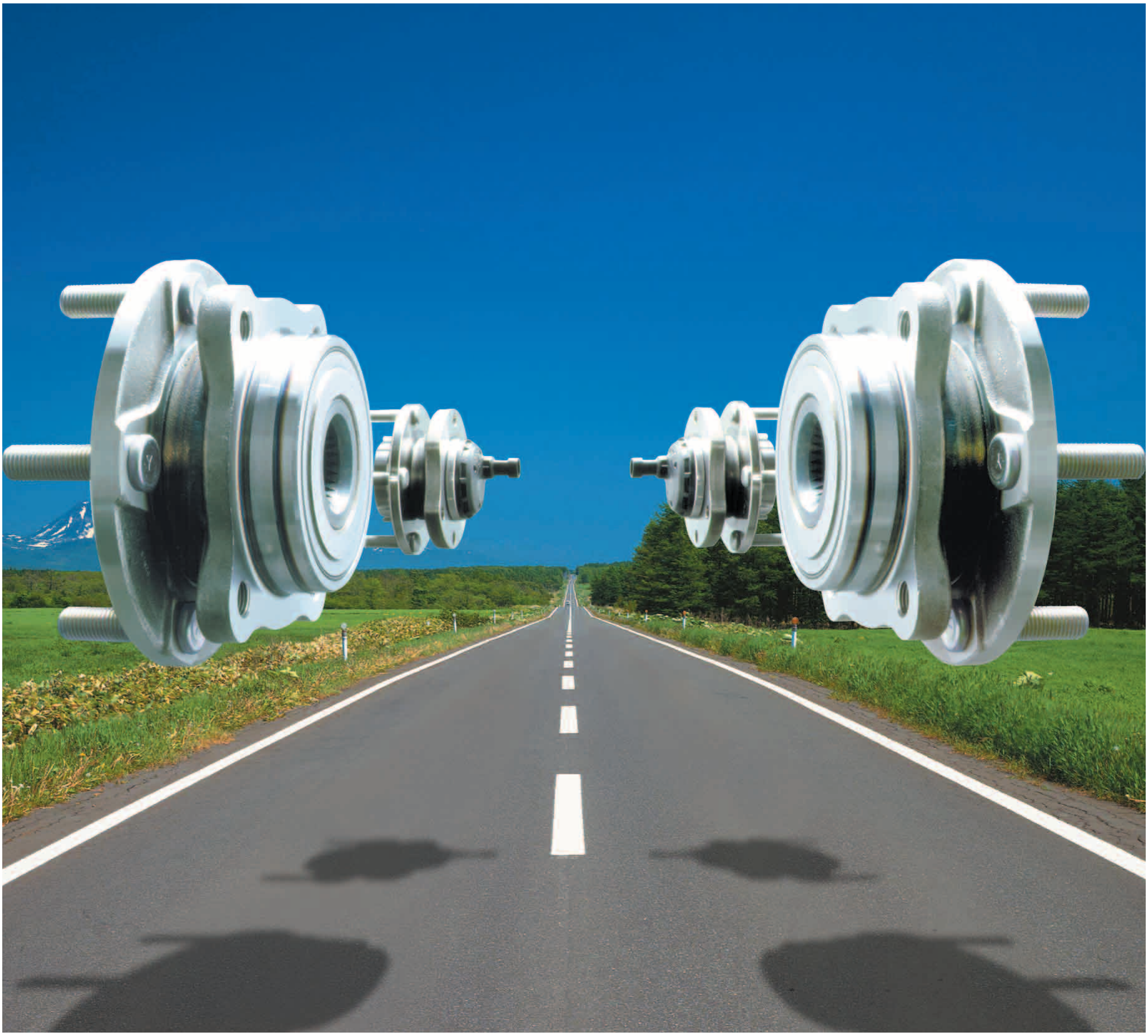
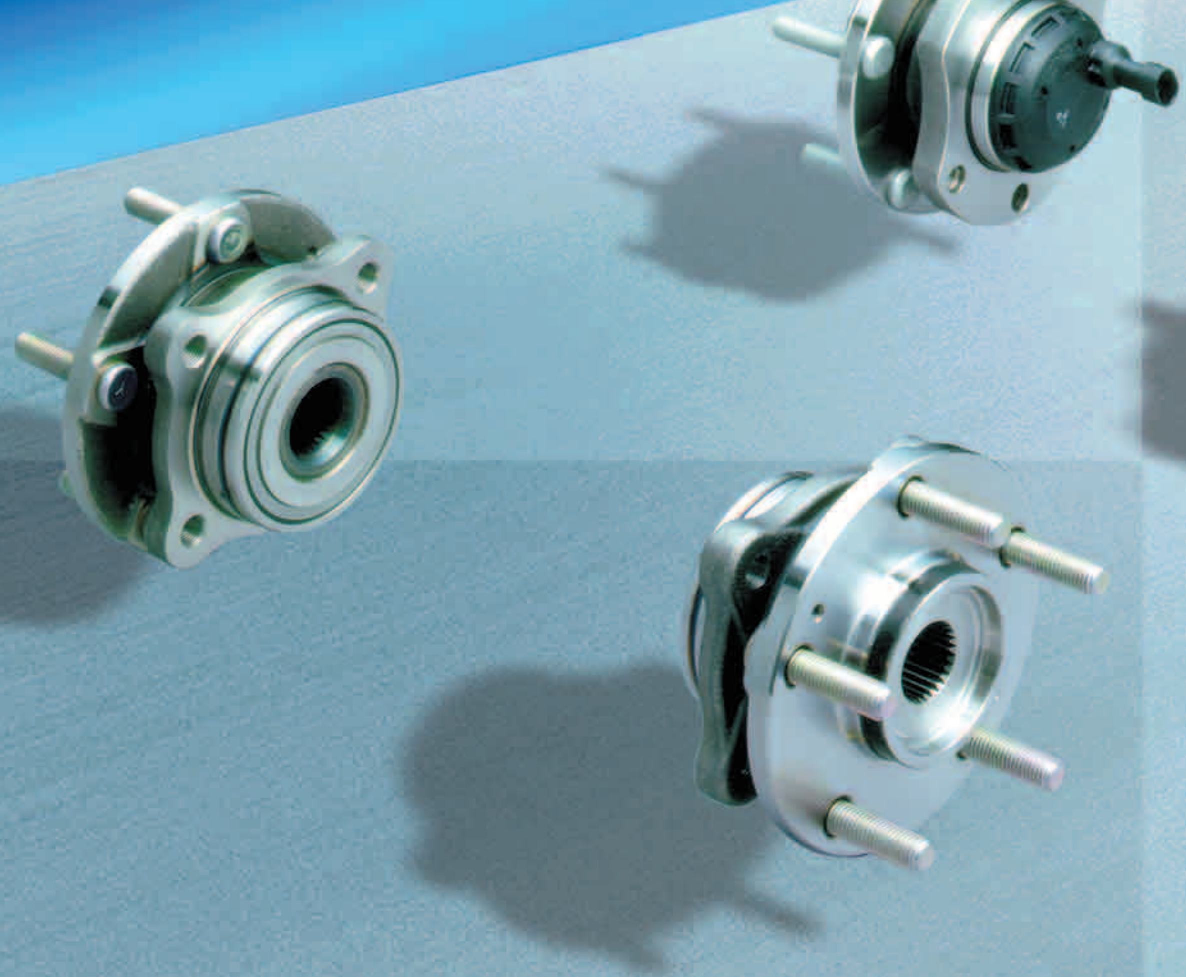
MOTION & CONTROL™
NSK

Hub Unit Bearings

Comfort for the 21st Century
Intelligently and reliably meeting the needs of a wide range of vehicle models.





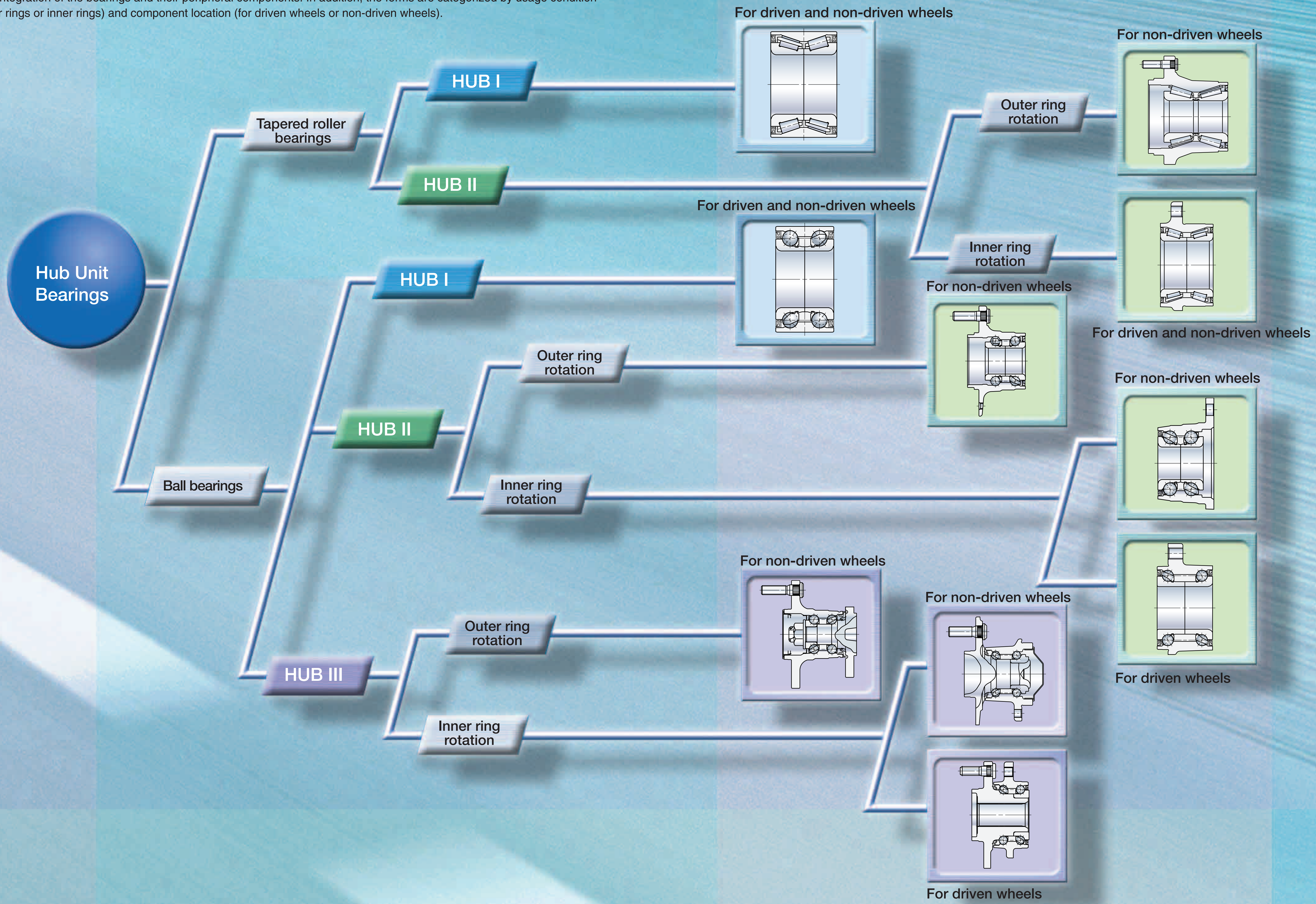
Hub Unit Bearings

CONTENTS

1. Types and Features of Hub Unit Bearings

1-1. Categories of hub unit bearings

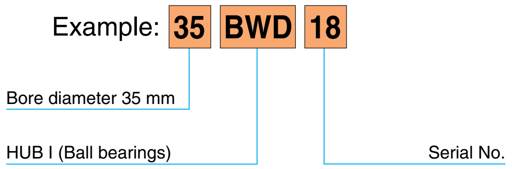
Hub unit bearings for automobile wheels are comprised of bearing rings, rolling elements, and cages, similar to general-purpose rolling bearings. The first-generation hub unit (Hub I), second-generation hub unit (Hub II), and third-generation hub unit (Hub III) vary according to the integration of the bearings and their peripheral components. In addition, the forms are categorized by usage condition (rotations of outer rings or inner rings) and component location (for driven wheels or non-driven wheels).

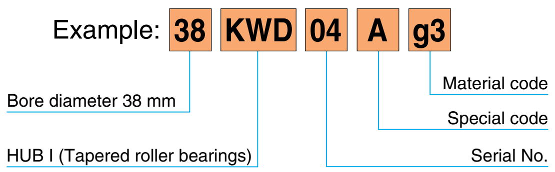


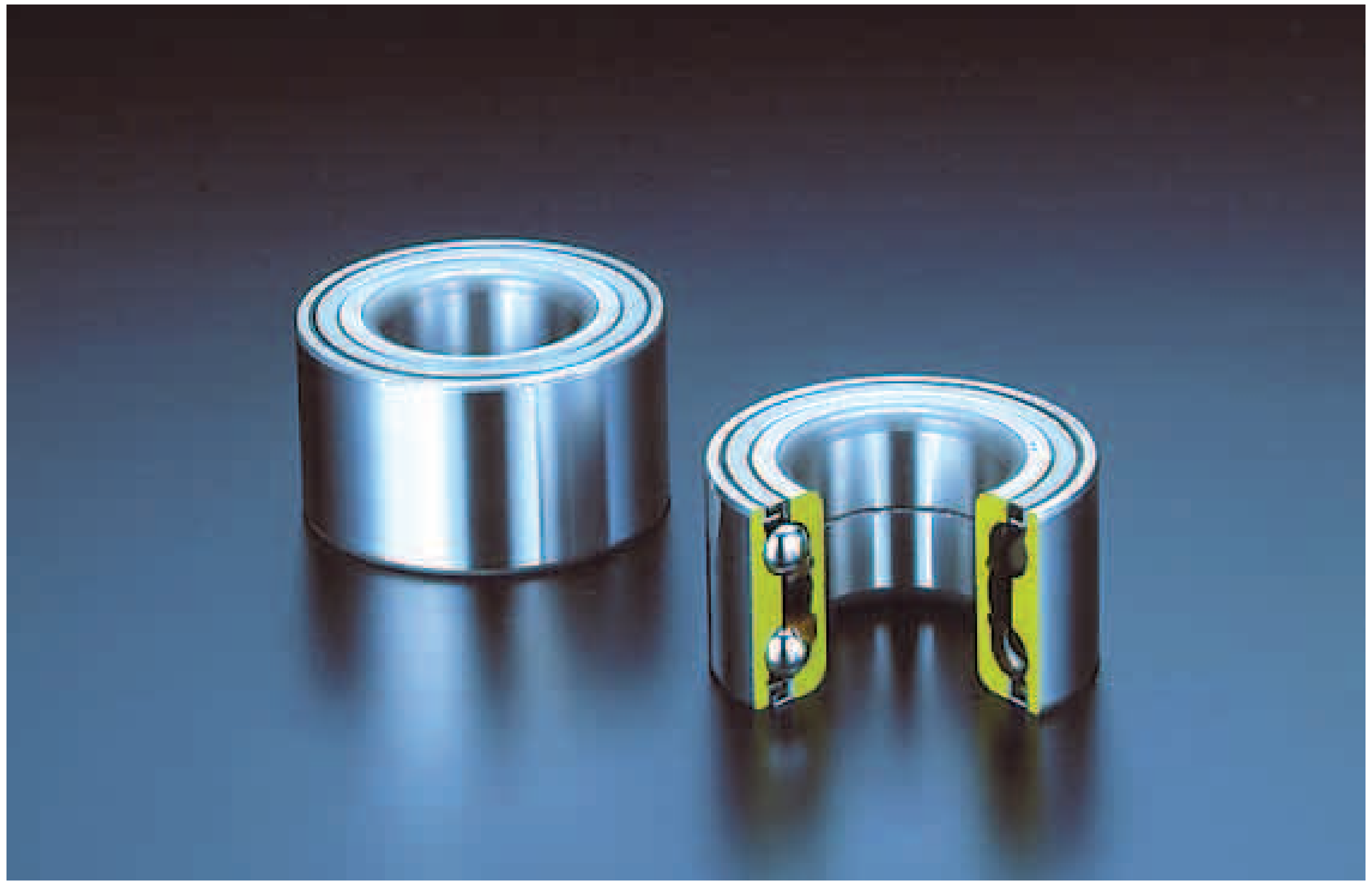
1-2. HUB I

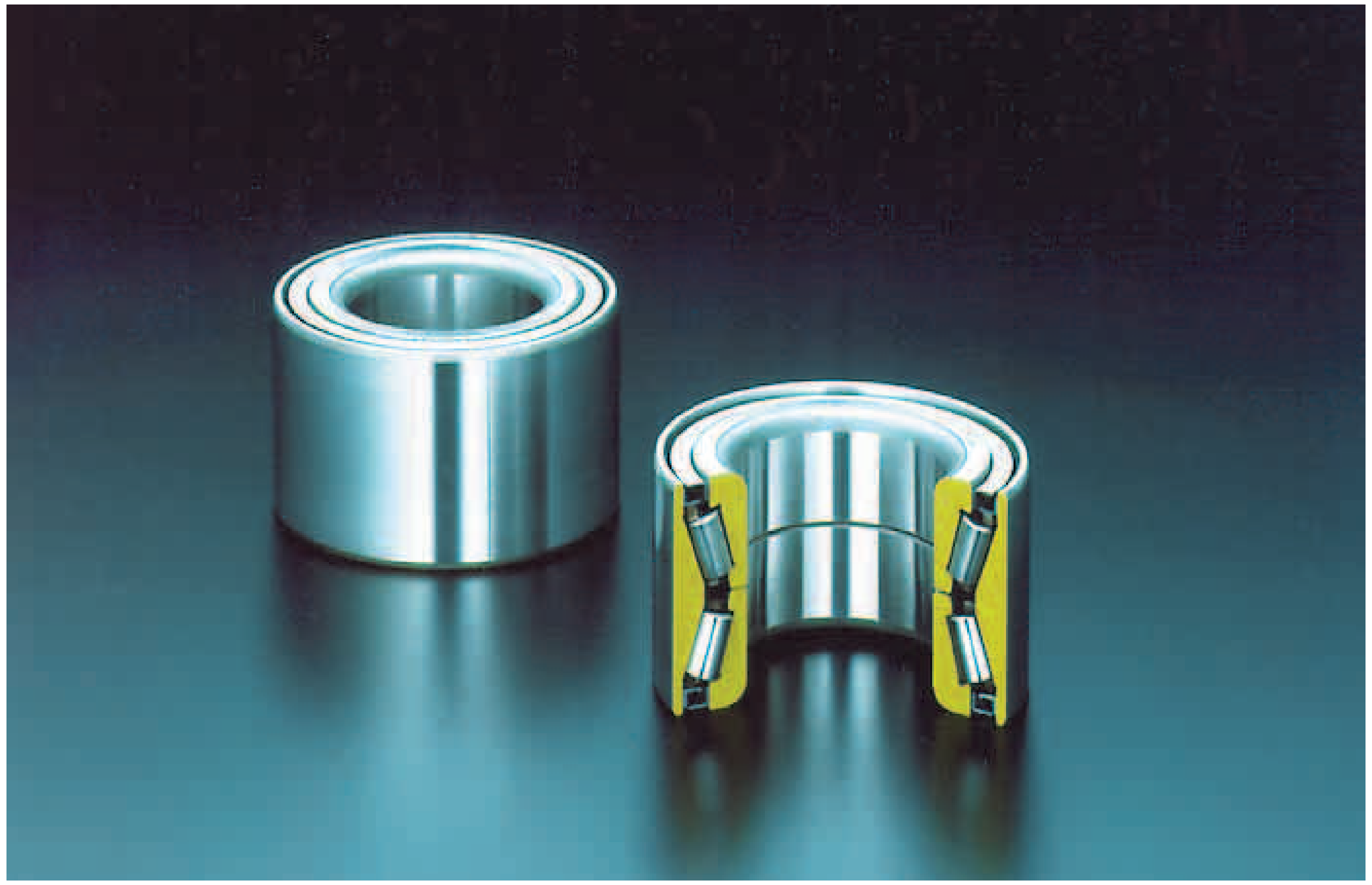
For HUB I, NSK uses proprietary bearing-type designations such as “BWD” for ball bearings and “KWD” for tapered roller bearings. The HUB I units are double-row angular contact ball bearings (BWD) and double-row tapered roller bearings (KWD) with back-to-back duplex outer rings.
No preload adjustments (including dimensional adjustments by shims) are required on the assembly line. The initial axial clearance is properly pre-set for the preload to fall within the specified range after mounting. In addition, the integral seal eliminates the need for automotive makers to externally apply seals.

