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GMN

# High precision ball bearings
# Special applications

4002 1214 ENG

## Contents:

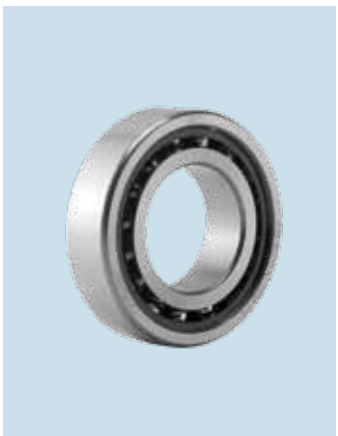
# The Company


## Precision as tradition

Leonardo da Vinci himself invented the principle of the ball bearing. Would he ever have imagined the maximum speeds, ball bearings could reach in the 21st century and the loads they would have to withstand?

From the beginning, GMN has specialized in products for high precision and high speed applications.

GMN was founded in 1908 as the mechanical workshop Georg Müller Nürnberg and was one of the first companies to start serial production of high precision bearings in 1928. Today, we export world-wide and do continuously step up to our traditional reputation as a specialist in sophisticated bearing applications.



## Precision as standard

Today, family owned and managed GMN is run by the fourth generation. The company's following three product areas benefit from almost a century of ongoing development work and production know-how about ball bearings:

High precision ball bearings starting from precision class P4 (ABEC7) as spindle bearings, deep groove bearings and hybrid bearings set international standards in terms of reliability, precision and quality.

Machining spindles for precision and/or high speed machining underline our concentration on challenging areas of technology.

Free-wheel clutches and seals extend our product range.


## Innovation as driving force

Around 450 employees at GMN represent an invaluable source of experience in successful solutions for machine tool applications, vacuum technology, measurement technology, medical technology and motion technology. In-house development work plus cooperation with universities, as well as international research projects on spindle technology, material science and tribology ensure our orientation to the future.

The ability to recognize synergies and to use them is an important reason for our long-term and close customer relations. We are continuously working on economical new and further developments and are developing optimized special solutions on the edge of technical feasibility.

## Quality as benchmark

To meet our customers' requirements on our products is only one part of our job. The real goal of efficient quality management at all levels and throughout all processes is the consistence of maintaining the highest standard across all product areas under cost-efficient aspects:

- Careful selection of suppliers
- Developments in our own test facilities, simulation calculations
- Measuring device and precision measuring division as independent in-house service provider
- High vertical range of manufacture using stateof- the-art technologies such as CBN grinding, hard turning and PVD sputtering
- Assembly under clean room conditions
- Constant research and development work
- Development assisted by 6-Sigma and continuous improvement processes
- Modern project management
- Excellent after-sales service
- Compliance with all environmental specifications

# The Process of Innovation

## Consultation comes first

As soon as standard bearings do not fulfill any longer the required specification regarding geometry, precision, material as well as tribological and application-specific requirements, special bearings are requested. Especially for the application in our customers' innovative products, we often develop pre-finished bearing systems up to the start of serial production.

The application engineers of our high precision ball bearings division provide support and advice regarding all questions and problems right from the start, as even small changes often have a major effect on the design and thus on the function of the bearing. All environmental conditions must be taken into account; therefore our solutions are not only developed on the drawing board or computer but first and foremost in discussion with our customers.

Consultation – no start to goal-oriented and cost- 6 effective project development without it!

## Ideas lead to system solutions

The next level proves your consultant's engineering capacity.Stron-

ger, higher load, faster, more precise – GMN. Our special bearings set technical benchmarks for a lot of applications. Hereby, we focus on areas of technology where we can contribute our strengths and expert knowledge.

*Main fields of application:*

- Touchdown bearings for magnetic bearing systems
- Vacuum applications (e. g. turbo molecular pumps)
- Medical technology (e. g. X-ray tube bearing units)
- Bearing systems
- Measurement and navigation bearings and units
- Machine tool applications

Our state-of-the-art design tools support the entire engineering process; test facilities of our own as well as simulation calculations guarantee products on the highest level.

## Production makes the difference

GMN philosophy of producing prototypes under series conditions is a key element. Up to the start of series production, GMN coordinates the entire process of production by itself, as our vertical range of manufacturing exceeds the requirements of the production of special ball bearings by far. It is almost unique for a ball bearing supplier of our size to have our own PVD coating system. The precision measuring division, precision metal machining and assembly are specifically geared to the production of sophisticated high precision bearings and bearing systems.

- Production of samples under series conditions
- Measurement of all purchased precision parts and those processed in-house
- Production with the aid of state-of-the-art technologies such as CBN grinding, hard turning, PVD sputtering (Phyiscal Vapour Deposition)

Single source units throughout the whole process – Your personal consultant is available and monitors the continuous testing of components and the production process.

