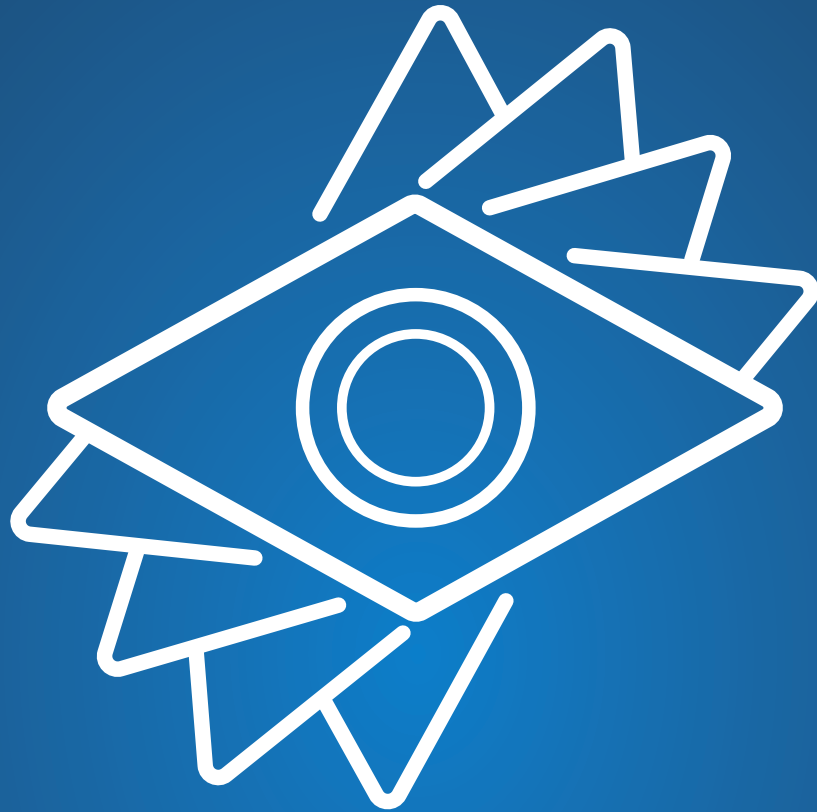


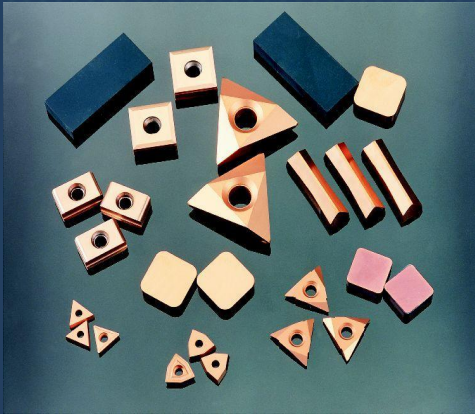


CERAMIC INSERTS



SILICON NITRIDE, WHITE, BLACK, AND WHISKERED CERAMICS

Our Products



Carbide



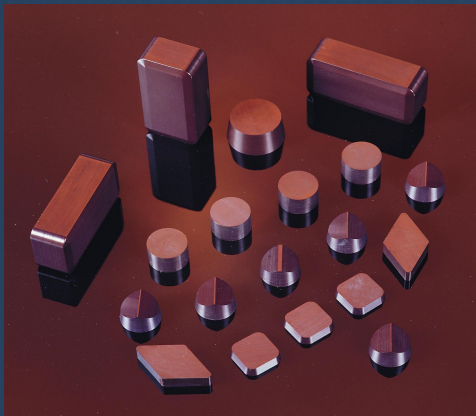
White Ceramic



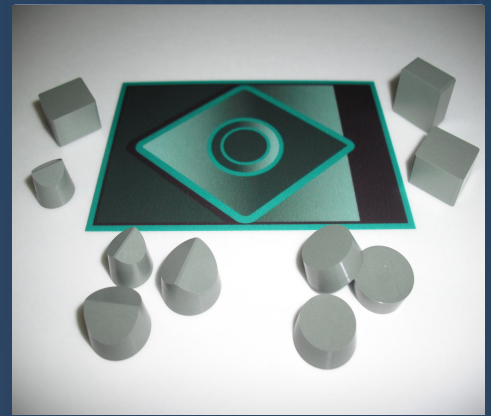
Black Ceramic



Silicon Nitride -MW30/
MW43/T IT AN



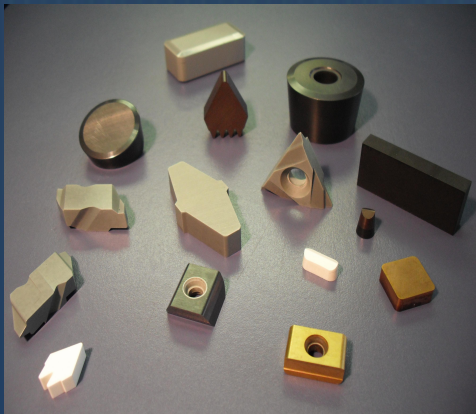
Silicon Nitride - MW 37



MWW



PCD/CBN



Specials

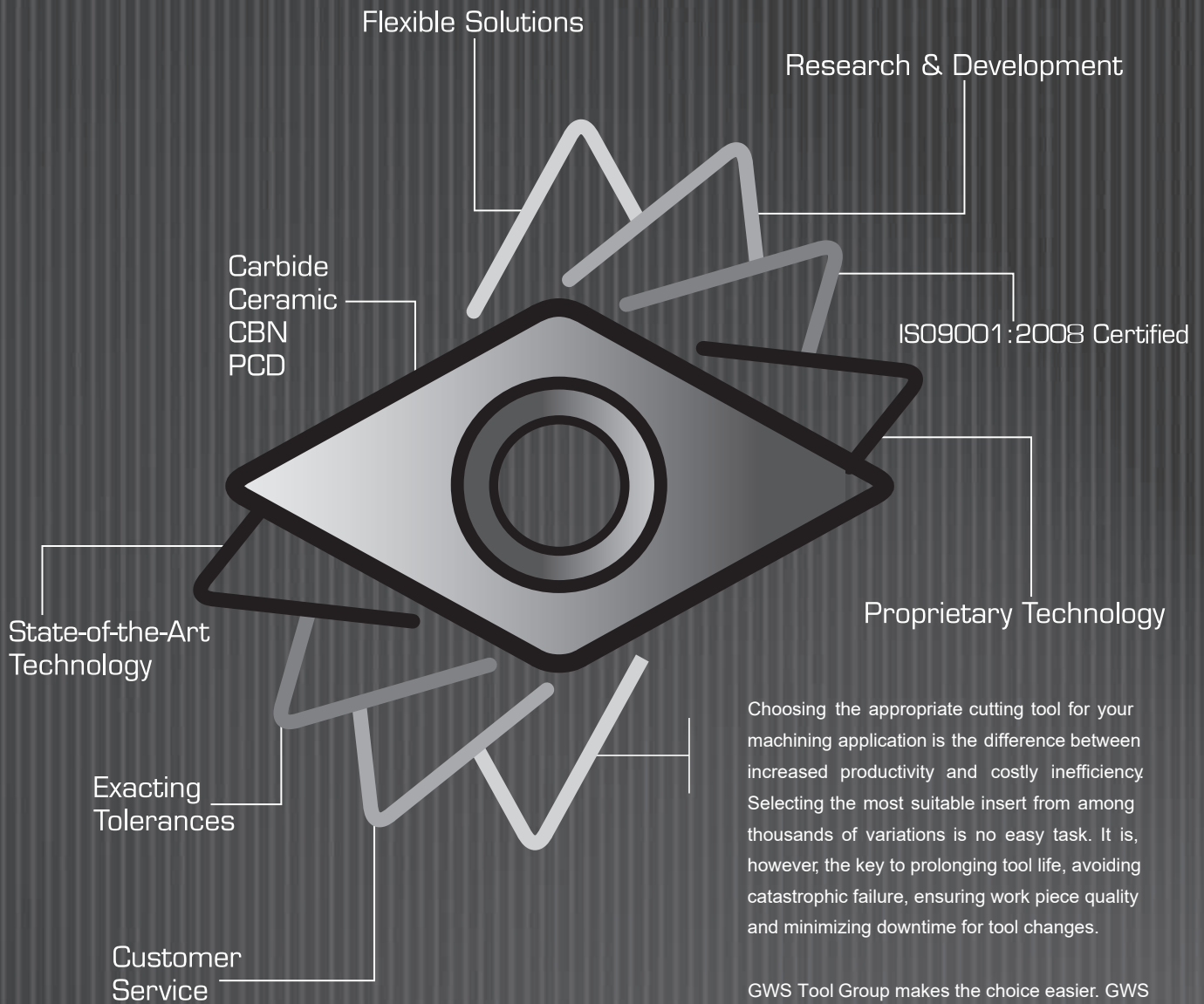
GWS Tool Group offers a wide variety of world-class cutting tool products.

For more information on any of these products or for a catalog of any specific product contact our knowledgeable staff at:

1-877-497-8665

www.GWSToolGroup.com

sales@gwstoolgroup.com



Choosing the appropriate cutting tool for your machining application is the difference between increased productivity and costly inefficiency. Selecting the most suitable insert from among thousands of variations is no easy task. It is, however, the key to prolonging tool life, avoiding catastrophic failure, ensuring work piece quality and minimizing downtime for tool changes.

GWS Tool Group makes the choice easier. GWS has been dedicated to meeting the cutting tool needs of customers in industries as diverse as automotive, aerospace, electronic and heavy equipment manufacturing. Through our broad range of products, technical expertise, R & D capabilities and commitment to customer service, GWS Tool Group provides cost-effective, flexible solutions to any cutting challenge.

