



TOOLMAKER SOLUTIONS BY CERATIZIT

P-LINE PROGRAM

ROUND TOOL MATERIALS

2016

EN

ROUND TOOL MATERIALS

P-LINE PROGRAM



Dear customer,

Benefit from innovative production technologies and an extensive range of carbide grades and precision tools with Toolmaker Solutions by CERATIZIT, your reliable partner for rods and preforms suitable for virtually all tools and applications. For the first time our catalogue presents our range of drill blanks with through-coolant and our extended selection of end mill blanks. Our recently developed carbide grades CTF25E for preforms, CTS25D and CTS30D for rods can also be found on the following pages.

In addition, customers can benefit from top class online service. Our E-Tech-store offers 900 articles available directly from stock 24/7 with short delivery times. Thanks to our high production capacity we are also able to process large orders quickly and flexibly. Looking for a customised solution? No problem! Regardless of whether you need special threads, axial and radial coolant holes or formed-in insert seats: we produce preforms near net shape according to your drawing and guarantee speedy delivery. Rely on the innovative capabilities of Toolmaker Solutions by CERATIZIT!

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Welcome to the world of CERATIZIT

Our dedication is your solution!

For over 90 years, we have been producing unique and consistently innovative hard material solutions for cutting tools, wear protection, as well as wood and stone working. Whether it's highly specialised cutting tools, inserts, or rods and preforms made of hard materials, with a total of four top-class brands, the CERATIZIT GROUP is your partner for exceptional and custom-made hard material solutions which guarantee the economy, consistency and performance of your production. Ever more powerful machines, facilities and machining methods constantly create new challenges for our development engineers. More than 5,900 employees worldwide are already working today on the solutions of tomorrow.

Hard material for your success

Hard materials in general and hard materials in particular are applied wherever tools or components are exposed to high wear. They improve the quality of the tools and parts, extend the life of the tool and ensure secure processes. High pressure and temperature, the application of abrasive or aggressive materials, and the machining of hard materials are just some

examples of factors that cause wear, and to which our hard materials and hard metals are resistant.

Toolmaker Solutions by CERATIZIT – carbide for any kind of request

Toolmaker Solutions by CERATIZIT is one of the four top-class brands of the CERATIZIT GROUP. As part of this quality label, we offer you a comprehensive range of rods and preforms for cutting tools. The multidisciplinary team of experts at Toolmaker Solutions by CERATIZIT is continually developing new carbides and cermets which enable you to produce drilling and milling tools with improved performance. We support you as a competent development partner with outstanding know-how in order to create the optimal product for your individual application.

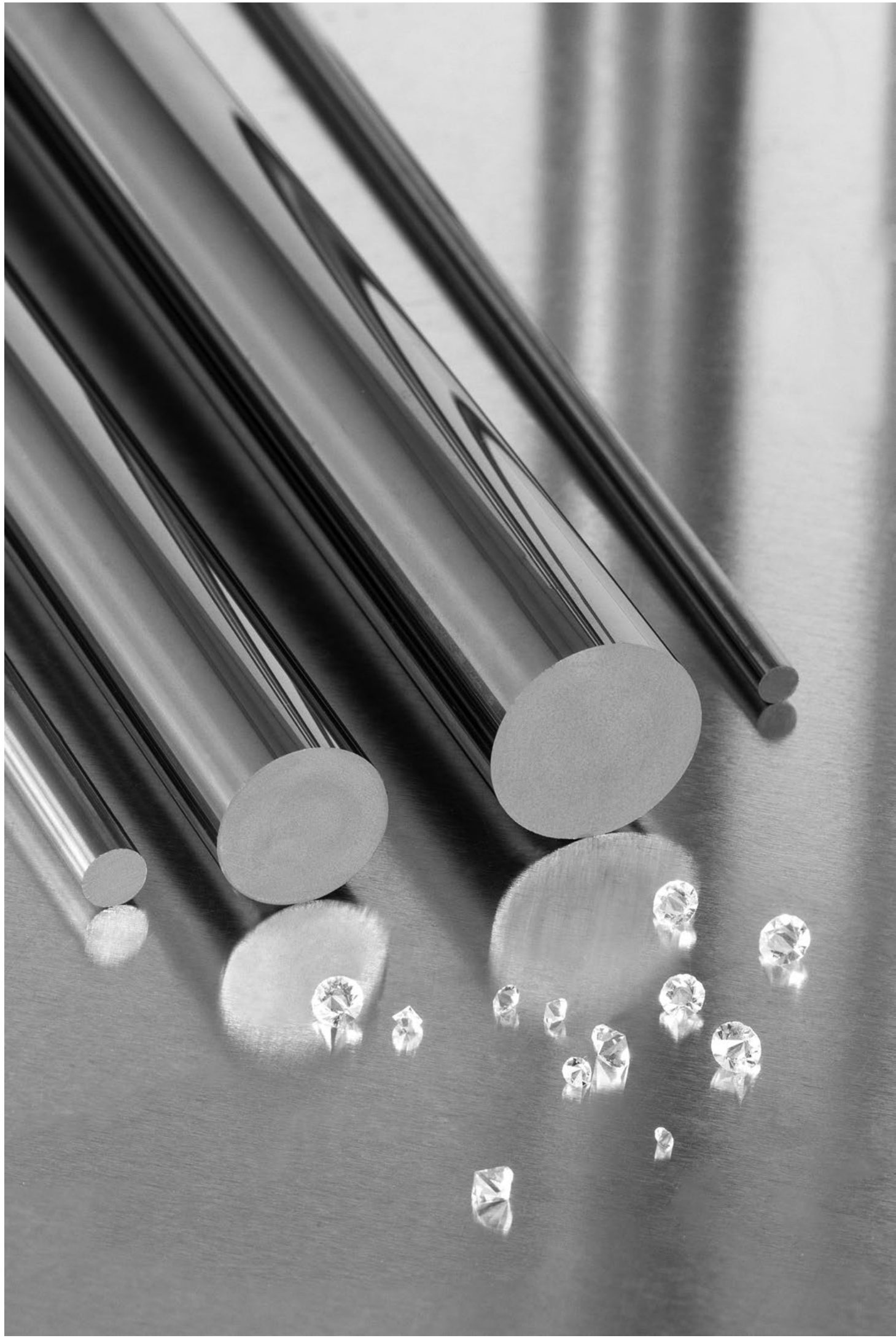


Guided by corporate values

We employ more than 5,900 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 800 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.



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 customised 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

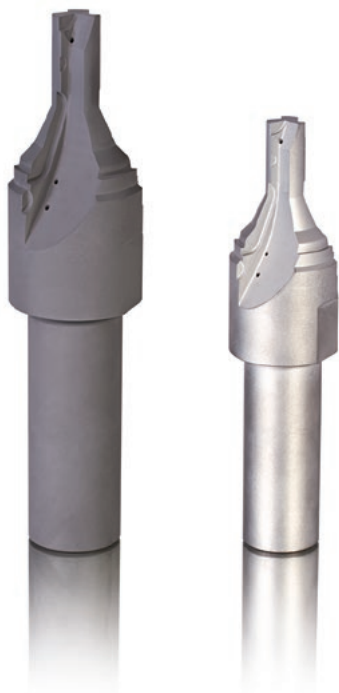
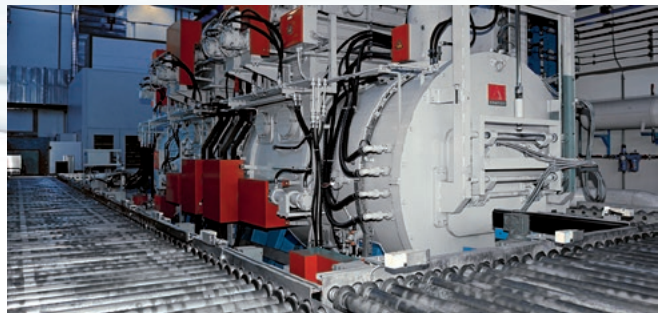
Machining

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.

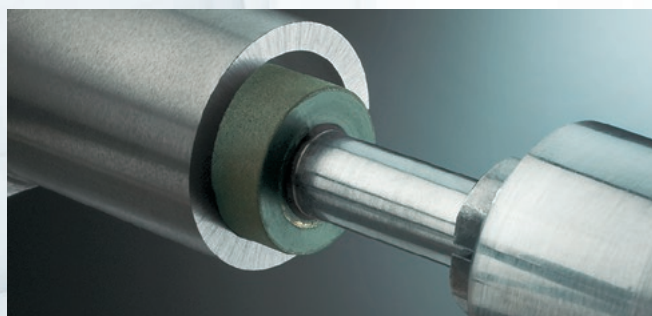
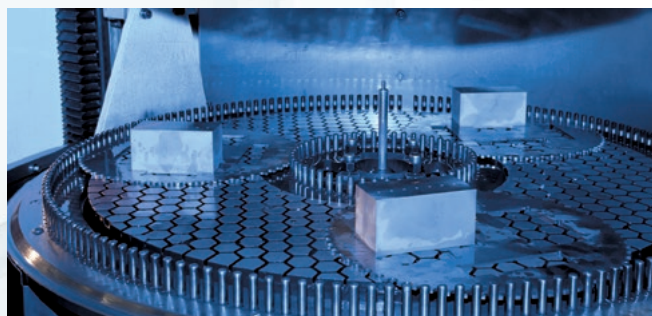
Sintering



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

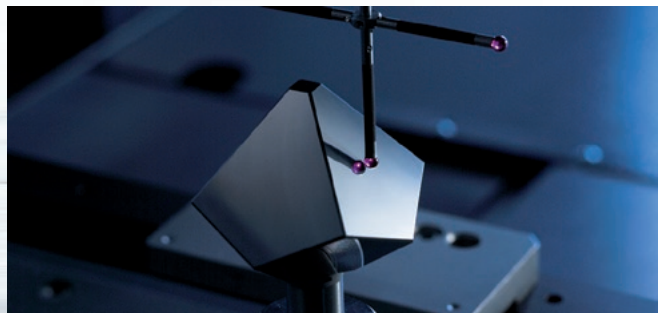
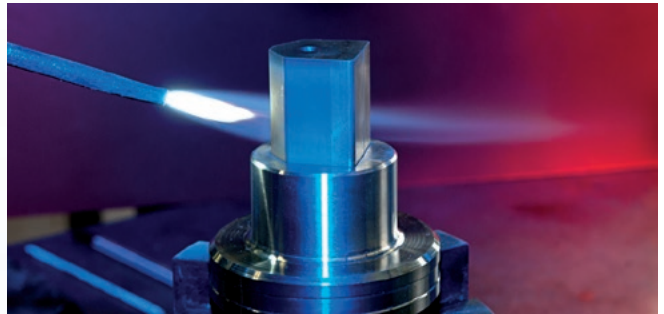
Grinding

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 adequate properties 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



RR Sintered rods	
RGM Ground rods, metric	
	C with chamfer
	D DualBlank
	Y with radial coolant exit holes
	W with Weldon shank
RGI Ground rods, inch	
00 Helix angle of coolant hole rods 30 40	R coolant hole rods, as sintered
	G coolant hole rods, ground
	B drill blanks
GD Blanks for gun drills	RK round rods with kidney-shaped coolant holes
	VK profiled rods with kidney-shaped coolant holes
	V2 profiled rods with two coolant holes
	V2P profiled tips with two coolant holes
FR Rectangular strips	
SR Square strips	

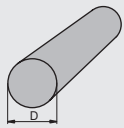
Number of coolant holes



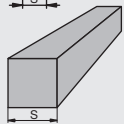
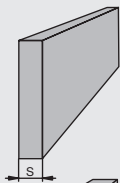
30

GB

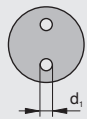
2



Thickness
[1/100 mm]



Outside diameter
[1/100 mm]



Diameter of the coolant holes
[mm]



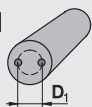
Rod length
[mm]

h5

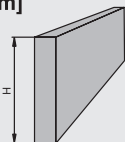
1000/4,8/1,3/54,4-104 CTS20D h5

Pitch circle of the coolant holes

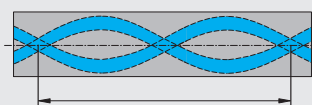
[mm]



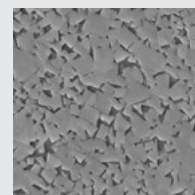
Height
[mm]



Nominal pitch of the coolant holes
[mm]

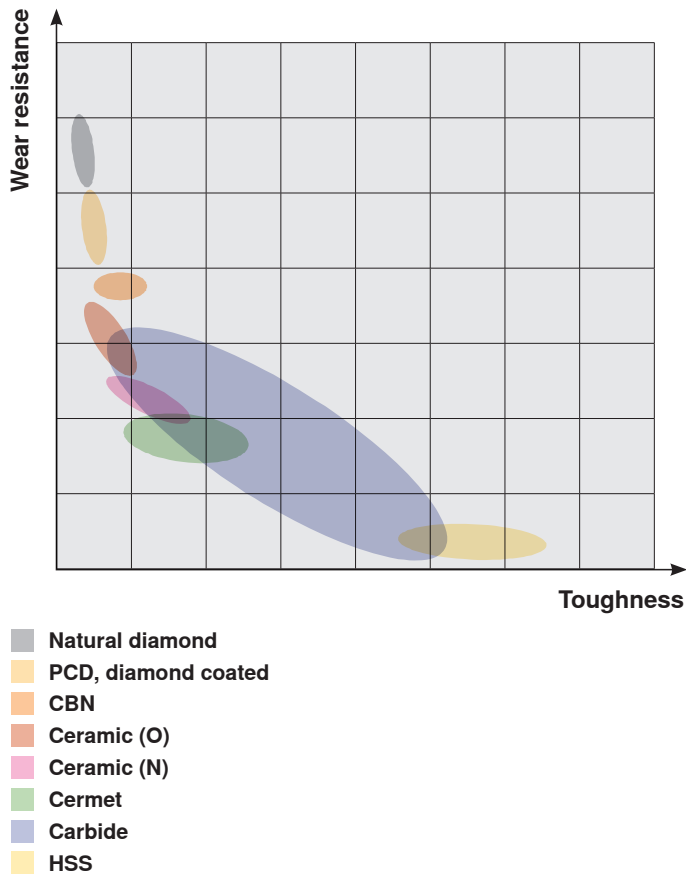


Grade



Introduction

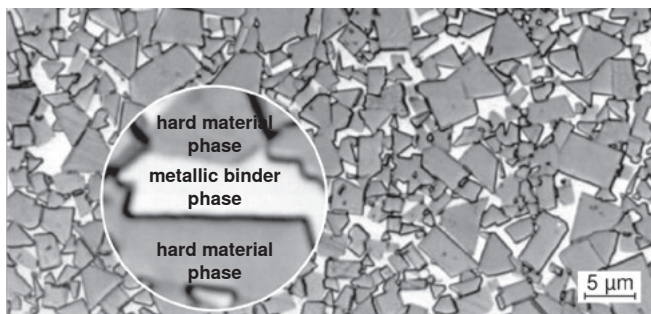
Carbide – application and composition



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

Composition and properties

CERATIZIT grade code	ISO code	U.S. code	Binder [m %]	Density [g/cm ³]	Hardness		Transverse rupture strength		K _{IC} * (Shetty) [MPa·m ^{1/2}]
					HV30	HRA	[MPa]	[psi]	

Ultrafine grades

CTU08L	K10	C-2	4,2	15,05	2200	95,2	3700	536.600	8,4
TSF22	K10 – K20	C-2	8,2	14,55	1930	93,7	4400	638.800	9,2
TSF44	K10 – K20	C-2	12,0	14,10	1730	92,7	4600	667.000	9,8

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
CTS25D	K20 – K40	C-2	12,5	14,13	1540	91,5	4300	623.700	11,8
CTS30D	K30 – K40	C-2	15,0	13,84	1400	90,4	4300	623.700	13,2

Fine grades

CTF12E	K15	C-2	6,0	14,95	1620	92,1	2200	319.100	9,9
CTF25E	K30 – K40	C-2	12,5	14,15	1300	89,5	3500	507.600	15,0

Cermet

CTF28T	K05 – K10	C-2	14,1	6,40	1580	91,8	2000	290.100	8,5
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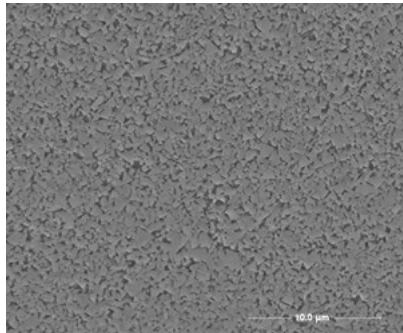
Grain size classification		CERATIZIT code
Average grain size [μm]	Classification	
< 0.2	nano	N
0.2 – < 0.5	ultrafine	U
0.5 – < 0.8	submicron	S
0.8 – < 1.3	fine	F
1.3 – < 2.5	medium	M
2.5 – < 6.0	coarse	C
> 6.0	extra-coarse	E

The classification of carbides according to grain size corresponds to the recommendations of the Powder Metallurgy Association. The standard ISO codes for carbides which were developed for fine to medium grain sizes no longer correspond to today's state of the art. In order to choose the correct grades, only the application data are relevant.

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



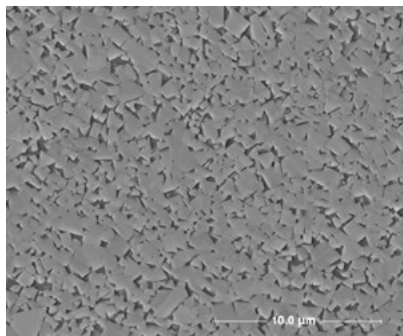
Picture example

CTU08L: ultrafine carbide grade with a typical grain size of 0.2 µm for the machining of materials with a hardness > 65 HRC. Thanks to the high wear resistance also excellent suitability for abrasive fibre composite materials.

TSF22: ultrafine carbide grade for HSC machining of tempered steels with a hardness of > 60 HRC and abrasive aluminium alloys.

TSF44: ultrafine carbide grade for HSC machining of tempered steels up to 60 HRC, suitable for micro- and finishing tools and for a variety of materials.

Submicron grades



Picture example

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.

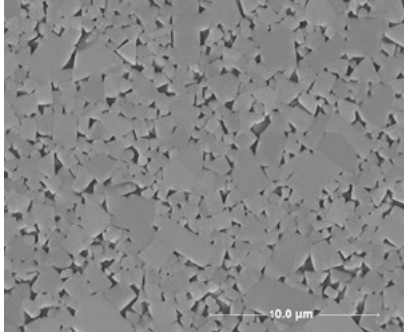
CTS18D: special submicron grade for high-performance machining of steel, stainless steel and the machining of difficult to machine materials, for example titanium or Inconel.

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.

CTS25D: submicron grade with high toughness for the machining of difficult materials and under unfavourable conditions.

CTS30D: submicron grade with very high toughness for difficult machining conditions.

Fine grain grades

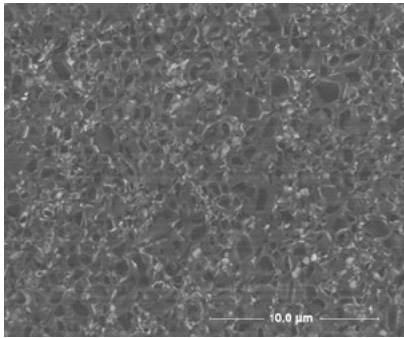


Picture example

CTF12E: fine grain carbide for gun drills with an adapted relation between hardness and toughness. Suitable also for diamond-coated solid carbide tools.

CTF25E: fine grain carbide for the production of PCD tools and tool shanks. The increased cobalt content and the coarser grain improve brazability while increasing fracture toughness.

Cermet



Picture example

CTF28T: cermet grade particularly for the finish machining of steel. Thanks to high oxidation resistance and low tendency to stick it is particularly suitable for the production of uncoated reamers.

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.

[illegible]

CERATIZIT E-Techstore

The CERATIZIT online shop offers a comprehensive range of cutting tools, rods and products for wear protection. We promise you a well-structured navigation and easy user guide!

E-TECHSTORE



Speed

You have access to more than 20,000 products online. The extended rapid product search via the material number, ISO designation or characteristics allows you to find the product you need. After ordering you will immediately receive an order confirmation. You may inform yourself online at any time on the delivery status of your products. (Track & Trace)

Services

The CERATIZIT E-Techstore is available to you around the clock. You may check the offer, order, consignments and invoice online. Open orders can be changed at the last minute if you wish to correct them. For this purpose you always use your personal order templates. Should you have any questions, a personal contact will additionally be available.

Information

You will receive state-of-the-art detailed technical information and graphic illustrations for all products in the E-Techstore. You will also be informed about possible connections and suitable accessories. Thanks to the up-to-date availability check applicable to all standard articles you can immediately see when you will receive the requested products.

Business

All products are ordered at net prices and conditions. We guarantee optimal safety through SSL-encoding.

CERATIZIT linkage

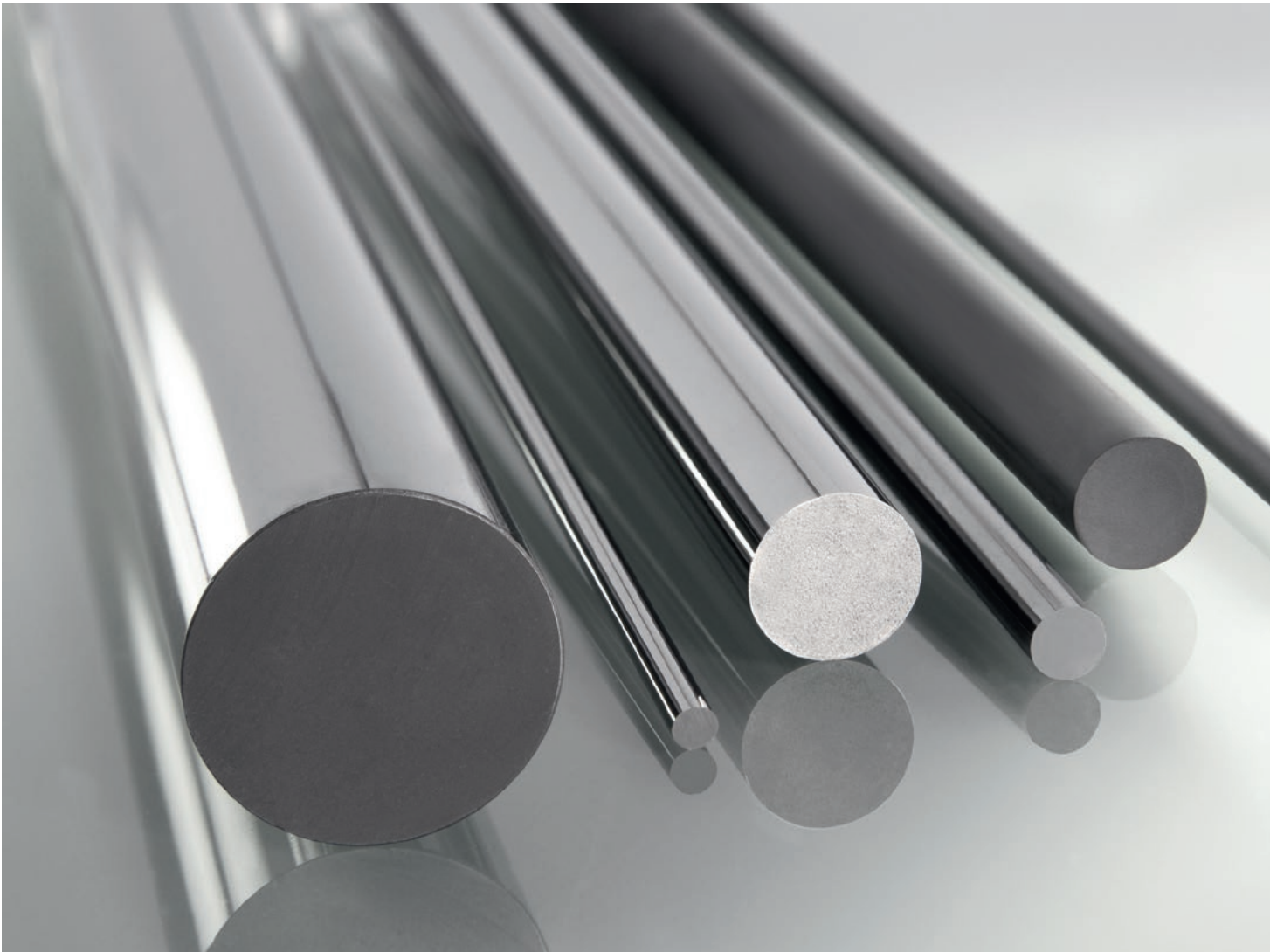
Would you like to link your system with CERATIZIT? CERATIZIT supports all common link formats (EDI, XML, OCI, etc.).

Get in touch with your contact person! Our technical engineer will analyse your requirements together with you and will help you when choosing the suitable technology.

