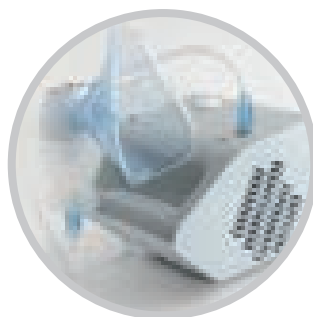


HEALTHCARE

Medical & Dental Solutions

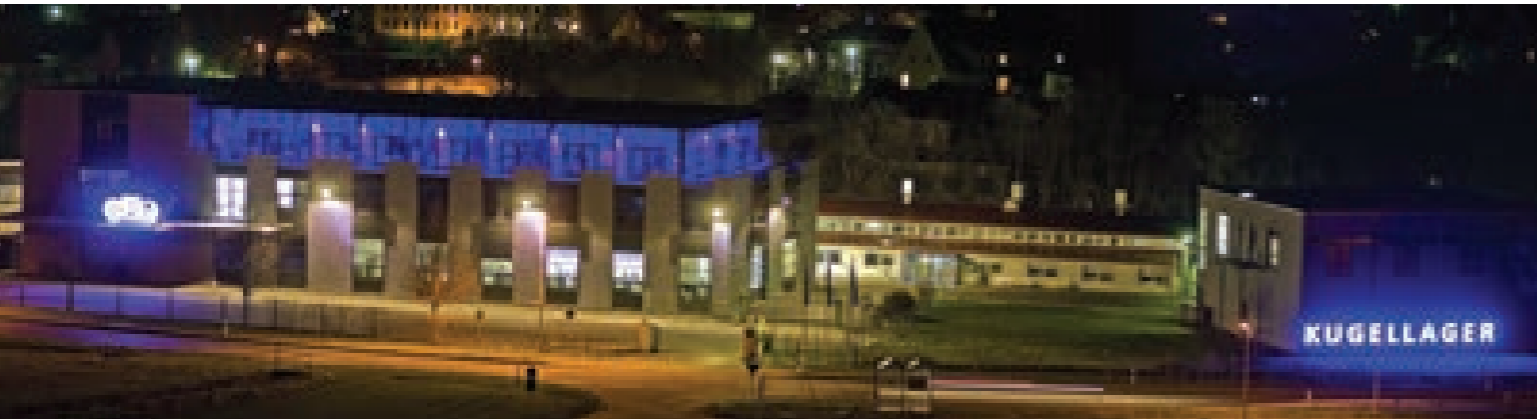


XTRA

Reliability
High Durability
Corrosion Resistance

Healthcare Solutions

Our company



Headquarter in Rimpar, Germany

The GRW corporation, with its head office in Rimpar near Würzburg and a production site in Prachatice CZ, with direct sales office in the USA is a global technology leader in the development and production of high-precision miniature ball bearings. The corporation consists of over 500 employees and is globally active with numerous regional representatives.

Our standard product range includes various versions of radial ball bearings with bore sizes from 1 to 35 millimeters and outer diameters from 3 to 47 millimeters in both metric and inch sizes. State of the art equipment

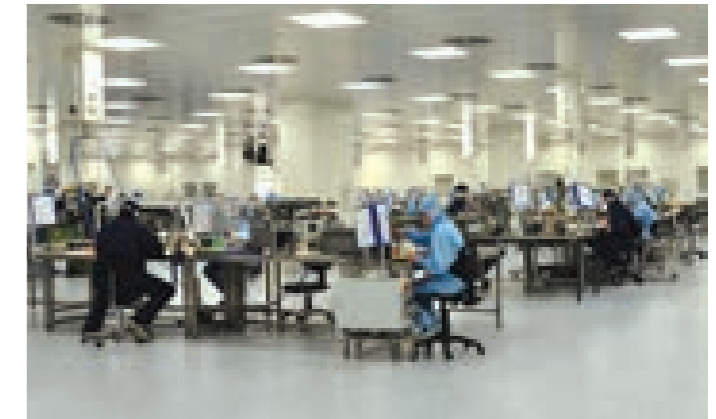
and processes are used for all manufacturing operations. From individual system solutions for small production runs to high volume standard applications, GRW offers tailor made designs, high-quality engineering and short lead times to provide market focused solutions in a timely manner. Where ever you have a need for precision – GRW is there.

Over one-third of GRW's products are used in the healthcare device industry. GRW is setting the standard for more innovations within medical & dental applications.

GRW manufacturing



The journey of our products starts in the turning department where our high-precision turning machines produce bearing rings from a variety of steels.



Ball bearing assembly at 1.400m² in a clean room class R10.000 ISO-Standard (ISO 14644-1, class 7).



After heat treat, all critical dimensions and raceway geometries are precisely machined to the micron (μ) in our grinding department!



Our dental test module, the Orakel III developed by GRW, guarantees a faster time-to-market for new jointly developed products for our customers. For more information about Orakel III, please see page 14.


