YOUR PARTNER IN THE BEARING INDUSTRY

Grinding solutions for
- Bearing rings
- Bearing balls and rollers

TYROLIT

A Company of the SWAROVSKI Group
**BEARING RINGS**

**TYPICAL GRINDING APPLICATIONS**

- **Race grinding, inner rings**
- **Bore grinding, inner rings**
- **Superfinishing, inner and outer rings**
- **Centerless grinding, outer rings**
- **Race grinding, outer rings**

**BEARING TYPES**

- Ball bearing (BB)
- Angular contact bearing (ACB)
- Taper roller bearing (TRB)
- Cylindrical roller bearing (CRB)
- Spherical roller bearing (SRB)
- Trust bearing (TB)

**Special types:**
- Hub bearings
- Large size bearings
- Miniature bearings
BEARING BALLS AND ROLLERS
TYPICAL GRINDING APPLICATIONS

Ball grinding
Centerless grinding, cylindrical and taper rollers
Centerless grinding, spherical rollers
Face grinding, cylindrical and spherical rollers
Face grinding, taper rollers
Face grinding taper rollers
Superfinishing, cylindrical and taper rollers
Superfinishing, spherical rollers

BALL AND ROLLER TYPES

Bail  Taper roller  Spherical roller  Cylindrical roller
FACE GRINDING OF INNER AND OUTER RINGS

After hardening, inner and outer rings must be ground parallel to final tolerance and finish requirements.

**Machine**
This is usually done on a double disc grinding machine which offers a very efficient way to produce good quality parts with high output. The rings are either fed in one or more passes by a rotary or straight feeding device or by the plunge grinding principle.

For special requirements, face lapping machines are used generally equipped with vitrified bonded CBN wheels.

**Double disc face grinding of rings**

<table>
<thead>
<tr>
<th>Product</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CENTURIA (A/O resin bonded)</td>
<td>high output, more parts per dress</td>
</tr>
<tr>
<td>CENTURIA (Ceramic A/O resin bonded)</td>
<td>increased productivity</td>
</tr>
</tbody>
</table>

Specials: vitrified bonded wheels, CBN vitrified and resin bonded

**GRINDING WHEELS**

**Grinding disc type 36ST**
Special design:
- Slots, perforation, coolant holes

**Grinding ring type 37ST**
CENTERLESS GRINDING
OF OUTER RINGS AND SHAFTS

This is the next operation after face grinding outer rings. The roundness and wave from the hardening process must be ground to tight tolerances by the centerless grinding process.

Machine
Centerless through-feed grinders can do this very efficiently. For profiled water pump shafts and large rings centerless plunge grinders are also used.

Through-feed grinding of rings

<table>
<thead>
<tr>
<th>Product</th>
<th>Benefits</th>
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<tbody>
<tr>
<td>A/O vitrified bonded</td>
<td>high through-feed speed, better roundness, low waviness of rings</td>
</tr>
</tbody>
</table>

Specials: wheel set with combination of vitrified and resin bonds

Plunge grinding of bearing shafts

<table>
<thead>
<tr>
<th>Product</th>
<th>Benefits</th>
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<tbody>
<tr>
<td>A/O vitrified bonded</td>
<td>better profile retention, reduced grinding time</td>
</tr>
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</table>

Specials: ceramic A/O vitrified bonded for high demands on productivity

GRINDING WHEELS

Grinding wheel type 1
Special design:
- With recess type 5 or 7
- Set grinding wheel made of X-parts
RACE GRINDING OF INNER AND OUTER RINGS

Depending on bearing type, race ways have different profiles which are usually pre-shaped by turning. The race grinding operation has to meet the quality requirements specified for roundness, wave, form and dimensional tolerances.

Machine
External and internal grinders are used in Race Grinding. The rings are generally supported by shoes and driven by a magnetic chuck or pressure plate. Different infeed steps (roughing, finishing and spark out) are used for grinding.

