

GUHRING



PCD and CBN tools

The optimum in
economic efficiency and quality
for complex machining tasks

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PCD and CBN tools from Guhring

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Guhring is one of the leading suppliers of PCD and CBN tools with world-wide production and service facilities.

From natural diamond to synthetic PCD and CBN

page 6

A natural diamond possesses numerous characteristics that makes it the ideal tool material. However, the industry believes it is not perfect enough. This is the reason why synthetic tool materials such as PCD and CBN were developed.

Advantages and application ranges

page 8

PCD and CBN tools are especially suitable for the machining of difficult-to-machine, highly abrasive materials offering highest quality and economic efficiency.

Application examples: aviation and automotive

page 10

The automotive, aviation and aerospace industries apply Guhring PCD and CBN tools for especially demanding operations such as the machining of cylinder heads or the production of rivet holes in aeroplanes.

Our tool program

page 12

A speciality of Guhring's PCD and CBN tool production are customer specific special tools for highly complex machining tasks.

Process design for optimal results

page 14

The application of PCD and CBN tools is only the first step to success. Decisive for a highly efficient production is the design of the complete process. Here, Guhring gives customers the benefit of a long-standing know-how.

Service for the entire tool life

page 16

Guhring's technical field service and service centres all over the world ensure a continuous and comprehensive support for our PCD and CBN customers.

Contacts

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Specialist technicians are available for further information in all matters of design and application of PCD and CBN tools.

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The new plant II in Albstadt / Germany

Choongnam / Korea

Brookfield / USA





PCD and CBN tools from Guhring

Global know-how

The development and production of PCD and CBN tools has been one of Guhring's high-tech sectors since the mid 80's. At three production locations, Germany, Czech Republic and USA, innovative and complex tools are developed globally for highly specialised machining tasks.

New PCD and CBN production

Centre-piece of our PCD and CBN production is our facility in Albstadt, located in a purpose-built, state-of-the-art building since early 2004. Here, a workforce of approximately 200 develops and produces predominantly customer specific special tools but also standard tools. In addition, design guidelines with world-wide validity are also developed and stipulated here.

Locations in USA, Korea and Poland

PCD and CBN tools have been produced in USA since 2001. Specifically trained field service engineers and an in-house design facility offer our customers on the American continent optimal support.

In addition to the PCD and CBN production in USA, Guhring opened

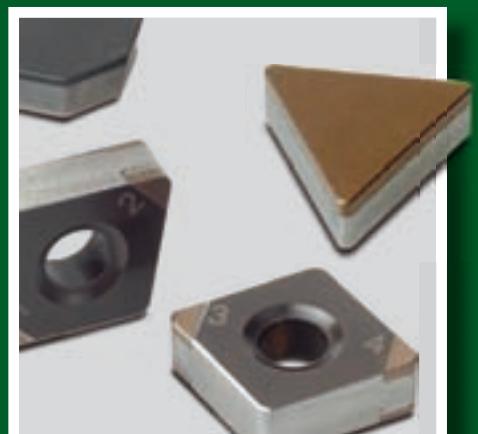
independent plants in Korea and Poland. Service centres for re-grinding and re-tipping of PCD and CBN tools are established in China, Great Britain, Italy, Mexico and India to offer a real global development and production service for these tools.

The application of the same type of machines at all locations ensures an identical quality standard. The origin of the PCD and CBN tools is immaterial, the customer always receives a consistently high quality. Equally, it doesn't matter which Guhring PCD and CBN plant the customer contacts, the selected tool is available at every location.

Competent personnel

The high demands for process knowledge and tool technology requires a competent workforce. Basic pre-requisite for the success of Guhring's PCD and CBN production is therefore our highly qualified technical personnel. Continuous training ensures that all personnel are constantly up-to-date with the latest technologies and know-how.

Strong inserts
Carbide interchangeable inserts with
PCD- and CBN-tipped



Regal
Highly complex flexible tools
are our speciality



Tough and resistant:
Tools with CBN cutting edges
for hard steels and cast materials





From natural diamond... Wonder of nature

As the hardest natural mineral the diamond is ideally suited for machining other materials. It also possesses extreme hardness as well as very sharp cutting edges if machined accordingly. For example, a diamond will scratch any other mineral but cannot be scratched by any other stone itself.

Treasure from the deep

Natural diamond consists of pure carbon and graphite. It was created millions of years ago in the earth's crust through complex geological processes. At a depth of 130 to 700 kilometres below the earth's surface there were large quantities of pure carbon. Under certain optimal conditions the carbon atoms combined and in time crystallised in the form of diamonds. Responsible for this synthesis were the temperatures of

in excess of 1000° C and enormous pressures of approximately 40,000 bar.

