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Coromant

# CoroMill® 390

End mills with size 07 inserts

Steel grade GC1130



With new end mills in small diameters, equipped with size 07 inserts, the proven performance of CoroMill 390 is now available for component features with limited cutting-depth requirements. Due to the smaller inserts, a higher cutter-teeth density delivers superior productivity in any type of milling operation. Add the steel grade GC1130, one of the key technological improvements for the world of milling, and your production is set for a profitable milling future.

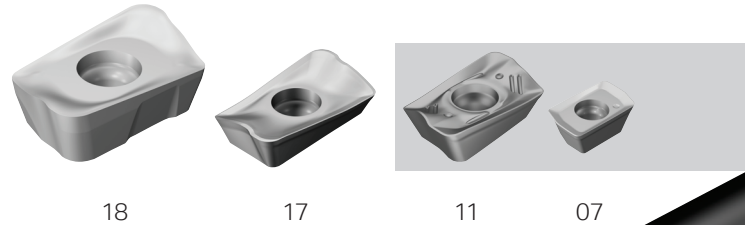
## Optimized cutter bodies

The end mills are produced in a new material with increased heat resistance. Choose between L, M or H pitch. Parts of the assortment have been optimized with differential pitch for vibration-prone applications.

## Durable and smooth-cutting inserts

The light-cutting insert geometries and high-performance grades of this cutter concept give secure milling in all material groups.

Insert size



## Reliable screw coupling

Cutters with Coromant EH coupling are available in diameter 9.7–25 mm (0.375–1.000 inch). The coupling has a self-centring screw that facilitates quick and accurate handling.

## Cylindrical shank

The full assortment of diameter 9.7–25 mm (0.375–1.000 inch) is available with cylindrical shank in normal or extra long versions.

## Secure insert clamping

A new torque key is delivered with each cutter. Its built-in spring functionality makes it easy to mount inserts with correct clamping force, giving reliable and consistent tool life.

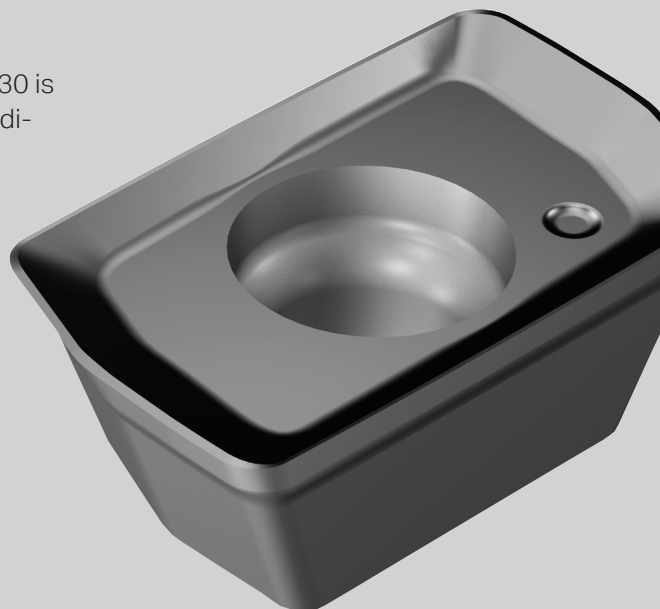
## Benefits with CoroMill 390

- Extremely versatile concept for productive milling in a wide range of operations and materials
- Trouble-free milling due to reliable cutter performance
- Easy-to-use clamping of inserts increases process security

# Zertivo™ grade GC1130

## First choice for steel milling

Taking edge-line security to a whole new level, the steel grade GC1130 is highly reliable and performs brilliantly in unstable or challenging conditions. This makes it a perfect grade for the versatile CoroMill 390.



### Application

- Roughing to finishing
- Wet and dry machining
- Demanding machining conditions

**P** ISO application area

## Unmatched edge-line security

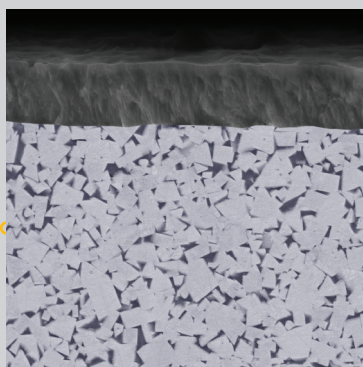
### High-Cr content substrate

The high-Cr content fine-grain substrate is optimized to withstand edge-line chipping and cracks arising from difficult machining and demanding conditions, such as temperature variations.

### Next generation PVD coating

The new PVD coating in GC1130 is optimized for steel milling. It is produced with Zertivo™ technology, giving great edge-line security and reduced flaking due to optimized cutting edge integrity. This makes the insert resistant to chipping.

[www.sandvik.coromant.com/zertivo](http://www.sandvik.coromant.com/zertivo)



### Benefits with GC1130

- Secure machining thanks to long and predictable tool life with a clean and intact edge
- High metal removal rate, even in difficult and unstable conditions
- Great performance in both dry and wet machining

# One tool. Many solutions.

Milling cutters that are able to perform at the top level in many different operations and conditions bring numerous benefits, for example a smaller tool inventory and shorter cycle times as a result of fewer tool changes. Whether your priority is optimized processes with close precision demands or mixed production with a focus on delivering value in a wide range of operations and materials, CoroMill® 390 is the end mill for you.

## **Pocket milling**

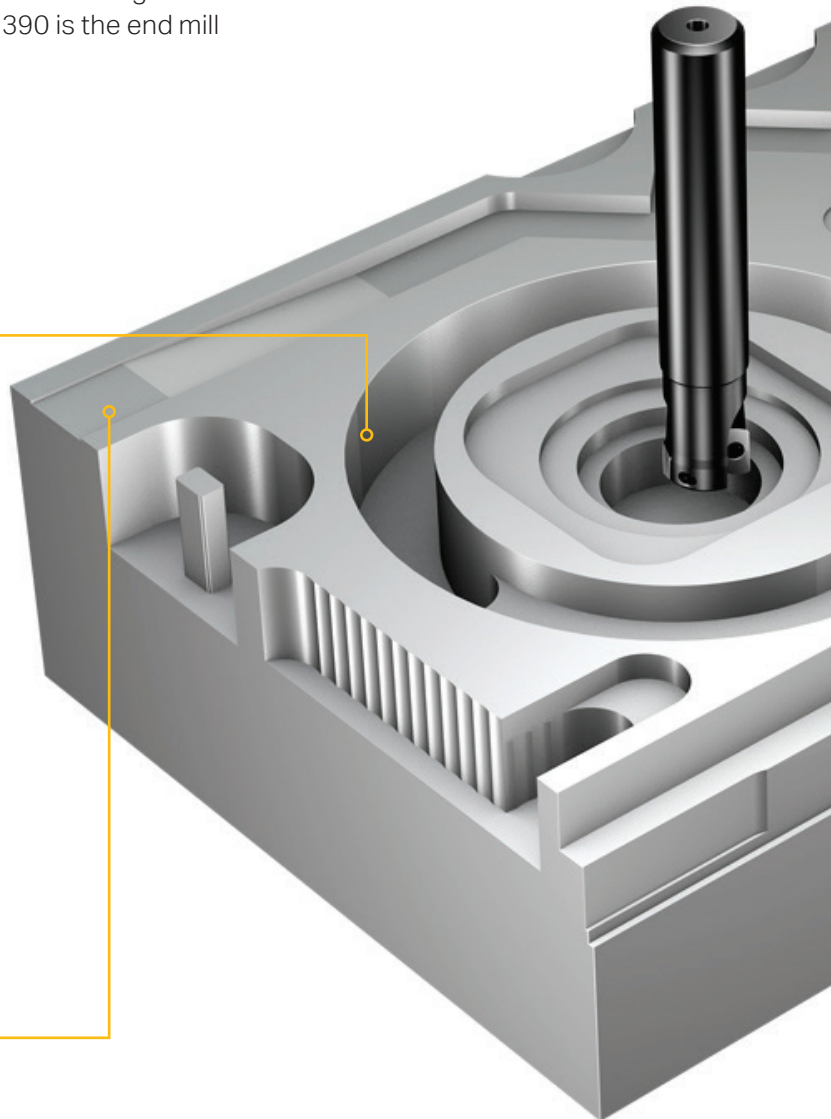
Challenge: Efficient and secure opening of cavities.

Solution: Using helical interpolation and linear ramping to create holes from a solid workpiece requires strong insert face geometry. The CoroMill 390 inserts are developed to adhere the stress caused by steep ramping or demanding interpolation, giving a low-vibration process with even tool life.

## **Slot milling**

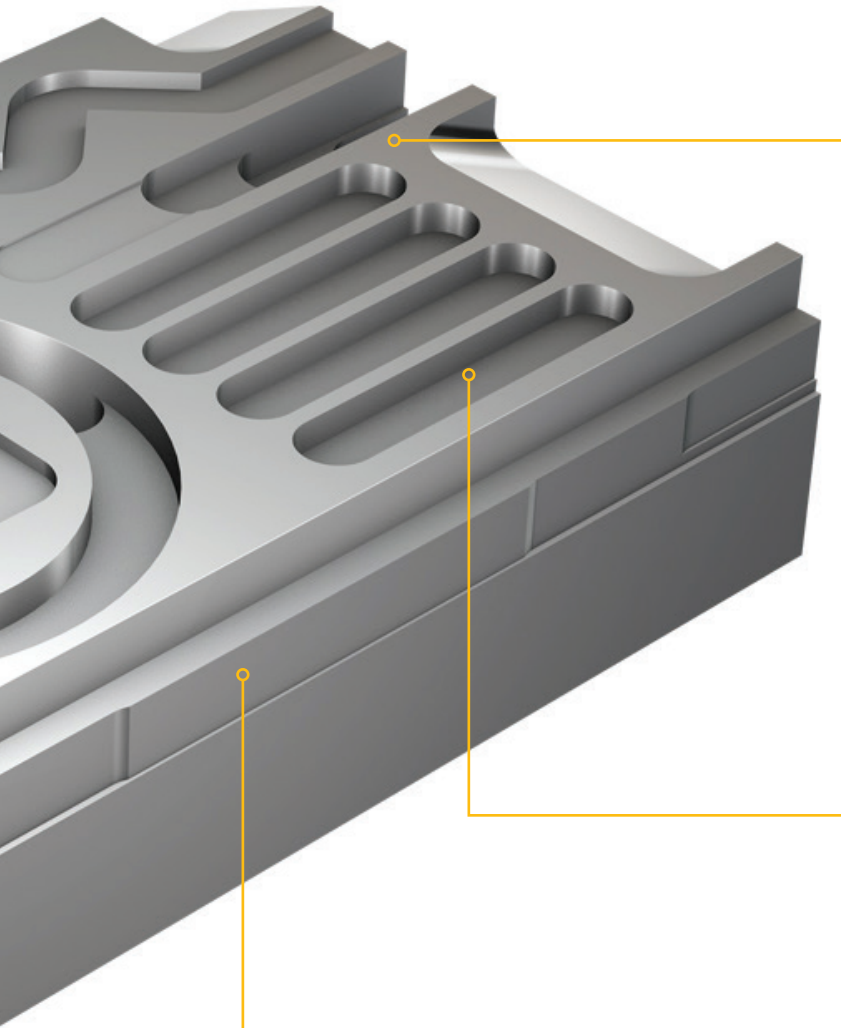
Challenge: Chip evacuation and vibration.

Solution: Insert geometries designed for favourable chip formation and chip evacuation. When milling with large engagements, vibration often cause rapid tool wear. The light cutting inserts of CoroMill 390 in combination with cutters with optimized differential pitch take care of this issue and give a low-vibration milling process.





ISO application area



### Face milling

Challenge: Metal removal rate and surface finish.

