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Diamond

Cutting Tools

MDC ▪ TFC ▪ PDC

Turning ■ Grooving ■ Boring

ultrahard

cutting materials

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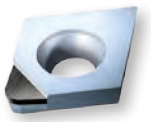
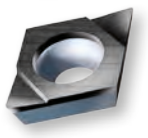
Contents





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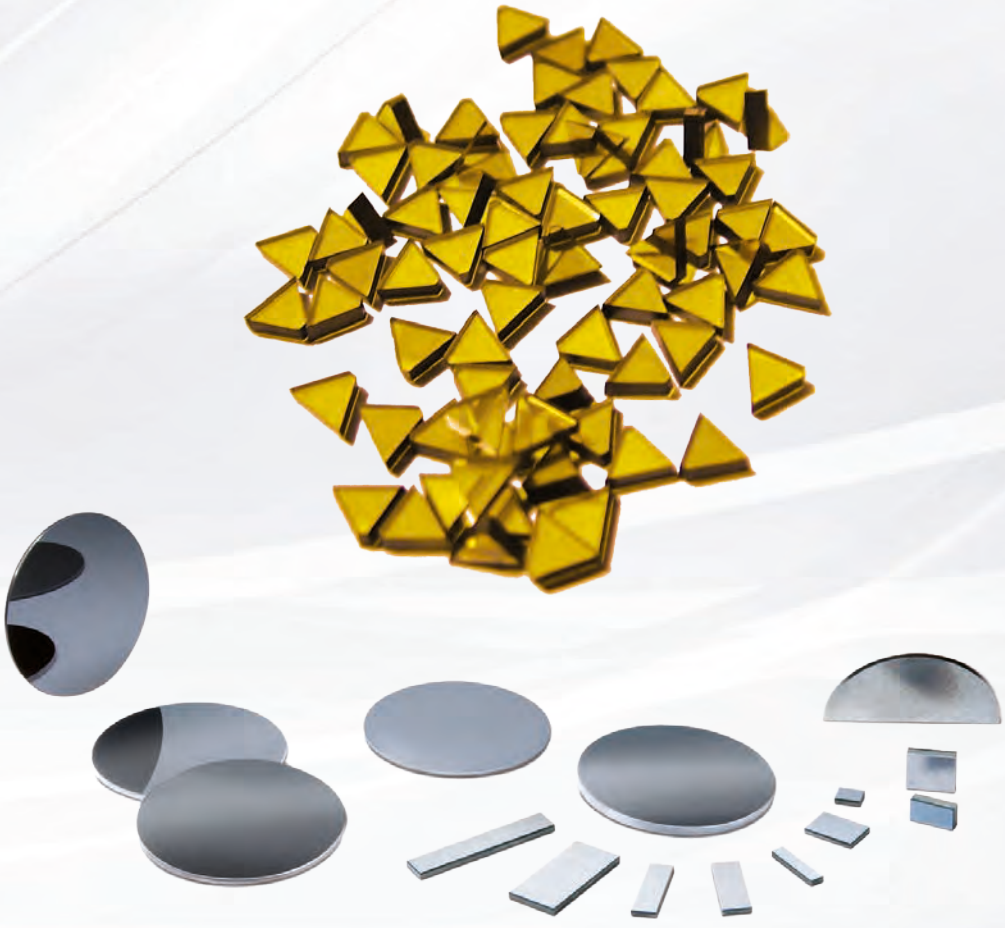
2200 years of diamond research and development

From engraver to high-tech tool

For over 3000 years diamond has been known to mankind as the hardest existing mineral. Until this day it still is the most treasured gemstone in the world. Even in early times this gem, crystallised of pure carbon, was used as a tool. Archaeologists have found proof dating back 200 years BC that unprocessed diamond was used as engraver even then. Later on the polishing technology came into development for the moulding of diamond blanks. During the Second World War the demand for natural diamonds has risen unexpectedly in all industries, thus the continuing need for diamonds soon exceeded the amount extracted from natural resources.

The synthetic diamond was born

The first real synthetic diamonds were crystallised in Sweden by ASEA in 1953. The General Electric Company in the USA was second to announce the successful results of their research in 1955. Synthetic diamonds are nowadays being produced as monocrystalline stones (MDC), polycrystalline Solid-CVD blanks (TFC) and as polycrystalline diamond compound material (PCD). The global demand of these ultrahard cutting materials is on a constant rise. In all modern machining, diamonds and cubic boron nitride have become cutting materials that are simply indispensable.



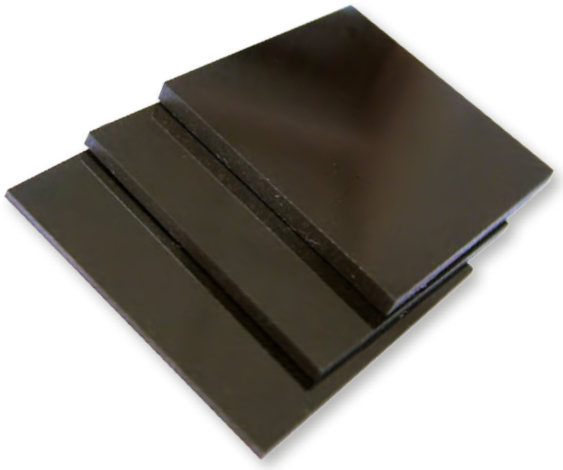
New ultrahard diamond cutting materials and their processing

Technical advancement never stands still. Fortunately we can present various new developments in regard to cutting tools. The diamond cutting edges will expedite the processing of nonferrous metals and plastics of all kinds into unknown dimensions.

First of all we would like to introduce new monocrystalline diamonds manufactured under the HPHT technique. The diamonds weigh between 0.8 and 3,5 carat and completely substitute the established natural diamond up to cutting edge lengths of 7mm.

Furthermore we can present the production and professional processing of polycrystalline TFC-solid CVD diamond with thicknesses between 0.5 and 1.8 mm. Since this pure diamond material without any binder cannot be eroded or economically ground, the only remaining machining procedure is the newly-developed laser technology.

The required segments are cut by laser. After the high vacuum brazing process the cutting edges are also treated by laser both in the periphery and on the top rake with or without a chip breaker geometry.



We are the world's market leader for full machining of diamond cutting edges by laser technology.

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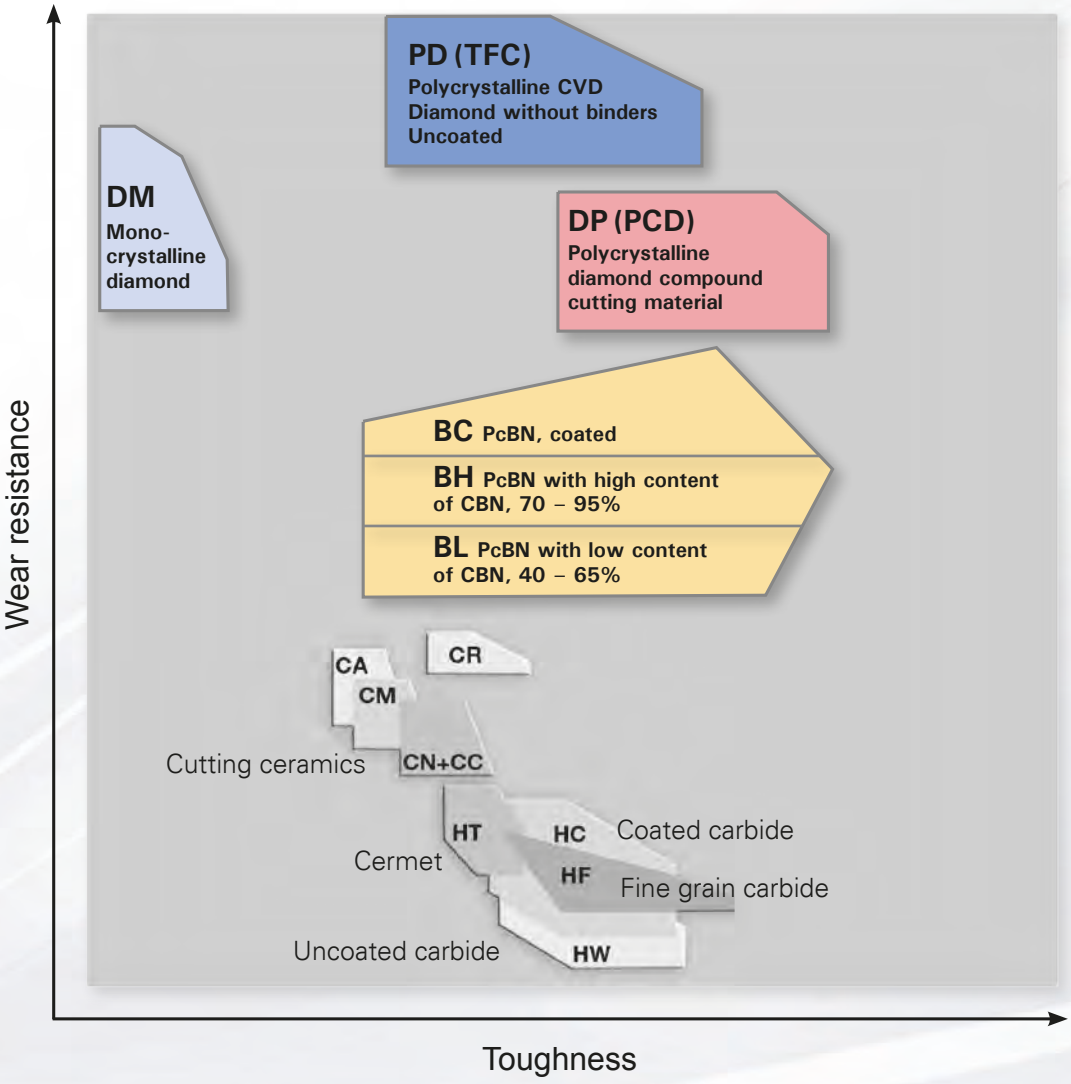
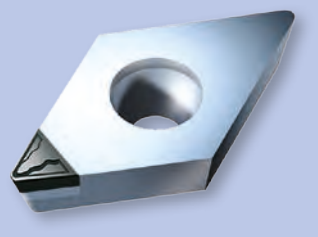
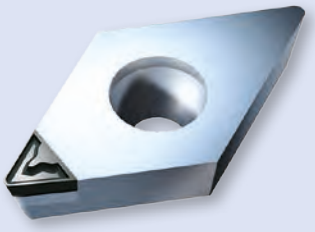
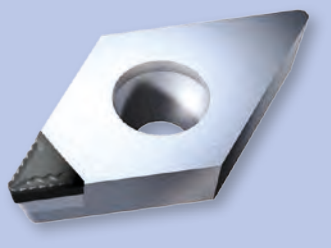
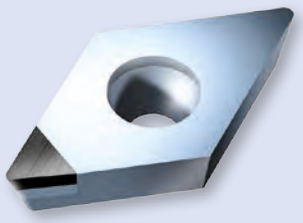
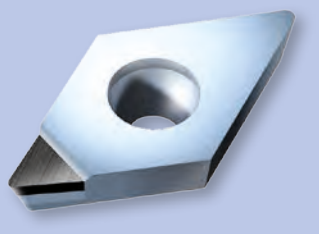
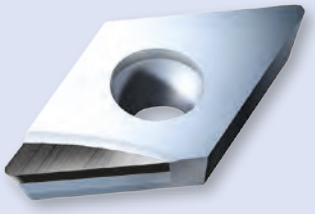
Groups of cutting materials (DIN ISO 513)



Additional ISO designation codes for carbide (also Cermet) and ceramics have been added to the DIN ISO 513 (2001) standard. Furthermore new ident letters for the ultahard cutting materials polycrystalline cubic boron nitride, monocrystalline and polycrystalline diamond have been introduced.

