HARD MATERIAL SOLUTIONS BY CERATIZIT

COMPLETE PROGRAMME
WEAR PARTS
2015

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CERATIZIT

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Dear customers,

From drawing tools for nail production and blanks for the tool and die industry to customised, abrasion-resistant components for specific industries – whatever the application, Hard Material Solutions by CERATIZIT offers the right solution for your wear protection needs. Thanks to our carbide and ceramic products, machines run longer and maintenance is quicker to carry out and less frequently required. The result? Even more efficient production.
In the new 'WEAR PARTS' main catalogue you will find more than 100 carbide grades perfectly suited to your needs. The latest news is that we have once again extended our product range for toolmakers and the metal forming sector. Regardless of the industry you work in, we will continue to look for new applications where individual carbide or ceramic solutions can efficiently replace wear parts – be it in the automotive industry, the medical systems sector, the watch and jewellery or the food industry. Browse through the catalogue and see for yourself which possibilities our carbide innovations create for you.

Made-to-measure solutions from Hard Material Solutions by CERATIZIT give customers decisive competitive advantage. We understand your processes, provide you with individual advice and then find the best solution for your application. Let's talk! We are looking forward to hearing from you!

Your CERATIZIT team

INTRODUCTION
CONTENTS

Welcome to the world of CERATIZIT ...

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

... because 'hard material matters'

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

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

Guided by corporate values

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

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

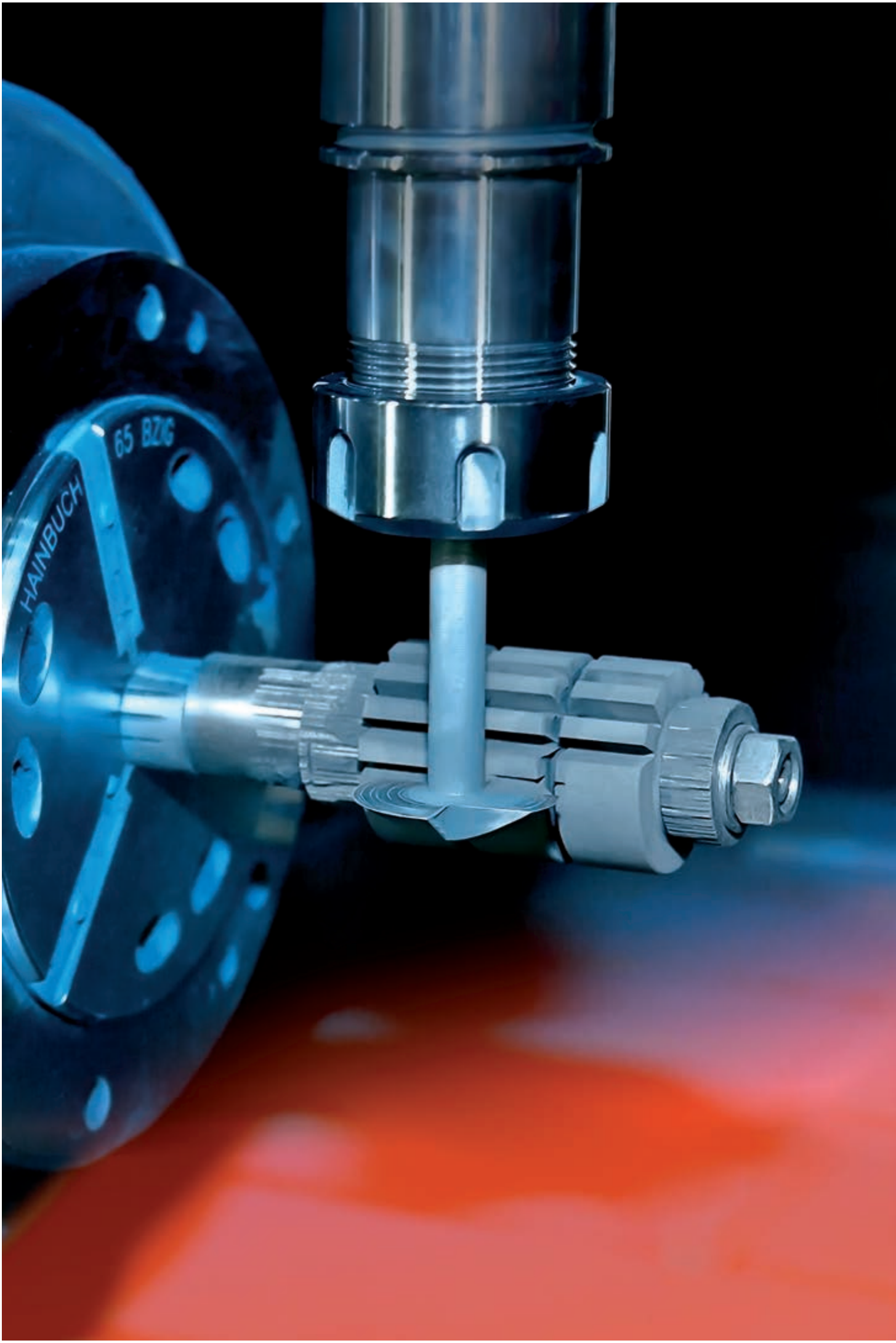
2 Innovative and flexible thinking matters
We challenge state-of-the-art technologies and develop intelligent alternatives. Our speed of thought and decisive actions give us a leading edge.

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

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

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

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

Four locations of the CERATIZIT Group focus on the development and the manufacture of products for wear protection.

Mamer (Luxembourg)

The CERATIZIT Group has its headquarters in Mamer in Luxembourg. Today the plant in Mamer has more than 1,150 employees and concentrates on industrial wear protection, wood and stone machining as well as inserts and tools.

Alserio (Italy)

CERATIZIT Italia, formerly known under the name 'Aldap' has around 180 employees and is the centre of excellence for metal forming within the CERATIZIT Group. The product range of the Alserio plant ranges from high-performance cold forming tools to fastening and nail making tools.

Empfingen (Germany)

Around 400 employees at the Empfingen plant are responsible for the development, construction, production and sales of carbide products in the wear parts sector as well as for the tool and die industry.

Hitzacker (Germany)

The plant in Hitzacker was founded in 1985 and today has around 50 employees. CERATIZIT Hitzacker GmbH specialises in the production of carbide blanks and semi-finished products for metal forming technology. At this production site single parts and small series with very short delivery times are mainly manufactured.

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

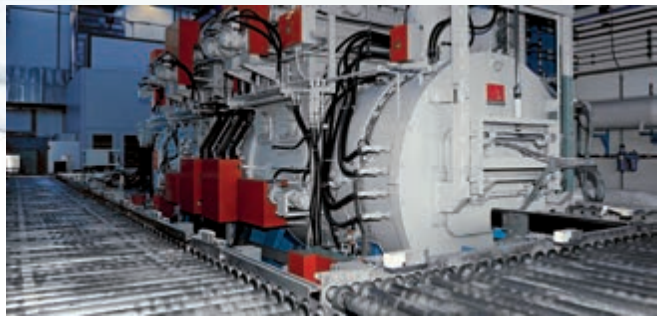
Machining

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.

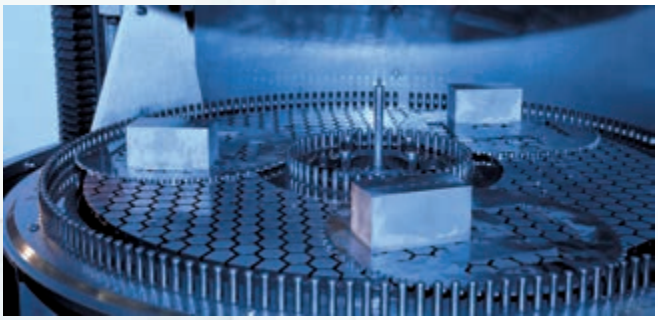
Sintering

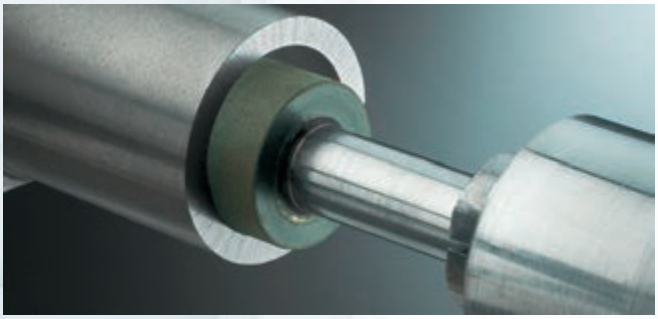


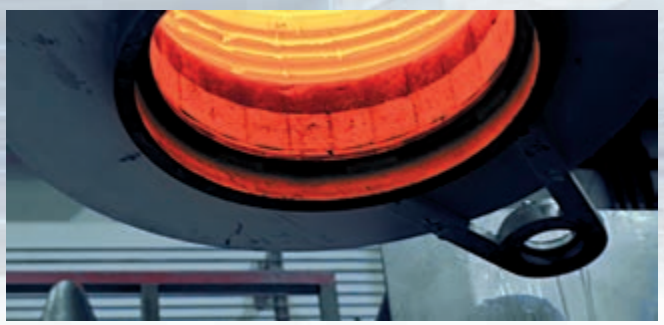
Finishing – grinding – coating

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

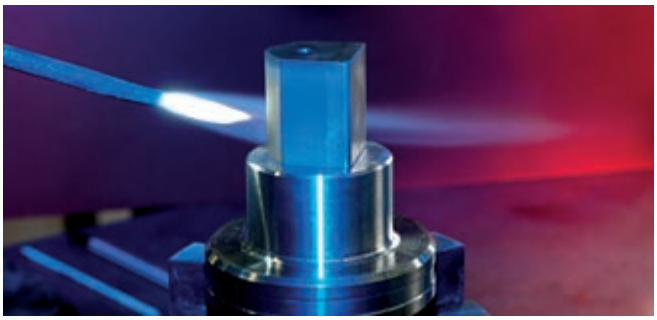
Joining – erosion – quality check

Composite parts

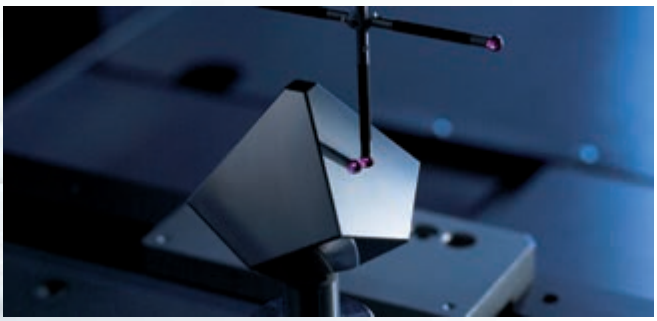
In many cases it is not optimal to manufacture the entire component in carbide. The use of carbide is then limited to the area in which wear occurs. Materials with appropriate wear resistance are used for the tool; they are easier to machine than carbide. Numerous tried and tested technologies, such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

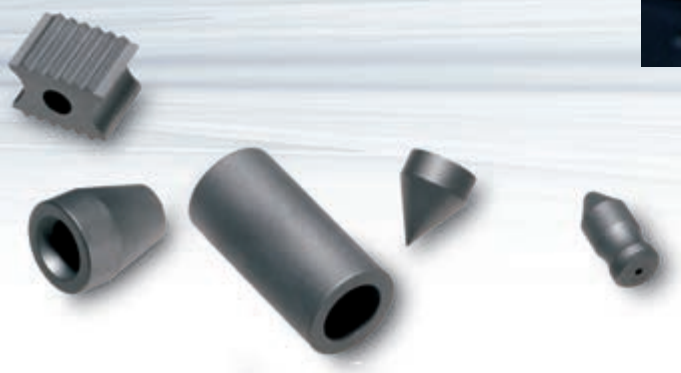
Joining

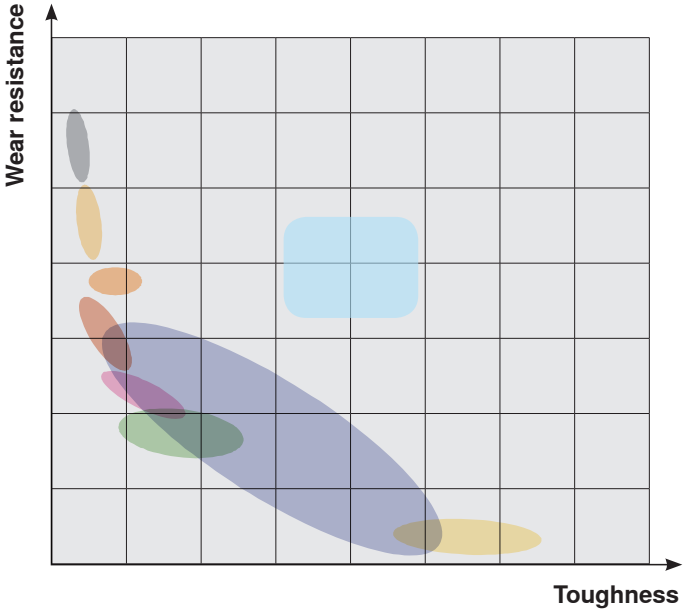
Erosion,
grinding, honing, ...



Quality check





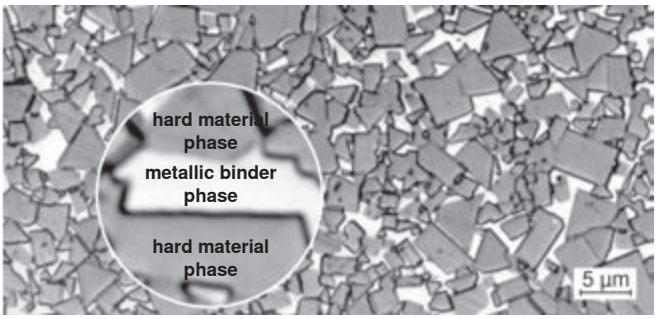


- Natural diamond
- PCD, diamond coated
- CBN
- Ceramic (O)
- Ceramic (N)
- Cermet
- Carbide
- HSS
- CTDIA02

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

Criteria relevant for application

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



Micrograph of WC-Co carbide

The hard material provides the necessary

- hardness
- wear resistance

The metallic binder provides

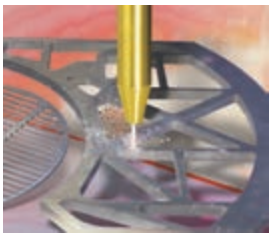
- toughness

Classification of the WC grain size		CERATIZIT code
Average grain size [µm]	Classification	
< 0.2	nano	N
0.2 - < 0.5	ultrafine	U
0.5 - < 0.8	submicron	S
0.8 - < 1.3	fine	F
1.3 - < 2.5	medium	M
2.5 - < 6.0	coarse	C
> 6.0	extra-coarse	E

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

Carbide properties depending on the Co contents and C grain size

Hardness (wear resistance)



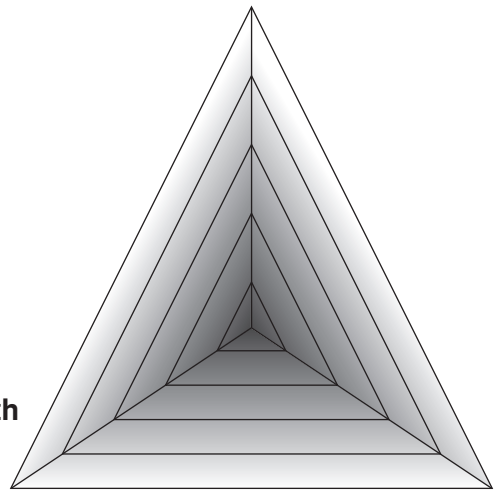
Nozzles for water jet cutting

Type of stress
- Wear
- Corrosion

Carbide grade
- Very high hardness: 2650 HV30
- Small grain size: < 0.5 um
- Low Co content: 0.4%
- Corrosion resistance when adding Cr_3C_2

Hardness

Cobalt content ↓ ↓
Grain size ↓ ↓

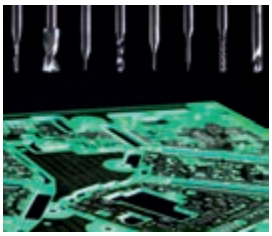


Transverse rupture strength

Cobalt content ↑ ↑
Grain size ↓ ↓

Toughness

Cobalt content ↑ ↑
Grain size ↑ ↑



Transverse rupture strength

Micro-drilling

Type of stress
- Wear
- Deflection

Carbide grade
- T.R.S.: >4000 MPa
- Small grain size: < 0.5 μm + VC
- Low Co content ~ 8.5%
- High wear resistance: 1930 HV30

Toughness

Hot rolling

Type of stress
- Wear due to abrasion
- Built-up edge
- Impact stress

Carbide grade
- Sufficient fracture toughness: Co content 20%
- Good wear resistance: 1030 HV30
- Medium grain size coarse or extra-coarse

Composition and properties

CERATIZIT grade code	ISO code	Appli-cation	Binder [m %]	Density [g/cm³]	Hardness HV10	HV30	HRA	Transverse rupture strength [MPa]	[P.S.I.]	Fracture toughness [MPa*m½]	Com-pressive strength [MPa]	Modulus of elasticity [GPa]	Thermal conduc-tivity [W/mK]	Thermal expansion coefficient [10⁻⁶/K]
Ultrafine grades														
CTU17R			8,5	14,55	1760	1730	92,7	2500	363000	8,0	4900	580	85	5,1
Submicron grain														
CTS06D	K01		3,0	15,35	2020	1980	93,9	3300	479000	7,3	8500	665	95	4,6
CTS12D	K10-K15		6,0	14,95	1800	1770	92,9	3700	537000	8,8	7200	625	90	5,1
CTS15D	K10-K30		7,5	14,75	1740	1710	92,6	3800	551000	9,5	6700	610	90	5,3
CTS17R			8,5	14,55	1600	1580	91,8	2800	406000	8,7	4800	585	100	5,1
CTS18D			9,0	14,55	1610	1590	91,9	3800	551000	11,0	6600	590	90	5,3
CTS20L	K20-K40		10,0	14,45	1680	1660	92,3	3700	537000	9,4	6600	580	85	5,5
CTS22D			11,0	14,35	1520	1500	91,2	3900	566000	12,0	6300	570	85	5,3
CTS24D	K40		12,0	14,25	1480	1460	90,9	4000	580000	12,5	6100	560	85	5,4
Fine / medium grain														
CTF08E			4,0	15,15	1845	1815	93,1	2050	297000	8,0	7400	650	100	4,6
CTF11E	K10	G05	5,6	14,95	1760	1730	92,7	2150	312000	9,2	7000	630	95	4,7
CTF12E	K20	G10	6,0	14,95	1640	1620	92,1	2200	319000	9,9	6400	625	100	4,7
CTF21O			10,5	14,50	1280	1270	89,2	2600	377000	11,9	5100	560	100	5,4
CTF24E	K40	G20	12,0	14,30	1330	1320	89,7	3000	435000	12,0	4900	560	95	5,5
CTF30E	>K40	G30	15,0	14,05	1250	1240	88,8	3100	450000	13,1	4600	530	90	5,7
CTF40A		G40	20,0	13,60	1070	1060	86,8	3400	493000	18,0	3900	490	90	6,4
CTF50A		G50	25,0	13,15	950	940	85,3	3400	493000	21,0	3900	450	90	6,4
CTF54A		>G50	27,0	12,95	920	910	85,0	3200	464000	22,0	3000	440	90	6,9
CTM14E			7,0	14,90	1550	1530	91,5	2600	377000	10,4	6000	615	95	5,0
CTM16O			8,0	14,85	1300	1290	89,4	2400	348000	10,8	4800	605	100	5,1
CTM17E			8,5	14,65	1420	1400	90,4	2800	406000	11,3	5300	600	95	5,1

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.

Composition and properties

Coarse grain

CERATIZIT grade code	ISO code	Appli-cation	Binder [m %]	Density [g/cm³]	Hardness HV10	HV30	HRA	Transverse rupture strength [MPa]	[P.S.I.]	Fracture toughness [MPa*m ½]	Com-pressive strength [MPa]	Modulus of elasticity [GPa]	Thermal conduc-tivity [W/mK]	Thermal expansion coefficient [10⁻⁶/K]
CTE20A			10,0	14,60	1130	1120	87,6	2600	377000	18,0	4000	580	110	5,1
CTE20M			10,0	14,50	1140	1130	87,7	2600	377000	21,0	3600	560	110	5,1
CTE25A			12,5	14,30	1050	1040	86,6	2700	392000	20,0	3800	555	107	5,3
CTE30A			15,0	14,05	970	960	85,6	2800	406000	22,0	3600	530	105	5,6
CTE30M			15,0	14,05	960	950	85,5	2900	421000	23,0	3400	530	105	5,6
CTE35A			17,5	13,80	910	900	84,8	2850	413000	23,0	3500	560	103	5,9
CTE40A			20,0	13,60	850	840	84,2	2900	421000	24,0	3400	490	100	6,3
CTE40M			20,0	13,50	810	800	83,6	2800	406000	25,0	3200	490	100	6,3
CTE44A			22,0	13,40	810	800	83,6	2900	421000	25,0	3300	475	100	6,5
CTE50A			25,0	13,15	760	750	82,6	2800	406000	26,0	3200	450	97	6,8
CTE50M			25,0	13,15	710	700	81,7	2700	392000	27,0	3100	450	97	7,0
CTE60A			30,0	12,75	690	680	81,4	2700	392000	27,0	3100	420	95	7,3
CTE60M			30,0	12,70	610	600	80,0	2700	392000	29,0	3000	420	95	7,4

Silicon nitride

SNC1			9,0	3,25	1550	1530	91,5	1100	160000	6,5	3000	305	30	3,3
SNCB5			12,5	3,25	1500	1480	91,1	1000	145000	6,0	3000	290	30	3,4
SNCE10			SN/TiN	4,20	1400	1380	90,3	>850	>123000	>7,0	3000	325	60	5,5
SNC20			11,0	3,24	1470	1450	90,8	850		5,7	3000	290	30	3,4

Comment:

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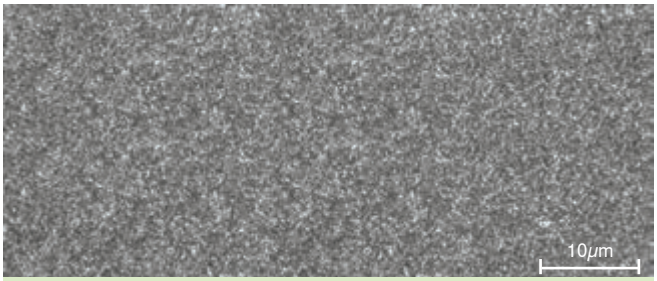
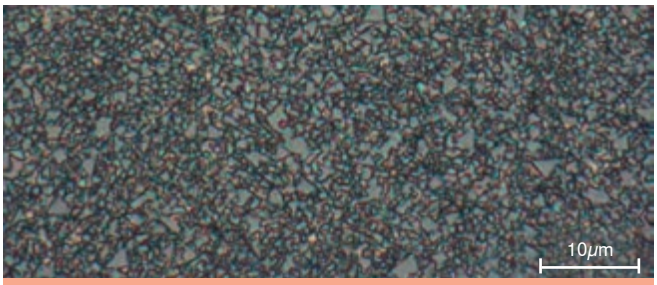
2. K_{IC}*: The measured critical tension intensity factors (K_{IC}) depend to a high degree on the sample geometry and sample preparation. A direct comparison with parameters which have been determined by means of a different method is therefore not admissible.

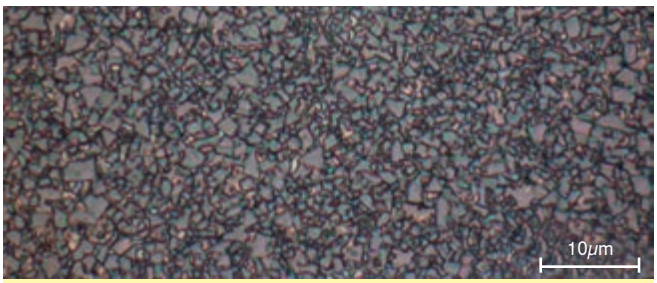
The graphic illustrations below show that the mechanical properties of the carbide mainly depend on the binder content (Co) and the TC grain size. Hardness, i.e. wear resistance, increases inversely proportional to the fracture toughness. This means that the harder the material the more it reacts to notch tensions and impact stress (the 'impact resistance' parameter, which cannot be precisely defined, correlates with the fracture toughness of the material).
On the other hand, the transverse rupture strength does not directly depend on the hardness but rather on the TC grain size and the cobalt content. The adhesive wear (tendency to stick), however, decreases with the grain size and the cobalt content of the carbide used. The list of the mentioned interdependencies, which could be extended at will for other wear and failure mechanisms, show that it is only possible to choose the correct carbide grade following a systematic procedure and/or based on experience with similar applications.



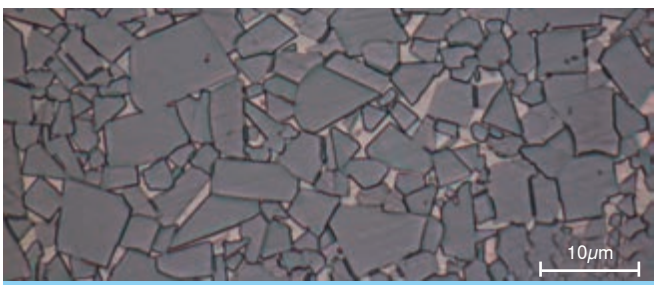
Ultrafine grades



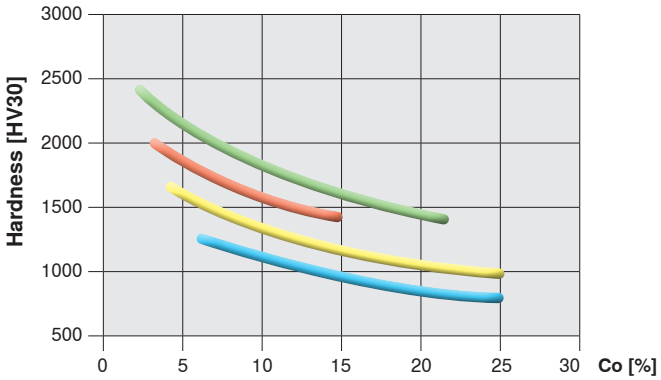
Submicron grain

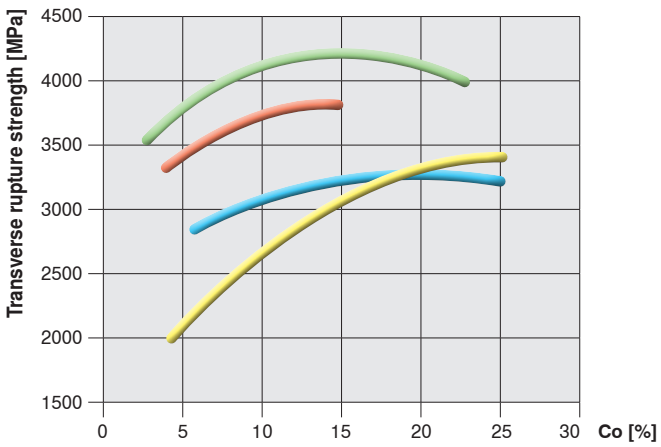


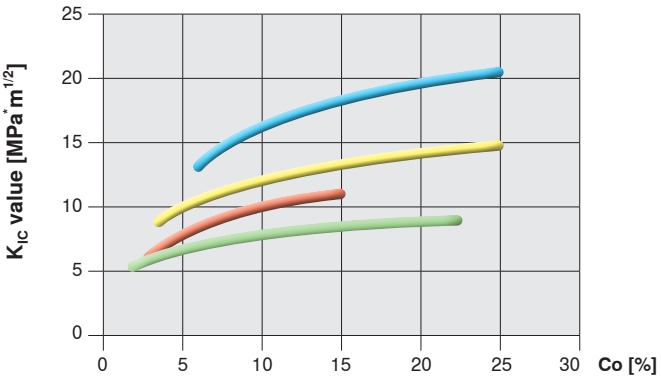
Fine / medium grain



Coarse grain







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!

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.

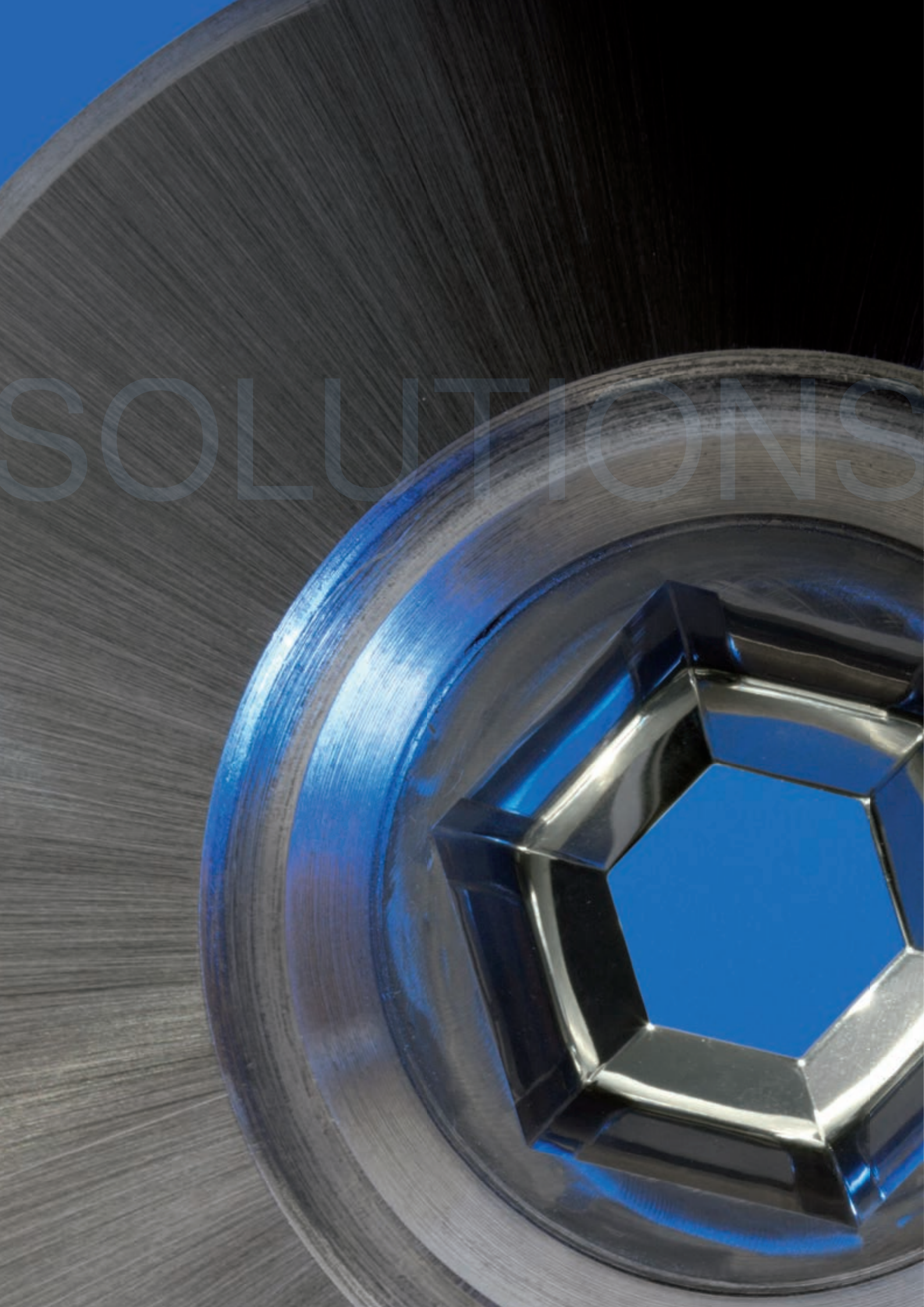
Information
You will receive state-of-the-art detailed technical information and graphic illustrations for all products in the E-Techstore. You will also be informed about possible connections and suitable accessories. Thanks to the up-to-date availability check applicable to all standard articles you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

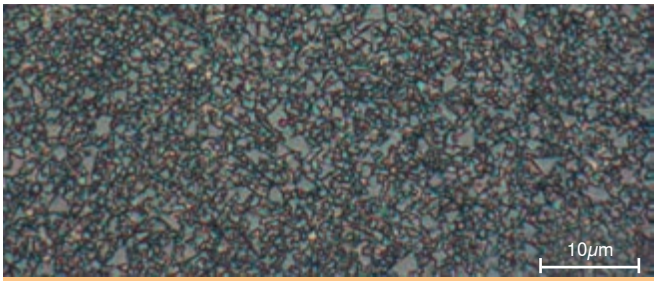
Get in touch with your contact person! Our technical engineer will analyse your requirements together with you and will help you when choosing the suitable technology.


SOLUTIONS

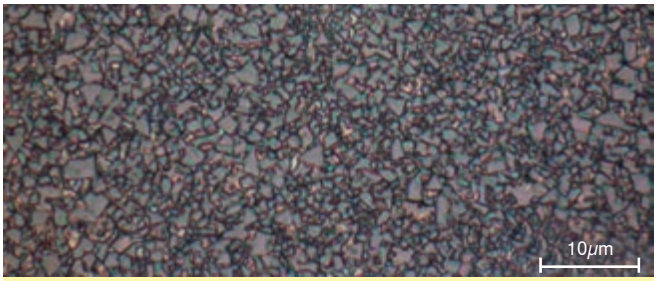
Solutions for metal forming

Wherever metal is formed into semi-finished and ready-to-use products, carbide tools are applied. It is the only material which is characterised by consistent resistance to pressure, heat and tension. At the same time, it guarantees high resistance to wear. Our special carbide grades offer a suitable solution for every forming process.
The wide product portfolio ranges from carbide blanks to ready-to-use pressing and drawing tools. In addition to the standard stock programme, our customised products offer maximum quality and a precise finish.

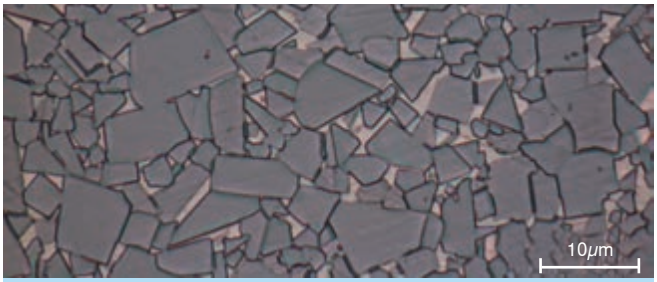
The graphic illustrations below show that the mechanical properties of the carbide mainly depend on the binder content (Co) and the TC grain size. Hardness, i.e. wear resistance, increases inversely proportional to the fracture toughness. This means that the harder the material the more it reacts to notch tensions and impact stress (the 'impact resistance' parameter, which cannot be precisely defined, correlates with the fracture toughness of the material).
On the other hand, the transverse rupture strength does not directly depend on the hardness but rather on the TC grain size and the cobalt content. The adhesive wear (tendency to stick), however, decreases with the grain size and the cobalt content of the carbide used. The list of the mentioned interdependencies, which could be extended at will for other wear and failure mechanisms, show that it is only possible to choose the correct carbide grade following a systematic procedure and/or based on experience with similar applications.



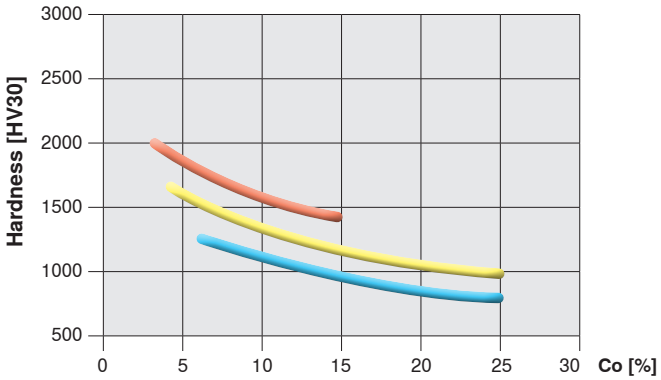
Submicron grain

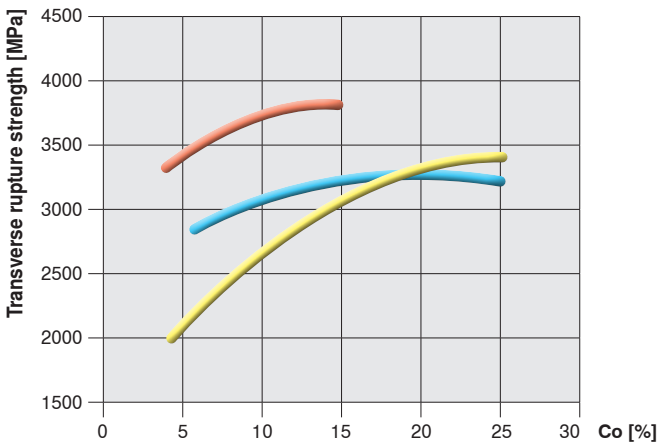


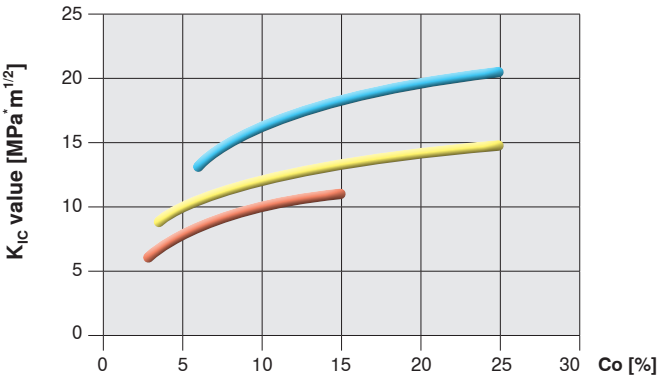
Fine / medium grain



Coarse grain







Fine / medium grain
Submicron grain
Coarse grain

Composition and properties

CERATIZIT grade code	ISO code	Application	Binder [m %]	Hardness HV10	Hardness HV30	Hardness HRA	Transverse rupture strength [MPa]	Transverse rupture strength [P.S.I.]	Fracture toughness [MPa*m^{½}]
Submicron grain									
CTS06			3,3	2020	1980	93,9	3300	479.000	6,5
CTS10			4,8	1980	1940	93,7	3400	493.000	7,4
CTS12	K05-K10		6,0	1820	1790	93,0	3500	508.000	8,2
CTS15	K15-K30		7,5	1740	1710	92,6	3600	522.000	8,6
CTS20	K20-40		10,0	1610	1590	91,9	3700	537.000	10,1
CTS24	K40		12,0	1480	1460	91,0	3900	566.000	9,9
CTS30	>K40		15,0	1330	1320	89,7	3800	552.000	11,9
Fine / medium grain									
CTF11	K10	G05	5,6	1760	1730	92,7	2150	312.000	9,2
CTF12	K20	G10	6,0	1640	1620	92,1	2200	319.000	9,9
CTF18	K30		9,0	1490	1470	91,0	2500	363.000	11,2
CTF24	K40		12,0	1330	1320	89,7	3000	435.000	12,0
CTF30	>K40	G30	15,0	1250	1240	88,8	3100	450.000	13,1
CTF40		G40	20,0	1070	1060	86,8	3400	493.000	18,0
CTF50			25,0	950	940	85,1	3400	493.000	21,0
CTF54		>G50	27,0	920	910	84,8	3200	464.000	22,0
CTM12			6,0	1520	1500	91,2	2600	377.000	10,4
CTM17			8,5	1420	1400	90,4	2800	406.000	11,3
CTM30			15,0	1130	1120	87,6	3000	435.000	13,3
CTM40			20,0	950	940	85,3	3100	450.000	18,6
Coarse grain									
CTC50			25,0	770	760	82,4	2800	406.000	23,5
CTE20			10,0	1130	1120	87,6	2600	377.000	18,0
CTE25			12,5	1050	1040	86,6	2700	392.000	20,0
CTE30			15,0	970	960	85,6	2800	406.000	22,0
CTE35			17,5	910	900	84,8	2850	413.000	23,0
CTE40			20,0	850	840	84,2	2900	421.000	24,0
CTE50			25,0	760	750	82,6	2800	406.000	26,0
CTE60			30,0	690	680	81,4	2700	331.000	27,0

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.

SOLUTIONS FOR METAL FORMING

GRADE OVERVIEW

The table below is intended as a guideline to show you which grades have been applied successfully in the various forming processes. It should, however, be taken into consideration that in addition to the correct grade selection, a consistently high metallurgical quality is a precondition for long tool life.

Benefit from the know-how and the experience of your contact person at Hard Material Solutions by CERATIZIT to optimise tool life using the right carbide grade.

CT grade code	Fastening tools		Drawing tools - ferrous metals (dies and mandrels) large ø → small ø			Drawing dies - non-ferrous metals (dies and mandrels) large ø → small ø			Hammering tools		
	Clamping dies	Cutting knives	High toughness	Medium toughness Medium wear resistance	High wear resistance	High toughness	Medium toughness Medium wear resistance	High wear resistance	High toughness	Medium toughness Medium wear resistance	High wear resistance
CTS 10											
CTS 12											
CTS 15											
CTS 20											
CTS 24											
CTS 30											
CTF 11											
CTF 12											
CTF 18											
CTF 24											
CTF 30											
CTF 40											
CTF 50											
CTF 54											
CTM 12											
CTM 17											
CTM 30											
CTM 40											
CTC 50											
CTE 35											
CTE 40											
CTE 50											
CTE 60											

Main carbide grade for the respective application

Increase wear resistance

Increase transverse rupture strength

Hammering mandrels			Cold forming punches			Extrusion dies			Calibration dies large ø → small ø			Simple cold forming dies		
High toughness	Medium toughness Medium wear resistance	High wear resistance	High toughness	Medium toughness Medium wear resistance	High wear resistance	High toughness	Medium toughness Medium wear resistance	High wear resistance	High toughness	Medium toughness Medium wear resistance	High wear resistance	High toughness	Medium toughness Medium wear resistance	High wear resistance

If you are interested or have any questions, please get in touch with **CERATIZIT Italia, Alserio**.
Alternatively, visit www.ceratizit.com/contact to find your local contact person.

General metal forming

Metal forming tools are subject to high stress, as they must resist both high temperatures and high pressure. Our special carbide grades are very wear-resistant and tough at the same time, giving them a long tool life.
When producing customised metal forming tools such as extrusion dies and punches, we attach great importance to an optimal combination of geometry and suitable materials.

Sectors, applications

- Automotive industry (bearings, screws, ...)
- Fastening industry (screws, steel plugs, ...)
- Aerospace industry

Materials

- Steel
- Aluminium

Products

- Stamping dies
- Calibration tools
- Reduction dies
- Hexagonal dies (integral or segmented)
- Shaped dies
- Extrusion punches

Carbide properties

- High wear resistance
- High fracture toughness
- Rigidity
- Repeatability

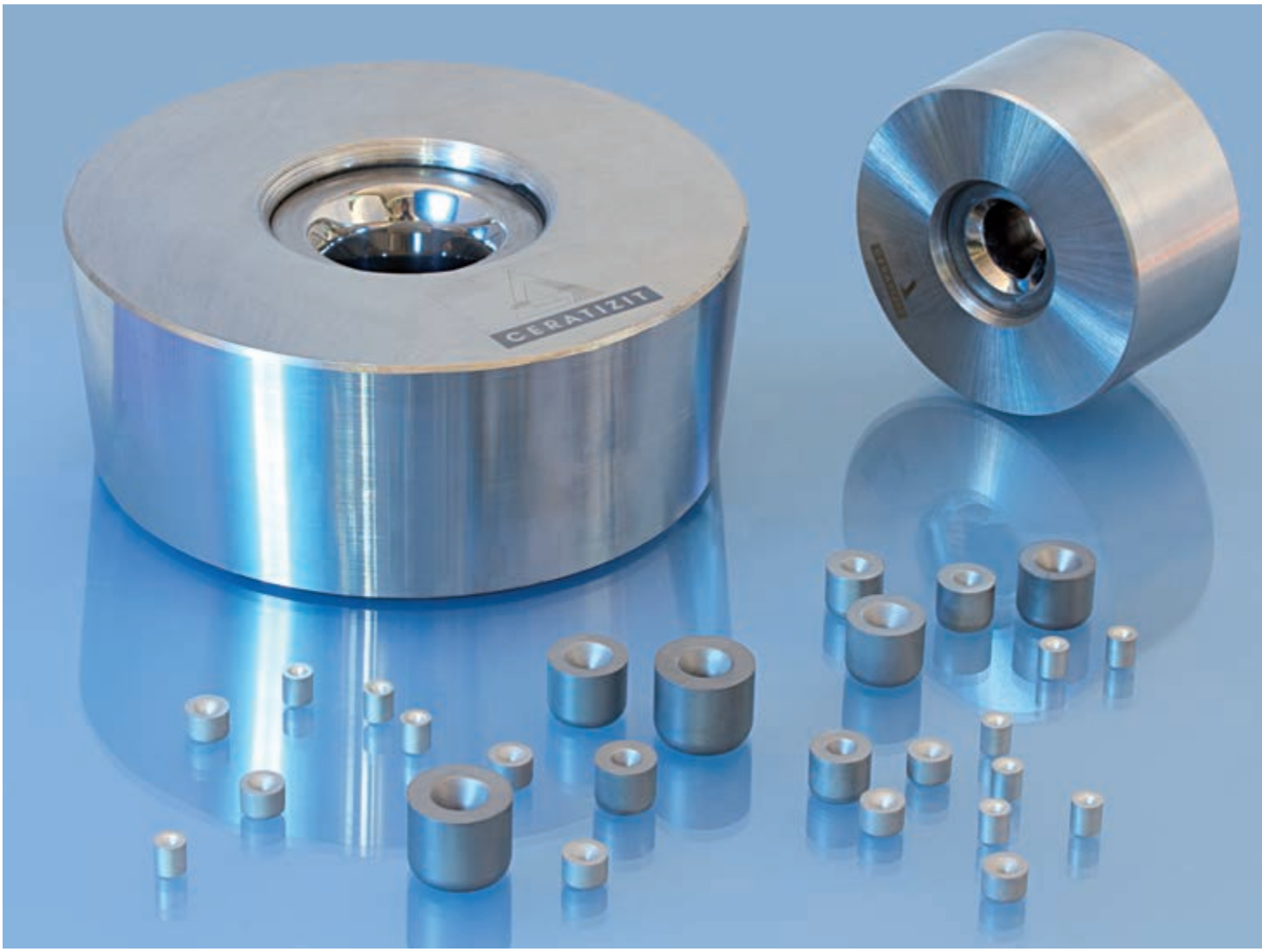
Finish

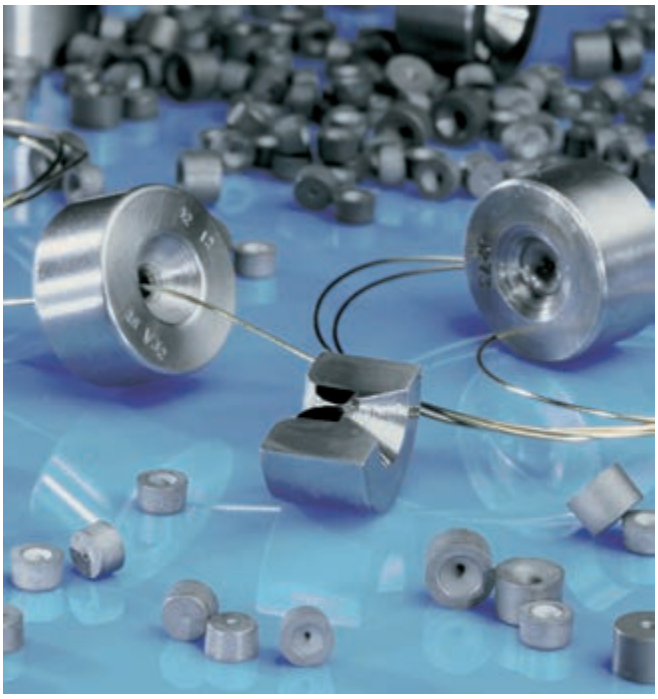
- As sintered
- Ground

If you are interested or have any questions, please get in touch with **CERATIZIT Italia, Alserio**.
Alternatively, visit www.ceratizit.com/contact to find your local contact person.

Drawing tools
(drawing nibs)

No matter whether it is the production of tubes, bars or wire, it is essential to achieve an optimum balance of hardness and fracture toughness in the carbide grade of the drawing tool.
We guarantee close tolerances thereby reducing the time needed to finish the tools significantly. The high-quality surface finish of our drawing nibs and mandrels enables high drawing speeds.



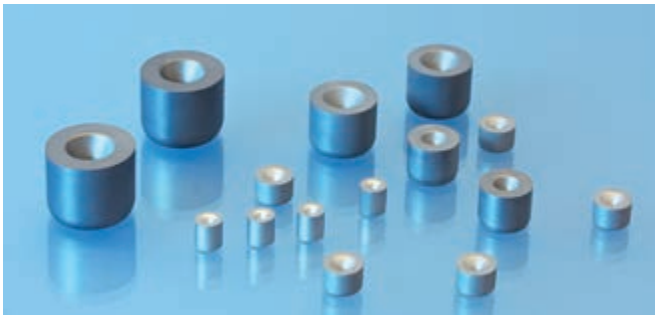


Sectors, applications

- Wire production
- Standard wire – ISO programme
- Steel cord & saw wire

Materials

- From high-tensile carbon steel to non-ferrous metals



Products

- Drawing nibs

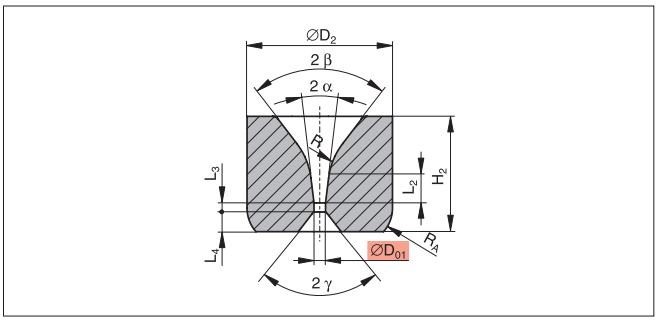
Carbide properties

- High dimensional accuracy
- Very good product surfaces
- Long tool life
- Maximum production security

Finish

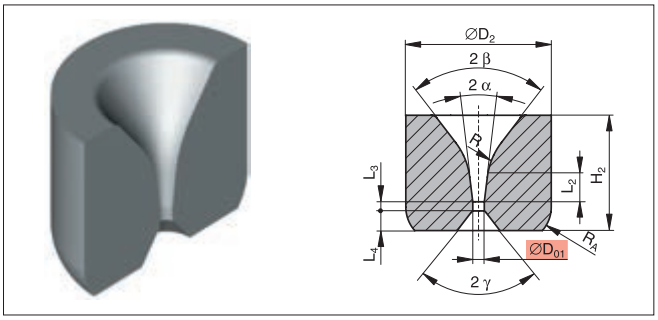
- Blank
- According to customer request

Extremely precise geometry of the sintered nib in order to achieve rapid die finishing and high die performance.
Hard Material Solutions by CERATIZIT take a special care in order to make the drawing cone and the exit cone co-axial. It is a very important feature especially for the smallest hole sizes.



Dimensions – ISO nibs

2 α drawing angle
2 β entrance angle
2 μ exit angle
R entrance radius
R_A RA outer edge radius
KON cone angle / 2
F cylinder length



Programme – ISO drawing nib blanks

Availability in stock starting from hole diameters Ø .3 - 6.0 mm
ISO 10 x 8
ISO 16 x 13
ISO 20 x 17

Production upon customer order
ISO 25 x 20
ISO 30 x 24

Designation for drawing nibs

ISO 20 x 17 / 4,00

1 2 3 4

1
ISO ISO nib

2
Ø D_2 nib diameter

3
H_2 nib height

4
Ø D_{01} hole as sintered .1 - 20.5 mm
(corresponds to nominal diameter with negative tolerance)

The dimensions of our CERATIZIT nibs for wire drawing are based on the current ISO recommendation. All our nibs come with a variety of conveniently graded hole dimensions with the most frequently used drawing angle (2 α) for each drilling range.

Our CERATIZIT grades are also adapted to the market requirements. In order to cater for situations where large nibs are required to be reworked several times to create the largest possible diameter used. Nibs can be manufactured on request with smaller exit holes.

Sectors, applications

- Automotive industry
- Construction and metal construction industry
- Electric and electronic industry
- Jewellery industry
- Tube and profile drawing tools
- Bar drawing

Materials

- Steel (C-steel, stainless steels, ...)
- Copper alloys
- Aluminium alloys
- Silver, gold, ...

Products

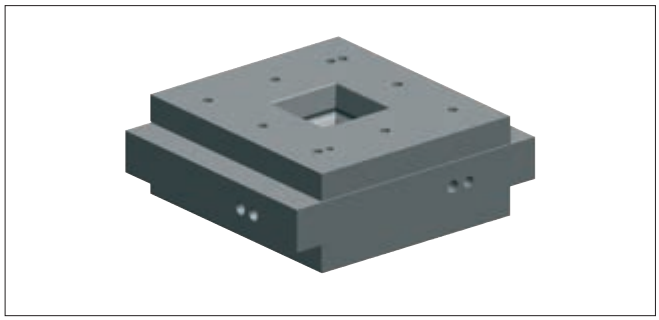
- Mandrels
- Drawing tools for special profiles

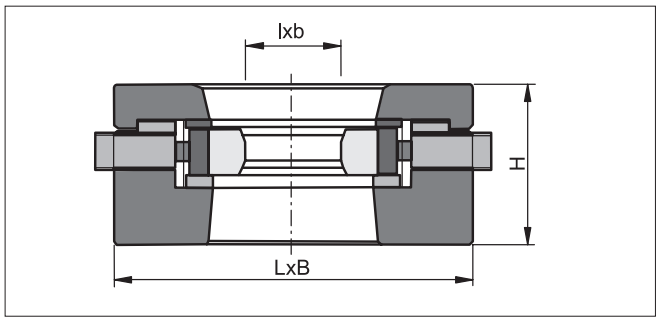
Carbide properties

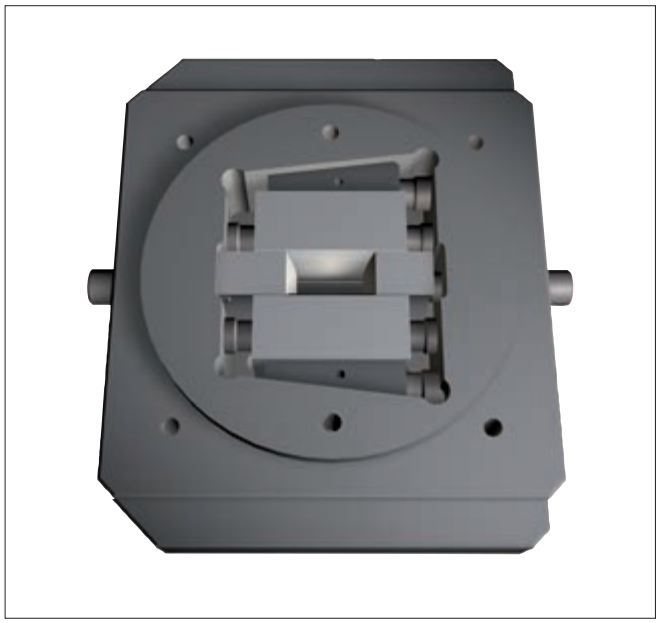
- High toughness
- High wear resistance

Finish

- Finish-ground (ready-to-use)







Drawing tool for rectangular and square bars

Model with saddles and shoulders

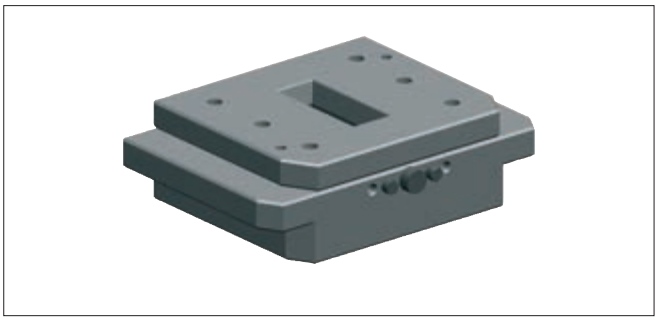
This adjustable tool makes drawing of intermediate dimensions between the maximum and minimum dimensions possible. The precision drawing tool is provided with wedges and screws and is particularly suitable for drawing rectangular and square flat profiles for drawing benches with pusher.
Dimension 'l' can be adjusted by moving the saddles forwards or backwards, even when the tool is on the drawing bench.

The advantages of this type of tool are the following:

- Various dimensions can be drawn with one tool, this results in improved flexibility and cost saving.
- In the case of breakage there is no need to replace the whole carbide insert but only the damaged segment.
- CERATIZIT can produce spare parts (saddles and shoulders) and also rework worn parts
- A suitable pair of saddles should be used to draw each width 'b'.

Adjustable drawing tool

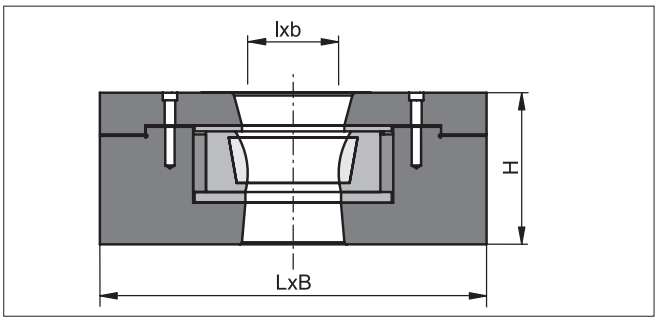
Profile dimensions				Case dimensions		
l_{max}	b_{max}	l_{min}	b_{min}	L	B	H
20	10	2	1	220	180	90
40	15	10	2	260	240	120
60	20	20	3	280	270	120
80	25	30	4	300	290	138
100	30	40	5	320	320	138
120	35	50	6	420	360	150
160	40	60	8	470	440	180
200	60	80	10	570	520	200
250	80	100	10	700	600	220
300	60	120	10	750	650	220

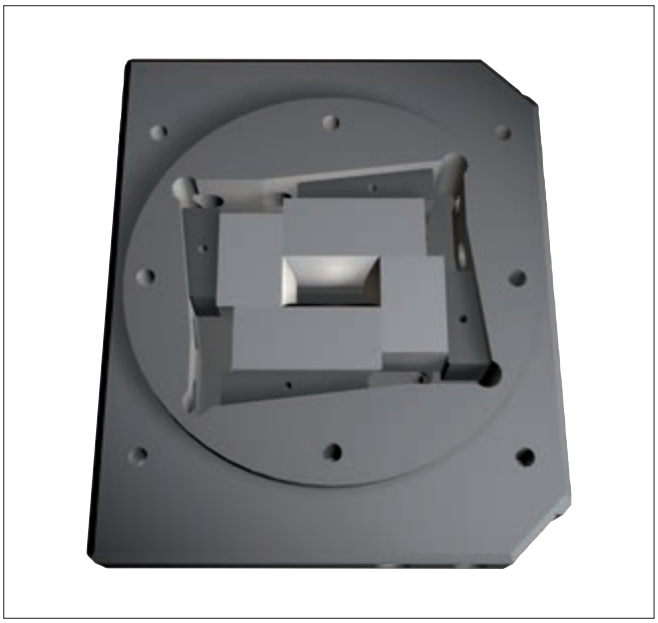


Drawing tool for rectangular and square bars

Traditional model with carbide inserts

This is a drawing die (adjustable from both sides) which enables the manufacture of all intermediate dimensions between the minimum and the maximum (l x b).
A high-precision tool adjustable by means of wedges and screws.





