

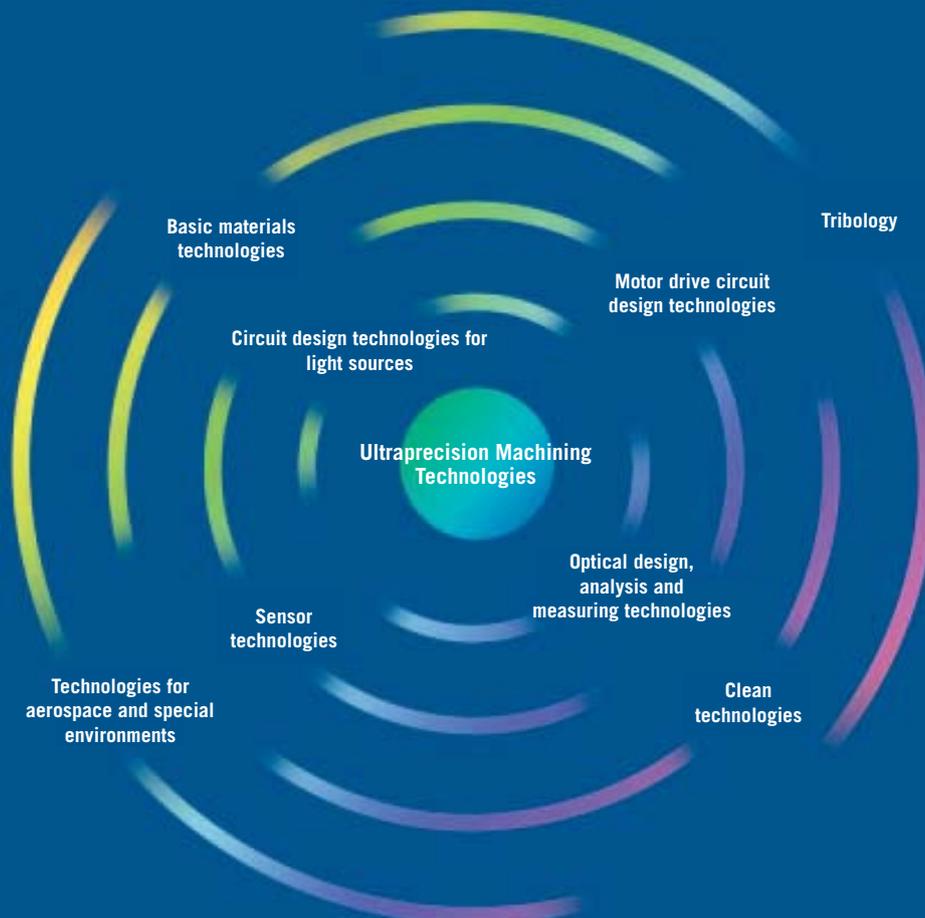
Capitalizing on Core Technologies to Develop Diverse New Businesses



Over the years, Minebea has amassed a portfolio of outstanding core technologies. Of particular note are its ultraprecision machining technologies, which underpin Minebea's 60% share of the global market for miniature ball bearings, as well as its optical, thin film, electric and electromagnetic and sensor technologies.

These technologies have enabled Minebea to introduce a wide range of market-leading products. Today, Minebea is stepping up efforts to integrate these technologies with the aim of developing even more competitive new products.

Minebea's Core Technologies



Focusing on Core Technologies, Responding to Market Needs and Enhancing Our Ability to Discover New Markets



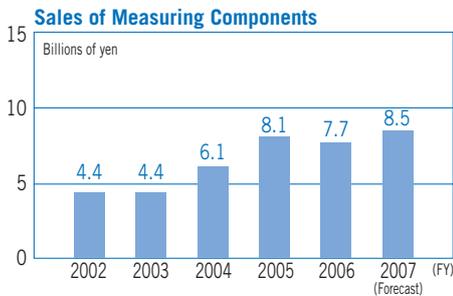
“We have grown our measuring components business by focusing on core strain gage technologies and responding effectively to the diverse needs of different markets.”

Motoyuki Nijima

Executive Officer and Head of the Measuring Components Business Unit

Minebea’s measuring components business centers on strain gages and products that have been developed by applying our strain gage technologies. This is a business that demands highly sophisticated technologies, but individual markets tend to be small and products are highly specialized with little scope for broad application.

For these reasons, it is important to focus on core technologies and respond effectively to the diverse needs of different markets. Enhancing one’s ability to discover new markets also influences business growth.