HW = Uncoated carbide **HF** = Fine grained carbide **HT** = Cermet, TiC or TiN **HC** = Carbide / Cermet as above, but coated	**DM** = Monocrystalline diamond **DP** = Polycrystalline diamond-compound **PD** = CVD - thickfilm diamond
CA = Ceramics, main content Al_2O_3 **CM** = Mixed ceramics, main content Al_2O_3, plus components other than oxides **CN** = Siliconnitride ceramics, main content Si_3N_4 **CR** = Ceramics, main content Al_2O_3 reinforced **CC** = Ceramics as above, but coated	**BL** = Polycrystalline Cubic Boron Nitride with low content of CBN (40 – 65%) **BH** = Polycrystalline Cubic Boron Nitride with high content of CBN (70 – 95%) **BC** = Polycrystalline Cubic Boron Nitride as above, but coated

Top Rake Geometries

Top rake geometries		Diamond grade	Applications
	**CB 1**	**TFC** **PDC** **PDC-S** **PDC-CU-S**	**Slight cutting pressure** ■ Thin-walled or instable workpieces ■ Minor tolerances ■ Medium surface finish ■ Chip breakage
	**CB 2**	**TFC** **PDC** **PDC-S** **PDC-CU-S**	**Increased cutting pressure** ■ Solid or firm workpieces ■ Minor tolerances ■ Best surface finish ■ Chip breakage
	**CB 3**	**PDC-CU-S**	**Roughing** ■ High cutting pressure ■ Massive or solid parts ■ Superior material removal rate ■ Chip breakage
	**Neutral**	**MDC** **TFC** **PDC** **PDC-S** **PDC-CU-S**	**Medium cutting pressure** ■ Solid or firm workpieces ■ Minor tolerances ■ Very good surface finish ■ No chip breakage, flow chip
	**Positive** **Neutral**	**MDC** **PDC** **PDC-S**	**Minor cutting pressure** ■ Thin-walled or instable workpieces ■ Minor tolerances ■ Medium surface finish ■ No chip breakage, flow chip
	**Positive** **R/L**	**PDC** **PDC-S**	**Minor cutting pressure** ■ Thin-walled or instable workpieces ■ Minor tolerances ■ Medium surface finish ■ High depth of cut ■ No chip breakage, flow chip

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Diamond grades in comparison

PDC-CU-S	PDC-S	PDC	TFC	MDC
• Sintered diamond of fine to coarse grit size • Reduced binder content - ultrahard PDC-compound-cutting material - optimized thermal conductivity • Grit size 20 – 35 µm (coarse grit content) • Result of lasered cutting edge • sharp cutting edge • Interrupted cut possible • Roughing and finishing possible • Well suited for cutting of - Hypo- and hypereutectic aluminium - All nonferrous metals and nonmetallics with high content of abrasive reinforcement or silicon	• Sintered diamond of coarse grit size • Grit size 8-10m • Cutting edge generated by grinding process • Suited for interrupted cut to a large extent • Roughing and pre-finishing/semi-finishing • Well suited for cutting of - hypoeutectic aluminium - non ferrous metals - nonmetallics	• Sintered diamond of fine grit size • Grit size 2-4µm • Cutting edge generated by grinding • Compound cutting material with optimum toughness • Suited for various interrupted cut possible (Finishing and Super-finishing) • Finishing and pre-finishing/semi-finishing • Well suited for cutting of - Hypoeutectic aluminium - Non ferrous metallics - Nonmetallics	• Solid polycristalline CVD-diamond without binder • The hardest grade of cutting material • Maximum thermal conductivity • Cutting edge generated by lasering • extreme sharp cutting edge • Limited use of interrupted cut • Roughing and Finishing • Well suited for cutting of - Hypereutectic aluminium - All nonferrous metals and nonmetallics with high content of abrasive reinforcement or silicon - Reinforced nonmetallics - Titanium alloy with coolant	• Solid monocrystalline diamond • Cutting edge extremely sharp • Cutting edge without microdamages • Superfinishing • Well suited for - Hypoeutectic aluminium - Copper - Nonmetallics without high content of abrasive reinforcement or silicon

	PDC-CU-S	PDC-S	PDC	TFC	MDC
Cutting edge generated by	Lasering	Grinding	Grinding	Lasering	Grinding
Rigidity/ Wear resistance	++	+	+	+++	+++
Toughness/ Interrupted cut	O	++	+	–	–
Roughing	++	++	+	O	–
Pre-finishing/ Semi-finishing	++	++	+	+	–
Finishing	+	+	++	+++	+++
Working material					
Aluminium with Si < 12%	+	++	++	+	++
Aluminium with Si ≥ 12%	++	O	O	+++	+
Nonferrous metals	With content of abrasive reinforcement	Without content of abrasive reinforcement	Without content of abrasive reinforcement	With content of abrasive reinforcement	Without content of abrasive reinforcement
Nonmetals	++	++	++	+++	++
GFRP / Carbon Firbre Reinforced Plastic	+	–	–	+++	++

+++ = perfectly suited
++ = suited at best
+ = well suited
O = suited
– = possible, not recommended

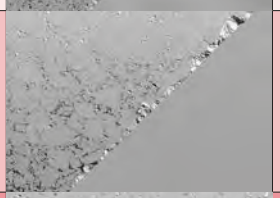
Cutting edge sharpness in comparison

The extreme cutting edge sharpness and its maximum diamond volume affect tool lifetime of the diamond cutting edge tremendously as a result of the extremely high thermal conductivity.

The newly developed laser technology offers great possibilities to produce such diamond cutting tools with TFC-CVD thick film and PDC diamond. Additionally all 3D geometries can be produced with the same cutting edge sharpness.

This development in laser technology and the production of the required diamond cutting materials makes us achieve our goal, which is the production of all necessary diamond cutting edges of highest quality with every optional chip control geometry without using a diamond grinding wheel.

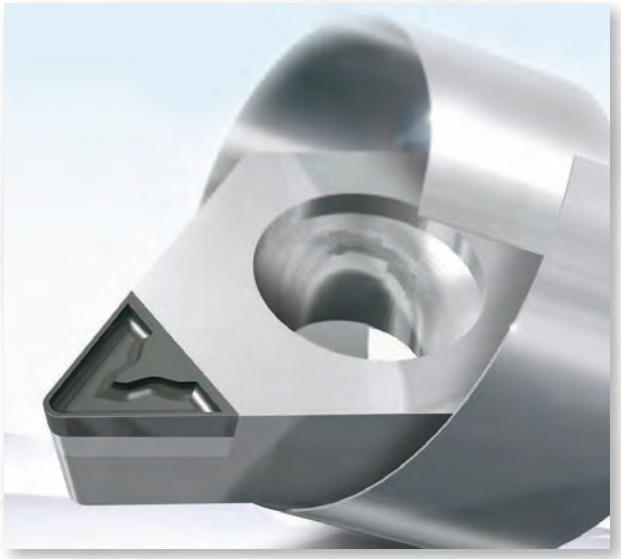
We are among the world-wide leaders in the application of laser technology for the complete machining of diamond cutting edges.

BECKER-Designation	ISO-Designation	Image of cutting edge: Magnification 1000x	Cutting material characteristics	Feed rate f (mm/rev)	Depth of cut
MDC	DM Monocrystalline		For best surface finishes in all applications, mirror finish	0,005 - 0,3 mm	0,005 - 1,5 mm
TFC	PD Polycristalline		Greater than 8% Si content or burr-free machining	0,01 - 0,4 mm	0,01 - 2,5 mm
PDC	DP Compound		up to max.12% Si content during continuous cut	0,05 - 0,5 mm	0,05 - 3,5 mm
PDC-S	DP Compound		up to max. 12% Si content during interrupted cut	0,06 - 0,5 mm	0,08 - 5,0 mm
PDC-CU-S	DP Compound		For roughing and milling of highly abrasive materials	0,08 - 0,8 mm	0,12 - 5,5 mm

Cutting Data - Range of chip breaker application

CB1:
Positive geometry for finishing and super finishing, a_p: 0.05 mm to 1.5 mm. Applicable for smallest tolerances at lowest cutting pressure.
Application: thin-walled and instable workpieces.

CB2:
Slightly negative edge preparation for roughing, semi finishing, finishing and super finishing, a_p: 0.5 mm to 2 mm. Due to an increased cutting pressure and smallest tolerances a better surface quality can be achieved.
Application: thick-walled solid workpieces under stable circumstances.



3D-chip breaker design CB1 and CB2									
Cutting radius	CB1 geometry				CB2 geometry				Cutting radius
	a_p in mm		f_z in mm/U		a_p in mm		f_z in mm/U		
	min.	max.	min.	max.	min.	max.	min.	max.	
0,1 mm	0,05	0,30	0,02	0,05					0,1 mm
0,2 mm	0,06	0,40	0,03	0,08	0,50	0,80	0,08	0,12	0,2 mm
0,4 mm	0,10	0,80	0,04	0,15	0,60	1,50	0,08	0,20	0,4 mm
0,8 mm	0,15	1,00	0,08	0,20	0,70	1,50	0,15	0,30	0,8 mm
1,2 mm	0,30	1,50	0,12	0,25	0,80	2,00	0,20	0,40	1,2 mm

The indicated cutting data are recommended values resulting from a chip breaker with CB1 and CB2 geometries. The machining should be performed without fluid coolant when PDC and PDC-S cutting edges are applied.

Without 3D-chip breaker: Flow chips

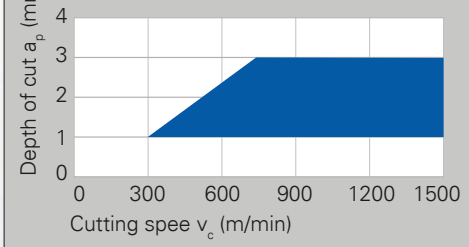
With 3D-chip breaker: Breakage chips

Cutting Data - Range of chip breaker application

CB3:
Wave-design of chip breaker generates constant chip-breaking during process of roughing. Suited for a wide range of applications, outstanding ablation rates.
Constant chip breaking under the circumstance of a_p < 1,1 mm, even with low cutting speeds from v_c 300.

Only for roughing of thick-walled or massive workpieces, under stable circumstances.