Adjustable drawing tool

The advantages of this type of tool are the following:

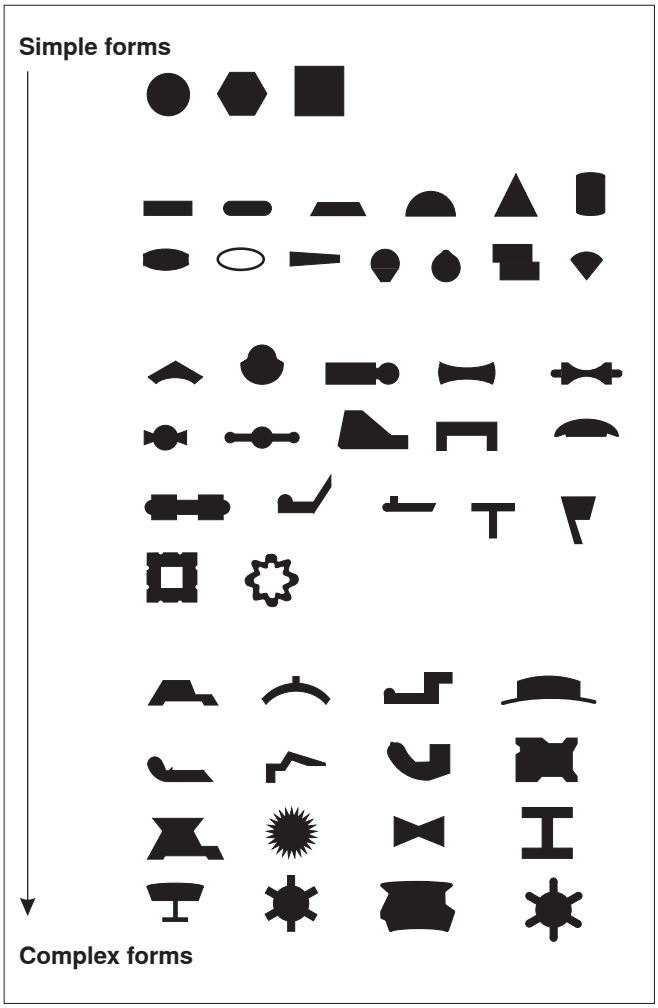
- Various dimensions can be drawn with one tool, this results in improved flexibility and cost saving.
- In the case of breakage there is no need to replace the whole carbide insert but only the damaged segment.
- CERATIZIT can produce spare parts (inserts) and also rework worn parts.
- Using the same tool (2+2 inserts) all dimensions between the minimum and the maximum can be realised.

Profile dimensions				Case dimensions		
l_{max}	b_{max}	l_{min}	b_{min}	L	B	H
20	20	2	2	220	220	100
40	40	10	10	270	270	110
60	60	20	20	320	320	120
80	80	40	40	370	370	138
40	20	10	2	270	250	100
60	40	20	10	300	280	110
80	40	40	10	340	310	120
100	50	50	15	380	340	138

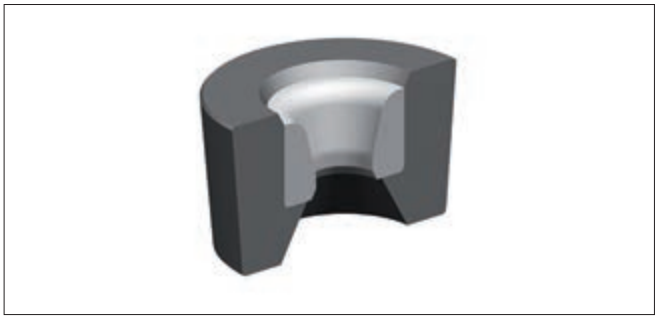
CERATIZIT blanks and semi-finished products for drawing tools

CERATIZIT Italia not only supplies ready-to-use drawing tools but also blanks with grinding allowance and premachined semi-finished products for the extensive application fields of tube, wire and bar drawing.

Thanks to the availability of the various carbide grades CERATIZIT Italia is able to produce customised parts according to drawings and specifications of the customer within a short time.

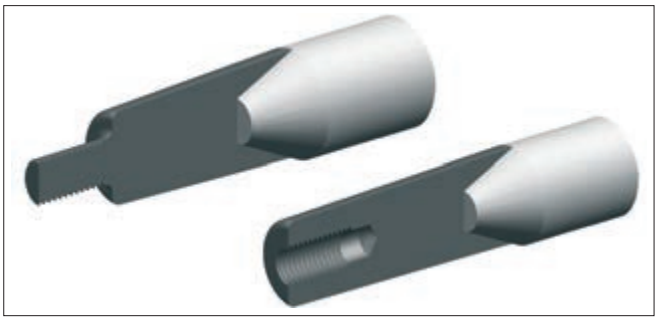


Tools for profile drawing of all materials ranging from tool steel for machine tools, copper for special cables and motor collectors as well as brass for industrial and decorative applications to precious metals, represent an absolute speciality of CERATIZIT Italia.
When it comes to producing profiles and preformed blanks, in-house carbide production plays an important role.
Electroerosion has also brought about significant changes in the field of drawing tools.
Today it is possible to produce parts in solid carbide that some years ago would have caused severe manufacturing problems. However, experience in the field of erosion and state-of-the-art facilities are necessary to prepare the parts for the subsequent hand polishing procedure which requires know-how and precision.
On the left-hand side you can see several profiles which have already been produced; they are listed according to their complexity.



Drawing tools for special profiles
(bars and tubes)

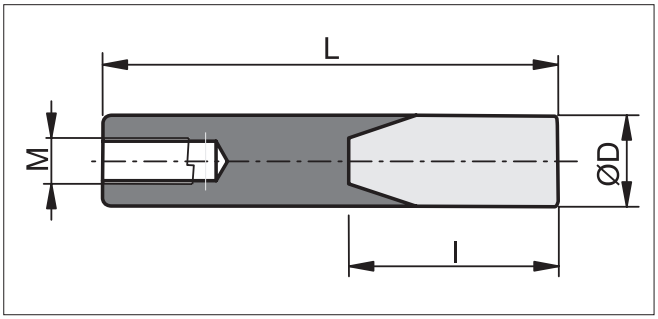
Produced according to customer drawings or CERATIZIT drawings.



Brazed drawing mandrel, round

M1

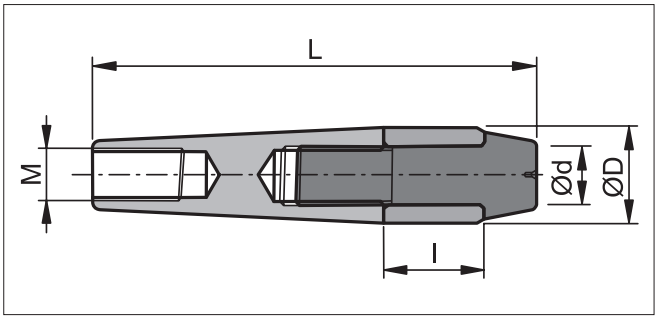
This mandrel consists of a carbide part that is brazed onto a steel bar and is suitable for drawing small tube diameters.

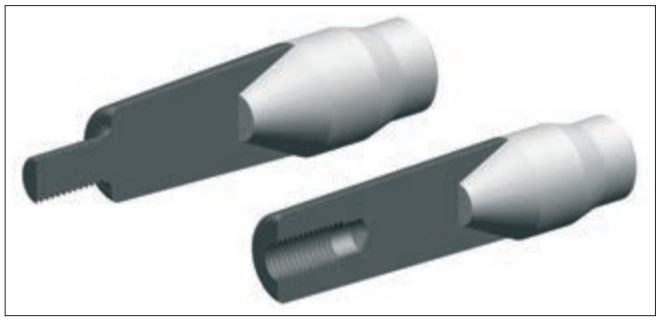


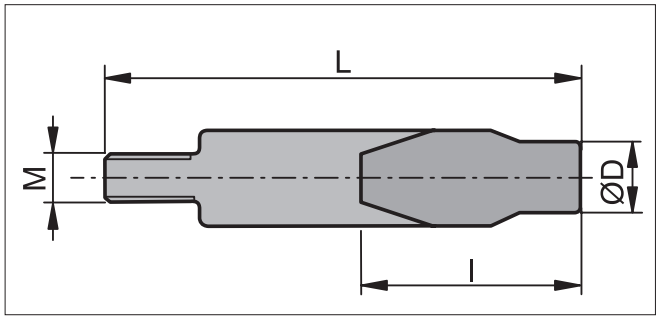
Drawing mandrel with thread, round

M2

This mandrel consists of a carbide bush which is mounted on a heat treated and ground steel shank.
The smallest diameter of this mandrel is 16 mm.



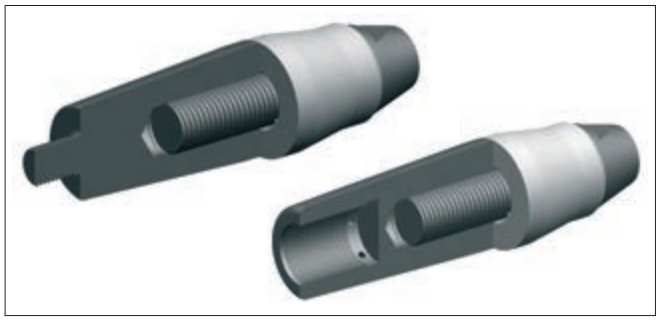


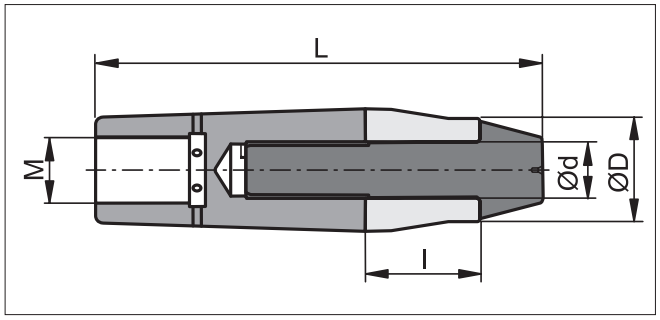


Semi-floating drawing mandrel, brazed

M3

This mandrel consists of a carbide insert which is brazed onto a steel shank.





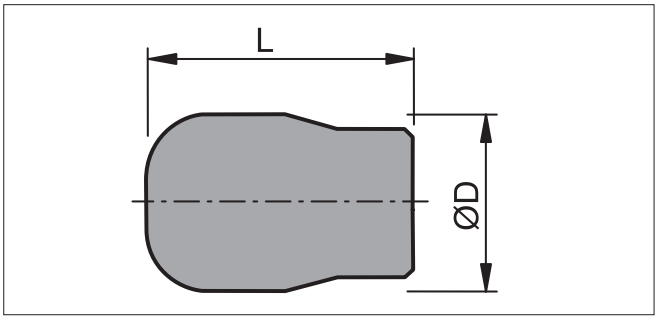
Semi-floating drawing mandrel, with thread

M4

This mandrel consists of a tapered bush which is mounted on a heat treated and ground steel shank.

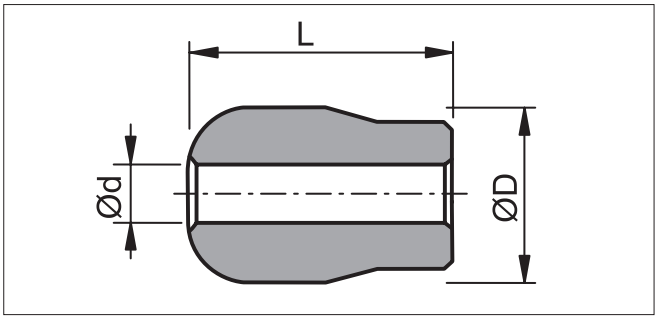
Solid carbide mandrel, floating
M5

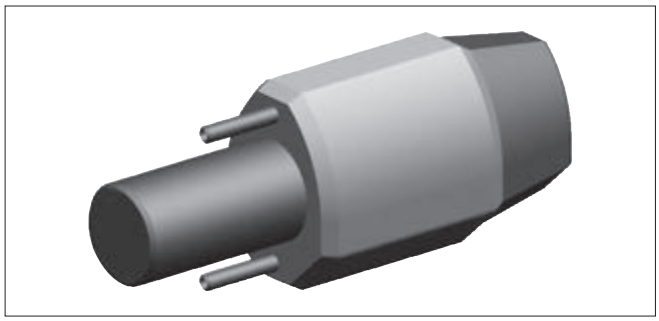
This mandrel consists of solid carbide and, due to its special geometry, centres itself during the drawing process. It is suitable for continuous drawing from tube.

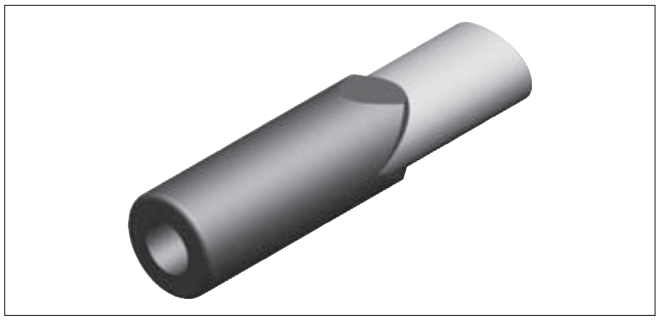


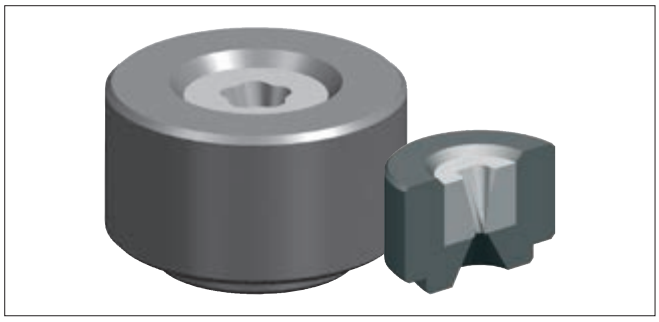
Solid carbide drawing mandrel – floating, with thread
M6

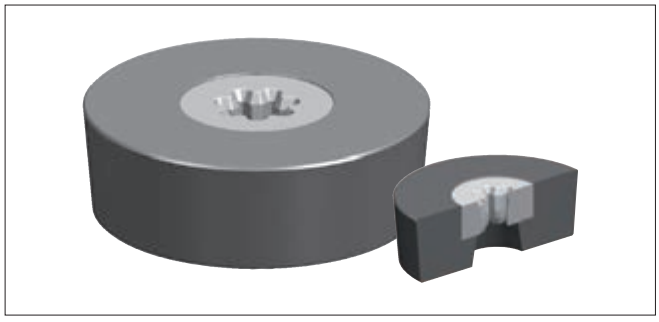
This mandrel consists of solid carbide and, due to its special geometry, centres itself during the drawing process. It is suitable for continuous drawing from tube.
In addition this mandrel can also be fixed on guide bars.

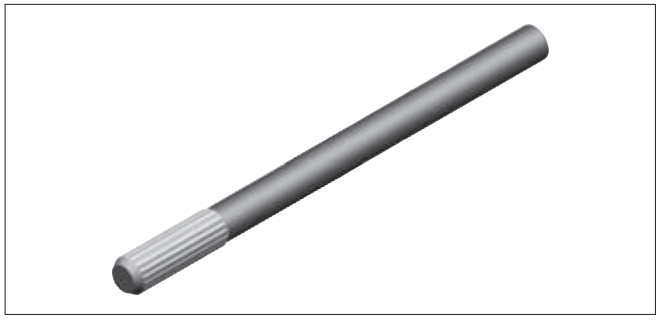






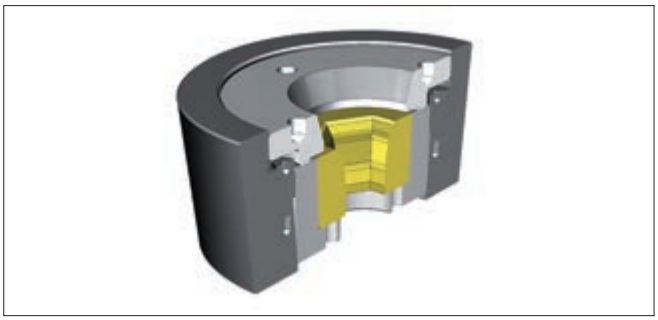






Drawing tools for special profiles

CERATIZIT Italia is mainly well-known for producing complex profile drawing tools.
The more complicated a profile, the more experience is necessary.



MasterDie drawing tools

The quality of CERATIZIT carbide in a new flexible design.

- Accelerates your drawing process
- Reduces tool wear
- Optimises stock management

Increase the efficiency of your drawing process:

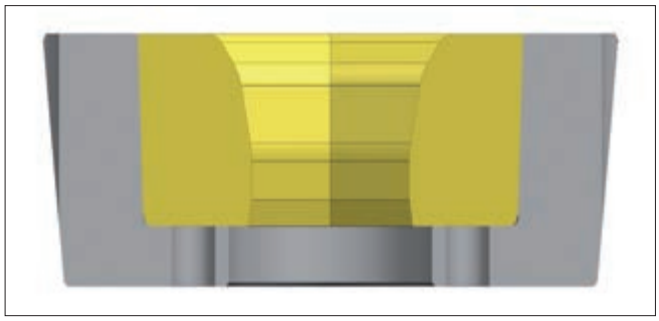
The MasterDie drawing tool consists of a CVD-coated* carbide nib which is shrunk into a high-tensile steel bush. The steel case and the threaded ring necessary for mounting can be re-used. The carbide nibs including the steel bush are pushed into the case by means of the threaded ring and are secured. Dismantling is carried out in reverse order. Each steel case and each threaded ring can be applied with any carbide nib of the same form (see next page).

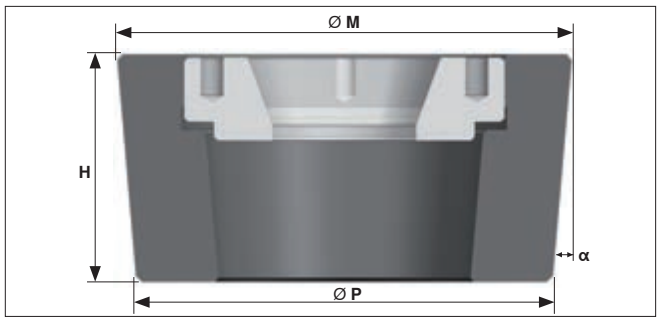
* The new CVD coating MasterDie-CVD was specially developed by CERATIZIT for the drawing of steel, carbon steel and stainless steel etc.

Threaded ring which can be re-used several times
(= MasterDie threaded ring)

Wear part (= MasterDie tool)
MasterDie CVD-coated carbide nib
with high-tensile steel bush

Steel case which can be re-used several times
(= MasterDie steel case)

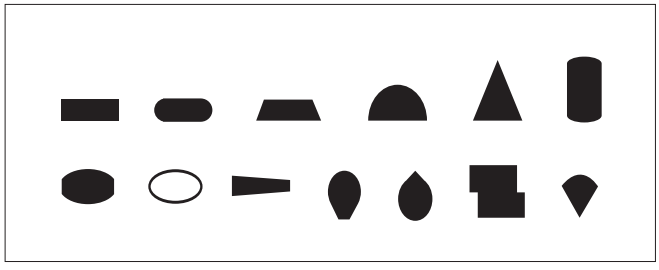




Form and dimensions

Every MasterDie tool with the same form can be mounted in the same MasterDie steel case.

Form	Round Ø [mm]	Hexagonal SW [mm]	Square SW [mm]	Necessary minimum dimensions Ø M (mm)	H (mm)
MasterDie-2	8,01 ÷ 13	8,01 ÷ 12	6,01 ÷ 10	72	45
MasterDie-3	13,01 ÷ 19	12,01 ÷ 17	10,01 ÷ 14	87	50
MasterDie-4	19,01 ÷ 25	17,01 ÷ 23	14,01 ÷ 18	103	55
MasterDie-5	25,01 ÷ 32	23,01 ÷ 29	18,01 ÷ 23	118	60
MasterDie-6	32,01 ÷ 40	29,01 ÷ 35	23,01 ÷ 29	133	65
MasterDie-7	40,01 ÷ 48	35,01 ÷ 41	29,01 ÷ 35	150	65
MasterDie-8	48,01 ÷ 56	41,01 ÷ 48	35,01 ÷ 41	165	70
MasterDie-9	56,01 ÷ 64	48,01 ÷ 56	41,01 ÷ 46	182	70
MasterDie-10	64,01 ÷ 72	56,01 ÷ 62	46,01 ÷ 50	200	75



Further geometries which can be produced with MasterDie

Please send your enquiries to CERATIZIT Engineering and we will carry out a feasibility study for you.
Taking into account the minimum dimensions and the respective geometry (see table) the MasterDie steel case (see table) is designed according to customer specifications.

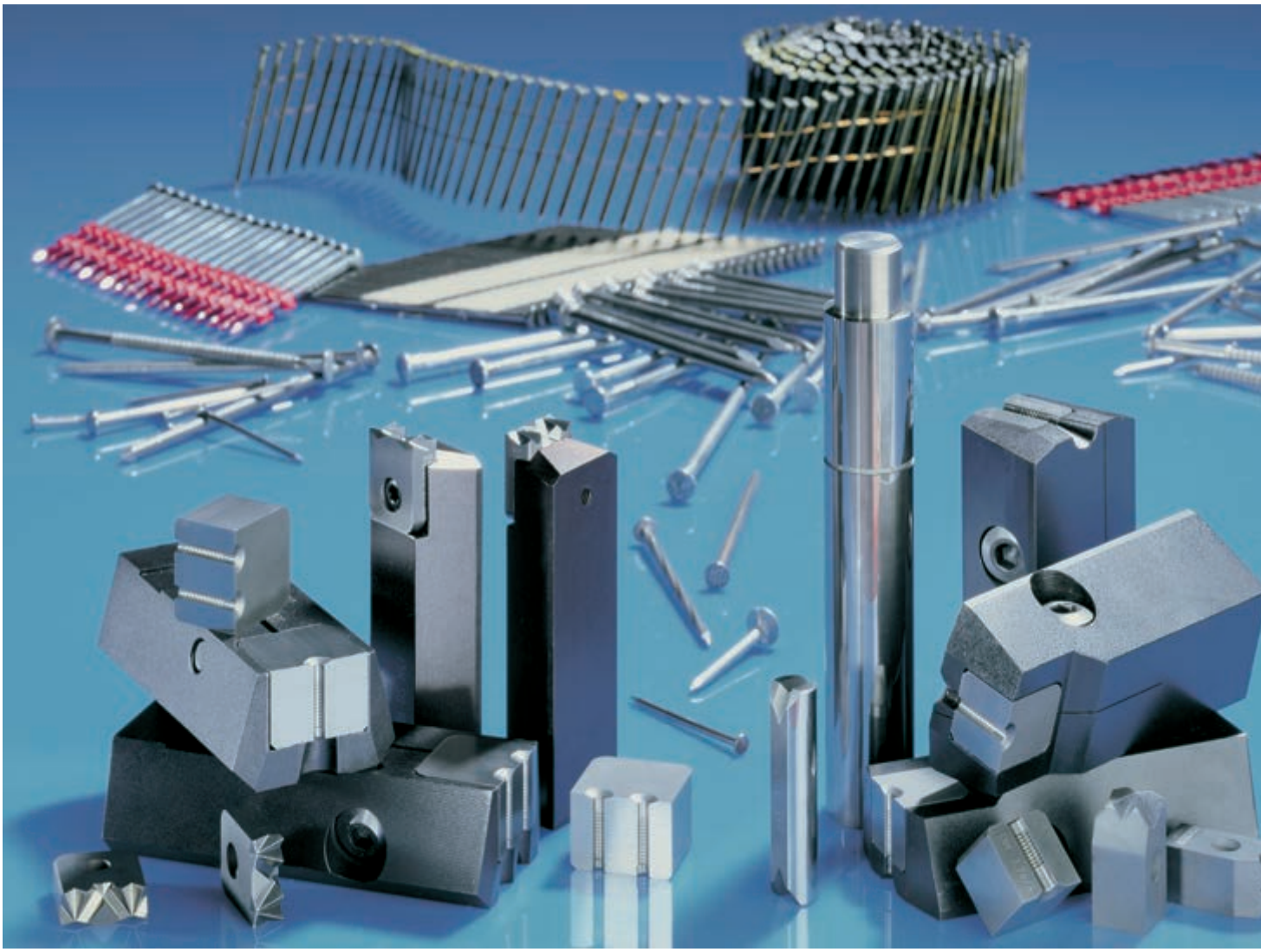
Mounting instructions

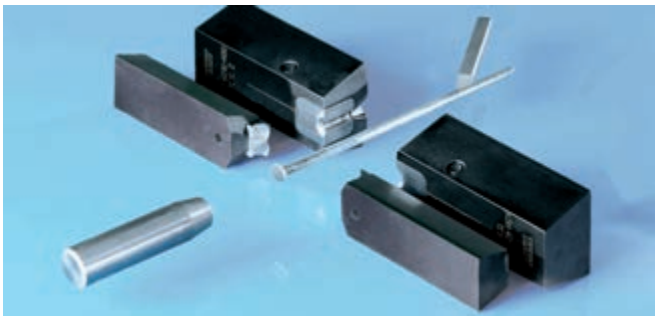
- Put the replaceable carbide nib into the steel case.
- Tighten the threaded ring with a ring key.

If you are interested or have any questions, please get in touch with **CERATIZIT Italia, Alserio**.
Alternatively, visit www.ceratizit.com/contact to find your local contact person.

Nail making industry

Forming tools are used in the high-volume production of nails and rivets. When made of carbide, they offer high wear protection and thus achieve excellent tool life.
Our tools and tooling systems cover all phases of nail manufacture. Products comprise everything from carbide inserts to tool holders.





Sectors, applications

- Nail making and rivet industry
- Screw production

Machine manufacturers

- WAFIOS
- KOVOPOL
- VITARI
- MORONI
- AMBA
- FASTECH

Products

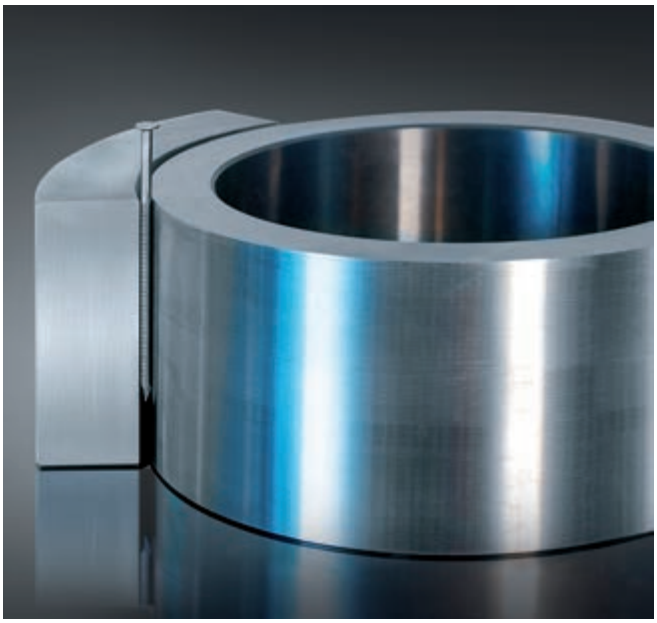
- Carbide inserts
- Tool holders
- Clamping profiles

Carbide properties

- Wear resistance
- Fracture toughness
- Maximum process security

Finish

- Finish-ground (ready-to-use)



Carbide planetary dies

Hard Material Solutions by CERATIZIT offers dies and die segments to imprint circlip grooves in nails and screws.
The tools consist of wear-resistant carbide, thus achieve longer tool life than dies made of other materials and enable a regular forming process. We produce planetary dies which can be mounted with common thread rolling machines.

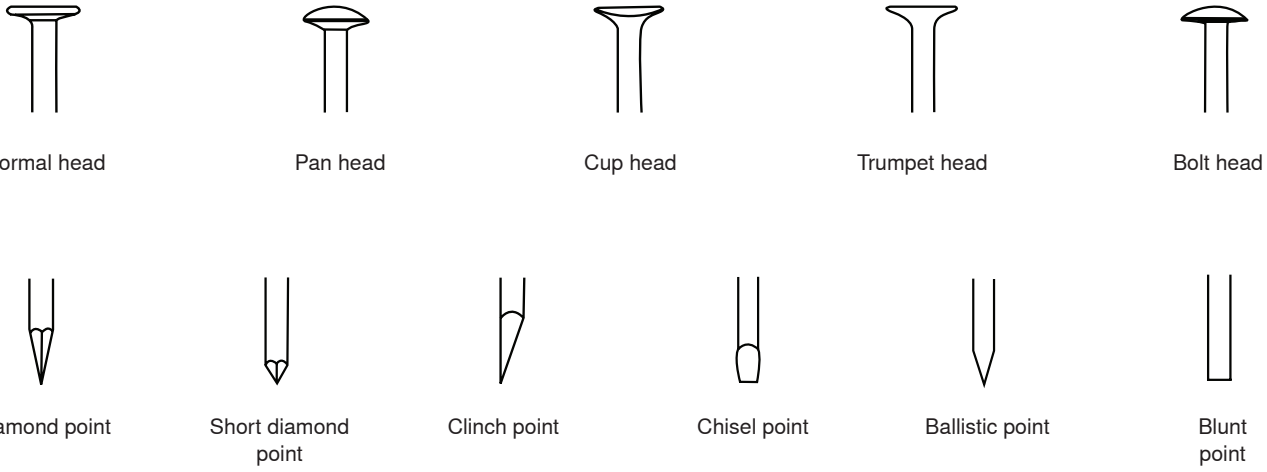
Power - Die - 2000

The new clamping insert offers the following:
- tool life doubled
- maximum process security
- automatic force compensation

The two-piece design is the first of its kind in the world and provides unique breakage protection for clamping inserts, thus helping nail producers to double tool life, a fact particularly appreciated by renowned machine manufacturers such as Wafios. This makes it possible to reduce machine downtime to a minimum while optimising machine utilisation.

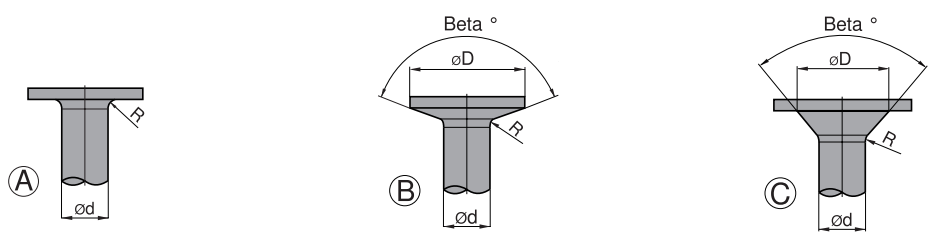
Contents

Clamped nail making tools



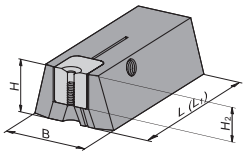
Possible types of screw head

After designation, please indicate the wire ∅, including tolerance and head shape



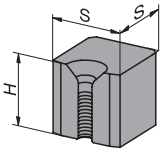
Supply details: tool holder including clamping screw, but without insert
Ordering example: 10 pairs of inserts 12 ∅d = $2.0^{+0,05}$; ∅D = 4.0; R = .3; β = 160°

Tool holder



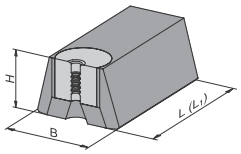
Type, ordering description	Machine type	Dimensions in mm			
		B	H	L	L_1
KBH2812-N1-N2	N1, N2, N11, N21	28	18	62	70

Clamping insert



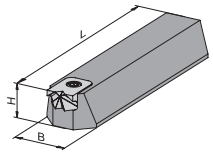
Type, ordering description	Machine type	Dimensions in mm	
		S	H
KBE 12	N1, N2, N11, N21	12	12

Brazed nail making tool



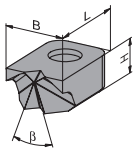
Type, ordering description	Machine type	Dimensions in mm			
		B	H	L	L_1
GKB2818-N1-N2	N1, N2, N11, N21	28	18	62	70

Tool holder for knife



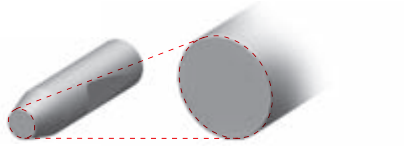
Type, ordering description	Machine type	Dimensions in mm		
		B	H	L
ZBH2012-N1-N2	N1, N2, N11, N21	20	12	66
ZBH2014-N1-N2	N1, N2, N11, N21	20	14	66

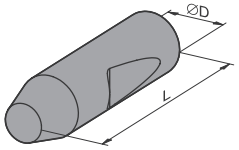
Insert for knife



Type, ordering description	Machine type	Dimensions in mm			
		B	H	L	β
ZBE 43-N3	N1, N2, N11, N21	12	7	20	43°

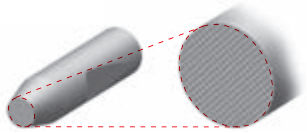
Header punch, plain



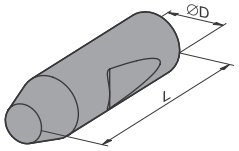


Type, ordering description	Machine type	Dimensions in mm	
		Ø D	L
DOP 11	N1, N2, N11, N21	11	52

Header punch, serrated

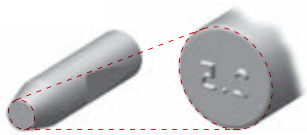


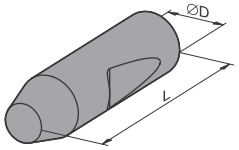
... additional profiles upon request



Type, ordering description	Machine type	Dimensions in mm			
		Ø D	L	t	α
DOP 11-R	N1, N2, N11, N21	11	52	1,0	60°

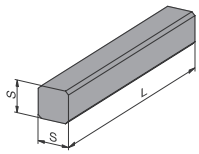
Header punch, with letters





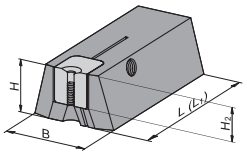
Type, ordering description	Machine type	Dimensions in mm	
		Ø D	L
DOP 11-S	N1, N2, N11, N21	11	52

Feeder



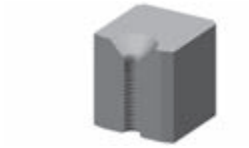
Type, ordering description	Machine type	Dimensions in mm	
		S	L
EKL 0505-35	N1, N2, N11, N21	5	35

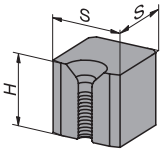
Tool holder



Type, ordering description	Machine type	Dimensions in mm			
		B	H	L	L_1
KBH 2812	N3, N31	28	18	74	74

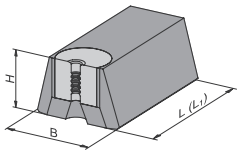
Clamping insert





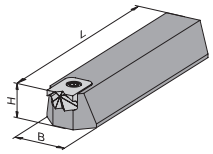
Type, ordering description	Machine type	Dimensions in mm	
		S	H
KBE 12	N3, N31	12	12

Brazed nail making tool



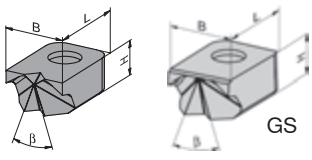
Type, ordering description	Machine type	Dimensions in mm			
		S	S	L	L_1
GKB 2818	N3, N31	28	18	74	74

Tool holder for knife



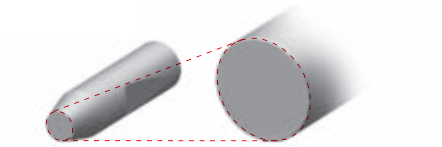
Type, ordering description	Machine type	Dimensions in mm		
		B	H	L
ZBH 2014	N3, N31	20	14	66

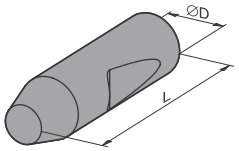
Insert for knife



Type, ordering description	Machine type	Dimensions in mm			
		B	H	L	β
ZBE 43-N3	N3, N31	12	7	20	43°

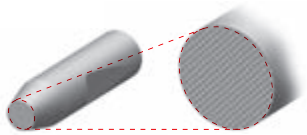
Header punch, plain



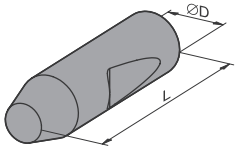


Type, ordering description	Machine type	Dimensions in mm	
		Ø D	L
DOP 13	N3, N31	13	52

Header punch, serrated

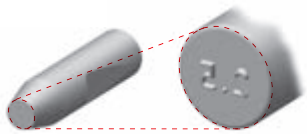


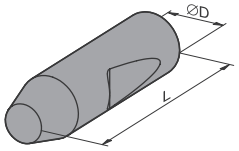
... additional profiles upon request



Type, ordering description	Machine type	Dimensions in mm			
		Ø D	L	t	α
DOP 13-R	N3, N31	13	52	1,0	60°

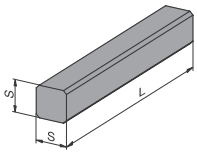
Header punch, with letters





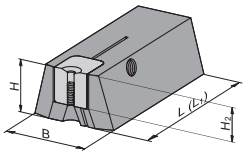
Type, ordering description	Machine type	Dimensions in mm	
		Ø D	L
DOP 13-S	N3, N31	13	52

Feeder



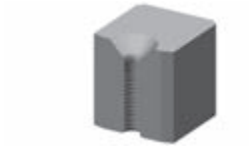
Type, ordering description	Machine type	Dimensions in mm	
		S	L
EKL 0707-40	N3	7	40
EKL 0707-50	N31	7	50

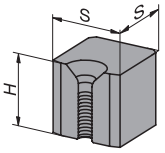
Tool holder



Type, ordering description	Machine type	Dimensions in mm			
		B	H	L	L_1
KBH 4016	N4, N41	40	25	80	95

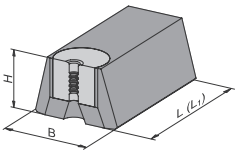
Clamping insert





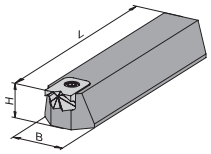
Type, ordering description	Machine type	Dimensions in mm	
		S	H
KBE 16	N4, N41	16,5	16,5

Brazed nail making tool



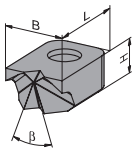
Type, ordering description	Machine type	Dimensions in mm			
		S	S	L	L_1
GKB 4025	N4, N41	40	25	80	95

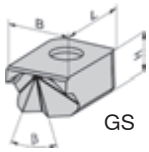
Tool holder for knife



Type, ordering description	Machine type	Dimensions in mm		
		B	H	L
ZBH 2516	N4, N41	25	16	81

Insert for knife

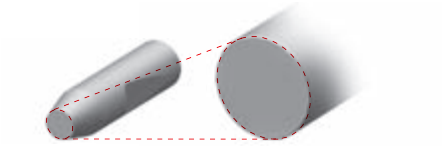


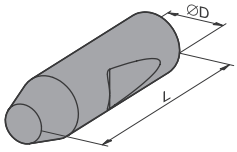


GS

Type, ordering description	Machine type	Dimensions in mm			
		B	H	L	β
ZBE 35	N4, N41	14	8,5	20	35°
ZBE 40	N4, N41	14	8,5	20	40°
ZBE 50	N4, N41	14	8,5	20	50°
ZBE 60.1	N4, N41	14	8,5	20	60°

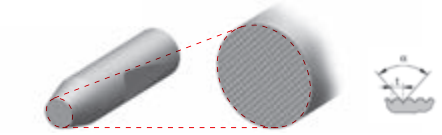
Header punch, plain



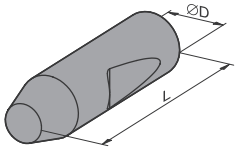


Type, ordering description	Machine type	Dimensions in mm	
		Ø D	L
DOP 16	N4, N41	16	62

Header punch, serrated

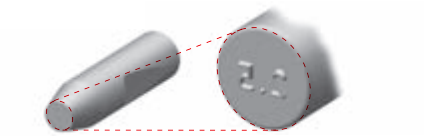


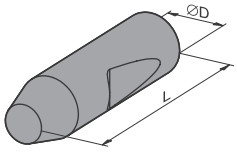
... additional profiles upon request



Type, ordering description	Machine type	Dimensions in mm			
		Ø D	L	t	α
DOP 16-R	N4, N41	16	62	1,5	60°

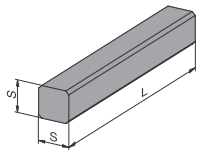
Header punch, with letters





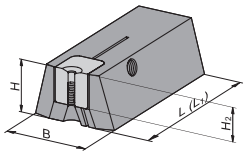
Type, ordering description	Machine type	Dimensions in mm	
		Ø D	L
DOP 16-S	N4, N41	16	62

Feeder



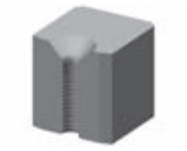
Type, ordering description	Machine type	Dimensions in mm	
		S	L
EKL 0707-50	N4, N41	7	50

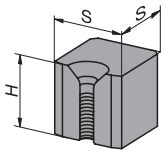
Tool holder



Type, ordering description	Machine type	Dimensions in mm			
		B	H	L	L_1
KBH 4516	N5, N51	45	30	105	120
KBH 4520	N5, N51	45	30	105	120

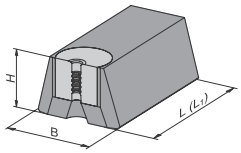
Clamping insert





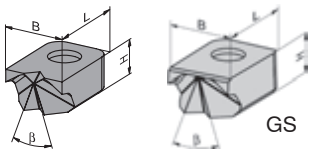
Type, ordering description	Machine type	Dimensions in mm	
		S	H
KBE 16	N5, N51	16,5	16,5
KBE 20	N5, N51	20	16,5

Brazed nail making tool



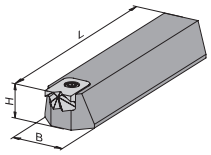
Type, ordering description	Machine type	Dimensions in mm			
		S	S	L	L_1
GKB 4530	N5, N51	45	30	105	120

Insert for knife



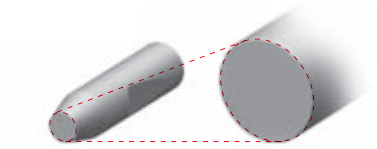
Type, ordering description	Machine type	Dimensions in mm			
		B	H	L	β
ZBE 35	N5, N51	14	8,5	20	35°
ZBE 40	N5, N51	14	8,5	20	40°
ZBE 40-H	N5, N51	14	11	20	40°
ZBE 50	N5, N51	14	8,5	20	50°
ZBE 50-H	N5, N51	14	11	20	50°
ZBE 60.1	N5, N51	14	8,5	20	60°

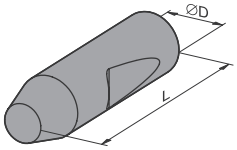
Tool holder for knife



Type, ordering description	Machine type	Dimensions in mm B	H	L
ZBH2818	N5, N51	28	18	108
ZBH2818-H	N5, N51	28	18	108

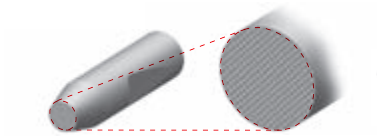
Header punch, plain



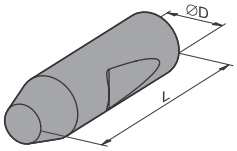


Type, ordering description	Machine type	Dimensions in mm Ø D	L
DOP 20	N5, N51	20	75

Header punch, serrated

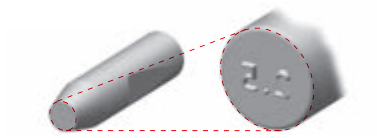


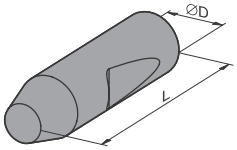
... additional profiles upon request



Type, ordering description	Machine type	Dimensions in mm Ø D	L	t	α
DOP 20-R	N5, N51	20	75	1,5	60°

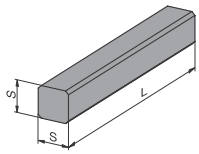
Header punch, with letters





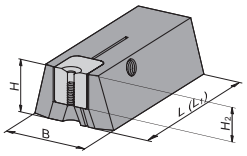
Type, ordering description	Machine type	Dimensions in mm Ø D	L
DOP 20-S	N5, N51	20	75

Feeder



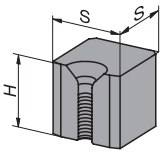
Type, ordering description	Machine type	Dimensions in mm	
		S	L
EKL 1010-60	N5, N51	10	60

Tool holder



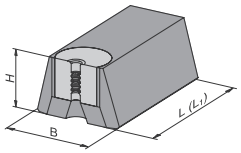
Type, ordering description	Machine type	Dimensions in mm			
		B	H	L	L_1
KBH 4516L	N6, N61	45	30	115	134
KBH 4520L	N6, N61	45	30	115	134

Clamping insert



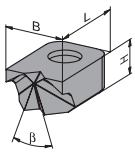
Type, ordering description	Machine type	Dimensions in mm	
		S	H
KBE 16	N6, N61	16	16,5
KBE 20	N6, N61	20	16,5

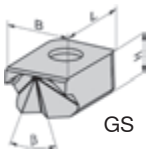
Brazed nail making tool



Type, ordering description	Machine type	Dimensions in mm			
		S	S	L	L_1
GKB 4530L	N6, N61	45	30	115	134

Insert for knife

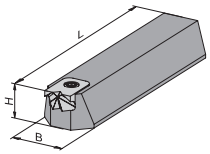




GS

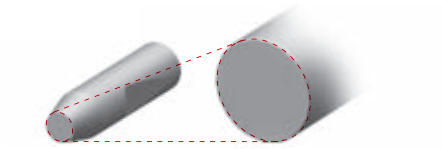
Type, ordering description	Machine type	Dimensions in mm			
		B	H	L	β
ZBE 35	N6, N61	14	8,5	20	35°
ZBE 40	N6, N61	14	8,5	20	40°
ZBE 40-H	N6, N61	14	11	20	40°
ZBE 50	N6, N61	14	8,5	20	50°
ZBE 50-H	N6, N61	14	11	20	50°
ZBE 60.1	N6, N61	14	8,5	20	60°

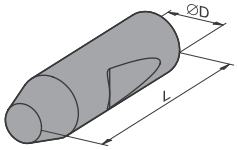
Tool holder for knife



Type, ordering description	Machine type	Dimensions in mm B	H	L
ZBH 3222	N6, N61	32	22	130
ZBH 3222 H	N6, N61	32	22	130

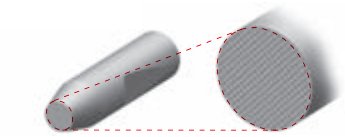
Header punch, plain



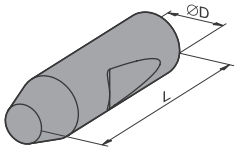


Type, ordering description	Machine type	Dimensions in mm Ø D	L
DOP 25	N6, N61	25	90

Header punch, serrated

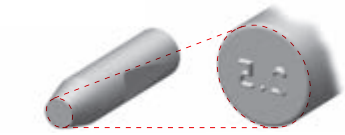


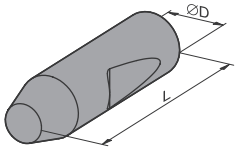
... additional profiles upon request



Type, ordering description	Machine type	Dimensions in mm Ø D	L	t	α
DOP 25-R	N6, N61	25	90	1,5	60°

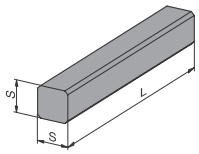
Header punch, with letters





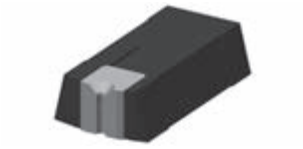
Type, ordering description	Machine type	Dimensions in mm Ø D	L
DOP 25-S	N6, N61	25	90

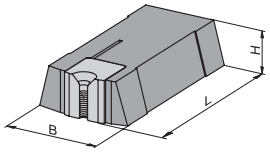
Feeder



Type, ordering description	Machine type	Dimensions in mm	
		S	L
EKL 1010-60	N6, N61	10	60

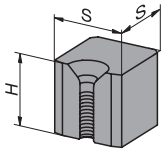
Tool holder





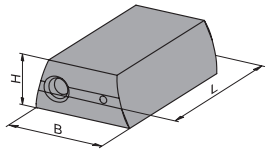
Type, ordering description	Dimensions in mm		
	B	H	L
KBH 3716	37	16,4	68,5

Clamping insert



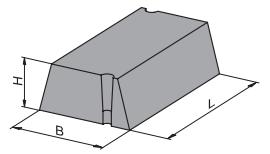
Type, ordering description	Dimensions in mm	
	S	H
KBE 16-ND	16,5	16,5
KBE 16-ND-G	16,5	16,5

Cutting tool



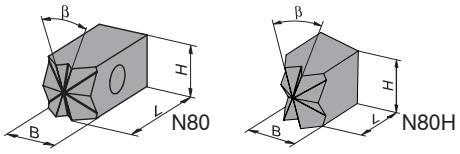
Type, ordering description	Wafios-№	Dimensions in mm		
		B	H	L
ASW-N80	4221.5.1305...	30	15	50

Cutting knife



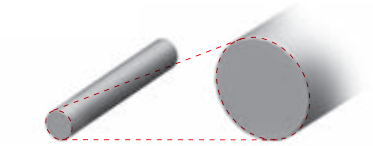
Type, ordering description	Wafios-№	Dimensions in mm		
		B	H	L
ASM-N80	4221.5.1301...	30	15	50

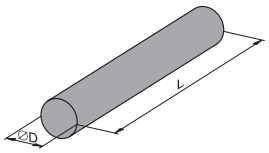
Insert for knife



Type, ordering description	Wafios-№	Dimensions in mm			
		B	H	L	β
ZBE 30.0-N80-H	4222.5.1346.03	16,5	20	20	30°
ZBE 40.0-N80-H	4222.5.1346.00	16,5	20	20	40°
ZBE 60.0-N80-H	4222.5.1346.04	16,5	20	20	60°
ZBE 35.0-N80	4222.5.1346.03	12	12	25	35°
ZBE 40.0-N80	4222.5.1346.00	12	12	25	40°
ZBE 47.0-N80	4222.5.1346.02	12	12	25	47°
ZBE 60.0-N80	4222.5.1346.04	12	12	25	60°

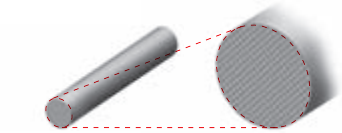
Header punch, plain



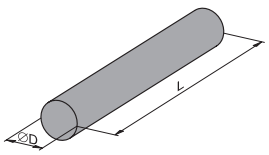


Type, ordering description	Wafios-№	Dimensions in mm	
		Ø D	L
DOP 16-N80	4222.5.1370.00	16	138
DOP 20-N80	4222.5.1377.00	20	138

Header punch, serrated

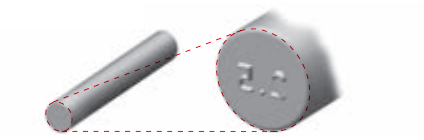


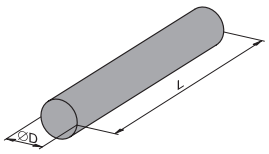
... additional profiles upon request



Type, ordering description	Wafios-№	Dimensions in mm			
		Ø D	L	t	α
DOP 16-N80-R	4222.5.1371.00	16	138	1,0	60°
DOP 20-N80-R	4222.5.1376.00	20	138	1,0	60°

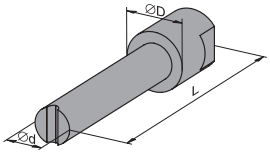
Header punch, with letters





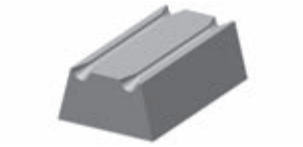
Type, ordering description	Wafios-№	Dimensions in mm	
		Ø D	L
DOP 16-N80-S	–	16	138
DOP 20-N80-S	–	20	138

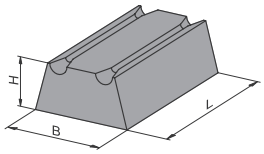
Carbide holding tool



Type, ordering description	Wafios-№	Dimensions in mm B	H	L
FHW-N80	4221.5.1310...	16	10	67,5
FHW-N80	4227.5.1312...	18	12	78

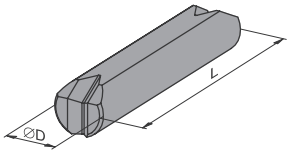
Holding anvil





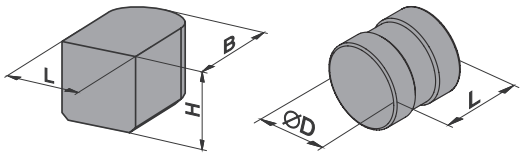
Type, ordering description	Wafios-№	Dimensions in mm Ø D	H	L
FHA-N80	4222.5.1315...	30	15	50

Feeder



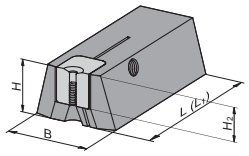
Type, ordering description	Wafios-№	Dimensions in mm Ø D	L
EKL 1045	4226.5.1308.01	10	45

Anvil



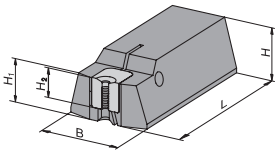
Type, ordering description	Wafios-№	Dimensions in mm B	H	L
ABO-N80	4221.5.1320...	21	12	12
ABO-N80-N	4227.5.1304.00	Ø 20 x 19,5		

Tool holder



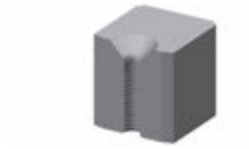
Type, ordering description	Machine type	Dimensions in mm			
		B	H	H_2	L
KBH 4016-N90	N90	40	25	16,5	80

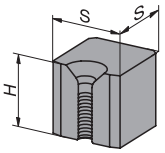
Tool holder



Type, ordering description	Machine type	Dimensions in mm				
		B	H	H_1	H_2	L
KBH 4016-N90A-20	N90A	40	25	20	14	80

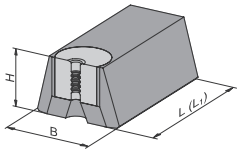
Clamping insert





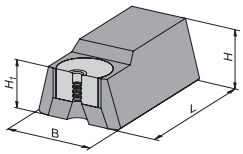
Type, ordering description	Machine type	Dimensions in mm	
		S	H
KBE 16	N90	16,5	16,5
KBE 16A-14	N90A	16,5	14
KBE 16-20	N90	16,5	20

Brazed nail making tool



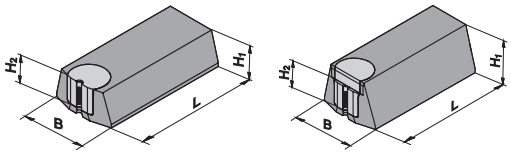
Type, ordering description	Machine type	Dimensions in mm		
		B	H	L
GKB 4025-N90	N90	40	25	80
GKB 4025-N90-35	N90	40	35	80

Brazed nail making tool



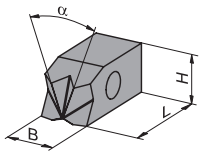
Type, ordering description	Machine type	Dimensions in mm			
		B	H	H_1	L
GKB 4025-N90A-20	N90A	40	25	20	80

Brazed nail making tool for D-head



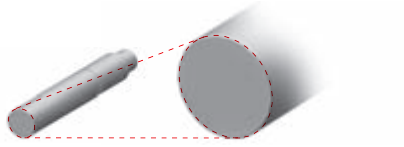
Type, ordering description	Machine type	Dimensions in mm			
		B	H	H_1	L
GKB 4025-N90-D1	N90	40	28	16	80
GKB 4025-N90-D2	N90	40	28	20	80
GKB 4025-N90-D3	N90	40	28	22	80

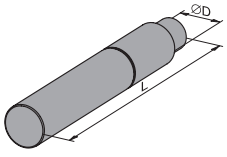
Insert for knife



Type, ordering description	Wafios-№	Dimensions in mm			
		B	H	L	β
ZBE 30.0-N90	4226.5.1267.00	12	12	25	30°
ZBE 35.0-N90	4226.5.1227.00	12	12	25	35°
ZBE 40.1-N90	4226.5.1202.00	12	12	25	40°
ZBE 47.0-N90	4226.5.1203.00	12	12	25	47°
ZBE 60.0-N90	4226.5.1241.02	12	12	25	60°
ZBE 35.0-N90-ES		12	12	–	35°

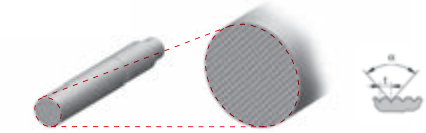
Header punch, plain



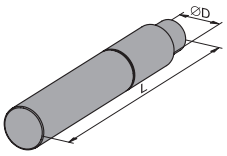


Type, ordering description	Wafios-№	Dimensions in mm	
		Ø D	L
DOP N90-122	4226.5.1170.00	20	122
DOP N90-126	4226.5.1370.00	20	126
DOP N90-130	4226.5.1351.00	20	130
DOP N90-137	4226.5.1395.01	20	137
DOP N90-144	4226.5.1379.00	20	144

Header punch, serrated

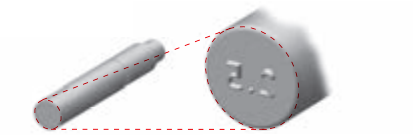


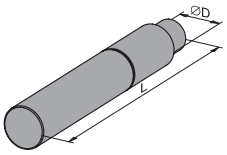
... additional profiles upon request



Type, ordering description	Wafios-№	Dimensions in mm	
		Ø D	L
DOP N90-122-R	–	20	122
DOP N90-126-R	4226.5.1384...	20	126
DOP N90-130-R	4226.5.1354...	20	130
DOP N90-137-R	4226.5.1388...	20	137
DOP N90-144-R	4226.5.1387...	20	144

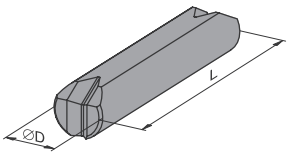
Header punch, with letters





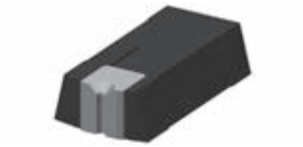
Type, ordering description	Wafios-№	Dimensions in mm	
		Ø D	L
DOP N90-122-S	–	20	122
DOP N90-126-S	–	20	126
DOP N90-130-S	–	20	130
DOP N90-137-S	–	20	137
DOP N90-144-S	–	20	144

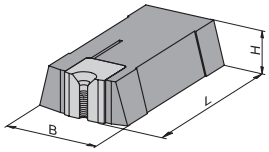
Feeder



Type, ordering description	Wafios-№	Dimensions in mm	
		Ø D	L
EKL 1045	4226.5.1308.01	10	45

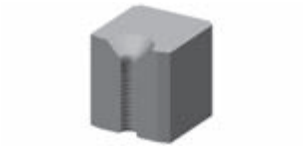
Tool holder

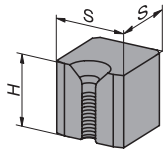




Type, ordering description	Wafios-№	Dimensions in mm		
		B	H	L
KBH 4816-ND	4233.5.1302.00+1303.00	48,2	16,4	78,5
KBH 4820-ND	4236.5.1302.00+1303.00	48,2	16,4	78,5
KBH 5020-ND-H	4236.5.1306.00+1307.00	50,2	20	78,5

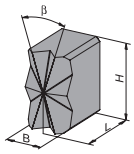
Clamping insert





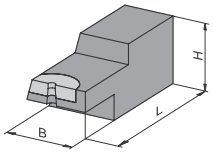
Type, ordering description	Machine type	Dimensions in mm	
		S	H
KBE 16-ND	ND90, ND91, ND92-S	16,5	16,5
KBE 20-ND	ND90, ND91, ND92-S	20	16,5
KBE 20-ND-H	ND90, ND91, ND92-S	20	20

Insert for knife



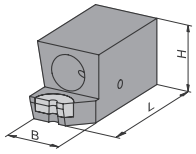
Type, ordering description	Wafios-№	Dimensions in mm			
		B	H	L	β
ZBE 30.0-ND	4233.5.3920.00	16,5	28	28	30°
ZBE 40.1-ND	4233.5.3919.00	16,5	28	28	40°
ZBE 45.0-ND	4233.5.3921.00	16,5	28	28	45°

Cutting knife



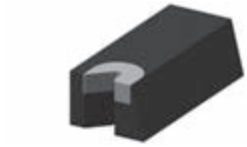
Type, ordering description	Wafios-№	Dimensions in mm		
		B	H	L
ASM-ND-G	4233.5.1809...	27	26	61
ASM-ND-M	4233.5.3907...	23	22	48

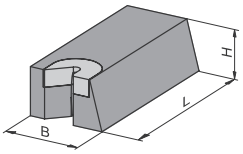
Counter knife



Type, ordering description	Wafios-№	Dimensions in mm		
		B	H	L
GGM-G	4233.5.1809...	27	26	61
GGM-M	4233.5.3907...	24	24	48

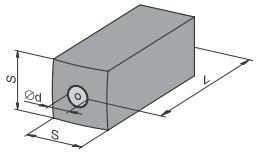
Cutting knife





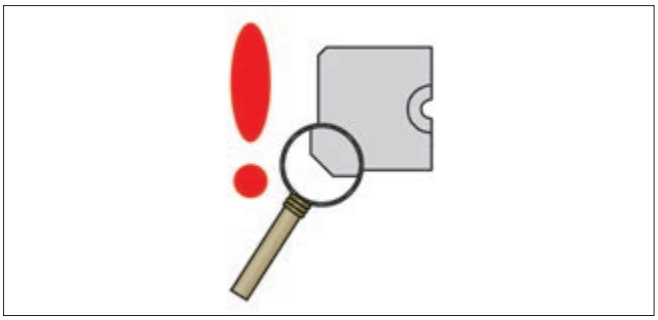
Type, ordering description	Wafios-№	Dimensions in mm		
		B	H	L
ASM-ND-B	4233.5.1213...	22	14	50

Cutting bush

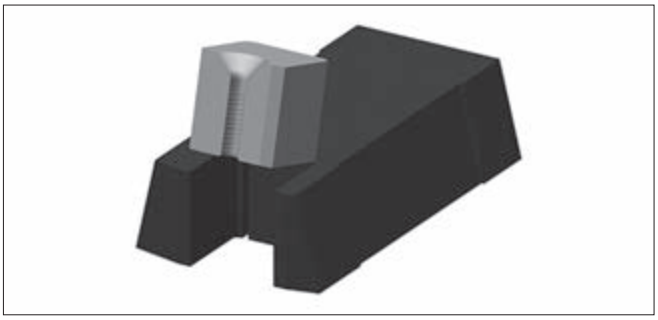


Type, ordering description	Wafios-№	Dimensions in mm		
		B	H	L
ASB-ND	4233.5.1210...	20	55	8
ASB-ND	4233.5.1216...	20	55	12
ASB-ND	4236.5.1216...	20	55	12

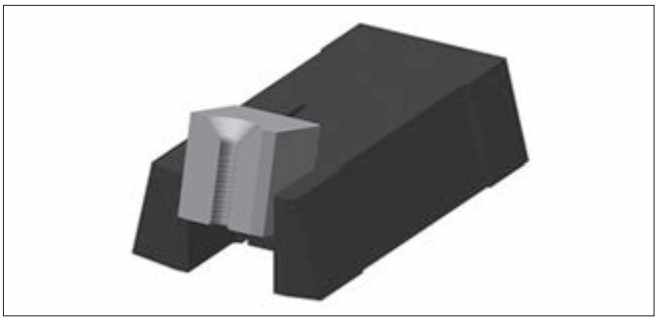
Supply details: tool holder including clamping screw, but without insert
Ordering example: 10 pairs of inserts 16 Ød = $3.1^{+0,05}$; ØD = 7.0; R = 0.3; β = 160°



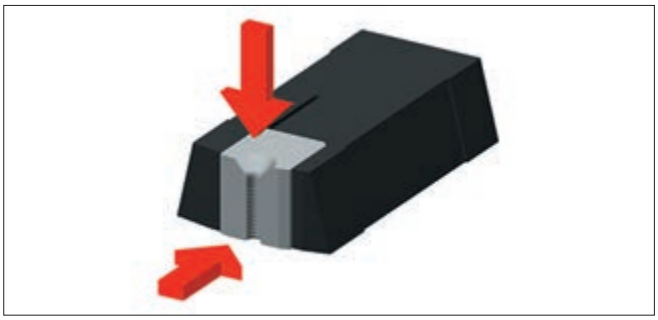
Exclusively use KBE 16ND and KBE 20 ND inserts with chamfered rear side.



