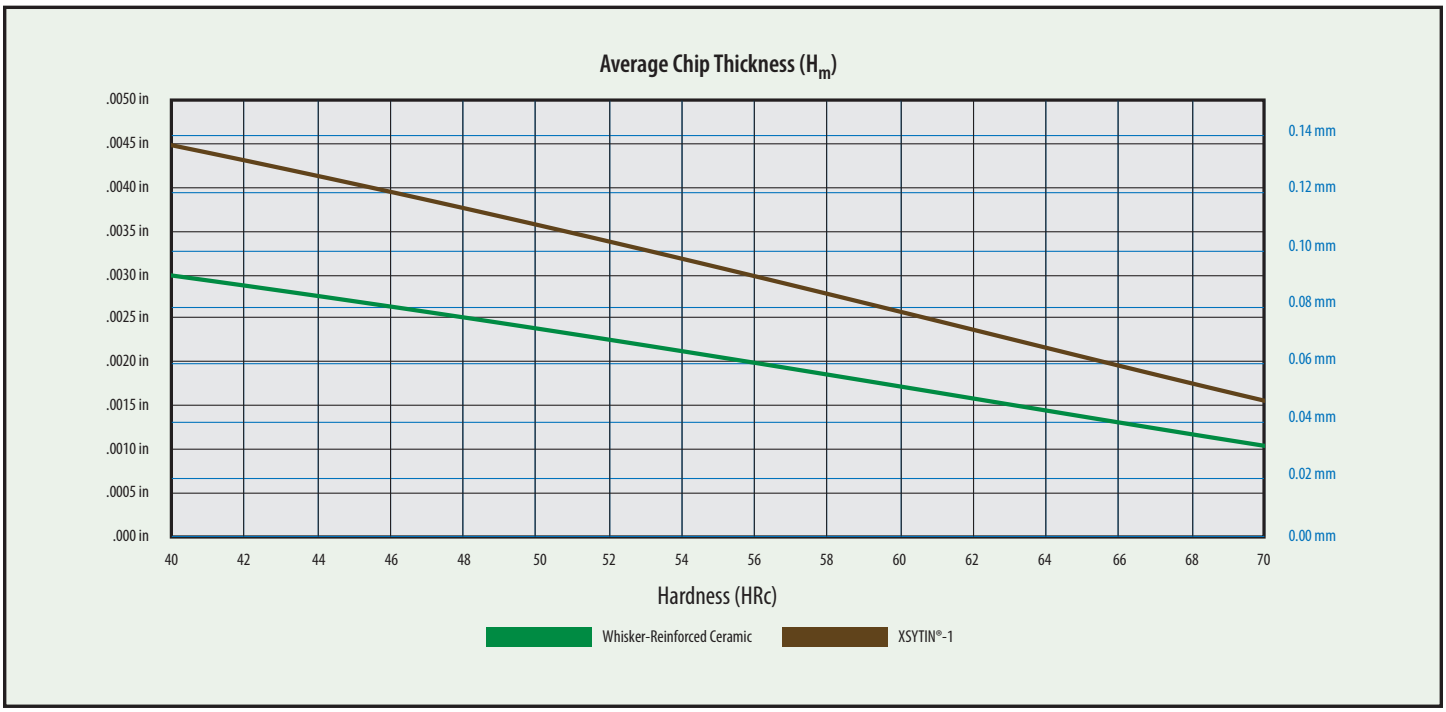
Milling Hardened Steel

with Whisker-Reinforced Ceramics/XSYTIN®-1

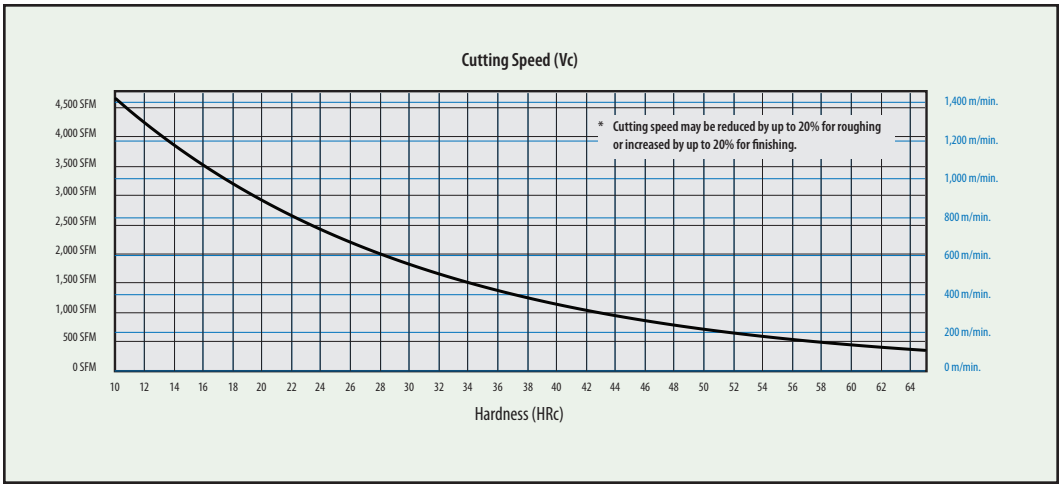


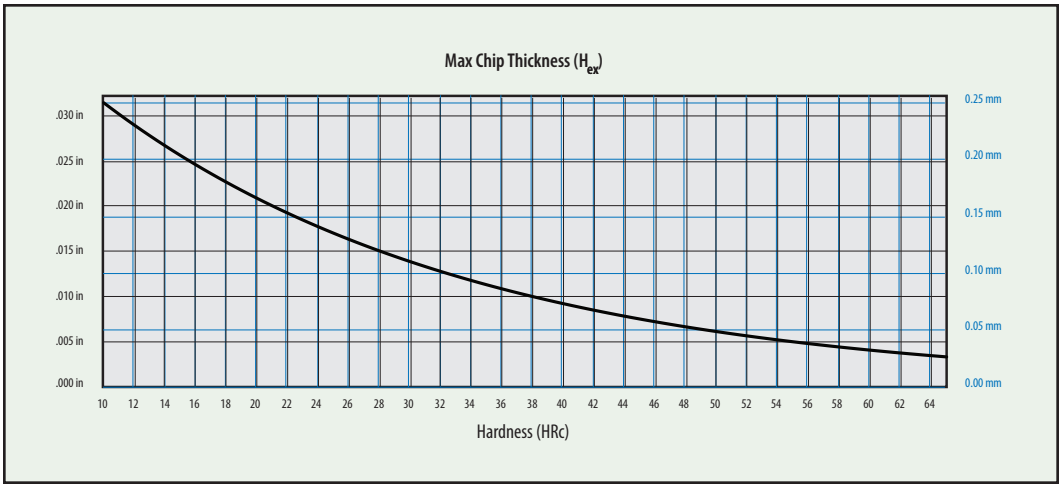


Note: for more recommendations on Cutting Speed and Chip Thickness in milling, see chart on ATI74.

Machining Cast Iron

with GSN100™





Note: for Chip Thickness recommendations, see charts on ATI49 and ATI74.

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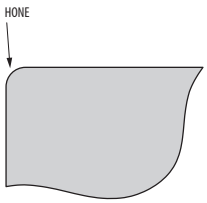
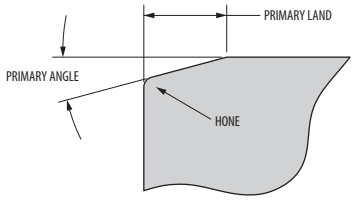
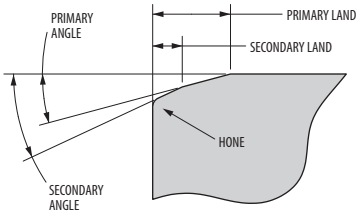
Edge Preparations and Application Guide



HONE



PRIMARY ANGLE



SECONDARY ANGLE

Edge Prep	Hone	Primary Land	Primary Angle	Secondary Land	Secondary Angle	Application
A	.0005 - .001″ R.					Light hone added to designated lands and chipforms • **GEM-8™** – Grooving of grey and nodular cast iron • **WG-300®, WG-600®, and WG-700™** – Finish turning and grooving of HRSA • **GSN100™** – Grooving of grey, nodular, and CGI cast iron • **XSYTIN®-1** – General-purpose milling of HRSA, hardened steel, and maraging steel
B	.001 - .002″ R.					Large hone used in conjunction with heavy machining chamfers and designated negative lands. Applied where more edge strength and protection from irregular wear is required over A-hone.
T1		.002 - .004″	20°			• **WG-300®, WG-600®, and WG-700™** – General-purpose turning of clean HRSA and steel below 50 HRC • **XSYTIN®-1** –General-purpose turning and milling of HRSA (especially of a higher hardness) and hardened steel
T1A	.0005 - .001″ R.	.002 - .004″	20°			• **GEM-8™** – Finish-turning of grey and nodular cast iron or hardened steel • **WG-300®, WG-600®, and WG-700™** – Light-medium turning and milling of hardened steel, lightly interrupted turning and turning of scale in HRSA, milling HRSA, general-purpose turning and milling of stainless steel • **XSYTIN®-1** – Same applications as T1 where the interruption or hardness gradient and size of hard particles are greater - particularly heavy HRSA forging scale turning
T2		.006 - .008″	20°			Used in the same applications as T1 but at heavier depths of cut and/or heavier feed rates • **WG-300®, WG-600®, and WG-700™** – Grey and nodular cast iron turning • **GSN100™** – General purpose grey, nodular, and CGI cast iron milling
T2A	.0005 - .001″ R.	.006 - .008″	20°			• **GEM-8™** – Light-medium turning of grey and nodular cast iron or hardened steel • **WG-300®, WG-600®, and WG-700™** – Grey and nodular cast iron milling, milling of hardened steel, heavy HRSA forging scale turning • **GSN100™** – Same applications as T2 where more edge strength and protection from irregular wear is required • **XSYTIN®-1** – General-purpose cast iron (including white cast iron, ADI, CGI) turning and milling

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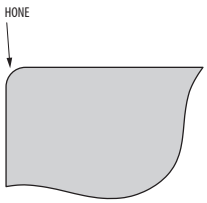
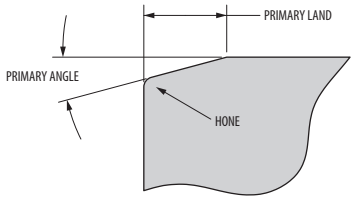
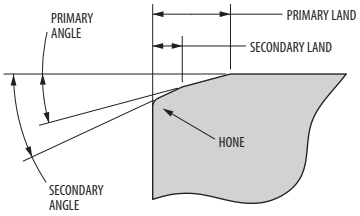
Edge Preparations and Application Guide *(Continued)*



HONE



PRIMARY ANGLE



SECONDARY ANGLE

Edge Prep	Hone	Primary Land	Primary Angle	Secondary Land	Secondary Angle	Application
T3		.013 - .015″	30°			Used on smaller IC inserts as an alternative to T7
T3A	.0005 - .001″ R.	.013 - .015″	30°			Used on smaller IC inserts as an alternative to T7A
T4A	.0005 - .001″ R.	.065 - .075″	10°	.006 - .008″	25°	• **GEM-8™** – Medium turning of roll materials and hardened steel • **WG-300®, WG-600®, and WG-700™** – Medium-rough continuous-interrupted turning of hardened steel and roll materials • **XSYTIN®-1** – Rough turning of roll materials
T4B	.001 - .002″ R.					
T5A	.0005 - .001″ R.	.050 - .060"	15°	.010 - .015"	30°	Same applications as T4A/B where more edge strength and protection from irregular wear is required
T5B	.001 - .002″ R.					
T6A	.0005 - .001″ R.	.050 - .060"	20°	.010 - .015"	30°	Same applications as T5A/B where more edge strength and protection from irregular wear is required
T6B	.001 - .002″ R.					
T7		.015 - .020″	20°			• **WG-300®, WG-600®, and WG-700™** – Heavy turning or milling of cast iron or rough turning of particularly abrasive (high T_i, Al) HRSA • **GSN100™** – Heavy turning or milling of grey, nodular, and CGI cast iron • **XSYTIN®-1** – Heavy turning or milling of cast iron or rough turning of particularly abrasive (high T_i, Al) HRSA
T7A	0005 - .001″ R.	.015 - .020″	20°			• **GEM-8™** – Medium-rough turning of grey and nodular cast iron. • **GSN100™** – Same applications as T7 where more edge strength and protection from irregular wear is required
T9		.006 - .008″	30°			For use with higher feed rates in the same applications as T7
T9A	0005 - .001″ R.	.006 - .008″	30°			Same applications as T9 where more edge strength and protection from irregular wear is required
T10A	0005 - .001″ R.	.090 - .100″	15°	.006 - .008″	30°	• **GEM-8™** – Rough turning of white cast iron and roll materials • **WG-300®, WG-600®, and WG-700™** – Rough, continuous-interrupted turning of roll materials
T10B	.001 - .002″ R.					

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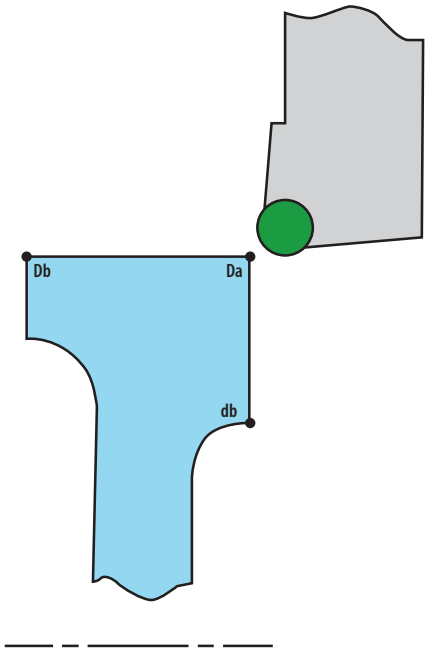
Formulas for Turning and Facing

Imperial



Turning

$$SFM = \frac{Dia. \times \pi \times RPM}{12} \qquad RPM = \frac{SFM \times 12}{Dia. \times \pi}$$

$$T = \frac{LOC}{IPR \times RPM} \qquad LOC\ Da\ to\ Db = \frac{SFM \times 12 \times IPR \times T}{Dia. \times \pi}$$

Facing

To calculate the time (T) for a facing operation from starting point (Da) to finishing point (db):

$$\textbf{Time}\ Da\ to\ db = \frac{\pi\,(Da^2 - db^2)}{48 \times SFM \times IPR}$$

To calculate the endpoint (db) for facing from starting point (Da) to finishing point (db):

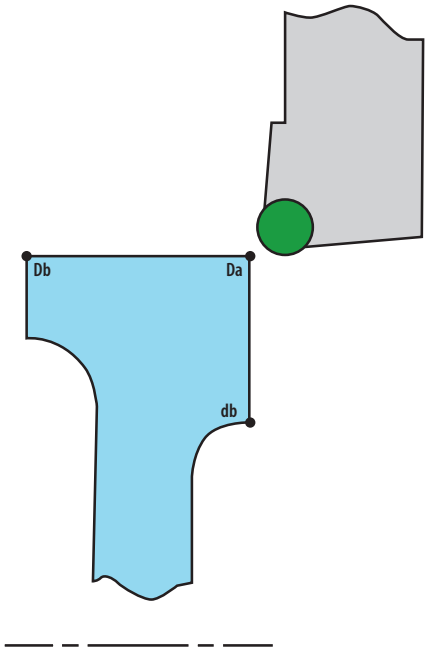
$$db = \sqrt{Da^2 - (15.279 \times T \times SFM \times IPR)}$$

If db is minus, you have passed center.

SFM	= Surface Speed (feet/minute)
IPR	= Feed Rate (inches/revolution)
LOC	= Length of cut (inches)
T	= Time (min.)
π	= 3.1416
D	= Large Diameter (inches)
d	= Small Diameter (inches)
15.279	$= \frac{48}{\pi}$

Note: The constant speed capabilities of the lathe are assumed in the above facing calculations.

Metric



Turning

$$V = \frac{Dia. \times \pi \times RPM}{1000} \qquad RPM = \frac{V \times 1000}{Dia. \times \pi}$$

$$T = \frac{LOC}{S \times RPM} \qquad LOC\ Da\ to\ Db = \frac{V \times 1000 \times S \times T}{Dia. \times \pi}$$

Facing

To calculate the time (T) for a facing operation from starting point (Da) to finishing point (db):

$$\textbf{Time}\ Da\ to\ db = \frac{\pi\,(Da^2 - db^2)}{4000 \times V \times S}$$

To calculate the endpoint (db) for facing from starting point (Da) to finishing point (db):

$$db = \sqrt{Da^1 - (1273{,}2 \times T \times V \times S)}$$

If db is minus, you have passed center.

V	= Surface Speed (meters/minute)
S	= Feed Rate (mm/revolution)
LOC	= Length of cut (mm)
T	= Time (min.)
π	= 3.1416
D	= Large Diameter (mm)
d	= Small Diameter (mm)
1273,2	$= \frac{4000}{\pi}$

Note: The constant speed capabilities of the lathe are assumed in the above facing calculations.

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Optional Clamps

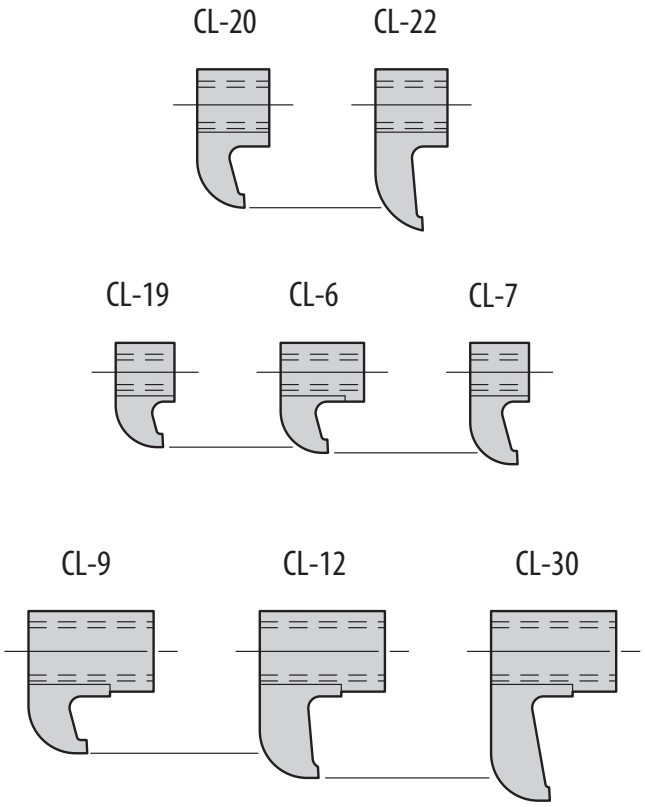
To give maximum flexibility and provide for maximum clamping advantage in any given cutting situation, there are alternative clamps available. The variation in these clamps is the reach. Barrel diameters are common.

A typical example of alternate clamp usage would be in holding an insert without a hole. In this case, the lock pin would be removed and the clamp substituted so that maximum top clamping capability may be applied.

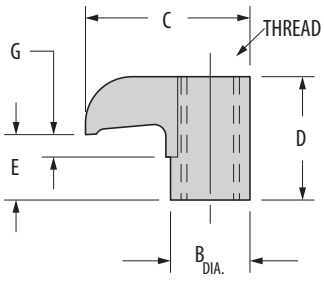
We have chosen as standard for each tool cataloged a clamp and differential screw combination for use with inserts with holes (pinlock). A longer reach clamp should be used when using top clamp alone. If conditions indicate, another combination would be advantageous. Please note as follows:

- Clamps CL-6, CL-7 and CL-19 are interchangeable. The difference is in the reach only.
- CL-9, CL-12 and CL-30 are all interchangeable, the difference being in the reach only.
- CL-20 and CL-22 are interchangeable, the difference being in the reach only.

Barrel diameters "B" and thread sizes are common. The reach "C", height "D", and "E" and "G" dimensions may be different. It is very important that sufficient clearance exist in the toolholder for the clamp to drop down far enough into the holder to attain clamping action on the insert.



Clamp Interchangeability



Order Number	B	C	D	E	G	Thread
CL-5	.280	.520	.350	.102	–	10-32
CL-6	.310	.580	.440	.187	.094	10-32
CL-7	.310	.640	.310	.062	–	10-32
CL-19	.310	.550	.310	.062	–	10-32
CL-9	.430	.750	.660	.344	.125	5/16-24
CL-12	.430	.880	.660	.344	.125	5/16-24
CL-30	.430	1.000	.660	.344	.125	5/16-24
CL-20	.375	.730	.380	.125	–	1/4-28
CL-22	.375	.850	.380	.125	–	1/4-28
CL-24	.491	1.000	.785	.453	.136	3/8-24

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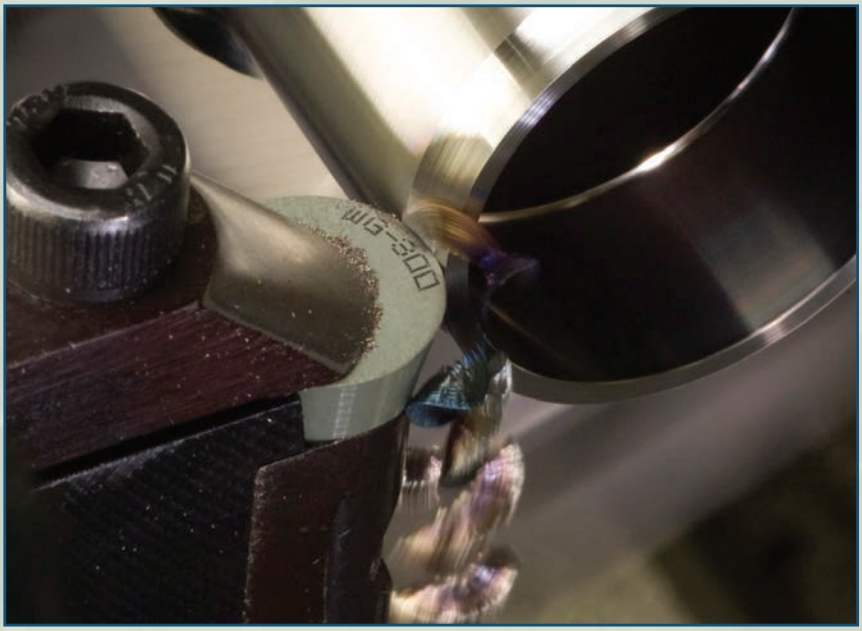
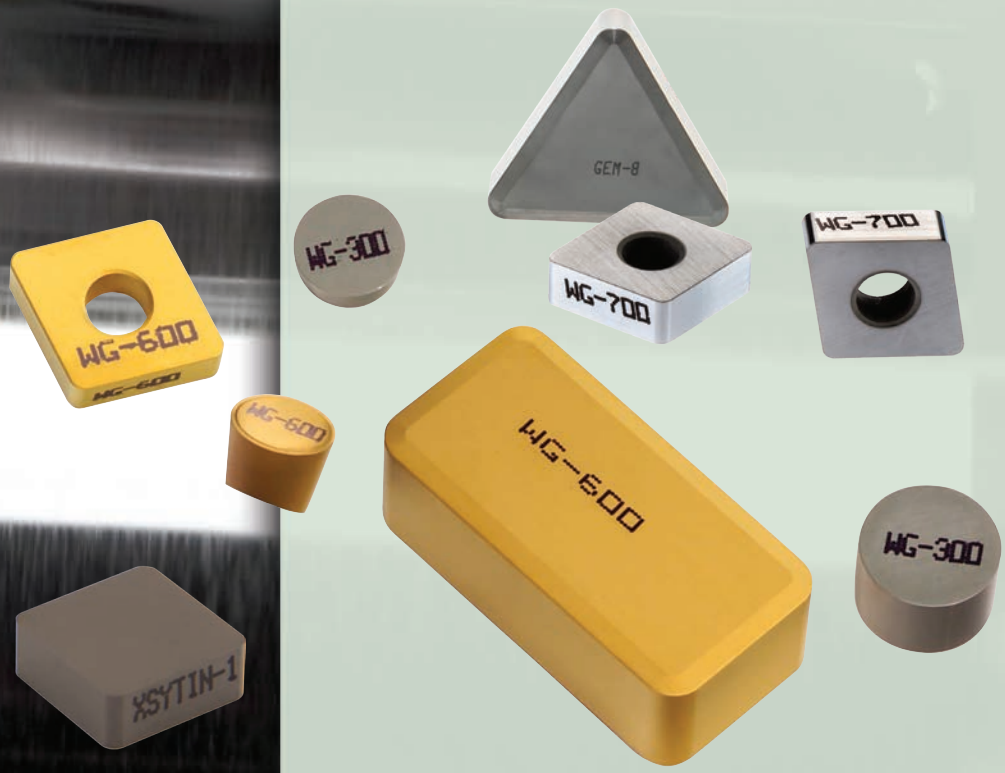
Greenleaf Advanced Ceramics





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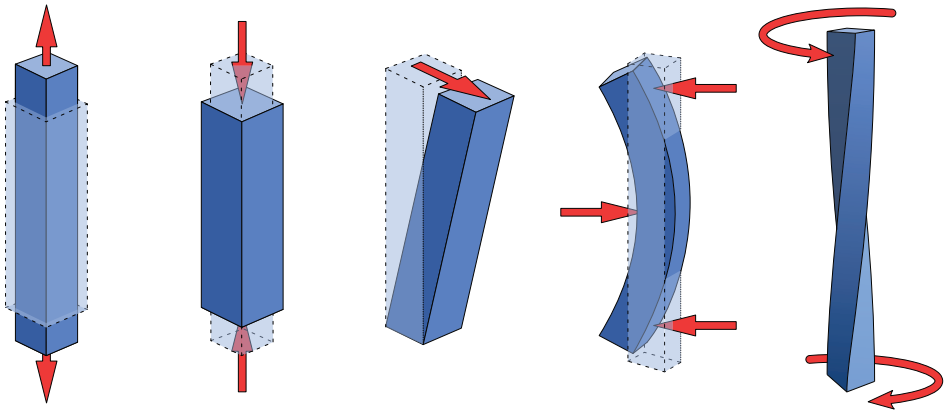
Glossary

Engineering stress	The state of being loaded in a particular direction, accompanied by deformation a.k.a. strain.  *Different types of mechanical stress EN — Creator: MikeRun https://creativecommons.org/licenses/by-sa/4.0/*
Fracture Toughness	The resistance of a material to crack growth. The single best predictor of regularity of wear and tool life in general for a ceramic cutting tool in a continuous cut.
Oxidation (v. Oxidize)	A mode of corrosion in which elements combine with oxygen to create oxides. Usually something to be avoided because it results in the deterioration of mechanical properties of a material. Rapid oxidation is also commonly referred to as 'being on fire.'
Plasticization (v. Plasticize)	The action of thermal softening. Most materials lose strength and hardness with increasing temperature, becoming more ductile and requiring lower forces to deform.
Specific Cutting Energy	The energy required to form a chip of unit volume. Varies with material and strain rate.
Strain	Deformation. Can be elastic, in which case the deformation is recovered after the stress is removed, but in this guide, is used almost exclusively to denote the degree of plastic deformation. Can be tensile, compressive, or shear.
Strain Rate	The rate at which something is deformed. The change in the magnitude of strain per unit of time.
Transverse Rupture Strength	Also known as "modulus of rupture", "bend strength", or "flexural strength". A material property, defined as the stress in a material just before it yields in a bending test.
WC-Co	Sintered tungsten carbide, commonly referred to as 'carbide' – the most common and widely used cutting tool material. It is usually composed of a substrate and a coating, with substrates varying by grain size, % of Co as binder, and any added carbides (TiC, TaC), as well as gradient sintering, enrichment, etc.