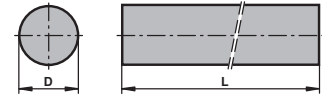
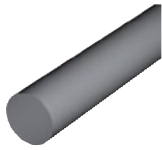


Solid carbide rods

Our programme offers you a wide range of dimensions, features and capabilities. Additionally, we will provide you with swift supply of the ideal product for your individual application. Thanks to the recent CTS grade generation extra-tough carbide grades are now also available for difficult applications.



Ultrafine grades

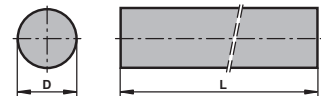


D [mm]	L [mm]	Type, description	Dia. tol. [mm]	CTU08L	TSF22	TSF44
3.25	330	RR 0325-330	-0/+0.20	●	●	●
4.20	330	RR 0420-330	-0/+0.20	●	●	●
5.20	330	RR 0520-330	-0/+0.25	●	●	●
6.20	330	RR 0620-330	-0/+0.25	●	●	●
6.70	330	RR 0670-330	-0/+0.25			●
8.20	330	RR 0820-330	-0/+0.30	●	●	●
10.20	330	RR 1020-330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

● = stock item

Other grades and dimensions upon request

Submicron grades



D [mm]	L [mm]	Type, description	Dia. tol. [mm]	CTS12D	CTS15D	CTS18D	CTS20D	CTS25D	CTS30D
1.15	330	RR 0115-330	-0/+0.15				●		
1.65	330	RR 0165-330	-0/+0.15	●			●		
1.80	330	RR 0180-330	-0/+0.15				●		
2.20	330	RR 0220-330	-0/+0.20	●			●		
2.70	330	RR 0270-330	-0/+0.20				●		
3.25	330	RR 0325-330	-0/+0.20	●	●	●	●		
3.70	330	RR 0370-330	-0/+0.20				●		
4.20	330	RR 0420-330	-0/+0.20	●	●	●	●		
4.70	330	RR 0470-330	-0/+0.20				●		
5.20	330	RR 0520-330	-0/+0.25	●	●		●		
5.70	330	RR 0570-330	-0/+0.25				●		
6.20	330	RR 0620-330	-0/+0.25	●	●	●	●	●	○
6.55	330	RR 0655-330	-0/+0.25				●		
6.70	330	RR 0670-330	-0/+0.25		●		●		

● = stock item

○ = limited stock

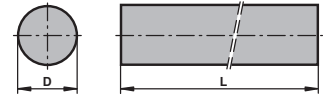
▲ = new stock item

Other grades and dimensions upon request

Solid carbide rods

As sintered

Submicron grades



D [mm]	L [mm]	Type, description	Dia. tol. [mm]	CTS12D	CTS15D	CTS18D	CTS20D	CTS25D	CTS30D
7.20	330	RR 0720-330	-0/+0.30				●		
7.70	330	RR 0770-330	-0/+0.30				●		
8.20	330	RR 0820-330	-0/+0.30	●	●	●	●	●	○
8.70	330	RR 0870-330	-0/+0.30				●		
9.20	330	RR 0920-330	-0/+0.30				●		
9.70	330	RR 0970-330	-0/+0.30				●		
10.20	330	RR 1020-330	-0/+0.30	●	●	●	●	●	○
10.70	330	RR 1070-330	-0/+0.30				●		
11.20	330	RR 1120-330	-0/+0.30				●		
11.70	330	RR 1170-330	-0/+0.30				●		
12.20	330	RR 1220-330	-0/+0.30	●	●	●	●	●	○
12.70	330	RR 1270-330	-0/+0.30		●		●		
13.00	330	RR 1300-330	-0/+0.30				●		
13.20	330	RR 1320-330	-0/+0.30				●		
14.20	330	RR 1420-330	-0/+0.30	●	●	●	●		
14.70	330	RR 1470-330	-0/+0.30				●		
15.20	330	RR 1520-330	-0/+0.30				●		
16.20	330	RR 1620-330	-0/+0.45	●	●	●	●	●	○
17.20	330	RR 1720-330	-0/+0.45				●		
18.20	330	RR 1820-330	-0/+0.45	●	●		●		
19.20	330	RR 1920-330	-0/+0.45				●		
20.20	330	RR 2020-330	-0/+0.45	●	●	●	●	●	○
21.20	330	RR 2120-330	-0/+0.55				●		
22.20	330	RR 2220-330	-0/+0.55				●		
23.20	330	RR 2320-330	-0/+0.55				●		
24.20	330	RR 2420-330	-0/+0.55				●		
25.20	330	RR 2520-330	-0/+0.65		●	●	●	●	○
25.80	330	RR 2580-330	-0/+0.60				●		
26.20	330	RR 2620-330	-0/+0.65				●		
28.20	330	RR 2820-330	-0/+0.65				●		
30.20	330	RR 3020-330	-0/+0.65				●		
32.20	330	RR 3220-330	-0/+0.65			●	●		
34.20	330	RR 3420-330	-0/+0.65				●		
36.20	330	RR 3620-330	-0/+0.65				●		
38.20	330	RR 3820-330	-0/+0.70				●		
40.20	330	RR 4020-330	-0/+0.70				●		
42.20	330	RR 4220-330	-0/+0.70				●		

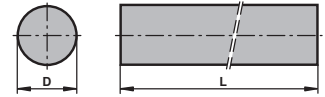
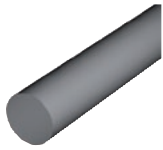
● = stock item

○ = limited stock

▲ = new stock item

Other grades and dimensions upon request

Fine grades



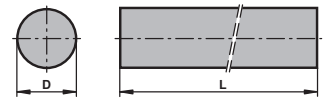
D [mm]	L [mm]	Type, description	Dia. tol. [mm]	CTF12E	CTF25E
3.25	330	RR 0325-330	-0/+0.20	●	
4.20	330	RR 0420-330	-0/+0.20	●	
5.20	330	RR 0520-330	-0/+0.25	●	
6.20	330	RR 0620-330	-0/+0.25	●	○
8.20	330	RR 0820-330	-0/+0.30	●	○
10.20	330	RR 1020-330	-0/+0.30	●	○
12.20	330	RR 1220-330	-0/+0.30	●	○
14.20	330	RR 1420-330	-0/+0.30	●	
16.20	330	RR 1620-330	-0/+0.45	●	○
18.20	330	RR 1820-330	-0/+0.45	○	
20.20	330	RR 2020-330	-0/+0.45	○	○

○ = limited stock

▲ = new stock item

Other grades and dimensions upon request

Cermet

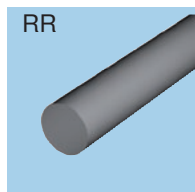


D [mm]	L [mm]	Type, description	Dia. tol. [mm]	CTF28T
3.40	330	RR 0340-330	-0/+0.20	●
4.40	330	RR 0440-330	-0/+0.20	●
6.40	330	RR 0640-330	-0/+0.25	●
8.40	330	RR 0840-330	-0/+0.30	●
10.40	330	RR 1040-330	-0/+0.30	●
12.40	330	RR 1240-330	-0/+0.30	●

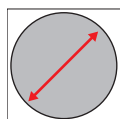
● = stock item

Other grades and dimensions upon request

Specifications

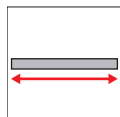


Outside diameter



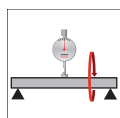
Outside diameter [mm]	Tolerance [mm]
0.8 – 2.1	+0/+0.15
2.2 – 4.7	+0/+0.20
4.8 – 6.7	+0/+0.25
6.8 – 15.2	+0/+0.30
15.3 – 20.2	+0/+0.45
20.3 – 24.2	+0/+0.55
24.3 – 36.2	+0/+0.65
36.3 – 46.2	+0/+0.70

Length



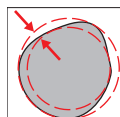
Tolerance [mm]
+0/+10

Straightness



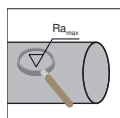
Outside diameter [mm]	max. deflection [mm]
0.80 – 3.20	1.2
3.25 – 46.2	0.5

Roundness



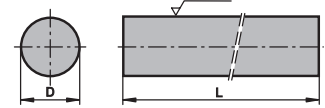
Outside diameter [mm]	Tolerance [mm]
0.8 – 5.7	0.05
5.8 – 7.7	0.08
7.8 – 12.7	0.10
12.8 – 30.2	0.13
30.3 – 46.2	0.16

Surface finish



Ra _{max} [μm]
as sintered

Ultrafine grades



D [mm]	L [mm]	Type, description	Dia. tol.		TSF22	TSF44
			[mm]			
2.00	330	RGM 0200-330	+0/-0.004	h5		●
3.00	330	RGM 0300-330	+0/-0.004	h5	●	●
4.00	330	RGM 0400-330	+0/-0.005	h5	●	●
5.00	330	RGM 0500-330	+0/-0.005	h5	●	●
6.00	330	RGM 0600-330	+0/-0.005	h5	●	●
8.00	330	RGM 0800-330	+0/-0.006	h5	●	●
10.00	330	RGM 1000-330	+0/-0.006	h5	●	●
12.00	330	RGM 1200-330	+0/-0.008	h5	●	●
14.00	330	RGM 1400-330	+0/-0.008	h5	○	●
16.00	330	RGM 1600-330	+0/-0.008	h5	●	●
20.00	330	RGM 2000-330	+0/-0.009	h5	●	●

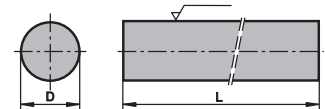
○ = limited stock

● = stock item

▲ = new stock item

Other grades and dimensions upon request

Submicron grades



D [mm]	L [mm]	Type, description	Dia. tol.		CTS12D	CTS15D	CTS18D	CTS20D	CTS25D	CTS30D
			[mm]							
1.00	330	RGM 0100-330	+0/-0.006	h6				●		
1.50	330	RGM 0150-330	+0/-0.006	h6				●		
2.00	330	RGM 0200-330	+0/-0.006	h6				●		
2.50	330	RGM 0250-330	+0/-0.006	h6		●		●		
3.00	330	RGM 0300-330	+0/-0.006	h6	●			●		
3.50	330	RGM 0350-330	+0/-0.008	h6				●		
4.00	330	RGM 0400-330	+0/-0.008	h6	●			●		
4.50	330	RGM 0450-330	+0/-0.008	h6				●		
5.00	330	RGM 0500-330	+0/-0.008	h6				●		
5.50	330	RGM 0550-330	+0/-0.008	h6				●		
6.00	330	RGM 0600-330	+0/-0.008	h6	●	●	●	●	●	○
6.50	330	RGM 0650-330	+0/-0.009	h6				●		
7.00	330	RGM 0700-330	+0/-0.009	h6				●		
7.50	330	RGM 0750-330	+0/-0.009	h6				●		
8.00	330	RGM 0800-330	+0/-0.009	h6	●	●	●	●	●	○

● = stock item

▲ = new stock item

○ = limited stock

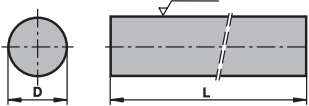
Other grades and dimensions upon request

Solid carbide rods

Ground, metric



Submicron grades



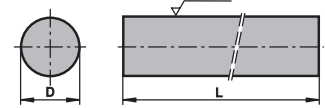
D [mm]	L [mm]	Type, description	Dia. tol.		CTS12D	CTS15D	CTS18D	CTS20D	CTS25D	CTS30D
			[mm]							
8.50	330	RGM 0850-330	+0/-0.009	h6				●		
9.00	330	RGM 0900-330	+0/-0.009	h6				●		
9.50	330	RGM 0950-330	+0/-0.009	h6				●		
10.00	330	RGM 1000-330	+0/-0.009	h6	●	●	●	●	●	○
11.00	330	RGM 1100-330	+0/-0.011	h6				●		
12.00	330	RGM 1200-330	+0/-0.011	h6	●	●	●	●	●	○
13.00	330	RGM 1300-330	+0/-0.011	h6				●		
14.00	330	RGM 1400-330	+0/-0.011	h6	●			●		
15.00	330	RGM 1500-330	+0/-0.011	h6				●		
16.00	330	RGM 1600-330	+0/-0.011	h6	●	●	●	●	●	○
18.00	330	RGM 1800-330	+0/-0.011	h6		●		●		
19.00	330	RGM 1900-330	+0/-0.013	h6				●		
20.00	330	RGM 2000-330	+0/-0.013	h6	●	●	●	●	●	○
22.00	330	RGM 2200-330	+0/-0.013	h6				●		
24.00	330	RGM 2400-330	+0/-0.013	h6				●		
25.00	330	RGM 2500-330	+0/-0.013	h6			●	●	●	○
28.00	330	RGM 2800-330	+0/-0.013	h6				●		
30.00	330	RGM 3000-330	+0/-0.013	h6				●		
32.00	330	RGM 3200-330	+0/-0.016	h6			●	●		
38.00	330	RGM 3800-330	+0/-0.016	h6				●		
40.00	330	RGM 4000-330	+0/-0.016	h6				●		
6.00	330	RGM 0600-330	+0/-0.008	h6						
8.00	330	RGM 0800-330	+0/-0.009	h6						
10.00	330	RGM 1000-330	+0/-0.009	h6						
12.00	330	RGM 1200-330	+0/-0.011	h6						
16.00	330	RGM 1600-330	+0/-0.011	h6						
20.00	330	RGM 2000-330	+0/-0.013	h6						

● = stock item
▲ = new stock item
○ = limited stock
Other grades and dimensions upon request

Ground, metric

Solid carbide rods

Fine grades



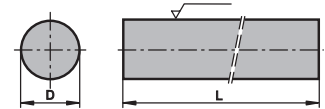
D [mm]	L [mm]	Type, description	Dia. tol.		CTF12E	CTF25E
			[mm]			
3.00	330	RGM 0300-330	+0/-0.004	h6	▲	
4.00	330	RGM 0400-330	+0/-0.008	h6	▲	
6.00	330	RGM 0600-330	+0/-0.008	h6	▲	○
8.00	330	RGM 0800-330	+0/-0.009	h6	▲	○
10.00	330	RGM 1000-330	+0/-0.009	h6	▲	○
12.00	330	RGM 1200-330	+0/-0.011	h6	▲	○
14.00	330	RGM 1400-330	+0/-0.011	h6	○	
16.00	330	RGM 1600-330	+0/-0.011	h6	▲	○
18.00	330	RGM 1800-330	+0/-0.011	h6	○	
20.00	330	RGM 2000-330	+0/-0.013	h6	○	○
25.00	330	RGM 2500-330	+0/-0.013	h6		○

▲ = new stock item

○ = limited stock

Other grades and dimensions upon request

Cermet



D [mm]	L [mm]	Type, description	Dia. tol.		CTF28T
			[mm]		
3.00	330	RGM 0300-330	+0/-0.004	h6	●
4.00	330	RGM 0400-330	+0/-0.008	h6	●
6.00	330	RGM 0600-330	+0/-0.008	h6	●
8.00	330	RGM 0800-330	+0/-0.009	h6	●
10.00	330	RGM 1000-330	+0/-0.009	h6	●

▲ = new stock item

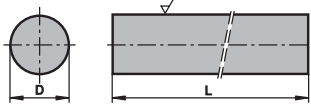
Other grades and dimensions upon request

Solid carbide rods

Ground, inch



Submicron grades (inch dimensions)



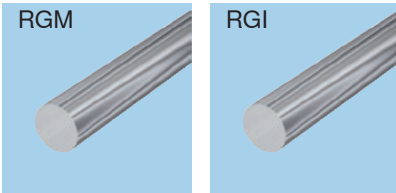
D [inch]	L [inch]	Type, description	Dia. tol.		CTS20D
			[mm]		
0.125	13	RGI 1/8-13	+0/-0.008	h6	●
0.188	13	RGI 3/16-13	+0/-0.008	h6	●
0.250	13	RGI 1/4-13	+0/-0.009	h6	●
0.313	13	RGI 5/16-13	+0/-0.009	h6	●
0.375	13	RGI 3/8-13	+0/-0.009	h6	●
0.438	13	RGI 7/16-13	+0/-0.011	h6	●
0.500	13	RGI 1/2-13	+0/-0.011	h6	●
0.625	13	RGI 5/8-13	+0/-0.011	h6	●
0.750	13	RGI 3/4-13	+0/-0.013	h6	●
1.000	13	RGI 1-13	+0/-0.013	h6	●

● = stock item
Other grades and dimensions upon request

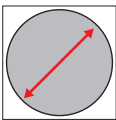
Ground, inch

Solid carbide rods

Specifications

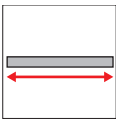


Outside diameter



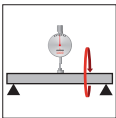
Outside diameter [mm]	Tolerance	
	h6 [mm]	h5 [mm]
1.0 – 3.0	+0/-0.006	+0/-0.004
3.1 – 6.0	+0/-0.008	+0/-0.005
6.1 – 10.0	+0/-0.009	+0/-0.006
10.1 – 18.0	+0/-0.011	+0/-0.008
18.1 – 30.0	+0/-0.013	+0/-0.009
30.1 – 40.0	+0/-0.016	+0/-0.011

Length



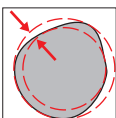
Total length tolerance [mm]
+0/+10

Straightness



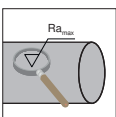
Outside diameter [mm]	max. deflection [mm]
1.0 – 2.9	1.20
3.0 – 5.9	0.15
6.0 – 7.9	0.12
8.0 – 9.9	0.10
10.0 – 11.9	0.08
12.0 – 19.9	0.05
20.0 – 40.0	< 0.05

Roundness



Outside diameter [mm]	Tolerance [mm]	
	RGI h6	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

Surface finish



Ra _{max} [μm]
0.05

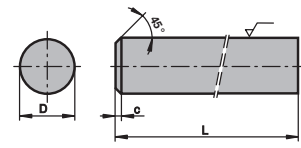
➡ For further information go to page 108.

End mill blanks

In addition to the DIN dimensions our highly precise semi-finished products are available as an extra-long version. We have extended our standard range by more than 50 dimensions for you! To achieve a particularly good price-performance ratio we have developed our unique DualBlank range which combines performance capacity of a premium grade in the cutting edge area with the cost-effectiveness of a recycled grade on the shank.



Ultrafine grades



D [mm]	L [mm]	Type, description	Dia. tol. [mm]		c [mm]	DIN 6527	CTU08L	TSF22	TSF44
3.00	39	RGMC 0300-039	+0/-0.004	h5	0.30	x	●	●	●
3.00	40	RGMC 0300-040	+0/-0.004	h5	0.30			●	
3.00	50	RGMC 0300-050	+0/-0.004	h5	0.30			●	●
3.00	60	RGMC 0300-060	+0/-0.004	h5	0.30			●	
4.00	51	RGMC 0400-051	+0/-0.004	h5	0.40	x	●	●	●
4.00	60	RGMC 0400-060	+0/-0.005	h5	0.40			●	
4.00	75	RGMC 0400-075	+0/-0.005	h5	0.40			●	
5.00	51	RGMC 0500-051	+0/-0.005	h5	0.40	x			●
6.00	51	RGMC 0600-051	+0/-0.005	h5	0.40	x		●	●
6.00	58	RGMC 0600-058	+0/-0.005	h5	0.40	x	●	●	●
6.00	60	RGMC 0600-060	+0/-0.005	h5	0.40			●	
6.00	65	RGMC 0600-065	+0/-0.005	h5	0.40			●	
6.00	70	RGMC 0600-070	+0/-0.005	h5	0.40			●	
6.00	75	RGMC 0600-075	+0/-0.005	h5	0.40			●	
6.00	80	RGMC 0600-080	+0/-0.005	h5	0.40			●	
6.00	100	RGMC 0600-100	+0/-0.005	h5	0.40			●	●
8.00	64	RGMC 0800-064	+0/-0.006	h5	0.60	x	●	●	●
8.00	70	RGMC 0800-070	+0/-0.006	h5	0.60			●	
8.00	75	RGMC 0800-075	+0/-0.006	h5	0.60			●	
8.00	100	RGMC 0800-100	+0/-0.006	h5	0.60			●	●
8.00	120	RGMC 0800-120	+0/-0.006	h5	0.60			●	●
10.00	67	RGMC 1000-067	+0/-0.006	h5	0.80	x			●
10.00	73	RGMC 1000-073	+0/-0.006	h5	0.80	x	●	●	●
10.00	75	RGMC 1000-075	+0/-0.006	h5	0.80			●	
10.00	80	RGMC 1000-080	+0/-0.006	h5	0.80			●	
10.00	100	RGMC 1000-100	+0/-0.006	h5	0.80			●	●
10.00	120	RGMC 1000-120	+0/-0.006	h5	0.80			●	●
12.00	84	RGMC 1200-084	+0/-0.008	h5	0.80	x		●	●
12.00	100	RGMC 1200-100	+0/-0.008	h5	0.80			●	●
12.00	120	RGMC 1200-120	+0/-0.008	h5	0.80			●	●
16.00	93	RGMC 1600-093	+0/-0.008	h5	0.80	x		●	●
16.00	110	RGMC 1600-110	+0/-0.008	h5	0.80			●	
16.00	120	RGMC 1600-120	+0/-0.008	h5	0.80				●
16.00	130	RGMC 1600-130	+0/-0.008	h5	0.80				●
16.00	150	RGMC 1600-150	+0/-0.008	h5	0.80				●
20.00	105	RGMC 2000-105	+0/-0.009	h5	1.00	x			●
20.00	125	RGMC 2000-125	+0/-0.009	h5	1.00			●	●
20.00	150	RGMC 2000-150	+0/-0.009	h5	1.00				●
25.00	125	RGMC 2500-125	+0/-0.009	h5	1.00				●

● = stock item

▲ = new stock item

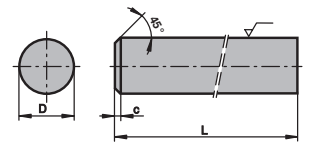
Other grades and dimensions upon request

End mill blanks

End mill blanks



Submicron grades



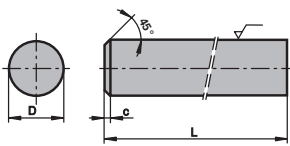
D [mm]	L [mm]	Type, description	Dia. tol. [mm]		c [mm]	DIN 6527	CTS18D	CTS20D
3.00	40	RGMC 0300-040	+0/-0.004	h5	0.30			●
3.00	39	RGMC 0300-039	+0/-0.006	h6	0.30	x		●
3.00	50	RGMC 0300-050	+0/-0.004	h5	0.30			●
3.00	60	RGMC 0300-060	+0/-0.004	h5	0.30			●
4.00	51	RGMC 0400-051	+0/-0.008	h6	0.40	x		●
4.00	60	RGMC 0400-060	+0/-0.005	h5	0.40			●
4.00	75	RGMC 0400-075	+0/-0.005	h5	0.40			●
5.00	51	RGMC 0500-051	+0/-0.008	h6	0.40	x		●
6.00	51	RGMC 0600-051	+0/-0.008	h6	0.40	x		●
6.00	55	RGMC 0600-055	+0/-0.008	h6	0.40	x		●
6.00	58	RGMC 0600-058	+0/-0.008	h6	0.40	x	●	●
6.00	60	RGMC 0600-060	+0/-0.005	h5	0.40			●
6.00	65	RGMC 0600-065	+0/-0.005	h5	0.40			●
6.00	70	RGMC 0600-070	+0/-0.005	h5	0.40			●
6.00	75	RGMC 0600-075	+0/-0.005	h5	0.40			●
6.00	80	RGMC 0600-080	+0/-0.005	h5	0.40			●
6.00	100	RGMC 0600-100	+0/-0.005	h5	0.40			●
8.00	59	RGMC 0800-059	+0/-0.009	h6	0.60	x		●
8.00	64	RGMC 0800-064	+0/-0.009	h6	0.60	x	●	●
8.00	70	RGMC 0800-070	+0/-0.006	h5	0.60			●
8.00	75	RGMC 0800-075	+0/-0.006	h5	0.60			●
8.00	80	RGMC 0800-080	+0/-0.006	h5	0.60			●
8.00	100	RGMC 0800-100	+0/-0.006	h5	0.60			●
8.00	120	RGMC 0800-120	+0/-0.006	h5	0.60			●
10.00	67	RGMC 1000-067	+0/-0.009	h6	0.80	x		●
10.00	73	RGMC 1000-073	+0/-0.009	h6	0.80	x	●	●
10.00	75	RGMC 1000-075	+0/-0.006	h5	0.80			●
10.00	80	RGMC 1000-080	+0/-0.006	h5	0.80			●
10.00	90	RGMC 1000-090	+0/-0.006	h5	0.80			●
10.00	100	RGMC 1000-100	+0/-0.006	h5	0.80			●
10.00	120	RGMC 1000-120	+0/-0.006	h5	0.80			●
12.00	74	RGMC 1200-074	+0/-0.011	h6	0.80	x		●
12.00	84	RGMC 1200-084	+0/-0.011	h6	0.80	x	●	●
12.00	100	RGMC 1200-100	+0/-0.008	h5	0.80			●
12.00	120	RGMC 1200-120	+0/-0.008	h5	0.80			●
14.00	76	RGMC 1400-076	+0/-0.011	h6	0.80	x		●
14.00	84	RGMC 1400-084	+0/-0.011	h6	0.80	x		●
16.00	83	RGMC 1600-083	+0/-0.011	h6	0.80	x		●
16.00	93	RGMC 1600-093	+0/-0.011	h6	0.80	x	●	●
16.00	110	RGMC 1600-110	+0/-0.008	h5	0.80			●
16.00	120	RGMC 1600-120	+0/-0.008	h5	0.80			●
16.00	130	RGMC 1600-130	+0/-0.008	h5	0.80			●