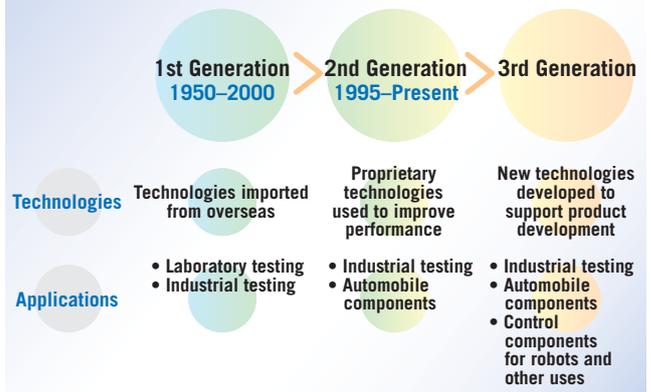


Core Strain Gage Technologies

Strain gages consist of a very fine metallic foil etched in a grid pattern, which is bonded to a device and used to measure the strain, or amount of deformation of the device when weight or force is applied. The resulting electrical output is proportional to the strain. Minebea manufactures strain gages engineered and developed in-house at its plants in Thailand and China for shipment to customers worldwide and is the world leader in terms of production volume.



Strain Gages: Minebea's Development Road Map



Minebea’s first generation of strain gages offered outstanding accuracy, but researchers still faced the challenge of significant zero drift, a time-dependent shifting of the zero calibration point—essential to measurement—from its original zero value. With its second generation of strain gages, Minebea sought to address this by, among others, using different materials and in 2000 succeeded in commercializing a strain gage that essentially eliminated zero drift. Boasting outstanding fatigue resistance, this unit can withstand more than 10 million uses, a key feature that has prompted its adoption by leading automakers for use in weight sensors mounted in passenger seat subframes.

Developing New Technologies

With the aim of expanding this business and ensuring a high level of profitability, we are striving to improve the precision of Minebea strain gages by introducing optical technologies and reinforcing our software development capabilities. At the same time, as a business unit we are promoting the expansion of this business by capitalizing on our sales, development and manufacturing capabilities.

Load cell assembly line



Optical six-axial force sensors



Placement of SOS structure in diffusion furnace



Used in the wrists and ankles of humanoid robots

Measuring Components

Strain Gages

Load Cells and Transducers

Digital Indicators

Tensile and Compression Testing Machines

Chip mounting line



Gage application process



Tensile and compression testing machine

Used to measure the amount of stretch and contraction of metal, plastic and other materials



Optical Six-Axial Force Sensor

Six-axial force sensors measure the force on all three axes (longitudinal, vertical and lateral) as well as torque. Typically, they are used in humanoid and industrial robots. Accordingly, key challenges include reducing size and minimizing price.

Minebea has used its proprietary optical sensing technology to develop an optical six-axial force sensor that achieves an outstanding balance between cost and performance. This groundbreaking new sensor also capitalizes on Minebea's advanced circuit technology—amassed over many years through the development and manufacture of measuring components—which has facilitated the incorporation of a high-speed arithmetic circuit, thereby facilitating a highly compact design.

Optical Transmission Torque Transducer

Like conventional torque transducers, this unit uses a strain gage to detect torque. With conventional torque meters, torque signals (analog) are transmitted via a coil from a rotating shaft to a stationary unit. In contrast, with Minebea's optical transmission torque transducer these analog signals are converted into digital signals and transmitted optically using an LED without the unit ever coming into contact with the shaft. The use of optical fibers as the receiving medium means this innovative unit is compact and lightweight, delivers high-speed revolution and is resistant to noise interference.

Advanced Applications

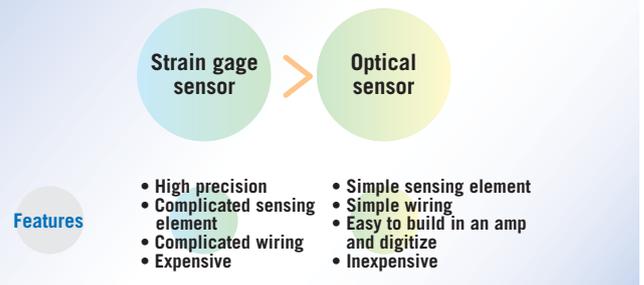
SOS transducers manufactured by Minebea's Measuring Components Business Unit are used in the Japan Aerospace Exploration Agency's H-IIA rockets. A total of 56 transducers in each H-IIA rocket control the pressure of combusted gas and monitor other types of pressure.

As the name indicates, SOS transducers employ silicon on sapphire (SOS), a process for integrated circuit manufacturing that consists of a thin layer of silicon and a strain gage epitaxially deposited on a sapphire wafer.

