



## YOUR PARTNER IN THE GEAR INDUSTRY

### MIRA tools and system solutions for

- Gear flank grinding
- Gear honing
- External and internal cylindrical grinding

**TYROLIT**

A Company within the SWAROVSKI Group

# TYROLIT

## THE EXPERT COMPLETE PROVIDER FOR THE MACHINING OF GEAR COMPONENTS

Requirements in the finishing of gear components are extremely complex. High-precision finishing is performed on the bore, the external diameter of shaft parts and, if necessary, on the gear teeth, end faces and other functional surfaces. Grinding as a manufacturing step is paramount due to its efficiency in the finishing process. Conventional abrasives and superabrasives are used.

The demands on transmissions and their components are constantly on the rise. Lower noise level, improved running smoothness, higher torque and generally with limits on the structural size and weight. In order to satisfy these requirements, it is increasingly necessary to hard fine finish gears after hardening.

Overview of the most important processes in the hard fine finishing of gears

	hobbing shaping	hobbing shaping	hobbing shaping	hobbing shaping
	shaving	▽	▽	▽
	▽	▽	▽	▽
	hardening	hardening	hardening	hardening
	▽	gear grinding	gear grinding	power honing
	▽	structure honing	▽	▽
	▽	▽	▽	▽
	installation	installation	installation	installation
	▽	▽	▽	▽
gear quality	average	very good	very good	very good
noise level	average	very good	good	very good
cost per workpiece	low	very high	high	high




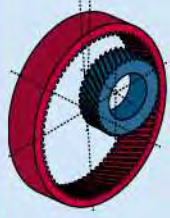






Hard fine finishing is decisive in the realization of the optimum tooth geometry and surface quality, with gear grinding and gear honing having now become the most important machining processes for this application.

The tools make up a large share of the costs in gear grinding, power honing and structure honing. Significant potential for cost savings can be realized through optimization of these tools.

As market leader in tools for hard fine finishing, TYROLIT offers a wide range of products.

**Overview of the processes and the availability of MIRA gear tools**

	gear grinding				gear honing	
	generating grinding		profile grinding		external	internal
	discontinuous	continuous	discontinuous	continuous		
grinding	 MIRA single-profile grinding wheels	 MIRA profiled grinding wheels	 MIRA single-profile wheels	 MIRA grinding wheels		
honing					MIRA honing rings	
dressing	MIRA diamond dressing tools	MIRA diamond dressing wheels MIRA diamond dressing gears	MIRA diamond dressing tools	MIRA diamond dressing gears	MIRA diamond dressing gears	MIRA diamond dressing rings



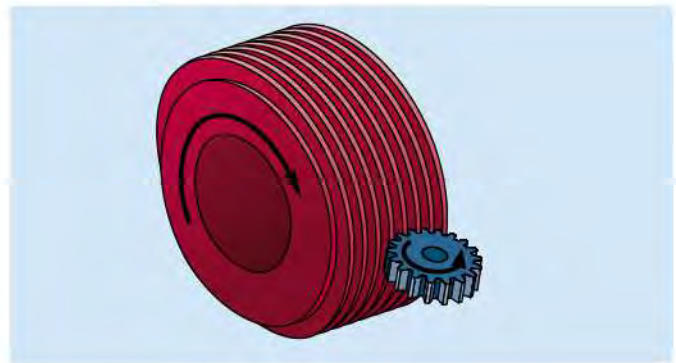
## MIRA GRINDING WHEELS FOR CONTINUOUS GENERATING GRINDING

Profiled grinding wheels are used for continuous generating grinding. The involute shape of the gear is created by grinding off the gear rack shaped profile of the profiled grinding wheel and the workpiece.

TYROLIT MIRA grinding wheels for gear flank grinding enable low thermal loads on the workpiece while also achieving maximum profile stability, increased dressing cycles and shorter grinding times. The abrasives used cover the range of special fused and sintered aluminum oxides.

TYROLIT offers you optimized specifications for grain and bond, adjusted to the specific machine, the module range, the dressing process and your special requirements. These MIRA grinding wheels can be supplied either as non-profiled, single or multi-profiled types.