Source volcano cone

Through convection currents in the earth's crust – also the engine for the plate tectonics, the movement of the continental plates – over millions of years the diamonds steadily rose further and further upwards with the magma and were eventually spat into the atmosphere with the eruption of a volcano. This created relatively small volcano cones with so-called "pipes" the current source of natural diamonds.

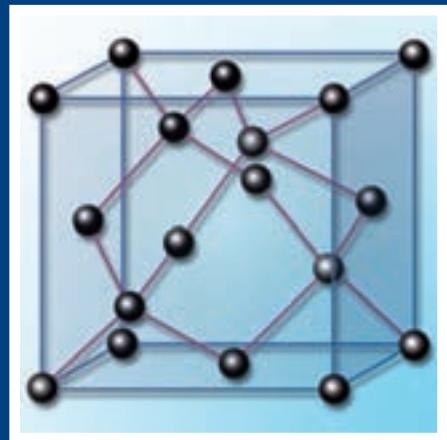
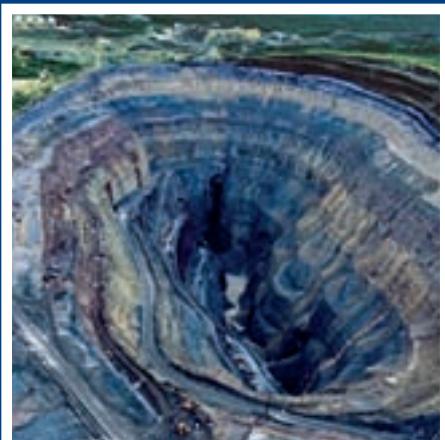
Equivalent characteristics

Natural diamonds are less suited for industrial application due to limited availability and heterogeneous structure. For this reason, PCD is applied in this instance because it

possesses similar characteristics with regard to hardness, wear-resistance and sharpness.

Impressive

*Ajchal diamond mine in Russia,
a rich source for diamonds*



Structure
Easily recognisable – the cubic structure



Valuable raw material
Raw diamonds cleansed from accompanying minerals and dirt

... to synthetic PCD and CBN

PCD – a super-hard tool material

Because diamonds have always been very valuable, mankind has attempted to artificially recreate diamonds – by means of magic and alchemy of course without success. However, natural science has increasingly unearthed the secret of the diamond and opened the door for a synthetic production.

20 tons per annum

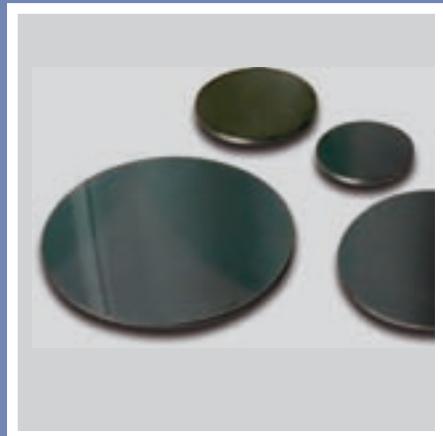
The first synthetic diamond was created at General Electric, USA in 1955. More or less simultaneously, ASEA in Sweden developed a similar process. With this special process, at a temperature between 1500° C and 1800° C and a pressure of between 53,000 and 100,000 bar, synthetic diamonds up to 1 mm diameter are produced from graphite, marketed under the name PCD (polycrystalline diamond). Currently, the annual production of PCD is approximately 20 tons, primarily applied for cutting tools, grinding powder and for the production of cutting wheels. The advantage of PCD is primarily its consistent high quality – a fundamental pre-requisite for the further machining of tools with the same characteristic.

CBN – a tough alternative

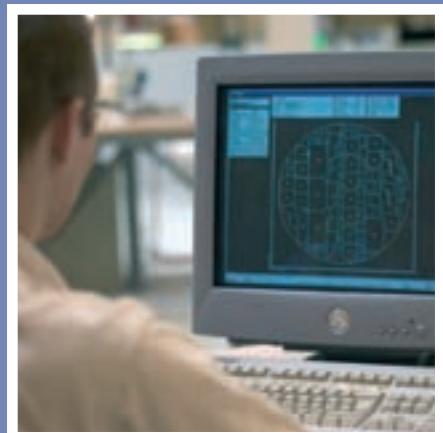
Cubic boron nitride (CBN) is a high-performance tool material from a polycrystalline mass, that similar to PCD is produced in a high temperature-pressure process. CBN, its hardness only surpassed by a diamond, is suitable for the machining of materials that cannot be machined with PCD or monocrystalline diamond. The main application range is ferrous materials possessing a hardness from approximately 45 HRC as well as grey cast iron, Cr-chilled cast iron and wear alloys on a cobalt, nickel or iron basis.

