Greenleaf®

Sustainable Productivity

PRODUCT CATALOG METRIC

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.

Master Table of Contents

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 Cutters *M04*
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 26, 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.

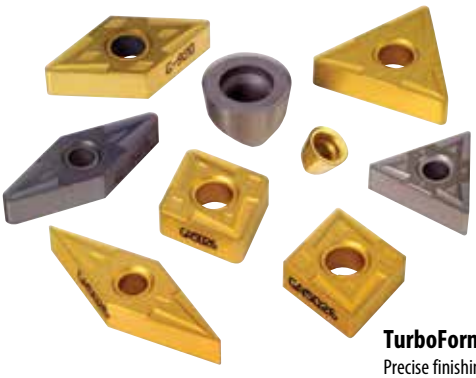
Indexable Drilling

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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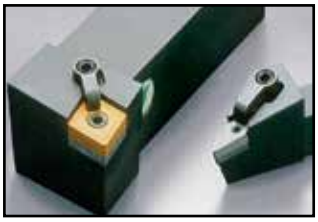
Grooving, Turning, and Boring Systems



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.

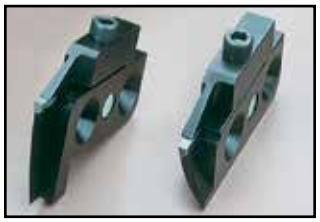
Quick-Change Toolholders..... *TB 82*
The Greenleaf Quick-Change Toolholders conform to ISO 26623, utilize standard components, and are designed to maximize tool life in carbide and ceramic turning applications. All holders are designed with additional axial and radial clearance to allow for use in both external and internal turning applications.

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.*

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.

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.



Face Grooving / Support Blades.. *GP 39*
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.

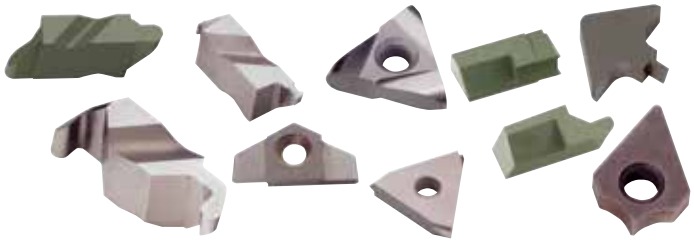
Advanced Tooling..... *TB 87*
Greenleaf ceramic insert tool-holders feature a geometry and pocket depth that maximizes ceramic performance.

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, 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.

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

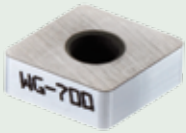
Greenleaf is the industry leader in the development and manufacture of ceramic and coated ceramic inserts in ANSI standard and special geometries. Some of the most prominent include:

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.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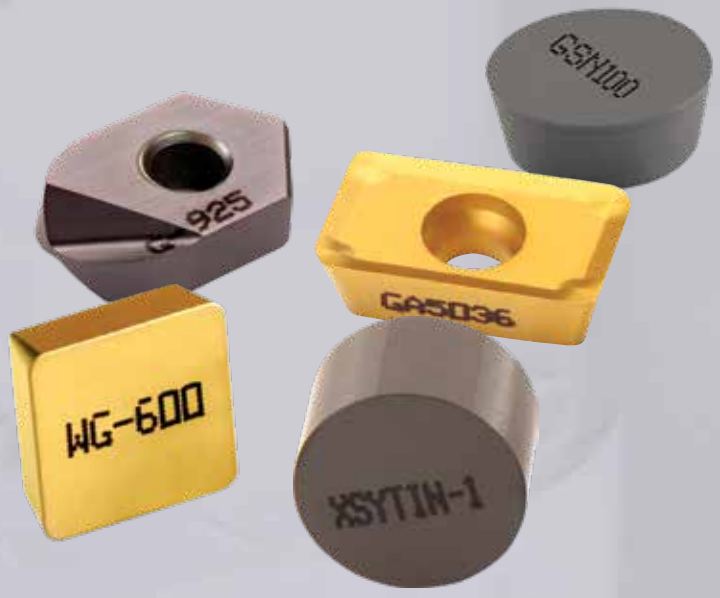
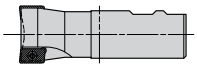
.625 DIA. TUNE-UP KIT
.375 DIA. TUNE-UP KIT

Milling

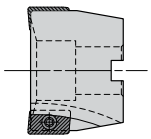


Pictorial Index

Hushcut® Series II Milling System

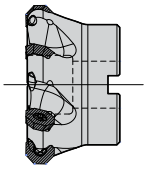


EM90
0° Lead End Mill
12mm – 50mm Diameter
page: M 06



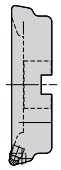
FM90
0° Lead Face Mill
40mm – 160mm Diameter
page: M 06

Index-O-Cut™ Milling System

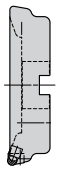


G-MOFHP
High Positive Face Mill
Octagon Inserts
50mm – 200mm Diameter
page: M 10

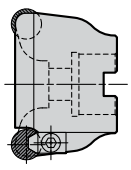
Excelerator Milling Cutters and Inserts



CP4 Series
Face Mill
Positive Rake Inserts
Cutters and Nests
80mm-315mm Diameter
page: M 14

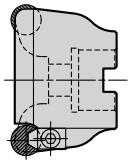


C4 Series
Face Mill
Negative Rake Inserts
Cutters and Nests
80mm-315mm Diameter
page: M 16

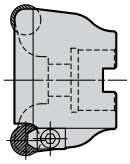


FMRP
Face Mill
Round Positive Inserts
50mm – 100mm Diameter
page: M 18

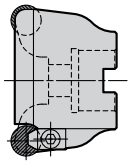
Excelerator Milling Cutters and Inserts *continued*



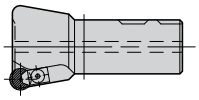
FMRPF
Face Mill (Fine Pitch)
Coolant Fed
Round Positive Inserts
38mm-100mm Diameter
page: M 18



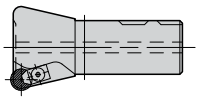
FMRN
Face Mill
Round Negative Inserts
50mm – 100mm Diameter
page: M 19



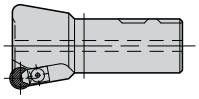
FMRNF
Face Mill (Fine Pitch)
Coolant Fed
Round Negative Inserts
38mm-100mm Diameter
page: M 19



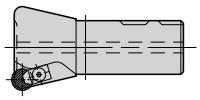
WSRP
End Mill
Round Positive Inserts
16mm – 63mm Diameter
page: M 20



WSRPF
End Mill (Fine Pitch)
Round Positive Inserts
Coolant Fed
20mm-63mm Diameter
page: M 20

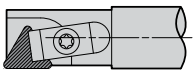


WSRN
End Mill
Round Negative Inserts
25mm – 63mm Diameter
page: M 22

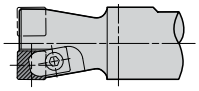


WSRNF
End Mill (Fine Pitch)
Coolant Fed
Round Negative Inserts
25mm – 63mm Diameter
page: M 22

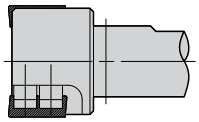
Excelerator Milling Cutters and Inserts *continued*



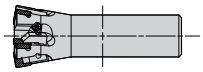
WSTP
End Mill
Positive Triangle Inserts
12mm – 16mm Diameter
page: M 24



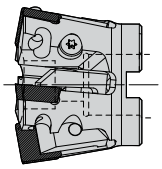
WSSP
End Mill
Positive Square Inserts
10mm – 40mm Diameter
page: M 25



WSAN
End Mill
Parallelogram Inserts
25mm – 63mm Diameter
page: M 26



XFSP
High-Feed Face Mill
Square Positive Inserts
25mm – 40mm Diameter
page: M 27



XFSP
High-Feed Face Mill
Square Positive Inserts
55mm Diameter
page: M 27

SSBN
Ball Nose End Mill
Ball Nose Inserts
10mm – 25mm Diameter
page: M 30

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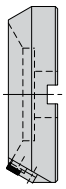
Powermill® Cutters



M430LNP-A
30° Lead Face Mill
Negative Radial,
Positive Axial
100mm – 315mm Dia.
page: M 34

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Hushcut® Series II Milling Cutters

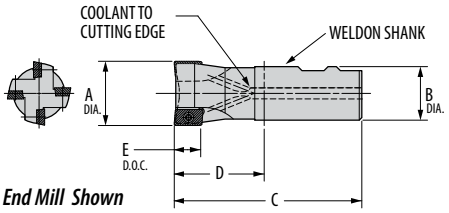
Quiet and free-cutting mills with screw-on insert designs to make the most out of the available power. The free-cutting action results in longer tool life and improved surface finishes. Available in end mills and face mills in a wide range of small to large diameters.

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 (mm)					No. of Inserts	Standard Components	*Tune-Up Kit
		A	B	C	D	E			
EM90S-12R-16W	ADGT-100308DFRLD	12	16	75	25	9	1	PT-589T	TK-01002
EM90S-16R-16W	ADGT-100308DFRLD	16	16	75	25	9	2	PT-589T	TK-01003
EM90S-20R-20W	ADGT-100308DFRLD	20	20	82	32	9	2	313631	TK-02878
EM90S-22R-25W	ADGT-100308DFRLD	22	25	88	32	9	3	313631	TK-02879
EM90S-25R-20W	ADGT-100308DFRLD	25	20	90	40	9	4	PT-542T	TK-00860
EM90S-25R-25W	ADGT-100308DFRLD	25	25	96	40	9	4	PT-542T	TK-00860
EM90S-32R-25W	ADGT-100308DFRLD	32	25	96	40	9	5	PT-542T	TK-00861
EM90S-32R-32W	ADGT-100308DFRLD	32	32	100	40	9	5	PT-542T	TK-00861
EM90S-40R-32W	ADGT-100308DFRLD	40	32	100	40	9	5	PT-542T	TK-00861
EM90L-20R-20W	APHT-160408PDR**	20	20	85	35	13	1	PT-559T	TK-00758
EM90L-25R-20W	APHT-160408PDR**	25	20	97	47	13	2	312679	TK-00780
EM90L-25R-25W	APHT-160408PDR**	25	25	97	47	13	2	312679	TK-00780
EM90L-25R-25WL	APHT-160408PDR**	25	25	151	95	13	2	312679	TK-00780
EM90L-32R-25W	APHT-160408PDR**	32	25	105	49	13	3	312679	TK-00781
EM90L-32R-32W	APHT-160408PDR**	32	32	114	54	13	3	312679	TK-00781
EM90L-32R-32WM	APHT-160408PDR**	32	32	135	75	13	3	312679	TK-00781
EM90L-32R-32WL	APHT-160408PDR**	32	32	167	107	13	3	312679	TK-00781
EM90L-40R-32W	APHT-160408PDR**	40	32	114	54	13	4	312679	TK-00782
EM90L-40R-32WL	APHT-160408PDR**	40	32	167	107	13	4	312679	TK-00782
EM90L-50R-40W	APHT-160408PDR**	50	40	123	63	13	5	312679	TK-00783

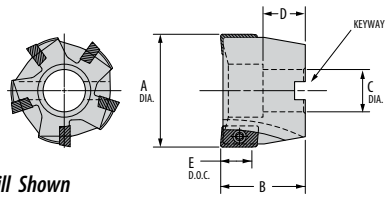
NOTE: For information on screw torque settings, please refer to the chart on page M38.

** 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 (mm)					No. of Inserts	Keyway	Standard Components	*Tune-Up Kit
		A	B	C	D	E				
FM90S-040R	ADGT-100308DFRLD	40	40	16	18	9	6	8	PT-542T	TK-00862
FM90S-050R	ADGT-100308DFRLD	50	40	22	20	9	7	10	PT-542T	TK-00863
FM90S-063R	ADGT-100308DFRLD	63	40	22	20	9	8	10	PT-542T	TK-00864
FM90S-080R	ADGT-100308DFRLD	80	50	27	22	9	9	12	PT-542T	TK-00913
FM90L-050R	APHT-160408PDR**	50	40	22	20	13	5	10	312679	TK-00783
FM90L-063R	APHT-160408PDR**	63	40	22	20	13	6	10	312679	TK-00784
FM90L-080R	APHT-160408PDR**	80	50	27	22	13	7	12	312679	TK-00785
FM90L-100R	APHT-160408PDR**	100	50	32	25	13	8	14	312679	TK-00786
FM90L-125R	APHT-160408PDR**	125	63	40	28	13	10	16	312679	TK-01249
FM90L-160R	APHT-160408PDR**	160	63	40	28	13	12	16	312679	TK-00787

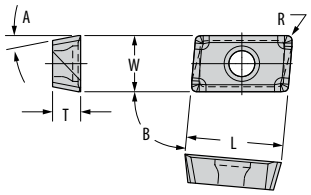
NOTE: For information on screw torque settings, please refer to the chart on page M38.

** 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 ISO	Steel P			Stainless Steel M		Cast Iron K		Heat-Resistant Super Alloys S		Part Number ANSI	Dimensions (mm)					
		GA5036	G-915	G-9120	G-915	G-9230	G-915	GA5023	G-915	G-9230		L	W	T	R	A	B
	ADGT-100308DFRLD	◆	▲	●	◆	▲	◆	▲	◆	▲	ADGT-16222DFR5LD	10,00	6,70	3,50	0,80	16°	84°
	ADGT-100316DFRLD	◆	▲	●	◆	▲	◆	▲	◆	▲	ADGT-16224DFR5LD	10,00	6,70	3,50	1,60	16°	84°
	APHT-160408PDR	◆	▲	●	◆	▲	◆	▲	◆	▲	APHT-32.73PD2R	16,50	9,50	4,76	0,80	11°	85°
	APHT-160416PDR	◆	▲	●	◆	▲	◆	▲	◆	▲	APHT-32.73PD4R	16,50	9,50	4,76	1,60	11°	85°
	APHT-160432PDR	◆	▲	●	◆	▲	◆	▲	◆	▲	APHT-32.73PD8R	16,50	9,50	4,76	3,20	11°	85°
	APET-160408PDR	◆	▲	●	◆	▲	◆	▲	◆	▲	APET-32.73XD2R	16,76	9,50	4,76	0,80	11°	85°
	APET-160416PDR	◆	▲	●	◆	▲	◆	▲	◆	▲	APET-32.73XD4R	16,59	9,50	4,76	1,60	11°	85°
	APET-160432PDR	◆	▲	●	◆	▲	◆	▲	◆	▲	APET-32.73XD6R	16,59	9,50	4,76	2,38	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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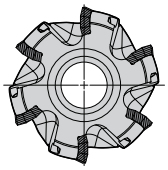
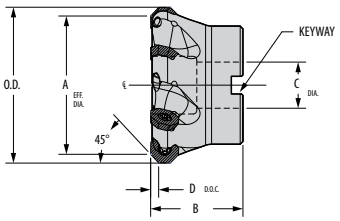
Index-O-Cut™ Milling Cutters

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-MOFHP Face Mill

Part Number	Gage Insert	Dimensions (mm)					No. of Inserts	Keyway	Standard Components	*Tune-Up Kit
		A	O.D.	B	C	D**				
G-MOFHP-0545E050	00EW-060416	50	59,4	40	22	4,39	4	10	PT-546-T	TK-03249
G-MOFHP-0545E063	00EW-060416	63	72,4	40	22	4,39	5	10	PT-546-T	TK-03165
G-MOFHP-0545E080	00EW-060416	80	89,4	50	27	4,39	6	12	PT-546-T	TK-03250
G-MOFHP-0545E100	00EW-060416	100	109,4	50	32	4,39	7	14	PT-546-T	TK-03444
G-MOFHP-0545E125	00EW-060416	125	134,4	63	40	4,39	8	16	PT-546-T	TK-03445
G-MOFHP-0545E150	00EW-060416	150	159,4	63	40	4,39	9	16	PT-546-T	TK-03651
G-MOFHP-0545E200	00EW-060416	200	209,4	63	60	4,39	10	25	PT-546-T	TK-03437

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

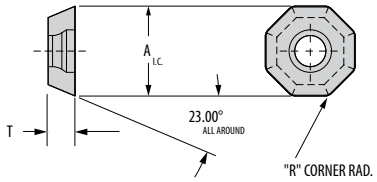
*** Maximum depth of cut is 0.173".*

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

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

Index-O-Cut™ Inserts

00EW



Inserts	Part Number ISO	Steel			Stainless Steel		Cast Iron		Heat-Resistant Super Alloys		Part Number ANSI	Dimensions (mm)		
		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-060416**	◆	◆	▲	◆	▲	▲	◆	◆	▲	**00EW-534**	15,88	4,76	1,59

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

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages M 36–37

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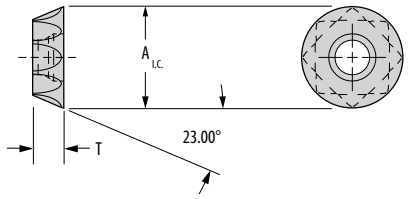
Index-O-Cut™ Inserts

ROEW



Inserts	Part Number ISO	Steel P		Stainless Steel M		Cast Iron K		Heat-Resistant Super Alloys S		Part Number ANSI	Dimensions (mm)	
		G-915	G-9120	G-915	G-9230	G-915	GA5023	G-915	G-9230		A	T
	ROEW-060416	◆	◆	◆	▲	▲	◆	◆	▲	ROEW-534	15,88	4,78

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

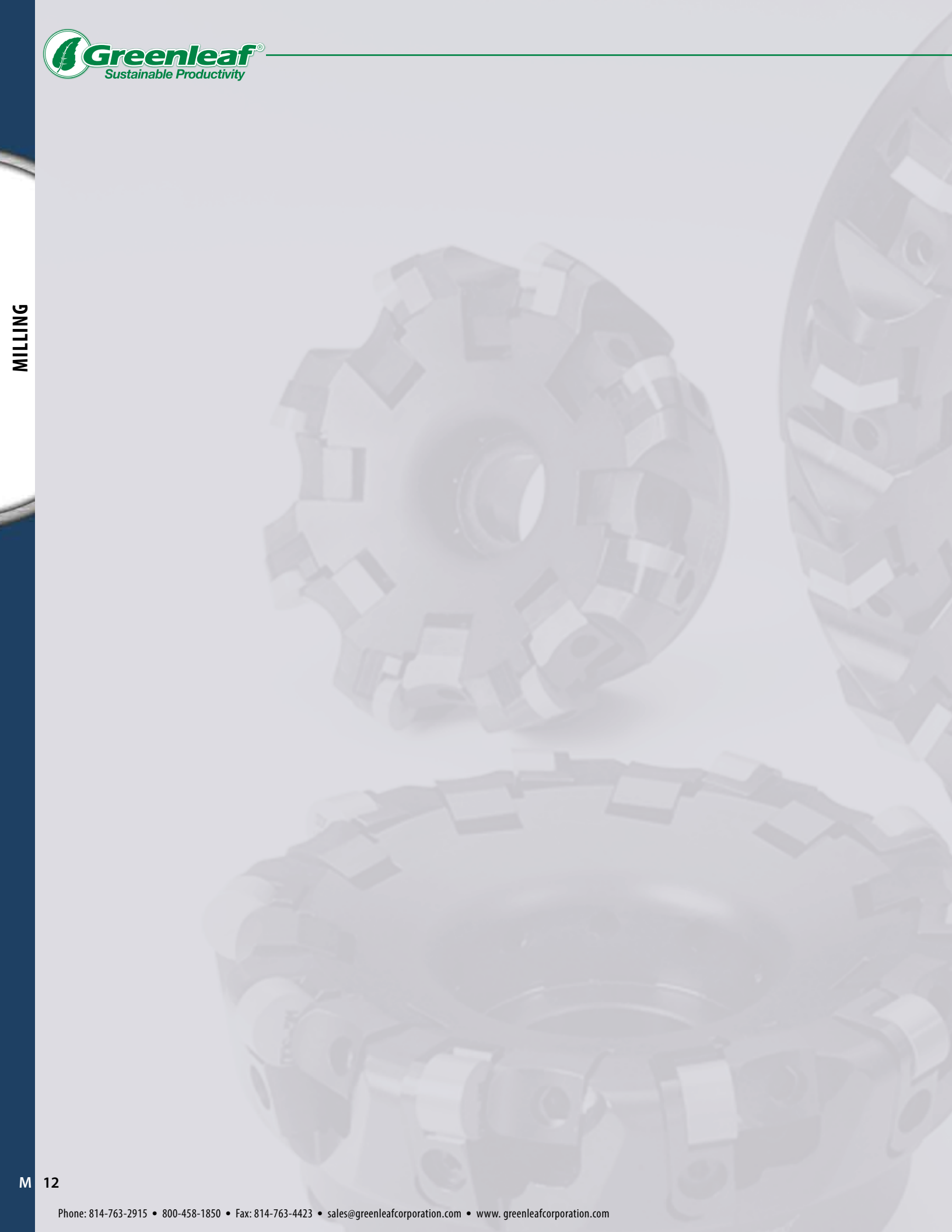
First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages M 36–37

Performance Calculations

Starting Speeds and Feeds for Index-O-Cut™

Work Material	Insert Grades	Hardness (HRc)	Cutting Speed (m/min.)	Maximum Feed per Tooth (IPT)
Low-Carbon Steel / Free Machining	G-9120	<25	365-487	0,12-0,25
Alloy Steel (4140, 4130, 6150, 8620)	G-9120	15-30	274-426	0,10-0,17
High-Carbon Steel (1080,1541, Nitralloy, 52100)	G-9120	25-40	182-304	0,07-0,15
Tool Steel (A6, D2, P-20, H-13)	G-9120	<30	243-365	0,10-0,20
HRSA (Inconel, Hastelloy, Waspaloy)	G-915	<35	46-91	0,07-0,17
Stainless Steel (304, 316, 17-4 PH)	G-915	<32	274-457	0,10-0,22



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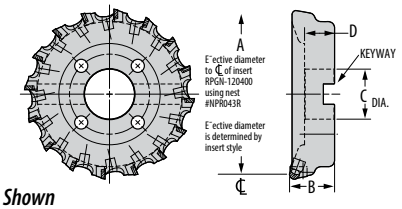
Excelerator® Milling Cutters

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 (mm)				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-4080R	–	80	50	27	22	12	–	6	425605	MS-1595	C0-5018	TK-01604
–	CP-4080L	80	50	27	22	12	–	6	425605	MS-1595	C0-5018	TK-01604
CP-4100R	–	100	50	32	25	14	–	8	425605	MS-1595	C0-5018	TK-01963
–	CP-4100L	100	50	32	25	14	–	8	425605	MS-1595	C0-5018	TK-01963
CP-4125R	–	125	63	40	28	16	–	10	425605	MS-1595	C0-5018	TK-01593
–	CP-4125L	125	63	40	28	16	–	10	425605	MS-1595	C0-5018	TK-01593
CP-4160R	–	160	63	40	28	16	66,7	12	425605	MS-1595	C0-5018	TK-01694
–	CP-4160L	160	63	40	28	16	66,7	12	425605	MS-1595	C0-5018	TK-01694
CP-4200R	–	200	63	60	38	25	101,6	16	425605	MS-1595	C0-5018	TK-01921
–	CP-4200L	200	63	60	38	25	101,6	16	425605	MS-1595	C0-5018	TK-01921
CP-4250R	–	250	63	60	38	25	101,6	20	425605	MS-1595	C0-5018	TK-01962
–	CP-4250L	250	63	60	38	25	101,6	20	425605	MS-1595	C0-5018	TK-01962
CP-4315R	–	315	80	60	38	25	101,6 177,8	24	425605	MS-1595	C0-5018	TK-01976
–	CP-4315L	315	80	60	38	25	101,6 177,8	24	425605	MS-1595	C0-5018	TK-01976

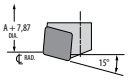
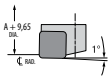
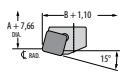
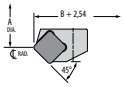
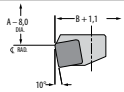
** Tune-Up Kits include all standard components and necessary wrenches to allow you to completely refurbish cutter.*

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-120412
	—	NPC043L	
	NPC1543R	—	CPGN-120412
	—	NPC1543L	
	NPR043R	—	RPGN-120400
	—	NPR043L	
	NPS143R	—	SPGN-120416
	—	NPS143L	
	NPS1543R		SPGN-120416
	—	NPS1543L	
	NPS4543R	—	SPGN-120416
	—	NPS4543L	
	XFNPS8043R	—	SPGN-120412
	—	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.

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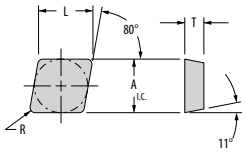
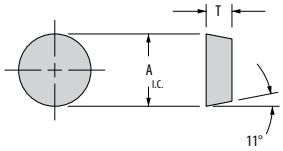
CP4 Inserts

CPGN, RPGN and SPGN

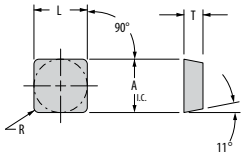
CPGN

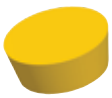


RPGN



SPGN



Inserts	Part Number ISO	Steel P			Stainless Steel M			Cast Iron K				Heat-Resistant Super Alloys S					Hardened Steel H			Part Number ANSI	Dimensions (mm)			
		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-120412	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	CPGN-433	12,70	12,90	4,76	1,20
	CPGN-120416	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	CPGN-434	12,70	12,90	4,76	1,60
	RPGN-120400	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RPGN-43	12,70	–	4,76	–
	SPGN-120412	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SPGN-433	12,70	12,70	4,76	1,20
	SPGN-120416	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SPGN-434	12,70	12,70	4,76	1,60

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

First Choice ◆ Second Choice ● Alternative ▲

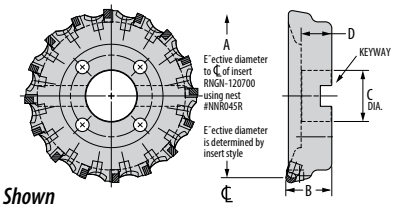
Grade descriptions — pages M 36–37

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 (mm)				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-4080R	–	80	50	27	22	12	–	6	425605	MS-1595	C0-5018	TK-01604
–	C-4080L	80	50	27	22	12	–	6	425605	MS-1595	C0-5018	TK-01604
C-4100R	–	100	50	32	25	14	–	8	425605	MS-1595	C0-5018	TK-01963
–	C-4100L	100	50	32	25	14	–	8	425605	MS-1595	C0-5018	TK-01963
C-4125R	–	125	63	40	28	16	–	10	425605	MS-1595	C0-5018	TK-01593
–	C-4125L	125	63	40	28	16	–	10	425605	MS-1595	C0-5018	TK-01593
C-4160R	–	160	63	40	28	16	66,7	12	425605	MS-1595	C0-5018	TK-01694
–	C-4160L	160	63	40	28	16	66,7	12	425605	MS-1595	C0-5018	TK-01694
C-4200R	–	200	63	60	32	25	101,6	16	425605	MS-1595	C0-5018	TK-01921
–	C-4200L	200	63	60	32	25	101,6	16	425605	MS-1595	C0-5018	TK-01921
C-4250R	–	250	63	60	32	25	101,6	20	425605	MS-1595	C0-5018	TK-01962
–	C-4250L	250	63	60	32	25	101,6	20	425605	MS-1595	C0-5018	TK-01962
C-4315R	–	315	80	60	32	25	101,6 177,8	24	425605	MS-1595	C0-5018	TK-01976
–	C-4315L	315	80	60	32	25	101,6 177,8	24	425605	MS-1595	C0-5018	TK-01976

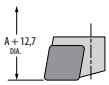
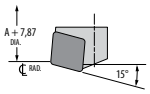
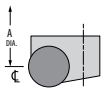
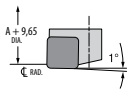
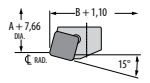
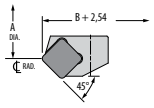
** Tune-Up Kits include all standard components and necessary wrenches to allow you to completely refurbish cutter.*

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

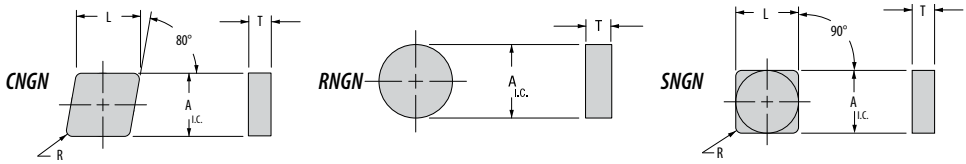
Nests

Nests	Nest Part Number		Gage Insert
	Right Hand	Left Hand	
	NNC043R	—	CNGN-120412
	—	NNC043L	
	NNC045R	—	CNGN-120712
	—	NNC045L	
	NNC1543R	—	CNGN-120412
	—	NNC1543L	
	NNC1545R	—	CNGN-120712
	—	NNC1545L	
	NNR043R	—	RNGN-120400
	—	NNR043L	
	NNR045R	—	RNGN-120700
	—	NNR045L	
	NNS143R	—	SNGN-120416
	—	NNS143L	
	NNS145R	—	SNGN-120716
	—	NNS145L	
	NNS1543R	—	SNGN-120416
	—	NNS1543L	
	NNS1545R	—	SNGN-120716
	—	NNS1545L	
	NNS4543R	—	SNGN-120416
	—	NNS4543L	
	NNS4545R	—	SNGN-120716
	—	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.

C4 Inserts

CNGN, RNGN, and SNGN



Inserts	Part Number ISO	Steel P			Stainless Steel M			Cast Iron K				Heat-Resistant Super Alloys S					Hardened Steel H			Part Number ANSI	Dimensions (mm)			
		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-120412	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	CNGN-433	112,70	12,90	4,76	1,20
	CNGN-120416	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	CNGN-434	12,70	12,90	4,76	1,60
	CNGN-120712	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	CNGN-453	12,70	12,90	7,94	1,20
	CNGN-120716	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	CNGN-454	12,70	12,90	7,94	1,60
	RNGN-120400	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RNGN-43	12,70	–	4,76	–
	RNGN-120700	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RNGN-45	12,70	–	7,94	–
	SNGN-120412	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SNGN-433	12,70	12,70	4,76	1,20
	SNGN-120416	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SNGN-434	12,70	12,70	4,76	1,60
	SNGN-120712	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SNGN-453	12,70	12,70	7,94	1,20
	SNGN-120716	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SNGN-454	12,70	12,70	7,94	1,60

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

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages M 36–37

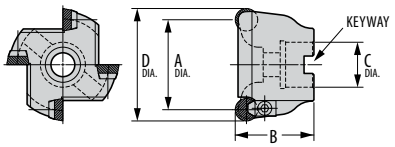
CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

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

FMRP–FMRPF

Round Positive Face Mill



Right-Hand Face Mill Shown

Part Number		Gage Inserts	Dimensions (mm)				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-050R		RPGN-120400	50	40	22	62,7	4	M10	10	308341	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-01446
	FMRP-050L	RPGN-120400	50	40	22	62,7	4	M10	10	308341	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-01446
FMRP-063R		RPGN-120400	63	40	22	75,7	4	M10	10	308341	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-01446
	FMRP-063L	RPGN-120400	63	40	22	75,7	4	M10	10	308341	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-01446
FMRP-080R		RPGN-120400	80	50	27	92,7	5	M12	12	308341	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-01445
	FMRP-080L	RPGN-120400	80	50	27	92,7	5	M12	12	308341	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-01445
FMRP-100R		RPGN-120400	100	50	32	112,7	6	M16	14	308341	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-01447
	FMRP-100L	RPGN-120400	100	50	32	112,7	6	M16	14	308341	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-01447
FMRPF-038R		RPGN-120400	38	40	22	50,7	5	M10	10	–	–	3025-1	438920	TK-04734
	FMRPF-038L	RPGN-120400	38	40	22	50,7	5	M10	10	–	–	3025-1	438920	TK-04734
FMRPF-050R		RPGN-120400	50	40	22	62,7	6	M10	10	308341	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-01447
	FMRPF-050L	RPGN-120400	50	40	22	62,7	6	M10	10	308341	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-01447
FMRPF-063R		RPGN-120400	63	40	22	75,7	7	M10	10	308341	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-04355
	FMRPF-063L	RPGN-120400	63	40	22	75,7	7	M10	10	308341	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-04355
FMRPF-080R		RPGN-120400	80	50	27	92,7	8	KLSS27M	12	308341	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-04416
	FMRPF-080L	RPGN-120400	80	50	27	92,7	8	KLSS27M	12	308341	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-04416
FMRPF-100R		RPGN-120400	100	50	32	112,7	10	KLSS32M	14	308341	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	–
	FMRPF-100L	RPGN-120400	100	50	32	112,7	10	KLSS32M	14	308341	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	–

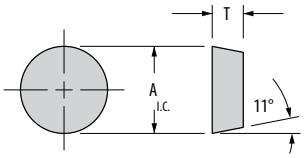
** Tune-Up Kits include all standard components and necessary wrenches to allow you to completely refurbish cutter.*

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

NOTE: Left-hand cutters are made to order only.

FMRP–FMRPF Inserts

RPGN



Inserts	Part Number ISO	Steel P			Stainless Steel M			Cast Iron K				Heat-Resistant Super Alloys S					Hardened Steel H			Part Number ANSI	Dimensions (mm)	
		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-120400	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RPGN-43	12,70	4,76

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

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

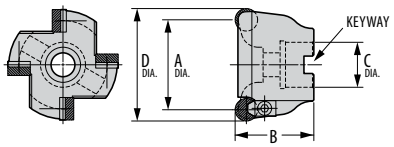
First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages M 36–37

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

FMRN–FMRNF

Round Negative Face Mill



Right-Hand Face Mill Shown

Part Number		Gage Inserts	Dimensions (mm)				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-050R		RNGN-120400	50	40	22	62,7	M10	4	10	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-02699
	FMRN-050L	RNGN-120400	50	40	22	62,7	M10	4	10	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-02699
FMRN-063R		RNGN-120400	63	40	22	75,7	M10	4	10	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-02699
	FMRN-063L	RNGN-120400	63	40	22	75,7	M10	4	10	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-02699
FMRN-080R		RNGN-120400	80	50	27	92,7	M12	5	12	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-02700
	FMRN-080L	RNGN-120400	80	50	27	92,7	M12	5	12	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-02700
FMRN-100R		RNGN-120400	100	50	32	112,7	M16	6	14	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-02701
	FMRN-100L	RNGN-120400	100	50	32	112,7	M16	6	14	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-02701
FMRNF-038R		RPGN-120400	38	40	22	50,7	5	M10	10	–	–	3025-1	438920	TK-04734
	FMRNF-038L	RPGN-120400	38	40	22	50,7	5	M10	10	–	–	3025-1	438920	TK-04734
FMRNF-050R		RPGN-120400	50	40	22	62,7	6	M10	10	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-04422
	FMRNF-050L	RPGN-120400	50	40	22	62,7	6	M10	10	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-04422
FMRNF-063R		RPGN-120400	63	40	22	75,7	7	M10	10	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-04277
	FMRNF-063L	RPGN-120400	63	40	22	75,7	7	M10	10	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-04277
FMRNF-080R		RPGN-120400	80	50	27	92,7	8	KLSS27M	12	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-04382
	FMRNF-080L	RPGN-120400	80	50	27	92,7	8	KLSS27M	12	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-04382
FMRNF-100R		RPGN-120400	100	50	32	112,7	10	KLSS32M	14	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-04786
	FMRNF-100L	RPGN-120400	100	50	32	112,7	10	KLSS32M	14	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-04786

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

† FMRNF-038 will not accept RNGN-120300 or RNGN-120700.

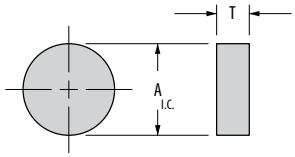
†† For Insert RNGN-120300, use anvil 312780. For insert RNGN-120700, use no anvil.

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

NOTE: Left-hand cutters are made to order only.

FMRN–FMRNF Inserts

RNGN



Inserts	Part Number ISO	Steel P			Stainless Steel M			Cast Iron K				Heat-Resistant Super Alloys S					Hardened Steel H			Part Number ANSI	Dimensions (mm)	
		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-120300	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RNGN-42	12,70	3,18
	RNGN-120400	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RNGN-43	12,70	4,76
	RNGN-120700	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RNGN-45	12,70	7,94

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

First Choice ◆ Second Choice ● Alternative ▲

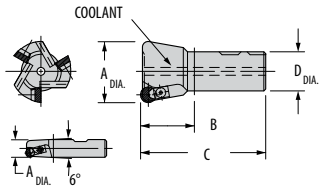
Grade descriptions — pages M 36–37

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 (mm)				No. of Inserts	Standard Components				*Tune-Up Kit
Right Hand	Left Hand**		A	B	C	D		Anvil	Anvil Screw	Clamp	Clamp Screw	
WSRP-1616R		RPGN-060200	16	32	80	16	2	–	–	430879	SHCS M2.5-.45x6mm	TK-01335
	WSRP-1616L †	RPGN-060200	16	32	80	16	2	–	–	430879	SHCS M2.5-.45x6mm	TK-01335
WSRP-2020R		RPGN-070300	20	32	82	20	2	–	–	429323	MS-1156	TK-01339
	WSRP-2020L †	RPGN-070300	20	32	82	20	2	–	–	429323	MS-1156	TK-01339
WSRP-2520RA		RPGN-070300	25	32	82	20	3	–	–	429323	MS-1156	TK-01840
	WSRP-2520LA	RPGN-070300	25	32	82	20	3	–	–	429323	MS-1156	TK-01840
WSRP-2520R		RPGN-090300	25	32	82	20	3	–	–	425716	MS-1156	TK-01325
	WSRP-2520L	RPGN-090300	25	32	82	20	3	–	–	425716	MS-1156	TK-01325
WSRP-3225R		RPGN-090300	32	32	88	25	3	–	–	425716	MS-1156	TK-01325
	WSRP-3225L	RPGN-090300	32	32	88	25	3	–	–	425716	MS-1156	TK-01325
WSRP-4032R		RPGN-120400	40	45	105	32	3	–	–	3025-1	438920	TK-01340
	WSRP-4032L	RPGN-120400	40	45	105	32	3	–	–	3025-1	438920	TK-01340
WSRP-5040R		RPGN-120400	50	45	115	40	3	308341	FHCS M 3-0.5x6mm	3025-1	438920	TK-01360
	WSRP-5040L	RPGN-120400	50	45	115	40	3	308341	FHCS M 3-0.5x6mm	3025-1	438920	TK-01360
WSRP-6340R		RPGN-120400	63	45	115	40	4	308341	FHCS M 3-0.5x6mm	3025-1	438920	TK-01357
	WSRP-6340L	RPGN-120400	63	45	115	40	4	308341	FHCS M 3-0.5x6mm	3025-1	438920	TK-01357
WSRPF-2020R		RPGN-060200	20	32	82	20	3	–	–	430879	SHCS M2.5-.45x6mm	TK-04373
	WSRPF-2020L †	RPGN-060200	20	32	82	20	3	–	–	430879	SHCS M2.5-.45x6mm	TK-04373
WSRPF-2520RA		RPGN-070300	25	32	82	20	4	–	–	429323	PT-488T	TK-04396
	WSRPF-2520LA	RPGN-070300	25	32	82	20	4	–	–	429323	PT-488T	TK-04396
WSRPF-2520R		RPGN-090300	25	32	82	20	4	–	–	425716	C03508	TK-04395
	WSRPF-2520L	RPGN-090300	25	32	82	20	4	–	–	425716	C03508	TK-04395
WSRPF-3225R		RPGN-090300	32	32	88	25	5	–	–	425716	C03508	TK-04423
	WSRPF-3225L	RPGN-090300	32	32	88	25	5	–	–	425716	C03508	TK-04423
WSRPF-4032R		RPGN-120400	40	45	105	32	4	–	–	3025	438920	TK-04424
	WSRPF-4032L	RPGN-120400	40	45	105	32	4	–	–	3025	438920	TK-04424
WSRPF-5040R		RPGN-120400	50	45	115	40	4	308341	FHCS M 3-0.5x6mm	3025	438920	TK-04276
	WSRPF-5040L	RPGN-120400	50	45	115	40	4	308341	FHCS M 3-0.5x6mm	3025	438920	TK-04276
WSRPF-6340R		RPGN-120400	63	45	115	40	5	308341	FHCS M 3-0.5x6mm	3025	438920	TK-04276
	WSRPF-6340L	RPGN-120400	63	45	115	40	5	308341	FHCS M 3-0.5x6mm	3025	438920	TK-04276

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

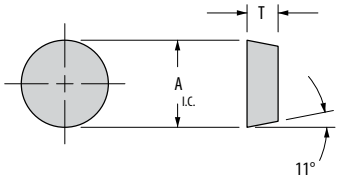
*** Left-Hand cutters are made to order only.*

† No thru-tool coolant available

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

WSRP-WSRPF Inserts

RPGN



Inserts	Part Number ISO	Steel P			Stainless Steel M			Cast Iron K				Heat-Resistant Super Alloys S					Hardened Steel H			Part Number ANSI	Dimensions (mm)	
		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-060200	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RPGN-21.5	6,35	2,38
	RPGN-070300	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RPGN-2.52	7,94	3,18
	RPGN-090300	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RPGN-32	9,53	3,18
	RPGN-120400	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RPGN-43	12,70	4,76

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

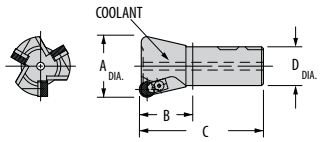
NOTE: For additional nose radii and available edge preps, please contact the Greenleaf Tech Team.

Maximum RPM

Cutter Part Number	Max RPM Carbide	Max RPM Ceramic
WSRP-1616R/L	15,000	40,000
WSRP-2020R/L	12,500	35,000
WSRP-2520R/L	9,500	26,000
WSRP-2520RA/LA	9,500	26,000
WSRP-3225R/L	7,500	21,000
WSRP-4032R/L	6,200	19,500
WSRP-5040R/L	4,600	13,000
WSRP-6340R/L	3,800	10,000
WSRPF-2020R/L	12,500	35,000
WSRPF-2520R/L	9,500	26,000
WSRPF-2520RA/LA	9,500	26,000
WSRPF-3225R/L	7,500	21,000
WSRPF-4032R/L	6,200	19,500
WSRPF-5040R/L	4,600	13,000
WSRPF-6340R/L	3,800	10,000

WSRN-WSRNF

Round Negative End Mill



Right-Hand Cutter Shown

Part Number		Gage Inserts	Dimensions (mm)				Inserts	Standard Components				*Tune-Up Kit
Right Hand	Left Hand**		A	B	C	No. of D		Anvil	Anvil Screw	Clamp	Clamp Screw	
†WSRN-2520R		RNGN-090300	25	30	80	20	2	–	–	425716	MS-1156	TK-01321
	†WSRN-2520L	RNGN-090300	25	30	80	20	2	–	–	425716	MS-1156	TK-01321
WSRN-3225R		RNGN-090300	32	30	86	25	3	–	–	425716	MS-1156	TK-01325
	WSRN-3225L	RNGN-090300	32	30	86	25	3	–	–	425716	MS-1156	TK-01325
WSRN-4032R		RNGN-120400	40	45	105	32	3	–	–	3025-1	438920	TK-01340
	WSRN-4032L	RNGN-120400	40	45	105	32	3	–	–	3025-1	438920	TK-01340
††WSRN-5040R		RNGN-120400	50	45	115	40	3	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-02702
	††WSRN-5040L	RNGN-120400	50	45	115	40	3	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-02702
††WSRN-6340R		RNGN-120400	63	45	115	40	4	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-02699
	††WSRN-6340L	RNGN-120400	63	45	115	40	4	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-02699
†WSRNF-2520R		RNGN-090300	25	30	80	20	3	–	–	425716	MS-1156	TK-01325
	†WSRNF-2520L	RNGN-090300	25	30	80	20	3	–	–	425716	MS-1156	TK-01325
WSRNF-3225R		RNGN-090300	32	30	86	25	4	–	–	425716	MS-1156	TK-04371
	WSRNF-3225L	RNGN-090300	32	30	86	25	4	–	–	425716	MS-1156	TK-04371
WSRNF-4032R		RNGN-120400	40	45	105	32	4	–	–	3025-1	438920	TK-04419
	WSRNF-4032L	RNGN-120400	40	45	105	32	4	–	–	3025-1	438920	TK-04419
††WSRNF-5040R		RNGN-120400	50	45	115	40	5	313572	FHCS M3-0.5x6mm	3025-1	438920	TK-02700
	††WSRNF-5040L	RNGN-120400	50	45	115	40	5	313572	FHCS M3-0.5x6mm	3025-1	438920	TK-02700
††WSRNF-6340R		RNGN-120400	63	45	115	40	6	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-02701
	††WSRNF-6340L	RNGN-120400	63	45	115	40	6	313572	FHCS M3-0.5x6mm	3025-1	SHCS M5-0.8x12mm	TK-02701

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

† This shank does not have any flats.

†† For Insert RNGN-120700, remove the anvil and anvil screw.

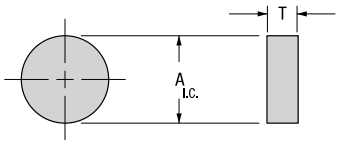
NOTE: For information on screw torque settings, please refer to the chart on page M38.

NOTE: Left-hand cutters are made to order only.

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

WSRN-WSRNF Inserts

RNGN



Inserts	Part Number ISO	Steel P			Stainless Steel M			Cast Iron K				Heat-Resistant Super Alloys S					Hardened Steel H			Part Number ANSI	Dimensions (mm)	
		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-090300	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RNGN-32	9,53	3,18
	RNGN-120300	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RNGN-42	12,70	3,18
	RNGN-120400	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RNGN-43	12,70	4,76
	RNGN-120700	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	RNGN-45	12,70	7,94

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

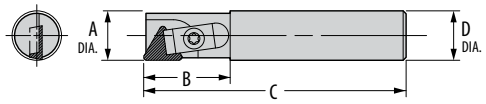
NOTE: For additional nose radii and available edge preps, please contact Greenleaf Tech Team.

Maximum RPM

Cutter Part Number	Max RPM Carbide	Max RPM Ceramic
WSRN-2520	9,500	26,000
WSRN-3225	7,500	21,000
WSRN-4032	6,200	19,500
WSRN-5040	4,600	13,000
WSRN-6340	3,800	10,000
WSRNF-2520	9,500	26,000
WSRNF-3225	7,500	21,000
WSRNF-4032	6,200	19,500
WSRNF-5040	4,600	13,000
WSRNF-6340	3,800	10,000

WSTP

Triangle Positive End Mill



Right-Hand Cutter Shown

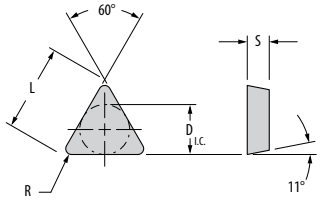
Part Number		Gage Inserts	Dimensions (mm)				No. of Inserts	Standard Components		*Tune-Up Kit
Right Hand	Left Hand		A	B	C	D		Clamp	Clamp Screw	
WSTP-1212R		TPGN-110308	12	22	67	12	1	429871	PT-317T	TK-00897
	WSTP-1212L	TPGN-110308	12	22	67	12	1	429871	PT-317T	TK-00897
WSTP-1412R		TPGN-110308	14	25	70	12	1	429871	PT-317T	TK-00897
	WSTP-1412L	TPGN-110308	14	25	70	12	1	429871	PT-317T	TK-00897
WSTP-1616R		TPGN-110308	16	25	85	16	1	429871	PT-317T	TK-00897
	WSTP-1616L	TPGN-110308	16	25	85	16	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 ISO	Steel			Stainless Steel			Cast Iron				Heat-Resistant Super Alloys					Hardened Steel			Part Number ANSI	Dimensions (mm)			
		P			M			K				S					H				L	D	S	R
		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					
	TPGN-110308	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	TPGN-222	11,0	6,35	3,18	0,80

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

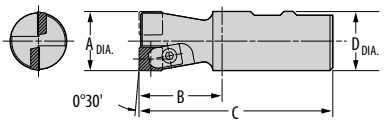
NOTE: For additional nose radii and available edge preps, please contact Greenleaf Tech Team.

Maximum RPM

Cutter Part Number	Max RPM Carbide	Max RPM Ceramic
WSTP-1212R/L	19,000	35,000
WSTP-1412R/L	17,000	35,000
WSTP-1616R/L	15,000	35,000

WSSP

Square Positive End Mill



Right-Hand Cutter Shown

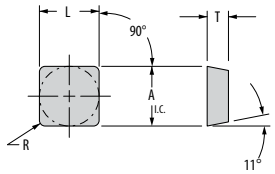
Part Number		Gage Inserts	Dimensions (mm)				No. of Inserts	Standard Components		*Tune-Up Kit
Right Hand	Left Hand		A	B	C	D		Clamp	Screw	
WSSP-1010R		SPGN-060208	10	12	52	10	1	429871	PT-317T	TK-00897
	WSSP-1010L	SPGN-060208	10	12	52	10	1	429871	PT-317T	TK-00897
WSSP-1212R		SPGN-060208	12	22	67	12	1	429871	PT-317T	TK-00897
	WSSP-1212L	SPGN-060208	12	22	67	12	1	429871	PT-317T	TK-00897
WSSP-1616R		SPGN-060308	16	25	73	16	2	430879	SHCSM2.5-0.45x6mm	TK-01335
	WSSP-1616L	SPGN-060308	16	25	73	16	2	430879	SHCSM2.5-0.45x6mm	TK-01335
WSSP-2020R		SPGN-060308	20	25	75	20	2	430879	SHCSM2.5-0.45x6mm	TK-01335
	WSSP-2020L	SPGN-060308	20	25	75	20	2	430879	SHCSM2.5-0.45x6mm	TK-01335
WSSP-2520R		SPGN-090308	25	32	82	20	2	429706	MS-1156	TK-01336
	WSSP-2520L	SPGN-090308	25	32	82	20	2	429706	MS-1156	TK-01336
WSSP-3225R		SPGN-090308	32	45	101	25	3	429706	MS-1156	TK-01337
	WSSP-3225L	SPGN-090308	32	45	101	25	3	429706	MS-1156	TK-01337
WSSP-4032R		SPGN-120408	40	45	105	32	3	3127-C	SHCSM5-0.8x12mm	TK-01338
	WSSP-4032L	SPGN-120408	40	45	105	32	3	3127-C	SHCSM5-0.8x12mm	TK-01338

* *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 ISO	Steel P			Stainless Steel M			Cast Iron K				Heat-Resistant Super Alloys S					Hardened Steel H			Part Number ANSI	Dimensions (mmm)			
		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-060208	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SPGN-21.52	6,35	6,35	2,38	0,80
	SPGN-060308	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SPGN-222	6,35	6,35	3,18	0,80
	SPGN-090308	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SPGN-322	9,53	9,53	3,18	0,80
	SPGN-120408	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SPGN-432	12,70	12,70	4,76	0,80
	SPGN-120412	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	SPGN-433	12,70	12,70	4,76	1,20

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.

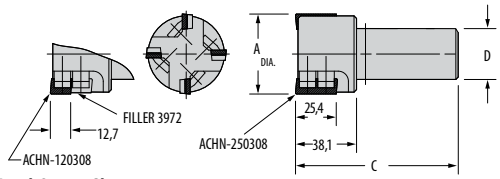
Maximum RPM

Cutter Part Number	Max RPM Carbide	Max RPM Ceramic
WSSP-1010R/L	25,000	40,000
WSSP-1212R/L	19,000	40,000
WSSP-1616R/L	15,000	40,000
WSSP-2020R/L	12,500	35,000
WSSP-2520R/L	9,500	26,000
WSSP-3225R/L	7,500	21,000
WSSP-4032R/L	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

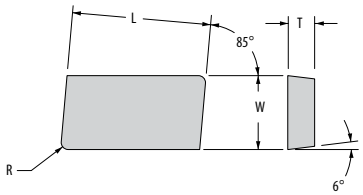
Part Number		Gage Inserts	Dimensions (mm)			No. of Inserts	Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand		A	B	C		Anvil	Anvil Screw	Clamp	Clamp Screw		Max. 1/2" D.O.C. Insert	Filler
WSAN-2520R		ACHN-250308	25	95	20	2	–	–	410756	BHCSM4-0.7x0mm	TK-01351	ACHN-120308	3972
	WSAN-2520L	ACHN-250308-LH	25	95	20	2	–	–	410756	BHCSM4-0.7x0mm	TK-01351	ACHN-120308-LH	3972
WSAN-2525R		ACHN-250308	25	101	25	2	–	–	410756	BHCSM4-0.7x0mm	TK-01351	ACHN-120308	3972
	WSAN-2525L	ACHN-250308-LH	25	101	25	2	–	–	410756	BHCSM4-0.7x0mm	TK-01351	ACHN-120308-LH	3972
WSAN-3225R		ACHN-250308	32	101	25	2	–	–	410756	BHCSM4-0.7x0mm	TK-01351	ACHN-120308	3972
	WSAN-3225L	ACHN-250308-LH	32	101	25	2	–	–	410756	BHCSM4-0.7x0mm	TK-01351	ACHN-120308-LH	3972
WSAN-4032R		ACHN-250308	40	105	32	3	AAP-3224	FHCSM3-0.5x6mm	410756	BHCSM4-0.7x0mm	TK-01617	ACHN-120308	3972
	WSAN-4032L	ACHN-250308-LH	40	105	32	3	AAP-3224-LH	FHCSM3-0.5x6mm	410756	BHCSM4-0.7x0mm	TK-02229	ACHN-120308-LH	3972
WSAN-5040R		ACHN-250308	50	115	40	4	AAP-3224	FHCSM3-0.5x6mm	410756	BHCSM4-0.7x0mm	TK-01616	ACHN-120308	3972
	WSAN-5040L	ACHN-250308-LH	50	115	40	4	AAP-3224-LH	FHCSM3-0.5x6mm	410756	BHCSM4-0.7x0mm	TK-02230	ACHN-120308-LH	3972
WSAN-6340R		ACHN-250308	63	115	40	4	AAP-3224	FHCSM3-0.5x6mm	410756	BHCSM4-0.7x0mm	TK-01616	ACHN-120308	3972
	WSAN-6340L	ACHN-250308-LH	63	115	40	4	AAP-3224-LH	FHCSM3-0.5x6mm	410756	BHCSM4-0.7x0mm	TK-02230	ACHN-120308-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 ISO	Steel P			Stainless Steel M			Cast Iron K				Heat-Resistant Super Alloys S					Hardened Steel H			Part Number ANSI	Dimensions (mm)			
		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-250308	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	ACHN-3422	3,18	9,50	25,40	0,80
	ACHN-120308	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	ACHN-3222	3,18	9,50	12,70	0,80
	ACHN-250308LH	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	ACHN-3422LH	3,18	9,50	25,40	0,80
	ACHN-120308LH	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	ACHN-3222LH	3,18	9,50	12,70	0,80

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.

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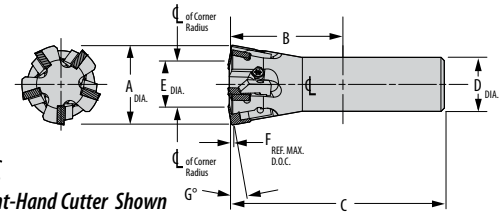
Excelerator® XF

Positive High-Feed Mills

25mm and 40mm High-Feed End Mill / Square Positive Inserts



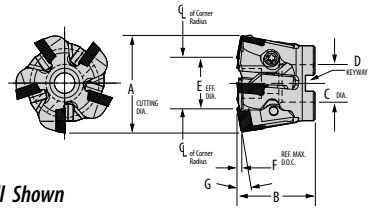
Right-Hand Cutter Shown

Cutter Order Number	Insert	Dimensions (mm)							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-2520-EM	SPGN-060308	25	32	82	20	14,0	0,79	10°	4	431402	PT-542-T	TK-01868	9,500	26,000
XFSP-4032-EM	SPGN-090308	40	45	105	32	22,8	1,32	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.

55mm High-Feed Face Mill / Square Positive Inserts



Right-Hand Face Mill Shown

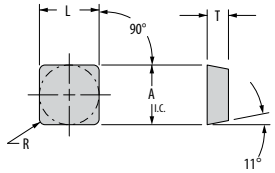
Cutter Order Number	Insert	Dimensions (mm)							No. of Inserts	Standard Components			*Tune-Up Kit	Max RPM Carbide	Max RPM Ceramic
		A	B	C	D	E	F	G		Clamp	Clamp Screw	Mount Screw			
XFSP-055-FM	SPGN-120408	55	40	22	31,52	1,93	10°	10,4	5	431628	SE03-72	SHCSM10-1.5	TK-02228	4,600	13,300

* *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 ISO	Steel P			Stainless Steel M			Cast Iron K				Heat-Resistant Super Alloys S					Hardened Steel H			Part Number ANSI	Dimensions (mm)			
		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-060308	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	**SPGN-222**	6,35	6,35	3,18	0,80
	SPGN-090308	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	**SPGN-322**	9,53	9,53	3,18	0,80
	SPGN-120408	◆	▲	●	▲	◆	◆	◆	▲	◆	▲	◆	▲	●	▲	◆	●	◆	▲	**SPGN-432**	12,70	12,70	4,76	0,80

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

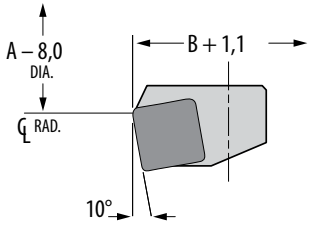
NOTE: For additional nose radii and available edge preps, please contact Greenleaf Tech Team.

XFNPS

Nest for CP4 Series

Nest Part Number		Gage Inserts
Right Hand	Left Hand	
XFNPS8043R	—	SPGN-120412
—	**XFNPS8043L**	SPGN-120412

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 (m/min)	Target Chip Thickness (mm)	Recommended Feed per Tooth (mm/tooth) Width of Cut (%) of Effective Diameter		
					15%	30%	45%+
Steel	60-65 HRC	WG-600®	150	0,038	0,307	0,239	0,221
	50-59 HRC	WG-600®	240	0,051	0,411	0,320	0,295
	40-49 HRC	WG-600®	400	0,069	0,554	0,432	0,396
	40-49 HRC	GA5036	120	0,043	0,348	0,272	0,249
	30-39 HRC	GA5036	180	0,076	0,615	0,480	0,442
	≤30 HRC	GA5036	240	0,104	0,838	0,660	0,610

DOC vs. Effective Diameter for Excelerator® XF

Depth of Cut	XFSP-2520-EM	XFSP-4032-EM	XFSP-055-FM	CP4 Series Face Mills: XFNPS8043 Nest						
	25mm	40mm	55mm	80mm	100mm	125mm	160mm	200mm	250mm	315mm
0,25	16,97	25,77	34,49	75,00	95,00	120,00	155,00	195,00	245,00	310,00
0,5	19,81	28,61	37,33	77,89	97,89	122,89	157,89	197,89	247,89	312,89
0,75	22,65	31,45	40,17	80,72	100,72	125,72	160,72	200,72	250,72	315,72
1,0	X	34,28	43,00	83,55	103,55	128,55	163,55	203,55	253,55	318,55
1,27	X	37,34	46,06	86,61	106,61	131,61	166,61	206,61	256,61	321,61
1,5	X	X	48,67	89,22	109,22	134,22	169,22	209,46	259,22	324,22
1,77	X	X	X	92,28	112,28	137,28	172,28	212,28	262,28	327,28
2,0	X	X	X	93,68	113,68	138,68	173,68	213,68	263,68	328,68
DIA OVER INSERT	25,00	40,00	55,00	100,50	120,50	145,50	180,50	220,50	270,50	335,50

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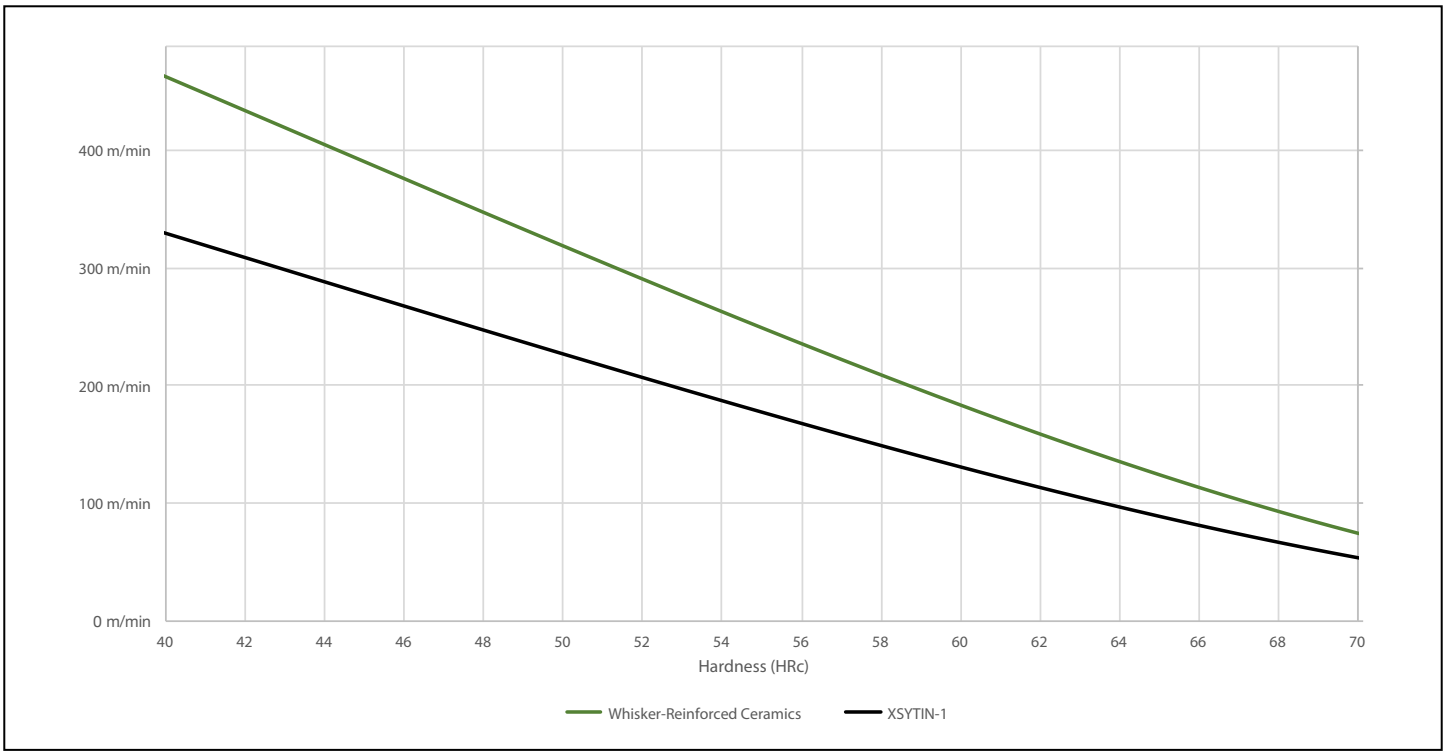
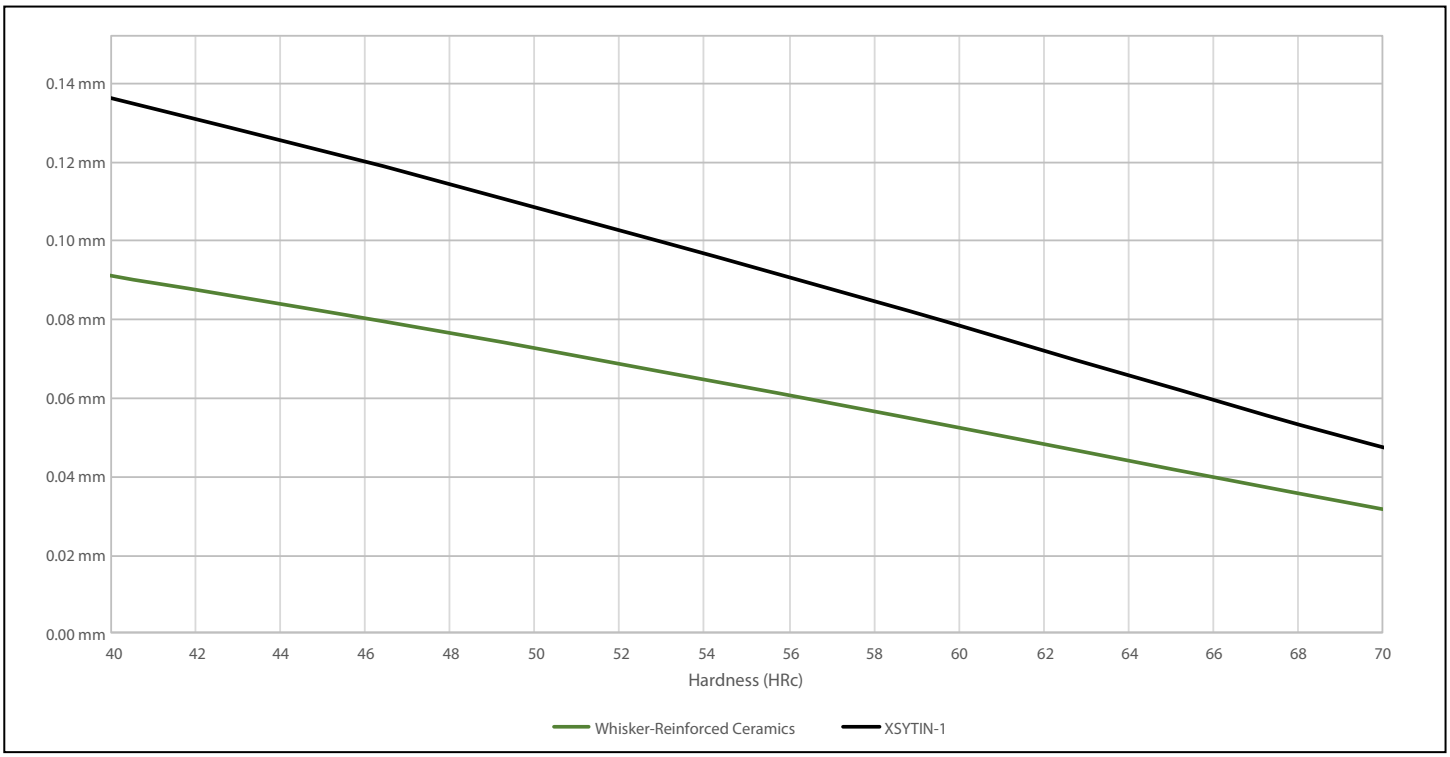
Milling Hardened Steel, Cutting Speed (Vc)



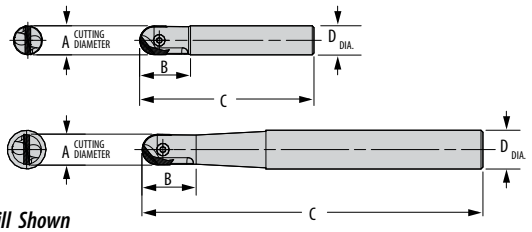
Milling Hardened Steel, Average Chip Thickness (Hm)



Ball Nose

End Mill

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



Right-Hand End Mill Shown

Part Number		Gage Insert	Dimensions (mm)				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-M010X		GBN-M010	10	17	100	16	SM30-083	TK-03466	40,000	40,000
	SSBN-M010EX	GBN-M010	10	17	180	16	SM30-083	TK-03466	40,000	40,000
SSBN-M012X		GBN-M012	12	19	110	16	SM40-106	TK-03461	40,000	40,000
	SSBN-M012EX	GBN-M012	12	19	200	16	SM40-106	TK-03461	40,000	40,000
SSBN-M016X		GBN-M016	16	25,4	130	20	SM50-139	TK-03175	40,000	40,000
	SSBN-M016EX	GBN-M016	16	25,4	220	20	SM50-139	TK-03175	40,000	40,000
SSBN-M020X		GBN-M020	20	32	140	25	SM60-167	TK-04138	40,000	40,000
	SSBN-M020EX	GBN-M020	20	32	250	25	SM60-167	TK-04138	40,000	40,000
SSBN-M025X		GBN-M025	25	36	150	32	SM70-210	TK-04142	40,000	40,000
	SSBN-M025EX	GBN-M025	25	36	250	32	SM70-210	TK-03462	40,000	40,000

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

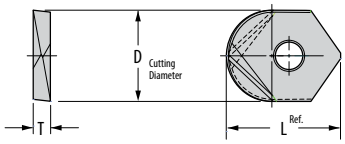
NOTE: For information on screw torque settings, please refer to the chart on page M38.

* *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 (mm)		
		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-M010	◆	◆	◆	▲	◆	◆	▲	◆	◆	◆	▲	12,7	3,18	10
	GBN-M012	◆	◆	◆	▲	◆	◆	▲	◆	◆	◆	▲	17,0	4,78	12
	GBN-M016	◆	◆	◆	▲	◆	◆	▲	◆	◆	◆	▲	20,3	4,78	16
	GBN-M020	◆	◆	◆	▲	◆	◆	▲	◆	◆	◆	▲	22,9	4,78	20
	GBN-M025	◆	◆	◆	▲	◆	◆	▲	◆	◆	◆	▲	31,2	4,78	25

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 (mm/m)	Target Chip Thickness (mm)	Recommended Feed per Tooth (mm/t) Depth of Cut to Radius Ratio (Ap/r)		
					0–13.4%	13.4–29.3%	29.3–50%
Steel	40 HRC	G-925	152	0,048	0,216	0,124	0,095
		XSYTIN®-1	320	0,080	0,365	0,206	0,159
		WG-600®	457	0,056	0,253	0,144	0,111
	50 HRC	G-925	107	0,032	0,107	0,062	0,048
		XSYTIN®-1	219	0,064	0,290	0,165	0,127
		WG-600®	311	0,048	0,216	0,124	0,095
	60 HRC	G-925	91	0,016	0,071	0,041	0,032
		XSYTIN®-1	131	0,048	0,216	0,124	0,095
		WG-600®	186	0,032	0,143	0,082	0,064
Tool Steel	65 HRC	G-925	84	0,016	0,071	0,041	0,032
		XSYTIN®-1	85	0,040	0,179	0,103	0,079
		WG-600®	122	0,024	0,107	0,062	0,048
HRSA	20-25 HRC	G-925	168	0,064	0,290	0,165	0,127
		XSYTIN®-1	914	0,064	0,290	0,165	0,127
		WG-600®	1204	0,040	0,179	0,103	0,079
	40-45 HRC	G-925	107	0,040	0,179	0,103	0,079
		XSYTIN®-1	792	0,040	0,179	0,103	0,079
		WG-600®	1052	0,024	0,107	0,062	0,048
Grapitic Cast Iron	≤40 HRC	G-925	259	0,086	0,395	0,223	0,171
		XSYTIN®-1	701	0,072	0,327	0,185	0,143
		WG-600®	899	0,048	0,216	0,124	0,095
Stainless Steel	≤40 HRC	G-925	137	0,064	0,290	0,165	0,127
		XSYTIN®-1	732	0,064	0,290	0,165	0,127
		WG-600®	1061	0,040	0,179	0,103	0,079
Titanium 6Al4V	35-40 HRC	G-925	76	0,024	0,107	0,062	0,048
Aluminum		G-925	290	0,095	0,441	0,247	0,190

* *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.*

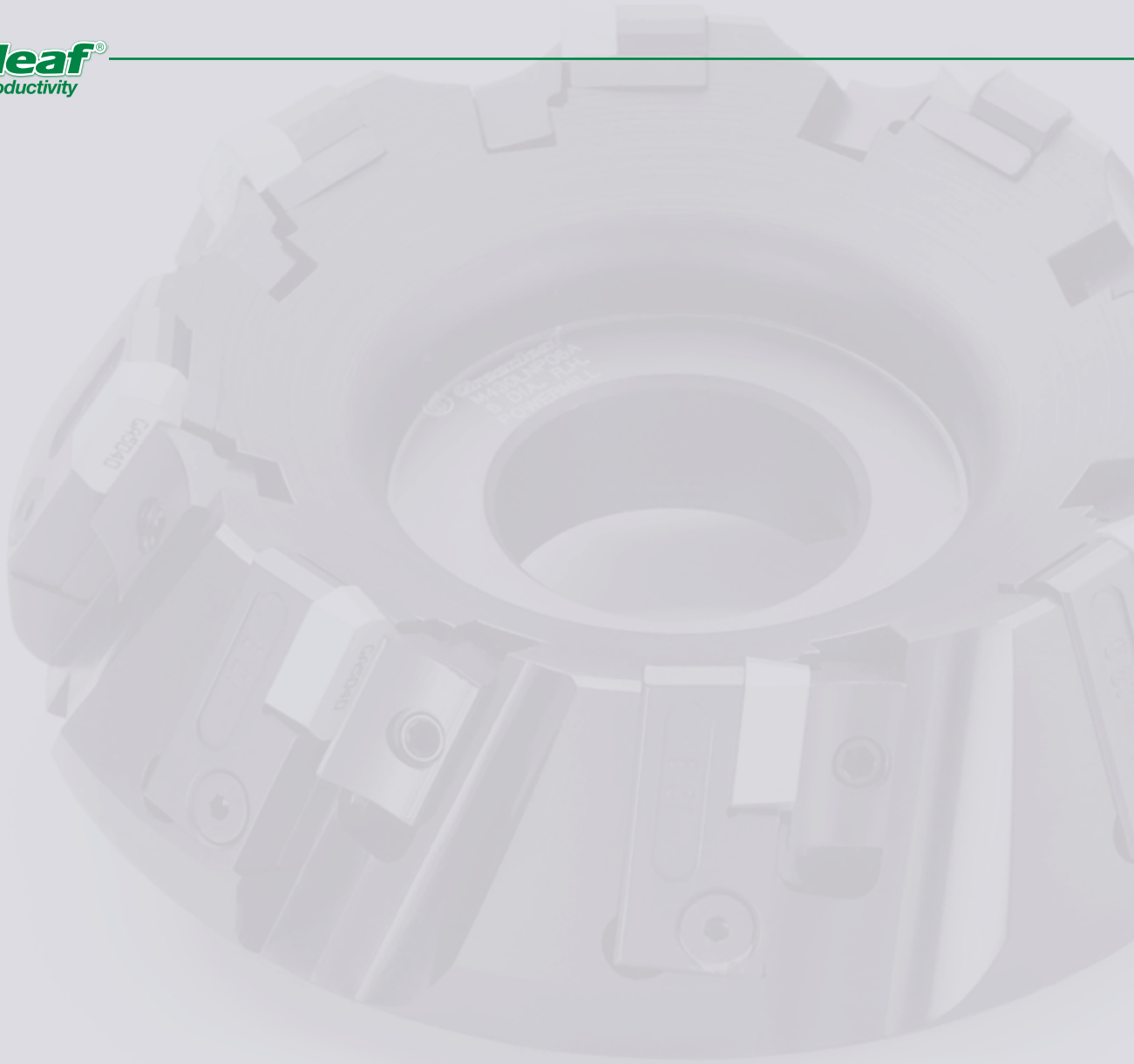
** *Maximum recommended depth of cut (DOC) when using XSYTIN-1 & G-925 is 20% of the insert diameter, and 15% of the insert diameter when using WG-600.*

Effective Cutting Diameter

		Effective Diameter D_{eff} (mm) for a given Depth of Cut												
	DOC	0,013	0,25	0,38	0,64	0,89	1,40	1,91	2,41	2,54	2,92	3,18	3,81	5,08
Insert Diameter (mm)	10	2,18	3,07	3,73	4,75	5,54	6,74	7,62	8,29	8,42	8,78	8,98	9,33	-
	12	2,53	3,56	4,33	5,54	6,48	7,95	9,07	9,96	10,16	10,69	11,00	11,64	12,44
	16	2,83	3,98	4,86	6,22	7,30	8,99	10,32	11,40	11,64	12,30	12,70	13,56	14,81
	20	3,10	4,37	5,33	6,84	8,04	9,93	11,43	12,67	12,95	13,73	14,20	15,24	16,85
	25	3,58	5,05	6,17	7,93	9,34	11,58	13,38	14,90	15,24	16,21	16,80	18,14	20,32

Maximum recommended DOC for WG-600®

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



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Powermill Milling Cutters

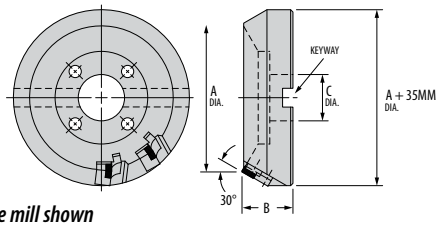
Ideal for heavy-duty cutting in severe interruptions and uneven surfaces. Replaceable components maximize cutter life while providing deep depths of cut.

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

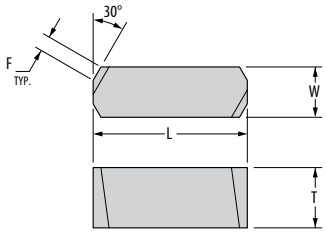
30º Lead, Neg-Pos

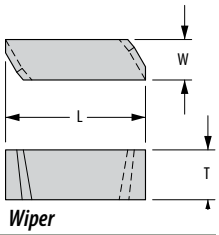


Right-hand face mill shown

Part Number		Gage Insert	No. of Inserts	Wiper Insert	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional
Right Hand	**Left Hand				A	B	C	Keyway	Bolt Circle	Anvil	Wedge Screw	Anvil	Back-Up Plate		†Anvil
M430LNP100AR		LNP-335R	6	LNP-335RW	100	63	32	14	–	430992	STCM-8	S-21M	303414	TK-02217	S-2M
	M430LNP100AL	LNP-335L	6	LNP-335LW	100	63	32	14	–	430992	STCM-8	S-21M	303414	TK-02217	S-2M
M430LNP125AR		LNP-335R	6	LNP-335RW	125	63	40	16	–	430992	STCM-8	S-21M	303414	TK-02217	S-2M
	M430LNP125AL	LNP-335L	6	LNP-335LW	125	63	40	16	–	430992	STCM-8	S-21M	303414	TK-02217	S-2M
M430LNP160AR		LNP-335R	8	LNP-335RW	160	63	40	16	66,7	430992	STCM-8	S-21M	303414	TK-02062	S-2M
	M430LNP160AL	LNP-335L	8	LNP-335LW	160	63	40	16	66,7	430992	STCM-8	S-21M	303414	TK-02062	S-2M
M430LNP200AR		LNP-335R	10	LNP-335RW	200	63	60	25	101,6	430992	STCM-8	S-21M	303414	TK-02218	S-2M
	M430LNP200AL	LNP-335L	10	LNP-335LW	200	63	60	25	101,6	430992	STCM-8	S-21M	303414	TK-02218	S-2M
M430LNP250AR		LNP-335R	12	LNP-335RW	250	63	60	25	101,6	430992	STCM-8	S-21M	303414	TK-02219	S-2M
	M430LNP250AL	LNP-335L	12	LNP-335LW	250	63	60	25	101,6	430992	STCM-8	S-21M	303414	TK-02219	S-2M
M430LNP315AR		LNP-335R	16	LNP-335RW	315	80	60	25	101,6 177,8	430992	STCM-8	S-21M	303414	TK-02063	S-2M
	M430LNP315AL	LNP-335L	16	LNP-335LW	315	80	60	25	101,6 177,8	430992	STCM-8	S-21M	303414	TK-02063	S-2M

NOTE: Maximum depth of cut is 12.7mm.
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 ISO	Steel P			Stainless Steel M		Part Number ANSI	Dimensions (mm)			
		GA5036	G-915	G-9120	G-910	G-9230		W	T	L	F
	LNP-335R	◆	▲	●	●	◆	LNP-335R	7,94	9,53	19,05	2,54
	LNP-335L	◆	▲	●	●	◆	LNP-335L	7,94	9,53	19,05	2,54
	LNP-335RW	◆	▲	●	●	◆	LNP-335RW	7,94	9,02	21,54	N/A
	LNP-335LW	◆	▲	●	●	◆	LNP-335LW	7,94	9,02	21,54	N/A
	LNP-34.57R	◆	▲	●	●	◆	LNP-34.57R	11,10	9,53	28,58	2,54
	LNP-34.57L	◆	▲	●	●	◆	LNP-34.57L	11,10	9,53	28,58	2,54
	LNP-34.57RW	◆	▲	●	●	◆	LNP-34.57RW	11,10	9,02	31,19	N/A
	LNP-34.57LW	◆	▲	●	●	◆	LNP-34.57LW	11,10	9,02	31,19	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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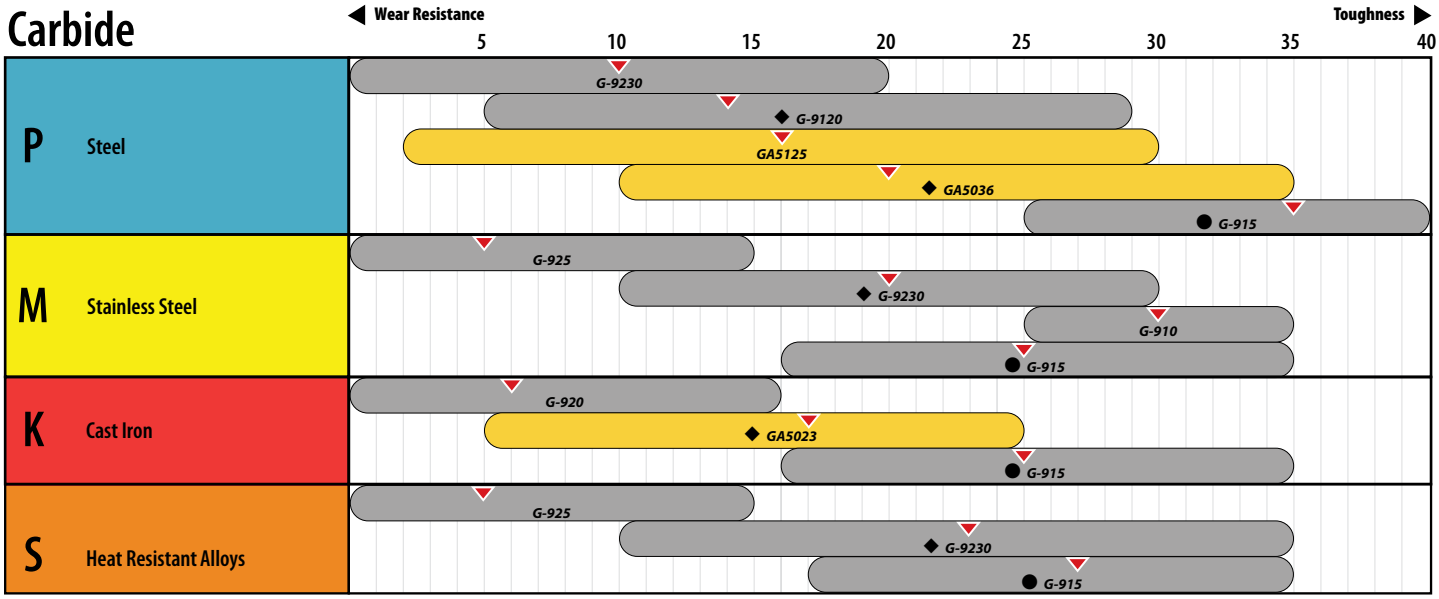
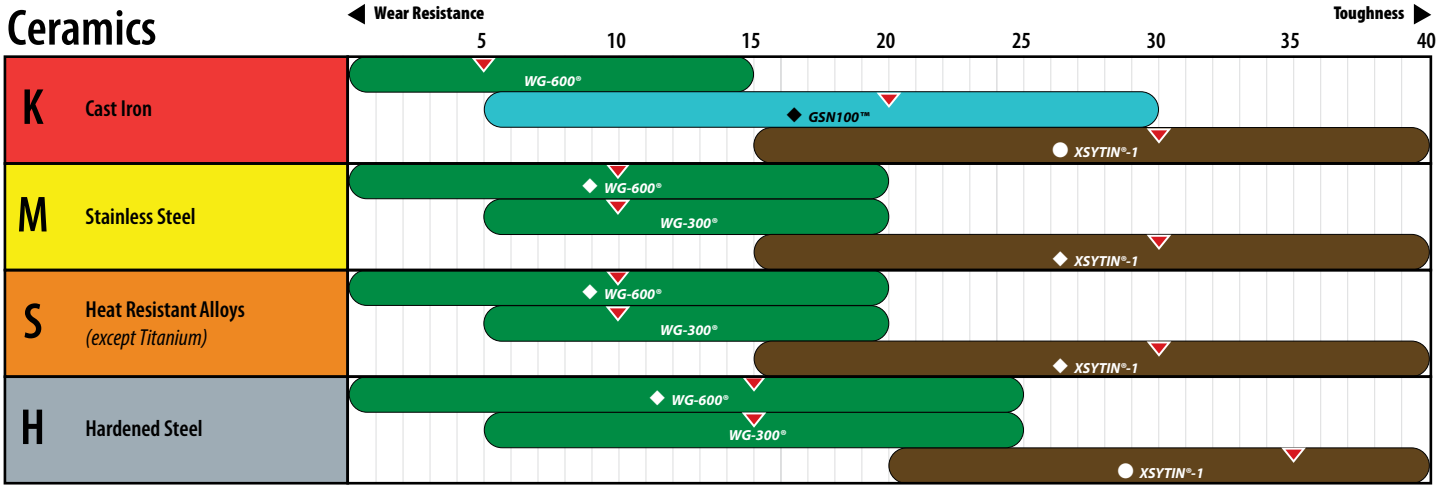
Insert Grade Reference for Milling

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

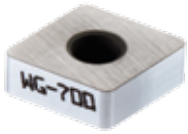
Greenleaf is the leader in the development and manufacture of ceramic and coated ceramic inserts. ANSI standard geometries are offered to fit in many of the milling lines offered.

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™™

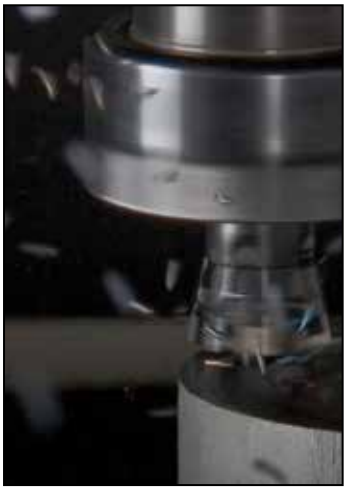
A SiC whisker-reinforced Al_2O_3 ceramic featuring improved toughness and a unique low-friction coating. WG-700™ is ideal for turning, grooving, and profiling nickel- and cobalt-based super alloys that other ceramics may struggle in. WG-700™ exhibits exceptional tool life and productivity in next-generation 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.



Screw Torque Settings

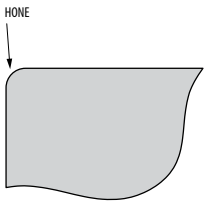
Screw Type	Part Number	Screw Torque (Nm)	Wrench
Insert Screw	PT-589T	0,9	T7
	313631	0,9	T7
	PT-542T	0,9	T7
	PT-559T	2,5	T15
	312679	2,5	T15
	PT-546T	5,0	T20
	SM30-083	2,0	T10
	SM40-106	2,9	T15
	SM50-139	4,4	T20
	SM60-167	5,8	T25
	SM70-210	10,7	T20
Wedge Screw	MS-1595	9,6	T30
	STCM-8	10,7	M4
Nest Screw	C0-5018	7,9	T20
Anvil Screw	FHCS M3-0.5x6mm	1,0	M2
	FHCS M5-0.8x20mm	6,8	M3
Clamp Screw	SHCS M5-0.8x12mm	13,6	M4
	438920	13,6	T25
	SHCS M2.5-.45x6mm	1,7	M2
	MS-1156	3,4	T15
	PT-488T	2,5	T10
	C03508	2,5	T15
	PT-317T	2,3	T10
	BHCS M4-0.7x10mm	3,4	M25
	PT-542T	1,7	T7
	SE02-01	4,0	T15
	SE03-72	7,9	T20
Back-Up Plate Screw	FHCS M3-0.5x10mm	1,5	M2

Excelerator® Mills

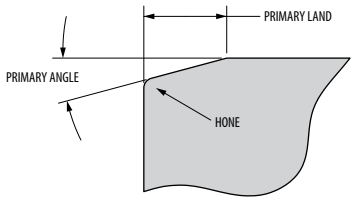
Setup and Operational Procedures

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.

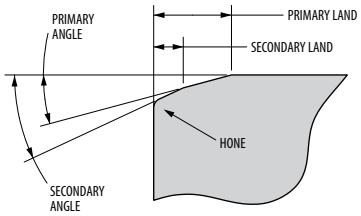
Ceramic Edge Preparations



HONE



PRIMARY ANGLE



SECONDARY ANGLE

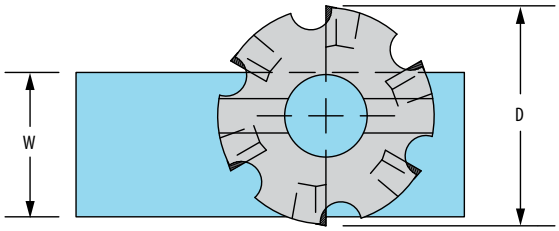
Edge Prep	Hone	Primary Land	Primary Angle	Application
A	0,015mm R.			Light hone added to designated lands and chipforms • **XSYTIN®-1** – General-purpose milling of HRSA, hardened steel, and maraging steel
T1		0,07mm	20°	• **XSYTIN®-1** – General-purpose milling of high-hardness HRSA, and hardened steel
T1A	0,015mm R.	0,07mm	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		0,17mm	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	0,015mm R.	0,17mm	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.

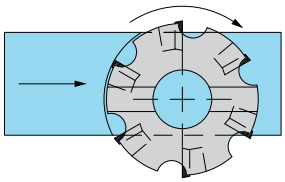
With smaller, low horsepower machines it will be better to select a smaller cutter and take two passes rather than a large diameter cutter forced to operate at low tooth loads (feed rates) to avoid stalling of the spindle.



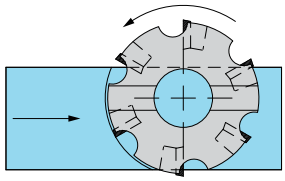
W = Width of work
D = Cutter diameter

Choose a cutter diameter approximately 1.5 times the workpiece width.

Hand of Cutters



Right-hand cutter



Left-hand cutter

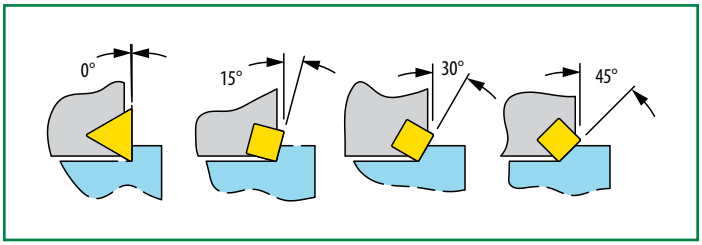
A *right-hand cutter* is one which, when viewed from above, rotates clockwise relative to the workpiece.

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.

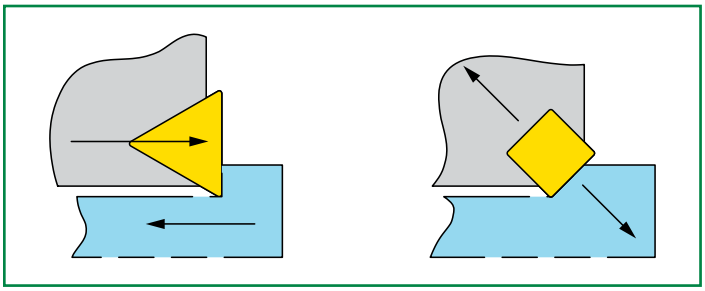
Lead Angles and Cutting Forces

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.

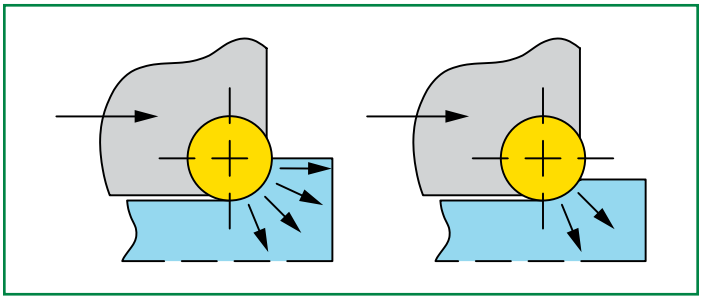
For example, in a thin section workpiece, a high lead angle may cause deflection since there is more tendency to "push" the part away from the cutter. On the other hand, a 0° lead cutter has more deflective force on the machine spindle.

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

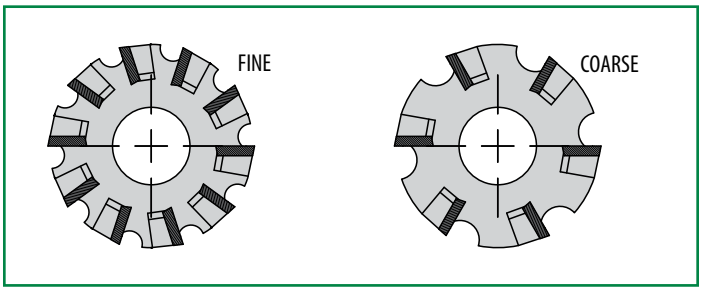
The exception to the rule in lead angle cutting forces is the round insert. With a round insert, the lead angle is entirely dependent upon the depth of cut. As the depth increases, the lead angle decreases. If cutting half the diameter deep, there is effectively 0° lead angle.



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.

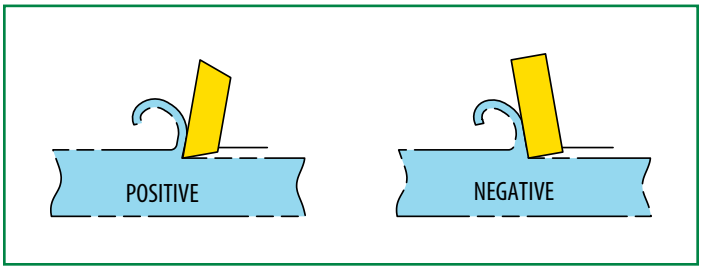
Negative Versus Positive Geometry

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.

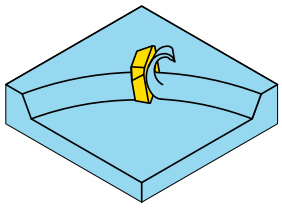
In general, use negative rakes for cast iron, interrupted cuts, and on rigid high horsepower machining for steels.

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



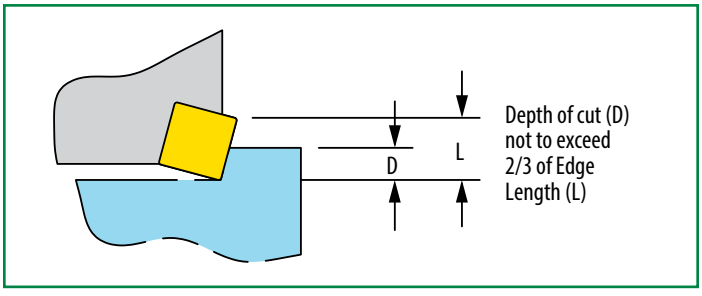
There are many milling cutters with a combination of positive and negative rakes often called shear-angle design. These cutters offer some of both worlds, although inserts are essentially like positive inserts and cannot be turned over. Shear angle cutters do provide continuous chip ejection since the 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.



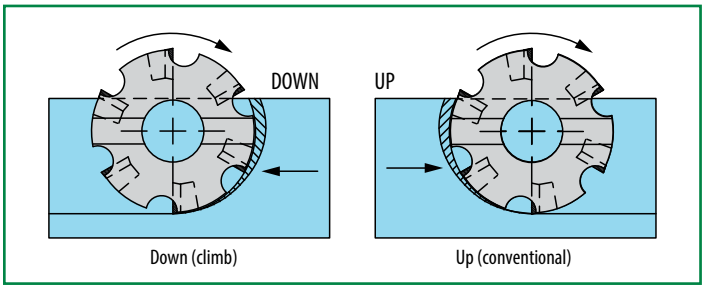
Depth of Cut

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.

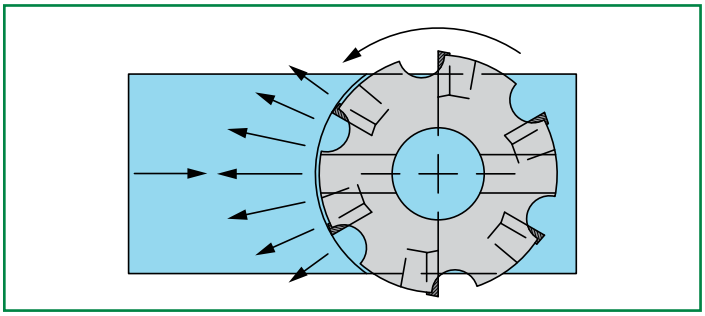


With a modern machine in good condition, down milling will give the best results. This is because the thickest section of the chip is against the insert to avoid welding, and pressure is progressively relieved towards the finished surface.

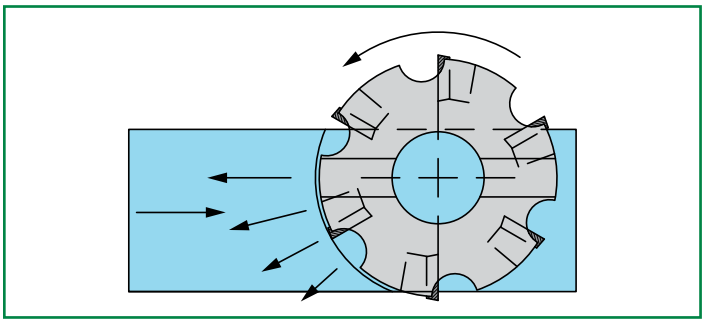
In up milling, friction and pressure build up before the chip starts to form, causing premature edge wear. It should be in rare cases that up milling is needed. This could be, for example, on an older machine with backlash in the table feed.

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.

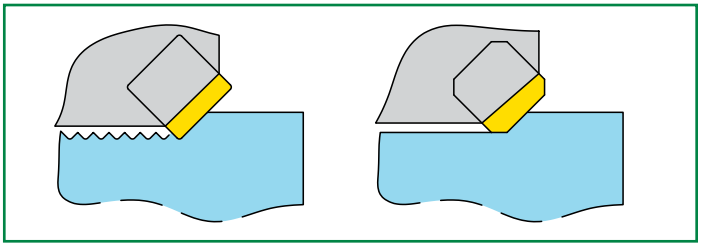


When moving off center, the path of cut is longer since each insert now sweeps a longer arc with each revolution. This may have a measureable impact on tool life, and cutting temperature will tend to increase.

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.

Speed Calculations

Recommended cutting speeds are usually given in surface meters per minute (m/min). Sometimes it is necessary to convert m/min to the correct RPM (rev/min) for a given cutter diameter. The following formulas can be used to make this conversion:

Vc	=	Cutting speed	m/min
D	=	Cutting diameter	mm
n	=	Spindle speed	rev/min

Cutting speed $Vc = \frac{(\pi \times D \times n)}{1000}$

Spindle speed $n = \frac{(Vc \times 1000)}{\pi \times D}$

Cutting speed recommendations are based upon the material to be machined and the cutting tool material which will be used – such as 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 millimeters 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 mm 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, such as the feed per tooth or how much work we are 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 0,08mm, 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 power available may be insufficient. This is an important consideration in selecting a cutter, especially larger diameter cutters with fine pitch. Here are the equations you will need to make your calculations:

D	=	**Cutting diameter**	**mm**
L	=	**Machined length**	**mm**
De	=	**Effective diameter**	**mm**
a_p	=	**Depth of cut**	**mm**
ae	=	**Working engagement**	**mm**
Vc	=	**Cutting speed**	**m/min**
Q	=	**Metal removal rate**	**cm^3/min**
T	=	**Period of engagement**	**min**
z	=	**Number of teeth**	**Piece**
fz	=	**Feed per tooth**	**mm**
fn	=	**Feed per revolution**	**mm/rev**
Vf	=	**Table feed**	**mm/min**
hex	=	**Maximum chip thickness**	**mm**
hm	=	**Average chip thickness**	**mm**
Kc	=	**Specific cutting force**	**N/mm^2**
n	=	**Spindle speed**	**rev/min**
Pc	=	**Cutting power net**	**Kw**
η	=	**Efficiency**	
Kr	=	**Major cutting edge angle**	**Degrees**

Table feed: $Vf = fz \times n \times z$

Feed per revolution: $Fn = \frac{Vf}{n}$

Removal rate: $Q = \frac{a_p \times ae \times Vf}{1000}$

Average chip thickness: $hm = \frac{\sqrt{ae}}{D}$

Machining time: $T = \frac{L}{Vf}$

Net power: $Pc = \frac{a_p \times ae \times Vf \times Kc}{60000000 * \eta}$

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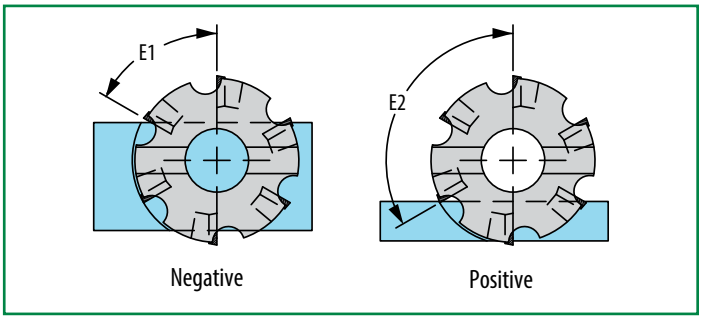
Angle of Entry

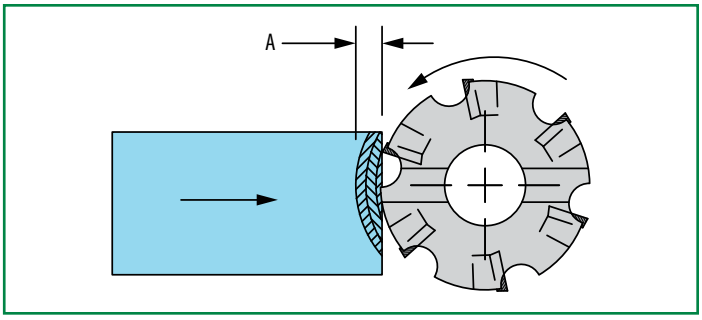
In face milling operations, the angle of entry can have a significant impact upon insert performance. A positive angle of entry can cause breakage or chipping, especially when using positive inserts. Positive angle of entry will occur when the path of cut is narrow relative to cutter diameter.



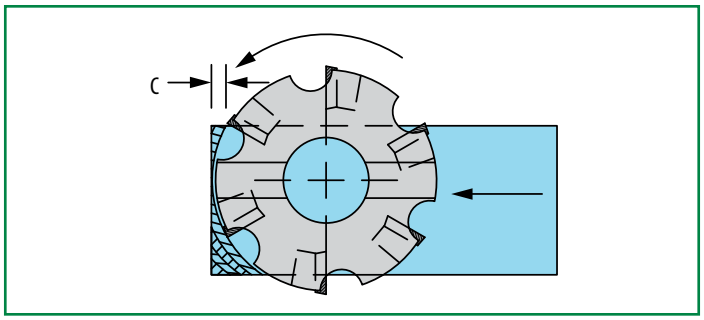
1. When the angle of entry (E1) is less than 90°, the initial impact occurs at a position behind the point of the tool. The insert has a greater section and is stronger here and better able to withstand the impacts.

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.

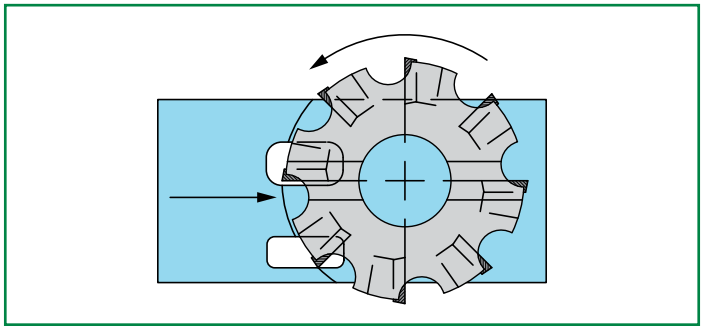
At this point, the cutter breaks through in the center, leaving two islands of material. Changes of entry angle occur which can result in insert problems. As in entry into the part, a reduction of feed rate can help alleviate chipping or breakage problems if they arise.

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 millimeters 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 millimeters per minute?

Use this formula to find feed per tooth:

Feed per tooth: $$fz = \frac{Vf}{n \times z}$$

fz	**=**	**Feed per tooth**	**mm**
Vf	**=**	**Table feed**	**mm/min**
n	**=**	**Spindle speed**	**rev/min**
z	**=**	**Number of teeth**	**Piece**

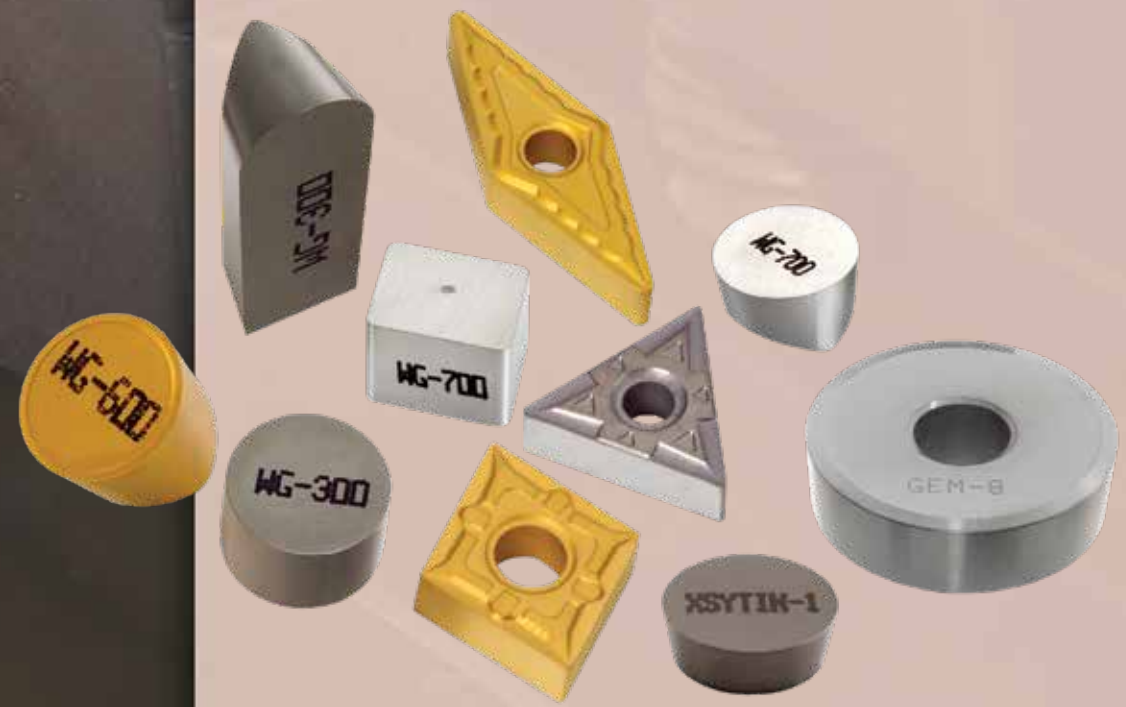
Once you know the feed per tooth, as a very broad general guide, try to keep the feed above 0,08mm per tooth and remember that power limitations usually come into play long before most cutters reach the upper limit. Efficient metal removal will usually dictate working in the 0,1mm to 0,25mm per tooth range.

Some heavy-duty cutters can be used as high as 0,75mm or more per tooth, but this will need a machine in the 40+ Kw class – and a larger cutter could well use over 75Kw.

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.

Turning and Boring



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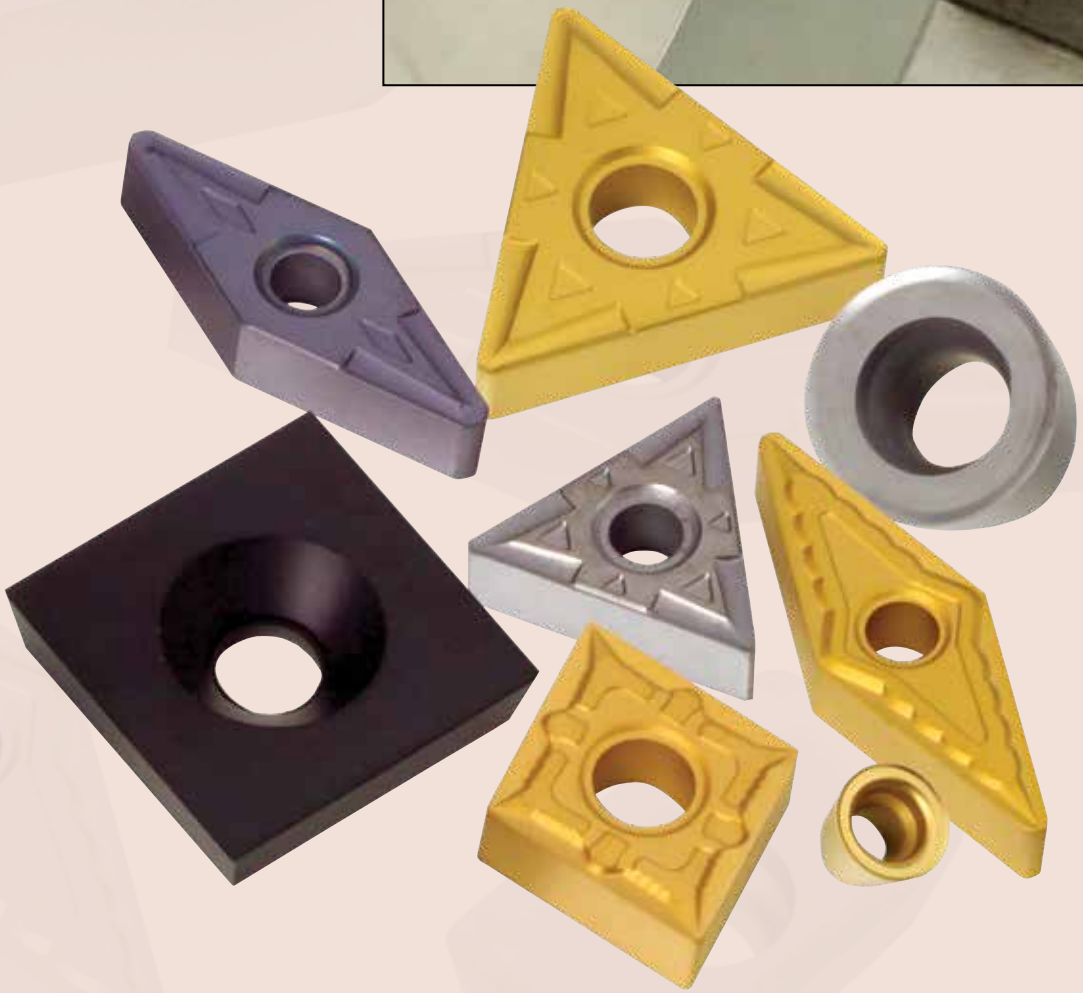
Advanced Carbide Inserts

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.