GRW historical milestones

<p>1958 Factory construction in Rimpar</p> 	<p>2009 Relocation of the administration to the new building in Rimpar</p> 	<p>2013 Construction of the new production site in the Czech Republic with 1.400m² clean room</p> 
<p>1942 Company founded in Würzburg</p> <p>1996 Purchase and construction of production site in the Czech Republic</p> 	<p>2003 Formation of GRW USA</p> 	<p>2013 Opening of new sales office on the East Coast of the USA</p> 

● Made
● in
● Germany



Your technical needs - our challenge!
Our sales engineers will be glad to advise you.

 worldwide: **+49 (0) 93 65/819 - 481**
 USA: **+1 (804) 328 0900**

 healthcare@grw.de

Medical Solutions

Surgeons require precision. This applies to surgical handpieces and corresponding attachments, as well as for tilt guards (tripods or hexapods) for head surgery, such as eye or brain operations.

GRW bearings ensure backlash-free and highly accurate products. They allow thermal disinfection, and they do not need to be re-lubricated – all this along with reduced friction, lower heat generation for use in the narrowest spaces. GRW supplies high-precision ball bearings and corresponding needle rollers made of standard as well as special materials and cage assemblies. Accessories like high-precision spring washers complete the GRW product portfolio.

If required we can adopt the standard bearing concept to the customer's needs using the latest production technologies.

For instance GRW bearings are used in micro blood-pumps, which ensure stabilization of vital body functions during heart surgery and recovery from surgical procedures. These micro blood-pumps are considerable less stressful for the patient than conventional heart-lung-machines.

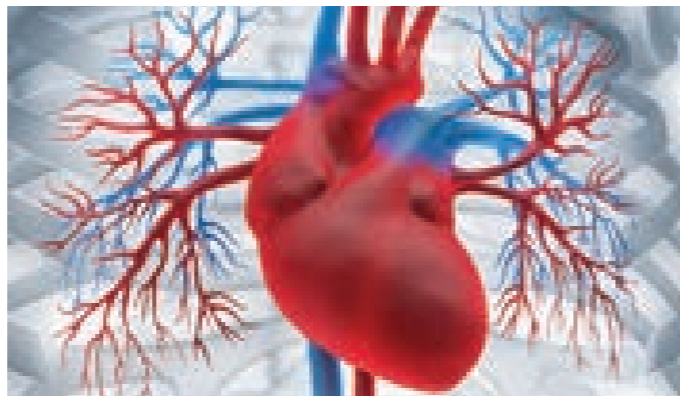
In addition GRW ball bearings are used in respiratory devices. Accident victims and patients are ventilated externally on stationary or mobile respirators.

Cardiovascular devices

Products that help save lives and have to work reliably when it matters! Patients benefit from GRW high-precision bearings used in dialysis machines or blood-pumps. Our technology know-how and quality bearings can be truly life saving.

The challenges

- Aggressive cleaning agents and processes
- Extremely corrosive environments
- Maximum product reliability
- Miniaturization and integration of assemblies



Respiratory devices

Whether inpatient respiration in a hospital or home-care, almost noiseless bearing solutions from GRW provide dependable and above all convenient patient-centered care.

No question, GRW products are resistant to oxidation.

The challenges

- Lowest noise and vibration
- Materials resistant to oxidation
- Maximum product reliability
- Miniaturization and integration of assemblies



Surgical power tools

Surgical power tools combine reliable power and smooth performance. GRW's highly non-corrosive and durable bearings ensure excellent performance and high reliability of surgical power tools which meet the needs and expectations of medical specialists.

The challenges

- Aggressive cleaning agents and processes
- Extremely corrosive environments
- Maximum product reliability
- Miniaturization and integration of assemblies



Post operative treatments

Not only during surgery and for life-support, GRW bearings also come into operation during post-surgery, for lengthy and difficult rehabilitation phases. GRW supports customers in the development and implementation of exo-skeletons, prostheses and laser treatment devices for skin and scar tissue.

The challenges

- High and undefined loads
- Miniaturization and integration of assemblies
- High-precision and stiffness



Pharmaceutical Industry

In pharmaceutical and medical fields, we have already successfully solved some long-standing customer problems: through the use of linear guides and end cap bearings for analytical or packaging machines, the integration of functional principles such as flexible engagement, using chemically resistant seals and steels or by increasing the bearing's load capacity.

The challenges

- Aggressive cleaning agents and processes
- Extremely corrosive environments
- Special sealing solutions



Customers trusting in GRW:



Dental Solutions

Noise characteristics and service life are critical criteria for GRW high speed bearings, which are used in turbine handpieces for dental applications. Our bearings are optimized in our test stations and developed further. In addition, development projects are being conducted regularly with industry and technological partners.

GRW high speed bearings have successfully passed product sampling inspections and production releases at all renowned dental manufacturers worldwide - not

High speed handpieces

Half a million revolutions and still barely audible, thanks to GRW ball bearing solutions. Who isn't familiar with the unpleasant sound of a dentist's drill in action! Our developers at GRW, together with the manufacturers of these devices, are working on silent bearing solutions which still meet the rising demands for miniaturization and service life.