## Start of production. What's next?

Once started, the process of innovation keeps running. Upon completion and delivery of the product, your GMN high precision ball bearing team, especially your personal project consultant, will stay in contact with you. In close cooperation with you we accomplish the following tasks:

- Product improvements
- Further developments
- Weak-point analyses
- Bearing examinations

*Join our process of innovation!*

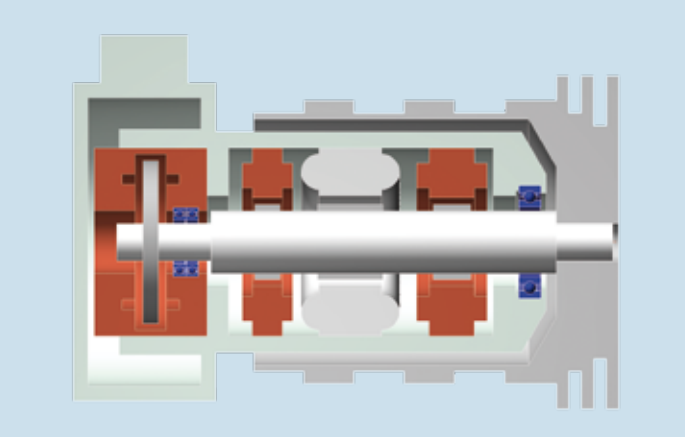
*We accept the challenge!*

Call us at:

+49 (0) 911 - 5691 - 225 / 229 / 217 / 326

# Touchdown Bearings

*The use of magnetic bearings gets more and more important for $CO_2$ laser systems, liquid pumps as well as in the optical industry. GMN has successfully been promoting the development and production of touchdown bearings since the mid-nineties.*



## Security of investments

In case of overload, or the failure of the magnetic bearings, touchdown bearings prevent the bearing system from being damaged by the rotating parts. “Emergency” bearings must withstand the extreme loads during a collapse of the shaft and must be capable of working under a lot of different environmental conditions.

*Requirements on touchtown bearings:*

- Extremely high acceleration from zero to nominal speed (n x dm up to 3.5 x $10^6$ mm/min)
- High-impulse radial and axial forces
- High frequency of touchdowns as well as “touch-and-goes”
- Limited dimensions
- Poor lubrication
- Low-cost systems
- Aggressive environment applications

## Optimized engineering

The design of the touchdown bearing arrangement has a major influence on the dynamic behaviour of the shaft during emergency operation. Triple bearing systems (one pair of spindle bearings with a deep groove ball bearing) or quadruple bearing systems (two pairs of spindle bearings) can be implemented.

*Important performance criteria:*

- Arrangement of the bearings (rigid, radial and/or axial spring loaded)
- Bearing friction
- Acceleration of touch-down bearing masses
- Friction between shaft and bore
- Lubrication
- Low-cost and space-saving solution, e.g. 3-bearing system
- High operating safety due to high load capacity, e.g. 4-bearing system

*Accordance of cost and performance*

An optimized bearing geometry, the use of HNS steels (High Nitrogen Steel) and ceramic balls as well as an application-specific tribology guarantee a high frequency of touchdowns.

In low-cost systems, GMN PVD ball coating enables the use of steel balls along with significant savings. The technical performance of high-end applications, on the other hand, can be further improved by using PVD coating on ceramic balls.

## Low-cost solutions

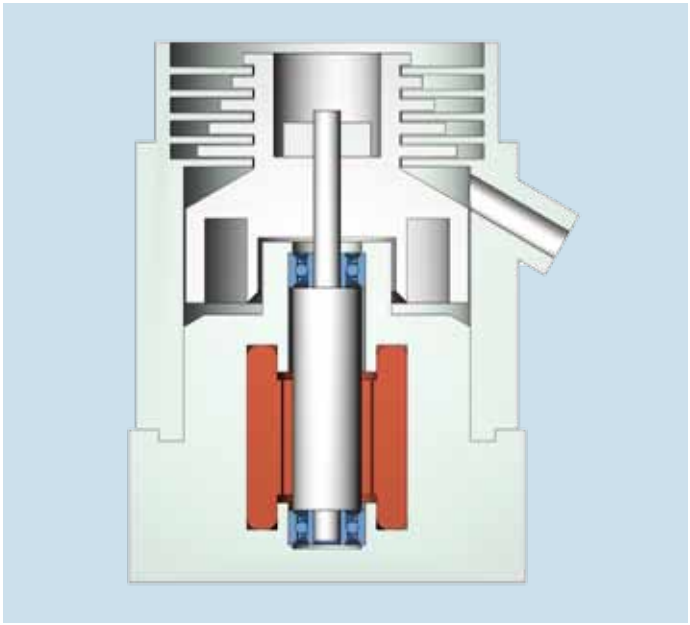
- Speed coefficient: 2.2 x $10^6$ mm/min
- Mass of rotating parts: < 1.5 kg
- Atmosphere: Fore-vacuum
- Bearing design: Series 618 / full complement
- Ring material: 100Cr6
- Ball material: 100Cr6
- Lubrication: Ball coating and oil

