



YOUR PARTNER IN THE BEARING INDUSTRY

Grinding solutions for

- Bearing rings
- Bearing balls and rollers

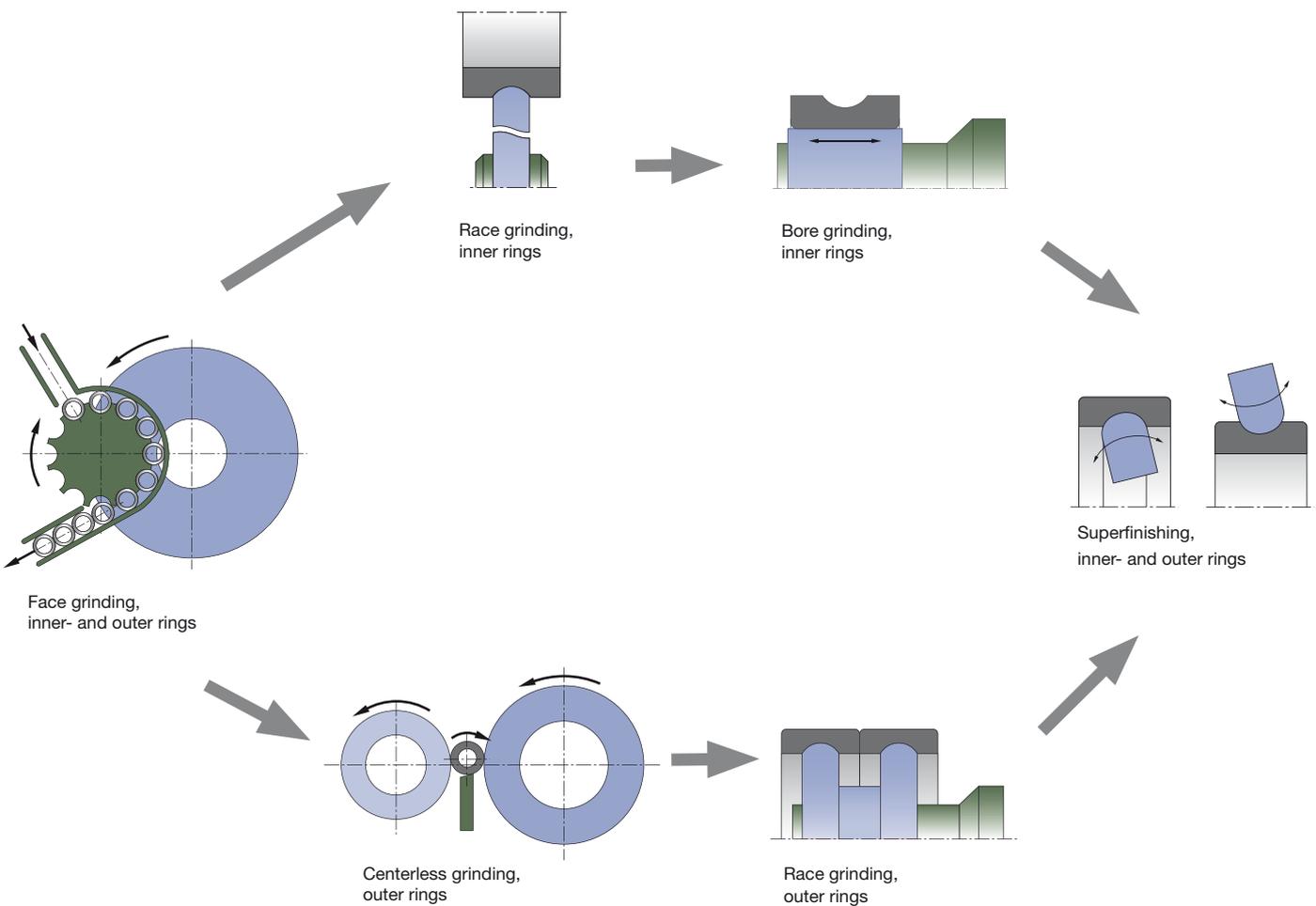
A Company within the SWAROVSKI Group

TYROLIT

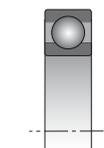


BEARING RINGS

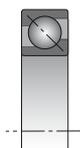
TYPICAL GRINDING APPLICATIONS



BEARING TYPES



Ball bearing
BB



Angular contact bearing
ACB



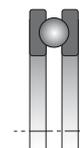
Taper roller bearing
TRB



Cylindrical roller bearing
CRB



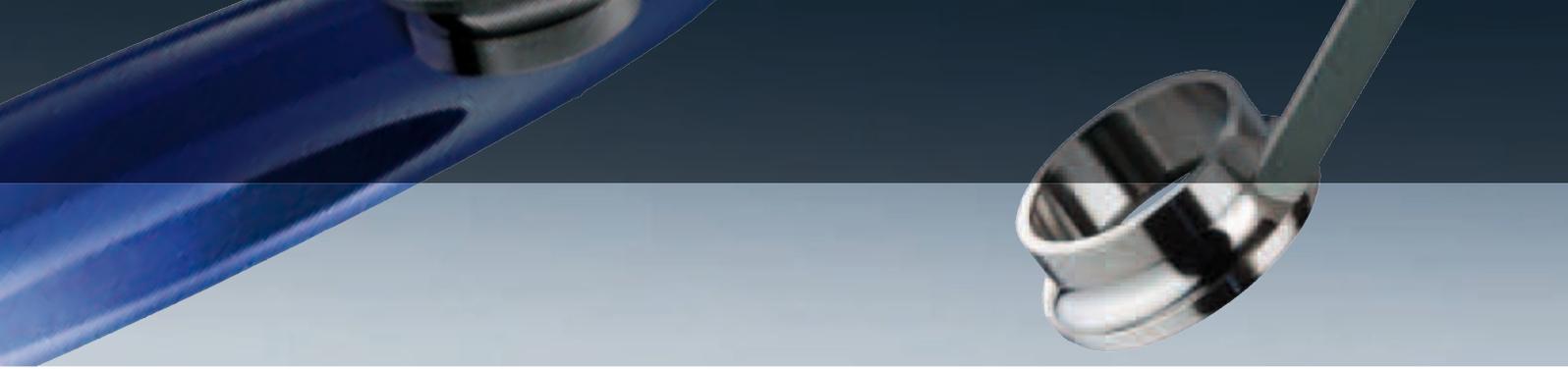
Spherical roller bearing
