



**ALLIED MACHINE
& ENGINEERING**

WOHLHAUPTER®

Holemaking Solutions for Today's Manufacturing



Drilling



Reaming



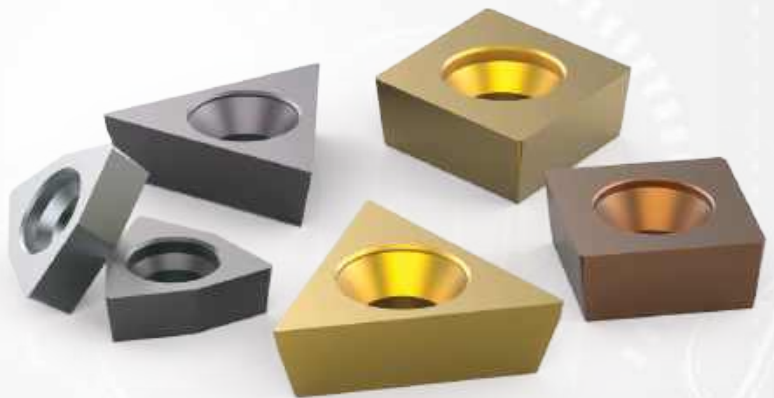
Burnishing



Threading



Specials



Wohlhaupter®

▶ **BORING**

Inserts

WOHLHAUPTER®

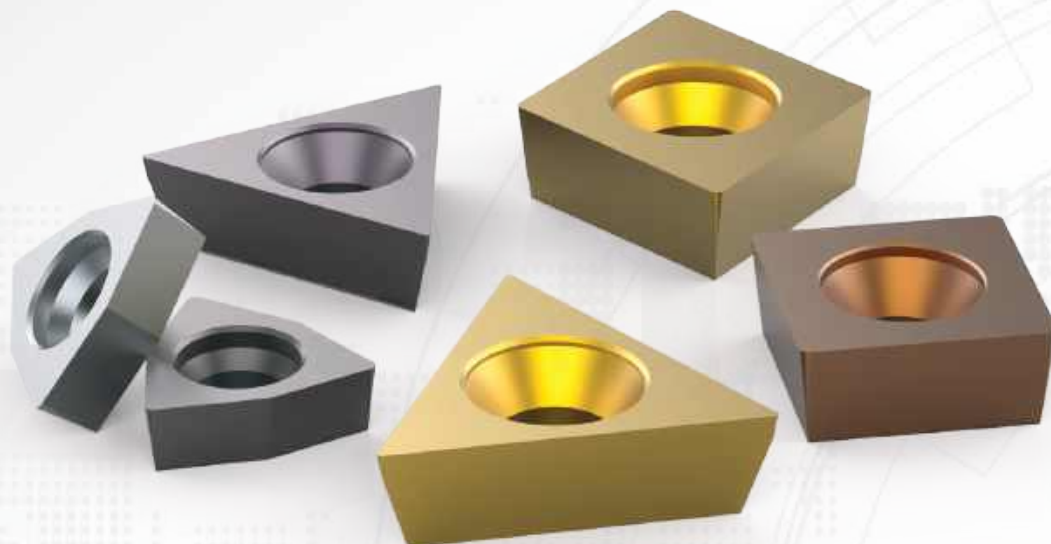
SECTION

B10-H

Inserts

Wohlhaupter® Inserts

Replaceable Boring Inserts



Cutting-Edge Technology

Wohlhaupter has the cutting-edge technology to achieve all of your boring applications. With precision in mind, our inserts are available in multiple insert geometries, coatings, and nose radii. Wohlhaupter inserts are offered in uncoated and coated carbide, cermet, and CBN and PCD materials.

Try our easy-to-use boring insert selector available online or to download from the app store to find the perfect inserts for your boring applications.

www.alliedmachine.com/bis

Applicable Industries



Aerospace



Agriculture



Automotive



Firearms



General
Machining



Oil & Gas



Renewable
Energy

Your safety and the safety of others is very important. This catalogue contains important safety messages. Always read and follow all safety precautions.



This triangle is a safety hazard symbol. It alerts you to potential safety hazards that can cause tool failure and serious injury.

When you see this symbol in the catalogue, look for a related safety message that may be near this triangle or referred to in the nearby text.

There are safety signal words also used in the catalogue. Safety messages follow these words.

WARNING

WARNING (shown above) means that failure to follow the precautions in this message could result in tool failure and serious injury.

NOTICE means that failure to follow the precautions in this message could result in damage to the tool or machine but not result in personal injury.

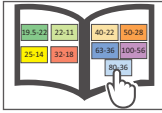
NOTE and **IMPORTANT** are also used. These are important that you read and follow but are not safety-related.

Visit www.alliedmachine.com for the most up-to-date information and procedures.

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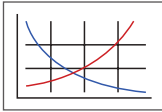
Reference Icons

The following icons will appear throughout the catalogue to help you navigate between products.



MVS Connection Colour Guide

Detailed instructions and information regarding the MVS connection(s)



Recommended Cutting Data

Speed and feed recommendations for optimum and safe boring

Product Nomenclature

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WOHLHAUPTER®

Boring Insert Selector

Find the best insert for your application.

- Generate the correct boring insert for your job in just six easy steps
- Choose type, shape, substrate, insert form, nose radius, and material
- Order easily by adding the item to your cart

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Wohlhaupter Insert Nomenclature

Reference Key

Symbol	Insert Type
▼	Roughing - Main Application
▽	Roughing - Extended Application
▼▼	Universal - Main Application
▽▽	Universal - Extended Application
▼▼▼	Finishing - Main Application
▽▽▽	Finishing - Extended Application

Reference Key

Symbol	Machining Conditions
●	Good - Main Application
○	Good - Extended Application
●	Average - Main Application
○	Average - Extended Application
⚙	Difficult - Main Application
⚙	Difficult - Extended Application

Reference Key

Symbol	Wohlhaupter Insert Grades
WHW	Uncoated carbide (HW)
WHC	Coated carbide (HC)
WHT	Uncoated cermet (HT)
WTC	Coated cermet (HC)
WCN	Ceramic cutting material (CN)
WBN	Cubic boron nitride CBN (BN)
WBC	Coated CBN (BC)
PCD	Polycrystalline diamond PCD (DP)

Wohlhaupter Inserts

F101	04	M	N	-	158	W	D
1	2	3	4		5	6	7

1. Wohlhaupter Insert Form	
211	262
20	264
161	112
163	113
47	114
101	04
103	05
104	89
105	90
123	91
124	304
39	325
75	

2. Corner Radius	
Metric (mm)	
005 = 0.05 mm	
01 = 0.10 mm	
02 = 0.20 mm	
03 = 0.30 mm	
04 = 0.40 mm	
06 = 0.60 mm	
08 = 0.80 mm	
12 = 1.20 mm	
16 = 1.60 mm	
20 = 2.00 mm	
24 = 2.40 mm	

3. Tolerance Group		
Metric (mm)		
G	Length of edge	±0.025
	IC	±0.025
M	Thickness	±0.13
	Length of edge	±0.08-0.15*
F	IC	±0.05-0.10*
	Thickness	±0.13
C	Length of edge	±0.013
	IC	±0.005
F	Thickness	±0.025
	Length of edge	±0.13
C	IC	±0.025
	Thickness	±0.025

*Varies upon insert size

4. Machining Direction	
N = Neutral	
L = Left	
R = Right	

5. Geometry						
Carbide	Carbide	Tangential	Ceramic	PCD	CBN	
108	155	880	711	720	741	
109	158	811		730	742	
112	161			735	745	
114	174W				747	
121	192				748	
122	199				749	
126	200				768	
127	650					
128	711					
129	840					
145	850					
146	860					

6. / 7. Optional Information	
W = Wiper Geometry	
D = Double Tipped	
T = Triple Tipped	

ISO Insert Nomenclature

DIN ISO 1832

C	C	M	T	09	T3	02
1	2	3	4	5	6	7

1. Basic Insert Form	2. Clearance Angle	3. Tolerance Group	4. Mounting Style
C = Rhomboid 80° D = Rhomboid 55° L = Rectangular R = Round S = Square T = Triangular V = Rhomboid 35° W = Trigon	B = 5° C = 7° N = 0° P = 11° O = 10°	Metric (mm) Length of edge ±0.025 G IC ±0.025 Thickness ±0.13 Length of edge ±0.08-0.15* M IC ±0.05-0.10* Thickness ±0.13 Length of edge ±0.013 F IC ±0.005 Thickness ±0.025 Length of edge ±0.13 C IC ±0.025 Thickness ±0.025 *Varies upon insert size	T = One-sided countersunk Cylindrical fixing hole Countersunk 40° - 60° H = One-sided chipbreaker Cylindrical fixing hole Countersunk 70° - 90° W = Without chipbreaker Cylindrical fixing hole Countersunk 40° - 60° X = Special design Special insert design A = Without chipbreaker Cylindrical fixing hole Without countersunk

5. Insert Size / Cutting Edge							
Metric (mm)	C	D	R	S	T	V	W
3.97 mm					006		02
5.00 mm					F20		
6.00 mm					F21		
6.35 mm	06				11	11	
7.94 mm				07			
9.52 mm	09	11		09	16	16	
10.00 mm		10					
12.00 mm	12	12					
12.70 mm	16	15		12			
15.87 mm			15	15			
16.00 mm			16				
19.05 mm		19		19			
20.00 mm			20				
25.00 mm			25				
25.40 mm				25			

6. Insert Thickness
Metric (mm) 01 = 1.59 mm 02 = 2.38 mm T2 = 2.78 mm 03 = 3.18 mm T3 = 3.97 mm 04 = 4.76 mm 05 = 5.56 mm 06 = 6.35 mm 07 = 7.94 mm

7. Corner Radius
Metric (mm) 005 = 0.05 mm 01 = 0.10 mm 02 = 0.20 mm 03 = 0.30 mm 04 = 0.40 mm 06 = 0.60 mm 08 = 0.80 mm 12 = 1.20 mm 16 = 1.60 mm 20 = 2.00 mm 24 = 2.40 mm

Wohlhaupter Insert Grades

Uncoated Carbide

Uncoated Carbide

Cutting Material	Description	Material	ISO Application							
			05	10	15	20	25	30	35	40
WHW01 (HW)	<ul style="list-style-type: none"> Fine-grain carbide Finishing & light roughing Nonferrous metals, cast materials & difficult-to-machine alloys 	P								
		M								
		K								
		N								
		S								
		H								
WHW16 (HW)	<ul style="list-style-type: none"> Fine-grain carbide Finishing & light roughing Nonferrous metals, cast materials & difficult-to-machine alloys 	P								
		M								
		K								
		N								
		S								
		H								
WHW20 (HW)	<ul style="list-style-type: none"> Tough fine-grain carbide Finishing, roughing & grooving Steel & cast materials, cast steel Nonferrous materials & difficult-to-machine alloys 	P								
		M								
		K								
		N								
		S								
		H								

Wohlhaupter Insert Grades

Coated Carbide

Coated Carbide

Cutting Material	Description	Material	ISO Application							
			05	10	15	20	25	30	35	40
WHC05 (HC)	<ul style="list-style-type: none"> PVD coating with nano-composite structure Finishing & roughing Steels, stainless steels, cast materials, & difficult-to-machine alloys 	P								
		M								
		K								
		N								
		S								
		H								
WHC18 (HC)	<ul style="list-style-type: none"> PVD-TiB2 coating Finishing & light roughing Nonferrous metals 	P								
		M								
		K								
		N								
		S								
		H								
WHC19 (HC)	<ul style="list-style-type: none"> Newest generation multilayer PVD coating Finishing & roughing Extremely universal & the first choice for poor machining conditions Excellent in cast steels, stainless steels, & super alloys 	P								
		M								
		K								
		N								
		S								
		H								
WHC20 (HC)	<ul style="list-style-type: none"> Multilayer CVD coating Finishing Steels & stainless steels 	P								
		M								
		K								
		N								
		S								
		H								
WHC30 (HC)	<ul style="list-style-type: none"> CVD coating Roughing Steel & cast steel 	P								
		M								
		K								
		N								
		S								
		H								
WHC79 (HC)	<ul style="list-style-type: none"> Multilayer MT CVD coating Roughing & finishing Steels, stainless steels & cast materials 	P								
		M								
		K								
		N								
		S								
		H								
WHC81 (HC)	<ul style="list-style-type: none"> Thick MT CVD coating with adominal AL203 High cutting speeds possible Excellent choice for cast materials 	P								
		M								
		K								
		N								
		S								
		H								
WHC88 (HC)	<ul style="list-style-type: none"> Multilayer PVD coating Finishing & roughing Universal usage 	P								
		M								
		K								
		N								
		S								
		H								

Wohlhaupter Insert Grades

Coated Carbide

Coated Carbide

Cutting Material	Description	Material	ISO Application								
			05	10	15	20	25	30	35	40	
WHC98 (HC)	<ul style="list-style-type: none"> PVD TiAlN coating Roughing & finishing Steels, stainless steels & difficult-to-machine materials 	P									
		M									
		K									
		N									
		S									
WHC111 (HC)	<ul style="list-style-type: none"> PVD TiAlN coating Finishing Machining of steels after heat treating with high Cr content up to 60 HRC Hard - soft transitions, difficult-to-machine alloys & stainless steels 	P									
		M									
		K									
		N									
		S									
WHC114 (HC)	<ul style="list-style-type: none"> Multilayer PVD coating Finishing & roughing Steels, stainless steels, & difficult-to-machine materials 	P									
		M									
		K									
		N									
		S									
WHC136 (HC)	<ul style="list-style-type: none"> Stronger PVD coating with improved coating adhesion High oxidation resistance allows a wide range of applications 	P									
		M									
		K									
		N									
		S									
WHC164 (HC)	<ul style="list-style-type: none"> Thick MT-CVD coating with a dominant Al₂O₃ Primarily developed for the material groups P,K & H Full & discontinuous cut High cutting speeds and feeds possible 	P									
		M									
		K									
		N									
		S									
WHC168 (HC)	<ul style="list-style-type: none"> Multilayer MT CVD coating Excellent combination of toughness & reliability Steels, cast materials & alternatively for stainless steel 	P									
		M									
		K									
		N									
		S									
WHC170 (HC)	<ul style="list-style-type: none"> Multilayer MT CVD coating Excellent toughness First choice for strong interruptions Cast materials and steel 	P									
		M									
		K									
		N									
		S									
WHC198 (HC)	<ul style="list-style-type: none"> Upgraded PVD grade with hard AlTiN coating Optimized cutting edge stability General machining of steel, stainless steel, high-temperature resistant alloys, titanium, iron, cast iron, & nonferrous materials 	P									
		M									
		K									
		N									
		S									