● = stock item

▲ = new stock item

Other grades and dimensions upon request

Submicron grades



D [mm]	L [mm]	Type, description	Dia. tol.		c [mm]	DIN 6527	CTS18D	CTS20D
			[mm]					
16.00	150	RGMC 1600-150	+0/-0.008	h5	0.80			●
18.00	93	RGMC 1800-093	+0/-0.011	h6	1.00	x		●
20.00	93	RGMC 2000-093	+0/-0.013	h6	1.00	x		●
20.00	105	RGMC 2000-105	+0/-0.013	h6	1.00	x	●	●
20.00	125	RGMC 2000-125	+0/-0.009	h5	1.00			●
20.00	150	RGMC 2000-150	+0/-0.009	h5	1.00			●
25.00	125	RGMC 2500-125	+0/-0.009	h5	1.00			●

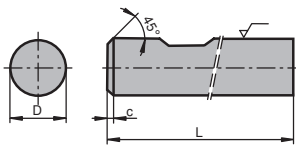
● = stock item
▲ = new stock item
Other grades and dimensions upon request

End mill blanks

With Weldon shank



With Weldon shank, submicron grades



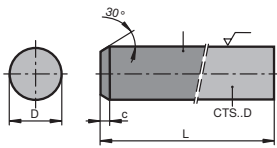
D [mm]	L [mm]	Type, description	Dia. tol.		c [mm]	DIN 6527	CTS20D
			[mm]				
6.00	51	RGMCW 0600-051	+0/-0.008	h6	0.40	x	●
6.00	55	RGMCW 0600-055	+0/-0.008	h6	0.40	x	●
6.00	58	RGMCW 0600-058	+0/-0.008	h6	0.40	x	●
8.00	64	RGMCW 0800-064	+0/-0.009	h6	0.60	x	●
10.00	67	RGMCW 1000-067	+0/-0.009	h6	0.80	x	●
10.00	73	RGMCW 1000-073	+0/-0.009	h6	0.80	x	●
12.00	74	RGMCW 1200-074	+0/-0.011	h6	0.80	x	●
12.00	84	RGMCW 1200-084	+0/-0.011	h6	0.80	x	●
16.00	93	RGMCW 1600-093	+0/-0.011	h6	0.80	x	●
20.00	93	RGMCW 2000-093	+0/-0.013	h6	1.00	x	●

● = stock item
Other grades and dimensions upon request

With Weldon shank

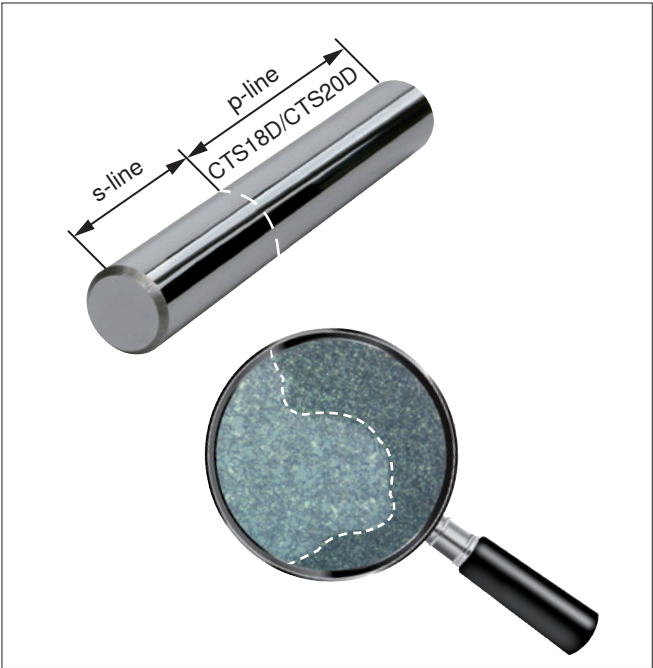
End mill blanks

DualBlank, submicron grades



D [mm]	L [mm]	Type, description	Dia. tol.		c [mm]	DIN 6527	CTS20D	CTS18D
			[mm]					
6.00	58	RGMCD 0600-058	+0/-0.008	h6	0.50	x	●	●
8.00	64	RGMCD 0800-064	+0/-0.009	h6	0.70	x	●	●
10.00	73	RGMCD 1000-073	+0/-0.009	h6	0.90	x	●	●
12.00	84	RGMCD 1200-084	+0/-0.011	h6	0.90	x	●	●
16.00	93	RGMCD 1600-093	+0/-0.011	h6	0.90	x	●	●
20.00	105	RGMCD 2000-105	+0/-0.013	h6	1.10	x	●	●

● = stock item
Other grades and dimensions upon request



DualBlank rods

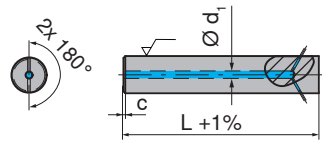
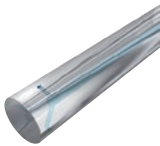
- DualBlank version: a combination of **s-line** for tool shanks and **p-line** (grade CTS18D or CTS20D) for the cutting edges.
- High-performance grade for the cutting edges guarantees high quality
 - Totally homogeneous product
 - Optimised price-performance ratio
 - Produced using few resources as possible

End mill blanks

With through-coolant



With through-coolant (2x 180°), submicron grades

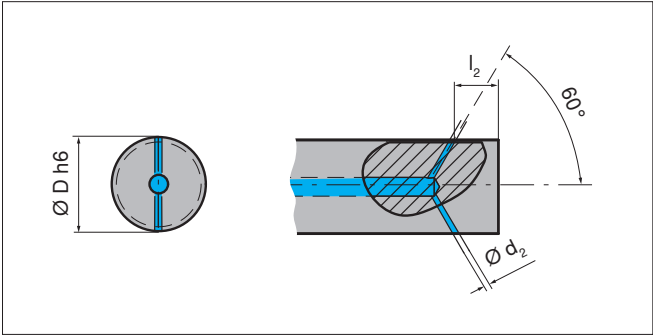


D [mm]	L [mm]	Type, description	Dia. tol. [mm]		d ₁ [mm]	d ₂ [mm]	l ₂ [mm]	c [mm]	CTS20D
6.0	58	RGMCY2 0600-058	+0/-0.008	h6	1.2	0.8	3.0	0.4	○
8.0	64	RGMCY2 0800-064	+0/-0.009	h6	1.6	1.1	4.0	0.6	○
10.0	73	RGMCY2 1000-073	+0/-0.009	h6	2.0	1.4	5.0	0.8	○
12.0	84	RGMCY2 1200-084	+0/-0.011	h6	2.2	1.6	6.0	0.8	○
14.0	84	RGMCY2 1400-084	+0/-0.011	h6	2.4	1.7	7.0	0.8	○
16.0	93	RGMCY2 1600-093	+0/-0.011	h6	2.6	1.9	8.0	0.8	○
18.0	93	RGMCY2 1800-093	+0/-0.011	h6	2.8	2.0	9.0	1.0	○
20.0	105	RGMCY2 2000-105	+0/-0.013	h6	3.0	2.1	10.0	1.0	○
25.0	125	RGMCY2 2500-125	+0/-0.013	h6	3.2	2.3	12.5	1.0	○

○ = limited stock
Other grades, dimensions or engineering drawings upon request

With through-coolant

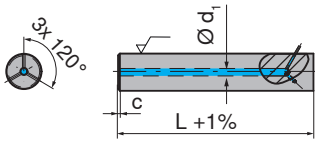
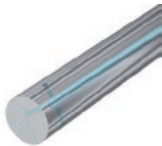
End mill blanks



Coolant exit holes

➡ Specifications see page(s) 33.

With through-coolant (3x 120°), submicron grades



D [mm]	L [mm]	Type, description	Dia. tol.		d ₁ [mm]	d ₂ [mm]	l ₂ [mm]	c [mm]	CTS20D
6.0	58	RGMCY3 0600-058	+0/-0.008	h6	1.2	0.7	3.0	0.4	●
8.0	64	RGMCY3 0800-064	+0/-0.009	h6	1.6	0.9	4.0	0.6	●
10.0	73	RGMCY3 1000-073	+0/-0.009	h6	2.0	1.2	5.0	0.8	●
12.0	84	RGMCY3 1200-084	+0/-0.011	h6	2.2	1.3	6.0	0.8	●
14.0	84	RGMCY3 1400-084	+0/-0.011	h6	2.4	1.4	7.0	0.8	●
16.0	93	RGMCY3 1600-093	+0/-0.011	h6	2.6	1.5	8.0	0.8	●
18.0	93	RGMCY3 1800-093	+0/-0.011	h6	2.8	1.6	9.0	1.0	●
20.0	105	RGMCY3 2000-105	+0/-0.013	h6	3.0	1.7	10.0	1.0	●

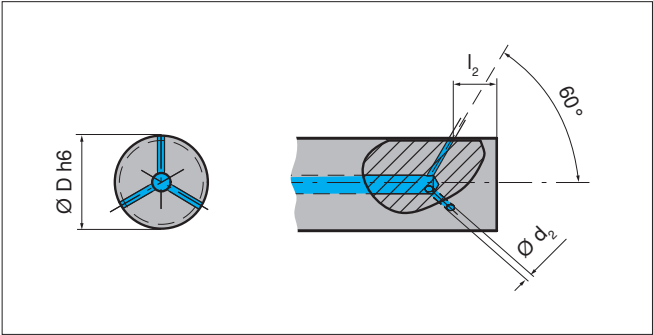
● = stock item

▲ = new stock item

Other grades, dimensions or engineering drawings upon request

With through-coolant

End mill blanks



Coolant exit holes

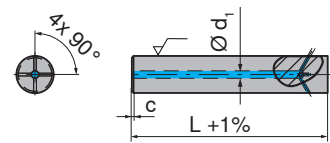
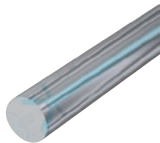
➡ Specifications see page(s) 33.

End mill blanks

With through-coolant



With through-coolant (4x 90°), submicron grades

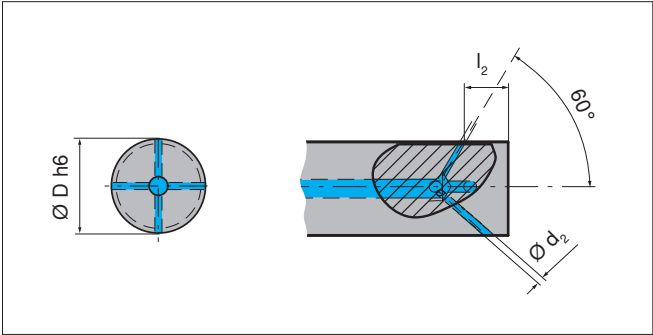


D [mm]	L [mm]	Type, description	Dia. tol.		d ₁ [mm]	d ₂ [mm]	l ₂ [mm]	c [mm]	CTS20D
			[mm]						
6.0	58	RGMCY4 0600-058	+0/-0.008	h6	1.2	0.6	3.0	0.4	●
8.0	64	RGMCY4 0800-064	+0/-0.009	h6	1.6	0.8	4.0	0.6	●
10.0	73	RGMCY4 1000-073	+0/-0.009	h6	2.0	1.0	5.0	0.8	●
12.0	84	RGMCY4 1200-084	+0/-0.011	h6	2.2	1.1	6.0	0.8	●
14.0	84	RGMCY4 1400-084	+0/-0.011	h6	2.4	1.2	7.0	0.8	●
16.0	93	RGMCY4 1600-093	+0/-0.011	h6	2.6	1.3	8.0	0.8	●
18.0	93	RGMCY4 1800-093	+0/-0.011	h6	2.8	1.4	9.0	1.0	●
20.0	105	RGMCY4 2000-105	+0/-0.013	h6	3.0	1.5	10.0	1.0	●

● = stock item
▲ = new stock item
Other grades, dimensions or engineering drawings upon request

With through-coolant

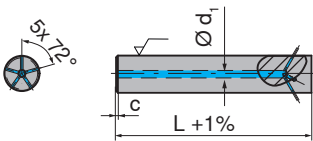
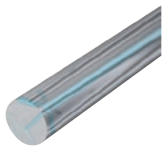
End mill blanks



Coolant exit holes

➡ Specifications see page(s) 33.

With through-coolant (5x 72°), submicron grades

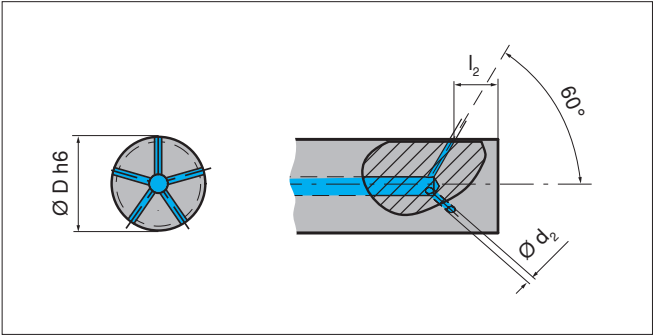


D [mm]	L [mm]	Type, description	Dia. tol.		d ₁ [mm]	d ₂ [mm]	l ₂ [mm]	c [mm]	CTS20D
6.0	58	RGMCY5 0600-058	+0/-0.008	h6	1.2	0.5	3.0	0.4	o
8.0	64	RGMCY5 0800-064	+0/-0.009	h6	1.6	0.7	4.0	0.6	o
10.0	73	RGMCY5 1000-073	+0/-0.009	h6	2.0	0.9	5.0	0.8	o
12.0	84	RGMCY5 1200-084	+0/-0.011	h6	2.2	1.0	6.0	0.8	o
14.0	84	RGMCY5 1400-084	+0/-0.011	h6	2.4	1.1	7.0	0.8	o
16.0	93	RGMCY5 1600-093	+0/-0.011	h6	2.6	1.2	8.0	0.8	o
18.0	93	RGMCY5 1800-093	+0/-0.011	h6	2.8	1.3	9.0	1.0	o
20.0	105	RGMCY5 2000-105	+0/-0.013	h6	3.0	1.4	10.0	1.0	o
25.0	125	RGMCY5 2500-125	+0/-0.013	h6	3.2	1.5	12.5	1.0	o

o = limited stock
Other grades, dimensions or engineering drawings upon request

With through-coolant

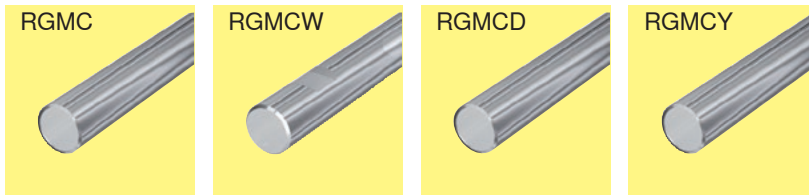
End mill blanks



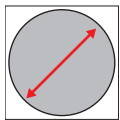
Coolant exit holes

➔ Specifications see page(s) 33.

Specifications

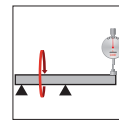


Outside diameter



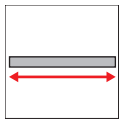
Outside diameter [mm]	Tolerance h6 [mm]	Tolerance h5 [mm]
1.0 – 3.0	+0/-0.006	+0/-0.004
3.1 – 6.0	+0/-0.008	+0/-0.005
6.1 – 10.0	+0/-0.009	+0/-0.006
10.1 – 18.0	+0/-0.011	+0/-0.008
18.1 – 30.0	+0/-0.013	+0/-0.009
30.1 – 40.0	+0/-0.016	+0/-0.011

Run-out



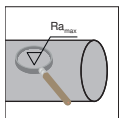
Outside diameter	max. concentricity [μm] starting length [mm]								
[mm]	30	40	50	60	70	80	90	110	140
3.0	5	5	6	7	-	-	-	-	-
4.0 – 5.0	5	5	6	6	7	-	-	-	-
6.0	4	5	5	6	6	7	8	-	-
8.0 – 10.0	4	4	4	5	5	5	6	7	-
12.0 – 14.0	3	4	4	4	4	5	5	6	-
16.0 – 20.0	3	4	4	4	4	4	5	5	6
25.0	3	4	4	4	4	4	5	5	6

Length



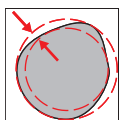
Total length tolerance [mm]
+0%/+1%

Surface finish



Ra _{max} [μm]
0.05

Roundness



Outside diameter [mm]	Tolerance [mm]	
	h6	h5
3.0	0.003	0.002
3.1 – 6.0	0.004	0.002
6.1 – 10.0	0.005	0.003
10.1 – 18.0	0.005	0.004
18.1 – 25.0	0.006	0.005

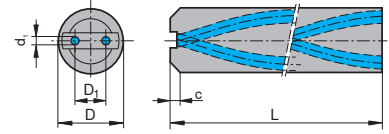
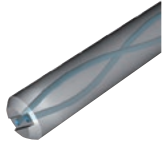


Drill blanks

New to the range in our stock programme are semi-finished tools for 5xD drills with through-coolant. In addition to maximum geometrical precision they feature improved pull-out resistance of the tool shank. The shank end corresponds to DIN 69090 and complies with the standards for cutting tools suitable for MQL.



Drill blanks



xD factor	D [mm]	L [mm]	Type, description	Dia. tol.		c [mm]	D ₁ [mm]	d ₁ [mm]	Nominal pitch		CTS20D
				[mm]					[mm]	[°]	
3	6.00	63	46GB2 0600/1,6/0,5/18,0-063	+0/-0.005	h5	0.95	1.60	0.50	18.00	46.3	○
3	6.00	63	40GB2 0600/1,9/0,7/22,5-063	+0/-0.005	h5	0.95	1.90	0.70	22.50	40.0	○
3	6.00	67	33GB2 0600/2,2/0,9/29,0-067	+0/-0.005	h5	0.95	2.20	0.90	29.00	33.0	○
3	6.00	67	30GB2 0600/2,7/0,8/32,7-067	+0/-0.005	h5	0.95	2.70	0.80	32.70	30.0	○
3	8.00	80	30GB2 0800/3,4/1,0/43,5-080	+0/-0.006	h5	1.25	3.40	1.00	43.50	30.0	○
3	10.00	90	30GB2 1000/4,8/1,3/54,4-090	+0/-0.006	h5	1.35	4.80	1.30	54.40	30.0	○
3	12.00	103	30GB2 1200/6,3/1,7/65,3-103	+0/-0.008	h5	1.75	6.30	1.70	65.30	30.0	○
3	14.00	108	30GB2 1400/6,7/1,8/76,2-108	+0/-0.008	h5	1.95	6.70	1.80	76.20	30.0	○
3	16.00	116	30GB2 1600/8,0/2,0/87,1-116	+0/-0.008	h5	2.45	8.00	2.00	87.10	30.0	○
3	18.00	124	30GB2 1800/9,0/2,3/98,0-124	+0/-0.008	h5	2.75	9.00	2.30	98.00	30.0	○
3	20.00	132	30GB2 2000/10,0/2,5/108,8-132	+0/-0.009	h5	3.25	10.00	2.50	108.80	30.0	○
5	6.00	67	46GB2 0600/1,6/0,5/18,0-067	+0/-0.005	h5	0.95	1.60	0.50	18.00	46.3	●
5	6.00	67	40GB2 0600/1,9/0,7/22,5-067	+0/-0.005	h5	0.95	1.90	0.70	22.50	40.0	●
5	6.00	75	33GB2 0600/2,2/0,9/29,0-075	+0/-0.005	h5	0.95	2.20	0.90	29.00	33.0	●
5	6.00	75	40GB2 0600/1,9/0,7/22,5-075	+0/-0.005	h5	0.95	1.90	0.70	22.50	40.0	●
5	6.00	82	30GB2 0600/2,7/0,8/32,7-083	+0/-0.005	h5	0.95	2.70	0.80	32.70	30.0	●
5	8.00	92	30GB2 0800/3,4/1,0/43,5-092	+0/-0.006	h5	1.25	3.40	1.00	43.50	30.0	●
5	10.00	104	30GB2 1000/4,8/1,3/54,4-104	+0/-0.006	h5	1.35	4.80	1.30	54.40	30.0	●
5	12.00	119	30GB2 1200/6,3/1,7/65,3-119	+0/-0.008	h5	1.75	6.30	1.70	65.30	30.0	●
5	14.00	125	30GB2 1400/6,7/1,8/76,2-125	+0/-0.008	h5	1.95	6.70	1.80	76.20	30.0	●
5	16.00	134	30GB2 1600/8,0/2,0/87,1-134	+0/-0.008	h5	2.45	8.00	2.00	87.10	30.0	●
5	18.00	144	30GB2 1800/9,0/2,3/98,0-144	+0/-0.008	h5	2.75	9.00	2.30	98.00	30.0	●

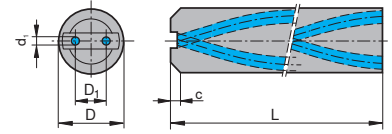
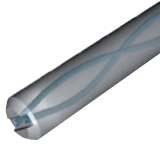
○ = limited stock

▲ = new stock item

Other grades, dimensions or engineering drawings upon request

Drill blanks

With through-coolant

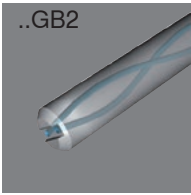


xD factor	D [mm]	L [mm]	Type, description	Dia. tol.		c [mm]	D ₁ [mm]	d ₁ [mm]	Nominal pitch		CTS20D
				[mm]					[mm]	[°]	
8	6.00	73	46GB2 0600/1,6/0,5/18,0-073	+0/-0.005	h5	0.95	1.60	0.50	18.00	46.3	○
8	6.00	73	40GB2 0600/1,9/0,7/22,5-073	+0/-0.005	h5	0.95	1.90	0.70	22.50	40.0	○
8	6.00	82	40GB2 0600/1,9/0,7/22,5-082	+0/-0.005	h5	0.95	1.90	0.70	22.50	40.0	○
8	6.00	82	33GB2 0600/2,2/0,9/29,0-082	+0/-0.005	h5	0.95	2.20	0.90	29.00	33.0	○
8	6.00	96	30GB2 0600/2,7/0,8/32,7-096	+0/-0.005	h5	0.95	2.70	0.80	32.70	30.0	○
8	8.00	115	30GB2 0800/3,4/1,0/43,5-115	+0/-0.006	h5	1.25	3.40	1.00	43.50	30.0	○
8	10.00	143	30GB2 1000/4,8/1,3/54,4-143	+0/-0.006	h5	1.35	4.80	1.30	54.40	30.0	○
8	12.00	163	30GB2 1200/6,3/1,7/65,3-163	+0/-0.008	h5	1.75	6.30	1.70	65.30	30.0	○
8	14.00	179	30GB2 1400/6,7/1,8/76,2-179	+0/-0.008	h5	1.95	6.70	1.80	76.20	30.0	○
8	16.00	204	30GB2 1600/8,0/2,0/87,1-204	+0/-0.008	h5	2.45	8.00	2.00	87.10	30.0	○
8	18.00	223	30GB2 1800/9,0/2,3/98,0-223	+0/-0.008	h5	2.75	9.00	2.30	98.00	30.0	○
8	20.00	244	30GB2 2000/10,0/2,5/108,8-244	+0/-0.009	h5	3.25	10.00	2.50	108.80	30.0	○
12	6.00	93	40GB2 0600/1,9/0,7/22,5-093	+0/-0.005	h5	0.95	1.90	0.70	22.50	40.0	○
12	6.00	93	46GB2 0600/1,6/0,5/18,0-093	+0/-0.005	h5	0.95	1.60	0.50	18.00	46.3	○
12	6.00	103	40GB2 0600/1,9/0,7/22,5-103	+0/-0.005	h5	0.95	1.90	0.70	22.50	40.0	○
12	6.00	103	33GB2 0600/2,2/0,9/29,0-103	+0/-0.005	h5	0.95	2.20	0.90	29.00	33.0	○
12	6.00	117	30GB2 0600/2,7/0,8/32,7-117	+0/-0.005	h5	0.95	2.70	0.80	32.70	30.0	○
12	8.00	147	30GB2 0800/3,4/1,0/43,5-147	+0/-0.006	h5	1.25	3.40	1.00	43.50	30.0	○
12	10.00	163	30GB2 1000/4,8/1,3/54,4-163	+0/-0.006	h5	1.35	4.80	1.30	54.40	30.0	○
12	12.00	205	30GB2 1200/6,3/1,7/65,3-205	+0/-0.008	h5	1.75	6.30	1.70	65.30	30.0	○
12	14.00	231	30GB2 1400/6,7/1,8/76,2-231	+0/-0.008	h5	1.95	6.70	1.80	76.20	30.0	○
12	16.00	261	30GB2 1600/8,0/2,0/87,1-261	+0/-0.008	h5	2.45	8.00	2.00	87.10	30.0	○
12	18.00	286	30GB2 1800/9,0/2,3/98,0-286	+0/-0.008	h5	2.75	9.00	2.30	98.00	30.0	○
12	20.00	311	30GB2 2000/10,0/2,5/108,8-311	+0/-0.009	h5	3.25	10.00	2.50	108.80	30.0	○