SRB



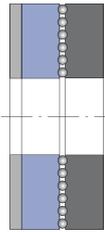
Thrust bearing
TB

Special types:

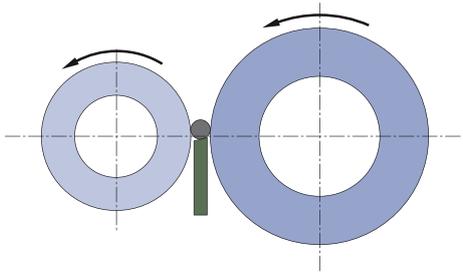
- Hub bearings
- Large size bearings
- Miniature bearings



BEARING BALLS AND ROLLERS TYPICAL GRINDING APPLICATIONS



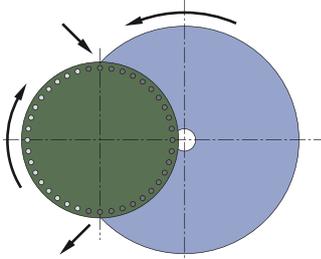
Ball grinding



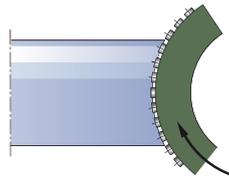
Centerless grinding,
cylindrical and taper rollers



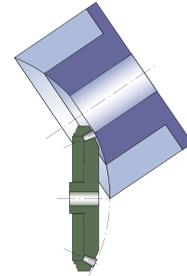
Centerless grinding,
spherical rollers



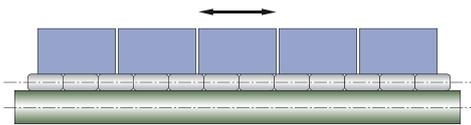
Face grinding,
cylindrical and spherical rollers



