Spherical Plain Bearing

THK General Catalog

A Technical Descriptions of the Products

B Product Specifications (Separate)

* Please see the separate "B Product Specifications".

Features of the Spherical Plain Bearing

Structure and Features

Spherical Bearings models SB and SA1 are self-aligning plain bearings designed for heavy loads. The inner and outer rings of these models use high-carbon chromium bearing steel that is hardened and ground, are treated with phosphate coating, which is highly resistant to corrosion and wear, and seized with molybdenum disulfide (MoS_2).
The Spherical Plain Bearing is capable of receiving a large radial load and thrust loads in both directions. Furthermore, because of its high resistance to impact loads, the Spherical Plain Bearing is optimal for low speed, heavy load rocking components such as the cylinder clevises or hinges of construction and civil-engineering machinery and the suspensions of trucks.

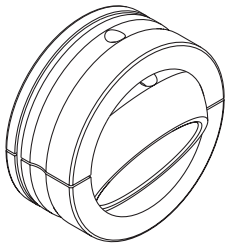
Types of the Spherical Plain Bearing

Types and Features

Model SB

Specification Table⇒B-828

The most popular type of Spherical Plain Bearing in Japan, model SB has wide spherical contact areas and is used as a bearing for heavy loads. The outer ring is split at two points, enabling the inner ring to be accommodated.

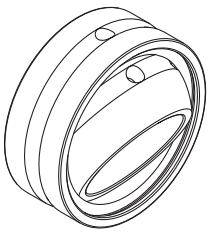


Model SB

Model SA1

Specification Table⇒B-830

This type of Spherical Plain Bearing is widely used in Europe. The outer ring is split at one point (outer rings with diameter of ϕ100 or thicker are split at two points), and the width and thickness are smaller than model SB. Thus, this model can be used in small spaces. Types attached with highly dust-preventive dust seals on both ends (model SA1⋯UU) are also available.



Model SA1

Selecting a Spherical Plain Bearing

When selecting a Spherical Plain Bearing, follow the instructions below while referring to the basic dynamic load rating (C) and the basic static load rating (C_0) indicated in the corresponding specification table, as a measuring stick.

[Spherical Plain Bearing Service Life G]

The basic dynamic load rating (C) is used to calculate the service life when the bearing oscillates under a load.

The basic dynamic load rating is calculated based on the contact surface pressure of the spherical sliding section.

The Spherical Plain Bearing service life G is expressed in the total number of rocking motions until it becomes impossible for the bearing to perform normal operation due to the increase in the radial clearance or in the temperature of the bearing as a result of wear on the spherical sliding section.

Since the bearing service life is affected by various factors such as the material of the bearing, magnitude and direction of the load, lubrication conditions and sliding speed, the calculated value can be used as an empirical, practical value.

$$G = b_1 \cdot b_2 \cdot b_3 \cdot b_4 \cdot b_5 \frac{3}{Da \cdot \beta} \cdot \frac{C}{P} \times 10^8$$

G : Bearing service life (total number of rocking motions or total number of revolutions)
C : Basic dynamic load rating (N)
P : Equivalent radial load (N)
b_1 : Load direction factor (see Table1)
b_2 : Lubrication factor (see Table1)
b_3 : Temperature factor (see Table1)
b_4 : Dimension factor (see Fig.1)
b_5 : Material factor (see Fig.2)
Da : Spherical diameter (mm) (see the specification table)
β : Oscillation half angle (degree) (for rotary motion, β=90°)

Table1

Type		b_1		b_2		b_3		
		Load direction		Regular lubrication		Temperature ℃		
		Fixed	Alternating	Not provided	Provided	−30 to +80	+80 to +150	+150 to +180
Spherical Plain Bearing	Without seal	1	5	0.08	1	1	1	0.7
	With seal	1	5	0.08	1	1	—	—

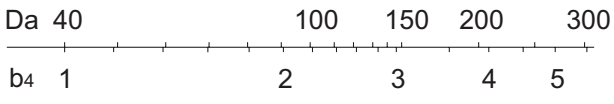


Fig.1 Dimension Factor

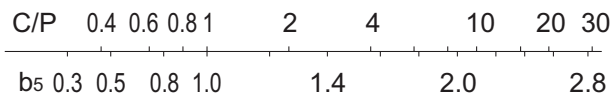


Fig.2 Material Factor

[Equivalent Radial Load]

The Spherical Plain Bearing is capable of receiving a radial load and a thrust load simultaneously. If the magnitude and direction of the load applied are constant, the equivalent radial load is obtained from the following equation.

$$P = Fr + YFa$$

P	: Equivalent radial load	(N)
Fr	: Radial load	(N)
Fa	: Trust load	(N)
Y	: Thrust load factor	(see Table2)

Table2 Thrust Load Factor

Fa/Fr≦	0.1	0.2	0.3	0.4	0.5
Thrust load factor (Y)	0.8	1	1.5	2.5	3

[Static Safety Factor f_s]

If the Spherical Plain Bearing is to be used under a stationary load or in slight rocking motion, select a model using the basic static load rating (C_0) as a guide. The basic static load rating refers to the stationary load that the bearing can receive without damaging the bearing and without causing permanent deformation that would prevent smooth motion.

In general, set the safety factor at three or greater taking into account the rigidity of the shaft and the housing.

$$f_s = \frac{C_0}{P} \geqq 3$$

f_s	: Static safety factor
C_0	: Basic static load rating
P	: Equivalent radial load

[pV Value]

The permissible sliding speed at which the Spherical Plain Bearing can be used varies depending on the load, lubrication conditions and cooling status. The recommended pV value for continuous motion under a load applied in a constant direction is calculated as follows.

$$pV \leqq 400\ N/mm^2 \cdot mm/sec$$

If the Spherical Plain Bearing performs adiabatic operation or the load direction changes, the heat produced on the sliding surface easily radiates. Therefore, it is possible to set a higher pV value.
The contact surface pressure (p) of the Spherical Plain Bearing is obtained from the following equation.

$$p = \frac{P}{Da \cdot B}$$

p	:	Contact surface pressure	(N/mm^2)
P	:	Equivalent radial load	(N)
Da	:	Spherical diameter (see the specification table)	(mm)
B	:	Outer ring width (see the specification table)	(mm)

The sliding speed is calculated as follows.

$$V = \frac{\pi \cdot Da \cdot \beta \cdot f}{90 \times 60}$$

V	:	Sliding speed	(mm/sec)
β	:	Oscillation half angle	(degree)
f	:	Number of rocking motions per minute	(min^{-1})

The Spherical Plain Bearing can be used at sliding speed of up to 100 mm/sec in oscillating motion, or up to 300 mm/sec in rotary motion in favorable lubrication status.

[Example of Calculating a pV Value]

Assuming that model SB25 is used in a location where the shaft rotates 60 turns per minute at an angle of 40° (oscillation half angle : 20°) and the maximum varying load of 1,500 N is applied, determine whether the model number is appropriate and calculate the service life under these conditions. Assume that the bearing temperature is +80 °C or less and the product is regularly provided with sufficient lubrication. Calculate the pV value and examine if the bearing size is appropriate.
The contact surface pressure (p) is calculated as follows.

$$p = \frac{P}{Da \cdot B} = \frac{1500}{36 \times 18} = 2.31\ N/mm^2$$

(B: outer ring width of model SB25 = 18
Da: spherical diameter of model SB25 = 36)

The sliding speed (V) is obtained from the following equation.

$$V = \frac{\pi \cdot Da \cdot \beta \cdot f}{90 \times 60} = \frac{3.14 \times 36 \times \left(\frac{40}{2}\right) \times 60}{90 \times 60} = 25.12\ mm/sec$$

The pV value is calculated as follows.
$pV = 58.0\ N/mm^2 \cdot mm/sec$
Since both the pV value and the sliding speed (V) meet the requirements, model SB25 can be used.
Next, calculate the service life of the bearing (G) as follows.

$$G = b_1 \cdot b_2 \cdot b_3 \cdot b_4 \cdot b_5 \frac{3}{Da \cdot \beta} \cdot \frac{C}{P} \times 10^8$$

$$= 5 \times 1 \times 1 \times 1 \times 2.2 \times \frac{3}{36 \times 20} \times \frac{15300}{1500} \times 10^8 = 4.7 \times 10^7\ (min^{-1})$$

Accuracy Standards

The dimensional tolerances of the Spherical Plain Bearing are defined as indicated in Table3.

Table3 Accuracy of the Spherical Plain Bearing Unit: μm

Nominal dimension of the inner diameter (d) and outer diameter (D) (mm)		Tolerance in inner diameter (dm)		Tolerance in outer diameter (Dm)		Tolerance of the inner outer ring in width (B_1, B)	
Above	Or less	Upper	Lower	Upper	Lower	Upper	Lower
10	18	0	−8	—	—	0	−120
18	30	0	−10	0	−9	0	−120
30	50	0	−12	0	−11	0	−120
50	80	0	−15	0	−13	0	−150
80	120	0	−20	0	−15	0	−200
120	150	0	−25	0	−18	0	−250
150	180	0	−25	0	−25	0	−250
180	250	0	−30	0	−30	0	−300
250	315	—	—	0	−35	0	−350
315	400	—	—	0	−40	0	−400

Note1) "dm" and "Dm" represent the arithmetic averages of the maximum and minimum diameters obtained in measuring the inner and outer diameters at two points.
Note2) The dimensional tolerances of the inner and outer diameters are the values before they are surface treated.
Note3) The dimensional tolerance of the outer ring is the value before it is split.
Note4) Tolerances of the inner and outer diameters in width (B_1, B) are assumed to be equal, and obtained from the nominal dimension of the inner diameter of the inner ring.

Radial Clearance

Table4 shows radial clearances of the Spherical Plain Bearing.

Table4 Radial Clearances of the Spherical Plain Bearing
Unit: μm

Berring inner diameter (d) (mm)		Radial clearance	
Above	Or less	Min.	Max.
—	17	70	125
17	30	75	140
30	50	85	150
50	65	90	160
65	80	95	170
80	100	100	185
100	120	110	200
120	150	120	215
150	240	130	230

Note1) The radial clearance indicates the value before the outer ring is split.
Note2) The axial clearance is approximately twice the radial clearance.

Fit

The fitting between the Spherical Plain Bearing and the shaft or the housing is selected according to the conditions. Table1 shows recommended values.

Table1 Recommended Fitting Values

Service condition		Shaft	Housing
Inner ring rotational load	Normal load	k6	H7
	Indeterminate load	m6	H7
Outer ring rotational load	Normal load	g6	M7
	Indeterminate load	h6	N7

Note1) If the product is to be installed so that the inner ring rotates and the fitting with the shaft is to be clearance fitting, harden the surface of the shaft in advance.
Note2) "N7" is recommended for light alloy housings.

[Shaft Designing]

If the inner ring is to be fit onto the shaft in loose fitting and the product is to be used under a heavy load, the shaft may slip on the inner circumference of the inner ring. To prevent the slippage, the shaft hardness must be 58 HRC or higher and the surface roughness must be 0.80 a or below.

