

+ AUTOMOTIVE PRODUCTS







There is the path that we have trodden.  
And the path that lies ahead.

# The NSK Way

## Contents

<b>01</b>	<b>The NSK Way</b>
<b>03</b>	EPS
<b>05</b>	Hub Unit Bearings
<b>07</b>	CVT
<b>09</b>	Think the Earth
<b>11</b>	The NSK Automotive Way
<b>13</b>	Our Fundamental Technology & Global Network
<b>15</b>	Product Line-up
<b>17</b>	Steering Systems
<b>23</b>	Hub Unit Bearings
<b>29</b>	Engine Parts
<b>31</b>	Electrical Accessories
<b>33</b>	Transmissions
<b>41</b>	Differential Gear & Propeller Shaft
<b>43</b>	Motorcycles & All-Terrain Vehicles
<b>45</b>	The Latest NSK Technology & Next-Generation Products
<b>47</b>	Offices & Plants



## Technology that values sensitivity for a new bond between the human and the machine.

Steering that precisely conveys the will of the driver to the vehicle, and accurately provides feedback to the driver of road conditions. Steering is an important human-and-machine interface that connects drivers to their cars. Besides a high level of maneuverability, comfort, and safety, the latest steering systems promote excellent fuel efficiency and environmental awareness.

## Electric Power Steering (EPS)



**EPS is the newest trend in power steering with enhanced fuel efficiency.**

Compact and lightweight, EPS contributes to a scaled-down chassis and improves fuel efficiency. Conventional hydraulic fluids are eliminated, making EPS an environmentally friendly technology. EPS motor control generates the right amount of power at just the right moment, thus enabling finely tuned handling for an exceptionally driver-friendly human-and-machine interface.





**When the going gets tough, the tough get going.**

Hub Unit Bearings provide reliable support for wheels exposed to a wide range of driving conditions, from extended highway driving to harsh, off-road paths. NSK is also examining ways to harmonize its products with future intelligent transport systems (ITS) and by-wire technologies.



## Hub Unit Bearings



**Hub unit bearings are highly durable and impervious to mud and water.**

Repetitive and thorough testing under various severe conditions has resulted in the development of bearings that are remarkably durable and offer high sealing performance. To meet increasingly diverse requirements such as lighter weight and higher fuel efficiency, as well as module production systems, we are furthering our research and development by updating to the latest technology. NSK hub unit bearings embody the comfort demanded in the 21st century.



## The comfort of watching a child sleeping peacefully.

A transmission converts power from the engine into the required speed and driving force, which is then conveyed to the drive wheels. NSK is the first company in the world to put the POWERTOROS Unit, a half-toroidal CVT, into practical use after research and development spanning 21 years. The POWERTOROS Unit is a continuously variable transmission (CVT) that is the result of NSK's advanced technology in tribology (friction, wear, and lubrication).

## Half Toroidal CVT POWERTOROS Unit



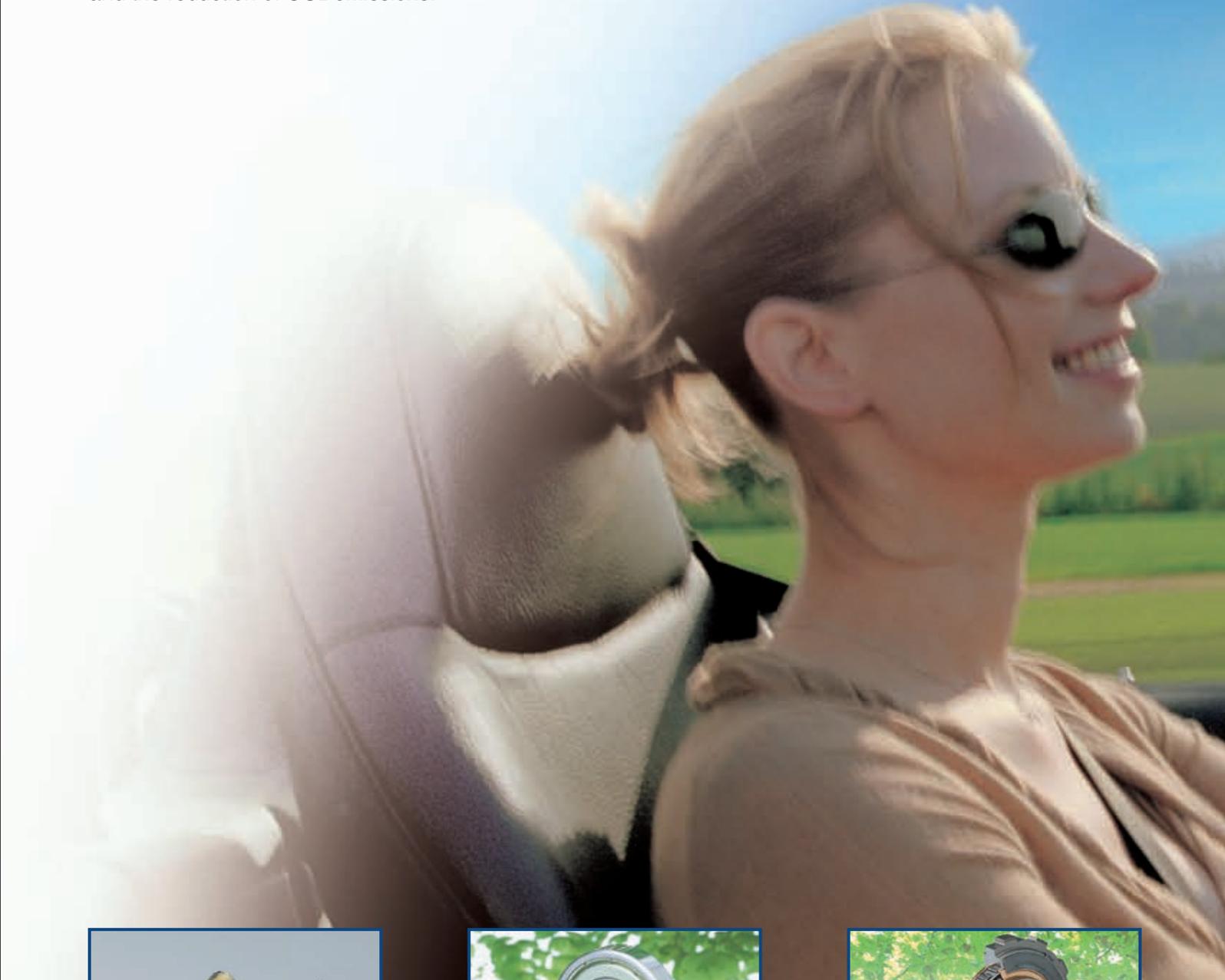
### Technology makes a car run silently and smoothly.

By changing the angle of the power rollers between two disks, the half-toroidal CVT POWERTOROS Unit executes smooth, continuous gear ratio changes. With its unique features of silent and smooth running performance minus the traditional shift shock, as well as high efficiency and excellent fuel efficiency, the CVT is the 21st century's transmission to which NSK, the world leader in automotive bearings, applied its company-wide technology for the cars of tomorrow.



## Because I want to drive through the beautiful scenery forever. . .

The Earth's beautiful natural environment is an irreplaceable gem for the present and for all future generations. In recent years, environmental issues have become a significant global concern. To combat global warming, the automobile industry has been called upon to help protect the environment by means such as vehicle weight reduction, resource-saving technologies, and the reduction of CO<sub>2</sub> emissions.





**Our regard for the environment is instilled in all of our products from bearings to EPS.**

Various NSK products, including bearings and other parts built into a car, are environmentally friendly products that contribute to conserving energy and preservation of natural resources by means of their function, their performance, and by their friction control and reduced energy-loss characteristics. Through our tribology technology, we at NSK contribute to reducing environmental stress, and are actively promoting preservation of the Earth today as well as in the future.

# The NSK Automotive Way

Our proactive approach: NSK shall continue to contemplate the future of cars through newly developed products incorporating true value.

1. Contribute to Global Motorization  
= Brand in Brands=
2. Contribute to the well being of humankind with policies and actions that protect the environment.
3. Create, refine and promote new values.  
Instill these values into our future generations.
4. Supply NSK Products that:  
Meet global standards for excellence  
Are of the highest quality  
Have an optimal price-performance ratio  
Are manufactured in the appropriate volume, and delivered to the appropriate locations, at the appropriate time.  
  
All these and more in order to give unparalleled customer satisfaction globally.
5. NSK accepts all its obligations to be a responsible corporate citizen.

In order to realize the NSK Automotive Way on a higher level, we shall maintain a corporate attitude to which we shall hold true:

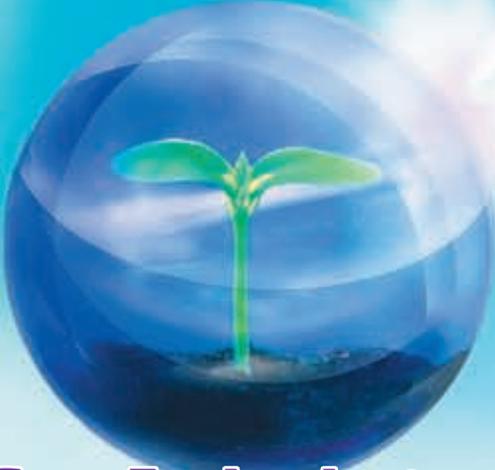
Keep that which should not be changed, and aggressively challenge that which should be.



**Cost**



**Quality**



**Core Technologies**

**Delivery**

**Create New Value**

**Development**

**Brand in Brands**

**Sales**

**Solution**

**Service**

# Our Fundamental Technology &

The basic technology of NSK that creates the future of automotive parts.

Motion and control is constantly evolving at NSK to further provide timely responses to the needs of our customers on a worldwide scale by continuously reinforcing our tribology technology and mechatronics technology, which we have accumulated from our many years of experience with rolling bearing technology.



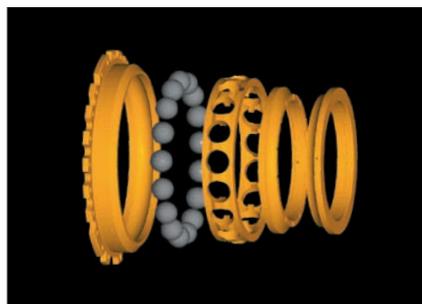
## Materials

In order to produce even more excellent products, NSK conducts research into a wide range of basic materials technologies. Products made with NSK's own materials enjoy long service life and provide customers with maintenance-free products. They have also contributed to the downsizing of machines for many industries.



## Lubrication

NSK is continuing its basic research into tribology as a key technology that takes full advantage, and maintains the performance, of machines. Applied to lubricants or lubrication methodologies, this research technology contributes to protecting the environment, including the preservation of natural resources and conserving energy.



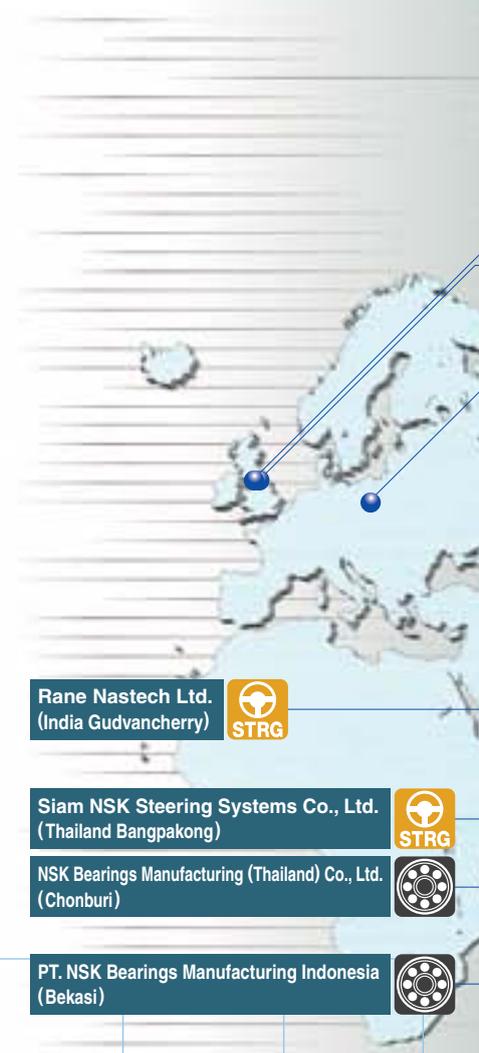
## Numerical Simulation

NSK has independently developed an analysis tool called BRAIN, which stands for Bearing Analysis In NSK. This software digitizes tribology technology, enabling simulations of movement and performance related to friction. Combining this data with the finite elements method (FEM), NSK has achieved advanced computer-aided engineering (CAE).



## Mechatronics

Based on advanced sensing, motor and control technology, NSK is developing a basic motion and control technology for further high-precision products. This in turn is contributing to the development of sensor bearings as well as highly advanced mechatronics products.