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What are Greenleaf ceramic cutting tools?

To answer this question thoroughly we need to start at the beginning – Greenleaf was born in the mid-1940s, as a manufacturer of indexable tungsten carbide and quickly evolved into a recognized toolmaker for the heavy machining industry. After being the first to bring CVD-coated carbide to the US market in 1969 Greenleaf started to develop ceramic cutting tools.

Greenleaf's first commercially viable ceramic cutting tool - "GemPrest" was introduced in 1973 and constituted a hot-pressed Al_2O_3 + TiC composite. Hot-pressing binds the components of a ceramic cutting tool more strongly than cold-pressing and sintering, increasing its hot-hardness and transverse rupture strength. This method of manufacturing cutting tools, with all the intricacies that were developed and added in the intervening years, continues to set Greenleaf cutting tools apart from the rest regardless of their chemical makeup.

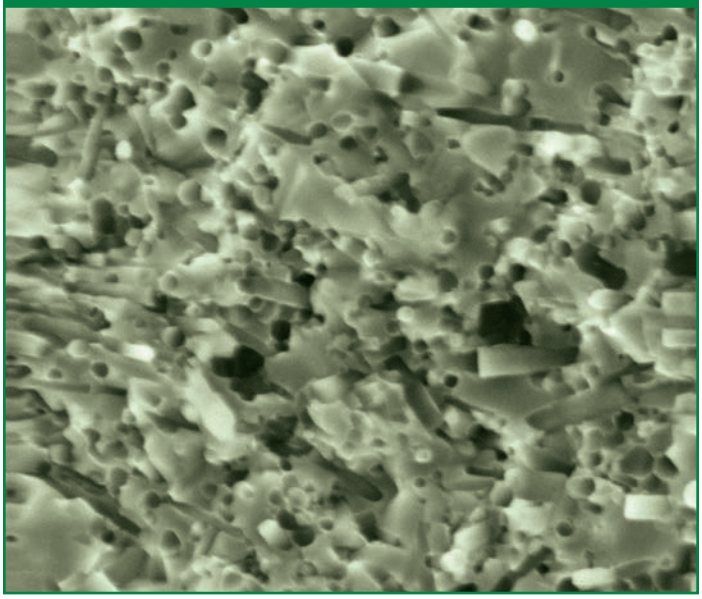
Al_2O_3 in its pure form is a ceramic that is hard, non-reactive, and able to withstand compressive stresses at extreme temperatures, but is also rather brittle – so its uses are limited to a number of specific applications. Reinforcing Al_2O_3 with another material introduces impediments to stress flow, significantly altering its apparent properties. The result is a thermally conductive composite that is tougher, stronger and more resistant to crack growth.

Titanium carbide (TiC) is a very hard ceramic with roughly spheroidal grains and so, mechanically, the reinforcement mechanism is not unlike the reinforcement of cement with gravel to create concrete. The energy a crack must have to go around a TiC grain does not vary significantly with the direction from which the crack approaches the grain. Adding TiC makes the Al_2O_3 matrix more resistant to abrasive wear and stronger in tension, and increases its fracture toughness without sacrificing too much of the original hot-hardness and compressive strength, making it a viable cutting tool. Naturally, much has changed between 1973 and now, and the viability of TiC-reinforced cutting tools especially when it comes to turning of hard, abrasive iron-based alloys has improved dramatically. As such, GEM-8™ shares little with GemPrest other than the most fundamental chemical constituents – Al_2O_3 and TiC.

Silicon carbide (SiC) is also a very hard material, but single grains can be grown to take the shape of elongated hexagonal prisms commonly referred to as 'whiskers' (SiC_w), which makes its reinforcement mechanism very different from that of TiC – closer to the reinforcement of concrete with rebar. Adding SiC_w transforms Al_2O_3 to a much greater extent and produces a composite with properties that strongly depart from both pure Al_2O_3 and TiC-reinforced Al_2O_3. Al_2O_3 + SiC_w was introduced by Greenleaf in 1985 as WG-300® – the cutting tool material that truly marked the beginning of the era of ceramic machining.

WG-300® is the first commercially available ceramic composite using the technology of whisker-reinforcement. These whiskers are grown under carefully controlled conditions and, due to their high purity and lack of grain boundaries, approach the theoretical maximum tensile strength obtainable – on the order of 1 million psi (6,900 MPa). As a direct consequence of the tensile strength of the whiskers, when a crack starts to grow in the Al_2O_3 matrix and encounters a SiC_w crystal at some angle to the plane of the crack it must either go around it where it will inevitably encounter another randomly-oriented SiC_w crystal (and so on and so forth expending large amounts of energy in the process) or it must force the whisker to be pulled out of the matrix – which also requires a lot of energy. If a crack has insufficient energy to force a whisker to be pulled out it will cause the whisker to deform elastically and, once the force is removed, the whisker which is now under tension will act to bring the two planes of the crack back together. In this manner, the fracture toughness of WG-300® is made unprecedentedly high. High fracture toughness in turn means that WG-300® will wear predictably and consistently in even the most abrasive materials.

Figure 30a
Whisker-Reinforced WG-300®'s Fracture Surface



A close examination of the fracture surface at extreme magnification will reveal not only a clear indication of the whiskers randomly dispersed throughout the matrix, but also the obvious hexagonal holes where whiskers have actually been pulled out in the fracture process.

WG-300® properties

Density [g/cm³]	—	3.74
Hardness Hv (500g load)	—	2100
Transverse Rupture Strength [MPa]	—	690
Fracture Toughness [MPa$\sqrt{m}$]	—	10.0
Thermal Expansion [10^{-6}/°C]	—	6.0
Thermal Conductivity [W/mK]	—	35

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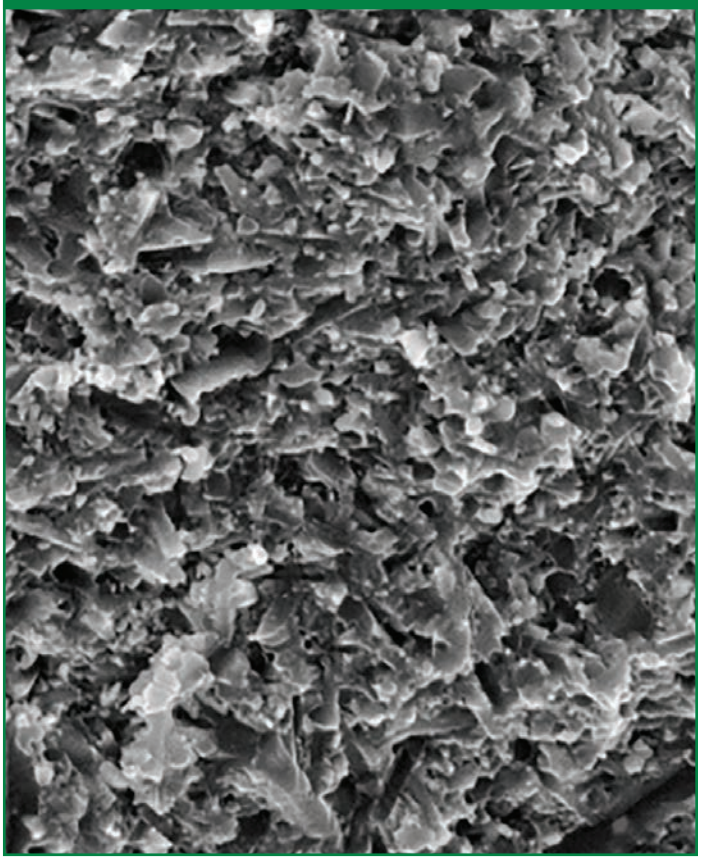
WG-600® is the first commercially available coated whisker-reinforced ceramic composite. The coating increases the tool's hot-hardness and serves to further protect the substrate from oxidation and softening, extending tool life.

WG-700™ is the newest whisker-reinforced ceramic composite featuring improved toughness and a unique high-speed coating.

Concurrent with the work on Al_2O_3 composites, Greenleaf was developing another promising type of ceramic – Silicon Nitride (Si_3N_4). In 1986 Greenleaf launched **GSN100™** – a hot-pressed Si_3N_4-based grade specifically for machining cast iron. Si_3N_4 and SiAlON (silicon nitride with the addition of aluminum and oxygen) ceramics differ from Al_2O_3 composites in a number of ways, but the primary properties that make them viable as cutting tools are their transverse rupture strength and toughness. Without additional strengthening mechanisms their fracture toughness does not begin to approach the fracture toughness of whisker-reinforced ceramics, making most silicon nitride and SiAlON grades currently on the market only suitable for machining grey and nodular cast iron and, in some cases, hardened steel.

XSYTIN®-1 is a Si_3N_4-based phase-toughened ceramic that exhibits a set of unique material properties that make it the ideal cutting tool for a range of applications previously inaccessible to ceramics. Through the manipulation of grain growth and phase distribution, XSYTIN®-1 attains an internal matrix of interlocked grains, that, together with the inherent properties of Si_3N_4 result in a reinforced structure that resists the nucleation and growth of cracks in a multitude of materials and machining environments and offers unparalleled transverse rupture strength and resistance to thermal shock. In practice, this means that XSYTIN®-1 is able to withstand unstable conditions with severe hardness gradients, interruption, or inclusions, or else support a very high chip load in clean cuts without notching. Because of its toughness and transverse rupture strength, applying XSYTIN®-1 outside the (very wide) envelope of recommended cutting conditions will not lead to catastrophic failure – rather the tool will top-slice until a deep notch forms, but will continue to cut while wearing in this fashion. When applied within the envelope of recommended cutting conditions XSYTIN®-1 will exhibit gradual flank wear with little to no notching in the majority of known heat-resistant super alloys, steels, hard cast irons, etc.

Figure 31a
XSYTIN®-1 Fracture Surface



XSYTIN®-1 properties

Density [g/cm^3]	—	3.55
Hardness Hv (500g load)	—	1830
Transverse Rupture Strength [MPa]	—	1200
Fracture Toughness [MPa$\sqrt{m}$]	—	7.5
Thermal Expansion [10^{-6}/°C]	—	3.5
Thermal Conductivity [W/mK]	—	26

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Applying Greenleaf Ceramics

All cutting tools exploit the fact that at a certain elevated temperature the hardness of the cutting tool is still higher than the hardness of the material being machined, and its strength is sufficient to withstand the mechanical loads the cutting tool is subjected to in the course of machining. The difference in hardness allows using the cutting tool to deform the workpiece material until it fails – forming a chip. The effect of the heat generated in cutting is two-fold:

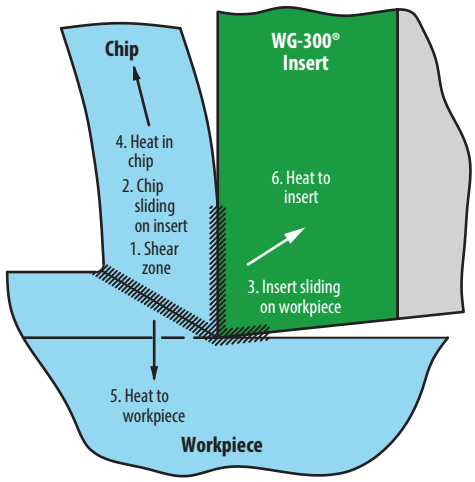
1. Heat produced in the workpiece plasticizes (softens) the material ahead of the cut, reducing the strength of the material, making it easier to cut
2. Heat conducted into the tool plasticizes the tool, reducing its hardness, strength, and adversely affecting tool life

Higher temperatures also tend to raise the reactivity of both cutting tool and workpiece and make it more likely that either will oxidize or otherwise chemically interact.

Heat in cutting is generated through the following actions in descending order of relative magnitude:

1. Chip formation, which, depending on the material being machined and the geometry of the cutting tool will cause the material to fail in some combination of shear and tension with ductile metals failing almost exclusively in shear.
2. Friction between the chip and the cutting tool
3. Friction between the cutting tool and the workpiece

Figure 32a
Heat Distribution in Ceramic Machining



This heat is then dissipated through:

4. Transport away from the cutting zone in the chip
5. Conduction into the workpiece
6. Conduction into the tool

The highest temperature in a metal-cutting operation is typically seen at the very edge of the cutting tool – both in the case of tungsten carbide (WC-Co) and ceramic tools. The main difference between carbide and ceramic cutting tools is how high this temperature can be.

Unlike carbide, ceramics retain strength and hardness at temperatures far exceeding 800°C (1472°F). This property allows for much higher cutting speeds than those of carbide, an attribute that ceramic cutting tools became known for in the machining of heat-resistant super alloys, hardened steel, and various cast irons. The generated heat is dissipated as shown above with the chip carrying away the majority of the heat but the heat produced ahead of the cut plasticizes the material to a much greater extent than in carbide machining, lowering its strength and reducing the specific cutting energy.

In addition to the chosen cutting speed, feed, and depth of cut, the following factors contribute to heat generation:

1. Chip formation
   a. Material: ductility, shear strength and how they vary with strain rate and temperature
   b. Tool:
      i. Macro-geometry: rake angles, cutting edge profile (e.g. extent of curvature)
      ii. Micro-geometry: edge preparation, chipform
2. Friction between the chip and the cutting tool
   a. Coefficient of friction between the workpiece material and the cutting tool
   b. Rake angles, cutting edge profile
   c. Coolant composition and pressure
3. Friction between the cutting tool and the workpiece
   a. Coefficient of friction between the workpiece material and the cutting tool
   b. Clearance between the flank of the tool and the workpiece as affected by the orientation and macro-geometry of the tool and geometry of the workpiece

Application Guideline

1. Use the right tool holder, minimize tool deflection
2. Use the strongest insert possible
3. Use the right edge preparation
4. Use the right grade
5. Use the right cutting conditions
6. Optimize the machining strategy and tool path

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Tool-Holding Selection

The term 'tool' usually refers to that part of the system which interacts with the workpiece to form a chip. When using a solid endmill, the endmill is the tool and the adapter that allows the endmill to be fixed in the spindle is the tool holder. In indexable tooling systems then, the insert is the tool and the milling cutter or turning holder are the tool holder.

Having chosen a tool holder that fits the geometry of the feature being machined (has enough reach to remove all of the programmed stock and enough clearance to avoid collisions), the number one concern when applying ceramics becomes rigidity. The cutting forces generated in ceramic machining are significantly higher than those in carbide machining, and the tool holder provides the interface through which these forces are transferred from the insert to the machine. It is necessary to use the most rigid tool holder and fix it in a manner that will minimize deflection. Any amount of deflection may lead to vibration. High-frequency loading, made higher by the speeds at which ceramics are applied, is extremely detrimental to the tool life of ceramics.

Increasing overhang of tool holders can produce dramatically unfavorable results. For the same cutting force, tool holder material, and cross-section having twice the overhang will result in an eight-fold increase in deflection! Increasing the cross-sectional area of the holder will increase its rigidity and reduce deflection. In practical terms, this means that the larger the cross-sectional area of the tool holder and the shorter the distance between the cutting edge and where the tool holder is attached to the machine (tool hangout) – the less deflection and the lower the detrimental effects of vibration. Whether it is audible or not – microvibration is a phenomenon that is not easy to detect or manage other than through meticulous observation and analysis of wear, or the use of specific measuring equipment in the course of machining.

Most notably, minimizing deflection must be considered when:

1. Using boring bars

Boring bars operate with much greater length-to-diameter ratios than turning tools. In this case, "heavy" metal or solid-carbide bars are often easily justified. Solid-carbide boring bars have three (3) times the modulus of elasticity (E) of a steel bar. This means that a carbide bar will only deflect 1/3 as much as a comparable steel bar under identical circumstances.

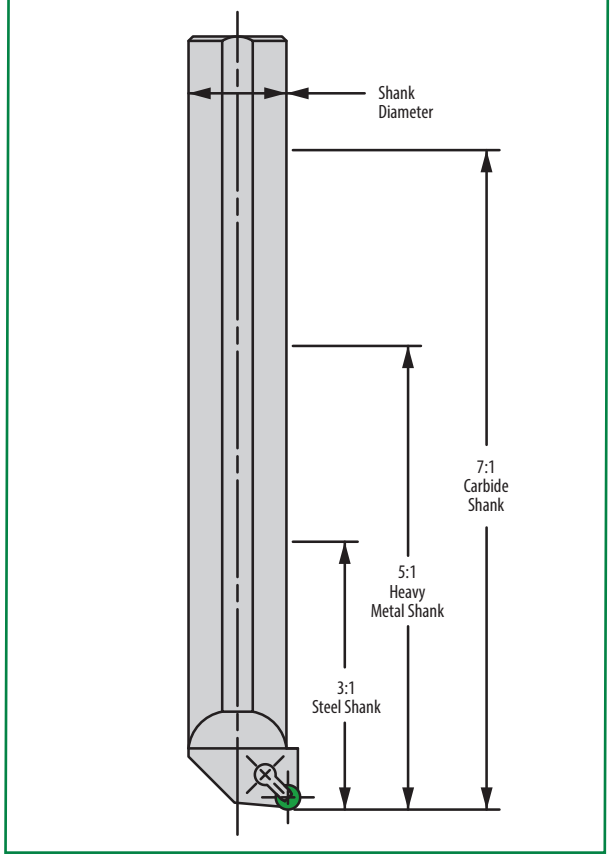
As a general rule, when machining nickel-based alloys, steel boring bars will give adequate performance at hangout-to-bar diameter ratios of up to 3:1. Special boring bars manufactured from "heavy" metals give an advantage over steel bars and can be used at ratios up to 5:1. Carbide boring bars extend this range to ratios up to 7:1. *See Figure 33a.*

2. Mounting shell-style milling cutters on an arbor or endmills in a longer holder

For shell-style milling cutters use an arbor of the largest diameter possible, ideally at least as large as the diameter of the mounting surface of the cutter, and the smallest length possible. For endmills – use the shortest holder possible.

Generally speaking, having a larger contact area between the tool holder and the spindle/turret is also beneficial. So a 50 taper is better than a 40, and fixing a square turning holder so that it is pushed as far into the turret as possible is better than having any of the tool hanging out for no reason.

Figure 33a
Shank Diameter-to-Bar-Length Ratio for Ceramic Inserted Boring Bars



Tool holders designed for ceramic inserts differ significantly from those designed for carbide and Greenleaf tools for ceramic inserts may differ from those produced by another manufacturer. These differences may be as follows:

1. Tolerances and shape of pocket and/or shim leading to incorrect insert seating, and incorrect distribution and transfer of stresses
2. Clamping / fixation leading to incorrect distribution and transfer of stresses
3. Rake angles that are not optimal for ceramic machining

Any of the above may lead to irregular wear or catastrophic failure on their own. Put together – poor tool life is almost guaranteed. Ceramic inserts should NOT[1] be used in a tool holder designed for carbide regardless of the manufacturer in question, and Greenleaf ceramic inserts should only be used in Greenleaf tool holders for ceramics – designed specifically and uniquely to extend tool life of ceramic inserts.

Finally, use integral tool holders whenever possible – modular tool holders add flexibility for usability in multiple applications, but add degrees of freedom that increase the potential for deflection and additional vibration.

[1] *The only set of circumstances in which using a ceramic insert in a carbide holder could be considered is if there is no way to replace the tool, the cut is fairly light, and the ceramic in question is XSYTIN®-1. And even then – regular wear would not be expected.*

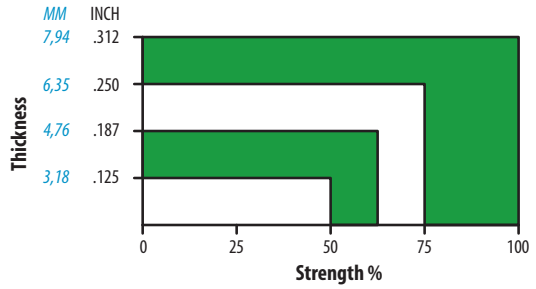
Insert Strength

The magnitude of the stresses that an insert is able to carry without failing are not only material-dependent, but also directly related to its geometry– its thickness, shape, and corner radius. Ceramic materials with higher (transverse rupture) strength can be applied in more fragile configurations.

Thickness:

Increased insert thickness results in better impact resistance, heat dispersion, and tool life, particularly in roughing, where light irregular wear is acceptable but may cause a thinner insert to fracture, but generally in any stage of machining.

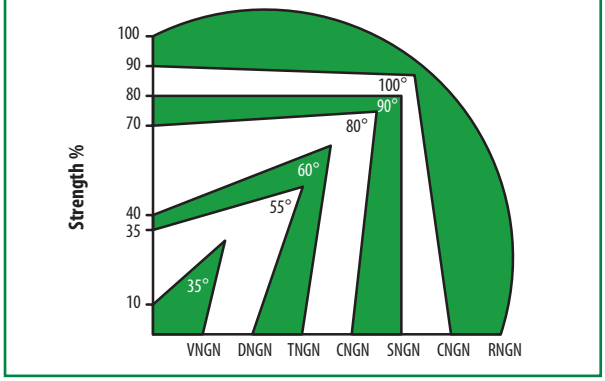
Figure 34a
Relative Strength for Various Insert Thicknesses



Shape:

In declining order of corner strength, the strongest inserts are: Round, 100° Diamond, Square, 80° Diamond, Triangle, 55° Diamond, and 35° Diamond. A pin-lock style insert – an insert with a hole (e.g. RNGA, SNGA, CNGA, DNGA, VNGA) is always weaker than an insert that is solid. Pin-lock style inserts should only be used when cutting forces are low, the cut is continuous, and tolerances are of primary importance – as in finishing operations. Inserts with increased flank clearance (e.g. RCGN, RPGN, SPGN, VCGN) are also weaker than negative inserts, but they are typically used with different rake angles, so the chip isn't as strongly sheared and the cutting forces are lower.

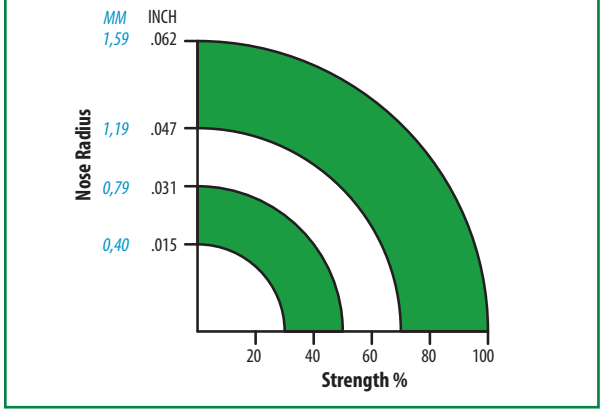
Figure 34b
Insert Shapes and Strengths



Corner radius:

The larger the corner radius, the stronger the corner. Do not attempt to do all roughing operations with a small corner radius just because the finished fillet calls for a small radius. Use a round insert or large radius insert for roughing and change the tool for the final cuts.

Figure 34c
Relative Strength for Various Insert Radii



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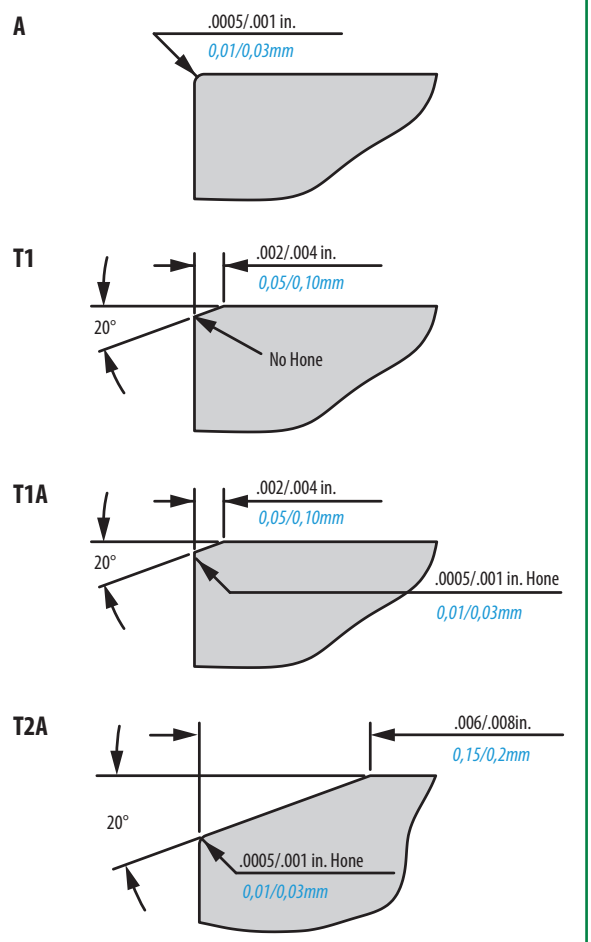
Edge Preparations

Figure 35a
Standard Edge Preparations



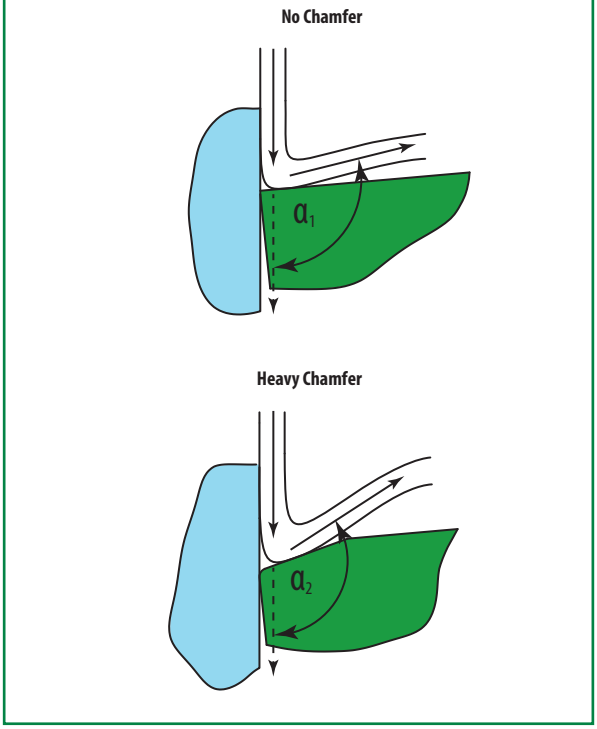
Unlike tungsten carbide (WC-Co) inserts whose edge is typically only honed, where the shape and size of the hone are quite important, ceramic inserts commonly require a chamfer ("upsharp" ceramic inserts without a hone or chamfer are generally not recommended). The size and angle of the chamfer(s) with respect to the rake face of the insert and the size of the hone define the edge preparation.

