

YOUR PARTNER FOR THE MACHINING OF CRANKSHAFTS AND CAMSHAFTS





TYROLIT

TECHNOLOGICAL LEADER AND PARTNER ON EQUAL FOOTING

TYROLIT has been developing innovative grinding tools with convincing performance levels for close to a century. Many of these tools are used for applications in the automotive industry. Excellent collaboration with grinding machine manufacturers, technical universities and the end-users has paved the way for continuous

improvement to existing products and the initiation of new ones. TYROLIT's own Research & Development department is the linchpin of such developments; it being where the basic raw materials are produced and combined.

COMBUSTION ENGINES OF THE FUTURE

INTENSIFICATION OF DEMANDS ON GRINDING TOOLS

The greatest challenge for the future development of the combustion engine will be in solving the conflicts between fuel consumption and range, exhaust emissions and driving performance.

Improved surface quality combined with a greater accuracy of geometry are prerequisites for the new generation of motor engines, requiring lower fuel consumption, reduced vibration and increased performance. Their realization can place special demands on the system as a whole: machine, grinding wheel and process management. TYROLIT, as a leading grinding wheel manufacturer, has a longstanding reputation as a reliable partner for these applications.

In future even greater potential can be realized in terms of reduced fuel consumption, or rather CO_2 emissions, by downsizing the combustion engines – i.e. reducing the technical parameters such as weight and cubic capacity, without any sacrifice of performance. A further positive effect is the reduction of internal friction in the engine. In particular a future reduction in the weight of the rotary components in the engine will only be possible by using new alloys and materials. TYROLIT identified these challenges some years ago and has thus already been successfully applying carbon fibre cores in combination with new vitrified bonds.



TRENDS IN CAMSHAFTS AND CRANKSHAFTS

GRINDING PROCESSES FOLLOW NEW DEVELOPMENTS

- New materials for weight reduction
- Composite and adjustable camshafts for optimum combustion
- Optimization of component geometries (roundness, concentricity, surface finish)

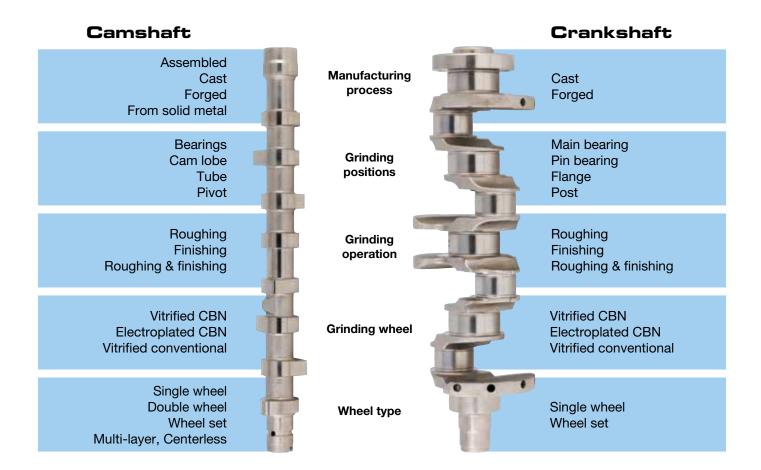


CAMSHAFTS AND CRANKSHAFTS COMBUSTION ENGINES PRINCIPLE SHAFTS

The future of the camshaft lies in precision and flexibility. New generation shafts have to take over optimum valve-timing with varying engine revolutions and performance requirements. We will therefore see a growth of their role in both automobiles and trucks. Its weight means that the crankshaft has a major role to play in the optimization of the combustion engine. New, light, but still torsion resistant materials are required, together with improved surface qualities (roundness, concentricity and surface finish).

Due to their different design both the camshaft and the crankshaft pose a special grinding challenge.

The grinding operation is basically defined by the interrelationship of component, clamping system, grinding tool and type of grinding machine.



In its design planning and implementation of new grinding concepts, TYROLIT works in close collaboration with the technical departments of automobile, commercial vehicle and machine manufacturers.



CAMSHAFTS - BEARING JOURNAL GRINDING

ROUGHING AND FINISHING WITH VITRIFIED BONDED CBN GRINDING WHEELS

To ensure top quality and maximum productivity within the automotive industry, new machine concepts have been developed that comprise of as many grinding processes as possible in one single operation. These new machine systems are able to process various grinding zones simultaneously; thereby reducing the cycle time. To achieve this the core is multi-layered, enabling for example, all bearings to be finished in one grinding operation.