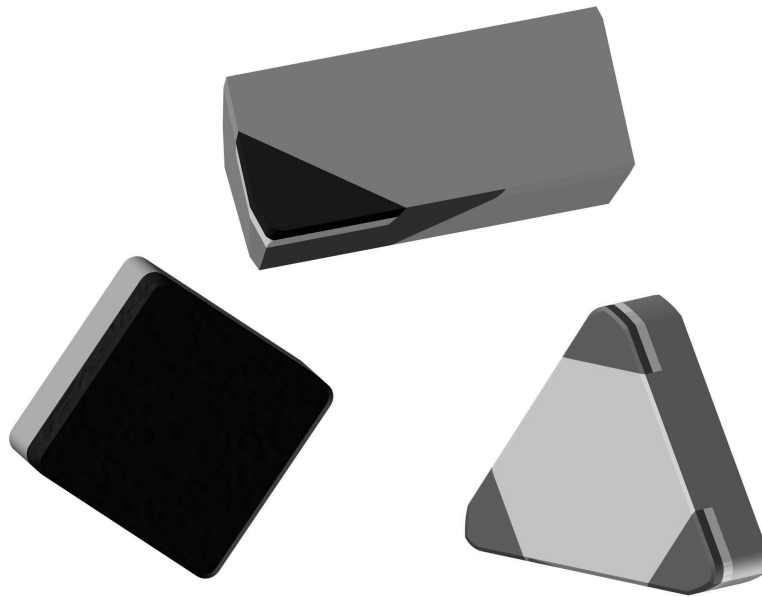
By utilizing advanced, proprietary technology, we manufacture precision ground inserts that provide consistent, increased productivity. An ISO9001:2008 registered company, GWS Tool Group is driven by an emphasis on quality in everything we do.



GWS Tool Group offers a broad range of cutting tool materials to meet your machining needs. Whether your production systems involve hard turning or milling, require heavy roughing or high speed finishing, machine high silica aluminum or tough superalloys, we have the product.

Our carbide inserts offer a cost-effective solution for general purpose machining as well as a number of special applications. With a wide variety of grades, chipbreakers and coatings, you'll find the tool best suited to your application.

The GWS line of CBN tooling (cubic boron nitride) offers great hardness and abrasion resistance, coupled with extreme chemical stability when in contact with ferrous alloys at high temperatures. It has the ability to machine both steels and cast irons at high speeds for long operating cycles.



GWS Tool Group's family of five PCD (polycrystalline diamond) grades can satisfy all of your nonferrous and non-metallic machining needs, from the roughest and most tenacious of conditions and materials to the tightest tolerance and smoothest surface finish requirements. Our PCD inserts deliver maximum productivity.

Made from the finest powders in the world, using proprietary technology, Indexable manufactures some of the strongest, wear resistant ceramics. A patented microwave sintering process produces a very fine-grained micro-structure with enhanced hardness, toughness and high temperature strength. Called MicroWear, this family of ceramics can machine a broad range of materials from the hardest cast irons to the toughest high-temperature alloys.

Engineered and manufactured using state-of-the-art technology, all of our inserts are of exceptional detail and exacting precision. So when you're looking for quality and increased productivity, look no further than GWS Tool Group.

TABLE OF CONTENTS

PLEASE NOTE:

GWS Tool Group's catalogs DO NOT SHOW the complete capability or range of our products. Many products available are specials or non-standard inserts not represented in our catalogs. For a more detailed understanding visit our website at GWSToolGroup.com.

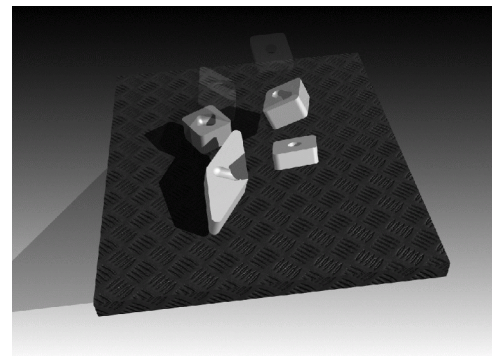
If you fail to find an item you are looking for please do not hesitate to contact our knowledgeable staff at sales@gwstoolgroup.com. GWS has the manufacturing capability of producing a broad range of inserts.

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GWS Tool Group, a leader in the development of pressed-to-size ceramic inserts is now offering this unique tooling in grades MW30, MW37 and MW43.

This product offers the customer significant savings in a majority of roughing applications. If you feel that a pressed-to-size insert would aid you in becoming a more productive company, please contact GWS' knowledgeable staff at sales@gwstoolgroup.com, or visit our website at GWSToolGroup.com.

All stocked pressed-to-size inserts are designated in the catalogue with a "M" tolerance. EX. CNMX 454.



CERAMIC INSERTS

GRADE APPLICATIONS

Grade	TRS (psi)	Hardness*	Toughness	Characteristics	General Applications
I-50	105,000	93.1	3.8	<ul style="list-style-type: none"> Toughened by ZrO₂ High chemical stability 	<ul style="list-style-type: none"> Finish/semi-finish/roughing of cast irons Finish/semi-finish cutting for steel
I-100	130,000	94.5	-	<ul style="list-style-type: none"> Excellent wear resistance High thermal shock resistance 	<ul style="list-style-type: none"> Hardened steel Finish & semi-finish machining of steels and cast iron
MW30	115,000	94.6	7.4	<ul style="list-style-type: none"> Thermal shock resistance Exceptionally tough Excellent wear resistance 	<ul style="list-style-type: none"> Roughing and semi-finishing of cast iron Can run with flood coolant Excellent milling grade
MW37	110,000	93.0	7.7	<ul style="list-style-type: none"> Excellent thermal shock resistance High fracture strength 	<ul style="list-style-type: none"> Suited for nickel based alloy material High velocity rough machining
MW43	168,000	94.9	6.5	<ul style="list-style-type: none"> Exceptionally high resistance to fracture and thermal cracking Excellent wear resistance 	<ul style="list-style-type: none"> Designed for machining cast irons at high surface speeds Excellent finishing grade Coolant is not recommended with this grade
MW43B	-	94.2	7.0	<ul style="list-style-type: none"> Increased toughness over MW43 Compatible with coolant 	<ul style="list-style-type: none"> For general purpose machining of cast iron with or without coolant Excellent grade for nodular iron More forgiving to inclusions and other casting defects
TITAN	-	93.2	7.2	<ul style="list-style-type: none"> Exceptionally tough Excellent wear resistance 	<ul style="list-style-type: none"> Developed specifically for milling cast iron Suitable for rough turning nodular iron
MWW	-	94.4	-	<ul style="list-style-type: none"> Excellent wear resistance Whisker reinforced Resistant to cracking 	<ul style="list-style-type: none"> Developed for high productivity machining of hardened steels, Ni and cobalt based alloys Excellent wear and notch resistance

* Hardness is measured in Ra

CERAMIC INSERTS

GRADE INFORMATION

GRADE	INFORMATION
I-50	I-50 is an Al ₂ O ₃ grade, which is enhanced with Zirconia. This is a very stable grade and can be used for general machining and finish cutting of cast iron.
I-100	Shows excellent thermal shock and wear resistance. A general purpose machining grade for hardened steel. It can be used for finish and semi-finish cutting of soft cast iron without interruption.
MW30	Designed for rough turning of cast irons. MW30 is the toughest grade for rough turning cast irons. Can be utilized with flood coolant to increase surface finish.
MW37	Developed specifically for the high speed machining of nickel based alloys. It is capable of machining materials such as Inconel 718 (45HRC) at speeds up to 10 times faster than carbide.
MW43	Specifically for high speed general and finishing turning cast iron, MW43 offers enhanced hardness, toughness and high temperature strength. Because of this, MW43 has very high wear resistance, promoting longer tool life. This grade also displays increased chipping resistance as well as higher speeds and feeds over competitor's grades. We recommend to NOT use coolant with this grade, as the exceptional red-hardness of MW43 allows it to maintain stable life without the risk of premature wear due to heat.
MW43B	A modified version of our highly successful MW43 grade. MW43B has been engineered to provide a tougher cutting edge, specifically for applications that require a more forgiving substrate. This grade also works with or without coolant depending on your application requirements. MW43B is also successful in finish turning of nodular iron providing dependable tool life and toughness.
TITAN	GWS Tool Group's TITAN was developed for milling applications involving cast irons. Titan offers high shock and impact resistance. Titan has proven exceptional at rough turning nodular irons.
MWW	Our whisker reinforced grade offers longer and more stable tool life over other competitors grades, with reduced chipping and notch wear. Specifically for machining hardened steels, nickel and cobalt based refractory alloys with greatly increased speeds and feeds over carbide.

CERAMIC INSERTS

GRADE APPLICATION GUIDE

WORK MATERIAL	Operation	GWS TOOL GROUP GRADE						
		I-50	I-100	MW30	MW37	MW43	TITAN	MWW
Steels (<35 Rc)	Turning	•						
	Milling		•					
Steels (>35 Rc)	Turning		•					
	Milling		•					•
High Temperature Alloys	Turning		•		•			•
	Milling				•	•	•	•
Cast Irons (<300 BHN)	Turning	•	•	•		•		
	Milling		•				•	
Cast Irons (>300 BHN)	Turning		•	•		•		
	Milling		•				•	
Brass, Bronze Carbon, Plastics	Turning	•						
	Milling					•	•	
Is coolant recommended?							No	

GRADE COMPARISON CHART

	GWS TOOL GROUP	GREENLEAF	ISCAR	KENNAMETAL	KYOCERA	MITSUBISHI	NTK	ROMAY	SANDVIK	SPK	SSANGYONG	SUMIOTOMO	TAEGUTECH	TUNGALOY
CAST IRON	I50	GEM19	IN11		KA30	MH1	HC1 HW2	CC10			SZ200 SZ300		AW20 AB120	
	I100 I150	GEM7	IN22 IN23	KO90 KY1615	A65 A66N PT600M	MH2 MH3	HC2 HC5 HC6	CC20 CC30	CC620 CC650	SH2	ST100 ST300 ST500 SD200 TC300 TA300	NB90S	AB30	LX11 LX21 CX710
	MW43 MW43B MW45HP TITAN2	CSN200 CSN100	IS8 IS80	KYK25 KYK35 KY3000 KY3400 KY3500	CS7050 KS6000 KS6050	MK1 MK2 MK3	SX1 SX6 SP9	CC510 CC513 CC514 CC514SC CC516 CC516SC	CC6190 CC1690	SL506 SL508 SL554C SL808 SL550C SL654 SL854C	SN26 SN300 SN400 SN500 SN600 SN700 SN800	SN2000K NS260 NS260C SN2100K	AS10 SC10 AS500	FX105
HEAT RESISTANT ALLOY	MWW	WG300 WG600	IW7	KY4300		MSW	WA1	CC600	CC670		SW400 SW500 SW700	WX2000	TC430	
	MW37	SIAIOX		KYS25 KYS30 KY2100 KY1525 KY1540	CF1	MS1	SX5 SX7 SX9	CC5477	CC6060 CC6065		SN900	SN1000H	AS20	
HARDENED MATERIAL	I100 I150	GEN7	IN22	KY4400	A65 KT66 A66N PT600M	MH2 MH3	HC4 ZC4 HC7 ZC7	CC30SC	CC6050			NB90S	AB20	LX11
	MWW	WG300 WG600	IW7	KYS25 KY4300		MSW	WA1		CC670		SW400 SW500 SW700			

CERAMIC INSERTS

EDGE PREPARATIONS

The application of T-lands (edge chamfers), hones, or both is generally required to increase the strength of ceramic cutting edges. Negative T-lands redirect the cutting forces into the body of the insert, thereby reducing the tensile stresses on the cutting edge. Honing or edge rounding eliminates the sharp edges at which chipping can occur in the early stages of use.