Permissible Tilt Angles

The permissible tilt angle of the Spherical Plain Bearing varies according to the shaft shape as indicated in Table2.

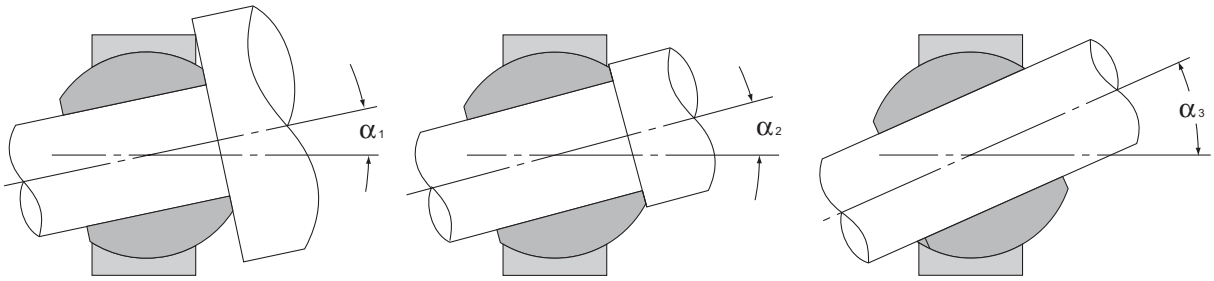


Table2 Permissible Tilt Angles

Unit: degree

Model No.	Permissible tilt angles		
	α_1	α_2	α_3
SB 12	5	7	18
SB 15	4	6	18
SB 20	3	4	14
SB 22	4	6	16
SB 25	4	5	16
SB 30	4	6	17
SB 35	4	5	14
SB 40	4	6	12
SB 45	4	5	13
SB 50	4	5	16
SB 55	4	6	16
SB 60	4	6	18
SB 65	4	5	16
SB 70	4	5	15
SB 75	4	5	18
SB 80	4	5	18
SB 85	4	6	16
SB 90	4	5	16
SB 95	4	5	17
SB 100	4	5	18
SB 110	4	5	16
SB 115	4	5	14
SB 120	4	6	15
SB 130	4	5	14
SB 150	4	5	12

Unit: degree

Model No.	Permissible tilt angles		
	α_1	α_2[Note]	α_3
SA1 12	8	11 (6)	25
SA1 15	6	8 (5)	18
SA1 17	7	10 (7)	23
SA1 20	6	9 (6)	21
SA1 25	6	7 (4)	18
SA1 30	4	6 (4)	16
SA1 35	5	6 (4)	16
SA1 40	5	7 (4)	16
SA1 45	6	7 (4)	16
SA1 50	5	6 (4)	15
SA1 60	5	6 (3)	14
SA1 70	5	6 (4)	14
SA1 80	4	6 (4)	14
SA1 90	4	5 (3)	12
SA1 100	5	7 (5)	14
SA1 110	5	6 (4)	15
SA1 120	4	6 (4)	15
SA1 140	5	7 (5)	16
SA1 160	6	8 (6)	13
SA1 180	5	6 (5)	16
SA1 200	6	7 (6)	13
SA1 220	6	8 (6)	15
SA1 240	6	8 (6)	17

Note) The values in the parentheses apply to types attached with a seal.

Installation

(1) Do not use the product in the manner that the permissible tilting angle is exceeded since doing so may damage the product.
(2) The Spherical Plain Bearing is designed for use under a radial load. Do not use the product if the trust load component or the load component in the thrust direction exceeds 50% of the resultant force consisting of the radial load and the thrust load.
(3) When installing the Spherical Plain Bearing, pay attention to the mounting orientation so that the slit of the outer ring receives a minimum load.

[Temperature Range]

The permissible temperature range of the Spherical Plain Bearing is limited between -30℃ and 80℃ depending on the seal material and determined by the permissible temperature range of the grease used.

Lubrication

The spherical sliding surface of the Spherical Plain Bearing is seized with a solid lubricant film of molybdenum disulfide. This enables the Spherical Plain Bearing to be used over a relatively long period without further lubrication under a static load, in low-speed rocking motion or in intermittent rotary motion. However, it is generally necessary to replenish grease on a regular basis. If a heavy load is applied, consider using lithium soap group grease containing molybdenum disulfide. The inner and outer rings of the Spherical Plain Bearing have greasing holes as a means to facilitate the flow of the lubricant inside the bearing.

[Lubrication Interval]

Since the Spherical Plain Bearing is delivered without being applied with a lubricant, it is necessary to replenish an appropriate amount of grease after installing the Spherical Plain Bearing. We recommend filling grease also to the space surrounding the Spherical Plain Bearing. It is also recommendable to shorten the lubrication interval in the start-up period in order to lighten the initial wear and extend the service life.
The lubrication interval varies according to the magnitude of the load, frequency of the vibrations and other conditions. Provide lubrication while referring to the values in Table1 as a guide.

Table1 Lubrication Interval

Type of load	Required minimum lubrication interval
Unilateral load	G/ 40
Fluctuating load	G/ 180

G: Service life of the bearing (total number of rocking motions or total number of revolutions)

Contamination Protection

Spherical Bearing model SA1 is provided with a seal designed to prevent humidity or other deleterious material from entering the bearing. This seal is effective in increasing the service life of the bearing. The seal for Spherical Bearing model SA1 is made of oil-resistant synthetic rubber and has double lips as the sealing element. These lips closely contact the spherical inner ring. The seal can be used within the temperature range between -30℃ and 80℃, and is highly resistant to wear and capable of operating for a long period of time. If the product is used in an environment where sand or soil matter may enter the bearing, the service life of the seal is shortened. We recommend lubricating the product on a regular basis.

[Handling]

(1) When installing model SA1 or model SB, they must not be disassembled before installation.
(2) Dropping or hitting the Spherical Plain Bearing may damage it.
Giving an impact to it could also cause damage to its function even if the product looks intact.

[Lubrication]

(1) For details of the lubrication, see A-918.
(2) Do not mix lubricants of different physical properties.

[Precautions on Use]

(1) When using the product in locations exposed to vibrations or an impact load or in a special environment such as a clean room, vacuum and low/high temperature, contact THK in advance.
(2) Entrance of foreign material such as dust between the outer and inner rings may cause damage or functional loss. Prevent foreign material, such as dust and cutting chips, from entering the product.

[Storage]

When storing the Spherical Plain Bearing, avoid high temperature, low temperature and high humidity.

Link Ball®

THK General Catalog

A Technical Descriptions of the Products

B Product Specifications (Separate)

* Please see the separate "B Product Specifications".

Features of the Link Ball

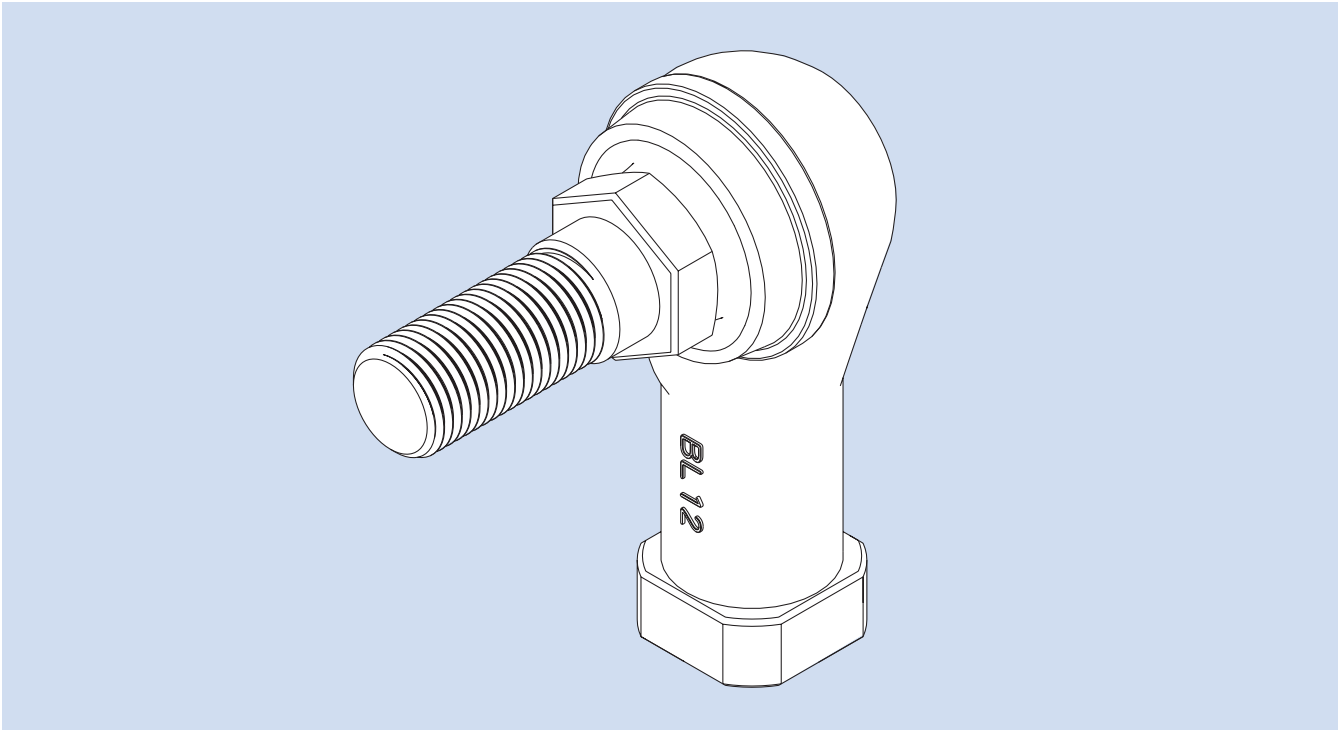


Fig.1 Structure of Link Ball Model BL

Structure and Features

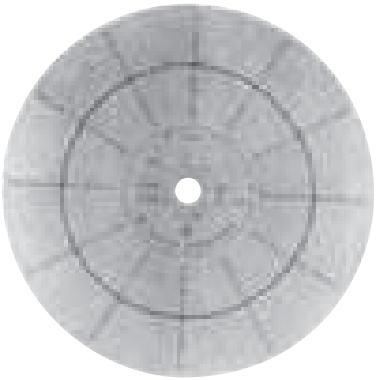
With the Link Ball, a highly accurate bearing steel ball used in the spherical area is first encased in the holder by die cast molding, and then is specially welded with the shank. This unique process enables the mirror surface of the steel ball to be transferred or duplicated on the spherical surface inside the holder to ensure full contact between the ball and the holder. As a result, smooth motion is achieved with a minimum clearance.

[Compact Design]

Model AL has an adequately firm and yet extremely compact shape because of a highly balanced design. Together with use of an A-1 alloy, a light-weight, compact design has been achieved. Thus, this model is optimal for use in an automobile height sensor or transmission control.