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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.

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 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.

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.

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-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.

PVD Coated *continued*

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

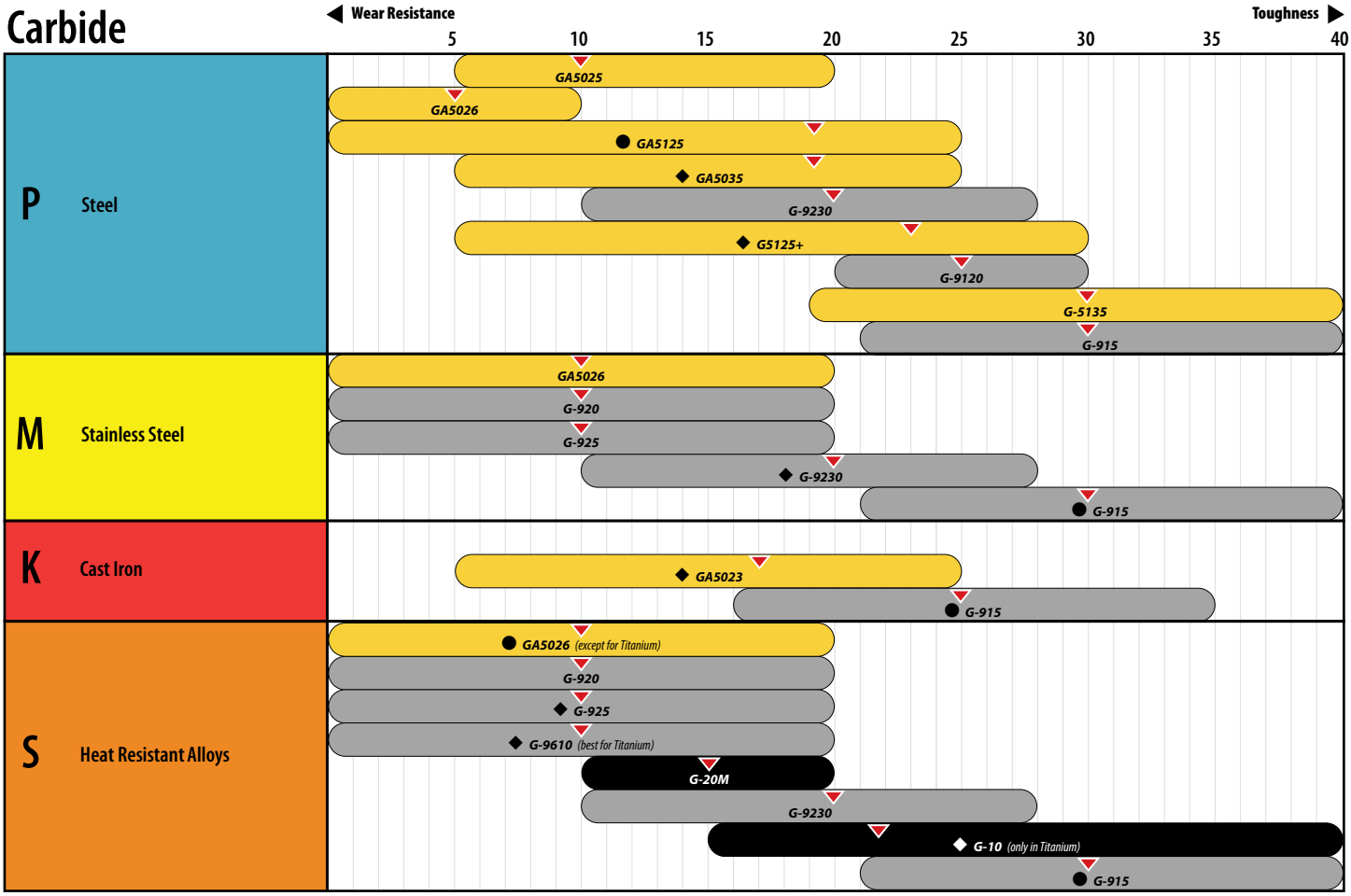
An excellent general-purpose cast-iron grade, G-02 can be used for milling and turning cast iron at moderately high speeds and medium feeds. G-02 is also a good choice for machining aluminum with positive rakes and light roughing of some heat-resistant alloys and stainless steels.

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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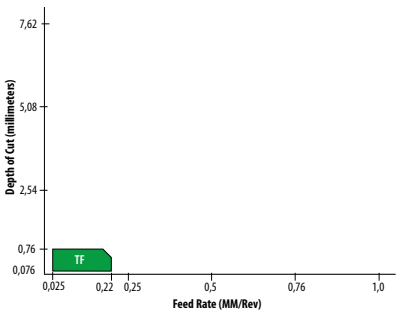
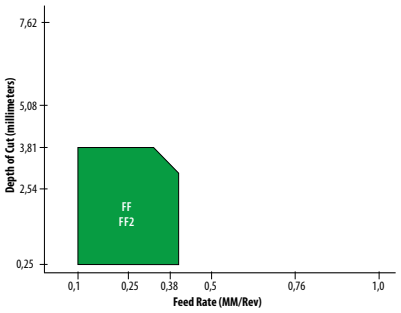
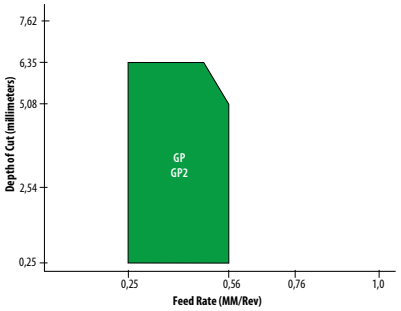
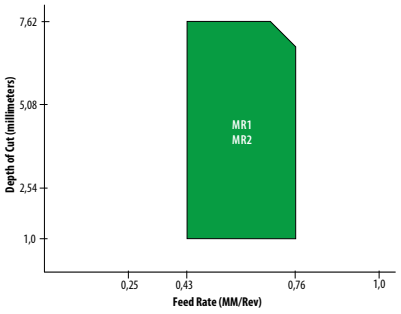
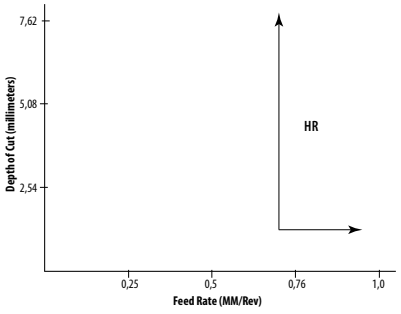
Chipform Application Range

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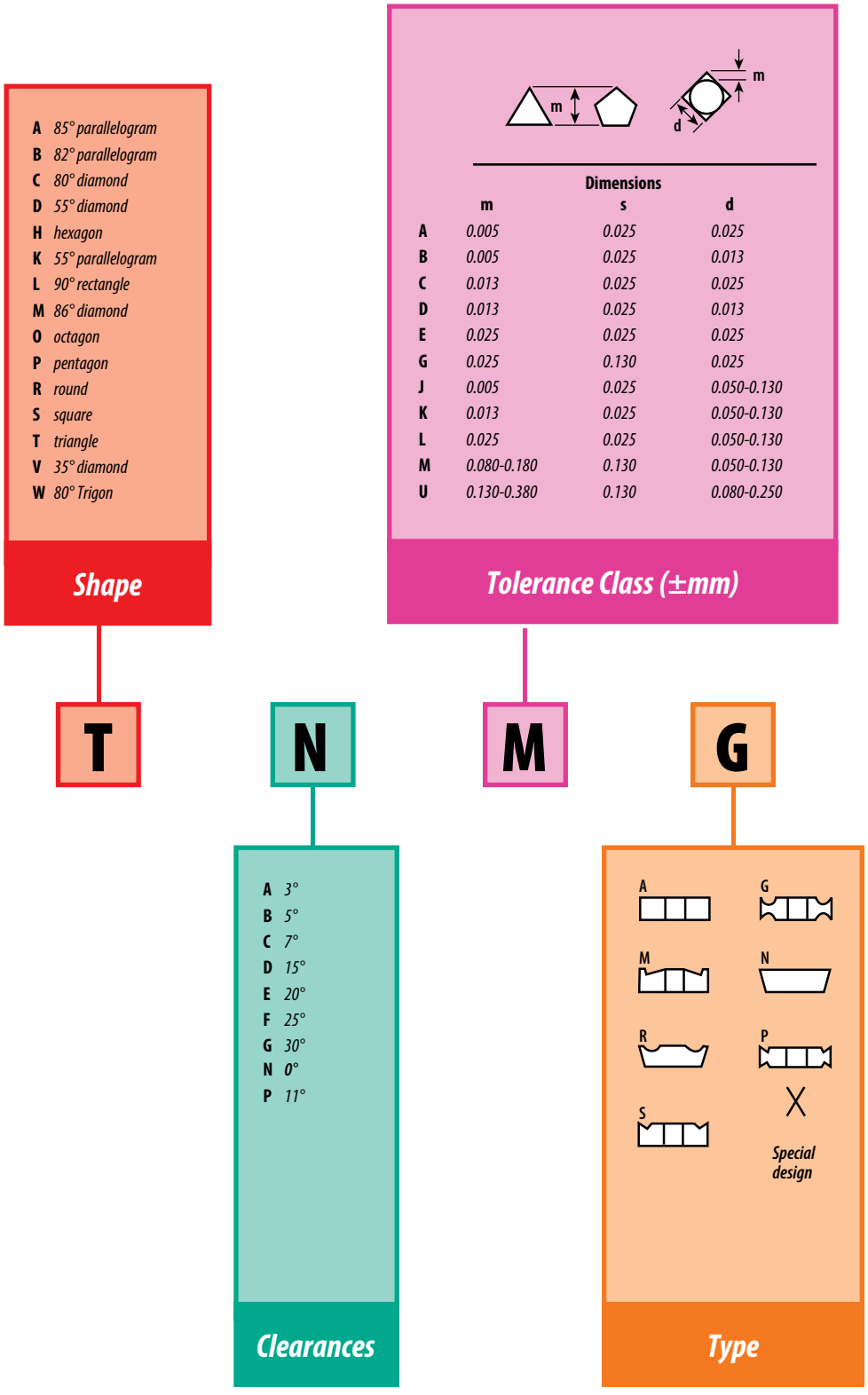
I.S.O. Identification for Turning and Boring Inserts



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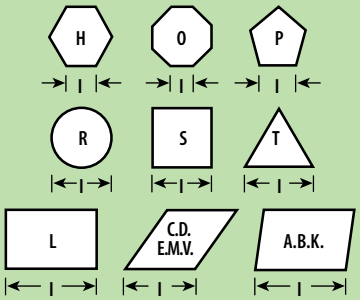
Comparison cutting edge length in mm – IC in inches

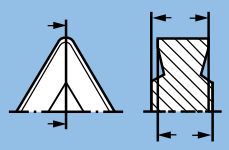
△	06	09	11	16	22	27	33	44
□ ○				09	12	15	19	25
55°					15	19		
80°					12	16	19	25
35°				16	22			
IC = d	5/32"	7/32"	1/4"	3/8"	1/2"	5/8"	3/4"	1"



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

Thickness

Unhoned	F
Honed	E
Chamfered	T
Chamfered and Honed	S

Cutting Edge

08

Radius in terms of 0.1 mm	
00	Round insert
00	sharp point
02	0.2
04	0.4
05	0.5
08	0.8
10	1.0
12	1.2
15	1.5
16	1.6
24	2.4
32	3.2
40	4.0

Cutting Point Configuration

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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 ⅛ths 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
¼" I.C.	2
5/16" I.C.	2.5
⅜" I.C.	3
½" I.C.	4
⅝" I.C.	5
¾" I.C.	6
⅞" I.C.	7
1" I.C.	8
1-¼" I.C.	10

Rectangles and parallelograms

Use two digits to size

1st digit: Number of ⅛ths of an inch in width

2nd digit: Number of ¼ths 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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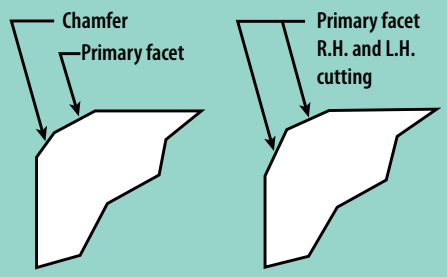
Regular polygons, diamonds, rectangles and parallelograms:
Number of 1/16ths of an inch in thickness as per table below:

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

Thickness

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



Special Cutting Point Definition (5)

R	*Right*
L	*Left*

Hand (5)

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

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°

Cutting Point Configuration

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)*

Other Conditions (5)

(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.

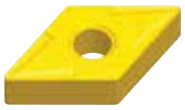
Pictorial Index

Negative Inserts

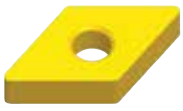
80° Diamond
Chip Control
page: T 14

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

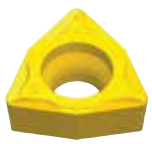
Round
Chip Control
page: T34

Round
Chip Control
page: T34

Square
Positive Flat Top
page: T35

Triangle
Positive Flat Top
page: T36-37

Triangle
Positive Flat Top
page: T38



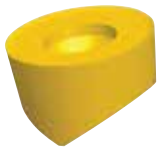
80° Trigon
Chip Control: Screw-On
page: T39

V-Bottom Round Inserts

RCGX
Positive: Carbide
page: GP 14

RPGX
Positive: Carbide
page: GP 15

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



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

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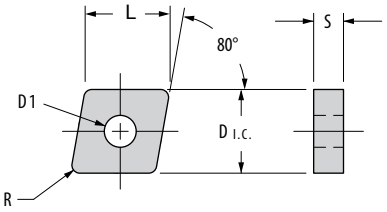
80° Diamond Inserts

Negative Chip Control (CNGG-CNMG-CNMM)



	Shape: 80° Diamond	Part Number ISO	Steel P					Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S						Titanium S			Part Number ANSI	Dimensions (mm)				
			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		$D_{I.C.}$	L	S	D1	R
PRECISION FINISHING	TurboForm® 	CNGG-120401.3-TF						●	▲	●	◆			●	◆	●	▲			●	◆		CNGG-430.3-TF	12,70	12,88	4,75	5,16	0,13
		CNGG-120402.6-TF						●	▲	●	◆			●	◆	●	▲			●	◆		CNGG-430.6-TF	12,70	12,88	4,75	5,16	0,25
		CNGG-120404-TF						●	▲	●	◆			●	◆	●	▲			●	◆		CNGG-431-TF	12,70	12,88	4,75	5,16	0,38
		CNGG-120408-TF						●	▲	●	◆			●	◆	●	▲			●	◆		CNGG-432-TF	12,70	12,88	4,75	5,16	0,79
		CNGG-120412-TF						●	▲	●	◆			●	◆	●	▲			●	◆		CNGG-433-TF	12,70	12,88	4,75	5,16	1,19
FINISHING	FF2 	CNMG-120404-FF2	▲	◆		●		●	▲	●	◆		◆	●	◆	●	▲			●	◆	▲	CNMG-431-FF2	12,70	12,88	4,75	5,16	0,38
		CNMG-120408-FF2	▲	◆		●		●	▲		◆		◆	●	◆		▲			●	◆	▲	CNMG-432-FF2	12,70	12,88	4,75	5,16	0,79
		CNMG-120412-FF2	▲	◆		●		●	▲		◆		◆	●	◆		▲			●	◆	▲	CNMG-433-FF2	12,70	12,88	4,75	5,16	1,19
		CNMG-120416-FF2	▲	◆		●		●	▲		◆		◆	●	◆		▲			●	◆	▲	CNMG-434-FF2	12,70	12,88	4,75	5,16	1,57
		CNMG-160608-FF	▲	◆		●		●	▲		◆		◆	●	◆		▲			●	◆	▲	CNMG-542-FF	15,88	16,13	6,35	6,35	0,79
		CNMG-160612-FF	▲	◆		●		●	▲		◆		◆	●	◆		▲			●	◆	▲	CNMG-543-FF	15,88	16,13	6,35	6,35	1,19
		CNMG-190612-FF	▲	◆		●		●	▲		◆		◆	●	◆		▲			●	◆	▲	CNMG-643-FF	19,05	19,33	6,35	7,92	1,19
GENERAL PURPOSE	GP2 	CNMG-120408-GP2	●	◆	▲	▲		●	▲		◆		◆	●	◆		▲			▲	●	◆	CNMG-432-GP2	12,70	12,88	4,75	5,16	0,79
		CNMG-120412-GP2	●	◆	▲	▲		●	▲		◆		◆	●	◆		▲			▲	●	◆	CNMG-433-GP2	12,70	12,88	4,75	5,16	1,19
		CNMG-120416-GP2	●	◆	▲	▲		●	▲		◆		◆	●	◆		▲			▲	●	◆	CNMG-434-GP2	12,70	12,88	4,75	5,16	1,57
		CNMG-160608-GP2	●	◆	▲	▲			▲		◆	●	◆		◆		▲		●	▲	●	◆	CNMG-542-GP2	15,88	16,13	6,35	6,35	0,79
		CNMG-160612-GP2	●	◆	▲	▲			▲		◆	●	◆		◆		▲		●	▲	●	◆	CNMG-543-GP2	15,88	16,13	6,35	6,35	1,19
		CNMG-190612-GP	●	◆	▲	▲			▲		◆	●	◆		◆		▲		●	▲	●	◆	CNMG-643-GP	19,05	19,33	6,35	7,92	1,19
MEDIUM ROUGHING	MR2 	CNMG-120408-MR2		◆	▲	▲	●		▲		◆	●	◆		◆		▲		●	●	▲	◆	CNMG-432-MR2	12,70	12,88	4,75	5,16	0,79
		CNMG-120412-MR2		◆	▲	▲	●		▲		◆	●	◆		◆		▲		●	●	▲	◆	CNMG-433-MR2	12,70	12,88	4,75	5,16	1,19
		CNMG-120416-MR2		◆	▲	▲	●		▲		◆	●	◆		◆		▲		●	●	▲	◆	CNMG-434-MR2	12,70	12,88	4,75	5,16	1,57
		CNMG-160608-MR2		◆	▲	▲	●		▲		◆	●	◆		◆		▲		●	●	▲	◆	CNMG-542-MR2	15,88	16,13	6,35	6,35	0,79
		CNMG-160612-MR2		◆	▲	▲	●		▲		◆	●	◆		◆		▲		●	●	▲	◆	CNMG-543-MR2	15,88	16,13	6,35	6,35	1,19
		CNMG-190608-MR		◆	▲	▲	●		▲		◆	●	◆		◆		▲		●	●	▲	◆	CNMG-642-MR	19,05	19,33	6,35	7,92	0,79
		CNMG-190612-MR		◆	▲	▲	●		▲		◆	●	◆		◆		▲		●	●	▲	◆	CNMG-643-MR	19,05	19,33	6,35	7,92	1,19
		CNMG-190616-MR		◆	▲	▲	●		▲		◆	●	◆		◆		▲		●	●	▲	◆	CNMG-644-MR	19,05	19,33	6,35	7,92	1,57
HEAVY ROUGHING	HR – single sided 	CNMM-190612-HR		◆		▲	●		▲		◆	●	◆		◆				●				CNMM-643-HR	19,05	19,33	6,35	7,92	1,19
		CNMM-250924-HR		◆			●		▲		◆	●	◆		◆				●				CNMM-866-HR	25,40	25,78	9,53	9,12	2,39

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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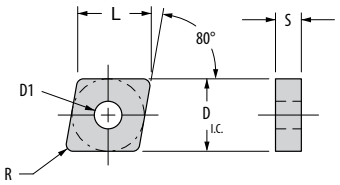
80° Diamond Inserts

Negative Flat Top (CNMA)



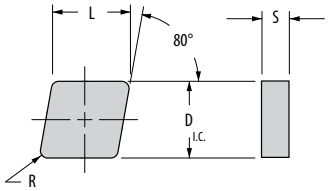
Shape: 80° Diamond	Part Number ISO	Cast Iron K GA5023	Cast Iron K G-02	Part Number ANSI	Dimensions (mm) $D_{I.C.}$	L	S	D1	R
	CNMA-120404	◆	▲	CNMA-431	12,70	12,88	4,75	5,16	0,38
	CNMA-120408	◆	▲	CNMA-432	12,70	12,88	4,75	5,16	0,79
	CNMA-120412	◆	▲	CNMA-433	12,70	12,88	4,75	5,16	1,19
	CNMA-120416	◆	▲	CNMA-434	12,70	12,88	4,75	5,16	1,57
	CNMA-160608	◆	▲	CNMA-542	15,88	16,13	6,35	6,35	0,79
	CNMA-160612	◆	▲	CNMA-543	15,88	16,13	6,35	6,35	1,19
	CNMA-190608	◆	▲	CNMA-642	19,05	19,33	6,35	7,92	0,79
	CNMA-190612	◆	▲	CNMA-643	19,05	19,33	6,35	7,92	1,19
	CNMA-190616	◆	▲	CNMA-644	19,05	19,33	6,35	7,92	1,57
	CNMA-250924	◆	▲	CNMA-866	25,40	25,78	9,53	9,12	2,39

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 ISO	Cast Iron K GA5023	Cast Iron K G-02	Part Number ANSI	Dimensions (mm) $D_{I.C.}$	L	S	R
	CNGN-120308	◆	▲	CNGN-422	12,70	12,88	3,18	0,79
	CNGN-120408	◆	▲	CNGN-432	12,70	12,88	4,75	0,79
	CNGN-190408	◆	▲	CNGN-632	19,05	19,33	4,75	0,79
	CNGN-190412	◆	▲	CNGN-633	19,05	19,33	4,75	1,19
	CNGN-190416	◆	▲	CNGN-634	19,05	19,33	4,75	1,57
	CNGN-190612	◆	▲	CNGN-643	19,05	19,33	6,35	1,19
	CNGN-190616	◆	▲	CNGN-644	19,05	19,33	6,35	1,57

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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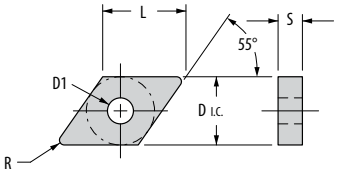
55° Diamond Inserts

Negative Chip Control (DNGG-DNMG)



	Shape: 55° Diamond	Part Number ISO	Steel P					Stainless Steel M						Cast Iron K	Heat-Resistant Super Alloys S						Titanium S			Part Number ANSI	Dimensions (mm)				
			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		$D_{I.C.}$	L	S	D1	R
PRECISION FINISHING	TurboForm®	DNGG-150401.3-TF						▲		●		◆			▲	◆		●			●	◆		DNGG-430.3-TF	12,70	15,49	4,75	5,16	0,13
		DNGG-150402.6-TF						▲		●		◆			▲	◆		●			●	◆		DNGG-430.6-TF	12,70	15,49	4,75	5,16	0,25
		DNGG-150404-TF						▲		●		◆			▲	◆		●			●	◆		DNGG-431-TF	12,70	15,49	4,75	5,16	0,38
		DNGG-150408-TF						▲		●		◆			▲	◆		●			●	◆		DNGG-432-TF	12,70	15,49	4,75	5,16	0,79
		DNGG-150412-TF						▲		●		◆			▲	◆		●			●	◆		DNGG-433-TF	12,70	15,49	4,75	5,16	1,19
		DNGG-190608-TF						▲		●		◆			▲	◆		●			●	◆		DNGG-542-TF	15,88	19,38	6,35	6,35	0,79
		DNGG-190612-TF						▲		●		◆			▲	◆		●			●	◆		DNGG-543-TF	15,88	19,38	6,35	6,35	1,19
FINISHING	FF2	DNMG-150404-FF2	▲	◆				●	▲	▲		◆		◆	●	◆		▲			●	◆		DNMG-431-FF2	12,70	15,49	4,75	5,16	0,38
		DNMG-150408-FF2	▲	◆				●	▲	▲		◆		◆	●	◆		▲			●	◆		DNMG-432-FF2	12,70	15,49	4,75	5,16	0,79
		DNMG-150412-FF2	▲	◆				●	▲	▲		◆		◆	●	◆		▲			●	◆		DNMG-433-FF2	12,70	15,49	4,75	5,16	1,19
		DNMG-150604-FF2	▲	◆				●	▲	▲		◆		◆	●	◆		▲			●	◆		DNMG-441-FF2	12,70	15,49	6,35	5,16	0,38
		DNMG-150608-FF2	▲	◆				●	▲	▲		◆		◆	●	◆		▲			●	◆		DNMG-442-FF2	12,70	15,49	6,35	5,16	0,79
		DNMG-150612-FF2	▲	◆				●	▲	▲		◆		◆	●	◆		▲			●	◆		DNMG-443-FF2	12,70	15,49	6,35	5,16	1,19
		DNMG-190608-FF2	▲	◆				●	▲	▲		◆		◆	●	◆		▲			●	◆		DNMG-542-FF2	15,88	19,38	6,35	6,35	0,79
		DNMG-190612-FF2	▲	◆				●	▲	▲		◆		◆	●	◆		▲			●	◆		DNMG-543-FF2	15,88	19,38	6,35	6,35	1,19
GENERAL PURPOSE	GP2	DNMG-150408-GP2	●	◆	▲			●	▲	▲		◆		◆	●	◆		▲			▲	●	◆	DNMG-432-GP2	12,70	15,49	4,75	5,16	0,79
		DNMG-150412-GP2	●	◆	▲			●	▲		◆		◆		◆		▲	●		▲	●	◆		DNMG-433-GP2	12,70	15,49	4,75	5,16	1,19
		DNMG-150608-GP2	●	◆	▲				▲	▲		◆	●	◆		◆		▲	●		▲	●	◆	DNMG-442-GP2	12,70	15,49	6,35	5,16	0,79
		DNMG-150612-GP2	●	◆	▲				▲	▲		◆	●	◆		◆		▲	●		▲	●	◆	DNMG-443-GP2	12,70	15,49	6,35	5,16	1,19
		DNMG-190608-GP2	●	◆	▲				▲	▲		◆	●	◆		◆		▲	●		▲	●	◆	DNMG-542-GP2	15,88	19,38	6,35	6,35	0,79
		DNMG-190612-GP2	●	◆	▲				▲	▲		◆	●	◆		◆		▲	●		▲	●	◆	DNMG-543-GP2	15,88	19,38	6,35	6,35	1,19
MEDIUM ROUGHING	MR2	DNMG-150408-MR		◆	▲		●		▲	▲		◆	●	◆		◆		▲	●		●	▲	◆	DNMG-432-MR	12,70	15,49	4,75	5,16	0,79
		DNMG-150608-MR		◆	▲		●		▲	▲		◆	●	◆		◆		▲	●		●	▲	◆	DNMG-442-MR	12,70	15,49	6,35	5,16	1,19
		DNMG-190608-MR2		◆	▲		●		▲	▲		◆	●	◆		◆		▲	●		●	▲	◆	DNMG-542-MR	15,88	19,38	6,35	6,35	0,79
		DNMG-190612-MR2		◆	▲		●		▲	▲		◆	●	◆		◆		▲	●		●	▲	◆	DNMG-543-MR2	15,88	19,38	6,35	6,35	1,19

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

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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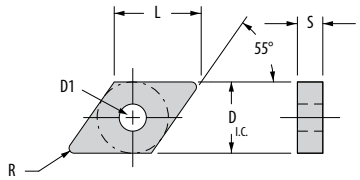
55° Diamond Inserts

Negative Flat Top (DNMA)



Shape: 55° Diamond	Part Number ISO	Cast Iron K GA5023	Cast Iron K G-02	Part Number ANSI	Dimensions (mm) $D_{I.C.}$	L	S	D1	R
	DNMA-150404	◆	▲	DNMA-431	12,70	15,49	4,75	5,16	0,13
	DNMA-150408	◆	▲	DNMA-432	12,70	15,49	4,75	5,16	0,79
	DNMA-150412	◆	▲	DNMA-433	12,70	15,49	4,75	5,16	1,19
	DNMA-150416	◆	▲	DNMA-434	12,70	15,49	4,75	5,16	1,57
	DNMA-190412	◆	▲	DNMA-533	15,88	19,38	4,75	6,35	1,19
	DNMA-190608	◆	▲	DNMA-542	15,88	19,38	6,35	6,35	0,79
	DNMA-190612	◆	▲	DNMA-543	15,88	19,38	6,35	6,35	1,19
	DNMA-190616	◆	▲	DNMA-544	15,88	19,38	6,35	6,35	1,57

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

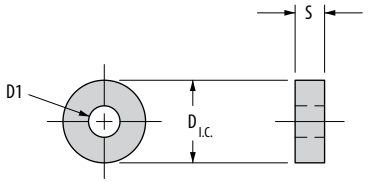
First Choice ◆ Second Choice ● Alternative ▲

***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 ISO	Steel P					Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S						Titanium S			Part Number ANSI	Dimensions (mm)		
			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		$D_{I.C.}$	T	D1
PRECISION FINISHING	TurboForm® 	RNGG-120400-TF						●	▲		◆			●	◆		▲			●	◆		RNGG-43-TF	12,70	4,75	5,16
GENERAL PURPOSE	GP2 	RNMG-090300-GP	▲	◆				●	▲		◆		◆	●	◆		▲			▲	●	◆	RNMG-32-GP	9,53	3,18	3,81
		RNMG-090400-GP	▲	◆				●	▲		◆		◆	●	◆		▲			▲	●	◆	RNMG-33-GP	9,53	4,75	3,81
		RNMG-120400-GP	▲	◆				●	▲		◆		◆	●	◆		▲			▲	●	◆	RNMG-43-GP	12,70	4,75	5,16
MEDIUM ROUGHING	MR2 	RNMG-190600-MR	●	◆	▲			●	▲		◆		◆	●	◆		▲			●	▲	◆	RNMG-64-MR	19,05	6,35	7,92
		RNMG-250900-MR	●	◆	▲			●	▲		◆		◆	●	◆		▲			●	▲	◆	RNMG-86-MR	25,40	9,53	9,12
HEAVY ROUGHING	HR – single sided 	RNMM-250600-MR	●	◆	▲			●	▲		◆		◆	●	◆		▲						RNMM-84 MR	25,40	6,35	9,12

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

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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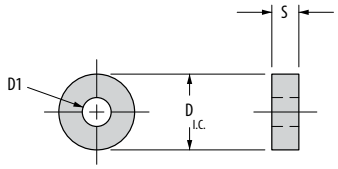
Round Inserts

Negative Flat Top (RNMA)



Shape: Round	Part Number ISO	Cast Iron K GA5023	Cast Iron K G-02	Part Number ANSI	Dimensions (mm) $D_{I.C.}$	T	D1
	RNMA-090300	◆	▲	RNMA-32	9,53	3,18	3,81
	RNMA-090400	◆	▲	RNMA-33	9,53	4,75	3,81
	RNMA-120400	◆	▲	RNMA-43	12,70	4,75	5,16
	RNMA-150600	◆	▲	RNMA-54	15,88	6,35	6,35
	RNMA-190600	◆	▲	RNMA-64	19,05	6,35	7,92
	RNMA-250900	◆	▲	RNMA-86	25,40	9,53	9,12
	RNMA-310900	◆	▲	RNMA-106	31,75	9,53	12,70

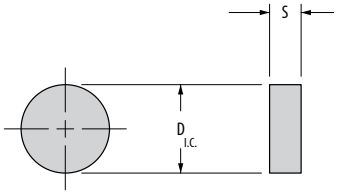
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

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) $D_{I.C.}$	S
	RNGN-090300	◆	▲	RNGN-32	9,53	3,81
	RNGN-120300	◆	▲	RNGN-42	12,70	3,81
	RNGN-120400	◆	▲	RNGN-43	12,70	4,75
	RNGN-120700	◆	▲	RNGN-45	12,70	7,92
	RNGN-150400	◆	▲	RNGN-53	15,88	4,75
	RNGN-190400	◆	▲	RNGN-63	19,05	4,75
	RNGN-250600	◆	▲	RNGN-84	25,40	6,35

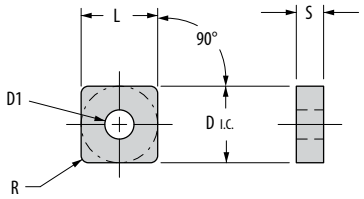
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

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 ISO	Steel P					Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S						Titanium S			Part Number ANSI	Dimensions (mm)				
			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		$D_{I.C.}$	L	S	D1	R
FINISHING	FF2	SNMG-090308-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	SNMG-322-FF2	9,53	9,53	3,18	3,81	0,79
		SNMG-120408-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	SNMG-432-FF2	12,70	12,70	4,75	5,16	0,79
		SNMG-120412-FF	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	SNMG-433-FF	12,70	12,70	4,75	5,16	1,19
		SNMG-150612-FF	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	SNMG-543-FF	15,88	15,88	6,35	6,35	1,19
GENERAL PURPOSE	GP2	SNMG-090308-GP	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	SNMG-322-GP	9,53	9,53	3,18	3,81	0,79
		SNMG-120408-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	SNMG-432-GP2	12,70	12,70	4,75	5,16	0,79
		SNMG-120412-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	SNMG-433-GP2	12,70	12,70	4,75	5,16	1,19
		SNMG-120416-GP	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	SNMG-434-GP	12,70	12,70	4,75	5,16	1,57
		SNMG-150612-GP2	●	◆	▲				▲		◆	●	◆		◆		▲	●		▲	●	◆	SNMG-543-GP2	15,88	15,88	6,35	6,35	1,19
		SNMG-190612-GP2	●	◆	▲				▲		◆	●	◆		◆		▲	●		▲	●	◆	SNMG-643-GP2	19,05	19,05	6,35	7,92	1,19
		SNMG-190616-GP2	●	◆	▲				▲		◆	●	◆		◆		▲	●		▲	●	◆	SNMG-644-GP2	19,05	19,05	6,35	7,92	1,57
MEDIUM ROUGHING	MR2	SNMG-120408-MR2	●	◆	▲				▲		◆	●	◆		◆		▲	●		●	▲	◆	SNMG-432-MR2	12,70	12,70	4,75	5,16	0,79
		SNMG-120608-MR	●	◆	▲				▲		◆	●	◆		◆		▲	●		●	▲	◆	SNMG-442-MR	12,70	12,70	6,35	5,16	0,79
		SNMG-150612-MR2		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	SNMG-543-MR2	15,88	15,88	6,35	6,35	1,19
		SNMG-190612-MR		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	SNMG-643-MR	19,05	19,05	6,35	7,92	1,19
		SNMG-190616-MR		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	SNMG-644-MR	19,05	19,05	6,35	7,92	1,57
		SNMG-250924-MR		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	SNMG-866-MR	25,40	25,40	9,53	9,12	2,39
HEAVY ROUGHING	HR – single sided	SNMM-190612-HR		◆			●		▲				◆		◆								SNMM-643-HR	19,05	19,05	6,35	7,92	1,19
		SNMM-190616-HR		◆			●		▲				◆		◆								SNMM-644-HR	19,05	19,05	6,35	7,92	1,57

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

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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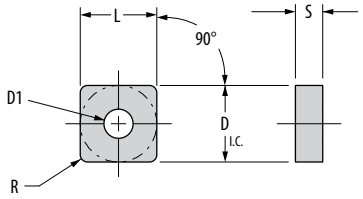
Square Inserts

Negative Flat Top (SNMA)



Shape: Square	Part Number ISO	Cast Iron K GA5023	Cast Iron K G-02	Part Number ANSI	Dimensions (mm) $D_{I.C.}$	L	S	D1	R
	SNMA-090304	◆	▲	SNMA-321	9,53	9,53	3,18	3,81	0,38
	SNMA-090308	◆	▲	SNMA-322	9.53	9,53	3,18	3,81	0,79
	SNMA-090312	◆	▲	SNMA-323	9,53	9,53	3,18	3,81	1,19
	SNMA-120404	◆	▲	SNMA-431	12,70	12,70	4,75	5,16	0,38
	SNMA-120408	◆	▲	SNMA-432	12,70	12,70	4,75	5,16	0,79
	SNMA-120412	◆	▲	SNMA-433	12,70	12,70	4,75	5,16	1,19
	SNMA-120416	◆	▲	SNMA-434	12,70	12,70	4,75	5,16	1,57
	SNMA-150608	◆	▲	SNMA-542	15,88	15,88	6,35	6,35	0,79
	SNMA-150612	◆	▲	SNMA-543	15,88	15,88	6,35	6,35	1,19
	SNMA-150616	◆	▲	SNMA-544	15,88	15,88	6,35	6,35	1,57
	SNMA-190612	◆	▲	SNMA-643	19,05	19,05	6,35	7,92	1,19
	SNMA-190616	◆	▲	SNMA-644	19,05	19,05	6,35	7,92	1,57
	SNMA-250916	◆	▲	SNMA-864	25,40	25,40	9,53	9,12	1,57
	SNMA-250924	◆	▲	SNMA-866	25,40	25,40	9,53	9,12	2,39

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

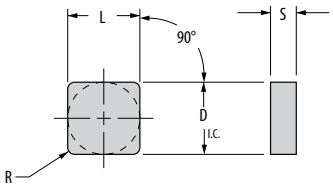
First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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

Square Inserts

Negative Flat Top (SNGN)



Shape: Square	Part Number ISO	Cast Iron K GA5023	Cast Iron K G-02	Part Number ANSI	Dimensions (mm) $D_{I.C.}$	L	S	R
	SNGN-090304	◆	▲	SNGN-321	9,53	9,53	3,18	0,38
	SNGN-090308	◆	▲	SNGN-322	9,53	9,53	3,18	0,79
	SNGN-120308	◆	▲	SNGN-422	12,70	12,70	3,18	0,79
	SNGN-120312	◆	▲	SNGN-423	12,70	12,70	3,18	1,19
	SNGN-120400	◆	▲	SNGN-430	12,70	12,70	4,75	0,13
	SNGN-120404	◆	▲	SNGN-431	12,70	12,70	4,75	0,38
	SNGN-120408	◆	▲	SNGN-432	12,70	12,70	4,75	0,79
	SNGN-120412	◆	▲	SNGN-433	12,70	12,70	4,75	1,19
	SNGN-120416	◆	▲	SNGN-434	12,70	12,70	4,75	1,57
	SNGN-150412	◆	▲	SNGN-533	15,88	15,88	4,75	1,19
	SNGN-150416	◆	▲	SNGN-534	15,88	15,88	4,75	1,57
	SNGN-150612	◆	▲	SNGN-543	15,88	15,88	6,35	1,19
	SNGN-190404	◆	▲	SNGN-631	19,05	19,05	4,75	0,38
	SNGN-190408	◆	▲	SNGN-632	19,05	19,05	4,75	0,79
	SNGN-190412	◆	▲	SNGN-633	19,05	19,05	4,75	1,19
	SNGN-190416	◆	▲	SNGN-634	19,05	19,05	4,75	1,57
	SNGN-190432	◆	▲	SNGN-638	19,05	19,05	4,75	3,18
	SNGN-190612	◆	▲	SNGN-643	19,05	19,05	6,35	1,19
	SNGN-190616	◆	▲	SNGN-644	19,05	19,05	6,35	1,57
	SNGN-190624	◆	▲	SNGN-646	19,05	19,05	6,35	2,39
	SNGN-250616	◆	▲	SNGN-844	25,40	25,40	6,35	1,57
	SNGN-250716	◆	▲	SNGN-854	25,40	25,40	7,92	1,57
	SNGN-310648	◆	▲	SNGN-10412	31,75	31,75	6,35	4,75
	SNGN-310924	◆	▲	SNGN-1066	31,75	31,75	9,53	2,39
	SNGN-310932	◆	▲	SNGN-1068	31,75	31,75	9,53	3,18
	SNGN-381232	◆	▲	SNGN-1288	38,10	38,10	12,70	3,18

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

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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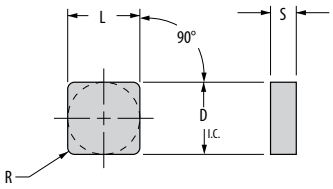
Square Inserts

Negative Flat Top (SNUN)



Shape: Square	Part Number ISO	Cast Iron K GA5023	Cast Iron K G-02	Part Number ANSI	Dimensions (mm) $D_{I.C.}$	L	S	R
	SNUN-090308	◆	▲	SNUN-322	9,53	9,53	3,18	0,79
	SNUN-090312	◆	▲	SNUN-323	9,53	9,53	3,18	1,19
	SNUN-120308	◆	▲	SNUN-422	12,70	12,70	3,18	0,79
	SNUN-120312	◆	▲	SNUN-423	12,70	12,70	3,18	1,19
	SNUN-120316	◆	▲	SNUN-424	12,70	12,70	3,18	1,57
	SNUN-120408	◆	▲	SNUN-432	12,70	12,70	4,75	0,79
	SNUN-120412	◆	▲	SNUN-433	12,70	12,70	4,75	1,19
	SNUN-120416	◆	▲	SNUN-434	12,70	12,70	4,75	1,57
	SNUN-150412	◆	▲	SNUN-533	15,88	15,88	4,75	1,19
	SNUN-190408	◆	▲	SNUN-632	19,05	19,05	4,75	0,79
	SNUN-190412	◆	▲	SNUN-633	19,05	19,05	4,75	1,19
	SNUN-190416	◆	▲	SNUN-634	19,05	19,05	4,75	1,57
	SNUN-250616	◆	▲	SNUN-844	25,40	25,40	6,35	1,57
	SNUN-250632	◆	▲	SNUN-848	25,40	25,40	6,35	3,18
	SNUN-250716	◆	▲	SNUN-854	25,40	25,40	7,92	1,57
	SNUN-310924	◆	▲	SNUN-1066	31,75	31,75	9,53	2,39
	SNUN-310932	◆	▲	SNUN-1068	31,75	31,75	9,53	3,18
	SNUN-381232	◆	▲	SNUN-1288	38,10	38,10	12,70	3,18

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

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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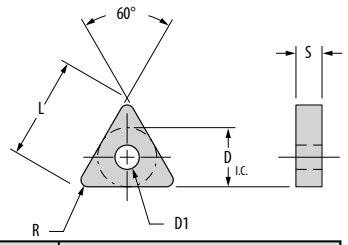
Triangle Inserts

Negative Chip Control (TNGG-TNMG-TNMM)



	Shape: Triangle	Part Number ISO	Steel P					Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S						Titanium S			Part Number ANSI	Dimensions (mm)				
			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		$D_{I.C.}$	L	S	D1	R
PRECISION FINISHING	TurboForm® 	TNGG-160401.3-TF						●	▲	●	◆			●	◆	●	▲			●	◆		TNGG-330.3-TF	9,53	16,51	4,75	3,81	0,13
		TNGG-160402.6-TF						●	▲	●	◆			●	◆	●	▲			●	◆		TNGG-330.6-TF	9,53	16,51	4,75	3,81	0,25
		TNGG-160404-TF						●	▲	●	◆			●	◆	●	▲			●	◆		TNGG-331-TF	9,53	16,51	4,75	3,81	0,38
		TNGG-160408-TF						●	▲	●	◆			●	◆	●	▲			●	◆		TNGG-332-TF	9,53	16,51	4,75	3,81	0,79
		TNGG-220401.3-TF						●	▲	●	◆			●	◆	●	▲			●	◆		TNGG-430.3-TF	12,70	22,00	4,75	5,16	0,13
		TNGG-220402.6-TF						●	▲	●	◆			●	◆	●	▲			●	◆		TNGG-430.6-TF	12,70	22,00	4,75	5,16	0,25
		TNGG-220404-TF						●	▲	●	◆			●	◆	●	▲			●	◆		TNGG-431-TF	12,70	22,00	4,75	5,16	0,38
		TNGG-220408-TF						●	▲	●	◆			●	◆	●	▲			●	◆		TNGG-432-TF	12,70	22,00	4,75	5,16	0,79
FINISHING	FF2 	TNMG-160304-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-321-FF2	9,53	16,51	3,18	3,81	0,38
		TNMG-160308-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-322-FF2	9,53	16,51	3,18	3,81	0,79
		TNMG-160312-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-323-FF2	9,53	16,51	3,18	3,81	1,19
		TNMG-160316-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-324-FF2	9,53	16,51	3,18	3,81	1,57
		TNMG-160404-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-331-FF2	9,53	16,51	4,75	3,81	0,38
		TNMG-160408-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-332-FF2	9,53	16,51	4,75	3,81	0,79
		TNMG-160416-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-334-FF2	9,53	16,51	4,75	3,81	1,57
		TNMG- 220404-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-431-FF2	12,70	22,00	4,75	5,16	0,38
		TNMG-220408-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-432-FF2	12,70	22,00	4,75	5,16	0,79
		TNMG-220412-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-433-FF2	12,70	22,00	4,75	5,16	1,19
		TNMG-220416-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-434-FF2	12,70	22,00	4,75	5,16	1,57
		TNMG-270608-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-542-FF2	15,88	27,51	6,35	6,35	0,79
		TNMG-270612-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	TNMG-543-FF2	15,88	27,51	6,35	6,35	1,19
GENERAL PURPOSE	GP2 	TNMG-160304-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	TNMG-321-GP2	9,53	16,51	3,18	3,81	0,38
		TNMG-160308-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	TNMG-322-GP2	9,53	16,51	3,18	3,81	0,79
		TNMG-160312-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	TNMG-323-GP2	9,53	16,51	3,18	3,81	1,19
		TNMG-160316-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	TNMG-324-GP2	9,53	16,51	3,18	3,81	1,57
		TNMG-160412-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	TNMG-333-GP2	9,53	16,51	4,75	3,81	1,19
		TNMG-220408-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	TNMG-432-GP2	12,70	22,00	4,75	5,16	0,79
		TNMG-220412-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	TNMG-433-GP2	12,70	22,00	4,75	5,16	1,19
		TNMG-220416-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	TNMG-434-GP2	12,70	22,00	4,75	5,16	1,57

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

First Choice ◆ Second Choice ● Alternative ▲

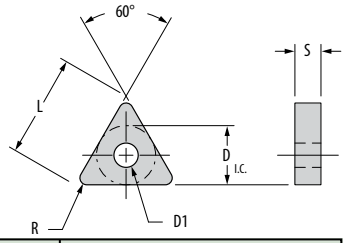
Grade descriptions — pages T 4

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 ISO	Steel P					Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S						Titanium S			Part Number ANSI	Dimensions (mm)				
			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		$D_{I.C.}$	L	S	D1	R
MEDIUM ROUGHING	MR2	TNMG-110308-MR2		◆	▲		●	●	▲		◆		◆	●	◆		▲			●	▲	◆	TNMG-222-MR2	6,35	11,00	3,18	2,36	0,79
		TNMG-220412-MR2		◆	▲		●	●	▲		◆		◆	●	◆		▲			●	▲	◆	TNMG-433-MR2	12,70	22,00	4,75	5,16	1,19
		TNMG-220416-MR2		◆	▲		●	●	▲		◆		◆	●	◆		▲			●	▲	◆	TNMG-434-MR2	12,70	22,00	4,75	5,16	1,57
		TNMG-220432-MR2		◆	▲		●	●	▲		◆		◆	●	◆		▲			●	▲	◆	TNMG-438-MR2	12,70	22,00	4,75	5,16	3,18
		TNMG-270608-MR2		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	TNMG-542-MR2	15,88	27,51	6,35	6,35	0,79
		TNMG-270612-MR2		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	TNMG-543-MR2	15,88	27,51	6,35	6,35	1,19
		TNMG-270616-MR2		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	TNMG-544-MR2	15,88	27,51	6,35	6,35	1,57
		TNMG-270624-MR2		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	TNMG-546-MR2	15,88	27,51	6,35	6,35	2,39
		TNMG-330924-MR		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	TNMG-666-MR	19,05	32,99	9,53	7,92	2,39
HEAVY ROUGHING	HR – single sided	TNMM-220412-HR		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	TNMM-433-HR	12,70	22,00	4,75	5,16	1,19
		TNMM-270616-HR		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	TNMM-544-HR	15,88	27,51	6,35	6,35	1,57

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

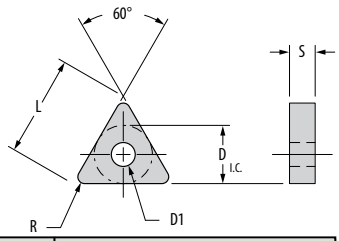
First Choice ◆ Second Choice ● Alternative ▲

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 ISO	Cast Iron K GA5023	Cast Iron K G-02	Part Number ANSI	Dimensions (mm) D I.C.	L	S	D1	R
	TNMA-110308	◆	▲	TNMA-222	6,35	11,00	3,18	2,36	0,79
	TNMA-160304	◆	▲	TNMA-321	9,53	16,51	3,18	3,81	0,38
	TNMA-160308	◆	▲	TNMA-322	9,53	16,51	3,18	3,81	0,79
	TNMA-160312	◆	▲	TNMA-323	9,53	16,51	3,18	3,81	1,19
	TNMA-160316	◆	▲	TNMA-324	9,53	16,51	3,18	3,81	1,57
	TNMA-160408	◆	▲	TNMA-332	9,53	16,51	4,75	3,81	0,79
	TNMA-160412	◆	▲	TNMA-333	9,53	16,51	4,75	3,81	1,19
	TNMA-220404	◆	▲	TNMA-431	12,70	22,00	4,75	5,16	0,38
	TNMA-220408	◆	▲	TNMA-432	12,70	22,00	4,75	5,16	0,79
	TNMA-220412	◆	▲	TNMA-433	12,70	22,00	4,75	5,16	1,19
	TNMA-220416	◆	▲	TNMA-434	12,70	22,00	4,75	5,16	1,57
	TNMA-270608	◆	▲	TNMA-542	15,88	27,51	6,35	6,35	0,79
	TNMA-270612	◆	▲	TNMA-543	15,88	27,51	6,35	6,35	1,19
	TNMA-270616	◆	▲	TNMA-544	15,88	27,51	6,35	6,35	1,57
	TNMA-270632	◆	▲	TNMA-548	15,88	27,51	6,35	6,35	3,18
	TNMA-270724	◆	▲	TNMA-556	15,88	27,51	7,92	6,35	2,39
	TNMA-270924	◆	▲	TNMA-566	15,88	27,51	9,53	6,35	2,39
	TNMA-330608	◆	▲	TNMA-642	19,05	32,99	6,35	7,92	0,79
	TNMA-330612	◆	▲	TNMA-643	19,05	32,99	6,35	7,92	1,19
	TNMA-330616	◆	▲	TNMA-644	19,05	32,99	6,35	7,92	1,57
	TNMA-330916	◆	▲	TNMA-664	19,05	32,99	9,53	7,92	1,57
	TNMA-330924	◆	▲	TNMA-666	19,05	32,99	9,53	7,92	2,39
	TNMA-330932	◆	▲	TNMA-668	19,05	32,99	9,53	7,92	3,18

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

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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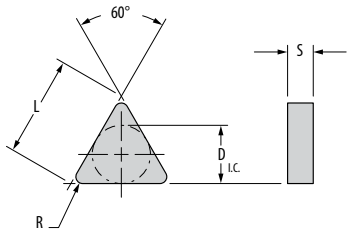
Triangle Inserts

Negative Flat Top (TNGN)



Shape: Triangle	Part Number ISO	Cast Iron K GA5023	Cast Iron K G-02	Part Number ANSI	Dimensions (mm) $D_{I.C.}$	L	D1	R
	TNGN-110308	◆	▲	TNGN-222	6,35	11,00	3,18	0,79
	TNGN-110312	◆	▲	TNGN-223	6,35	11,00	3,18	1,19
	TNGN-160300	◆	▲	TNGN-320	9,53	16,51	3,18	0,13
	TNGN-160304	◆	▲	TNGN-321	9,53	16,51	3,18	0,38
	TNGN-160308	◆	▲	TNGN-322	9,53	16,51	3,18	0,79
	TNGN-160312	◆	▲	TNGN-323	9,53	16,51	3,18	1,19
	TNGN-160316	◆	▲	TNGN-324	9,53	16,51	3,18	1,57
	TNGN-160404	◆	▲	TNGN-331	9,53	16,51	4,75	0,38
	TNGN-160408	◆	▲	TNGN-332	9,53	16,51	4,75	0,79
	TNGN-160412	◆	▲	TNGN-333	9,53	16,51	4,75	1,19
	TNGN-160416	◆	▲	TNGN-334	9,53	16,51	4,75	1,57
	TNGN-220404	◆	▲	TNGN-431	12,70	22,00	4,75	0,38
	TNGN-220408	◆	▲	TNGN-432	12,70	22,00	4,75	0,79
	TNGN-220412	◆	▲	TNGN-433	12,70	22,00	4,75	1,19
	TNGN-220416	◆	▲	TNGN-434	12,70	22,00	4,75	1,57
	TNGN-220432	◆	▲	TNGN-438	12,70	22,00	4,75	3,18
	TNGN-220608	◆	▲	TNGN-442	12,70	22,00	6,35	0,79
	TNGN-220612	◆	▲	TNGN-443	12,70	22,00	6,35	1,19
	TNGN-220616	◆	▲	TNGN-444	12,70	22,00	6,35	1,57
	TNGN-270408	◆	▲	TNGN-532	15,88	27,51	4,75	0,79
	TNGN-270432	◆	▲	TNGN-538	15,88	27,51	4,75	3,18
	TNGN-270604	◆	▲	TNGN-541	15,88	27,51	6,35	0,38
	TNGN-270608	◆	▲	TNGN-542	15,88	27,51	6,35	0,79
	TNGN-270612	◆	▲	TNGN-543	15,88	27,51	6,35	1,19
	TNGN-270616	◆	▲	TNGN-544	15,88	27,51	6,35	1,57
	TNGN-270716	◆	▲	TNGN-554	15,88	27,51	7,92	1,57
	TNGN-270724	◆	▲	TNGN-556	15,88	27,51	7,92	2,39
	TNGN-330716	◆	▲	TNGN-654	19,05	32,99	7,92	1,57
	TNGN-330724	◆	▲	TNGN-656	19,05	32,99	7,92	2,39
	TNGN-330916	◆	▲	TNGN-664	19,05	32,99	9,53	1,57
	TNGN-330924	◆	▲	TNGN-666	19,05	32,99	9,53	2,39
	TNGN-330932	◆	▲	TNGN-668	19,05	32,99	9,53	3,18
	TNGN-381124	◆	▲	TNGN-776	22,23	38,51	11,10	2,39
	TNGN-381132	◆	▲	TNGN-778	22,23	38,51	11,10	3,18
	TNGN-381140	◆	▲	TNGN-7710	22,23	38,51	11,10	3,96
	TNGN-441132	◆	▲	TNGN-878	25,40	43,99	11,10	3,18

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

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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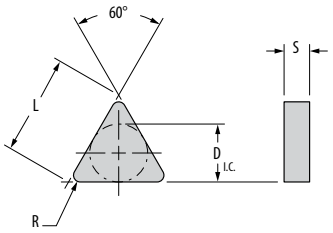
Triangle Inserts

Negative Flat Top (TNUN)



Shape: Triangle	Part Number ISO	Cast Iron K GA5023	Cast Iron K G-02	Part Number ANSI	Dimensions (mm) $D_{I.C.}$	L	S	R
	TNUN-160304	◆	▲	TNUN-321	9,53	16,51	3,18	0,38
	TNUN-160308	◆	▲	TNUN-322	9,53	16,51	3,18	0,79
	TNUN-160312	◆	▲	TNUN-323	9,53	16,51	3,18	1,19
	TNUN-160408	◆	▲	TNUN-332	9,53	16,51	4,75	0,79
	TNUN-160412	◆	▲	TNUN-333	9,53	16,51	4,75	1,19
	TNUN-160416	◆	▲	TNUN-334	9,53	16,51	4,75	1,57
	TNUN-220408	◆	▲	TNUN-432	12,70	22,00	4,75	0,79
	TNUN-220412	◆	▲	TNUN-433	12,70	22,00	4,75	1,19
	TNUN-220416	◆	▲	TNUN-434	12,70	22,00	4,75	1,57
	TNUN-220432	◆	▲	TNUN-438	12,70	22,00	4,75	3,18
	TNUN-220604	◆	▲	TNUN-441	12,70	22,00	6,35	0,38
	TNUN-220608	◆	▲	TNUN-442	12,70	22,00	6,35	0,79
	TNUN-220612	◆	▲	TNUN-443	12,70	22,00	6,35	1,19
	TNUN-220616	◆	▲	TNUN-444	12,70	22,00	6,35	1,57
	TNUN-220632	◆	▲	TNUN-448	12,70	22,00	6,35	3,18
	TNUN-270608	◆	▲	TNUN-542	15,88	27,51	6,35	0,79
	TNUN-270612	◆	▲	TNUN-543	15,88	27,51	6,35	1,19
	TNUN-270616	◆	▲	TNUN-544	15,88	27,51	6,35	1,57
	TNUN-270624	◆	▲	TNUN-546	15,88	27,51	6,35	2,39
	TNUN-270708	◆	▲	TNUN-552	15,88	27,51	7,92	0,79
	TNUN-270712	◆	▲	TNUN-553	15,88	27,51	7,92	1,19
	TNUN-270716	◆	▲	TNUN-554	15,88	27,51	7,92	1,57
	TNUN-270724	◆	▲	TNUN-556	15,88	27,51	7,92	2,39
	TNUN-330716	◆	▲	TNUN-654	19,05	32,99	7,92	1,57
	TNUN-330724	◆	▲	TNUN-656	19,05	32,99	7,92	2,39
	TNUN-330916	◆	▲	TNUN-664	19,05	32,99	9,53	1,57
	TNUN-330924	◆	▲	TNUN-666	19,05	32,99	9,53	2,39
	TNUN-330932	◆	▲	TNUN-668	19,05	32,99	9,53	3,18
	TNUN-381124	◆	▲	TNUN-776	22,23	38,51	11,10	2,39
	TNUN-381132	◆	▲	TNUN-778	22,23	38,51	11,10	3,18
	TNUN-381140	◆	▲	TNUN-7710	22,23	38,51	11,10	3,96

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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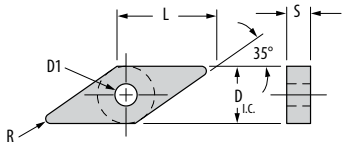
35° Diamond Inserts

Negative Chip Control (VNGG-VNMG)



	Shape: 35° Diamond	Part Number ISO	Steel P					Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S						Titanium S			Part Number ANSI	Dimensions (mm)				
			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		$D_{I.C.}$	L	S	D1	R
PRECISION FINISHING	TurboForm®	VNGG-160401.3-TF						●	▲	●	◆			●	◆		▲			●	◆		VNGG-330.3-TF	9,53	16,61	4,75	3,81	0,13
		VNGG-160402.6-TF						●	▲	●	◆			●	◆		▲			●	◆		VNGG-330.6-TF	9,53	16,61	4,75	3,81	0,25
		VNGG-160404-TF						●	▲	●	◆			●	◆		▲			●	◆		VNGG-331-TF	9,53	16,61	4,75	3,81	0,38
		VNGG-160408-TF						●	▲	●	◆			●	◆		▲			●	◆		VNGG-332-TF	9,53	16,61	4,75	3,81	0,79
		VNGG-160412-TF						●	▲	●	◆			●	◆		▲			●	◆		VNGG-333-TF	9,53	16,61	4,75	3,81	1,19
FINISHING	FF2	VNMG-160404-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	VNMG-331-FF2	9,53	16,61	4,75	3,81	0,38
		VNMG-160408-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	VNMG-332-FF2	9,53	16,61	4,75	3,81	0,79
		VNMG-160412-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	VNMG-333-FF2	9,53	16,61	4,75	3,81	1,19
		VNMG-220408-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	VNMG-432-FF2	12,70	22,15	4,75	5,16	0,79
GENERAL PURPOSE	GP2	VNMG-160408-GP2	●	◆	▲				▲		◆	●	◆		◆		▲	●		▲	●	◆	VNMG-332-GP2	9,53	16,61	4,75	3,81	0,79
		VNMG-160412-GP2	●	◆	▲				▲		◆	●	◆		◆		▲	●		▲	●	◆	VNMG-333-GP2	9,53	16,61	4,75	3,81	1,19
		VNMG-220408-GP2	●	◆	▲				▲		◆	●	◆		◆		▲	●		▲	●	◆	VNMG-432-GP2	12,70	22,15	4,75	5,16	0,79

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

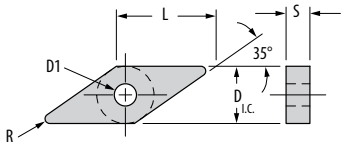
First Choice ◆ Second Choice ● Alternative ▲

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 ISO	Cast Iron K GA5023	Cast Iron K G-02	Part Number ANSI	Dimensions (mm) $D_{I.C.}$	L	S	D1	R
	VNMA-160404	◆	▲	VNMA-331	9,53	16,61	4,75	3,81	0,38
	VNMA-160408	◆	▲	VNMA-332	9,53	16,61	4,75	3,81	0,79
	VNMA-220404	◆	▲	VNMA-431	12,70	22,15	4,75	5,16	0,38
	VNMA-220408	◆	▲	VNMA-432	12,70	22,15	4,75	5,16	0,79

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

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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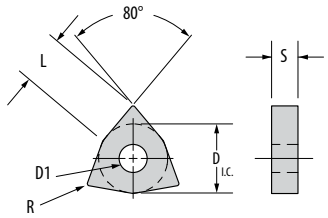
80° Trigon Inserts

Negative Chip Control (WNMG)



	Shape: 80° Trigon	Part Number ISO	Steel P					Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S						Titanium S			Part Number ANSI	Dimensions (mm)				
			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		$D_{I.C.}$	L	S	D1	R
PRECISION FINISHING	FF 	WNMG-060404-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	WNMG-331-FF2	9,53	6,53	4,75	3,81	0,38
		WNMG-060408-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	WNMG-332-FF2	9,53	6,53	4,75	3,81	0,79
		WNMG-080404-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	WNMG-431-FF2	12,70	8,69	4,75	5,16	0,38
		WNMG-080408-FF2	▲	◆				●	▲		◆		◆	●	◆		▲			●	◆	▲	WNMG-432-FF2	12,70	8,69	4,75	5,16	0,79
FINISHING	GP2 	WNMG-060404-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	WNMG-331-GP2	9,53	6,53	4,75	3,81	0,38
		WNMG-060408-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	WNMG-332-GP2	9,53	6,53	4,75	3,81	0,79
		WNMG-080404-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	WNMG-431-GP2	12,70	8,69	4,75	5,16	0,38
		WNMG-080408-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	WNMG-432-GP2	12,70	8,69	4,75	5,16	0,79
		WNMG-080412-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	WNMG-433-GP2	12,70	8,69	4,75	5,16	1,19
		WNMG-080416-GP2	●	◆	▲			●	▲		◆		◆	●	◆		▲			▲	●	◆	WNMG-434-GP2	12,70	8,69	4,75	5,16	1,57
GENERAL PURPOSE	MR2 	WNMG-080408-MR2		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	WNMG-432-MR2	12,70	8,69	4,75	5,16	0,79
		WNMG-080412-MR2		◆	▲		●		▲		◆	●	◆		◆		▲	●		●	▲	◆	WNMG-433-MR2	12,70	8,69	4,75	5,16	1,19

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

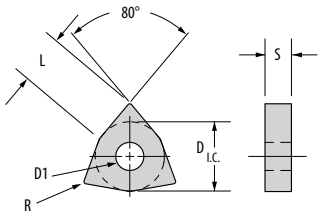
First Choice ◆ Second Choice ● Alternative ▲

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 ISO	Cast Iron K GA5023	Cast Iron K G-02	Part Number ANSI	Dimensions (mm) D I.C.	L	S	D1	R
	WNMA-060404	◆	▲	WNMA-331	9,53	6,53	4,75	3,81	0,38
	WNMA-060408	◆	▲	WNMA-332	9,53	6,53	4,75	3,81	0,79
	WNMA-060412	◆	▲	WNMA-333	9,53	6,53	4,75	3,81	1,19
	WNMA-080404	◆	▲	WNMA-431	12,70	8,69	4,75	5,16	0,38
	WNMA-080408	◆	▲	WNMA-432	12,70	8,69	4,75	5,16	0,79
	WNMA-080412	◆	▲	WNMA-433	12,70	8,69	4,75	5,16	1,19
	WNMA-080416	◆	▲	WNMA-434	12,70	8,69	4,75	5,16	1,57

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

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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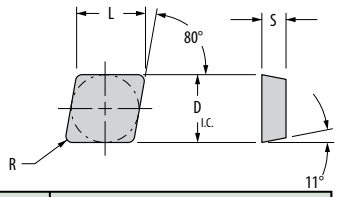
80° Diamond Inserts

Positive Flat Top (CPGN)



Shape: 80° Diamond	Part Number ISO	Steel P				Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S					Part Number ANSI	Dimensions (mm)			
		GA5025	GA5035	GA5125	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-20M		$D_{I.C.}$	L	S	R
	CPGN-120308	●	◆	▲		●	▲		◆		◆	●	◆		▲		CPGN-422	12,70	12,88	3,18	0,79
	CPGN-120316	●	◆	▲		●	▲		◆		◆	●	◆		▲		CPGN-424	12,70	12,88	3,18	1,57
	CPGN-120324	●	◆	▲		●	▲		◆		◆	●	◆		▲		CPGN-426	12,70	12,88	3,18	2,39
	CPGN-120412	●	◆	▲		●	▲		◆		◆	●	◆		▲		CPGN-433	12,70	12,88	4,75	1,19
	CPGN-120416	●	◆	▲		●	▲		◆		◆	●	◆		▲		CPGN-434	12,70	12,88	4,75	1,57
	CPGN-190408		◆	▲	●		▲		◆	●	◆		◆		▲	●	CPGN-632	19,05	19,33	4,75	0,79
	CPGN-190412		◆	▲	●		▲		◆	●	◆		◆		▲	●	CPGN-633	19,05	19,33	4,75	1,19

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

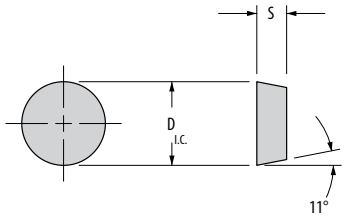
First Choice ◆ Second Choice ● Alternative ▲

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 ISO	Steel P				Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S					Part Number ANSI	Dimensions (mm)	
		GA5025	GA5035	GA5125	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-20M		$D_{I.C.}$	S
	RPGN-090300	●	◆	▲		●	▲		◆		◆	●	◆		▲		RPGN-32	9,53	3,18
	RPGN-120400	●	◆	▲		●	▲		◆		◆	●	◆		▲		RPGN-43	12,70	4,75

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

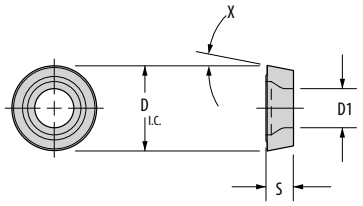
First Choice ◆ Second Choice ● Alternative ▲

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)



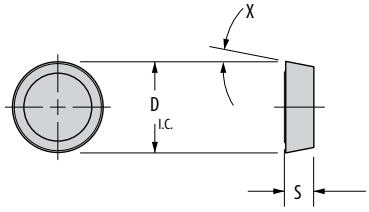
Shape: Round	Part Number ISO	Steel P					Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S						Titanium S			Part Number ANSI	Dimensions (mm)			
		GA5025	GA5035	GA5125	G-5125+	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-9610	G-20M	G-925	G-9610	G-10		$D_{I.C.}$	S	D1	X
TurboForm® 	RCGT-060300-TF						●	▲		◆			●	◆		▲			●	◆		RCGT-22-TF	0.250	0.125	0.134	7°
	RCGT-09T300-TF						●	▲		◆			●	◆		▲			●	◆		RCGT-32.5-TF	0.375	0.156	0.173	7°
	RCGT-120400-TF						●	▲		◆			●	◆		▲			●	◆		RCGT-43-TF	0.500	0.187	0.217	7°
	RPGT-060300-TF						●	▲		◆			●	◆		▲			●	◆		RPGT-22-TF	0.250	0.125	0.134	11°
	RPGT-09T300-TF						●	▲		◆			●	◆		▲			●	◆		RPGT-32.5-TF	0.375	0.156	0.173	11°
	RPGT-120400-TF						●	▲		◆			●	◆		▲			●	◆		RPGT-43-TF	0.500	0.187	0.217	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.

Round Inserts

Positive Chip Control (RCGR-RPGR)



Shape: Round	Part Number ISO	Steel P					Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S						Titanium S			Part Number ANSI	Dimensions (mm)		
		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		$D_{I.C.}$	S	X
TurboForm® 	RCGR-060300-TF						●	▲		◆			●	◆		▲			●	◆		RCGR-22-TF	6,35	3,18	7°
	RCGR-09T300-TF						●	▲		◆			●	◆		▲			●	◆		RCGR-32.5-TF	9,53	3,96	7°
	RCGR-120400-TF						●	▲		◆			●	◆		▲			●	◆		RCGR-43-TF	12,70	4,75	7°
	RPGR-060300-TF						●	▲		◆			●	◆		▲			●	◆		RPGR-22-TF	6,35	3,18	11°
	RPGR-09T300-TF						●	▲		◆			●	◆		▲			●	◆		RPGR-32.5-TF	9,53	3,96	11°
	RPGR-120400-TF						●	▲		◆			●	◆		▲			●	◆		RPGR-43-TF	12,70	4,75	11°

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

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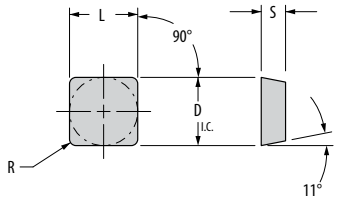
Square Inserts

Positive Flat Top (SPGN-SPUN)



Shape: Square	Part Number ISO	Steel P				Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S					Part Number ANSI	Dimensions (mm)			
		GA5025	GA5035	GA5125	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-20M		$D_{I.C.}$	L	S	R
	SPGN-090308	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPGN-322	9,53	9,53	3,18	0,79
	SPGN-090312	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPGN-323	9,53	9,53	3,18	1,19
	SPGN-120308	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPGN-422	12,70	12,70	3,18	0,79
	SPGN-120312	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPGN-423	12,70	12,70	3,18	1,19
	SPGN-120316	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPGN-424	12,70	12,70	3,18	1,57
	SPGN-120408	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPGN-432	12,70	12,70	4,75	0,79
	SPGN-120412	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPGN-433	12,70	12,70	4,75	1,19
	SPGN-120416	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPGN-434	12,70	12,70	4,75	1,57
	SPGN-150408	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPGN-532	15,88	15,88	4,75	0,79
	SPGN-150416	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPGN-534	15,88	15,88	4,75	1,57
	SPGN-190404		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPGN-631	19,05	19,05	4,75	0,38
	SPGN-190408		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPGN-632	19,05	19,05	4,75	0,79
	SPGN-190412		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPGN-633	19,05	19,05	4,75	1,19
	SPGN-190416		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPGN-634	19,05	19,05	4,75	1,57
	SPGN-190424		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPGN-636	19,05	19,05	4,75	2,39
	SPGN-190432		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPGN-638	19,05	19,05	4,75	3,18
	SPUN-120308	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPUN-422	12,70	12,70	3,18	0,79
	SPUN-120312	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPUN-423	12,70	12,70	3,18	1,19
	SPUN-120316	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPUN-424	12,70	12,70	3,18	1,57
	SPUN-120408	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPUN-432	12,70	12,70	4,75	0,79
	SPUN-120412	●	◆	▲		●	▲		◆		◆	●	◆		▲		SPUN-433	12,70	12,70	4,75	1,19
	SPUN-190412		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPUN-633	19,05	19,05	4,75	1,19
	SPUN-190416		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPUN-634	19,05	19,05	4,75	1,57
	SPUN-190612		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPUN-643	19,05	19,05	6,35	1,19
	SPUN-190616		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPUN-644	19,05	19,05	6,35	1,57
	SPUN-250916		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPUN-864	25,40	25,40	9,53	1,57
	SPUN-250924		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPUN-866	25,40	25,40	9,53	2,39
	SPUN-250932		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPUN-868	25,40	25,40	9,53	3,18
	SPUN-310932		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPUN-1068	31,75	31,75	9,53	3,18
	SPUN-381232		◆	▲	●		▲		◆	●	◆		◆		▲	●	SPUN-1288	38,10	38,10	12,70	3,18

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

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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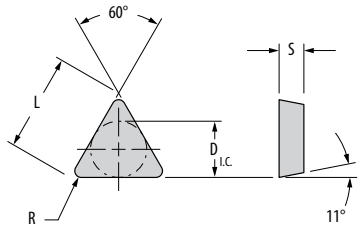
Triangle Inserts

Positive Flat Top (TPGN)



Shape: Triangle	Part Number ISO	Steel P				Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S					Part Number ANSI	Dimensions (mm)			
		GA-5025	GA-5035	GA-5125	G-9120	GA-5026	G-925	G-920	G-9230	G-915	GA-5023	GA-5026	G-925	G-920	G-9230	G-20M		$D_{I.C.}$	L	S	R
	TPGN-110304	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-221	6,35	11,00	3,18	0,38
	TPGN-110308	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-222	6,35	11,00	3,18	0,79
	TPGN-110312	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-223	6,35	11,00	3,18	1,19
	TPGN-110316	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-224	6,35	11,00	3,18	1,57
	TPGN-160300	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-320	9,53	16,51	3,18	0,13
	TPGN-160304	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-321	9,53	16,51	3,18	0,38
	TPGN-160308	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-322	9,53	16,51	3,18	0,79
	TPGN-160312	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-323	9,53	16,51	3,18	1,19
	TPGN-160316	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-324	9,53	16,51	3,18	1,57
	TPGN-160416	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-334	9,53	16,51	4,75	1,57
	TPGN-160424	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-336	9,53	16,51	4,75	2,39
	TPGN-220404	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-431	12,70	22,00	4,75	0,38
	TPGN-220408	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-432	12,70	22,00	4,75	0,79
	TPGN-220412	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-433	12,70	22,00	4,75	1,19
	TPGN-220416	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-434	12,70	22,00	4,75	1,57
	TPGN-220424	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGN-436	12,70	22,00	4,75	2,39
	TPGN-270408	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-532	15,88	27,51	4,75	0,79
	TPGN-270412	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-533	15,88	27,51	4,75	1,19
	TPGN-270416	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-534	15,88	27,51	4,75	1,57
	TPGN-270604	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-541	15,88	27,51	6,35	0,38
	TPGN-270608	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-542	15,88	27,51	6,35	0,79
	TPGN-270612	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-543	15,88	27,51	6,35	1,19
	TPGN-270616	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-544	15,88	27,51	6,35	1,57
	TPGN-270632	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-548	15,88	27,51	6,35	3,18
	TPGN-270716	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-554	15,88	27,51	7,92	1,57
	TPGN-270724	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-556	15,88	27,51	7,92	2,39
	TPGN-330924	●	◆	▲			▲		◆	●	◆		◆		▲	●	TPGN-666	19,05	32,99	9,53	2,39

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

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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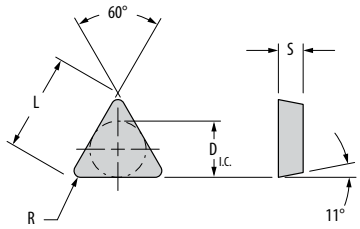
Triangle Inserts

Positive Flat Top (TPUN)



Shape: Triangle	Part Number ISO	Steel P				Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S					Part Number ANSI	Dimensions (mm)			
		GA-5025	GA-5035	GA-5125	G-9120	GA-5026	G-925	G-920	G-9230	G-915	GA-5023	GA-5026	G-925	G-920	G-9230	G-20M		$D_{I.C.}$	L	S	R
	TPUN-160304	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-321	9,53	16,51	3,18	0,38
	TPUN-160308	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-322	9,53	16,51	3,18	0,79
	TPUN-160312	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-323	9,53	16,51	3,18	1,19
	TPUN-220404	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-431	12,70	22,00	4,75	0,38
	TPUN-220408	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-432	12,70	22,00	4,75	0,79
	TPUN-220412	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-433	12,70	22,00	4,75	1,19
	TPUN-220416	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-434	12,70	22,00	4,75	1,57
	TPUN-270608	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-542	15,88	27,51	6,35	0,79
	TPUN-270612	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-543	15,88	27,51	6,35	1,19
	TPUN-270616	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-544	15,88	27,51	6,35	1,57
	TPUN-270708	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-552	15,88	27,51	7,92	0,79
	TPUN-270712	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-553	15,88	27,51	7,92	1,19
	TPUN-270716	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-554	15,88	27,51	7,92	1,57
	TPUN-270724	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPUN-556	15,88	27,51	7,92	2,39
	TPUN-330916		◆	▲	●		▲		◆	●	◆		◆		▲	●	TPUN-664	19,05	32,99	9,53	1,57
	TPUN-330924		◆	▲	●		▲		◆	●	◆		◆		▲	●	TPUN-666	19,05	32,99	9,53	2,39

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

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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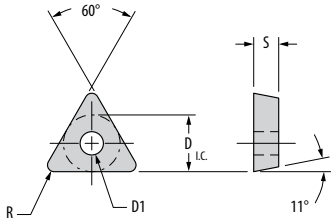
Triangle Inserts

Positive Flat Top (TP-TPGA)



Shape: Triangle	Part Number ISO	Steel P				Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S					Part Number ANSI	Dimensions (mm)			
		GA5025	GA5035	GA5125	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-20M		$D_{I.C.}$	S	D1	R
	TP-41	●	◆	▲		●	▲		◆		◆	●	◆		▲		TP-41	6,35	2,36	3,48	0,38
	TP-42	●	◆	▲		●	▲		◆		◆	●	◆		▲		TP-42	6,35	2,36	3,48	0,79
	TP-62	●	◆	▲		●	▲		◆		◆	●	◆		▲		TP-62	9,53	3,18	4,14	0,79
	TP-64	●	◆	▲		●	▲		◆		◆	●	◆		▲		TP-64	9,53	3,18	4,14	1,57
	TP-82	●	◆	▲		●	▲		◆		◆	●	◆		▲		TP-82	12,70	4,75	5,16	0,79
	TPGA-160304	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGA-321	9,53	3,18	3,8	0,38
	TPGA-160308	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGA-322	9,53	3,18	3,8	0,79
	TPGA-160312	●	◆	▲		●	▲		◆		◆	●	◆		▲		TPGA-323	9,53	3,18	3,8	1,19

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

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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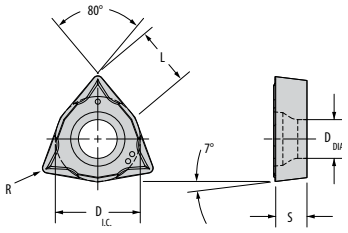
80° Trigon Inserts

Chip Control: Screw On (WCMT)



Shape: 80° Trigon	Part Number ISO	Steel P				Stainless Steel M					Cast Iron K	Heat-Resistant Super Alloys S					Part Number ANSI	Dimensions (mm)				
		GA5025	GA5035	GA5125	G-9120	GA5026	G-925	G-920	G-9230	G-915	GA5023	GA5026	G-925	G-920	G-9230	G-20M		$D_{I.C.}$	L	S	D	R
	WCMT-060202-X3	●	◆	▲		●	▲		◆		◆	●	◆		▲		WCMT-21.5.5-X3	6,35	4,34	2,36	2,79	0,20
	WCMT-060204-X3	●	◆	▲		●	▲		◆		◆	●	◆		▲		WCMT-21.51-X3	6,35	4,34	2,36	2,79	0,38
	WCMT-09T304-X3	●	◆	▲		●	▲		◆		◆	●	◆		▲		WCMT-32.51-X3	9,53	6,50	3,96	4,39	0,38
	WCMT-09T308-X3	●	◆	▲		●	▲		◆		◆	●	◆		▲		WCMT-32.52-X3	9,53	6,50	3,96	4,39	0,79

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

First Choice ◆ Second Choice ● Alternative ▲

Grade descriptions — pages T 4

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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

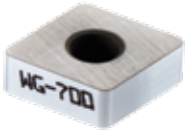
Greenleaf is the industry leader in the development and manufacturing of ceramic and coated ceramic inserts in ANSI standard and special geometries. Some of the most prominent include:

WG-300®

WG-300® is a whisker-reinforced Al_2O_3 ceramic that is very effective at machining nickel and cobalt-based super-alloys and hard steels at metal removal rates up to 10 times higher than carbide. It has excellent thermal and shock resistance at very high surface speeds. WG-300® is the first choice worldwide for milling, grooving, and turning difficult-to-cut, non-ferrous materials.

WG-600®

WG-600® is 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. It has extended tool life over uncoated whisker-reinforced ceramics. Application areas for WG-600® include rough and finish turning and high-performance milling of high-strength alloys, hardened steels, and select stainless steels.



WG-700™

WG-700™ is a whisker-reinforced Al_2O_3 ceramic substrate featuring improved toughness and a unique friction-reducing coating. WG-700™ is ideal for machining nickel- and cobalt-based super alloys and other difficult-to-machine materials. WG-700™ exhibits exceptional tool life with metal-removal rates up to ten times greater than carbide.

XSYTIN®-1

XSYTIN®-1 is a phase-toughened ceramic grade capable of extreme feed rates. XSYTIN®-1 excels at machining rough forgings and castings of high-strength alloy materials. XSYTIN®-1 is ideal for use in interrupted cuts, scale, and milling.

GSN100™

GSN100™ is an engineered blend of 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™

GEM-8™ is an Al_2O_3 + TiC composite ceramic with a high degree of predictability in roll turning and hard alloy (up to 65 HRc) machining.

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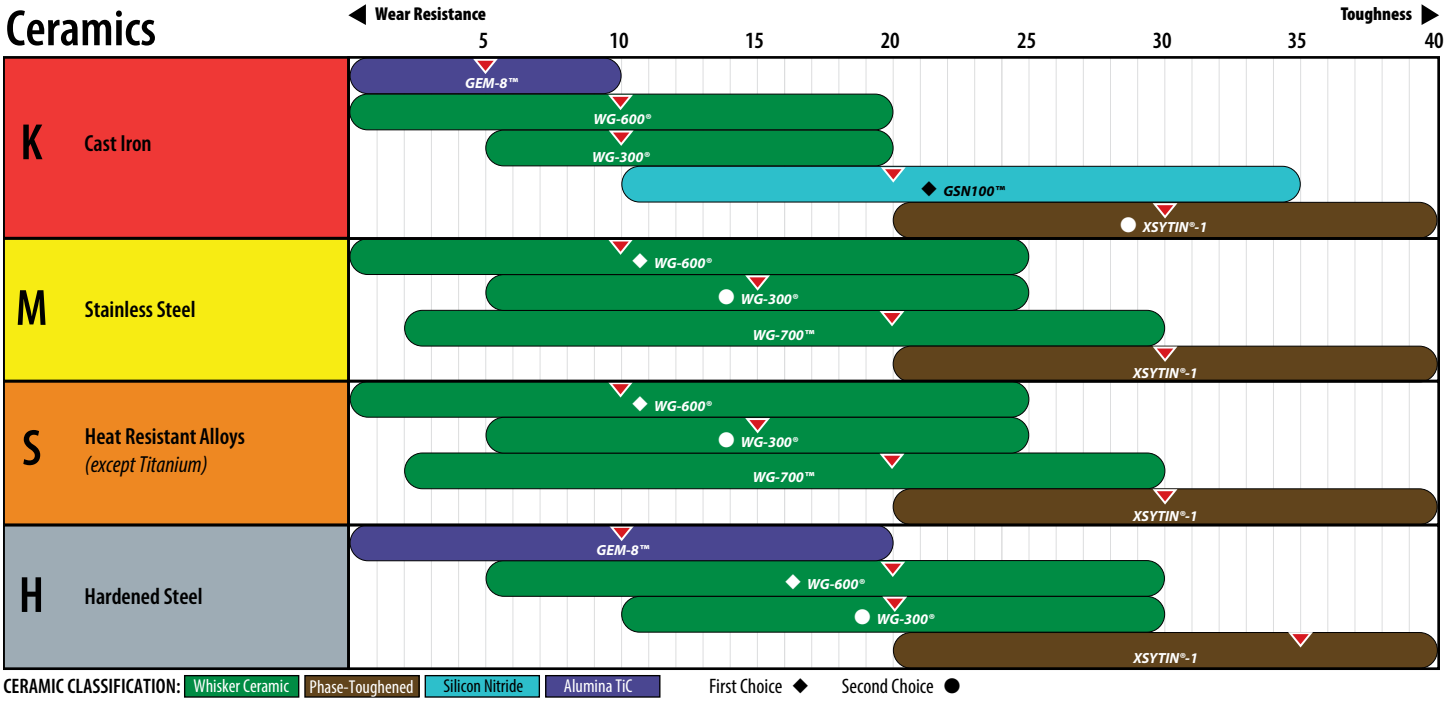
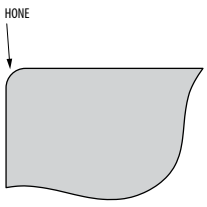
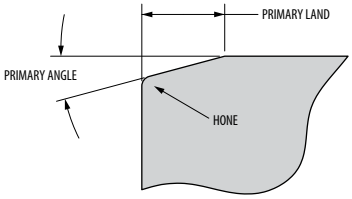
Insert Grade Reference for Turning



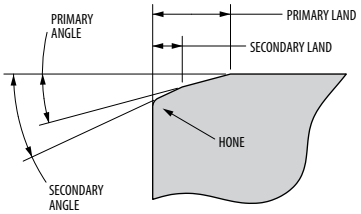
Edge Preparations



HONE



PRIMARY ANGLE



SECONDARY ANGLE

Edge Prep	Hone	Primary Land	Primary Angle	Application
A	0,015 R	–	–	For light finishing and grooving, also added to designated negative lands (i.e. T1, T2, T9).
T1	–	0,07	20°	General purpose for turning and light milling in clean high-temp. alloys and materials <50HRc.
T1A	0,015 R	0,07	20°	Used where more protection is needed than T1 such as in scale and light interruptions, hard turning.
T2	–	0,17	20°	General purpose chamfer for light to medium feed rates, cast-iron machining.
T2	0,015 R	0,17	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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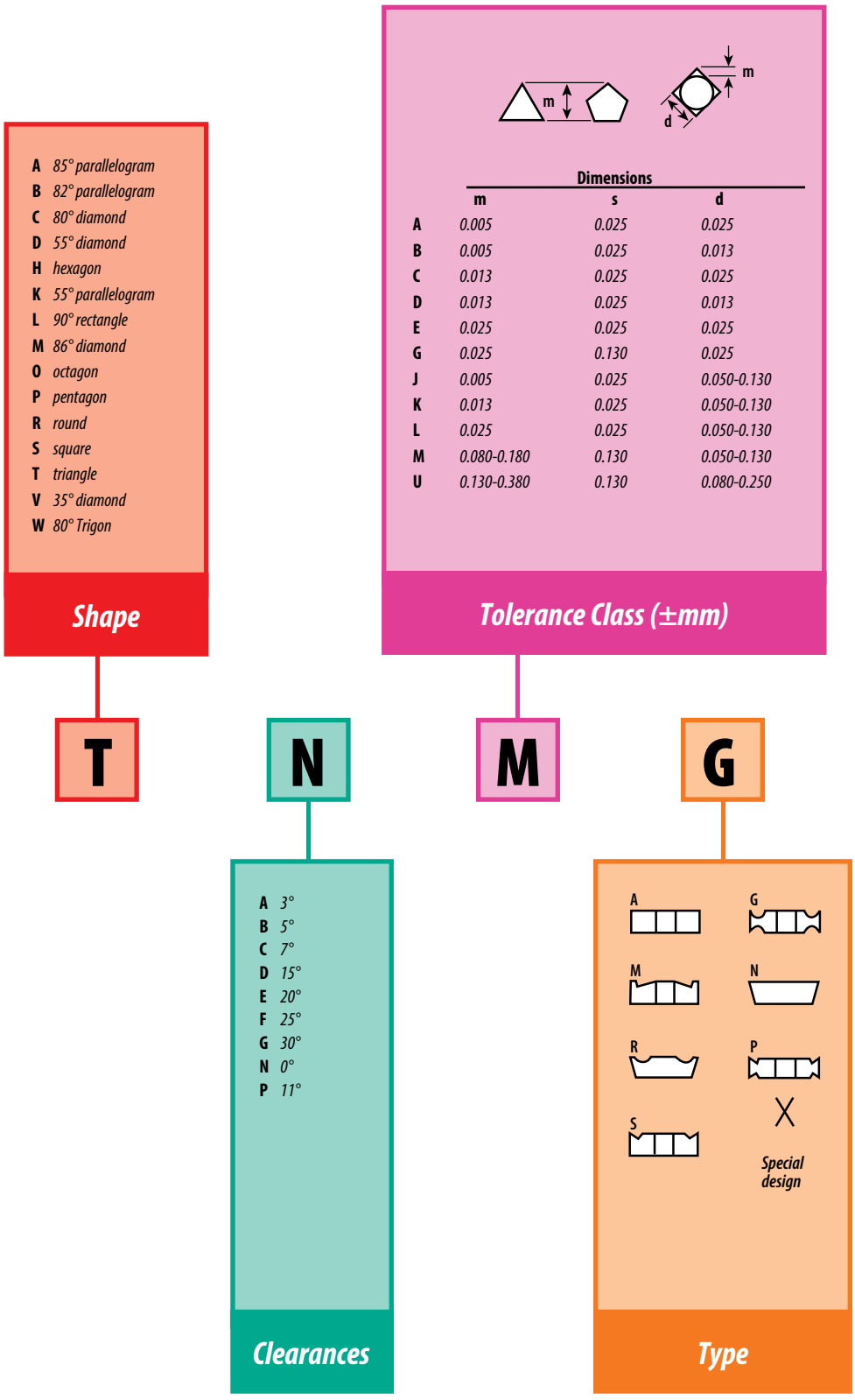
I.S.O. Identification for Turning and Boring Inserts



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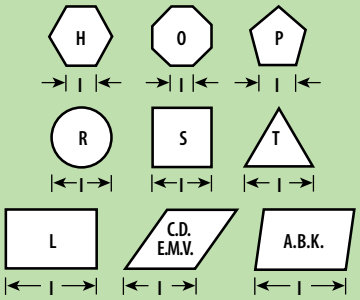
Comparison cutting edge length in mm – IC in inches

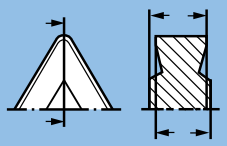
△	06	09	11	16	22	27	33	44
□ ○				09	12	15	19	25
55°					15	19		
80°					12	16	19	25
35°				16	22			
IC = d	5/32"	7/32"	1/4"	3/8"	1/2"	5/8"	3/4"	1"



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

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 ⅛ths 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
¼" I.C.	2
5/16" I.C.	2.5
⅜" I.C.	3
½" I.C.	4
⅝" I.C.	5
¾" I.C.	6
⅞" I.C.	7
1" I.C.	8
1-¼" I.C.	10

Rectangles and parallelograms

Use two digits to size

1st digit: Number of ⅛ths of an inch in width

2nd digit: Number of ¼ths 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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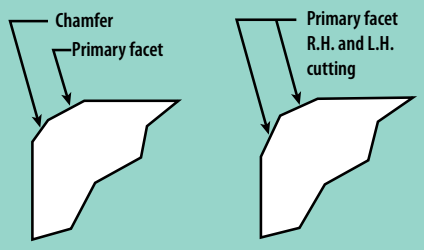
Regular polygons, diamonds, rectangles and parallelograms:
Number of 1/16ths of an inch in thickness as per table below:

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

Thickness

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



Special Cutting Point Definition (5)

R *Right*
L *Left*

Hand (5)

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

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°*

Cutting Point Configuration

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)*

Other Conditions (5)

(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.

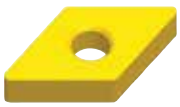
(6) Dimensions are established prior to supplemental edge or coating modification.

Pictorial Index

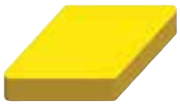
Negative Inserts

80° Diamond
page: T49

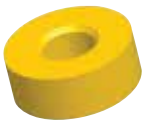
80° Diamond
page: T49



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

RCGX
Positive: Ceramic
page: GP 14

RPGX
Positive: Ceramic
page: GP 15

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

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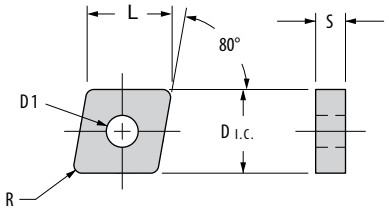
80° Diamond Inserts

Negative (CNGA)



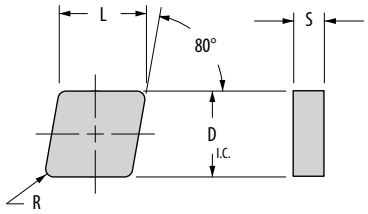
Shape: 80° Diamond	Part Number ISO	S Steel M	Cast Iron K			Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ANSI	Dimensions (mm)				
		WG-600®	WG-600®	GSN100™	XSYTIN®-1	WG-300®	WG-600®	WG-700™	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1	GEM-8™		$D_{I.C.}$	L	S	D1	R
	CNGA-120404	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-431	12,70	12,90	4,75	5,16	0,38
	CNGA-120408	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-432	12,70	12,90	4,75	5,16	0,79
	CNGA-120412	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-433	12,70	12,90	4,75	5,16	1,19
	CNGA-120416	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-434	12,70	12,90	4,75	5,16	1,57
	CNGA-120712	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-453	12,70	12,90	7,92	5,16	1,19
	CNGA-120716	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-454	12,70	12,90	7,92	5,16	1,57
	CNGA-160608	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-542	15,88	16,13	6,35	6,35	0,79
	CNGA-160612	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-543	15,88	16,13	6,35	6,35	1,19
	CNGA-160616	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-544	15,88	16,13	6,35	6,35	1,57
	CNGA-190612	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-643	19,05	19,35	6,35	7,92	1,19
	CNGA-190616	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-644	19,05	19,35	6,35	7,92	1,57
	CNGA-190708	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-652	19,05	19,35	7,92	7,92	0,79
	CNGA-190712	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-653	19,05	19,35	7,92	7,92	1,19
	CNGA-190716	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGA-654	19,05	19,35	7,92	7,92	1,57

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)



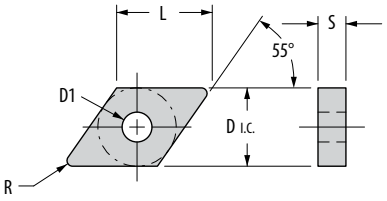
Shape: 80° Diamond	Part Number ISO	S Steel M	Cast Iron K			Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ANSI	Dimensions (mm)			
		WG-600®	WG-600®	GSN100™	XSYTIN®-1	WG-300®	WG-600®	WG-700™	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1	GEM-8™		$D_{I.C.}$	L	S	R
	CNGN-120404	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-431	12,70	12,90	4,75	0,38
	CNGN-120408	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-432	12,70	12,90	4,75	0,79
	CNGN-120412	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-433	12,70	12,90	4,75	1,19
	CNGN-120416	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-434	12,70	12,90	4,75	1,57
	CNGN-120704	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-451	12,70	12,90	7,92	0,38
	CNGN-120708	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-452	12,70	12,90	7,92	0,79
	CNGN-120712	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-453	12,70	12,90	7,92	1,19
	CNGN-120716	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-454	12,70	12,90	7,92	1,57
	CNGN-160608	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-542	15,88	16,13	6,35	0,79
	CNGN-160612	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-543	15,88	16,13	6,35	1,19
	CNGN-190608	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-642	19,05	19,35	6,35	0,79
	CNGN-190612	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-643	19,05	19,35	6,35	1,19
	CNGN-190616	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-644	19,05	19,35	6,35	1,57
	CNGN-190732	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CNGN-658	19,05	19,35	7,92	3,18

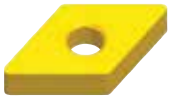
CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC — First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖ — *Grade descriptions — pages T 42*

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 (DNGA)



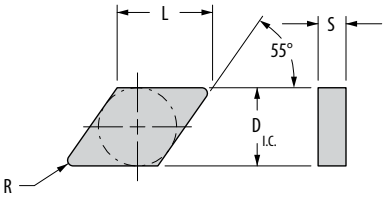
Shape: 55° Diamond	Part Number ISO	S Steel M	Cast Iron K			Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ANSI	Dimensions (mm)				
		WG-600®	WG-600®	GSN100™	XSYTIN®-1	WG-300®	WG-600®	WG-700™	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1	GEM-8™		D I.C.	L	S	D1	R
	DNGA-110308	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGA-322	9,53	11,63	3,18	3,81	0,79
	DNGA-110312	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGA-323	9,53	11,63	3,18	3,81	1,19
	DNGA-110316	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGA-324	9,53	11,63	3,18	3,81	1,57
	DNGA-110408	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGA-332	9,53	11,63	4,75	3,81	0,79
	DNGA-150404	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGA-431	12,70	15,49	4,75	5,16	0,38
	DNGA-150408	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGA-432	12,70	15,49	4,75	5,16	0,79
	DNGA-150412	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGA-433	12,70	15,49	4,75	5,16	1,19
	DNGA-150416	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGA-434	12,70	15,49	4,75	5,16	1,57
	DNGA-150612	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGA-443	12,70	15,49	6,35	5,16	1,19
	DNGA-190612	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGA-543	15,88	19,38	6,35	6,35	1,19

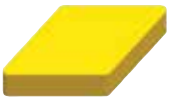
CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC — First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖ *Grade descriptions — pages T 42*

For additional nose radii and available edge preps, please contact Greenleaf Technical Service.
See pages ATI 22-23 for other Greenleaf edge preps or call Greenleaf Technical Service for application concerns.

55° Diamond Inserts

Negative (DNGN)



Shape: 55° Diamond	Part Number ISO	S Steel M	Cast Iron K			Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ANSI	Dimensions (mm)			
		WG-600®	WG-600®	GSN100™	XSYTIN®-1	WG-300®	WG-600®	WG-700™	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1	GEM-8™		D I.C.	L	S	R
	DNGN-110308	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGN-322	9,53	11,63	3,18	0,79
	DNGN-110312	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGN-323	9,53	11,63	3,18	1,19
	DNGN-110316	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGN-324	9,53	11,63	3,18	1,57
	DNGN-150408	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGN-432	12,70	15,49	4,75	0,79
	DNGN-150412	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGN-433	12,70	15,49	4,75	1,19
	DNGN-150416	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	DNGN-434	12,70	15,49	4,75	1,57

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 other Greenleaf edge preps or call Greenleaf Technical Service for application concerns.

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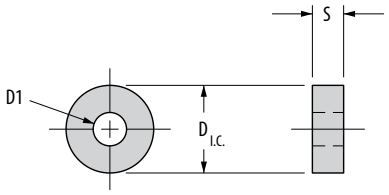
Round Inserts

Negative (RNGA)



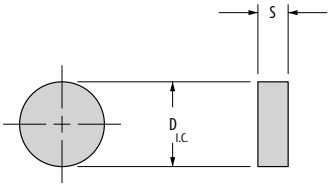
Shape: Round	Part Number ISO	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ANSI	Dimensions (mm)		
		M	K			S				H							
		WG-600®	WG-600®	GSN100™	XSYTIN®-1	WG-300®	WG-600®	WG-700™	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1	GEM-8™		D I.C.	S	D1
	RNGA-090300	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGA-32	9,53	3,18	3,81
	RNGA-090400	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGA-33	9,53	4,75	3,81
	RNGA-120400	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGA-43	12,70	4,75	5,16
	RNGA-120700	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGA-45	12,70	7,92	5,16
	RNGA-150700	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGA-55	15,88	7,92	6,35
	RNGA-190700	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGA-65	19,05	7,92	7,92
	RNGA-250700	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGA-85	25,40	7,92	9,12

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 other Greenleaf edge preps or call Greenleaf Technical Service for application concerns.

Round Inserts

Negative (RNGN)



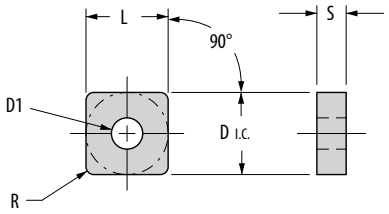
Shape: Round	Part Number ISO	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ANSI	Dimensions (mm)	
		M	K			S				H						
		WG-600®	WG-600®	GSN100™	XSYTIN®-1	WG-300®	WG-600®	WG-700™	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1	GEM-8™		D I.C.	S
	RNGN-090300	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-32	9,53	3,18
	RNGN-090400	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-33	9,53	4,75
	RNGN-120300	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-42	12,70	3,18
	RNGN-120400	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-43	12,70	4,75
	RNGN-120700	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-45	12,70	7,92
	RNGN-150700	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-55	15,88	7,92
	RNGN-190600	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-64	19,05	6,35
	RNGN-190700	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-65	19,05	7,92
	RNGN-250600	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-84	25,40	6,35
	RNGN-250700	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-85	25,40	7,92
	RNGN-250900	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-86	25,40	9,53
	RNGN-310900	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RNGN-106	31,75	9,53

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 other Greenleaf edge preps or call Greenleaf Technical Service for application concerns.

Square Inserts

Negative (SNGA)



Shape: Square	Part Number ISO	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ANSI	Dimensions (mm)				
		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™		$D_{I.C.}$	L	S	D1	R
	SNGA-120408	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-432	12,70	12,70	4,75	5,16	0,79
	SNGA-120412	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-433	12,70	12,70	4,75	5,16	1,19
	SNGA-120416	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-434	12,70	12,70	4,75	5,16	1,57
	SNGA-120708	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-452	12,70	12,70	7,92	5,16	0,79
	SNGA-120712	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-453	12,70	12,70	7,92	5,16	1,19
	SNGA-120716	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-454	12,70	12,70	7,92	5,16	1,57
	SNGA-150608	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-542	15,88	15,88	6,35	6,35	0,79
	SNGA-150612	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-543	15,88	15,88	6,35	6,35	1,19
	SNGA-150616	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-544	15,88	15,88	6,35	6,35	1,57
	SNGA-190608	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-642	19,05	19,05	6,35	7,92	0,79
	SNGA-190612	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-643	19,05	19,05	6,35	7,92	1,19
	SNGA-190616	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGA-644	19,05	19,05	6,35	7,92	1,57

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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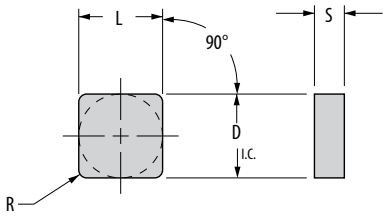
Square Inserts

Negative (SNGN)



Shape: Square	Part Number ISO	S Steel M	Cast Iron K			Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ANSI	Dimensions (mm)			
		WG-600®	WG-600®	GSN100™	XSYTIN®-1	WG-300®	WG-600®	WG-700™	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1	GEM-8™		$D_{I.C.}$	L	S	R
	SNGN-090308	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-322	9,53	9,53	3,18	0,79
	SNGN-090412	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-333	9,53	9,53	4,75	1,19
	SNGN-120408	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-432	12,70	12,70	4,75	0,79
	SNGN-120412	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-433	12,70	12,70	4,75	1,19
	SNGN-120416	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-434	12,70	12,70	4,75	1,57
	SNGN-120708	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-452	12,70	12,70	7,92	0,79
	SNGN-120712	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-453	12,70	12,70	7,92	1,19
	SNGN-120716	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-454	12,70	12,70	7,92	1,57
	SNGN-150608	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-542	15,88	15,88	6,35	0,79
	SNGN-150612	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-543	15,88	15,88	6,35	1,19
	SNGN-150616	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-544	15,88	15,88	6,35	1,57
	SNGN-190663	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-6416	19,05	19,05	6,35	6,35
	SNGN-190608	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-642	19,05	19,05	6,35	0,79
	SNGN-190612	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-643	19,05	19,05	6,35	1,19
	SNGN-190616	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-644	19,05	19,05	6,35	1,57
	SNGN-190708	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-652	19,05	19,05	7,92	0,79
	SNGN-190712	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-653	19,05	19,05	7,92	1,19
	SNGN-190716	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-654	19,05	19,05	7,92	1,57
	SNGN-190720	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-655	19,05	19,05	7,92	1,98
	SNGN-190723	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-656	19,05	19,05	7,92	2,39
	SNGN-250924	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SNGN-866	25,40	25,40	9,53	2,39

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

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

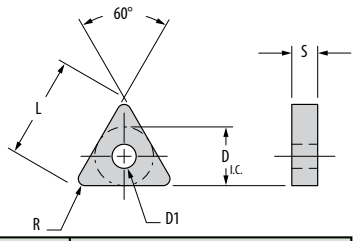
Grade descriptions — pages T 42

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

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

Triangle Inserts

Negative (TNGA)



Shape: Triangle	Part Number ISO	S Steel M	Cast Iron K			Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ANSI	Dimensions (mm)				
		WG-600®	WG-600®	GSN100™	XSYTIN®-1	WG-300®	WG-600®	WG-700™	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1	GEM-8™		$D_{I.C.}$	L	S	D1	R
	TNGA-160404	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGA-331	9,53	16,51	4,75	3,81	0,38
	TNGA-160408	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGA-332	9,53	16,51	4,75	3,81	0,38
	TNGA-160412	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGA-333	9,53	16,51	4,75	3,81	1,19
	TNGA-160416	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGA-334	9,53	16,51	4,75	3,81	1,57
	TNGA-220408	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGA-432	12,70	22,00	4,75	5,16	0,38
	TNGA-220412	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGA-433	12,70	22,00	4,75	5,16	1,19
	TNGA-220416	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGA-434	12,70	22,00	4,75	5,16	1,57
	TNGA-220716	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGA-454	12,70	22,00	7,92	5,16	1,57

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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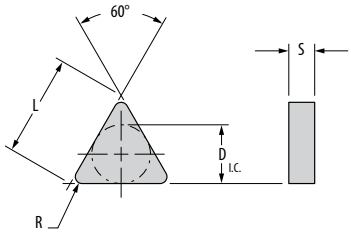
Triangle Inserts

Negative (TNGN)



Shape: Triangle	Part Number ISO	S Steel M	Cast Iron K			Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ANSI	Dimensions (mm)			
		WG-600®	WG-600®	GSN100™	XSYTIN®-1	WG-300®	WG-600®	WG-700™	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1	GEM-8™		$D_{I.C.}$	L	S	R
	TNGN-110308	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-222	6,35	11,00	3,18	0,79
	TNGN-160304	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-321	9,53	16,51	3,18	0,38
	TNGN-160308	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-322	9,53	16,51	3,18	0,79
	TNGN-160404	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-331	9,53	16,51	4,75	0,38
	TNGN-160408	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-332	9,53	16,51	4,75	0,79
	TNGN-160412	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-333	9,53	16,51	4,75	1,19
	TNGN-160416	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-334	9,53	16,51	4,75	1,57
	TNGN-220404	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-431	12,70	22,00	4,75	0,38
	TNGN-220408	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-432	12,70	22,00	4,75	0,79
	TNGN-220412	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-433	12,70	22,00	4,75	1,19
	TNGN-220416	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-434	12,70	22,00	4,75	1,57
	TNGN-220432	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-438	12,70	22,00	4,75	3,18
	TNGN-220708	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-452	12,70	22,00	7,92	0,79
	TNGN-220712	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-453	12,70	22,00	7,92	1,19
	TNGN-220716	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-454	12,70	22,00	7,92	1,57
	TNGN-270612	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-543	15,88	27,51	6,35	1,19
	TNGN-270616	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-544	15,88	27,51	6,35	1,57
	TNGN-270632	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-548	15,88	27,51	6,35	3,18
	TNGN-330924	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-666	19,05	32,99	9,53	2,39
	TNGN-440932	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TNGN-868	25,40	43,99	9,53	3,18

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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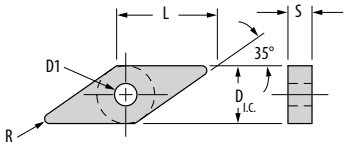
35° Diamond Inserts

Negative (VNGA)



Shape: 35° Diamond	Part Number ISO	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ANSI	Dimensions (mm)				
		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™		$D_{I.C.}$	L	S	D1	R
	VNGA-160408	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	VNGA-332	9,53	16,61	4,75	3,81	0,79
	VNGA-160412	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	VNGA-333	9,53	16,61	4,75	3,81	1,19
	VNGA-220408	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	VNGA-432	12,70	22,15	4,75	5,16	0,79
	VNGA-220424	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	VNGA-436	12,70	22,15	4,75	5,16	2,39

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 other Greenleaf edge preps or call Greenleaf Technical Service for application concerns.