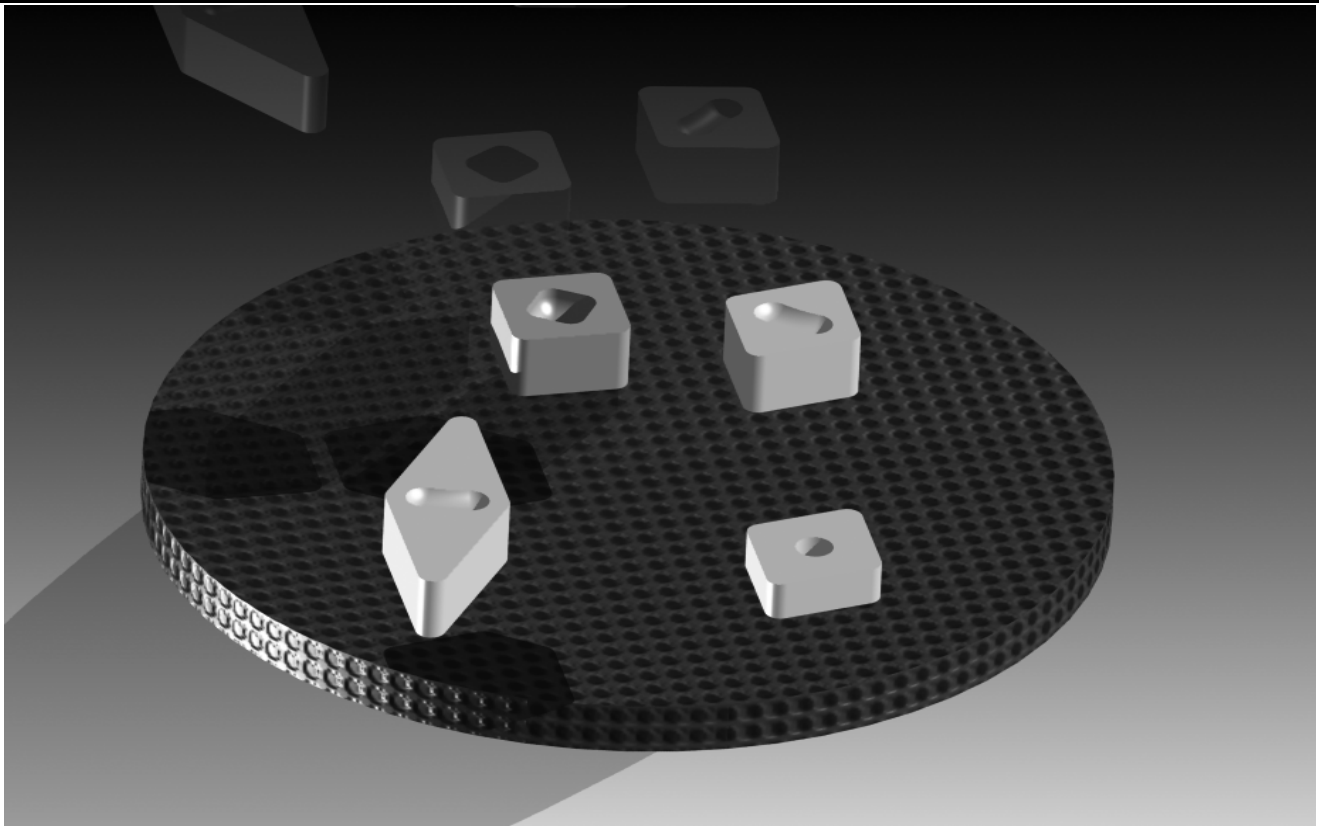
Selecting the proper edge preparation is often the most important factor affecting the performance of ceramic inserts. The size and type of the edge preparation required are related primarily to the feed rate and the severity of the operation. Light feed rates demand small T-lands and/or hones; heavy feed rates require larger T-lands and hones.

The ideal edge preparation is the smallest which consistently provides adequate edge strength and resistance to chipping in a given operation. As a general rule, the feed rate (in inches/revolution) should be 1 - 1.5 times the width of the T-land.

GWS Tool Group's standard edge preparations have been selected to provide a high degree of edge security over a wide range of applications and machining conditions. These standards and corresponding general application guidelines are listed in the table below.

DESIGNATION	LAND	OPERATION
T1	.002" X 30°	Precision Finishing Operations
T2	.004" X 30°	Finishing Operations
T3	.006" X 30°	Milling Operations
T4	.008" X 30°	Roughing & Finishing Operations
T5	.012" X 30°	High Speed Roughing
T6	.004" X 20°	Light Finishing
T7	.008" X 20°	Roughing & Finishing
T8	.012" X 20°	High Speed Roughing
T9	.060" X 10°	Steel Roll Applications
T10	.060" X 20°	Steel Roll Applications
T11	.060" X 30°	Steel Roll Applications
DESIGNATION	HONE RADIUS	OPERATION
A	.001" - .003"	Light Hone
B	.003" - .005"	Medium Hone
C	.006" - .008"	Heavy Hone

To add a hone size to the above edge preparations, the above letter should be used.



CERAMIC INSERTS

RECOMMENDED CUTTING CONDITIONS FOR TURNING AND MILLING

Material	Hardness Bhn	Depth of Cut (in.)	Recommended Speed Range (sfm)						
			I-50	I-100	MW30	MW37	MW43	TITAN	MWW
Carbon Steels AISI Series 1000 1100 1200	150-200	.025	2000-3000	1800-2500	-	-	-	-	-
		.075	1800-2200	1500-2000	-	-	-	-	-
		.150	-	1200-1600	-	-	-	-	-
	200-250	.025	1600-2400	1200-1800	-	-	-	-	-
		.075	1200-1800	1000-1500	-	-	-	-	-
		.150	-	800-1200	-	-	-	-	-
	250-350	.020	1000-1500	1000-1500	-	-	-	-	-
		.060	800-1200	800-1200	-	-	-	-	-
		.125	-	700-1000	-	-	-	-	-
	40-50 Rc	.015	-	500-1000	-	-	-	-	-
		.030	-	400-800	-	-	-	-	-
		.060	-	350-600	-	-	-	-	-
50-60 Rc	.010	-	350-600	-	-	-	-	-	
	.020	-	300-500	-	-	-	-	-	
	.040	-	250-400	-	-	-	-	-	
Alloy Steels AISI Series 1300 4000 5000 6000 8000 9000	130-200	.025	1600-2200	1500-2000	-	-	-	-	-
		.075	1400-1800	1200-1800	-	-	-	-	-
		.150	-	1000-1500	-	-	-	-	-
	200-250	.025	1200-1600	1000-1500	-	-	-	-	-
		.075	1000-1400	900-1300	-	-	-	-	-
		.150	-	800-1200	-	-	-	-	-
	250-350	.020	900-1300	800-1200	-	-	-	-	-
		.060	800-1200	700-1000	-	-	-	-	-
		.125	-	600-900	-	-	-	-	-
	40-50 Rc	.015	-	500-800	-	-	-	-	-
		.030	-	400-600	-	-	-	-	-
		.060	-	300-500	-	-	-	-	-
50-60 Rc	.010	-	300-500	-	-	-	-	-	
	.020	-	250-450	-	-	-	-	-	
	.040	-	200-400	-	-	-	-	-	
Tool Steels Bearing Steels	250-350	.025	-	1000-1500	-	-	-	-	-
		.075	-	800-1200	-	-	-	-	-
		.150	-	600-900	-	-	-	-	-
	45-50 Rc	.020	-	600-900	-	-	-	-	-
		.040	-	500-800	-	-	-	-	-
		.080	-	400-700	-	-	-	-	-
	50-55 Rc	.010	-	400-600	-	-	-	-	-
		.020	-	350-550	-	-	-	-	-
		.040	-	300-500	-	-	-	-	-
55-60 Rc	.010	-	300-500	-	-	-	-	-	
	.020	-	250-450	-	-	-	-	-	
	.040	-	200-400	-	-	-	-	-	