Product	Benefits
GENIS	High bonding strength of the CBN I Customised solutions Optimum resistance to cooling lubricants I Optimum profile retention Maximum breaking strength I Optimum chip clearance (porosity) I High thermal resistance
GENIS CF Damping effect I Lower weight (only approx. 20% of a comparable steel version)	

Grinding concepts for optimized machining processes

Multi-layer wheels

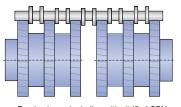
Carbon-fibre bodied grinding wheels with up to 250mm wheel width are used for this concept. When machining the bearings of the cam lobe two CBN grinding wheels are applied simultaneously. Besides the low weight, which facilitates the mounting process and reduces load on the spindle, using carbon fibre also has the added benefit of reducing vibration during grinding. With its GENIS CF product line TYROLIT has already accumulated many years of experience with vitrified CBN carbon-fibre mounted tools for the grinding of shafts.

Vertical grinding machines

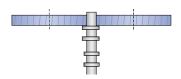
Thanks to the equilibrium of forces achieved by machining a bearing journal with two grinding wheels there are lower mechanical influences on the component part. This in turn allows for higher material removal rates – and these can be realized with the new bond systems GENIS and GENIS CF.

Grinding Wheel Sets

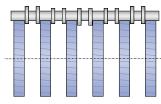
Several vitrified bonded CBN grinding wheels are clamped together as a set and dressed. Over many years the TYROLIT product line GENIS has proven its suitability for this application – confirmed by its many success stories from around the world.



Bearing journal grinding with vitrified CBN carbon fibre multi-layer wheels



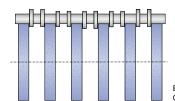
Bearing journal grinding with vitrified CBN vertical grinding machines



Bearing journal grinding with vitrified CBN grinding wheel set – OD between centres

ROUGH GRINDING WITH ELECTROPLATED CBN GRINDING WHEELS

With the POLARIS product – electroplated CBN grinding wheels by TYROLIT – it is possible to increase the diamond concentration on the main wear zones of the grinding process to extend the life of the grinding wheel. The geometry and specification can also be finely tuned to the individual customer requirements. In doing so TYROLIT can confidently depend on its many years of know-how and experience in the manufacture of electroplated grinding wheels to achieve the optimum result.



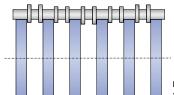
Bearing journal grinding with electroplated CBN grinding wheel set



Product	Benefits
POLARIS	Specifically addresses zones with highest wear I Highest profile accuracy I Maximum tool life

FINISH GRINDING WITH VITRIFIED BONDED ALUMINIUM OXIDE GRINDING WHEELS

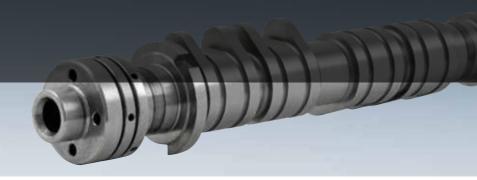
The bearings of the camshaft are ground using a set of vitrified bonded grinding wheels. With its CSS-ULTRA product line TYROLIT achieved a breakthrough in the quality of vitrified bonded aluminium oxide grinding wheels. CSS-ULTRA is used in all high-end applications. Besides its exceptionally long tool life, other significant success features include the balance of the complete system (with correct mounting) and the required radial and axial run-out values.



Bearing journal grinding with vitrified bonded aluminium oxide grinding wheel set

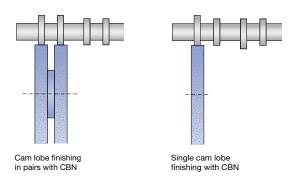


Product	Benefits
CSS-ULTRA	Shorter grinding times I Reduced dressing I Lower grinding costs per workpiece



CAMSHAFT - CAM LOBE GRINDING ROUGHING WITH ELECTROPLATED CBN WHEELS

Electroplated or vitrified bonded CBN grinding wheels are used for the cam lobe roughing operation. This application entails roughing of the cam contour – irrespective of whether it is a re-entry cam profile or not. Optimum retention of the profile accuracy and maximum tool life are achieved with POLARIS as it specifically addresses the main wear zones.