Hones on ceramic inserts are applied for the same reasons that hones are applied on carbide – to protect the edge from microchipping which then leads to uneven heat and stress distributions and may reduce tool life. Some applications, however, do not require a hone. The most common example of such would be the use of the T1 edge preparation on WG-300®, WG-600®, WG-700™ in clean turning of Inconel 718 – something made possible by the exceptional fracture toughness of WG-300®.

The choice of edge preparation depends on a number of factors, among them:

1. The transverse rupture strength and fracture toughness of the ceramic cutting tool material
2. The extent of variation of mechanical stresses in the course of machining: is the cut continuous or interrupted? How heavily interrupted? Are the fixture, part, and tool sufficiently rigid or prone to deflection? Are the spindle bearings worn and likely to encourage vibration?
3. Chip formation: does the chip separate well or is the material quite ductile and retains a large range of plastic deformation at high strain rates? In other words, is the chip typically continuous (e.g. nickel-based alloys), discontinuous (e.g. cast iron), or cyclical (e.g. titanium)? Is the material being machined homogeneous or not (e.g. large particles of a very high hardness embedded in a softer matrix; multiple phases that respond differently to high strain rates)?

Figure 35b
Edge Prep Effect on Chip Formation



The edge preparation also affects chip formation, in that a chamfer will force a ductile chip through a greater change in direction (i.e. higher strain rate) increasing the degree to which the surface layer of the material is deformed in producing a chip, generating more heat and higher cutting forces. $\alpha_2 > \alpha_1$

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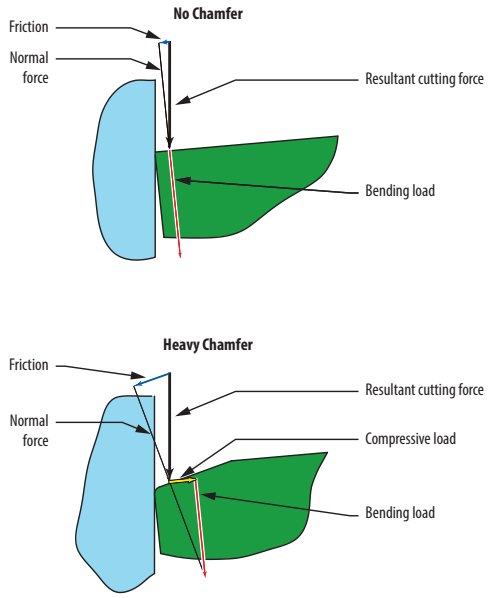
A chamfer redirects some of the mechanical stresses so that a part of what would load the insert in bending instead loads it in compression. The compressive strength of ceramics is substantially higher than their tensile strength so that, when appropriate and necessary, a chamfer can be used to protect the edge from irregular wear such as chipping or top-slicing if the static loads or impact encountered in the course of machining locally exceed the strength or toughness of the cutting tool.

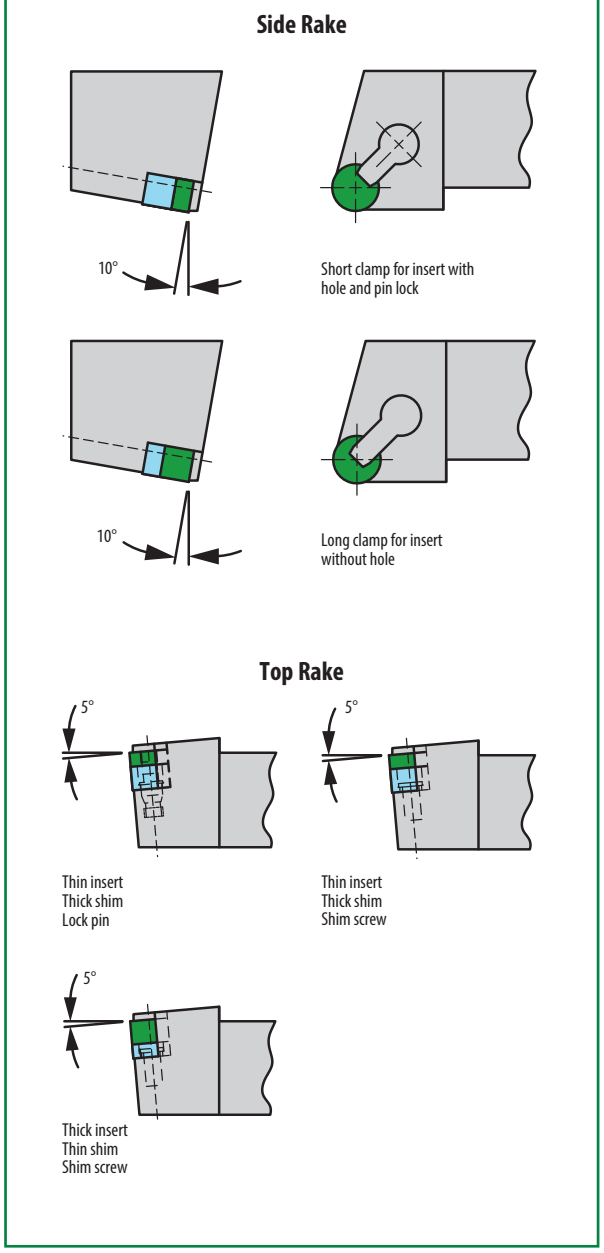
Figure 36a
Edge Prep Effect on Tool Stress



Selecting the appropriate edge preparation for the given combination of workpiece material, type of machining, and cutting tool material is paramount to the stability of the machining process and optimal tool life.

The same logic applies to increasing rake angles for negative inserts, which is one reason why standard Greenleaf tools for negative ceramic inserts have -10° side rake instead of the -5°-6° common in toolholders for WC-Co.

Figure 36b
Toolholder System



See pages ATI 22-23 and the following section on material-specific tool selection for more details.

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Material Classification and Tool Selection

Use the tables that follow as a guide.

The grade and edge preparation recommendations below are not definitive and should not be considered final. You may need to apply other grades and edge preparations to optimize the process. However, based on decades of ceramic application history, the information that follows provides the best starting point.

For additional information on materials, grades, edge preparations, and other product application data, please contact Greenleaf Technical Service.

For the purposes of the remainder of this guide, we will divide all materials commonly addressable with ceramics into groups that closely follow ISO material definitions and sub-groups as follows:

1. Heat-resistant super alloys S
   (corrosion-resistant 1, high-strength 2, wear-resistant 3)
2. Hardened steel H (Fe base, C <2%)
   (carbon and alloyed 1, maraging 2, tool steel 3, nitrided and/or carburized 4)
3. Cast iron K (Fe base, C >2%)
   (lamellar 1, nodular 2, CGI 3, white 4, ADI 5, nitrided and/or carburized 6)
4. Stainless steel M (Fe base, Cr >10%)
   (austenitic 1, martensitic 2, super-austenitic 3, duplex 4, PH 5)

Heat-Resistant Super Alloys (S)

Depending on one's definition of 'heat' and 'resistance' the term heat-resistant super alloys (HRSA) can refer to anything from 316 austenitic stainless steel to near-alpha titanium alloy Ti-6242. For the purposes of this guide, however, heat-resistant super alloys will specifically denote alloys with a nickel or cobalt matrix. Recent developments in stainless steel (duplex and super-austenitic stainless steel) produced alloys that offer a high resistance to corrosion at moderate temperatures with a significantly lower material cost than Ni-based alloys that were used for the same purpose. Corrosion-resistant Ni-based alloys are now almost exclusively used in environments that are not only corrosive but also require strength at elevated temperatures.

The reason why nickel and cobalt are so prized in high-temperature environments is that their melting point is relatively high, and unlike iron (which transforms from ferrite to austenite long before it starts to melt), they retain the same microstructure all the way until melting. With the addition of chromium, Ni- and Co-based alloys also exhibit remarkable resistance to corrosion at high temperatures. Finally, multiple mechanisms can be put in place through alloying and heat treatments to strengthen the nickel and cobalt base and stabilize the microstructure to prevent or slow down degradation at higher temperatures.

Corrosion-Resistant HRSA (S1)

Industry segments:
Oil and gas, petrochemical, pulp and paper, marine and offshore environments, pharma, hydraulics

Common S1 alloys:
Inconel 6XX series, Incoloy, Hastelloy, Monel

Recommended grades and edge preparations:

		Material Deposition Scale	Roughing	Medium-Roughing	Semi-Finishing	Finishing	Coolant
	Continuous Cuts	XSYTIN®-1 A / T1A	WG-300® T1	WG-600® T1	WG-600® T1	WG-600® A GF-1	YES
		WG-300® T1A	XSYTIN®-1 A	WG-300® T1	WG-300® T1	WG-300® A GF-1	
	Thin-Walled Turning	XSYTIN®-1 A	XSYTIN®-1 A	XSYTIN®-1 A	WG-300® T1	WG-600® A GF-1	YES
		WG-300® T1A	WG-300® T1	WG-300® T1	WG-600® T1	WG-300® A GF-1	
Interrupted Cuts	**Light Interruption**	XSYTIN®-1 A	XSYTIN®-1 A	WG-600® T1	WG-600® T1	WG-600® A GF-1	YES
		WG-300® T1A	WG-300® T1	WG-300® T1	WG-300® T1	WG-300® A GF-1	
	Medium Interruption	XSYTIN®-1 A / T1	XSYTIN®-1 A / T1	XSYTIN®-1 A / T1	WG-700™ T1A	WG-600® A GF-1	NO
		WG-300® T1A	WG-300® T1A	WG-300® T1A	WG-300® T1A	WG-300® A GF-1	
	Severe Interruption or Milling	XSYTIN®-1 A / T1A	XSYTIN®-1 A / T1A	XSYTIN®-1 A / T1A	XSYTIN®-1 A / T1A	-	NO
		WG-300® T1A	WG-300® T1A	WG-300® T1A	WG-300® T1A	-	

High-Strength HRSA (S2)

Industry segments:
Turbo- and super-chargers for reciprocating engines, high-performance reciprocating engines, gas turbines for propulsion or power generation, rocket engines, and ramjets

Common S2 alloys:
Inconel 7XX series, Waspaloy, Rene, Mar-M, Nimonic, IN100, Udimet, RR1000, GTD 111, Haynes

Recommended grades and edge preparations:

		Forging Scale	Roughing	Medium-Roughing	Semi-Finishing	Finishing	Coolant
	Continuous Cuts	XSYTIN®-1 A / T1A	XSYTIN®-1 A	WG-600® T1	WG-600® T1	WG-600® A GF-1	YES
		WG-700™ T1A	WG-300® T1	WG-300® T1	WG-300® T1	WG-300® A GF-1	
	Thin-Walled Turning	XSYTIN®-1 A	XSYTIN®-1 A	WG-700™ T1	WG-700™ T1	WG-600® A GF-1	YES
		WG-300® T1A	WG-700™ T1	XSYTIN®-1 A	XSYTIN®-1 A	WG-300® A GF-1	
Interrupted Cuts	Light Interruption	XSYTIN®-1 A	XSYTIN®-1 A	WG-600® T1	WG-600® T1	WG-600® A GF-1	YES
		WG-300® T1A	WG-300® T1	WG-300® T1	WG-300® T1	WG-300® A GF-1	
	Medium Interruption	XSYTIN®-1 A / T1	XSYTIN®-1 A / T1	XSYTIN®-1 A / T1	WG-700™ T1A	WG-600® A GF-1	NO
		WG-700™ T1A	WG-700™ T1A	WG-700™ T1A	XSYTIN®-1 A	WG-300® A GF-1	
	Severe Interruption or Milling	XSYTIN®-1 A / T1A	XSYTIN®-1 A / T1A	XSYTIN®-1 A / T1A	XSYTIN®-1 A / T1A	-	NO
		WG-700™ T1A	WG-700™ T1A	WG-700™ T1A	WG-700™ T1A	-	

Wear-Resistant HRSA (S3)

Industry segments:
Oil & gas, power generation, petrochemical, hydraulics, material processing

Common S3 alloys:
Stellite, Eutalloy, Metco, Wall Colmonoy, Weartech, Triballoy

Recommended grades and edge preparations for materials with a hardness below 50 HRc:

		Material Deposition Scale	Roughing	Medium-Roughing	Semi-Finishing	Finishing	Coolant
	Continuous Cuts	XSYTIN®-1 A / T1A	XSYTIN®-1 A	WG-600® T1	WG-600® T1	WG-600® A GF-1	YES
		WG-300® T1A	WG-300® T1	WG-300® T1	WG-300® T1	WG-300® A GF-1	
	Thin-Walled Turning	XSYTIN®-1 A	XSYTIN®-1 A	WG-300® T1	WG-300® T1	WG-600® A GF-1	YES
		WG-300® T1A	WG-300® T1	XSYTIN®-1 A	XSYTIN®-1 A	WG-300® A GF-1	
Interrupted Cuts	Light Interruption	XSYTIN®-1 A	XSYTIN®-1 A	WG-600® T1	WG-600® T1	WG-600® A GF-1	YES
		WG-300® T1A	WG-300® T1	WG-300® T1	WG-300® T1	WG-300® A GF-1	
	Medium Interruption	XSYTIN®-1 A / T1	XSYTIN®-1 A / T1	XSYTIN®-1 A / T1	WG-300® T1A	WG-600® A GF-1	NO
		WG-300® T1A	WG-300® T1A	WG-300® T1A	XSYTIN®-1 A	WG-300® A GF-1	
	Severe Interruption or Milling	XSYTIN®-1 A / T1A	XSYTIN®-1 A / T1A	XSYTIN®-1 A / T1A	XSYTIN®-1 A / T1A	-	NO
		WG-300® T1A	WG-300® T1A	WG-300® T1A	WG-300® T1A	-	

Recommended grades and edge preparations for materials with a hardness of 50 HRc or higher:

		Material Deposition Scale	Roughing	Medium-Roughing	Semi-Finishing	Finishing	Coolant
	Continuous Cuts	WG-300® T1A	WG-300® T1A	WG-600® T1A	WG-600® T1A	WG-600® A	YES
		WG-600® T1A	WG-600® T1A	WG-300® T1A	WG-300® T1A	WG-300® A	
	Thin-Walled Turning	WG-300® T1A	WG-300® T1A	WG-600® T1A	WG-600® T1A	WG-600® A GF-1	YES
		WG-600® T1A	WG-600® T1A	WG-300® T1A	WG-300® T1A	WG-300® A GF-1	
Interrupted Cuts	Light Interruption	WG-300® T1A	WG-300® T1A	WG-600® T1A	WG-600® T1A	WG-600® A	YES
		WG-600® T1A	WG-600® T1A	WG-300® T1A	WG-300® T1A	WG-300® A	
	Medium Interruption	XSYTIN®-1 T1A	XSYTIN®-1 T1A	WG-300® T1A	WG-600® T1A	WG-600® T1A	NO
		WG-300® T1A	WG-300® T1A	WG-600® T1A	WG-300® T1A	WG-300® T1A	
	Severe Interruption or Milling	XSYTIN®-1 A / T1A	XSYTIN®-1 A / T1A	XSYTIN®-1 A / T1A	XSYTIN®-1 A / T1A	-	NO
		WG-300® T1A	WG-300® T1A	WG-300® T1A	WG-300® T1A	-	

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Hardened Steel (H)

When referring to a material as 'hardened steel' this guide will address iron-based alloys that are hardened through quenching and machined at 40 HRc or higher. It is worth noting that there are essentially two kinds of hardened steel: one where there's enough carbon to create the microstructure, and low-carbon steels where nickel or other elements are used instead. The higher the carbon content – the more internal strain is produced and the higher the attainable hardness through quenching. High-carbon hardened steels are rather brittle, with favorable chip formation. Low-carbon hardened steels are more ductile and require a different approach because the chip doesn't shear as easily. A class of materials known as TRIP (transformation-induced plasticity as in, for example, Mangalloy) steels where the hardening occurs in service as a result of mechanical stress will not be addressed in this guide, though their applications in earth-moving and high-impact environments are numerous and ceramics are exceptionally well-suited for their machining.

Carbon and Alloyed Hardened Steel (H1)

Industry segments:
General engineering, automotive, tools

Common H1 alloys:
All 4-digit AISI-SAE grades

Recommended grades and edge preparations for materials with a hardness of 40-49 HRc:

		Forging / Material Deposition Scale	Roughing	Finishing	Coolant
	Continuous Cuts	WG-300® T1A	WG-600® T1A	WG-600® T1A	YES
		GEM-8™ T1A	GEM-8™ T1A	GEM-8™ T1A	
	Thin-Walled Turning	XSYTIN®-1 A	WG-300® T1A	WG-600® T1A	YES
		WG-300® T1A	XSYTIN®-1 A	WG-300® T1A	
Interrupted Cuts	**Light Interruption**	XSYTIN®-1 A	XSYTIN®-1 A	WG-600® T1A	YES
		WG-300® T1A	WG-300® T1A	WG-300® T1A	
	Medium Interruption	XSYTIN®-1 A	XSYTIN®-1 A	WG-600® T1A	NO
		WG-300® T1A	WG-300® T1A	WG-300® T1A	
	Severe Interruption or Milling	XSYTIN®-1 A	XSYTIN®-1 A	WG-600® T1A	NO
		WG-300® T1A	WG-300® T1A	WG-300® T1A	

Recommended grades and edge preparations for materials with a hardness of 50-59 HRc:

		Forging / Material Deposition Scale	Roughing	Finishing	Coolant
	Continuous Cuts	WG-300® T1A	WG-600® T1A	WG-600® T1A	NO
		GEM-8™ T2A	GEM-8™ T2A	GEM-8™ T2A	
	Thin-Walled Turning	WG-300® T1A	WG-600® T1A	WG-600® T1A	NO
		WG-600® T1A	WG-300® T1A	WG-300® T1A	
Interrupted Cuts	**Light Interruption**	WG-300® T1A	WG-300® T1A	WG-600® T1A	NO
		XSYTIN®-1 T1A	XSYTIN®-1 T1A	WG-300® T1A	
	Medium Interruption	XSYTIN®-1 T1A	XSYTIN®-1 T1A	WG-600® T1A	NO
		WG-300® T1A	WG-300® T1A	WG-300® T1A	
	Severe Interruption or Milling	XSYTIN®-1 T1A	XSYTIN®-1 T1A	WG-600® T1A	NO
		WG-300® T2A	WG-300® T2A	WG-300® T1A	

Carbon and Alloyed Hardened Steel (H1) *(Continued)*

Recommended grades and edge preparations for materials with a hardness of 60 HRc or higher:

		Forging / Material Deposition Scale	Roughing	Finishing	Coolant
	Continuous Cuts	WG-300® T4B+	WG-600® T4B	WG-600® T1A	NO
		GEM-8™ T4B+	GEM-8™ T4B	GEM-8™ T2A	
	Thin-Walled Turning	WG-300® T4B+	WG-600® T4B	WG-600® T1A	NO
		WG-600® T4B+	WG-300® T4B	WG-300® T1A	
Interrupted Cuts	**Light Interruption**	WG-300® T4B+	WG-600® T4B	WG-600® T1A	NO
		WG-600® T4B+	WG-300® T4B	WG-300® T1A	
	Medium Interruption	WG-300® T4B+	WG-600® T4B	WG-600® T1A	NO
		WG-600® T4B+	WG-300® T4B	WG-300® T1A	
	Severe Interruption or Milling	XSYTIN®-1 T2A	XSYTIN®-1 T2A	WG-600® T1A	NO
		WG-300® T2A	WG-300® T2A	WG-300® T1A	

NOTE: T4B+ denotes the following edge preparations: T4B, T5B, T6B, T10B.

Maraging Steel (H2)

Industry segments:
Turbine engine shafts, drive shafts, crankshafts, gears, aircraft landing gear, ordnance

Common H2 alloys:
Maraging, AerMet, ML340, Super CMV, F1E, ES-1

Recommended grades and edge preparations:

		Forging Scale	Roughing	Finishing	Coolant
	Continuous Cuts	XSYTIN®-1 A	XSYTIN®-1 A	XSYTIN®-1 A	YES
	Thin-Walled Turning	XSYTIN®-1 A	XSYTIN®-1 A	XSYTIN®-1 A	YES
Interrupted Cuts	**Light Interruption**	XSYTIN®-1 A	XSYTIN®-1 A	XSYTIN®-1 A	YES
	Medium Interruption	XSYTIN®-1 A / T1A	XSYTIN®-1 A	XSYTIN®-1 A	NO
	Severe Interruption or Milling	XSYTIN®-1 A / T1A	XSYTIN®-1 A	XSYTIN®-1 A	NO

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Tool Steel (H3)

Industry segments:
Material processing, wear-resistant applications (die and mold in particular)

Common H3 alloys:
W, O, A, D, S, T, M, H, P, L, F AISI-SAE tool steel grades such as: D2, S7, A2

Recommended grades and edge preparations for materials with a hardness of 40-49 HRc:

		Forging / Material Deposition Scale	Roughing	Finishing	Coolant
	Continuous Cuts	WG-300® T1A	WG-600® T1A	WG-600® T1A	YES
		GEM-8™ T1A	GEM-8™ T1A	GEM-8™ T1A	
	Thin-Walled Turning	XSYTIN®-1 A	WG-300® T1A	WG-600® T1A	YES
		WG-300® T1A	XSYTIN®-1 A	WG-300® T1A	
Interrupted Cuts	Light Interruption	XSYTIN®-1 A	XSYTIN®-1 A	WG-600® T1A	YES
		WG-300® T1A	WG-300® T1A	WG-300® T1A	
	Medium Interruption	XSYTIN®-1 A	XSYTIN®-1 A	WG-600® T1A	NO
		WG-300® T1A	WG-300® T1A	WG-300® T1A	
	Severe Interruption or Milling	XSYTIN®-1 A	XSYTIN®-1 A	WG-600® T1A	NO
		WG-300® T1A	WG-300® T1A	WG-300® T1A	

Recommended grades and edge preparations for materials with a hardness of 50-59 HRc:

		Forging / Material Deposition Scale	Roughing	Finishing	Coolant
	Continuous Cuts	WG-300® T1A	WG-600® T1A	WG-600® T1A	NO
		GEM-8™ T2A	GEM-8™ T2A	GEM-8™ T2A	
	Thin-Walled Turning	WG-300® T1A	WG-600® T1A	WG-600® T1A	NO
		WG-600® T1A	WG-300® T1A	WG-300® T1A	
Interrupted Cuts	Light Interruption	WG-300® T1A	WG-300® T1A	WG-600® T1A	NO
		XSYTIN®-1 T1A	XSYTIN®-1 T1A	WG-300® T1A	
	Medium Interruption	XSYTIN®-1 T1A	XSYTIN®-1 T1A	WG-600® T1A	NO
		WG-300® T1A	WG-300® T1A	WG-300® T1A	
	Severe Interruption or Milling	XSYTIN®-1 T1A	XSYTIN®-1 T1A	WG-600® T1A	NO
		WG-300® T2A	WG-300® T2A	WG-300® T1A	

Recommended grades and edge preparations for materials with a hardness of 60 HRc or higher:

		Forging / Material Deposition Scale	Roughing	Finishing	Coolant
	Continuous Cuts	WG-300® T4B+	WG-600® T4B	WG-600® T1A	NO
		GEM-8™ T4B+	GEM-8™ T4B	GEM-8™ T2A	
	Thin-Walled Turning	WG-300® T4B+	WG-600® T4B	WG-600® T1A	NO
		WG-600® T4B+	WG-300® T4B	WG-300® T1A	
Interrupted Cuts	Light Interruption	WG-300® T4B+	WG-600® T4B	WG-600® T1A	NO
		WG-600® T4B+	WG-300® T4B	WG-300® T1A	
	Medium Interruption	WG-300® T4B+	WG-600® T4B	WG-600® T1A	NO
		WG-600® T4B+	WG-300® T4B	WG-300® T1A	
	Severe Interruption or Milling	XSYTIN®-1 T2A	XSYTIN®-1 T2A	WG-600® T1A	NO
		WG-300® T2A	WG-300® T2A	WG-300® T1A	

Note: Roughing is for DOC greater than 0.04" (1mm)

Nitrided and/or Carburized Steel (H4)

Industry segments:
Bearings, hydraulics, wear-resistant applications

Common H4 alloys:
32CrMoV13, M50, M50NiL, M2, Pyrowear 675, Nitralloy

Recommended grades and edge preparations:

		White Layer	Roughing	Finishing	Coolant
	Continuous Cuts	GEM-8™ T4B+	GEM-8™ T4B+	GEM-8™ T7A	NO
		WG-300® T4B+	WG-300® T4B	WG-300® T7A	
	Thin-Walled Turning	GEM-8™ T4B+	GEM-8™ T4B+	GEM-8™ T7A	NO
		WG-300® T4B+	WG-300® T4B	WG-300® T7A	
Interrupted Cuts	**Light Interruption**	GEM-8™ T4B+	GEM-8™ T4B+	GEM-8™ T7A	NO
		WG-300® T4B+	WG-300® T4B	WG-300® T7A	
	Medium Interruption	WG-300® T4B+	WG-300® T4B	WG-300® T7A	NO
		GEM-8™ T4B+	GEM-8™ T4B+	GEM-8™ T7A	
	Severe Interruption or Milling	XSYTIN®-1 T2A	XSYTIN®-1 T2A	WG-600® T1A	NO
		WG-300® T2A	WG-300® T2A	WG-300® T1A	

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Cast Iron (K)

Cast iron is an alloy of iron and >2% carbon where carbon forms graphite (because of the addition of silicon) or cementite (Fe_3C). Because of the inability of graphite to carry stresses or the high fraction of brittle phases most cast iron is quite brittle. The quantity of carbon that remains as graphite and relative fraction and morphology of phases ultimately affect hardness, strength, and the behavior of the material. This guide will not address the machining of malleable cast irons (EN-GJMB, EN-GJMW), austenitic nodular cast irons (EN-GJSA, Ni-resist), or cast irons specific to the roll industry, though all of them lend themselves exceptionally well to ceramic machining.

