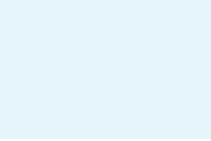
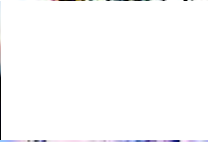
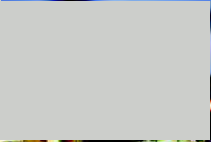
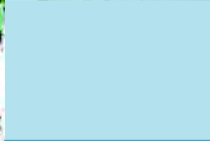
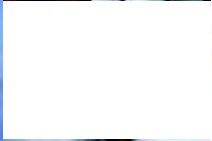


# ***Applications***



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**Panasonic**



**SANYO**



美的 **Midea**<sup>®</sup>

**SERVO**

**TOSHIBA**



**OTIS**

Welling<sup>®</sup> | 威靈電機

**SIEMENS**

**Haier**

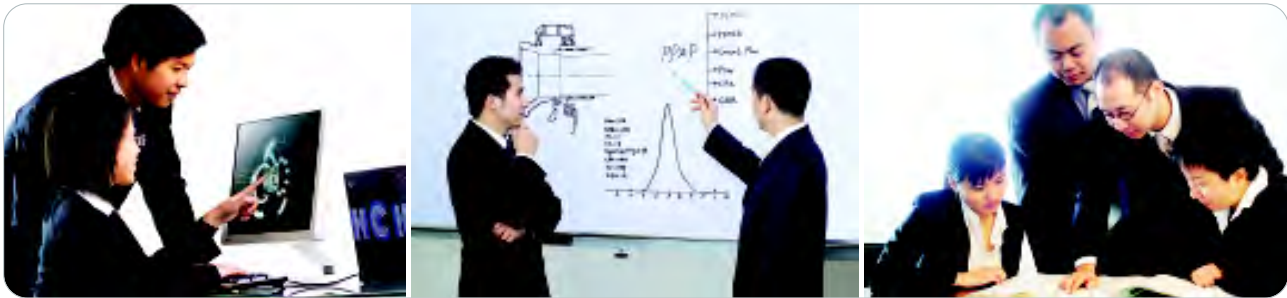


**A.O.SMITH**  
史密斯

**AUX**

**FOTILE 方太**

At HCH, we recognize that the key to customer satisfaction and success is delivering superior, cost-effective bearings and application solutions. Our commitment to continually combine and advance technology and engineering enables us to produce solutions that provide a competitive advantage for our customers. With HCH, you can rely on products and services that are designed to meet the specific demands of your application and specific conditions. We achieve this by applying the latest technology and our accumulated application knowledge and experience doing our part to add customer value and contribute to a more efficient, profitable process.



Lucas-TVS

HONDA



Pioneer



荣事达 Royalstar



Our customers are important to us and we work closely with them to ensure they get all the support they need to enable them to design new products and applications. Currently, more than 500 world leading manufacturers of household appliances, electric motors, pumps, gearboxes, electric power tools, automotive etc like Sanyo, Panasonic, Mitsubishi, Samsung, Hyundai, GE, Midea, AUX, Gree, Fotile has further established relationship with HCH.

At the mean time, with good reputation in continuous stable and quality bearings' supplying, HCH aftermarket sales volume also increased rapidly.



## 1. Household Appliances

Today, we are surrounded by the machines that make our life easier in a way that we can dedicate out free time to ourselves instead, for instance, of washing clothes or dishes manually. Home appliances make people enjoy life more.

Bearings for household electrical appliance motors are a very important market for HCH. Household electrical appliance motors mainly include air conditioner fan motors, range hood fan motors, washing machine motors, vacuum cleaner motors and ceiling fan motors. In line with appliance manufacturers' increasingly stringent requirements, motor manufacturers demand bearings of higher quality and better performance.

HCH understands your requirements of low noise, silent running, long life, high quality, less friction and more energy saving for household appliances. HCH bearings are at the very heart of all the answers. Worldwide availability of HCH products is supported by a comprehensive technical advisory service. In committing itself to excellence in products and performance, HCH puts at the service of household appliance industry its expertise acquired through years of research and commitment and we highly appreciate our customers in household appliances to share their requirements and improve together with HCH.



All over the world, manufacturers of household appliances rely on the products and services of HCH. We have the wide product range in this field. Our experienced application engineers optimize the standard bearing solutions by choosing the bearing dimensions, clearances, lubrication and sealing best suited to the different requirements.





## General requirements for household appliances

### Reduce noise & vibration

Household appliances are usually working in indoor places. Excessive vibration and noise levels associated with household appliances are strongly required to be eliminated. Excessive vibration can cause premature equipment failure. High vibration levels also increase energy consumption. High noise levels, in turn, result in a poorer life environment for personnel and family. HCH offers a range of solutions for exceptionally smooth and quiet bearing operation.



### Energy saving

The cost for energy rises day by day. Reduced energy consumption is of ever increasing importance. Energy consumption can be reduced in several ways. However, the most important for bearings is to reduce the friction inside, by choosing low-friction grease, optimized seals and shields design.

### Environment concerning

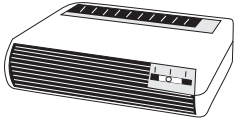
When environmental legislation becomes more stringent, environment protection also comes important of ever, especially in household appliance, which is the closest part to personnel. Even the bearing is an inner part of a household appliance, HCH bearings all pass RoHS to make sure that no single piece is with harm.



### Less weight

In many applications of household appliances, especially when we talk about a portable tool, the reduction of weight is extremely important. As a result of the engineering knowledge application on new materials, advanced calculation tools and integrated solutions, it is now possible to increase the power density. This improvement has a strong impact on weight and size reduction with the highest level of reliability.

## 1.1 Air Conditioners



With fast social development level, consumption level and ideology, air-conditioning equipment is more and more spreading all over the world. For Japan, USA and China, the families that have air conditioners have reached more than 70%. Even in the warm country, Australia, 45% families are currently using air conditioners in their houses.

For the air conditioners, the conditioning process is helped by two fans (one for the cold and the other for the hot circuit) that improve the efficiency of the system. Since the air conditioners are usually placed in bedrooms or sitting rooms, a low noise level is essential.

There are numerous fan motor manufacturers in China and many are affiliated with Chinese, Japanese, American and European air conditioner manufacturers. An estimated 20 to 30 million fan motors are produced per year in China for air conditioners. Worldwide air conditioner fan motor consumption is approximately 50 million per year and 50 percent of these motors are produced in China. HCH are at the leading position in this area. Top 10 brand air conditioners are with HCH bearings inside their fan motors.

### Window and portable air conditioners

Window and portable air conditioners require silent running characteristics. Comparatively, these air conditioners are usually small and easy for carrying. They are less energy consumption and are applied in small rooms. The conditioning process is helped by two fans (one for cold and the other for hot circuit) that improve the efficiency of the system. Blower motors are usually single-phase induction motors (permanent split capacitor or shaded pole).

### Split-system air conditioners

They are used for flat and house conditioning. The hot circuit (condensing unit) is separated from the cold circuit, which is usually placed in an air handler inside the house. The air handler system is commonly placed in the basement or a dedicated room. The low noise requirement here is less demanding. The condensing unit is placed outside the building. For this reason the unit and all the components must be weather resistant.



### HCH bearings for air conditioners

608, 6200, 6201, 6202 bearings with inside diameters ranging from 8mm to 15mm are the main bearings used in air conditioner fan motors. Blower motors are usually single-phase induction motors (permanent split capacitor or shaded pole). HCH can offer deep groove ball bearings with high running accuracy and special bore tolerances if required by the design. Lubrication using special greases gives good performance for noise and vibration dampening needs.

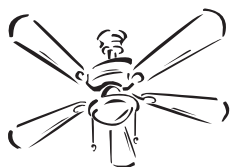
The internal radial clearance is specially chosen to meet the silent running requirements. Bearings are usually supplied fitted with metal shields but for special applications can be zinc coated. If required, glass fiber reinforced polyamide cages can be offered as well.



The quiet running is critical. Serving this industry for long time, HCH has accumulated abundant of knowledge. Moreover, HCH EMQ quality bearings for air conditioners again significantly reducing noise and internal friction compared to the previous standard product. Now these bearings are widely applied as bearing standard of air conditioner in the world leading air conditioner manufacturers.



## 1.2 Fans & Blowers



Bearings in fans and blowers often operate at high speed and relatively light radial loads. They may also operate in inaccessible surroundings. This will reduce uptime and the service life of the fan. From long and genuine experience, HCH has developed a range of excellent solutions for industrial fans and blowers. These solutions improve cost-efficiency and provide trouble-free operation.

For fan and blower industry, compare to air-conditioner and other household appliances, the noise demand is less and rotation speed is usually not exceeding 2000 rpm. But since it is also used indoors, HCH still suggests low noise and vibration bearings should be applied.

### Ceiling fans:

These are used to move air around rooms. This action helps to improve bodily evaporation giving a cooling sensation. Vibration levels need to be kept as low as possible. Maintenance free is also important to cut the cost of repairing.



### Other fans:

Applications here include drive blowers, bathroom ventilators, attic ventilators and fan coils. The requirements for these fans are less restrictive. However, low noise capability and good resistance to environmental conditions (humidity) is important.



The bearings need to conform to the specific technical requirements of high cooling efficiency and long service life.



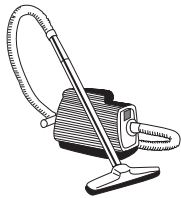
### HCH bearings for fans

For ceiling fans, two deep groove ball bearings are often used. They are usually metal-shielded. In order to maintain vibration levels within acceptable limits, the internal radial clearance is optimized to suit operating conditions. Bearings are lubricated for life with grease having properties including noise dampening qualities, good humidity and corrosion resistance together with high service life at medium temperature. The grease fill is dependent upon the application needs.

Since many fan producers inject the grease between the rotators and bearings, open type deep groove ball bearings are also common now. In such application, for the sealed bearings with grease, special attention should be paid to the compatibility between bearing grease and fan grease.

For other domestic fans, HCH can provide metal-shielded deep groove ball bearings, which are grease lubricated for life and meet the needs of low noise and resistance to adverse environmental conditions. For further information please contact your HCH Application Specialist.

## 1.3 Vacuum Cleaners



Vacuum cleaner manufacturers are driven by consumer needs for increased efficiency, more compact and value for money devices. To meet this challenge, producers have looked at ways to:

- > Improve suction through increased motor power.
- > Introduce higher speed motors (above 50 000 rpm).
- > Improve air circulation giving increased ventilation efficiency and more compact machines.
- > Reduce noise levels.
- > Review ways to reduce power consumption.

The effect of the higher power requirement has been an increase in temperature (above 110 °C). Friction torque therefore needs to be as low as possible.

### Wet vacuum cleaner

Since these kinds of vacuum cleaners are working in humid environment, special attention should be paid to ensure the safety from electric attack. Bearings are usually fitted with heavy contact rubber seals incorporating a steel insert. Cages can be made of glass fiber reinforced plastic. Lubrication is often special grease designed for good performance at high speed and temperature together with good resistance to contamination and condensation.

### Dry vacuum cleaner

For dry vacuum cleaners, single row deep groove ball bearings with metal shields are particularly versatile. The shields of bearings are designed with a special labyrinth to improve sealing capability. Lubrication consists of grease, which can meet the stringent requirements of high speed and high temperature conditions. Nylon cages are also available for HCH bearings.



### HCH bearings for vacuum cleaner

Vacuum cleaner motors are commonly used to drive the fan, which produces the air suction. It is supported by two small single row deep groove ball bearings normally with metal shields. They should be suitable for high speed and are robust in operation, requiring little maintenance. Deep raceway grooves and the close conformity between the raceway grooves and the balls enable deep groove ball bearings to

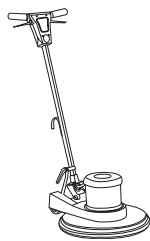
accommodate axial loads in both directions, in addition to radial loads, even at high speeds.

For very high speed, a special design is needed. The internal radial clearance will depend on the design requirements for speed and running temperature. Please contact HCH Application Specialists for further information. HCH will be pleased to find the best solution for your design.



HCH has wide experience in this area. Moreover, HCH offers extra benefits to the manufacturers of vacuum cleaner manufacturers. In close cooperation with our customers' development engineers, we design bearing concepts for new generations of vacuum cleaner motors with the focus on technical and economical optimization.

## 1.4 Floor Polisher



The development of compact motors and cleaning tools has increased the use of floor polishers both in industry and in the household. The cleaning part of these appliances consists of two or three brushes or pads for functions including:

- > Polishing/buffing hardwood floors and other materials.
- > Removing stains from carpets.
- > Stripping floors and applying wax.

The brush and pad rotation is achieved by universal motors. These motors can be placed either in the machining or brush cases. Motor power varies between 0.5-1.5 kW giving a rotor speed of approximately 1000 rpm.



### HCH bearings for rotor movement

The rotor of the universal motor is supported by two single row deep groove ball bearings. To ensure good protection against ingress of dust and other particles whilst cleaning, the bearings need to be fitted with contact rubber seals. The internal radial clearance is optimized to meet the machine design and to achieve a good compromise between noise and temperature rise. The bearings are charged with the optimum quantity of the appropriate grease to ensure good lubrication for the machine's service life.

Improved service life can be achieved for HCH bearings due to:

Improved service life can be achieved for HCH bearings due to:

- > Extended grease life
- > Good performance in air-streams and condensation
- > High wear resistance against particulate contamination (sand, pigments, abrasives, steel, iron oxides etc.)
- > Resistance to electric current

### ● The radial clearances of bearings with electric motor quality

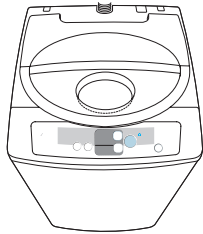
Tolerance in  $\mu\text{m}$ .

| Bore |        |           |        | CM            |               |
|------|--------|-----------|--------|---------------|---------------|
| Over |        | Including |        | Min.          | Max.          |
| mm   | Inch   | mm        | Inch   | $\mu\text{m}$ | $\mu\text{m}$ |
| 10   | 0.3937 | 18        | 0.7087 | 4             | 11            |
| 18   | 0.7087 | 24        | 0.9449 | 5             | 12            |
| 24   | 0.9449 | 30        | 1.1811 | 5             | 12            |
| 30   | 1.1811 | 40        | 1.5748 | 9             | 17            |
| 40   | 1.5748 | 50        | 1.9685 | 9             | 17            |
| 50   | 1.9685 | 65        | 2.5591 | 12            | 22            |



In today's floor polisher industry, demands for lightweight, compactness, cost efficiency and high performance components have steadily increased under the background of environmental problems and competition among manufacturers both in cost and performance. HCH's advanced technology and high capacity motor bearings production can satisfy these demands better.

## 1.5 Washing Machines



Technological advances and recent environmental demands have led manufacturers to focus their efforts on improving washing and rinsing efficiency whilst lowering power and water consumption. Labels are placed on each appliance to aid consumers in their purchasing decisions. These regulations take into account energy efficiency, noise level, service life and rust free. In addition to the normal features we look for in a washer, there are now new developments:

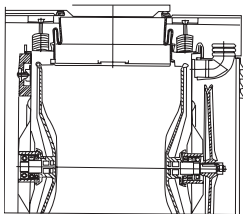
- >Increasing speeds in the spin cycle (1600 rpm and over) to improve water removal
- >Systems that can electronically control drum speed, position and rotation sense
- >Reduction in machine size and silent running that gives flexibility in room installation placement
- >Electronic power managing systems that regulate water consumption according to laundry load

### Horizontal axis - front loading washing machines

The drum is overhung in respect to the two support single row deep groove ball bearings. The out of balance load is predominantly taken by the bearing closest to the drum. Therefore,, this bearing tends to be larger than that on the pulley side.



### Horizontal axis - top loading washing machines



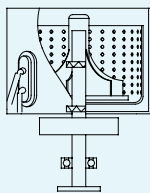
The drum is supported at both sides usually with deep groove ball bearings. The out of balance load is centered between the two support bearings, so the maximum speed of the drum is not as critical as it is for the front-loading design. This means that for the same load size and speed, the bearings used in the top loading design are usually smaller than those used in front loading applications.



### Vertical axis - top loading washing machines

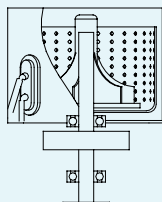
Contrary to horizontal axis washing machines, in vertical axis washing machines, the nature of the load is predominantly axial and the drum is stationary during the washing cycle (only the agitator is in motion) and rotates during the spinning operations.

Arrangement for the vertical axis washing machine



Solution with one deep groove ball bearing

Arrangement for the vertical axis washing machine



Solution with two deep groove ball bearings

Generation mechanism of the HCH bearing material and performance were studied by leading washing machine manufacturers through qualitatively, combining experimental and FEM analysis result. HCH bearings have been fully accepted. Now HCH has been successfully supplying large quantity of deep groove ball bearings to world renowned washing machine manufacturers in Japan, Korea and Europe.



### HCH deep groove ball bearings for washing machines

The ball bearings commonly used have metal shields and an internal radial clearance dependent on the press-fit required and material of the housing. For high-speed washers (over 1 000 rpm), HCH offers special greases with extreme pressure additives to withstand the higher unbalanced loads and vibrations. Following are the reasons that why so many world famous washing machine manufacturers choose HCH deep groove ball bearings:

- > Noise dampening capabilities
- > Long life at medium temperatures
- > Good resistance to corrosion and humidity

### HCH bearings for vertical axis - top loading washing machines

The ball bearings commonly used have heavy contact seals to prevent the ingress of contaminants from the outside environment. Higher than normal internal radial clearances are suggested in order to compensate for the tight press-fit of the bearing outer ring inside the housing. The application commonly calls for greases with high temperature capability.



## 1.6 Tumble Dryers

Except for the huge demand of washing machines, tumble dryers are considered critical in the washing system especially in Europe and USA. With the increased attention to environmental pollution, improved efficiency and low public noise of tumble dryers has developed. Requirements of silent running and high efficiency with an expectation of long service life are strongly demanded by the manufacturers. In the tumble dryers, a small electric motor drives a drum while a ventilating fan provides the hot air through the clothes.



HCH has developed a high-load, long-life ball bearings to satisfy the needs of compactness and low cost. With optimized sealing function, grease selection, and material heat treatment, this bearing has the same boundary dimensions as those of a corresponding standard deep groove ball bearing, but with longer life and higher rigidity than the standard ones.



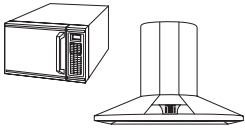
### HCH bearings for drums in dryers

The deep groove ball bearings for this application are commonly supplied with metal shields. The working conditions will determine whether standard or special internal radial clearance is needed. Lubrication is often a high temperature grease with good oxidation stability combined with good corrosion resistance in wet conditions.

### HCH bearings for electric motors in dryers

Two deep groove ball bearings are mounted to support the motor shaft. Typically the bearings have metal shields. The internal radial clearance is normally standard except where special technical needs arise. The choice of lubricant depends on the application requirements for noise and temperature.

## 1.7 Kitchen Appliances



As one of the most demanding appliances for both clean and contaminated environments, HCH has the solutions to meet the needs of the kitchen appliances. From dishwashers, cooker hoods, electric ovens, to food processors and sliding doors - we have the products to meet the variety of applications found in your industry.

### Dishwashers



The layout and number of spray arms is designed to ensure that every dish comes out sparkly clean. Typically, dishwashers are placed in the kitchen. Therefore noise and vibration requirements are stringent. This is reflected in the newer machines, which have an improved noise level (in many cases below 45 dB).

### Cooker hoods



In every cooker hood, there is an electric motor that has to rotate at high speed and low noise. A fractional single-phase induction motor usually drives the blower. The motor is supported by two single row deep groove ball bearings with special vibration characteristics. They are metal-shielded with optimized internal radial clearance.

### Electric oven



Components for this application usually need to meet the requirements of high temperature and low speed. HCH deep groove ball bearings can be used. Internal radial clearance is larger than normal to accommodate the high temperatures involved. Cages are usually metallic, which are more suitable for very high temperatures.

### Food processors



The main requirements for the bearings used in mixer knives are for food compatibility and resistance to pollution from food processing. HCH also specially designed the internal radial clearance to meet the application needs. HCH environment policy for its bearings further confirm your equipment will leave unnecessary trouble from environment harasses.

### Sliding doors

Where the space is limited or the owner wants to create a specific effect and a traditional door does not fit then sliding door is used. A sliding door is usually supported by a couple or more (depends on the load) trolleys mounted in a built-in frame. The requirements of a sliding door are low friction, reduced free play and low noise in operation.



A House and especially a kitchen is full of appliances. Think about all the electrical motors, sliding system that are around us, in each of them the HCH knowledge can be applied to make the life easier and better.