Rane Nastech Ltd.  
(India Gudvancherry)



Siam NSK Steering Systems Co., Ltd.  
(Thailand Bangkok)



NSK Bearings Manufacturing (Thailand) Co., Ltd.  
(Chonburi)



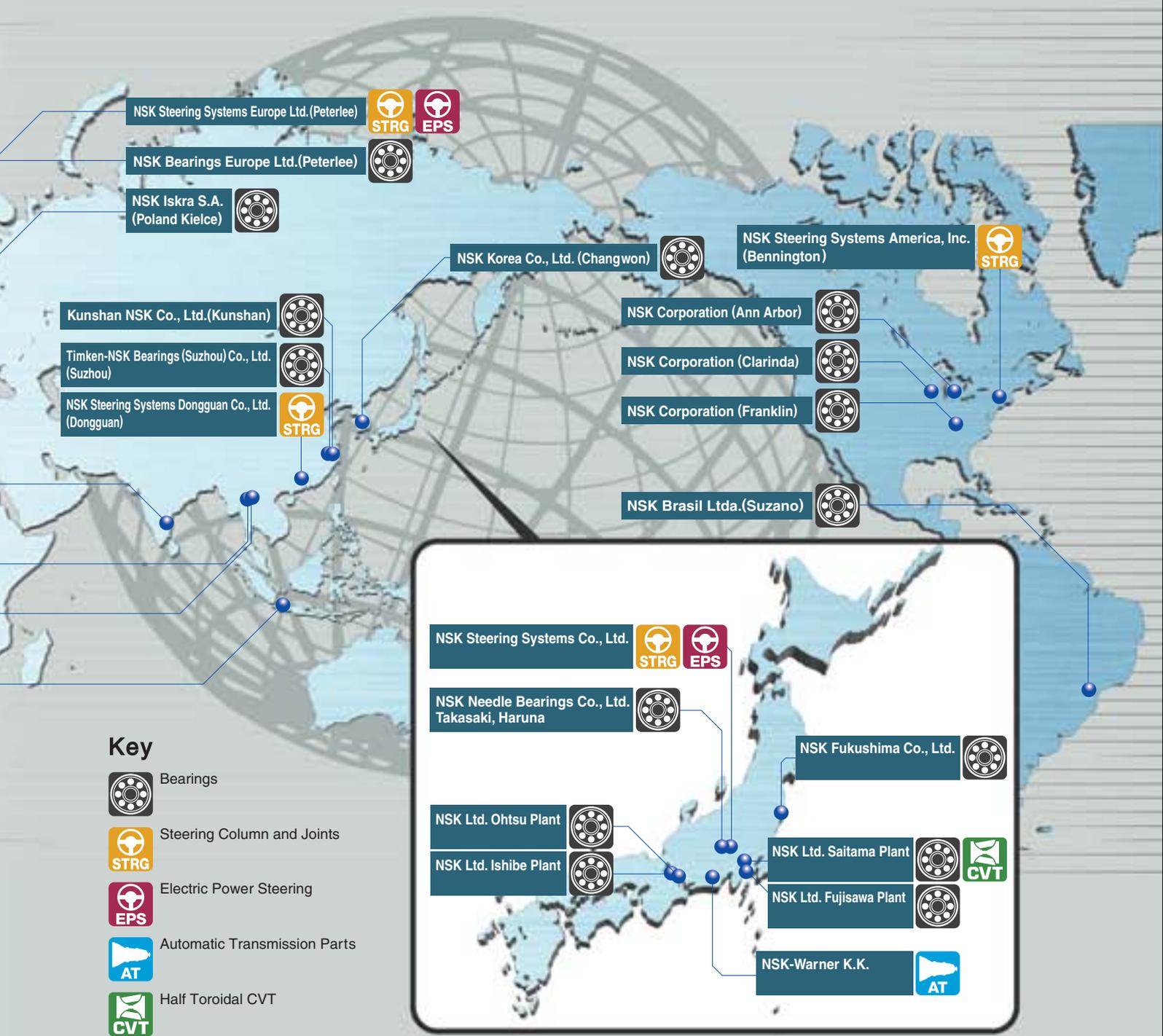
PT. NSK Bearings Manufacturing Indonesia  
(Bekasi)



# Global Network

We provide just-in-time delivery to vehicle makers worldwide.

Automakers have extended their manufacturing across national borders. Extensive alliances and mergers are forming between manufacturers from various countries. The big issue of efficiency and cost savings for these large-scale manufacturers is to standardize their platforms. In order to fulfill the requirements of borderless production and cost savings, NSK has set up a network that combines production in the best supply base and production in areas with a large demand. NSK is supplying its products as required to meet market needs with just-in-time delivery on a global scale.



(as of August 2003)

# Product Line-up

From Bearings to EPS.  
NSK manufactures various products that contribute to the three greatest elements of automobiles: running, turning, and stopping.

Since the start of Japanese production of ball bearings in 1916, NSK has been playing the role of supplying optimal bearings for growing industries in each era. For the automobile industry as well, NSK has foreseen the potential and expanded its business field to automotive parts. As a global brand in automotive parts, NSK has supplied high-performance and high-quality products unrivaled by competitors worldwide. These include various types of bearings as well as automatic transmission parts, steering column, joints, and EPS, which is associated with 21st century steer-by-wire technology.



# Chassis

17

Steering Systems

23

Hub Unit Bearings



# Power train

29

Engine Parts

31

Electrical Accessories



# Drive train

33

Transmissions

41

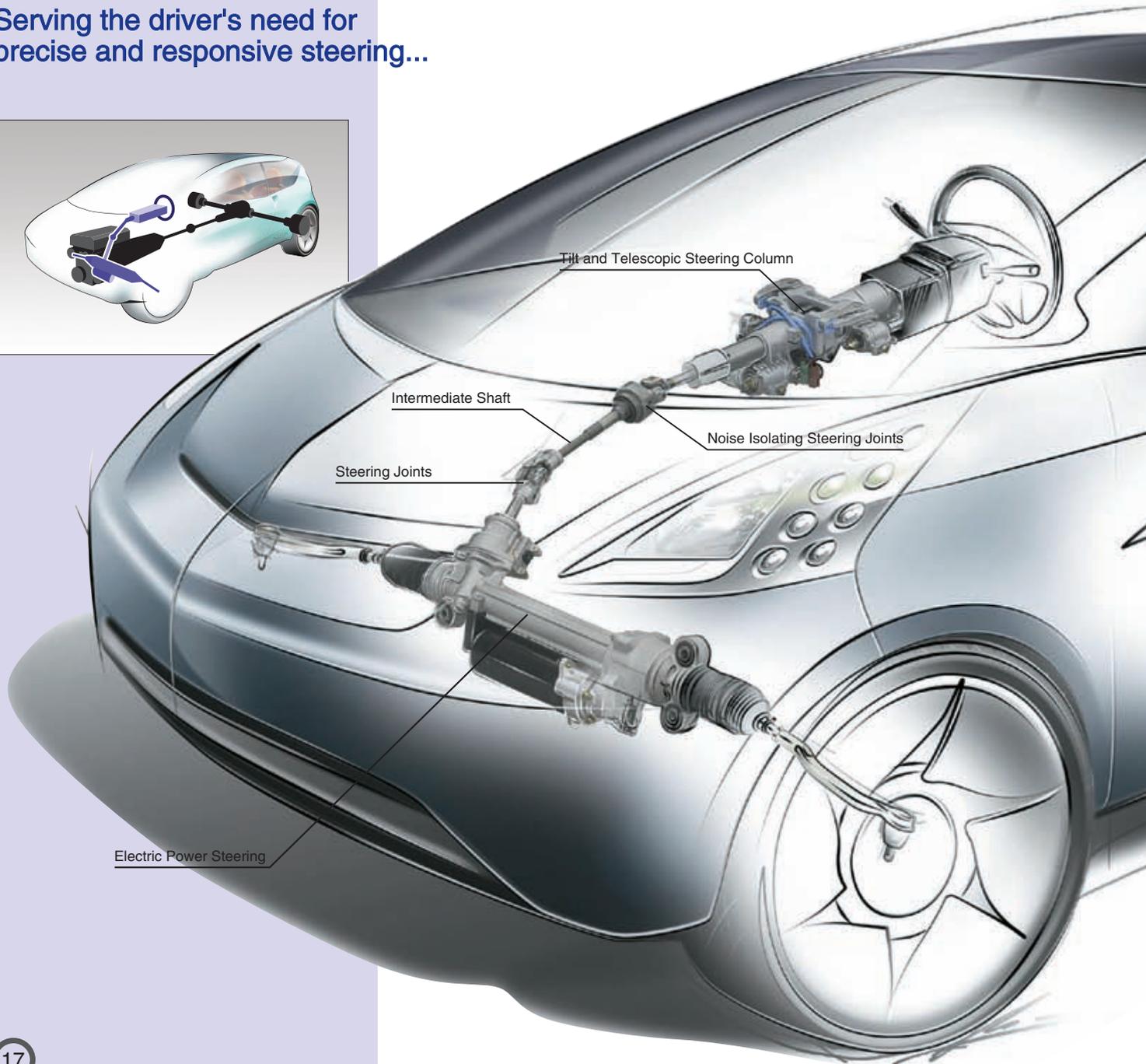
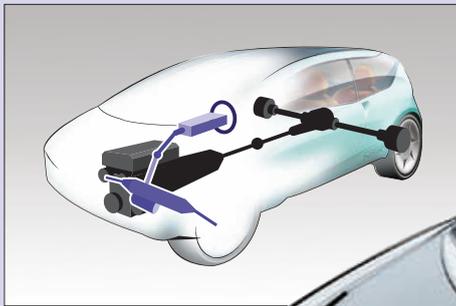
Differential Gear & Propeller Shaft



# Steering Systems

The lightweight and compact EPS creates various merits for the future, in addition to improvements in fuel efficiency due to its lightweight. The steering system, which accurately conveys road conditions to the driver, is indispensable for safe and comfortable driving. By applying its unique precision control based on vehicle running tests, NSK can ensure flexible management for the different input loads of various types of vehicles. NSK's ideal EPS will be one where you can truly sense the car. Moreover, NSK's original plastic technology used in various types of steering columns contributes to improved safety due to its excellent impact-absorbing characteristics.

Serving the driver's need for precise and responsive steering...





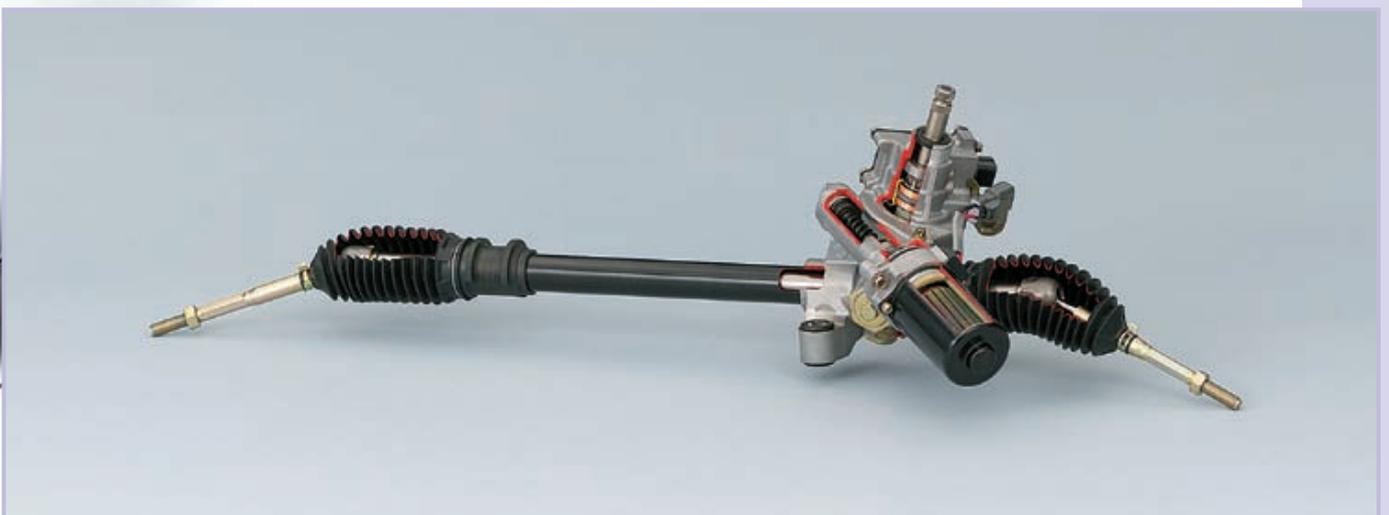
**Column Type Electric Power Steering**

Column type EPS with lower pivot tilt mechanism for small cars.



**Column Type Electric Power Steering**

Column type EPS for minivehicles.



**Pinion Type Electric Power Steering**

Pinion type EPS for small cars.

# Steering Systems



## Column Type Electric Power Steering

Column type EPS with mid-tilt mechanism for small cars.



## Dual Pinion Type Electric Power Steering

Pinion type EPS that transmits power assist to the rack gear by a pinion gear located separately in consideration of limited space availability.