NSK uses bearing reference for hub unit bearings clarifying boundary dimensions, types, and specification codes. Below are examples of bearing reference:

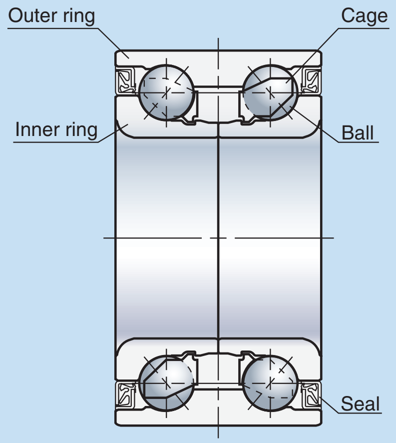




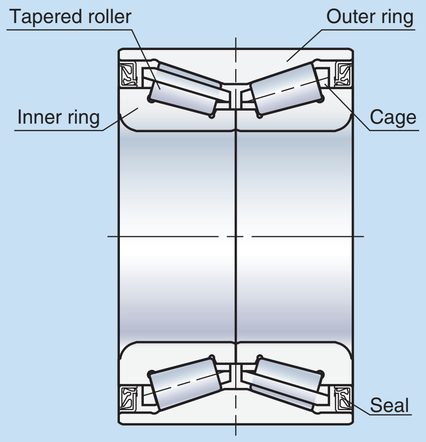




BWD (Ball bearings) for driven and non-driven wheels



KWD (Tapered roller bearings) for driven and non-driven wheels



1-3. HUB II

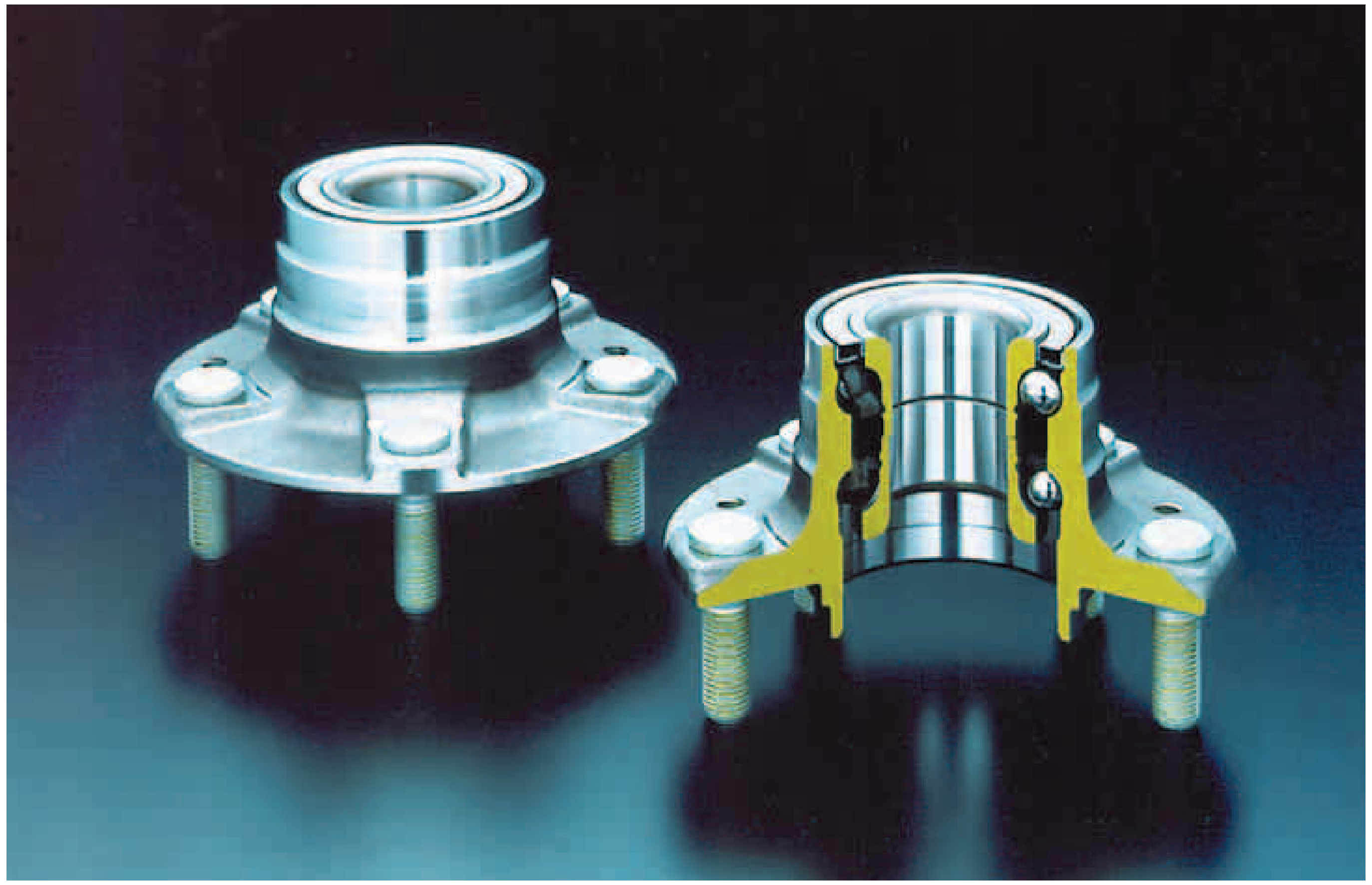
For HUB II, NSK uses proprietary bearing-type designations such as “BWK” for ball bearings and “KWH” for tapered roller bearings. HUB II configurations are BWD or KWD HUB I with flanged outer rings.

● **Outer ring rotation type (for non-driven wheels):** Wheels and brake disks are mounted at the flanges. Spindles are inserted into the inner rings and fixed with nuts.

● **Inner ring rotation type (for non-driven wheels):** The flanges are fixed to the car body. Hub spindles are pressed into the inner rings and fixed with nuts.

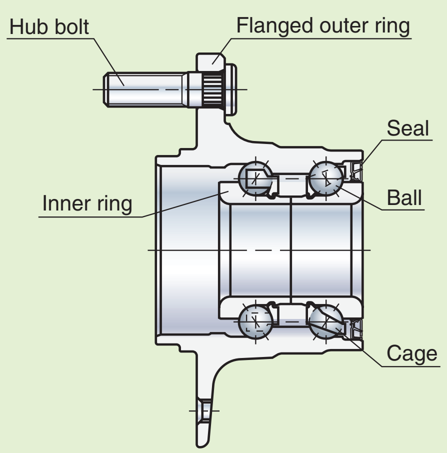
● **Inner ring rotation type (for driven wheels):** The flanges are fixed to the axle housing. Wheel hubs and drive shafts are engaged to the inner rings.

With all of the HUB II types, the initial axial clearance is properly pre-set for the preload to fall within the specified range after mounting, similar to the HUB I.

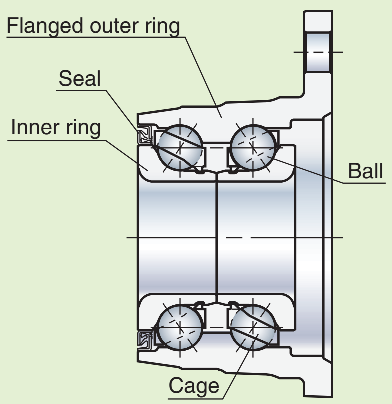


BWK (Ball bearings)

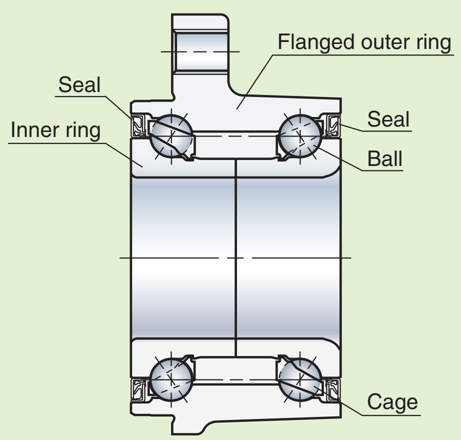
Outer ring rotation type for non-driven wheels



Inner ring rotation type for non-driven wheels



Inner ring rotation type for driven wheels



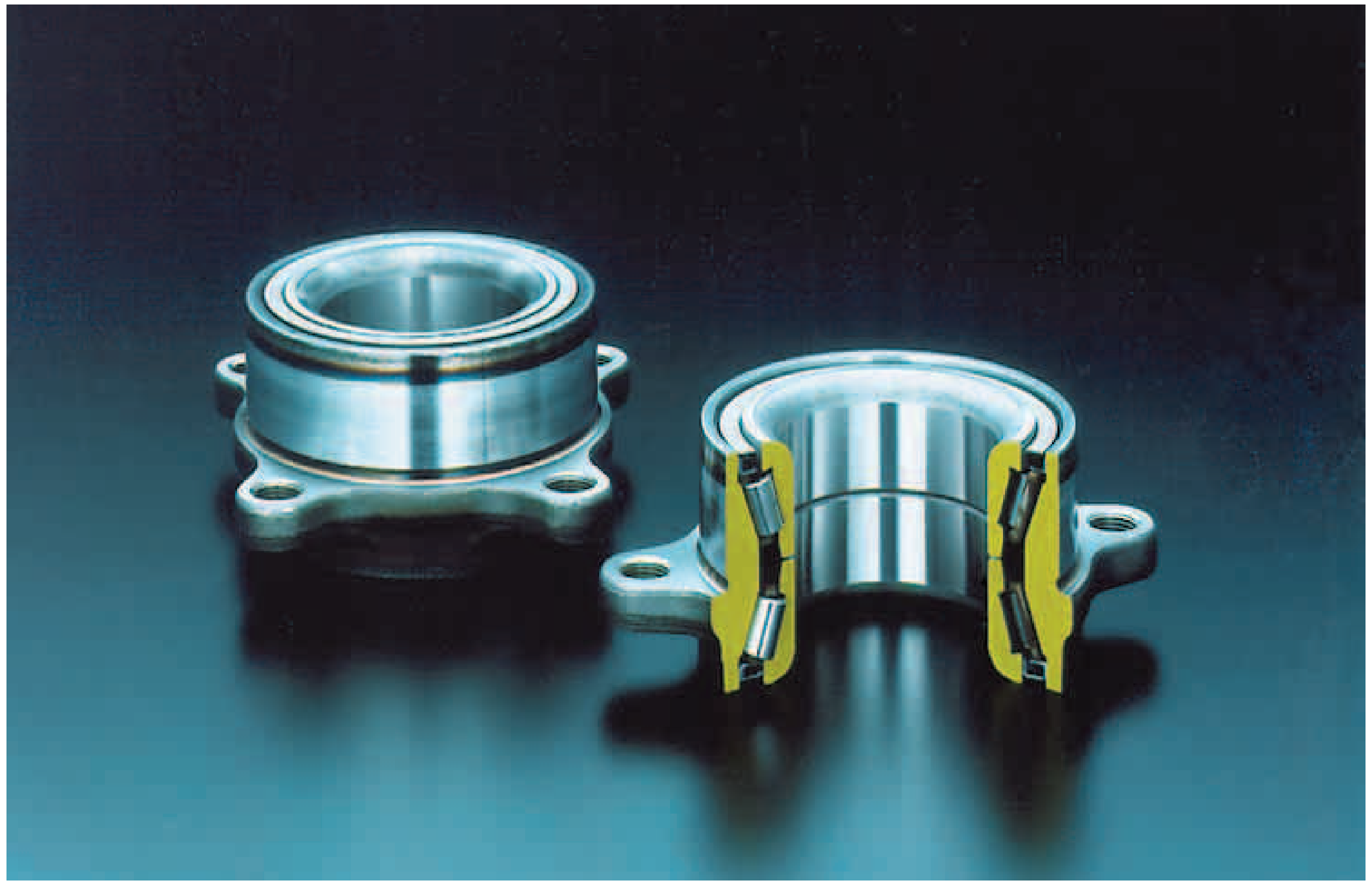
NSK uses bearing reference for hub unit bearings clarifying boundary dimensions, types, and specification codes. Below are examples of bearing reference:

Example: **27 BWK 04 D2a y2**

- 27: Bore diameter 27 mm
- BWK: HUB II (Ball bearings)
- 04: Serial No.
- D2a: Special code
- y2: Material code

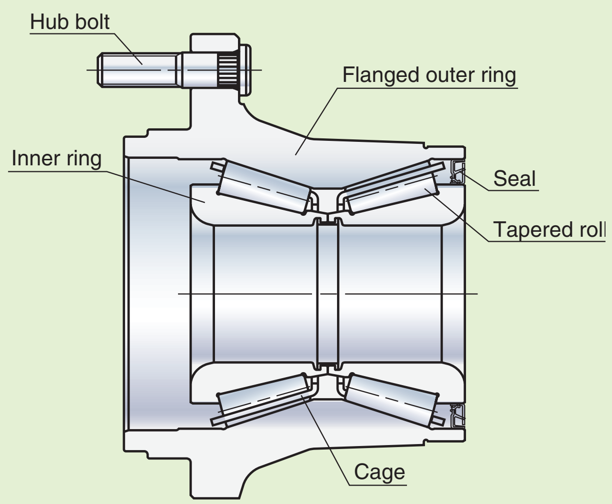
Example: **54 KWH 01 y2**

- 54: Bore diameter 54 mm
- KWH: HUB II (Tapered roller bearings)
- 01: Serial No.
- y2: Material code

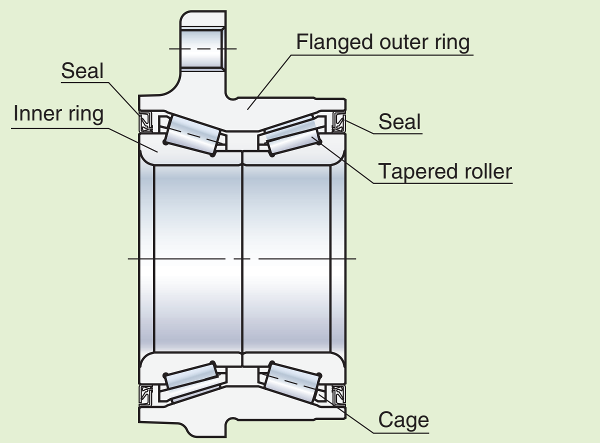


KWH (Tapered roller bearings)

Outer ring rotation type for non-driven wheels



Inner ring rotation type for non-driven and driven wheels



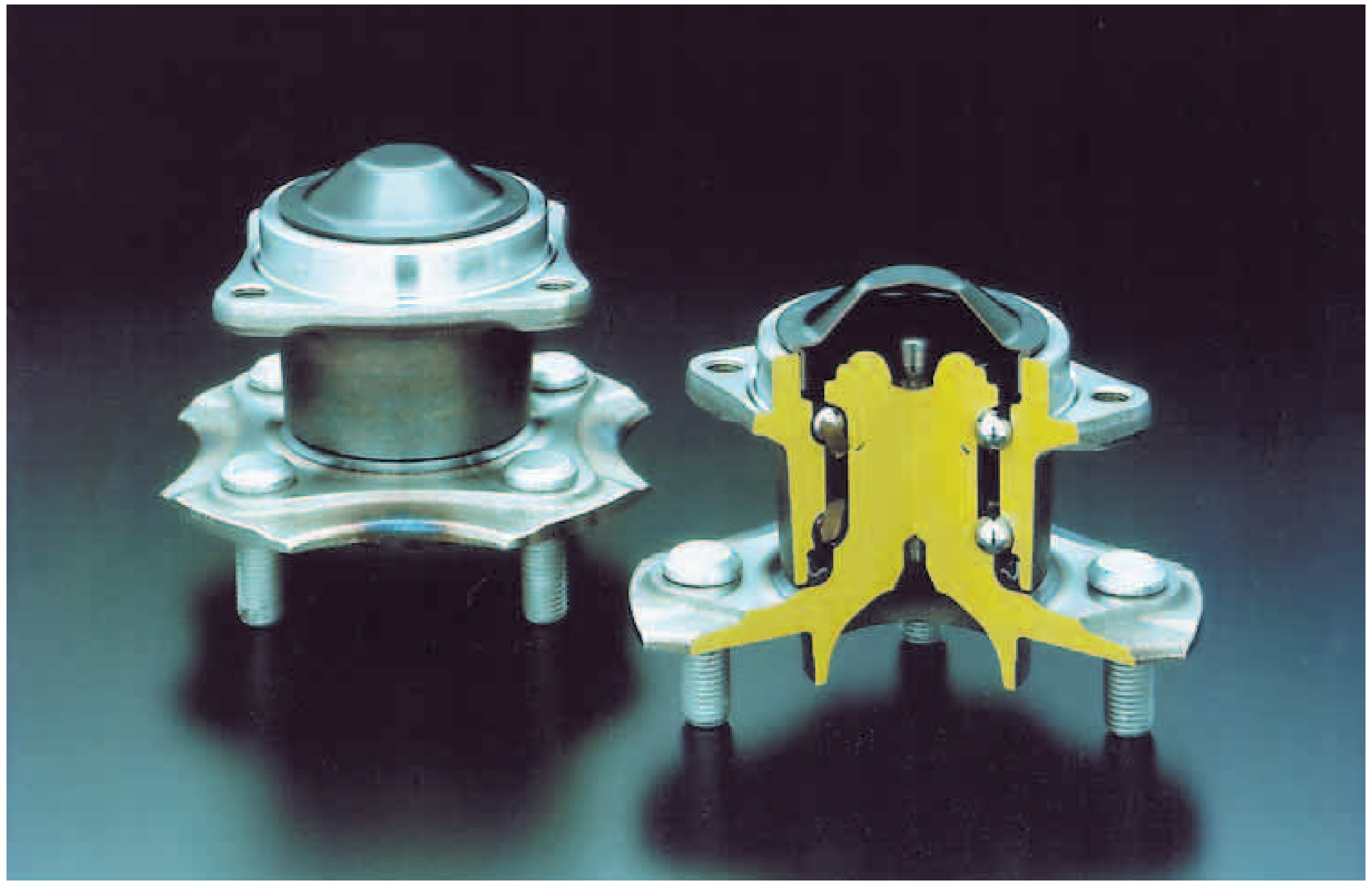
1-4. HUB III

For HUB III, NSK uses proprietary bearing-type designations such as “BWKH” for ball bearings. The HUB III configuration is a BWD HUB I with flanged inner and outer rings.

● **Outer ring rotation type (for non-driven wheels):** Wheels and brake disks are mounted at the outer ring flanges. The inner ring flanges are mounted on the car body, and the preload is pre-adjusted.

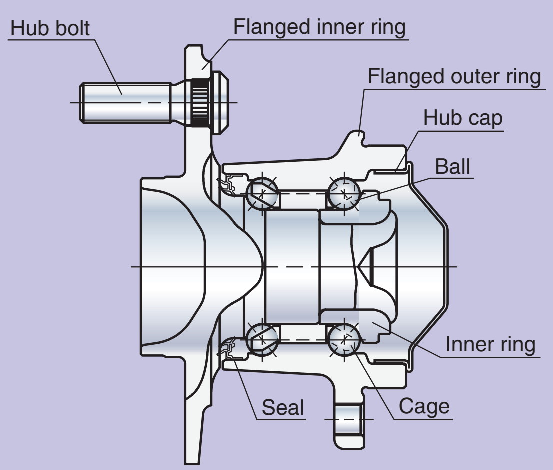
● **Inner ring rotation type (for non-driven wheels):** Wheels and brake disks are mounted at the inner ring flanges. The outer ring flanges are mounted on the car body, and the preload is pre-adjusted.

● **Inner ring rotation type (for driven wheels):** Wheels and brake disks are mounted at the inner ring flanges. A splined bore allows bearings to be engaged to the CVJ shaft end. The outer ring flanges are fixed at the axle housing. The initial axial clearance is properly pre-set for the preload to fall within the specified range after the nuts are fastened.