Range of constant chip breaking of CB3



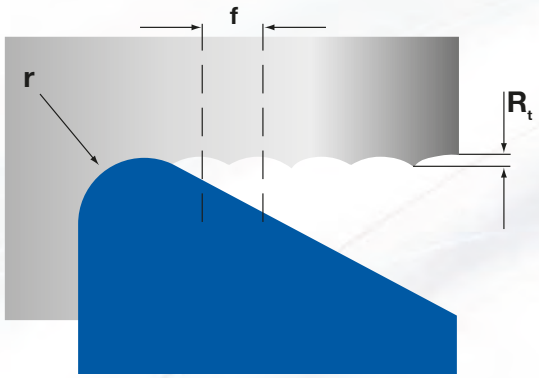
Recommended cutting data

v_c = 750 - 2500 m/min
f_z = 0,2 - 0,35 mm/U
a_p = 0,8 - 3mm

Emulsion coolant required in case of CB3 application!

Wiper Cutting Edge Geometry and Surface Finish

The theoretical R_t surface roughness value can be determined with the radius and the feed rates on hand. The required surface finish can be calculated very precisely in advance, provided all relevant peripheral prerequisites are given. As an example instable conditions of machine and/or workpiece, incorrect chucking, faulty or wrong tool system, wrong cutting speed and depth of cut etc. will all impair the results.

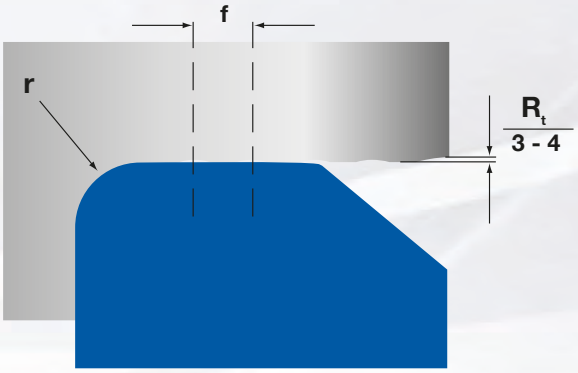


$$R_t = \frac{f^2}{8 \times r} \qquad r = \frac{f^2}{8 \times R_t} \qquad f = \sqrt{8 \times r \times R_t}$$

All values converted to µm

Theoretical surface roughness	Corner radius Feed rate per revolution (f = mm/rev)					
R_a	R_t	r = 0,2	r = 0,4	r = 0,8	r = 1,2	r = 1,6
0,6	1,6	f = 0,05	f = 0,07	f = 0,10	f = 0,12	f = 0,14
1,6	4	f = 0,08	f = 0,11	f = 0,15	f = 0,19	f = 0,23
3,2	10	f = 0,12	f = 0,17	f = 0,24	f = 0,29	f = 0,36
6,3	16	f = 0,16	f = 0,22	f = 0,30	f = 0,37	f = 0,45

A clear improvement of the theoretical surface roughness can be achieved with our Wiper geometry. For the high-performance cutting of all aspects we have developed a number of inserts with WIPER geometry for internal, external and milling processes. This WIPER edge replaces the minor cutting edge reducing its angle to a minimum, whereas it automatically improves the theoretically computed surface roughness by 2 to 4 times.

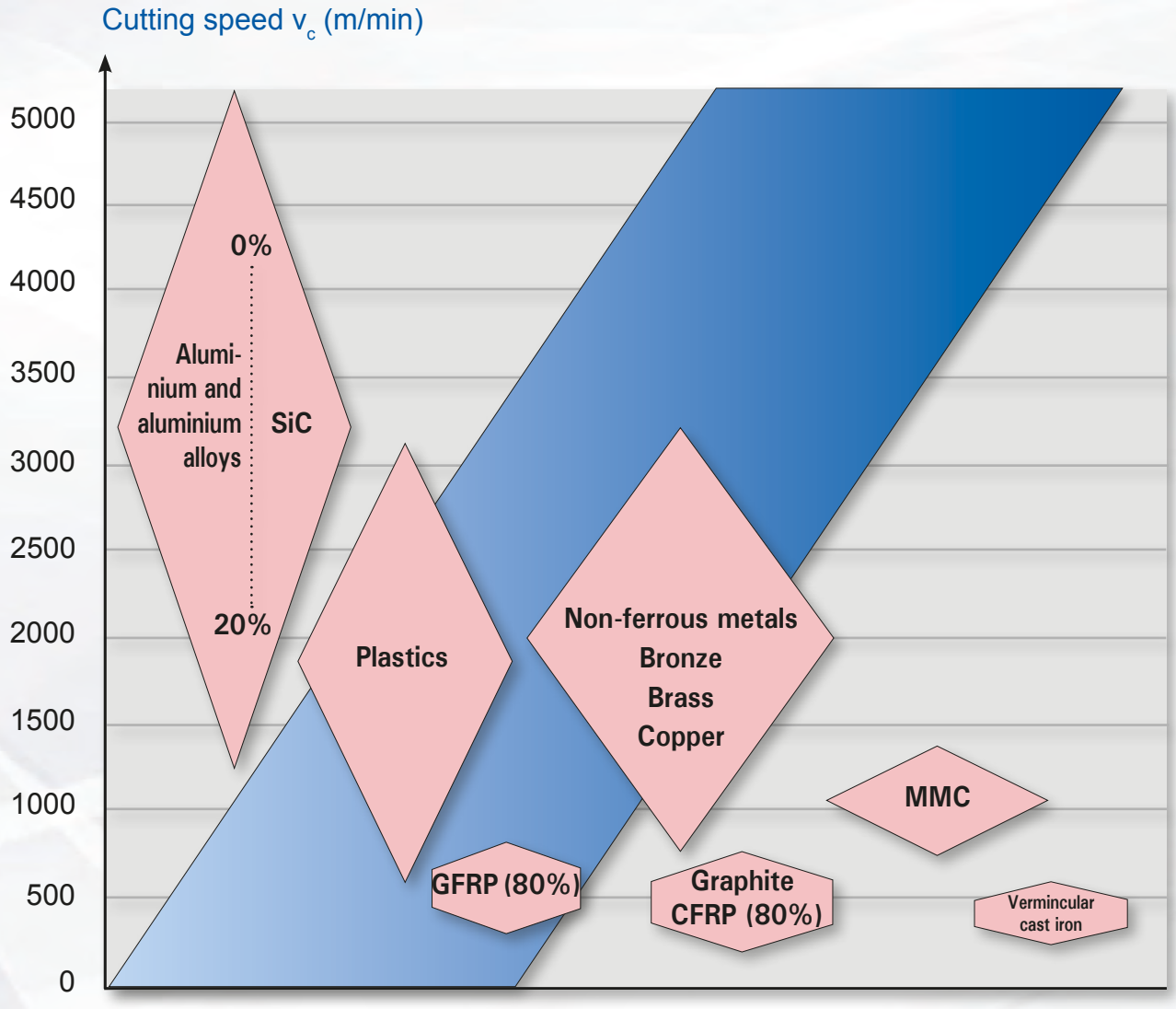


In practise these are the two possibilities
for high-performance and high-tech cutting:

1) 2-4x higher feed rate = same surface finish
2) same feed rate = 2-4x improved surface finish

Recommended cutting data

Turning and milling



Recommended values for turning

Diamond grade	Feed rate f (mm/rev)	Depth of cut
MDC	0,005 - 0,3 mm	0,005 - 1,5 mm
TFC	0,01 - 0,4 mm	0,01 - 2,5 mm
PDC	0,05 - 0,5 mm	0,05 - 3,5 mm
PDC-S	0,06 - 0,5 mm	0,08 - 5,0 mm
PDC-CU-S	0,08 - 0,8 mm	0,12 - 5,5 mm

Information

ISO turning and milling inserts

Worldwide successful wide range of 3D – chip breaker designs: CB1 – CB3.

Optimized by our special TFC-Solid-Diamond and Solid PDC-CU-S grades. Outstanding performance for cutting of abrasive material.

FormCut grooving range

This proven grooving- and grooving-turning program has been streamlined and, at the same time extended with the diamond grades TFC-solid-diamond and PDC-CU-S. We offer the chipbreaker 3D-designs CB1 and CB2 as standard or customized. Performance has been enhanced significantly. We would like to point out the high reliability of our FormCut system.

MiniCut boring range

Our boring range has been steamlined, as well and extended by the cutting material TFC-solid-diamond. Available also with the 3D-chipbreaker design CB1 and CB2. This increased performance, specially with drilling depths of 7xD, is standard at BECKER.

The new MiniCut boring bar X-GE has been developed with TFC-solid-diamond tipping especially for carbide applications.

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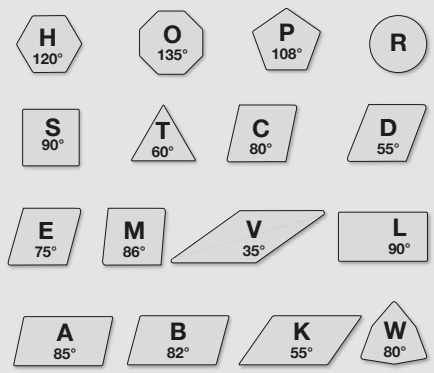
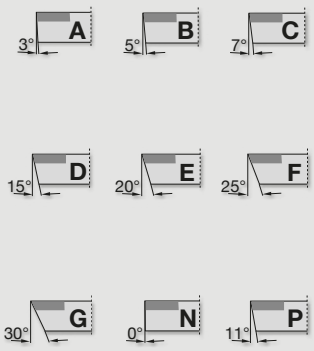
ISO - Insert Nomenclature

Order designation

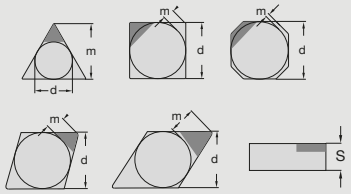
1 Basic shape



2 Clearance



3 Tolerance class



Tolerances in mm

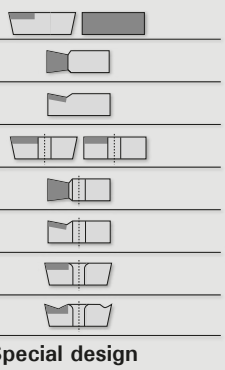
	m	s	d
A	0,005	0,025	0,025
F	0,005	0,025	0,013
C	0,013	0,025	0,025
H	0,013	0,025	0,013
E	0,005	0,025	0,025
G	0,025	0,130	0,025

	m		s	d[1]	
J	0,005		0,025	0,05	0,15
K	0,013		0,025	0,05	0,15
L	0,025		0,025	0,05	0,15
M[1]	0,08	0,20	0,130	0,05	0,15
N[1]	0,08	0,20	0,250	0,05	0,15
U[1]	0,13	0,38	0,130	0,08	0,15

[1]) The exact tolerance is determined by size of insert.