The challenges

- Aggressive cleaning agents and processes
- Extremely corrosive environments
- High speeds up to 500.000rpm
- Lowest running noise
- Miniaturization and integration of assemblies

Implant and surgical handpieces

SV30, GRW's extreme corrosion resistant ball bearing material – our customers first choice when it comes to direct contact with blood or aggressive cleaning agents. Worldwide GRW customers in oral maxillofacial surgery are already convinced with the increased life and operational safety of their products using SV30 material.

The challenges

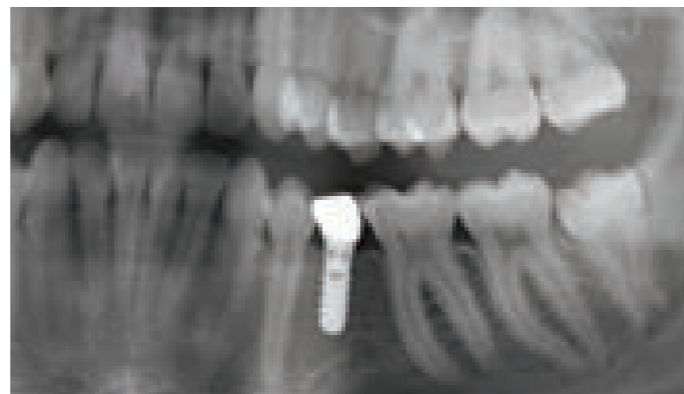
- Aggressive cleaning agents and processes
- Extremely corrosive environments
- Low friction and high loads
- Miniaturization and integration of assemblies

Customers trusting in GRW:



only for use in turbine handpieces, but also for straight and contra-angle handpieces, in dental and minor surgery applications, as well as for their electric or pneumatic drive motors.

Dental technicians are delighted with the extended life of our GRW products, thanks to intelligent sealing designs that generate less heat. This way, even working for longer periods remain agreeable, at a comfortable temperature.



Laboratory handpieces & dental CAD/CAM

Laboratory handpieces are the most used equipment in a dental lab.

Abrasive dust created by the dental technician's work is a serious threat to ball bearings and other mechanical parts. Sophisticated GRW sealing designs extend life time of the products while reducing friction at the same time, when compared to standard sealing solutions. Our bearing technology allows not only longer service life of their instruments, but also even longer periods of operation while minimizing heat due to friction.

Today more and more dental laboratories and dentists see the advantages of dental CAD/CAM systems. Production of high precise and cost effective restorations! Even here GRW is providing the customized bearing solution that make these systems so precise and effective.

The challenges

- High torque
- High precision and stiffness especially for CAD/CAM to cut ceramic materials
- Low heat and noise generation
- Miniaturization and integration of assemblies
- Special sealing solutions due to abrasive dust



Image source: Sirona



Know-How

Bearing design

In addition to our standard deep groove ball bearings in metric and inch dimensions, GRW develops and manufactures a wide range of customized designs. Whether the application requires high stiffness and load capacity or low friction and noise, combined with integrated sealing solutions, GRW is your perfect partner!

Deep groove ball bearings

Short-term availability and economy – customized bearing solutions based on standard parts.



Customized ball bearings

Various designs and materials available – when standard is not enough.



Ball bearing units

Miniaturization and integration of assemblies – outsourcing costs and effort.



Super duplex ball bearings

High precision and stiffness – all this in the narrowest available space.



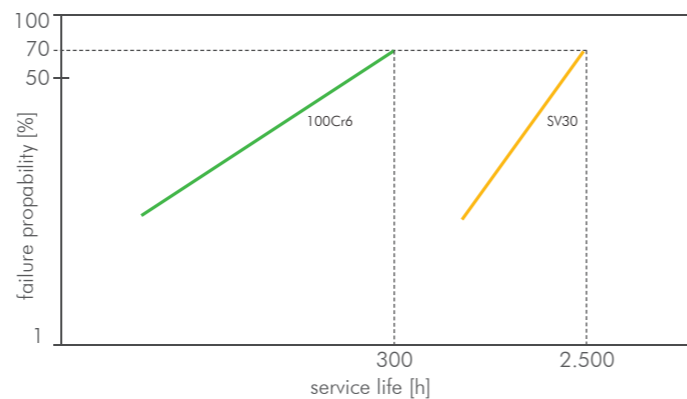
Bearing steel

The professional selection of raw materials, parts and components enables us to constantly provide our customers with consistently high quality. It has always been our policy to choose the most advanced material available – for example the alloy **SV30** (1.4108). A new material composition of nitrogen, carbon, chrome and molybdenum.

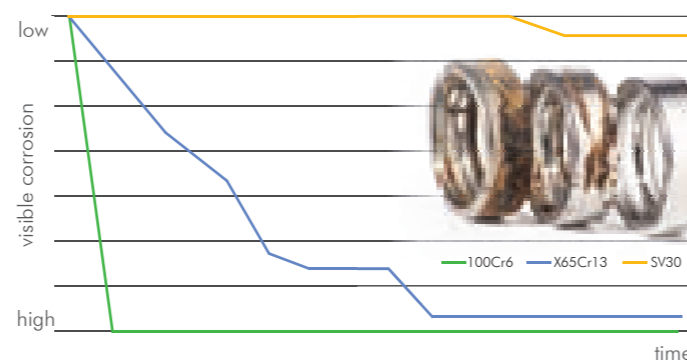
SV30 - the new dimension in bearing steel. SV30 stands out by its improved alternating bending strength, elongation at rupture, high temperature resistance, toughness and chemical resistance. SV30 is well ahead of all ball-bearing steels used in production to date.