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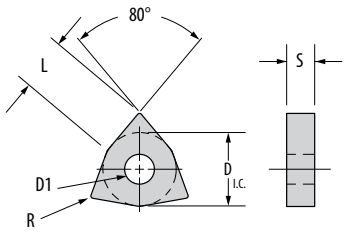
Trigon Inserts

Negative (WNGA)



Shape: Trigon	Part Number ISO	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ANSI	Dimensions (mm)				
		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™		$D_{I.C.}$	L	S	D1	R
	WNGA-060404	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	WNGA-331	9,53	6,53	4,75	3,86	0,38
	WNGA-060408	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	WNGA-332	9,53	6,53	4,75	3,86	0,79
	WNGA-060412	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	WNGA-333	9,53	6,53	4,75	3,86	1,19
	WNGA-080404	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	WNGA-431	12,70	8,69	4,75	5,16	0,38
	WNGA-080408	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	WNGA-432	12,70	8,69	4,75	5,16	0,79
	WNGA-080412	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	WNGA-433	12,70	8,69	4,75	5,16	1,19

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 other Greenleaf edge preps or call Greenleaf Technical Service for application concerns.

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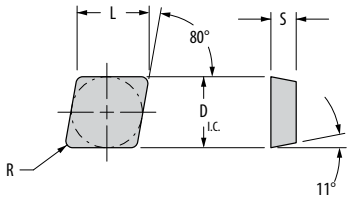
80° Diamond Inserts

Positive (CPGN)



Shape: 80° Diamond	Part Number ISO	S Steel M	Cast Iron K			Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ANSI	Dimensions (mm)			
		WG-600®	WG-600®	GSN100™	XSYTIN®-1	WG-300®	WG-600®	WG-700™	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1	GEM-8™		$D_{I.C.}$	L	S	R
	CPGN-090304	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CPGN-321	9,53	9,65	3,18	0,38
	CPGN-090308	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CPGN-322	9,53	9,65	3,18	0,79
	CPGN-090312	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CPGN-323	9,53	9,65	3,18	1,19
	CPGN-120308	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CPGN-422	12,70	12,90	3,18	0,79
	CPGN-120316	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CPGN-424	12,70	12,90	3,18	1,57
	CPGN-120408	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CPGN-432	12,70	12,90	4,75	0,79
	CPGN-120412	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CPGN-433	12,70	12,90	4,75	1,19
	CPGN-120416	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	CPGN-434	12,70	12,90	4,75	1,57

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 other Greenleaf edge preps or call Greenleaf Technical Service for application concerns.

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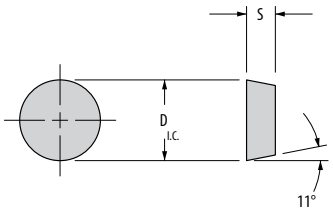
Round Inserts

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™		$D_{I.C.}$	S
	RPGN-090300	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RPGN-32	9,53	3,18
	RPGN-120400	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	RPGN-43	12,70	4,75

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 other Greenleaf edge preps or call Greenleaf Technical Service for application concerns.

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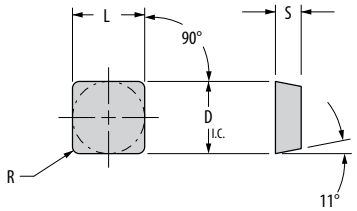
Square Inserts

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™		$D_{I.C.}$	L	S	R
	SPGN-090308	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SPGN-322	0.375	0.375	0.125	0.031
	SPGN-120308	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SPGN-422	0.500	0.500	0.125	0.031
	SPGN-120312	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SPGN-423	0.500	0.500	0.125	0.047
	SPGN-120408	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SPGN-432	0.500	0.500	0.187	0.031
	SPGN-120412	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SPGN-433	0.500	0.500	0.187	0.047
	SPGN-120416	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SPGN-434	0.500	0.500	0.187	0.062
	SPGN-190408	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SPGN-632	0.750	0.750	0.187	0.031
	SPGN-190412	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SPGN-633	0.750	0.750	0.187	0.047
	SPGN-190416	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SPGN-634	0.750	0.750	0.187	0.062
	SPGN-190608	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	SPGN-642	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 ❖

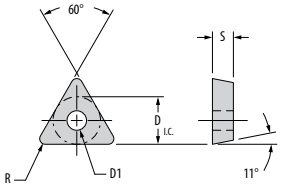
Grade descriptions — pages T 42

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

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

Triangle Inserts

Positive Flat Top (TP)



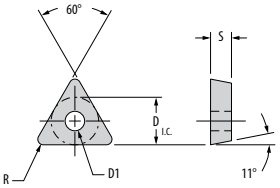
Shape: Triangle	Part Number ISO	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ANSI	Dimensions (mm)				
		M	K			S				H									
		WG-600®	WG-600®	GSN100™	XSYTIN®-1	WG-300®	WG-600®	WG-700™	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1	GEM-8™		$D_{I.C.}$	L	S	D1	R
	TP-41	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TP-41	6,35	11,00	2,36	3,48	0,38
	TP-42	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TP-42	6,35	11,00	2,36	3,48	0,79
	TP-62	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TP-62	9,53	16,51	3,18	4,14	0,79
	TP-64	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TP-64	9,53	16,51	3,18	4,14	1,57
	TP-82	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TP-82	12,70	22,00	4,75	5,16	0,79

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 other Greenleaf edge preps or call Greenleaf Technical Service for application concerns.

Triangle Inserts

Positive Flat Top (TPGA)



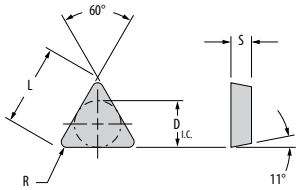
Shape: Triangle	Part Number ISO	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ANSI	Dimensions (mm)				
		M	K			S				H									
		WG-600®	WG-600®	GSN100™	XSYTIN®-1	WG-300®	WG-600®	WG-700™	XSYTIN®-1	WG-300®	WG-600®	XSYTIN®-1	GEM-8™		$D_{I.C.}$	L	S	D1	R
	TPGA-160304	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGA-321	9,53	16,51	3,18	3,81	0,38
	TPGA-160308	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGA-322	9,53	16,51	3,18	3,81	0.79

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 other Greenleaf edge preps or call Greenleaf Technical Service for application concerns.

Triangle Inserts

Positive Flat Top (TPGN)



Shape: Triangle	Part Number ISO	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ANSI	Dimensions (mm)			
		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™		$D_{I.C.}$	L	S	R
	TPGN-110304	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGN-221	6,35	11,00	3,18	0,38
	TPGN-110308	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGN-222	6,35	11,00	3,18	0,79
	TPGN-160304	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGN-321	9,53	16,51	3,18	0,38
	TPGN-160308	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGN-322	9,53	16,51	3,18	0,79
	TPGN-160312	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGN-323	9,53	16,51	3,18	1,19
	TPGN-160316	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGN-324	9,53	16,51	3,18	1,57
	TPGN-220404	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGN-431	12,70	22,00	4,75	0,38
	TPGN-220408	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGN-432	12,70	22,00	4,75	0,79
	TPGN-220412	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGN-433	12,70	22,00	4,75	1,19
	TPGN-220416	◆	▲	◆	●	●	◆	▲	❖	●	◆	❖	▲	TPGN-434	12,70	22,00	4,75	1,57

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 other Greenleaf edge preps or call Greenleaf Technical Service for application concerns.

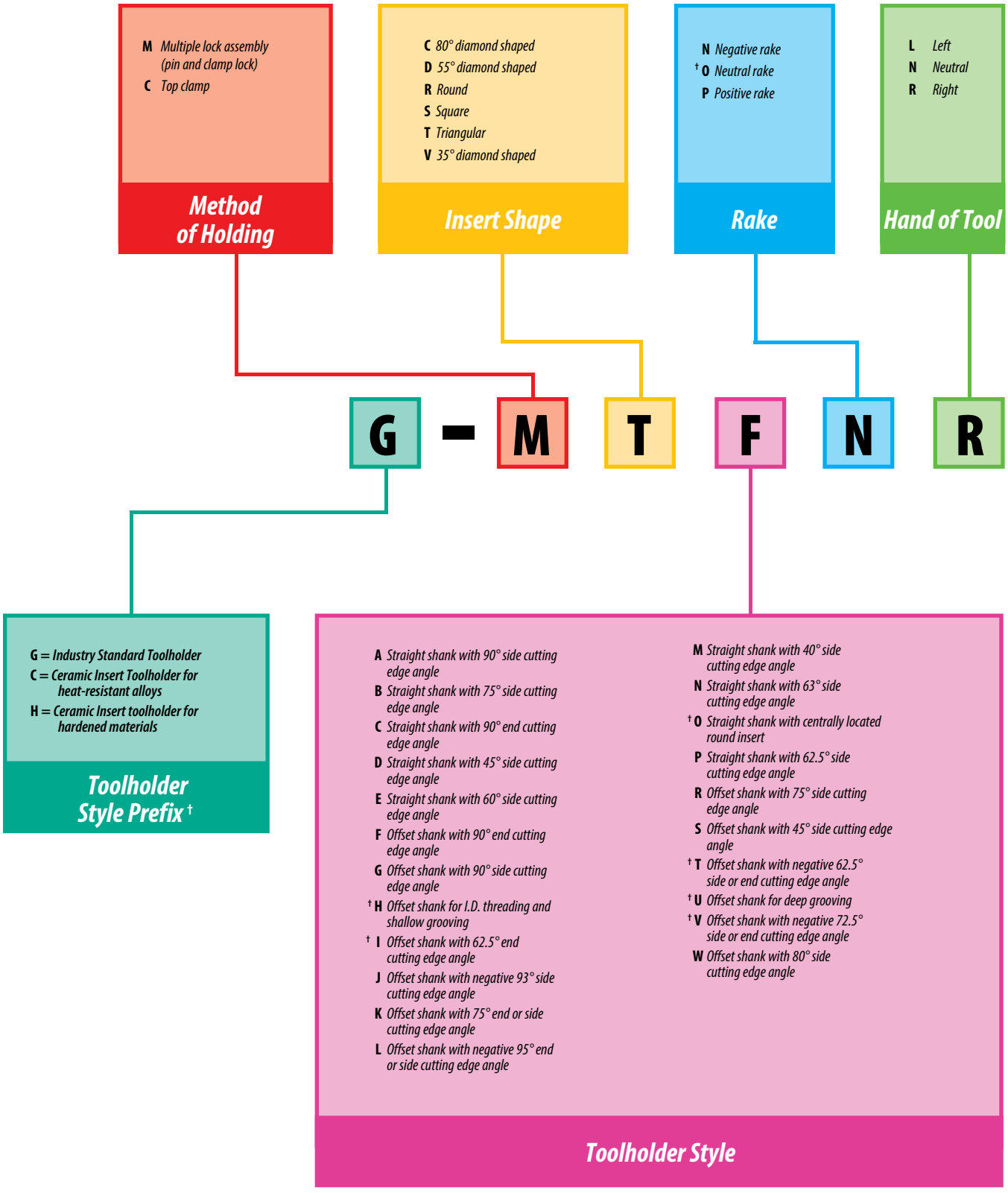
Industry-Standard Toolholders for Carbide Inserts

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



†Greenleaf standard.

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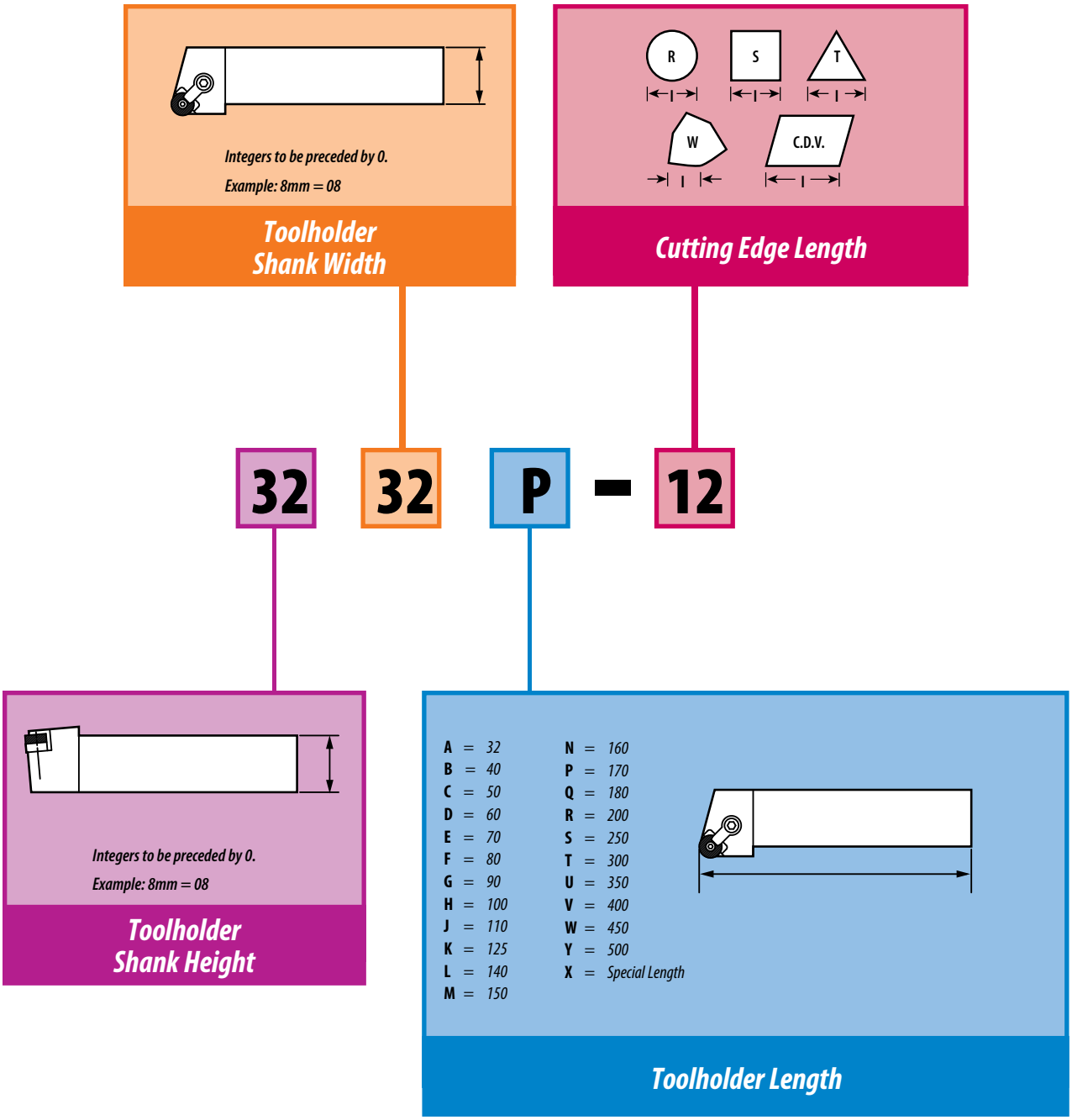
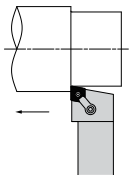


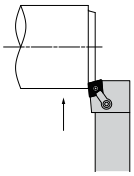
NOTE:
All toolholders are qualified to ±0,07 over gage insert radius on the "C" and "F" dimensions as standard. Some toolholders are qualifiable on the "C" length dimension only.

Pictorial Index

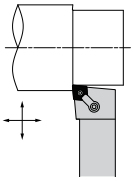
80° Diamond – Negative



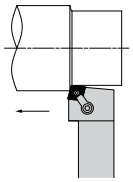
G-MCGNR/L
Style G
80° Diamond
Negative Rake
90° Lead
page: T66



G-MCKNR/L
Style K
80° Diamond
(Using 100° Corner)
Negative Rake
75° Lead
page: T66

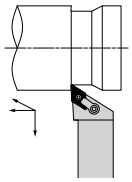


G-MCLNR/L
Style L
80° Diamond
Negative Rake
95° Lead
page: T67

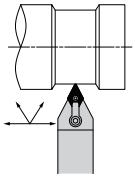


G-MCRNR/L
Style R
80° Diamond
(Using 100° Corner)
Negative Rake
75° Lead
page: T67

55° Diamond – Negative

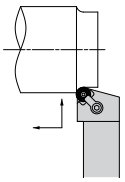


G-MDJNR/L
Style J
55° Diamond
Negative Rake
93° Lead
page: T68



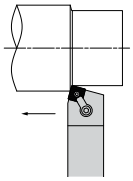
G-MDPNN
Style P
55° Diamond
Negative Rake
62,5° Lead
page: T68

Round – Negative

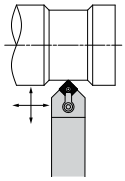


G-MRGNR/L
Style G
Round
Negative Rake
page: T69

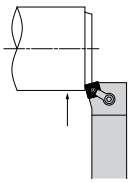
Square – Negative



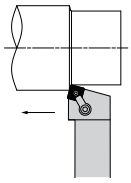
G-MSBNR/L
Style B
Square
Negative Rake
75° Lead
page: T70



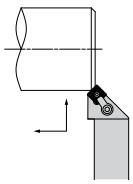
G-MSDNN
Style D
Square
Negative Rake
45° Lead
page: T71



G-MSKNR/L
Style K
Square
Negative Rake
75° Lead
page: T71

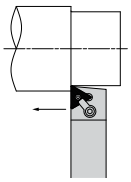


G-MSRNR/L
Style R
Square
Negative Rake
75° Lead
page: T72

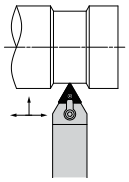


G-MSSNR/L
Style S
Square
Negative Rake
45° Lead
page: T72

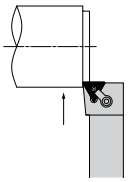
Triangle – Negative



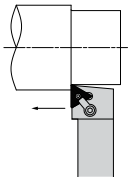
G-MTANR/L
Style A
Triangle
Negative Rake
90° Lead
page: T73



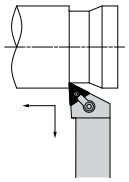
G-MTENNS
Style E
Triangle
Negative Rake
60° Lead
page: T73



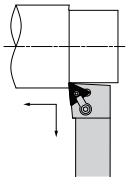
G-MTFNR/L
Style F
Triangle
Negative Rake
90° Lead
page: T74



G-MTGNR/L
Style G
Triangle
Negative Rake
90° Lead
page: T75



G-MTJNRS
Style J
Triangle
Negative Rake
93° Lead
page: T75



G-MTLNR/L
Style L
Triangle
Negative Rake
95° Lead
page: T76

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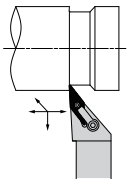
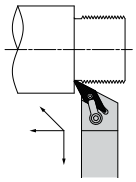
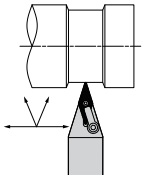
35° Diamond – Negative



G-MVJNR/L
Style J
35° Diamond
Negative Rake
93° Lead
page: T 77

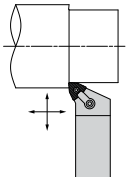


G-MVTNR/L
Style T
35° Diamond
Negative Rake
117,5° Lead
page: T 77



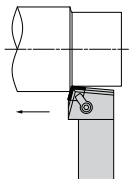
G-MVVNN
Style V
35° Diamond
Negative Rake
72,5° Lead
page: T 78

Trigon – Negative



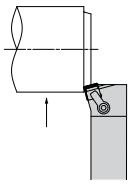
G-MWLNR/L
Style L
Trigon
Negative Rake
95° Reverse Lead
page: T 78

80° Diamond – Positive



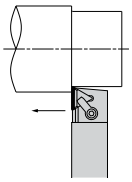
G-CCRPR/L
Style R
80° Diamond
(Using 100° Corner)
Positive Rake
75° Lead
page: T 79

Square – Positive

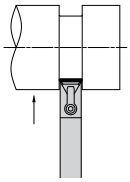


G-CSKPR/L
Style K
Square
Positive Rake
75° Lead
page: T 80

Triangle – Positive

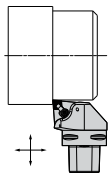


G-CTAPR/L
Style A
Triangle
Positive Rake
90° Lead
page: T 81

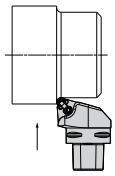


G-CTCPN
Style C
Triangle
Positive Rake
90° Lead
page: T 81

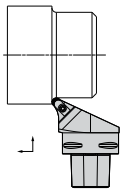
Quick-Change Toolholders



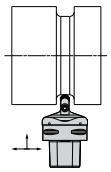
MCLNR/L
80° Diamond
Negative Rake
5° Reverse Lead
C6 & C8 Tool Heads
page: T 84



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



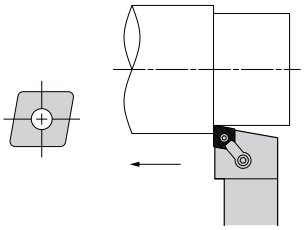
CRGPR/L
45° Grooving/Profiling
Replaceable Nest
page: T 85

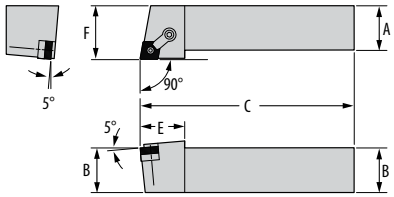


CRDPN
Neutral
Replaceable Nest
page: T 85

G-MCGNR/L

Style G / 80° Diamond / Negative Rake / 90° Lead





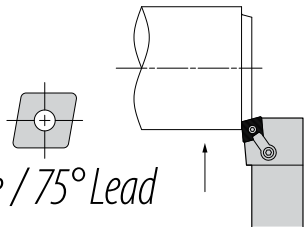
Right-Hand Toolholder Shown

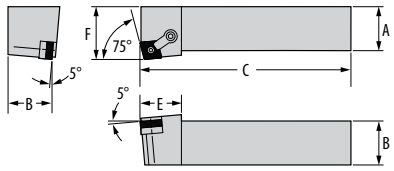
Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Seat
G-MCGNR-2020M12	G-MCGNL-2020M12	CNMG-120408	20	20	150	32	25	CSN-433	NLM-46	CLM-20	STCM-20	TK-02718	S-46M	–
G-MCGNR-2525M12	G-MCGNL-2525M12	CNMG-120408	25	25	150	32	32	CSN-433	NLM-46	CLM-20	STCM-20	TK-02718	S-46M	–
G-MCGNR-3225P12	G-MCGNL-3225P12	CNMG-120408	25	32	170	32	32	CSN-433	NLM-46	CLM-20	STCM-20	TK-02718	S-46M	–
G-MCGNR-3232P12	G-MCGNL-3232P12	CNMG-120408	32	32	170	32	40	CSN-433	NLM-46	CLM-20	STCM-20	TK-02718	S-46M	–
G-MCGNR-2525M16	G-MCGNL-2525M16	CNMG-160612	25	25	150	38	32	CSN-533	NLM-58	CLM-12	STCM-8	TK-02728	S-58M	CSN-543
G-MCGNR-3225P16	G-MCGNL-3225P16	CNMG-160612	25	32	170	38	32	CSN-533	NLM-58	CLM-12	STCM-8	TK-02728	S-58M	CSN-543
G-MCGNR-3232P16	G-MCGNL-3232P16	CNMG-160612	32	32	170	38	40	CSN-533	NLM-58	CLM-12	STCM-8	TK-02728	S-58M	CSN-543
G-MCGNR-4040R16	G-MCGNL-4040R16	CNMG-160612	40	40	200	38	50	CSN-533	NLM-58	CLM-12	STCM-8	TK-02728	S-58M	CSN-543
G-MCGNR-2525M19	G-MCGNL-2525M19	CNMG-190612	25	25	150	41	32	CSN-633	NLM-68	CLM-12	STCM-8	TK-02722	S-68M	CSN-643
G-MCGNR-3225P19	G-MCGNL-3225P19	CNMG-190612	25	32	170	41	32	CSN-633	NLM-68	CLM-12	STCM-8	TK-02722	S-68M	CSN-643
G-MCGNR-3232P19	G-MCGNL-3232P19	CNMG-190612	32	32	170	41	40	CSN-633	NLM-68	CLM-12	STCM-8	TK-02722	S-68M	CSN-643
G-MCGNR-4040R19	G-MCGNL-4040R19	CNMG-190612	40	40	200	41	50	CSN-633	NLM-68	CLM-12	STCM-8	TK-02722	S-68M	CSN-643
G-MCGNR-4040R25	G-MCGNL-4040R25	CNMG-250924	40	40	200	41	50	CSN-846	NLM-810	CLM-24	STCM-19	TK-02723	S-810M	–

** 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 / 75° Lead





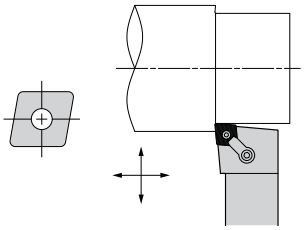
Neutral Toolholder Shown

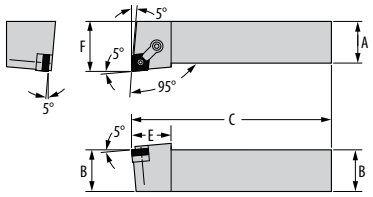
Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Seat
G-MCKNR-2020M12	G-MCKNL-2020M12	CNMG-120408	20	20	150	30	25	CSN-433	NLM-46	CLM-20	STCM-20	TK-02718	S-46M	–
G-MCKNR-2525M12	G-MCKNL-2525M12	CNMG-120408	25	25	150	30	32	CSN-433	NLM-46	CLM-20	STCM-20	TK-02718	S-46M	–
G-MCKNR-3232P12	G-MCKNL-3232P12	CNMG-120408	32	32	170	30	40	CSN-433	NLM-46	CLM-20	STCM-20	TK-02718	S-46M	–
G-MCKNR-4040R12	G-MCKNL-4040R12	CNMG-120408	40	40	200	30	50	CSN-433	NLM-46	CLM-20	STCM-20	TK-02718	S-46M	–
G-MCKNR-2525M16	G-MCKNL-2525M16	CNMG-160612	25	25	150	37	32	CSN-533	NLM-58	CLM-9	STCM-4	TK-02720	S-58M	CSN-543
G-MCKNR-3225P16	G-MCKNL-3225P16	CNMG-160612	25	32	170	37	32	CSN-533	NLM-58	CLM-9	STCM-4	TK-02720	S-58M	CSN-543
G-MCKNR-3232P16	G-MCKNL-3232P16	CNMG-160612	32	32	170	37	40	CSN-533	NLM-58	CLM-9	STCM-4	TK-02720	S-58M	CSN-543
G-MCKNR-2525M19	G-MCKNL-2525M19	CNMG-190612	25	25	150	37	32	CSN-633	NLM-68	CLM-12	STCM-8	TK-02722	S-68M	CSN-643
G-MCKNR-3225P19	G-MCKNL-3225P19	CNMG-190612	25	32	170	37	32	CSN-633	NLM-68	CLM-12	STCM-8	TK-02722	S-68M	CSN-643
G-MCKNR-3232P19	G-MCKNL-3232P19	CNMG-190612	32	32	170	37	40	CSN-633	NLM-68	CLM-12	STCM-8	TK-02722	S-68M	CSN-643
G-MCKNR-4040R19	G-MCKNL-4040R19	CNMG-190612	40	40	200	37	50	CSN-633	NLM-68	CLM-12	STCM-8	TK-02722	S-68M	CSN-643
G-MCKNR-4040R25	G-MCKNL-4040R25	CNMG-250924	40	40	200	50	50	CSN-846	NLM-810	CLM-24	STCM-19	TK-02723	S-810M	–

** 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 / 95° Lead





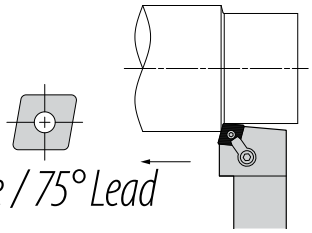
Right-Hand Toolholder Shown

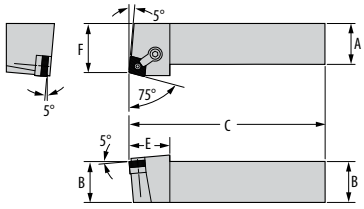
Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Seat
G-MCLNR-2020M12	G-MCLNL-2020M12	CNMG-120408	20	20	150	30	25	CSN-433	NLM-46	CLM-20	STCM-20	TK-02718	S-46M	–
G-MCLNR-2525M12	G-MCLNL-2525M12	CNMG-120408	25	25	150	30	32	CSN-433	NLM-46	CLM-20	STCM-20	TK-02718	S-46M	–
G-MCLNR-3225P12	G-MCLNL-3225P12	CNMG-120408	25	32	170	30	32	CSN-433	NLM-46	CLM-20	STCM-20	TK-02718	S-46M	–
G-MCLNR-3232P12	G-MCLNL-3232P12	CNMG-120408	32	32	170	30	40	CSN-433	NLM-46	CLM-20	STCM-20	TK-02718	S-46M	–
G-MCLNR-4040R12	G-MCLNL-4040R12	CNMG-120408	40	40	200	30	50	CSN-433	NLM-46	CLM-20	STCM-20	TK-02718	S-46M	–
G-MCLNR-2525M16	G-MCLNL-2525M16	CNMG-160612	25	25	150	35	32	CSN-533	NLM-58	CLM-12	STCM-8	TK-02728	S-58M	CSN-543
G-MCLNR-3225P16	G-MCLNL-3225P16	CNMG-160612	25	32	170	35	32	CSN-533	NLM-58	CLM-12	STCM-8	TK-02728	S-58M	CSN-543
G-MCLNR-3232P16	G-MCLNL-3232P16	CNMG-160612	32	32	170	35	40	CSN-533	NLM-58	CLM-12	STCM-8	TK-02728	S-58M	CSN-543
G-MCLNR-4040R16	G-MCLNL-4040R16	CNMG-160612	40	40	200	35	50	CSN-533	NLM-58	CLM-12	STCM-8	TK-02728	S-58M	CSN-543
G-MCLNR-2525M19	G-MCLNL-2525M19	CNMG-190612	25	25	150	35	32	CSN-633	NLM-68	CLM-12	STCM-8	TK-02722	S-68M	CSN-643
G-MCLNR-3225P19	G-MCLNL-3225P19	CNMG-190612	25	32	170	35	32	CSN-633	NLM-68	CLM-12	STCM-8	TK-02722	S-68M	CSN-643
G-MCLNR-3232P19	G-MCLNL-3232P19	CNMG-190612	32	32	170	35	40	CSN-633	NLM-68	CLM-12	STCM-8	TK-02722	S-68M	CSN-643
G-MCLNR-4040R19	G-MCLNL-4040R19	CNMG-190612	40	40	200	35	50	CSN-633	NLM-68	CLM-12	STCM-8	TK-02722	S-68M	CSN-643
G-MCLNR-4040R25	G-MCLNL-4040R25	CNMG-250924	40	40	200	38	50	CSN-846	NLM-810	CLM-24	STCM-19	TK-02723	S-810M	–

** 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 / 75° Lead





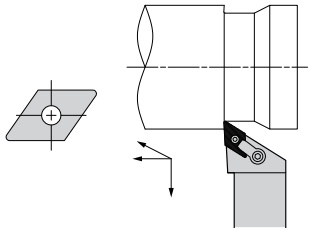
Right-Hand Toolholder Shown

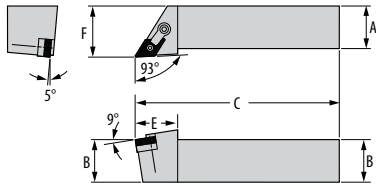
Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Seat
G-MCRNR-2020M12	G-MCRNL-2020M12	CNMG-120708	20	20	150	32	25	CSN-433	NLM-46	CLM-9	STCM-4	TK-02719	S-46M	–
G-MCRNR-2525M12	G-MCRNL-2525M12	CNMG-120708	25	25	150	32	32	CSN-433	NLM-46	CLM-9	STCM-4	TK-02719	S-46M	–
G-MCRNR-3232P12	G-MCRNL-3232P12	CNMG-120708	32	32	170	32	40	CSN-433	NLM-46	CLM-9	STCM-4	TK-02719	S-46M	–
G-MCRNR-4040R12	G-MCRNL-4040R12	CNMG-120708	40	40	200	32	50	CSN-433	NLM-46	CLM-9	STCM-4	TK-02719	S-46M	–
G-MCRNR-2525M16	G-MCRNL-2525M16	CNMG-160612	25	25	150	34	32	CSN-533	NLM-58	CLM-9	STCM-4	TK-02720	S-58M	CSN-543
G-MCRNR-3225P16	G-MCRNL-3225P16	CNMG-160612	25	32	170	34	32	CSN-533	NLM-58	CLM-9	STCM-4	TK-02720	S-58M	CSN-543
G-MCRNR-3232P16	G-MCRNL-3232P16	CNMG-160612	32	32	170	34	40	CSN-533	NLM-58	CLM-9	STCM-4	TK-02720	S-58M	CSN-543
G-MCRNR-3225M19	G-MCRNL-3225M19	CNMG-196012	25	32	150	38	32	CSN-633	NLM-68	CLM-12	STCM-4	TK-02721	S-68M	CSN-643
G-MCRNR-3232P19	G-MCRNL-3232P19	CNMG-196012	32	32	170	38	40	CSN-633	NLM-68	CLM-12	STCM-4	TK-02721	S-68M	CSN-643
G-MCRNR-4040R19	G-MCRNL-4040R19	CNMG-196012	40	40	200	38	50	CSN-633	NLM-68	CLM-12	STCM-4	TK-02721	S-68M	CSN-643
G-MCRNR-4040R25	G-MCRNL-4040R25	CNMG-250923	40	40	200	42	50	CSN-846	NLM-810	CLM-24	STCM-19	TK-02723	S-810M	–

** 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 / 93° Lead





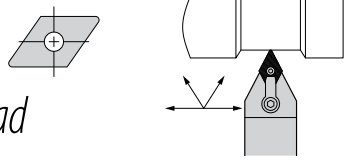
Right-Hand Toolholder Shown

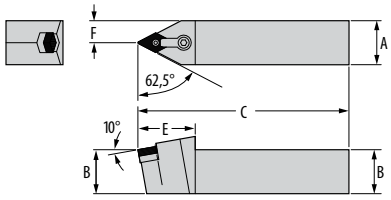
Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Seat
G-MDJNR-2020M15	G-MDJNL-2020M15	DNMG-150408	20	20	150	35	25	DSN-433	NLM-46	CLM-20	STCM-26	TK-02724	S-46M	DSN-423**
G-MDJNR-2525M15	G-MDJNL-2525M15	DNMG-150408	25	25	150	35	32	DSN-433	NLM-46	CLM-20	STCM-26	TK-02724	S-46M	DSN-423**
G-MDJNR-3225P15	G-MDJNL-3225P15	DNMG-150408	25	32	170	35	32	DSN-433	NLM-46	CLM-20	STCM-26	TK-02724	S-46M	DSN-423**
G-MDJNR-3232P15	G-MDJNL-3232P15	DNMG-150408	32	32	170	35	40	DSN-433	NLM-46	CLM-20	STCM-26	TK-02724	S-46M	DSN-423**
G-MDJNR-4040R15	G-MDJNL-4040R15	DNMG-150408	40	40	200	35	50	DSN-433	NLM-46	CLM-20	STCM-26	TK-02724	S-46M	DSN-423**
G-MDJNR-2525M19	G-MDJNL-2525M19	DNMG-190612	25	25	150	38	32	DSN-533	NLM-58	CLM-12	STCM-4	TK-02726	S-58M	DSN-543
G-MDJNR-3225P19	G-MDJNL-3225P19	DNMG-190612	25	32	170	38	32	DSN-533	NLM-58	CLM-12	STCM-4	TK-02726	S-58M	DSN-543
G-MDJNR-3232P19	G-MDJNL-3232P19	DNMG-190612	32	32	170	38	40	DSN-533	NLM-58	CLM-12	STCM-4	TK-02726	S-58M	DSN-543
G-MDJNR-4040R19	G-MDJNL-4040R19	DNMG-190612	40	40	200	38	50	DSN-533	NLM-58	CLM-12	STCM-4	TK-02726	S-58M	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 / 62,5° Lead





Neutral Toolholder Shown

Part Number	Gage	Dimensions (mm)					Standard Components				*Tune-Up	Optional Components	
Neutral	Inserts	B	C	E	F		Seat	Lock Pin	Clamp	Kit Clamp Screw		Seat Screw	Seat
G-MDPNN-2020M15	DNMG-150408	20	20	150	42	10	DSN-433	NLM-46	CLM-12	STCM-4	TK-02725	S-46M	DSN-423**
G-MDPNN-2525M15	DNMG-150408	25	25	150	42	12,5	DSN-433	NLM-46	CLM-12	STCM-4	TK-02725	S-46M	DSN-423**
G-MDPNN-3225P15	DNMG-150408	25	32	170	42	12,5	DSN-433	NLM-46	CLM-12	STCM-4	TK-02725	S-46M	DSN-423**
G-MDPNN-3232P15	DNMG-150408	32	32	170	42	16	DSN-433	NLM-46	CLM-12	STCM-4	TK-02725	S-46M	DSN-423**
G-MDPNN-4040R15	DNMG-150408	40	40	200	42	20	DSN-433	NLM-46	CLM-12	STCM-4	TK-02725	S-46M	DSN-423**
G-MDPNN-2525M19	DNMG-190612	25	25	150	49	12,5	DSN-533	NLM-58	CLM-12	STCM-4	TK-02726	S-58M	DSN-543
G-MDPNN-3225P19	DNMG-190612	25	32	170	49	12,5	DSN-533	NLM-58	CLM-12	STCM-4	TK-02726	S-58M	DSN-543
G-MDPNN-3232P19	DNMG-190612	32	32	170	49	16	DSN-533	NLM-58	CLM-12	STCM-4	TK-02726	S-58M	DSN-543
G-MDPNN-4040R19	DNMG-190612	40	40	200	49	20	DSN-533	NLM-58	CLM-12	STCM-4	TK-02726	S-58M	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.*

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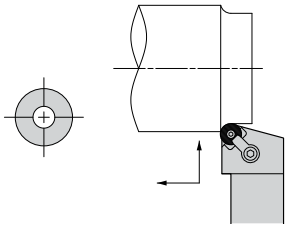
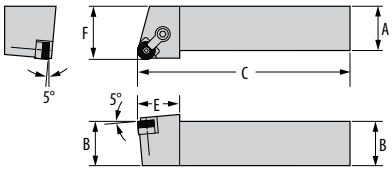
G-MRGNR/L

Style G / Round / Negative Rake





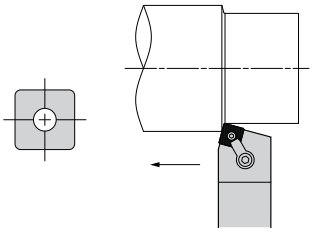
Right-Hand Toolholder Shown

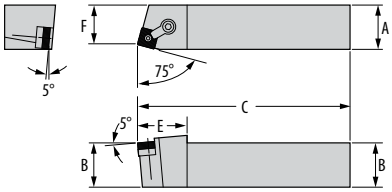
Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Seat
G-MRGNR-2020M09	G-MRGNL-2020M09	RNMG-090300	20	20	150	25	25	–	NLM-33	CLM-6	STCM-25	TK-02727	–	–
G-MRGNR-2020M12	G-MRGNL-2020M12	RNMG-120400	20	20	150	30	25	IRSN-43	NLM-46	CLM-9	STCM-4	TK-02705	S-46M	IRSN-44
G-MRGNR-2525M12	G-MRGNL-2525M12	RNMG-120400	25	25	150	30	32	IRSN-43	NLM-46	CLM-9	STCM-4	TK-02705	S-46M	IRSN-44
G-MRGNR-3225P12	G-MRGNL-3225P12	RNMG-120400	25	32	170	30	32	IRSN-43	NLM-46	CLM-9	STCM-4	TK-02705	S-46M	IRSN-44
G-MRGNR-3232P12	G-MRGNL-3232P12	RNMG-120400	32	32	170	30	40	IRSN-43	NLM-46	CLM-9	STCM-4	TK-02705	S-46M	IRSN-44
G-MRGNR-2525M15	G-MRGNL-2525M15	RNMG-150600	25	25	150	35	32	RSN-53	NLM-58	CLM-9	STCM-4	TK-02706	S-58M	–
G-MRGNR-3225P15	G-MRGNL-3225P15	RNMG-150600	25	32	170	35	32	RSN-53	NLM-58	CLM-9	STCM-4	TK-02706	S-58M	–
G-MRGNR-3232P15	G-MRGNL-3232P15	RNMG-150600	32	32	170	35	40	RSN-53	NLM-58	CLM-9	STCM-4	TK-02706	S-58M	–
G-MRGNR-2525M19	G-MRGNL-2525M19	RNMG-190600	25	25	150	39	32	RSN-63	NLM-68	CLM-12	STCM-4	TK-02707	S-68M	–
G-MRGNR-3225P19	G-MRGNL-3225P19	RNMG-190600	25	32	170	39	32	RSN-63	NLM-68	CLM-12	STCM-4	TK-02707	S-68M	–
G-MRGNR-3232P19	G-MRGNL-3232P19	RNMG-190600	32	32	170	39	40	RSN-63	NLM-68	CLM-12	STCM-4	TK-02707	S-68M	–
G-MRGNR-4040R25	G-MRGNL-4040R25	RNMG-250900	40	40	200	43	50	RSN-84	NLM-810	CLM-24	STCM-19	TK-02708	S-810M	–

** 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 / 75° Lead





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	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Seat
G-MSBNR-1616M09	G-MSBNL-1616M09	SNMG-090308	16	16	150	27	12	ISSN-322	NLM-34	CLM-6	STCM-25	TK-02710	S-34M	–
G-MSBNR-2020M09	G-MSBNL-2020M09	SNMG-090308	20	20	150	27	16	ISSN-322	NLM-34	CLM-6	STCM-25	TK-02710	S-34M	–
G-MSBNR-2525M09	G-MSBNL-2525M09	SNMG-090308	25	25	150	27	22	ISSN-322	NLM-34	CLM-6	STCM-25	TK-02710	S-34M	–
G-MSBNR-2020M12	G-MSBNL-2020M12	SNMG-120408	20	20	150	36	20	ISSN-433	NLM-46	CLM-9	STCM-4	TK-02712	S-46M	ISSN-443
G-MSBNR-2525M12	G-MSBNL-2525M12	SNMG-120408	25	25	150	36	22	ISSN-433	NLM-46	CLM-9	STCM-4	TK-02712	S-46M	ISSN-443
G-MSBNR-3225P12	G-MSBNL-3225P12	SNMG-120408	25	32	170	36	22	ISSN-433	NLM-46	CLM-9	STCM-4	TK-02712	S-46M	ISSN-443
G-MSBNR-3232P12	G-MSBNL-3232P12	SNMG-120408	32	32	170	36	28	ISSN-433	NLM-46	CLM-9	STCM-4	TK-02712	S-46M	ISSN-443
G-MSBNR-2525M15	G-MSBNL-2525M15	SNMG-150612	25	25	150	40	21	SSN-533	NLM-58	CLM-12	STCM-4	TK-02713	S-58M	ISSN-543
G-MSBNR-3225P15	G-MSBNL-3225P15	SNMG-150612	25	32	170	40	21	SSN-533	NLM-58	CLM-12	STCM-4	TK-02713	S-58M	ISSN-543
G-MSBNR-3232P15	G-MSBNL-3232P15	SNMG-150612	32	32	170	40	28	SSN-533	NLM-58	CLM-12	STCM-4	TK-02713	S-58M	ISSN-543
G-MSBNR-4040R15	G-MSBNL-4040R15	SNMG-150612	40	40	200	40	34	SSN-533	NLM-58	CLM-12	STCM-4	TK-02713	S-58M	ISSN-543
G-MSBNR-3232P19	G-MSBNL-3232P19	SNMG-190612	32	32	170	40	26	ISSN-633	NLM-68	CLM-12	STCM-4	TK-02714	S-68M	ISSN-643
G-MSBNR-4040R19	G-MSBNL-4040R19	SNMG-190612	40	40	200	40	33	ISSN-633	NLM-68	CLM-12	STCM-4	TK-02714	S-68M	ISSN-643
G-MSBNR-4040R25	G-MSBNL-4040R25	SNMG-250924	40	40	200	50	32	SSN-844	NLM-810	CLM-24	STCM-19	TK-02647	S-810M	–

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

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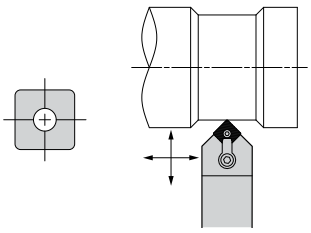
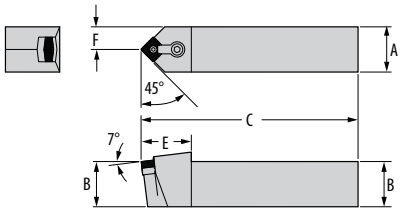
G-MSDNN

Style D / Square / Negative Rake / 45° Lead





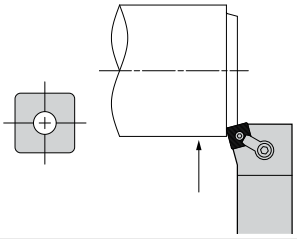
Neutral Toolholder Shown

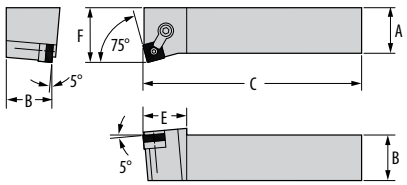
Part Number	Gage Inserts	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Components	
		A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Seat
G-MSDNN-1616M09	SNMG-090308	16	16	150	29	8	ISSN-322	NLM-34	CLM-6	STCM-25	TK-02710	S-34M	–
G-MSDNN-2020M09	SNMG-090308	20	20	150	29	10	ISSN-322	NLM-34L	CLM-6	STCM-25	TK-02711	S-34M	–
G-MSDNN-2020M12	SNMG-120408	20	20	150	35	10	ISSN-433	NLM-46	CLM-9	STCM-4	TK-02712	S-46M	ISSN-443
G-MSDNN-2525M12	SNMG-120408	25	25	150	35	12,5	ISSN-433	NLM-46	CLM-9	STCM-4	TK-02712	S-46M	ISSN-443
G-MSDNN-3225P12	SNMG-120408	25	32	170	35	12,5	ISSN-433	NLM-46	CLM-9	STCM-4	TK-02712	S-46M	ISSN-443
G-MSDNN-3232P12	SNMG-120408	32	32	170	35	16	ISSN-433	NLM-46	CLM-9	STCM-4	TK-02712	S-46M	ISSN-443
G-MSDNN-2525M15	SNMG-150612	25	25	150	41	12,5	SSN-533	NLM-58	CLM-12	STCM-4	TK-02713	S-58M	ISSN-543
G-MSDNN-3225P15	SNMG-150612	25	32	170	41	12,5	SSN-533	NLM-58	CLM-12	STCM-4	TK-02713	S-58M	ISSN-543
G-MSDNN-3232P15	SNMG-150612	32	32	170	41	16	SSN-533	NLM-58	CLM-12	STCM-4	TK-02713	S-58M	ISSN-543
G-MSDNN-4040R15	SNMG-150612	40	40	200	41	20	SSN-533	NLM-58	CLM-12	STCM-4	TK-02713	S-58M	ISSN-543
G-MSDNN-3225P19	SNMG-190612	25	32	170	44	12,5	ISSN-633	NLM-68	CLM-12	STCM-4	TK-02714	S-68M	ISSN-643
G-MSDNN-3232P19	SNMG-190612	32	32	170	44	16	ISSN-633	NLM-68	CLM-12	STCM-4	TK-02714	S-68M	ISSN-643
G-MSDNN-4040R19	SNMG-190612	40	40	200	44	20	ISSN-633	NLM-68	CLM-12	STCM-4	TK-02714	S-68M	ISSN-643
G-MSDNN-4040R25	SNMG-250924	40	40	200	57	20	SSN-844	NLM-810	CLM-24	STCM-19	TK-02647	S-810M	–

** 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 / 75° Lead





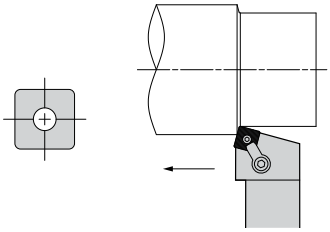
Right-Hand Toolholder Shown

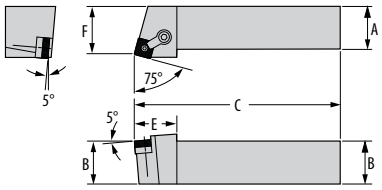
Part Number		Gage Inserts	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand		A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Seat
G-MSKNR-1616M09	G-MSKNL-1616M09	SNMG-090308	16	16	150	25	20	ISSN-322	NLM-34	CLM-6	STCM-25	TK-02710	S-34M	–
G-MSKNR-2020M09	G-MSKNL-2020M09	SNMG-090308	20	20	150	25	25	ISSN-322	NLM-34	CLM-6	STCM-25	TK-02710	S-34M	–
G-MSKNR-2525M09	G-MSKNL-2525M09	SNMG-090308	25	25	150	25	32	ISSN-322	NLM-34	CLM-6	STCM-25	TK-02710	S-34M	–
G-MSKNR-2020M12	G-MSKNL-2020M12	SNMG-120408	20	20	150	31	25	ISSN-433	NLM-46	CLM-9	STCM-4	TK-02712	S-46M	ISSN-443
G-MSKNR-2525M12	G-MSKNL-2525M12	SNMG-120408	25	25	150	31	32	ISSN-433	NLM-46	CLM-9	STCM-4	TK-02712	S-46M	ISSN-443
G-MSKNR-3225P12	G-MSKNL-3225P12	SNMG-120408	25	32	170	31	32	ISSN-433	NLM-46	CLM-9	STCM-4	TK-02712	S-46M	ISSN-443
G-MSKNR-3232P12	G-MSKNL-3232P12	SNMG-120408	32	32	170	31	40	ISSN-433	NLM-46	CLM-9	STCM-4	TK-02712	S-46M	ISSN-443
G-MSKNR-2525M15	G-MSKNL-2525M15	SNMG-150612	25	25	150	37	32	SSN-533	NLM-58	CLM-12	STCM-4	TK-02713	S-58M	ISSN-543
G-MSKNR-3225P15	G-MSKNL-3225P15	SNMG-150612	25	32	170	37	32	SSN-533	NLM-58	CLM-12	STCM-4	TK-02713	S-58M	ISSN-543
G-MSKNR-3232P15	G-MSKNL-3232P15	SNMG-150612	32	32	170	37	40	SSN-533	NLM-58	CLM-12	STCM-4	TK-02713	S-58M	ISSN-543
G-MSKNR-3225P19	G-MSKNL-3225P19	SNMG-190612	25	32	170	40	32	ISSN-633	NLM-68	CLM-12	STCM-4	TK-02714	S-68M	ISSN-643
G-MSKNR-3232P19	G-MSKNL-3232P19	SNMG-190612	32	32	170	40	40	ISSN-633	NLM-68	CLM-12	STCM-4	TK-02714	S-68M	ISSN-643
G-MSKNR-4040R19	G-MSKNL-4040R19	SNMG-190612	40	40	200	40	50	ISSN-633	NLM-68	CLM-12	STCM-4	TK-02714	S-68M	ISSN-643
G-MSKNR-4040R25	G-MSKNL-4040R25	SNMG-250924	40	40	200	50	50	SSN-844	NLM-810	CLM-24	STCM-19	TK-02647	S-810M	–

** 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 / 75° Lead





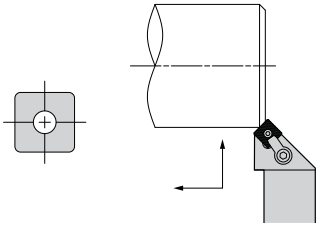
Right-Hand Toolholder Shown

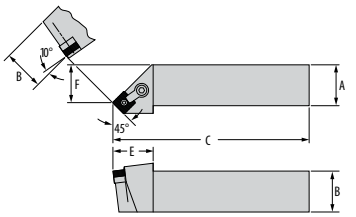
Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Filler
G-MSRNR-1616M09	G-MSRNL-1616M09	SNMG-090308	16	16	150	27	20	ISSN-322	NLM-34	CLM-6	STCM-25	TK-02710	S-34M	–
G-MSRNR-2020M09	G-MSRNL-2020M09	SNMG-090308	20	20	150	27	23	ISSN-322	NLM-34L	CLM-6	STCM-25	TK-02711	S-34M	–
G-MSRNR-2020M12	G-MSRNL-2020M12	SNMG-120408	20	20	150	31	22	ISSN-433	NLM-46	CLM-9	STCM-4	TK-02712	S-46M	ISSN-443
G-MSRNR-2525M12	G-MSRNL-2525M12	SNMG-120408	25	25	150	31	29	ISSN-433	NLM-46	CLM-9	STCM-4	TK-02712	S-46M	ISSN-443
G-MSRNR-3225P12	G-MSRNL-3225P12	SNMG-120408	25	32	170	31	29	ISSN-433	NLM-46	CLM-9	STCM-4	TK-02712	S-46M	ISSN-443
G-MSRNR-3232P12	G-MSRNL-3232P12	SNMG-120408	32	32	170	31	35	ISSN-433	NLM-46	CLM-9	STCM-4	TK-02712	S-46M	ISSN-443
G-MSRNR-2525M15	G-MSRNL-2525M15	SNMG-150612	25	25	150	37	28	SSN-533	NLM-58	CLM-12	STCM-4	TK-02713	S-58M	ISSN-543
G-MSRNR-3225P15	G-MSRNL-3225P15	SNMG-150612	25	32	170	37	28	SSN-533	NLM-58	CLM-12	STCM-4	TK-02713	S-58M	ISSN-543
G-MSRNR-3232P15	G-MSRNL-3232P15	SNMG-150612	32	32	170	37	34	SSN-533	NLM-58	CLM-12	STCM-4	TK-02713	S-58M	ISSN-543
G-MSRNR-4040R15	G-MSRNL-4040R15	SNMG-150612	40	40	200	37	47	SSN-533	NLM-58	CLM-12	STCM-4	TK-02713	S-58M	ISSN-543
G-MSRNR-3225P19	G-MSRNL-3225P19	SNMG-190612	25	32	170	38	27	ISSN-633	NLM-68	CLM-12	STCM-4	TK-02714	S-68M	ISSN-643
G-MSRNR-3232P19	G-MSRNL-3232P19	SNMG-190612	32	32	170	38	33	ISSN-633	NLM-68	CLM-12	STCM-4	TK-02714	S-68M	ISSN-643
G-MSRNR-4040R19	G-MSRNL-4040R19	SNMG-190612	40	40	200	38	46	ISSN-633	NLM-68	CLM-12	STCM-4	TK-02714	S-68M	ISSN-643
G-MSRNR-4040R25	G-MSRNL-4040R25	SNMG-250924	40	40	200	41	45	SSN-844	NLM-810	CLM-24	STCM-19	TK-02647	S-810M	–

** 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





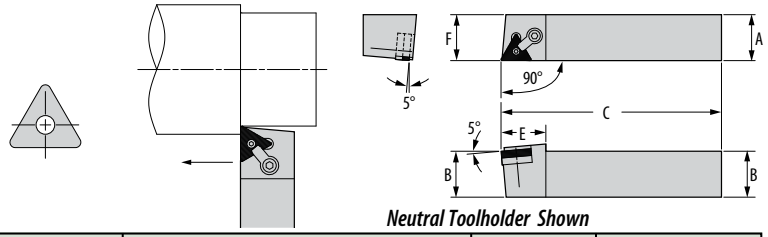
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (mm)					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-2020M12	G-MSSNL-2020M12	SNMG-120408	20	20	150	31	17	ISSN-433	NLM-46	CLM-9	STCM-4	TK-02712	S-46M	ISSN-443
G-MSSNR-2525M12	G-MSSNL-2525M12	SNMG-120408	25	25	150	31	23	ISSN-433	NLM-46	CLM-9	STCM-4	TK-02712	S-46M	ISSN-443
G-MSSNR-3225P12	G-MSSNL-3225P12	SNMG-120408	25	32	170	31	23	ISSN-433	NLM-46	CLM-9	STCM-4	TK-02712	S-46M	ISSN-443
G-MSSNR-3232P12	G-MSSNL-3232P12	SNMG-120408	32	32	170	31	30	ISSN-433	NLM-46	CLM-9	STCM-4	TK-02712	S-46M	ISSN-443
G-MSSNR-2525M15	G-MSSNL-2525M15	SNMG-150612	25	25	150	35	21	SSN-533	NLM-58	CLM-9	STCM-4	TK-02688	S-58M	ISSN-543
G-MSSNR-3225P15	G-MSSNL-3225P15	SNMG-150612	25	32	170	35	21	SSN-533	NLM-58	CLM-9	STCM-4	TK-02688	S-58M	ISSN-543
G-MSSNR-3232P15	G-MSSNL-3232P15	SNMG-150612	32	32	170	35	27	SSN-533	NLM-58	CLM-9	STCM-4	TK-02688	S-58M	ISSN-543
G-MSSNR-4040R15	G-MSSNL-4040R15	SNMG-150612	40	40	200	35	34	SSN-533	NLM-58	CLM-9	STCM-4	TK-02688	S-58M	ISSN-543
G-MSSNR-3225P19	G-MSSNL-3225P19	SNMG-190612	25	32	170	38	20	ISSN-633	NLM-68	CLM-9	STCM-4	TK-02735	S-68M	ISSN-643
G-MSSNR-3232P19	G-MSSNL-3232P19	SNMG-190612	32	32	170	38	25	ISSN-633	NLM-68	CLM-9	STCM-4	TK-02735	S-68M	ISSN-643
G-MSSNR-4040R19	G-MSSNL-4040R19	SNMG-190612	40	40	200	38	40	ISSN-633	NLM-68	CLM-9	STCM-4	TK-02735	S-68M	ISSN-643

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

G-MTANR/L

Style A / Triangle / Negative Rake / 90° Lead



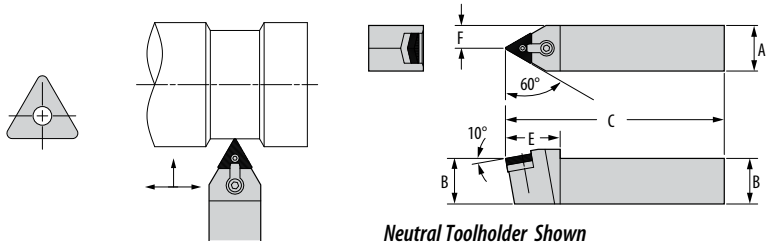
Neutral Toolholder Shown

Part Number		Gage	Dimensions (mm)					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-1616M11	G-MTANL-1616M11	TNMG-110304	16	16	150	25	16	–	NLM-23	CLM-19	STCM-25	TK-02762	–	–
G-MTANR-1616M16	G-MTANL-1616M16	TNMG-160308	16	16	150	29	16	ITSN-333	NLM-34L	CLM-6	STCM-25	TK-02753	S-34M	ITSN-323
G-MTANR-2020M16	G-MTANL-2020M16	TNMG-160308	20	20	150	29	20	ITSN-333	NLM-34L	CLM-6	STCM-25	TK-02753	S-34M	ITSN-323
G-MTANR-2525M16	G-MTANL-2525M16	TNMG-160308	25	25	150	29	25	ITSN-333	NLM-34L	CLM-6	STCM-25	TK-02753	S-34M	ITSN-323
G-MTANR-3225P16	G-MTANL-3225P16	TNMG-160308	25	32	170	29	25	ITSN-333	NLM-34L	CLM-6	STCM-25	TK-02753	S-34M	ITSN-323
G-MTANR-2525M22	G-MTANL-2525M22	TNMG-220408	25	25	150	29	25	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02763	S-46M	ITSN-424
G-MTANR-3225P22	G-MTANL-3225P22	TNMG-220408	25	32	170	29	25	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02763	S-46M	ITSN-424
G-MTANR-3232P22	G-MTANL-3232P22	TNMG-220408	32	32	170	29	32	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02763	S-46M	ITSN-424
G-MTANR-4040R22	G-MTANL-4040R22	TNMG-220408	40	40	200	29	40	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02763	S-46M	ITSN-424
G-MTANR-2525M27	G-MTANL-2525M27	TNMG-270612	25	25	150	37	25	ITSN-533	NLM-58	CLM-9	STCM-4	TK-02755	S-58M	ITSN-543
G-MTANR-3225P27	G-MTANL-3225P27	TNMG-270612	25	32	170	37	25	ITSN-533	NLM-58	CLM-9	STCM-4	TK-02755	S-58M	ITSN-543
G-MTANR-3232P27	G-MTANL-3232P27	TNMG-270612	32	32	170	37	32	ITSN-533	NLM-58	CLM-9	STCM-4	TK-02755	S-58M	ITSN-543
G-MTANR-4040R27	G-MTANL-4040R27	TNMG-270612	40	40	200	37	40	ITSN-533	NLM-58	CLM-9	STCM-4	TK-02755	S-58M	ITSN-543
G-MTANR-4040R33	G-MTANL-4040R33	TNMG-330912	40	40	200	50	40	TSN-637	NLM-68L	CLM-12	STCM-4	TK-02756	S-68M	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 / 60° Lead



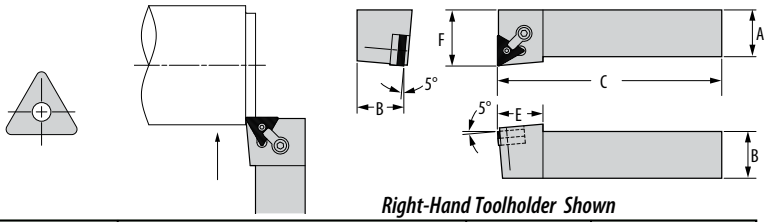
Neutral Toolholder Shown

Part Number	Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Components	
	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Filler
G-MTENNS-1616M11	TNMG-110304	16	16	150	25	8	–	NLM-23	CLM-6	STCM-25	TK-02752	–	–
G-MTENNS-1616M16	TNMG-160308	16	16	150	30	8	ITSN-333	NLM-34L	CLM-6	STCM-25	TK-02753	S-34M	ITSN-323
G-MTENNS-2020M16	TNMG-160308	20	20	150	30	10	ITSN-333	NLM-34L	CLM-6	STCM-25	TK-02753	S-34M	ITSN-323
G-MTENNS-2525M16	TNMG-160308	25	25	150	30	12,5	ITSN-333	NLM-34L	CLM-6	STCM-25	TK-02753	S-34M	ITSN-323
G-MTENNS-3225P16	TNMG-160308	25	32	170	30	12,5	ITSN-333	NLM-34L	CLM-6	STCM-25	TK-02753	S-34M	ITSN-323
G-MTENNS-2020M22	TNMG-220408	20	20	150	38	10	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02754	S-46M	–
G-MTENNS-2525M22	TNMG-220408	25	25	150	38	12,5	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02754	S-46M	–
G-MTENNS-3225P22	TNMG-220408	25	32	170	38	12,5	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02754	S-46M	–
G-MTENNS-3232P22	TNMG-220408	32	32	170	38	16	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02754	S-46M	–
G-MTENNS-3232P27	TNMG-270612	32	32	170	42	16	ITSN-533	NLM-58	CLM-9	STCM-4	TK-02755	S-58M	–
G-MTENNS-4040R27	TNMG-270612	40	40	200	42	20	ITSN-533	NLM-58	CLM-9	STCM-4	TK-02755	S-58M	–
G-MTENNS-4040R33	TNMG-330912	40	40	200	50	20	TSN-637	NLM-68L	CLM-12	STCM-4	TK-02756	S-68M	–

** 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 / 90° Lead



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	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Filler
G-MTFNR-1616M11	G-MTFNL-1616M11	TNMG-110304	16	16	150	20	22	–	NLM-23	CLM-19	STCM-25	TK-02762	–	–
G-MTFNR-1616M16	G-MTFNL-1616M16	TNMG-160308	16	16	150	24	22	ITSN-333	NLM-34L	CLM-6	STCM-25	TK-02753	S-34M	ITSN-323
G-MTFNR-2020M16	G-MTFNL-2020M16	TNMG-160308	20	20	150	24	25	ITSN-333	NLM-34L	CLM-6	STCM-25	TK-02753	S-34M	ITSN-323
G-MTFNR-2525M16	G-MTFNL-2525M16	TNMG-160308	25	25	150	24	32	ITSN-333	NLM-34L	CLM-6	STCM-25	TK-02753	S-34M	ITSN-323
G-MTFNR-3225P16	G-MTFNL-3225P16	TNMG-160308	25	32	170	24	32	ITSN-333	NLM-34L	CLM-6	STCM-25	TK-02753	S-34M	ITSN-323
G-MTFNR-3232P16	G-MTFNL-3232P16	TNMG-160308	32	32	170	24	40	ITSN-333	NLM-34L	CLM-6	STCM-25	TK-02753	S-34M	ITSN-323
G-MTFNR-2525M22	G-MTFNL-2525M22	TNMG-220408	25	25	150	31	32	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02754	S-46M	ITSN-424
G-MTFNR-3225P22	G-MTFNL-3225P22	TNMG-220408	25	32	170	31	32	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02754	S-46M	ITSN-424
G-MTFNR-3232P22	G-MTFNL-3232P22	TNMG-220408	32	32	170	31	40	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02754	S-46M	ITSN-424
G-MTFNR-4040R22	G-MTFNL-4040R22	TNMG-220408	40	40	200	31	50	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02754	S-46M	ITSN-424
G-MTFNR-2525M27	G-MTFNL-2525M27	TNMG-270612	25	25	150	36	32	ITSN-533	NLM-58	CLM-9	STCM-4	TK-02755	S-58M	ITSN-543
G-MTFNR-3225P27	G-MTFNL-3225P27	TNMG-270612	25	32	170	36	32	ITSN-533	NLM-58	CLM-9	STCM-4	TK-02755	S-58M	ITSN-543
G-MTFNR-3232P27	G-MTFNL-3232P27	TNMG-270612	32	32	170	36	40	ITSN-533	NLM-58	CLM-9	STCM-4	TK-02755	S-58M	ITSN-543
G-MTFNR-4040R27	G-MTFNL-4040R27	TNMG-270612	40	40	200	36	50	ITSN-533	NLM-58	CLM-9	STCM-4	TK-02755	S-58M	ITSN-543
G-MTFNR-4040R33	G-MTFNL-4040R33	TNMG-330912	40	40	200	38	50	TSN-637	NLM-68L	CLM-12	STCM-4	TK-02756	S-68M	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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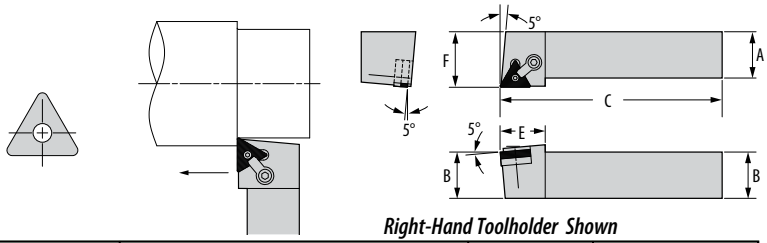
G-MTGNR/L

Style G / Triangle / Negative Rake / 90° Lead



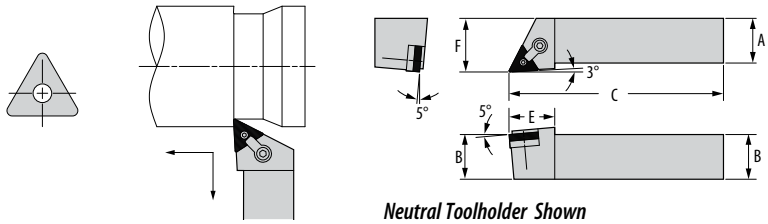
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Filler
G-MTGNR-1616M11	G-MTGNL-1616M11	TNMG-110304	16	16	150	25	20	–	NLM-23	CLM-19	STCM-25	TK-02639	–	–
G-MTGNR-1616M16	G-MTGNL-1616M16	TNMG-160308	16	16	150	28	22	ITSN-333	NLM-34L	CLM-6	STCM-25	TK-02753	S-34M	ITSN-323
G-MTGNR-2020M16	G-MTGNL-2020M16	TNMG-160308	20	20	150	28	25	ITSN-333	NLM-34L	CLM-6	STCM-25	TK-02753	S-34M	ITSN-323
G-MTGNR-2525M16	G-MTGNL-2525M16	TNMG-160308	25	25	150	28	32	ITSN-333	NLM-34L	CLM-6	STCM-25	TK-02753	S-34M	ITSN-323
G-MTGNR-3225P16	G-MTGNL-3225P16	TNMG-160308	25	32	170	28	32	ITSN-333	NLM-34L	CLM-6	STCM-25	TK-02753	S-34M	ITSN-323
G-MTGNR-3232P16	G-MTGNL-3232P16	TNMG-160308	32	32	170	28	40	ITSN-333	NLM-34L	CLM-6	STCM-25	TK-02753	S-34M	ITSN-323
G-MTGNR-2020M22	G-MTGNL-2020M22	TNMG-220408	20	20	150	31	25	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02754	S-46M	ITSN-424
G-MTGNR-2525M22	G-MTGNL-2525M22	TNMG-220408	25	25	150	31	32	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02754	S-46M	ITSN-424
G-MTGNR-3225P22	G-MTGNL-3225P22	TNMG-220408	25	32	170	31	32	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02754	S-46M	ITSN-424
G-MTGNR-3232P22	G-MTGNL-3232P22	TNMG-220408	32	32	170	31	40	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02754	S-46M	ITSN-424
G-MTGNR-4040R22	G-MTGNL-4040R22	TNMG-220408	40	40	200	31	50	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02754	S-46M	ITSN-424
G-MTGNR-2525M27	G-MTGNL-2525M27	TNMG-270612	25	25	150	37	32	ITSN-533	NLM-58	CLM-9	STCM-4	TK-02755	S-58M	ITSN-543
G-MTGNR-3225P27	G-MTGNL-3225P27	TNMG-270612	25	32	170	37	32	ITSN-533	NLM-58	CLM-9	STCM-4	TK-02755	S-58M	ITSN-543
G-MTGNR-3232P27	G-MTGNL-3232P27	TNMG-270612	32	32	170	37	40	ITSN-533	NLM-58	CLM-9	STCM-4	TK-02755	S-58M	ITSN-543
G-MTGNR-4040R27	G-MTGNL-4040R27	TNMG-270612	40	40	200	37	50	ITSN-533	NLM-58	CLM-9	STCM-4	TK-02755	S-58M	ITSN-543
G-MTGNR-4040R33	G-MTGNL-4040R33	TNMG-330912	40	40	200	38	50	TSN-637	NLM-68L	CLM-12	STCM-4	TK-02756	S-68M	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 / 93° Lead



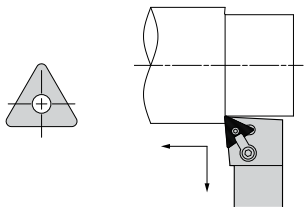
Neutral Toolholder Shown

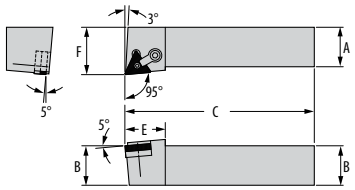
Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Filler
G-MTJNRS-2020M16	G-MTJNLS-2020M16	TNMG-160308	20	20	150	28	25	ITSN-333	NLM-34L	CLM-6	STCM-25	TK-02753	S-34M	ITSN-323
G-MTJNRS-2525M16	G-MTJNLS-2525M16	TNMG-160308	25	25	150	28	32	ITSN-333	NLM-34L	CLM-6	STCM-25	TK-02753	S-34M	ITSN-323
G-MTJNRS-2525M22	G-MTJNLS-2525M22	TNMG-220408	25	25	150	30	25	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02754	S-46M	–
G-MTJNRS-3225P22	G-MTJNLS-3225P22	TNMG-220408	25	32	170	30	25	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02754	S-46M	–
G-MTJNRS-3232P22	G-MTJNLS-3232P22	TNMG-220408	32	32	170	30	40	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02754	S-46M	–
G-MTJNRS-3232P27	G-MTJNLS-3232P27	TNMG-270612	32	32	170	36	40	ITSN-533	NLM-58	CLM-9	STCM-4	TK-02755	S-58M	–
G-MTJNRS-4040R27	G-MTJNLS-4040R27	TNMG-270612	40	40	200	36	50	ITSN-533	NLM-58	CLM-9	STCM-4	TK-02755	S-58M	–
G-MTJNRS-4040R33	G-MTJNLS-4040R33	TNMG-330912	40	40	200	42	50	TSN-637	NLM-68L	CLM-12	STCM-4	TK-02756	S-68M	–

** 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 / 95° Lead





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	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw	Filler
G-MTLNR-2525M22	G-MTLNL-2525M22	TNMG-220408	25	25	150	32	25	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02754	S-46M	TS-424**
G-MTLNR-3225P22	G-MTLNL-3225P22	TNMG-220408	25	32	170	32	32	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02754	S-46M	TS-424**
G-MTLNR-3232P22	G-MTLNL-3232P22	TNMG-220408	32	32	170	32	40	ITSN-433	NLM-46	CLM-9	STCM-4	TK-02754	S-46M	TS-424**
G-MTLNR-3232P27	G-MTLNL-3232P27	TNMG-270612	32	32	170	36	40	ITSN-533	NLM-58	CLM-9	STCM-4	TK-02755	S-58M	ITSN-543
G-MTLNR-4040R27	G-MTLNL-4040R27	TNMG-270612	40	40	200	36	50	ITSN-533	NLM-58	CLM-9	STCM-4	TK-02755	S-58M	ITSN-543
G-MTLNR-4040R33	G-MTLNL-4040R33	TNMG-330912	40	40	200	39	50	TSN-637	NLM-68L	CLM-12	STCM-4	TK-02756	S-68M	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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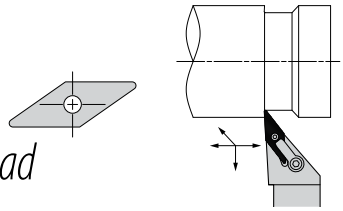
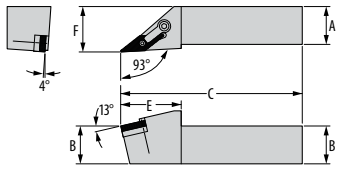
G-MVJNR/L

Style J / 35° Diamond / Negative Rake / 93° Lead





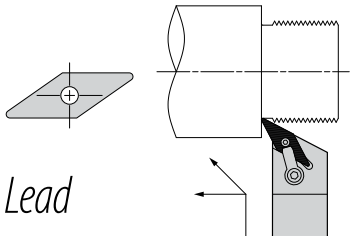
Right-Hand Toolholder Shown

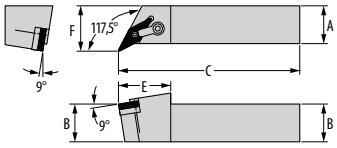
Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Component
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw
G-MVJNR-2020M16	G-MVJNL-2020M16	VNMG-160408	20	20	150	43	25	IVSN-322	NLM-34L	CLM-30	STCM-4	TK-02758	S-34M
G-MVJNR-2525M16	G-MVJNL-2525M16	VNMG-160408	25	25	150	43	32	IVSN-322	NLM-34L	CLM-30	STCM-4	TK-02758	S-34M
G-MVJNR-3225P16	G-MVJNL-3225P16	VNMG-160408	25	32	170	43	32	IVSN-322	NLM-34L	CLM-30	STCM-4	TK-02758	S-34M
G-MVJNR-3232P16	G-MVJNL-3232P16	VNMG-160408	32	32	170	43	40	IVSN-322	NLM-34L	CLM-30	STCM-4	TK-02758	S-34M
G-MVJNR-4040R16	G-MVJNL-4040R16	VNMG-160408	40	40	200	43	50	IVSN-322	NLM-34L	CLM-30	STCM-4	TK-02758	S-34M
G-MVJNR-2525M22	G-MVJNL-2525M22	VNMG-220408	25	25	150	50	32	IVSN-433	NLM-46	CLM-30	STCM-4	TK-02759	S-46M
G-MVJNR-3232P22	G-MVJNL-3232P22	VNMG-220408	32	32	170	50	40	IVSN-433	NLM-46	CLM-30	STCM-4	TK-02759	S-46M
G-MVJNR-4040R22	G-MVJNL-4040R22	VNMG-220408	40	40	200	50	50	IVSN-433	NLM-46	CLM-30	STCM-4	TK-02759	S-46M

** 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 / 117,5° Lead





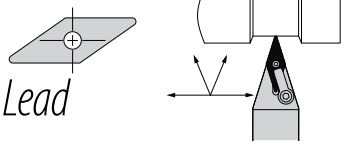
Right-Hand Toolholder Shown

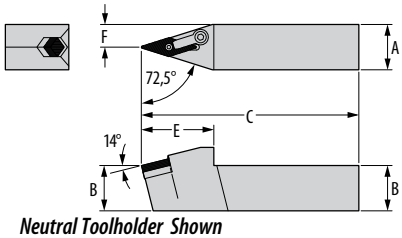
Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Component
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw
G-MVTNR-2020M16	G-MVTNL-2020M16	VNMG-160408	20	20	150	44	25	IVSN-322	NLM-34L	CLM-30	STCM-4	TK-02758	S-34M
G-MVTNR-2525M16	G-MVTNL-2525M16	VNMG-160408	25	25	150	44	32	IVSN-322	NLM-34L	CLM-30	STCM-4	TK-02758	S-34M
G-MVTNR-3225P16	G-MVTNL-3225P16	VNMG-160408	25	32	170	44	32	IVSN-322	NLM-34L	CLM-30	STCM-4	TK-02758	S-34M
G-MVTNR-3232P16	G-MVTNL-3232P16	VNMG-160408	32	32	170	44	40	IVSN-322	NLM-34L	CLM-30	STCM-4	TK-02758	S-34M
G-MVTNR-4040R16	G-MVTNL-4040R16	VNMG-160408	40	40	200	44	45	IVSN-322	NLM-34L	CLM-30	STCM-4	TK-02758	S-34M

** 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 / 72,5° Lead





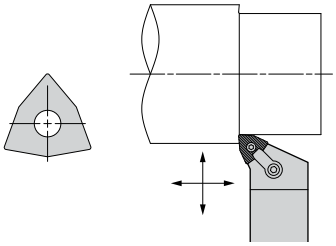
Neutral Toolholder Shown

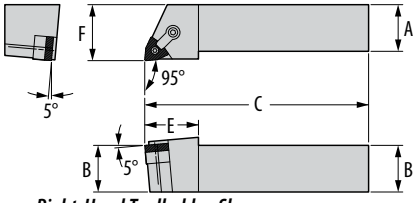
Part Number	Gage Inserts	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Component
		A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw
G-MVVNN-2020M16	VNMG-160408	20	20	150	45	10	IVSN-322	NLM-34L	CLM-30	STCM-4	TK-02758	S-34M
G-MVVNN-2525M16	VNMG-160408	25	25	150	45	12,5	IVSN-322	NLM-34L	CLM-30	STCM-4	TK-02758	S-34M
G-MVVNN-3225P16	VNMG-160408	25	32	170	45	12,5	IVSN-322	NLM-34L	CLM-30	STCM-4	TK-02758	S-34M
G-MVVNN-3232P16	VNMG-160408	32	32	170	45	16	IVSN-322	NLM-34L	CLM-30	STCM-4	TK-02758	S-34M
G-MVVNN-4040R16	VNMG-160408	40	40	200	45	20	IVSN-322	NLM-34L	CLM-30	STCM-4	TK-02758	S-34M
G-MVVNN-2525M22	VNMG-220408	25	25	150	54	12,5	IVSN-433	NLM-46	CLM-30	STCM-4	TK-02759	S-46M
G-MVVNN-3232P22	VNMG-220408	32	32	170	54	16	IVSN-433	NLM-46	CLM-30	STCM-4	TK-02759	S-46M
G-MVVNN-4040R22	VNMG-220408	40	40	200	54	20	IVSN-433	NLM-46	CLM-30	STCM-4	TK-02759	S-46M

** 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 / 95° Lead





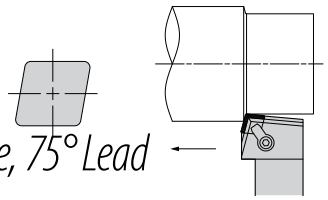
Right-Hand Toolholder Shown

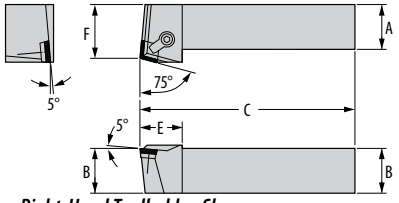
Part Number		Gage Inserts	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Component
Right Hand	Left Hand		A	B	C	E	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat Screw
G-MWLNR-2020M06	G-MWLNL-2020M06	WNMG-060408	20	20	150	25	25	IWSN-323	NLM-34L	CLM-6	STCM-25	TK-02807	IWSN-332
G-MWLNR-2525M06	G-MWLNL-2525M06	WNMG-060408	25	25	150	25	32	IWSN-323	NLM-34L	CLM-6	STCM-25	TK-02807	IWSN-332
G-MWLNR-3232P06	G-MWLNL-3232P06	WNMG-060408	32	32	170	25	40	IWSN-323	NLM-34L	CLM-6	STCM-25	TK-02807	IWSN-332
G-MWLNR-4040R06	G-MWLNL-4040R06	WNMG-060408	40	40	200	25	50	IWSN-323	NLM-34L	CLM-6	STCM-25	TK-02807	IWSN-332
G-MWLNR-2020M08	G-MWLNL-2020M08	WNMG-080408	20	20	150	30	25	IWSN-433	NLM-46	CLM-20	STCM-26	TK-02808	–
G-MWLNR-2525M08	G-MWLNL-2525M08	WNMG-080408	25	25	150	30	32	IWSN-433	NLM-46	CLM-20	STCM-26	TK-02808	–
G-MWLNR-3232P08	G-MWLNL-3232P08	WNMG-080408	32	32	170	30	40	IWSN-433	NLM-46	CLM-20	STCM-26	TK-02808	–
G-MWLNR-4040R08	G-MWLNL-4040R08	WNMG-080408	40	40	200	30	50	IWSN-433	NLM-46	CLM-20	STCM-26	TK-02808	–

** 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, 75° Lead





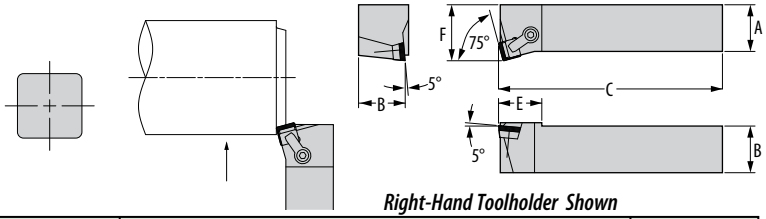
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (mm)					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-CCLPR-2020M12	G-CCLPL-2020M12	CPGN-120308	20	20	150	31	25	CSP-422	TFHCSM3-0.5x10mm	CLM-9	STCM-4	CBDC-415L	TK-02737
G-CCLPR-2525M12	G-CCLPL-2525M12	CPGN-120308	25	25	150	31	32	CSP-422	TFHCSM3-0.5x10mm	CLM-9	STCM-4	CBDC-415L	TK-02737
G-CCLPR-3225P12	G-CCLPL-3225P12	CPGN-120308	25	32	170	31	32	CSP-422	TFHCSM3-0.5x10mm	CLM-9	STCM-4	CBDC-415L	TK-02737
G-CCLPR-3232P12	G-CCLPL-3232P12	CPGN-120308	32	32	170	31	40	CSP-422	TFHCSM3-0.5x10mm	CLM-9	STCM-4	CBDC-415L	TK-02737
G-CCLPR-4040R12	G-CCLPL-4040R12	CPGN-120308	40	40	200	31	50	CSP-422	TFHCSM3-0.5x10mm	CLM-9	STCM-4	CBDC-415L	TK-02737
G-CCLPR-2525M19	G-CCLPL-2525M19	CPGN-190412	25	25	150	33	32	CSP-632	TFHCSM3-0.5x10mm	CLM-12	STCM-4	CBDC-615G	TK-02742
G-CCLPR-3225P19	G-CCLPL-3225P19	CPGN-190412	25	32	170	33	32	CSP-632	TFHCSM3-0.5x10mm	CLM-12	STCM-4	CBDC-615G	TK-02742
G-CCLPR-3232P19	G-CCLPL-3232P19	CPGN-190412	32	32	170	33	40	CSP-632	TFHCSM3-0.5x10mm	CLM-12	STCM-4	CBDC-615G	TK-02742
G-CCLPR-4040R19	G-CCLPL-4040R19	CPGN-190412	40	40	200	33	50	CSP-632	TFHCSM3-0.5x10mm	CLM-12	STCM-4	CBDC-615G	TK-02742

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

G-CSKPR/L

Style K / Square / Positive Rake / 15° Lead



Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (mm)					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-2020M12	G-CSKPL-2020M12	SPGN-120308	20	20	150	29	25	SP-40	TFHCSM3-0.5x12mm	CLM-12	STCM-8	CBS-4G	TK-02766
G-CSKPR-2525M12	G-CSKPL-2525M12	SPGN-120308	25	25	150	29	32	SP-40	TFHCSM3-0.5x12mm	CLM-12	STCM-8	CBS-4G	TK-02766
G-CSKPR-3225P12	G-CSKPL-3225P12	SPGN-120308	25	32	170	29	32	SP-40	TFHCSM3-0.5x12mm	CLM-12	STCM-4	CBS-4G	TK-02767
G-CSKPR-3232P12	G-CSKPL-3232P12	SPGN-120308	32	32	170	29	40	SP-40	TFHCSM3-0.5x12mm	CLM-12	STCM-4	CBS-4G	TK-02767
G-CSKPR-4040R12	G-CSKPL-4040R12	SPGN-120308	40	40	200	29	50	SP-40	TFHCSM3-0.5x12mm	CLM-12	STCM-4	CBS-4G	TK-02767
G-CSKPR-2525M19	G-CSKPL-2525M19	SPGN190412	25	25	150	38	32	SP-60M	TFHCSM5-0.8x12mm	CLM-30	STCM-4	CBS-6G	TK-02768
G-CSKPR-3225P19	G-CSKPL-3225P19	SPGN190412	25	32	170	38	32	SP-60M	TFHCSM5-0.8x12mm	CLM-30	STCM-4	CBS-6G	TK-02768
G-CSKPR-3232P19	G-CSKPL-3232P19	SPGN190412	32	32	170	38	40	SP-60M	TFHCSM5-0.8x12mm	CLM-30	STCM-4	CBS-6G	TK-02768
G-CSKPR-4040R19	G-CSKPL-4040R19	SPGN190412	40	40	200	38	50	SP-60M	TFHCSM5-0.8x12mm	CLM-30	STCM-4	CBS-6G	TK-02768

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

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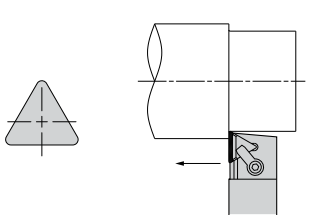
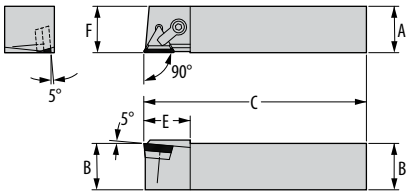
G-CTAPR/L

Style A / Triangle / Positive Rake / 90° Lead





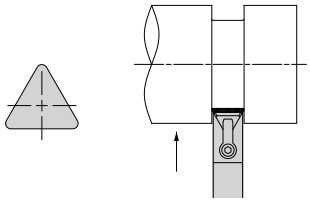
Right-Hand Toolholder Shown

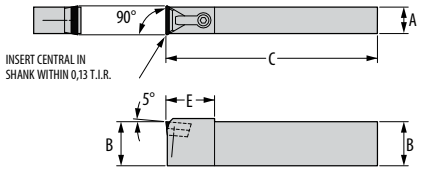
Part Number		Gage	Dimensions (mm)					Standard Components					*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Seat	Seat Screw	Clamp	Clamp Screw	Chip Breaker	Includes all Standard Components
G-CTAPR-2020M16	G-CTAPL-2020M16	TPGN-160308	20	20	150	25	20	TSP-321	TFHCSM3-0.5x10mm	CLM-7	STCM-25	CBT-3G	TK-02773
G-CTAPR-2525M16	G-CTAPL-2525M16	TPGN-160308	25	25	150	25	25	TSP-321	TFHCSM3-0.5x10mm	CLM-7	STCM-25	CBT-3G	TK-02773
G-CTAPR-3225P16	G-CTAPL-3225P16	TPGN-160308	25	32	170	25	25	TSP-321	TFHCSM3-0.5x10mm	CLM-7	STCM-25	CBT-3G	TK-02773
G-CTAPR-2525M22	G-CTAPL-2525M22	TPGN-220408	25	25	150	32	25	SP-4	TFHCSM3-0.5x12mm	CLM-12	STCM-4	CBT-4G	TK-02774
G-CTAPR-3225P22	G-CTAPL-3225P22	TPGN-220408	25	32	170	32	25	SP-4	TFHCSM3-0.5x12mm	CLM-12	STCM-4	CBT-4G	TK-02774
G-CTAPR-3232P22	G-CTAPL-3232P22	TPGN-220408	32	32	170	32	32	SP-4	TFHCSM3-0.5x12mm	CLM-12	STCM-4	CBT-4G	TK-02774
G-CTAPR-4040R22	G-CTAPL-4040R22	TPGN-220408	40	40	200	32	40	SP-4	TFHCSM3-0.5x12mm	CLM-12	STCM-4	CBT-4G	TK-02774
G-CTAPR-2525M27	G-CTAPL-2525M27	TPGN-270612	25	25	150	35	25	SP-5	TFHCSM4-0.7x12mm	CLM-12	STCM-4	CBT-5G	TK-02775
G-CTAPR-3232P27	G-CTAPL-3232P27	TPGN-270612	32	32	170	35	32	SP-5	TFHCSM4-0.7x12mm	CLM-12	STCM-4	CBT-5G	TK-02775
G-CTAPR-4040R27	G-CTAPL-4040R27	TPGN-270612	40	40	200	35	40	SP-5	TFHCSM4-0.7x12mm	CLM-12	STCM-4	CBT-5G	TK-02775
G-CTAPR-4040R33	G-CTAPL-4040R33	TPGN-330924	40	40	200	40	40	SP-6	TFHCSM5-0.8x12mm	CLM-12	STCM-4	CBT-6G	TK-02776

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

G-CTCPN

Style C / Triangle / Positive Rake / 90° Lead





Neutral Toolholder Shown

Part Number	Gage	Dimensions (mm)				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-2512M16	TPGN-160308	12	25	150	32	TSP-321	TFHCSM3-0.5x10mm	CLM-22	STCM-26	CBT-3G	TK-02830
G-CTCPN-2520M22	TPGN-220408	20	25	150	35	SP-4	TFHCSM3-0.5x10mm	CLM-30	STCM-4	CBT-4G	TK-02831
G-CTCPN-3220P22	TPGN-220408	20	32	170	35	SP-4	TFHCSM3-0.5x10mm	CLM-30	STCM-4	CBT-4G	TK-02831
G-CTCPN-4020R22	TPGN-220408	20	40	200	35	SP-4	TFHCSM3-0.5x10mm	CLM-30	STCM-4	CBT-4G	TK-02831
G-CTCPN-4025R27	TPGN-270612	22	40	200	40	SP-5	TFHCSM5-0.8x12mm	CLM-30	STCM-4	CBT-5G	TK-02832

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

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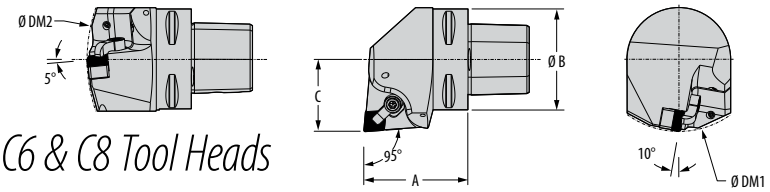
Quick-Change Toolholders

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

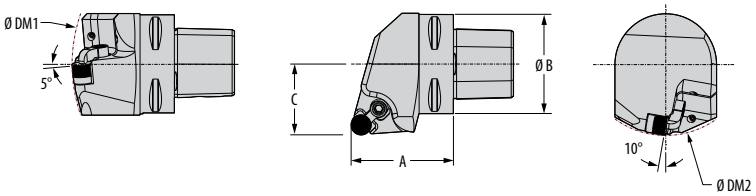
80° Diamond Negative Rake / 5º Reverse Lead / C6 & C8 Tool Heads



Part Number		Gage	Dimensions (mm)					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-120408	65	63	45	110	195	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-120408	80	80	55	235	300	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 (mm)					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	CNGN-120700	65	63	45	110	195	IRSN-43	S-46M	CLM-12	STCM-4	5691 026-03	NLM-46L	CLM9	IRSN-45
GC8-MRGNR-55080-12	GC8-MRGNL-55080-12	CNGN-120700	80	80	55	235	300	IRSN-43	S-46M	CLM-12	STCM-4	5691 026-03	NLM-46L	CLM9	IRSN-45

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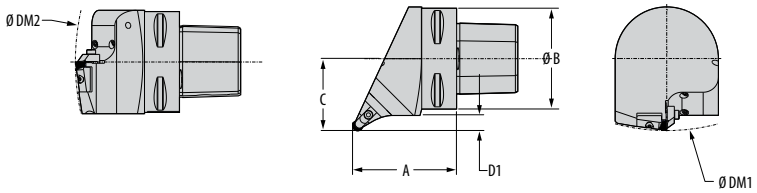
CRGPR/L

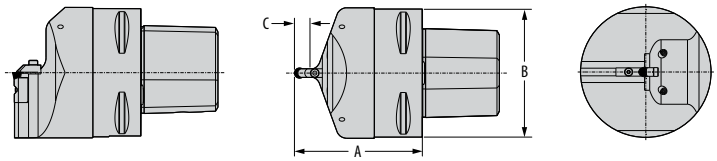
45° Grooving/Profiling / Replaceable Nest



Part Number		Gage Insert	Dimensions (mm)						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	RPGX-060400	65	63	45	9,53	250	300	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	RPGX-060400	80	80	55	9,53	300	350	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	RPGX-090700	65	63	45	9,53	250	300	414009	M3-0.5 x 12mm TBHCS	308063	M5-.8 x 12mm TSHCS	5691 026-03
GC8-CRGPR-55080-09V	GC8-CRGPL-55080-09V	RPGX-090700	80	80	55	9,53	300	350	414009	M3-0.5 x 12mm TBHCS	308063	M5-.8 x 12mm TSHCS	5691 026-03
GC6-CRGPR-45065-12V	GC6-CRGPL-45065-12V	RPGX-120700	65	63	45	9,53	250	300	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	RPGX-120700	80	80	55	9,53	300	350	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 (mm)			Standard Components				
		A	B	C	Nest	Nest Screw	Clamp	Clamp Screw	Coolant Nozzle
GC6-CRDPN-03065-06V	RPGX-060400	65	63	9,53	410631	M2.5-.45 x 10mm BHCS	308618	M3-0.5 x 12mm SHCS	5691 026-03
GC8-CRDPN-03080-06V	RCGX-120700	80	80	9,53	410631	M2.5-.45 x 10mm BHCS	308618	M3-0.5 x 12mm SHCS	5691 026-03
GC6-CRDPN-05065-09V	RPGX-090700	65	63	14,28	413970	M3-0.5 x 12mm TBHCS	308063	M5-.8 x 12mm TSHCS	5691 026-03
GC8-CRDPN-05080-09V	RCGX-090700	80	80	14,28	413970	M3-0.5 x 12mm TBHCS	308063	M5-.8 x 12mm TSHCS	5691 026-03
GC6-CRDPN-06065-12V	RPGX-120700	65	63	19,05	414007	M5-.8 x 16mm TBHCS	308136	434258 (M6-1.0 x 19mm TSHCS)	5691 026-03
GC8-CRDPN-06080-12V	RCGX-120700	80	80	19,05	414007	M5-.8 x 16mm TBHCS	308136	434258 (M6-1.0 x 19mm TSHCS)	5691 026-03

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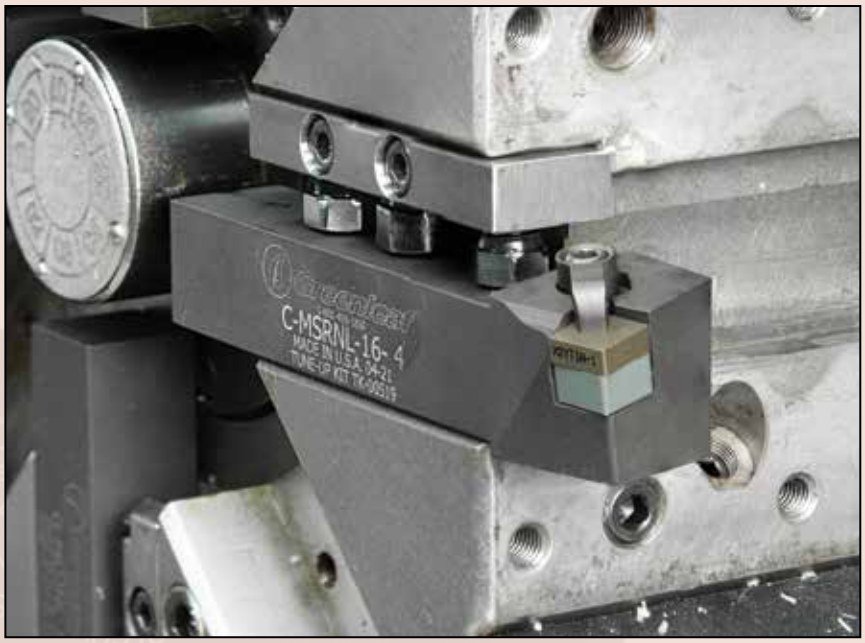
Toolholders for Ceramic Inserts

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.

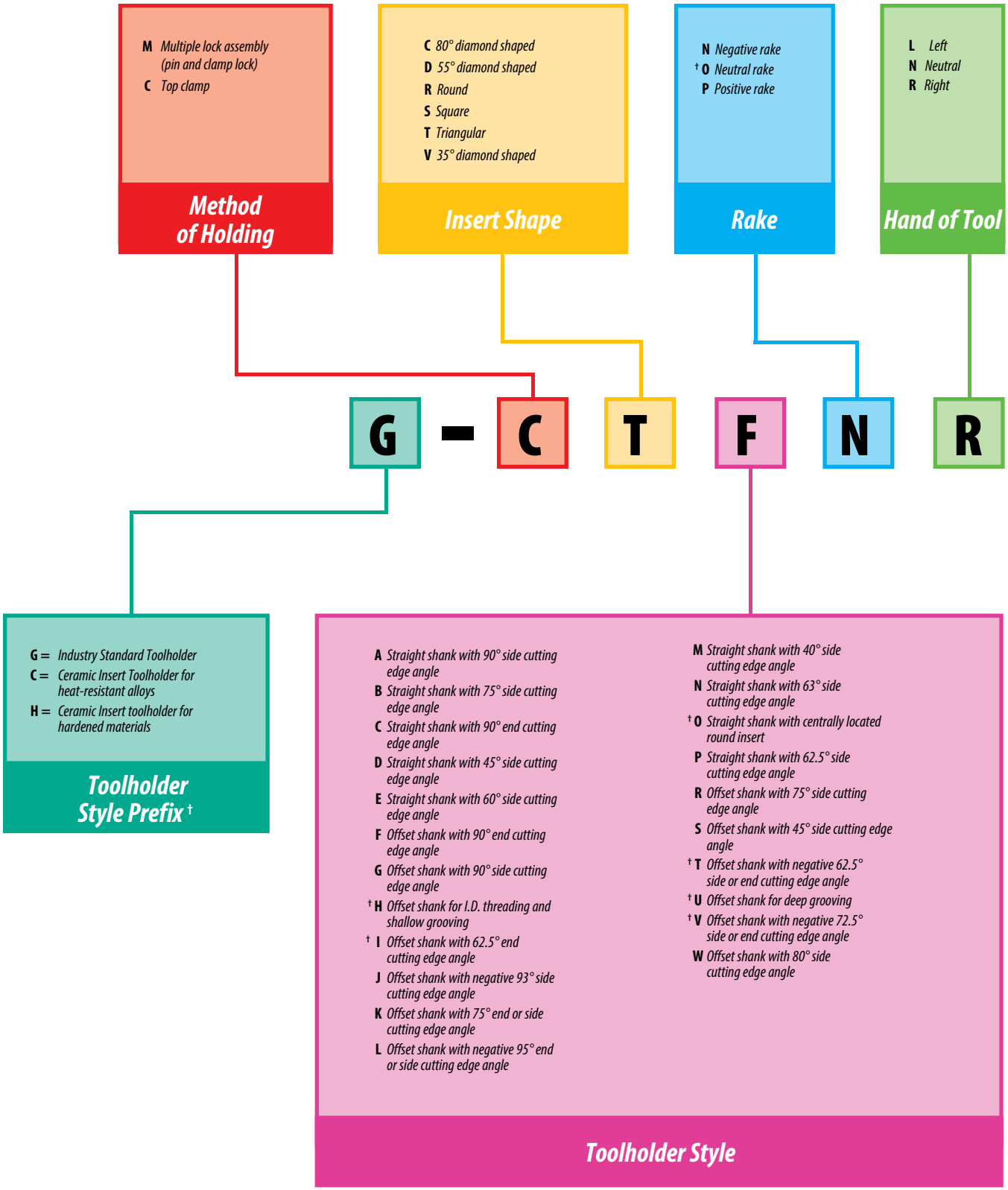
Greenleaf has designated a "C" prefix for a ceramic insert toolholder and an "H" prefix for ceramic insert toolholder for hard material machining.



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



†Greenleaf standard.

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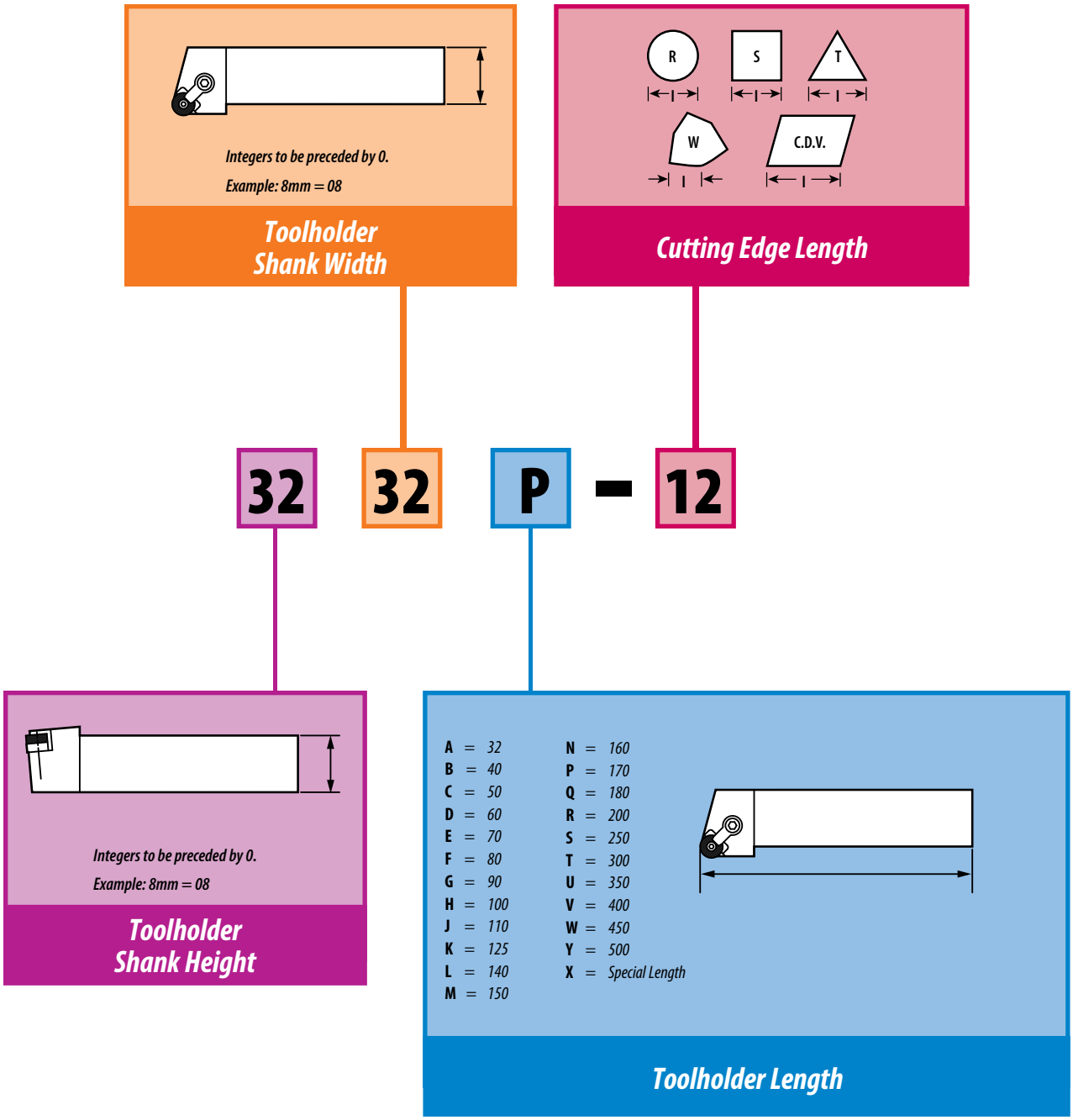
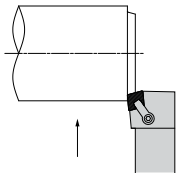


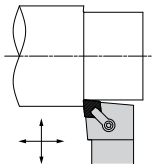
NOTE:
All toolholders are qualified to ±0,07 over gage insert radius on the "C" and "F" dimensions as standard. Some toolholders are qualifiable on the "C" length dimension only.