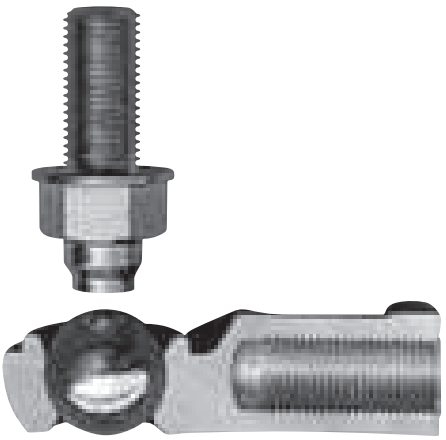
[Achieves Sphericity of 0.001 mm]

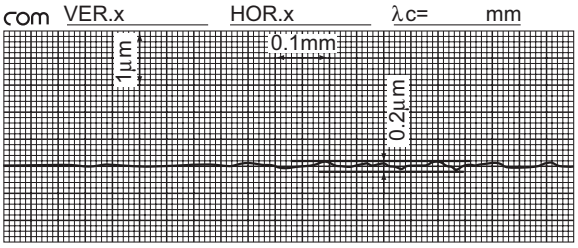
The spherical surface of the shank ball is transferred on the inner surface of the holder while maintaining the sphericity of the bearing steel ball. This allows smooth motion to be achieved with a minimum clearance and provides favorable operability and feel to the link motion.



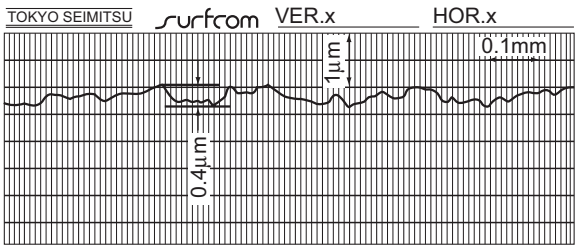
Sphericity: 0.001 mm

Sphericity of the spherical surface of the ball shank

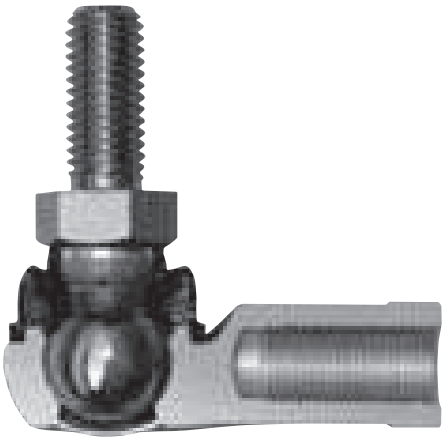




Roughness of the spherical surface of the ball shank



Roughness of the spherical surface of the holder



Cut sample of the spherical area of model BL

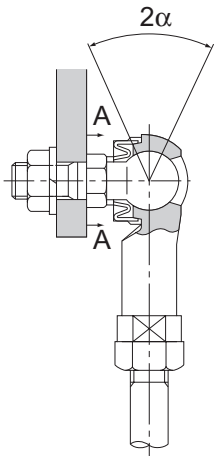
[Two Types of Holder Material]
Model AL uses the newly developed high strength aluminum alloy "A-1 Alloy" (see A-925), which is light and highly resistant to wear. Models BL, RBL and RBI use the proven, high strength zinc alloy (see A-926).

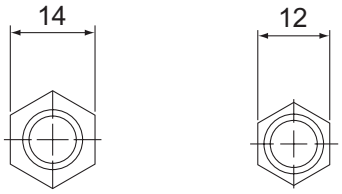
[High Lubricity]
Since models AL and BL and those models attached with boots contain grease, they have high lubricity and increased wear resistance.

[Large Hexagonal Bolt Seat]
The hexagonal bolt seat of the shank has the same dimensions as the seating surface for small hexagon head bolts in accordance with automotive specifications. This prevents the seating surface from sinking and ensures a stable link motion mechanism.

[Lightweight, High Strength]
Use of the A-1 Alloy enables the Link Ball to achieve mechanical strength approximately twice that of the commonly used aluminum die cast material ADC 12, or almost equal to the high strength zinc alloy, while maintaining aluminum alloys' advantages: lightweight and corrosion resistance.

[Equipped with a Boot for Protection against Muddy Water]
Use of a boot with high trackability in the ball shank prevents muddy water from entering the spherical area even in a muddy atmosphere. Accordingly, those types equipped with boots are used also in outdoor applications and automobile parts under the chassis. For details, see the muddy water test data (A-930 and A-931).





Model AL10
Model BL10

Model equivalent to similar product

A-A cross section

Jaw Span for Wrenching

Alloy

[High Strength Aluminum Alloy "A-1 Alloy"]

"A-1 Alloy," a newly developed high strength aluminum alloy, is an alloy with Aℓ-Zn-Si3 being the main components, is used in the holder of model AL.

● Features of the A-1 Alloy

- Achieves one of the highest strengths among the existing aluminum die cast alloys.
- Has yield strength approximately twice that of the commonly used aluminum die cast alloy (ADC 12).
- Has hardness equal to the high strength zinc alloy and achieves high wear resistance.
- Achieves specific gravity less than a half of the high strength zinc alloy to allow significant weight saving.
- Highly corrosion resistance and can be used as an automotive part related to wheel control.

● Mechanical Properties

Tensile strength	: 343 to 392 N/mm^2
Tensile yield strength (0.2%)	: 245 to 294 N/mm^2
Compressive strength	: 490 to 637 N/mm^2
Compressive yield strength (0.2%)	: 294 to 343 N/mm^2
Charpy impact	: 0.098 to 0.196 N-m/mm^2
Elongation	: 2 to 3 %
Hardness	: 140 to 160 HV

● Physical Properties

Specific gravity	: 3
Melting point	: 570℃
Specific heat	: 793 J/(kg・k)
Linear expansion rate	: 22×10^{-6}

● Wear Resistance

The result of our test has proven that the wear resistance of the A-1 alloy is equivalent to the high strength zinc alloy.

Rotation-and-rocking durability test between model AL10D (A-1 alloy) and model BL10D (high strength zinc alloy)

<Test conditions>

Item	Description	
Environment temperature	Normal temperature	
Applied load	±1.9kN (perpendicular to the axis) (note)	
Loading frequency	0.6Hz	
Kinematic angle	Rotation ±20°	Rocking ±20°
No. of cycles	40 times/min.	40 times/min.
Total No. of cycles	1,000,000 cycles	

Note) For the load direction, see A-927.

<Test result: change in clearance (mm)> Unit: mm

Model No.	AL10D (A-1 alloy)	BL10D (high strength zinc alloy)
Perpendicular to the axis	0.036	0.033
Axial direction	0.052	0.045

[High Strength Zinc Alloy]

The high strength zinc alloy used in the holders of models BL, RBL, RBI and TBS has been developed as a bearing alloy by mixing Aℓ, Cu, Mg, Be and Ti as well as zinc as the base component. It is excellent in mechanical properties, seizure resistance and wear resistance.

● Composition

Table1 Composition of the High Strength Zinc Alloy

Unit: %

Item	Description
Aℓ	3 to 4
Cu	3 to 4
Mg	0.03 to 0.06
Be	0.02 to 0.06
Ti	0.04 to 0.12
Zn	Remaining portion

● Mechanical Properties

Tensile strength : 275 to 314 N/mm^2
Tensile yield strength (0.2%) : 216 to 245 N/mm^2
Compressive strength : 539 to 686 N/mm^2
Compressive yield strength (0.2%) : 294 to 343 N/mm^2
Fatigue strength : 132 $N/mm^2 \times 10^7$ (Schenk bending test)
Charpy impact : 0.098 to 0.49 $N\text{-}m/mm^2$
Elongation : 1 to 5%
Hardness : 120 to 145 HV

● Physical Properties

Specific gravity : 6.8
Melting point : 390℃
Specific heat : 460 J/(kg・k)
Linear expansion rate : 24×10^{-6}

● Wear Resistance

The wear resistance of the high strength zinc alloy is superior to that of class-3 brass and class-3 bronze, almost equal to that of class-2 phosphor bronze.

Amsler wear-tester
Test piece rotation speed : 185 min^{-1}
Load : 392 N
Lubricant : Dynamo oil

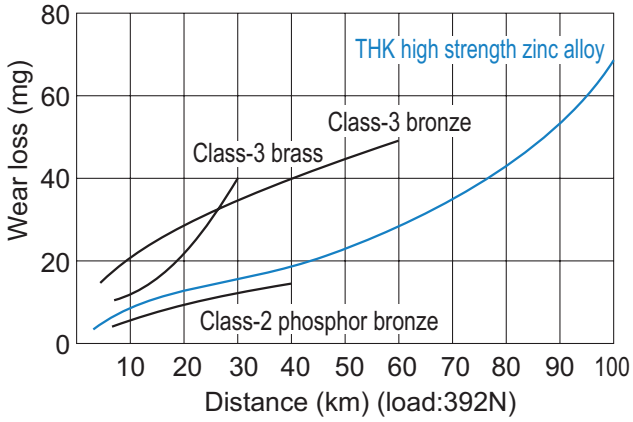


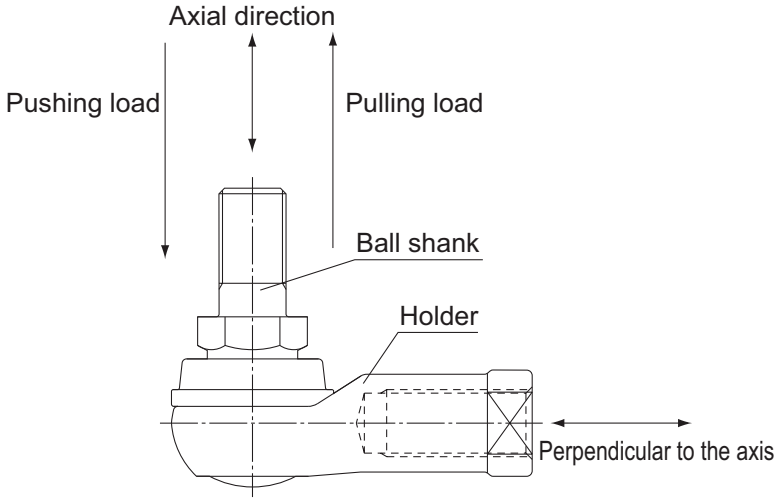
Fig.2 Wear Resistance of the High Strength Zinc Alloy

How Load Directions Are Called

Regardless of the shape, the direction of the load applied to the Link Ball is called "axial direction" if it is parallel to the axis of the ball shank, and "perpendicular-to-axis direction" if it is perpendicular to the axis.

Pushing Load and Pulling Load

Of the loads applied in the axial direction, the load in the direction of the ball shank being pressed toward the holder is called "pushing load" and the load in the direction of the ball shank being pulled from the holder is called "pulling load."



Performance Tests with the Link Ball

Tensile Strength Test with Model AL10D

[Test Method]
Place model AL10D on an Amsler universal testing machine as shown in Fig.3, then apply a load perpendicular to the axis to measure the tensile break load.

