RODS & PREFORMS

CERATIZIT

hard material matters

MAIN CATALOGUE

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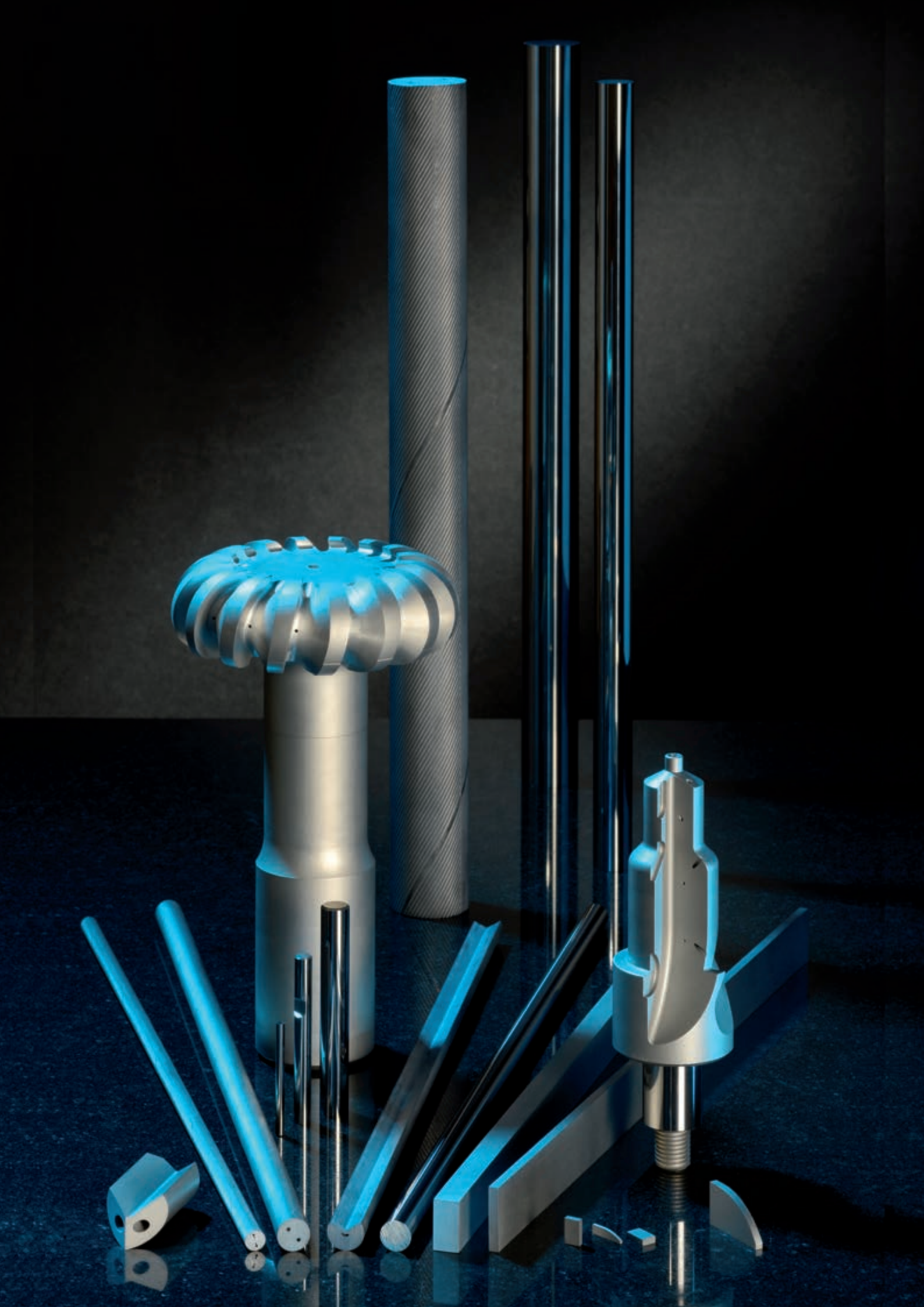
hard material matters

RODS & PREFORMS

MAIN CATALOGUE



Dear customer,

With innovative production technologies and newly developed carbide grades for the precision tool industry, we offer solutions for every field of application. Thanks to our extended product range and wide variety of carbide grades, we deliver suitable carbide rods and preforms for every tool. We offer the right high-performance carbide grade for everything from hard machining and diamond-coated tools to the machining of heat-resistant alloys. Via our online shop, the E-Techstore, you have 24-hour access to more than 800 articles in stock. Our extended production capacity allows flexible and rapid implementation of high-volume orders.
Are you looking for customised solutions which are not covered by our standard range? The staff at our customer service centre are available at any time to help you with questions about made-to-measure products. We manufacture preforms in near net shape according to specification drawings and at shortest delivery times.
Do you need special threads, axial and radial coolant holes or formed-in insert seats? No problem. See for yourself our innovation, strength, expertise and service.

Your CERATIZIT team

Welcome to the world of CERATIZIT ...

... a world of unique and consistently innovative solutions for wear parts, cutting tools and wood and stone machining. CERATIZIT is your partner for exceptional and highly personalised hard material products which guarantee cost efficiency, resistance and performance. Increasing both the productivity and service life of your products in a very diverse range of industrial sectors is the very essence of our business.

... because “hard material matters”

Hard materials in general and hard metals in particular are characterised by a range of interesting properties for all applications where maximum wear resistance is required. High pressure, high temperature and highly abrasive or aggressive conditions are factors to which hard materials or metals must be resistant. Our powder metallurgical production of parts for wear protection enables tailor-made adaptation of the material properties to your wear criteria.

This fact makes CERATIZIT hard materials and carbides indispensable materials in order to significantly increase the service life of components which are subject to high stress. Ever more powerful machines, facilities and machining methods constantly create new challenges for the CERATIZIT development engineers. Intensive research and development activities which precisely match your requirements and work processes already today are able to provide the solutions for tomorrow.

Guided by corporate values

We employ more than 5,500 people worldwide who are guided by our corporate values in their daily work:

1 The views and focus of our business partners matter
Instead of talking product with customers, we work on real solutions for business partners.

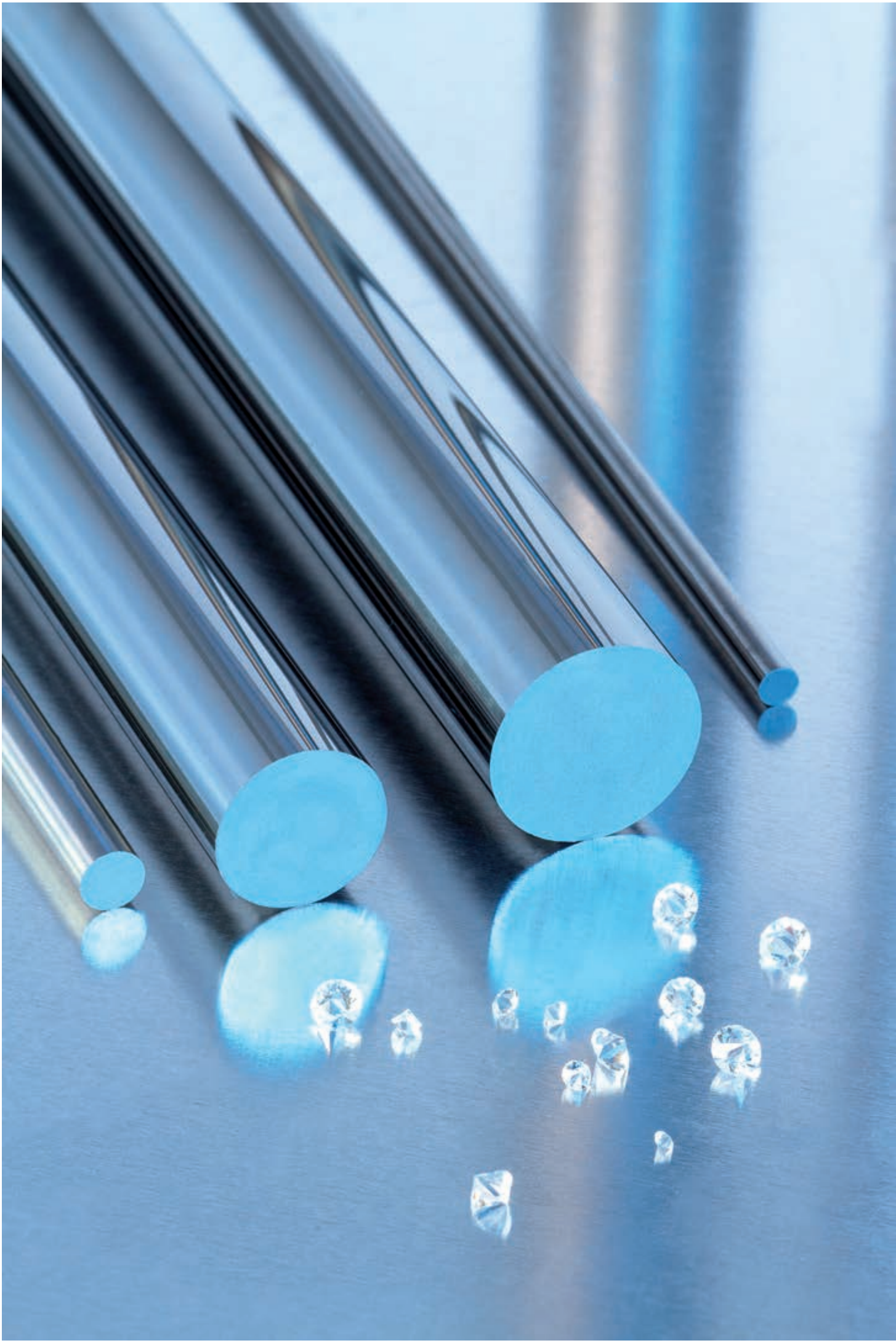
2 Innovative and flexible thinking matters
We challenge state-of-the-art technologies and develop intelligent alternatives. Our speed of thought and decisive actions give us a leading edge.

3 Communication matters
Trust and respect enable open communication. We show who we are and what we feel. We keep our promises. We are open to and accept constructive criticism.

4 Employee development matters
We continuously invest in personnel and offer outstanding internal development opportunities. We attract talents around the world and create a favourable environment for long-term personal growth.

5 Professionalism matters
We strive to be professional in everything we do. Our performance leads to results and growth which are always above average.

6 Our environment matters
Environmental protection is a matter of each employee – at home and at work. As a company we guarantee the community to be a 'considerate neighbour'.



Production site

Reutte (Austria)

The CERATIZIT centre of excellence for cutting tool products, rods and preforms can be found at the Breitenwang/Reutte site in Austria. CERATIZIT Austria GmbH currently has around 730 employees, making it the second-largest site of the CERATIZIT Group.
From preparing powder to producing rods and preforms and recycling carbide - all production processes are located in Reutte. The CERATIZIT Group continues to focus strongly on this successful production site and in 2013 extended the production surface by more than 4,000 square metres.

Mamer (Luxembourg)

Parent company

Carbide – a composite material with valuable properties

Carbides are composite materials consisting of a hard material and a comparatively soft binder metal, like cobalt (Co). The performance characteristics of carbide are determined by hardness, transverse rupture strength and fracture toughness. With regard to their application, important parameters for the optimisation of these characteristics are the cobalt content and the grain size of the metal binder phase. The tungsten carbide grains have an average size of less than 0.2 µm up to several micrometres (µm). The cobalt fills the gaps between the carbide grains. When extremely high toughness is required, the cobalt content can amount up to 30%, whereas, for maximum wear resistance, the cobalt content is reduced and the grain size decreased to the nano-crystalline range of < 0.2 µm.

CERATIZIT produces far more than 100 different carbide grades particularly for wear parts and cutting tools, thus offering a customized solution for every application.

Carbide production

Carbide production at CERATIZIT started in 1929.
Last but not least, thanks to long-standing experience CERATIZIT handles the entire process chain, from the raw material to the dispatching of the finished products to customers. The production process of powder-metallurgical products basically includes the four steps of powder preparation, forming, sintering and finishing.

Tungsten carbide production

The APT (ammonium para-tungstate) is calcined into tungsten oxide under high temperature. Subsequently the oxide is reduced to tungsten metal in a hydrogen atmosphere. The metal powder is then mixed with carbon and carburised under inert atmosphere at high temperatures. The production parameters are decisive for the WC grain size in the sintered carbide.

Powder preparation

The tungsten carbide is intensely mixed with the binder metal cobalt, nickel or iron, various grain growth inhibitors and materials, which promote compaction, by wet grinding so that a homogeneous suspension is created.
Afterwards, the suspension is dried in a spray tower to produce a granulate with good flow characteristics.
This granulate represents the basis for all forming processes.

APT (ammonium para-tungstate)

Yellow tungsten oxide

Blue tungsten oxide

Tungsten

Tungsten carbide

Metal forming – pressing – machining

Metal forming

The objective of the forming process is to obtain a near net shape sample. Pressing is normally carried out at room temperature with pressures reaching up to several tons per square centimetre.
There are several ways of pressing blanks:

During isostatic cold pressing the powder is filled into an elastic flexible hose and pressed into a compacted form through high liquid pressure. The powder blocks which are produced in this way can then be processed mechanically. All common machining methods like milling, cutting, drilling or turning may be applied.

In uniaxial pressing the pressing tool consists of a die and an upper and a lower punch. The carbide powder is filled into the die and then compacted to create the so called green carbide, which is ejected from the pressing die.

Extrusion pressing is mainly used to produce rectangular bar or cylindrical rod, with or without axial hole(s). A plasticiser is added to the powder. The resulting paste is pressed through an extrusion nozzle. Before sintering, the plasticiser must be evaporated in special drying furnaces.

Metal Injection Moulding (MIM) is a process used to produce more complex forms which cannot be produced by direct pressing. The paste preparation is similar to the extrusion process.

Pressing

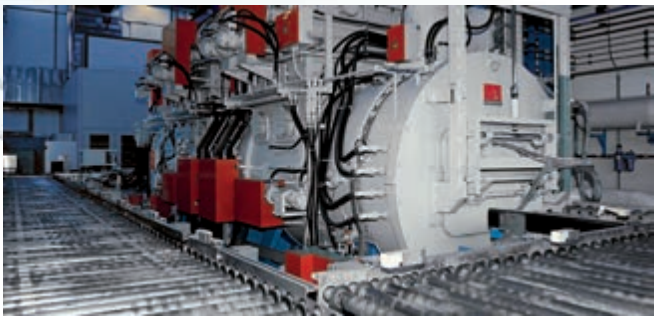
Machining

Sintering

Sintering process

The sintering process converts the blank into a homogeneous and dense carbide with a high level of hardness. The material is sintered at temperatures between 1,300 and 1,500 °C (liquid phase sintering) and sometimes also at high pressure (up to 100 bar). The volume is reduced by up to 50 % during this process.

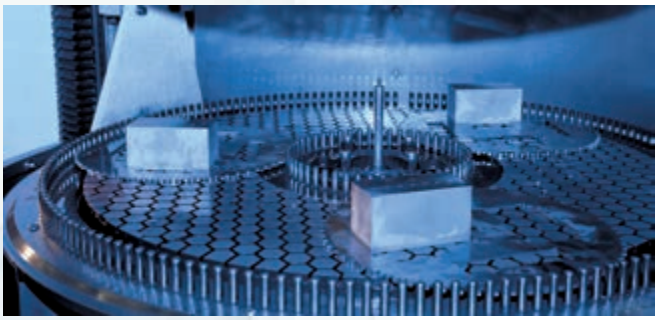
Sintering

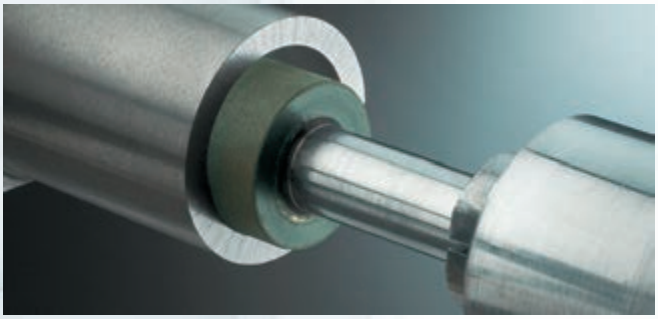


Finishing – grinding – coating

Finishing

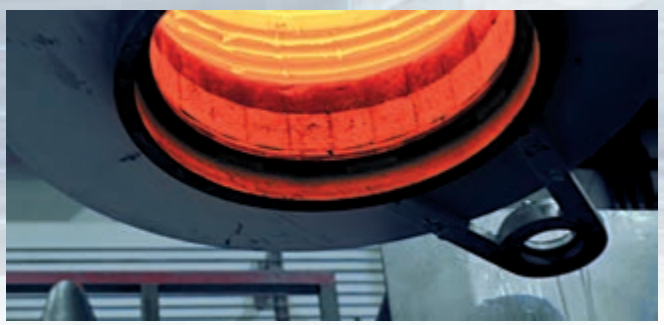
In order to achieve the final requirements of surface finish, tolerances, etc. carbide parts can be subjected to a series of finishing processes such as grinding, spark erosion and coating. As a pioneer in coating technology we set new standards through revolutionary coating developments even today. Our coating competency covers classic hard material coatings, functional tailor-made coatings for specific customer applications as well as multi-layer coating. These coatings, which consist for example of titanium carbide, titanium nitride or aluminium oxide, maximise the cutting performance and service life of the CERATIZIT carbide products. The most important coating procedures are CVD (Chemical Vapour Deposition) and PVD (Physical Vapour Deposition).
Cemented carbide machining by spark erosion meets the highest technological standards. Wire erosion and cavity sinking by EDM guarantee high precision. Long-standing experience combined with carbide grades that are specially adapted for erosion guarantee optimum machining results.





Finishing

Grinding



Coating

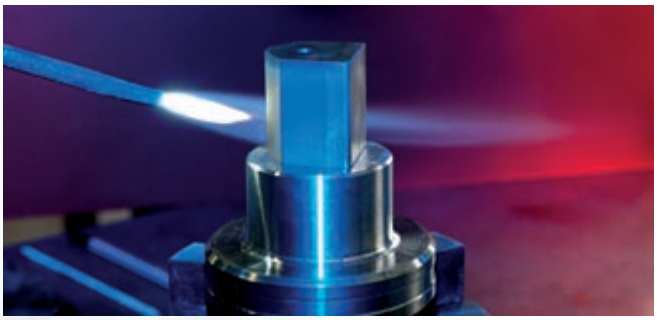
Joining – erosion – quality check

Composite parts

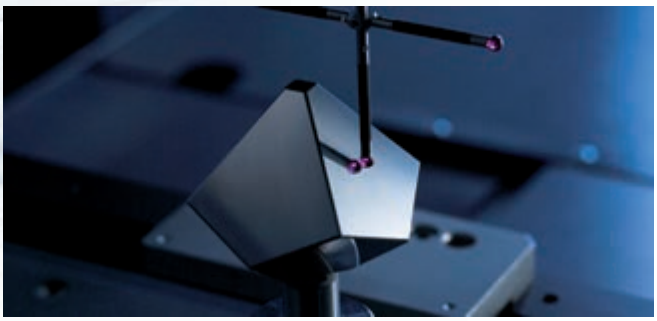
In many cases it is not optimal to manufacture the entire component in carbide. The use of carbide is then limited to the area in which wear occurs. Materials with appropriate wear resistance are used for the tool; they are easier to machine than carbide. Numerous tried and tested technologies, such as brazing, gluing, clamping, connections with screws and shrinking are applied to combine carbide with other materials.

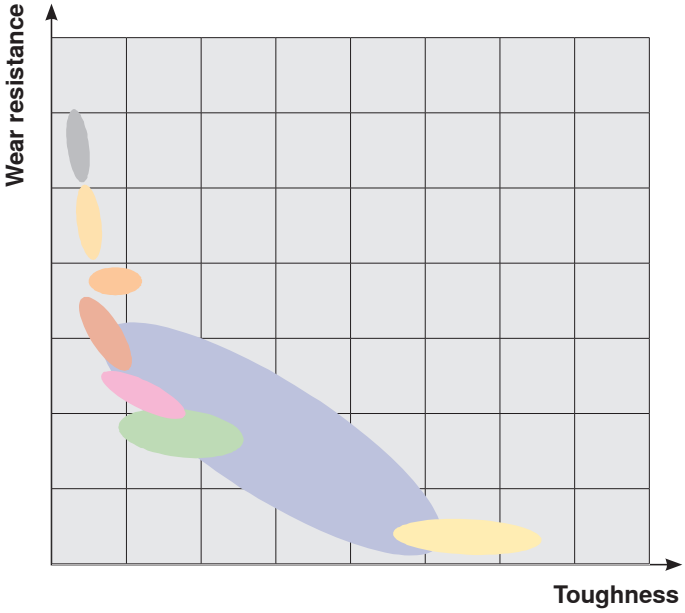
Joining

Erosion
(grinding, honing, ...)



Quality check



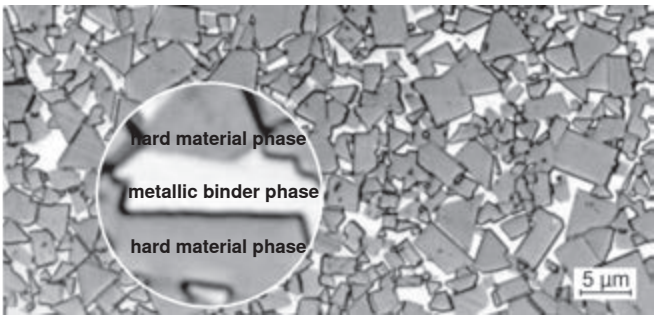


- Natural diamond
- PCD, diamond coated
- CBN
- Ceramic (O)
- Ceramic (N)
- Cermet
- Carbide
- HSS

Carbide is a hard material with mechanical properties that can be adjusted within a very wide range, given its composition and microstructure. The hardness and toughness range of the CERATIZIT grades includes everything from wear-resistant tool steel to super-hard ceramic materials.

Criteria relevant for application

- Wear resistance, hardness
- Compressive strength
- Impact strength
- Transverse rupture strength
- Tribological properties
- Specific weight
- Magnetic properties
- Modulus of elasticity, rigidity
- Thermal properties
- Corrosion resistance, resistance to oxidation
- Toughness



Micrograph of WC-Co carbide

The hard material provides the necessary

- hardness
- wear resistance

The metallic binder provides

- toughness

Classification of the WC grain size		CERATIZIT code
Average grain size [µm]	Classification	
< 0,2	nano	N
0,2 - < 0,5	ultrafine	U
0,5 - < 0,8	submicron	S
0,8 - < 1,3	fine	F
1,3 - < 2,5	medium	M
2,5 - < 6,0	coarse	C
> 6,0	extra-coarse	E

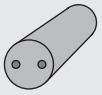
The classification of carbides according to grain size corresponds to the recommendations of the Powder Metallurgy Association.