Pictorial Index

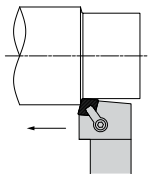
80° Diamond – Negative



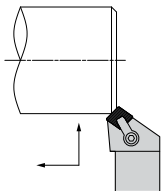
C-MCKNR/L
Style K
80° Diamond
(Using 100° Corner)
Negative Rake
75° Lead Angle
page: T 92



C-MCLNR/L
Style L
80° Diamond
Negative Rake
95° Lead Angle
page: T 92

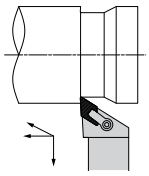


C-MCRNR/L
Style R
80° Diamond
(Using 100° Corner)
Negative Rake
75° Lead Angle
page: T 93

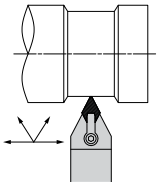


C-MCSNR/L
Style S
80° Diamond
(Using 100° Corner)
Negative Rake
45° Lead Angle
page: T 93

55° Diamond – Negative

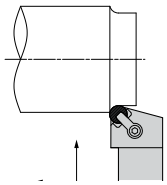


C-MDJNR/L
Style J
55° Diamond
Negative Rake
93° Lead Angle
page: T 94

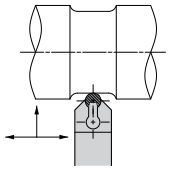


C-MDPNN
Style P
55° Diamond
Negative Rake
72,5° Lead Angle
page: T 94

Round – Negative

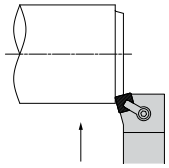


C-MRGNR/L
Style G
Round
Negative Rake
page: T 95

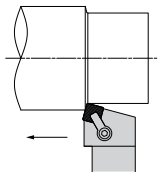


C-MRDNN
Style D
Round
Negative Rake
page: T 95

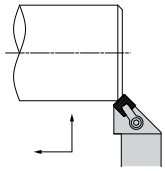
Square – Negative



C-MSKNR/L
Style K
Square
Negative Rake
75° Lead Angle
page: T 96

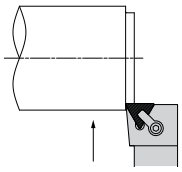


C-MSRNR/L
Style R
Square
Negative Rake
75° Lead Angle
page: T 96

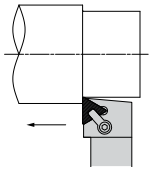


C-MSSNR/L
Style S
Square
Negative Rake
45° Lead Angle
page: T 97

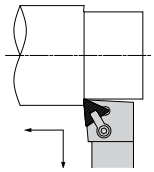
Triangle – Negative



C-MTFNR/L
Style F
Triangle
Negative Rake
90° Lead Angle
page: T 98

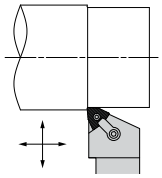


C-MTGNR/L
Style G
Triangle
Negative Rake
90° Lead Angle
page: T 98



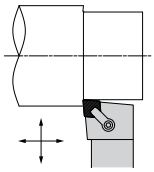
C-MTLNR/L
Style L
Triangle
Negative Rake
95° Lead Angle
page: T 99

Trigon – Negative

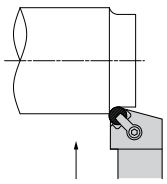


C-MWLNR/L
Style L
Trigon
Negative Rake
95° Lead Angle
page: T 99

Hard-Turning – Negative



H-MCLNR/L
Style L
80° Diamond
Negative Rake
95° Lead Angle
page: T 100



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

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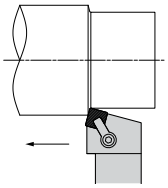
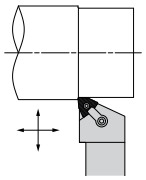
Hard-Turning – Negative *continued*

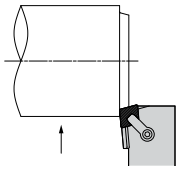


H-MSRNR/L
Style R
Square
Negative Rake
75° Lead Angle
page: T 101

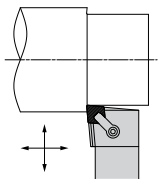


H-MWLNR/L
Style L
Trigon
Negative Rake
95° Lead Angle
page: T 101

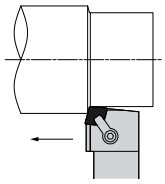
80°/100° Diamond – Positive



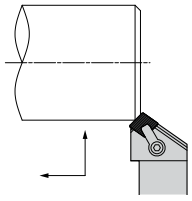
C-CCKPR/L
Style K
80° Diamond
(Using 100° Corner)
Positive Rake
75° Lead Angle
page: T 102



C-CCLPR/L
Style L
80° Diamond
Positive Rake
95° Lead Angle
page: T 102

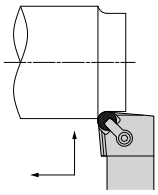


C-CCRPR/L
Style R
80° Diamond
(Using 100° Corner)
Positive Rake
75° Lead Angle
page: T 102



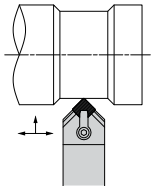
C-CCSPR/L
Style S
80° Diamond
(Using 100° Corner)
Positive Rake
45° Lead Angle
page: T 103

Round – Positive

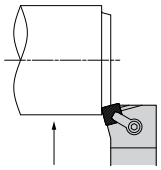


C-CRGPR/L
Style G
Round
Positive Rake
page: T 103

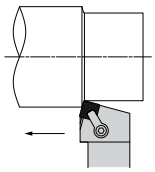
Square – Positive



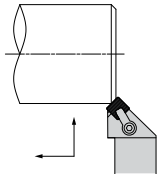
C-CSDPN
Style D
Square
Positive Rake
45° Lead Angle
page: T 104



C-CSKPR/L
Style K
Square
Positive Rake
75° Lead Angle
page: T 104

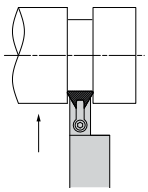


C-CSRPR/L
Style R
Square
Positive Rake
75° Lead Angle
page: T 105



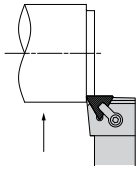
C-CSSPR/L
Style S
Square
Positive Rake
45° Lead Angle
page: T 105

Triangle – Positive

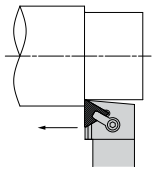


C-CTCPR/L
Style C
Triangle
Positive Rake
90° Lead Angle
page: T 106

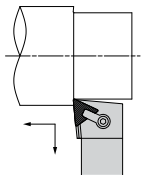
Triangle – Positive *continued*



C-CTFPR/L
Style F
Triangle
Positive Rake
90° Lead Angle
page: T 106

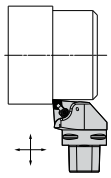


C-CTGPR/L
Style G
Triangle
Positive Rake
90° Lead Angle
page: T 107

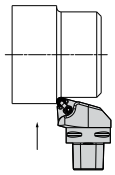


C-CTLPR/L
Style F
Triangle
Positive Rake
95° Lead Angle
page: T 107

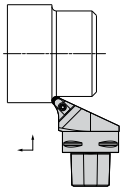
Quick-Change Toolholders



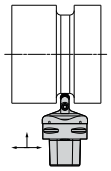
MCLNR/L
80° Diamond
Negative Rake
5° Reverse Lead
C6 & C8 Tool Heads
page: T 84



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



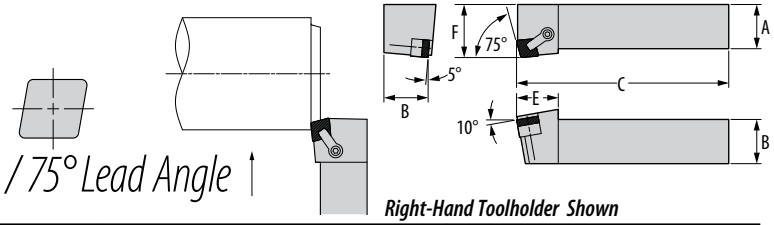
CRGPR/L
45° Grooving/Profiling
Replaceable Nest
page: T 85



CRDPN
Neutral
Replaceable Nest
page: T 85

C-MCKNR/L

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



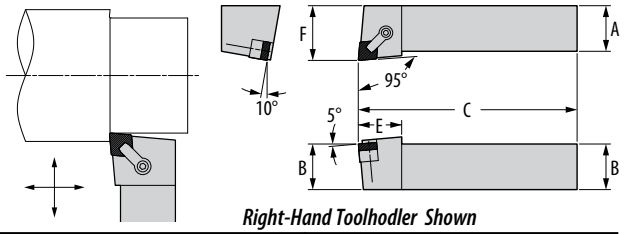
Right-Hand Toolholder Shown

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-MCKNR-2525M12	C-MCKNL-2525M12	CNGN-120408	25	25	150	30	32	CSN-453	S-46M	CLM-12	STCM-4	TK-02750	NLM-46L	CLM-9	CSN-433
C-MCKNR-2525P12	C-MCKNL-2525P12	CNGN-120408	25	25	170	30	32	CSN-453	S-46M	CLM-12	STCM-4	TK-02750	NLM-46L	CLM-9	CSN-433
C-MCKNR-3232P12	C-MCKNL-3232P12	CNGN-120408	32	32	170	30	40	CSN-453	S-46M	CLM-12	STCM-4	TK-02750	NLM-46L	CLM-9	CSN-433
C-MCKNR-3232P19	C-MCKNL-3232P19	CNGN-190612	32	32	170	36	40	CSN-643	S-68M	CLM-30	STCM-4	TK-02751	NLM-68L	CLM-12	CSN-633
C-MCKNR-4040R19	C-MCKNL-4040R19	CNGN-190612	40	40	200	36	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-MCLNR/L

Style L / 80° Diamond / Negative Rake / 95° Lead Angle



Right-Hand Toolhodler 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-MCLNR-2525M12	C-MCLNL-2525M12	CNGN-120408	25	25	150	30	32	CSN-453	S-46M	CLM-12	STCM-4	TK-02750	NLM-46L	CLM-9	CSN-433
C-MCLNR-2525P12	C-MCLNL-2525P12	CNGN-120408	25	25	170	30	32	CSN-453	S-46M	CLM-12	STCM-4	TK-02750	NLM-46L	CLM-9	CSN-433
C-MCLNR-3232P12	C-MCLNL-3232P12	CNGN-120408	32	32	170	30	40	CSN-453	S-46M	CLM-12	STCM-4	TK-02750	NLM-46L	CLM-9	CSN-433
C-MCLNR-3232P19	C-MCLNL-3232P19	CNGN-190612	32	32	170	40	40	CSN-643	S-68M	CLM-30	STCM-4	TK-02751	NLM-68L	CLM-12	CSN-633
C-MCLNR-4040R19	C-MCLNL-4040R19	CNGN-190612	40	40	200	40	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.*

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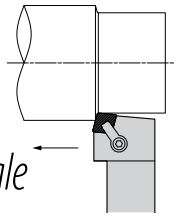
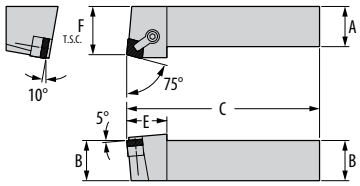
C-MCRNR/L

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





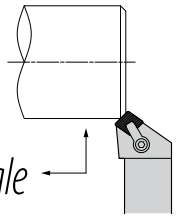
Right-Hand Toolholder Shown

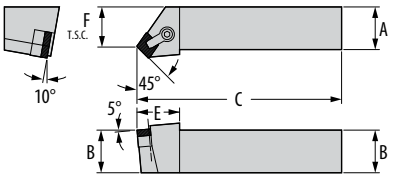
Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Components		
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp	5/16" Insert Shim Seat
C-MCRNR-2525M12	C-MCRNL-2525M12	CNGN-120408	25	25	150	32	32	CSN-453	S-46M	CLM-12	STCM-4	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





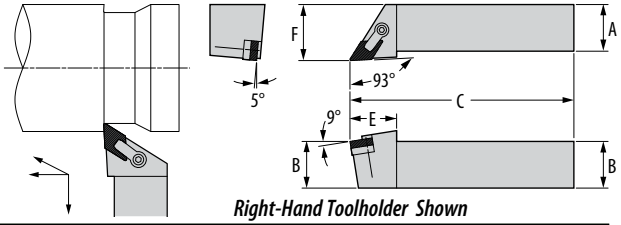
Right-Hand Toolholder Shown

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 / 93° Lead Angle



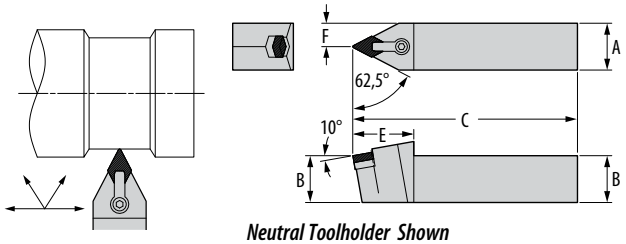
Right-Hand Toolholder Shown

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
C-MDJNR-2525M11	C-MDJNL-2525M11	DNGN-110308	25	25	150	25	32	DSN-333	S-34M	CLM-7	STCM-25	TK-02788	NLM-34L	CLM-6
C-MDJNR-2525P11	C-MDJNL-2525P11	DNGN-110308	25	25	170	25	32	DSN-333	S-34M	CLM-7	STCM-25	TK-02788	NLM-34L	CLM-6
C-MDJNR-3232P11	C-MDJNL-3232P11	DNGN-110308	32	32	170	25	40	DSN-333	S-34M	CLM-7	STCM-25	TK-02788	NLM-34L	CLM-6
C-MDJNR-2525M15	C-MDJNL-2525M15	DNGN-150408	25	25	150	32	32	DSN-433	S-46M	CLM-22	STCM-26	TK-02789	NLM-46	CLM-20
C-MDJNR-2525P15	C-MDJNL-2525P15	DNGN-150408	25	25	170	32	32	DSN-433	S-46M	CLM-22	STCM-26	TK-02789	NLM-46	CLM-20
C-MDJNR-3232P15	C-MDJNL-3232P15	DNGN-150408	32	32	170	32	40	DSN-433	S-46M	CLM-22	STCM-26	TK-02789	NLM-46	CLM-20
C-MDJNR-4040R15	C-MDJNL-4040R15	DNGN-150408	40	40	200	32	50	DSN-433	S-46M	CLM-22	STCM-26	TK-02789	NLM-46	CLM-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 / 62,5° Lead Angle



Neutral 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
C-MDPNN-2525M11		DNGN-110308	25	25	150	40	12,5	DSN-333	S-34M	CLM-12	STCM-4	TK-02785	NLM-34L	CLM-9
C-MDPNN-2525P11		DNGN-110308	25	25	170	40	12,5	DSN-333	S-34M	CLM-12	STCM-4	TK-02785	NLM-34L	CLM-9
C-MDPNN-3232P11		DNGN-110308	32	32	170	40	16	DSN-333	S-34M	CLM-12	STCM-4	TK-02785	NLM-34L	CLM-9
C-MDPNN-2525M15		DNGN-150408	25	25	150	41	12,5	DSN-433	S-46M	CLM-30	STCM-4	TK-02786	NLM-46L	CLM-12
C-MDPNN-2525P15		DNGN-150408	25	25	170	41	12,5	DSN-433	S-46M	CLM-30	STCM-4	TK-02786	NLM-46L	CLM-12
C-MDPNN-3232P15		DNGN-150408	32	32	170	41	16	DSN-433	S-46M	CLM-30	STCM-4	TK-02786	NLM-46L	CLM-12
C-MDPNN-4040R15		DNGN-150408	40	40	200	41	20	DSN-433	S-46M	CLM-30	STCM-4	TK-02786	NLM-46L	CLM-12

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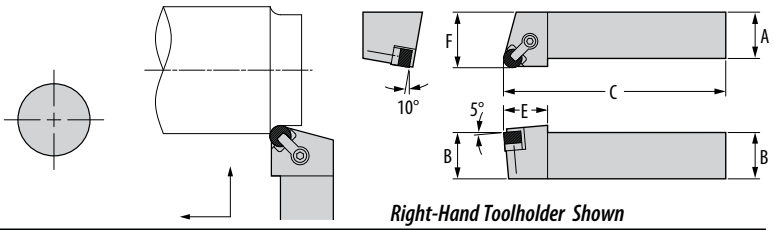
C-MRGNR/L

Style G / Round / Negative Rake



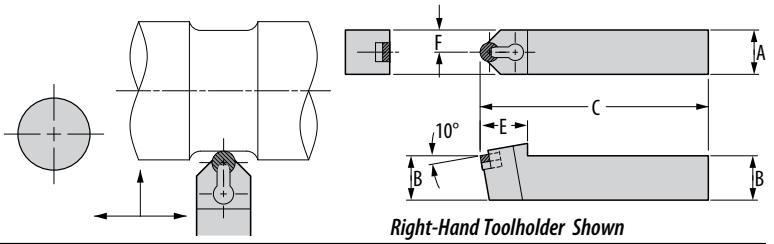
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (mm)					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-2525M09	C-MRGNL-2525M09	RNGN-090400	25	25	150	25	32	RSN-32	S-34M	CLM-7	STCM-25	TK-02790	NLM-34L	CLM-6	3,18	RSN-33
C-MRGNR-2525P09	C-MRGNL-2525P09	RNGN-090400	25	25	170	25	32	RSN-32	S-34M	CLM-7	STCM-25	TK-02790	NLM-34L	CLM-6	3,18	RSN-33
C-MRGNR-3232P09	C-MRGNL-3232P09	RNGN-090400	32	32	170	25	40	RSN-32	S-34M	CLM-7	STCM-25	TK-02790	NLM-34L	CLM-6	3,18	RSN-33
C-MRGNR-2525M12	C-MRGNL-2525M12	RNGN-120700	25	25	150	30	32	IRSN-43	S-46M	CLM-12	STCM-4	TK-02791	NLM-46L	CLM-9	4,75	IRSN-45
C-MRGNR-2525P12	C-MRGNL-2525P12	RNGN-120700	25	25	170	30	32	IRSN-43	S-46M	CLM-12	STCM-4	TK-02791	NLM-46L	CLM-9	4,75	IRSN-45
C-MRGNR-3232P12	C-MRGNL-3232P12	RNGN-120700	32	32	170	30	40	IRSN-43	S-46M	CLM-12	STCM-4	TK-02791	NLM-46L	CLM-9	4,75	IRSN-45
C-MRGNR-4040R12	C-MRGNL-4040R12	RNGN-120700	40	40	200	30	50	IRSN-43	S-46M	CLM-12	STCM-4	TK-02791	NLM-46L	CLM-9	4,75	IRSN-45
C-MRGNR-2525M19	C-MRGNL-2525M19	RNGN-190700	25	25	150	38	32	RSN-63	S-68M	CLM-30	STCM-4	TK-02792	NLM-68L	CLM-12	–	–
C-MRGNR-2525P19	C-MRGNL-2525P19	RNGN-190700	25	25	170	38	32	RSN-63	S-68M	CLM-30	STCM-4	TK-02792	NLM-68L	CLM-12	–	–
C-MRGNR-3232P19	C-MRGNL-3232P19	RNGN-190700	32	32	170	38	40	RSN-63	S-68M	CLM-30	STCM-4	TK-02792	NLM-68L	CLM-12	–	–
C-MRGNR-4040R19	C-MRGNL-4040R19	RNGN-190700	40	40	200	38	50	RSN-63	S-68M	CLM-30	STCM-4	TK-02792	NLM-68L	CLM-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



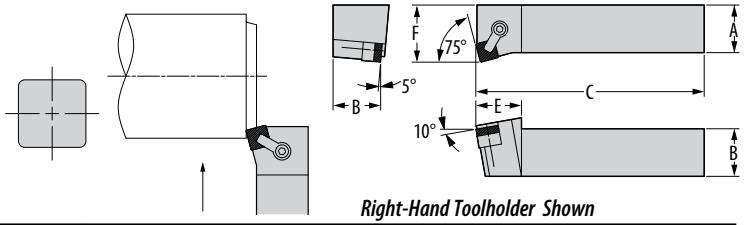
Right-Hand Toolholder Shown

Part Number	Gage	Dimensions (mm)					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-2525M09	RNGN-090400	25	25	150	25	12,5	RSN-32	S-34M	CLM-7	STCM-25	TK-02790	NLM-34L	CLM-6	3,18	RSN-33
C-MRDNN-2525P09	RNGN-090400	25	25	170	25	12,5	RSN-32	S-34M	CLM-7	STCM-25	TK-02790	NLM-34L	CLM-6	3,18	RSN-33
C-MRDNN-3232P09	RNGN-090400	32	32	170	25	16	RSN-32	S-34M	CLM-7	STCM-25	TK-02790	NLM-34L	CLM-6	3,18	RSN-33
C-MRDNN-2525M12	RNGN-120700	25	25	150	35	12,5	IRSN-43	S-46M	CLM-12	STCM-4	TK-02791	NLM-46L	CLM-9	4,75	IRSN-45
C-MRDNN-2525P12	RNGN-120700	25	25	170	35	12,5	IRSN-43	S-46M	CLM-12	STCM-4	TK-02791	NLM-46L	CLM-9	4,75	IRSN-45
C-MRDNN-3232P12	RNGN-120700	32	32	170	35	16	IRSN-43	S-46M	CLM-12	STCM-4	TK-02791	NLM-46L	CLM-9	4,75	IRSN-45
C-MRDNN-4040R12	RNGN-120700	40	40	200	35	20	IRSN-43	S-46M	CLM-12	STCM-4	TK-02791	NLM-46L	CLM-9	4,75	IRSN-45
C-MRDNN-2525M19	RNGN-190700	25	25	150	40	12,5	RSN-63	S-68M	CLM-30	STCM-4	TK-02792	NLM-68L	CLM-12	–	–
C-MRDNN-2525P19	RNGN-190700	25	25	170	40	12,5	RSN-63	S-68M	CLM-30	STCM-4	TK-02792	NLM-68L	CLM-12	–	–
C-MRDNN-3232P19	RNGN-190700	32	32	170	40	16	RSN-63	S-68M	CLM-30	STCM-4	TK-02792	NLM-68L	CLM-12	–	–
C-MRDNN-4040R19	RNGN-190700	40	40	200	40	20	RSN-63	S-68M	CLM-30	STCM-4	TK-02792	NLM-68L	CLM-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 / 75° Lead Angle



Right-Hand Toolholder Shown

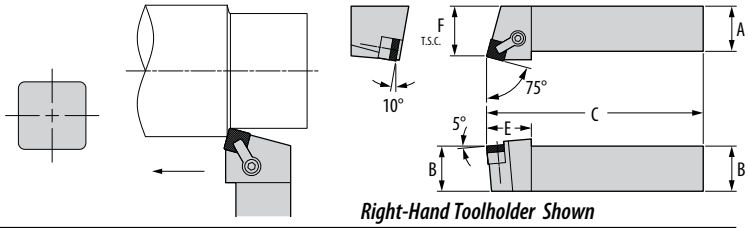
Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Components		
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp	5/16" Insert Shim Seat
C-MSKNR-2525M12	C-MSKNL-2525M12	SNGN-120408	25	25	150	31	32	ISSN-453	S-46M	CLM-12	STCM-4	TK-02793	NLM-46L	CLM-9	ISSN-433
C-MSKNR-2525P12	C-MSKNL-2525P12	SNGN-120408	25	25	170	31	32	ISSN-453	S-46M	CLM-12	STCM-4	TK-02793	NLM-46L	CLM-9	ISSN-433
C-MSKNR-3232P12	C-MSKNL-3232P12	SNGN-120408	32	32	170	31	40	ISSN-453	S-46M	CLM-12	STCM-4	TK-02793	NLM-46L	CLM-9	ISSN-433
C-MSKNR-3232P15	C-MSKNL-3232P15	SNGN-150612	32	32	170	36	40	SSN-533	S-58M	CLM-12	STCM-4	TK-02794	NLM-58	CLM-9	–
C-MSKNR-4040R15	C-MSKNL-4040R15	SNGN-150612	40	40	200	36	50	SSN-533	S-58M	CLM-12	STCM-4	TK-02794	NLM-58	CLM-9	–
C-MSKNR-3232P19	C-MSKNL-3232P19	SNGN-190612	32	32	170	40	40	ISSN-633	S-68M	CLM-30	STCM-4	TK-02795	NLM-68	CLM-12	**ISSN-623
C-MSKNR-4040R19	C-MSKNL-4040R19	SNGN-190612	40	40	200	40	50	ISSN-633	S-68M	CLM-30	STCM-4	TK-02795	NLM-68	CLM-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 / 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-MSRNR-2525M12	C-MSRNL-2525M12	SNGN-120408	25	25	150	31	28	ISSN-453	S-46M	CLM-12	STCM-4	TK-02793	NLM-46L	CLM-9	ISSN-433
C-MSRNR-2525P12	C-MSRNL-2525P12	SNGN-120408	25	25	170	31	28	ISSN-453	S-46M	CLM-12	STCM-4	TK-02793	NLM-46L	CLM-9	ISSN-433
C-MSRNR-3232P12	C-MSRNL-3232P12	SNGN-120408	32	32	170	31	39	ISSN-453	S-46M	CLM-12	STCM-4	TK-02793	NLM-46L	CLM-9	ISSN-433
C-MSRNR-3232P15	C-MSRNL-3232P15	SNGN-150612	32	32	170	37	34	SSN-533	S-58M	CLM-12	STCM-4	TK-02794	NLM-58	CLM-9	–
C-MSRNR-4040R15	C-MSRNL-4040R15	SNGN-150612	40	40	200	37	47	SSN-533	S-58M	CLM-12	STCM-4	TK-02794	NLM-58	CLM-9	–
C-MSRNR-3232P19	C-MSRNL-3232P19	SNGN-190612	32	32	170	40	33	ISSN-633	S-68M	CLM-30	STCM-4	TK-02795	NLM-68	CLM-12	**ISSN-623
C-MSRNR-4040R19	C-MSRNL-4040R19	SNGN-190612	40	40	200	40	46	ISSN-633	S-68M	CLM-30	STCM-4	TK-02795	NLM-68	CLM-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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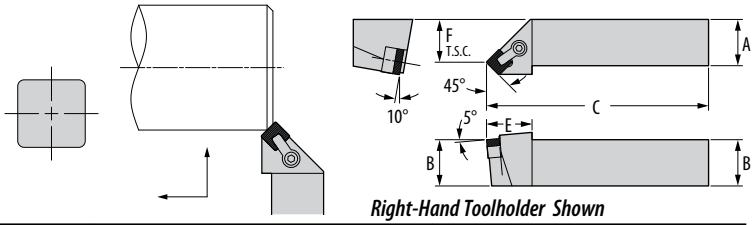
C-MSSNR/L

Style S / Square / Negative Rake / 45° Lead Angle



Right-Hand Toolholder Shown

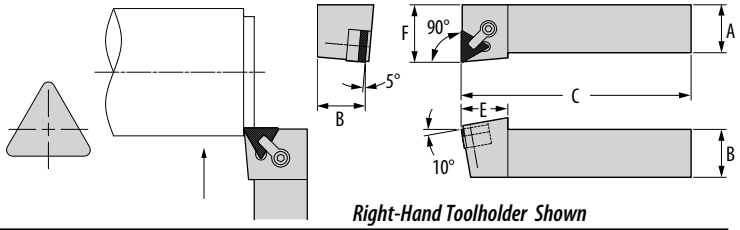
Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Components		
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp	5/16" Insert Shim Seat
C-MSSNR-2525M12	C-MSSNL-2525M12	SNGN-120408	25	25	150	31	23	ISSN-453	S-46M	CLM-12	STCM-4	TK-02793	NLM-46L	CLM-9	ISSN-433
C-MSSNR-2525P12	C-MSSNL-2525P12	SNGN-120408	25	25	170	31	23	ISSN-453	S-46M	CLM-12	STCM-4	TK-02793	NLM-46L	CLM-9	ISSN-433
C-MSSNR-3232P12	C-MSSNL-3232P12	SNGN-120408	32	32	170	31	29	ISSN-453	S-46M	CLM-12	STCM-4	TK-02793	NLM-46L	CLM-9	ISSN-433
C-MSSNR-3232P15	C-MSSNL-3232P15	SNGN-150612	32	32	170	35	27	SSN-533	S-58M	CLM-12	STCM-4	TK-02794	NLM-58	CLM-9	–
C-MSSNR-4040R15	C-MSSNL-4040R15	SNGN-150612	40	40	200	35	40	SSN-533	S-58M	CLM-12	STCM-4	TK-02794	NLM-58	CLM-9	–
C-MSSNR-3232P19	C-MSSNL-3232P19	SNGN-190612	32	32	170	38	25	ISSN-633	S-68M	CLM-30	STCM-4	TK-02795	NLM-68	CLM-12	**ISSN-623
C-MSSNR-4040R19	C-MSSNL-4040R19	SNGN-190612	40	40	200	38	40	ISSN-633	S-68M	CLM-30	STCM-4	TK-02795	NLM-68	CLM-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 / 90° Lead Angle



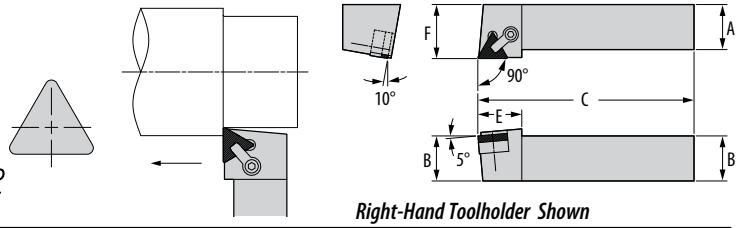
Right-Hand Toolholder Shown

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-MTFNR-2525M16	C-MTFNL-2525M16	TNGN-160408	25	25	150	24	32	ITSN-322	S-34M	CLM-7	STCM-25	TK-02809	NLM-34L	CLM-6	–
C-MTFNR-2525P16	C-MTFNL-2525P16	TNGN-160408	25	25	170	24	32	ITSN-322	S-34M	CLM-7	STCM-25	TK-02809	NLM-34L	CLM-6	–
C-MTFNR-3232P16	C-MTFNL-3232P16	TNGN-160408	32	32	170	24	40	ITSN-322	S-34M	CLM-7	STCM-25	TK-02809	NLM-34L	CLM-6	–
C-MTFNR-2525M22	C-MTFNL-2525M22	TNGN-220408	25	25	150	30	32	ITSN-453	S-46M	CLM-12	STCM-4	TK-02810	NLM-46L	CLM-9	ITSN-433
C-MTFNR-2525P22	C-MTFNL-2525P22	TNGN-220408	25	25	170	30	32	ITSN-453	S-46M	CLM-12	STCM-4	TK-02810	NLM-46L	CLM-9	ITSN-433
C-MTFNR-3232P22	C-MTFNL-3232P22	TNGN-220408	32	32	170	30	40	ITSN-453	S-46M	CLM-12	STCM-4	TK-02810	NLM-46L	CLM-9	ITSN-433
C-MTFNR-4040R22	C-MTFNL-4040R22	TNGN-220408	40	40	200	30	50	ITSN-453	S-46M	CLM-12	STCM-4	TK-02810	NLM-46L	CLM-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 / 90° 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-MTGNR-2525M16	C-MTGNL-2525M16	TNGN-160408	25	25	150	28	32	ITSN-322	S-34M	CLM-7	STCM-25	TK-02809	NLM-34L	CLM-6	–
C-MTGNR-2525P16	C-MTGNL-2525P16	TNGN-160408	25	25	170	28	32	ITSN-322	S-34M	CLM-7	STCM-25	TK-02809	NLM-34L	CLM-6	–
C-MTGNR-3232P16	C-MTGNL-3232P16	TNGN-160408	32	32	170	28	40	ITSN-322	S-34M	CLM-7	STCM-25	TK-02809	NLM-34L	CLM-6	–
C-MTGNR-2525M22	C-MTGNL-2525M22	TNGN-220408	25	25	150	30	32	ITSN-453	S-46M	CLM-12	STCM-4	TK-02810	NLM-46L	CLM-9	ITSN-433
C-MTGNR-2525P22	C-MTGNL-2525P22	TNGN-220408	25	25	170	30	32	ITSN-453	S-46M	CLM-12	STCM-4	TK-02810	NLM-46L	CLM-9	ITSN-433
C-MTGNR-3232P22	C-MTGNL-3232P22	TNGN-220408	32	32	170	30	40	ITSN-453	S-46M	CLM-12	STCM-4	TK-02810	NLM-46L	CLM-9	ITSN-433
C-MTGNR-4040R22	C-MTGNL-4040R22	TNGN-220408	40	40	200	30	50	ITSN-453	S-46M	CLM-12	STCM-4	TK-02810	NLM-46L	CLM-9	ITSN-433

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

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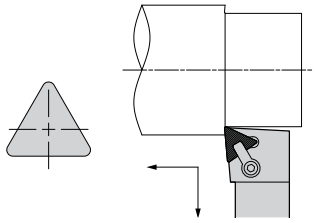
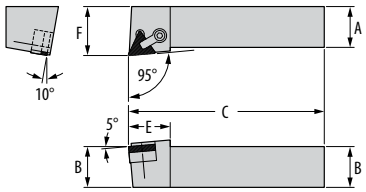
C-MTLNR/L

Style L / Triangle / Negative Rake / 95° Lead Angle





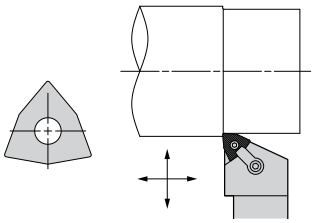
Right-Hand Toolholder Shown

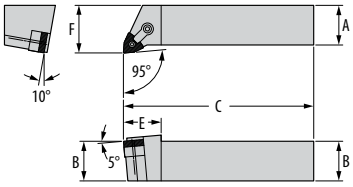
Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Components		
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp	5/16" Insert Shim Seat
C-MTLNR-2525M16	C-MTLNL-2525M16	TNGN-160408	25	25	150	28	32	ITSN-322	S-34M	CLM-7	STCM-25	TK-02809	NLM-34L	CLM-6	–
C-MTLNR-2525P16	C-MTLNL-2525P16	TNGN-160408	25	25	170	28	32	ITSN-322	S-34M	CLM-7	STCM-25	TK-02809	NLM-34L	CLM-6	–
C-MTLNR-3232P16	C-MTLNL-3232P16	TNGN-160408	32	32	170	28	40	ITSN-322	S-34M	CLM-7	STCM-25	TK-02809	NLM-34L	CLM-6	–
C-MTLNR-2525M22	C-MTLNL-2525M22	TNGN-220408	25	25	150	30	32	ITSN-453	S-46M	CLM-12	STCM-4	TK-02810	NLM-46L	CLM-9	ITSN-433
C-MTLNR-2525P22	C-MTLNL-2525P22	TNGN-220408	25	25	170	30	32	ITSN-453	S-46M	CLM-12	STCM-4	TK-02810	NLM-46L	CLM-9	ITSN-433
C-MTLNR-3232P22	C-MTLNL-3232P22	TNGN-220408	32	32	170	30	40	ITSN-453	S-46M	CLM-12	STCM-4	TK-02810	NLM-46L	CLM-9	ITSN-433
C-MTLNR-4040R22	C-MTLNL-4040R22	TNGN-220408	40	40	200	30	50	ITSN-453	S-46M	CLM-12	STCM-4	TK-02810	NLM-46L	CLM-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 / 95° Lead Angle





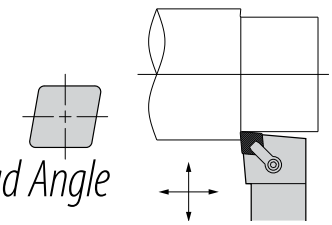
Right-Hand Toolholder Shown

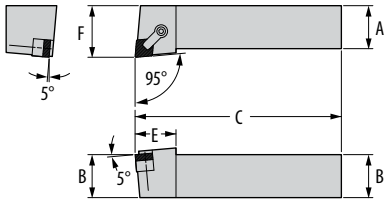
Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-MWLNR-2020M06	C-MWLNL-2020M06	WNGA-060408	20	20	150	25	25	IWSN-322	NLM-34L	CLM-6	STCM-25	TK-02811
C-MWLNR-2525M06	C-MWLNL-2525M06	WNGA-060408	25	25	150	25	32	IWSN-322	NLM-34L	CLM-6	STCM-25	TK-02811
C-MWLNR-3232P06	C-MWLNL-3232P06	WNGA-060408	32	32	170	25	40	IWSN-322	NLM-34L	CLM-6	STCM-25	TK-02811
C-MWLNR-4040R06	C-MWLNL-4040R06	WNGA-060408	40	40	200	25	50	IWSN-322	NLM-34L	CLM-6	STCM-25	TK-02811
C-MWLNR-2020M08	C-MWLNL-2020M08	WNGA-080408	20	20	150	27	25	IWSN-453	NLM-46L	CLM-20	STCM-26	TK-02812
C-MWLNR-2525M08	C-MWLNL-2525M08	WNGA-080408	25	25	150	27	32	IWSN-453	NLM-46L	CLM-20	STCM-26	TK-02812
C-MWLNR-3232P08	C-MWLNL-3232P08	WNGA-080408	32	32	170	27	40	IWSN-453	NLM-46L	CLM-20	STCM-26	TK-02812
C-MWLNR-4040R08	C-MWLNL-4040R08	WNGA-080408	40	40	200	27	50	IWSN-453	NLM-46L	CLM-20	STCM-26	TK-02812

** 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 / 95° Lead Angle





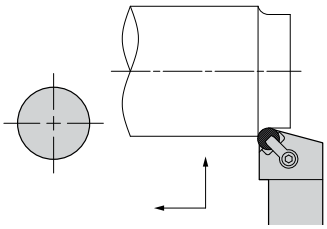
Right-Hand Toolholder Shown

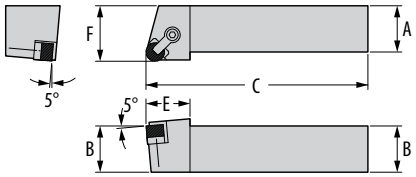
Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Components		
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp	5/16" Insert Shim Seat
H-MCLNR-2525M12	H-MCLNL-2525M12	CNGN-120408	25	25	150	30	32	CSN-453	S-46M	CLM-12	STCM-4	TK-02750	NLM-46L	CLM-9	CSN-433
H-MCLNR-2525P12	H-MCLNL-2525P12	CNGN-120408	25	25	170	30	32	CSN-453	S-46M	CLM-12	STCM-4	TK-02750	NLM-46L	CLM-9	CSN-433
H-MCLNR-3232P12	H-MCLNL-3232P12	CNGN-120408	32	32	170	30	40	CSN-453	S-46M	CLM-12	STCM-4	TK-02750	NLM-46L	CLM-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 (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	3/16" Insert Shim Seat
H-MRGNR-2525M12	H-MRGNL-2525M12	RNGN-120700	25	25	150	30	32	IRSN-43	S-46M	CLM-12	STCM-4	TK-02791	NLM-46L	CLM-9	IRSN-45
H-MRGNR-2525P12	H-MRGNL-2525P12	RNGN-120700	25	25	170	30	32	IRSN-43	S-46M	CLM-12	STCM-4	TK-02791	NLM-46L	CLM-9	IRSN-45
H-MRGNR-3232P12	H-MRGNL-3232P12	RNGN-120700	32	32	170	30	40	IRSN-43	S-46M	CLM-12	STCM-4	TK-02791	NLM-46L	CLM-9	IRSN-45
H-MRGNR-4040R12	H-MRGNL-4040R12	RNGN-120700	40	40	200	30	50	IRSN-43	S-46M	CLM-12	STCM-4	TK-02791	NLM-46L	CLM-9	IRSN-45

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

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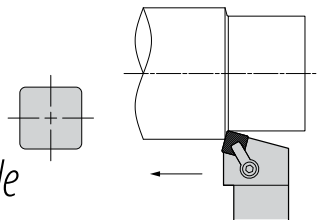
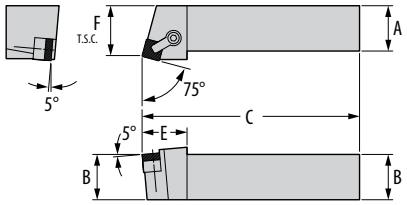
H-MSRNR/L

Style R / Square / Negative Rake / 75° Lead Angle





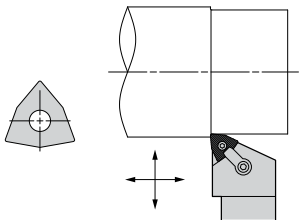
Right-Hand Toolholder Shown

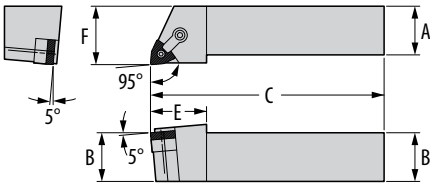
Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit	Optional Components		
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp	5/16" Insert Shim Seat
H-MSRNR-2525M12	H-MSRNL-2525M12	SNGN-120408	25	25	150	31	28	ISSN-453	S-46M	CLM-12	STCM-4	TK-02793	NLM-46L	CLM-9	ISSN-433
H-MSRNR-2525P12	H-MSRNL-2525P12	SNGN-120408	25	25	170	31	28	ISSN-453	S-46M	CLM-12	STCM-4	TK-02793	NLM-46L	CLM-9	ISSN-433
H-MSRNR-3232P12	H-MSRNL-3232P12	SNGN-120408	32	32	170	31	35	ISSN-453	S-46M	CLM-12	STCM-4	TK-02793	NLM-46L	CLM-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 / 95° Lead Angle





Right-Hand Toolholder Shown

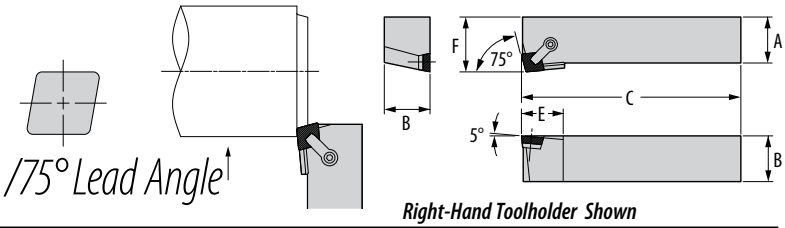
Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
H-MWLNR-2020M06	H-MWLNL-2020M06	WNGA-060408	20	20	150	25	25	IWSN-322	NLM-34L	CLM-6	STCM-25	TK-02811
H-MWLNR-2525M06	H-MWLNL-2525M06	WNGA-060408	25	25	150	25	32	IWSN-322	NLM-34L	CLM-6	STCM-25	TK-02811
H-MWLNR-3232P06	H-MWLNL-3232P06	WNGA-060408	32	32	170	25	40	IWSN-322	NLM-34L	CLM-6	STCM-25	TK-02811
H-MWLNR-4040R06	H-MWLNL-4040R06	WNGA-060408	40	40	200	25	50	IWSN-322	NLM-34L	CLM-6	STCM-25	TK-02811
H-MWLNR-2020M08	H-MWLNL-2020M08	WNGA-080408	20	20	150	27	25	IWSN-453	NLM-46L	CLM-20	STCM-26	TK-02812
H-MWLNR-2525M08	H-MWLNL-2525M08	WNGA-080408	25	25	150	27	32	IWSN-453	NLM-46L	CLM-20	STCM-26	TK-02812
H-MWLNR-3232P08	H-MWLNL-3232P08	WNGA-080408	32	32	170	27	40	IWSN-453	NLM-46L	CLM-20	STCM-26	TK-02812
H-MWLNR-4040R08	H-MWLNL-4040R08	WNGA-080408	40	40	200	27	50	IWSN-453	NLM-46L	CLM-20	STCM-26	TK-02812

** 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 /75° Lead Angle



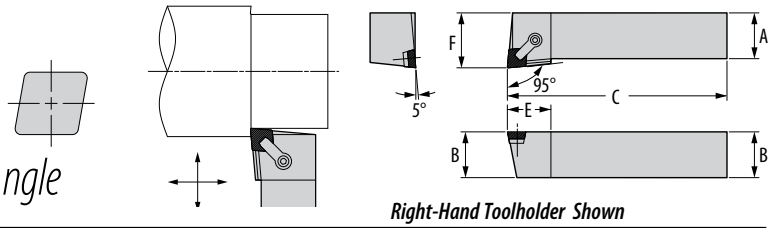
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CCKPR-2525M12	C-CCKPL-2525M12	CPGN-120408	25	25	150	30	32	SP-49	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02779
C-CCKPR-2525P12	C-CCKPL-2525P12	CPGN-120408	25	25	170	30	32	SP-49	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02779
C-CCKPR-3232P12	C-CCKPL-3232P12	CPGN-120408	32	32	170	30	40	SP-49	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02779

** 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 / 95° Lead Angle



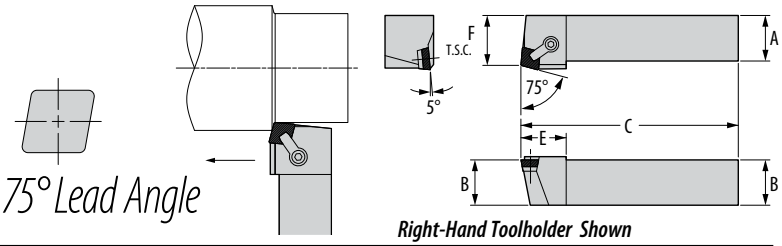
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CCLPR-2525M12	C-CCLPL-2525M12	CPGN-120408	25	25	150	30	32	SP-49	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02779
C-CCLPR-2525P12	C-CCLPL-2525P12	CPGN-120408	25	25	170	30	32	SP-49	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02779
C-CCLPR-3232P12	C-CCLPL-3232P12	CPGN-120408	32	32	170	30	40	SP-49	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02779

** 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 / 75° Lead Angle



Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CCRPR-2525M12	C-CCRPL-2525M12	CPGN-120408	25	25	150	32	32	SP-49	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02779
C-CCRPR-2525P12	C-CCRPL-2525P12	CPGN-120408	25	25	170	32	32	SP-49	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02779
C-CCRPR-3232P12	C-CCRPL-3232P12	CPGN-120408	32	32	170	32	40	SP-49	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02779

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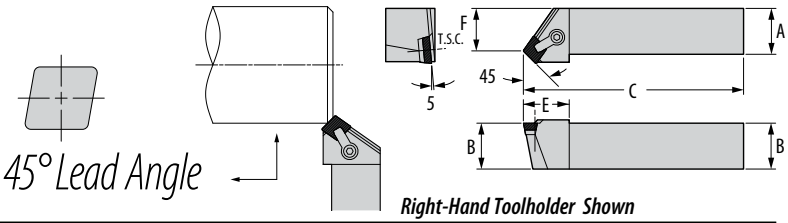
C-CCSPR/L

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



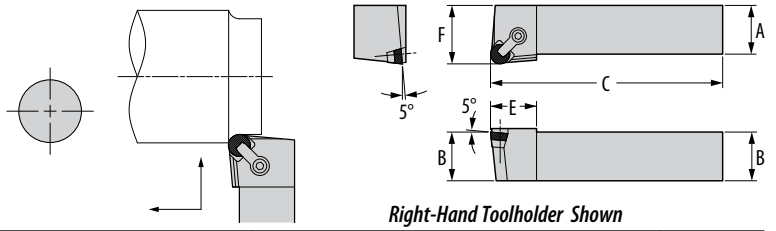
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CCSPR-2525M12	C-CCSPL-2525M12	CPGN-120408	25	25	150	32	32	SP-49	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02779
C-CCSPR-2525P12	C-CCSPL-2525P12	CPGN-120408	25	25	170	32	32	SP-49	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02779
C-CCSPR-3232P12	C-CCSPL-3232P12	CPGN-120408	32	32	170	32	40	SP-49	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02779

** 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 (mm)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CRGPR-2525M09	C-CRGPL-2525M09	RPGN-090300	25	25	150	25	32	SP-34	TSHCSM2-0.4x6mm	CLM-7	STCM-25	TK-02813
C-CRGPR-2525P09	C-CRGPL-2525P09	RPGN-090300	25	25	170	25	32	SP-34	TSHCSM2-0.4x6mm	CLM-7	STCM-25	TK-02813
C-CRGPR-3232P09	C-CRGPL-3232P09	RPGN-090300	32	32	170	25	40	SP-34	TSHCSM2-0.4x6mm	CLM-7	STCM-25	TK-02813
C-CRGPR-2525M12	C-CRGPL-2525M12	RPGN-120400	25	25	150	30	32	SP-44	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02814
C-CRGPR-2525P12	C-CRGPL-2525P12	RPGN-120400	25	25	170	30	32	SP-44	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02814
C-CRGPR-3232P12	C-CRGPL-3232P12	RPGN-120400	32	32	170	30	40	SP-44	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02814
C-CRGPR-4040R12	C-CRGPL-4040R12	RPGN-120400	40	40	200	30	50	SP-44	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02814

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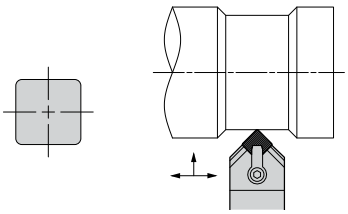
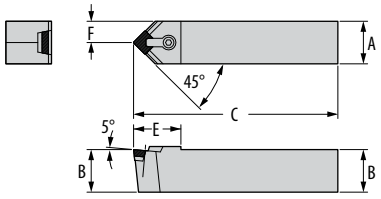
C-CSDPN

Style D / Square / Positive Rake / 45° Lead Angle





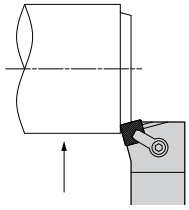
Neutral Toolholder Shown

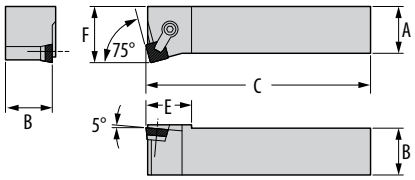
Part Number	Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit
Neutral	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CSDPN-2525M12	SPGN-120408	25	25	150	35	12,5	SP-41	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02780
C-CSDPN-2525P12	SPGN-120408	25	25	170	35	12,5	SP-41	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02780
C-CSDPN-3232P12	SPGN-120408	32	32	170	35	16	SP-41	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02780

** 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 / 75° Lead Angle





Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CSKPR-2525M12	C-CSKPL-2525M12	SPGN-120408	25	25	150	31	32	SP-41	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02780
C-CSKPR-2525P12	C-CSKPL-2525P12	SPGN-120408	25	25	170	31	32	SP-41	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02780
C-CSKPR-3232P12	C-CSKPL-3232P12	SPGN-120408	32	32	170	31	40	SP-41	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02780

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

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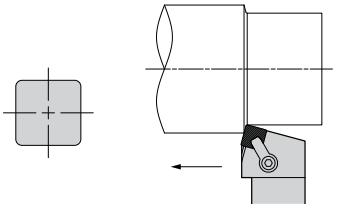
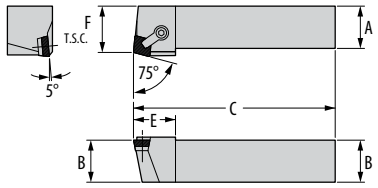
C-CSRPR/L

Style R / Square / Positive Rake / 75° Lead Angle





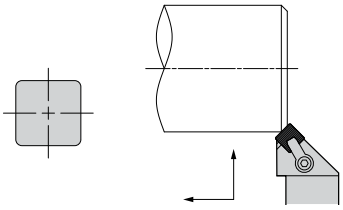
Right-Hand Toolholder Shown

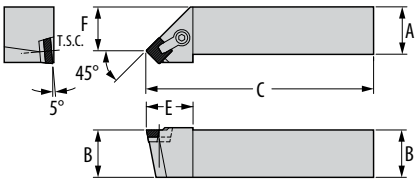
Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CSRPR-2525M12	C-CSRPL-2525M12	SPGN-120408	25	25	150	31	28	SP-41	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02780
C-CSRPR-2525P12	C-CSRPL-2525P12	SPGN-120408	25	25	170	31	28	SP-41	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02780
C-CSRPR-3232P12	C-CSRPL-3232P12	SPGN-120408	32	32	170	31	35	SP-41	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02780

** 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 Angle





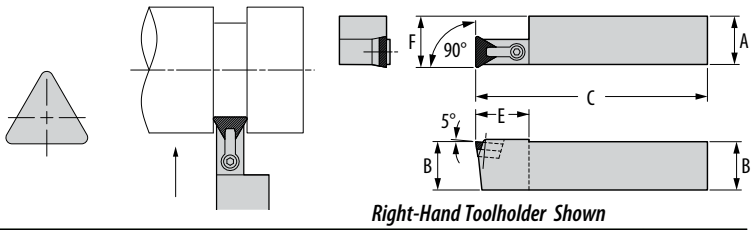
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CSSPR-2525M12	C-CSSPL-2525M12	SPGN-120408	25	25	150	31	23	SP-41	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02780
C-CSSPR-2525P12	C-CSSPL-2525P12	SPGN-120408	25	25	170	31	23	SP-41	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02780
C-CSSPR-3232P12	C-CSSPL-3232P12	SPGN-120408	32	32	170	31	29	SP-41	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02780

** 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 / 90° Lead Angle



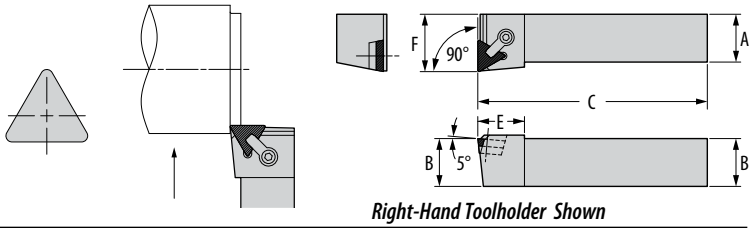
Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CTCPR-2525M16	C-CTCPL-2525M16	TPGN-160308	25	25	150	29	26,2	SP3A	TFHCSM3-0.5x10mm	CLM-22	STCM-26	TK-02815
C-CTCPR-2525P16	C-CTCPL-2525P16	TPGN-160308	25	25	170	29	26,2	SP3A	TFHCSM3-0.5x10mm	CLM-22	STCM-26	TK-02815
C-CTCPR-3232P16	C-CTCPL-3232P16	TPGN-160308	32	32	170	29	33,2	SP3A	TFHCSM3-0.5x10mm	CLM-22	STCM-26	TK-02815
C-CTCPR-2525M22	C-CTCPL-2525M22	TPGN-220408	25	25	150	35	27	SP-4	TFHCSM3-0.5x12mm	CLM-30	STCM-4	TK-02816
C-CTCPR-2525P22	C-CTCPL-2525P22	TPGN-220408	25	25	170	35	27	SP-4	TFHCSM3-0.5x12mm	CLM-30	STCM-4	TK-02816
C-CTCPR-3232P22	C-CTCPL-3232P22	TPGN-220408	32	32	170	35	34	SP-4	TFHCSM3-0.5x12mm	CLM-30	STCM-4	TK-02816
C-CTCPR-4040R22	C-CTCPL-4040R22	TPGN-220408	40	40	200	35	42	SP-4	TFHCSM3-0.5x12mm	CLM-30	STCM-4	TK-02816

** 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 / 90° Lead Angle



Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CTFPR-2525M16	C-CTFPL-2525M16	TPGN-160308	25	25	150	24	32	SP3A	TFHCSM3-0.5x10mm	CLM-7	STCM-25	TK-02817
C-CTFPR-2525P16	C-CTFPL-2525P16	TPGN-160308	25	25	170	24	32	SP3A	TFHCSM3-0.5x10mm	CLM-7	STCM-25	TK-02817
C-CTFPR-3232P16	C-CTFPL-3232P16	TPGN-160308	32	32	170	24	40	SP3A	TFHCSM3-0.5x10mm	CLM-7	STCM-25	TK-02817
C-CTFPR-2525M22	C-CTFPL-2525M22	TPGN-220408	25	25	150	31	32	SP-4	TFHCSM3-0.5x12mm	CLM-12	STCM-4	TK-02818
C-CTFPR-2525P22	C-CTFPL-2525P22	TPGN-220408	25	25	170	31	32	SP-4	TFHCSM3-0.5x12mm	CLM-12	STCM-4	TK-02818
C-CTFPR-3232P22	C-CTFPL-3232P22	TPGN-220408	32	32	170	31	40	SP-4	TFHCSM3-0.5x12mm	CLM-12	STCM-4	TK-02818
C-CTFPR-4040R22	C-CTFPL-4040R22	TPGN-220408	40	40	200	31	50	SP-4	TFHCSM3-0.5x12mm	CLM-12	STCM-4	TK-02818

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

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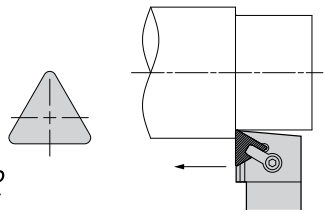
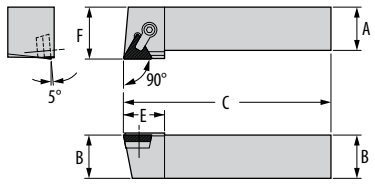
C-CTGPR/L

Style G / Triangle / Positive Rake / 90° Lead Angle





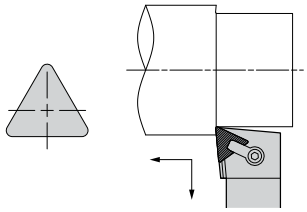
Right-Hand Toolholder Shown

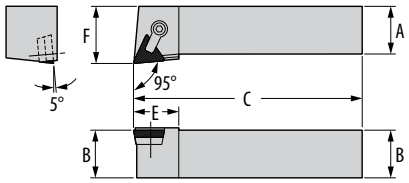
Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CTGPR-2525M16	C-CTGPL-2525M16	TPGN-160308	25	25	150	28	32	SP3A	TFHCSM3-0.5x10mm	CLM-7	STCM-25	TK-02817
C-CTGPR-2525P16	C-CTGPL-2525P16	TPGN-160308	25	25	170	28	32	SP3A	TFHCSM3-0.5x10mm	CLM-7	STCM-25	TK-02817
C-CTGPR-3232P16	C-CTGPL-3232P16	TPGN-160308	32	32	170	28	40	SP3A	TFHCSM3-0.5x10mm	CLM-7	STCM-25	TK-02817
C-CTGPR-2525M22	C-CTGPL-2525M22	TPGN-220408	25	25	150	30	32	SP-4	TFHCSM3-0.5x12mm	CLM-12	STCM-4	TK-02818
C-CTGPR-2525P22	C-CTGPL-2525P22	TPGN-220408	25	25	170	30	32	SP-4	TFHCSM3-0.5x12mm	CLM-12	STCM-4	TK-02818
C-CTGPR-3232P22	C-CTGPL-3232P22	TPGN-220408	32	32	170	30	40	SP-4	TFHCSM3-0.5x12mm	CLM-12	STCM-4	TK-02818
C-CTGPR-4040R22	C-CTGPL-4040R22	TPGN-220408	40	40	200	30	50	SP-4	TFHCSM3-0.5x12mm	CLM-12	STCM-4	TK-02818

** 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 / 95° Lead Angle





Right-Hand Toolholder Shown

Part Number		Gage	Dimensions (mm)					Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts	A	B	C	E	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
C-CTLPR-2525M16	C-CTLPL-2525M16	TPGN-160308	25	25	150	28	32	SP3A	TFHCSM3-0.5x10mm	CLM-7	STCM-25	TK-02817
C-CTLPR-2525P16	C-CTLPL-2525P16	TPGN-160308	25	25	170	28	32	SP3A	TFHCSM3-0.5x10mm	CLM-7	STCM-25	TK-02817
C-CTLPR-3232P16	C-CTLPL-3232P16	TPGN-160308	32	32	170	28	40	SP3A	TFHCSM3-0.5x10mm	CLM-7	STCM-25	TK-02817
C-CTLPR-2525M22	C-CTLPL-2525M22	TPGN-220408	25	25	150	30	32	SP-4	TFHCSM3-0.5x12mm	CLM-12	STCM-4	TK-02818
C-CTLPR-2525P22	C-CTLPL-2525P22	TPGN-220408	25	25	170	30	32	SP-4	TFHCSM3-0.5x12mm	CLM-12	STCM-4	TK-02818
C-CTLPR-3232P22	C-CTLPL-3232P22	TPGN-220408	32	32	170	30	40	SP-4	TFHCSM3-0.5x12mm	CLM-12	STCM-4	TK-02818
C-CTLPR-4040R22	C-CTLPL-4040R22	TPGN-220408	40	40	200	30	50	SP-4	TFHCSM3-0.5x12mm	CLM-12	STCM-4	TK-02818

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

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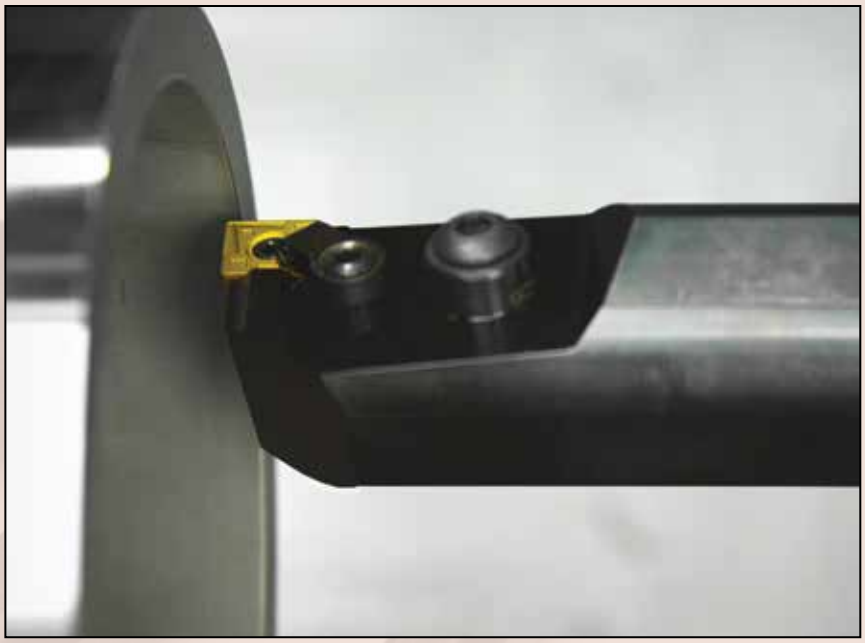
Industry-Standard Boring Bars for Carbide Inserts

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.

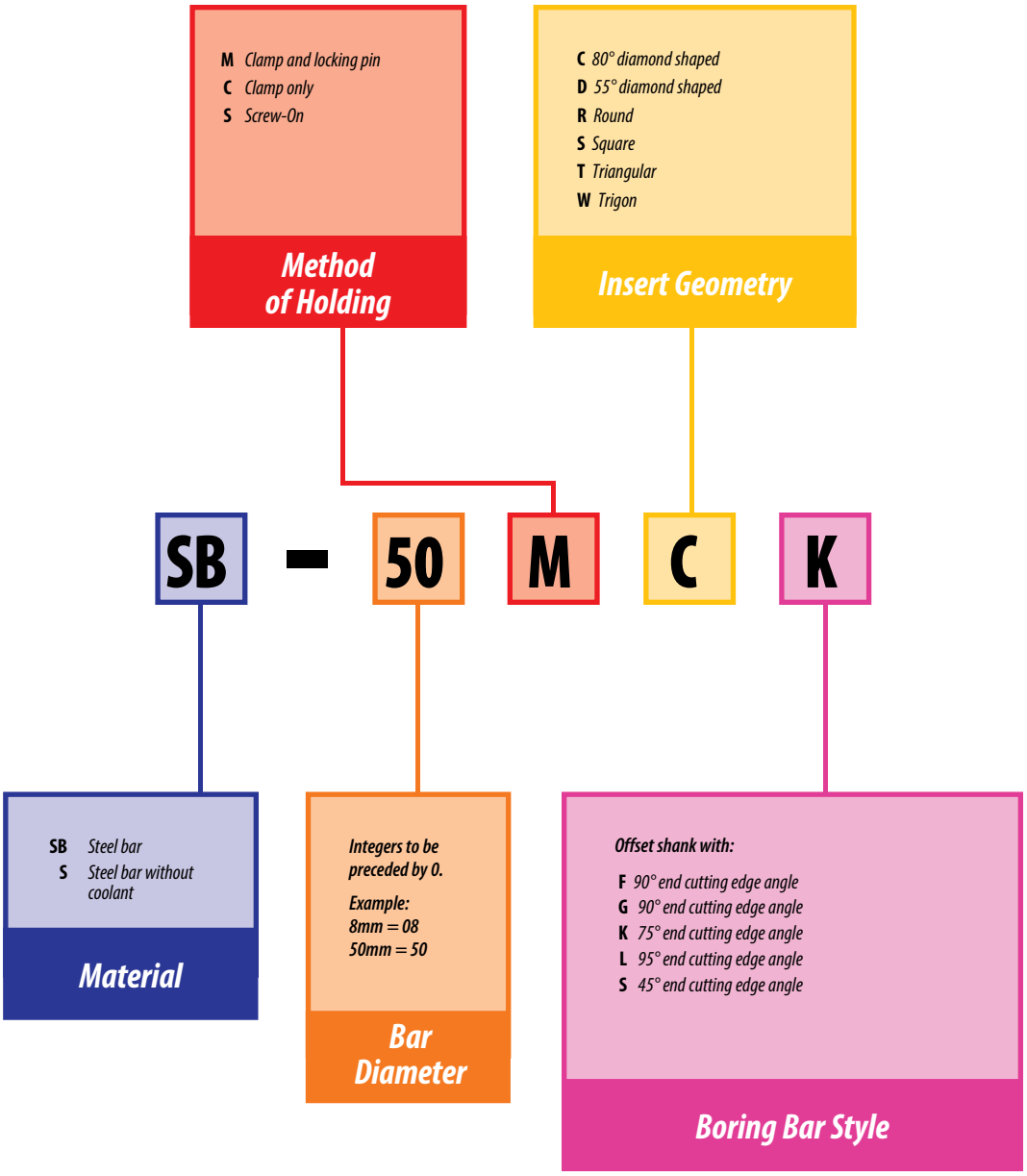
Custom engineered tooling is a Greenleaf specialty and we will be pleased to quote your special requirements for boring. Additionally, Greenleaf has the capability to quote boring bars made of heavy metal shanks or "No-Chat" material.



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



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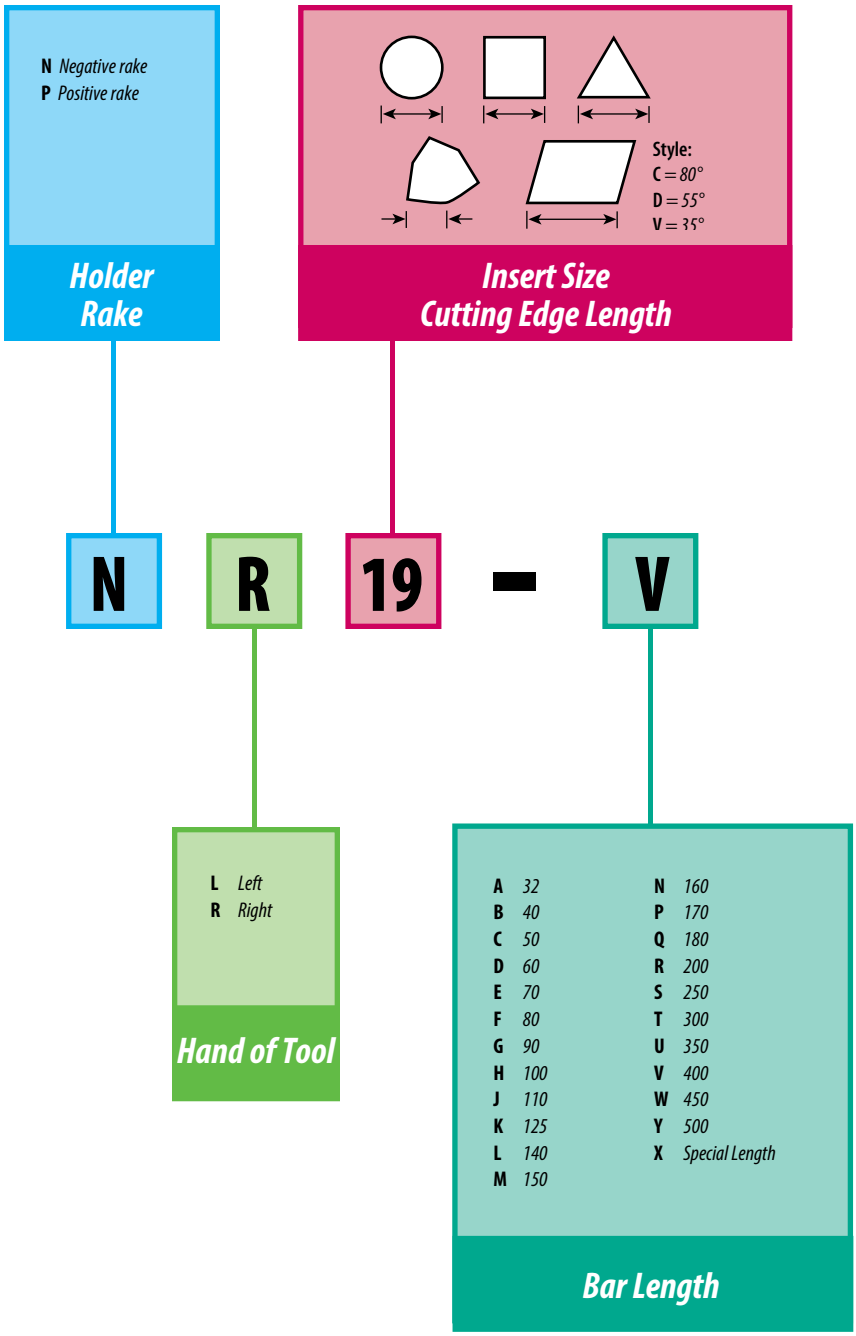
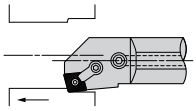
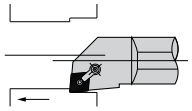

N Negative rake
P Positive rake
Holder Rake
Style:
C = 80°
D = 55°
V = 35°
Insert Size
Cutting Edge Length
N
R
19
-
V
L Left
R Right
Hand of Tool
A 32
B 40
C 50
D 60
E 70
F 80
G 90
H 100
J 110
K 125
L 140
M 150
N 160
P 170
Q 180
R 200
S 250
T 300
U 350
V 400
W 450
Y 500
X Special Length
Bar Length

Pictorial Index

80° Diamond – Negative

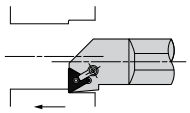


SB-MCKNR/L
Style K
80° Diamond
(Using 100° Corner)
Negative Rake
75° Lead Angle
page: T 114

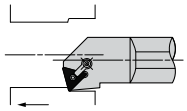


SB-MCLNR/L
Style L
80° Diamond
Negative Rake
95° Lead Angle
page: T 114

Triangle – Negative

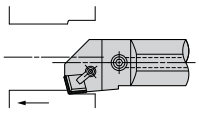


SB-MTFNR/L
Style F
Triangle
Negative Rake
90° Lead Angle
page: T 117

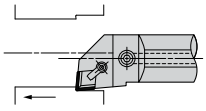


SB-MTKNR/L
Style K
Triangle
Negative Rake
75° Lead Angle
page: T 117

80° Diamond – Positive

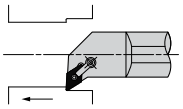


SB-CCKPR/L
Style K
80° Diamond
(Using 100° Corner)
Positive Rake
75° Lead Angle
page: T 119



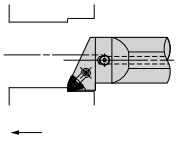
SB-CCLPR/L
Style L
80° Diamond
Positive Rake
95° Lead Angle
page: T 119

55° Diamond – Negative



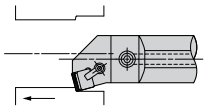
SB-MDUNR/L
Style U
55° Diamond
Negative Rake
93° Lead Angle
page: T 115

Trigon – Negative



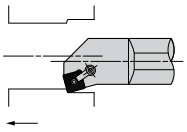
SB-MWLNR/L
Style L
80° Trigon
Negative Rake
95° Lead Angle
page: T 118

Square – Positive



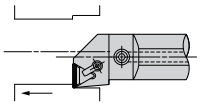
SB-CSKPR/L
Style K
Square
Positive Rake
75° Lead Angle
page: T 120

Square – Negative



SB-MSKNR/L
Style K
Square
Negative Rake
75° Lead Angle
page: T 116

Triangle – Positive



SB-CTFPR/L
Style F
Triangle
Positive Rake
90° Lead Angle
page: T 121

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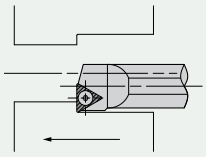
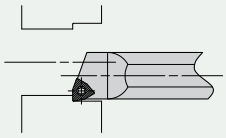
Screw-On



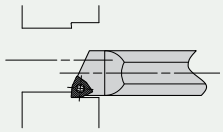
S-STFNR/L

Style F
Triangle
Positive Rake
90° Lead Angle
page: T 121



C-SWFCR/L

Style F
Screw-On Trigon
Solid Steel
90° Lead Angle
page: T 122



S-SWLCR/L

Style L
Screw-On Trigon
Solid Steel
95° Lead Angle
page: T 123

These Boring Bars do not follow the Boring Bar Identification System.

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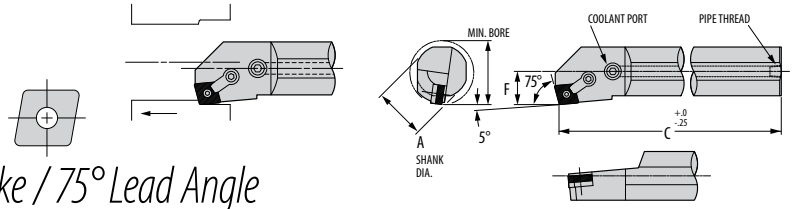
SB-MCKNR/L

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



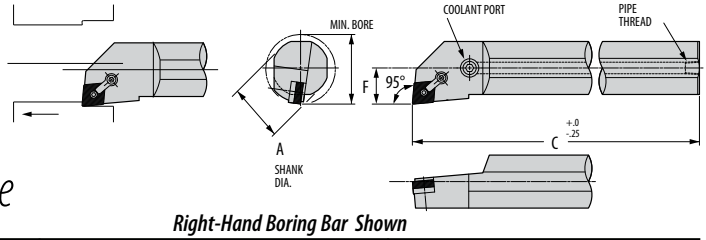
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Clamp Screw	Shim	Lock Pin		Shim Screw	Shim
SB25-MCKNR-12T	SB25-MCKNL-12T	CNGA-120408	32	25	300	17	CLM-20	STCM-11	–	NLM-44	TK-02796	–	–
SB32-MCKNR-12U	SB32-MCKNL-12U	CNGA-120408	38	32	350	20	CLM-20	STCM-11	CSNB-433	NLM-46S	TK-02797	S-46MS	–
SB40-MCKNR-12U	SB40-MCKNL-12U	CNGA-120408	44	40	350	23	CLM-20	STCM-11	CSN-432	NLM-46	TK-02798	S-46MS	–
SB50-MCKNR-19V	SB50-MCKNL-19V	CNGA-190612	63	50	400	33	CLM-12	STCM-4	CSN-633	NLM-68	TK-02721	S-68MS	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 / 95° Lead Angle



Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Clamp Screw	Shim	Lock Pin		Shim Screw	Shim
SB25-MCLNR-12T	SB25-MCLNL-12T	CNGA-120408	32	25	300	17	CLM-20	STCM-11	–	NLM-44	TK-02796	–	–
SB32-MCLNR-12U	SB32-MCLNL-12U	CNGA-120408	38	32	350	20	CLM-20	STCM-11	CSNB-433	NLM-46S	TK-02797	S-46MS	–
SB40-MCLNR-12U	SB40-MCLNL-12U	CNGA-120408	44	40	350	23	CLM-20	STCM-11	CSN-432	NLM-46	TK-02798	S-46MS	–
SB50-MCLNR-19V	SB50-MCLNL-19V	CNGA-190612	63	50	400	33	CLM-12	STCM-4	CSN-633	NLM-68	TK-02721	S-68MS	CSN-642

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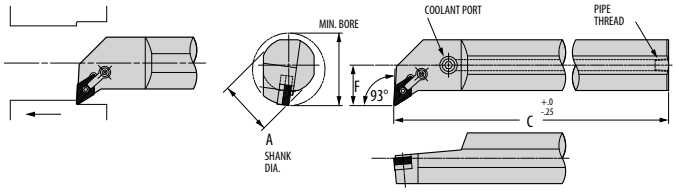
SB-MDUNR/L

Style U / 55° Diamond / Negative Rake / 93° Lead Angle



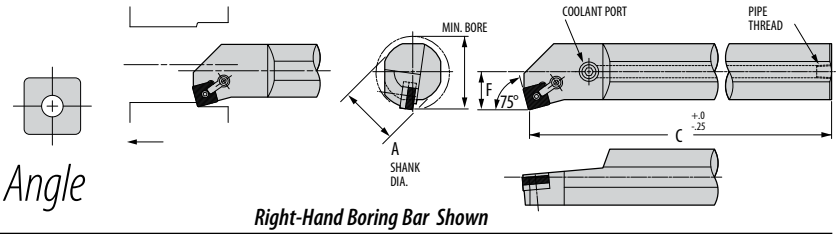
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components				*Tune-Up Kit	Optional Components
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Clamp Screw	Shim	Lock Pin		Shim Screw
SB32-MDUNR-15U	**SB32-MDUNR-15U**	DNGA-150408	50	32	350	25	CLM-12	STCM-4	DSN-433	NLM-46	TK-02725	S-46MS
SB40-MDUNR-15U	**SB40-MDUNR-15U**	DNGA-150408	58	40	350	29	CLM-12	STCM-4	DSN-433	NLM-46	TK-02725	S-46MS
SB50-MDUNR-19V	**SB50-MDUNR-19V**	DNGA-190612	76	50	400	38	CLM-30	STCM-4	DSN-533	NLM-58	TK-02799	S-58MS

** 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 / 75° Lead Angle



Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Clamp Screw	Shim	Lock Pin		Shim Screw	Shim
SB25-MSKNR-12T	SB25-MSKNL-12T	SNGA-120408	32	25	300	16	CLM-6	STCM-25	–	NLM-44	TK-02801	–	–
SB32-MSKNR-12U	SB32-MSKNL-12U	SNGA-120408	38	32	350	19	CLM-9	STCM-4	ISSNB-433	NLM-46	TK-02802	S-46MS	–
SB40-MSKNR-12U	SB40-MSKNL-12U	SNGA-120408	44	40	350	22	CLM-9	STCM-4	ISSNB-433	NLM-46	TK-02802	S-46MS	–
SB40-MSKNR-15V	SB40-MSKNL-15V	SNGA-150612	63	50	400	32	CLM-12	STCM-4	SSN-533	NLM-58	TK-02713	S-58MS	ISSN-543
SB50-MSKNR-19V	SB50-MSKNL-19V	SNGA-190612	63	50	400	32	CLM-12	STCM-4	ISSN-633	NLM-68	TK-02714	S-68MS	ISSN-643

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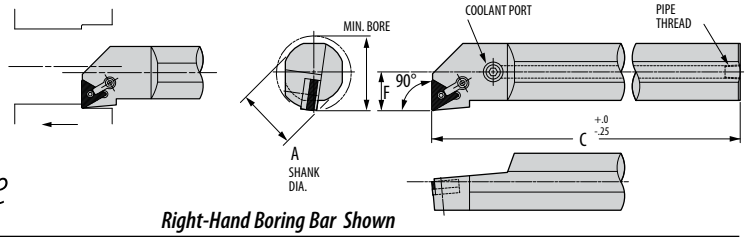
SB-MTFNR/L

Style F / Triangle / Negative Rake / 90° Lead Angle



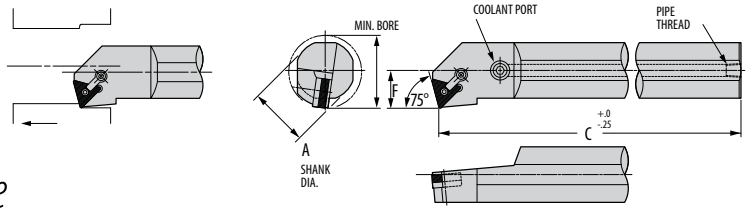
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Clamp Screw	Shim	Lock Pin		Shim Screw	Shim
SB25-MTFNR-16T	SB25-MTFNL-16T	TNGA-160408	32	25	300	16	CLM-6	STCM-25	–	NLM-33L	TK-02803	–	–
SB32-MTFNR-16U	SB32-MTFNL-16U	TNGA-160408	38	32	350	19	CLM-6	STCM-25	ITSN-322	NLM-34L	TK-02804	S-34MS	–
SB40-MTFNR-16U	SB40-MTFNL-16U	TNGA-160408	44	40	350	22	CLM-6	STCM-25	ITSN-322	NLM-34L	TK-02804	S-34MS	–
SB40-MTFNR-22U	SB40-MTFNL-22U	TNGA-220408	50	40	350	26	CLM-9	STCM-4	ITSN-432	NLM-46	TK-02805	S-46MS	TS-424
SB50-MTFNR-27V	SB50-MTFNL-27V	TNGA-270612	63	50	400	32	CLM-12	STCM-4	ITSN-533	NLM-58	TK-02806	S-58MS	–

** 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 / 75° Lead Angle



Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Clamp Screw	Shim	Lock Pin		Shim Screw	Shim
SB25-MTKNR-16T	SB25-MTKNL-16T	TNGA-160408	32	25	300	16	CLM-6	STCM-9	–	NLM-33L	TK-02777	–	–
SB32-MTKNR-16U	SB32-MTKNL-16U	TNGA-160408	38	32	350	19	CLM-6	STCM-9	ITSN-322	NLM-34L	TK-02828	S-34MS	–
SB40-MTKNR-16U	SB40-MTKNL-16U	TNGA-160408	44	40	350	22	CLM-6	STCM-9	ITSN-322	NLM-34L	TK-02828	S-34MS	–
SB40-MTKNR-22U	SB40-MTKNL-22U	TNGA-220408	50	40	350	26	CLM-9	STCM-4	ITSN-432	NLM-46	TK-02805	S-46MS	TS-424
SB50-MTKNR-27V	SB50-MTKNL-27V	TNGA-270612	63	50	400	32	CLM-12	STCM-4	ITSN-533	NLM-58	TK-02806	S-58MS	–

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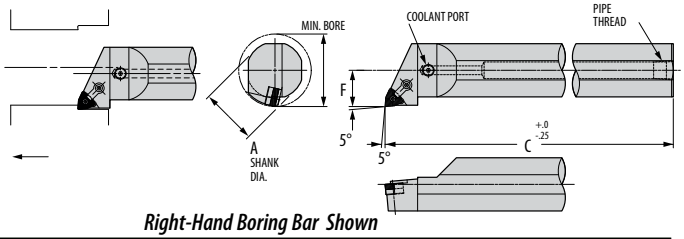
SB-MWLNR/L

Style L / 80° Trigon / Negative Rake / 95° Lead Angle



Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components				*Tune-Up Kit	Optional Components
Right Hand	Left Hand	Inserts		A	C	F	Seat	Lock Pin	Clamp	Clamp Screw		Seat
SB20-MWLNR-06S†	SB20-MWLNL-06S†	WNMA-060408	24	20	250	13	–	NLM-33L	CLM-6	STCM-25	TK-02803	–
SB25-MWLNR-06T	SB25-MWLNL-06T	WNMA-060408	30	25	300	16	–	NLM-33L	CLM-6	STCM-25	TK-02803	–
SB32-MWLNR-06U	SB32-MWLNL-06U	WNMA-060408	38	32	350	19	IWSN-322	NLM-34L	CLM-6	STCM-25	TK-02811	IWSN-332
SB40-MWLNR-06U	SB40-MWLNL-06U	WNMA-060408	46	40	350	22	IWSN-322	NLM-34L	CLM-6	STCM-25	TK-02811	IWSN-332
SB25-MWLNR-08T	SB25-MWLNL-08T	WNMA-080408	33	25	300	16	–	NLM-44	CLM-20	STCM-11	TK-02796	–
SB32-MWLNR-08U	SB32-MWLNL-08U	WNMA-080408	39	32	350	19	IWSN-433	NLM-46	CLM-20	STCM-26	TK-02808	–
SB40-MWLNR-08U	SB40-MWLNL-08U	WNMA-080408	45	40	350	22	IWSN-433	NLM-46	CLM-20	STCM-26	TK-02808	–

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

† *Coolant port not available.*

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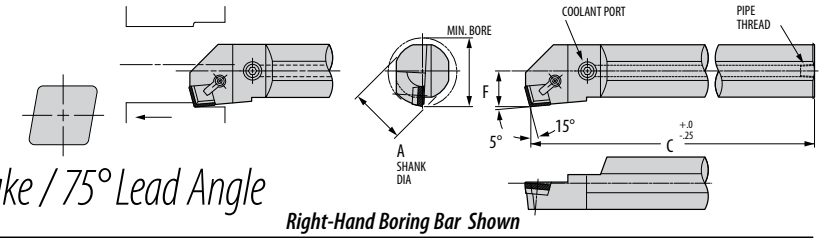
SB-CCKPR/L

Style K / 80° Diamond (Using 100° Corner) / Positive Rake / 75° Lead Angle



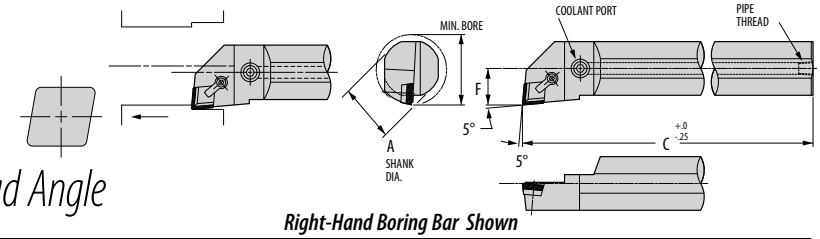
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components					*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Clamp Screw	Shim	Shim Screw	Chipbreaker	
SB25-CCKPR-12T	SB25-CCKPL-12T	CPGN-120308	32	25	300	16	CLM-7	STCM-25	–	–	CBDC-415L	TK-02833
SB32-CCKPR-12U	SB32-CCKPL-12U	CPGN-120308	38	32	350	19	CLM-20	STCM-11	CSP-422	TFHCSM3-0.5x6mm	CBDC-415L	TK-02834
SB40-CCKPR-12U	SB40-CCKPL-12U	CPGN-120308	44	40	350	22	CLM-20	STCM-11	CSP-422	TFHCSM3-0.5x6mm	CBDC-415L	TK-02834
SB50-CCKPR-19V	SB50-CCKPL-19V	CPGN-190412	63	50	400	32	CLM-30	STCM-4	CSP-632	TFHCSM3-0.5x10mm	CBDC-615G	TK-02835

** 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 / 95° Lead Angle



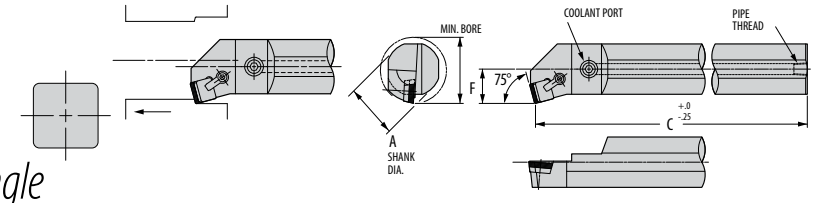
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components					*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Clamp Screw	Shim	Shim Screw	Chipbreaker	
SB25-CCLPR-12T	SB25-CCLPL-12T	CPGN-120308	32	25	300	16	CLM-7	STCM-25	–	–	CBDC-4L	TK-02782
SB32-CCLPR-12U	SB32-CCLPL-12U	CPGN-120308	38	32	350	19	CLM-20	STCM-11	CSP-422	TFHCSM3-0.5x6mm	CBDC-4L	TK-02836
SB40-CCLPR-12U	SB40-CCLPL-12U	CPGN-120308	44	40	350	22	CLM-20	STCM-11	CSP-422	TFHCSM3-0.5x6mm	CBDC-4L	TK-02836
SB50-CCLPR-19V	SB50-CCLPL-19V	CPGN-190412	63	50	400	32	CLM-30	STCM-4	CSP-632	TFHCSM3-0.5x10mm	CBDC-6G	TK-02784

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

SB-CSKPR/L

Style K / Square / Positive Rake / 75° Lead Angle



Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components					*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Clamp Screw	Shim	Shim Screw	Chipbreaker	
SB25-CSKPR-12T	**SB25-CSKPL-12T**	SPGN-120308	32	25	300	16	CLM-7	STCM-25	–	–	CBS-4G	TK-02782
SB32-CSKPR-12U	**SB32-CSKPL-12U**	SPGN-120308	38	32	350	19	CLM-20	STCM-11	–	–	CBS-4G	TK-02868
SB40-CSKPR-12U	**SB40-CSKPL-12U**	SPGN-120308	44	40	350	22	CLM-20	STCM-11	SP-40	TFHCSM3-0.5x12mm	CBS-4G	TK-02869
SB50-CSKPR-19V	**SB50-CSKPL-19V**	SPGN-190412	63	50	400	32	CLM-30	STCM-4	SP-60	TFHCSM4-0.7x12mm	CBS-6G	TK-02870

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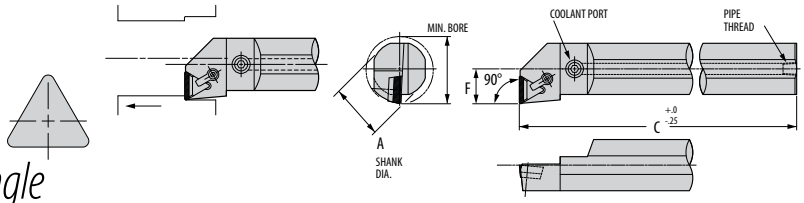
SB-CTFPR/L

Style F / Triangle / Positive Rake / 90° Lead Angle



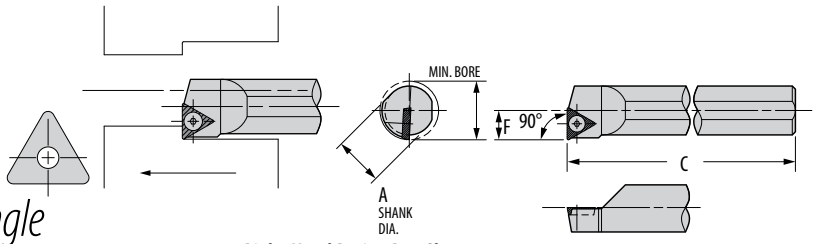
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components					*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Clamp Screw	Shim	Shim Screw	Chipbreaker	
SB25-CTFPR-16T	SB25-CTFPL-16T	TPGN-160308	32	25	300	16	CLM-7	STCM-25	–	–	CBT-3G	TK-02783
SB32-CTFPR-16U	SB32-CTFPL-16U	TPGN-160308	38	32	350	19	CLM-6	STCM-25	TSP-321	–	CBT-3G	TK-02840
SB40-CTFPR-16U	SB40-CTFPL-16U	TPGN-160308	44	40	350	22	CLM-6	STCM-25	TSP-321	TFHCSM3-0.5x10mm	CBT-3G	TK-02840
SB40-CTFPR-22U	SB40-CTFPL-22U	TPGN-220408	50	40	350	26	CLM-12	STCM-8	SP-4	TFHCSM3-0.5x12mm	CBT-4G	TK-02748
SB50-CTFPR-27V	SB50-CTFPL-27V	TPGN-270612	63	50	400	32	CLM-12	STCM-4	SP-5	TFHCSM3-0.5x12mm	CBT-5G	TK-02749

** 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 / 90° Lead Angle



Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Std Components	*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Insert Screw	
S10-STFNR-11M	S10-STFNL-11M	TP41	13	10	150	6	TBHCSM3-0.5x6mm	TK-02838
S12-STFNR-11R	S12-STFNL-11R	TP41	16	12	200	8	TBHCSM3-0.5x6mm	TK-02838
S16-STFNR-11S	S16-STFNL-11S	TP41	20	16	250	9	TBHCSM3-0.5x6mm	TK-02838

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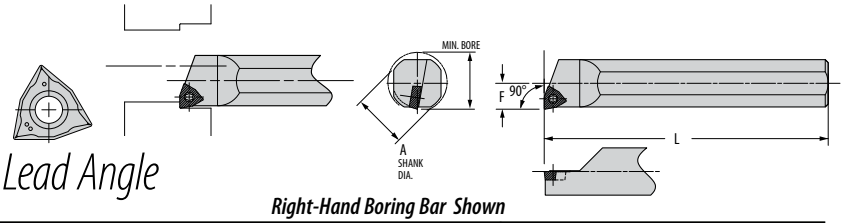
S-SWFCR/L

Style F / Screw-On Trigon / Solid Steel / 90° Lead Angle



Right-Hand Boring Bar Shown

Part Number		Gage		Dimensions (mm)			Std Components	
Right Hand	Left Hand	Inserts	Minimum Bore	A	F	C	Insert Screw	*Tune-Up Kit
S10-SWFCR-04K	S10-SWFCL-04K	WCMT-060204	11	10	5,5	125	PT-589T	TK-00804
S12-SWFCR-04M	S12-SWFCL-04M	WCMT-060204	14	12	7	150	PT-589T	TK-00804
S12-SWFCR-06D	S12-SWFCL-06D	WCMT-09T304	16	12	8	60	PT-559T	TK-00807
S12-SWFCR-06M	S12-SWFCL-06M	WCMT-09T304	16	12	8	150	PT-559T	TK-00807
S16-SWFCR-06H	S16-SWFCL-06H	WCMT-09T304	18	16	9	100	PT-559T	TK-00807
S16-SWFCR-06Q	S16-SWFCL-06Q	WCMT-09T304	18	16	9	180	PT-559T	TK-00807
S20-SWFCR-06H	S20-SWFCL-06H	WCMT-09T304	22	20	11	100	PT-559T	TK-00807
S20-SWFCR-06R	S20-SWFCL-06R	WCMT-09T304	22	20	11	200	PT-559T	TK-00807
S25-SWFCR-06K	S25-SWFCL-06K	WCMT-09T304	28	25	14	125	PT-559T	TK-00807
S25-SWFCR-06S	S25-SWFCL-06S	WCMT-09T304	28	25	14	250	PT-559T	TK-00807
S32-SWFCR-06T	S32-SWFCL-06T	WCMT-09T304	34	32	17	300	PT-559T	TK-00807

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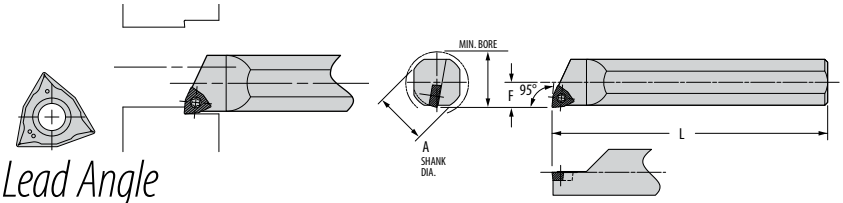
S-SWLCR/L

Style L / Screw-On Trigon / Solid Steel / 95° Lead Angle



Right-Hand Boring Bar Shown

Part Number		Gage		Dimensions (mm)			Std Components	
Right Hand	Left Hand	Inserts	Minimum Bore	A	F	C	Insert Screw	*Tune-Up Kit
S10-SWLCR-04K	S10-SWLCL-04K	WCMT-060204	11	10	5,5	125	PT-589T	TK-00804
S12-SWLCR-04M	S12-SWLCL-04M	WCMT-060204	14	12	7	150	PT-589T	TK-00804
S12-SWLCR-06D	S12-SWLCL-06D	WCMT-09T304	16	12	8	60	PT-559T	TK-00807
S12-SWLCR-06M	S12-SWLCL-06M	WCMT-09T304	16	12	8	150	PT-559T	TK-00807
S16-SWLCR-06H	S16-SWLCL-06H	WCMT-09T304	18	16	9	100	PT-559T	TK-00807
S16-SWLCR-06Q	S16-SWLCL-06Q	WCMT-09T304	18	16	9	180	PT-559T	TK-00807
S20-SWLCR-06H	S20-SWLCL-06H	WCMT-09T304	22	20	11	100	PT-559T	TK-00807
S20-SWLCR-06R	S20-SWLCL-06R	WCMT-09T304	22	20	11	200	PT-559T	TK-00807
S25-SWLCR-06K	S25-SWLCL-06K	WCMT-09T304	28	25	14	125	PT-559T	TK-00807
S25-SWLCR-06S	S25-SWLCL-06S	WCMT-09T304	28	25	14	250	PT-559T	TK-00807
S32-SWLCR-06T	S32-SWLCL-06T	WCMT-09T304	34	32	17	300	PT-559T	TK-00807

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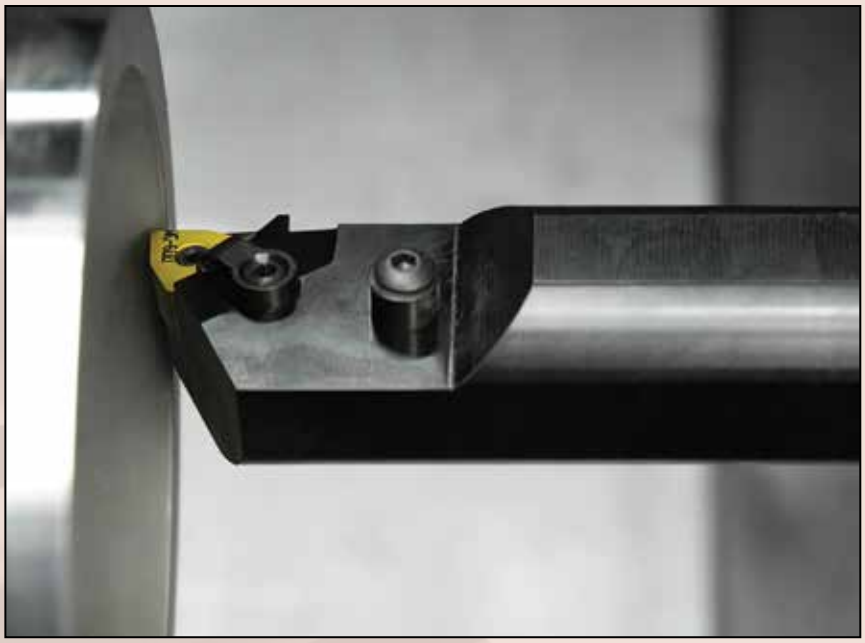
Boring Bars for Ceramic Inserts

This section contains boring bars using the ceramic inserts most often used by industry.

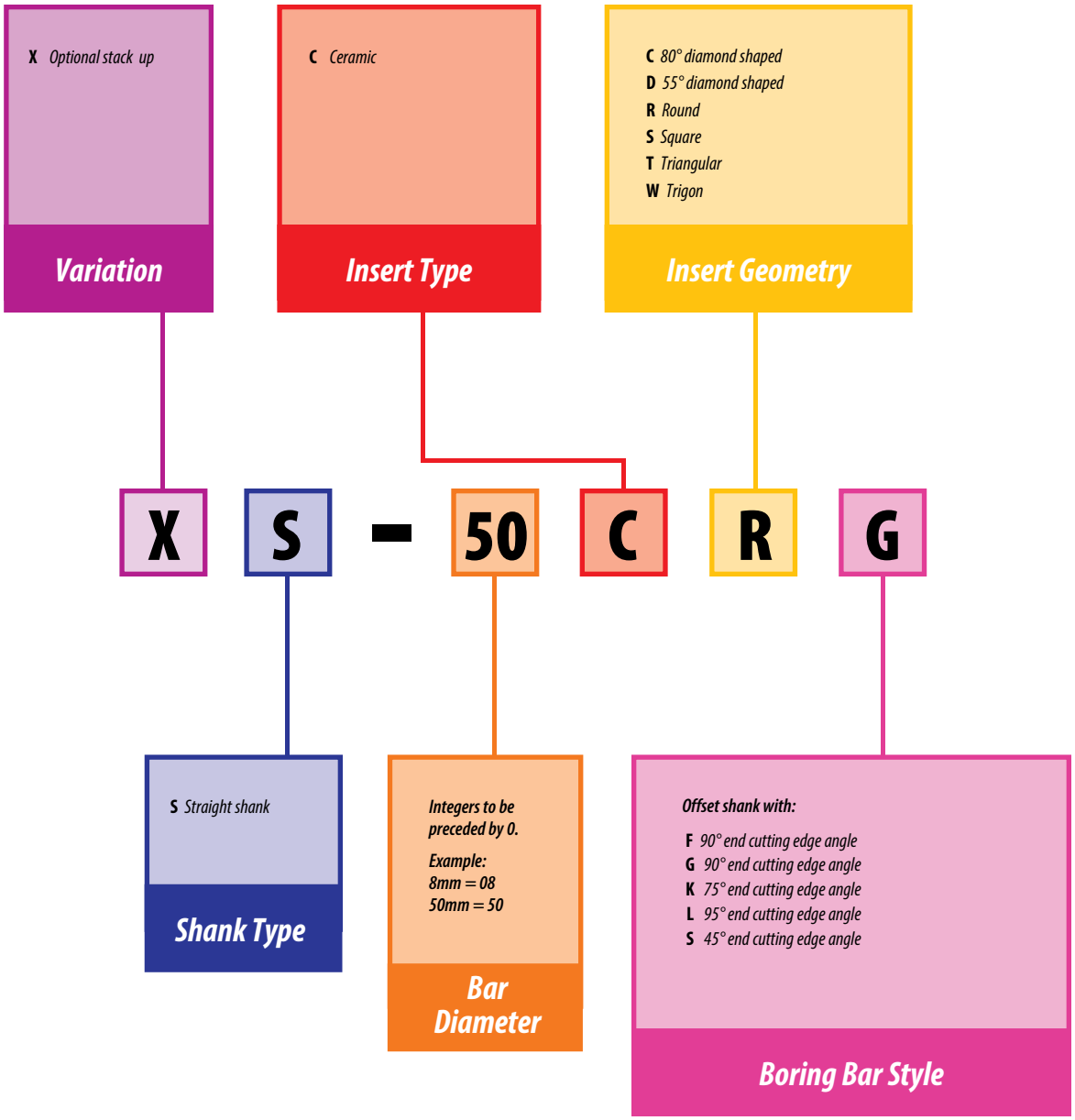
In addition to tempered-steel bars, Greenleaf also can supply Heavy Metal or "No Chat" high-density steel bars that can reduce, and sometimes eliminate, "chatter" for those applications that require a longer reach.

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



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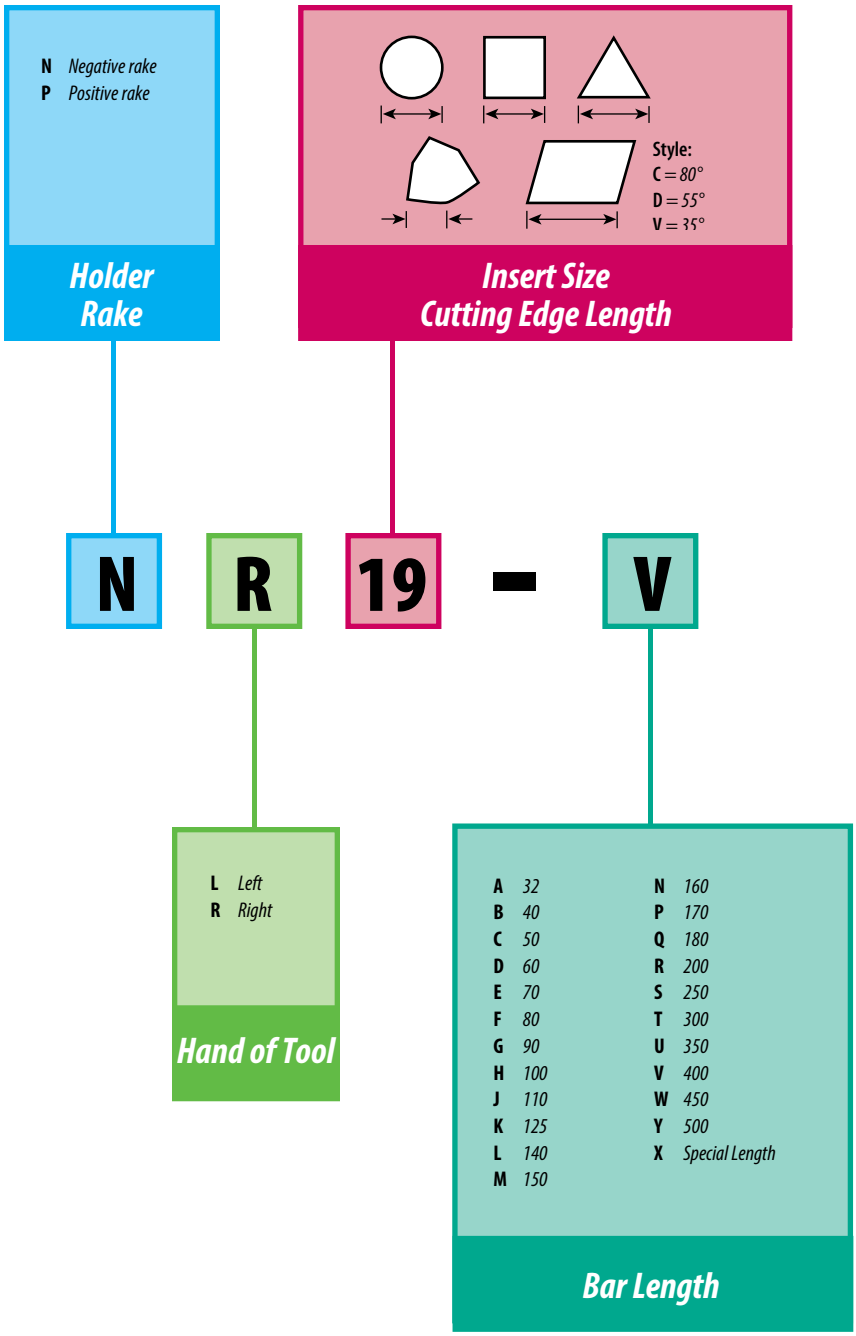
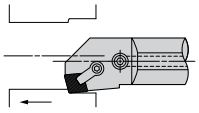
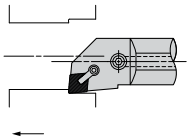

N Negative rake
P Positive rake
Holder Rake
Style:
C = 80°
D = 55°
V = 35°
Insert Size
Cutting Edge Length
N
R
19
-
V
L Left
R Right
Hand of Tool
A 32
B 40
C 50
D 60
E 70
F 80
G 90
H 100
J 110
K 125
L 140
M 150
N 160
P 170
Q 180
R 200
S 250
T 300
U 350
V 400
W 450
Y 500
X Special Length
Bar Length

Pictorial Index

80°/100° Diamond – Negative

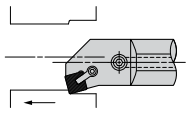


S-CCKNR/L
Style K
80° Diamond
(Using 100° Corner)
Negative Rake
15° Lead
page: T 130

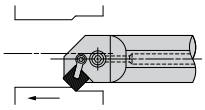


S-CCLNR/L
Style L
80° Diamond
Negative Rake
5° Reverse Lead
page: T 130

Square – Negative

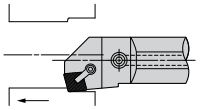


S-CSKNR/L
Style K
Square
Negative Rake
15° Lead
page: T 132

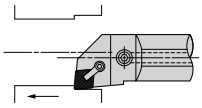


S-CSSNR/L
Style S
Square
Negative Rake
45° Lead
page: T 132

80° Diamond – Positive

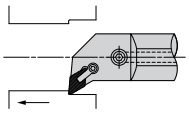


S-CCKPR/L
Style K
80° Diamond
(Using 100° Corner)
Positive Rake
15° Lead
page: T 134



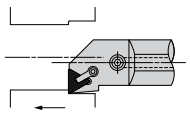
S-CCLPR/L
Style L
80° Diamond
Positive Rake
5° Reverse Lead
page: T 134

55° Diamond – Negative



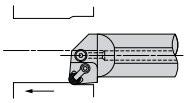
S-CDLNR/L
Style L
55° Diamond
Negative Rake
5° Reverse Lead
page: T 131

Triangle – Negative



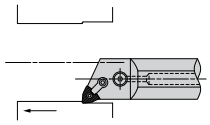
S-CTFNR/L
Style F
Triangle
Negative Rake
0° Lead
page: T 133

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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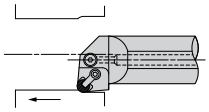
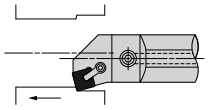
Round – Positive

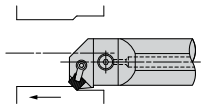


S-CRGPR/L
Style G
Round
Positive Rake
page: T 134

Square – Positive

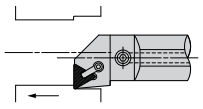


S-CSKPR/L
Style K
Square
Positive Rake
15° Lead
page: T 135

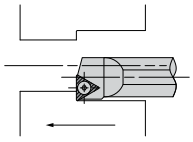


S-CSSPR/L
Style S
Square
Positive Rake
45° Lead
page: T 135

Triangle – Positive



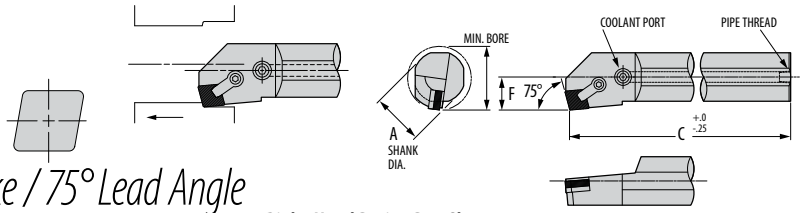
S-CTFPR/L
Style F
Triangle
Positive Rake
0° Lead
page: T 136



S-STFNR/L
Style F
Triangle
Positive Rake
0° Lead
page: T 136

S-CCKNR/L

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



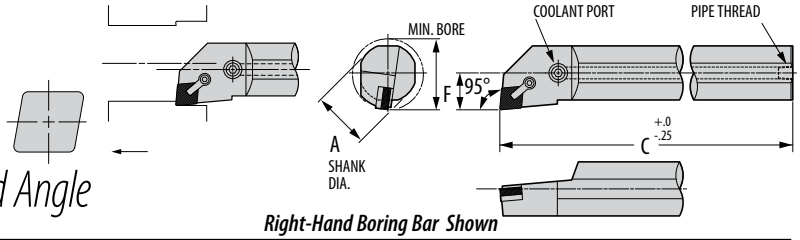
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp
S25-CCKNR-12T	S25-CCKNL-12T	CNGN-120408	76	25	300	16	–	–	CLM-12	STCM-8	TK-02822	NLM-44	CLM-9
S40-CCKNR-12U	S40-CCKNL-12U	CNGN-120408	102	40	350	22	CSN-433	S-46MS	CLM-12	STCM-4	TK-02841	NLM-46	CLM-9
S50-CCKNR-12V	S50-CCKNL-12V	CNGN-120408	102	50	400	29	CSN-433	S-46M	CLM-12	STCM-4	TK-02823	NLM-46	CLM-9
S50-CCKNR-19V	S50-CCKNL-19V	CNGN-190612	127	50	400	32	CSN-633	S-68M	CLM-30	STCM-4	TK-02824	NLM-68	CLM-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 / 95° Lead Angle



Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp
S25-CCLNR-12T	S25-CCLNL-12T	CNGN-120408	76	25	300	16	–	–	CLM-12	STCM-8	TK-02822	NLM-44	CLM-9
S40-CCLNR-12U	S40-CCLNL-12U	CNGN-120408	102	40	350	22	CSN-433	S-46M	CLM-12	STCM-4	TK-02823	NLM-46	CLM-9
S50-CCLNR-12V	S50-CCLNL-12V	CNGN-120408	102	50	400	29	CSN-433	S-46M	CLM-12	STCM-4	TK-02823	NLM-46	CLM-9
S50-CCLNR-19V	S50-CCLNL-19V	CNGN-190612	127	50	400	32	CSN-633	S-68M	CLM-30	STCM-4	TK-02824	NLM-68	CLM-12

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

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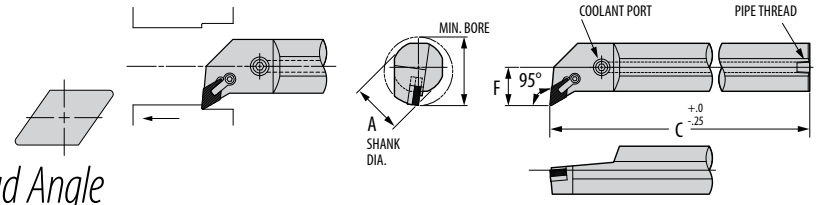
S-CDLNR/L

Style L / 55° Diamond / Negative Rake / 95° Lead Angle



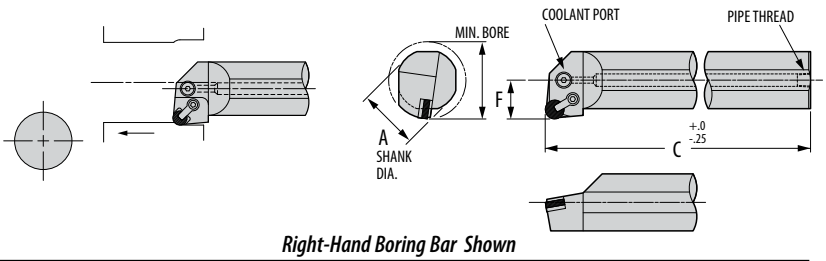
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp
S40-CDLNR-11U	S40-CDLNL-11U	DNGN-110308	90	40	350	25	DSN-333	S-34M	CLM-12	STCM-4	TK-02785	NLM-34L	–
S50-CDLNR-11V	S50-CDLNL-11V	DNGN-110308	90	50	400	32	DSN-333	S-34M	CLM-12	STCM-4	TK-02785	NLM-34L	–
S50-CDLNR-15V	S50-CDLNL-15V	DNGN-150408	102	50	400	35	DSN-433	S-46M	CLM-30	STCM-4	TK-02786	NLM-46	CLM-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 (mm)			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
S40-CRGNR-09U	S40-CRGNL-09U	RNGN-090400	76	40	350	25	–	–	CLM-6	STCM-25	TK-02819	CLM-6	–	–
S50-CRGNR-09V	S50-CRGNL-09V	RNGN-090400	76	50	400	32	–	–	CLM-6	STCM-25	TK-02819	CLM-6	–	–
S50-CRGNR-12V	S50-CRGNL-12V	RNGN-120400	90	50	400	32	IRSN-42	S-46M	CLM-12	STCM-4	TK-02820	CLM-9	7,92	No Shim
XS50-CRGNR-12V	XS50-CRGNL-12V	RNGN-120700	125	50	400	32	IRSN-43	S-46MS	CLM-12	STCM-4	TK-03064	CLM-9	4,75	IRSN-45
S50-CRGNR-15V	S50-CRGNL-15V	RNGN-150700	90	50	400	32	–	–	CLM-12	STCM-4	TK-02821	CLM-9	4,75	RSN-52
XS50-CRGNR-15V	XS50-CRGNL-15V	RNGN-150700	125	50	400	32	RSN-53	S-58M	CLM-12	STCM-4	TK-02825	CLM-9	4,75	IRSN-55
S50-CRGNR-19V	S50-CRGNL-19V	RNGN-190700	90	50	400	32	–	–	CLM-30	STCM-4	TK-02829	CLM-12	4,75	RSN-62
XS50-CRGNR-19V	XS50-CRGNL-19V	RNGN-190700	125	50	400	32	RSN-63	S-68M	CLM-30	STCM-4	TK-02792	CLM-12	4,75	IRSN-65

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

† You can alternately use a 3/16 thick insert with the corresponding shim or a 1/4 thick insert with the right shim.

