

PCD AND CBN TOOLS



GUHRING

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.

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.

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 characteristics for 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 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.

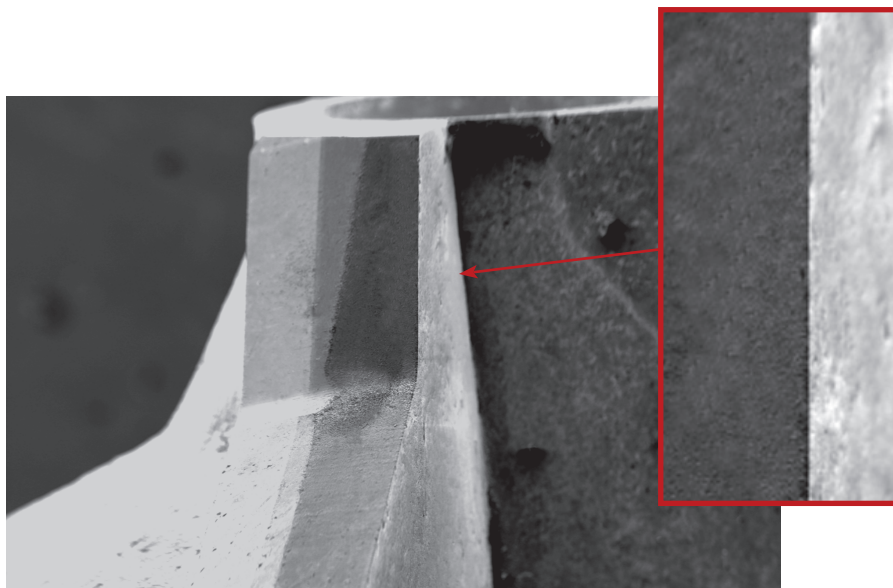


Fig. 1: PCD-tool
Convincing, wear-resistant diamond cutting edge

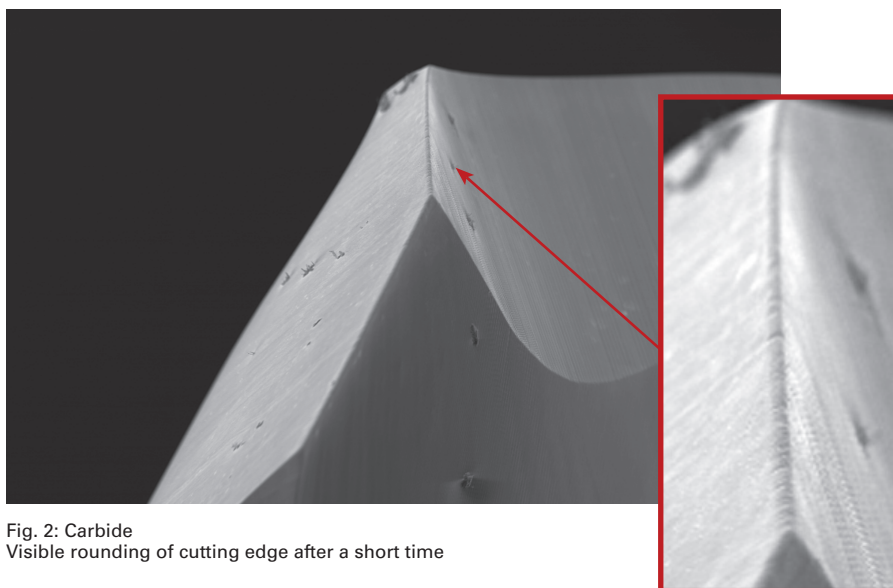


Fig. 2: Carbide
Visible rounding of cutting edge after a short time

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 the machine tool 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