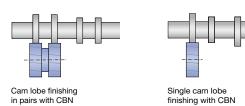




Product	Benefits
POLARIS	Specifically addresses zones with highest wear I Highest profile accuracy I Maximum tool life

FINISH GRINDING WITH VITRIFIED CBN WHEELS

For the finish grinding of a cam lobe a grinding tool that has been adjusted to the geometry of the lobe is applied. As the lobes are usually arranged in pairs they are machined as such with a double grinding wheel. Both TYROLIT product lines – GENIS and GENIS CF – generate a significant improvement in performance.





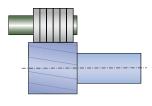
Product	Benefits
GENIS	High bonding strength of the CBN I Customised solutions Optimum resistance to cooling lubricants I Optimum profile retention Maximum breaking strength I Optimum chip clearance (porosity) I High thermal resistance
GENIS CF	Damping effect I Lower weight (only approx. 20% of a comparable steel version)

CAMSHAFT - CAM LOBE GRINDING IN PACKETS

FINISH GRINDING WITH VITRIFIED CBN WHEELS

In the case of assembled camshafts a newly developed machine concept is used to grind the individual lobes: up to eight lobes can be machined simultaneously with one grinding tool. The lobes are clamped as a package on a mandrel and then ground with a wide carbon-fibre (CF) mounted vitrified bonded CBN wheel. GENIS

CF is the ideal choice for this application. Its new bond system not only has optimum porosity, but also facilitates excellent profile retention. Additional benefits are realized in the surface quality thanks to the damping properties of the CF bodies.



Packet-wise grinding of cam lobes with vitrified CBN



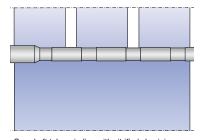
Product	Benefits
GENIS CF	Damping effect I Lower weight (only approx. 20% of a comparable steel version)

CAMSHAFT TUBE GRINDING

FINISH GRINDING WITH VITRIFIED BONDED ALUMINIUM OXIDE GRINDING WHEELS USING A CENTERLESS PROCESS

A centerless operation with vitrified conventional CSS-Ultra grinding wheels – single or in a set – is used to grind the camshaft tubes. TYROLIT not only

has a range of excellent centerless grinding wheels, but with its CSS Regulator, can also supply the appropriate control wheel.



Camshaft tube grinding with vitrified aluminium oxide centerless grinding wheels



Product	Benefits
CSS-ULTRA	Shorter grinding times I Reduced dressing I Lower grinding costs per workpiece
CSS-Regulator	Excellent profile retention and friction coefficient to reliably regulate the workpiece.



CRANKSHAFT ROUGHING AND FINISHING

MAIN BEARING AND PIN BEARING GRINDING WITH VITRIFIED BONDED CBN GRINDING WHEELS

We generally find vitrified bonded CBN grinding wheels being applied for the finish grinding - and in part also for the roughing process - of the main bearings and pin bearings. Latest bond systems provide high bonding strength of the CBN abrasive grains; enabling GENIS to produce optimum material removal rates.

Cutting fuel consumption, minimizing CO₂ emissions and reducing the generation of noise has led to increased demands in terms of roundness, concentricity and surface quality. To lower the weight of moving components and at the same time achieve the required fuel consumption and emissions values it has been necessary to employ new and lighter materials. TYROLIT's product lines GENIS and GENIS CF excel themselves in the machining of just such materials.

It is especially in the grinding of all types of shafts that TYROLIT not only draws on its many years of experience, but has also always had an active collaboration with machine manufacturers and end users to achieve the required grinding performance.

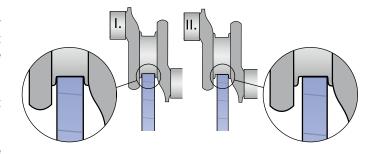
For this particular process two separate spindles are used to grind two different bearings simultaneously.

Main bearing and pin bearing grinding with vitrified CBN

Different processes for the CBN grinding operation are called upon for crankshafts for truck diesel engines and for high-performance car engines. In so doing the tangent radii and shoulders are also ground.