[Test Result]
All samples are broken in the shank, indicating that the holder has sufficient strength.

Sample No.	Breaking load (kN)	Broken point
1	18.82	A
2	18.72	A
3	18.6	A
4	18.78	A
5	18.45	A
6	18.95	A
7	18.65	A
8	18.91	A
9	18.55	A
10	18.5	A
$\overline{X}$	18.693	—
R	0.5	—

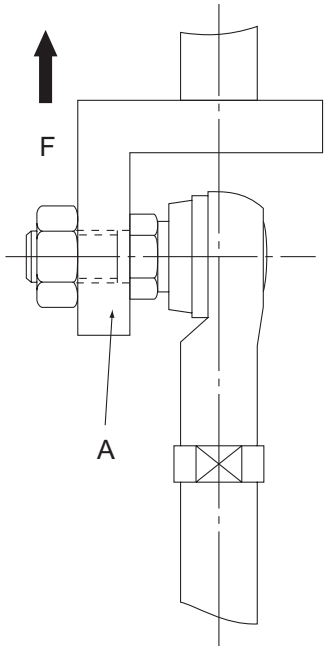


Fig.3

Durability Tests with Link Ball Model AL

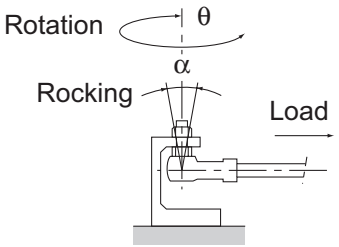
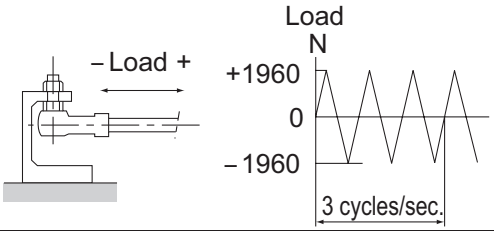
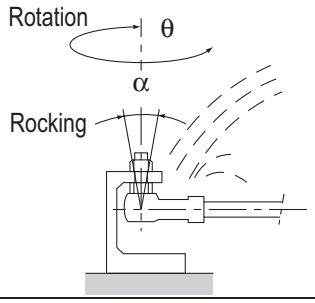
[Purpose of the Tests]

The tests were conducted to identify the durability of Link Ball model AL while assuming that it is used for automobile suspensions.

[Tested Product]

Link Ball model AL10D

[Test Items, Test Conditions and Test Results]

Test item	Test conditions					
	Applied load	Rotation or rocking angle	Frequency	Total number of revolutions or time	Service environment	Load conditions, etc.
Rotation-and-rocking durability	1960N Load direction: Perpendicular to the axis (one direction)	Rotation angle: θ=±5° Rocking angle: θ=±10°	Rotation: 25 times/min. Rocking: 75 times/min.	500,000 cycles (rocking)	Normal temperature	
Fatigue durability test	±1960N Load direction: Perpendicular to the axis (both directions)	—	180 times/min.	1 million cycles (rocking)	Normal temperature	
Muddy-water rotation-and-rocking durability (identify sealability of the boot)	—	Rotation angle: θ=±12° Rocking angle: θ=±12°	Rotation: 25 times/min. Rocking: 75 times/min.	500,000 cycles (rocking)	Normal temperature	Discharge muddy water to the boot ● Discharge rate: 1 ℓ/min. ● Contaminates 10% of JIS Class-8 Kanto loamy layer powder 
Boot weathering test	—	—	—	96 hours	−30℃	Left standing
				96 hours	70℃	Left standing
		Rotation angle: θ=±10°	60 times/min.	144 hours	40℃	● Ozone concentration: 80pphm
Salt-water spray resistance test	—	—	—	200 hours	35℃	● Salt-water concentration: 5% ● Spray solution temperature: 33 to 37℃ ● Spray pressure: 0.098MPa ● Following spray test, apply pushing load to measure strength

[Comprehensive Evaluation]

The results of the durability tests indicate that Link Ball model AL has sufficient strength, wear resistance, corrosion resistance and boot sealability.

This is attributable to the superb characteristics of the newly developed alloy A-1 and the effect of THK's unique manufacturing process. Thus,THK Link Ball model AL provides a high level of performance as a lightweight component.

dammy

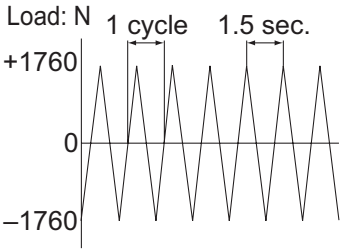
<table>
<tr><th></th><th colspan="3">Test Result</th><th>Evaluation</th></tr>
<tr><td></td><td rowspan="2">Sample No.</td><td colspan="2">Change in clearance (mm)</td><td rowspan="5">● Despite harsh test conditions where complex link motion was required under an axial load, no anomaly was observed in the samples after the test, and the abrasion loss was minimal and consistent among the samples. This indicates that the Link Ball has superb wear resistance and stable quality.</td></tr>
<tr><td>Perpendicular to the axis</td><td>Axial direction</td></tr>
<tr><td></td><td>(1)</td><td>0.038</td><td>0.02</td></tr>
<tr><td></td><td>(2)</td><td>0.04</td><td>0.03</td></tr>
<tr><td></td><td>(3)</td><td>0.042</td><td>0.04</td></tr>
<tr><td></td><td>(4)</td><td>0.038</td><td>0.03</td></tr>
<tr><td></td><td colspan="3">● Appearance
No anomaly was observed including fracture of the samples.
● Motion
The ball shank was capable of smoothly oscillating after the test, without any anomaly such as heavy and jerky motion.</td><td>● No anomaly in appearance or function was observed in the sample after the fatigue durability test involving 1 million cycles of rocking. This indicates that the product is sufficiently capable of continuously operating and has superb wear resistance.</td></tr>
<tr><td></td><td colspan="3">● Motion
The ball shank was capable of smoothly oscillating after the test, without any anomaly such as heavy and jerky motion.
● Muddy water penetration
No muddy water penetration was observed in visual inspection with the boot removed.
● Boot status
No breakage of the boot or abnormal wear of the lip was observed.</td><td>● No anomaly in motion was observed in the sample, and no muddy water penetration into the boot or no grease deterioration was found after the test. This verifies that the boot has reliable sealability.</td></tr>
<tr><td></td><td colspan="3">● Boot status
The boot showed no harmful ozone crack and maintained its pre-test status, including softness, after the test.</td><td>● No anomaly was observed in the sample after the test. The fact that no muddy water penetration into the boot or no grease deterioration was found in the sample after the above durability test verifies that the boot has reliable weatherability.</td></tr>
<tr><td></td><td colspan="3">● Appearance
No erosion was observed in the holder, and no other anomaly including breakage was found either.
● Appearance
The ball shank was capable of smoothly oscillating after the test.</td><td>● No erosion-based deterioration of the sample was observed in function and performance.
This demonstrates that the A-1 alloy has superb corrosion resistance.</td></tr>
</table>

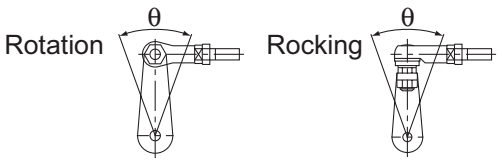
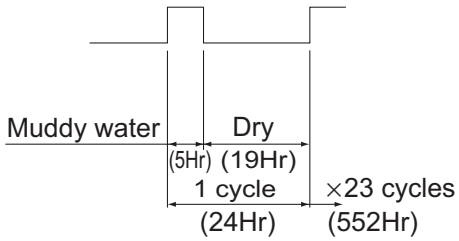
Durability Tests with Link Ball Model BL

[Purpose of the Tests]

The tests were conducted to identify the performance difference between THK Link Ball model BL and an equivalent product of a competitor. As a result, model BL has been used in joints for transmission control units of automobiles, trucks and buses and for steering mechanisms of agricultural tractors.

[Tested Product, Test Items, Test Conditions and Test Results]

<table>
<tr><th rowspan="2">Test item</th><th rowspan="2">Tested model No.</th><th colspan="6">Test conditions</th></tr>
<tr><th>Applied load</th><th>Rotation or rocking angle</th><th>Frequency</th><th>Total number of revolutions or time</th><th>Service environment</th><th>Load conditions, etc.</th></tr>
<tr><td>Rotation-and-rocking durability</td><td>Comparison of THK Link Ball model BL10D and competitor's product</td><td>±1760N (load direction: perpendicular to the axis)</td><td>Rotation angle: θ=±20° Rocking angle: α=±20°</td><td>40 times/min.</td><td rowspan="5">1,000,000 cycles</td><td>Normal temperature</td><td>The loading diagram is as follows.
 

The motion direction is as follows:
 
</td></tr>
<tr><td>Low-temperature rotation durability</td><td rowspan="3">THK Link Ball model BL10D only</td><td rowspan="4">±1225N (load direction: perpendicular to the axis)</td><td rowspan="2">Rotation angle: θ=±30°</td><td rowspan="4">60 times/min.</td><td>–30℃</td><td>Low-temperature retention time: 280 hours
Motion in the rotational direction</td></tr>
<tr><td>High temperature rotation durability</td><td>100℃</td><td>High temperature retention time: 280 hours
Motion in the rotational direction</td></tr>
<tr><td>Muddy-water rotation durability</td><td rowspan="2">Normal temperature</td><td rowspan="2">Motion: rotational direction and oscillation on a separate basis
Muddy water discharge pattern
Muddy water concentration: 5 Wt% of salt and dust each in 1 liter of water
Discharge direction: against the boot lip
Discharge pressure: 5 kg/cm³
 
</td></tr>
<tr><td>Muddy-water rocking durability</td><td>Comparison of THK Link Ball model BL10D and competitor's product</td><td>Rocking angle: α=±20°</td></tr>
</table>

[Comprehensive Evaluation]

As a result of comparing THK Link Ball model BL10D and a competitor's product in representative durability tests, it is demonstrated that model BL10D is superior in strength and wear resistance of the holder and sealability of the boot.

These features are achieved through THK's unique manufacturing process for the holder and the shank, the material used, the structure of upper and lower grease pockets on the spherical area and the development of a highly sealable boot.