Wohlhaupter Insert Grades

Uncoated Cermet | Coated Cermet

Uncoated Cermet

Cutting Material	Description	Material	ISO Application							
			05	10	15	20	25	30	35	40
WHT10 (HT)	<ul style="list-style-type: none"> Uncoated cermet Finishing Steels, stainless steels & cast materials 	P								
		M								
		K								
		N								
		S								
WHT12 (HC)	<ul style="list-style-type: none"> Uncoated cermet Finishing Steels, cast materials, sintered metals, & nonferrous metals 	P								
		M								
		K								
		N								
		S								
WHT32 (HC)	<ul style="list-style-type: none"> Uncoated cermet Finishing Steels & cast materials 	P								
		M								
		K								
		N								
		S								

Coated Cermet

Cutting Material	Description	Material	ISO Application							
			05	10	15	20	25	30	35	40
WTC15 (TC)	<ul style="list-style-type: none"> New PVD brilliant coating Reduce friction coefficient in turning applications Coated cermet general purpose grade for material group Achieves excellent surface finish with excellent wear resistance Usable in stainless steels 	P								
		M								
		K								
		N								
		S								
WTC121 (TC)	<ul style="list-style-type: none"> PVD coated cermet Finishing of steels & stainless steels 	P								
		M								
		K								
		N								
		S								

Wohlhaupter Insert Grades

Uncoated Cubic Boron Nitride | Coated Cubic Boron Nitride

Uncoated Cubic Boron Nitride

Cutting Material	Description	Material	ISO Application							
			05	10	15	20	25	30	35	40
WBN150 (BN)	<ul style="list-style-type: none"> Uncoated CBN grade Roughing & finishing smooth & slightly discontinuous cuts Hardened steels 52 - 64 HRC Grain size 2 µm CBN content: 50% 	P								
		M								
		K								
		N								
		S								
		H								
WBN200 (BN)	<ul style="list-style-type: none"> Uncoated CBN grade Roughing & finishing highly discontinuous cuts Hardened steels 52 - 64 HRC Grain size 3 µm CBN content: 65% 	P								
		M								
		K								
		N								
		S								
		H								
WBN300 (BN)	<ul style="list-style-type: none"> Uncoated CBN grade Roughing & finishing smooth cuts Hardened steels 52 - 64 HRC Grain size 0.5 - 1.0 µm CBN content: approximately 50% 	P								
		M								
		K								
		N								
		S								
		H								
WBN450 (BN)	<ul style="list-style-type: none"> Uncoated CBN grade Roughing & finishing smooth & discontinuous cuts Pearlite grey cast iron & sintered metals Grain size 2 µm CBN content: 90% 	P								
		M								
		K								
		N								
		S								
		H								
WBN448 (BN)	<ul style="list-style-type: none"> Uncoated CBN grade Roughing & finishing smooth & discontinuous cuts Pearlite grey cast iron & sintered metals and ductile iron CBN content: 90% 	P								
		M								
		K								
		N								
		S								
		H								

Coated Cubic Boron Nitride

Cutting Material	Description	Material	ISO Application							
			05	10	15	20	25	30	35	40
WBC300 (BC)	<ul style="list-style-type: none"> Coated CBN Roughing and finishing smooth cuts Hardened steels 52 - 64 HRC Grain size 1 µm CBN content: 50% 	P								
		M								
		K								
		N								
		S								
		H								

Wohlhaupter Insert Grades

Polycrystalline Diamond | Ceramic Cutting Material

Polycrystalline Diamond

Cutting Material	Description	Material	ISO Application							
			05	10	15	20	25	30	35	40
PCD D30 (DP)	<ul style="list-style-type: none"> • PCD medium grain grade • Finishing • Al alloys & Mg alloys up to 12% Si • Grain size 10 µm 	P								
		M								
		K								
		N								
		S								
PCD D50 (DP)	<ul style="list-style-type: none"> • PCD mixed-grain grade • Finishing • CFRP, GRP, MMC, Al alloys over 12% Si • Grain size 2 - 30 µm 	P								
		M								
		K								
		N								
		S								
		H								























Ceramic Cutting Material

Cutting Material	Description	Material	ISO Application							
			05	10	15	20	25	30	35	40
WCN40(CN)	<ul style="list-style-type: none"> • Uncoated silicon-nitride ceramic • Roughing • Pearlite grey cast iron 	P								
		M								
		K								
		N								
		S								
		H								

Wohlhaupter Insert Geometries

Cermet | Carbide


Cermet | Carbide

Geometry	Description	Application	Available Form
108 	<ul style="list-style-type: none"> Sintered chip breaker for higher feeds Suitable for highly discontinuous cuts 		F101, F103, F104, F112, F113
109 	<ul style="list-style-type: none"> Sintered geometry with V-shaped chip breaker for roughing & finishing Good chip control even for shallow depth of cut 		F101, F103, F104
112 	<ul style="list-style-type: none"> Sintered chip breaker Finishing & light roughing 		F101, F103
121 	<ul style="list-style-type: none"> Positive geometry with stable cutting edge Finishing in different material groups Good chip control 		F20, F211
122 	<ul style="list-style-type: none"> Sintered chip breaker Good chip control - even with long-chipping materials 		F101, F103, F161
126 	<ul style="list-style-type: none"> Sintered version with a wide range of applications 		F105
127 	<ul style="list-style-type: none"> Highly positive sintered geometry For nonferrous metals & cast iron 		F37, F39, F101, F103, F104, F112, F113
128 	<ul style="list-style-type: none"> Highly positive sintered geometry Polished for finishing nonferrous metals, cast iron, & steel 		F20
129 	<ul style="list-style-type: none"> Highly positive chip breaking geometry Polished for nonferrous metals, cast iron, & steel Ideal for structural steel applications 		F37, F39, F101, F103
145 	<ul style="list-style-type: none"> Geometry for finishing in smooth & discontinuous cut Good chip control - even with long-chipping materials 		F101, F103, F112, F113, F161
146 	<ul style="list-style-type: none"> Positive geometry with stable cutting edge Universal usage for roughing, finishing and chamfering 		F037, F039, F101, F103, F104, F112, F113,

Wohlhaupter Insert Geometries

Cermet | Carbide



Cermet | Carbide

Geometry	Description	Application	Available Form
155 	<ul style="list-style-type: none"> Positive sintered geometry Special cutting edge design in combination with the chip breaker design enables exceptional chip control even at shallow cutting depths & light feeds 		F20, F101, F103, F39
158 	<ul style="list-style-type: none"> Stable sintered geometry for roughing & finishing with & without discontinuous cuts 		F101, F103, F104, F105, F113, F114, F163
174W 	<ul style="list-style-type: none"> Wiper geometry for highly productive turning & boring Can be used with pitch angle 92° - 95° Good chip breaking properties even at lower feed rates 		F101, F103
192 	<ul style="list-style-type: none"> Sintered version for a variety of applications Low cutting pressure because of sharp cutting edge prep 		F39, F101, F103, F104, F112, F113, F163, F161, F262, F264
199 	<ul style="list-style-type: none"> Positive sintered geometry for wide variety of applications Special chip breaker allows chip control with different radial depth of cut 		F101, F103, F104, F112, F113
200 	<ul style="list-style-type: none"> Highly positive sintered geometry Applicable for various material groups for low cutting pressure 		F39, F101, F103, F104, F264
650 	<ul style="list-style-type: none"> Obliquely ground chip breaker reduces cutting forces Finishing & smooth interrupted cuts 		F20, F211
711 	<ul style="list-style-type: none"> Negative geometry with 0 rake suitable for fine finishing and semi roughing Machined materials in groups K & H Continuous and moderately interrupted cut 		F101, F103, F104, F113, F163
840 	<ul style="list-style-type: none"> Parallel ground chip breaker For finish operations with stable cutting edge 		F20
850 	<ul style="list-style-type: none"> Parallel ground chip breaker Good chip control with short to medium feeds 		F161
860 	<ul style="list-style-type: none"> Parallel ground chip breaker reduces cutting forces Stable for a wide range of applications 		F101, F103, F104, F105, F325


Wohlhaupter Insert Geometries

Tangential | Ceramic

Tangential

Geometry	Description	Application	Available Form
880 	<ul style="list-style-type: none"> • Large parallel ground chip breaker with 10° rake angle for reduced cutting force 	▼	F04, F05
811 	<ul style="list-style-type: none"> • Smooth geometry without additional ground chip breaker • Reinforced cutting edges provide stability • Excellent for cast materials 	▼	F05




Ceramic

Geometry	Description	Application	Available Form
711 	<ul style="list-style-type: none"> • Smooth geometry with 0° rake angle • High cutting edge stability particularly in discontinuous cuts 	▼	F75, F103, F104, F123








Wohlhaupter Insert Geometries

PCD | CBN

PCD

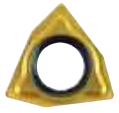
Geometry	Description	Application	Available Form
720 	<ul style="list-style-type: none"> Smooth geometry in positive version with 7° rake angle for PCD Sharp cutting edge 	▼▼▼	F20, F101, F103
730 	<ul style="list-style-type: none"> Smooth geometry with 0° rake angle for PCD Sharp cutting edge 	▼▼▼	F20, F39, F75, F101, F103, F123, F211, F262, F264
735 	<ul style="list-style-type: none"> Smooth geometry Laser-cut chip breaker for PCD Suitable for long-chipping aluminium wrought alloys 	▼▼▼	F20, F39, F101, F103, F211, F262, F264

CBN

Geometry	Description	Diagram			Application	Available Form
		R	Fb	Fw		
741 	<ul style="list-style-type: none"> Smooth geometry with 0° rake angle for CBN Rounded cutting edge with 30° chamfer 	0.015	0.15	30°	▼▼▼	F20, F101, F103
742 	<ul style="list-style-type: none"> Smooth geometry with 0° rake angle for CBN Rounded cutting edge with 15° chamfer 	0.015	0.1	15°	▼▼▼	F20, F101, F103
745 	<ul style="list-style-type: none"> Smooth geometry with 0° rake angle for CBN Rounded cutting edge with 30° chamfer 	0.015	0.05	30°	▼▼▼	F20, F211
747 	<ul style="list-style-type: none"> Smooth geometry with 0° rake angle for CBN Rounded cutting edge with a small 20° chamfer 	0.015	0.1	20°	▼▼▼	F39, F104, F262, F264
748 	<ul style="list-style-type: none"> Smooth geometry with 0° rake angle for CBN Rounded cutting edge No chamfer 	0.015	-	-	▼▼▼	F20, F101, F103, F211
749 	<ul style="list-style-type: none"> Smooth geometry with 0° rake angle for CBN Rounded cutting edge with a large 20° chamfer 	0.015	0.2	20°	▼▼▼ ▼	F75, F123, F264
768 	<ul style="list-style-type: none"> Smooth geometry with 7° rake angle for CBN Rounded cutting edge 	0.015	-	-	▼▼▼	F20, F101, F103

Insert Form 211

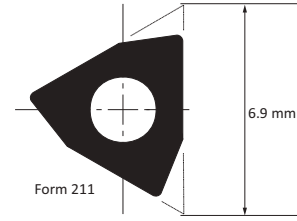
Cermet | Carbide



121 Geometry



650 Geometry



						Cermet					Carbide										
						Uncoated			Coated		Uncoated		Coated								
						WHT10	WHT12	WHT32	WTC15	WTC121	WHW01	WHW16	WHC05	WHC18	WHC19	WHC79	WHC98	WHC111	WHC114	WHC136	WHC164
Steel	P	▼▼▼											▼▼▼	▼▼▼			▼▼▼	▼▼▼			
Stainless Steel	M	▼▼▼											▼▼▼	▼▼▼			▼▼▼	▼▼▼			
Cast Iron	K	▼▼▼											▼▼▼	▼▼▼			▼▼▼	▼▼▼			
Nonferrous Materials	N	▼▼▼											▼▼▼	▼▼▼			▼▼▼	▼▼▼			
Titanium	S	▼▼▼											▼▼▼	▼▼▼			▼▼▼	▼▼▼			
Hard Materials	H																▼▼▼	▼▼▼			
Geometry	Radius		Part No.	ISO Code	Index No.	WHT10	WHT12	WHT32	WTC15	WTC121	WHW01	WHW16	WHC05	WHC18	WHC19	WHC79	WHC98	WHC111	WHC114	WHC136	WHC164
	mm	in																			
121	0.10	0.004	F21101GN121	WBGX020101	397675										⚙			⚙			
121	0.20	0.008	F21102GN121	WBGX020102	397676										⚙			⚙			
650	0.10	0.004	F21101GL650	WBGX020101	097755		●				●		●	●							●
650	0.20	0.008	F21102GL650	WBGX020102	097454		●				●		●								●

Reference Key

Symbol	Machining Conditions
●	Good - Main Application
⚙	Average - Main Application
⚙	Difficult - Main Application

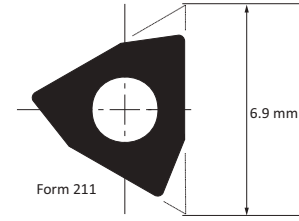
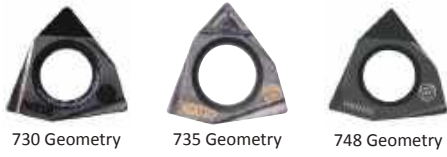
Reference Key

Symbol	Insert Type
▼▼▼	Finishing - Main Application
▼▼▼	Finishing - Extended Application

				Technical Data	
Insert Form	Countersunk Screw	Torque Driver	Service Key	Torque	Key Size
211	215377 M2 x 0.4 x 4	415507	115537	0.6 Nm	T6

Insert Form 211

CBN | PCD



						Ceramic		CBN				PCD		
						Uncoated	Coated	Uncoated		Coated				
Steel						P								
Stainless Steel						M								
Cast Iron						K			▼▼▼					
Nonferrous Materials						N						▼▼▼	▼▼▼	
Titanium						S								
Hard Materials						H			▼▼▼					
Geometry	Radius		Part No.	ISO Code	Index No.			WBN150	WBN200	WBN300	WBN450			
	mm	in								PKDD30	PKDD50			
730	0.10	0.004	F21101GN730	WBGX020101	397763							●		
730	0.20	0.008	F21102GN730	WBGX020102	097557							●	●	
735	0.20	0.008	F21102GN735	WBGX020102	397237							●		
748	0.10	0.004	F21101GN748	WBGX020101	097486			●		●				
748	0.20	0.008	F21102GN748	WBGX020102	097552			●		●				