RR Sintered rods			
RG Ground rods	**I**	Inch	
	DC	to DIN 6527, cut to length, with chamfer	
			D DualBlank (s-line/p-line)
			Y with radial coolant exit holes
	DCW	to DIN 6527, cut to length with chamfer and Weldon	
	DO	cut to length, with chamfer, for extra-long tool shanks	
00 **15** **30** **40** Helix angle of coolant hole rods	**R**	Coolant hole rods, as sintered	
	G	Coolant hole rods, ground	
GD Blanks for gun drills	**RK**	round rods with kidney-shaped coolant holes	
	VK	rods with kidney-shaped coolant holes and vee flute	
	V2	with two coolant holes and vee flute	
	V2P	brazing head with two coolant holes and vee flute	
FR Rectangular strips			
SR Square strips			

Number of coolant holes

1 =

2 =

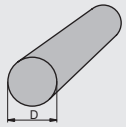


3 =

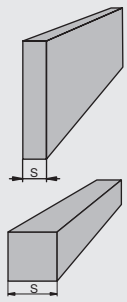
4 =

30	**R**		**2**

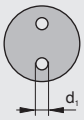
Outside diameter
[mm]



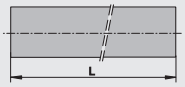
Thickness
[mm]



Ø of the coolant holes
[mm]

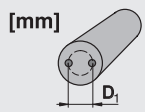


Rod length
[mm]

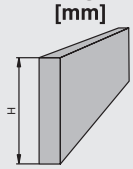


1030 / 4,8 / 1,3 / 54,4 - 330 CTS20D

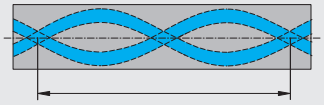
Pitch circle of the coolant holes
[mm]



Height
[mm]



Nominal pitch of the coolant hole
[mm]



Grade

Composition and properties

CERATIZIT grade code	ISO code	U.S. code	Binder [m %]	Density [g/cm³]	Hardness HV30	Hardness HRA	Transverse rupture strength [MPa]	Transverse rupture strength [P.S.I.]	K_{IC}* (Shetty) [MPa*m ½]
Ultrafine grades									
CTU08L	K10	C-2	4,2	15,05	2200	95,2	3700	536.600	6,3
TSF22	K10-K20	C-2	8,2	14,55	1930	93,7	4400	638.800	7,5
TSF44	K10-K20	C-2	12,0	14,10	1730	92,7	4600	667.000	7,8
Submicron grades									
CTS12D	K05-K10	C-3	6,0	14,80	1820	93,1	3600	522.100	9,3
CTS15D	K10-K30	C-3	7,5	14,70	1750	92,8	3700	536.000	9,5
CTS18D	K20-K40	C-2	9,0	14,55	1590	91,9	3650	529.400	10,7
CTS20D	K20-K40	C-2	10,0	14,38	1600	91,9	4000	580.100	10,4
Fine grades									
CTF12A	K15	C-2	6,0	15,00	1630	92,1	2600	377.000	10,2
H20X	K15	C-2	6,0	14,95	1650	92,2	2200	333.500	9,9
HC20	K20	C-2	6,0	14,95	1620	92,1	2200	319.000	9,9

Classification of the WC grain size		CERATIZIT code
Average grain size [µm]	Classification	
< 0,2	nano	N
0,2 - < 0,5	ultrafine	U
0,5 - < 0,8	submicron	S
0,8 - < 1,3	fine	F
1,3 - < 2,5	medium	M
2,5 - < 6,0	coarse	C
> 6,0	extra-coarse	E

The classification of carbides according to grain size corresponds to the recommendations of the Powder Metallurgy Association.

Comment:

1. The data in this table are typical material parameters. We reserve the right to modify the data due to technical progress or due to further development within our company.
2. K_{IC}*: The measured critical tension intensity factors (K_{IC}) depend to a high degree on the sample geometry and sample preparation. A direct comparison with parameters which have been determined by means of a different method is therefore not admissible.

Ultrafine grades

CTU08L: ultrafine carbide grade with typical grain sizes between 0.2 µm-0.5 µm for machining of ultra-hard materials > 65HRC. Also, excellent suitability for abrasive materials.

TSF22: ultrafine carbide grade for HSC machining. For hard machining of materials >60 HRC.

TSF44: ultrafine carbide grade for HSC machining, e.g. 1.2311 & 1.2312 hardened up to 59 HRC.

Submicron grades

CTS12D: submicron grade for machining aluminium alloys, fibre-reinforced plastics (carbon-fibre and glass-fibre reinforced), composite materials, graphite; particularly suitable for diamond coating.

CTS15D: submicron grade for machining grey cast iron, tempered cast iron, non alloyed steel, non ferrous metals and plastics.

CTS18D: special submicron grade for high-performance machining of steel, stainless steel and the machining of difficult to machine materials, for example titanium or Inconel. Optimum toughness and very good wear resistance.

CTS20D: submicron grade for the universal machining of alloyed and non alloyed steels, titanium alloys and nickel-based alloys. Improved toughness ensures a reduced risk of ruptures on the cutting edges.

Fine grain grades

CTF12A: fine grain grade for solid carbide tools with diamond coating. Excellent suitability for the machining of graphite and aluminium with a high silicon content.

H20X / **HC20:** fine grain carbide specifically for gun drills with an optimised balance of hardness and toughness.

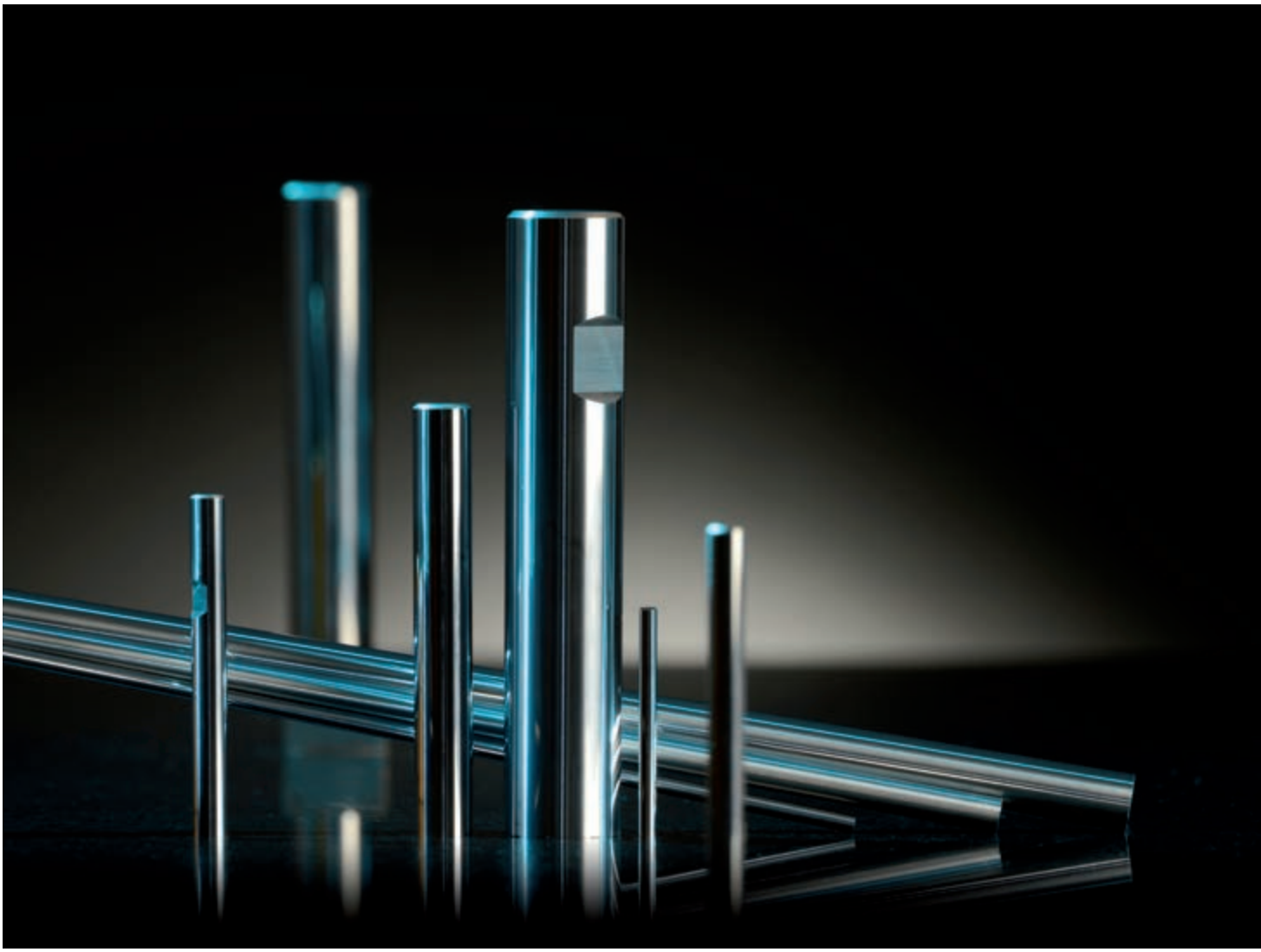
Stock programme at a glance

The product map below provides you with a quick overview of the grades and rods which are available in stock.
Other products are available upon request.

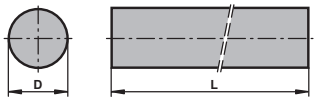
		CTU08L	TSF22	TSF44	CTS12D	CTS15D	CTS18D	CTS20D	CTF12A	HC20	H20X
Solid carbide rods, as sintered	RR	■	■	■	■	■	■	■	■		
Solid carbide rods, ground	RG		■	■	■	■	■	■	■		
Solid carbide rods, inch	RGI							■			
Solid carbide rods cut to length, ground	RGDC	■	■	■			■	■			
Solid carbide rods cut to length, ground (DualBlank)	RGDCD						■				
Solid carbide rods cut to length, according to factory standard	RGDO			■				■			
Rods cut to length, ground (Weldon)	RGDCW							■			
Rods with two helical coolant holes, as sintered	..R2							■			
Rods with three helical coolant holes, as sintered	..R3							■			
Rods with four helical coolant holes, as sintered	..R4							■			
Rods with two helical coolant holes, ground	..G2							■			
Rods with three helical coolant holes, ground	..G3							■			
Rods with central coolant hole, as sintered	00R1			■		■		■			
Rods with two straight coolant holes, as sintered	00R2					■		■			
Rods with central coolant hole, ground	00G1					■					
Rods with two straight coolant holes, ground	00G2					■					
Milling blanks cut to length with a central coolant channel and radial exit holes	RGDCY							■			
Square and rectangular strips	FR + SR							■			
Blanks for gun drills with kidney-shaped coolant hole	GDRK							■			■
Blanks for gun drills with kidney-shaped coolant hole and vee flute	GDVK							■			■
Blanks for gun drills with two coolant holes and vee flute	GDV2										■
Blanks for gun drill heads with two coolant holes and vee flute	GDV2P									■	

Solid carbide rods

With the new CTS grade line, our range of solid carbide rods has been completely redesigned to offer you a broad selection of dimensions and grades.



Submicron grades

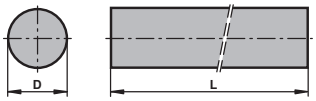


D [mm]	Type, description	L [mm]	Dia. tol. [mm]	CTS12D	CTS15D	CTS18D	CTS20D	CTF12A
1.15	RR 0115-330	330	-0/+0.15				●	
1.65	RR 0165-330	330	-0/+0.15	●			●	
1.80	RR 0180-330	330	-0/+0.15				●	
2.20	RR 0220-330	330	-0/+0.20	●			●	
2.70	RR 0270-330	330	-0/+0.20				●	
3.25	RR 0325-330	330	-0/+0.10	●	●	●	●	●
3.70	RR 0370-330	330	-0/+0.20				●	
4.20	RR 0420-330	330	-0/+0.20	●	●	●	●	●
4.70	RR 0470-330	330	-0/+0.20				●	
5.20	RR 0520-330	330	-0/+0.25	●	●		●	●
5.70	RR 0570-330	330	-0/+0.25				●	
6.20	RR 0620-330	330	-0/+0.25	●	●	●	●	●
6.55	RR 0655-330	330	-0/+0.25				●	
6.70	RR 0670-330	330	-0/+0.25		●		●	
7.20	RR 0720-330	330	-0/+0.30				●	
7.70	RR 0770-330	330	-0/+0.30				●	
8.20	RR 0820-330	330	-0/+0.30	●	●	●	●	●
8.70	RR 0870-330	330	-0/+0.30				●	
9.20	RR 0920-330	330	-0/+0.30				●	
9.70	RR 0970-330	330	-0/+0.30				●	
10.20	RR 1020-330	330	-0/+0.30	●	●	●	●	●
10.70	RR 1070-330	330	-0/+0.30				●	
11.20	RR 1120-330	330	-0/+0.30				●	
11.70	RR 1170-330	330	-0/+0.30				●	
12.20	RR 1220-330	330	-0/+0.30	●	●	●	●	●
12.70	RR 1270-330	330	-0/+0.30		●		●	
13.00	RR 1300-330	330	-0/+0.30				●	
13.20	RR 1320-330	330	-0/+0.30				●	
14.20	RR 1420-330	330	-0/+0.30	●	●	●	●	●
14.70	RR 1470-330	330	-0/+0.30				●	
15.20	RR 1520-330	330	-0/+0.30				●	
16.20	RR 1620-330	330	-0/+0.45	●	●	●	●	●
17.20	RR 1720-330	330	-0/+0.45				●	
18.20	RR 1820-330	330	-0/+0.45	●	●		●	●
19.20	RR 1920-330	330	-0/+0.45				●	
20.20	RR 2020-330	330	-0/+0.45	●	●	●	●	●
21.20	RR 2120-330	330	-0/+0.55				●	
22.20	RR 2220-330	330	-0/+0.55				●	
23.20	RR 2320-330	330	-0/+0.55				●	

● = stock item

Other grades and dimensions upon request

Submicron grades

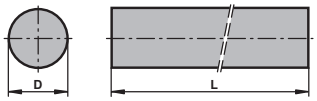


D [mm]	Type, description	L [mm]	Dia. tol. [mm]	CTS15D	CTS18D	CTS20D
24.20	RR 2420-330	330	-0/+0.55			●
25.20	RR 2520-330	330	-0/+0.65	●	●	●
25.80	RR 2580-330	330	-0/+0.60			●
26.20	RR 2620-330	330	-0/+0.65			●
28.20	RR 2820-330	330	-0/+0.65			●
30.20	RR 3020-330	330	-0/+0.65			●
32.20	RR 3220-330	330	-0/+0.65		●	●
34.20	RR 3420-330	330	-0/+0.65			●
36.20	RR 3620-330	330	-0/+0.65			●
38.20	RR 3820-330	330	-0/+0.70			●
40.20	RR 4020-330	330	-0/+0.70			●
42.20	RR 4220-330	330	-0/+0.70			●
46.20	RR 4620-330	330	-0/+0.70			●

● = stock item

Other grades and dimensions upon request

Ultrafine grades



D [mm]	Type, description	L [mm]	Dia. tol. [mm]	CTU08L	TSF22	TSF44
3.25	RR 0325-330	330	-0/+0.10	●	●	●
4.20	RR 0420-330	330	-0/+0.20	●	●	●
5.20	RR 0520-330	330	-0/+0.25	●	●	●
6.20	RR 0620-330	330	-0/+0.25	●	●	●
6.70	RR 0670-330	330	-0/+0.25			●
8.20	RR 0820-330	330	-0/+0.30	●	●	●
10.20	RR 1020-330	330	-0/+0.30	●	●	●
12.20	RR 1220-330	330	-0/+0.30	●	●	●
14.20	RR 1420-330	330	-0/+0.30		●	●
16.20	RR 1620-330	330	-0/+0.45		●	●
18.20	RR 1820-330	330	-0/+0.45		●	●
20.20	RR 2020-330	330	-0/+0.45		●	●
25.20	RR 2520-330	330	-0/+0.65		●	●
32.20	RR 3220-330	330	-0/+0.65			●

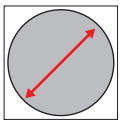
● = stock item

Other grades and dimensions upon request

Specifications

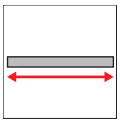
For further information see **92**

Outside diameter



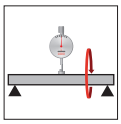
Ø [mm]	Tolerance [mm]
0,8 - 2,1	+0/+0,15
2,2 - 4,7	+0/+0,20
5,2 - 6,7	+0/+0,25
7,2 - 15,2	+0/+0,30
16,2 - 20,2	+0/+0,45
21,2 - 24,2	+0/+0,55
24,3 - 36,2	+0/+0,65
36,3 - 46,2	+0/+0,70

Length



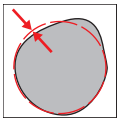
Length tolerance [mm]
+0/+10

Straightness



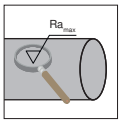
Ø [mm]	max. deflection [mm]
0,80 - 2,7	1,2
3,25 - 46,2	0,5

Roundness



Ø [mm]	Tolerance [mm]
0,8 - 5,7	0,05
6,2 - 7,7	0,08
8,2 - 12,7	0,10
13,2 - 30,2	0,13
30,3 - 46,2	0,16

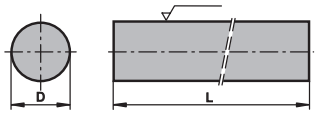
Surface finish



Ra_{max} [µm]
as sintered

Submicron grades

h6



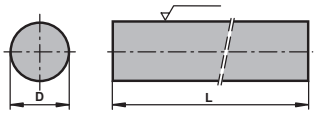
D [mm]	Type, description	L [mm]	Dia. tol. [mm]	CTS12D	CTS15D	CTS18D	CTS20D	CTF12A
1.00	RG 0100-330	330	+0/-0.006				●	
1.50	RG 0150-330	330	+0/-0.006				●	
2.00	RG 0200-330	330	+0/-0.006				●	
2.50	RG 0250-330	330	+0/-0.006		●		●	
3.00	RG 0300-330	330	+0/-0.006	●			●	●
3.50	RG 0350-330	330	+0/-0.008				●	
4.00	RG 0400-330	330	+0/-0.008	●			●	●
4.50	RG 0450-330	330	+0/-0.008				●	
5.00	RG 0500-330	330	+0/-0.008				●	
5.50	RG 0550-330	330	+0/-0.008				●	
6.00	RG 0600-330	330	+0/-0.008	●	●	●	●	●
6.50	RG 0650-330	330	+0/-0.009				●	
7.00	RG 0700-330	330	+0/-0.009				●	
7.50	RG 0750-330	330	+0/-0.009				●	
8.00	RG 0800-330	330	+0/-0.009	●	●	●	●	●
8.50	RG 0850-330	330	+0/-0.009				●	
9.00	RG 0900-330	330	+0/-0.009				●	
9.50	RG 0950-330	330	+0/-0.009				●	
10.00	RG 1000-330	330	+0/-0.009	●	●	●	●	●
11.00	RG 1100-330	330	+0/-0.011				●	
12.00	RG 1200-330	330	+0/-0.011	●	●	●	●	●
13.00	RG 1300-330	330	+0/-0.011				●	
14.00	RG 1400-330	330	+0/-0.011	●			●	●
15.00	RG 1500-330	330	+0/-0.011				●	
16.00	RG 1600-330	330	+0/-0.011	●	●	●	●	●
18.00	RG 1800-330	330	+0/-0.011		●		●	●
19.00	RG 1900-330	330	+0/-0.013				●	
20.00	RG 2000-330	330	+0/-0.013	●	●	●	●	●
22.00	RG 2200-330	330	+0/-0.013				●	
24.00	RG 2400-330	330	+0/-0.013				●	
25.00	RG 2500-330	330	+0/-0.013			●	●	
28.00	RG 2800-330	330	+0/-0.013				●	
30.00	RG 3000-330	330	+0/-0.013				●	
32.00	RG 3200-330	330	+0/-0.016			●	●	
38.00	RG 3800-330	330	+0/-0.016				●	
40.00	RG 4000-330	330	+0/-0.016				●	

● = stock item

Other grades and dimensions upon request

Ultrafine grades

h5



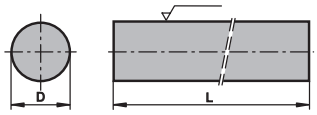
D [mm]	Type, description	L [mm]	Dia. tol. [mm]	TSF22	TSF44
2.00	RG 0200-330	330	+0/-0.004		●
3.00	RG 0300-330	330	+0/-0.004	●	●
4.00	RG 0400-330	330	+0/-0.005	●	●
5.00	RG 0500-330	330	+0/-0.005	●	
6.00	RG 0600-330	330	+0/-0.005	●	●
8.00	RG 0800-330	330	+0/-0.006	●	●
10.00	RG 1000-330	330	+0/-0.006	●	●
12.00	RG 1200-330	330	+0/-0.008	●	●
14.00	RG 1400-330	330	+0/-0.008		●
16.00	RG 1600-330	330	+0/-0.008	●	●
20.00	RG 2000-330	330	+0/-0.009	●	●
25.00	RG 2500-330	330	+0/-0.009	●	●

● = stock item

Other grades and dimensions upon request

Submicron grades (inch dimensions)

h6

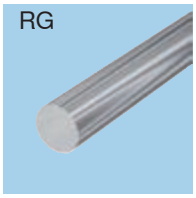


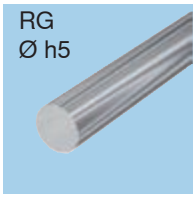
D [mm]	Type, description	L [mm]	Dia. tol. [mm]	CTS20D
3.175	RGI 1/8-13	330	+0/-0.008	●
4.763	RGI 3/16-13	330	+0/-0.008	●
6.35	RGI 1/4-13	330	+0/-0.009	●
7.938	RGI 5/16-13	330	+0/-0.009	●
9.525	RGI 3/8-13	330	+0/-0.009	●
11.113	RGI 7/16-13	330	+0/-0.011	●
12.7	RGI 1/2-13	330	+0/-0.011	●
19.05	RGI 3/4-13	330	+0/-0.013	●
25.4	RGI 1-13	330	+0/-0.013	●

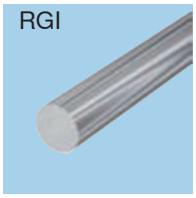
● = stock item

Other grades and dimensions upon request

Specifications

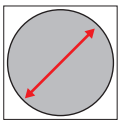






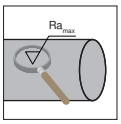
For further information see **92**

Outside diameter



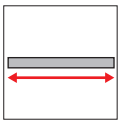
Ø [mm]	Tolerance h6 [mm]	Tolerance h5 [mm]
1,0 - 3,0	+0/-0,006	+0/-0,004
3,1 - 6,0	+0/-0,008	+0/-0,005
6,1 - 10,0	+0/-0,009	+0/-0,006
10,1 - 18,0	+0/-0,011	+0/-0,008
18,1 - 30,0	+0/-0,013	+0/-0,009
30,1 - 40,0	+0/-0,016	+0/-0,011