## High-end solutions

- Speed coefficient: 2.2 x $10^6$ mm/min
- Mass of rotating parts: < 3.5 kg
- Atmosphere: Aggressive gases
- Bearing design: Series 618 / full complement
- Ring material: HNS (High Nitrogen Steel)
- Ball material: Silicon nitride ($Si_3N_4$)
- Lubrication: Oil

# Vacuum Technology

*In close cooperation with industrial partners, GMN develops overall concepts for complex bearing systems, especially for turbo molecular pumps (TMP).*



## Long life guarantee

Vacuum technology is substantial for the research, development and production of innovative products from semiconductor industry to solar power industry. Depending on the application, the design of the vacuum pump differs in respect of final pressure, pumping speed or resistance to various media. The bearing is the heart of the vacuum pump – in a harsh vacuum environment and high speeds, only robust bearings guarantee a long life.

*Requirements on bearings for turbo molecular pumps:*

- Long life
- Absolute reliability
- High speeds
- Low noise level
- Low vibration
- Cleanliness

## Optimized engineering

For turbo molecular pumps GMN develops custom made high precision ball bearings with special dimensions, designs and cages.

*Important performance criteria:*

- Product-optimized bearing design
- Use of shielded bearings for protection from contamination and to increase life
- Ceramic balls for higher speeds, minimum friction and optimized bearing dynamics
- Total tribology concept (lubrication, preservation, surface quality, materials)
- For grease lubrication, use of the GMN TXM cage for low-vibration, low-noise running

## Spindle bearings for TMP

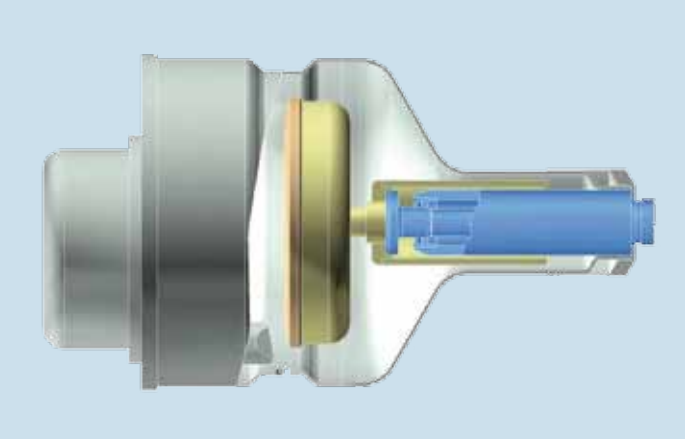
- Open or shielded
- Silicon nitride balls ($Si_3N_4$)
- Vacuum up to $10^{-3}$ mbar
- Speed coefficient up to 1.1 x $10^6$mm/min
- Service life > 30,000 h
- Cages: Oil-impregnated textile reinforced phenolic resin cage or TXM cage
- Special design (dimensions, internal design, cage)
- Optimized grease reservoir

## Deep groove bearings for TMP

- Open or shielded
- Silicon nitride balls ($Si_3N_4$)
- Vacuum up to $10^{-3}$ mbar
- Speed coefficient up to 0.8 x $10^6$mm/min
- Oil lubrication
- Service life > 30,000 h
- Special design (dimensions, internal design, cage)

# Medical Technology / X-Ray

*Based on bearings and bearing units for more than 100,000 X-ray tube systems – amongst them one of the first tubes world-wide which enabled X-rays of the heart – GMN has been an innovative and reliable partner to medical technology for decades.*



## Extraordinary resilience

The extreme operating conditions for the bearing unit of rotating anode X-ray tubes are a complex challenge and require experience in the area of materials, surface technology as well as the design of the system as a whole.

*Requirements on bearings for X-ray tube systems:*

- Temperatures up to 550° C surrounding the bearing
- Ultra-high vacuum ($10^{-7}$ bis $10^{-9}$ mbar)
- Electric conductivity, high voltage
- Dry lubrication
- Surface pressure inside the bearing of up to 3,200 N/mm$^2$
- Low running noise
- Low vibrations
- No bearing-related particles or flitter

## Optimized engineering

GMN coats components such as bearing rings, sliding fits and balls on its own PVD sputter system.
Ball coatings in lead or silver with a thickness of nanometers ($10^{-9}$ m) have resulted from various research projects and are the basis for the low-noise, low-vibration, particle-free GMN bearing systems which perform impressively in their various applications.

*Accordance of cost and performance*

In addition, particle-free tribology enables a simplified design without complex and cost-intensive shielding of the bearings. Calculation tools, trials and design-tocost studies are reflected in the design of the systems. Compared to a spring-preloaded system, the use of temperature-compensated bearing units increasingly proves to be the better solution from both a technical and economic point of view.