This all results in considerable advantages for our miniature ball bearings:

- Higher resistance to corrosion
- Longer life time at high temperatures, in aggressive environments, with reduced lubrication or dry running
- Dimension stability at high temperature



The performance features of hybrid bearings increase through the use of SV30 by the factor 8.



Test Results from Salt Spray Test according to DIN 50021 / ASTM B117-7.

Surface treatment

Coatings and surface modifications can have positive effects on the characteristics of a ball bearing in medical and dental applications.



In addition to hard material coatings, which help to reduce friction and wear, GRW uses "soft coatings" which are applied either by electroplating methods or from a drum. Depending on the type of application, these can act as a dry lubricant, thus preserving the tribological properties of the ball bearing even if the functioning of the lubricant (grease or oil) is impaired following repeated cleaning cycles.

Our **XTRACoat**: For improved tribological conditions and extended service life!

Cage material

The choice of the cage material is a crucial factor in determining if the ball bearing satisfies the individual requirements of the customer. In fast rotating dental ball bearings in particular, the cage material is the main determinant of service life time. Through its ongoing developments with partners from research and industry, GRW aims to operate in a manner which targets the growing requirements for cleaning and maintenance.

Our **XTRAlon**: The patented cage material! Unbeatable in cases of insufficient lubrication and hygienic processing.



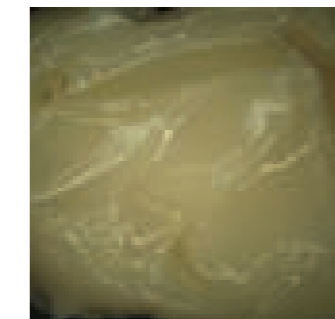
Lubrication

Ball bearings are exposed to harsh conditions in medical and dental devices not only during use, but also due to aggressive cleaning and sterilisation with steam under pressure, which particularly attacks the lubricants. For these tough conditions GRW has a wide range of lubricants and is constantly validating new oils and greases for customer applications. At our in-house laboratory, in addition to the analytical/visual inspection criteria (weight variation, visual condition, SEM, IR spectroscopy) applied to fresh greases and sterilized grease samples, GRW also performs various functional tests (friction, noise, service life) with untreated and autoclaved ball bearings.

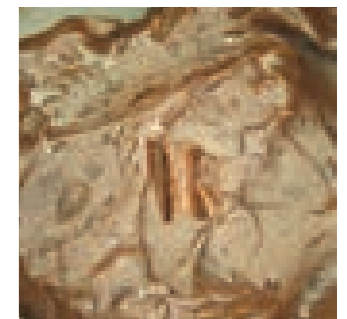
In the pre-selection of suitable grease specifications, GRW collaborates very closely with reputable grease manufacturers.

Our **XTRAlube**: Optimized lubrication conditions at high speed for applications close to the limits.

Suitable lubricant

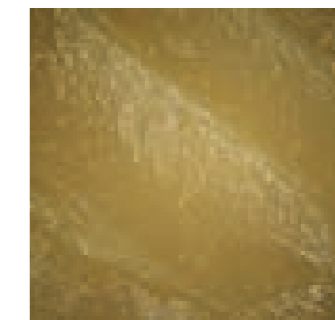


Fresh grease

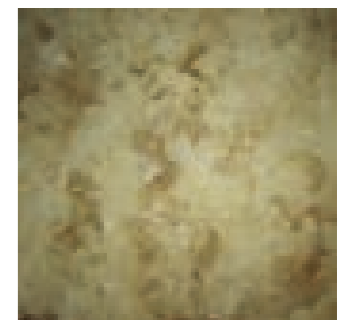


After 1.000 cycles of pressurised steam sterilisation: Discolouration of the surface layer; base oil and thickeners are intact

Unsuitable lubricant



Fresh grease



After 10 cycles of pressurised steam sterilisation: Separation of base oil and destruction of thickener

XTRA

Enhancing Performance!

In order to successfully meet the challenges of the market, our products are being continuously developed and their performance improved, based on the latest innovations from GRW.

Developments that we have achieved in the areas of product design, ball bearing steels, cage design and materials, lubricants and surface coatings, are the basis for the technological leadership the company has today.

With GRW **XTRA**, we are not so much reinventing the ball bearing but using our expertise to improve, for example, performance levels in terms of running noise, service lifetime and speed! The ball bearing designed by GRW to your individual requirements acquires superior performance due to **XTRA**.

XTRA – the GRW solution for your challenges!

For more information about **XTRA** contact our sales engineers. They will be glad to advise you.

☎ worldwide: **+49 (0) 93 65/819 - 481**

☎ USA: **+1 (804) 328 0900**

✉ **healthcare@grw.de**

XTRA

XTRAcOat

For improved tribological conditions and extended longer service life!