Gray (Lamellar) Cast Iron (K1)

Industry segments:
Automotive, general engineering, housings, machine tools

Common K1 alloys:
GG15 – GG35 a.k.a. EN-GJL-150 – EN-GJL-350
(for 150-350 MPa minimum tensile strength)

Recommended grades and edge preparations:

		Roughing	Finishing	Coolant
	Continuous Cuts	GSN100™ T2	GSN100™ T2	POSSIBLE
		XSYTIN®-1 T2	WG-600® T2	
Interrupted Cuts	**Light-Medium Interruption**	GSN100™ T2	GSN100™ T2	NO
		XSYTIN®-1 T2	WG-600® T2	
	Severe Interruption or Milling	GSN100™ T2A	GSN100™ T2	NO
		XSYTIN®-1 T2A	WG-600® T2	

Ductile (Nodular) Cast Iron (K2)

Industry segments:
Pipe, automotive, wind energy, machine tools, metal processing

Common K2 alloys:
GGG40 – GGG80 a.k.a. EN-GJS-400 – EN-GJS-800
(for 400-800 MPa minimum tensile strength)

Recommended grades and edge preparations:

		Roughing	Finishing	Coolant
	Continuous Cuts	GSN100™ T2	GSN100™ T2	POSSIBLE
		XSYTIN®-1 T2	WG-600® T2	
Interrupted Cuts	**Light-Medium Interruption**	GSN100™ T2	GSN100™ T2	NO
		XSYTIN®-1 T2	WG-600® T2	
	Severe Interruption or Milling	GSN100™ T2A	GSN100™ T2	NO
		XSYTIN®-1 T2A	WG-600® T2	

Compacted Graphite (Vermicular) Cast Iron (K3)

Industry segments:
Automotive, high-compression (and high-displacement) diesel engines, turbochargers

Common K3 alloys:
CGI, EN-GJV-300 – EN-GJV-500 (for 300-500 MPa minimum tensile strength)

Recommended grades and edge preparations:

		Roughing	Finishing	Coolant
	Continuous Cuts	XSYTIN®-1 A / T2	XSYTIN®-1 A / T2	POSSIBLE
		GSN100™ T2	GSN100™ T2	
Interrupted Cuts	Light-Medium Interruption	XSYTIN®-1 A / T2	XSYTIN®-1 A / T2	NO
		GSN100™ T2	GSN100™ T2	
	Severe Interruption or Milling	XSYTIN®-1 A / T2A	XSYTIN®-1 A	NO
		GSN100™ T2A	GSN100™T2A	

White Cast Iron (K4)

Industry segments:
Grinding and ore crushing equipment, rolls, pumps, extrusion, and various applications requiring high resistance to abrasion and high hot-hardness

Common K4 alloys:
Ni-Hard, EN-GJN-HV350 – EN-GJN-HV600 (for 350-600 minimum HV hardness)

Recommended grades and edge preparations:

		Roughing	Finishing	Coolant
	Continuous Cuts	GEM-8™ T10B	WG-600® T4B+	NO
		WG-300® T4B+	GEM-8™ T10B	
Interrupted Cuts	Light-Medium Interruption	WG-300® T4B+	WG-600® T4B+	NO
		XSYTIN®-1 T2A+	WG-300® T4B+	
	Severe Interruption or Milling	XSYTIN®-1 T2A+	WG-600® T1A	NO
		WG-300® T2A+	WG-300® T1A	

Austempered Ductile Iron (K5)

Industry segments:
Structural applications requiring lower overall weight than the equivalent in structural steel: construction, mining, agriculture, automotive, railroad, etc.

Common K5 alloys:
ADI, EN-GJS-800 – EN-GJS-1400 (for 800-1400 MPa minimum tensile strength)

Recommended grades and edge preparations:

		Roughing	Finishing	Coolant
	Continuous Cuts	GSN100™ T2	GSN100™ T2	POSSIBLE
		XSYTIN®-1 T2	WG-600® T2	
Interrupted Cuts	Light-Medium Interruption	GSN100™ T2	GSN100™ T2	NO
		XSYTIN®-1 T2	WG-600® T2	
	Severe Interruption or Milling	GSN100™ T2A	GSN100™ T2	NO
		XSYTIN®-1 T2A	WG-600® T2	

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Nitrided and/or Carburized Cast Iron (K6)

Industry segments:
High-compression, high-displacement diesel engines, wear-resistant applications not requiring tensile strength

Common K6 alloys:
K1, K2

Recommended grades and edge preparations:

		White Layer	Roughing	Finishing	Coolant
	Continuous Cuts	GEM-8™ T4B+	GEM-8™ T4B+	GEM-8™ T7A	NO
		WG-300® T4B+	WG-300® T4B	WG-300® T7A	
	Thin-Walled Turning	GEM-8™ T4B+	GEM-8™ T4B+	GEM-8™ T7A	NO
		WG-300® T4B+	WG-300® T4B	WG-300® T7A	
Interrupted Cuts	**Light Interruption**	GEM-8™ T4B+	GEM-8™ T4B+	GEM-8™ T7A	NO
		WG-300® T4B+	WG-300® T4B	WG-300® T7A	
	Medium Interruption	WG-300® T4B+	WG-300® T4B	WG-300® T7A	NO
		GEM-8™ T4B+	GEM-8™ T4B+	GEM-8™ T7A	
	Severe Interruption or Milling	XSYTIN®-1 T2A	XSYTIN®-1 T2A	WG-600® T1A	NO
		WG-300® T2A	WG-300® T2A	WG-300® T1A	

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Stainless Steel (M)

Steel containing more than ~11% chrome where the chrome is available to form a passivating layer of oxides on the surface that prevents any layers below from being affected and reforms almost instantly if any part of it is removed is known as stainless for its resistance to corrosion. Stainless steels can be ferritic, austenitic, martensitic, or some mixture thereof. Higher alloying content is associated with higher resistance to different corrosive media, while martensite and precipitates are associated with higher hardness and strength. With the exception of high-carbon martensitic stainless steel, M class alloys are low-carbon and as such are tough and ductile. The majority of machined stainless steels are not ferritic, which is why this guide will not address ferritic stainless steels.

Austenitic Stainless Steel (M1)

Industry segments:
Petrochemical, oil & gas, power generation, medical, pulp and paper, structural elements

Common M1 alloys:
300 and 200 AISI/ASTM series, with 304 and 316 being the most common of all

Recommended grades and edge preparations:

		Roughing	Coolant
	Continuous Cuts	WG-600® T1A	YES
		WG-300® T1A	
Interrupted Cuts	Light-Medium Interruption	WG-600® T1A	YES
		WG-300® T1A	
	Severe Interruption or Milling	WG-600® T1A	NO
		WG-300® T1A	

Martensitic Stainless Steel (M2)

Industry segments:
Aerospace, power generation, medical, gears, valves, shafts, offshore oil & gas, bearings

Common M2 alloys:
416 (1.4005), 410 (1.4006), 420 (1.4021), 431 (1.4057), 248SV (1.4418), CA6NM (1.4313), Jethete M152 (1.4938)

Recommended grades and edge preparations:

		Forging / Material Deposition Scale	Roughing	Finishing	Coolant
	Continuous Cuts	WG-300® T1A	WG-600® T1A	WG-600® T1A	YES
		WG-600® T1A	WG-300® T1A	WG-300® T1A	
Interrupted Cuts	Light-Medium Interruption	WG-300® T1A	WG-600® T1A	WG-600® T1A	YES
		WG-600® T1A	WG-300® T1A	WG-300® T1A	
	Severe Interruption or Milling	WG-300® T1A	WG-600® T1A	-	NO
		WG-600® T1A	WG-300® T1A	-	

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Super-Austenitic Stainless Steel (M3)

Industry segments:
Pulp & paper, petrochemical, water treatment, pollution control, offshore oil & gas, power generation

Common M3 alloys:
S31266 (1.4659), 904L (1.4539), N08031 (1.4562), S34565 (1.4565), N08926 (1.4529), S31254 (1.4547), N0828 (1.4563), S32654 (1.4652), 1.4588

Recommended grades and edge preparations:

		Roughing	Coolant
	Continuous Cuts	WG-600® T1A	YES
		WG-300® T1A	
Interrupted Cuts	Light-Medium Interruption	WG-600® T1A	YES
		WG-300® T1A	
	Severe Interruption or Milling	WG-600® T1A	NO
		WG-300® T1A	

Duplex Stainless Steel (M4)

Industry segments:
Petrochemical, oil & gas, power generation, pharmaceutical, geothermal, desalination, biomass, mining

Common M4 alloys:
F51 (1.4462), F53 (1.4410), F55 (1.4501), 255 (1.4507), 1.4162, 1.4362, CD3MN

Recommended grades and edge preparations:

		Roughing	Coolant
	Continuous Cuts	WG-600® T1A	YES
		WG-300® T1A	
Interrupted Cuts	Light-Medium Interruption	WG-600® T1A	YES
		WG-300® T1A	
	Severe Interruption or Milling	WG-600® T1A	NO
		WG-300® T1A	

Precipitation-Hardening Stainless Steel (M5)

Industry segments:
Aerospace, power generation, petrochemical, oil & gas

Common M5 alloys:
A286, PH14-8Mo, PH15-7Mo, 17-7PH, PH13-8Mo, 15-5PH, 15-7PH, 17-4PH

Recommended grades and edge preparations:

		Roughing	Coolant
	Continuous Cuts	WG-600® T1A	YES
		WG-300® T1A	
Interrupted Cuts	Light-Medium Interruption	WG-600® T1A	YES
		WG-300® T1A	
	Severe Interruption or Milling	WG-600® T1A	NO
		WG-300® T1A	

Chip Formation

Broadly speaking, ceramic machining differs from carbide machining in the strain rates that the machined materials are subjected to. The strain rates are significantly higher because of the speeds at which ceramics are applied, the significantly more negative rake angles, and absence of chipforms in roughing, all of which the ceramic cutting tool materials are able to withstand because of their high-temperature strength and hardness.

Machining processes produce high strain rates in ductile materials, and the goal in general is to:

1. Make use of the compressive strain in the primary shear zone to plasticize the machined layer of material ahead of the cut, reducing specific cutting energy. Then force the chip through a great degree of deformation quickly, embrittling it and making it easier to break
2. Direct chip flow with geometric features of the tool to minimize strain rates at and ahead of the cutting edge (so minimize heat generation) but force the chip to curl and break on impact

With strain rates that WC-Co tools are able to produce (the primary limitation being hot-hardness: the higher the strain rate the more heat is produced, which greatly diminishes the strength and hardness of WC-Co) option 1 is not viable. Option 2 is then the primary method, which is why chipforms play such a pivotal role in carbide machining.

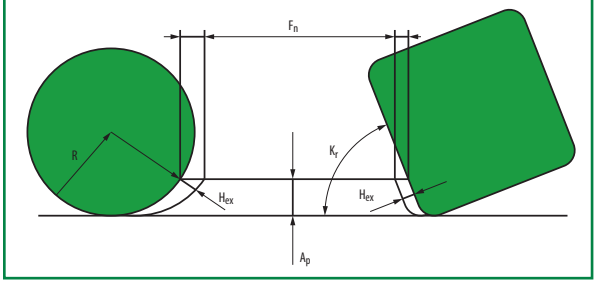
With the much higher temperatures that Greenleaf ceramics are able to sustain, option 1 is the primary method of chip formation and breaking in all ductile materials.

Because hardness and strength are most often positively correlated, it also follows that the strain rates required for the same type of chip formation are lower for harder materials and vice versa. So, Waspaloy heat treated to 34 HRc will contain a lower fraction of fine precipitates (and/or have higher average grain size) than Waspaloy heat treated to 42 HRc, and the strain rates required to produce a favorably sheared chip in 34 HRc Waspaloy are higher, corresponding to higher cutting speeds.

Chip Thickness

Chip thickness is a parameter that is particularly important in ceramic machining because of its role in the distribution of heat and the importance of heat in a ceramic machining operation. In turning, chip thickness is a function of feed and lead angle, where a round insert's lead angle varies with depth of cut, while in milling it is also affected by the engagement (stepover).

Figure 48a – Maximum Chip Thickness - Turning



For straight-edged inserts in turning:

$$H_{ex} = F_n \sin(K_r)$$

For round inserts in turning:

$$H_{ex} \approx F_n \sin\left(\cos^{-1}(1 - A_p/R)\right)$$

The majority of the heat generated in ceramic machining is a result of the strain that the deformed surface layer of the workpiece experiences, so it comes as no surprise that the majority of the heat is also evacuated as the deformed surface layer separates and becomes the chip. The capacity of the chip to carry heat, however, is limited by its thickness – the thinner the chip the less heat it is able to carry out of the cutting area. It is possible, then, to control the distribution of heat to some degree by adjusting the chip thickness.

It is a common misconception that ceramic machining can only be carried out at a single 'optimal speed.' Reducing the cutting speed lowers strain rates, reducing the extent to which the chip is embrittled and the heat that is generated, increasing the specific cutting energy and requiring higher effort to continue deforming the surface layer to failure. This, in turn, may exceed the strength of the cutting tool, leading to irregular wear or fracture. So, to compensate for the higher material strength one must reduce the mechanical loads by reducing the cross-sectional area of the chip. And reducing the chip thickness (as opposed to chip cross-sectional area, which would imply the ability to control heat evacuation the same effect by reducing feed or depth of cut independently) reduces the capacity of the chip to carry heat away, allowing more heat to remain in the cutting zone, plasticizing the workpiece material and locally reducing its strength.

A **rule of thumb** that holds for **all** ceramic turning of ductile materials:

> Having determined the optimal cutting speed and chip thickness for a given insert in a given material, one can vary speed and chip thickness proportionately up or down as required. Adjusting up is dependent on the limits of the cutting tool, machine, and workpiece.

Note that this relationship is far from exact and cannot be used to reduce the speed indefinitely – there is a minimum speed below which strain rates are too low and the stress required to deform the material to failure is higher than the strength of the ceramic cutting tool, resulting in irregular wear or fracture.

It does, however, mean that having found one combination of speed and chip thickness with RNGN-45 T1 WG-300® in forged Inconel 718 at 45 HRc we are able to apply any other WG-300® negative insert with the T1 edge preparation at the same rake angles in any other part from forged Inconel 718 at 45 HRc.

Suppose that you run a test and find that a solid cylinder of forged Inconel 718 at 45 HRc is best machined with an RNGN-45 T1 WG-300® at $V_c = 1150$ SFM (350m/min) and a chip thickness of $H_{ex} = 0.0063"$ (0.16mm). Suppose then, that instead of machining a solid cylinder you are machining a thin-walled seal in a used VTL – the rigidity of part, fixture, and machine are rather different, and it's likely that the cutting forces required to turn the part at $V_c = 1150$ SFM (350m/min) and $H_{ex} = 0.0063"$ (0.16mm) with a round insert would lead to deflection, vibration, and very poor tool life. So, changing

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the tool to a CNGN-452 T1 WG-300® and reducing the speed to 820 SFM (250m/min) would require reducing the chip thickness to 0.0063"×820/1150=0.0043" (0.11mm) which at nearly no lead angle[2] for a CNGN would translate into 0.0047 IPR (0.12mm/rev) feed and a depth of cut that the insert can sustain without failure – something that should be determined through trial and error.

It also follows that for every combination of material and cutting tool there is an optimal V_c x H_{ex} pair at the higher end of speeds (so in stable machining environments) that can be adjusted to fit the given application, as above.

These recommendations for continuous cuts are provided in the tables on the folowing pages.

[2] *The convention in this guide is to measure the lead angle as the angle between the cutting edge and a line drawn perpendicular to the direction of feed. As such, the lead angle of the 80° corner of a CNGN is typically -5°, while the lead angle of a high-feed milling cutter is, for example, 80°.*

Note that these are the recommended starting cutting conditions. You may need to adjust both speed and chip thickness up or down to optimize the process for your unique machining environment.

Speed and Chip Thickness Recommendations — Turning

	HRc		Cutting Speed: V_c [SFM] Maximum Chip Thickness: H_{ex} [inch]				Cutting Speed: V_c [m/min] Maximum Chip Thickness: H_{ex} [mm]			
			GEM-8™	WG-300® WG-600® WG-700™	XSYTIN®-1	GSN100™	GEM-8™	WG-300® WG-600® WG-700™	XSYTIN®-1	GSN100™
S1: Corrosion-Resistant HRSA		V_c:		1500	800			450	250	
Inconel 625, Incoloy 825, Hastelloy, Monel		H_{ex}:		0.0065	0.0095			0.16	0.24	
S2: High-Strength HRSA (Solution-Treated[3])	20	V_c:		1950	1250			600	375	
		H_{ex}:		0.007	0.0105			0.18	0.27	
Low γ' [4] S2 (Solution-Treated and Aged)	40-45	V_c:		1150	800			350	250	
Inconel 706, Inconel 718, Inconel 725		H_{ex}:		0.0065	0.0095			0.16	0.24	
High γ' S2 (Solution-Treated and Aged)	40-50	V_c:		650	500			200	150	
IN100, Udimet 720, Waspaloy, C1023, Rene 88, N-18		H_{ex}:		0.0045	0.007			0.12	0.18	
S3: Wear-Resistant HRSA	20 [5]	V_c:		1950	1250			600	375	
		H_{ex}:		0.007	0.0105			0.18	0.27	
Stellite, Eutalloy, Metco, Wall Colmonoy, Weartech	62	V_c:		250	200			80	55	
		H_{ex}:		0.003	0.0045			0.08	0.12	
H1: Carbon and Alloyed Steel	40	V_c:	1000	1000	700		300	300	210	
		H_{ex}:	0.0045	0.0065	0.0095		0.12	0.16	0.24	
All 4-digit AISI-SAE grades: 1010, 1060, 4140, 2550, 2350, etc.	60	V_c:	500	500	350		150	150	105	
		H_{ex}:	0.002	0.0025	0.0035		0.05	0.06	0.09	
H2: Maraging Steel	55	V_c:			600				180	
Maraging 250, AerMet 100, ML340, Super CMV, F1E, ES-1		H_{ex}:			0.008				0.2	
H3: Tool Steel	45	V_c:	750	750	500		225	225	160	
		H_{ex}:	0.004	0.0045	0.007		0.1	0.12	0.18	
D2, M4, S7, A2, etc.	65	V_c:	250	250	200		80	80	55	
		H_{ex}:	0.0015	0.0015	0.0025		0.04	0.04	0.06	
H4: Nitrided and/or Carburized Steel	64	V_c:	250	250	200		80	80	55	
32CrMoV13, M50, M50NiL, M2, Pyrowear 675, Nitralloy		H_{ex}:	0.0015	0.0015	0.0025		0.04	0.04	0.06	
K1: Lamellar (Grey) Cast Iron		V_c:			3600	3600			1100	1100
GG15, GG25, GG35 (EN-GJL-150, EN-GJL-250, EN-GJL-350)		H_{ex}:			0.014	0.014			0.35	0.35
K2 [6] : Nodular Cast Iron		V_c:			2600	2600			800	800
GGG40 – GGG80 (EN-GJS-400 – EN-GJS-800)		H_{ex}:			0.01	0.01			0.25	0.25
K3: Compacted Graphite Iron (CGI)		V_c:			1150	1150			350	350
EN-GJV-300 – EN-GJV-500		H_{ex}:			0.01	0.01			0.25	0.25

[3] *Solution Treated condition - most alloying elements are in solid solution, strength and hardness are low*

Table continued on following pages

[4] *Solution Treated and Aged condition - secondary phases have been precipitated. γ': Ni_3Ti & Ni_3Al, so alloys with lower Al and Ti content (like Inconel 718) have less γ' and alloys with more Al and Ti (like IN100) have more γ'. The heat treatment (particularly solutioning temperature and aging temperature and time) also affect γ' fraction.*

[5] *Where two sets of values are shown for different hardness, extrapolate cutting speed and chip thickness linearly to obtain starting cutting data for the material machined. e.g., turning H1 steel at 50HRc with GEM-8™: V_c = 750 SFM (225m/min).*

[6] *Cast irons used as rolls in material processing applications vary greatly in composition, microstructure, and machinability. Cutting speeds range from 130 SFM (40m/min) in particularly hard white irons to 650 SFM (200m/min) in alloyed pearlite.*

Speed and Chip Thickness Recommendations — Turning *(Continued)*

	HRc		Cutting Speed: V_c [SFM] Maximum Chip Thickness: H_{ex} [inch]				Cutting Speed: V_c [m/min] Maximum Chip Thickness: H_{ex} [mm]			
			GEM-8™	WG-300® WG-600® WG-700™	XSYTIN®-1	GSN100™	GEM-8™	WG-300® WG-600® WG-700™	XSYTIN®-1	GSN100™
K4: White Cast Iron	60	V_c:	250	250	200		80	80	55	
Ni-Hard, EN-GJN-HV350 – EN-GJN-HV600		H_{ex}:	0.001	0.0015	0.0025		0.03	0.04	0.06	
K5: Austempered Ductile Iron (ADI)		V_c:			1000				300	
EN-GJS-800 – EN-GJS-1400		H_{ex}:			0.01				0.25	
K6: Nitrided and/or Carburized Cast Iron	64	V_c:	250	250	200		80	80	55	
K1 and K2 are commonly used as the parent material		H_{ex}:	0.001	0.0015	0.002		0.03	0.04	0.05	
M1: Austenitic Stainless Steel		V_c:		1300				400		
304, 316, 301, 201, 202, 205, etc.		H_{ex}:		0.011				0.28		
M2: Martensitic Stainless Steel	50	V_c:		500				150		
416, 410, 420, 431, etc.		H_{ex}:		0.0045				0.12		
M3: Super-Austenitic Stainless Steel		V_c:		1000				300		
S31266, 904L, N08031, S34565, 1.4588, etc.		H_{ex}:		0.0065				0.16		
M4: Duplex Stainless Steel		V_c:		1300				400		
F51 (1.4462), F53 (1.4410), F55 (1.4501), 255 (1.4507), CD3MN		H_{ex}:		0.011				0.28		
M5: Precipitation-Hardening Stainless Steel	40	V_c:		1000				300		
A286, PH14-8Mo, PH15-7Mo, 15-5PH, 15-7PH, 17-4PH, 17-7PH		H_{ex}:		0.0065				0.16		

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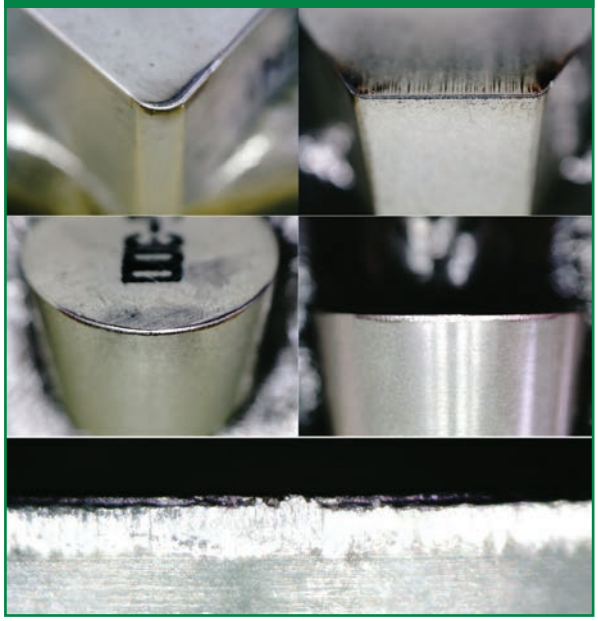
Ceramic Wear Patterns

While there are always multiple wear mechanisms in play, one will typically be dominant and tool-life limiting. The following are the most common dominant modes of wear when machining with ceramics:

1. FLANK: Flank Wear and Edge Rounding

Figure 51a

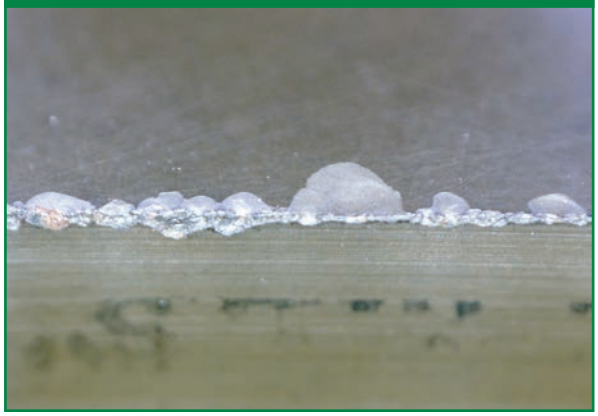


Flank wear and edge rounding is what is referred to as 'regular wear' (where all other entries below are jointly described as 'irregular wear'). It is by far the best kind of wear to have. Simply put, it means that the machining process is stable, stresses are carried well, heat distribution does not result in insufficient plasticization or excessive heat in either tool or workpiece, and the tool is being consumed evenly as material is removed.

2. RAKE: Chipping

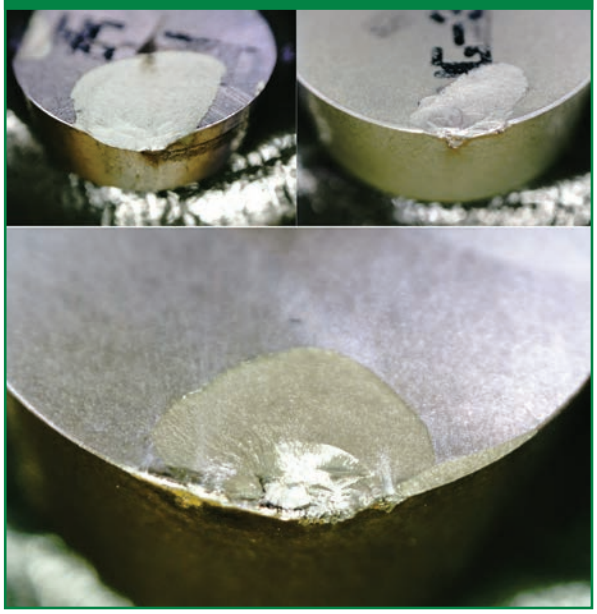
Chipping is frequently a result of vibration and instability, or the cutting tool encountering large inclusions along the cutting path that are significantly different (typically harder) from the rest of the material being machined. Chipping leads to an uneven distribution of mechanical stresses and heat along the cutting edge and lowers tool life. Prolonged chipping may lead to flaking. To maximize rigidity, use the strongest tool and fixture available, and reduce tool hangout to a minimum. Cutting forces may need to be reduced through insert geometry and cutting conditions. Lower speed generally corresponds to lower likelihood of hitting harmonics, but it may also be enough to introduce variation in RPM (+/-5% for example) to break up any resonance. If chipping is a result of hitting hard particles in the material – use a heavier edge preparation, and potentially lower the cutting speed to reduce thermal softening of the tool and force of impact.