In contrast to PCD and diamond, CBN does not react with the carbide constituents existing in these materials. Also of no consequence are the occurring machining temperatures, because CBN only reacts with oxygen from a temperature of approximately 1200° C and subsequently possesses an unequalled thermal hardness. Only in so-called super-alloys in the aircraft or reactor industry with a distinctive austenitic phase and simultaneously high toughness do CBN tools generally reach their application limits. Typical representatives are high Ni-alloyed materials such as Inconel 718 or Nimonic. For these materials machining trials are necessary to clarify the application possibility.

*Synthetically produced
PCD and CBN circular blanks*



*Like a puzzle
The segment separation is performed
with optical programs*



*Bear strength
PCD or CBN equipped face milling cutter*

Advantages of PCD and CBN tools

Powerful and economical

Tools with PCD and CBN cutting edges are the ideal solution for difficult-to-machine, highly abrasive materials. These tools achieve highest quality and economic efficiency. The result: Long tool life, highest surface quality, optimal process reliability and repeatability.

CFK is probably the most suitable future material applied in the aircraft industry thanks to its high rigidity and low weight. A consequence of this development is the difficult machining. The abrasive wear leads to a visible rounding of carbide cutting edges within a short time (fig. 2). This results in the fibres no longer being cut but squashed and then being ripped from the laminate (delamination).

The range of application of our PCD tools begins with applications that have the highest demands on surface quality.

PCD tools do not display the typical initial wear (fig. 1), but guarantee no delamination tendencies during the machining process thanks to the extremely resilient diamond cutting edge.

However, in order to take full advantage of their performance potential, the customer's production must fulfil certain minimum requirements. This includes applying the tools on rigid and vibration-free machines as well as highly accurate spindle bearings or slide ways respectively.

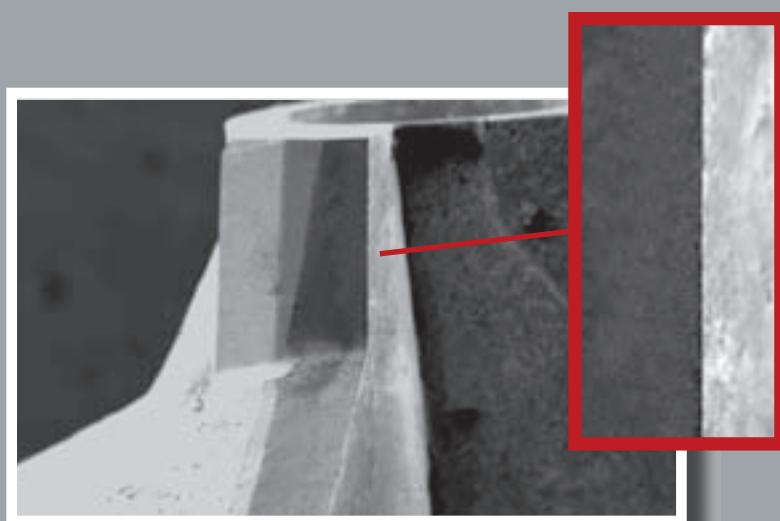


Figure 1: PCD tool
Convincing, wear-resistant diamond cutting edge

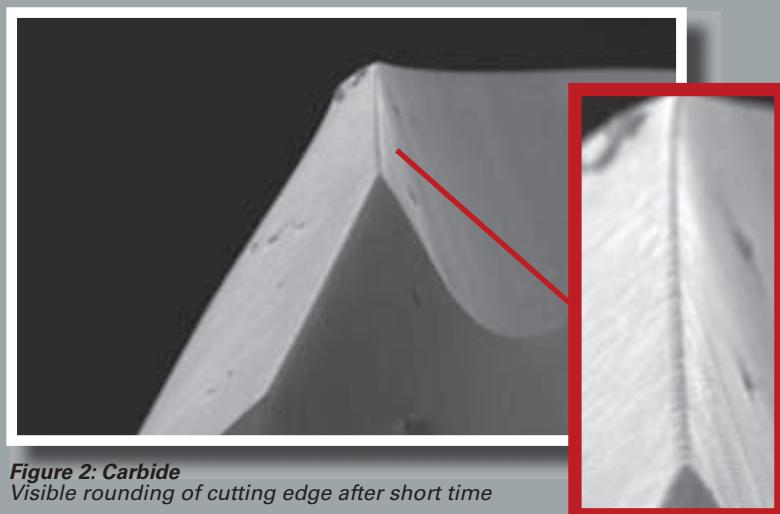


Figure 2: Carbide
Visible rounding of cutting edge after short time



Assembly of the new Airbus A380
Where the precision of
Guhring tools counts.
Photograph: Airbus S.A.S.