The sophisticated assembly concept enables an optimum design and in addition reduces the number of critical components as well as costs. A reliable chain of suppliers for precision vacuum components, GMN measurement technology and production equipment for plasma cleaning and vacuum packaging provide our customers with the required safety in this highly sensitive field of application. In this respect, our close contact with leading partners in technology from both industry and research is equally important.

## Bearing systems for mammography and computed tomography

*General features:*

- Cartridge or integral housing design
- Temperature-compensated or spring-preloaded design
- Full complement bearings
- Speeds of up to 200 Hz
- Special heat dissipation system

*Mammography*

- Temperatures of up to 400° C
- Pb-coated balls
- Running noise < 52 dB

*Computed tomography*

- Temperatures of up to 550° C
- Ag-coated balls
- Centrifugal forces of up to 16 g
- Running noise < 55 dB

# Bearing Systems

*GMN develops and produces ready-to-install, complex bearing systems apart from special bearings. The customer can concentrate on his core competencies by procuring the entire bearing system.*

## Optimized engineering and production from one single source

The success of a product often depends on the interplay of many details far beyond the ball bearing layout. Finally, everything has to fit perfectly. Thus shaft and housing fits and internal preloads are optimized for the respective application and negative side effects must not arise from the lubricant used in connection with the existing work environment.

*Important performance criteria:*

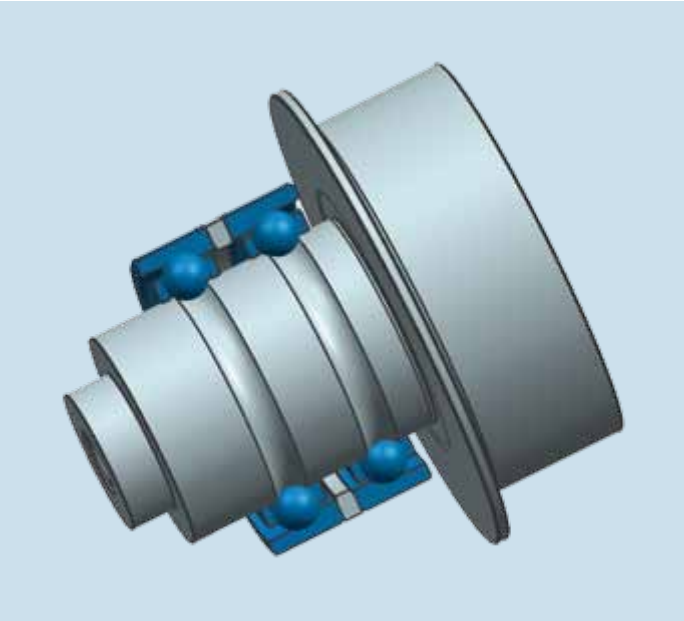
- Functionality of the system
- Selection of materials suitable for the respective application
- Cleanliness of the components thus high purity of the bearing system and prevention of contamination, e.g. in optical applications
- Low-vibration and low-friction running
- Perfect adaptation of the system to attachment point

## Solutions for precise bearing units

Where individual bearings no longer provide a solution, bearing systems can be the key to success. Here it makes no difference whether your devices are equipped with high-precision optics, for instance, or operate under extreme ambient conditions. Bearing systems provide your product with a unique characteristic and can mature to an economic diversity of variants in the module principle. Here individual requirements regarding lubrication, materials used, installation sizes required and necessary precision are taken into account.

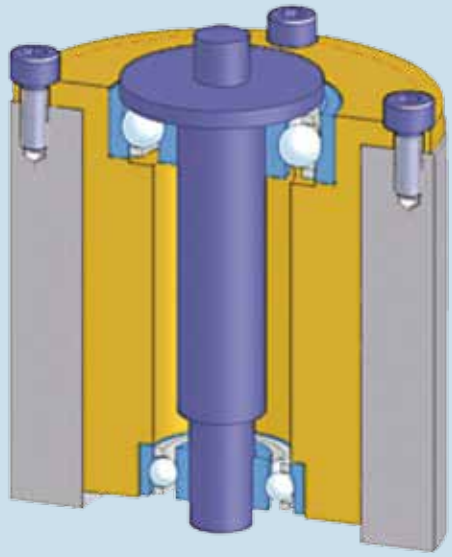
*Requirements on bearing systems:*

- All components must comply with the technical requirements with regard to quality and characteristics
- Material selection, bearing design, machining as well as cleaning and assembly need to be carefully harmonized
- Appropriate selection of lubricants for maximum durability of the bearing system
- Cost optimization due to production grade adapted to customers' requirements



## Excimer laser fan roll bearing unit

- Use of stainless steels and high-quality aluminium alloys
- Magnetic coupling, special fan roll coupling
- Precision-balanced components/units
- High-precision components
- Lubricants adapted to various media and tribology
- Plasma cleaning as well as vacuum packaging
- Modular principle for the economic design of variants