Schematic diagram of continuous generating grinding





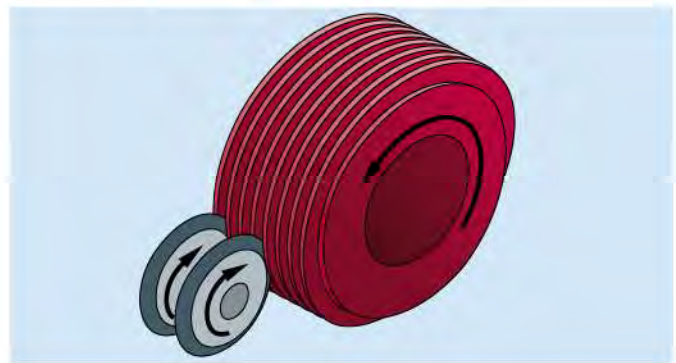
## MIRA DIAMOND DRESSING WHEELS FOR DRESSING IN CONTINUOUS GENERATING GRINDING

The conditioning or dressing of the cylindrical grinding wheel is a selective profiling, in other words, setting of the macro geometry. In addition, the micro geometry is also set with the dressing process. This has a very significant influence on the grinding properties of the profiled grinding wheel. The grinding wheel is also cleaned and chips are removed from the functional area.

A profiled grinding wheel is profiled using rotary dressing tools. Using corresponding gear modifications the required lead profile is transferred to the grinding wheel as a single or multi-start profile.

TYROLIT MIRA diamond dressing wheels and dressing sets ensure top precision with a low thermal load on the workpiece thanks to optimum geometry, maximum manufacturing quality and the recognized professional competence in gears. The MIRA diamond dressing wheels and dressing sets are adjusted to the profiled grinding wheel specifications, the respective machines, the module ranges and the specific customer requirements. TYROLIT offers optimized system solutions in connection with TYROLIT MIRA grinding wheels.

Schematic diagram of dressing in continuous generating grinding

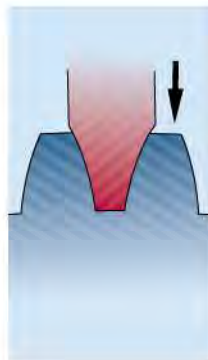


## MIRA SINGLE PROFILE WHEELS FOR GEAR FLANK GRINDING

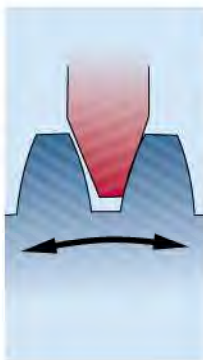
MIRA single profile wheels are used for discontinuous profile grinding. The grinding wheel is shaped according to the gear profile of the workpiece so that the gear profile is generated on the workpiece through direct reproduction of the grinding wheel profile.

MIRA single profile wheels are also used for discontinuous generating grinding. The gear profile is created by grinding the grinding wheel profile on to the workpiece. In addition, one can differentiate between single or double flank grinding.

Schematic diagram  
of discontinuous  
profile grinding



Schematic diagram  
of discontinuous  
generating grinding



With the MIRA single profile wheels, TYROLIT offers a comprehensive solution for discontinuous generating and profile grinding.

Minimal thermal load on the workpiece and maximum profile retention are key aspects, as are increased dressing cycles and shortened grinding times. TYROLIT offers optimized specifications for grain and bond, which are adapted to the specific machine, the module range, the dressing process and your specific requirements. The grinding wheels can be supplied either pre-profiled or non-profiled.



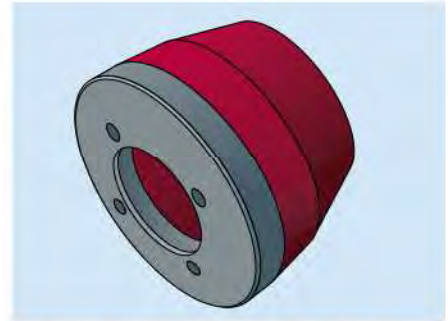


## MIRA BEVEL GEAR FOR GRINDING OF SPIRAL BEVEL GEARS

A spiral bevel gear set consists of a spiral ring crown gear and a spiral bevel gear. Using gear grinding to hard fine finish these gear sets results in significantly improved gear qualities compared with the frequently used lapping process. The grinding is carried out using cup wheels and the generating grinding process.