Application

Satisfying highest demands

PCD is especially suitable for the drilling, milling and reaming of non-ferrous materials, light and heavy metals, fibre-reinforced plastics, ceramics as well as synthetic glass.

CBN is especially efficient for the machining of hardened steels and pearlitic cast materials.

These materials are currently specifically applied in the automotive and aerospace industry

as well as in the machine tool industry.



Field of application - Aircraft industry

High-tech and the dream of flying

The increasing demands on aeroplanes, helicopters, rockets and satellites drives forward the continuous development of new materials, especially synthetic composite materials or special alloys. The machining of these materials is, however, becoming increasingly more difficult. In addition, the quality and precision requirements of the aerospace industry are constantly increasing.

The solution:

Guhring's PCD and CBN know-how

In many cases it is the high hardness and the very sharp cutting edges of PCD and CBN tools that actually makes the machining of modern materials applied in the aerospace industry possible. In addition, Guhring's extensive know-how in the PCD and CBN sector regarding the design of tools and machining

processes ensures that the tools developed by Guhring achieve the required quality and economical cutting parameters as well as tool life.



Complete trust in Guhring:
Eurocopter, the market leader



Airbus application:
Guhring tools with PCD cutting edges



Technology leader - Airbus:
Composite materials require
PCD or CBN tools respectively

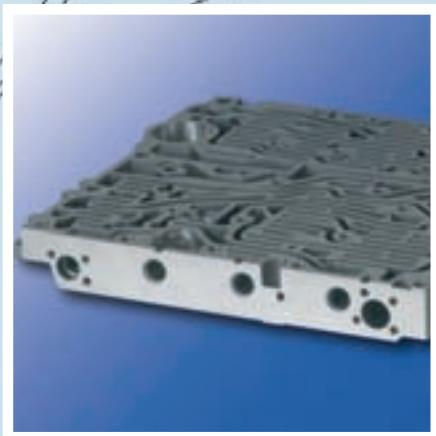
Field of application - Automotive industry

Better performance - less fuel consumption



Photograph: Volkswagen AG*

Multi-faceted application:
Milling, drilling and reaming of a transmission housing.



Fine machining:
Slide valve holes in a control plate.



Photograph: Volkswagen AG*

Complete machining:
Motor mountings in a revolving machine



Demanding:
Complete machining of cylinder head



Safety components:
Drilling and reaming a master brake cylinder

The PCD tool program

Standard and highly complex special tools

Guhring's PCD tool range on the one hand includes drills, milling cutters and reamers as well as interchangeable inserts. In addition, Guhring develops, designs and produces predominantly

customer specific special tools for highly complex machining tasks. This includes, for example, PCD-tipped finishing reamers for the machining of valve seats in the automotive industry or combination

tools enabling different machining operations with one single tool.



A small selection from our PCD tool program

The CBN tool program

Standard and highly complex special tools

Guhring's CBN tool range includes, dependent on the range of application, drills, milling cutters, reamers and other specific applications. For

example, CBN tools from Guhring are successfully and economically applied in the production of wheels, pumps and shafts.



A small selection from our CBN tool program



Process design for optimal results

The machining process should be observed in its entirety

To take full advantage of the efficiency of PCD and CBN tools, the complete machining process should be looked at. This applies to the application of complex special solutions combining several machining steps in one tool. From process design to the application of the tool in volume production, Guhring's complete know-how is available to the

customer. World-wide, Guhring's technical field service engineers for PCD and CBN tools provide advice to customers on-site.

State-of-the-art production process
World-wide, a total workforce of in excess of 200 is engaged in the development and production of PCD and CBN tools.