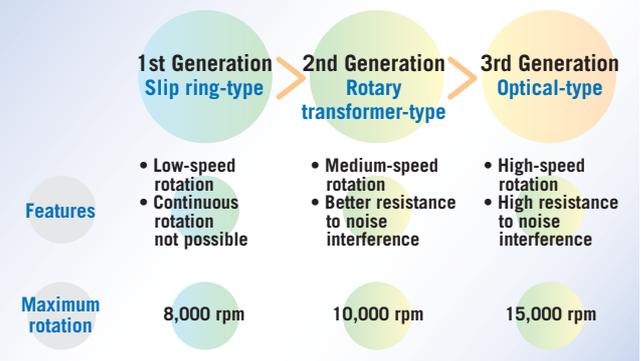


H-IIA rocket
(Photo courtesy of Mitsubishi Heavy Industries, Ltd.)

Advantages of Six-Axial Force Sensors



Torque Transducers: Development Road Map



Striving to Balance Reliability, Safety and High Performance



“Since Minebea began to manufacture rod-end bearings in 1969, we have cultivated key technologies and gained approval to supply leading aircraft manufacturers.”

Tsugihiko Musha
Head of the Rod-End Bearings Business Unit

Malfunctioning components in an aircraft can be a life-and-death problem, so reliability is absolutely crucial.

Components used in aircraft must be able not only to bear a load of several tons and withstand sudden load shifts, harsh temperatures ranging from 500°C+ near the engine to -60°C outside the aircraft, rapid temperature changes, and diverse and fluctuating weather conditions, but also offer proven—i.e., backed up with extensive test data—durability and safety in all applications at all times, from takeoff to landing.

Manufacturers of aircraft bearings must therefore possess both technological prowess—enabling them to accommodate rigorous specifications—and sophisticated testing facilities. These are the absolute minimum requirements for component manufacturers to become an approved supplier. Being an approved supplier is the minimum condition for competing in this market. Moreover, approval must be earned not only for individual components, but also for production processes, including heat treatment and surface treatment, which also require advanced expertise.

Since Minebea began to manufacture rod-end bearings in 1969, we have cultivated key technologies and gained approval to supply leading aircraft manufacturers. Since the 1990s, we have diversified into areas that are beyond the capabilities of our competitors. These include bearings for use in dry (i.e., unlubricated) conditions, which hamper slide, and for applications requiring extremely high durability. Thanks to these efforts, many aircraft manufacturers today view us as indispensable.

We have formulated a technology road map that will guide our efforts going forward. In line with this, we will strive to develop highly competitive products by maximizing our ultraprecision machining technologies, as well as by enhancing our stress analysis simulation and testing technologies.

Hideki Kawada
Deputy Head of the Rod-End Bearings Business Unit

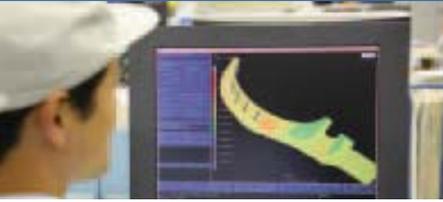
Rod-end bearings for aerospace use is a field in which we have achieved both a high market share and outstanding profitability. Although there was a slight dip after the attacks of September 11, 2001, demand today is expanding robustly. With the introduction of the new Airbus A380 ahead, we expect this trend to continue.

In response to rising demand, Minebea will implement a carefully planned program of product development and capital investment, thereby maintaining a healthy balance between profitability and growth.