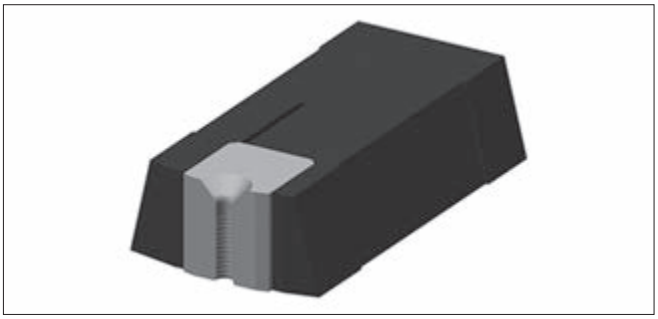
Carefully position carbide insert as shown in the picture



Press in manually.

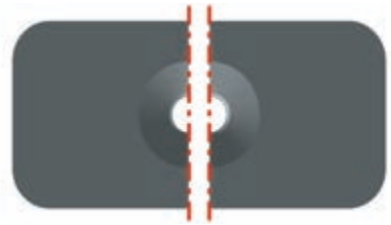


Position with soft hammer (plastic, copper, ...) in the seat

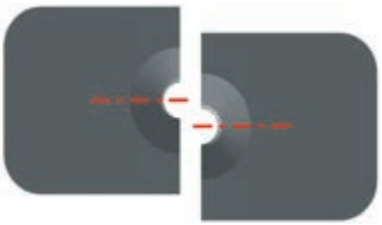


Tool is ready for application in production

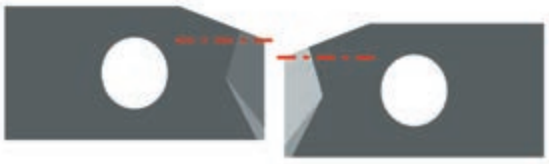
Correct mounting



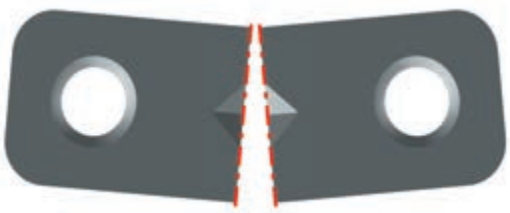
Incorrect mounting



Axial displacement
e.g.: KBE 12



Height displacement
e.g.: ZB 40.1 N90



Angle displacement
e.g.: ZBE 40

If you are interested or have any questions, please get in touch with **CERATIZIT Italia, Alserio**.
Alternatively, visit www.ceratizit.com/contact to find your local contact person.

Forging technology

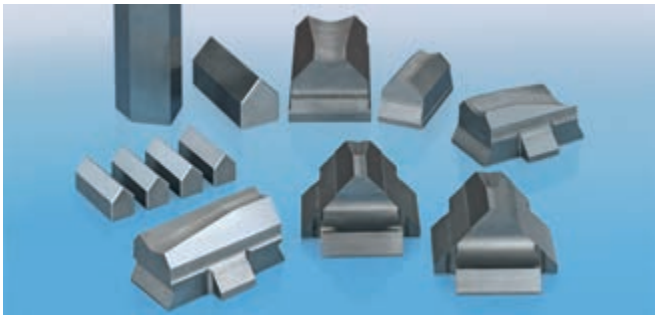
Metal forming tools which are used to reduce tubes or bars through hammering, must be wear resistant. Tools such as these machine the work piece at a high frequency and must consistently withstand the pressure.
When it comes to our hammering tools and mandrels, we pay great attention to achieving an optimum balance between material and geometry. This allows us to guarantee high repeatability and long-lasting quality.

Sectors, applications

- Automotive industry
- Defence engineering
- Hot forging
- O.E.M.

Materials

- Steel
- Steel and sintered alloys



Products

- Forging hammers
- Forging mandrels

Carbide properties

- High wear resistance
- Good repeatability

If you are interested or have any questions, please get in touch with **CERATIZIT Italia, Alserio**.
Alternatively, visit www.ceratizit.com/contact to find your local contact person.

Hot forming technology

CERATIZIT has developed shear blades for hot forming applications. Our shear blades are made of a special hard material suitable for hot forming at working temperatures up to 1,300 °C.
They are used in automatic hot forging machines for steel bar shearing up to a diameter of 45 mm.
Hard material blades grant a much longer tool life compared to other tool materials. Longer tool life means higher productivity and better shearing quality.

Shear blades with brazed carbide insert

Sectors, applications

Hot forming for:
- Automotive industry
- Fastening industry

Materials

- Steel

Products

- Shear blades with brazed insert for automatic hot forging machines
- Shearing diameters from 14 to 45 mm

Carbide properties

- High wear resistance
- High fracture toughness
- High heat resistance

If you are interested or have any questions, please get in touch with **CERATIZIT Deutschland, Hitzacker**. Alternatively, visit www.ceratizit.com/contact to find your local contact person.

Blanks for cold forming

Cold forming is the most economic method of high volume production. It is for this reason that carbide tools are increasingly used, as they are able to withstand the pressure and to achieve long tool life.
Thanks to decades of experience, we have the necessary expertise in all manufacturing and machining technologies and are able to fulfil both the current and future requirements in the metal forming sector.

Sectors, applications

- Construction and metal construction industry
- Automotive industry
- Producers of metal fittings
- Wire production
- Electric and electronic industry
- Nail and rivet production
- Jewellery industry
- Bearings industry
- Tool and die production

Materials

- Stainless steel and steel
- Non-ferrous metals

Products

- Drawing dies
- Hammering tools
- Mandrels
- Extrusion components
- Calibration components
- Components for deep drawing tools
- Customised parts for metal forming

Carbide properties

- Wear resistance
- Fracture toughness
- Suitable grade available for every application
- Suitable for coating
- Compressive strength
- Machinability

Finish

- As sintered
- Semi-finished, preground

BLANKS FOR COLD FORMING

TABLE OF TOLERANCES

Thanks to advanced machines we are able to produce round parts with a diameter of 4 mm up to 200 mm and lengths of up to 250 mm.

For prismatic parts the maximum dimensions possible in production are l = 250 mm, w = 100 mm and h = 42 mm. We are happy to provide individual offers for special dimensions.

External diameter [mm]	Length [mm]					
from - to	<19	20 - 35	35 - 50	55 - 80	90 - 120	>140
10 - 14	0,4 - 1,0	0,4 - 1,1	0,4 - 1,1	0,4 - 1,2		
15 - 18		0,4 - 1,1	0,4 - 1,2	0,4 - 1,3		
19 - 24		0,4 - 1,3	0,4 - 1,3	0,4 - 1,4	0,5 - 1,6	
25 - 28		0,4 - 1,4	0,4 - 1,5	0,4 - 1,5	0,5 - 1,7	
29 - 40		0,4 - 1,5	0,4 - 1,6	0,4 - 1,6	0,5 - 1,8	0,5 - 1,9
41 - 50			0,5 - 2,0	0,5 - 2,0	0,5 - 2,1	0,6 - 2,2

Tolerances external diameter

Example:
Blank for finished dimension **D 20.00** / 2,0 x 50 mm will be supplied as,
D_{min} = 20.4 to D_{max} = 21.3 mm

Internal diameter [mm]	Length [mm]					
from - to	<19	20 - 30	31 - 50	51 - 80	81 - 120	>140
0 - 6	0,3 - 0,7	0,3 - 0,8	0,3 - 0,8	0,4 - 1,0		
6 - 10		0,3 - 0,9	0,3 - 1,0	0,4 - 1,1	0,4 - 1,2	
10 - 14		0,4 - 1,1	0,4 - 1,1	0,4 - 1,2	0,4 - 1,3	
14 - 18		0,4 - 1,1	0,4 - 1,2	0,4 - 1,3	0,5 - 1,4	0,5 - 1,5
18 - 24			0,4 - 1,3	0,4 - 1,4	0,5 - 1,6	0,5 - 1,6

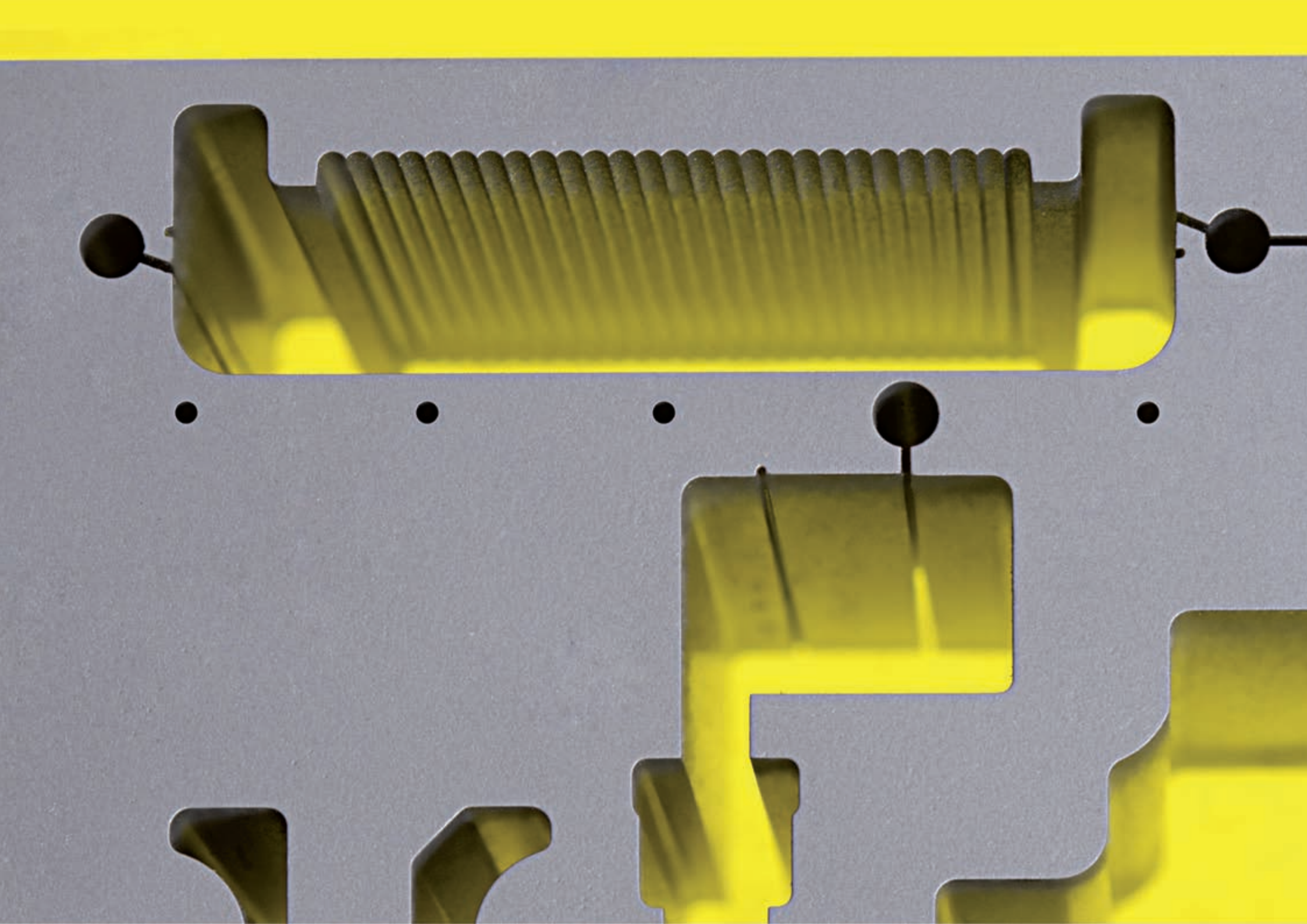
Tolerances internal diameter

Example:
Blank for finished dimension D 20.00 / **3.5** x 50 mm will be supplied as,
D_{min} = 2.7 to D_{max} = 3.2 mm

Length [mm]	External diameter [mm]		
from - to	10 - 18	20 - 28	32 - 50
<15	0,4 - 1,1		
16 - 25	0,4 - 1,2		
26 - 30	0,4 - 1,3	0,4 - 1,4	0,4 - 1,5
31 - 40	0,4 - 1,5	0,4 - 1,5	0,4 - 1,6
41 - 50	0,5 - 1,8	0,5 - 1,9	0,5 - 2,0
51 - 60	0,5 - 2,2	0,5 - 2,3	0,5 - 2,3
61 - 80	0,5 - 2,6	0,5 - 2,7	0,5 - 2,7
81 - 100		0,5 - 3,1	0,5 - 3,1
101 - 120		0,6 - 3,7	0,6 - 3,7
>121			0,6 - 4,2

Length tolerances

Example:
Blank for finished dimension D 20.00 / 20.0 x **50 mm** will be supplied as,
L_{min} = 50.5 to L_{max} = 51.9 mm



Solutions
for the tool and die industry

In order to come out on top against competitors, tool designers must meet constantly increasing demands. Tools, and in particular active components, must be sophisticated, powerful and of the highest quality.
This is only possible using high quality carbide. The prerequisite for this is a permanently homogeneous and consistent carbide structure which guarantees long tool life and process stability. Specifically developed for the tool and die industry, our carbide grades are extremely resistant to both wear and corrosion. Moreover, they are specifically adapted to each individual application.

The application fields of our carbides

The tool and die industry places carbides under extreme strain. Our carbide grades are tailored to match the many different applications in this sector.
The wide range of grades we offer shows the technological edge that, in combination with our long-standing experience in powder metallurgy, guarantees maximum quality and consistency. Our technological edge is the basis for your success.

Corrosion-resistant grades

CF grades exhibit excellent corrosion resistance combined with the mechanical and physical properties required in the tool and die industry.

CF-S12Z: due to its high hardness particularly adapted for applications with substantial abrasive wear.

CF-S18Z: for small punches and dies with thin walls and delicate shapes which require high transverse rupture strength. This grade offers both excellent wear resistance as well as better edge stability compared to the standard grades.

CF-H25S+: for difficult abrasive materials and wherever there is a tendency for galling.
Good edge stability despite high hardness.

CF-H40S+: ideal compromise between wear resistance and fracture toughness.
Ideal grade for universal application.

CF-F35Z: grade with high toughness, specifically developed for stamping, bending and forming operations which lead to high stress on the active components.

CF-20HP: combines high toughness with good wear resistance and is the ideal grade for stamping, bending, blanking and forming of material with large cross-sections and high tensile strength.
Compared to standard grades with similar toughness, this new development shows improved wear resistance and reduced tendency to adhesion.

Submicron grades

For difficult abrasive materials and wherever there is a tendency for galling.
Excellent wear resistance.
For stamping thin sheet metal and foils as well as for extremely thin-walled active components.

Fine / medium grain grades

The standard grades for the tool and die industry. Ideal compromise between wear resistance and fracture toughness with very good edge stability.

Coarse grain grades

Very high toughness combined with sufficient hardness for cutting, stamping, bending and embossing operations.

Composition and properties

CERATIZIT grade code	ISO code	U.S. code	Binder [m %]	Hardness HV10	Hardness HV30	Hardness HRA	Transverse rupture strength [MPa]	Transverse rupture strength [P.S.I.]	Fracture toughness [MPa*m$^{1/2}$]
Corrosion-resistant grades									
Submicron grain									
CF-S12Z			6,0	1860	1830	93,2	3600	522.000	9,0
CF-S18Z			9,0	1630	1610	92,0	3500	508.000	11,0
Fine / medium grain									
CF-H25S+	K20-K30		8,5	1660	1640	92,2	3000	435.000	10,2
CF-H40S+	K40	C11/C12	12,0	1400	1380	90,3	3200	464.000	12,5
CF-F35Z			17,5	1200	1190	88,2	3300	479.000	15,6
Coarse grain									
CF-20HP			10,0	1300	1290	89,4	2800	406.000	15,1
Non magnetic grades									
CTS17R NM		C18	8,5	1600	1580	91,6	2800	406.000	8,7

* Other grades available upon request. See 'General grade overview'

Classification of the WC grain size		CERATIZIT code
Average grain size [µm]	Classification	
< 0.2	nano	N
0.2 - < 0.5	ultrafine	U
0.5 - < 0.8	submicron	S
0.8 - < 1.3	fine	F
1.3 - < 2.5	medium	M
2.5 - < 6.0	coarse	C
> 6.0	extra-coarse	E

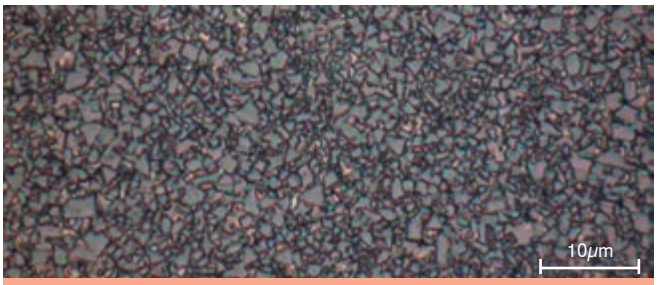
The classification of carbides according to grain size corresponds to the recommendations of the Powder Metallurgy Association.

Comment:

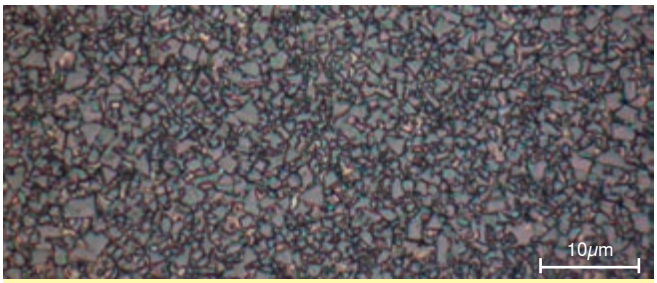
1. The data in this table are typical material parameters. We reserve the right to modify the data due to technical progress or due to further development within our company.
2. K_{IC}*: The measured critical tension intensity factors (K_{IC}) depend to a high degree on the sample geometry and sample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

SOLUTIONS FOR THE TOOL AND DIE INDUSTRY

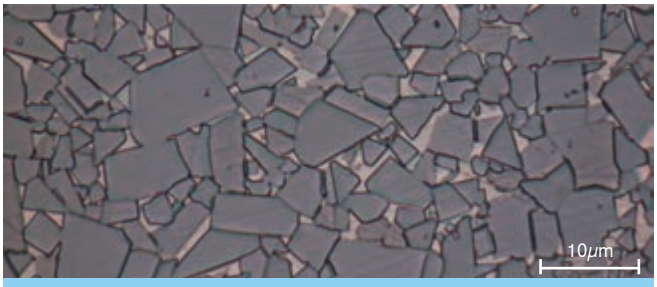
GRADE PROPERTIES



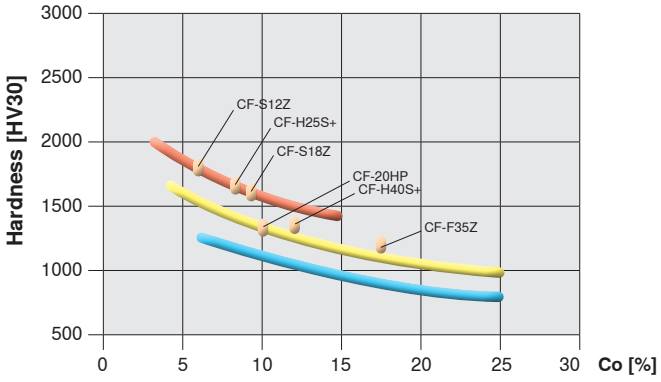
Submicron grain

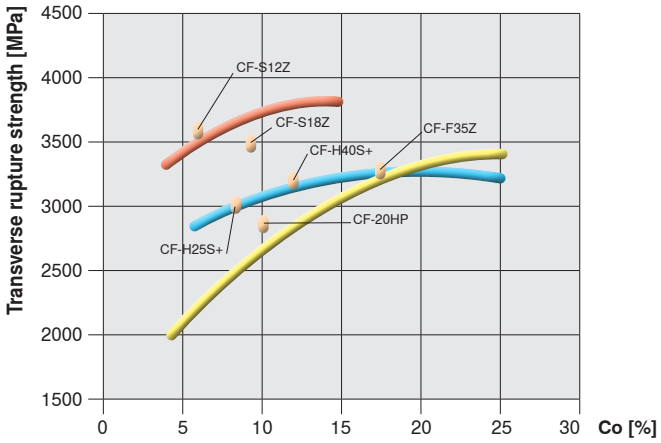


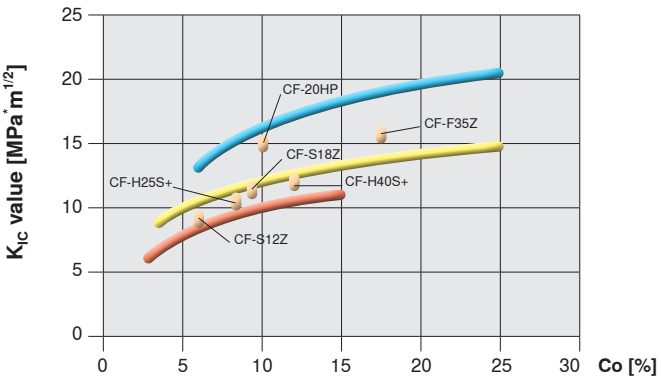
Fine / medium grain



Coarse grain





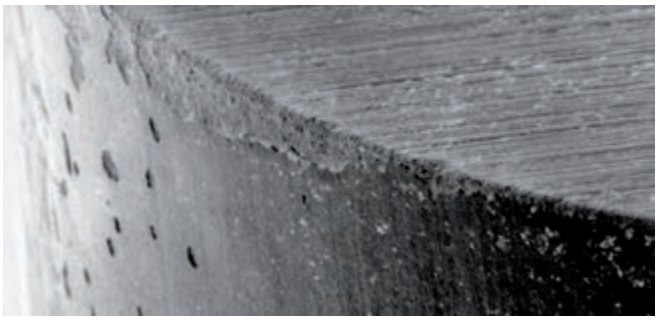


Submicron grain

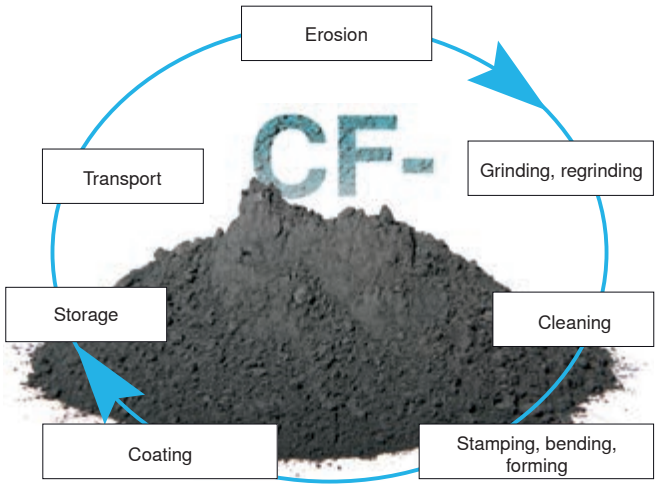
Fine / medium grain

Corrosion-resistant

Coarse grain

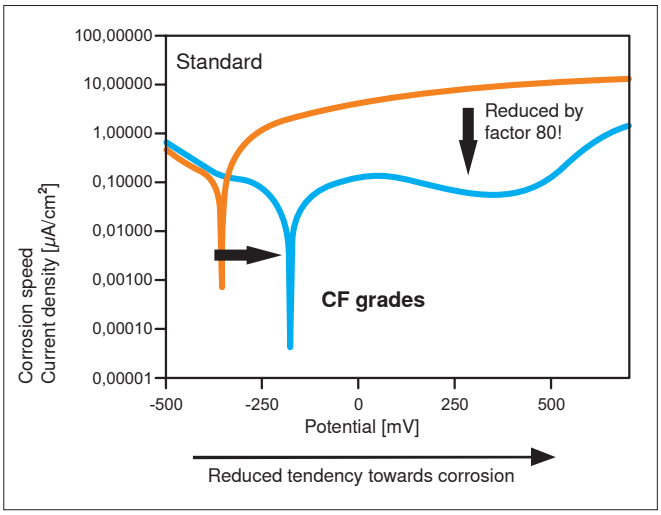


Corrosion is still a topic which must be taken seriously. While in the past years corrosion was mainly associated with wire erosion, today's increasing demands mean that follow-up processes like further machining operations and handling are now also becoming more and more important. Severe wear in active components is frequently due to corrosive damage.



The causes for wear can often be determined only through detailed metallurgic examination. CERATIZIT offers this service to its PARTNERS in the tool and die industry.

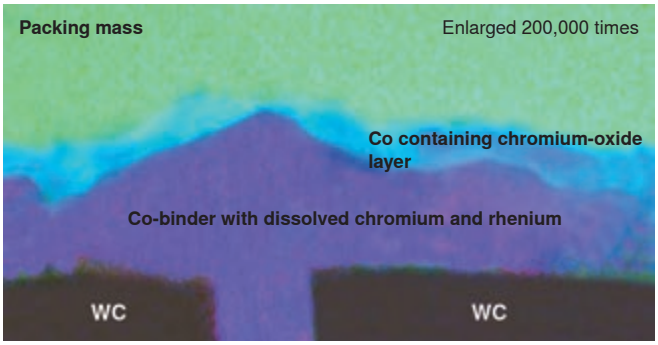
Graph CF-process chain



Corrosion-resistant carbide

CERATIZIT's corrosion-resistant CF grades have become the standard in the tool and die industry. Maximum metallurgical consistency in combination with a factor 80 reduction in susceptibility to and speed of corrosion provide for longer machining times and maximum security, as depicted in the graphic showing the CF processes.

Measured current density potential curves



Detailed information about our patented corrosion protection can be found in our technical article 'Carbide in the tool and die industry is a matter of confidence'.

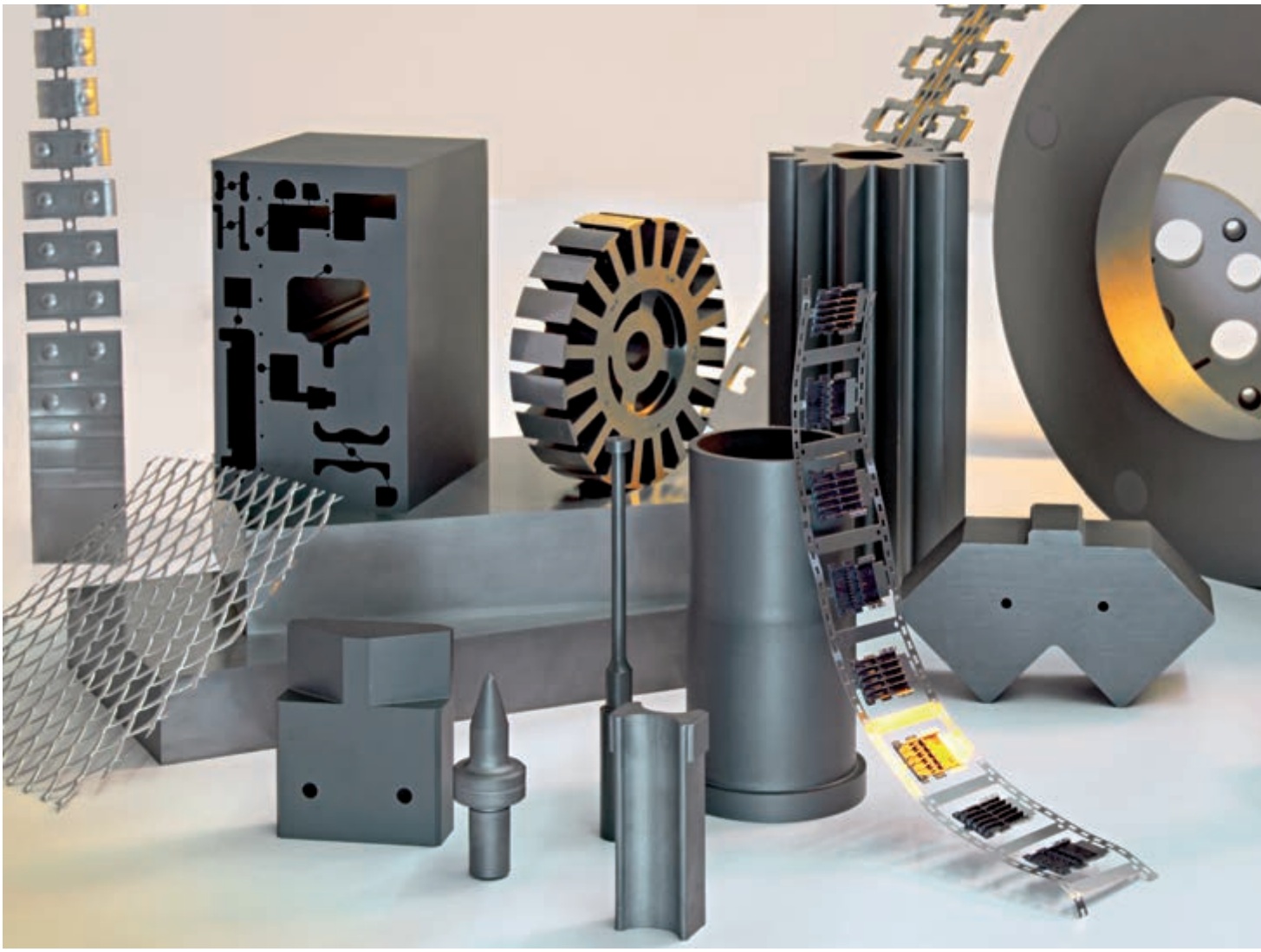
TEM picture of the protection layer of a carbide grade containing Cr and Re

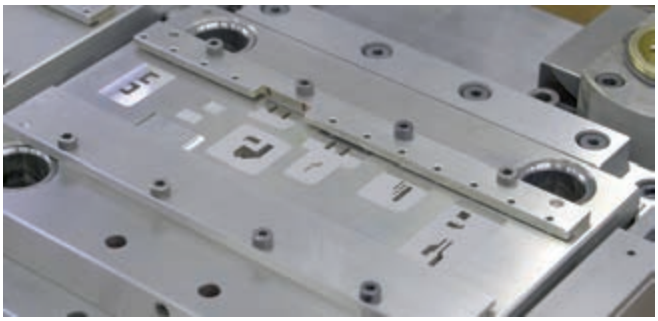
Contents

If you are interested or have any questions, please get in touch with **CERATIZIT Deutschland, Empfingen**. Alternatively, visit www.ceratizit.com/contact to find your local contact person.

Blanking and lamination tools
(bending and blanking tools)

An ever increasing number of products is manufactured using serial production, particularly when it comes to stamping, bending and forming. This requires maximum tool life of the active components combined with consistent results. The extremely corrosion-resistant carbide grades of our patented CF series are also resistant to rupture and wear, which ensures process security during the machining of complex and delicate tooling geometries. Applications range from thin foil to the fine cutting of strip with a thickness of several millimetres.



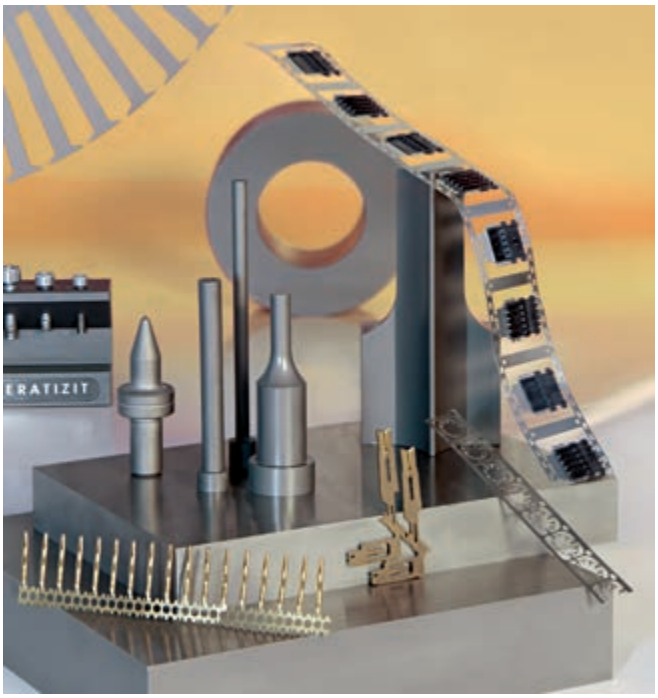


Sectors, applications

- Automotive and aerospace construction
- Construction and furniture industry
- Electric and electronic industry
- Mould and die construction
- White good producers

Materials

- Steels
- Non-ferrous metals
- Plastics
- Composite materials



Products

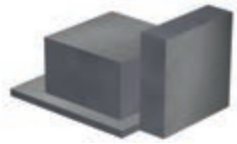
- Carbide blocks for erosion
- Rectangular strips
- Rods
- Customised preforms for punches and dies

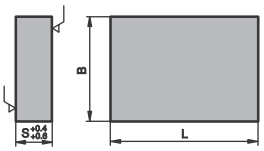
Carbide properties

- Wear resistance
- Compressive strength
- Corrosion resistance
- Transverse rupture strength
- Very good machinability in all following processes
- Good suitability for coating and removal of coating

Carbide blocks for wire erosion, as sintered

with grinding allowance on all dimensions, thickness ground to clean up + 0.4/+ 0.6 mm, *CF-S12Z*

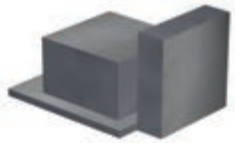


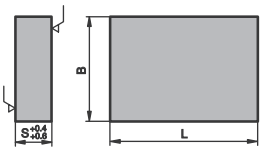


Type, description	Material	L [mm]	B [mm]	S [mm]
CTEB20-100,0x082,5x76,5 CF-S12Z	11965713	100	82.5	76.5
CTEB20-150,0x072,0x062,0 CF-S12Z	11965715	150	72	62
CTEB20-150,0x100,0x002,0 CF-S12Z	11965684	150	100	2
CTEB20-150,0x100,0x003,0 CF-S12Z	11965685	150	100	3
CTEB20-150,0x100,0x004,0 CF-S12Z	11965687	150	100	4
CTEB20-150,0x100,0x005,0 CF-S12Z	11965688	150	100	5
CTEB20-150,0x100,0x006,0 CF-S12Z	11965689	150	100	6
CTEB20-150,0x100,0x007,0 CF-S12Z	11965690	150	100	7
CTEB20-150,0x100,0x008,0 CF-S12Z	11965691	150	100	8
CTEB20-150,0x100,0x009,0 CF-S12Z	11965693	150	100	9
CTEB20-150,0x100,0x010,0 CF-S12Z	11965695	150	100	10
CTEB20-150,0x100,0x012,0 CF-S12Z	11965697	150	100	12
CTEB20-150,0x100,0x015,0 CF-S12Z	11965699	150	100	15
CTEB20-150,0x100,0x016,0 CF-S12Z	11965702	150	100	16
CTEB20-150,0x100,0x018,0 CF-S12Z	11965703	150	100	18
CTEB20-150,0x100,0x020,0 CF-S12Z	11965704	150	100	20
CTEB20-150,0x100,0x023,0 CF-S12Z	11965705	150	100	23
CTEB20-150,0x100,0x025,0 CF-S12Z	11965706	150	100	25
CTEB20-150,0x100,0x028,0 CF-S12Z	11965708	150	100	28
CTEB20-150,0x100,0x030,0 CF-S12Z	11965709	150	100	30
CTEB20-150,0x100,0x032,0 CF-S12Z	11965711	150	100	32
CTEB20-150,0x100,0x055,0 CF-S12Z	11965717	150	100	55
CTEB20-150,0x100,0x060,0 CF-S12Z	11965720	150	100	60

Carbide blocks for wire erosion, as sintered

with grinding allowance on all dimensions, thickness ground to clean up + 0.4/+ 0.6 mm, *CF-S18Z*

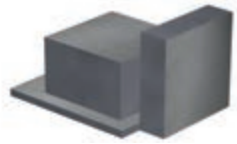


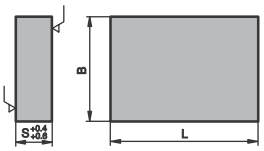


Type, description	Material	L [mm]	B [mm]	S [mm]
CTEB20-100,0x082,5x076,5 CF-S18Z	11797537	100	82.5	76.5
CTEB20-100,0x100,0x002,0 CF-S18Z	11797538	100	100	2
CTEB20-100,0x100,0x003,0 CF-S18Z	11797539	100	100	3
CTEB20-100,0x100,0x004,0 CF-S18Z	11797546	100	100	4
CTEB20-100,0x100,0x005,0 CF-S18Z	11797548	100	100	5
CTEB20-100,0x100,0x007,0 CF-S18Z	11797549	100	100	7
CTEB20-100,0x100,0x009,0 CF-S18Z	11797550	100	100	9
CTEB20-100,0x100,0x010,0 CF-S18Z	11797552	100	100	10
CTEB20-100,0x100,0x012,0 CF-S18Z	11797555	100	100	12
CTEB20-100,0x100,0x015,0 CF-S18Z	11797557	100	100	15
CTEB20-150,0x072,0x062,0 CF-S18Z	11965739	150	72	62
CTEB20-150,0x100,0x006,0 CF-S18Z	11797558	150	100	6
CTEB20-150,0x100,0x008,0 CF-S18Z	11797559	150	100	8
CTEB20-150,0x100,0x016,0 CF-S18Z	11797560	150	100	16
CTEB20-150,0x100,0x018,0 CF-S18Z	11965729	150	100	18
CTEB20-150,0x100,0x020,0 CF-S18Z	11797561	150	100	20
CTEB20-150,0x100,0x023,0 CF-S18Z	11965732	150	100	23
CTEB20-150,0x100,0x025,0 CF-S18Z	11797563	150	100	25
CTEB20-150,0x100,0x028,0 CF-S18Z	11965735	150	100	28
CTEB20-150,0x100,0x030,0 CF-S18Z	11797564	150	100	30
CTEB20-150,0x100,0x032,0 CF-S18Z	11797565	150	100	32
CTEB20-150,0x100,0x055,0 CF-S18Z	11965741	150	100	55
CTEB20-150,0x100,0x060,0 CF-S18Z	11965742	150	100	60

Carbide blocks for wire erosion, as sintered

with grinding allowance on all dimensions, thickness ground to clean up + 0.4/+ 0.6 mm, *CF-H25S+*

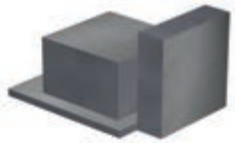


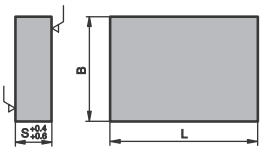


Type, description	Material	L [mm]	B [mm]	S [mm]
CTEB20-100,0x100,0x001,0 CF-H25S+	11966382	100	100	1
CTEB20-100,0x100,0x002,0 CF-H25S+	11966384	100	100	2
CTEB20-100,0x100,0x002,5 CF-H25S+	11966385	100	100	2.5
CTEB20-100,0x100,0x003,0 CF-H25S+	11627613	100	100	3
CTEB20-100,0x100,0x004,0 CF-H25S+	11627614	100	100	4
CTEB20-100,0x100,0x005,0 CF-H25S+	11966386	100	100	5
CTEB20-100,0x100,0x006,0 CF-H25S+	11627615	100	100	6
CTEB20-100,0x100,0x007,0 CF-H25S+	11966387	100	100	7
CTEB20-100,0x100,0x008,0 CF-H25S+	11627619	100	100	8
CTEB20-100,0x100,0x009,0 CF-H25S+	11797450	100	100	9
CTEB20-100,0x100,0x010,0 CF-H25S+	11627621	100	100	10
CTEB20-100,0x100,0x012,0 CF-H25S+	11627622	100	100	12
CTEB20-100,0x100,0x013,0 CF-H25S+	11966388	100	100	13
CTEB20-100,0x100,0x015,0 CF-H25S+	11627623	100	100	15
CTEB20-100,0x100,0x016,0 CF-H25S+	11966390	100	100	16
CTEB20-100,0x100,0x018,0 CF-H25S+	11966391	100	100	18
CTEB20-100,0x100,0x020,0 CF-H25S+	11627625	100	100	20
CTEB20-100,0x100,0x025,0 CF-H25S+	11797453	100	100	25
CTEB20-100,0x100,0x030,0 CF-H25S+	11627626	100	100	30
CTEB20-100,0x100,0x035,0 CF-H25S+	11627628	100	100	35
CTEB20-120,0x072,0x062,0 CF-H25S+	11966392	120	72	62
CTEB20-150,0x070,0x042,0 CF-H25S+	11966393	150	70	42
CTEB20-150,0x070,0x050,0 CF-H25S+	11797458	150	70	50
CTEB20-150,0x072,0x052,0 CF-H25S+	11797459	150	72	52
CTEB20-150,0x072,0x062,0 CF-H25S+	11966394	150	72	62
CTEB20-150,0x075,0x003,0 CF-H25S+	11966395	150	75	3
CTEB20-150,0x075,0x004,0 CF-H25S+	11966396	150	75	4
CTEB20-150,0x075,0x005,0 CF-H25S+	11966397	150	75	5
CTEB20-150,0x075,0x006,0 CF-H25S+	11966399	150	75	6
CTEB20-150,0x075,0x008,0 CF-H25S+	11797464	150	75	8
CTEB20-150,0x075,0x010,0 CF-H25S+	11797465	150	75	10
CTEB20-150,0x075,0x012,0 CF-H25S+	11797466	150	75	12
CTEB20-150,0x075,0x016,0 CF-H25S+	11966400	150	75	16
CTEB20-150,0x075,0x020,0 CF-H25S+	11797467	150	75	20
CTEB20-150,0x075,0x028,0 CF-H25S+	11966401	150	75	28
CTEB20-150,0x100,0x015,0 CF-H25S+	11966402	150	100	15
CTEB20-150,0x100,0x020,0 CF-H25S+	11966403	150	100	20
CTEB20-150,0x100,0x025,0 CF-H25S+	11966404	150	100	25
CTEB20-150,0x100,0x060,0 CF-H25S+	11966405	150	100	60
CTEB20-190,0x072,0x010,0 CF-H25S+	11966406	190	72	10
CTEB20-200,0x056,7x012,0 CF-H25S+	11966407	200	56.7	12
CTEB20-200,0x100,0x020,0 CF-H25S+	11966409	200	100	20
CTEB20-200,0x100,0x025,0 CF-H25S+	11966410	200	100	25

Carbide blocks for wire erosion, as sintered

with grinding allowance on all dimensions, thickness ground to clean up + 0.4/+ 0.6 mm, *CF-H40S+*

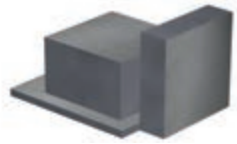


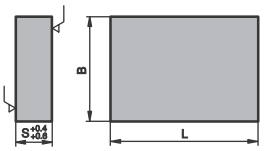


Type, description	Material	L [mm]	B [mm]	S [mm]
CTEB20-100,0x020,0x020,0 CF-H40S+	11966414	100	20	20
CTEB20-100,0x025,0x025,0 CF-H40S+	11966416	100	25	25
CTEB20-100,0x072,0x004,0 CF-H40S+	11966418	100	72	4
CTEB20-100,0x072,0x005,0 CF-H40S+	11966419	100	72	5
CTEB20-100,0x072,0x006,0 CF-H40S+	11966420	100	72	6
CTEB20-100,0x072,0x008,0 CF-H40S+	11966421	100	72	8
CTEB20-100,0x072,0x010,0 CF-H40S+	11966422	100	72	10
CTEB20-100,0x072,0x012,0 CF-H40S+	11966423	100	72	12
CTEB20-100,0x072,0x062,0 CF-H40S+	11966424	100	72	62
CTEB20-100,0x082,5x076,5 CF-H40S+	11797470	100	82.5	76.5
CTEB20-100,0x100,0x002,0 CF-H40S+	11797471	100	100	2
CTEB20-100,0x100,0x003,0 CF-H40S+	11627647	100	100	3
CTEB20-100,0x100,0x004,0 CF-H40S+	11627648	100	100	4
CTEB20-100,0x100,0x005,0 CF-H40S+	11797472	100	100	5
CTEB20-100,0x100,0x006,0 CF-H40S+	11627650	100	100	6
CTEB20-100,0x100,0x007,0 CF-H40S+	11797473	100	100	7
CTEB20-100,0x100,0x008,0 CF-H40S+	11797474	100	100	8
CTEB20-100,0x100,0x009,0 CF-H40S+	11966425	100	100	9
CTEB20-100,0x100,0x010,0 CF-H40S+	11627631	100	100	10
CTEB20-100,0x100,0x011,0 CF-H40S+	11966426	100	100	11
CTEB20-100,0x100,0x012,0 CF-H40S+	11627640	100	100	12
CTEB20-100,0x100,0x015,0 CF-H40S+	11627641	100	100	15
CTEB20-100,0x100,0x016,0 CF-H40S+	11797477	100	100	16
CTEB20-100,0x100,0x018,0 CF-H40S+	11627642	100	100	18
CTEB20-100,0x100,0x020,0 CF-H40S+	11627633	100	100	20
CTEB20-100,0x100,0x022,0 CF-H40S+	11966427	100	100	22
CTEB20-100,0x100,0x025,0 CF-H40S+	11797478	100	100	25
CTEB20-100,0x100,0x030,0 CF-H40S+	11797484	100	100	30
CTEB20-100,0x100,0x035,0 CF-H40S+	11797486	100	100	35
CTEB20-100,0x100,0x050,0 CF-H40S+	11627643	100	100	50
CTEB20-100,0x100,0x060,0 CF-H40S+	11627644	100	100	60
CTEB20-100,0x100,0x070,0 CF-H40S+	11966428	100	100	70
CTEB20-150,0x050,0x042,0 CF-H40S+	11797487	150	50	42
CTEB20-150,0x070,0x050,0 CF-H40S+	11797489	150	70	50
CTEB20-150,0x072,0x021,0 CF-H40S+	11966429	150	72	21
CTEB20-150,0x072,0x026,0 CF-H40S+	11797491	150	72	26
CTEB20-150,0x072,0x031,0 CF-H40S+	11966431	150	72	31
CTEB20-150,0x072,0x052,0 CF-H40S+	11797492	150	72	52
CTEB20-150,0x072,0x062,0 CF-H40S+	11797494	150	72	62
CTEB20-150,0x080,0x045,0 CF-H40S+	11797497	150	80	45
CTEB20-150,0x080,0x065,0 CF-H40S+	11797498	150	80	65
CTEB20-150,0x090,0x076,5 CF-H40S+	11966437	150	90	76.5
CTEB20-150,0x100,0x004,0 CF-H40S+	11797499	150	100	4
CTEB20-150,0x100,0x005,0 CF-H40S+	11797501	150	100	5

Carbide blocks for wire erosion, as sintered

with grinding allowance on all dimensions, thickness ground to clean up + 0.4/+ 0.6 mm, *CF-H40S+*

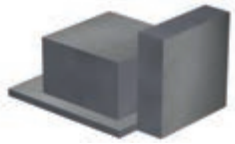


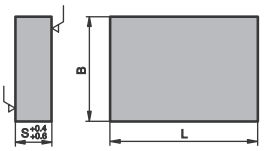


Type, description	Material	L [mm]	B [mm]	S [mm]
CTEB20-150,0x100,0x006,0 CF-H40S+	11797503	150	100	6
CTEB20-150,0x100,0x008,0 CF-H40S+	11627646	150	100	8
CTEB20-150,0x100,0x010,0 CF-H40S+	11627651	150	100	10
CTEB20-150,0x100,0x012,0 CF-H40S+	11627634	150	100	12
CTEB20-150,0x100,0x015,0 CF-H40S+	11627653	150	100	15
CTEB20-150,0x100,0x016,0 CF-H40S+	11627636	150	100	16
CTEB20-150,0x100,0x018,0 CF-H40S+	11966438	150	100	18
CTEB20-150,0x100,0x020,0 CF-H40S+	11627637	150	100	20
CTEB20-150,0x100,0x022,0 CF-H40S+	11797504	150	100	22
CTEB20-150,0x100,0x025,0 CF-H40S+	11797506	150	100	25
CTEB20-150,0x100,0x028,0 CF-H40S+	11797508	150	100	28
CTEB20-150,0x100,0x030,0 CF-H40S+	11627638	150	100	30
CTEB20-150,0x100,0x032,0 CF-H40S+	11797510	150	100	32
CTEB20-150,0x100,0x035,0 CF-H40S+	11797511	150	100	35
CTEB20-150,0x100,0x040,0 CF-H40S+	11797512	150	100	40
CTEB20-150,0x100,0x042,0 CF-H40S+	11966444	150	100	42
CTEB20-150,0x100,0x045,0 CF-H40S+	11966445	150	100	45
CTEB20-150,0x100,0x050,0 CF-H40S+	11966446	150	100	50
CTEB20-150,0x100,0x055,0 CF-H40S+	11797513	150	100	55
CTEB20-150,0x100,0x060,0 CF-H40S+	11966447	150	100	60
CTEB20-150,0x100,0x066,0 CF-H40S+	11966448	150	100	66
CTEB20-150,0x100,0x076,5 CF-H40S+	11966449	150	100	76.5
CTEB20-150,0x150,0x020,0 CF-H40S+	11797518	150	150	20
CTEB20-150,0x150,0x022,0 CF-H40S+	11797519	150	150	22
CTEB20-150,0x150,0x030,0 CF-H40S+	11966450	150	150	30
CTEB20-200,0x072,0x010,0 CF-H40S+	11797521	200	72	10
CTEB20-200,0x072,0x015,0 CF-H40S+	11966451	200	72	15
CTEB20-200,0x072,0x020,0 CF-H40S+	11966452	200	72	20
CTEB20-200,0x072,0x025,0 CF-H40S+	11966453	200	72	25
CTEB20-200,0x072,0x030,0 CF-H40S+	11797523	200	72	30
CTEB20-200,0x072,0x060,0 CF-H40S+	11966454	200	72	60
CTEB20-200,0x100,0x025,0 CF-H40S+	11797524	200	100	25
CTEB20-200,0x150,0x020,0 CF-H40S+	11966455	200	150	20
CTEB20-200,0x200,0x020,0 CF-H40S+	11797525	200	200	20
CTEB20-200,0x200,0x022,0 CF-H40S+	11797526	200	200	22
CTEB20-200,0x200,0x025,0 CF-H40S+	11797527	200	200	25
CTEB20-200,0x200,0x030,0 CF-H40S+	11797529	200	200	30
CTEB20-250,0x150,0x020,0 CF-H40S+	11797530	250	150	20
CTEB20-250,0x150,0x026,0 CF-H40S+	11797532	250	150	26
CTEB20-250,0x150,0x032,0 CF-H40S+	11966456	250	150	32
CTEB20-285,0x285,0x022,0 CF-H40S+	11797533	285	285	22
CTEB20-285,0x285,0x028,0 CF-H40S+	11797534	285	285	28
CTEB20-285,0x285,0x035,0 CF-H40S+	11797535	285	285	35

Carbide blocks for wire erosion, as sintered

with grinding allowance on all dimensions, thickness ground to clean up + 0.4/+ 0.6 mm, *CF-F35Z*

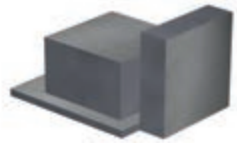


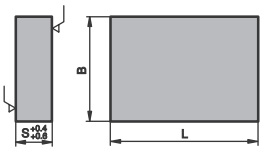


Type, description	Material	L [mm]	B [mm]	S [mm]
CTEB20-100,0x082,5x076,5 CF-F35Z	11965825	100	82.5	76.5
CTEB20-150,0x072,0x062,0 CF-F35Z	11965829	150	72	62
CTEB20-150,0x100,0x002,0 CF-F35Z	11965762	150	100	2
CTEB20-150,0x100,0x003,0 CF-F35Z	11965768	150	100	3
CTEB20-150,0x100,0x004,0 CF-F35Z	11965769	150	100	4
CTEB20-150,0x100,0x005,0 CF-F35Z	11965771	150	100	5
CTEB20-150,0x100,0x006,0 CF-F35Z	11965772	150	100	6
CTEB20-150,0x100,0x007,0 CF-F35Z	11965775	150	100	7
CTEB20-150,0x100,0x008,0 CF-F35Z	11965776	150	100	8
CTEB20-150,0x100,0x009,0 CF-F35Z	11965778	150	100	9
CTEB20-150,0x100,0x010,0 CF-F35Z	11965782	150	100	10
CTEB20-150,0x100,0x012,0 CF-F35Z	11965788	150	100	12
CTEB20-150,0x100,0x015,0 CF-F35Z	11965790	150	100	15
CTEB20-150,0x100,0x016,0 CF-F35Z	11965791	150	100	16
CTEB20-150,0x100,0x018,0 CF-F35Z	11965793	150	100	18
CTEB20-150,0x100,0x020,0 CF-F35Z	11965799	150	100	20
CTEB20-150,0x100,0x023,0 CF-F35Z	11965801	150	100	23
CTEB20-150,0x100,0x025,0 CF-F35Z	11965809	150	100	25
CTEB20-150,0x100,0x028,0 CF-F35Z	11965813	150	100	28
CTEB20-150,0x100,0x030,0 CF-F35Z	11965814	150	100	30
CTEB20-150,0x100,0x032,0 CF-F35Z	11965818	150	100	32
CTEB20-150,0x100,0x055,0 CF-F35Z	11965830	150	100	55
CTEB20-150,0x100,0x060,0 CF-F35Z	11965831	150	100	60

Carbide blocks for wire erosion, as sintered

with grinding allowance on all dimensions, thickness ground to clean up + 0.4/+ 0.6 mm, *CF-20HP*