Reference Key

Symbol	Machining Conditions
●	Average - Main Application

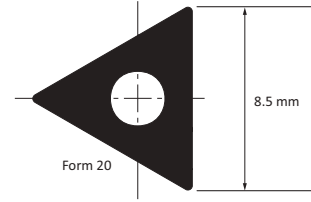
Reference Key

Symbol	Insert Type
▼▼▼	Finishing - Main Application

Insert Form	Countersunk Screw		Torque Driver	Service Key	Technical Data	
					Torque	Key Size
211	215377	M2 x 0.4 x 4	415507	115537	0.6 Nm	T6

Insert Form 20

Cermet | Carbide



						Cermet					Carbide									
						Uncoated		Coated			Uncoated		Coated							
						WHT10	WHT12	WHT32	WTC15	WTC121	WHW01	WHW16	WHC05	WHC18	WHC19	WHC79	WHC98	WHC111	WHC114	WHC136
Geometry	Radius		Part No.	ISO Code	Index No.															
	mm	in																		
Steel																				
Stainless Steel																				
Cast Iron																				
Nonferrous Materials																				
Titanium																				
Hard Materials																				
121	0.10	0.004	F02001GN121	TOGX080201	397672															
121	0.20	0.008	F02002GN121	TOGX080202	397673															
121	0.40	0.016	F02004GN121	TOGX080204	397674															
121W	0.20	0.008	F02002GX121W	TOGX080202	397916															
121W	0.40	0.016	F02004GX121W	TOGX080204	397917															
128	0.10	0.004	F02001GN128	TOGX080201	297473															
128	0.20	0.008	F02002GN128	TOGX080202	297541															
128	0.40	0.016	F02004GN128	TOGX080204	297542															
155	0.20	0.008	F02002MN155	TOMX080202	397688															
155	0.40	0.016	F02004MN155	TOMX080204	397689															
650	0.10	0.004	F02001GL650	TOGX080201	097153															
650	0.20	0.008	F02002GL650	TOGX080202	097546															
650	0.30	0.012	F02003GL650	TOGX080203	097154															
650	0.40	0.016	F02004GL650	TOGX080204	097599															
650	0.80	0.031	F02008GL650	TOGX080208	397764															
840	0.20	0.008	F02002GR840	TOGX080202	097701															

Reference Key

Symbol	Machining Conditions
●	Good - Main Application
◐	Average - Main Application
⚙	Difficult - Main Application

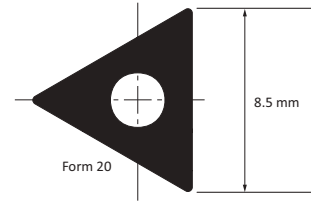
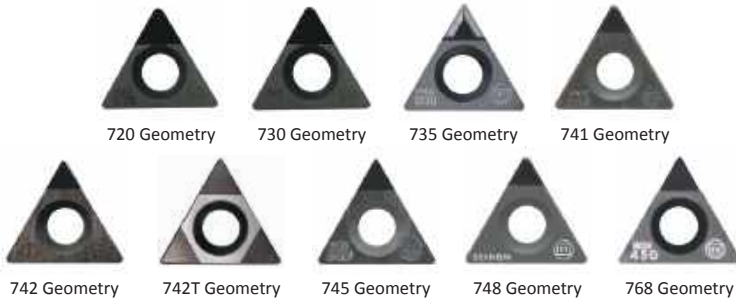
Reference Key

Symbol	Insert Type
▼▼	Finishing - Main Application
▽▽	Finishing - Extended Application

				Technical Data	
Insert Form	Countersunk Screw	Torque Driver	Service Key	Torque	Key Size
20	115535 M2 x 0.4 x 5	415508	115591	0.9 Nm	T7

Insert Form 20

CBN | PCD







						CBN					PCD		
						Uncoated			Coated				
Steel													
Stainless Steel													
Cast Iron							▼▼▼	▼▼▼	▼▼▼				
Nonferrous Materials											▼▼▼	▼▼▼	
Titanium													
Hard Materials							▼▼▼	▼▼▼			▼▼▼		
Geometry	Radius		Part No.	ISO Code	Index No.	WBN150	WBN200	WBN300	WBN450	WBN448	WBC300	PKDD30	PKDD50
	mm	in											
720	0.20	0.008	F02002GN720	TOGX080202	297692							●	
720	0.40	0.016	F02004GN720	TOGX080204	297845							●	
730	0.20	0.008	F02002GN730	TOGX080202	097487							●	●
730	0.40	0.016	F02004GN730	TOGX080204	097686							●	●
730	0.80	0.031	F02008GN730	TOGX080208	097877							●	
735	0.20	0.008	F02002GN735	TOGX080202	397133							●	
735	0.40	0.016	F02004GN735	TOGX080204	397301							●	
741	0.20	0.008	F02002GN741	TOGX080202	297260		●						
741	0.40	0.016	F02004GN741	TOGX080204	297262		●						
742	0.20	0.008	F02002GN742	TOGX080202	297264			●					
742	0.40	0.016	F02004GN742	TOGX080204	397610			●					
742T	0.20	0.008	F02002GN742T	TOGX080202	397961					●	●		
742T	0.40	0.016	F02004GN742T	TOGX080204	397551					●	●		
745	0.10	0.004	F02001GN745	TOGX080201	297259		●						
748	0.20	0.008	F02002GN748	TOGX080202	297780				●				
748	0.40	0.016	F02004GN748	TOGX080204	297782				●				
768	0.20	0.008	F02002GN768	TOGX080202	397146				●				
768	0.40	0.016	F02004GN768	TOGX080204	397192				●				

Reference Key

Symbol	Machining Conditions
●	Good - Main Application
●	Average - Main Application

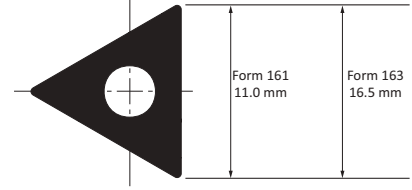
Reference Key

Symbol	Insert Type
▼▼▼	Finishing - Main Application

				Technical Data		
Insert Form	Countersunk Screw		Torque Driver	Service Key	Torque	Key Size
20	115535	M2 x 0.4 x 5	415508	115591	0.9 Nm	T7

Insert Forms 161, 163

Cermet | Carbide



					Cermet					Carbide												
					Uncoated		Coated			Uncoated		Coated										
Steel					▼▼▼		▼▼▼			▼▼▼		▼▼▼										
Stainless Steel					▼▼▼		▼▼▼			▼▼▼		▼▼▼										
Cast Iron					▼▼▼		▼▼▼			▼▼▼		▼▼▼										
Nonferrous Materials					▼▼▼		▼▼▼			▼▼▼		▼▼▼										
Titanium					▼▼▼		▼▼▼			▼▼▼		▼▼▼										
Hard Materials					▼▼▼		▼▼▼			▼▼▼		▼▼▼										
Geometry	Radius		Part No.	ISO Code	Index No.	WHT10	WHT12	WHT32	WTC15	WTC121	WHW01	WHW16	WHC05	WHC19	WHC81	WHC88	WHC79	WHC111	WHC114	WHC136	WHC164	
	mm	in				WHT10	WHT12	WHT32	WTC15	WTC121	WHW01	WHW16	WHC05	WHC19	WHC81	WHC88	WHC79	WHC111	WHC114	WHC136	WHC164	
122	0.40	0.016	F16104MN122	TCMT110204	097953	●																
129	0.20	0.008	F16102GN129	TCGT110202	397769							●	●									
129	0.40	0.016	F16104GN129	TCGT110204	397770							●	●									
129	0.40	0.016	F16304GN129	TCGT16T304	397771							●	●									
145	0.40	0.016	F16104GN145	TCGT110204	297993													●				
146	0.40	0.016	F16104MN146	TCMT110204	397977										●	●						
146	0.80	0.031	F16108MN146	TCMT110208	397026										●	●						
146	0.40	0.016	F16304MN146	TCMT16T304	397990										●	●						
146	0.80	0.031	F16308MN146	TCMT16T308	397974										●	●						
158	0.40	0.016	F16304MN158	TCMT16T304	297604												●					
192	0.40	0.016	F16104MN192	TCMT110204	397663									●								●
192	0.40	0.016	F16304MN192	TCMT16T304	397654									●								●
192	0.80	0.031	F16308MN192	TCMT16T308	397772									●								
711	0.40	0.016	F16304MN711	TCMT16T304	397898										●							
711	0.80	0.031	F16304MN711	TCMT16T308	397899										●							
850	0.20	0.008	F16102GL850	TCGT110202	097512		●															

Reference Key

Symbol	Machining Conditions
●	Good - Main Application
◐	Average - Main Application
⚙	Difficult - Main Application

Reference Key

Symbol	Insert Type
▼▼▼	Finishing - Main Application
▽▽▽	Finishing - Extended Application

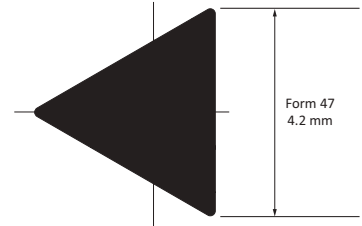
Insert Form	Countersunk Screw		Torque Driver	Service Key	Technical Data	
	Part No.	Dimensions			Torque	Key Size
161	115676	M2.5 x 0.45 x 5	415514	115590	1.2 Nm	T8
163	115673	M3.5 x 0.6 x 9	415510	115664	3.0 Nm	T15

Insert Form 47

Cermet | Carbide



650 Geometry



						Carbide									
						Uncoated				Coated					
Material	ISO Code	Symbol				WHW01	WHW16	WHC05	WHC18	WHC20	WHC79	WHC111	WHC114	WHC136	WHC164
Steel	P	▼▼▼								●					
Stainless Steel	M	▽▽▽													
Cast Iron	K	▽▽▽													
Nonferrous Materials	N	▼▼▼													
Titanium	S	▽▽▽													
Hard Materials	H														
Geometry	Radius		Part No.	ISO Code	Index No.	WHW01	WHW16	WHC05	WHC18	WHC20	WHC79	WHC111	WHC114	WHC136	WHC164
650	mm	in													
650	0.10	0.004	F04701FL650	TOFX040101	097832	●				●					
650	0.20	0.008	F04702FL650	TOFX040102	097833	●				●					

Reference Key

Symbol	Machining Conditions
●	Good - Main Application

Reference Key

Symbol	Insert Type
▼▼▼	Finishing - Main Application
▽▽▽	Finishing - Extended Application

Insert Form	Countersunk Screw	Clamping Jaw	Torque Driver	Service Key	Technical Data	
					Torque	Key Size
47	315324 M1.8 x 0.35 x 4	315323	-	115537	0.5 Nm	T6

Insert Forms 101, 103, 104, 105

Cermet | Carbide



		Cermet						Carbide					
		Uncoated			Coated			Uncoated			Coated		
Material	Grade	108	109	112	122	126	127	108	109	112	122	126	127
Steel	P	▽▽▽			▽							▽▽▽	▽
Stainless Steel	M											▽▽▽	▽
Cast Iron	K	▽▽▽			▽			▽				▽▽▽	▽
Nonferrous Materials	N	▽▽▽			▽			▽	▽				
Titanium	S							▽					▽
Hard Materials	H												▽

Geometry	Radius		Part No.	ISO Description	Index No.	WHT10	WHT12	WHT16	WHT32	WTC15	WTC121	WHW01	WHW16	WHC05	WHC18	WHC19	WHC79	WHC98	WHC111	WHC114	WHC136	WHC164	
	mm	in																					
108	0.20	0.008	F10102MN108	CCMT060202	297833													●					
108	0.40	0.016	F10104MN108	CCMT060204	297537													●					
108	0.40	0.016	F10304MN108	CCMT09T304	297891													●					
108	0.80	0.031	F10308MN108	CCMT09T308	397118													●					
108	0.40	0.016	F10404MN108	CCMT120404	297725													●					
108	0.80	0.031	F10408MN108	CCMT120408	297724													●					
109	0.20	0.008	F10102MN109	CCMT060202	397352																		●
109	0.40	0.016	F10104MN109	CCMT060204	397765																		●
109	0.40	0.016	F10304MN109	CCMT09T304	397354																		●
109	0.80	0.031	F10308MN109	CCMT09T308	397355																		●
109	0.40	0.016	F10404MN109	CCMT120404	397356																		●
109	0.80	0.031	F10408MN109	CCMT120408	397357																		●
112	0.20	0.008	F10102GN112	CCGT060202	297485				●														
112	0.40	0.016	F10104MN112	CCMT060204	297434				●														
112	0.20	0.008	F10302GN112	CCGT09T302	297534				●														
112	0.40	0.016	F10304MN112	CCMT09T304	297387				●														
122	0.20	0.008	F10102MN122	CCMT060202	097899	●																	
122	0.40	0.016	F10104MN122	CCMT060204	097926	●																	
122	0.20	0.008	F10302MN122	CCMT09T302	097862	●																	
122	0.40	0.016	F10304MN122	CCMT09T304	097957	●																	
126	0.80	0.031	F10508MN126	CCMT160508	297557																		●
126	1.20	0.047	F10512MN126	CCMT160512	297558																		●
127	0.20	0.008	F10102GN127	CCGT060202	097529								●		●								
127	0.40	0.016	F10104GN127	CCGT060204	097445								●		●								
127	0.20	0.008	F10302GN127	CCGT09T302	297550								●		●								
127	0.40	0.016	F10304GN127	CCGT09T304	097497								●		●								
127	0.40	0.016	F10404GN127	CCGT120404	097496								●		●								

Reference Key

Symbol	Machining Conditions
●	Good - Main Application
◐	Average - Main Application

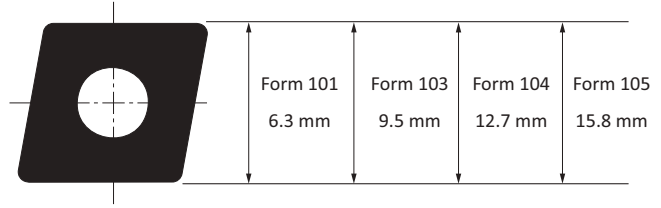
Reference Key

Symbol	Insert Type
▽	Roughing - Main Application
▽	Roughing - Extended Application
▽▽	Finishing - Main Application
▽▽	Finishing - Extended Application