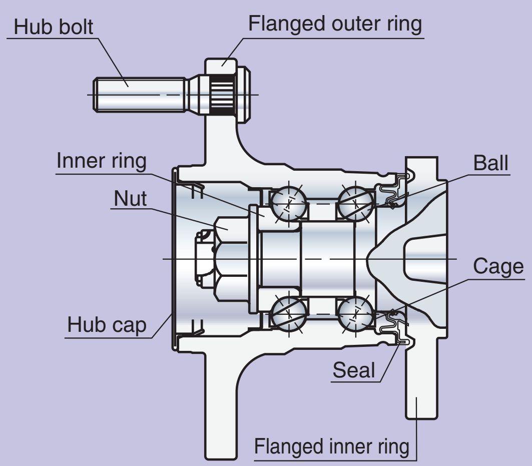


BWK (Ball bearings)

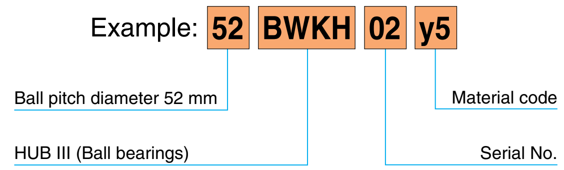
Inner ring rotation type for non-driven wheels

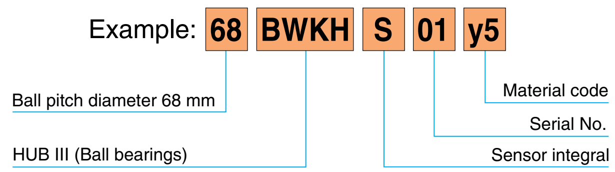


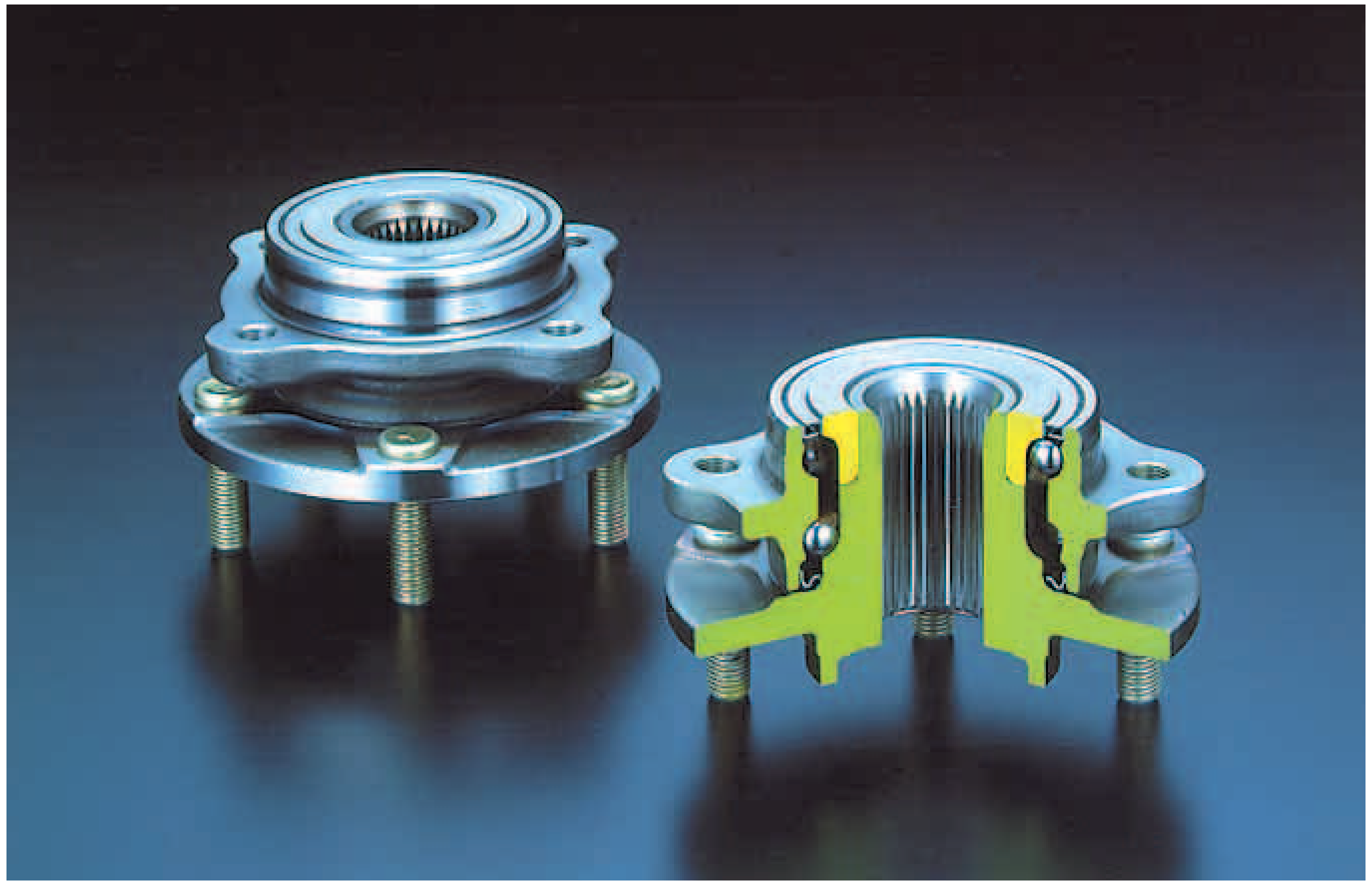
Outer ring rotation type for non-driven wheels



NSK uses bearing reference for hub unit bearings clarifying boundary dimensions, types, and specification codes. Below are examples of bearing reference:

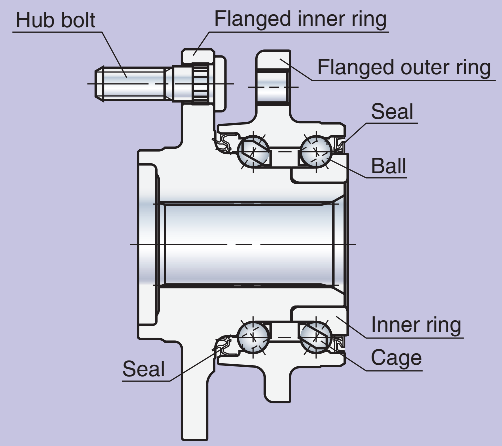






BWKH (Ball bearings)

Inner ring rotation type for driven wheels



2-1. Overview of selection

While higher performance is demanded for hub unit bearings, the constraints and conditions of their application are becoming increasingly diverse. The selection of optimum bearing types satisfying such constraints and conditions requires the examination of various aspects. Please contact NSK for comprehensive technical services, such as functional evaluation, or technical consultations on design specifications in the development process, costs, and scheduling, for suitable selection of hub unit bearings.
Fig. 1 shows the sample selection process of hub unit bearing types, and Fig. 2 shows sample specifications of hub unit bearings for automobiles.

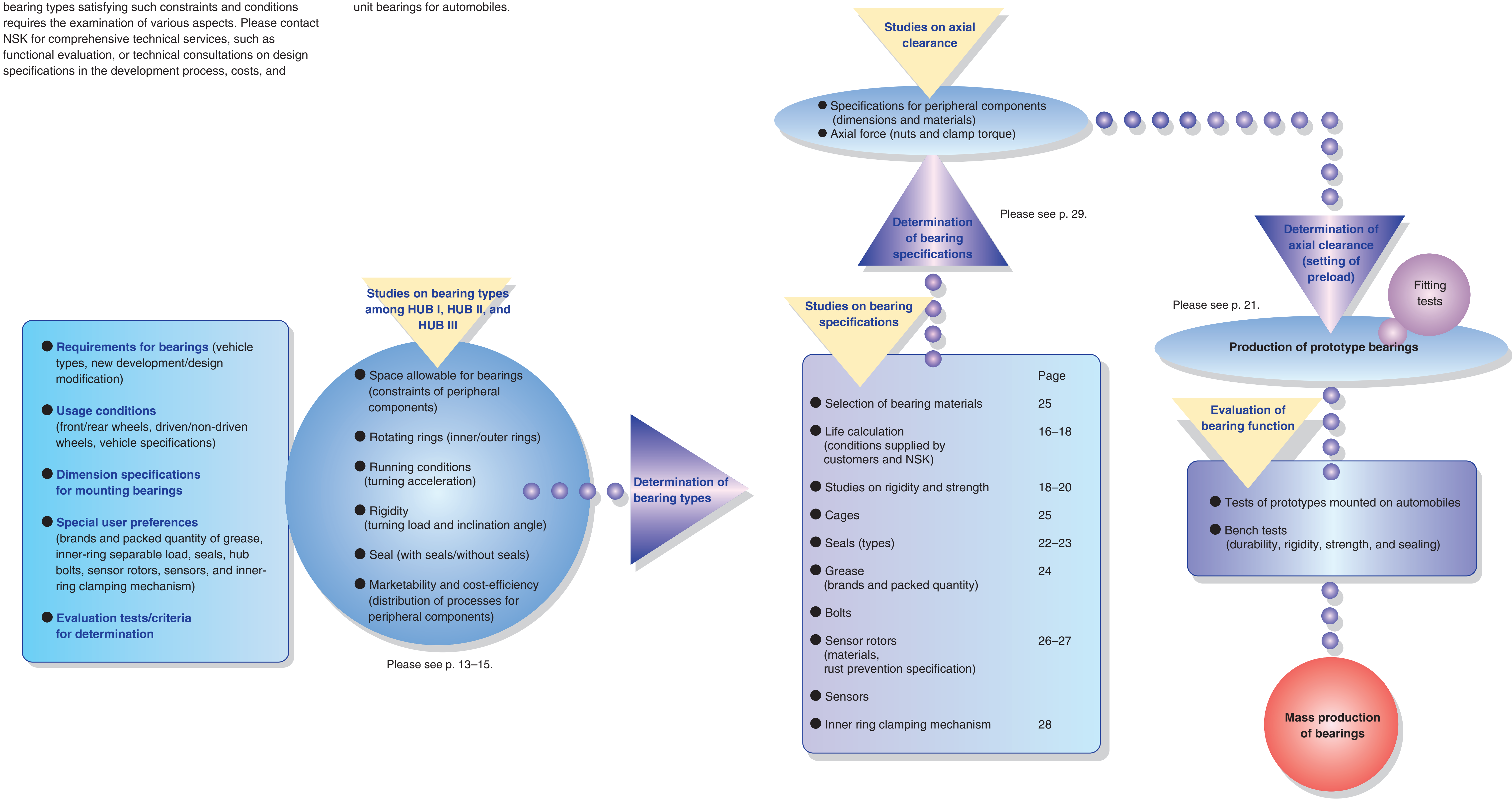


Fig. 1 Sample selection process of hub unit bearing types

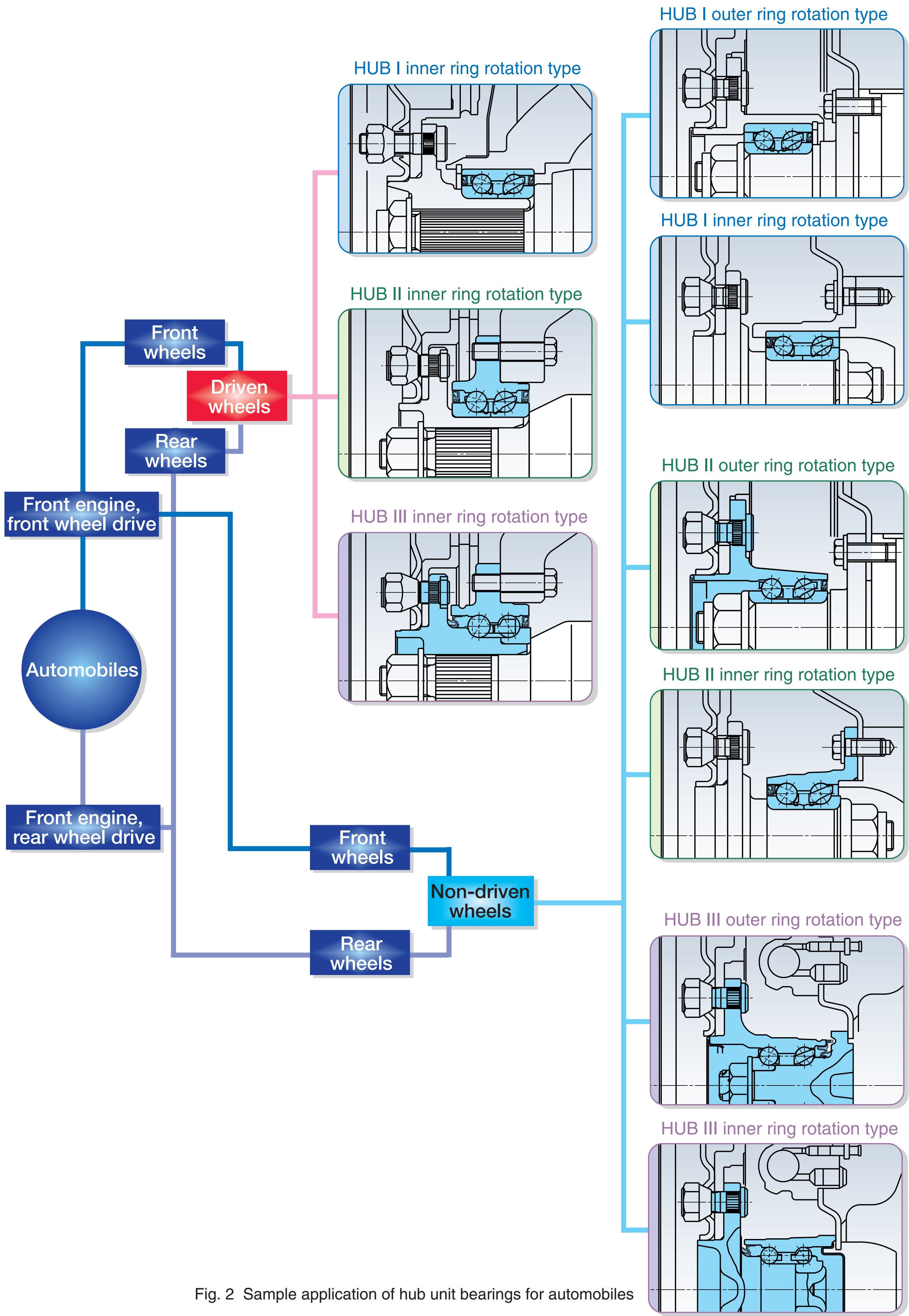


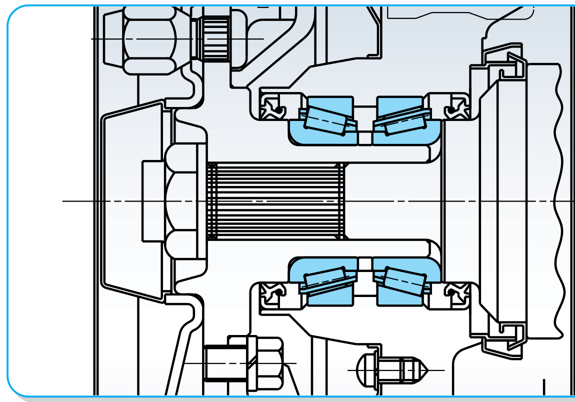
Fig. 2 Sample application of hub unit bearings for automobiles

2-2. Selection of bearing types

Table 1 describes the comparable features of the different bearing types to help customers select the suitable bearing. Carefully consider all aspects, including each type's features, peripheral components, mounting time, and facilities.

Table 1 Features of hub unit bearing types

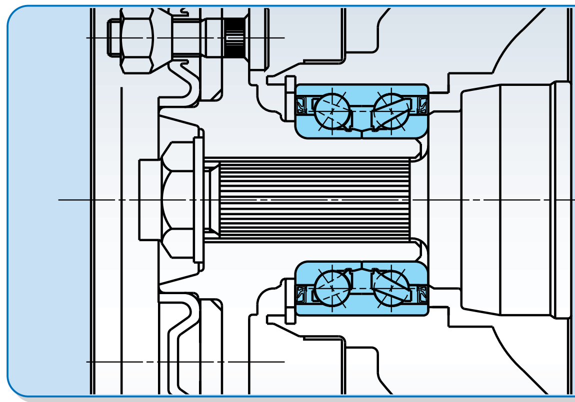
Application with 2 sets of single-row bearings



Features
- Long distances between effective load centers (non-driven wheels)
- Difficult preload setting
- Complicated mounting process
- Grease packing required
- Large packaging required

HUB I

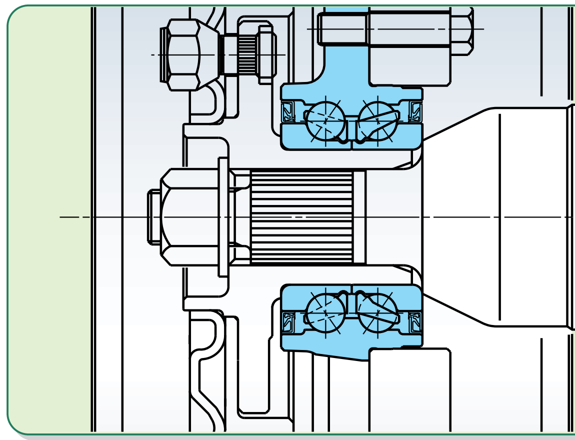
I



Features compared to 2 sets of single-row bearings
- Easier and more reliable preload setting
- Shorter distance between effective load centers
- Easy mounting process
- No spacer adjustment required
- No grease packing required
- Compact
- No operations required to press seals into hub units (integral seals are optional)

HUB II

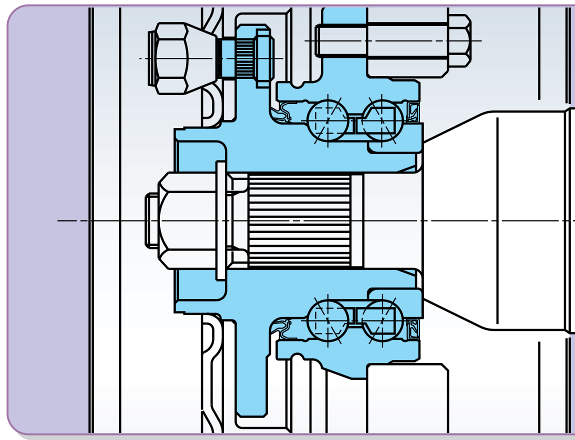
II



Features compared to HUB I
- Easy preload setting
- Easy mounting process
- No requirements to fit to knuckles
- Integral seals (improved reliability)
- Integral sensor rotors are optional (outer ring rotation)
- Lightweight and compact

HUB III

III



Features compared to HUB II
- Pre-set preload (non-driven wheels)
- Easier mounting
- Enhanced rigidity
- Easy incorporation of ABS sensors

2-3. Types and characteristics of bearings

Table 2 shows the characteristics according to the requirements of hub unit bearing types.

Table 2 Types and characteristics of hub unit bearings

Characteristics	Items	HUB I		HUB II				HUB III
		BWD	KWD	BWK outer ring rotation	BWK inner ring rotation	KWH outer ring rotation	KWH inner ring rotation	BWKH
Functionality	Load capacity	○	◎	○	○	◎	◎	○
	Rigidity	△	◎	△	△	◎	◎	○
	Rotation torque	○	△	◎	○	△	△	◎
	Seizure resistance	◎	△	◎	◎	△	△	◎
Compactness	Axle weight	△	△	○	○	○	○	◎
	Cross-section space	△	△	△	△	◎	◎	◎
	Width space	○	△	◎	◎	○	○	◎
Reliability	Seals	△ Without seals ◎ With seals	△ Without seals ◎ With seals	◎	◎	◎	◎	◎
	Preload range under motion	△	△	○	○	○	○	◎
	Reliability in service	△	△	○	○	○	○	◎
Maintenance	Preload management	△	△	◎	○	○	○	◎
	Mounting and serviceability	△	△	○	○	○	○	◎

◎Excellent ○ Good △ Fair

Selection of the dimensions of hub unit bearings requires consideration of their service life, rigidity, and strength.

3-1. Life calculation

This section shows the method used to calculate the bearing life. NSK performs life calculation using proprietary computer software, so please supply your application condition information to an NSK representative.

(1) Required information

The service life of hub unit bearings is calculated based on the following information:

- Axle load on front wheels or rear wheels ………… W_f (N)
- Front or rear wheel tread ……………………………… T_r (mm)
- Height of gravity center……………………………… H_g (mm)
- Effective tire radius ……………………………………… R_w (mm)
- Offset amount…………………………………………… S (mm)

(External car body is positive (+) from bearing center.)