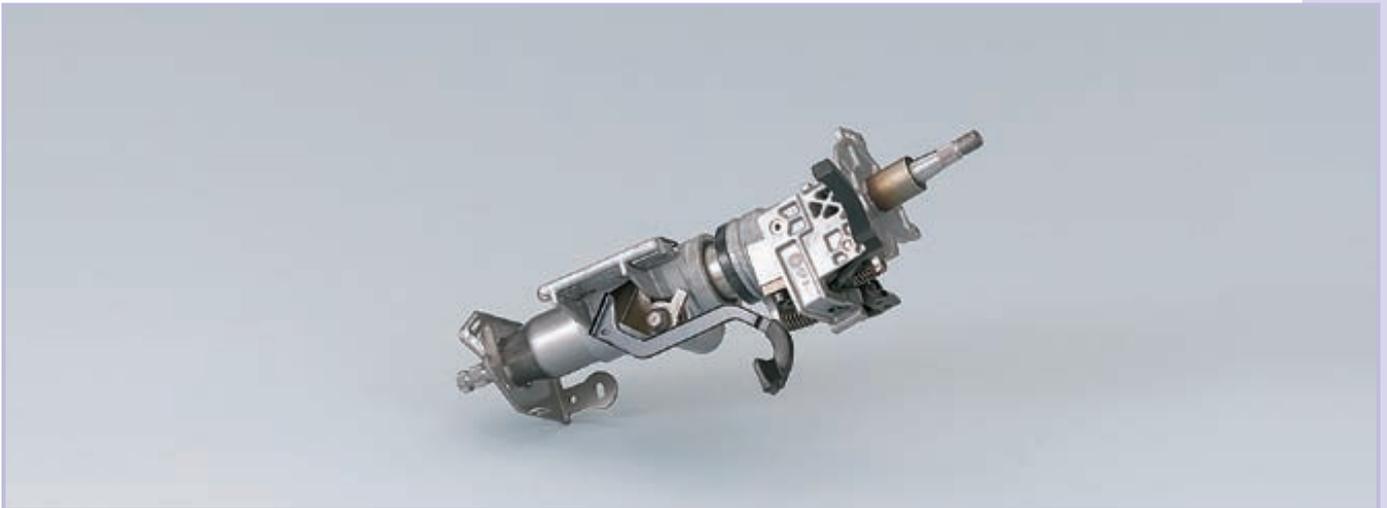
## Offset Ball Screw Type Electric Power Steering

Offset ball screw type EPS that transmits robust power assist to the rack gear by a highly efficient reduction gear and ball screw.



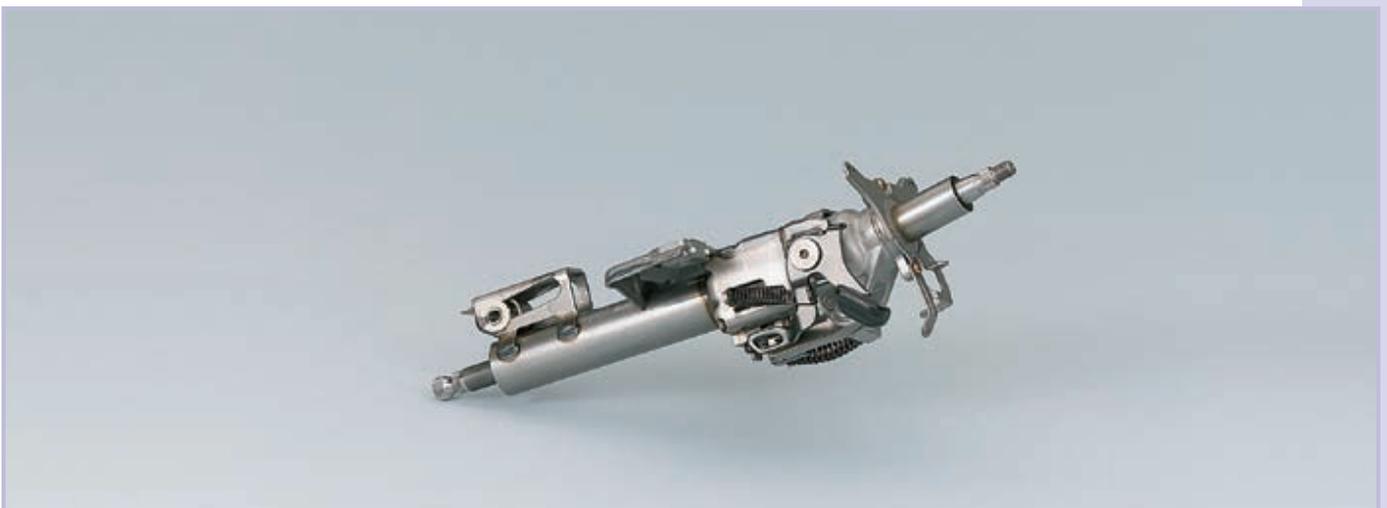
### **Electrical Tilt and Telescopic Steering Column**

Electrical adjustment mechanism for position memory steering column.



### **Upper Pivot Tilt and Telescopic Steering Column**

Tilt and telescopic steering column with a pivot center in the upper part of the column. Steering wheel position can be adjusted back and forth, and up and down. The automatic tilt-away steering column feature raises the steering wheel for ease when exiting the vehicle.



### **Upper Pivot Tilt Steering Column**

Tilt steering column with a pivot center in the upper part of the column. Steering wheel position can be adjusted up and down. The automatic tilt-away steering column feature raises the steering wheel for ease when exiting the vehicle.

# Steering Systems



## Lower Pivot Tilt and Telescopic Steering Column

Tilt and telescopic steering column with a pivot center in the lower part of the column. Steering wheel position can be adjusted up and down. Lightweight achieved by using magnesium materials. The unitized design of the steering wheel and lock is an added deterrent to vehicle theft.



## Lower Pivot Tilt Steering Column

Tilt steering column with a pivot center in the lower part of the column. Steering wheel position can be adjusted up and down.



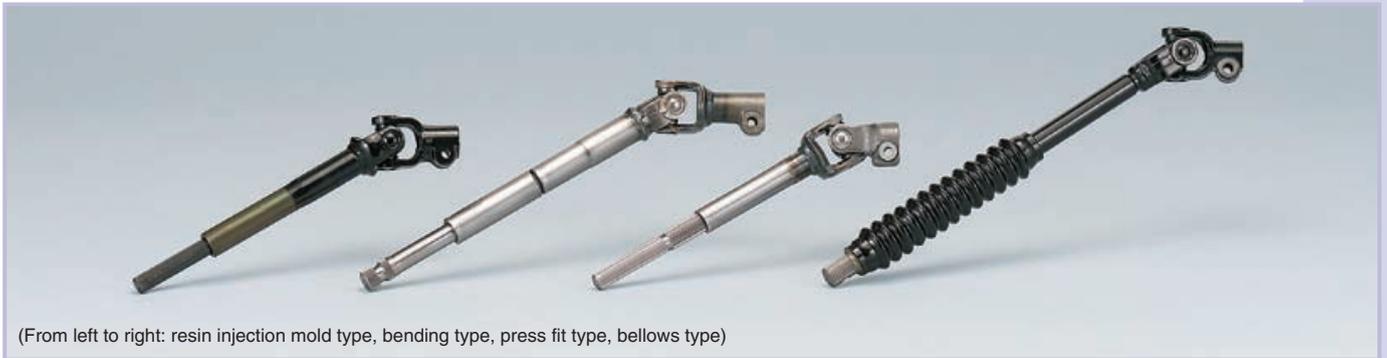
## Tilt and Telescopic Steering Column for Trucks

Steering column with added rigidity for trucks.



(From left to right: resin coated spline type, triangular section type, expandable serration type)  
 左から樹脂コーティングタイプスプライン、樹脂スリーブタイプ(三角断面形状)、すきま調整タイプスプライン

**Slidable Intermediate Shafts** スライドタイプ中間シャフト  
 Slidable intermediate shafts for absorbing displacement of body frame.  
 車体フレームの変位吸収に対応した、常時スライド機構付き中間シャフト。



(From left to right: resin injection mold type, bending type, press fit type, bellows type)

**Collapsible Intermediate Shafts**  
 Intermediate shafts for displacement and load absorption at the time of a collision.



(From left to right: bush type (high performance), disk type rubber coupling, compact bush type)

**Noise Isolating Steering Joints**  
 Noise isolating steering joints that excel in characteristics of vibration absorption and soundproofing.



**Double Cardan Constant Velocity Joint**  
 Compact joint that maintain constant velocity.



(From left to right: single flange type, free phase type, slap-up type)



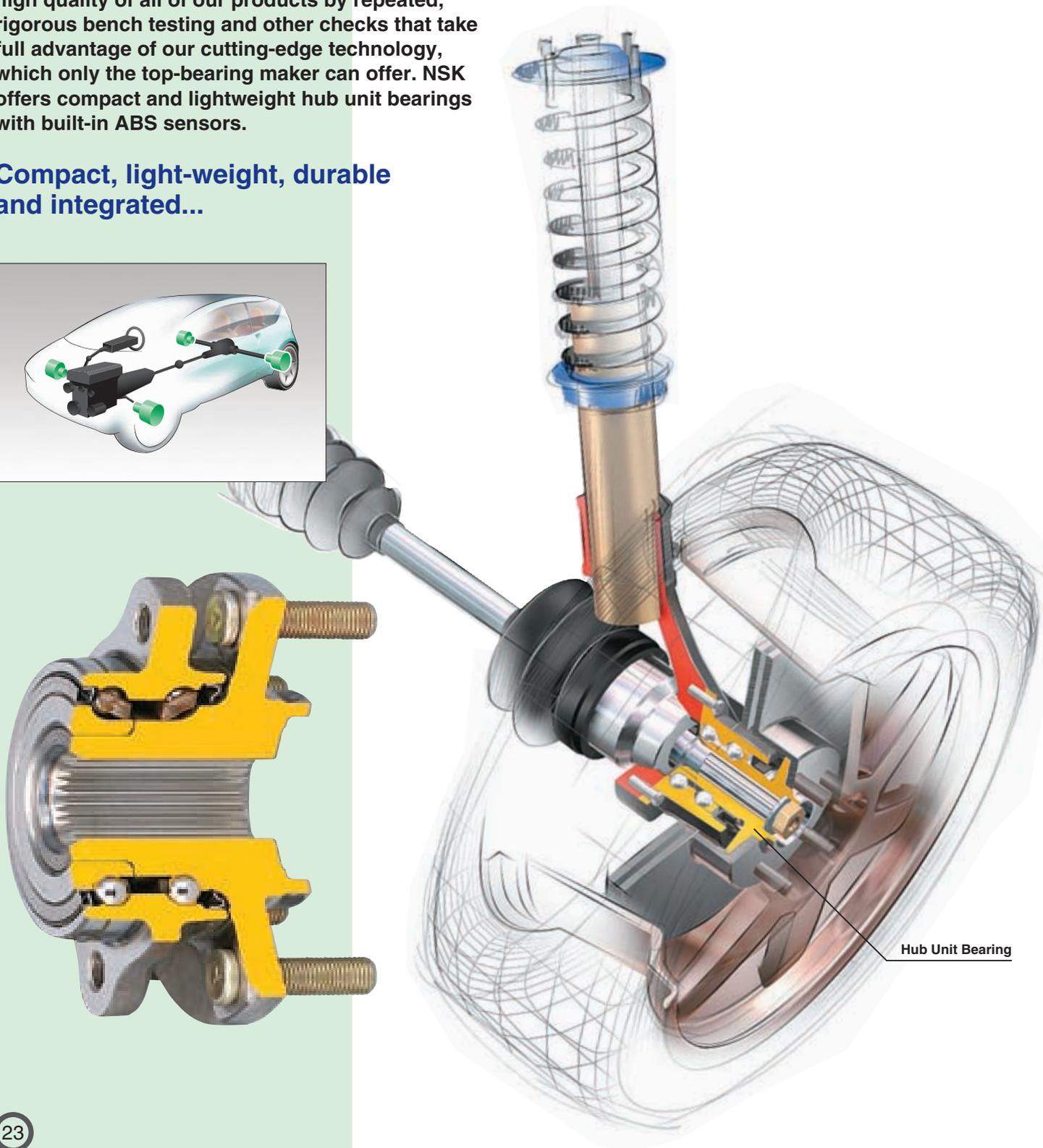
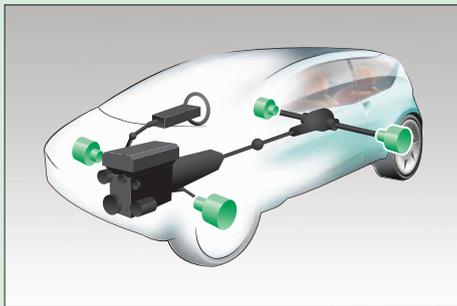
(From left to right: double flange type, forged type)

**Steering Joints**  
 Various joints that can be selected according to the usage.

# Hub Unit Bearings

Hub unit bearings have to meet increasingly strict requirements that demand lighter weight, greater promotion of fuel efficiency, and enhanced module production systems. Along with the widespread adoption of antilock braking systems (ABS) to ensure stable maneuverability during braking, there is a growing need for our hub unit bearings with a built-in sensor. NSK guarantees high quality of all of our products by repeated, rigorous bench testing and other checks that take full advantage of our cutting-edge technology, which only the top-bearing maker can offer. NSK offers compact and lightweight hub unit bearings with built-in ABS sensors.

**Compact, light-weight, durable  
and integrated...**

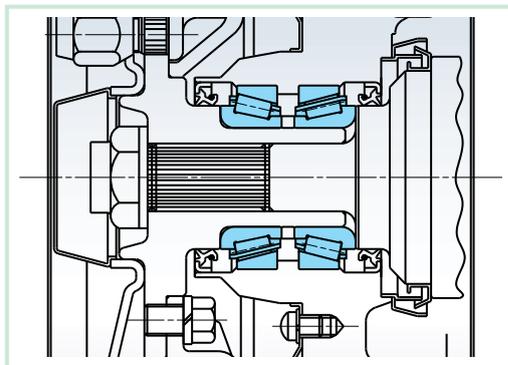


## Hub Unit Bearings Conventional Type

### [Features]

**Long distance between effective load centers**  
(for non-driven wheels);

- 1 Difficult to set pre load.
- 2 Complicated mounting process.
- 3 Grease packing required.