Inner ring race and rib grinding

<table>
<thead>
<tr>
<th>Product</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSS-ULTRA (A/O vitrified bonded)</td>
<td>better profile retention, reduced grinding time</td>
</tr>
<tr>
<td>CSS-ULTRA (Ceramic A/O vitrified bonded)</td>
<td>increased productivity</td>
</tr>
</tbody>
</table>

Specials:
- CBN vitrified bonded for steel materials
- Diamond vitrified bonded for ceramic materials
- Elastic bonded wheels for fine surface finish

GRINDING WHEELS

Grinding wheel type 1LB
Special design:
- High speed grinding wheel up to 125 m/s
- All different types of profiles
- Type 38LB, 39LB with thicker core
- Type 5LB with recess
**RACE GRINDING**
**OF OUTER RINGS**

<table>
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<tr>
<th>Product</th>
<th>Benefits</th>
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<tbody>
<tr>
<td>A/O vitrified bonded</td>
<td>better profile retention, reduced grinding time</td>
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<tr>
<td>COLUMBIA (Ceramic A/O vitrified bonded)</td>
<td>increased productivity</td>
</tr>
</tbody>
</table>

Specials:
- CBN vitrified bonded for steel materials
- Diamond vitrified bonded for ceramic materials
- Elastic bonded wheels for fine surface finish

**GRINDING TOOLS**

**Grinding wheel type 1LB**
Special design:
- All different types of profiles

**Cup wheel type 6F**
Grinding of spherical outer rings

**Outer ring flange grinding (CRB)**

<table>
<thead>
<tr>
<th>Product</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>A/O vitrified and resin bonded</td>
<td>better cutting ability, reduced grinding time</td>
</tr>
<tr>
<td>Ceramic A/O vitrified and resin bonded</td>
<td>increased productivity</td>
</tr>
</tbody>
</table>

Specials:
- Sulphur impregnation for longer dressing cycles
- CBN resin bonded for steel materials
- Diamond resin bonded for ceramic materials

**GRINDING WHEELS**

**Cup wheel type 11**
BORE GRINDING
OF INNER RINGS

The bore grinding operation is done the same way for most bearing types. The bore must be ground concentric and perfectly straight to the profile of the inner ring track.

Machine
Internal grinders are used for Bore Grinding. The rings are generally supported by shoes and driven by a magnetic chuck or pressure plate. Different infeed steps (roughing, finishing and spark out) are used with small oscillation.

Bore grinding of inner rings

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<tr>
<th>Product</th>
<th>Benefits</th>
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<tbody>
<tr>
<td>A/O vitrified bonded</td>
<td>better profile retention, reduced grinding time</td>
</tr>
<tr>
<td>COLUMBIA (Ceramic A/O vitrified bonded)</td>
<td>increased productivity</td>
</tr>
<tr>
<td>CBN vitrified bonded</td>
<td>for smaller rings and process optimization</td>
</tr>
</tbody>
</table>

Specials:
- Sulphur impregnation for longer dressing cycles
- Diamond resin bonded for ceramic materials

GRINDING WHEELS

Grinding wheel type 1
Special design:
- Type 5 with recess
- Type 1A8, 1A1 for CBN wheels
**SUPERFINISHING**
OF INNER AND OUTER RINGS

Superfinishing is the final operation for bearing races. All ring characteristics, including roundness, wave, form and surface finish must meet tight tolerances.

**Machine**
With superfinishing machines the rings are usually supported and driven by steel rolls. This can be done with one or more stations and steps (roughing and finishing). The stone oscillates across the race.