## Bearing systems for optical applications

- Shafts with bearings under rigid or spring preload
- Customer-specific designs and external geometries, e.g. flange bearings, extra-wide bearings, etc.
- Bearing systems with raceways on the shaft
- Bearing units composed of housing, bearing and shaft

*Make use of our experience and you will benefit from:*

- Reduced development time and costs
- One single partner for engineering, production and after sales
- Simplified logistics due to delivery of complete assemblies

## We provide:

*Engineering:*

- Experience in the design of bearing systems / spindles
- Realization of bearing concepts
- Development of tribology concepts
- Know how from the most varied fields of application

*Production / purchase:*

- Precision machining as in-house core competence
- High-precision components
- Precision-balanced components / units
- Qualified suppliers for special requirements
- Suitable measuring equipment to ensure a high quality level

*Assembly:*

- Experience in handling sophisticated systems
- Maximum cleanliness in the case of severe requirements on high purity of the bearing system

# Measurement and Navigation Technology

*More than 40 years ago GMN started with the production of special bearings for navigation systems thereby establishing the long-standing company tradition in measurement technology.*

## Precision guaranteed

GMN bearings and bearing units for measurement technology feature extremely high precision and solid quality, combined with limited dimensions and low weight. Products are e.g.:

- Shaft encoders
- Navigation systems (e.g. gyro compass)
- Probe heads of coordinate measuring systems

*The challenge to measurement technology:*

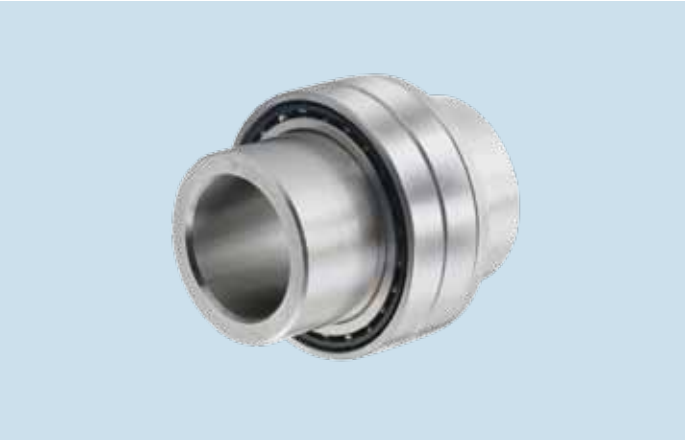
- System running accuracy of up to < 1 µm
- Low, non-repeatable run out (NRR)
- High system rigidity
- High matching accuracy
- Low starting and running friction torque
- Compact dimensions (thin-walled bearings)
- Low system weight (materials, construction)
- Absolute cleanliness during assembly

## Optimized engineering

The development and manufacture of products and services in measurement technology make high demands on design, production, measuring systems and component handling. 100% testing of individual components and complete systems is an essential prerequisite for constant quality at the highest levels of precision.

*Important performance criteria:*

- Very compact designs due to GMN production technologies for thin-walled bearings
- Innovative weight-saving bonding techniques
- Assembly using laminar flow boxes



## Flange bearings for positioning systems

- Special design (thin-walled, double-row)
- Special cage (Toroid)
- Very low specified starting torque
- Constant specified friction torque
- Very high running accuracy
- Very high matching accuracy
- Material: Stainless steel (AISI 440 C)

## Bearings for shaft encoders

*As individual bearing with special design (Dimension, cage, sealing)*

- Thin-walled bearings (compact dimensions)
- Very high running accuracy
- Bearings paired and matched
- For life lubrication

*or as completely assembled unit (Bushing and bearing)*

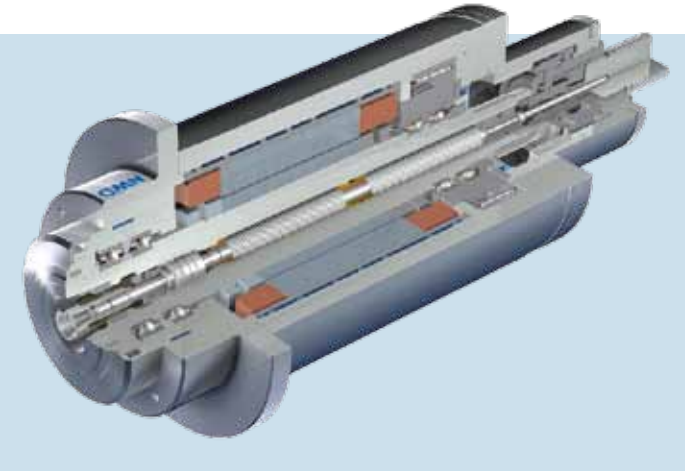
- Very high running accuracy
- Material of bushing: steel

## Bearing unit for probe head in coordinate measuring machines

- Completely assembled unit (bushing and bearing)
- Thin-walled bearings (compact dimensions)
- Bearings paired and matched
- Very high running accuracy
- High rigidity
- For life lubrication
- Material of bushing: Aluminum