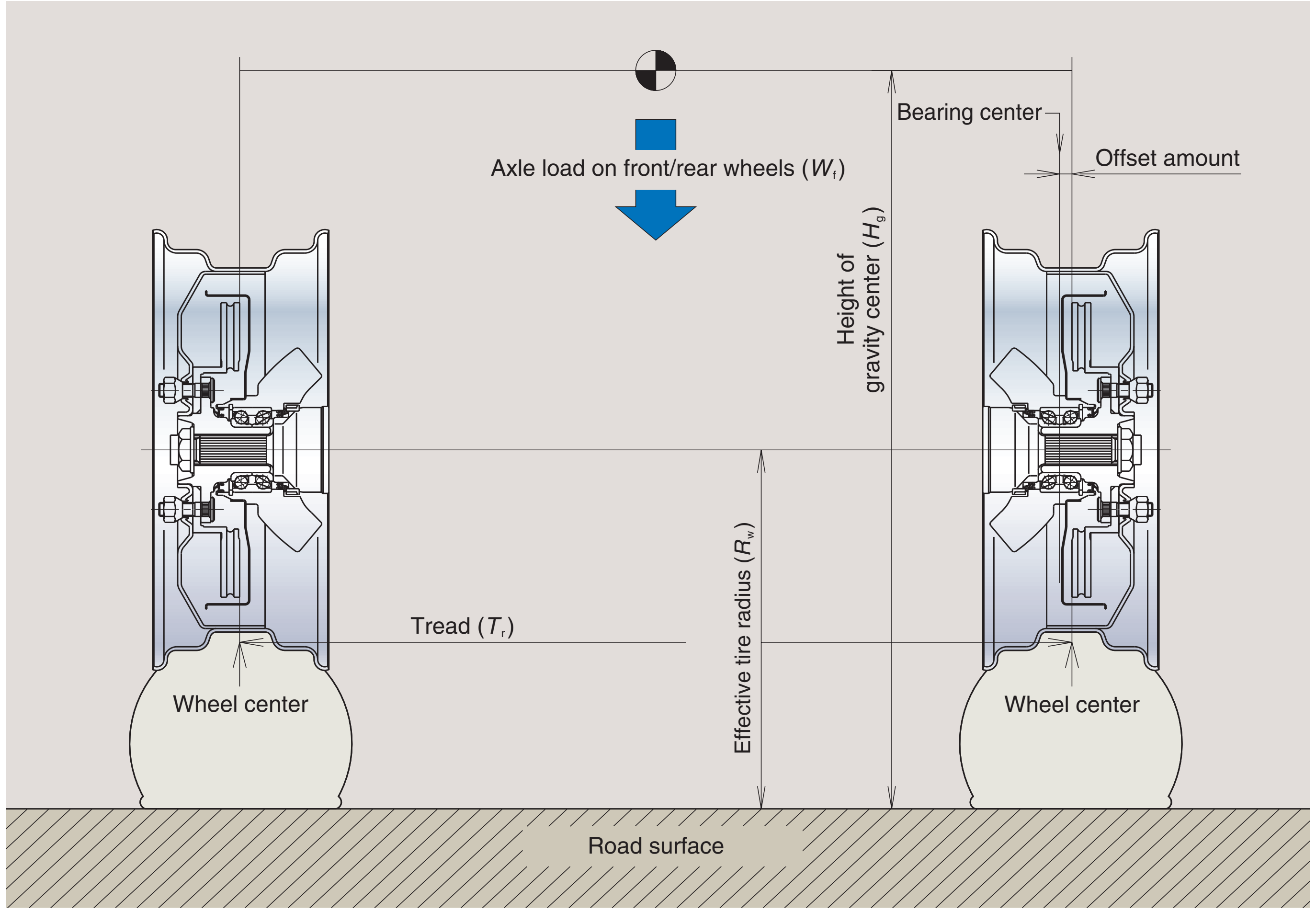


Fig. 3

(2) Calculation of road reaction

The road reaction on wheels is calculated as follows:

$$R = \frac{f_w \cdot W_f}{2}\left(1 + \frac{2 \cdot H_g \cdot \zeta}{T_r}\right)$$

$$T = \frac{\zeta \cdot W_f}{2}\left(1 + \frac{2 \cdot H_g \cdot \zeta}{T_r}\right)$$

R: Vertical road reaction (N)
T: Horizontal road reaction (N)
f_w: Vertical load coefficient (coefficient of vertical road reaction)
ζ: Turning acceleration (G)
(Positive (+) in case of outside turning wheels. Negative (–) in case of inside turning wheels.)

(3) Calculation of bearing load

The bearing load is calculated when automobiles take on vertical road reaction R and horizontal road reaction T from the road surface.

(a) Radial load

The radial load is calculated as follows:

$$F_{ri} = \frac{m}{\ell} R + \frac{R_w}{\ell} T$$

$$F_{ro} = \frac{n}{\ell} R - \frac{R_w}{\ell} T$$

F_{ri}: Radial load on inboard row of bearings (N)
F_{ro}: Radial load on outboard row of bearings (N)
ℓ: Distance between effective load center (mm)
m: Distance from the effective space rating on outboard row to the wheel center (mm)

$$m = \frac{\ell}{2} - S$$

n: Distance from the point of load application of inboard row to the wheel center (mm)

$$n = \frac{\ell}{2} + S$$

(b) Axial load and load factor

Axial load and load factor must satisfy the formulas below. As these formulas are extremely complicated, computers are used. This also allows ease of iterative calculations by modifying the axial clearance and preload.

Balance of axial load

$F_{ai} = F_{ao} + T$

F_{ai}: Axial load imposed on inboard row of bearings (N)

F_{ao}: Axial load imposed on outboard row of bearings (N)

Balance of axial displacement

$\delta_{ai} + \delta_{ao} = -\delta_0$

δ_{ai}: Axial displacement on inboard row of bearings (mm)

δ_{ao}: Axial displacement on outboard row of bearings (mm)

δ_0: Axial clearance (mm)

(+ for clearance, – for preload)

Relation between radial load and axial load

$$F_{ai(O)} = F_{ri(O)} \cdot \tan\alpha \cdot \frac{J_a}{J_r}$$

α: Contact angle of bearings

J_a: Axial integral

$$J_a = \frac{1}{\pi}\int_0^{\psi_0}\{1-\frac{1}{2\varepsilon}(1-\cos\psi)\}^t d\psi$$

J_r: Radial integral

$$J_r = \frac{1}{\pi}\int_0^{\psi_0}\{1-\frac{1}{2\varepsilon}(1-\cos\psi)\}^t \cos\psi \, d\psi$$

ε: Load factor

ψ_0: Angle indicating load range

Where $\varepsilon \leq 1$ $\cos\psi_0 = 1-2\varepsilon$

Where $\varepsilon \leq 1$ $\psi_0 = \pi$

t: Constant (3/2 for ball bearings, and 1/0.9 for roller bearings)

(c) Calculation of bearing life

The following formula produces the relation between the bearing life and load factor:

$$L = \left(\frac{J_1(0.5)}{J_r(0.5)} \cdot \frac{J_r}{J_1}\right)^p \cdot L_o$$

L: Calculated bearing life when load factor of ε (per 10^6 rotations)

L_o: Calculated bearing life when load factor of ε equals 0.5 (per 10^6 rotations)

$$L = \left(\frac{C_r}{F_r}\right)^p$$

C_r: Basic dynamic load rating (N)

F_r: Bearing radial load (N)

P: Constant (3 for ball bearings, 10/3 for roller bearings)

J_1: Radial integral against average rolling element load

$$J_1 = \left(\frac{1}{\pi}\int_0^{\psi_0}\{1-\frac{1}{2\varepsilon}(1-\cos\psi)\}^r d\psi\right)^{1/8}$$

r: Constant (4.5 for both of ball bearings and roller bearings)

s: Constant (3 for ball bearings and 4 for roller bearings)

(d) Average life of running distance

Based on certain running conditions, calculations are made with the service life to obtain the average life of running distance.

$$L_m = \frac{1}{\Sigma \frac{S_r(i)}{L(i)}}$$

L_m: Average life (per 10^6 rotations)

S_r (i): Ratio under running conditions

L (i): Calculated life under running conditions (per 10^6 rotations)

Average life Lm multiplied with running distance per rotation equals average life of running distance L_{sm}.

$$L_{sm} = 2\pi \cdot R_w \cdot L_m \text{ (km)}$$

Fig. 4 shows a graph of the calculation results.

Please contact NSK for life calculation of hub unit bearings.

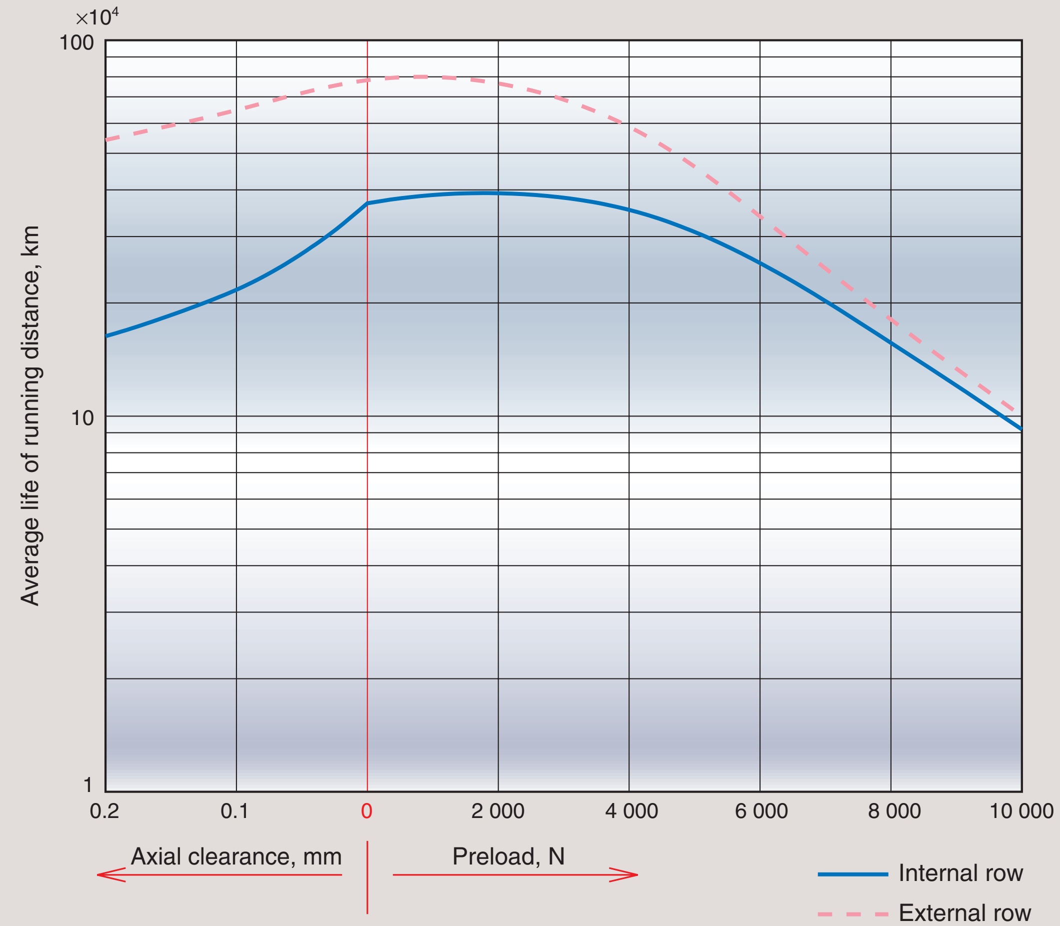


Fig. 4 Sample results of the bearing life calculation

3-2. Rigidity

The following elements must be taken into account regarding the rigidity of hub unit bearings:

(1) Deformation of rolling elements and raceway

(2) Deformation of outer and inner rings

(1) for HUB I, and (1), (2) for HUB II and III.

(1) Deformation of rolling elements and raceway

Rigidity of bearings (relative inclination angle θ) are calculated based on axial displacement $\delta_{ai(o)}$ derived from the life calculation, and radial displacement $\delta_{ri(o)}$ derived from the load factor.

$$1 + \frac{\delta_{ai(0)}}{\delta_{ri(0)}} = 2 \cdot \varepsilon$$

$$\theta = \tan^{-1}\frac{\delta_{ri} - \delta_{ro}}{\ell}$$

δ_{ri}: Radial displacement on inboard row (mm)

δ_{ro}: Radial displacement on outboard row (mm)

θ: Relative inclination angle between inboard and outboard rows

(2) Deformation of outer and inner rings

For HUB II and III, the Finite Element Analysis (FEA) is used to calculate deformation considering the flange rigidity of outer and inner rings.

Please contact NSK for rigidity calculations with FEA.

3-3. Strength

FEA is used for the analysis of flange strength and rigidity in hub unit bearings for optimal design. NSK applies this technology to reduce the weight of hub units when proposing highly rigid and lightweight shapes to automobile manufacturers.

(1) Bore hub flange
Relieved stress concentration in the inboard row of the hub units and reduced unit weight

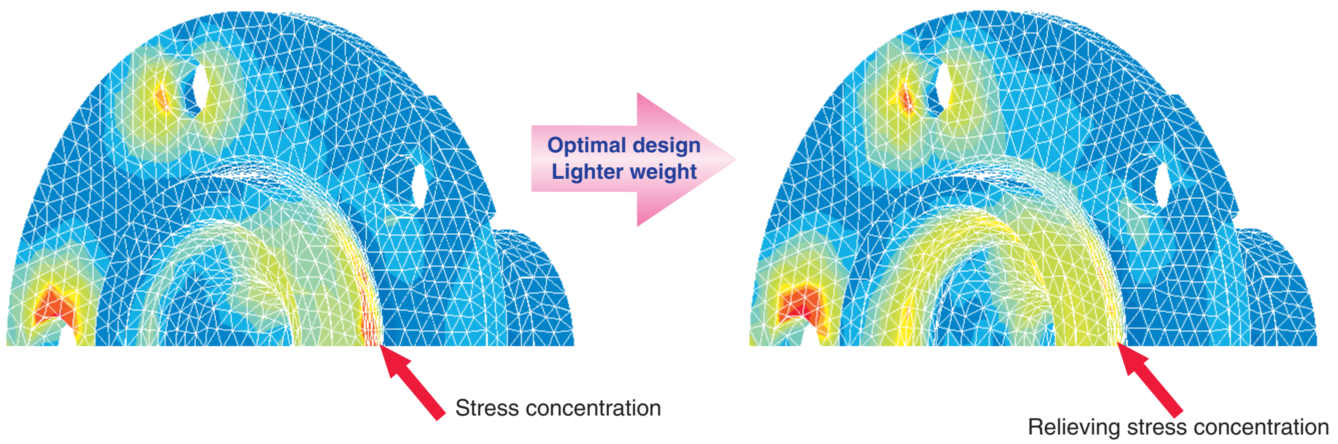


Fig. 5 Sample of FEA (bore flange)

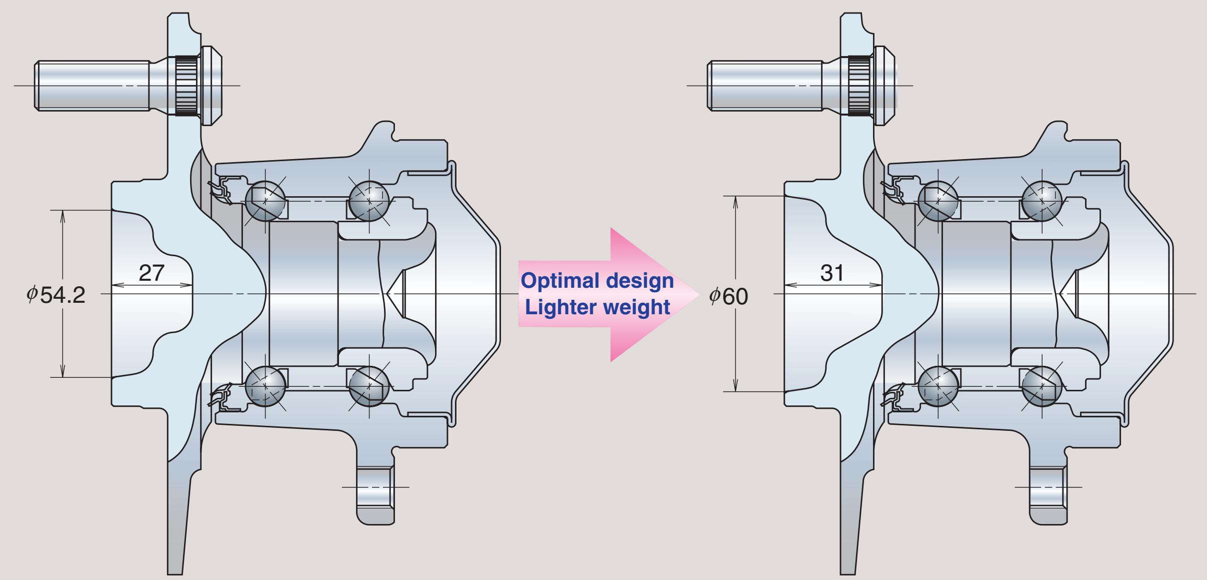


Fig. 6 Sample of optimal design (bore flange)

(2) Outboard hub flange
Realized optimal design of outside hub flanges by FEA for keeping stress concentration within the permissible range, and for weight reduction

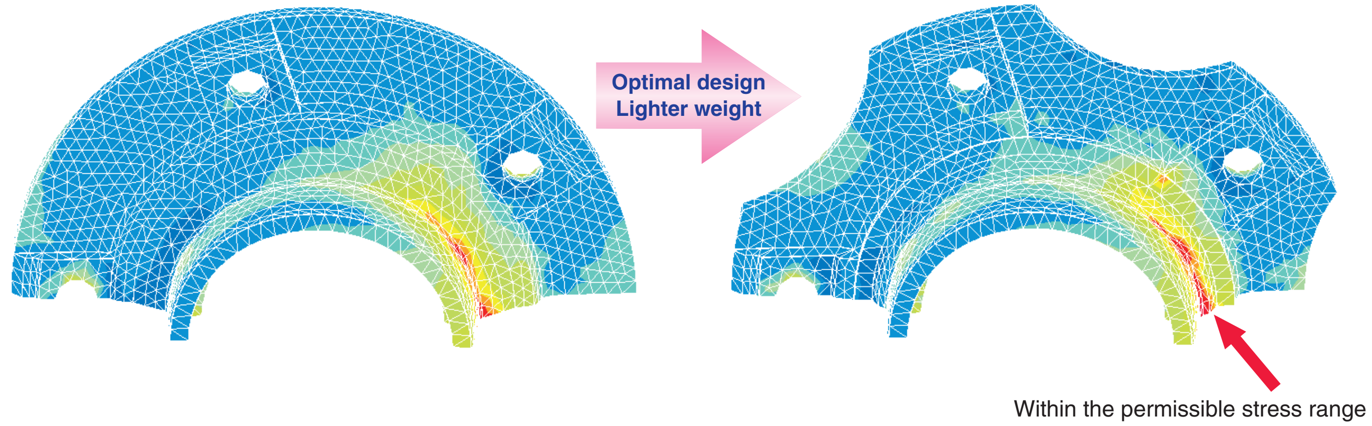


Fig. 7 Sample of FEA (outboard flange)

(3) Hub flange thickness
Realized optimal design of hub flange thickness by FEA for keeping stress concentration within the permissible range, and for weight reduction

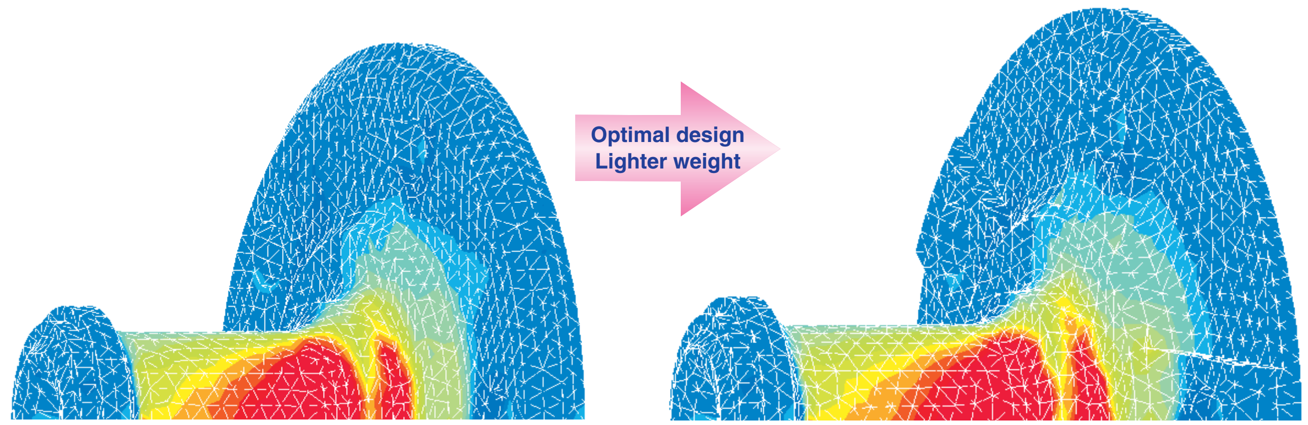


Fig. 8 Sample of FEA (flange thickness)

4. Fit and Preload of Hub Unit Bearings

Axial clearance and fit are specified to allow hub unit bearings to operate within an optimal preload range (life, rigidity, creep, and heat generation).

4-1. Fit and preload

The preload must be pre-adjusted based on the fit with other components and nut clamping force, which reduces axial clearance.

For calculating tolerances, NSK has standard preload settings of zero to negative clearances using the 3σ method and maximum preload of 9 800N using the direct sum method.

4-2. Recommended fitting measurements

Table 3 indicates the fitting measurements recommended for each type.