### HCH bearings for kitchen appliances

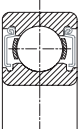
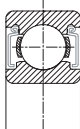
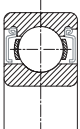
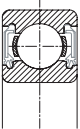
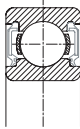
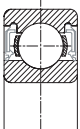
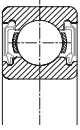
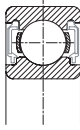
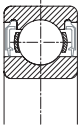
The requirements for the bearings are similar to those found in other appliances:

- > Low noise and vibration levels
- > Medium and high temperature environment
- > Long service life
- > Maintenance-free components

However, due to various specific applications in kitchen appliances, more requirements are raised. HCH can offer stainless steel shields or rubber seals for deep groove ball bearings of this application. Following lists common type sealing structures applied in HCH:



Thanks to the high quality standard in manufacturing, which also includes 100% noise and vibration testing, HCH bearings already meet most of the noise requirements placed by electric motor applications for kitchen appliances.

|  |  |  |
|--|--|--|
| <p><b>"V" sealing groove (inner ring)</b></p>  <p>Metal shields (ZZ)<br/>Non-contact<br/>High temperature<br/>Very high speed<br/>For small and medium size bearings</p>         | <p><b>"L" sealing groove (inner ring)</b></p>  <p>Metal shields (ZZ)<br/>Non-contact<br/>High temperature<br/>Very high speed<br/>For miniature size bearings</p>      | <p><b>No sealing groove (inner ring)</b></p>  <p>Metal shields (ZZ)<br/>Non-contact<br/>High temperature<br/>Vert high speed<br/>Applicable due to assembly requirement</p>    |
| <p><b>"V" sealing groove (inner ring)</b></p>  <p>Rubber seals (2RS)<br/>Multi-lips contact<br/>Excellent dust and water proofing<br/>For small and medium size bearings</p>    | <p><b>"L" sealing groove (inner ring)</b></p>  <p>Rubber seals (2RS)<br/>Multi-lips contact<br/>Excellent dust and water proofing<br/>For miniature size bearings</p> | <p><b>No sealing groove (inner ring)</b></p>  <p>Rubber seals (2RS)<br/>Tight contact<br/>Good dust and water proofing<br/>Applicable due to assembly requirement</p>         |
| <p><b>"V" sealing groove (inner ring)</b></p>  <p>Rubber seals (2RZ)<br/>Non-contact<br/>Very high speed<br/>Good dust proofing<br/>For small and medium size ball bearings</p> | <p><b>"L" sealing groove (inner ring)</b></p>  <p>Rubber seals (2RZ)<br/>Non-contact<br/>Very high speed<br/>Good dust proofing<br/>For miniature size bearings</p>   | <p><b>No sealing groove (inner ring)</b></p>  <p>Rubber seals (2RZ)<br/>Non-contact<br/>Very high speed<br/>Good dust proofing<br/>Applicable due to assembly requirement</p> |

- Note:**
- 1) This chart lists double shielded and double sealed bearings, but single shielded (Z) and single sealed (RZ, RS, RW) are also available.
  - 2) The above sealing structures are only for reference. We reserve the right to change specifications and other information included in this catalogue without notice.
  - 3) HCH also could provide bearings with other sealing designs including customized sealing design. Please consult HCH engineers for more information.



## 2. Office Equipments

Because of the expanded use of personal computers, internet and other digital equipments, multi-function copy machines and printers are now used around the world as image outputting equipment. Such office equipment has many different bearings built into them to meet various needs.

Office equipments must be designed to meet strict precision standards, and those standards must be easy to maintain. Further, the equipment needs to be reliable, with a focus on ergonomics for the operators and comfort for the office staff. HCH has been involved in the design of various office equipment applications and can draw on its knowledge of this specialized field. As the need for quiet-operating products is great in office applications, HCH has developed a range of low noise bearings that enhance operators' comfort.

In order to meet the needs for more compact and lighter office equipments, we supply the Series 67 thin-type ball bearings that have smaller bearing cross section dimensions than the Series 68 deep-groove ball bearings. In addition, design can be optimized for sealed bearings and models with snap rings.



Higher capacity and down-sizing are technical trends of office equipments. Moreover, cleanliness and particle-emission performance of bearings become very important. HCH will be your reliable partner to solve all these difficulties.



## General requirements for office equipments

### High productivity

High productivity is one of the constant pressures within the office equipment industry. To increase profitability there is a trend to further increase the speed of the machines in order to get even higher outputs. This must be done while keeping a consistent high quality. HCH provides a wide range of solutions to meet customers' demands for improved productivity. Also, HCH's highly skilled application engineers could help to meet specific targets.



### Increase service life

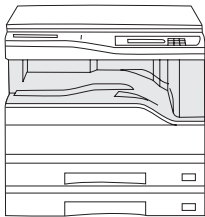
Office equipments long-term performance and maintenance free are important and critical since the repair is costly and not convenient. Consequently, long bearing life is a key requirement. Low operating temperature, high quality raw material, adequate lubrication and avoiding contamination are important factors in extending bearing service life. As the world's leading manufacturer of bearing solutions, HCH has a wide range of solutions and services to extend bearing service life and improve application profitability.



### Environment concerning

Creation and maintenance of the best environmental conservation structure is one of the important social responsibilities for HCH. We not only comply with the requirements set forth in applicable governmental laws and regulations but also with customers' requirements and internal standards, as HCH deems necessary. For office equipments, environment protection, to a great extent, means reducing energy consumption. However, the most important for bearings is to reduce the friction inside by choosing low-friction grease, optimized seals and shields design. With HCH systematic quality control, we offer you with the best application solutions for your office equipment energy saving purpose.

## 2.1 Copy Machines & Printers



Copy machine manufacturers are driven by consumer needs for increased efficiency, multifunction and value for money devices. To meet this challenge, producers have looked at ways to:

- > Reduce noise levels
- > Environmental
- > Maintenance free
- > Cost reduction

In order to concentrate many different functions in a small space, HCH has been providing products that save space and are easy to maintain. These are made possible by the relation of key technology that helps us to realize highly reliable products.



### HCH bearings for copy machines

Deep groove ball bearings, which are designed to meet strict precision standards, are mounted to support the copy machine shafts. Typically the bearings have metal shields. The precision of a ball bearing is determined by several factors, including the raceway roundness of the inner and outer rings, the sphericity of the balls, the tolerance of the balls and the quality of the raw materials used in each of the bearing's parts.

Improving precision demands uncompromising strictness on all counts. Building on expertise amassed over 30 years, HCH has developed high-precision technologies and efficient plant-line layouts, enabling it to produce all parts for its bearings in-house and to aim constantly for higher levels of precision.

Series 67 are designed to be thinner than those of Series 68. Both open and non-contact sealed models are available. Furthermore, shield models (ZZ) are compatible with bores of 10, 12, 15, and 17. The dimensional accuracy and rotating accuracy meet JIS class 0 standards. Open models have seal grooves on their outer rings (except for the 6700). The inner rings do not have seal grooves.

### ● Data of the mini-deep groove ball bearing under no load

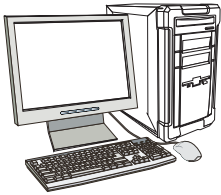
Tolerance in  $\mu\text{m}$ .

| Clearance Code | MC1 |     | MC2 |     | MC3 |     |
|----------------|-----|-----|-----|-----|-----|-----|
|                | min | max | min | max | min | max |
| Clearance      | 0   | 5   | 3   | 8   | 5   | 10  |
| Clearance Code | MC4 |     | MC5 |     | MC6 |     |
|                | min | max | min | max | min | max |
| Clearance      | 8   | 13  | 14  | 21  | 21  | 29  |



HCH deep groove ball bearings provide rotary motion of the copy machines and multi-function printers. The HCH deep groove ball bearings are highly heat resistant and have a long rating life. We offer you thin-wall bearings to meet your requirement for more compact design.

## 2.2 Computers



The ongoing popularization of computers is truly amazing. One computer per person is now the norm in offices and the development of the internet has accelerated the spread of computers into households. For many years, HCH has been producing rolling bearings for that most vital of tools for the modern world. With the unremitting growth in personal computers, minimizing the size of hard disks and cooling fans while maximizing their capacity has been and will

continue to be a primary focus.

### HCH bearings for computer hard disk drives

Rather than their usual role as transferring force, the function of ball bearings in computers is supporting the accurate transfer of information. For this purpose, primary importance is placed not on load-carrying capability, but on accurate rotation without irregular motion throughout the entire service life of the bearings. The unique requirements of this function have necessitated specialized bearing designs, greases, seals and cages.

### Requirements of HDDs, spindle motors and the bearings they contain

| HDD                   | HDD spindle motor     | Rolling bearing             |
|-----------------------|-----------------------|-----------------------------|
| Small size            | Thin motors           | Small width                 |
| High density,         | Low NRRO,             | Low NRRO,                   |
| High capability       | High speed            | High speed                  |
| High reliability      | Long life             | High quality clean material |
| Low noise             | Low noise             | Low noise                   |
| Low power consumption | Low power consumption | Low torque                  |
| Low cost              | Low cost              | Low cost                    |



The design, manufacturing and quality assurance HCH incorporates throughout production minimize electric motor noise and years of trouble-free operation. HCH is committed to bringing advanced engineering support and products to the computer industry.

### HCH bearings for computer fans

The bearings used in computer fans are usually with metal shields because they provide sufficient sealing at low cost. However, when high speed is demanded, the tightness between the metal shield and groove in the outer ring is not sufficient to prevent grease leakage. This reason has led to use of rubber seals, whose greater flexibility and resilience ensure adequate sealing and minimization of grease leakage.

In addition to their excellent sealing performance, rubber seals can contribute to limiting particle emission problems if they are made of an appropriate type of rubber.







## 3. Electric Motors & Generators

In the electrical motor service industry, top quality and problem solving ability are crucial to maintain profitability and customer loyalty. When bearings do not solve the customer's reliability problems, it will erode customer loyalty easily.

The preferred brand for virtually all leading electric motor manufacturers, HCH is widely recognized as the leader of bearing suppliers in the electric motor industry. By working with HCH, you gain access to the resources of a proven leader that has earned OEM quality awards from many quality-conscious corporations.

Our product range offers extra benefits to the manufacturers of electric motors and electrical appliances:

- > High reliability and long life through proven product design, excellent material quality and production technology
- > Reduced energy consumption due to special bearing solutions and light-weight design
- > High power density due to space-saving solutions
- > Safety in bearing selection through the proven knowledge of our application experts
- > Customized solutions developed in close cooperation with the customer using the latest technologies and continuous further development



In recent years, the demand for electric motors has grown. At the mean time, requirements for improving quietness, durability and efficiency in these motors have become increasingly stringent. You can rely on HCH to improve your motor quality performance.





## General requirements for electric motors

### Noise & vibrations level reduction

Electric motors for consumer applications especially household appliances are usually working in indoor places. Excessive vibration and noise levels associated with these applications are strongly required to be eliminated. Excessive vibrations can cause premature equipment failure. High vibration levels also increase energy consumption. High noise levels, in turn, result in a poorer living environment for personnel and family. HCH offers a range of solutions for exceptionally smooth and quiet bearing operation.



### Maintenance elimination

Consequently, electric motor's long-term performance and maintenance free are important and critical since the repair is comparatively costly and not convenient. Thus, long bearing life is a key requirement. Low operating temperature, high quality raw material, adequate lubrication and avoiding contamination are important factors in extending bearing service life. HCH offers a range of sealed bearings that will extend bearing service life and improve cost-effectiveness as well as reduce the total cost for the application.



### Environment concerning

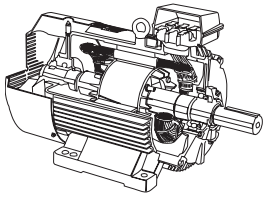
When it comes to the important issue of environment protection, reduced energy consumption is of ever increasing importance. HCH states our commitment to endeavor to reduce the impact of our bearings on the environment and to maintain a safe environment for the future. In connection with its manufacture of bearings for electric motors, HCH takes into account protection of the environment, preservation of resources and more efficient use of energy.

### Avoid electric current damages

In an electric motor, stray currents can cause cratering in the bearing raceways and in the rolling element surfaces. The damages from bearing currents lead to increased noise and heat levels, reduced effectiveness of the lubricant, excessive vibration and possible bearing failure. HCH's high quality bearing material as well as the most advanced heat treatment and full automatic Japanese grinding and super finish machineries guarantee the bearing reliable performance and prevent bearings from early fatigue failure from current damages.



## 3.1 Blush Motors



The magnetic field comes from either wound coils or a permanent magnet. This type of motor has a mechanical switch or commutator, which reverses the current in the armature of the machine. The "speed per torque" characteristic is constant and the slope of the speed/torque curve depends on the strength of the magnetic field.

### Universal motors

Universal motors are commutator fitted machines adapted to work with AC voltage. They can achieve high speeds. However, the speed is sensitive to the load applied. The main advantage is the flexibility to adjust speed to an appliance needs. This type of motor is widely used to drive horizontal axis washing machines and vacuum cleaners.

### Permanent magnet DC motors

Permanent magnet DC motors are commutator fitted machines in which the magnetic field source is a permanent magnet. They require a DC power source and therefore are typically used in cordless appliances. In addition, speed control can be made available.

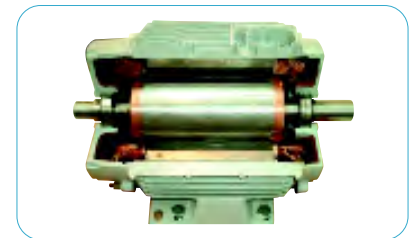


### HCH bearings for brush motors

Except for the common requirements, HCH bearings used in brush motors are usually with non-contact rubber seals incorporating a special labyrinth design to meet high running speeds and provide good protection against ingress of brush dust contamination. Decades of research and development in the industry, HCH has produced several technological breakthroughs, setting new industry standards for performance:

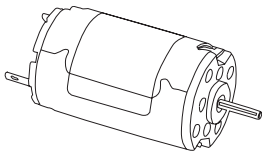
- > Noise free operation
- > Increased dent resistance
- > Ultra long life
- > Elimination of bearing creep

Universal motors driving washing machines are fitted with metal shielded deep groove ball bearings. The internal radial clearance is optimized to meet the requirements of high speed and low noise. Bearings are typically charged with grease combining high speed lubrication capability and low noise properties. The design requirements on wet and dry vacuum cleaners are for deep groove ball bearings that can provide protection against ingress of brush dust contamination and humidity. Where brush dust is the contaminant, bearings are fitted with metal shields incorporating a special labyrinth design. In conditions where humidity is a problem, heavy contacting rubber seals are the preferred solution.



Conventionally, the blush motors are wide accepted and applied in many industries, e.g. they are common for a driving system or a steering system in an automobile. Cooperating with HCH, we offer you solution to optimize blush motors' low noise and durability performance.

## 3.2 AC Single-phase Induction Motors



Induction motors are the most used driving system, from fractional horsepower to hundreds of horsepower, where speed rotation does not require varying. Single-phase induction motors are largely used in low power applications. Split phase, capacitor start and permanent split capacitor motors are commonly used to drive washing machine drums. Shaded pole and permanent split capacitor motors are used to drive dishwasher water pumps. Thus bearing design strongly depends upon the final application of the motor.

The types of fractional horsepower motors are designed to match the requirements of each application.

### Split-phase induction motors

This type of motor has good efficiency and moderate starting torque. They are widely used as drive motors for washing machines, tumble dryers and dishwashers.

### Capacitor start induction motors

They have the same running performance as split-phase motors but a higher starting torque. They are mainly used in washing machine drive systems.

### Permanent split capacitor motors

With characteristics of high efficiency, quiet operation and continuous reversibility, they are suitable for washing machines, tumble dryers, fans, air-conditioners, and dish washer pumps.

### Shaded pole motors

They are suitable for low power applications (less than 200 W). Typical use is in small domestic fans, which can be found in home appliances such as range hoods, air conditioning systems.



The motor performance is greatly influenced by bearing performance. Requirements for bearings are low noise and vibration operation, low/high temperature and high speed durability, low torque and anti-fretting properties.

### HCH bearings for AC single-phase induction motors

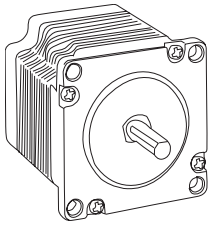
The normal bearing arrangement for these types of motors is two HCH deep groove ball bearings. The required performances for these types of motor bearings are low noise and vibration, low torque and wide temperature resistance. HCH R&D department efforts have been done to develop various greases and optimized bearing designs that meet such performance requirements.



Grease suitable for low and high temp operation together with low noise capacity and special requirement (e.g. anti-water, rust-prevention, no reaction with surrounding environment) is used. HCH has abundant knowledge about the grease characteristics. For your various application demands, we supply you a wide range of greases. The bearing design is dependant upon the motor application. For horizontal axis washing machines metal-shielded bearings are commonly used. For vertical axis washing machines light contacting rubber seals are preferred. The internal radial clearance is optimized to achieve the best compromise between speed and noise requirements.



## 3.3 Advanced Motors



The main advantage with this type of machine is the absence of brushes. This means that they can give good performance in service life with low noise and low contamination (from brush dust).

### Switched reluctance motors

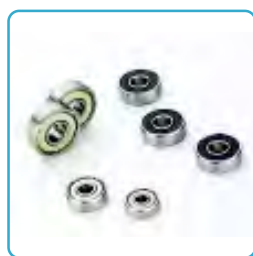
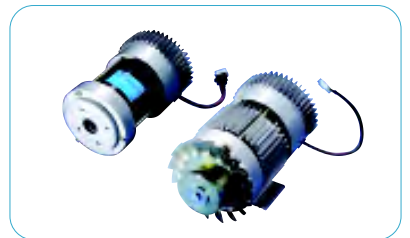
The rotor is made of a laminated soft steel armature. Rotation is generated by the interaction of the rotor armature lobes and stator coils which are energized in sequence. A sophisticated electronic control ensures the current commutation. The absence of permanent magnets and rotor coils allows high performance levels in terms of absolute speed and efficiency. SRM can be used in many fields of applications including washing machines, as servomotors in aerospace designs and in the automotive segment.

### Controlled induction motors

Typically they do not use a rotor-speed sensor. The speed characteristic is controlled by using predefined volts/Hz profiles and slip-compensation techniques. A good low noise level can be achieved with proper pulse width modulation techniques.

### Brushless permanent magnets motors

The stator is similar to that of an induction motor. The rotor has permanent magnets mounted on a ferromagnetic core. A hall sensor encoder or similar device is frequently used to sense rotor position. The motors are used in refrigeration compressors, washing machines, fans and blowers.



### HCH bearings for advanced drive systems

HCH can offer bearings to meet the high performance requirements of advanced drive systems.

The absence of brush dust contamination enables the use of metal shields as a capping solution. The internal radial clearance is selected to meet the requirements of high speed and low noise. Bearings are usually lubricated for life with grease that has low noise properties. To achieve the required service life, special attention needs to be focused on the grease specified and the grease fill used. A plastic cage can be chosen to increase the speed rating. If necessary, bearing component tolerances and internal geometry can be developed to meet specific application requirements.

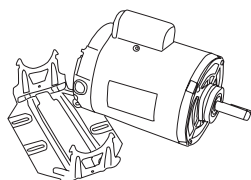
Please contact HCH application engineers to determine the appropriate bearing arrangement for your motor design.



With the improvement of technology for safety, energy saving and global environment, the advanced motors are more and more popular. HCH bearings are contributing to satisfy your more diversified and intensified performance requirements.

Please contact HCH application engineers to determine the appropriate bearing arrangement for your motor design.

### 3.4 Industrial Electric Motors & Generators



HCH has a long and vast experience in the electric motor industry as well as in most of the industries where electric motors and generators are used. In this highly competitive industry, the profound knowledge of HCH has been used to develop solutions to meet the ever increasing demands for higher quality, shorter delivery time, lower noise levels and improved technical support.

Motors for specific applications are high volume products, which are typically small to medium sized, ranging from 1 to 500 KW. These motors are used within specific applications e.g. fans, pumps and compressors where the reliability and trouble-free operation of the motor are of high importance. Also generators have to cope with the same or even tougher needs. The three-phase induction motor is a robust and maintenance-free solution that is the most commonly used type in industrial applications. For application specific motors, it is very important to select the right bearings and bearing arrangements to optimize performance for the specific application operating conditions. HCH's expertise in this field could add further benefits with significant improvement in motor reliability and performance, thus improving machine profitability.



The use of motors is expected to grow more and more in every industry. Along with the growth, operating conditions will become severer which will ultimately require better performing bearings. We would like to continue our efforts to enhance our technology that will exceed future requirements.



#### HCH bearings for industrial electric motors

Longer service life, smaller motors, no re-lubrication, low vibration, energy saving, low weight and low heat generation all can find their answer in HCH's full range of bearings.

Improper lubrication or relubrication will lead to excessive wear and shortened bearing service life. Even premature bearing breakdowns might occur resulting in substantially increased operation costs. For optimal reliability and long service life, lubrication is crucial.

Either grease or oil can be used as lubricant. Grease should be used when simplified maintenance, improved cleanliness (i.e. fewer leaks) and better protection against contamination are required. However, to meet all demands in the same time is not an easy job. As grease is composed of base oil, thickener and additives, it is important to select optimum composition for such performance requirement. Oil lubrication should be used where normal operating temperatures are high as a result of an external heat source or excess heat generated by the machine itself in high speed applications. Industrial electric motors are usually hard to access, which makes maintenance procedures difficult. Fully automatic lubrication systems can be specified by HCH, to attain maximum bearing service life and lower operating costs.