Surface finish



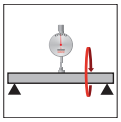
Ra_{max} [µm]
0,05

Length



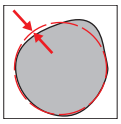
Length tolerance [mm]
+0/+10

Straightness



Ø [mm]	max. deflection [mm]
1,0 - 2,9	1,20
3,0 - 5,9	0,15
6,0 - 7,9	0,12
8,0 - 9,9	0,10
10,0 - 11,9	0,08
12,0 - 19,9	0,05
20,0 - 40,0	<0,05

Roundness



Ø [mm]	Tolerance [mm]	
	RG, RGI	RG h5
1,0 - 3,0	0,003	0,003
3,1 - 6,0	0,004	0,003
6,1 - 10,0	0,005	0,003
10,1 - 30,0	0,006	0,004
30,1 - 40,0	0,008	0,005

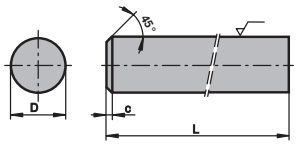
CERATIZIT hard material matters

Solid carbide rods

Ground, cut to length

Submicron grades to DIN 6527 K+L

h6



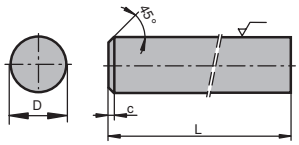
D [mm]	Type, description	L [mm]	Dia. tol. [mm]	c [mm]	CTS18D	CTS20D
3.00	RGDC 0300-039	39	+0/-0.006	0.30		●
4.00	RGDC 0400-051	51	+0/-0.008	0.30		●
5.00	RGDC 0500-051	51	+0/-0.008	0.40		●
6.00	RGDC 0600-051	51	+0/-0.008	0.40		●
6.00	RGDC 0600-055	55	+0/-0.008	0.40		●
6.00	RGDC 0600-058	58	+0/-0.008	0.40	●	●
8.00	RGDC 0800-059	59	+0/-0.009	0.60		●
8.00	RGDC 0800-064	64	+0/-0.009	0.60	●	●
10.00	RGDC 1000-067	67	+0/-0.009	0.60		●
10.00	RGDC 1000-073	73	+0/-0.009	0.80	●	●
12.00	RGDC 1200-074	74	+0/-0.011	0.80		●
12.00	RGDC 1200-084	84	+0/-0.011	0.80	●	●
14.00	RGDC 1400-076	76	+0/-0.011	0.80		●
14.00	RGDC 1400-084	84	+0/-0.011	0.80		●
16.00	RGDC 1600-083	83	+0/-0.011	0.80		●
16.00	RGDC 1600-093	93	+0/-0.011	0.80	●	●
18.00	RGDC 1800-093	93	+0/-0.011	1.00		●
20.00	RGDC 2000-093	93	+0/-0.013	1.00		●
20.00	RGDC 2000-105	105	+0/-0.013	1.00	●	●

● = stock item

Other grades and dimensions upon request

Ultrafine grades to DIN 6527 K+L

h5



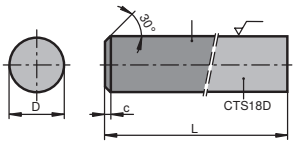
D [mm]	Type, description	L [mm]	Dia. tol. [mm]	c [mm]	CTU08L	TSF22	TSF44
3.00	RGDC 0300-039	39	+0/-0.004	0.30	●	●	●
4.00	RGDC 0400-051	51	+0/-0.004	0.30	●	●	●
5.00	RGDC 0500-051	51	+0/-0.005	0.40			●
6.00	RGDC 0600-051	51	+0/-0.005	0.40		●	●
6.00	RGDC 0600-058	58	+0/-0.005	0.40	●	●	●
8.00	RGDC 0800-064	64	+0/-0.006	0.60	●	●	●
10.00	RGDC 1000-067	67	+0/-0.006	0.60			●
10.00	RGDC 1000-073	73	+0/-0.006	0.80	●	●	●
12.00	RGDC 1200-084	84	+0/-0.008	0.80		●	●
16.00	RGDC 1600-093	93	+0/-0.008	0.80		●	●
20.00	RGDC 2000-105	105	+0/-0.009	1.00			●

● = stock item

Other grades and dimensions upon request

Submicron grades to DIN 6527 K+L "DualBlank"

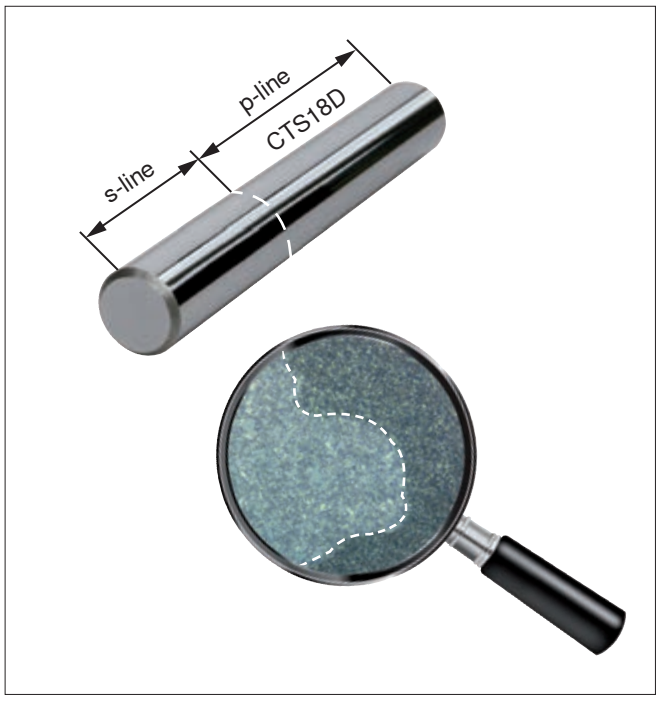
h6



D [mm]	Type, description	L [mm]	Dia. tol. [mm]	c [mm]	CTS18D
6.00	RGDCD 0600-058	58	+0/-0.008	0.50	●
8.00	RGDCD 0800-064	64	+0/-0.009	0.70	●
10.00	RGDCD 1000-073	73	+0/-0.009	0.90	●
12.00	RGDCD 1200-084	84	+0/-0.011	0.90	●
16.00	RGDCD 1600-093	93	+0/-0.011	0.90	●
20.00	RGDCD 2000-105	105	+0/-0.013	1.10	●

● = stock item

Other grades and dimensions upon request



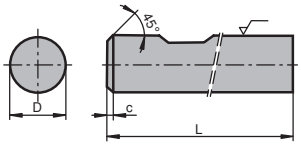
DualBlank rods

DualBlank version: a combination of **s-line** for tool shanks and **p-line** (grade CTS18D) for the cutting edges.

- High-performance grade for the cutting edges guarantees high quality
- Totally homogeneous product
- Optimised price-performance ratio
- Produced using few resources as possible

Submicron grades to DIN 6527 K+L with Weldon shank

h6



D [mm]	Type, description	L [mm]	Dia. tol. [mm]	c [mm]	CTS20D
6.00	RGDCW 0600-051	51	+0/-0.008	0.40	●
6.00	RGDCW 0600-055	55	+0/-0.008	0.40	●
6.00	RGDCW 0600-058	58	+0/-0.008	0.40	●
8.00	RGDCW 0800-064	64	+0/-0.009	0.60	●
10.00	RGDCW 1000-067	67	+0/-0.009	0.60	●
10.00	RGDCW 1000-073	73	+0/-0.009	0.60	●
12.00	RGDCW 1200-074	74	+0/-0.011	0.80	●
12.00	RGDCW 1200-084	84	+0/-0.011	0.80	●
16.00	RGDCW 1600-093	93	+0/-0.011	0.80	●
20.00	RGDCW 2000-093	93	+0/-0.013	1.00	●
20.00	RGDCW 2000-105	105	+0/-0.013	1.00	●

● = stock item

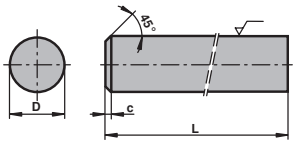
Other grades and dimensions upon request

Solid carbide rods

Ground, cut to length

Submicron/ultrafine grades according to factory standard

h5

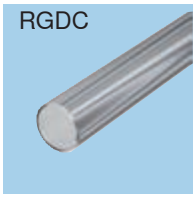


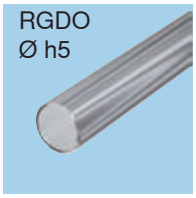
D [mm]	Type, description	L [mm]	Dia. tol. [mm]	c [mm]	CTS20D	TSF44
6.00	RGDO 0600-100	100	+0/-0.005	0.40	●	●
8.00	RGDO 0800-100	100	+0/-0.006	0.60	●	●
8.00	RGDO 0800-120	120	+0/-0.006	0.60	●	●
10.00	RGDO 1000-100	100	+0/-0.006	0.60	●	●
10.00	RGDO 1000-120	120	+0/-0.006	0.60		●
12.00	RGDO 1200-100	100	+0/-0.008	0.80	●	●
12.00	RGDO 1200-120	120	+0/-0.008	0.80	●	●
16.00	RGDO 1600-120	120	+0/-0.008	0.80	●	●
20.00	RGDO 2000-150	150	+0/-0.009	1.00		●
25.00	RGDO 2500-125	125	+0/-0.009	1.00	●	●
25.00	RGDO 2500-150	150	+0/-0.009	1.00		●

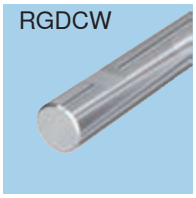
● = stock item

Other grades and dimensions upon request

Specifications

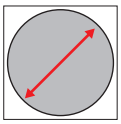






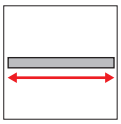
For further information see **92**

Outside diameter



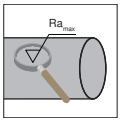
Ø [mm]	Tolerance h6 [mm]	Tolerance h5 [mm]
1,0 - 3,0	+0/-0,006	+0/-0,004
3,1 - 6,0	+0/-0,008	+0/-0,005
6,1 - 10,0	+0/-0,009	+0/-0,006
10,1 - 18,0	+0/-0,011	+0/-0,008
18,1 - 30,0	+0/-0,013	+0/-0,009
30,1 - 40,0	+0/-0,016	+0/-0,011

Length



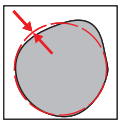
Length tolerance [mm]
+0% / +1%

Surface finish



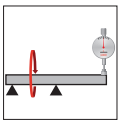
Ra_{max} [µm]
0,05

Roundness



Ø [mm]	Tolerance [mm]		
	RGDC, RGDCW RGDCD	RGDC h5	RGDO h5
3	0,003	0,003	0,002
4 - 6	0,004	0,003	0,002
8 - 10	0,005	0,003	0,002
12 - 25	0,006	0,004	0,002

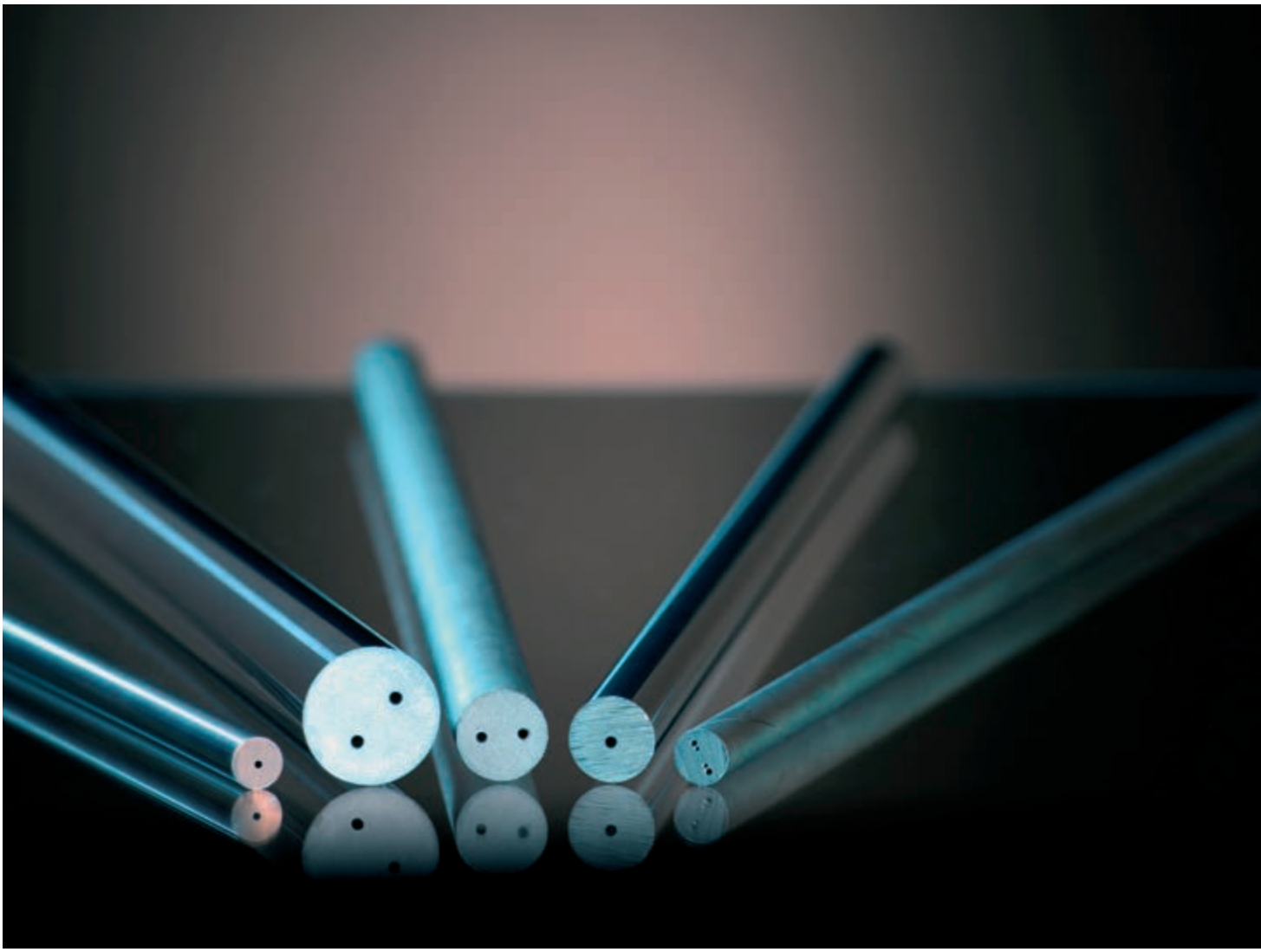
Run-out



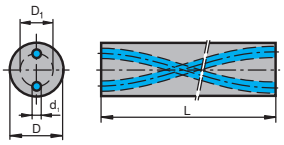
Length [mm]	Ø [mm]	max. run-out [mm]	
		RGDC h6, RGDC h5, RGDCW, RGDCD	RGDO h5
30 - 65	3	0,008	-
30 - 65	4 - 10	0,005	-
65 - 80	8 - 10	0,008	-
65 - 80	12 - 25	0,006	-
80 - 110	4	0,015	0,010
80 - 110	6	0,015	0,006
80 - 110	8 -10	0,010	0,004
80 - 110	12 - 25	0,010	-
110 - 150	6	-	0,010
110 - 150	8 - 25	-	0,004

Coolant hole rods

We offer a wide range of coolant hole rods manufactured with the greatest precision. Our latest innovations are rods with four helical coolant holes as well as cut-to-length rods with radial coolant exit holes.



With two coolant holes



D [mm]	Type, description	L [mm]	D_1 [mm]	d_1 [mm]	Nominal pitch [mm]	[°]	CTS20D
3.30	40R2 0330/0,3/0,15/11,2-330	330	0.30	0.15	11.20	40.1	●
3.30	39R2 0330/0,8/0,23/11,5-330	330	0.80	0.23	11.50	39.3	●
4.20	46R2 0420/1,0/0,3/12,0-330	330	1.00	0.30	12.00	46.3	●
4.20	35R2 0420/1,3/0,7/18,0-330	330	1.30	0.70	18.00	34.9	●
4.30	30R2 0430/2,1/0,45/21,8-330	330	2.10	0.45	21.80	30.0	●
5.30	33R2 0530/2,2/0,6/24,5-330	330	2.20	0.60	24.50	32.7	●
6.30	46R2 0630/1,6/0,5/18,0-330	330	1.60	0.50	18.00	46.3	●
6.30	46R2 0630/1,6/0,5/18,0-350	350	1.60	0.50	18.00	46.3	●
6.30	40R2 0630/1,9/0,7/22,5-330	330	1.90	0.70	22.50	40.0	●
6.30	40R2 0630/1,9/0,7/22,5-350	350	1.90	0.70	22.50	40.0	●
6.30	30R2 0630/2,0/0,9/32,7-330	330	2.00	0.90	32.70	30.0	●
6.30	30R2 0630/2,2/0,7/32,7-330	330	2.20	0.70	32.70	30.0	●
6.30	30R2 0630/2,2/0,7/32,7-350	350	2.20	0.70	32.70	30.0	●
6.30	30R2 0630/2,7/0,8/32,7-330	330	2.70	0.80	32.70	30.0	●
6.30	30R2 0630/3,0/0,9/32,7-330	330	3.00	0.90	32.70	30.0	●
7.30	30R2 0730/3,5/1,0/38,1-330	330	3.50	1.00	38.10	30.0	●
8.30	43R2 0830/2,3/0,7/27,2-330	330	2.30	0.70	27.20	42.7	●
8.30	40R2 0830/2,9/0,7/30,0-330	330	2.90	0.70	30.00	40.0	●
8.30	36R2 0830/3,3/1,0/35,0-330	330	3.30	1.00	35.00	35.7	●
8.30	36R2 0830/3,3/1,0/35,0-350	350	3.30	1.00	35.00	35.7	●
8.30	30R2 0830/3,4/1,0/43,5-330	330	3.40	1.00	43.50	30.0	●
8.30	30R2 0830/3,4/1,0/43,5-350	350	3.40	1.00	43.50	30.0	●
8.30	30R2 0830/4,1/1,2/43,5-330	330	4.10	1.20	43.50	30.0	●
9.30	30R2 0930/4,35/1,0/49,0-330	330	4.35	1.00	49.00	30.0	●
10.30	40R2 1030/2,7/0,8/37,0-330	330	2.70	0.80	37.00	40.3	●
10.30	34R2 1030/3,9/1,1/46,0-330	330	3.90	1.10	46.00	34.3	●
10.30	34R2 1030/4,4/1,15/46,0-330	330	4.40	1.15	46.00	34.3	●
10.30	30R2 1030/4,8/1,3/54,4-330	330	4.80	1.30	54.40	30.2	●
10.30	33R2 1030/5,0/1,2/49,0-330	330	5.00	1.20	49.00	32.7	●
11.30	40R2 1130/3,2/0,8/41,2-330	330	3.20	0.80	41.20	40.0	●
11.30	30R2 1130/5,5/1,5/59,9-330	330	5.50	1.50	59.90	30.0	●
12.30	39R2 1230/3,5/1,0/46,3-330	330	3.50	1.00	46.30	39.2	●
12.30	40R2 1230/4,0/0,9/44,9-330	330	4.00	0.90	44.90	40.0	●
12.30	33R2 1230/5,0/1,35/57,0-330	330	5.00	1.35	57.00	33.5	●
12.30	33R2 1230/5,4/1,5/57,0-250	250	5.40	1.50	57.00	33.5	●
12.30	33R2 1230/5,4/1,5/57,0-330	330	5.40	1.50	57.00	33.5	●
12.30	32R2 1230/6,0/1,5/59,9-330	330	6.00	1.50	59.90	32.2	●
12.30	30R2 1230/6,3/1,7/65,3-250	250	6.30	1.70	65.30	30.0	●
12.30	30R2 1230/6,3/1,7/65,3-330	330	6.30	1.70	65.30	30.0	●
13.30	40R2 1330/4,4/1,0/48,7-330	330	4.40	1.00	48.70	40.0	●
13.30	30R2 1330/6,5/1,6/70,7-330	330	6.50	1.60	70.70	30.0	●

● = stock item

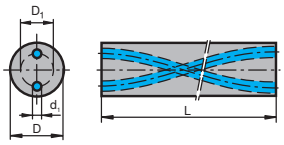
Other grades and dimensions upon request

CERATIZIT hard material matters

Coolant hole rods

As sintered, helical

With two coolant holes

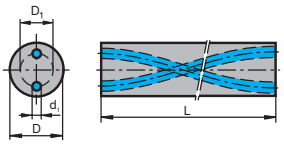


D [mm]	Type, description	L [mm]	D_1 [mm]	d_1 [mm]	Nominal pitch [mm]	[°]	CTS20D
14.30	40R2 1430/4,6/1,3/52,4-330	330	4.60	1.30	52.40	40.0	●
14.30	34R2 1430/6,0/1,6/65,0-330	330	6.00	1.60	65.00	34.1	●
14.30	30R2 1430/6,7/1,8/76,2-330	330	6.70	1.80	76.20	30.0	●
14.30	30R2 1430/7,0/2,0/76,2-330	330	7.00	2.00	76.20	30.0	●
14.30	30R2 1430/7,6/2,0/76,2-330	330	7.60	2.00	76.20	30.0	●
15.30	30R2 1530/7,6/2,0/81,6-330	330	7.60	2.00	81.60	30.0	●
16.30	40R2 1630/5,5/1,2/59,9-330	330	5.50	1.20	59.90	40.0	●
16.30	35R2 1630/7,0/2,0/73,0-330	330	7.00	2.00	73.00	34.6	●
16.30	30R2 1630/8,0/2,0/87,1-280	280	8.00	2.00	87.10	30.0	●
16.30	30R2 1630/8,0/2,0/87,1-330	330	8.00	2.00	87.10	30.0	●
16.30	32R2 1630/8,4/2,0/81,6-330	330	8.40	2.00	81.60	31.6	●
16.30	30R2 1630/8,6/2,5/87,1-330	330	8.60	2.50	87.10	30.0	●
17.30	40R2 1730/5,75/1,3/63,6-330	330	5.75	1.30	63.60	40.0	●
17.30	30R2 1730/8,9/2,5/92,5-330	330	8.90	2.50	92.50	30.0	●
18.30	40R2 1830/5,6/1,6/68,0-330	330	5.60	1.60	68.00	39.7	●
18.30	40R2 1830/6,3/1,7/68,0-330	330	6.30	1.70	68.00	39.7	●
18.30	35R2 1830/7,75/2,2/82,0-330	330	7.75	2.20	82.00	34.6	●
18.30	30R2 1830/9,3/2,7/98,0-330	330	9.30	2.70	98.00	30.0	●
20.30	30R2 2030/10,0/2,5/108,8-330	330	10.00	2.50	108.80	30.0	●
20.30	30R2 2030/10,7/3,2/108,8-330	330	10.70	3.20	108.80	30.0	●
20.30	37R2 2030/6,5/1,7/84,3-330	330	6.50	1.70	84.30	36.7	●
20.30	40R2 2030/7,1/1,5/74,9-330	330	7.10	1.50	74.90	40.0	●
21.30	30R2 2130/11,5/3,2/114,2-330	330	11.50	3.20	114.20	30.0	●
22.30	33R2 2230/10,0/2,50/108,0-330	330	10.00	2.50	108.00	32.6	●
22.30	30R2 2230/11,5/3,4/119,7-330	330	11.50	3.40	119.70	30.0	●
22.30	40R2 2230/7,7/1,7/82,4-330	330	7.70	1.70	82.40	40.0	●
25.30	33R2 2530/12,0/3,2/119,0-330	330	12.00	3.20	119.00	33.4	●
25.30	40R2 2530/7,7/1,75/93,6-330	330	7.70	1.75	93.60	40.0	●
28.30	29R2 2830/14,8/2,5/159,0-330	330	14.80	2.50	159.00	29.0	●
28.30	39R2 2830/9,0/2,0/107,7-330	330	9.00	2.00	107.70	39.2	●
30.30	39R2 3030/10,0/2,0/116,0-330	330	10.00	2.00	116.00	39.1	●
30.30	29R2 3030/16,0/2,5/172,0-330	330	16.00	2.50	172.00	28.7	●
32.30	40R2 3230/11,0/2,0/119,8-330	330	11.00	2.00	119.80	40.0	●
32.30	29R2 3230/17,0/3,0/177,8-330	330	17.00	3.00	177.80	29.5	●
35.30	30R2 3530/18,0/3,0/189,5-330	330	18.00	3.00	189.50	30.0	●