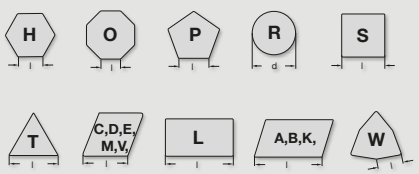
1	2	3	4	5	6
C	C	G	T	09	T3

4 Insert type



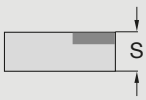
X Special design

5 Insert size



If less than 10 use 0 in first place, decimals are omitted
(Example: 9,525 mm = 09)

6 Thickness in mm



01 s = 1,59
T1 s = 1,98
02 s = 2,38
03 s = 3,18
T3 s = 3,97
04 s = 4,76
05 s = 5,56
06 s = 6,35

If less than 10 use 0 in first place, decimals are omitted
(Example: 3,18 mm = 03)

8 Corner configuration

Turning inserts Wiper edge

W = Wiper edge left + right hand
WR = Wiper edge right hand
WL = Wiper edge left hand

Milling inserts major cutting edge angle

Major cutting edge angle

A – 45°
D – 60°
E – 75°
F – 85°
P – 90°

ZZ = Special design, exact details are required

Milling inserts clearance of wiper edge

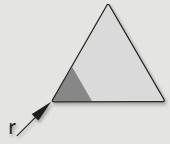
A – 3°
B – 5°
C – 7°
D – 15°
E – 20°
F – 25°
G – 30°
N – 0°
P – 11°

9 Cutting material characteristics

MDC	For best surfaces in all applications
TFC	As of 8% Si content or burr-free machining
PDC	1 – 7% Si content during continuous cut
PDC-S	1 – 7% Si content during interrupted cut
PDC-CU-S	For roughing and milling of highly abrasive materials

7	8	9	10	11
04	W	PDC	CB2	GS

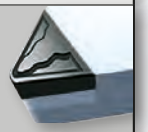
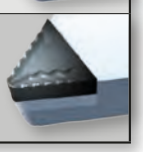
7 Corner configuration



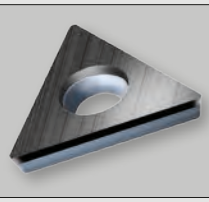
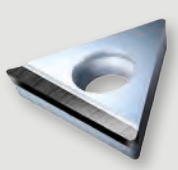
Radius

02 = 0,2 mm
04 = 0,4 mm
08 = 0,8 mm
12 = 1,2 mm
16 = 1,6 mm
00 = Round insert (inch)
M0 = Round insert (metr.)

10 Chip breaker design

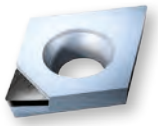
CB 1	Instable workpieces	
CB 2	General solid machining	
CB 3	General solid machining, roughing	

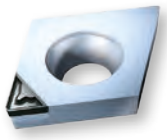
11 Tipping versions

VM	
GS	

CCGT

positive-neutral



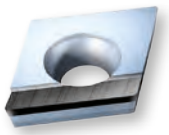
Wiper


insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions						
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	PDC l_1	TFC l_1
060201					●			●							6,35	2,8	2,38	6,5	0,1	3,5	
060202					●		●	●	●			●	●						0,2	3,4	2,4
060204				●			●	●	●	●		●	●						0,4	3,2	2,2
060208							●	●	●			●	●						0,8	3,0	2,0
060201W*					●			●											0,1	3,4	
060202W*					●		●	●		●			●						0,2	3,3	2,3
060204W*							●	●	●	●		●	●						0,4	3,1	2,1
09T302					●		●	●	●				●		9,52	4,4	3,97	9,7	0,2	4,5	2,4
09T304				●			●	●	●			●	●						0,4	4,3	2,2
09T308				●			●	●	●				●						0,8	4,1	2,0
09T301W*					●			●											0,1	4,5	
09T302W*					●		●	●	●	●			●						0,2	4,4	2,3
09T304W*							●	●	●	●		●	●						0,4	4,2	2,1
120404					●		●	●	●				●		12,70	5,5	4,76	12,9	0,4	4,3	2,2
120408							●	●	●				●						0,8	4,1	2,1
120402W*					●		●	●		●		●	●						0,2	4,4	2,3
120404W*					●		●	●	●	●		●	●						0,4	4,2	2,1

* Wiper = 95° holder

CCGT

whole edge
positive-neutral



insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
060204R/L-GS					●	❍									6,35	2,8	2,38		0,4	6,45
060208R/L-GS					●	❍	❍												0,8	6,45
09T308R/L-GS					●		❍								9,52	4,4	3,97		0,8	9,70
09T312R/L-GS					●														1,2	9,70
120412R/L-GS					●										12,70	5,5	4,76		1,2	12,90

● = ex stock
❍ = on short call

ordering example: CCGT060204-PDC-S-CB 1

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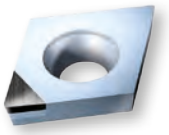
CERATIZIT GROUP

CCGW
neutral

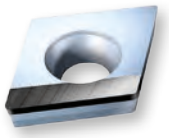


Wiper

insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions						
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	PDC l_1	TFC l_1
060201					●			●							6,35	2,8	2,38	6,6	0,1	3,5	
060202	●				●			●			●			❍					0,2	3,4	2,4
060204	●				●			●			●			❍					0,4	3,2	2,2
060208								●						❍					0,8	3,0	
060201W*					●			●						❍					0,1	3,4	
060202W*					●			●						❍					0,2	3,3	
060204W*								●						❍					0,4	3,1	
09T302					●			●			●			❍	9,52	4,4	3,97	9,7	0,2	4,5	2,4
09T304	●				●			●			●			❍					0,4	4,3	2,2
09T308	●							●			●			❍					0,8	4,1	2,0
09T301W*					●			●											0,1	4,5	
09T302W*					●			●											0,2	4,4	
09T304W*								●											0,4	4,2	
120404					●			●			●				12,70	5,5	4,76	12,9	0,4	4,3	
120408								●			●								0,8	4,1	
120402W*					●			●											0,2	4,4	
120404W*					●			●											0,4	4,2	

* Wiper = 95° holder

CCGW
whole edge neutral



insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
060204R/L-GS								●							6,35	2,8	2,38		0,4	6,45
060208R/L-GS								●											0,8	6,45
09T308R/L-GS								●							9,52	4,4	3,97		0,8	9,70
09T312R/L-GS								●											1,2	9,70
120412R/L-GS								●							12,70	5,5	4,76		1,2	12,90

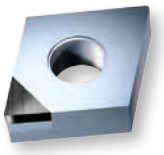
right hand shown

ordering example: CCGW060204R-PDC-GS

● = ex stock
❍ = on short call

CNGA

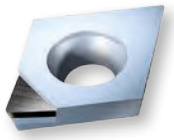
neutral

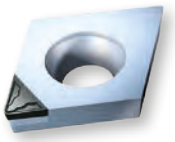


insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
120404					●			●							12,70	5,13	4,76	12,9	0,4	6,3
120408	●			●	●			●											0,8	6,0
120412	●			●	●			●											1,2	5,7

CPGT

positive-neutral





insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
060202					●		●	●	●	●					6,35	2,8	2,38	6,5	0,2	3,4
060204								●	●	●									0,4	3,2
060208								●											0,8	3,0

● = ex stock
❍ = on short call

ordering example: CPGT060204-PDC

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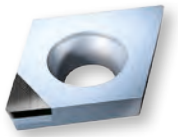
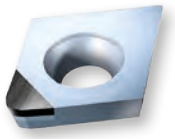
BECKER CERATİZİT GROUP

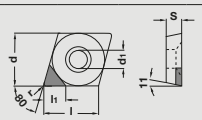
CPGW

neutral





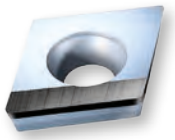
Wiper

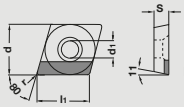
insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral						
															d	d_1	s	l	r	l_1
05T102					●			●							5,56	2,2	1,98	5,6	0,2	2,4
05T104								●											0,4	2,2
05T102-W*					●			●							5,56	2,2	1,98	5,5	0,2	2,4
05T104-W*								●											0,4	2,1
050202					●			●							5,56	2,5	2,38	5,6	0,2	2,4
050204								●											0,4	2,2
050202-W*					●			●							5,56	2,5	2,38	5,5	0,2	2,4
050204-W*								●											0,4	2,1
060202					●			●							6,35	2,8	2,38	6,5	0,2	3,4
060204								●											0,4	3,2
060208								●											0,8	3,0
060202-W*					●			●							6,35	2,8	2,38	6,5	0,2	3,3
060204-W*								●											0,4	3,1
09T304								●							9,52	4,4	3,97	9,7	0,4	4,3
09T308								●											0,8	4,1
09T302-W*					●			●							9,52	4,4	3,97	9,7	0,2	4,4
09T304-W*								●											0,4	4,2
120404								●							12,70	5,5	4,76	12,9	0,4	4,3
120408								●											0,8	4,1
120404-W*					●			●							12,70	5,5	4,76	12,9	0,4	4,4

* Wiper = 95° holder

CPGW

neutral whole edge



insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	 right hand shown					
															d	d_1	s	l	r	l_1
060204R/L-GS								●							6,35	2,8	2,38		0,4	6,5
09T308R/L-GS								●							9,52	4,4	3,97		0,8	9,7
120408R/L-GS								●							12,70	5,5	4,76		0,8	12,9
120412R/L-GS								●							12,70	5,5	4,76		1,2	12,9

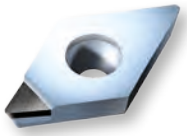
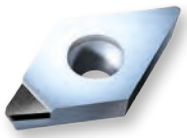
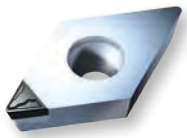
ordering example: CPGW120408R-PDC-GS

● = ex stock
❍ = on short call

TURNING | ISO

DCGT

positive-neutral

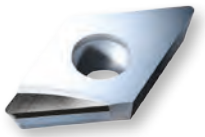


Wiper


insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions						
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	PDC l_1	TFC l_1
070201					●	●	●		●						6,35	2,8	2,38	7,75	0,1	3,8	
070202		●	●		●	●	●	●	●			●	●	❍					0,2	3,7	2,6
070204		●	●	●		●	●	●	●			●	●	●					0,4	3,4	2,3
070208							●	●	●			●	●	●					0,8	3,0	2,0
070201-LW *					●									❍	6,35	2,8	2,38	7,75	0,1	3,0	
070201-RW *					●									❍					0,1	3,0	
070202-LW *					●									❍					0,2	3,0	
070202-RW *					●									❍					0,2	3,0	
070204-LW *								●						❍					0,4	3,0	
070204-RW *								●						❍					0,4	3,0	
11T301					●	●	●		●						9,52	4,4	3,97	11,6	0,1	4,8	
11T302					●	●	●	●	●			●	●	●					0,2	4,7	2,6
11T304		●	●	●		●	●	●	●			●	●	●					0,4	4,3	2,3
11T308		●	●	●		●	●	●	●			●	●	●					0,8	4,0	2,0
11T312								●											1,2	3,5	
11T301-LW *					●										9,52	4,4	3,97	11,6	0,1	4,0	
11T301-RW *					●														0,1	4,0	
11T302-LW *					●									❍					0,2	4,0	
11T302-RW *					●									❍					0,2	4,0	
11T304-LW *								●						❍					0,4	4,0	
11T304-RW *								●						❍					0,4	4,0	