Proper sealing is also an important part of the bearing lubricating function. HCH offers a range of sealed bearings that will improve cost-effectiveness and reduce the total cost for the application.





## 4. Electric Power Tools

Electric power tools are one of the most competitive industries with new models coming out every day. Manufacturers are trying to develop new technology to meet customers' demand for comfort and higher efficiency.

More than one third of premature bearing failures in this industry are caused by incorrect lubricant and/or inadequate application of the lubricant. By using recommended HCH lubricants, tools and techniques, downtime and maintenance requirements can be significantly reduced. Lubricants can be specified according to demands on vertical shafts and resistance to solids, pressure, temperatures, loads, chemical aggression, etc.

Moreover, to serve the best interests of electrical power tools industry, we have tailored our resources to meet your needs, so that your objectives become our objectives. To help you develop new products more quickly, we have introduced simultaneous engineering to give you immediate and open access to our process, product development and applications expertise.



As one of the most traditional industry, the electric power tools are common all over the world. Nevertheless, the demand for rolling bearings with higher performance and reliability is increasing year by year for this application. Working with world renowned electric power tools manufacturers, HCH could provide you reliable bearings with cost efficiency.





## General requirement for electric power tools

### Maintenance free solutions

Electric power tools' long-term performance and maintenance free are important and critical since the repair is costly and not convenient. Consequently, long bearing life is a key requirement. Low operating temperature, high quality raw material, adequate lubrication and avoiding contamination are important factors in extending bearing service life. As the world's leading manufacturer of bearing solutions, HCH has a wide range of solutions and services to extend bearing service life and improve application profitability.

### Long service life

Electric power tools long term performance is critical for manufacturers' image for consumers. Special materials, special heat treatment, a range of special seals and the HCH life theory, which points the way to infinite life of a bearing, are the major tools to optimize your applications. HCH bearings for power tools are also available for special requirements: bearings with high-temp grease and special designed clearance and raceway radius for higher speed.



### Prevention from dust

For electric power tools, no matter that applied indoors or outdoors, they are facing difficult environment situation. The environment for electric power tools is highly contaminated with dust etc. Hence, it is necessary to ensure good contamination protection. HCH proper lubrication greases that prevent water and dust are usually applied. HCH offers a range of sealed bearings with labyrinth design to further prevent dust ingress.

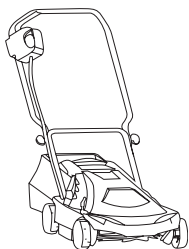


### Environment

Environmental care is one of today's main issues. The more legal requirements become diverse and complex, the more swiftly and accurately we must respond. Consequently, the electric power tool industry is demanding more and more environmental friendly solutions. For this application, HCH offers low friction bearings with optimized seal structure and low friction grease to further meet reduced power consumption requirements.








## 4.1 Electric Lawn Mowers & Garden Tools



### Electric lawn mowers

Corded and cordless versions are available. The market demand for cordless machines is increasing. The modern cordless machine combines the low noise and low maintenance of corded versions with the movement flexibility of petrol equivalents. The typical design of an electric lawn mower has an armature shaft (vertical axis electric motor) on

which the cutting blade is mounted through a safety clutch device.

|   |   |  |
|---|---|--|
|  <p><b>Blower/Vacuums</b><br/>They are used as both a blower and a vacuum-clearing leaves, driveways, etc.</p> |  <p><b>Chain saw</b><br/>A hand-held power saw. The blade is chain driven and is mainly used to cut tree limbs.</p>          |  <p><b>Grass shears and hedge cutters</b><br/>The operation principle for both is the same - two metal blades moving in opposite directions.</p> |
|  <p><b>Grass trimmer</b><br/>This tool uses a fast spinning line (plastic or wire) to trim grass etc.</p>    |  <p><b>Power sprayer</b><br/>A tool consisting of a pump providing consistent high pressure of water or other liquids.</p> |  |



The products can be analyzed in the HCH°Øs modern measuring laboratories to investigate additional potential for improvements in the finished product. By supporting our customers with frequency analyses of the complete system, we can achieve significant vibration reduction and dust preventing for the complete system in cooperation with our customers.

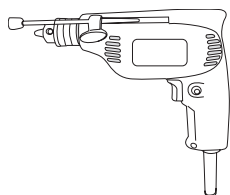


### HCH bearings for garden tools

Since the garden tools are usually working in outdoors, HCH bearings are typically fitted with contact rubber seals on both sides to prevent ingress of dust/grass and grease leakage. Bearings are life lubricated with greases capable of operating at temperatures among -30/+130 °C with dust and water ingress characteristics. An internal radial clearance dependant upon the fitting tolerances - normally ISO CN or C3. In

the cordless applications, low friction and good contaminant protection are required. HCH bearings can be fitted with light contact rubber seals together with pressed steel cages. HCH also offer non-contact rubber seals and metal shields when high speed is required in these tools.

## 4.2 DIY Power Tools



The "Do It Yourself" market asks for reliability, economy and easy handling (low weight). The market for cordless products continues to grow with users looking for tools that can offer low weight for ease of handling and high power output combined with low power loss to optimize performance. The environment for DIY power tools is highly contaminated with dust etc. Hence, it is necessary to ensure good contamination protection.



### DIY drills

The drill family covers standard drills, hammer drills, impact drivers and wrenches. Screwdrivers could also be included. Drills were the first tools to be marketed in the cordless revolution.



### DIY angle grinders

This type of power tool is very versatile and can be used for polishing, burnishing, removing rust and deburring. The bearing arrangement and running conditions depend on the location within the tool.



### Hand saws

A wide variety of designs exist including reciprocating saws, circular saws, jig saws, miter saws, table saws, scroll saws and band saws, to name a few. Reciprocating, circular and jig saws are included in hand saws.



### HCH bearings for DIY electric power tools

HCH deep groove ball bearings are normally used to support the armature and output shafts. They can be fitted with metal shields or light contact rubber seals (dependant upon dust exclusion properties required) to satisfy high speed and friction torque requirements. Grease is selected to give good performance at temperatures in the range -30/+ 130 °C and give good performance with low leakage under high vibration conditions. Internal radial clearance will depend on the fitting tolerances required.

HCH bearings give improved service life due to:

- > Extended grease life
- > Good performance in air-streams and condensation
- > High wear resistance against particulate contamination (sand, pigments, abrasives, steel, iron oxides etc.)
- > Resistance to electric current

To serve the best interests of DIY electrical power tools industry, we have tailored our resources to meet your needs, so that your objectives become our objectives. To help you develop new products more quickly, we have introduced simultaneous engineering to give you immediate and open access to our process, product development and applications expertise.



## 4.3 Industrial Power Tools

Professional end users ask for the same features with additional requirement of a high power output while maintaining a low operational power loss. Thus, longer life, higher power and enhanced safety features are required by industrial power tools. Moreover, high performance professional hand tools also need to meet the requirements of high-speed capability and resistance to the passage of electric current.



### Industrial drills

The environment for industrial drills is contaminated with dust etc. Hence the need to ensure good contamination protection. In heavy duty professional hammer drills, the electric motor is usually mounted vertically and gives the motion to the spindle shaft through a series of gears.



### Machinery saws

Table saws, scroll saws and band saws tend to be used by professional craftsmen. The critical usage parameters should be reliable as well as the precision of the cut. Important issues are therefore dust protection capability and resistance to heavy loads and misalignment.



### Industrial angle grinders

The angle grinder consists of an electric motor connected through a pinion gear to an output spindle where the grinding wheel is mounted. This type of power tool is very versatile and can be used for polishing, burnishing, removing rust and deburring.



### HCH bearings for industrial power tools

For industrial power tools, HCH can offer bearings with characteristics of dust prevention and higher speed. The deep groove ball bearings used are usually fitted with contact rubber seals, which combine low friction with good dust exclusion properties. To ensure good performance at high speed, special greases are available in HCH that perform well at high speed and have low leakage characteristics. The grease also

has to be selected to meet the demand of high temperature with dust and water ingress characteristics since these professional power tools may work in tough environment.



Special challenges such as high speeds, high loads in small design spaces or special environmental conditions have always been motivation for HCH to further develop or redevelop its bearings. We create solutions that secure a competitive advantage for our customers.

## 4.4 Bearings work in different parts of electric power tools



For different parts of electric power tools, the bearings' characteristics will vary accordingly as well. Take the angle grinders for example, the bearings in this application will mainly be divided into three parts: the bearings for fan end, the bearings for commutator end as well as the bearings for grinder output spindle. Check the details for these three applications as following:

### Fan end

The bearing will need to cope with a combination of high speed, high temperature, heavy loads and a dusty environment. The HCH solution is a single row deep groove ball bearing fitted with light contact Rubber seals or metal shields (the choice is dependant upon the environmental conditions). Special greases with high-speed capability and low grease leakage properties are used.

### Commutator end

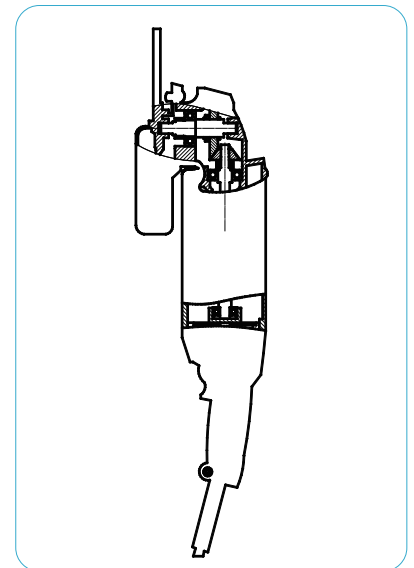
The bearing will need to cope with high speed, high temperatures and a dusty environment. The HCH solution is a single row deep groove ball bearing fitted with light contacting rubber seals to ensure good dust resistance and high-speed capability. Special greases with high-speed capability and low grease leakage properties are used.

### Grinder output spindle

On the tool side, bearings shall sustain the cutting loads (axial and radial), with risk of high misalignment in a dusty environment. HCH bearings for this application are equipped with heavy contact rubber seals that ensure a very good resistance to pollution as well as special greases for high speed and low leakage performances. Also, our product range offers extra benefits to the manufacturers of electric power tools:

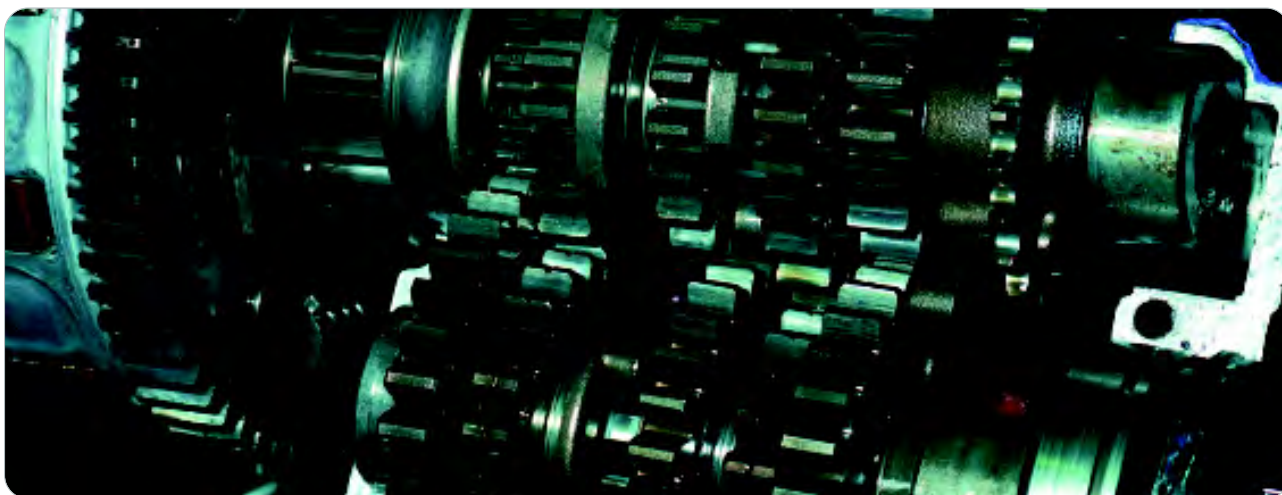
- > High reliability and long life through proven product design, excellent material quality and production technology
- > Reduced energy consumption due to special bearing solutions and lightweight design
- > High power density due to space-saving solutions
- > Safety in bearing selection through the proven knowledge of our application experts
- > Customized solutions developed in close cooperation with the customer using the latest technologies and continuous further development

In all, HCH understands your requirements for longer service life, no relubrication, low vibration, energy saving, low weight and low heat generation for electric power tools. HCH high quality raw material with most advanced heat treatment technology as well as a range of optimized seals solutions are the major tools to optimize your applications.



Technology for analyzing bearing performance is important to optimization of the electric power tools running performance. At the same time, shorter development period and lower development costs are also being sought. Equipped with most advanced analysis tools, HCH will supply you the latest bearing technology for this application.





## 5. Gearboxes

Gearboxes are important subsystems in almost every industrial application. Together with the electrical motors (or with other prime movers) they form the drive train that is needed in most processes. Due to the variety of the existing applications, the industry requirements are the most diverse ranging from so called standard components up to the fully customized solutions that include advanced co-engineering.

Knowledge is power. HCH remains a driving force behind the gearbox industry through our research and close working relationships. We recognize that standard solutions are just as important as innovation. HCH gearbox bearing solutions minimize downtime and improve operational efficiency. But of course, no level of innovation is complete without technical support. Our gearbox specialists provide world-class assistance on everything from making bearing recommendations, to validating new gearbox designs, and even defusing crises on shop floors.



Innovation continuously increases the standard of technically based products. Technological leaps are getting greater - a development which is taking place in the gear construction sector.





## General requirements for gearboxes

### Optimized design and production

To be competitive, gear boxes must be designed to enable cost-effective design and production processes for the right level of performance. This requires an understanding of the gear boxes as a system. Only then can you evaluate the influence of a light alloy casing on gear and bearing behavior, for example, or the effect of contaminated lubrication on overall performance. HCH engineering capabilities can complement your own technical expertise throughout the design project.



### High performance

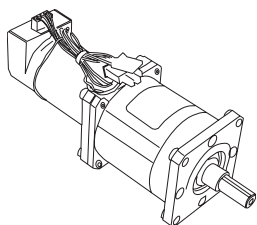
Demands on gearbox performance typically include high speeds under combined load on the input shaft and relatively heavy radial loads on the intermediate shaft. Not to mention external loads at low speed on the output shaft. Furthermore, the stiffness behavior of the complete system and the overall effects of an oil-splashed, contaminated lubrication are also highly demanded. Working together with HCH, you can achieve the enhanced performance by our expertise, from the analysis of your specific needs, to design optimization and verification in our virtual test rigs, and to analyzing gear box working conditions in the field.



### Cost-effective

As the person working with or responsible for operations, your priority is to get maximum return on money invested. It takes high operational reliability, energy efficiency and minimal service requirements - throughout the life of the gear unit. To do this, you have to be able to focus on optimizing the drive system integrated in the process. This is true for all types of industrial processes, such as steelmaking, mining and cement, as well as for harbor cranes and movable bridges, for example.

## 5.1 Geared Motors



Manufactured in relatively high volumes, geared motors are designed to meet specific multipurpose demands, in applications like material handling, packaging machines and automation. Fierce competition in a global marketplace means that manufacturers must find ways to achieve more cost-effective design and production processes, while continuing to improve technical performance. Designing a more competitive geared motor is a challenging task. Demands on bearing arrangements typically include high speeds under combined loads on the input shaft and relatively heavy radial loads on the intermediate shaft. Equally important, you can optimize performance by increasing torque, decreasing heat and noise levels.

HCH has the unique capability to offer high-level engineering capabilities and high performance products. HCH offers a complete range of high performance bearings optimally suited for geared motors: deep groove ball bearings and tapered roller bearings. Working together with HCH, you can achieve the enhanced performance you are looking for by increasing torque and decreasing both heat generation and noise levels.

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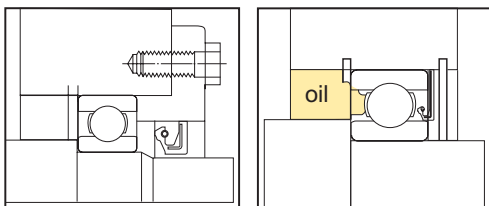


### HCH bearings for gear motors

To meet our customers' strict demand for the bearings in geared motors, HCH provides bearings with following characteristics:

- > Improved bearing internal sealing structure (for RS and 2RS type)
- > Long-life high performance applied ultra clean bearing material
- > Low friction with precise bearing manufacturing process
- > Optimized clearance for customized unique gear design

Oil leakage must be absolutely avoided in geared motors. This is a growing challenge since increasingly aggressive lubricants are being introduced, threatening reliable sealing performance. To meet the performance challenges, for sealed bearings, HCH has provided a variety of optimized bearing internal structure to prevent oil emission and dust invasion. Moreover, working with HCH, specific technical suggestions can be available from HCH expertise throughout your design project. For example, excellent external sealing structure to increase transmitted torque and decrease heat generation, or the lubricant selection to better oil compatibility.



**Note:** When the oil seal and the bearing are in very close proximity, internal bearing clearances are sometimes too small to accommodate the additional heat generated by friction between the seal and shaft. Internal bearing clearances must also be selected with caution.



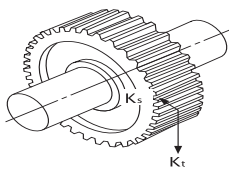
Together, we can help increase torque or downsize, double the service life, aim for 100% operational reliability and improve energy efficiency.

## 5.2 Planetary & Helical Gear Units

Small to medium planetary and helical gear units must meet the tough challenges of specific applications such as wheel drives in agriculture and construction vehicles; and slewing drives in construction equipment and wind turbines. They operate under heavy-duty cycles with heavy radial loads, shock loads and tilting movements. These gear units must provide reliable performance in highly contaminated conditions as well.

### HCH bearings for planetary and helical gear units

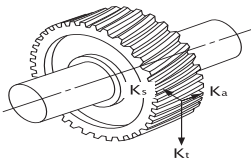
The type and size of the bearings needed for a specific application are determined by the results of a life calculation carried out for the bearings. In close cooperation with gear manufacturers, based on extensive testing, HCH has developed calculation methods and programs that are among the most advanced in the rolling bearing industry for planetary and helical gear units.



The loads operating on gears can be divided into three main types according to the direction in which the load is applied; i.e. tangential ( $K_t$ ), radial ( $K_s$ ), and axial ( $K_a$ ). Loads acting on planetary shaft gears are depicted in the pictures. The load magnitude can be found by using or formulas:

$$K_t = \frac{19.1 \times 10^6 \cdot H}{D_p \cdot n} \text{ N} = \frac{1.95 \times 10^6 \cdot H}{D_p \cdot n} \text{ kgf}$$

$$K_s = K_t \cdot \tan \alpha \text{ (Spur gear)} = K_t \cdot \frac{\tan \alpha}{\cos \beta} \text{ (Helical gear)}$$



$$K_r = \sqrt{K_t^2 + K_s^2} \quad K_a = K_t \cdot \tan \beta \text{ (Helical gear)}$$

where,

$K_t$  : Tangential gear load (tangential force), N

$K_s$  : Radial gear load (separating force), N

$K_r$  : Right angle shaft load (resultant force of tangential force and separating force), N

$K_a$  : Parallel load on shaft, N

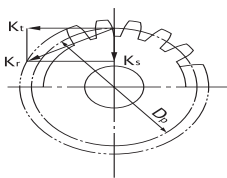
H : Transmission force, kW

n : Rotational speed, r/min

$D_p$  : Gear pitch circle diameter, mm

$\alpha$  : Gear pressure angle

$\beta$  : Gear helix angle



Because the actual gear load also contains vibrations and shock loads as well, the theoretical load obtained by the above formula should also be adjusted by the gear factor fz as shown in the table below:

### Gear factor fz

| Gear type   | fz       |
|---|----------|
| Precision ground gears (Pitch and tooth profile errors of less than 0.02mm) | 1.05~1.1 |
| Ordinary machined gears (Pitch and tooth profile errors of less than 0.1mm) | 1.1~1.3  |



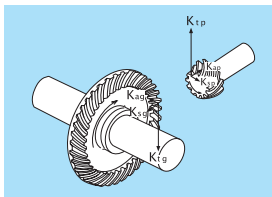
We will help you settle questions concerning the design of bearing mating components, lubrication and sealing, mounting and dismounting, etc.

## 5.3 Bevel & Bevel-helical Gear Units

Bevel and bevel-helical gear units are designed for tough applications such as mining conveyors, paper mills, extruders, continuous casters or harbour cranes. They must provide high operational reliability in harsh conditions such as hot, humid and dusty environments, at very low speed and with heavy loads.