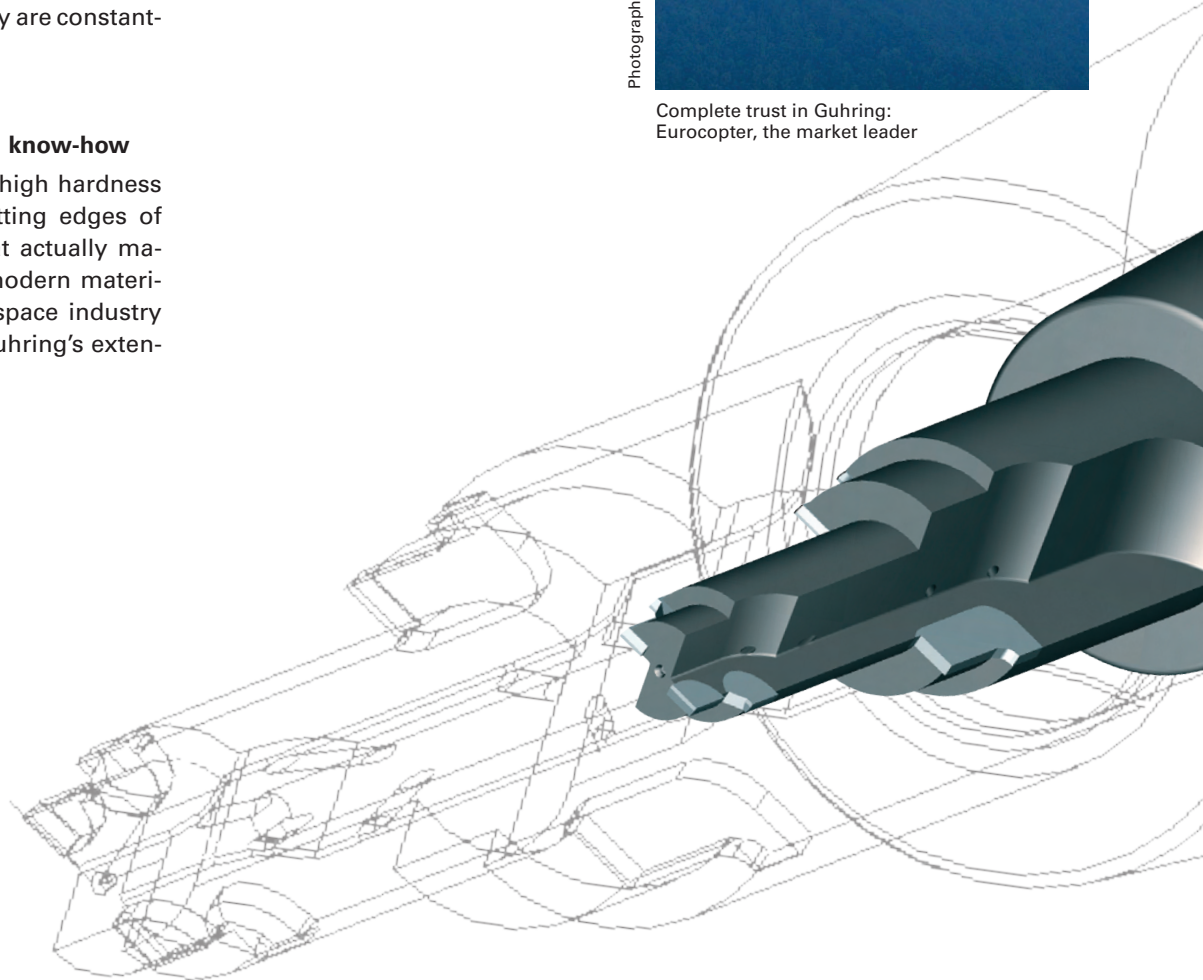
In many cases it is the high hardness and the very sharp cutting edges of PCD and CBN tools that actually makes the machining of modern materials applied in the aerospace industry possible. In addition, Guhring's exten-

sive know-how in 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.



Photograph: Eurocopter

Complete trust in Guhring: Eurocopter, the market leader



Airbus application: Guhring tools with PCD cutting edges



Technology leader – Airbus: Composite materials require PCD and CBN tools



Photograph: Volkswagen AG*

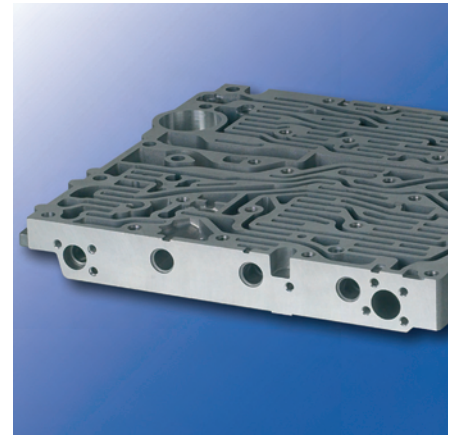


Multi-faceted application:
Milling, drilling and reaming of a transmission housing

Better performance - less fuel consumption

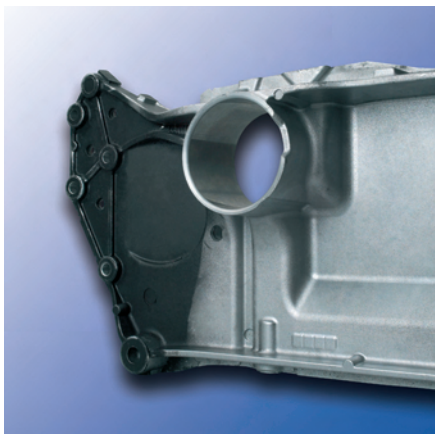
Lightweight construction for better performance and less fuel consumption in the automotive industry is leading increasingly to the application of special materials such as aluminium and magnesium alloys in this field. Typical workpieces are, for example, engine blocks, cylinder heads, crankshafts and camshafts as well as transmission housings – ideal for the application of PCD and CBN tools.

*Publication with kind permission of Volkswagen AG



Finish machining:
Slide valve holes in a control plate.

Photograph: Volkswagen AG*



Complete machining:
Motor mountings in a revolving machine



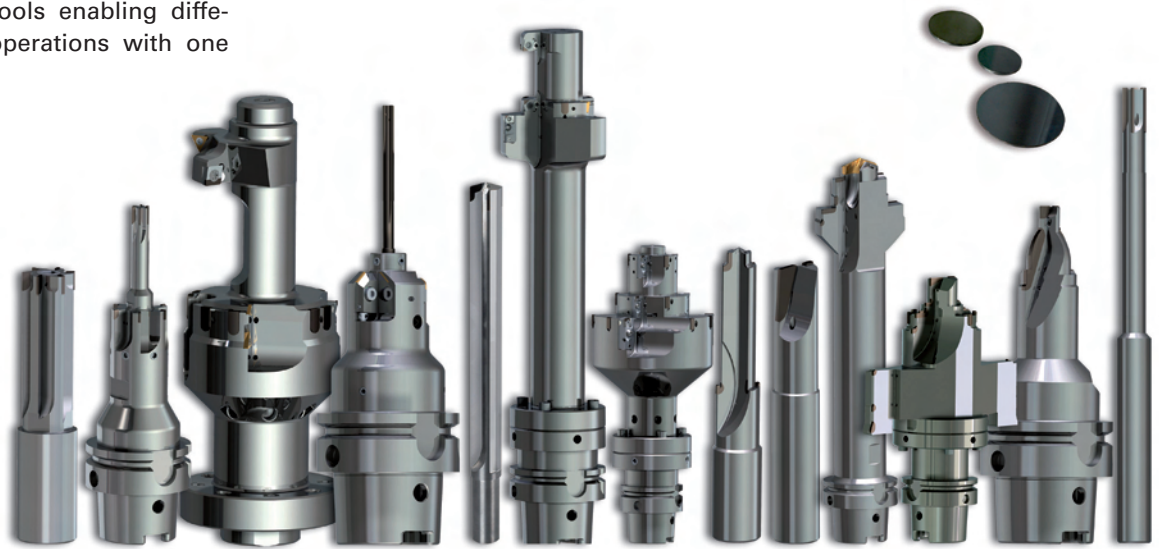
Demanding:
Complete machining of a cylinder head