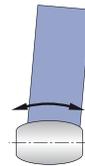
Face grinding,
taper rollers



Face grinding
taper rollers



Superfinishing,
cylindrical and taper rollers



Superfinishing,
spherical rollers

BALL AND ROLLER TYPES



Ball



Taper roller



Spherical roller



Cylindrical roller



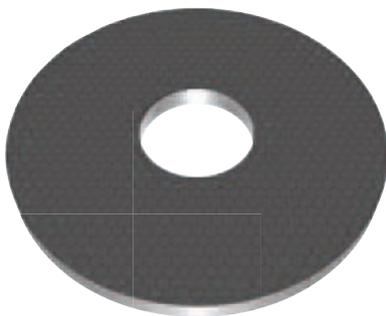
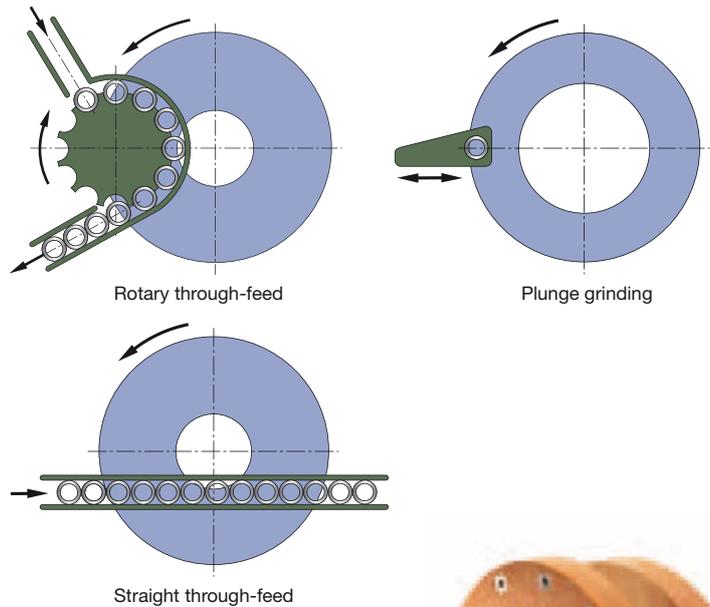
FACE GRINDING OF INNER- AND OUTER RINGS

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

Machine

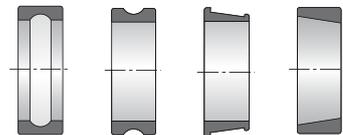
This is usually done in a double disc grinding machine, which offers a very efficient way to produce good quality and high output. The rings are either feed in one or more passes by a rotary or straight feeding device or by the plunge grinding principle.

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



Double disc face grinding of rings

Product	Benefits
CENTURIA (A/O resin bonded)	high output, more parts per dress
CENTURIA (Sintered A/O resin bonded)	for high demands on productivity



Specials: vitrified bonded wheels, CBN vitrified and resin bonded

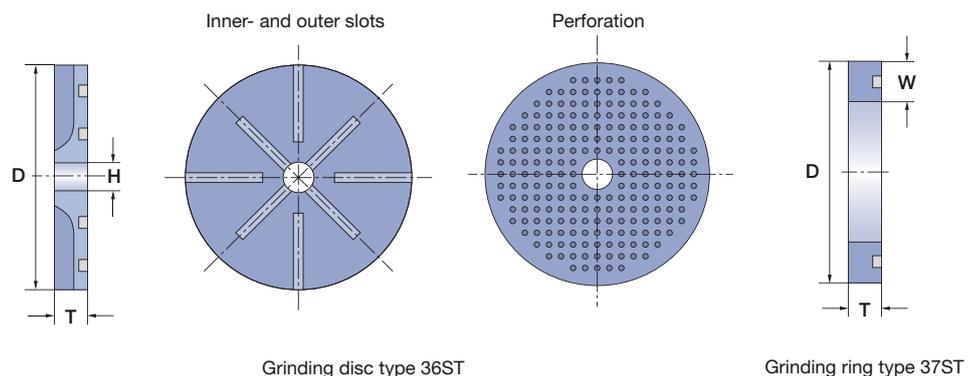
GRINDING TOOLS

Grinding disc type 36ST

Special design:

- Slots, perforation, coolant holes

Grinding ring type 37ST

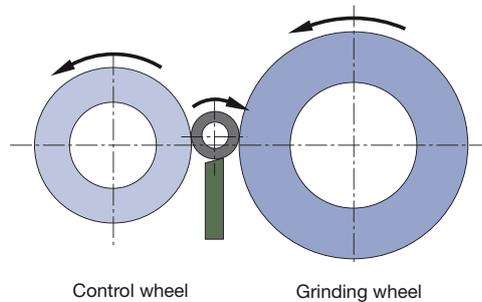


CENTERLESS GRINDING OF OUTER RINGS AND SHAFTS

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.