### HCH bearings for bevel and bevel-helical gear units

By applying a systematic approach and modular thinking, HCH has developed advanced load and life calculation ways for bevel and bevel-helical gear units. Gear loads acting on straight tooth bevel gears and spiral bevel gears on cross shafts are shown in the pictures on the left side. In general, the relationship between the gear load and the pinion gear load, due to the right angle intersection of the two shafts, is as follows:



Loads on bevel gears

$$K_{sp} = K_{ag}$$

$$K_{ap} = K_{sg}$$

where,

$K_{sp}$ ,  $K_{sg}$ : Pinion and gear separating force, N

$K_{ap}$ ,  $K_{ag}$ : Pinion and gear axial load, N

The calculation methods for these gear loads are shown in table as following:

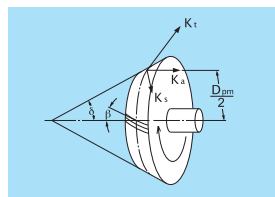
| Pinion                                    | Rotation direction        | Clockwise  | Counter clockwise  | Clockwise  | Counter clockwise |
|---|---------------------------|--|--|--|-------------------|
|   | Helix direction           | Right  | Left   | Left   | Right             |
| Tangential load $K_t$                     |                           | $K_t = \frac{19.1 \times 10^6 \cdot H}{D_{pm} \cdot n} \left\{ \frac{1.95 \times 10^6 \cdot H}{D_{pm} \cdot n} \right\}$ |  |  |                   |
| Straight <sup>(1)</sup><br>bevel<br>gears | Separating<br>force $K_s$ | Driving side   | $K_s = K_t \left[ \tan \alpha \frac{\cos \delta}{\cos \beta} \right]$                          |  |                   |
|   | Axial<br>load $K_a$       | Driven side  | $K_a = K_t \left[ \tan \alpha \frac{\sin \delta}{\cos \beta} \right]$                          |  |                   |
| Spiral <sup>(1,2)</sup><br>bevel<br>gears | Separating<br>force $K_s$ | Driving side   | $K_s = K_t \left[ \tan \alpha \frac{\cos \delta}{\cos \beta} + \tan \beta \sin \delta \right]$ | $K_s = K_t \left[ \tan \alpha \frac{\cos \delta}{\cos \beta} - \tan \beta \sin \delta \right]$ |                   |
|   |                           | Driven side  | $K_s = K_t \left[ \tan \alpha \frac{\cos \delta}{\cos \beta} - \tan \beta \sin \delta \right]$ | $K_s = K_t \left[ \tan \alpha \frac{\cos \delta}{\cos \beta} + \tan \beta \sin \delta \right]$ |                   |
|   | Axial<br>load $K_a$       | Driving side   | $K_a = K_t \left[ \tan \alpha \frac{\sin \delta}{\cos \beta} - \tan \beta \cos \delta \right]$ | $K_a = K_t \left[ \tan \alpha \frac{\sin \delta}{\cos \beta} + \tan \beta \cos \delta \right]$ |                   |
|   |                           | Driven side  | $K_a = K_t \left[ \tan \alpha \frac{\sin \delta}{\cos \beta} + \tan \beta \cos \delta \right]$ | $K_a = K_t \left[ \tan \alpha \frac{\sin \delta}{\cos \beta} - \tan \beta \cos \delta \right]$ |                   |

where,

$D_{pm}$ : Mean pitch circle diameter, mm

$\delta$ : Pitch cone angle

Herein, to calculate gear loads for straight bevel gears, the helix angle  $\beta = 0$ .



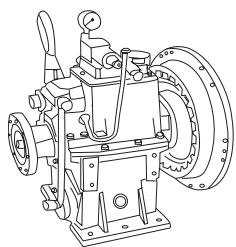
Bevel gear diagram

For spiral bevel gears, the direction of the load varies depending on the direction of the helix angle, the direction of rotation, and which side is the driving side or the driven side. The directions for the separating force ( $K_s$ ) and axial load ( $K_a$ ) shown in the left picture are positive directions. The direction of rotation and the helix angle direction are defined as viewed from the large end of the gear. The gear rotation direction in the picture is assumed to be clockwise (right).



As a rule, design engineers have only a few months to develop a new gear. Usually there is no opportunity to test a gear under field conditions before it is delivered to a customer. That is why the support of HCH is of particularly great importance.

## 5.4 Customized gear units



Large, customized gear units are tailored to the specific demands within industries such as cement, steel, mineral processing, wind power and traditional power generation. The tough operating conditions can include high torque, heavy external loads, shock loads, high environmental contamination and varying speeds. Reliability and performance are crucial, placing strong demands on the design process. Worth to mention, until now, an increasing precision of calculation methods, constantly increasing computing power and improved technological know-how - e.g. in the fields of materials technology, strength and tribology - have utilized reserve capacities: the gear-weight/driving-torque ratio has been reduced by 80% over the last 20 years.

### HCH bearings for customized gear units

HCH offers high-level engineering capabilities and high performance products, both standard and special executions for specific positions by understanding your demands of:

- > High operational reliability
- > High load carrying capacity
- > Low friction
- > Exact radial and axial guidance of the shafts for exact meshing

What is more, HCH offers the unique ability to combine high-level engineering services with high performance products and condition monitoring systems. HCH rolling bearings have contributed considerably to current developments. Through targeted research and development, constant increases in quality and an intensive exchange of experience with gear manufacturers and users, we have increased our bearings' functionality and operational reliability and at the same time minimized power losses. Gearboxes that are fitted with high-quality rolling bearings have become generally more efficient and more reliable, and as a result more competitive.

Oil leakage is a common problem in many oil-lubricated machines, including gear motors. It lowers the machine's perceived quality. It can cause environmental contamination and in the long run it can cause the machine to run without lubricant. Many efforts are spent by HCH engineers to design effective oil sealing systems that could cope with the following parameters:

- > Space and weight constraints
- > Chemical aggressivity of additivated oils (that can cause premature ageing of many rubber materials)
- > Relatively high temperatures
- > Pressure differentials (that can deformate the seal and make it ineffective)
- > Shaft displacements and deflection
- > Shaft hardness and surface finishing
- > Assembling methods



Our goal is to work together with you to discover the golden opportunities in your gear unit designs - whatever the industry or type of gear unit.



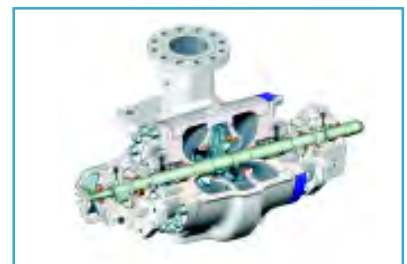


## 6. Pumps & Compressors

HCH knows your requirements for long service life, no re-lubrication, less friction, energy saving and low heat generation. For pumps and compressors, HCH high quality raw material as well as a range of optimized seals solutions are the major tools to optimize your applications. By working with HCH, you can gain the profound knowledge of HCH which has been used to develop solutions to meet the demands for high quality, lower noise levels, and outstanding water-proof support.

Take a good, hard look at virtually any industry and you'll find pumps and compressors in the mix. From oil and gas to chemical processing, water and waste treatment, medical, manufacturing, power generation, paper, and mining - there are pumps and compressors working behind the scenes and around the clock. For each of these industries, the requirement for greater Mean Time Between Failure (MTBF) places increasingly severe demands on the bearings being used.

HCH is the leading supplier of bearings and engineering solutions to the pump and compressor industry. Through decades of close cooperation with leading manufacturers, HCH research and development activities have led to innovative engineering solutions and advancements in bearing design. The incorporation of these solutions has led to better performing pumps and compressors for today and more reliable for tomorrow.



Expertise across all pump and compressor system in conjunction with bearings of the highest quality and customer proximity are the key to more power and higher productivity for pump and compressor industry. HCH achieve this due to our pump and compressor system solutions built by our experienced knowledge from long-term cooperation with leading manufacturers in these industries.





## General requirements for pumps and compressors

### Increase service life

Effective maintenance is critical to minimize life-cycle costs and downtime. Poor maintenance may result in a loss of 10 to 15% of pump efficiency. HCH can further assist with the integration of efficient maintenance and reliability plan into your maintenance practices as well as provide upgrading services. Thus, costly unplanned stops can be reduced which will finalize total economic improvement. Furthermore, pumps and compressors equipped with HCH sealed, greased-for-life bearings are considered to be maintenance-free.



### Lower energy consumption

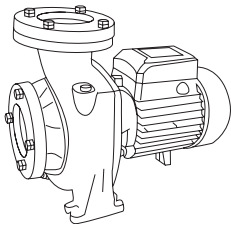
Pumping and compressing systems account for nearly 20% of the world's electrical energy demand and can range from 20-25% of the energy usage in an industrial plant operation. Energy consumption covers 45% of the total cost of owning a pump or compressor. HCH offers a range of excellent solutions and engineering services for reducing energy consumption in pumps and compressors. The most important for bearings is to reduce the friction inside, by choosing low-friction grease, optimized seals and shields design.



### Reduce vibration and noise levels

Excessive vibration and noise levels associated with industrial pumps are an increasing concern for optimum performance reasons as well as for compliance with legislation. Often the root cause of too high vibration and noise levels is related to poor shaft alignment, inadequate lubrication, poor mounting procedure and improper bearing arrangements or inefficient cooling. HCH offers a range of solutions for exceptionally quiet bearing operation spanning from selection of bearings and lubrication to advanced engineering services, such as dynamic simulation, virtual testing and design concepts.

## 6.1 Conventional Pumps



Conventional pumps usually refer to those deal with the clean fluid handling processes such as water treatment and supply, milk pasteurization and de-scaling. Reduced total cost of ownership is a critical issue for these pumps. High vibration levels increase energy consumption and can cause premature equipment failure and costly maintenance, often including unplanned downtime and loss of production. HCH offers application knowledge and high quality bearings for energy-efficient pumping systems that can reduce energy consumption in the entire process.

HCH's sealed bearings, food compatible greases and reliable high quality bearings' material offer maintenance-free and lubrication-free technology for submersible and seal-less pumps, reducing the risk of contamination of the fluid. This means vastly increased production efficiency and enhanced operational profitability.

Since these bearings are working mainly indoors, for example, the bearings in household pumps and milk workshop pumps, excessive vibration and noise levels are an increasing concern for optimum performance reasons as well as for compliance with legislation. Often the root cause of too high vibration and noise levels is related to poor shaft alignment, inadequate lubrication, poor mounting procedure or improper bearing arrangements.

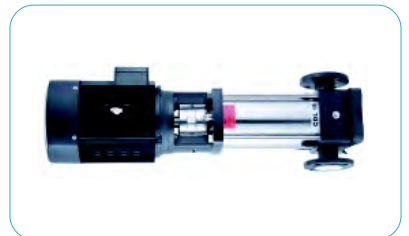
### HCH bearings for conventional pumps

For conventional pumps, bearings are important factors in the development towards higher pump performance. HCH deep groove ball bearings are often used. They are usually rubber-sealed or metal-shielded. In order to maintain vibration levels within acceptable limits, the internal radial clearance is optimized to suit operating conditions. Bearings are lubricated for life with grease having properties including noise dampening qualities, good humidity and corrosion resistance together with high service life at medium temperature to meet the needs of low noise and resistance to adverse environmental conditions. The filling quantity of grease is dependent upon the application needs.

Through advanced technology and knowledge, HCH can support pump designers to meet these challenges with a number of proven quality solutions including:

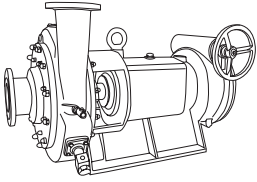
- > Maintenance free solutions
- > Advanced engineering calculation tools
- > Food compatible lubricants
- > High performing sealing solutions

HCH offers a range of special executions for these applications. For further information, please contact your HCH application specialist to ensure best results.



The challenge is to enhance performance, while enabling cost-effective, modular production. Bearings and components for these demanding applications must be extremely reliable and efficient. We offer comprehensive range of HCH products for traditional pumps application.

## 6.2 Industrial Pumps



Industrial pumps often operate under harsh and remote conditions with demanding duty cycles. The operating difficulties for the bearing arrangements may result in reduced uptime, performance and service life. For pumps that handle chemical fluid handling process, for instance, in the chemical industry and pulp & paper processes, design engineers and pump owners face a multitude of challenges. Crucial requirements include the ability to comply with industry standards and legislation and to improve energy efficiency. The problem is also faced by pumps that doing mineral fluid handling process, for instance, slurry pumping in mines, sub sea applications or coolant systems. To address these challenges, besides offering the high quality and reliable bearings for these demands, HCH also can help analyze operating conditions and select the appropriate bearing solutions to ensure high reliability, increased efficiency and extended service life.

For industrial pumps, other critical attention should be paid to the safety and environmental issues. Industry and safety standards, as well as government and environmental legislation are becoming more stringent day by day. Industrial pumping systems are the vascular apparatus of several industry processes where hazardous materials such as flammable hydrocarbons, toxic chemicals and thermally reactive chemicals are constantly moved. Any leakage of a material in the pumps could represent a serious risk for workers and for the environment. Through advanced material and manufacturing technology and application knowledge, HCH contributeS safe and high reliable bearings for industrial pump manufacturers to reach working and safety requirement. All bearings produced by HCH conform to RoHS directive and have passed SGS testing, so you can use them with full confidence.

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Our application engineering experts can help you design rolling bearings quickly but carefully. It takes a lot of experience to realize reliable and cost effective bearings for industrial pumps, taking into account all operating conditions.



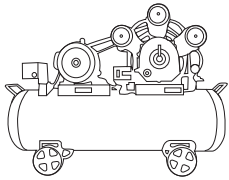
### HCH bearings for industrial pumps

To meet the challenges of industrial pump applications, HCH has developed a variety of deep groove ball bearings and tapered roller bearings. These bearings are engineered to withstand heavy radial loads, perform longer and more efficiently, operate smoother with less noise and vibration, and last longer for maximum productivity and minimal downtime.

HCH provides bearings with following characteristics:

- > Noise free operation
- > Superior heat, chemical, and wear resistance
- > Increased dent resistance
- > Improved lubrication performance

## 6.3 Reciprocating Compressors



Although one of the earliest compressor models, reciprocating, or piston compressors are still commonly used today in many applications where there are low volume and high pressure requirements. By design, reciprocating compressors produce high pressures in small volumes and are generally used for home and light industrial applications.

### Reciprocating air compressors

In reciprocating air compressors, air is compressed in a chamber defined by a cylinder wall and piston. The piston, connected to a connecting rod, has its position in the cylinder controlled by a crankshaft. As the crankshaft turns, the piston moves downward increasing the chamber size and draws air through a suction valve into the chamber. When the piston reaches its bottom position in the cylinder, it reverses direction and moves upward, decreasing the chamber size. When the piston reaches its top position in the cylinder, the compressed air is discharged through a discharge valve in the housing.

### Reciprocating refrigerant compressors

Reciprocating refrigerant compressors produce high pressures for small volumes and are generally used for air conditioning applications. In reciprocating refrigerant compressors, refrigerant is compressed in a chamber defined by a cylinder wall and piston. The piston, connected to a connecting rod, has its position in the cylinder controlled by a crankshaft. As the crankshaft turns, the piston moves downward increasing the chamber size and draws refrigerant gas through a suction valve into the chamber. When the piston reaches its bottom position in the cylinder, it reverses direction and moves upwards decreasing the chamber size. The working process is almost the same as reciprocating air compressors.



### HCH bearings for reciprocating compressors

Two bearings are generally used as the main crankshaft bearings while other bearings are used at the connecting rod bearing positions. Bearings in reciprocating air compressors must be able to withstand very high temperatures; perform longer and more efficiently; operate smoother with less noise and vibration, and last longer for maximum productivity and minimal downtime.

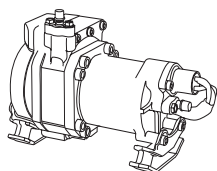
Through advanced technology and vast experience, HCH can support reciprocating air compressors to meet these challenges with following characteristics:

- > Long, trouble-free performance
- > Elimination of bearing creep
- > Superior heat and wear resistance
- > High temperature lubrication performance



Recently, low friction loss, high efficiency, and energy saving are increasingly required in correspond to the movement for environmentally friendliness. Current bearings are required to have low torque, low vibration, high load carrying capacity and high speed performance in the reciprocating compressor industry as well.

## 6.4 Scroll Compressors



Scroll compressors are a small but important segment of the overall compressor market. Their designs and capabilities make them ideal especially for home refrigerators and building comfort-cooling systems that do not require the high performance capabilities of larger twin screw or centrifugal compressor designs.

In a scroll compressor, an orbiting scroll-shaped component moves relative to a similar shaped stationary component inside a housing. On the suction side of the compressor, gas is drawn into the suction opening in the housing and into the cavity produced between the orbiting and stationary scroll components and the housing. As the shaft rotates and moves the orbiting scroll, the cavity begins to decrease in size as it continues to move inwards along the scroll walls. When the cavity reaches the discharge location of the compressor, the compressed gas is discharged through the discharge opening in the housing.



### HCH bearings for scroll compressors

The most commonly used bearings in scroll compressors are deep groove ball bearings. Scroll compressor bearings are exposed to refrigerant gases and need to be able to withstand high speeds and high loads while providing high running accuracy and reliability. Decades of research and development in the industry have produced several technological breakthroughs, setting new industry standards for performance.

- > Ultra long life
- > Increased load capacity
- > Long, trouble-free performance
- > Elimination of bearing creep



The basic function of the rolling bearing in this application is to support the rotating shaft under load. The performance required for bearing is becoming increasingly sophisticated, reflecting diversified applications and severer use conditions in each system. HCH can supply you the bearings with reliable material and low friction characteristics.

### ● Data of standard radial clearances for bearings under no load

| Bore |           | C2   |      | Normal |      | C3   |      | C4   |      | C5   |      |
|------|-----------|------|------|--------|------|------|------|------|------|------|------|
| Over | Including |      |      |        |      |      |      |      |      |      |      |
| mm   | mm        | min. | max. | min.   | max. | min. | max. | min. | max. | min. | max. |
| 2.5  | 10        | 0    | 7    | 2      | 13   | 8    | 23   | 14   | 29   | 20   | 37   |
| 10   | 18        | 0    | 9    | 3      | 18   | 11   | 25   | 18   | 33   | 25   | 45   |
| 18   | 24        | 0    | 10   | 5      | 20   | 13   | 28   | 20   | 36   | 28   | 48   |
| 24   | 30        | 1    | 11   | 5      | 20   | 13   | 28   | 23   | 41   | 30   | 53   |
| 30   | 40        | 1    | 11   | 6      | 20   | 15   | 33   | 28   | 46   | 40   | 64   |
| 40   | 50        | 1    | 11   | 6      | 23   | 18   | 36   | 30   | 51   | 45   | 73   |
| 50   | 65        | 1    | 15   | 8      | 28   | 23   | 43   | 38   | 61   | 55   | 90   |





## 7. Exercise & Sports

In the exercise and sports industry, demand continues to increase for improvements in energy consumption, long service life, safety and comfort. The exercise & sports equipments must be designed to meet strict precision standards which must be easy to maintain.

As an equipment manufacturer, you expect a comprehensive range of standard parts. Products from HCH bearing group ensure peak performance in practically any type of sports and fitness equipment. Our products are characterized by:

- > Very high quality
- > Long life
- > Good price/performance ratio

In addition, our application engineering and sales experts can use their extensive experience to support you on special solutions. For example, for the need of high impact resistance in this kind of application, HCH has developed a range of good basic load ratings and optimized bearings that enhance operators' comfort. The know-how and resources of a strong international distributionship are thus available to you on a local basis, anywhere in the world.



In cycles, inline skates or treadmills bearings from HCH ensure peak performance in practically any type of sports and fitness equipment. With our HCH brand, we are a leading global supplier in this sector. In addition, our sales engineers can use their extensive experience to support you on special solutions.





## General requirements for exercise & sports

### Save power by reducing friction

Some exercise equipments are used in indoor places. Excessive noise and vibration level associated with exercise equipments are strongly required to be eliminated. High noise levels result in a poor living environment for personnel and family. High vibration levels also increase energy consumption. HCH offers a range of solutions with low friction materials, optimized seals solutions, clearance as well as the lubricants.



### Comfort

It is absolutely vital that an optimal comfort level can be obtained during driving. Avoiding stress and fatigue is an important way to keep a good way of comfort. As for HCH, customer comfort considering is a prioritized area. Therefore, we offer both original equipment manufacturers and drivers a range of excellent and reliable precision bearings to satisfy a high level of comfort. Since precision is a key issue to HCH's customers, it's also a key issue to us at HCH.



### Maintenance free

For both manufacturers and end-users, it is of utmost importance that exercise and sports demand as low maintenance efforts as possible. To meet these demands for reduced maintenance, HCH can offer you a wide range of solutions to improve bearing quality and steel material to sustain long service life.

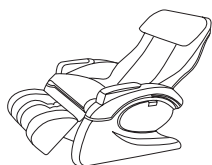
### Environmental concerning

Advocating harmony with the global environment is HCH's most important issue and we will make constant efforts to contribute to the harmonious development of society, while aiming to reduce environmental impacts and create a recycling society. HCH bearings all pass RoHS to make sure that every single piece used in exercise & sport equipments is with no harm.