Solution: The durable CoroMill 390 inserts are capable of ambitious cutting parameters. -L geometries designed for milling with low cutting forces are perfect for facing surfaces with shiny finish and close tolerances.

### Key slot milling

Challenge: Accurate slot dimensions and tolerances.

Solution: The CoroMill 390 assortment includes cutters with size 07 inserts in dimensions specifically designed for key slots. With a tool diameter 0.3 mm (0.012 inch) smaller than the slot width, a suitable amount of stock is left for the subsequent finishing operation.

### Shoulder milling

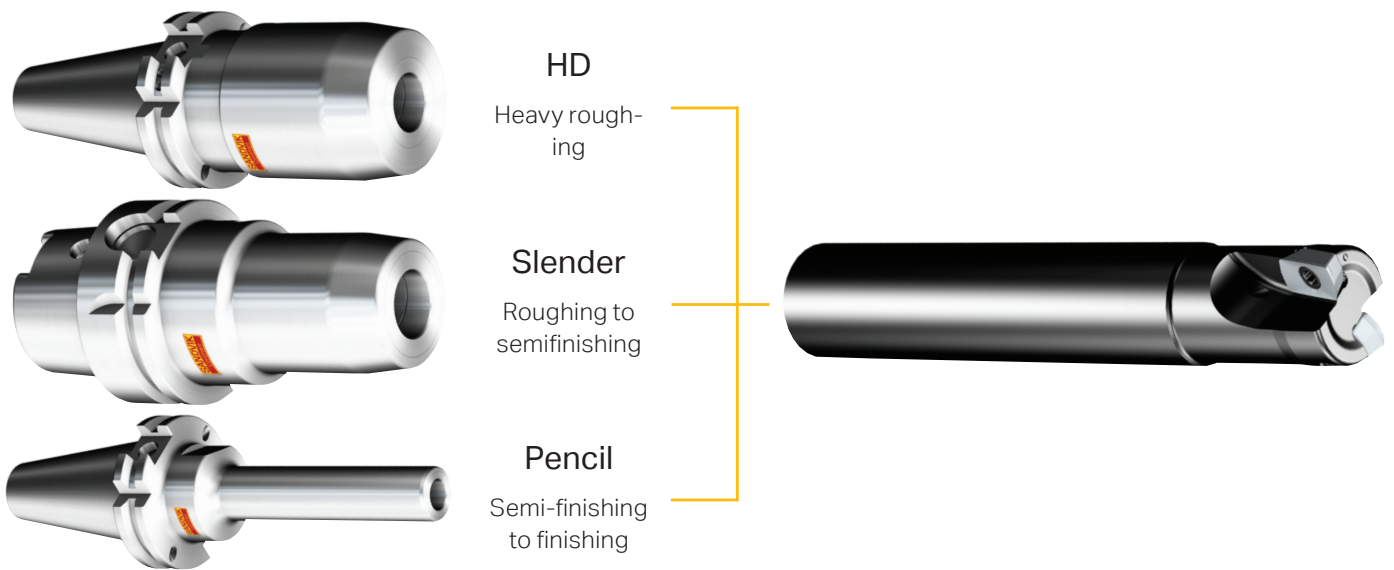
Challenge: Precise contours without steps in repeated shoulder milling.

Solution: Close-tolerance inserts and an exact insert position secure shoulders without steps. The typical smooth cutting action of CoroMill 390 limits radial cutting forces, which gives machining with minimal bending and good wall perpendicularity.

See how CoroMill 390 cuts this component with ease.



# Successful machining with optimized tool assemblies



## High-precision hydraulic chuck

CoroChuck™ 930 is the first choice tool holder for cylindrical shanks.



## Modular system Coromant EH

Get the required reach and accessibility with shanks and modular adaptors. In short overhang applications you can increase your productivity due to short gauge length with integrated machine adaptors.





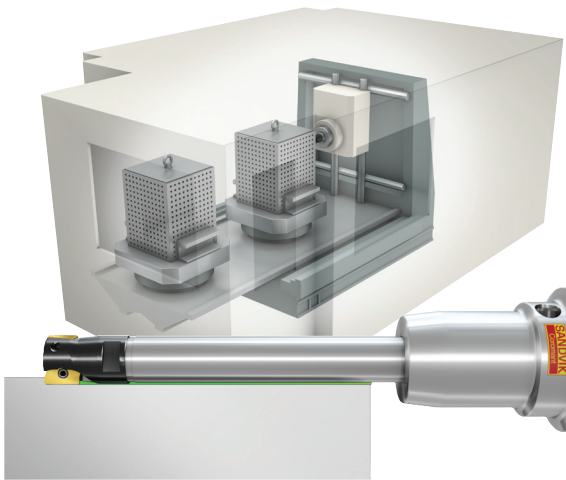
## Small to medium machining centres

Cylindrical shanks are a flexible solution suitable for numerous tool holding options.

The short tool assembly of an integrated machine adaptor and cutter head with Coromant EH coupling gives high productivity when the gauge line is critical.

Don't just take our word for it. See films of CoroMill 390 with Coromant EH coupling to discover how big the difference can be.

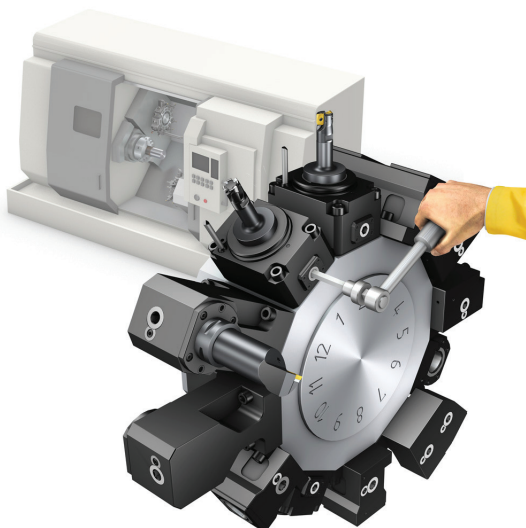
[www.youtube.com/sandvikcoromant](http://www.youtube.com/sandvikcoromant)



## Multi-task machines

Use undersized shanks in different lengths and materials for stability and clearance when milling with long overhang.

The combined modularity of Coromant Capto® and Coromant EH offers accessibility for hard-to-reach features.



## Turning centres with driven tool holders

With the short tool assembly consisting of only the adaptor and cutter you can reach high productivity when the gauge line is critical or the swing diameter is limited. The versatile CoroMill® 390 is perfect when the number of tool positions are limited.

## Coromant Capto® quick change clamping units for driven tools

Reduce set-up time to below one minute with quick change. Find out more about how to increase machine utilization online.

[www.sandvik.coromant.com/coromantcapto](http://www.sandvik.coromant.com/coromantcapto)

## Performance: Slot milling in steel

A subcontractor's productivity was limited by its end mill as the two-insert cutter could only manage 2 mm (0.079 inch) cutting depth. When switching to a CoroMill 390 cutter with three size O7 inserts the cutting depth could be increased to 3 mm (0.118 inch). As bonus, the burr formation caused by the previous tool was nowhere to be seen when milling with the new cutter. The overall verdict: a double win for CoroMill 390 with increased productivity and tool life.

+225%  
productivity

Customer case		
Workpiece material	P2.1.Z.AN	
Operation	Slot milling	
Tool	R390-012A12-07M 390R-070204M-PM 1130	Competitor tool
Cutting data		
$v_c$ m/min (ft/min)	200 (656.166)	150 (492.125)
$v_f$ mm/min (in/min)	900 (35.433)	600 (23.622)
$h_{ex}$ mm (inch)	0.1 (0.004)	0.1 (0.004)
$a_p$ mm (inch)	3 (1.118)	2 (0.079)
$a_e$ mm (inch)	12 (0.472)	12 (0.472)
Result		
Time in cut, min	3.76	5.5

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# CoroBore® 826

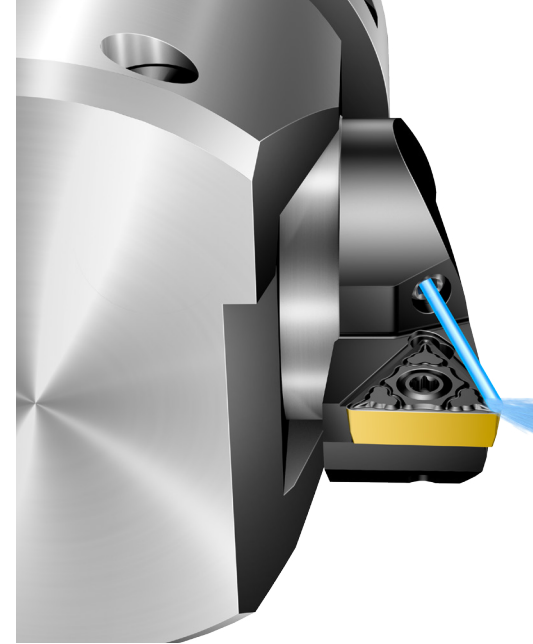
with high precision coolant

## Chip control solution

Machine stops caused by chip tangling around the tool or spindle is a common problem in fine boring. Not anymore. With the unique high precision (HP) coolant directed to the cutting edge, CoroBore® 826 HP ensures excellent chip control and chip evacuation. Combine this with the user-friendly stepwise scale setting of the tool diameter and you have the perfect tool for accurate fine boring. Enjoy trouble-free machining and close hole tolerances!

## High precision coolant

Chip control is critical to ensure high surface quality. The nozzle on CoroBore® 826 HP directs the high precision coolant jet to the cutting edge in order to efficiently control and break the chip. Chips are then easily evacuated from the hole.



## Precise and easy diameter setting

With the stepwise setting of the hole diameter you can actually feel the microns! This makes tool setting extremely user-friendly and precise, even when visibility or access is limited. Due to precise setting, process security and close hole tolerances are achieved.

Each step adjusts the diameter 0.002 mm (0.0000787 inch).



## TCEX – Brings out the best in fine boring

TCEX Wiper inserts are designed for optimized chip formation in fine boring operations, allowing easy chip evacuation and great surface finish, even at very high feeds.

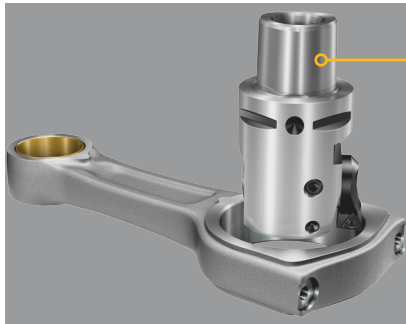
## Benefits

- Process repeatability due to controlled chip breakage with high precision coolant
- Great surface quality and close hole tolerances
- User-friendly diameter setting, even when visibility and access are limited

## Application

CoroBore® 826 HP is your first choice fine boring tool in the range of 36–1260 mm (1.417–49.606 inch). It is optimized for process repeatability, hence ensuring excellent surface finish and close hole tolerances in large batch machining.

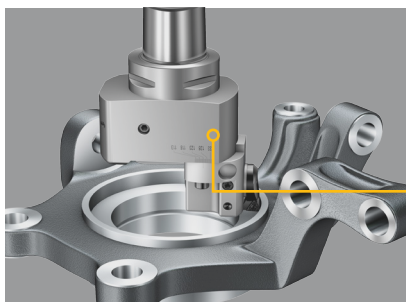
**P M K N S**  
ISO application area



Connecting rod

## CoroBore – Modular Tooling

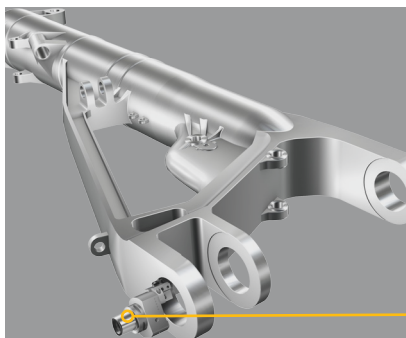
To make it easy to find your CoroBore® 826 HP fine boring solution, dedicated assembly kits are available for a wide range of hole diameters. For best stability and hole quality, use Coromant Capto® machine interface adaptors in combination with CoroBore 826 HP as a modular tooling solution.



