



Feature Article 1

Improving Vehicle Performance through Tribology

Super-sealed, low-torque hub bearings: Lower fuel consumption achieved with a 15% decrease in frictional resistance

In recent years, automotive development has been spurred on by an increased demand for higher fuel economy. Bearings, which have always been used to limit rotational friction, need to have less torque than ever before (low rotational resistance).

Over 100 bearings are used in a single automobile; reducing the torque of the hub bearings supporting the vehicle wheels is particularly effective for increasing fuel economy. To satisfy this demand, NTN developed the super-sealed, low-torque hub bearing.

Approximately half of the rotational resistance of a hub bearing occurs in the seal that seals off the gap between the inner and outer rings. Also, conventional wisdom held that reducing the sliding resistance of the seal reduced its performance, allowing the entry of foreign matter, such as muddy water.

To solve this problem, NTN created a "low-friction rubber" formulated for optimum elasticity as a seal material, and used this material

in the new product. The radial lip, which comes in contact with the inner ring in conventional bearings, was changed so that it does not make contact, allowing the torque during operation in the new product to be reduced by 15%.

In addition, increasing the number of side lips from two to four has halved the entry of muddy water, increasing the durability of the bearing.

Hub Bearings with high-resolution rotational sensors: Significant improvement in ABS performance

Automobile safety performance is more important than ever.

Anti-lock Brake System (ABS) improves braking by measuring the speed of the automobile and the rotational speed of the wheels to control the brakes so that the wheels don't lock up during sudden braking. Improved ABS performance is also being sought after.

Our company has been ahead of the curve since the 1990s, when we started the development of hub bearings with an internal sensor for measuring the rotational speed of automobile wheels. In 2007, we entered into

Muddy water test results

(Muddy water cycles)

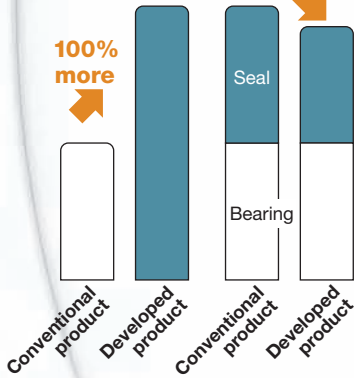
Torque test results

(Rotational torque)

Good sealing with low torque

15% less

100% more

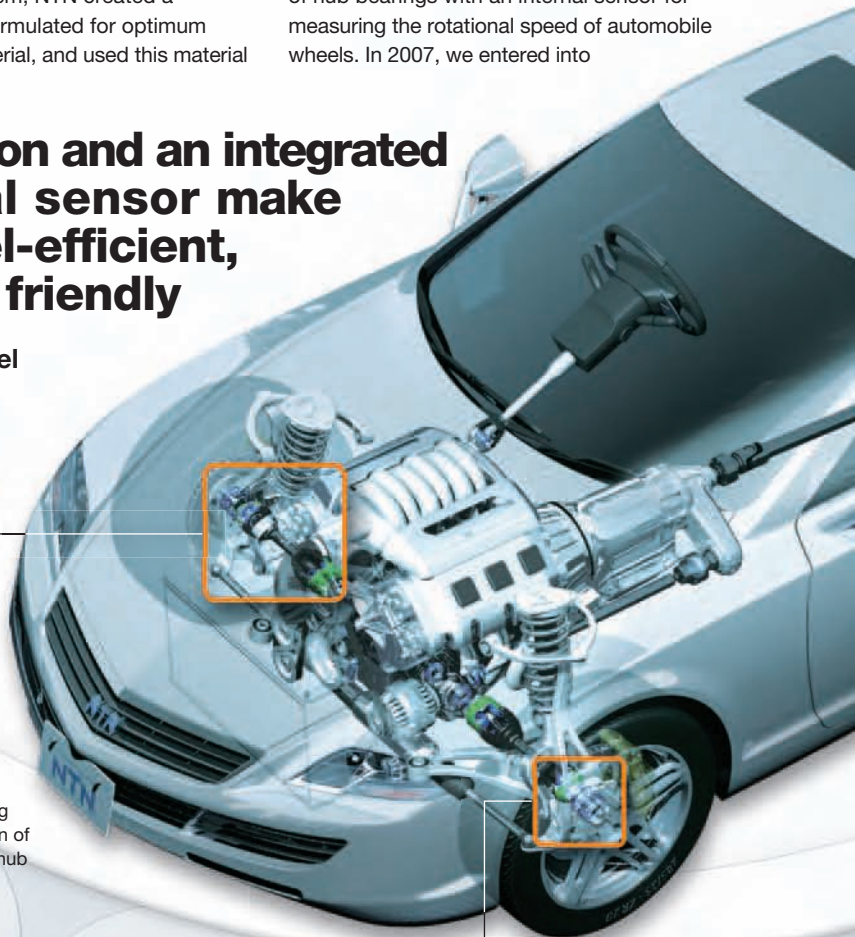


Hub bearings with low friction and an integrated high-resolution rotational sensor make vehicles that are more fuel-efficient, safe, and environmentally friendly