Figure 51b



3. RAKE: Flaking

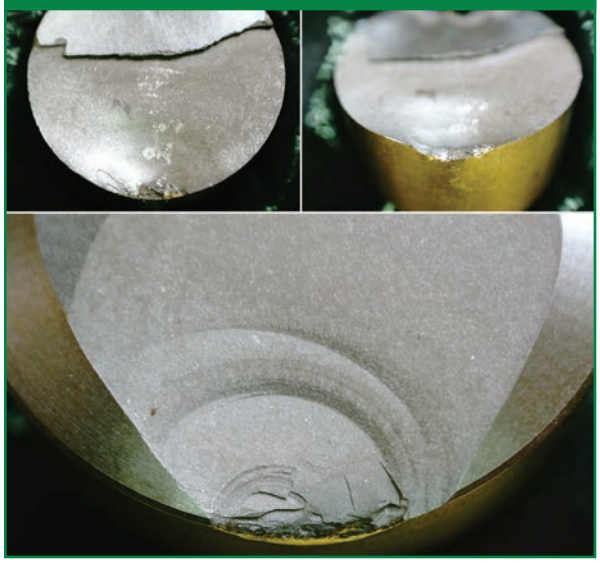
Figure 51c



Flaking is a more severe version of chipping and may indicate the speed being too low to reach optimal strain rates and plasticization, or the chip thickness being too high resulting in excessive mechanical stress and too much heat leaving the cutting zone with the chip. Prolonged flaking may lead to top-slicing. Optimize cutting speed first since it is the parameter that is of greatest influence in ceramic machining. Make sure that entry into the material and any changes in the direction of the tool path are as smooth and gradual as possible. If the material has particles of high hardness (more common in roll turning) – increase the edge preparation and use an insert with a stronger shape.

4. RAKE: Top-Slicing

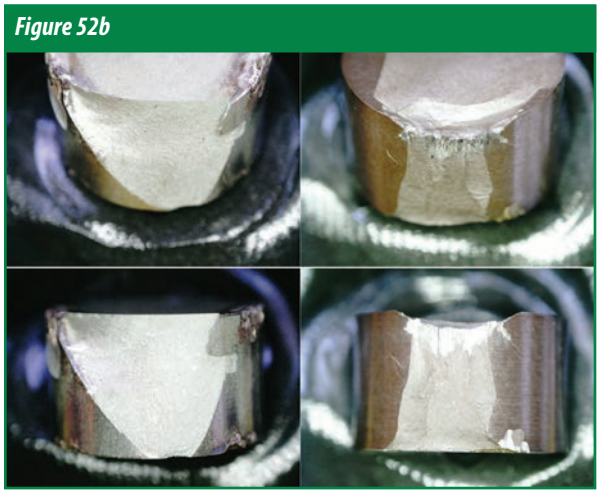
Figure 52a



Top-slicing occurs when the mechanical stresses parallel to the surface of the tool exceed the transverse rupture strength of the cutting tool. This is generally a result of excessive chip thickness combined with speed that is too low or too high. In Al_2O_3-based ceramics it's more likely that the speed is too low, while in Si_3N_4-based ceramics it's more likely that the speed is too high. Unexpected top-slicing generally indicates instability. Reevaluate the cutting path to rule out any sudden increases in chip thickness, and reduce cutting conditions, particularly feed rate.

5. FLANK: Flank-Slicing

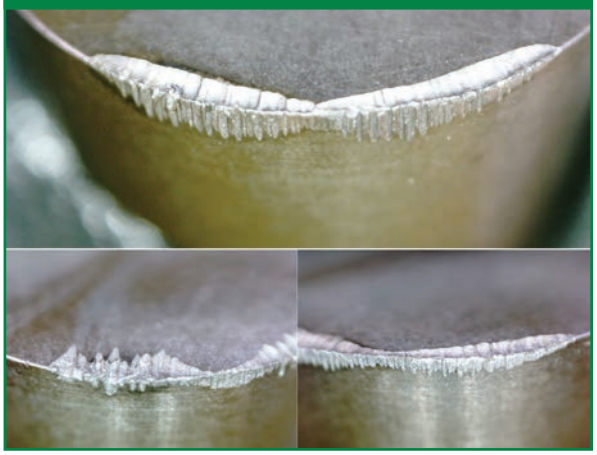
Figure 52b



Flank slicing is usually a result of impact that exceeds the toughness and transverse rupture strength of the cutting tool. Flank slicing is also an end-case of existing irregular wear and excessive speed. Use a tougher cutting tool grade (e.g. XSYTIN®-1), lower the cutting speed, and once again make sure that everything about the cutting path is as smooth as can be.

6. RAKE & FLANK: Chemical Wear

Figure 52c



Chemical wear occurs as a result of chemical interaction between the tool and the workpiece at elevated temperatures. It is expressed as crater wear on the rake face and aggressive abrasion and ridges on the flank. Reducing the amount of generated (lower cutting speed) and retained (higher chip thickness) heat is somewhat helpful, but cutting tool and workpiece material incompatibility may ultimately mean that another cutting tool should be used. This mode of wear is the least common, provided the material being machined is addressed in this guide and recommendations for cutting tool selection are followed. Particularly aggressive chemical wear looks like mechanical abrasion.

7. FLANK: Mechanical Abrasion

Figure 52d

In instances where mechanical abrasion is the primary wear mechanism the flank of the insert looks like it's been ground by the workpiece after a short time in the cut. The material being machined is probably more like a composite in microstructure – with significant strength and hardness variation between the main phases, and 1) the hardness of the cutting tool is not sufficiently higher than the microhardness of certain phases of the workpiece material 2) the heat retained in the cutting zone is too high 3) there is aggressive chemical wear. Reduce cutting speed and feed, use a heavier edge prep, or ultimately switch to a grade with higher hot hardness (e.g. GEM-8™). This wear is more common in S3, H4, K4, K6, and M4 material sub-groups.

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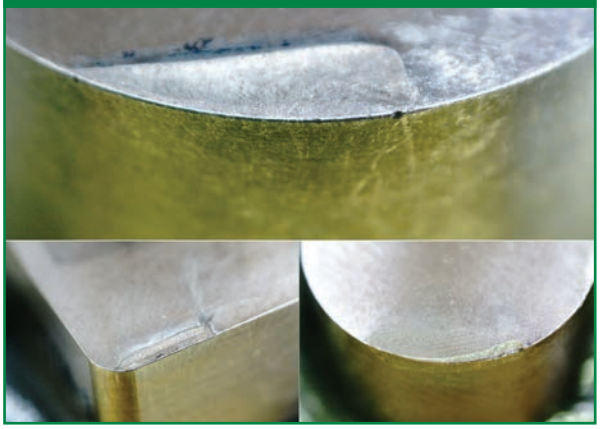
8. FLANK: Notching

Figure 53a

Notching is mostly mechanical in nature, with the additional chemical element if the temperature at the surface is sufficiently high to allow the cutting tool to oxidize. Otherwise, it's a special case of mechanical abrasion that occurs when a cutting tool that is less resistant to crack initiation is used to machine a material that exhibits heavy strain-hardening, or when a carbide/oxide-rich scale is present. In either case – the hardness of the surface layer is higher than the hardness of the material deeper in the cut, which leads to higher heat generated in the portion of the cutting zone where this harder layer is being removed, which softens the cutting tool sufficiently to enable heavier abrasive wear. This wear is more common with Al_2O_3-based ceramics in S and M material groups, or when removing any hard scale. Straight-edged inserts are generally more susceptible to notching than round inserts (because of the higher edge strength of round inserts) though a much stronger determinant is the lead angle – the lower the lead angle the more likely it is that there will be notching. Lower speed and higher lead angles (or lower depth of cut with round inserts) reduce notching. Ceramics with a combination of high fracture toughness and transverse rupture strength (e.g. XSYTIN®-1) are inherently more resistant to notching and should be used to their full extent. Having found the optimal cutting speed, try increasing the feed rate to widen the notch and reduce the contact time between the tool and the workpiece.

9. RAKE: Crater Wear

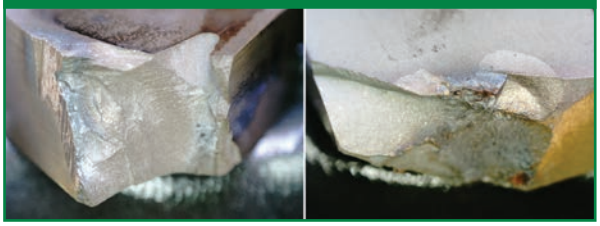
Figure 53b



Crater wear is more common in XSYTIN®-1 and is mostly a combination of chemical wear and mechanical abrasion. Unless the crater wear is very aggressive, which would then make it more likely to be predominantly chemical in nature, it is a reliable and manageable wear pattern. Increasing the feed (and reducing the depth of cut if chip thickness should be preserved with a round insert) would move the crater farther from the edge, not compromising the strength and toughness of the cutting tool. Reducing the speed will also reduce the rate at which the crater forms.

10.RAKE & FLANK: Fracture

Figure 53c



Fracture, otherwise known as catastrophic failure, is what happens when ceramic tools are grossly misapplied. And even when grossly misapplied, XSYTIN®-1 will likely not fracture but will show heavy top-slicing that has a deep notch-like appearance from the flank of the insert.

Figure 53d
XSYTIN®-1 Heavy Top-Slicing

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Machining Strategy: Continuous and Lightly-Interrupted Cuts

This section of the guide aims to describe how best to apply ceramics in turning to extend tool life. Tool life here is measured in volume of material removed per edge – not minutes. While a WC-Co tool is capable of perhaps 20-30 minutes of tool life in a demanding application, it will remove significantly less material than a well-applied ceramic cutting tool that's been in the cut for 5-10 minutes. The more "difficult" the material machined – the more important it is to adhere to the recommendations put forth in this guide. In order of decreasing "difficulty", they are roughly as follows:

S2, S3, S1, H2, K5, K3, M4, M5, M3, H4, K6, K4, M1, H3, M2, H1, K2, K1.

WC-Co vs. Ceramics

It is quite important to note that carbide machining is much more forgiving than ceramic machining –carbide will machine most materials with some degree of success. Because of the toughness and strength of carbide, it does not require as much care when applied – speed being too low is rarely a concern, the variation of mechanical stresses is less detrimental to tool life, inserts with holes are the norm, and positive rake angles can be applied almost indiscriminately of the material being machined.

One cannot apply ceramics in the same fashion as carbide and expect to be successful.

In 99% of all cases changing from carbide to ceramics requires rethinking the entire process. But after all is said and done, the productivity and tool life that ceramics offer are more than worth the efforts that go into the extensive trial and implementation period.

Material-Independent Guidelines

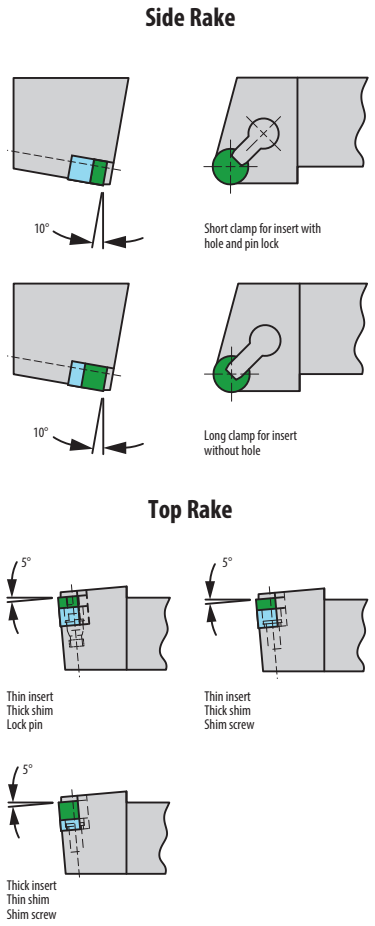
Regardless of the workpiece material and application, ensuring the wear is regular (so is kept to flank wear and edge rounding) is beneficial to the reliability of the process and will result in higher tool life. To that end, one must consider the following when machining with ceramics:

1. Rake angles and clearance
2. Mechanical stresses
3. Heat distribution
4. Cutting tool properties

Rake Angles and Clearance

Under normal tool wear circumstances, a tool is said to be "worn out" when the flank wear has developed to the point that surface finish has deteriorated outside of acceptable limits. This is determined when the width of the wear land has decreased clearance and increased heat and pressures in the tool-workpiece interface area to the point that further use will lead to complete failure of the tool by severe flaking or fracture. Assuming that flank wear is the primary mode of wear, tool life, as judged by wear land development, can be prolonged by increasing the tool side clearance. The same logic applies to increasing rake angles for negative inserts, which is another reason why standard Greenleaf tools for negative ceramic inserts have -10° side rake instead of the -5°-6° common in toolholders for WC-Co.

Figure 54a
Toolholder System



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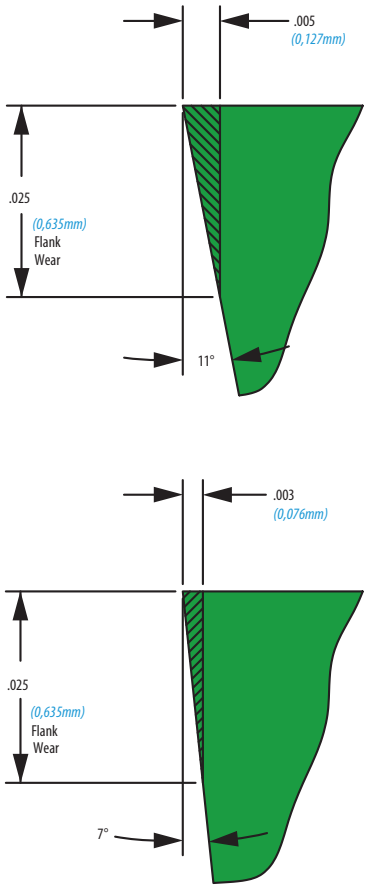
For example, to see the difference that 11° clearance makes compared to 7° clearance, refer to the illustration. (Figure 55a) With a 7° clearance angle, 0.003" (0.07 mm) of material will be worn from the insert to produce a 0.025" (0.64 mm) wear land, whereas 0.005" (0.12 mm) of material must be worn from an 11° clearance insert to produce the same amount of wear land. This will then equate to increased tool life between indexes. It is recommended that tooling be carefully evaluated on all operations relative to using clearance angle inserts. In most cases, investments in new tools can be justified. Standard Greenleaf tools for V-bottom round inserts are designed to take 7° and 11° side clearance inserts.

Figure 55a
The Effect of Increased Clearance on Tool Life



Note that 11° clearance and -10° side rake are only beneficial when wear is regular and the cut is stable. For applications where deflection and vibration are likely because the workpiece material is more difficult to machine and the holder lacks rigidity because of the geometry of the feature machined, 7° clearance will provide higher edge strength and more reliability.

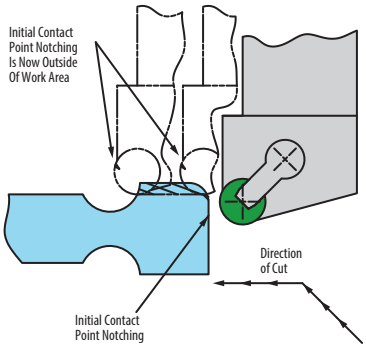
Mechanical Stresses

Reducing variation in cutting forces is perhaps the most important because, with lower tensile strength and brittle fracture being the primary mechanism of failure, ceramics are generally not as resistant to impact as WC-Co. The following are instances in which extra care must be taken to protect the edge from irregular wear by avoiding changes in cutting forces:

1. Entering and exiting the cut

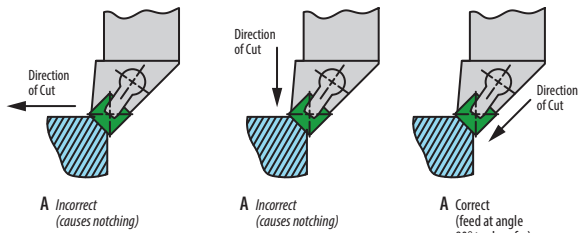
It is highly beneficial to enter the cut on a large radius (rolling in) or at least with a 50% reduction in feed to prevent the sharp edge of the workpiece from damaging the tool while the heat distribution has not reached an equilibrium and plasticization of the workpiece is low. Failure to do so may result in notching (particularly in S materials), chipping, and flaking.

Figure 55b
Chamfering and Facing



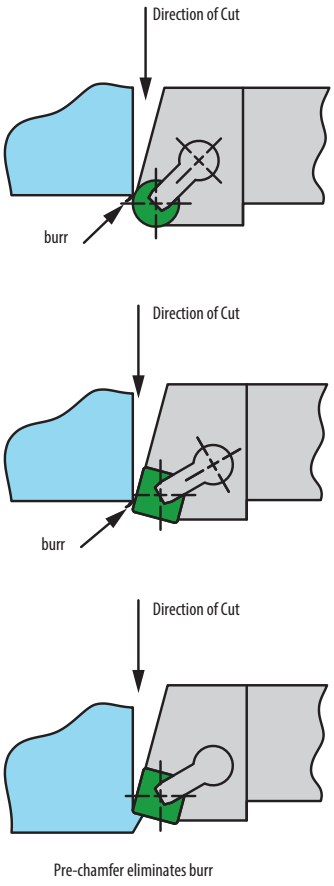
Another approach is to pre-chamfer the entry, eliminating first contact with a sharp edge:

Figure 55c
Chamfering Techniques



Exiting the part can also be damaging to the tool, because both the workpiece and the tool can spring back after the load of the cutting force is removed. To avoid this, pre-chamfer the exit or reduce the feed to 50% when exiting the material:

Figure 56a
Pre-Chamfer to Eliminate Burrs

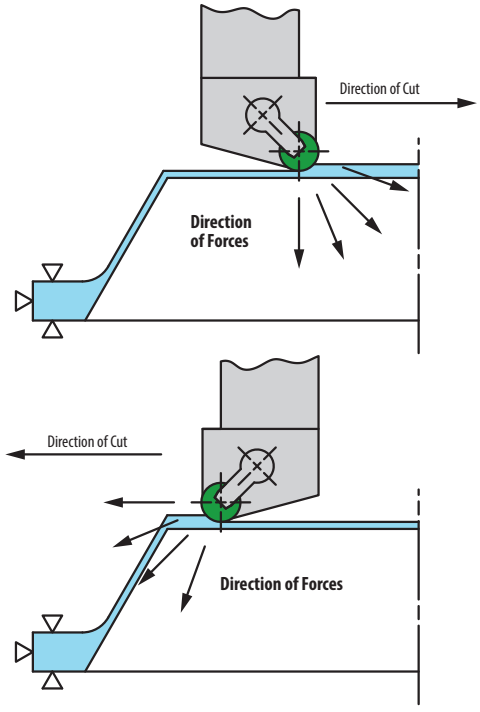


In ductile materials (S, M, H2) this also prevents the thin and plasticized wall of material from coiling over and forming a burr.

2. Direction and magnitude of cutting forces

Always consider the direction and magnitude of the cutting force produced by the chosen tool with respect to the geometry of the workpiece and the location and rigidity of the fixture. The greater the length of the edge engaged in the cut – the greater the cutting forces. So, higher lead angles will result in higher cutting forces, and round inserts will produce higher cutting forces at the same depth of cut than straight-edged inserts at a lead angle of 45° or less. Higher lead angles will also direct a greater portion of the resultant cutting force perpendicular to the machined surface. Machining in a direction that does not have sufficient rigidity in the component – when there is no clear compressive path for the stresses to flow into the fixture, will likely lead to deflection, vibration, and irregular wear.

Figure 56a
Cutting Direction Resultant Forces



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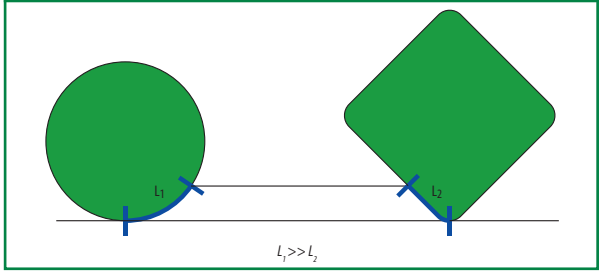
3. Round vs. straight-edged

Round inserts should be used in ceramic machining whenever possible, because they are strongest and most versatile.

The main downside to using a round insert is that at equal cutting conditions and with the same edge preparation the cutting forces will be significantly higher than with a straight-edged insert (at a lead angle of, say 45°), owing to the higher length of edge in the cut.

Figure 57a
Length of Cutting Edge Engaged for Equal IC Round and Square Inserts

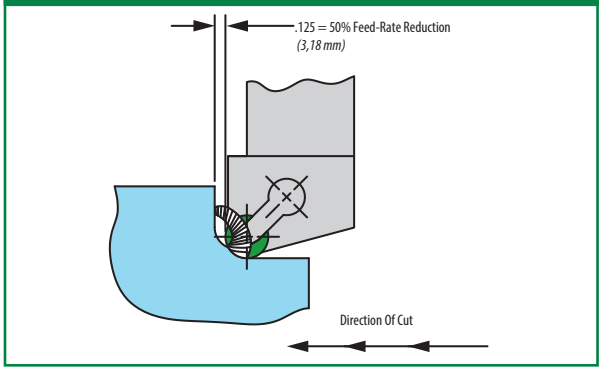


Higher cutting forces mean higher spindle loads (so one may also run into machine power as a limitation when using round inserts), but also higher mechanical stresses that the component and tool have to carry without deflecting. An extreme case would be the use of a round negative insert for small-ID and large OAL boring – often this is impossible and a straight-edged insert has to be used instead. S and M material groups' tendency to strain-harden, however, means that the higher cutting forces that a round insert produces have to be weighed against the lower resistance to notching of straight-edged inserts, particularly at lower lead angles. Some instances warrant the use of an SNGN for roughing instead. XSYTIN®-1 is particularly well-suited for this in S materials because of its superb resistance to notching – more on this in the section on machining heat-resistant super alloys.

4. Turning to a shoulder

One of the most common operations encountered in all turning is machining to a flange or shoulder. Regardless of the shape of the insert, approaching the shoulder leaves no room for the chips to flow, trapping them between the tool and the part and increasing cutting forces. If higher spindle loads are observed with a straight-edged insert machining to a shoulder, reduce the feed by 50% in subsequent passes.

Figure 57b
Chip Being Trapped Against Shoulder (increased engagement increases tool pressure)

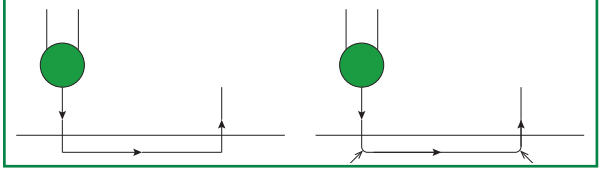


From the perspective of chip thickness, turning to a shoulder with an insert with a small corner radius actually presents less of a challenge, but as the corner radius grows and round inserts or full-nose grooving inserts are used, more and more material is left at the shoulder for subsequent passes, so that, eventually, the depth of cut grows to the radius of the insert when approaching the shoulder as seen in Figure 57b above.

Without a reduction in feed, this causes the chip thickness to increase considerably as the lead angle approaches 0, and causes the cross-sectional area of the chip to grow considerably, increasing the cutting forces. The increase in chip thickness changes the heat distribution, while the increase in cutting forces may exceed the strength of the insert leading to flaking or top-slicing or, in extreme cases, fracture. With access to CAM or validation modules that can track chip thickness and adjust the feed rate when generating the tool path this is no longer a concern because feed will be adjusted in the program with the increasing depth of cut. Otherwise, a reduction of feed on the order of 50% is recommended for the segment of the tool path where depth of cut starts to grow at the shoulder.

5. Connecting tool path segments

Figure 57c –Always Connect Tool Path Segments with Radii



It is paramount to have **NO** sharp points in the tool path. All segments must be connected by a radius, no matter how small, but preferably the larger the better. Any sharp points in the path will result in sudden changes of direction and/or magnitude of cutting forces, or dwell if the feed speed is too high for the dynamics of the machine. That being said, CNC is not a prerequisite for ceramic machining, especially on a lathe.

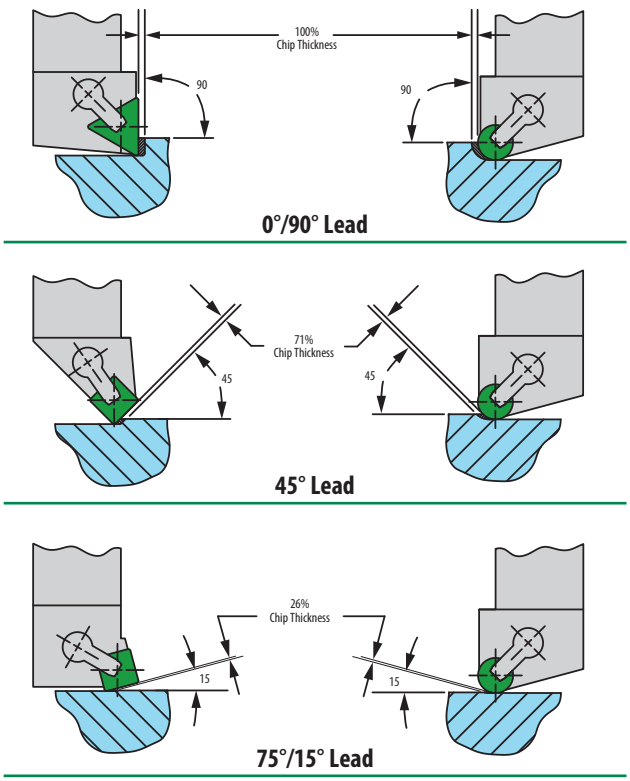
6. Face-turning to center

Ceramics do not tolerate near-0 cutting speed because the strain rate approaches 0, as does heat that is so necessary in reducing the strength of the workpiece material and thereby reducing cutting forces. It is generally not recommended to machine with ceramics in conditions that approach 0 cutting speed. Some exceptions can be made and it can, on occasion, be done successfully, but as a rule – drill a hole with carbide before face turning whenever possible.

Heat Distribution

As previously mentioned in the section on chip thickness, heat generation and evacuation are pivotal in the ceramic machining process. Since chip thickness is affected by the lead angle and feed, chip thickness for round inserts is a function of the radius of the insert, feed, and depth of cut.

Figure 58a
Lead-Angle Effect on Round vs. Straight-Edged Inserts and the Theoretical Chip Thickness



Using a smaller or larger insert, or changing the depth of cut with a round insert will change the chip thickness and affect the heat distribution. Increasing the chip thickness removes more heat from the cutting zone, and reducing the chip thickness does the opposite.

The best scenario is one where a CAM or validation module is used to monitor the chip thickness to adjust the feed rate based on the radius of the insert and the depth of cut at which the insert is currently engaged.