	Test Result					Evaluation
		Sample No.	Change in clearance (μm)		Conditions of the holder, etc.	
			Perpendicular to the axis	Axial direction		
	THK model BL10D	(1)	26	42	The shank was capable of smoothly rotating after the 1-million cycle test, and capable of continuously operating.	● Even in complex link motion, THK model BL10D demonstrated higher durability and wear resistance of the holder than competitor's product.
		(2)	25	40		
	Competitor's product	(1)	Broke in the holder neck after 8,600 cycles		Wear and damage were observed in the holder's spherical area in approx. 150,000-cycle operation.	● The abrasion loss of the competitor's product immediately before the breakage of the holder was 6 times greater than THK model BL10D (perpendicular to the axis).
			154	60		
		(2)	Broke in the holder neck after 151,300 cycles			
			62	20		
	THK model BL10D	(1)	63	65	The boot did not show a crack or the like at low temperature	● This indicates that THK model BL10D is sufficiently capable of operating in outdoor applications in cold climates.
		(2)	56	59		
		(1)	79	84	The holder did not show abnormal wear and the boot did not show thermal deterioration at high temperature.	● This indicates that THK model BL10D is sufficiently capable of operating in hot areas of a truck engine.
		(2)	74	78		
		(1)	48	51	No muddy-water penetration that may cause wear was observed.	● This indicates that THK model BL10D is sufficiently capable of operating in environments subject to muddy water such as trucks, construction vehicles and agricultural machines since the sealing effect of the boot prevents penetration of muddy water.
		(2)	57	63		
		(1)	32	38		
		(2)	35	42		
	Competitor's product	(1)	240	105	Muddy water penetrated the boot, the spherical area showed chipping and the boot had cuts.	● The competitor's product cannot be used in environments subject to muddy water since chipping or the like may occur in such environments. In addition, wear of the spherical area reached 0.24 mm, 7.4 times greater than THK model BL10D.
		(2)	246	107		

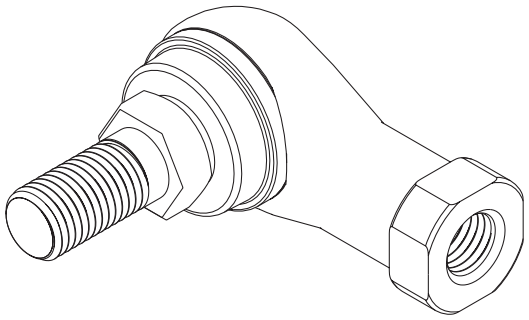
Types of the Link Ball

Types and Features

Model AL

Specification Table⇒B-834

The holder is connected in perpendicular to the shank, which comprises a male thread specially welded with a highly accurate steel ball. With a grease pocket formed on the top and bottom of the spherical area, this model achieves high lubricity and high wear resistance.
Use of the A-1 alloy in the holder significantly reduces the weight.



Model AL

"A-1 Alloy," a high strength aluminum alloy newly developed for the Link Ball, has yield strength approximately twice that of the commonly used aluminum die cast material ADC 12, and its strength and wear resistance are equivalent to the high strength zinc alloy.
With its specific gravity less than that of the high strength zinc alloy, model AL is optimal as an automotive part that requires lightweight, high strength, high corrosion resistance and high wear resistance.

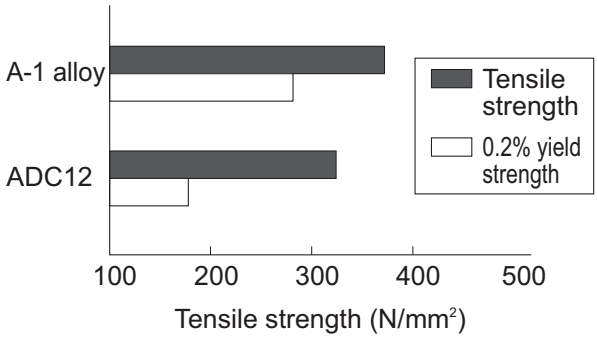
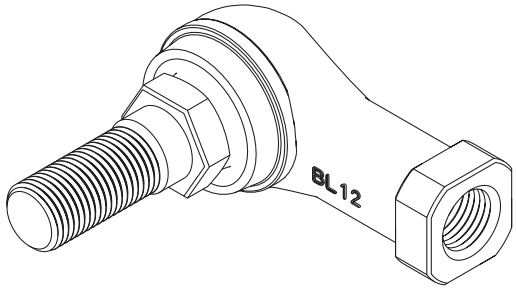


Fig.4 Tensile Strength and Yield Strength of THK A-1 Alloy and ADC 12

Model BL

Specification Table⇒B-836

A compact type of model RBL, this model's holder made of the high strength-zinc alloy is connected in perpendicular to the shank, which is incorporated with a ball.
With a grease pocket formed on the top and bottom of the spherical area, this model achieves high lubricity and high wear resistance.

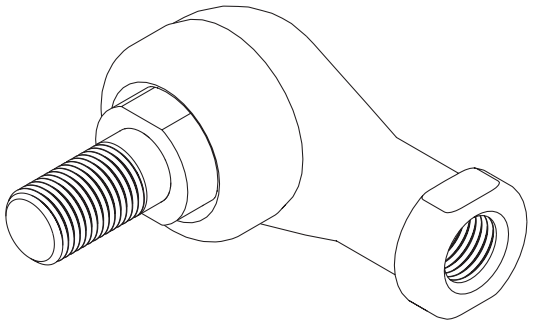


Model BL

Model RBL

Specification Table⇒B-838

The holder made of the high strength zinc alloy is connected in perpendicular to the shank, which is incorporated with a ball.
Since grease is contained in the boot, this model achieves high lubricity and high wear resistance.

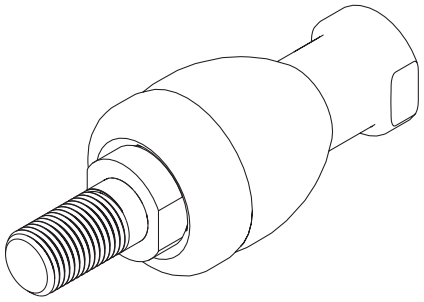


Model RBL

Model RBI

Specification Table⇒B-840

With this Link Ball model, the high strength zinc alloy is used in its holder and the mounting bolt and the holder are arranged on the same axis, allowing this model to receive both a compressive load and a pulling load.
Since grease is contained in the boot, this model achieves high lubricity and high wear resistance.

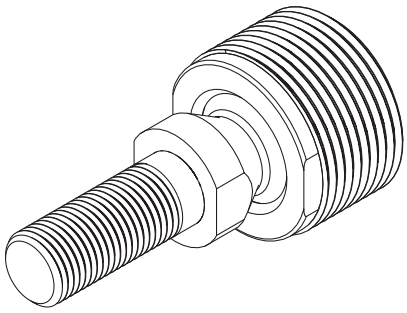


Model RBI

Model TBS

Specification Table⇒B-842

The rolled thread on the circumference of the outer ring allows this model to easily be mounted on the housing. Simply by tightening the screw, the user can achieve play-free, firm installation.
Since the coating area of sphere is large, the model is capable of receiving a large axial load.



Model TBS

Selecting a Link Ball

The selected bearing must meet both the permissible load obtained from equation (1) and the dynamic load capacity obtained from equation (2).

[Permissible Load P]

The yield-point strength indicated in the specification tables refers to the mechanical strength of the bearing. With models AL, BL and RBL, the yield point strength indicates the strength when a load is applied perpendicular to the ball shank axis. With model RBI, it indicates the strength when an axial load is applied to the holder in the shank axis direction.

Table1 Safety Factor (f_s)

Type of load	Lower limit of f_s
Constant load in a constant direction	2 to 3
Fluctuating load in a constant direction	3 to 5
Load in varying directions	5 to 8

According to the type of the load, select a bearing that satisfies the following equation from a mechanical strength's viewpoint.

$$P \leqq \frac{P_k}{f_s} \quad \cdots\cdots\cdots\cdots(1)$$

P : Permissible Load (N)
P_k : Yield-point strength (N)
f_s : Safety factor (see Table1)

[Dynamic Load Capacity C_d]

The dynamic load capacity (C_d) refers to the upper limit of load that the spherical area of the Link Ball can receive without showing seizure while the Link Ball is rotating or oscillating. The dynamic load capacity is obtained from the following approximation formula using the static load capacity (C_s) (note) indicated in the dimensional table.

$$C_d = \frac{C_s}{\sqrt[3]{n}} \quad \cdots\cdots\cdots\cdots(2)$$

C_d : Dynamic load capacity (N)
C_s : Static load capacity (N)
n : Rotation speed per minute (min^{-1})

Note) Static load capacity (C_s) refers to the value obtained by multiplying the projected area on the spherical section by the permissible surface pressure, and is used to obtain the dynamic load capacity.

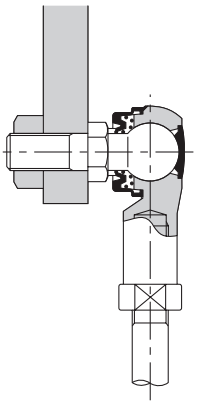
Permissible Tilt Angles

The permissible tilting angles of Link Ball models are indicated in the corresponding specification tables.

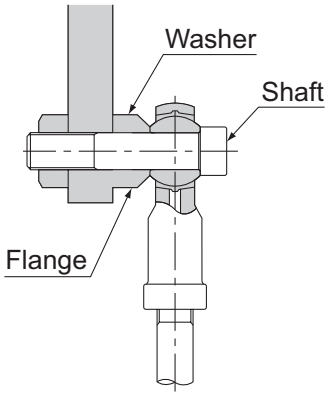
Note) If the permissible tilt angle is exceeded, it may cause serious damage to the holder or the boot. Be sure to use the Link Ball within its permissible tilt angle.

Example of Installation

[Comparison of THK Link Ball and the Conventional Rod End]



THK model BL

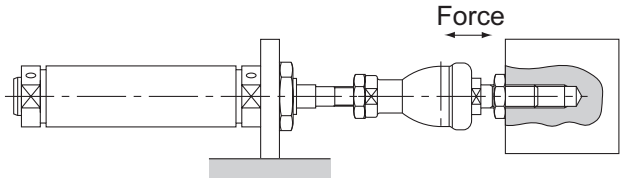


Conventional Rod End model PHS

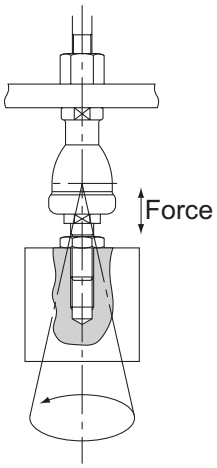
- Sine it has a shaft, model BL can easily be installed (especially useful for rod assembly).
- Because of the improved shape of the boot lip, the spherical area is protected from muddy water even in a muddy atmosphere.
- Since it contains grease, it can be used without further lubrication. (with the boot attached)
- Unlike the conventional type, which has a clearance between the shaft and the inner circumference of the inner ring and cannot be fixed completely, model BL has minimum distortion and high rigidity since the shank is integrated with the ball.