Bearings for aerospace use

Computerized stress analysis



Load test equipment



Bearings for Aerospace Use

Rod-End Bearings

Spherical Bearings

Roller Bearings

Sleeve Bearings

Mechanical Assemblies



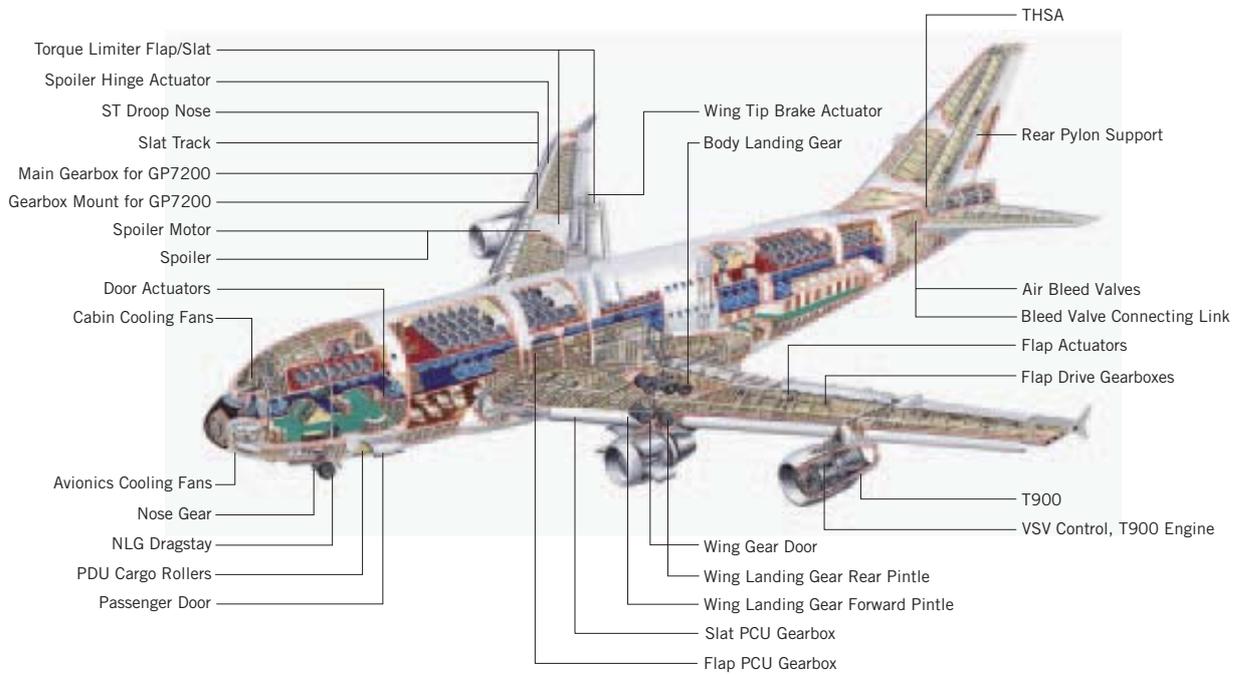
Rod-end bearings

Inspection

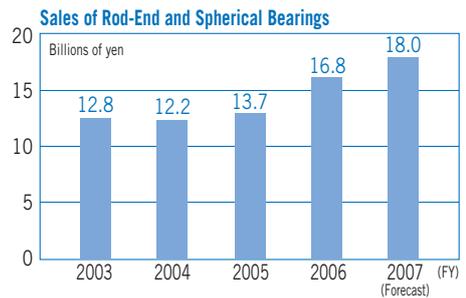


Inspections guarantee the quality and reliability of every bearing

Applications for Minebea Bearings in the Airbus A380



Roller bearings for aerospace use



Maximizing Superior Elemental Technologies in Growth Markets Driven by Technological Innovation



“Outstanding elemental technologies, together with a road map that effectively responded to market and technological trends and facilitated strategic product development, enabled Minebea to become a top manufacturer of small LED backlights soon after it entered this market.”

Hirotaka Fujita

Managing Executive Officer and Head of the Electronic Device Business Unit

A late entrant to the market for small LED backlights about five years ago, Minebea today has a global market share of approximately 10% and is one of the world’s top three manufacturers. This achievement is attributable to the fact that Minebea:

- 1) possesses outstanding and directly relevant elemental technologies,
- 2) formulated a road map that effectively responded to market and technological trends, and
- 3) facilitated strategic product development.

The key to developing advanced small LED backlights is to design light guide plates that provide greater and more uniform luminance and have a slimmer profile, thereby bringing the light source to the surface.

At present, light guide plates with a thickness of approximately 0.6 mm dominate the market. Simply making the plate slimmer reduces the amount of light that is carried from the light source to

the LED surface. Accordingly, designing a slimmer light guide plate demands ultraprecision machining technologies as well as highly advanced optical simulation and optical thin film technologies.

Minebea has amassed outstanding ultraprecision machining technologies through the manufacture of its mainstay bearings and small motors. Going forward, these technologies will have increased currency in the area of LED backlights.

In line with our development road map for LED backlights, we are promoting product development that maximizes while at the same time reflects a solid grasp of trends in the displays market. One initiative to date has involved the development of a high-performance LED backlight in collaboration with a leading LED manufacturer. Through such moves, we will endeavor to increase our share of the market for small LED backlights as well as expand our focus to include the markets for medium-sized and large units.

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Display Market

Minebea’s lineup includes products for the small, medium-sized and large display markets.