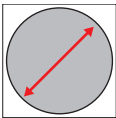
○ = limited stock

Other grades, dimensions or engineering drawings upon request

Specifications

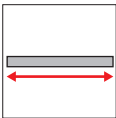


Outside diameter



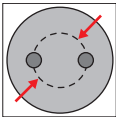
Outside diameter [mm]	Tolerance h5 [mm]
6.0	+0/-0.005
8.0 – 10.0	+0/-0.006
12.0 – 18.0	+0/-0.008
20.0	+0/-0.009

Length



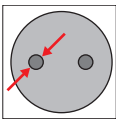
Tolerance
+0%/+1%

Pitch circle diameter



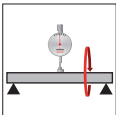
Outside diameter [mm]	Tolerance [mm]
6.0 – 12.0	+/-0.20
14.0 – 18.0	+/-0.25
18.0 – 20.0	+/-0.30

Hole diameter



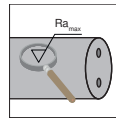
Hole diameter [mm]	Tolerance [mm]
0.50 – 1.30	+0/-0.050
1.31 – 2.50	+0/-0.075

Straightness



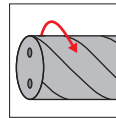
Outside diameter [mm]	max. deflection [μm] with length [mm]					
	63-66	67-81	82-114	115-133	134-162	163-310
6.0	10	15	30	40	-	-
8.0	-	15	20	40	40	-
10.0	-	-	20	30	40	50
12.0	-	-	20	30	30	50
14.0	-	-	20	30	30	50
16.0	-	-	-	20	30	50
18.0	-	-	-	20	30	50
20.0	-	-	-	20	30	50

Surface finish



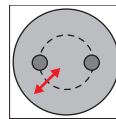
Ra _{max} [μm]
Ground mat, 0.05 - 0.1

Helix angle



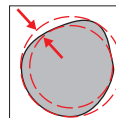
Total tolerance class [°]	Number of classes	Tolerance class [°]
+/-1	3	+/-0.33

Excentricity



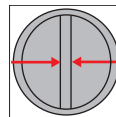
Outside diameter [mm]	max. excentricity [mm]
6.0 – 8.0	0.10
10.0	0.15
12.0 – 14.0	0.18
16.0 – 20.0	0.20

Roundness



Outside diameter [mm]	Tolerance [mm]
6.0	0.002
8.0 – 10.0	0.003
12.0 – 18.0	0.004
20.0	0.005

Cross groove profile



Outside diameter [mm]	Cross groove width		Cross groove depth	
	[mm]	[mm]	[mm]	[mm]
6	1.5	+/-0.1	0.30	+/-0.05
8	1.5	+/-0.1	0.40	+/-0.05
10	2.0	+/-0.1	0.50	+/-0.10
12	2.0	+/-0.1	0.60	+/-0.10
14	2.5	+/-0.1	0.80	+/-0.10
16	2.5	+/-0.1	1.10	+/-0.10
18	3.0	+/-0.1	1.31	+/-0.10
20	3.0	+/-0.1	1.60	+/-0.10

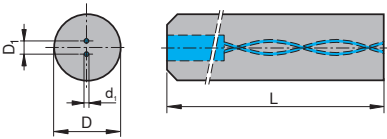
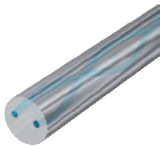
➔ For further information go to page 108.

Drill blanks

For micro-drills with through-coolant

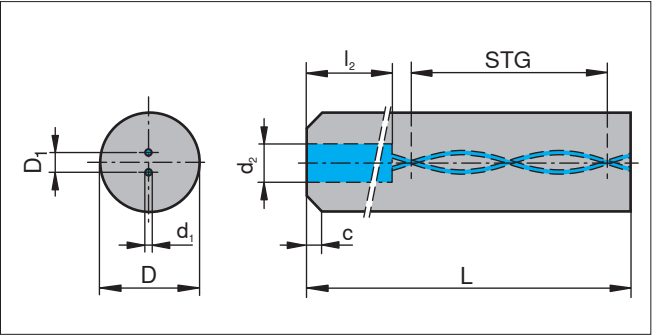


Blanks for micro-drills



D [mm]	L [mm]	Type, description	Dia. tol.		c [mm]	D ₁ [mm]	d ₁ [mm]	Nominal pitch		I ₂ [mm]	d ₂ [mm]	CTS20D
			[mm]					[mm]	[°]			
3.00	55	71G2 0300/0,29/0,05/3,2-055	+0/-0.004	h5	0.2	0.29	0.05	3.2	71.2	25	0.7	●
3.00	60	67G2 0300/0,37/0,07/4,0-060	+0/-0.004	h5	0.2	0.37	0.07	4.0	67.0	25	0.9	●
3.00	65	62G2 0300/0,47/0,10/5,0-065	+0/-0.004	h5	0.2	0.47	0.10	5.0	62.1	25	1.2	●
3.00	75	58G2 0300/0,60/0,13/6,0-075	+0/-0.004	h5	0.2	0.60	0.13	6.0	57.5	25	1.5	●
3.00	85	53G2 0300/0,75/0,16/7,2-085	+0/-0.004	h5	0.2	0.75	0.16	7.2	52.6	25	1.5	●
3.00	95	46G2 0300/0,90/0,20/9,0-095	+0/-0.004	h5	0.2	0.90	0.20	9.0	46.3			●
3.00	105	42G2 0300/1,05/0,25/10,6-105	+0/-0.004	h5	0.2	1.05	0.25	10.6	41.6			●
3.00	120	37G2 0300/1,25/0,30/12,5-120	+0/-0.004	h5	0.2	1.25	0.30	12.5	37.0			●
3.00	140	33G2 0300/1,50/0,35/14,5-140	+0/-0.004	h5	0.2	1.50	0.35	14.5	33.0			●
4.00	55	76G2 0400/0,29/0,05/3,2-055	+0/-0.004	h5	0.3	0.29	0.05	3.2	75.7	25	0.7	●
4.00	60	72G2 0400/0,37/0,07/4,0-060	+0/-0.004	h5	0.3	0.37	0.07	4.0	72.3	25	0.9	●
4.00	65	68G2 0400/0,47/0,10/5,0-065	+0/-0.004	h5	0.3	0.47	0.10	5.0	68.3	25	1.2	●
4.00	75	64G2 0400/0,60/0,13/6,0-075	+0/-0.004	h5	0.3	0.60	0.13	6.0	64.5	25	1.5	●
4.00	85	60G2 0400/0,75/0,16/7,2-085	+0/-0.004	h5	0.3	0.75	0.16	7.2	60.2	25	2.0	●
4.00	95	54G2 0400/0,90/0,20/9,0-095	+0/-0.004	h5	0.3	0.90	0.20	9.0	54.4	25	2.5	●
4.00	105	50G2 0400/1,05/0,25/10,6-105	+0/-0.004	h5	0.3	1.05	0.25	10.6	49.9			●
4.00	120	46G2 0400/1,25/0,30/12,0-120	+0/-0.004	h5	0.3	1.25	0.30	12.0	46.3			●
4.00	140	38G2 0400/1,50/0,35/16,2-140	+0/-0.004	h5	0.3	1.50	0.35	16.2	37.8			●
4.00	160	35G2 0400/1,70/0,40/18,0-160	+0/-0.004	h5	0.3	1.70	0.40	18.0	34.9			●

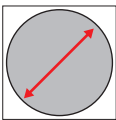
▲ = new stock item
Other grades, dimensions or engineering drawings upon request



Specifications

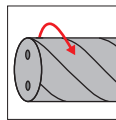


Outside diameter



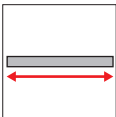
Outside diameter [mm]	Tolerance h5 [mm]
3.0 – 4.0	+0/-0.005

Helix angle



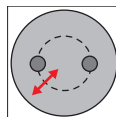
Total tolerance class [°]	Number of classes	Tolerance class [°]
+/-0.75	6	+/-0.125

Length



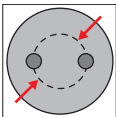
Tolerance
+0%/+1%

Excentricity



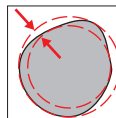
Outside diameter [mm]	max. excentricity [mm]
0.29	0.025
0.30 – 0.59	0.035
0.60 – 1.50	0.040
1.51 – 2.00	0.050

Pitch circle diameter



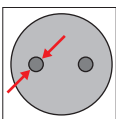
Outside diameter [mm]	Tolerance [mm]
0.29	+/-0.03
0.30 – 1.05	+/-0.05
1.06 – 2.00	+/-0.08

Roundness



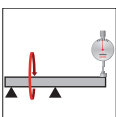
Outside diameter [mm]	Tolerance [mm]
3.0 – 4.0	0.002

Hole diameter



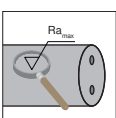
Hole diameter [mm]	Tolerance [mm]
0.05	+/-0.001
0.06 – 0.20	+/-0.015
0.21 – 0.45	+/-0.030

Run-out



Length [mm]	max. concentricity [μm] starting length [mm]	
	3.0 mm	4.0 mm
55 – 65	0.005	0.005
66 – 85	0.008	0.008
86 – 105	0.020	0.015
106 – 180	0.020	0.020

Surface finish



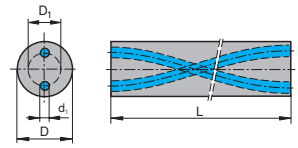
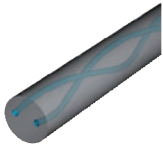
Ra _{max} [μm]
0.05

➡ For further information go to page 108.

Rods with helical coolant holes

Our range of sintered and ground rods with helical coolant holes enables the production of blanks for drills with coolant holes in diameters ranging from 3 mm to 35 mm. The latest innovation, available from stock, are ground rods with 15° helical coolant holes.



With two helical coolant holes ($\leq 22^\circ$)

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

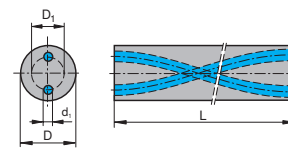
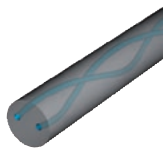
● = stock item

Other grades and dimensions upon request

Rods with helical coolant holes

As sintered

With two coolant holes (23° – 49°)



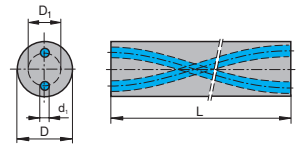
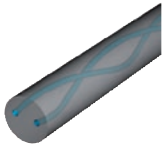
D [mm]	L [mm]	Type, description	D ₁ [mm]	d ₁ [mm]	Nominal pitch		CTS20D
					[mm]	[°]	
3.30	330	40R2 0330/0,3/0,15/11,2-330	0.30	0.15	11.20	40.1	●
3.30	330	49R2 0330/0,55/0,20/8,2-330	0.55	0.20	8.20	49.0	●
3.30	330	39R2 0330/0,8/0,23/11,5-330	0.80	0.23	11.50	39.3	●
3.30	330	34R2 0330/1,1/0,35/14,0-330	1.10	0.35	14.00	34.0	●
3.30	330	30R2 0330/1,4/0,35/16,32-330	1.40	0.35	16.32	30.0	●
4.30	330	46R2 0430/1,0/0,3/12,0-330	1.00	0.30	12.00	46.3	●
4.30	330	38R2 0430/1,2/0,35/16,2-330	1.20	0.35	16.20	37.8	●
4.30	330	35R2 0430/1,6/0,45/18,0-330	1.60	0.45	18.00	34.9	●
4.30	330	30R2 0430/2,1/0,45/21,8-330	2.10	0.45	21.80	30.0	●
5.30	330	33R2 0530/2,2/0,6/24,5-330	2.20	0.60	24.50	32.7	●
6.30	330	46R2 0630/1,6/0,5/18,0-330	1.60	0.50	18.00	46.3	●
6.30	350	46R2 0630/1,6/0,5/18,0-350	1.60	0.50	18.00	46.3	●
6.30	330	40R2 0630/1,9/0,7/22,5-330	1.90	0.70	22.50	40.0	●
6.30	350	40R2 0630/1,9/0,7/22,5-350	1.90	0.70	22.50	40.0	●
6.30	330	30R2 0630/2,0/0,9/32,7-330	2.00	0.90	32.70	30.0	●
6.30	330	30R2 0630/2,2/0,7/32,7-330	2.20	0.70	32.70	30.0	●
6.30	350	30R2 0630/2,2/0,7/32,7-350	2.20	0.70	32.70	30.0	●
6.30	330	30R2 0630/2,7/0,8/32,7-330	2.70	0.80	32.70	30.0	●
6.30	330	30R2 0630/3,0/0,9/32,7-330	3.00	0.90	32.70	30.0	●
6.80	330	30R2 0680/3,3/0,9/35,4-330	3.30	0.90	35.40	28.0	●
7.30	330	30R2 0730/3,5/1,0/38,1-330	3.50	1.00	38.10	30.0	●
8.30	330	43R2 0830/2,3/0,7/27,2-330	2.30	0.70	27.20	42.7	●
8.30	330	40R2 0830/2,9/0,7/30,0-330	2.90	0.70	30.00	40.0	●
8.30	330	36R2 0830/3,3/1,0/35,0-330	3.30	1.00	35.00	35.7	●
8.30	350	36R2 0830/3,3/1,0/35,0-350	3.30	1.00	35.00	35.7	●
8.30	330	30R2 0830/3,4/1,0/43,5-330	3.40	1.00	43.50	30.0	●
8.30	350	30R2 0830/3,4/1,0/43,5-350	3.40	1.00	43.50	30.0	●
8.30	330	30R2 0830/4,1/1,2/43,5-330	4.10	1.20	43.50	30.0	●
9.30	330	30R2 0930/4,35/1,0/49,0-330	4.35	1.00	49.00	30.0	●
9.80	330	30R2 0980/4,8/1,3/51,7-330	4.80	1.30	51.70	28.7	●
10.30	330	40R2 1030/2,7/0,8/37,0-330	2.70	0.80	37.00	40.3	●
10.30	330	34R2 1030/3,9/1,1/46,0-330	3.90	1.10	46.00	34.3	●
10.30	330	34R2 1030/4,4/1,15/46,0-330	4.40	1.15	46.00	34.3	●
10.30	330	30R2 1030/4,8/1,3/54,4-330	4.80	1.30	54.40	30.2	●
10.30	330	33R2 1030/5,0/1,2/49,0-330	5.00	1.20	49.00	32.7	●
11.30	330	40R2 1130/3,2/0,8/41,2-330	3.20	0.80	41.20	40.0	●
11.30	330	30R2 1130/5,5/1,5/59,9-330	5.50	1.50	59.90	30.0	●
11.80	330	30R2 1180/5,5/1,5/62,6-330	5.50	1.50	62.60	28.9	●
12.30	330	39R2 1230/3,5/1,0/46,3-330	3.50	1.00	46.30	39.2	●
12.30	330	40R2 1230/4,0/0,9/44,9-330	4.00	0.90	44.90	40.0	●
12.30	330	33R2 1230/5,0/1,35/57,0-330	5.00	1.35	57.00	33.5	●
12.30	250	33R2 1230/5,4/1,5/57,0-250	5.40	1.50	57.00	33.5	●

○ = limited stock

● = stock item

▲ = new stock item

Other grades and dimensions upon request

With two coolant holes ($23^{\circ} - 49^{\circ}$)

D [mm]	L [mm]	Type, description	D ₁ [mm]	d ₁ [mm]	Nominal pitch		CTS20D
					[mm]	[°]	
12.30	330	33R2 1230/5,4/1,5/57,0-330	5.40	1.50	57.00	33.5	●
12.30	330	32R2 1230/6,0/1,5/59,9-330	6.00	1.50	59.90	32.2	●
12.30	250	30R2 1230/6,3/1,7/65,3-250	6.30	1.70	65.30	30.0	●
12.30	330	30R2 1230/6,3/1,7/65,3-330	6.30	1.70	65.30	30.0	●
13.30	330	40R2 1330/4,4/1,0/48,7-330	4.40	1.00	48.70	40.0	●
13.30	330	30R2 1330/6,5/1,6/70,7-330	6.50	1.60	70.70	30.0	●
14.30	330	40R2 1430/4,6/1,3/52,4-330	4.60	1.30	52.40	40.0	●
14.30	330	34R2 1430/6,0/1,6/65,0-330	6.00	1.60	65.00	34.1	●
14.30	330	30R2 1430/6,7/1,8/76,2-330	6.70	1.80	76.20	30.0	●
14.30	330	30R2 1430/7,0/2,0/76,2-330	7.00	2.00	76.20	30.0	●
14.30	330	30R2 1430/7,6/2,0/76,2-330	7.60	2.00	76.20	30.0	●
15.30	330	30R2 1530/7,6/2,0/81,6-330	7.60	2.00	81.60	30.0	●
16.30	330	40R2 1630/5,5/1,2/59,9-330	5.50	1.20	59.90	40.0	●
16.30	330	35R2 1630/7,0/2,0/73,0-330	7.00	2.00	73.00	34.6	●
16.30	280	30R2 1630/8,0/2,0/87,1-280	8.00	2.00	87.10	30.0	●
16.30	330	30R2 1630/8,0/2,0/87,1-330	8.00	2.00	87.10	30.0	●
16.30	330	32R2 1630/8,4/2,0/81,6-330	8.40	2.00	81.60	31.6	●
16.30	330	30R2 1630/8,6/2,5/87,1-330	8.60	2.50	87.10	30.0	●
17.30	330	40R2 1730/5,75/1,3/63,6-330	5.75	1.30	63.60	40.0	●
17.30	330	30R2 1730/8,9/2,5/92,5-330	8.90	2.50	92.50	30.0	●
18.30	330	40R2 1830/5,6/1,6/68,0-330	5.60	1.60	68.00	39.7	●
18.30	330	40R2 1830/6,3/1,7/68,0-330	6.30	1.70	68.00	39.7	●
18.30	330	35R2 1830/7,75/2,2/82,0-330	7.75	2.20	82.00	34.6	●
18.30	330	30R2 1830/9,3/2,7/98,0-330	9.30	2.70	98.00	30.0	●
19.80	330	30R2 1980/9,6/2,4/106,1-330	9.60	2.40	106.10	29.4	●
20.30	330	37R2 2030/6,5/1,7/84,3-330	6.50	1.70	84.30	36.7	●
20.30	330	40R2 2030/7,1/1,5/74,9-330	7.10	1.50	74.90	40.0	●
20.30	330	30R2 2030/10,0/2,5/108,8-330	10.00	2.50	108.80	30.0	●
20.30	330	30R2 2030/10,7/3,2/108,8-330	10.70	3.20	108.80	30.0	●
21.30	330	30R2 2130/10,65/2,0/114,2-330	10.65	2.00	114.20	30.0	●
21.30	330	30R2 2130/11,5/3,2/114,2-330	11.50	3.20	114.20	30.0	○
22.30	330	40R2 2230/7,7/1,7/82,4-330	7.70	1.70	82.40	40.0	●
22.30	330	33R2 2230/10,0/2,5/108,0-330	10.00	2.50	108.00	32.6	●
22.30	330	30R2 2230/11,3/2,0/119,7-330	11.30	2.00	119.70	30.0	●
22.30	330	30R2 2230/11,5/3,4/119,7-330	11.50	3.40	119.70	30.0	○
25.30	330	40R2 2530/7,7/1,75/93,6-330	7.70	1.75	93.60	40.0	●
25.30	330	33R2 2530/12,0/3,2/119,0-330	12.00	3.20	119.00	33.4	●
28.30	330	39R2 2830/9,0/2,0/107,7-330	9.00	2.00	107.70	39.2	●
28.30	330	29R2 2830/14,8/2,5/159,0-330	14.80	2.50	159.00	29.0	●
30.30	330	39R2 3030/10,0/2,0/116,0-330	10.00	2.00	116.00	39.1	●
30.30	330	29R2 3030/16,0/2,5/172,0-330	16.00	2.50	172.00	28.7	●

○ = limited stock

● = stock item

▲ = new stock item

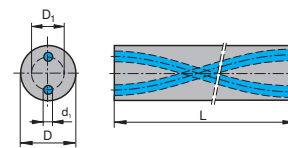
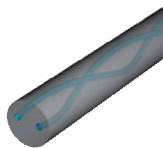
Other grades and dimensions upon request

Rods with helical coolant holes

As sintered

56

With two coolant holes (23° – 49°)



D [mm]	L [mm]	Type, description	D ₁ [mm]	d ₁ [mm]	Nominal pitch		CTS20D
					[mm]	[°]	
32.30	330	40R2 3230/11,0/2,0/119,8-330	11.00	2.00	119.80	40.0	●
32.30	330	29R2 3230/17,0/3,0/177,8-330	17.00	3.00	177.80	29.5	●

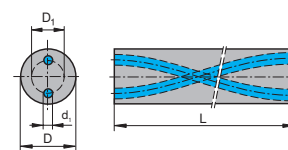
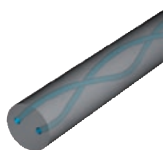
○ = limited stock

● = stock item

▲ = new stock item

Other grades and dimensions upon request

With two coolant holes (≥ 50°)

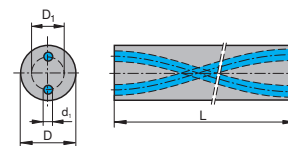
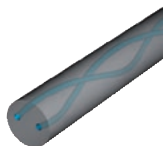


D [mm]	L [mm]	Type, description	D ₁ [mm]	d ₁ [mm]	Nominal pitch		CTS20D
					[mm]	[°]	
10.30	330	50R2 1030/2,3/0,7/26,0-330	2.30	0.70	26.00	50.4	●
12.30	330	51R2 1230/2,3/0,7/30,1-330	2.30	0.70	30.10	51.4	●
13.30	330	50R2 1330/2,6/0,7/34,0-330	2.60	0.70	34.00	50.2	●
16.30	330	50R2 1630/3,7/1,0/42,0-330	3.70	1.00	42.00	50.1	●
20.30	330	50R2 2030/4,4/1,2/52,7-330	4.40	1.20	52.70	50.0	●

● = stock item

Other grades and dimensions upon request

With two coolant holes (extra-long, 23° – 49°)

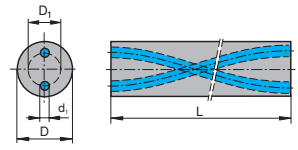
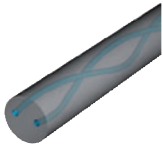


D [mm]	L [mm]	Type, description	D ₁ [mm]	d ₁ [mm]	Nominal pitch		CTS20D
					[mm]	[°]	
6.30	430	46R2 0630/1,6/0,5/18,0-430	1.60	0.50	18.00	46.3	●
6.30	430	40R2 0630/1,9/0,7/22,5-430	1.90	0.70	22.50	40.0	●
6.30	430	30R2 0630/2,2/0,7/32,7-430	2.20	0.70	32.70	30.0	●

● = stock item

Other grades and dimensions upon request

With two coolant holes (extra-long, 23° – 49°)

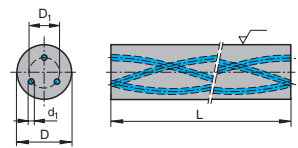
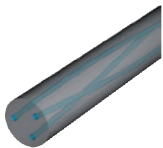


D [mm]	L [mm]	Type, description	D ₁ [mm]	d ₁ [mm]	Nominal pitch		CTS20D
					[mm]	[°]	
6.30	430	30R2 0630/3,0/0,9/32,7-430	3.00	0.90	32.70	30.0	●
8.30	430	30R2 0830/3,4/1,0/43,5-430	3.40	1.00	43.50	30.0	●
10.30	430	30R2 1030/4,8/1,3/54,4-430	4.80	1.30	54.40	30.0	●
10.30	530	30R2 1030/4,8/1,3/54,4-530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