NOMENCLATURE

SHAPE	TOLERANCE																	
	ANSI			ISO														
A - Parallelogram 85° B - Parallelogram 82° C - Diamond 80° D - Diamond 55° E - Diamond 75° F - Diamond 50° H - Hexagon K - Parallelogram 55° L - Rectangle M - Diamond 86° O - Octagon P - Pentagon R - Round S - Square T - Triangle V - Diamond 35°	Cutting point Thickness						Triangular insert with secondary cutting edge											
	A	±.0002	±.001	SYM.	m	d	s	I.C.										
	B	±.0002	±.005	A	±.005	±.025	±.025	6.35	±.08	-	-	-	-					
	C	±.0005	±.001	F	±.005	±.013	±.025	9.525	±.08	±.08	±.08	±.11	±.13					
	D	±.0005	±.005	C	±.013	±.013	±.025	12.7	±.13	±.13	±.13	±.15	-					
	E	±.001	±.001	H	±.025	±.025	±.025	15.875	±.15	±.15	±.15	±.18	-					
	G	±.001	±.005	E	±.025	±.025	±.13	19.05	±.15	±.15	±.15	±.18	-					
	M	±.002 to ±.005*		G	±.025	±.025	±.13	25.4	-	±.18	-	-	-					
	U	±.005 to ±.012*±.005		J	±.005	±.05~±.13	±.025	31.75	-	±.25	-	-	-					
	Exact tolerances determined by size of insert			K	±.013	±.05~±.13	±.025	TOLERANCE ON THE CIRCUMSCRIBED CIRCLE										
				L*	±.025	±.05~±.13	±.025	M*	±.08~±.18	±.05~±.13	±.13	I.C.						
				N*	±.08~±.18	±.05~±.13	±.025	6.35	±.05	-	-	-	-	-	-	-	-	
				U*	±.13~±.38	±.08~±.25	±.13	9.525	±.05	±.05	±.05	±.05	±.05	±.05	±.05	±.05	±.05	
				*Exact tolerances determined by size of insert. FOR CLASS M INSERTS SEE TABLE TO RIGHT				12.7	±.08	±.08	±.08	±.08	±.08	-	±.08	±.08	±.08	±.08
								15.88	±.10	±.10	±.10	±.10	±.10	-	±.10	±.10	±.10	±.10
							19.05	±.10	±.10	±.10	±.10	-	±.10	±.10	±.10	±.10	±.10	
							25.4	-	±.13	-	-	-	-	±.10	±.10	±.10	±.10	
							31.75	-	±.20	-	-	-	-	±.10	±.10	±.10	±.12	

T SHAPE	N CLEARANCE	G TOLERANCE	N TYPE
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CLEARANCE	TYPE(ANSI)	TYPE(ISO)
N - 0°	A - With hole	A - With hole
A - 3°	B - With hole and one countersink	B - With hole and one 70°-90° countersink
B - 5°	C - With hole and two countersinks	C - With hole and two 70°-90° countersinks
C - 7°	D - Smaller than 1/4" I.C. with hole	F - Chipbreaker both sides
P - 11°	E - Smaller than 1/4" I.C.	G - With hole, chipbreaker on both sides
D - 15°	F - Chip grooves on top rake surfaces, without hole	H - With hole, one 70°-90° countersink and chipbreaker on one side
E - 20°	G - Chip grooves on top rake surfaces, with hole	J - With hole, two 70°-90° countersinks and chipbreaker on both sides
F - 25°	H - With hole, one countersink and chip grooves on one top rake surface	M - With hole and chipbreaker on one side
G - 30°	J - With hole, two countersinks and chip grooves on top rake surfaces	N - No hole, no chipbreaker
	M - With hole and chip grooves on one top rake surface	Q - With hole, one 40°-60° countersink
	P - With hole and 10° positive chip-breaker both sides	R - Chipbreaker one side
	S - With hole and 20° chip-breaker one side	T - With hole, one 40°-60° countersink, chipbreaker one side
	X - Dimple Lock (interchangeable with competitors notch lock style inserts)	W - With hole, one 40°-60° countersink
	X - V-Bottom	X - Dimple Lock (interchangeable with competitors notch lock style inserts)
		X - V-Bottom

SIZE									
							MM	INCH	ANSI SYMBOL
03		04	03	03	06	03	3,97	0.156	1.25
04	08	05	04	04	08	04	4,76	0.188	1.5
05	09	06	05	05	09	05	5,56	0.219	1.8
06	11*	06					6,00	0.236	
06*	11	07	06	06	11	06	6,35	0.250	2
07	13	09	08	07	13	07	7,94	0.313	2.5
08*							8,00	0.315	
09	16	11	09	09	16	09	9,525	0.375	3
10*							10,00	0.394	
12*							12,00	0.472	
12	22	15	12	12	22	12	12,70	0.500	4
15		19	16	15	27	15	15,875	0.625	5
16							16,00		
19	33	23	19	19	33	19	19,05	0.750	6
20*							20,00	0.787	
	38	27	22	22	38	22	22,225		
25*							25,00	0.984	
25	44	31	25	25	44	25	25,40	1.000	8
31		38	32	31	53	31	31,75	1.250	10
32							32,00		

THICKNESS			
ISO	MM	ANSI	INCH
01	1,59	1	0.062
T1	1,98	1.2	0.078
02	2,38	1.5	0.094
03	3,18	2	0.125
T3	3,97	2.5	0.156
04	4,76	3	0.188
05	5,56	3.5	0.219
06	6,35	4	0.250
07	7,94	5	0.313
09	9,52	6	0.375
12	12,70	8	0.500

Rectangles and parallelograms use a 2 digits to size:
 1st digit-Number of 1/8ths inch in width
 2nd digit-Number of 1/4 inches in length

22	04	08	E
SIZE	THICKNESS	RADIUS	OTHER CONDITIONS
4	3	2	E

RADIUS			
ISO	MM	ANSI	INCH
00	SHARP EDGE	0	SHARP EDGE
02	0,20	0.5	0.008
04	0,40	1	0.016
08	0,80	2	0.031
12	1,20	3	0.047
16	1,60	4	0.062
20	2,00	5	0.078
2	2,40	6	0.094
28	2,78	7	0.109
32	3,18	8	0.125
00	ROUND INSERT	0	ROUND INSERT

OTHER CONDITIONS
A -Light hone
B -Medium hone
C -Heavy hone
D -Ground top and bottom only- Heavy hone
E -Unground insert honed
F -Unground insert not honed
J -Polished(rake face only)
T - Land or chamfer
FA -Finishing application
SA -Standard application

CERAMIC INSERTS

INDEX-A-FEED WIPER INSERTS

Boost finish-turning productivity with GWS Tool Group's *INDEX-A-FEED* wiper inserts.

In finish turning the feed rate has always been limited. If the tool moves farther than the width of its cutting edge in one revolution of the workpiece, material is left uncut. As the feed rate increases the gap of uncut material increases as well.

GWS has found a solution that overcomes the limitation that geometry imposes on finish turning operations. We've modified the nose geometry of our tools to produce finish turning wiper inserts.

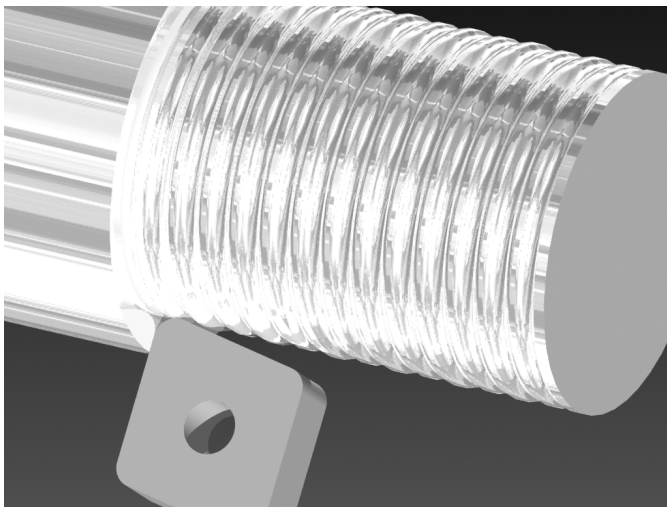
The blended radii of the Index-a-feed insert creates a crowned wiper effect. The trailing edge wipes or smears the wave pattern that is left behind by the quickly moving insert. The blended radii knocks off the high points creating a smoother surface finish.

One brake rotor manufacturer was able to eliminate a grinding step by finish turning brake rotors using Indexable's IF wiper insert.

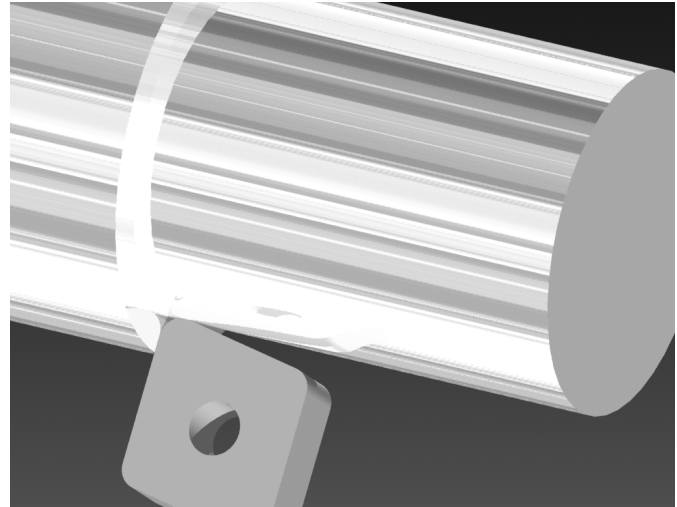
BENEFITS OF INDEX-A-FEED WIPER INSERTS

- Increased productivity due to increased feed rates
- Better surface finishes lead to less secondary operations
- Less heat generated in finish operation, cooler parts
- Longer tool life



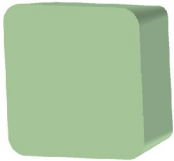


* For examples of GWS Tool Group's INDEX-A-FEED wiper inserts, please refer to page 11