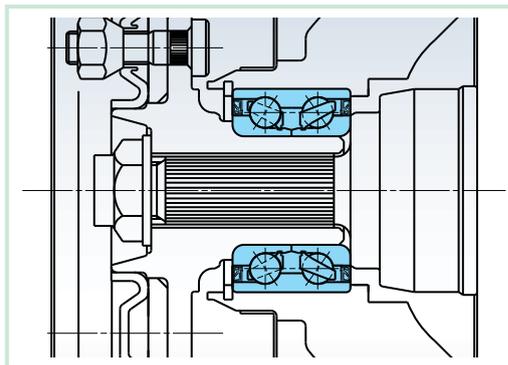


## HUB I

### [Features]

**Compared to conventional type;**

- 1 Easy and reliable pre load setting.
- 2 Easy mounting process.
- 3 No spacer required.
- 4 No grease packing required.
- 5 Compact.
- 6 Integral high performance seal.

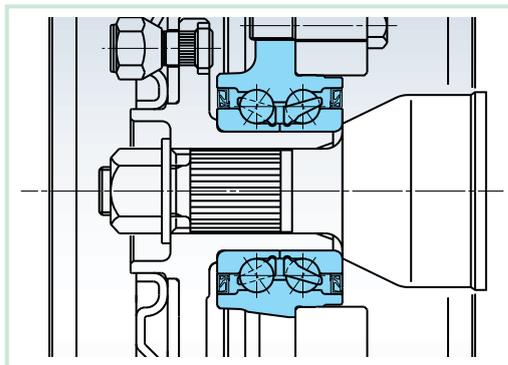


## HUB II

### [Features]

**Compared to HUB I;**

- 1 Easier and more reliable pre load setting.
- 2 Easy mounting process.
- 3 No need to press fit into knuckle.
- 4 Integral sensor rotor is optional.  
(for outer ring rotation type)

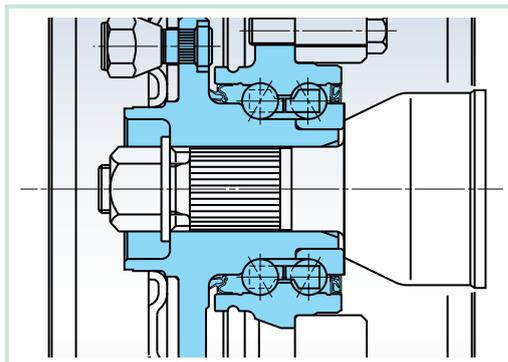


## HUB III

### [Features]

**Compared to HUB II;**

- 1 Preset optimum pre load.  
(for non-driven wheels)
- 2 Easy mounting process.
- 3 High rigidity.
- 4 Easy incorporation of ABS sensor.



# Hub Unit Bearings

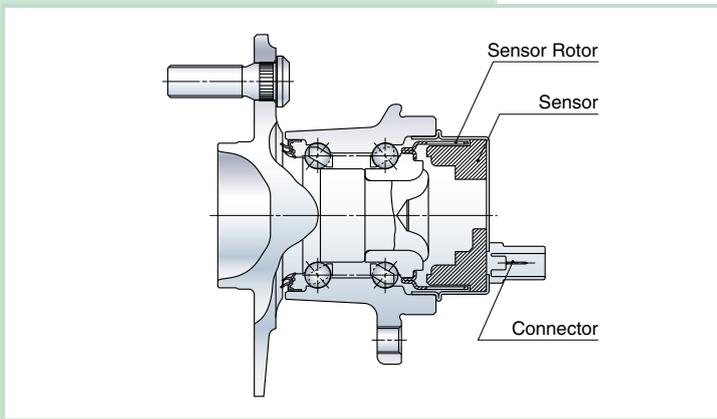


## Hub unit bearings with annular passive sensor

An annular passive sensor is located in the radial space between the swaged shaft end and sensor cover.

### [ Features ]

1. Compact size attained by utilizing the space inside the bearing.
2. Improvement of reliability by sealing the sensor part.
3. Integral high-output sensor.
4. Small fluctuation output by elastic deformation of bearing.

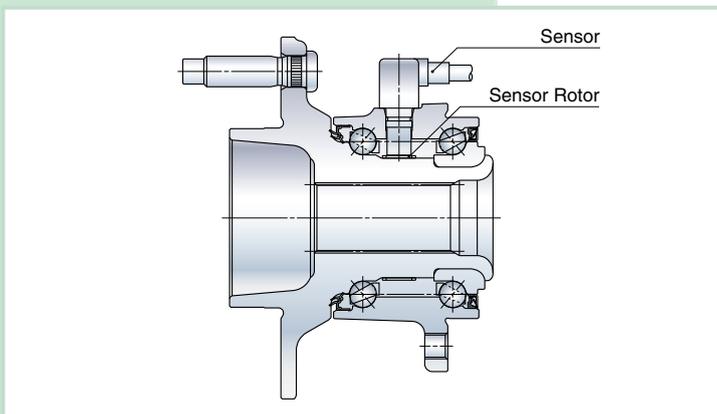


## Hub unit bearings with integral sensor located between the rows

The ABS sensor is located between the rows with a very small air gap.

### [ Features ]

1. Compact size achieved by utilizing the space inside the bearing.
2. Improved reliability by sealing the sensor part.
3. Integral sensor for driven wheels.
4. Stabilized sensing under high moment load.



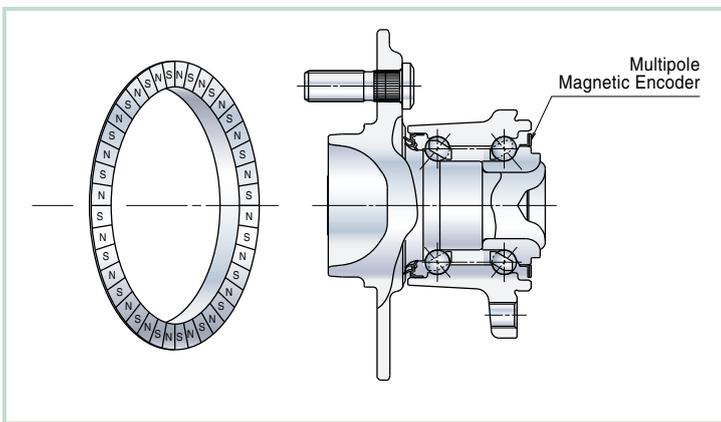


## Hub unit bearings with multipole magnetic encoder

A multipole magnetic encoder for active sensor is used for ABS attached to the HUB unit bearing.

### [Features]

1. Integrated sensor rotor (encoder).
2. For active sensor.
3. Utilizing high performance encoder.
4. Stabilized sensing at low speed rotation.
5. Packed Seal with encoder is available.

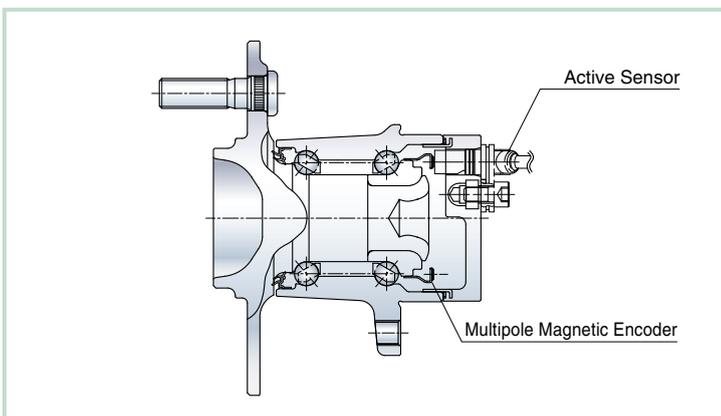


## Hub unit bearings with end-cap type active sensor

Integration of ABS Active Sensor and Bearing.

### [Features]

1. Integrated sensor rotor (encoder).
2. Compact size and lightweight achieved by utilizing active sensor.
3. Senses, stability at low speed rotation.



# Hub Unit Bearings



## Double-Row Angular Contact Ball Bearings (HUB I)

Double-row angular contact ball bearing with integral high performance seal. Easier preload setting.



## Double-Row Tapered Roller Bearings (HUB I)

Double-row tapered roller bearing with integral high performance seal. Suitable for heavy-duty vehicles.



## Double-Row Angular Contact Ball Bearings with Outer Mounting Flange(HUB II for Outer Ring Rotation Type)

Outer ring rotating hub unit bearing with outer flange for mounting the wheel.



## Double-Row Angular Contact Ball Bearings with Outer Mounting Flange(HUB II for Inner Ring Rotation Type)

Inner ring rotating hub unit bearing with outer flange for mounting onto the knuckle.



## Double-Row Tapered Roller Bearings with Outer Mounting Flange(HUB II for Inner Ring Rotation Type)

Inner ring rotating tapered roller hub unit bearing with integral flange for mounting onto knuckle. Suitable for heavy-duty vehicles.



**Double-Row Angular Contact Ball Bearings with Inner and Outer Mounting Flange (HUB III for Driven Wheels)**

Double-row angular contact ball bearing with integral inner and outer mounting flange. Easier mounting because of preset preload.

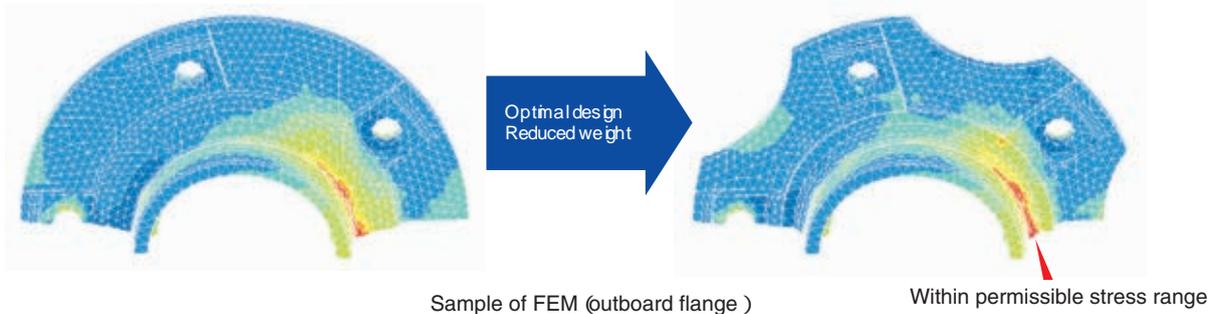


**Double-Row Angular Contact Ball Bearings with Inner and Outer Mounting Flange (HUB III for Non-Driven Wheels)**

Double-row angular contact ball bearing with integral inner and outer mounting flange. Easy incorporation of ABS sensor.

**Outboard hub flange**

Achieved optimal design of outboard hub flange using FEM to maintain stress concentrations within the permissible range, and for further weight reduction.



Sample of FEM (outboard flange )

Within permissible stress range



**Double-Row Angular Contact Ball Bearings with Inner and Outer Mounting Flange (HUB III for Minivehicles)**

Hub unit bearing achieves lightweight by incorporating a unique design specifically for minivehicles.

# Engine Parts

An engine utilizes a large number of bearings and engine-related parts. The requirements for comfort and convenience in the vehicle have diversified in the car market in recent years, resulting in roomier car interiors with reduced engine sizes. NSK offers compact and durable engine parts that lead the trend toward smaller engines.

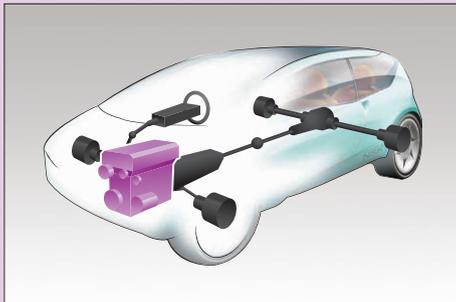
## Roller Followers for Engine Tappets

Low friction has been achieved by changing a part of the rocker arm tappet that makes contact with the cam for rolling.



## Water Pump Bearings

High reliability has been achieved by special grease and high performance seals. NSK offers a wide line of bearings to meet all requirements.



Pressed Rocker Arm Assemblies

Roller Followers for Engine Tappets

Auto-Tensioner for Timing Belt

Ball Bearing for Turbocharger

Water Pump Bearing

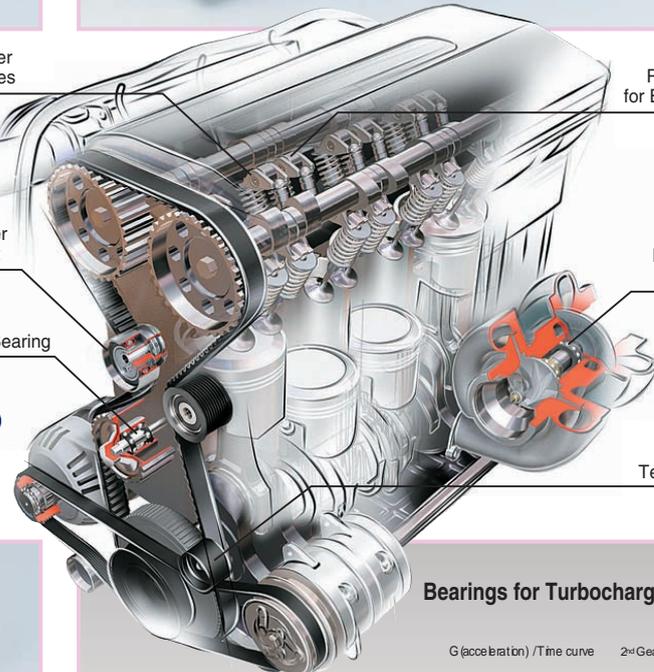
Bearings for Tensioner & Idler

State-of-the-art technology contributes to ever-evolving engines...

