YOUR PARTNER IN THE BEARING INDUSTRY

Grinding solutions for
- Bearing rings
- Bearing balls and rollers

A Company within the SWAROVSKI Group
BEARING RINGS
TYPICAL GRINDING APPLICATIONS

Race grinding, inner rings

Bore grinding, inner rings

Face grinding, inner- and outer 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

Ball  Taper roller  Spherical roller  Cylindrical roller
**FACE GRINDING**
**OF INNER- AND OUTER RINGS**

After hardening, inner- and outer rings have to be ground parallel to the final dimension and quality.

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

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

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**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 (Sintered A/O resin bonded)</td>
<td>for high demands on productivity</td>
</tr>
</tbody>
</table>

Specials: vitrified bonded wheels, CBN vitrified and resin bonded

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**GRINDING TOOLS**

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

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

This is the following operation after the face grinding for outer rings. The ovality and wave from the hardening process has to be reduced to low tolerances by this process.

Machine
Centerless through-feed grinders can do this in a very efficient way. 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>
</tr>
</thead>
<tbody>
<tr>
<td>A/O vitrified bonded</td>
<td>high through-feed speed, better roundness,</td>
</tr>
<tr>
<td></td>
<td>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, short grinding time</td>
</tr>
</tbody>
</table>

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

GRINDING TOOLS

Grinding wheel type 1
Special design:
With recess type 5 or 7
Set grinding wheel made of X-parts

Grinding wheel type 1
Grinding wheel type 5
Set grinding wheel (3 parts)
RACE GRINDING
OF INNER- AND OUTER RINGS

According to the bearing type, the 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, the rings are usually 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, short grinding time</td>
</tr>
<tr>
<td>CSS-ULTRA (Sintered A/O vitrified bonded)</td>
<td>for higher demands on 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:
- 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>
<thead>
<tr>
<th>Product</th>
<th>Benefits</th>
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<tbody>
<tr>
<td>A/O vitrified bonded</td>
<td>better profile retention, short grinding time</td>
</tr>
<tr>
<td>COLUMBIA (Sintered A/O vitrified bonded)</td>
<td>for higher demands on 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, short grinding time</td>
</tr>
<tr>
<td>Sintered A/O vitrified and resin bonded</td>
<td>for higher demands on 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 TOOLS**

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

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

**Machine**

Internal grinder, the rings are usually 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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<th>Product</th>
<th>Benefits</th>
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<tr>
<td>A/O vitrified bonded</td>
<td>better profile retention, short grinding time</td>
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<tr>
<td>COLUMBIA (Sintered A/O vitrified bonded)</td>
<td>for higher demands on productivity</td>
</tr>
<tr>
<td>CBN vitrified bonded</td>
<td>for smaller rings and optimized process</td>
</tr>
</tbody>
</table>

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

**GRINDING TOOLS**

**Grinding wheel type 1**

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

The superfinishing is the final operation for bearing races. All qualities like roundness, wave, form and surface finish have to meet low tolerances.

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

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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 material removal, good surface quality with fine grit size</td>
</tr>
<tr>
<td>SIC vitrified bonded</td>
<td>better surface quality</td>
</tr>
<tr>
<td>CBN vitrified bonded</td>
<td>long stone life, 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**

The high forces applied in the machine require extremely hard grinding wheels, which are made in a special production technology. This regards both, the vitrified and the resin bonded wheels.

**Machine**

Ball grinding is done in specially designed machines with horizontal or vertical axis. The balls are ground between a grooved plate and the grinding wheel. The stationary grooved plate is made of cast steel in different hardness according to the application. It has a section cut out of it; this is where the balls enter and exit the grooves. The grinding wheel spins, while the balls travel through the grooves and get ground down 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>
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<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 TOOLS**

**Grinding wheel type 35**

- Special design:
  - Glued onto steel plate
- **Type 36ST with inserted nuts**
CENTERLESS GRINDING OF ROLLERS

This is the next step after the face grinding for cylindrical- and spherical rollers (the first step for taper rollers). The ovality and wave from the hardening process has to be reduced to low 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>
<thead>
<tr>
<th>Product</th>
<th>Benefits</th>
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<tbody>
<tr>
<td>A/O and SiC vitrified bonded</td>
<td>high through-feed speed, specially for rough grinding</td>
</tr>
<tr>
<td>A/O resin bonded</td>
<td>good surface quality, specially 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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<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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<th>Product</th>
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<tr>
<td>A/O vitrified bonded</td>
<td>better profile retention, short grinding time</td>
</tr>
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<td>Sintered A/O vitrified bonded</td>
<td>for higher demands on productivity</td>
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GRINDING TOOLS

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

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

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 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 (Sintered A/O resin bonded)</td>
<td>for high demands on productivity</td>
</tr>
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</table>

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

GRINDING TOOLS

Grinding disc type 36ST
Special design:
- Slots, perforation, coolant holes
FACE GRINDING
OF TAPER ROLLERS

The face grinding is done after the centerless grinding.

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

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

Specials:
- Multiple layer wheels for roughing and finishing

GRINDING TOOLS

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
OF ROLLERS

The superfinishing is the final operation for the OD of the rollers. All qualities like roundness, wave, form and surface finish have to meet low tolerances.

Machine
Cylindrical and taper rollers:
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:
Mostly 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>
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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 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 low 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
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 the concept
The team of experienced application engineers defines approaches 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 direct 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 the experience on a broad basis. Service is also offered to our customers by way of practice-oriented information, data preparation, trainings and seminars.
Our worldwide subsidiary companies can be found on our website at www.tyrolit.com