Standard Insert



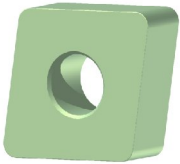

Wiper Insert

CNG	INSERT NUMBER	DIMENSIONS			ISO CODE NUMBERS	
		I.C.	T	R		
	CNG 43 IF	0.500	0.188	-	CNGN 12 04 ZZ	
CNGA		I.C.	T	R		
	CNGA 43 IF	0.500	0.188	-	CNGA 12 04 ZZ	
SCG		I.C.	T	R		
	SCG 33 IF	0.375	0.188	-	SCGN 09 04 ZZ	
SNG		I.C.	T	R		
	SNG 43 IF	0.500	0.188	-	SNGN 12 04 ZZ	
CDH		I.C.	T	R		
	CDH 33	0.750	0.375	-	RCMA 19 09 00	
	CDH 43	1.000	0.375	-	RCMA 25 19 00	
	CDH 53	1.250	0.375	-	RCMA 31 19 00	
AVAILABLE GRADES(For grade characteristics and applications see pages 1-3)						
I-50	I-100	MW30	MW37	MW43	TITAN	MWW

CNG	INSERT NUMBER	DIMENSIONS			ISO CODE NUMBERS
		I.C.	T	R	
	CNG 431	0.500	0.188	0.016	CNGN 12 04 04
	CNG 432			0.031	CNGN 12 04 08
	CNG 433			0.047	CNGN 12 04 12
	CNG 434			0.063	CNGN 12 04 16
	CNG 441		0.250	0.016	CNGN 12 06 04
	CNG 442			0.031	CNGN 12 06 08
	CNG 443			0.047	CNGN 12 06 12
	CNG 444			0.063	CNGN 12 06 16
	CNG 451		0.313	0.016	CNGN 12 07 04
	CNG 452			0.031	CNGN 12 07 08
	CNG 453			0.047	CNGN 12 07 12
	CNG 454			0.063	CNGN 12 07 16
	CNG 531	0.625	0.188	0.016	CNGN 16 04 04
	CNG 532			0.031	CNGN 16 04 08
	CNG 533			0.047	CNGN 16 04 12
	CNG 534			0.063	CNGN 16 04 16
	CNG 541		0.250	0.016	CNGN 16 06 04
	CNG 542			0.031	CNGN 16 06 08
	CNG 543			0.047	CNGN 16 06 12
	CNG 544			0.063	CNGN 16 06 16
	CNG 551		0.313	0.016	CNGN 16 07 04
	CNG 552			0.031	CNGN 16 07 08
	CNG 553			0.047	CNGN 16 07 12
	CNG 554			0.063	CNGN 16 07 16
	CNG 631	0.750	0.188	0.016	CNGN 19 04 04
	CNG 632			0.031	CNGN 19 04 08
	CNG 633			0.047	CNGN 19 04 12
	CNG 634			0.063	CNGN 19 04 16
	CNG 641		0.250	0.016	CNGN 19 06 04
	CNG 642			0.031	CNGN 19 06 08
	CNG 643			0.047	CNGN 19 06 12
	CNG 644			0.063	CNGN 19 06 16
	CNG 651		0.313	0.016	CNGN 19 07 04
	CNG 652			0.031	CNGN 19 07 08
	CNG 653			0.047	CNGN 19 07 12
	CNG 654			0.063	CNGN 19 07 16


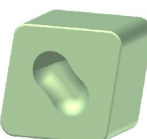
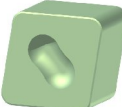
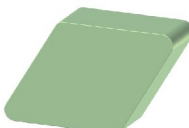
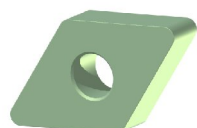
AVAILABLE GRADES(For grade characteristics and applications see pages 1-3)

I-50	I-100	MW30	MW37	MW43	TITAN	MWW
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CNGA	INSERT NUMBER	DIMENSIONS			ISO CODE NUMBERS
		I.C.	T	R	
	CNGA 431	0.500	0.188	0.016	CNGA 12 04 04
	CNGA 432			0.031	CNGA 12 04 08
	CNGA 433			0.047	CNGA 12 04 12
	CNGA 434			0.063	CNGA 12 04 16
	CNGA 441		0.250	0.016	CNGA 12 06 04
	CNGA 442			0.031	CNGA 12 06 08
	CNGA 443			0.047	CNGA 12 06 12
	CNGA 444			0.063	CNGA 12 06 16
	CNGA 451		0.313	0.016	CNGA 12 07 04
	CNGA 452			0.031	CNGA 12 07 08
	CNGA 453			0.047	CNGA 12 07 12
	CNGA 454			0.063	CNGA 12 07 16
	CNGA 531	0.625	0.188	0.016	CNGA 16 04 04
	CNGA 532			0.031	CNGA 16 04 08
	CNGA 533			0.047	CNGA 16 04 12
	CNGA 534			0.063	CNGA 16 04 16
	CNGA 541		0.250	0.016	CNGA 16 06 04
	CNGA 542			0.031	CNGA 16 06 08
	CNGA 543			0.047	CNGA 16 06 12
	CNGA 544			0.063	CNGA 16 06 16
	CNGA 551		0.313	0.016	CNGA 16 07 04
	CNGA 552			0.031	CNGA 16 07 08
	CNGA 553			0.047	CNGA 16 07 12
	CNGA 554			0.063	CNGA 16 07 16
	CNGA 631	0.750	0.188	0.016	CNGA 19 04 04
	CNGA 632			0.031	CNGA 19 04 08
	CNGA 633			0.047	CNGA 19 04 12
	CNGA 634			0.063	CNGA 19 04 16
	CNGA 641		0.250	0.016	CNGA 19 06 04
	CNGA 642			0.031	CNGA 19 06 08
	CNGA 643			0.047	CNGA 19 06 12
	CNGA 644			0.063	CNGA 19 06 16
	CNGA 651		0.313	0.016	CNGA 19 07 04
	CNGA 652			0.031	CNGA 19 07 08
	CNGA 653			0.047	CNGA 19 07 12
	CNGA 654			0.063	CNGA 19 07 16
CNMA		I.C.	T	R	
	CNMA 434	0.500	0.188	0.063	CNMA 12 04 16
	CNMA 454		0.313	0.063	CNMA 12 07 16

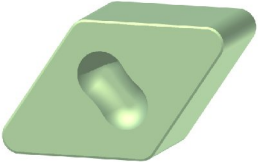
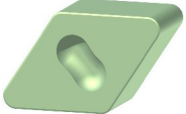
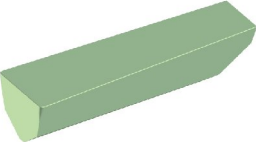
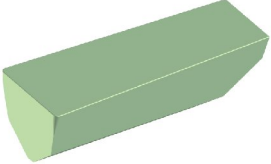

AVAILABLE GRADES(For grade characteristics and applications see pages 1-3)



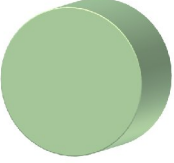

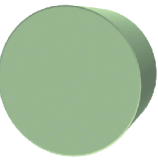

I-50	I-100	MW30	MW37	MW43	TITAN	MWW
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CNMN	INSERT NUMBER	DIMENSIONS			ISO CODE NUMBERS
		I.C.	T	R	
	CNMN 434	0.500	0.188	0.063	CNMN 12 04 16
	CNMN 454		0.313	0.063	CNMN 12 07 16
CNGX (DIMPLE LOCK)		I.C.	T	R	
	CNGX 452	0.500	0.313	0.031	CNGX 12 07 08
	CNGX 453			0.047	CNGX 12 07 12
	CNGX 454			0.063	CNGX 12 07 16
CNMX (DIMPLE LOCK)		I.C.	T	R	
	CNMX 453	0.500	0.313	0.047	CNMX 12 07 12
	CNMX 454			0.063	CNMX 12 07 16
DNG		I.C.	T	R	
	DNG 431	0.500	0.188	0.016	DNGN 15 04 04
	DNG 432			0.031	DNGN 15 04 08
	DNG 433			0.047	DNGN 15 04 12
	DNG 434			0.063	DNGN 15 04 16
	DNG 441		0.250	0.016	DNGN 15 06 04
	DNG 442			0.031	DNGN 15 06 08
	DNG 443			0.047	DNGN 15 06 12
	DNG 444			0.063	DNGN 15 06 16
	DNG 451		0.313	0.016	DNGN 15 07 04
	DNG 452			0.031	DNGN 15 07 08
	DNG 453			0.047	DNGN 15 07 12
	DNG 454			0.063	DNGN 15 07 16
DNGA		I.C.	T	R	
	DNGA 431	0.500	0.188	0.016	DNGA 15 04 04
	DNGA 432			0.031	DNGA 15 04 08
	DNGA 433			0.047	DNGA 15 04 12
	DNGA 434			0.063	DNGA 15 04 16
	DNGA 441		0.250	0.016	DNGA 15 06 04
	DNGA 442			0.031	DNGA 15 06 08
	DNGA 443			0.047	DNGA 15 06 12
	DNGA 444			0.063	DNGA 15 06 16
	DNGA 451		0.313	0.016	DNGA 15 07 04
	DNGA 452			0.031	DNGA 15 07 08
	DNGA 453			0.047	DNGA 15 07 12
	DNGA 454			0.063	DNGA 15 07 16

AVAILABLE GRADES(For grade characteristics and applications see pages 1-3)