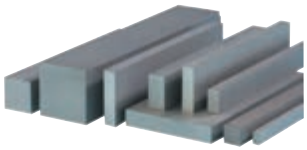




Type, description	Material	L [mm]	B [mm]	S [mm]
CTEB20-150,0x072,0x045,0 CF-20HP	11965755	150	72	45
CTEB20-150,0x075,0x062,0 CF-20HP	11965761	150	75	62
CTEB20-150,0x080,0x055,0 CF-20HP	11965759	150	80	55
CTEB20-150,0x100,0x008,0 CF-20HP	11965686	150	100	8
CTEB20-150,0x100,0x010,0 CF-20HP	11965692	150	100	10
CTEB20-150,0x100,0x012,0 CF-20HP	11965694	150	100	12
CTEB20-150,0x100,0x015,0 CF-20HP	11965696	150	100	15
CTEB20-150,0x100,0x020,0 CF-20HP	11965698	150	100	20
CTEB20-150,0x100,0x023,0 CF-20HP	11965701	150	100	23
CTEB20-150,0x100,0x025,0 CF-20HP	11965710	150	100	25
CTEB20-150,0x100,0x028,0 CF-20HP	11965750	150	100	28
CTEB20-150,0x100,0x030,0 CF-20HP	11965754	150	100	30
CTEB20-150,0x100,0x035,0 CF-20HP	11965757	150	100	35

Rectangular strips for punching dies

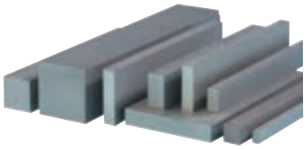
as sintered, with positive sintering tolerance, *CF-H40S+*



Type, description	Material	L [mm]	B [mm]	S [mm]
CTSS 02,5x02,5x80 CF-H40S+	11803282	80	2.5	2.5
CTSS 03,5X03,5X80 CF-H40S+	11803306	80	3.5	3.5
CTSS 04,5X02,5X80 CF-H40S+	11803285	80	4.5	2.5
CTSS 04,5X04,5X80 CF-H40S+	11803322	80	4.5	4.5
CTSS 05,5X02,5X80 CF-H40S+	11803288	80	5.5	2.5
CTSS 05,5X03,5X80 CF-H40S+	11803307	80	5.5	3.5
CTSS 05,5X05,5X80 CF-H40S+	11803331	80	5.5	5.5
CTSS 06,5X02,5X80 CF-H40S+	11803292	80	6.5	2.5
CTSS 06,5X03,5X80 CF-H40S+	11803308	80	6.5	3.5
CTSS 06,5X04,5X80 CF-H40S+	11803323	80	6.5	4.5
CTSS 06,5X06,5X80 CF-H40S+	11803341	80	6.5	6.5
CTSS 07,5X07,5X80 CF-H40S+	11803361	80	7.5	7.5
CTSS 08,5X02,5X80 CF-H40S+	11803297	80	8.5	2.5
CTSS 08,5X03,5X80 CF-H40S+	11803310	80	8.5	3.5
CTSS 08,5X04,5X80 CF-H40S+	11803324	80	8.5	4.5
CTSS 08,5X05,5X80 CF-H40S+	11803332	80	8.5	5.5
CTSS 08,5X06,5X80 CF-H40S+	11803342	80	8.5	6.5
CTSS 08,5X08,5X80 CF-H40S+	11803368	80	8.5	8.5
CTSS 10,5X02,5X80 CF-H40S+	11803299	80	10.5	2.5
CTSS 10,5X03,5X80 CF-H40S+	11803313	80	10.5	3.5
CTSS 10,5X04,5X80 CF-H40S+	11803325	80	10.5	4.5
CTSS 10,5X05,5X80 CF-H40S+	11803333	80	10.5	5.5
CTSS 10,5X06,5X80 CF-H40S+	11803343	80	10.5	6.5
CTSS 10,5X07,5X80 CF-H40S+	11803363	80	10.5	7.5
CTSS 10,5X08,5X80 CF-H40S+	11803369	80	10.5	8.5
CTSS 10,5X10,5X80 CF-H40S+	11803379	80	10.5	10.5
CTSS 12,5X02,5X80 CF-H40S+	11803301	80	12.5	2.5
CTSS 12,5X03,5X80 CF-H40S+	11803316	80	12.5	3.5
CTSS 12,5X04,5X80 CF-H40S+	11803326	80	12.5	4.5
CTSS 12,5X05,5X80 CF-H40S+	11803334	80	12.5	5.5
CTSS 12,5X06,5X80 CF-H40S+	11803346	80	12.5	6.5
CTSS 12,5X08,5X80 CF-H40S+	11803370	80	12.5	8.5
CTSS 12,5X10,5X80 CF-H40S+	11803381	80	12.5	10.5
CTSS 12,5X12,5X80 CF-H40S+	11803389	80	12.5	12.5
CTSS 14,5X02,5X80 CF-H40S+	11803304	80	14.5	2.5
CTSS 14,5X03,5X80 CF-H40S+	11803319	80	14.5	3.5
CTSS 14,5X14,5X80 CF-H40S+	11803395	80	14.5	14.5
CTSS 15,5X07,5X80 CF-H40S+	11803365	80	15.5	7.5
CTSS 15,5X10,5X80 CF-H40S+	11803384	80	15.5	10.5
CTSS 15,5X12,5X80 CF-H40S+	11803390	80	15.5	12.5
CTSS 16,5X02,5X80 CF-H40S+	11803305	80	16.5	2.5
CTSS 16,5X04,5X80 CF-H40S+	11803327	80	16.5	4.5
CTSS 16,5X05,5X80 CF-H40S+	11803335	80	16.5	5.5
CTSS 16,5X06,5X80 CF-H40S+	11803353	80	16.5	6.5

Rectangular strips for punching dies

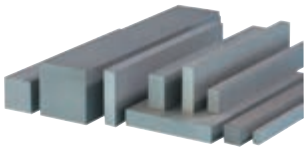
as sintered, with positive sintering tolerance, *CF-H40S+*



Type, description	Material	L [mm]	B [mm]	S [mm]
CTSS 16,5X08,5X80 CF-H40S+	11803372	80	16.5	8.5
CTSS 16,5X16,5X80 CF-H40S+	11803399	80	16.5	16.5
CTSS 18,5X03,5X80 CF-H40S+	11803320	80	18.5	3.5
CTSS 18,5X07,5X80 CF-H40S+	11803366	80	18.5	7.5
CTSS 18,5X18,5X80 CF-H40S+	11803400	80	18.5	18.5
CTSS 20,5X03,5X80 CF-H40S+	11803321	80	20.5	3.5
CTSS 20,5X04,5X80 CF-H40S+	11803328	80	20.5	4.5
CTSS 20,5X05,5X80 CF-H40S+	11803336	80	20.5	5.5
CTSS 20,5X06,5X80 CF-H40S+	11803356	80	20.5	6.5
CTSS 20,5X07,5X80 CF-H40S+	11803367	80	20.5	7.5
CTSS 20,5X08,5X80 CF-H40S+	11803374	80	20.5	8.5
CTSS 20,5X10,5X80 CF-H40S+	11803385	80	20.5	10.5
CTSS 20,5X12,5X80 CF-H40S+	11803392	80	20.5	12.5
CTSS 20,5X14,5X80 CF-H40S+	11803396	80	20.5	14.5
CTSS 20,5X20,5X80 CF-H40S+	11803401	80	20.5	20.5
CTSS 25,5X04,5X80 CF-H40S+	11803330	80	25.5	4.5
CTSS 25,5X05,5X80 CF-H40S+	11803338	80	25.5	5.5
CTSS 25,5X06,5X80 CF-H40S+	11803359	80	25.5	6.5
CTSS 25,5X08,5X80 CF-H40S+	11803376	80	25.5	8.5
CTSS 25,5X10,5X80 CF-H40S+	11803386	80	25.5	10.5
CTSS 25,5X12,5X80 CF-H40S+	11803394	80	25.5	12.5
CTSS 25,5X14,5X80 CF-H40S+	11803398	80	25.5	14.5
CTSS 30,5X05,5X80 CF-H40S+	11803339	80	30.5	5.5
CTSS 30,5X06,5X80 CF-H40S+	11803360	80	30.5	6.5
CTSS 30,5X08,5X80 CF-H40S+	11803377	80	30.5	8.5
CTSS 30,5X10,5X80 CF-H40S+	11803388	80	30.5	10.5

Rectangular strips for punching dies

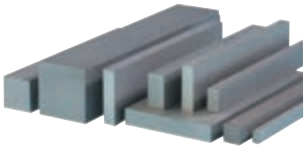
as sintered, with positive sintering tolerance, *CF-S18Z*



Type, description	Material	L [mm]	B [mm]	S [mm]
CTSS 02,5X02,5X80 CF-S18Z	11803405	80	2.5	2.5
CTSS 03,5X03,5X80 CF-S18Z	11803418	80	3.5	3.5
CTSS 04,5X02,5X80 CF-S18Z	11803407	80	4.5	2.5
CTSS 04,5X04,5X80 CF-S18Z	11803430	80	4.5	4.5
CTSS 05,5X03,5X80 CF-S18Z	11803420	80	5.5	3.5
CTSS 05,5X05,5X80 CF-S18Z	11803451	80	5.5	5.5
CTSS 06,5X04,5X80 CF-S18Z	11803431	80	6.5	4.5
CTSS 06,5X06,5X80 CF-S18Z	11803459	80	6.5	6.5
CTSS 08,5X02,5X80 CF-S18Z	11803411	80	8.5	2.5
CTSS 08,5X03,5X80 CF-S18Z	11803421	80	8.5	3.5
CTSS 08,5X04,5X80 CF-S18Z	11803432	80	8.5	4.5
CTSS 08,5X05,5X80 CF-S18Z	11803452	80	8.5	5.5
CTSS 08,5X06,5X80 CF-S18Z	11803460	80	8.5	6.5
CTSS 08,5X08,5X80 CF-S18Z	11803474	80	8.5	8.5
CTSS 10,5X02,5X80 CF-S18Z	11803412	80	10.5	2.5
CTSS 10,5X03,5X80 CF-S18Z	11803422	80	10.5	3.5
CTSS 10,5X04,5X80 CF-S18Z	11803433	80	10.5	4.5
CTSS 10,5X05,5X80 CF-S18Z	11803453	80	10.5	5.5
CTSS 10,5X06,5X80 CF-S18Z	11803461	80	10.5	6.5
CTSS 10,5X08,5X80 CF-S18Z	11803475	80	10.5	8.5
CTSS 10,5X10,5X80 CF-S18Z	11803491	80	10.5	10.5
CTSS 12,5X02,5X80 CF-S18Z	11803414	80	12.5	2.5
CTSS 12,5X03,5X80 CF-S18Z	11803423	80	12.5	3.5
CTSS 12,5X04,5X80 CF-S18Z	11803434	80	12.5	4.5
CTSS 12,5X05,5X80 CF-S18Z	11803454	80	12.5	5.5
CTSS 12,5X06,5X80 CF-S18Z	11803462	80	12.5	6.5
CTSS 12,5X08,5X80 CF-S18Z	11803478	80	12.5	8.5
CTSS 12,5X10,5X80 CF-S18Z	11803497	80	12.5	10.5
CTSS 12,5X12,5X80 CF-S18Z	11803507	80	12.5	12.5
CTSS 14,5X02,5X80 CF-S18Z	11803415	80	14.5	2.5
CTSS 14,5X03,5X80 CF-S18Z	11803425	80	14.5	3.5
CTSS 15,5X10,5X80 CF-S18Z	11803501	80	15.5	10.5
CTSS 16,5X02,5X80 CF-S18Z	11803416	80	16.5	2.5
CTSS 16,5X04,5X80 CF-S18Z	11803449	80	16.5	4.5
CTSS 16,5X05,5X80 CF-S18Z	11803455	80	16.5	5.5
CTSS 16,5X06,5X80 CF-S18Z	11803463	80	16.5	6.5
CTSS 16,5X08,5X80 CF-S18Z	11803480	80	16.5	8.5
CTSS 18,5X03,5X80 CF-S18Z	11803427	80	18.5	3.5
CTSS 18,5X07,5X80 CF-S18Z	11803471	80	18.5	7.5
CTSS 20,5X03,5X80 CF-S18Z	11803429	80	20.5	3.5
CTSS 20,5X04,5X80 CF-S18Z	11803450	80	20.5	4.5
CTSS 20,5X05,5X80 CF-S18Z	11803456	80	20.5	5.5
CTSS 20,5X06,5X80 CF-S18Z	11803464	80	20.5	6.5
CTSS 20,5X07,5X80 CF-S18Z	11803472	80	20.5	7.5

Rectangular strips for punching dies

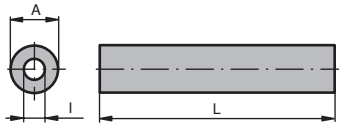
as sintered, with positive sintering tolerance, *CF-S18Z*



Type, description	Material	L [mm]	B [mm]	S [mm]
CTSS 20,5X08,5X80 CF-S18Z	11803482	80	20.5	8.5
CTSS 20,5X10,5X80 CF-S18Z	11803504	80	20.5	10.5
CTSS 20,5X12,5X80 CF-S18Z	11803518	80	20.5	12.5
CTSS 20,5X14,5X80 CF-S18Z	11803525	80	20.5	14.5
CTSS 25,5X06,5X80 CF-S18Z	11803465	80	25.5	6.5
CTSS 25,5X08,5X80 CF-S18Z	11803485	80	25.5	8.5
CTSS 25,5X12,5X80 CF-S18Z	11803522	80	25.5	12.5
CTSS 25,5X14,5X80 CF-S18Z	11803526	80	25.5	14.5
CTSS 26,5X14,5X80 CF-S18Z	11803531	80	26.5	14.5
CTSS 30,5X05,5X80 CF-S18Z	11803457	80	30.5	5.5
CTSS 30,5X06,5X80 CF-S18Z	11803468	80	30.5	6.5
CTSS 30,5X08,5X80 CF-S18Z	11803487	80	30.5	8.5
CTSS 35,5X05,5X80 CF-S18Z	11803458	80	35.5	5.5
CTSS 35,5X06,5X80 CF-S18Z	11803469	80	35.5	6.5

Bushes for guides and dies

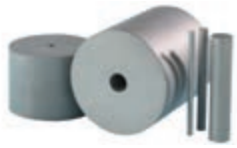
outer dimensions with grinding allowance, inner diameter with positive sintering tolerances, *CF-H40S+*

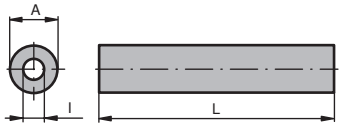


Type, description	Material	A [mm]	l [mm]	L [mm]
CTSB 0501-110 CF-H40S+	11797639	5	1	110
CTSB 0601-110 CF-H40S+	11797641	6	1	110
CTSB 0701-110 CF-H40S+	11797575	7	1	110
CTSB 0801-110 CF-H40S+	11797644	8	1	110
CTSB 1001-110 CF-H40S+	11797645	10	1	110
CTSB 1202-110 CF-H40S+	11797646	12	2	110
CTSB 1402-110 CF-H40S+	11797666	14	2	110
CTSB 1602-110 CF-H40S+	11797670	16	2	110
CTSB 1802-110 CF-H40S+	11797672	18	2	110
CTSB 2002-110 CF-H40S+	11797674	20	2	110
CTSB 2202-110 CF-H40S+	11797676	20	2	110
CTSB 2503-110 CF-H40S+	11797677	25	3	110
CTSB 3003-110 CF-H40S+	11797679	30	3	110
CTSB 3203-110 CF-H40S+	11797680	32	3	110

Bushes for guides and dies

outer dimensions with grinding allowance, inner diameter with positive sintering tolerances, *CF-S18Z*

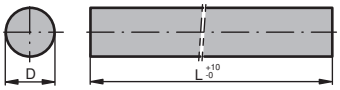




Type, description	Material	A [mm]	l [mm]	L [mm]
CTSB 0501-110 CF-S18Z	11797706	5	1	110
CTSB 0601-110 CF-S18Z	11797707	6	1	110
CTSB 0701-110 CF-S18Z	11797711	7	1	110
CTSB 0801-110 CF-S18Z	11797715	8	1	110
CTSB 1001-110 CF-S18Z	11797716	10	1	110
CTSB 1202-110 CF-S18Z	11797717	12	2	110
CTSB 1402-110 CF-S18Z	11797718	14	2	110
CTSB 1602-110 CF-S18Z	11797719	16	2	110
CTSB 1802-110 CF-S18Z	11797720	18	2	110
CTSB 2002-110 CF-S18Z	11797721	20	2	110
CTSB 2202-110 CF-S18Z	11797722	22	2	110
CTSB 2503-110 CF-S18Z	11797723	25	3	110
CTSB 3003-110 CF-S18Z	11797725	30	3	110
CTSB 3203-110 CF-S18Z	11797727	32	3	110

Rods for punching dies

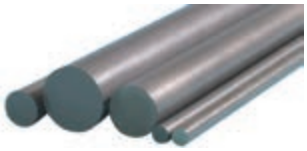
as sintered, length: 330 mm, CF-H40S+

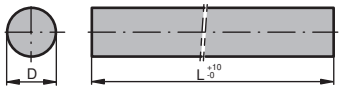


Type, description	Material	D [mm]	Dia. tol. [mm]	L [mm]
RR 0115-330 CF-H40S+	11807645	1.15	-0/+0.15	330
RR 0165-330 CF-H40S+	11807651	1.65	-0/+0.15	330
RR 0180-330 CF-H40S+	11807653	1.80	-0/+0.15	330
RR 0220-330 CF-H40S+	11807654	2.20	-0/+0.20	330
RR 0270-330 CF-H40S+	11807655	2.70	-0/+0.20	330
RR 0325-330 CF-H40S+	11807657	3.25	-0/+0.10	330
RR 0370-330 CF-H40S+	11807662	3.70	-0/+0.20	330
RR 0420-330 CF-H40S+	11807663	4.20	-0/+0.20	330
RR 0470-330 CF-H40S+	11807668	4.70	-0/+0.20	330
RR 0520-330 CF-H40S+	11807670	5.20	-0/+0.25	330
RR 0570-330 CF-H40S+	11807672	5.70	-0/+0.25	330
RR 0620-330 CF-H40S+	11807674	6.20	-0/+0.25	330
RR 0670-330 CF-H40S+	11807675	6.70	-0/+0.25	330
RR 0720-330 CF-H40S+	11807676	7.20	-0/+0.30	330
RR 0770-330 CF-H40S+	11807677	7.70	-0/+0.30	330
RR 0820-330 CF-H40S+	11807679	8.20	-0/+0.30	330
RR 0870-330 CF-H40S+	11807681	8.70	-0/+0.30	330
RR 0920-330 CF-H40S+	11807683	9.20	-0/+0.30	330
RR 0970-330 CF-H40S+	11807684	9.70	-0/+0.30	330
RR 1020-330 CF-H40S+	11807685	10.20	-0/+0.30	330
RR 1070-330 CF-H40S+	11807686	10.70	-0/+0.30	330
RR 1120-330 CF-H40S+	11807687	11.20	-0/+0.30	330
RR 1170-330 CF-H40S+	11807688	11.70	-0/+0.30	330
RR 1220-330 CF-H40S+	11807690	12.20	-0/+0.30	330
RR 1270-330 CF-H40S+	11807691	12.70	-0/+0.30	330
RR 1320-330 CF-H40S+	11807693	13.20	-0/+0.30	330
RR 1420-330 CF-H40S+	11807694	14.20	-0/+0.30	330
RR 1470-330 CF-H40S+	11807695	14.70	-0/+0.30	330
RR 1520-330 CF-H40S+	11807696	15.20	-0/+0.30	330
RR 1620-330 CF-H40S+	11807698	16.20	-0/+0.45	330
RR 1720-330 CF-H40S+	11807699	17.20	-0/+0.45	330
RR 1820-330 CF-H40S+	11807701	18.20	-0/+0.45	330
RR 1920-330 CF-H40S+	11807702	19.20	-0/+0.45	330
RR 2020-330 CF-H40S+	11807704	20.20	-0/+0.45	330
RR 2120-330 CF-H40S+	11807708	21.20	-0/+0.55	330
RR 2220-330 CF-H40S+	11807710	22.20	-0/+0.55	330
RR 2320-330 CF-H40S+	11807712	23.20	-0/+0.55	330
RR 2420-330 CF-H40S+	11807713	24.20	-0/+0.55	330
RR 2520-330 CF-H40S+	11807714	25.20	-0/+0.65	330
RR 2620-330 CF-H40S+	11807715	26.20	-0/+0.65	330
RR 2820-330 CF-H40S+	11807716	28.20	-0/+0.65	330
RR 3020-330 CF-H40S+	11807717	30.20	-0/+0.65	330
RR 3220-330 CF-H40S+	11807719	32.20	-0/+0.65	330

Rods for punching dies

as sintered, length: 330 mm, CF-S18Z

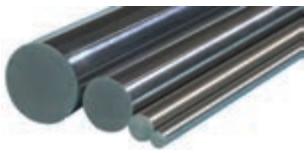


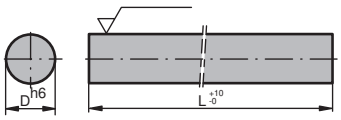


Type, description	Material	D [mm]	Dia. tol. [mm]	L [mm]
RR 0115-330 CF-S18Z	11807741	1.15	-0/+0.15	330
RR 0165-330 CF-S18Z	11807743	1.65	-0/+0.15	330
RR 0180-330 CF-S18Z	11807745	1.80	-0/+0.15	330
RR 0220-330 CF-S18Z	11807746	2.20	-0/+0.20	330
RR 0270-330 CF-S18Z	11807747	2.70	-0/+0.20	330
RR 0325-330 CF-S18Z	11807748	3.25	-0/+0.10	330
RR 0370-330 CF-S18Z	11807749	3.70	-0/+0.20	330
RR 0420-330 CF-S18Z	11807750	4.20	-0/+0.20	330
RR 0470-330 CF-S18Z	11807751	4.70	-0/+0.20	330
RR 0520-330 CF-S18Z	11807752	5.20	-0/+0.25	330
RR 0570-330 CF-S18Z	11807754	5.70	-0/+0.25	330
RR 0620-330 CF-S18Z	11807755	6.20	-0/+0.25	330
RR 0670-330 CF-S18Z	11807757	6.70	-0/+0.25	330
RR 0720-330 CF-S18Z	11807758	7.20	-0/+0.30	330
RR 0770-330 CF-S18Z	11807759	7.70	-0/+0.30	330
RR 0820-330 CF-S18Z	11807761	8.20	-0/+0.30	330
RR 0870-330 CF-S18Z	11807762	8.70	-0/+0.30	330
RR 0920-330 CF-S18Z	11807767	9.20	-0/+0.30	330
RR 0970-330 CF-S18Z	11807768	9.70	-0/+0.30	330
RR 1020-330 CF-S18Z	11807769	10.20	-0/+0.30	330
RR 1070-330 CF-S18Z	11807770	10.70	-0/+0.30	330
RR 1120-330 CF-S18Z	11807771	11.20	-0/+0.30	330
RR 1170-330 CF-S18Z	11807772	11.70	-0/+0.30	330
RR 1220-330 CF-S18Z	11807773	12.20	-0/+0.30	330
RR 1270-330 CF-S18Z	11807774	12.70	-0/+0.30	330
RR 1320-330 CF-S18Z	11807775	13.20	-0/+0.30	330
RR 1420-330 CF-S18Z	11807776	14.20	-0/+0.30	330
RR 1470-330 CF-S18Z	11807777	14.70	-0/+0.30	330
RR 1520-330 CF-S18Z	11807778	15.20	-0/+0.30	330
RR 1620-330 CF-S18Z	11807779	16.20	-0/+0.45	330
RR 1720-330 CF-S18Z	11807780	17.20	-0/+0.45	330
RR 1820-330 CF-S18Z	11807781	18.20	-0/+0.45	330
RR 1920-330 CF-S18Z	11807782	19.20	-0/+0.45	330
RR 2020-330 CF-S18Z	11807783	20.20	-0/+0.45	330
RR 2120-330 CF-S18Z	11807784	21.20	-0/+0.55	330
RR 2220-330 CF-S18Z	11807785	22.20	-0/+0.55	330
RR 2320-330 CF-S18Z	11807786	23.20	-0/+0.55	330
RR 2420-330 CF-S18Z	11807787	24.20	-0/+0.55	330
RR 2520-330 CF-S18Z	11807788	25.20	-0/+0.65	330
RR 2620-330 CF-S18Z	11807789	26.20	-0/+0.65	330
RR 2820-330 CF-S18Z	11807790	28.20	-0/+0.65	330
RR 3020-330 CF-S18Z	11807791	30.20	-0/+0.65	330
RR 3220-330 CF-S18Z	11807792	32.20	-0/+0.65	330

Rods for punching dies

diameter ground to h6, length: 330 mm, *CF-H40S+*

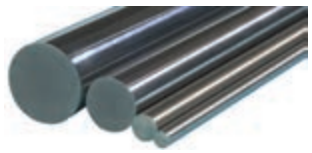


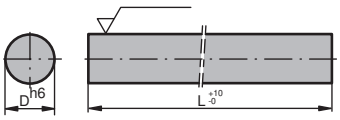


Type, description	Material	D [mm]	Dia. tol. [mm]	L [mm]
RG 0100-330 CF-H40S+ h6	11807720	1.00	+0/-0.006	330
RG 0150-330 CF-H40S+ h6	11807722	1.50	+0/-0.006	330
RG 0200-330 CF-H40S+ h6	11807723	2.00	+0/-0.006	330
RG 0250-330 CF-H40S+ h6	11807724	2.50	+0/-0.006	330
RG 0300-330 CF-H40S+ h6	11807726	3.00	+0/-0.006	330
RG 0350-330 CF-H40S+ h6	11807727	3.50	+0/-0.008	330
RG 0400-330 CF-H40S+ h6	11807728	4.00	+0/-0.008	330
RG 0450-330 CF-H40S+ h6	11807729	4.50	+0/-0.008	330
RG 0500-330 CF-H40S+ h6	11807730	5.00	+0/-0.008	330
RG 0550-330 CF-H40S+ h6	11807731	5.50	+0/-0.008	330
RG 0600-330 CF-H40S+ h6	11807732	6.00	+0/-0.008	330
RG 0700-330 CF-H40S+ h6	11807734	7.00	+0/-0.009	330
RG 0800-330 CF-H40S+ h6	11807735	8.00	+0/-0.009	330
RG 0900-330 CF-H40S+ h6	11807738	9.00	+0/-0.009	330
RG 1000-330 CF-H40S+ h6	11807739	10.00	+0/-0.009	330

Rods for punching dies

diameter ground to h6, length: 330 mm, *CF-S18Z*



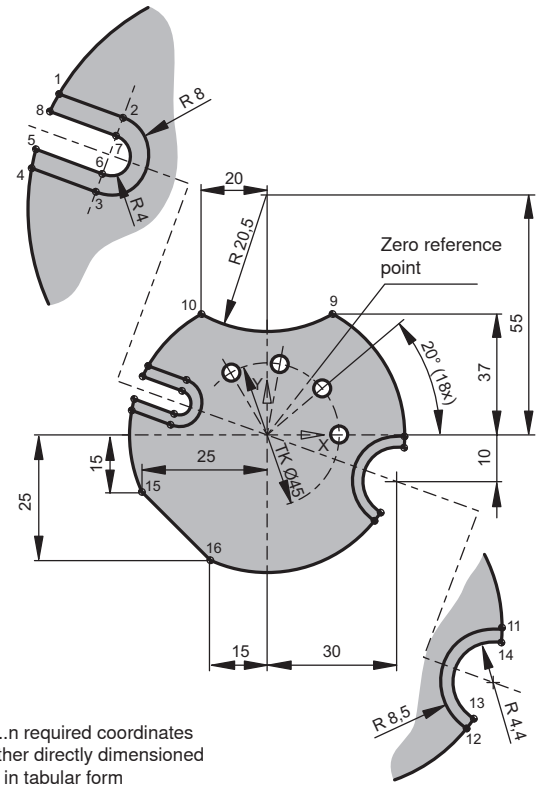


Type, description	Material	D [mm]	Dia. tol. [mm]	L [mm]
RG 0100-330 CF-S18Z h6	11807793	1.00	+0/-0.006	330
RG 0150-330 CF-S18Z h6	11807794	1.50	+0/-0.006	330
RG 0200-330 CF-S18Z h6	11807795	2.00	+0/-0.006	330
RG 0250-330 CF-S18Z h6	11807796	2.50	+0/-0.006	330
RG 0300-330 CF-S18Z h6	11807797	3.00	+0/-0.006	330
RG 0350-330 CF-S18Z h6	11807798	3.50	+0/-0.008	330
RG 0400-330 CF-S18Z h6	11807799	4.00	+0/-0.008	330
RG 0450-330 CF-S18Z h6	11807800	4.50	+0/-0.008	330
RG 0500-330 CF-S18Z h6	11807801	5.00	+0/-0.008	330
RG 0550-330 CF-S18Z h6	11807802	5.50	+0/-0.008	330
RG 0600-330 CF-S18Z h6	11807803	6.00	+0/-0.008	330
RG 0650-330 CF-S18Z h6	11807804	6.50	+0/-0.009	330
RG 0700-330 CF-S18Z h6	11807805	7.00	+0/-0.009	330
RG 0750-330 CF-S18Z h6	11807806	7.50	+0/-0.009	330
RG 0800-330 CF-S18Z h6	11807807	8.00	+0/-0.009	330
RG 0850-330 CF-S18Z h6	11807808	8.50	+0/-0.009	330
RG 0900-330 CF-S18Z h6	11807809	9.00	+0/-0.009	330
RG 0950-330 CF-S18Z h6	11807810	9.50	+0/-0.009	330
RG 1000-330 CF-S18Z h6	11807811	10.00	+0/-0.009	330

For the tool and die industry we exclusively deliver sintered parts which are produced on our state-of-the-art machines by the CERATIZIT skilled workers. It is therefore necessary to speak the same 'language' with regard to the dimensions indicated in the drawings in order to manufacture products correctly (see illustrations below).
In this context, it is a big advantage for you that you can illustrate the hole specifications etc. in a simplified way. The part will then be supplied in accordance with the appropriate tables.

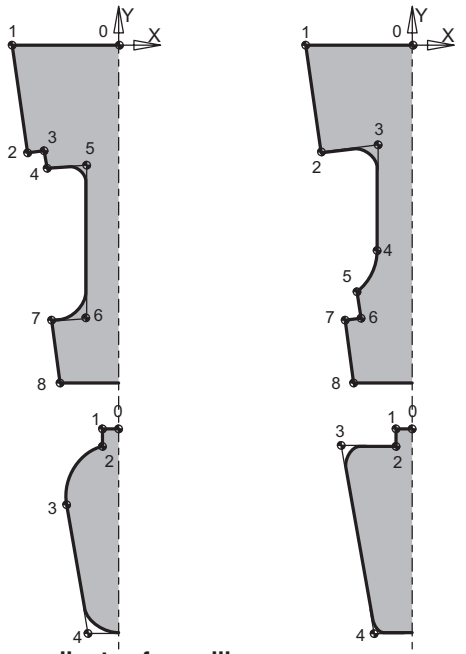
The way of transmitting the drawing represents a significant factor with regard to the time taken to process an order and the quality that is achieved. This is why we are going to use drawing transmission via e-mail to a larger degree. The file format should be .dwg or .dxf and large data amounts should be zipped.

Round part with holes

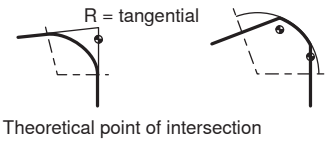


1...n required coordinates either directly dimensioned or in tabular form

Punches and segments

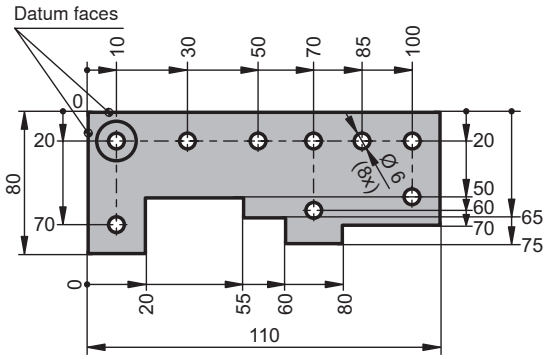


Detail coordinates for radii

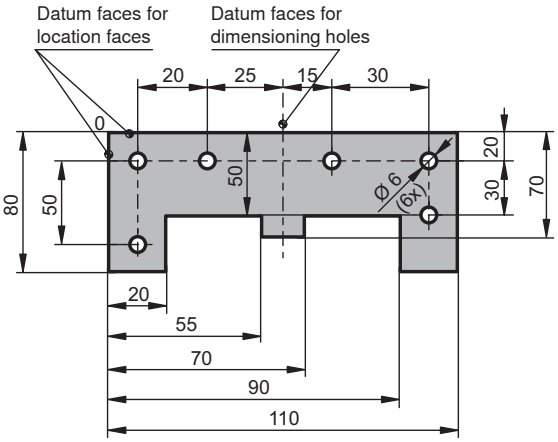


1...n required coordinates either directly dimensioned or in tabular form

Blocks with holes



Absolute dimensions



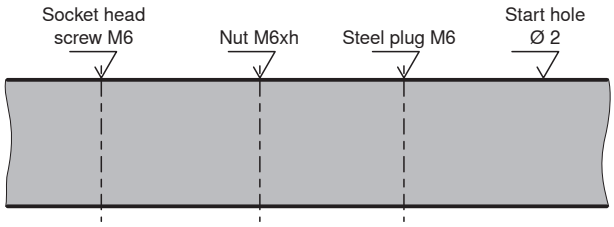
Profile: absolute dimensions
Holes: incremental dimensions

Preformed thread as sintered

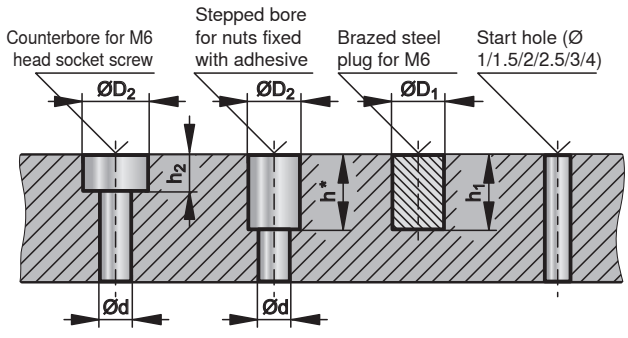
Thread	Max. length
M4	16
M5	20
M6	20
M8	30
M10	30

Holes in sintered blanking parts

Simplified illustration for use with your order drawing



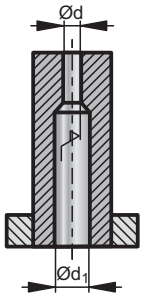
Supplied as follows:



Thread	Steel plugs for threads Ø D_1	h_1	Bores for socket head screws Ø D_2	h_2	Ø d	h
M4	8					As required by customer
M5	10					
M6	10					
M8	14					
M10	16					

Stepped holes (Ø d_1)

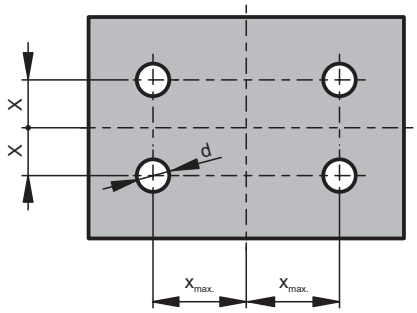
with grinding allowance on Ø d!



Ø d_1	Ø d	Ø d_1
≤ 4	d_1 - 1,0	6,5
> 4 ≤ 6	d_1 - 1,0	8,0
> 6 ≤ 10	d_1 - 1,5	12,0

Dowel holes

(finished dimensions df = 4.0/5.0/6.0/7.0/8.0/10.0)



x_{max}	d
≤ 40	d_f - 0,5
> 40 ≤ 100	d_f - 1,0
> 100	d_f - 1,5

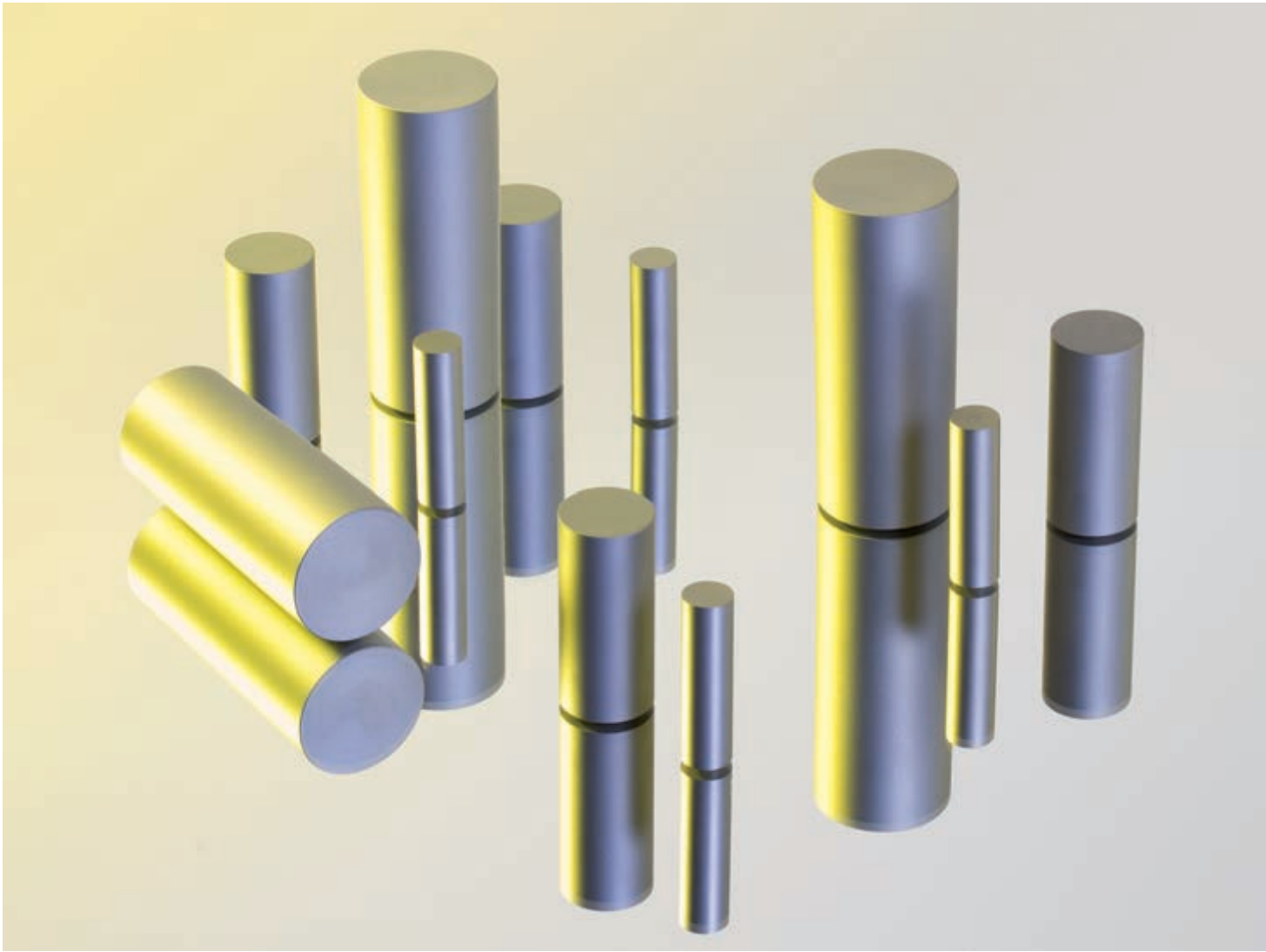
Through holes

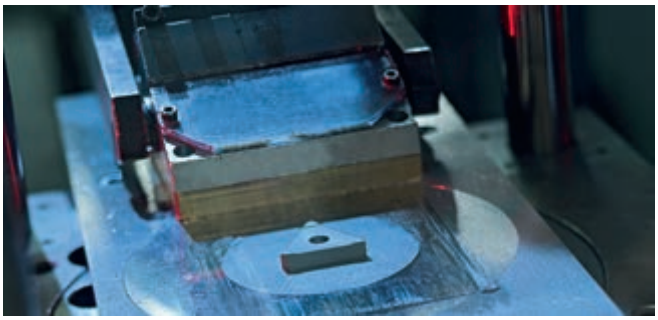
d	Increment
> 7	0,5
≤ 7,0	1,0

If you are interested or have any questions, please get in touch with **CERATIZIT Deutschland, Empfingen** or **Hitzacker**.
Alternatively, visit www.ceratizit.com/contact to find your local contact person.

Powder compaction tools

Tools and active components must compensate the differences in tension during the compaction procedure and be wear-resistant to the sometimes very abrasive powder. Our corrosion-resistant carbide grades are perfectly suited, as their homogeneous and consistent structure guarantees secure and stable processes.



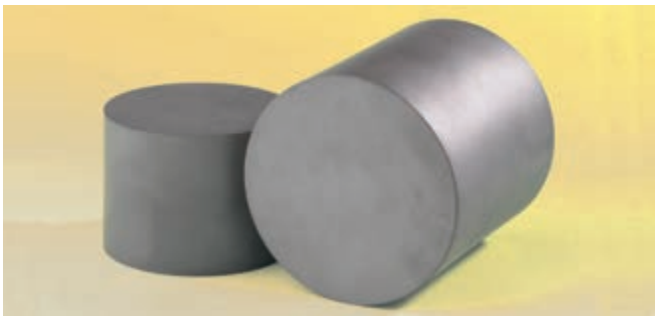


Sectors, applications

- Automotive and aircraft construction
- Construction and furniture industry
- Electric and electronic industry
- Pharmaceutic industry
- Grinding material industry
- Mould and die making

Materials

- Powder and powder-metallurgical materials



Products

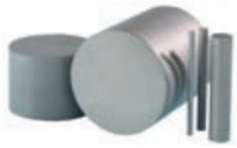
- Rods for powder compaction tools
- Customised preforms for punches and dies

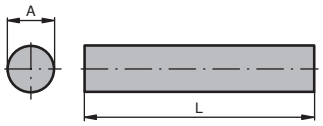
Carbide properties

- Wear resistance
- Corrosion resistance
- Toughness (edge stability)
- Compressive strength
- Transverse rupture strength
- Very good machinability in all following processes
- Good suitability for coating and removal of coating

Rods for powder compaction tools

as sintered, with grinding allowance on all dimensions, CF-H40S+



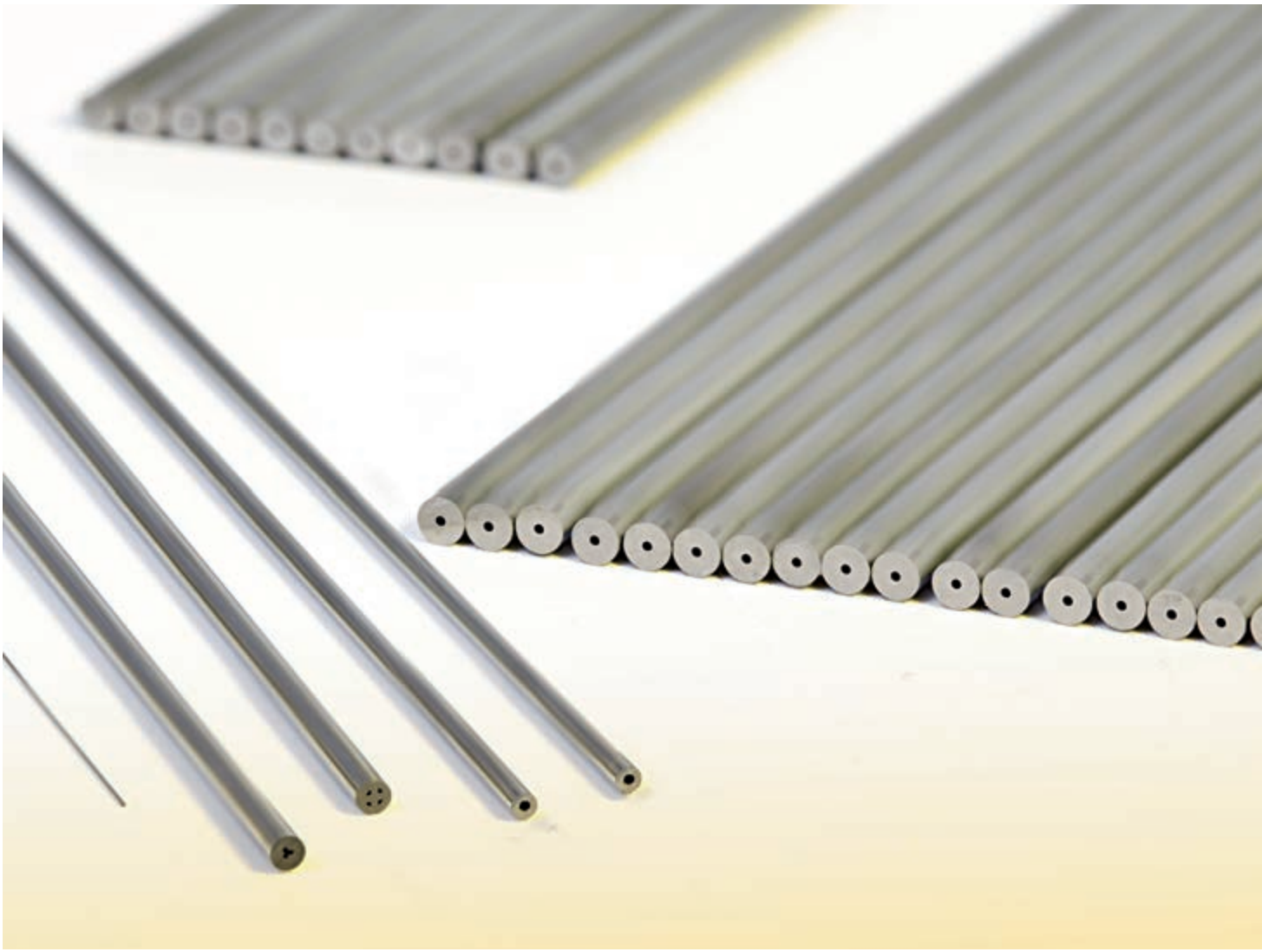


Type, description	Material	A [mm]	L [mm]	
CTPP-035000-320 CF-H40S+	11801200	35	320	
CTPP-040000-320 CF-H40S+	11801201	40	320	
CTPP-045000-320 CF-H40S+	11801202	45	320	
CTPP-050000-320 CF-H40S+	11801204	50	320	
CTPP-055000-320 CF-H40S+	11801205	55	320	
CTPP-060000-320 CF-H40S+	11801207	60	320	
CTPP-065000-320 CF-H40S+	11801208	65	320	
CTPP-070000-320 CF-H40S+	11801209	70	320	
CTPP-075000-320 CF-H40S+	11801210	75	320	
CTPP-080000-320 CF-H40S+	11801211	80	320	
CTPP-085000-320 CF-H40S+	11801212	85	320	
CTPP-090000-320 CF-H40S+	11801213	90	320	
CTPP-095000-320 CF-H40S+	11801214	95	320	
CTPP-100000-320 CF-H40S+	11801215	100	320	
CTPP-110000-265 CF-H40S+	11801216	110	265	
CTPP-120000-240 CF-H40S+	11801217	120	240	
CTPP-130000-170 CF-H40S+	11801219	130	170	
CTPP-140000-170 CF-H40S+	11801220	140	170	
CTPP-150000-130 CF-H40S+	11801221	150	130	
CTPP-160000-130 CF-H40S+	11801227	160	130	
CTPP-170000-130 CF-H40S+	11801234	170	130	
CTPP-180000-130 CF-H40S+	11801238	180	130	
CTPP-200000-120 CF-H40S+	11801250	200	120	
CTPP-220000-120 CF-H40S+	11801252	220	120	

If you are interested or have any questions, please get in touch with **CERATIZIT Deutschland, Empfingen**. Alternatively, visit www.ceratizit.com/contact to find your local contact person.

Erosion material for die-sinking and erosion of start holes

Die-sinking is the optimum procedure for the production of small and deep holes. Today, every material with electric conductivity can be machined very economically using this technique.
Die-sinking requires wear-resistant carbide electrodes. These electrodes are superior to electrodes made of copper, brass or tungsten copper thanks to their precision, process security and economy.



Sectors, applications

- Automotive industry
- Electric and electronic industry
- Gas and aircraft turbine construction
- Medical systems
- Watch and clock industry
- Mould and die making

Materials

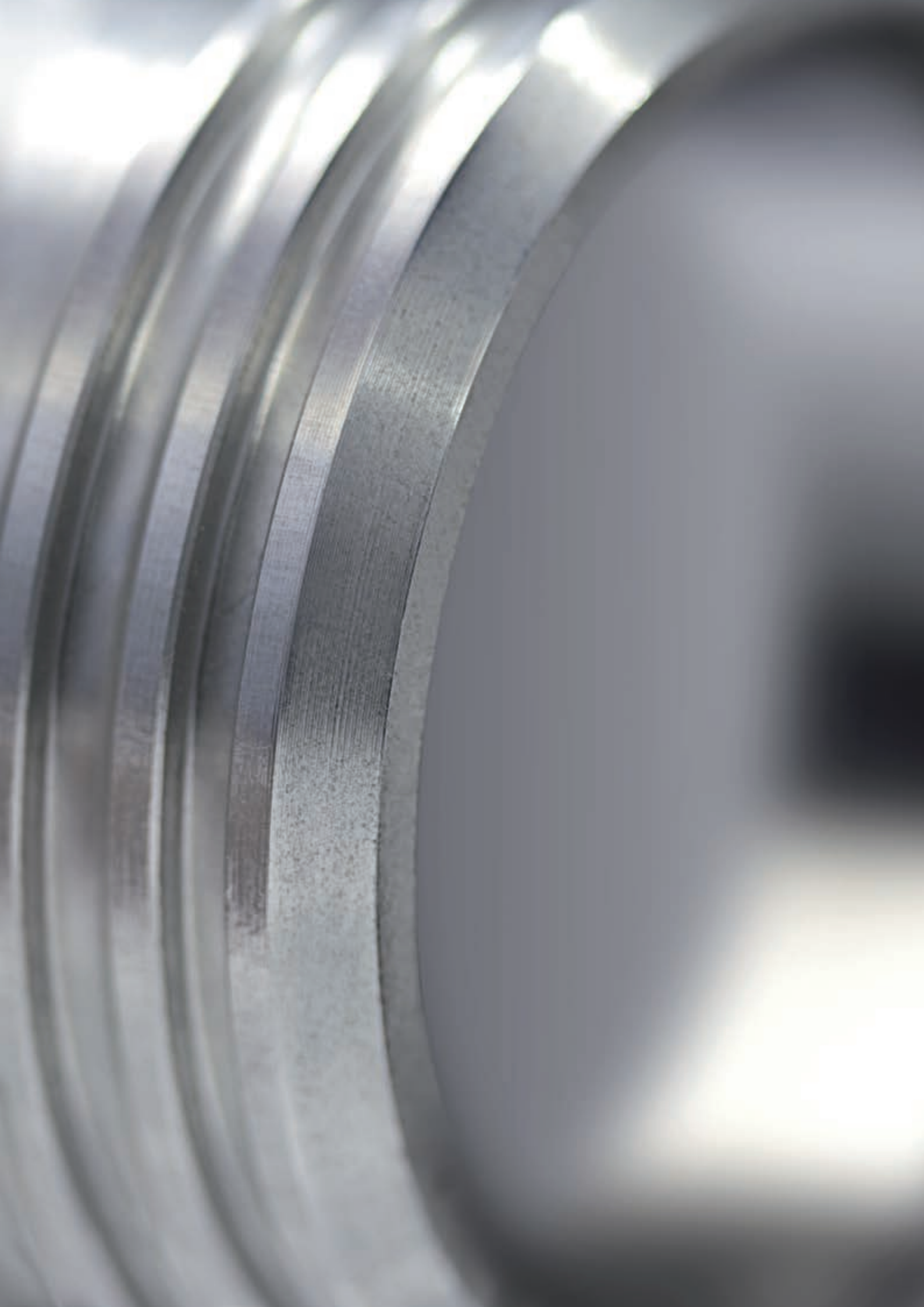
- Carbide
- Metals
- Conductive materials

Products

- Erosion rods, ready-to-use
- Erosion tubes, ready-to-use
- Tubes with clover profile inside, ready-to-use
- Multichannel erosion tubes, ready-to-use
- Customised EDM rods and tubes with various internal shapes, as sintered

Carbide properties

- Wear resistance
- Rigidity, strength and positioning accuracy
- Cutting to size without burrs possible
- Good economy



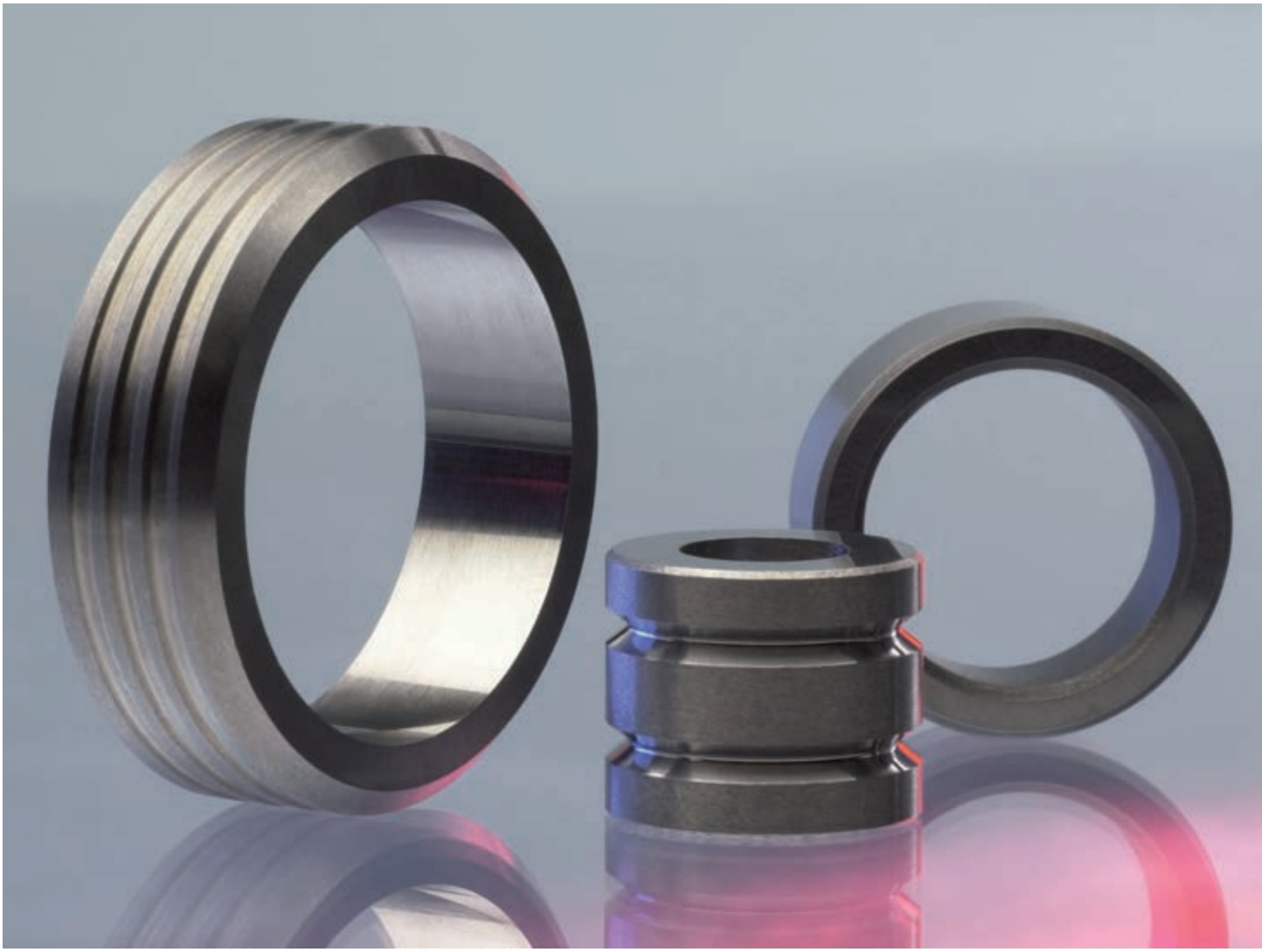
Solutions for mills

The rolling of wire, rods, ribbons and tubes places enormous forces on mill rolls. When it comes to hot rolling, the combination of these forces and high temperatures represent an additional challenge. Compared to steel, carbide is characterised by both high wear resistance and surface quality in such products. Our range includes everything from sintered rolls to ready-to-use rolls. We also offer special fine grain grades for rolls which are applied in cold rolling.

If you are interested or have any questions, please get in touch with **CERATIZIT Luxembourg, Mamer**. Alternatively, visit www.ceratizit.com/contact to find our local contact person.

Rolls for hot rolling

Our carbide rolls offer optimum characteristics for hot rolling. They are wear-resistant and at the same time very tough. We provide various carbide grades and sintered rolls in different sizes as well as semi-finished and ready-to-use rolls suitable for all fields of application.
In addition to the carbide products we also manufacture rolls made of silicon ceramic, which achieve excellent performance as guide rolls or pressure rolls.