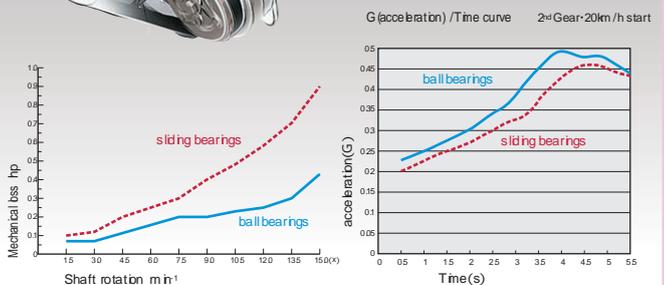


## Bearings for Tensioner & Idler テンショナ / アイドラ軸受

High reliability has been achieved by special grease and high performance seal. NSK offers a wide line of bearings to meet the needs of every type of belt and layout. 専用グリースと高密封シールの採用により高い信頼性を確立。あらゆるベルト形式やレイアウトに対応可能なラインナップ。



## Bearings for Turbocharger



Mechanical loss of ball bearings is 50% less than sliding bearings.



**Pressed Rocker Arm Assemblies**

Reduced weight and costs have been achieved with press technology including thickening of the necessary parts for strength.



**Drawn-Cup Needle Roller Bearings for Camshaft Journals**

Super thin cross section and low friction have been achieved.



**BWFH Type Water Pump Bearings**

High capacity and high moment rigidity have been achieved by increasing the limited number of balls in the front row.



**Ball Bearings for Turbocharger**

The cartridge bearing has little mechanical loss while requiring no preload setting.



**Plastic Pulley for Accessory & Timing Belt**

High precision & lightweight plastic pulley bearing with creep prevention mechanism.



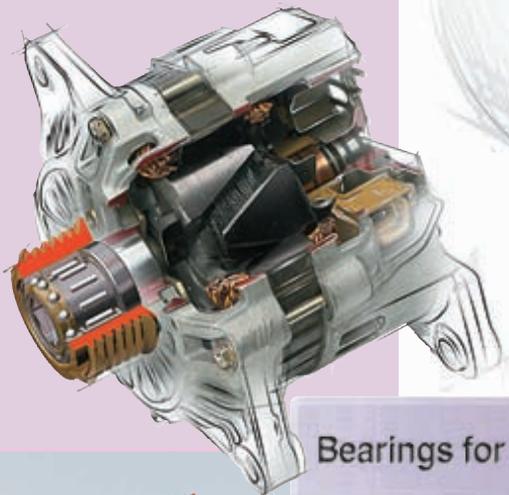
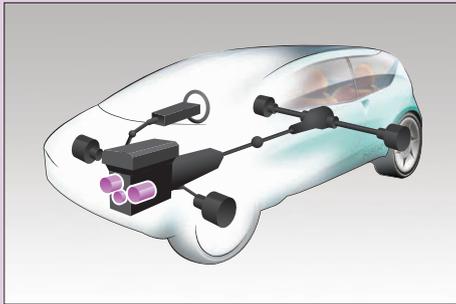
**Auto-Tensioner for Timing Belt**

Optimum timing belt tension has been achieved with a multi-disc damper adjusted to various engine specifications.

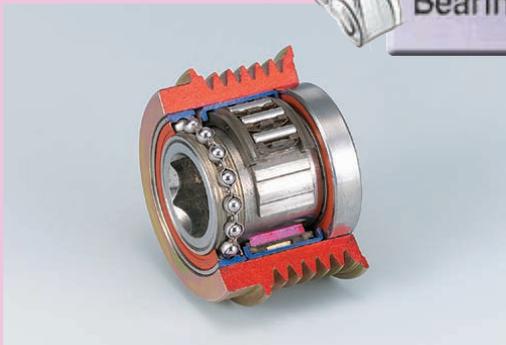
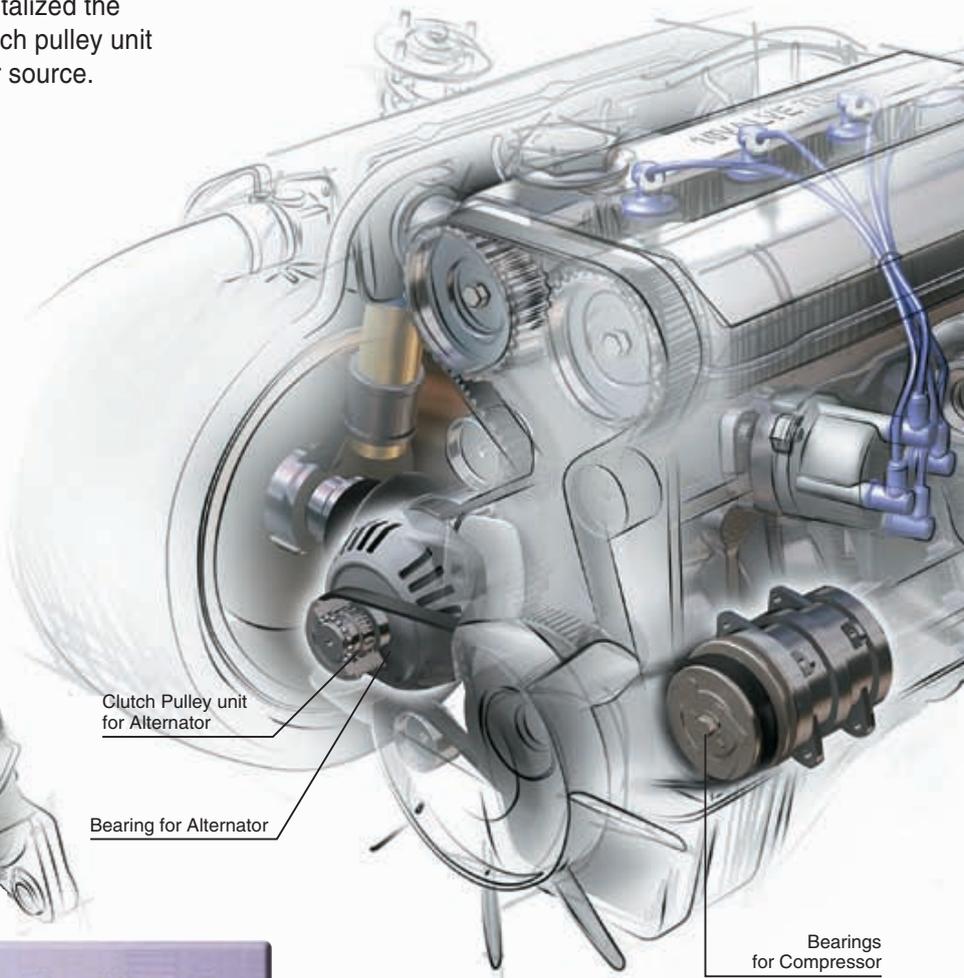
# Electrical Accessories

Vehicles include a vast array of electrical accessories such as engine starters, air-conditioning systems for a comfortable riding environment, windshield wipers for safety, and oil-pressurized motors to assist power steering. These days, we cannot even imagine a vehicle on the road without these components. Unlike household appliances, these parts are exposed to extreme temperatures and vibrations. Therefore, they are equipped with far more durable and reliable bearings. NSK's advanced bearing technology has revitalized the automobile industry with such items as a clutch pulley unit for alternators, which is an automotive power source.

For additional comfort...



**Bearings for Alternator**



## Clutch Pulley Unit for Alternator

The pulley unit with a one-way clutch decreases belt noise and extends belt life by absorbing the speed fluctuation transmitted through the crank pulley.



## Bearings for Alternator

Highly reliable alternator bearings that offer high performance under high-temperature conditions, high speed, with sealing features. Includes creep prevention function between the bearing and housing.

## Bearings for Compressor



### Thin Cross-Section Double Row Angular Contact Ball Bearings for Magnetic Clutch

Magnetic clutch bearings with high sealing performance, high moment rigidity, and long life.



### Thrust Needle Roller Bearings with Integrated Races for Compressor

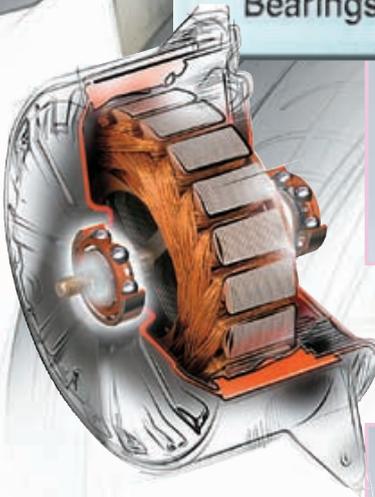
High durability under the alternative coolant (non-Freon type) and high rotating speed.



### Drawn-Cup Needle Roller Bearings for Compressor

High durability under the alternative coolant (non-Freon type) and high rotating speed.

## Bearings for Motors



### Needle Roller Bearings for ABS Motor

Reduced weight and costs have been achieved with pressed outer ring.



### Bearings for Cooling Fan Motor

Long life for high temperature and brush wear particle conditions have been achieved with special grease.



### Bearings for Electric Power Steering Motor

EPS motor bearing for low torque, low vibration, and high reliability.



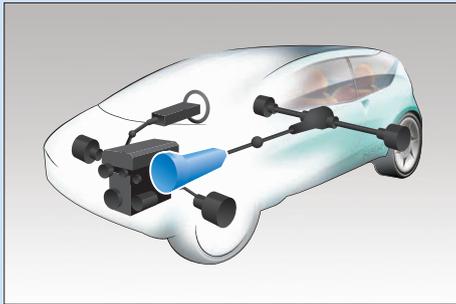
### Bearings for Throttle Motor, Bearings for EGR Motor

Low torque for low temperatures, and long life under high temperatures have been achieved with newly developed exclusive grease.

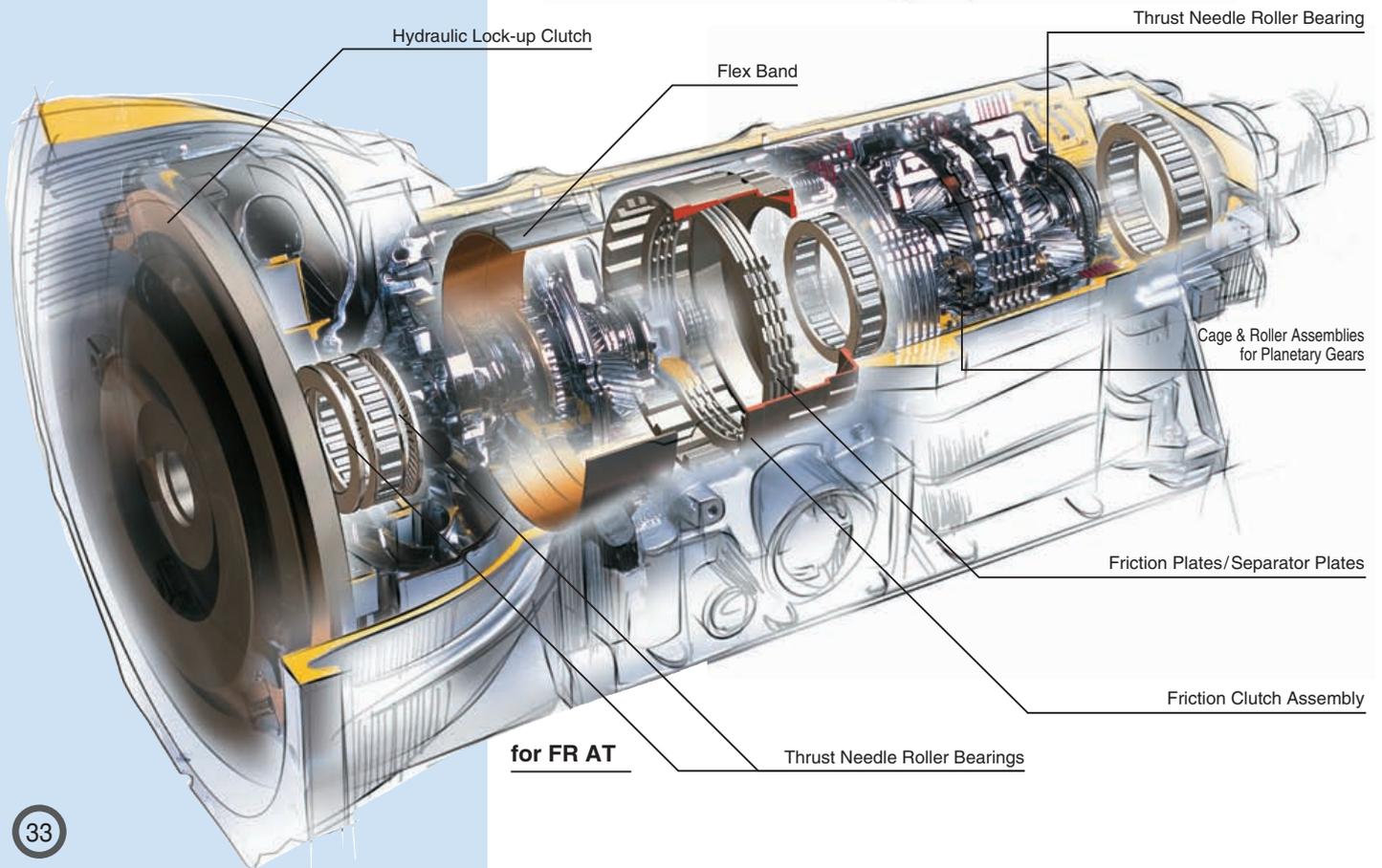
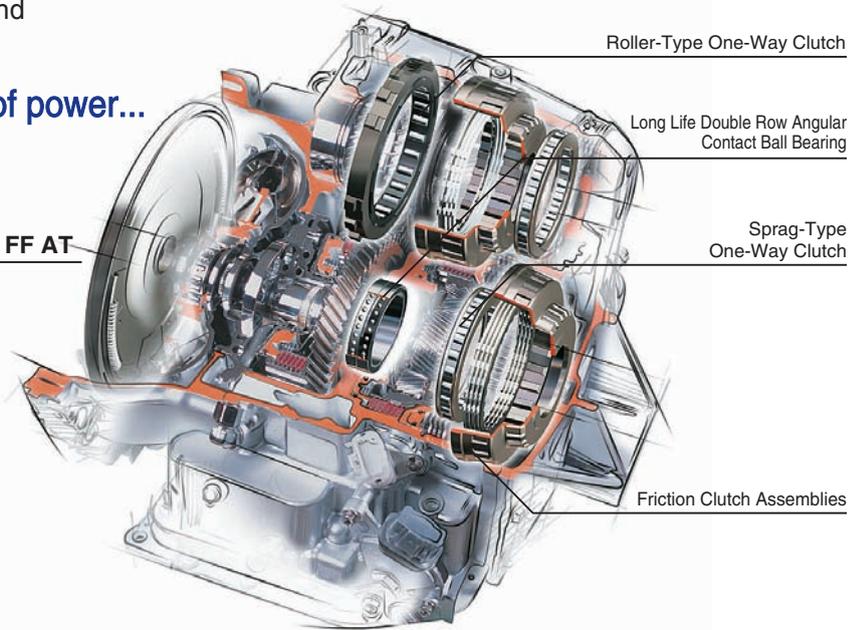
# Automatic Transmission