● = stock item

Other grades and dimensions upon request

With three coolant holes



D [mm]	L [mm]	Type, description	D ₁ [mm]	d ₁ [mm]	Nominal pitch		CTS20D
					[mm]	[°]	
6.30	330	30R3 0630/3,0/0,6/32,7-330	3.00	0.60	32.7	31.2	●
8.30	330	40R3 0830/2,9/0,7/30,0-330	2.90	0.70	30.0	40.0	●
8.30	330	30R3 0830/4,0/0,75/43,5-330	4.00	0.75	43.5	30.0	●
10.30	330	40R3 1030/3,5/0,75/37,0-330	3.50	0.75	37.0	40.3	●
10.30	330	30R3 1030/4,9/1,0/54,4-330	4.90	1.00	54.4	30.0	●
12.30	330	40R3 1230/4,0/0,9/44,9-330	4.00	0.90	44.9	40.0	●
12.30	330	30R3 1230/6,0/1,1/65,3-330	6.00	1.10	65.3	30.0	●
14.30	330	40R3 1430/4,65/1,2/52,4-330	4.65	1.20	52.4	40.0	●
14.30	330	30R3 1430/7,1/1,3/76,2-330	7.10	1.30	76.2	30.0	●
16.30	330	40R3 1630/5,5/1,2/59,9-330	5.50	1.20	59.9	40.0	●
16.30	330	30R3 1630/8,3/1,5/87,0-330	8.30	1.50	87.0	30.0	●
18.30	330	40R3 1830/6,25/1,5/67,4-330	6.25	1.50	67.4	40.0	●

● = stock item

Other grades and dimensions upon request

Rods with helical coolant holes

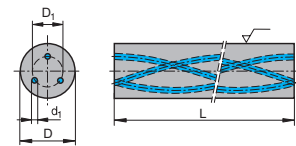
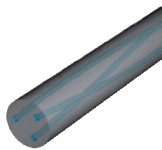
As sintered

As sintered

Rods with helical coolant holes



With three coolant holes

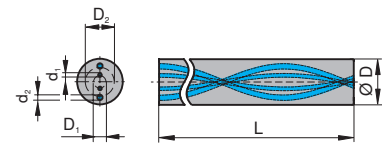
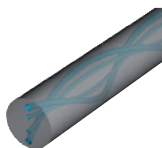


D [mm]	L [mm]	Type, description	D ₁ [mm]	d ₁ [mm]	Nominal pitch		CTS20D
					[mm]	[°]	
18.30	330	30R3 1830/9,6/1,7/98,0-330	9.60	1.70	98.0	30.0	●
20.30	330	40R3 2030/7,1/1,5/74,9-330	7.10	1.50	74.9	40.0	●
20.30	330	30R3 2030/10,4/2,0/108,8-330	10.40	2.00	108.8	30.0	●
22.30	330	40R3 2230/7,7/1,7/82,4-330	7.70	1.70	82.4	40.0	●
22.30	330	30R3 2230/10,7/2,0/119,7-330	10.70	2.00	119.7	30.0	●
25.30	330	40R3 2530/8,1/1,7/93,6-330	8.10	1.70	93.6	40.0	●
25.30	330	33R3 2530/11,5/2,2/119,0-330	11.50	2.20	119.0	33.4	●

● = stock item

Other grades and dimensions upon request

With four coolant holes

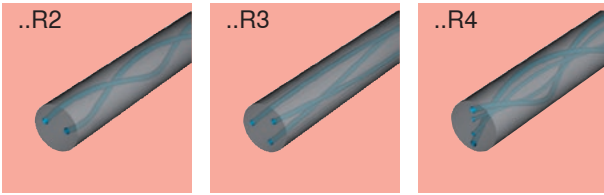


D [mm]	L [mm]	Type, description	D ₁ [mm]	D ₂ [mm]	d ₁ [mm]	d ₂ [mm]	Nominal pitch		CTS20D
							[mm]	[°]	
8.30	330	33R4 0830/1,9/3,9/0,4/0,8/38-330	1.90	3.90	0.40	0.80	38.10	33.4	●
8.30	330	30R4 0830/2,2/4,5/0,45/0,9/44-330	2.20	4.50	0.45	0.90	43.50	29.7	●
10.30	330	33R4 1030/2,5/5,1/0,5/1,0/49-330	2.50	5.10	0.50	1.00	49.00	32.7	●
10.30	330	30R4 1030/2,8/5,7/0,6/1,1/54-330	2.80	5.70	0.60	1.10	54.40	30.0	●
12.30	330	32R4 1230/3,1/6,3/0,7/1,2/60-330	3.10	6.30	0.70	1.20	59.90	32.2	●
12.30	330	30R4 1230/3,4/6,9/0,7/1,4/65-330	3.40	6.90	0.70	1.40	65.30	30.0	●
14.30	330	32R4 1430/3,6/7,5/0,8/1,5/70-330	3.60	7.50	0.80	1.50	70.70	31.9	●
14.30	330	30R4 1430/3,9/8,1/0,8/1,6/76-330	3.90	8.10	0.80	1.60	76.20	30.0	●
16.30	330	30R4 1630/4,4/9,0/0,9/1,8/87-330	4.40	9.00	0.90	1.80	87.10	30.0	●
18.30	330	30R4 1830/5,0/10,2/1,0/2,0/98-330	5.00	10.20	1.00	2.00	98.00	30.0	●
20.30	330	30R4 2030/5,6/11,4/1,2/2,3/109-330	5.60	11.40	1.20	2.30	108.80	30.0	●
22.30	330	30R4 2230/6,1/12,6/1,2/2,5/120-330	6.10	12.60	1.20	2.50	119.70	30.0	●
25.30	330	29R4 2530/6,9/14,1/1,4/2,8/139-330	6.90	14.10	1.40	2.80	139.30	29.4	●

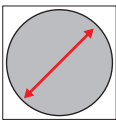
● = stock item

Other grades and dimensions upon request

Specifications

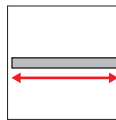


Outside diameter



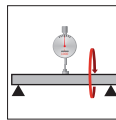
Outside diameter [mm]	Tolerance core diameter [mm]	Tolerance outside diameter [mm]
3.3 – 4.3	+0.10/+0.20	+0.20/+0.60
4.4 – 8.3	+0.10/+0.30	+0.20/+0.70
8.4 – 10.3	+0.10/+0.35	+0.20/+0.75
10.4 – 12.3	+0.10/+0.40	+0.25/+0.80
12.4 – 14.3	+0.10/+0.40	+0.30/+0.80
14.4 – 16.3	+0.10/+0.45	+0.35/+0.95
16.4 – 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

Length



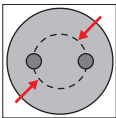
Total length tolerance [mm]
+0/+10

Straightness



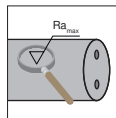
Length [mm]	max. deflection [mm]
250 – 280	0.4
> 280	0.5

Pitch circle diameter



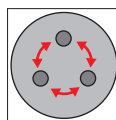
Outside diameter [mm]	Tolerance [mm]
≤ 3.3	+/-0.10
3.4 – 4.3	+/-0.15
4.4 – 12.3	+/-0.20
12.4 – 18.3	+/-0.25
18.4 – 35.3	+/-0.30

Surface finish



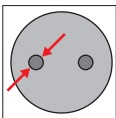
Ra_max [μm]
as sintered

Pitch error



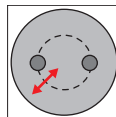
max. pitch error with ..R3 [°]
+/-3

Hole diameter



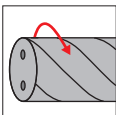
Outside diameter [mm]	Hole diameter [mm]	Tolerance [mm]
3.3 – 4.3	≤ 1.00	+/-0.030
3.3 – 4.3	≥ 1.01	+/-0.050
4.4 – 35.3	0.40 – 1.30	+/-0.050
4.4 – 35.3	1.31 – 2.50	+/-0.075
4.4 – 35.3	2.51 – 5.00	+/-0.100

Excentricity



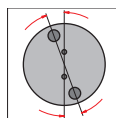
Outside diameter [mm]	Tolerance [mm]
3.3	0.04
3.4 – 4.3	0.05
4.4 – 8.3	0.10
8.4 – 10.3	0.15
10.4 – 14.3	0.18
14.4 – 35.3	0.20

Helix angle



Product group	Total tolerance class [°]	Number of classes	Tolerance class [°]
standard	+/-1	3	+/-0.33
> 330 mm, 3 coolant h.	+/-0.75	6	+/-0.125

Torsion



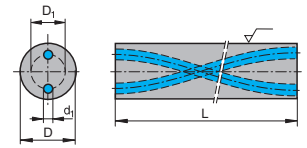
max. torsion with ..R4 [°]
2.0

➔ For further information go to page 108.

Rods with helical coolant holes

Ground

With two helical coolant holes ($\leq 22^\circ$)

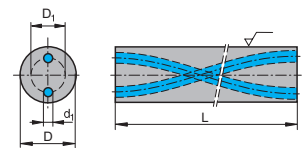
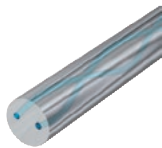


D [mm]	L [mm]	Type, description	Dia. tol.		D ₁ [mm]	d ₁ [mm]	Nominal pitch		CTS20D
			[mm]				[mm]	[°]	
8.00	330	15G2 0800/3,6/1,25/93,8-330	+0/-0.009	h6	3.60	1.25	93.80	15.0	●
6.00	330	15G2 0600/2,6/0,7/70,35-330	+0/-0.008	h6	2.60	0.70	70.35	15.0	●
10.00	330	15G2 1000/4,80/1,40/117,25-330	+0/-0.009	h6	4.80	1.40	117.25	15.0	●
12.00	330	15G2 1200/6,25/1,55/140,70-330	+0/-0.011	h6	6.25	1.55	140.70	15.0	●
14.00	330	15G2 1400/6,70/1,90/164,14-330	+0/-0.011	h6	6.70	1.90	164.14	15.0	●
16.00	330	15G2 1600/8,0/2,10/187,59-330	+0/-0.011	h6	8.00	2.10	187.59	15.0	●
18.00	330	15G2 1800/9,0/2,3/211,0-330	+0/-0.011	h6	9.00	2.30	211.00	15.0	●

▲ = new stock item

Other grades and dimensions upon request

With two coolant holes ($23^\circ - 49^\circ$)

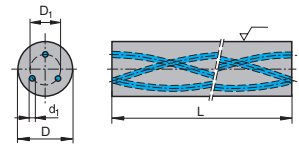
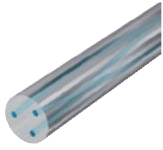


D [mm]	L [mm]	Type, description	Dia. tol.		D ₁ [mm]	d ₁ [mm]	Nominal pitch		CTS20D
			[mm]				[mm]	[°]	
6.00	330	40G2 0600/1,9/0,7/22,5-330	+0/-0.008	h6	1.90	0.70	22.50	40.0	●
6.00	330	30G2 0600/3,0/0,9/32,7-330	+0/-0.008	h6	3.00	0.90	32.70	30.0	●
8.00	330	43G2 0800/2,3/0,7/27,2-330	+0/-0.009	h6	2.30	0.70	27.20	42.7	●
8.00	330	30G2 0800/3,4/1,0/43,5-330	+0/-0.009	h6	3.40	1.00	43.50	30.0	●
10.00	330	40G2 1000/2,7/0,8/37,0-330	+0/-0.009	h6	2.70	0.80	37.00	40.0	●
10.00	330	30G2 1000/4,8/1,3/54,4-330	+0/-0.009	h6	4.80	1.30	54.40	30.0	●
12.00	330	39G2 1200/3,5/1,0/46,3-330	+0/-0.011	h6	3.50	1.00	46.30	39.0	●
12.00	330	30G2 1200/6,3/1,7/65,3-330	+0/-0.011	h6	6.30	1.70	65.30	30.0	●
14.00	330	40G2 1400/4,6/1,3/52,4-330	+0/-0.011	h6	4.60	1.30	52.40	40.0	●
14.00	330	30G2 1400/6,7/1,8/76,2-330	+0/-0.011	h6	6.70	1.80	76.20	30.0	●
16.00	330	40G2 1600/5,5/1,2/59,9-330	+0/-0.011	h6	5.50	1.20	59.90	40.0	●
16.00	330	30G2 1600/8,0/2,0/87,1-330	+0/-0.011	h6	8.00	2.00	87.10	30.0	●
18.00	330	40G2 1800/6,3/1,7/68,0-330	+0/-0.011	h6	6.30	1.70	68.00	39.7	●
18.00	330	30G2 1800/9,3/2,7/98,0-330	+0/-0.011	h6	9.30	2.70	98.00	30.0	●
20.00	330	40G2 2000/7,1/1,5/74,9-330	+0/-0.013	h6	7.10	1.50	74.90	40.0	●
20.00	330	30G2 2000/10,0/2,5/108,8-330	+0/-0.013	h6	10.00	2.50	108.80	30.0	●
25.00	330	40G2 2500/7,7/1,75/93,6-330	+0/-0.013	h6	7.70	1.75	93.60	40.0	●
25.00	330	33G2 2500/12,0/3,2/119,0-330	+0/-0.013	h6	12.0	3.20	119.00	33.4	●
32.00	330	40G2 3200/11,0/2,0/119,8-330	+0/-0.016	h6	11.00	2.00	119.80	40.0	●
32.00	330	29G2 3200/17,0/3,0/177,8-330	+0/-0.016	h6	17.00	3.00	177.80	29.5	●

● = stock item

Other grades and dimensions upon request

With three coolant holes



D [mm]	L [mm]	Type, description	Dia. tol.		D ₁ [mm]	d ₁ [mm]	Nominal pitch		CTS20D
			[mm]				[mm]	[°]	
6.00	330	30G3 0600/3,0/0,6/32,7-330	+0/-0.008	h6	3.00	0.60	32.70	30	●
8.00	330	30G3 0800/4,0/0,75/43,5-330	+0/-0.009	h6	4.00	0.75	43.50	30	●
10.00	330	30G3 1000/4,9/1,0/54,4-330	+0/-0.009	h6	4.90	1.00	54.40	30	●
12.00	330	30G3 1200/6,0/1,1/65,3-330	+0/-0.011	h6	6.00	1.10	65.30	30	●
14.00	330	30G3 1400/7,1/1,3/76,2-330	+0/-0.011	h6	7.10	1.30	76.20	30	●
16.00	330	30G3 1600/8,3/1,5/87,0-330	+0/-0.011	h6	8.30	1.50	87.00	30	●
18.00	330	30G3 1800/9,6/1,7/98,0-330	+0/-0.011	h6	9.60	1.70	98.00	30	●
20.00	330	30G3 2000/10,4/2,0/108,8-330	+0/-0.013	h6	10.40	2.00	108.80	30	●
25.00	330	33G3 2500/11,5/2,2/119,0-330	+0/-0.013	h6	11.50	2.20	119.00	33	●

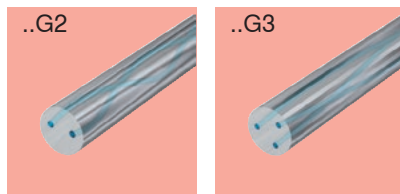
● = stock item

Other grades and dimensions upon request

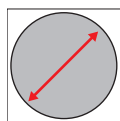
Rods with helical coolant holes

Ground

Specifications

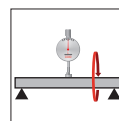


Outside diameter



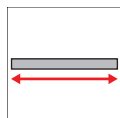
Outside diameter [mm]	Tolerance [mm]
6.0	+0/-0.008
6.1 – 10.0	+0/-0.009
10.1 – 18.0	+0/-0.011
18.1 – 30.0	+0/-0.013
30.1 – 32.0	+0/-0.016

Straightness



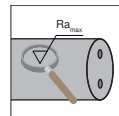
Outside diameter [mm]	max. deflection [mm]
6.0 – 7.9	0.12
8.0 – 9.9	0.10
10.0 – 11.9	0.08
12.0 – 19.9	0.05
20.0 – 32.0	< 0.05

Length



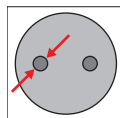
Total length tolerance [mm]
+0/+10

Surface finish



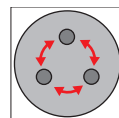
Ra _{max} [μm]
0.05

Hole diameter



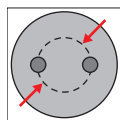
Hole diameter [mm]	Tolerance [mm]
0.40 – 1.30	+/-0.050
1.31 – 2.50	+/-0.075
2.51 – 5.00	+/-0.100

Pitch error



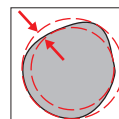
max. pitch error with ..G3 [°]
+/-3.0

Pitch circle diameter



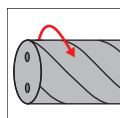
Outside diameter [mm]	Tolerance [mm]
6.0 – 12.3	+/-0.20
12.4 – 18.3	+/-0.25
18.4 – 32.0	+/-0.30

Roundness



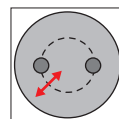
Outside diameter [mm]	Tolerance [mm]
6.0	0.004
6.1 – 10.0	0.005
10.1 – 30.0	0.006
30.1 – 32.0	0.008

Helix angle

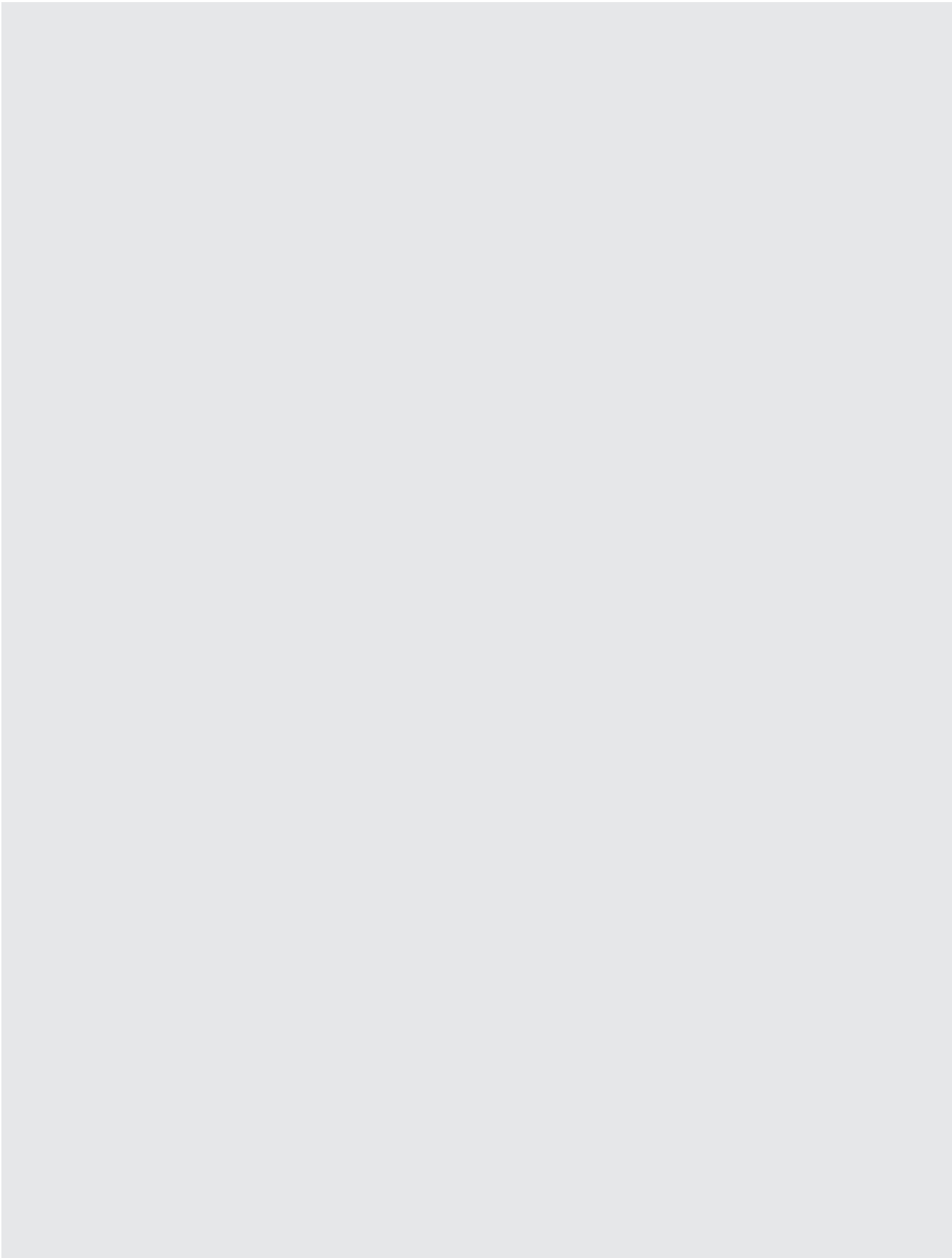


Product group	Total tolerance class [°]	Number of classes	Tolerance class [°]
standard	+/-1	3	+/-0.33
> 330 mm, 3 coolant h.	+/-0.75	6	+/-0.125

Excentricity



Outside diameter [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

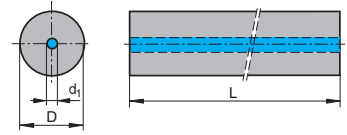
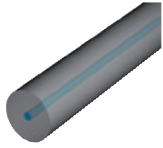


Rods with straight coolant holes

The ideal blank – sintered or ground – can be provided for every tooling configuration. In addition to our established high-performance carbides we now offer selected dimensions in the new cermet grade, CTF28T, developed specifically for the finish machining of steel.