Insert Form	Countersunk Screw		Torque Driver		Service Key		Technical Data	
	Torque	Key Size	Torque	Key Size	Torque	Key Size	Torque	Key Size
101	115676	M2.5 x 0.45 x 5	415514	115590	1.2 Nm	T8		
103	115672 ($\phi 37\text{ mm}$)	M3.5 x 0.6 x 7.5	415510	115664	3.0 Nm	T15		
103	115673 (>math>\phi 36\text{ mm}</math>)	M3.5 x 0.6 x 9	415510	115664	3.0 Nm	T15		
104	215149	M4.5 x 0.75 x 11.5	415543	215150	5.0 Nm	T20		
105	215149	M4.5 x 0.75 x 11.5	415543	215150	5.0 Nm	T20		

Insert Forms 101, 103, 104, 105

Cermet | Carbide



						Cermet				Carbide													
						Uncoated		Coated		Uncoated		Coated											
						WHT10	WHT32	WTC15	WTC121	WHW01	WHW16	WHC05	WHC18	WHC19	WHC79	WHC81	WHC88	WHC98	WHC111	WHC114	WHC136	WHC164	
Geometry	Radius		Part No.	ISO Description	Index No.																		
	mm	in																					
Steel	P																						
Stainless Steel	M																						
Cast Iron	K																						
Nonferrous Materials	N																						
Titanium	S																						
Hard Materials	H																						
129	0.05	0.002	F101005GN129	CCGT0602005	397738						●	●											
129	0.10	0.004	F10101GN129	CCGT060201	397737						●	●											
129	0.20	0.008	F10102GN129	CCGT060202	297545						●	●	●										
129	0.40	0.016	F10104GN129	CCGT060204	297546						●	●	●	●									
129	0.20	0.008	F10302GN129	CCGT09T302	297547						●	●	●										
129	0.40	0.016	F10304GN129	CCGT09T304	297548						●	●	●										
145	0.40	0.016	F10104GN145	CCGT060204	297980															●			
145	0.80	0.031	F10108GN145	CCGT060208	397742															●			
145	0.40	0.016	F10304GN145	CCGT09T304	297994															●			
145	0.80	0.031	F10308GN145	CCGT09T308	297995															●			
146	0.40	0.016	F10104MN146	CCMT060204	397953											●	●						
146	0.40	0.016	F10304MN146	CCMT09T304	397142											●	●	●					
146	0.80	0.031	F10308MN146	CCMT09T308	397946											●	●	●					
146	0.40	0.016	F10404MN146	CCMT120404	397469												●	●	●				
146	0.80	0.031	F10408MN146	CCMT120408	397143												●	●	●				
146	1.20	0.047	F10412MN146	CCMT120412	397939												●	●	●				
155	0.20	0.008	F10102MN155	CCMT060202	397662			●															
155	0.40	0.016	F10104MN155	CCMT060204	397739			●															
155	0.40	0.016	F10304MN155	CCMT09T304	397740			●															

Insert Form	Countersunk Screw		Torque Driver		Service Key		Technical Data	
	Torque	Key Size	Torque	Key Size	Torque	Key Size	Torque	Key Size
101	115676	M2.5 x 0.45 x 5	415514	115590	1.2 Nm	T8		
103	115672 ($\le \varnothing 37\text{ mm}$)	M3.5 x 0.6 x 7.5	415510	115664	3.0 Nm	T15		
103	115673 (>math>\varnothing 36\text{ mm}</math>)	M3.5 x 0.6 x 9	415510	115664	3.0 Nm	T15		
104	215149	M4.5 x 0.75 x 11.5	415543	215150	5.0 Nm	T20		
105	215149	M4.5 x 0.75 x 11.5	415543	215150	5.0 Nm	T20		

Reference Key

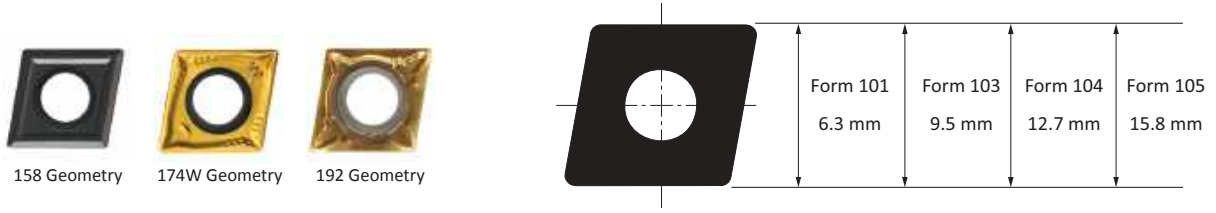
Symbol	Machining Conditions
●	Good - Main Application
●	Average - Main Application

Reference Key

Symbol	Insert Type
▼	Roughing - Main Application
▽	Roughing - Extended Application
▼▼	Finishing - Main Application
▽▽	Finishing - Extended Application

Insert Forms 101, 103, 104, 105

Carbide



						Carbide										
						Uncoated					Coated					
						WHW01	WHW16	WHC05	WHC18	WHC19	WHC79	WHC98	WHC111	WHC114	WHC136	WHC164
Geometry	Radius		Part No.	ISO Code	Index No.											
	mm	in														
Steel	P															
Stainless Steel	M															
Cast Iron	K															
Nonferrous Materials	N															
Titanium	S															
Hard Materials	H															
158	0.20	0.008	F10102MN158	CCMT060202	297248											
158	0.40	0.016	F10104MN158	CCMT060204	297377											
158	0.40	0.016	F10304MN158	CCMT09T304	297239											
158	0.80	0.031	F10308MN158	CCMT09T308	297240											
158	0.40	0.016	F10404MN158	CCMT120404	297242											
158	0.80	0.031	F10408MN158	CCMT120408	297241											
158	0.80	0.031	F10508MN158	CCMT160508	297559											
158	1.20	0.047	F10512MN158	CCMT160512	297560											
174W	0.40	0.016	F10104MN174W	CCMT060204	397766											
174W	0.40	0.016	F10304MN174W	CCMT09T304	397767											
174W	0.80	0.031	F10308MN174W	CCMT09T308	397768											
192	0.20	0.008	F10102MN192	CCMT060202	297531											
192	0.40	0.016	F10104MN192	CCMT060204	297658											
192	0.80	0.031	F10108MN192	CCMT060208	297588											
192	0.20	0.008	F10302MN192	CCMT09T302	297958											
192	0.40	0.016	F10304MN192	CCMT09T304	297653											
192	0.80	0.031	F10308MN192	CCMT09T308	397614											
192	0.40	0.016	F10404MN192	CCMT120404	397666											
192	0.80	0.031	F10408MN192	CCMT120408	297878											
192	1.20	0.047	F10412MN192	CCMT120412	397632											

Reference Key

Symbol	Machining Conditions
●	Good - Main Application
◐	Average - Main Application
⊕	Difficult - Main Application

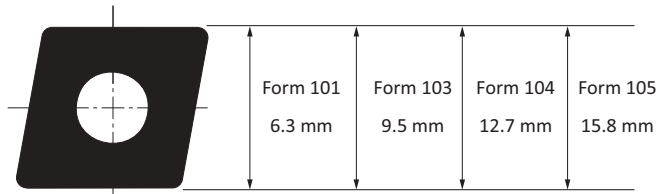
Reference Key

Symbol	Insert Type
▽	Roughing - Main Application
▽	Roughing - Extended Application
▽▽	Finishing - Main Application
▽▽	Finishing - Extended Application

Insert Form	Countersunk Screw		Torque Driver		Service Key		Technical Data	
	Torque	Key Size	Torque	Key Size	Torque	Key Size	Torque	Key Size
101	115676	M2.5 x 0.45 x 5	415514	115590	1.2 Nm	T8		
103	115672 (\varnothing37 mm)	M3.5 x 0.6 x 7.5	415510	115664	3.0 Nm	T15		
103	115673 (>math>\varnothing</math>36 mm)	M3.5 x 0.6 x 9	415510	115664	3.0 Nm	T15		
104	215149	M4.5 x 0.75 x 11.5	415543	215150	5.0 Nm	T20		
105	215149	M4.5 x 0.75 x 11.5	415543	215150	5.0 Nm	T20		

Insert Forms 101, 103, 104, 105

Cermet | Carbide



						Cermet						Carbide											
						Uncoated			Coated			Uncoated			Coated								
Material	ISO Code	Application																					
Steel	P	▼▼▼																					
Stainless Steel	M	▽▽▽																					
Cast Iron	K	▼▼▼																					
Nonferrous Materials	N	▼▼▼																					
Titanium	S	▽▽▽																					
Hard Materials	H	▽▽▽																					
Geometry	Radius		Part No.	ISO Code	Index No.	WHT10	WHT12	WHT16	WHT32	WTC15	WTC121	WHW01	WHW16	WHC05	WHC18	WHC19	WHC77	WHC79	WHC98	WHC111	WHC114	WHC136	WHC164
	mm	in																					
199	0.20	0.008	F10102MN199	CCMT060202	397164																		
199	0.40	0.016	F10104MN199	CCMT060204	397165																		
199	0.20	0.008	F10302MN199	CCMT09T302	397702																		
199	0.40	0.016	F10304MN199	CCMT09T304	397166																		
199	0.80	0.031	F10308MN199	CCMT09T308	397167																		
199	0.40	0.016	F10404MN199	CCMT120404	397191																		
199	0.80	0.031	F10408MN199	CCMT120408	397168																		
200	0.20	0.008	F10102GN200	CCGT060202	397585																		
200	0.40	0.016	F10104GN200	CCGT060204	397586																		
200	0.20	0.008	F10302GN200	CCGT09T302	397587																		
200	0.40	0.016	F10304GN200	CCGT09T304	397588																		
200	0.40	0.016	F10404GN200	CCGT120404	397589																		
711	0.40	0.016	F10104MN711	CCMT060204	097637																		
711	0.40	0.016	F10404MN711	CCMW120404	097692																		
711	0.80	0.031	F10308MN711	CCMT09T308	297910																		
711	0.80	0.031	F10408MN711	CCMT120408	297911																		
860	0.10	0.004	F10101GL860	CCGT060201	097324																		
860	0.20	0.008	F10102GL860	CCGT060202	097241																		
860	0.40	0.016	F10104GL860	CCGT060204	097242																		
860	0.20	0.008	F10302GL860	CCGT09T302	097245																		
860	0.40	0.016	F10304GL860	CCGT09T304	097244																		
860	0.40	0.016	F10404GL860	CCGT120404	097738																		
860	0.80	0.031	F10408GL860	CCGT120408	097247																		
860	0.80	0.031	F10508ML860	CCMT160508	097249																		

Insert Form	Countersunk Screw		Torque Driver		Service Key		Technical Data	
	Part No.	Dimensions	Part No.	Part No.	Torque	Key Size		
101	115676	M2.5 x 0.45 x 5	415514	115590	1.2 Nm	T8		
103	115672 ($\leq \phi 37 \text{ mm}$)	M3.5 x 0.6 x 7.5	415510	115664	3.0 Nm	T15		
103	115673 (>math>\phi 36 \text{ mm}</math>)	M3.5 x 0.6 x 9	415510	115664	3.0 Nm	T15		
104	215149	M4.5 x 0.75 x 11.5	415543	215150	5.0 Nm	T20		
105	215149	M4.5 x 0.75 x 11.5	415543	215150	5.0 Nm	T20		

Reference Key

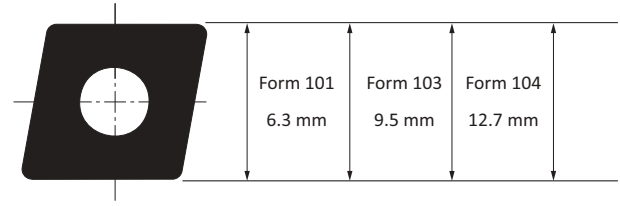
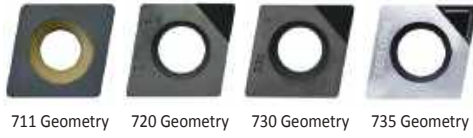
Symbol	Machining Conditions
●	Good - Main Application
◐	Average - Main Application

Reference Key

Symbol	Insert Type
▼	Roughing - Main Application
▽	Roughing - Extended Application
▼▼▼	Finishing - Main Application
▽▽▽	Finishing - Extended Application

Insert Forms 101, 103, 104

Ceramic | CBN | PCD



						Ceramic				CBN				PCD	
						Uncoated		Coated		Uncoated		Coated			
						WCN40				WBN150	WBN200	WBN300	WBN450	PKDD30	PKDD50
Geometry	Radius		Part No.	ISO Code	Index No.										
	mm	in													
Steel															
Stainless Steel															
Cast Iron						▼				▼▼▼					
Nonferrous Materials														▼▼▼▼	
Titanium															
Hard Materials															
711	0.40	0.016	F10304GN711	CCGW09T304	297561	⚙️									
711	0.80	0.031	F10308GN711	CCGW09T308	297192	⚙️									
711	0.80	0.031	F10408GN711	CCGW120408	297249	⚙️									
711	1.20	0.047	F10412GN711	CCGW120412	297234	⚙️									
720	0.20	0.008	F10102GN720	CCGT060202	297501									●	
720	0.40	0.016	F10104GN720	CCGT060204	297502									●	
720	0.20	0.008	F10302GN720	CCGT09T302	297578									●	
720	0.40	0.016	F10304GN720	CCGT09T304	297483									●	
730	0.20	0.008	F10102GN730	CCGW060202	097462									●	●
730	0.40	0.016	F10104GN730	CCGW060204	297164									●	●
730	0.80	0.031	F10108GN730	CCGW060208	297165									●	●
730	0.20	0.008	F10302GN730	CCGW09T302	397251									●	●
730	0.40	0.016	F10304GN730	CCGW09T304	297533									●	●
730	0.40	0.016	F10404GN730	CCGW120404	397257									●	●
730	0.80	0.031	F10408GN730	CCGW120408	297871									●	●
735	0.20	0.008	F10102GN735	CCGT060202	297872									●	
735	0.40	0.016	F10104GN735	CCGT060204	397244									●	
735	0.20	0.008	F10302GN735	CCGT09T302	397252									●	
735	0.40	0.016	F10304GN735	CCGT09T304	297870									●	