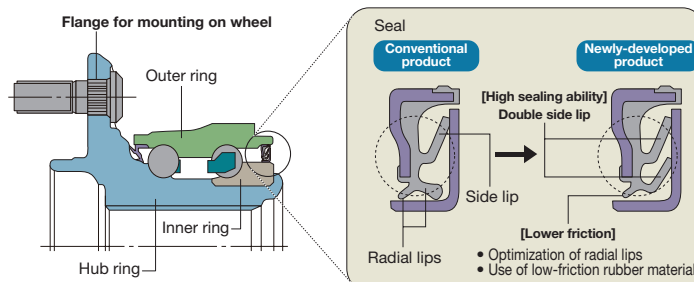
NTN hub bearings, which contribute to lower fuel consumption and safety, hold a leading share of the world market.



"V-series hub joint", reducing weight in terms of integration of constant velocity joint* and hub bearing.



Structure of super-sealed, low-torque hub bearings



High-sealing, low-torque hub bearing

a business tie-up with the French bearing manufacturer SNR and developed a hub bearing with a high-resolution rotational sensor.

The rotational speed of the wheels is measured using magnetic encoders that are mounted with alternating polarity at evenly spaced intervals around the rotating ring of the bearing. A magnetic sensor detects the magnetic field of these encoders. This sensor was developed by SNR, a world-class sensor company, and has more than 40 times the resolution of conventional sensors.

By combining these delicate parts with NTN's sealing technology to protect them from harsh external environments, it is possible to rapidly predict unsteady behavior that occurs from differences in the rotational speed of the wheels on each side of the vehicle, thereby significantly improving the ability of vehicles to avoid hazards. Also, this product allows subtle movements of the vehicle to be detected, so it is expected to be used

in applications such as automatic driving.

Contributing to the ease of automobile assembly

Ease of assembly is also important in vehicles. NTN has been working on **integrated hub bearing units** (integrated multiple components) for a long time.

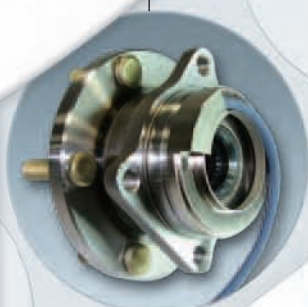
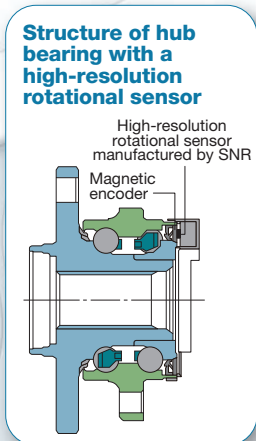
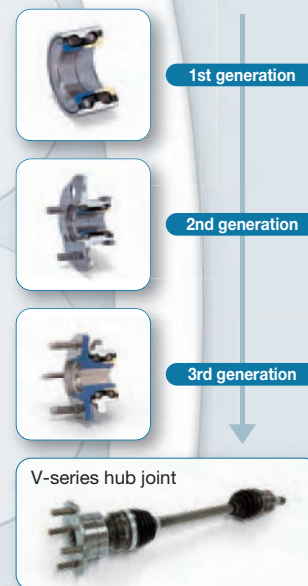
Until the 1970's, bearings for supporting axles in vehicles were typically made up of two parts aligned. At the time, we created the first-generation integrated bearing that combined the two bearings into one unit. Next, we created the second-generation unit that combined the wheel mounting flange or the vehicle mounting flange. In the early 1980's, we created and started mass production of the third-generation integrated unit with both of these mounting flanges.

Since then, we have developed and have started commercializing the "V-series hub joint," reducing weight in terms of integration of constant velocity joint* and hub bearing.

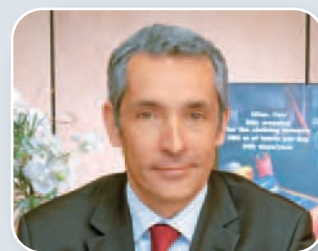
Our company will continue to work to improve vehicle fuel economy, improve safety, reduce weight, and reduce costs.

* Constant velocity joint: Joint portion of driveshaft, which transmits engine power to wheel.

Evolution of hub bearings



Hub bearings with a high-resolution rotational sensor



Hervé Brelaud
Vice-President of Engineering, SNR

Cooperative Development NTN-SNR: Bearing "A la carte" for the World

Automotive has entered into a new era of maximum safety for passengers, highest reliability and environmental friendly technology.

In many fields this must lead to technical quantum leap.

In that spirit NTN and SNR join their research forces to develop a new generation of wheel bearings combining the best achievable performance for conventional function (torque reduction, life duration, precision) and most advanced mechatronics features as high resolution speed measurement and real time wheel load sensing.

These new technologies will offer a breakthrough in Global Chassis Control (GCC) and Powertrain efficiency (Engine management, Traction Control).

By union of both NTN and SNR technological assets, by sharing a common vision, we aim to develop Human and earth friendly products and solutions.

* In April 2008, NTN obtained 51% of the outstanding shares of SNR, which is now an NTN subsidiary.