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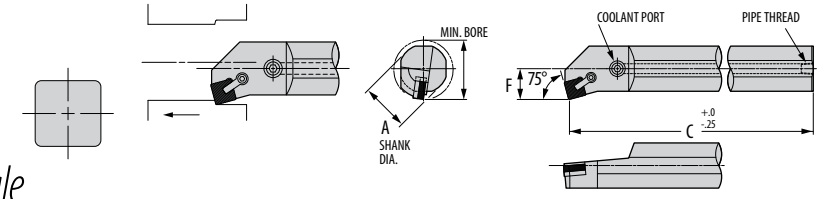
S-CSKNR/L

Style K / Square / Negative Rake / 75° Lead Angle



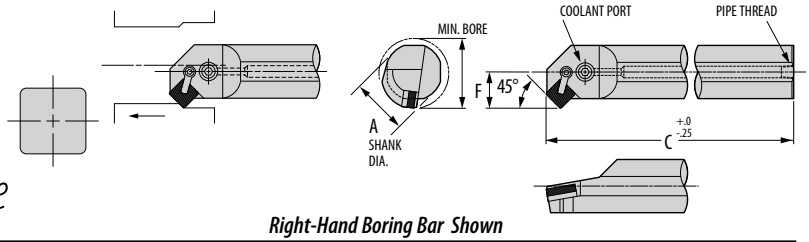
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp
S25-CSKNR-12T	S25-CSKNL-12T	SNGN-120408	76	25	300	16	–	–	CLM-12	STCM-8	TK-02822	NLM-44	CLM-9
S40-CSKNR-12U	S40-CSKNL-12U	SNGN-120408	102	40	350	22	ISSN-433	S-46M	CLM-12	STCM-4	TK-02844	NLM-46	CLM-9
S50-CSKNR-12V	S50-CSKNL-12V	SNGN-120408	102	50	400	29	ISSN-433	S-46M	CLM-12	STCM-4	TK-02844	NLM-46	CLM-9
S50-CSKNR-15V	S50-CSKNL-15V	SNGN-150612	127	50	400	32	SSN-533	S-58M	CLM-12	STCM-4	TK-02794	NLM-58	CLM-9
S50-CSKNR-19V	S50-CSKNL-19V	SNGN-190612	127	50	400	32	ISSN-633	S-68M	CLM-30	STCM-4	TK-02795	NLM-68	CLM-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 Angle



Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp
S25-CSSNR-12T	S25-CSSNL-12T	SNGN-120408	76	25	300	16	–	–	CLM-12	STCM-4	TK-02821	NLM-44	CLM-9
S40-CSSNR-12U	S40-CSSNL-12U	SNGN-120408	102	40	350	22	ISSN-433	S-46M	CLM-12	STCM-4	TK-02844	NLM-46	CLM-9
S50-CSSNR-12V	S50-CSSNL-12V	SNGN-120408	102	50	400	29	ISSN-433	S-46M	CLM-12	STCM-4	TK-02844	NLM-46	CLM-9
S50-CSSNR-15V	S50-CSSNL-15V	SNGN-150612	127	50	400	32	SSN-533	S-58M	CLM-12	STCM-4	TK-02794	NLM-58	CLM-9
S50-CSSNR-19V	S50-CSSNL-19V	SNGN-190612	127	50	400	32	ISSN-633	S-68M	CLM-30	STCM-4	TK-02795	NLM-68	CLM-12

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

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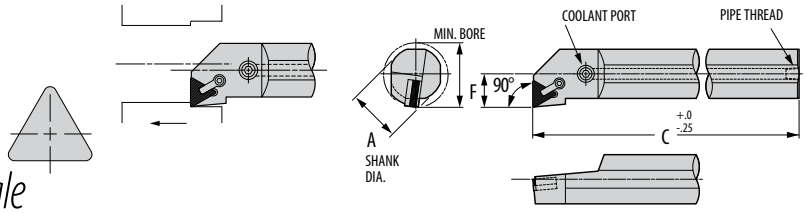
S-CTFNR/L

Style F / Triangle / Negative Rake / 90° Lead Angle



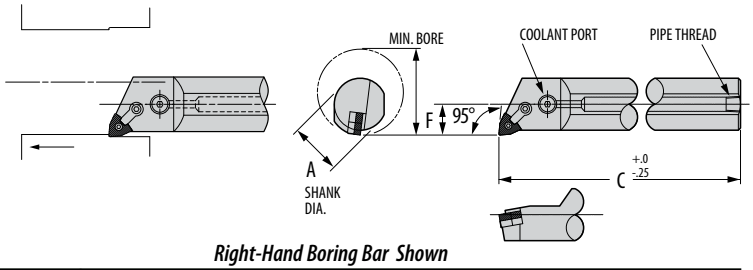
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components				*Tune-Up Kit	Optional Components	
Right Hand	Left Hand	Inserts		A	C	F	Clamp	Seat Screw	Clamp	Clamp Screw		Lock Pin	Clamp
S25-CTFNR-16T	S25-CTFNL-16T	TNGN-160408	76	25	300	16	–	–	CLM-7	STCM-25	TK-02782	NLM-33L	CLM-6
S40-CTFNR-16U	S40-CTFNL-16U	TNGN-160408	90	40	350	22	ITSN-322	S-34M	CLM-7	STCM-25	TK-02757	NLM-34L	CLM-6
S40-CTFNR-22U	S40-CTFNL-22U	TNGN-220408	102	40	350	26	ITSN-432	S-46M	CLM-12	STCM-4	TK-02771	NLM-46	CLM-9
S50-CTFNR-22V	S50-CTFNL-22V	TNGN-220408	102	50	400	32	ITSN-432	S-46M	CLM-12	STCM-4	TK-02771	NLM-46	CLM-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 / 95° Lead Angle



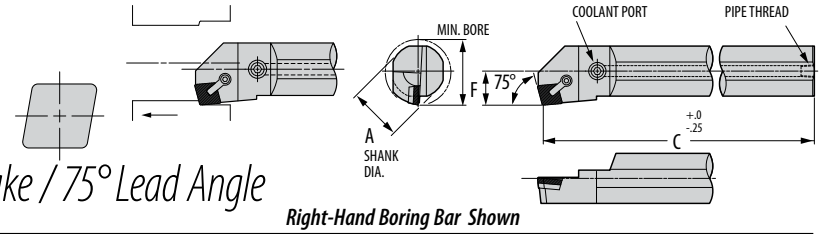
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Shim Seat	Lock Pin	Clamp	Clamp Screw	
S25-CWLNR-06T	S25-CWLNL-06T	WNGA-060408	76	25	300	16	–	NLM-33L	CLM-6	STCM-25	TK-02803
S40-CWLNR-06U	S40-CWLNL-06U	WNGA-060408	90	40	350	22	IWSN-322	NLM-34L	CLM-6	STCM-25	TK-02811
S40-CWLNR-08T	S40-CWLNL-08T	WNGA-080408	76	25	300	16	–	NLM-44	CLM-20	STCM-26	TK-02826
S50-CWLNR-08U	S50-CWLNL-08U	WNGA-080408	102	40	350	22	IWSN-433	NLM-46	CLM-20	STCM-26	TK-02808
S63-CWLNR-08V	S63-CWLNL-08V	WNGA-080408	102	50	400	32	IWSN-433	NLM-46	CLM-20	STCM-26	TK-02808

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

S-CCKPR/L

Style K / 80° Diamond *(Using 100° Corner)* / Positive Rake / 75° Lead Angle



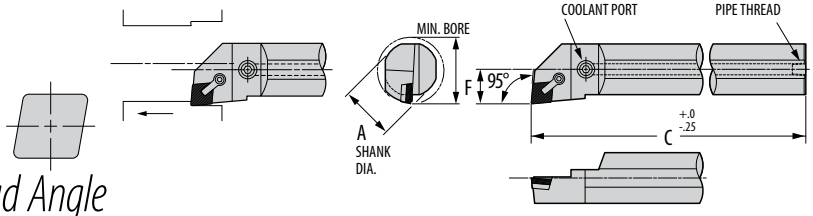
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
S25-CCKPR-12T	S25-CCKPL-12T	CPGN-120408	32	25	300	16	–	–	CLM-22	STCM-32	TK-02778
S40-CCKPR-12U	S40-CCKPL-12U	CPGN-120408	44	40	350	22	SP-49	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02779
S50-CCKPR-12V	S50-CCKPL-12V	CPGN-120408	56	50	400	29	SP-49	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02779

** 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 / 95° Lead Angle



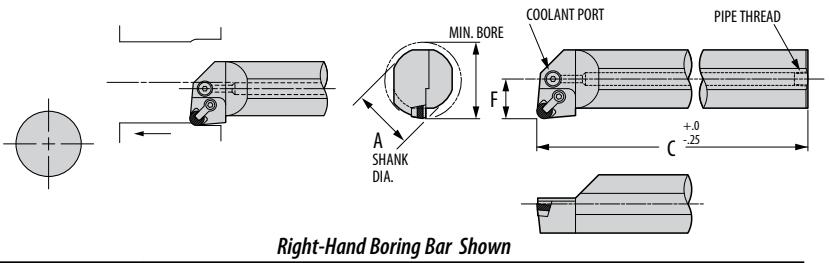
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
S25-CCLPR-12T	S25-CCLPL-12T	CPGN-120408	32	25	300	16	–	–	CLM-22	STCM-32	TK-02778
S40-CCLPR-12U	S40-CCLPL-12U	CPGN-120408	44	40	350	22	SP-49	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02779
S50-CCLPR-12V	S50-CCLPL-12V	CPGN-120408	56	50	400	29	SP-49	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02779

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

S-CRGPR/L

Style G / Round / Positive Rake



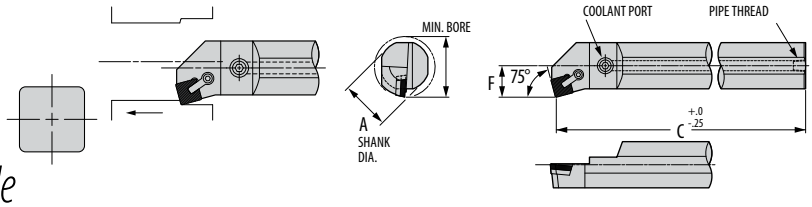
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
S25-CRGPR-09T	S25-CRGPL-09T	RPGN-090300	32	25	300	16	–	–	CLM-7	STCM-25	TK-02782
S40-CRGPR-09U	S40-CRGPL-09U	RPGN-090300	44	40	350	22	SP-34	TSHCSM2-0.4x6mm	CLM-7	STCM-25	TK-02813
S50-CRGPR-09V	S50-CRGPL-09V	RPGN-090300	56	50	400	29	SP-34	TSHCSM2-0.4x6mm	CLM-7	STCM-25	TK-02813
S50-CRGPR-12V	S50-CRGPL-12V	RPGN-120400	63	50	400	32	SP-44	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02814

** 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 / 75° Lead Angle



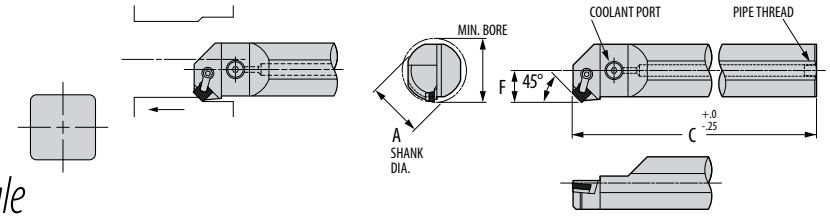
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
S25-CSKPR-12T	S25-CSKPL-12T	SPGN-120408	32	25	300	16	–	–	CLM-7	STCM-25	TK-02782
S40-CSKPR-12U	S40-CSKPL-12U	SPGN-120408	44	40	350	22	SP-41	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02780
S50-CSKPR-12V	S50-CSKPL-12V	SPGN-120408	56	50	400	29	SP-41	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02780

** 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 Angle



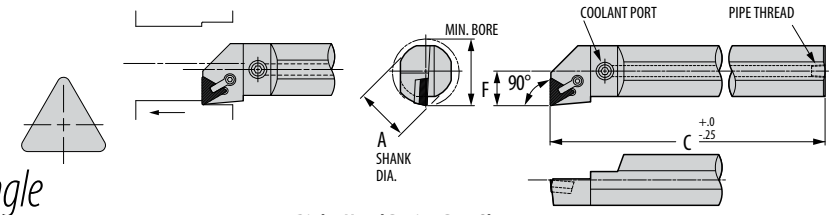
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
S25-CSSPR-12T	S25-CSSPL-12T	SPGN-120408	32	25	300	16	–	–	CLM-7	STCM-25	TK-02782
S40-CSSPR-12U	S40-CSSPL-12U	SPGN-120408	44	40	350	22	SP-41	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02780
S50-CSSPR-12V	S50-CSSPL-12V	SPGN-120408	56	50	400	29	SP-41	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02780

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

S-CTFPR/L

Style F / Triangle / Positive Rake / 90° Lead Angle



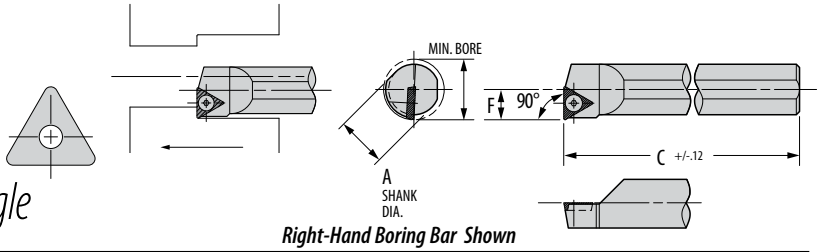
Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components				*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Shim Seat	Seat Screw	Clamp	Clamp Screw	
S25-CTFPR-16T	S25-CTFPL-16T	TPGN-160308	32	25	300	16	–	–	CLM-7	STCM-25	TK-02782
S40-CTFPR-16U	S40-CTFPL-16U	TPGN-160308	44	40	350	22	SP-3A	TFHCSM3-0.5x10mm	CLM-7	STCM-25	TK-02817
S40-CTFPR-22U	S40-CTFPL-22U	TPGN-220408	50	40	350	26	SP-4	TFHCSM3-0.5x10mm	CLM-12	STCM-4	TK-02839
S50-CTFPR-22V	S50-CTFPL-22V	TPGN-220408	63	50	400	32	SP-4	TFHCSM3-0.5x12mm	CLM-12	STCM-4	TK-02818

** 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 / 90° Lead Angle



Right-Hand Boring Bar Shown

Part Number		Gage	Minimum Bore	Dimensions (mm)			Standard Components	*Tune-Up Kit
Right Hand	Left Hand	Inserts		A	C	F	Insert Screw	
S10-STFNR-11M	S10-STFNL-11M	TP41	13	10	150	6	TBHCSM3-0.5x6mm	TK-02838
S12-STFNR-11R	S12-STFNL-11R	TP41	16	12	200	8	TBHCSM3-0.5x6mm	TK-02838
S16-STFNR-11S	S16-STFNL-11S	TP41	20	16	250	9	TBHCSM3-0.5x6mm	TK-02838

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Notes:

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Heavy Turning

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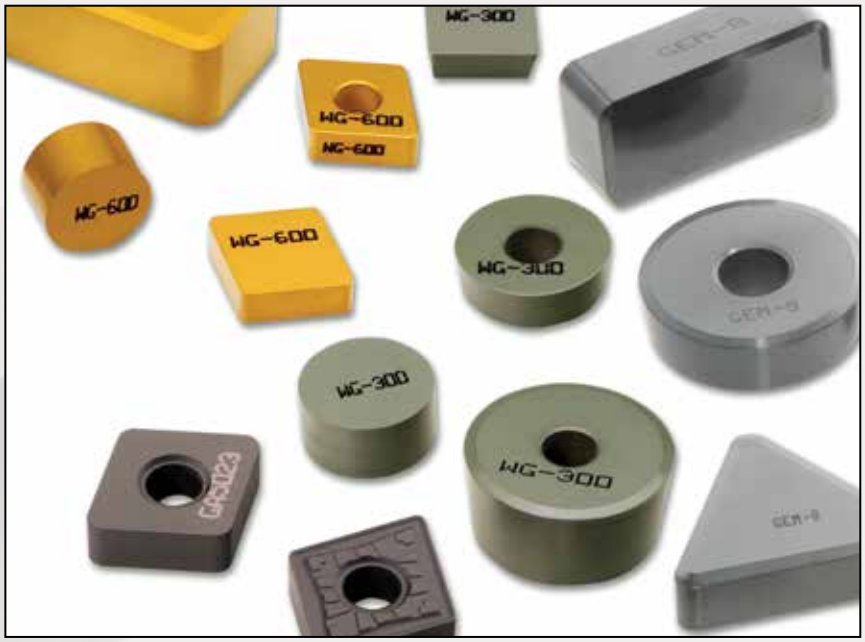
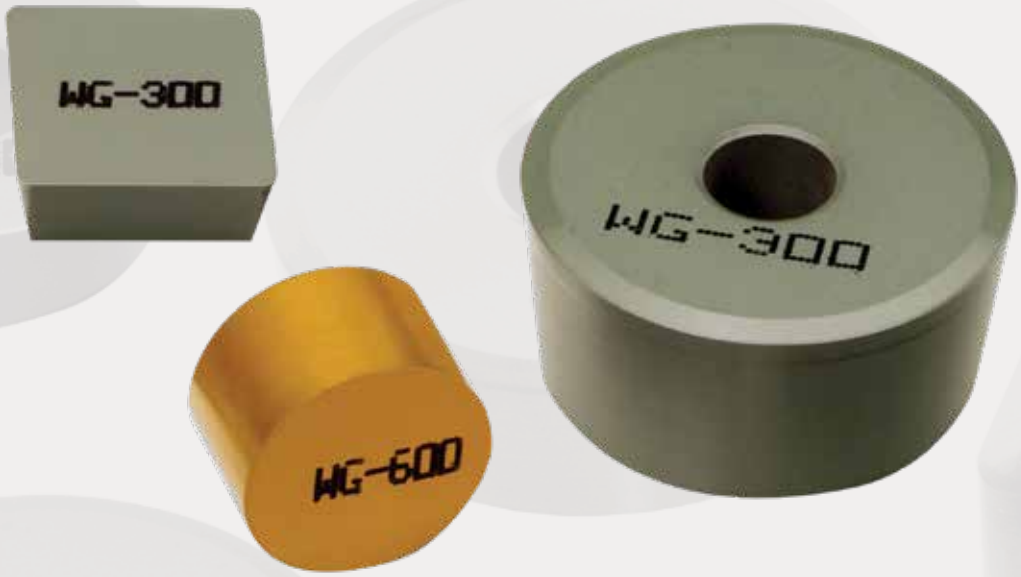
Heavy Turning

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.

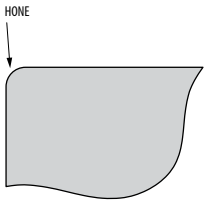
GSN100™

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.

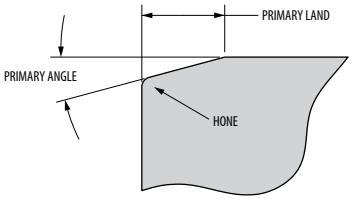
GEM-8™

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.

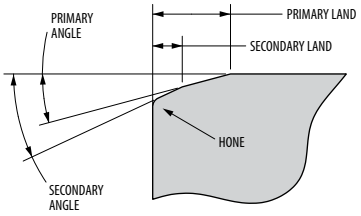
Edge Preparations



HONE



PRIMARY ANGLE



SECONDARY ANGLE

Edge Prep	Hone	Primary Land	Primary Angle	Secondary Land	Secondary Angle	Application
T2A	0,015R	0,17	20°			Scale applications, light interruptions, weld overlays, finish turning and milling of hardened materials.
T4A	0,015R	1,90	10°	0,17	25°	Heavy machining <19mm IC - Roll turning, 3V, 4V, CDH-22, CDH-33.
T4B	0,035R	1,90	10°	0,17	25°	Heavy machining <19mm IC - Roll turning, 3V, 4V, CDH-22, CDH-33.
T10B	0,035R	2,41	15°	0,17	30°	Heavy machining, iron and steel roll turning >19mm IC, CDH-43, CDH-53.

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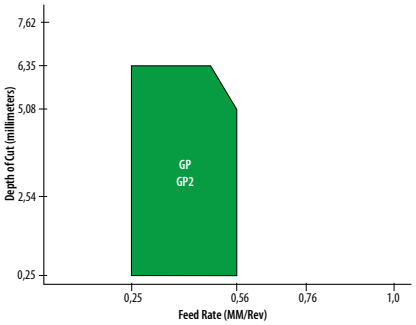
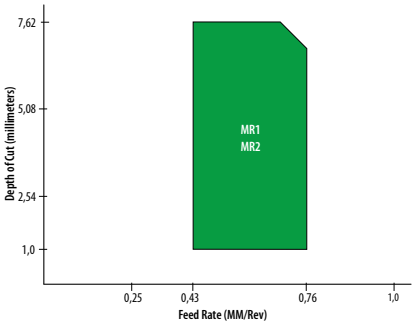
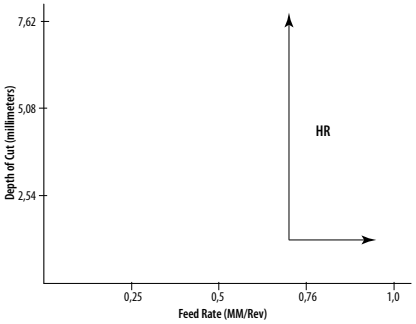
Chipform Application Range

GENERAL PURPOSE	GP and GP2 	General purpose chipbreaker. Feed rates up to 0,56/rev and 6,35 depth of cut.	
MEDIUM ROUGHING	MR and MR2 	Used for medium roughing of all material. Feeds up to 0,71 /rev and depths up to 7,62	
HEAVY ROUGHING	HR *single sided* 	Heavy roughing for all materials. Feeds above 0,58/rev. One-sided chipbreaker for heaviest feeds (MM). *Example: CNMM 644 HR*	

Pictorial Index

Carbide Inserts – Negative

80° Diamond
Chip Control
GP2, MR, HR – single sided
page: HT 10

80° Diamond
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
page: HT 13

Carbide Inserts – Negative *continued*

Square
Flat Top
page: HT 13

Square
Flat Top
page: HT 14

Triangle
Chip Control
MR
page: HT 15

Triangle
Flat Top
page: HT 15

Triangle
Flat Top
TNGN, TNUN
page: HT 16

Carbide Inserts – Positive

Triangle
Flat Top
page: HT 17

Square
Flat Top
page: HT 17

Ceramic Inserts – Negative

80° Diamond
page: HT 18

Round
page: HT 18

Square
page: HT 19

Triangle
page: HT 19

Ceramic Inserts – Positive

Square
page: HT 20

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Roll Turning

Roll Turning
page: HT 21

Roll Turning
page: HT 21

Roll Turning
page: HT 22

Roll Turning
page: HT 23

Round
V-Bottom
page: HT 24

Round
V-Bottom
page: HT 24

Square
Negative
page: HT 25

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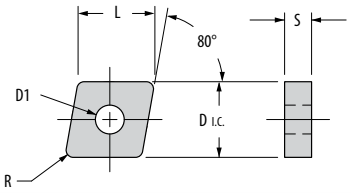
80° Diamond Inserts

Chip Control — CNMG, CNMM



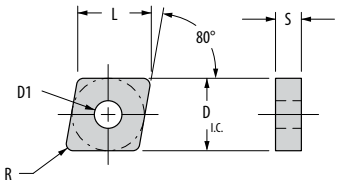
Shape: 80° Diamond		Part Number ISO	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ANSI	Dimensions (mm)				
			GA5035	GA-5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		D I.C.	L	S	D1	R
General Purpose		CNMG-190612-GP	▲	●	◆	◆	▲	◆	▲		CNMG-643-GP	19,05	19,33	6,35	7,92	1,19
Medium Roughing		CNMG-190608-MR	▲	●	◆	◆	▲	◆	▲		CNMG-642-MR	19,05	19,33	6,35	7,92	0,79
		CNMG-190612-MR	▲	●	◆	◆	▲	◆	▲		CNMG-643-MR	19,05	19,33	6,35	7,92	1,19
		CNMG-190616-MR									CNMG-644-MR	19,05	19,33	6,35	7,92	1,57
Heavy Roughing		CNMM-190612-HR	▲	●	◆	◆	▲	◆	▲		CNMG-643-HR	19,05	19,33	6,35	7,92	0,79

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 ISO	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ANSI	Dimensions (mm)				
			GA5035	GA-5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		D I.C.	L	S	D1	R
		CNMA-190608	◆	●			◆	◆	●	◆	CNMA-642	19,05	19,33	6,35	7,92	0,79
		CNMA-190612	◆	●			◆	◆	●	◆	CNMA-643	19,05	19,33	6,35	7,92	1,19
		CNMA-190616	◆	●			◆	◆	●	◆	CNMA-644	19,05	19,33	6,35	7,92	1,57
		CNMA-250924	◆	●			◆	◆	●	◆	CNMA-866	25,4	25,78	9,53	9,12	2,36

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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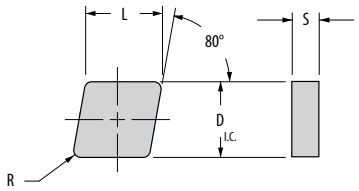
80° Diamond Inserts

Flat Top — CNGN



Shape: 80° Diamond	Part Number ISO	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ANSI	Dimensions (mm)			
		GA5035	GA-5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		D I.C.	L	S	R
	CNGN-190408	◆	●			◆	◆	●	◆	CNGN-632	19,05	19,33	4,75	0,79
	CNGN-190412	◆	●			◆	◆	●	◆	CNGN-633	19,05	19,33	4,75	1,19
	CNGN-190416	◆	●			◆	◆	●	◆	CNGN-634	19,05	19,33	4,75	1,57
	CNGN-190612	◆	●			◆	◆	●	◆	CNGN-643	19,05	19,33	6,35	1,19
	CNGN-190616	◆	●			◆	◆	●	◆	CNGN-644	19,05	19,33	6,35	1,57

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

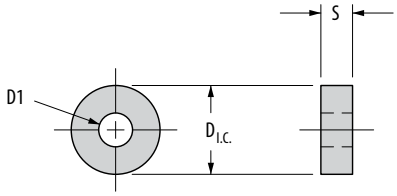
CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

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

Grade descriptions *— pages HT 4–5*

Round Inserts

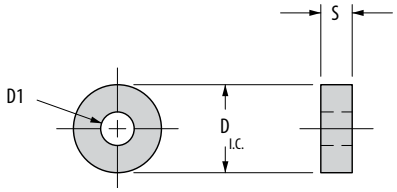
Chip Control — RNMG, RNMM



Shape: Round		Part Number ISO	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ANSI	Dimensions (mm)		
			GA5035	GA-5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		D I.C.	S	D1
Medium Roughing		RNMG-190600-MR	◆	●			◆	◆	●	◆	RNMG-64-MR	19,05	6,35	7,92
		RNMG-250900-MR	◆	●			◆	◆	●	◆	RNMG-86-MR	25,40	9,53	9,12
												25,40	6,35	9,12
Heavy Roughing		RNMM-250600-MR	◆	●			◆	◆	●	◆	RNMM-84-MR			

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

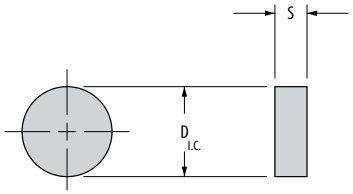


Flat Top — RNMA

Shape: Round		Part Number ISO	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ANSI	Dimensions (mm)		
			GA5035	GA-5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		D I.C.	S	D1
		RNMA-190600	◆	●			◆	◆	●	◆	RNMA-64-MR	19,05	6,35	7,92
		RNMA-250900	◆	●			◆	◆	●	◆	RNMA-86-MR	25,40	9,53	9,12

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



Flat Top — RNGN

Shape: Round		Part Number ISO	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ANSI	Dimensions (mm)	
			GA5035	GA-5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		D I.C.	S
		RNGN-190400	◆	●			◆	◆	●	◆	RNGN-63	19,05	4,75
		RNGN-250600	◆	●			◆	◆	●	◆	RNGN-84	25,40	6,35

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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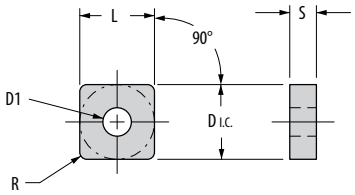
Square Inserts

Chip Control — SNMG, SNMM



Shape: Square	Part Number ISO	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ANSI	Dimensions (mm)				
		GA5035	GA-5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		D I.C.	L	S	D1	R
General Purpose	SNMG-190612-GP2	▲	●			◆	◆	●	◆	SNMG-643-GP2	19,05	19,05	6,35	7,92	1,19
	SNMG-190616-GP2	▲	●			◆	◆	●	◆	SNMG-644-GP2	19,05	19,05	6,35	7,92	1,57
Medium Roughing	SNMG-190612-MR	▲	●			◆	◆	●	◆	SNMG-643-MR	19,05	19,05	6,35	7,92	1,19
	SNMG-190616-MR	▲	●			◆	◆	●	◆	SNMG-644-MR	19,05	19,05	6,35	7,92	1,57
	SNMG-250924-MR	▲	●			◆	◆	●	◆	SNMG-866-MR	25,40	25,40	9,53	9,12	2,36
Heavy Roughing	SNMM-190612-HR	▲	●			◆	◆	●	◆	SNMM-643-HR	25,40	19,05	6,35	7,92	1,19
	SNMM-190616-HR	▲	●			◆	◆	●	◆	SNMM-644-HR	19,05	19,05	6,35	7,92	1,57

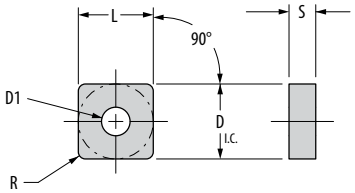
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

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 ISO	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ANSI	Dimensions (mm)				
		GA5035	GA-5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		D I.C.	L	S	D1	R
	SNMA-190612	▲	●			◆	◆	●	◆	SNMA-643	19,05	19,05	6,35	7,92	1,19
	SNMA-190616	▲	●			◆	◆	●	◆	SNMA-644	19,05	19,05	6,35	7,92	1,57
	SNMA-250916	▲	●			◆	◆	●	◆	SNMA-864	25,40	25,40	9,53	9,12	1,57
	SNMA-250924	▲	●			◆	◆	●	◆	SNMA-866	25,40	25,40	9,53	9,12	2,36

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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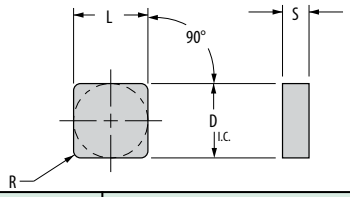
Square Inserts

Flat Top — SNGN / SNUN



Shape: Square	Part Number ISO	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ANSI	Dimensions (mm)			
		GA5035	GA-5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		D I.C.	L	S	R
	SNGN-190412	▲	●			◆	◆	●	◆	SNGN-633	19,05	19,05	4,75	1,19
	SNGN-190416	▲	●			◆	◆	●	◆	SNGN-634	19,05	19,05	4,75	1,57
	SNGN-190432	▲	●			◆	◆	●	◆	SNGN-638	19,05	19,05	4,75	3,18
	SNGN-190612	▲	●			◆	◆	●	◆	SNGN-643	19,05	19,05	6,35	1,19
	SNGN-190616	▲	●			◆	◆	●	◆	SNGN-644	19,05	19,05	6,35	1,57
	SNGN-190624	▲	●			◆	◆	●	◆	SNGN-646	19,05	19,05	6,35	2,36
	SNGN-250616	▲	●			◆	◆	●	◆	SNGN-844	25,40	25,40	6,35	1,57
	SNGN-250716	▲	●			◆	◆	●	◆	SNGN-854	25,40	25,40	7,92	1,57
	SNGN-310648	▲	●			◆	◆	●	◆	SNGN-10412	31,75	31,75	6,35	4,75
	SNGN-310924	▲	●			◆	◆	●	◆	SNGN-1066	31,75	31,75	9,53	2,36
	SNGN-310932	▲	●			◆	◆	●	◆	SNGN-1068	31,75	31,75	9,53	3,18
	SNGN-381232	▲	●			◆	◆	●	◆	SNGN-1288	38,10	38,10	12,70	3,18
	SNUN-190412	▲	●			◆	◆	●	◆	SNUN-633	19,05	19,05	4,75	1,19
	SNUN-190416	▲	●			◆	◆	●	◆	SNUN-634	19,05	19,05	4,75	1,57
	SNUN-250616	▲	●			◆	◆	●	◆	SNUN-844	25,40	25,40	6,35	1,57
	SNUN-250632	▲	●			◆	◆	●	◆	SNUN-848	25,40	25,40	6,35	3,18
	SNUN-250716	▲	●			◆	◆	●	◆	SNUN-854	25,40	25,40	7,92	1,57
	SNUN-310924	▲	●			◆	◆	●	◆	SNUN-1066	31,75	31,75	9,53	2,36
	SNUN-310932	▲	●			◆	◆	●	◆	SNUN-1068	31,75	31,75	9,53	3,18
	SNUN-381232	▲	●			◆	◆	●	◆	SNUN-1288	38,10	38,10	12,70	3,18

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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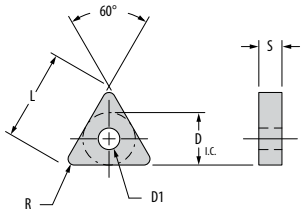
Triangle Inserts

Chip Control — TNMG



Shape: Triangle		Part Number ISO	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ANSI	Dimensions (mm)				
			GA5035	GA-5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		D I.C.	L	S	D1	R
Medium Roughing		TNMG-330924-MR	▲	●			◆	◆	●	◆	TNMG-666-MR	19,05	32,99	9,53	7,92	2,39

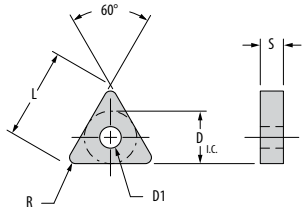
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

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 ISO	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ANSI	Dimensions (mm)				
			GA5035	GA-5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		D I.C.	L	S	D1	R
		TNMA-330608	▲	●			◆	◆	●	◆	TNMA-642	19,05	32,99	6,35	7,92	0,79
		TNMA-330612	▲	●			◆	◆	●	◆	TNMA-643	19,05	32,99	6,35	7,92	1,19
		TNMA-330616	▲	●			◆	◆	●	◆	TNMA-644	19,05	32,99	6,35	7,92	1,57
		TNMA-330916	▲	●			◆	◆	●	◆	TNMA-664	19,05	32,99	9,53	7,92	1,57
		TNMA-330924	▲	●			◆	◆	●	◆	TNMA-666	19,05	32,99	9,53	7,92	2,36
		TNMA-330932	▲	●			◆	◆	●	◆	TNMA-668	19,05	32,99	9,53	7,92	3,18

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

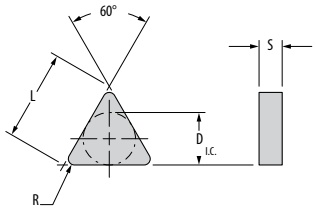
CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

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

Grade descriptions — pages HT 4–5

Triangle Inserts

Flat Top — TNGN



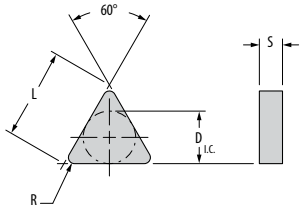
Shape: Triangle	Part Number ISO	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ANSI	Dimensions (mm)			
		GA5035	GA-5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		D I.C.	L	S	R
	TNGN-330716	◆	●			◆	◆	●	◆	TNGN-654	19,05	32,99	7,92	1,57
	TNGN-330724	◆	●			◆	◆	●	◆	TNGN-656	19,05	32,99	7,92	2,36
	TNGN-330916	◆	●			◆	◆	●	◆	TNGN-664	19,05	32,99	9,53	1,57
	TNGN-330924	◆	●			◆	◆	●	◆	TNGN-666	19,05	32,99	9,53	2,36
	TNGN-330932	◆	●			◆	◆	●	◆	TNGN-668	19,05	32,99	9,53	3,18
	TNGN-381124	◆	●			◆	◆	●	◆	TNGN-776	22,23	38,51	11,10	2,36
	TNGN-381132	◆	●			◆	◆	●	◆	TNGN-778	22,23	38,51	11,10	3,18
	TNGN-381140	◆	●			◆	◆	●	◆	TNGN-7710	22,23	38,51	11,10	3,96
	TNGN-441132	◆	●			◆	◆	●	◆	TNGN-878	25,40	43,99	11,10	3,18

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 ISO	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ANSI	Dimensions (mm)			
		GA5035	GA-5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		D I.C.	L	S	R
	TNUN-330716	◆	●			◆	◆	●	◆	TNUN-654	19,05	32,99	7,92	1,57
	TNUN-330724	◆	●			◆	◆	●	◆	TNUN-656	19,05	32,99	7,92	2,36
	TNUN-330916	◆	●			◆	◆	●	◆	TNUN-664	19,05	32,99	9,53	1,57
	TNUN-330924	◆	●			◆	◆	●	◆	TNUN-666	19,05	32,99	9,53	2,36
	TNUN-330932	◆	●			◆	◆	●	◆	TNUN-668	19,05	32,99	9,53	3,18
	TNUN-381124	◆	●			◆	◆	●	◆	TNUN-776	22,23	38,51	11,10	2,36
	TNUN-381132	◆	●			◆	◆	●	◆	TNUN-778	22,23	38,51	11,10	3,18
	TNUN-381140	◆	●			◆	◆	●	◆	TNUN-7710	22,23	38,51	11,10	3,96
	TNUN-441132	◆	●			◆	◆	●	◆	TNUN-878	25,40	43,99	11,10	3,18

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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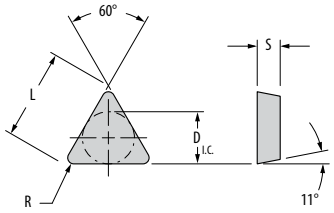
Triangle Inserts

Flat Top — TPGN/TPUN



Shape: Triangle	Part Number ISO	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ANSI	Dimensions (mm)			
		GA5035	GA-5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		D I.C.	L	S	R
	TPGN-330924	◆	●			◆	◆	●	◆	TPGN-666	19,05	32,99	9,53	2,36
	TPUN-330916	◆	●			◆	◆	●	◆	TPUN-664	19,05	32,99	9,53	1,57
	TPUN-330924	◆	●			◆	◆	●	◆	TPUN-666	19,05	32,99	9,53	2,36

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

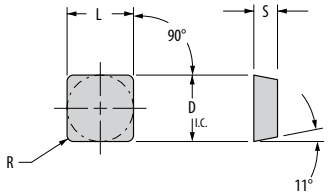
CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

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

Grade descriptions *— pages HT 4–5*

Square Inserts

Flat Top — SPGN / SPUN



Shape: Square	Part Number ISO	Steel P			Stainless Steel M		Cast Iron K	Heat-Resistant Super Alloys S		Part Number ANSI	Dimensions (mm)			
		GA5035	GA-5125	GA5036	GA5023	G-915	GA5023	G-915	G-20M		D I.C.	L	S	R
	SPGN-190412	◆	●			◆	◆	●	◆	SPGN-633	19,05	19,05	4,75	1,19
	SPGN-190416	◆	●			◆	◆	●	◆	SPGN-634	19,05	19,05	4,75	1,57
	SPGN-190424	◆	●			◆	◆	●	◆	SPGN-636	19,05	19,05	4,75	2,36
	SPGN-190432	◆	●			◆	◆	●	◆	SPGN-638	19,05	19,05	4,75	3,18
	SPUN-190412	◆	●			◆	◆	●	◆	SPUN-633	19,05	19,05	4,75	1,19
	SPUN-190416	◆	●			◆	◆	●	◆	SPUN-634	19,05	19,05	4,75	1,57
	SPUN-190612	◆	●			◆	◆	●	◆	SPUN-643	19,05	19,05	6,35	1,19
	SPUN-190616	◆	●			◆	◆	●	◆	SPUN-644	19,05	19,05	6,35	1,57
	SPUN-250916	◆	●			◆	◆	●	◆	SPUN-864	25,40	25,40	9,53	1,57
	SPUN-250924	◆	●			◆	◆	●	◆	SPUN-866	25,40	25,40	9,53	2,36
	SPUN-250932	◆	●			◆	◆	●	◆	SPUN-868	25,40	25,40	9,53	3,18
	SPUN-310932	◆	●			◆	◆	●	◆	SPUN-1068	31,75	31,75	9,53	3,18
	SPUN-381232	◆	●			◆	◆	●	◆	SPUN-1288	38,10	38,10	12,70	3,18

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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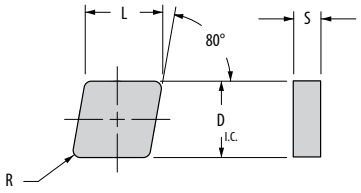
80° Diamond Inserts

CNGN



Shape: Diamond	Part Number ISO	Steel P				S Steel M	Cast Iron K				Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ANSI	Dimensions (mm)			
		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		D I.C.	L	S	R
	CNGN-190608	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	CNGN-642	19,05	19,33	6,35	0,79
	CNGN-190612	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	CNGN-643	19,05	19,33	6,35	1,19
	CNGN-190616	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	CNGN-644	19,05	19,33	6,35	1,57

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

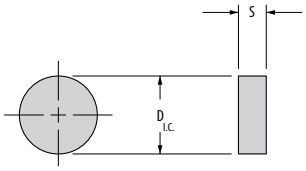
CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

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

Grade descriptions — pages HT 4–5

Round Inserts

RNGN



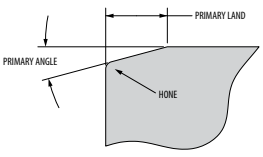
Shape: Round	Part Number ISO	Steel P				S Steel M	Cast Iron K				Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ANSI	Dimensions (mm)	
		WG-300	WG-600	XSYTIN-1	GEM-8	WG-600	WG-600	GSN100	XSYTIN-1	GEM-8	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		D I.C.	S
	RNGN-190600	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RNGN-64	19,05	6,35
	RNGN-190700	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RNGN-65	19,05	7,92
	RNGN-250600	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RNGN-84	25,40	6,35
	RNGN-250700	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RNGN-85	25,40	7,92
	RNGN-250900	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RNGN-86	25,40	9,53
	RNGN-310900	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RNGN-106	31,75	9,53

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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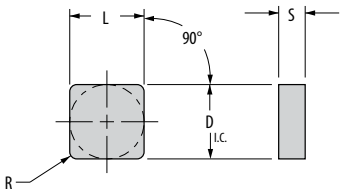
Square Inserts

SNGN



Shape: Square	Part Number ISO	Steel P				S Steel M	Cast Iron K				Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ANSI	Dimensions (mm)			
		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		D I.C.	L	S	R
	SNGN-190608	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SNGN-642	19,05	19,05	6,35	0,79
	SNGN-190612	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SNGN-643	19,05	19,05	6,35	1,19
	SNGN-190616	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SNGN-644	19,05	19,05	6,35	1,57
	SNGN-190712	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SNGN-653	19,05	19,05	7,92	1,19
	SNGN-190716	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SNGN-654	19,05	19,05	7,92	1,57
	SNGN-190720	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SNGN-655	19,05	19,05	7,92	1,98
	SNGN-250924	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SNGN-866	25,40	25,40	9,53	2,39

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

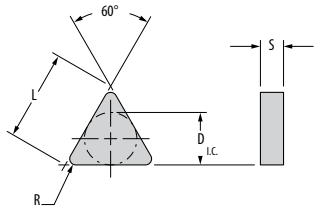
CERAMIC CLASSIFICATION: Whisker Ceramic | Phase-Toughened | Silicon Nitride | Alumina TiC

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

Grade descriptions — pages HT 4–5

Triangle Inserts

TNGN



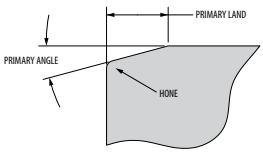
Shape: Triangle	Part Number ISO	Steel P				S Steel M	Cast Iron K				Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ANSI	Dimensions (mm)			
		WG-300	WG-600	XSYTIN-1	GEM-8	WG-600	WG-600	GSN100	XSYTIN-1	GEM-8	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		D I.C.	L	S	R
	TNGN-330924	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	TNGN-666	19,05	32,99	9,53	2,39
	TNGN-440932	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	TNGN-868	25,40	43,99	9,53	3,18

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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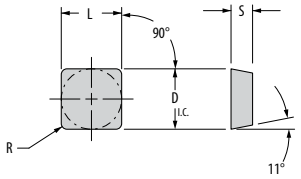
Square Inserts

SPGN



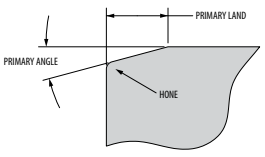
Shape: Square	Part Number ISO	Steel P				S Steel M	Cast Iron K				Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ANSI	Dimensions (mm)			
		WG-300	WG-600	XSYTIN-1	GEM-8	WG-600	WG-600	GSN100	XSYTIN-1	GEM-8	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		D I.C.	L	S	R
	SPGN-190412	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SPGN-633	19,05	19,05	4,75	1,19
	SPGN-190416	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SPGN-634	19,05	19,05	4,75	1,57
	SPGN-190608	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SPGN-642	19,05	19,05	6,35	0,79

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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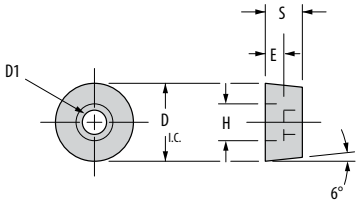
Roll Turning Inserts

Carbide — CDH



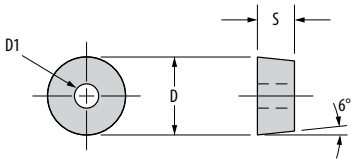
Shape: CDH	Part Number ISO	GA5035	GA5036	G-02	G-60	Part Number ANSI	Dimensions (mm) D I.C.	T	H	D1	E
	CDH-42	▲	▲	▲	▲	CDH-42	25,40	12,70	10,31	6,73	6,35
	CDH-43	▲	▲	▲	▲	CDH-43	25,40	19,05	10,31	6,73	12,70
	CDH-51.5	▲	▲	▲	▲	CDH-51.5	31,75	9,53	15,06	9,91	9,53
	CDH-53	▲	▲	▲	▲	CDH-53	31,75	19,05	15,06	9,91	9,53

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 ISO	Steel P				S Steel M	Cast Iron K				Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ANSI	Dimensions (mm) D I.C.	S	D1
		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	12,70	6,35	3,18
	C-CDH-22	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	C-CDH-22	12,70	6,35	3,18
	C-CDH-31	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	C-CDH-31	19,05	6,35	6,73
	C-CDH-31.5	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	C-CDH-31.5	19,05	9,53	6,73
	C-CDH-42	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	C-CDH-42	25,40	12,70	6,73
	C-CDH-43	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	C-CDH-43	25,40	19,05	6,73
	C-CDH-51.5	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	C-CDH-51.5	31,75	9,53	9,91
	C-CDH-53	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	C-CDH-5	31,75	19,05	9,91

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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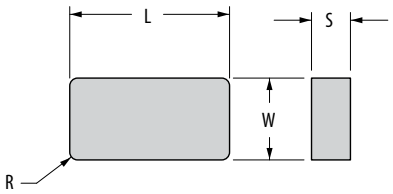
Roll Turning Inserts

LNUN



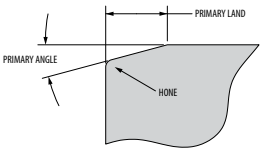
Shape: LNUN	Part Number ISO	GA5035	G-935	G-50	G-74	Part Number ANSI	Dimensions (mm) W	L	S	R
	LNUN-4442	▲	▲	▲	▲	LNUN-4442	12,70	25,40	6,35	0,79
	LNUN-4444	▲	▲	▲	▲	LNUN-4444	12,70	25,40	6,35	1,57
	LNUN-4452	▲	▲	▲	▲	LNUN-4452	12,70	25,40	7,92	0,79
	LNUN-4454	▲	▲	▲	▲	LNUN-4454	12,70	25,40	7,92	1,57
	LNUN-5444	▲	▲	▲	▲	LNUN-5444	15,88	25,40	6,35	1,57
	LNUN-5464	▲	▲	▲	▲	LNUN-5464	15,88	25,40	9,53	1,57
	LNUN-5564	▲	▲	▲	▲	LNUN-5564	15,88	31,75	9,53	1,57
	LNUN-6568	▲	▲	▲	▲	LNUN-6568	19,05	31,75	9,53	3,18
	LNUN-6684	▲	▲	▲	▲	LNUN-6684	19,05	38,10	12,70	1,57
	LNUN-6688	▲	▲	▲	▲	LNUN-6688	19,05	38,10	12,70	3,18
	LNUN-66812	▲	▲	▲	▲	LNUN-66812	19,05	38,10	12,70	4,75
	LNUN-68812	▲	▲	▲	▲	LNUN-68812	19,05	50,80	12,70	4,75

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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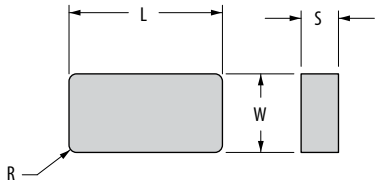
Roll Turning Inserts

LNMN



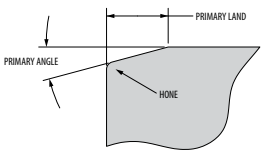
Shape: LNMN	Part Number ISO	Steel P				S Steel M	Cast Iron K				Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ANSI	Dimensions (mm)			
		WG-300	WG-600	XSYTIN-1	GEM-8	WG-600	WG-600	GSN100	XSYTIN-1	GEM-8	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		W	L	S	R
	LNMN-4442	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-4442	12,70	25,40	6,35	0,79
	LNMN-4444	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-4444	12,70	25,40	6,35	1,57
	LNMN-4452	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-4452	12,70	25,40	7,92	0,79
	LNMN-4454	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-4454	12,70	25,40	7,92	1,57
	LNMN-5444	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-5444	15,88	25,40	6,35	1,57
	LNMN-5464	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-5464	15,88	25,40	9,53	1,57
	LNMN-5564	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-5564	15,88	31,75	9,53	1,57
	LNMN-6568	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-6568	19,05	31,75	9,53	3,18
	LNMN-6684	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-6684	19,05	38,10	12,70	1,57
	LNMN-6688	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-6688	19,05	38,10	12,70	3,18
	LNMN-66812	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	LNMN-66812	19,05	38,10	12,70	4,75

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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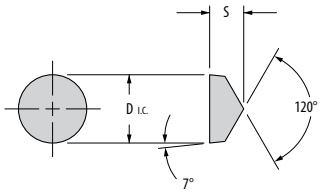
Round V-Bottom Inserts

RCGN-V



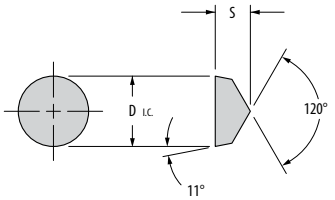
Shape: Round V-Bottom	Part Number ISO	Steel P				S Steel M	Cast Iron K				Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ANSI	Dimensions (mm)	
		WG-300	WG-600	XSYTIN-1	GEM-8	WG-600	WG-600	GSN100	XSYTIN-1	GEM-8	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		D I.C.	S
	RCGX-060400	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RCGN-2V	6,35	4,75
	RCGX-090700	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RCGN-3V	9,53	7,92
	RCGX-120700	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RCGN-4V	12,70	7,92
	RCGX-151000	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RCGN-5V	15,88	10,01
	RCGX-191000	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RCGX-106	19,05	10,01
	RCGX-191000	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RCGN-6V	19,05	12,70

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

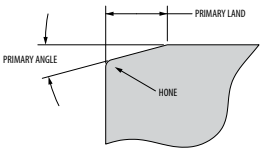
Shape: Round V-Bottom	Part Number ISO	Steel P				S Steel M	Cast Iron K				Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ANSI	Dimensions (mm)	
		WG-300	WG-600	XSYTIN-1	GEM-8	WG-600	WG-600	GSN100	XSYTIN-1	GEM-8	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		D I.C.	S
	RPGX-060400	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RPGN-2V	6,35	4,75
	RPGX-090700	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RPGN-3V	9,53	7,92
	RPGX-120700	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	RPGN-4V	12,70	7,92

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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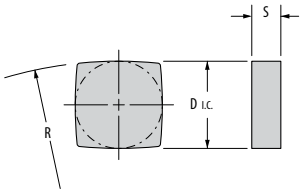
Square Inserts

SNGN



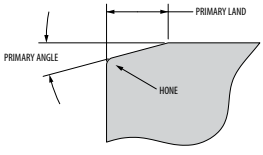
Shape: Square	Part Number ISO	Steel P				S Steel M	Cast Iron K				Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ANSI	Dimensions (mm)		
		WG-300	WG-600	XSYTIN-1	GEM-8	WG-600	WG-600	GSN100	XSYTIN-1	GEM-8	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8		D I.C.	S	R
	SNGN-128-R4.5	▲	●	●	◆	◆	▲	●	❖	◆	●	◆	▲	❖	▲	●	❖	◆	SNGN-128-R4.5	38,10	12,70	114,30

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 ❖

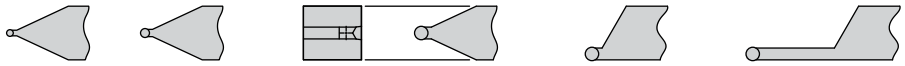
Grade descriptions *— pages HT 4–5*



Edge preparations *— page HT 06*

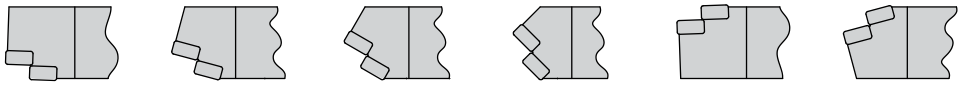
Inserts

Round V-Bottom
RPGN , RCGN STYLES



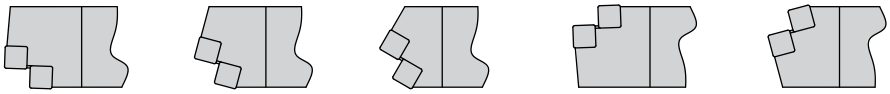
Single Rectangle
LNU STYLE

Double Rectangle
LNU STYLE

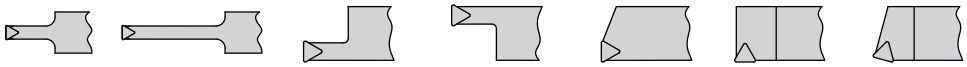


Single Square
NEGATIVE OR POSITIVE
SNUN , SPUN STYLES

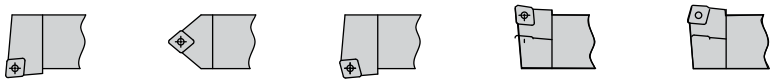
Double Square
NEGATIVE OR POSITIVE
SNUN , SPUN STYLES



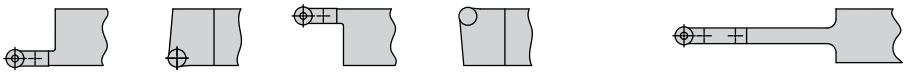
Triangular Insert
NEGATIVE OR POSITIVE
TPGN, TNUN STYLES



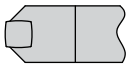
Diamond Insert
NEGATIVE OR POSITIVE
CNGN , CPGN STYLES

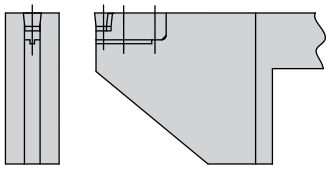


Round Insert
NEGATIVE OR POSITIVE
RNGN , RCGN STYLES
CDH STYLES



1½ I.C.
Finishing Insert
SNGN-128R4.5





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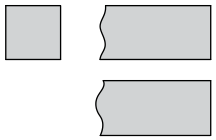
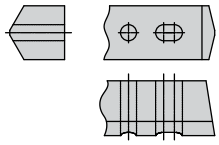
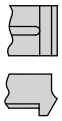
Shank Options



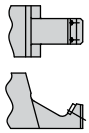
Straight Shank



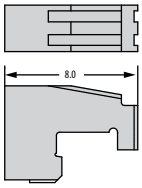
Customized V-Bottom Shank



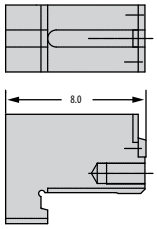
Farrel Quick Change



Greenleaf Cam Lock



Customized Shank for Hercules 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.

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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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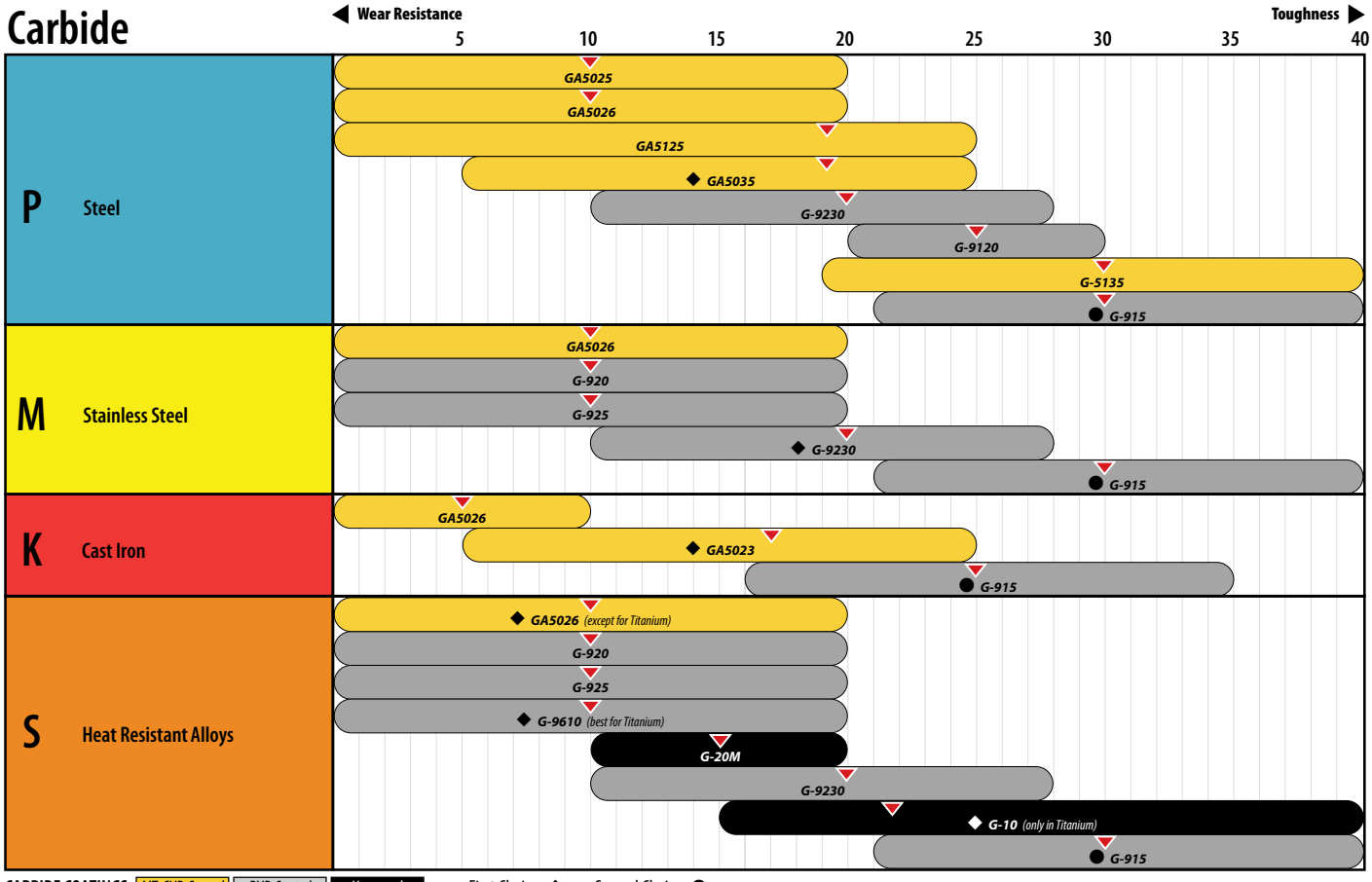
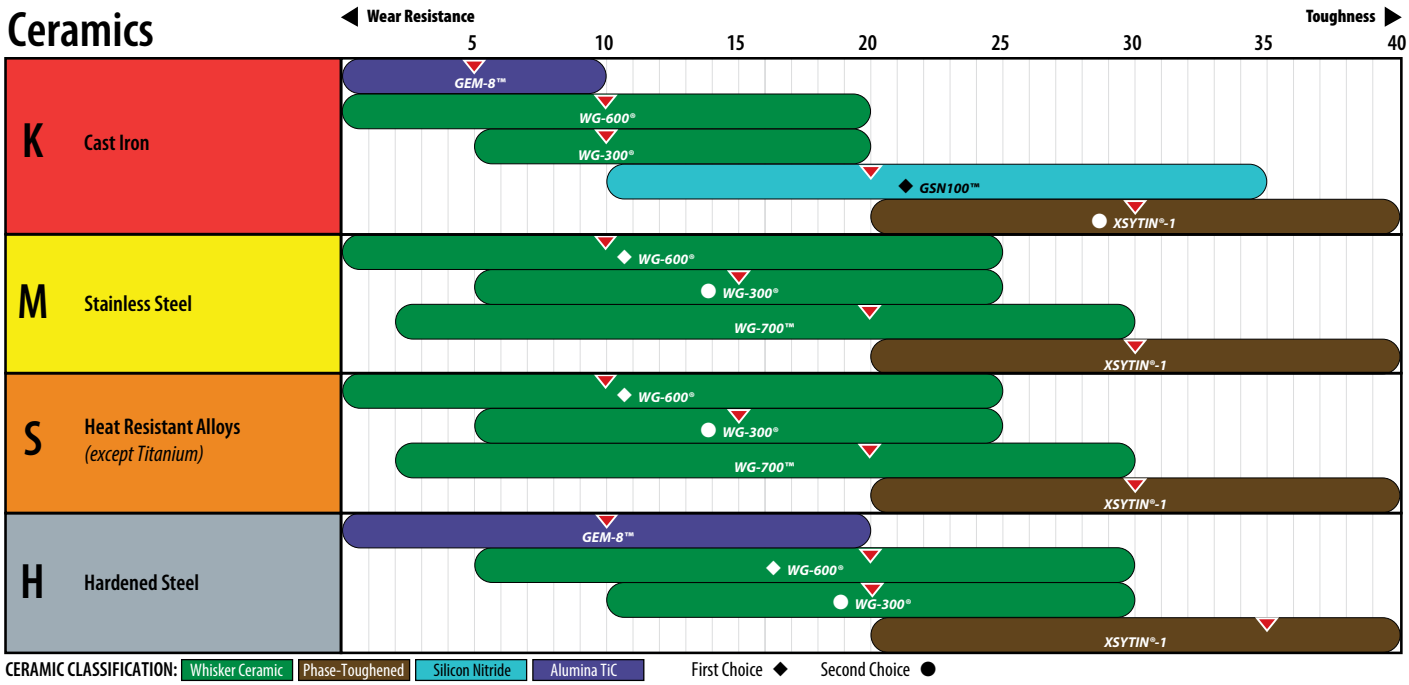
Insert Grade Reference for Grooving, Profiling, and Cut-Off

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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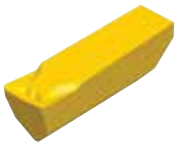
Pictorial Index

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

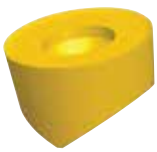
RCGX
Positive: Carbide
page: GP 14

RCGX
Positive: Ceramic
page: GP 14

RPGX
Positive: Carbide
page: GP 15

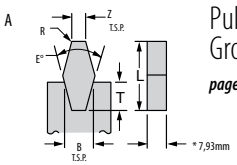
RPGX
Positive: Ceramic
page: GP 15

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



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

Pulley and Poly Groove Inserts



Pulley and Poly
Groove Inserts
page: GP 18

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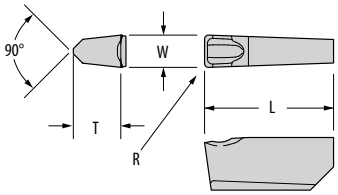
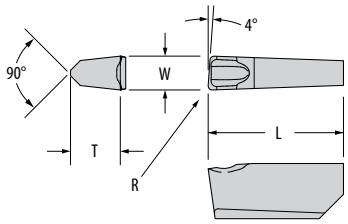
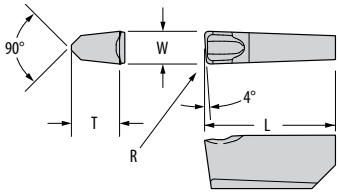
Greenleaf Cut-Off System



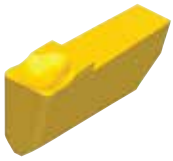
0° Lead



4° Left Hand



4° Right Hand

Shape: Groove/Turn	Part Number ISO	G-915	Part Number ANSI	Dimensions (mm)			
				W	L	T	R
	COS-4094-0	◆	COS-4094-0	2,39	12,70	4,75	0,25
	COS-4125-0	◆	COS-4125-0	3,18	12,70	4,75	0,25
	COS-4187-0	◆	COS-4187-0	4,75	12,70	4,75	0,25
	COS-4094-4L	◆	COS-4094-4L	2,39	12,70	4,75	0,25
	COS-4125-4L	◆	COS-4125-4L	3,18	12,70	4,75	0,25
	COS-4187-4L	◆	COS-4187-4L	4,75	12,70	4,75	0,25
	COS-4094-4R	◆	COS-4094-4R	2,39	12,70	4,75	0,25
	COS-4125-4R	◆	COS-4125-4R	3,18	12,70	4,75	0,25
	COS-4187-4R	◆	COS-4187-4R	4,75	12,70	4,75	0,25

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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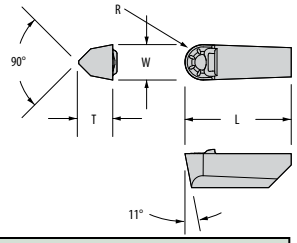
GTS Style, Full Nose Grooving Inserts



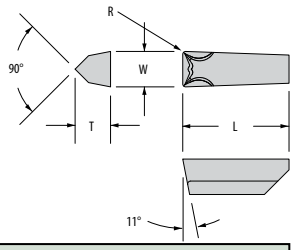
Shape: Groove/Turn	Part Number ISO	Steel P			Stainless Steel M		Cast Iron K	Heat Resistant Super Alloys S		Part Number ANSI	Dimensions (mm)			
		GA5035	G-915	G-935	GA5026	G-915	G-915	GA5026	G-925		W	L	T	R
	GTS-4125	▲	◆	●	◆	●	◆	●	◆	GTS-4125	3,18	12,70	4,75	1,59
	GTS-4187	▲	◆	●	◆	●	◆	●	◆	GTS-4187	4,75	12,70	4,75	2,37
	GTS-6250	▲	◆	●	◆	●	◆	●	◆	GTS-6250	6,35	19,05	6,35	3,18

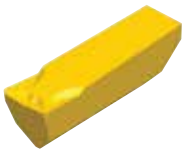
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

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

Grade descriptions — pages GP 04

GTS Style, Flat Nose Grooving Inserts



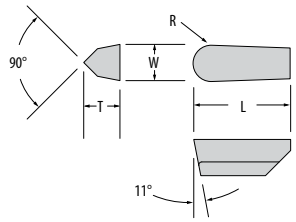
Shape: Groove/Turn	Part Number ISO	Steel P			Stainless Steel M		Cast Iron K	Heat Resistant Super Alloys S		Part Number ANSI	Dimensions (mm)			
		GA5035	G-915	G-935	GA5026	G-915	G-915	GA5026	G-925		W	L	T	R
	GTS-4125-1	▲	◆	●	◆	●	◆	●	◆	GTS-4125-1	3,18	12,70	4,75	0,38
	GTS-4125-2	▲	◆	●	◆	●	◆	●	◆	GTS-4125-2	3,18	12,70	4,75	0,79
	GTS-4187-1	▲	◆	●	◆	●	◆	●	◆	GTS-4187-1	4,75	12,70	4,75	0,38
	GTS-4187-2	▲	◆	●	◆	●	◆	●	◆	GTS-4187-2	4,75	12,70	4,75	0,79
	GTS-6250-1	▲	◆	●	◆	●	◆	●	◆	GTS-6250-1	6,35	19,05	6,35	0,38
	GTS-6250-2	▲	◆	●	◆	●	◆	●	◆	GTS-6250-2	6,35	19,05	6,35	0,79

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 ISO	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ANSI	Dimensions (mm)			
		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	2,39	12,70	4,75	1,19
	WG-4125	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4125	3,18	12,70	4,75	1,59
	WG-4156	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4156	3,96	12,70	4,75	1,98
	WG-4187	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4187	4,75	12,70	4,75	2,37
	WG-6218	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6218	5,54	19,05	6,35	2,77
	WG-6250	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6250	6,35	19,05	6,35	3,18
	WG-6281	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6281	7,14	19,05	6,35	3,57
	WG-8312	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8312	7,93	25,40	8,56	3,96
	WG-8344	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8344	8,74	25,40	8,56	4,37
	WG-8375	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8375	9,53	25,40	8,56	4,76

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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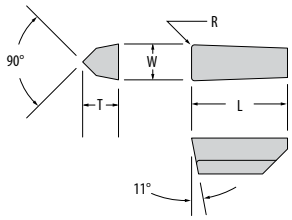
WG-Style, Flat Nose Grooving Inserts



Shape: Groover	Part Number ISO	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ANSI	Dimensions (mm)			
		M	K			S				H					W	L	T	R
		WG-600	GSN100	XSYTIN-1	WG-600	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8					
	WG-4094-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4094-1	2,39	12,70	4,75	0,38
	WG-4094-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4094-2	2,39	12,70	4,75	0,79
	WG-4125-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4125-1	3,18	12,70	4,75	0,38
	WG-4125-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4125-2	3,18	12,70	4,75	0,79
	WG-4156-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4156-1	3,96	12,70	4,75	0,38
	WG-4156-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4156-2	3,96	12,70	4,75	0,79
	WG-4156-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4156-3	3,96	12,70	4,75	1,17
	WG-4187-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4187-1	4,75	12,70	4,75	0,38
	WG-4187-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-4187-2	4,75	12,70	4,75	0,79
	WG-6218-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6218-1	5,54	19,05	6,35	0,38
	WG-6218-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6218-2	5,54	19,05	6,35	0,79
	WG-6250-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6250-1	6,35	19,05	6,35	0,38
	WG-6250-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6250-2	6,35	19,05	6,35	0,79
	WG-6250-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6250-3	6,35	19,05	6,35	1,17
	WG-6250-4	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6250-4	6,35	19,05	6,35	1,57
	WG-6281-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6281-1	7,14	19,05	6,35	0,38
	WG-6281-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6281-2	7,14	19,05	6,35	0,79
	WG-6281-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-6281-3	7,14	19,05	6,35	1,17
	WG-8312-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8312-1	7,92	25,40	8,56	0,38
	WG-8312-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8312-2	7,92	25,40	8,56	0,79
	WG-8312-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8312-3	7,92	25,40	8,56	1,17
	WG-8312-4	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8312-4	7,92	25,40	8,56	1,57
	WG-8344-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8344-1	8,74	25,40	8,56	0,38
	WG-8344-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8344-2	8,74	25,40	8,56	0,79
	WG-8344-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8344-3	8,74	25,40	8,56	1,17
	WG-8344-4	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8344-4	8,74	25,40	8,56	1,57
	WG-8375-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8375-1	9,53	25,40	8,56	0,38
	WG-8375-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8375-2	9,53	25,40	8,56	0,79
	WG-8375-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8375-3	9,53	25,40	8,56	1,17
	WG-8375-4	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WG-8375-4	9,53	25,40	8,56	1,57

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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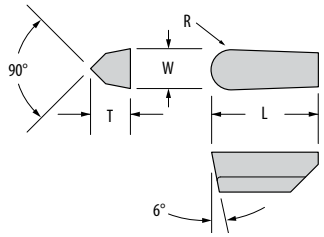
WGC, Full Nose Grooving Inserts



Shape: Groover	Part Number ISO	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ANSI	Dimensions (mm)			
		M	K			S				H					W	L	T	R
		WG-600	GSN100	XSYTIN-1	WG-600	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8					
	WGC-4094	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4094	2,39	12,70	4,75	1,19
	WGC-4125	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4125	3,18	12,70	4,75	1,59
	WGC-4156	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4156	3,96	12,70	4,75	1,98
	WGC-4187	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4187	4,75	12,70	4,75	2,37
	WGC-6218	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6218	5,54	19,05	6,35	2,77
	WGC-6250	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6250	6,35	19,05	6,35	3,18
	WGC-6281	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6281	7,14	19,05	6,35	3,57
	WGC-8312	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8312	7,93	25,40	8,56	3,96
	WGC-8344	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8344	8,74	25,40	8,56	4,37
	WGC-8375	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8375	9,53	25,40	8,56	4,76

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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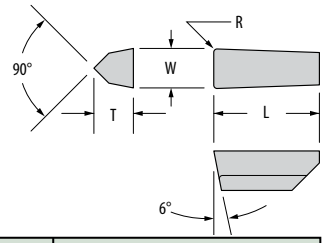
WGC, Flat Nose Grooving Inserts



Shape: Groover	Part Number ISO	S Steel	Cast Iron			Heat-Resistant Super Alloys				Hardened Steel				Part Number ANSI	Dimensions (mm)			
		M	K			S				H					W	L	T	R
		WG-600	GSN100	XSYTIN-1	WG-600	WG-300	WG-600	WG-700	XSYTIN-1	WG-300	WG-600	XSYTIN-1	GEM-8					
	WGC-4094-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4094-1	2,39	12,70	4,75	0,38
	WGC-4094-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4094-2	2,39	12,70	4,75	0,79
	WGC-4125-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4125-1	3,18	12,70	4,75	0,38
	WGC-4125-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4125-2	3,18	12,70	4,75	0,79
	WGC-4156-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4156-1	3,96	12,70	4,75	0,38
	WGC-4156-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4156-2	3,96	12,70	4,75	0,79
	WGC-4187-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4187-1	4,75	12,70	4,75	0,38
	WGC-4187-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-4187-2	4,75	12,70	4,75	0,79
	WGC-6218-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6218-1	5,54	19,05	6,35	0,38
	WGC-6218-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6218-2	5,54	19,05	6,35	0,79
	WGC-6250-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6250-1	6,35	19,05	6,35	0,38
	WGC-6250-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6250-2	6,35	19,05	6,35	0,79
	WGC-6250-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6250-3	6,35	19,05	6,35	1,17
	WGC-6281-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6281-1	7,14	19,05	6,35	0,38
	WGC-6281-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6281-2	7,14	19,05	6,35	0,79
	WGC-6281-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-6281-3	7,14	19,05	6,35	1,17
	WGC-8312-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8312-1	7,92	25,40	8,56	0,38
	WGC-8312-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8312-2	7,92	25,40	8,56	0,79
	WGC-8312-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8312-3	7,92	25,40	8,56	1,17
	WGC-8312-4	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8312-4	7,92	25,40	8,56	1,57
	WGC-8344-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8344-1	8,74	25,40	8,56	0,38
	WGC-8344-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8344-2	8,74	25,40	8,56	0,79
	WGC-8344-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8344-3	8,74	25,40	8,56	1,17
	WGC-8344-4	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8344-4	8,74	25,40	8,56	1,57
	WGC-8375-1	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8375-1	9,53	25,40	8,56	0,38
	WGC-8375-2	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8375-2	9,53	25,40	8,56	0,79
	WGC-8375-3	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8375-3	9,53	25,40	8,56	1,17
	WGC-8375-4	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	WGC-8375-4	9,53	25,40	8,56	1,57

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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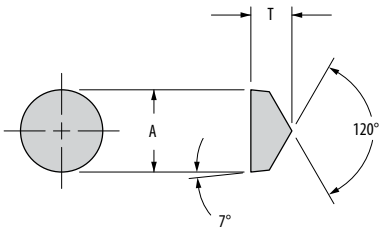
Round Positive V-Bottom Inserts

RCGX-V — Carbide



Shape: Round V-Bottom	Part Number ISO	Steel P				Stainless Steel M			Cast Iron K	Heat-Resistant Super Alloys S							Part Number ANSI	Dimensions (mm)	
		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
	RCGX-060400	●	◆	▲	❖	●	◆	❖	◆	❖	❖	●	▲	◆	▲	▲	RCGN-2V	6,35	4,75
	RCGX-060600	●	◆	▲	❖	●	◆	❖	◆	❖	❖	●	▲	◆	▲	▲	RCGX-102	6,35	6,35
	RCGX-090700	●	◆	▲	❖	●	◆	❖	◆	❖	❖	●	▲	◆	▲	▲	RCGN-3V	9,53	7,92
	RCGX-120700	●	◆	▲	❖	●	◆	❖	◆	❖	❖	●	▲	◆	▲	▲	RCGN-4V	12,70	7,92

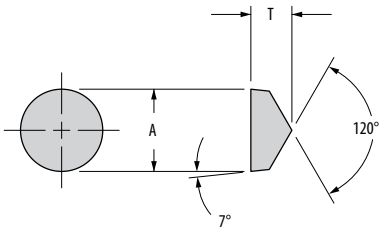
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

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

Grade descriptions — pages GP 04

Round Positive V-Bottom Inserts

RCGX-V — Ceramic



Shape: Round V-Bottom	Part Number ISO	S Steel M	Cast Iron K			Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ANSI	Dimensions (mm)	
		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
	RCGX-060400	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	RCGN-2V	6,35	4,75
	RCGX-060600	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	RCGN-102	6,35	6,35
	RCGX-090700	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	RCGN-3V	9,53	7,92
	RCGX-120700	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	RCGN-4V	12,70	7,92

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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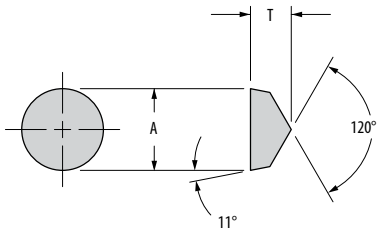
Round Positive V-Bottom Inserts

RPGX-V — Carbide



Shape: Round V-Bottom	Part Number ISO	Steel P				Stainless Steel M			Cast Iron K	Heat-Resistant Super Alloys S							Part Number ANSI	Dimensions (mm)	
		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
	RPGX-060400	●	◆	▲	❖	●	◆	❖	◆	❖	❖	●	▲	◆	▲	▲	RPGN-2V	6,35	4,75
	RPGX-090700	●	◆	▲	❖	●	◆	❖	◆	❖	❖	●	▲	◆	▲	▲	RPGN-3V	9,53	7,92
	RPGX-120700	●	◆	▲	❖	●	◆	❖	◆	❖	❖	●	▲	◆	▲	▲	RPGN-4V	12,70	7,92

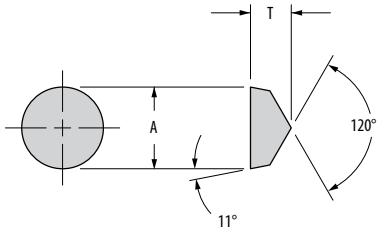
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

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

Grade descriptions — pages GP 04

Round Positive V-Bottom Inserts

RPGX-V — Ceramic



Shape: Round V-Bottom	Part Number ISO	S Steel M	Cast Iron K			Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ANSI	Dimensions (mm)	
		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
	RPGX-060400	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	RPGN-2V	6,35	4,75
	RPGX-090700	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	RPGN-3V	9,53	7,92
	RPGX-120700	◆	◆	▲	●	●	◆	▲	▲	●	●	❖	▲	RPGN-4V	12,70	7,92

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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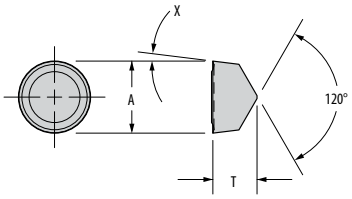
Round Positive Chipform V-Bottom Inserts

RCGR-V/RPGR-V — Carbide



Shape: Round V-Bottom	Part Number ISO	Steel P				Stainless Steel M			Cast Iron K	Heat-Resistant Super Alloys S							Part Number ANSI	Dimensions (mm)		
		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-060400V-TF					●	◆					●	▲	◆	▲	▲	RCGR-2V-TF	6,35	4,75	7°
	RCGR-090700V-TF					●	◆					●	▲	◆	▲	▲	RCGR-3V-TF	9,53	7,92	7°
	RCGR-120700V-TF					●	◆					●	▲	◆	▲	▲	RCGR-4V-TF	12,70	7,92	7°
	RPGX-060400V-TF					●	◆					●	▲	◆	▲	▲	RPGR-2V-TF	6,35	4,75	11°
	RPGX-090700V-TF					●	◆					●	▲	◆	▲	▲	RPGR-3V-TF	9,53	7,92	11°
	RPGX-120700V-TF					●	◆					●	▲	◆	▲	▲	RPGR-4V-TF	12,70	7,92	11°

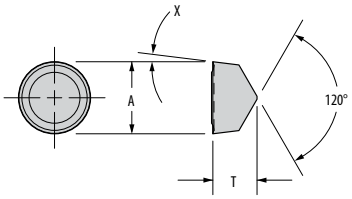
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

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 ISO	S Steel M	Cast Iron K			Heat-Resistant Super Alloys S				Hardened Steel H				Part Number ANSI	Dimensions (mm)		
		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-060400V-GF1	◆		▲	●	●	◆	▲	▲	●	●	❖		RCGR-2V-GF1	6,35	4,75	7°
	RCGR-090700V-GF1	◆		▲	●	●	◆	▲	▲	●	●	❖		RCGR-3V-GF1	9,53	7,92	7°
	RCGR-120700V-GF1	◆		▲	●	●	◆	▲	▲	●	●	❖		RCGR-4V-GF1	12,70	7,92	7°
	RPGR-060400V-GF1	◆		▲	●	●	◆	▲	▲	●	●	❖		RPGR-2V-GF1	6,35	4,75	11°
	RPGR-090700V-GF1	◆		▲	●	●	◆	▲	▲	●	●	❖		RPGR-3V-GF1	9,53	7,92	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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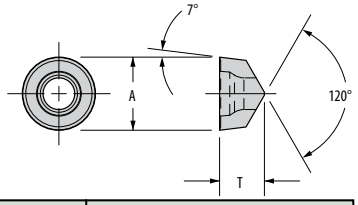
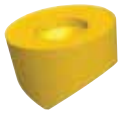
Round Positive Chipform V-Bottom Inserts

RCGT-V — Carbide



Shape: Round V-Bottom	Part Number ISO	Steel P				Stainless Steel M			Cast Iron K	Heat-Resistant Super Alloys S							Part Number ANSI	Dimensions (mm)	
		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-060400V-TF					●	◆					●	▲	◆	▲	▲	RCGT-2V-TF	6,35	4,75
	RCGT-090700V-TF					●	◆					●	▲	◆	▲	▲	RCGT-3V-TF	9,53	7,92
	RCGT-120700V-TF					●	◆					●	▲	◆	▲	▲	RCGT-4V-TF	12,70	7,92

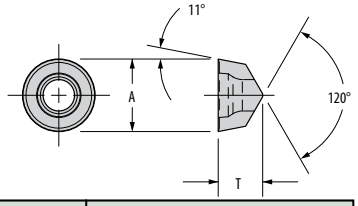
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated

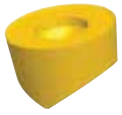
First Choice ◆ Second Choice ● Alternative ▲ Interrupted/Milling ❖

Grade descriptions *— pages GP 04*

Round Positive Chipform V-Bottom Inserts

RPGT-V — Carbide



Shape: Round V-Bottom	Part Number ISO	Steel P				Stainless Steel M			Cast Iron K	Heat-Resistant Super Alloys S							Part Number ANSI	Dimensions (mm)	
		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-060400V-TF					●	◆					●	▲	◆	▲	▲	RPGT-2V-TF	6,35	4,75
	RPGT-090700V-TF					●	◆					●	▲	◆	▲	▲	RPGT-3V-TF	9,53	7,92
	RPGT-120700V-TF					●	◆					●	▲	◆	▲	▲	RPGT-4V-TF	12,70	7,92

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

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

Grade descriptions *— pages GP 04*

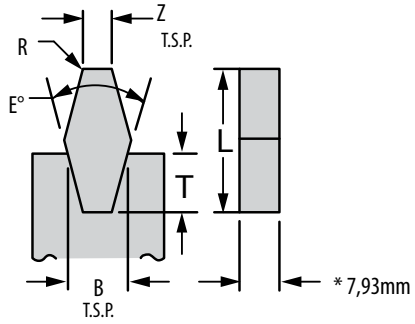
Pulley and Poly Grooving Inserts

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



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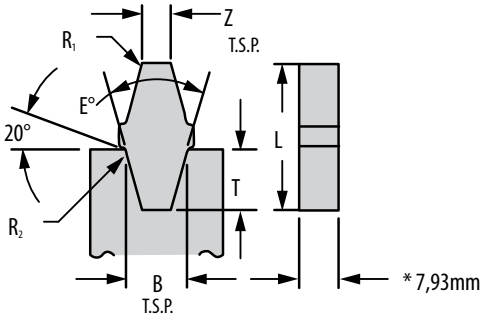

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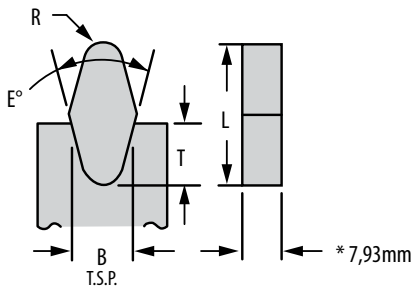
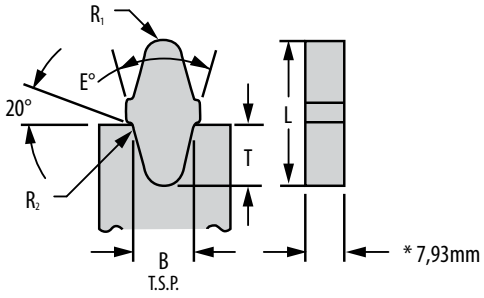
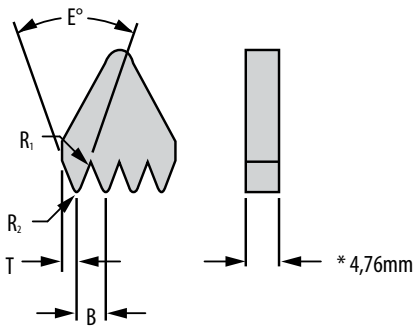


D



E



Z NUMBER OF TEETH REQUIRED ON INSERT

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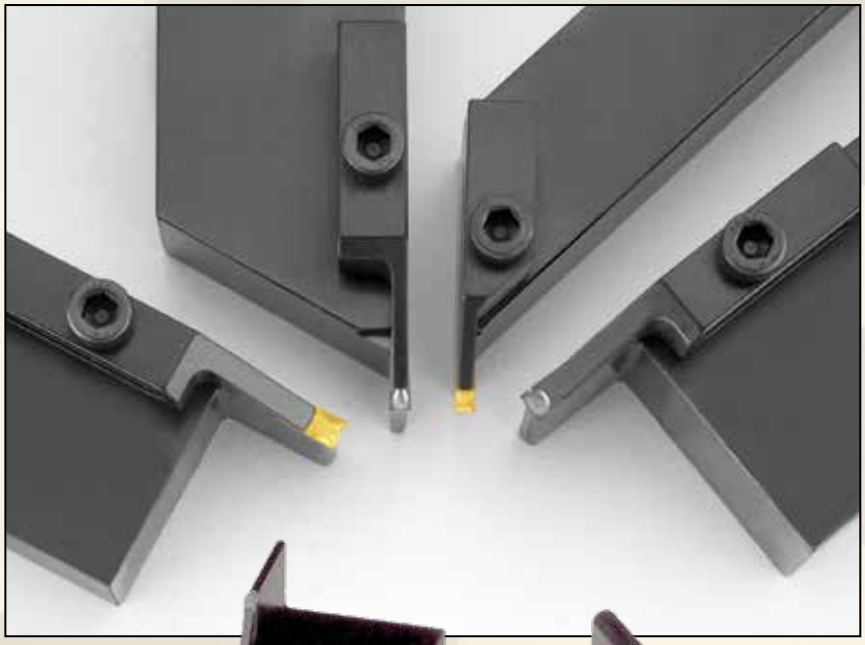
Grooving, Profiling and Cut-Off Toolholders

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.

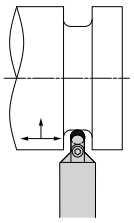


Greenleaf Tune-Up Kits

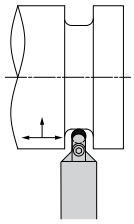
A Tune-Up Kit consists of all the standard hardware to refurbish a particular toolholder, boring bar, or milling cutter. A toolholder will have a readily visible, laser-inscribed Tune-Up Kit number on it for ease in ordering. This number will prevent any confusion created by searching a catalog for hardware,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

Pictorial Index

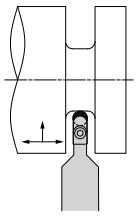
V-Bottom Round Toolholders



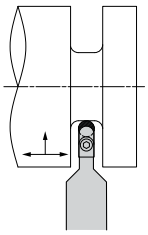
CRDPN-VS
Replaceable Nest
Shallow D.O.C.
page: GP 22



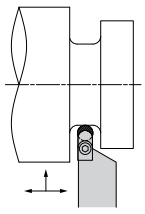
CRDPN-V
Replaceable Nest
Deep D.O.C.
page: GP 22



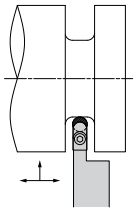
CRDPN-VMS
Milled Nest
Shallow D.O.C.
page: GP 23



CRDPN-VM
Milled Nest
Deep D.O.C.
page: GP 23

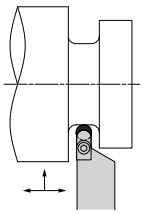


O.D. G/P Toolholder
Replaceable Nest
Shallow D.O.C.
page: GP 24

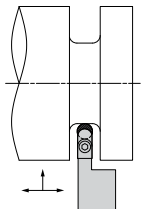


O.D. G/P Toolholder
Replaceable Nest
Deep D.O.C.
page: GP 24

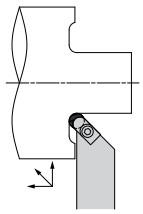
V-Bottom Round Toolholders *continued*



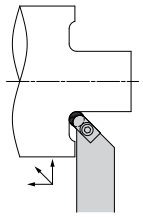
O.D. G/P Toolholder
Milled Nest
Shallow D.O.C.
page: GP 25



O.D. G/P Toolholder
Milled Nest
Deep D.O.C.
page: GP 25

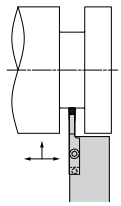


CRGPR-V
CRGPL-V
45°
Replaceable Nest
page: GP 26

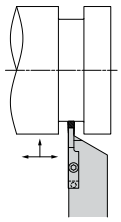


CRGPR-VM
CRGPL-VM
45°
Milled Nest
page: GP 26

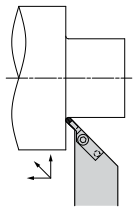
Single-Ended Groovers



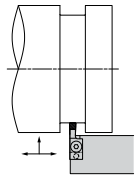
Deep D.O.C.
page: GP 27-28



Shallow D.O.C.
page: GP 29-30



45° G/P Toolholder
page: GP 31



90° G/P Toolholder
page: GP 32-33

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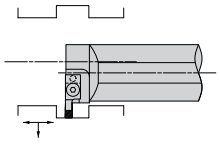
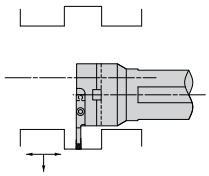
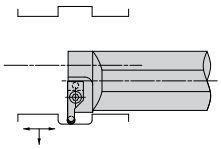
Grooving, Profiling, and Cut-Off Bars



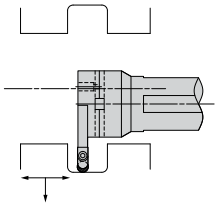
Cut-Off Grooving Bar
page: GP 34



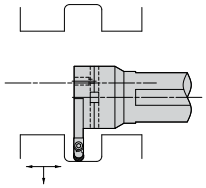
Cut-Off Grooving Support Blade
For Single-Ended, V-Bottom Inserts
page: GP 35



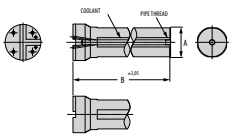
Profiling Bar
Round V-Bottom Insert
Milled Nest
page: GP 36



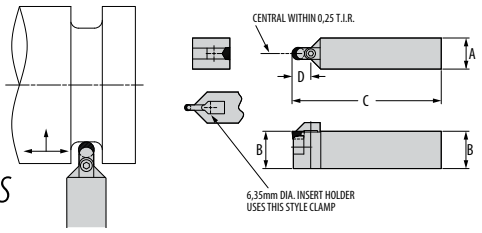
Profiling Support Blade
Round V-Bottom Insert
Milled Nest
page: GP 37



Profiling Support Blade
Round V-Bottom Insert
Replaceable Nest
page: GP 37



Shank Options
For Bolt-On Support Blades
page: GP 38



CRDPN-VS Toolholder

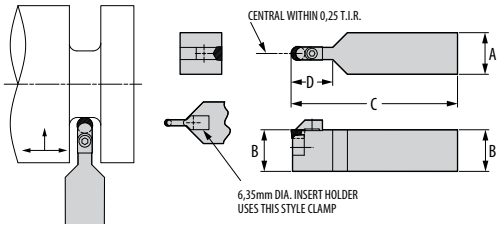
Round V-Bottom Insert / Replaceable Nest / Shallow D.O.C. (D) Series

Part Number	Gage Inserts	D.O.C. D	Dimensions (mm) A	B	C	Standard Components Nest	Nest Screw	Clamp	Clamp Screw	*Tune-Up Kit Includes all Standard Components
CRDPN-2525-06VS	**RPGX-060400	10	25	25	150	410631	BHCS M2.5-0.45x10mm	411910-250VRC	434416	TK-02684
CRDPN-3232-06VS	**RPGX-060400	10	32	32	170	410631	BHCS M2.5-0.45x10mm	411910-250VRC	434416	TK-02684
CRDPN-4040-06VS	**RPGX-060400	10	40	40	200	410631	BHCS M2.5-0.45x10mm	411910-250VRC	434416	TK-02684
CRDPN-2525-09VS	**RPGX-090700	15	25	25	150	413970	TBHCS M3-0.5x12mm	308063	TSHCS M5-0.8x12mm	TK-0268
CRDPN-3232-09VS	**RPGX-090700	15	32	32	170	413970	TBHCS M3-0.5x12mm	308063	TSHCS M5-0.8x12mm	TK-02685
CRDPN-4040-09VS	**RPGX-090700	15	40	40	200	413970	TBHCS M3-0.5x12mm	308063	TSHCS M5-0.8x12mm	TK-02685
CRDPN-2525-12VS	**RPGX-120700	20	25	25	150	414007	TBHCS M5-0.8x16mm	308136	434258	TK-02686
CRDPN-3232-12VS	**RPGX-120700	20	32	32	170	414007	TBHCS M5-0.8x16mm	308136	434258	TK-02686
CRDPN-4040-12VS	**RPGX-120700	20	40	40	200	414007	TBHCS M5-0.8x16mm	308136	434258	TK-02686

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 (mm) A	B	C	Standard Components Nest	Nest Screw	Clamp	Clamp Screw	*Tune-Up Kit Includes all Standard Components
CRDPN-2525-06V	**RPGX-060400	19	25	25	150	410631	BHCS M2.5-0.45x10mm	411910-250VRC	434416	TK-02684
CRDPN-3232-06V	**RPGX-060400	19	32	32	170	410631	BHCS M2.5-0.45x10mm	411910-250VRC	434416	TK-02684
CRDPN-4040-06V	**RPGX-060400	19	40	40	200	410631	BHCS M2.5-0.45x10mm	411910-250VRC	434416	TK-02684
CRDPN-2525-09V	**RPGX-090700	28	25	25	150	413970	TBHCS M3-0.5x12mm	308063	TSHCS M5-0.8x12mm	TK-02685
CRDPN-3232-09V	**RPGX-090700	28	32	32	170	413970	TBHCS M3-0.5x12mm	308063	TSHCS M5-0.8x12mm	TK-02685
CRDPN-4040-09V	**RPGX-090700	28	40	40	200	413970	TBHCS M3-0.5x12mm	308063	TSHCS M5-0.8x12mm	TK-02685
CRDPN-2525-12V	**RPGX-120700	38	25	25	150	414007	TBHCS M5-0.8x16mm	308136	434258	TK-02686
CRDPN-3232-12V	**RPGX-120700	38	32	32	170	414007	TBHCS M5-0.8x16mm	308136	434258	TK-02686
CRDPN-4040-12V	**RPGX-120700	38	40	40	200	414007	TBHCS M5-0.8x16mm	308136	434258	TK-02686

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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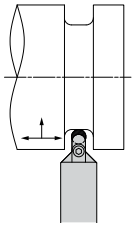
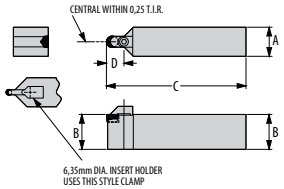
CRDPN-VMS Toolholder

Round V-Bottom Insert / Milled Nest / Shallow D.O.C. (D) Series



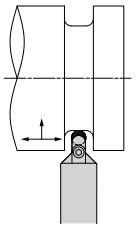


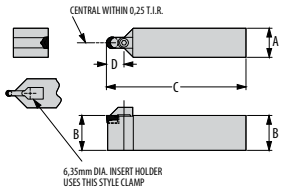
Part Number	Gage Inserts	D.O.C. D	Dimensions (mm) A	B	C	Standard Components Clamp	Clamp Screw	*Tune-Up Kit Includes all Standard Components	Opt. Component Insert Screw
CRDPN-2525-06VMS	**RPGX-060400	10	25	25	150	411910-250VRC	434416	TK-02717	PT-542T
CRDPN-3232-06VMS	**RPGX-060400	10	32	32	170	411910-250VRC	434416	TK-02717	PT-542T
CRDPN-4040-06VMS	**RPGX-060400	10	40	40	200	411910-250VRC	434416	TK-02717	PT-542T
CRDPN-2525-09VMS	**RPGX-090700	15	25	25	150	308063	TSHCS M5-0.8x12mm	TK-01709	PT-545T
CRDPN-3232-09VMS	**RPGX-090700	15	32	32	170	308063	TSHCS M5-0.8x12mm	TK-01709	PT-545T
CRDPN-4040-09VMS	**RPGX-090700	15	40	40	200	308063	TSHCS M5-0.8x12mm	TK-01709	PT-545T
CRDPN-2525-12VMS	**RPGX-120700	20	25	25	150	308136	434258	TK-02691	CO-5018
CRDPN-3232-12VMS	**RPGX-120700	20	32	32	170	308136	434258	TK-02691	CO-5018
CRDPN-4040-12VMS	**RPGX-120700	20	40	40	200	308136	434258	TK-02691	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



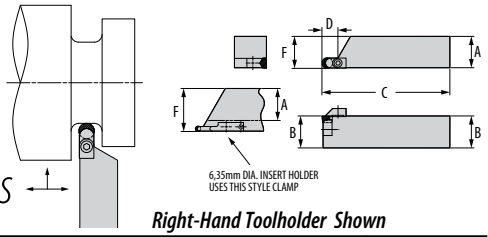


Part Number	Gage Inserts	D.O.C. D	Dimensions (mm) A	B	C	Standard Components Clamp	Clamp Screw	*Tune-Up Kit Includes all Standard Components	Opt. Component Insert Screw
CRDPN-2525-06VM	**RPGX-060400	19	25	25	150	411910-250VRC	434416	TK-02717	PT-542T
CRDPN-3232-06VM	**RPGX-060400	19	32	32	170	411910-250VRC	434416	TK-02717	PT-542T
CRDPN-4040-06VM	**RPGX-060400	19	40	40	200	411910-250VRC	434416	TK-02717	PT-542T
CRDPN-2525-09VM	**RPGX-090700	28	25	25	150	308063	TSHCS M5-0.8x12mm	TK-02734	PT-545T
CRDPN-3232-09VM	**RPGX-090700	28	32	32	170	308063	TSHCS M5-0.8x12mm	TK-02734	PT-545T
CRDPN-4040-09VM	**RPGX-090700	28	40	40	200	308063	TSHCS M5-0.8x12mm	TK-02734	PT-545T
CRDPN-2525-12VM	**RPGX-120700	38	25	25	150	308136	434258	TK-02691	CO-5018
CRDPN-3232-12VM	**RPGX-120700	38	32	32	170	308136	434258	TK-02691	CO-5018
CRDPN-4040-12VM	**RPGX-120700	38	40	40	200	308136	434258	TK-02691	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 (mm)				Standard Components				*Tune-Up Kit
Right	Left	Inserts	D	A†	B	C	F	Nest	Nest Screw	Clamp	Clamp Screw	Includes all Standard Components
M-415419-06VRS	–	**RPGX-060400	10	37	25	150	38	410631	BHCS M2.5-0.45x10mm	411905-250VRC	434259	TK-02692
–	M-415420-06VRS	**RPGX-060400	10	37	25	150	38	410631	BHCS M2.5-0.45x10mm	411906-250VRC	434259	TK-02693
M-415421-06VRS	–	**RPGX-060400	10	44	32	170	45	410631	BHCS M2.5-0.45x10mm	411905-250VRC	434259	TK-02692
–	M-415422-06VRS	**RPGX-060400	10	44	32	170	45	410631	BHCS M2.5-0.45x10mm	411906-250VRC	434259	TK-02693
M-415423-06VRS	–	**RPGX-060400	10	52	40	200	53	410631	BHCS M2.5-0.45x10mm	411905-250VRC	434259	TK-02692
–	M-415424-06VRS	**RPGX-060400	10	52	40	200	53	410631	BHCS M2.5-0.45x10mm	411906-250VRC	434259	TK-02693
M-415427-09VRS	M-415428-09VRS	**RPGX-090700	15	24	25	150	25	413970	TBHCS M3-0.5x12mm	308063	TSHCS M5-0.8x12mm	TK-02685
M-415429-09VRS	M-415430-09VRS	**RPGX-090700	15	31	32	170	32	413970	TBHCS M3-0.5x12mm	308063	TSHCS M5-0.8x12mm	TK-02685
M-415431-09VRS	M-415432-09VRS	**RPGX-090700	15	39	40	200	40	413970	TBHCS M3-0.5x12mm	308063	TSHCS M5-0.8x12mm	TK-02685
M-415435-12VRS	M-415436-12VRS	**RPGX-120700	20	24	25	150	25	414007	TBHCS M5-0.8x16mm	308136	434258	TK-02696
M-415437-12VRS	M-415438-12VRS	**RPGX-120700	20	31	32	170	32	414007	TBHCS M5-0.8x16mm	308136	434258	TK-02696
M-415439-12VRS	M-415440-12VRS	**RPGX-120700	20	40	40	200	40	414007	TBHCS M5-0.8x16mm	308136	434258	TK-02696

NOTE: See page GP 14 for ceramic and carbide inserts.