● = stock item

Other grades and dimensions upon request

With two coolant holes (extra-long)



D [mm]	Type, description	L [mm]	D_1 [mm]	d_1 [mm]	Nominal pitch [mm]	[°]	CTS20D
6.30	46R2 0630/1,6/0,5/18,0-430	430	1.60	0.50	18.00	46.3	●
6.30	40R2 0630/1,9/0,7/22,5-430	430	1.90	0.70	22.50	40.0	●
6.30	30R2 0630/2,2/0,7/32,7-430	430	2.20	0.70	32.70	30.0	●
6.30	30R2 0630/3,0/0,9/32,7-430	430	3.00	0.90	32.70	30.0	●
8.30	30R2 0830/3,4/1,0/43,5-430	430	3.40	1.00	43.50	30.0	●
10.30	30R2 1030/4,8/1,3/54,4-430	430	4.80	1.30	54.40	30.0	●
10.30	30R2 1030/4,8/1,3/54,4-530	530	4.80	1.30	54.40	30.0	●
12.30	30R2 1230/6,3/1,7/65,3-430	430	6.30	1.70	65.30	30.0	●
12.30	30R2 1230/6,3/1,7/65,3-530	530	6.30	1.70	65.30	30.0	●
14.30	30R2 1430/6,7/1,8/76,2-430	430	6.70	1.80	76.20	30.0	●
14.30	30R2 1430/6,7/1,8/76,2-530	530	6.70	1.80	76.20	30.0	●
16.30	30R2 1630/8,0/2,0/87,1-430	430	8.00	2.00	87.10	30.0	●
16.30	30R2 1630/8,0/2,0/87,1-530	530	8.00	2.00	87.10	30.0	●
18.30	30R2 1830/9,3/2,7/98,0-430	430	9.30	2.70	98.00	30.0	●
18.30	30R2 1830/9,3/2,7/98,0-530	530	9.30	2.70	98.00	30.0	●
20.30	30R2 2030/10,0/2,5/108,8-430	430	10.00	2.50	108.80	30.0	●
20.30	30R2 2030/10,0/2,5/108,8-530	530	10.00	2.50	108.80	30.0	●
25.30	33R2 2530/12,0/3,2/119,0-430	430	12.00	3.20	119.00	33.4	●
25.30	33R2 2530/12,0/3,2/119,0-530	530	12.00	3.20	119.00	33.4	●

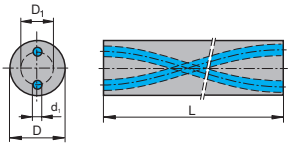
● = stock item

Other grades and dimensions upon request

Coolant hole rods

As sintered, helical

With two coolant holes (15°-22° pitch)

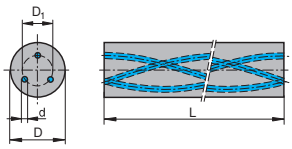


D [mm]	Type, description	L [mm]	D_1 [mm]	d_1 [mm]	Nominal pitch [mm]	[°]	CTS20D
6.30	22R2 0630/1,9/0,6/46,9-415	415	1.90	0.60	46.90	21.9	●
6.30	15R2 0630/2,6/0,7/70,35-330	330	2.60	0.70	70.35	15.0	●
6.30	15R2 0630/2,6/0,7/70,35-415	415	2.60	0.70	70.35	15.0	●
8.30	20R2 0830/3,3/1,0/70,34-415	415	3.30	1.00	70.34	19.7	●
8.30	15R2 0830/3,6/1,25/93,8-330	330	3.60	1.25	93.80	15.0	●
8.30	15R2 0830/3,6/1,25/93,8-415	415	3.60	1.25	93.80	15.0	●
10.30	19R2 1030/4,40/1,20/93,80-415	415	4.40	1.20	93.80	18.5	●
10.30	15R2 1030/4,80/1,40/117,25-330	330	4.80	1.40	117.25	15.0	●
10.30	15R2 1030/4,80/1,40/117,25-415	415	4.80	1.40	117.25	15.0	●
12.30	18R2 1230/5,40/1,50/117,25-415	415	5.40	1.50	117.25	17.8	●
12.30	15R2 1230/6,25/1,55/140,70-330	330	6.25	1.55	140.70	15.0	●
12.30	15R2 1230/6,25/1,55/140,70-415	415	6.25	1.55	140.70	15.0	●
14.30	15R2 1430/6,70/1,90/164,14-330	330	6.70	1.90	164.14	15.0	●
14.30	15R2 1430/6,70/1,90/164,14-415	415	6.70	1.90	164.14	15.0	●
16.30	15R2 1630/8,0/2,10/187,59-330	330	8.00	2.10	187.59	15.0	●
18.30	15R2 1830/9,0/2,3/211,0-330	330	9.00	2.30	211.00	15.0	●
20.30	15R2 2030/10,0/2,50/234,49-330	330	10.00	2.50	234.49	15.0	●
22.30	15R2 2230/12,0/2,5/257,94-330	330	12.00	2.50	257.94	15.0	●

● = stock item

Other grades and dimensions upon request

With three coolant holes



D [mm]	Type, description	L [mm]	D_1 [mm]	d_1 [mm]	Nominal pitch [mm]	[°]	CTS20D
6.30	30R3 0630/3,0/0,6/32,7-330	330	3.00	0.60	32.7	31.2	●
8.30	40R3 0830/2,9/0,7/30,0-330	330	2.90	0.70	30.0	40.0	●
8.30	30R3 0830/4,0/0,75/43,5-330	330	4.00	0.75	43.5	30.0	●
10.30	40R3 1030/3,5/0,75/37,0-330	330	3.50	0.75	37.0	40.3	●
10.30	30R3 1030/4,9/1,0/54,4-330	330	4.90	1.00	54.4	30.0	●
12.30	40R3 1230/4,0/0,9/44,9-330	330	4.00	0.90	44.9	40.0	●
12.30	30R3 1230/6,0/1,1/65,3-330	330	6.00	1.10	65.3	30.0	●
14.30	40R3 1430/4,65/1,2/52,4-330	330	4.65	1.20	52.4	40.0	●
14.30	30R3 1430/7,1/1,3/76,2-330	330	7.10	1.30	76.2	30.0	●
16.30	40R3 1630/5,5/1,2/59,9-330	330	5.50	1.20	59.9	40.0	●
16.30	30R3 1630/8,3/1,5/87,0-330	330	8.30	1.50	87.0	30.0	●
18.30	40R3 1830/6,25/1,5/67,4-330	330	6.25	1.50	67.4	40.0	●
18.30	30R3 1830/9,6/1,7/98,0-330	330	9.60	1.70	98.0	30.0	●
20.30	30R3 2030/10,4/2,0/108,8-330	330	10.40	2.00	108.8	30.0	●
20.30	40R3 2030/7,1/1,5/74,9-330	330	7.10	1.50	74.9	40.0	●
22.30	30R3 2230/10,7/2,0/119,7-330	330	10.70	2.00	119.7	30.0	●
22.30	40R3 2230/7,7/1,7/82,4-330	330	7.70	1.70	82.4	40.0	●
25.30	33R3 2530/11,5/2,2/119,0-330	330	11.50	2.20	119.0	33.4	●
25.30	40R3 2530/8,1/1,7/93,6-330	330	8.10	1.70	93.6	40.0	●

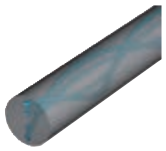
● = stock item

Other grades and dimensions upon request

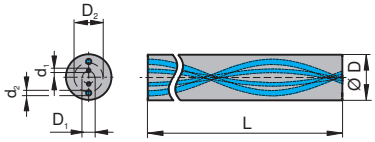
Coolant hole rods

As sintered, helical

With four coolant holes



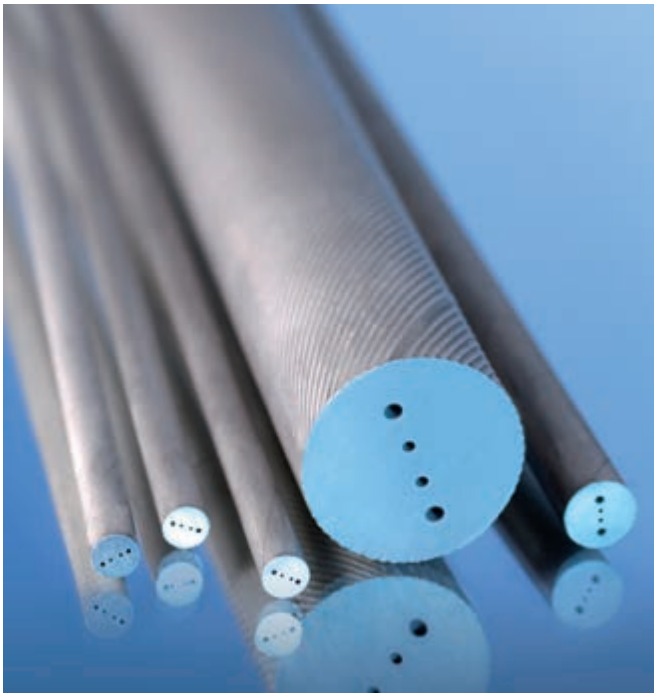
NEW



D [mm]	Type, description	L [mm]	D_1 [mm]	D_2 [mm]	d_1 [mm]	d_2 [mm]	Nominal pitch [°]	Nominal pitch [mm]	CTS20D
8.3	33R4 0830/1,9/3,9/0,4/0,8/38-330	330	1.9	3.9	0.4	0.8	33.4	38.1	●
8.3	30R4 0830/2,2/4,5/0,45/0,9/44-330	330	2.2	4.5	0.45	0.9	29.7	43.5	●
10.3	30R4 1030/2,8/5,7/0,6/1,1/54-330	330	2.8	5.7	0.6	1.1	30.0	54.4	●
10.3	33R4 1030/2,5/5,1/0,5/1,0/49-330	330	2.5	5.1	0.5	1.0	32.7	49.0	●
12.3	32R4 1230/3,1/6,3/0,7/1,2/60-330	330	3.1	6.3	0.7	1.2	32.2	59.9	●
12.3	30R4 1230/3,4/6,9/0,7/1,4/65-330	330	3.4	6.9	0.7	1.4	30.0	65.3	●
14.3	30R4 1430/3,9/8,1/0,8/1,6/76-330	330	3.9	8.1	0.8	1.6	30.0	76.2	●
14.3	32R4 1430/3,6/7,5/0,8/1,5/70-330	330	3.6	7.5	0.8	1.5	31.9	70.7	●
16.3	30R4 1630/4,4/9,0/0,9/1,8/87-330	330	4.4	9.0	0.9	1.8	30.0	87.1	●
18.3	30R4 1830/5,0/10,2/1,0/2,0/98-330	330	5.0	10.2	1.0	2.0	30.0	98.0	●
20.3	30R4 203/5,6/11,4/1,2/2,3/109-330	330	5.6	11.4	1.2	2.3	30.0	108.8	●
22.3	30R4 223/6,1/12,6/1,2/2,5/120-330	330	6.1	12.6	1.2	2.5	30.0	119.7	●
25.3	29R4 253/6,9/14,1/1,4/2,8/139-330	330	6.9	14.1	1.4	2.8	29.4	139.3	●

● = stock item

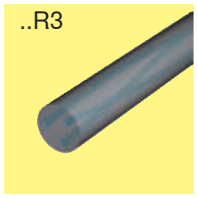
Other grades and dimensions upon request



Advantages

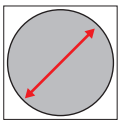
- Optimised coolant hole design and increased flow rate thanks to larger cross section of the holes
- Outer coolant hole for improved cooling and enhanced chip evacuation
- Inner coolant hole for improved cooling of the tip and coolant rinsing of the cutting edge

Specifications



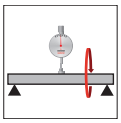
For further information see **92**

Outside diameter



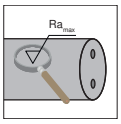
ø [mm]	Tolerance core diameter [mm]	Tolerance outside diameter [mm]
3,3 - 4,3	+ 0,10 / + 0,20	+ 0,20 / + 0,60
4,4 - 8,3	+ 0,10 / + 0,30	+ 0,20 / + 0,70
8,4 - 10,3	+ 0,10 / + 0,35	+ 0,20 / + 0,75
10,4 - 12,3	+ 0,10 / + 0,40	+ 0,25 / + 0,80
12,4 - 14,3	+ 0,10 / + 0,40	+ 0,30 / + 0,80
14,4 - 16,3	+ 0,10 / + 0,45	+ 0,35 / + 0,95
16,4 - 18,3	+ 0,10 / + 0,50	+ 0,40 / + 1,00
18,4 - 20,3	+ 0,10 / + 0,55	+ 0,40 / + 1,05
20,4 - 22,3	+ 0,10 / + 0,60	+ 0,45 / + 1,10
22,4 - 35,3	+ 0,10 / + 0,60	+ 0,50 / + 1,10

Straightness



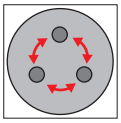
Length [mm]	max. deflection [mm]
250 - 280	0,4
>280	0,5

Surface finish



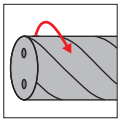
Ra_{max} [µm]
as sintered

Pitch error



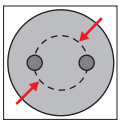
max. pitch error with ..R3 [°]
+/- 3

Helix angle



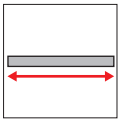
Product group	Total tolerance class [°]	Number of classes	Tolerance class [°]
>22°	+/- 1	3	+/- 0,33
>330 mm, 3 coolant h.	+/- 0,75	6	+/- 0,125
≤22°	+/- 0,5	1	+/- 0,5

Pitch circle diameter



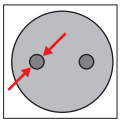
ø [mm]	Tolerance [mm]
up to 3.3	+/- 0,10
3,4 - 4,3	+/- 0,15
4,4 - 12,3	+/- 0,20
12,4 - 18,3	+/- 0,25
18,4 - 35,3	+/- 0,30

Length



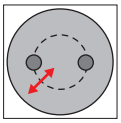
Length tolerance [mm]
+0/+10

Hole diameter



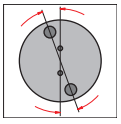
ø [mm]	Hole diameter [mm]	Tolerance [mm]
3,3 - 4,3	<=1,00	+/- 0,030
3,3 - 4,3	>=1,01	+/- 0,050
4,4 - 35,3	0,40 - 1,30	+/- 0,050
4,4 - 35,3	1,31 - 2,50	+/- 0,075
4,4 - 35,3	2,51 - 5,00	+/- 0,100

Excentricity



ø [mm]	Tolerance [mm]
3,3	0,04
3,4 - 4,3	0,05
4,4 - 8,3	0,10
8,4 - 10,3	0,15
10,4 - 14,3	0,18
14,4 - 35,3	0,20

Torsion



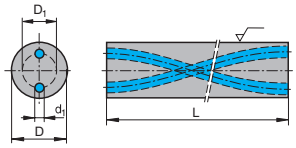
max. torsion with ..R4 [°]
2,0

Coolant hole rods

Ground, helical

With two coolant holes

h6



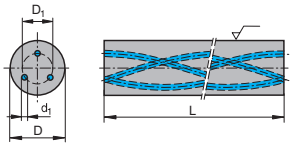
D [mm]	Type, description	L [mm]	D_1 [mm]	d_1 [mm]	Nominal pitch [mm]	[°]	CTS20D
6.00	40G2 0600/1,9/0,7/22,5-330	330	1.90	0.70	22.50	40.0	●
6.00	30G2 0600/3,0/0,9/32,7-330	330	3.00	0.90	32.70	30.0	●
8.00	43G2 0800/2,3/0,7/27,2-330	330	2.30	0.70	27.20	42.7	●
8.00	30G2 0800/3,4/1,0/43,5-330	330	3.40	1.00	43.50	30.0	●
10.00	40G2 1000/2,7/0,8/37,0-330	330	2.70	0.80	37.00	40.0	●
10.00	30G2 1000/4,8/1,3/54,4-330	330	4.80	1.30	54.40	30.0	●
12.00	39G2 1200/3,5/1,0/46,3-330	330	3.50	1.00	46.30	39.0	●
12.00	30G2 1200/6,3/1,7/65,3-330	330	6.30	1.70	65.30	30.0	●
14.00	40G2 1400/4,6/1,3/52,4-330	330	4.60	1.30	52.40	40.0	●
14.00	30G2 1400/6,7/1,8/76,2-330	330	6.70	1.80	76.20	30.0	●
16.00	40G2 1600/5,5/1,2/59,9-330	330	5.50	1.20	59.90	40.0	●
16.00	30G2 1600/8,0/2,0/87,1-330	330	8.00	2.00	87.10	30.0	●
18.00	40G2 1800/6,3/1,7/68,0-330	330	6.30	1.70	68.00	39.7	●
18.00	30G2 1800/9,3/2,7/98,0-330	330	9.30	2.70	98.00	30.0	●
20.00	30G2 2000/10,0/2,5/108,8-330	330	10.00	2.50	108.80	30.0	●
20.00	40G2 2000/7,1/1,5/74,9-330	330	7.10	1.50	74.90	40.0	●
25.00	33G2 2500/12,0/3,2/119,0-330	330	12.0	3.20	119.00	33.4	●
25.00	40G2 2500/7,7/1,75/93,6-330	330	7.70	1.75	93.60	40.0	●
32.00	40G2 3200/11,0/2,0/119,8-330	330	11.00	2.00	119.80	40.0	●
32.00	29G2 3200/17,0/3,0/177,8-330	330	17.00	3.00	177.80	29.5	●

● = stock item

Other grades and dimensions upon request

With three coolant holes

h6



D [mm]	Type, description	L [mm]	D_1 [mm]	d_1 [mm]	Nominal pitch [mm]	[°]	CTS20D
6.00	30G3 0600/3,0/0,6/32,7-330	330	3.0	0.6	32.7	30	●
8.00	30G3 0800/4,0/0,75/43,5-330	330	4.0	0.75	43.5	30	●
10.00	30G3 1000/4,9/1,0/54,4-330	330	4.9	1.0	54.4	30	●
12.00	30G3 1200/6,0/1,1/65,3-330	330	6.0	1.1	65.3	30	●
14.00	30G3 1400/7,1/1,3/76,2-330	330	7.1	1.3	76.2	30	●
16.00	30G3 1600/8,3/1,5/87,0-330	330	8.3	1.5	87.0	30	●
18.00	30G3 1800/9,6/1,7/98,0-330	330	9.6	1.7	98.0	30	●
20.00	30G3 2000/10,4/2,0/108,8-330	330	10.4	2.0	108.8	30	●
25.00	33G3 2500/11,5/2,2/119,0-330	330	11.5	2.2	119.0	33	●

● = stock item

Other grades and dimensions upon request

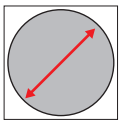
Coolant hole rods

Ground, helical

Specifications

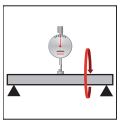
For further information see **92**

Outside diameter



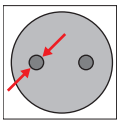
Ø [mm]	Tolerance [mm]
6,0	+0/-0,008
6,1 - 10,0	+0/-0,009
10,1 - 18,0	+0/-0,011
18,1 - 30,0	+0/-0,013
30,1 - 32,0	+0/-0,016

Straightness



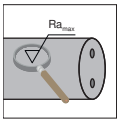
Ø [mm]	max. deflection [mm]
6,0 - 7,9	0,12
8,0 - 9,9	0,10
10,0 - 11,9	0,08
12,0 - 19,9	0,05
20,0 - 32,0	<0,05

Hole diameter



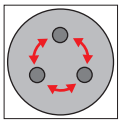
Hole diameter [mm]	Tolerance [mm]
0,40 - 1,30	+/- 0,050
1,31 - 2,50	+/- 0,075
2,51 - 5,00	+/- 0,100

Surface finish



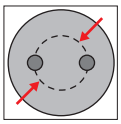
Ra_{max} [µm]
0,05

Pitch error



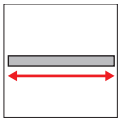
max. pitch error with ..G3 [°]
+/- 3

Pitch circle diameter



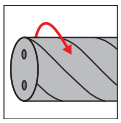
Ø [mm]	Tolerance [mm]
6,0 - 12,3	+/- 0,20
12,4 - 18,3	+/- 0,25
18,4 - 32,0	+/- 0,30

Length



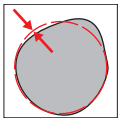
Length tolerance [mm]
+0/+10

Helix angle



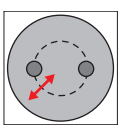
Product group	Total tolerance class [°]	Number of classes	Tolerance class [°]
>22°	+/- 1	3	+/- 0,33
>330 mm, 3 coolant h.	+/- 0,75	6	+/- 0,125
≤22°	+/- 0,5	1	+/- 0,5

Roundness



Ø [mm]	Tolerance [mm]
6,0	0,004
6,1 - 10,0	0,005
10,1 - 30,0	0,006
30,1 - 32,0	0,008

Excentricity



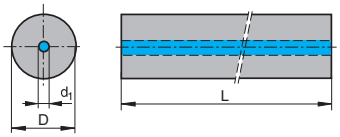
Ø [mm]	Tolerance [mm]
6,0 - 8,3	0,10
8,4 - 10,3	0,15
10,4 - 14,3	0,18
14,4 - 32,0	0,20