Safety component:
Drilling and reaming of a master brake cylinder

Standard and highly complex PCD 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.



Standard and highly complex CBN special tools

Guhring's CBN tool range includes, dependent on the range of application, drills, milling cutters, reamers and interchangeable inserts. These tools are applied in the automotive and medical industry as well as other specific applications. For example, CBN tools from Guhring are successfully and economically applied in the production of wheels, pumps and shafts.





Standard solutions for special tools

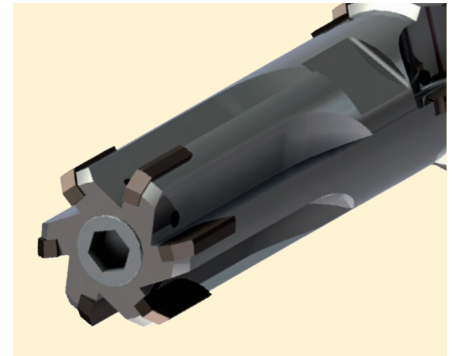
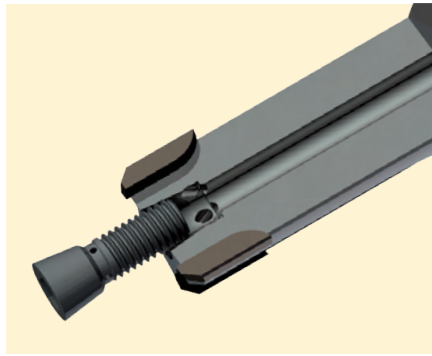
As individual as your special tool may be, with indexable inserts, short clamping holders and cartridges – i.e. the wear components in the highly stressed cutting area of the tool – you can with Guhring draw upon a broad and extensive standard range. Your advantages: fast stock availability and favourable costs together with highest quality and ease of operation!

Reaming with maximum Accuracy

Unique technologies for perfect, highly efficient reaming

For reaming operations with PCD- or CBN-tipped tools, Guhring has developed unique solutions opening up completely new possibilities regarding accuracy and economic efficiency. Reaming tools with these technologies offer the user the following clear competitive advantages:

- simple, quick and highly accurate diameter setting for first and second step.
- both tool diameters can be re-adjusted when tool is in clamped condition.
- machining of through and blind holes thanks to the integrated expanding screw in the tool point.
- optimal coolant delivery to the cutting edges thanks to radial coolant exits in the expanding screw.
- highest feed rates thanks to several cutting edges.
- reduction in machining time.
- maximum accuracy and extreme tool life.



Patent applied for coolant delivery directly to the cutting edges via expanding screw

- quick, simple and highly accurate setting of the first tool step diameter.
- radial delivery of the coolant directly at the cutting edges via expanding screw.
- optimal tool lubrication.
- optimal chip evacuation from the hole.

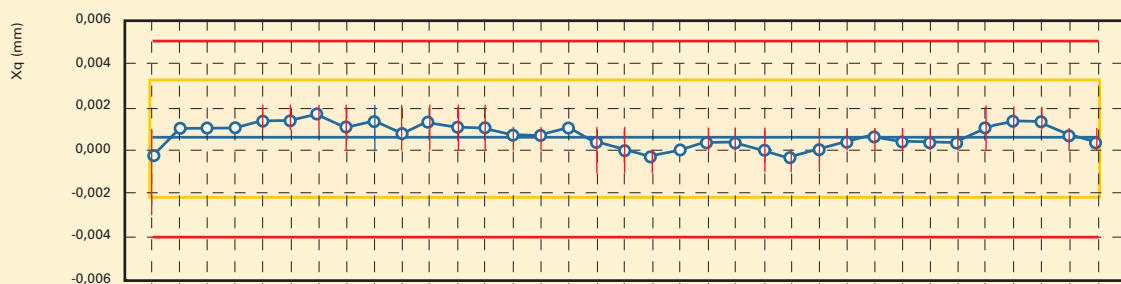
The expanding screw is integrated in the tool head

- the expanding screw is completely integrated in the tool head.
- the reamer operates - in contrast to conventional solutions with a protrusive expansion screw - down to the base of the hole without problem.
- it enables the machining of through holes as well as blind holes.

The patent pending stepped reamer diameter setting

- with two-step reamers the inner tool body acts as an expanding screw.
- inner tool body and outer unit are screwed together.
- the expansion of the step diameter is performed via the integrated taper of the inner tool body.
- the diameter setting of the second

- step is carried out by simply turning the inner tool body.
- the diameter setting can, therefore, be carried out when the tool is clamped.
- the ground flats on the inner tool body suit an adjusting wrench.