Failing that, feed rates need to be programmed manually so that the chip thickness that is found to be optimal at a given speed is kept constant. Changes to chip thickness alter the heat distribution and will likely lead to irregular wear, lowering tool life. This is especially important in the machining of S-class materials, but also applies to all ceramic machining.

Cutting Tool Material Properties

Al_2O_3-based ceramics are inherently different from Si_3N_4-based ceramics. Alumina-based grades are harder, more wear-resistant, more chemically stable at higher temperatures, but less resistant to notching whereas silicon nitride is tougher, stronger, more resistant to thermal shock, but starts to oxidize around 1000°C (1832 F). It is no surprise then, that applications requiring wear resistance and hot hardness are best tackled with whisker-reinforced ceramics, while applications requiring strength, toughness, and resistance to thermal shock should be addressed with XSYTIN®-1.

It also follows that, as far as optimal chip thickness is concerned, having a lower chip thickness is more damaging to XSYTIN®-1 (too much heat), and having a higher chip thickness is more damaging to whisker-reinforced ceramics because the mechanical stresses may be too high, or there may be insufficient plasticization.

Some materials remain ductile and retain strength despite high strain rates and plasticization, and so require cutting tools that exhibit both high fracture toughness and transverse rupture strength. These materials, previously not machinable with ceramics, can now be machined with XSYTIN®-1.

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Material-Specific Guidelines

Heat-Resistant Super Alloys (S)

The importance of chip thickness in machining of heat-resistant super alloys cannot be overstated. Suffice it to say that if you deal with the production of large quantities of complex components in nickel- or cobalt-based HRSAs then tool life and therefore cost of tooling per component could be dramatically improved through the use of a CAM or verification module that has the ability to adjust programmed feed to keep chip thickness constant.

Nickel- and cobalt-based alloys are very susceptible to strain-hardening. This means that even if there isn't a carbide/oxide-rich forging scale, the surface of the component after every subsequent pass in turning or milling is harder than the rest of the workpiece. The strains that the surface is subjected to as it is being machined dictate the degree to which strain-hardening occurs. So, using a negative ceramic insert with a negative edge preparation at negative rake angles will strain-harden the surface considerably more than a very positive carbide insert with a positive chipform and 0 or positive rake.

Regardless of which machining method preceded the operation now being addressed with ceramics – the surface is harder, and, unless specific measures are taken, notching is a concern.

Because of differences in material properties, whisker-reinforced ceramics are more prone to notching than XSYTIN®-1. The best tool path for WG-300® can vary significantly from the best tool path for XSYTIN®-1.

Forging Scale Removal

Forging scale in S materials goes hand in hand with some degree of runout and presents the first challenge in machining. One false assumption that should be dispelled is that the depth of cut must be kept low to reduce stresses and prevent the insert from flaking – on the contrary, because of the quantity of large, hard particles, keeping the depth of cut low will result in aggressive abrasive wear that will grind down the flank, weakening the edge and making catastrophic failure more likely. The cutting edge should be below the scale for as much of every revolution as possible – ideally 100% of the time. The higher the runout, however, the higher the maximum depth of cut needed to keep the edge of the insert in clean material for scale removal. This means higher cutting forces, a higher lead angle for round inserts, and a higher chance of notching.

Due to their higher edge strength and resistance to notching, round inserts are generally recommended for forging scale removal; but if the radial runout and cutting forces are too high, manifesting as deflection, vibration, or high spindle loads, a straight-edged insert in XSYTIN®-1 at a lead angle of 45° or higher can be used for outstanding results instead.

Because of the difference in hardness between the scale and the material below it, it is almost impossible to find a set of cutting conditions at which the wear would be regular in both, so some notching is always expected. However, with XSYTIN®-1's transverse rupture strength and toughness, we are able to apply it at conditions that are optimal for the hardness of the scale without fearing irregular wear in base material. It is recommended to reduce both speed and chip thickness by 20-30% from optimal cutting conditions in clean material for both XSYTIN®-1 and whisker-reinforced ceramics when machining forging scale.

Roughing: Straight Cuts

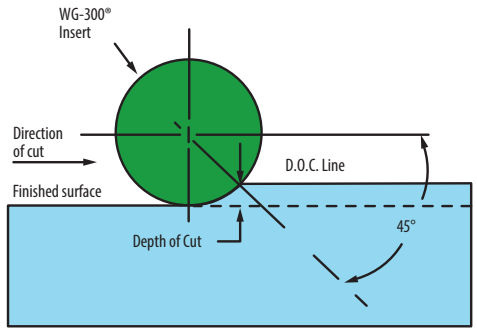
Whisker-reinforced ceramics and XSYTIN®-1 are both extremely capable of productive and reliable roughing of heat-resistant super alloys that can reduce cycle times by a factor of 4 or more compared to coated carbide. Whisker-reinforced ceramics generally perform better in stable environments capable of sustaining high speeds without any loss of rigidity or increase in vibration. XSYTIN®-1 performs better in applications with cutting speed limitations, in unstable environments, but in machines that are nevertheless capable of producing enough power at the spindle, because with the lower strain rates and higher chip thickness that are optimal in applying XSYTIN®-1, cutting forces can be as much as double those for WG-300®. This also makes sense because the transverse rupture strength of XSYTIN®-1 is roughly double that of WG-300® and cutting tools should be applied at the limit of their material properties to maximize productivity.

Whisker-Reinforced Ceramics

1. Optimal depth of cut

When notching is the primary mode of wear – i.e., the wear that progresses quickest and ultimately limits tool life, round inserts and straight-edged inserts with a corner radius should be applied at or below 45° radial engagement. The higher the lead angle – the higher the component of the cutting force acting perpendicular to the cutting edge – the stronger the notching. Reducing the depth of cut while keeping the chip thickness constant, however, reduces the rate of metal removal, because the increase in feed does not keep the cross-sectional chip area constant. And so, the right compromise between tool life and productivity must be found.

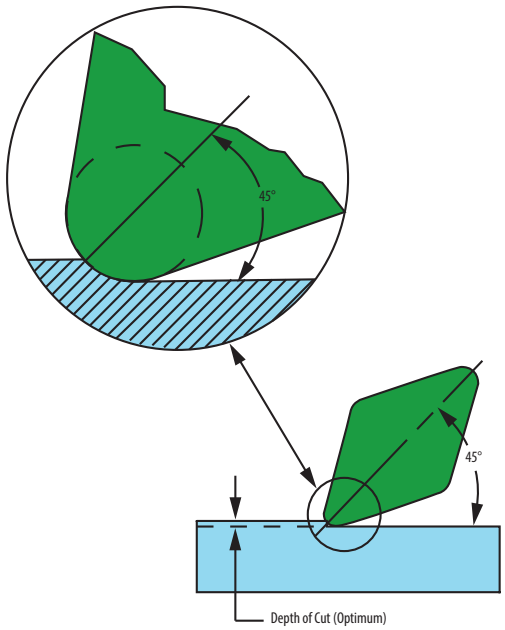
Figure 59a
Recommended Depth of Cut for Round Inserts



Insert Radius		Optimum Depth of Cut	
Inches	***Millimeter***	**Inches**	***Millimeter***
.125	*3,18*	.037	*0,93*
.187	*4,76*	.052	*1,40*
.250	*6,35*	.073	*1,86*
.312	*7,94*	.092	*2,33*
.375	*9,53*	.110	*2,79*
.437	*11,11*	.128	*3,26*
.500	*12,70*	.147	*3,72*

When notching is not the primary concern and wear is regular, a better balance between the rate of metal removal and wear is reached at 60° engagement with round inserts in whisker-reinforced ceramics.

Figure 60a
Recommended Depth of Cut for Insert Nose Radii

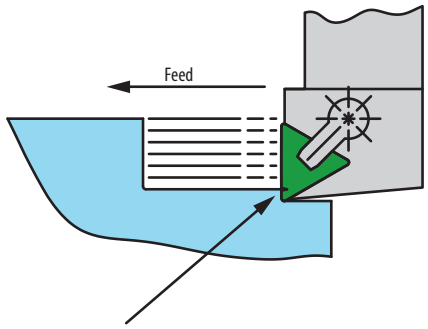


Insert Radius		Optimum Depth of Cut	
Inches	***Millimeter***	**Inches**	***Millimeter***
.015	*0,38*	.0046	*0,12*
.031	*0,80*	.0092	*0,23*
.048	*1,21*	.0139	*0,35*
.063	*1,59*	.0183	*0,47*
.094	*2,38*	.0275	*0,70*
.125	*3,18*	.0370	*0,93*

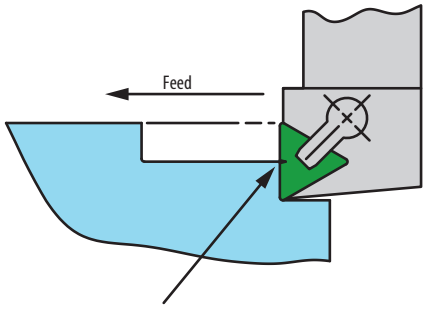
2. Taking fewer passes

Reducing contact time is generally beneficial to wear so long as the same or higher quantity of material is removed per operation. So, when applying a straight-edged insert, and so long as cutting forces aren't too high – the wear is regular, there is no deflection-vibration, the spindle load is not too high – take fewer passes at a higher depth of cut instead of multiple passes at a lower depth of cut. This also extends tool life by using more of the insert, distributing the wear over a greater portion of the cutting edge.

Figure 60b
Rethink Depth of Cut



Multiple passes at the same depth of cut causes notching at weak section of insert.



Fewer deep passes moves notching to a stronger section of the insert.
(A reduction of feed rate will be necessary.)

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3. Varying the depth of cut

Since notching occurs at the depth of cut it makes sense to distribute the notching and vary the depth of cut between passes instead of repeating multiple passes at the same depth of cut. If notching is the primary mode of wear – depth of cut should be reduced with each subsequent pass to present an un-notched edge to the cut. If wear is regular then depth of cut should be increased with each subsequent pass instead. Always keep in mind that with round inserts changing the depth of cut affects lead angle and feed rate must be adjusted to keep the chip thickness constant.

Figure 61a
Multiple Passes at the Same Depth of Cut

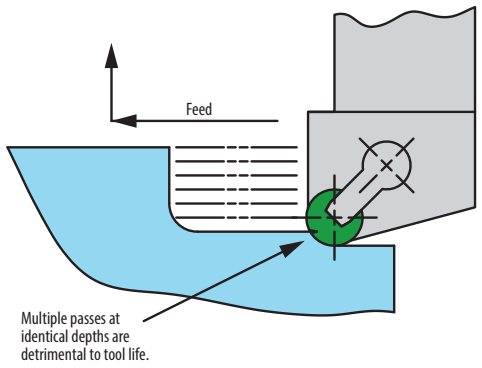


Figure 61b
Multiple Passes at Varying Depths of Cut with Notching

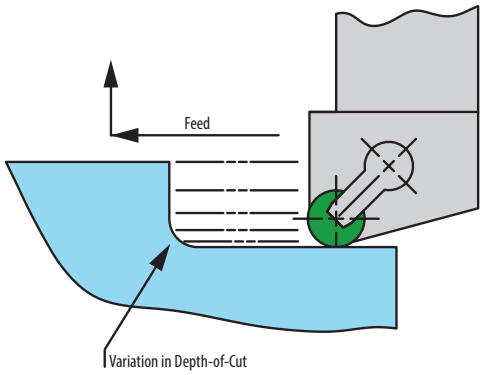
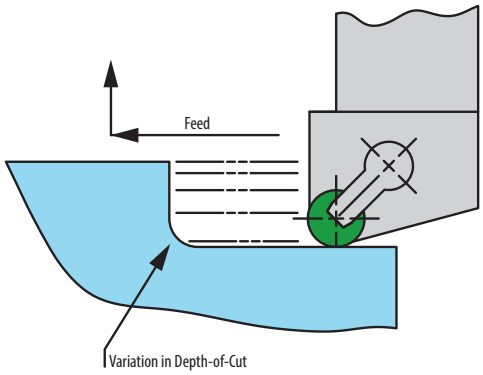


Figure 61c
Multiple Passes at Varying Depths of Cut with Regular Wear



4. Ramping

The best way to vary the depth of cut if notching is the primary mode of wear is to vary it continuously by ramping. Ramping on straight cuts can be done with both negative and positive inserts. Negative inserts can only be used to ramp out and then ramp in by doing a subsequent straight pass (as in Figure 61d) while positive inserts can be used to ramp in, plunge, and carry out sinusoidal ramping (as in Figure 61e) though ramping out following a plunge is preferable because the cross-sectional chip area decreases as wear increases – resulting in lower peak loads than ramping in.

Note that in all cases, optimal chip thickness must be kept as close to constant as possible for a given speed. For passes that are sufficiently short – say, a minute or less in cut time, split the ramp into four segments and assign a feed value to each segment that would, on average, result in the right chip thickness. For longer passes – increase the number of segments. Finally, the more aggressive (steep) the ramp – the more segments should be programmed to reduce the variation in chip thickness.

Figure 61d
Multiple Passes Using Ramping Technique

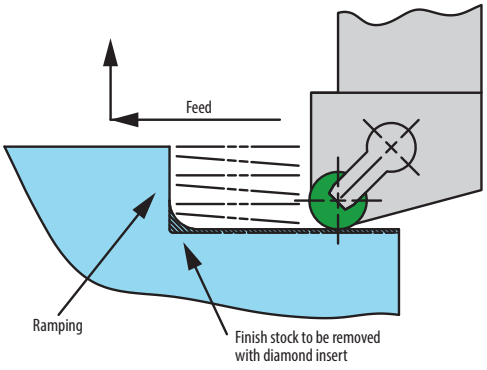
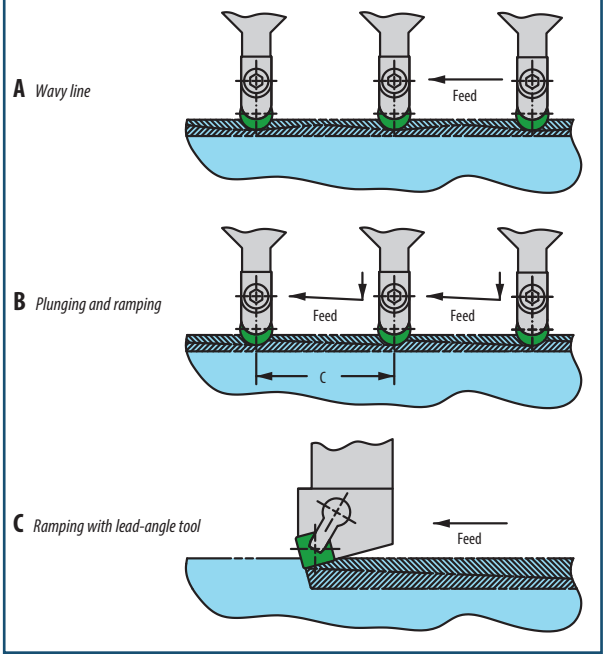


Figure 61e
Various Ramping Methods



XSYTIN®-1

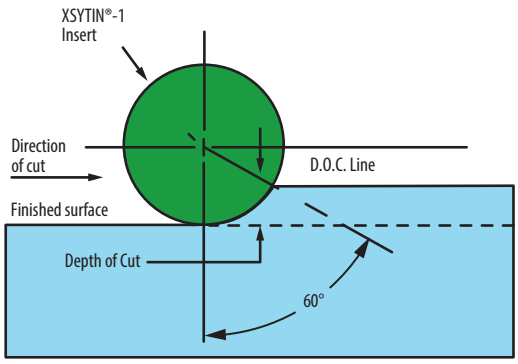
Because XSYTIN®-1 is considerably stronger and more resistant to notching but less stable at higher temperatures compared to whisker-reinforced ceramics, the main concern when applying XSYTIN®-1 is to avoid any tool paths where the chip thickness drops off and the heat in the cutting zone increases beyond optimal levels.

Since notching is generally less common, there is less need to vary the point of contact between the surface of the workpiece and the tool. In fact, ramping, especially when depth of cut is low, can be detrimental to tool life because the chip is not sufficiently thick to carry enough heat out of the cutting zone.

1. Optimal depth of cut

Because of heat, optimal cutting speeds for XSYTIN®-1 are always lower than those for whisker-reinforced ceramics. Because of the lower strain rates, the material is typically more ductile and stronger, and requires higher effort to be sheared off. Because of the increased ductility the chip also doesn't break as easily, which can lead to crater wear. To avoid crater wear entirely, the optimal depth of cut for round XSYTIN®-1 inserts even where whisker-reinforced ceramics notch, is greater than 60°-65° radial engagement.

Figure 62a
Recommended Depth of Cut for Round Inserts (XSYTIN®-1)



Insert Radius		Optimum Depth of Cut	
Inches	***Millimeter***	**Inches**	***Millimeter***
.125	*3,18*	.063	*1,50*
.187	*4,76*	.094	*2,38*
.250	*6,35*	.125	*3,18*
.312	*7,94*	.156	*3,97*
.375	*9,53*	.188	*4,76*
.437	*11,11*	.219	*5,55*
.500	*12,70*	.250	*6,35*

The higher the curvature of the chip (the higher the depth of cut with a round insert) the less likely it is that the chip will stay intact as it separates from the workpiece.

2. Taking fewer passes

Reducing contact time is generally beneficial to wear so long as the same or higher quantity of material is removed per operation. While the cutting forces aren't too high – wear is regular, there is no deflection-vibration, the spindle load is not too high, take fewer passes at a higher depth of cut instead of multiple passes at a lower depth of cut.

3. Round vs. straight-edged

Because of XSYTIN®-1's resistance to notching and edge strength, straight-edged inserts (SNGN, for example) can be used at 45° or higher lead angles in heat-resistant super alloys to reduce cutting forces at the same depth of cut, or significantly increase metal removal rates at the same spindle load.

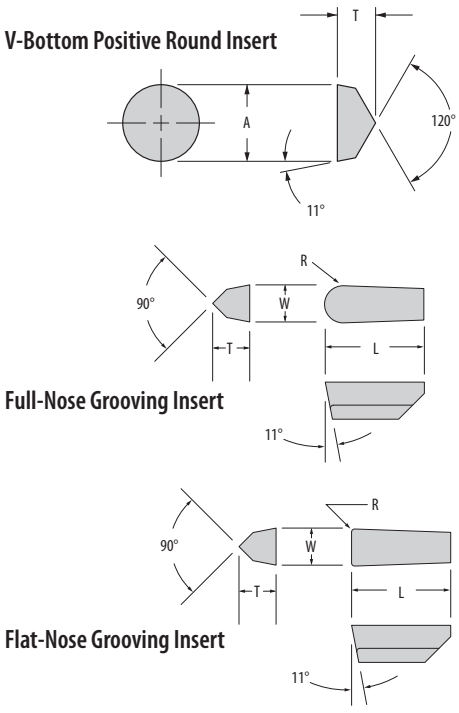
Roughing: Opening Cavities

The two mechanically different approaches to opening cavities are grooving and profiling. While grooving is indisputably more productive, it is also more costly, and generally requires more sister tooling. Profiling (the use of a v-bottom positive round insert or a full-nose grooving insert) is the most cost-effective, but not the fastest.

There are, ultimately, three styles of inserts, then, that can be used in combination to open cavities:

- V-bottom positive rounds – e.g., RPGN-3V
- Full-nose grooving inserts – e.g., WG-6250A, where the last three digits denote the width of the insert in 1/1000ths of an inch, and the 'A' stands for 'A-hone'
- Flat-nose grooving inserts – e.g., WG-6250-2A, where the last digit indicates the corner radii of the insert in 1/64ths of an inch

Figure 62b
Insert Styles Used in Combination to Open Cavities



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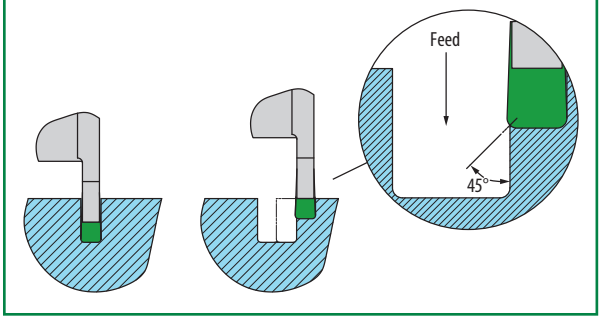
Grooving

When the corner radii of the cavity are small (0.050" / 1.2mm or less) using a flat-nose grooving insert makes the most sense, but notching is difficult to avoid with partial engagement of the insert. If the material being machined is sufficiently strong (e.g. all S2 alloys in the STA condition), chips will shear off well and burring will not occur. If, however, we are grooving an S1 alloy, it is likely that following the method shown in Figure 63a will result in a thin wall of the material peeling off despite the fact that the width of the machined area is smaller than the width of the insert. To avoid this, and assuming some productivity can be sacrificed for reliability, we recommend using a full-nose grooving insert or a round v-bottom insert to profile the cavity as discussed in the 'Profiling' section below.

Alternating the plunge order to engage the insert fully instead of stepping over and having a slight imbalance in cutting forces with higher susceptibility to notching is not recommended because the flanges left to machine between grooves are generally not rigid, which, combined with the relative flexibility of the grooving blade typically leads to vibration and irregular wear.

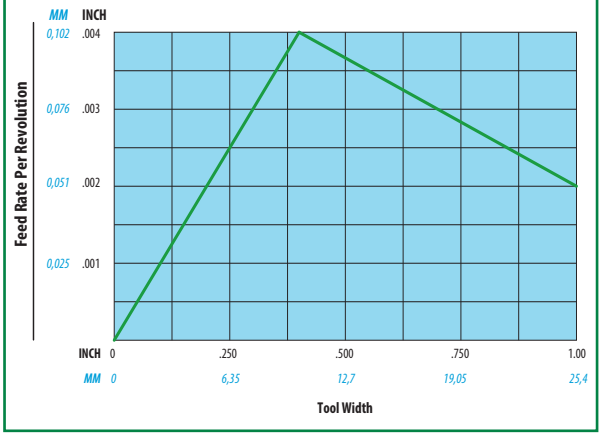
Figure 63a
Additional Cavity Techniques



Note that grooving with a round V-bottom insert or a full-nose grooving insert is an exceptionally stable and effective operation, provided the machine has enough power and the workpiece/tool/fixture are sufficiently rigid. The only downsides are the scallops that are left and have to be machined at the end, any resulting burrs, and the difficulty in chip breaking.

The feed rates recommended for grooving differ from the feed rates recommended for regular turning because the cutting forces that would be produced if regular chip thickness recommendations were followed would exceed the strength of the cutting tool for most narrow groovers. Instead, use the same cutting speed as in turning, but determine the feed from Figure 63b below:

Figure 63b
Grooving Feeds vs. Tool Width for Whisker-Reinforced Ceramics in HRSA

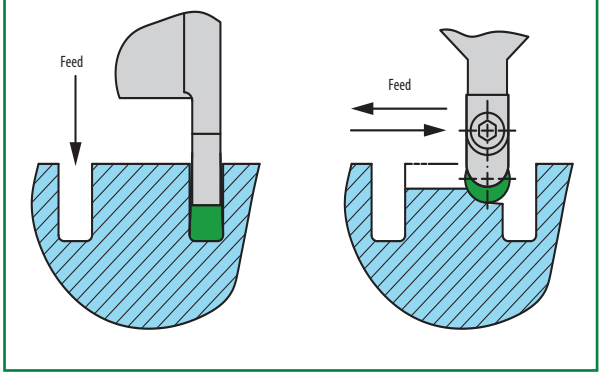


For XSYTIN®-1, increase the feed from the determined value by a factor of x1.5.

Grooving and Profiling

An alternative to the methods above would combine a flat-nose grooving insert and a round (RPGN or WG-XXXX) insert using the flat-nose groover first, removing the remaining stock with a round, and doing a final blend cut with the flat-nose groover if necessary.

Figure 63c
Alternative Method for Grooving and Profiling



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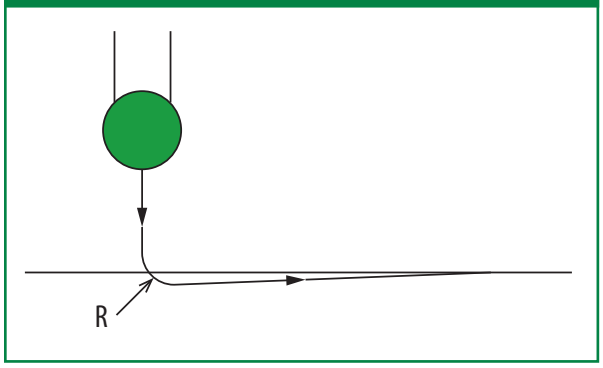
Profiling

Provided the corner radii of a cavity are sufficiently large, profiling is a method that requires only one tool to complete the operation. Here a V-bottom round insert or a full-nose grooving insert are used to feed in multiple directions.

Whisker-Reinforced Ceramics

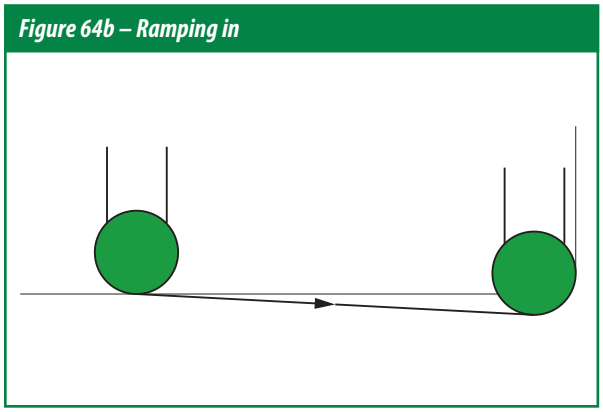
To avoid notching, the most effective method of profiling with whisker-reinforced ceramics is ramping. To start the cut, one can either plunge into the material or ramp into it – both with their pros and cons. Plunging allows ramping out, which alleviates the stress on the tool towards the end of the cut. Because we need to avoid any sharp corners in the tool path, however, plunging should be connected to the ramp by a radius sufficiently large to allow the machine to execute the cut with no sudden changes in direction, which is slightly more difficult to program while keeping the chip thickness constant. Plunging on a radius followed by feeding perpendicular to the axis of the tool is known as trochoidal turning. With whisker-reinforced ceramics, plunging on a radius is a great way to enter the material, provided the path then follows a ramp (in or out) and chip thickness is kept constant throughout.

Figure 64a – Plunging Followed by Ramping out



Ramping in is generally better for mechanical stresses, but will end with the insert at its highest wear approaching the shoulder. In the following passes, this tool path will require a significant reduction in feed when approaching the shoulder because the depth of cut will grow to the radius of the insert, where the lead angle and chip thinning are 0.