## 7.1 Fitness Equipments

Leisure and excercising is more and more enjoyed by people all over the world. It is practiced in gymnasium or in family to have fun. HCH's experience and expertise in the design and manufacture of high reliability and quiet running bearings make us an ideal partner for your excercising equipment needs. From massage chairs to treadmills to various newly developed fitness equipments, HCH offers a complete line of solutions for the movement of your product. Among our customers, there are world leading fitness equipment manufacturers in USA, Italy, Japan and China. We believe that their success and HCH's professional skill and continuous improvement cannot be separated.



### Massage chairs

Massage chairs must be designed ergonomically for the excercisers as well as smooth and quiet for comfort. As people size and weight varies, chair design has to be reliable and robust.



### Treadmills

For this game, HCH makes no compromises between bearings' efficiency and robustness. HCH has access to the best bearing technology, which brings the absolute combination of low friction and extreme robustness.



### HCH bearings for fitness equipments

HCH bearings are designed to fulfill the requirements of different types of fitness equipments. All HCH bearings are of high quality level. There are no compromises. At HCH, we know that robustness, protection, low friction and comfort are important for every equipment performance. HCH engineers are more than bearing specialists. They are experts in the industries they serve as well. They understand the demands of a specific industry and the role played within it by

bearings. That's why we have put our expertise at the service of fitness equipment market with a complete range of deep groove ball bearings to satisfy every need.

In some difficult area, HCH also provides specific high quality grease with additives for extreme pressures. Rubber seals are also considered when the environment is extremely dusty. For further information, please contact your HCH application specialist to ensure best results.



Modern sports and fitness equipment combine very high performance capability with high levels of comfort and long life. A significant proportion includes bearings of the HCH brand which ensure unrestricted sports and leisure enjoyment. The technical know-how of our engineers ensures reliability, long life and cost-effectiveness of the bearings.

## 7.2 Skating



From everyday fun to racing, HCH are able to satisfy every needs with full range of bearings for skating. Among our customers, there are many market-leader skates manufacturers and important skating racing teams. We believe that some of their successes derive from working together with the HCH's professional skill. HCH also enjoys itself in sponsoring world famous skating races especially in Brazil and USA.

### Leisure skating

Fitness skating becomes popular in the beginning of the 1990's when more and more people came together to practice inline skating. At the end of 1990's, a skating bicycle started to be popular. Because skating bicycle needs no professional skill even without any training, from the child to adult, people enjoy the fun by this equipment. To faster the speed, engineers improved this equipment with electric motors inside to replace manual moving. Since then, it becomes to be a miniature vehicle, which is also enjoyed by students and office people to ride instead of bicycle. HCH bearings have been supporting leisure skating since the beginning.

### Sports skating

It is usually practiced by 4 wheels skates with short frames for higher mobility. Sports skating could be divided in function as aggressive skating (in which skateboard can be also included) and skate racing. Aggressive skating means pushing the limit of extreme practices, having fun with stunts and figures while skating on skate-parks, streets and sidewalks. Equipment like bearings must survive to 3 meters and over high jumps! For racing games, there are several big events like Roller World Cup, National Cups and Championships, and many more everywhere in the world, Speed and reliability become the most important in that area. For all of them, skaters need the best bearings.



Deep groove ball bearings of the HCH brand ensure that the rollers on inline skates and skateboards run smoothly and easily. Even at high speeds such as those achieved by sports skaters, these bearings have very low friction and can even withstand the vibrations occurring in travel over uneven ground or in jumps.



### HCH bearings for skating

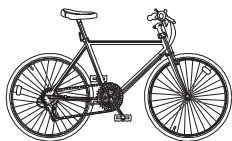
608 bearings and other miniature bearings are usually applied in the skating. HCH bearings are made from high quality chromium steel with the standard grease applied. In addition HCH high precision standard satisfy skating players who want to have access to the best bearing technology, which brings the absolute combination of low friction and extreme robustness as well as maintenance free.

HCH can support makers to meet their requirements with a number of proven quality solutions including:

- > Standard rolling: standard grease filling
- > Good protection against dust: 2 metallic shields
- > Excellent robustness: made of world class cleanest chromium steel
- > HCH average precision standard, optimized internal clearance for skates bearings



## 7.3 Bicycles



HCH has put its expertise at the service of bike market to satisfy every bikers needs from racing to everyday fun. 5 years ago, cooperating with famous bicycle producer LOOKCYCLE, we have developed extreme thin series ball bearings for the bottom bracket unit of bicycles. By now this has become a standard feature in almost all high quality bikes. After taking a close look into the biker's demands and wishes of today, we found plenty of room for improving the reliability, durability and all-round-performance of this most critical part of any bicycle. Currently, HCH offers an absolutely unique solution for mountain, road and trekking bikers that ask for a truly reliable BB-set.

ity and all-round-performance of this most critical part of any bicycle. Currently, HCH offers an absolutely unique solution for mountain, road and trekking bikers that ask for a truly reliable BB-set.

### Mountain bike

The nature of mountain bikers is always to have fun and being active without limits. When doing so, the bikes have to withstand high loads and forces, which can lead to destruction and early failures. HCH are offering a variety of thin series ball bearings that can survive from different kinds of impacts. It gives you security and good feeling to ride wherever you like and forget about possible failures.

### Road bike

Road cycling is a passion, which is shared by many bikers across the world. They love to spend hours on their bikes by covering many kilometers in highest possible speed. It is vital for those that the bike is light and functions perfectly. We have put a lot of efforts to design light but reliable ball bearings for BB, which nevertheless fulfills these needs for many years.



### HCH bearings for bicycles

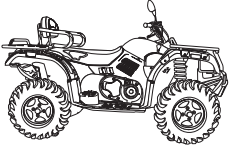
HCH thin series bearings and other miniature bearings are usually applied in the bicycles. At the same time, it allows for great freedom in designing both optimized cranks and bottom bracket units. The bearings are made from high quality chromium steel with the specific grease applied. Especially in road bikes, many bikers rely on light and convenient packing way. HCH developed extreme thin series ball bearings to satisfy the biker's light, easy for carrying requirement. In such kind of bearings, cage is also specially designed with crown shape.

Our goal is to be recognized as a leader in bearing solutions for performance of bicycles. By understanding that the bearing performance is part of a complex system, HCH can offer the competitive advantage you need in sealing, lubrication, and material to a variety of bearing types.



Our range offers maximum benefits to motorcycle manufacturers and their customers, including an extended operating life of the bicycles thanks to highly-developed and weight-optimized bearings. We support our customers with environmentally-friendly products and offer them perfection by optimizing costs, performance and quality in an integrated approach.

## 7.4 Recreation Race Vehicles



Except for cars and motorcycles, there are a variety of race vehicles currently all over the world such as lonestar racing, snowmobile racing etc. They are generally called recreation race vehicles. Under the harsh conditions of recreation race vehicles exposed to the vehicles are experiencing bearing failures in the form of material wear as that there was not enough reliability to make it through practice on Saturday and the race on Sunday. To avoid losing a race over failed bearings, the bearings are normally changed out on Saturday night.

bearings, the bearings are normally changed out on Saturday night.

We have an end-user come to us in USA who meets the problem with bearings in the vehicle that can easily fail during the competition. He provided us the temperature data taken under competition conditions. So we specified high temp double lipped seals, high temp synthetic grease and all in a greased-for-life package, and told him to leave off the grease fitting. The HCH bearings were installed and away we went. Instantly the failures disappeared and not only were the HCH bearings running whole weekend, they were running multiple race weekends with no failures.



### HCH bearings for recreation race vehicles



There are a lot of cheap bearings out there these days. They stack up easily when a little snow, salt, dirt or water ingress inside. It happens to bearings in the field in recreational products applications which destroy the dream of players. By applying HCH bearings, customers will be surprised to find that result is much better than what they can expect.

Following listed two bearing applications for recreational race vehicles and the requirement for these two applications:

|   |   |
|---|---|
| <p><b>Deep groove ball bearings for crankshafts, transmissions, and differentials</b></p> | <ul style="list-style-type: none"> <li>&gt; Single row deep groove ball bearings in popular sizes</li> <li>&gt; High capacity and special heat treatments available for long life</li> <li>&gt; High quality clean bearing material for long life</li> </ul>  |
| <p><b>Deep groove ball bearings for wheels</b></p>  | <ul style="list-style-type: none"> <li>&gt; Full line of 6 series ball bearings in popular sizes</li> <li>&gt; Steel cage or glass filled nylon cage</li> <li>&gt; Available with a variety of sealing options</li> <li>&gt; Greased for life with rust inhibiting greases</li> <li>&gt; High temperature versions available</li> </ul> |

Through targeted research and development, constant increases in quality and an intensive exchange of experience with manufacturers and drivers, we have increased our bearings' functionality and operational reliability and at the same time minimized friction. Vehicles that are fitted with high-quality HCH rolling bearings have become generally more efficient and more reliable, and as a result more competitive.





## 8. Automobile

The automobile industry is going through a period of unprecedented change. Computer technology is moving into control and monitoring arrangements for many vehicle systems. Demand continues to increase for improvements in energy consumption, safety and comfort. Accordingly, demand is also rising for high-performance motors for advanced control systems. These sector's products are almost precision machinery components and enable us to maximize our competitive advantages. HCH offers the high reliable bearings for rotary components of automobiles as a business that offers outstanding medium to long-term growth potential and will actively cultivate new demand for these products. Now, it is the exciting and challenging times for all involved in engineering vehicles and vehicle systems.

For the aftermarket for cars and commercial vehicles, HCH has distribution partners all over the world. Our concept is to offer high quality products and premium services to our customers, whether your profession involves maintaining vehicles or supplying products to those who do. As a knowledge engineering company, HCH is much more than a components supplier. Our partners' engineers are well trained directly by HCH to be an expertise to improve overall system reliability, safety and efficiency.



The HCH developed bearing is recommended for use in various automobile parts used under high moments and heavy loads, we can expect further improvement of fatigue life in HCH with improved material and heat treatment.





## General requirements for automobile

### Maintenance free

For both manufacturers and drivers, it is of utmost importance that all vehicles demand as low maintenance efforts as possible. Because maintenance means standstills and standstills mean loss of income. To meet these needs for reduced maintenance, HCH has been always trying the best to improve its bearings' quality and steel material to sustain long HCH bearings' long service life.



### Save power by reducing friction

Reduced energy consumption is of ever increasing importance. The most important for HCH bearings is to reduce the friction inside, by choosing low-friction grease, optimized seals and shields design. With HCH systematic quality control, we offer you with the best application solution for your automobile motor energy saving purpose.

### Reduce vibration and noise levels

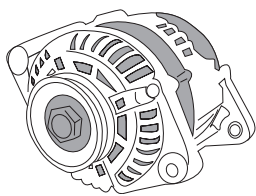
Excessive vibration and noise levels associated with automobile are an increasing concern for optimum performance reasons as well as for compliance with legislation. HCH offers a range of solutions for exceptionally quiet bearing operation, spanning from selection of bearings and lubrication to advanced engineering services, such as dynamic simulation, virtual testing and design concepts.

### Environmental friendly

Our products represent a significant contribution to environmentally friendly mobility. As an engineering partner and supplier for almost all automobile manufacturers, we develop and manufacture forward-looking products and system solutions for alternators, engines, transmissions, steering system, metro-electricity and chassis. We use our "advance development and product innovation" process to work on requirements and solutions for the future.

## 8.1 Alternators & Starter Motors

### Alternators



An alternator is a rotating machine supplying power for a vehicle's electric system and charging the battery. The increasing demand for electrical power in cars and the quest for weight reduction is driving the development of high power alternators: more compact alternators, more current producing. This development trend is pushing up alternator speed and operating temperature. Both factors are significant in the selection of a suitable bearing solution.

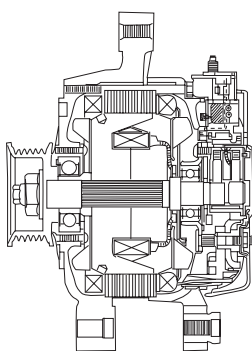
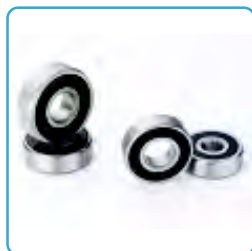
Alternators work in a difficult environment. Engine assembly packaging has often exacerbated this condition by placing alternators in locations where they are more exposed to road-spray or close to the high temperature of the engine's exhaust system. With the requirement for operation in cold-climate starting and hot-climate motorway conditions, alternators must span a very wide operating temperature range, typically from 40 °C to highs approaching 200 °C. High speed alternators run at three to four times engine speed, so the alternator will be subjected to speeds, albeit for limited periods, in excess of 20,000 rev/min.

### HCH bearings for alternators

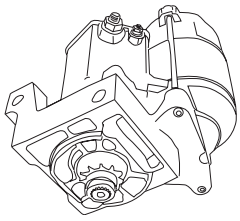
It is important to make various improvements in response to requirements for high-temperature, high-speed performance. Some technical breakthroughs in HCH have been achieved which have contributed to HCH alternator bearing specifications being what they are today. The most noteworthy among them was the development of new grease which eliminated the peculiar problem of early flaking in the outer rings of alternator front bearings. The breakthrough of high-temperature resistance seal material has greatly improved the life of automobile alternator bearings.

High efficiency type alternators as shown in the left picture and water cooled alternators have been developed in order to improve power generation efficiency and lower noise level, and for these rotor support bearings, extremely high heat resistance is required in most cases.

The research and development of new seal structure for alternator bearings to meet the escalating requirements of our customers is ongoing at HCH.



HCH has already developed alternator bearings for high temperature of 180 C and 200 C, based on those for generally required temperature of 150 C, and they are now in mass production.



### Starter motors

Most people don't think much about their starter motor until it stops. Car starters and truck starters have to deliver loads of torque for cranking vehicle engines in all conditions. In cold weather, battery drain and oil viscosity take their toll on the starter motor. In hot weather, starter heat soak can lock an iffy starter up. Either way, you're not getting anywhere if your starter motor decides to give up the ghost. Moreover,

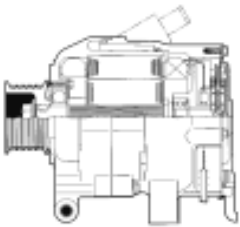
high-torque starter motors and gear-reduction starter motors are available for a high-performance or race engine. We've got you covered there too.

### HCH bearings for starters

All of HCH bearings for car and truck starter motors meet rigorous quality standards and are guaranteed to work with your application. Since starter motors face a wide range of temperature and the operating speed are usually high (can reach 10000 rpm), HCH offer synthetic grease that can suffer the temperature range of -40 C to 200 C. with good fatigue resistance characteristics. For the rubber sealed bearings, HCH offer optimized sealing design for your requirement of high running speed and low torque.



### Starter generators



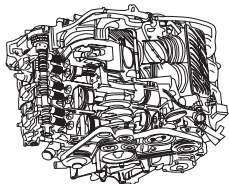
Recently, a starter generator show in the left picture, a new type of alternator with an added function as a starter is already in the market. The purpose of a starter generator are: an easy drive change from a motor to an engine, smooth re-start after a vehicle or an engine stops, and regeneration of brake energy while hybrid vehicles are running. By adding starter function, higher belt tension is required and higher load is imposed on

the bearing at start time, and then a higher capacity bearing is needed. For drastic reduction in fuel consumption in the future, hybrid technology of an electric motor and gasoline engine as exemplified in idle stop is requisite. Starter generators are thought to be increasingly used in the future as essential accessories for hybrid vehicles. As the basic construction of a starter generator is similar to that of an alternator, the required specifications such as maximum rotational speed, heat and environmental resistance, and vibration resistance can be fulfilled by HCH technology accumulated in the alternator bearing development.

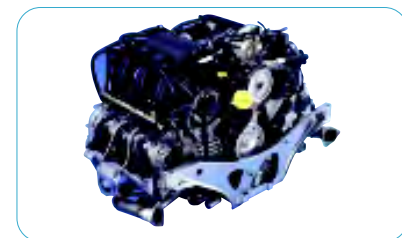
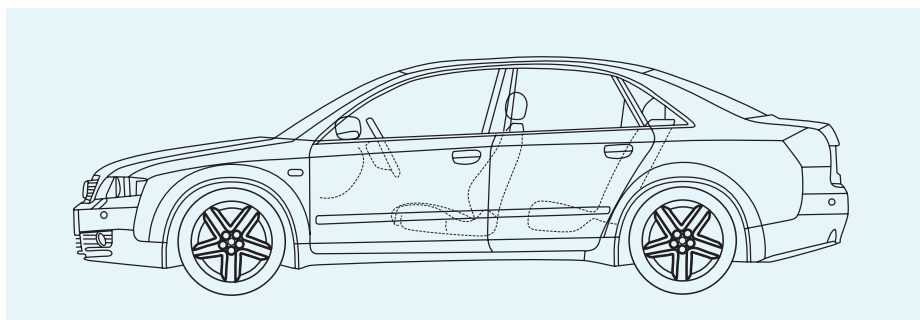


Bearings of the HCH brands are characterized by high performance density, long operating life and maintenance-free bearing solutions in various installation points.

## 8.2 Engine system



Today's petrol (gasoline) and diesel engines are highly sophisticated and computer regulated devices. The substantial gains seen in recent years in economy and emission levels have been, in the main, due to the very complex and detailed control provided by modern ECU engine management systems. For most of cars, gasoline engines are applied. However, for many heavy vehicles, diesel engines are widely applied.



### Cooling system, pumps and fans-- Electric cooling fan motor for engine radiator and air conditioning condenser

Air-conditioning condenser and engine radiator are typically grouped together as a unit at the front of the engine compartment. Automatic air-conditioning systems require efficient and frequent condenser cooling. However, high demands for reduced fuel consumption, longer service life and extended warranty periods impose higher requirements on engine thermal management. Therefore, recent developments further focused on electric water pumps, motorized fans between engine and radiator, as between heater matrix and the vehicle's interior. Usual performance features requested for engine radiator and air-conditioning condenser cooling fan motors are:

- > Compactness
- > Silent running
- > Mechanical and electric components compatibility with frequent and occasional severe contamination
- > Longer service life including systematic running from engine start.
- > Low friction torque for saving electric energy particularly at low operating temperatures.



It goes without saying that social demands for automobiles will continue to rise. HCH would focus on intelligent, modulated, innovative technologies to meet the increasing demands for the future.



### HCH bearings for cooling system, pumps and fans of engines

HCH low friction deep groove ball bearings with optimized clearance improve fan running accuracy, power full and silent air flow and contribute to a long service life for the complete motor assembly. HCH has developed a wide variety of innovative solutions. In our work, we continue to aim at combining reduced fuel consumption, emissions and noise with best performance and cost-effectiveness.

### Chain / belt shaft load

The tangential loads on sprockets or pulleys when power (load) is transmitted by means of chains or belts can be calculated by formula:

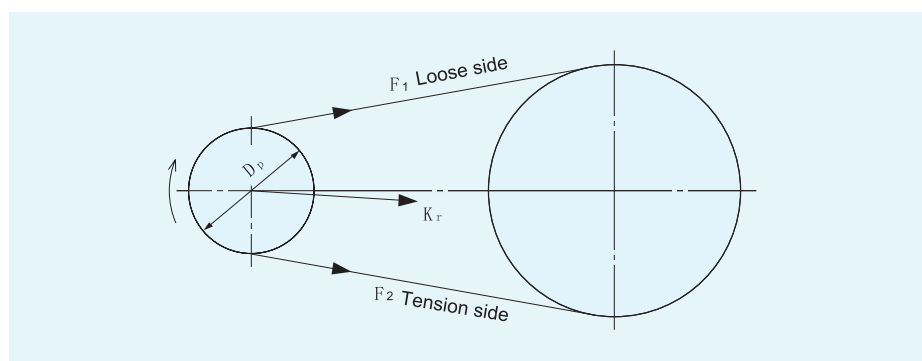
$$K_t = \frac{19.1 \times 10^6 \cdot H}{D_p \cdot n} \text{ N} = \frac{1.95 \times 10^6 \cdot H}{D_p \cdot n} \text{ kgf}$$

where,

$K_t$ : Sprocket/pulley tangential load, N

$H$ : Transmitted force, kW

$D_p$ : Sprocket/pulley pitch diameter, mm



For belt drives, an initial tension is applied to give sufficient constant operating tension on the belt and pulley. Taking this tension into account, the radial loads acting on the pulley are expressed by formula. For chain drives, the same formula can also be used if vibrations and shock loads are taken into consideration.

$$K_r = f_b \cdot K_t$$

where,

$K_r$ : Sprocket or pulley radial load, N

$f_b$ : Chain or belt factor

| Chain or belt type             | $f_b$   |
|--------------------------------|---------|
| Chain (single)                 | 1.2~1.5 |
| V-belt                         | 1.5~2.0 |
| Timing belt                    | 1.1~1.3 |
| Flat belt (w / tension pulley) | 2.5~3.0 |
| Flat belt                      | 3.0~4.0 |



Innovation continuously increases the standard of technically based products. Keep updated is critical for automobile transmission manufacturers. We offer our customers perfectly coordinated system solutions. This means that you receive drives and bearing supports from one source and can therefore benefit from entirely new opportunities in performance and design.