Steering knuckle

For small diameter boring, 36–91 mm (1.417–3.583 inch), choose the integrated Coromant Capto® solution.

For diameters in the range of 92–154 mm (3.662–6.063 inch), the modular solution with the internal counterweight is the optimal choice.



Landing gear

For large diameter boring, 154–1260 mm (6.063–49.606 inch), combine a separate fine boring head with our flexible CoroBore XL system based on your specific needs.

## Assortment

Diameter range	Fine boring solution	Sold as
36–91 mm (1.417–3.583 inch)	Integrated Coromant Capto®	Assembly kit including adaptor and cartridge
92–154 mm (3.662–6.063 inch)	Modular solution	Assembly kit including adaptor, fine boring head and cartridge
154–1260 mm (6.063–49.606 inch)	Fine boring head	Separate component

For additional information see [www.sandvik.coromant.com/corobore826](http://www.sandvik.coromant.com/corobore826)

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The logo consists of the word "SANDVIK" in a bold, red, sans-serif font, with "Coromant" in a smaller, black, sans-serif font directly below it. The text is contained within a thin red rectangular border.



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# Turning grades GC3225 and GC3210

Two grades covering  
all cast iron turning  
operations

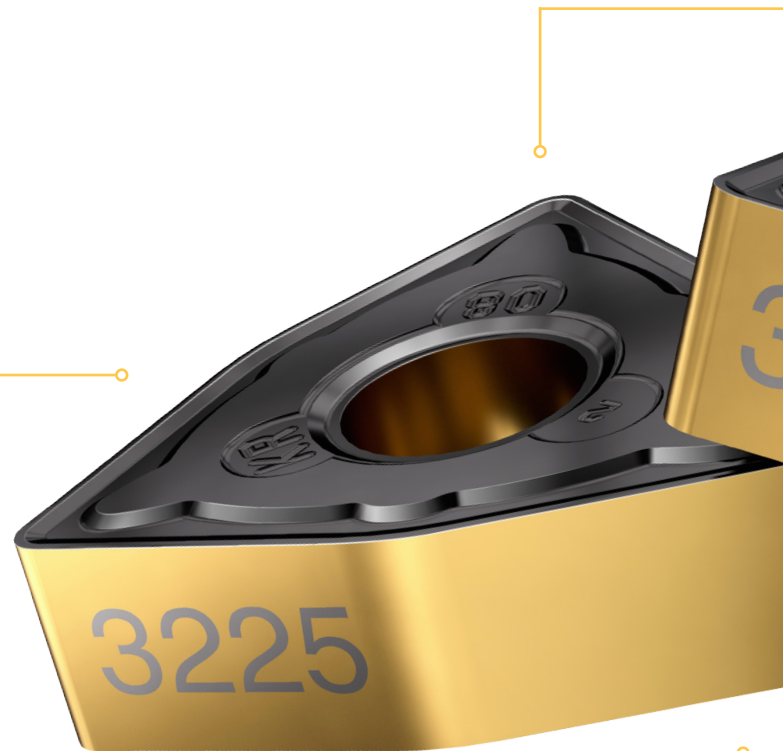
# Security and high wear resistance in cast iron

The insert grades GC3225 and GC3210 are two broad grades designed to excel within their application area. Together they give you a high-performance grade chain for secure machining in any cast iron operation.

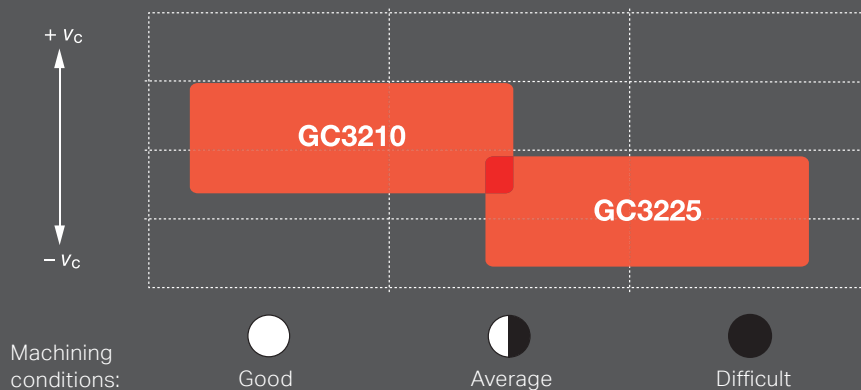
**GC3225: secure turning even in the most difficult machining conditions.**

Cemented carbide substrate with high toughness designed to match coating for optimal performance in demanding operations

The coating properties provide the greatest edge-line security with good wear resistance, which gives prolonged tool life under difficult to very difficult machining conditions



## Application



**GC3210: high flank wear resistance at good to average machining conditions.**

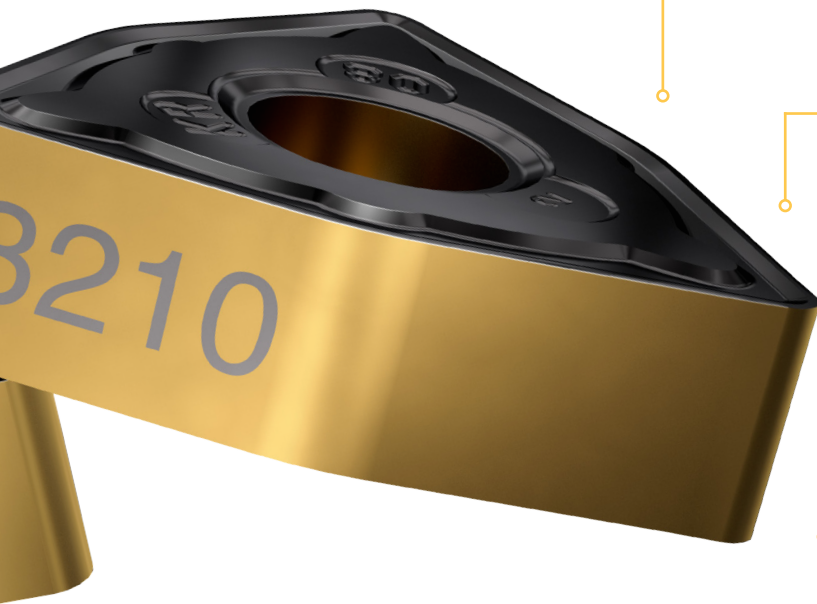
Optimized micro-geometry design for light cutting action, reducing cutting forces and improving tool life

Cemented carbide substrate designed to match the coating for optimal performance

The coating properties provide high wear resistance combined with good edge-line security, which gives prolonged tool life in good to difficult conditions

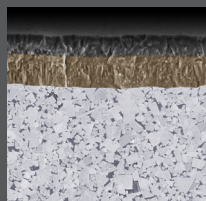
FSMT-CVD coating (Fine Structure Medium Temperature process) with fine-grained columnar TiCN coating and a smooth surface layer of Al<sub>2</sub>O<sub>3</sub>

New CVD coating with columnar TiCN coating and a smooth surface layer of Al<sub>2</sub>O<sub>3</sub>

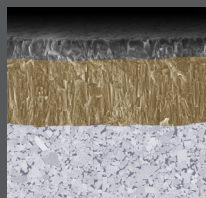


## Benefits

- Easy to choose – the two grades cover the cast iron application area suitable for cemented carbide
- High edge-line security and flank wear resistance in cast iron turning



Coating, substrate in layers, GC3225



Coating, substrate in layers: GC3210

## Assortment

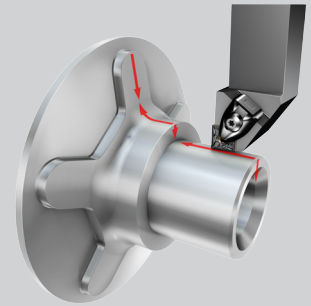
The insert grades GC3210 and GC3225 are available in T-Max® P, T-Max®, CoroTurn® 107 and CoroTurn® 111.

[For more information see Supplement 15.2](#)

### Performance GC3225: machining a hub

In this test involving the machining of nodular cast iron, it was possible to increase tool life by 70% using GC3225 instead of a competitor grade.

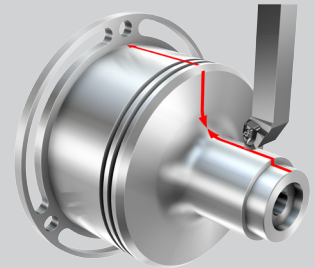
Operation	External axial and facing, roughing	
Coolant	Emulsion	
Workpiece material	Cast surface, CMC09.1, (MC K3.1.C.UT), 200 HB	
Insert	WNMA080412 (WNMA433)-KR	
$v_c$ m/min (ft/min)	220 (722)	
$f_n$ mm/rev (inch/rev)	0.15–0.3 (0.006–0.012)	
$a_p$ mm (inch)	1.5 (0.059)	
Time in cut (min/component)	1.2	
Results	<b>GC3225</b>	<b>Competitor</b>
Tool life, pcs	17	10
Tool life increase	70%	



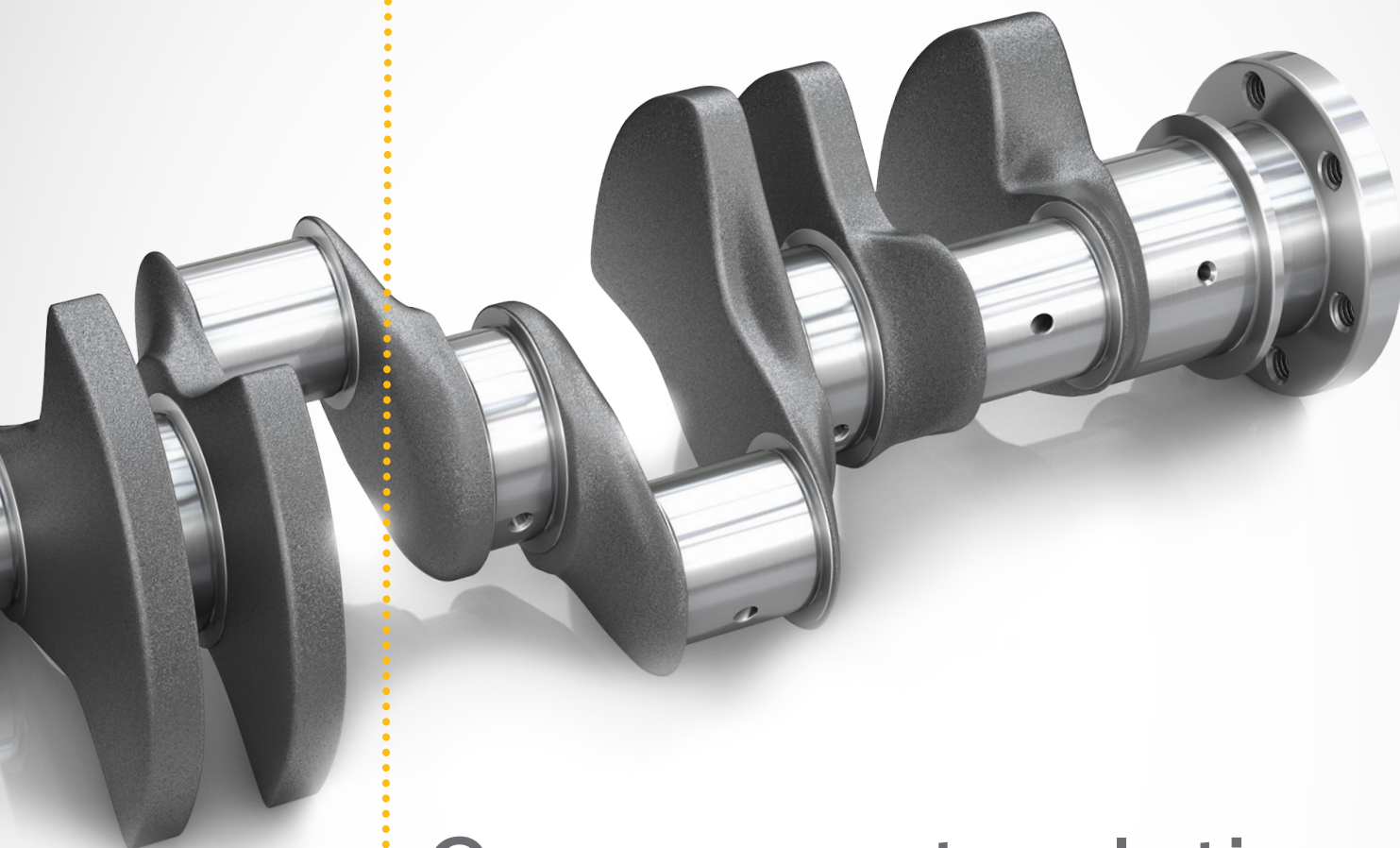
### Performance GC3210: machining a differential case cover

After changing to GC3210 instead of a competitor grade, it was possible to increase tool life by 38%.