Differing bearing grinding processes with and without undercut:

- I. Straight plunge cut over the whole of the bearing width
- II. Combined grinding of the shoulders and diameter





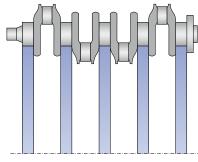
Product	Benefits
GENIS	High bonding strength of the CBN I Customised solutions Optimum resistance to cooling lubricants I Optimum profile retention Maximum breaking strength I Optimum chip clearance (porosity) I High thermal resistance
GENIS CF	Damping effect I Lower weight (only approx. 20% of a comparable steel version)



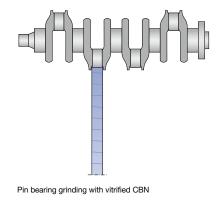
MAIN BEARING WITH VITRIFIED ALUMINIUM OXIDE WHEEL SET, PIN BEARING GRINDING WITH VITRIFIED CBN WHEELS

Vitrified aluminium oxide grinding wheels are used in a set to grind the crankshaft main bearing. With its CSS-ULTRA product line TYROLIT is able to provide an extremely efficient, high-performing tool for this application.

A separate machine with vitrified CBN wheels is used to grind the pin bearings. The GENIS and GENIS CF product lines are the ideal choice for this operation.



Main bearing grinding with vitrified aluminium oxide





Product	Benefits
CSS-ULTRA	Shorter grinding times I Reduced dressing I Lower grinding costs per workpiece I High speed grinding up to 125 m/s

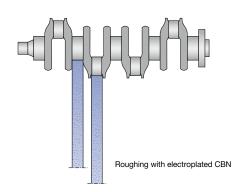


Product	Benefits
GENIS	High bonding strength of the CBN Customised solutions Optimum resistance to cooling lubricants Optimum profile retention Maximum breaking strength Optimum chip clearance (porosity) High thermal resistance
GENIS CF	Damping effect I Lower weight (only approx. 20% of a comparable steel version)



ROUGHING WITH ELECTROPLATED CBN WHEELS, FINISHING WITH VITRIFIED CBN WHEELS

A pin chasing process with electroplated CBN wheels is used for the roughing of the main and in particular the pin bearings of a crankshaft. The ideal solution for this operation comes from TYROLIT: POLARIS – electroplated high performance grinding wheels with variable layers to target the areas with the highest wear.



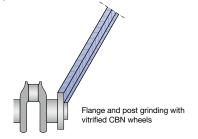


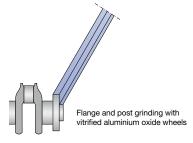
Product	Benefits
POLARIS	Specifically addresses zones with highest wear I Highest profile accuracy I Maximum tool life

CRANKSHAFT - FLANGE AND POST GRINDING

FINISH GRINDING WITH VITRIFIED BONDED ALUMINIUM OXIDE OR VITRIFIED CBN WHEELS

During cylindrical grinding operations for the flange and post it is possible to use different specifications depending on the requirements of the respective contact zones. With the new bond systems of GENIS, GENIS CF and CSS-ULTRA an easy-cutting, vitrified bonded grinding wheel is not just a desire – it has become a reality.







Product	Benefits
GENIS	High bonding strength of the CBN I Customised solutions Optimum resistance to cooling lubricants I Optimum profile retention Maximum breaking strength I Optimum chip clearance (porosity) I High thermal resistance
GENIS CF	Damping effect I Lower weight (only approx. 20% of a comparable steel version)



SOLUTIONS EXPERTISE

APPLICATION ENGINEERING

Successful enterprises expect not only top products from their partners, but also process know-how and a program of comprehensive support for their individual requirements.

Concentration on the production and supply of top quality tools is in itself no longer sufficient. Good "software" has to be offered alongside the "hardware". With the wealth of process expertise commanded by our team of application engineers we are able to provide our customers with sustained solutions in line with today's demanding technical and economical expectations.



Clarify the task

We place great emphasis on knowing the targets of our customers. Application engineering specialists analyze the task in detail. A requirements profile which takes technological and profitability aspects into account is then drawn up together with the customer.



Define approaches

The team of experienced application engineers defines an approach to the solution, calling on the additional input from our specialists from R & D and our in-house test center as required.



Realize the solution

The process solution is then taken directly to the customer where it is put into practice on the relevant machine. Within the scope of a sustained process optimization the application engineer sets the mode of operation for the grinding tool, the interaction between machine, workpiece, material, cooling lubricant and kinematical parameters.



Share the know-how

Our know-how in the field of grinding technology is crucial to successful cooperation. A one-off optimization is not the solution for the customer. Sustained results come from the continuous application of experience on a broad basis. Service is also offered to our customers by way of practical oriented information, data preparation, trainings and seminars.



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Our worldwide subsidiary companies can be found on our website at www.tyrolit.com