Automatic transmissions ensure smooth gear changes with minimal shift shock while operating under various kinds of driving conditions. A complex and extremely intricate form of technology known as friction control is ideal for efficiently conveying power from the engine and for smooth gear shifting. Friction-related parts and one-way clutches, which have been developed based on our advanced tribology technology, are the most important products in determining the performance of automatic transmissions. They contribute to a smooth and powerful driving experience.

For smooth driving with minimal loss of power...



for FF AT



for FR AT

Thrust Needle Roller Bearings



**Friction Plates / Separator Plates**

Unique friction materials produce an excellent and smooth shift quality.



**Sprag-Type One-Way Clutches**

Lightweight, compact, and reliable shifting can be achieved.



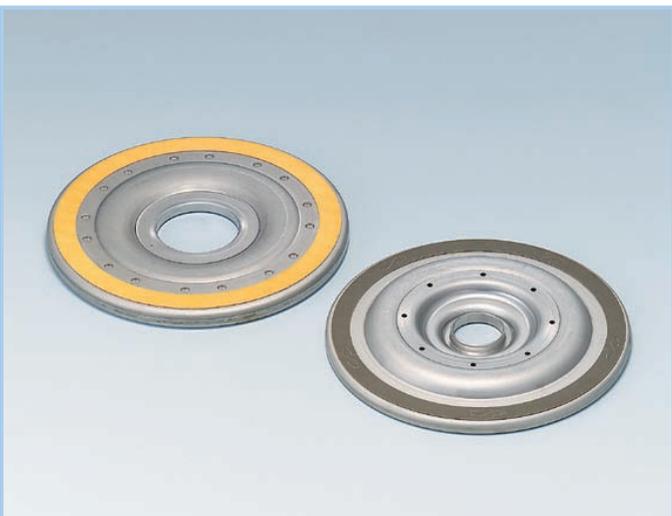
**Flex Bands / Maji Bands**

The compact design for high torque capacity is established.



**Friction Clutch Assemblies**

An optimal design to maximize functionality of the clutch.



**Hydraulic Lock-up Clutches**

A traction control system is achieved with high anti-shudder performance.



**Roller-Type One-Way Clutches**

The action of roller and spring reduce drag torque remarkably.

# Automatic Transmission



## Thrust Needle Roller Bearings for Power Train

Selection of the raceway washer and retainer type can be according to operating conditions, such as load, rotation speed, and lubrication.



## Thrust Needle Roller Bearings for Torque Converter

A bearing and a raceway washer with anti-rotation function have been unified for easy assembly and high capacity.



## Cage & Roller Assemblies and Shaft for Planetary Gears

For coping with increasingly high-speed rotations and low-friction torque while maintaining durability.



## Drawn-Cup Needle Roller Bearings for Power Train

From sliding bearings to rolling bearings, low friction torque has been achieved by the technology of thin cross section drawn-cup bearings.



## Drawn-Cup Needle Roller Bearings for Shift Linkage

Smoother shifting is achieved by replacing sliding bearing with rolling bearing.



## Linear Bearings for Solenoid Valve

Special arrangement of balls achieves a reduction of rotational torque and sliding friction torque.



**Long Life Double Row Angular Contact Ball Bearings**

Reduced weight and costs have been achieved by using PA46 plastic cage with superior oil and heat resistance. Initial internal clearance is used to provide optimum preload.



**Long Life Double Row Tapered Roller Bearings**

Original materials and heat treatment have been developed for longer life. Initial internal clearance is used to provide optimum preload.



**Long Life Tapered Roller Bearings with Outer Mounting Flange**

The number of parts is reduced by unitization of the housing and outer ring, which also allows for easier assembly.



**Long Life Double Row Bearings with Outer Ring Splines**

The outer ring has a mounting flange and splines, which attach to the one-way clutch. This affords greater compactness of FF-type automatic transmissions.



**Cylindrical Roller Bearings with PA46 Plastic Cage**

Reduced weight and costs have been achieved by using PA46 plastic cage with superior oil and heat resistance.



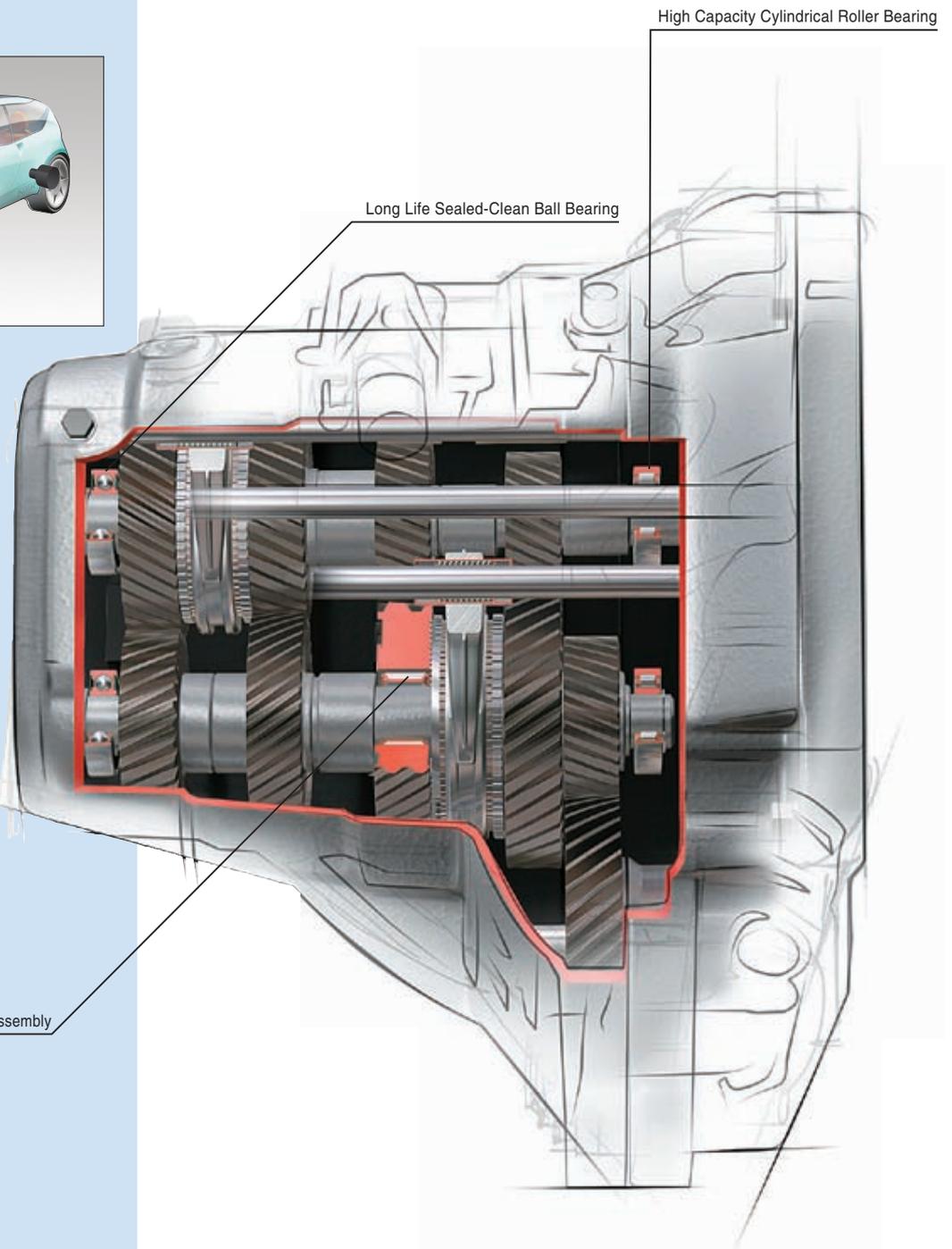
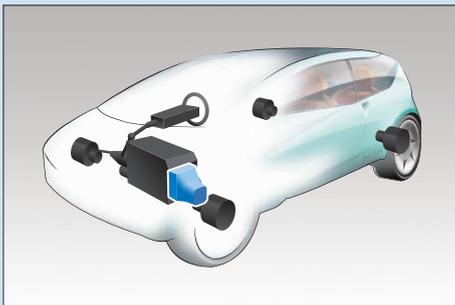
**Thin-Walled Tapered Roller Bearings**

Maximum capacity in a limited space (thin section) has been achieved by high-level design technology, which promotes greater compactness of FF-type automatic transmissions.

# Manual Transmission

Manual transmissions must adequately meet driver expectations of control by conveying a smooth, precise, and crisp feeling. Transmissions must also be compact, lightweight, and be able to deliver excellent fuel efficiency for the increased number of gears that are appearing in newer vehicles. The bearings and synchronized parts created by NSK play a key role in supporting the future of manual transmissions with their unsurpassed reliability and capability developed with tribology technology.

Reflecting the driver's feel for "driving"...



Split Needle Roller & Plastic Cage Radial Assembly

Long Life Sealed-Clean Ball Bearing

High Capacity Cylindrical Roller Bearing



### Long Life Sealed-Clean Ball Bearings

Long life has been achieved by specially designed seals for transmissions. The seals prevent ingress of contaminants in the oil. Size reductions from standard open type bearings can be achieved.



### High Thrust Capacity Cylindrical Roller Bearings

High capacity cylindrical roller bearings for radial load, as well as axial load from gear meshing.



### Quick-Assembly Tapered(QAT) Roller Bearings

Superior roller stability after assembling the cup and the cone achieves quick and high precision preload setting. The set preload is maintained at higher levels for longer periods.



### Drawn-Cup Linear Ball Bearings

Smooth rotation and sliding have been achieved in a compact size.



### Needle Roller & Plastic Cage Radial Assemblies

Reduced weight and costs have been achieved by using plastic cage with superior oil and heat resistance.



### Split Needle Roller & Plastic Cage Radial Assemblies

Best for preventing fretting generated at the time of non-relative rotation between gear and shaft.



### Light weight and Low Costs TKZ Type Clutch Release Bearings

Self-centering clutch release bearing with reduced weight and costs has been achieved by reducing the number of parts combined with press technology.