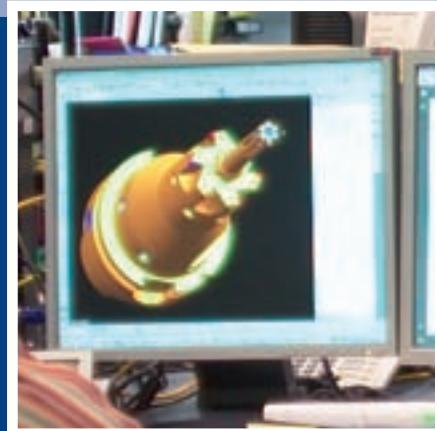
State-of-the-art CAD programs and

computers provide support to personnel in their development work that is carried out in close consultation with the customer. Simultaneous engineering guarantees a continuous interaction between Guhring and its customers – world-wide without complication thanks to three Guhring locations.

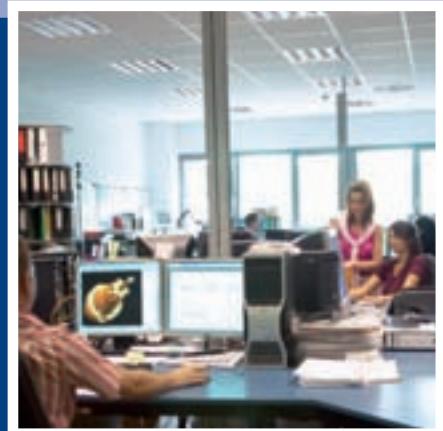
1. Tool design and imperfection inspection.

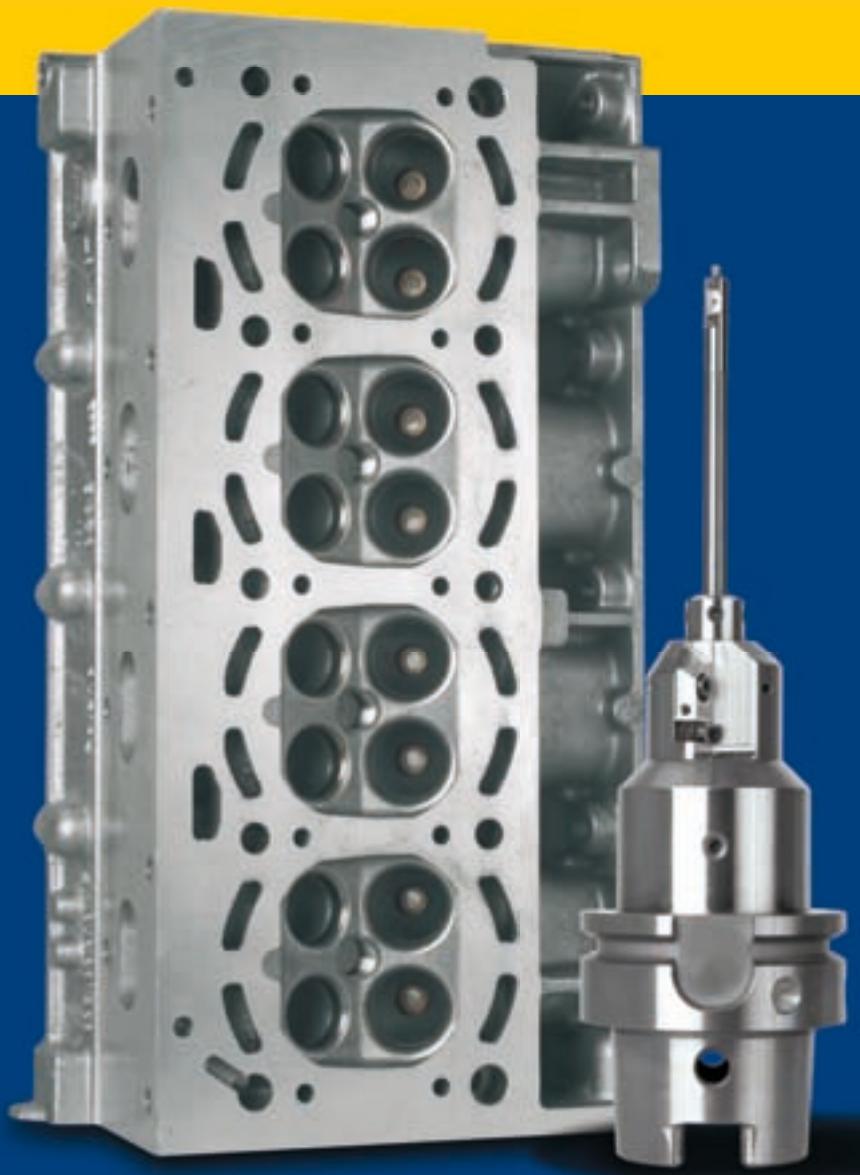


2. Design



3. Planning and co-ordination.





Highest demands

Highest production accuracy is demanded for the new high-performance engines in the automotive industry.