Operation	External axial and facing, roughing	
Coolant	Oil	
Workpiece material	Cast surface, CMC09.2, (MC K3.2.C.UT) 240 HB	
Insert	CNMA160616 (CNMA544)-KR	
$v_c$ m/min (ft/min)	300–350 (984–1148)	
$f_n$ mm/rev (inch/rev)	0.31 (0.012)	
$a_p$ mm (inch)	0.3–2 (0.012–0.079)	
Time in cut (min/component)	1	
Results	<b>GC3210</b>	<b>Competitor</b>
Tool life, pcs	11	8
Tool life increase	38%	







# Component solutions

## Automotive

Crankshaft excellence

# Expertise for challenging production

Sandvik Coromant has helped customers from all over the world to design tools and solutions for crankshaft machining. We have a global operating competence center with the hub in Germany and specialists in all key markets, where we continuously develop cutting edge solutions together with customers and machine tool makers. Throughout the years, we've built a reference library of more than 1,800 customized disc tools with diameters ranging from 450 to 1,400 millimeter.

Our customers bring us crankshafts in a variety of shapes and sizes, but common to all is the asymmetrical, long and relatively slender design, that is prone to vibration. The instability, along with high tolerance demands and challenging material machinability call for truly optimized tools and methods to succeed. We've presented a complete offer of crankshaft tools and solutions that call for extra attention.


Best regards,



Stefan Knecht  
ECC and Global Solutions  
Manager, Crankshaft

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## Customer case

Chongqing Changan Automobile ordered four new crankshaft production lines, with a total of 32 machines including the supply of tools for production of 600,000 crankshafts at the starting stage of the production line construction.

Sandvik Coromant was sole tools supplier and thus responsible for the total tooling and engineering solutions. And it's a large project that gets supports from both China and other organizations within Sandvik Coromant across the world.

The huge challenges of the project include the large variety of different methods and operations of manufacturing and the tight schedule.

In addition to general applications such as turn-turn broaching of flange ends, post-end and main bearings, the customer also needed special tooling and external milling of pin bearings, specific tapping operations and deep-hole drilling.

The timing of this project was also very strict, with only seven weeks between receipt of the order and the first delivery.

SANDVIK Coromant

## Main and pin journals

For roughing and semi finishing operations we recommend an internal or external milling concept for the pin journals and a turn-turn-broaching or milling solution for the main journals depending on the stock situation.

## Internal milling

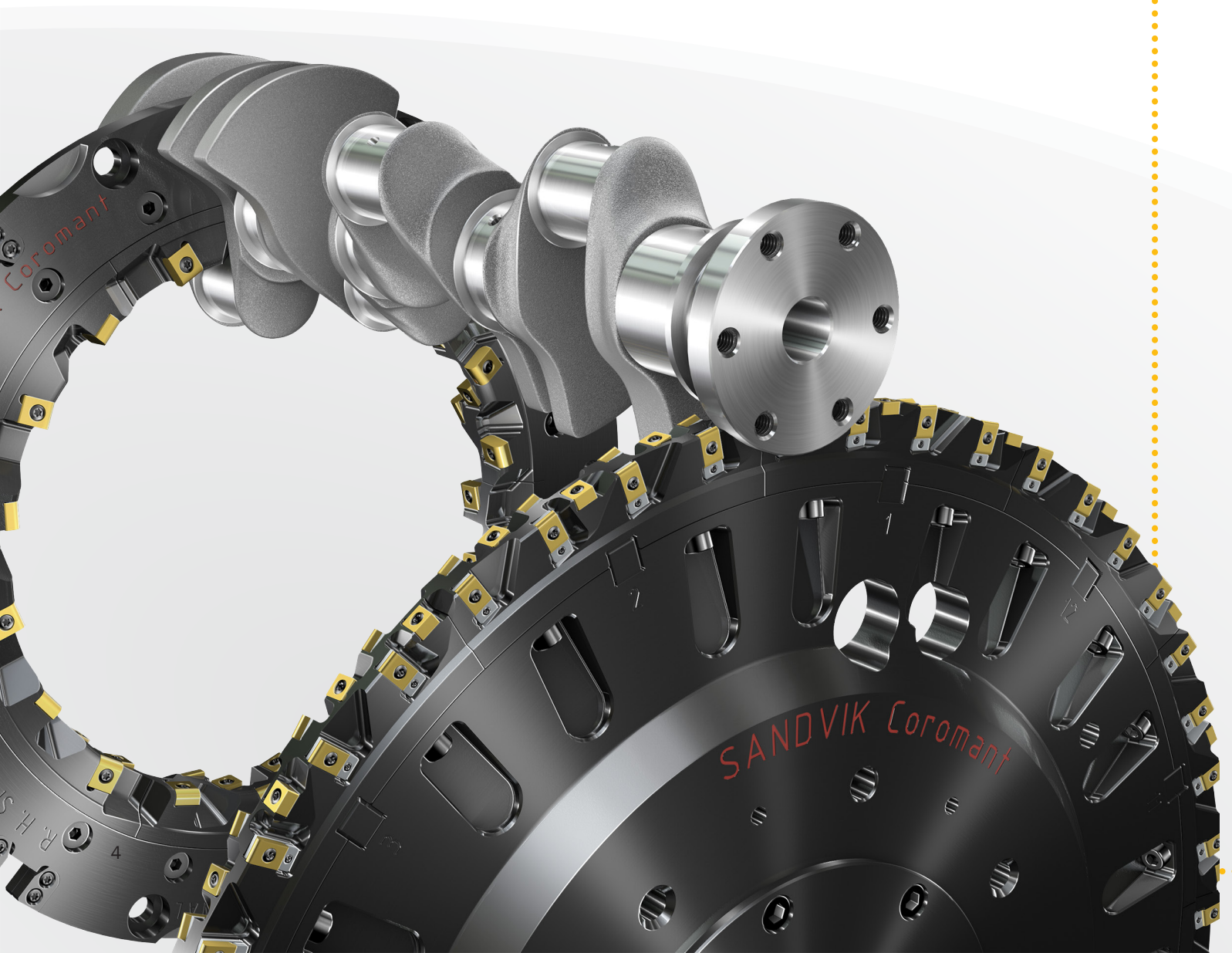
The Sandvik Coromant internal milling solution is a stable, exchangeable segment system with a high process security. There are several benefits compared to external milling. Firstly, the process stability enables low cost per part. The high tool life also improves the cost efficiency of this method.

The range of different tools range from less than 15 kg tools up to large tools for ship diesel crankshafts. Tangential inserts with pressed geometries are available.

## External milling

External milling is a flexible and productive method used mainly for large-volume machining of small to medium-size automotive crankshafts.

The first adjustable cutters for external milling were based on a Sandvik Coromant patent, and we've continued to develop productive solutions. Our large discs with a high number of effective teeth are designed to secure excellent chip removal, high cutting speeds and process security. The latest innovation shortens tool change substantially as only segments with a weight of less than seven kilo are exchanged. This means that you will not need a crane in front of the machine.



## Turn milling for small batches

Turn milling is a productive and cost efficient method for small batches as there is a wide range of standard tools available. The longest crankshaft we've helped machine through turn milling so far was nine metres, but we haven't reached the limit yet.

## Cut to length and centering

Our standard product range contains face-milling cutters with up to 12 cutting edges per insert.

## Turn-turn broaching

Turn-turn broaching is a combination of turning and turn-broaching where the turning and turn-broaching tools are mounted radially on a disk turret that moves into the crankshaft and along the bearings, machining as the crankshaft rotates. It is a productive, cost effective and flexible method, capable of short cycle times, highest flexibility and fast tool-handling and tool-setting times.

The crankshaft-chasing insert is actually a Sandvik Coromant patented development as well as many other solutions as the tools weigh less than 15 kilos. You can use up to 48 cassettes on a 700-millimetre tool.

## Inserts for turn-turn broaching

Sandvik Coromant offers inserts for machining crankshafts in turn-turn broaching machines - for turning disc tools with up to 48 cassettes. The inserts various Taylor made are available in C, T, W and S insert styles and have screw clamping for best stability. The inserts enable to apply inserts with a maximum number of possible cutting edges in small cassettes with limited space. In 2014 we introduce a new standard program of TTB inserts in the most modern grades 4315 and 4325 with 23 variants of CNMU, WNMU, TNMU and SNMU types.



## Oil hole drilling

Needless to say, chip evacuation and precision are the main challenges when drilling the oil holes. We recommend producing both the pilot hole and the actual hole with a solid carbide deep hole drill such as CoroDrill 861. It gives accurate deep holes with hole tolerance IT8-IT9 to depths up to  $30 \times$  drill diameter, without pecking.

High speeds and feeds reduce the cost per hole. Additionally, fast and efficient chip evacuation reduces machine downtime and increases tool life. Clamp with high precision chucks only.

We have a standard product assortment for deep hole drills with lengths up to 30 times the diameter. They all promise reliable chip evacuation crankshaft oil hole drills are suitable for minimum quantity lubrication (MQL).