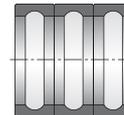
Machine

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

Product	Benefits
A/O vitrified bonded	high through-feed speed, better roundness, low waviness of rings



Specials: wheel set with combination of vitrified and resin bonds

Plunge grinding of bearing shafts

Product	Benefits
A/O vitrified bonded	better profile retention, short grinding time

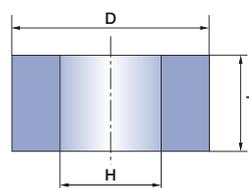


Specials: sintered A/O vitrified bonded for high demands on productivity

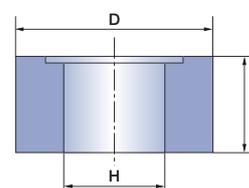
GRINDING TOOLS

Grinding wheel type 1

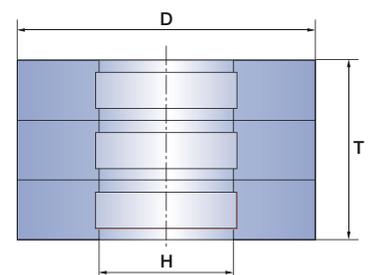
- Special design:
- With recess type 5 or 7
- Set grinding wheel made of X-parts



Grinding wheel type 1



Grinding wheel type 5



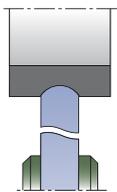
Set grinding wheel (3 parts)

RACE GRINDING OF INNER- AND OUTER RINGS

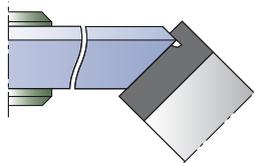
According to the bearing type, the race ways have different profiles, which are usually pre-shaped by turning. The race grinding operation has to meet the quality requirements specified for roundness, wave, form- and dimensional tolerances.

Machine

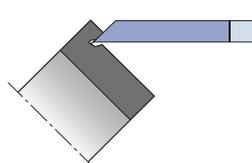
External- and internal grinders, the rings are usually supported by shoes and driven by a magnetic chuck or pressure plate. Different infeed steps (roughing, finishing and spark out) are used for grinding.



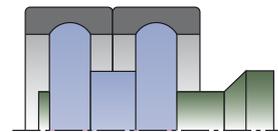
Inner ring ball track



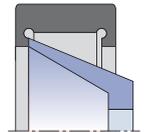
Inner ring track and rib



Inner ring rib



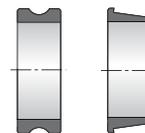
Outer ring ball track



Outer ring flange

Inner ring race and rib grinding

Product	Benefits
CSS-ULTRA (A/O vitrified bonded)	better profile retention, short grinding time
CSS-ULTRA (Sintered A/O vitrified bonded)	for higher demands on productivity



Specials:

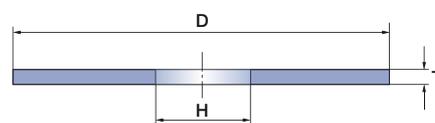
- CBN vitrified bonded for steel materials
- Diamond vitrified bonded for ceramic materials
- Elastic bonded wheels for fine surface finish

GRINDING TOOLS

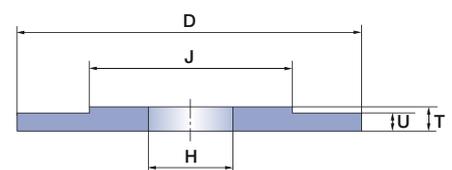
Grinding wheel type 1LB

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



Grinding wheel type 1LB

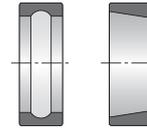


Grinding wheel type 38LB



RACE GRINDING OF OUTER RINGS

Product	Benefits
A/O vitrified bonded	better profile retention, short grinding time
COLUMBIA (Sintered A/O vitrified bonded)	for higher demands on productivity



Specials:

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

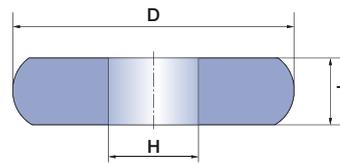


GRINDING TOOLS

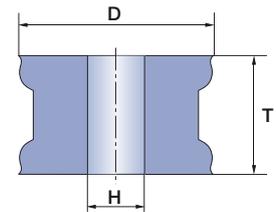
Grinding wheel type 1LB

Special design:

- All different types of profiles



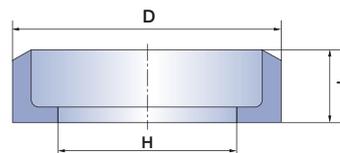
Profile type L



Profile type T

Cup wheel type 6F

Grinding of spherical outer rings



Cup wheel type 6F



Outer ring flange grinding (CRB)

Product	Benefits
A/O vitrified and resin bonded	better cutting ability, short grinding time
Sintered A/O vitrified and resin bonded	for higher demands on productivity

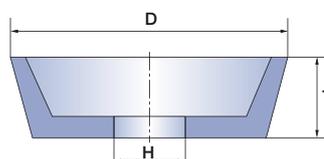


Specials:

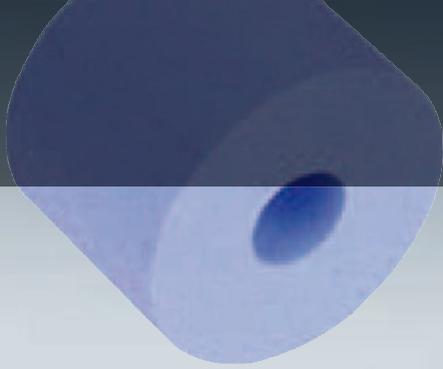
- Sulphur impregnation for longer dressing cycles
- CBN resin bonded for steel materials
- Diamond resin bonded for ceramic materials

GRINDING TOOLS

Cup wheel type 11



Cup wheel type 11

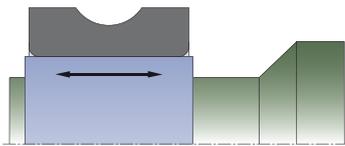


BORE GRINDING OF INNER RINGS

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

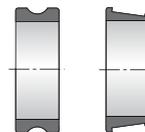
Internal grinder, the rings are usually supported by shoes and driven by a magnetic chuck or pressure plate. Different infeed steps (roughing, finishing and spark out) are used with small oscillation.



Bore grinding

Bore grinding of inner rings

Product	Benefits
A/O vitrified bonded	better profile retention, short grinding time
COLUMBIA (Sintered A/O vitrified bonded)	for higher demands on productivity
CBN vitrified bonded	for smaller rings and optimized process



Specials:

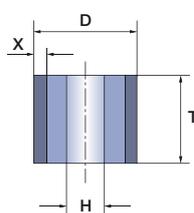
- └ Sulphur impregnation for longer dressing cycles
- └ Diamond resin bonded for ceramic materials

GRINDING TOOLS

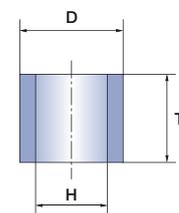
Grinding wheel type 1

Special design:

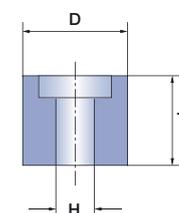
- └ Type 5 with recess
- └ Type 1A8, 1A1 for CBN wheels