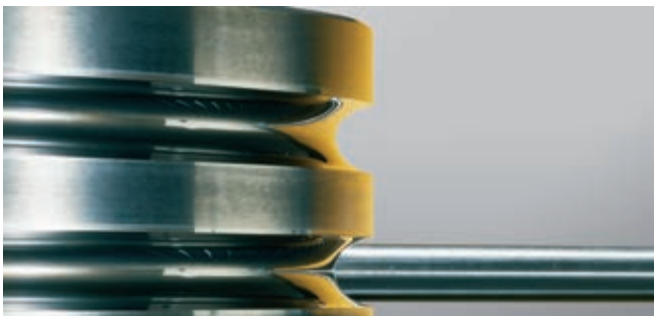


Sectors, applications

- Mills
- Automotive industry
- Steel industry

Materials

- From classical constructional steel to high-alloyed steels



Products

- Rolls with and without caliber
- Guide rolls

Carbide properties

- High wear resistance
- Economic rolling operations
- High fracture toughness
- High compressive strength

Composition and properties

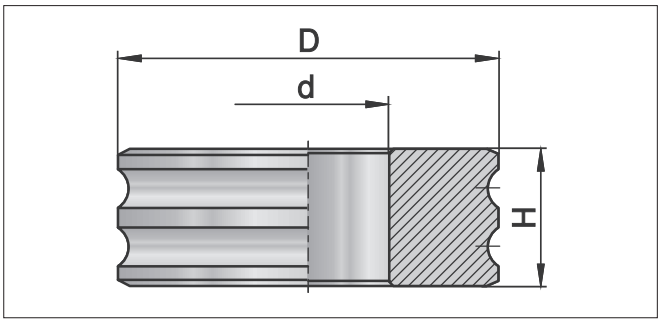
CERATIZIT grade code	Binder [m %]	Density [g/cm³]	Hardness HV10	Hardness HV30	Hardness HRA	Transverse rupture strength [MPa]	Fracture toughness [MPa*m½]	Compressive strength [MPa]	Modulus of elasticity [GPa]	Thermal expansion coefficient [W/mK]	Thermal conductivity [10⁻⁶/K]
Coarse grain											
CTE12A	6,0	15,00	1300	1290	89,4	2400	16,0	4300	630	115	4,7
CTE20A	10,0	14,60	1130	1120	87,6	2600	18,0	4000	580	110	5,1
CTE25A	12,5	14,30	1050	1040	86,6	2700	20,0	3800	555	107	5,3
CTE30A	15,0	14,05	970	960	85,6	2800	22,0	3600	530	105	5,6
CTE35A	17,5	13,80	910	900	84,8	2850	23,0	3500	510	103	5,9
CTE40A	20,0	13,60	850	840	84,2	2900	24,0	3400	490	100	6,3
CTE44A	22,0	13,40	810	800	83,6	2900	25,0	3300	475	100	6,5
CTE50A	25,0	13,15	760	750	82,6	2800	26,0	3200	450	97	6,8
CTE60A	30,0	12,75	690	680	81,4	2700	27,0	3100	420	95	7,3
CTE20M	10,0	14,50	1140	1130	87,7	2600	21,0	3600	580	110	5,1
CTE30M	15,0	14,05	960	950	85,5	2900	23,0	3400	530	105	5,6
CTE40M	20,0	13,50	810	800	83,6	2800	25,0	3200	490	100	6,3
CTE50M	25,0	13,15	710	700	81,7	2700	27,0	3100	450	97	7,0
CTE60M	30,0	12,70	610	600	80,0	2700	29,0	3000	420	95	7,4

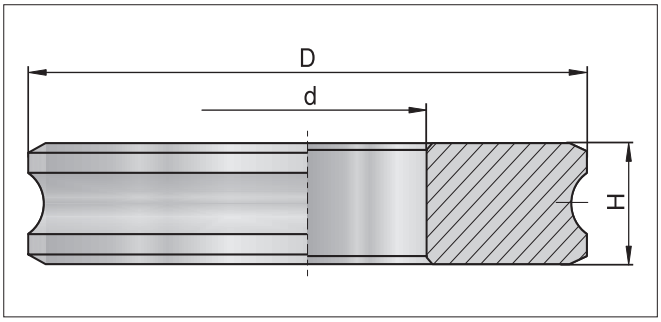
Classification of the WC grain size		CERATIZIT code
Average grain size [µm]	Classification	
< 0.2	nano	N
0.2 - < 0.5	ultrafine	U
0.5 - < 0.8	submicron	S
0.8 - < 1.3	fine	F
1.3 - < 2.5	medium	M
2.5 - < 6.0	coarse	C
> 6.0	extra-coarse	E

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

Comment:

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





Carbide rolls

for No-Twist mills

CTE carbide rolls have the necessary characteristics for the hot rolling of long steel products. The binder content as well as the form and distribution of the tungsten carbides allow us to achieve the perfect balance between wear resistance and toughness.

Applications

- Stretch-reducing mill
- 8-inch standard mill

We supply the following roll types:

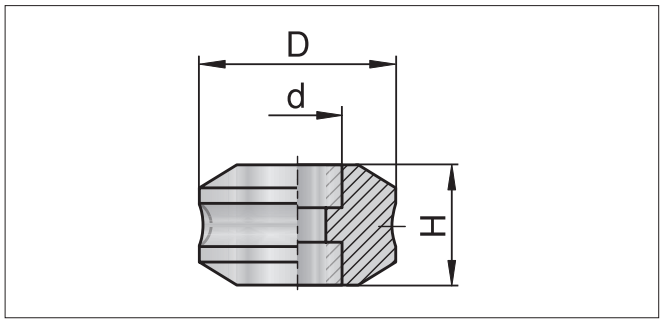
1. As sintered, with sintering tolerances that are common in the sector, external diameter max. 600 mm

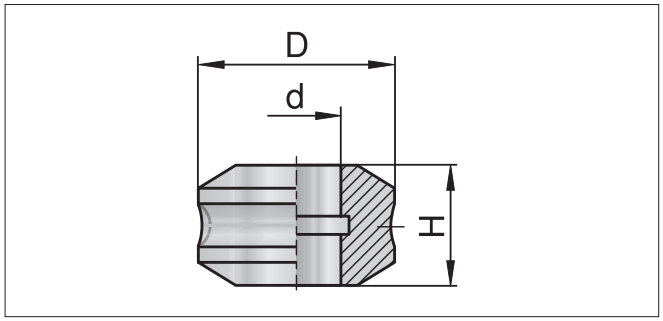
2. Semi-finished, with external diameter as sintered (bore and sides finish-ground)

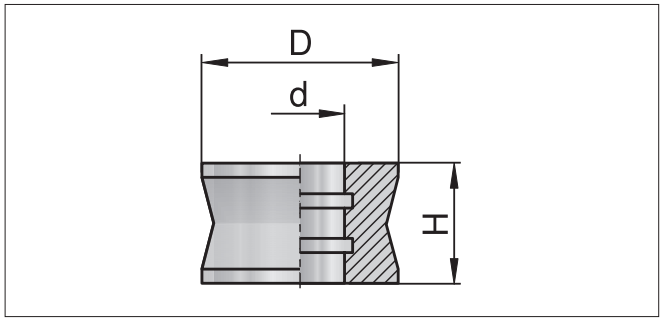
3. External diameter machined, bore and sides finish-ground, without groove

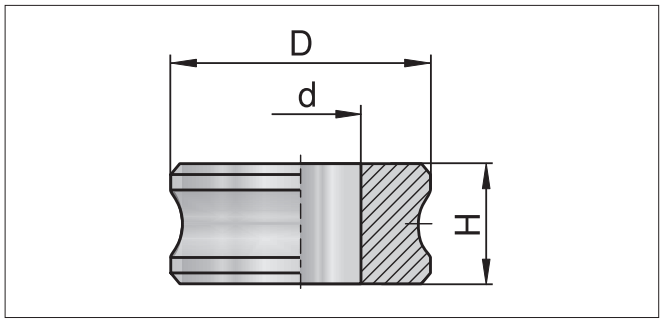
4. Completely finished with grooves

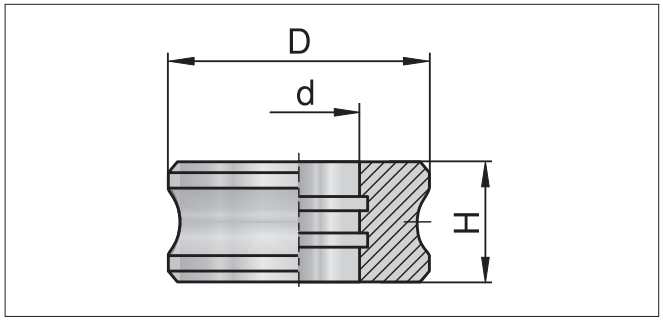
Upon request types 1, 2, 3 can be delivered with a sintered groove.











Carbide guide rolls

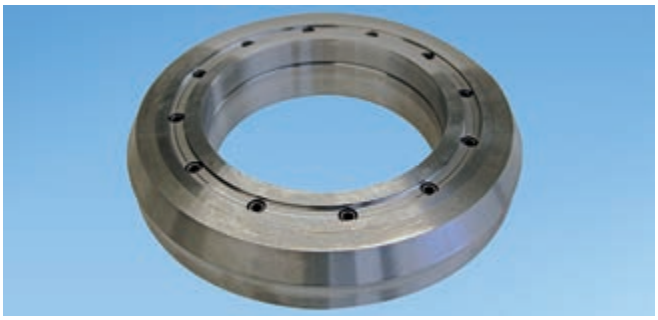
Ready-to-use

We also guarantee long tool life for our guide rolls made of silicone ceramic. As well as being extraordinarily wear-resistant and hard, they are characterised by excellent thermal shock resistance.
The low density leads to low moments of inertia, making ceramic perfectly suited for guide rolls. They have electric insulating properties and are used with pressure rolls for tube welding plants.

Applications

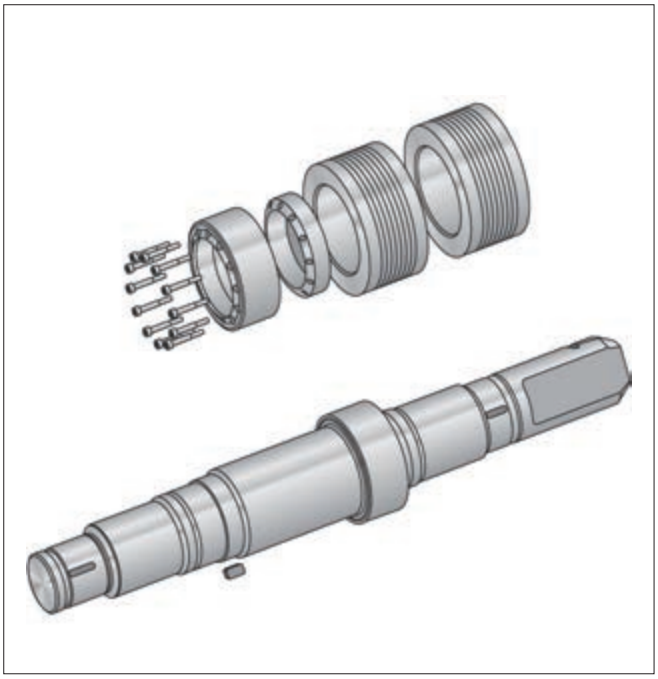
- Guide rolls
- Pressure rolls in tube welding plants (induction heating)

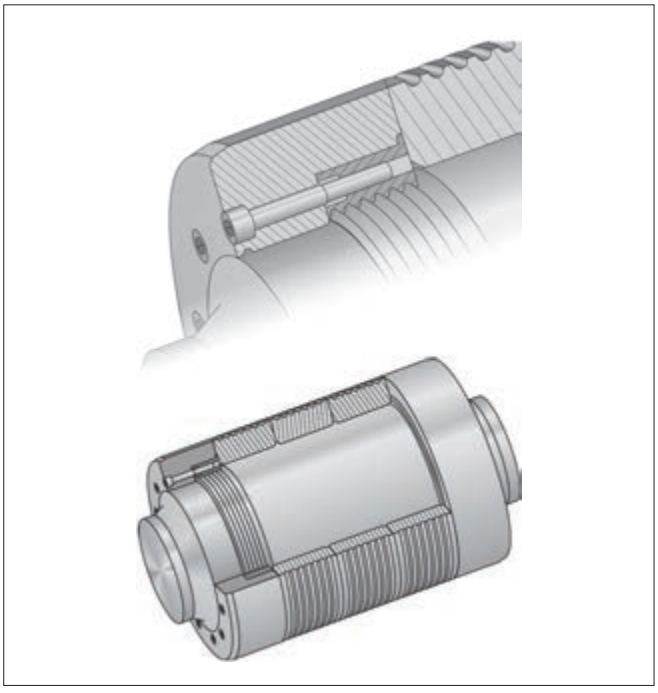
Types: same as carbide rolls
Grades: carbides, cermets, silicon nitride
Minimum external diameter: D = 30 mm



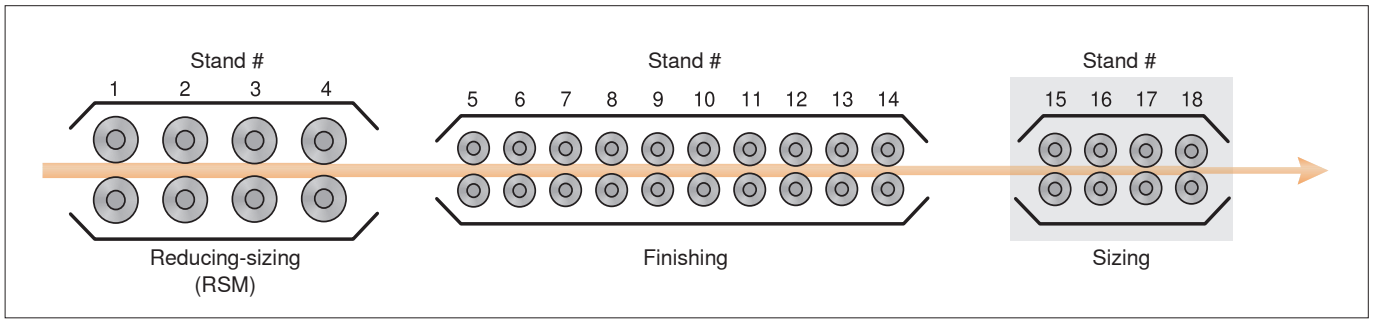
Composite rolls
for conventional hot rolling lines

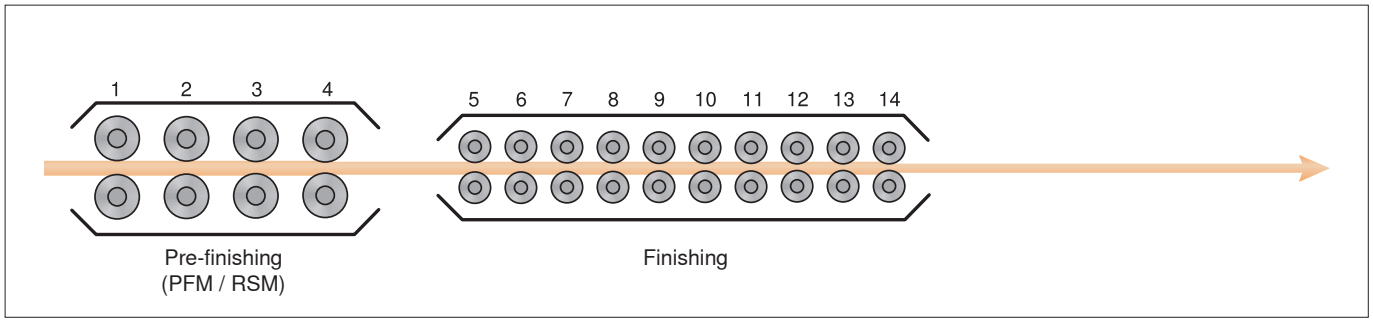
Composite rolls are provided with a mechanical clamping system for purely axial pre-clamping. When removing the rolls from service, the steel support and carbide ring can be easily separated, resulting in resource-conserving production.

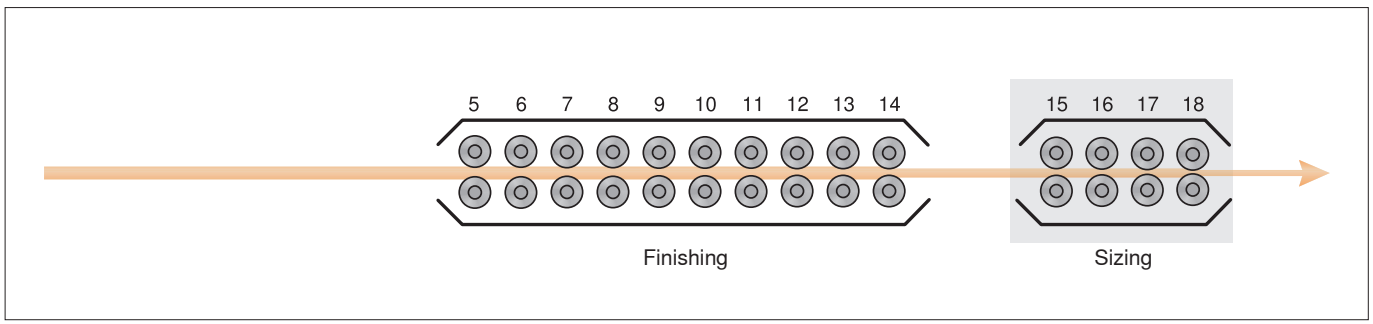




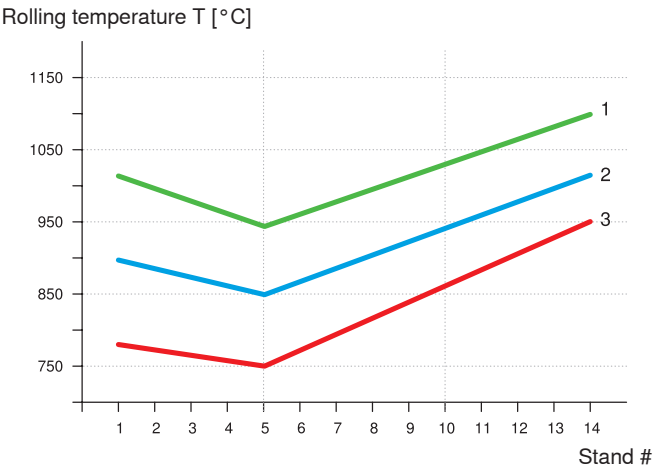
Schematic view of a No-Twist wire rolling mill







Temperatures in the wire rolling mill

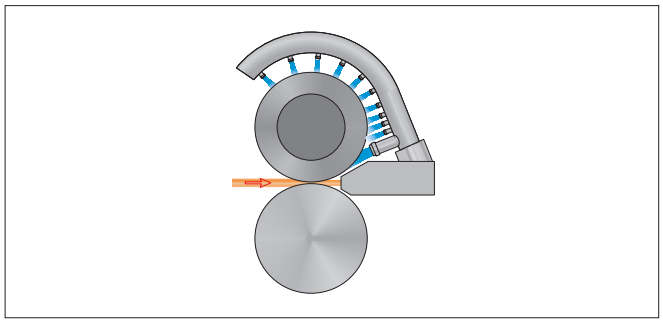


Material:

A = low carbon steel
B = carbon steel
C = alloyed steel
D = special steel

Grade/stand (recommended values)									
Stand #	1	2	3	4	5	6	7	Material	Rolling temperature T [°C]
Product Ø		21 – 24		18 – 20		15 – 17			
Binder % (Co-Ni-Cr)									
	CTE50M	CTE50M	CTE50M	CTE50M	CTE40M	CTE40M	CTE30M	A	1
	CTE60M	CTE60M					CTE40M	B	
								C	
			CTE60M	CTE60M	CTE50M	CTE50M		D	
	CTE60M	CTE60M	CTE50M	CTE50M	CTE40M	CTE40M	CTE40M	A	2
					CTE50M	CTE50M		B	
			CTE60M	CTE60M				C	
								D	
	CTE60M	CTE60M	CTE50M	CTE50M	CTE50M	CTE50M	CTE40M	A	3
								B	
			CTE60M	CTE60M			CTE50M	C	
								D	

Grade/stand (recommended values)									
Stand #	8	9	10	11	12	13	14	Material	Rolling temperature T [°C]
Product Ø	12 – 14		9 – 11		7 – 8		5.5 – 6		
Binder % (Co-Ni-Cr)									
	CTE30M	CTE30M	CTE30 M	CTE20M	CTE20M	CTE20M	CTE20M	A	1
	CTE40M							B	
				CTE30M	CTE30M	CTE30M	CTE30M	C	
		CTE40M	CTE40M					D	
	CTE40M	CTE30M	CTE30M	CTE20M	CTE20M	CTE20M	CTE20M	A	2
				CTE30M	CTE30M	CTE30M	CTE30M	B	
		CTE40M	CTE40M					C	
				CTE40M	CTE40M			D	
	CTE40M	CTE30M	CTE30M	CTE30M	CTE30M	CTE30M	CTE30M	A	3
		CTE40M	CTE40M					B	
	CTE50M			CTE40M	CTE40M			C	
						CTE40M	CTE40M	D	

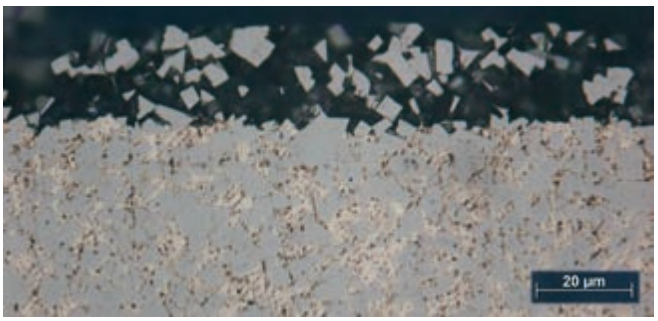


Coolant

The extremely high temperature, especially in the contact zone between the roll and the wire, causes a series of effects which reduce roll life. These negative factors, such as corrosion, wear, reduced dimensional accuracy and cracks can be decreased by applying sufficient cooling. In fact, a roll which is cooled enough can be used up to 100 % longer compared to rolls which are not provided with an appropriate amount of cooling. Optimum cooling is determined by the water volume supplied, adequate pressure and correct positioning of the exit nozzles for the coolant. Approx. 70 % of the coolant quantity should be focused on the exit side of the rolled product, close to the rolling line.

Corrosion

In hot rolling operations, corrosion represents an electro-chemical process which causes anticipated wear and leads to a rougher surface of the groove. The degree of corrosion increases with the rolling temperature, therefore the groove shows more corrosion than the rest of the roll. Corrosion causes the cobalt matrix to detach from the tungsten carbide structure. In the case of regular surface corrosion this leads to considerably higher wear and, with irregular corrosion it can result in mechanical or thermal cracks. Apart from the rolling temperature, both the temperature and pH-value of the coolant are decisive with regard to corrosion. The highest acceptable temperature of the water with a pH-value ranging between 7.5 and 8.5 is 35 °C. If the water temperature is 25 °C, the pH-value lies between 6.5 and 9. Acid water attacks the cobalt binder, while extremely alcaline water will attack the tungsten carbide. Special binders such as nickel-cobalt-chromium alloys show notably higher corrosion resistance, i.e. they may be used up to pH 5.5.



pH4 – duration of test: 168 hours

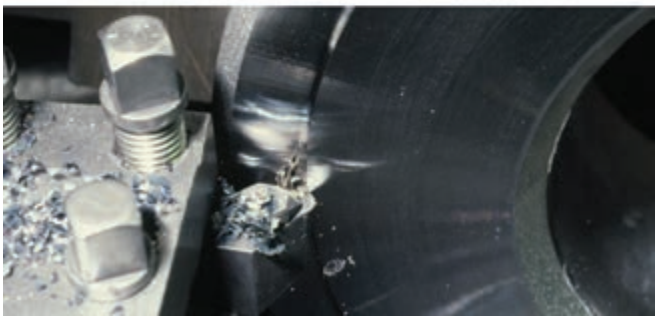
Binder: Co
High degree of cobalt detachment

Binder: Co/NI
Low degree of cobalt detachment

Network of cracks

Thermal cracks

The alternating cooling and heating phases of the roll during the process lead to a considerable thermal gradient. The tension arising from these temperature changes mainly concerns the profile of the roll and produces a whole network of surface cracks, their type depending primarily on the carbide grade chosen. Carbide grades with a major binder content have a higher thermal expansion coefficient and are characterised by low thermal conductivity. In such grades cracks occur more often but are basically limited to the surface. Obviously, for carbide grades with a low binder content the opposite is true. With optimum cooling, a rolling speed of more than 10 m/sec. and a reduction of the section by a maximum of 20 % the depth of the cracks is limited to 0.2 mm. For lower rolling speeds and thus longer contact time between the roll and the rolled product, the crack depth can go up to 0.8 mm. It is important that cracks caused by tension are eliminated completely when redressing the roll.



Finishing of carbide rolls

Hard materials such as carbides, cermets and silicon nitride are mainly ground by applying a diamond wheel. For turning with a binder content of >15 % the use of a geometrically defined cutting edge is recommended. Suitable cutting materials are cubic boron nitride (CBN) and polycrystalline diamond (PCD). The insert shape should be as robust as possible depending on the roll profile that is to be produced. For classic longitudinal and face turning operations button inserts have proven to be best. When finish-turning the groove, it is the shape of the groove itself which is decisive for the choice of the insert type. The cutting edge should be sharp, a negative protective edge chamfer is, however, not necessary. When using CBN, dry machining is possible, whereas the application of polycrystalline diamond requires abundant quantities of cooling emulsion.

The CERATIZIT engineers will gladly help you choose the suitable tool and cutting parameters.

Carbide roll	Cutting data for CBN and PCD		
Binder content			
15 - 20	10 - 20	0,1 - 2,5	0,15 - 0,3
20 - 25	20 - 30	0,1 - 2,5	0,15 - 0,3
>25	30 - 50	0,1 - 2,5	0,15 - 0,3

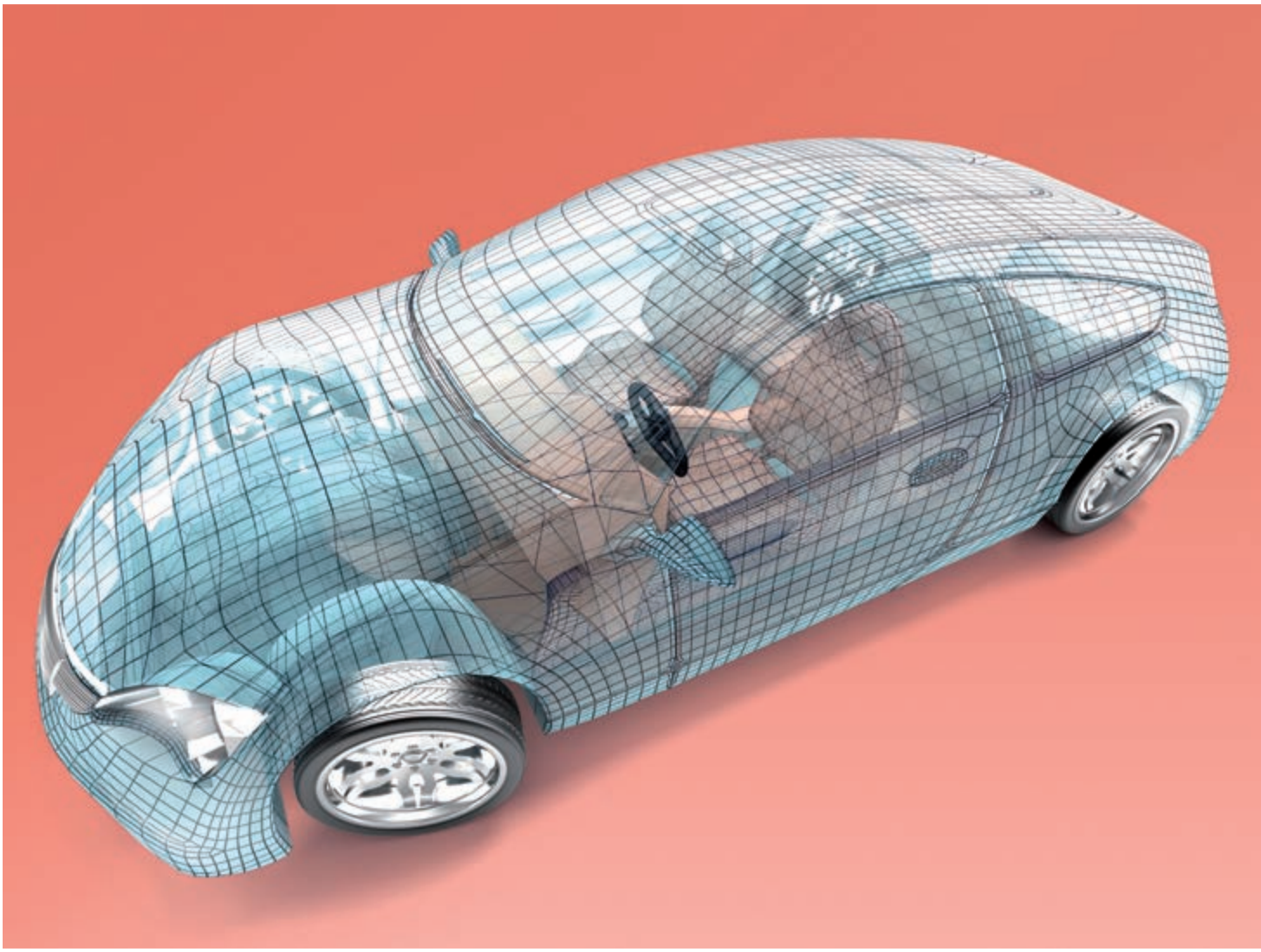
Solutions for specific industries

Carbide products are used for a variety of applications. However, the requirements with regard to the carbide itself remain the same, no matter whether in the automotive or plastics industry, in medical systems, or in the food or oil sector. Our carbide products are extraordinarily wear-resistant and guarantee long tool life as well as secure processes. We manufacture them as sintered blanks or as ready-to-use products, in standard geometries or in customised form.
For special sectors such as the food industry or the medical systems sector we have developed special carbides which meet the respective health standards.

If you are interested or have any questions, please get in touch with **CERATIZIT Deutschland, Empfingen**. Alternatively, visit www.ceratizit.com/contact to find your local contact person.

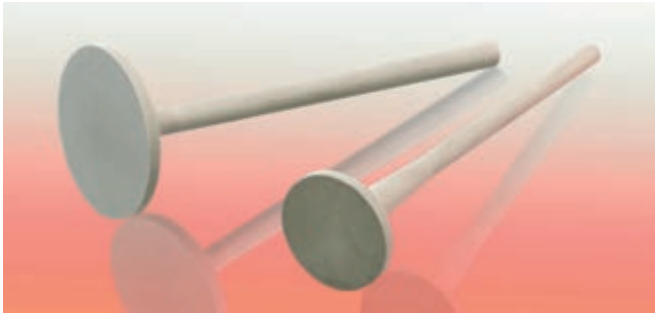
Automotive industry

In the automotive industry precision is decisive for both the quality and the performance of the individual parts. Together with our customers, we develop specific components with perfect dimensional accuracy. In particular in the field of injection technology, our carbide components support the precise and regular direct injection of diesel fuel. They are able to withstand pressure and thermal stress and are wear- and corrosion-resistant.



Sectors, applications

- Automotive industry
  (injection pumps, engine components, inserts for diesel injectors, locking pins)



Products

- Sealings
- Rings
- Bolts
- Sleeves
- Bushes
- Cam rollers
- Balls
- Customised parts

Carbide properties

- Wear resistance
- Compressive strength

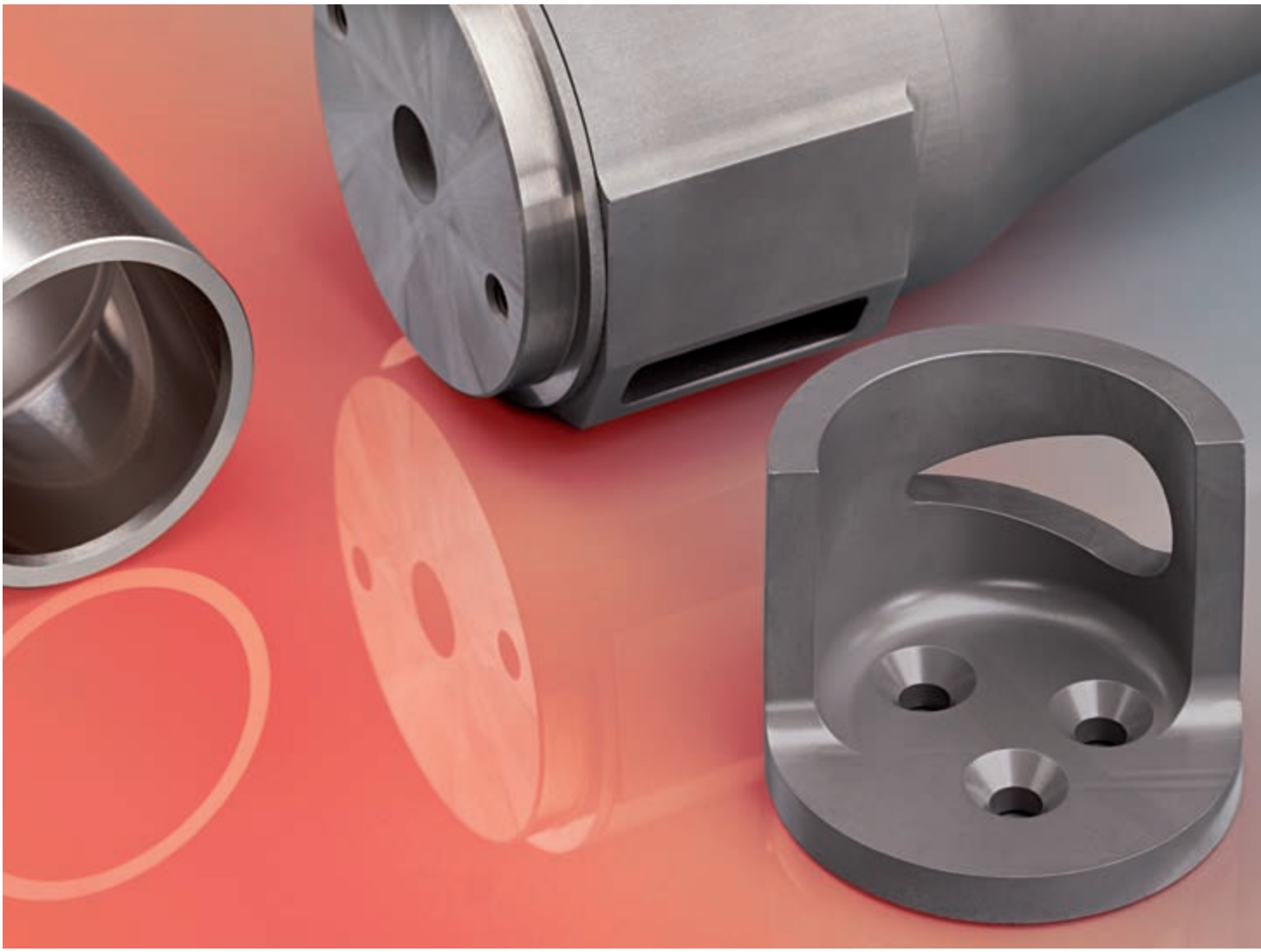
Finish

- As sintered with close tolerances
- Ground ready-to-use
- Complex geometries
  (metal injection molding)

If you are interested or have any questions, please get in touch with **CERATIZIT Luxembourg, Mamer**. Alternatively, visit www.ceratizit.com/contact to find our local contact person.

Oil industry

Our products for the oil industry range from drill tips to very complex large components. The biggest challenge however, in undersea oil drilling is corrosion of the components caused by water-borne media and oil. In order to counteract this phenomenon, we offer blanks with various Co/Cr/Ni metal binder alloys. These blanks are also characterised by excellent mechanical properties.



Sectors, applications

- Oil industry
  - Oil and gas extraction (downstream + upstream)

Products

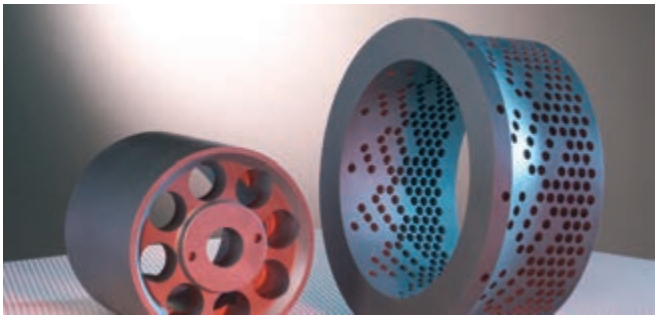
- Inserts for drill heads
- Valve components
- Complex customised components

Carbide properties

- Corrosion resistance
- Good mechanical properties

Finish

- As sintered
- Ground
- Component dimensions up to dia. 400 x 500 mm
- Larger dimensions upon request



If you are interested or have any questions, please get in touch with **CERATIZIT Luxembourg, Mamer**. Alternatively, visit www.ceratizit.com/contact to find our local contact person.

Glass industry

Carbide is increasingly being used in new fields such as the machining of glass. Liquid and solid glass machining requires tools which are heat- and wear-resistant. Compared to conventional steel tools, our tools achieve a longer service life and the most consistent and precise cutting quality.
We offer special binder-free carbide grades for manufacturing glass lenses. This is the only way to guarantee an extremely precise mirror-polished surface.

Composition and properties

CERATIZIT grade code	ISO code	Application	Binder [m %]	Hardness HV10	Hardness HV30	Hardness HRA	Transverse rupture strength [MPa]	Transverse rupture strength [P.S.I.]	Fracture toughness [MPa*m^{½}]
Ultrafine grades									
CTU05E	K01	glass cutting wheels	2,4	2300	2200	95,2	3500	508.000	5,7
Submicron grain									
CTS06M		glass cutting wheels	3,0	1950	1910	93,6	2300	334.000	8,5
CTS20L	K20-40	glass cutting wheels	10,0	1680	1610	92,3	3700	537.000	9,4
Fine / medium grain									
CTF12A		glass cutting wheels	6,0	1640	1620	92,1	2200	319.000	9,9
CTF16R		glass shear blades	8,0	1480	1460	90,9	2900	421.000	11,4
Coarse grain									
CTE20A		glass shear blades	10,0	1130	1120	87,6	2600	377.000	18,0
CTE30A		glass shear blades	15,0	970	960	85,6	2800	406.000	22,0

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

Classification of the WC grain size		CERATIZIT code
Average grain size [µm]	Classification	
< 0.2	nano	N
0.2 - < 0.5	ultrafine	U
0.5 - < 0.8	submicron	S
0.8 - < 1.3	fine	F
1.3 - < 2.5	medium	M
2.5 - < 6.0	coarse	C
> 6.0	extra-coarse	E

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.

Sectors, applications

- Container and crystal glass production

Materials

- Liquid glass

Products

- Shear blades for single, double and multiple gobs

Carbide properties

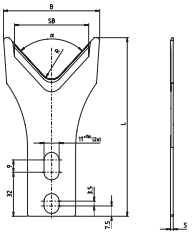
- High wear resistance
- Heat resistance
- Maximum quality

Finish

- Finish-ground (ready-to-use)
- Some products provided with coating

AM 0830 / AM 1510

CTE20A

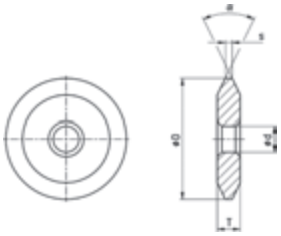


Finish:
Ecoline: uncoated
Premiumline: Al_2O_3-coated

Type, description	Material	mm					
		L	B	SB	S	R	α
AM 0830 Premiumline	11272687	130	70	54	2	8	85°
AM 0830 Ecoline	11602114	145	104	75	2	8	84°
AM 1510 Premiumline	11254971	130	70	54	2	8	85°
AM 1510 Ecoline	11963680	145	104	75	2	8	84°

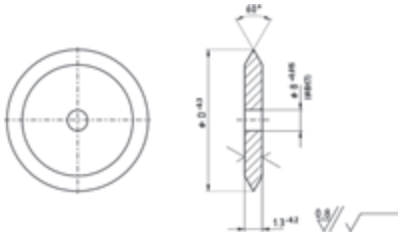
Minimum order quantity:
Premiumline: 100 pcs. (coating)
Ecoline: upon request

Glass cutting wheels, as sintered



Type, description	mm D	d	T	S	α	Carbide grade	U.S. code
GSR 0330.110.110	3,30	1,10	1,10	0,20	118°	CTS20	C2
GSR 0455.135.101	4,55	1,35	1,01	0,30	60°	CTS20	C2
GSR 0520.130.120	5,20	1,30	1,20	0,30	90°	CTS12	C3
GSR 0525.113.100	5,25	1,13	1,00	0,30	50°	CTS15	C3
GSR 0560.150.120	5,60	1,50	1,20	0,20	60°	CTS12	C3
GSR 0570.151.120	5,70	1,51	1,20	0,20	60°	CTS12	C3
GSR 0610.150.120	6,10	1,50	1,20	0,20	90°	CTS12	C3
GSR 0620.140.110	6,20	1,40	1,10	0,15	70°	CTS12	C3
GSR 0830.215.235	8,30	2,15	2,35	0,35	70°	CTS11	C3
GSR 1240.300.300	12,40	3,00	3,00	0,20	90°	CTS12	C3
GSR 1540.605.300	15,40	6,05	3,00	0,17	60°	CTS11	C3
GSR 2240.605.470	22,40	6,05	4,70	0,52	42°	CTS11	C3

Glass cutting wheels, finish-ground (ready-to-use)



Type, description	mm D	d	S	α	Carbide grade	U.S. code
GSRG 5000.800.130	50	8	1,30	60°	CTS15	C3
GSRG 5000.800.130	50	8	1,30	100°	CTS15	C3
GSRG 6510.800.130	65,10	8	1,30	60°	CTS15	C3
GSRG 7000.800.130	70	8	1,30	60°	CTS15	C3
GSRG 7200.800.130	72	8	1,30	60°	CTS15	C3

The listed grades are available: prices and delivery times upon request.
Other dimensions and types according to customer specifications upon request.

GLASS INDUSTRY

COMPACTION TOOLS FOR OPTICAL LENSES

Sectors, applications

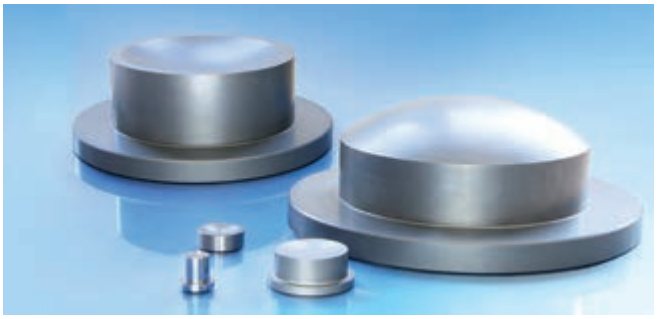
- Manufacture of optical lenses for
  - mobile phones
  - photo cameras

Materials

- Liquid glass

Products

- Press moulds
- Bushes
- Dies
- Punch stamps



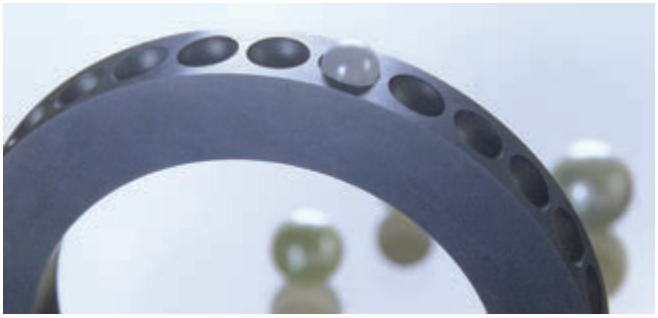
Carbide properties

- High wear resistance
- Heat resistance
- Maximum quality

Finish

- Blanks
- Finish-ground (surface with mirror polish)

Do not hesitate to contact us for advice on the suitable grade for your specific application.



Sectors, applications

○ Manufacture of glass balls

Products

○ Carbide rings

Finish

○ Blank
○ Pre-ground

Products

○ Punches

Finish

○ Finish-ground (ready-to-use, polished surface)

If you are interested or have any questions, please get in touch with **CERATIZIT Deutschland, Empfingen**. Alternatively, visit www.ceratizit.com/contact to find your local contact person.

Plastics industry

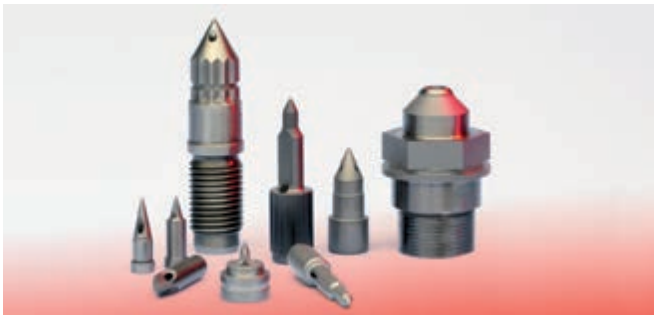
The continually growing plastics industry benefits from an ever increasing quantity of carbide products, which have all the necessary properties – they are resistant to wear, corrosion and high temperatures, while at the same time conducting heat.
We have carbide solutions for the complete life cycle of the plastics industry: for extrusion and underwater granulation, for hot nozzle technology and shredding machines. The extraordinary hardness and rigidity of the carbide products improve the tool life many times over.

Sectors, applications

- Plastics industry
  - Granulate production
  - Injection moulding plants
  - Shredding plants

Materials

- Abrasive plastics



Products

- Hot runner nozzle tips
- Pelletizing dies
- Knives
- Crusher jaws
- Shredding plates
- Rotor and stator knives for granulators

Carbide properties

- Wear resistance
- Fracture toughness
- Heat conductivity
- Corrosion resistance

Finish

- Blanks
- Finish-ground (ready-to-use)

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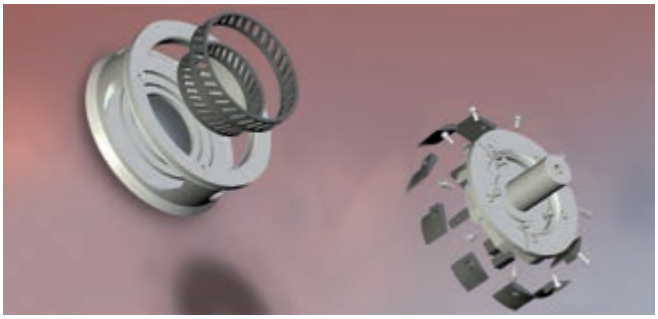
Food industry

Breakers and agitator pins grind thousands of cocoa beans one after the other at incredible speed. In order to achieve consistent quality you need special carbide grades that are extremely wear- and corrosion-resistant.
The American Food and Drug Administration (FDA) has confirmed that our carbide grades are suitable for use in the food industry.

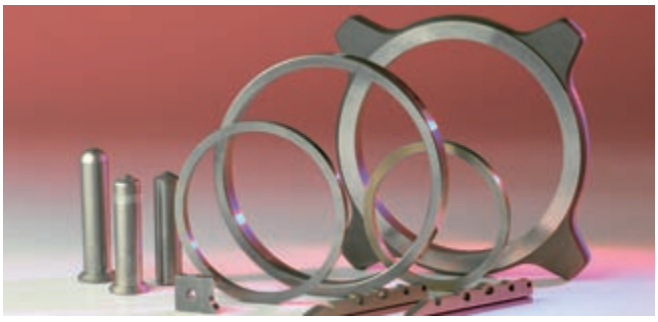
Sectors, applications

- Food industry



Products

- Crushers
- Pins
- Knives
- Bushes
- Sleeves
- Semi-finished products
- Customised components



Carbide properties

- Fracture toughness
- Food impact
- Corrosion resistance
- Compressive strength

Finish

- As sintered
- Ground (ready-to-use)
- Composite parts (carbide/steel)

There are often concerns surrounding the use of carbide in the food industry. Therefore, we have taken steps to have all of our carbide and ceramic grades that are used in the food industry examined. The American Food and Drug Administration (FDA) carried out a study using their own criteria to assess the impact of our carbide and ceramic grades on both food and the environment.

The results of the study confirm that the CERATIZIT grades are suitable for use throughout the food industry. The FDA included all grades in their 'Inventory of Effective Food Contact Substance (FCS) Notifications'.

FDA overview of substances coming into contact with food

http://www.fda.gov/Food/

Classification of the WC grain size		CERATIZIT code
Average grain size [µm]	Classification	
< 0.2	nano	N
0.2 - < 0.5	ultrafine	U
0.5 - < 0.8	submicron	S
0.8 - < 1.3	fine	F
1.3 - < 2.5	medium	M
2.5 - < 6.0	coarse	C
> 6.0	extra-coarse	E

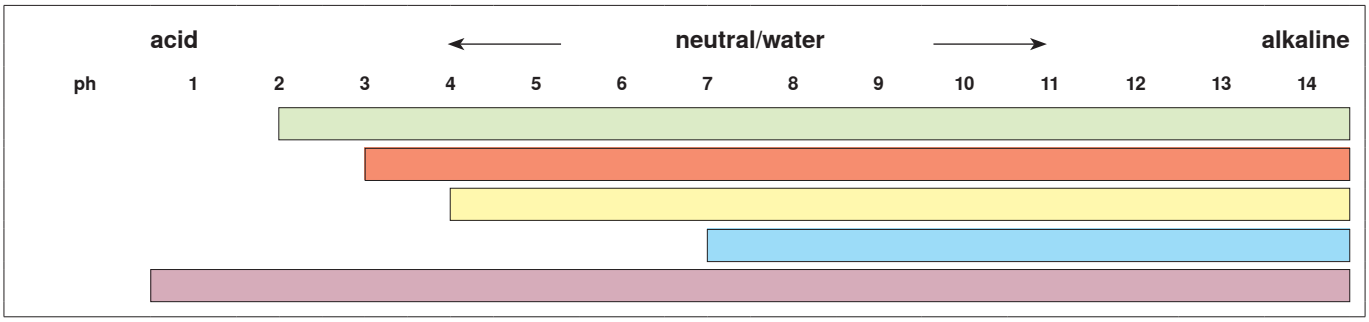
The classification of carbides according to grain size corresponds to the recommendations of the Powder Metallurgy Association.

CERATIZIT grades with FDA food contact notification

	Grade description	FCN number #	Composition	Binder	Grain size		Hardness			Density	Transverse rupture strength	Fracture toughness
				[m %]	Classification	[µm]	HV10	HV30	HRA	[g/cm³]	[MPa]	[MPa*m½]
ph > 2	CTF00Q	578 - 585	WC - (TiTaNb)C	<0,3	fine	0,8 - <1,3	2100	2060	94,2	14,40	1600	6,6
ph > 3	CTU05R	586 - 591	WC - Ni	2,2	ultrafine	0,2 - <0,5	2350	2250	95,2	15,20	2000	
	CTF16R	586 - 591	WC - Ni	8,0	fine	0,8 - <1,3	1480	1460	90,9	14,80	2900	11,4
	CTM16N	586 - 591	WC - Ni	8.0	medium	1,3 - <2,5	1300	1290	89,4	14,85	2400	10,8
	CTS17R	586 - 591	WC - Ni	8,5	submicron	0,5 - <0,8	1600	1580	91,8	14,55	2800	8,7
	CTU17R	586 - 591	WC - Ni	8,5	ultrafine	0,2 - <0,5	1760	1730	92,7	14,55	2500	8,0
	CTF21N	586 - 591	WC - Ni	10,5	fine	0,8 - <1,3	1280	1270	89,2	14,50	2600	11,9
ph > 4	CTS12L	578 - 585	WC - Co	6,0	submicron	0,5 - <0,8	1820	1790	93,0	14,80	3500	8,2
	CTS20L	578 - 585	WC - Co	10,0	submicron	0,5 - <0,8	1680	1660	92,3	14,45	3700	9,4
	CTU05E	578 - 585	WC - Co	2.4	submicron	0,5 - <0,8	2300	2200	95,2	15,25	3500	5,7
ph > 7	CTF11E	578 - 585	WC - Co	5,6	fine	0,8 - <1,3	1760	1730	92,7	14,95	2150	9,2
	CTF12E	578 - 585	WC - Co	6,0	fine	0,8 - <1,3	1640	1620	92,1	14,95	2200	9,9
	CTF12F	578 - 585	WC - Co	5,8	fine	0,8 - <1,3	1730	1700	92,5	14,90	2500	9,0
	CTF24E	578 - 585	WC - Co	12,0	fine	0,8 - <1,3	1330	1320	89,7	14,30	3000	12,0
	CTE30A	578 - 585	WC - Co	15,0	coarse	2,5 - <6,0	970	960	85,6	14,05	2800	22,0
all ph	SNC1	575 - 577	Si_3N_4 - Al_2O_3 / Y_2O_3	9,0	ultrafine	0,2 - <0,5	1550	1530	91,5	3,25	1100	6,5
	SNC20	575 - 577	Si_3N_4 - Al_2O_3 / Y_2O_3	11,0	ultrafine	0,2 - <0,5	1470	1450	90,8	3,24	850	5,7
	SNCB5	575 - 577	Si_3N_4 - Al_2O_3 / Y_2O_3	12,5	ultrafine	0,2 - <0,5	1500	1480	91,1	3,25	1000	6,0

Based on the FDA website: **http://www.fda.gov/Food/**

Grade selection according to food's pH-value



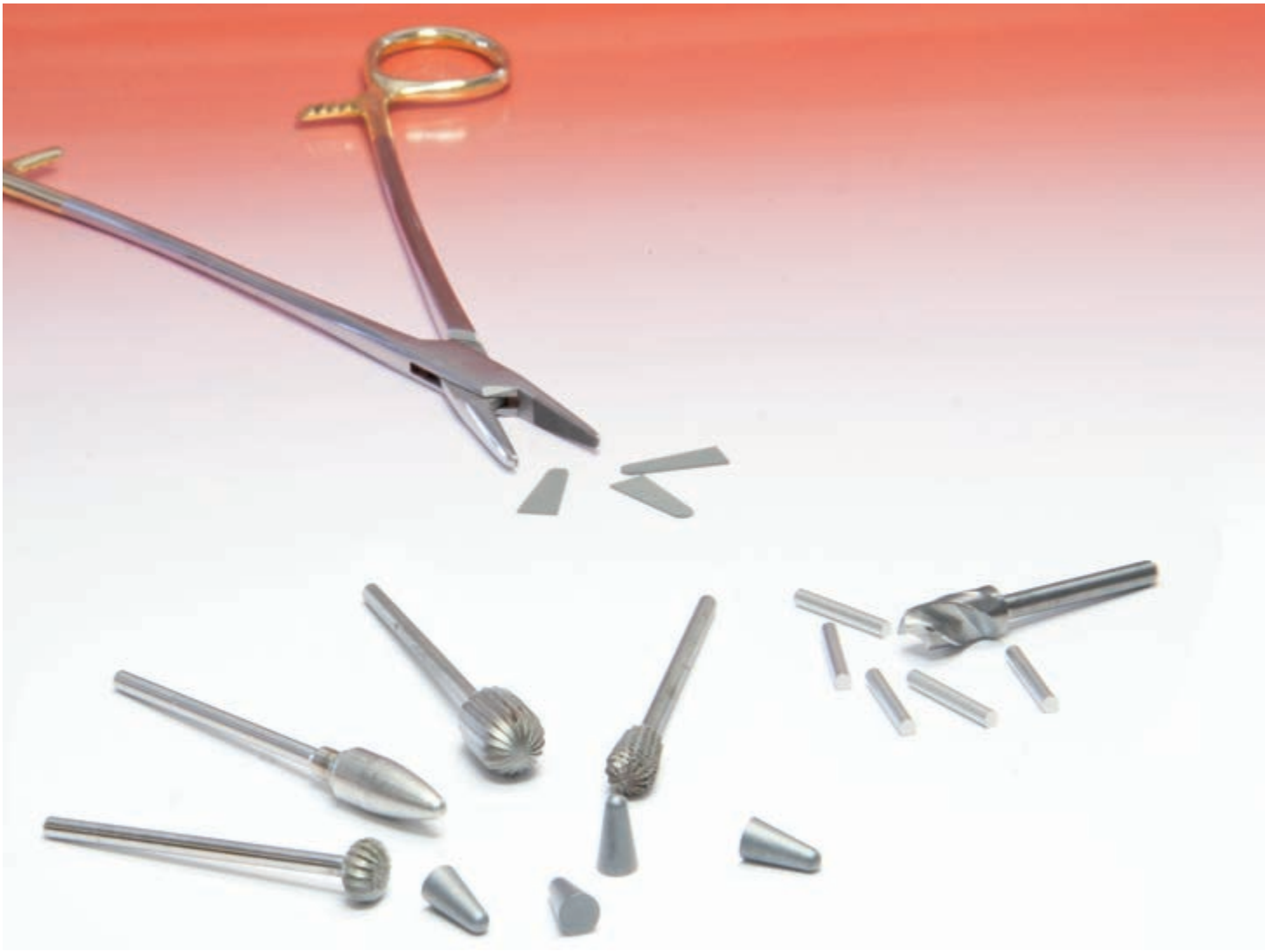
Comment:

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.

If you are interested or have any questions, please get in touch with **CERATIZIT Luxembourg, Mamer**. Alternatively, visit www.ceratizit.com/contact to find our local contact person.

Medical systems and dental industry

Incredibly precise tools are needed when treating teeth and bones. In order to make these instruments hard and resistant to breakage, we have developed carbide grades which are particularly suitable for the medical sector. Medical instruments in particular must be of the highest quality in order to meet healthcare regulations. We guarantee that our products correspond to these regulations by providing a metallurgical certificate. In addition, our carbides are easily weldable.

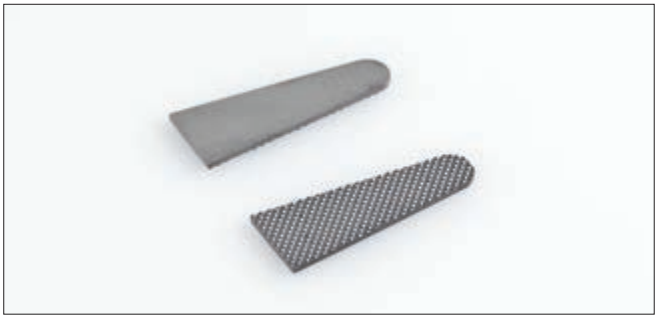


Sectors, applications

- Dental equipment manufacturers
- Medical instruments

Materials

- Metal ceramics, full ceramics
- Precious metal alloys and alloys with reduced precious metal content
- Non-precious metal alloys
- CrCo, CrNi
- Titanium
- Crown and bridge materials
- Denture acrylics and plate materials
- Dental plaster
- Soft plastics



Products

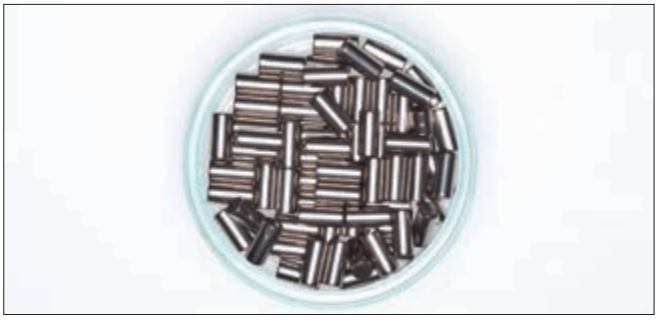
- Preforms
- Pins
- Needle holder tips
- According to customer requirements

Carbide properties

- High wear resistance
- High fracture toughness
- Corrosion resistance
- Sometimes difficult to weld

Finish

- As sintered
- Ground



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Watch and clock industry, jewellery industry

We are the only company which produces watch-cases and jewellery components made of carbide. Characterised by a shiny surface and high durability, carbide watches and jewellery are resistant to knocks and scratches. All jewellery components consist of carbide grades which are well-tolerated by the skin and are extremely wear- and corrosion-resistant.

Sectors, applications

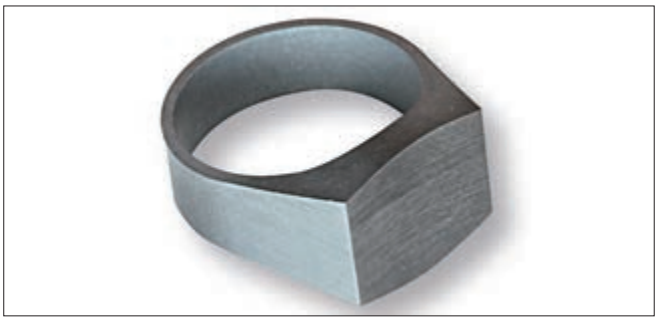
- Watch and clock producers
- Jewellery producers

Products

- Watch and clock cases
- Items of jewellery

Carbide properties

- Wear resistance
- Impact strength
- Scratch resistance
- Low weight



Finish

- As sintered
- Ground

Complex shapes may be produced (Metal Injection Molding)

If you are interested or have any questions, please get in touch with **CERATIZIT Luxembourg, Mamer**. Alternatively, visit www.ceratizit.com/contact to find our local contact person.