XTRAlube

Optimized lubrication conditions for high-speed applications.

XTRAlon

The PAI based patented cage material! Unbeatable in cases of insufficient lubrication and hygienic processing.

XTRAcOat

Developed for extreme conditions in handpieces of medical and dental equipment, we offer our customers special ball bearings with the new coating system **XTRAcOat**.

The coating developed exclusively for GRW equips the ball bearing components with the special capability to bind the applied grease to surfaces, and therefore to prevent as far as possible an insufficient lubrication situation from occurring, even under adverse operating conditions.

Which leads to a significantly higher service life, even in extreme cases where hygienic cleaning and maintenance are omitted.

Comparing the effect of **XTRAcOat** at a contact angle measurement with dental maintenance oil, can be clearly seen that the contact angle falls below 5° using **XTRAcOat**.

untreated surface



Contact angle: 24,2° (material: X65Cr13; 1.4037)

treated surface



Contact angle: 4,9° (material: X65Cr13; 1.4037)

Facts about GRW XTRAcOat:

- It is possible to completely wet ring or ball surfaces with minimum oil quantities.
- Less oil escapes from the ball bearing to the environment.
- The oil adheres better to the surfaces, consequently starved lubrication is avoided or delayed.
- Bearing life is prolonged.

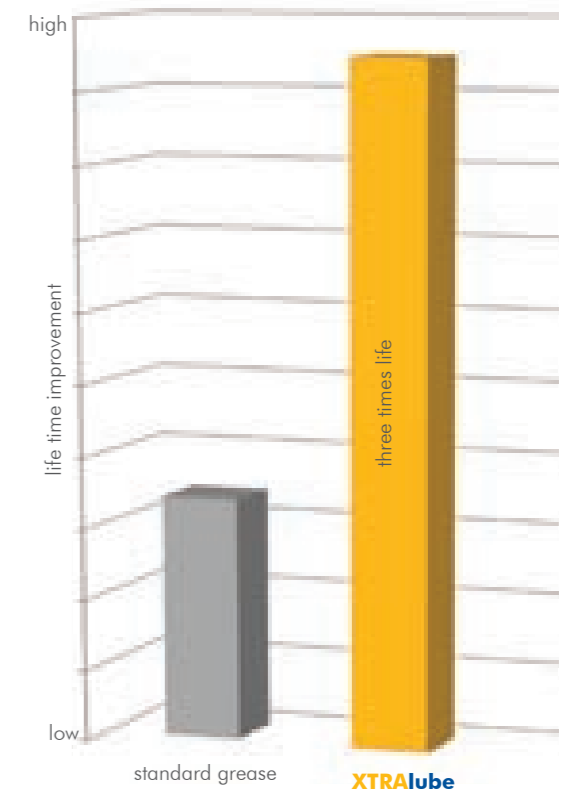
XTRAlube



For the toughest operating conditions in dental applications, GRW relies on developing its own lubricants, which have the potential for significantly longer life: **XTRAlube**.

The new **XTRAlube** developed in the GRW laboratory delivers outstanding results both in the test criteria which GRW considers crucial and in the various functional tests. It also has the special ability to adhere to the contact surfaces of the inner ring and outer ring much better than standard greases.

It is precisely in ball bearings for dental turbines that this property is particularly sought after, because the air extracted from the turbine flows partly through the ball bearings and transports the grease reservoir to the outside very rapidly. This leads to a situation of inadequate lubrication, which is responsible for the failure of the ball bearings.



Average value at life test on the GRW test bench Orakel III. Initial lubricated and no relube during test.

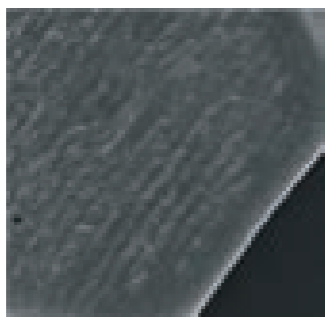
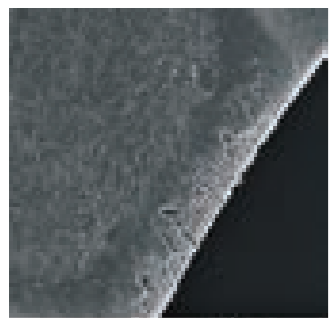
XTRA

XTRAlon

Our premium material is designed for the most demanding requirements in terms of friction, thermal stability and wear. The unique production method involving the chemical binding of solid lubricant to the base polymer polyamidimide (PAI) creates a homogeneous, dense fabric, which offers little opportunity for attack by the superheated steam during autoclaving.

The fine distribution of solid lubricant and the chemical bond to the base material means that the exceptional property of dry-running suitability is obtained, even in extreme applications where rotational speeds of $n \times dm > 1.000.000$ mm/min are the norm. In internal tests on GRW's own test rigs, service lifetimes of up to 15 hours were attained with completely dry ball bearings. All conventional cage materials fail after only a few minutes in the same test.