With central coolant hole, ultra-fine grades

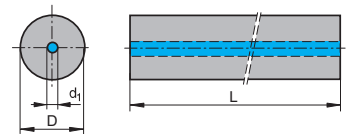
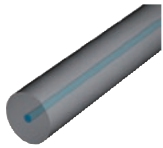


D [mm]	L [mm]	Type, description	d ₁ [mm]	TSF44
6.45	330	00R1 0645/1,0-330	1.00	●
8.55	330	00R1 0855/1,3-330	1.30	●
10.55	330	00R1 1055/1,3-330	1.30	●
10.55	330	00R1 1055/2,0-330	2.00	●
12.55	330	00R1 1255/2,0-330	2.00	●
14.70	330	00R1 1470/2,0-330	2.00	●
16.70	330	00R1 1670/2,0-330	2.00	●
20.70	330	00R1 2070/3,0-330	3.00	●

● = stock item

Other grades and dimensions upon request

With central coolant hole, submicron grades



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

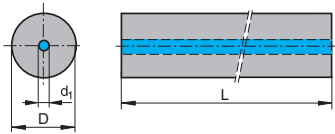
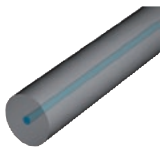
● = stock item

Other grades and dimensions upon request

Rods with straight coolant holes

As sintered

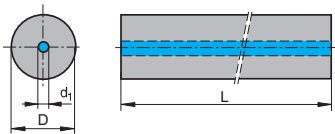
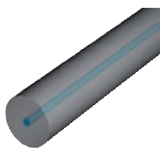
With central coolant hole, submicron grades



D [mm]	L [mm]	Type, description	d ₁ [mm]	CTS15D	CTS20D
28.30	330	00R1 2830/4,0-330	4.00		●
30.30	330	00R1 3030/5,0-330	5.00		●
32.30	330	00R1 3230/5,0-330	5.00		●

● = stock item
Other grades and dimensions upon request

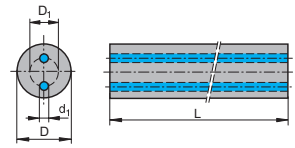
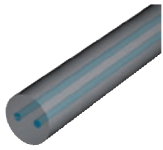
With central coolant hole, cermet



D [mm]	L [mm]	Type, description	d ₁ [mm]	CTF28T
6.45	330	00R1 0645/1,0-330	1.00	●
8.55	330	00R1 0855/1,3-330	1.30	●
10.55	330	00R1 1055/2,0-330	2.00	●
12.55	330	00R1 1255/2,0-330	2.00	●

● = stock item
Other grades and dimensions upon request

With two straight coolant holes, submicron grades



D [mm]	L [mm]	Type, description	D ₁ [mm]	d ₁ [mm]	CTS15D	CTS20D
3.30	330	00R2 0330/1,1/0,425-330	1.10	0.425	●	
3.70	228	00R2 0370/1,75/0,55-228	1.75	0.55		
4.20	330	00R2 0420/1,1/0,45-330	1.10	0.45	●	
5.20	330	00R2 0520/2,0/0,9-330	2.00	0.90	●	●
5.20	279	00R2 0520/2,3/0,75-279	2.30	0.75		
6.20	330	00R2 0620/1,1/0,5-330	1.10	0.50	●	
6.20	330	00R2 0620/1,5/0,9-330	1.50	0.90	●	
6.20	330	00R2 0620/1,7/0,6-330	1.70	0.60	●	●
6.20	330	00R2 0620/2,0/0,9-330	2.00	0.90	●	●
6.20	330	00R2 0620/2,3/0,9-330	2.30	0.90	●	
6.20	330	00R2 0620/2,6/0,9-330	2.60	0.90		●
6.20	330	00R2 0620/3,0/1,2-330	3.00	1.20	●	
6.80	309	00R2 0680/2,9/0,95-309	2.90	0.95		
7.20	330	00R2 0720/2,0/0,9-330	2.00	0.90	●	●
7.20	330	00R2 0720/3,0/0,9-330	3.00	0.90		●
8.20	330	00R2 0820/2,0/0,9-330	2.00	0.90	●	●
8.20	330	00R2 0820/2,6/0,9-330	2.60	0.90	●	
8.20	330	00R2 0820/2,6/1,2-330	2.60	1.20		●
8.20	330	00R2 0820/3,4/1,0-330	3.40	1.00		●
8.20	330	00R2 0820/3,5/1,5-330	3.50	1.50	●	
8.20	330	00R2 0820/4,0/0,9-330	4.00	0.90	●	●
9.20	330	00R2 0920/2,6/1,2-330	2.60	1.20		●
9.20	330	00R2 0920/3,5/1,5-330	3.50	1.50	●	
9.20	330	00R2 0920/3,8/1,2-330	3.80	1.20		●
9.20	330	00R2 0920/4,0/1,3-330	4.00	1.30	●	
10.20	330	00R2 1020/2,0/1,0-330	2.00	1.00	●	
10.20	330	00R2 1020/2,6/1,2-330	2.60	1.20		●
10.20	330	00R2 1020/2,8/1,0-330	2.80	1.00	●	
10.20	330	00R2 1020/3,5/1,5-330	3.50	1.50	●	
10.20	330	00R2 1020/4,2/1,4-330	4.20	1.40	●	●
10.20	330	00R2 1020/5,0/1,2-330	5.00	1.20	●	
10.20	330	00R2 1020/5,2/1,4-330	5.20	1.40	●	
12.20	330	00R2 1220/2,6/1,2-330	2.60	1.20	●	
12.20	330	00R2 1220/3,5/1,5-330	3.50	1.50	●	●
12.20	330	00R2 1220/4,8/1,5-330	4.80	1.50	●	
12.20	330	00R2 1220/5,0/2,0-330	5.00	2.00	●	●
12.20	330	00R2 1220/6,0/1,5-330	6.00	1.50	●	
13.20	330	00R2 1320/5,4/2,0-330	5.40	2.00		●
14.20	330	00R2 1420/3,5/1,5-330	3.50	1.50		●
14.20	330	00R2 1420/5,0/2,0-330	5.00	2.00	●	●
14.20	330	00R2 1420/5,0/1,7-330	5.00	1.70	●	
14.20	330	00R2 1420/5,8/2,0-330	5.80	2.00		●
14.20	330	00R2 1420/7,0/2,0-330	7.00	2.00	●	
15.20	330	00R2 1520/5,0/2,0-330	5.00	2.00	●	

● = stock item

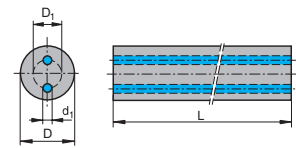
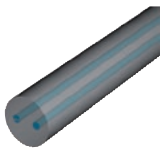
Other grades and dimensions upon request

Rods with straight coolant holes

As sintered



With two straight coolant holes, submicron grades



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

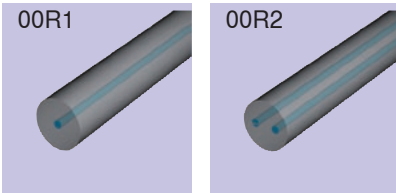
● = stock item

Other grades and dimensions upon request

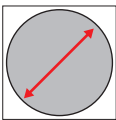
As sintered

Rods with straight coolant holes

Specifications

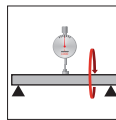


Outside diameter



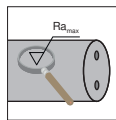
Outside diameter [mm]	Tolerance [mm]
3.3	+0/+0.20
3.4 – 5.0	+0/+0.30
5.1 – 6.5	+0/+0.35
6.6 – 15.2	+0/+0.40
15.3 – 20.7	+0/+0.55
20.8 – 22.2	+0/+0.65
22.3 – 34.3	+0/+0.75

Straightness



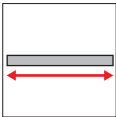
max. deflection [mm]
0.5

Surface finish



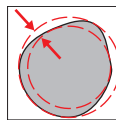
Ra _{max} [μm]
as sintered

Length



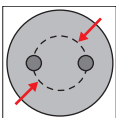
Total length tolerance [mm]
+0/+10

Roundness



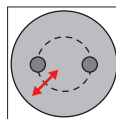
Outside diameter [mm]	Tolerance [mm]
3.3 – 5.7	0.05
6.2 – 7.7	0.08
8.2 – 12.7	0.10
13.2 – 30.2	0.13
30.3 – 34.3	0.16

Pitch circle diameter



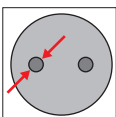
Outside diameter [mm]	Tolerance [mm]
3.3 – 3.9	+/-0.05
4.0 – 5.9	+/-0.10
6.0 – 14.9	+/-0.20
15.0 – 20.9	+/-0.25
21.0 – 34.3	+/-0.30

Excentricity



Outside diameter [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

Hole diameter



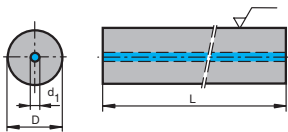
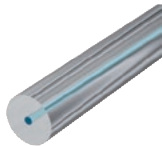
Product group	Hole diameter [mm]	Tolerance [mm]
00R1	0.10 – 0.50	+0.05
00R1	0.51 – 1.30	+0.10
00R1	1.31 – 2.50	+0.15
00R1	2.51 – 5.00	+0.20
00R2	0.10 – 0.50	+/-0.025
00R2	0.51 – 1.30	+/-0.050
00R2	1.31 – 2.50	+/-0.075
00R2	2.51 – 5.00	+/-0.100

Rods with straight coolant holes

Ground



With central coolant hole, submicron grades

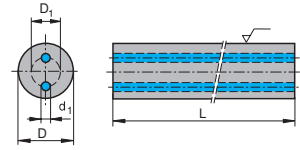


D [mm]	L [mm]	Type, description	Dia. tol.		d ₁ [mm]	CTS15D
			[mm]			
6.00	330	00G1 0600/1,0-330	+0/-0.008	h6	1.00	●
8.00	330	00G1 0800/1,3-330	+0/-0.009	h6	1.30	●
10.00	330	00G1 1000/2,0-330	+0/-0.009	h6	2.00	●
12.00	330	00G1 1200/2,0-330	+0/-0.011	h6	2.00	●
14.00	330	00G1 1400/2,0-330	+0/-0.011	h6	2.00	●
16.00	330	00G1 1600/2,0-330	+0/-0.011	h6	2.00	●
16.00	330	00G1 1600/3,0-330	+0/-0.011	h6	3.00	●
20.00	330	00G1 2000/3,0-330	+0/-0.013	h6	3.00	●
25.00	330	00G1 2500/3,0-330	+0/-0.013	h6	3.00	●
32.00	330	00G1 3200/5,0-330	+0/-0.016	h6	5.00	●

● = stock item

Other grades and dimensions upon request

With two straight coolant holes, submicron grades



D [mm]	L [mm]	Type, description	Dia. tol.		D ₁ [mm]	d ₁ [mm]	CTS15D
			[mm]				
6.00	330	00G2 0600/1,5/0,9-330	+0/-0.008	h6	1.50	0.90	●
6.00	330	00G2 0600/3,0/1,2-330	+0/-0.008	h6	3.00	1.20	●
8.00	330	00G2 0800/2,0/0,9-330	+0/-0.009	h6	2.00	0.90	●
8.00	330	00G2 0800/4,0/0,9-330	+0/-0.009	h6	4.00	0.90	●
10.00	330	00G2 1000/2,8/1,0-330	+0/-0.009	h6	2.80	1.00	●
10.00	330	00G2 1000/5,2/1,4-330	+0/-0.009	h6	5.20	1.40	●
12.00	330	00G2 1200/3,5/1,5-330	+0/-0.011	h6	3.50	1.50	●
12.00	330	00G2 1200/6,0/1,5-330	+0/-0.011	h6	6.00	1.50	●
14.00	330	00G2 1400/5,0/1,7-330	+0/-0.011	h6	5.00	1.70	●
14.00	330	00G2 1400/7,0/2,0-330	+0/-0.011	h6	7.00	2.00	●
16.00	330	00G2 1600/5,0/1,5-330	+0/-0.011	h6	5.00	1.50	●
16.00	330	00G2 1600/8,0/2,0-330	+0/-0.011	h6	8.00	2.00	●
18.00	330	00G2 1800/6,0/2,0-330	+0/-0.011	h6	6.00	2.00	●
18.00	330	00G2 1800/9,0/2,0-330	+0/-0.011	h6	9.00	2.00	●
20.00	330	00G2 2000/10,0/2,5-330	+0/-0.013	h6	10.00	2.50	●
20.00	330	00G2 2000/6,2/2,0-330	+0/-0.013	h6	6.20	2.00	●
25.00	330	00G2 2500/12,0/3,0-330	+0/-0.013	h6	12.00	3.00	●
25.00	330	00G2 2500/6,2/2,0-330	+0/-0.013	h6	6.20	2.00	●
25.00	330	00G2 2500/8,0/2,0-330	+0/-0.013	h6	8.00	2.00	●

● = stock item

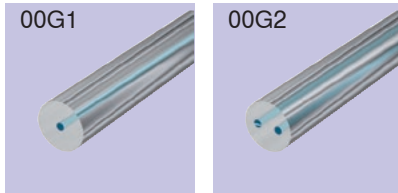
Other grades and dimensions upon request

Rods with straight coolant holes

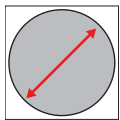
Ground

72

Specifications

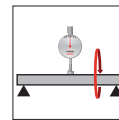


Outside diameter



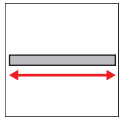
Outside diameter [mm]	Tolerance [mm]
4.0 – 6.0	+0/-0.008
6.1 – 10.0	+0/-0.009
10.1 – 18.0	+0/-0.011
18.1 – 30.0	+0/-0.013
30.1 – 32.0	+0/-0.016

Straightness



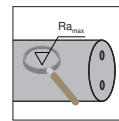
Outside diameter [mm]	max. deflection [mm]
4.0 – 5.9	0.15
6.0 – 7.9	0.12
8.0 – 9.9	0.10
10.0 – 11.9	0.08
12.0 – 19.9	0.05
20.0 – 32.0	< 0.05

Length



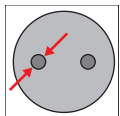
Total length tolerance [mm]
+0/+10

Surface finish



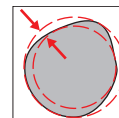
Ra _{max} [μm]
0.05

Hole diameter



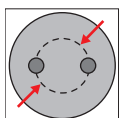
Product group	Hole diameter [mm]	Tolerance [mm]
00G1	0.10 – 0.50	+0.05
00G1	0.51 – 1.30	+0.10
00G1	1.31 – 2.50	+0.15
00G1	2.51 – 5.00	+0.20
00G2	0.10 – 0.50	+/-0.025
00G2	0.51 – 1.30	+/-0.050
00G2	1.31 – 2.50	+/-0.075
00G2	2.51 – 5.00	+/-0.100

Roundness



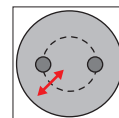
Outside diameter [mm]	Tolerance [mm]
4.0 – 6.0	0.004
6.1 – 10.0	0.005
10.1 – 30.0	0.006
30.1 – 32.0	0.008

Pitch circle diameter

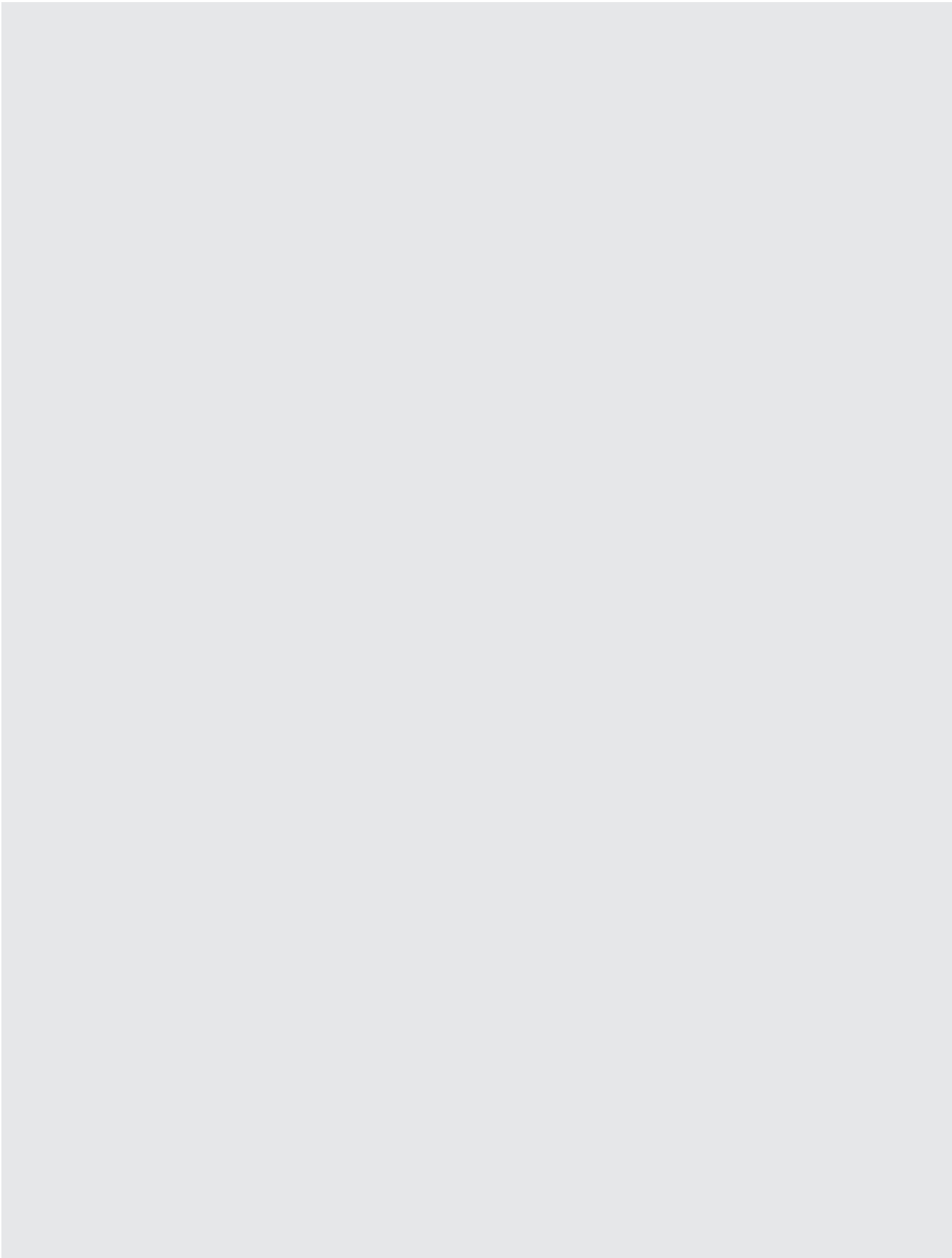


Outside diameter [mm]	Tolerance [mm]
4.0 – 5.9	+/-0.10
6.0 – 14.9	+/-0.20
15.0 – 20.9	+/-0.25
21.0 – 34.3	+/-0.30

Excentricity

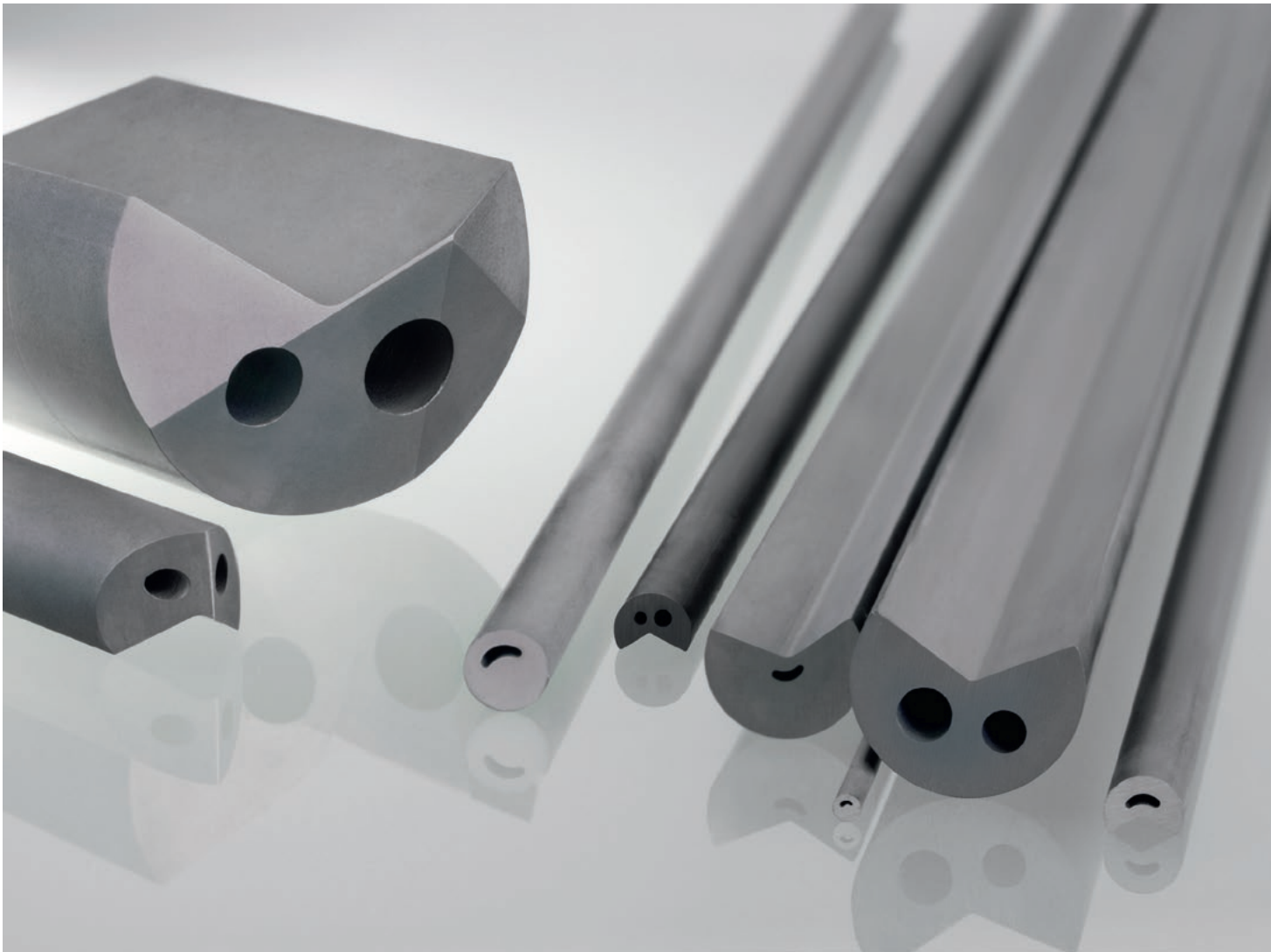


Outside diameter [mm]	max. excentricity [mm]
4.0 – 5.9	0.050
6.0 – 7.9	0.100
8.0 – 10.9	0.120
11.0 – 24.9	0.150
25.0 – 32.0	0.200

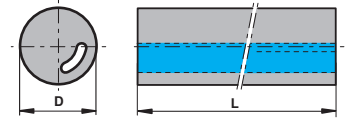
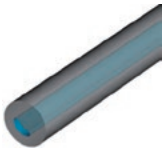


Blanks for gun drills

We offer a complete stock range of profiled rods and tips for the production of gun drills in solid carbide and carbide tipped gun drills. Now also available in the new grade, CTF12E, a fine grain carbide for gun drills with an improved balance of hardness and toughness.



Rods with kidney-shaped coolant holes, submicron grades



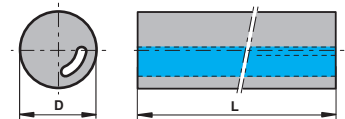
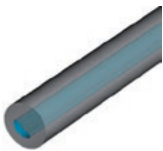
D [mm]	L [mm]	Type, description	Dia. tol. [mm]	CTS20D
2.40	310	GDRK 0240-310	±0.15	●
2.60	310	GDRK 0260-310	±0.15	●
2.90	310	GDRK 0290-310	±0.15	●
3.15	310	GDRK 0315-310	±0.15	●
3.45	310	GDRK 0345-310	±0.15	●
3.50	310	GDRK 0350-310	±0.15	●
3.90	310	GDRK 0390-310	±0.15	●
4.40	310	GDRK 0440-310	±0.15	●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

● = stock item

○ = limited stock

Other grades, dimensions or engineering drawings upon request

Rods with kidney-shaped coolant holes, fine grain grades



D [mm]	L [mm]	Type, description	Dia. tol. [mm]	CTF12E
2.40	310	GDRK 0240-310	±0.15	●
2.60	310	GDRK 0260-310	±0.15	○
2.90	310	GDRK 0290-310	±0.15	●
3.15	310	GDRK 0315-310	±0.15	●
3.45	310	GDRK 0345-310	±0.15	●
3.50	310	GDRK 0350-310	±0.15	○
3.90	310	GDRK 0390-310	±0.15	●
4.40	310	GDRK 0440-310	±0.15	●

● = stock item

○ = limited stock

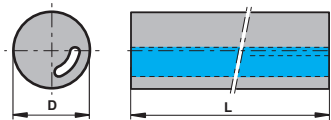
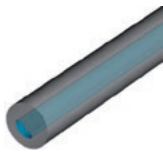
Other grades, dimensions or engineering drawings upon request

Blanks for gun drills

Rods



Rods with kidney-shaped coolant holes, fine grain grades



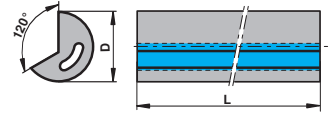
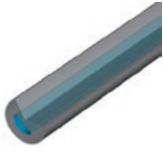
D [mm]	L [mm]	Type, description	Dia. tol. [mm]	CTF12E
4.90	310	GDRK 0490-310	±0.15	●
5.50	310	GDRK 0550-310	±0.15	●
6.00	310	GDRK 0600-310	±0.15	○
6.50	310	GDRK 0650-310	±0.15	●
7.10	310	GDRK 0710-310	±0.15	○
7.60	310	GDRK 0760-310	±0.15	○
8.10	310	GDRK 0810-310	±0.15	○
8.30	310	GDRK 0830-310	±0.15	●
8.70	310	GDRK 0870-310	±0.15	●
9.20	310	GDRK 0920-310	±0.15	●
10.60	310	GDRK 1060-310	±0.15	○
11.30	310	GDRK 1130-310	±0.15	○

● = stock item
○ = limited stock
Other grades, dimensions or engineering drawings upon request

Rods

Blanks for gun drills

With kidney-shaped coolant holes, 120°, submicron grades



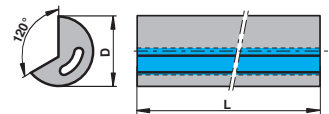
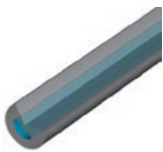
D [mm]	L [mm]	Type, description	Dia. tol. [mm]	CTS20D
2.40	310	GDVK 0240-310	±0.15	○
2.60	310	GDVK 0260-310	±0.15	○
2.90	310	GDVK 0290-310	±0.15	○
3.15	310	GDVK 0315-310	±0.15	●
3.45	310	GDVK 0345-310	±0.15	●
3.90	310	GDVK 0390-310	±0.15	●
4.40	310	GDVK 0440-310	±0.15	●
4.90	310	GDVK 0490-310	±0.15	●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

● = stock item

○ = limited stock

Other grades, dimensions or engineering drawings upon request

With kidney-shaped coolant holes, 120°, fine grain grades



D [mm]	L [mm]	Type, description	Dia. tol. [mm]	CTF12E
2.40	310	GDVK 0240-310	±0.15	●
2.60	310	GDVK 0260-310	±0.15	●
2.90	310	GDVK 0290-310	±0.15	●
3.15	310	GDVK 0315-310	±0.15	●
3.45	310	GDVK 0345-310	±0.15	●
3.90	310	GDVK 0390-310	±0.15	●
4.40	310	GDVK 0440-310	±0.15	●
4.90	310	GDVK 0490-310	±0.15	●
5.50	310	GDVK 0550-310	±0.15	●
6.00	310	GDVK 0600-310	±0.15	●
6.50	310	GDVK 0650-310	±0.15	●
7.10	310	GDVK 0710-310	±0.15	●
7.60	310	GDVK 0760-310	±0.15	●

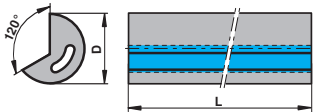
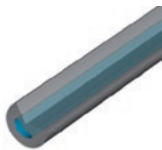
● = stock item