* Wiper R/L = 93° holder

DCGT

positive right or left hand



insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
070204R/L					●			●							6,35	2,8	2,38	7,8	0,4	5,5
070208R/L					●			●											0,8	5,0
11T304R/L					●			●							9,52	4,4	3,97	11,6	0,4	7,5
11T308R/L					●			●											0,8	7,0
11T312R/L					●														1,2	6,5

● = ex stock
❍ = on short call

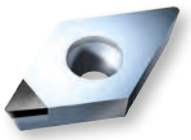
ordering example: DCGT11T304R-PDC

v_c page 4-15

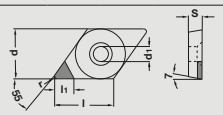
BECKER CERATİZİT GROUP

DCGW

neutral



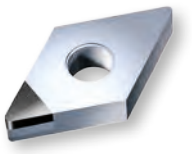
Wiper

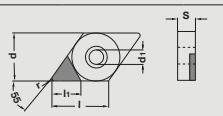
insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions						
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral							
															d	d_1	s	l	r	PDC l_1	TFC l_1
070201					●									❍	6,35	2,8	2,38	7,75	0,1	3,8	
070202					●			●			●			❍					0,2	3,7	2,6
070204	●				●			●			●			●					0,4	3,4	2,3
070208	●				●			●			●			●					0,8	3,0	2,0
110302								●							9,52	4,4	3,18	11,6	0,2	4,7	
110304								●											0,4	4,3	
110308								●											0,8	4,0	
11T301					●									●	9,52	4,4	3,97	11,6	0,1	4,8	
11T302					●			●			●			●					0,2	4,7	2,6
11T304	●				●			●			●			●					0,4	4,3	2,3
11T308	●				●			●			●			●					0,8	4,0	2,0
11T312					●			●											1,2	3,6	
11T302-LW *					●										9,52	4,4	3,97	11,6	0,2	4,0	
11T302-RW *					●														0,2	4,0	
11T304-LW*					●									❍					0,4	4,0	
11T304-RW *					●									❍					0,4	4,0	
150404								●						❍	12,70	5,5	4,76	15,5	0,4	4,3	
150408								●						❍					0,8	4,0	

* Wiper R/L = 93° holder

DNGA

neutral



insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral						
															d	d_1	s	l	r	l_1
150404					●			●							12,70	5,13	4,76	15,5	0,4	6,4
150408					●			●											0,8	6,0
150412					●			●											1,2	5,6
150604	●				●			●							12,70	5,13	6,35	15,5	0,4	6,4
150608	●			●	●			●											0,8	6,0
150612					●			●											1,2	5,6

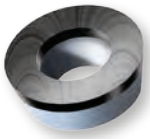
VC page 4-15

ordering example: DNGA150604-PDC-S

● = ex stock
❍ = on short call

TURNING | ISO

RCGW
fullface


PDC


TFC

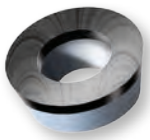
insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
0602M0-VM					●			●							6,0	2,8	2,38			
0803M0-VM					●			●			●				8,0	3,4	3,18			
1003M0-VM								●			●				10,0	4,4	3,18			
10T3M0-VM								●							10,0	4,4	3,97			
1204M0-VM								●							12,0	4,4	4,76			

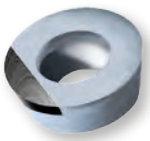
RCGT
fullface


PDC

insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
0602M0-VM						●	●		●						6,0	2,8	2,38			
10T3M0-VM						●	●		●						10,0	4,4	3,97			

RPGW
fullface


PDC


TFC

insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
0802M0-VM								●			●				8,00	3,4	2,38			
1204M0-VM								●							12,00	4,4	4,76			
120400-VM								●							12,70	5,5	4,76			

● = ex stock
❍ = on short call

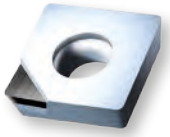
ordering example: RPGW1204MO-PDC-VM

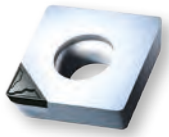
v_c page 4-15

BECKER CERATİZİT GROUP

SCGT

positive-neutral

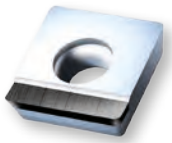




insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d1	s	l	r	l_1
09T304				●	●		●		●			●	●		9,52	4,4	3,97	9,52	0,4	4,4
09T308				●	●		●		●			●	●						0,8	4,3
09T312					●														1,2	4,2

SCGT

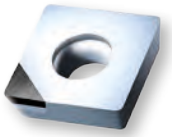
positive whole edge



insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
09T308-GS					●										9,52	4,4	3,97		0,8	9,5
09T312-GS					●														1,2	9,5
120408-GS					●										12,70	5,5	4,76		0,8	12,7
120412-GS					●														1,2	12,0

SCGW

neutral



insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions						
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	PDC l_1	TFC l_1
09T302											●				9,52	4,4	3,97	9,52	0,2		3,0
09T304					●			●			●								0,4	4,4	2,8
09T308								●			●			❍					0,8	4,3	2,6
09T312								●						❍					1,2	4,2	
120404					●			●							12,70	5,5	4,76	12,70	0,4	4,4	
120408								●						❍					0,8	4,3	
120412								●						❍					1,2	4,2	

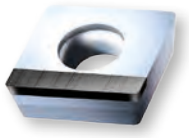
v_c page 4-15

ordering example: SCGW09T302-TFC

● = ex stock
❍ = on short call

SCGW

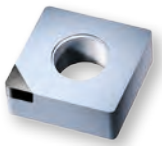
neutral whole edge



insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
09T304-GS								●							9,52	4,4	3,97		0,4	9,52
09T308-GS								●											0,8	9,52
120404-GS								●							12,70	5,5	4,76		0,4	12,70
120408-GS								●											0,8	12,70
120412-GS								●											1,2	12,70

SNGA

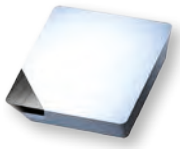
neutral



insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
120404					●			●							12,70	5,13	4,76	12,7	0,4	4,3
120408					●			●										12,7	0,8	4,2
120412					●			●										12,7	1,2	4,0

SPGN

neutral



insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
120304					●			●							12,70		3,18	12,7	0,4	4,4
120308								●						❍					0,8	4,3

● = ex stock
❍ = on short call

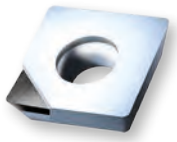
ordering example: SPGN120304-PDC

v_c page 4-15

BECKER CERATIZIT GROUP

SPGT

positive-neutral



insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
09T304					●										9,52	4,4	3,97	9,5	0,4	4,4
09T308					●														0,8	4,3
09T312					●														1,2	4,2

SPGT

positive whole edge

insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
09T308-GS					●										9,52	4,4	3,97		0,8	9,52
09T312-GS					●														1,2	

SPGW

neutral

insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions						
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	PDC l_1	MDC l_1
09T304								●							9,52	4,4	3,97	9,52	0,4	4,4	
09T308								●						❍					0,8	4,3	2,6
09T312								●											1,2	4,2	

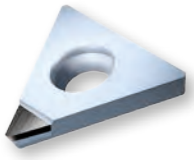
ordering example: SPGW09T304-PDC

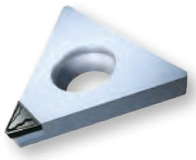
● = ex stock
❍ = on short call

TURNING | ISO

TCGT

positive-neutral

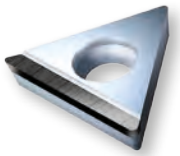




insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions						
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	PDC l_1	TFC l_1
090202					●		●	●	●			●	●		5,56	2,5	2,38	9,6	0,2	3,7	2,6
090204					●		●	●	●			●	●						0,4	3,4	2,3
090208								●											0,8	3,0	
110202					●		●	●	●			●	●		6,35	2,8	2,38	11,0	0,2	3,7	2,6
110204				●	●		●	●	●			●	●						0,4	3,4	2,3
110208								●											0,8	3,0	
16T304					●		●	●	●			●	●		9,52	4,4	3,97	16,5	0,4	4,6	2,3
16T308				●			●	●	●			●	●						0,8	4,2	2,0

TCGT

positive whole edge



insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
090204-GS					●										5,56	2,5	2,38		0,4	9,6
090208-GS					●														0,8	
110204-GS					●										6,35	2,8	2,38		0,4	11,0
110208-GS					●														0,8	
110212-GS					●														1,2	
16T304-GS					●										9,52	4,4	3,97		0,4	16,5
16T308-GS					●														0,8	

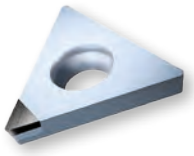
● = ex stock
❍ = on short call

ordering example: TCGT16T304-PDC-S-GS

v_c page 4-15

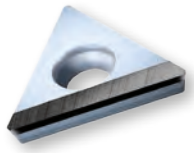
BECKER CERATİZİT GROUP

TCGW
neutral



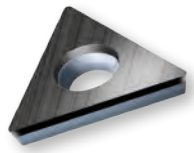
insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions						
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	PDC l_1	TFC l_1
090202					●			●			●			○					0,2	3,7	
090204					●			●			●			●	5,56	2,5	2,38	9,6	0,4	3,4	
090208								●						○					0,8	3,0	
110202					●			●			●			○					0,2	3,7	2,6
110204	●				●			●			●			●	6,35	2,8	2,38	11,0	0,4	3,4	2,3
110208	●							●			●			●					0,8	3,0	2,0
16T304	●							●			●								0,4	4,6	2,3
16T308	●							●			●			○	9,52	4,4	3,97	16,5	0,8	4,2	2,0
16T312								●						○					1,2	3,8	

TCGW
neutral whole edge



insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
090208-GS								●							5,56	2,5	2,38		0,8	9,6
110204-GS	●							●							6,35	2,8	2,38		0,4	11,0
110208-GS								●											0,8	
16T304-GS								●							9,52	4,4	3,97		0,4	16,5
16T308-GS								●											0,8	

TCGW
fullface



insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
110202-VM								●							6,35	2,8	2,38		0,2	11,0
110204-VM								●											0,4	
110208-VM								●											0,8	

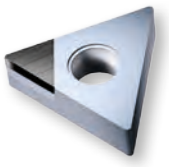
v_c page 4-15

ordering example: TCGW110208-PDC-VM

● = ex stock
○ = on short call

TNGA

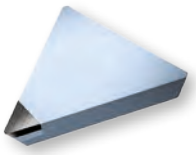
neutral



insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
160404	●				●			●							9,52	3,81	4,76	16,5	0,4	6,2
160408	●			●	●			●											0,8	5,8
160412					●			●											1,2	5,4