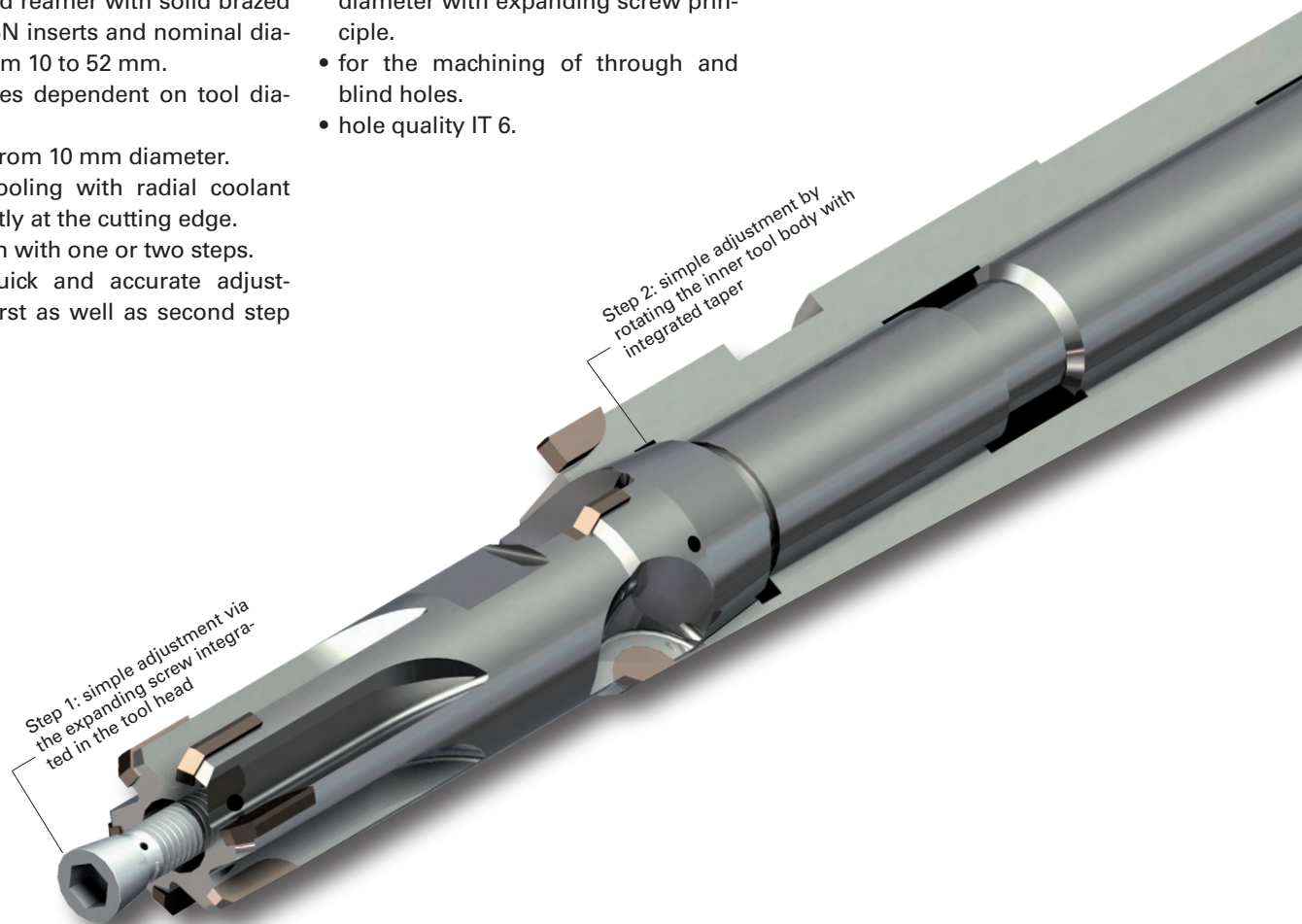


Continued maximum accuracy: For 10,000 holes inspected the max. scattering was 2 μm .

PCD-tool Designs and their application possibilities

Various PCD or CBN reamer designs

- multi-fluted reamer with solid brazed PCD or CBN inserts and nominal diameters from 10 to 52 mm.
- no. of flutes dependent on tool diameter.
- six flutes from 10 mm diameter.
- internal cooling with radial coolant exits directly at the cutting edge.
- tool design with one or two steps.
- simple, quick and accurate adjustment of first as well as second step diameter with expanding screw principle.
- for the machining of through and blind holes.
- hole quality IT 6.



Stepped PCD-reamer

Multi-fluted two-step PCD-reamer with step diameters 17 mm and 27 mm

Performance data:

- hole quality IT 6
- concentricity 2 μm
- feed rate 2800 mm/min.
- cutting speed 680 m/min.
- applied for 120,000 holes

PCD-reamer without step

Multi-fluted PCD-reamer with diameter 28 mm

Performance data:

- hole quality IT 5
- concentricity 2 μm
- feed rate 2900 mm/min.
- cutting speed 710 m/min.
- applied for 160,000 holes



Efficient parent metal machining of valve seat and valve guide bores

The parent metal machining of valve seat and valve guide bores in a cylinder head belongs to the most demanding machining tasks in the automotive industry. Due to the high demands for circularity, form accuracy and concentricity a single-flute, adjustable reamer is the classic tool for this machining task as it guarantees the required precision with a long tool life. The tool, however, has its limits regards satisfying the demand for reducing the cycle time because it has only one flute.

For this reason, Guhring has developed a multi-flute and double adjustable PCD-tipped two step reamer that optimally satisfies the demand for the efficient parent metal machining of valve seat and valve guide bores:

- highest accuracy with an extremely long tool life through the diameter setting at the cutting edges of both steps.
- highest cutting parameters thanks to multiple flutes and optimal cooling.
- simple to operate as the diameter setting of both steps can be carried out while the tool is clamped.