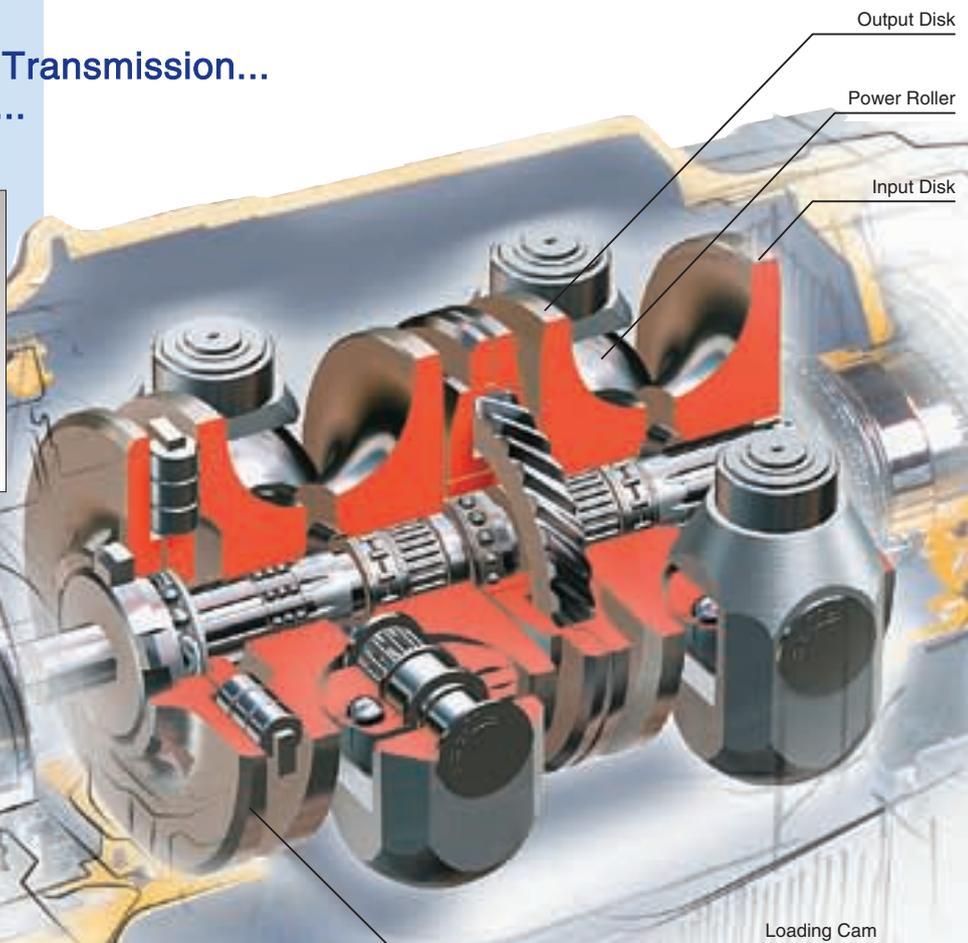
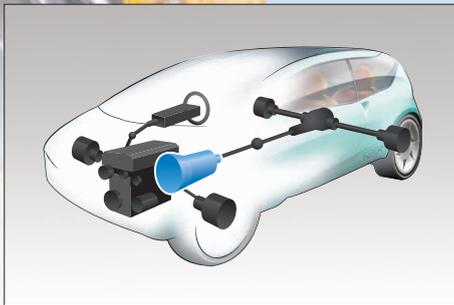
### Synchronizer Steel Cones

Reduced costs have been achieved by using original material that allows for press forming and through hardening. Superior friction characteristics from precision taper surface processing technology contribute to smoother shifting.

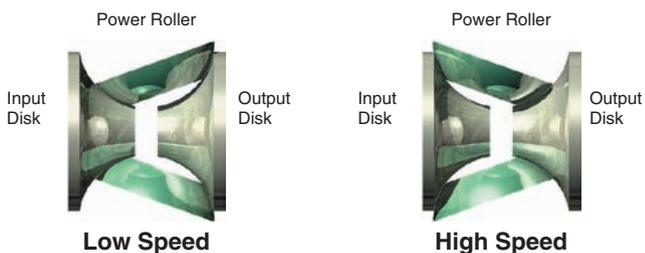
# Half Toroidal CVT POWERTOROS

The half-toroidal CVT is an innovative transmission that executes smooth, continuous gear ratio changes by changing the angle of the power rollers between the input disk and output disk. Toroidal CVT development began in 1877. One hundred years later, NSK undertook its development in 1978, spending as much as 21 years to develop a practical application. Featuring smooth, silent, and continuous gear ratio changes, as well contributing to conserving energy and further reduction of CO<sub>2</sub> emissions, the highly efficient half-toroidal CVT POWERTOROS Unit is the desired transmission that is a result of NSK's advanced technology in tribology.

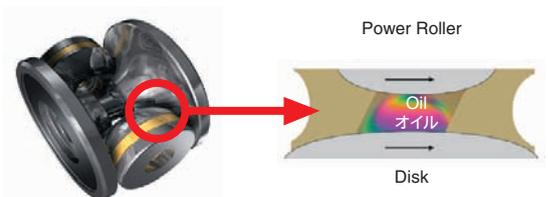
The Continuously Variable Transmission...  
quiet and energy efficient...



## Operation of the Half Toroidal CVT POWERTOROS Unit



Power is transmitted by this lubricating oil film, which is only 1/1,000mm thick.



# Unit

## Tribology in Half Toroidal CVT

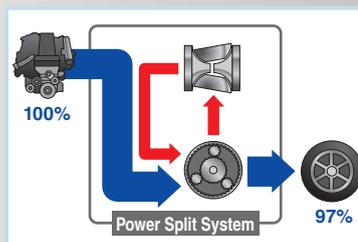
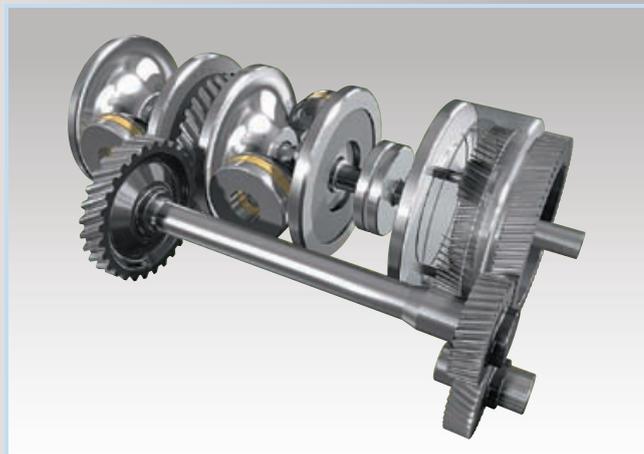
Power can be transmitted much more smoothly if the gear teeth that transmit power are made as small as possible. Although a half-toroidal CVT has no real gear teeth, power is transmitted by a mechanism called traction drive. In the half-toroidal CVT, which achieves a quiet and smooth transmission of great power, is a layer of oil that is pressurized under an extreme load to approximately 1/1000 mm thick at the point of contact between the disk and power roller. This special oil has a characteristic of forming into a glass-like substance under high pressure. Power is transmitted from the disk to the oil, and then to the power roller. In other words, since it is in rolling contact under high surface pressure, the durability of the contact surface becomes an issue. In order to solve this issue, NSK gathered all of its tribology technology to develop CVT steel, which is highly purified steel for CVTs where non-metal inclusions have been removed to the most possible extent. This material achieves constant rigidity by increasing the amount of austenite composition in the steel, which helps make foreign substances entering the gear virtually harmless.

We succeeded in developing a material that is highly reliable with long life while operating under the most severe conditions of massive loads, high temperatures, and high speeds.



## Power Split System

The next generation of the half-toroidal CVT is even more efficient thanks to NSK's power-split system. This system utilizes planetary gears combined with the half-toroidal CVT and a planetary gear device. This power circulatory speed-changing mechanism had been conceived in theory before, but had not actually been developed since the best non-level speed changer had not yet been developed. By changing two modes, a wide range of speeds and a very highly efficient form of power conveyance was achieved in our power-split system, which is the truly ideal speed changer.

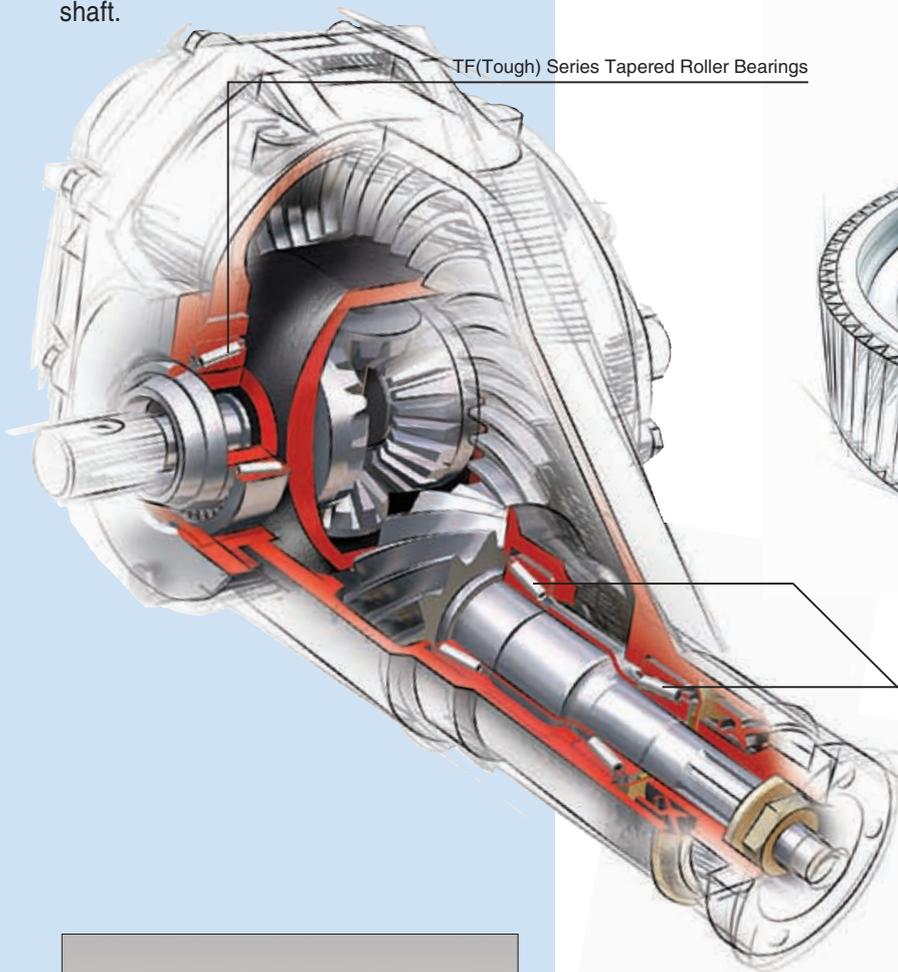


Incorporating a planetary gear allows most of the engine power to be transmitted directly to the wheel, bypassing the half-toroidal CVT.

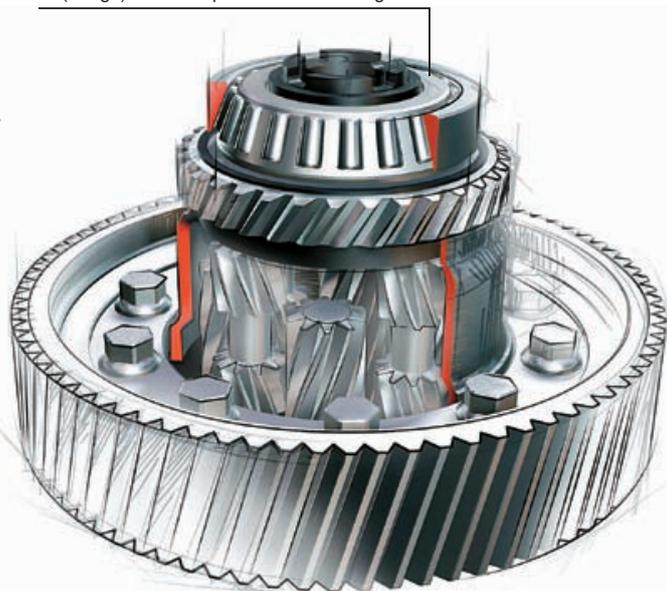
# Differential Gear & Propeller Shaft

In FR vehicles, the engine power is transmitted to the rear differential gear via the propeller shaft. The fact that the center bearing used to support the propeller shaft is located on the vehicle's exterior gives rise to a demand for optimum mud and turbid water resistance in addition to maintaining fast rotational speeds. Due to the large speed-reduction gear ratio of the rear differential gear that conveys engine power to the rear wheels, a large gear-interlocking load affects the bearings that provide support for the pinion gear and the ring gear. In particular, bearings that support the pinion gear require low torque and high durability since these bearings rotate at the same speed as the propeller shaft.

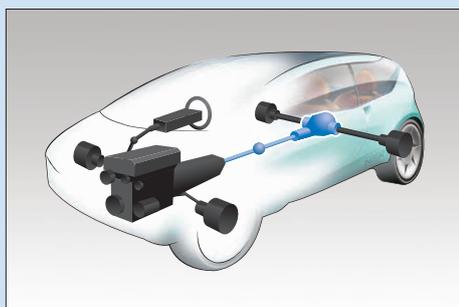
TF(Tough) Series Tapered Roller Bearings



TF(Tough) Series Tapered Roller Bearings

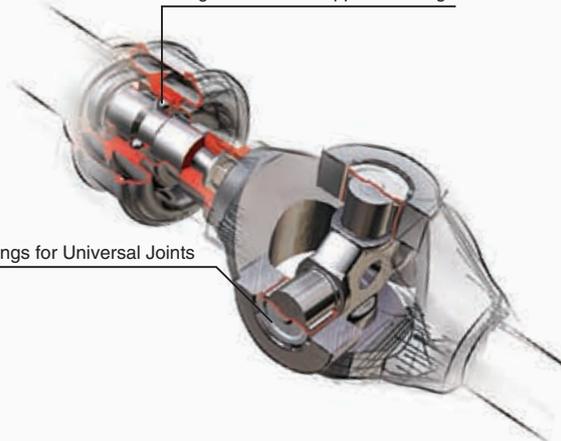


TF & Low Torque Tapered Roller Bearings



For smooth rotation under conditions of high-temperature and heavy load....