CERATIZIT hard material matters

Coolant hole rods

As sintered, straight

With central coolant hole

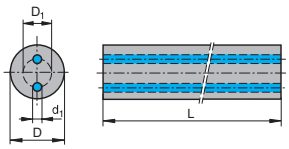


D [mm]	Type, description	L [mm]	d_1 [mm]	CTS20D	CTS15D	TSF44
4.95	00R1 0495/0,6-330	330	0.60		●	
6.30	00R1 0630/1,0-330	330	1.00	●		
6.45	00R1 0645/1,0-330	330	1.00		●	●
8.30	00R1 0830/1,3-330	330	1.30	●		
8.55	00R1 0855/1,3-330	330	1.30		●	●
8.55	00R1 0855/2,0-330	330	2.00		●	
10.30	00R1 1030/2,0-330	330	2.00	●		
10.55	00R1 1055/1,3-330	330	1.30		●	●
10.55	00R1 1055/2,0-330	330	2.00		●	●
11.30	00R1 1130/2,0-330	330	2.00	●		
12.30	00R1 1230/2,0-330	330	2.00	●		
12.55	00R1 1255/2,0-330	330	2.00		●	●
13.30	00R1 1330/2,0-330	330	2.00	●		
14.30	00R1 1430/2,0-330	330	2.00	●		
14.70	00R1 1470/2,0-330	330	2.00		●	●
16.30	00R1 1630/2,0-330	325	2.00	●		
16.70	00R1 1670/2,0-330	330	2.00		●	●
18.30	00R1 1830/3,0-330	330	3.00	●		
18.70	00R1 1870/3,0-330	330	3.00		●	
20.30	00R1 2030/3,0-330	330	3.00	●		
20.70	00R1 2070/3,0-330	330	3.00		●	●
25.30	00R1 2530/3,0-330	330	3.00	●		
28.30	00R1 2830/4,0-330	330	4.00	●		
30.30	00R1 3030/5,0-330	330	5.00	●		
32.30	00R1 3230/5,0-330	325	5.00	●		

● = stock item

Other grades and dimensions upon request

With two parallel coolant holes



D [mm]	Type, description	L [mm]	D_1 [mm]	d_1 [mm]	CTS15D	CTS20D
3.30	00R2 0330/1,1/0,425-330	330	1.10	0.425	●	
4.20	00R2 0420/1,1/0,45-330	330	1.10	0.45	●	
5.20	00R2 0520/2,0/0,9-330	330	2.00	0.90	●	●
6.20	00R2 0620/1,1/0,5-330	330	1.10	0.50	●	
6.20	00R2 0620/1,5/0,9-330	330	1.50	0.90	●	
6.20	00R2 0620/1,7/0,6-330	330	1.70	0.60	●	●
6.20	00R2 0620/2,0/0,9-330	330	2.00	0.90	●	●
6.20	00R2 0620/2,3/0,9-330	330	2.30	0.90	●	
6.20	00R2 0620/2,6/0,9-330	330	2.60	0.90		●
6.20	00R2 0620/3,0/1,2-330	330	3.00	1.20	●	
7.20	00R2 0720/2,0/0,9-330	330	2.00	0.90	●	●
7.20	00R2 0720/3,0/0,9-330	330	3.00	0.90		●
8.20	00R2 0820/2,0/0,9-330	330	2.00	0.90	●	●
8.20	00R2 0820/2,6/0,9-330	330	2.60	0.90	●	
8.20	00R2 0820/2,6/1,2-330	330	2.60	1.20		●
8.20	00R2 0820/3,4/1,0-330	330	3.40	1.00		●
8.20	00R2 0820/3,5/1,5-330	330	3.50	1.50	●	
8.20	00R2 0820/4,0/0,9-330	330	4.00	0.90	●	●
9.20	00R2 0920/2,6/1,2-330	330	2.60	1.20		●
9.20	00R2 0920/3,5/1,5-330	330	3.50	1.50	●	
9.20	00R2 0920/3,8/1,2-330	330	3.80	1.20		●
9.20	00R2 0920/4,0/1,3-330	330	4.00	1.30	●	
10.20	00R2 1020/2,0/1,0-330	330	2.00	1.00	●	
10.20	00R2 1020/2,6/1,2-330	330	2.60	1.20		●
10.20	00R2 1020/2,8/1,0-330	330	2.80	1.00	●	
10.20	00R2 1020/3,5/1,5-330	330	3.50	1.50	●	
10.20	00R2 1020/4,2/1,4-330	330	4.20	1.40	●	●
10.20	00R2 1020/5,0/1,2-330	330	5.00	1.20	●	
10.20	00R2 1020/5,2/1,4-330	330	5.20	1.40	●	
12.20	00R2 1220/2,6/1,2-330	330	2.60	1.20	●	
12.20	00R2 1220/3,5/1,5-330	330	3.50	1.50	●	●
12.20	00R2 1220/4,8/1,5-330	330	4.80	1.50	●	
12.20	00R2 1220/5,0/2,0-330	330	5.00	2.00	●	●
12.20	00R2 1220/6,0/1,5-330	330	6.00	1.50	●	
13.20	00R2 1320/5,4/2,0-330	330	5.40	2.00		●
14.20	00R2 1420/3,5/1,5-330	330	3.50	1.50		●
14.20	00R2 1420/5,0/1,7-330	330	5.00	1.70	●	
14.20	00R2 1420/5,0/2,0-330	330	5.00	2.00	●	●
14.20	00R2 1420/5,8/2,0-330	330	5.80	2.00		●
14.20	00R2 1420/7,0/2,0-330	330	7.00	2.00	●	
15.20	00R2 1520/5,0/2,0-330	330	5.00	2.00	●	

● = stock item

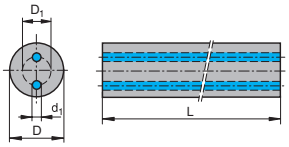
Other grades and dimensions upon request

CERATIZIT hard material matters

Coolant hole rods

As sintered, straight

With two parallel coolant holes



D [mm]	Type, description	L [mm]	D_1 [mm]	d_1 [mm]	CTS15D	CTS20D
16.20	00R2 1620/3,5/1,5-330	330	3.50	1.50	●	
16.20	00R2 1620/5,0/1,5-330	330	5.00	1.50	●	
16.20	00R2 1620/5,0/2,0-330	330	5.00	2.00	●	●
16.20	00R2 1620/6,2/2,0-400	330	6.20	2.00	●	
16.20	00R2 1620/6,6/2,5-330	330	6.60	2.50		●
16.20	00R2 1620/8,0/2,0-330	330	8.00	2.00	●	
16.20	00R2 1620/8,0/2,0-415	330	8.00	2.00	●	
18.20	00R2 1820/5,0/2,0-330	330	5.00	2.00	●	
18.20	00R2 1820/6,0/2,0-330	330	6.00	2.00	●	●
18.20	00R2 1820/7,5/2,5-330	330	7.50	2.50		●
18.20	00R2 1820/9,0/2,0-330	330	9.00	2.00	●	●
19.20	00R2 1920/7,9/2,5-330	330	7.90	2.50		●
20.20	00R2 2020/10,0/2,5-330	330	10.00	2.50	●	
20.20	00R2 2020/3,5/1,5-330	330	3.50	1.50	●	
20.20	00R2 2020/6,0/2,0-330	330	6.00	2.00		●
20.20	00R2 2020/6,2/2,0-330	330	6.20	2.00	●	
20.20	00R2 2020/8,2/2,5-330	330	8.20	2.50	●	
21.20	00R2 2120/7,0/2,3-330	330	7.00	2.30		●
22.20	00R2 2220/10,5/3,0-330	330	10.50	3.00		●
22.20	00R2 2220/7,0/2,3-330	330	7.00	2.30		●
25.30	00R2 2530/10,0/2,5-330	330	10.00	2.50	●	
25.30	00R2 2530/12,0/3,0-330	330	12.00	3.00	●	●
25.30	00R2 2530/6,2/2,0-330	330	6.20	2.00	●	●
25.30	00R2 2530/8,0/2,0-330	330	8.00	2.00	●	
26.30	00R2 2630/12,0/3,0-330	330	12.00	3.00		●
26.30	00R2 2630/7,5/2,0-330	330	7.50	2.00		●
28.30	00R2 2830/13,0/3,0-330	330	13.00	3.00		●
30.30	00R2 3030/13,0/3,0-330	330	13.00	3.00		●
32.30	00R2 3230/13,8/3,0-330	330	13.80	3.00		●
32.30	00R2 3230/9,0/2,2-330	330	9.00	2.20		●
34.30	00R2 3430/13,8/3,0-330	330	13.80	3.00		●

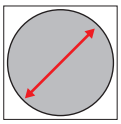
● = stock item

Other grades and dimensions upon request

Specifications

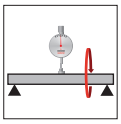
For further information see **92**

Outside diameter



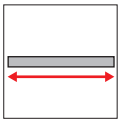
Ø [mm]	Tolerance [mm]
3,3	+0/+0,20
3,4 - 5,0	+0/+0,30
5,1 - 6,5	+0/+0,35
6,6 - 15,2	+0/+0,40
15,3 - 20,7	+0/+0,55
20,8 - 22,2	+0/+0,65
22,3 - 34,3	+0/+0,75

Straightness



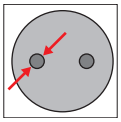
max. deflection [mm]
0,5

Length



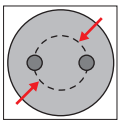
Length tolerance [mm]
+0/+10

Hole diameter



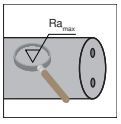
Product group	Hole diameter [mm]	Tolerance [mm]
00R1	0,10 - 0,50	+ 0,05
00R1	0,51 - 1,30	+ 0,10
00R1	1,31 - 2,50	+ 0,15
00R1	2,51 - 5,00	+ 0,20
00R2	0,10 - 0,50	+/- 0,025
00R2	0,51 - 1,30	+/- 0,050
00R2	1,31 - 2,50	+/- 0,075
00R2	2,51 - 5,00	+/- 0,100

Pitch circle diameter



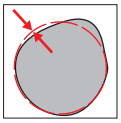
Ø [mm]	Tolerance [mm]
3,3 - 3,9	+/- 0,05
4,0 - 5,9	+/- 0,10
6,0 - 14,9	+/- 0,20
15,0 - 20,9	+/- 0,25
21,0 - 34,3	+/- 0,30

Surface finish



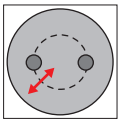
Ra_{max} [µm]
as sintered

Roundness



Ø [mm]	Tolerance [mm]
3,3 - 5,7	0,05
6,2 - 7,7	0,08
8,2 - 12,7	0,10
13,2 - 30,2	0,13
30,3 - 34,3	0,16

Excentricity



Ø [mm]	max. excentricity [mm]
3,3 - 3,9	0,025
4,0 - 5,9	0,050
6,0 - 7,9	0,100
8,0 -10,9	0,120
11,0 - 24,9	0,150
25,0 - 34,3	0,200

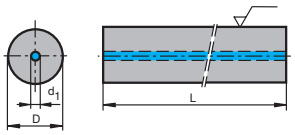
Coolant hole rods

Ground, straight

With central coolant hole

NEW

h6



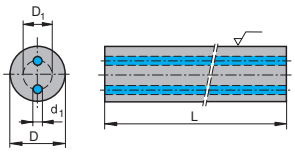
D [mm]	Type, description	L [mm]	d_1 [mm]	CTS15D
6.00	00G1 0600/1,0-330	330	1.00	●
8.00	00G1 0800/1,3-330	330	1.30	●
10.00	00G1 1000/2,0-330	330	2.00	●
12.00	00G1 1200/2,0-330	330	2.00	●
14.00	00G1 1400/2,0-330	330	2.00	●
16.00	00G1 1600/2,0-330	330	2.00	●
16.00	00G1 1600/3,0-330	330	3.00	●
20.00	00G1 2000/3,0-330	330	3.00	●
25.00	00G1 2500/3,0-330	330	3.00	●
32.00	00G1 3200/5,0-330	330	5.00	●

● = stock item

Other grades and dimensions upon request

With two parallel coolant holes

h6



D [mm]	Type, description	L [mm]	D_1 [mm]	d_1 [mm]	CTS15D
6.00	00G2 0600/1,5/0,9-330	330	1.50	0.90	●
6.00	00G2 0600/3,0/1,2-330	330	3.00	1.20	●
8.00	00G2 0800/2,0/0,9-330	330	2.00	0.90	●
8.00	00G2 0800/4,0/0,9-330	330	4.00	0.90	●
10.00	00G2 1000/2,8/1,0-330	330	2.80	1.00	●
10.00	00G2 1000/5,2/1,4-330	330	5.20	1.40	●
12.00	00G2 1200/3,5/1,5-330	330	3.50	1.50	●
12.00	00G2 1200/6,0/1,5-330	330	6.00	1.50	●
14.00	00G2 1400/5,0/1,7-330	330	5.00	1.70	●
14.00	00G2 1400/7,0/2,0-330	330	7.00	2.00	●
16.00	00G2 1600/5,0/1,5-330	330	5.00	1.50	●
16.00	00G2 1600/8,0/2,0-330	330	8.00	2.00	●
18.00	00G2 1800/6,0/2,0-330	330	6.00	2.00	●
18.00	00G2 1800/9,0/2,0-330	330	9.00	2.00	●
20.00	00G2 2000/10,0/2,5-330	330	10.00	2.50	●
20.00	00G2 2000/6,2/2,0-330	330	6.20	2.00	●
25.00	00G2 2500/12,0/3,0-330	330	12.00	3.00	●
25.00	00G2 2500/6,2/2,0-330	330	6.20	2.00	●
25.00	00G2 2500/8,0/2,0-330	330	8.00	2.00	●

● = stock item

Other grades and dimensions upon request

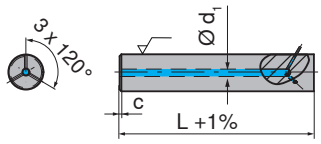
Coolant hole rods

Ground, straight

Cut-to-length milling blanks with three radial coolant exit holes

NEW

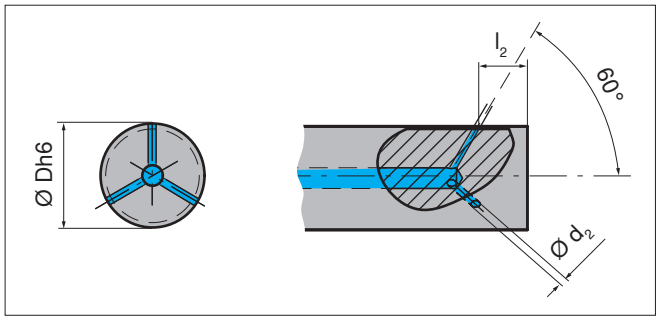
h6



D [mm]	Type, description	L [mm]	d_1 [mm]	d_2 [mm]	l_2 [mm]	c [mm]	CTS20D
6.0	RGDCY3 0600-058	58	1.2	0.7	3.0	0.4	●
8.0	RGDCY3 0800-064	64	1.6	0.9	4.0	0.6	●
10.0	RGDCY3 1000-073	73	2.0	1.2	5.0	0.8	●
12.0	RGDCY3 1200-084	84	2.2	1.3	6.0	0.8	●
14.0	RGDCY3 1400-084	84	2.4	1.4	7.0	0.8	●
16.0	RGDCY3 1600-093	93	2.6	1.5	8.0	0.8	●
18.0	RGDCY3 1800-093	93	2.8	1.6	9.0	1.0	●
20.0	RGDCY3 2000-105	105	3.0	1.7	10.0	1.0	●

● = stock item

Other grades and dimensions upon request



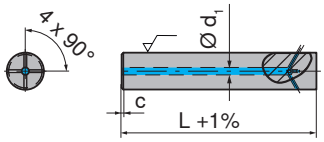
Coolant exit holes

For specifications see **41**

Cut-to-length milling blanks with four radial coolant exit holes

NEW

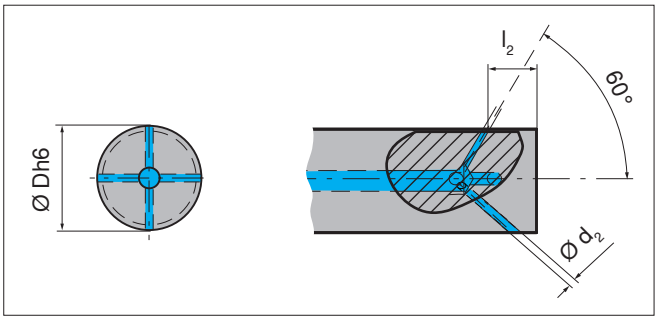
h6



D [mm]	Type, description	L [mm]	d_1 [mm]	d_2 [mm]	l_2 [mm]	c [mm]	CTS20D
6.0	RGDCY4 0600-058	58	1.2	0.6	3.0	0.4	●
8.0	RGDCY4 0800-064	64	1.6	0.8	4.0	0.6	●
10.0	RGDCY4 1000-073	73	2.0	1.0	5.0	0.8	●
12.0	RGDCY4 1200-084	84	2.2	1.1	6.0	0.8	●
14.0	RGDCY4 1400-084	84	2.4	1.2	7.0	0.8	●
16.0	RGDCY4 1600-093	93	2.6	1.3	8.0	0.8	●
18.0	RGDCY4 1800-093	93	2.8	1.4	9.0	1.0	●
20.0	RGDCY4 2000-105	105	3.0	1.5	10.0	1.0	●

● = stock item

Other grades and dimensions upon request



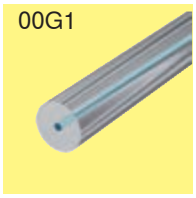
Coolant exit holes

For specifications see **41**

Ground rods with straight coolant holes

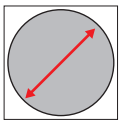
Ground, straight

Specifications



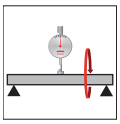
For further information see **92**

Outside diameter



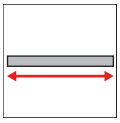
Ø [mm]	Tolerance [mm]
4,0 - 6,0	+0/-0,008
6,1 - 10,0	+0/-0,009
10,1 - 18,0	+0/-0,011
18,1 - 30,0	+0/-0,013
30,1 - 32,0	+0/-0,016

Straightness



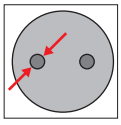
Ø [mm]	max. deflection [mm]
4,0 - 5,9	0,15
6,0 - 7,9	0,12
8,0 - 9,9	0,10
10,0 - 11,9	0,08
12,0 - 19,9	0,05
20,0 - 32,0	<0,05

Length



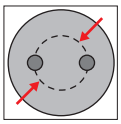
Length tolerance [mm]
+0/+10

Hole diameter



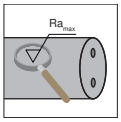
Product group	Hole diameter [mm]	Tolerance [mm]
00G1	0,10 - 0,50	+ 0,05
00G1	0,51 - 1,30	+ 0,10
00G1	1,31 - 2,50	+ 0,15
00G1	2,51 - 5,00	+ 0,20
00G2	0,10 - 0,50	+/- 0,025
00G2	0,51 - 1,30	+/- 0,050
00G2	1,31 - 2,50	+/- 0,075
00G2	2,51 - 5,00	+/- 0,100

Pitch circle diameter



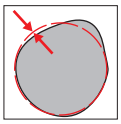
Ø [mm]	Tolerance [mm]
4,0 - 5,9	+/- 0,10
6,0 - 14,9	+/- 0,20
15,0 - 20,9	+/- 0,25
21,0 - 34,3	+/- 0,30

Surface finish



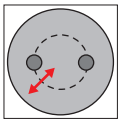
Ra_{max} [µm]
0,05

Roundness



Ø [mm]	Tolerance [mm]
4,0 - 6,0	0,004
6,1 - 10,0	0,005
10,1 - 30,0	0,006
30,1 - 32,0	0,008

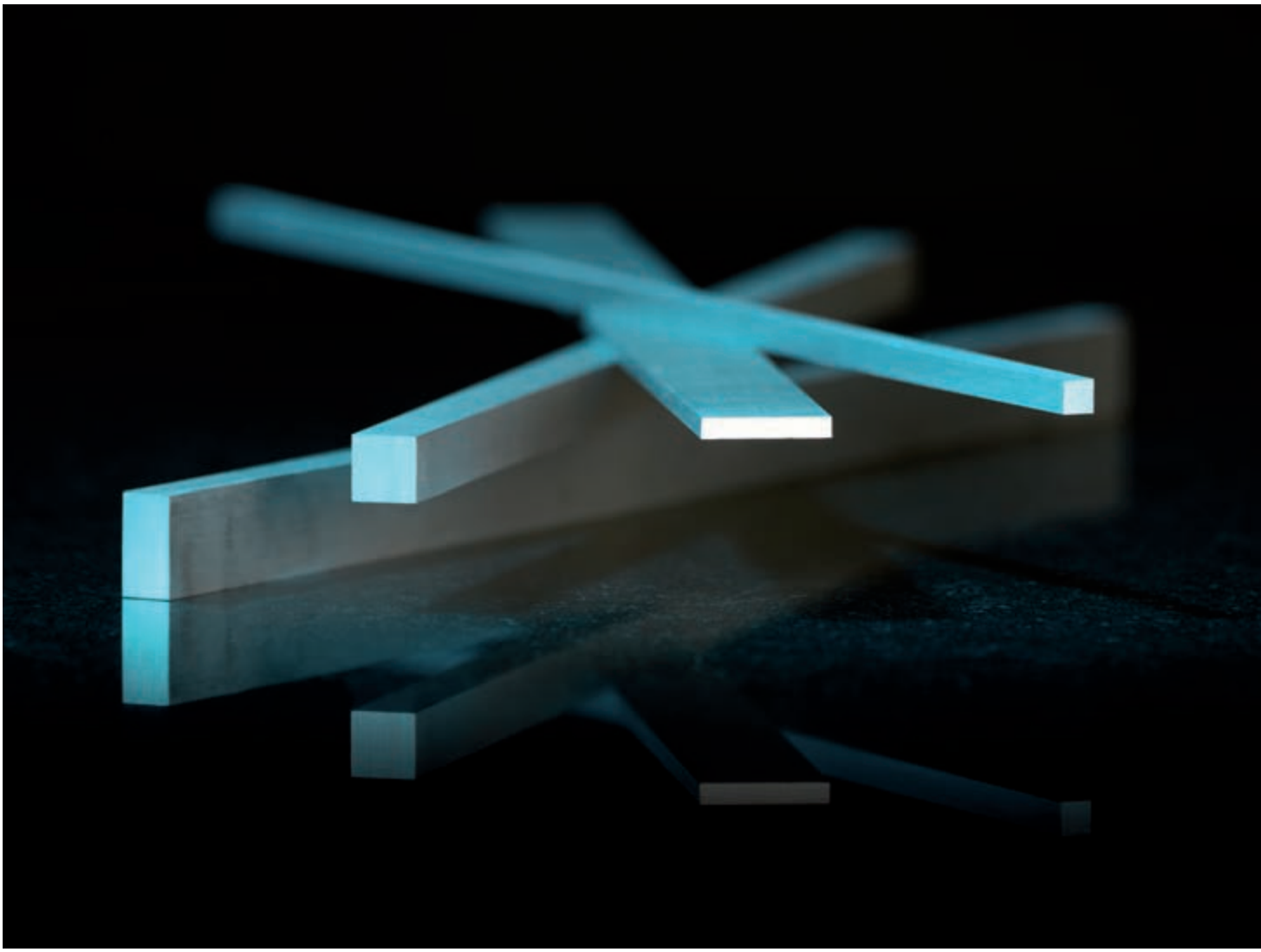
Excentricity



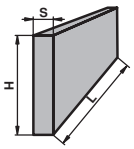
Ø [mm]	max. excentricity [mm]
4,0 - 5,9	0,050
6,0 - 7,9	0,100
8,0 - 10,9	0,120
11,0 - 24,9	0,150
25,0 - 32,0	0,200

Square and rectangular strips

CERATIZIT square and rectangular strips are available in various dimensions in our new high-performance grade CTS20D.