Table 3 Recommended fitting measurements

unit: mm

Type		Housing		Shaft	
HUB I	Inner ring rotations	T7	−0.064 −0.094	m6	+0.025 +0.009
	Outer ring rotations		−0.061 −0.088		−0.018 −0.034
HUB II	Inner ring rotations	—		m6	+0.025 +0.009
	Outer ring rotations	—		Loose	
HUB III	Inner ring rotations	—		—	
	Outer ring rotations	—		—	

Notes: 1) The dimensional tolerance of the diameter between inner rings and outer rings of hub unit bearings is in compliance with JIS0.
2) Excessive fastening by fitting bearing inner rings may cause defects (high pressure, deformation of pressed surface, plastic deformation, cracking of inner rings). Check to see that the maximum stress on the inner rings does not exceed 147 MPa.

4-3. Fitting tests

When mounting bearings on vehicles, use actual components to confirm that the axial clearance is properly set and the preload is within the appropriate range as specified by the users.

Table 4 lists the actual components required for fitting tests.

Table 4 Components required for fitting tests

unit: mm

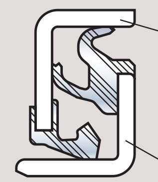
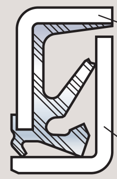
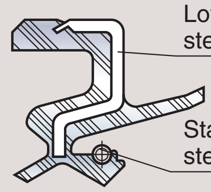
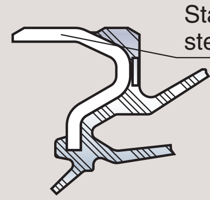
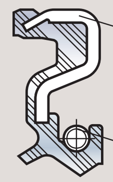
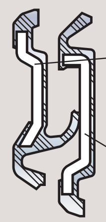
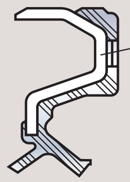
	Components	Usage conditions	Knuckle (housing)	Hub	CVJ	Spindle (shaft)	Nut washer	Snap ring	Others (sensor rotors, etc.)
HUB I	Driven wheels	Inner ring rotations	6	6	6	—	18	6	—
	Non-driven wheels	Inner ring rotations	6	6	—	—	18	6	—
		Outer ring rotations	—	6	—	6	18	6	6
HUB II	Driven wheels	Inner ring rotations	—	6	6	—	18	—	—
	Non-driven wheels	Inner ring rotations	—	6	—	—	18	—	—
		Outer ring rotations	—	—	—	6	18	—	6
HUB III	Driven wheels	Inner ring rotations	—	—	6	—	18	—	—

5. Hub Unit Bearing Seals

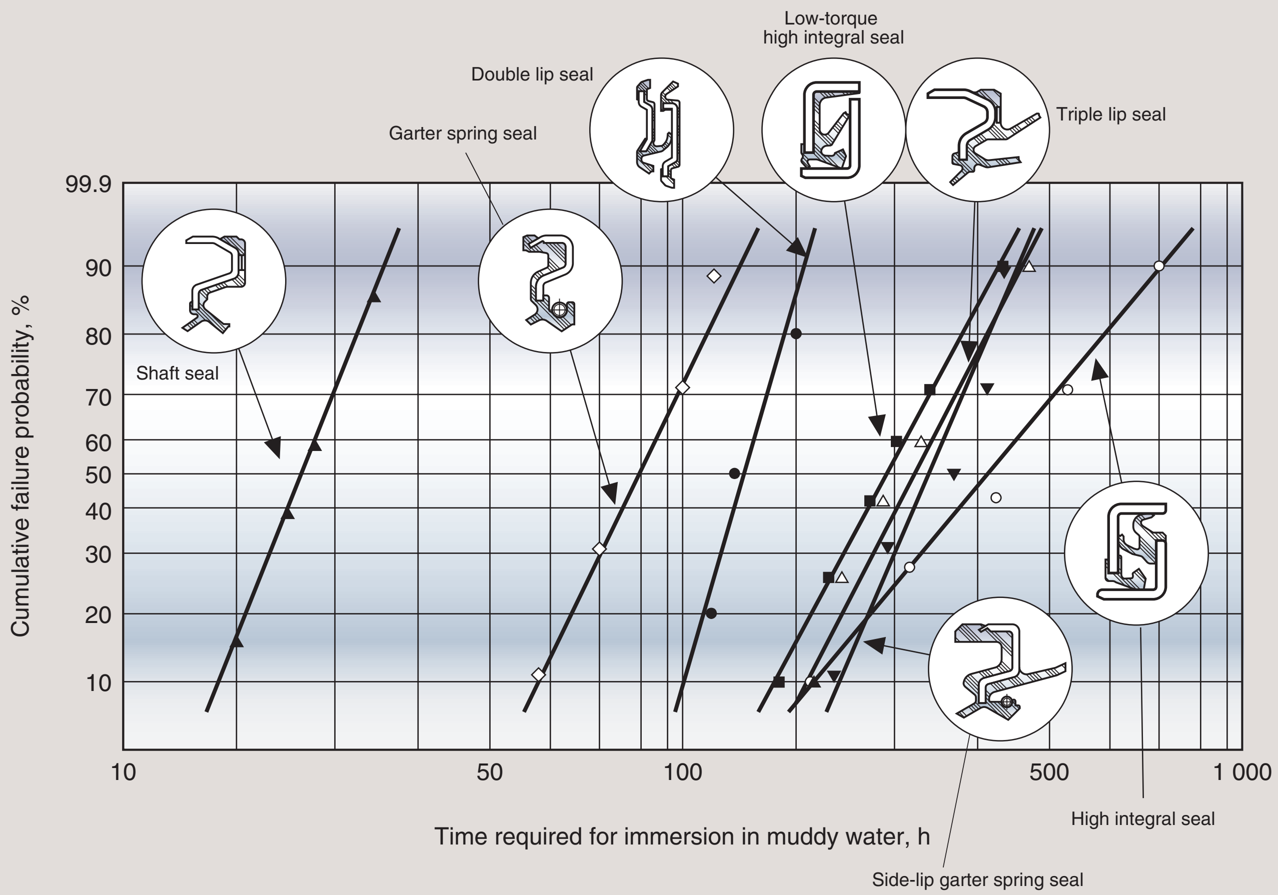
NSK offer customers a flexible choice of seals (illustrated in Table 5 and Fig. 9) that vary in capabilities and cost.

Please submit your specific requirements for muddy water resistance, rotation torque, and cost to us for design evaluation.

Table 5 Hub unit bearing seals

Seal type	Seal configuration	Muddy water resistance	Friction torque	Cost
High-integral seal		AA	C	C
Low-torque high integral seal		A	BB	B
Side-lip garter spring seal		A	BB	B
Triple lip seal		A	A	BB
Garter spring seal		B	A	BB
Double seal		BB	AA	A
Shaft seal		C	AA	AA

[Symbols] The ratings of AA > A > BB > B > C are ranked from AA (highest) to C (lowest).



Testing conditions

- Mixture of elements in water: 125g of Kanto Loam powder and 50g of salt to 1 liter of water
- Water level: center of shaft
- Wobbling eccentricity: 0.4 TIR
- Number of rotations: 1 000 min^{-1}
- Cycle patterns: (immersion + rotations) (immersion + stop) (dry-up + stop) (dry-up + rotations)

Fig. 9 Muddy water resistance performance of hub unit bearing seals

6. Hub Unit Bearing Grease

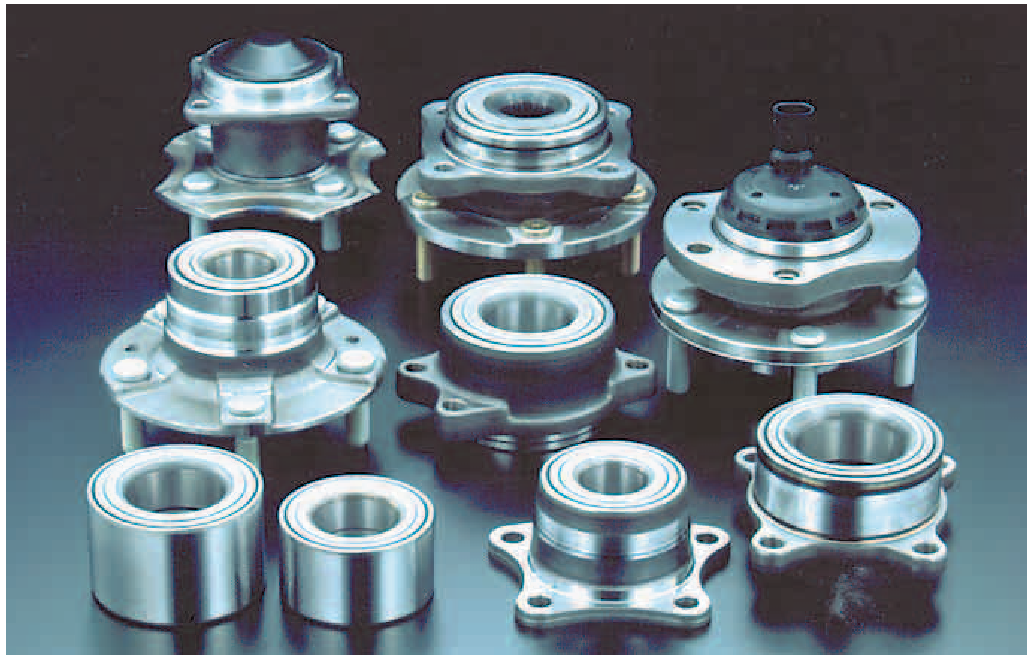
Grease is used to lubricate hub unit bearings. Lubrication is applied to prevent metal contact between the hub unit's raceway rings and rolling elements, reducing friction and wear in order to extend its fatigue life.

Grease with urea as a thickener is especially recommended during transportation by rail, when strong vibrations may cause fretting damage to the hub unit raceway.

Table 6 Hub unit bearing grease

Grease Brands	Manufacturers	Thickener	Base Oil
RareMax AF-1	Kyodo Yushi Co., Ltd.	Urea	Mineral oil
6459 Grease N	Showa Shell Sekiyu, K.K.	Urea	Mineral oil
Pyronoc Universal N-6C	Nisseki Mitsubishi Oil Corporation	Urea	Mineral oil
HB-1	Kyodo Yushi Co., Ltd.	Urea	Mineral oil
Ronex MP	Exxon/Mobil	Lithium	Mineral oil

7. Material for Hub Unit Bearings



7-1. Material for raceway rings and rolling elements

NSK offers customers various types of steel for raceway rings and rolling elements according to their usage conditions and locations, including its most popular, high quality (*1) steel SUJ2 (SAE52100).

*1: Unlike general-purpose steel, the steel used for bearings contains fewer non-metallic inclusions, improving the subsurface-originated rolling fatigue life.

(1) SUJ2

For many years NSK has been striving to improve the quality of steel with the cooperation of bearing-steel makers. Through advances in the technology and facilities of steel mills and accumulated test data on bearing life, we have developed a high-quality, long-life bearing steel. This steel is a long-life material that is largely free of harmful non-metallic inclusions, and it is frequently adopted in hub unit bearings. It is used for the rollers and contact balls, the outer and inner rings of HUB I (BWD), the outer ring of HUB I (KWD), and as the standard material of the inner rings for HUB II and HUB III.

(2) SUJ2 (EP Steel)

Please refer to EP Steel Catalog CAT. NO. 5001 (super-long life, highly reliable bearing steel) for detailed information.
Based on NSK's proprietary evaluation method, the technology for mass production of high-purity steel was established, and resulted in SUJ2 (EP Steel), which has a subsurface-originated roller fatigue life that is even longer than that of SUJ2.
This material is used for the outer and inner rings of HUB I (BWD) and the inner rings of HUB I (KWD), HUB II, and HUB III.

(3) S53CG (in compliance with SAE1055)

This is an induction heat-treated material, which can be inexpensively die-forged into complex shapes. It is mainly used for parts such as axle components, which require impact-load resistance. Induction heat treatment allows NSK to control the hardness of the component parts. This material is used for the outer rings of HUB II and III, and the flanged inner rings of HUB III.

(4) Carburizing Steel (SCr420H)

Carburizing allows proper hardening depth, a dense structure, and appropriate surface and core hardness of materials in order to extend the fatigue life of bearings. This material is used for the inner rings of HUB I (KWD), HUB II, and HUB III.

(5) Hi-TF Steel

Please refer to Super TF Bearings, Hi-TF Bearings Catalog CAT. No. 399 for detailed information.
Hi-TF steel was developed in order to extend service life under conditions in which lubricants become mixed with foreign matter, providing excellent resistance against wear and seizure at a reasonable cost. This material is used for the inner rings of HUB II (KWH).

(6) New-TF Steel

Please refer to New-TF Bearings Catalog CAT. No. 1213 for detailed information.
New-TF steel has the advantage of long service life under conditions in which lubricants become mixed with foreign matter, maintaining excellent resistance against wear and seizure at a reasonable cost. This material is used for the inner rings of HUB II (KWH).

7-2. Cage material

The cage for hub unit bearings is made from Nylon 66 with glass fiber. Pressed cages for HUB I (KWD) are made of low-carbon steel.
Now that improved automotive safety has become a primary goal of manufacturers, the Antilock Brake System (ABS) has become widely used in automobiles, ensuring safe braking on slippery and icy roads.
NSK has been active in the research and development of ABS-related products.

8. Hub Unit Bearings with Integral ABS Sensors

8-1. Multi-pole magnetic encoder for ABS

The next-generation ABS uses annular magnets for multi-pole encoding, instead of the conventional magnetic sensor rotor. The semiconductor magnetic sensor (active sensor) fixed on the car body detects the rotation speed of the wheel.

(1) Types

There are two types of multi-pole magnetic encoder: the radial type, for setting the sensor close to the radius; and the axial type, for setting the sensor close to the axle.

(2) Features

By using the active sensor, the multi-pole magnetic encoder allows constant output without the sensor's output voltage relying on the rotation speed of the sensor rotor.
As a result, the encoder can detect the rotation speed of the wheel running at low speed. The active sensor requires no magnet, reducing cost and weight.

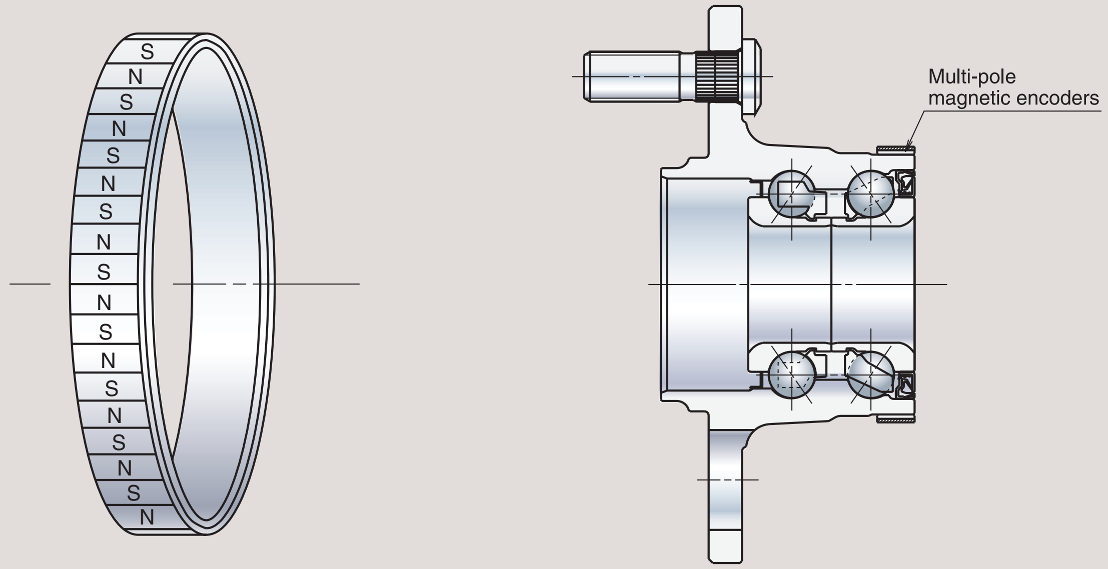


Fig. 10 Sample of radial type structure

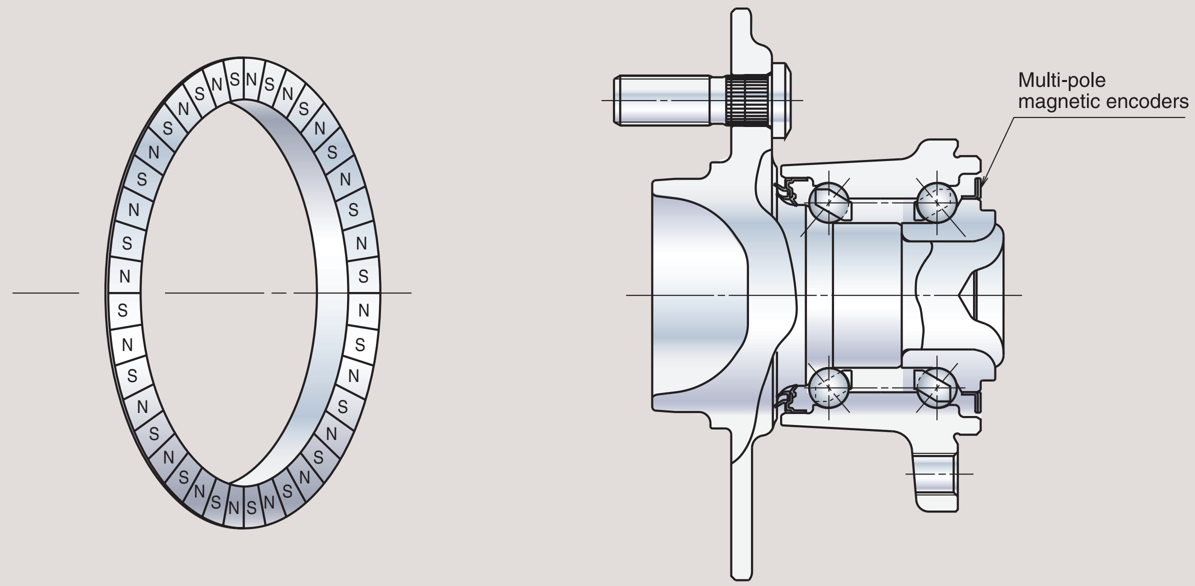


Fig. 11 Sample of axial type structure

8-2. Hub unit bearings with integral ABS sensors

(1) Structure

Hub unit bearings with integral ABS sensors incorporate rotation-detecting sensors and the sensor rotors of magnetic rings or multi-pole magnetic encoders. Assembly with electromagnetic sensors (passive sensors) limits the sensor mounting space, making it difficult to mount sensors. NSK has solved these space issues by adopting annular passive sensors with highly efficient magnetic circuits.

(2) Features

●Lightweight and compact

Bearings with integral sensors and sensor rotors result in lighter, more compact hub units. Incorporating sensor rotors and high integral seals further reduces the size of hub units, increasing the flexibility of the design in the axial direction.

●Easier mounting of hub units

Incorporating sensors and sensor rotors eliminates air gap adjustments between the sensors and sensor rotors, which are normally performed on automobile assembly lines, thereby facilitating the mounting of hub units.

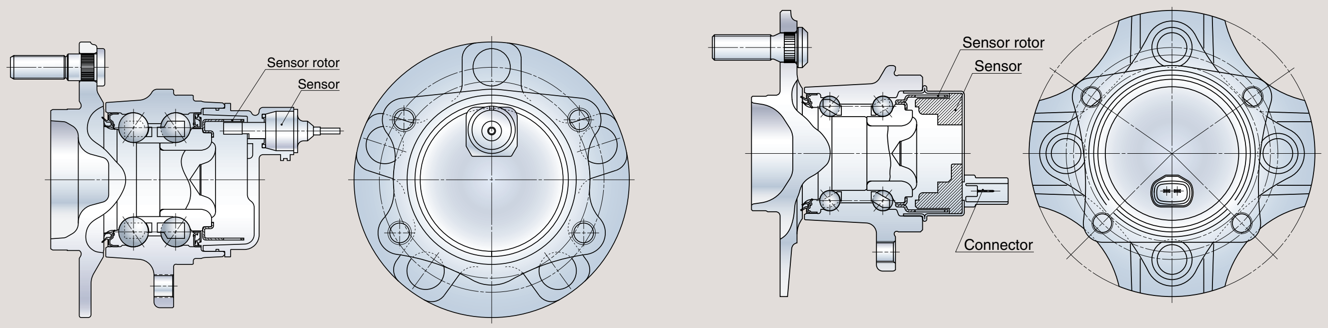
●Prevents the harmful effects of foreign objects on hub unit performance

Incorporating sensors and sensor rotors prevents lower performance caused by the intake of gravel from the road.

●High output sensors

Higher sensor output values even at low driving speeds enable stable control.