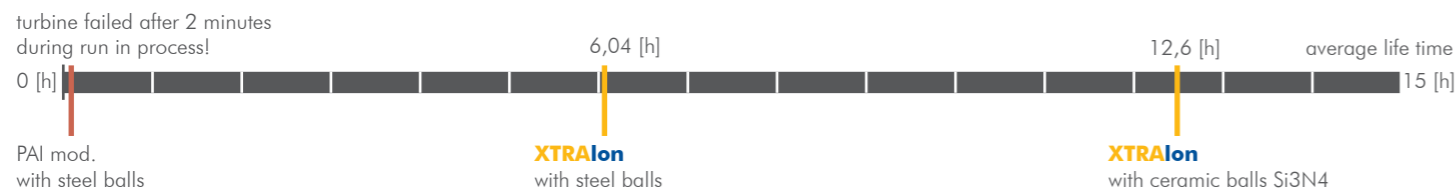
The SEM images show the surfaces of XTRAlon and PAI mod. after 1.000 cycles of sterilisation by steam under pressure. It is clearly seen that the surface structure of XTRAlon is preserved, while the PAI mod. has a very jagged surface.



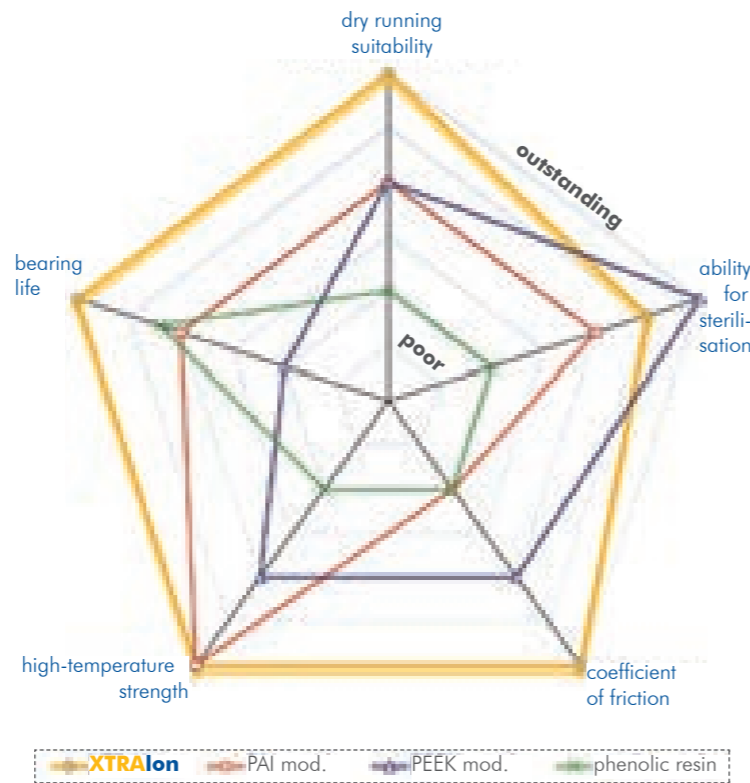
SEM image: PAI mod.

SEM image: XTRAlon

Life time test with XTRAlon modified ball bearings without initial lubrication:



Effect of the cage material to the life time of dental turbines without any initial lubrication tested on Orakel III test bench ($n=350.000$ min⁻¹).



Performance overview of standard dental cage materials compared to GRW XTRAlon used in high-speed dental handpieces.



Your success with GRW XTRA bearings:

As part of a development project for a major GRW customer, extremely high performance improvements over the current product design were obtained, in conjunction with XTRA developments. As part of this, parameters such as running noise, product service life and rotation speed were tested on GRW internal test rigs and optimized by applying XTRA advancements.