Perfect results thanks to optimal tool design

A multi-flute, PCD-tipped two step reamer is applied for the parent metal machining of the valve seat and the valve guide bores in one setting. Two tools of identical design are applied for the machining of the inlet and exhaust valve.

- exhaust: Machining of the valve seat bore of 28.5 mm diameter and the valve guide bore of 11 mm diameter, each with 6 flutes. Both step diameters can be adjusted independently of each other.
- inlet: Machining of the valve seat bore of 35.5 mm diameter and the valve guide bore of 11 mm diameter, each with 6 flutes. Both step diameters can be adjusted independently of each other.
- the simple, quick and highly accurate diameter setting when the tool is clamped allows the re-adjustment of both diameters at any time. Subsequently, it also results in increased tool life.
- the design of the reamer provides a reliable and compliant process with the demand for circularity, form accuracy and concentricity and an extremely long tool life with high cutting rates.
- the coolant delivery enables an optimal lubrication of the cutting edges and supports the chip evacuation.



Especially for the complete machining of cylinder heads, accuracy as well as the economic efficiency are the centre point of demands on the tool supplier. Due to the multi-valve technology a large proportion of the overall cost of cylinder head machining falls on the pre- and finish machining of valve seats and valve guides.

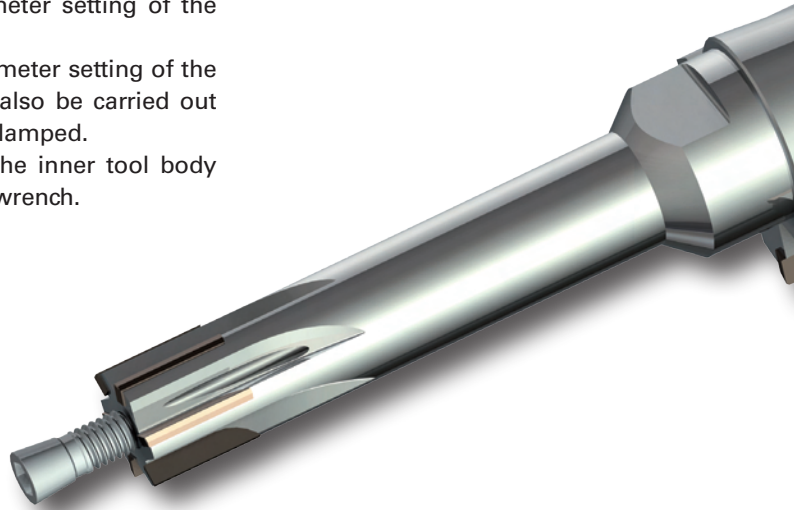
In order to reduce costs with the application of multi-flute reamers with considerably increased cutting speeds while retaining the same accuracy and long tool life in comparison to conventional single-flute tools, Guhring has developed the diameter setting for both steps.

The patent pending diameter setting of the second step

- the inner tool body acts as expanding screw for the second step.
- inner tool body and outer unit are screwed together.
- the expansion of the step diameter is performed via the integrated taper of the inner tool body.
- simple rotation of the inner tool body leads to the diameter setting of the second step.
- therefore, the diameter setting of the second step can also be carried out when the tool is clamped.
- ground flats on the inner tool body suit an adjusting wrench.

The expanding screw is integrated in the tool head

- the expanding screw is completely integrated in the tool head.
- the reamer operates - in contrast to conventional solutions with a protrusive expansion screw - down to the base of the hole without problem.
- it enables the machining of through holes as well as blind holes.



The PCD-tipped, double adjustable multi-flute two step reamer is successfully applied for the machining of the initial hole in the following work-piece:

- 6-valve cylinder head for a 3-cylinder engine
- material G-AISI7Cu3
- horizontal machining on machining centre
- tool holder HSK 63
- internal cooling with soluble oil 6 %
- coolant pressure 20 bar

Performance data comparison

6-flute PCD-tipped, double adjustable two-step reamer

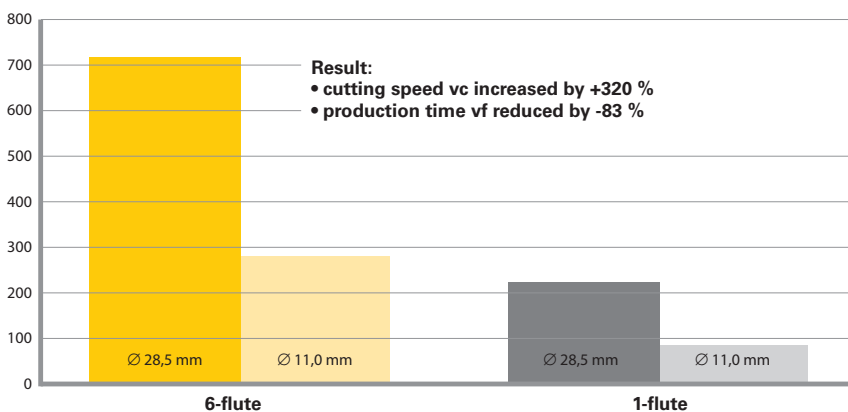
- production time: 7.80 seconds per cylinder head
- cutting speeds for machining the initial exhaust valve hole:
diameter 11 mm = 276.46 m/min
diameter 28.5 mm = 716.28 m/min
- feed rate vf:
both vf = 2400 mm/min