Spiral bevel gear set

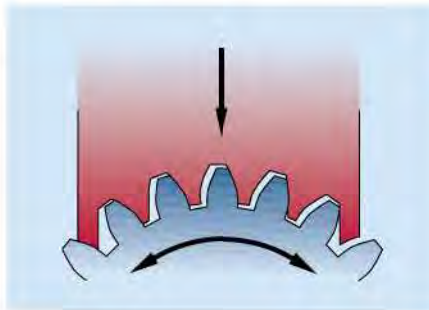


Schematic diagram of grinding wheel on the base plate

TYROLIT MIRA bevel gears guarantee maximum profile retention for spiral bevel gear grinding, with increased dressing cycles, shortened grinding times and a low thermal load on the workpiece. The specifications for grain and bond are specially adapted to and optimized for the machine types and gears in question. The cup wheels can be supplied either pre-profiled or non-profiled. Disposable Bakelite or metal discs as mounts are available on request.

## MIRA GRINDING WHEELS FOR CONTINUOUS PROFILE GRINDING

A profiled grinding wheel with globoid-like external contour is applied for continuous profile grinding operations on Reishauer RZF and RZP gear grinding machines. The profile of this wheel corresponds to the gear profile and rolling line contact takes place over the entire width of the gear.



Schematic diagram of continuous profile grinding

The specifications of TYROLIT MIRA grinding wheels are specially adapted to this process and the gear profiles.

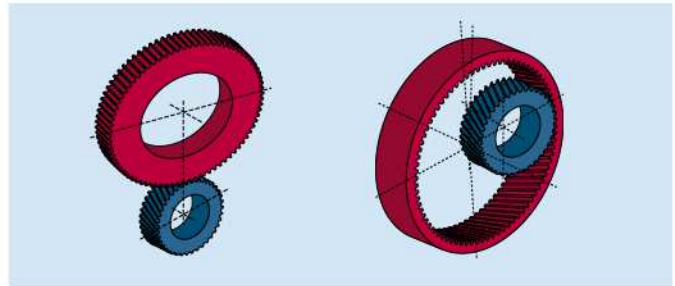
Dressing of the grinding wheel is performed with MIRA diamond dressing wheels, which have gear profiles corresponding to that of the workpiece. MIRA diamond dressing wheels ensure not only an optimal dressing result, but also maximum stock removal rates with the best gear qualities and long wheel lifetimes. These grinding wheels are only supplied as non-profiled.

## MIRA HONING RINGS FOR GEAR FLANK HONING

The contact kinematics during gear honing occurs by rolling off the workpiece and honing ring at an axis crossing angle. The resulting relative motion causes the creation of curved machining tracks that do not run parallel to the flank. The surface created can lead to significantly reduced noise levels of the gear.

Power honing leads to sufficient stock removal rates, making pre-grinding unnecessary. In traditional structure honing, on the other hand, pre-grinding is still required.