Other grades, dimensions or engineering drawings upon request

Blanks for gun drills

Rods

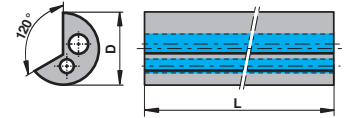
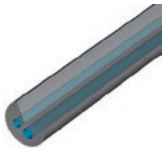
With kidney-shaped coolant holes, 120°, fine grain grades



D [mm]	L [mm]	Type, description	Dia. tol. [mm]	CTF12E
8.10	310	GDVK 0810-310	±0.15	●
8.70	310	GDVK 0870-310	±0.15	●
9.20	310	GDVK 0920-310	±0.15	●

● = stock item
Other grades, dimensions or engineering drawings upon request

Profiled rods with two coolant holes, 120°, fine grain grades



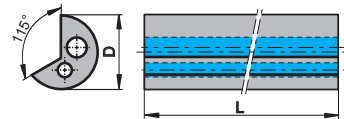
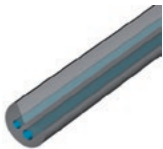
D [mm]	L [mm]	Type, description	Dia. tol. [mm]	CTF12E
5.50	310	GDV2 0550-310	±0.15	●
6.00	310	GDV2 0600-310	±0.15	○
6.50	310	GDV2 0650-310	±0.15	●
7.10	310	GDV2 0710-310	±0.15	●
7.60	310	GDV2 0760-310	±0.15	●
8.10	310	GDV2 0810-310	±0.15	●
8.70	310	GDV2 0870-310	±0.15	●
9.20	310	GDV2 0920-310	±0.15	●
9.70	310	GDV2 0970-310	±0.15	●
10.80	310	GDV2 1080-310	±0.15	●
11.30	310	GDV2 1130-310	±0.15	●
11.80	310	GDV2 1180-310	±0.15	●
12.30	310	GDV2 1230-310	±0.15	●
12.80	310	GDV2 1280-310	±0.15	●

● = stock item

○ = limited stock

Other grades, dimensions or engineering drawings upon request

With two coolant holes, 115°, fine grain grades

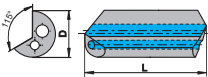
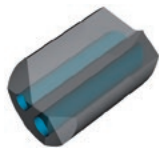


D [mm]	L [mm]	Type, description	Dia. tol. [mm]	CTF12E
13.50	310	GDV2 1350/115-310	±0.20	●
13.90	310	GDV2 1390/115-310	±0.20	●
15.50	310	GDV2 1450/115-310	±0.20	●
15.50	310	GDV2 1550/115-310	±0.20	●
16.50	310	GDV2 1650/115-310	±0.20	●
17.50	310	GDV2 1750/115-310	±0.20	●
18.60	310	GDV2 1860/115-310	±0.20	●
19.60	310	GDV2 1960/115-310	±0.25	●
20.60	310	GDV2 2060/115-310	±0.25	●
21.60	310	GDV2 2160/115-310	±0.25	●

● = stock item

Other grades, dimensions or engineering drawings upon request

With two coolant holes, 115°, fine grain grades



D [mm]	L [mm]	Type, description	Dia. tol. [mm]	CTF12E
13.50	40	GDV2P 1350-040	±0.20	●
14.50	40	GDV2P 1450-040	±0.20	●
15.50	40	GDV2P 1550-040	±0.20	●
16.50	40	GDV2P 1650-040	±0.25	●
17.50	40	GDV2P 1750-040	±0.20	●
18.60	40	GDV2P 1860-040	±0.25	●
19.60	45	GDV2P 1960-045	±0.25	●
20.60	45	GDV2P 2060-045	±0.25	●
21.60	45	GDV2P 2160-045	±0.25	●
22.60	50	GDV2P 2260-050	±0.25	●
23.60	50	GDV2P 2360-050	±0.25	●
24.60	55	GDV2P 2460-055	±0.25	●
25.60	55	GDV2P 2560-055	±0.25	●
26.60	55	GDV2P 2660-055	±0.25	●
27.20	55	GDV2P 2720-055	±0.25	●
28.70	65	GDV2P 2870-065	±0.25	●
30.80	65	GDV2P 3080-065	±0.25	●
33.10	65	GDV2P 3310-065	±0.25	●
36.10	75	GDV2P 3610-075	±0.25	●
39.10	75	GDV2P 3910-075	±0.25	●
40.00	80	GDV2P 4000-080	±0.30	●
42.00	80	GDV2P 4200-080	±0.30	●
45.00	80	GDV2P 4500-080	±0.30	●

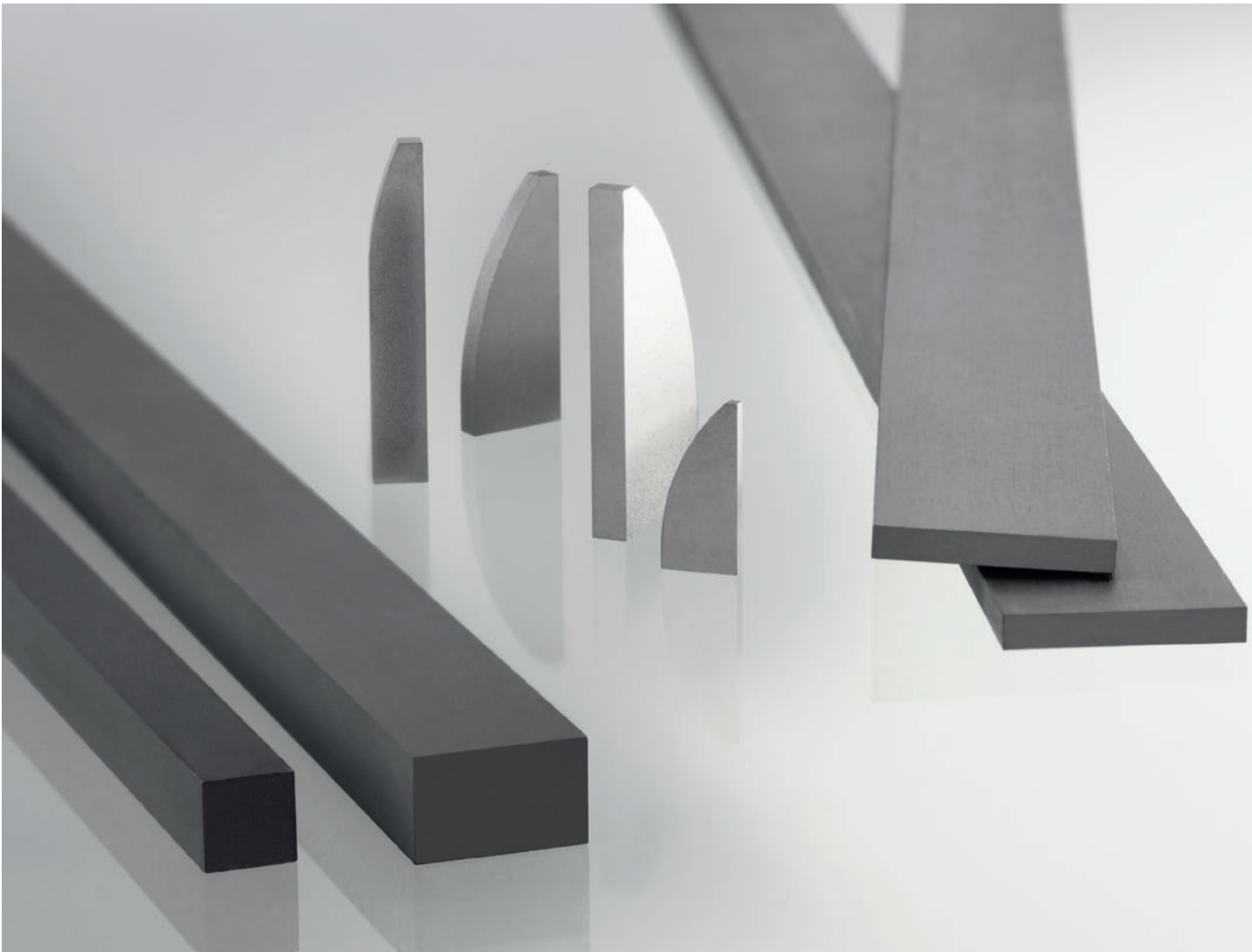
● = stock item

Other grades, dimensions or engineering drawings upon request

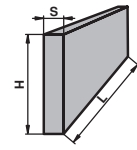


Square and rectangular strips, brazing tips

Our square and rectangular strips will be dispatched to you in a variety of dimensions directly from stock. Our brazing tips are characterised by very good brazability and are available upon request in the most common DIN dimensions.



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	●

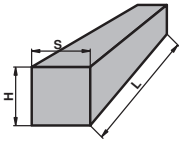
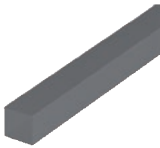
● = stock item

Other grades and dimensions upon request

Square and rectangular strips, brazing tips

Square strips

Square strips

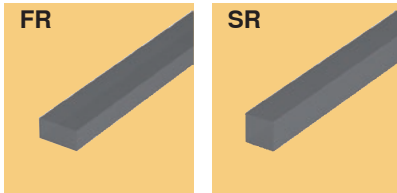


Type, description	H [mm]	S [mm]	L [mm]	CTS20D
SR 0330-330	3.30	3.30	330	●
SR 0430-330	4.30	4.30	330	●
SR 0530-330	5.30	5.30	330	●
SR 0830-330	8.30	8.30	330	●
SR 1030-330	10.30	10.30	330	●

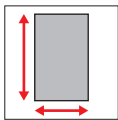
● = stock item

Other grades and dimensions upon request

Specifications

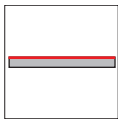


Width, height



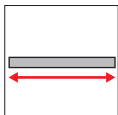
Width, height [mm]	Tolerance [mm]
2,3 – 4,3	+0/+0,20
4,4 – 6,3	+0/+0,25
6,4 – 10,3	+0/+0,30
10,4 – 14,3	+0/+0,35
14,4 – 16,3	+0/+0,40
16,4 – 20,3	+0/+0,50

Straightness



Bending [mm]
max. 0.4

Length



Length tolerance [mm]
+0/+10

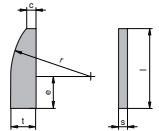
New: Expanded stock range for brazing tips

The competence brand Toolmaker Solutions by CERATIZIT has expanded the stock program with DIN8011 brazing tips. Our brazing tips distinguish themselves by their remarkable brazability and are available in the most common dimensions according to the DIN standard. Our brand new stock range of brazing tips is available in two grades:

CTS12D: Submicron carbide grade with 6% binder and a hardness of 1820 HV30 - ideal for reamers or the machining of aluminium alloys, carbon- and glass-fibre reinforced plastics and other abrasive materials.

CTF28T: Cermet grade particularly for the finish machining of steel. Thanks to high oxidation resistance and low tendency to stick it is particularly suitable for the production of uncoated reamers and the machining of ferrous materials.

R-T-U-shape



Type, description	L [mm]	r [mm]	e [mm]	s [mm]	t [mm]	CTS12D	CTF28T
R 12	12.0	25.0	5.0	0.8	2.0	○	○
R 16	16.0	25.0	7.1	1.2	2.5	●	●
R 19	19.0	25.0	9.0	1.4	3.0	●	●
R 22	22.0	25.0	11.2	1.8	3.5	●	●
R 25	25.0	25.0	15.0	2.2	4.0	●	●
R 30	30.0	25.0	18.0	2.8	5.0	●	●
T 12	12.0	15.0	4.5	1.2	3.0	○	
T 16	16.0	15.0	7.5	1.6	3.5	○	
T 19	19.0	25.0	7.5	2.0	4.5	●	
T 22	22.0	25.0	9.5	2.5	5.6	●	
T 25	25.0	25.0	10.0	2.8	8.0	●	
U 12	12.0	15.0	1.4	1.2	5.6	○	
U 16	16.0	15.0	4.0	1.6	6.7	○	
U 19	19.0	25.0	2.5	2.0	8.0	●	
U 22	22.0	25.0	2.8	2.5	11.2	●	
U 25	25.0	25.0	4.0	2.8	14	●	

● = stock item

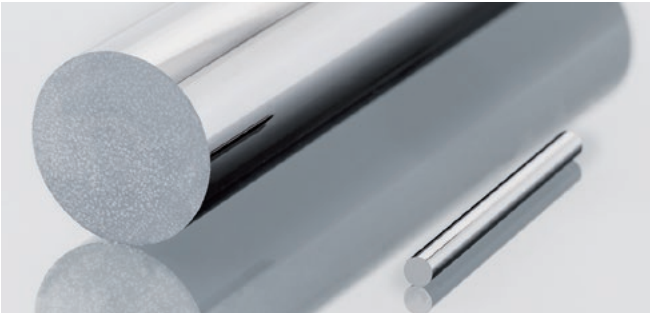
○ = limited stock

Special products

In addition to our standard programme we also offer individual solutions for our rods. Thanks to our comprehensive manufacturing possibilities we can also implement your most demanding requirements. Whether special coolant hole profiles, large helix angles or other customised 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.





- o Broad selection of diameters starting at 0.40 mm , e.g. for erosion electrodes up to 80.00 mm for special milling tools. For semi-finished tools bigger than that we offer customised preforms.



- o Solid carbide or coolant hole rods up to a metre in length are no problem for us. Close tolerance production techniques of spiral through hole rod minimise the risk of grinding through into the coolant channels. Using leading-edge technologies we are also able to deliver coolant hole rod with pre-formed flutes if required.



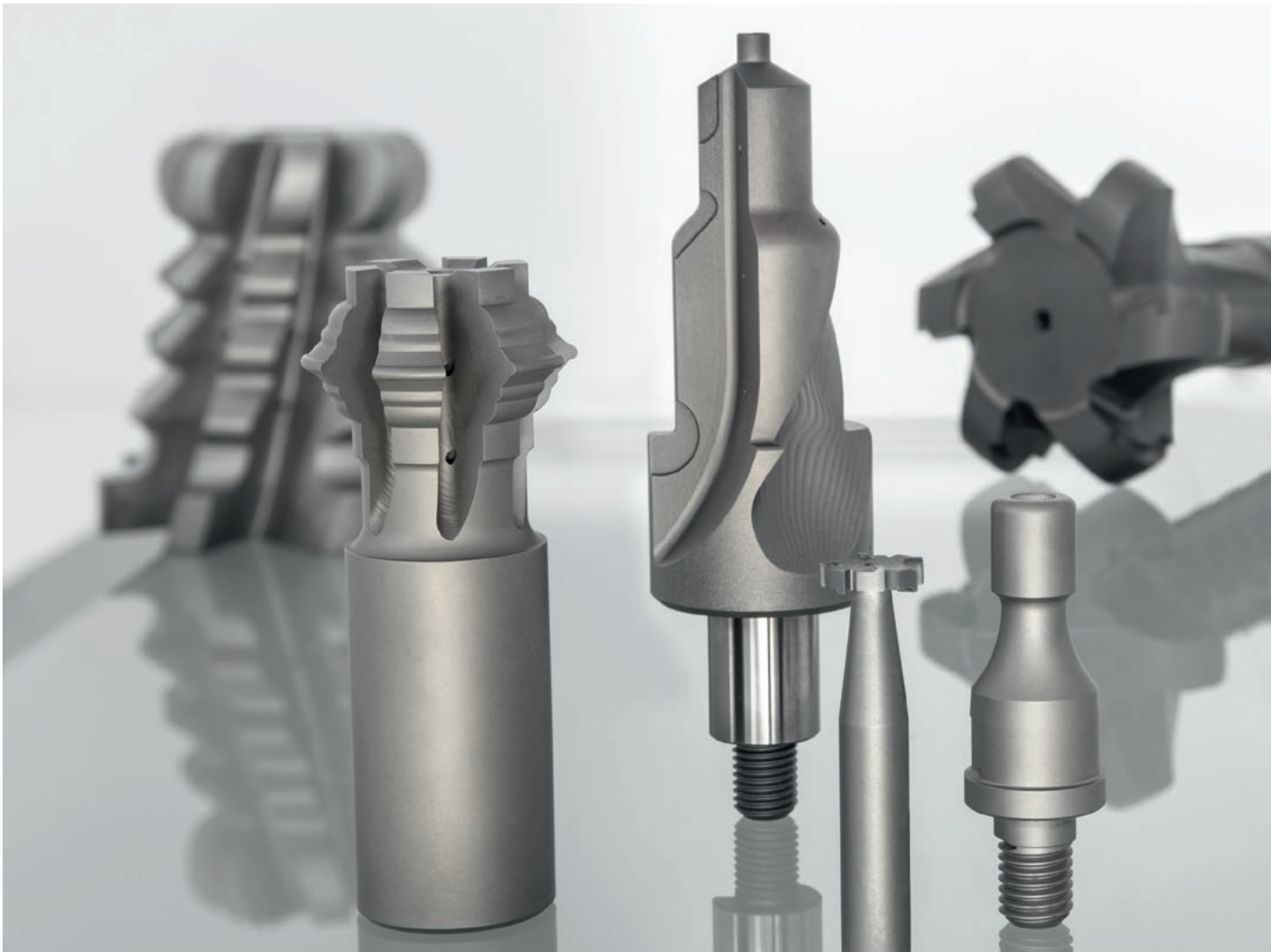
- o Increasingly, tool producers rely on prefabricated semi-finished products. In this context we offer ground cut-to-lengths in a variety of versions. For example steps, tapers, cones, male or female centres, ball noses, chamfers, recesses, ground holes and many others.



- o Thanks to our modern extrusion processes we can offer you a variety of coolant hole profiles.

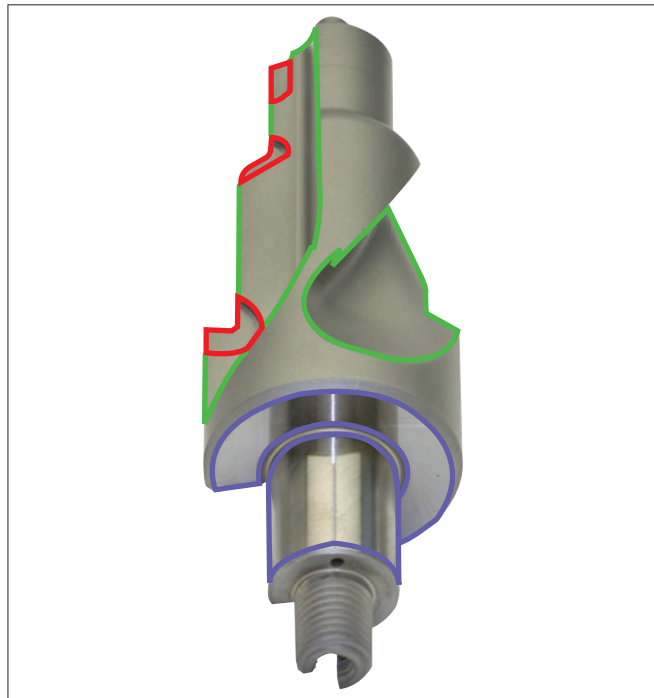
Preforms

In addition to our comprehensive range of rods we also offer various types of preforms for rotary cutting tools. The products include both blanks and semi-finished tools for solid carbide and PCD tools, exchangeable head systems and tool shanks. Years of experience in the field of blank machining combined with a state-of-the-art production plant make it possible for us to produce the most complex, near net shape geometries with short delivery times. In particular for tool shanks and PCD tool bodies we have developed the new grade CTF25E which is ideal even for the most sophisticated executions, problematic jointing applications and critical forms.

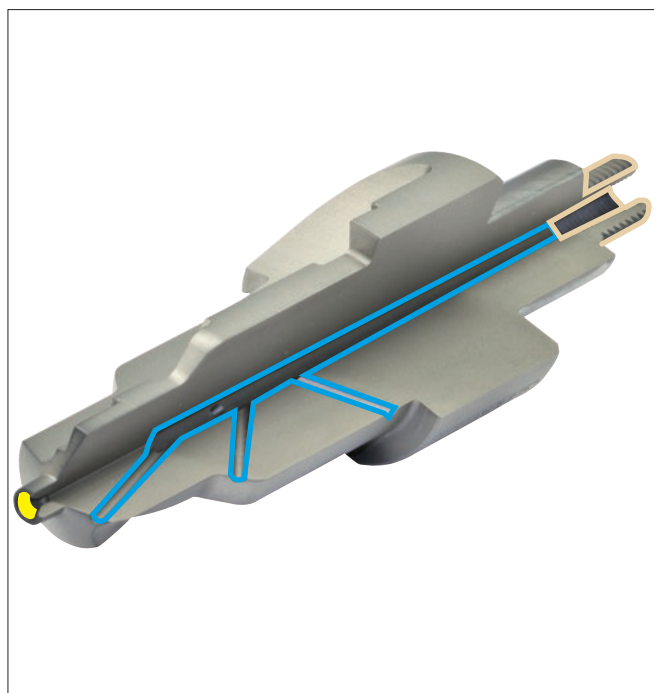


Based on your drawings of blanks or finished parts, we are able to produce outside diameters of up to approx. 300 mm and lengths of approx. 500 mm. Ideally, you should provide us with digital drawings or 3-D models (.stp, .prt,...).

- o Diameter as sintered up to around 500 mm
- o Lengths up to around 300 mm



- 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.

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



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



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



- o Upon request ground version also available
- o 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.

Main grades for preforms

An extensive stock of the most important grades makes shortest delivery times for customised blanks possible.

CERATIZIT grade code	ISO code	U.S. code	Binder [m %]	Density [g/cm³]	Hardness		Transverse rupture strength		K _{IC} * (Shetty) [MPa·m ^{1/2}]
					HV30	HRA	[MPa]	[psi]	

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
	CTS20D	K20 – K40	C-2	10,0	14,38	1600	91,9	4000	580.100	10,4

Fine grades

	CTF25E	K30 – K40	C-2	12,5	14,15	1300	89,5	3500	507.600	15,0
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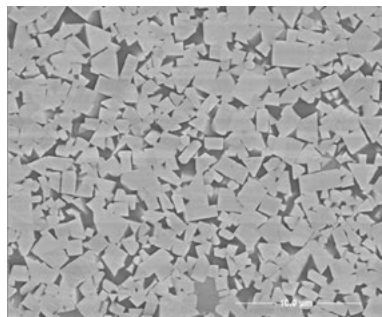
Our new CTF25E fine grain grade has been particularly designed for PCD tools and tool shanks.

The coarser grain structure combined with higher cobalt content provides this grade with increased resistance to breakage and excellent brazability.

CTF25E vs. CTS20D

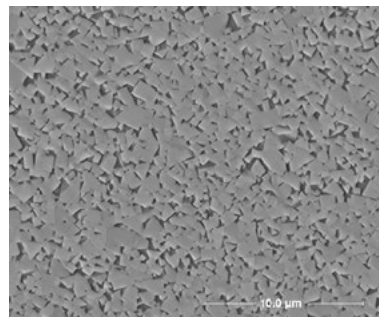
CTF25E

- Medium grain size: fine grain
- Cobalt content: 12,5 %
- Additives: 1,2 %
- Hardness: 1300 HV30
- Transverse rupture strength: 3500 MPa
- Fracture toughness K_{IC}: 15 Mpa·m^{0,5}



CTS20D

- Medium grain size: submicron
- Cobalt content: 10,0 %
- Additives: 1,15 %
- Hardness: 1600 HV30
- Transverse rupture strength: 4000 MPa
- Fracture toughness K_{IC}: 10,4 Mpa·m^{0,5}

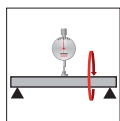


Of course we also offer preforms in all other 'Round Tool Materials' grades upon request.

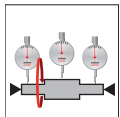
Specifications



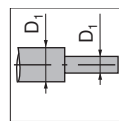
Straightness



max. deflection [mm]
0.3

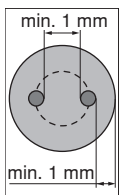


Diameter steps



Different diameters, dia. steps
$D_1 - D_2 \geq 1 \text{ mm}$

Wall thicknesses



Min. wall thicknesses and hole distances
$\geq 1 \text{ mm}$

Tolerance table for preforms

Diameters for preforms

Nominal Ø [mm]	Blank tolerance incl. grinding allowance [mm]	Sintering 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]	Sintering 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.