Long Life Center Support Bearings



Needle Roller Bearings for Universal Joints



**TF(Tough)Series Tapered Roller Bearings**

Long life in contaminated oil including metal wear powder has been achieved by original materials and heat treatment. Size reductions from standard open type bearings are available.



**Low Torque Tapered Roller Bearings**

Low friction torque has been achieved by logical friction analysis and improved parts surface processing technology.



**Long Life Cylindrical Roller Bearings for Pinion Shaft Pilot Support**

For a pinion shaft pilot in a straddle mount type differential of heavy trucks. The full roller design allows for heavy radial loads.



**Long Life Needle Roller Bearings for Universal Joints**

Low friction torque and improvement of seizure resistance between the spider and bearings have been achieved by using specially designed bearing cups.



**Long Life Center Support Bearings**

Center support bearings for propeller shaft with high sealing performance against mud, turbid water, and particles.



**Long Life Coupling Support Bearings for 4WD Vehicles.**

Thin walled and large diameter bearings for 4WD coupling. These bearings with large bore and minimized outer diameter have superior heat resistance, high load capacity, and sealing performance against mud and turbid water.

# Motorcycles & All-Terrain Vehicles

NSK's products are also used in a wide variety of vehicles ranging from motorcycles to all-terrain vehicles. The mechanical parts of motorcycles are exposed to rough running and high-rotation conditions, while all-terrain vehicles are utilized in a vast range of activities and environmental conditions. Bearings for these vehicles must be durable against water and dirt. To meet these requirements, NSK offers highly durable, well-sealed bearings. NSK has put a great deal of effort in to developing unitized products to enhance usability.





**Deep Groove Ball Bearings for Wheel**

The open type bearing and grease filled type bearings having high durability for wheels.



**Deep Groove Ball Bearings for Crankshaft**

Bearing with an anti-creep pin on the outer ring. Bearing with a strengthened cage to resist vibration and shock.



**Needle Roller Bearings for Balance Shaft**

High durability under hard operating conditions is shown by special coating on the surface of the cage.



**Deep Groove Ball Bearings and Needle Roller Bearings for Transmission**

Long life open type ball bearings in contaminated lubricant oil. Ball bearings with pressure resistant seals to cut the flow of oil.



**Angular Contact Ball Bearing and Tapered Roller Bearing for Steering**

Angular contact ball bearing for low friction applications and tapered roller bearings for high rigidity applications of high capacity motorcycles.



**Needle Roller Bearings for Swing Arm**

High strength design of the outer ring achieves high durability under heavy loads.



**Ball Screw for Hydro-static CVT**

High efficiency ball screw can help reduce motor size.



**Wheel Hub Bearings for All-Terrain Vehicles**

Unitized bearings for wheels with high performance seals for mud and turbid water.

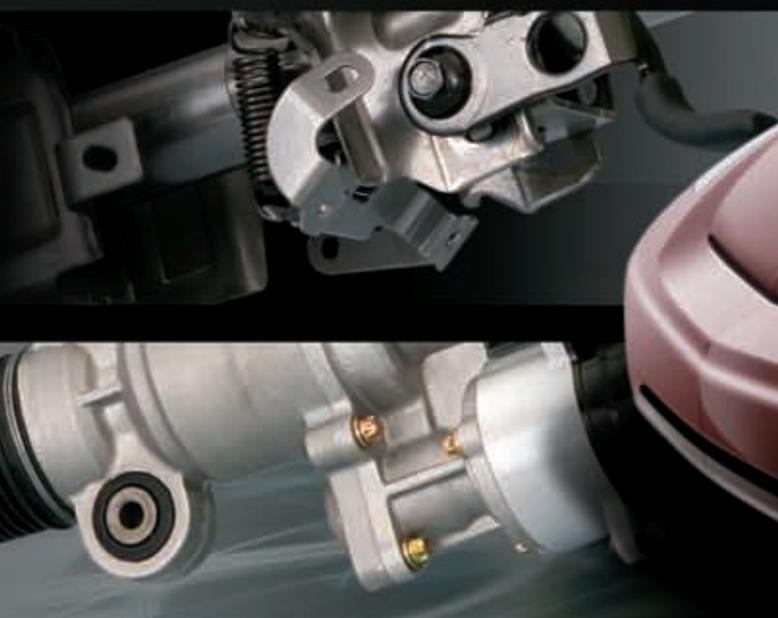
# The Latest NSK Technology & Next Generation Products

Far beyond its advances in compactness and fuel efficiency, automobile technology continues to evolve to meet the needs of the times, such as 42-volt batteries, by-wire technology, ITS, hybrid electric vehicles (HEV), and fuel cell electric vehicles (FCEV).

In order to respond adequately to the immediate and pressing technological needs of our customers, NSK has established a support system that unites the four economic zones of Japan, the Americas, Europe, and Asia. Moreover, in 2002, NSK established the new Fujisawa R&D Center to serve as a core location for developing technology that will play a pivotal role in the 21st century. With cutting-edge tribology technology as our foundation, NSK will continue to develop its products, including bearings, drive train-related products, and EPS to meet the needs of the changing times.

## Next Generation Steering Columns

The column guarantees stable operation and control for superior driving in any desired position while providing energy absorption properties.



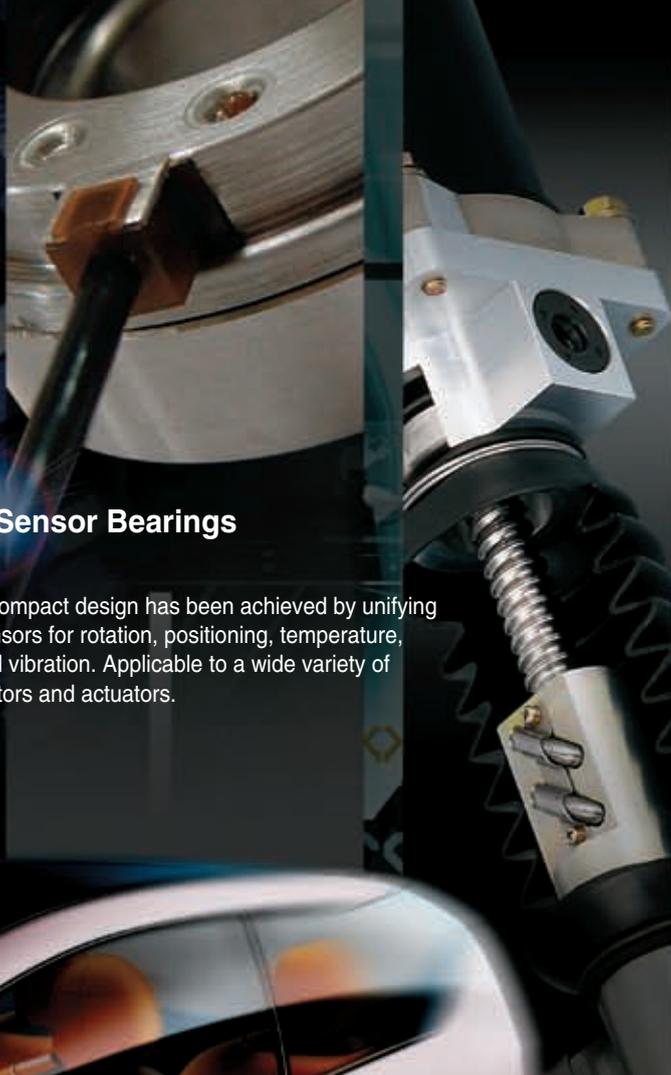
## Next Generation Electric Power Steering

Achieving high output levels with the adoption of a brushless motor.

## Snap Fit Hub Shaft (HUB 3.5)

Significantly reduced weight and improved mounting operations achieved by eliminating the nut and adding a snap ring that secures the hub unit bearing and drive shaft with a single operation. Maintenance also can be carried out at automobile repair shops easily.



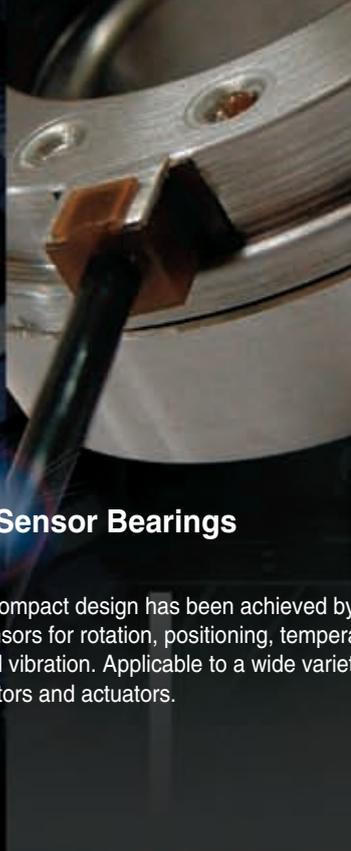


## Electric Linear Actuator

An electric linear actuator that harmoniously incorporates a highly effective ball screw with control technology. A critical product for the advancement of drive-by-wire technology.

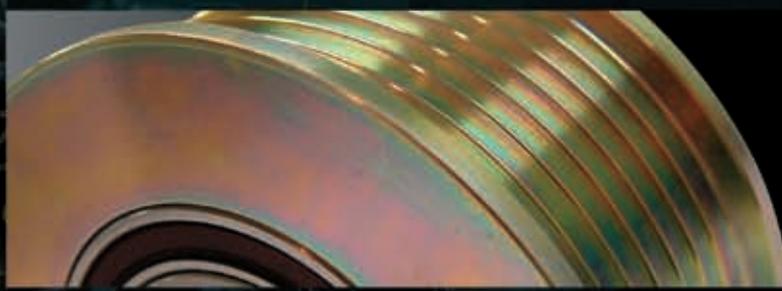
## Clutch Pulley Unit

A pulley unit brings together a one-way clutch, bearings, and a pulley, for diverse applications due to its reduced weight and size.



## Sensor Bearings

A compact design has been achieved by unifying sensors for rotation, positioning, temperature, and vibration. Applicable to a wide variety of motors and actuators.



## Sophisticated Clutch Unit

A sophisticated clutch unit that offers smooth, powerful acceleration and shifting for a more exciting driving experience.



## Needle Roller Bearings for Planetary Gears

Cage and rollers optimized for planetary gears featuring low torque, high durability, and lightweight properties. A pinion shaft is used to support the needle roller bearings.



## Drawn-Cup Needle Roller Bearings with Floating Seal for Automatic Transmission

Incorporates a floating seal between the outer mounting flange and the retainer, featuring dramatically extended bearing life.

## European NSK Sales Offices

### UK

NSK UK Ltd.  
Northern Road, Newark  
Nottinghamshire NG24 2JF  
Tel. +44 (0) 1636 605123  
Fax +44 (0) 1636 643276  
info-uk@nsk.com

### France

NSK France S.A.S.  
Quartier de l'Europe  
2, rue Georges Guynemer  
78283 Guyancourt Cedex  
Tel. +33 (0) 1 30573939  
Fax +33 (0) 1 30570001  
info-fr@nsk.com

### Germany

NSK Deutschland GmbH  
Harkortstraße 15  
40880 Ratingen  
Tel. +49 (0) 2102 4810  
Fax +49 (0) 2102 4812290  
info-de@nsk.com

### Italy

NSK Italia S.p.A.  
Via Garibaldi, 215  
20024 Garbagnate  
Milanese (MI)  
Tel. +39 02 995 191  
Fax +39 02 990 25 778  
info-it@nsk.com

### Norway

#### Nordic Sales Office

NSK Europe Norwegian Branch NUF  
Østre Kullerød 5  
N-3241 Sandefjord  
Tel. +47 33 293160  
Fax +47 33 429002  
info-n@nsk.com

### Poland & CEE

NSK Polska Sp. z o.o.  
Warsaw Branch  
Ul. Migdałowa 4/73  
02-796 Warszawa  
Tel. +48 22 645 15 25  
Fax +48 22 645 15 29  
info-pl@nsk.com

### South Africa

NSK South Africa (Pty) Ltd.  
27 Galaxy Avenue  
Linbro Business Park  
Sandton 2146  
Tel. +27 (011) 458 3600  
Fax +27 (011) 458 3608  
nsk-sa@nsk.com

### Spain

NSK Spain, S.A.  
C/ Tarragona, 161 Cuerpo Bajo  
2ª Planta, 08014 Barcelona  
Tel. +34 93 2892763  
Fax +34 93 4335776  
info-es@nsk.com

### Sweden

NSK Sweden Office  
Karolinen Företagscenter  
Växnäsgratan 10  
SE-65340 Karlstad  
Tel. +46 5410 3545  
Fax +46 5410 3544  
info-de@nsk.com

### Turkey

NSK Rulmanları Orta Doğu Tic. Ltd. Şti  
19 Mayıs Mah. Atatürk Cad.  
Ulya Engin İş Merkezi No: 68 Kat. 6  
P.K.: 34734 - Kozyatağı - İstanbul  
Tel. +90 216 3550398  
Fax +90 216 3550399  
turkey@nsk.com

Please also visit our website: [www.nskeurope.com](http://www.nskeurope.com)  
Global NSK: [www.nsk.com](http://www.nsk.com)