Optical evaluation



A wide range of equipment enables precise optical evaluation

Circuit technologies



Advanced circuit design technologies facilitate highly efficient and reliable circuitry

Circuit evaluation



Performance evaluation supports efforts to enhance the reliability and attributes of circuitry developed in-house

FPD Peripheral Components

LED Backlights

CCFL Backlight Inverters

Color Wheels

Ballasts

Thin film technology



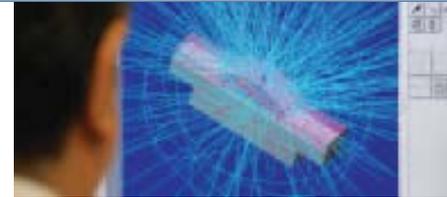
Minebea boasts advanced thin film coating technology and a clean room work area

Design technologies



A range of two- and three-dimensional computer-assisted design (CAD) systems help shorten lead times from die design to production of the finished unit

Lighting technologies



Optical simulation is essential to elemental technologies used in the manufacture of high-performance optical components.

For medium-sized LED backlights for car navigation systems—a newer market for Minebea—technologies to reduce thermal radiation are also essential. The heat reduction technologies we accumulated through the manufacture of fan motors and switching power supplies are enabling us to develop highly competitive products.

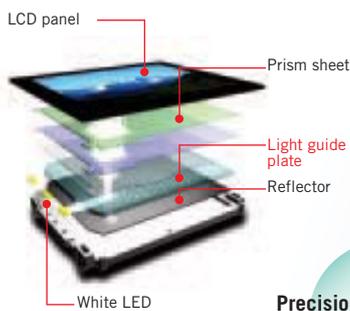
In the area of backlight inverters, we are capitalizing on circuit design technologies cultivated through the manufacture of switching power supplies and optical thin film technologies. The area of color wheels allows us to use optical thin film technologies amassed through the manufacture of MODs and precision small-

motor technologies accumulated through the manufacture of HDD spindle motors. These technologies are underpinning efforts to develop products that boast distinctive competitive advantages.

Going forward, we will continue to develop attractive and commercially viable products by integrating these key technologies. These efforts will focus on products that satisfy two key conditions, that is, they:

- 1) allow us to maximize Minebea's core technologies, and
- 2) are in growth markets driven by technological innovation.

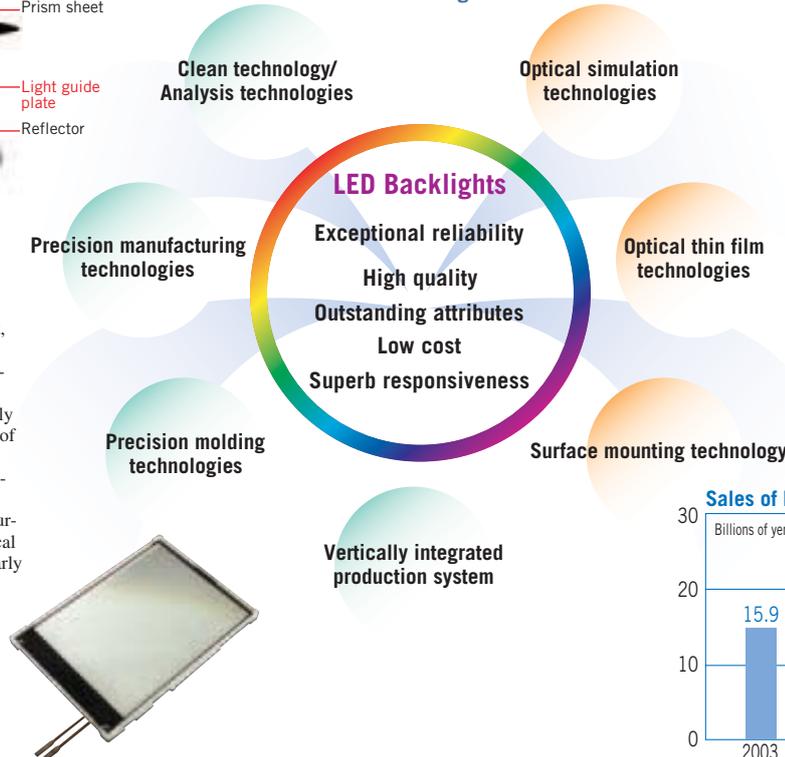
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LED Backlights

The light from an LED display actually comes from a backlight, which, as its name indicates, is positioned at the back of the display unit. The performance of a standard LED backlight is largely determined by the performance of the LED, optical film and light guide plate. Minebea's technologies and expertise in such areas as molding, precision manufacturing, optical simulation and optical thin film formation are particularly relevant to the manufacture of superior light guide plates.

Technologies Supporting the Manufacture of High-Performance LED Backlights



Clean room assembly line for LED backlights

Sales of Electronic Devices