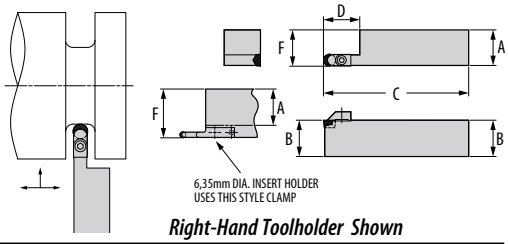
† *"A" indicates width of shank available for clamping, (not necessarily overall shank width).*

* *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 (mm)				Standard Components				*Tune-Up Kit
Right	Left	Inserts	D	A†	B	C	F	Nest	Nest Screw	Clamp	Clamp Screw	Includes all Standard Components
M-411149-06VRS	–	**RPGX-060400	19	37	25	150	38	410631	BHCS M2.5-0.45x10mm	411905-250VRC	434259	TK-02692
–	411150-06VRS	**RPGX-060400	19	37	25	150	38	410631	BHCS M2.5-0.45x10mm	411906-250VRC	434259	TK-02693
M-411151-06VRS	–	**RPGX-060400	19	44	32	170	45	410631	BHCS M2.5-0.45x10mm	411905-250VRC	434259	TK-02692
–	M-411956-06VRS	**RPGX-060400	19	44	32	170	45	410631	BHCS M2.5-0.45x10mm	411906-250VRC	434259	TK-02693
M-411957-06VRS	–	**RPGX-060400	19	52	40	200	53	410631	BHCS M2.5-0.45x10mm	411905-250VRC	434259	TK-02692
–	M-411958-06VRS	**RPGX-060400	19	52	40	200	53	410631	BHCS M2.5-0.45x10mm	411906-250VRC	434259	TK-02693
M-411157-09VRS	M-411158-09VRS	**RPGX-090700	29	24	25	150	25	413970	TBHCS M3-0.5x12mm	308063	TSHCS M5-0.8x12mm	TK-02685
M-411159-09VRS	M-411160-09VRS	**RPGX-090700	29	31	32	170	32	413970	TBHCS M3-0.5x12mm	308063	TSHCS M5-0.8x12mm	TK-02685
M-411161-09VRS	M-411162-09VRS	**RPGX-090700	29	39	40	200	40	413970	TBHCS M3-0.5x12mm	308063	TSHCS M5-0.8x12mm	TK-02685
M-411165-12VRS	M-411166-12VRS	**RPGX-120700	38	24	25	150	25	414007	TBHCS M5-0.8x16mm	308136	434258	TK-02686
M-411167-12VRS	M-411168-12VRS	**RPGX-120700	38	31	32	170	32	414007	TBHCS M5-0.8x16mm	308136	434258	TK-02686
M-411169-12VRS	M-411170-12VRS	**RPGX-120700	38	39	40	200	40	414007	TBHCS M5-0.8x16mm	308136	434258	TK-02686

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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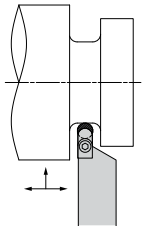
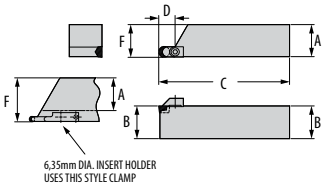
O.D. Grooving/Profiling Toolholder

Round V-Bottom Insert / Milled Nest / Shallow D.O.C. (D) Series





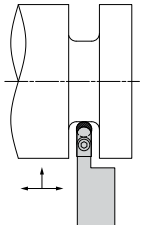
Right-Hand Toolholder Shown

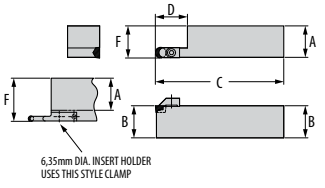
Part Number		Gage	D.O.C.	Dimensions (mm)				Standard Components		*Tune-Up Kit	Opt. Component
Right	Left	Inserts	D	A†	B	C	F	Clamp	Clamp Screw	Includes all Standard Components	Insert Screw
M-421450-06VMRS	–	**RPGX-060400	10	37	25	150	38	411905-250VRC	434259	TK-02689	PT-542T
–	M-421451-06VMRS	**RPGX-060400	10	37	25	150	38	411906-250VRC	434259	TK-02690	PT-542T
M-421452-06VMRS	–	**RPGX-060400	10	44	32	170	45	411905-250VRC	434259	TK-02689	PT-542T
–	M-421453-06VMRS	**RPGX-060400	10	44	32	170	45	411906-250VRC	434259	TK-02690	PT-542T
M-421454-06VMRS	–	**RPGX-060400	10	52	40	200	53	411905-250VRC	434259	TK-02689	PT-542T
–	M-421455-06VMRS	**RPGX-060400	10	52	40	200	53	411906-250VRC	434259	TK-02690	PT-542T
M-421458-09VMRS	M-421459-09VMRS	**RPGX-090700	15	24	25	150	25	308063	TSHCS M5-0.8x12mm	TK-02734	PT-545T
M-421460-09VMRS	M-421461-09VMRS	**RPGX-090700	15	31	32	170	32	308063	TSHCS M5-0.8x12mm	TK-02734	PT-545T
M-421462-09VMRS	M-421463-09VMRS	**RPGX-090700	15	39	40	200	40	308063	TSHCS M5-0.8x12mm	TK-02734	PT-545T
M-421466-12VMRS	M-421467-12VMRS	**RPGX-120700	20	24	25	150	25	308136	434258	TK-02691	CO-5018
M-421468-12VMRS	M-421469-12VMRS	**RPGX-120700	20	31	32	170	32	308136	434258	TK-02691	CO-5018
M-421470-12VMRS	M-421471-12VMRS	**RPGX-120700	20	39	40	200	40	308136	434258	TK-02691	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





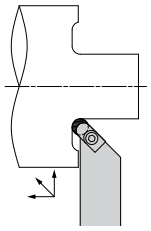
Right-Hand Toolholder Shown

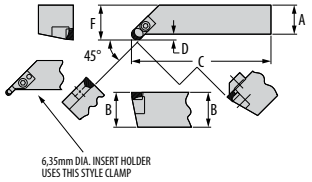
Part Number		Gage	D.O.C.	Dimensions (mm)				Standard Components		*Tune-Up Kit	Opt. Component
Right	Left	Inserts	D	A†	B	C	F	Clamp	Clamp Screw	Includes all Standard Components	Insert Screw
M-421498-06VMRS	–	**RPGX-060400	19	37	25	150	38	411905-250VRC	434259	TK-02689	PT-542T
–	M-421499-06VMRS	**RPGX-060400	19	37	25	150	38	411906-250VRC	434259	TK-02690	PT-542T
M-421500-06VMRS	–	**RPGX-060400	19	44	32	170	45	411905-250VRC	434259	TK-02689	PT-542T
–	M-421501-06VMRS	**RPGX-060400	19	44	32	170	45	411906-250VRC	434259	TK-02690	PT-542T
M-421502-06VMRS	–	**RPGX-060400	19	52	40	200	53	411905-250VRC	434259	TK-02689	PT-542T
–	M-421503-06VMRS	**RPGX-060400	19	52	40	200	53	411906-250VRC	434259	TK-02690	PT-542T
M-421504-09VMRS	M-421505-09VMRS	**RPGX-090700	29	24	25	150	25	308063	TSHCS M5-0.8x12mm	TK-02734	PT-545T
M-421506-09VMRS	M-421507-09VMRS	**RPGX-090700	29	331	32	170	32	308063	TSHCS M5-0.8x12mm	TK-02734	PT-545T
M-421508-09VMRS	M-421509-09VMRS	**RPGX-090700	29	39	40	200	40	308063	TSHCS M5-0.8x12mm	TK-02734	PT-545T
M-421510-12VMRS	M-421511-12VMRS	**RPGX-120700	38	24	25	150	25	308136	434258	TK-02691	CO-5018
M-421512-12VMRS	M-421513-12VMRS	**RPGX-120700	38	31	32	170	32	308136	434258	TK-02691	CO-5018
M-421514-12VMRS	M-421515-12VMRS	**RPGX-120700	38	39	40	200	40	308136	434258	TK-02691	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 (mm)				Standard Components				*Tune-Up Kit
Right	Left	Inserts	D	A†	B	C	F	Nest	Nest Screw	Clamp	Clamp Screw	Includes all Standard Components
CRGPR-2525-06V	–	**RPGX-060400	7	25	25	150	32	411108	BHCS M2.5-0.45x10mm	412131-250GC	434258	TK-02687
–	CRGPL-2525-06V	**RPGX-060400	7	25	25	150	32	411108	BHCS M2.5-0.45x10mm	412132-250GC	434258	TK-02731
CRGPR-3232-06V	–	**RPGX-060400	7	32	32	170	39	411108	BHCS M2.5-0.45x10mm	412131-250GC	434258	TK-02687
–	CRGPL-3232-06V	**RPGX-060400	7	32	32	170	39	411108	BHCS M2.5-0.45x10mm	412132-250GC	434258	TK-02731
CRGPR-4040-06V	–	**RPGX-060400	7	40	40	200	47	411108	BHCS M2.5-0.45x10mm	412131-250GC	434258	TK-02687
–	CRGPL-4040-06V	**RPGX-060400	7	40	40	200	47	411108	BHCS M2.5-0.45x10mm	412132-250GC	434258	TK-02731
CRGPR-2525-09V	CRGPL-2525-09V	**RPGX-090700	7	25	25	150	32	414009	TBHCS M3-0.5x12mm	308063	TSHCS M5-0.8x12mm	TK-02733
CRGPR-3232-09V	CRGPL-3232-09V	**RPGX-090700	7	32	32	170	39	414009	TBHCS M3-0.5x12mm	308063	TSHCS M5-0.8x12mm	TK-02733
CRGPR-4040-09V	CRGPL-4040-09V	**RPGX-090700	7	40	40	200	47	414009	TBHCS M3-0.5x12mm	308063	TSHCS M5-0.8x12mm	TK-02733
CRGPR-2525-12V	CRGPL-2525-12V	**RPGX-120700	7	25	25	150	32	414008	TBHCS M5-0.8x16mm	308136	434258	TK-02732
CRGPR-3232-12V	CRGPL-3232-12V	**RPGX-120700	7	32	32	170	39	414008	TBHCS M5-0.8x16mm	308136	434258	TK-02732
CRGPR-4040-12V	CRGPL-4040-12V	**RPGX-120700	7	40	40	200	47	414008	TBHCS M5-0.8x16mm	308136	434258	TK-02732

NOTE: See page GP 14 for ceramic and carbide inserts.

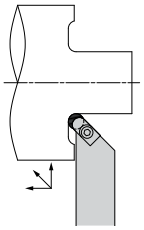
† *"A" indicates width of shank available for clamping, (not necessarily overall shank width).*

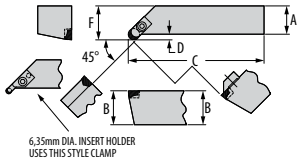
* *Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the toolholder.*

** *RCGN can be used in place of RPGN.*

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 (mm)				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-2525-06VM	–	**RPGX-060400	7	25	25	150	32	412131-250GC	434259	TK-02745	PT-542T
–	CRGPL-2525-06VM	**RPGX-060400	7	25	25	150	32	412132-250GC	434258	TK-02746	PT-542T
CRGPR-3232-06VM	–	**RPGX-060400	7	32	32	170	39	412131-250GC	434259	TK-02745	PT-542T
–	CRGPL-3232-06VM	**RPGX-060400	7	32	32	170	39	412132-250GC	434258	TK-02746	PT-542T
CRGPR-4040-06VM	–	**RPGX-060400	7	40	40	200	47	412131-250GC	434259	TK-02745	PT-542T
–	CRGPL-4040-06VM	**RPGX-060400	7	40	40	200	47	412132-250GC	434258	TK-02746	PT-542T
CRGPR-2525-09VM	CRGPL-2525-09VM	**RPGX-090700	7	25	25	150	32	308063	TSHCS M5-0.8x12mm	TK-02733	PT-545T
CRGPR-3232-09VM	CRGPL-3232-09VM	**RPGX-090700	7	32	32	170	39	308063	TSHCS M5-0.8x12mm	TK-02733	PT-545T
CRGPR-4040-09VM	CRGPL-4040-09VM	**RPGX-090700	7	40	40	200	47	308063	TSHCS M5-0.8x12mm	TK-02733	PT-545T
CRGPR-2525-12VM	CRGPL-2525-12VM	**RPGX-120700	7	25	25	150	32	308136	434258	TK-02691	CO-5018
CRGPR-3232-12VM	CRGPL-3232-12VM	**RPGX-120700	7	32	32	170	39	308136	434258	TK-02691	CO-5018
CRGPR-4040-12VM	CRGPL-4040-12VM	**RPGX-120700	7	40	40	200	47	308136	434258	TK-02691	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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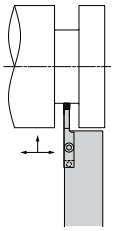
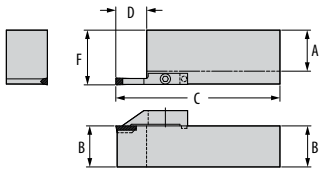
Grooving/Profiling/Cut-Off Toolholder

Deep D.O.C. Series





Right-Hand Toolholder Shown

Part Number			D.O.C.	Dimensions (mm)				Standard Components		*Tune-Up Kit	Optional Components	
Right	Left	Groove Width	D	A†	B	C	F	Insert	Clamp	Includes all Standard Components	Insert	Clamp
M-427635-094VGS	–	2,39	19	25	25	150	38		427651-094GC	TK-02626		429524-094GC
–	M-427636-094VGS	2,39	19	25	25	150	38	WGC-4094	427652-094GC	TK-02627	COS-4094-0	429525-094GC
M-427637-094VGS	–	2,39	19	32	32	170	45		427651-094GC	TK-02626		429524-094GC
–	M-427638-094VGS	2,39	19	32	32	170	45	WG-4094	427652-094GC	TK-02627	COS-4094-4L	429525-094GC
M-427639-094VGS	–	2,39	19	40	40	200	53		427651-094GC	TK-02626		429524-094GC
–	M-427640-094VGS	2,39	19	40	40	200	53		427652-094GC	TK-02627	COS-4094-4R	429525-094GC
M-411173-125VGS	–	3,18	19	25	25	150	38		411966-125GC	TK-02628		429512-125GC
–	M-411961-125VGS	3,18	19	25	25	150	38	WGC-4125	411967-125GC	TK-02629	GTS-4125	429513-125GC
M-411250-125VGS	–	3,18	19	32	32	170	45	WG-4125	411966-125GC	TK-02628	COS-4125-0	429512-125GC
–	M-411251-125VGS	3,18	19	32	32	170	45	GTS-4125-1	411967-125GC	TK-02629	COS-4125-4L	429513-125GC
M-411962-125VGS	–	3,18	19	40	40	200	53	GTS-4125-2	411966-125GC	TK-02628	COS-4125-4R	429512-125GC
–	M-411963-125VGS	3,18	19	40	40	200	53		411967-125GC	TK-02629		429513-125GC
M-411964-156VGS	–	3,96	19	25	25	150	38		411968-156GC	TK-02630		436373-156GC
–	M-411965-156VGS	3,96	19	25	25	150	38	WGC-4156	411969-156GC	TK-02631		436374-156GC
M-411256-156VGS	–	3,96	19	32	32	170	45		411968-156GC	TK-02630		436373-156GC
–	M-411257-156VGS	3,96	19	32	32	170	45	WG-4156	411969-156GC	TK-02631	GTS-4156	436374-156GC
M-411258-156VGS	–	3,96	19	40	40	200	53		411968-156GC	TK-02630		436373-156GC
–	M-411259-156VGS	3,96	19	40	40	200	53		411969-156GC	TK-02631		436374-156GC
M-411970-187VGS	–	4,75	19	25	25	150	38	WGC-4187	411977-187GC	TK-02632		429518-187GC
–	M-411178-187VGS	4,75	19	25	25	150	38	WG-4187	411978-187GC	TK-02633	GTS-4187	429519-187GC
M-411262-187VGS	–	4,75	19	32	32	170	45		411977-187GC	TK-02632	COS-4187-0	429518-187GC
–	M-411263-187VGS	4,75	19	32	32	170	45	GTS-4187-1	411978-187GC	TK-02633	COS-4187-4L	429519-187GC
M-411971-187VGS	–	4,75	19	40	40	200	53	GTS-4187-2	411977-187GC	TK-02632	COS-4187-4R	429518-187GC
–	M-411972-187VGS	4,75	19	40	40	200	53		411978-187GC	TK-02633		429519-187GC
M-411179-218VGS	–	5,54	29	25	25	150	38		411979-218GC	TK-02634	–	–
–	M-411180-218VGS	5,54	29	25	25	150	38	WGC-6218	411130-218GC	TK-02635	–	–
M-411268-218VGS	–	5,54	29	32	32	170	45		411979-218GC	TK-02634	–	–
–	M-411269-218VGS	5,54	29	32	32	170	45	WG-6218	411130-218GC	TK-02635	–	–
M-411270-218VGS	–	5,54	29	40	40	200	53		411979-218GC	TK-02634	–	–
–	M-411271-218VGS	5,54	29	40	40	200	53		411130-218GC	TK-02635	–	–

† *"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.*

GTS is Greenleaf's groove/turn system insert with chip control. Page GP 09.

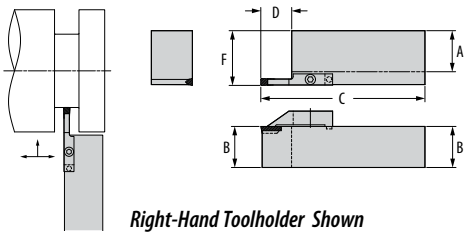
COS is Greenleaf's cut-off system insert. Page GP 08.

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			D.O.C.	Dimensions (mm)				Standard Components		*Tune-Up Kit	Optional Components	
Right	Left	Groove Width	D	A†	B	C	F	Insert	Clamp	Includes all Standard Components	Insert	Clamp
M-411973-250VGS	–	6,35	29	25	25	150	38	WGC-6250	411980-250GC	TK-02636	–	–
–	M-411974-250VGS	6,35	29	25	25	150	38	WG-6250	411981-250GC	TK-02637	–	–
M-411975-250VGS	–	6,35	29	32	32	170	45		411980-250GC	TK-02636	–	–
–	M-411275-250VGS	6,35	29	32	32	170	45	GTS-6250	411981-250GC	TK-02637	–	–
M-411276-250VGS	–	6,35	29	40	40	200	53	GTS-6250-1	411980-250GC	TK-02636	–	–
–	M-411277-250VGS	6,35	29	40	40	200	53	GTS-6250-2	411981-250GC	TK-02637	–	–
M-411183-281VGS	–	7,14	29	25	25	150	38		411133-281GC	TK-02638	–	–
–	M-411184-281VGS	7,14	29	25	25	150	38	WGC-6281	411134-281GC	TK-02648	–	–
M-411280-281VGS	–	7,14	29	32	32	170	45		411133-281GC	TK-02638	–	–
–	M-411281-281VGS	7,14	29	32	32	170	45	WG-6281	411134-281GC	TK-02648	–	–
M-411282-281VGS	–	7,14	29	40	40	200	53		411133-281GC	TK-02638	–	–
–	M-411283-281VGS	7,14	29	40	40	200	53		411134-281GC	TK-02648	–	–
M-411982-312VGS	–	7,92	38	25	25	150	38		411985-312GC	TK-02640	–	–
–	M-411186-312VGS	7,92	38	25	25	150	38	WGC-8312	411136-312GC	TK-02641	–	–
M-411286-312VGS	–	7,92	38	32	32	170	45		411985-312GC	TK-02640	–	–
–	M-411287-312VGS	7,92	38	32	32	170	45	WG-8312	411136-312GC	TK-02641	–	–
M-411288-312VGS	–	7,92	38	40	40	200	53		411985-312GC	TK-02640	–	–
–	M-411289-312VGS	7,92	38	40	40	200	53		411136-312GC	TK-02641	–	–
M-411187-344VGS	–	8,74	38	25	25	150	38		411137-344GC	TK-02642	–	–
–	M-411188-344VGS	8,74	38	25	25	150	38	WGC-8344	411138-344GC	TK-02643	–	–
M-411292-344VGS	–	8,74	38	32	32	170	45		411137-344GC	TK-02642	–	–
–	M-411293-344VGS	8,74	38	32	32	170	45	WG-8344	411138-344GC	TK-02643	–	–
M-411294-344VGS	–	8,74	38	40	40	200	53		411137-344GC	TK-02642	–	–
–	M-411295-344VGS	8,74	38	40	40	200	53		411138-344GC	TK-02643	–	–
M-411189-375VGS	–	9,53	38	25	25	150	38		411986-375GC	TK-02649	–	–
–	M-411190-375VGS	9,53	38	25	25	150	38	WGC-8375	411987-375GC	TK-02645	–	–
M-411983-375VGS	–	9,53	38	32	32	170	45		411986-375GC	TK-02649	–	–
–	M-411984-375VGS	9,53	38	32	32	170	45	WG-8375	411987-375GC	TK-02645	–	–
M-411300-375VGS	–	9,53	38	40	40	200	53		411986-375GC	TK-02649	–	–
–	M-411301-375VGS	9,53	38	40	40	200	53		411987-375GC	TK-02645	–	–

† *"A" indicates width of shank available for clamping, (not necessarily overall shank width).*

* *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.

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WGC is Greenleaf's flat-top groover with a 6° nose clearance. Pages GP 12 and GP 13.

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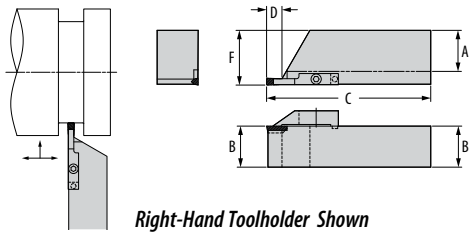
Grooving/Profiling/Cut-Off Toolholder

Shallow D.O.C. Series



Right-Hand Toolholder Shown

Part Number		Groove Width	D.O.C.	Dimensions (mm)				Standard Components		*Tune-Up Kit	Optional Components	
Right	Left		D	A†	B	C	F	Insert	Clamp	Includes all Standard Components	Insert	Clamp
M-427641-094VGS	–	2,39	10	25	25	150	38		427651-094GC	TK-02626		429524-094GC
–	M-427642-094VGS	2,39	10	25	25	150	38		427652-094GC	TK-02627	COS-4094-0	429525-094GC
M-427643-094VGS	–	2,39	10	32	32	170	45	WG-4094	427651-094GC	TK-02626		429524-094GC
–	M-427644-094VGS	2,39	10	32	32	170	45	WGC-4094	427652-094GC	TK-02627	COS-4094-4L	429525-094GC
M-427645-094VGS	–	2,39	10	40	40	200	53		427651-094GC	TK-02626	COS-4094-4R	429524-094GC
–	M-427646-094VGS	2,39	10	40	40	200	53		427652-094GC	TK-02627		429525-094GC
M-415316-125VGS	–	3,18	10	25	25	150	38		411966-125GC	TK-02628		429512-125GC
–	M-415317-125VGS	3,18	10	25	25	150	38	GTS-4125-1	411967-125GC	TK-02629	GTS-4125	429513-125GC
M-415318-125VGS	–	3,18	10	32	32	170	45	GTS-4125-2	411966-125GC	TK-02628	COS-4125-0	429512-125GC
–	M-415319-125VGS	3,18	10	32	32	170	45	WG-4125	411967-125GC	TK-02629	COS-4125-4L	429513-125GC
M-415320-125VGS	–	3,18	10	40	40	200	53	WGC-4125	411966-125GC	TK-02628	COS-4125-4R	429512-125GC
–	M-415321-125VGS	3,18	10	40	40	200	53		411967-125GC	TK-02629		429513-125GC
M-415324-156VGS	–	3,96	10	25	25	150	38		411968-156GC	TK-02630		436373-156GC
–	M-415325-156VGS	3,96	10	25	25	150	38	WG-4156	411969-156GC	TK-02631		436374-156GC
M-415326-156VGS	–	3,96	10	32	32	170	45		411968-156GC	TK-02630	GTS-4156	436373-156GC
–	M-415327-156VGS	3,96	10	32	32	170	45	WGC-4156	411969-156GC	TK-02631		436374-156GC
M-415328-156VGS	–	3,96	10	40	40	200	53		411968-156GC	TK-02630		436373-156GC
–	M-415329-156VGS	3,96	10	40	40	200	53		411969-156GC	TK-02631		436374-156GC
M-415332-187VGS	–	4,75	10	25	25	150	38		411977-187GC	TK-02632		429518-187GC
–	M-415333-187VGS	4,75	10	25	25	150	38	GTS-4187-1	411978-187GC	TK-02633	GTS-4187	429519-187GC
M-415334-187VGS	–	4,75	10	32	32	170	45	GTS-4187-2	411977-187GC	TK-02632	COS-4187-0	429518-187GC
–	M-415335-187VGS	4,75	10	32	32	170	45	WG-4187	411978-187GC	TK-02633	COS-4187-4L	429519-187GC
M-415336-187VGS	–	4,75	10	40	40	200	53	WGC-4187	411977-187GC	TK-02632	COS-4187-4R	429518-187GC
–	M-415337-187VGS	4,75	10	40	40	200	53		411978-187GC	TK-02633		429519-187GC
M-415340-218VGS	–	5,54	15	25	25	150	38		411979-218GC	TK-02634	–	–
–	M-415341-218VGS	5,54	15	25	25	150	38	WG-6218	411130-218GC	TK-02635	–	–
M-415342-218VGS	–	5,54	15	32	32	170	45		411979-218GC	TK-02634	–	–
–	M-415343-218VGS	5,54	15	32	32	170	45	WGC-6218	411130-218GC	TK-02635	–	–
M-415344-218VGS	–	5,54	15	40	40	200	53		411979-218GC	TK-02634	–	–
–	M-415345-218VGS	5,54	15	40	40	200	53		411130-218GC	TK-02635	–	–

† *"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.*

GTS is Greenleaf's groove/turn system insert with chip control. Page GP 09.

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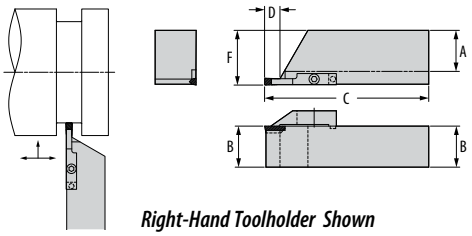
WGC is Greenleaf's flat-top groover with a 6° nose clearance. Pages GP 12 and GP 13.

Grooving/Profiling/Cut-Off Toolholder

Shallow D.O.C. Series *(Continued)*



Right-Hand Toolholder Shown

Part Number		Grove Width	D.O.C.	Dimensions (mm)				Standard Components		*Tune-Up Kit	Optional Components	
Right	Left		D	A†	B	C	F	Insert	Clamp	Includes all Standard Components	Insert	Clamp
M-415348-250VGS	–	6,35	15	25	25	150	38		411980-250GC	TK-02636	–	–
–	M-415349-250VGS	6,35	15	25	25	150	38	GTS-6250	411981-250GC	TK-02637	–	–
M-415350-250VGS	–	6,35	15	32	32	170	45	GTS-6250-1	411980-250GC	TK-02636	–	–
–	M-415351-250VGS	6,35	15	32	32	170	45	GTS-6250-2	411981-250GC	TK-02637	–	–
M-415352-250VGS	–	6,35	15	40	40	200	53	WG-6250	411980-250GC	TK-02636	–	–
–	M-415353-250VGS	6,35	15	40	40	200	53	WGC-6250	411981-250GC	TK-02637	–	–
M-415356-281VGS	–	7,14	15	25	25	150	38		411133-281GC	TK-02638	–	–
–	M-415357-281VGS	7,14	15	25	25	150	38	WG-6281	411134-281GC	TK-02648	–	–
M-415358-281VGS	–	7,14	15	32	32	170	45		411133-281GC	TK-02638	–	–
–	M-415359-281VGS	7,14	15	32	32	170	45	WGC-6281	411134-281GC	TK-02648	–	–
M-415360-281VGS	–	7,14	15	40	40	200	53		411133-281GC	TK-02638	–	–
–	M-415361-281VGS	7,14	15	40	40	200	53		411134-281GC	TK-02648	–	–
M-415364-312VGS	–	7,92	20	25	25	150	38		411985-312GC	TK-02640	–	–
–	M-415365-312VGS	7,92	20	25	25	150	38	WG-8312	411136-312GC	TK-02641	–	–
M-415366-312VGS	–	7,92	20	32	32	170	45		411985-312GC	TK-02640	–	–
–	M-415367-312VGS	7,92	20	32	32	170	45	WGC-8312	411136-312GC	TK-02641	–	–
M-415368-312VGS	–	7,92	20	40	40	200	53		411985-312GC	TK-02640	–	–
–	M-415369-312VGS	7,92	20	40	40	200	53		411136-312GC	TK-02641	–	–
M-415372-344VGS	–	8,74	20	25	25	150	38		411137-344GC	TK-02642	–	–
–	M-415373-344VGS	8,74	20	25	25	150	38		411138-344GC	TK-02643	–	–
M-415374-344VGS	–	8,74	20	32	32	170	45	WG-8344	411137-344GC	TK-02642	–	–
–	M-415375-344VGS	8,74	20	32	32	170	45		411138-344GC	TK-02643	–	–
M-415376-344VGS	–	8,74	20	40	40	200	53	WGC-8344	411137-344GC	TK-02642	–	–
–	M-415377-344VGS	8,74	20	40	40	200	53		411138-344GC	TK-02643	–	–
M-415380-375VGS	–	9,53	20	25	25	150	38		411986-375GC	TK-02649	–	–
–	M-415381-375VGS	9,53	20	25	25	150	38		411987-375GC	TK-02645	–	–
M-415382-375VGS	–	9,53	20	32	32	170	45	WG-8375	411986-375GC	TK-02649	–	–
–	M-415383-375VGS	9,53	20	32	32	170	45		411987-375GC	TK-02645	–	–
M-415384-375VGS	–	9,53	20	40	40	200	53		411986-375GC	TK-02649	–	–
–	M-415385-375VGS	9,53	20	40	40	200	53		411987-375GC	TK-02645	–	–

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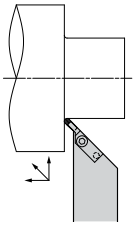
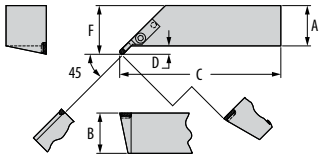
45° Grooving/Profiling Toolholder





Right-Hand Toolholder Shown

Part Number		Gage	D.O.C.	Dimensions (mm)				Std Component	*Tune-Up Kit	Optional Components	
Right	Left	Insert	D	A†	B	C	F	Clamp	Includes all Standard Components	Insert	Clamp
M-415293-45VGS	M-415294-45VGS	GTS-4125-1	8	25	25	150,5	33,43	415305-GC 415306-GC	TK-02655 TK-02656	GTS-4125	429514-GC 429515-GC
		GTS-4125-2	8	25	25	150,3	33,25				
		WG-4125	8	25	25	150,0	32,92				
		WG-4125-1	8	25	25	150,5	33,43				
		WG-4125-2	8	25	25	150,3	33,25				
		WG-4156	8	25	25	150,1	33,05				
		WG-4156-1	8	25	25	150,6	33,71				
		WG-4156-2	8	25	25	150,6	33,53				
M-415295-45VGS	M-415296-45VGS	GTS-4125-1	8	32	32	170,5	40,43	415305-GC 415306-GC	TK-02655 TK-02656	GTS-4125	429514-GC 429515-GC
		GTS-4125-2	8	32	32	170,3	40,26				
		WG-4125	8	32	32	170,0	39,93				
		WG-4125-1	8	32	32	170,5	40,43				
		WG-4125-2	8	32	32	170,3	40,26				
		WG-4156	8	32	32	170,1	40,05				
		WG-4156-1	8	32	32	170,6	40,71				
		WG-4156-2	8	32	32	170,6	40,53				
M-415297-45VGS	M-415298-45VGS	GTS-4125-1	8	40	40	200,5	33,43	415305-GC 415306-GC	TK-02655 TK-02656	GTS-4125	429514-GC 429515-GC
		GTS-4125-2	8	40	40	200,3	33,43				
		WG-4125	8	40	40	200,0	47,93				
		WG-4125-1	8	40	40	200,5	48,43				
		WG-4125-2	8	40	40	200,3	48,26				
		WG-4156	8	40	40	200,1	48,05				
		WG-4156-1	8	40	40	200,8	33,43				
		WG-4156-2	8	40	40	200,6	33,43				
M-415299-45VGS	M-415300-45VGS	GTS-4187-1	8	25	25	150,83	33,76	415307-GC 415308-GC	TK-02657 TK-02658	GTS-4187	429520-GC 429521-GC
		GTS-4187-2	8	25	25	150,66	33,59				
		WG-4187	8	25	25	150,0	32,92				
		WG-4187-1	8	25	25	150,83	33,76				
		WG-4187-2	8	25	25	150,66	33,58				
M-415301-45VGS	M-415302-45VGS	GTS-4187-1	8	32	32	170,83	40,76	415307-GC 415308-GC	TK-02657 TK-02658	GTS-4187	429520-GC 429521-GC
		GTS-4187-2	8	32	32	170,66	40,59				
		WG-4187	8	32	32	170,00	39,92				
		WG-4187-1	8	32	32	170,83	40,76				
		WG-4187-2	8	32	32	170,66	40,59				
M-415303-45VGS	M-415304-45VGS	GTS-4187-1	8	40	40	200,8	48,76	415307-GC 415308-GC	TK-02657 TK-02658	GTS-4187	429520-GC 429521-GC
		GTS-4187-2	8	40	40	200,7	49,73				
		WG-4187	8	40	40	200,0	47,92				
		WG-4187-1	8	40	40	200,8	48,76				
		WG-4187-2	8	40	40	200,7	48,58				

† *"A" indicates width of shank available for clamping, (not necessarily overall shank width).*

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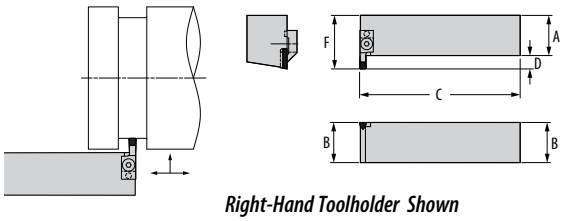
90° Grooving/Profiling Toolholder



Right-Hand Toolholder Shown

Part Number		Groove Width	D.O.C.	Dimensions (mm)				Standard Components		*Tune-Up Kit	Optional Components	
Right	Left		D	A†	B	C	F	Insert	Clamp	Includes all Standard Components	Insert	Clamp
M-411693-125VGS	–	3,18	10	25	25	150	35		411765-125GC	TK-02659		429516-125GC
–	M-411694-125VGS	3,18	10	25	25	150	35	GTS-4125-1	411766-125GC	TK-02660	GTS-4125	429517-125GC
M-411695-125VGS	–	3,18	10	32	32	170	42	GTS-4125-2	411765-125GC	TK-02659	COS-4125-0	429516-125GC
–	M-411696-125VGS	3,18	10	32	32	170	42	WG-4125	411766-125GC	TK-02660	COS-4125-4R	429517-125GC
M-411697-125VGS	–	3,18	10	40	40	200	50	WGC-4125	411765-125GC	TK-02659	COS-4125-4L	429516-125GC
–	M-411698-125VGS	3,18	10	40	40	200	50		411766-125GC	TK-02660		429517-125GC
M-411701-156VGS	–	3,96	10	25	25	150	35		411767-156GC	TK-02661	–	–
–	M-411702-156VGS	3,96	10	25	25	150	35	WG-4156	411768-156GC	TK-02662	–	–
M-411703-156VGS	–	3,96	10	32	32	170	42		411767-156GC	TK-02661	–	–
–	M-411704-156VGS	3,96	10	32	32	170	42	WGC-4156	411768-156GC	TK-02662	–	–
M-411705-156VGS	–	3,96	10	40	40	200	50		411767-156GC	TK-02661	–	–
–	M-411706-156VGS	3,96	10	40	40	200	50		411768-156GC	TK-02662	–	–
M-411709-187VGS	–	4,75	10	25	25	150	35		411769-187GC	TK-02663		429522-187GC
–	M-411710-187VGS	4,75	10	25	25	150	35	GTS-4187-1	411770-187GC	TK-02664	GTS-4187	429523-187GC
M-411711-187VGS	–	4,75	10	32	32	170	42	GTS-4187-2	411769-187GC	TK-02663	COS-4187-0	429522-187GC
–	M-411712-187VGS	4,75	10	32	32	170	42	WG-4187	411770-187GC	TK-02664	COS-4187-4R	429523-187GC
M-411713-187VGS	–	4,75	10	40	40	200	50	WGC-4187	411769-187GC	TK-02663	COS-4187-4L	429522-187GC
–	M-411714-187VGS	4,75	10	40	40	200	50		411770-187GC	TK-02664		429523-187GC
M-411717-218VGS	–	5,54	13	25	25	150	38		411771-218GC	TK-02665	–	–
–	M-411718-218VGS	5,54	13	25	25	150	38	WG-6218	411772-218GC	TK-02666	–	–
M-411719-218VGS	–	5,54	13	32	32	170	45		411771-218GC	TK-02665	–	–
–	M-411720-218VGS	5,54	13	32	32	170	45	WGC-6218	411772-218GC	TK-02666	–	–
M-411721-218VGS	–	5,54	13	40	40	200	53		411771-218GC	TK-02665	–	–
–	M-411722-218VGS	5,54	13	40	40	200	53		411772-218GC	TK-02666	–	–
M-411725-250VGS	–	6,35	13	25	25	150	38		411773-250GC	TK-02667	–	–
–	M-411726-250VGS	6,35	13	25	25	150	38	GTS-6250	411774-250GC	TK-02668	–	–
M-411727-250VGS	–	6,35	13	32	32	170	45	GTS-6250-1	411773-250GC	TK-02667	–	–
–	M-411728-250VGS	6,35	13	32	32	170	45	GTS-6250-2	411774-250GC	TK-02668	–	–
M-411729-250VGS	–	6,35	13	40	40	200	53	WG-6250	411773-250GC	TK-02667	–	–
–	M-411730-250VGS	6,35	13	40	40	200	53	WGC-6250	411774-250GC	TK-02668	–	–

† *"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.*

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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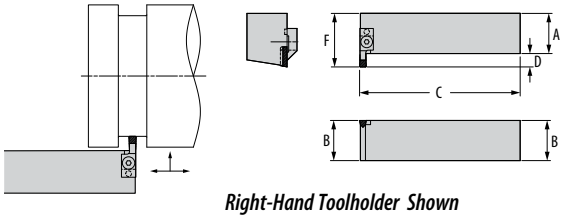
90° Grooving/Profiling Toolholder

(Continued)



Right-Hand Toolholder Shown

Part Number		Groove Width	D.O.C.	Dimensions (mm)				Standard Components		*Tune-Up Kit	Optional Components	
Right	Left		D	A†	B	C	F	Insert	Clamp	Includes all Standard Components	Insert	Clamp
M-411733-281VGS	–	7,14	13	25	25	150	38		411775-281GC	TK-02669	–	–
–	**M-411734-281VGS**	7,14	13	25	25	150	38	WG-6281	411776-281GC	TK-02670	–	–
M-411735-281VGS	–	7,14	13	32	32	170	45		411775-281GC	TK-02669	–	–
–	**M-411736-281VGS**	7,14	13	32	32	170	45	WGC-6281	411776-281GC	TK-02670	–	–
M-411737-281VGS	–	7,14	13	40	40	200	53		411775-281GC	TK-02669	–	–
–	**M-411738-281VGS**	7,14	13	40	40	200	53		411776-281GC	TK-02670	–	–
M-411743-312VGS	–	7,92	16	32	32	170	48		411777-312GC	TK-02671	–	–
–	**M-411744-312VGS**	7,92	16	32	32	170	48	WG-8312	411778-312GC	TK-02672	–	–
M-411745-312VGS	–	7,92	16	40	40	200	56	WGC-8312	411777-312GC	TK-02671	–	–
–	**M-411746-312VGS**	7,92	16	40	40	200	56		411778-312GC	TK-02672	–	–
M-411751-344VGS	–	8,74	16	32	32	170	48		411779-344GC	TK-02673	–	–
–	**M-411752-344VGS**	8,74	16	32	32	170	48	WG-8344	411780-344GC	TK-02674	–	–
M-411753-344VGS	–	8,74	16	40	40	200	56	WGC-8344	411779-344GC	TK-02673	–	–
–	**M-411754-344VGS**	8,74	16	40	40	200	56		411780-344GC	TK-02674	–	–
M-411759-375VGS	–	9,53	16	32	32	170	48		411781-375GC	TK-02675	–	–
–	**M-411760-375VGS**	9,53	16	32	32	170	48	WG-8375	411782-375GC	TK-02676	–	–
M-411761-375VGS	–	9,53	16	40	40	200	56	WGC-8375	411781-375GC	TK-02675	–	–
–	**M-411762-375VGS**	9,53	16	40	40	200	56		411782-375GC	TK-02676	–	–

† *"A" indicates width of shank available for clamping, (not necessarily overall shank width).*

* *All toolholders include standard clamp and 1/4-20 x 1 SHCS.*

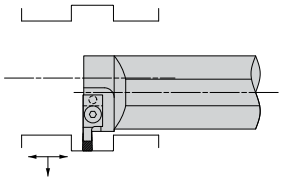
GTS is Greenleaf's groove/turn system insert with chip control. Page GP 09.

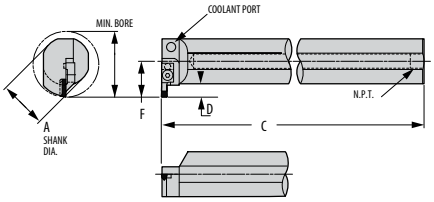
COS is Greenleaf's cut-off system insert. Page GP 08.

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.

Cut-Off Grooving Bar





Right-Hand Grooving Bar Shown

Part Number		Groove Width	D.O.C.	Min. Bore	Dimensions (mm)			Standard Components		*Tune-Up Kit	Optional Components	
Right	Left		D		A	C	F	Insert	Clamp	Includes all Standard Components	Insert	Clamp
M-512074-125VGS	–	3,18	10	63	50	400	35	GTS-4125-1	411765-125GC	TK-02659	GTS-4125	429516-125GC
–	**M-512075-125VGS**	3,18	10	63	50	400	35	GTS-4125-2	411766-125GC	TK-02660	COS-4125-0	429517-125GC
								WG-4125			COS-4125-4R	
								WGC-4125			COS-4125-4L	
M-512086-156VGS	–	3,96	10	63	50	400	35	WG-4156	411767-156GC	TK-02661	–	–
–	**M-512087-156VGS**	3,96	10	63	50	400	35	WGC-4156	411768-156GC	TK-02662	–	–
M-512098-187VGS	–	4,75	10	63	50	400	35	GTS-4187-1	411769-187GC	TK-02663	GTS-4187	429522-187GC
–	**M-512099-187VGS**	4,75	10	63	50	400	35	GTS-4187-2	411770-187GC	TK-02664	COS-4187-0	429523-187GC
								WG-4187			COS-4187-4R	
								WGC-4187			COS-4187-4L	
M-512106-218VGS	–	5,54	13	70	50	400	38	WG-6218	411771-218GC	TK-02665	–	–
–	**M-512107-218VGS**	5,54	13	70	50	400	38	WGC-6218	411772-218GC	TK-02666	–	–
M-512116-250VGS	–	6,35	13	70	50	400	38	GTS-6250	411773-250GC	TK-02667	–	–
–	**M-512117-250VGS**	6,35	13	70	50	400	38	GTS-6250-1	411774-250GC	TK-02668	–	–
								GTS-6250-2				
								WG-6250				
								WGC-6250				
M-512126-281VGS	–	7,14	13	70	50	400	38	WG-6281	411775-281GC	TK-02669	–	–
–	**M-512127-281VGS**	7,14	13	70	50	400	38	WGC-6281	411776-281GC	TK-02670	–	–
M-512132-312VGS	–	7,92	16	77	50	400	41	WG-8312	411777-312GC	TK-02671	–	–
–	**M-512133-312VGS**	7,92	16	77	50	400	41	WGC-8312	411778-312GC	TK-02672	–	–
M-512138-344VGS	–	8,74	16	77	50	400	41	WG-8344	411779-344GC	TK-02673	–	–
–	**M-512139-344VGS**	8,74	16	77	50	400	41	WGC-8344	411780-344GC	TK-02674	–	–
M-512144-375VGS	–	9,53	16	77	50	400	41	WG-8375	411781-375GC	TK-02675	–	–
–	**M-512145-375VGS**	9,53	16	77	50	400	41	WGC-8375	411782-375GC	TK-02676	–	–

** 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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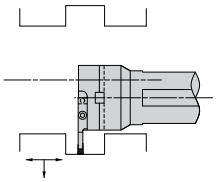
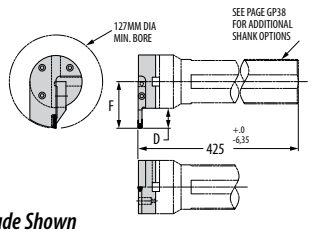
Cut-Off Grooving Support Blade

For Single-Ended V-Bottom Inserts





Right-Hand Support Blade Shown

Part Number			D.O.C.	Dimensions (mm)	Standard Components		*Tune-Up Kit	Optional Components	
Right	Left	Groove Width	D	F	Insert	Clamp	Includes all Std Components and *Clamp Screw	Insert	Clamp
M-511309-125VGB	**–**	3,18	19	57,15	GTS-4125-1	411967-125GC	TK-02629	GTS-4125	429513-125GC
–	**M-512228-125VGB**	3,18	19	57,15	GTS-4125-2	411966-125GC	TK-02628	COS-4125-0	429512-125GC
					WG-4125			COS-4125-4R	
					WGC-4125			COS-4125-4L	
M-511311-156VGB	**–**	3,96	19	57,15	WG-4156	411969-156GC	TK-02631	–	–
–	**M-511312-156VGB**	3,96	19	57,15	WGC-4156	411968-156GC	TK-02630	–	–
M-511313-187VGB	**–**	4,75	19	57,15	GTS-4187-1	411978-187GC	TK-02633	GTS-4187	429519-187GC
–	**M-511314-187VGB**	4,75	19	57,15	GTS-4187-2	411977-187GC	TK-02632	COS-4187-0	429518-187GC
					WG-4187			COS-4187-4R	
					WGC-4187			COS-4187-4L	
M-511315-218VGB	**–**	5,54	28,6	66,68	WG-6218	411130-218GC	TK-02635	–	–
–	**M-512229-218VGB**	5,54	28,6	66,68	WGC-6218	411979-218GC	TK-02634	–	–
M-512230-250VGB	**–**	6,35	28,6	66,68	GTS-6250	411981-250GC	TK-02637	–	–
–	**M-511318-250VGB**	6,35	28,6	66,68	GTS-6250-1	411980-250GC	TK-02636	–	–
					GTS-6250-2				
					WG-6250				
					WGC-6250				
M-511319-281VGB	**–**	7,14	28,6	66,68	WG-6281	411134-281GC	TK-02648	–	–
–	**M-511320-281VGB**	7,14	28,6	66,68	WGC-6281	411133-281GC	TK-02638	–	–
M-511321-312-VGB	**–**	7,92	38,1	76,20	WG-8312	411136-312GC	TK-02641	–	–
–	**M-511322-312VGB**	7,92	38,1	76,20	WGC-8312	411985-312GC	TK-02640	–	–
M-511323-344VGB	**–**	8,74	38,1	76,20	WG-8344	411138-344GC	TK-02643	–	–
–	**M-511324-344VGB**	8,74	38,1	76,20	WGC-8344	411137-344GC	TK-02642	–	–
M-511325-375VGB	**–**	9,53	38,1	76,20	WG-8375	411987-375GC	TK-02645	–	–
–	**M-511326-375VGB**	9,53	38,1	76,20	WGC-8375	411986-375GC	TK-02649	–	–

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.

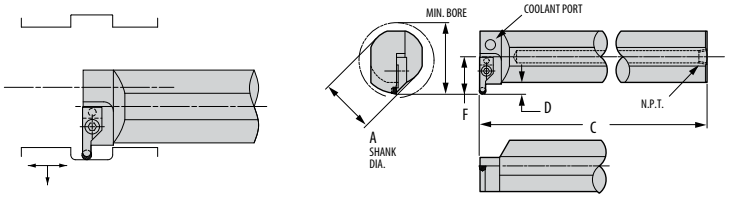
COS is Greenleaf's cut-off system insert. Page GP 08.

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.

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 (mm)			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
M-519700-06VMRB	–	RPGN-060400	38	RCGN-060400	90	10	25	300	22	412131-250GC	434258	TK-02745	PT-542T
–	M-519701-06VMRB	RPGN-060400	38	RCGN-060400	90	10	25	300	22	412132-250GC	434258	TK-02746	PT-542T
M-519702-06VMRB	–	RPGN-060400	45	RCGN-060400	90	10	32	300	25	412131-250GC	434258	TK-02745	PT-542T
–	M-519703-06VMRB	RPGN-060400	45	RCGN-060400	90	10	32	300	25	412132-250GC	434258	TK-02746	PT-542T
M-519704-06VMRB	–	RPGN-060400	50	RCGN-060400	90	10	40	350	28	412131-250GC	434258	TK-02745	PT-542T
–	M-519705-06VMRB	RPGN-060400	50	RCGN-060400	90	10	40	350	28	412132-250GC	434258	TK-02746	PT-542T
M-519706-06VMRB	–	RPGN-060400	64	RCGN-060400	90	10	50	400	35	412131-250GC	434258	TK-02745	PT-542T
–	M-519707-06VMRB	RPGN-060400	64	RCGN-060400	90	10	50	400	35	412132-250GC	434258	TK-02746	PT-542T
M-519708-09VMRB	M-519709-09VMRB	RPGN-090700	57	RCGN-090700	115	13	32	300	29	308063	TSHCS M5-0.8x12mm	TK-02734	PT-545T
M-519710-09VMRB	M-519711-09VMRB	RPGN-090700	64	RCGN-090700	115	13	40	350	33	308063	TSHCS M5-0.8x12mm	TK-02734	PT-545T
M-519712-09VMRB	M-519713-09VMRB	RPGN-090700	70	RCGN-090700	115	13	50	400	38	308063	TSHCS M5-0.8x12mm	TK-02734	PT-545T
M-519714-12VMRB	M-519715-12VMRB	RPGN-120700	57	RCGN-120700	115	16	32	300	32	308136	434258	TK-02691	CO-5018
M-519716-12VMRB	M-519717-12VMRB	RPGN-120700	64	RCGN-120700	115	16	40	350	35	308136	434258	TK-02691	CO-5018
M-519718-12VMRB	M-519719-12VMRB	RPGN-120700	70	RCGN-120700	115	16	50	400	41	308136	434258	TK-02691	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.*

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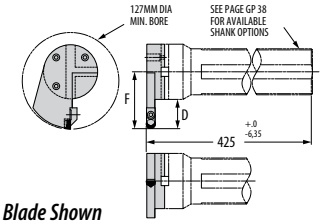
Profiling Support Blade

Round V-Bottom Insert / Milled Nest



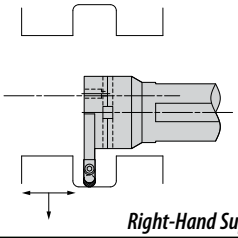
Right-Hand Support Blade Shown

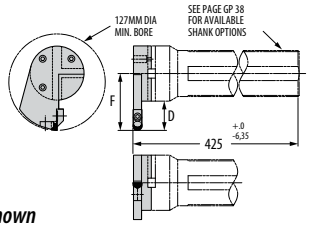
Part Number		Gage	D.O.C.	Dimensions (mm)	Standard Components		*Tune-Up Kit	Opt. Component
Right	Left	Insert	D	F	Clamp	Clamp Screw	Includes all Standard Components	Insert Screw
M-519740-06VMRB	–	** RPGN-060400	19,05	60,33	411906-250VRC	434259	TK-02690	PT-542T
–	M-519741-06VMRB	** RPGN-060400	19,05	60,33	411905-250VRC	434259	TK-02689	PT-542T
M-519742-09VMRB	–	** RPGN-090700	28,60	69,85	308063	TSHCS M5-0.8x16mm	TK-01709	PT-545T
–	M-519743-09VMRB	** RPGN-090700	28,60	69,85	308063	TSHCS M5-0.8x16mm	TK-01709	PT-545T
M-519744-12VMRB	–	** RPGN-120700	38,10	79,38	308136	434258	TK-02691	CO-5018
–	M-519745-12VMRB	** RPGN-120700	38,10	79,38	308136	434258	TK-02691	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.*

Profiling Support Blade

Round V-Bottom Insert / Replaceable Nest





Right-Hand Support Blade Shown

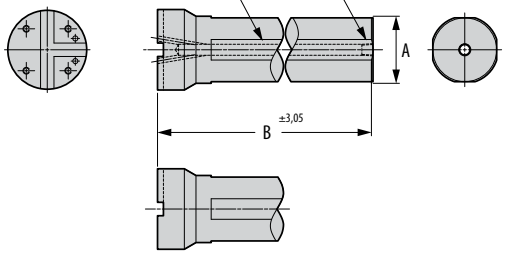
Part Number		Gage	D.O.C.	Dimensions (mm)	Standard Components				*Tune-Up Kit
Right	Left	Insert	D	F	Nest	Nest Screw	Clamp	Clamp Screw	Includes all Standard Components
M-512227-06VRB	–	** RPGN-060400	19,05	60,33	411108	BHCS M2.5-0.45x10mm	411906-250VRC	434259	TK-02739
–	M-511287-06VRB	** RPGN-060400	19,05	60,33	411108	BHCS M2.5-0.45x10mm	411905-250VRC	434259	TK-02740
M-511288-09VRB	–	** RPGN-090700	28,60	69,85	414009	TBHCS M3-0.5x12mm	308063	TSHCS M5-0.8x12mm	TK-02741
–	M-511289-09VRB	** RPGN-090700	28,60	69,85	414009	TBHCS M3-0.5x12mm	308063	TSHCS M5-0.8x12mm	TK-02741
M-511290-12VRB	–	** RPGN-120700	38,10	79,38	414008	TBHCS M5-0.8x16mm	308136	434258	TK-02732
–	M-511291-12VRB	** RPGN-120700	38,10	79,38	414008	TBHCS M5-0.8x16mm	308136	434258	TK-02732

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 / Shank Number	Dimensions (mm) A	Dimensions (mm) B
M-529756	50	400
M-529757	60	400
M-529758	72	400



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Grooving, Profiling and Cut-Off Support Blades

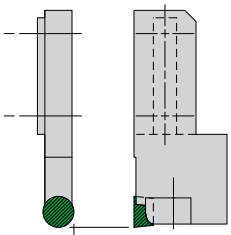
The Greenleaf tooling system for grooving, profiling, and cut-off is complemented by a support blade system that combines qualified shanks and support blades to expand the application range of each toolholder or bar. Greenleaf tools can be coupled with 248 support blades holding cut-off, V-bottom round 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

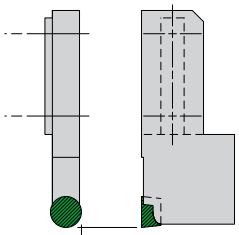
A Tune-Up Kit consists of all the standard hardware to refurbish a particular toolholder, boring bar, or milling cutter. A toolholder will have a readily visible, laser-inscribed Tune-Up Kit number on it for ease in ordering. This number will prevent any confusion created by searching a catalog for hardware,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

Support Blade Overview



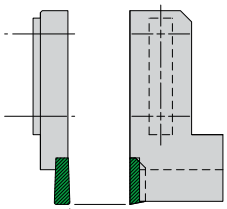
Round V-Bottom Insert with Replaceable Nest
3 sizes available using 12 insert combinations

page GP 42



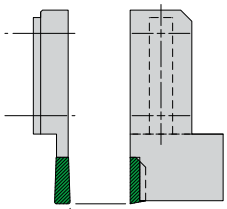
Round V-Bottom Insert with Milled Nest
3 sizes available using 18 insert combinations

page GP 42



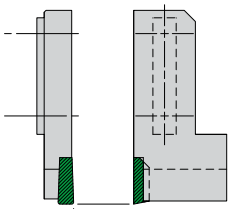
O.D. Grooving/Profiling Shallow Series
10 sizes available using 56 insert combinations

page GP 43



O.D. Grooving/Profiling Deep Series
10 sizes available using 56 insert combinations

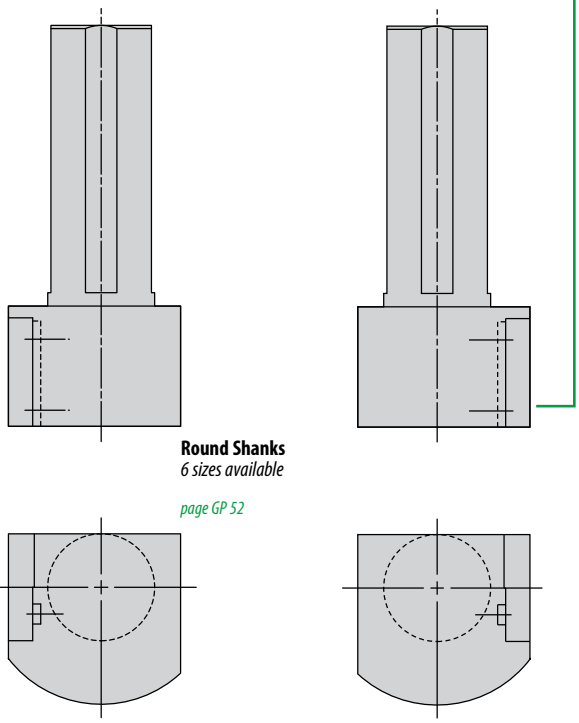
page GP 43



Face Grooving B Shallow Series
25 sizes available using 47 insert combinations

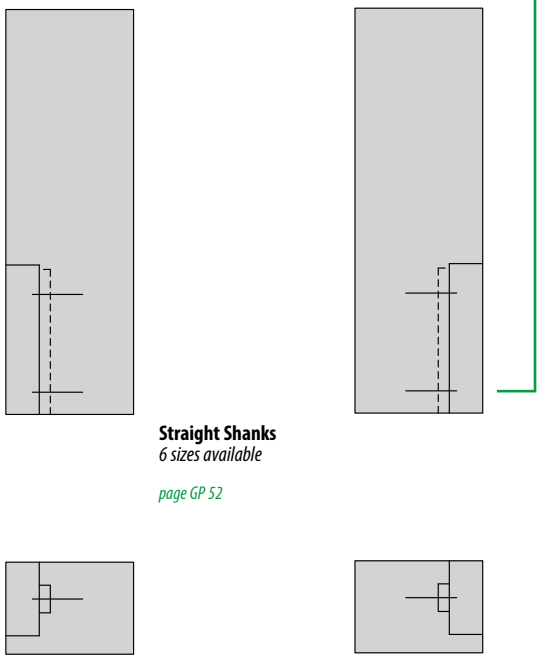
page GP 46

RIGHT HAND



Round Shanks
6 sizes available

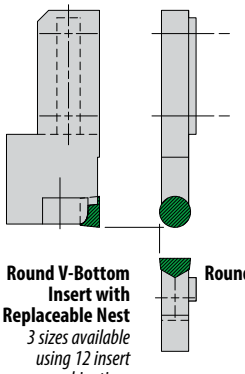
page GP 52



Straight Shanks
6 sizes available

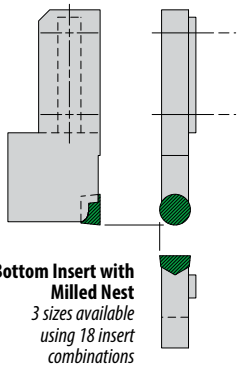
page GP 52

LEFT HAND



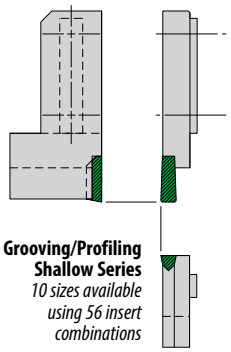
Round V-Bottom Insert with Replaceable Nest
3 sizes available using 12 insert combinations

page GP 42



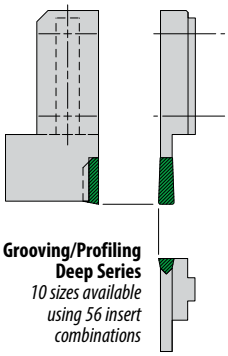
Round V-Bottom Insert with Milled Nest
3 sizes available using 18 insert combinations

page GP 42



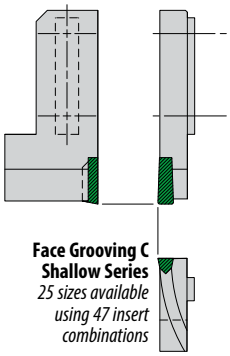
O.D. Grooving/Profiling Shallow Series
10 sizes available using 56 insert combinations

page GP 44



O.D. Grooving/Profiling Deep Series
10 sizes available using 56 insert combinations

page GP 44



Face Grooving C Shallow Series
25 sizes available using 47 insert combinations

page GP 47

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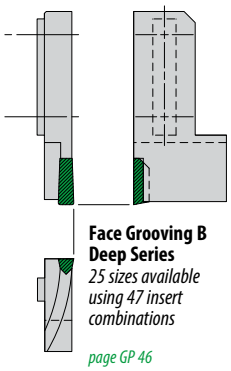
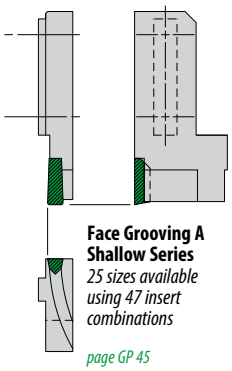


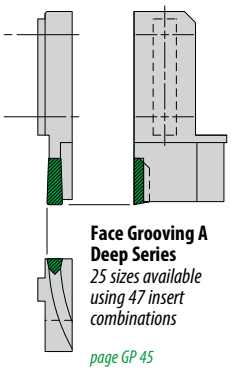
Face Grooving B Deep Series
25 sizes available using 47 insert combinations

page GP 46



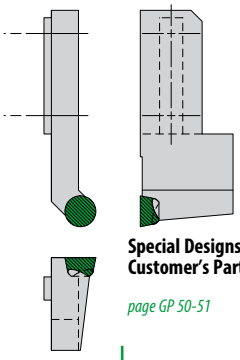
Face Grooving A Shallow Series
25 sizes available using 47 insert combinations

page GP 45



Face Grooving A Deep Series
25 sizes available using 47 insert combinations

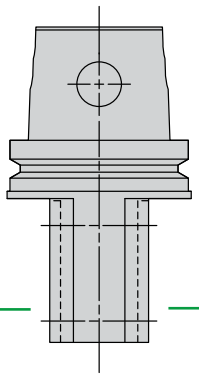
page GP 45

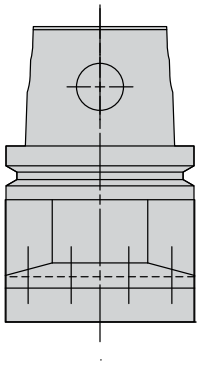


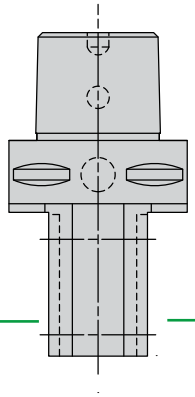
Special Designs to Fit Customer's Parts

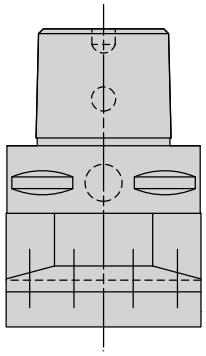
page GP 50-51

RIGHT HAND



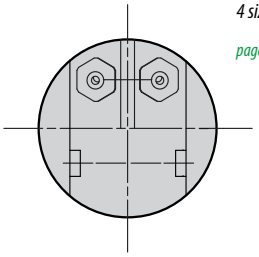


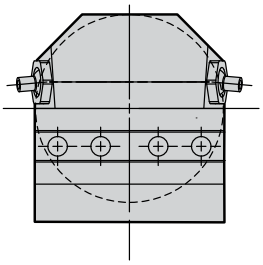




KM Tool Shanks
4 sizes available

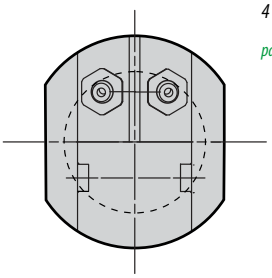
page GP 53

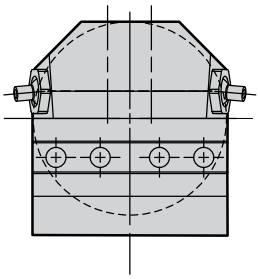




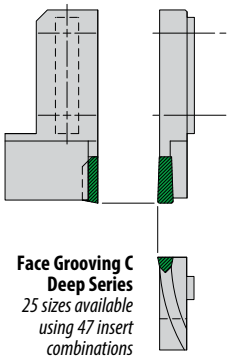
ISO 26623 Tool Shanks
4 sizes available

page GP 53



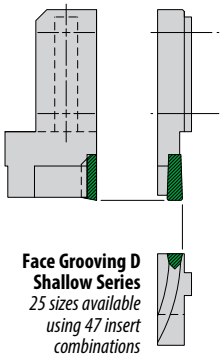


LEFT HAND



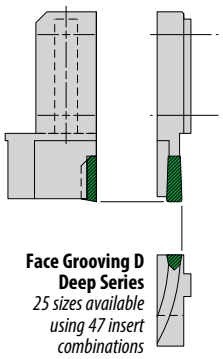
Face Grooving C Deep Series
25 sizes available using 47 insert combinations

page GP 47



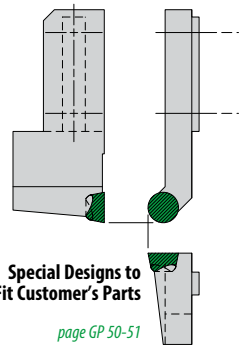
Face Grooving D Shallow Series
25 sizes available using 47 insert combinations

page GP 48



Face Grooving D Deep Series
25 sizes available using 47 insert combinations

page GP 48

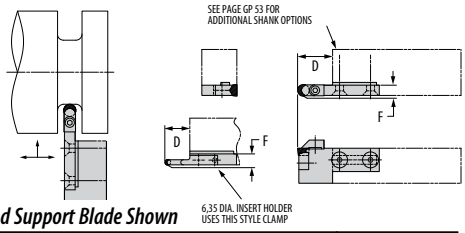


Special Designs to Fit Customer's Parts

page GP 50-51

O.D. Grooving/Profiling Support Blade

Round V-Bottom Insert Replaceable Nest



Right-Hand Support Blade Shown

Part Number		Gage	D.O.C.	Dimensions (mm)	Standard Components				*Tune-Up Kit
Right	Left	Insert	D	F	Back-Up Plate	Plate Screw	Clamp	Clamp Screw	Includes all Standard Components
M-411959-06VR	–	** RPGN-060400	19,05	11,91	410631	BHCS M2.5-0.45x10mm	411905-250VRC	434259	TK-02692
–	M-411960-06VR	** RPGN-060400	19,05	11,91	410631	BHCS M2.5-0.45x10mm	411906-250VRC	434259	TK-02693
M-411011-09VR	M-411012-09VR	** RPGN-090700	28,60	11,91	413970	TBHCS M3-0.5x12mm	308063	TSHCS M5-0.8x12mm	TK-02685
M-411009-12VR	M-411010-12VR	** RPGN-120700	38,10	11,91	414007	TBHCS M5-0.8x16mm	308136	434258	TK-02686

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

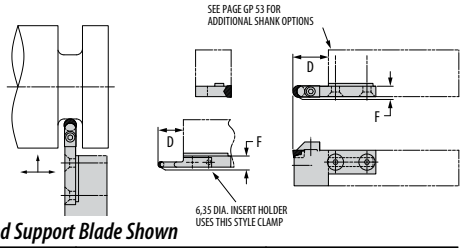
*** RCGN can be used in place of RPGN.*

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 (mm)	Standard Components		*Tune-Up Kit	Optional Component
Right	Left	Insert	D	F	Clamp	Clamp Screw	Includes all Standard Components	Insert Screw
M-421534-06VMR	–	** RPGN-060400	19,05	11,91	411905-250VRC	434259	TK-02689	PT-542T
–	M-421535-06VMR	** RPGN-060400	19,05	11,91	411906-250VRC	434259	TK-02690	PT-542T
M-421536-09VMR	M-421537-09VMR	** RPGN-090700	28,60	11,91	308063	TSHCS M5-0.8x12mm	TK-02734	PT-545T
M-421538-12VMR	M-421539-12VMR	** RPGN-120700	38,10	11,91	308136	434258	TK-02691	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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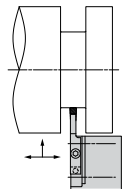
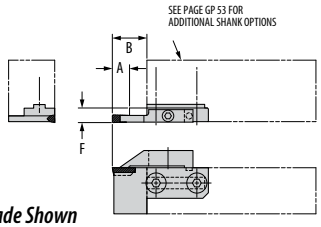
O.D. Grooving/Profiling/ Cut-Off Support Blade *Right Hand*





Right-Hand Support Blade Shown

Part Number		Groove Width	Dimensions (mm)			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
M-427647-094VG		2,39	9,6	–	11,91	WG-4094	427651-094GC	TK-02626	COS-4094-0	429524-094GC
	M-427648-094VG		–	19	11,91	WGC-4094	427651-094GC	TK-02626	COS-4094-4L	429524-094GC
									COS-4094-4R	
M-421109-125VG		3,18	9,6	–	11,91	GTS-4125-1	411966-125GC	TK-02628	GTS-4125	429512-125GC
	M-411988-125VG		–	19	11,91	GTS-4125-2	411966-125GC	TK-02628	COS-4125-0	429512-125GC
						WG-4125			COS-4125-4R	
						WGC-4125			COS-4125-4L	
M-421110-156VG		3,96	9,6	–	11,91	WG-4156	411968-156GC	TK-02630		
	M-411066-156VG		–	19	11,91	WGC-4156	411968-156GC	TK-02630	–	–
M-421111-187VG		4,75	9,6	–	11,91	GTS-4187-1	411977-187GC	TK-02632	GTS-4187	429518-187GC
	M-411068-187VG		–	19	11,91	GTS-4187-2	411977-187GC	TK-02632	COS-4187-0	429518-187GC
						WG-4187			COS-4187-4R	
						WGC-4187			COS-4187-4L	
M-421112-218VG		5,54	14,2	–	11,91	WG-6218	411979-218GC	TK-02634		
	M-411081-218VG		–	28,7	11,91	WGC-6218	411979-218GC	TK-02634	–	–
M-421113-250VG		6,35	14,2	–	11,91	WG-6250	411980-250GC	TK-02636		
	M-411992-250VG		–	28,7	11,91	WGC-6250	411980-250GC	TK-02636	–	–
						GTS-6250				
						GTS-6250-1				
						GTS-6250-2				
M-421114-281VG		7,14	14,2	–	11,91	WG-6281	411133-281GC	TK-02638		
	M-411085-281VG		–	28,7	11,91	WGC-6281	411133-281GC	TK-02638	–	–
M-421115-312VG		7,92	19	–	11,91	WG-8312	411985-312GC	TK-02640		
	M-411087-312VG		–	38,1	11,91	WGC-8312	411985-312GC	TK-02640	–	–
M-421116-344VG		8,74	19	–	11,91	WG-8344	411137-344GC	TK-02642		
	M-411089-344VG		–	38,1	11,91	WGC-8344	411137-344GC	TK-02642	–	–
M-421117-375VG		9,53	19	–	11,91	WG-8375	411986-375GC	TK-02649		
	M-411994-375VG		–	38,1	11,91	WGC-8375	411986-375GC	TK-02649	–	–

** 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.

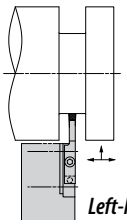
COS is Greenleaf's cut-off system insert. Page GP 08.

WG is Greenleaf flat-top groover with an 11° nose clearance. See pages GP 10 and GP 11.

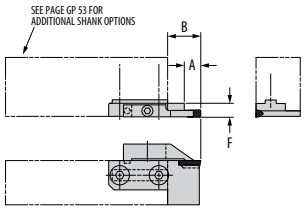
WGC is Greenleaf's flat-top groover with a 6° nose clearance. See pages GP 12 and GP 13.

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		Groove Width	Dimensions (mm)			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
M-427649-094VG			9,6	–	11,91	WG-4094	427652-094GC	TK-02627	COS-4094-0	429525-094GC
	M-427650-094VG	2,39	–	19,05	11,91	WGC-4094	427652-094GC	TK-02627	COS-4094-4L	429525-094GC
									COS-4094-4R	
M-421100-125VG			9,6	–	11,91	GTS-4125-1	411967-125GC	TK-02629	GTS-4125	429513-125GC
	M-411989-125VG	3,18	–	19,05	11,91	GTS-4125-2	411967-125GC	TK-02629	COS-4125-0	429513-125GC
						WG-4125			COS-4125-4R	
						WGC-4125			COS-4125-4L	
M-421101-156VG			9,6	–	11,91	WG-4156	411969-156GC	TK-02631		
	M-411990-156VG	3,96	–	19,05	11,91	WGC-4156	411969-156GC	TK-02631	–	–
M-421102-187VG			9,6	–	11,91	GTS-4187-1	411978-187GC	TK-02633	GTS-4187	429519-187GC
	M-411991-187VG	4,75	–	19,05	11,91	GTS-4187-2	411978-187GC	TK-02633	COS-4187-0	429519-187GC
						WG-4187			COS-4187-4R	
						WGC-4187			COS-4187-4L	
M-421103-218VG			14,2	–	11,91	WG-6218	411130-218GC	TK-02635		
	M-411082-218VG	5,54	–	28,7	11,91	WGC-6218	411130-218GC	TK-02635	–	–
M-421104-250VG			14,2	–	11,91	WG-6250	411981-250GC	TK-02637		
	M-411993-250VG	6,35	–	28,7	11,91	WGC-6250	411981-250GC	TK-02637	–	–
						GTS-6250				
						GTS-6250-1				
						GTS-6250-2				
M-421105-281VG			14,2	–	11,91	WG-6281	411134-281GC	TK-02648		
	M-411086-281VG	7,14	–	28,7	11,91	WGC-6281	411134-281GC	TK-02648	–	–
M-421106-312VG			19	–	11,91	WG-8312	411136-312GC	TK-02641		
	M-411088-312VG	7,92	–	38,1	11,91	WGC-8312	411136-312GC	TK-02641	–	–
M-421107-344VG			19	–	11,91	WG-8344	411138-344GC	TK-02643		
	M-411090-344VG	8,74	–	38,1	11,91	WGC-8344	411138-344GC	TK-02643	–	–
M-421108-375VG			19	–	11,91	WG-8375	411987-375GC	TK-02645		–
	M-411122-375VG	9,53	–	38,1	11,91	WGC-8375	411987-375GC	TK-02645	–	–

** 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. 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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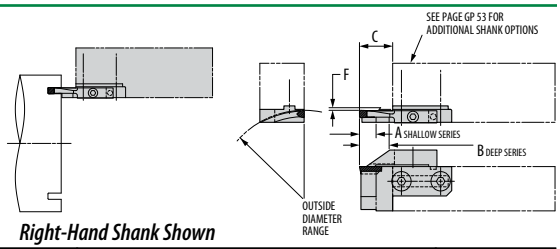
Face Grooving Support Blade A



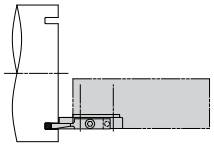
Right-Hand Shank Shown

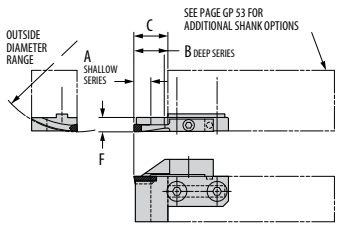
Part Number		Gage		Dimensions (mm)				Standard Components		*Tune-Up Kit
Shallow Series	Deep Series	Insert	Outside Diameter Range	A	B	C	F	Clamp	Clamp Screw	Includes all Standard Components
M-421218-125S-030	M-421243-125L-030	WG-4125	76,20 - 88,90	9,65	16	19,05	0,79	421323-125GC	434259	TK-02650
M-421219-125S-035	M-421244-125L-035	WG-4125	88,90 - 107,95	9,65	16	19,05	0,79	421323-125GC	434259	TK-02650
M-421220-125S-0425	M-421245-125L-0425	WG-4125	107,95 - 139,70	9,65	16	19,05	0,79	421323-125GC	434259	TK-02650
M-421221-125S-055	M-421246-125L-055	WG-4125	139,70 - 190,50	9,65	16	19,05	0,79	421323-125GC	434259	TK-02650
M-421222-125S-075	M-421247-125L-075	WG-4125	190,50 - 317,50	9,65	16	19,05	0,79	421323-125GC	434259	TK-02650
M-421223-125S-125	M-421248-125L-125	WG-4125	317,50 - 1016,0	9,65	16	19,05	0,79	421323-125GC	434259	TK-02650
M-421224-187S-030	M-421249-187L-030	WG-4187	76,20 - 88,90	9,65	16	19,05	0,79	421324-187GC	434259	TK-02651
M-421225-187S-035	M-421250-187L-035	WG-4187	88,90 - 107,95	9,65	16	19,05	0,79	421324-187GC	434259	TK-02651
M-421226-187S-0425	M-421251-187L-0425	WG-4187	107,95 - 139,70	9,65	16	19,05	0,79	421324-187GC	434259	TK-02651
M-421227-187S-055	M-421252-187L-055	WG-4187	139,70 - 190,50	9,65	16	19,05	0,79	421324-187GC	434259	TK-02651
M-421228-187S-075	M-421253-187L-075	WG-4187	190,50 - 317,50	9,65	16	19,05	0,79	421324-187GC	434259	TK-02651
M-421229-187S-125	M-421254-187L-125	WG-4187	317,50 - 1016,0	9,65	16	19,05	0,79	421324-187GC	434259	TK-02651
M-421230-250S-030	M-421255-250L-030	WG-6250	76,20 - 107,95	14,22	25,40	28,58	0,79	421325-250GC	434259	TK-02652
M-421231-250S-0425	M-421256-250L-0425	WG-6250	107,95 - 152,40	14,22	25,40	28,58	0,79	421325-250GC	434259	TK-02652
M-421232-250S-060	M-421257-250L-060	WG-6250	152,40 - 215,90	14,22	25,40	28,58	0,79	421325-250GC	434259	TK-02652
M-421233-250S-085	M-421258-250L-085	WG-6250	215,90 - 393,70	14,22	25,40	28,58	0,79	421325-250GC	434259	TK-02652
M-421234-250S-155	M-421259-250L-155	WG-6250	393,70 - 1016,0	14,22	25,40	28,58	0,79	421325-250GC	434259	TK-02652
M-421235-312S-030	M-421260-312L-030	WG-8312	76,20 - 127,00	19,05	33,27	38,10	0,79	421326-312GC	434259	TK-02653
M-421236-312S-050	M-421261-312L-050	WG-8312	127,00 - 228,60	19,05	33,27	38,10	0,79	421326-312GC	434259	TK-02653
M-421237-312S-090	M-421262-312L-090	WG-8312	228,60 - 482,60	19,05	33,27	38,10	0,79	421326-312GC	434259	TK-02653
M-421238-312S-190	M-421263-312L-190	WG-8312	482,60 -	19,05	33,27	38,10	0,79	421326-312GC	434259	TK-02653
M-421239-375S-030	M-421264-375L-030	WG-8375	76,20 - 127,00	19,05	33,27	38,10	0,79	421327-375GC	434259	TK-02654
M-421240-375S-050	M-421265-375L-050	WG-8375	127,00 - 228,60	19,05	33,27	38,10	0,79	421327-375GC	434259	TK-02654
M-421241-375S-090	M-421266-375L-090	WG-8375	228,60 - 482,60	19,05	33,27	38,10	0,79	421327-375GC	434259	TK-02654
M-421242-375S-190	M-421267-375L-190	WG-8375	482,60 -	19,05	33,27	38,10	0,79	421327-375GC	434259	TK-02654

** 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 (mm)				Standard Components		*Tune-Up Kit
Shallow Series	Deep Series	Insert	Outside Diameter Range	A	B	C	F	Clamp	Clamp Screw	Includes all Standard Components
M-421118-125S-030	M-421143-125L-030	WG-4125	76,20 - 88,90	9,65	16	19,05	11,91	421318-125GC	434259	TK-02677
M-421119-125S-035	M-421144-125L-035	WG-4125	88,90 - 107,95	9,65	16	19,05	11,91	421318-125GC	434259	TK-02677
M-421120-125S-0425	M-421145-125L-0425	WG-4125	107,95 - 139,70	9,65	16	19,05	11,91	421318-125GC	434259	TK-02677
M-421121-125S-055	M-421146-125L-055	WG-4125	139,70 - 190,50	9,65	16	19,05	11,91	421318-125GC	434259	TK-02677
M-421122-125S-075	M-421147-125L-075	WG-4125	190,50 - 317,50	9,65	16	19,05	11,91	421318-125GC	434259	TK-02677
M-421123-125S-125	M-421148-125L-125	WG-4125	317,50 - 1016,0	9,65	16	19,05	11,91	421318-125GC	434259	TK-02677
M-421124-187S-030	M-421149-187L-030	WG-4187	76,20 - 88,90	9,65	16	19,05	11,91	421319-187GC	434259	TK-02678
M-421125-187S-035	M-421150-187L-035	WG-4187	88,90 - 107,95	9,65	16	19,05	11,91	421319-187GC	434259	TK-02678
M-421126-187S-0425	M-421151-187L-0425	WG-4187	107,95 - 139,70	9,65	16	19,05	11,91	421319-187GC	434259	TK-02678
M-421127-187S-055	M-421152-187L-055	WG-4187	139,70 - 190,50	9,65	16	19,05	11,91	421319-187GC	434259	TK-02678
M-421128-187S-075	M-421153-187L-075	WG-4187	190,50 - 317,50	9,65	16	19,05	11,91	421319-187GC	434259	TK-02678
M-421129-187S-125	M-421154-187L-125	WG-4187	317,50 - 1016,0	9,65	16	19,05	11,91	421319-187GC	434259	TK-02678
M-421130-250S-030	M-421155-250L-030	WG-6250	76,20 - 107,95	14,22	25,40	28,58	11,91	421320-250GC	434259	TK-02679
M-421131-250S-0425	M-421156-250L-0425	WG-6250	107,95 - 152,40	14,22	25,40	28,58	11,91	421320-250GC	434259	TK-02679
M-421132-250S-060	M-421157-250L-060	WG-6250	152,40 - 215,90	14,22	25,40	28,58	11,91	421320-250GC	434259	TK-02679
M-421133-250S-085	M-421158-250L-085	WG-6250	215,90 - 393,70	14,22	25,40	28,58	11,91	421320-250GC	434259	TK-02679
M-421134-250S-155	M-421159-250L-155	WG-6250	393,70 - 1016,0	14,22	25,40	28,58	11,91	421320-250GC	434259	TK-02679
M-421135-312S-030	M-421160-312L-030	WG-8312	76,20 - 127,00	19,05	33,27	38,10	11,91	421321-312GC	434259	TK-02680
M-421136-312S-050	M-421161-312L-050	WG-8312	127,00 - 228,60	19,05	33,27	38,10	11,91	421321-312GC	434259	TK-02680
M-421137-312S-090	M-421162-312L-090	WG-8312	228,60 - 482,60	19,05	33,27	38,10	11,91	421321-312GC	434259	TK-02680
M-421138-312S-190	M-421163-312L-190	WG-8312	482,60 -	19,05	33,27	38,10	11,91	421321-312GC	434259	TK-02680
M-421139-375S-030	M-421164-375L-030	WG-8375	76,20 - 127,00	19,05	33,27	38,10	11,91	421322-375GC	434259	TK-02681
M-421140-375S-050	M-421165-375L-050	WG-8375	127,00 - 228,60	19,05	33,27	38,10	11,91	421322-375GC	434259	TK-02681
M-421141-375S-090	M-421166-375L-090	WG-8375	228,60 - 482,60	19,05	33,27	38,10	11,91	421322-375GC	434259	TK-02681
M-421142-375S-190	M-421167-375L-190	WG-8375	482,60 -	19,05	33,27	38,10	11,91	421322-375GC	434259	TK-02681

** 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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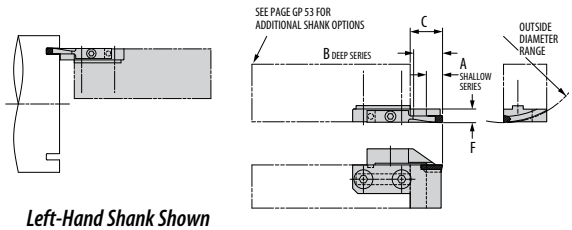
Face Grooving Support Blade C



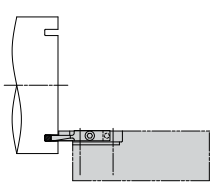
Left-Hand Shank Shown

Part Number		Gage		Dimensions (mm)				Standard Components		*Tune-Up Kit
Shallow Series	Deep Series	Insert	Outside Diameter Range	A	B	C	F	Clamp	Clamp Screw	Includes all Standard Components
M-421168-125S-030	M-421193-125L-030	WG-4125	76,20 - 88,90	9,65	16	19,05	11,91	421323-125GC	434259	TK-02650
M-421169-125S-035	M-421194-125L-035	WG-4125	88,90 - 107,95	9,65	16	19,05	11,91	421323-125GC	434259	TK-02650
M-421170-125S-0425	M-421195-125L-0425	WG-4125	107,95 - 139,70	9,65	16	19,05	11,91	421323-125GC	434259	TK-02650
M-421171-125S-055	M-421196-125L-055	WG-4125	139,70 - 190,50	9,65	16	19,05	11,91	421323-125GC	434259	TK-02650
M-421172-125S-075	M-421197-125L-075	WG-4125	190,50 - 317,50	9,65	16	19,05	11,91	421323-125GC	434259	TK-02650
M-421173-125S-125	M-421198-125L-125	WG-4125	317,50 - 1016,0	9,65	16	19,05	11,91	421323-125GC	434259	TK-02650
M-421174-187S-030	M-421199-187L-030	WG-4187	76,20 - 88,90	9,65	16	19,05	11,91	421324-187GC	434259	TK-02651
M-421175-187S-035	M-421200-187L-035	WG-4187	88,90 - 107,95	9,65	16	19,05	11,91	421324-187GC	434259	TK-02651
M-421176-187S-0425	M-421201-187L-0425	WG-4187	107,95 - 139,70	9,65	16	19,05	11,91	421324-187GC	434259	TK-02651
M-421177-187S-055	M-421202-187L-055	WG-4187	139,70 - 190,50	9,65	16	19,05	11,91	421324-187GC	434259	TK-02651
M-421178-187S-075	M-421203-187L-075	WG-4187	190,50 - 317,50	9,65	16	19,05	11,91	421324-187GC	434259	TK-02651
M-421179-187S-125	M-421204-187L-125	WG-4187	317,50 - 1016,0	9,65	16	19,05	11,91	421324-187GC	434259	TK-02651
M-421180-250S-030	M-421205-250L-030	WG-6250	76,20 - 107,95	14,22	25,40	28,58	11,91	421325-250GC	434259	TK-02652
M-421181-250S-0425	M-421206-250L-0425	WG-6250	107,95 - 152,40	14,22	25,40	28,58	11,91	421325-250GC	434259	TK-02652
M-421182-250S-060	M-421207-250L-060	WG-6250	152,40 - 215,90	14,22	25,40	28,58	11,91	421325-250GC	434259	TK-02652
M-421183-250S-085	M-421208-250L-085	WG-6250	215,90 - 393,70	14,22	25,40	28,58	11,91	421325-250GC	434259	TK-02652
M-421184-250S-155	M-421209-250L-155	WG-6250	393,70 - 1016,0	14,22	25,40	28,58	11,91	421325-250GC	434259	TK-02652
M-421185-312S-030	M-421210-312L-030	WG-8312	76,20 - 127,00	19,05	33,27	38,10	11,91	421326-312GC	434259	TK-02653
M-421186-312S-050	M-421211-312L-050	WG-8312	127,00 - 228,60	19,05	33,27	38,10	11,91	421326-312GC	434259	TK-02653
M-421187-312S-090	M-421212-312L-090	WG-8312	228,60 - 482,60	19,05	33,27	38,10	11,91	421326-312GC	434259	TK-02653
M-421188-312S-190	M-421213-312L-190	WG-8312	482,60 -	19,05	33,27	38,10	11,91	421326-312GC	434259	TK-02653
M-421189-375S-030	M-421214-375L-030	WG-8375	76,20 - 127,00	19,05	33,27	38,10	11,91	421327-375GC	434259	TK-02654
M-421190-375S-050	M-421215-375L-050	WG-8375	127,00 - 228,60	19,05	33,27	38,10	11,91	421327-375GC	434259	TK-02654
M-421191-375S-090	M-421216-375L-090	WG-8375	228,60 - 482,60	19,05	33,27	38,10	11,91	421327-375GC	434259	TK-02654
M-421192-375S-190	M-421217-375L-190	WG-8375	482,60 -	19,05	33,27	38,10	11,91	421327-375GC	434259	TK-02654

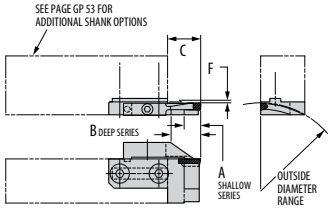
** Tune-Up Kits include one complete set of Standard Components to allow you to refurbish the support blade.*

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 (mm)				Standard Components		*Tune-Up Kit
Shallow Series	Deep Series	Insert	Outside Diameter Range	A	B	C	F	Clamp	Clamp Screw	Includes all Standard Components
M-421268-125S-030	M-421293-125L-030	WG-4125	76,20 - 88,90	9,65	16	19,05	0,79	421318-125GC	434259	TK-02677
M-421269-125S-035	M-421294-125L-035	WG-4125	88,90 - 107,95	9,65	16	19,05	0,79	421318-125GC	434259	TK-02677
M-421270-125S-0425	M-421295-125L-0425	WG-4125	107,95 - 139,70	9,65	16	19,05	0,79	421318-125GC	434259	TK-02677
M-421271-125S-055	M-421296-125L-055	WG-4125	139,70 - 190,50	9,65	16	19,05	0,79	421318-125GC	434259	TK-02677
M-421272-125S-075	M-421297-125L-075	WG-4125	190,50 - 317,50	9,65	16	19,05	0,79	421318-125GC	434259	TK-02677
M-421273-125S-125	M-421298-125L-125	WG-4125	317,50 - 1016,0	9,65	16	19,05	0,79	421318-125GC	434259	TK-02677
M-421274-187S-030	M-421299-187L-030	WG-4187	76,20 - 88,90	9,65	16	19,05	0,79	421319-187GC	434259	TK-02678
M-421275-187S-035	M-421300-187L-035	WG-4187	88,90 - 107,95	9,65	16	19,05	0,79	421319-187GC	434259	TK-02678
M-421276-187S-0425	M-421301-187L-0425	WG-4187	107,95 - 139,70	9,65	16	19,05	0,79	421319-187GC	434259	TK-02678
M-421277-187S-055	M-421302-187L-055	WG-4187	139,70 - 190,50	9,65	16	19,05	0,79	421319-187GC	434259	TK-02678
M-421278-187S-075	M-421303-187L-075	WG-4187	190,50 - 317,50	9,65	16	19,05	0,79	421319-187GC	434259	TK-02678
M-421279-187S-125	M-421304-187L-125	WG-4187	317,50 - 1016,0	9,65	16	19,05	0,79	421319-187GC	434259	TK-02678
M-421280-250S-030	M-421305-250L-030	WG-6250	76,20 - 107,95	14,22	25,40	28,58	0,79	421320-250GC	434259	TK-02679
M-421281-250S-0425	M-421306-250L-0425	WG-6250	107,95 - 152,40	14,22	25,40	28,58	0,79	421320-250GC	434259	TK-02679
M-421282-250S-060	M-421307-250L-060	WG-6250	152,40 - 215,90	14,22	25,40	28,58	0,79	421320-250GC	434259	TK-02679
M-421283-250S-085	M-421308-250L-085	WG-6250	215,90 - 393,70	14,22	25,40	28,58	0,79	421320-250GC	434259	TK-02679
M-421284-250S-155	M-421309-250L-155	WG-6250	393,70 - 1016,0	14,22	25,40	28,58	0,79	421320-250GC	434259	TK-02679
M-421285-312S-030	M-421310-312L-030	WG-8312	76,20 - 127,00	19,05	33,27	38,10	0,79	421321-312GC	434259	TK-02680
M-421286-312S-050	M-421311-312L-050	WG-8312	127,00 - 228,60	19,05	33,27	38,10	0,79	421321-312GC	434259	TK-02680
M-421287-312S-090	M-421312-312L-090	WG-8312	228,60 - 482,60	19,05	33,27	38,10	0,79	421321-312GC	434259	TK-02680
M-421288-312S-190	M-421313-312L-190	WG-8312	482,60 -	19,05	33,27	38,10	0,79	421321-312GC	434259	TK-02680
M-421289-375S-030	M-421314-375L-030	WG-8375	76,20 - 127,00	19,05	33,27	38,10	0,79	421322-375GC	434259	TK-02681
M-421290-375S-050	M-421315-375L-050	WG-8375	127,00 - 228,60	19,05	33,27	38,10	0,79	421322-375GC	434259	TK-02681
M-421291-375S-090	M-421316-375L-090	WG-8375	228,60 - 482,60	19,05	33,27	38,10	0,79	421322-375GC	434259	TK-02681
M-421292-375S-190	M-421317-375L-190	WG-8375	482,60 -	19,05	33,27	38,10	0,79	421322-375GC	434259	TK-02681

** 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

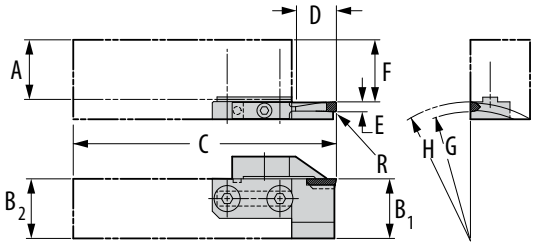
Face grooving tools must be matched to a specific radius and are, therefore, manufactured to order for your particular application.

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.

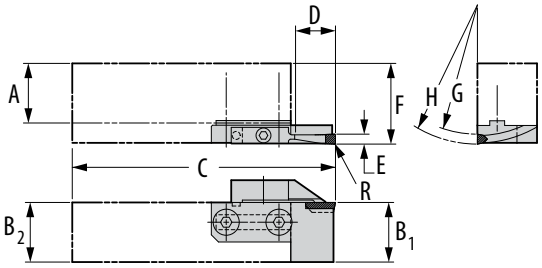
When ordering replaceable blade styles, we suggest the purchase of additional back-up blades at time of original order.

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



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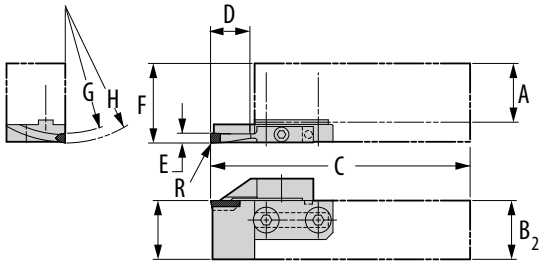

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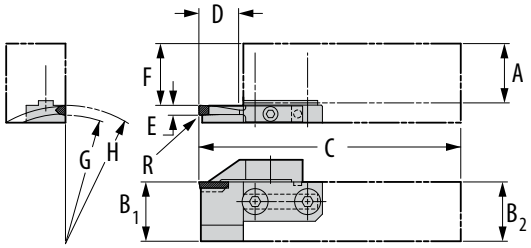

AFGVRR

AFGV_ _	A	C	F
Drawing #	B_1	D (depth of cut)	G (radius)
R (radius)	B_2	E	H (radius)

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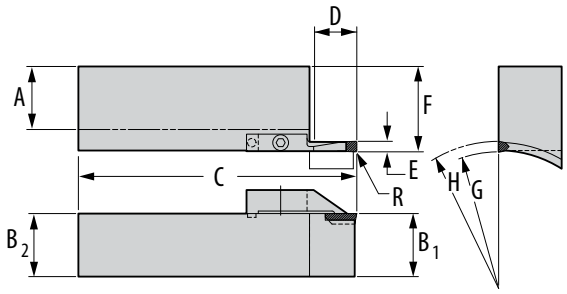
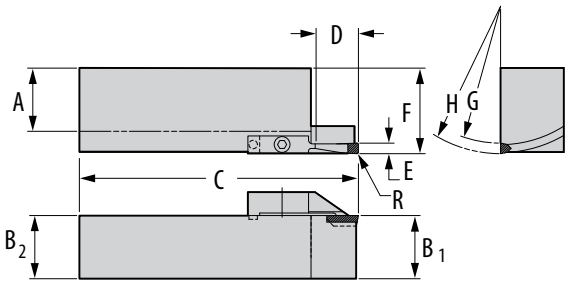
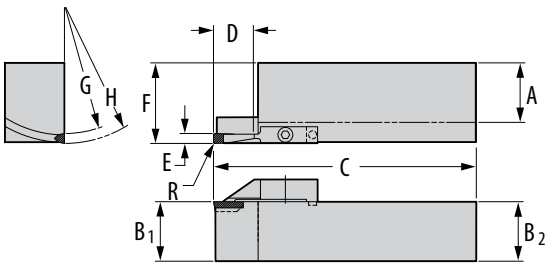


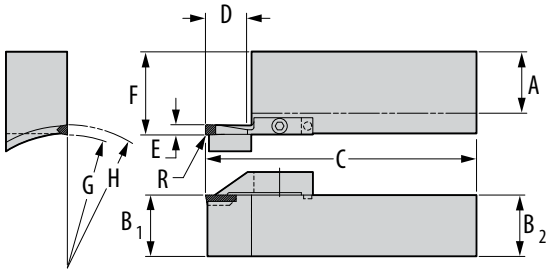
SFGVLL



SFGVLR



SFGVRL

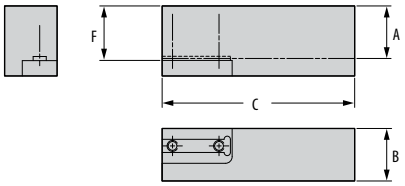


SFGVRR

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

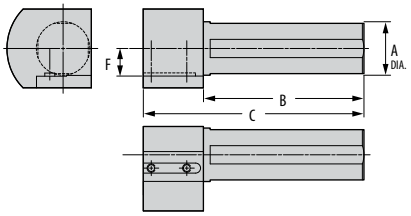


Part Number		Dimensions (mm)				Standard Components	*Tune-Up Kit
Right	Left	A	B	C	F	Mounting Screw	Includes all Standard Components
M-411055	M-411056	25	25	125	26	FHCS M8-1.25x25mm	TK-02682
M-411059	M-411449	32	32	150	33	FHCS M8-1.25x25mm	TK-02682
M-411015	M-411016	40	40	200	41	FHCS M8-1.25x25mm	TK-02682

** 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 (mm)				Standard Components	*Tune-Up Kit
Right	Left	A	B	C	F	Mounting Screw	Includes all Standard Components
M-529678	M-529679	32	150	200	23	FHCS M8-1.25x25mm	TK-02682
M-529680	M-529681	40	150	200	27	FHCS M8-1.25x25mm	TK-02682
M-529682	M-529683	50	150	200	32	FHCS M8-1.25x25mm	TK-02682
M-529684	M-529685	60	150	200	37	FHCS M8-1.25x25mm	TK-02682

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

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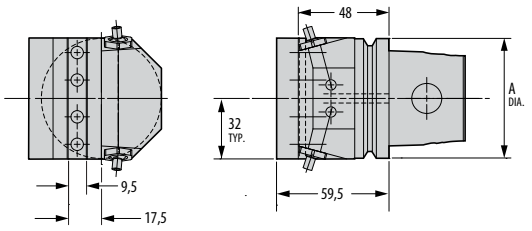
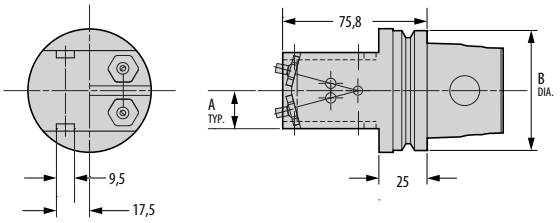
KM Shank
Face Mount



Part Number	Dimensions (mm)	Standard Components	*Tune-Up Kit
Face Mount †	A	Mounting Screw	Includes all Standard Components
M-SBH-KM50-F	50	FHCS M8-1.25x25mm	TK-02682
M-SBH-KM63-F	63	FHCS M8-1.25x25mm	TK-02682

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.

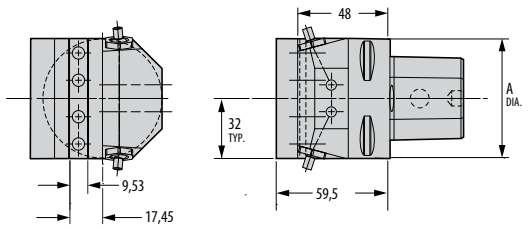
KM Shank
Side Mount



Part Number	Dimensions (mm)		Standard Components	*Tune-Up Kit
Face Mount †	A	B	Mounting Screw	Includes all Standard Components
M-SBH-KM50-S	17,5	50	FHCS M8-1.25x25mm	TK-02682
M-SBH-KM63-S	20	63	FHCS M8-1.25x25mm	TK-02682

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.

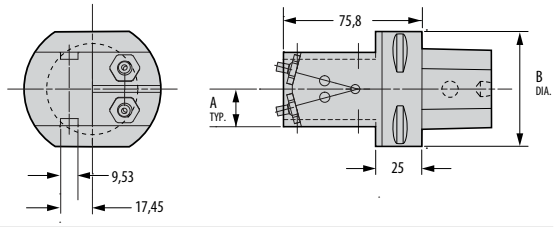
ISO 26623 Shank
Face Mount



Part Number	Dimensions (mm)	Standard Components	*Tune-Up Kit
Face Mount	A	Mounting Screw	Includes all Standard Components
M-SBH-C5-F	50	FHCS M8-1.25x25mm	TK-02682
M-SBH-C6-F	63	FHCS M8-1.25x25mm	TK-02682

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

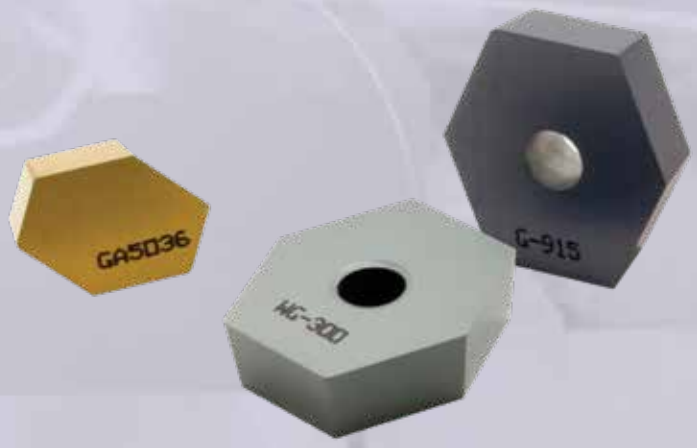


Part Number	Dimensions (mm)		Standard Components	*Tune-Up Kit
Face Mount	A	B	Mounting Screw	Includes all Standard Components
M-SBH-C5-S	17,5	50	FHCS M8-1.25x25mm	TK-02682
M-SBH-C6-S	20	63	FHCS M8-1.25x25mm	TK-02682

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.*


RING MAX™ GRM-GC-BX-150

API Ring Groove



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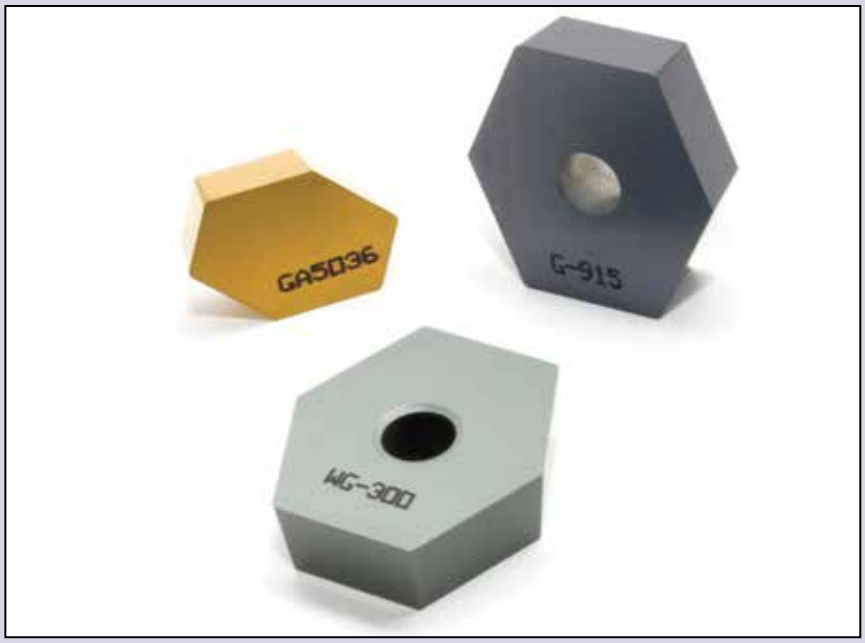
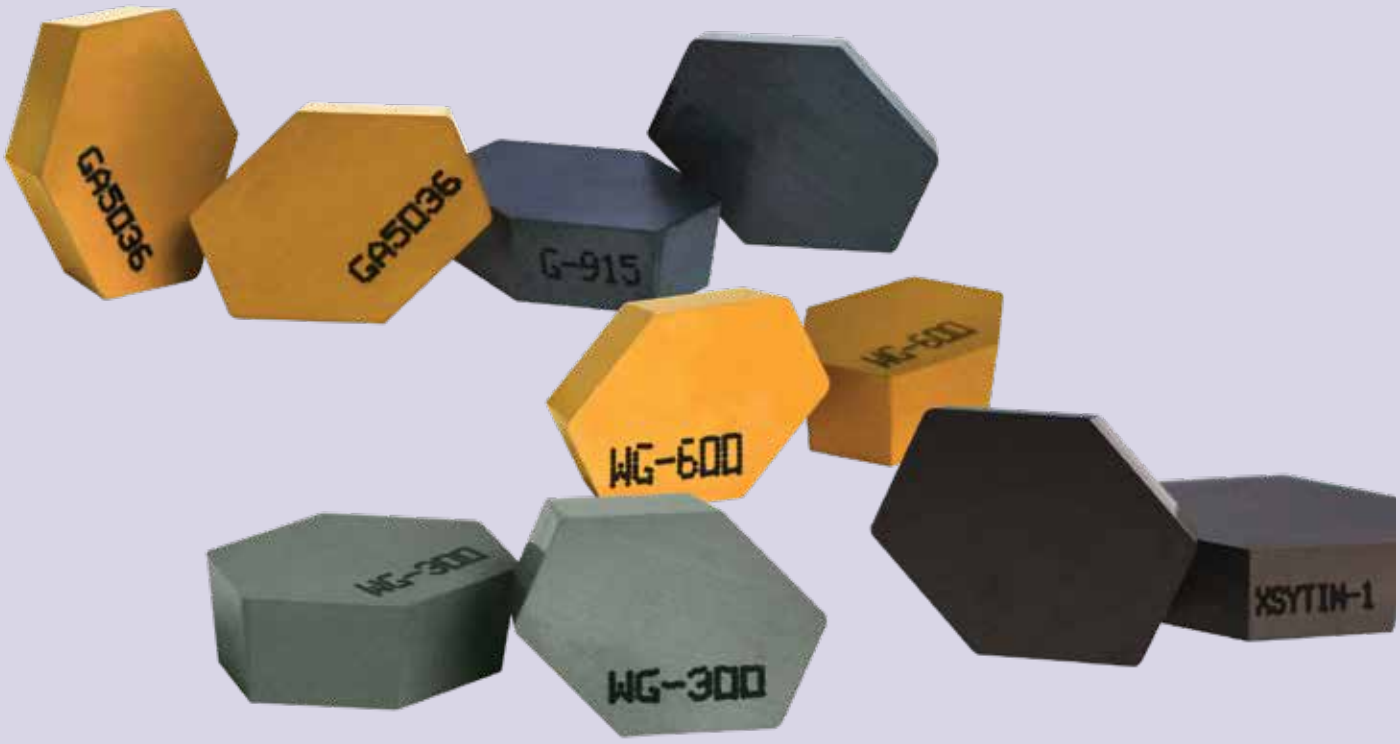
Ring Max™ Grooving Inserts

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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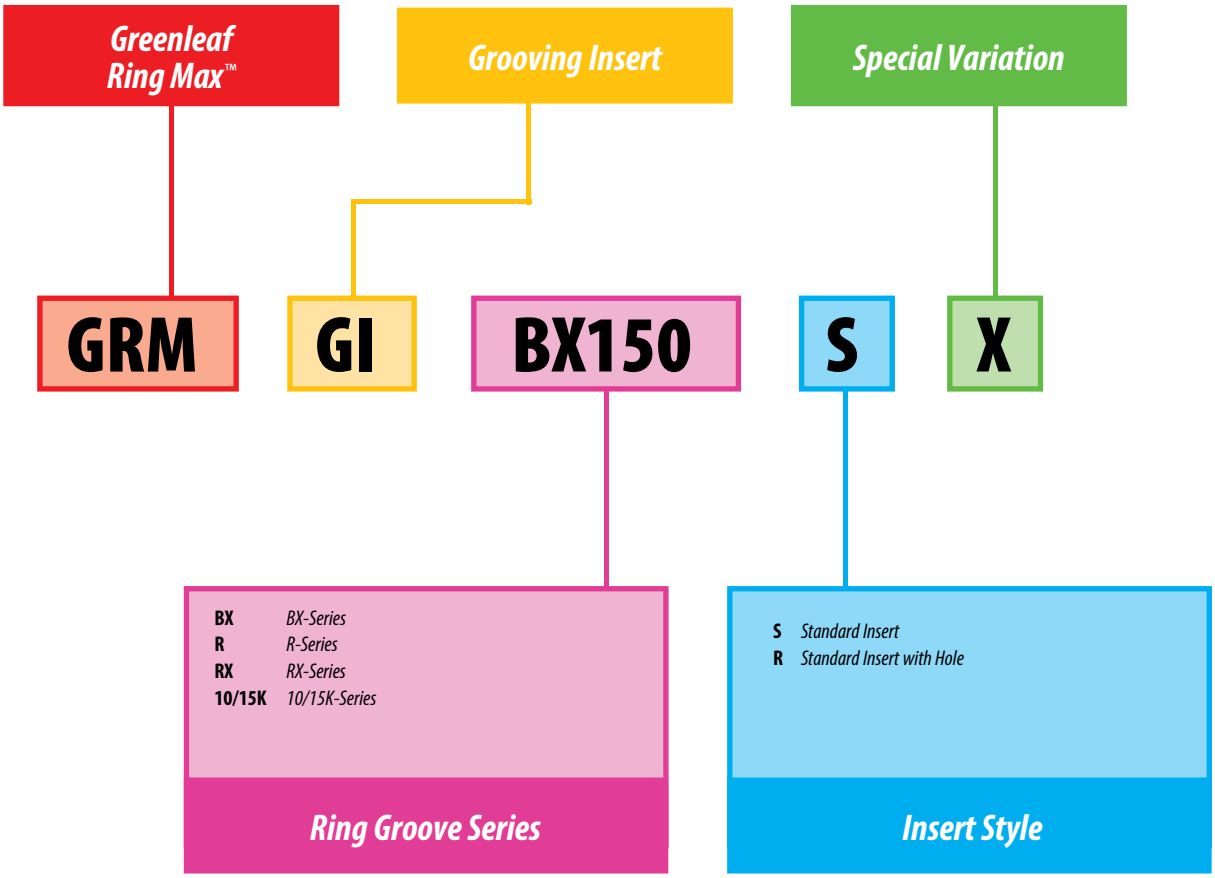
Ring Max™

Grooving Insert Identification System



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Insert Grades

Carbide

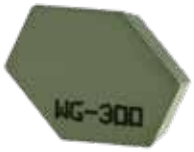
GA5036

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

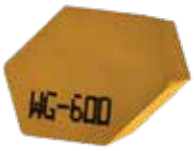
Greenleaf's most versatile grade for machining API ring grooves, G-915 can easily machine most materials and works well on machines with low RPMs.