Reference Key

Symbol	Machining Conditions
●	Good - Main Application
●	Average - Main Application
⚙️	Difficult - Main Application

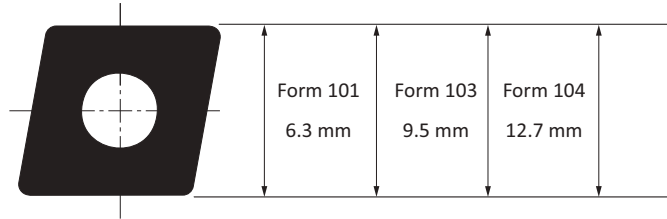
Reference Key

Symbol	Insert Type
▼	Roughing - Main Application
▽	Roughing - Extended Application
▼▼▼	Finishing - Main Application
▽▽▽	Finishing - Extended Application

Insert Form	Countersunk Screw		Torque Driver		Service Key		Technical Data	
	Part No.	Dimensions	Part No.	Part No.	Torque	Key Size		
101	115676	M2.5 x 0.45 x 5	415514	115590	1.2 Nm	T8		
103	115672 ($\le \varnothing 37\text{ mm}$)	M3.5 x 0.6 x 7.5	415510	115664	3.0 Nm	T15		
103	115673 (>math>\varnothing 36\text{ mm}</math>)	M3.5 x 0.6 x 9	415510	115664	3.0 Nm	T15		
104	215149	M4.5 x 0.75 x 11.5	415543	215150	5.0 Nm	T20		

Insert Forms 101, 103, 104

CBN



CBN											
						Uncoated				Coated	
Steel						P					
Stainless Steel						M					
Cast Iron						K					
Nonferrous Materials						N					
Titanium						S					
Hard Materials						H					
Geometry	Radius		Part No.	ISO Code	Index No.	WBN150	WBN200	WBN300	WBN450	WBN448	WBC300
	mm	in									
741	0.20	0.008	F10102GN741	CCGW060202	297290		●				
741	0.40	0.016	F10104GN741	CCGW060204	297291		●				
741	0.40	0.016	F10304GN741	CCGW09T304	297303		●				
742	0.20	0.008	F10102GN742	CCGW060202	297293			●			
742	0.40	0.016	F10104GN742	CCGW060204	297294			●			
742	0.40	0.016	F10304GN742	CCGW09T304	297306			●			
742D	0.20	0.008	F10102GN742D	CCGW060202	397949					●	●
742D	0.40	0.016	F10104GN742D	CCGW060204	397999					●	●
742D	0.40	0.016	F10304GN742D	CCGW090204	397931					●	●
742D	0.80	0.031	F10308GN742D	CCGW090208	397958					●	●
747	0.40	0.016	F10404GN747	CCGW120404	397260	●			●		
748	0.20	0.008	F10102GN748	CCGW060202	297787				●		
748	0.40	0.016	F10104GN748	CCGW060204	297788				●		
748	0.20	0.008	F10302GN748	CCGW09T302	297790				●		
748	0.40	0.016	F10304GN748	CCGW09T304	297419				●		
749	0.80	0.031	F10408GN749	CCGW120408	397261	●			●		
768	0.20	0.008	F10102GN768	CCGT060202	297486				●		
768	0.40	0.016	F10104GN768	CCGT060204	297659				●		
768	0.20	0.008	F10302GN768	CCGT09T302	397439				●		
768	0.40	0.016	F10304GN768	CCGT09T304	297660				●		

Insert Form	Countersunk Screw		Torque Driver		Service Key		Technical Data	
	Part No.	Dimensions	Part No.	Part No.	Torque	Key Size		
101	115676	M2.5 x 0.4 x 5	415514	115590	1.2 Nm	T8		
103	115672 ($\varnothing 37\text{ mm}$)	M3.5 x 0.6 x 7.5	415510	115664	3.0 Nm	T15		
103	115673 (>math>\varnothing 36\text{ mm}</math>)	M3.5 x 0.6 x 9	415510	115664	3.0 Nm	T15		
104	215149	M4.5 x 0.75 x 11.5	415543	215150	5.0 Nm	T20		

Reference Key

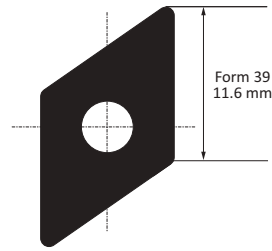
Symbol	Machining Conditions
●	Good - Main Application
●	Average - Main Application

Reference Key

Symbol	Insert Type
▼	Roughing - Main Application
▽	Roughing - Extended Application
▼▼	Finishing - Main Application
▽▽	Finishing - Extended Application

Insert Form 39

Cermet | Carbide



						Cermet						Carbide											
						Uncoated			Coated			Uncoated			Coated								
Material	Index					WHT10	WHT12	WHT16	WHT32	WTC15	WTC121	WHW01	WHW16	WHC05	WHC19	WHC81	WHC88	WHC98	WHC111	WHC114	WHC136	WHC164	
Steel	P									▽▽▽				▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽
Stainless Steel	M									▽▽▽				▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽
Cast Iron	K									▽▽▽				▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽
Nonferrous Materials	N													▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽
Titanium	S													▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽
Hard Materials	H																		▽▽▽	▽▽▽	▽▽▽	▽▽▽	▽▽▽
Geometry	Radius		Part No.	ISO Code	Index No.	WHT10	WHT12	WHT16	WHT32	WTC15	WTC121	WHW01	WHW16	WHC05	WHC19	WHC81	WHC88	WHC98	WHC111	WHC114	WHC136	WHC164	
	mm	in																					
121	0.20	0.008	F03902MN121	DCMT11T302	397787										⚙								
121	0.40	0.016	F03904MN121	DCMT11T304	397788										⚙								
127	0.20	0.008	F03702GN127	DCGT070202	397234								●										
127	0.40	0.016	F03704GN127	DCGT070204	097787								●										
127	0.20	0.008	F03902GN127	DCGT11T302	397235								●										
127	0.40	0.016	F03904GN127	DCGT11T304	097559								●										
129	0.20	0.008	F03702GN129	DCGT070202	397708								●										
129	0.20	0.008	F03902GN129	DCGT11T302	397816								●	●									
129	0.40	0.016	F03904GN129	DCGT11T304	397817								●	●									
146	0.40	0.016	F03704MN146	DCMT070204	397968											●	⚙						
146	0.80	0.031	F03708MN146	DCMT070208	397047											●	⚙						
146	0.40	0.016	F03904MN146	DCMT11T304	397591											●	⚙						
146	0.80	0.031	F03908MN146	DCMT11T308	397598											●	⚙						
155	0.20	0.008	F03902MN155	DCMT11T302	397809					●													
155	0.40	0.016	F03904MN155	DCMT11T304	397810					●													
192	0.20	0.008	F03902MN192	DCMT11T302	397783										⚙							●	
192	0.40	0.016	F03904MN192	DCMT11T304	297721										⚙							●	
192	0.80	0.031	F03908MN192	DCMT11T308	397784										⚙							●	
200	0.20	0.008	F03902GN200	DCGT11T302	397785															●			
200	0.40	0.016	F03904GN200	DCGT11T304	397786															●			

Reference Key

Symbol	Machining Conditions
●	Good - Main Application
◐	Average - Main Application
⚙	Difficult - Main Application

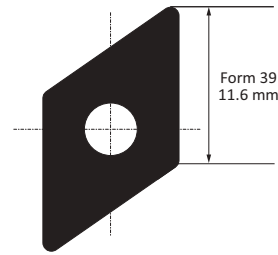
Reference Key

Symbol	Insert Type
▽	Roughing - Main Application
▽	Roughing - Extended Application
▽▽▽	Finishing - Main Application
▽▽▽	Finishing - Extended Application

				Technical Data	
Insert Form	Countersunk Screw	Torque Driver	Service Key	Torque	Key Size
39	115673 M3.5 x 0.6 x 9	414510	115664	3.0 Nm	T15

Insert Form 39

CBN | PCD







						CBN					PCD			
						Uncoated			Coated					
Steel														
Stainless Steel														
Cast Iron						▽▽▽		▽▽▽						
Nonferrous Materials											▽▽▽			
Titanium														
Hard Materials						▽▽▽								
Geometry	Radius		Part No.	ISO Code	Index No.	WBN150	WBN200	WBN300	WBN450	WBN200			PKDD30	PKDD50
	mm	in												
730	0.20	0.008	F03902GN730	DCGW11T302	397269								●	
730	0.40	0.016	F03904GN730	DCGW11T304	397270								●	
735	0.20	0.008	F03902GN735	DCGT11T302	397271								●	
735	0.40	0.016	F03904GN735	DCGT11T304	397272								●	
747	0.20	0.008	F03902GN747	DCGW11T302	397273	●			●					
747	0.40	0.016	F03904GN747	DCGW11T304	397274	●			●					

Reference Key

Symbol	Machining Conditions
●	Average - Main Application
⊕	Difficult - Main Application

Reference Key

Symbol	Insert Type
▽	Roughing - Main Application
▽	Roughing - Extended Application
▽▽▽	Finishing - Main Application
▽▽▽	Finishing - Extended Application

				Technical Data		
Insert Form	Countersunk Screw		Torque Driver	Service Key	Torque	Key Size
39	115673	M3.5 x 0.6 x 9	414510	115664	3.0 Nm	T15

Insert Forms 112, 113, 114

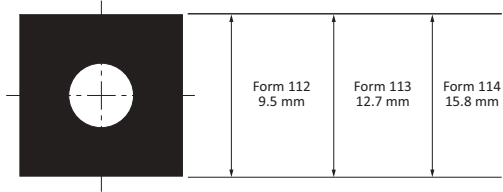
Carbide



108 Geometry 127 Geometry 145 Geometry



158 Geometry 192 Geometry 199 Geometry 711 Geometry



						Carbide													
						Uncoated		Coated											
Material	ISO Code	Index No.	Machining Conditions																
Steel	P		WHW01	WHW16	WHC05	WHC19	WHC30	WHC77	WHC79	WHC81	WHC88	WHC98	WHC111	WHC114	WHC136	WHC164			
Steel	P					▽▽	▽▽	▽	▽	▽	▽	▽	▽	▽	▽	▽			
Stainless Steel	M					▽	▽		▽		▽	▽	▽	▽	▽				
Cast Iron	K			▽▽	▽	▽	▽	▽	▽	▽	▽	▽	▽	▽	▽	▽			
Nonferrous Materials	N			▽															
Titanium	S			▽		▽	▽				▽		▽	▽	▽				
Hard Materials	H							▽		▽			▽			▽			

Geometry	Radius		Part No.	ISO Code	Index No.	WHW01	WHW16	WHC05	WHC19	WHC30	WHC77	WHC79	WHC81	WHC88	WHC98	WHC111	WHC114	WHC136	WHC164
	mm	in																	
108	0.40	0.016	F11204MN108	SCMT09T304	297535										●				
108	0.80	0.031	F11308MN108	SCMT120408	397110										●				
127	0.40	0.016	F11204GN127	SCGT09T304	097539		●												
127	0.40	0.016	F11304GN127	SCGT120404	397590		●												
127	0.80	0.031	F11308GN127	SCGT120408	097566		●												
145	0.80	0.031	F11208GN145	SCGT09T308	297996											●			
145	0.80	0.031	F11308GN145	SCGT120408	297997											●			
146	0.40	0.016	F11204MN146	SCMT09T304	397940								●	⚙					
146	0.80	0.031	F11208MN146	SCMT09T308	397992								●	⚙					
146	0.40	0.016	F11304MN146	SCMT12T304	397049								●	⚙					
146	0.80	0.031	F11308MN146	SCMT12T308	397969								●	⚙					
158	0.80	0.031	F11308MN158	SCMT120408	297497							●							
158	1.20	0.047	F11412MN158	SCMT150512	097252					⚙									
192	0.40	0.016	F11204MN192	SCMT09T304	397741				⚙										●
192	0.80	0.031	F11208MN192	SCMT09T308	397640				⚙										●
192	0.80	0.031	F11308MN192	SCMT120408	397709				⚙										●
192	1.20	0.047	F11312MN192	SCMT120412	397710				⚙										
199	0.40	0.016	F11204MN199	SCMT09T304	397703														●
199	0.80	0.031	F11208MN199	SCMT09T308	397704														●
199	0.80	0.031	F11308MN199	SCMT120408	397705														●
711	0.80	0.031	F11308MN711	SCMT120408	297212						●								

Reference Key

Symbol	Machining Conditions
●	Good - Main Application
●	Average - Main Application
⚙	Difficult - Main Application

Reference Key

Symbol	Insert Type
▽	Roughing - Main Application
▽	Roughing - Extended Application
▽▽	Finishing - Extended Application

Insert Form	Countersunk Screw		Torque Driver		Service Key		Technical Data	
	Part No.	Dimensions	Part No.	Part No.	Torque	Key Size		
112	115672 ($\phi 37\text{ mm}$)	M3.5 x 0.6 x 7.5	415510	115664	3.0 Nm	T15		
112	115673 (>math>\phi 36\text{ mm}</math>)	M3.5 x 0.6 x 9	415510	115664	3.0 Nm	T15		
113	215149	M4.5 x 0.75 x 11.5	415543	215150	5.0 Nm	T20		
114	215149	M4.5 x 0.75 x 11.5	415543	215150	5.0 Nm	T20		

Insert Forms 04, 05

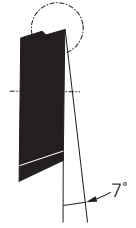
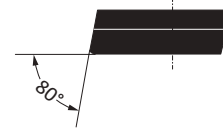
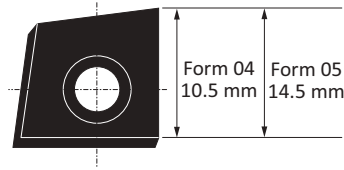
Carbide



880 Geometry



811 Geometry



						Carbide										
						Uncoated			Coated							
Steel		P											▼	▼	▼	
Stainless Steel		M											▽	▽	▼	
Cast Iron		K											▼	▼	▼	
Nonferrous Materials		N													▽	
Titanium		S													▽	
Hard Materials		H														
Geometry	Radius		Part No.	ISO Code	Index No.	WHW16	WHC05	WHC18	WHC19	WHC79	WHC98	WHC111	WHC114	WHC170	WHC168	WHC198
	mm	in														
880	0.40	0.016	F00404ML880	-	397595											●
880	0.40	0.016	F00504ML880	-	397593											●
880	0.80	0.031	F00508ML880	-	397594									⚡	⚡	●
811	0.80	0.031	F00508ML811	-	397844									⚡	⚡	●