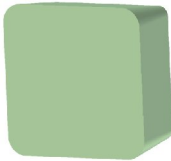




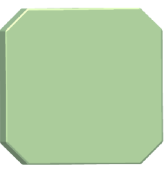
I-50	I-100	MW30	MW37	MW43	TITAN	MWW
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DNGX (DIMPLE LOCK)	INSERT NUMBER	DIMENSIONS			ISO CODE NUMBERS		
		I.C.	T	R			
	DNGX 351	0.375	0.313	0.016	DNGX 11 07 04		
	DNGX 352			0.031	DNGX 11 07 08		
	DNGX 353			0.047	DNGX 11 07 12		
	DNGX 354			0.063	DNGX 11 07 16		
	DNGX 451	0.500	0.313	0.016	DNGX 15 07 04		
	DNGX 452			0.031	DNGX 15 07 08		
	DNGX 453			0.047	DNGX 15 07 12		
	DNGX 454			0.063	DNGX 15 07 16		
DNMX (DIMPLE LOCK)		I.C.	T	R			
	DNMX 353	0.375	0.313	0.047	DNMX 11 07 12		
	DNMX 354			0.063	DNMX 11 07 16		
	DNMX 454	0.500	0.313	0.063	DNMX 15 07 16		
IGK		DIMENSIONS					
		W	T	L	R		
	IGK 8250-2T	0.250	0.328	1.000	0.031		
	IGK 8250-3T				0.047		
	IGK 8250-4T				0.063		
	IGK 8312-2T	0.3125			0.031		
	IGK 8312-4T				0.063		
	IGK 8375-2T	0.375			0.031		
	IGK 8375-4T			0.063			
	IGK 9250-2T	0.250		1.125	0.031		
	IGK 9250-4T				0.063		
	IGK 9375-2T	0.375			0.031		
	IGK 9375-4T				0.063		
	IGW				DIMENSIONS		
W			T		L	R	
	IGW 4187-1T	0.1875	0.1875	0.500	0.031		
	IGW 4187-2T				0.047		
	IGW 4187-4T				0.063		
	IGW 6250-2T	0.250	0.250	0.625	0.031		
	IGW 6250-3T				0.063		
	IGW 6250-4T				0.031		
	IGW 8312-2T	0.3125	0.337	1.000	0.063		
	IGW 8312-3T				0.031		
	IGW 8312-4T				0.063		
	IGW 8375-2T	0.375	0.337	1.000	0.031		
	IGW 8375-4T				0.063		
	LNU		I.C.	L	T	R	
	LNU 6688	0.750	1.500	0.500	0.125	LNUN 66 88	
AVAILABLE GRADES(For grade characteristics and applications see pages 1-3)							
I-50	I-100	MW30	MW37	MW43	TITAN	MWW	


ONC	INSERT NUMBER	DIMENSIONS			ISO CODE NUMBERS
		I.C.	T	R	
	ONC 631	0.750	0.188	0.016	ONCN 19 04 04
	ONC 632			0.031	ONCN 19 04 08
	ONC 633			0.047	ONCN 19 04 12
	ONC 634			0.063	ONCN 19 04 16
RCGX		I.C.	T	A	
	RCGX 35	0.375	0.313	120 deg.	RCGX 09 07 00
	RCGX 45	0.500	0.313	120 deg.	RCGX 12 07 00
	RCGX 55	0.625	0.313	120 deg.	RCGX 15 07 00
	RCGX 66	0.750	0.375	120 deg.	RCGX 19 09 00
	RCGX 88	1.000	0.465	140 deg.	RCGX 25 12 00
RNG		I.C.	T	R	
	RNG 32	0.375	0.125	-	RNGN 09 03 00
	RNG 33		0.188	-	RNGN 09 04 00
	RNG 35		0.313	-	RNGN 09 07 00
	RNG 42	0.500	0.125	-	RNGN 12 03 00
	RNG 43		0.188	-	RNGN 12 04 00
	RNG 44		0.250	-	RNGN 12 06 00
	RNG 45		0.313	-	RNGN 12 07 00
	RNG 54	0.625	0.250	-	RNGN 15 06 00
	RNG 55		0.313	-	RNGN 15 07 00
	RNG 64	0.750	0.250	-	RNGN 19 06 00
	RNG 65		0.313	-	RNGN 19 07 00
	RNG 86	1.000	0.375	-	RNGN 25 09 00
	RNGX		I.C.	T	R
	RNGX 43	0.500	0.188	-	RNGX 12 04 00
	RNGX 45		0.313	-	RNGX 12 07 00
RPG		I.C.	T	R	
	RPG 32	0.375	0.125	-	RPGN 09 03 00
	RPG 33		0.188	-	RPGN 09 04 00
	RPG 43	0.500	0.188	-	RPGN 12 04 00
	RPG 44		0.250	-	RPGN 12 06 00
	RPG 45		0.313	-	RPGN 12 07 00
	RPG 54	0.625	0.250	-	RPGN 15 06 00
	RPG 55		0.313	-	RPGN 15 07 00
	RPG 64	0.750	0.250	-	RPGN 19 06 00
	RPG 65		0.313	-	RPGN 19 07 00
	RPG 85	1.000	0.313	-	RPGN 25 07 00
RPG 86	0.375		-	RPGN 25 09 00	
RPGX		I.C.	T	R	
	RPGX 35	0.375	0.313	-	RPGX 09 07 00
	RPGX 45	0.500	0.313	-	RPGX 12 07 00
	RPGX 55	0.625	0.313	-	RPGX 15 07 00

AVAILABLE GRADES(For grade characteristics and applications see pages 1-3)

I-50	I-100	MW30	MW37	MW43	TITAN	MWW
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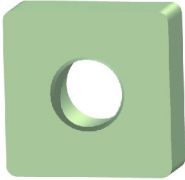


SCG	INSERT NUMBER	DIMENSIONS			ISO CODE NUMBERS
		I.C.	T	R	
	SCG 331	0.375	0.188	0.016	SCGN 09 04 04
	SCG 332			0.031	SCGN 09 04 08
	SCG 333			0.047	SCGN 09 04 12
	SCG 334			0.063	SCGN 09 04 16
SEAN		I.C.	T	R	
	SEAN 42AFTN	0.500	0.125	-	SEAN 12 03 AFTN
	SEAN 43AFTN		0.188	-	SEAN 12 04 AFTN
SEMN		I.C.	T	R	
	SEMN 43AZ	0.500	0.188	-	SEMN 12 04 AZ
SNC		I.C.	T	R	
	SNC 431	0.500	0.188	0.016	SNCN 12 04 04
	SNC 432			0.031	SNCN 12 04 08
	SNC 433			0.047	SNCN 12 04 12
	SNC 434			0.063	SNCN 12 04 16
SNE		I.C.	T	R	
	SNE 431	0.500	0.188	0.016	SNE 12 04 04
	SNE 432			0.031	SNE 12 04 08
	SNE 433			0.047	SNE 12 04 12
	SNE 434			0.063	SNE 12 04 16
	SNE 63A	0.750	0.188	-	SNE 19 04 00

AVAILABLE GRADES(For grade characteristics and applications see pages 1-3)						
I-50	I-100	MW30	MW37	MW43	TITAN	MWW

SNG	INSERT NUMBER	DIMENSIONS			ISO CODE NUMBERS	
		I.C.	T	R		
	SNG 321	0.375	0.125	0.016	SNGN 09 03 04	
	SNG 322			0.031	SNGN 09 03 08	
	SNG 323			0.047	SNGN 09 03 12	
	SNG 324			0.063	SNGN 09 03 16	
	SNG 331		0.188	0.016	SNGN 09 04 04	
	SNG 332			0.031	SNGN 09 04 08	
	SNG 333			0.047	SNGN 09 04 12	
	SNG 334			0.063	SNGN 09 04 16	
	SNG 421	0.500	0.125	0.016	SNGN 12 03 04	
	SNG 422			0.031	SNGN 12 03 08	
	SNG 423			0.047	SNGN 12 03 12	
	SNG 424			0.063	SNGN 12 03 16	
	SNG 431		0.188	0.016	SNGN 12 04 04	
	SNG 432			0.031	SNGN 12 04 08	
	SNG 433			0.047	SNGN 12 04 12	
	SNG 434			0.063	SNGN 12 04 16	
	SNG 436			0.094	SNGN 12 04 24	
	SNG 438			0.125	SNGN 12 04 32	
	SNG 441			0.250	0.016	SNGN 12 06 04
	SNG 442				0.031	SNGN 12 06 08
	SNG 443		0.047		SNGN 12 06 12	
	SNG 444		0.063		SNGN 12 06 16	
	SNG 451		0.313	0.016	SNGN 12 07 04	
	SNG 452			0.031	SNGN 12 07 08	
	SNG 453			0.047	SNGN 12 07 12	
	SNG 454			0.063	SNGN 12 07 16	
	SNG 531		0.625	0.188	0.016	SNGN 15 04 04
	SNG 532				0.031	SNGN 15 04 08
	SNG 533				0.047	SNGN 15 04 12
	SNG 534				0.063	SNGN 15 04 16
	SNG 541			0.250	0.016	SNGN 15 06 04
	SNG 542				0.031	SNGN 15 06 08
	SNG 543	0.047			SNGN 15 06 12	
	SNG 544	0.063			SNGN 15 06 16	
	SNG 551	0.313		0.016	SNGN 15 07 04	
	SNG 552			0.031	SNGN 15 07 08	
	SNG 553			0.047	SNGN 15 07 12	
	SNG 554			0.063	SNGN 15 07 16	
	SNG 561	0.375		0.016	SNGN 15 08 04	
	SNG 562			0.031	SNGN 15 08 08	
	SNG 563			0.047	SNGN 15 08 12	
	SNG 564			0.063	SNGN 15 08 16	
	SNG 631	0.750		0.188	0.016	SNGN 19 04 04
	SNG 632				0.031	SNGN 19 04 08
	SNG 633				0.047	SNGN 19 04 12
	SNG 634				0.063	SNGN 19 04 16
	SNG 641		0.250	0.016	SNGN 19 06 04	
	SNG 642			0.031	SNGN 19 06 08	
	SNG 643			0.047	SNGN 19 06 12	
	SNG 644			0.063	SNGN 19 06 16	
	SNG 651		0.3130	0.016	SNGN 19 07 04	
	SNG 652			0.031	SNGN 19 07 08	
	SNG 653			0.047	SNGN 19 07 12	
	SNG 654			0.063	SNGN 19 07 16	
	SNG 656			0.094	SNGN 19 07 24	
	SNG 661			0.3750	0.016	SNGN 19 08 04
	SNG 662				0.031	SNGN 19 08 08
	SNG 663				0.047	SNGN 19 08 12
	SNG 664		0.063		SNGN 19 08 16	


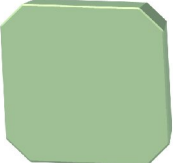
AVAILABLE GRADES(For grade characteristics and applications see pages 1-3)