# Machine Tool Applications

*GMN is the leading manufacturer of machine tool spindles worldwide. This technical competence is, of course, used to continuously improve our bearing technology. GMN develops special custom designed solutions in close cooperation with customers for all fields of modern machine tool applications.*



## Core competence with tradition

*Market knowledge*

GMN knows what is important for the customer in the intense global competition. The bearing arrangement has considerable influence on the performance of machines and machining centers and is the first and most precise part of a long, highly precise production chain, e.g.:

- High-precision grinding machines for the machining of injection nozzles
- Multi spindle machines for the machining of engine and gear blocks
- Machining lines for serial components with a very high number of cycles
- Industrial paint shops

*The challenge to mechanical engineering:*

- Highest n x dm factor with oil and grease lubrication
- Bearing systems
- Materials (steel/ceramic/PEEK)
- Special designs (rings/cages) at highest precision levels

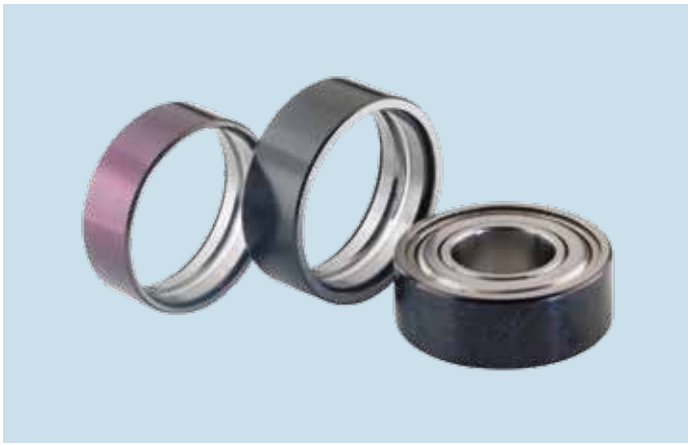
## Optimized engineering

For GMN, flexibility is not just a slogan, but an indispensable part of the total concept.

- Production of small batches under series conditions
- Determination of suitable lubricants with the support of experienced lubricant manufacturers
- Special designs such as cages, matching, contact angle and bearing clearances
- In-house test facilities help to determine reliable reallife data
- Optimized bearing configurations allow extremely high speed coefficients

## Rotary union for machining spindles

- Triple set of spindle bearings (TBT) based on series SN 619
- Extra-wide design
- Sealed on both sides
- Ceramic balls ($Si_3N_4$)
- n = 36,000 rpm
- TXM cage
- For life lubrication



## Bearings for paint shop spindles (Atomizer)

- Spindle bearing set based on series SN 60
- Extra-wide design
- Shielded on both sides, for protection from turbine air
- Ceramic balls ($Si_3N_4$)
- n = 40,000 rpm
- TXM-Käfig
- For life lubrication
- Outside diameter DLC-coated for optimized floating bearing function (friction, fretting corrosion)


# Standard Program

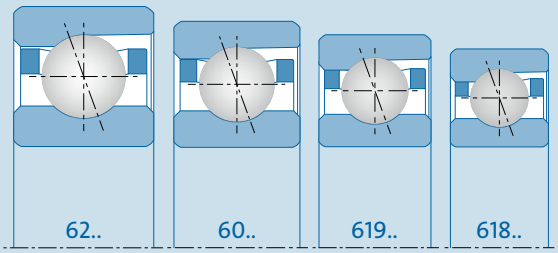
*GMN manufactures spindle bearings and deep groove bearings in precision classes P4/ABEC7 to P2/ABEC9 to the highest specifications. Our reliability, precision and quality set international standards.*

## Bearing types

The spindle bearing range covers bore diameters from 5 to 120 mm.

Deep groove bearings are manufactured with bore diameters from 5 to 40 mm.

A great variety of bearing designs and bearing series ensures that the customer is always provided with an optimal solution in respect of load capacity, rigidity, speed and lifetime.




Bearing series

## Spindle bearings

Spindle bearings of various types can be used universally:

*Bearing types S*

- Standard spindle bearings
- Standard contact angles 15° and 25°
- Reference speed factor n x dm = 1.7 x $10^6$ mm/min
- High load rating

*Bearing types SM*

- Geometry of inner ring modified for extremely high speeds
- Standard contact angle 15°
- Higher radial clearance for high speed applications
- Low operating temperature due to low friction
- Reference speed factor n x dm = 2.0 · $10^6$ mm/min

*Bearing types KH*

- Bearing geometry modified for extremely high speeds
- Standard contact angles 15° and 25°
- High radial clearance
- Sealed spindle bearing with life grease lubrication
- Open version for oil lubrication enables extremely high speeds
- Reference speed factor n x dm = 2.1 · $10^6$ mm/min

The sealed version of the KH bearing types for life grease lubrication offers increased service life, easy and safe handling, and is insensitive towards contamination of the area of assembly.