1-flute two step reamer with PCD interchangeable insert

- production time: 46.35 seconds per cylinder head
- cutting speeds for machining the initial exhaust valve hole:
diameter 11 mm = 86,39 m/min
diameter 28,5 mm = 223,84 m/min
- feed rate vf:
both vf = 338 mm/min

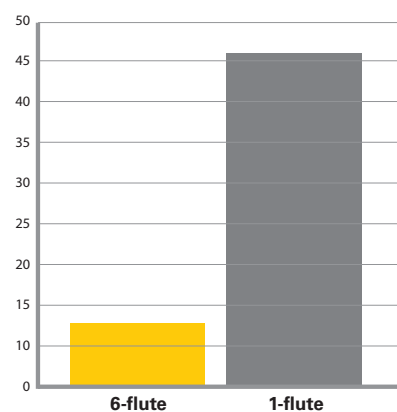
Cutting speed

vc (m/min)



Production time

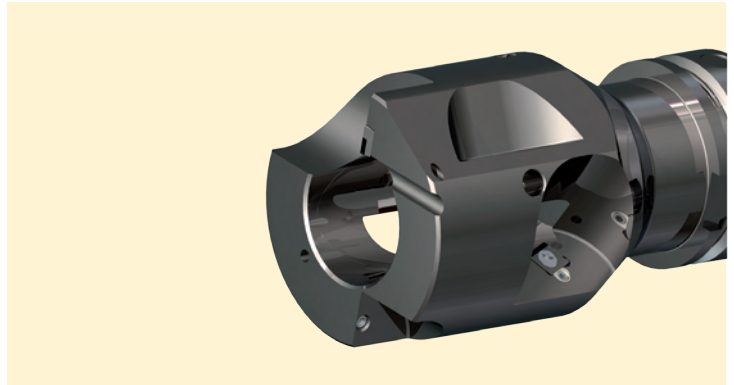
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Intelligent solutions for fine adjustment

Fine adjustment:

- Threaded key adjustment (direct installation)
- ISO indexable inserts, PCD-tipped

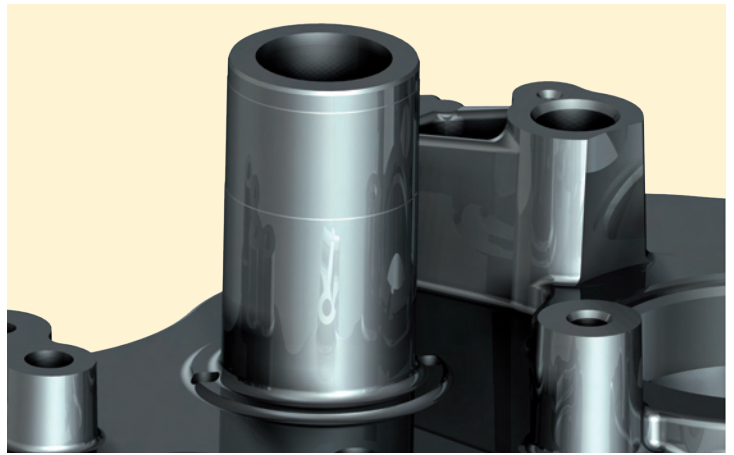


Workpiece:

- Intermediate plate

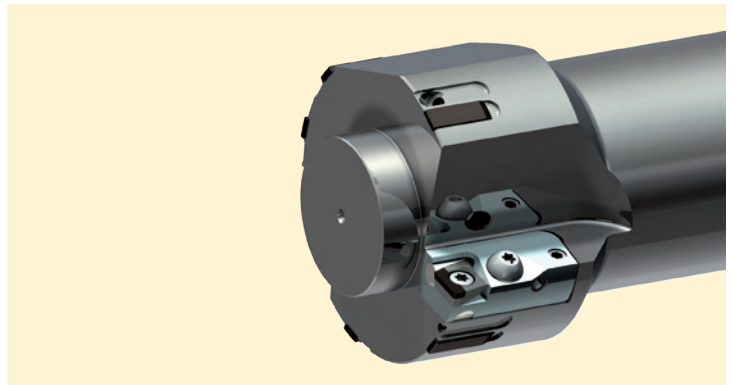
Machining:

- External contour
- Diameter tolerance IT6 (D = 41mm)



Fine adjustment:

- Locating wedge adjustment in cartridge installation Guhring no. 4051) with integrated diameter and length adjustment
- ISO indexable inserts, PCD-tipped
- PCD guide pads



Workpiece:

- Intermediate plate

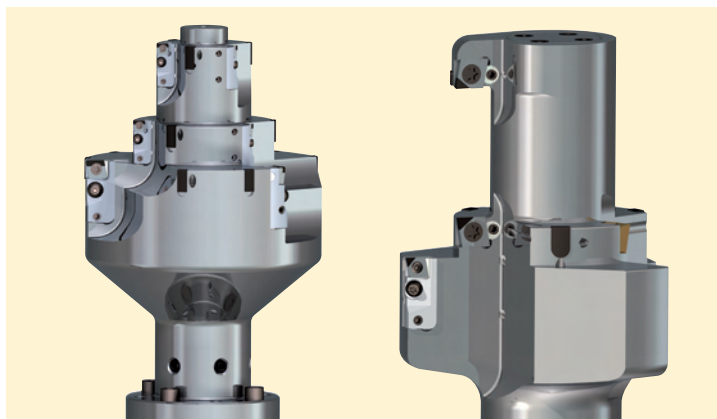
Machining:

- Precision hole
- Diameter tolerance IT6 (D = 70mm)



Fine adjustment:

- Locating wedge adjustment in cartridge installation (Guhring no. 4051) with integrated diameter and length adjustment
- Threaded key adjustment (direct installation)
- Indexable inserts, PCD-tipped
- PCD guide pad and alignment adaptor

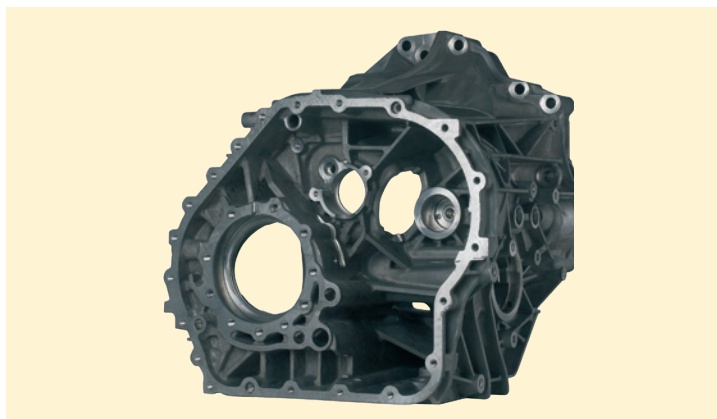


Workpiece:

- Transmission

Machining:

- Bearing seats
- Diameter tolerance IT6



Fine adjustment:

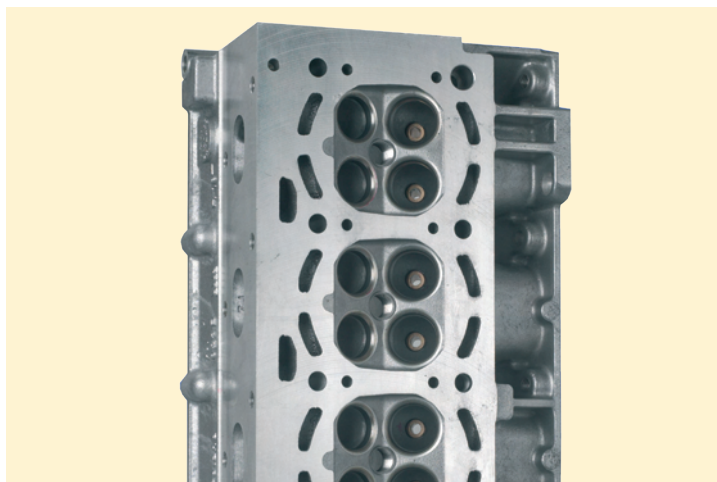
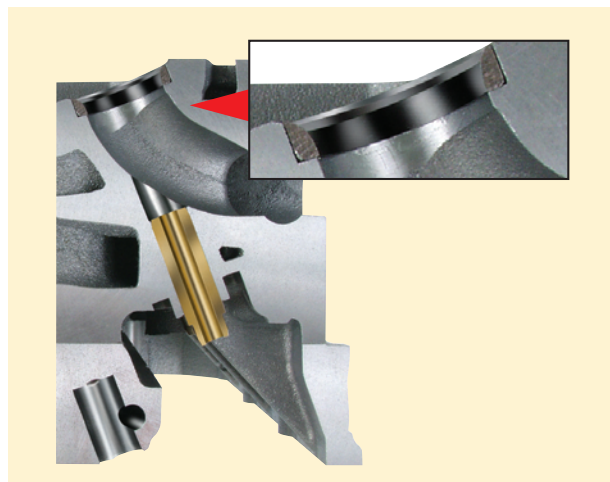
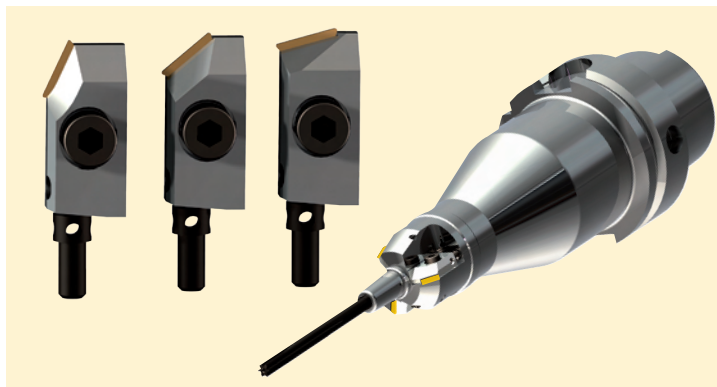
- GP 100

Workpiece:

- Cylinder head

Machining:

- Valve seats
- 60° and 120° adjacent angle
- 90° main seal angle



Fine adjustment via threaded key (GKV)

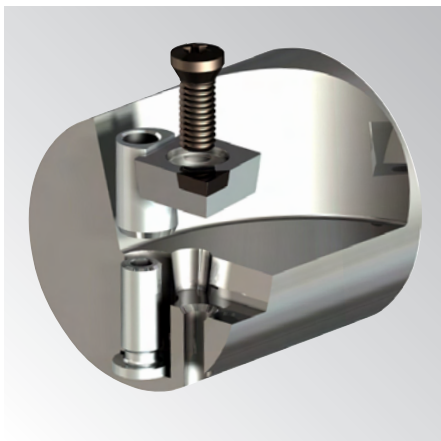
The threaded key adjustment enables the realisation of close stepped tools for finishing operations. A particular advantage is the simple adjustment possibility of the indexable inserts for the adjustment range 0.30 mm in diameter. Depending on the insert position it is possible to carry out an axial as well as a radial adjustment, herewith adjusting the overall length as well as the diameter. Per right hand

turn, the fine adjustment forces the insert into the adjustment direction (forced adjustment).