4. Acquisition and production.



5. Assembly and pre-adjustment.



6. Packing and despatch.



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1. Tool arrival,...



2. ...incoming tool inspection,...



3. ...re-grinding and/or...

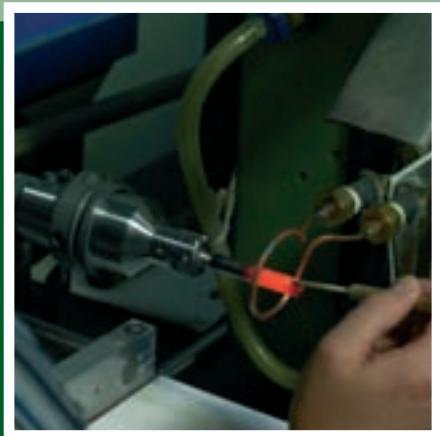


After Sales Service

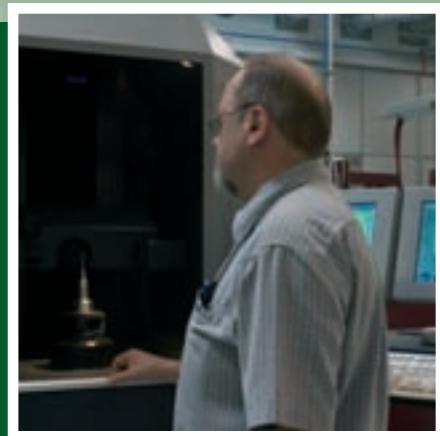
From refurbishing, including
re-grinding, re-tipping and re-coating,
to a complete Tool Management,
you can rely on our know-how.



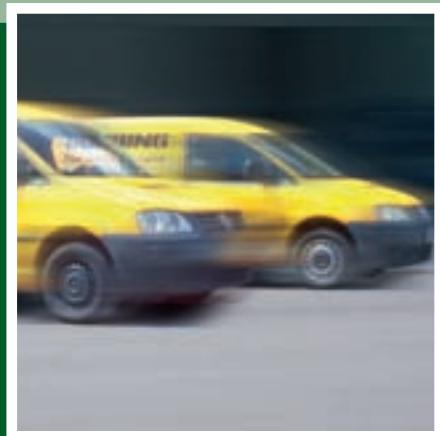
4. ...re-tipping of tools, ...



5. ...final inspection followed by...



6. ...the delivery to the customer.



Service - for the entire tool life

For the benefit of our customers

Naturally, Guhring's service commitment doesn't end when the tools are delivered to our customers. We continue to take care of our products, including PCD and CBN tools, for the duration of their application – world-wide. This includes customer support on-site by our technical field service as well as a comprehensive service program.

Refurbishment

For the PCD and CBN sector our service includes the refurbishment of worn but also the repair of damaged tools.

Prior to the refurbishment we carry out a comprehensive inspection of the incoming tool and determine the overall work required for the refurbishment. In accordance with the result of the incoming tool inspection we choose the most practical and economical way to proceed in close co-operation with the customer: to refurbish the tool or to supply a new tool.

Our refurbishment service also includes the re-tipping of heavily worn PCD and CBN cutting edges, if there is only slight wear we can re-grind the cutting edge. A final inspection and the return of the as new tool follows.

Tool Management

Naturally, Guhring not only provides a re-tipping or re-grinding service for your PCD and CBN cutting tools via our PCD and CBN tool production. Guhring's service division provides a complete tool management – not only for PCD and CBN tools, but for all your tools!



Our technical field service

Competent support provided by qualified personnel

A specifically trained and qualified technical field service team provides global support in all matters regarding the application of PCD and CBN tools. Guhring PCD and CBN technicians analyse

each specific machining process on-site with the customer. The technicians then work out the optimal tool solution in close co-operation with the customer and with support provided by the tool

design department and production. Furthermore, they provide on-site support for the initial trial run and of course for the duration of the entire production run.



World-wide network

In addition to a specialised PCD and CBN field service, Guhring provides a comprehensive support network for its customers on every continent. This includes a

world-wide technical field service with in excess of 130 application technicians and technical field service engineers, 26 production centres, 36 service centres for re-grinding and re-coating as well as

subsidiaries in 43 countries and marketing partners all over the world.

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