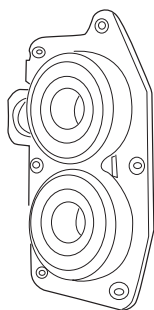
## 8.3 Driveline

A car's driveline is normally considered to include everything from the clutch through to the driven wheels.

### Gearboxes

The gearbox can be considered as a translator working between the engine and the wheels of a vehicle. Or put it another way, it is the gearbox, that enables the engine to answer the driver's request for power in any driving condition, whether the need is for high torque at low speed in hill climbing or for high speed at low torque on the motorway. It is the gearbox, that allows the engine to run in a balanced state and at an appropriate level.

As old as the car industry, there is a strong need for continuous development and innovation in gearbox designs. There are two gearbox designs currently common in car production: one are manual transmission, and the other is automatic transmission. The demands are coming from the market, such as reduction of fuel consumption and noise, improvements in drivability and, last but not least, the "fun-to-drive" factor. HCH contributes to meeting these targets by offering high quality anti-friction bearings.



### Bearing carrier

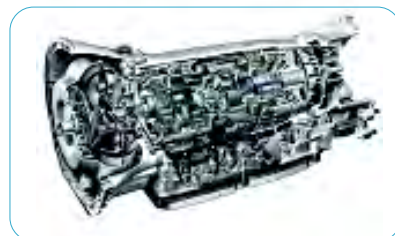
In a car gearbox, the accuracy and stability of the gear wheels' relative position on the main shaft and the layshaft is vital for the correct functioning of the gear mesh. Directly linked to this is the noise and friction behavior of the gearbox. In order to have a stable condition, it is important to have a rigid support of the mainshaft and layshaft. In transmissions with a high power density, this requirement can be enhanced by bearing carrier unit consisting of a sheet metal carrier, and two bearings (typically either deep groove ball bearings) pressed into the carrier. The bearing carrier offers potential for cost saving on the gearbox assembly line. Pre-assembling

the gear shafts in the bearing carrier and then mounting this complete assembly in the casing can be a significantly simplify to the assembly process.

### HCH bearings for gearbox

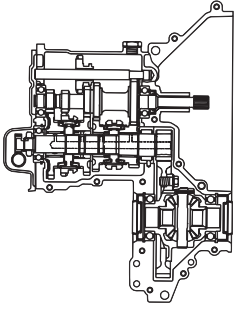
HCH high efficiency tapered roller bearings and ball bearings are used primarily on the pinion and differential shafts in the final drives of rear-wheel drive or all-wheel drive cars. This new improved level of efficiency is possible through the detailed application of HCH's comprehensive theoretical knowledge and specialized manufacturing know-how. HCH high efficiency tapered roller bearings offer reduction of bearing power loss and increased service life by optimized bearing

design which adapts to the external loading conditions. HCH deep groove ball bearings in the gear box usually appear as a pair with located position in the pre-assembled unit bolts onto the gearbox housing. With high quality bearing material and optimized seal construction, we meet our customers' demand with their satisfaction.



Research and development on drive lines to improve fuel consumption is making progress. HCH would focus on attractive product and technology development to meet the increasing demands for the future.





### Transmission & Gearbox bearings and HCH solution

Bearings used in transmission or differential gears are usually lubricated by oil containing foreign particles such as swarf, burrs produced when parts are machined, worn powders of gears, and debris from the case. Particularly, the failure mode of bearings under lubricating conditions including hard foreign particles is surface flaking originated at the edges of dents due to roll-over of foreign particles or surface layer peeling caused by abrasive wear. With ordinary bearings, life is shortened to one of several parts to one of several tens of parts of that in clean oil. Therefore this problem is solved

either by the material/heat treatment or the sealing technology improvement as indicated below:

#### Material/heat treatment technology solution

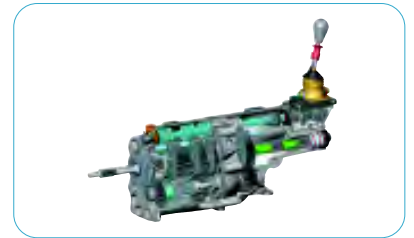
With tapered roller bearings, life is extended by applying HCH's original carburizing steel materials and heat treatment technology. In order to reduce crack propagation and cracking and at the same time for early elimination of dent edges due to foreign particle, a special heat treatment to raise surface hardness and optimize the amount of retained austenite was developed, which extremely extended the bearing service life.

#### Seal design solution

Regarding sealed ball bearings in transmissions, entry of foreign particles in the oil into bearings is drastically reduced and running torque is also lowered by the HCH optimized seal lip design to minimize the amount of interference change relative to misalignment and axial gear load. The rubber material of the seal is selected considering heat resistance and compatibility with oil. The bearing is filled with grease and sealed to improve initial lubricating performance.

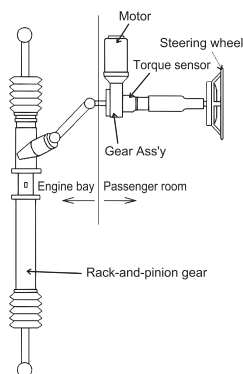
#### Coping with high load and high moment

Along with making units like transmissions more compact and lightweight, more compact bearings are demanded. On the other hand, engine torque increase and weight reduction of casing bring increase in bearing load and in shaft deflection, resulting a harsh condition for the bearing. As a result, particularly with tapered roller bearings have line contact; life is often shortened due to the edge stress. Based on the results of rigidity analysis of case and shaft systems using the latest computer technology, HCH has developed a special crowning shape in the axial direction that makes contact stress distribution of the area where the rollers contact with the raceway uniformly based on the results of rigidity analysis of case and shaft system, and is now mass producing the bearing with such technology. The life is around 3 times longer compared with an ordinary bearing.



At HCH, we have worked primarily to improve materials and heat treatment methods as well as develop new bearing internal designs that can operate under higher and moment loads and apply these to long-life bearings.

## 8.4 Steering System

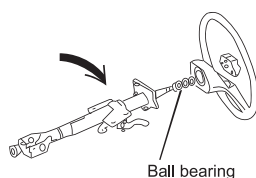


Vehicles have three basic functions: moving, turning and stopping. Turning is the job of the steering system. Steering systems are mechanisms by which turning displacement of the steering wheel is converted to turning of the tires via the steering gear. Various types of rolling bearings are used in the various rotational mechanisms of steering system. The main steering system from the steering wheel to the tires consists of the following components:

- >Steering column
- >Steering gear
- >Hydraulic pump

### HCH bearings for steering column

One ball bearing is used on the upper side and the other is on the lower side as column shaft support bearings. This series ball bearings are used due to limited space. Because the radial and axial play of the steering wheel should be minimized, the residual radial clearance of the bearing after mounting should be very small even slightly negative. HCH are able to supply these kinds of bearings with optimized clearance.



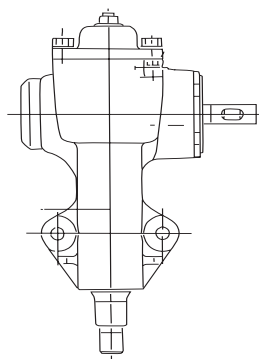
Moreover material with high purity and long service life is heat treated by most advanced machines.

### HCH bearings for steering gear

Steering gear bearings are usually for rack-and-pinion type steering. For this application, axial and radial loads are produced by gear reaction. Axial load is supported by the deep groove ball bearing. Since the axial load being placed on the bearing is usually high, and therefore thorough consideration should be given to the allowable axial load of the bearings. In the case of power steering, bearings are also used in the torsion bar, if the clearance after assembly is a source of noise, deep groove ball bearings are used and clearance after assembly is made negative.

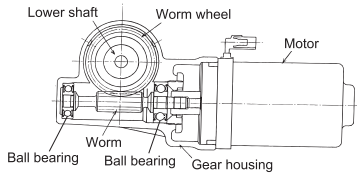
### HCH bearings for pumps

Ball bearings are used for pulley support of the engine-driven hydraulic pump (vane pump), which serves as the power source for hydraulic power steering. The configuration is shown in the picture. The side of the bearing facing the pulley is exposed to the air in the engine bay, so the bearing must be sealed. Furthermore, the bearing must have a small running torque in order to minimize energy loss. Therefore, HCH has developed a very light contact type seals for this application. However, if the bearing is mounted near the road surface in the engine bay, HCH contact type seals are used so that muddy water can't get into the bearing if it gets on the bearing from the pulley side.



The performance required of bearings differs somewhat according to the part in which the bearing is used. Excessive axial play must be avoided for parts that affect steering feeling, such as the steering column and steering gear.

## Electric power steering



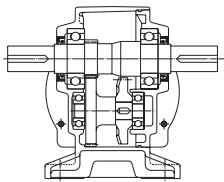
Electric power steering (EPS), which uses an electric motor as its power source, is now being used increasingly in the place of engine-driven hydraulic power steering because it reduces energy loss. Regarding the features of column type EPS shown in the picture, because the motor, reduction gear and other parts com-

posing the power assist mechanism are concentrated on the column, a manual steering system can be converted to a power system merely by changing the column unit. Basically, only the motor and the reduction mechanism are added, and therefore column type EPS is much lighter and more compact than a conventional hydraulic power steering system.



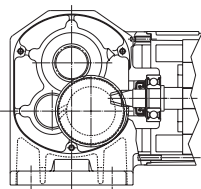
### HCH bearings for reduction gear and electric motors

Two deep groove ball bearings are used for worm shaft support. The pre-load is applied from the outer ring side of the motor side bearings. The axial and radial loads produced by reaction of the worm gear are supported by the two bearings. Quiet operation is especially important because it is located in the passenger room, and sufficient consideration must be given to noise regarding these bearings.



Brush-less permanent magnets motors will provide better steering feel due to lower rotor inertia. A brush-less approach will typically provide a longer service life than brush equivalent. The usual performance criteria requested for electric motors are:

- > Silent running
- > Mechanical and electric components compatible with frequent and occasional severe contamination
- > Long service life including resistance to knocks and shocks which may occur during vehicle maintenance
- > Low friction torque, conserving battery power



Accordingly, HCH endeavor to develop bearings in electric motors for driving hydraulic gear pump or worm gear reducer with following characteristics:

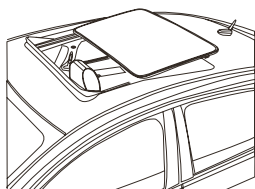
- > Torque reduction
- > Improved stiffness, under low and high load
- > Low friction for reduced energy consumption
- > Longer service life with HCH high quality bearing material and advanced heat treatment technology



Electro-hydraulic assisted steering, where the hydraulic pump is driven by electric motor, are also becoming more common. In this case steering power is supplied with the required amount of energy for a relatively short duration.

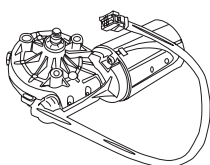
## 8.5 Metro-electricity

Integrating mechanical systems with electric power lead to more efficient, reliable and safer products. These applications are used everywhere in vehicles such as air conditioning, engine radiator, automatic window lifter, wipers and various sliders. Serving OEM customers of these applications for many years,



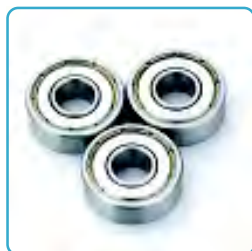
### Sliders

When it comes to various sliders, drivers' comfort is paramount. Effortless control of equipment movement and low operating noise levels should be considered. These features increase comfort for drivers and optimize driving conditions.



### Wiper motors

One of the most obvious components in this section is wiper motors which are applied with the requirements of silent running and low friction torque for continuously variable speed and permanent rotation.



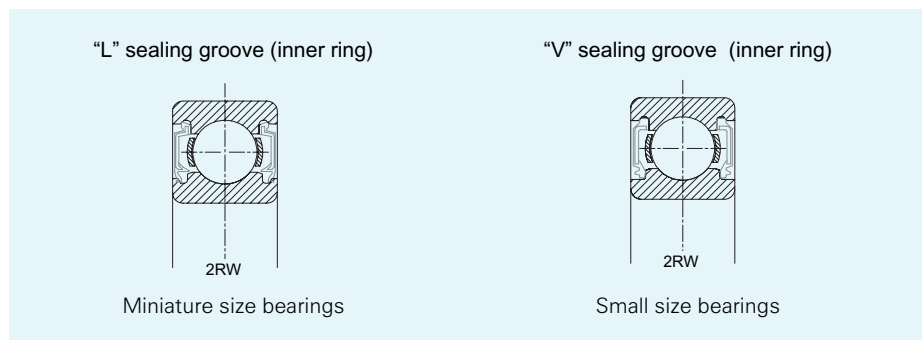
### HCH bearings for metro-electricity appliances

HCH low friction deep groove ball bearings with optimized clearance improve motors silent running. What is more, now HCH is improving the seal lip design (2RW) in new ball bearing series production with new sealing standard and improves sealing properties like:

- > Low friction
- > Speed ability
- > Long service life
- > Grease retention
- > Dust exclusion
- > Static and dynamic high pressure water exclusion

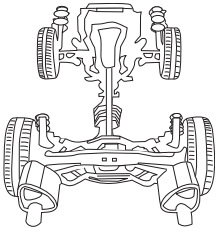


HCH has developed unique application knowledge. We have been able to develop a number of standard and customized solutions. In this work, we continue to focus on our customers by supplying ultra low noise and low vibration, low friction and low torque bearings.



This is a new generation of bearing seals, which offers more possibilities and a wide range of applications. Low-friction HCH ball bearings make shifting easy. In contrast to steel-steel solutions, these rolling bearings offer consistent, low radial internal clearance for the shift drum and wear-free operation.

## 8.6 Chassis

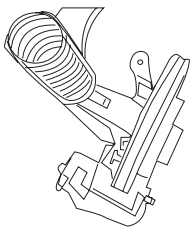


To be cost-effective, these applications need to be compact and require a minimum of maintenance, but there is also an urgent need for these to contribute to increased safety for operators. To meet these demands, HCH offers a wide range of high reliable bearings. For improved cost-effectiveness, the HCH bearings are maintenance-free and facilitate downsizing.

### HCH bearings for chassis

Ball bearings with integrated seals that have been lubricated for life are the preferred choice due to their shock resistance and smooth operation. Their low friction and low wear also contribute to fuel savings. HCH offers bearings with the characteristics as following:

- > HCH high quality, ultra clean steel material can improve bearings' liability further than customers' expectation.
- > HCH synthetic grease with multi-temperature function further strengthen the bearing reliability in different working environment.
- > HCH bearings with special designed sealing structure with three sealing lips for better dust preventing function.
- > HCH customized clearance selection system guarantees the bearing's high efficiency and prevent bearings from creep.



### Suspension

A vehicle's suspension must:

- > Carry the vehicle mass.
- > Ensure contact between the tyre and the road.
- > Isolate the chassis from the disturbances created by the interface between tyre and road.
- > Guide the wheel in its displacement.



Bearing applications in chassis and attachments are commonly exposed to heavy loads, often in rough working conditions. HCH bearings are designed for tough working environments and also offer minimal environmental impact.

### HCH bearings for suspension

Bearings under vehicles' suspension system are usually under very high loads and in very harsh environment especially when the vehicles are on the muddy or dusty road. Working with world famous automotive manufactures, HCH has abundant experience of bearings for suspension. We highly understand the customers' demands on high reliability, low friction, and dust preventing products. HCH's engineering resources and consulting services can help the design engineer improve the overall functionality of suspension.



resources and consulting services can help the design engineer improve the overall functionality of suspension.





## 9. Heavy Vehicles

In the competitive heavy vehicle industry, HCH knows your requirements of low noise, long life, high quality, less friction, energy saving and anti-dust. Accordingly, demand is also rising for high-performance and maintenance free. HCH offers the best quality raw material of bearings and optimized seals solutions to sustain the long service life and operators' comfort.

HCH believes that downtime is not an option. No industry knows that better than the agriculture, mining, and construction industry, where the competitive nature of business is often fought in the world's harshest environments. To help maintain uptime and improve the efficiency needed to improve the bottom line, HCH offers a complete line of products, services, and solutions.

Over years, HCH has completed extensive research to gain a better understanding of the needs of these industries. As a result, we are able to provide reliable solutions to problems that are inherent in vibratory equipment, contaminated environments, and applications with shock load. For this industry, we provide some of the toughest and most dependable products, as well as a team of the field and application engineers to assist in protecting vital capital equipment.



HCH provides support to direct the heavy vehicle industry customers and sales partners worldwide. International sales, application engineering, the relevant product lines as a service provider help our customers find solutions for how are HCH reliable bearings dealing with your problems.



## General requirements for heavy vehicles

### Productivity

In the heavy vehicle industry, equipment precision is continuously being improved. Take agriculture for example, When working in the field, higher accuracy means improved productivity for the farmer. To the landowner in intensive agriculture, it is vital that every square meter of land is used in the most efficient way. Since precision is a key issue to HCH's customers, it's also a key issue to us. Therefore, we combine profound knowledge in bearings with low friction materials, optimized seals structure, clearance as well as the lubricants.



### Comfort

For operators of heavy vehicles, it is absolutely vital that an optimal comfort level can be obtained during the often long working days. Avoiding stress and fatigue is an important way to keep productivity up. At HCH too, comfort is a prioritized area. Therefore, we offer both original equipment manufacturers and end-users a range of excellent and reliable solutions that generate a high level of comfort as well as high productivity. Behind our mechatronics solutions, lies sound bearing and lubrication knowledge combined with high quality materials, low friction and surface treatment expertise.

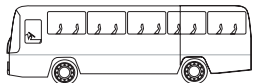


### Environmental friendly





Due to the increasing environmental awareness in the market and stricter exhaust emissions and noise legislations, the development of engines used in heavy vehicles strives towards environmental friendly solutions. In addition, rising fuel prices affect the market greatly and engine designs are optimized in order to reduce emissions. For this, HCH has developed a wide variety of innovative solutions to provide performance durability as well as environmental friendly solutions.



## 9.1 Trucks & Buses



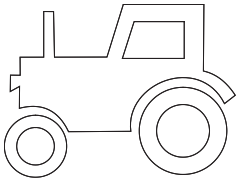
The commercial transport market is extremely competitive. Whether the operation is in Europe or in North America, ensuring vehicles are on the road is a prime focus for all areas of the industry. From designers working on the next generation of vehicles to a fleet's service manager, providing reliable on-road operation with extended yet flexible service intervals now drives much of the thinking.

|  |   |
|--|---|
| <p><b>Power train</b></p>                 | <p>By offering not only advanced application competence, but also a wide range of innovative and environmentally sustainable solutions for power train of trucks and buses, HCH is a competent engineering partner. By fast delivery and high quality product offering, we add further value to your equipments.</p>  |
| <p><b>Chassis &amp; attachments</b></p>  | <p>The working environment for chassis and attachments in trucks and buses is tough. To be cost-effective, these applications should require only a minimum of maintenance, but also contribute to increased productivity as well as comfort and safety. To meet these demands, HCH offers a wide range of special designed seal structure and lubrication solutions.</p> |
| <p><b>Mechelectricity</b></p>           | <p>For this application in trucks and buses, drivers' comfort is critical. Effortless control of equipment movement and low operating noise levels should be considered. HCH's engineering resources and consulting services can help the design engineers to improve the overall comfort and fuction of metroelectricity.</p>  |
| <p><b>Engine</b></p>                    | <p>Truck engines are going through significant technology upgrades, with legislation changes. In addition, engine designs are optimized in order to reduce fuel consumption. HCH offers bearing products with optimized sealing structure and customized grease choices to save energy and particulate emission levels.</p>   |



In collaboration with our customers' design specialists, we have developed a wide range of specific solutions for engines, transmissions, and running gears as well as for special applications. The know-how provided by HCH experts guarantees the highest quality and optimum coordination for every area of this application.

## 9.2 Agriculture



Rough working conditions and heavy loads are not the only factors that put great strain on today's agricultural machines and equipment. Along with end-users' constant demands for enhanced performance and cost-efficiency, these circumstances present a great challenge to original equipment manufacturers. For optimum result, we offer everything from perfectly adapted, customized solutions to well-trying and reliable standard products and solutions.

|   |   |
|---|---|
| <p><b>Power train</b></p>                  | <p>Agricultural equipment is designed for maximum power density and minimum power losses. At the same time, the demands for reliability and cost-effectiveness are high. HCH offers you standard and customized solutions, sealing solutions for harsh environment. By worldwide HCH distribution availability, we can offer you fast delivery time.</p>  |
| <p><b>Chassis &amp; attachments</b></p>  | <p>For this application, bearings are commonly exposed to heavy loads, often in muddy and dusty working conditions. These applications should be extremely reliable. HCH offers a wide range of high quality bearing products which are designed for tough working environments and also offer minimal environmental impact.</p>  |
| <p><b>Mechelectricity</b></p>            | <p>Integrating electronic solutions with the mechanical systems traditionally used in agricultural applications, often improves farm productivity as well as operator safety and comfort. By being at the forefront of this technology for many years, HCH has developed unique application knowledge. We have been able to develop a number of customized bearings for these solutions.</p>                                      |
| <p><b>Engine</b></p>                     | <p>Due to the increasing environmental awareness in the market and stricter exhaust emissions and noise legislations, the development of engines used in agricultural vehicles strives towards environmental friendly solutions. For this, HCH has developed a wide variety of innovative solutions and bearing products to achieve combining reduced fuel consumption and emissions with performance and cost-effectiveness.</p> |

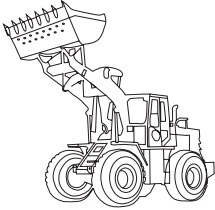


You can rely on efficient sourcing worldwide, solutions for a more efficient mounting process, and shorter time-to-market. HCH rolling bearings significantly contribute to the outstanding performance of a large variety of agriculture equipments worldwide.