KH bearing

## Materials

GMN ball bearings with rings and balls made of ball bearing steel 100Cr6 (SAE52100) are used for normal applications. For applications with high speeds and high loads, hybrid bearings with rings made of 100Cr6 and balls made of ceramic (e.g. silicon nitride $Si_3N_4$) are often a reasonable alternative.

All ball bearings are available as hybrid bearings.

Alternatively, high-temperature steels as well as HNS steel (High Nitrogen Steel) are used.

TXM cage TA cage

## Cages

GMN ball bearings are available with standard cages made of textile reinforced phenolic resin which are guided on the outer or inner ring. Other bearing designs and materials (such as TORLON, Al-Bronze) can be used for customer-specific applications.

More than 20 years ago, GMN developed and launched the low-wear TXM cage made of PEEK (polyetheretherketone). It has been sold over a hundred thousand times and is still state of the art. It was especially designed for grease lubrication and allows operating temperatures of up to 250 °C. The optimized ball pockets serve as a grease reservoir and guarantee a long life. The TXM cage has proven to be a reliable solution to cage vibrations.

# Sample Production and Precision Machining

*GMN production technologies are optimally suited to the requirements of high precision ball bearings and complex bearing systems.*

## Prototype production under serial conditions

The production of prototypes under serial conditions is a basic element of GMN's philosophy. Thus uniform quality is guaranteed after product approval already at the start of series production.

## Precision machining of bearing rings

For the precision machining of bearing rings GMN has machinery at its disposal that is optimized for the serial production of high precision ball bearings.

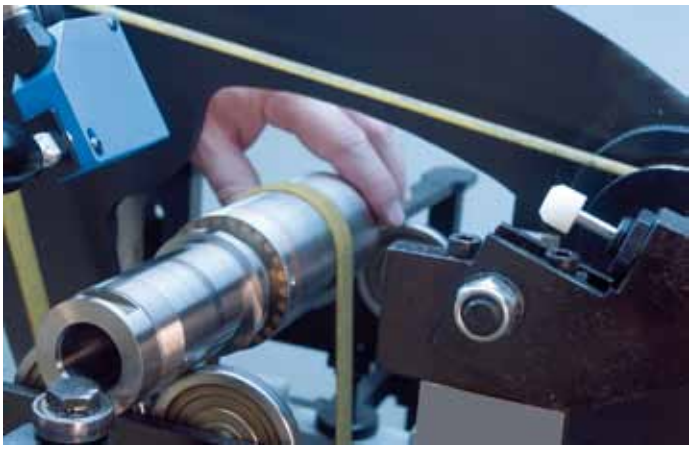
Surface quality and geometry are at constant focus of optimization processes in order that both, standard series and special bearings can be produced with extremely high precision.

*Special designs*

- Thin-walled bearings
- Flange bearings
- Special dimensions

*Materials*

- Chrome steel (100Cr6)
- Stainless steel
- HNS steel (High Nitrogen Steel)
- High-temperature steel



## Precision machining of shafts

Our spindle production machinery and know-how are used for the precision machining of shafts.

Grinding of cylinder faces and ball raceways is part of our standard processes.

*Important quality features:*

- Dimensional accuracy of the parts
- Form and position tolerances
- Surface quality

## Balancing

The balancing quality of the rotating components is substantial for the functionality of the final product, especially when very high speeds are required. For this reason, GMN carries out custom designed precision balancing for many components.

## Precision machining of associated components

In addition to ball bearings we increasingly develop and offer complex bearing systems for many fields of application such as medical technology, laser technology or measurement technology.

The precision of associated components such as bearing bushings and housings is of fundamental importance for the function and accuracy of the system down to µ-precision levels.

## Tool-Making

The tools and equipment required for production and assembly are individually and promptly manufactured in our tool-making division which is especially geared to our machinery and product range.

# From Measurement to Assembly

*The credo of the precision measuring division is accuracy.*

## Measurement technology

Working independently as a service provider, it carries out all measurements of precision parts. This covers goods received, the current production as well as examinations within the scope of bearing analyses.

*The following standard tests and measurements are carried out:*

- Hardness and structural tests
- Topographic analyses (surfaces)
- Form and position tolerances
- Measurements of coordinates (2- and 3-D measurements)

The reference standards are regularly compared to those of the Physikalisch-Technische Bundesanstalt (PTB is the German national metrology institute providing scientific and technical services). The precision measuring area is, of course, fitted with air conditioning and vibration-proofed.

Product-specific measuring equipment is developed, built and tested in an in-house division for test and measuring equipment production.