## CoroDrill® 861

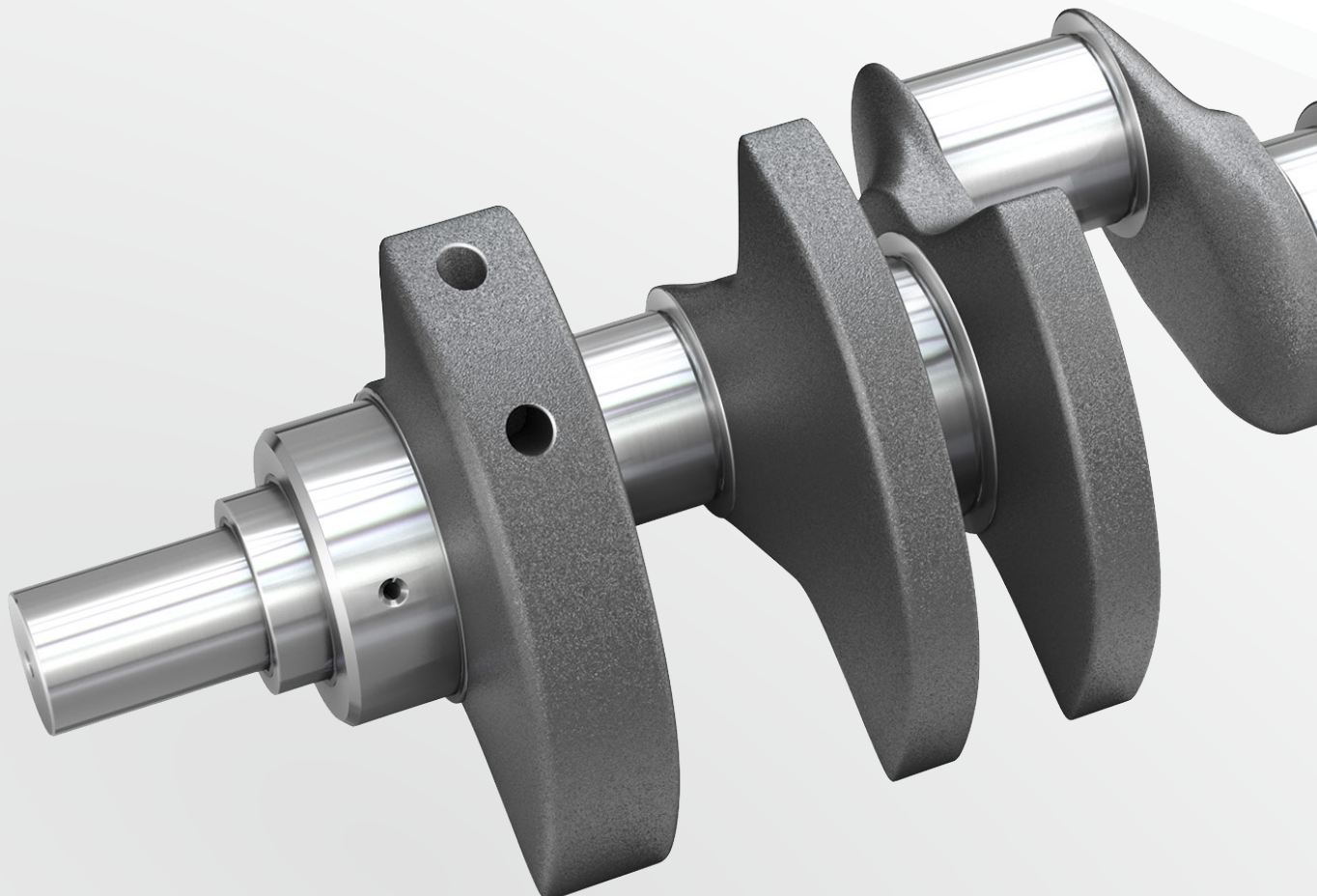
provides the high stability essential for drilling deep holes, with high speed and efficiency.

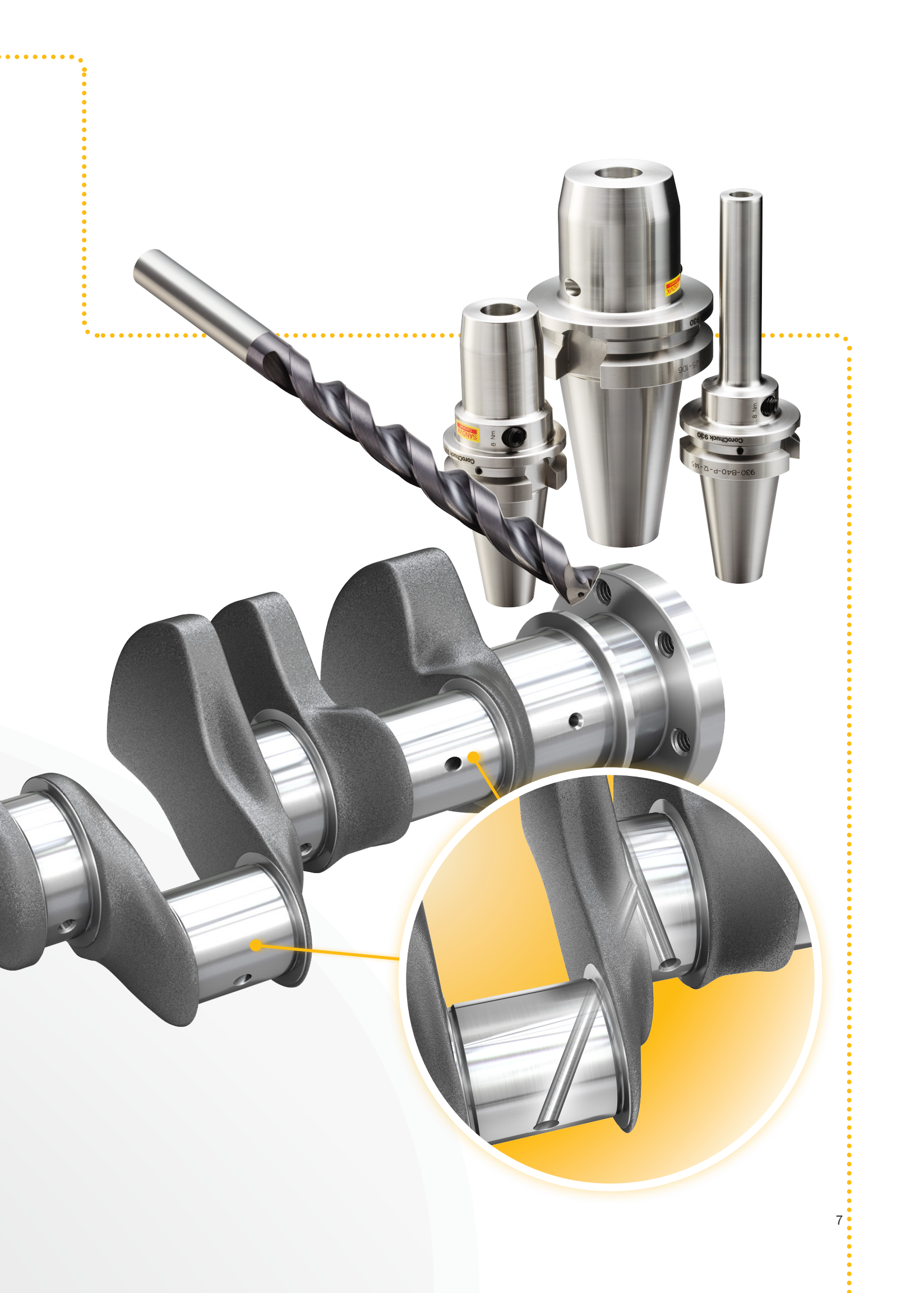
- Accurate deep holes to depths up to  $30 \times$  drill diameter, without pecking
- High speeds and feeds allow greater productivity to reduce cost per hole
- Fast and efficient chip evacuation reduces machine downtime and increases tool life

## CoroChuck™ 930

is designed to eliminate vibration for excellent stability and accessibility in all drilling operations and has the best pull-out security on the market. Covering all machine interfaces, CoroChuck™ 930 helps to maintain efficient production through quick and easy tool set-ups and changes.

- High metal removal rate provides increased productivity
- Secure processes and safe machining
- Enhanced surface finish and increased tool life
- Close hole tolerance







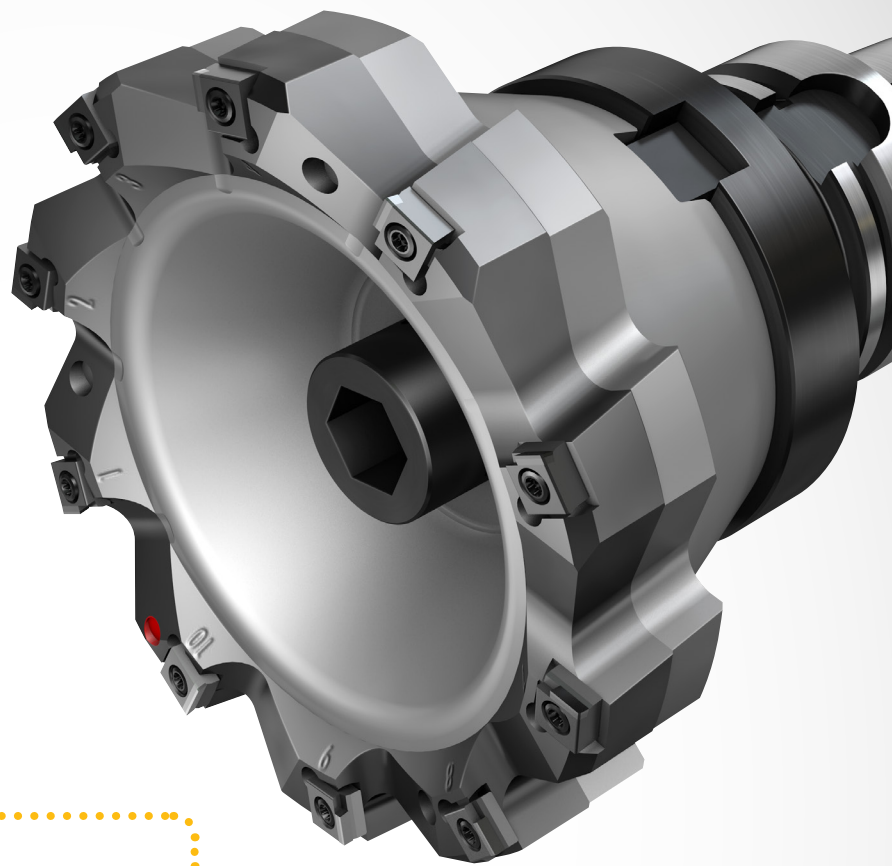
## Engineering Competence Center (ECC)

Düsseldorf is globally responsible for R&D, engineering, design and manufacturing in crank- and camshaft machining, as well as for linear broaching globally and turnmilling in EMEA.

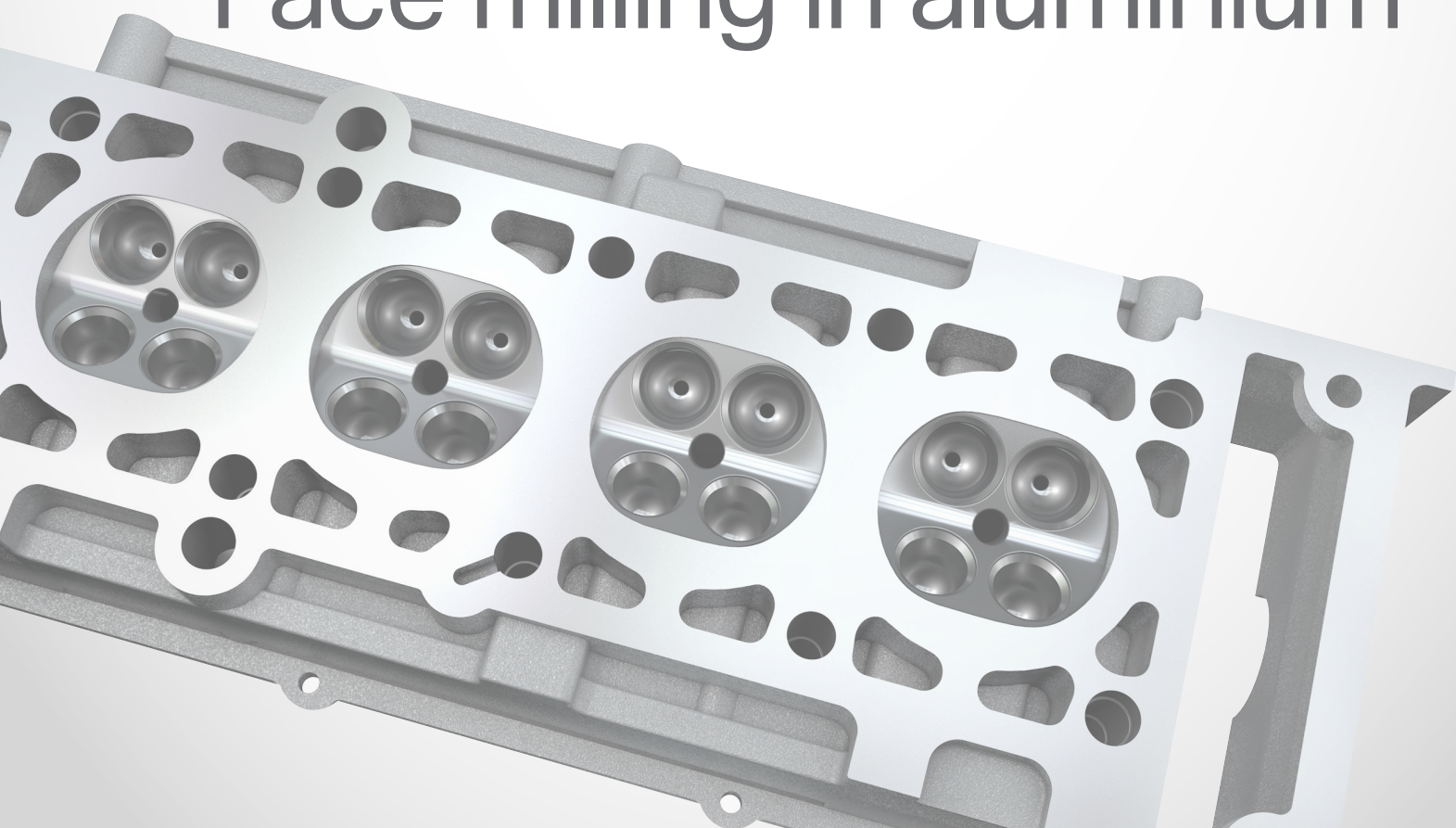
The crankshaft area is dominated by OEM and MTM customer projects with Turn-Turnbroaching, ID Milling, OD Milling and oil hole drilling.