Reference Key

Symbol	Machining Conditions
●	Average - Main Application
⚡	Difficult - Main Application

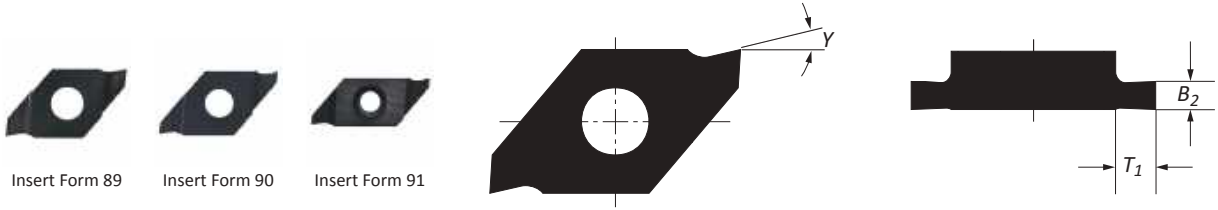
Reference Key

Symbol	Insert Type
▼	Roughing - Main Application
▽	Roughing - Extended Application

Insert Form	Countersunk Screw		Torque Driver	Service Key	Technical Data	
					Torque	Key Size
04	415977	M4 x 0.7 x 7.9	415510	115664	3.0 Nm	T15
05	415949	M4 x 0.7 x 11	415543	215150	5.0 Nm	T20

Radial Grooving Insert Forms 89, 90, 91

Carbide



						Carbide														
						Uncoated			Coated											
Steel						P														▼▼
Stainless Steel						M														▽▽
Cast Iron						K			▽▽											▼▼
Nonferrous Materials						N			▼▼											
Titanium						S			▽▽											▼▼
Hard Materials						H														
Insert Form	B ₂	Y	T ₁	Ring Width	Part No.	WHW01	WHW16	WHW20	WHC05	WHC18	WHC19	WHC79	WHC98	WHC111	WHC114	WHC136	WHC164			
89	1.24	13°	1.30	1.00	097257			●											●	
89	1.44	13°	1.30	1.20	097258			●											●	
89	1.74	13°	1.50	1.50	097259			●											●	
90	1.99	9°	2.40	1.75	097256			●											●	
90	2.29	9°	2.40	2.00	097253			●											●	
90	2.79	9°	2.40	2.50	097254			●											●	
90	3.29	9°	2.40	3.00	097255			●											●	
91	2.79	9°	2.40	2.50	097260			●											●	
91	3.29	9°	2.40	3.00	097261			●											●	
91	4.29	9°	3.30	4.00	097262			●											●	
91	5.29	9°	4.50	5.00	097294			●											●	

Reference Key

Symbol	Machining Conditions
●	Average - Main Application

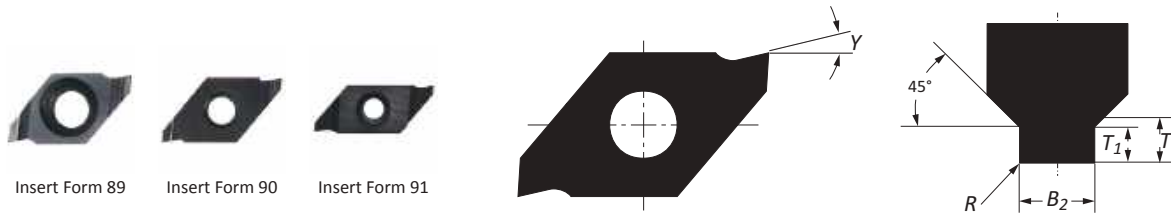
Reference Key

Symbol	Insert Type
▼▼	Universal - Main Application
▽▽	Universal - Extended Application

Insert Form	Countersunk Screw		Torque Driver	Service Key	Technical Data	
					Torque	Key Size
89	115676	M2.5 x 0.45 x 5	415514	115590	1.2 Nm	T8
90	115531	M3 x 0.5 x 7.5	415514	115590	1.2 Nm	T8
91	115802	M3 x 0.5 x 12	415514	115590	1.2 Nm	T8

Radial Grooving Insert Forms 89, 90, 91

Carbide



									Carbide																
									Uncoated			Coated													
Steel									P																▼▼
Stainless Steel									M															▽▽	
Cast Iron									K															▼▼	
Nonferrous Materials									N																
Titanium									S															▼▼	
Hard Materials									H																
Insert Form	Boring Ø	B ₂	Y	R	T ₁	T	Ring Width	Part No.	WHW01	WHW16	WHW20	WHC05	WHC18	WHC19	WHC79	WHC98	WHC111	WHC114	WHC136	WHC164					
89	24.00 - 26.00	1.44	13°	0.10	0.54	0.65	1.20	297937													●				
89	28.00 - 30.00	1.44	13°	0.10	0.64	0.75	1.20	297938													●				
89	31.00 - 32.00	1.44	13°	0.10	0.78	0.91	1.20	297939													●				
89	34.00	1.74	13°	0.10	0.78	0.91	1.50	297940													●				
89	35.00 - 38.00	1.74	13°	0.10	0.93	1.06	1.50	297941													●				
90	40.00 - 48.00	1.99	9°	0.15	1.18	1.31	1.75	297942													●				
90	50.00 - 63.00	2.29	9°	0.15	1.43	1.58	2.00	297943													●				
91	65.00 - 78.00	2.79	9°	0.20	1.43	1.58	2.50	297944													●				
91	80.00 - 82.00	2.79	9°	0.20	1.68	1.84	2.50	297945													●				
91	85.00 - 100.00	3.29	9°	0.20	1.68	1.84	3.00	297946													●				
91	102.00 - 145.00	4.29	9°	0.20	1.94	2.14	4.00	297947													●				

III

Reference Key

Symbol	Machining Conditions
●	Average - Main Application

Reference Key

Symbol	Insert Type
▼▼	Universal - Main Application
▽▽	Universal - Extended Application

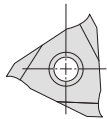
Insert Form	Countersunk Screw		Torque Driver		Service Key		Technical Data	
	Part No.	Size	Part No.	Part No.	Torque	Key Size		
89	115676	M2.5 x 0.45 x 5	415514	115590	1.2 Nm	T8		
90	115531	M3 x 0.5 x 7.5	415514	115590	1.2 Nm	T8		
91	115802	M3 x 0.5 x 12	415514	115590	1.2 Nm	T8		

Axial Grooving Insert Blanks Form 304

Carbide



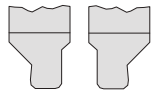
			Carbide											
			Uncoated			Coated								
Material	Grade		WHW01	WHW16	WHW20	WHC05	WHC18	WHC19	WHC79	WHC98	WHC111	WHC114	WHC136	WHC164
Steel	P													
Stainless Steel	M													
Cast Iron	K				▽▽									
Nonferrous Materials	N				▼▼									
Titanium	S				▽▽									
Hard Materials	H													
Geometry	S ₁	Part No.	WHW01	WHW16	WHW20	WHC05	WHC18	WHC19	WHC79	WHC98	WHC111	WHC114	WHC136	WHC164
	3.50	297150			●									
	4.30	297151			●									
	5.30	297152			●									
	6.50	297154			●									
	7.50	297493			●									
	3.50	397850			●									
	4.30	397851			●									
	5.30	397852			●									
	6.50	397853			●									
	7.50	397854			●									



Other insert types available upon request.



Two-Sided Cutting Form



Single-Sided Cutting Form (Right / Left)



Two-Sided Angle Cutting



With Corner Radius



Full Radius

Reference Key

Symbol	Machining Conditions
●	Average - Main Application

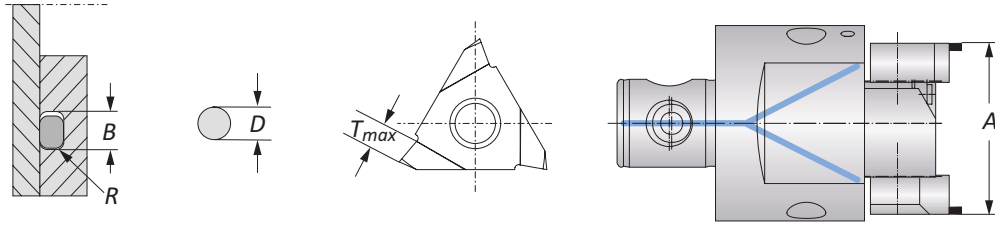
Reference Key


Symbol	Insert Type
▼▼	Universal - Main Application
▽▽	Universal - Extended Application

Insert Form	Countersunk Screw	Torque Driver	Service Key	Technical Data	
304	215392 M5 x 0.8 x 12.9	415543	215150	Torque 5.0 Nm	Key Size T20

Axial Grooving O-Rings for Single Cutter Tools Insert Form 304

Carbide



								Carbide															
								Uncoated				Coated											
Steel								P															▼▼
Stainless Steel								M															▽▽
Cast Iron								K															▼▼
Nonferrous Materials								N															
Titanium								S															▼▼
Hard Materials								H															
Geometry	Boring Range	O-Ring Cross Section	B + 0.05	B _{max}	T _{max}	R ± 0.05	Part No.	WHW01	WHW16	WHW20	WHC05	WHC18	WHC19	WHC79	WHC98	WHC111	WHC114	WHC136	WHC164				
	20 - 54	1.00	1.50	1.50	1.65	0.20	297969													●			
	20 - 54	1.50	2.20	2.20	2.35	0.30	297970													●			
	20 - 54	2.00	2.90	2.90	3.15	0.40	297971													●			
	20 - 54	2.50	3.50	3.50	3.85	0.50	297972													●			
	20 - 54	3.00	4.10	4.10	4.45	0.60	297973													●			
	20 - 54	4.00	5.40	5.40	4.95	0.80	297974														●		
	20 - 54	5.00	6.80	6.80	4.95	0.80	297975														●		

Reference Key

Symbol	Machining Conditions
●	Average - Main Application

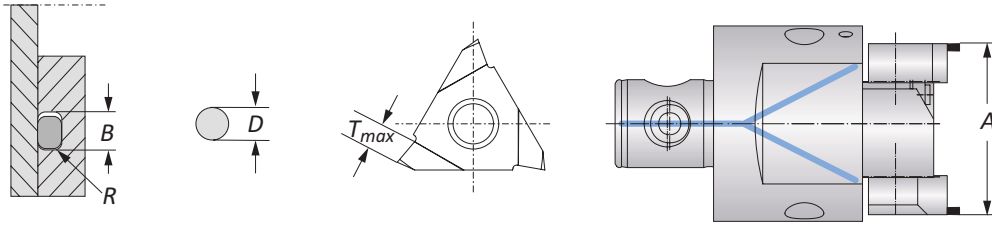
Reference Key

Symbol	Insert Type
▼▼	Universal - Main Application
▽▽	Universal - Extended Application

Insert Form	Countersunk Screw		Torque Driver	Service Key	Technical Data	
304	215392	M5 x 0.8 x 12.9	415543	215150	Torque	Key Size
					5.0 Nm	T20

Axial Grooving O-Rings for Twin Cutter Tools Insert Form 304

Carbide



		Carbide																		
		Uncoated							Coated											
		Material																		
Steel		P																		
Stainless Steel		M																		
Cast Iron		K																		
Nonferrous Materials		N																		
Titanium		S																		
Hard Materials		H																		
Geometry	Boring Range	O-Ring Cross Section	B + 0.05	B _{max}	T _{max}	R ± 0.05	Part No.	WHW01	WHW16	WHW20	WHC05	WHC18	WHC19	WHC79	WHC98	WHC111	WHC114	WHC136	WHC164	
	53.00 - 1000.00	1.00 - 1.50	1.50	2.50	1.65	0.20	297976												●	
	53.00 - 1000.00	1.50 - 2.40	2.20	3.70	2.35	0.30	297977												●	
	53.00 - 1000.00	2.40 - 4.00	3.40	5.70	3.65	0.50	297978												●	
	53.00 - 1000.00	4.00 - 5.50	5.40	9.10	4.95	0.80	297979												●	

Reference Key

Symbol	Machining Conditions
●	Average - Main Application

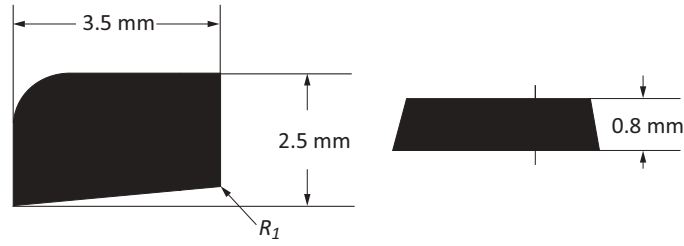
Reference Key

Symbol	Insert Type
▼▼	Universal - Main Application
▽▽	Universal - Extended Application

Insert Form	Countersunk Screw	Torque Driver	Service Key	Technical Data	
304	215392 M5 x 0.8 x 12.9	415543	215150	Torque	Key Size
				5.0 Nm	T20

Insert Form 325

Carbide



				Carbide											
				Uncoated			Coated								
Material	Grade	Symbol	Index No.	WHW01	WHW16	WHW20	WHC05	WHC18	WHC19	WHC79	WHC98	WHC111	WHC114	WHC136	WHC164
Steel	P	▼▼▼													
Stainless Steel	M	▼▼▼													
Cast Iron	K	▼▼▼													
Nonferrous Materials	N	▼▼▼													
Titanium	S	▼▼▼													
Hard Materials	H														
Geometry	Radius R_1	Part No.	Index No.	WHW01	WHW16	WHW20	WHC05	WHC18	WHC19	WHC79	WHC98	WHC111	WHC114	WHC136	WHC164
860	0.10	F32501CN860	097831			●								●	

Reference Key

Symbol	Machining Conditions
●	Average - Main Application

Reference Key

Symbol	Insert Type
▼▼▼	Finishing - Main Application
▽▽▽	Finishing - Extended Application

Insert Form	Countersunk Screw	Clamping Jaw	Torque Driver	Service Key	Technical Data	
					Torque	Key Size
325	315321 M1.6 x 0.35 x 3	315320	-	315322	0.3 Nm	0.5x3