Figure 64b – Ramping in

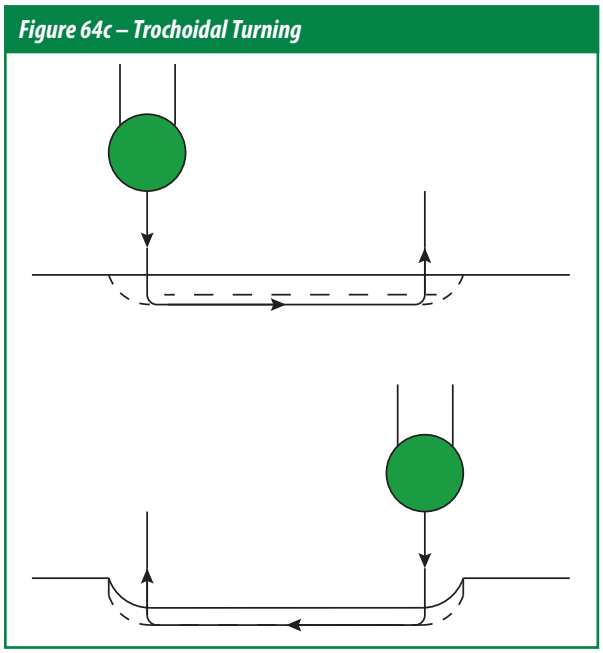


Throughout both ramping methods, chip thickness must be kept constant to preserve the balance of heat. Plunging should be done at a feed rate equal to the recommended chip thickness since the chip thickness then equals the feed rate, with feed rate adjusted in all other paths to conserve chip thickness for the given speed and insert radius.

XSYTIN®-1

Since notching is generally not a concern, profiling with XSYTIN®-1 needs only to minimize the variation in mechanical stresses but depth of cut can usually be kept constant. Ramping where the depth of cut is below 60° engagement is not recommended. Ramping, in general, is not needed and the most efficient and productive method is to use trochoidal turning.

Figure 64c – Trochoidal Turning



When programming the tool path, use a radius of twice the radius of the insert for entry and exit to reduce radial engagement. And as always, adjust feed rates to keep chip thickness constant throughout.

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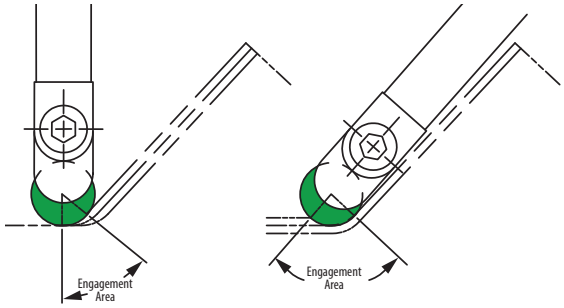
Radial Engagement a.k.a. Wraparound

One final aspect that should be considered when profiling is the direction from which a cut should be executed given surfaces that do not meet at a right angle.

Figure 65a
Tool Engagement Angle

Maintaining a reduced engagement area as shown is preferred. If the increased engagement area is unavoidable, then a 50% feed reduction may be necessary.



Preferred - reduced engagement area

Semi-Finishing

Semi-finishing is an operation that is carried out at a low depth of cut and removes any material left over by larger inserts, mismatches, excessive internal surface stresses, and otherwise prepares the workpiece for finishing.

Fillets and Shoulders

The most common semi-finishing operation requires the removal of material left behind by round inserts in corners. To avoid notching, the best methods are as follows:

Figure 65b
Finishing a Fillet Using an 80° Diamond Insert (Plunge Cut)

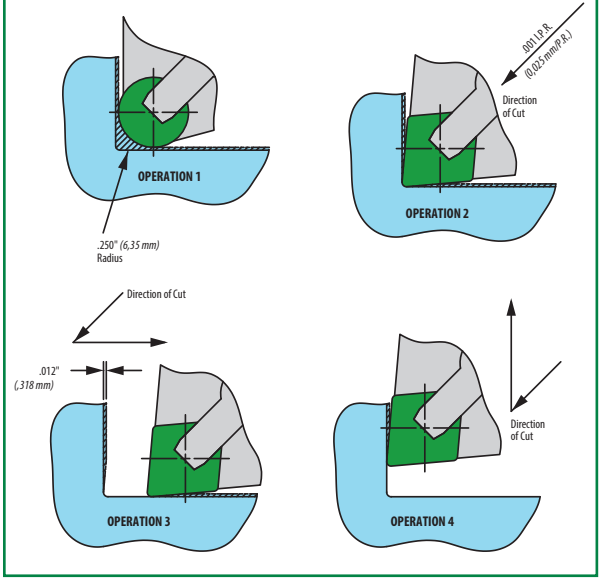
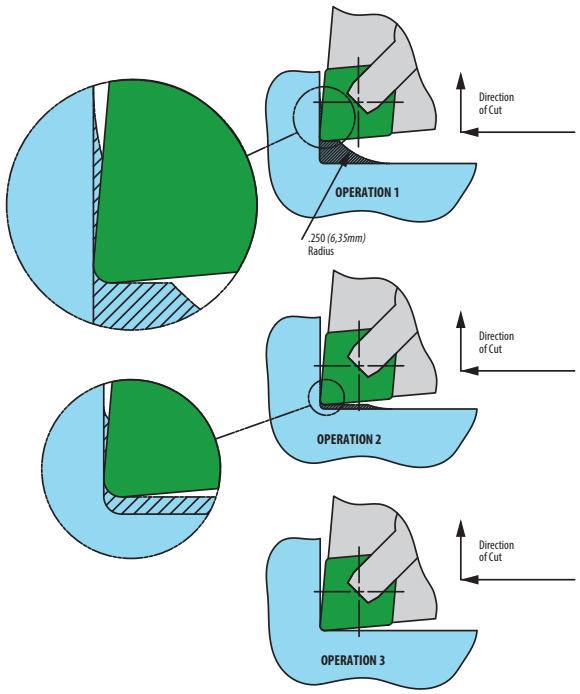


Figure 65c
Ramping Effect on Shoulder Cuts

In this method, a CNGN452 (12 07 08) insert is shown in the finish operation on a fillet roughed with a RNGN45 (12 07 00) insert leaving a .250" *(6,3 mm)* radius. The finish operation is performed by feeding several times into the fillet. It is essential when the wall is reached to *immediately* raise the tool vertical to remove the scallop which would otherwise be left on the wall. This material will tend to cool and present a hardened, irregular surface needing a subsequent operation. The finish passes described will tend to notch the tool and should be programmed at various depths to reduce this effect. The final pass should be less than the 45° line of the tool nose radius.



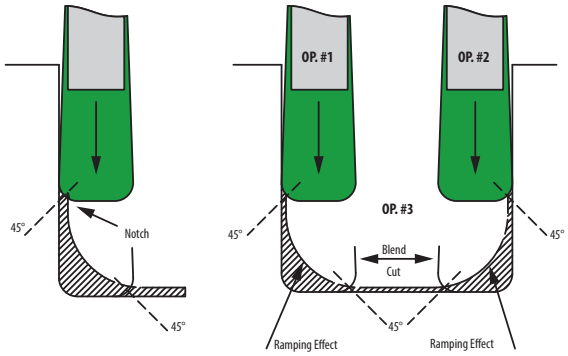
Corners in a Cavity

Semi-finishing of corners in a cavity requires the use a flat-nose grooving insert to produce the corners and blend the cut, as seen in Figure 66a.

Figure 66a
Turning to a Shoulder in Cavities with V-Bottom Grooving Inserts

This example shows the profiling of the groove or cavity using a V-bottom grooving insert. It is important to keep the finish stock very light on the sides so that the cut is below the 45° mark on the insert radius. This will vary with the radius needed. The larger the radius, the greater the stock can be.

In the corner itself, we use the "ramp" inherent in the radius left by the round insert used for roughing to reduce or eliminate notching of the tool. This is a further benefit of roughing with round inserts or profiling the corner in the program.



Watch the depth-of-cut line!

Finishing

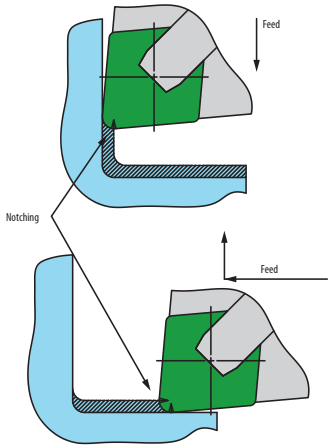
Finishing is the final stage of machining that leaves the surface in the desired condition with the appropriate Ra, Rz, acceptable thickness of deformed layer, and magnitude of internal stresses.

Because of the very strict requirements on surface quality of heat-resistant super alloys, particularly in critical rotating parts in aircraft engines, the finishing is typically done with WC-Co tools. Greenleaf's whisker-reinforced ceramics, however, are exceptionally well-suited for the task of finishing heat-resistant super alloys.

Leaving less than 0.0079" (0.2mm) of stock material for finishing is not recommended, especially when using the T1 edge preparation – the insert may refuse the cut, bouncing along the surface and smearing the material instead of cutting it. However, GF-1 (below) is able to take much lower depths of cut consistently and reliably – as little as 0.002" (0.05mm).

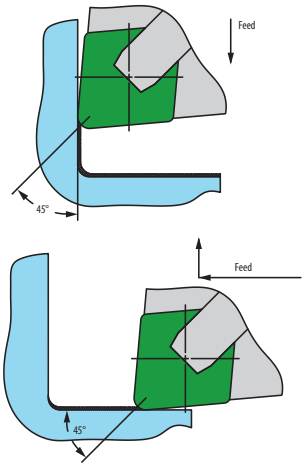
Leaving too much material poses the risk of notching, as seen in Figure 66b below.

Figure 66b
Carbide Method Beware



The ideal amount of material would be such that the straight-edged insert executing the finish cut is engaged to 45° of the corner radius.

Figure 66c
Ceramic Method



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WG-600

Following grinding, the edge of any ceramic (or CBN/PCD) insert is ultimately a well-aligned collection of jagged peaks. The coating of WG-600® levels these peaks out, providing a smoother surface with which to remove material, which itself produces a smoother surface (especially after the coating has "worn in" slightly) and protecting the substrate from heat and abrasive wear. With the high strain rates and plasticization of whisker-reinforced ceramics in heat-resistant super alloys, chips separate well and the surface finish is excellent.

GF-1

GF-1 is a chipform that Greenleaf adds to round v-bottom inserts that makes the cut more positive. Combining the high strain rates and plasticization of ceramic machining with the positive rake angle of GF-1 significantly reduces the cutting forces and compressive stresses that the surface is subjected to. The result is a surface with fewer defects and a lower thickness of deformed layer than what is commonly seen in finishing with WC-Co tools.

Multiple OEMs and share partners have certified WG-300®/WG-600® GF-1 for finishing of critical rotating components in gas turbines.

Figure 67a – GF-1 Chipform

Figure 67b
Theoretical Surface Roughness

Roughness average Micro inches (Ra)		8	16	32	63	80	100	125	150	200	250
Micro meter (µm)		*0,2*	*0,4*	*0,8*	*1,6*	*2,0*	*2,5*	*3,1*	*3,8*	*5,0*	*6,3*
	Nose radius	Feed rate per revolution									
Inches	.0156	.002	.0025	.004	.0055	.0065	.007	.0075	.008	.010	.011
mm	*0,40*	*0,05*	*0,06*	*0,10*	*0,14*	*0,17*	*0,18*	*0,19*	*0,20*	*0,25*	*0,23*
Inches	.0313	.003	.004	.0055	.008	.009	.010	.011	.012	.014	.016
mm	*0,79*	*0,08*	*0,10*	*0,14*	*0,20*	*0,23*	*0,25*	*0,28*	*0,30*	*0,35*	*0,41*
Inches	.0469	.0035	.005	.007	.0095	.0105	.012	.013	.015	.017	.019
mm	*1,19*	*0,09*	*0,13*	*0,18*	*0,24*	*0,27*	*0,30*	*0,33*	*0,38*	*0,43*	*0,42*
Inches	.0625	.004	.0055	.008	.011	.0125	.014	.015	.017	.020	.022
mm	*1,59*	*0,10*	*0,14*	*0,20*	*0,28*	*0,32*	*0,35*	*0,38*	*0,43*	*0,50*	*0,56*
Inches	.0938	.0045	.007	.009	.013	.015	.017	.019	.021	.023	.026
mm	*2,38*	*0,11*	*0,18*	*0,23*	*0,33*	*0,33*	*0,43*	*0,43*	*0,53*	*0,58*	*0,66*
Inches	.125	.0055	.008	.011	.016	.018	.020	.022	.024	.027	.031
mm	*3,13*	*0,14*	*0,20*	*0,23*	*0,41*	*0,45*	*0,50*	*0,56*	*0,60*	*0,69*	*0,79*
Inches	.1875	.007	.0095	.0135	.017	.021	.025	.027	.030	.034	.040
mm	*4,76*	*0,18*	*0,24*	*0,34*	*0,43*	*0,53*	*0,64*	*0,69*	*0,76*	*0,86*	*1,02*
Inches	.250	.008	.011	.016	.022	.025	.027	.031	.034	.040	.044
mm	*6,35*	*0,20*	*0,28*	*0,41*	*0,56*	*0,65*	*0,69*	*0,79*	*0,86*	*1,02*	*1,12*

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Thin-Walled Components

Components with thin walls are quite common in gas turbines. Because of the lack of rigidity, special measures must be taken to ensure that the component is produced reliably and efficiently.

1. Reduce and redirect cutting forces if there is deflection and/or vibration.
   a. Use smaller-radius round and full-nose grooving inserts.
   b. Use smaller-corner-radius straight-edged inserts.
   c. Use a toolholder with a lower lead angle for straight edged-inserts.
   d. Use positive inserts at 0°/0° rake instead of negative inserts at -5°/-10°
   e. Use a lighter edge preparation for more positive cutting (uncoated instead of coated, un-honed instead of A-hone, A instead of T1, T1 instead of T1A, T1A instead of T2A, or GF-1 instead of a flat top, for example), lowering the compressive stress in the deformed layer of the workpiece material.
   f. Reduce the cutting speed and chip thickness proportionately.
2. Use whisker-reinforced ceramics instead of XSYTIN®-1 to reduce cutting forces so long as high-RPM machining is stable – there is no vibration at high speed.
3. Use XSYTIN®-1 if whisker-reinforced ceramics notch too quickly or if higher speed leads to vibration but the part and fixture can handle higher cutting forces at lower RPM
4. Do not continue to cut with an edge that exhibits irregular wear – avoid irregular wear at all costs
5. Apply high volume of coolant to the cutting zone to prevent the thin walls from becoming too saturated with heat – this may alter the microstructure of the material, scrapping the part

The following are two examples of thin-walled applications where simple adjustments to the process solved the problem:

Figure 68a
Thin-Wall Grooving

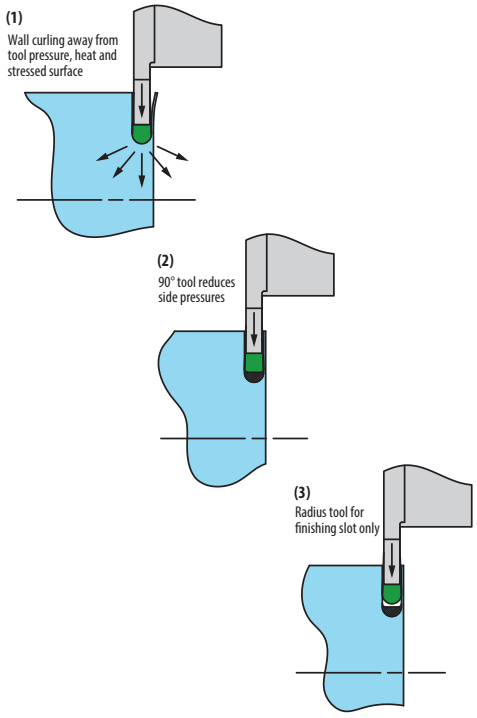
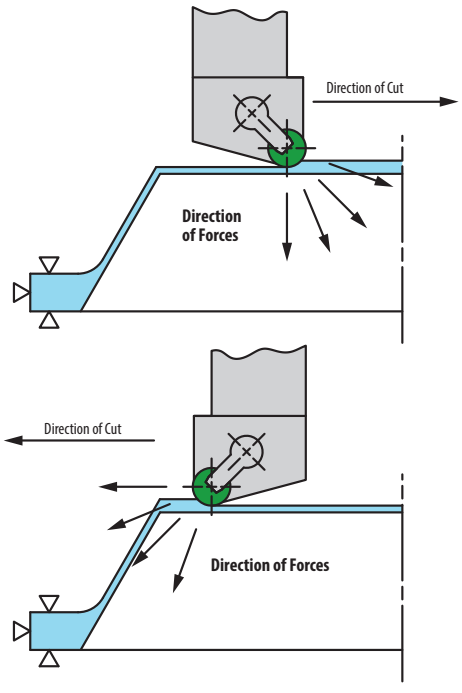


Figure 68b
Cutting Direction Resultant Forces



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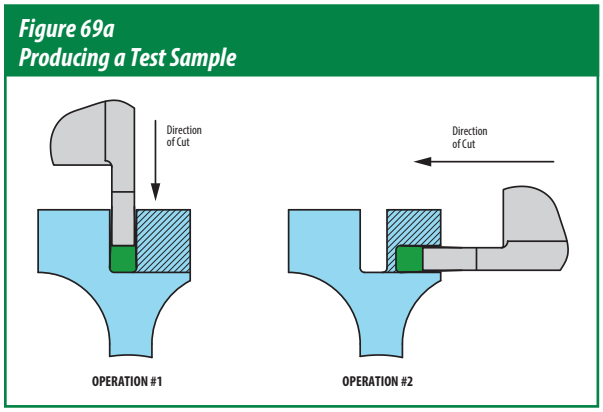
Test Ring Production

Figure 69a
Producing a Test Sample



It is possible to make shoulder cuts with grooving tools involving the removal of large amounts of material by producing a complete ring.

This technique is being applied in the production of large gas turbine discs very effectively but requires a special set-up. The method is illustrated in Figure 69a.

In effect, two 90° opposing grooves are plunged into the part using a V-bottom grooving tool. This generates two clean walls and the required corner radius.

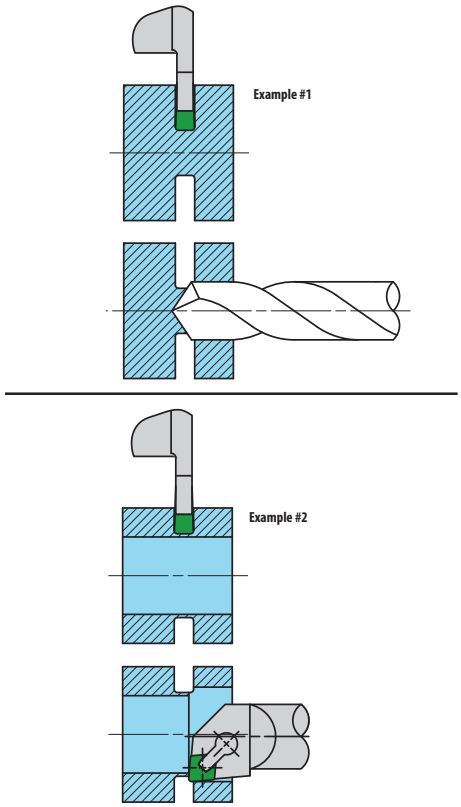
When the second groove breaks into the first one, a complete ring is produced. A fixture must be used to hold the ring as it parts from the main forging or else the tool will be damaged. It is worth constructing a special clamping fixture for such cases since the method itself is so economical.

Cut-Off

Face-turning or grooving to center reduces the cutting speed to 0, which ceramics generally don't tolerate. If it must be done – use XSYTIN®-1. Not reducing the speed to 0 is still very much preferred.

Using a whisker-reinforced ceramic grooving tool and then completing the cut-off with a drill or boring tool in a secondary operation is shown in Figure 69b. This technique works best with smaller components where the cut-off piece can be captured on the drill or boring tool.

Figure 69b
Ceramic Inserts Used in Cut-Off Operations



Coolant

Note: This section of the guide concerns continuous cuts and very light interruption only.

The heat produced in ceramic machining as a result of strain is beneficial, but having the heat accumulate in the workpiece and tool is generally detrimental to tool life. Coolant does not affect the heat distribution in the cutting zone, but it does influence the capacity of the tool and workpiece to carry heat away from the cutting zone. Excess heat conducted into the tool and workpiece from the cutting zone should be removed through coolant. Higher flow rates are more beneficial than higher pressure, though high-pressure coolant (HPC) will evacuate (and segment) the chips more expeditiously. HPC should be kept below 65bar for finishing operations – higher pressure of coolant tends to bombard the finished surface with the chips, resulting in a shot-peening effect.

Oil-based, water-soluble, emulsion-type coolants are best. The use of straight oils is to be avoided since the hazards of oil smoke and fire exist.

The delivery of coolant is quite important, particularly in grooving operations. It should be delivered as close to the cutting edge as possible, preferably through the clamp or tool.

Stainless Steel (M)

M1, M2 (low-carbon), M3-M5

All the best practices covered in the section on machining S-class materials apply to the machining of stainless steel. There are two major distinctions that make austenitic, duplex, or low-carbon martensitic stainless steel more difficult to address with ceramics than even heat-resistant super alloys:

1. Because of the lack of high-temperature-strengthening mechanisms, the heat produced by the strain of ceramic machining lowers their strength to such an extent that the plastic deformation regime is dramatically extended. This means that the strain rates produced with negative inserts at standard rake angles at 1300 SFM (400m/min) are not sufficiently high to cause the deformed layer of the workpiece material to separate cleanly and segment as a result of further deformation (as intended in option 1 described in 'Chip Formation'), instead coiling off but remaining intact. Or rather, they would be sufficiently high if a high enough chip thickness could be sustained to evacuate much more heat from the cutting zone. But increasing the chip thickness increases mechanical stresses to where the strength of the cutting tool or the power available at the spindle are exceeded.
2. XSYTIN®-1 is typically not recommended in stainless steels.

   In short – only whisker-reinforced ceramics should be used, and breaking the chip is very difficult.

   There are some exceptions, of course:
   - The free-machining grade 303 (304 with added sulfur) drastically lowers high-strain ductility of an otherwise very ductile 304, and chips form well.
   - Cold-worked stainless steel is harder, stronger, and more brittle because of the higher density of dislocations introduced through strain-hardening.
   - Precipitation-hardened stainless steels generally have higher strength at elevated temperatures, which can be exploited in chip formation as it is in heat-resistant super alloys. So higher-hardness PH stainless has more favorable chip formation.

In all other cases – high-pressure coolant is helpful but not by any means the conclusive solution to chip-breaking. So long as there is no or limited notching, increasing the depth of cut with a round insert will improve chip-breaking. So will increasing feed and reducing speed. Using positive inserts will produce a cleaner surface but will not help break the chip. Primary modes of wear are flank wear and crater wear, while notching is usually an indicator of excessive cutting speed, wrong insert geometry, or poor coolant delivery.

M2 (high-carbon)

High-carbon martensitic stainless steels have a similar microstructure to conventional hardened steel that is brittle at higher strain rates. Machinability is good, and positive inserts are usually not required. Strain-hardening is almost non-existent, so notching is rarely a concern. For workpieces with a hardness higher than 55 HRc, the edge preparation should always have a hone, and heavier lands may be required. Coolant should then not be applied. Primary wear is flank wear. Chipping and flaking are usually signs of insufficient cutting speed, and abrasive wear – that the speed is too high.

Coolant

See Heat-Resistant Super Alloys.

Hardened Steel (H)

H1, H3

Hardness and ductility in H1 and H3 steels are inversely proportional. So, at lower hardness edge preparations can be light, while beyond 50-55 HRc a wider (or even secondary) land is beneficial to tool life. Whisker-reinforced ceramics and XSYTIN®-1 are both very capable of turning the full range of hardnesses though XSYTIN®-1 generally performs better in softer steels and whisker-reinforced ceramics are preferable beyond 50-55 HRc. At optimal cutting conditions, primary wear is flank wear for alumina-based grades and crater wear for silicon nitride grades. Chipping and flaking may indicate that the speed is too low, while aggressive abrasive wear is usually a result of the speed being too high.

Coolant should not be used.

H2

Maraging steel is very difficult to machine. It is exceptionally strong, yet ductile, and cutting forces easily exceed those found in the machining of HRSA. XSYTIN®-1 is much better suited for the rough turning of maraging steel (in the tempered condition) than any other Greenleaf ceramic grade. The edge needs to be sharp (A-hone in the majority of cases), and to reduce cutting forces straight-edged inserts can be used instead of rounds. The primary mode of wear is crater wear. Excessive speed or chip thickness result in chipping.

High volume and/or pressure of coolant delivered to the cutting edge is essential.

H4

Carburized and/or nitrided steel is exceptionally abrasive, with large grains of carbides/nitrides between the grains of the parent alloy. GEM-8™ and whisker-reinforced ceramics are the primary choice, with heavy edge preparations to reduce abrasive wear and chipping in the white layer. Depth of cut should be sufficiently high to always be in the material, but not so high that the insert cuts through a very steep hardness gradient, though the white layer will always be considerably harder than the diffusion zone. Round inserts are strongly recommended. Primary wear is abrasive wear. Chipping is common.

Coolant should not be used. Unless the parent material is a low-carbon steel and the turning operation cuts into the diffusion zone – then the chips tend to stay intact and coolant will extend tool life appreciably.

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Cast Iron (K)

K1, K2

Grey and nodular cast iron (not the kind used in roll production) are probably the easiest to machine among all the materials discussed in this guide. Shear strength is low since the material is brittle and cracks grow easily, and graphite lubricates the cut. GSN100™ is the best grade and T2 and T2A are the only edge preparations needed. Primary mode of wear is flank wear. Chipping and flaking are an indication of the speed being too low, the chip thickness being too high, or insufficient rigidity in the machining operation.

Coolant can be used but serves no purpose in the cutting process.

K3, K5

Most 'hybrid' materials are much more difficult to machine than either of the materials whose properties or microstructures they aim to combine. Such is the case with compacted graphite iron and austempered ductile iron. Other ceramics generally don't have the combination of fracture toughness and transverse rupture strength required to machine CGI and ADI, XSYTIN®-1 being the exception. Primary wear is flank wear, and T2 or A-hone can be used depending on the needs of the application. Irregular wear is uncommon and will only appear when the combination of chosen speed and chip thickness lead to excessive heat.

Coolant can be used but serves no purpose in the cutting process.

K4, K6

With the very high fraction of cementite and other carbides, K4 and K6 are more cermet than regular alloy. Extra care needs to be taken to protect the edge from chipping and abrasion – heavy edge preparations and high lead angles are recommended. Notching and flaking are possible when removing the scale – round inserts will work best there. With the right edge preparation (cases where special edge preparations have been necessary are not unheard of) and cutting conditions in clean material the primary mode of wear is flank wear. The choice between alumina-based grades and XSYTIN®-1 depends on the needs of the operation though higher hardness is a better fit for alumina-based grades rather than XSYTIN®-1.