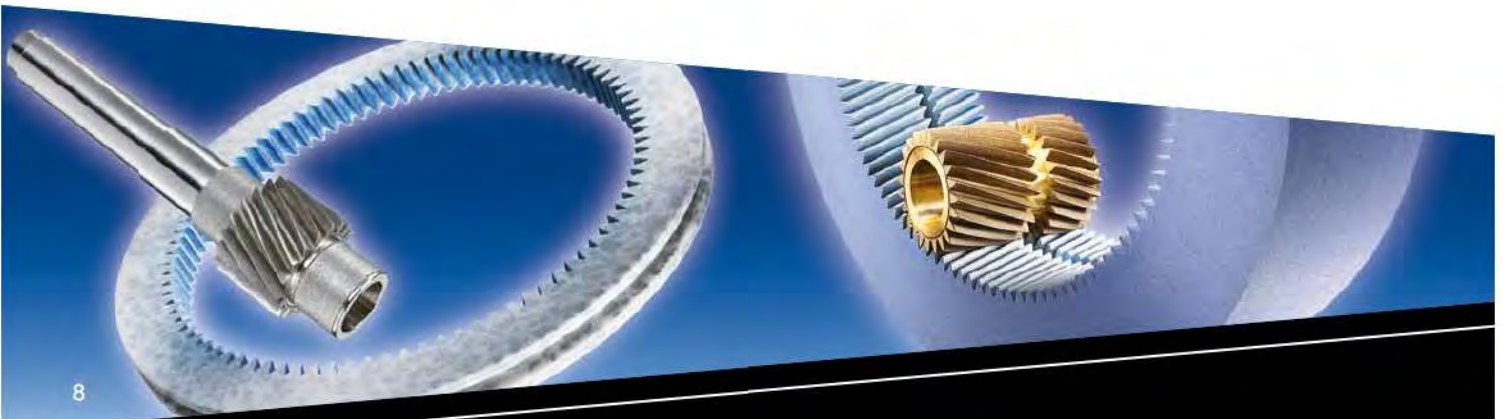
Schematic diagram of honing with internally and externally profiled honing rings



Schematic diagram of the contact lines in grinding and honing



With the TYROLIT MIRA range of honing rings, we offer you technical solutions for all honing processes. Over 15 years of experience in gear honing have made TYROLIT the market leader with top quality. Specifications in vitrified and epoxy resin bonding have been developed and optimized for the various honing processes and honing machines. With MIRA honing rings and MIRA diamond dressing wheels, we offer you a system solution for gear honing from a single source, together with optimized tool design and technical support to ensure your success. The best gear qualities are guaranteed, along with maximum stock removal rates and extended dressing cycles. TYROLIT's ongoing development and advancement of its honing rings ensures that tools of maximum quality and performance will continue to be available to optimize process costs during the hard fine finishing of gears.





## MIRA DIAMOND DRESSING GEARS FOR DRESSING OF HONING RINGS AND PROFILED GRINDING WHEELS

Dressing of the honing rings entails precise profiling and edging. Diamond dressing wheels with gear profiles corresponding to that of the workpiece are used.

TYROLIT MIRA diamond dressing wheels are synonymous with optimum dressing results, best gear qualities and long life. MIRA diamond dressing wheels are used for the dressing of internally and externally geared honing rings, for dressing globoid wheels on Reishauer RZP/RZF machines and for dressing profiled grinding wheels in continuous generating grinding.

Our competence and expertise in the geometric design of tools and our high quality standards guarantee that even the most complicated gear geometries, gear modifications and twists can be achieved, as well as best surface qualities. We offer MIRA diamond dressing wheels, MIRA diamond dressing rings and MIRA honing ring or MIRA grinding wheels as a system solution from a single source. With this complete system, our professional application technology and optimized tool design we ensure your success.

MIRA diamond dressing wheels are produced by positive electroplating and reverse plating in individual manufacturing. MIRA diamond dressing rings, required for controlling the contact lengths with internally geared honing rings, are generally manufactured by positive electroplating.



MIRA diamond dressing wheel  
manufactured using positive  
electroplating



MIRA diamond dressing  
wheel with shaft manufactured  
using positive electroplating



MIRA diamond dressing wheel  
manufactured using reverse  
plating

# EXTERNAL AND INTERNAL CYLINDRICAL GRINDING OF GEAR COMPONENTS



## CSS Ultra grinding wheels

With the product line CSS Ultra, TYROLIT has succeeded in making a lasting impact on the micro architecture of the grinding wheel through the use of new, high-quality components and innovative sinter technology. As a result, the abrasive grain can be subjected to significantly higher loads before finally fracturing.

These improvements are demonstrated in practice during external cylindrical grinding of gear components with CSS Ultra through maximum profile retention with minimum wear.