Rectangular strips



Type, description	H [mm]	S [mm]	L [mm]	CTS20D
FR 0230/0530-330	5.30	2.30	330	●
FR 0230/0630-330	6.30	2.30	330	●
FR 0230/0830-330	8.30	2.30	330	●
FR 0230/1030-330	10.30	2.30	330	●
FR 0230/1630-330	16.30	2.30	330	●
FR 0330/0430-330	4.30	3.30	330	●
FR 0330/0530-330	5.30	3.30	330	●
FR 0330/0630-330	6.30	3.30	330	●
FR 0330/0830-330	8.30	3.30	330	●
FR 0330/1030-330	10.30	3.30	330	●
FR 0330/1230-330	12.30	3.30	330	●
FR 0330/1630-330	16.30	3.30	330	●
FR 0330/2030-330	20.30	3.30	330	●
FR 0430/0630-330	6.30	4.30	330	●
FR 0430/0830-330	8.30	4.30	330	●
FR 0430/1030-330	10.30	4.30	330	●
FR 0430/1330-330	13.30	4.30	330	●
FR 0430/1630-330	16.30	4.30	330	●
FR 0430/2030-330	20.30	4.30	330	●
FR 0530/1030-330	10.30	5.30	330	●
FR 0530/1330-330	13.30	5.30	330	●
FR 0630/1030-330	10.30	6.30	330	●
FR 0630/1330-330	13.30	6.30	330	●
FR 0830/1230-330	12.30	8.30	330	●
FR 0830/1630-330	16.30	8.30	330	●
FR 1030/1630-330	16.30	10.30	330	●

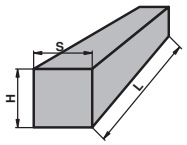
● = stock item

Other grades and dimensions upon request

Square and rectangular strips

As sintered

Square strips

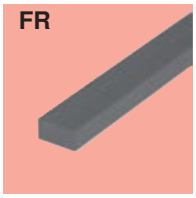


Type, description	H [mm]	S [mm]	L [mm]	CTS20D
SR 0330-330	3.30	3.30	330	●
SR 0430-330	4.30	4.30	330	●
SR 0530-330	5.30	5.30	330	●
SR 0830-330	8.30	8.30	330	●
SR 1030-330	10.30	10.30	330	●

● = stock item

Other grades and dimensions upon request

Specifications



For further information see
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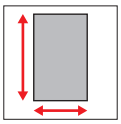
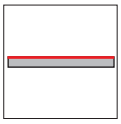
Width, height



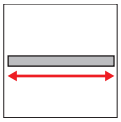
Width, height [mm]	Tolerance [mm]
2,3 - 4,3	+0/+ 0,20
4,4 - 6,3	+0/+ 0,25
6,4 - 10,3	+0/+ 0,30
10,4 - 14,3	+0/+ 0,35
14,4 - 16,3	+0/+ 0,40
16,4 - 20,3	+0/+ 0,50

Straightness



Bending [mm]
max. 0.4

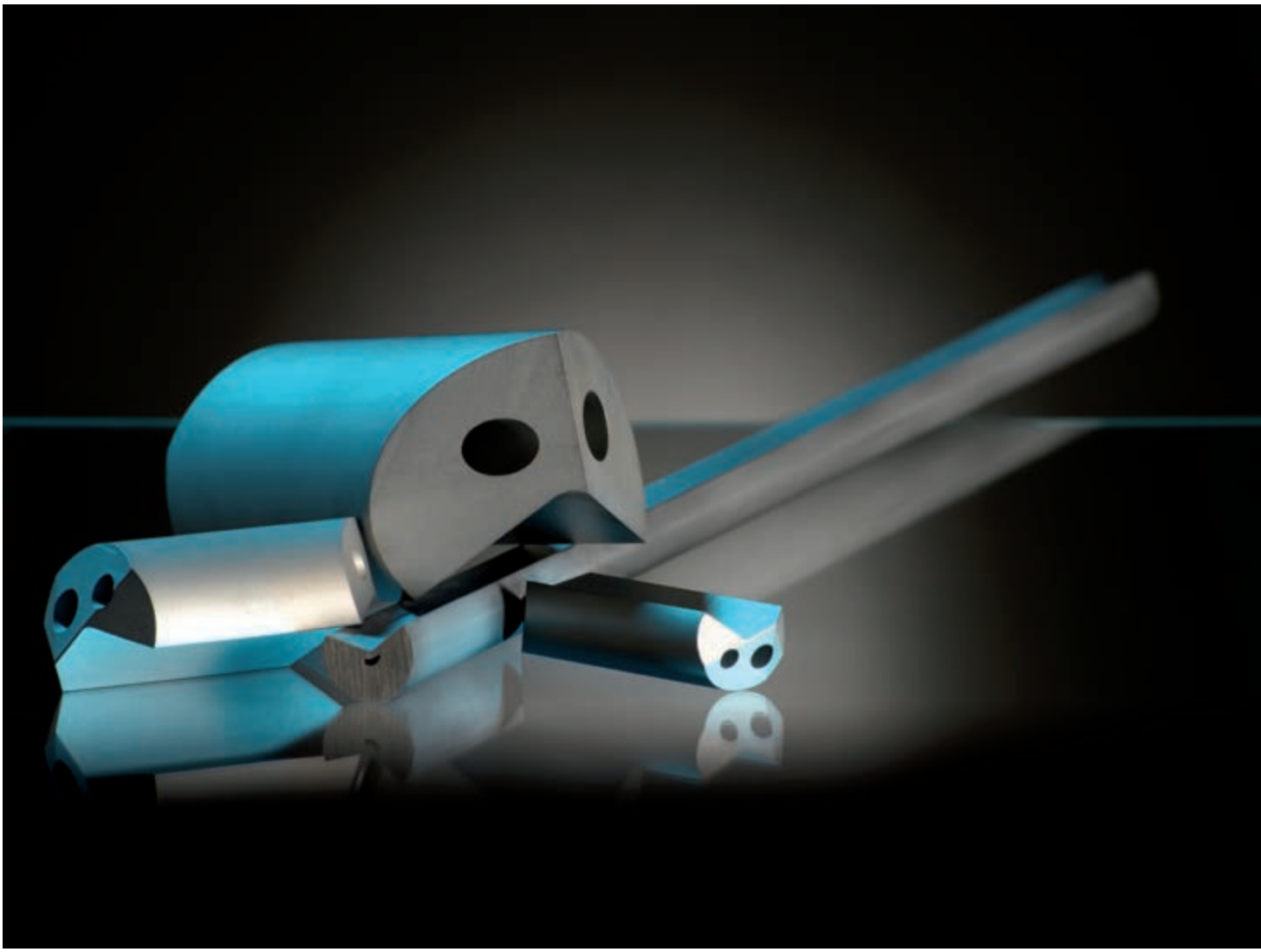
Length



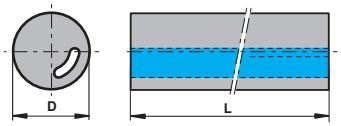
Length tolerance [mm]
+0/+10

Blanks for gun drills

As with all our catalogue products, these blanks for gun drills are available from stock.



With kidney-shaped coolant hole

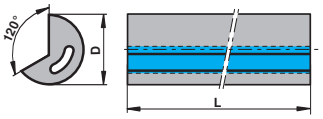


D [mm]	Type, description	L [mm]	Dia. tol. [mm]	CTS20D	H20X
2.40	GDRK 0240-310	310	±0.15	●	●
2.60	GDRK 0260-310	310	±0.15	●	●
2.90	GDRK 0290-310	310	±0.15	●	●
3.15	GDRK 0315-310	310	±0.15	●	●
3.45	GDRK 0345-310	310	±0.15	●	●
3.50	GDRK 0350-310	310	±0.15	●	●
3.90	GDRK 0390-310	310	±0.15	●	●
4.40	GDRK 0440-310	310	±0.15	●	●
4.90	GDRK 0490-310	310	±0.15	●	●
5.50	GDRK 0550-310	310	±0.15	●	●
6.00	GDRK 0600-310	310	±0.15	●	
6.50	GDRK 0650-310	310	±0.15	●	●
7.10	GDRK 0710-310	310	±0.15	●	●
7.60	GDRK 0760-310	310	±0.15	●	●
8.10	GDRK 0810-310	310	±0.15	●	●
8.30	GDRK 0830-310	310	±0.15	●	●
8.70	GDRK 0870-310	310	±0.15	●	●
9.20	GDRK 0920-310	310	±0.15	●	●
10.60	GDRK 1060-310	310	±0.15	●	●
11.30	GDRK 1130-310	310	±0.15	●	●

● = stock item

Other grades and dimensions upon request

With kidney-shaped coolant hole and vee flute (120°)

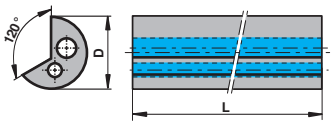


D [mm]	Type, description	L [mm]	Dia. tol. [mm]	CTS20D	H20X
2.40	GDVK 0240-310	310	±0.15	●	●
2.60	GDVK 0260-310	310	±0.15	●	●
2.90	GDVK 0290-310	310	±0.15	●	●
3.15	GDVK 0315-310	310	±0.15	●	●
3.45	GDVK 0345-310	310	±0.15	●	●
3.90	GDVK 0390-310	310	±0.15	●	●
4.40	GDVK 0440-310	310	±0.15	●	●
4.90	GDVK 0490-310	310	±0.15	●	●
5.50	GDVK 0550-310	310	±0.15	●	●
6.00	GDVK 0600-310	310	±0.15	●	●
6.50	GDVK 0650-310	310	±0.15	●	●
7.10	GDVK 0710-310	310	±0.15	●	●
7.60	GDVK 0760-310	310	±0.15	●	●
8.10	GDVK 0810-310	310	±0.15	●	●
8.70	GDVK 0870-310	310	±0.15	●	●
9.20	GDVK 0920-310	310	±0.15	●	●

● = stock item

Other grades and dimensions upon request

With two coolant holes and vee flute (120°)



D [mm]	Type, description	L [mm]	Dia. tol. [mm]	H20X
5.50	GDV2 0550-310	310	±0.15	●
6.00	GDV2 0600-310	310	±0.15	●
6.50	GDV2 0650-310	310	±0.15	●
7.10	GDV2 0710-310	310	±0.15	●
7.60	GDV2 0760-310	310	±0.15	●
8.10	GDV2 0810-310	310	±0.15	●
8.70	GDV2 0870-310	310	±0.15	●
9.20	GDV2 0920-310	310	±0.15	●
9.70	GDV2 0970-310	310	±0.15	●
10.80	GDV2 1080-310	310	±0.15	●
11.30	GDV2 1130-310	310	±0.15	●
11.80	GDV2 1180-310	310	±0.15	●
12.30	GDV2 1230-310	310	±0.15	●
12.80	GDV2 1280-310	310	±0.15	●

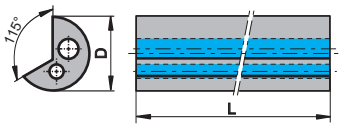
● = stock item

Other grades and dimensions upon request

Blanks for gun drills

Rods

With two coolant holes and vee flute (115°)

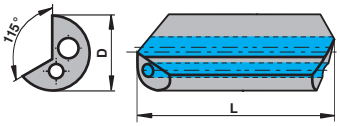


D [mm]	Type, description	L [mm]	Dia. tol. [mm]	HC20
13.50	GDV2 1350/115-310	310	±0.20	●
13.90	GDV2 1390/115-310	310	±0.20	●
15.50	GDV2 1450/115-310	310	±0.20	●
15.50	GDV2 1550/115-310	310	±0.20	●
16.50	GDV2 1650/115-310	310	±0.20	●
17.50	GDV2 1750/115-310	310	±0.20	●
18.60	GDV2 1860/115-310	310	±0.20	●
19.60	GDV2 1960/115-310	310	±0.25	●
20.60	GDV2 2060/115-310	310	±0.25	●
21.60	GDV2 2160/115-310	310	±0.25	●

● = stock item

Other grades and dimensions upon request

With two coolant holes and vee flute (115°)



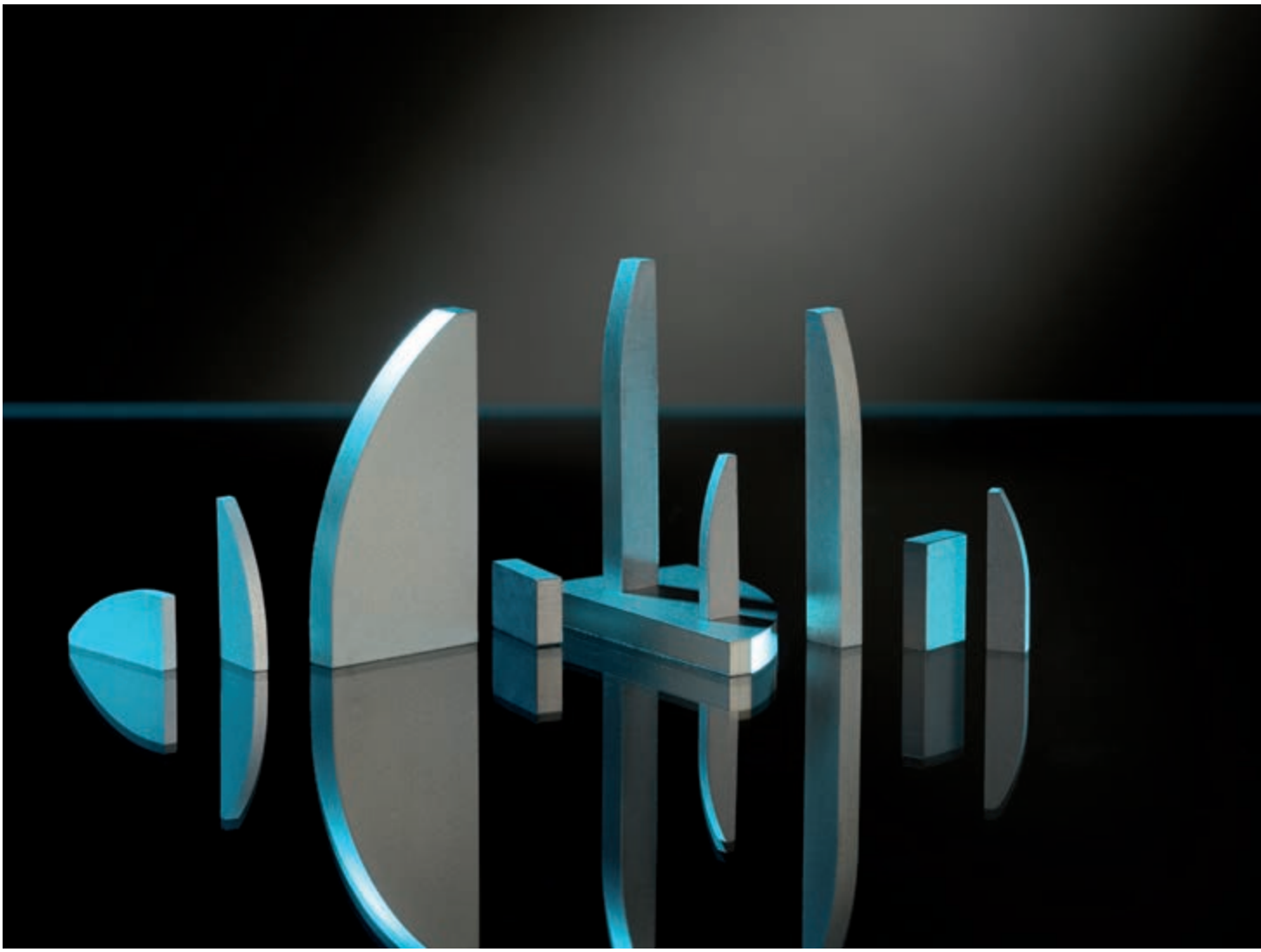
D [mm]	Type, description	L [mm]	Dia. tol. [mm]	HC20
13.50	GDV2P 1350-040	40	±0.20	●
14.50	GDV2P 1450-040	40	±0.20	●
15.50	GDV2P 1550-040	40	±0.20	●
16.50	GDV2P 1650-040	40	±0.25	●
17.50	GDV2P 1750-040	40	±0.20	●
18.60	GDV2P 1860-040	40	±0.25	●
19.60	GDV2P 1960-045	45	±0.25	●
20.60	GDV2P 2060-045	45	±0.25	●
21.60	GDV2P 2160-045	45	±0.25	●
22.60	GDV2P 2260-050	50	±0.25	●
23.60	GDV2P 2360-050	50	±0.25	●
24.60	GDV2P 2460-055	55	±0.25	●
25.60	GDV2P 2560-055	55	±0.25	●
26.60	GDV2P 2660-055	55	±0.25	●
27.20	GDV2P 2720-055	55	±0.25	●
28.70	GDV2P 2870-065	65	±0.25	●
30.80	GDV2P 3080-065	65	±0.25	●
33.10	GDV2P 3310-065	65	±0.25	●
36.10	GDV2P 3610-075	75	±0.25	●
39.10	GDV2P 3910-075	75	±0.25	●
40.00	GDV2P 4000-080	80	±0.30	●
42.00	GDV2P 4200-080	80	±0.30	●
45.00	GDV2P 4500-080	80	±0.30	●

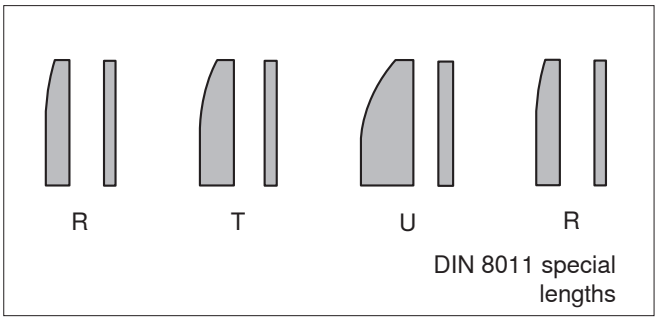
● = stock item

Other grades and dimensions upon request

Brazing tips

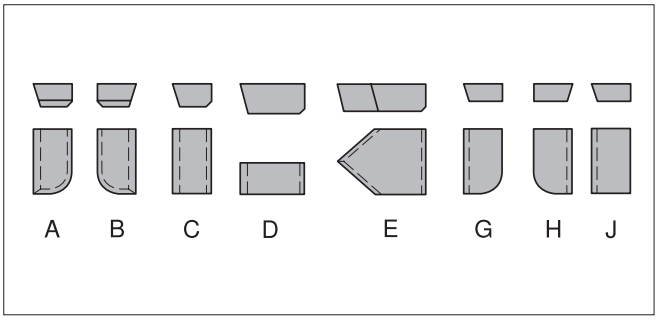
For brazed tools we offer brazing tips to DIN 8011, DIN 4950 and DIN 4966. Our tips are characterised by excellent brazability and long service life.



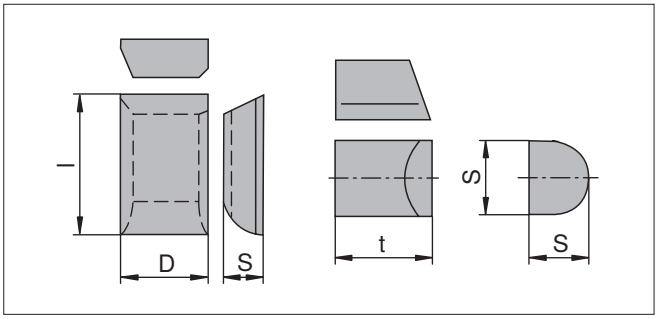


DIN 8011 special lengths

Brazing tips according to DIN 8011



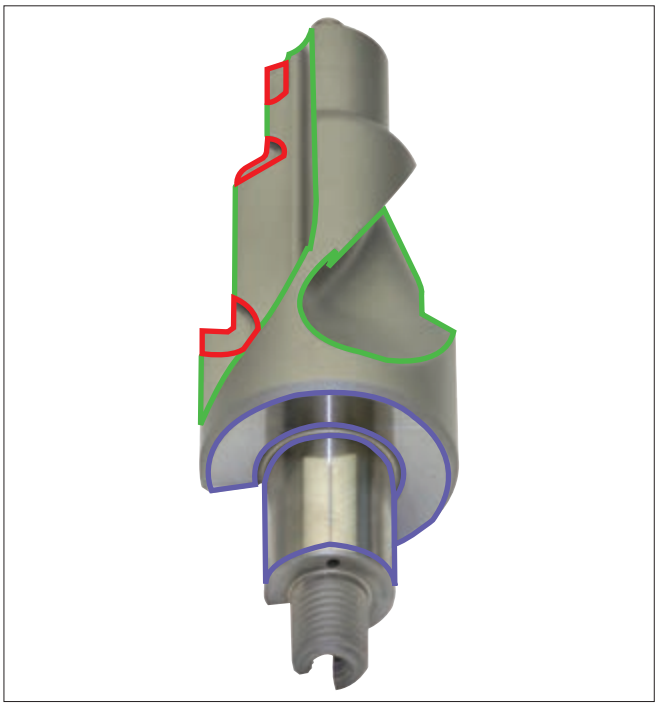
Brazing tips to ISO, DIN 4950 ÖNORM M4370 are available upon request



Brazing tips for spiral fluted milling cutters and long-reach milling cutters are available upon request

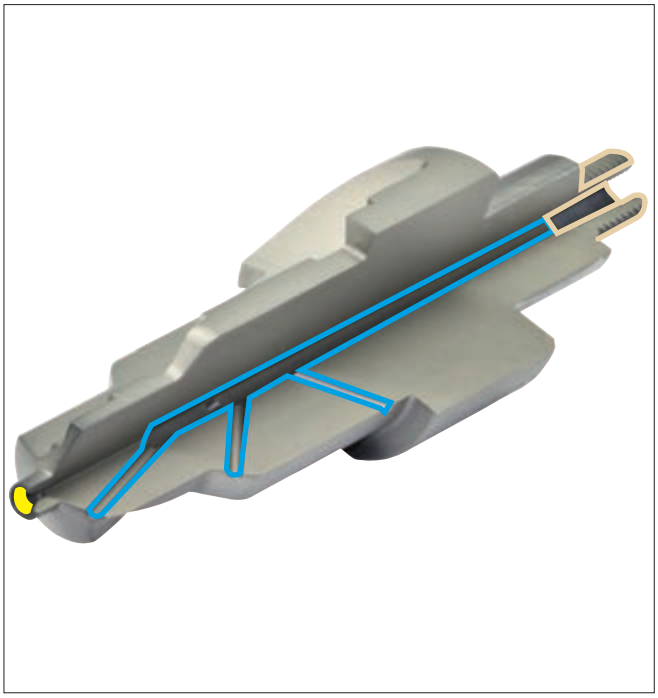
Preforms

In addition to our comprehensive selection of rods and strips, we also offer a variety of preforms for rotating cutting tools. The product range includes everything from blanks and semi-finished tools for solid carbide and PCD tools to systems with replaceable heads and tool shanks. Long-standing experience in the machining of blanks, together with state-of-the-art manufacturing facilities, enables us to produce complex geometries near net shape and with minimum lead times.