Mining industry

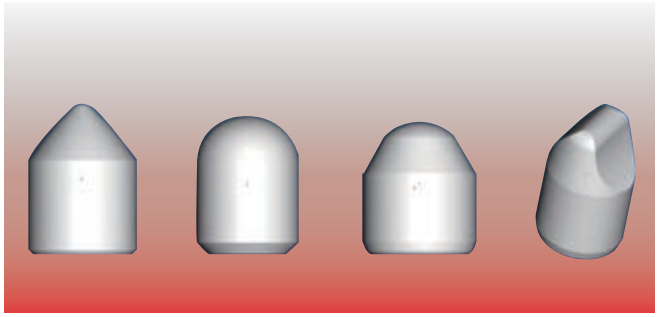
In order to complete large projects such as tunnel drilling or mining, particularly tough and wear-resistant tools are decisive.
For all special applications we offer a wide range of both carbide grades and geometries.

Sectors, applications

- Tunnel construction
- Mining
- Road construction
- Oil industry

Materials

- Stone

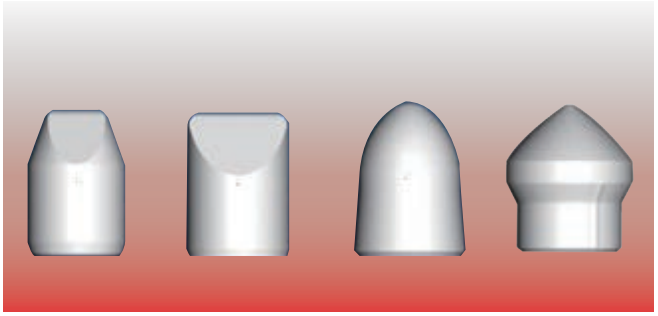


Products

- Drill heads
- Road milling bits
- Customised plates

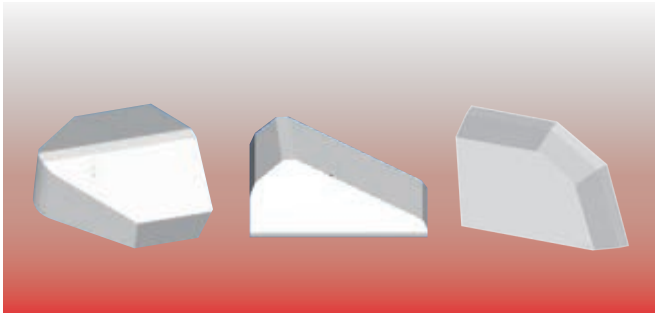
Carbide properties

- High wear resistance
- High toughness
- Impact strength



Finish

- As sintered



Overview of CERATIZIT standard grades

Applications: MINING INDUSTRY – TUNNEL CONSTRUCTION – DRILLING – SHREDDING INDUSTRY

Grade	Binder [m %]	Grain size classification	Hardness HV10	Hardness HV30	Hardness HRA	Density [g/m³]	Remarks
CTM12A	6,0	medium	1430	1410	90,5	14,95	
CTE12A	6,0	extra-coarse	1300	1290	89,4	15,00	
CTM14E	7,0	medium	1550	1530	91,5	14,90	
CTF16R	8,0	fine	1480	1460	90,9	14,80	corrosion-resistant (1)
CTM16N	8,0	medium	1300	1290	89,4	14,85	corrosion-resistant (2)
CTM17E	8,5	medium	1420	1400	90,4	14,65	
CTF18Y	9,0	fine	1470	1450	90,8	14,25	
CTF20RC	10,0	fine	1470	1450	90,8	14,30	ECO grade
CTE20A	10,0	extra-coarse	1130	1120	87,6	14,60	
CTE20M	10,0	extra-coarse	1140	1130	87,7	14.50	corrosion-resistant (3)
CTM24RC	12,0	medium	1170	1160	88,0	14,10	ECO grade
CTE25A	12,5	extra-coarse	1050	1040	86,6	14,30	
CTF30RC	15,0	fine	1250	1240	88,8	14,05	ECO grade
CTF30M	15,0	fine	1150	1140	87,8	14,00	corrosion-resistant (3)
CTE30A	15,0	extra-coarse	970	960	85,6	14,05	
CTE30RC	15,0	coarse / extra-coarse	1100	1090	87,3	14,00	ECO grade
CTE30M	15,0	extra-coarse	960	950	85,5	14,05	corrosion-resistant (3)
CTE35A	17,5	extra-coarse	910	900	84,8	13,80	
CTE40A	20,0	extra-coarse	850	840	84,2	13,60	
CTE40M	20,0	extra-coarse	810	800	83,6	13,50	corrosion-resistant (3)

Classification of the carbide grain size	
Medium grain size [µm]	Classification
0.8 - < 1.3	fine
1.3 - < 2.5	medium
2.5 - < 6.0	coarse
> 6.0	extra-coarse

☐ standard grades – Co binder

☐ corrosion-resistant grades

(1) = Ni/Cr binder
(2) = Ni binder
(3) = Co/Ni/Cr binder

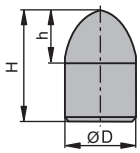
CERATIZIT 'E-Line' grade overview

Applications: MINING INDUSTRY – TUNNEL CONSTRUCTION – DRILLING – SHREDDING INDUSTRY

Grade	Binder [m %]	Grain size classification	Hardness HV10	Hardness HV30	Hardness HRA	Density [g/m³]
KE2	6,0	medium / coarse	1330	1320	89,7	14,93
KE6	6,0	extra-coarse	1120	1130	87,5	14,93
KG2	6,5	coarse	1430	1410	90,5	14,90
KE7	7,0	extra-coarse	1000	990	86,0	14,85
KE8	8,0	coarse	1220	1210	88,5	14,73
KG3	9,0	medium / coarse	1290	1280	89,3	14,61
KE9	9,0	coarse / extra-coarse	1150	1140	87,8	14,61
KE20 NEW	10,0	extra-coarse	960	950	85,5	14,50
KE10	10,5	coarse	1080	1070	87,0	14,50
KE11	11,0	coarse / extra-coarse	1040	1030	86,5	14,42
KG4	12,0	medium	1290	1280	89,3	14,30
KG5	12,0	medium / coarse	1210	1200	88,3	14,31
KE12	12,0	coarse / extra-coarse	1080	1070	87,0	14,31
KE13	13,0	extra-coarse	920	910	85,0	14,22
KG6	14,0	medium / coarse	1100	1090	87,3	14,12
KE16	16,0	coarse	960	950	85,5	13,90

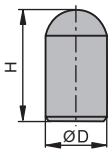
☐ standard grades – Co binder

Ballistic Compact



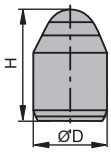
Type, ordering description	Standard dimensions Ø D [mm]	H [mm]	h [mm]
CBD...	7,4 - 29,7	10,0 - 32,0	3,7 - 13,0

Spherical Compact



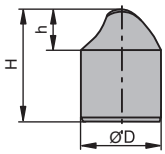
Type, ordering description	Standard dimensions Ø D [mm]	H [mm]
CBQ...	4,4 - 28,6	6,0 - 38,0

Conical Compact



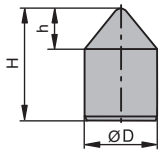
Type, ordering description	Standard dimensions Ø D [mm]	H [mm]
CBZ...	5,4 - 25,4	7,0 - 42,0

Scoop Compact



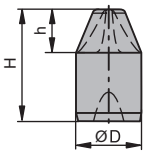
Type, ordering description	Standard dimensions Ø D [mm]	H [mm]	h [mm]
CBS...	8,3 - 32,6	13,0 - 52,0	4,7 - 22,5

Ballistic Wedge Compact, I



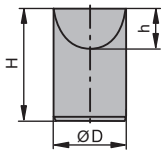
Type, ordering description	Standard dimensions Ø D [mm]	H [mm]	h [mm]
CBX...	8,0 - 30,5	10,0 - 40,0	3,5 - 16,3

Ballistic Wedge Compact, II



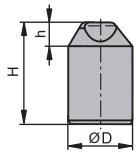
Type, ordering description	Standard dimensions Ø D [mm]	H [mm]	h [mm]
CBW...	18,4 - 25,4	30,0 - 42,0	11,7 - 18,0

Aerofoil Compact



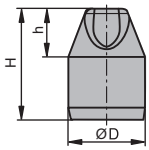
Type, ordering description	Standard dimensions Ø D [mm]	H [mm]	h [mm]
CBY...	10,0 - 22,8	15,0 - 35,0	4,8 - 9,2

Special Head Preform, I



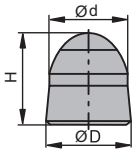
Type, ordering description	Standard dimensions Ø D [mm]	H [mm]	h [mm]
CB...	11,15 - 12,84	13,7 - 16,2	8,5 - 10,4

Special Head Preform, II



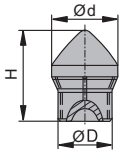
Type, ordering description	Standard dimensions Ø D [mm]	H [mm]	h [mm]
CB...	11,15 - 14,35	13,5 - 10,7	7,5 - 19,7

Special Head Preform, III



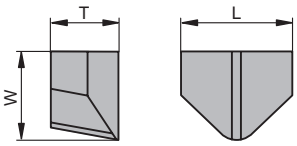
Type, ordering description	Standard dimensions Ø D [mm]	H [mm]	h [mm]
CB...	10,2	14,6	9,4

Special Head Preform, IV



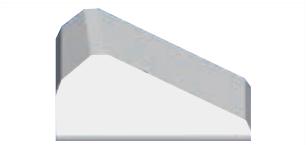
Type, ordering description	Standard dimensions Ø D [mm]	H [mm]	h [mm]
CB...	18,0 - 24,0	10,0 - 35,0	22,0 - 30,0

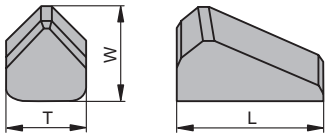
Blade Inserts, I



Type, ordering description	Standard dimensions T [mm]	W [mm]	L [mm]
CBB1-...	15,0 - 30,0	20,0 - 45,0	40,0 - 60,0

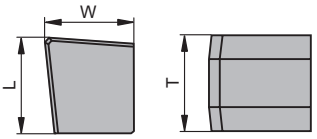
Blade Inserts, II





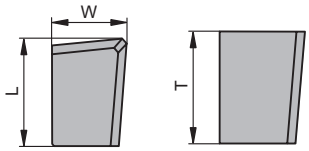
Type, ordering description	Standard dimensions T [mm]	W [mm]	L [mm]
CBB2-...	22,0 - 40,0	24,0 - 65,0	40,0 - 100,0

Blade Inserts, III



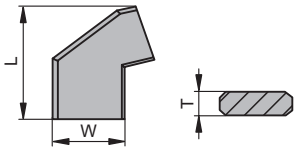
Type, ordering description	Standard dimensions T [mm]	W [mm]	L [mm]
CBB3-...	40,0	35,0	45,0

Blade Inserts, IV



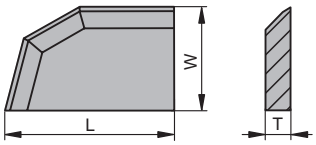
Type, ordering description	Standard dimensions T [mm]	W [mm]	L [mm]
CBB4-...	40,0	34,0	44,0

Blade Inserts, V



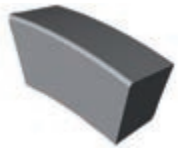
Type, ordering description	Standard dimensions T [mm]	W [mm]	L [mm]
CBB5-...	15,0	35,0	71,3

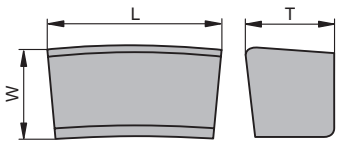
Blade Inserts, VI



Type, ordering description	Standard dimensions T [mm]	W [mm]	L [mm]
CBB6-...	12,0	50,0	81,8

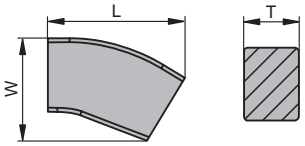
Blade Inserts, VII





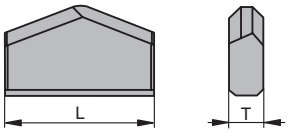
Type, ordering description	Standard dimensions T [mm]	W [mm]	L [mm]
CBB7-...	35,0	45,0	67,2

Blade Inserts, VIII



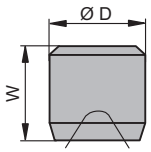
Type, ordering description	Standard dimensions T [mm]	W [mm]	L [mm]
CBB8-...	15,0	20,0	37,5

Concrete Inserts



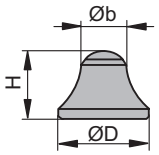
Type, ordering description	Standard dimensions T [mm]	W [mm]	L [mm]
CBMD...	3,0 - 4,0	5,1 - 14,0	6,3 - 14,6

Flat Topped Compact

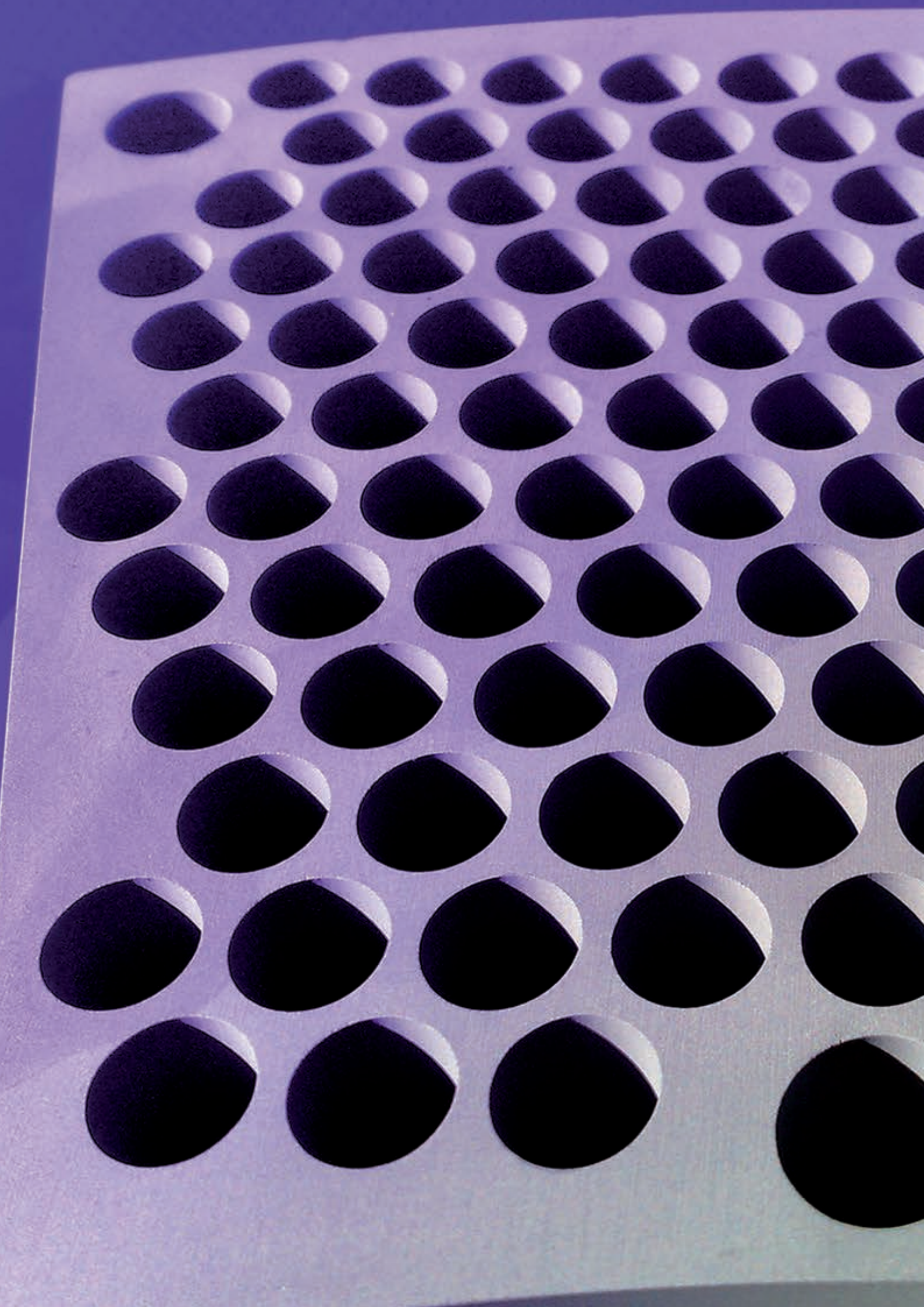


Type, ordering description	Standard dimensions	
	Ø D [mm]	H [mm]
CB1213	12,3	13,0

Road Planing Compact



Type, ordering description	Standard dimensions		
	Ø D [mm]	d [mm]	H [mm]
CB...	16,0 - 18,5	8,0 - 11,5	15,7 - 23,0



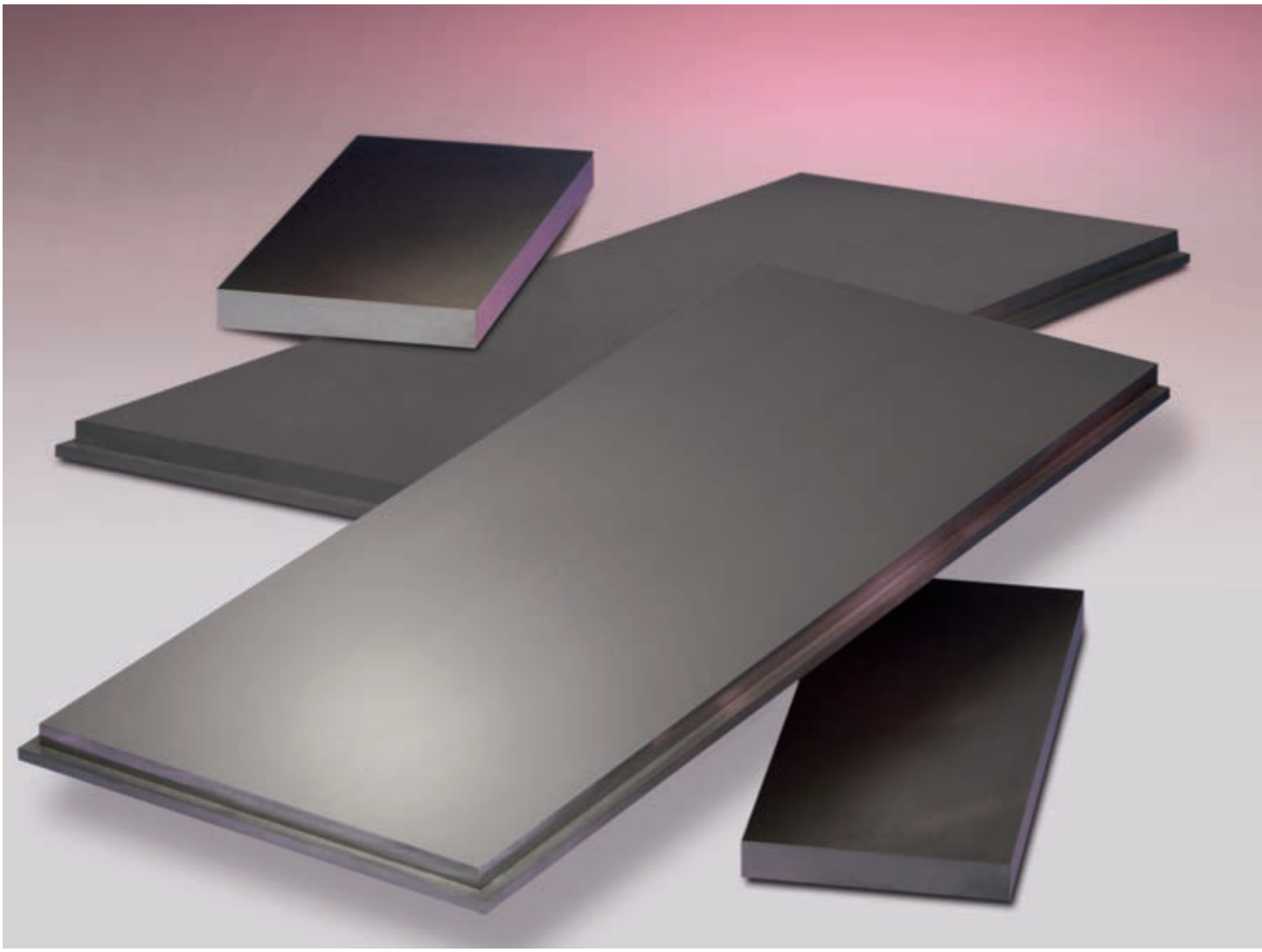
Wear parts

Our wear protection parts are often not recognised as such at first glance. However, they are present in everyday life, for example in door locks, rock drills, pumps or nozzles.
Rough finish or high precision, fracture toughness or excellent hardness, standard or customised – we offer the right solution for every application.

If you are interested or have any questions, please get in touch with **CERATIZIT Luxembourg, Mamer**. Alternatively, visit www.ceratizit.com/contact to find our local contact person.

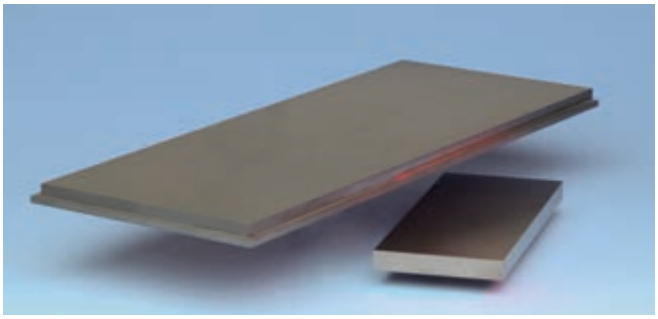
Coating technology

Sputter targets are needed for physical coating procedures. Achieving a high-quality coating depends on the composition, a homogeneous structure, density and purity of the target.
For this purpose, we have developed a binder-free material.



Sectors, applications

- Automotive industry (racing)
- Optical industry
- Tooling industry
- Production of tribological coatings
- Electronic industry



Products

- Sputter targets

Carbide properties

- Good mechanical properties
- Binder-free (Co-content < 0.3%)
- Homogeneous structure (uniform removal rate possible)

Finish

- Ground all over

Composition and properties

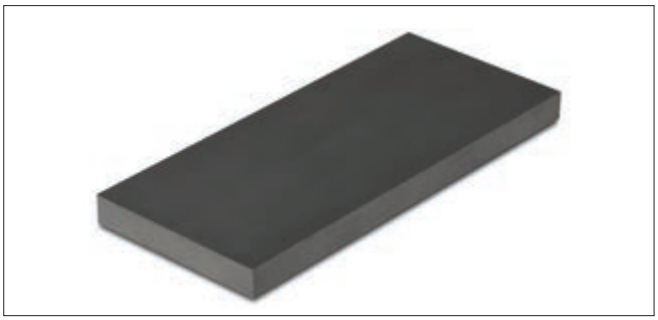
CERATIZIT grade code	Binder composition	Binder [m %]	Density [g/cm³]	Hardness HV10	Hardness HV30	Hardness HRA	Transverse rupture strength [MPa]	Transverse rupture strength [P.S.I.]	Fracture toughness [MPa*m^{½}]
Submicron grain									
CTS12R	(Ni grade)	6,0	14,9	1720	1690	92,5	2700	391.000	7,5
Fine / medium grain									
CTF11E		5,6	14,95	1760	1730	92,7	2150	312.000	9,2
CTF00Q		<0,3	14,4	2100	2060	94,2	1600	232.000	6,6

Classification of the WC grain size		CERATIZIT code
Average grain size [µm]	Classification	
< 0.2	nano	N
0.2 - < 0.5	ultrafine	U
0.5 - < 0.8	submicron	S
0.8 - < 1.3	fine	F
1.3 - < 2.5	medium	M
2.5 - < 6.0	coarse	C
> 6.0	extra-coarse	E

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

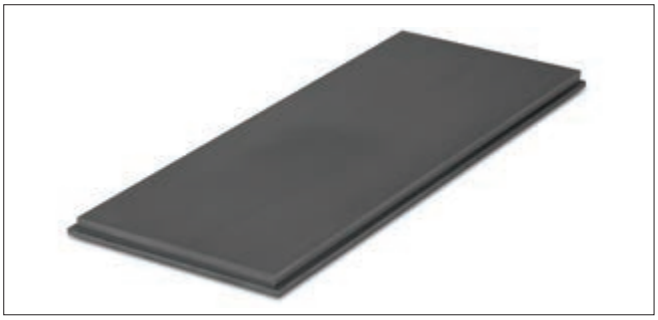
Comment:

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



Standard dimensions

l x w x h, 170 x 75 x 12 mm – available in stock



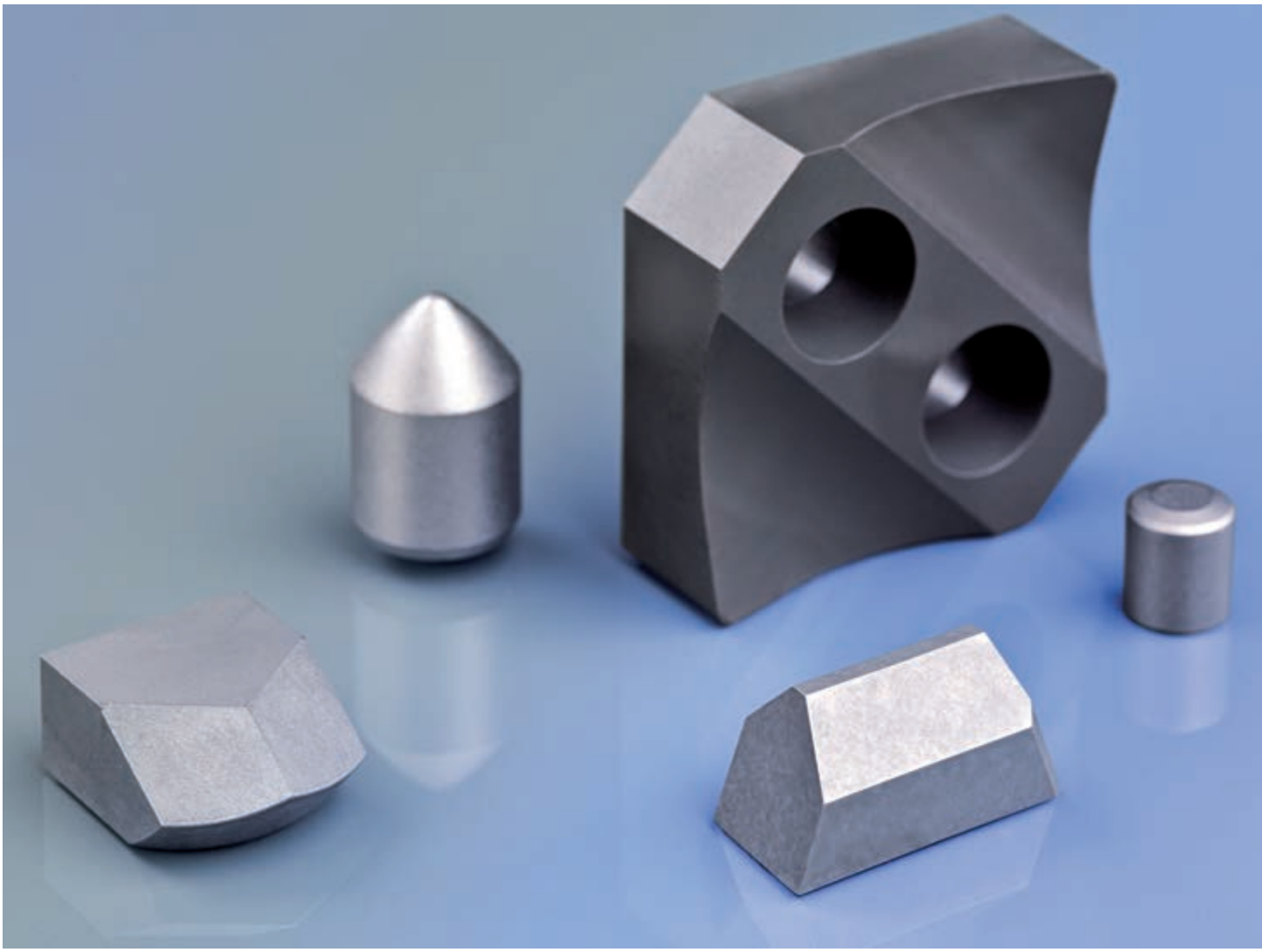
Other dimensions, e.g. for round (D x h) or rectangular types (l x w x h) are availble upon request.

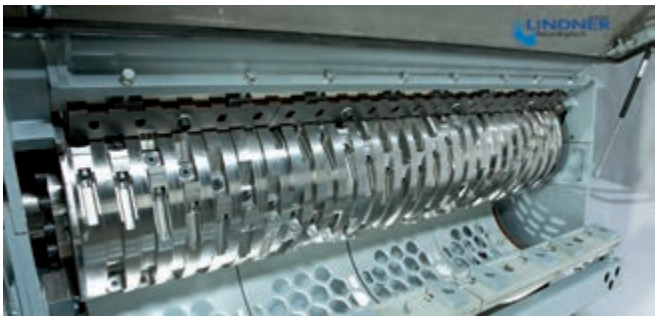
If you are interested or have any questions, please get in touch with **CERATIZIT Luxembourg, Mamer**. Alternatively, visit www.ceratizit.com/contact to find our local contact person.

Recycling and shredding technology

As regular pre-crushing frequently is an essential prerequisite for separating materials during recycling, carbides are also used in this field. In plastics shredding plants, for example, rotor disks with carbide inserts are used because they improve the tool life many times over.

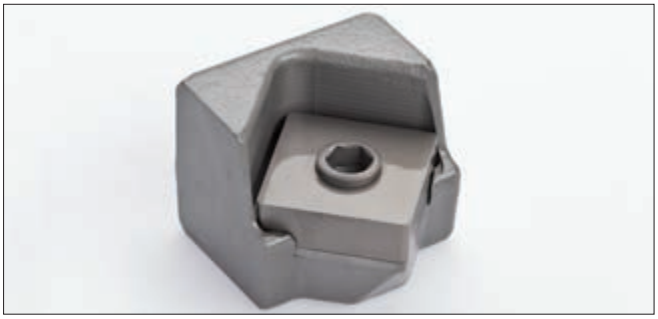
The quantity of waste which must be recycled is continuously on the rise, so shredding plants are becoming larger and larger. Our product range offers a wide variety of geometries, including complex forms.





Sectors, applications

- Shredding industry
- Recycling industry
- Shredding systems

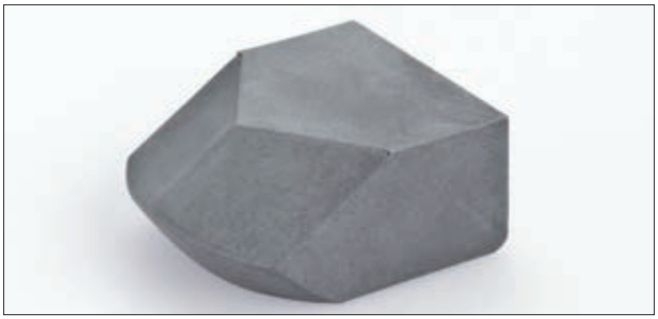


Products

- Rotor and stator knives
- Special knives
- Inserts
- Complex forms according to customer requirements

Carbide properties

- Wear resistance
- High fracture toughness

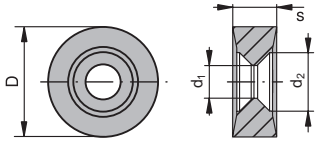


Finish

- As sintered or ground all over

Button insert

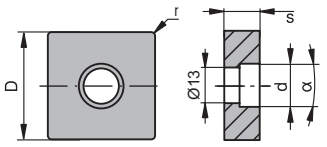
with 90 ° countersunk hole, CTF24E



Type, ordering description	Material	D [mm]	d_1 [mm]	d_2 [mm]	s [mm]
RC 4016 R	11232902	40,0	12	21,1	16,0

Square insert

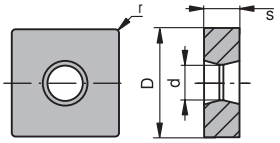
with counterbore on one side CTE30RC



Type, ordering description	Material	D [mm]	s [mm]	d [mm]	r [mm]	α [°]
RC 4020 Q	11512668	40,0	20,0	20,0	1,5	0

Square insert

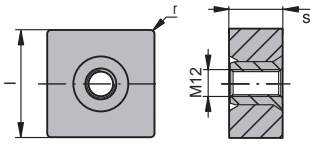
with 30 ° countersunk hole, CTE30RC



Type, ordering description	Material	D [mm]	s [mm]	r [mm]
RC 3812 Q	11032008	38,3	12,5	2,0
RC 4319 QS	11057465	43,0	19,5	1,5
RC 4323 Q	11032011	43,0	23,0	1,5

Square insert

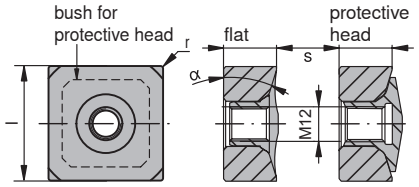
with threaded bush, CTE30RC



Type, ordering description	Material	l [mm]	s [mm]	r [mm]
RC 4020 G	11287837	40,0	20,0	0,5

Square cutter block

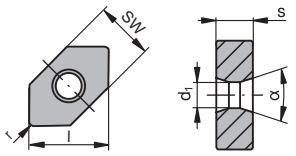
with threaded bush, CTE30RC



Type, ordering description	Material	l [mm]	s [mm]	r [mm]	α [°]
SK 4020 G	11619192	40,0	20,0	0,5	15
SK 4020 G-SK	11180762	40,0	20,0	0,5	15
SK 4020 G-SK (M10)	11523207	40,0	20,0	0,5	15

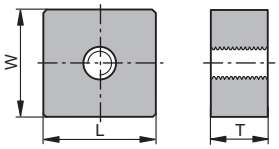
Long insert

with 30 ° countersunk hole, CTE30RC



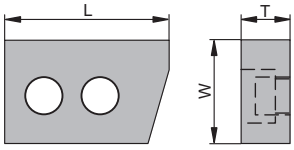
Type, ordering description	Material	l [mm]	d_1 [mm]	s [mm]	r [mm]	SW [mm]	α [°]
RC 3817 F	11035734	38,3	13	17,5	2,0	28,0	30

Crushing Insert I



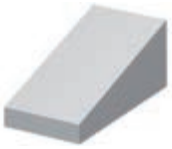
Type, ordering description	Standard dimensions T (mm)	W (mm)	L (mm)
CBC1-...	20,0	40,0	40,0

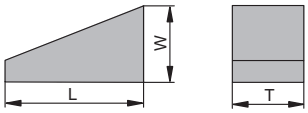
Crushing Insert II



Type, ordering description	Standard dimensions T (mm)	W (mm)	L (mm)
CBC2-...	23,0	50,0	76,0

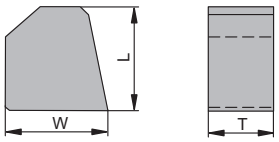
Crushing Insert III





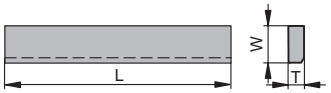
Type, ordering description	Standard dimensions T (mm)	W (mm)	L (mm)
CBC3-...	16,5	14,0	32,0

Crushing Insert IV



Type, ordering description	Standard dimensions T (mm)	W (mm)	L (mm)
CBC4-...	16,5	26,0	28,0

Crushing Insert V

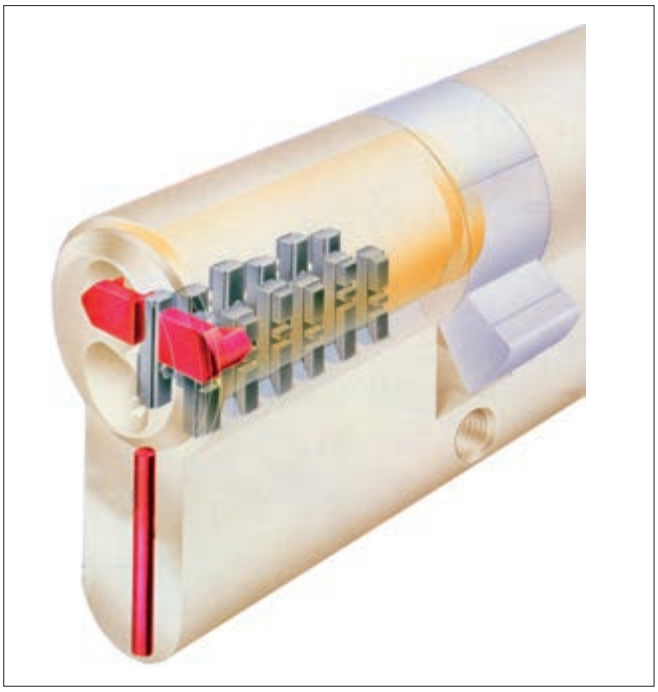


Type, ordering description	Standard dimensions T (mm)	W (mm)	L (mm)
CBC5-...	7,0	8,0	99,0

If you are interested or have any questions, please get in touch with **CERATIZIT Luxembourg, Mamer**. Alternatively, visit www.ceratizit.com/contact to find our local contact person.

Lock industry and security engineering

Carbides are essential components of all locks that must meet the highest security standards. Their specific properties and the manufacturing options they offer give lock producers a variety of possibilities to find the right solution to security issues.



Sectors, applications

- Security engineering
- Producers of safes
- Lock industry (lock producers, locking systems and cylinder locks)

Products

- Pins
- Plates
- Preforms
- Geometries according to customer requirements

Carbide properties

- High hardness
- Corrosion resistance

Finish

- As sintered with minimum tolerances
- Precision-ground

Complex forms can be produced (Metal Injection Molding)

If you are interested or have any questions, please get in touch with **CERATIZIT Deutschland, Empfingen**. Alternatively, visit www.ceratizit.com/contact to find your local contact person.

Nozzles

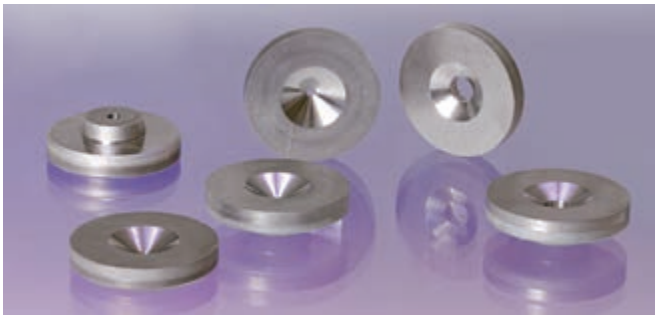
There can be few products with a more diverse range of applications than nozzles. Our nozzles, for example, are used to spray lacquer or liquid magnesium, in sand blasting equipment, and to produce snow. They are resistant to chemicals and corrosion.

Sectors, applications

- Paint shops
- Sand blasting systems
- Plants for the production of artificial snow
- Magnesium spray cast plants
- Plastics industry

Products

- Painting nozzles
- Jet nozzles
- Magnesium spray cast nozzles
- Snow gun nozzles
- Tips for hot runner nozzles
- Special nozzles



Carbide properties

- Corrosion resistance
- Acid resistance
- Wear resistance

Finish

- As sintered
- Ground (ready-to-use)

If you are interested or have any questions, please get in touch with **CERATIZIT Luxembourg, Mamer**. Alternatively, visit www.ceratizit.com/contact to find our local contact person.

Stone machining
(brick industry, agricultural industry, road construction, ...)

Although the nature of grain fields and tarmac roads could not be more different, the requirements regarding the tools are the same.
Our carbide tools are used wherever materials have highly abrasive effect. They are wear-resistant, extremely hard and tough at the same time.

Composition and properties

CERATIZIT grade code	Binder [m %]	Density [g/cm³]	Hardness HV10	Hardness HV30	Hardness HRA	Transverse rupture strength [MPa]	Transverse rupture strength [P.S.I.]	Fracture toughness [MPa*m½]
Submicron grain								
CTS06M	3,0		1950	1910	93,6	2300	334.000	8,5
Fine / medium grain								
CTF11E	5,6	14,95	1760	1730	92,7	2150	312.000	9,2

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.

Sectors, applications

- Mineral extraction
- Road construction machines

Products

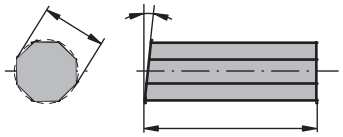
- Parts combined with carbide

Finish

- As sintered
- Complex forms can be produced

Octogonal drill bits

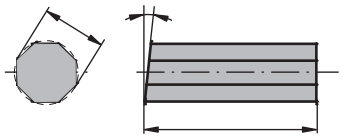
CTE20A



Type, description	Material	d (mm)	l (mm)	α (°)	CTE20A
ODB 05516-6	11522299	5,5 ±0,25	16,35 ±0,35	6	O
ODB 07512-6	11466381	7,5 ±0,25	12,35 ±0,35	6	O
ODB 07516-6	11085393	7,5 ±0,25	16,35 ±0,35	6	O
ODB 10012-6	11466394	10,25 ±0,25	12,35 ±0,35	6	O
ODB 10016-6	11085399	10,25 ±0,25	16,35 ±0,35	6	O

Octogonal drill bits

CTE30RC



Type, description	Material	d (mm)	l (mm)	α (°)	CTE30RC
ODB 06516-6	11627530	6,5 ±0,25	16,35 ±0,35	6	O

O = limited stock or upon request

Sectors, application

○ Stone machining

Products

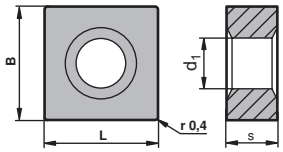
○ Cutting inserts

Finish

○ As sintered
○ Ground all over

Stone cutting insert

CTM12A

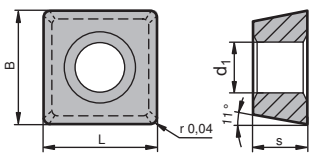


Type, description	Material	L (mm)	B (mm)	d_1 (mm)	s (mm)
STP 10,20x9,70x3,30	11119265	10,20	9,70	–	3,30
STP 12,70x12,70x5,60	11121422	12,70	12,70	5,16	5,60
STP 12,70x12,70x5,60	11245577	12,70	12,70	5,16	5,60
STP 12,70x12,70x5,60	11245581	12,70	12,70	5,16	5,60
STP 15,62x16,82x5,50 ST	11119264	15,62	16,82	5,10	5,50
STP 23,85x23,85x6,10	11129052	23,85	23,85	8,05	6,10

ST = star-shaped

Stone cutting insert with angle

CTM12A

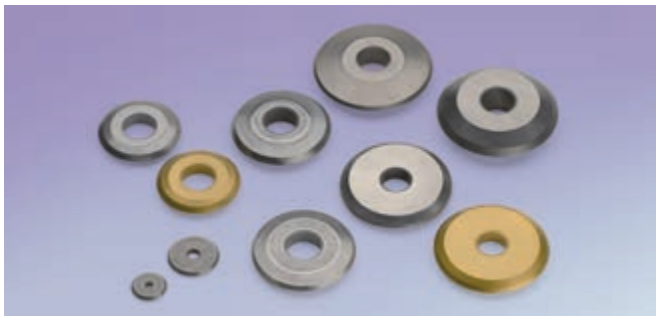


Type, description	Material	L (mm)	B (mm)	d_1 (mm)	s (mm)
STPW 12,50x12,50x6,35	11337742	12,50	12,50	5,16	6,35
STPW 12,50x12,50x6,35*	11128983	12,50	12,50	5,16	6,35
STPW 12,50x12,50x6,35	11337743	12,50	12,50	5,16	6,35
STPW 12,50x12,50x6,35*	11155977	12,50	12,50	5,16	6,35

* = ground version

STONE MACHINING – TILE CUTTING WHEELS

PROGRAMME – CERACut/CERACut Gold



Sectors, applications

- Tile cutting wheels

Products

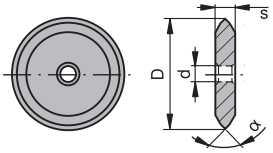
- Tile cutting wheels
- CeraCut (without coating)
- CeraCut gold (with coating)

Finish

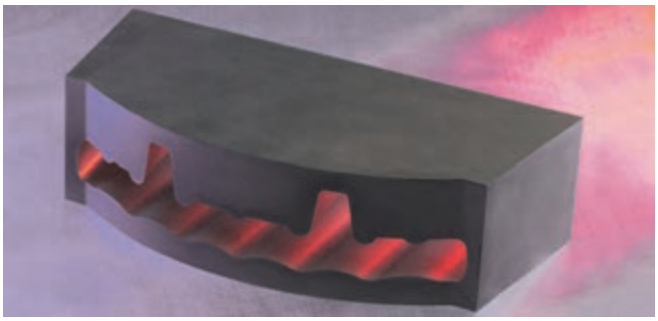
- As sintered
- Ground (ready-to-use)
- Coated

Tile cutting wheels

CTF12Y



Type, description	Material	D (mm)	d (mm)	s (mm)	α (°)
CC 092010	109602	9,0	2,10	1,0	95
CC 146015	181595	14,0	6,00	1,5	90
CC 156020	324512	15,0	6,05	2,0	90
CC 156028	363108	15,0	6,05	2,8	80
CC 155030	121350	15,1	5,05	3,0	104
CC 205030	121097	20,0	5,05	3,0	90
CC 226048	39212	22,0	6,05	408	90
CC 226019	223767	22,1	6,05	1,9	95
CCG 146015	11128341	14,0	6,00	1,5	90
CCG 156028	11118234	15,0	6,05	2,8	80
CCG 205030	11104831	20,0	5,05	3,0	90
CCG 226048	11104830	22,0	6,05	4,8	90

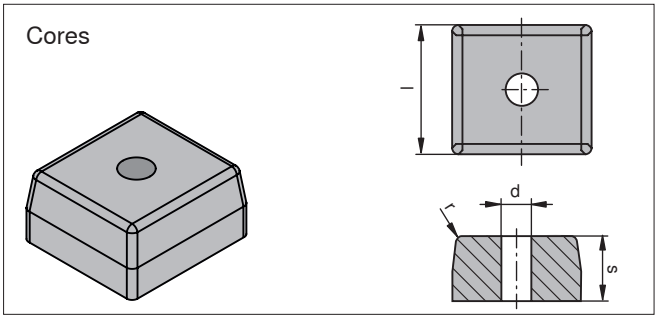


Sectors, applications

- Brick industry, production

Products

- Mouth pieces
- Cores
- Dies
- Geometries according to customer requirements

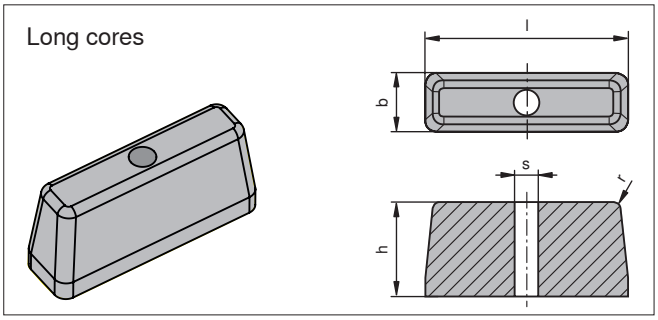


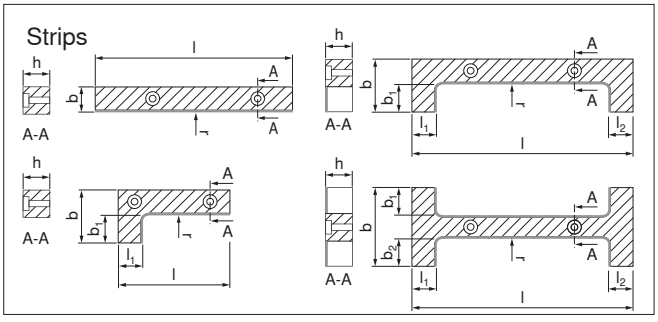
Carbide properties

- Wear resistance
- Corrosion resistance
- Fracture toughness

Finish

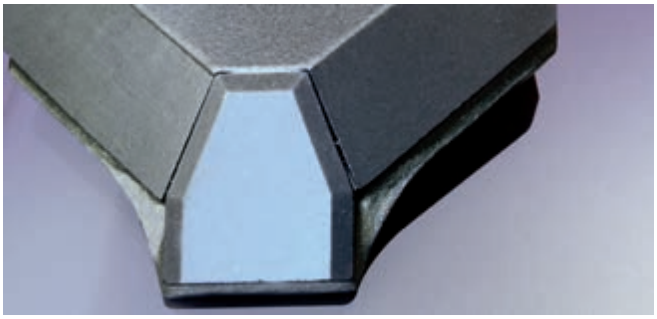
- As sintered
- Ground





Sectors, applications

- Agricultural industry

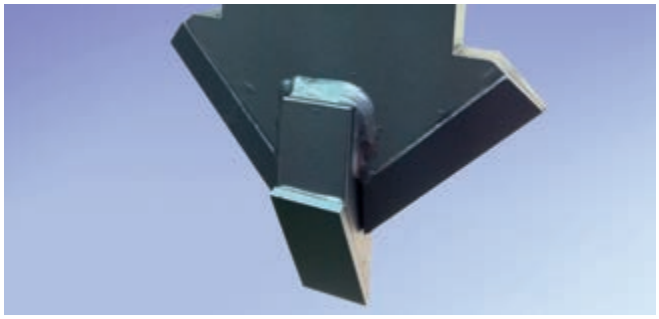


Products

- Plow tips
- Carbide tipped plough blades

Carbide properties

- Wear resistance
- Fracture toughness



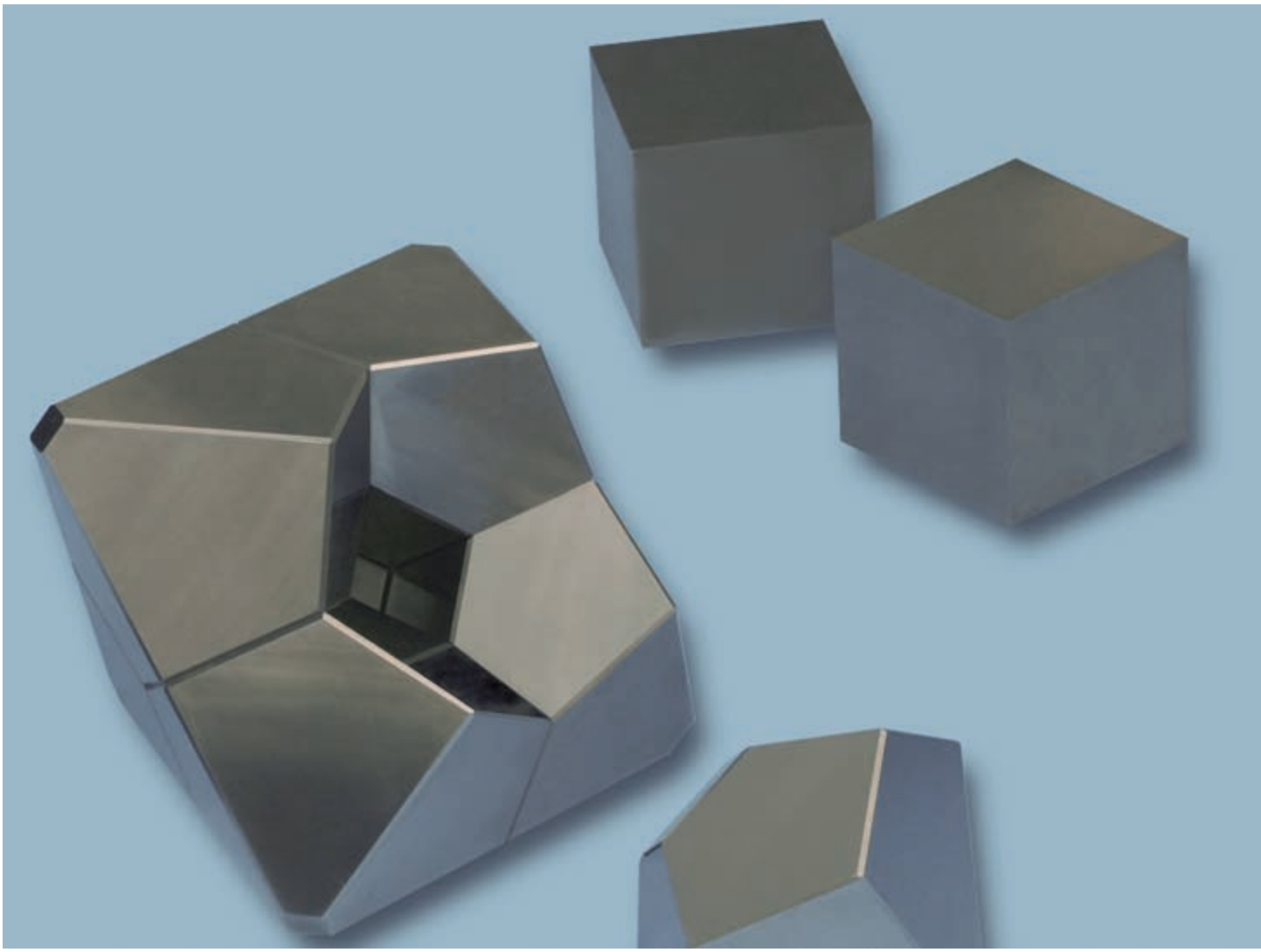
Finish

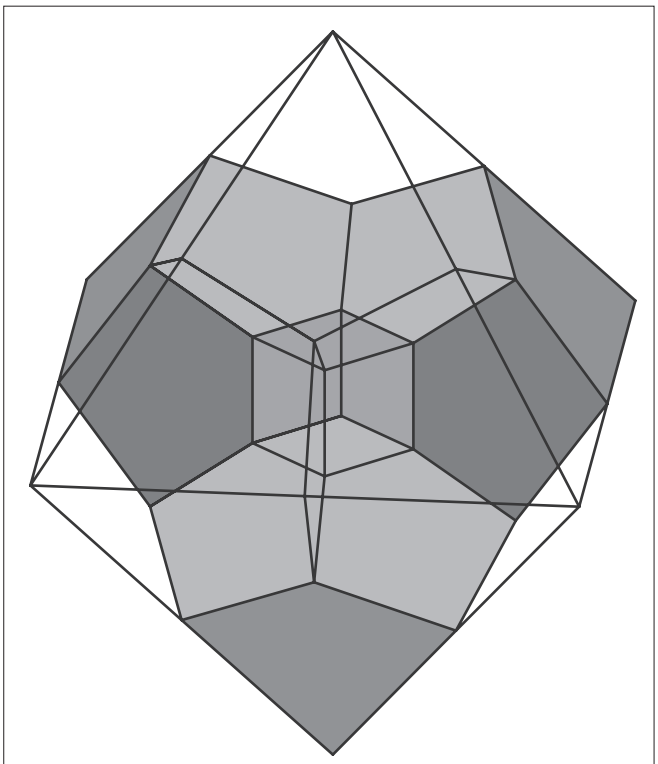
- As sintered

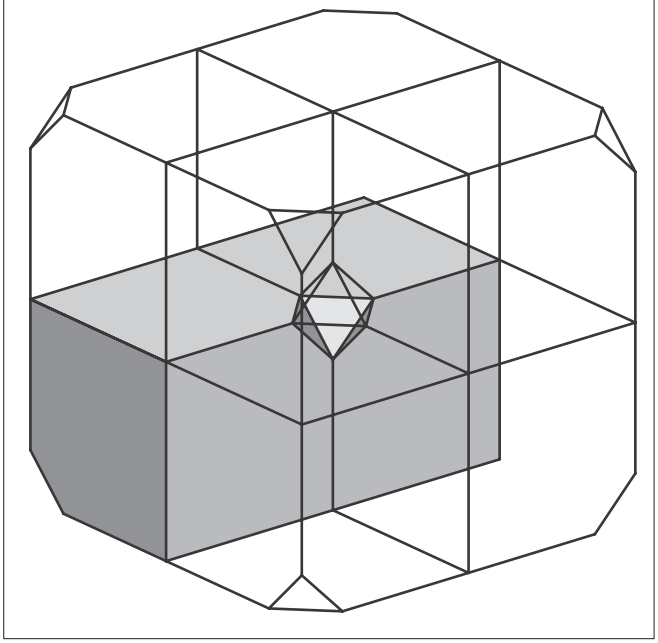
If you are interested or have any questions, please get in touch with **CERATIZIT Luxembourg, Mamer**. Alternatively, visit www.ceratizit.com/contact to find our local contact person.

High-pressure tools

The physical properties of the earth are analysed with high-pressure tools. The oil and tooling industry uses high-pressure procedures to manufacture polycrystalline diamonds (e.g. for drills) or diamond grit (e.g. for grinding wheels).
Our carbide tools stand out thanks to their very high carbide quality. They are extremely resistant to heat and compressive strength and are characterised by long tool life.







Sectors, applications

- Production of industrial diamonds, CBN and PCD
- Analysis of physical and chemical properties of the earth

Products

- Anvils and dies
- Pyramids
- Cubes

Carbide properties

- Wear resistance
- Fracture toughness
- Dimensional accuracy
- Resistant to compressive pressure

Finish

- As sintered
- Ground (ready-to-use)

Long-standing experience in powder metallurgy combined with comprehensive application knowledge ensure that our high-pressure tools, which are characterised by high carbide quality, have a clear competitive edge.

Carbide cubes and pyramids are constructed in various sizes and geometries to meet the needs of every high-pressure application.

All information and drawings are treated strictly confidentially.

If you are interested or have any questions, please get in touch with **CERATIZIT Luxembourg, Mamer**. Alternatively, visit www.ceratizit.com/contact to find our local contact person.

Cutting rolls

Highly precise blanks are the prerequisite for rotating tools that stamp out millions of nappies, sanitary towels and numerous other hygiene articles every day. As the pulp causes the tool to wear quickly, it must be particularly tough and hard.
The cutting edge of the blank is manufactured with precision and near net-shape, enabling simple and fast machining.

Sectors, applications

- Sanitary industry
  (nappies, sanitary towels, general hygiene articles, ...)