It all comes down to the total cost per component.





# Face milling in aluminium



# Cylinder head

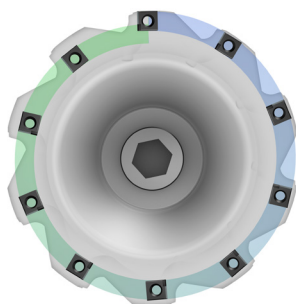
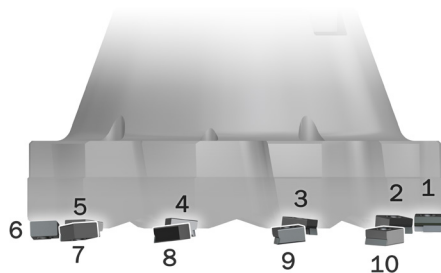
The cylinder head conveys air, plus gasoline or diesel to the combustion chamber and serves as a cover for the cylinders. In most four-stroke engines it also mounts the valves, camshafts and work as framework for a number of other components. It therefore needs to be strong and rigid. Thanks to the high thermal conductivity and low weight, the cylinder head is normally alloyed with aluminium.

## Machining challenges

The greatest challenge when machining cylinder heads is to minimize the cycle time and at the same time produce components with close tolerances and a defined surface quality. Deburring, irregular tool wear and unpredictable insert tool-life typically provide long cycle times in the face milling operation.

## Solution – new face milling cutter

The CoroMill® 5B90 is designed with a unique axial and radial positioning of the inserts, which allows each insert to instantly cut chips efficiently without any insert adjustments. Each cutter is tailor made for each component, enabling an optimized number of cutting inserts, where one is always a wiper to ensure outstanding surface quality. High feed machining is therefore possible with a reduced number of teeth compared to conventional cutters.



Do you want to learn more about how the exact placement of each CoroMill 5B90-insert allows for a unique combination of high feed milling and close tolerances?



# Success story

A Spanish manufacturer of cylinder heads for passenger car engines asked Sandvik Coromant for help. The machining process was unstable and they had problems with burr. Another problem was the unpredictable insert tool-life, which depended on the cartridge adjustments that differed slightly from set-up to set-up.

## Challenge

Provide a stable and burr-free machining process with predictable insert tool-life. The arrows show the most critical areas for remaining burr.

## Quality requirements

Roughness (R): 4 ( $R_{max}$ : 20)

Waviness (W): 4

Flatness: 0.05

## Solution

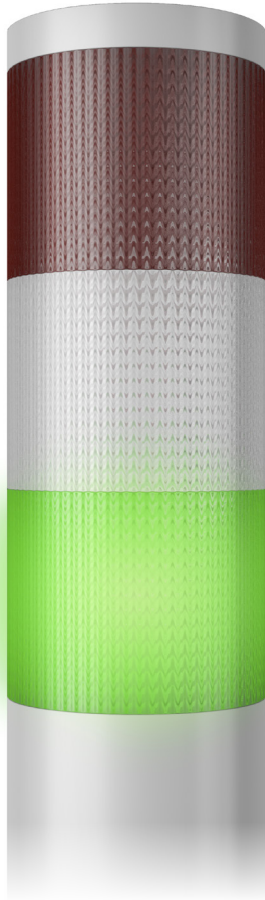
The CoroMill® 5B90 cutter offered a smooth finishing operation with predictable wear and no burr. As the cutter provides thin chips, they are easily removed from the component to avoid damaging of the face in the subsequent operation.



Yearly savings: 21 000 €

	Existing cutter	CoroMill® 5B90-cutter
Number of teeth, $z_n$	16	9
Cutting speed, $v_c$	3140 m/min	3800 m/min
Spindle speed, $n$	5000 r/min	6000 r/min
Feed rate, $v_f$	8280 mm/min	9000 mm/min
Depth of cut, $a_p$	0.5 mm	0.5 mm
Tool life	30000 in average	45000

With an optimized number of inserts that are always correctly positioned on the cutter, the customer could speed up the cutting data and save money on both a limited number of inserts and reduced cycle time.



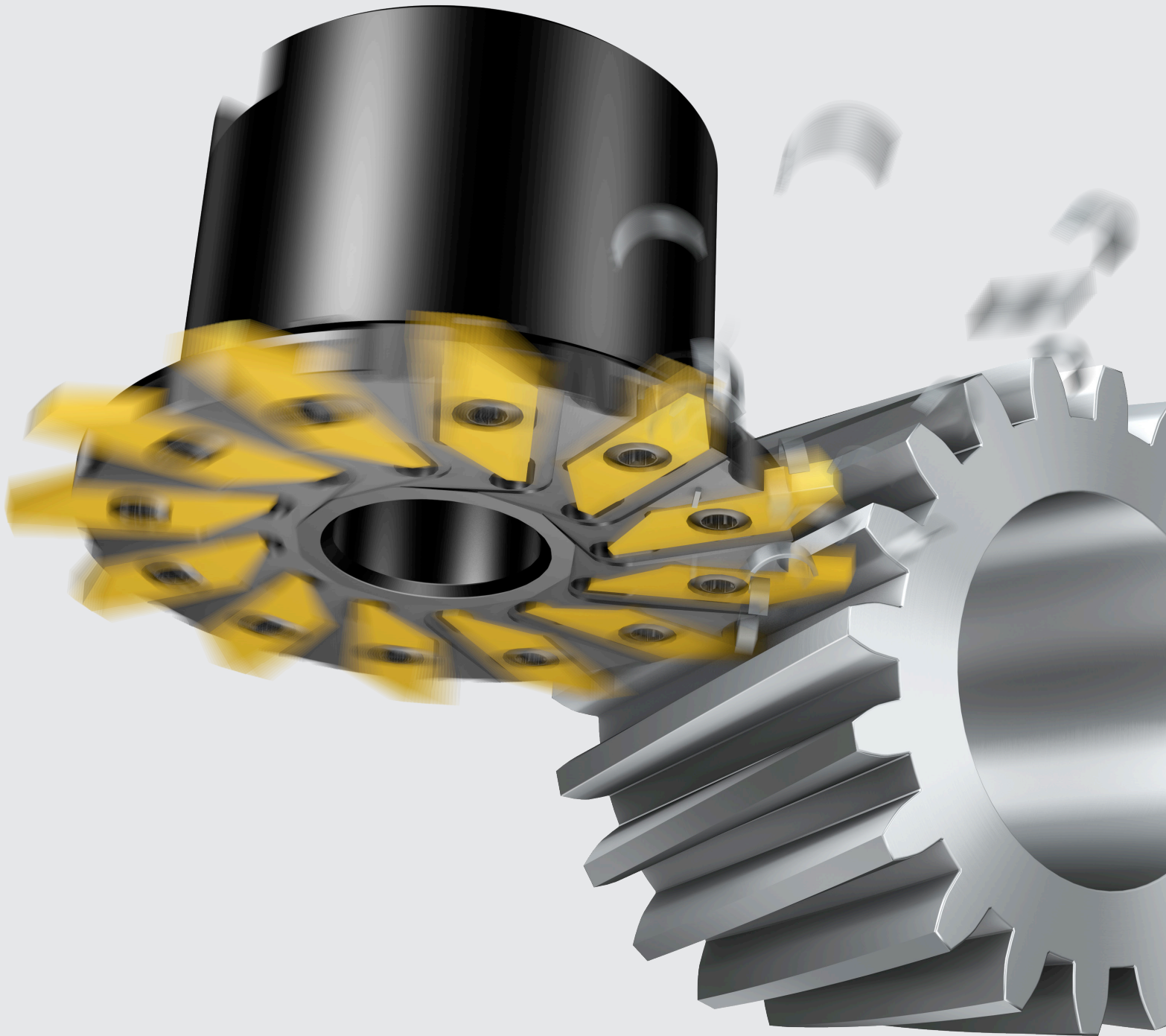
## Keep the green light on

When producing a large series of components, the most important success factor is high machine utilization. When the machine is running at full capacity, it is making money and drives your business forward. We call it green light machining.

Automotive transmission components are often slender and have a complex design that is difficult to clamp. As the level of automation is usually high, a rigid and secure machining process is key to succeed.

Low alloy steel is the traditional raw material for transmission components that can be case hardened through a heat treatment process. Other materials include powder metals, cast iron and low carbon steel.

Green light machining of many transmission components can be challenging, but we have quite a few solutions at hand.



# InvoMilling™

AGILE GEAR MANUFACTURING

# Cutting lead times in gear manufacturing

Machining gears normally requires dedicated tools for the specific gear profile. With the patented InvoMilling process it is possible to use the same cutters for different gear profiles. By changing the CNC program instead of changing the tool, the time from receiving an order for a component and delivering it can be greatly reduced.

Since multi-task machines or five-axis machining centres are used, complete components can be machined in one set-up. For manufacturers that move components between different machines or outsource the gear operation, InvoMilling can reduce lead times and shorten total manufacturing time significantly.

## In-house gear milling in standard machines

- Flexibility – same tools for many gear profiles
- Gear machining in multi-task machines and five-axis machining centres
- Complete components in one machine and one set-up
- More environmentally-friendly - runs dry, does not use cutting oil

See how it works on [www.sandvik.coromant.com/invomilling](http://www.sandvik.coromant.com/invomilling)



### Success story

#### Gear wheel data

Module, mn/diametral pitch, DP:	6 mm/4.23 inch <sup>-1</sup>
Number of teeth, z:	27
Helix angle, β:	17 degrees
Face width, b:	130 mm/5.12 inch
Pitch circle, d:	170 mm/6.69 inch

#### Result:

1 pass HSS hob stable hobbing machine	2 passes HSS hob "old" hobbing machine	New method on multi-task machine
31.5 minutes	57 minutes	23 minutes

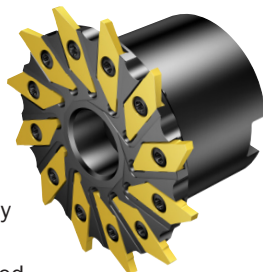
*The preferred solution for small to medium batch sizes!*

First choice for large batch sizes - CoroMill® 176.