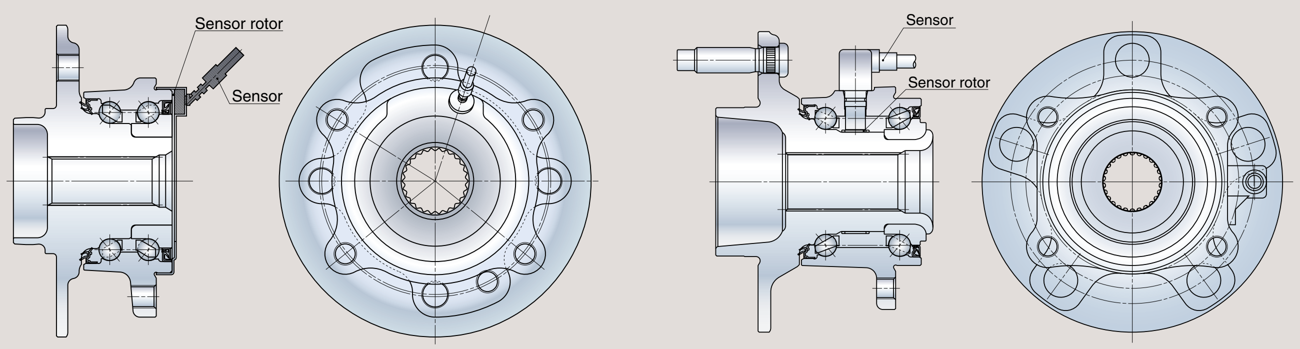
Structures of hub unit bearings with integral sensors for non-driven wheels (Fig. 12) and for driven wheels (Fig. 13) are described below.
Please contact NSK for hub unit bearings with integral ABS sensors.



Integral end cap type active sensor

Integral annular passive sensor

Fig. 12 Structure of HUB III for non-driven wheels with integral ABS sensors



Multi-pole magnetic encoder + Active sensor

Integral sensors between rows

Fig. 13 Sample of structure for HUB III for driven wheels with integral ABS sensor

9. Hub Unit Bearings with Swaging

NSK's latest proposals are hub unit bearings with swaging as a HUB III inner ring clamping mechanism.
Hub unit bearings for non-driven wheels require fewer components compared to the conventional nut-clamping method, and manufacturers can benefit from their lower cost, reduced size, and lighter weight. Hub unit bearings for driven wheels require no preload control at mounting, making it easier to mount them to axles.

Figs. 14 and 15 shows samples of the inner ring clamping mechanism.
Please contact NSK for further information about the swaging technique.

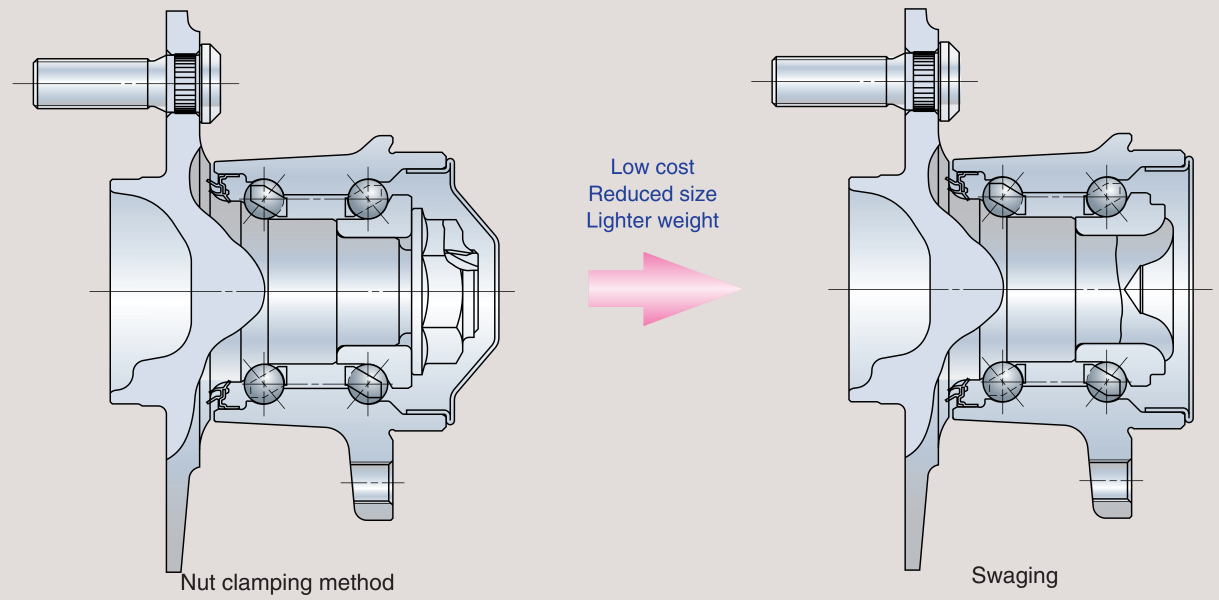


Fig. 14 Structure of the inner ring clamping mechanism for non-driven wheels

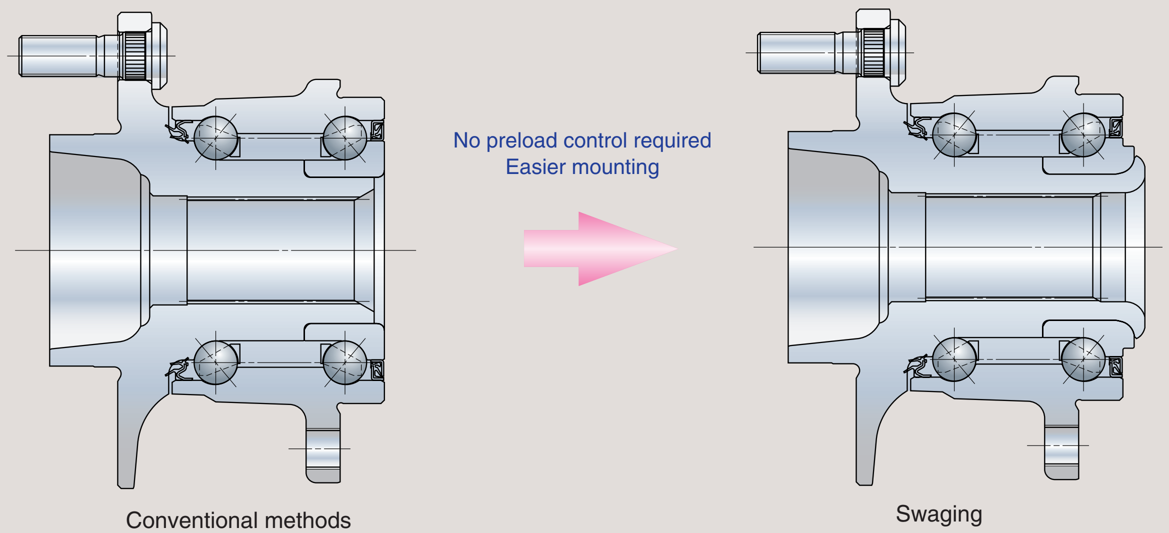


Fig. 15 Structure of the inner ring clamping mechanism for driven wheels

10. Recommended Bearing Nomenclatures Hub Unit Bearings

The following table indicates our recommended list of well-established bearings according to vehicle models, displacement, front/rear wheels, and axle load:

Table 7 Bearings reference recommended

(1) For front engine, front wheel drive automobiles

Displacement (cc)	HUB I		HUB II		HUB III	
	Front wheels	Rear wheels	Front wheels	Rear wheels	Front wheels	Rear wheels
Less than 660	35BWD19E	25BWD01	☆	27BWK02A*	☆	☆
Less than 1 300	38BWD22	↑	☆	27BWK06* 28BWK12**	58BWKH03	44BWKH10B
1 300 to 1 800	↑	↑	☆	↑	↑	↑
1 500 to 2 000	40BWD12	30BWD04	43BWK07**	30BWK13A* 30BWK17**	66BWKH02A	49BWKH04A
2 000 to 3 000	43BWD06B	32BWD05	↑	30BWK18*	↑	55BWKH01

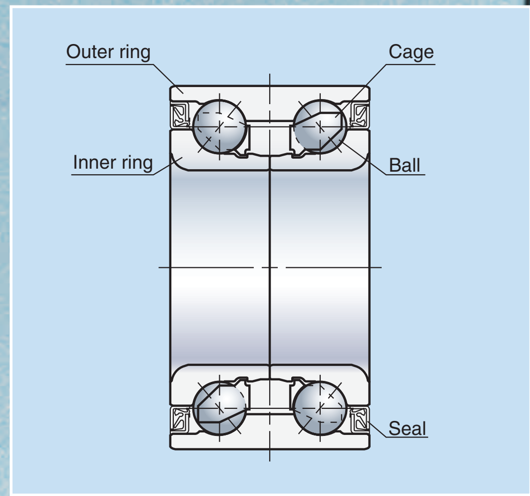
(2) For front engine, rear wheel drive automobiles

Displacement (cc)	HUB I		HUB II		HUB III	
	Front wheels	Rear wheels	Front wheels	Rear wheels	Front wheels	Rear wheels
2 000 to 2 500	32BWD05	43BWD06B	30BWK18*	43BWK07**	49BWKH04A	66BWKH02A
More than 2 500	38BWD23A 38KWD04A	43BWD06B 46KWD04	↑	☆	55BWKH01	↑

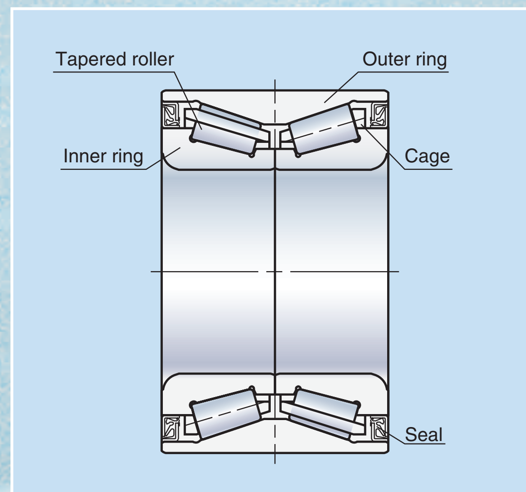
Notes: 1) Please contact NSK for products with the ☆ symbol.
2) In the columns under HUB II, * indicates outer ring rotation types, ** indicates inner ring rotation types.
3) All HUB III are inner ring rotation types.

HUB I Dimension Table

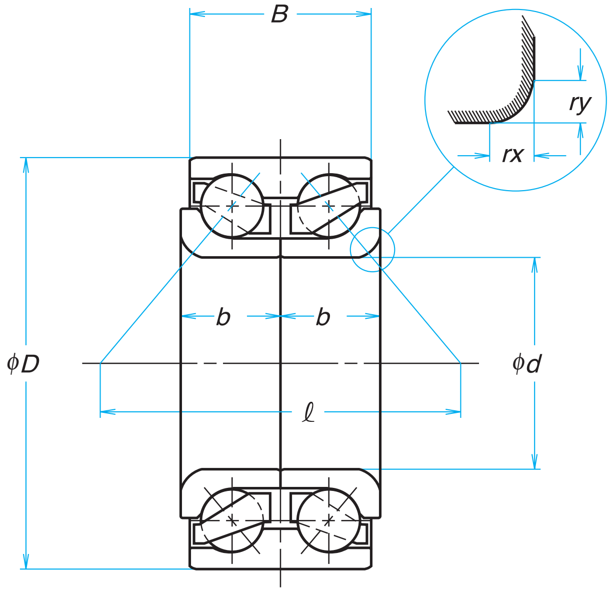
BWD type



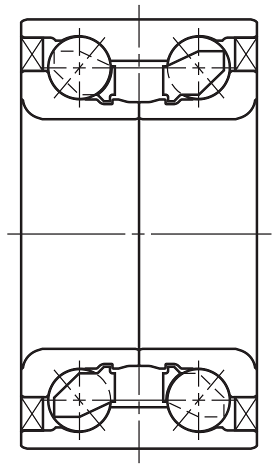
KWD type



BWD type
for driven/non-driven wheels



Standard type

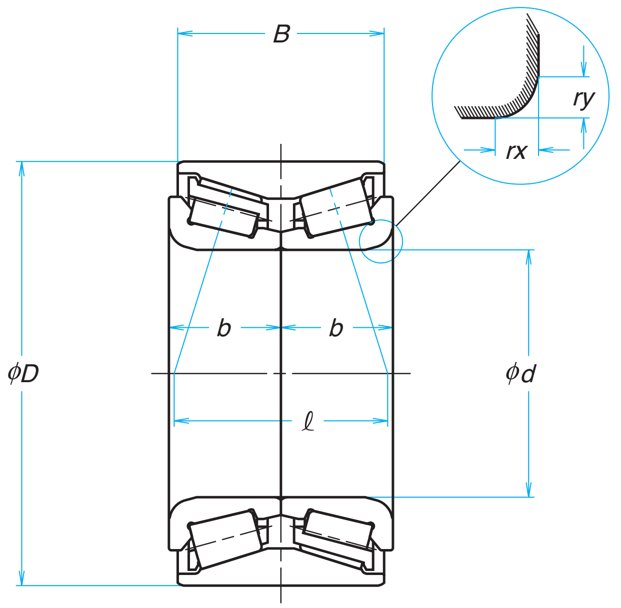


Seal integral type

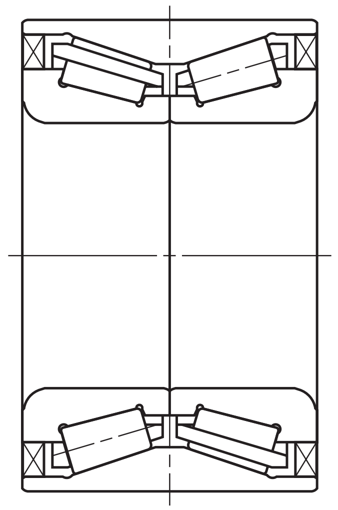
Boundary dimensions (mm)						Distance between effective load centers ℓ (mm)	Bearing reference	Basic load ratings (N) Double row		Seal integral type	Mass (kg) (approx.)
d	D	B	b	rx (Min.)	ry (Min.)			C_r	C_{or}		
25	52	42	21	2.6	2.6	52.0	25BWD01	28 500	21 400	○	0.36
27	60	50	25	3.6	3.6	52.8	27BWD01J	42 500	32 500	○	0.36
28	58	42	21	2.8	2.8	54.1	28BWD03A	33 500	25 700	○	0.40
	61	42	21	3.6	3.6	55.5	28BWD01A	38 500	29 800	–	0.53
30	55	26	13	1.2	1.2	39.1	30BWD08	15 600	14 700	○	0.26
	63	42	21	3.6	3.6	57.3	30BWD01A	40 500	33 000	–	0.55
	68	45	22.5	3.6	3.6	53.5	30BWD04	52 500	40 000	○	0.69
32	72	45	22.5	3.6	3.6	61.4	32BWD05	58 500	45 000	○	0.80
34	64	37	18.5	2	1.2	52.5	34BWD04B	36 500	31 000	○	0.82
	64	37	18.5	3.3	2.4	50.7	34BWD11	36 500	31 000	○	0.46
	66	37	18.5	3.3	2.4	51.0	34BWD10B	40 500	33 500	○	0.51
	68	42	21	3.5	2.5	55.7	34BWD07B	44 000	35 000	○	0.64
	68	37	18.5	2	1.2	55.7	34BWD09A	44 000	35 000	○	0.54
35	65	37	18.5	3	3	51.0	35BWD19E	36 500	31 000	○	0.48
	68	30	16.5	3.5	3.5	52.4	35BWD07	42 500	36 500	–	0.48
	68	30	16.5	3.5	3.5	59.6	35BWD07A	40 500	34 500	–	0.48
	68	36	19.5	3.5	3.5	58.4	35BWD16	42 500	36 500	–	0.48
	72	31	16.5	3.5	3.4	53.0	35BWD06A	50 000	40 000	–	0.55
36	68	33	16.5	3.5	3.1	52.4	36BWD04	42 500	36 500	–	0.48
	72	42	21	3	3	61.1	36BWD03	50 000	40 000	–	0.68
	72.041	34	17	2.5	2	51.6	36BWD01B	50 000	40 000	–	0.57
37	74	45	22.5	2.4	2.4	60.9	37BWD01	52 500	44 000	○	0.79

Boundary dimensions (mm)						Distance between effective load centers ℓ (mm)	Bearing reference	Basic load ratings (N) Double row		Seal integral type	Mass (kg) (approx.)
d	D	B	b	rx (Min.)	ry (Min.)			C_r	C_{or}		
38	70	37	18.5	3	3	51.0	38BWD19	44 500	39 500	○	0.48
	70	38	19	4	3.5	55.2	38BWD21	44 500	39 500	○	0.57
	71	30	16.5	3.5	3.4	61.7	38BWD09A	45 500	39 000	–	0.50
	71	39	19.5	3.5	3.4	65.9	38BWD22	42 000	37 500	○	0.62
	72	33	18	3.5	3.4	56.5	38BWD12	48 500	42 000	–	0.56
	72.041	34	17	2.5	2	55.9	38BWD04	47 500	41 000	–	0.55
	74	33	18	3.5	3.5	57.2	38BWD01A	52 500	44 000	–	0.60
	74	50	25	4.5	3.6	57.2	38BWD06D	52 500	44 000	○	0.82
	74	40	20	3.8	3.8	56.7	38BWD10B	52 500	44 000	○	0.69
	74	33	18	4	3.5	57.2	38BWD15A	52 500	44 000	–	0.61
	74	33	18	3.5	3.5	67.2	38BWD24	48 000	43 000	–	0.62
	76	43	21.5	4.8	3.8	71.9	38BWD23A	48 000	43 500	○	0.82
	80	33	18	3.5	3.5	64.1	38BWD18	47 500	46 000	–	0.79
39	68	37	18.5	3.6	3.6	54.5	39BWD03	38 000	34 000	○	0.5
	72	37	18.5	3.3	2.4	53.9	39BWD01L	47 500	41 000	○	0.60
	74	39	19.5	3.8	3.8	56.4	39BWD05	48 500	42 500	○	0.66
40	74	40	20	3.8	3.8	57.4	40BWD06D	54 000	47 000	○	0.66
	74	42	21	3.5	3.5	70.1	40BWD12	48 000	43 000	○	0.71
	74	36	18	4.8	3.8	64.1	40BWD15A	48 000	43 000	○	0.62
	74	34	18	2.6	2.6	58.8	40BWD16	50 500	45 500	–	0.59
	76	38	20.5	3	1.8	55.0	40BWD05	52 500	44 500	○	0.70
	76	33	16.5	3.6	3.6	54.3	40BWD08A	51 500	48 000	○	0.61
	80	34	18	2.6	2.6	60.3	40BWD07A	65 500	56 000	–	0.73
	80	34	18	3.5	3	57.8	40BWD14	47 500	46 000	○	0.77
42	76	33	16.5	3.6	3.6	54.3	42BWD12	46 000	43 000	○	0.65
	76	35	19	3.6	3.5	62.1	42BWD06	50 500	46 000	–	0.64
	78	38	19	3.5	2.5	57.0	42BWD09	55 000	48 500	○	0.72
	80	45	22.5	3.8	3.8	63.9	42BWD11	59 000	50 500	○	0.90
	80	34	18	3.5	3	57.8	42BWD13	47 500	46 000	○	0.76
43	76	43	21.5	4.8	3.8	71.9	43BWD12A	48 000	43 500	○	0.71
	79	38	20.5	4	3	58.7	43BWD08	55 000	48 500	○	0.77
	79	45	22.5	4.8	3.1	76.4	43BWD13A	49 500	47 000	○	0.87
	80	45	25	3.5	3	73.1	43BWD03	55 000	48 500	–	0.91
	82	45	22.5	3.5	3.4	65.5	43BWD06B	62 000	54 500	○	0.94
45	83	45	22.5	3.8	3.8	66.8	45BWD06	57 500	52 500	○	0.95
	84	39	20.5	2.6	2.6	72.9	45BWD03	58 500	52 500	○	0.88
	84	40	21	4.5	3.5	62.8	45BWD07B	69 000	61 000	○	0.89
	84	40	21	4.5	3.5	62.9	45BWD09	64 500	57 500	○	0.90
	84	45	22.5	3.5	3.35	76.8	45BWD10	58 500	52 500	○	0.98
46	79	45	22.5	4.8	3.1	76.4	46BWD01A	49 500	47 000	○	0.79
48	89	42	22	4.5	3.5	67.2	48BWD01	69 000	62 000	○	0.9
49	84	50	25	3.5	2	87.1	49BWD02	46 000	47 000	○	1.00
	88	46	23	3.7	3.7	71.1	49BWD01B	64 500	60 000	○	1.05