Materials

- Pulp
- Paper

Products

- Cutting blanks
- Cutting rolls
- Knives

Carbide properties

- High wear resistance
- Fracture toughness
- Corrosion resistance

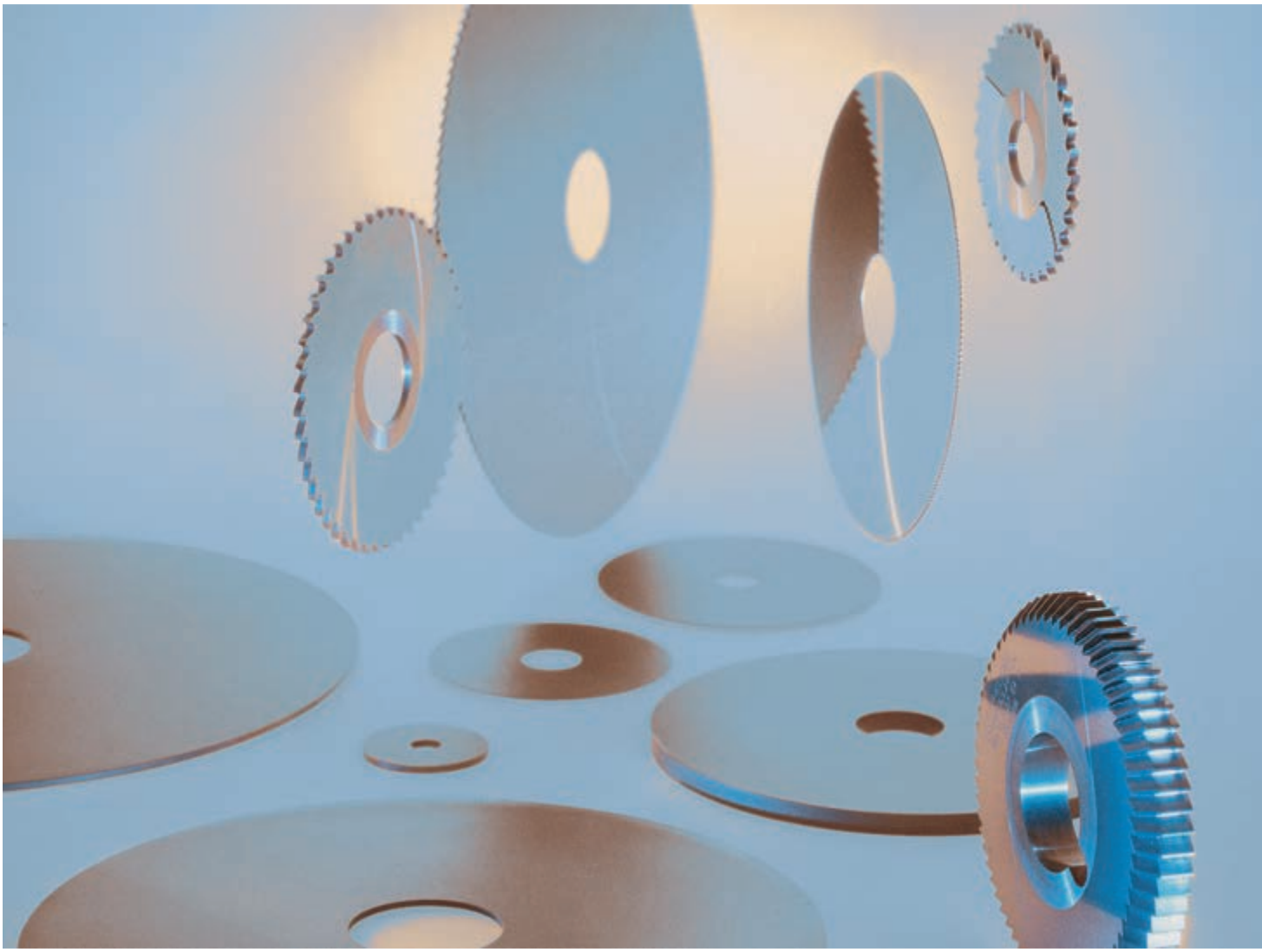
Finish

- As sintered, near net-shape geometries
- Partly ground

If you are interested or have any questions, please get in touch with **CERATIZIT Luxembourg, Mamer**. Alternatively, visit www.ceratizit.com/contact to find our local contact person.

Tooling blanks
(carbide discs, circular knives and long knives)

Precision tooling places high demands on carbide as a material. Our wide range means there is an optimum solution for every application.
The carbide tooling blanks guarantee good parallelism and concentricity.



Sectors, applications

- Cutting tools manufacturers

Materials

- Metals
- Plastics
- Cardboard

Products

- Carbide discs

Carbide properties

- High wear resistance
- Good machining properties

Finish

- As sintered with low grinding allowance ('near net-shape' technology)
- Faces and bore ground
- Good parallelism
- Good concentricity

Composition and properties

CERATIZIT grade code	ISO code	U.S. code	Binder [m %]	Hardness HV10	Hardness HV30	Hardness HRA	Transverse rupture strength [MPa]	Transverse rupture strength [P.S.I.]	Fracture toughness [MPa*m^{½}]
Submicron grain									
CTS12L	K05-K10	C3	6,0	1820	1790	93,0	3500	508.000	8,2
CTS15E	K10-K30	C3	7,5	1750	1720	92,6	3500	508.000	8,6
CTS20L	K20-K40	C2	10,0	1680	1660	92,3	3700	537.000	9,4
CTS24L	K40		12,0	1510	1490	91,2	4000	580.000	9,9
Fine / medium grain									
CTS14Y	K10-K20	C3	7,0	1720	1690	92,5	2500	363.000	8,7
CTF24E	K40		12,0	1330	1320	89,7	3000	435.000	12,0

Application

Submicron grades

CTS12L: for machining non-ferrous metals, aluminium alloys, glass and carbon fibre reinforced plastics, artificial carbon, graphite, cast irons of low or medium hardness, chilled castings, hardened steels.

CTS15E: for machining grey cast iron, tempered iron, non alloyed steels, super alloys, titanium and tantalum alloys, non-ferrous metals, heat-resistant steels, plastics.

CTS20L: for machining corrosion, acid- and heat-resistant steels, chromium alloyed steels, nickel & cobalt alloyed steels, titanium alloys, non-ferrous metals, plastics.

CTS24L: for machining submicron carbide grades with high toughness under unfavourable process conditions.

Fine and medium grain grades

CTS14Y: for machining grey cast iron, tempered iron, non alloyed steels, super alloys, titanium and tantalum alloys, copper, graphite, aluminium, heat-resistant steels, plastics.

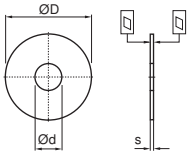
CTF24E: for cutting paper, cardboard and plastic.

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.

Standard dimensions

Blank sizes, CTS14Y



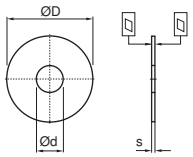
Type, description	Material	D [mm]	Dia. tol. [mm]	d [mm]	d tol. [mm]	s [mm]	s tol. [mm]	
KSR 0153-0048-005 CTS14Y/TW15	11065827	15.3	+0,25	4.8	-0,15	0.8	+0,15	0,1
KSR 0153-0048-006 CTS14Y/TW15	11190059	15.3	+0,25	4.8	-0,15	0.9	+0,15	0,1
KSR 0153-0048-008 CTS14Y/TW15	11065838	15.3	+0,25	4.8	-0,15	1.1	+0,15	0,1
KSR 0153-0048-010 CTS14Y/TW15	11065839	15.3	+0,25	4.8	-0,15	1.3	+0,15	0,1
KSR 0153-0048-012 CTS14Y/TW15	11598161	15.3	+0,25	4.8	-0,15	1.5	+0,15	0,1
KSR 0153-0048-013 CTS14Y/TW15	11065841	15.3	+0,25	4.8	-0,15	1.6	+0,15	0,1
KSR 0153-0048-015 CTS14Y/TW15	11088142	15.3	+0,25	4.8	-0,15	1.8	+0,15	0,1
KSR 0153-0048-018 CTS14Y/TW15	11065842	15.3	+0,25	4.8	-0,15	2.1	+0,15	0,1
KSR 0153-0048-020 CTS14Y/TW15	11084009	15.3	+0,25	4.8	-0,15	2.3	+0,15	0,1
KSR 0153-0048-022 CTS14Y/TW15	11056305	15.3	+0,25	4.8	-0,15	2.5	+0,15	0,1
KSR 0153-0048-023 CTS14Y/TW15	11065843	15.3	+0,25	4.8	-0,15	2.3	+0,15	0,1
KSR 0153-0048-025 CTS14Y/TW15	11084011	15.3	+0,25	4.8	-0,15	2.8	+0,15	0,1
KSR 0153-0048-027 CTS14Y/TW15	11056307	15.3	+0,25	4.8	-0,15	3.0	+0,15	0,1
KSR 0153-0048-033 CTS14Y/TW15	11065845	15.3	+0,25	4.8	-0,15	3.6	+0,15	0,1
KSR 0153-0048-040 CTS14Y/TW15	11599948	15.3	+0,25	4.8	-0,15	4.3	+0,15	0,1
KSR 0153-0048-043 CTS14Y/TW15	11065846	15.3	+0,25	4.8	-0,15	4.6	+0,15	0,1
KSR 0205-0048-005 CTS14Y/TW15	11065766	20.5	+0,30	4.8	-0,15	0.8	+0,15	0,1
KSR 0205-0048-006 CTS14Y/TW15	11065767	20.5	+0,30	4.8	-0,15	0.9	+0,15	0,1
KSR 0205-0048-007 CTS14Y/TW15	11458873	20.5	+0,30	4.8	-0,15	1.0	+0,15	0,1
KSR 0205-0048-008 CTS14Y/TW15	11065778	20.5	+0,30	4.8	-0,15	1.1	+0,15	0,1
KSR 0205-0048-010 CTS14Y/TW15	11065780	20.5	+0,30	4.8	-0,15	1.3	+0,15	0,1
KSR 0205-0048-012 CTS14Y/TW15	11035241	20.5	+0,30	4.8	-0,15	1.5	+0,15	0,1
KSR 0205-0048-013 CTS14Y/TW15	11065784	20.5	+0,30	4.8	-0,15	1.6	+0,15	0,1
KSR 0205-0048-014 CTS14Y/TW15	11597803	20.5	+0,30	4.8	-0,15	1.7	+0,15	0,1
KSR 0205-0048-015 CTS14Y/TW15	11065785	20.5	+0,30	4.8	-0,15	1.8	+0,15	0,1
KSR 0205-0048-017 CTS14Y/TW15	11159462	20.5	+0,30	4.8	-0,15	2.0	+0,15	0,1
KSR 0205-0048-018 CTS14Y/TW15	11065786	20.5	+0,30	4.8	-0,15	2.1	+0,15	0,1
KSR 0205-0048-020 CTS14Y/TW15	11065787	20.5	+0,30	4.8	-0,15	2.3	+0,15	0,1
KSR 0205-0048-021 CTS14Y/TW15	11065788	20.5	+0,30	4.8	-0,15	2.4	+0,15	0,1
KSR 0205-0048-023 CTS14Y/TW15	11065789	20.5	+0,30	4.8	-0,15	2.3	+0,15	0,1
KSR 0205-0048-025 CTS14Y/TW15	11065790	20.5	+0,30	4.8	-0,15	2.8	+0,15	0,1
KSR 0205-0048-028 CTS14Y/TW15	11065792	20.5	+0,30	4.8	-0,15	3.1	+0,15	0,1
KSR 0205-0048-030 CTS14Y/TW15	11088144	20.5	+0,30	4.8	-0,15	3.3	+0,15	0,1
KSR 0205-0048-033 CTS14Y/TW15	11065793	20.5	+0,30	4.8	-0,15	3.6	+0,15	0,1
KSR 0205-0048-037 CTS14Y/TW15	11159464	20.5	+0,30	4.8	-0,15	4.0	+0,15	0,1
KSR 0205-0048-040 CTS14Y/TW15	11593562	20.5	+0,30	4.8	-0,15	4.3	+0,15	0,1
KSR 0205-0048-043 CTS14Y/TW15	11065795	20.5	+0,30	4.8	-0,15	4.6	+0,15	0,1
KSR 0205-0048-053 CTS14Y/TW15	11111485	20.5	+0,30	4.8	-0,15	5.6	+0,15	0,1
KSR 0253-0068-006 CTS14Y/TW15	11243324	25.3	+0,35	6.8	-0,15	0.9	+0,15	0,1
KSR 0253-0068-009 CTS14Y/TW15	11152546	25.3	+0,35	6.8	-0,15	1.2	+0,15	0,1
KSR 0253-0078-005 CTS14Y/TW15	11074690	25.3	+0,35	7.8	-0,25	0.8	+0,15	0,1

Other dimensions and tungsten carbide grades are available upon request.

Upon request, all dimensions are available with groove and/or hole according to customer drawing.

Standard dimensions

Blank sizes, CTS14Y



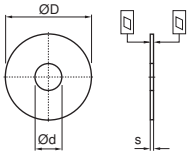
Type, description	Material	D [mm]	Dia. tol. [mm]	d [mm]	d tol. [mm]	s [mm]	s tol. [mm]	
KSR 0253-0078-006 CTS14Y/TW15	11201855	25.3	+0,35	7.8	-0,25	0.9	+0,15	0,1
KSR 0253-0078-008 CTS14Y/TW15	11147498	25.3	+0,35	7.8	-0,25	1.1	+0,15	0,1
KSR 0253-0078-010 CTS14Y/TW15	11147499	25.3	+0,35	7.8	-0,25	1.3	+0,15	0,1
KSR 0253-0078-012 CTS14Y/TW15	11035238	25.3	+0,35	7.8	-0,25	1.5	+0,15	0,1
KSR 0253-0078-013 CTS14Y/TW15	11101726	25.3	+0,35	7.8	-0,25	1.6	+0,15	0,1
KSR 0253-0078-015 CTS14Y/TW15	11147500	25.3	+0,35	7.8	-0,25	1.8	+0,15	0,1
KSR 0253-0078-017 CTS14Y/TW15	11143058	25.3	+0,35	7.8	-0,25	2.0	+0,15	0,1
KSR 0253-0078-021 CTS14Y/TW15	11599251	25.3	+0,35	7.8	-0,25	2.4	+0,15	0,1
KSR 0253-0078-023 CTS14Y/TW15	11147502	25.3	+0,35	7.8	-0,25	2.3	+0,15	0,1
KSR 0253-0078-028 CTS14Y/TW15	11154151	25.3	+0,35	7.8	-0,25	3.1	+0,15	0,1
KSR 0253-0078-033 CTS14Y/TW15	11147504	25.3	+0,35	7.8	-0,25	3.6	+0,15	0,1
KSR 0253-0078-043 CTS14Y/TW15	11071811	25.3	+0,35	7.8	-0,25	4.6	+0,15	0,1
KSR 0253-0078-053 CTS14Y/TW15	11117880	25.3	+0,35	7.8	-0,25	5.6	+0,15	0,1
KSR 0305-0077-005 CTS14Y/TW15	11055386	30.5	+0,40	7.7	-0,25	0.8	+0,15	0,1
KSR 0305-0077-006 CTS14Y/TW15	11065719	30.5	+0,40	7.7	-0,25	0.9	+0,15	0,1
KSR 0305-0077-007 CTS14Y/TW15	11213084	30.5	+0,40	7.7	-0,25	1.0	+0,15	0,1
KSR 0305-0077-008 CTS14Y/TW15	11055387	30.5	+0,40	7.7	-0,25	1.1	+0,15	0,1
KSR 0305-0077-010 CTS14Y/TW15	11055398	30.5	+0,40	7.7	-0,25	1.3	+0,15	0,1
KSR 0305-0077-011 CTS14Y/TW15	11065763	30.5	+0,40	7.7	-0,25	1.4	+0,15	0,1
KSR 0305-0077-012 CTS14Y/TW15	11035063	30.5	+0,40	7.7	-0,25	1.5	+0,15	0,1
KSR 0305-0077-013 CTS14Y/TW15	11035678	30.5	+0,40	7.7	-0,25	1.6	+0,15	0,1
KSR 0305-0077-014 CTS14Y/TW15	11242358	30.5	+0,40	7.7	-0,25	1.7	+0,15	0,1
KSR 0305-0077-015 CTS14Y/TW15	11055399	30.5	+0,40	7.7	-0,25	1.8	+0,15	0,1
KSR 0305-0077-017 CTS14Y/TW15	11159466	30.5	+0,40	7.7	-0,25	2.0	+0,15	0,1
KSR 0305-0077-018 CTS14Y/TW15	11055400	30.5	+0,40	7.7	-0,25	2.1	+0,15	0,1
KSR 0305-0077-020 CTS14Y/TW15	11055403	30.5	+0,40	7.7	-0,25	2.3	+0,15	0,1
KSR 0305-0077-021 CTS14Y/TW15	11065765	30.5	+0,40	7.7	-0,25	2.4	+0,15	0,1
KSR 0305-0077-022 CTS14Y/TW15	11242359	30.5	+0,40	7.7	-0,25	2.5	+0,15	0,1
KSR 0305-0077-023 CTS14Y/TW15	11055405	30.5	+0,40	7.7	-0,25	2.6	+0,15	0,1
KSR 0305-0077-025 CTS14Y/TW15	11066421	30.5	+0,40	7.7	-0,25	2.8	+0,15	0,1
KSR 0305-0077-028 CTS14Y/TW15	11016415	30.5	+0,40	7.7	-0,25	3.1	+0,15	0,1
KSR 0305-0077-030 CTS14Y/TW15	11066424	30.5	+0,40	7.7	-0,25	3.3	+0,15	0,1
KSR 0305-0077-032 CTS14Y/TW15	11159468	30.5	+0,40	7.7	-0,25	3.5	+0,15	0,1
KSR 0305-0077-033 CTS14Y/TW15	11055406	30.5	+0,40	7.7	-0,25	3.6	+0,15	0,1
KSR 0305-0077-035 CTS14Y/TW15	11590308	30.5	+0,40	7.7	-0,25	3.8	+0,15	0,1
KSR 0305-0077-038 CTS14Y/TW15	11055407	30.5	+0,40	7.7	-0,25	4.1	+0,15	0,1
KSR 0305-0077-043 CTS14Y/TW15	11035159	30.5	+0,40	7.7	-0,25	4.6	+0,15	0,1
KSR 0305-0077-050 CTS14Y/TW15	11592191	30.5	+0,40	7.7	-0,25	5.3	+0,15	0,1
KSR 0305-0077-053 CTS14Y/TW15	11055419	30.5	+0,40	7.7	-0,25	5.6	+0,15	0,1
KSR 0305-0077-063 CTS14Y/TW15	11136397	30.5	+0,40	7.7	-0,25	6.6	+0,15	0,1
KSR 0305-0077-073 CTS14Y/TW15	11071816	30.5	+0,40	7.7	-0,25	7.6	+0,15	0,1

Other dimensions and tungsten carbide grades are available upon request.

Upon request, all dimensions are available with groove and/or hole according to customer drawing.

Standard dimensions

Blank sizes, CTS14Y



Type, description	Material	D [mm]	Dia. tol. [mm]	d [mm]	d tol. [mm]	s [mm]	s tol. [mm]	
KSR 0325-0077-005 CTS14Y/TW15	11090462	32.5	+0,45	7.7	-0,25	0.8	+0,15	0,1
KSR 0325-0077-006 CTS14Y/TW15	11252209	32.5	+0,45	7.7	-0,25	0.9	+0,15	0,1
KSR 0325-0077-007 CTS14Y/TW15	11147118	32.5	+0,45	7.7	-0,25	1.0	+0,15	0,1
KSR 0325-0077-008 CTS14Y/TW15	11065801	32.5	+0,45	7.7	-0,25	1.1	+0,15	0,1
KSR 0325-0077-010 CTS14Y/TW15	11066459	32.5	+0,45	7.7	-0,25	1.3	+0,15	0,1
KSR 0325-0077-011 CTS14Y/TW15	11090464	32.5	+0,45	7.7	-0,25	1.4	+0,15	0,1
KSR 0325-0077-013 CTS14Y/TW15	11065329	32.5	+0,45	7.7	-0,25	1.6	+0,15	0,1
KSR 0325-0077-015 CTS14Y/TW15	11085472	32.5	+0,45	7.7	-0,25	1.8	+0,15	0,1
KSR 0325-0077-018 CTS14Y/TW15	11065330	32.5	+0,45	7.7	-0,25	2.1	+0,15	0,1
KSR 0325-0077-021 CTS14Y/TW15	11090465	32.5	+0,45	7.7	-0,25	2.4	+0,15	0,1
KSR 0325-0077-023 CTS14Y/TW15	11065802	32.5	+0,45	7.7	-0,25	2.6	+0,15	0,1
KSR 0325-0077-030 CTS14Y/TW15	11056377	32.5	+0,45	7.7	-0,25	3.3	+0,15	0,1
KSR 0325-0077-033 CTS14Y/TW15	11065331	32.5	+0,45	7.7	-0,25	3.6	+0,15	0,1
KSR 0325-0077-043 CTS14Y/TW15	11065332	32.5	+0,45	7.7	-0,25	4.6	+0,15	0,1
KSR 0325-0077-053 CTS14Y/TW15	11065333	32.5	+0,45	7.7	-0,25	5.6	+0,15	0,1
KSR 0405-0077-005 CTS14Y/TW15	11232569	40.5	+0,45	7.7	-0,25	0.8	+0,15	0,1
KSR 0405-0077-009 CTS14Y/TW15	11238803	40.5	+0,45	7.7	-0,25	1.2	+0,15	0,1
KSR 0405-0077-013 CTS14Y/TW15	11035685	40.5	+0,45	7.7	-0,25	1.6	+0,15	0,1
KSR 0405-0077-018 CTS14Y/TW15	11180510	40.5	+0,45	7.7	-0,25	2.1	+0,15	0,1
KSR 0405-0077-028 CTS14Y/TW15	11103774	40.5	+0,45	7.7	-0,25	3.1	+0,15	0,1
KSR 0405-0077-033 CTS14Y/TW15	11125394	40.5	+0,45	7.7	-0,25	3.6	+0,15	0,1
KSR 0405-0077-038 CTS14Y/TW15	11038301	40.5	+0,45	7.7	-0,25	4.1	+0,15	0,1
KSR 0405-0077-043 CTS14Y/TW15	11090048	40.5	+0,45	7.7	-0,25	4.6	+0,15	0,1
KSR 0405-0077-048 CTS14Y/TW15	11135139	40.5	+0,45	7.7	-0,25	5.1	+0,15	0,1
KSR 0405-0077-053 CTS14Y/TW15	11152482	40.5	+0,45	7.7	-0,25	5.6	+0,15	0,1
KSR 0405-0077-058 CTS14Y/TW15	11135259	40.5	+0,45	7.7	-0,25	6.1	+0,15	0,1
KSR 0405-0077-063 CTS14Y/TW15	11135141	40.5	+0,45	7.7	-0,25	6.6	+0,15	0,1
KSR 0405-0077-068 CTS14Y/TW15	11136398	40.5	+0,45	7.7	-0,25	7.1	+0,15	0,1
KSR 0405-0077-073 CTS14Y/TW15	11136399	40.5	+0,45	7.7	-0,25	7.6	+0,15	0,1
KSR 0405-0097-005 CTS14Y/TW15	11055216	40.5	+0,45	9.7	-0,25	0.8	+0,15	0,1
KSR 0405-0097-006 CTS14Y/TW15	11058066	40.5	+0,45	9.7	-0,25	0.9	+0,15	0,1
KSR 0405-0097-007 CTS14Y/TW15	11242361	40.5	+0,45	9.7	-0,25	1.0	+0,15	0,1
KSR 0405-0097-008 CTS14Y/TW15	11016416	40.5	+0,45	9.7	-0,25	1.1	+0,15	0,1
KSR 0405-0097-010 CTS14Y/TW15	363063	40.5	+0,45	9.7	-0,25	1.3	+0,15	0,1
KSR 0405-0097-012 CTS14Y/TW15	11035047	40.5	+0,45	9.7	-0,25	1.5	+0,15	0,1
KSR 0405-0097-013 CTS14Y/TW15	11016417	40.5	+0,45	9.7	-0,25	1.6	+0,15	0,1
KSR 0405-0097-015 CTS14Y/TW15	11055296	40.5	+0,45	9.7	-0,25	1.8	+0,15	0,1
KSR 0405-0097-018 CTS14Y/TW15	11016428	40.5	+0,45	9.7	-0,25	2.1	+0,15	0,1
KSR 0405-0097-020 CTS14Y/TW15	11055379	40.5	+0,45	9.7	-0,25	2.3	+0,15	0,1
KSR 0405-0097-022 CTS14Y/TW15	11242362	40.5	+0,45	9.7	-0,25	2.5	+0,15	0,1
KSR 0405-0097-023 CTS14Y/TW15	11016429	40.5	+0,45	9.7	-0,25	2.6	+0,15	0,1

Other dimensions and tungsten carbide grades are available upon request.

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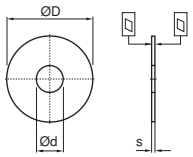
Standard dimensions

Blank sizes, CTS14Y



Type, description	Material	D [mm]	Dia. tol. [mm]	d [mm]	d tol. [mm]	s [mm]	s tol. [mm]	
KSR 0405-0097-025 CTS14Y/TW15	11065806	40.5	+0,45	9.7	-0,25	2.8	+0,15	0,1
KSR 0405-0097-028 CTS14Y/TW15	11035165	40.5	+0,45	9.7	-0,25	3.1	+0,15	0,1
KSR 0405-0097-030 CTS14Y/TW15	11055382	40.5	+0,45	9.7	-0,25	3.3	+0,15	0,1
KSR 0405-0097-032 CTS14Y/TW15	11159471	40.5	+0,45	9.7	-0,25	3.5	+0,15	0,1
KSR 0405-0097-033 CTS14Y/TW15	11055381	40.5	+0,45	9.7	-0,25	3.6	+0,15	0,1
KSR 0405-0097-040 CTS14Y/TW15	11598277	40.5	+0,45	9.7	-0,25	4.3	+0,15	0,1
KSR 0405-0097-043 CTS14Y/TW15	11055383	40.5	+0,45	9.7	-0,25	4.6	+0,15	0,1
KSR 0405-0097-048 CTS14Y/TW15	11055384	40.5	+0,45	9.7	-0,25	5.1	+0,15	0,1
KSR 0405-0097-053 CTS14Y/TW15	11016430	40.5	+0,45	9.7	-0,25	5.6	+0,15	0,1
KSR 0405-0097-060 CTS14Y/TW15	11600309	40.5	+0,45	9.7	-0,25	6.3	+0,15	0,1
KSR 0405-0097-063 CTS14Y/TW15	11055385	40.5	+0,45	9.7	-0,25	6.6	+0,15	0,1
KSR 0405-0097-068 CTS14Y/TW15	11083474	40.5	+0,45	9.7	-0,25	7.1	+0,15	0,1
KSR 0405-0097-073 CTS14Y/TW15	11142693	40.5	+0,45	9.7	-0,25	7.6	+0,15	0,1
KSR 0405-0097-080 CTS14Y/TW15	11142696	40.5	+0,45	9.7	-0,25	8.3	+0,15	0,1
KSR 0505-0097-005 CTS14Y/TW15	11123911	50.5	+0,55	9.7	-0,25	0.8	+0,15	0,1
KSR 0505-0097-008 CTS14Y/TW15	11072042	50.5	+0,55	9.7	-0,25	1.1	+0,15	0,1
KSR 0505-0097-010 CTS14Y/TW15	11162063	50.5	+0,55	9.7	-0,25	1.3	+0,15	0,1
KSR 0505-0097-018 CTS14Y/TW15	11137168	50.5	+0,55	9.7	-0,25	2.1	+0,15	0,1
KSR 0505-0097-021 CTS14Y/TW15	11231978	50.5	+0,55	9.7	-0,25	2.4	+0,15	0,1
KSR 0505-0097-028 CTS14Y/TW15	11112934	50.5	+0,55	9.7	-0,25	3.1	+0,15	0,1
KSR 0505-0127-005 CTS14Y/TW15	11054967	50.5	+0,55	12.7	-0,25	0.8	+0,15	0,1
KSR 0505-0127-006 CTS14Y/TW15	11054978	50.5	+0,55	12.7	-0,25	0.9	+0,15	0,1
KSR 0505-0127-007 CTS14Y/TW15	11054979	50.5	+0,55	12.7	-0,25	1.0	+0,15	0,1
KSR 0505-0127-008 CTS14Y/TW15	11054980	50.5	+0,55	12.7	-0,25	1.1	+0,15	0,1
KSR 0505-0127-010 CTS14Y/TW15	11011908	50.5	+0,55	12.7	-0,25	1.3	+0,15	0,1
KSR 0505-0127-011 CTS14Y/TW15	11032720	50.5	+0,55	12.7	-0,25	1.4	+0,15	0,1
KSR 0505-0127-013 CTS14Y/TW15	11016433	50.5	+0,55	12.7	-0,25	1.6	+0,15	0,1
KSR 0505-0127-015 CTS14Y/TW15	11035219	50.5	+0,55	12.7	-0,25	1.8	+0,15	0,1
KSR 0505-0127-018 CTS14Y/TW15	11035221	50.5	+0,55	12.7	-0,25	2.1	+0,15	0,1
KSR 0505-0127-023 CTS14Y/TW15	11016434	50.5	+0,55	12.7	-0,25	2.6	+0,15	0,1
KSR 0505-0127-025 CTS14Y/TW15	11035256	50.5	+0,55	12.7	-0,25	2.8	+0,15	0,1
KSR 0505-0127-026 CTS14Y/TW15	11593119	50.5	+0,55	12.7	-0,25	2.9	+0,15	0,1
KSR 0505-0127-028 CTS14Y/TW15	11035255	50.5	+0,55	12.7	-0,25	3.1	+0,15	0,1
KSR 0505-0127-029 CTS14Y/TW15	11202549	50.5	+0,55	12.7	-0,25	3.2	+0,15	0,1
KSR 0505-0127-030 CTS14Y/TW15	11066458	50.5	+0,55	12.7	-0,25	3.3	+0,15	0,1
KSR 0505-0127-032 CTS14Y/TW15	11159474	50.5	+0,55	12.7	-0,25	3.5	+0,15	0,1
KSR 0505-0127-033 CTS14Y/TW15	11038330	50.5	+0,55	12.7	-0,25	3.6	+0,15	0,1
KSR 0505-0127-038 CTS14Y/TW15	11054984	50.5	+0,55	12.7	-0,25	4.1	+0,15	0,1
KSR 0505-0127-040 CTS14Y/TW15	11593046	50.5	+0,55	12.7	-0,25	4.3	+0,15	0,1
KSR 0505-0127-043 CTS14Y/TW15	11016435	50.5	+0,55	12.7	-0,25	4.6	+0,15	0,1
KSR 0505-0127-048 CTS14Y/TW15	11054985	50.5	+0,55	12.7	-0,25	5.1	+0,15	0,1

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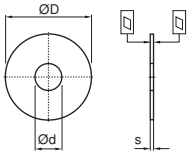
Standard dimensions

Blank sizes, CTS14Y



Type, description	Material	D [mm]	Dia. tol. [mm]	d [mm]	d tol. [mm]	s [mm]	s tol. [mm]	
KSR 0505-0127-050 CTS14Y/TW15	11597420	50.5	+0,55	12.7	-0,25	5.3	+0,15	0,1
KSR 0505-0127-053 CTS14Y/TW15	11054987	50.5	+0,55	12.7	-0,25	5.6	+0,15	0,1
KSR 0505-0127-063 CTS14Y/TW15	11035254	50.5	+0,55	12.7	-0,25	6.6	+0,15	0,1
KSR 0505-0127-068 CTS14Y/TW15	11095024	50.5	+0,55	12.7	-0,25	7.1	+0,15	0,1
KSR 0505-0127-073 CTS14Y/TW15	11121156	50.5	+0,55	12.7	-0,25	7.6	+0,15	0,1
KSR 0635-0097-005 CTS14Y/TW15	11066113	63.5	+0,75	9.7	-0,30	0.8	+0,15	0,1
KSR 0635-0097-006 CTS14Y/TW15	11066114	63.5	+0,75	9.7	-0,30	0.9	+0,15	0,1
KSR 0635-0097-008 CTS14Y/TW15	11017661	63.5	+0,75	9.7	-0,30	1.1	+0,15	0,1
KSR 0635-0097-010 CTS14Y/TW15	11054549	63.5	+0,75	9.7	-0,30	1.3	+0,15	0,1
KSR 0635-0097-011 CTS14Y/TW15	11066115	63.5	+0,75	9.7	-0,30	1.4	+0,15	0,1
KSR 0635-0097-013 CTS14Y/TW15	11054550	63.5	+0,75	9.7	-0,30	1.6	+0,15	0,1
KSR 0635-0097-018 CTS14Y/TW15	11054552	63.5	+0,75	9.7	-0,30	2.1	+0,15	0,1
KSR 0635-0127-005 CTS14Y/TW15	11038334	63.5	+0,75	12.7	-0,30	0.8	+0,15	0,1
KSR 0635-0127-008 CTS14Y/TW15	11038336	63.5	+0,75	12.7	-0,30	1.1	+0,15	0,1
KSR 0635-0127-013 CTS14Y/TW15	11035708	63.5	+0,75	12.7	-0,30	1.6	+0,15	0,1
KSR 0635-0127-018 CTS14Y/TW15	11038348	63.5	+0,75	12.7	-0,30	2.1	+0,15	0,1
KSR 0635-0127-023 CTS14Y/TW15	11054543	63.5	+0,75	12.7	-0,30	2.6	+0,15	0,1
KSR 0635-0127-025 CTS14Y/TW15	11054544	63.5	+0,75	12.7	-0,30	2.8	+0,15	0,1
KSR 0635-0127-033 CTS14Y/TW15	11054546	63.5	+0,75	12.7	-0,30	3.6	+0,15	0,1
KSR 0635-0157-005 CTS14Y/TW15	11016436	63.5	+0,75	15.7	-0,30	0.8	+0,15	0,1
KSR 0635-0157-006 CTS14Y/TW15	11032725	63.5	+0,75	15.7	-0,30	0.9	+0,15	0,1
KSR 0635-0157-007 CTS14Y/TW15	11011917	63.5	+0,75	15.7	-0,30	1.0	+0,15	0,1
KSR 0635-0157-008 CTS14Y/TW15	11016437	63.5	+0,75	15.7	-0,30	1.1	+0,15	0,1
KSR 0635-0157-009 CTS14Y/TW15	11035279	63.5	+0,75	15.7	-0,30	1.2	+0,15	0,1
KSR 0635-0157-010 CTS14Y/TW15	11011918	63.5	+0,75	15.7	-0,30	1.3	+0,15	0,1
KSR 0635-0157-011 CTS14Y/TW15	11011913	63.5	+0,75	15.7	-0,30	1.4	+0,15	0,1
KSR 0635-0157-012 CTS14Y/TW15	11035283	63.5	+0,75	15.7	-0,30	1.5	+0,15	0,1
KSR 0635-0157-013 CTS14Y/TW15	11016438	63.5	+0,75	15.7	-0,30	1.6	+0,15	0,1
KSR 0635-0157-015 CTS14Y/TW15	11011915	63.5	+0,75	15.7	-0,30	1.8	+0,15	0,1
KSR 0635-0157-016 CTS14Y/TW15	11035281	63.5	+0,75	15.7	-0,30	1.9	+0,15	0,1
KSR 0635-0157-018 CTS14Y/TW15	11016440	63.5	+0,75	15.7	-0,30	2.1	+0,15	0,1
KSR 0635-0157-020 CTS14Y/TW15	11035647	63.5	+0,75	15.7	-0,30	2.3	+0,15	0,1
KSR 0635-0157-022 CTS14Y/TW15	11035284	63.5	+0,75	15.7	-0,30	2.5	+0,15	0,1
KSR 0635-0157-023 CTS14Y/TW15	11035288	63.5	+0,75	15.7	-0,30	2.6	+0,15	0,1
KSR 0635-0157-025 CTS14Y/TW15	11035308	63.5	+0,75	15.7	-0,30	2.8	+0,15	0,1
KSR 0635-0157-028 CTS14Y/TW15	11011916	63.5	+0,75	15.7	-0,30	3.1	+0,15	0,1
KSR 0635-0157-030 CTS14Y/TW15	11035658	63.5	+0,75	15.7	-0,30	3.3	+0,15	0,1
KSR 0635-0157-033 CTS14Y/TW15	11040852	63.5	+0,75	15.7	-0,30	3.6	+0,15	0,1
KSR 0635-0157-035 CTS14Y/TW15	11035312	63.5	+0,75	15.7	-0,30	3.8	+0,15	0,1
KSR 0635-0157-038 CTS14Y/TW15	11035295	63.5	+0,75	15.7	-0,30	4.1	+0,15	0,1
KSR 0635-0157-040 CTS14Y/TW15	11035644	63.5	+0,75	15.7	-0,30	4.3	+0,15	0,1

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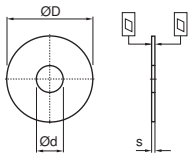
Standard dimensions

Blank sizes, CTS14Y



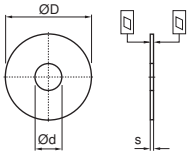
Type, description	Material	D [mm]	Dia. tol. [mm]	d [mm]	d tol. [mm]	s [mm]	s tol. [mm]	
KSR 0635-0157-048 CTS14Y/TW15	11035291	63.5	+0,75	15.7	-0,30	5.1	+0,15	0,1
KSR 0635-0157-050 CTS14Y/TW15	11598369	63.5	+0,75	15.7	-0,30	5.3	+0,15	0,1
KSR 0635-0157-053 CTS14Y/TW15	11035290	63.5	+0,75	15.7	-0,30	5.6	+0,15	0,1
KSR 0635-0157-060 CTS14Y/TW15	11591982	63.5	+0,75	15.7	-0,30	6.3	+0,15	0,1
KSR 0635-0157-063 CTS14Y/TW15	11019280	63.5	+0,75	15.7	-0,30	6.6	+0,15	0,1
KSR 0635-0157-068 CTS14Y/TW15	11151166	63.5	+0,75	15.7	-0,30	7.1	+0,15	0,1
KSR 0635-0157-073 CTS14Y/TW15	11120038	63.5	+0,75	15.7	-0,30	7.6	+0,15	0,1
KSR 0635-0157-083 CTS14Y/TW15	11065879	63.5	+0,75	15.7	-0,30	8.6	+0,15	0,1
KSR 0635-0217-010 CTS14Y/TW15	11054512	63.5	+0,75	21.7	-0,30	1.3	+0,15	0,1
KSR 0635-0217-011 CTS14Y/TW15	11085495	63.5	+0,75	21.7	-0,30	1.4	+0,15	0,1
KSR 0635-0217-018 CTS14Y/TW15	11054516	63.5	+0,75	21.7	-0,30	2.1	+0,15	0,1
KSR 0635-0217-023 CTS14Y/TW15	11054524	63.5	+0,75	21.7	-0,30	2.6	+0,15	0,1
KSR 0635-0217-028 CTS14Y/TW15	11054525	63.5	+0,75	21.7	-0,30	3.1	+0,15	0,1
KSR 0635-0217-033 CTS14Y/TW15	11054527	63.5	+0,75	21.7	-0,30	3.6	+0,15	0,1
KSR 0635-0217-043 CTS14Y/TW15	11054538	63.5	+0,75	21.7	-0,30	4.6	+0,15	0,1
KSR 0635-0217-048 CTS14Y/TW15	11153484	63.5	+0,75	21.7	-0,30	5.1	+0,15	0,1
KSR 0635-0217-053 CTS14Y/TW15	11054539	63.5	+0,75	21.7	-0,30	5.6	+0,15	0,1
KSR 0635-0217-060 CTS14Y/TW15	11594125	63.5	+0,75	21.7	-0,30	6.3	+0,15	0,1
KSR 0635-0217-063 CTS14Y/TW15	11019279	63.5	+0,75	21.7	-0,30	6.6	+0,15	0,1
KSR 0635-0217-080 CTS14Y/TW15	11591587	63.5	+0,75	21.7	-0,30	8.3	+0,15	0,1
KSR 0635-0217-083 CTS14Y/TW15	11081968	63.5	+0,75	21.7	-0,30	8.6	+0,15	0,1
KSR 0705-0157-006 CTS14Y/TW15	11088146	70.5	+0,75	15.7	-0,30	0.9	+0,15	0,1
KSR 0705-0157-008 CTS14Y/TW15	11066288	70.5	+0,75	15.7	-0,30	1.1	+0,15	0,1
KSR 0705-0157-011 CTS14Y/TW15	11071847	70.5	+0,75	15.7	-0,30	1.4	+0,15	0,1
KSR 0705-0157-013 CTS14Y/TW15	11066228	70.5	+0,75	15.7	-0,30	1.6	+0,15	0,1
KSR 0705-0157-018 CTS14Y/TW15	11071879	70.5	+0,75	15.7	-0,30	2.1	+0,15	0,1
KSR 0705-0157-023 CTS14Y/TW15	11088179	70.5	+0,75	15.7	-0,30	2.6	+0,15	0,1
KSR 0705-0157-025 CTS14Y/TW15	11088181	70.5	+0,75	15.7	-0,30	2.8	+0,15	0,1
KSR 0705-0157-028 CTS14Y/TW15	11088182	70.5	+0,75	15.7	-0,30	3.1	+0,15	0,1
KSR 0705-0157-033 CTS14Y/TW15	11088184	70.5	+0,75	15.7	-0,30	3.6	+0,15	0,1
KSR 0705-0157-043 CTS14Y/TW15	11088186	70.5	+0,75	15.7	-0,30	4.6	+0,15	0,1
KSR 0705-0157-053 CTS14Y/TW15	11088198	70.5	+0,75	15.7	-0,30	5.6	+0,15	0,1
KSR 0705-0217-011 CTS14Y/TW15	11166419	70.5	+0,75	21.7	-0,30	1.4	+0,15	0,1
KSR 0705-0217-053 CTS14Y/TW15	11142282	70.5	+0,75	21.7	-0,30	5.6	+0,15	0,1
KSR 0755-0157-006 CTS14Y/TW15	11088268	75.5	+0,85	15.7	-0,30	0.9	+0,15	0,1
KSR 0755-0157-008 CTS14Y/TW15	11071913	75.5	+0,85	15.7	-0,30	1.1	+0,15	0,1
KSR 0755-0157-009 CTS14Y/TW15	11064572	75.5	+0,85	15.7	-0,30	1.2	+0,15	0,1
KSR 0755-0157-011 CTS14Y/TW15	11088269	75.5	+0,85	15.7	-0,30	1.4	+0,15	0,1
KSR 0755-0157-013 CTS14Y/TW15	11071915	75.5	+0,85	15.7	-0,30	1.6	+0,15	0,1
KSR 0755-0157-023 CTS14Y/TW15	11088273	75.5	+0,85	15.7	-0,30	2.6	+0,15	0,1
KSR 0755-0157-025 CTS14Y/TW15	11088274	75.5	+0,85	15.7	-0,30	2.8	+0,15	0,1

Other dimensions and tungsten carbide grades are available upon request.

Upon request, all dimensions are available with groove and/or hole according to customer drawing.

Standard dimensions

Blank sizes, CTS14Y



Type, description	Material	D [mm]	Dia. tol. [mm]	d [mm]	d tol. [mm]	s [mm]	s tol. [mm]	
KSR 0755-0157-028 CTS14Y/TW15	11088275	75.5	+0,85	15.7	-0,30	3.1	+0,15	0,1
KSR 0755-0157-033 CTS14Y/TW15	11088277	75.5	+0,85	15.7	-0,30	3.6	+0,15	0,1
KSR 0805-0157-006 CTS14Y/TW15	11035388	80.5	+0,85	15.7	-0,30	0.9	+0,15	0,1
KSR 0805-0157-008 CTS14Y/TW15	11054477	80.5	+0,85	15.7	-0,30	1.1	+0,15	0,1
KSR 0805-0157-010 CTS14Y/TW15	11054478	80.5	+0,85	15.7	-0,30	1.3	+0,15	0,1
KSR 0805-0157-013 CTS14Y/TW15	11038349	80.5	+0,85	15.7	-0,30	1.6	+0,15	0,1
KSR 0805-0157-017 CTS14Y/TW15	11159591	80.5	+0,85	15.7	-0,30	2.0	+0,15	0,1
KSR 0805-0157-018 CTS14Y/TW15	11054483	80.5	+0,85	15.7	-0,30	2.1	+0,15	0,1
KSR 0805-0157-020 CTS14Y/TW15	11054484	80.5	+0,85	15.7	-0,30	2.3	+0,15	0,1
KSR 0805-0157-023 CTS14Y/TW15	11054486	80.5	+0,85	15.7	-0,30	2.6	+0,15	0,1
KSR 0805-0157-025 CTS14Y/TW15	11054488	80.5	+0,85	15.7	-0,30	2.8	+0,15	0,1
KSR 0805-0157-028 CTS14Y/TW15	11054490	80.5	+0,85	15.7	-0,30	3.1	+0,15	0,1
KSR 0805-0157-033 CTS14Y/TW15	11054492	80.5	+0,85	15.7	-0,30	3.6	+0,15	0,1
KSR 0805-0157-038 CTS14Y/TW15	11038350	80.5	+0,85	15.7	-0,30	4.1	+0,15	0,1
KSR 0805-0157-043 CTS14Y/TW15	11054494	80.5	+0,85	15.7	-0,30	4.6	+0,15	0,1
KSR 0805-0157-053 CTS14Y/TW15	11054496	80.5	+0,85	15.7	-0,30	5.6	+0,15	0,1
KSR 0805-0157-063 CTS14Y/TW15	11054497	80.5	+0,85	15.7	-0,30	6.6	+0,15	0,1
KSR 0805-0217-005 CTS14Y/TW15	11200761	80.5	+0,85	21.7	-0,30	0.8	+0,15	0,1
KSR 0805-0217-006 CTS14Y/TW15	11035389	80.5	+0,85	21.7	-0,30	0.9	+0,15	0,1
KSR 0805-0217-007 CTS14Y/TW15	11064469	80.5	+0,85	21.7	-0,30	1.0	+0,15	0,1
KSR 0805-0217-008 CTS14Y/TW15	11016441	80.5	+0,85	21.7	-0,30	1.1	+0,15	0,1
KSR 0805-0217-009 CTS14Y/TW15	11035419	80.5	+0,85	21.7	-0,30	1.2	+0,15	0,1
KSR 0805-0217-010 CTS14Y/TW15	11035999	80.5	+0,85	21.7	-0,30	1.3	+0,15	0,1
KSR 0805-0217-011 CTS14Y/TW15	11032621	80.5	+0,85	21.7	-0,30	1.4	+0,15	0,1
KSR 0805-0217-012 CTS14Y/TW15	11035042	80.5	+0,85	21.7	-0,30	1.5	+0,15	0,1
KSR 0805-0217-013 CTS14Y/TW15	11016442	80.5	+0,85	21.7	-0,30	1.6	+0,15	0,1
KSR 0805-0217-015 CTS14Y/TW15	11010572	80.5	+0,85	21.7	-0,30	1.8	+0,15	0,1
KSR 0805-0217-017 CTS14Y/TW15	11019087	80.5	+0,85	21.7	-0,30	2.0	+0,15	0,1
KSR 0805-0217-018 CTS14Y/TW15	11016443	80.5	+0,85	21.7	-0,30	2.1	+0,15	0,1
KSR 0805-0217-019 CTS14Y/TW15	11017662	80.5	+0,85	21.7	-0,30	2.2	+0,15	0,1
KSR 0805-0217-020 CTS14Y/TW15	368859	80.5	+0,85	21.7	-0,30	2.3	+0,15	0,1
KSR 0805-0217-022 CTS14Y/TW15	11035446	80.5	+0,85	21.7	-0,30	2.5	+0,15	0,1
KSR 0805-0217-023 CTS14Y/TW15	11016444	80.5	+0,85	21.7	-0,30	2.6	+0,15	0,1
KSR 0805-0217-025 CTS14Y/TW15	11009639	80.5	+0,85	21.7	-0,30	2.8	+0,15	0,1
KSR 0805-0217-028 CTS14Y/TW15	11016445	80.5	+0,85	21.7	-0,30	3.1	+0,15	0,1
KSR 0805-0217-030 CTS14Y/TW15	11035641	80.5	+0,85	21.7	-0,30	3.3	+0,15	0,1
KSR 0805-0217-033 CTS14Y/TW15	11011923	80.5	+0,85	21.7	-0,30	3.6	+0,15	0,1
KSR 0805-0217-035 CTS14Y/TW15	11035444	80.5	+0,85	21.7	-0,30	3.8	+0,15	0,1
KSR 0805-0217-038 CTS14Y/TW15	11035442	80.5	+0,85	21.7	-0,30	4.1	+0,15	0,1
KSR 0805-0217-040 CTS14Y/TW15	11035659	80.5	+0,85	21.7	-0,30	4.3	+0,15	0,1
KSR 0805-0217-043 CTS14Y/TW15	11035441	80.5	+0,85	21.7	-0,30	4.6	+0,15	0,1

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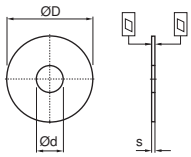
Standard dimensions

Blank sizes, CTS14Y



Type, description	Material	D [mm]	Dia. tol. [mm]	d [mm]	d tol. [mm]	s [mm]	s tol. [mm]	
KSR 0805-0217-048 CTS14Y/TW15	11035440	80.5	+0,85	21.7	-0,30	5.1	+0,15	0,1
KSR 0805-0217-050 CTS14Y/TW15	11591983	80.5	+0,85	21.7	-0,30	5.3	+0,15	0,1
KSR 0805-0217-053 CTS14Y/TW15	11035439	80.5	+0,85	21.7	-0,30	5.6	+0,15	0,1
KSR 0805-0217-063 CTS14Y/TW15	11035438	80.5	+0,85	21.7	-0,30	6.6	+0,15	0,1
KSR 0805-0217-065 CTS14Y/TW15	11600504	80.5	+0,85	21.7	-0,30	6.8	+0,15	0,1
KSR 0805-0217-068 CTS14Y/TW15	11164849	80.5	+0,85	21.7	-0,30	7.1	+0,15	0,1
KSR 0805-0217-073 CTS14Y/TW15	11104409	80.5	+0,85	21.7	-0,30	7.6	+0,15	0,1
KSR 0865-0217-005 CTS14Y/TW15	11595419	86.5	+1,00	21.7	-0,30	0.8	+0,15	0,1
KSR 0865-0217-011 CTS14Y/TW15	11129446	86.5	+1,00	21.7	-0,30	1.4	+0,15	0,1
KSR 0865-0217-013 CTS14Y/TW15	11129448	86.5	+1,00	21.7	-0,30	1.6	+0,15	0,1
KSR 0865-0217-015 CTS14Y/TW15	11129450	86.5	+1,00	21.7	-0,30	1.8	+0,15	0,1
KSR 0865-0217-017 CTS14Y/TW15	11127865	86.5	+1,00	21.7	-0,30	2.0	+0,15	0,1
KSR 0865-0217-038 CTS14Y/TW15	11157141	86.5	+1,00	21.7	-0,30	4.1	+0,15	0,1
KSR 0905-0217-006 CTS14Y/TW15	11088283	90.5	+1,00	21.7	-0,30	0.9	+0,15	0,1
KSR 0905-0217-008 CTS14Y/TW15	11071910	90.5	+1,00	21.7	-0,30	1.1	+0,15	0,1
KSR 0905-0217-011 CTS14Y/TW15	11088284	90.5	+1,00	21.7	-0,30	1.4	+0,15	0,1
KSR 0905-0217-012 CTS14Y/TW15	11132663	90.5	+1,00	21.7	-0,30	1.5	+0,15	0,1
KSR 0905-0217-013 CTS14Y/TW15	11088285	90.5	+1,00	21.7	-0,30	1.6	+0,15	0,1
KSR 0905-0217-014 CTS14Y/TW15	11132665	90.5	+1,00	21.7	-0,30	1.7	+0,15	0,1
KSR 0905-0217-015 CTS14Y/TW15	11088286	90.5	+1,00	21.7	-0,30	1.8	+0,15	0,1
KSR 0905-0217-017 CTS14Y/TW15	11132672	90.5	+1,00	21.7	-0,30	2.0	+0,15	0,1
KSR 0905-0217-019 CTS14Y/TW15	11104664	90.5	+1,00	21.7	-0,30	2.2	+0,15	0,1
KSR 0905-0217-021 CTS14Y/TW15	11088298	90.5	+1,00	21.7	-0,30	2.4	+0,15	0,1
KSR 0905-0217-023 CTS14Y/TW15	11088299	90.5	+1,00	21.7	-0,30	2.6	+0,15	0,1
KSR 0905-0217-025 CTS14Y/TW15	11036900	90.5	+1,00	21.7	-0,30	2.8	+0,15	0,1
KSR 0905-0217-027 CTS14Y/TW15	11163786	90.5	+1,00	21.7	-0,30	3.0	+0,15	0,1
KSR 0905-0217-028 CTS14Y/TW15	11088300	90.5	+1,00	21.7	-0,30	3.1	+0,15	0,1
KSR 0905-0217-030 CTS14Y/TW15	11088301	90.5	+1,00	21.7	-0,30	3.3	+0,15	0,1
KSR 0905-0217-033 CTS14Y/TW15	11088302	90.5	+1,00	21.7	-0,30	3.6	+0,15	0,1
KSR 0905-0217-038 CTS14Y/TW15	11088303	90.5	+1,00	21.7	-0,30	4.1	+0,15	0,1
KSR 0905-0217-048 CTS14Y/TW15	11124682	90.5	+1,00	21.7	-0,30	5.1	+0,15	0,1
KSR 0905-0217-053 CTS14Y/TW15	11088305	90.5	+1,00	21.7	-0,30	5.6	+0,15	0,1
KSR 0905-0217-058 CTS14Y/TW15	11171735	90.5	+1,00	21.7	-0,30	6.1	+0,15	0,1
KSR 1005-0217-006 CTS14Y/TW15	11623061	100.5	+1,10	21.7	-0,30	0.9	+0,15	0,1
KSR 1005-0217-007 CTS14Y/TW15	11159487	100.5	+1,10	21.7	-0,30	1.0	+0,15	0,1
KSR 1005-0217-008 CTS14Y/TW15	11033420	100.5	+1,10	21.7	-0,30	1.1	+0,15	0,1
KSR 1005-0217-009 CTS14Y/TW15	11069502	100.5	+1,10	21.7	-0,30	1.2	+0,15	0,1
KSR 1005-0217-010 CTS14Y/TW15	11035645	100.5	+1,10	21.7	-0,30	1.3	+0,15	0,1
KSR 1005-0217-011 CTS14Y/TW15	11040856	100.5	+1,10	21.7	-0,30	1.4	+0,15	0,1
KSR 1005-0217-012 CTS14Y/TW15	11035081	100.5	+1,10	21.7	-0,30	1.5	+0,15	0,1
KSR 1005-0217-013 CTS14Y/TW15	11011924	100.5	+1,10	21.7	-0,30	1.6	+0,15	0,1

Other dimensions and tungsten carbide grades are available upon request.

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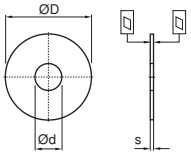
Standard dimensions

Blank sizes, CTS14Y



Type, description	Material	D [mm]	Dia. tol. [mm]	d [mm]	d tol. [mm]	s [mm]	s tol. [mm]	
KSR 1005-0217-014 CTS14Y/TW15	11072398	100.5	+1,10	21.7	-0,30	1.7	+0,15	0,1
KSR 1005-0217-015 CTS14Y/TW15	11054438	100.5	+1,10	21.7	-0,30	1.8	+0,15	0,1
KSR 1005-0217-018 CTS14Y/TW15	11050882	100.5	+1,10	21.7	-0,30	2.1	+0,15	0,1
KSR 1005-0217-020 CTS14Y/TW15	11054469	100.5	+1,10	21.7	-0,30	2.3	+0,15	0,1
KSR 1005-0217-022 CTS14Y/TW15	11242368	100.5	+1,10	21.7	-0,30	2.5	+0,15	0,1
KSR 1005-0217-023 CTS14Y/TW15	11050918	100.5	+1,10	21.7	-0,30	2.6	+0,15	0,1
KSR 1005-0217-025 CTS14Y/TW15	11054471	100.5	+1,10	21.7	-0,30	2.8	+0,15	0,1
KSR 1005-0217-026 CTS14Y/TW15	11159489	100.5	+1,10	21.7	-0,30	2.9	+0,15	0,1
KSR 1005-0217-027 CTS14Y/TW15	11056392	100.5	+1,10	21.7	-0,30	3.0	+0,15	0,1
KSR 1005-0217-028 CTS14Y/TW15	11032939	100.5	+1,10	21.7	-0,30	3.1	+0,15	0,1
KSR 1005-0217-030 CTS14Y/TW15	11011925	100.5	+1,10	21.7	-0,30	3.3	+0,15	0,1
KSR 1005-0217-033 CTS14Y/TW15	11040878	100.5	+1,10	21.7	-0,30	3.6	+0,15	0,1
KSR 1005-0217-038 CTS14Y/TW15	11054475	100.5	+1,10	21.7	-0,30	4.1	+0,15	0,1
KSR 1005-0217-040 CTS14Y/TW15	11390534	100.5	+1,10	21.7	-0,30	4.3	+0,15	0,1
KSR 1005-0217-043 CTS14Y/TW15	11054476	100.5	+1,10	21.7	-0,30	4.6	+0,15	0,1
KSR 1005-0217-048 CTS14Y/TW15	11121839	100.5	+1,10	21.7	-0,30	5.1	+0,15	0,1
KSR 1005-0217-050 CTS14Y/TW15	11598720	100.5	+1,10	21.7	-0,30	5.3	+0,15	0,1
KSR 1005-0217-053 CTS14Y/TW15	11065819	100.5	+1,10	21.7	-0,30	5.6	+0,15	0,1
KSR 1005-0217-060 CTS14Y/TW15	11596429	100.5	+1,10	21.7	-0,30	6.3	+0,15	0,1
KSR 1005-0217-063 CTS14Y/TW15	11065820	100.5	+1,10	21.7	-0,30	6.6	+0,15	0,1
KSR 1005-0217-070 CTS14Y/TW15	11592960	100.5	+1,10	21.7	-0,30	7.3	+0,15	0,1
KSR 1005-0217-073 CTS14Y/TW15	11130140	100.5	+1,10	21.7	-0,30	7.6	+0,15	0,1
KSR 1005-0217-083 CTS14Y/TW15	11033250	100.5	+1,10	21.7	-0,30	8.6	+0,15	0,1
KSR 1005-0397-023 CTS14Y/TW15	11058603	100.5	+1,10	39.7	-0,45	2.6	+0,15	0,1
KSR 1255-0217-006 CTS14Y/TW15	11606275	125.5	+1,40	21.7	-0,30	0.9	+0,20	0,15
KSR 1255-0217-007 CTS14Y/TW15	11246975	125.5	+1,40	21.7	-0,30	1.0	+0,20	0,15
KSR 1255-0217-008 CTS14Y/TW15	11141396	125.5	+1,40	21.7	-0,30	1.1	+0,20	0,15
KSR 1255-0217-009 CTS14Y/TW15	11142583	125.5	+1,40	21.7	-0,30	1.2	+0,20	0,15
KSR 1255-0217-010 CTS14Y/TW15	11197545	125.5	+1,40	21.7	-0,30	1.3	+0,20	0,15
KSR 1255-0217-011 CTS14Y/TW15	11142504	125.5	+1,40	21.7	-0,30	1.4	+0,20	0,15
KSR 1255-0217-012 CTS14Y/TW15	11035244	125.5	+1,40	21.7	-0,30	1.5	+0,20	0,15
KSR 1255-0217-013 CTS14Y/TW15	11141393	125.5	+1,40	21.7	-0,30	1.6	+0,20	0,15
KSR 1255-0217-015 CTS14Y/TW15	11142586	125.5	+1,40	21.7	-0,30	1.8	+0,20	0,15
KSR 1255-0217-017 CTS14Y/TW15	11142588	125.5	+1,40	21.7	-0,30	2.0	+0,20	0,15
KSR 1255-0217-018 CTS14Y/TW15	11141545	125.5	+1,40	21.7	-0,30	2.1	+0,20	0,15
KSR 1255-0217-019 CTS14Y/TW15	11011585	125.5	+1,40	21.7	-0,30	2.2	+0,20	0,15
KSR 1255-0217-022 CTS14Y/TW15	11103584	125.5	+1,40	21.7	-0,30	2.5	+0,20	0,15
KSR 1255-0217-023 CTS14Y/TW15	11141542	125.5	+1,40	21.7	-0,30	2.6	+0,20	0,15
KSR 1255-0217-025 CTS14Y/TW15	11096111	125.5	+1,40	21.7	-0,30	2.8	+0,20	0,15
KSR 1255-0217-028 CTS14Y/TW15	11122148	125.5	+1,40	21.7	-0,30	3.1	+0,20	0,15
KSR 1255-0217-030 CTS14Y/TW15	11592775	125.5	+1,40	21.7	-0,30	3.3	+0,20	0,15

Other dimensions and tungsten carbide grades are available upon request.