**Superfinishing of rings**

<table>
<thead>
<tr>
<th>Product</th>
<th>Benefits</th>
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<tbody>
<tr>
<td>A/O vitrified bonded</td>
<td>increased material removal, good surface finish</td>
</tr>
<tr>
<td></td>
<td>with fine grit size</td>
</tr>
<tr>
<td>SIC vitrified bonded</td>
<td>better surface finish</td>
</tr>
<tr>
<td>CBN vitrified bonded</td>
<td>long stone life, excellent for small rings or special steel materials</td>
</tr>
</tbody>
</table>

Specials:
- Paraffin or sulphur impregnation for higher material removal rates
- Mixtures of A/O and SIC

**GRINDING TOOLS**

**Superfinishing stone type 54SCH**
Special design:
- With profile to match the race
- Stone block type 54SCHP to be cut to size

**Superfinishing ring type 5420 and cup wheel type 5460, 6F**
**BALL GRINDING**  
**OF BEARING BALLS**

Specifically designed and formulated to withstand the extreme pressures of grinding bearing balls, ball grinding wheels are extremely hard. Available in both vitrified and resin bond systems with aluminum oxide and silicon carbide blends, each specification is tailored to specific customer requirements.

**Machine**
Ball grinding is done on specially designed machines with horizontal or vertical axis. The balls are ground between a grooved plate and a grinding wheel. The stationary grooved plate is made of cast steel in different hardnesses depending on the application. The wheel has a section removed where the balls enter and exit the grooves. The grinding wheel spins, while the balls travel through the grooves and are ground to their final dimension.

**Rough-grinding of balls (G1)**

<table>
<thead>
<tr>
<th>Product</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixture of SIC and A/O vitrified bonded (grit size 80 – 320)</td>
<td>Formulated specifications to fit specific application requirements. Longer wheel life, better profile retention – for various materials – hard and soft. Better cutting ability, shorter grinding time, for bearing and hardened material</td>
</tr>
</tbody>
</table>

**Finish-grinding of balls (G2)**

<table>
<thead>
<tr>
<th>Product</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain combination of SIC and/or A/O resin bonded (grit size 400 – 1200)</td>
<td>Flexible with grain combinations to meet application requirements. Eliminates lapping compound, improves ball grade quality, wheel life, reduces cycle time</td>
</tr>
</tbody>
</table>

**GRINDING WHEELS**

**Grinding wheel type 35**
Special design:
— Glued onto steel plate
Type 36ST with inserted nuts

![Grinding wheel type 35](image-url)  
Grinding wheel type 35

![Grinding wheel type 36ST](image-url)  
Grinding wheel type 36ST
CENTERLESS GRINDING OF ROLLERS

This is the next step after face grinding for cylindrical and spherical rollers (the first step for taper rollers). The roundness and wave from the hardening process are ground to tight tolerances by this process.

Machine
Centerless through-feed grinders are used for cylindrical and taper rollers. Taper rollers are transported by a profiled steel drum as control wheel. For spherical rollers, centerless plunge grinders are used.

Through-feed grinding of cylindrical rollers

<table>
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<tr>
<th>Product</th>
<th>Benefits</th>
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</thead>
<tbody>
<tr>
<td>A/O and SIC vitrified bonded</td>
<td>high through-feed speed, excellent for rough grinding</td>
</tr>
<tr>
<td>A/O resin bonded</td>
<td>good surface finish, excellent for finish grinding</td>
</tr>
</tbody>
</table>

Specials:
- CBN vitrified and resin bonded for steel materials
- Diamond resin bonded for ceramic materials

Through-feed grinding of taper rollers

<table>
<thead>
<tr>
<th>Product</th>
<th>Benefits</th>
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</thead>
<tbody>
<tr>
<td>A/O elastic bonded</td>
<td>stable through-feed system as compared to the steel control wheel</td>
</tr>
</tbody>
</table>

Specials:
- Resin bonded wheels

Plunge grinding of spherical rollers

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<tr>
<th>Product</th>
<th>Benefits</th>
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<tr>
<td>A/O vitrified bonded</td>
<td>better profile retention, reduced grinding time</td>
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<td>Ceramic A/O vitrified bonded</td>
<td>increased productivity</td>
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GRINDING WHEELS

**Grinding wheel type 1**
Special design:
- With recess type 5 or 7
- Set wheels made of X-parts
FACE GRINDING
OF CYLINDRICAL AND SPHERICAL ROLLERS

Face grinding is the first operation after hardening. The rollers are ground parallel to final dimension and finish.

Machine
This is usually done in a double disc grinder in mostly one pass. For larger rollers or small series, grinders with cup wheels or grinding rings are used.