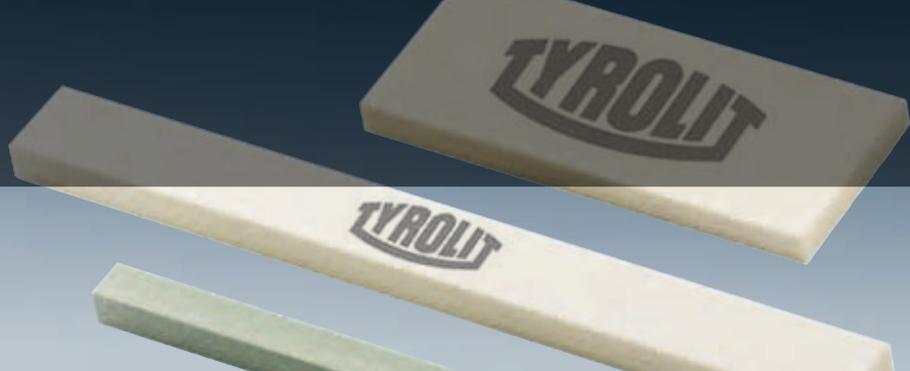
Grinding wheel type 1A1



Grinding wheel type 1



Grinding wheel type 5

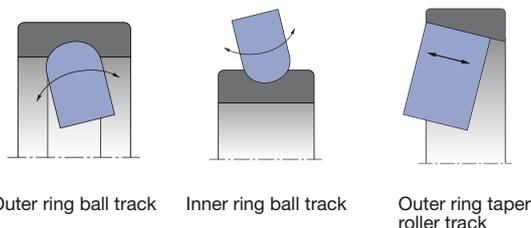


SUPERFINISHING OF INNER- AND OUTER RINGS

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

Machine

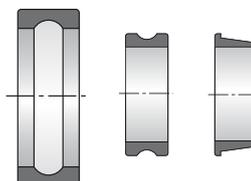
Superfinishing machines, the rings are usually supported and driven by steel rolls. It can be done with one or more stations and steps (roughing and finishing). The stone oscillates across the race.



Outer ring ball track Inner ring ball track Outer ring taper roller track

Superfinishing of rings

Product	Benefits
A/O vitrified bonded	better material removal, good surface quality with fine grit size
SIC vitrified bonded	better surface quality
CBN vitrified bonded	long stone life, for small rings or special steel materials



Specials:

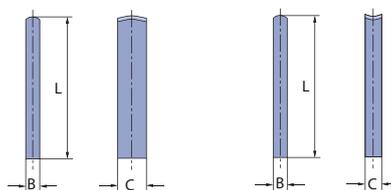
- Paraffin or sulphur impregnation for higher material removal rates
- Mixtures of A/O and SIC

GRINDING TOOLS

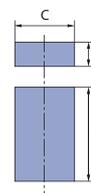
Superfinishing stone type 54SCH

Special design:

- With profile to match the race
- Stone block type 54SCHP to be cut to size

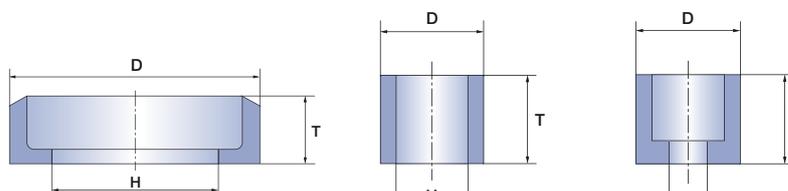


Superfinishing stone type 54SCH



Stone block type 54SCHP

Superfinishing ring type 5420 and cup wheel type 5460, 6F



Cup wheel type 6F

Ring type 5420

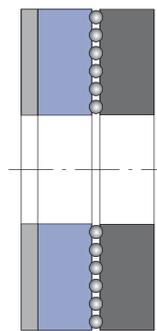
Cup wheel type 5460

BALL GRINDING OF BEARING BALLS

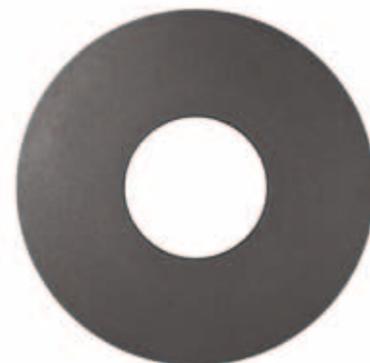
The high forces applied in the machine require extremely hard grinding wheels, which are made in a special production technology. This regards both, the vitrified and the resin bonded wheels.

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.



Ball grinding



Rough-grinding of balls (G1)

Product	Benefits
Mixture of SIC and A/O vitrified bonded (grit size 80 – 320)	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



Finish-grinding of balls (G2)

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



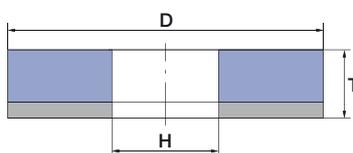
GRINDING TOOLS

Grinding wheel type 35

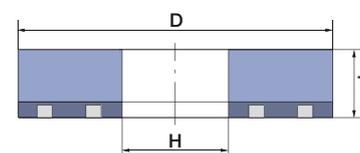
Special design:

– Glued onto steel plate

Type 36ST with inserted nuts



Grinding wheel type 35



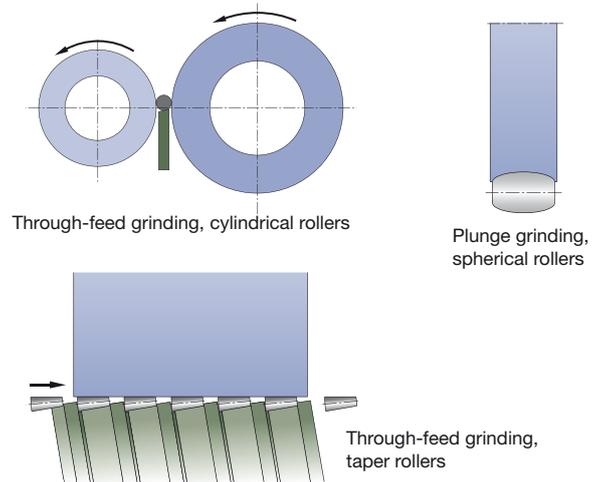
Grinding wheel type 36ST

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

Product	Benefits
A/O and SIC vitrified bonded	high through-feed speed, specially for rough grinding
A/O resin bonded	good surface quality, specially for finish grinding



Specials:

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

Through-feed grinding of taper rollers

Product	Benefits
A/O elastic bonded	stable through-feed system as compared to the steel control wheel

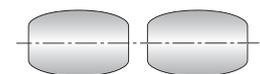


Specials:

- Resin bonded wheels

Plunge grinding of spherical rollers

Product	Benefits
A/O vitrified bonded	better profile retention, short grinding time
Sintered A/O vitrified bonded	for higher demands on productivity

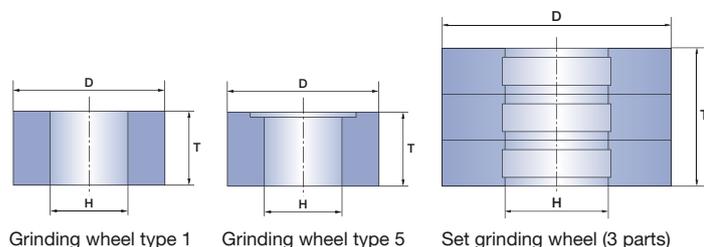


GRINDING TOOLS

Grinding wheel type 1

Special design:

- With recess type 5 or 7
- Set wheels made of X-parts

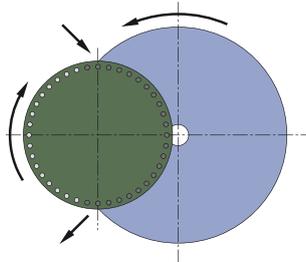


FACE GRINDING OF CYLINDRICAL AND SPHERICAL ROLLERS

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.

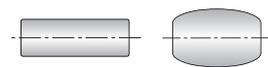


Double disc grinding, cylindrical or spherical rollers



Double disc face grinding of cylindrical and spherical rollers

Product	Benefits
CENTURIA (A/O resin bonded)	high output, more parts per dress
CENTURIA (Sintered A/O resin bonded)	for high demands on productivity



Specials:

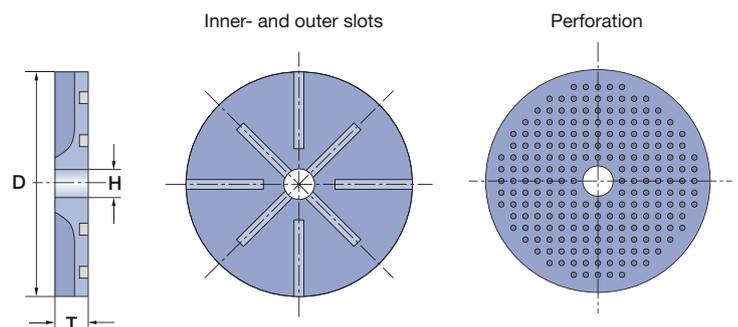
- Vitrified bonded wheels
- CBN vitrified and resin bonded

GRINDING TOOLS

Grinding disc type 36ST

Special design:

- Slots, perforation, coolant holes



Grinding disc type 36ST

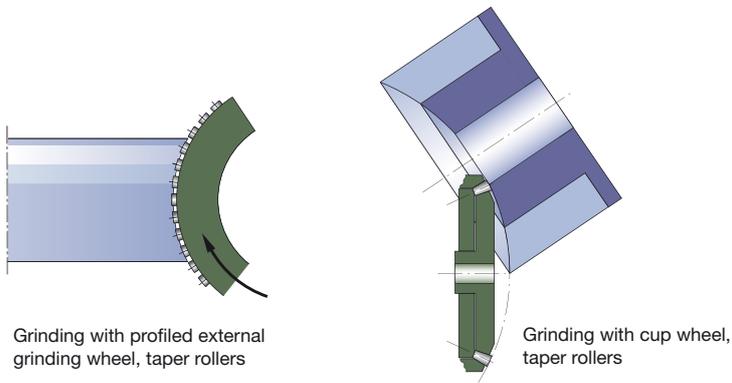


FACE GRINDING OF TAPER ROLLERS

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.



Face grinding of taper rollers

Product	Benefits
A/O resin bonded	high output, good surface quality



Specials:

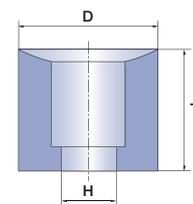
- Multiple layer wheels for roughing and finishing

GRINDING TOOLS

Cup wheel type 5ST

Special design:

- Modler type wheel with two layers (rough-/finish grinding)

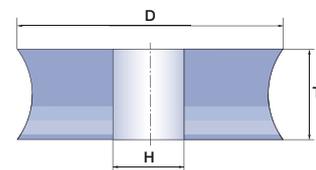


Cup wheel type 5ST

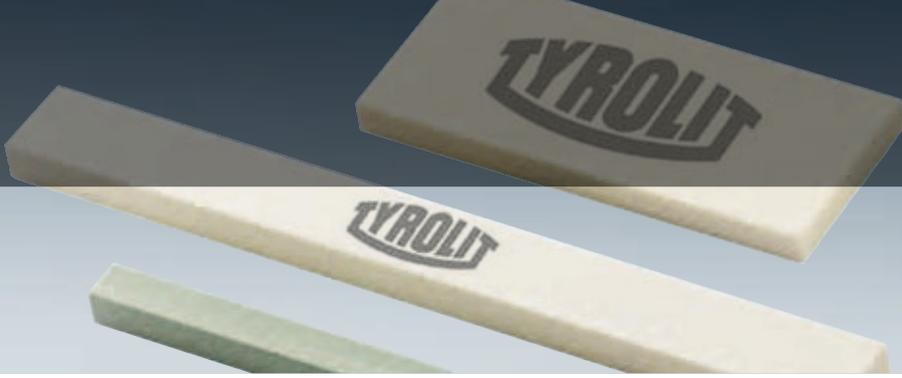
Straight wheel type 1 - S

Special design:

- Sandwich wheel with 2-4 layers (rough-/semi finish-/finish grinding)



Straight wheel type 1 - S



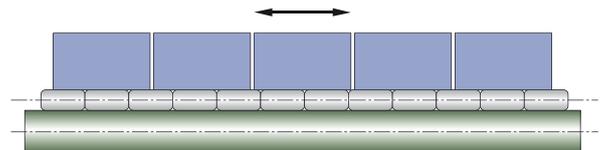
SUPERFINISHING OF ROLLERS

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.

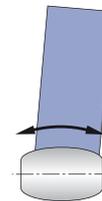
Machine

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.



Through-feed superfinishing of cylindrical and taper rollers



Superfinishing of spherical rollers

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

Product	Benefits
A/O vitrified bonded	better material removal, mainly for the first station(s)
SIC vitrified bonded	better surface quality, mainly for the last station(s)
Mixture of A/O and SIC, vitrified bonded	combines advantage of both (surface finish and material removal)
A/O resin bonded with graphite	for very low surface finish, mainly for last station of multi-station machines



Specials:

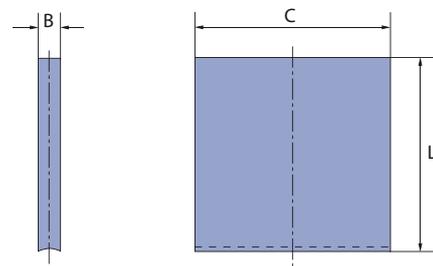
- Paraffin or sulphur impregnation for higher material removal rates

GRINDING TOOLS

Superfinishing stone type 54SCH

Special design:

- With profile to match the roller shape
- Stone blocks type 54SCHP to be cut to size



Superfinishing stone type 54SCH

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 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.

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