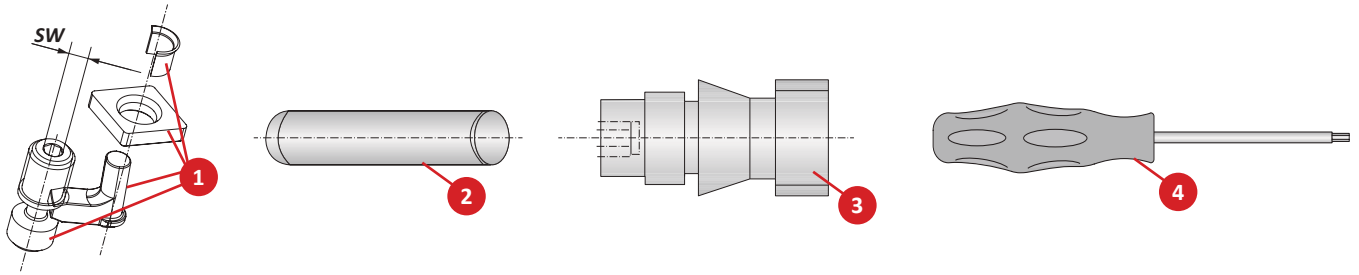
Insert Accessories

Countersunk Screws | Torque Drivers

Insert Form	Countersunk Screw		Clamping Jaw	Torque Driver		Technical Data	
				Torque Driver	Service Key	Torque	Key Size
04	415977	M4 x 0.7 x 7.9	–	415510	115664	3.0 Nm	T15
05	415949	M4 x 0.7 x 11	–	415543	215150	5.0 Nm	T20
20	115535	M2 x 0.4 x 5	–	415508	115591	0.9 Nm	T7
39	115673	M3.5 x 0.6 x 9	–	414510	115664	3.0 Nm	T15
47	315324	M1.8 x 0.35 x 4	315323	–	115537	0.5 Nm	T6
89	115676	M2.5 x 0.45 x 5	–	415514	115590	1.2 Nm	T8
90	115531	M3 x 0.5 x 7.5	–	415514	115590	1.2 Nm	T8
91	115802	M3 x 0.5 x 12	–	415514	115590	1.2 Nm	T8
101	115676	M2.5 x 0.45 x 5	–	415514	115590	1.2 Nm	T8
103	115672(<Ø37 mm)	M3.5 x 0.6 x 7.5	–	415510	115664	3.0 Nm	T15
103	115673(>Ø36 mm)	M3.5 x 0.6 x 9	–	415510	115664	3.0 Nm	T15
104	215149	M4.5 x 0.75 x 11.5	–	415543	215150	5.0 Nm	T20
105	215149	M4.5 x 0.75 x 11.5	–	415543	215150	5.0 Nm	T20
111	115531	M3 x 0.5 x 7.5	–	415514	115590	1.2 Nm	T8
112	115672(<Ø37 mm)	M3.5 x 0.6 x 7.5	–	415510	115664	3.0 Nm	T15
112	115673(>Ø36 mm)	M3.5 x 0.6 x 9	–	415510	115664	3.0 Nm	T15
113	215149	M4.5 x 0.75 x 11.5	–	415543	215150	5.0 Nm	T20
114	215149	M4.5 x 0.75 x 11.5	–	415543	215150	5.0 Nm	T20
161	115676	M2.5 x 0.45 x 5	–	415514	115590	1.2 Nm	T8
163	115673	M3.5 x 0.6 x 9	–	415510	115664	3.0 Nm	T15
211	215377	M2 x 0.4 x 4	–	415507	115537	0.6 Nm	T6
262	215987	M2.5 x 0.45 x 6	–	415514	115590	1.2 Nm	T8
264	115673	M3.5 x 0.6 x 9	–	415510	115664	3.0 Nm	T15
304	215392	M5 x 0.8 x 12.9	–	415543	215150	5.0 Nm	T20
325	315321	M1.6 x 0.35 x 3	315320	–	315322	0.3 Nm	0.5x3
394	215915	M2.5 x 0.45 x 7	–	415514	115590	1.1 Nm	T8
395	215985	M3 x 0.5 x 7.5	–	415514	115590	1.2 Nm	T8
396	415320	M3.5 x 0.6 x 11	–	415510	115664	3.0 Nm	T15
397	215149	M4.5 x 0.75 x 11.5	–	415543	215150	5.0 Nm	T20

Insert Accessories

Countersunk Screws | Torque Drivers



Insert Form	1. Clamping Set		2. Mounting Arbor for Sleeve	3. Clamping Bolt		4. Service Key	
	Part No.	Key Size	Part No.	Part No.	Key Size	Part No.	Key Size
75	315004	s3	415642	-	-	415578	s3
123	315003	s3	415642	115775	s2.5	415578 115575	s3 s2.5
124	315054	s3	415644	115776	s3	415578 115630	s3 s3

Technical Information

Surface Finish | General Formulas

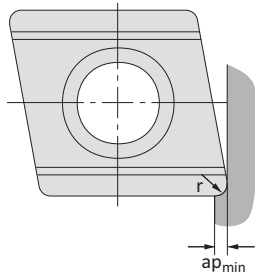
The corner radius of replaceable inserts is very important in finish machining. Large corner radii (0.8 mm (0.031")) or higher allow for high feed rates with good surface quality.

The expected surface quality can be estimated by using the function of corner radius and feed rate formula.

	<p>1. The larger the corner radius and the lighter the feed rate is, the better the surface quality.</p>
	<p>2. If the feed is approximately 1/3 of the corner radius, the better the machining time and surface finish will be in finish machining applications.</p>
	<p>3. A larger corner radius increases radial forces, which can negatively affect dimensional accuracy. Large corner radii also require increased depth of cut.</p>



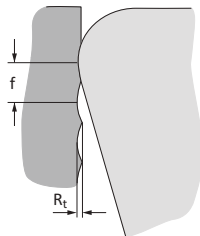
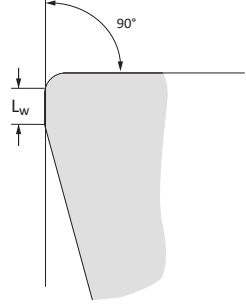
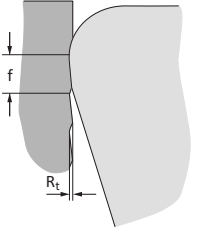
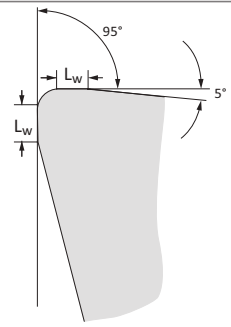
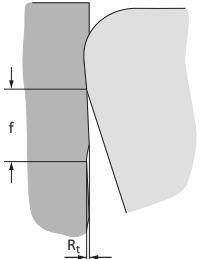
Minimum depth of cut (a_p) should at least match the corner radius. This minimizes the radial forces.



General Formulas		
Cutting Speed	$\frac{V_c = D \times \pi \times n}{1000}$	(M/min)
RPM	$\frac{n = V_c \times 1000}{D \times \pi}$	(min ⁻¹)
Feed Speed	$V_f = f \times n$	(mm/min)
	$D = \text{Machining } \varnothing$	(mm)
	$f = \text{Feed}$	(mm/u)
	$V_c = \text{Cutting Speed}$	(M/min)
	$n = \text{RPM}$	(min ⁻¹)

Technical Information

Wiper Geometries

Replaceable Inserts with Wiper Geometry		Wiper Geometry for 90° Approach Angle	
<p>Insert with conventional corner radius with feed (f)</p> 		<p>Replaceable inserts produce a right-angled step at the bottom of the hole. When used in a Wohlhaupter standard insert holder that has a 90° approach angle, the secondary wiper cutting edge is nearly parallel with the wall of the hole.</p> <p>Wiper geometry for 90° approach angle L_w = length of the wiper secondary cutting edge</p> 	
<p>Insert with wiper geometry radius with same feed (f)</p> 		<h3>Wiper Geometry for 95° Approach Angle</h3> <p>Wiper inserts can also be used with 95° insert holders, which are included in the Wohlhaupter standard insert range.</p> <p>Wiper geometry for 95° approach angle (left and right cutting) L_w = length of the secondary wiper cutting edge</p> 	
<p>Insert with wiper geometry with increased feed (f)</p> 			

Rough Machining Recommended Cutting Data | Metric (mm)

ISO	Material	(BHN) Hardness	Grade	*Speed M / Min	Recommended Feed (mm / tooth) Nose Radii			
					0.2 mm	0.4 mm	0.8 mm	1.2 mm
P	Free-Machining Steel 1118, 1215, 12L14, etc.	100 - 250	Carbide	150 - 230	0.10 - 0.15	0.10 - 0.30	0.20 - 0.50	0.10 - 0.80
	Cermet		150 - 250	0.10 - 0.15	0.10 - 0.30	0.20 - 0.50	0.10 - 0.80	
	Low-Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85 - 275	Carbide	140 - 250	0.10 - 0.15	0.10 - 0.30	0.20 - 0.50	0.10 - 0.80
	Medium-Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.		Carbide	140 - 250	0.10 - 0.15	0.10 - 0.30	0.20 - 0.50	0.10 - 0.80
	Alloy Steel 4140, 5140, 8640, etc.	125 - 375	Carbide	120 - 200	0.10 - 0.15	0.10 - 0.30	0.20 - 0.50	0.10 - 0.80
	High-Strength Alloy 4340, 4330V, 300M, etc.		Carbide	100 - 180	0.10 - 0.15	0.10 - 0.30	0.20 - 0.50	0.10 - 0.80
	Structural Steel A36, A285, A516, etc.	100 - 350	Carbide	150 - 260	0.10 - 0.15	0.10 - 0.30	0.20 - 0.50	0.10 - 0.80
	Cermet		150 - 280	0.10 - 0.15	0.10 - 0.30	0.20 - 0.50	0.10 - 0.80	
	Tool Steel H-13, H-21, A-4, O-2, S-3, etc.	150 - 250	Carbide	100 - 180	0.10 - 0.15	0.10 - 0.30	0.20 - 0.50	0.10 - 0.80
S	High-Temp Alloy Hastelloy B, Inconel 600, etc.	140 - 310	Carbide	20 - 50	0.10 - 0.15	0.10 - 0.2	0.15 - 0.35	0.20 - 0.40
	Titanium Alloy		Carbide	40 - 80	0.10 - 0.15	0.10 - 0.2	0.15 - 0.35	0.20 - 0.40
	Aerospace Alloy S82	185 - 350	Carbide	40 - 80	0.10 - 0.15	0.10 - 0.2	0.15 - 0.35	0.20 - 0.40
M	Stainless Steel 400 Series 416, 420, etc.	185 - 350	Carbide	50 - 100	0.10 - 0.15	0.10 - 0.25	0.10 - 0.35	0.20 - 0.60
	Stainless Steel 300 Series 304, 316, 17-4PH, etc.		Carbide	80 - 150	0.10 - 0.15	0.10 - 0.25	0.10 - 0.35	0.20 - 0.60
	Super Duplex Stainless Steel	135 - 275	Carbide	60 - 100	0.10 - 0.15	0.10 - 0.25	0.10 - 0.35	0.20 - 0.60
H	Wear Plate Hardox®, AR400, T-1, etc.	400 - 600	Carbide	30 - 50	0.05 - 0.15	0.10 - 0.20	0.10 - 0.20	0.10 - 0.25
	CBN		60 - 140	0.05 - 0.15	0.10 - 0.20	0.10 - 0.20	0.10 - 0.25	
	Hardened Steel	300 - 500	Carbide	40 - 60	0.05 - 0.15	0.10 - 0.20	0.10 - 0.20	0.10 - 0.25
			CBN	60 - 140	0.05 - 0.15	0.10 - 0.20	0.10 - 0.20	0.10 - 0.25
K	SG / Nodular Cast Iron	120 - 320	Carbide	130 - 250	0.10 - 0.15	0.15 - 0.35	0.20 - 0.50	0.20 - 0.80
	Ceramic		200 - 400	0.10 - 0.15	0.15 - 0.35	0.20 - 0.50	0.20 - 0.80	
	Grey / White Iron	180 - 320	Carbide	150 - 280	0.10 - 0.15	0.15 - 0.35	0.20 - 0.60	0.20 - 0.80
Ceramic	400 - 1000		0.10 - 0.15	0.15 - 0.35	0.20 - 0.60	0.20 - 0.80		
N	Cast Aluminum	30 - 180	Carbide	250 - 800	0.10 - 0.15	0.15 - 0.35	0.20 - 0.60	0.20 - 0.80
	PCD		400 - 1200	0.10 - 0.15	0.15 - 0.35	0.20 - 0.60	0.20 - 0.80	
	Wrought Aluminum	30 - 180	Carbide	200 - 500	0.10 - 0.15	0.15 - 0.35	0.15 - 0.50	0.20 - 0.80
	Aluminum Bronze	100 - 250	Carbide	120 - 250	0.10 - 0.15	0.15 - 0.25	0.15 - 0.40	0.20 - 0.60
Brass	100	Carbide	200 - 500	0.10 - 0.15	0.15 - 0.25	0.15 - 0.40	0.20 - 0.80	
Copper	60	Carbide	100 - 150	0.10 - 0.15	0.15 - 0.25	0.15 - 0.35	0.20 - 0.40	

*Not to exceed max recommended RPM for boring head found in corresponding Wohlhaupter Operation Manual.

Deep Hole Boring Speed Adjustment

⚠ For Dynamic Boring Tool NOVI ^{TECH} Length			
Boring Type	8xD	9xD	10xD
Roughing	0.80	0.60	0.40
Finishing	0.90	0.70	0.50

Recommended Speed Example

If the recommended speed for a finish boring assembly under 5xD is 120 m/min, then the speed for a 10xD finish boring assembly in the same application would be 60 m/min (120 m/min x 0.50 = 60 m/min).

5xD = 120 m/min	10xD = 60 m/min
-----------------	-----------------

*Not to exceed recommended RPM printed on NOVI^{TECH} module. Single-edge use is recommended.