## 9.3 Construction & Mining



It's not only the heavy loads but also the tough working conditions that put pressure on modern construction machines and equipments, the users' ever-increasing demands for performance and cost-efficiency add further to this pressure. Living up to these demands is a tough challenge to the world's equipment manufacturers.

### Power train



Construction equipment is engineered for demanding duty, often in harsh environments. This requires power train applications that to be reliable and efficient, as well as functional and cost-effective. We offer you standard and customized solutions that are pre-set in the factory, heavy-duty sealing solutions.

### Chassis & attachments



There is an urgent need for operator comfort and safety. Whether your bearings are suffering from contamination and over consumption of grease in your roll neck applications, excessive loads, or if you're just looking for a fresh approach to achieving maximum uptime, HCH has the answer.

### Mechelectricity



Integrating mechanical systems with electricity solutions leads to more efficient, reliable and safer products. HCH endeavors to design and produce bearings with standard to meet customers' requirement. We continue to focus on our customers by enhancing quality, design flexibility and total cost optimization.

### Engine



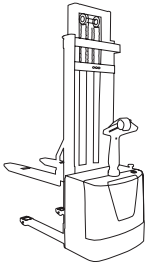
The development of engines used in construction vehicles strives towards environmental friendly solutions. Keeping the correct balance between price and performance is a real challenge. For this, HCH has developed a wide variety of innovative solutions and bearing products to provide performance durability as well as sustainability.



The construction and mining industries require high performance equipment for efficiently carrying out construction and mining projects. To achieve and ensure this efficiency, construction equipment manufacturers consequently come to HCH bearings to expect suitable solutions from their applications.



## 9.4 Material Handling



Bearings in material handling are exposed to a number of different heavy-load environments-in addition to dirt, mud, rain and dust when used in outdoor applications. HCH medium size deep groove ball bearings and tapered roller bearings keep construction and mining machineries in production longer with less downtime. HCH products for these applications overcome contamination, debris, good resistance to temperature change, operate in poorly lubricated environments, and keep performing even with heavy loads at ultra-low speeds.

### Hand trucks, pallet jacks and walkies



Hand trucks, pallet jacks and walkies operate in highly diverse environments with varying levels of operator use/abuse. They are subject to a lot of ramming and pushing. Bearings, particularly in the mast area and wheels must be able to withstand the resulting shock loads.



### Forklift trucks



Forklift trucks used in the warehouse environment are exposed to varying loads under changing environmental conditions. Bearings must be able to withstand cold temperatures (-40 °C) when equipment is used to transport materials in and out of freezers. And, they must be able to perform properly upon returning to warmer temperatures. In addition, forklifts typically operating in a highly abusive environment where the mast, in particular, are subjected to a lot of ramming and pushing. Therefore, the ability to withstand heavy shock loads is paramount.



HCH bearings are used in the mast and bracket sections of material handling. These bearings rotate in constant contact with the masts under heavy load while the mast and bracket move upward and downward. HCH bearings are with enough compression strength to prevent wear of the masts.

### HCH bearings for material handling

HCH mast guide and chain guide bearings are specially designed for forklift trucks. Engineered to accommodate heavy radial loads, HCH bearings can withstand heavy shock loads and handle over-turning moments produced by combined radial and thrust loads. The outer diameter profile of these bearings can be customized to meet the needs of a particular application. Bore diameters typically range from 25 mm to 60 mm. A bearing is always part of a system which requires lubrication to perform well and seals to retain the lubricant and keep it clean.



## 10. Conveyors

Machines and equipments used to transport, lift or convey loads of all kinds have to meet special requirements. The working environment in the transmission industry is extraordinary and specific in different environment. For bulk conveyors, the equipments are constantly exposed to extreme temperatures, dust, contaminants and humidity that can cause costly, unplanned stops. What is more, shock loads and high torque add to this pressure. For warehouse conveyors, since they are working in house, the work environment is much better than bulk conveyors. However, special attention must be paid due to the in-house working condition such as the noise and vibration concerning as well as the working efficiency. For both bulk conveyors and warehouse conveyors, bearings are not only applied in the electric motors, but the rolling rollers as well. For unit conveyors, they are usually working in the precise production. Bearings for electric motors are their main application; bearings for rollers are usually not demanded.

One of the most important requirements for conveyor manufacturers and endusers efficient assembly. To meet this requirement, HCH has developed a range of solutions to facilitate this step in the manufacturing and assembling process. These solutions are also characterized by inventiveness, ease of use and a minimal need for maintenance. They not only lead to a cost-effective operation, with these solutions we are also able to help increasing our customers' productivity and strengthening their competitiveness. And when the product's total life-cycle costs are kept at the lowest possible level, raised revenues and optimized profitability can be achieved.



Wherever people or loads need to be moved, a wide variety of HCH bearings are used. All of these products must be able to withstand rough environmental conditions such as heat, cold, humidity and salt water.



## General requirements for transmission

### Productivity

It goes without saying that increased productivity is the key to increased profitability. For transmission equipment end-users, a smooth production process with a consistent, high-level output means secured deliveries and satisfied customers. In addition, transmission equipment producers facing global competition and environmental scrutiny seek ways to enhance efficiency and reduce costs. To meet these productivity demands from HCH customers, we rely on our experience and application-specific expertise to optimize seals solutions and clearance etc., which can help you to less unplanned downtime and most cost-effective lifecycle, further results in a wide range of enhanced productivity.



### Save power by reducing friction

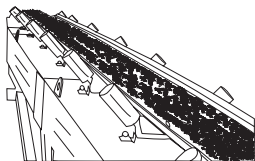
For wide using of transmission and rising cost of energy, reducing energy consumption is of ever increasing importance. We can work with you to discover the golden opportunities in designs to increase torque or downsize, enhance operational reliability and improve energy efficiency.



### Environment

Environmental concern has played one of the most important roles in most transmission producers and end-users' agenda especially under recent legal regulation in different countries. Meeting the environmental challenges is important for the company's image towards shareholders, customers, employees and the general public. Protecting the environment is also central to HCH's thinking. Bearing products with environmental material, seals and lubricants ensure our products are not harmful to surroundings of the transmission equipment. Furthermore, our low friction bearings made from precise manufacturing and optimized seal structure and low friction grease further decrease the power consumption of the transmission equipment.

## 10.1 Bulk Conveyors



All equipments in the material transferring are working under massive stress. The heavy loads and harsh working environments constantly put machinery into the dirt and other contaminants. Because bulk handling conveyors are considered as slow moving applications, bearing speed and temperatures are typically not a factor. However, heavy loads, shock loads and contamination can significantly reduce bearing service life. The usual problems in bulk conveyors are as following:

- > Loose parts (loose toggle parts, loose screen mesh)
- > Unbalance
- > Lack of lubrication
- > Impacts



### HCH bearings for bulk conveyors

HCH improved materials to enhance performance. The materials from which the bearing components are made determine to a large extent the performance and reliability of rolling bearings. HCH knows very well of bulk conveyors' working environment that fatigue phenomenon will occur to the bearing material after a duration of operation. To delay the advent of material fatigue and prevent shock loads damage, HCH takes special care of its raw material used in bearings.

The raw material applied in the bearing rings and rolling elements is 100% from the company that sell the same quality material to world leading bearing manufacturers in Japan and Europe. Also, HCH's latest computerized heat treatment system and technology distinguish HCH brand bearings from others. It helps the bearing material to reach the characteristics of high level of hardness, high rolling contact fatigue resistance, excellent wear resistance, dimensional stability and excellent mechanical strength which are essential to delay the advent of material fatigue.

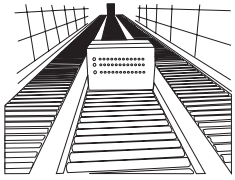
HCH bearings' optimized seal structure and clearance, customized grease reduce the cost of the maintenance. HCH knows that the slow speed makes difficult between rolling elements and raceways. In addition, the rolling bearings in continuous transferring processes are continuously exposed to extremely heavy loads. We have a variety of appropriate and high quality greases to prevent bearings' metal-to-metal contact. What is more, our optimized seal structure prevents the bearings from the threat of cooling water entering into the bearing cavity, which can dilute the lubricant and corrode the bearing. For this application, please also consult our engineers for clearance selection to avoid unnecessary creep.



HCH knows that the bulk conveyor industry expects high reliable products, also increased productivity and cost-effectiveness. The challenge is to be able to monitor performance and identify potential problems at an early stage. Thus, to understand the nature of problem is critical.



## 10.2 Warehouse Conveyors



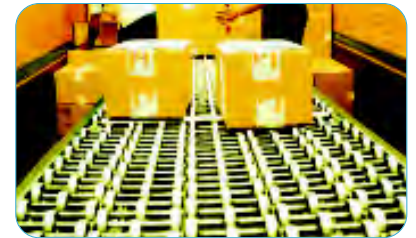
Warehouse conveyors are one of the most frequently used conveyor systems. They are used to transport parts in package form of boxes or pallets. They are most often indoors and are relatively slow speed moving, so speed and operating temperature are typically not factors in bearing selection. With the fast development in this industry, the fully automatic warehouse handling becomes realistic. However, costly shutdowns for maintenance are inevitable due to the wear of equipment components or contaminants get baked onto the bearings.

This and other problems are constant challenges to this industry. As a long-time partner to conveyor producers all over the world, HCH, with our competencies and abundant bearing application knowledge, offers a wide range of solutions, resulting in reduced costs for maintenance, and increased productivity.

### HCH bearings for warehouse conveyors

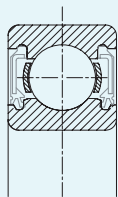


In order to delay the advent of material fatigue, HCH bearing's ring and rolling element materials adopt following properties: high level of hardness, high rolling contact fatigue resistance, good wear resistance, dimensional stability, good mechanical strength. HCH's bearing material is applying clean and homogenous steel with an absolute minimum number of inclusions. To maximize the benefits of this improved steel, HCH developed new heat treatment procedures. These new procedures further improved the wear resistance of HCH's high quality bearings.



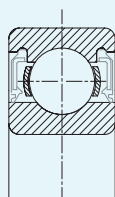
Working together with HCH, you can enhance performance by increasing torque and external load carrying capability, and achieve more compact and lighter arrangements. With our wide range of solutions, we put our competencies and business experience into practice.

HCH current seals design



"V" sealing groove (inner ring)

HCH previous seals design

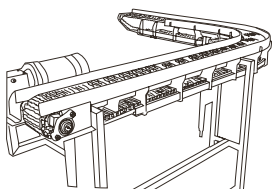


No sealing groove (inner ring)

Together, HCH's seal structure adopts an optimized design with three lips that can better prevent dust and water entering inside. Moreover, due to the low speed in the warehouse conveyors, and to avoid the metal-to-metal contact inside bearings, HCH has a variety of excellent grease types to meet our customer's satisfaction of maintenance reduction. In addition, with abundant experience of application knowledge, we can supply greases with anti-water function to the places that are moist.



## 10.3 Unit Conveyors



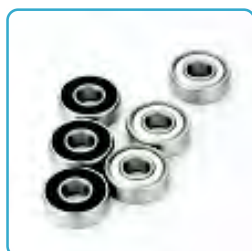
Unit conveyors are conveyor systems, often modular, used to transport parts, boxes, and other individual pieces or assemblies around a warehouse, factory or other facilities. They are most often indoors and are relatively slow moving, so speed and operating temperatures are typically not factors in bearing selection. Total rolling resistance (friction), bearing noise, maintenance requirements and personnel safety are more often the features considered when choosing bearings

for unit conveyors.

Unit conveyors are also getting progressively more “high tech” with needs for precision speed control and placement of the items being conveyed and integration of weighing and tracking systems into the equipment.

In assembly system, unit conveyor makes production more efficient, rapid and safer. All conveyors in the range are modular in design which together with the extensive choice of ancillary conveyor equipment enables the user to create a tailor made conveyor system to suit their own specific requirements.

HCH continuously provides unique bearing application knowledge. For unit conveyors, this results in a wide range of safe and reliable solutions, all aiming to reduce overall costs and meet new environmental demands.



### HCH bearings for unit conveyors

For unit conveyor equipment manufacturers, the stability and maintenance reduction are considered to be the most important since they can save cost. The unit conveyors are usually running continuously with low speed, so reliability with low vibration is critical. Therefore, naturally, HCH's solutions for the converter process focus on performance and operational reliability.

HCH purchases clean and homogenous steel with an absolute minimum number of inclusions from the world top-level steel manufacturer. To maximize the benefits of this improved steel, HCH developed new heat treatment procedures. These new procedures further improved the wear resistance of HCH's high quality bearings.

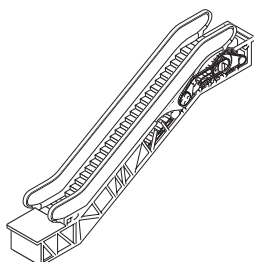
Moreover, aiming at total cost-efficiency and increased productivity, HCH has developed more efficient bearing designs and arrangements as well as improved sealing and lubrication systems. Try a quiet running, low friction and bearing requiring virtually no maintenance in your unit conveyor!



Unit conveyors are expected to work smoothly and reliably, and costly downtime should be kept to a minimum. Proper bearing selection, lubrication, and maintenance are key factors in maximizing the service life of the bearings.

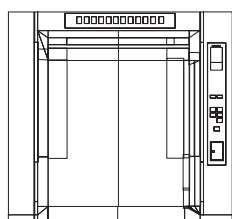
## 10.4 Lifts

Lifts are usually divided into elevators and escalators, carrying both people and goods.



### Escalators

There are well over 100 bearings in a typical escalator, with two bearings used to support each stair and several contained in the drive motor, transmission and handrail assemblies. The majority of these bearings are deep groove ball bearings operating at low speeds and moderate loads.

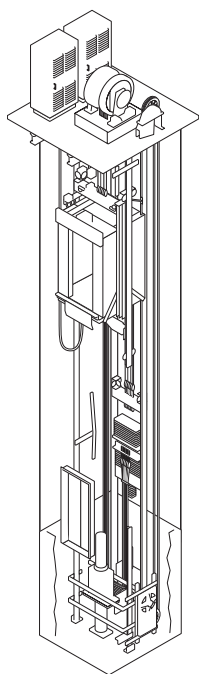


As the majority of escalators are installed in controlled indoor environments, contamination and temperature are generally not big concerns. Bearings in escalators are, however, required to be quiet running, highly reliable and low maintenance. HCH supplies bearings meeting all of these criteria. In addition, HCH can provide products and systems that allow improved control and ease of maintenance of the escalator.



### Elevators

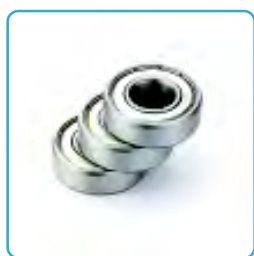
Another type of popular lift is elevators which can be classified as either traction or hydraulic types. In traction elevators, cables and electric motors are used to raise and lower the car. In hydraulic elevators, a hydraulic cylinder is used to control the car's ascent and descent. Both types of elevators use multiple bearing types, and safety and reliability are the primary concerns in bearing selection. The modern elevators are also required to be very quiet, thus the bearings must generate as little noise as possible.



### HCH bearings for lifts

HCH rolling bearings help to ensure reliable and trouble-free function for long periods of time. For years, lift producers worldwide have turned to HCH for competitive solutions. For years, HCH continuously strives to improve the quality of its products. Our expertise in bearings, services, seals, lubrication systems makes us a strong partner. With reliable standard products and solutions, we can help increase your productivity, reduce your operational costs and manage your environmental impact.

Please consult HCH bearing application expertise and engineers to select the appropriate clearance for your specific industry and work environment to prevent the creep of bearings.



Low operating temperature, high quality raw material, adequate lubrication and avoiding contamination are important factors in extending bearing service life. As the world's leading manufacturer of bearing solutions, HCH has a wide range of solutions and services to extend bearing service life and improve application profitability.



## 11. Motorcycles

The motorcycle market is becoming more and more high tech demanding in terms of performance, safety, reliability, speed and satisfaction. Extended operating life of motorcycles is via highly developed bearings with durable materials. HCH is currently supplying bearings to the major motorcycle brands in the world. In the mean time, HCH has a close and effective cooperation with our customers in research and development for new types of motorcycles as well as new bearings. In collaboration with our customers' design specialists, we have developed a wide range of specific solutions for engines, transmissions, chasises as well as for wheel system. The know-how provided by HCH experts guarantees the highest quality and optimum coordination for every area of application. In general, the benefits of applying HCH bearings includes:

- > Supporting the system cost reduction.
- > Increasing service life and system performance.
- > Reducing friction and weight.
- > Cutting energy consumption and emission.

Our range offers maximum benefits to motorcycle manufacturers and their customers, including an extended operating life of the motorcycles thanks to highly-developed components and assemblies, reduced fuel consumption, as well as increased operating efficiency through innovative engine components and weight-optimized parts. We support our customers with environmental friendly products that contribute to a reduction in CO<sub>2</sub> emissions, and offer them perfection by optimizing costs, performance and quality in an integrated approach.



Motorbike manufacturers are looking for a differentiation in terms of value recognition from the end user. Innovation. The combination of HCH new products and new solutions with a perfect integration with the original design achieve better performances leading to further technical standards.



## General requirements for motorcycles

### Comfort

For motorcycle drivers, it is absolutely vital that an optimal comfort level can be obtained during driving. Avoiding stress and fatigue is an important way to keep a good way of comfort. As for HCH, customer comfort considering is a prioritized area. We offer both original equipment manufacturers and drivers a range of excellent and reliable precision bearings to satisfy a high level of comfort.



### Save power by reducing friction

Friction causes vibration; vibration leads to noise, waste of energy and comfort troubles. HCH is equipped with advanced tools to make the best analysis focus on friction decreases. By choosing low-friction grease, optimized seals and shields design. Providing end-users with maintenance-free solutions is therefore a matter of course for the original equipment manufacturer and for HCH. With HCH systematic quality control, we offer you with the best application solutions for your energy saving purpose.

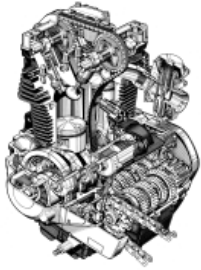


### Environmental friendly

A serious approach to environmental concerns is one of today's main issues for both manufacturers and drivers of motorcycles. Complying with ever changing environmental legislations is expensive but necessary. Here, HCH's expertise and innovative approaches to lubrication optimization, noise dampening and emission reduction is particularly valuable. With our lubrication and low friction solutions for bearings and seals, we reduce CO<sub>2</sub> emissions as well as grease and oil leakage, which helps protect the environment. Moreover, reduced fuel consumption and increased cost-efficiency is achieved by weight-optimized bearings through HCH highly reliable raw material.



## 11.1 Engine



Engine is the most demanding part from performance for motorcycles in respect to high power and speed conditions, reliability and long service life. The special feature of engine includes easy installation, high fuel efficiency, designed for high loads, durable, low-noise and cost-effective. HCH has developed numerous engine solutions in cooperation with our customers' engine design specialists. We offer customized solutions based on low friction bearings which can perform in severe operating conditions like: contamination condition, poor lubrication, and high temperature. During operation, the ball bearings are quiet and easy to maintain.

perform in severe operating conditions like: contamination condition, poor lubrication, and high temperature. During operation, the ball bearings are quiet and easy to maintain.

### Crankshaft and camshaft

The crankshaft and camshaft are most important parts of the engine to achieve certain level of performance. The crankshaft runs at low friction in maintenance-free ball bearings. Crankshaft support bearing takes all the pressure generated by the engine power stroke. Camshaft manages the valves' operations with high accuracy supported by HCH bearings. The main technical demands for the crankshaft and camshaft bearings in motorcycle applications are:

- > Crankshaft accurate guidance resulting from limited radial and axial clearance value
- > Heat transfer resistance from engine combustion chambers
- > Protection to support engine oil solid and chemical contaminants
- > Long service life in terms of rolling contact fatigue resistance
- > Structural fatigue resistance due to housing deformation.



### HCH bearings for crankshaft and camshaft

HCH's strong commitment for a sustainable world in terms of less energy consumption, and HCH's contribution to the design's accuracy and the precise product customization make possible the positive net result of industrial activity and individual savings for the end user. HCH crankshaft and camshaft bearings are made from high quality bearing material which gives a good performance in hard operating conditions.