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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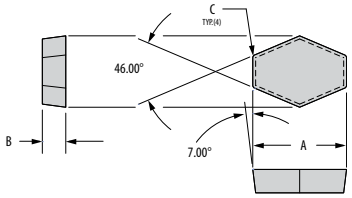
Ring Max™ Inserts

GRM-GI



Insert	Part Number	Steel		Stainless Steel		Heat-Resistant Super Alloys				Dimensions (mm)		
		P		M		S						
		G-915	GA5035	WG-300	G-915	WG-300	WG-600	XSYLTIN-1	G-915	A	B	C
	GRM-GI-BX150S	●	▲	◆	◆	●	◆	▲	▲	15,88	6,35	0,79
	GRM-GI-BX151S	●	▲	◆	◆	●	◆	▲	▲	15,88	6,35	0,79
	GRM-GI-BX152S	●	▲	◆	◆	●	◆	▲	▲	19,05	6,35	0,79
	GRM-GI-BX153S	●	▲	◆	◆	●	◆	▲	▲	19,05	6,35	0,79
	GRM-GI-BX154S	●	▲	◆	◆	●	◆	▲	▲	19,05	6,35	0,79
	GRM-GI-BX155R	●	▲	◆	◆	●	◆	▲	▲	22,23	6,35	0,79
	GRM-GI-BX156R	●	▲	◆	◆	●	◆	▲	▲	25,73	7,93	0,79
	GRM-GI-BX169R	●	▲	◆	◆	●	◆	▲	▲	25,40	6,35	0,79
	GRM-GI-RSET1-SX*	●	▲	◆	◆	●	◆	▲	▲	25,40	6,35	0,79
	GRM-GI-R46R	●	▲	◆	◆	●	◆	▲	▲	25,40	6,35	1,52
	GRM-GI-RSET2-SX*	●	▲	◆	◆	●	◆	▲	▲	15,88	3,96	0,79
	GRM-GI-RX201/5SX*	●	▲	◆	◆	●	◆	▲	▲	15,34	4,78	0,38
	GRM-GI-10K/15KSX*	●	▲	◆	◆	●	◆	▲	▲	15,88	6,35	0,76

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 RM 05

** 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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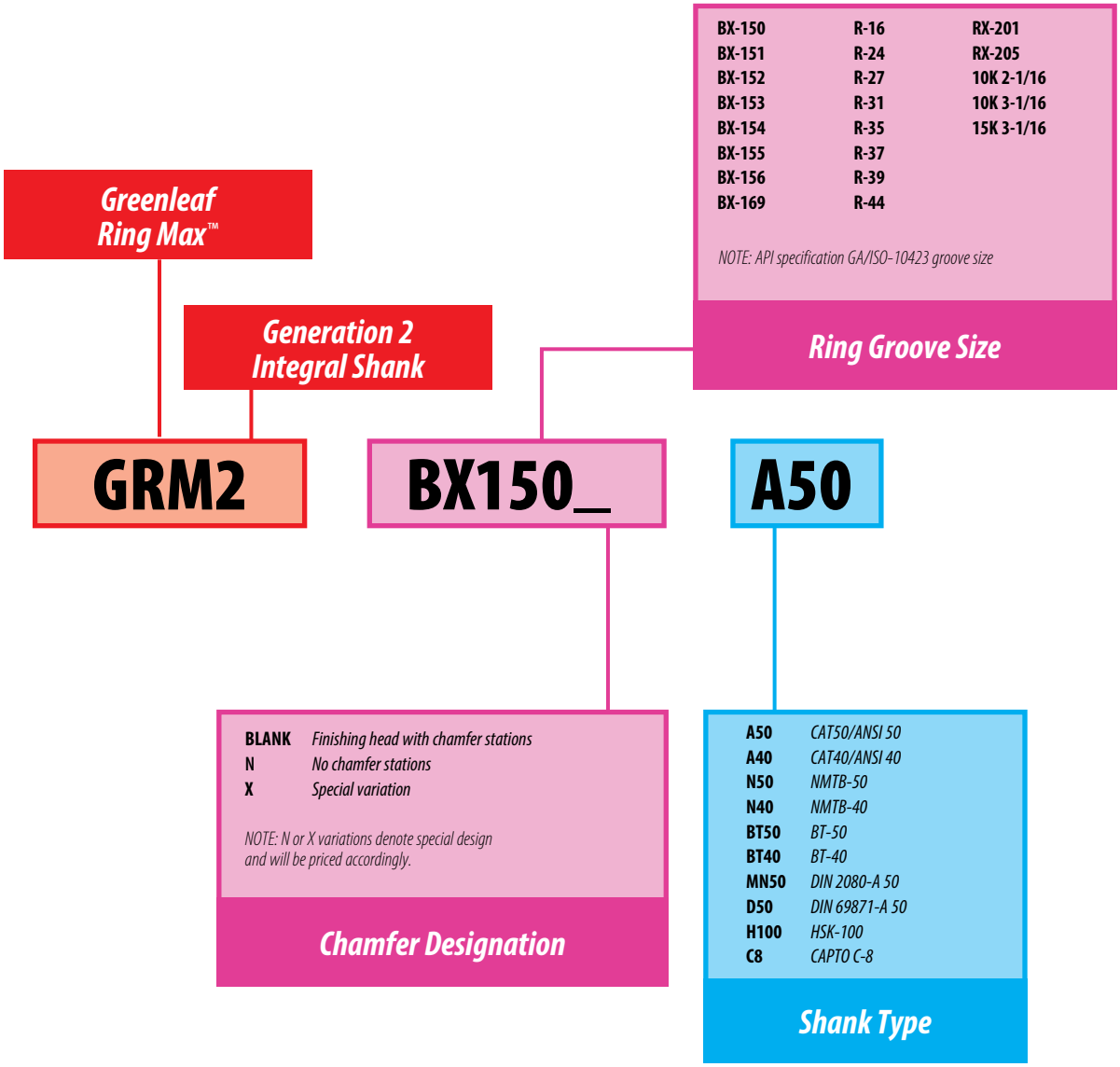
Ring Max™ II

Finishing Head Identification System



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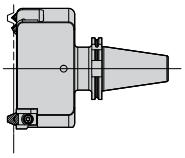
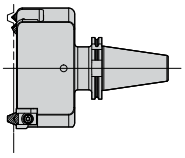
Pictorial & Reference Index

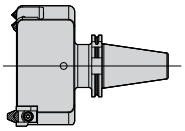
Ring Max™ II Tooling



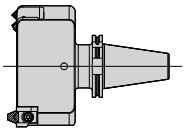
BX Series
page: RM 10



R Series
page: RM 11



RX Series
page: RM 12



10K and 15K Series
page: RM 12

Reference

Ring Max™ II
Models
page: RM 13

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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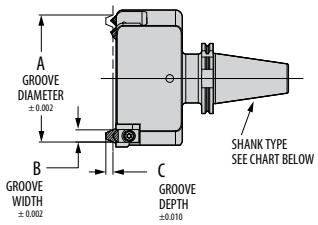
Ring Max™ II

BX Series



Part Number		Dimensions (mm)			Standard Components		Inserts	
Groove Series - Shank Type*	Stock	A	B	C	Grooving Cartidge	Chamfer Cartidge	Grooving Insert	Chamfer Insert
GRM2-BX150-_ _ _ _	See chart	73,53	11,48	5,84	GRM-GC-BX-150	GRMCC01	GRM-GI-BX150S	SPGN-322
GRM2-BX151-_ _ _ _	below	77,83	11,89	5,84	GRM-GC-BX-151	GRMCC01	GRM-GI-BX151S	SPGN-322
GRM2-BX152-_ _ _ _	for	86,28	12,70	6,10	GRM-GC-BX-152	GRMCC01	GRM-GI-BX152S	SPGN-322
GRM2-BX153-_ _ _ _	stocked	102,82	14,12	7,11	GRM-GC-BX-153	GRMCC01	GRM-GI-BX153S	SPGN-322
GRM2-BX154-_ _ _ _	sizes.	119,05	15,44	7,87	GRM-GC-BX-154	GRMCC01	GRM-GI-BX154S	SPGN-322
GRM2-BX155-_ _ _ _		150,67	17,78	8,64	GRM-GC-BX-155	GRMCC01	GRM-GI-BX155R	SPGN-322
GRM2-BX156-_ _ _ _		241,88	23,44	11,43	GRM-GC-BX-156	GRMCC01	GRM-GI-BX156R	SPGN-322
GRM2-BX169-_ _ _ _		176,71	16,97	9,91	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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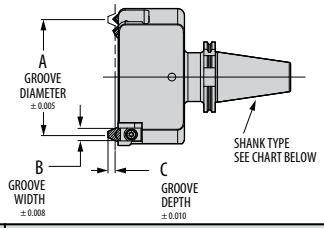
Ring Max™ II

R Series



Part Number		Dimensions (mm)			Standard Components		Inserts	
Groove Series - Shank Type*	Stock	A	B	C	Grooving Cartidge	Chamfer Cartidge	Grooving Insert	Chamfer Insert
GRM2-R16-_ _ _ _	See chart	50,80	8,74	6,35	GRM-GC-RSET 2 X	GRMCC01	GRM-GI-RSET 2 SX	SPGN-322
GRM2-R24-_ _ _ _	below	95,25	11,91	8,13	GRM-GC-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
GRM2-R27-_ _ _ _	for	107,95	11,91	8,13	GRM-GC-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
GRM2-R31-_ _ _ _	stocked	123,83	11,91	8,13	GRM-GC-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
GRM2-R35-_ _ _ _	sizes.	136,53	11,91	8,13	GRM-GC-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
GRM2-R37-_ _ _ _		149,23	11,91	8,13	GRM-GC-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
GRM2-R39-_ _ _ _		161,93	11,91	8,13	GRM-GC-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
GRM2-R44-_ _ _ _		193,68	11,91	8,13	GRM-GC-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
GRM2-R46-_ _ _ _		211,15	13,49	9,91	GRM-GC-R46	GRMCC01	GRM-GI-R46R	SPGN-322

** See chart to below*

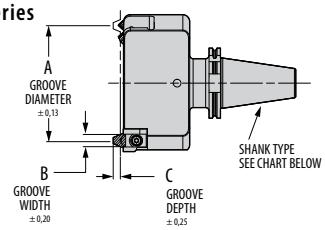
Shank Description	Ordering Code
CAT50/ANSI 50	A50
CAT40/ANSI 40	A40
NMTB-50	N50
NMTB-40	N40
BT-50	BT50
BT-40	BT40
DIN 2080-A 50	MN50
DIN 69871-A 50	D50
HSK-100	H100
CAPTO C-8	C8

Stocked Sizes
GRM2-R24-A50
GRM2-R24-D50
GRM2-R24N-A50
GRM2-R24N-D50

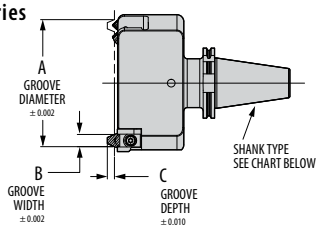
Ring Max™ II

RX Series / 10K and 15K Series

RX Series



10/15K Series



Part Number	Stock	Dimensions (mm)			Standard Components		Inserts	
Groove Series - Shank Type*		A	B	C	Grooving Cartidge	Chamfer Cartidge	Grooving Insert	Chamfer Insert
GRM2-RX201N-_ _ _ _	See chart	46,05	5,56	4,06	GRM-GCRX201/5-X	N/A	GRM-GI-RX201/5SX	N/A
GRM2-RX205N-_ _ _ _	below	57,15	5,56	4,06	GRM-GCRX201/5-X	N/A	GRM-GI-RX201/5SX	N/A
GRM2-10K2-_ _ _ _	for	117,42	9,58	6,55	GRM-GC10/15K-X	GRMCC01	GRM-GI-10/15KSX	SPGN-322
GRM2-10K3N-_ _ _ _	stocked	146,00	9,58	6,55	GRM-GC10/15K-X	N/A	GRM-GI-10/15KSX	N/A
GRM2-10K5-_ _ _ _	sizes.	222,20	9,58	6,55	GRM-GC10/15K-X	GRMCC01	GRM-GI-10/15KSX	SPGN-322
GRM2-15K3-_ _ _ _		168,22	9,58	6,55	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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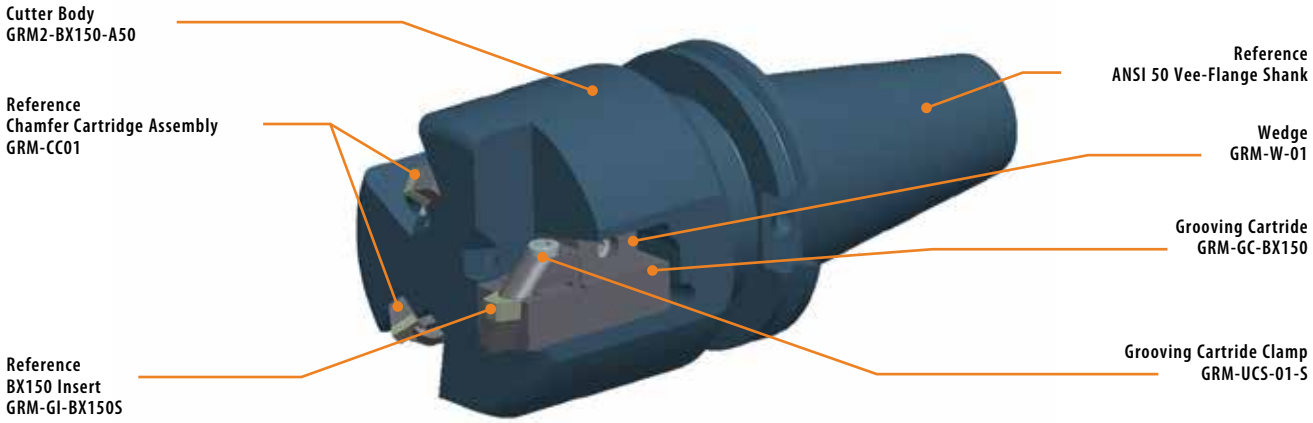
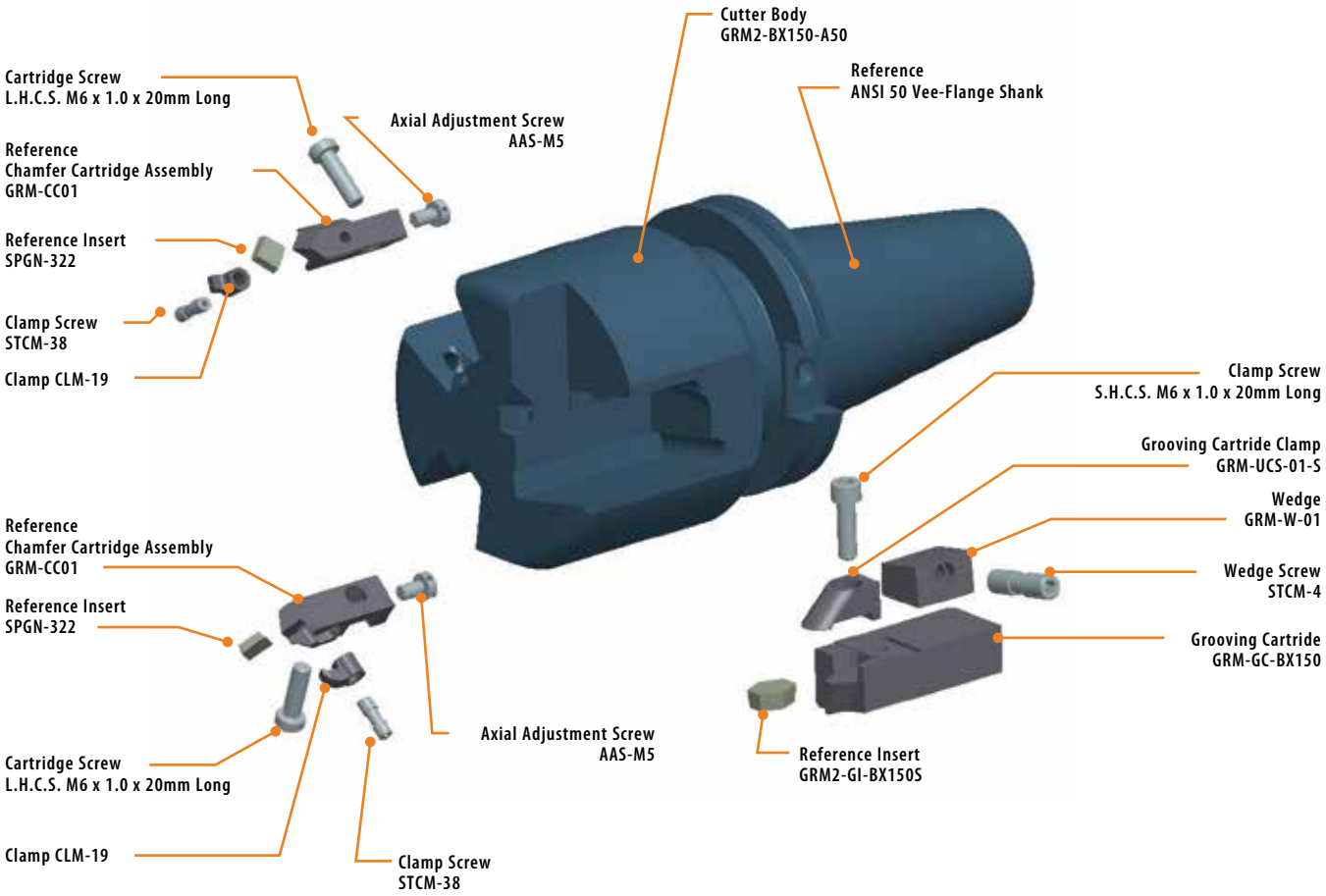
Ring Max™ II

Assembled and Exploded Views Reference Guide





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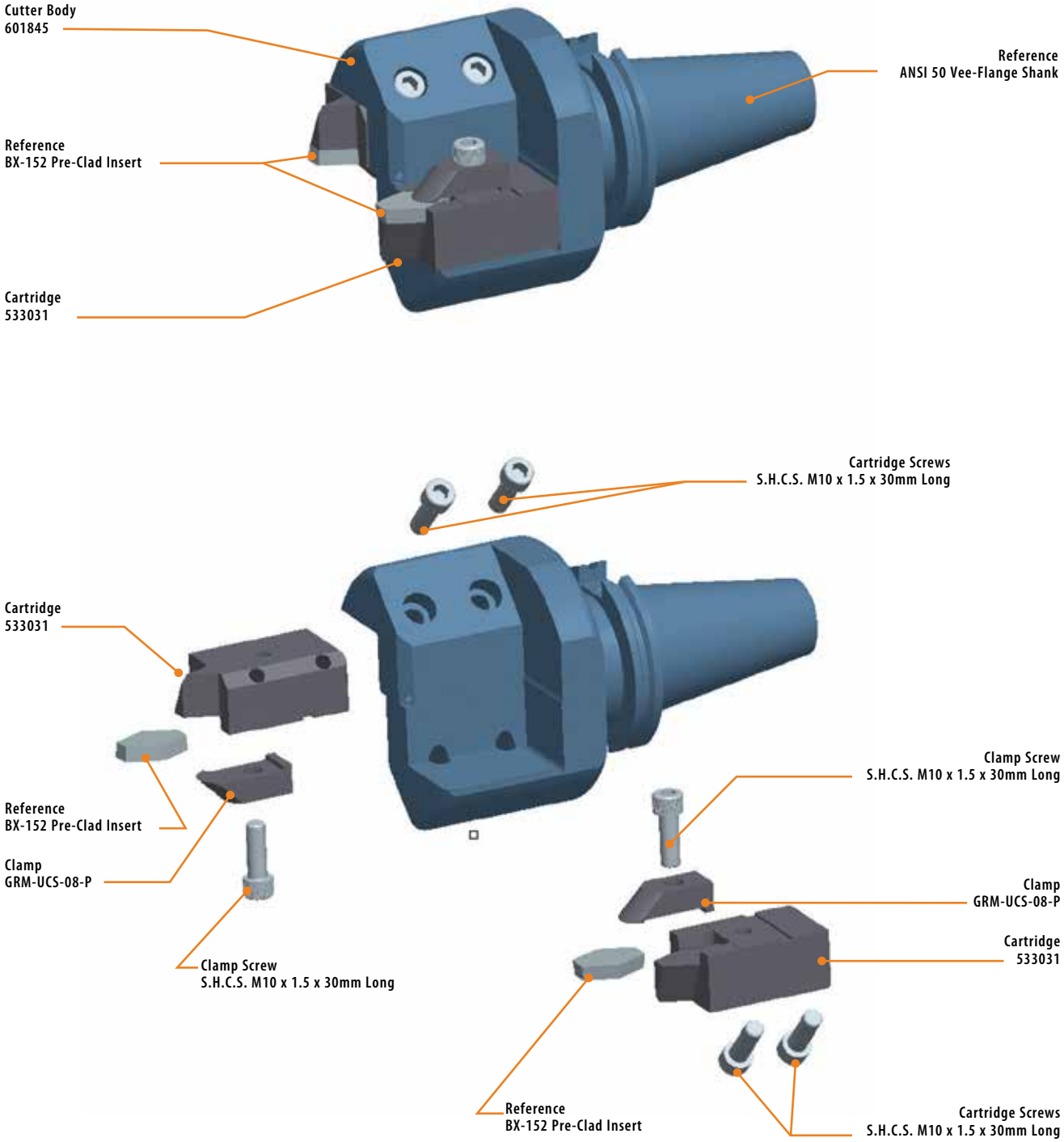
Ring Max™ BX-152 Pre-Clad

Assembled and Exploded Views Reference Guide



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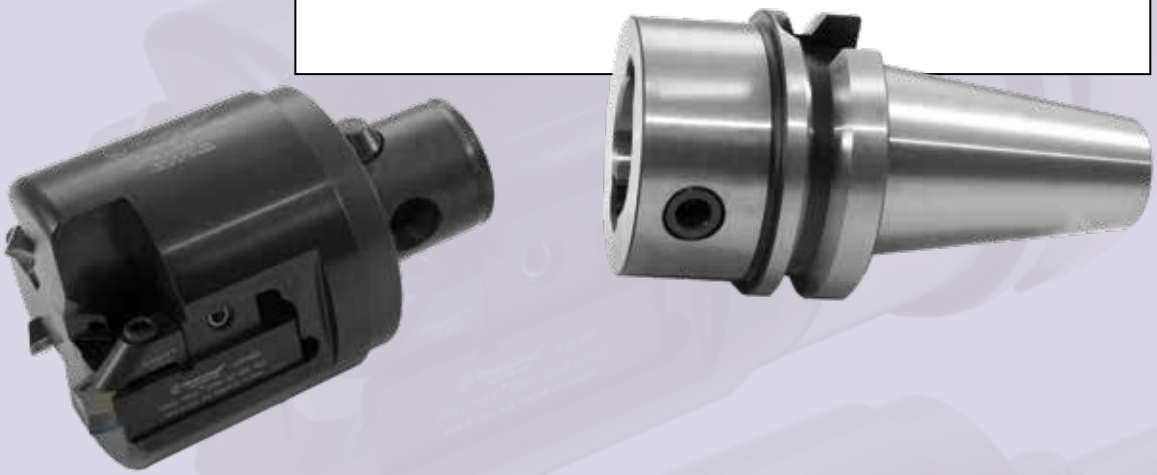
Ring Max™ III Ring Groove Tooling

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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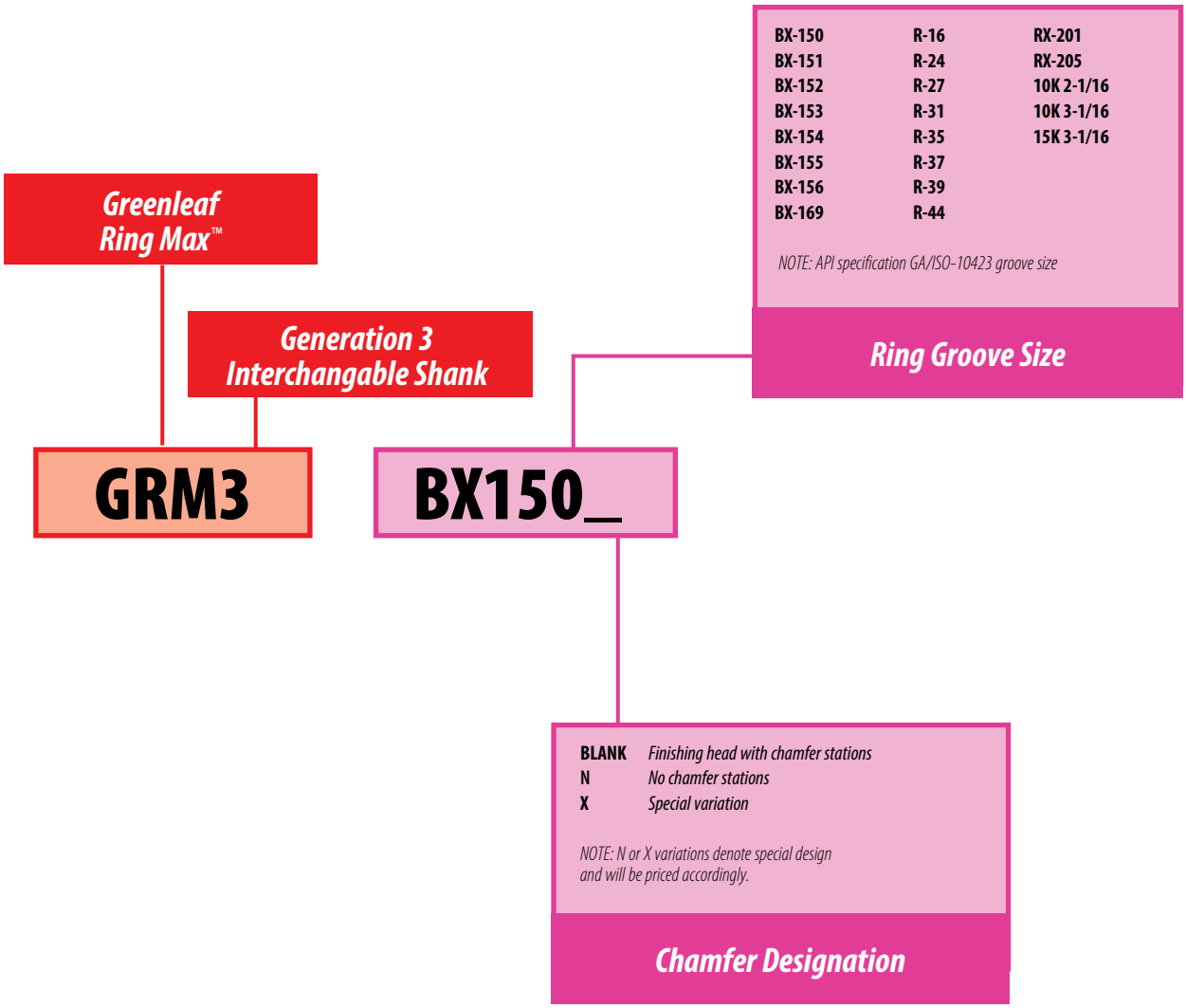
Ring Max™ III

Finishing Head Identification System



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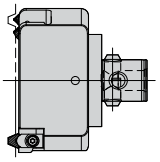
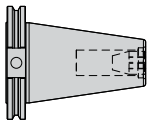
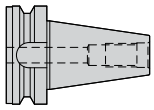
Pictorial & Reference Index

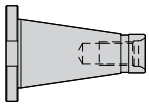
Ring Max™ III Tooling

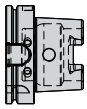


BX Series
R Series
RX Series
10/15K Series
page: RM 18

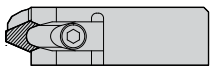




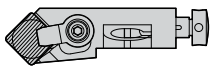




Ring Max™
Shank Options
page: RM 19



Ring Max™
Grooving Cartridge
page: RM 23



Ring Max™
Chamfer Cartridge
page: RM 24

Reference

Ring Max™ III
Models
page: RM 20

Ring Max™ III Pre-Clad
Models
page: RM 21

Machining Methods
Reference Guide
page: RM 30

Pre-Clad Head
Quote Request Form
page: RM 31

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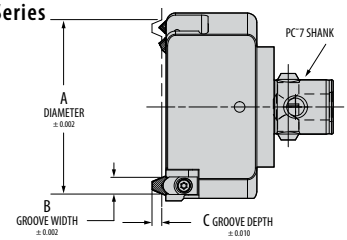
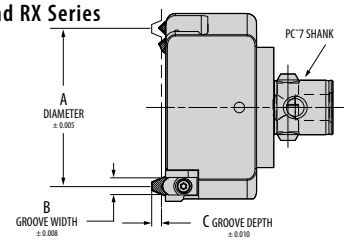
Ring Max™ III

BX Series / R Series / RX and 10/15K Series

BX and 10/15K Series



R and RX Series



	Part Number	Dimensions (mm)			Standard Components		Inserts	
	Groove Series - Shank Type*	A	B	C	Grooving Cartidge	Chamfer Cartidge	Grooving Insert	Chamfer Insert
BX Series	**GRM3-BX150**	73,53	11,48	5,84	GRM-GI-BX-150	GRMCC01	GRM-GI-BX150S	SPGN-322
	GRM3-BX151	77,83	11,89	5,84	GRM-GI-BX-151	GRMCC01	GRM-GI-BX151S	SPGN-322
	GRM3-BX152	86,28	12,70	6,10	GRM-GI-BX-152	GRMCC01	GRM-GI-BX152S	SPGN-322
	GRM3-BX153	102,82	14,12	7,11	GRM-GI-BX-153	GRMCC01	GRM-GI-BX153S	SPGN-322
	GRM3-BX154	119,05	15,44	7,87	GRM-GI-BX-154	GRMCC01	GRM-GI-BX154S	SPGN-322
	GRM3-BX155	150,67	17,78	8,64	GRM-GI-BX-155	GRMCC01	GRM-GI-BX155R	SPGN-322
	GRM3-BX169	176,71	16,97	9,91	GRM-GI-BX-169	GRMCC01	GRM-GI-BX169R	SPGN-322
R Series	**GRM3-R16**	50,80	8,74	6,35	GRM-GI-RSET 2 AX	GRMCC01	GRM-GI-RSET 2 SX	SPGN-322
	GRM3-R24	95,25	11,91	8,13	GRM-GI-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
	GRM3-R27	107,95	11,91	8,13	GRM-GI-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
	GRM3-R31	123,83	11,91	8,13	GRM-GI-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
	GRM3-R35	136,53	11,91	8,13	GRM-GI-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
	GRM3-R37	149,23	11,91	8,13	GRM-GI-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
	GRM3-R39	161,93	11,91	8,13	GRM-GI-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
	GRM3-R44	193,68	11,91	8,13	GRM-GI-RSET 1 X	GRMCC01	GRM-GI-RSET 1 SX	SPGN-322
RX and 10/15K Series	**GRM3-RX201N**	46,05	5,56	4,06	GRM-GIRX201/5-X	N/A	GRM-GI-RX201/5SX	N/A
	GRM3-RX205N	57,15	5,56	4,06	GRM-GIRX201/5-X	N/A	GRM-GI-RX201/5SX	N/A
	GRM3-10K2	117,42	9,58	6,55	GRM-GI10/15K-X	GRMCC01	GRM-GI-10/15KSX	SPGN-322
	GRM3-10K3N	146,00	9,58	6,55	GRM-GI10/15K-X	N/A	GRM-GI-10/15KSX	N/A
	GRM3-15K3	168,22	9,58	6,55	GRM-GI10/15K-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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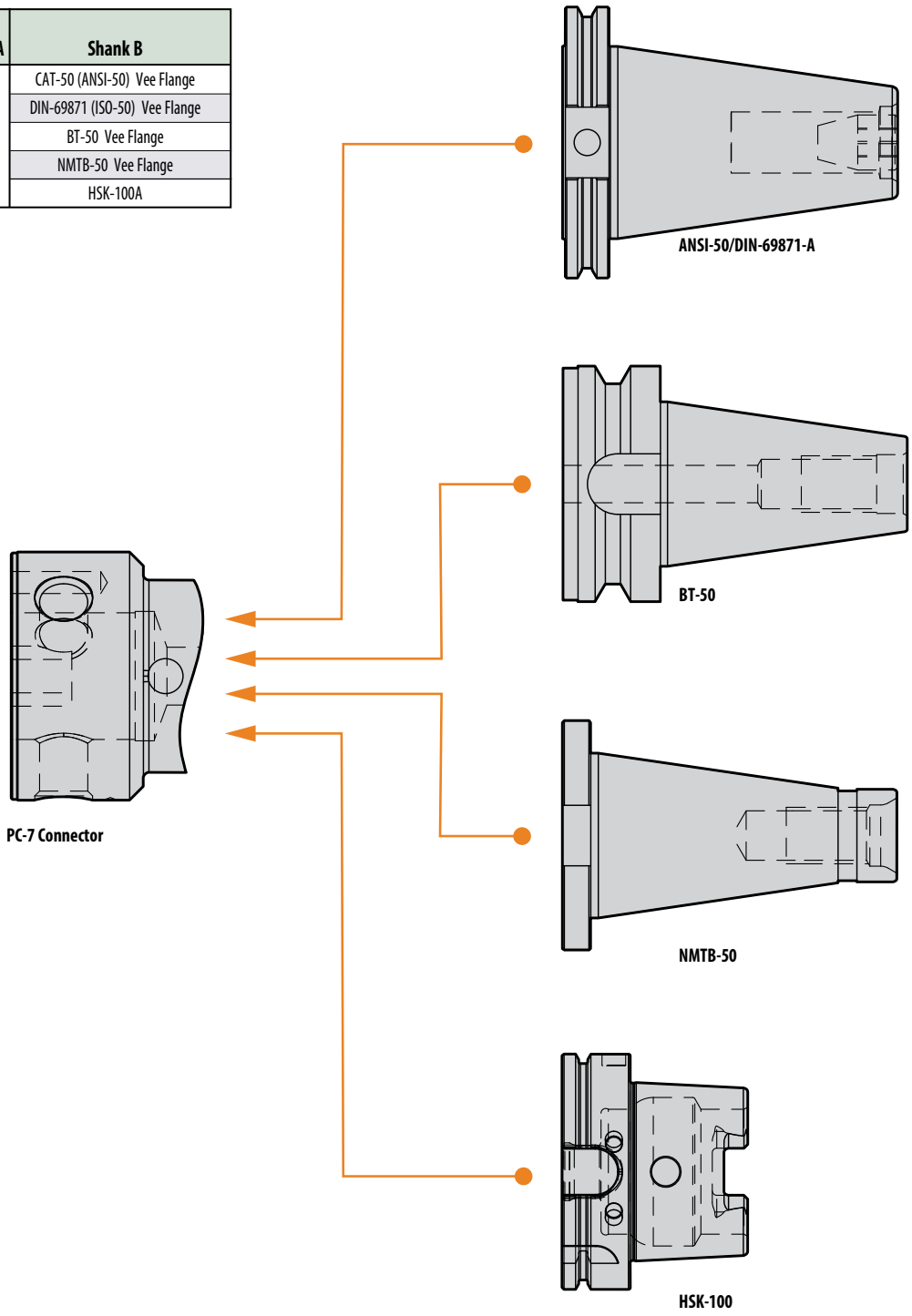
Ring Max™ III

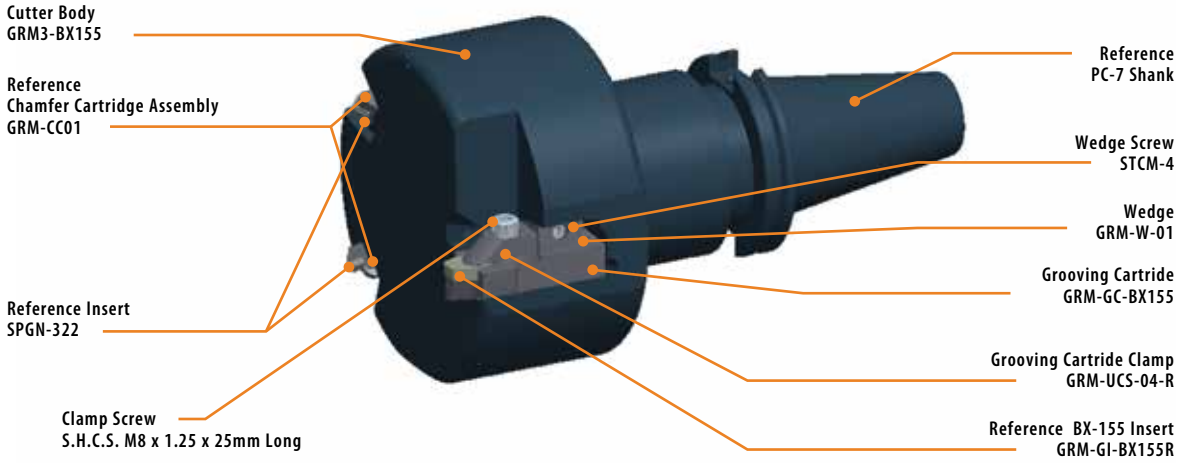
Shank Options

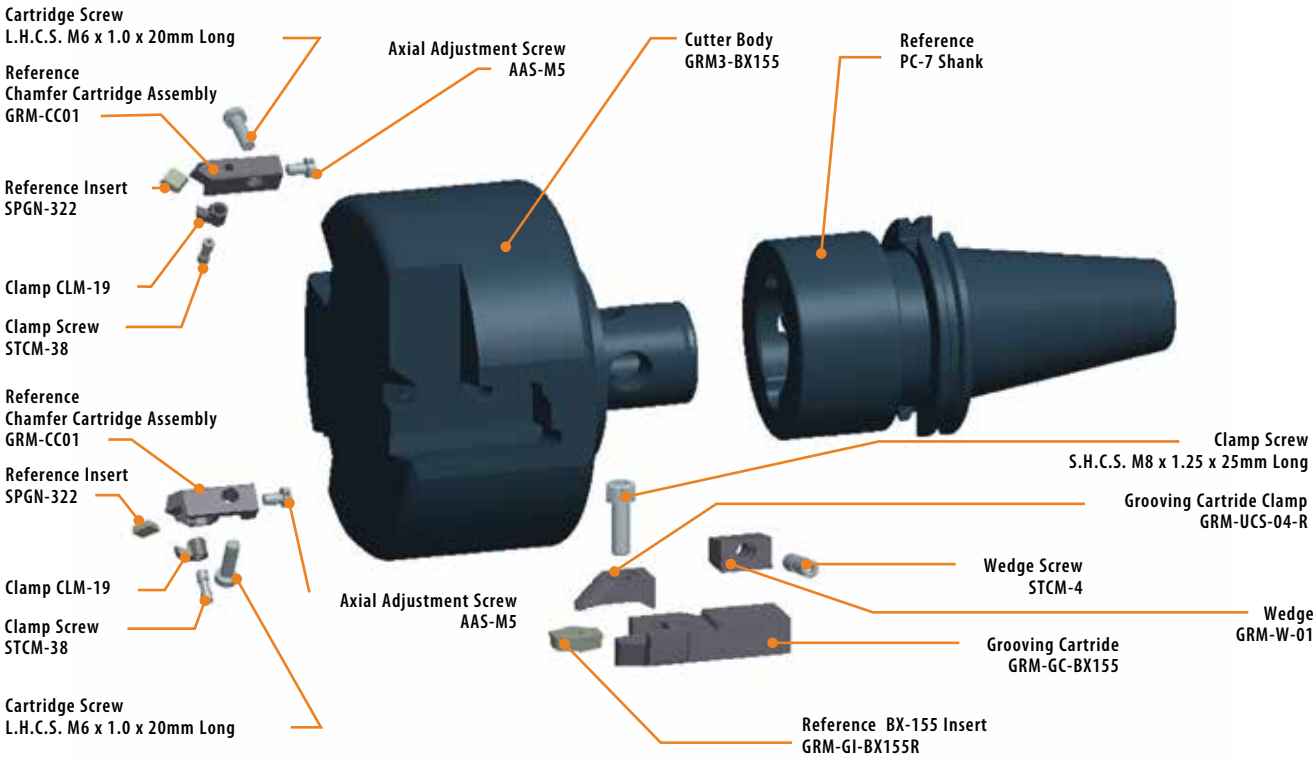
Adapter Designation	Shank A	Shank B
04-GRMA50-000	PC-7	CAT-50 (ANSI-50) Vee Flange
04-GRMA50-000		DIN-69871 (ISO-50) Vee Flange
04-GRMBT50-000		BT-50 Vee Flange
04-GRMNMTB50-000		NMTB-50 Vee Flange
04-GRMHSK100-000		HSK-100A



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

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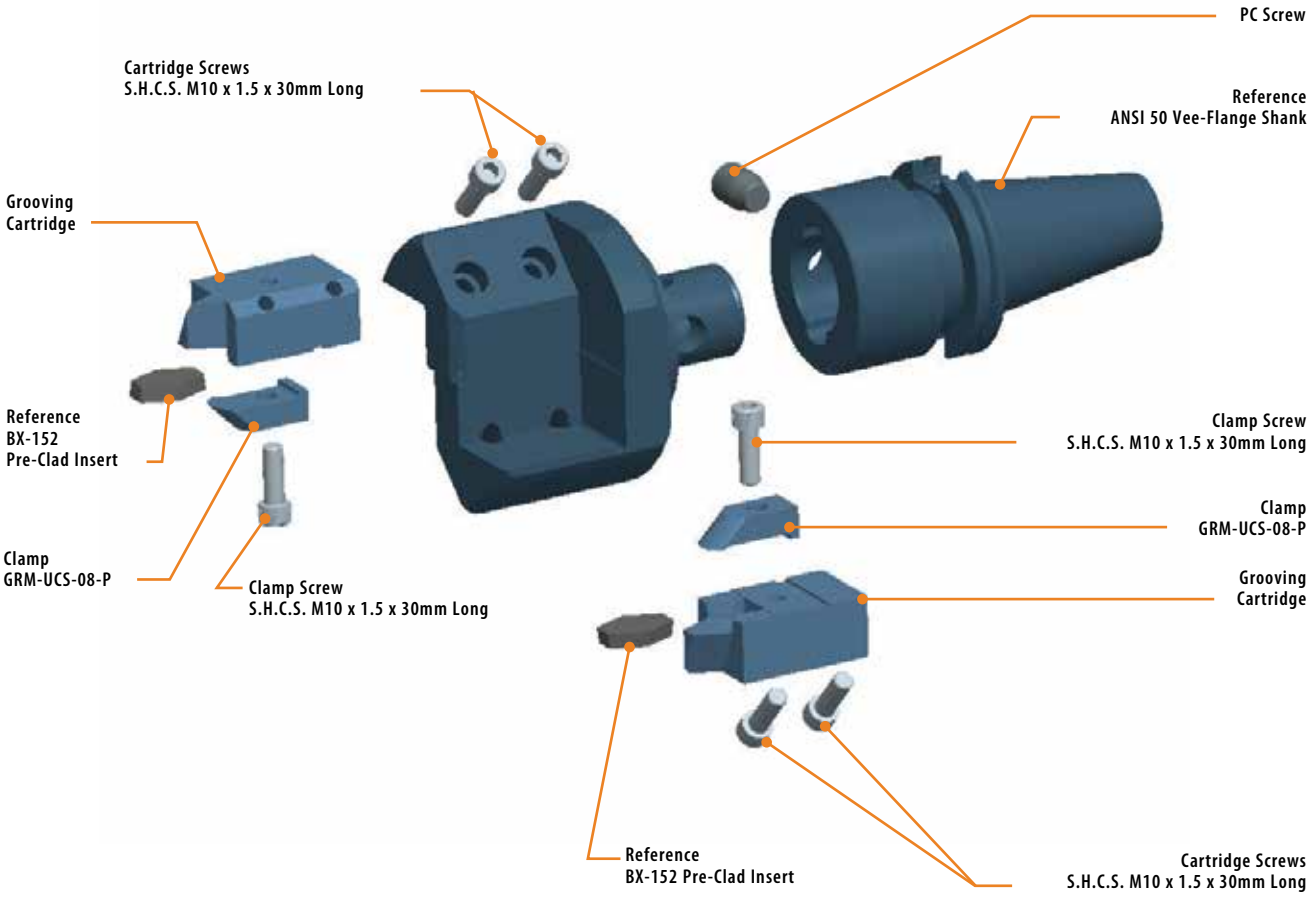
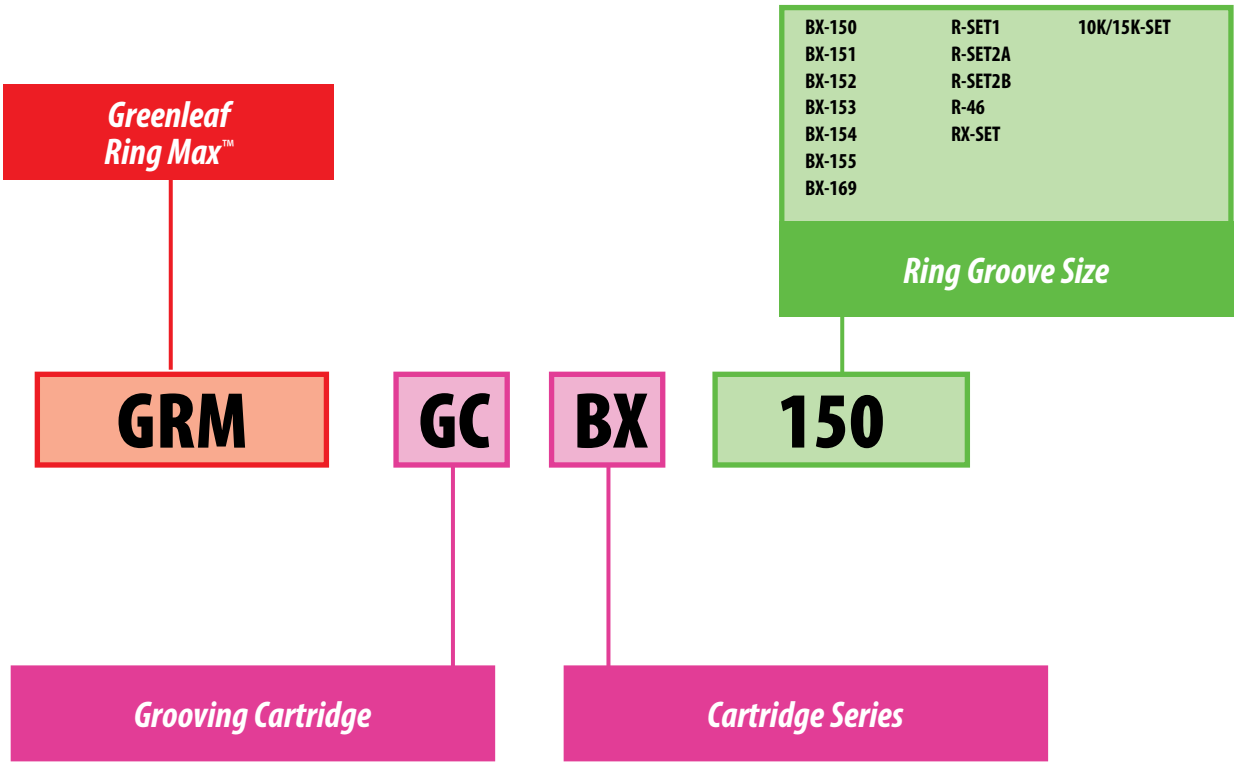


Ring Max™ III Pre-Clad Head Quote Request Form For information for a quote form you can download, see page RM 31.

Ring Max™

Grooving Cartridge Identification System



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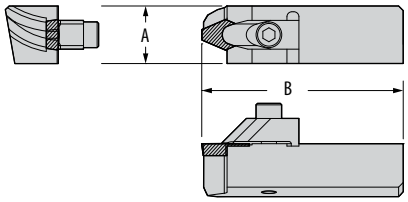


Ring Max™

Grooving Cartridge

Cartridge		Dimensions (mm)		Standard Components		Inserts
Groove Size	**Part Number**	**A**	**B**	**Clamp**	**Clamp Screw**	**Purchased Seperately**
BX-150	**GRM-GC-BX-150**	25,40	66,68	GRMUCS01S	M6-1.0 SHCS	GRM-GI-BX150S
BX-151	**GRM-GC-BX-151**	25,40	66,68	GRMUCS01S	M6-1.0 SHCS	GRM-GI-BX151S
BX-152	**GRM-GC-BX-152**	25,40	66,68	GRMUCS01S	M6-1.0 SHCS	GRM-GI-BX152S
BX-153	**GRM-GC-BX-153**	25,40	66,68	GRMUCS01S	M6-1.0 SHCS	GRM-GI-BX153S
BX-154	**GRM-GC-BX-154**	28,37	66,68	GRMUCS01S	M6-1.0 SHCS	GRM-GI-BX154S
BX-155	**GRM-GC-BX-155**	31,98	79,38	GRMUCS04R	M8-1.25 SHCS	GRM-GI-BX155R
BX-156	**GRM-GC-BX-156**	30,18	79,38	GRMUCS04R	M8-1.25 SHCS	GRM-GI-BX156R
BX-169	**GRM-GC-BX-169**	25,40	79,38	GRMUCS04R	M8-1.25 SHCS	GRM-GI-BX169R
R-SET1*	**GRM-GCRSET1-X**	25,40	79,38	GRMUCS03S	M6-1.0 SHCS	GRM-GI-RSET1SX
R-SET2A*	**GRM-GCRSET2A-X**	19,05	66,68	GRMUCS05S	M5-0.8 SHCS	GRM-GI-RSET2SX
R-SET2B*	**GRM-GCRSET2B-X**	25,40	66,68	GRMUCS03S	M5-0.8 SHCS	GRM-GI-RSET2SX
R-46	**GRM-GCR46**	25,40	79,38	GRMUCS04R	M8-1.25 SHCS	GRM-GI-R46R
RX-SET*	**GRM-GCRX201/5-X**	19,05	66,68	GRMUCS05S	M5-0.8 SHCS	GRM-GI-RX201/5SX
10/15K-SET*	**GRM-GC10/15-X**	25,40	66,68	GRMUCS05S	M5-0.8 SHCS	GRM-GI-10/15KSX

**** Denotes multiple groove sizes (See chart below.)***

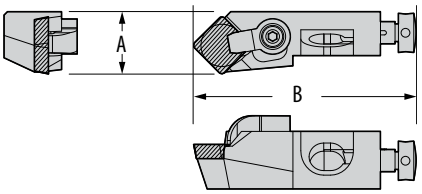
Multiple-Groove Compatibility

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 (mm)		Standard Components			Inserts	Mounting Screws
	A	B	Clamp	Clamp Screw	Adj. Screw	Purchased Seperately	Supplied with Grooving Head
GRM-CC01	14,00	50,06	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.

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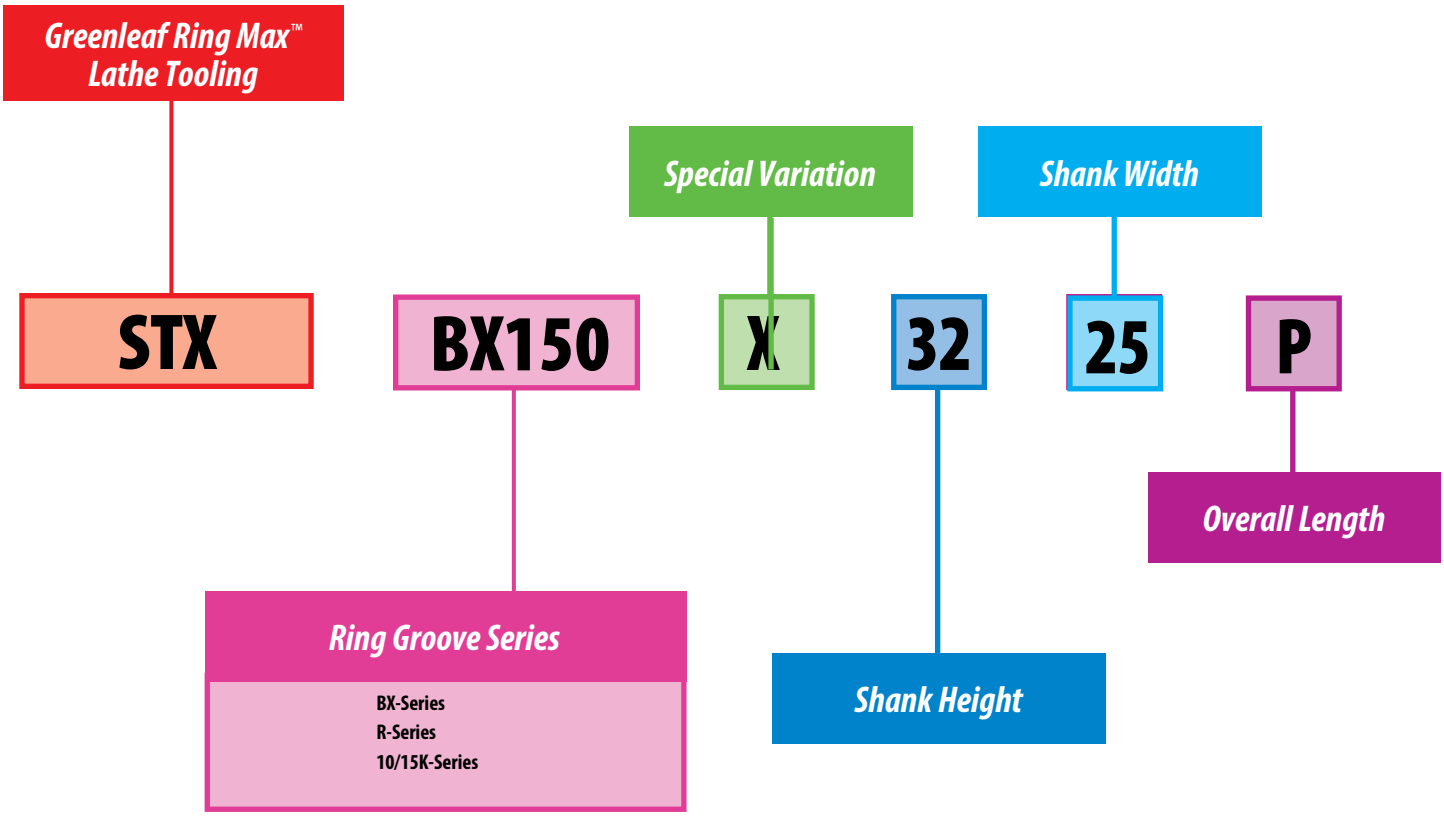
Ring Max™ STX

Lathe Tooling Identification System



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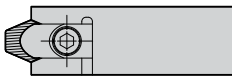
Pictorial & Reference Index

RING MAX™ Lathe Tooling



Reference

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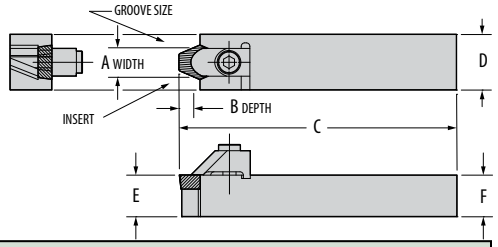
Ring Max™ STX

Lathe Tooling



Holder		Dimensions (inches)					
Groove Size	Part Number	A†	B†	C	D	E	F
BX-150	**STXBX1502525P**	11,48	5,84	170	25	25	25
	STXBX1503225P	11,48	5,84	170	25	32	32
BX-151	**STXBX1512525P**	11,89	5,84	170	25	25	25
	STXBX1513225P	11,89	5,84	170	25	32	32
BX-152	**STXBX1522525P**	12,70	6,10	170	25	25	25
	STXBX1523225P	12,70	6,10	170	25	32	32
BX-154	**STXBX1542525P**	15,44	7,87	170	25	25	25
	STXBX1543225P	15,44	7,87	170	25	32	32
BX-155	**STXBX1552525P**	17,78	8,64	170	25	25	25
	STXBX1553225P	17,78	8,64	170	25	32	32
BX-156	**STXBX1562525P**	23,44	11,43	170	25	25	25
	STXBX1563225P	23,44	11,43	170	25	32	32
BX-169	**STXBX1692525P**	16,97	9,91	170	25	25	25
	STXBX1693225P	16,97	9,91	170	25	32	32
R-SET1SX*	**STXRSET12525P**	11,91	8,13	170	25	25	25
	STXRSET13225P	11,91	8,13	170	25	32	32
R-SET2SX*	**STXRSET22525P**	8,74	6,35	170	25	25	25
	STXRSET23225P	8,74	6,35	170	25	32	32
R-46R	**STXR462525P**	13,49	9,91	170	25	25	25
	STXR463225P	13,49	9,91	170	25	32	32
10/15KSX*	**STX1015KX2525P**	9,58	6,55	170	25	25	25
	STX1015KX3225P	9,58	6,55	170	25	32	32

† 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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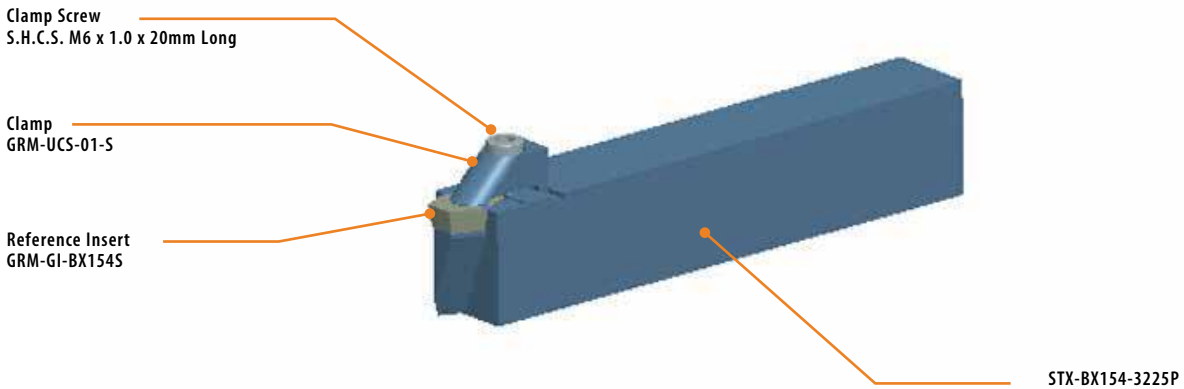
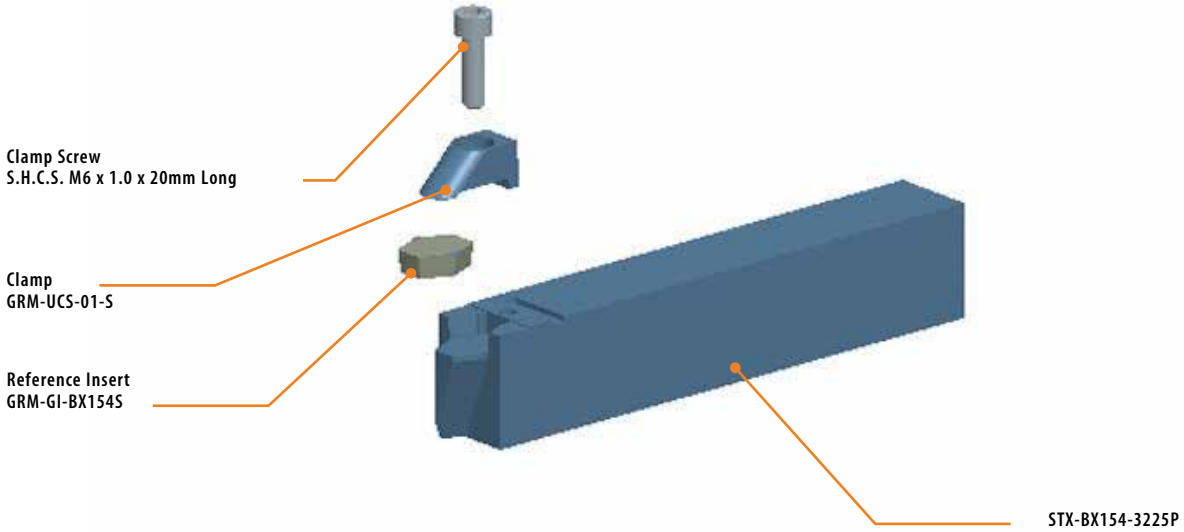
Ring Max™ STX

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.

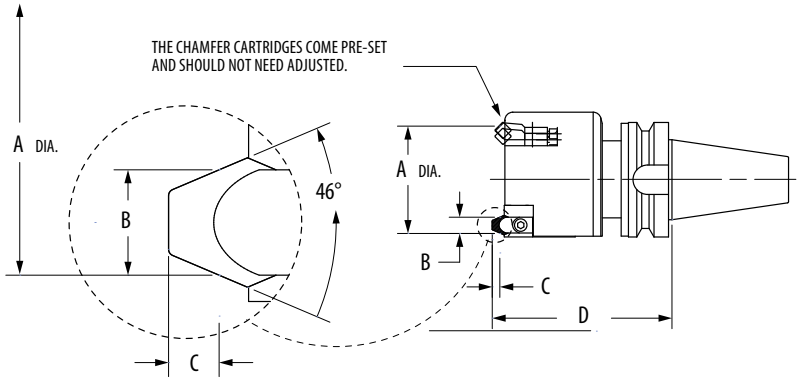
Step One:

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
86,233mm +0.10 −0.00	86,283mm	12,649mm +0.10 −0.00	5,84mm		

Method Two

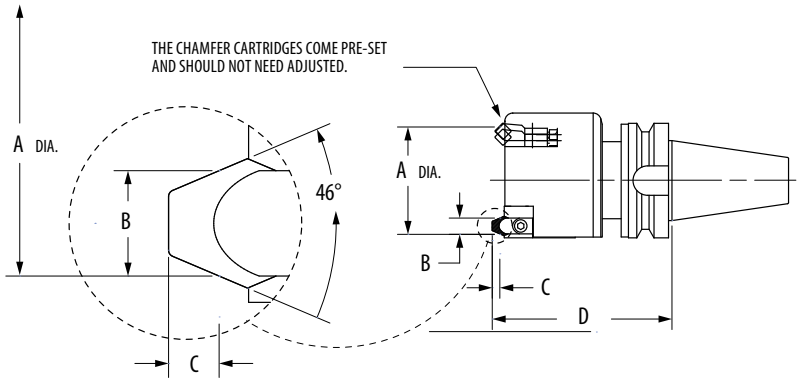
This method is used to machine ring grooves in a rough and finish pass.

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:
0.025mm	0.029mm
0.050mm	0.059mm
0.075mm	0.088mm
0.100mm	0.118mm
0.125mm	0.147mm
0.150mm	0.177mm
0.175mm	0.206mm
0.200mm	0.236mm
0.225mm	0.265mm
0.250mm	0.295mm
0.275mm	0.324mm
0.300mm	0.353mm

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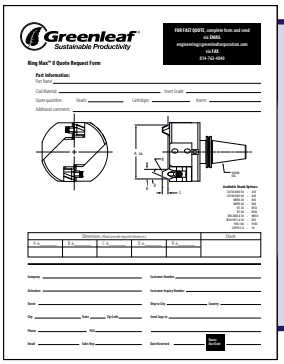

Ring Max™ II Quote Request Form

We have a Ring Max™ II Quote Request Form that you can download at —
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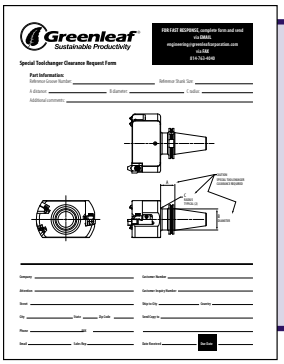
If you have any questions, contact the Greenleaf Tech Team at 800-458-1850,
or email the engineering department at engineering@greenleafcorporation.com.



Special Toolchanger Clearance Request Form

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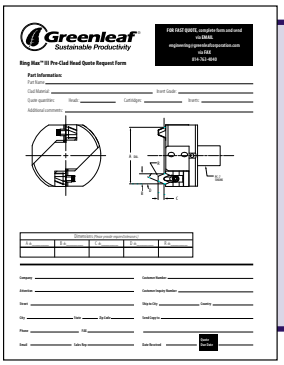

Ring Max™ III Pre-Clad Head Quote Request Form

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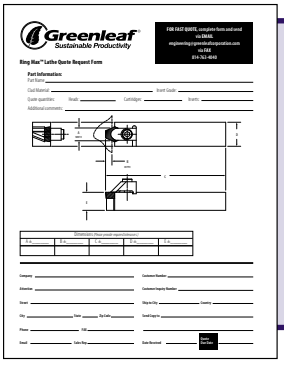
If you have any questions, contact the Greenleaf Tech Team at 800-458-1850,
or email the engineering department at engineering@greenleafcorporation.com.



Ring Max™ Lathe Quote Request Form

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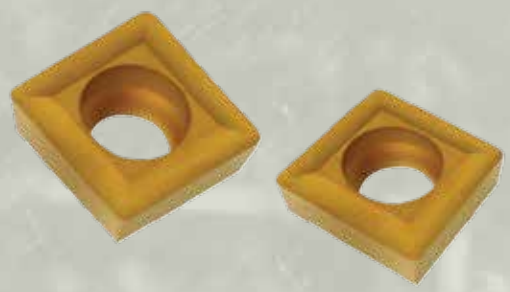
or email the engineering department at engineering@greenleafcorporation.com.

Indexable Drilling



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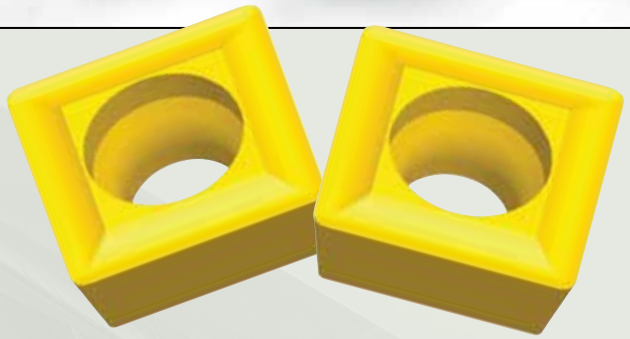
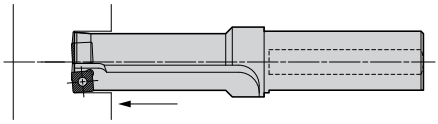
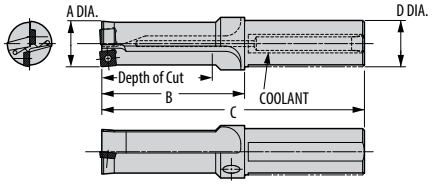
Indexable Drilling

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 from 24mm to 40mm diameters in increments of 1mm.



Holemill™ System





Part Number Right Hand	Gage				Dimensions (mm)					Standard Components	*Tune-Up Kit
	Insert Inboard	Qty	Insert Outboard	Qty	A	Depth of Cut	B	C	D	Insert Screw	
M-HM3X-24	SPMT-070308-X2	1	SPMT-070308-X2	1	24	72	99	164	32	PT-543-T	TK-00737
M-HM3X-25	SPMT-070308-X2	1	SPMT-070308-X2	1	25	75	104	169	32	PT-543-T	TK-00737
M-HM3X-26	SPMT-070308-X2	1	SPMT-09T308-X2	1	26	78	107	172	32	PT-543-T & PT-559-T	TK-02619
M-HM3X-27	SPMT-070308-X2	1	SPMT-09T308-X2	1	27	81	110	175	32	PT-543-T & PT-559-T	TK-02619
M-HM3X-28	SPMT-070308-X2	1	SPMT-09T308-X2	1	28	84	118	183	32	PT-588-T & PT-559-T	TK-02619
M-HM3X-29	SPMT-09T308-X2	1	SPMT-09T308-X2	1	29	87	121	186	32	PT-559-T	TK-00738
M-HM3X-30	SPMT-09T308-X2	1	SPMT-09T308-X2	1	30	90	124	189	32	PT-559-T	TK-00738
M-HM3X-31	SPMT-09T308-X2	1	SPMT-09T308-X2	1	31	93	127	192	32	PT-559-T	TK-00738
M-HM3X-32	SPMT-09T308-X2	1	SPMT-09T308-X2	1	32	96	135	200	32	PT-559-T	TK-00738
M-HM3X-33	SPMT-09T308-X2	1	SPMT-120408-X2	1	33	99	138	213	40	PT-559-T & PT-588-T	TK-00936
M-HM3X-34	SPMT-09T308-X2	1	SPMT-120408-X2	1	34	102	141	216	40	PT-559-T & PT-588-T	TK-00936
M-HM3X-35	SPMT-09T308-X2	1	SPMT-120408-X2	1	35	105	144	219	40	PT-559-T & PT-588-T	TK-00936
M-HM3X-36	SPMT-09T308-X2	1	SPMT-120408-X2	1	36	108	147	222	40	PT-559-T & PT-588-T	TK-00936
M-HM3X-37	SPMT-09T308-X2	1	SPMT-120408-X2	1	37	111	150	225	40	PT-559-T & PT-588-T	TK-00936
M-HM3X-38	SPMT-120408-X2	1	SPMT-120408-X2	1	38	114	153	228	40	PT-588-T	TK-00739
M-HM3X-39	SPMT-120408-X2	1	SPMT-120408-X2	1	39	117	156	231	40	PT-588-T	TK-00739
M-HM3X-40	SPMT-120408-X2	1	SPMT-120408-X2	1	40	120	159	234	40	PT-588-T	TK-00739

* *Tune-Up Kits include one complete set of standard components to allow you to refurbish the Holemill.*

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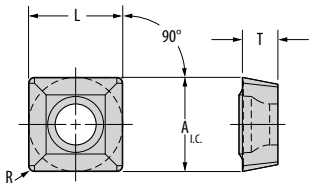
Holemill™ Inserts

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 (mm)			
			G-935	G-915	G-915	G-935	G-915	G-935	G-935	G-915		A	L	T	R
	SPMT-070308-X2	Inboard	◆	●	◆	●	◆	●	◆	●	SPMT-2.522-X2	7,92	7,92	3,18	0,79
	SPMT-070308-X2	Outboard	●	◆	●	◆	●	◆	●	◆	SPMT-2.522-X2	7,92	7,92	3,18	0,79
	SPMT-09T308-X2	Inboard	◆	●	◆	●	◆	●	◆	●	SPMT-32.52-X2	9,53	9,53	3,96	0,79
	SPMT-09T308-X2	Outboard	●	◆	●	◆	●	◆	●	◆	SPMT-32.52-X2	9,53	9,53	3,96	0,79
	SPMT-120408-X2	Inboard	◆	●	◆	●	◆	●	◆	●	SPMT-432-X2	12,70	12,70	4,75	0,79
	SPMT-120408-X2	Outboard	●	◆	●	◆	●	◆	●	◆	SPMT-432-X2	12,70	12,70	4,75	0,79

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 ❖

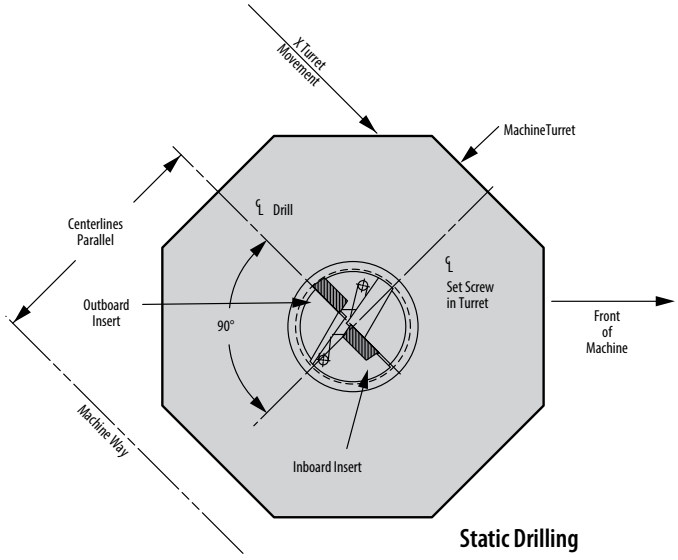
Grade descriptions *— pages ID 7*

Feed and Speed for Greenleaf Holemill™

Material	Hardness (HRc)	Vc (m/min)	Fn (mm/rev)	
			25,40 – 50 Dia.	50 – 80 Dia.
Low Carbon Steel / Free Machining 1010, 1018, 12L14	up to 25	140–305	0,1–0,2	0,13–0,25
High Carbon Steel 1080, 1541, Nitralloy, 52100	25-40	60–180	0,1–0,2	0,13–0,25
Alloy Steel 4140, 4340, 6150, 8620	15-30	120–275	0,1–0,2	0,13–0,25
Tool Steel A-6, D-2, P-20, H-13	up to 30	75–180	0,1–0,2	0,13–0,25
High-Temp Alloys Inconel, Hastelloy, Waspaloy, Stellite	up to 45	25–70	0,075–0,13	0,075–0,13
Stainless Steel 304, 316, 17-4PH	up to 32	75–170	0,075–0,18	0,1–0,2

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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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

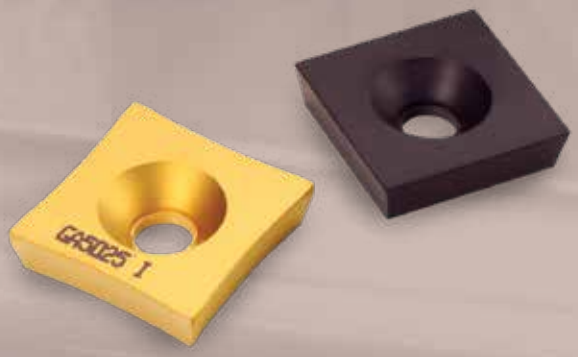
A multi-layer PVD-coated grade, G-915 is excellent for heat-resistant alloys, stainless steels, and low-carbon steels. The multi-layer PVD coating adds heat and abrasion resistance to the tough, impact-resistant substrate. G-915 should be used at moderate speeds and moderate to high feeds.

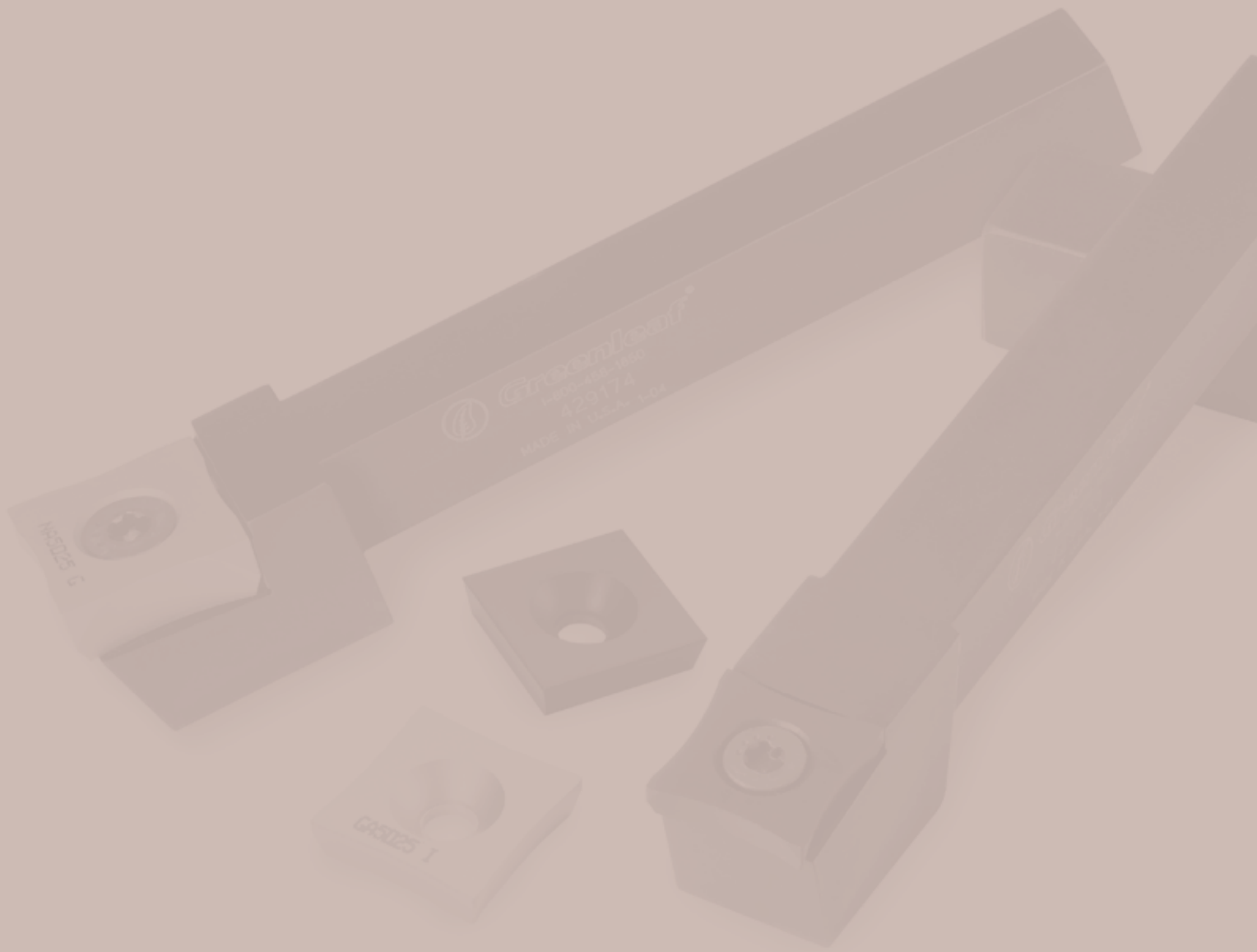
G-935

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.


Greenleaf
420174
428170
Greenleaf
428154

Tube Scarfing





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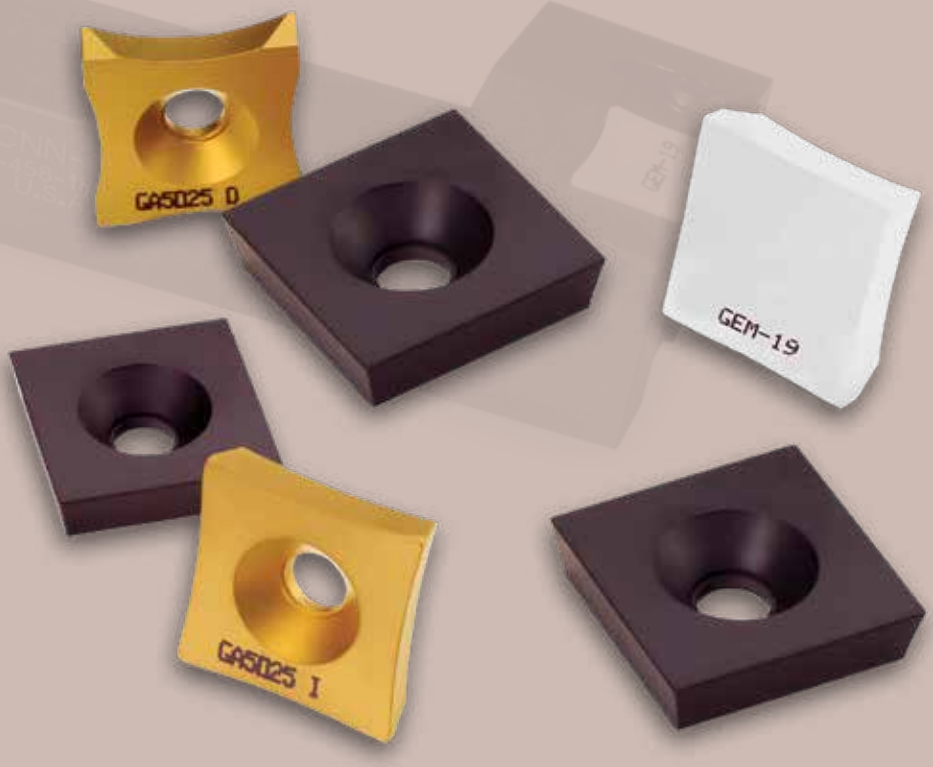
Tube Scarfing

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

Insert

S-SPUB-63
page: TS 06

S-SPUB-86
page: TS 06

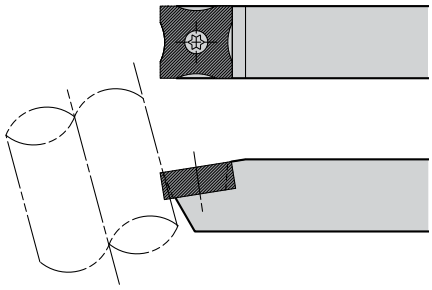
S-SGUB-63
page: TS 07

S-SNUN-46
page: TS 07

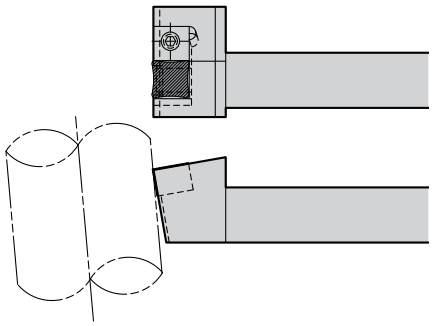
ID Scarfing
page: TS 08

Toolholders

M-SSCPS
page: TS 09



M-WSCNN
page: TS 09



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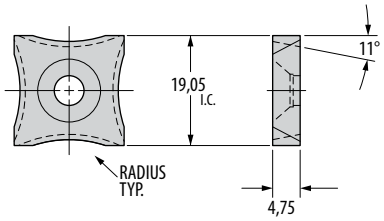
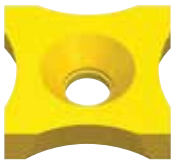
S-SPUB-63



Shape: Scarfing	Part Number	GA5023	GA5025	Dimensions (mm)	
				Tube Size	Radius
	S-SPUB-63-B	●	◆	Up to 22	12
	S-SPUB-63-C	●	◆	22–28	15
	S-SPUB-63-D	●	◆	28–38	20
	S-SPUB-63-R	●	◆	44	22
	S-SPUB-63-E	●	◆	38–47	25
	S-SPUB-63-F	●	◆	47–57	30
	S-SPUB-63-G	●	◆	57–79	40
	S-SPUB-63-H	●	◆	79–98	50
	S-SPUB-63-I	●	◆	98–123	63
	S-SPUB-63-J	●	◆	123–149	75
	S-SPUB-63-K	●	◆	149–174	88
	S-SPUB-63-L	●	◆	174–200	101
	* S-SPUB-63-M	●	◆	200 and Up	NONE
	S-SPUB-63-P	●	◆		152
	S-SPUB-63-S	●	◆		9,5

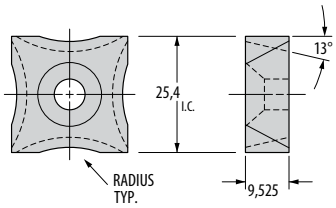
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated — First Choice ◆ Second Choice ● Alternative ▲ — *Grade descriptions — pages TS 04*

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

Note: Applicable for thin-wall pipe up to 6,35mm 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 127mm are available.

Shape: Scarfing	Part Number	GA5023	GA5025	Dimensions (mm)	
				Tube Size	Radius
	S-SPUB-86-B	●	◆	Up to 22	12
	S-SPUB-86-C	●	◆	22–28	15
	S-SPUB-86-D	●	◆	28–38	20
	S-SPUB-86-E	●	◆	38–47	25
	S-SPUB-86-F	●	◆	47–57	30
	S-SPUB-86-G	●	◆	57–79	40
	S-SPUB-86-H	●	◆	79–98	50
	S-SPUB-86-I	●	◆	98–123	63
	S-SPUB-86-J	●	◆	123–149	75
	S-SPUB-86-K	●	◆	149–174	88
	S-SPUB-86-L	●	◆	174–200	101
	* S-SPUB-86-M	●	◆	200 and Up	NONE
	S-SPUB-86-N	●	◆		127
	S-SPUB-86-S	●	◆		241
	S-SPUB-86-P	●	◆		158

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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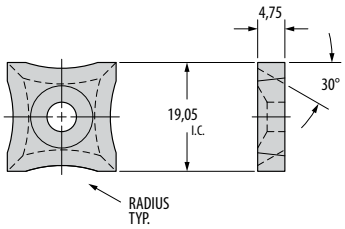
S-SGUB-63



Additional flank clearance for coated tube operations.

Shape: Scarfing	Part Number	GA5025	Dimensions (mm)	
			Tube Size	Radius
	S-SGUB-63-B	◆	Up to 22	12
	S-SGUB-63-C	◆	22–28	15
	S-SGUB-63-D	◆	28–38	20
	S-SGUB-63-E	◆	38–47	25
	S-SGUB-63-F	◆	47–57	30
	S-SGUB-63-G	◆	57–79	40
	S-SGUB-63-H	◆	79–98	50
	S-SGUB-63-I	◆	98–123	63
	S-SGUB-63-J	◆	123–149	75
	S-SGUB-63-K	◆	149–174	88
	S-SGUB-63-L	◆	174–200	101
	* S-SGUB-63-M	◆	200 and Up	NONE
	S-SGUB-63-R	◆	44	22
	S-SGUB-63-S	◆		9,5
	S-SGUB-63-P	◆		152

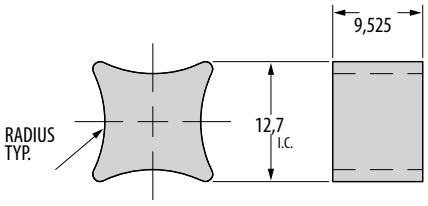
CARBIDE COATINGS: MT-CVD Coated | PVD Coated | Uncoated — First Choice ◆ Second Choice ● Alternative ▲ — *Grade descriptions — pages TS 04*

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



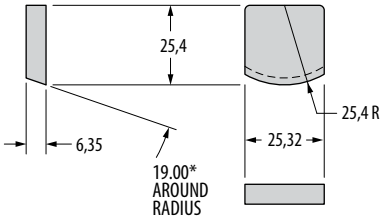
Shape: Scarfing	Part Number	GEM-19	Dimensions (mm)	
			Tube Size	Radius
	S-SNUN-46-B	◆	Up to 22	12
	S-SNUN-46-C	◆	22-28	15
	S-SNUN-46-D	◆	28-38	20
	S-SNUN-46-E	◆	38-47	25
	S-SNUN-46-F	◆	47-57	30
	S-SNUN-46-G	◆	57-79	40
	S-SNUN-46-H	◆	79-98	50

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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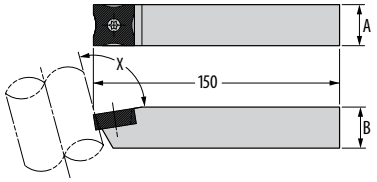
M-SSCPS

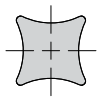


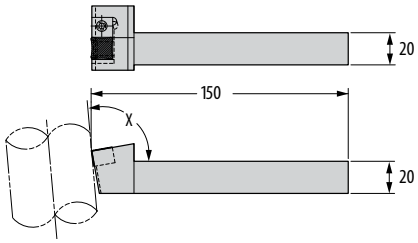
Part Number	Gage Insert	Angle X	Dimensions (inches) A	Dimensions (inches) B	Standard Component Insert Screw	Tune-Up Kit* Includes All Standard Components
M-SSCPS-2090	S-SPUB-63	90°	20	20	TORX SCREW #10-32 x 1/2 TFHCS	TK-00576
M-SSCPS-2095	S-SPUB-63	95°	20	20	TORX SCREW #10-32 x 1/2 TFHCS	TK-00576
M-SSCPS-20100	S-SPUB-63	100°	20	20	TORX SCREW #10-32 x 1/2 TFHCS	TK-00576
M-SSCPS-20105	S-SPUB-63	105°	20	20	TORX SCREW #10-32 x 1/2 TFHCS	TK-00576
M-SSCPS-2590	S-SPUB-86	90°	25	25	TORX SCREW 1/4-20 x 3/4 TFHCS	TK-00760
M-SSCPS-2595	S-SPUB-86	95°	25	25	TORX SCREW 1/4-20 x 3/4 TFHCS	TK-00760
M-SSCPS-25100	S-SPUB-86	100°	25	25	TORX SCREW 1/4-20 x 3/4 TFHCS	TK-00760
M-SSCPS-25105	S-SPUB-86	105°	25	25	TORX SCREW 1/4-20 x 3/4 TFHCS	TK-00760

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

M-WSCNN

Ceramic Insert Holder

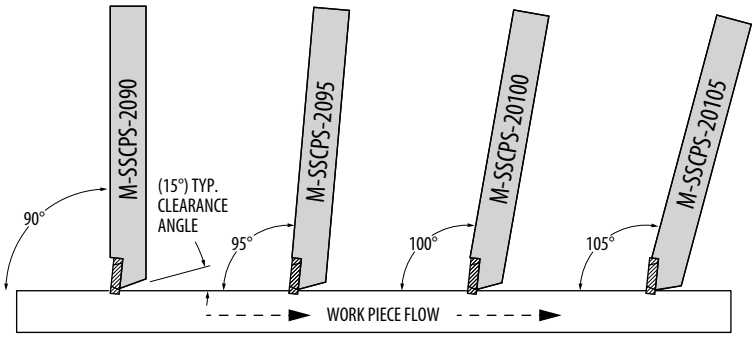




Part Number	Gage Insert	Angle X	Standard Component Wedge	Standard Component Wedge Screw	Tune-Up Kit* Includes All Standard Components
M-WSCNN-2090	S-SNUN-46	90°	313393	STCM-11	TK-02624
M-WSCNN-2095	S-SNUN-46	95°	313393	STCM-11	TK-02624
M-WSCNN-20100	S-SNUN-46	100°	313393	STCM-11	TK-02624
M-WSCNN-20105	S-SNUN-46	105°	313393	STCM-11	TK-02624

** 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.

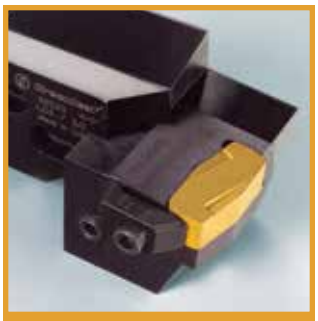
Special Tool Design Information Checklist

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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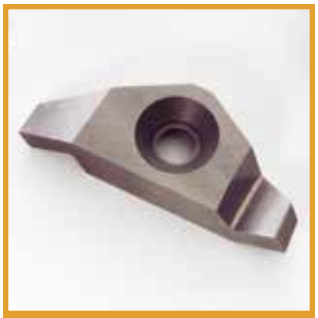
Dovetail Cutter



Heligroove Group

Hogmill

Hook Groove Holder

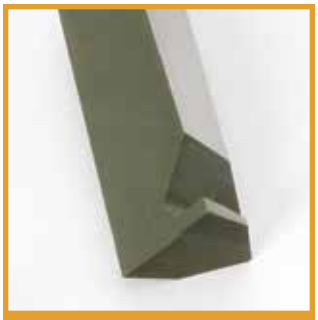
Long Shaft End Mill

Plungeface Cutter

Pod Bore Head

Special Form Insert

Roll Lathe Tool

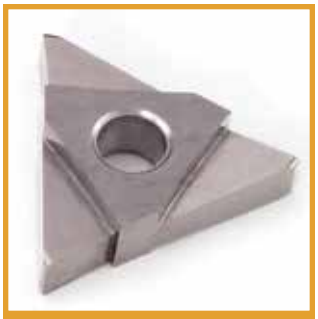


V-Bottom

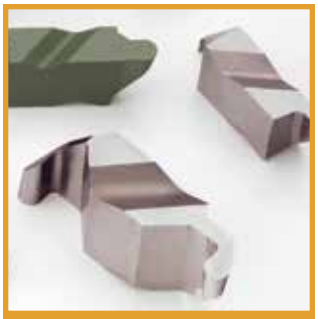
Aero Grooving Tools

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, 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.

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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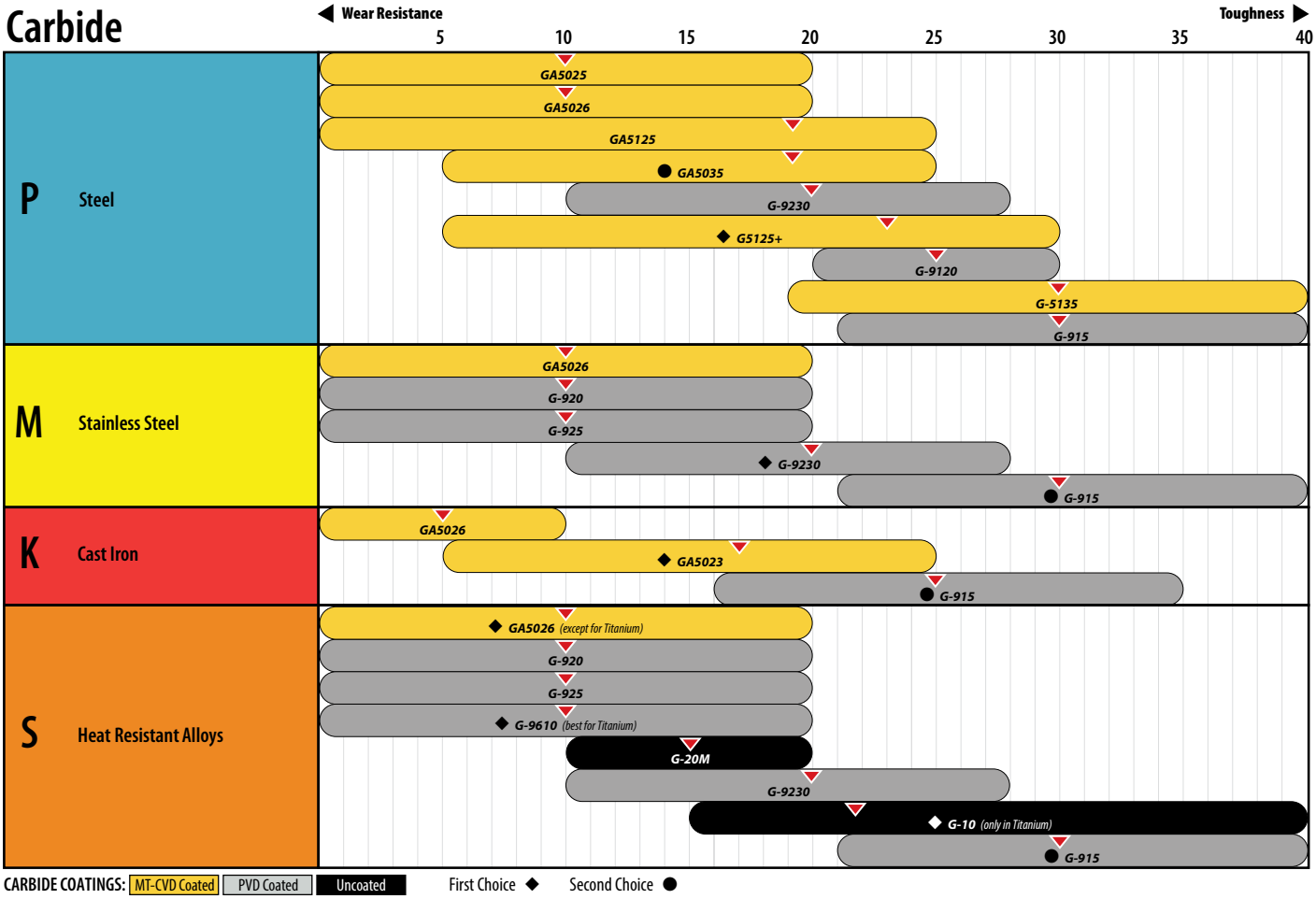
GA5025 D
GA5025
GA5D36
GA5125
G-915
G-9120
G-925

Insert Grade Reference

Carbide for Turning, Grooving, and Profiling



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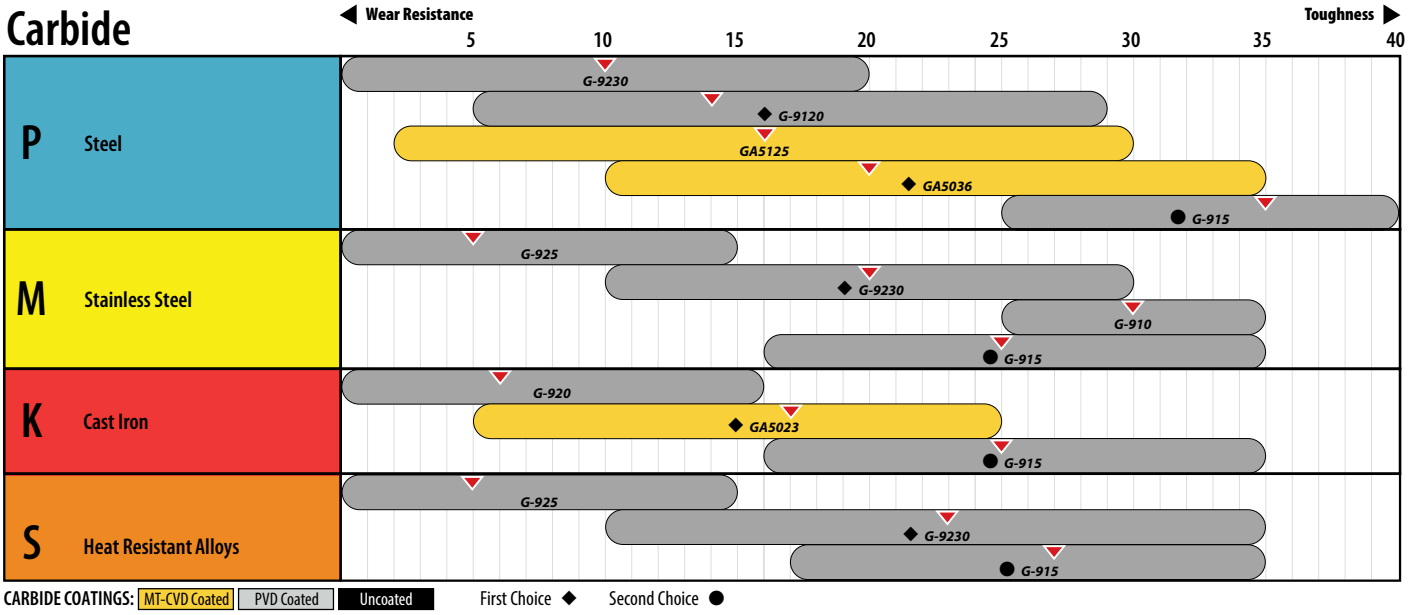
Insert Grade Reference

Carbide for Milling



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Carbide Grade Machining

Recommendations for Turning – Cutting Speed, mm/m

	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	305	275	275	245	215	230	200	185
	Alloy Steels	4340, 4140	20-25	245	220	220	200	170	185	160	150
	Tool Steels	A2, D2, S7	< 25	200	185	185	160	145	150	135	135
	Die Steels	H13, P20	< 25	200	185	185	160	145	150	135	135

	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	95	95	95	95	260	210	175	205	180
	Austenitic	*Austenite*	300 series (301, 303, 304, 304L, 309, 310, 316, 316L, 316Ti, 321), 200 series (201, 202, 204Cu, 205)	0-25	80	80	80	80	215	175	145	170	150
	Super-austenitic	*Austenite*	S31266, 904L, N08031, S34565, N08926, S31254, N0828, S32654, 1.4588	0-25	45	50	50	50	130	105	85	100	90
	Duplex	*Ferrite + Austenite*	F51 (1.4462), F53 (1.4410), F55 (1.4501), 255 (1.4507), CD3MN	0-25	55	55	55	55	150	125	100	120	105
	Martensitic	*Plate martensite (high-C)*	Quenched and tempered 400 series (416, 410, 420, 431)	30	90	90	90	90	235	195	160	185	165
				40	80	80	80	80	215	175	145	170	150
		Lath martensite (low-C)	Jethete M152										
	PH	*Austenite and/or Lath Martensite*	A286, PH14-8Mo, PH15-7Mo, 15-5PH, 15-7PH, 17-4PH, 17-7PH	35	45	45	45	45	120	100	80	95	85
				0-25	50	50	50	50	135	110	90	105	95
				35	45	45	45	45	120	100	80	95	85
				40-45	40	40	40	40	110	90	70	85	75

	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	135	350	305	185
	Nodular (Ductile) Cast Iron	GGG40 - GGG80 (EN-GJS-400 -- EN-GJS-800)	< 28	110	280	245	185
	Compacted Graphite Iron (CGI)	EN-GJV-300 -- EN-GJV-500	< 28	70	185	160	130
	Austempered Ductile Iron (ADI)	800 (EN-GJS-800-10	25-30	80	210	185	135
		1200 (EN-GS-1200-3)	35-40	60	160	135	105
		1600 (EN-GJS-HB450)	≥ 47	35	95	80	60

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Carbide Grade Machining

Recommendations for Turning – Cutting Speed, mm/m

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	380	275	230	-	-	610	550	505	505
Brass, Copper, Bronze	120	90	75	200	150	200	185	170	170

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	–	35	30	30	30	85	75	70	55	65	60
High-Strength	*Nickel or cobalt*	Inconel 718, Rene 220, C-263, Haynes 188, Haynes 282, FSX-414	0-25	35	30	30	30	85	75	70	55	65	60
			35	30	25	25	25	80	65	60	50	55	50
			40-45	25	20	20	20	65	60	55	45	50	45
			45-50	25	20	20	20	60	55	50	40	45	45
			50+	20	15	15	15	50	45	40	30	35	35
	Nickel	Waspaloy, RR1000, Rene 41-125, Udimet, GTD111-444, MM-247, C1023, IN100	0-25	30	25	25	25	80	65	60	50	55	50
			35	25	20	20	20	65	60	55	45	50	45
			40-45	25	20	20	20	50	55	50	40	45	45
			45-50	20	15	15	15	40	45	40	30	35	35
			50+	15	10	10	10	40	40	35	30	30	30
Wear-resistant	*Nickel or cobalt*	Stellite, Eutalloy, Metco, Wall Colmonoy, Weartech	20	30	25	25	25	85	75	70	55	65	60
			40	15	10	10	10	50	45	40	30	35	35
Titanium	*Alpha Ti*	Commercially pure, grades 1-4	–	50	40	40	40	-	100	90	70	85	80
		Ti-5Al2Sn, Ti-8Al1Mo1V	–	45	35	35	35	-	90	80	65	75	70
		Ti-5522, Ti-834, Ti-6242, Ti-6246, Ti 1100	–	40	30	30	30	-	80	70	55	65	60
	Alpha+Beta Ti	Ti-6Al4V, Ti-6Al6V2Sn, Ti-6Al7Nb	–	30	20	20	20	-	70	60	50	55	50
	Beta Ti	Ti-17, Ti-5553, Ti-10V2Fe3Al, Ti-8823	–	20	15	15	15	-	60	50	40	45	45

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	125	110	125	110	110	95	95	80
		50-55	95	85	95	85	85	75	75	65
Tool Steels	D2, M4, S7, A2	45-50	95	80	95	80	80	70	70	55
		50-55	75	65	75	65	65	55	55	45
Die Steels	H13, P20	45-50	125	110	125	110	110	95	95	80
		50-55	95	85	95	85	85	75	75	65

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Carbide Grade Machining

Recommendations for Milling – Cutting Speed, mm/m

	Type	Common Alloys	HRc	MT-CVD	PVD			
					< Wear Resistance			Toughness >
Steel (P)				GA5036	G-9120	G-955	G-935	G-915
	Soft Steel	A36,1018, 8620,1045	< 25	245	305	250	250	230
	Alloy Steels	4340, 4140	20-25	200	260	215	215	190
	Tool Steels	A2, D2, S7	< 25	185	215	190	190	175
	Die Steels	H13, P20	< 25	185	215	190	190	175

	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	125	110	110	110	305	260	205	250	210
	Austenitic	*Austenite*	300 series (301, 303, 304, 304L, 309, 310, 316, 316L, 316Ti, 321), 200 series (201, 202, 204Cu, 205)	0-25	105	90	90	90	255	215	170	210	175
	Super-austenitic	*Austenite*	S31266, 904L, N08031, S34565, N08926, S31254, N0828, S32654, 1.4588	0-25	65	55	55	55	155	130	100	125	105
	Duplex	*Ferrite + Austenite*	F51 (1.4462), F53 (1.4410), F55 (1.4501), 255 (1.4507), CD3MN	0-25	75	65	65	65	180	150	120	145	125
	Martensitic	*Plate martensite (high-C)*	Quenched and tempered 400 series (416, 410, 420, 431)	30	115	100	100	100	280	235	185	230	195
				40	105	90	90	90	255	215	170	210	175
		Lath martensite (low-C)	Jethete M152	35	60	50	50	50	145	120	95	115	100
	PH	*Austenite and/or Lath Martensite*	A286, PH14-8Mo, PH15-7Mo, 15-5PH, 15-7PH, 17-4PH, 17-7PH	0-25	65	55	55	55	160	135	105	130	110
				35	60	50	50	50	145	120	95	115	100
				40-45	50	45	45	45	130	110	85	105	90

	Type	Common Alloys	HRc	MT-CVD	PVD
				GA5023	G-915
Cast Iron (K)	**Lamellar (Grey) Cast Iron**	GG15, GG25, GG35 (EN-GJL-150, EN-GJL-250, EN-GJL-350)	< 32	185	380 230
	Nodular (Ductile) Cast Iron	GGG40 - GGG80 (EN-GJS-400 -- EN-GJS-800)	< 28	185	305 230
	Compacted Graphite Iron (CGI)	EN-GJV-300 -- EN-GJV-500	< 28	130	200 160
	Austempered Ductile Iron (ADI)	800 (EN-GJS-800-10	25-30	135	230 170
		1200 (EN-GS-1200-3)	35-40	105	170 130
		1600 (EN-GJS-HB450)	≥ 47	60	105 80

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Carbide Grade Machining

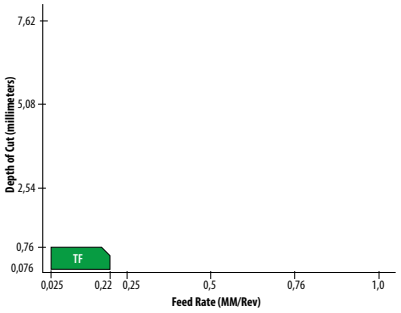
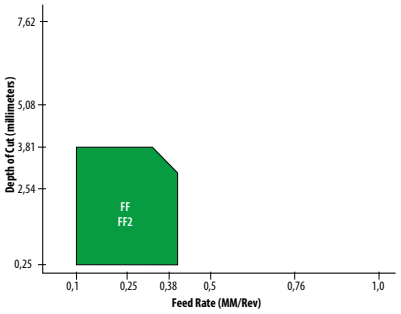
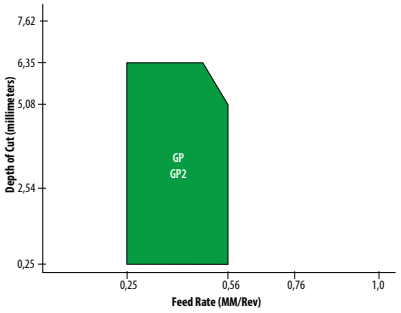
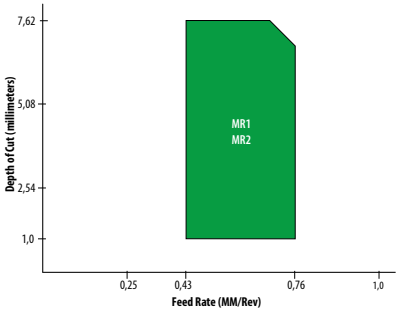
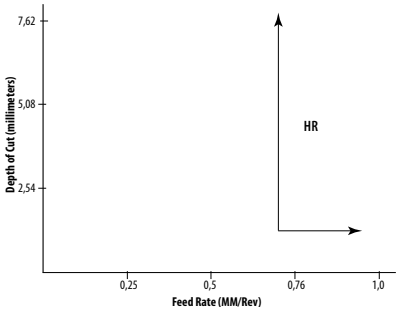
Recommendations for Milling – Cutting Speed, mm/m

	Type	Uncoated	PVD	
			< Wear Resistance	Toughness >
		G-01M	G-9230	G-915
Non-Ferrous (N)	Aluminum Alloys	365	610	610
	Brass, Copper, Bronze	120	200	205

	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
Heat-Resistant Super Alloys (S)	Corrosion-Resistant	*Nickel or iron*	Inconel 625, Incoloy 825, Hastelloy, Monel	–	40	35	35	35	100	90	85	65	80	70
	High-Strength	*Nickel or cobalt*	Inconel 718, Rene 220, C-263, Haynes 188, Haynes 282, FSX-414	0-25	40	35	35	35	100	90	85	65	80	70
				35	35	30	30	30	95	80	70	60	65	60
				40-45	30	25	25	25	80	70	65	55	60	55
				45-50	30	25	25	25	70	65	60	50	55	55
				50+	25	20	20	20	60	55	50	35	40	40
		Nickel	Waspaloy, RR1000, Rene 41-125, Udimet, GTD111-444, MM-247, C1023, IN100	0-25	35	30	30	30	95	80	70	60	65	60
				35	30	25	25	25	80	70	65	55	60	55
				40-45	30	25	25	25	60	65	60	50	55	55
				45-50	25	20	20	20	50	55	50	35	40	40
				50+	20	10	10	10	50	50	40	35	35	35
	Wear-resistant	*Nickel or cobalt*	Stellite, Eutalloy, Metco, Wall Colmonoy, Weartech	20	35	30	30	30	100	90	85	65	80	70
				40	20	10	10	10	60	55	50	35	40	40
	Titanium	*Alpha Ti*	Commercially pure, grades 1-4	–	60	50	50	50	–	120	110	85	100	95
			Ti-5Al2Sn, Ti-8Al1Mo1V	–	55	40	40	40	–	110	95	80	90	85
			Ti-5522, Ti-834, Ti-6242, Ti-6246, Ti 1100	–	50	35	35	35	–	95	85	65	80	70
		Alpha+Beta Ti	Ti-6Al4V, Ti-6Al6V2Sn, Ti-6Al7Nb	–	35	25	25	25	–	85	70	60	65	60
		Beta Ti	Ti-17, Ti-5553, Ti-10V2Fe3Al, Ti-8823	–	25	20	20	20	–	70	60	50	55	55

	Type	Common Alloys	HRc	MT-CVD		PVD		
				< Wear Resistance	Toughness >	< Wear Resistance		Toughness >
				GA5026	GA5025	G5125+	GA5035	GA5125
Hardened Steel (H)	Alloy Steels	4340, 4140, 2550	45-50	125	110	125	110	110
			50-55	95	85	95	85	85
	Tool Steels	D2, M4, S7, A2	45-50	95	80	95	80	80
			50-55	75	65	75	65	65
	Die Steels	H13, P20	45-50	125	110	125	110	110
			50-55	95	85	95	85	85

Chipform Application Range

PRECISION FINISHING	TF		Precision ground chipbreaker for nickel alloys. Good for feeds up to 0,22/rev and depths to 0,76.	
FINISHING	FF and FF2		For finishing all types of material. Designed for feeds up to 0,47/rev and 3,81 depth of cut.	
GENERAL PURPOSE	GP and GP2		General purpose chipbreaker. Feed rates up to 0,56/rev and 6,35 depth of cut.	
MEDIUM ROUGHING	MR and MR2		Used for medium roughing of all material. Feeds up to 0,71/rev and depths up to 7,62.	
HEAVY ROUGHING	HR		Heavy roughing for all materials. Feeds above 0,58/rev. One-sided chipbreaker for heaviest feeds (MM). *Example: CNMM-190612 HR*	

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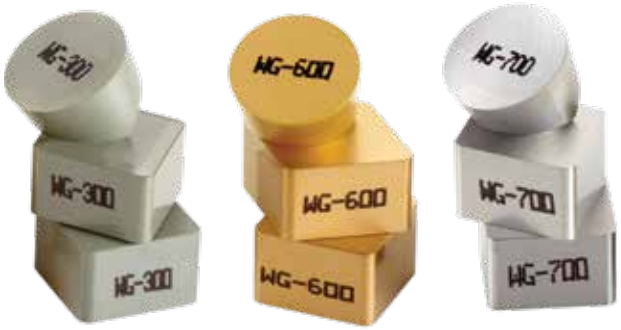
Insert Grades

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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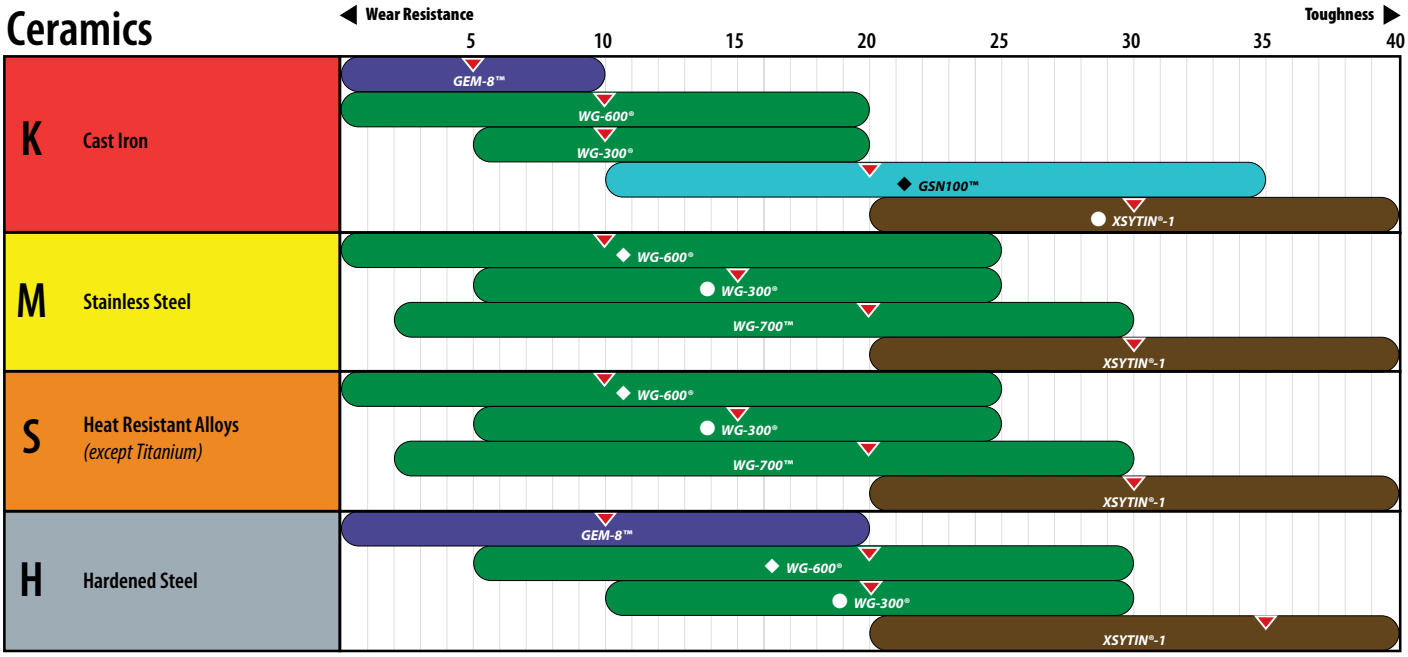
Insert Grade Reference

Ceramic for Turning, Grooving, and Profiling



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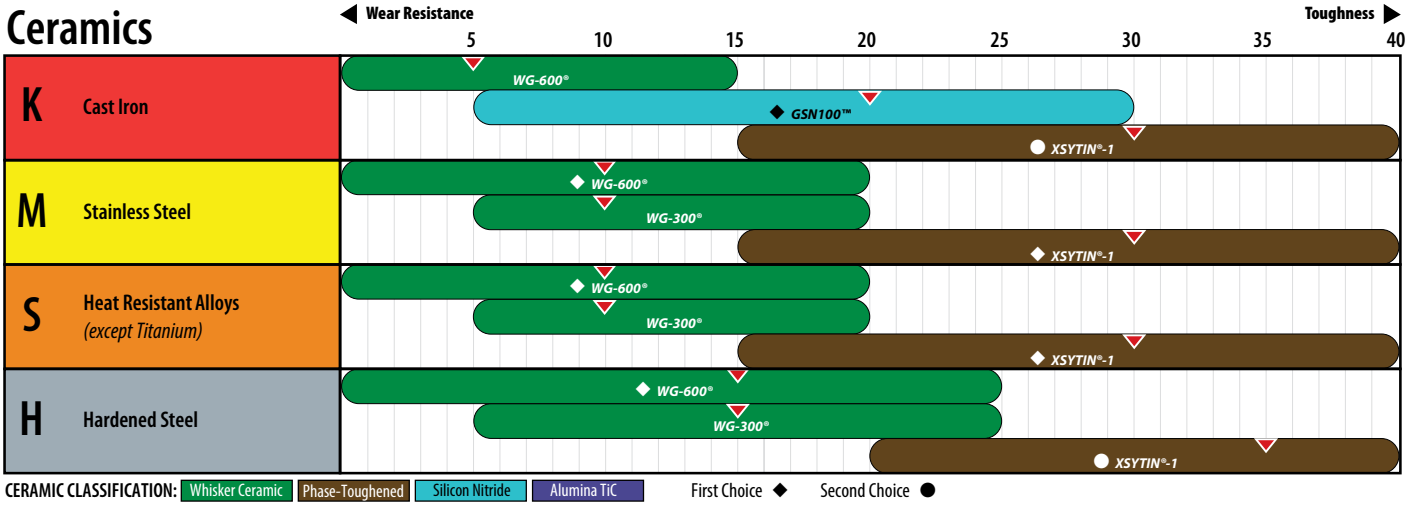
Insert Grade Reference

Ceramic for Milling



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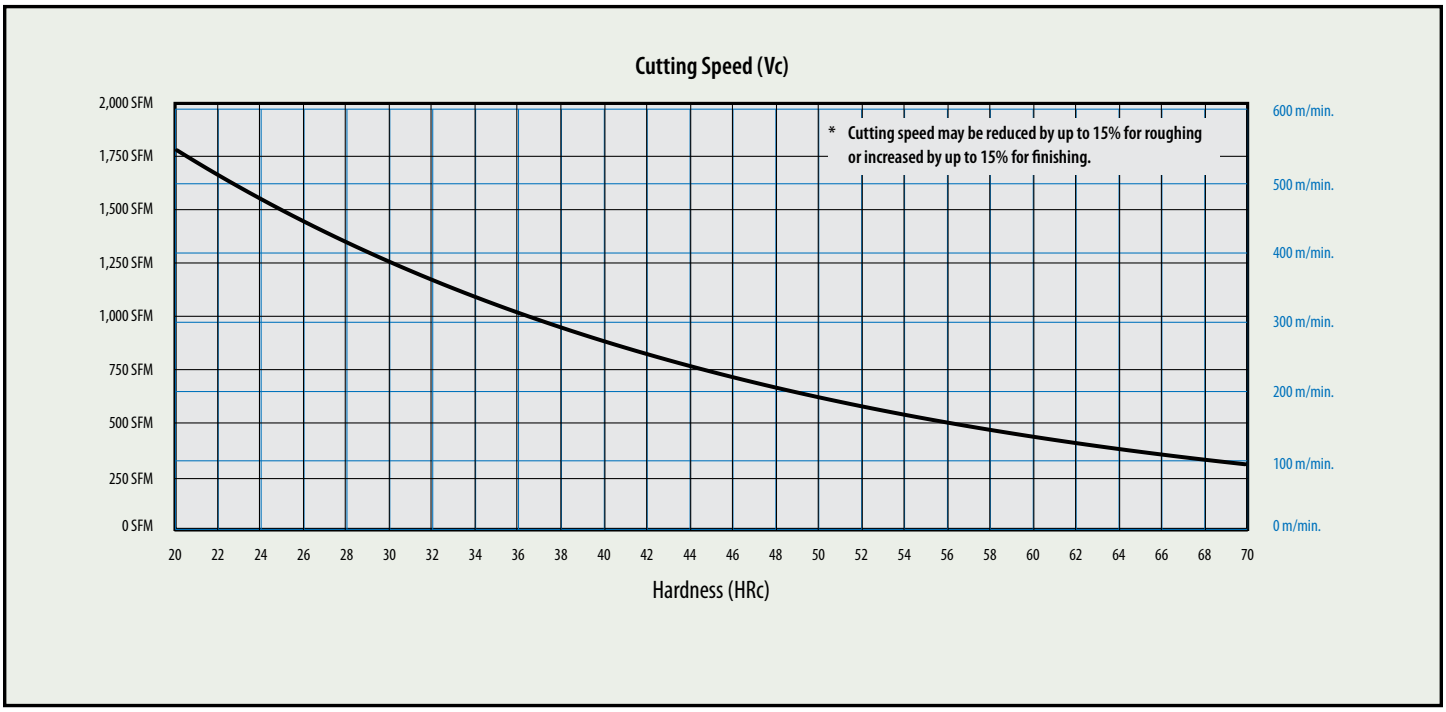
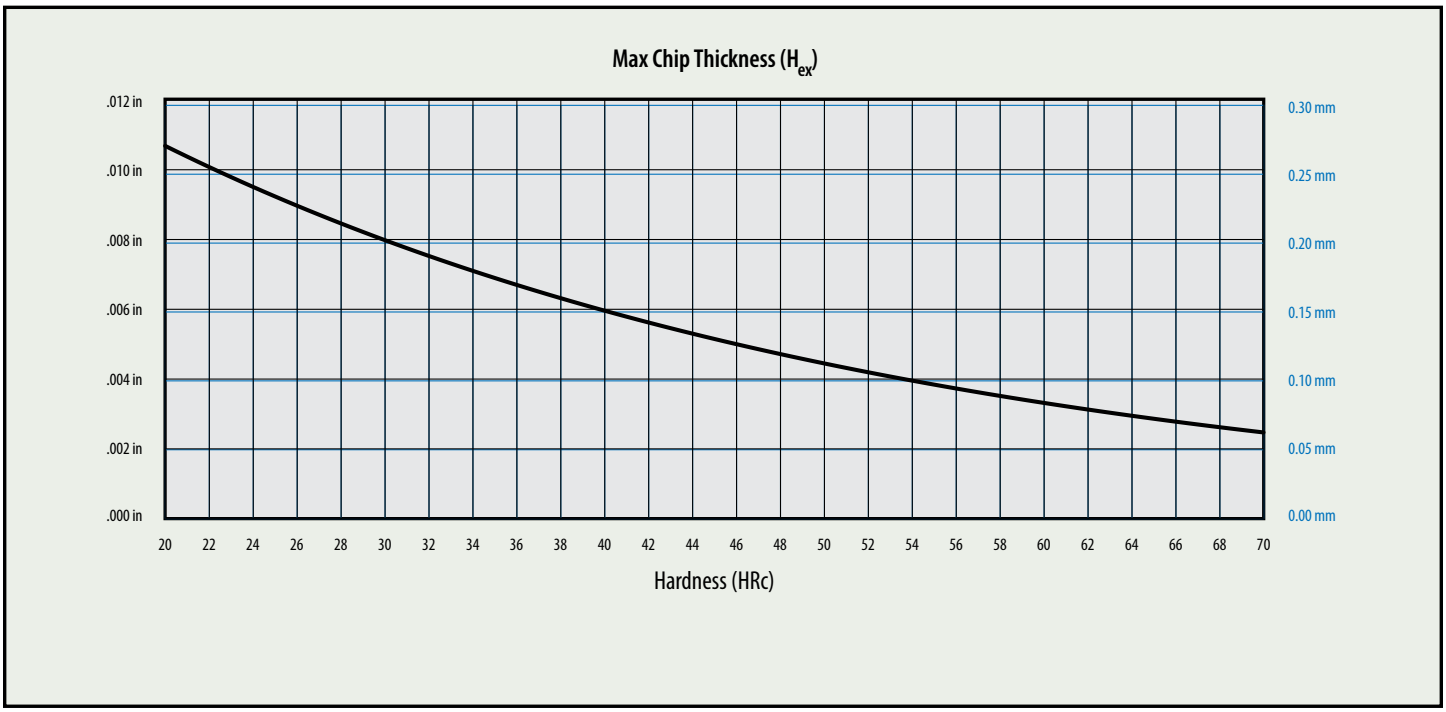
Steel Roll Turning

with GEM-8™





Note: for more recommendations on Cutting Speed and Chip Thickness in turning, see chart on ATI49.