## Electroplated CBN grinding wheels

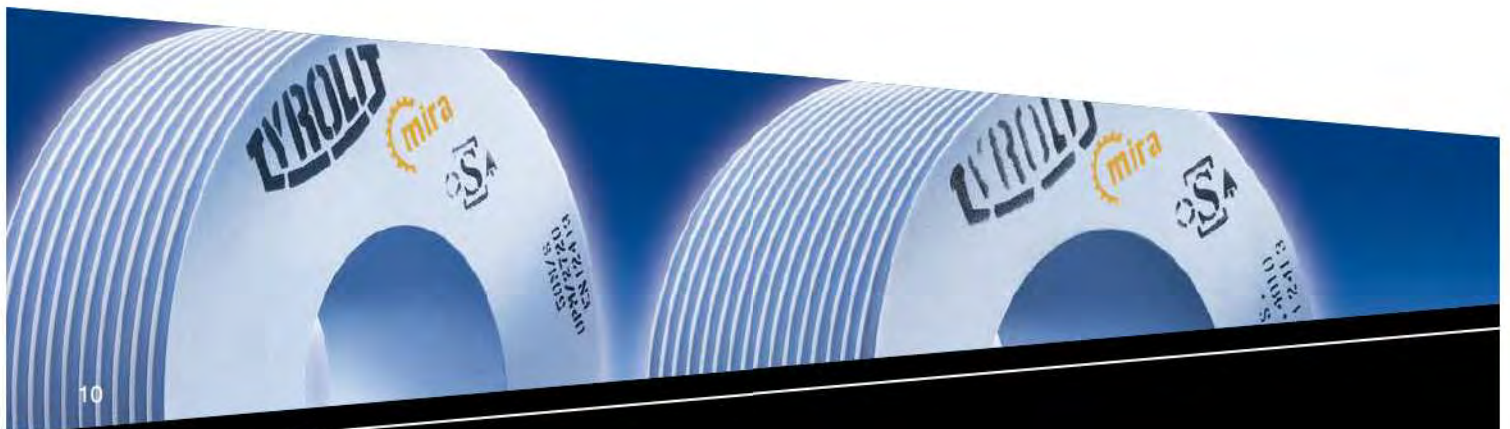
The TYROLIT PEP grinding wheels are characterized by the highest stock removal rates and maximum precision. Our new electroplated bonding matrix is the result of years of experience and offers significantly improved grain adhesion properties. It was possible to reduce the embedding depth of the CBN grain without losing adhesion strength, thereby creating larger chip spaces.

Our modern manufacturing equipment ensures first-class and reproducible quality, as well as short delivery times.



## Vitrified CBN grinding wheels

Vitrified bonded CBN wheels means that the potential of the latest generation of machines can be fully realized. The combination of reduced grinding times, minimum dressing cycles, high wheel lifetime, high stock removal rates, constant surface quality and minimum thermal load results in maximum efficiency and process stability. Improved efficiency can be achieved in external and internal cylindrical grinding operations, particularly for spur gears and gear shafts.





# TYROLIT

## COMPETENCE CENTER GEAR

With the establishment of a competence center for gear tools, TYROLIT is the no. 1 partner for customers in the gear grinding industry.

The TYROLIT Competence Center Gear was set up in 2007 as an extension to its manufacturing site in Neuenrade, Germany.



### Service program

- Experienced and competent application engineers and technically qualified staff cover the areas of power honing, structure honing, continuous and discontinuous generating grinding, continuous and discontinuous profile grinding and bevel gear grinding
- Support in the selection of optimum tools and tool systems
- On-site technical support for all processes and machine types
- Optimum design of the grinding, honing and dressing tools
- Simulation of customer processes on in-house test machines
- Tool development and optimization on in-house test machines
- Continuous reduction and optimization of process costs

Our product range and application engineering services include grinding tools, honing tools and dressing tools. Synergy effects and experience from the various hard fine finishing processes can be utilized and effectively realized both internally and externally at the locations of our customers. The competent gear application technology team is made up of highly motivated employees who can translate their skills and many years of experience in the field of hard fine finishing into practical results. Centering the activities at a single location ensures the exchange of experiences and competence as well as guaranteeing optimal support throughout the process.

Superior system solutions and application technology from a single source: TYROLIT, the complete system provider of tools for the hard fine finishing of gears. We will be pleased to help you develop the solution your system requires.

**TYROLIT SCHLEIFMITTELWERKE SWAROVSKI K.G.**

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