TPGN

neutral



insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions						
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	PDC l_1	MDC l_1
110302					●			●							6,35		3,18	11,0	0,2	3,7	
110304					●			●						❍					0,4	3,4	2,3
110308								●						❍					0,8	3,0	2,0
160304					●			●							9,52		3,18	16,5	0,4	4,6	
160308					●			●						❍					0,8	4,2	2,0
160312								●											1,2	3,8	

● = ex stock
❍ = on short call

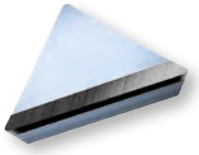
ordering example: TPGN160304-PDC

v_c page 4-15

BECKER CERATİZİT GROUP

TPGN

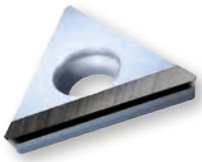
neutral whole edge



insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
110304-GS								●							6,35		3,18		0,4	11,0
110308-GS								●											0,8	
160304-GS								●							9,52		3,18		0,4	16,5
160308-GS								●											0,8	

TPGW

neutral whole edge



insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
080204-GS								●							4,76	2,2	2,38		0,4	8,2
090204-GS								●							5,56	2,5	2,38		0,4	9,6
110204-GS								●							6,35	2,8	2,38		0,4	11,0
110304-GS								●									3,18		0,4	11,0

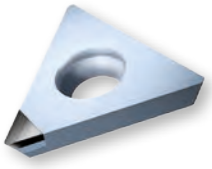
ordering example: TPGW110304-PDC-GS

● = ex stock
❍ = on short call

TURNING | ISO

TPGW

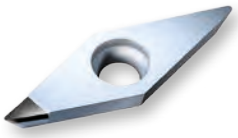
neutral

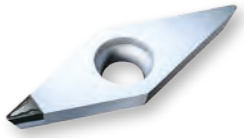


insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	r	l	PDC l_1
080204								●							4,76	2,8	2,38	0,4	8,2	2,7
090202								●							5,56	2,5	2,38	0,2	9,6	3,7
090204								●										0,4		3,4
090208								●										0,8		3,0
110202								●							6,35	2,8	2,38	0,2	11,0	3,7
110204								●										0,4		3,4
110208								●										0,8		3,0
110302								●							6,35	2,8	3,18	0,4	11,0	3,7
110304								●										0,8		3,4
110308								●										1,2		3,0

VBGT

positive-neutral





insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions						
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	PDC l_1	TFC l_1
110201					●										6,35	2,8	2,38	11,1	0,1	5,4	
110202					●			●											0,2	4,6	
110204					●			●											0,4	3,9	
110208								●											0,8	3,3	
160402		●			●		●	●	●			●	●		9,52	4,4	4,76	16,6	0,2	5,9	3,0
160404			●	●	●	●	●	●	●			●	●	❍					0,4	5,5	3,0
160408			●			●	●	●	●			●	●						0,8	5,0	3,0
160412						●	●		●			●	●						1,2	4,4	3,0

● = ex stock
❍ = on short call

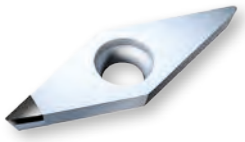
ordering example: VBGT160404-TFC-CB 2

v_c page 4-15

BECKER CERATİZİT GROUP

VBGW

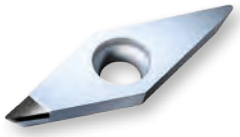
neutral

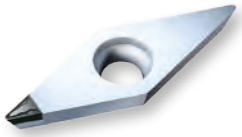


insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions						
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	PDC l_1	TFC l_1
110202								●							6,35	2,8	2,38	11,1	0,2	4,6	
110204								●						❍					0,4	3,9	
110208								●											0,8	3,3	
160402	●							●			●				9,52	4,4	4,76	16,6	0,2	5,9	3,0
160404	●							●			●			❍					0,4	5,5	3,0
160408	●							●			●								0,8	5,0	3,0
160412								●											1,2	4,4	

VCGT

positive-neutral





insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions						
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	PDC l_1	TFC l_1
070201					●										3,97	2,2	2,38	6,9	0,1	3,8	
070202					●			●						❍					0,2	3,6	
070204					●			●						❍					0,4	3,2	
110301					●			●	●			●			6,35	2,8	3,18	11,1	0,1	5,4	3,0
110302			●		●	●	●	●	●			●	●	❍					0,2	4,6	3,0
110304			●	●	●	●	●	●	●			●	●	❍					0,4	3,9	3,0
110308							●	●					●	❍					0,8	3,3	3,0
130302					●			●							7,94	3,4	3,18	13,3	0,2	5,9	
130304								●											0,4	5,5	
160401					●			●							9,52	4,4	4,76	16,6	0,1	6,0	
160402			●		●		●	●	●			●	●	❍					0,2	5,9	3,0
160404	●		●	●	●	●	●	●	●			●	●	❍					0,4	5,5	3,0
160408						●	●	●	●			●	●	❍					0,8	5,0	3,0
160412						●	●	●	●			●	●						1,2	4,5	3,0

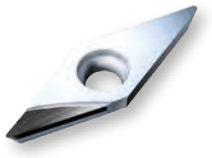
v_c page 4-15

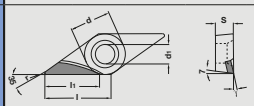
ordering example: VCGT110304-PDC-S-CB 2

● = ex stock
❍ = on short call

VCGT

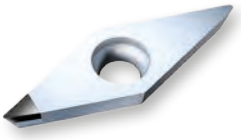
positive, right or left hand

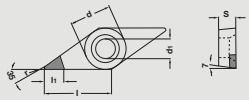


insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	 right hand shown					
															d	d_1	s	l	r	l_1
110304R/L								●							6,35	2,8	3,18	11,1	0,4	6,5
110308R/L								●											0,8	6,0
160404R/L								●							9,52	4,4	4,76	16,6	0,4	7,5
160408R/L								●											0,8	7,0
160412R/L								●											1,2	7,0

VCGW

neutral



insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions						
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral							
															d	d_1	s	l	r	PDC l_1	TFC l_1
070201					●										3,97	2,2	2,38	6,9	0,1	3,8	
070202					●			●											0,2	3,6	
070204					●			●											0,4	3,2	
110301					●										6,35	2,8	3,18	11,1	0,1	5,4	
110302	●				●			●			●			❍					0,2	4,6	3,0
110304	●				●			●			●			❍					0,4	3,9	3,0
110308								●			●			❍					0,8	3,3	3,0
130302					●			●							7,94	3,4	3,18	13,3	0,2	5,9	
130304								●											0,4	5,5	
160401					●										9,52	4,4	4,76	16,6	0,1	6,0	
160402	●				●			●			●			❍					0,2	5,9	3,0
160404	●				●			●			●			❍					0,4	5,5	3,0
160408					●			●			●			❍					0,8	5,0	3,0
160412					●			●						❍					1,2	4,5	

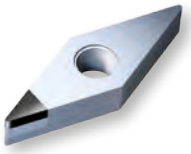
● = ex stock
❍ = on short call

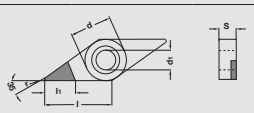
ordering example: VCGW160404-PDC-CU-S

VC page 4-15

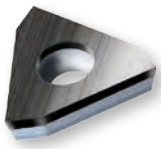
BECKER CERATİZİT GROUP

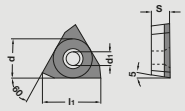
VNGA
neutral



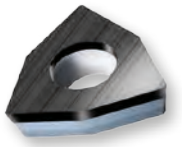
insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral						
															d	d_1	s	l	r	l_1
160404					●			●							9,52	3,81	4,76	16,6	0,4	5,5
160408	●			●	●			●											0,8	5,0
160412					●			●											1,2	4,5

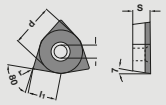
WBGW
fullface



insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral						
															d	d_1	s	l	r	l_1
020102L-VM								●							3,97	2,3	1,59		0,2	4,8
020104L-VM								●											0,4	

WCGW
fullface



insert size	PDC-CU-S				PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	CB 3	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral						
															d	d_1	s	l	r	l_1
020102-VM	●							●							3,97	2,3	1,59		0,2	2,7
020104-VM	●							●											0,4	

ordering example: WCGW020104-PDC-VM

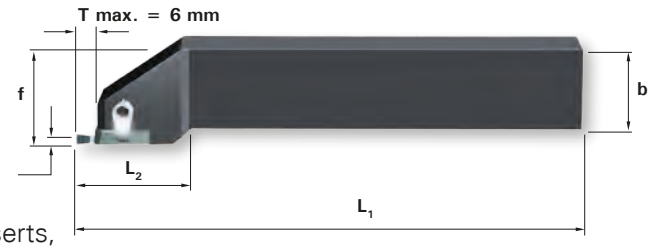
● = ex stock
❍ = on short call

CERATIZIT GROUP

GROOVING | FormCut

BSAFR/L

Toolholder, external radial grooving



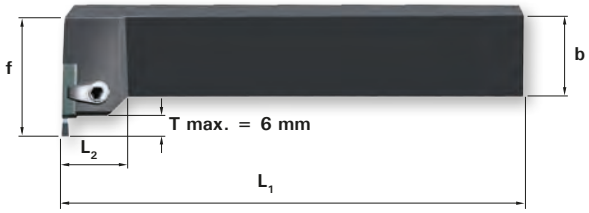
right hand shown

Note: For right-hand toolholders use right-hand inserts, for left-hand toolholders use left-hand inserts only.

designation		dimensions					
right-hand	left-hand	h_1	h_2	b	f	L_1	L_2
BSAFR 1616 - 12	BSAFL 1616 - 12	16	16	16	20	106	31
BSAFR 2020 - 12	BSAFL 2020 - 12	20	20	20	24	131	31
BSAFR 2525 - 12	BSAFL 2525 - 12	25	25	25	30	156	31
BSAFR 3225 - 12	BSAFL 3225 - 12	32	32	25	30	176	31

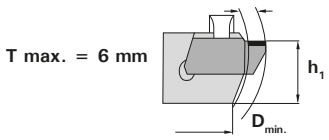
BSIFR/L

Toolholder, internal radial grooving



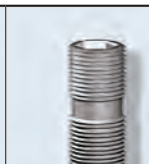
right hand shown

Note: For right-hand toolholders use left-hand inserts, for left-hand toolholders use right-hand inserts only.



designation		dimensions						
right-hand	left-hand	h_1	h_2	b	f	L_1	L_2	$D_{min.}$
BSIFR 1616 - 12	BSIFL 1616 - 12	16	16	16	28	100	18	50
BSIFR 2020 - 12	BSIFL 2020 - 12	20	20	20	32	125	18	72
BSIFR 2525 - 12	BSIFL 2525 - 12	25	25	25	37	150	18	110
BSIFR 3225 - 12	BSIFL 3225 - 12	32	32	25	37	170	18	110