[Examples of Installing Model RBI]

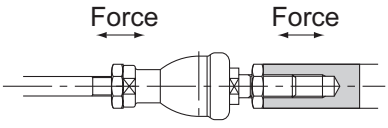
Joint for cylinder end metal fitting



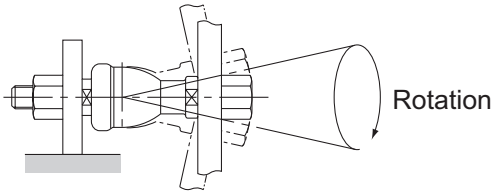
Suspending a light object



Connecting a rod in the axial direction



Rotation support



[Temperature Range]
The temperature range of the Link Ball series is basically between -20℃ and 80℃. If the service temperature exceeds this range, contact THK(see examples of testing the product at temperature other than the above temperature range on A-930 to A-933)

[Handling]
Dropping or hitting the Link Ball may damage it. Giving an impact to it could also cause functional damage to it even if the product looks intact.

[Lubrication]
(1) All Link Ball models except model TBS contain lithium soap-based grease in their boots and can be used without further greasing. For model TBS and those models without boot, apply grease to the spherical section as necessary.
(2) Do not mix lubricants of different physical properties.

[Precautions on Use]
(1) Do not use the product in the manner that the permissible tilting angle is exceeded since doing so may damage the product.
(2) When using the product in locations exposed to vibrations or an impact load or in a special environment such as a clean room, vacuum and low/high temperature, contact THK in advance.
(3) Entrance of foreign material such as dust between the holder and the inner ring may cause damage or functional loss. Prevent foreign material, such as dust and cutting chips, from entering the product.
(4) Models AL, BL and RBL are designed for use under a load in the direction perpendicular to the axis, while models RBI and TBS are designed for use under an axial load. Take this into account when selecting a model.

[Storage]
When storing the Link Ball, avoid high temperature, low temperature and high humidity.

Rod End

THK General Catalog

A Technical Descriptions of the Products

B Product Specifications (Separate)

* Please see the separate "B Product Specifications".

Features of the Rod End

Features

The Rod End is a self-aligning plain bearing that uses a spherical inner ring which has the same level of accuracy and hardness as bearing steel balls. With the combination of a spherical inner ring whose sliding surface is mirror-finished and a rationally designed holder, the Rod End ensures play-free, extremely smooth rotation and oscillation.

Special Bearing Alloy

[High Strength Zinc Alloy]

The high strength zinc alloy, developed as an alloy for bearings, is composed of Aℓ, Cu, Mg, Be and Ti as well as zinc as the base. It is excellent in mechanical properties, seizure resistance and wear resistance.

● Composition

Table1 Composition of the High Strength Zinc Alloy

Unit: %

Item	Description
Aℓ	3 to 4
Cu	3 to 4
Mg	0.03 to 0.06
Be	0.02 to 0.06
Ti	0.04 to 0.12
Zn	Remaining portion

● Mechanical Properties

Tensile strength : 275 to 314 N/mm^2
Tensile yield strength (0.2%) : 216 to 245 N/mm^2
Compressive strength : 539 to 686 N/mm^2
Compressive yield strength (0.2%) : 294 to 343 N/mm^2
Fatigue strength : 132 N/mm^2×10^7 (Schenk bending test)
Charpy impact : 0.098 to 0.49 N-m/mm^2
Elongation : 1 to 5%
Hardness : 120 to 145 HV

● Physical Properties

Specific gravity : 6.8
Melting point : 390℃
Specific heat : 460 J/ (kg・k)
Linear expansion rate : 24×10^{-6}

● Wear Resistance

The wear resistance of the high strength zinc alloy is superior to that of class-3 brass and class-3 bronze, almost equal to that of class-2 phosphor bronze.

Amsler wear-tester
Test piece rotation speed : 185 min^{-1}
Load : 392 N
Lubricant : Dynamo oil

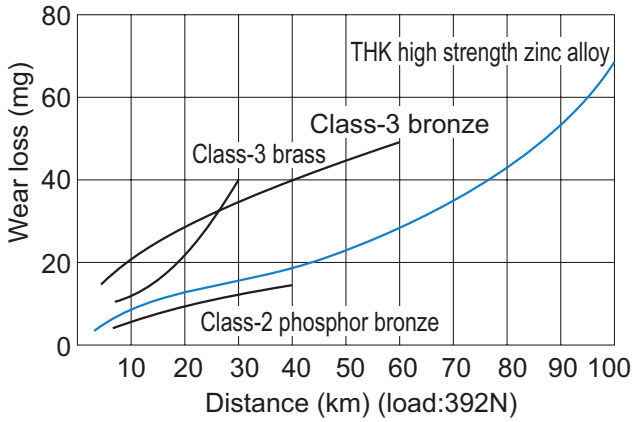


Fig.1 Wear Resistance of the High Strength Zinc Alloy

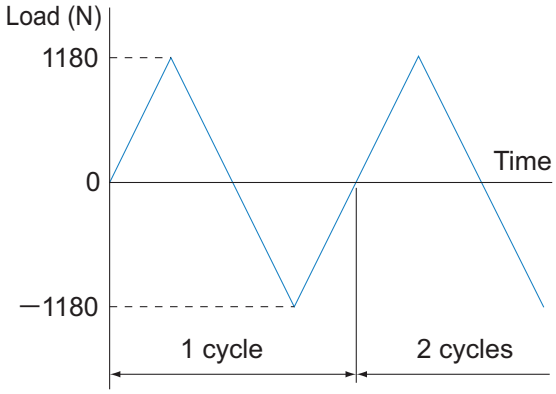
Performance Test with the Rod End

This test has been conducted to identify the difference in performance between THK Rod End model HS and an equivalent product by a competitor.

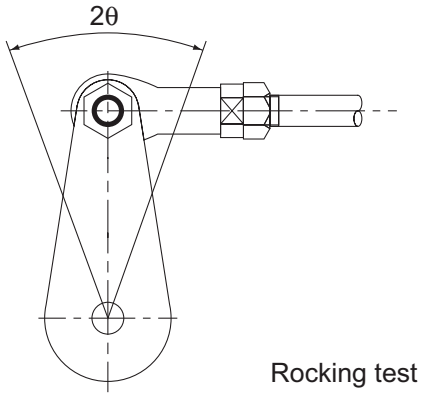
[Wear Test Conditions]

Item	Description
Subject Rod End	THK: Model HS8
	Stainless steel model equivalent of the above
Type of test	Rocking test
Applied load	±1,180 N in the radial direction
Kinematic angle	Oscillation angle: 2θ=40°(±20°)
Lubrication	No lubrication
Number of cycles per minute	60opm
Total number of cycles	1 million cycles
Testing equipment	Bench testing machine (normal temperature)

The applied load diagram is shown below.



The kinematic angle is shown below.



[Result of the Wear Test]

Table2 Change in the Spherical Clearance Unit: mm

Abrasion loss after 1-million-cycle test			
Model No.	Number of times	Rocking test	
		Radial direction	Axial direction
HS 8	Initial stage (at start-up)	0.008	0.01
	1 million cycles	0.035	0.075
	Change	0.027	0.065
Stainless steel model equivalent of the above	Initial stage (at start-up)	0.005	0.005
	40,000 cycles	0.22	0.2
	Change after 40,000 cycles	0.215	0.065
	Note: The holder is elongated and fractured after 76,300 cycles.		

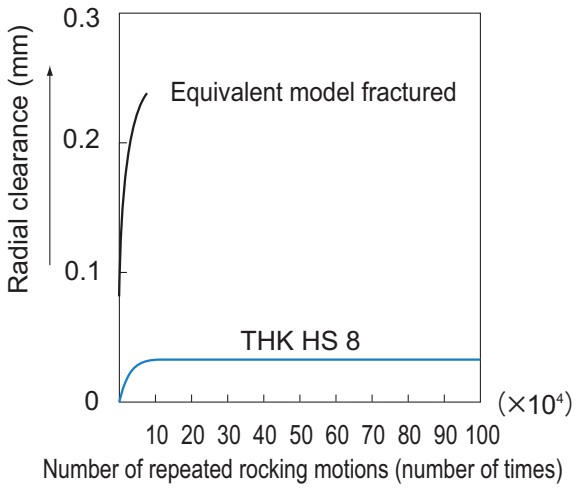


Fig.2 Wear Diagram

(1) Although model HS8 withstood the repeated durability test with an applied load of ±1,180 N and the total number of cycles being 1 million, the holder of the stainless steel equivalent model was elongated and fractured after only 76,300 cycles.

(2) The result shows that the increase in wear of model HS8 in the radial direction since the initial wear (approximately 100,000 cycles) was minimal.

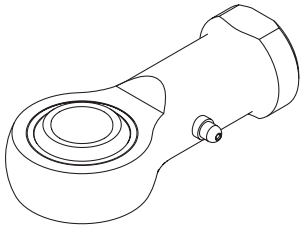
Types of the Rod End

Types and Features

Type Provided with a Female Threading - Model PHS

Specification Table⇒B-846

With model PHS, a special copper alloy with high conformability is inserted between the chromate treatment steel holder and the spherical inner ring in which only the circumference of the spherical area is hard chrome plated. This structure ensures high rigidity, high wear resistance and high corrosion resistance.
The grease nipple on the holder allows grease to be applied to the sliding surface as necessary.

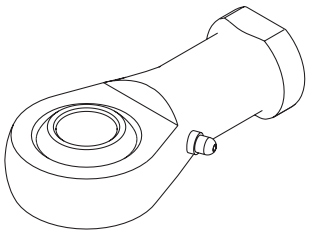


Model PHS

Die Cast, Low Price Type - Model RBH

Specification Table⇒B-848

This model is a high-accuracy, low cost rod end in which the spherical inner ring serves as the core and the holder is formed by die casting.
The holder is made of a high strength zinc alloy (see A-942), which is superb in mechanical properties and bearing characteristics.

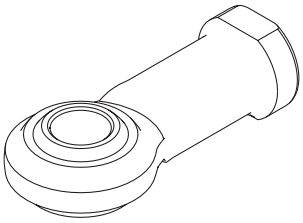


Model RBH

No Lubrication Type - Model NHS-T

Specification Table⇒B-850

This no lubrication rod end uses self-lubricating synthetic resin formed between the steel holder and the spherical inner ring.
Since the clearance on the sliding surface is minimized, an accurate link motion is achieved.

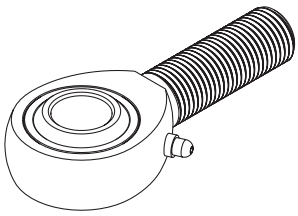


Model NHS-T

Male thread Type - Model POS

Specification Table⇒B-852

This model is a highly rigid rod end that is basically the same as the female threading type model PHS, but has a male thread on the holder end.

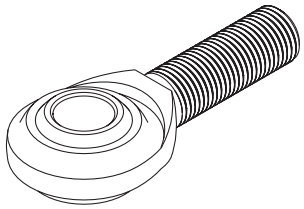


Model POS

No Lubrication, Male thread Type - Model NOS-T

Specification Table⇒B-854

This model is a no lubrication rod end that is basically the same as the female threading type model NHS-T, but has a male thread on the holder end.