I-50	I-100	MW30	MW37	MW43	TITAN	MWW
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SNGA	INSERT NUMBER	DIMENSIONS			ISO CODE NUMBERS	
		I.C.	T	R		
	SNGA 321	0.375	0.125	0.016	SNGA 09 03 04	
	SNGA 322			0.031	SNGA 09 03 08	
	SNGA 323			0.047	SNGA 09 03 12	
	SNGA 324			0.063	SNGA 09 03 16	
	SNGA 431	0.500	0.188	0.016	SNGA 12 04 04	
	SNGA 432			0.031	SNGA 12 04 08	
	SNGA 433			0.047	SNGA 12 04 12	
	SNGA 434			0.063	SNGA 12 04 16	
	SNGA 436			0.094	SNGA 12 04 24	
	SNGA 441			0.016	SNGA 12 06 04	
	SNGA 442		0.250	0.031	SNGA 12 06 08	
	SNGA 443			0.047	SNGA 12 06 12	
	SNGA 444			0.063	SNGA 12 06 16	
	SNGA 451		0.313	0.016	SNGA 12 07 04	
	SNGA 452			0.031	SNGA 12 07 08	
	SNGA 453			0.047	SNGA 12 07 12	
	SNGA 454	0.063		SNGA 12 07 16		
	SNGA 531	0.625		0.188	0.016	SNGA 15 04 04
	SNGA 532				0.031	SNGA 15 04 08
	SNGA 533		0.047		SNGA 15 04 12	
	SNGA 534		0.063		SNGA 15 04 16	
	SNGA 536		0.094	SNGA 15 04 24		
	SNGA 541		0.250	0.016	SNGA 15 06 04	
	SNGA 542			0.031	SNGA 15 06 08	
	SNGA 543			0.047	SNGA 15 06 12	
	SNGA 544			0.063	SNGA 15 06 16	
	SNGA 551		0.313	0.016	SNGA 15 07 04	
	SNGA 552			0.031	SNGA 15 07 08	
	SNGA 553			0.047	SNGA 15 07 12	
	SNGA 554	0.063		SNGA 15 07 16		
	SNGA 631	0.750	0.188	0.016	SNGA 19 04 04	
	SNGA 632			0.031	SNGA 19 04 08	
	SNGA 633			0.047	SNGA 19 04 12	
	SNGA 634			0.063	SNGA 19 04 16	
	SNGA 641		0.250	0.016	SNGA 19 06 04	
	SNGA 642			0.031	SNGA 19 06 08	
	SNGA 643			0.047	SNGA 19 06 12	
	SNGA 644			0.063	SNGA 19 06 16	
	SNGA 651		0.313	0.016	SNGA 19 07 04	
	SNGA 652			0.031	SNGA 19 07 08	
	SNGA 653			0.047	SNGA 19 07 12	
	SNGA 654			0.063	SNGA 19 07 16	
	SNGX (DIMPLE LOCK)		I.C.	T	R	
		SNGX 451	0.500	0.313	0.016	SNGX 12 07 04
		SNGX 452			0.031	SNGX 12 07 08
		SNGX 453			0.047	SNGX 12 07 12
		SNGX 454			0.063	SNGX 12 07 16
	SNMX (DIMPLE LOCK)		I.C.	T	R	
		SNMX 453	0.500	0.313	0.047	SNMX 12 07 12
		SNMX 454			0.063	SNMX 12 07 16
		SNMX 554	0.625	0.313	0.063	SNMX 15 07 16

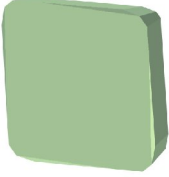
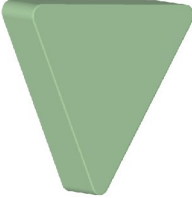
AVAILABLE GRADES(For grade characteristics and applications see pages 1-3)

I-50	I-100	MW30	MW37	MW43	TITAN	MWW
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SPG	INSERT NUMBER	DIMENSIONS			ISO CODE NUMBERS		
		I.C.	T	R			
	SPG 321	0.375	0.125	0.016	SPGN 09 03 04		
	SPG 322			0.031	SPGN 09 03 08		
	SPG 323			0.047	SPGN 09 03 12		
	SPG 324			0.063	SPGN 09 03 16		
	SPG 331		0.188	0.016	SPGN 09 04 04		
	SPG 332			0.031	SPGN 09 04 08		
	SPG 333			0.047	SPGN 09 04 12		
	SPG 334			0.063	SPGN 09 04 16		
	SPG 421	0.500	0.125	0.016	SPGN 12 03 04		
	SPG 422			0.031	SPGN 12 03 08		
	SPG 423			0.047	SPGN 12 03 12		
	SPG 424			0.063	SPGN 12 03 16		
	SPG 431		0.188	0.016	SPGN 12 04 04		
	SPG 432			0.031	SPGN 12 04 08		
	SPG 433			0.047	SPGN 12 04 12		
	SPG 434			0.063	SPGN 12 04 16		
	SPG 441		0.250	0.016	SPGN 12 06 04		
	SPG 442			0.031	SPGN 12 06 08		
	SPG 443			0.047	SPGN 12 06 12		
	SPG 444			0.063	SPGN 12 06 16		
	SPG 451		0.313	0.016	SPGN 12 07 04		
	SPG 452			0.031	SPGN 12 07 08		
	SPG 453			0.047	SPGN 12 07 12		
	SPG 454			0.063	SPGN 12 07 16		
	SPG 531		0.625	0.188	0.016	SPGN 15 04 04	
	SPG 532				0.031	SPGN 15 04 08	
	SPG 533				0.047	SPGN 15 04 12	
	SPG 534				0.063	SPGN 15 04 16	
	SPG 541	0.250		0.016	SPGN 15 06 04		
	SPG 542			0.031	SPGN 15 06 08		
	SPG 543			0.047	SPGN 15 06 12		
	SPG 544			0.063	SPGN 15 06 16		
	SPG 551	0.313		0.016	SPGN 15 07 04		
	SPG 552			0.031	SPGN 15 07 08		
	SPG 553			0.047	SPGN 15 07 12		
	SPG 554			0.063	SPGN 15 07 16		
	SPG 631	0.750		0.188	0.016	SPGN 19 04 04	
	SPG 632				0.031	SPGN 19 04 08	
	SPG 633				0.047	SPGN 19 04 12	
	SPG 634				0.063	SPGN 19 04 16	
	SPG 641		0.250	0.016	SPGN 19 06 04		
	SPG 642			0.031	SPGN 19 06 08		
	SPG 643			0.047	SPGN 19 06 12		
	SPG 644			0.063	SPGN 19 06 16		
	SPG 651		0.313	0.016	SPGN 19 07 04		
	SPG 652			0.031	SPGN 19 07 08		
	SPG 653			0.047	SPGN 19 07 12		
	SPG 654			0.063	SPGN 19 07 16		
	SPG 661		0.375	0.016	SPGN 19 08 04		
	SPG 662			0.031	SPGN 19 08 08		
	SPG 663			0.047	SPGN 19 08 12		
	SPG 664			0.063	SPGN 19 08 16		
			SPG 63A	0.750	0.188	-	SPGN 19 04 00

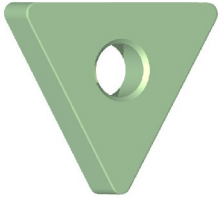
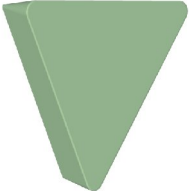
AVAILABLE GRADES(For grade characteristics and applications see pages 1-3)

I-50	I-100	MW30	MW37	MW43	TITAN	MWW
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SPK	INSERT NUMBER	DIMENSIONS			ISO CODE NUMBERS
		I.C.	T	R	
	SPK 42ZR	0.500	0.125	-	SPKN 12 03 ZR
	SPK 43ZR		0.188	-	SPKN 12 04 ZR
TNG		I.C.	T	R	
	TNG 221	0.250	0.125	0.016	TNGN 11 03 04
	TNG 222			0.031	TNGN 11 03 08
	TNG 223			0.047	TNGN 11 03 12
	TNG 224			0.063	TNGN 11 03 16
	TNG 321	0.375	0.125	0.016	TNGN 16 03 04
	TNG 322			0.031	TNGN 16 03 08
	TNG 323			0.047	TNGN 16 03 12
	TNG 324			0.063	TNGN 16 03 16
	TNG 331		0.188	0.016	TNGN 16 04 04
	TNG 332			0.031	TNGN 16 04 08
	TNG 333			0.047	TNGN 16 04 12
	TNG 334			0.063	TNGN 16 04 16
	TNG 341	0.250	0.016	TNGN 16 06 04	
	TNG 342		0.031	TNGN 16 06 08	
	TNG 343		0.047	TNGN 16 06 12	
	TNG 344		0.063	TNGN 16 06 16	
	TNG 431	0.500	0.188	0.016	TNGN 22 04 04
	TNG 432			0.031	TNGN 22 04 08
	TNG 433			0.047	TNGN 22 04 12
	TNG 434			0.063	TNGN 22 04 16
	TNG 441		0.250	0.016	TNGN 22 06 04
	TNG 442			0.031	TNGN 22 06 08
	TNG 443			0.047	TNGN 22 06 12
	TNG 444			0.063	TNGN 22 06 16
	TNG 451	0.313	0.016	TNGN 22 07 04	
	TNG 452		0.031	TNGN 22 07 08	
	TNG 453		0.047	TNGN 22 07 12	
	TNG 454		0.063	TNGN 22 07 16	
	TNG 531	0.625	0.188	0.016	TNGN 27 04 04
	TNG 532			0.031	TNGN 27 04 08
	TNG 533			0.047	TNGN 27 04 12
	TNG 534			0.063	TNGN 27 04 16

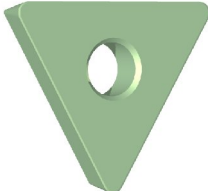
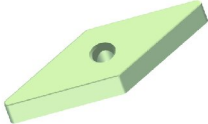
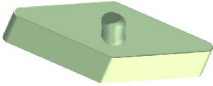

AVAILABLE GRADES(For grade characteristics and applications see pages 1-3)