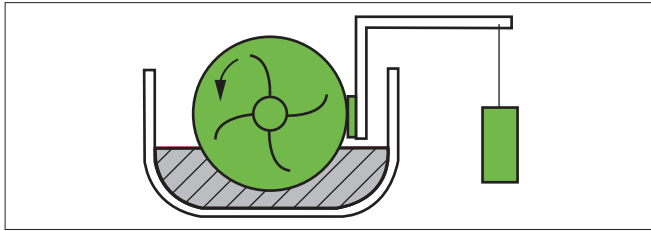
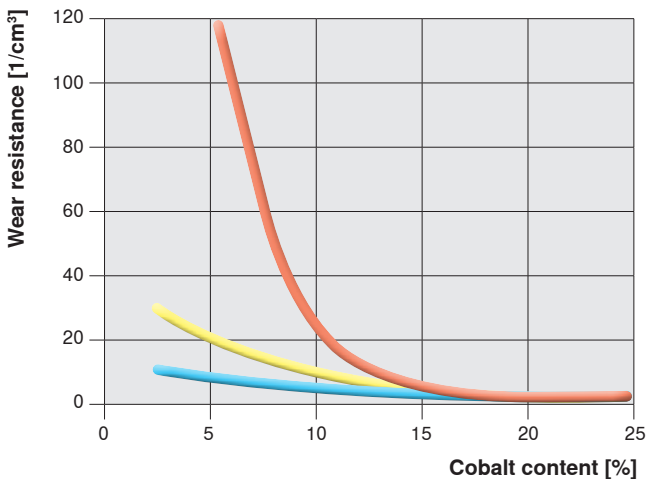


Figure 1: test assembly for the determination of wear resistance according to ASTM B611-85



Submicron grades Coarse grades
Fine / medium grades

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

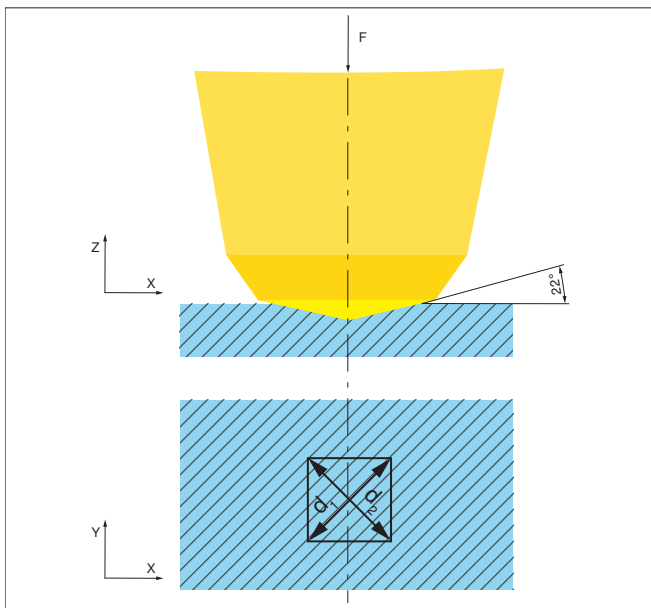


Figure 3: Vickers hardness test according to ISO 3878

$$HV = \frac{0.102 \cdot 2 \cdot F \cdot \sin \frac{136^\circ}{2}}{d^2} \approx 0.1891 \frac{F}{d^2}$$

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 mm³. 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

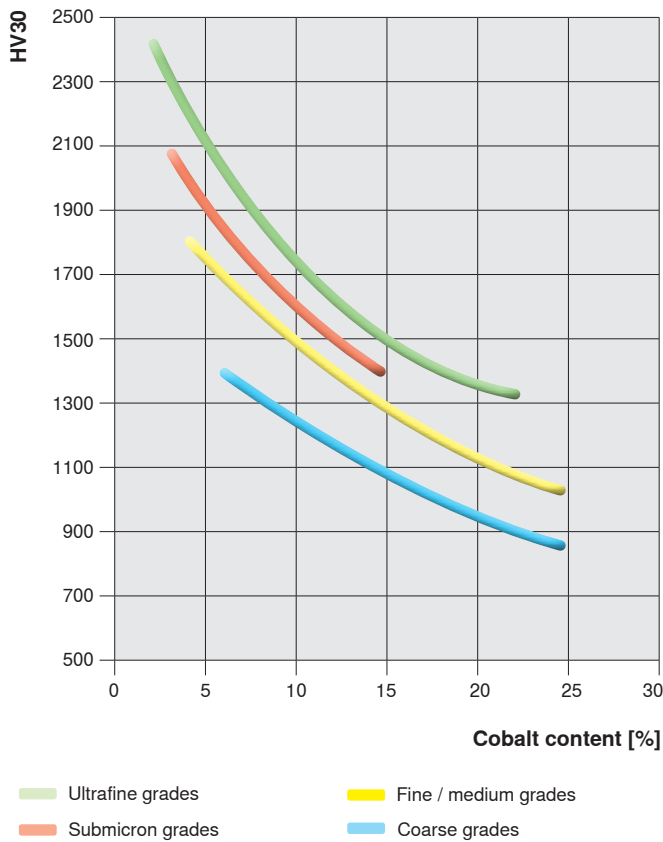


Figure 4: hardness in relation to the cobalt content and grain size

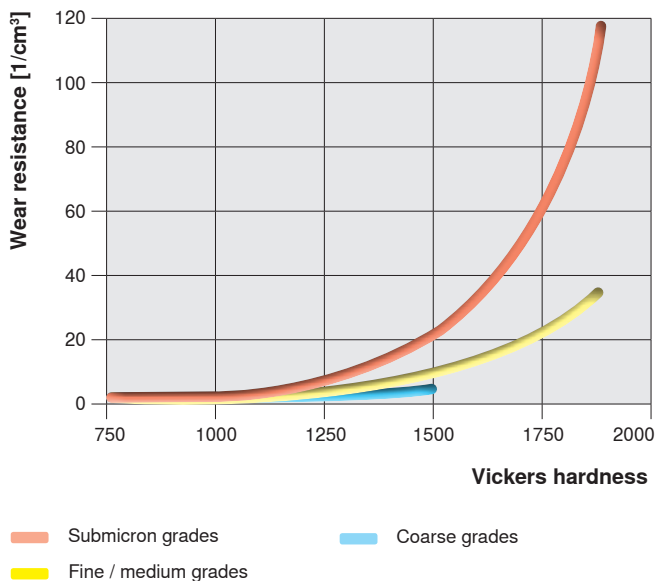


Figure 5: wear resistance in function of hardness with different grain sizes

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).

$$K_{IC} = 0.15 \sqrt{\frac{HV_{30}}{\Sigma L}} \left[\frac{MN}{m^{\frac{3}{2}}} \right]$$

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

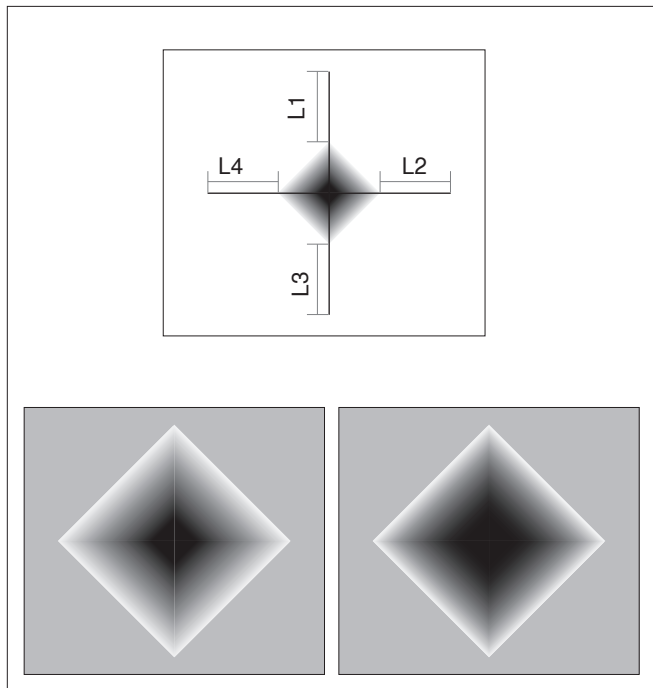


Figure 6: Palmqvist method for the determination of fracture toughness

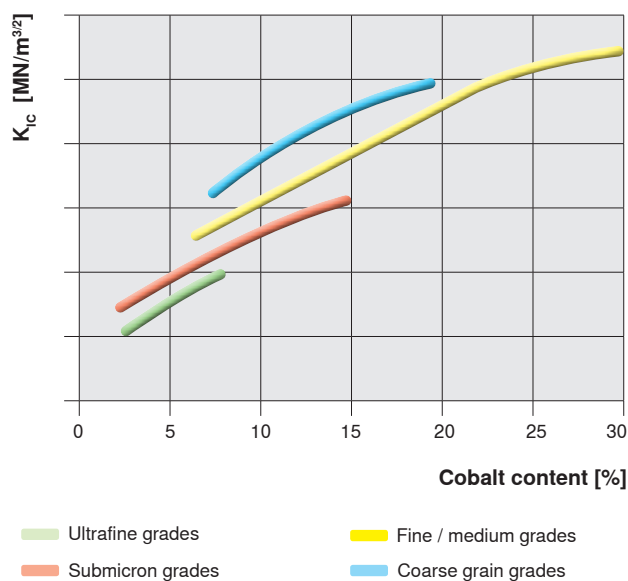


Figure 7: fracture toughness in relation to the grain size and the cobalt content

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.

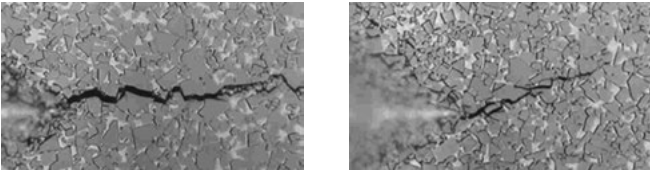


Figure 8: rupture growth in large grain sizes; larger rupture growth - requires higher fracture energy - higher toughness

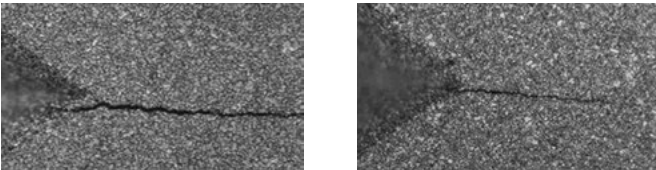


Figure 9: rupture growth in small grain sizes; direct, shorter rupture growth - requires lower fracture energy - lower toughness

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).

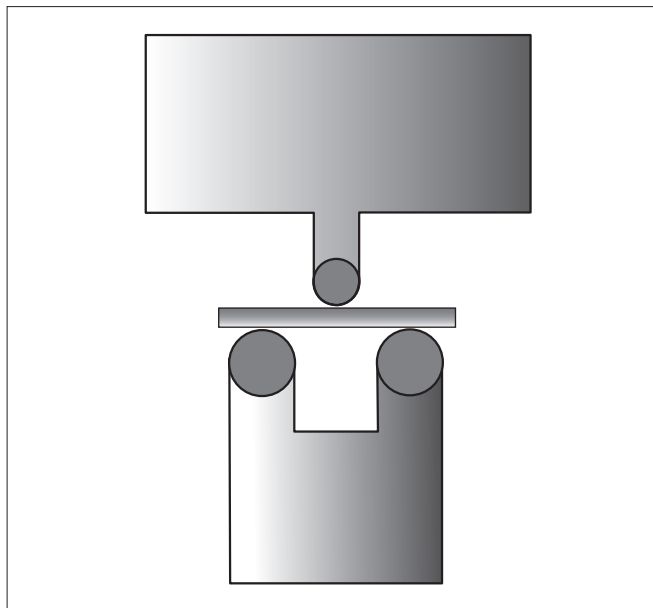


Figure 10: illustration of a transverse rupture strength test

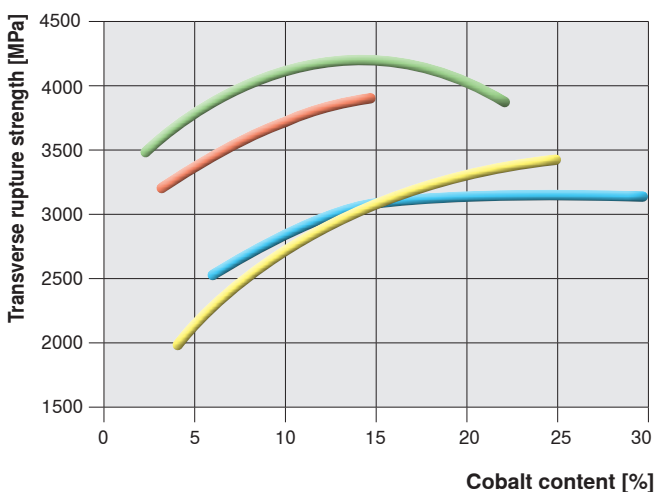


Figure 11: transverse rupture strength in relation to the grain size and the cobalt content

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 $0.2 - 0.5\mu\text{m}$.

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.

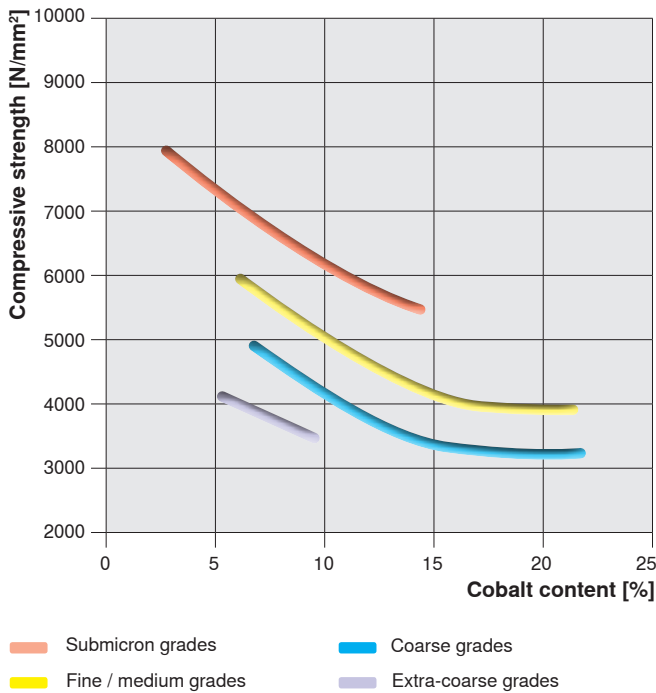


Figure 12: compressive strength in relation to the grain size and the cobalt content

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.

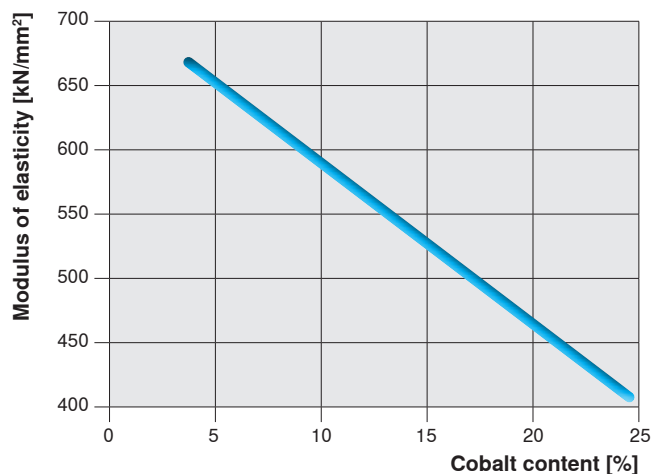


Figure 13: modulus of elasticity of WC-Co carbides

Property	from	to:
Hardness [HV30]	1300	2200
Transverse rupture strength [MPa]	2000	4600
Fracture toughness [MPa * m ^{1/2}]	8,4	15

Figure 14: properties of CERATIZIT round rods and preforms

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.

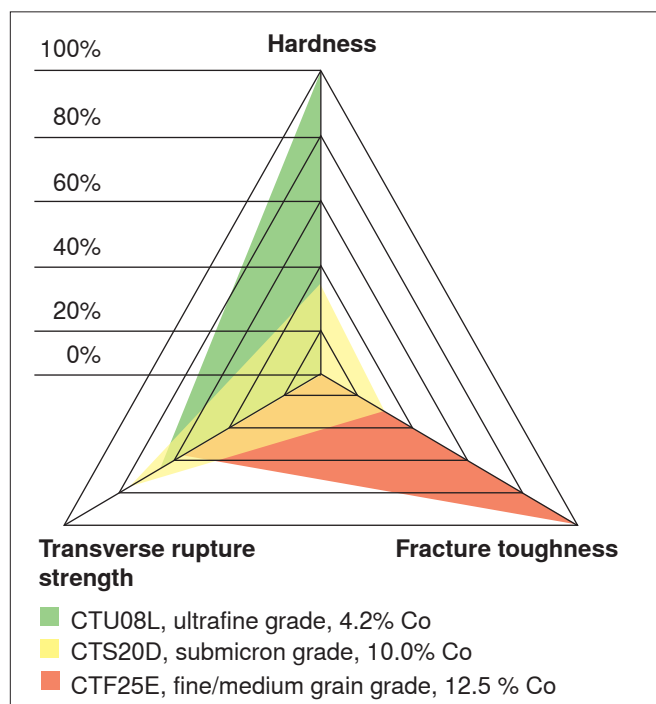


Figure 15: tension fields of three CERATIZIT grades, 0% - lowest value of all grades, 100% - highest value of all grades

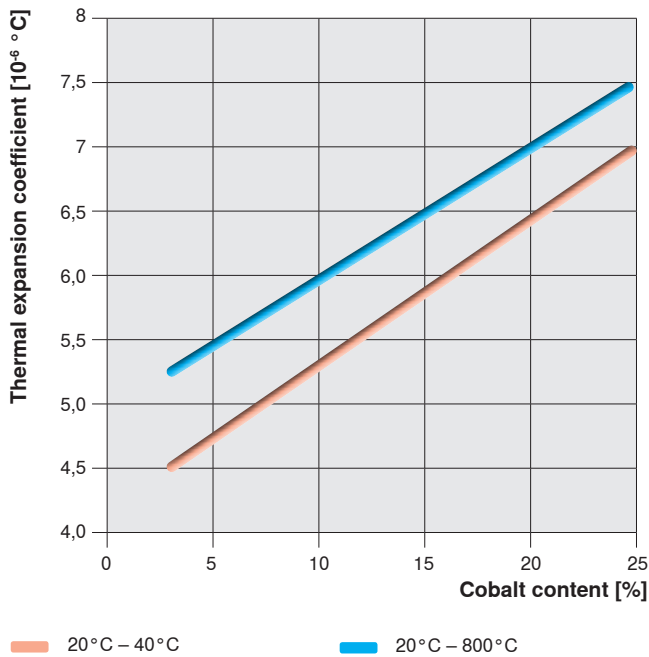


Figure 16: thermal expansion in function of the cobalt content for two temperature intervals

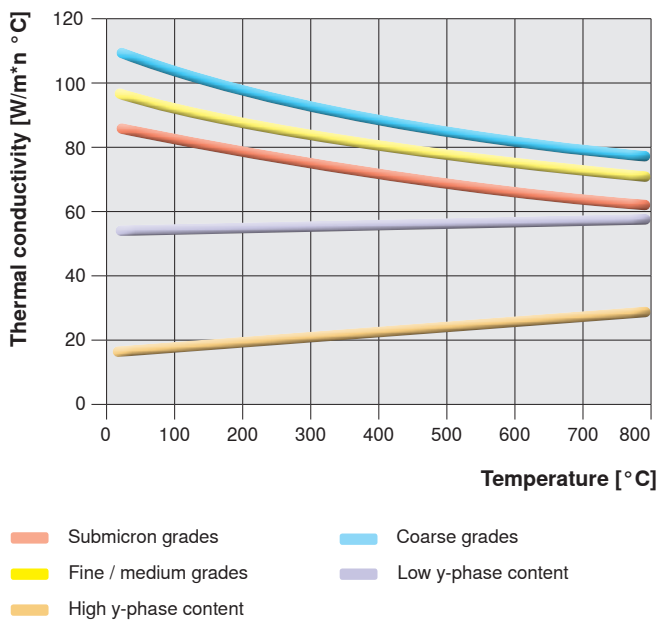


Figure 17: thermal conductivity in relation to the temperature of various micro-structures and grain sizes

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 $20\mu\Omega\text{ cm}$ and, as such, are good conductors of electricity. Carbides with γ -phases have a higher specific resistance.

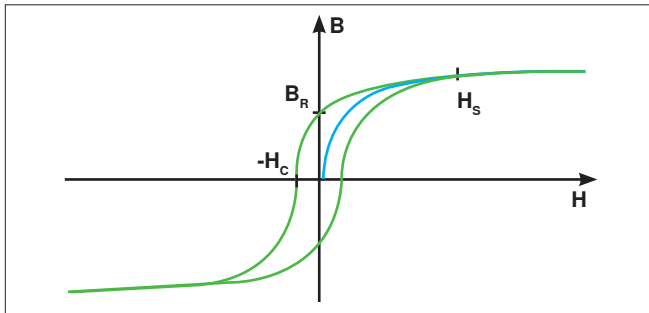


Figure 18: hysteresis curve of a ferromagnetic material

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 ($4\pi\sigma$). 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 (B_R), 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 H_C 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.

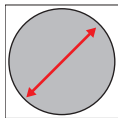
Chemical compounds	Resistance
Acetone	high resistance
Ethanol	high resistance
Sodium hydroxide	high resistance
All acids	low resistance
Tap water	high resistance
Petroleum	high resistance

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

3. Corrosion resistance of carbide

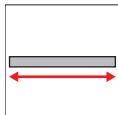
According to DIN EN ISO 8044 corrosion is a reaction of a metal material with its environment, which causes a measurable modification of the material and may lead to a reduced performance of the metal element or the entire system. In most cases the reaction is electrochemical in nature or in some cases 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



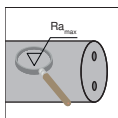
Measured outside diameter of the round rod.

Length



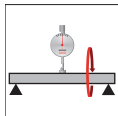
Measured length of the round rod.

Surface



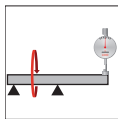
The surface quality describes the state of the surface. For ground rods the surface value is indicated as maximum average roughness value R_a (DIN EN ISO 4287:1998).

Straightness



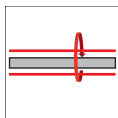
Maximum deflection of a rotating rod which lies on two contact points, measured in the middle of the rod. The distance between the two contact points is 300 mm. When the rod is longer or shorter than 330 mm the contact width corresponds to the rod length minus 10 mm.

Concentricity



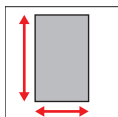
Maximum deflection of a rod. Contact point A is 5 mm before the chamfer. Contact point B is in the middle of the rod. The measurement is carried out 2 mm from the end.

Cylindricity



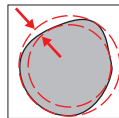
The cylindricity describes the tolerance field of an ideal cylinder inside which the skin surface of the rod should be.

Width, height



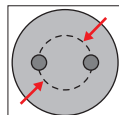
Lateral length of square and rectangular strips.

Roundness



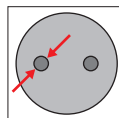
Roundness is the radial distance of two concentric circles which include the circumference line of the round rod's section. (DIN ISO 1101).

Pitch circle diameter



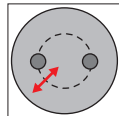
The pitch circle is defined as the circle which goes through two or three centre points of coolant holes.

Hole diameter



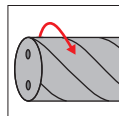
The hole diameter is the diameter of the coolant holes inside the rod.

Excentricity



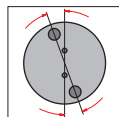
Excentricity means the deviation of the pitch circle centre point or, in case of a coolant hole, the deviation of the coolant hole centre point from the centre point of the rod.

Helix angle



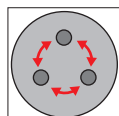
The helix angle is the angle between the longitudinal axis and the helix line.

Torsion

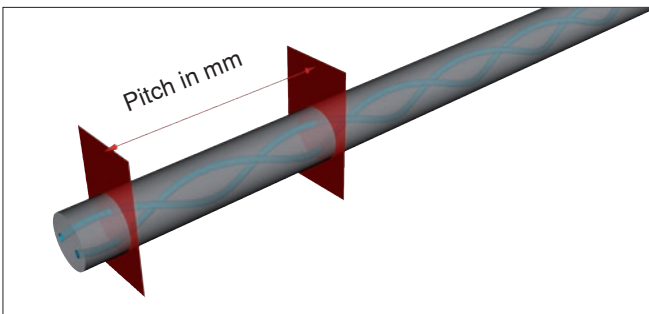
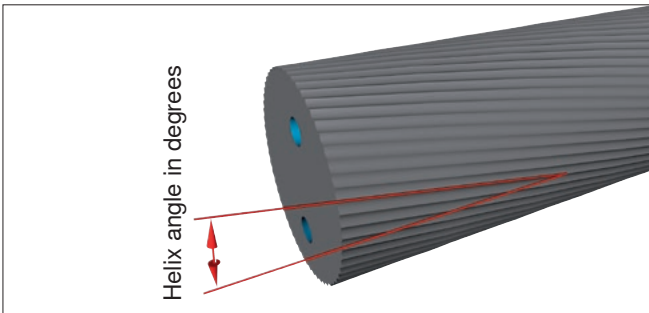


Maximum difference of the angle of the two imaginary lines which go through the centre point of the coolant holes which are on the pitch circle.

Pitch error



For rods with three helical coolant holes the section surface is divided into three 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:

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

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

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 59 and 62.

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We reserve the right to make technical changes for improvement of the product.

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