The special heat treatments for the rings provide better dimensional stability at higher operating temperature and contamination level.

For sealed bearings, sealing perfection in terms of improvement on lubrication preservation and dirt prevention optimizes the operation cost of the machine which has a direct impact on maintenance cost reduction and long service life. HCH has developed the seal lip design with new sealing standard and improves sealing properties like: low friction, speed ability, grease retention, dust exclusion, long service life and static and dynamic high pressure water exclusion.



By an accurate component selection, a correct assembly process and the right use, HCH can assure that the quality standards give a tangible added value to the Customer. HCH is prepared to face the challenge of obtaining a longer service life as well as the Customer and market's requests.



## 11.2 Transmission



Drivers of light and heavy motorcycles take durable components with high fuel economy for granted. Hidden from sight and totally reliable, rolling bearings play a decisive role. Low-noise, hi-speed gear bearing supported with lightweight, plastic cages increase the life of the transmission since they minimize the risk of false brinelling. The market performance expectations for motorcycles' transmissions are:

- > Low transmission losses
- > Low noise and vibration
- > Long service life
- > Trouble free operation in all working conditions



### HCH bearings for transmission

Developing and manufacturing lightweight and space-saving components is one of HCH's core areas of expertise. For over 30 years in this area, for example, we have produced rolling bearings with economical cold-formed bearing rings. We develop high-precision components with the lowest movable mass, which can economically be produced in volume.

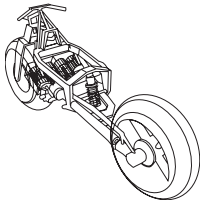
HCH optimized bearings for the transmission applications meet the customers' specific requirements by controlling radial clearance, special surface treatments and sealing aspects. HCH deep groove ball bearings for transmission applications offer:

- > Customized bearing solutions
- > Bearings for low noise and vibration.
- > Thin section bearings for compactness
- > Correct selection methods for low friction and reduced transmission losses
- > Advanced heat treatment for better wear resistance and dimensional stability



HCH provides customized bearing designs for the specific motorcycle applications by optimizing external dimensions, load carrying capacity, internal geometry, cage design, and seal design.

## 11.3 Steering



HCH does not want safety aspects to fall by the wayside. This is why we provide our customers with support in developing and designing the motorcycle steering system. A precise steering system ensures that the motorcycle performs exactly what the driver wants in critical situations. The motorcycle steering application demands:

- > Easy installation
- > Cost-effective
- > Designed for high loads
- > Maintenance free solutions
- > Longer service life under severe operating condition

### Steering column

The main application area, which is more critical for motorcycle steering system is steering column application. The bearings for steering columns are lubricated with the grease. The main constraints of this system are:

- > Ball & raceway wear out at early running
- > Complex & time consuming assembly method
- > No re-lubrication possibilities
- > Shorter service life due to water & contamination entry



### HCH bearings for steering column

HCH has the knowledge to offer solutions to face a steering column application under severe contamination and shock conditions. Adjustable HCH tapered roller bearings or deep groove ball bearings can absorb the highest loads and provide a precise steering system, thereby ensuring the driver's safety in extreme situations.

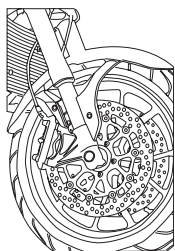
HCH tapered roller bearings consist of solid outer and inner rings with tapered raceways and tapered rollers with cages. The bearings are not self-retaining. This allows the inner ring with the rollers and cage to be fitted separately from the outer ring.

HCH deep groove ball bearings applied in this application are usually with larger clearance than normal to accurate the loads from radial or axial direction. With optimized grease selection and improved sealing design, HCH has developed a special system, which has the ability to keep the lubricant in perfect condition and the dust out. This solution keeps the steering column lubricated for a long working time. Moreover, The greases filled into the bearings are comparatively thicker to prevent interal metal-to-metal contact due to the ultra low speed.



Motorcycles with improved steering technology deliver a riding excellence and achieve a quick reaction on when unexpected situations turn up. As a result of HCH engineering knowledge of applications and integrated solution, it is now possible to upgrade your steering system.

## 11.4 Wheels



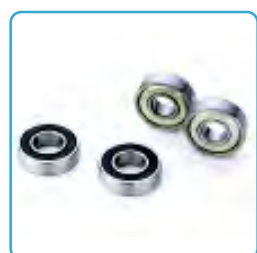
In wheel application, ball bearings with integrated seals that have been lubricated for life offer shock resistance and smooth operation. Their low friction and low wear also help to save fuel consumption. Low-friction ball bearings (with integrated seal as an optional extra), manufactured with the highest precision, are designed for the highest loads. During operation, the ball bearings are required to be stable and easy to maintain.

Lubrication humidity or oil leakage on a motorbike are synonymous of low cost components or extremely wrong use. This affects the brand's image and robustness. No HCH wheel bearing failure under severe operating conditions like:

- > Wet and dry contaminated environment
- > Speed and temperature increased
- > Poor maintenance
- > Heavy axial and radial loads
- > Compact size and light weight



Motorbike end users look for riding with satisfaction without any unexpected interruptions and for a long use in between maintenance service programs. By supplying confidence HCH can reach customer and the market prestige for bearing evaluated from a cost effective view instead of simply cost point of view.



### HCH bearing For wheel

HCH has developed a wide range of wheel bearings and wheel bearing sealing solutions for all kinds of motorcycle applications like mopeds, scooters, light and heavy motor cycles, off road and racing bikes to satisfy today's motorcycle market performance expectations like:

- > Low friction
- > Stiff rotary motion guidance
- > Long service life
- > Vibration free braking

No news about operation is the best news for a business and customer satisfaction point of view. No operation failure could be considered as a standard, but this is the result of the well done job more than a simple matter of chance. As for different motorcycles, we all have optimized choices:

- > HCH enhanced 2RS type seal leads the industry in protection from contaminants.
- > HCH 2RZ type bearings with non-contacted seals keep contaminants out of the bearings.
- > HCH nylon cage is a glass filled nylon that performs better in the oil less conditions.
- > HCH optimized grease is a high performance, wide temperature range synthetic with special rust inhibitor additives.
- > HCH optimized clearance is suggested to meet customers' specific application.



## 12.Machineries

HCH has been working with the machinery industry almost since the company's founding. Today, HCH offers a variety of customized solutions that are intended to ensure production efficiency and machine reliability while taking into consideration the quality, cost and environmental concerns of the industry.

Selecting the appropriate lubrication grease according to requirements could be crucial for operation reliability. HCH offers a variety of different lubrication greases for different machineries applications, e.g. printing and textile machines, plastic and rubber machines ask for long fatigue life etc. While the medical machineries ask for reliable operation with quite condition and the food machineries have extreme requirement of healthy and clean operation. HCH offers the appropriate lubrication greases which leads to reduced maintenance cost and a trouble-free operation.

Environmental concerns are one of today's main issues for machinery industry, whether you are a consumer, a manufacturer or an environmental agency. It is often expensive to comply with environmental legislation, but due to the heavy penalties involved, it is often even more expensive not to. The existence of an environmental policy is thought to have a positive impact on consumers and consequently on business. Some of the areas in which HCH can contribute include lubrication optimization, controlling lubricant leakage and usage, as well as minimizing waste from production.



There are many rolling bearings have been "tailored" to individual machinery applications. HCH's particular strength is in developing the right bearings to meet the respect requirements of low temperature, high temperature, high speed, low speed, low noise and vibration, high loads and moment loads, rust prevention...





## General requirements for machinery industry

### High productivity and high reliability

High productivity is one of the constant pressures within the machinery industry. To increase profitability there is a trend to further increase the speed of the machines in order to get even higher outputs. What is more, unexpected break-downs are costly. To maximize profitability, the machineries must be kept working. For machine operators, it is of utmost importance to run the machines with as low maintenance efforts as possible. For OEMs, to maximize revenue and to improve profitability, life cycle cost should be kept to a minimum. HCH's high quality material and full automatic bearing processes that ensure stable precise bearings, which are offered to improve machineries' reliability.



### Reduce costs

In all businesses, cost control is a major issue, since it is the key to profitability. Even if the biggest costs for a textile making plant are related to energy, raw materials and personnel, saving money on components such as bearings and lubricants that will have an immediate effect on the bottom line. HCH's experience and understanding of industrial processes is a unique resource with respect to cost-effectiveness. HCH has extensive know-how in areas such as maintenance strategy, bearing selection, fitting, lubrication, and monitoring. With the right components correctly fitted and properly maintained, overall costs can be considerably reduced and performance improved.

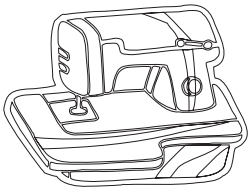


### Save power by reducing friction

For many reasons, e.g. cost as well as environmental reasons, our dependence on fossil fuels needs to be reduced. In the machinery industry power saving is a major objective. Reducing friction in bearings and seals can considerably contribute to decrease energy consumption. Less power needed to run machines helps to downsize the power unit and at the end to save life cycle cost. The intense HCH product development has led to a wide range of products with excellent low friction operation.



## 12.1 Textile Machines



HCH has been working with the textile industry for more than 20 years and developing the bearing always together with the customers. HCH bearings perform valuable services in this industry every day. We can offer you a comprehensive product line of precision rolling bearings for textile machines for the reliable support of rotating. What is more, HCH offers a variety of customized solutions that are intended to ensure production efficiency and machine reliability while taking into consideration the quality, cost and environmental concerns of the industry.

Modern textiles, yarn and fabric can be found in retail, boutiques and department stores or in the mail order business. However, hardly anyone is aware of the technological accomplishments that are achieved every day in spinning, weaving, refining and processing cotton or synthetic fiber.

For textile industry, high speed is critical through the whole production process, especially during spinning, the rotating speed can reach 18,000 rpm, or even more than 20,000 rpm and the machines are usually in a non-stop working condition - 24 hours per day and 30 days per month.



### HCH bearings for textile machinery

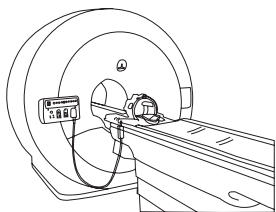
There can be no doubt that the right bearing components are a crucial cost factor. High vibration levels increase energy consumption and can cause premature equipment failure and costly maintenance, often including unplanned downtime and loss of production. For bearings in textile machines, "right" means low friction, high precision, clearance free, as easy to mount as possible, low maintenance, long product life, etc. And for these requirements you are at the right place

with HCH. HCH products and systematic solutions considerably increase machine power, whilst simultaneously keeping costs down in spinning preparation, thread production, creating surfaces, finishes and in the manufacture of ready-to-wear clothing.



HCH develops and manufactures high-precision bearings for a textile machine moves. In doing so, we pay particular attention to maximum operating safety and low operating costs. Reliable in operation, our rolling bearings increase cost-effectiveness and offer compact system designs.

## 12.2 Medical Equipments



The safety and reliability of medical equipment is literally a matter of life and death. It is imperative that medical OEMs are able to integrate many components into fully functioning systems with ease and, and have full confidence in the reliability of their designs. Working with medical original equipment manufacturers, HCH's engineers provide solutions that optimize the performance of the equipment while helping medical design engineers achieve their goals of reliability and enhanced performance.

### Dental equipment

Dental equipment must be designed to meet strict hygienic standards, and those standards must be easy to maintain. Further, the equipment needs to be reliable, with a focus on ergonomics for the dentist and comfort for the patient. HCH has been involved in the design of various dental equipment applications and can draw on its knowledge of this specialized field.



### Life support equipment

Life support equipment such as baby incubators, respiratory equipment and equipment used for critical patient conditions need to be safe and reliable. With the growing complexity in hospital environments, the patient-care staff has to rely on their equipment to an increasing extent, which consequently places ever-higher demands on its function. HCH applies knowledge, experience and global capability to help you meet increasingly tough requirements.



### HCH bearing for medical machinery

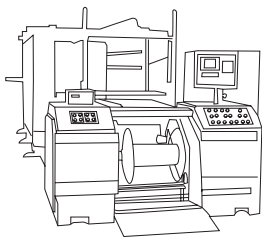


Engineering expertise is vital from both the supplier and the manufacturer so that the components and assemblies in the equipment meet the design requirements. Fortunately, you can rely on HCH to meet your specific demands. As the need for quiet-operating products is great in medical applications, HCH has developed a range of low noise bearings that enhance patient comfort. As one of the most demanding industries for clean and precise products, HCH has a product

offering to meet your needs. From precise, miniature products to clean room and special coating capabilities, HCH has the products and solutions to meet the high requirement of accuracy in the medical industry.

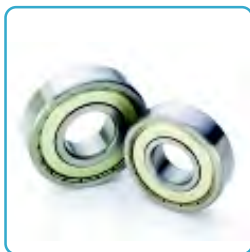
Safe and efficient bearing supports for moving machine parts has been our profession for over 30 years. We are both an engineering partner and a reliable supplier for bearings that are responsible for movement in medical technology.

## 12.3 Printing Machines



High productivity and improved printing quality coupled with reliability are just some of the constant pressures within the printing industry. High precision and accuracy as well as high stiffness of a bearing solution highly contribute to the high printing quality. Printing press manufacturers also look to their component suppliers for innovative solutions that will meet such demands.

For many years, HCH has been partner to the printing industry, supporting the need for maximum reliability. By continuous innovation and development of customized products. HCH has contributed to increase productivity and printing quality. HCH manufactures a full range of ball bearings suitable for a wide variety of applications. HCH's competence in service and application engineering is the base to be the best partner for the Graphic Arts Industry worldwide.



### HCH bearings for printing machinery

HCH has developed a range of solutions to facilitate assembly and reduce the need for maintenance. These solutions are characterized by their ease of use, their innovativeness and low requirement for maintenance. What is more, friction reduction in HCH bearings and seals can considerably contribute to decrease energy consumption. Less power needed to run printing machines helps to downsize the power unit

and at the end to save life cycle cost. With these solutions, HCH adds value to the product offers, strengthening the customers' competitiveness by providing cost-effective operation.

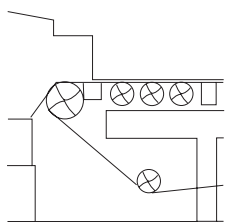
Both end-users and manufacturers expect high-performing products that are conformable to current and future legislation. In addition, end-users want to reduce cost of ownership to stay competitive, while manufacturers want to cut production costs to stay profitable. Here, HCH's in-depth application knowledge, experience of cost-effective solutions and understanding of manufacturing processes is a unique resource at your service. We offer you standard and customized solutions that enable you to improve performance and, simultaneously, reduce overall costs.

HCH also provides a wide range of solutions to meet customers' demands for improved productivity. For this factor, HCH's highly skilled application engineers could help to meet specific targets.



As a result of cooperation over decades with reputable printing machine manufacturers as well as with maintenance and production departments, our engineers have achieved a great deal of expertise. Now, hundreds of printing factories have benefited from the quality of HCH tailor-made solutions that are reliable and efficient and achieve ever increasing production speeds.

## 12.4 Pulp & Paper



Paper machines are the giants in the machine construction sector: many of them are 200 meters long and 10 meters wide. In just a single minute, nearly 2000 meters of paper fly through the machine over rolls and cylinders at a speed of 120 km/h. The rolling bearings installed in such a machine must meet extreme requirements: moisture, very high temperatures, shaft deflections, high speeds and long running times. Only bearings that work with a very high degree of reliability make it possible to produce paper of the highest quality.

### Forming section

The forming section consists of the headbox and the wire section. It is a critical section of the paper machine, since it is here that the quality and structure of the finished product is determined. However, for bearings, the operating conditions are not too challenging - except for the water and moisture present in the process. As in all paper machine applications, reliability is critical to ensure continuous production.

### Breast, drive, guide and stretch wire rolls

Breast, drive, guide and stretch wire rolls are not particularly demanding applications from a bearing perspective. The main issue is the amount of process water present and consequent problems relating to corrosion and lubrication. However, like most applications in a paper machine, these rolls are subject to misalignment and axial expansion of the shaft, and the bearings must accommodate this.

### Suction rolls

Suction rolls are used for dewatering the web. Like most applications in a paper machine, they are subject to misalignment and axial expansion of the shaft and the bearing arrangement must accommodate this. In addition, of all the rolls in a paper machine, suction rolls have the highest speed demands. As production capacity is pushed further and further, speed requirements are likely to increase even more in the future. The operating conditions for this application are therefore considerable, placing high demands on the machinery components.



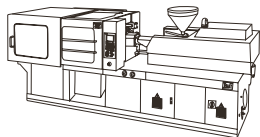
As a global bearing technology leader, HCH understands and provides solutions to the challenges found in the pulp & paper industry. With products specifically designed to support equipment utilized in high temperature, and highly contaminated environments, HCH bearings allow longer life and higher limiting speeds which result in greater productivity.



### HCH bearing for pulp and paper machinery

Bearings in pulp and paper machinery often operate under high-temperature conditions, vulnerable to problems such as fracturing of the inner ring, which can result in work stoppages. Excellent durability under high temperature conditions including moisture and dust laden environments can result in longer life, high limiting speed and dramatically enhanced productivity. Operating difficulties often put great demands on the bearing solutions in pulp and paper machinery.

## 12.5 Plastic & Rubber



The industry of plastic and rubber are always working to improve the reliability of the processes. The downtime costs are so high and the margins in many cases so tight that the survival of a factory itself is the result of a delicate balance. The challenge for plastic and rubber making is to maximize uptime and reduce maintenance costs for improved productivity. To play the game, you need reliable partners

and state-of-the-art solutions.

### Extrusion machines

Extrusion process is critical both for the quality of the production and for the productivity of a plant. During the process, the raw material and the additives (lubricants, colors, strengtheners...) are mixed, melted and then pushed through a drawplate. The resulting product could be either sent to the next transformation or sold to a customer that will transform it later.



### HCH bearing for plastic and rubber machinery

As in screw extrusion, the rotational speed of the screw is a few rpm only. Furthermore the cyclic stop and go generated by the moulding process negatively affects the bearing lubrication condition. When there is no rotation, the lubricating oil film thickness between rollers and raceways drops down to zero. In this metal-to-metal contact, the strong accelerations and the high axial loads acting on the bearings cause surface smearing and the consequent bearing failure. In a process where high shock loads can be a realistic risk, the choice of the right components is an important moment to guarantee the good performance of the machine in any situation.

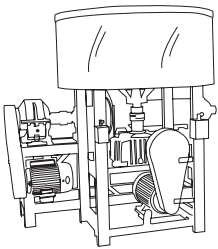
HCH intimate process knowledge and enhanced competences now can lead both machine and plastic manufacturers to remove all the significant downtime causes, thus giving the right answer to the reliability requirements. What is more, HCH has applied advanced technology to exceed the life and limiting speed of conventional bearings. Our superior bearings offer higher limiting speed and longer operating life, thereby reducing maintenance costs.



Plastic and rubber are the basis material for the modern industries. For this application, It is critical for you to be able to understand the nature of the problems in order to recommend appropriate actions.



## 12.6 Tough Machinery



The process of mechanical parts processing machine is not all the same and the configuration of these machines vary according to the products they are designed to produce. Generally they are divided into turning machines, grinding machines, punching machines, cutting machines and mixer machines. However, process efficiency and profitability is one common ground of all mechanical parts processing machinery requirements.

The working environment of bearings in tough machineries are extraordinary in most respects, mainly including high speed and relatively light radial loads, extreme temperatures, dust, contaminants and humidity that can cause costly, unplanned stops. Superior bearing quality can bring you utmost plant availability. Normally it contains following characteristics:

- > High operational safety and reliability
- > High load carrying capacity
- > Insensitive to shocks and vibration
- > Simple mounting and dismounting



### HCH bearing for tough machinery

The rough operating and environmental conditions require extremely robust bearings. Due to our research and development activities and to an intensive exchange of experience with manufacturers and operators of machines and plants. We dedicate to supply our customers cost-effective and trouble-free operation solutions. HCH is your reliable partner who can help increase productivity, reduce costs and protect the environment and workforce.

HCH has achieved a great deal of expertise for this tough machinery application. We are able to offer a variety of solutions that are intended to ensure production efficiency and machine reliability while taking into consideration the quality, cost and environmental concerns of the industry. The high quality and toughness of HCH bearings reduce maintenance costs in the tough machinery.

HCH has produced bearings with superior resistance to inner ring fractures, outstanding hardness, and excellent dimensional stability under high temperatures, producing solutions for a host of tough machinery applications and operating environments.



This application includes a variety of machines that running in the factories or construction places. The high quality of our products and the technical expertise of our engineers ensure the reliable, durable and cost-efficient use of our bearings in your specific machines.



**CHINA · HUANCHI BEARING GROUP**

Add: No.12 Hengpeng Road, Henghe Industry Zone, Cixi City, zhejiang, China

Tel: 0086-574- 63199899 63198088

Fax: 0086-574-63197123 63196123

P.C.: 315318

<http://www.hchbearing.com>

[www.hch.cn](http://www.hch.cn)