# Tools for different module sizes

## CoroMill® 161

CoroMill 161 cutter is for manufacturing smaller module gears. High-precision insert seats ensure low tool run-out plus excellent component quality. Furthermore, modules from 2 to 4 can be efficiently covered with only a limited range of inserts. CoroMill 161 cutter is supplied in various diameters, starting at 66 mm, in both Coromant Capto® and arbor coupling configurations.



## CoroMill® 162

CoroMill 162 cutter uses a unique i-Lock interface between the insert and tool body to ensure both stability and precision. CoroMill 162 comes in two sizes. Size 4 is ideal for the efficient manufacturing of module 4 to 8 gears starting with a diameter of 90 mm, while size 6 performs equally well for manufacturing module 6 to 12 gears. Tools are available with different arbor coupling sizes.



### Cutter

CoroMill 161  
CoroMill 162

### Ideal module range

2–4  
4–12

### Possible module range

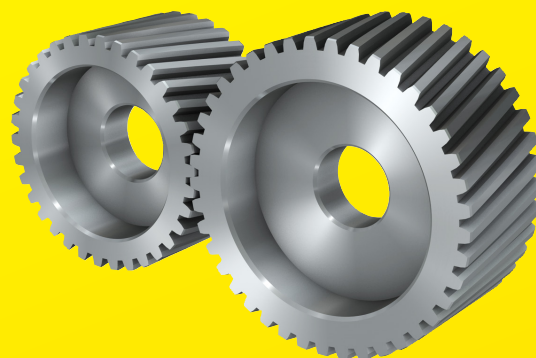
>2  
>4

For more information see [www.sandvik.coromant.com/coromill161](http://www.sandvik.coromant.com/coromill161) and [www.sandvik.coromant.com/coromill162](http://www.sandvik.coromant.com/coromill162)

Measuring example:

## Produce a high quality gear

To precise machine movements and a high precision cutter, InvoMilling yields a high quality gear both regarding dimensional accuracy and surface finish. A gear measurement report for helical gear manufacture using InvoMilling is shown on pages 4 and 5.



### Helical gear

#### Data

Normal module, mn/diametral pitch, DP:	4.15 mm/6.12 inch <sup>-1</sup>
Number of teeth, z:	22
Helix angle, β:	-22.5 degrees
Profile shift, x (high profile):	0.41
Pressure angle:	20 degrees
Tip diameter, d <sub>a</sub> :	112.8 mm/4.44 inch
Root diameter, d <sub>f</sub> :	87.4 mm/3.44 inch
Face width, b:	30 mm/1.18 inch
Material:	42CrMo4 (260 HB)

Surface finish, from root to tip, Rz:

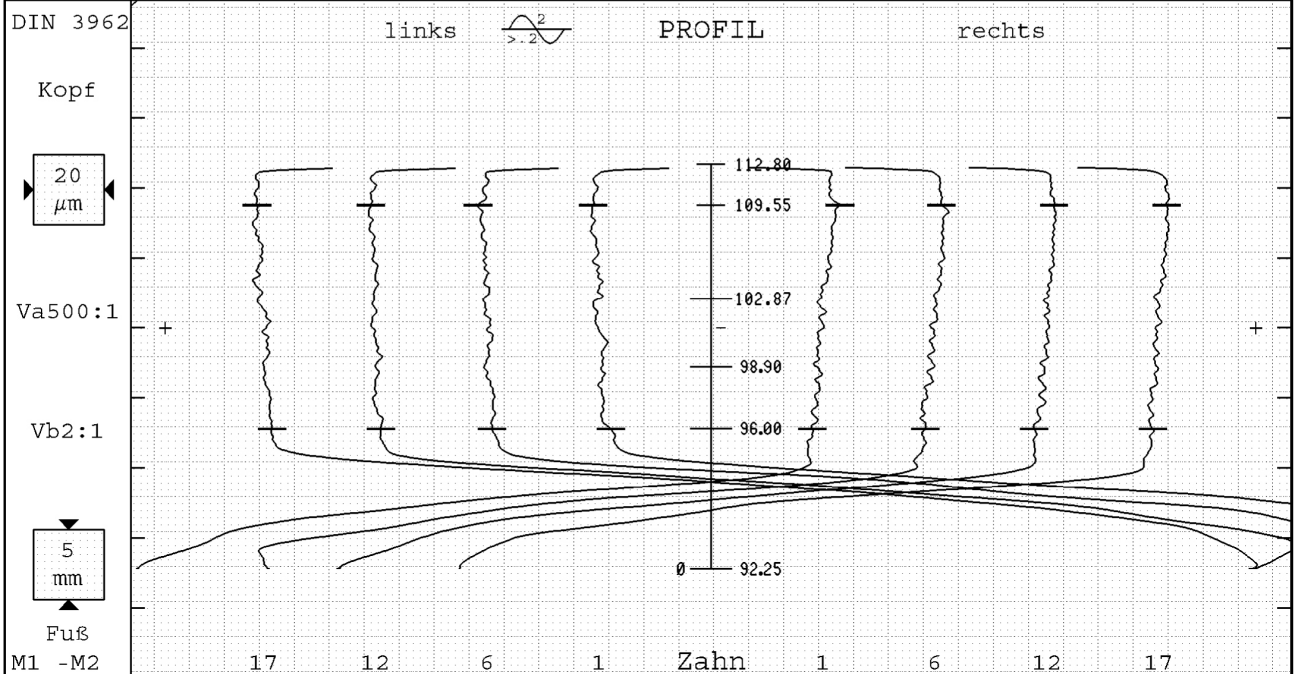
2 microns

*Example of a helical gear produced using the InvoMilling method.*

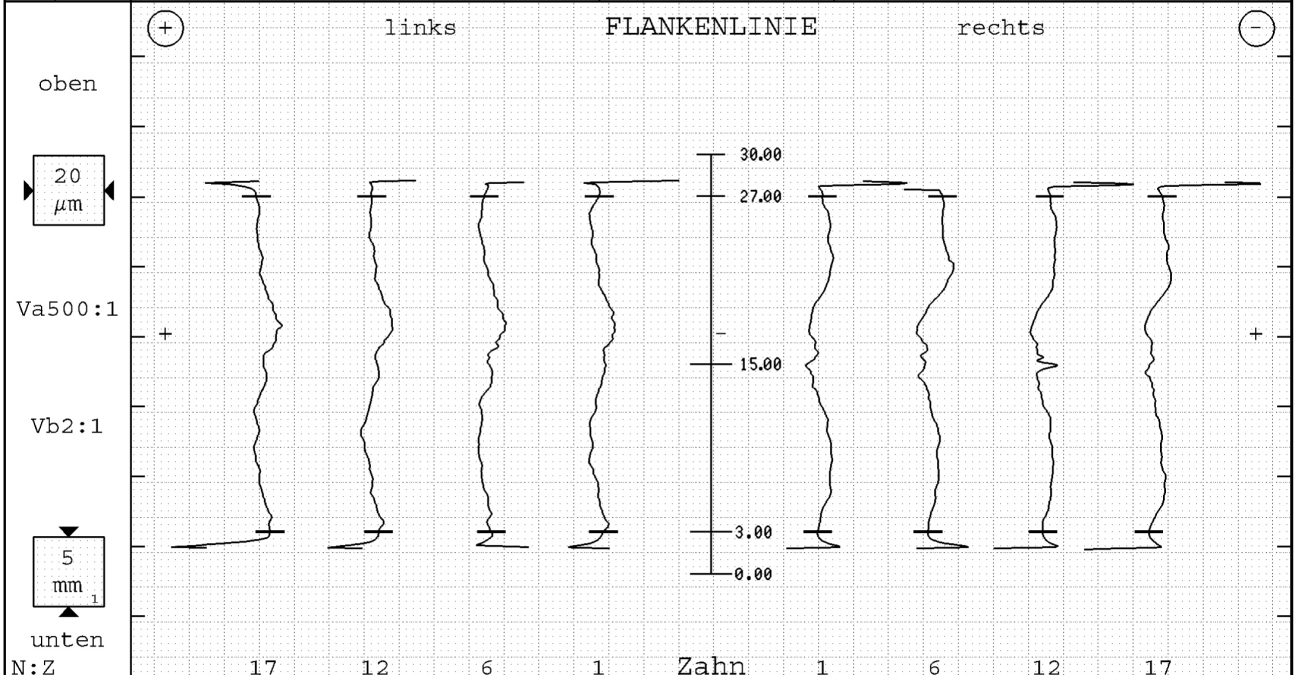
Profile example of a helical gear produced using the InvMilling method.

# Stirnrad Profil/Flankenlinie

0409j19 0	P100	Prüfer:	Datum: 07.03.2011~15:21
Zahnrad Nr.1		Zähnezahl z	22
Zeichnungsnr.: 5 Achsentest		Zahnbreite b	30mm
Auftr./Seriennr.: Sandvik1		Modul m	4.15mm
Kunde/Masch. Nr.:		Eingriffswinkel	20°
Messplatz: P100		Schrägungswinkel	-22.5°
Zustand: Fertigdiagramm		Grundkreis-Ø db	91.9446mm
		Grundschr.winkel	-21.076°
		Prof.-Prüfber. La	15.98mm
		Flnk.-Prüfber. LB	24mm
		Ausw.-Anfang M1	13.8mm
		Taster Ø	(#7)2mm
		Pr.versch.F. x	.01



	Meßwert [µm]Qualität				zul. Wert Qual				Meßwert [µm]Qualität			
	V 2.3		V 1.6		±7 6		±7 6		V 1.6		V 1.6	
fH <sub>tot</sub>	3.3	4	5.9	6	±7	6	±7	6	5.9	6	5.0	5.4
fH <sub>α</sub>	4.4	5	6.4	6	±7	6	±7	6	6.4	6	5.0	5.4
F <sub>α</sub>	5.5	4	8.2	5	12	6	12	6	8.2	5	6.4	6.0
f f <sub>α</sub>	4.3	4	3.6	3	10	6	10	6	3.6	3	2.9	3.1
F/K-φ[mm]									<b>112.176</b>		[112.5/113.1]	



	V 1.7				V 4.2			
	V 1.7		V 4.2		V 1.7		V 4.2	
fH <sub>βm</sub>	-0.5	1	-1.9	1	-0.5	1	-1.9	1
fH <sub>β</sub>	0.2	1	-4.1	4	0.2	1	-4.1	4
F <sub>β</sub>	7.8	6	10.5	7	7.8	6	10.5	7
f f <sub>β</sub>	7.9	7	7.9	8	7.9	7	7.9	8

TW: 20°C

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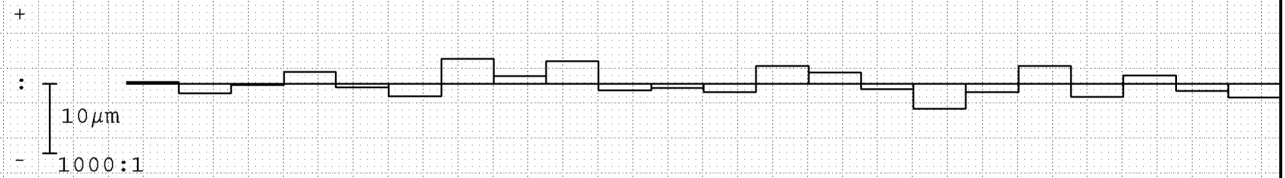