I-50	I-100	MW30	MW37	MW43	TITAN	MWW
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TNGA	INSERT NUMBER	DIMENSIONS			ISO CODE NUMBERS		
		I.C.	T	R			
	TNGA 321	0.375	0.125	0.016	TNGA 16 03 04		
	TNGA 322			0.031	TNGA 16 03 08		
	TNGA 323			0.047	TNGA 16 03 12		
	TNGA 324			0.063	TNGA 16 03 16		
	TNGA 326			0.094	TNGA 16 03 24		
	TNGA 331			0.016	TNGA 16 04 04		
	TNGA 332	0.031	TNGA 16 04 08				
	TNGA 333	0.047	TNGA 16 04 12				
	TNGA 334	0.063	TNGA 16 04 16				
	TNGA 336	0.094	TNGA 16 04 24				
	TNGA 338	0.125	TNGA 16 04 32				
	TNGA 431	0.500	0.188	0.016	TNGA 22 04 04		
	TNGA 432			0.031	TNGA 22 04 08		
	TNGA 433			0.047	TNGA 22 04 12		
	TNGA 434			0.063	TNGA 22 04 16		
	TNGA 438			0.125	TNGA 22 04 32		
	TNGA 441			0.250	0.250	0.016	TNGA 22 06 04
	TNGA 442	0.031	TNGA 22 06 08				
TNGA 443	0.047	TNGA 22 06 12					
TNGA 444	0.063	TNGA 22 06 16					
TPG		I.C.	T	R			
	TPG 221	0.250	0.125	0.016	TPGN 11 03 04		
	TPG 222			0.031	TPGN 11 03 08		
	TPG 223			0.047	TPGN 11 03 12		
	TPG 224			0.063	TPGN 11 03 16		
	TPG 321	0.375	0.125	0.016	TPGN 16 03 04		
	TPG 322			0.031	TPGN 16 03 08		
	TPG 323			0.047	TPGN 16 03 12		
	TPG 324		0.063	TPGN 16 03 16			
	TPG 331		0.188	0.188	0.016	TPGN 16 04 04	
	TPG 332				0.031	TPGN 16 04 08	
	TPG 333	0.047			TPGN 16 04 12		
	TPG 334	0.500	0.250	0.063	TPGN 16 04 16		
	TPG 341			0.250	0.250	0.016	TPGN 16 06 04
	TPG 342					0.031	TPGN 16 06 08
	TPG 343		0.047			TPGN 16 06 12	
	TPG 344		0.063	TPGN 16 06 16			
	TPG 431		0.500	0.188	0.016	TPGN 22 04 04	
	TPG 432	0.031			TPGN 22 04 08		
	TPG 433	0.047			TPGN 22 04 12		
	TPG 434	0.063		TPGN 22 04 16			
	TPG 441	0.250		0.250	0.016	TPGN 22 06 04	
	TPG 442				0.031	TPGN 22 06 08	
	TPG 443		0.047		TPGN 22 06 12		
	TPG 444	0.313	0.313	0.063	TPGN 22 06 16		
	TPG 451			0.313	0.313	0.016	TPGN 22 07 04
	TPG 452					0.031	TPGN 22 07 08
	TPG 453					0.047	TPGN 22 07 12
	TPG 454	0.063	TPGN 22 07 16				
	TPG 531	0.625	0.188	0.016	TPGN 27 04 04		
	TPG 532			0.031	TPGN 27 04 08		
TPG 533	0.047			TPGN 27 04 12			
TPG 534	0.063			TPGN 27 04 16			

AVAILABLE GRADES(For grade characteristics and applications see pages 1-3)

I-50	I-100	MW30	MW37	MW43	TITAN	MWW
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TPGA	INSERT NUMBER	DIMENSIONS			ISO CODE NUMBERS
		I.C.	T	R	
	TPGA 321	0.375	0.125	0.016	TPGA 16 03 04
	TPGA 322			0.031	TPGA 16 03 08
	TPGA 323			0.047	TPGA 16 03 12
	TPGA 324			0.063	TPGA 16 03 16
	TPGA 331		0.188	0.016	TPGA 16 04 04
	TPGA 332			0.031	TPGA 16 04 08
	TPGA 333			0.047	TPGA 16 04 12
	TPGA 334			0.063	TPGA 16 04 16
	TPGA 431	0.500	0.188	0.016	TPGA 22 04 04
	TPGA 432			0.031	TPGA 22 04 08
	TPGA 433			0.047	TPGA 22 04 12
	TPGA 434			0.063	TPGA 22 04 16
	TPGA 441		0.250	0.016	TPGA 22 06 04
	TPGA 442			0.031	TPGA 22 06 08
	TPGA 443			0.047	TPGA 22 06 12
	TPGA 444			0.063	TPGA 22 06 16
VNGA		I.C.	T	R	
	VNGA 331	0.375	0.188	0.016	VNGA 16 04 04
	VNGA 332			0.031	VNGA 16 04 08
	VNGA 333			0.047	VNGA 16 04 12
	VNGA 334			0.063	VNGA 16 04 16
	VNGA 431	0.500	0.188	0.016	VNGA 22 04 04
	VNGA 432			0.031	VNGA 22 04 08
	VNGA 433			0.047	VNGA 22 04 12
	VNGA 434			0.063	VNGA 22 04 16
* Available only in selected grades					
VNGX (DIMPLE LOCK)		I.C.	T	R	
	VNGX 352	0.375	0.313	0.031	VNGX 16 07 08
	VNGX 353			0.047	VNGX 16 07 12
	VNGX 354			0.063	VNGX 16 07 16
WNGA		I.C.	T	R	
	WNGA 431	0.500	0.188	0.016	WNGA 08 04 04
	WNGA 432			0.031	WNGA 08 04 08
	WNGA 433			0.047	WNGA 08 04 12
	WNGA 434			0.063	WNGA 08 04 16

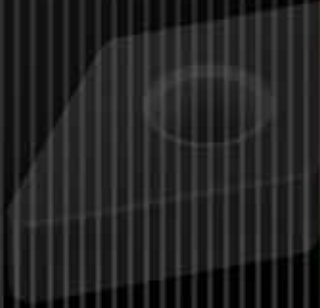
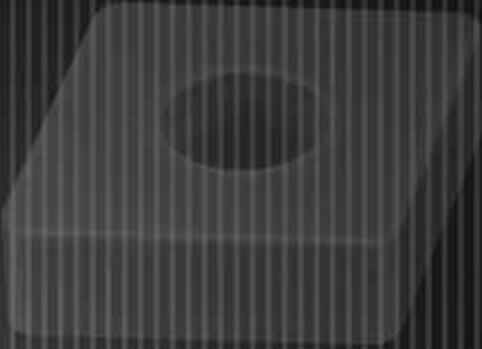
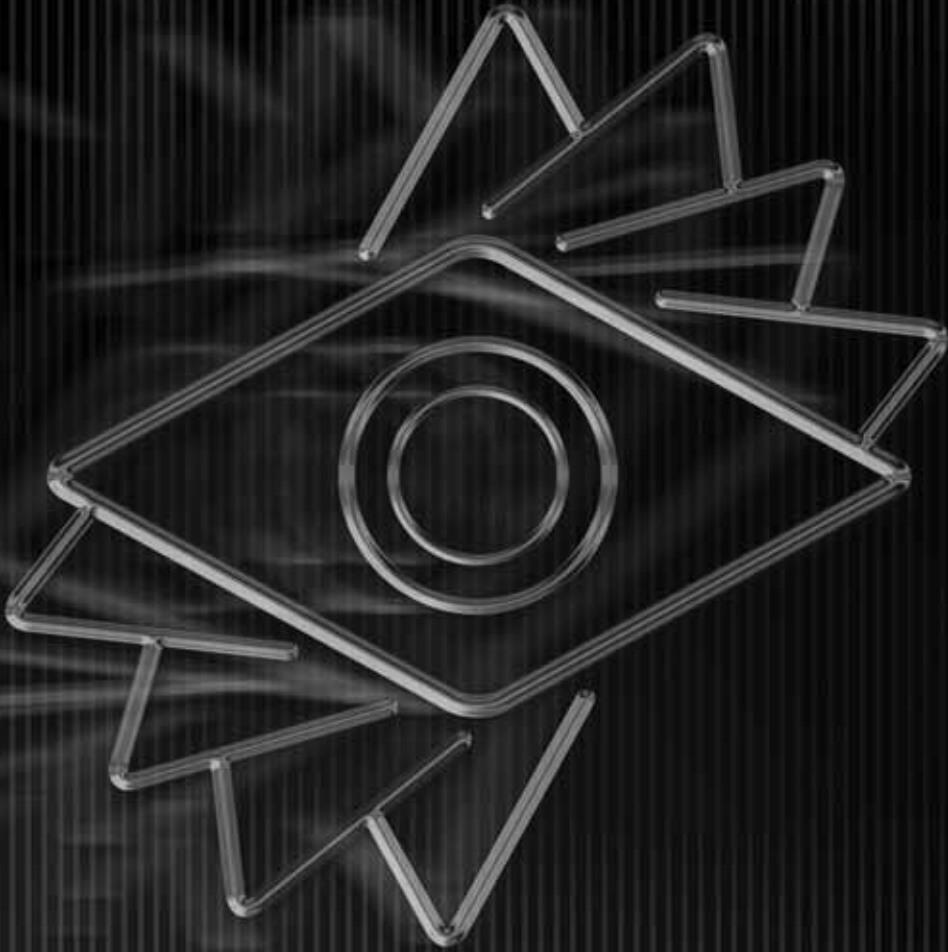
AVAILABLE GRADES(For grade characteristics and applications see pages 1-3)

I-50	I-100	MW30	MW37	MW43	TITAN	MWW
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A scanning electron micrograph showing a dense network of elongated, needle-like structures. The structures are light gray and appear to be embedded in a darker gray matrix. They are oriented in various directions, creating a complex, interlocking pattern. The structures have a slightly rough, crystalline appearance.

THE MATRIX

This material is the heart of MicroWare. The overlapping elongated structures shown reinforce the ceramic, giving it superb toughness. This high resolution picture was taken with a scanning electron microscope at a magnification of approximately 10,000 times.



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