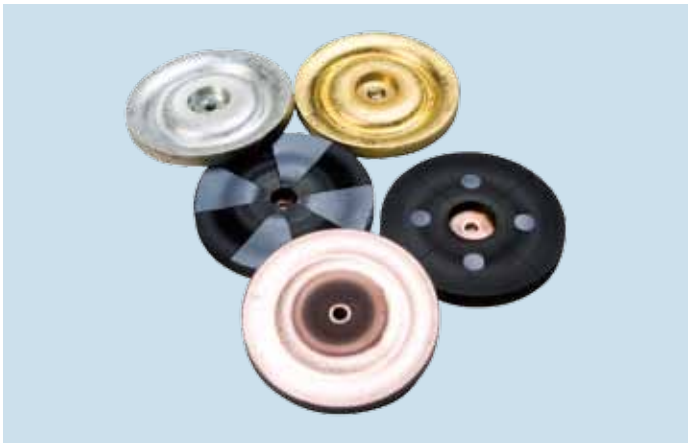
## Assembly

The smooth interplay between human, material and system allows us to assemble ready-to-install prefinished units from a single source at a quality level that meets the highest standards.

*You will benefit from:*

- Experience in the design of sophisticated bearing units
- Experience in the handling of complex systems
- Optimized measurement and assembly technology
- A wide scope of bonding techniques for the assembly of units
- Final assembly of the systems under optimal environment conditions
- Continual process and component testing
- Experience in handling, storage and packaging of components for high-vacuum applications
- Delivery of complete units which simplifies customer logistics

# PVD Coating



## Fields of application

GMN has been coating components for different fields of application since 1996 on an in-house PVD sputtering system (Physical Vapour Deposition) using a coating chamber which was optimized for ball bearing applications:

- Medical technology (dry lubrication)
- Vacuum technology (dry lubrication)
- Laser technology (protection from aggressive gases)
- Aeronautics and aerospace
- Touchdown bearings (solid lubrication)

*Coating examples:*

- Bearing rings
- Shafts and axles
- Cages
- Balls

## Materials

Depending on the field of application various ultra pure materials (targets) are used as an undercoating or functional coating:

- Silver (Ag)
- Lead (Pb)
- Gold (Au)
- Molybdenum disulphide ($MoS_2$)

## Technology

To be able to efficiently coat three-dimensional surfaces the work piece holders are individually adapted. Technological know-how and our experience in PVD coating provide the basis for many developments and products.

- Uniform coating thicknesses of very high adhesive strength at high accumulation rates
- Coating thicknesses from a few nanometers ($10^{-9}$ m) to several micrometers ($10^{-6}$ m)
- Coating thickness variations in the region of nanometers ($10^{-9}$ m)
- Technical equipment for the simultaneous sputtering of several materials (co-sputtering)
- High process stability since fully automatic
- Application of coatings without exceeding a critical substrate temperature


## GMN

GMN Paul Müller Industrie GmbH & Co. KG, the family enterprise now run in the 4th generation, produces with the experience of more than 90 years high precision ball bearings, machining spindles, freewheel clutches and non-contact seals for a wide range of applications. Most of our products are made for special applications on customer requests.


## GMN Quality management – tested and certified

GMN guarantees utmost quality for its products and services that is based on long-term reliability. Highly modern development and production methods ensure products that always represent state-of-the-art technology.

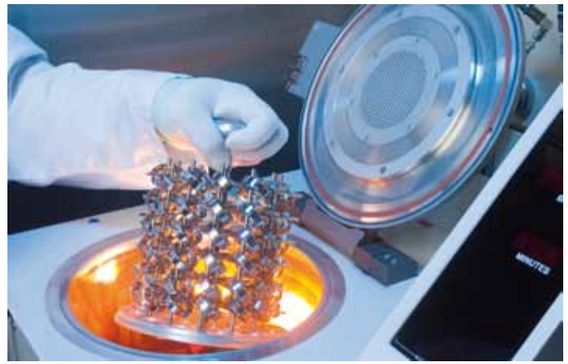
All GMN corporate divisions are certified to DIN ISO 9001:2008.

## GMN – Safeguarding the future

For GMN, progress means the best possible customer support combined with performance-oriented optimization of its technical products. This claim is realized at GMN under especially strict observance of national and international environmental standards with regard to efficient, responsible utilization of ecological resources.


## Internet

At our Internet site www.gmn.de we provide comprehensive product information that can be downloaded.



## Cleaning

**Before PVD coating or as final treatment for vacuum applications, the components are cleaned in several processing steps:**

- Ultrasound cleaning
- Degreasing
- Vacuum drying
- Plasma cleaning

For many applications additional purification annealing of the components is required.

## Coating thickness measurement and material analysis (XRF)

GMN applies the latest high technology to analyse coatings. Coating thickness measurements at the nanoscale and analyses of coating materials are measurements necessary and helpful for high-end bearings in medical and ultra-high vacuum engineering.

- High-precision and programmable XY(Z) measuring table
- Analysis and coating thickness measurement of very thin films and multi-coating systems
- Analysis of the basic material through a coating system
- Autofocus or visual focus setting