# Stirnrad Teilung

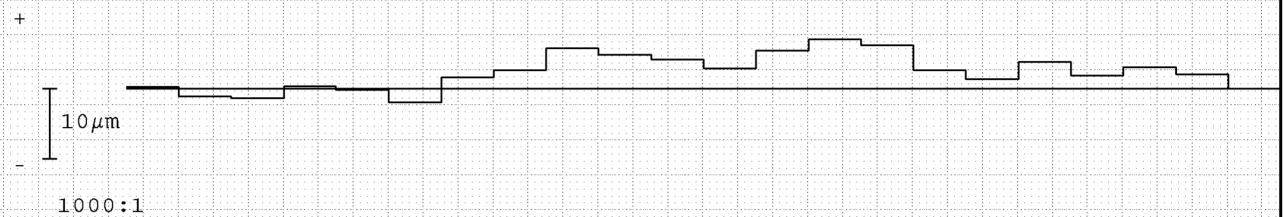
Prog.Nr.: GST0409j19 0 P100	Prüfer:	Datum: 07.03.2011~15:21
Benennung: Zahnrad Nr.1	Zähnezahl z: 22	Eingriffswinkel: 20°
Zeichnungsnr.: 5 Achsentest	Modul m: 4.15mm	Schrägungswinkel: -22.5°
Auftr./Serienr.: Sandvik1	Messplatz: P100	
Kunde/Masch. Nr.:	Zustand: Fertigdiagramm	

DIN 3962

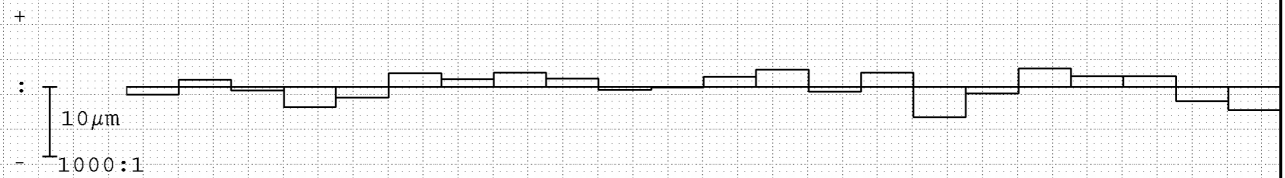
## Teilungs-Einzelabweichungen fp linke Flanke



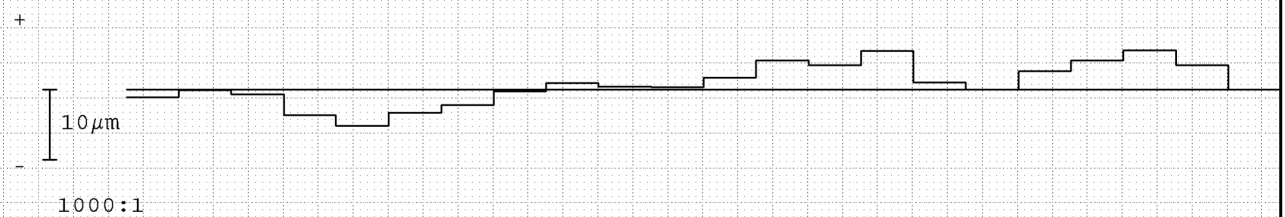
## Teilungs-Summenabweichungen Fp linke Flanke



## Teilungs-Einzelabweichungen fp rechte Flanke



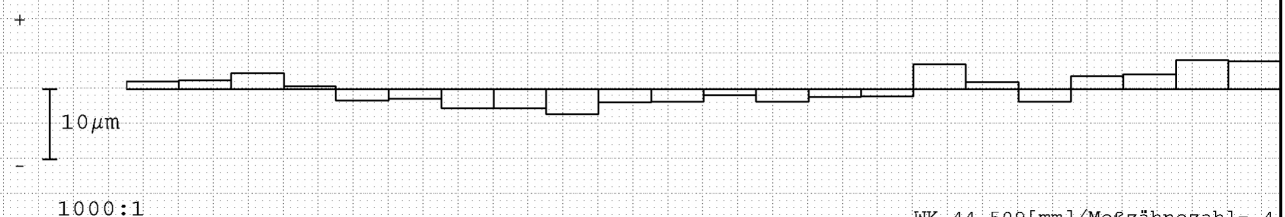
## Teilungs-Summenabweichungen Fp rechte Flanke



	linke Flanke				rechte Flanke			
	Meßwert	Qual.	zul. Wert	Qual.	Meßwert	Qual.	zul. Wert	Qual.
gr. Teilungs-Einzelabweichung fp max	3.6	4	9.0	6	4.5	5	9.0	6
gr. Teilungssprung fu max	5.4	5	11.0	6	6.5	5	11.0	6
Teilungsschwankung Rp	7.1				7.1			
Teilungs-Gesamtabweichung Fp	9.0	3	28.0	6	10.8	4	28.0	6
Teilungs-Spannenabweichung Fpz/8	7.7	4	18.0	6	6.7	3	18.0	6

DIN 3962

## Rundlauf Fr



WK 44.509[mm]/Meßzähnezahl= 4

Rundlaufabweichung Fr	7.7	3	22.0	6	Soll	194.214	194.12
Zahndickenschwankung Rs					Ist	45.619	45.61

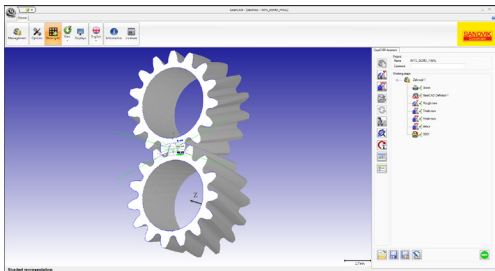
TW: 20°C

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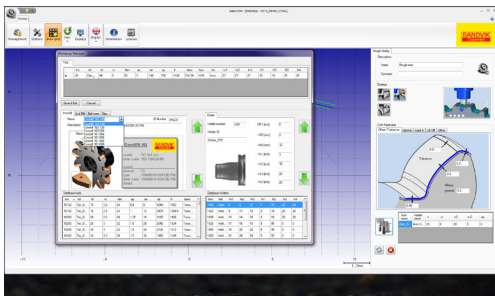


# Easy to program

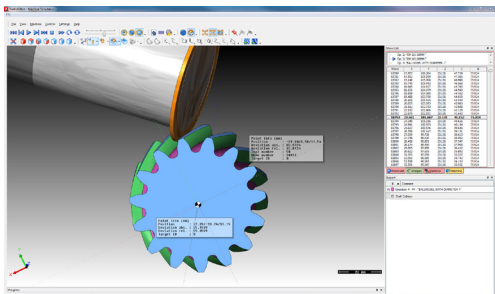
The software InvoMilling™ 1.0 is developed for quick and easy CNC programming of the patented InvoMilling process. Combine the software with our dedicated precision cutters CoroMill® 161 and CoroMill® 162 for truly flexible gear manufacturing.



*1. Define your gear geometry.*



*2. Select your machining strategy, add roughing and finishing operations and select tools to be used from the tool library.*



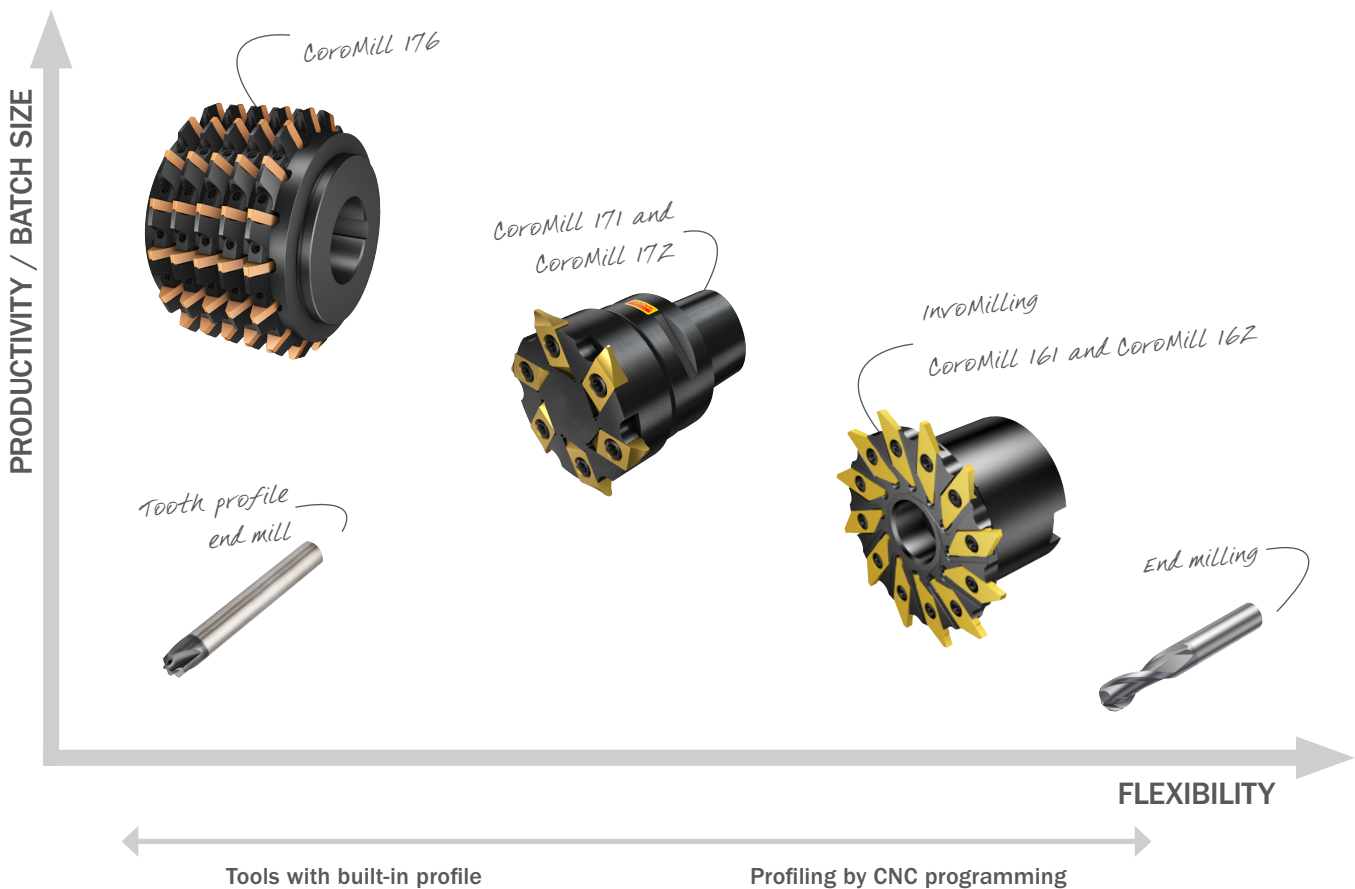
*3. Simulate the machining process to verify tool paths.*

# Comparison of methods

Sandvik Coromant has an extensive portfolio of gear manufacturing tools and methods. For large batch production of spur and helical gears, where high productivity is paramount, we offer a range of competitive disc cutters and hobs, e.g. CoroMill® 170 and CoroMill 176. Both offer much higher productivity than HSS tools.

First choice cutters for medium batch sizes are CoroMill 171 and CoroMill 172. These disc cutters are easily applied in machining centres, multi-task machines and turning centres, making it possible to machine complete components in one set-up.

InvoMilling with CoroMill 161 or CoroMill 162 cutters is the natural choice for small to medium batches when the focus is on greater flexibility. The productivity of InvoMilling is nevertheless comparable to HSS hobbing. What's more, all the advantages of using a multi-task machine still apply.



# Gear cutters for your demands



Sandvik Coromant has developed a new assortment of indexable insert gear milling cutters, an initiative that has taken place in close cooperation with our customers and MTM partners. Unrivalled engineering know-how together with extensive metal cutting experience ensures a tool solution that suits your needs.

Over recent years, we have introduced a completely new insert generation. Developments in insert substrates, coating materials, coating manufacturing, and post processes provide higher metal-removal rates with longer tool-life. These new gear milling tools deliver all the performance and benefits you need to take your production to levels not possible with conventional HSS cutters.

With Sandvik Coromant as your partner, you gain all the experience to optimize your overall manufacturing and reduce your cost per component.

[www.sandvik.coromant.com](http://www.sandvik.coromant.com)

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