Spare parts

			
CLA-3103	SCR-1303	KEY-2104	VAR-5101

● = ex stock
❍ = on short call

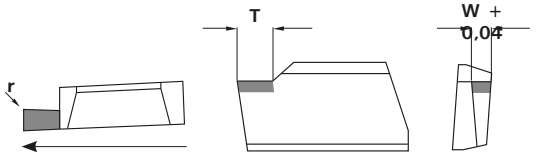
ordering example: BSAFR2020-12

V_C page 4-15

CERATİZİT GROUP

BFSN-R/L

External grooving

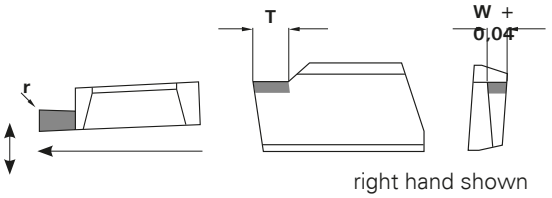


right hand shown

insert size	PDC-CU-S			PDC-S			PDC			TFC			MDC	dimensions			
	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	W	T	r	r
BFSN-2,5-R/L							●			●	❍			2,5	5	0,2	
BFSN-3,0-R/L			●				●			●	❍			3,0	6	0,2	
BFSN-3,5-R/L			●				●			●	❍			3,5	6	0,2	
BFSN-4,0-R/L			●				●			●	❍			4,0	6	0,2	0,4
BFSN-4,5-R/L							●			❍				4,5	6	0,2	
BFSN-5,0-R/L							●			❍				5,0	6	0,2	0,4

BFSV-R/L

External grooving and turning



right hand shown

insert size	PDC-CU-S			PDC-S			PDC			TFC			MDC	dimensions			
	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	W	T	r	r
BFSV-3,0-R/L			●				●			●	❍			3,0	6	0,2	0,4
BFSV-3,5-R/L			●				●			●	❍			3,5	6	0,2	0,4
BFSV-4,0-R/L			●				●			●	❍			4,0	6	0,2	0,5
BFSV-4,5-R/L			●				●			❍				4,5	6	0,2	0,5
BFSV-5,0-R/L			●				●			❍				5,0	6	0,2	0,6

v_c page 4-15

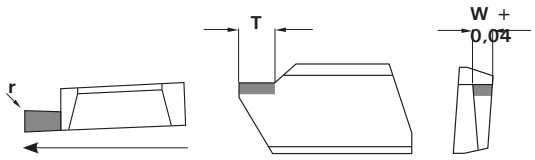
ordering example: BFSV4,5R-PDC R=0,2

● = ex stock
❍ = on short call

GROOVING | FormCut

BFIN-R/L

Internal grooving

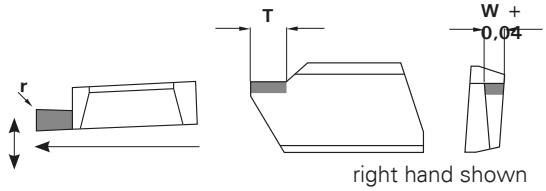


right hand shown

insert size	PDC-CU-S			PDC-S			PDC			TFC			MDC	dimensions			
	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	W	T	r	r
BFIN-2,5-R/L							●							2,5	5	0,2	
BFIN-3,0-R/L							●							3,0	6	0,2	0,4
BFIN-3,5-R/L							●							3,5	6	0,2	
BFIN-4,0-R/L							●							4,0	6	0,2	0,4
BFIN-4,5-R/L							●							4,5	6	0,2	
BFIN-5,0-R/L							●							5,0	6	0,2	0,4

BFIV-R/L

Internal grooving
and turning

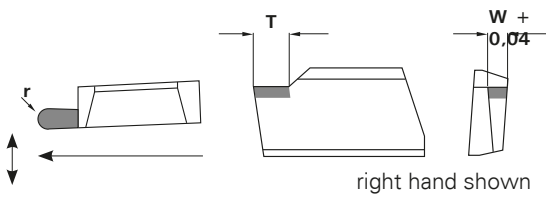


right hand shown

insert size	PDC-CU-S			PDC-S			PDC			TFC			MDC	dimensions			
	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	W	T	r	r
BFIV-3,0-R/L							●							3,0	6	0,2	0,4
BFIV-3,5-R/L							●							3,5	6	0,2	0,4
BFIV-4,0-R/L							●							4,0	6	0,2	0,4
BFIV-4,5-R/L							●							4,5	6	0,2	0,4
BFIV-5,0-R/L							●							5,0	6	0,2	0,4

BFRV-R/L

External copying



right hand shown

insert size	PDC-CU-S			PDC-S			PDC			TFC			MDC	dimensions		
	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	W	T	r
BFRV-3,0-R/L			●				●			●	❍			3,0	6	1,50
BFRV-3,5-R/L			●				●			●	❍			3,5	6	1,75
BFRV-4,0-R/L			●				●			●	❍			4,0	6	2,00
BFRV-4,5-R/L			●				●			●	❍			4,5	6	2,25
BFRV-5,0-R/L			●				●			●	❍			5,0	6	2,50

● = ex stock
❍ = on short call

ordering example: BFRV4,0R-PDC

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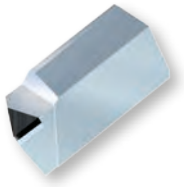
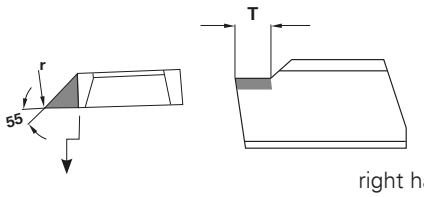
BFDV-R/L

External profiling



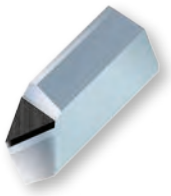


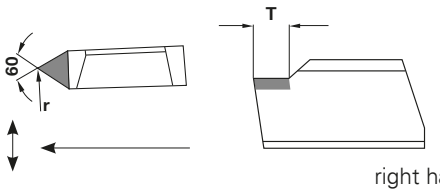
right hand shown

insert size	PDC-CU-S			PDC-S			PDC			TFC			MDC	dimensions		
	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	W	T	r
BFDV-0,2-R/L							●							5	5	0,2
BFDV-0,4-R/L							●							5	5	0,4
BFDV-0,8-R/L							●							5	5	0,8
BFDV-1,2-R/L							●							5	5	1,2

BFTV-R/L

External threading
(partial profile)





right hand shown

insert size	PDC-CU-S			PDC-S			PDC			TFC			MDC	dimensions		
	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	W	T	r
BFTV-0,10-R/L							●			●				5	5	0,10
BFTV-0,14-R/L							●			●				5	5	0,14
BFTV-0,18-R/L							●			●				5	5	0,18
BFTV-0,21-R/L							●			●				5	5	0,21
BFTV-0,25-R/L							●			●				5	5	0,25
BFTV-0,28-R/L							●			●				5	5	0,28
BFTV-0,36-R/L							●			●				5	5	0,36
BFTV-0,43-R/L							●			●				5	5	0,43

Size of radius for metric ISO-thread.			
Size of radius	Pitch P (max.)	Pitch P (min.)	Pitch P (average)
r = 0,10	P = 0,80	P = 0,69	P = 0,75
r = 0,14	P = 1,12	P = 0,97	P = 1,00
r = 0,18	P = 1,44	P = 1,25	P = 1,35
r = 0,21	P = 1,68	P = 1,46	P = 1,55
r = 0,25	P = 2,00	P = 1,74	P = 1,87
r = 0,28	P = 2,24	P = 1,95	P = 2,10
r = 0,36	P = 2,99	P = 2,50	P = 2,70
r = 0,43	P = 3,44	P = 2,99	P = 3,20

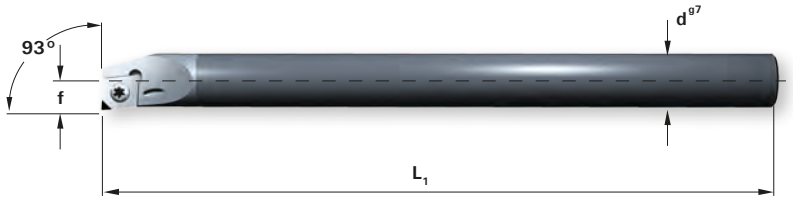
Vc page 4-15

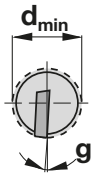
ordering example: BFTV0,28R-PDC

● = ex stock
❍ = on short call

Boring bars solid carbide

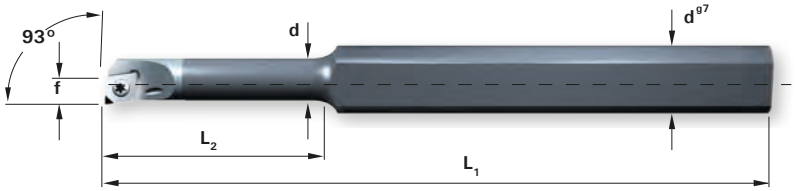
Design E...SEUP L/R

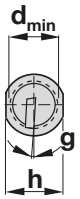




right hand shown
Right-hand boring bar with cylindrical solid carbide shank
and internal coolant feed.

order number	insert	dimensions				
		d_{min}	d^{g7}	f	L_1	g
E 06 F - SEUP L/R 04	EPH.. 0401..	6,8	6	3,4	80	9°
E 07 H - SEUP L/R 04	EPH.. 0401..	8,4	7	4,4	100	5°
E 08 H - SEUP L/R 04	EPH.. 0401..	9,5	8	4,9	100	5°
E 10 K - SEUP L/R 06	EPH.. 06T1..	11,5	10	5,8	125	5°
E 12 M - SEUP L/R 06	EPH.. 06T1..	13,5	12	6,9	150	3°
E 16 R - SEUP L/R 06	EPH.. 06T1..	18,5	16	9,8	200	0°





right hand shown
Right-hand boring bar with cylindrical solid carbide shank,
two clamping surfaces and internal coolant feed.

order number	insert	dimensions							
		d_{min}	d	f	L_1	L_2	d^{g7}	h	g
E 06 10 H - SEUP L/R 04	EPH.. 0401..	6,8	6	3,4	100	36	10	8	9°
E 07 10 K - SEUP L/R 04	EPH.. 0401..	8,4	7	4,4	125	42	10	8	5°
E 08 10 K - SEUP L/R 04	EPH.. 0401..	9,5	8	4,9	125	48	10	8	5°

Spare parts

screws and keys					
order number	SCR-1101	SCR-1102	KEY-2101	KEY-2102	VAR-5101
suitable for	EPH-0401..	EPH-06T1..	SCR-1101	SCR-1102	