Double disc grinding, cylindrical or spherical rollers

Double disc face grinding of cylindrical and spherical rollers

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<td>high output, more parts per dress</td>
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<td>CENTURIA (Ceramic A/O resin bonded)</td>
<td>increased productivity</td>
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</table>

Specials:
- Vitrified bonded wheels
- CBN vitrified and resin bonded

GRINDING WHEELS

Grinding disc type 36ST
Special design:
- Slots, perforation, coolant holes

Grinding disc type 36ST
Face grinding is done after centerless grinding.

**Machine**
Custom made machinery is used. The grinding tool is a cup wheel, grinding ring or a profiled external grinding wheel.

**Face grinding of taper rollers**

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<tr>
<th>Product</th>
<th>Benefits</th>
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<tbody>
<tr>
<td>A/O resin bonded</td>
<td>high output, good surface finish</td>
</tr>
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</table>

Specials:
- Multiple layer wheels for roughing and finishing

**GRINDING WHEELS**

**Cup wheel type 5ST**
Special design:
- Modler type wheel with two layers (rough/finish grinding)

**Straight wheel type 1 - S**
Special design:
- Sandwich wheel with 2-4 layers (rough/semi-finish/finish grinding)
Superfinishing is the final operation for the OD of the rollers. All roller characteristics including roundness, wave, form and surface finish must meet tight tolerances.

Machine

Cylindrical and taper rollers:
These rollers are typically ground using multi-station superfinishing machines. The rollers are usually supported and driven by steel rolls. A set up of different stone plates oscillate on top.

Spherical rollers:
These rollers are generally ground using one or two station superfinishing machines. The rollers are usually supported and driven by control wheels. The stone oscillates across the OD.

Superfinishing of rollers on multi-station machine

<table>
<thead>
<tr>
<th>Product</th>
<th>Benefits</th>
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<tbody>
<tr>
<td>A/O vitrified bonded</td>
<td>increased material removal, mainly for the first station(s)</td>
</tr>
<tr>
<td>SIC vitrified bonded</td>
<td>better surface quality, mainly for the last station(s)</td>
</tr>
<tr>
<td>Mixture of A/O and SIC, vitrified bonded</td>
<td>combines advantage of both (surface finish and material removal)</td>
</tr>
<tr>
<td>A/O resin bonded with graphite</td>
<td>for very fine surface finish, mainly for last station of multi-station machines</td>
</tr>
</tbody>
</table>

Specials:
- Paraffin or sulphur impregnation for higher material removal rates

GRINDING TOOLS

Superfinishing stone type 54SCH
Special design:
- With profile to match the roller shape
- Stone blocks type 54SCHP to be cut to size
In addition to top performing products from their partners, successful companies are also looking for engineering expertise and overall process knowledge. Reduction in cost per piece is the objective of every successful grinding application.

Simply concentrating on the manufacturing and supply of top quality grinding tools is not enough. 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 economic expectations.

Clarify the task
We place great emphasis on learning our customers’ requirements. Application engineering specialists analyze each grinding job in detail. Together with each customer a requirements profile which includes both technological and profitability considerations is then drawn up.

Define the concept
Our team of experienced application engineers defines various approaches to the solution, calling on the additional input from our over 100 Research and Development specialists and as required, our in-house test center.

Realize the solution
The process solution is then taken direct to the customer where it is put into practice on each specific 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 with the workpiece, material, cooling lubricant and kinematical parameters all working together. All products for the bearing industry are manufactured in our facilities located in both the USA and Austria.

Share the know-how
Our know-how in the field of grinding technology is crucial to each and every customer’s success. Sustained results come from the continuous application of the experience on a broad basis. In addition to grinding tools, Radiac Abrasives, Inc. – A Tyrolit Company also offers a series of services to our customers including practice-oriented information, data preparation, training sessions and seminars. Our Bearing Team’s broad base of experience coupled with a global presence, customer service expertise and close face-to-face interaction are key to creating a long term partnership with each and every customer.