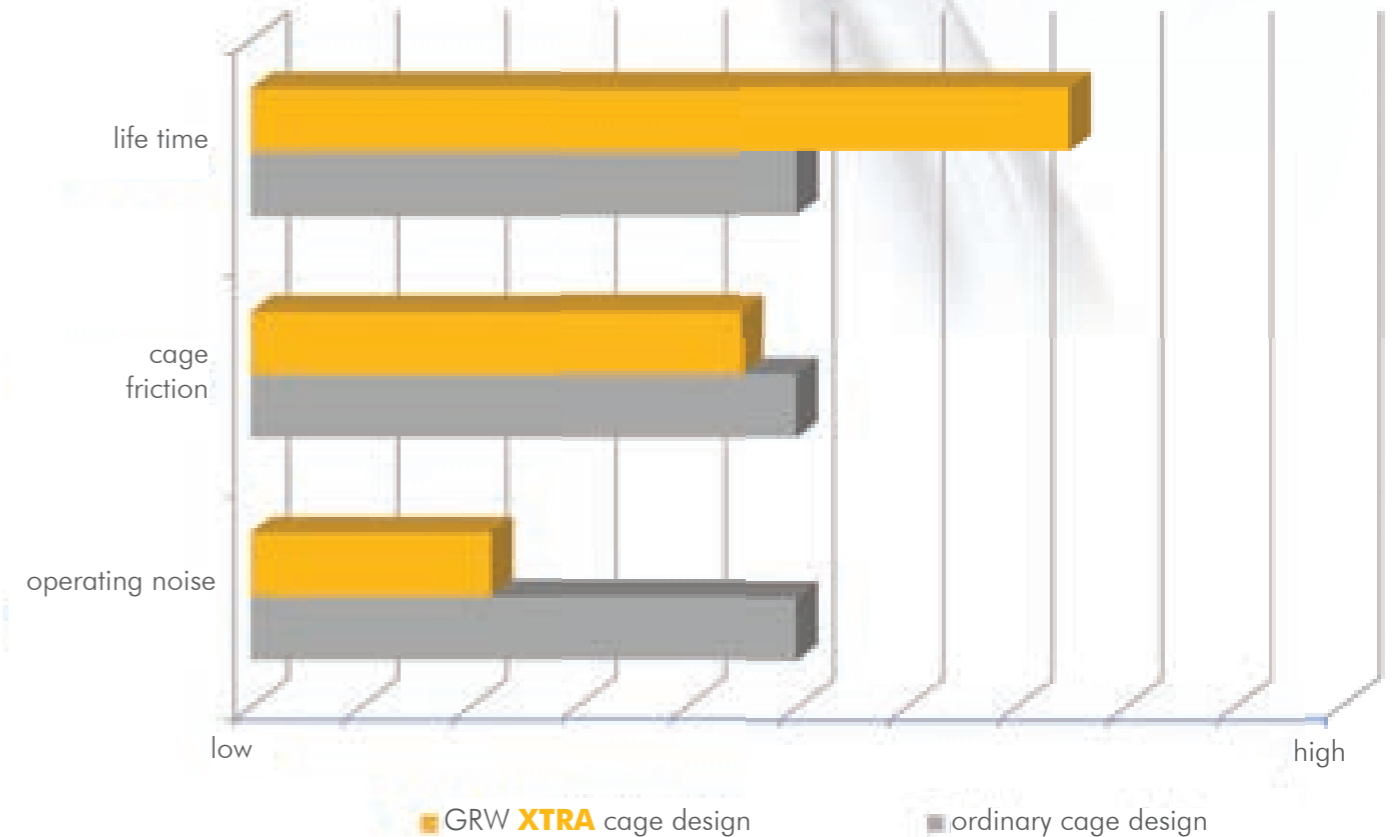
GRW customers benefit from our XTRA bearings:

- Silent bearings ensure a more pleasant work for dentist and patient.
- The high product reliability of GRW XTRA bearings ensures longer life time and reduces costs.
- Higher idle speed for more torque during treatment.
- GRW XTRA makes ball bearings resistant and more durable despite poor care, extreme temperatures and highest speeds.

Our benchmarks and results using XTRA products:

Measurable target	2013	2014 XTRA	Improvement
Noise [dB(A)]	70	65	- 29% *
Life time [h]	90	260	+ 189%
Early failure [h]	> 50	> 120	+ 140%
Idle speed [rpm]	360.000	370.000	+ 3%

Improvement of a high speed handpiece of a GRW customer.
* Decrease by 10 dB is a reduction of the noise level by 50% (logarithmic scale).



Effect of cage design on the running properties of high-speed dental ball bearings.

Test Technology

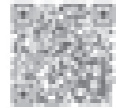
Orakel III

Orakel III is an automated, stand-alone test module for performing cyclical loading tests on dental turbines and surgical handpieces.

Benefits:

- Uniform test processes can be exactly reproduced.
- The operation of the module only requires electric power and clean compressed air.
- Testing capacities can be expanded at any time by adding additional modules.
- Easy documentation: For each cycle, the measured speed is stored and can be written in a text file along with details of the completed testing time.

Simple, cost-effective and convenient test device for a faster time-to-market.



Get more information at www.grw.de



Note: Orakel III and Speedmaster are developed by GRW and are available for purchase. Contact us for price and availability!

Speedmaster

The GRW Speedmaster is a noncontact speed measuring device especially designed for high RPM rotating instruments used in the dental industry.

The device has proven to be particularly useful in development and production as well as at the repair of dental turbines and surgical handpieces.

Get more information at www.grw.de



Hygienic treatment

The directives of the Robert Koch Institute for the hygienic preparation of medical instruments place high demands on the miniature ball bearings used in medical and dental devices.

In researching novel, high-performance materials and lubricants for ball bearings, it is therefore essential to apply methods and devices for autoclaving and thermal disinfection that are standard practice. This means that the suitability of new materials is demonstrated in a stress test prior to market launch.

For hot steam sterilisation GRW is using LISA 500 (W&H) and DAC (Sirona) and for thermal disinfection the Professional G7835CD (Miele).