● = ex stock
❍ = on short call

ordering example: E0610H-SEUPR04

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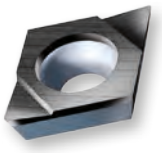
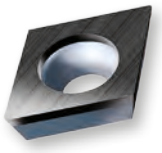
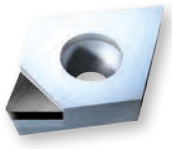
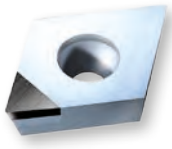
EPHT
EPHW
fullface

insert size	PDC-CU-S			PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
EPHT040101-VM						●	●	●						4,76	2,2	1,59	4,9	0,1	4,9
EPHT040102-VM						●	●	●										0,2	4,8
EPHT040104-VM						●	●	●										0,4	4,7
EPHW040102-VM				●			●							4,76	2,2	1,59	4,9	0,2	4,9
EPHW040103-VM				●			●											0,3	4,8
EPHW040104-VM				●			●											0,4	4,7

EPHT
EPHW
positive-neutral, neutral

insert size	PDC-CU-S			PDC-S			PDC			TFC			MDC	dimensions					
	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	r	l_1
EPHT06T101				●			●							6,35	2,8	1,98	6,6	0,1	3,1
EPHT06T102				●		●	●	●			●	●						0,2	3,0
EPHT06T104				●		●	●	●			●	●						0,4	2,8
EPHW04T102										●				4,76	2,2	1,59	4,9	0,2	2,0
EPHW04T104										●								0,4	1,9
EPHW06T101				●			●							6,35	2,8	1,98	6,6	0,1	3,1
EPHW06T102				●			●			●								0,2	3,0
EPHW06T104				●			●			●								0,4	2,8

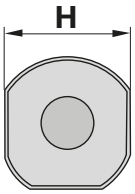
Contray to most conventional tool systems we use positive indexable insert types EPHW / EPHT 0401.. and 06T1.. with a 75 style. This established insert type make us achieve best-possible performance for boring. Our solid carbide boring bars allow for a boring depth of 7xD with the highest precision and surface finish.

ordering example: EPHT06T102-PDC-S

● = ex stock
❍ = on short call

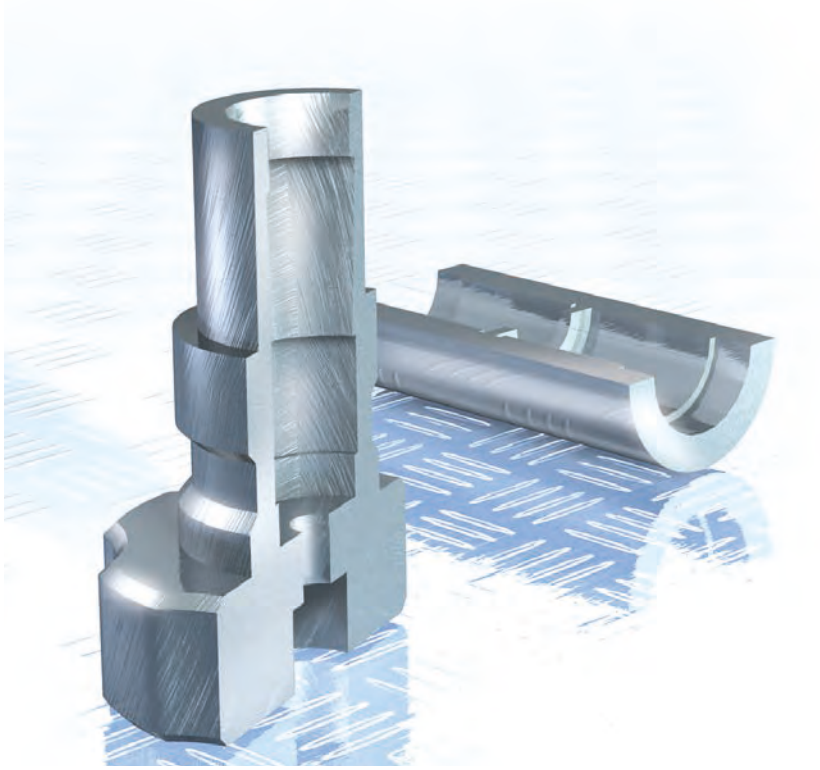
Adapter sleeve

For boring bars design X...GEUP



Adapter sleeves enable versatile use of the boring bars in all areas.
Coolant feed is provided through the adapter.

order number	for boring bars	dimensions				
		D	d	D^{H7}	H	L
Adap - 1635	X 3,5 F-GEUP L/R	16	4	3,5	14	100
Adap - 1640	X 04 F-GEUP L/R	16	5	4,0	14	100
Adap - 1650	X 05 H-GEUP L/R	16	6	5,0	14	100
Adap - 1660	X 06 H-GEUP L/R	16	8	6,0	14	100



● = ex stock
❍ = on short call

ordering example: Adap-1640

v_c page 4-15

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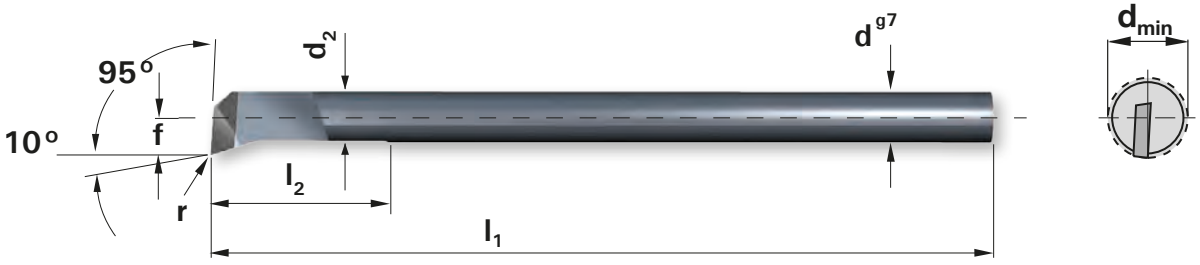
X-GE R/L

Solide carbide boring bars with one clamping surface, brazed cutting edges and internal coolant feed.
Adapter sleeve refer to page 40.



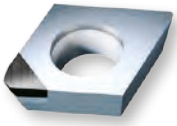
right hand shown

order number	PDC-CU-S			PDC-S			PDC			TFC			MDC	dimensions						
	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d^{g7}	d_{min}	d_2	f	l_1	l_2	r
X2,5F-GEUP-R/L										●				3,5	3,0	2,6	1,46	80	11	0,1
X2,5F-GEUP-R/L										●										0,2
X3,5F-GEUP-R/L				●						●				3,5	4,0	3,5	1,96	80	12	0,1
X3,5F-GEUP-R/L				●						●										0,2
X04F-GEUP-R/L				●						●				4,0	5,0	4,0	2,48	80	14	0,1
X04F-GEUP-R/L				●						●										0,2
X04F-GEUP-R/L				●						●										0,4
X05H-GEUP-R/L				●						●				5,0	6,0	5,0	2,96	100	18	0,1
X05H-GEUP-R/L				●						●										0,2
X05H-GEUP-R/L				●						●										0,4
X06H-GEUP- R/L				●						●				6,0	7,0	6,0	3,42	100	20	0,1
X06H-GEUP- R/L				●						●										0,2
X06H-GEUP- R/L				●						●										0,4

* = on request

All tipped MiniCut-boring bars consist of solid carbide with integrated coolant feed and allow for boring depth up to 7xD. Like our MiniCut-inserts, the boring bars are designed in 75 style and ensure highest performance.

CPGW-PDR

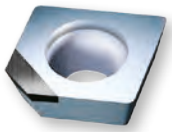


insert size	PDC-CU-S			PDC-S			PDC			TFC			MDC	dimensions				
	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	l_1
1204PDR-4				●										12,7	5,5	4,76	12,7	4,5
1204PDR-6				●														7,5

RDHX

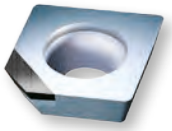
insert size	PDC-CU-S			PDC-S			PDC			TFC			MDC	dimensions				
	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	l_1
0501M0				●										5,0	2,0	1,50		
0702M0				●										7,0	2,7	2,38		
1003M0				●										10,0	3,8	3,18		
12T3M0				●										12,0	3,8	3,97		

SDHW-AEN



insert size	PDC-CU-S			PDC-S			PDC			TFC			MDC	dimensions				
	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	l_1
1204AEN-4				●										12,7	5,5	4,76	12,7	4,0
1204AEN-6				●														6,0

SEHW-AFN



insert size	PDC-CU-S			PDC-S			PDC			TFC			MDC	dimensions				
	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	l_1
1204AFN-4				●										12,7	5,5	4,76	12,7	4,0

● = ex stock
❍ = on short call

ordering example: SEHW1204AFN-4PDC-S

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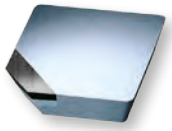
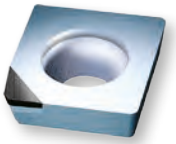
SEKN-AFN



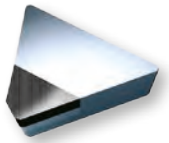
insert size	PDC-CU-S			PDC-S			PDC			TFC			MDC	dimensions				
	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	l_1
1203AFN-4				●										12,7		3,18	12,7	4,0
1203AFN-6				●														6,0

SPGW-PDR



insert size	PDC-CU-S			PDC-S			PDC			TFC			MDC	dimensions				
	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	l_1
1204PDR-4				●										12,7	5,5	4,76	12,7	4,0

TPKN-PDR



insert size	PDC-CU-S			PDC-S			PDC			TFC			MDC	dimensions				
	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	CB 1	CB 2	Neutral	d	d_1	s	l	l_1
1603PDR-4				●										9,52		3,18	16,5	4,0

Trouble Shooting

Trouble shooting diamond cutting edges		
Problem	**Possible cause**	**Suggested action**
Poor surface finish	Vibration	Check rigidity of toolholder, clamping-system and machine
	Too high feed rate	Lower feed rate, increase nose radius or change to a wiperedge
	Wrong diamond grade	Use PDC grade with finer grain size, or use TFC or MDC
Extreme flank wear	Too high cutting speed	Decrease speed according to cutting data tables
	Wrong diamond grade	Use PDC-grade with coarser grain size or use TFC or MDC
Edge chipping	Vibration	Check rigidity of toolholder, clamping system and machine
	Wrong cutting data	Check speeds & feeds in cutting data for your application
	Wrong grade	Use PDC-grade with coarser grain size (PDC-S or PDC-CU-S))
Loosen the diamond tip	Excessive cutting temperature Excessive flank wear	1. Increase coolant to tip and holder (air or fluid coolant) 2. Reduce speed and depth of cut 3. Use TFC grade
No chip breakage despite chip breaker geometry	Wrong cutting data	1. Check cutting data according to table on page 9 2. Use fluid coolant

In addition to the recommendations in this catalogue, the following general rules apply to diamond cutting edge applications:

- Rigid set-up of machines and tools
- Ensure best-possible coolant supply to tip due to thermal resistance of diamond up to only about 700°

Please observe our full range of tools with ultrahard cutting materials

Imprint

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Diamond

Cutting Tools

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