IMPORTANT: Max spindle speed refers to maximum possible speed for individual boring head and is not a recommended parameter. Factory technical assistance is available for your specific applications through our Application Engineering department. *email: engineering.eu@alliedmachine.com*

⚠ WARNING Tool failure can cause serious injury. To prevent:

- Do not exceed recommended 10xD length-to-diameter ratio or exceed 4 total components (including shank.)
 - When using Alu-Line components, do not exceed recommended 5xD length-to-diameter ratio.
 - When using tool steel components, do not exceed recommended 6xD length-to-diameter ratio.
 - When using heavy metal components, do not exceed recommended 8xD length-to-diameter ratio.
 - When using a carbide shank, do not exceed recommended 9xD length-to-diameter ratio.
 - When using a NOVI^{TECH} module, do not exceed recommended 10xD length-to-diameter ratio.
- Factory technical assistance is available for your specific applications through our Application Engineering department. *email: engineering.eu@alliedmachine.com*

Finish Machining Recommended Cutting Data | Metric (mm)

ISO	Material	(BHN) Hardness	Grade	*Speed M / Min	Recommended Feed (mm / tooth) Nose Radii			
					0.1 mm	0.2 mm	0.4 mm	0.8 mm
P	Free-Machining Steel 1118, 1215, 12L14, etc.	100 - 250	Carbide	150 - 300	0.02 - 0.08	0.05 - 0.13	0.10 - 0.15	0.15 - 0.23
	Low-Carbon Steel 1010, 1020, 1025, 1522, 1144, etc.	85 - 275	Carbide	145 - 280	0.02 - 0.05	0.05 - 0.10	0.08 - 0.13	0.13 - 0.20
	Medium-Carbon Steel 1030, 1040, 1050, 1527, 1140, 1151, etc.	125 - 325	Carbide	145 - 280	0.02 - 0.05	0.05 - 0.10	0.08 - 0.13	0.13 - 0.20
	Alloy Steel 4140, 5140, 8640, etc.	125 - 375	Carbide	120 - 215	0.02 - 0.05	0.05 - 0.10	0.08 - 0.13	0.13 - 0.20
	High-Strength Alloy 4340, 4330V, 300M, etc.	225 - 400	Carbide	100 - 180	0.02 - 0.05	0.05 - 0.10	0.08 - 0.13	0.13 - 0.20
	Structural Steel A36, A285, A516, etc.	100 - 350	Carbide	145 - 280	0.02 - 0.05	0.05 - 0.10	0.08 - 0.13	0.13 - 0.20
	Tool Steel H-13, H-21, A-4, O-2, S-3, etc.	150 - 250	Carbide	100 - 180	0.02 - 0.05	0.05 - 0.08	0.08 - 0.10	0.10 - 0.15
S	High-Temp Alloy Hastelloy B, Inconel 600, etc.	140 - 310	Carbide	30 - 70	0.02 - 0.05	0.05 - 0.08	0.08 - 0.13	0.10 - 0.15
	Titanium Alloy	140 - 310	Carbide	40 - 90	0.02 - 0.05	0.05 - 0.08	0.08 - 0.13	0.10 - 0.15
	Aerospace Alloy S82	185 - 350	Carbide	40 - 90	0.02 - 0.05	0.05 - 0.08	0.08 - 0.13	0.10 - 0.15
M	Stainless Steel 400 Series 416, 420, etc.	185 - 350	Carbide	50 - 120	0.02 - 0.05	0.05 - 0.10	0.08 - 0.10	0.10 - 0.15
	Stainless Steel 300 Series 304, 316, 17-4PH, etc.	135 - 275	Carbide	90 - 160	0.02 - 0.05	0.05 - 0.10	0.08 - 0.10	0.10 - 0.15
	Super Duplex Stainless Steel	135 - 275	Carbide	60 - 160	0.02 - 0.05	0.05 - 0.10	0.08 - 0.10	0.10 - 0.15
H	Wear Plate Hardox®, AR400, T-1, etc.	400 - 600	Carbide	30 - 60	0.02 - 0.05	0.05 - 0.08	0.08 - 0.10	0.10 - 0.15
			CBN	70 - 180	0.02 - 0.05	0.05 - 0.08	0.08 - 0.10	0.10 - 0.15
	Hardened Steel	300 - 500	Carbide	40 - 80	0.02 - 0.05	0.05 - 0.08	0.08 - 0.10	0.10 - 0.15
			CBN	70 - 180	0.02 - 0.05	0.05 - 0.08	0.08 - 0.10	0.10 - 0.15
K	SG / Nodular Cast Iron	120 - 320	Carbide	145 - 260	0.02 - 0.05	0.05 - 0.10	0.08 - 0.13	0.13 - 0.20
	Grey / White Iron	180 - 320	Carbide	180 - 320	0.02 - 0.05	0.05 - 0.10	0.08 - 0.13	0.13 - 0.20
			CBN	400 - 1000	0.02 - 0.05	0.05 - 0.10	0.08 - 0.13	0.13 - 0.20
N	Cast Aluminium	30 - 180	Carbide	260 - 850	0.02 - 0.05	0.05 - 0.10	0.08 - 0.13	0.13 - 0.20
			PCD	495 - 1995	0.02 - 0.05	0.05 - 0.10	0.08 - 0.13	0.13 - 0.20
	Wrought Aluminium	30 - 180	Carbide	205 - 600	0.02 - 0.05	0.05 - 0.13	0.10 - 0.15	0.15 - 0.23
	Aluminium Bronze	100 - 250	Carbide	145 - 280	0.02 - 0.05	0.05 - 0.10	0.10 - 0.13	0.13 - 0.20
	Brass	100	Carbide	205 - 600	0.02 - 0.05	0.05 - 0.10	0.08 - 0.13	0.13 - 0.20
Copper	60	Carbide	100 - 180	0.02 - 0.05	0.05 - 0.08	0.08 - 0.10	0.10 - 0.13	

*Not to exceed max recommended RPM for boring head found in corresponding Wohlhaupter Operation Manual.

Deep Hole Boring Speed Adjustment

1. For Dynamic Boring Tool NOVI ^{TECH} Length			
Boring Type	8xD	9xD	10xD
Roughing	0.80	0.60	0.40
Finishing	0.90	0.70	0.50

*Not to exceed recommended RPM printed on NOVI^{TECH} module.

Recommended Speed Example

If the recommended speed for a finish boring assembly under 5xD is 120 m/min, then the speed for a 10xD finish boring assembly in the same application would be 60 m/min (120 m/min x 0.50 = 60 m/min).

5xD = 120 m/min

10xD = 60 m/min

IMPORTANT: Max spindle speed refers to maximum possible speed for individual boring head and is not a recommended parameter. Factory technical assistance is available for your specific applications through our Application Engineering department. *email: engineering.eu@alliedmachine.com*

1. WARNING Tool failure can cause serious injury. To prevent:

- Do not exceed recommended 10xD length-to-diameter ratio or exceed 4 total components (including shank.)
- When using Alu-Line components, do not exceed recommended 5xD length-to-diameter ratio.
- When using tool steel components, do not exceed recommended 6xD length-to-diameter ratio.
- When using heavy metal components, do not exceed recommended 8xD length-to-diameter ratio.
- When using a carbide shank, do not exceed recommended 9xD length-to-diameter ratio.
- When using a NOVI^{TECH} module, do not exceed recommended 10xD length-to-diameter ratio.

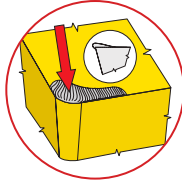
Factory technical assistance is available for your specific applications through our Application Engineering department. *email: engineering.eu@alliedmachine.com*

Boring Insert Wear Patterns

Built-up Edge

Potential Problem

- Machined material adheres to the cutting edge of insert.
- When it breaks, the edge becomes brittle and cracks.
- This can negatively affect machined surface.



Possible Solution

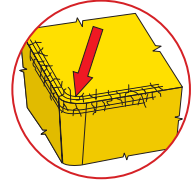
- Increase temperature by increasing speed or feed.
- Use an insert with higher lubricity coating.
- Choose a freer cutting insert geometry.



Comb Cracks

Potential Problem

- Caused by high stress on the cutting edge during interrupted cuts.



Possible Solution

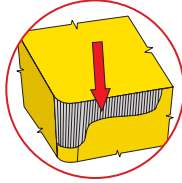
- Switch off coolant or increase coolant flow to obtain an even temperature level.
- Reduce cutting speed.
- Use tougher insert grade.



Flank Wear

Potential Problem

- Caused by friction between the insert and machined material.
- It cannot be fully eliminated, but it can be reduced.



Possible Solution

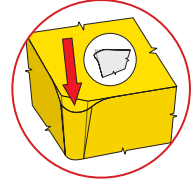
- Use a more wear-resistant grade.
- Reduce cutting speed.
- Use coolant or increase coolant flow to the cutting edge.



Plastic Deformation

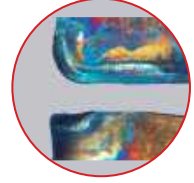
Potential Problem

- Caused by high thermal stress on the cutting edge from excessive feed rate and cutting speed.



Possible Solution

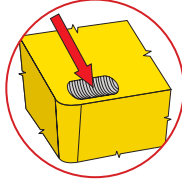
- Use a more wear-resistant grade.
- Reduce cutting speed.
- Reduce feed rate.
- Use coolant or increase coolant flow to the cutting edge.



Cratering

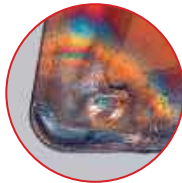
Potential Problem

- Appears when the geometry is too neutral or material is too hard for the substrate.



Possible Solution

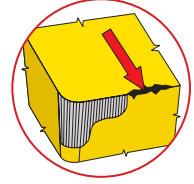
- Use a more wear-resistant grade.
- Reduce cutting speed or feed.
- Use coolant or increase coolant flow to the cutting edge.



Chipping of Cutting Edge (Out of Cut)

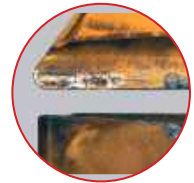
Potential Problem

- Caused by poor chip control.
- Can damage the portion of the cutting edge that might not be engaged in the cut.



Possible Solution

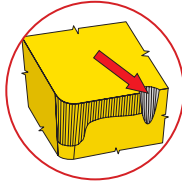
- Change feed rate to gain chip control.
- Select a tool with a different approach angle.
- Use an insert with a different geometry.
- Use a tougher grade of carbide.



Notch Wear

Potential Problem

- Occurs when cutting edge of insert comes in contact with surface of machined material.
- Caused by hardening of surface layer of material and burrs.
- Often appears on stainless austenitic steels and other high-temperature alloy steels.



Possible Solution

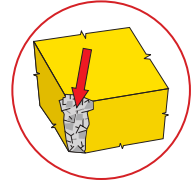
- Use a more wear-resistant grade (Al₂O₃).
- Select a tool with a smaller approach angle.
- Vary the radial depth of cut.
- Use coolant or increase coolant flow to the cutting edge.



Insert Fracture

Potential Problem

- Caused by workpiece material, grade, condition, the rigidity of the machine-tool workpiece, extent of wear, and cutting conditions.



Possible Solution

- Use a tougher grade of carbide.
- Reduce the feed and depth of cut.
- Use an insert with a stronger chip breaker.
- Use an insert with a bigger corner radius.



Guaranteed Test / Demo Application Form

Distributor PO #	
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The following must be filled out completely before your test will be considered

IMPORTANT: For processing, send purchase order to your Allied Field Sales Engineer (FSE). Please clearly mark the paperwork as "Test Order."

Distributor Information

Company Name: _____
 Contact: _____
 Account Number: _____
 Phone: _____
 Email: _____

End User Information

Company Name: _____
 Contact: _____
 Industry: _____
 Phone: _____
 Email: _____

Current Process

List all tooling, coatings, substrates, speeds and feeds, tool life, and any problems you are experiencing

Test Objective

List what would make this a successful test (i.e. penetration rate, finish, tool life, hole size, etc.)

Application Information

Hole Diameter: _____ in/mm	Tolerance: _____	Material: _____ (4150, A36, cast iron, etc.)
Pre-existing Diameter: _____ in/mm	Depth of Cut: _____ in/mm	Hardness: _____ (BHN, Rc)
Required Finish: _____ RMS		State: _____ (Casting, hot rolled, forging)

Machine Information

Machine Type: _____ (Lathe, screw machine, machine center, etc.)	Builder: _____ (Haas, Mori Seiki, etc.)	Model #: _____
Shank Required: _____ (CAT50, Morse taper, etc.)		Power: _____ HP/KW
Rigidity: _____	Orientation: _____	Tool Rotating: _____
<input type="checkbox"/> Excellent	<input type="checkbox"/> Vertical	<input type="checkbox"/> Yes
<input type="checkbox"/> Good	<input type="checkbox"/> Horizontal	<input type="checkbox"/> No
<input type="checkbox"/> Poor		Thrust: _____ lbs/N

Coolant Information

Coolant Delivery: _____ (Through tool, flood)	Coolant Pressure: _____ PSI / bar
Coolant Type: _____ (Air mist, oil, synthetic, water soluble, etc.)	Coolant Volume: _____ GPM / LPM

Requested Tooling

QTY	Item Number

QTY	Item Number

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Warranty Information



Allied Machine & Engineering (“Allied Machine”) warrants to original equipment manufacturers, distributors, industrial and commercial users of its products for one year from the original date of sale that each new product manufactured or supplied by Allied Machine shall be free from defects in material and workmanship.

Allied Machine’s sole and exclusive obligation under this warranty is limited to, at its option, without additional charge, replacing or repairing this product or issuing a credit. For this warranty to be applied, the product must be returned freight prepaid to the plant designated by an Allied Machine representative and which, upon inspection, is determined by Allied Machine to be defective in material and workmanship.

Complete information as to operating conditions, machine, setup, and the application of cutting fluid should accompany any product returned for inspection. This warranty shall not apply to any Allied Machine products which have been subjected to misuse, abuse, improper operating conditions, improper machine setup or improper application of cutting fluid or which have been repaired or altered if such repair or alteration, in the judgement of Allied Machine, would adversely affect the performance of the product.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Allied Machine shall have no liability or responsibility for any claim, whether in contract, tort or otherwise, for any loss or damage arising out of, connected with, or resulting from the manufacture, sale, delivery or use of any product sold hereunder, in excess of the cost of replacement or repair as provided herein.

Allied Machine shall not be liable in contract or in tort (including, without limitation, negligence, strict liability or otherwise) for economic losses of any kind or for any special, incidental, indirect, consequential, punitive or exemplary damages arising in any way out of the performance of, or failure to perform this agreement.

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