Based on your drawings of blanks or finished parts, we are able to produce outside diameters of up to approx. 300 mm and lengths of approx. 500 mm. Ideally, you should provide us with digital drawings or 3-D models (.stp, .prt,….).

- Preformed seats for PCD inserts
- Straight and helical chip flutes
- Ground shanks



- External and internal thread
- Coolant holes
- As sintered male or female centres

Preforms

Available types

Our preformed chip flutes and insert seats with optimised machining allowance make it possible to save production costs thanks to reduced grinding times in tool production.

Individually designed coolant exit holes can be formed into the blank.

- Axial holes from Ø 0.65 mm
- Radial exit holes from Ø 0.5 mm and greater
- Smaller holes available depending on the depth and upon request

- Outside and inside threads
- Metric ISO threads, as sintered, tolerance class 8H
- UN threads, as sintered
- Special threads upon request
- Ground threads are possible upon request

- As sintered centres
- Female centres to DIN 332, preferably form R
- Male centres

- Upon request ground version also available
- For example ground shank h6

Do not hesitate to contact us with questions about possible variations. We will be pleased to help you design blanks for cost-efficient production of precision tools.

Specifications

For further information see
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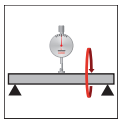
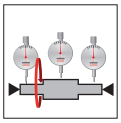
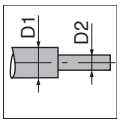
Straightness



max. deflection [mm]
0,3

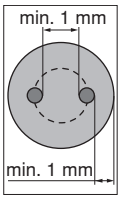


Diameter steps



Different diameters, dia. steps
D1-D2 ≥ 1 mm

Wall thicknesses



Min. wall thicknesses and hole distances
≥ 1 mm

Tolerance table for preforms

Diameters for preforms

Nominal Ø [mm]	Blank tolerance incl. grinding allowance [mm]	Blank tolerance [±]
< 20	0,55	± 0,15
> 20 - 35	0,60	± 0,20
> 35 - 45	0,65	± 0,25
> 45 - 55	0,70	± 0,30
> 55 - 70	0,85	± 0,35
> 70 - 100	0,90	± 0,40
> 100 - 150	1,00	± 0,50

Example of a finished diameter 22 mm with grinding allowance:

Finished dimension Ø 22.00
Grinding allowance +0.60
Blank dimensions Ø 22.60 ±0.20

Lengths for preforms

Length [mm]	Blank tolerance incl. grinding allowance [mm]	Blank tolerance [±]
L	0,5% L+0,4	± 0,5%L

Example of a finished length 150 mm with grinding allowance:

Finished dimension 150 mm
Grinding allowance +1.15
Blank dimensions 151,15 ±0.75

Technical information

Which parameters influence the properties of carbide? What is the rupture strength in relation to the cobalt content? On the following pages you will find the most important properties of carbide and how to apply them. As well as information on the different specification parameters of our products, there is also an overview of the kind of customised products available in addition to products which can be ordered from stock.

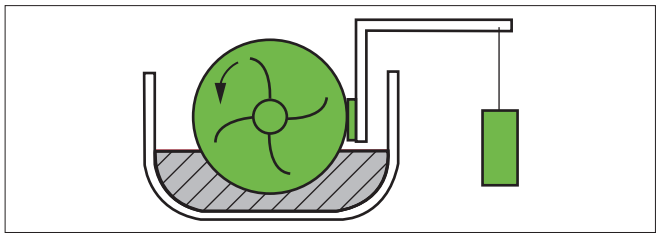


Figure 1: test assembly for the determination of wear resistance according to ASTM B611-85

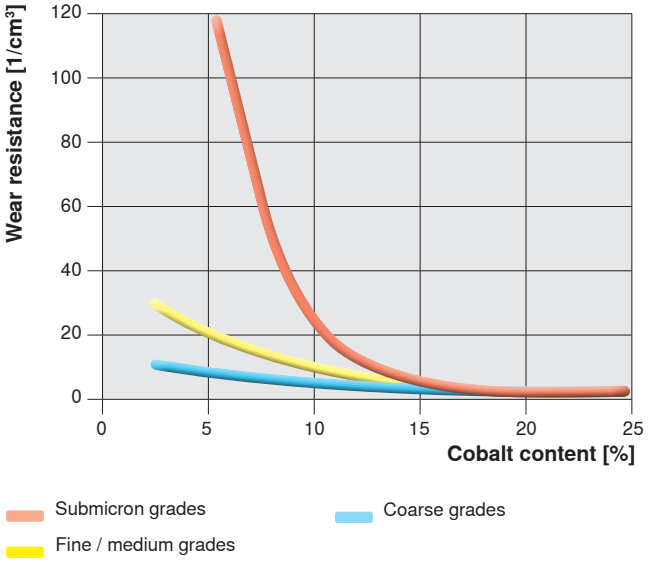


Figure 2: wear resistance in relation to the cobalt content and grain size

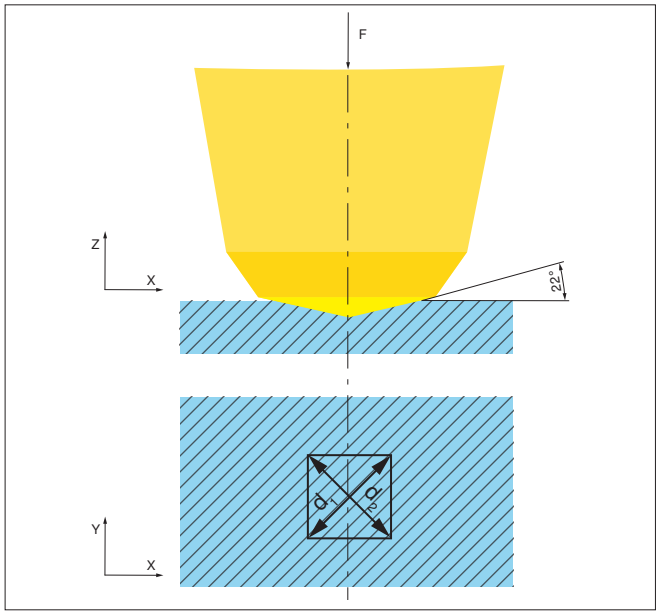


Figure 3: Vickers hardness test according to ISO 3878

$$HV = \frac{0{,}102 \cdot 2 \cdot F \cdot \sin\frac{136°}{2}}{d^2} \approx 0{,}1891 \frac{F}{d^2}$$

Formula #1: calculation of the Vickers hardness (ISO 3878)

1. Mechanical properties of carbide

1.1. Wear resistance

The most important property of carbide is wear resistance. This property - or, to be precise, this combination of properties - refers to the surface of the component. When two surfaces rub against each other, material is removed from both of them. Under low stress the material removed consists of single grains or particles. This phenomenon is called 'scoring'. In cases of high stress the material removed consists of grain clusters and is called 'abrasion'. The concept of wear is very complex and depends on many variables. Wear resistance is mainly tested using the ASTM B611-85 method. In this method a carbide piece is pressed onto a rotating steel disk using a lever. The rotating steel disk is the carrier for the abrasive material, which together with the material that is subject to analysis is transported from a tank below the container directly to the contact zone (see figure 1). The abrasive material consists of water and aluminium oxide (corundum).
Wear resistance is determined by measuring the volume of material removed from the carbide piece while the revolution number, test time and the force applied at 90° on the steel disk are held at consistent levels. A gravimetric evaluation is carried out, with the volume removal indicated in mm^3. As shown in figure 2, wear resistance increases the finer the grain and the lower the cobalt content.

1.2. Hardness

Hardness is a material's mechanical resistance to another, harder, material which penetrates it. The hardness is normally determined based on the Vickers hardness test according to ISO 3878. In this test a 136° pyramidal diamond indenter is pressed onto a work piece with a determined test force. The size of the indent is determined optically by measuring the two diagonals of the square indent produced by the applied force (F). The impression surface is calculated with formula #1 (see fig. 3). When introducing this test method the obsolete unit 'kilopond' was used for the test force. Therefore in the formula the factor 0.102 is used for conversion. The standardised indication of the Vickers hardness, for example, is as follows:

620 HV 30

Parameters:
- 620 = hardness
- HV = test procedure
- 30 = test force in kilopond

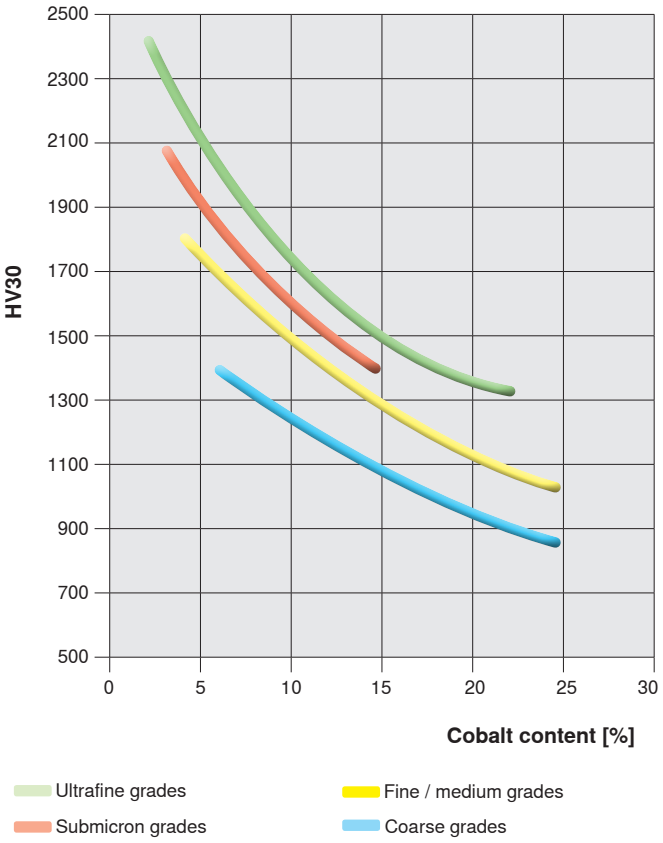


Figure 4: hardness in relation to the cobalt content and grain size

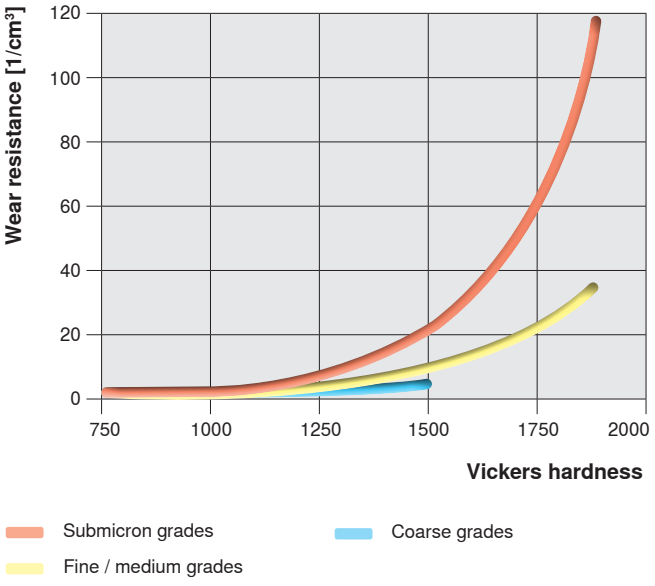


Figure 5: wear resistance in function of hardness with different grain sizes

Another method for determining hardness is the Rockwell procedure (ISO 3738). It is similar to the Vickers procedure but uses a diamond brale indenter. Here, the depth of penetration is used as the degree of hardness. There is no theoretical basis for a conversion between the two procedures. In order to create a comparison a determinate test must be carried out. Like wear resistance, hardness also increases with a smaller grain size and lower cobalt content (see figure 4). As wear resistance and hardness show similar behaviour with regard to cobalt content and grain size, hardness is often used as a reference for wear resistance. Furthermore, the Vickers procedure is easier and quicker than ASTM B611-85. Nevertheless the relation of hardness and wear resistance is exponential and also depends on the grain size (see figure 5).

$$K_{IC} = 0{,}15 \sqrt{\frac{HV30}{\sum L}} \quad \left[\frac{MN}{m^{\frac{3}{2}}}\right]$$

Formula #2: calculation of the critical tension intensity factor K_{IC}

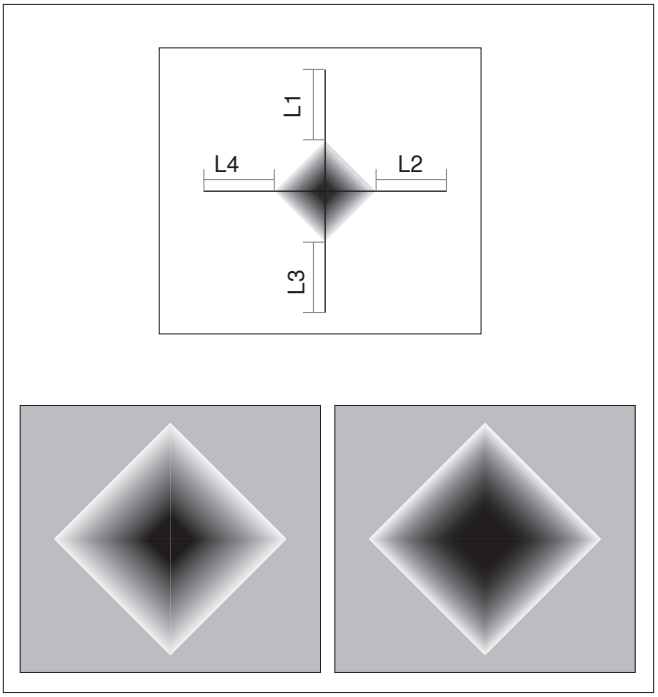


Figure 6: Palmqvist method for the determination of fracture toughness

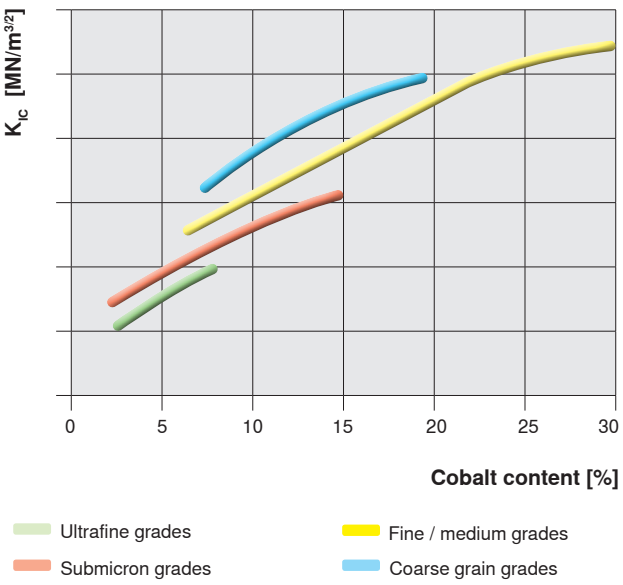


Figure 7: fracture toughness in relation to the grain size and the cobalt content

1.3. Toughness

When a material is exposed to external static or dynamic stress, this leads to mechanical tensions. In many cases, particularly with impact loads, both the strength and ductility of the material have to be taken into account. These two properties represent the basis for the concept of toughness, which is defined as the capacity to resist fracture or rupture growth. Fracture in this context means the complete separation of the material into at least two parts. There are numerous possibilities to define or determine toughness, transverse rupture strength or fracture toughness. In the definition above, the integrated product of force and deformation until fracture occurs is used as the toughness value. In the case of carbide, the Palmqvist method is frequently applied to determine the toughness as a critical tension intensity factor K_{IC}. For this purpose, the crack length of a Vickers hardness indent is used to deduce the fracture toughness (see figure 6). This is then converted into the tension intensity factor using formula #2. As can be seen in figure 7, toughness increases with the metal binder content and growing grain size. Compared to other metal materials, carbide can be found in the lower part of the toughness range, about the same as hardened steel.

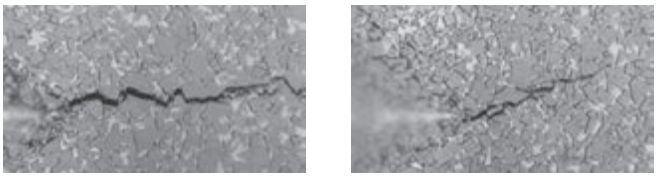


Figure 8: rupture growth in large grain sizes; larger rupture growth - requires higher fracture energy - higher toughness

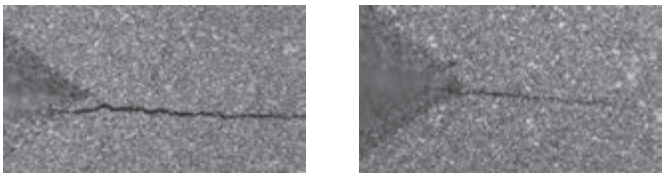


Figure 9: rupture growth in small grain sizes; direct, shorter rupture growth - requires lower fracture energy - lower toughness

By definition, carbide is to be considered a brittle material as there is basically no plastic deformation prior to fracture. This is confirmed by examination of surfaces where breakage occurred. Various carbides, however, show very big differences in terms of toughness which can be best explained by taking a look at the microstructure. Cracks inside the carbide grains may occur just like intergranular fractures and shear fractures in the binder metal. Generally the number of grain cracks rises with increasing grain size and the number of shear fractures when raising the binder content. In terms of fracture energy, the main contribution to toughness comes from the length of the rupture in the metal binder (see figures 8 and 9).

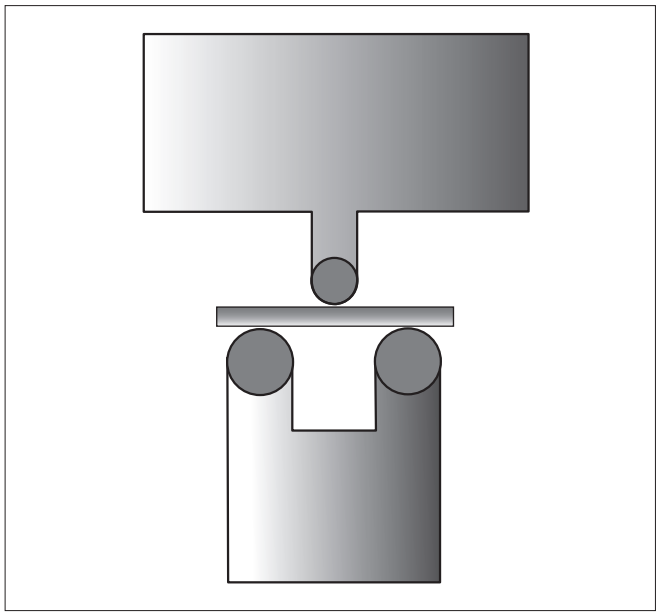


Figure 10: illustration of a transverse rupture strength test

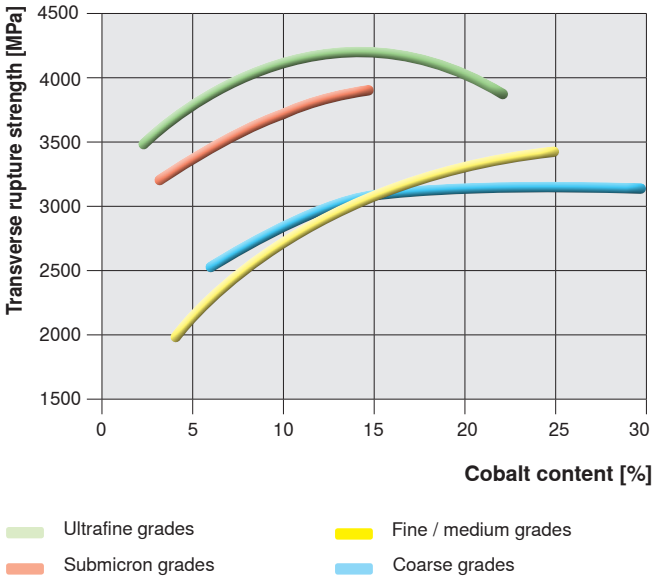


Figure 11: transverse rupture strength in relation to the grain size and the cobalt content

1.4. Mechanical strength

Every material has defects such as inclusions and micro-ruptures. For brittle materials such as hardened steels or carbide the mechanical strength is limited by the number and size of these defects. In this context the mechanical strength depends on the volume, as with a growing material volume the probability of a large defect rises. Depending on the type of stress, various types of strength are distinguished.

1.4.1. Transverse rupture strength

Testing the transverse rupture strength is the easiest and most common procedure of analysing the mechanical strength of carbide. According to the standardised ISO 3327 procedure a test material of a certain length is placed on a surface and put under stress in the middle until it breaks (see figure 10). The transverse rupture strength (T.R.S.) is then the average value of several tests. The maximum value is achieved with a cobalt content of around 14 weight-% and grain sizes of around 0.2 – 0.5μm.

The very low plastic deformation is normally not taken into account as it occurs only in the toughest carbides. Transverse rupture strength decreases with increasing temperature.

Furthermore, the carbides show creep values when they are subjected to stress or to high temperatures for a long time. The transverse rupture strength is decisively influenced by the number and size of defects in the structure or on the surface. Fractures always occur at the weakest point of the structure, which is also where the largest defect is. A high number of defects therefore increases the probability that one of these defects causes a premature fracture on the point with the highest stress. As the quality demands in the field of carbide manufacturing are high, impurities or defects can be minimised and thus the risk of breakage reduced.

1.4.2. Tensile strength

When testing the tensile strength of brittle materials it is difficult to measure exact results. A precise result depends on both the perfect preparation of the test materials as well as on the additional stress present on the mounting fixtures. Applying the Weibull theory, however, the tensile strength can be deducted from the values of the transverse rupture strength.