KWD type
for driven/non-driven wheels



Standard type

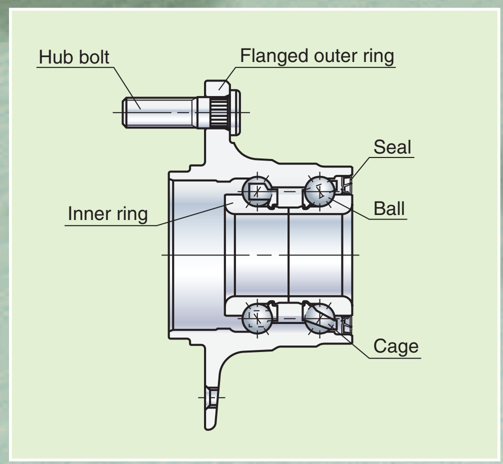


Seal integral type

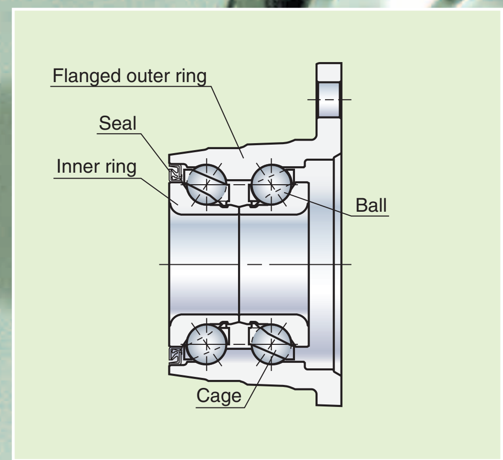
Boundary dimensions (mm)						Distance between effective load centers ℓ (mm)	Bearing reference	Basic load ratings (N) Double row		Seal integral type	Mass (kg) (approx.)
d	D	B	b	rx (Min.)	ry (Min.)			C_r	C_{or}		
27	52	43	21.5	3.3	3.3	36.9	27KWD02	53 000	73 500	–	0.41
30	58	42	21	3.3	3.3	31.8	30KWD01A	62 000	89 000	○	0.50
34	67.8	40	21.5	5	3.6	37.4	34KWD03D	89 500	120 000	–	0.73
35	60	30.4	16.2	2.5	2.5	27.6	35KWD02	60 000	93 500	–	0.38
37	74	45	22.5	2.4	2.4	36.9	37KWD01	89 000	123 000	○	0.84
38	64	37	18.5	3	3	31.2	38KWD01A	60 500	88 000	○	0.46
	68	37	18.5	3	3	31.2	38KWD02	63 000	92 500	–	0.56
	76	40	21.5	5	4	38.1	38KWD04A	92 500	138 000	–	0.94
38.993	72.011	37	18.5	3.3	2.4	32.5	39KWD02	68 500	92 500	○	0.63
42	72	38	19	4.75	3.6	36.3	42KWD02A	76 500	108 000	–	0.58
	72	38	19	4.7	3.6	36.3	42KWD02D	76 500	108 000	–	0.58
	80	38	19	3.5	3.5	32.8	42KWD08	95 000	128 000	–	0.82
43	76	40	21.5	3.6	3.5	38.3	43KWD02	94 000	138 000	–	0.82
	77	38	21	3.5	3.5	38.9	43KWD04	79 500	111 000	–	0.81
45	77	50	25	3.5	3.5	40.6	45KWD04	96 000	142 000	–	0.89
	78	37	20	3.5	3.5	37.3	45KWD03	91 000	130 000	–	0.73
	80	50	25	3.8	3.8	42.5	45KWD05	99 500	153 000	○	1.02
46	77	41	22.5	4.8	3.8	35.8	46KWD04	82 500	138 000	–	0.84
	78	49	24.5	5	4	35.8	46KWD03	82 500	138 000	○	0.97
47	82	57.5	28.75	3.5	3.5	57.5	EP47KWD01	95 000	138 000	○	1.10

HUB II Dimension Table

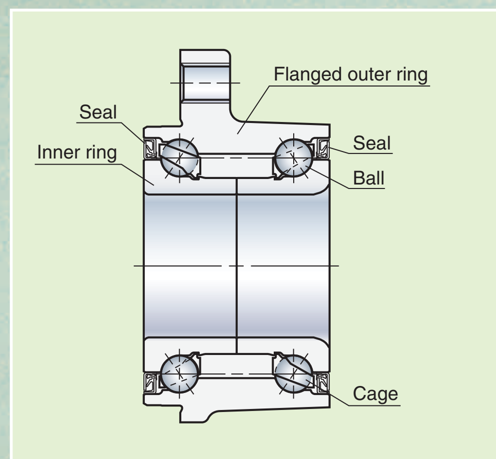
BWK outer ring rotation type for non-driven wheels



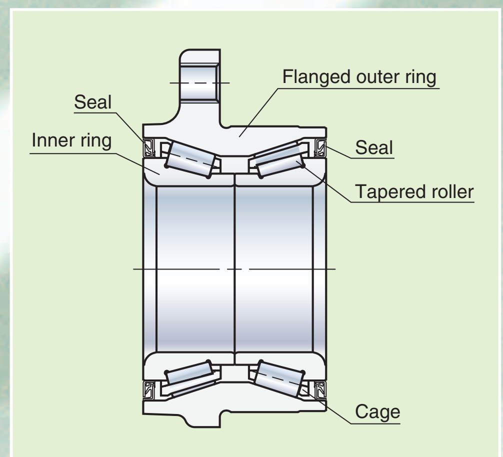
BWK inner ring rotation type for non-driven wheels



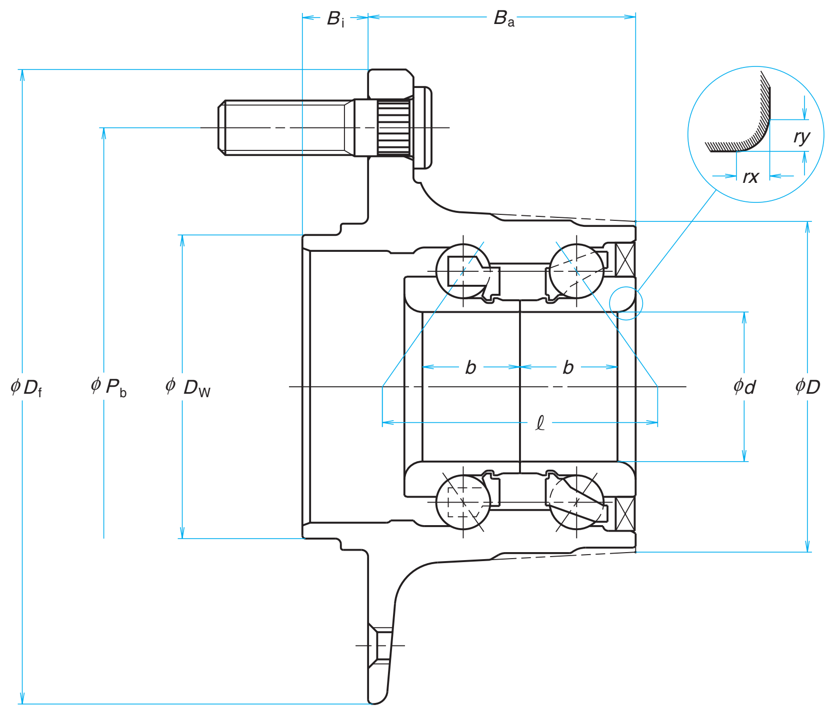
BWK inner ring rotation type for driven wheels



KWH inner ring rotation type for driven/non-driven wheels

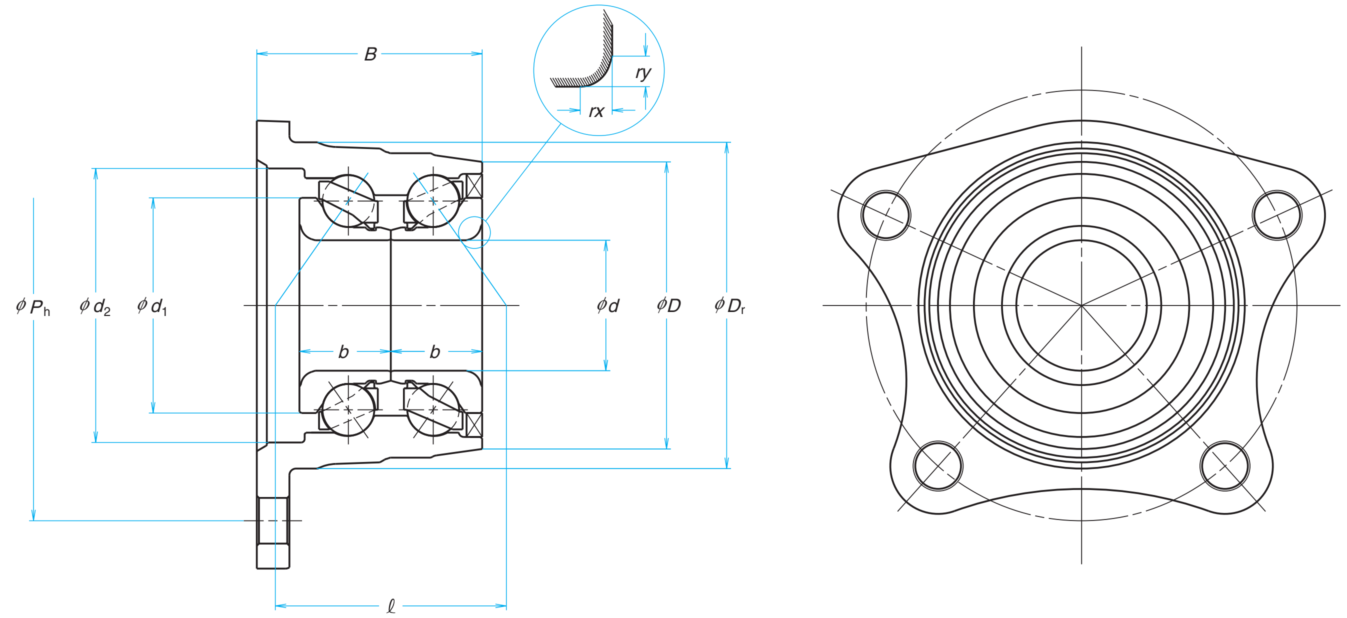


BWK outer ring rotation type for non-driven wheels



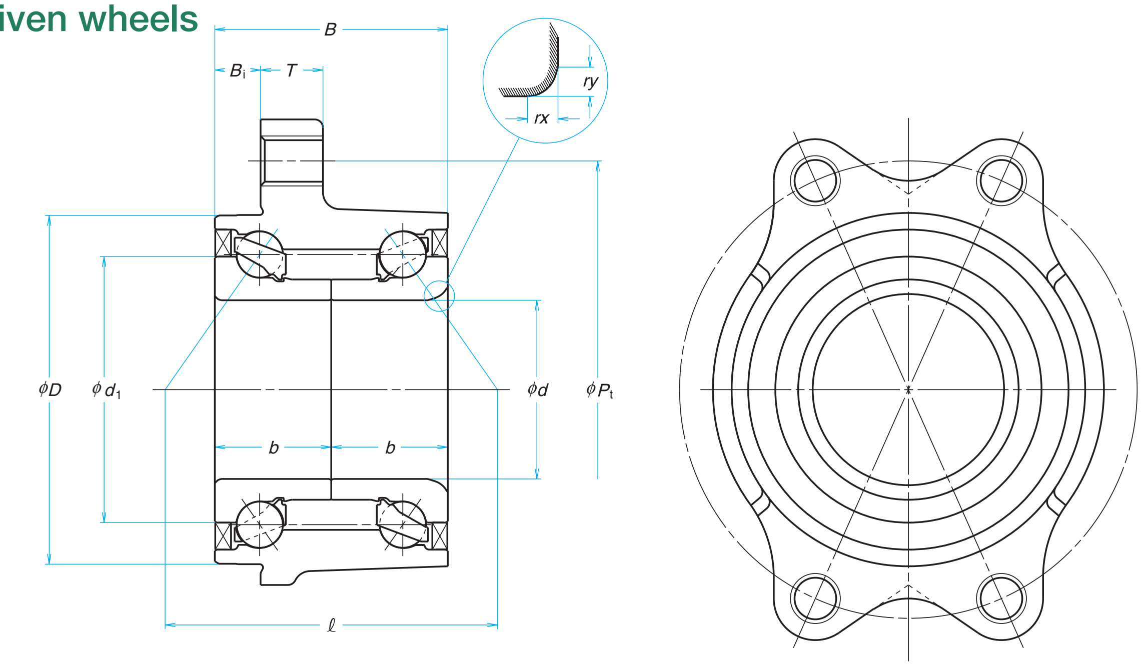
Boundary dimensions (mm)										Distance between effective load centers	Bearing reference	Basic load ratings (N) Double row		No. of outer ring flange bolts	Mass (kg) (approx.)
d	D	B_i	b	B_a	D_f	D_w	P_b	rx (Min.)	ry (Min.)	ℓ (mm)		C_r	C_{or}		
27	60	15	20	45	134	59	100	3.5	3.5	49.8	27BWK02A	38 500	29 600	4	1.33
	63.2	15.5	27.5	57.5	148	66	114.3	4.5	3.6	61.8	27BWK03J	41 500	30 500	4	1.9
	64.7	15	25	52.5	134	59	100	4.5	3.6	59.8	27BWK04D2a	38 500	29 600	4	1.45
	65.4	15.5	25	52.5	148	66	114.3	4.5	3.6	59.8	27BWK06	38 500	29 600	4	1.9
28	63	14	24	56.5	125	56	100	4	3.3	56.8	28BWK08J	41 500	30 500	4	1.75
	64	14	25.25	57	141	56	100	3.5	3.5	59.3	28BWK06D	38 500	29 600	4	1.74
	64	6	20	49.5	120	60	100	3.5	2.5	49.8	28BWK15J	38 500	29 600	4	1.38
	69	10.35	24	57.5	135	56.9	100	3.5	3.5	58.9	28BWK16	44 000	34 500	5	1.8
30	66.1	15.5	27.5	57.5	148	66	114.3	4.5	3.6	64.3	30BWK13A	44 000	34 500	4	1.93
	67	11.5	20.5	55	136	56	100	3.5	2.5	51.2	30BWK02J	41 500	31 000	4	1.8
	67	14	25	56.5	125	56	100	4	3.5	61.3	30BWK11	44 000	34 500	4	1.91
	73.8	15.5	24	49	148	66	114.3	4.5	3.6	59.7	30BWK18	55 000	40 000	4	1.98
33	73	14.5	25.5	59	140	67	114.3	4	4	60.7	33BWK02S	50 000	39 500	5	2.17
41	86.5	17.5	20	37	170	105	139.7	3.6	3.6	71.0	41BWK03	52 000	46 500	5	2.69

BWK inner ring rotation type for non-driven wheels



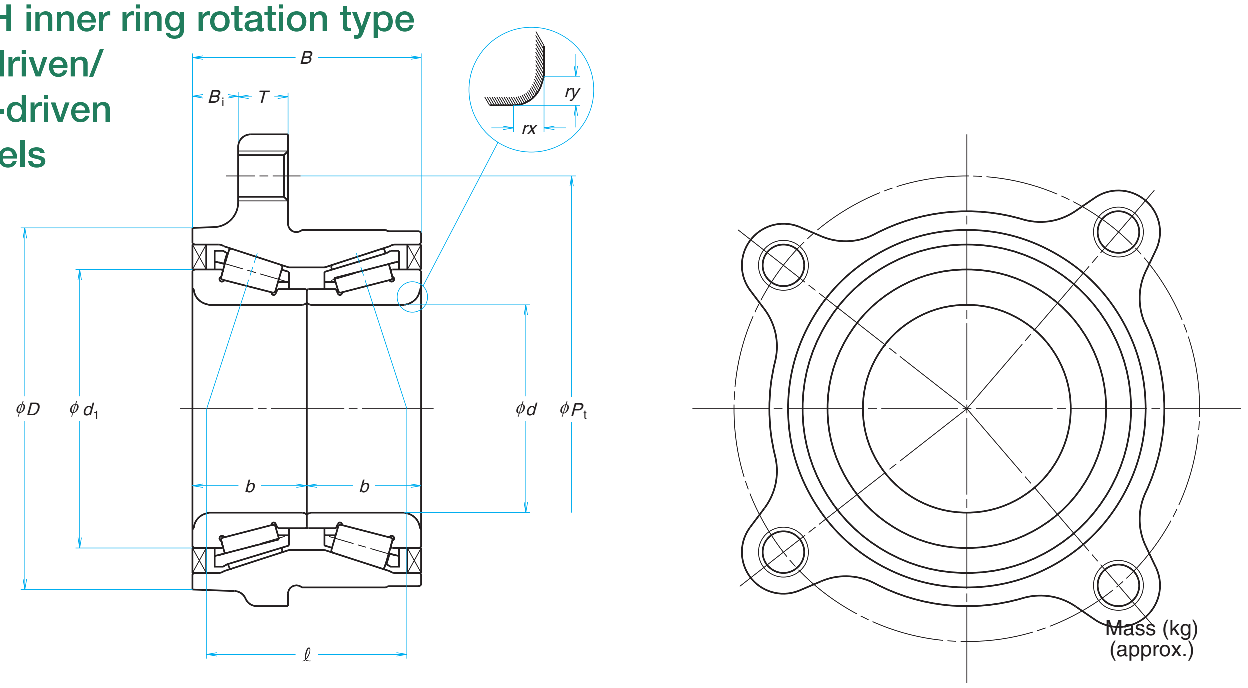
Boundary dimensions (mm)										Distance between effective load centers	Bearing reference	Basic load ratings (N) Double row		No. of outer ring flange bolts	Mass (kg) (approx.)
d	B	b	D	D_f	d_1	d_2	P_h	rx (Min.)	ry (Min.)	ℓ (mm)		C_r	C_{or}		
28	51.8	21	66	73	46.2	61	97	3.6	3.6	62.9	28BWK12	35 000	29 300	4	1.03
30	51.8	21	60.5	75	49.5	63	99	3.6	3.6	53.1	EP30BWK16	47 000	35 500	4	1.06
	51.8	21	66	75	45.5	63	99	3.6	3.6	53.1	30BWK03B	47 000	35 500	4	1.05
	51.8	21	66	75	49.5	63	99	3.6	3.6	63.7	30BWK17	38 500	31 500	4	1.15
	51.8	21	67	75	45.5	63	99	3.6	3.6	54.3	30BWK10	40 500	33 000	4	1.01
	46.3	21	67	80	49.5	71	106	3.6	3.6	53.1	EP30BWK14	47 000	35 500	4	1.35

BWK inner ring rotation type for driven wheels



Boundary dimensions (mm)										Distance between effective load centers ℓ (mm)	Bearing reference	Basic load ratings (N) Double row		No. of outer ring flange bolts	Mass (kg) (approx.)
d	D	B	b	d_1	T	B_i	P_t	rx (Min.)	ry (Min.)			C_r	C_{or}		
38	87.4	54.8	18	55.2	10	3.2	106	3.5	3.5	57.3	38BWK01J	59 000	49 500	4	1.25
43	83	42.5	22	58.6	14	16.5	102	5	3.5	58.7	43BWK03D	55 000	48 500	4	1.22
	83	47.5	24.5	58.6	14	21.5	102	5	3.5	63.7	43BWK04	55 000	48 500	4	1.32
	84	56	28	64	15	11	c	4.8	3.1	79.9	43BWK07	52 500	50 000	4	1.67

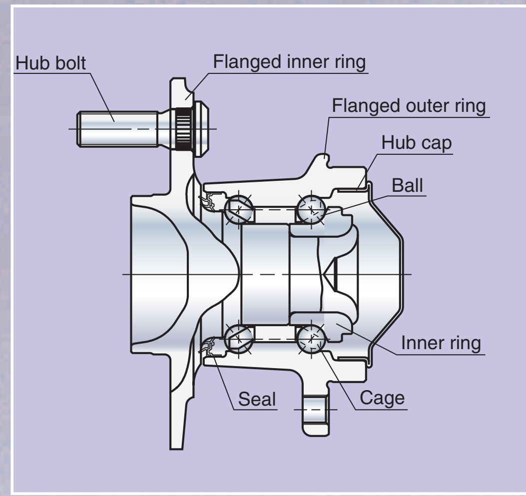
KWH inner ring rotation type for driven/ non-driven wheels



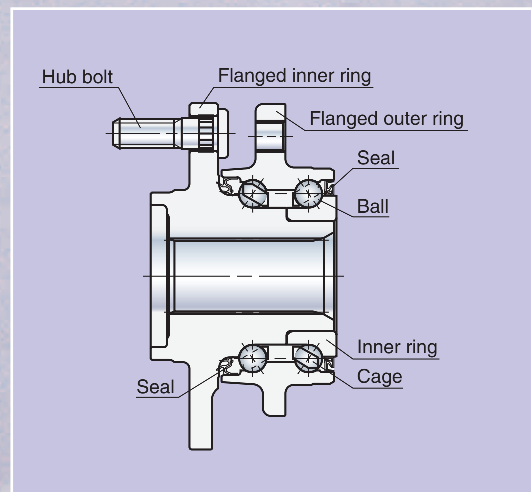
Boundary dimensions (mm)										Distance between effective load centers ℓ (mm)	Bearing reference	Basic load ratings (N) Double row		No. of outer ring flange bolts	Mass (kg) (approx.)
d	D	B	b	d_1	T	B_i	P_t	rx (Min.)	ry (Min.)			C_r	C_{or}		
50	86	55	27.5	67	12	32	112	5.5	5.5	49.2	NTF50KWH01B	98 000	157 000	4	1.488
51	87	55	27.5	68.4	15.5	19.5	112	5	5	50.0	51KWH01A	101 000	164 000	4	1.533