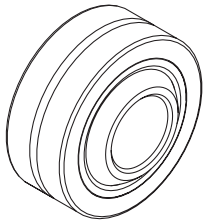


Model NOS-T

Standard Type - Model PB

Specification Table⇒B-856

With model PB, a special copper alloy with high conformability is inserted between the steel outer ring and the spherical inner ring in which only the spherical area is hard chrome plated. This structure makes this model a high rigid Spherical Plain Bearing with high corrosion resistance and high wear resistance.
The oil groove and the greasing hole on the outer ring allow grease to be applied to the sliding surface as necessary.

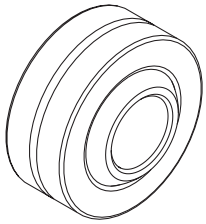


Model PB

Die Cast Type - Model PBA

Specification Table⇒B-857

This model is a high-accuracy, low cost Spherical Plain Bearing in which the spherical inner ring serves as the core and the outer ring is formed by die casting.
The outer ring is made of a high strength zinc alloy (see A-942), which is superb in bearing characteristics.

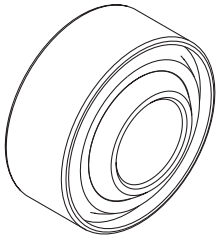


Model PBA

No Lubrication Type - Model NB-T

Specification Table⇒B-858

This no lubrication bearing uses self-lubricating synthetic resin formed between the steel outer ring and the spherical inner ring.



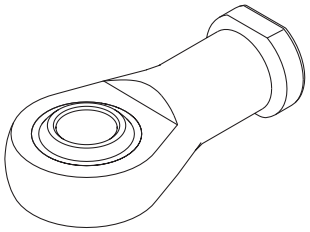
Model NB-T

[Build to Order]

No Lubrication, Corrosion-resistant Type - Model HS

Specification Table⇒B-860

This no lubrication Spherical Plain Bearing uses a special fluorine sheet adhering to the holder's spherical area. The holder is made of an aluminum alloy.
This product is built to order. Contact THK for details.



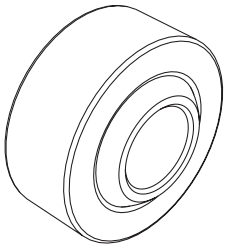
Model HS

[Build to Order]

No Lubrication Type - Model HB

Specification Table⇒B-862

This no lubrication Spherical Plain Bearing uses a special fluorine sheet adhering to the outer ring's spherical area.
This product is built to order. Contact THK for details.



Model HB

Selecting a Rod End

[Permissible Load P]

The static load capacity (C_s) indicated in the specification tables, is presented as a guide for the mechanical strength of the Rod End. Select a bearing while taking into account the safety factor (f_s) indicated in Table1 according to the type of the load.

Table1 Safety Factor (f_s)

Type of load	Lower limit of f_s
Constant load in a constant direction	2 to 3
Fluctuating load in a constant direction	3 to 5
Load in varying directions	5 to 8

According to the type of load, select a bearing that satisfies the following equation from a mechanical strength's viewpoint.

$$P \leqq \frac{C_s}{f_s} \quad \cdots\cdots\cdots (1)$$

P : Permissible Load (N)
C_s : Static load capacity (N)
f_s : Safety factor (see Table1)

[Dynamic Load Capacity C_d]

The dynamic load capacity refers to the upper limit of load that the spherical area can receive without showing seizure while the Rod End is rotating or oscillating. The dynamic load capacity is obtained from the following approximation formula using the static load capacity (C_s) (note 1) indicated in the specification table.

$$C_d = \frac{C_s}{\sqrt[3]{n}} \quad \cdots\cdots\cdots (2)$$

C_d : Dynamic load capacity (N)
C_s : Static load capacity (N)
n : Rotation speed per minute (min^{-1})

The selected bearing must meet both the permissible load obtained from equation (1) and the dynamic load capacity obtained from equation (2).

Note1) Static load capacity (C_s) refers to the value obtained by multiplying the projected area on the spherical section by the permissible surface pressure, and is used to obtain the dynamic load capacity.

Permissible Tilt Angles

The permissible tilt angles α_1, α_2 and α_3 of the Rod End are indicated in Table1.

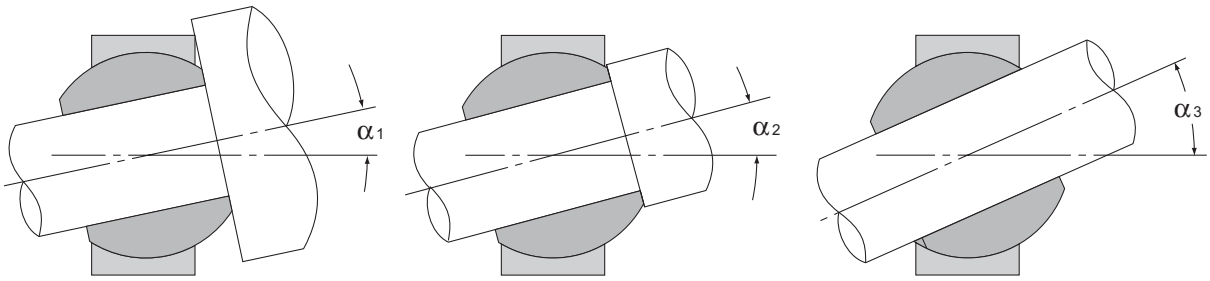


Table1 Permissible Tilt Angles

Model No.	Permissible tilt angles		
	α_1	α_2	α_3
NHS 3T, NOS 3T	8	10	42
NHS 4T, NOS 4T	9	11	35
PHS 5, RBH 5, NHS 5T, POS 5, NOS 5T, PB 5, PBA 5	8	13	30
PHS 6, RBH 6, NHS 6T, POS 6, NOS 6T, PB 6, PBA 6	8	13	30
PHS 8, RBH 8, NHS 8T, POS 8, NOS 8T, PB 8, PBA 8	8	14	25
PHS 10, RBH 10, NHS 10T, POS 10, NOS 10T, PB 10, PBA 10	8	14	25
PHS 12, RBH 12, NHS 12T, POS 12, NOS 12T, PB 12, PBA 12	8	13	25
PHS 14, RBH 14, NHS 14T, POS 14, NOS 14T, PB 14, PBA 14, NB 14T	10	16	24
PHS 16, RBH 16, NHS 16T, POS 16, NOS 16T, PB 16, PBA 16, NB 16T	9	15	24
PHS 18, RBH 18, NHS 18T, POS 18, NOS 18T, PB 18, PBA 18, NB 18T	9	15	24
PHS 20, RBH 20, NHS 20T, POS 20, NOS 20T, PB 20, PBA 20, NB 20T	9	15	24
PHS 22, RBH 22, NHS 22T, POS 22, NOS 22T, PB 22, PBA 22, NB 22T	10	15	23
PHS 25, POS 25, PB 25	9	15	23
PHS 30, POS 30, PB 30	10	17	23

Installation

Please note that the Rod End is not capable of receiving a thrust load indicated in Fig.1.

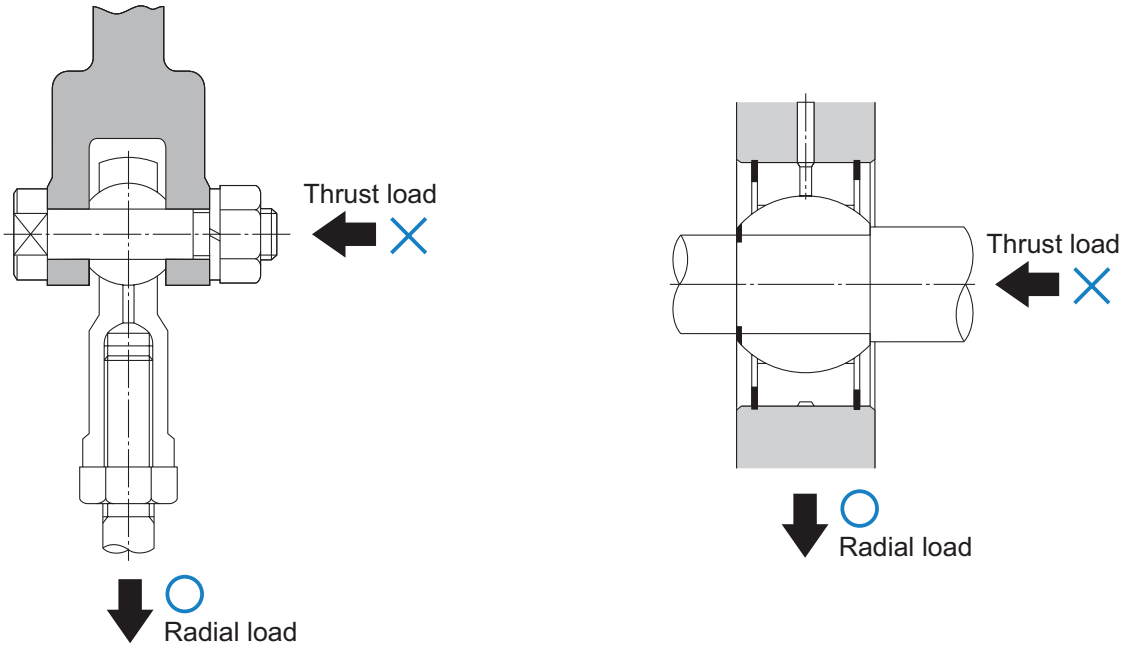


Fig.1 Examples of Installing the Rod End

[Service Temperature]
If any of models RBH, PBA, HS and HB, all of which use the high strength zinc alloy and an aluminum alloy in the holder and the outer ring, and of models NHS-T, NOS-T and NB-T, which use synthetic-resin bushes, is to be used at temperature of 80 ℃ or higher, or receives an impact at low temperature, contact THK.

[Handling]
Dropping or hitting the Rod End may damage it. Giving an impact to it could also cause damage to its function even if the product looks intact.

[Lubrication]
All Rod End models except lubrication-free types must be greased before being used (lithium soap-based grease No. 2 is recommended). When greasing the Rod End before using it, do not mix lubricants of different physical properties. In addition, replenish a lubricant also during operation as necessary.

[Precautions on Use]
(1) Do not use the product in the manner that the permissible tilting angle is exceeded since doing so may damage the product.
(2) When using the product in locations exposed to vibrations or an impact load or in a special environment such as a clean room, vacuum and low/high temperature, contact THK in advance.
(3) Entrance of foreign material such as dust between the holder and the inner ring may cause damage or functional loss. Prevent foreign material, such as dust and cutting chips, from entering the product.
(4) The Rod End is designed for use under a radial load. Do not use the product under a thrust load.

[Storage]
When storing the Rod End, avoid high temperature, low temperature and high humidity.