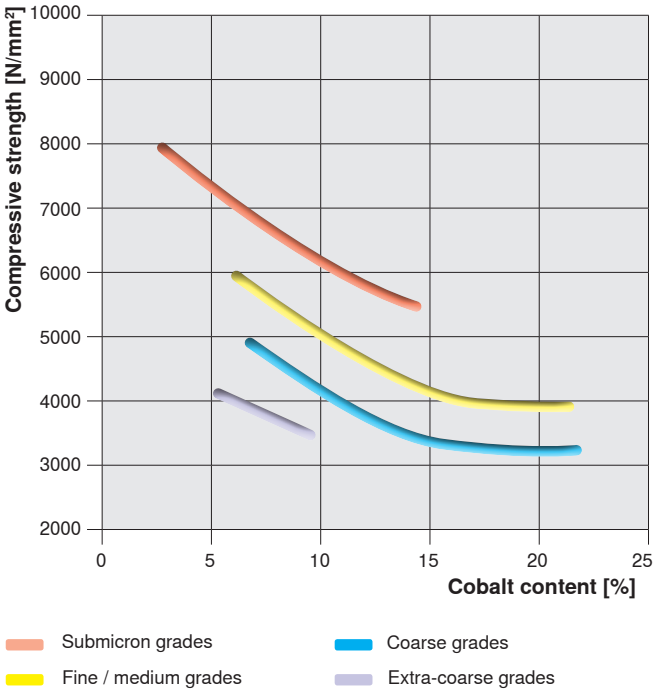


Figure 12: compressive strength in relation to the grain size and the cobalt content

1.4.3. Compressive strength

One of the most remarkable properties of carbide is the extremely high compressive strength under uniaxial stress. This valuable property is used in virtually all application fields (cutting edges with high compressive strength in all machining processes, pressing and drawing dies, rolls, anvils and dies for the production of synthetic diamonds, etc.). The tension of this kind of stress doesn't actually cause fracture due to pressure but due to tension: a shear fracture. A suitable procedure for determining compressive strength can be found in ISO 4506. To achieve precise values for carbide, the test piece's geometry must be changed so that the effects of the edges and contact, which occur in a simple cylindrical test piece, are eliminated. Elastic deformation is produced under initial load; however, before fracture a degree of plastic deformation results. Figure 12 shows the compressive strength of various grain sizes in relation to the cobalt content.

The compressive strength increases when the metal binder content decreases and the grain size is reduced. A small grain carbide grade with a low metal binder content typically has a compressive strength of almost 7,000 N/mm². The compressive strength decreases when the temperature increases. The degree of plastic deformation increases notably with the temperature, so that the results are variable when temperatures are high.

1.4.4. Shear strength

The implementation of pure shear tests is very difficult. However, numerous things speak for the fact that the shear strength is somewhat higher than the compressive strength.

1.4.5. Fatigue strength

The fatigue strength of carbide is above 2 million pulsating compressive loads at around 65 to 85% of the static compressive strength. The compressive fatigue strength increases with a decreasing cobalt content and with decreasing grain size.

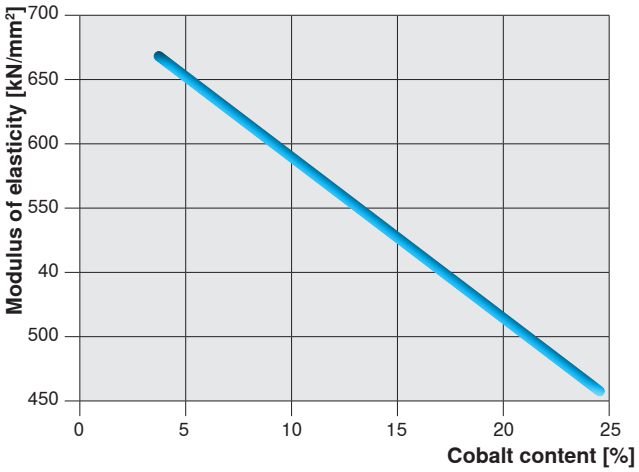


Figure 13: modulus of elasticity of WC-Co carbides

Property:	from:	to:
Hardness [HV30]	1590	2200
Transverse rupture strength [MPa]	2200	4600
Fracture toughness [MPa * $m^{1/2}$]	6,3	10,7

Figure 14: properties of CERATIZIT round rods and preforms

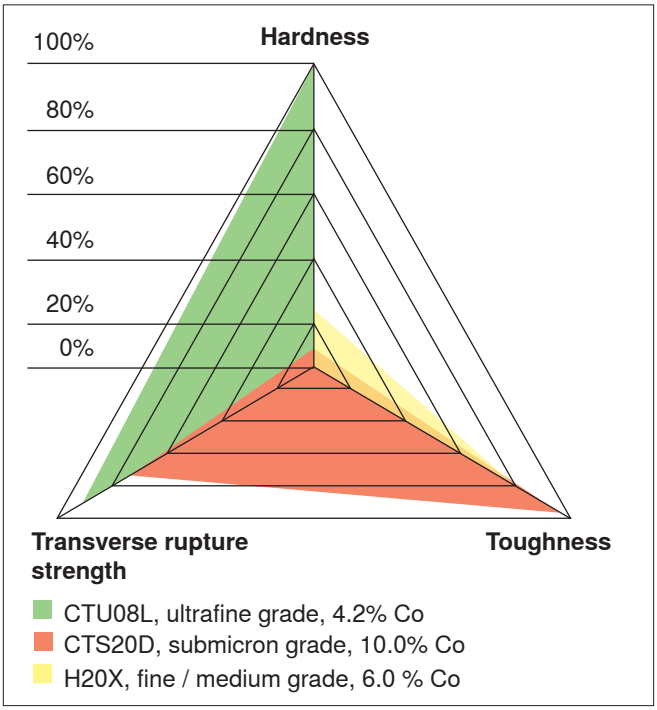


Figure 15: tension fields of three CERATIZIT grades, 0% - lowest value of all grades, 100% - highest value of all grades

1.5. Modulus of elasticity, shear modulus, Poisson's ratio

The modulus of elasticity indicates the resistance of a material against elastic deformation and is higher the more rigid a material is. In the case of carbide the modulus of elasticity is 2 to 3 times higher than in steel and increases linearly with decreasing metal binder content. See fig. 13: additives of γ-phase reduce the modulus of elasticity. An exact determination of the modulus of elasticity based on the tension-expansion diagram is difficult. Therefore, for reliable results resonance measurements of transverse and longitudinal waves are carried out according to ISO 3312. The shear module is determined in the same way with the help of torsional vibration. By determining the modulus of elasticity and the shear module the Poisson's ratio can be calculated.

1.6. Influence of the grain size and the cobalt content on the most important properties

The most important mechanical properties of the carbide, such as hardness, transverse rupture strength and fracture toughness, are determined by the grain size of the tungsten carbide and cobalt content. Figure 14 shows the properties of CERATIZIT round rods and preforms are depicted.
Sporadically it can be sustained that through smaller grain sizes higher hardness and transverse rupture strength can be achieved. At the same time, however, fracture toughness decreases. By increasing the cobalt content hardness is reduced, while the transverse rupture strength and fracture toughness are raised. Based on this fact a compromise between hardness and fracture toughness can be made. Figure 15 shows three different CERATIZIT grades and their hardness, fracture toughness and transverse rupture strength. 0% is the lowest value and 100% the highest value of all CERATIZIT grades.

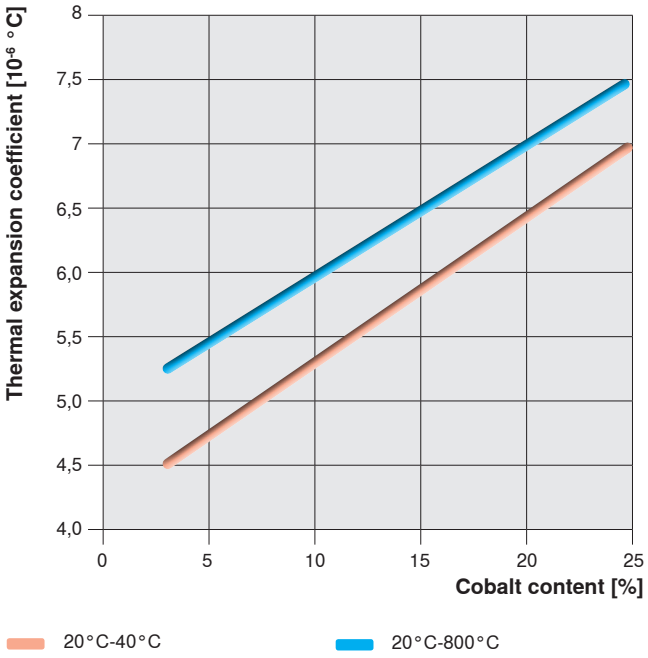


Figure 16: thermal expansion in function of the cobalt content for two temperature intervals

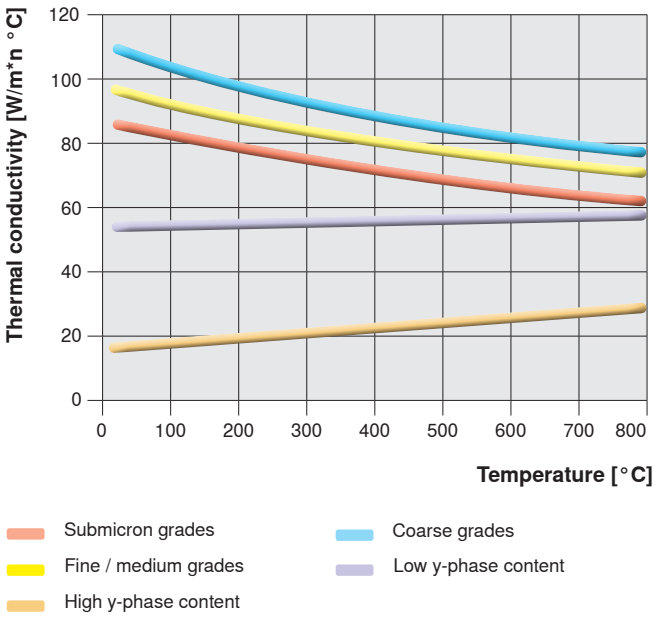


Figure 17: thermal conductivity in relation to the temperature of various microstructures and grain sizes

2. Physical properties of carbide

2.1. Density

The density of carbide is determined according to ISO 3369 and varies strongly depending on the composition of the carbide grade. Grades with a very high WC content have the highest density. Grades with high a titanium carbide content and a high binder content have the lowest density. Typically it can however be assumed that the density is around 50 to 100% higher than that of steel.

2.2. Thermal expansion

As tungsten carbide has a very low thermal expansion coefficient, the values for carbide compared to steel are very low. For carbide grades which contain titanium carbide the values are somewhat higher than for the pure WC-Co carbides. Figure 16 shows the thermal expansion in relation to the cobalt content can be seen.

2.3. Thermal conductivity

The thermal conductivity is of great significance for carbide applications, as it determines the temperature in the wear areas and has a large influence on the carbide's thermal fatigue resistance and resistance to thermal fluctuations resistance. The thermal conductivity of WC-Co carbide is around twice that of unalloyed steels. It is only slightly influenced by the cobalt content and the grain size, while γ-phases like titanium carbide or tantalum carbide have an impact. Titanium carbide strongly reduces the thermal conductivity. Therefore, for milling grades tantalum carbide is mostly used as γ-phase (see figure 17).

2.4. Specific thermal capacity

The specific thermal capacity is the quantity of heat which is necessary to heat up 1 kg of a material by 1 °C. In application technology it is equally as important as thermal conductivity, because during the machining processes the heat has to be taken away from the cutting edge. Through a high thermal capacity the surrounding area is less hot as it can absorb more energy.

2.5. Specific electric resistance

WC-Co carbides have a low specific resistance of around 20$\mu\Omega$ cm and, as such, are good conductors of electricity. Carbides with γ-phases have a higher specific resistance.

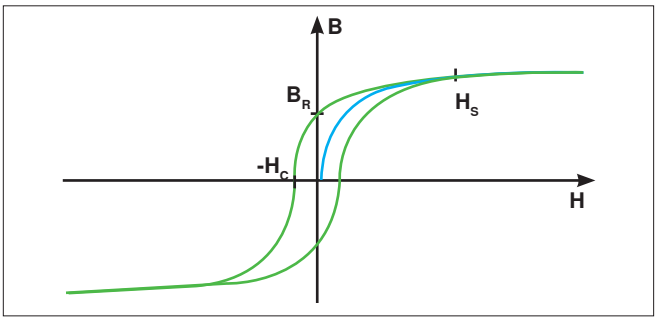


Figure 18: hysteresis curve of a ferromagnetic material

2.6. Magnetic saturation & coercive field strength

Carbides with cobalt as a metal binder are ferromagnetic. If a ferromagnetic material is exposed to a magnetic field strength H, the magnetic flux density B in this material increases (figure 18, blue line). The flux density decreases when the field strength rises, until maximum saturation is achieved. This maximum flux density is defined as magnetic saturation (4πσ). When the external field strength is removed, the flux density in the material is reduced along the upper green line to a certain residual magnetism (BR), the so called 'remanence'. The higher the remanence is, the better a material can be magnetised and the remanence can only be eliminated when the material is subjected to an inverse field. The inverse field strength HC which is necessary to reduce the magnetic flux density to zero, or to 'de-magnetise' the material, is defined as coercive field strength.

The finer the magnetic field lines of the metal binder phase in the carbide, the higher the coercive field strength. This means that the coercive field strength provides information about the state of the metal binder phase. The metal binder phase becomes finer with smaller tungsten carbide grains and lower binder content. As described under 1.1.2, the smaller the grains and the lower the metal binder content, the higher the hardness of the structure. In this way an accordant correlation between coercive field strength and hardness can be seen. In practical applications this represents a non-destructive measuring method for the hardness.
The magnetic saturation of carbide also depends on the content and the state of the cobalt binder. When one of these parameters is known, information can be given about the other parameters. In this context the carbon content of the carbide has a decisive influence on the magnetic state of the cobalt. The magnetic saturation provides information about the carburisation of the carbide. This measuring method represents an important tool for checking the production quality.

2.7. Permeability

Magnetic permeability means the penetrability of materials for magnetic fields. Although carbide is ferromagnetic, the magnetic permeability values are low. They increase equally along with the magnetic saturation and with the cobalt content and amount to around 5 H/m with 20 vol.%. Compared to this, vacuum has a magnetic permeability of 1 H/m and iron between 300 and 10,000 H/m.

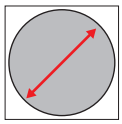
Chemical compounds	Resistance
Acetone	high resistance
Ethanol	high resistance
Sodium hydroxide	high resistance
All acids	low resistance
Tap water	high resistance
Petroleum	high resistance

Figure 19: some chemical compounds and the corresponding resistance of carbide

3. Corrosion resistance of carbide

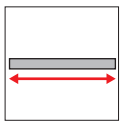
According to DIN EN ISO 8044 corrosion is a reaction of a metal material with its environment, which causes a measurable modification of the material and may lead to a reduced performance of the metal element or the entire system. In most cases the reaction is electrochemical in nature or in some cases chemical or metal-physical in nature. In carbides corrosion causes a reduction of the surface of the binder phase, thus on the surface there remains only a carbide 'skeleton'. The bond between carbide grains next to each other is very weak, so the rate of destruction increases correspondingly. When the metal binder content is low the carbide 'skeleton' is more pronounced. Consequently this type of carbide grade shows higher wear resistance and corrosion resistance than carbides with a higher metal binder content. In practical applications, however, this is not sufficient to significantly increase the service life. Due to their limited corrosion resistance pure WC-Co carbides are often not suitable for application fields with difficult corrosion conditions. Typically, it can be assumed that WC-Co carbides down to pH 7 are corrosion-resistant.

Outside diameter



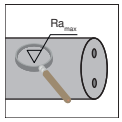
Measured outside diameter of the round rod.

Length



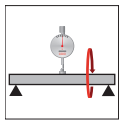
Measured length of the round rod.

Surface



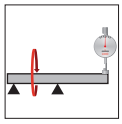
The surface quality describes the state of the surface. For ground rods the surface value is indicated as maximum average roughness value R_a (DIN EN ISO 4287:1998).

Straightness



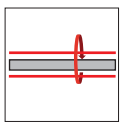
Maximum deflection of a rotating rod which lies on two contact points, measured in the middle of the rod. The distance between the two contact points is 300 mm. When the rod is longer or shorter than 330 mm the contact width corresponds to the rod length minus 10 mm.

Concentricity



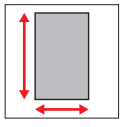
Maximum deflection of a rod. Contact point A is 5 mm before the chamfer. Contact point B is in the middle of the rod. The measurement is carried out 2 mm from the end.

Cylindricity



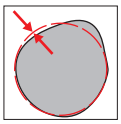
The cylindricity describes the tolerance field of an ideal cylinder inside which the skin surface of the rod should be.

Width, height



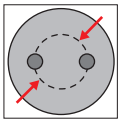
Lateral length of square and rectangular strips.

Roundness



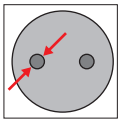
Roundness is the radial distance of two concentric circles which include the circumference line of the round rod's section. (DIN ISO 1101).

Pitch circle diameter



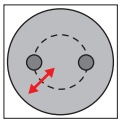
The pitch circle is defined as the circle which goes through two or three centre points of coolant holes.

Hole diameter



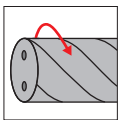
The hole diameter is the diameter of the coolant holes inside the rod.

Excentricity



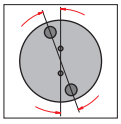
Excentricity means the deviation ot the pitch circle centre point or, in case of a coolant hole, the deviation of the coolant hole centre point from the centre point of the rod.

Helix angle



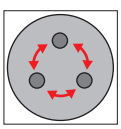
The helix angle is the angle between the longitudinal axis and the helix line.

Torsion

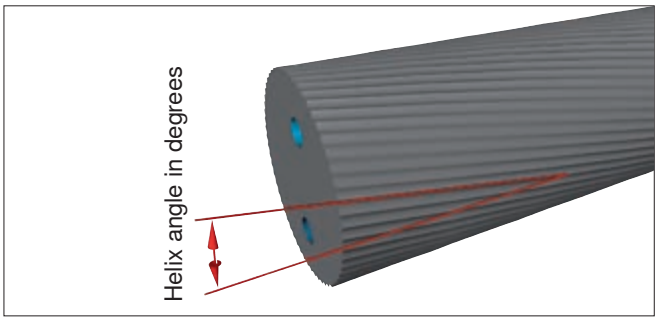


Maximum difference of the angle of the two imaginary lines which go through the centre point of the coolant holes which are on the pitch circle.

Pitch error

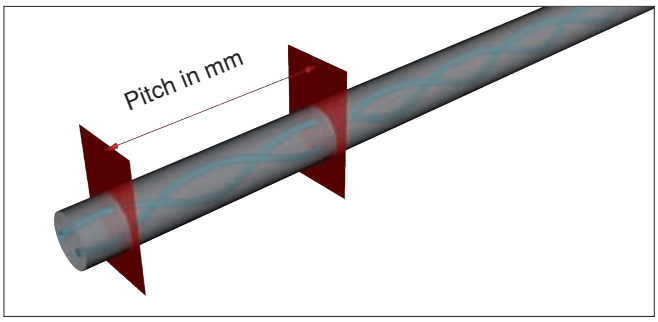


For rods with three helical coolant holes the section surface is divided into thre circle sectors which go through the centre point of the coolant holes. The pitch error is the difference of the angles between the circle sectors.



Definition of the helix angle

The helix angle indicates the torsion of the coolant holes in relation to the nominal diameter. In this context it has to be taken into account that the angle decreases depending on the diameter steps. For this reason, rods with 40° coolant holes are used for step drills in order to achieve an optimal spiral flute helix angle of 25 to 30°.



Definition of pitch

The pitch is the length of a complete 360° rotation of the coolant holes. This value is independent of the diameter or the diameter steps. The CERATIZIT designation system for coolant hole rods includes both the helix angle in degrees and the pitch of the helix in millimetres.

Conversion helix angle/pitch:

Conversion pitch to angle: $\alpha = \tan^{-1} \frac{d \cdot \pi}{Stg}$

Conversion angle to pitch: $Stg = \frac{d \cdot \pi}{\tan \alpha}$

Stg.	pitch
d	nominal diameter
α	helix angle

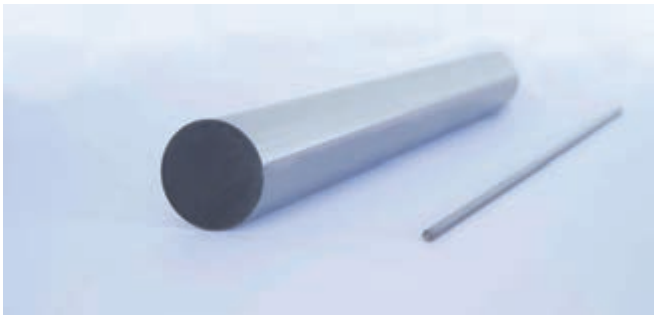
Pitch classification

In order to guarantee closest pitch tolerances our carbide rods with helical coolant holes are divided into tolerance classes. For this purpose all rods are measured and assigned to the respective class, which is indicated on the product label. For details of our pitch classification see pages 47 and 50.

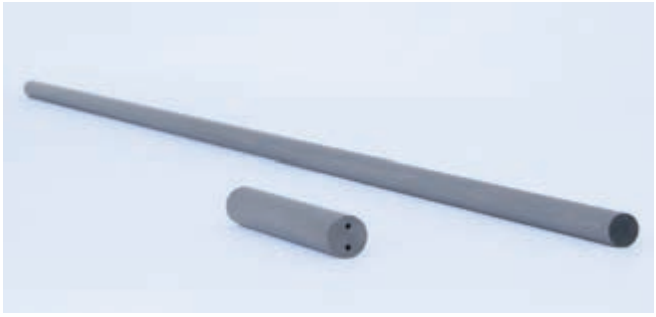
In addition to our standard programme we also offer individual solutions for our rods.

Thanks to our comprehensive manufacturing possibilities we can also meet your most demanding requirements. No matter whether special coolant hole profiles, large helix angles or other special versions, see for yourself and benefit from our expertise.

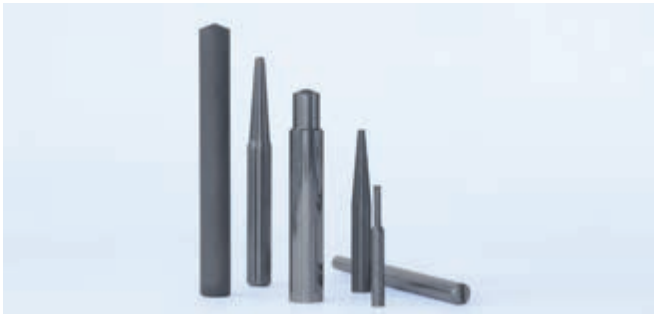
In our up-to-date grinding department we also produce semi-finished ground articles, in high volumes as well as in small batches.



○ Diameters of round rods from 0.40mm to 80.00mm



○ Lengths from 15mm to 700mm



○ Ground semi-finished products

○ Blanks for micro-drills with through-coolant and blind hole on the shank for improved coolant supply

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