Coolant should not be used.

Machining Strategy: Interrupted Cuts and Milling

Interrupted cuts are an area where most experienced machinists would not choose to use ceramics, because the first ceramics introduced in cutting tools were, understandably, less than promising in terms of impact toughness. The stigma of ceramics lacking toughness persists.

In the meantime, Greenleaf's whisker-reinforced ceramics and XSYTIN®-1 have been successfully implemented in heavily interrupted cuts (weld-overlay Stellite-6 with a 50% interruption in conical valves, for example) and milling in most of the materials addressed in this guide.

The main difference in applying ceramics and WC-Co tools in interrupted cuts comes from the fact that ceramics, being more brittle, do not tolerate thermal shock as well as carbide. Large variation in temperature of the inserts results in accelerated crack growth that leads to weakening of the tool and irregular wear. Additionally, continuous cuts differ from strongly interrupted cuts in that the heat builds up from the moment the tool enters the material and reaches an equilibrium, with a constant amount of heat remaining in the cutting zone and plasticizing the material ahead of the cut. Interrupted cuts, provided they are executed at the same cutting speed as continuous cuts, therefore result in the heat never reaching the necessary levels for optimal plasticization.

To tackle both thermal shock and insufficient plasticization, cutting speed must be increased when interruptions are present.

The degree to which the speed is increased, however, is different for turning and milling, and for whisker-reinforced ceramics and XSYTIN®-1.

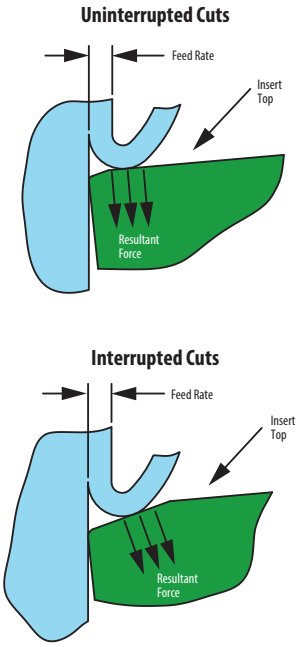
Interrupted Turning

Whisker-Reinforced Ceramics

For whisker-reinforced ceramics, it is recommended to increase the speed sufficiently to compensate exactly for the missing material. That is to say, if 50% of the material is taken away by voids or interruptions at the surface, 50% of the surface remains in contact with the tool compared to an uninterrupted part and the cutting speed should be doubled. If 30% of the material is missing, then RPM should be calculated as if the circumference/diameter is actually 70% of what it is, resulting in $1/0.7 = 1.428 \sim 43\%$ higher RPM, etc. To further increase the amount of heat that remains in the material, feed rates should be decreased from where they would be for continuous cuts.

To protect the edge from impact and redirect more of the incident cutting force into the insert (loading it more in compression instead of bending) heavier edge preparations are recommended for whisker-reinforced ceramics in interrupted cuts – T2A or T7A.

Figure 72a – Heavier Edge Preparations for Interrupted Cuts



Feed rates should be kept below the width of the land – less than 0.0059 IPR (0.15mm/rev) for T2A and less than 0.0138 IPR (0.35mm/rev) for T7A.

XSYTIN®-1

The peak temperature reached by XSYTIN®-1 is of higher importance than the average temperature in the cutting zone (for plasticization) and since XSYTIN®-1 is significantly more resistant to mechanical impact and thermal shock than whisker-reinforced ceramics, cutting speed should not be increased as much. In some cases, wear is actually improved when XSYTIN®-1 has the opportunity to cool down before reentering the material. As a rule of thumb, increase cutting speed by X% when X% of material is missing.

Because of the much higher edge strength of XSYTIN®-1, sharper edges are actually preferred in interrupted cuts, to reduce the overall magnitude of the impact, so the recommended edge preparation for severe interruptions and milling is A-hone. No feed reduction is generally required in interrupted turning for XSYTIN®-1.

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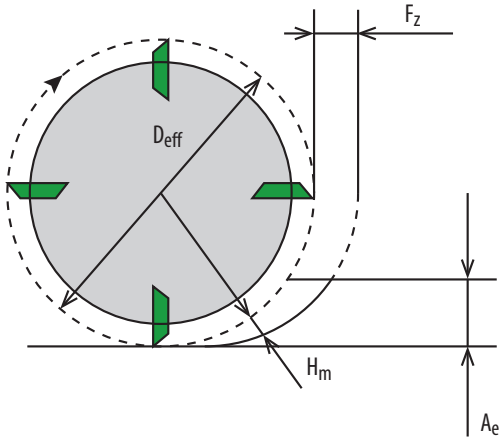
Milling

Since milling is essentially a special case of interrupted turning one would think that the adjustments in cutting conditions are similar, but they aren't. This is due to the fact that the chip thickness evolves for each sweep of the insert in the milling cutter through the machined surface.

Figure 73a – Average Chip Thickness - Milling



For round inserts, average chip thickness H_m is a function of

1. Effective diameter, D_{eff}
2. Width of cut, A_e
3. Radius of the insert, R
4. Depth of cut, A_p
5. Feed per tooth, F_z

$$H_m \approx F_z \sin\left(\cos^{-1}\left(1 - A_p/R\right)\right)\sqrt{A_e/D_{eff}}$$

For straight-edged inserts, average chip thickness H_m is a function of

1. Effective diameter, D_{eff}
2. Width of cut, A_e
3. Lead angle, K_r
4. Feed per tooth, F_z

$$H_m \approx F_z \sin\left(K_r\right)\sqrt{A_e/D_{eff}}$$

Material-Independent Guidelines

Many considerations in ceramic milling are similar to those in turning.

- Mechanical stress variation needs to be kept to a minimum, so that
  - Entry/exit into the material should be soft, and kept to an absolute minimum – staying in contact with the workpiece will drastically extend tool life
  - Tool path radii need to be as large as the workpiece would allow, with absolutely no sharp points
  - Ramping in is always significantly better than plunging or a straight entry
  - The shortest possible arbors are to be used to reduce deflection and vibration of the tool
  - The direction and magnitude of cutting forces need to be accounted for with respect to the rigidity of the workpiece and fixture, again, to reduce deflection and vibration
- Heat distribution should be kept constant as much as possible, so that
  - Chip thickness is kept constant for varying width of cut (engagement) and depth of cut
  - Speed is increased when engagement drops below 65%
  - Staying in contact with the workpiece is preferred to exit and re-entry

The importance of the tool path cannot be overstated. The programming makes or breaks a ceramic milling application.

Additionally:

- The machine needs to have sufficient power for the dramatic increase in metal removal (and associated increase in spindle loads), particularly in heavy milling applications with XSYTIN®-1
- The machine needs to have a sufficiently high spindle speed, because 3280 SFM (1000m/min) with an effective diameter of 0.630" (16mm) translates into ~20,000 RPM
- The machine needs to be closed. Molten chips leaving at 3280 SFM (1000m/min) can be a safety hazard.

Material-Specific Guidelines

The recommended speed and chip thickness for 65-100% engagement are shown in the table below.

When engagement is lower than 65%, speed should be increased further.

Note that these are the recommended starting cutting conditions. You may need to adjust both speed and chip thickness up or down to optimize the process for your unique machining environment.

Speed and Chip Thickness Recommendations — Milling

	HRc		Cutting Speed: V_c [SFM] Average Chip Thickness: H_m [inch]			Cutting Speed: V_c [m/min] Average Chip Thickness: H_m [mm]		
			WG-300® WG-600® WG-700™	XSYTIN®-1	GSN100™	WG-300® WG-600® WG-700™	XSYTIN®-1	GSN100™
S1: Corrosion-Resistant HRSA		V_c:	4600	3600		1400	1100	
Inconel 625, Incoloy 825, Hastelloy, Monel		H_m:	0.003	0.0045		0.08	0.12	
S2: High-Strength HRSA (Solution-Treated[3])	20	V_c:	3950	3000		1200	920	
		H_m:	0.003	0.0045		0.08	0.12	
Low γ' [4] S2 (Solution-Treated and Aged)	40-45	V_c:	3450	2600		1050	800	
Inconel 706, Inconel 718, Inconel 725		H_m:	0.0015	0.0025		0.04	0.06	
High γ' S2 (Solution-Treated and Aged)	40-50	V_c:	2600	1950		800	600	
IN100, Udimet 720, Waspaloy, C1023, Rene 88, N-18		H_m:	0.001	0.002		0.03	0.05	
S3: Wear-Resistant HRSA	20 [5]	V_c:	3950	2600		1200	800	
		H_m:	0.0015	0.0025		0.04	0.06	
Stellite, Eutalloy, Metco, Wall Colmonoy, Weartech	62	V_c:	1950	1650		600	500	
		H_m:	0.001	0.001		0.02	0.03	
H1: Carbon and Alloyed Steel	40	V_c:	1500	1050		450	320	
		H_m:	0.003	0.0045		0.08	0.12	
All 4-digit AISI-SAE grades: 1010, 1060, 4140, 2550, 2350, etc.	60	V_c:	650	450		200	140	
		H_m:	0.002	0.0025		0.05	0.065	
H3: Tool Steel	45	V_c:	1300	900		400	280	
		H_m:	0.003	0.0045		0.08	0.12	
D2, M4, S7, A2, etc.	65	V_c:	400	300		120	85	
		H_m:	0.0015	0.0025		0.04	0.06	
H4: Nitrided and/or Carburized Steel	64	V_c:	400	300		120	85	
32CrMoV13, M50, M50NiL, M2, Pyrowear 675, Nitralloy		H_m:	0.0015	0.0025		0.04	0.06	
K1: Lamellar (Grey) Cast Iron		V_c:		3950	3950		1200	1200
GG15, GG25, GG35 (EN-GJL-150, EN-GJL-250, EN-GJL-350)		H_m:		0.0045	0.0045		0.12	0.12
K2 [6] : Nodular Cast Iron		V_c:		2950	2950		900	900
GGG40 – GGG80 (EN-GJS-400 – EN-GJS-800)		H_m:		0.003	0.003		0.08	0.08
K3: Compacted Graphite Iron (CGI)		V_c:		2450	2450		750	750
EN-GJV-300 – EN-GJV-500		H_m:		0.003	0.003		0.08	0.08

Table continued

[3] *Solution Treated condition - most alloying elements are in solid solution, strength and hardness are low*

[4] *Solution Treated and Aged condition - secondary phases have been precipitated. γ': Ni_3Ti & Ni_3Al, so alloys with lower Al and Ti content (like Inconel 718) have less γ' and alloys with more Al and Ti (like IN100) have more γ'. The heat treatment (particularly solutioning temperature and aging temperature and time) also affect γ' fraction.*

[5] *Where two sets of values are shown for different hardness, extrapolate cutting speed and chip thickness linearly to obtain starting cutting data for the material machined.*

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Speed and Chip Thickness Recommendations — Milling *(Continued)*

	HRc		Cutting Speed: V_c [SFM] Average Chip Thickness: H_m [inch]			Cutting Speed: V_c [m/min] Average Chip Thickness: H_m [mm]		
			WG-300® WG-600® WG-700™	XSYTIN®-1	GSN100™	WG-300® WG-600® WG-700™	XSYTIN®-1	GSN100™
K4: White Cast Iron	60	V_c:	400	300		120	85	
Ni-Hard, EN-GJN-HV350 – EN-GJN-HV600		H_m:	0.0015	0.0025		0.04	0.06	
K5: Austempered Ductile Iron (ADI)		V_c:		1950			600	
EN-GJS-800 – EN-GJS-1400		H_m:		0.0035			0.09	
K6: Nitrided and/or Carburized Cast Iron	64	V_c:	400	300		120	85	
K1 and K2 are commonly used as the parent material		H_m:	0.0015	0.0025		0.04	0.06	
M1: Austenitic Stainless Steel		V_c:	3300			1000		
304, 316, 301, 201, 202, 205, etc.		H_m:	0.0025			0.06		
M2: Martensitic Stainless Steel	50	V_c:	1000			300		
416, 410, 420, 431, etc.		H_m:	0.0025			0.06		
M3: Super-Austenitic Stainless Steel		V_c:	3300			1000		
S31266, 904L, N08031, S34565, 1.4588, etc.		H_m:	0.0025			0.06		
M4: Duplex Stainless Steel		V_c:	3300			1000		
F51 (1.4462), F53 (1.4410), F55 (1.4501), 255 (1.4507), CD3MN		H_m:	0.0025			0.06		
M5: Precipitation-Hardening Stainless Steel	40	V_c:	3300			1000		
A286, PH14-8Mo, PH15-7Mo, 15-5PH, 15-7PH, 17-4PH, 17-7PH		H_m:	0.0025			0.06		

Heat-Resistant Super Alloys (S)

Only round inserts should be used, with softer materials benefitting from the more positive cutting of RPGN.

Climb/down mill for the best wear and tool life below 50 HRc, and combine down and up milling for the best wear and tool life above 50 HRc. Excessive wear leads to chips welding to the tool. The extreme strain that the workpiece material experiences in ceramic milling means that the surface is generally quite rough and should be finished with WC-Co tools.

High-Carbon Martensite (H1, H3<60 HRc, M2)

Below 60 HRc – XSYTIN®-1, climb/down milling. Above 60 HRc – WG-300®/WG-600®, conventional/up milling.

Carbides and Nitrides (H3>60HRc, H4, K4, K6)

Only round inserts should be used. WG-300®/WG-600®, conventional/up milling.

ADI (K5)

Round and straight-edged inserts in XSYTIN®-1 can be used with T2, A, or T2A edge preparations.

Grey, Nodular, and Vermicular Cast Iron (K1, K2, K3)

Round and straight-edged inserts in GSN100™ or XSYTIN®-1 can be used with T2 or T2A edge preparations.

Low-Carbon Stainless Steel (M1, M2 (low-carbon), M3, M4, M5)

Only round inserts in WG-600® or WG-300® with the T1A edge preparation should be used. Negative inserts will withstand the high cutting forces better and will generally perform better than positive inserts, despite the very high ductility of low-carbon stainless steels.

Coolant

Coolant in interrupted cuts only exacerbates thermal shock and causes cracks in the cutting tool to grow faster, drastically reducing tool life and increasing the likelihood of irregular wear.

Coolant should NOT be used in strongly interrupted cuts or milling with ceramics.

Extended Material Guide

Heat-Resistant Super Alloys (S)

Corrosion-Resistant HRSA (S1)

Parts intended for service in corrosive environments are rarely heat treated to the same Ultimate Tensile Strength (UTS) and hardness as, for example, rotating components in an aircraft engine, though the same alloys (from the perspective of chemical composition, most notably Inconel 718) have been used in both types of applications. The main difference between the two, then, is the microstructure resulting from the heat treatment.

S1 alloys are generally Ni-based, tough (large grain size), and enter service without a solutioning and aging treatment, relying on (coarse) primary precipitates for high-temperature strength. Many alloying elements are not bound in any ceramic or intermetallic species and are readily available to form passivating layers or regions, preventing the corrosive agents from penetrating deeper into the material. The alloying elements also provide solid solution strengthening.

With a few exceptions, S1 alloys contain less Ti, Al, Nb, or V and more Fe than S2 alloys, because high-temperature strength is less of a priority and (especially through inclusion of more Fe) the cost of the alloy can then be made significantly lower.

S1 alloys are rarely forged and more often cast, or wrought in ways that do not significantly affect their grain orientation or internal stresses. Some S1 alloys (most notably Inconel 625) can be deposited onto other base materials by means of welding, laser-sintering, etc. to provide a corrosion- and heat-resistant interface without the need for manufacturing whole parts out of a nickel-based material.

High-Strength HRSA (S2)

The main design criteria for S2 alloys are ultimate tensile strength, stress rupture strength, resistance to creep, resistance to fatigue crack growth, and resistance to oxidation at high temperatures. Most alloys in this sub-group contain some fraction of precipitates and a higher quantity of refractory metals which raise the overall melting temperature and form very stable carbides. All alloys in the S2 group exploit what's known as the yield strength anomaly where, because of the precipitation strengthening, the yield strength of the alloy increases (or remains constant) with increasing temperature until a certain maximum.

The primary mechanism by which the majority of S2 alloys attain most of their high-temperature strength is precipitation hardening. Where the austenitic face-centered-cubic phase of nickel and cobalt are commonly denoted with γ, the (beneficial) precipitate phases are denoted with γ′ (gamma prime, or g′) for Ni_3Ti, Ni_3Al, Co_3Ti, Co_3Ta, and γ″ (gamma double-prime, or g″) for Ni_3Nb and Ni_3V. The average grain size of the matrix, the fraction of g′ and g″, their size, and their distribution in the matrix to a large extent determine the hardness and high-temperature UTS of the resulting part. Following solution treatment, S2 alloys undergo aging, which, in the simplest of terms, raises the temperature sufficiently and for an appropriate period of time to allow just enough mobility of atoms for precipitates to form. Along with g′ and g″ this results in the formation of intergranular carbides. The remainder of the alloying elements in S2 alloys contribute in varying degrees to the formation of inter- and intragranular carbides, resistance to oxidation, and, crucially, stabilizing g′ and g″ (retardation of precipitation kinetics) because both phases are metastable and transform into non-desirable TCP phases when exposed to exceedingly high temperatures for extended periods of time, unfavorably altering the mechanical properties of the material.

The same Ni-based alloy can be heat-treated to have different mechanical properties – optimizing tensile strength, stress-rupture strength, creep resistance, and other properties as desired. A higher quantity of precipitates invariably raises the hardness, however, so that stationary Ni-based components that are treated for impact toughness tend to be softer, more ductile, with larger grain size, and rotating components that are treated for tensile strength are harder, less ductile, and have lower grain size. Ni-based S2 parts are either cast (with directional solidification being the dominant route for turbine blades) forged from a VIM-VAR (Vacuum Induction Melting, Vacuum Arc Remelting) or HIP (Hot Isostatic Pressing – a method of compacting atomized powder to have better control of grain size and homogeneity) billet, rolled, or printed prior to heat-treatment and machining.

Co-based S2 alloys are less common than their Ni-based counterparts because g′ in Co is less stable at high temperatures, giving Ni-based alloys an advantage in strength-demanding high-temperature applications. However, carbides in Co-based alloys are more stable at temperatures exceeding 900C and so, in environments that do not require as much strength but require resistance to corrosion at very high temperatures Co-based alloys prevail. These are typically stationary components in gas turbines, and elements in and around combustion chambers. Co-based S2 alloys are cast and rarely aged before machining.

Wear-Resistant HRSA (S3)

These alloys are designed to have resistance to abrasive wear and galling at higher temperatures. Strength is then of lower importance and hardness, chemical stability, and passivating layers take center stage. Because of the higher stability of carbides in a cobalt matrix at high temperatures, cast S3 alloys are frequently cobalt-based. Many proprietary formulations for Ni- and Co-based wear-resistant alloys exist, with the most common denominator being a high fraction of Cr, Si, W, V, Mo, etc. carbides, nitrides, oxides, and borides. When not cast, they are applied to the base material through additive manufacturing. While the matrix of an S3 alloy remains ductile, the coarse secondary phases are hard and brittle, resulting in an alloy that behaves not unlike a grinding wheel when machined.

If the hardness and size/fraction of the secondary phases are too high, it's possible that the material is not addressable with ceramics and can only be machined with CBN or processed through grinding.

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Hardened steel (H)

Carbon and Alloyed Hardened Steel (H1)

These steels are characterized by relatively low alloying content and a microstructure of martensite and ferrite. Depending on the heat treatment (austenitizing temperature, quench procedure, etc.) the hardness can vary considerably. The higher the martensite content, the higher the dislocation density and the higher the strength and hardness. Hardness and ductility here are inversely related – higher hardness corresponds with lower ductility.

Maraging Steel (H2)

Maraging steels (martensitic + aging) are a class of duplex-hardening ultra-high-strength steels that obtain their properties through a complex heat treatment process that increases the strength of a lath martensitic matrix with the precipitation of secondary phases – most commonly carbides. Maraging steels have high tensile strength, high hardness, and high toughness. Unlike in H1 steels, higher hardness in maraging steels does not correlate with lower ductility.

Tool Steel (H3)

Tool steels are so called because of their suitability for use as tools. Their high strength, hardness, and resistance to abrasion are a result of plate martensite and very hard carbides, predominantly of Cr, W, V, and Mo. Higher alloying content and carbide fraction is linked directly to higher hot-hardness, with High-Speed Steels (HSS) containing a significantly higher fraction of alloying elements. H3 steels are quenched and tempered, reaching 66HRc in hardness. The inverse correlation between hardness and ductility is definitely a property of H3 steels, with brittle intergranular fracture as the primary failure mode for the grades with a higher quantity of carbides.

Nitrided and/or Carburized Steel (H4)

Most steels can be surface-hardened through various means, with diffusion of nitrogen and carbon having the most pronounced effect on resistance to surface stresses and abrasion. Steels designed to be nitrided or carburized are typically hardened through conventional means prior to surface treatment and are known as duplex-hardening. The formation of carbides and nitrides in the layers of the materials adjacent to the surface introduces internal compressive stresses and raises the overall hardness. The nature of the nitriding or carburizing process determines the hardness of the compound layer and the depth of the diffusion zone. Mechanical properties of the material vary with varying carbide and nitride fraction from least ductile at the surface to most ductile past the diffusion zone.

Cast Iron (K)

Lamellar Cast Iron (K1)

Lamellar cast iron, also known as grey cast iron, has graphite in the shape of flakes with sharp, point-like ends, which act as stress concentrators and sites for crack initiation, making it brittle and rather weak in tension or shear. Also because of the shape of the graphite, grey cast iron is excellent at conducting heat and converting mechanical energy into heat – making it a great material for use in dampening. A useful side effect is that nodular and grey cast irons can be told apart by whether or not the part 'rings' – grey cast iron will sound dull after being struck while nodular cast iron will audibly ring.

Nodular Cast Iron (K2)

Commonly through the addition of magnesium, graphite takes the shape of spherical nodules, serving to inhibit crack nucleation and improve the mechanical properties but hindering heat transfer. Also referred to as spheroidal graphite iron or ductile cast iron, owing to the higher ductility compared to grey cast iron.

Compacted Graphite Iron (K3)

Also known as Vermicular Graphite Iron, compacted graphite iron (or CGI) is a cast iron that follows a slightly different processing route and the graphite takes the shape of clusters of connected nodules with rounded ends, combining the best of the properties of lamellar and nodular cast irons.

White Cast Iron (K4)

White cast iron is a type of cast iron where most of the carbon forms carbides and cementite in a predominantly pearlitic or martensitic matrix. As a result of the high fraction of cementite and carbides white cast iron is extremely hard and brittle, with good compressive strength and excellent resistance to abrasion.

Austempered Ductile Iron (K5)

ADI is ductile (nodular) cast iron that has been alloyed and heat-treated to convert the matrix to ausferrite – acicular ferrite in an austenitic matrix, improving the tensile strength and ductility of nodular cast iron in a bid to replace structural steel at a lower cost.

Nitrided and/or Carburized Cast Iron (K6)

In a similar fashion to steel, cast iron can be case-hardened through the diffusion of nitrogen and/or carbon in the surface layers, forming nitrides and carbides along grain boundaries. This raises the hardness, compressive stresses, and generally imparts more resistance to abrasion to the affected layer of material without compromising the material properties of the core.

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Stainless Steel (M)

Austenitic Stainless Steel (M1)

Austenitic stainless steel is probably the most common and widely used class of stainless steels. It has acceptable strength at slightly elevated temperatures, excellent corrosion resistance and ductility, and is easy to produce, requiring no special heat treatments. The austenite is stabilized through addition of nickel, manganese, and/or nitrogen, with nickel improving toughness and ductility and manganese improving strength at the expense of ductility.

Martensitic Stainless Steel (M2)

High-carbon martensitic stainless steel has the potential to be treated to the highest hardness (and also to be the most brittle) of all the stainless steels. Low-carbon martensitic stainless steels with the addition of nickel feature the same type of lath martensite that serves as the matrix in maraging steels (H2), which is significantly more ductile than plate martensite, despite the strength and hardness.

Super-Austenitic Stainless Steel (M3)

M3 alloys are austenitic with a higher volume of alloying elements (most notably nickel, molybdenum, and nitrogen) to increase corrosion resistance (commonly chloride pitting and crevice corrosion). They have higher strength than regular austenitic grades, comparable to that of duplex stainless steel. Higher nickel and chrome content are also responsible for excellent toughness and ductility.

Duplex Stainless Steel (M4)

Duplex stainless steels are so called because they combine two phases of iron at room temperature – approximately 50% ferrite and 50% austenite in a layered structure. Their resistance to corrosion is similar to that of austenitic stainless steels but they have considerably higher strength. Despite the higher strength, duplex stainless steel is very ductile even at high strain rates.

Precipitation-Hardening Stainless Steel (M5)

Precipitation-Hardening (PH) stainless steels are a class of stainless steels that can be austenitic, martensitic, or a mix thereof in microstructure. Following solution treatment M5 alloys are aged to form Ni_3Cu, ordered Ni_3Ti and Ni_3Al g′, carbides, and some less useful (Laves, $Ni_3(Al,Ti)$, etc.) phases. These finely dispersed phases inhibit the movement of dislocations, raising the strength of the alloy. Coarsening of the precipitates as a result of overaging lowers the resulting strength because dislocations can then bypass them. The martensite in PH stainless steels is always lath martensite, lending this class of alloys ductility and toughness. Fully austenitic M5 alloys are, nevertheless, more ductile and able to deform plastically without failure to greater strains than their martensitic counterparts. The corrosion resistance of M5 alloys is comparable to that of austenitic stainless steels.

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Greenleaf Corporation
18695 Greenleaf Drive
Saegertown, PA 16433 USA
800-458-1850 • 814-763-2915
sales@greenleafcorporation.com

Greenleaf Europe BV
De Steeg 2
6333 AP Schimmert
The Netherlands
+31-45-404-1774
eurooffice@greenleafcorporation.com

Greenleaf (Hunan) High-Tech Materials Co., Ltd.
Changsha, Hunan 410205, China
+86-731-89954796
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Greenleaf Corporation
18695 Greenleaf Drive
Saegertown, PA 16433 USA
800-458-1850 • 814-763-2915
sales@greenleafcorporation.com

Greenleaf Europe BV
De Steeg 2
6333 AP Schimmert
The Netherlands
+31-45-404-1774
eurooffice@greenleafcorporation.com

Greenleaf (Hunan) High-Tech Materials Co., Ltd.
Changsha, Hunan 410205, China
+86-731-89954796
info@greenleafcorporation.com.cn

Discover more at: **https://greenleafcorporation.com**

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