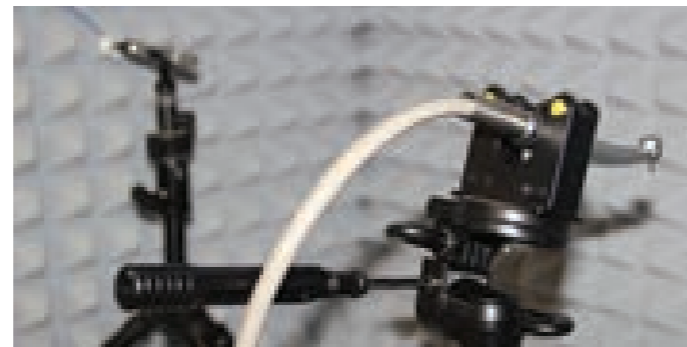


Noise analysis

The obligatory 100% structure-borne noise test (GPR) after ball bearing assembly is the final quality check every GRW ball bearing has to pass. In addition the test lab in the R&D department has the ability to make evaluation of ball-bearing assemblies concerning their noise performance and optimization.

Precisely the requirement for quiet handpieces for medical and dental devices has risen sharply in recent years.

Due to many years of experience in the field of ball bearing technology, GRW has the required expertise to reduce the noise level of ball bearings within the assembly to a minimum.



Test setup in an almost anechoic test box. With the help of a special sensing microphone the undistorted raw signals from the assembly are recorded, which can be evaluated using an FFT analysis (Fast Fourier Transformation).

Laboratory Services

GRW - the specialists in high-precision miniature ball bearings now offer laboratory services as well. Do you want to analyze materials? Do you need surface treatment but do not have your own laboratory or do you simply lack the expertise?

Then act flexibly and make use of the services of a competent analysis and chemistry laboratory!

We are the right partner, especially when it comes to such demanding procedures as FTIR spectroscopy with ATR technology or the functional and decorative gold plating of components.

GRW offers the following services:

General analysis, e.g. the determination of

- pH
- Acid concentration
- Oil or preservative content
- Evaporation residue
- Nitrite levels

Lubricant analysis with determination of protection by means of

- Dissolving and filtering
- Microscopy
- FTIR analysis



Surface treatments

- Gold plating
- Ultrasonic cleaning
- Hot and cold bronze finishing
- Passivating high-alloy steels

Medicinal hygienic treatments

- Steam pressure sterilization
- Thermal disinfection

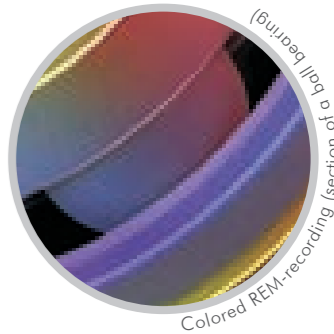
Condensation - and salt spray test

- Corrosion testing according to DIN 50021 / ASTM B117-73



As a partner of laboratory network GRW is able to offer you additional services apart from our own spectrum:

Examinations with scanning electron microscope (SEM) and X-ray spectroscopy (EDX)



X-ray fluorescence analysis (RFA)

Detailed analysis by means of differential scanning calorimetry (DSC)

Thermal gravimetric analysis (TGA)



Do you need other laboratory services?
Give us a call, we will be glad to advise you!

📞 worldwide: +49 (0) 93 65/819 - 481

📞 USA: +1 (804) 328 0900

Healthcare solutions

- Integrated space saving features suitable for extremely high speeds and loads
- Know-How and innovation in hightech materials
- Temperature management designs
- Durability for most common cleaning processes
- Broad expertise in development of highly sophisticated test facilities
- Cutting-edge development partner for many OEM`s

GRW product range

- High-Precision ball bearings from 1 to 35 mm bore and 3 to 47 mm outer diameter, available in metric and inch sizes
- Precision classes ISO P0 to P2 or alternatively AFBMA ABEC1 to ABEC9
- Angular contact and spindle ball bearings (separable and non-separable)
- Duplex bearings, special bearings
- Hybrid and full ceramic ball bearings
- Accessories (spring washers, spacers, retaining rings)
- Specialities (super precision bushings, needle roller assemblies)
- Standard deep groove ball bearings (single or double row)
- Ball bearings features with flanged outer and extended inner rings
- Numerous options for shields and seals
- Different cage designs and materials
- Bearings with customized oil or grease, dry film lubrications or coatings
- Matched and preloaded sets of bearings
- Bearing sub-assemblies and special bearings built with standard production components

Expertise

- Bearing assembly in a clean room class R10.000 (ISO 14644-1, class 7) flow bench R100
- Fully automated manufacturing for economic production of large quantities
- Technical support and recommendations including bearing selection
- System solutions engineered uniquely for each customer
- Wide range of lubricants for all applications
- Highly corrosion-resistant SV30 bearing steel
- 100% noise tested



Contact



GEBR. REINFURT GMBH & CO. KG HOCHPRÄZISIONSKUGELLAGER

Niederhoferstr. 105
97222 Rimpar · Germany

phone: +49 (0) 93 65/819 - 481
fax: +49 (0) 93 65/819 - 100
e-mail: healthcare@grw.de
web: www.grw.de



GRW HIGH PRECISION BALL BEARINGS

530 Eastpark Court Suite H
Sandston, Virginia 23150 · USA

phone: +1 (804) 328 0900
fax: +1 (801) 495 7839
e-mail: info@grwbearing.com
web: www.grwbearing.com