HUB III Dimension Table

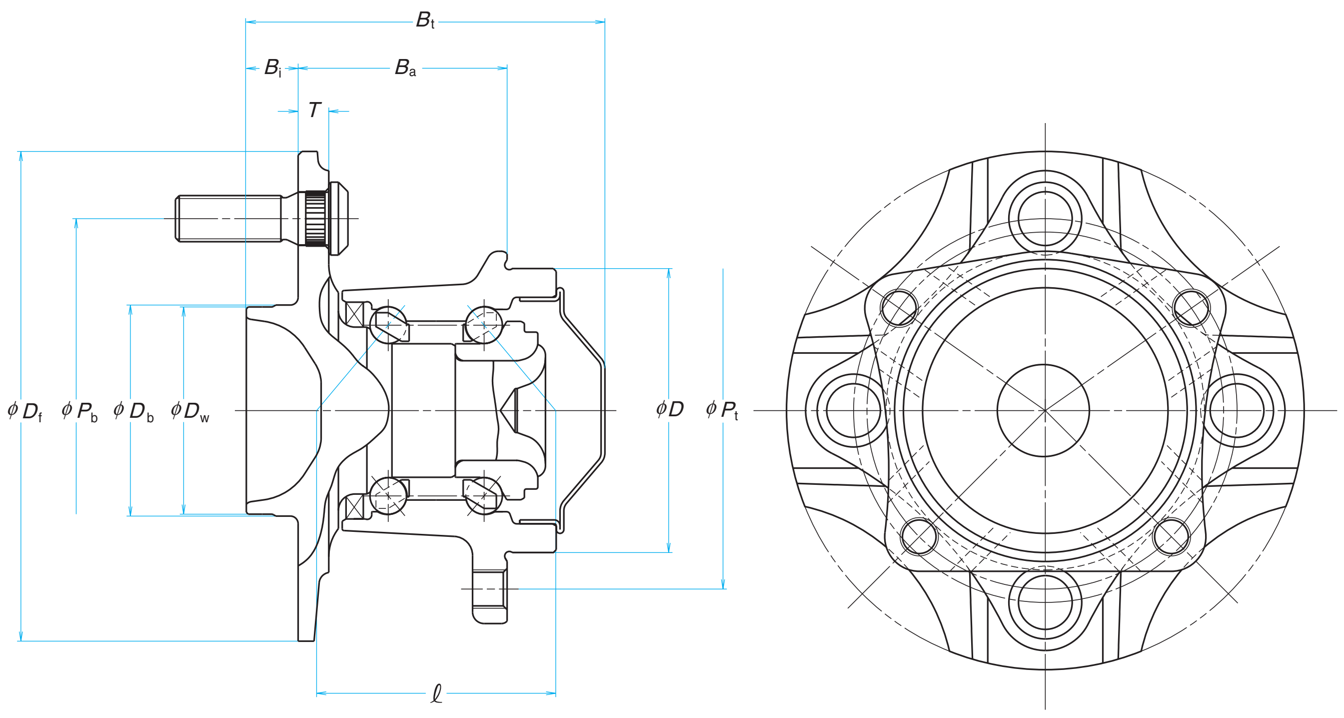
BWKH inner ring rotation type for non-driven wheels



BWKH inner ring rotation type for driven wheels

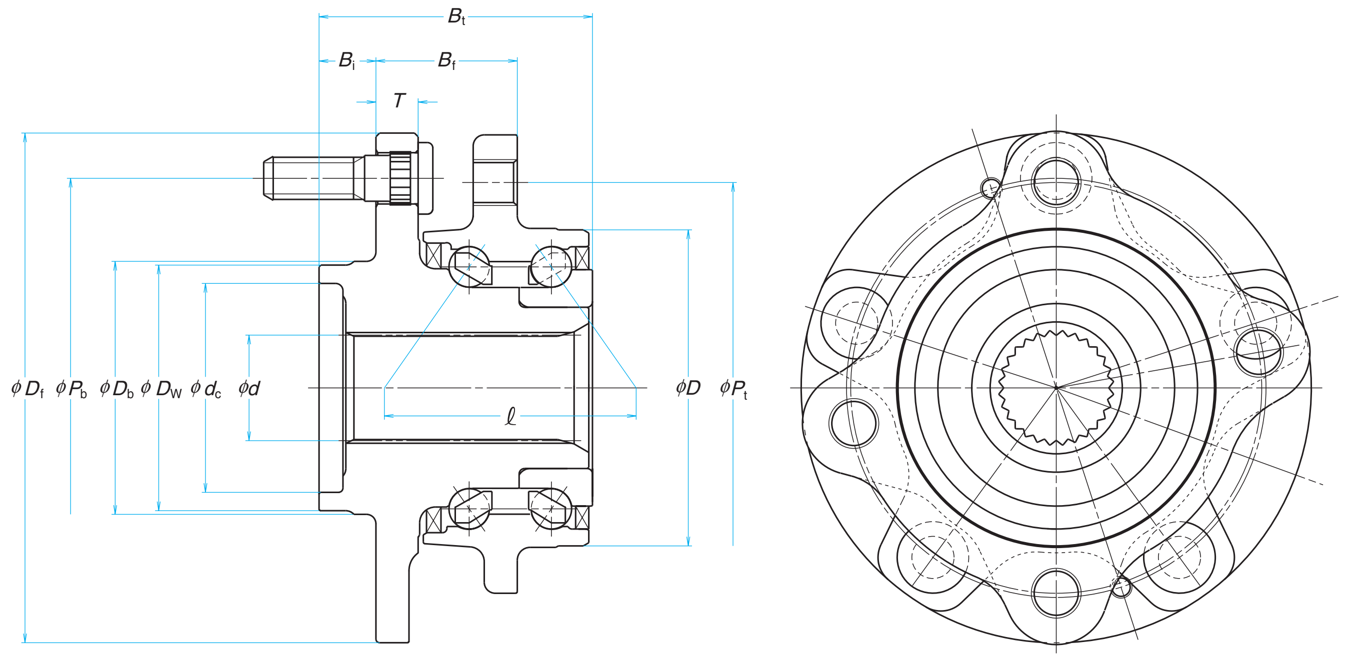


BWKH inner ring rotation type for non-driven wheels



Boundary dimensions (mm)										Distance between effective load centers ℓ (mm)	Bearing reference	Basic load ratings (N) Double row		No. of flanged inner ring hub bolts	No. of outer ring flange tapped holes	Mass (kg) (approx.)	ABS Sensor integral type
D_w	D	D_b	B_a	T	B_i	B_t	P_b	P_t	D_f			C_r	C_{or}				
54	67	55	54.5	8	13.5	93.5	100	92	135	62.3	44BWKH09	3 500	26 800	4	4	2.3	○
54	74	55	54.5	8	13.5	93.5	100	93	135	62.3	44BWKH10B	33 500	26 800	4	4	2.34	○
54	74	55	54.5	10	13.5	93.3	100	93	135	66.1	49BWKH04A	50 500	38 000	5	4	2.96	○
56.8	86	57.3	48	9	14.5	100.8	100	–	126	57.4	52BWKH01	61 000	44 500	5	4	3.4	–
60	74	62	74.5	11	13.5	100.8	114.3	99	152	66.1	49BWKH17	50 500	38 000	5	4	3.68	○
60	84	62	69	10	13.5	108.3	114.3	106	152	77.6	49BWKH11	50 500	38 000	5	4	3.94	○
69.5	76	71.5	43	10.4	25	86.1	120	108	140	63.0	55BWKH01	50 000	41 500	5	3	3.8	○
71.4	86	71.9	48	9	14.5	100.8	114.3	–	140	57.5	53BWKH01	66 500	49 000	5	4	3.6	–

BWKH inner ring rotation type for driven wheels



Boundary dimensions (mm)												Distance between effective load centers ℓ (mm)	Bearing reference	Basic load ratings (N) Double row		No. of flanged inner ring hub bolts	No. of outer ring flange tapped holes	Mass (kg) (approx.)
d *1	D	B_t	B_f	d_c	D_w	D_b	T	B_i	P_b	P_t	D_f			C_r	C_{or}			
26	74	81.5	54.5	45	54	55	10	13.5	100	93	135	80.6	55BWKH02A	42 000	37 500	4	4	2.7
26	84	98.5	69	51	60	62	10	13.5	114.3	106	152	81.7	58BWKH03	48 000	43 500	5	4	3.32
27	87	74.5	38.5	57	67	69	11.5	15.5	114.3	112	139	68.6	66BWKH02A	53 500	52 000	5	4	3.58
31.75	84	102.5	67.5	50	60	62	11	14	114.3	112	154	98.6	64BWKH02A	46 500	46 500	5	4	3.84

*1: Pitch circle diameter of spline

Table 1 Tolerances for shaft diameters

Unit: μm

Diameter classification (mm) Over	Incl.	Single plane mean bore diameter deviation (class normal)	e7	e8	e9	f6	f7	f8	g5	g6	h5
10	18	0	−32	− 32	− 32	−16	−16	−16	− 6	− 6	0
		− 8	−50	− 59	− 75	−27	−34	−43	−14	−17	− 8
18	30	0	−40	− 40	− 40	−20	−20	−20	− 7	− 7	0
		−10	−61	− 73	− 92	−33	−41	−53	−16	−20	− 9
30	50	0	−50	− 50	− 50	−25	−25	−25	− 9	− 9	0
		−12	−75	− 89	−112	−41	−50	−64	−20	−25	−11
50	65	0	−60	− 60	− 60	−30	−30	−30	−10	−10	0
65	80	−15	−90	−106	−134	−49	−60	−76	−23	−29	−13

Over	Incl.	h6	h7	h8	h9	js5	js6	js7	k5	k6	m5	m6	n6	p6	r6
10	18	0	0	0	0	± 4	±5.5	± 9	+ 9	+12	+15	+18	+23	+29	+34
		−11	−18	−27	−43				+ 1	+ 1	+ 7	+ 7	+12	+18	+23
18	30	0	0	0	0	± 4.5	±6.5	±10.5	+11	+15	+17	+21	+28	+35	+41
		−13	−21	−33	−52				+ 2	+ 2	+ 8	+ 8	+15	+22	+28
30	50	0	0	0	0	± 5.5	±8	±12.5	+13	+18	+20	+25	+33	+42	+50
		−16	−25	−39	−62				+ 2	+ 2	+ 9	+ 9	+17	+26	+34
50	65	0	0	0	0	± 6.5	±9.5	±15	+15	+21	+24	+30	+39	+51	+60 +41
65	80	−19	−30	−46	−74				+ 2	+ 2	+11	+11	+20	+32	+62 +43

Table 2 Tolerances for housing bore diameters

Unit: μm

Diameter classification (mm) Over	Incl.	Single plane mean outside diameter deviation (class normal)	F6	F7	F8	G6	G7	H6	H7	H8	JS6
18	24	0	+33	+41	+53	+20	+28	+13	+21	+33	±6.5
24	30	− 9	+20	+20	+20	+ 7	+ 7	0	0	0	
30	40	0	+41	+50	+64	+25	+34	+16	+25	+39	± 8
40	50	−11	+25	+25	+25	+ 9	+ 9	0	0	0	
50	65	0	+49	+60	+76	+29	+40	+19	+30	+46	±9.5
65	80	−13	+30	+30	+30	+10	+10	0	0	0	
80	100	0	+58	+71	+90	+34	+47	+22	+35	+54	±11
100	120	−15	+36	+36	+36	+12	+12	0	0	0	

Over	Incl.	JS7	K6	K7	M6	M7	N6	N7	P6	P7	R7	S7	T7	U7
18	24	±10.5	+ 2	+ 6	− 4	0	−11	− 7	−18	−14	−20	− 27	—	− 33 − 54
24	30		−11	−15	−17	−21	−24	−28	−31	−35	−41	− 48	− 33 − 54	− 40 − 61
30	40	±12.5	+ 3	+ 7	− 4	0	−12	− 8	−21	−17	−25	− 34	− 39 − 64	− 51 − 76
40	50		−13	−18	−20	−25	−28	−33	−37	−42	−50	− 59	− 45 − 70	− 61 − 86
50	65	±15	+ 4	+ 9	− 5	0	−14	− 9	−26	−21	−30 −60	− 42 − 72	− 55 − 85	− 76 −106
65	80		−15	−21	−24	−30	−33	−39	−45	−51	−32 −62	− 48 − 78	− 64 − 94	− 91 −121
80	100	±17.5	+ 4	+10	− 6	0	−16	−10	−30	−24	−38 −73	− 58 − 93	− 78 −113	−111 −146
100	120		−18	−25	−28	−35	−38	−45	−52	−59	−41 −76	− 66 −101	− 91 −126	−131 −166

Worldwide Sales Offices

NSK Ltd.–Headquarters, Tokyo, Japan **www.nsk.com**
INDUSTRIAL MACHINERY BEARINGS DIVISION-HEADQUARTERS tel: 03-3779-7227
AFTERMARKET BUSINESS DIVISION-HEADQUARTERS tel: 03-3779-8893
AUTOMOTIVE BUSINESS DIVISION-HEADQUARTERS tel: 03-3779-7189
NEEDLE ROLLER BEARINGS STRATEGIC DIVISION-HEADQUARTERS tel: 03-3779-7288
PRECISION MACHINERY & PARTS DIVISION-HEADQUARTERS tel: 03-3779-7163

Africa
South Africa:
NSK South Africa (Pty) Ltd.
Johannesburg tel: 011-458-3600

Asia and Oceania
Australia:
NSK Australia Pty. Ltd. **www.au.nsk.com**
Melbourne tel: 03-9764-8302
China:
NSK Hong Kong Ltd.
Hong Kong tel: 2739-9933
Kunshan NSK Co., Ltd.
Kunshan Plant tel: 0512-5771-5654
Changshu NSK Needle Bearing Co., Ltd.
Jiangsu Plant tel: 0512-5230-1111
Guizhou HS NSK Bearings Co., Ltd.
Anshun Plant tel: 0853-3522332
NSK Steering Systems Dongguan Co., Ltd.
Dongguan Plant tel: 0769-262-0960
Zhangjiagang NSK Precision Machinery Co., Ltd.
Jiangsu Plant tel: 0512-5867-6496
Timken-NSK Bearings (Suzhou) Co., Ltd.
Jiangsu Plant tel: 0512-6665-5666
NSK China Technology Center
Jiangsu tel: 0512-5771-5654
NSK (Shanghai) Trading Co., Ltd.
Shanghai tel: 021-6235-0198
NSK Representative Offices **www.nsk.com.cn**
Beijing tel: 010-6590-8161
Guangzhou tel: 020-3786-4833
Anshun tel: 0853-3522522
Chengdu tel: 028-8661-4200
Shenzhen tel: 0755-25904886
Changchun tel: 0431-88988682
NSK (China) Investment Co., Ltd.
Shanghai tel: 021-6235-0198
India:
Rane NSK Steering Systems Ltd.
Chennai tel: 044-274-66002
NSK Ltd. India Blanch Office
Chennai tel: 044-2446-6862
Gurgaon tel: 124-4104530
Indonesia:
PT. NSK Bearings Manufacturing Indonesia
Jakarta tel: 021-898-0155
PT. NSK Indonesia
Jakarta tel: 021-252-3458
Korea:
NSK Korea Co., Ltd. **www.kr.nsk.com**
Seoul tel: 02-3287-0300
Changwon Plant tel: 055-287-6001
Malaysia:
NSK Bearings (Malaysia) Sdn. Bhd. **www.my.nsk.com**
Kuala Lumpur tel: 03-7803-8859
NSK Micro Precision (M) Sdn. Bhd. **www.my.nsk.com**
Malaysia Plant tel: 03-8961-6288
New Zealand:
NSK New Zealand Ltd. **www.nsk-rhp.co.nz**
Auckland tel: 09-276-4992
Philippines:
NSK Representative Office
Manila tel: 02-759-6246
Singapore:
NSK International (Singapore) Pte Ltd.
Singapore tel: 65-6273-0357
NSK Singapore (Pte) Ltd. **www.nsk-singapore.com.sg**
Singapore tel: 65-6278-1711
Taiwan:
Taiwan NSK Precision Co., Ltd.
Taipei tel: 02-2509-3305
Taiwan NSK Technology Co., Ltd.
Taipei tel: 02-2509-3305
Thailand:
NSK Bearings (Thailand) Co., Ltd.
Bangkok tel: 02-6412-150
NSK Bearings Manufacturing (Thailand) Co., Ltd.
Chonburi tel: 038-454010~454016
SIAM NSK Steering Systems Co., Ltd.
Chachoengsao tel: 038-522-343~350
NSK Asia Pacific Technology Center (Thailand) Co., Ltd.
Chonburi tel: 038-454631~454633
Vietnam:
NSK Vietnam Co., Ltd.
Hanoi tel: 04-955-0159
NSK Representative Office
Ho Chi Minh City tel: 08-822-7907

Europe
NSK Europe Ltd.
(European Headquarters) **www.eu.nsk.com**
Maidenhead, U.K. tel: 01628-509800
France:
NSK France S.A.S
Paris tel: 01-30-57-39-39
Germany:
NSK Deutschland GmbH
Düsseldorf tel: 02102-481-0
NSK Precision Europe GmbH
Düsseldorf tel: 02102-481-0
NSK Steering Systems Europe Ltd.
Stuttgart tel: 0771-79082-277
Neuweg Fertigung GmbH
Munderkingen tel: 07393-540
Italy:
NSK Italia S.p.A.
Milano tel: 02-995-19-1
Industria Cuscinetti S.p.A.
Torino Plant tel: 0119824811
Netherlands:
NSK European Distribution Centre B.V.
Tilburg tel: 013-4647647
Poland:
NSK Europe Ltd. Warsaw Liaison Office
Warsaw Liaison tel: 022-645-1525, 1526
NSK Bearings Polska S.A.
Kielce tel: 041-367-0505
NSK European Technology Center, Poland Office
Kielce tel: 041-366-5812
NSK Steering Systems Europe (Polska) Sp.zo.o
Walbrzych tel: 074-664-4101
Spain:
NSK Spain S.A.
Barcelona tel: 093-289-27-63
Turkey:
NSK Bearings Middle East Trading Co., Ltd.
Istanbul tel: 0216-355-0398
United Kingdom:
NSK Bearings Europe Ltd.
Peterlee Plant tel: 0191-586-6111
NSK European Technology Centre
Newark tel: 01636-605123
NSK UK Ltd.
Newark tel: 01636-605123
NSK Precision UK Ltd.
Newark tel: 01636-605123
NSK Steering Systems Europe Ltd.
Coventry tel: 024-76-588588

North and South America
NSK Americas, Inc. (American Headquarters)
Ann Arbor tel: 734-913-7500
Argentina:
NSK Argentina SRL
Buenos Aires tel: 11-4704-5100
Brazil:
NSK Brasil Ltda. **www.br.nsk.com**
São Paulo tel: 011-3269-4700
Canada:
NSK Canada Inc. **www.ca.nsk.com**
Toronto tel: 905-890-0740
Mexico:
NSK Rodamientos Mexicana, S.A. de C.V. **www.mx.nsk.com**
Mexico City tel: 55-5390-4312
United States of America:
NSK Corporation **www.us.nsk.com**
Ann Arbor tel: 734-913-7500
NSK American Technology Center
Ann Arbor tel: 734-913-7500
NSK Precision America, Inc. **www.npa.nsk.com**
Franklin tel: 317-738-5000
NSK Steering Systems America, Inc. **www.nssa.nsk.com**
Bennington, Vermont tel: 802-442-5448
NSK Latin America, Inc. **www.la.nsk.com**
Miami tel: 305-477-0605

NSK Ltd. has a basic policy not to export any products or technology designated as controlled items by export-related laws. When exporting the products in this brochure, the laws of the exporting country must be observed. Specifications are subject to change without notice and without any obligation on the part of the manufacturer. Every care has been taken to ensure the accuracy of the data contained in this brochure, but no liability can be accepted for any loss or damage suffered through errors or omissions. We will gratefully acknowledge any additions or corrections.

For more information about NSK products, please contact:

Eco-awareness and reliability in motion

Printed on 100% recycled paper.

CAT. No. E4201b 2007 C-7 Printed in Japan