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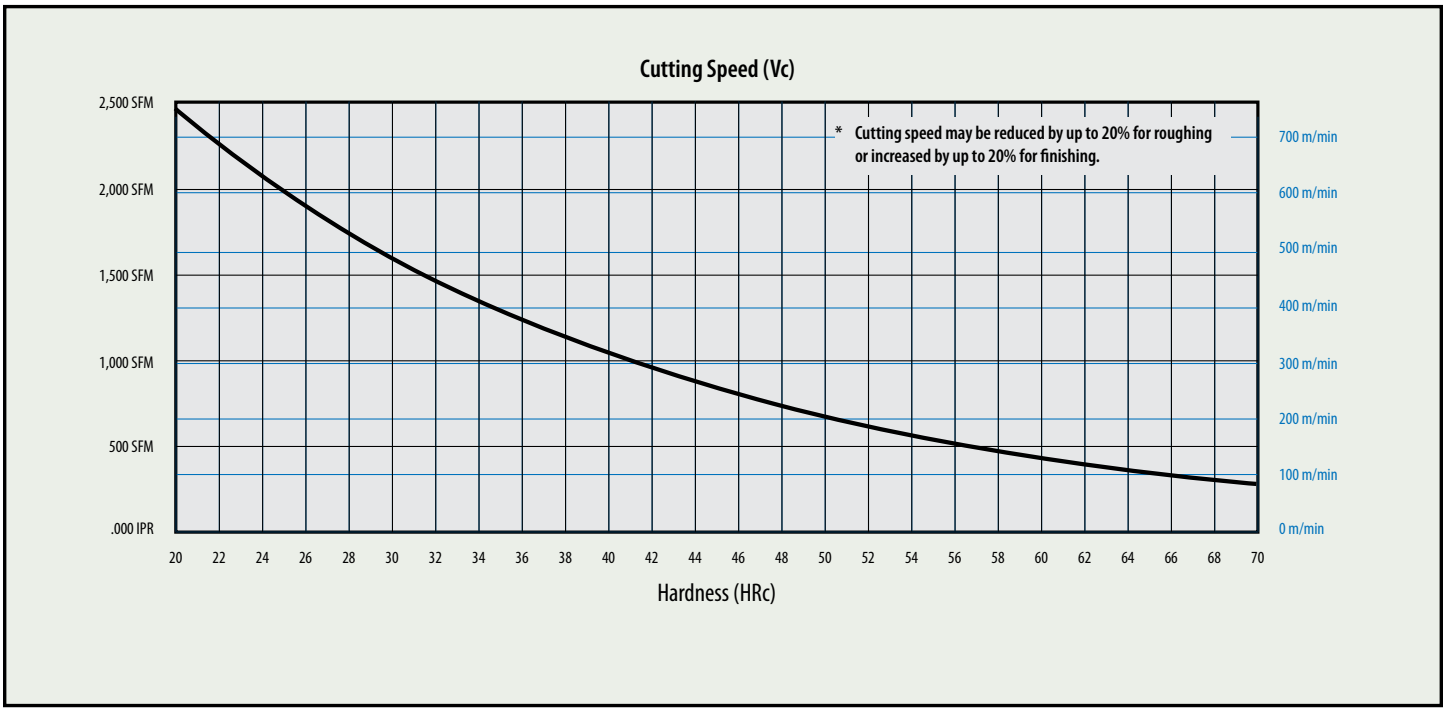
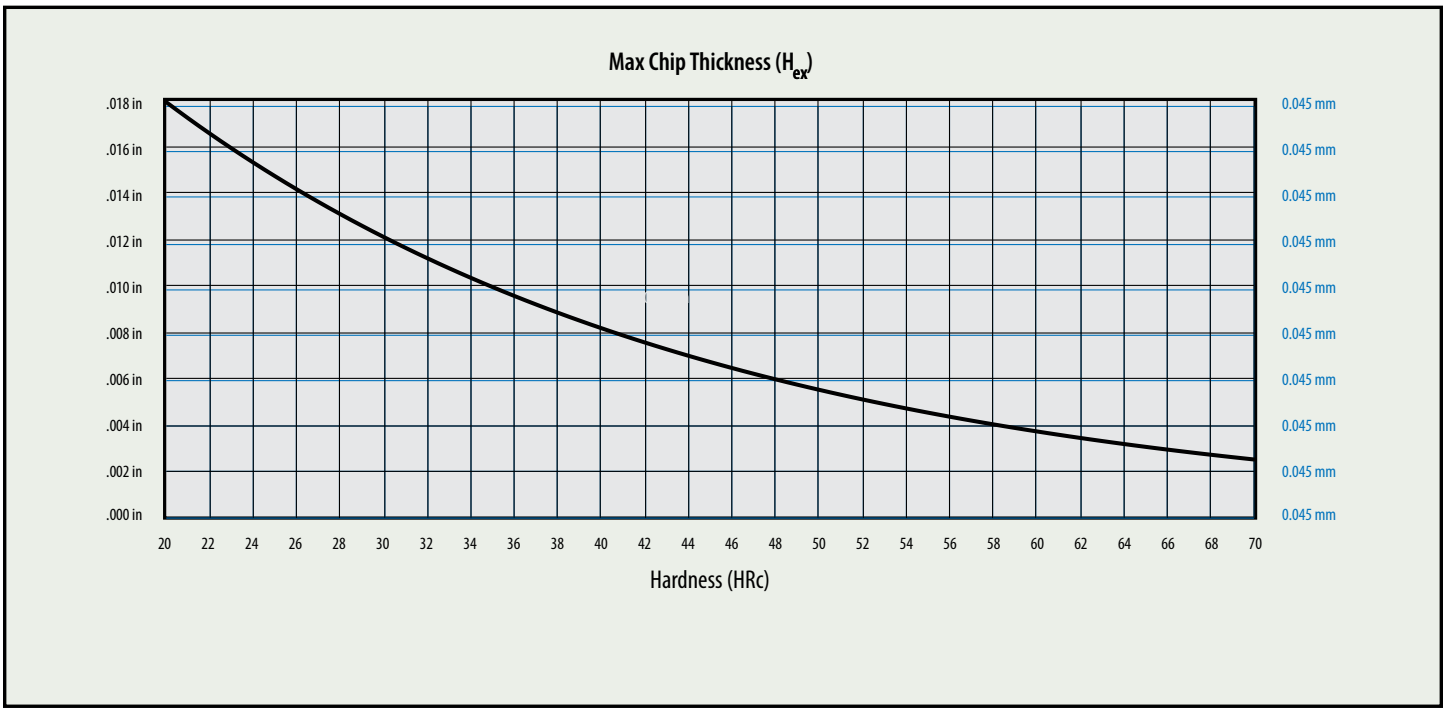
Cast Iron Roll Turning

with GEM-8™

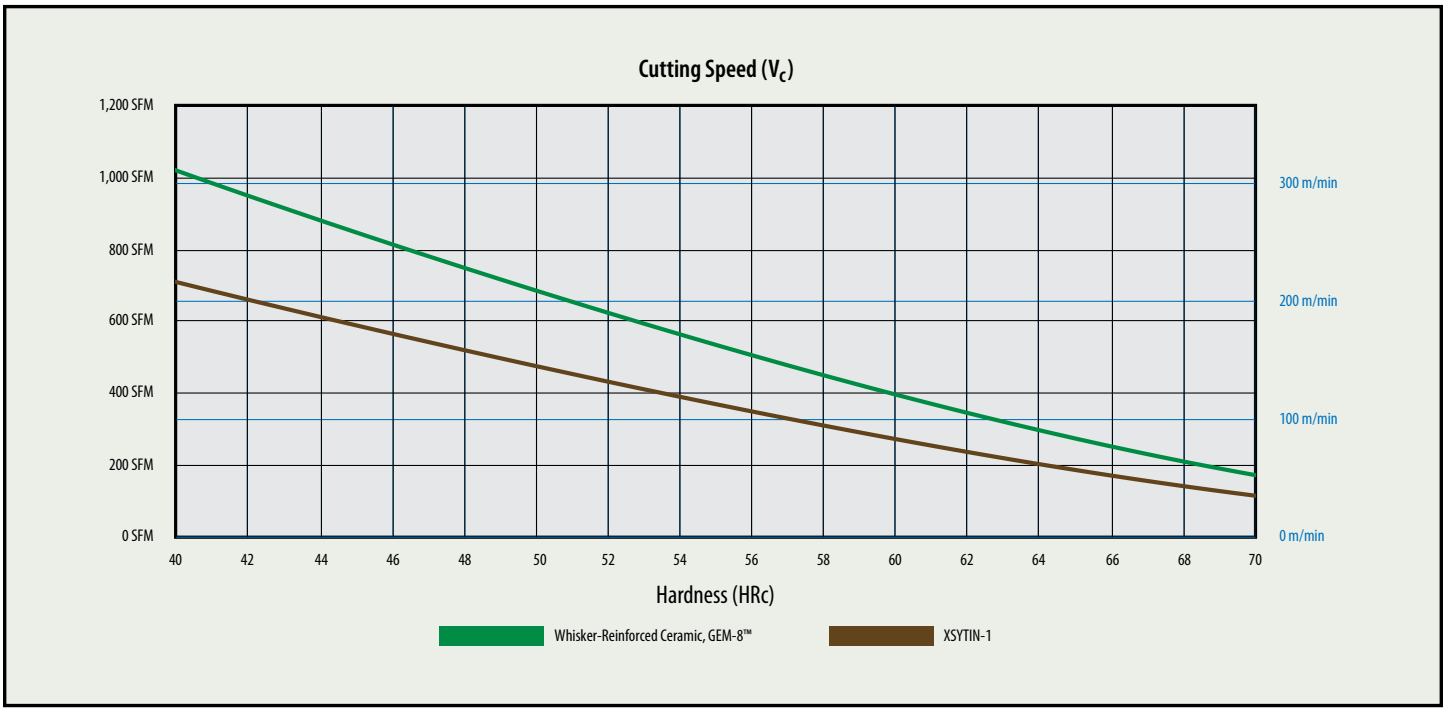


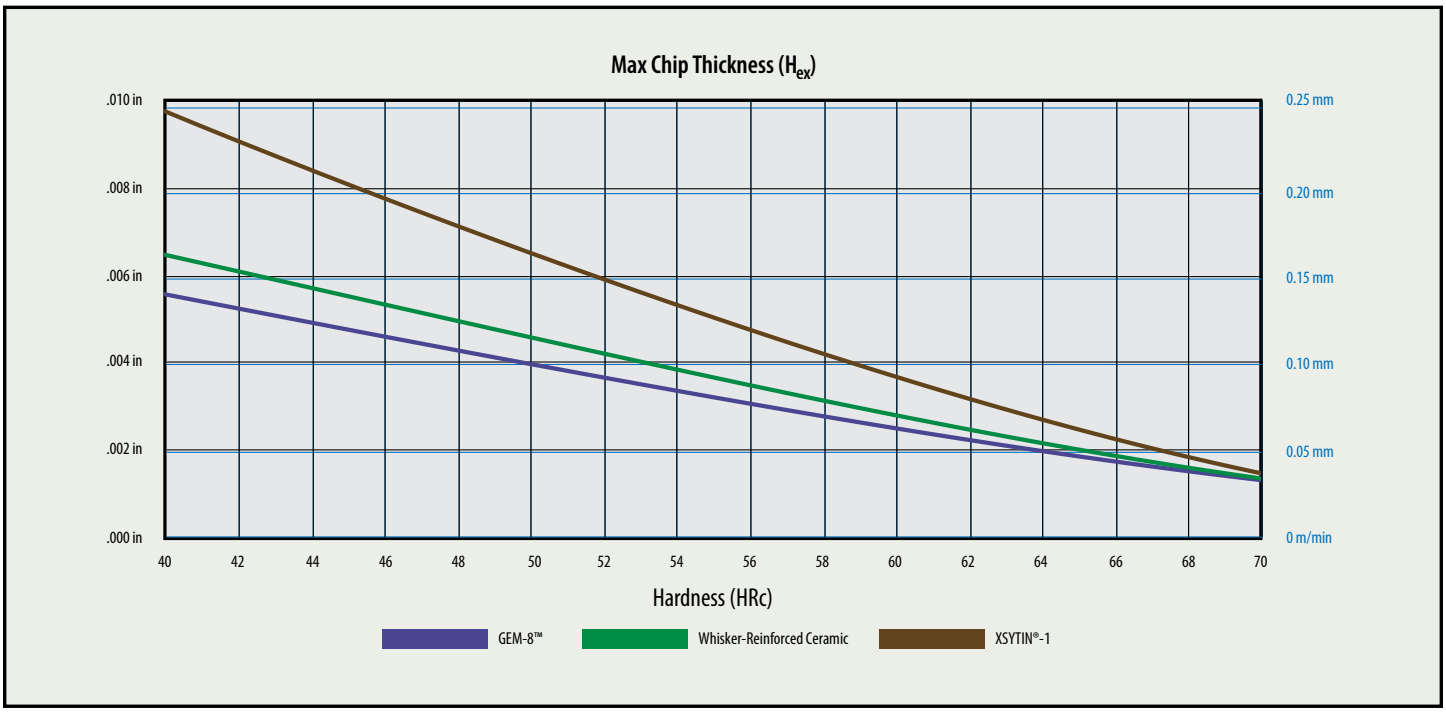


Note: for more recommendations on Cutting Speed and Chip Thickness in turning, see chart on ATI49.

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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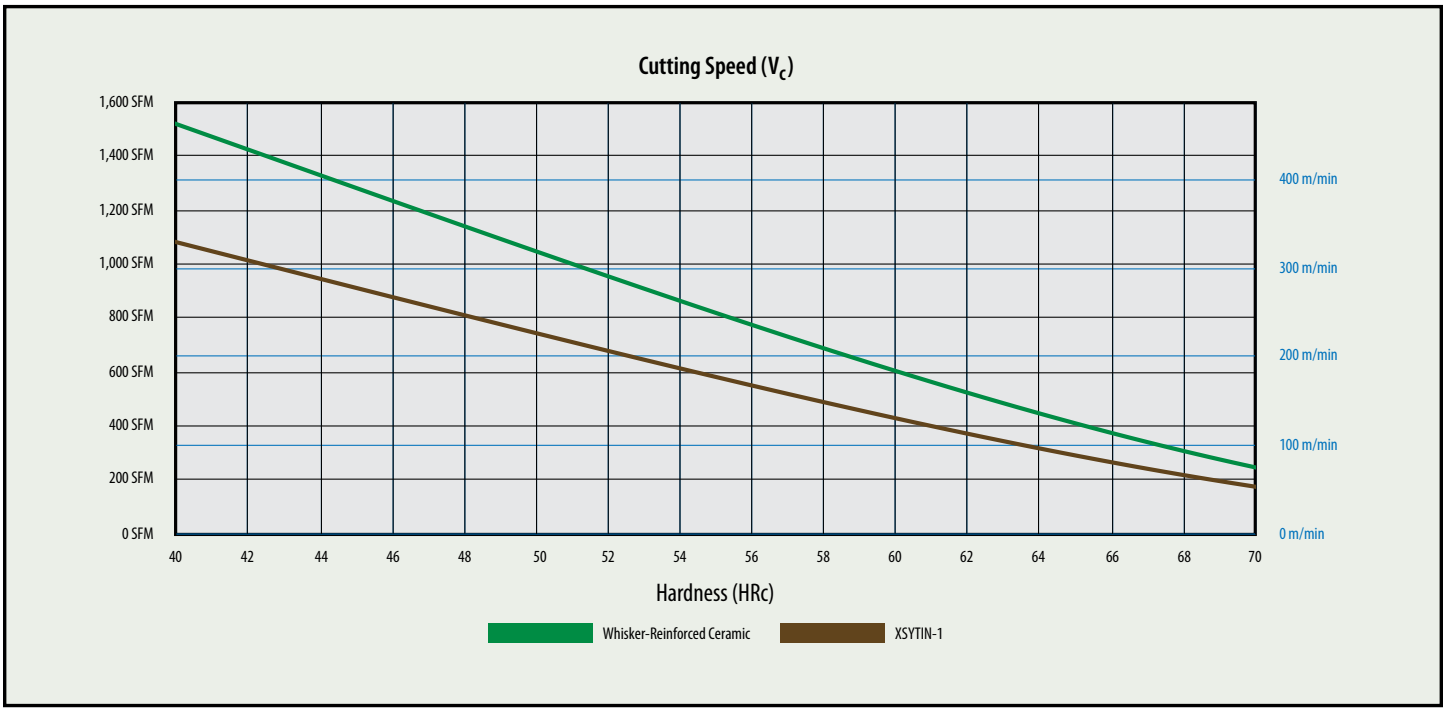
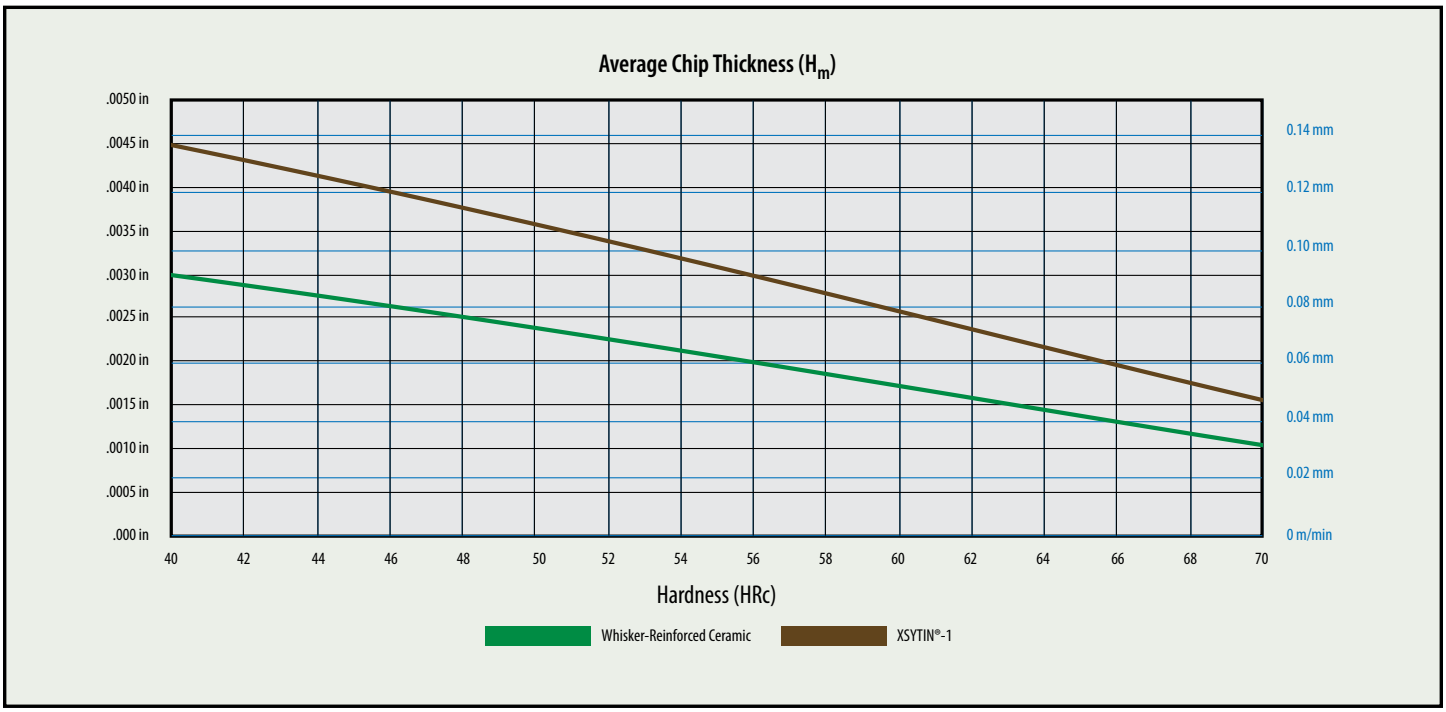
Milling Hardened Steel

with Whisker-Reinforced Ceramics/XSYTIN®-1

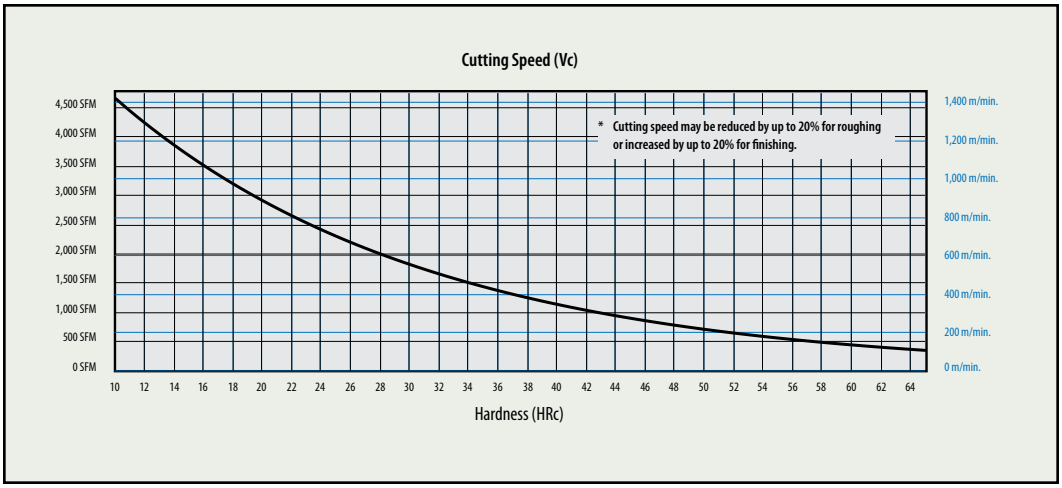




Note: for more recommendations on Cutting Speed and Chip Thickness in milling, see chart on ATI74.

Machining Cast Iron

with GSN100™



Note: for Chip Thickness recommendations, see charts on ATI49 and ATI74.

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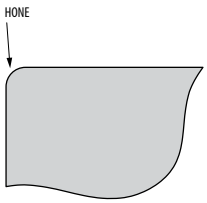
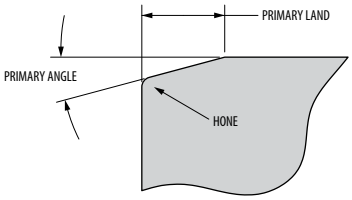
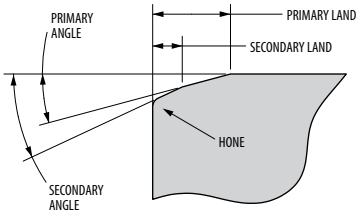
Edge Preparations and Application Guide



HONE



PRIMARY ANGLE



SECONDARY ANGLE

Edge Prep	Hone	Primary Land	Primary Angle	Secondary Land	Secondary Angle	Application
A	0,013 - 0,025mm 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	0,025 - 0,051mm 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		0,051 - 0,102mm	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	0,013 - 0,025mm R	0,051 - 0,102mm	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		0,152 - 0,203mm	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	0,013 - 0,025mm R	0,152 - 0,203mm	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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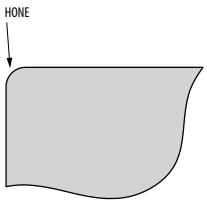
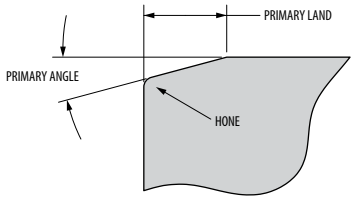
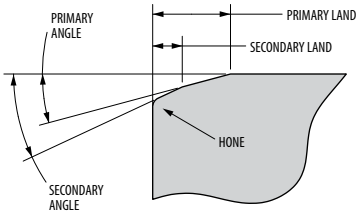
Edge Preparations and Application Guide *(Continued)*



HONE



PRIMARY ANGLE

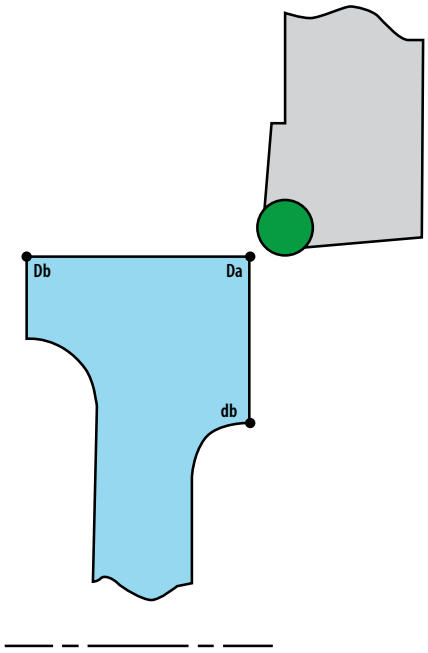


SECONDARY ANGLE

Edge Prep	Hone	Primary Land	Primary Angle	Secondary Land	Secondary Angle	Application
T3		0,330 - 0,381mm	30°			Used on smaller IC inserts as an alternative to T7
T3A	0,013 - 0,025mm R	0,330 - 0,381mm	30°			Used on smaller IC inserts as an alternative to T7A
T4A	0,013 - 0,025mm R	1,90mm	10°	0,17mm	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	0,025 - 0,051mm R					
T5A	0,013 - 0,025mm R	1,52mm	15°	0,17mm	30°	Same applications as T4A/B where more edge strength and protection from irregular wear is required
T5B	0,025 - 0,051mm R					
T6A	0,013 - 0,025mm R	1,52mm	20°	0,32mm	30°	Same applications as T5A/B where more edge strength and protection from irregular wear is required
T6B	0,025 - 0,051mm R					
T7		0,381 - 0,508mm	20°			• **WG-300®, WG-600®, and WG-700™** – Heavy turning or milling of cast iron or rough turning of particularly abrasive (high Ti, 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 Ti, Al) HRSA
T7A	0,013 - 0,025mm R	0,381 - 0,508mm	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		0,152 - 0,203mm	30°			For use with higher feed rates in the same applications as T7
T9A	0,013 - 0,025mm R	0,152 - 0,203mm	30°			Same applications as T9 where more edge strength and protection from irregular wear is required
T10A	0,013 - 0,025mm R	2,290 - 2,540mm	15°	0,17mm	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	0,025 - 0,051mm R					

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):

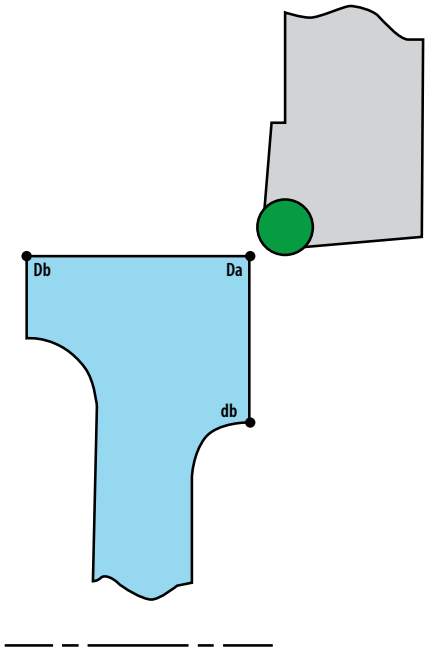
$$db = \sqrt{Da^2 - (15.279 \times T \times SFM \times IPR)}$$

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

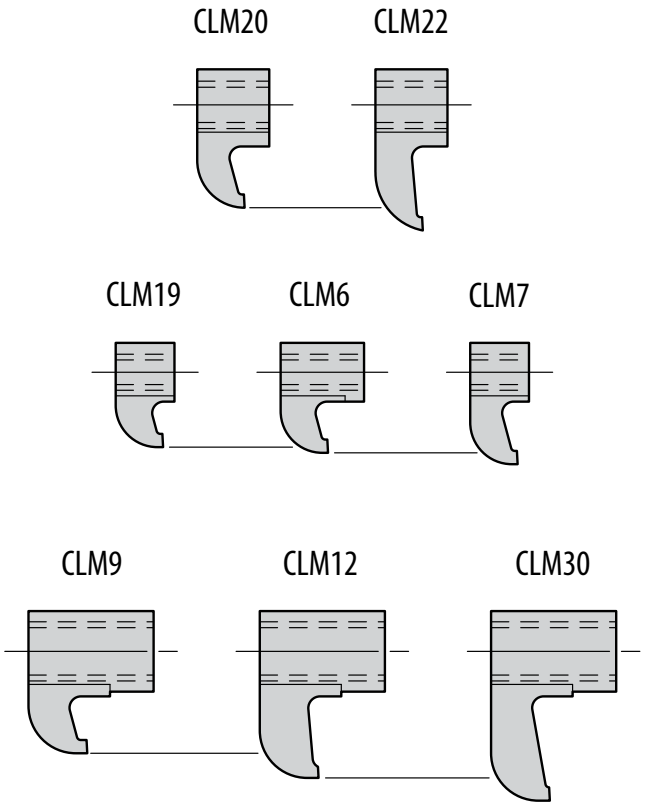
To give maximum flexibility and provide for maximum clamping advantage in any given cutting situation, there are alternative clamps available. The variation in these clamps is the reach. Barrel diameters are common.

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.

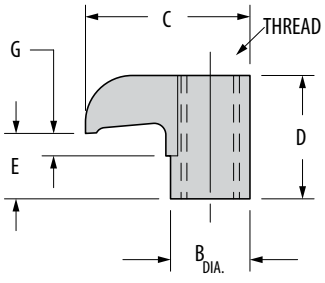
We have chosen as standard for each tool cataloged a clamp and differential screw combination for use with inserts with holes (pinlock). A longer reach clamp should be used when using top clamp alone. If conditions indicate, another combination would be advantageous. Please note as follows:

- Clamps CLM6, CLM7 and CLM19 are interchangeable. The difference is in the reach only.
- CLM9, CLM12 and CLM30 are all interchangeable, the difference being in the reach only.
- CLM20 and CLM22 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
CLM6	7,87	14,73	11,18	4,83	2,29	M5 x 0.8
CLM7	7,87	16,26	7,87	1,65	-	M5 x 0.8
CLM9	10,87	19,05	16,76	8,89	3,05	M8 x 1
CLM12	10,87	22,35	17,53	8,89	3,05	M8 x 1
CLM19	7,87	13,97	7,11	1,65	-	M5 x 0.8
CLM20	9,47	18,54	10,16	3,30	-	M6 x 1
CLM22	9,47	21,59	13,46	7,11	3,30	M6 x 1
CLM24	12,52	25,40	19,81	11,68	3,30	M10 x 1.25
CLM30	10,87	25,40	16,76	8,89	3,05	M8 x 1

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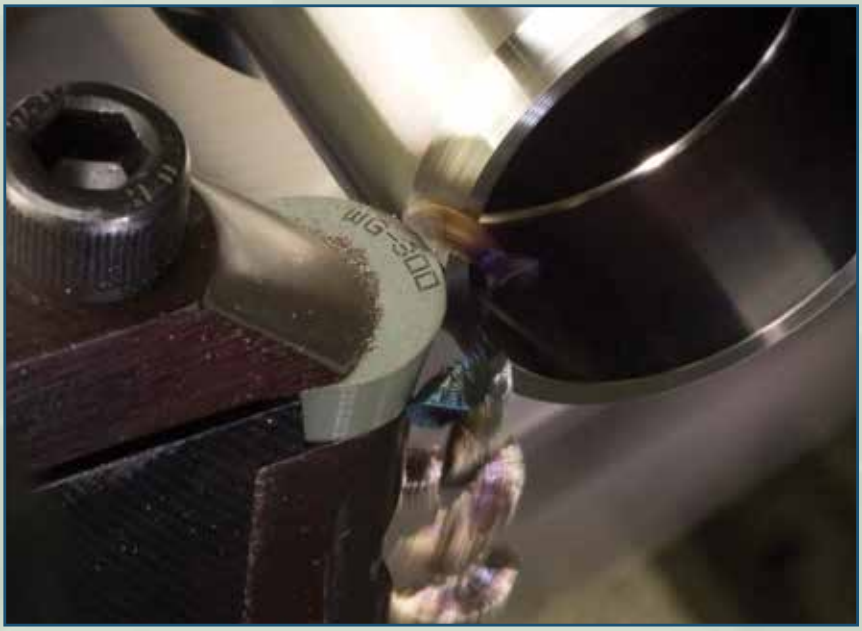
Greenleaf Advanced Ceramics



Index

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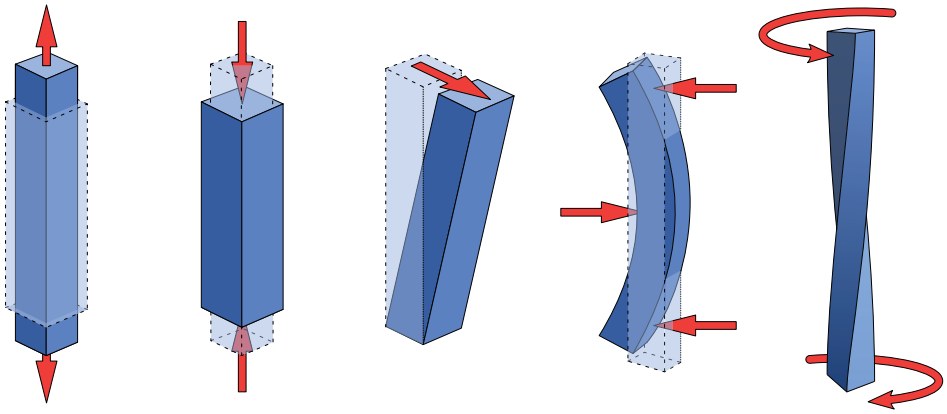
Glossary

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.

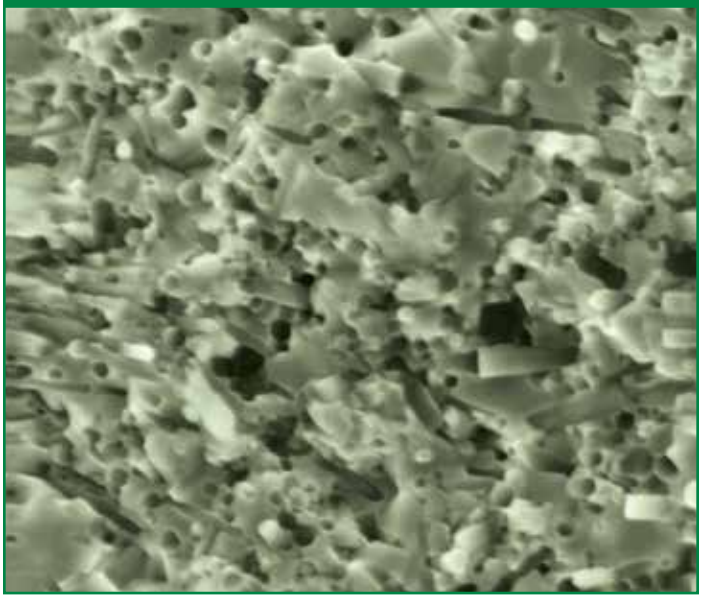
Al_2O_3 in its pure form is a ceramic that is hard, non-reactive, and able to withstand compressive stresses at extreme temperatures, but is also rather brittle – so its uses are limited to a number of specific applications. Reinforcing Al_2O_3 with another material introduces impediments to stress flow, 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 SiCw 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 SiCw crystal at some angle to the plane of the crack it must either go around it where it will inevitably encounter another randomly-oriented SiCw 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˜ $\bar{m}$]	—	10.0
Thermal Expansion [10^{-6}/°C]	—	6.0
Thermal Conductivity [W/mK]	—	35

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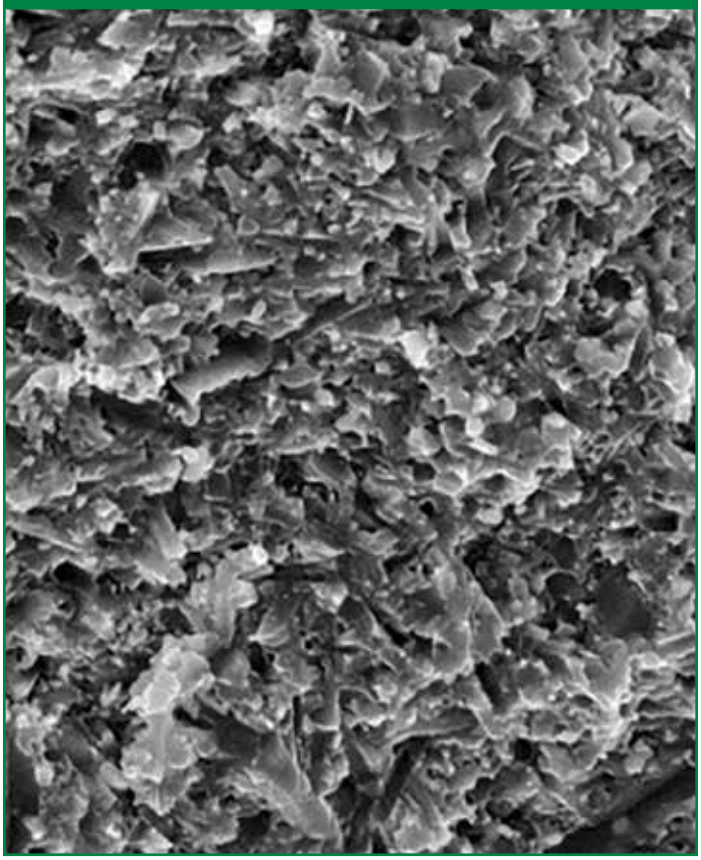
WG-600® is the first commercially available coated whisker-reinforced ceramic composite. The coating increases the tool's hot-hardness and serves to further protect the substrate from oxidation and softening, extending tool life.

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$\tilde{}$ $\bar{m}$]	—	7.5
Thermal Expansion [10^{-6}/°C]	—	3.5
Thermal Conductivity [W/mK]	—	26

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:

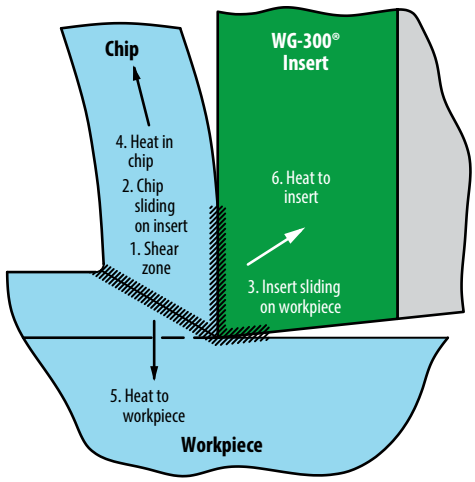
1. Heat produced in the workpiece plasticizes (softens) the material ahead of the cut, reducing the strength of the material, making it easier to cut
2. Heat conducted into the tool plasticizes the tool, reducing its hardness, strength, and adversely affecting tool life

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:

1. Transport away from the cutting zone in the chip
2. Conduction into the workpiece
3. 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.

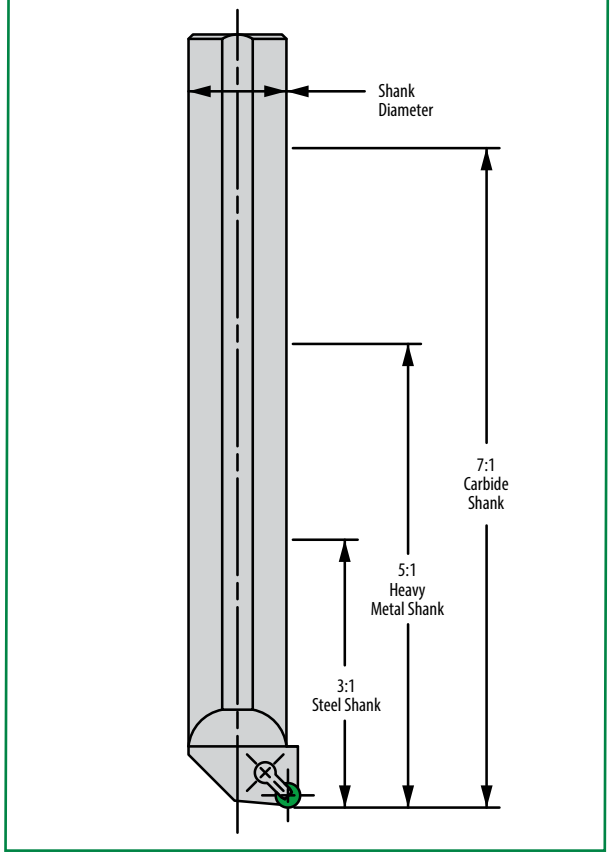
As a general rule, when machining nickel-based alloys, steel boring bars will give adequate performance at hangout-to-bar diameter ratios of up to 3:1. Special boring bars manufactured from "heavy" metals give an advantage over steel bars and can be used at ratios up to 5:1. Carbide boring bars extend 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.

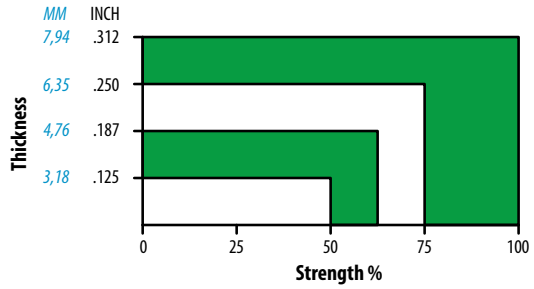
Insert Strength

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.

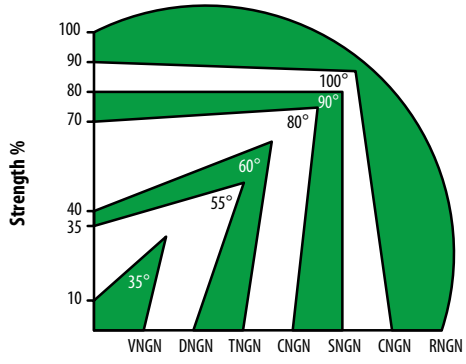
Figure 34a
Relative Strength for Various Insert Thicknesses



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.

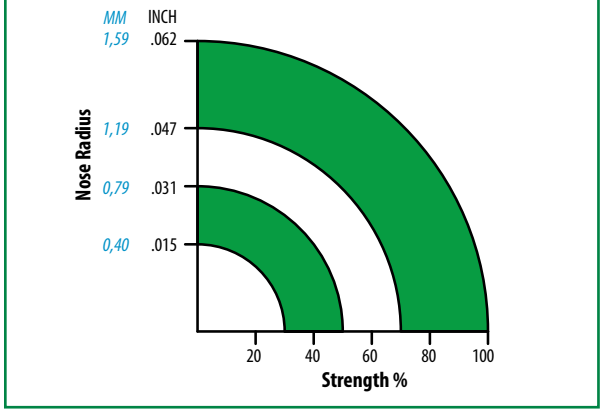
Figure 34b
Insert Shapes and Strengths



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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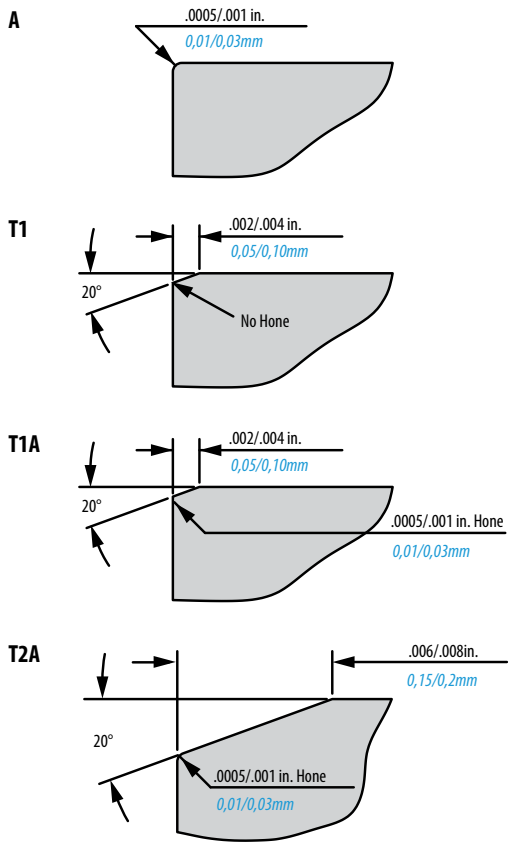
Edge Preparations

Figure 35a
Standard Edge Preparations



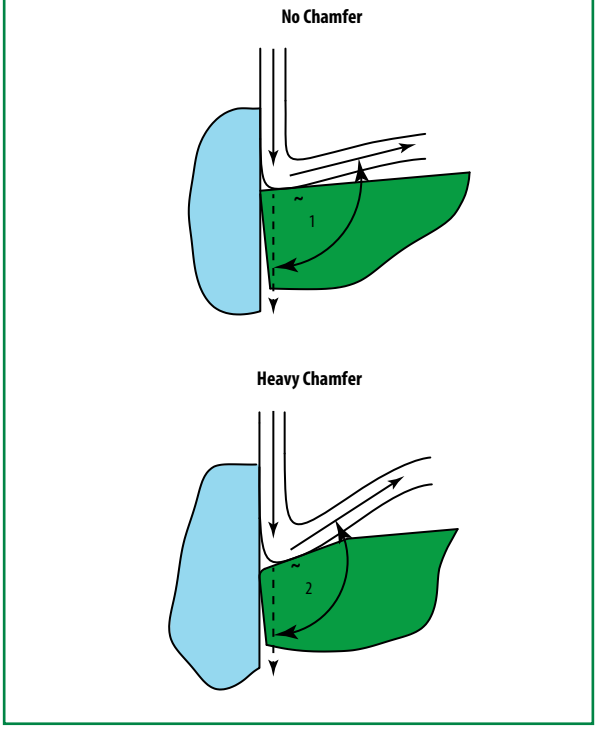
Unlike tungsten carbide (WC-Co) inserts whose edge is typically only honed, where the shape and size of the hone are quite important, ceramic inserts commonly require a chamfer ("upsharp" ceramic inserts without a hone or chamfer are generally not recommended). The size and angle of the chamfer(s) with 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)?

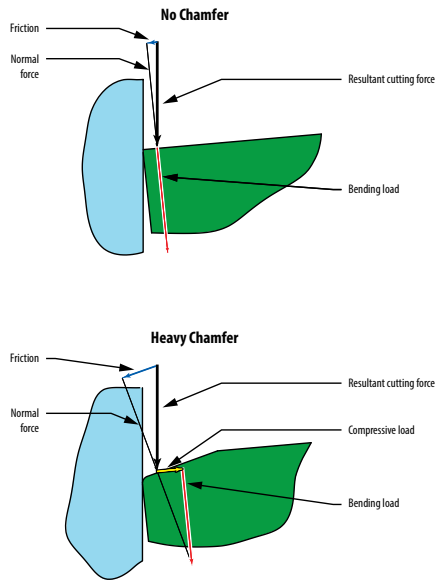
Figure 35b
Edge Prep Effect on Chip Formation



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. $\alpha_2 > \alpha_1$

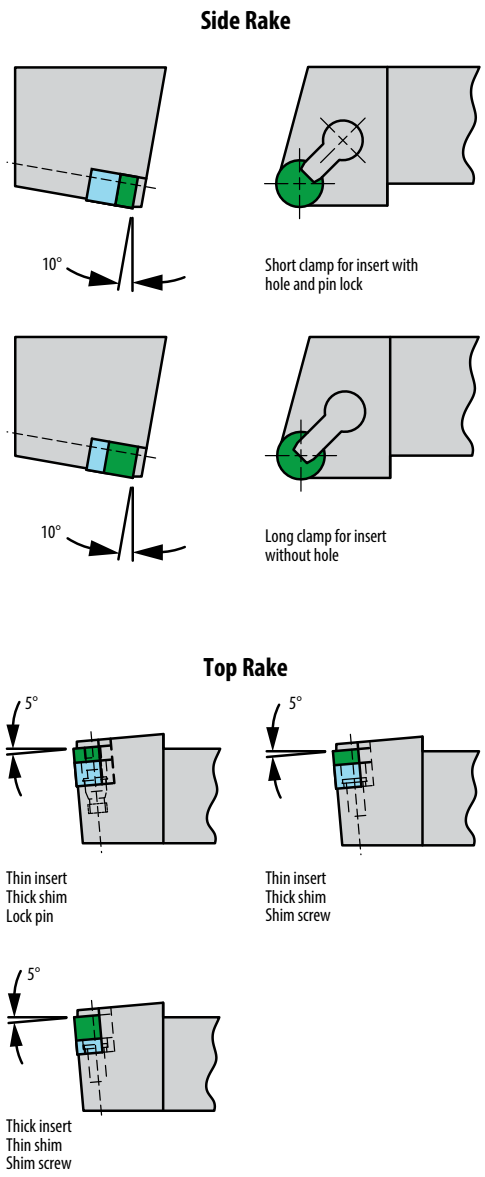
A chamfer redirects some of the mechanical stresses so that a part of what would load the insert in bending instead loads it in compression. The compressive strength of ceramics is substantially higher than their tensile strength so that, when appropriate and necessary, a chamfer can be used to protect 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



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



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.

See pages ATI 22-23 and the following section on material-specific tool selection for more details.

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 in the tables 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-30®0 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 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	

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.

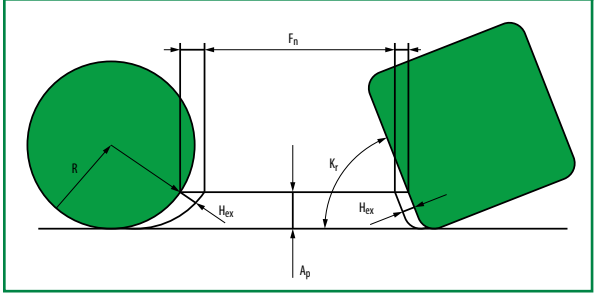
With the much higher temperatures that Greenleaf ceramics are able to sustain, option 1 is the primary method of chip formation and breaking in all ductile materials.

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	
Low γ' [4] S2 (Solution-Treated and Aged)		H_{ex}:		0.007	0.0105			0.18	0.27	
Inconel 706, Inconel 718, Inconel 725	40-45	V_c:		1150	800			350	250	
High γ' S2 (Solution-Treated and Aged)		H_{ex}:		0.0065	0.0095			0.16	0.24	
IN100, Udimet 720, Waspaloy, C1023, Rene 88, N-18	40-50	V_c:		650	500			200	150	
		H_{ex}:		0.0045	0.007			0.12	0.18	
	20 [5]	V_c:		1950	1250			600	375	
S3: Wear-Resistant HRSA		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	
	40	V_c:	1000	1000	700		300	300	210	
H1: Carbon and Alloyed Steel		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	
	45	V_c:	750	750	500		225	225	160	
H3: Tool Steel		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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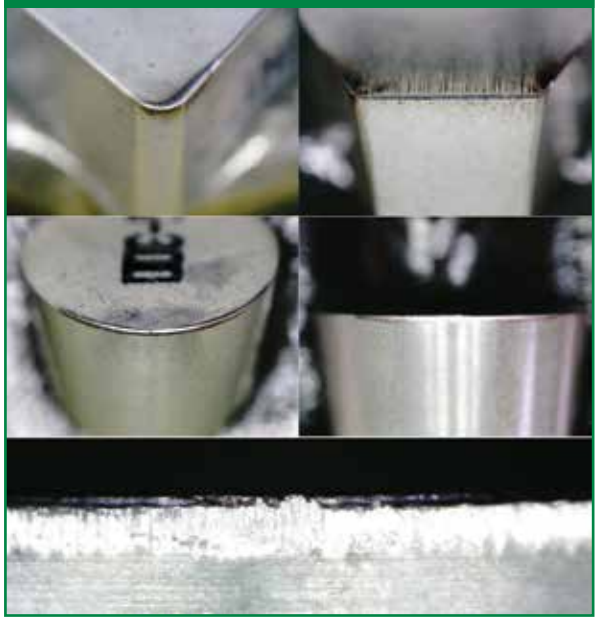
Ceramic Wear Patterns

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

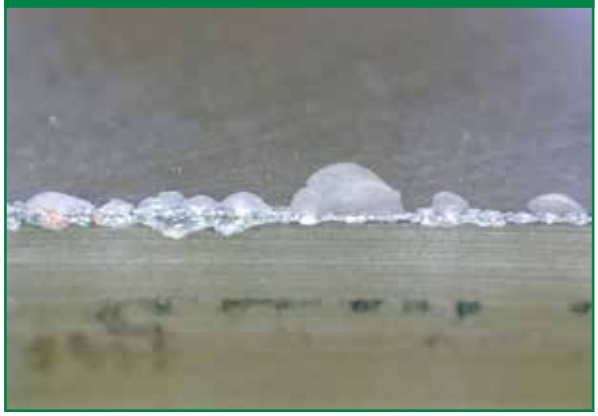


Flank wear and edge rounding is what is referred to as 'regular wear' (where all other entries below are jointly described as 'irregular wear'). It is by far the best kind of wear to have. Simply put, it means that the machining process is stable, stresses are carried well, heat distribution does not 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

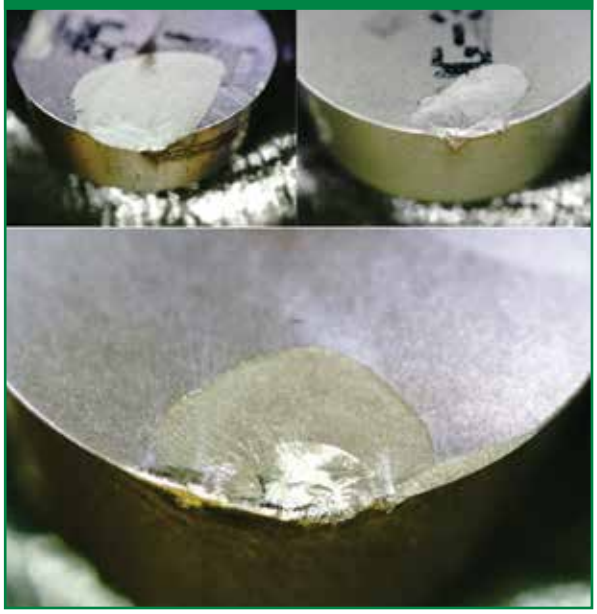
Chipping is frequently a result of vibration and instability, or the cutting tool encountering large inclusions along the cutting path that are significantly different (typically harder) from the rest of the material being machined. Chipping leads to an uneven distribution of mechanical stresses and 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.

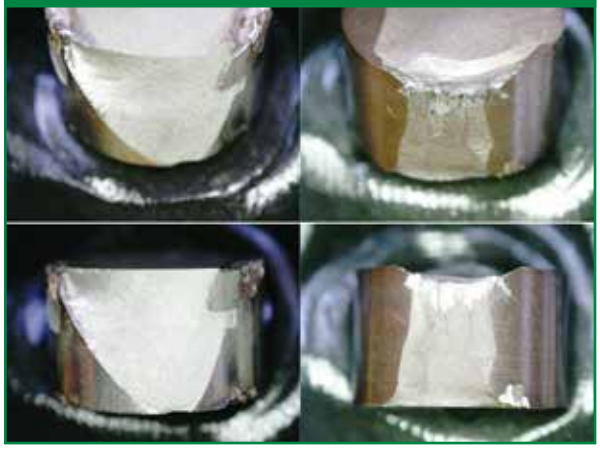
4. RAKE: Top-Slicing

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.

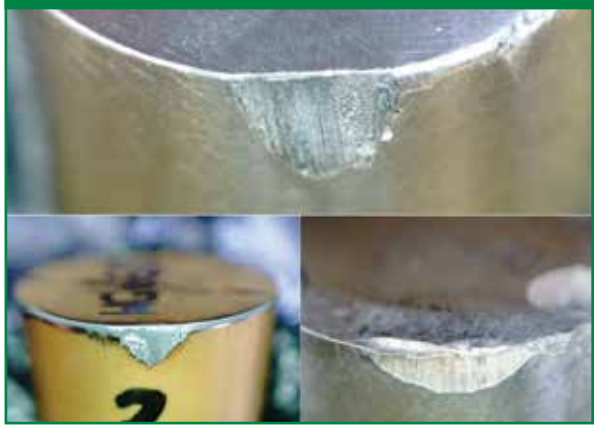
6. RAKE & FLANK: Chemical Wear

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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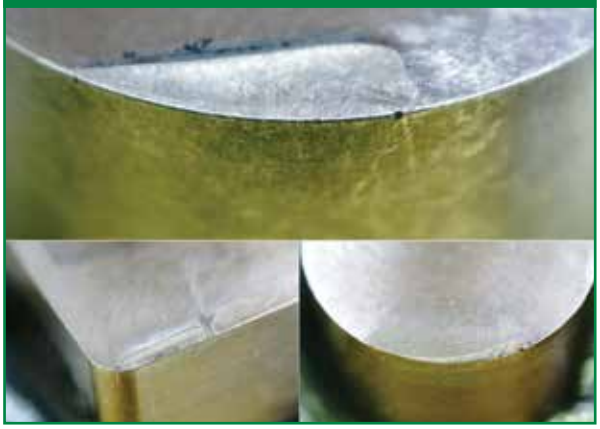
8. FLANK: Notching

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

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

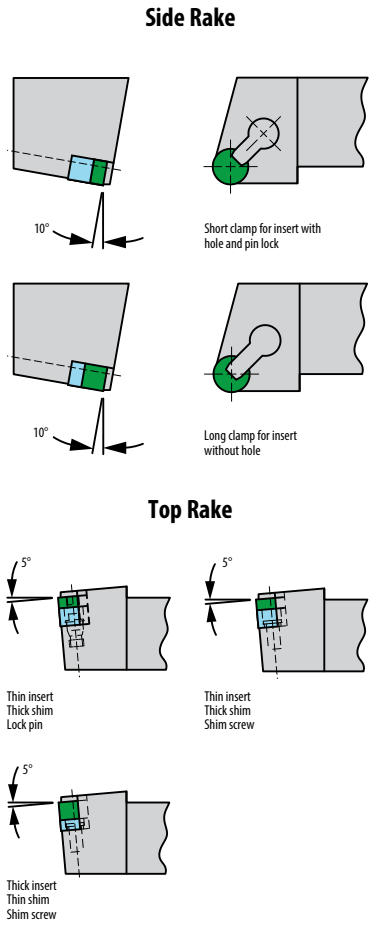
Regardless of the workpiece material and application, ensuring the wear is regular (so is kept to flank wear and edge rounding) is beneficial to the reliability of the process and will result in higher tool life. To that end, one must consider the following when machining with ceramics:

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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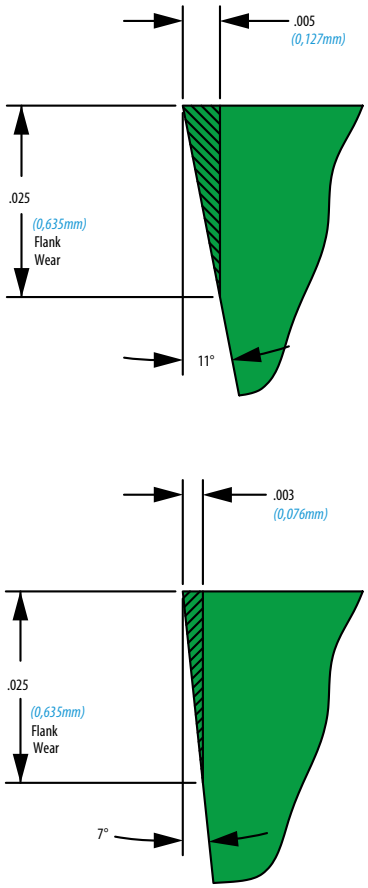
For example, to see the difference that 11° clearance makes compared to 7° clearance, refer to the illustration. (Figure 55a) With a 7° clearance angle, 0.003" (0.07 mm) of material will be worn from the insert to produce a 0.025" (0.64 mm) wear land, whereas 0.005" (0.12 mm) of material must be worn 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.

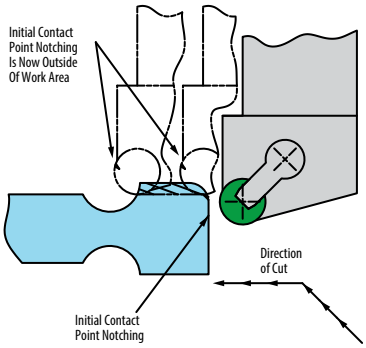
Mechanical Stresses

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

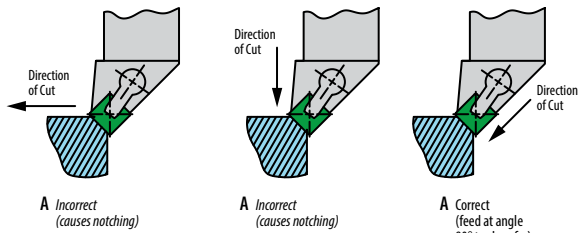
It is highly beneficial to enter the cut on a large radius (rolling in) or at least with a 50% reduction in feed to prevent the sharp edge of the workpiece from damaging the tool while the heat distribution has not reached an equilibrium and plasticization of the workpiece is low. Failure to do so may result in notching (particularly in S materials), chipping, and flaking.

Figure 55b
Chamfering and Facing



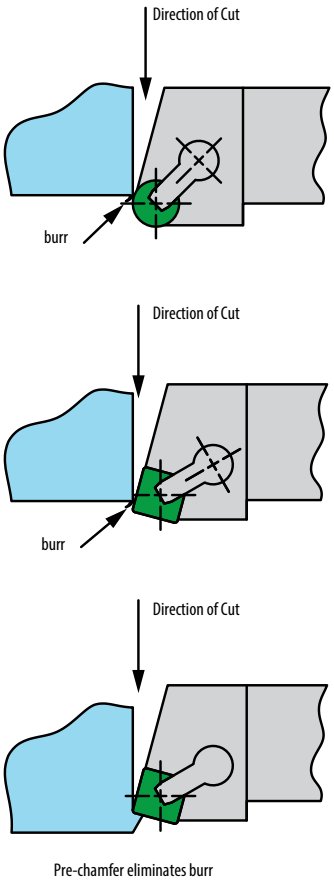
Another approach is to pre-chamfer the entry, eliminating first contact with a sharp edge:

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

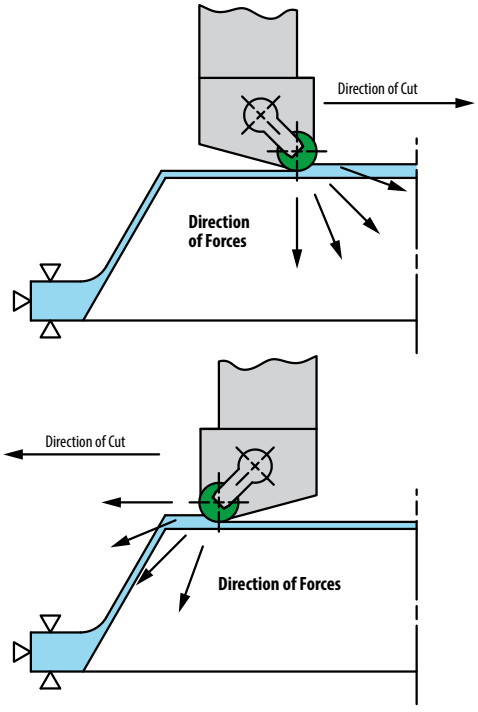


In ductile materials (S, M, H2) this also prevents the thin and plasticized wall of material from coiling over and forming a burr.

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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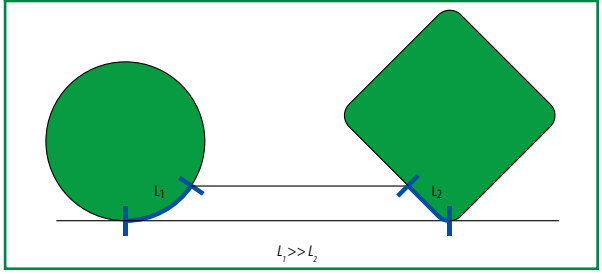
3. Round vs. straight-edged

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

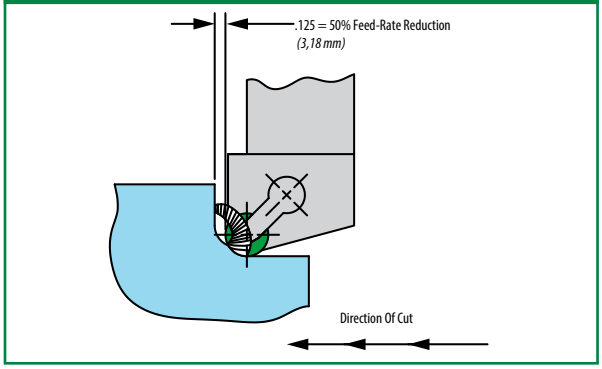


Higher cutting forces mean higher spindle loads (so one may also run into machine power as a limitation when using round inserts), but also higher mechanical stresses that the component and tool have to carry without deflecting. An extreme case would be the use of a round negative insert for small-ID 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)

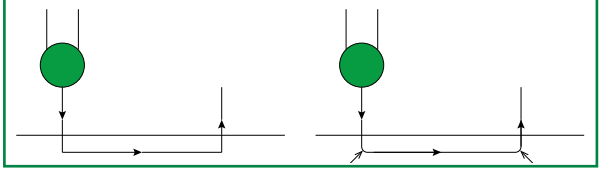


From the perspective of chip thickness, turning to a shoulder with an insert with a small corner radius actually presents less of a challenge, but as the corner radius grows and round inserts or full-nose grooving inserts are used, more and more material is left at the shoulder for subsequent passes, 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.

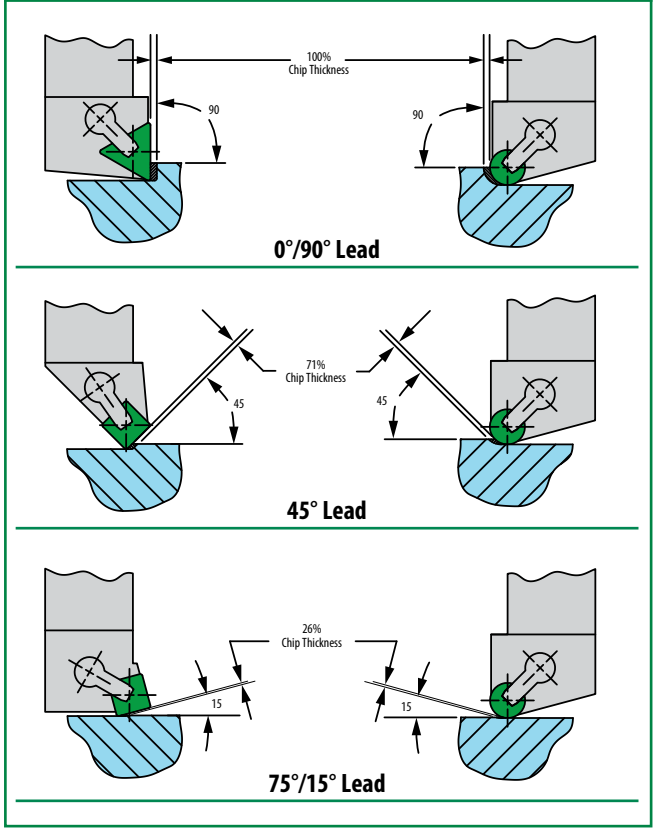
6. Face-turning to center

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

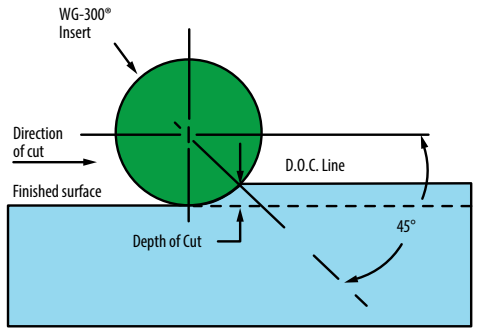
Whisker-reinforced ceramics and XSYTIN®-1 are both extremely capable of productive and reliable roughing of heat-resistant super alloys that can reduce cycle times by a factor of 4 or more compared to coated carbide. Whisker-reinforced ceramics generally perform better in stable environments capable 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.

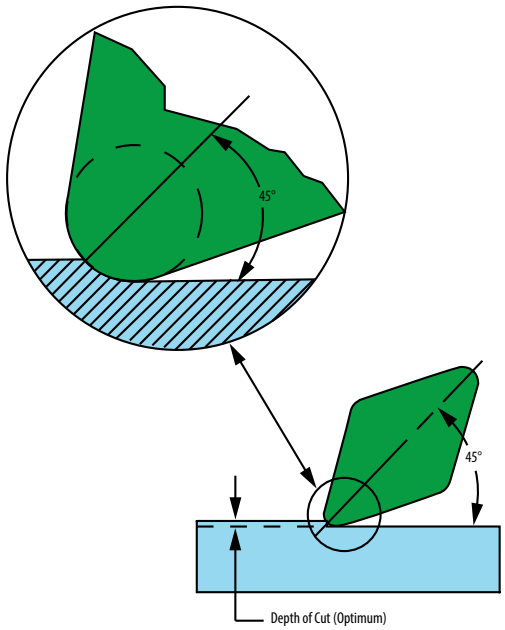
Figure 55b
Recommended Depth of Cut for Round Inserts



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

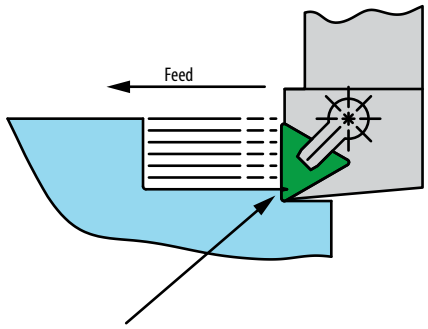


Insert Radius		Optimum Depth of Cut	
Inches	***Millimeter***	**Inches**	***Millimeter***
.015	*0,38*	.0046	*0,12*
.031	*0,80*	.0092	*0,23*
.048	*1,21*	.0139	*0,35*
.063	*1,59*	.0183	*0,47*
.094	*2,38*	.0275	*0,70*
.125	*3,18*	.0370	*0,93*

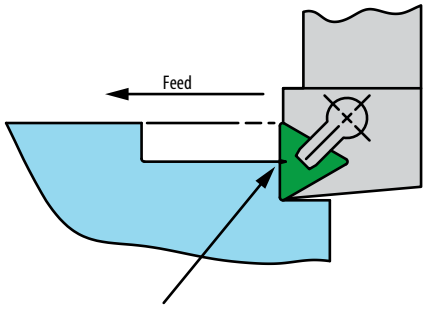
2. Taking fewer passes

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

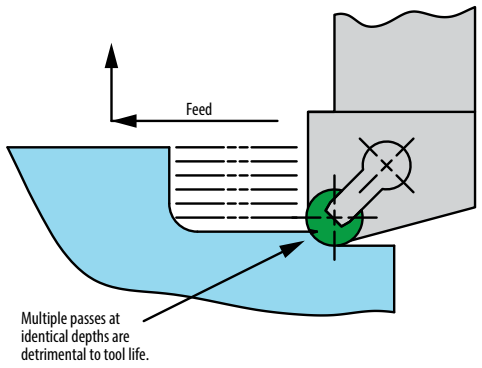


Figure 61b
Multiple Passes at Varying Depths of Cut with Notching

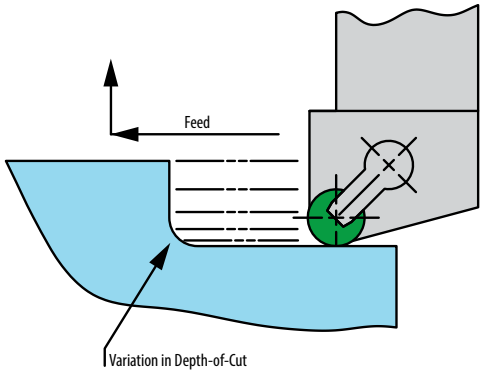
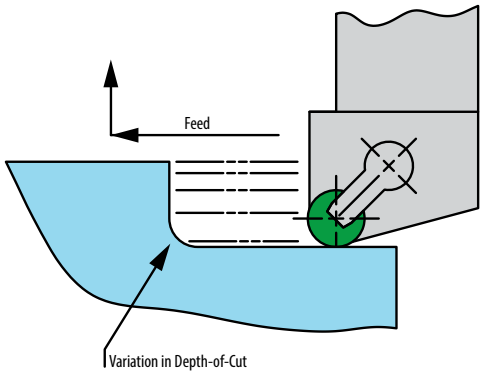


Figure 61c
Multiple Passes at Varying Depths of Cut with Regular Wear



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

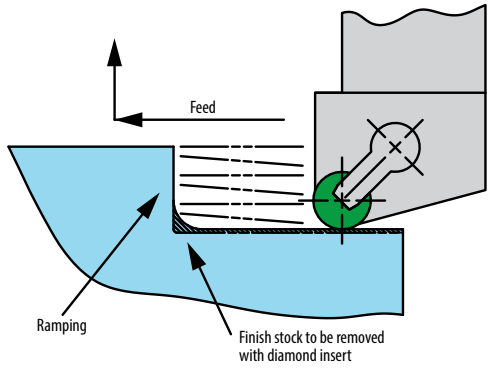
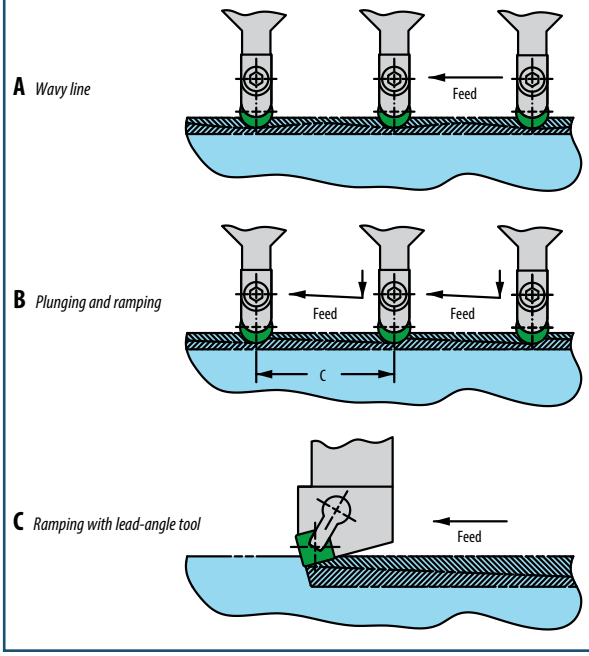


Figure 61e
Various Ramping Methods



XSYTIN®-1

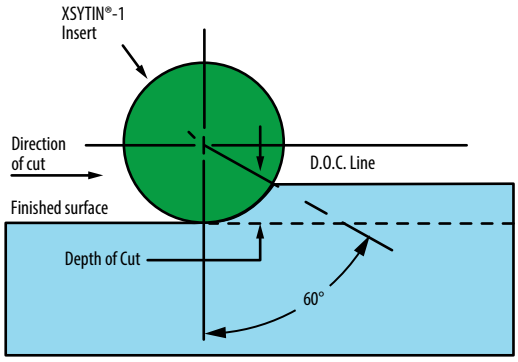
Because XSYTIN®-1 is considerably stronger and more resistant to notching but less stable at higher temperatures compared to whisker-reinforced ceramics, the main concern when applying XSYTIN®-1 is to avoid any tool paths where the chip thickness drops off and the heat in the cutting zone increases beyond 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.

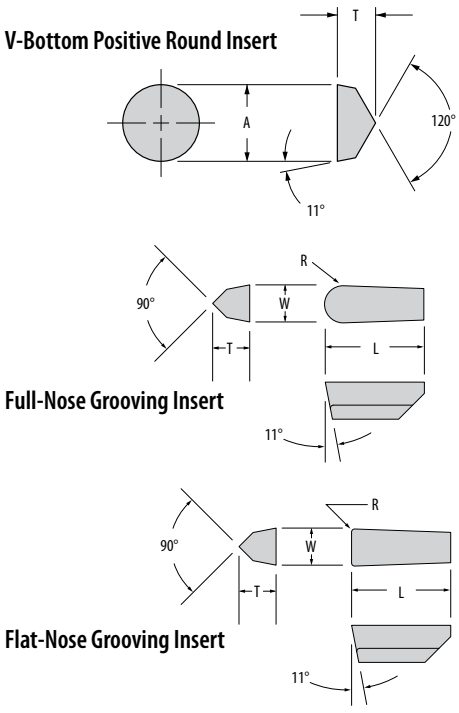
Roughing: Opening Cavities

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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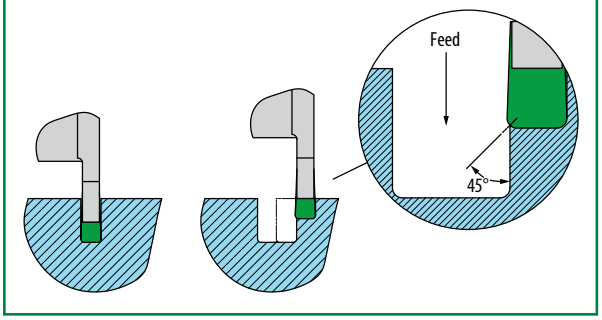
Grooving

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 56 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.

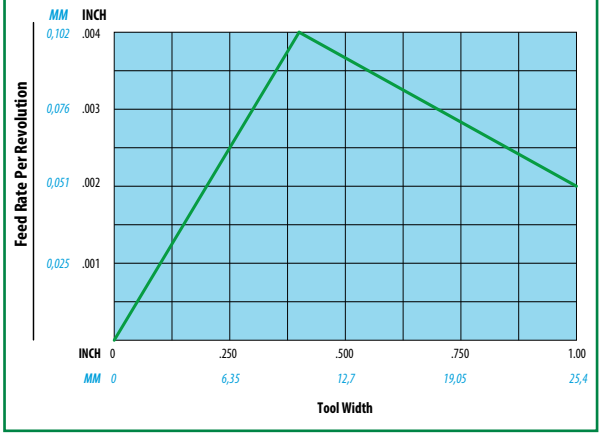
Figure 63a
Additional Cavity Techniques



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

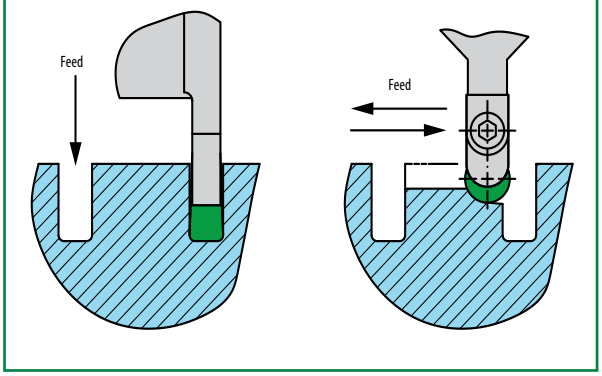


For XSYTIN®-1, increase the feed from the determined value by a factor of x1.5.

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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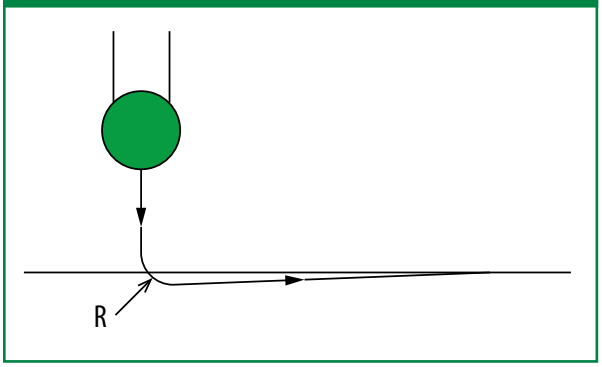
Profiling

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

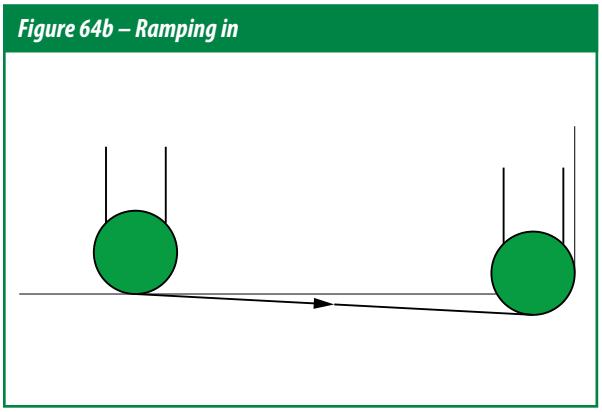
To avoid notching, the most effective method of profiling with whisker-reinforced ceramics is ramping. To start the cut, one can either plunge into the material or ramp into it – both with their pros and cons. Plunging allows ramping out, which alleviates the stress on the tool towards the end of the 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

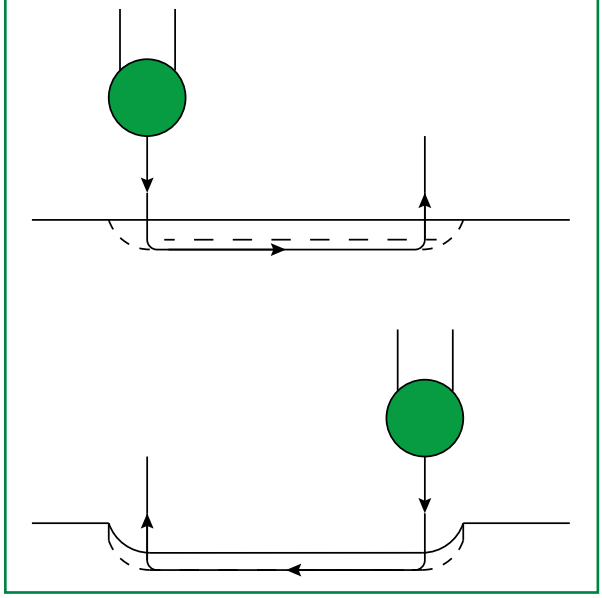


Throughout both ramping methods, chip thickness must be kept constant to preserve the balance of heat. Plunging should be done at a feed rate equal to the recommended chip thickness since the chip thickness then equals the feed rate, with feed rate adjusted in all other paths to conserve chip thickness 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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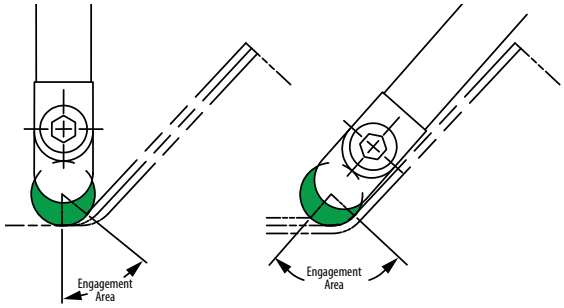
Radial Engagement a.k.a. Wraparound

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)

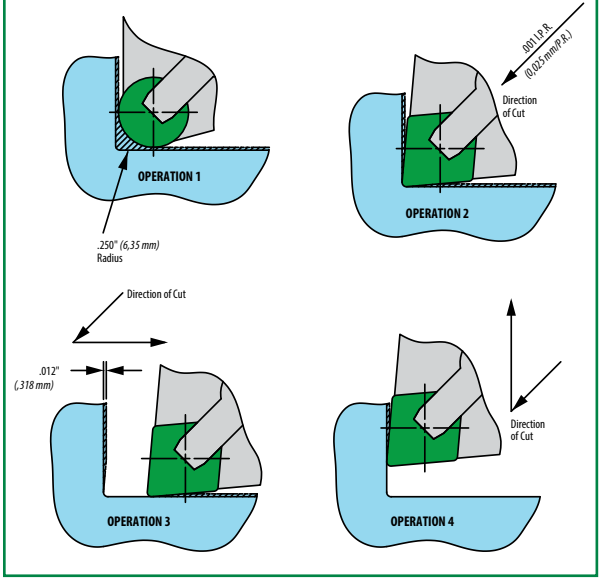
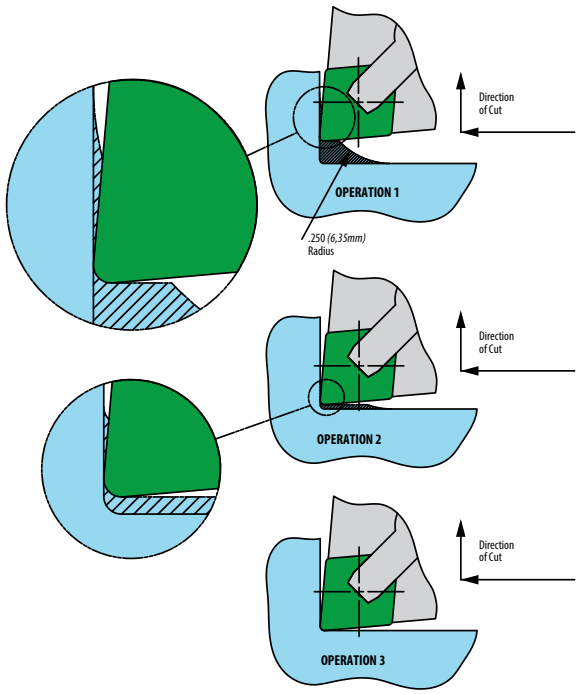


Figure 65c
Ramping Effect on Shoulder Cuts

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.



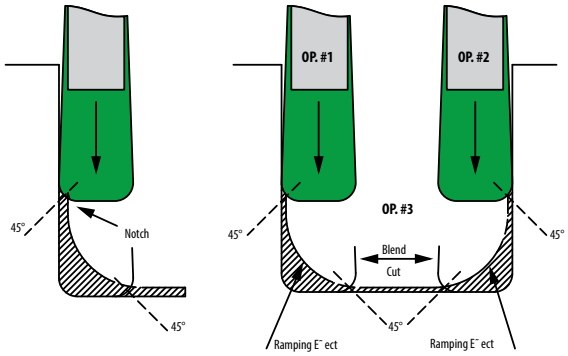
Corners in a Cavity

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

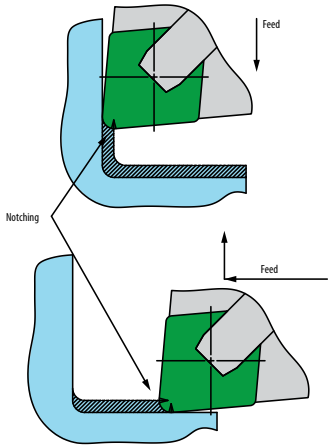
Finishing is the final stage of machining that leaves the surface in the desired condition with the appropriate Ra, Rz, acceptable thickness of deformed layer, and magnitude of internal stresses.

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).

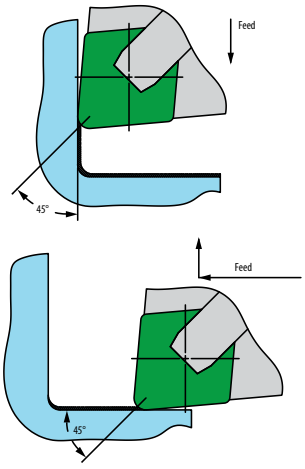
Leaving too much material poses the risk of notching, as seen in Figure 66b below.

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-300/600 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*

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

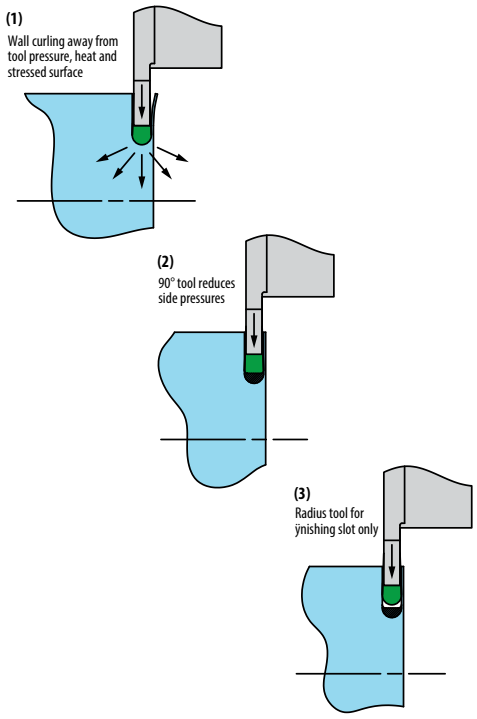
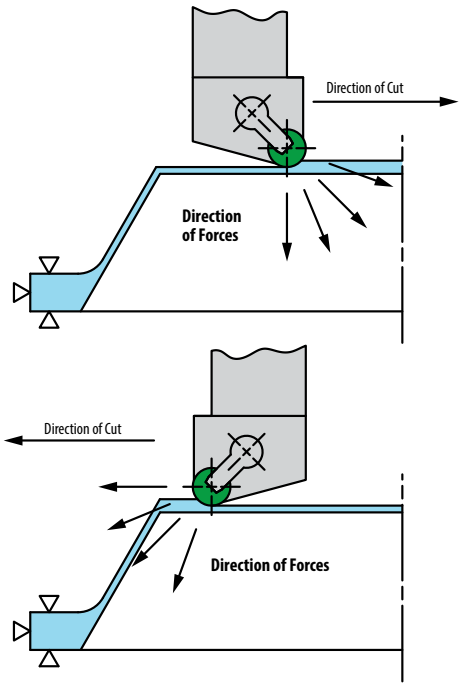


Figure 68b
Cutting Direction Resultant Forces



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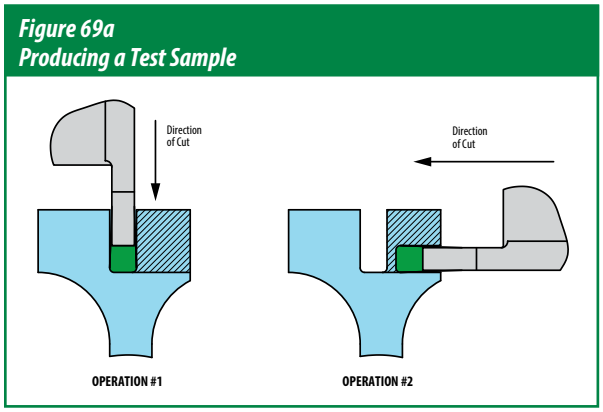
Test Ring Production

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.

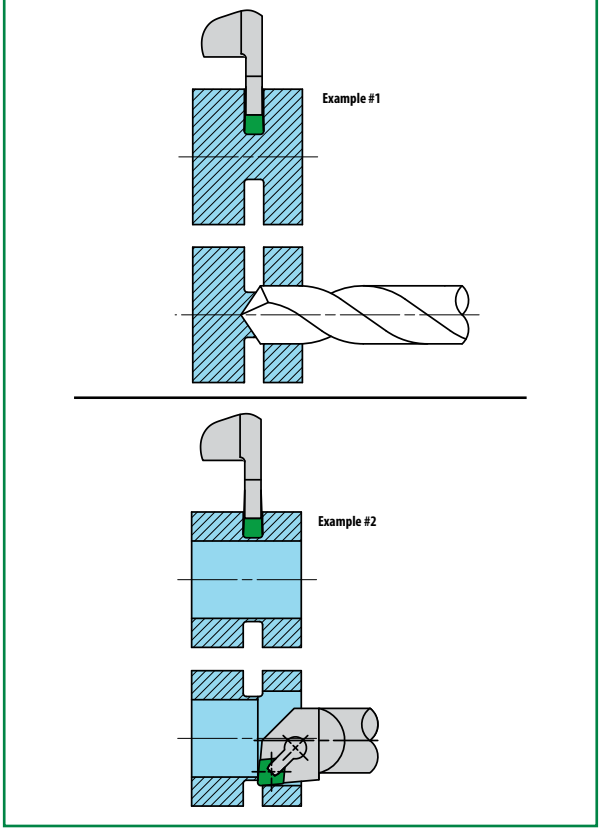
When the second groove breaks into the first one, a complete ring is produced. A fixture must be used to hold the ring as it parts from the main forging or else the tool will be damaged. It is worth constructing a special clamping fixture for such cases since the method itself is so economical.

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.

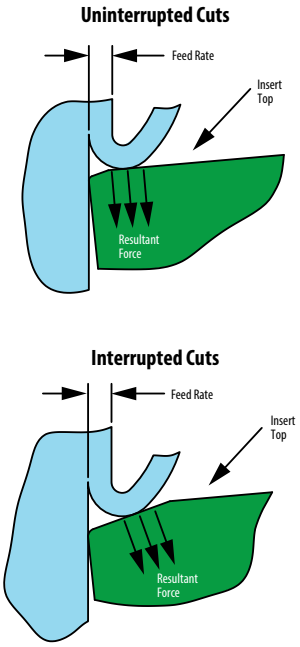
Interrupted Turning

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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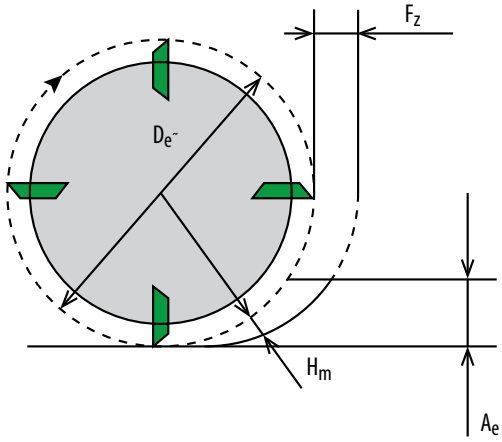
Milling

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

$$H_m \approx F_z \sin\left(\cos^{-1}(1 - A_p/R)\right)\sqrt{A_e/D_{eff}}$$

For straight-edged inserts, average chip thickness Hm 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

$$H_m \approx F_z \sin(K_r)\sqrt{A_e/D_{eff}}$$

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	
Low γ′ [4] S2 (Solution-Treated and Aged)		H_m:	0.003	0.0045		0.08	0.12	
Inconel 706, Inconel 718, Inconel 725	40-45	V_c:	3450	2600		1050	800	
High γ′ S2 (Solution-Treated and Aged)		H_m:	0.0015	0.0025		0.04	0.06	
IN100, Udimet 720, Waspaloy, C1023, Rene 88, N-18	40-50	V_c:	2600	1950		800	600	
		H_m:	0.001	0.002		0.03	0.05	
	20 [5]	V_c:	3950	2600		1200	800	
S3: Wear-Resistant HRSA		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	
	40	V_c:	1500	1050		450	320	
H1: Carbon and Alloyed Steel		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	
D2, M4, S7, A2, etc.		H_m:	0.003	0.0045		0.08	0.12	
	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
info@greenleafcorporation.com.cn

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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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