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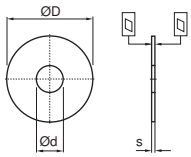
Standard dimensions

Blank sizes, CTS14Y



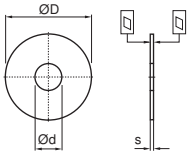
Type, description	Material	D [mm]	Dia. tol. [mm]	d [mm]	d tol. [mm]	s [mm]	s tol. [mm]	
KSR 1255-0217-032 CTS14Y/TW15	11246979	125.5	+1,40	21.7	-0,30	3.5	+0,20	0,15
KSR 1255-0217-033 CTS14Y/TW15	11142589	125.5	+1,40	21.7	-0,30	3.6	+0,20	0,15
KSR 1255-0217-038 CTS14Y/TW15	11122149	125.5	+1,40	21.7	-0,30	4.1	+0,20	0,15
KSR 1255-0217-043 CTS14Y/TW15	11142590	125.5	+1,40	21.7	-0,30	4.6	+0,20	0,15
KSR 1255-0217-050 CTS14Y/TW15	11597218	125.5	+1,40	21.7	-0,30	5.3	+0,20	0,15
KSR 1255-0217-053 CTS14Y/TW15	11123631	125.5	+1,40	21.7	-0,30	5.6	+0,20	0,15
KSR 1255-0217-063 CTS14Y/TW15	11125053	125.5	+1,40	21.7	-0,30	6.6	+0,20	0,15
KSR 1255-0217-068 CTS14Y/TW15	11205965	125.5	+1,40	21.7	-0,30	7.1	+0,20	0,15
KSR 1505-0217-011 CTS14Y/TW15	11268463	150.5	+2,20	21.7	-0,60	1.4	+0,20	0,15
KSR 1505-0217-013 CTS14Y/TW15	11122728	150.5	+2,20	21.7	-0,60	1.6	+0,20	0,15
KSR 1505-0217-048 CTS14Y/TW15	11153965	150.5	+2,20	21.7	-0,60	5.1	+0,20	0,15
KSR 1505-0217-063 CTS14Y/TW15	11129439	150.5	+2,20	21.7	-0,60	6.6	+0,20	0,15
KSR 1505-0317-013 CTS14Y/TW15	11058022	150.5	+2,20	31.7	-0,60	1.6	+0,20	0,15
KSR 1505-0317-018 CTS14Y/TW15	11066105	150.5	+2,20	31.7	-0,60	2.1	+0,20	0,15
KSR 1505-0317-019 CTS14Y/TW15	11128027	150.5	+2,20	31.7	-0,60	2.2	+0,20	0,15
KSR 1505-0317-023 CTS14Y/TW15	11058069	150.5	+2,20	31.7	-0,60	2.6	+0,20	0,15
KSR 1605-0217-010 CTS14Y/TW15	11594666	160.5	+2,20	21.7	-0,60	1.3	+0,20	0,15
KSR 1605-0217-013 CTS14Y/TW15	11010017	160.5	+2,20	21.7	-0,60	1.6	+0,20	0,15
KSR 1605-0217-015 CTS14Y/TW15	11035473	160.5	+2,20	21.7	-0,60	1.8	+0,20	0,15
KSR 1605-0217-018 CTS14Y/TW15	11012062	160.5	+2,20	21.7	-0,60	2.1	+0,20	0,15
KSR 1605-0217-023 CTS14Y/TW15	11088311	160.5	+2,20	21.7	-0,60	2.6	+0,20	0,15
KSR 1605-0317-011 CTS14Y/TW15	11017913	160.5	+2,20	31.7	-0,60	1.4	+0,20	0,15
KSR 1605-0317-012 CTS14Y/TW15	11146212	160.5	+2,20	31.7	-0,60	1.5	+0,20	0,15
KSR 1605-0317-013 CTS14Y/TW15	11017315	160.5	+2,20	31.7	-0,60	1.6	+0,20	0,15
KSR 1605-0317-014 CTS14Y/TW15	11276070	160.5	+2,20	31.7	-0,60	1.7	+0,20	0,15
KSR 1605-0317-015 CTS14Y/TW15	11032872	160.5	+2,20	31.7	-0,60	1.8	+0,20	0,15
KSR 1605-0317-018 CTS14Y/TW15	11066578	160.5	+2,20	31.7	-0,60	2.1	+0,20	0,15
KSR 1605-0317-019 CTS14Y/TW15	11017539	160.5	+2,20	31.7	-0,60	2.2	+0,20	0,15
KSR 1605-0317-020 CTS14Y/TW15	11597113	160.5	+2,20	31.7	-0,60	2.3	+0,20	0,15
KSR 1605-0317-022 CTS14Y/TW15	11242372	160.5	+2,20	31.7	-0,60	2.5	+0,20	0,15
KSR 1605-0317-023 CTS14Y/TW15	11063762	160.5	+2,20	31.7	-0,60	2.6	+0,20	0,15
KSR 1605-0317-027 CTS14Y/TW15	11242374	160.5	+2,20	31.7	-0,60	3.0	+0,20	0,15
KSR 1605-0317-032 CTS14Y/TW15	11242375	160.5	+2,20	31.7	-0,60	3.5	+0,20	0,15
KSR 1605-0317-033 CTS14Y/TW15	11035522	160.5	+2,20	31.7	-0,60	3.6	+0,20	0,15
KSR 1605-0317-038 CTS14Y/TW15	11224775	160.5	+2,20	31.7	-0,60	4.1	+0,20	0,15
KSR 1605-0317-043 CTS14Y/TW15	11020435	160.5	+2,20	31.7	-0,60	4.6	+0,20	0,15
KSR 1805-0217-010 CTS14Y/TW15	11597949	180.5	+2,50	21.7	-0,60	1.3	+0,20	0,15
KSR 1805-0217-013 CTS14Y/TW15	11034577	180.5	+2,50	21.7	-0,60	1.6	+0,20	0,15
KSR 1805-0217-018 CTS14Y/TW15	11063022	180.5	+2,50	21.7	-0,60	2.1	+0,20	0,15
KSR 2005-0217-015 CTS14Y/TW15	11085560	200.5	+2,80	21.7	-0,60	1.8	+0,20	0,15
KSR 2005-0217-019 CTS14Y/TW15	11059419	200.5	+2,80	21.7	-0,60	2.2	+0,20	0,15

Other dimensions and tungsten carbide grades are available upon request.

Upon request, all dimensions are available with groove and/or hole according to customer drawing.

Standard dimensions

Blank sizes, CTS14Y



Type, description	Material	D [mm]	Dia. tol. [mm]	d [mm]	d tol. [mm]	s [mm]	s tol. [mm]	
KSR 2005-0217-023 CTS14Y/TW15	11059420	200.5	+2,80	21.7	-0,60	2.6	+0,20	0,15
KSR 2005-0317-011 CTS14Y/TW15	11068934	200.5	+2,80	31.7	-0,60	1.4	+0,20	0,15
KSR 2005-0317-013 CTS14Y/TW15	11017488	200.5	+2,80	31.7	-0,60	1.6	+0,20	0,15
KSR 2005-0317-015 CTS14Y/TW15	11012518	200.5	+2,80	31.7	-0,60	1.8	+0,20	0,15
KSR 2005-0317-019 CTS14Y/TW15	11009867	200.5	+2,80	31.7	-0,60	2.2	+0,20	0,15
KSR 2005-0317-023 CTS14Y/TW15	11017542	200.5	+2,80	31.7	-0,60	2.6	+0,20	0,15
KSR 2005-0317-028 CTS14Y/TW15	11071738	200.5	+2,80	31.7	-0,60	3.1	+0,20	0,15
KSR 2005-0317-053 CTS14Y/TW15	11113257	200.5	+2,80	31.7	-0,60	5.6	+0,20	0,15
KSR 2005-0317-068 CTS14Y/TW15	11221669	200.5	+2,80	31.7	-0,60	7.1	+0,20	0,15
KSR 2255-0317-015 CTS14Y/TW15	11035512	225.5	+3,00	31.7	-0,60	1.8	+0,20	0,2
KSR 2255-0317-018 CTS14Y/TW15	293912	225.5	+3,00	31.7	-0,60	2.1	+0,20	0,2
KSR 2255-0317-023 CTS14Y/TW15	11088317	225.5	+3,00	31.7	-0,60	2.6	+0,20	0,2
KSR 2505-0317-013 CTS14Y/TW15	11088338	250.5	+3,50	31.7	-0,60	1.6	+0,20	0,2
KSR 2505-0317-019 CTS14Y/TW15	11010611	250.5	+3,50	31.7	-0,60	2.2	+0,20	0,2
KSR 2505-0317-023 CTS14Y/TW15	11015135	250.5	+3,50	31.7	-0,60	2.6	+0,20	0,2
KSR 2505-0317-028 CTS14Y/TW15	11062489	250.5	+3,50	31.7	-0,60	3.1	+0,20	0,2
KSR 2505-0317-033 CTS14Y/TW15	11159667	250.5	+3,50	31.7	-0,60	3.6	+0,20	0,2
KSR 2505-0397-015 CTS14Y/TW15	11080059	250.5	+3,50	39.7	-0,70	1.8	+0,20	0,2
KSR 2505-0397-019 CTS14Y/TW15	11041773	250.5	+3,50	39.7	-0,70	2.2	+0,20	0,2
KSR 2505-0397-023 CTS14Y/TW15	11088339	250.5	+3,50	39.7	-0,70	2.6	+0,20	0,2
KSR 2505-0497-016 CTS14Y/TW15	11623456	250.5	+3,50	49.7	-0,90	1.9	+0,20	0,2
KSR 2505-0497-023 CTS14Y/TW15	11019789	250.5	+3,50	49.7	-0,90	2.6	+0,20	0,2
KSR 2755-0317-023 CTS14Y/TW15	11010351	275.5	+3,50	31.7	-0,70	2.6	+0,30	0,2
KSR 2755-0397-020 CTS14Y/TW15	11593296	275.5	+3,50	39.7	-0,70	2.3	+0,30	0,2
KSR 3005-0317-023 CTS14Y/TW15	11005414	300.5	+4,00	31.7	-0,70	2.6	+0,30	0,2
KSR 3005-0317-028 CTS14Y/TW15	11062490	300.5	+4,00	31.7	-0,70	3.1	+0,30	0,2
KSR 3155-0317-023 CTS14Y/TW15	11058075	315.5	+4,00	31.7	-0,70	2.6	+0,30	0,2
KSR 3155-0317-028 CTS14Y/TW15	11070107	315.5	+4,00	31.7	-0,70	3.1	+0,30	0,2
KSR 3505-0317-023 CTS14Y/TW15	11057698	350.5	+4,00	31.7	-0,70	2.6	+0,30	0,2
KSR 3505-0317-028 CTS14Y/TW15	11088340	350.5	+4,00	31.7	-0,70	3.1	+0,30	0,2

Other dimensions and tungsten carbide grades are available upon request.

Upon request, all dimensions are available with groove and/or hole according to customer drawing.

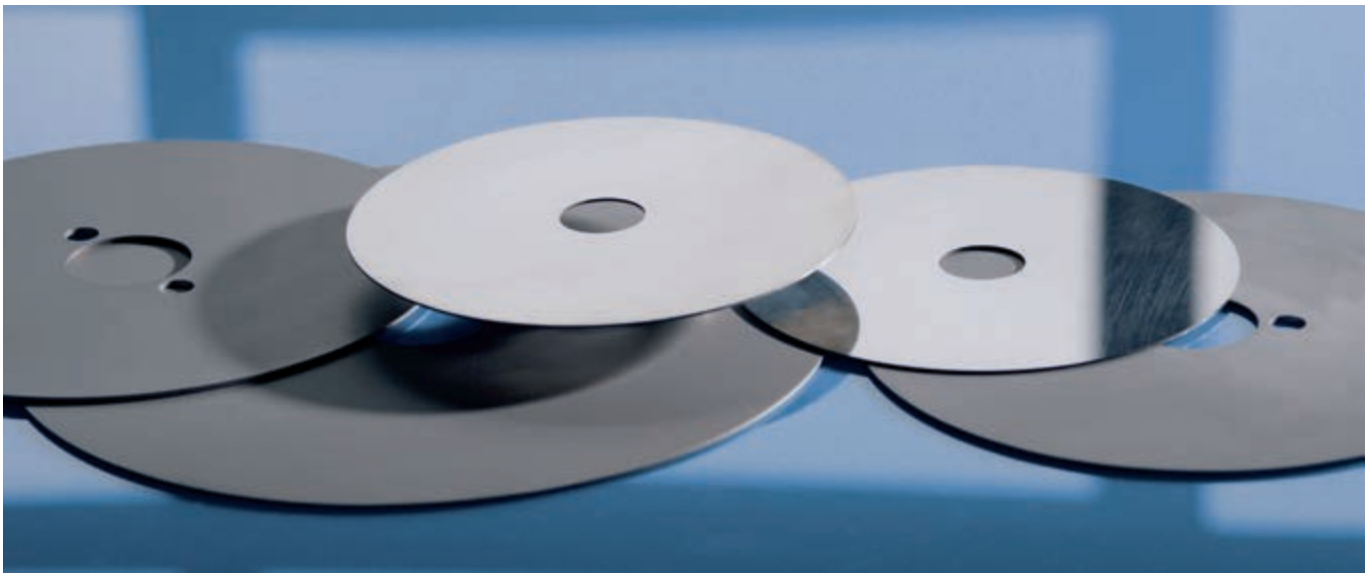
Preground disks

Surface ground and hole ground!

Upon request, we also deliver preground discs.

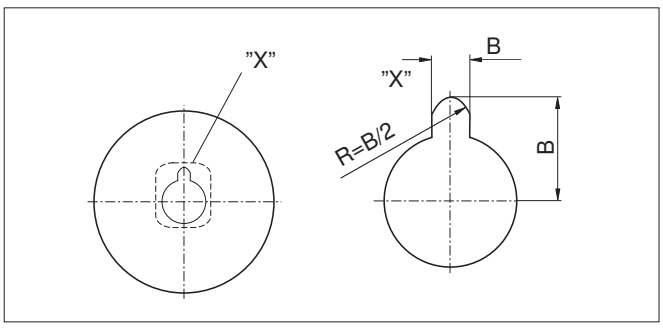
Range of dimensions for outer diameters	50 mm – 400 mm	
Max. thickness	¼ of the outer diameter	
Min. thickness	depends on the outer diameter	
Thickness tolerance	up to ± 0.005 mm	
Surface	≤ R_a 0.4 (no mirror finish)	
Minimum quantity	< Ø 100mm 4 items	≥ Ø 100mm 3 items

Prices and delivery time upon request.



Upon request, blanks for slitting knives including preformed groove

(CERATIZIT factory standard)

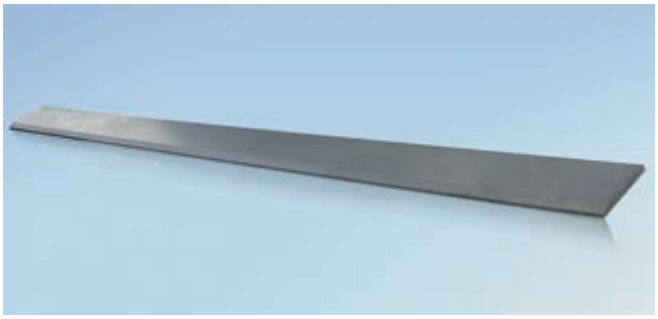


Ø d	H	B
10	8,25 ±0,15	3,1 ±0,2
13	9,85 ±0,15	3,1 ±0,2
16	12,00 ±0,20	4,1 ±0,2
22	16,30 ±0,20	6,1 ±0,2
32	23,10 ±0,25	8,1 ±0,2

Other versions upon request!

Sectors, applications

- Paper industry
- Metal industry



Products

- Blanks for circular knives up to Ø 400 mm
- Blanks for long knives >4500 mm (no length limit)
- Customised production

Carbide properties

- Fracture toughness
- Wear resistance

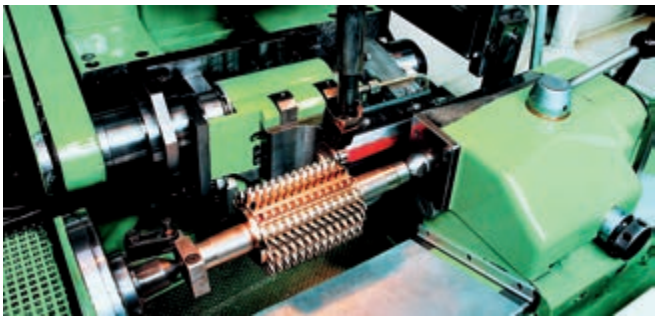
Finish

- As sintered
- Preground

If you are interested or have any questions, please get in touch with **CERATIZIT Deutschland, Empfingen**. Alternatively, visit www.ceratizit.com/contact to find your local contact person.

Hobs

Based on customer drawings we produce blanks for hobs and skiving hobs with low grinding allowance. The most advanced cutting tools cut the most demanding teeth geometries.
The cutting edges are extremely stable thanks to the homogeneous carbide and guarantee secure processes. Furthermore, our premium grades offer excellent protection against corrosion.

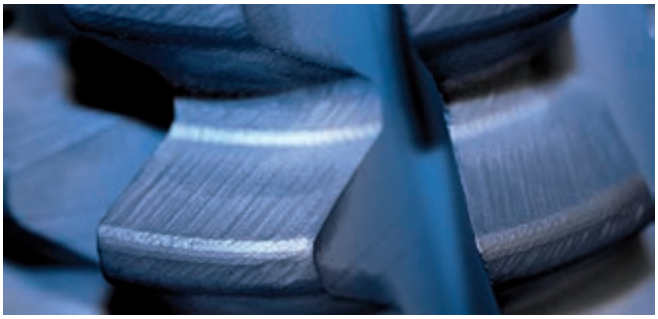


Sectors, applications

- Automotive industry
- Watch and clock industry

Materials

- Steel
- Non-ferrous metals
- Composite materials
- Precious metals



Products

- Blanks for hobs
  - with shaft
  - with hole
  - with or without indentation
  - with or without drive slot

Carbide properties

- Wear resistance
- Rigidity
- Compressive strength
- Coatability
- Fracture toughness

Finish

- As sintered
  ('near net-shape' technology)

Composition and properties

Submicron grain

CERATIZIT grade code	ISO code	Binder [m %]	Density [g/cm³]	Hardness HV10	Hardness HV30	Hardness HRA	Transverse rupture strength [MPa]	Transverse rupture strength [P.S.I.]	Fracture toughness [MPa*m ½]	Compressive strength [MPa]	Modulus of elasticity [GPa]	Thermal conductivity [W/mK]	Thermal expansion coefficient [10^{-6}/K]
CTS12L	K05/K10	6,0	14,78	1870	1840	93,3	3500	508.000	8,2	7200	630	90	5,1
CTS20L	K20/K40	10	14,40	1650	1630	91,9	4000	580.000	9,4	6600	580	85	5,5
CTS30L	K40	15,0	13,88	1400	1380	90,1	3800	551.000	11,9	5000	530	85	6,1

Corrosion-resistant grades

CERATIZIT grade code	ISO code	Binder [m %]	Density [g/cm³]	Hardness HV10	Hardness HV30	Hardness HRA	Transverse rupture strength [MPa]	Transverse rupture strength [P.S.I.]	Fracture toughness [MPa*m ½]	Compressive strength [MPa]	Modulus of elasticity [GPa]	Thermal conductivity [W/mK]	Thermal expansion coefficient [10^{-6}/K]
CF-S12Z		6,0		1860	1830	93,2	3600	522.000	9,0				
CF-S18Z		9,0		1630	1610	92,0	3500	508.000	11,0				

Ordering description using the example of a hob

WFSG 065-203/150-16 CTS20L

a b

1 2 3 4 5 6

1

WF.. hobs

(a)
S shank
B bore

(b)
N gashes, neutral, without threading
G gashes and threading
(*) Special milling cutters according to drawing
* Other additional information

2

outer diameter (in mm)

3

total length (mm)

4

cutting length (mm)

5

number of gashes

6

carbide grade

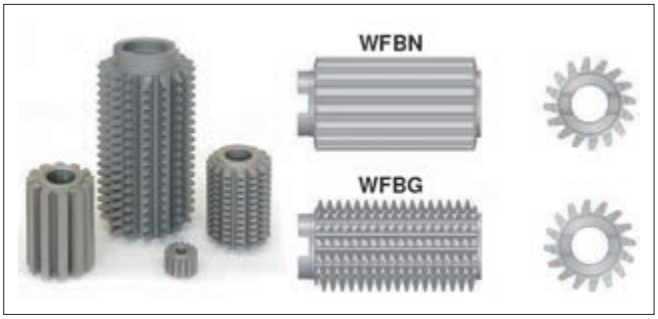
Additional information	Description and example
QN	with cross groove / WFBN 060 - 100 / 080 - 15 **QN**
LN	with longitudinal groove / WFBN 060 - 100 / 080 - 15 **LN**
F	with clearance angle and cutting edge / WFBN 060 - 100 / 080 - 15 **F**
BG	with ground bore / WFBN 060 - 100 / 080 - 15 **BG**

Special milling cutters

* Other additional information

Grades	Hard milling	Soft milling
CF-S12Z	■	□
CTS12L	■	□
CF-S18Z	■	■
CTS20L	□	■
CTS30L		■

Recommended grades



Hobs with bore and gashes or thread

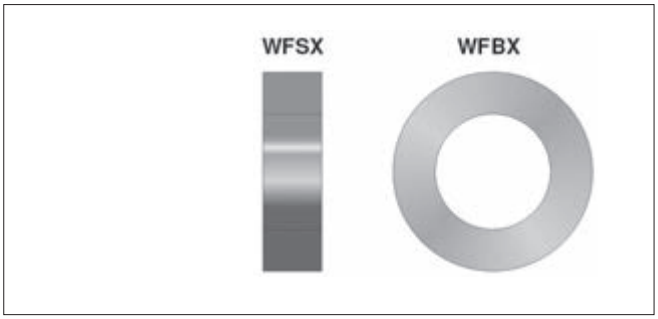
WFBN

WFBG
with thread

Shank-type hobs with gashes or thread

WFSN

WFSG
with thread



Special milling cutters

* Other additional information

WFSX
Special milling cutters – with shank

WFBX
Special milling cutters – with bore

If you are interested or have any questions, please get in touch with **CERATIZIT Luxembourg, Mamer**. Alternatively, visit www.ceratizit.com/contact to find our local contact person.

Winders

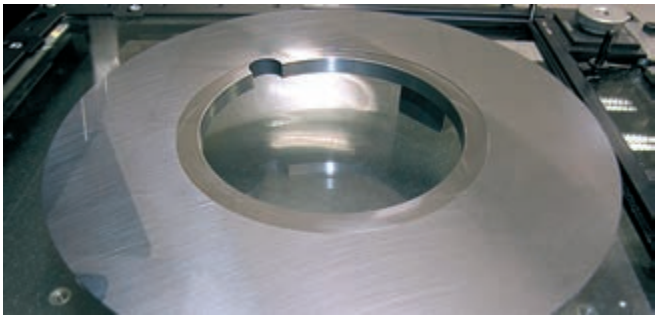
Winders are applied in longitudinal and lateral slitting knives. All knives are manufactured from one source, from powder preparation through to grinding. The knives are ground, lapped or polished with extremely low tolerances. State-of-the-art measuring machines test our carbide knives in the μ-range, guaranteeing a precise cut.

Sectors, applications

- Metal industry
- Electric industry
- Packaging industry

Materials

- Powder steel
- Tinplate
- Stainless steels
- Electrical sheet
- Composite materials



Products

- Winders
  – Tolerancesn in the μ-range possible

Carbide properties

- Wear resistance
- High edge stability
- Fracture toughness

Finish

- Ground, lapped or polished with minimum tolerances
- Solid carbide or carbide tipped
- Diameter up to 600 mm

Perfect results

- We test your carbide knives using state-of-the-art measuring machines in order to guarantee longer tool life and the cleanest cut. We do not only manufacture products but also measure and document them in the μ-range.

- Carbide grades optimised for the cutting process guarantee perfect cutting quality over a long period of time.

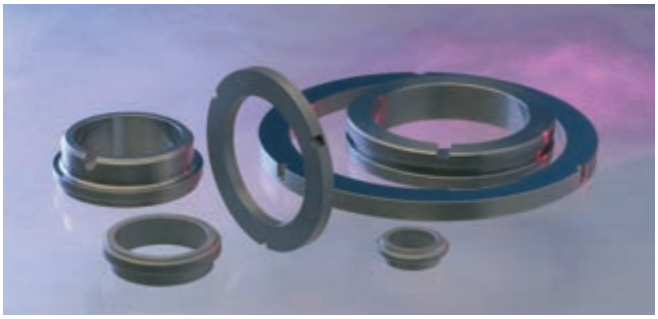
If you are interested or have any questions, please get in touch with **CERATIZIT Luxembourg, Mamer**. Alternatively, visit www.ceratizit.com/contact to find our local contact person.

Sealing rings

Sealing rings in pumps are normally components that cause a lot of maintenance work, as friction results in high levels of wear.
As well as the geometry, the carbide used is decisive for the performance and the tool life of the ring. Our carbide sealing rings are resistant to pressure, wear and corrosion.

Sectors, applications

- Pump manufacturers

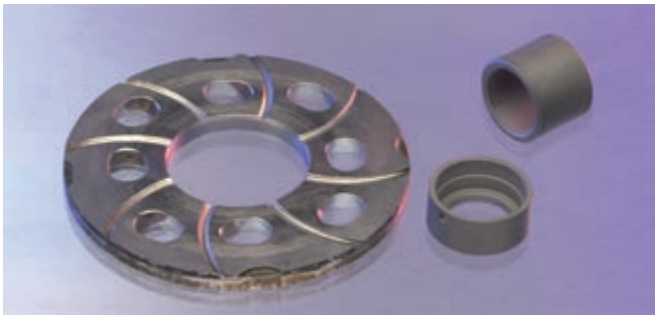


Products

- Rings
- Disks
- Special parts according to customer drawing

Carbide properties

- High wear resistance
- Resistance to pressure
- Corrosion resistance



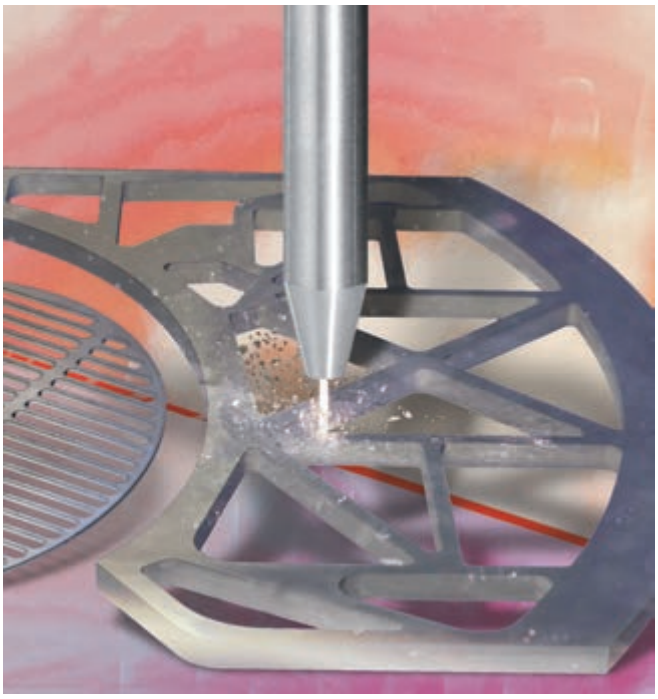
Finish

- As sintered
- Ground (ready-to-use)

If you are interested or have any questions, please get in touch with **CERATIZIT Luxembourg, Mamer**. Alternatively, visit www.ceratizit.com/contact to find our local contact person.

Focusing tubes for abrasive water jet cutting

Extreme pressures of up to 6,200 bar and high exit speeds of up to around 1,000 m/sec make water an optimum cutting tool for temperature-intensive and thick materials with complex geometries.
Specifically developed carbide grades provide very good wear protection of the focusing tubes as well as consistently high cutting quality. Thanks to the 3-line concept for every application field there is a suitable solution: Economy, Standard and Premium.



The cutting head

When it comes to water jet cutting, the key component is the focusing tube in the cutting head. It provides an accurate jet and thereby ensures process security and a consistently high quality of the cut.

Our focusing tubes are manufactured with comprehensive know-how and long-standing experience. They are characterised by close drilling tolerances, a perfect grind and concentricity.

The focusing tubes are suitable for all modern cutting head systems and support their automatic centring during mounting. The entire service package includes technical advice, well-assorted stocks and short lead times.

Sectors, applications

- General mechanical engineering
- Automotive industry
- Aerospace
- Packaging industry
- Medical systems
- Electric industry

Materials

- Optimal for a variety of materials: metallic materials, stone, ceramic, plastics, composites, materials for sealings and food
- Material thickness up to 150 mm can be machined

Products

- Focusing tubes
- Mixing chambers

Carbide properties

- Long tool life
- Consistent cutting performance
- Optimal relation between hardness and toughness

Finish

- Ready-to-use – 3-line concept
  - Economy
  - Standard
  - Premium

Unlike the thermal procedures, water jet cutting is free of waste gases and emissions. It also avoids playing thermal stress on the component (water jet cutting is carried out at room temperature) and tension on the component (only low forces are applied during the cutting procedure).

Composition and properties

CERATIZIT grade code	Binder [m %]	Density [g/cm³]	Hardness HV10	Transverse rupture strength [MPa]	[P.S.I.]
Nano-grades					
UMG01	0,40	15,55	2675	2400	348.000
CTN01L	0,25	15,60	2825	2000	290.000

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.

Ordering description for focusing tubes

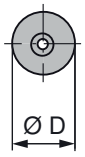
WJNS 0714 - 102 - 0762 - 25 - 15R UMG01

1 2 3 4 5 6 7

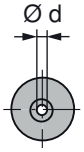
1 Type

- WJNR = Economy
- WJNS = Standard
- WJNP = Premium

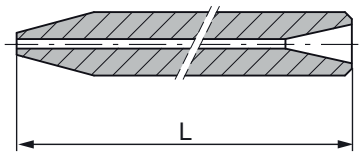
2 External diameter



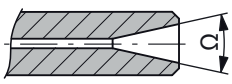
3 Internal diameter



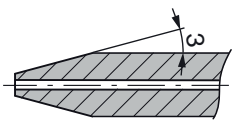
4 Length



5 Type

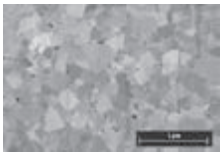


6 External taper



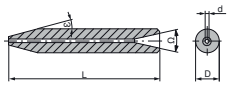
15. = angle
...R = ring
...S = special
...M = mixing chamber
...Q = square

7 Grade



Focusing tubes - Economy

UMG01

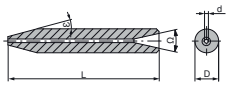


Type, description	Material	D [mm]	d [mm]	L [mm]	UMG01
WJNR 0635-076-0762-25-15	11783235	6.35	0.76	76.2	●
WJNR 0635-102-0762-25-15	11783236	6.35	1.02	76.2	●
WJNR 0714-076-0762-25-15	11783240	7.14	0.76	76.2	●
WJNR 0714-102-0762-25-15	11783242	7.14	1.02	76.2	●

● = stock item

Focusing tubes - Standard

UMG01

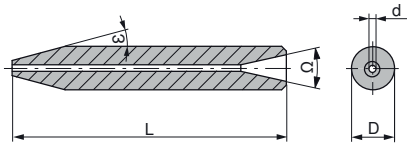


Type, description	Material	D [mm]	d [mm]	L [mm]	UMG01
WJNS 0600-120-0700-25-15	11469017	6.00	1.20	70.0	O
WJNS 0635-076-0762-25-15	6234852	6.35	0.76	76.2	●
WJNS 0635-091-0762-25-15	6261074	6.35	0.91	76.2	●
WJNS 0600-102-0700-25-15	6260218	6.00	1.02	70.0	●
WJNS 0600-102-0762-25-15	6234938	6.00	1.02	76.2	O
WJNS 0714-076-0762-25-15	6234943	7.14	0.76	76.2	●
WJNS 0714-091-0762-25-15	11557017	7.14	0.91	76.2	O
WJNS 0714-102-0762-25-15	6210224	7.14	1.02	76.2	●
WJNS 0714-102-1016-25-15	6248003	7.14	1.02	101.6	●
WJNS 0762-102-0762-25-15	6225154	7.62	1.02	76.2	●
WJNS 0797-076-1016-25-15	6234841	7.97	0.76	101.6	●
WJNS 0812-091-0762-25-15	11254622	8.12	0.91	76.2	●
WJNS 0812-102-0762-25-15	6282927	8.12	1.02	76.2	●
WJNS 0900-076-0762-40-15M	6254177	9.00	0.76	76.2	●
WJNS 0943-076-0762-25-15	6234942	9.43	0.76	76.2	●
WJNS 0943-102-0762-25-15	6219026	9.43	1.02	76.2	●
WJNS 0943-109-0790-25-15	11525265	9.43	1.09	79.0	O
WJNS 0600-076-0700-25-15	11179461	6.00	0.76	70.0	●
WJNS 0634-076-0750-14-0	11260179	6.34	0.76	75.0	●

● = stock item
O = limited stock or upon request
Other dimensions upon request

Focusing tubes - Premium

CTN01L



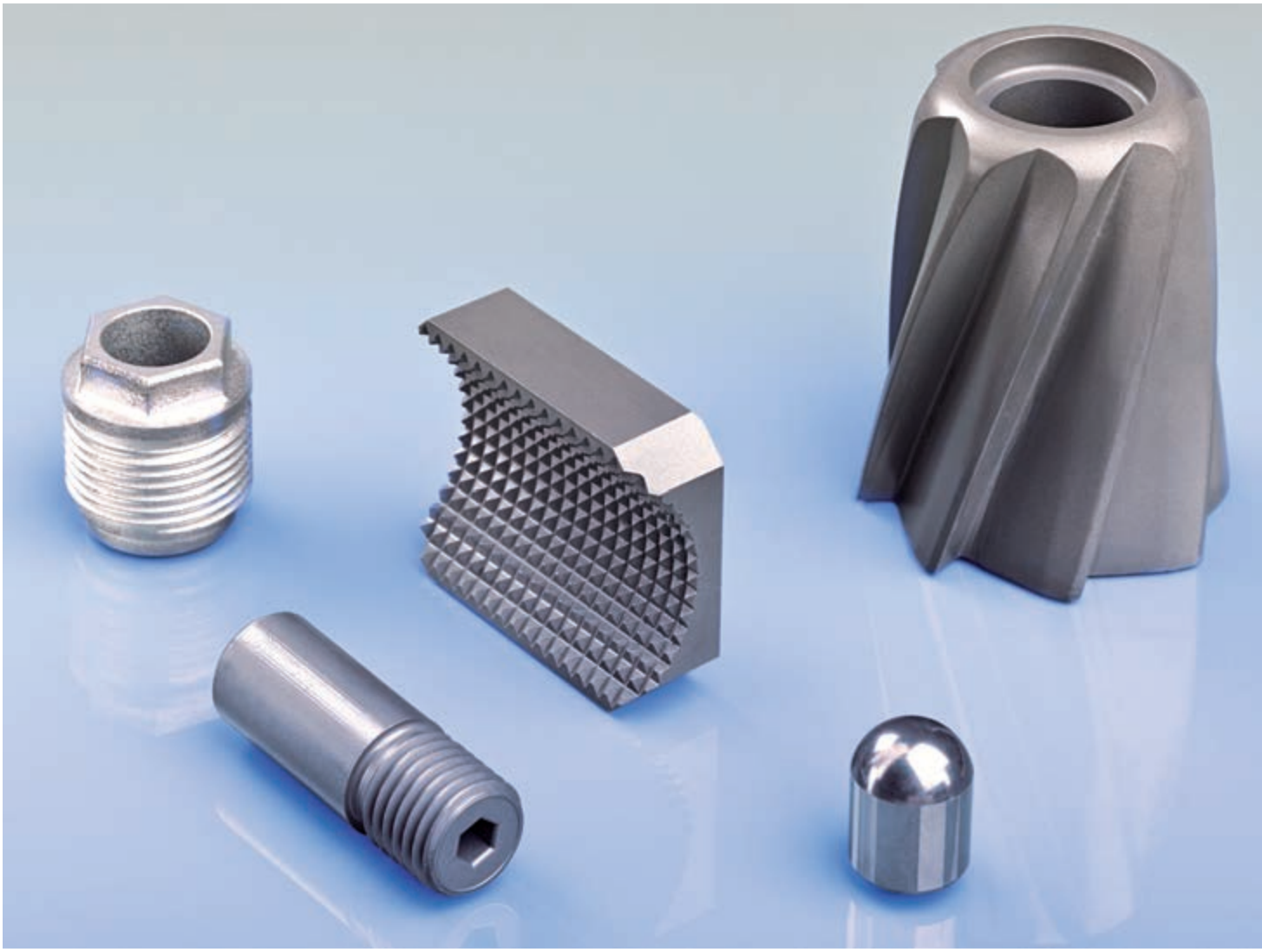
Type, ordering description	Material	Ø D [mm]	Ø d [mm]	L [mm]	CTN01L
WJNP 0635-076-0762-32-15	11796308	6,35	0,76	76,2	O
WJNP 0635-091-0762-32-15	11796315	6,35	0,91	76,2	O
WJNP 0635-102-0762-32-15	11796309	6,35	1,02	76,2	O
WJNP 0714-076-0762-32-15	11796311	7,14	0,76	76,2	O
WJNP 0714-076-1016-32-15	11796327	7,14	0,76	101,6	O
WJNP 0714-102-0762-32-15	11796304	7,14	1,02	76,2	O
WJNP 0714-102-1016-32-15	11796312	7,14	1,02	101,6	O
WJNP 0762-102-0762-32-15	11796310	7,62	1,02	76,2	O
WJNP 0797-076-1016-32-15	11796319	7,97	0,76	101,6	O
WJNP 0943-076-0762-32-15	11796316	9,43	0,76	76,2	O
WJNP 0943-102-0762-32-15	11796318	9,43	1,02	76,2	O

● = stock item
O = limited stock or upon request
Other dimensions upon request

If you are interested or have any questions, please get in touch with **CERATIZIT Luxembourg, Mamer** or **CERATIZIT Deutschland, Empfingen**.
Alternatively, visit www.ceratizit.com/contact to find your local contact person.

Components
(textile and cigarette industry, balls)

We develop numerous customer-specific components, including for the textile and cigarette industry. As they are applied in high-speed machines and are subject to strong wear, our carbide offers a fundamental advantage. Furthermore, we produce all our components with high precision and low tolerances according to customer specification.

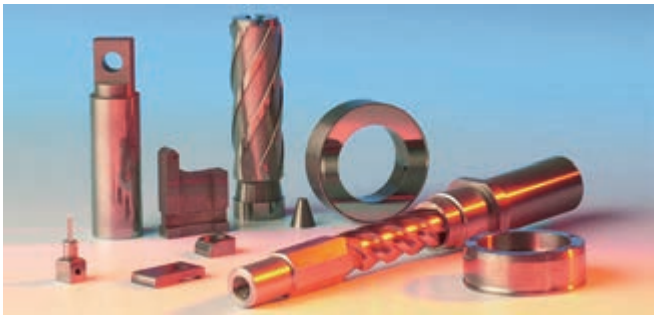


Sectors, applications

- General mechanical engineering
- Textile industry
- Cigarette industry
- General industry

Materials

- Various materials



Products

- Customer-specific, complex components and forms
- Large components

Carbide properties

- Wear resistance
- Fracture toughness
- Corrosion resistance
- Resistance to pressure

Finish

- As sintered
- Ground
- According to customer specifications, upon customer request

Surface quality

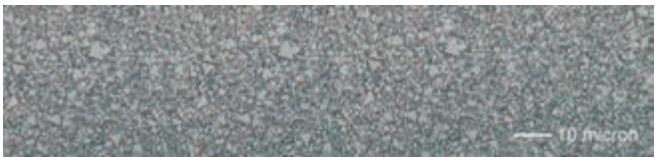
Class A: surface quality R_a from 0 to 10 nm
Class B: surface roughness R_a from 10 to 20 nm

Finish

- As sintered
- Ground
  (according to ISO 3290-1:2008-12 from grade G3 to G200)

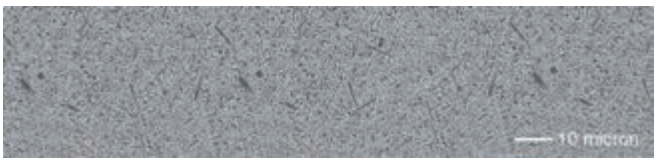
Product range for wear part applications

Properties	Unit	CTF12E	CTM16N	SNCB5
Material		Carbide	Carbide	Silicon nitride
Binder	%	6.0 (Co)	8.0 (Ni)	12.5 (Al_2O_3/Y_2O_3)
Density	g/cm^3	14.95	14.84	3.25
Hardness	HV10	1640	1300	1500
Hardness	HV30	1620	1290	1480
Hardness	HRA	92.1	89.4	91.1
Transverse rupture strength (ISO3327 – 3 points)	MPa	2200	2400	1000
Toughness (SEVNB)	MPa · m$^{-1/2}$	9.9	10.8	6.0



CTF12E

CTM16N



SNCB5

Ordering description on the example of precision balls

PB 4.00 HC20

1 2 3

1 Precision balls

2 Diameter

3 Grade

Programme:

Standard programme of precision balls diameter 1.57 – 151.9 mm.

Other dimensions upon request.

COMPONENTS – TEXTILE INDUSTRY

PRODUCTS / GRADE PROPERTIES

Sectors, applications

- Textile industry, machines

Products

- Knives
- Nozzles
- Bushes
- Sleeves
- Semi-finished products

Carbide properties

- Wear resistance
- Corrosion resistance

Finish

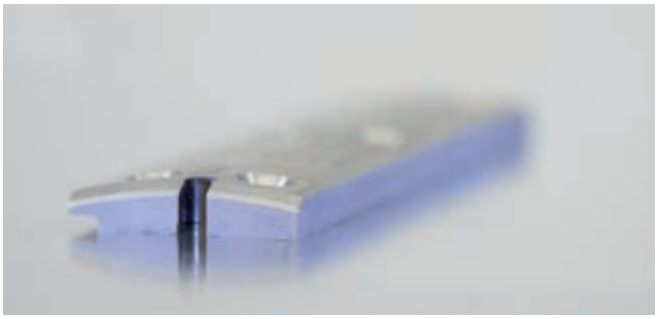
- As sintered
- Ground

Sectors, applications

- Cigarette industry
- General mechanical engineering

Products

- Knives
- Strips
- Scrapers
- Rolls



Carbide properties

- Wear resistance
- Corrosion resistance

If you are interested or have any questions, please get in touch with **CERATIZIT Luxembourg, Mamer**. Alternatively, visit www.ceratizit.com/contact to find our local contact person.

Powder and grit

Our expertise is not only limited to blanks and ready-to-use products. We also offer carbide powder with various grain sizes. You can choose from a variety of carbide grades with mechanical properties tailored to the application. As well as the powder we also produce sharp-edged and flaky grit.

Tungsten carbide powder

Product range – see table

Material	Grain size [µm]
6010216	0,8 - 0,9
6010326	1,1 - 1,3
6010427	1,3 - 1,5
6010219	1,6 - 2,0
6010220	1,8 - 2,1
6010223	2,8 - 3,3
11469150	4,5 - 5,0
6010225	9,0 - 12,0
6010226	13,7 - 22,5

According to measuring standard FSSS

Smallest packaging unit: 15 kg
Minimum order quantity: 100 kg

Powder RTP (ready to press)

Technical specifications available upon request only

Smallest packaging unit: 15 kg
Minimum order quantity: 100 kg

Grit

Available sharp-edged or in form of plates

Sharp-edged grit

Product range – see table

Material	Grain size [mm]
11982134	0,6 - 1,0
11738926	1,0 - 1,5
11793886	1,6 - 3,2
11793887	3,2 - 4,8
11793888	4,8 - 6,4
11793890	6,0 - 10,0

Smallest packaging unit: 15 kg
Minimum order quantity: 100 kg

Grit in form of plates

Product range – see table

Material	Grain size [mm]
11564149	1,0 - 1,5

Smallest packaging unit: 15 kg
Minimum order quantity: 100 kg

Ceramic

Apart from carbide, ceramic is one of the most important hard materials. It is applied when conventional materials are not able to achieve the necessary performance. Characterised by low density and mechanic stability, ceramic has low thermal conductivity properties. These unique characteristics mean that ceramic can be used in a wide range of fields.

If you are interested or have any questions, please get in touch with **CERATIZIT Luxembourg, Mamer**. Alternatively, visit www.ceratizit.com/contact to find our local contact person.

Components made of silicon nitride

For over 20 years our solutions made of silicon nitride have contributed to the success of our customers. Even parts with complex geometries can be produced.
Compared to other ceramics, silicon nitride has a low specific weight, very good mechanical properties and is highly resistant to thermal shock.

Applications

- Bearings
- Guide rolls
- Rods

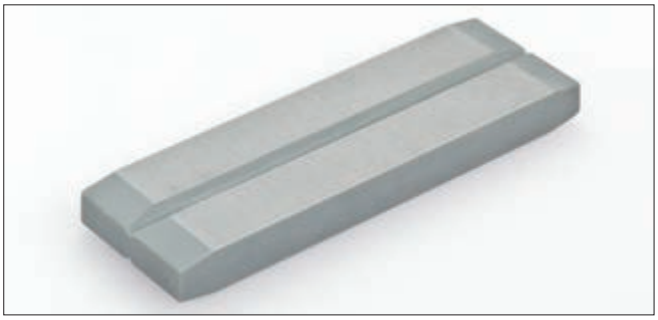
Our grade SNCB5 is certified as material for roller bearings with leading manufaturers of the sector.

Sectors

- Metal forming
- Chemical industry
- Automotive industry
- Aerospace industry

Products

- Bearings, balls and bearing rolls
- Guide rolls, hot rolls, nozzles
- Bolts and devices for heat treatment
- Extrusion and drawing dies



Characteristics

- Low weight
- Good mechanical properties up to 1,200 °C
- Good reliability
- High hardness even with high temperatures
- Good corrosion resistance even with aggressive media
- High resistance to thermal shock
- Low thermal expansion
- Good friction properties

COMPONENTS MADE OF SILICON NITRIDE

GRADE PROPERTIES

Composition and properties

CERATIZIT grade code		Binder [m %]	Density [g/cm³]	Hardness HV10	Hardness HRA	Transverse rupture strength [MPa]	Fracture toughness [MPa*m½]	Compressive strength [MPa]	Modulus of elasticity [GPa]	Thermal conductivity [W/mK]	Thermal expansion coefficient [10⁻⁶ 1/K]
Ultrafine grades											
SNC1	**grey**	9,0	3,25	1550	91,5	1100	6,5	3000	305	30	3,3
SNCB5	**black**	12,5	3,25	1500	91,1	900	6,0	3000	290	30	3,4
SNCE10*	**bronze**	SN/TiN	4,2	1400	90,3	>850	>7,0	3000	325	60	5,5
SNC20		11,0	3,24	1470	90,8	850	5,7	3000	290	30	3,4

Product range for wear part applications

Properties	Unit	SNC1	SNCB5	SNCE10*	SNC20
Material		grey	black	bronze	
Binder	%	9	12.5	SN/TiN	11.0
Grain size		ultrafine	ultrafine	ultrafine	ultrafine
Density (ISO3369)	g/cm³	3.25	3.25	4.2	3.24
Hardness (ISO3878)	HV10	1550	1500	1400	1470
Hardness (ISO3738)	HRA	91.5	91.1	90.3	90.8
Transverse rupture strength (ISO3327 – 3 points)	MPa	1100	900	>850	850
Compressive strength	MPa	3000	3000	3000	3000
Modulus of elasticity	GPa	300	300	325	290
Toughness (SEVNB)	MPa · $m^{-1/2}$	6.5	6.0	>7	5.7
Thermal conductivity	$Wm^{-1}K^{-1}$	30	30	60	30
Expansion coefficient	$10^{-6}K^{-1}$	3.3	3.4	5.5	3.4

*) electro-conductive, suitable for erosion

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.

Technical information

Which grain size is suitable for which application? How does the cobalt content influence the various parameters? Are there different tolerances in the blanks? On the following pages you can find the answers regarding the quality of our certified carbide, the various measuring systems and the procedures with which a high surface quality is achieved.
In addition, our index of buzzwords will make it easier for you to search for the suitable solution in our wear-protection catalogue.

Competence and know-how

At CERATIZIT we consider the carbide business a matter of confidence. Mutual trust is a good requisite for long and stable customer relationships. Long-standing experience in developing and manufacturing carbide is the basis for justifying your trust. Our quality management systems meet the highest standards. This is documented by the ISO 9001:2000 certificate.


Certificate

Standard ISO 9001:2008

Certificate Holder: CERATIZIT Luxembourg S.à r.l. 101, route de Holzem L - 8232 Mamer

Scope: Development and production of hardmetal, ceramic and cermet parts at the site of Mamer

Validity: The certificate is valid from 2012-01-01 until 2014-12-31. First certification 1993

2011-12-20

TÜVRheinland® Precisely Right.


CERTIFICAT

The ESCEM asbl Certification Body hereby certifies that the company

Ceratizit Luxembourg Sàrl
Route de Holzem - BP 51
L-8201 Mamer

has established and applies an environmental management system for the scope

Development and production of hardmetal, ceramic, and cermet parts at the site of Mamer

An audit was performed, report No 176
Proof has been furnished that the requirements according to

ISO 14001:2004

are fulfilled.

The certificate is valid until
16.10.2014
Certificate Registration No
1400 176


DNV BUSINESS ASSURANCE
MANAGEMENT SYSTEM CERTIFICATE

Certificate No. / Certificato No. CERT-00110-94-AQ-MIL-SINCERT

Si attesta che / This is to certify that

Ceratizit Italia S.p.A.

Via Milanese, 6 - 22040 Alserio (CO) - Italy

è conforme ai requisiti della norma per i sistemi di gestione
has been found to conform to the management system standard

UNI EN ISO 9001:2008 (ISO 9001:2008)

Questa Certificazione è valida per il seguente campo applicativo:
This Certificate is valid for the following product or service ranges:

Produzione di metallo duro per attrezzi speciali.
Progettazione e produzione di trafile, matrici di stampaggio ed utensili per chiodatrice, in metallo duro
(Settore EA : 17)

Manufacture of hard metal blanks for special tools.
Design and manufacture of drawing dies, cold heading dies and nail making tools in hard metal
(Sector EA : 17)

1994-11-10

2015-09-23

Agrate Brianza (MB), 2012-09-04

Sergio Vannucci
Lead Auditor

Zeno Beltrami
Management Representative

ACCREDIA


Certificate

Standard ISO 9001:2008

Certificate Holder: CERATIZIT Deutschland GmbH Robert-Bosch-Straße 23 D - 72186 Empfingen

Scope: Manufacture and sale of cemented carbide products for industrial wear parts solutions, automotive industry and tool & die industry

An audit was performed, Report No. 061946. Proof has been furnished that the requirements according to ISO 9001:2008 are fulfilled.
The due date for all future audits is 20-09 (dd.mm).

Validity: The certificate is valid from 2012-12-12 until 2015-10-20. First certification 2007

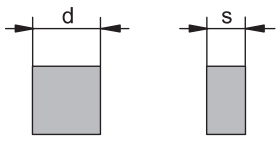
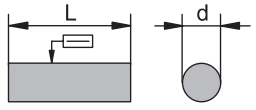
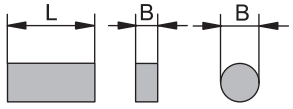
2012-12-12

TÜVRheinland® Precisely Right.

The production of a compact preform through pressing and subsequent sintering results in a length shrinkage of around 20%. Maintaining close tolerances of the blanks is therefore a particularly big challenge for the production experts.
In addition to the composition and the geometrical form, the manufacturing procedure is also especially decisive for the result that can be achieved.
For standard parts tolerances are also defined in the respective ISO standards (for example: ISO 2768).

Preform Sintered part

Examples of blank tolerances according to the manufacturing procedure:

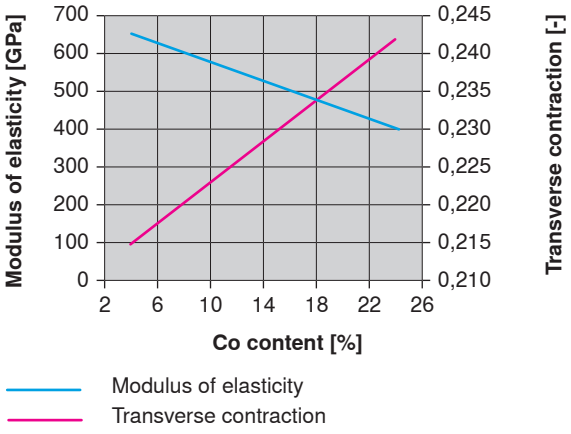
Manufacturing process	Dimensions (example) [mm]	Tolerances [mm]	Grinding allowance [mm]
Directly pressed parts 	d s 12,70 x 12,70 x 4,76 15,88 x 15,88 x 6,35 19,05 x 11,05 x 7,15	d s ± 0,10 ± 0,05 ± 0,12 ± 0,06 ± 0,15 ± 0,07	0.2 – 0.5 per side + 50% of the sintering tolerance
Extrusion pressed parts 	d L 3,25 330 6,20 330 16,20 330	d + 0,10 0,25 + 0,25 0,25 + 0,30 0,25	0,25 0,20 0,20
Formed parts 	L B 40–50 50–50 100–120 80–120 200–225 > 120	± 0,45 ± 1,10 ± 1,25	0,40 0,50 0,50

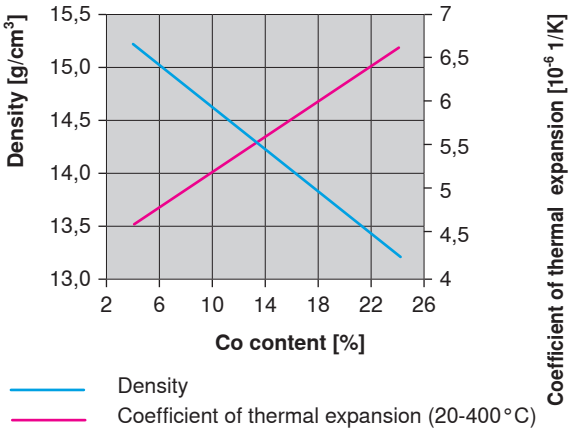
Fundamental guidelines for selecting the right carbide grade:

Grain size	Impact strength	Stress caused by notch tensions	Tension and bending stress (with good surface quality!)	Resistance to adhesion (against metal)
Coarse/medium	++	+	o	o
Fine	+	o	o	+
Submicron	o	-	+	++
Ultrafine	-	--	++	++

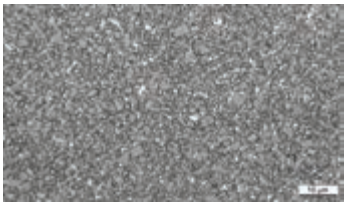
Within the grain size categories the following applies: with decreasing Co content (= increasing hardness) wear resistance and compressive strength rise, while toughness decreases considerably.

Modulus of elasticity, transverse contraction, density and coefficient of thermal expansion

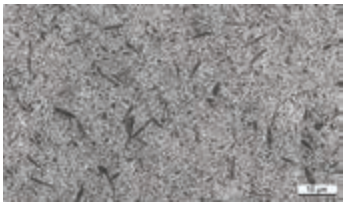




Micrographs



WC-Co carbide



Silicon nitride

Surface roughness

Table for the comparison of the measuring systems (metric and inch) of surface roughness

1 µm = 0,001 mm = 39,37 µ″
1 µ″ = 0,000001″ = 0,0000254 mm

R_{tmax} [µm]	CLA/R_a [µm]	CLA [µ"]	RMS [µm]	RMS [µ"]
0,06	0,02	0,75	0,02	0,8
0,1	0,03	1,2	0,04	13
0,2	0,06	2,5	0,08	2,8
0,3	0,09	3,7	0,1	4,2
0,4	0,13	5,0	0,14	5,6
0,5	0,16	6,7	0,18	6,9
0,6	0,19	7,5	0,21	8,3
0,7	0,22	8,7	0,25	9,7
0,8	0,25	10,0	0,28	11,1
0,9	0,28	11,2	0,32	12,5
1,0	0,31	12,5	0,35	14,0
1,2	0,38	15,8	0,42	16,7
1,5	0,47	18,8	0,53	20,9
1,8	0,57	22,6	0,64	25,5
2,0	0,64	25,1	0,78	27,9

R_{tmax} [µm]	CLA/R_a [µm]	CLA [µ"]	RMS [µm]	RMS [µ"]
2,4	0,73	30,1	0,85	33,4
2,8	0,89	35,2	0,99	39,0
3,0	0,95	37,6	1,06	41,9
3,5	1,11	43,9	1,24	48,8
4,0	1,27	50,2	1,41	55,8
5,0	1,59	62,7	1,77	69,7
6,0	1,91	75,5	2,12	83,6
7,0	2,22	87,5	2,48	92,6
8,0	2,54	100,0	2,83	111,7
10,0	3,18	125,5	3,54	140,0
20,0	6,64	251,5	7,8	279,0
40,0	12,7	502,0	14,1	558,0
60,0	19,1	755,0	21,2	836,0
125,0	39,5	1560,0	43,5	1750,0
200,0	64,0	2510,0	78,0	2790,0

CLA (centre line average)
RMS (root mean square)

Surface quality according to manufacturing method

Surface symbol according to ISO 1302	new	0,025	0,05	0,1	0,2	0,4	0,8	1,6	3,2	6,3	12,5	25	50
Surface symbol according to ISO 3141	previous	▽▽▽▽					▽▽▽		▽▽		▽		
Roughness index		N 1	N 2	N 3	N 4	N 5	N 6	N 7	N 8	N 9	N 10	N 11	N 12
Average roughness value	R_a [µm]	0,025	0,05	0,1	0,2	0,4	0,8	1,6	3,2	6,3	12,5	25	50
Roughness depth	R_z [µm]	0,25	0,63	1	1,6	2,5	4-6,3	10	16-25	40	63	100	160
Longitudinal grinding Surface grinding													
Peripheral grinding													
Face grinding													
Ground hole													
Polish grinding													
Long-stroke honing													
Short-stroke honing													
Cylindrical lapping Flat lapping													
Ultrasonic lapping													
Polish-lapping													

≙ Roughness (achieved through special methods)
≙ Roughness (achievable through normal workshop methods)
≙ Roughness (achievable through rough machining methods)

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