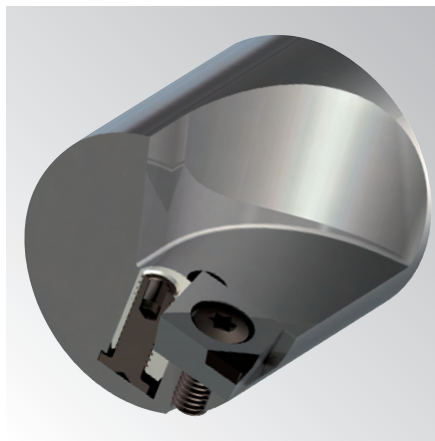
Due to the small dimensions it is possible to produce tools from diameter 16.0 mm with insert size 06 (see table). Different basic insert forms can be applied, i.e. triangular, rhombic or square. Under ideal application conditions, stepped precision holes with quality IT7 can be produced with several inserts in one

machining cycle without prior roughing operations.

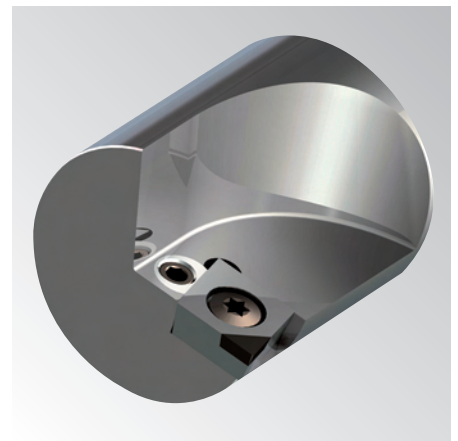
No. of edges	from tool-Ø		
	# insert 06	# insert 09	# insert 12
1	Ø 16 mm	Ø 29 mm	Ø 36 mm
2	Ø 23 mm	Ø 33 mm	Ø 44 mm
3	Ø 30 mm	Ø 44 mm	Ø 60 mm



Easy:
The installation and fine adjustment...



...of a single fluted tool with indexable inserts...



...via threaded key.

Fine adjustment via locating wedge (AKV)

Gühring provides two solutions for the indexable insert installation and the fine adjustment via a locating wedge: either the direct type installation or the cartridge type installation. Both systems provide a secure and tension-free seating of the insert allowing the transmission of high cutting forces thanks to the large area positioning arrangement of the indexable insert to the locating wedge. This enables

large cutting widths and interrupted machining processes. The adjustment range is 0.5 mm in diameter.

A particular advantage of the cartridge solution is that the complete fine adjustment for diameter and length is accommodated in the cartridge. Under ideal application conditions, stepped precision holes with quality IT7 can be produced with the direct as well as the

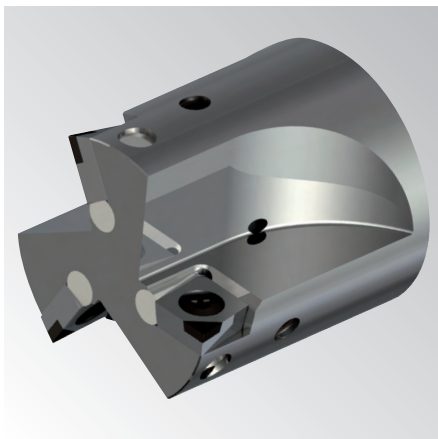
cartridge installation system, applying several inserts in one machining cycle without prior roughing operations.

No. of edges	from tool-Ø	
	index insert. 06	index. insert 09
1	Ø 14 mm	Ø 22 mm
2	Ø 20 mm	Ø 29 mm
3	Ø 23 mm	Ø 33 mm

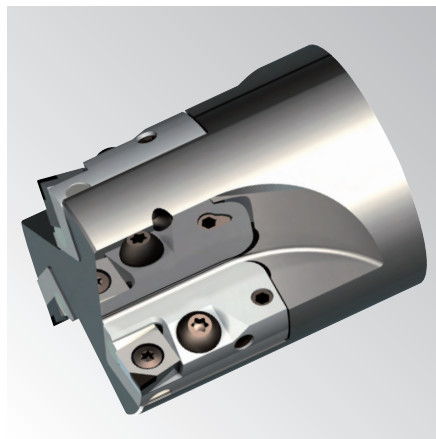
Direct installation with CC/CP 06 +09 as well as with SC/SP 06 +09

No. of edges	from tool-Ø		
	# insert 06	# insert 09	# insert 12
1	Ø 28 mm	Ø 40 mm	Ø 45 mm
2	Ø 28 mm	Ø 40 mm	Ø 45 mm
3	Ø 31 mm	Ø 44 mm	Ø 58 mm

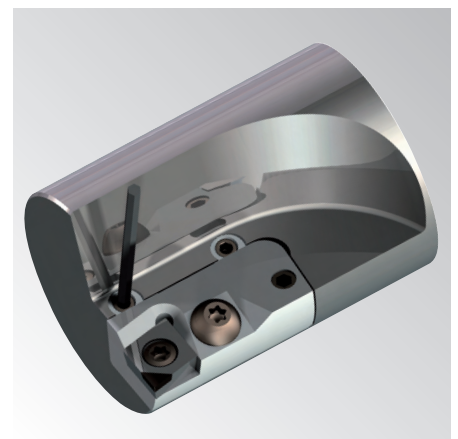
Cartridge installation with CC 06 +09 +12



Direct type installation:
Three fluted tool with locating wedge.



Cartridge type installation:
The complete fine adjustment is located in the cartridge.



Cartridge type installation:
The fine adjustment is located besides the cartridge via threaded key.