Spherical Plain Bearing

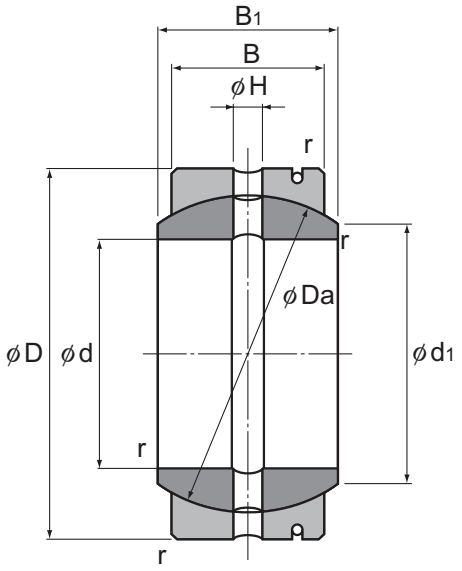
THK General Catalog

B Product Specifications

A Technical Descriptions of the Products (Separate)

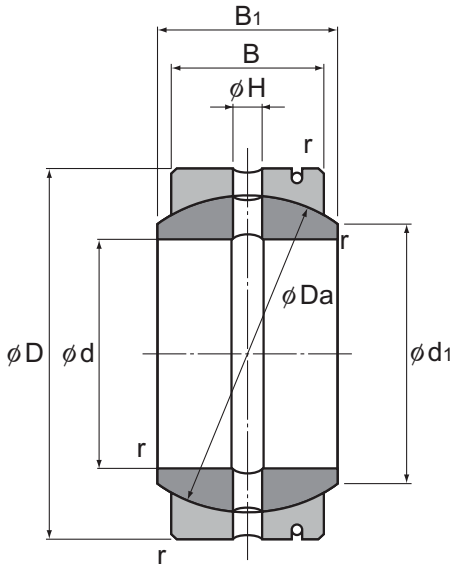
* Please see the separate "A Technical Descriptions of the Products".

Model SB



Unit: mm

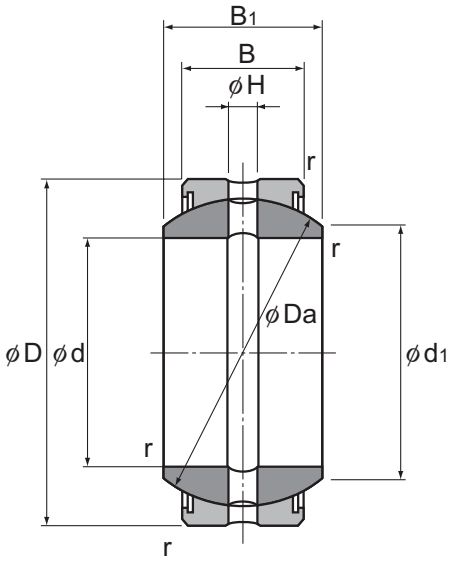
Model No.	Main dimensions								Basic load rating		Mass
	Inner diameter	Outer diameter	Outer ring width	Inner ring width					C	C_0	
	d	D	B	B_1	d_1	Da	H	r	kN	kN	kg
SB 12	12	22	9	11	14	18	1.5	0.5	3.82	95.3	0.019
SB 15	15	26	11	13	17.5	22	2.5	0.5	5.69	142	0.028
SB 20	20	32	14	16	23	28	2.5	0.5	9.22	230	0.053
SB 22	22	37	16	19	25.5	32	2.5	0.5	12.1	301	0.085
SB 25	25	42	18	21	29	36	4	0.5	15.3	381	0.116
SB 30	30	50	23	27	36	45	4	1	24.3	609	0.225
SB 35	35	55	26	30	40	50	4	1	30.6	765	0.3
SB 40	40	62	28	33	44	55	4	1	36.3	906	0.375
SB 45	45	72	31	36	50.5	62	6	1	45.2	1130	0.6
SB 50	50	80	36	42	58.5	72	6	1	61	1530	0.87
SB 55	55	90	40	47	64.5	80	6	1	75.3	1880	1.26
SB 60	60	100	45	53	72.5	90	6	1	95.3	2380	1.7
SB 65	65	105	47	55	76	94	6	1	104	2600	2.05



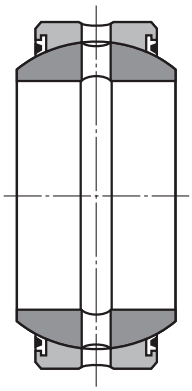
Unit: mm

Model No.	Main dimensions								Basic load rating		Mass
	Inner diameter d	Outer diameter D	Outer ring width B	Inner ring width B_1	d_1	Da	H	r	C kN	C_0 kN	kg
SB 70	70	110	50	58	81.5	100	8	1	118	2940	2.22
SB 75	75	120	55	64	89.5	110	8	1	142	3560	3.02
SB 80	80	130	60	70	97.5	120	8	1	170	4240	3.98
SB 85	85	135	63	74	100.5	125	8	1	185	4640	4.29
SB 90	90	140	65	76	105.5	130	8	1	199	4970	4.71
SB 95	95	150	70	82	113.5	140	8	1	230	5760	6.05
SB 100	100	160	75	88	121.5	150	10	1.5	265	6620	7.42
SB 110	110	170	80	93	130	160	10	1.5	301	7530	8.55
SB 115	115	180	85	98	132.5	165	10	1.5	330	8250	10.3
SB 120	120	190	90	105	140	175	10	1.5	371	9260	12.4
SB 130	130	200	95	110	148.5	185	10	1.5	414	10300	13.8
SB 150	150	220	105	120	166	205	10	1.5	507	12600	17

Model SA1



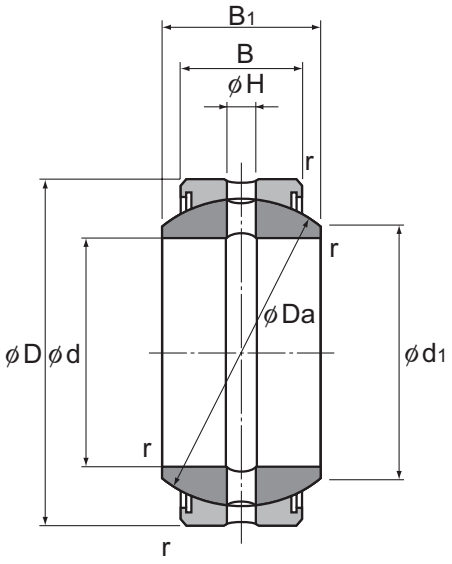
Model SA1



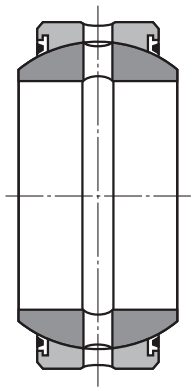
Model SA1-UU

Unit: mm

Model No.		Main dimensions								Basic load rating		Mass
Standard type	Seal type	Inner diameter d	Outer diameter D	Outer ring width B	Inner ring width B_1	d_1	Da	H	r	C kN	C_0 kN	kg
SA1 12	SA1 12UU	12	22	7	10	15	18	1.5	0.3	2.94	74.1	0.017
SA1 15	SA1 15UU	15	26	9	12	18.4	22	2.5	0.3	4.7	117	0.032
SA1 17	SA1 17UU	17	30	10	14	20.7	25	2.5	0.3	5.88	147	0.049
SA1 20	SA1 20UU	20	35	12	16	24.2	29	2.5	0.3	8.23	205	0.065
SA1 25	SA1 25UU	25	42	16	20	29.3	35.5	4	0.3	13.3	334	0.115
SA1 30	SA1 30UU	30	47	18	22	34.2	40.7	4	0.3	17.3	431	0.16
SA1 35	SA1 35UU	35	55	20	25	39.8	47	4	1	22.1	553	0.258
SA1 40	SA1 40UU	40	62	22	28	45	53	4	1	27.5	686	0.315
SA1 45	SA1 45UU	45	68	25	32	50.8	60	6	1	35.3	882	0.413
SA1 50	SA1 50UU	50	75	28	35	56	66	6	1	43.5	1090	0.56
SA1 60	SA1 60UU	60	90	36	44	66.8	80	6	1.5	67.7	1700	1.1
SA1 70	SA1 70UU	70	105	40	49	77.9	92	8	1.5	86.6	2170	1.54



Model SA1



Model SA1-UU

Unit: mm

Model No.		Main dimensions								Basic load rating		Mass
Standard type	Seal type	Inner diameter d	Outer diameter D	Outer ring width B	Inner ring width B_1	d_1	Da	H	r	C kN	C_0 kN	kg
SA1 80	SA1 80UU	80	120	45	55	89.4	105	8	1.5	111	2780	2.29
SA1 90	SA1 90UU	90	130	50	60	98.1	115	8	2	135	3380	2.84
SA1 100	SA1 100UU	100	150	55	70	109.5	130	8	2	169	4210	4.43
SA1 110	SA1 110UU	110	160	55	70	121.2	140	8	2	181	4530	4.94
SA1 120	SA1 120UU	120	180	70	85	135.6	160	8	2	264	6590	8.12
SA1 140	SA1 140UU	140	210	70	90	155.9	180	8	3	296	7410	11.3
SA1 160	SA1 160UU	160	230	80	105	170.2	200	10	3	376	9410	14.4
SA1 180	SA1 180UU	180	260	80	105	199	225	10	3	424	10600	18.9
SA1 200	SA1 200UU	200	290	100	130	213.5	250	10	3	588	14700	28.1
SA1 220	SA1 220UU	220	320	100	135	239.6	275	10	3.5	647	16200	36.1
SA1 240	SA1 240UU	240	340	100	140	265.3	300	10	3.5	706	17600	40.4

Note) Model numbers "...100" or higher have double-slit outer rings.

Link Ball®

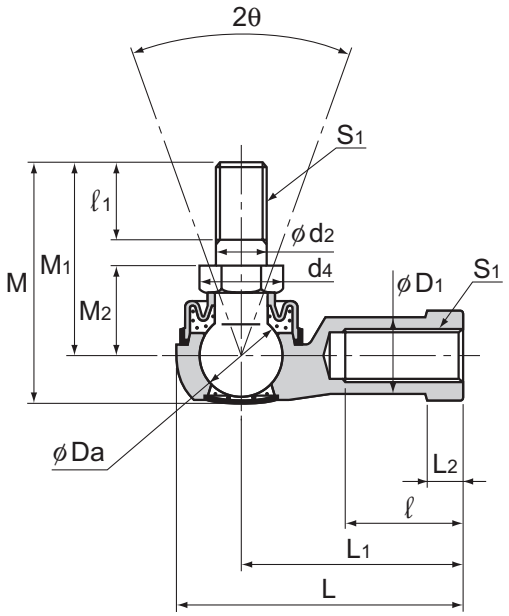
THK General Catalog

B Product Specifications

A Technical Descriptions of the Products (Separate)

* Please see the separate "A Technical Descriptions of the Products".

Model AL



Model No.	Outer dimensions			Threaded	Holder dimensions					
	Length	Diameter	Height	S_1	L_1	ℓ	L_2	D_1	D_2	W
	L	D	M	JIS Class 2						$^{0}_{-0.3}$
AL 4D	24.5	13	20	M4×0.7	18	8	4	7.5	9.5	8
AL 5D	34.5	15	26.7	M5×0.8	27	15	4	9	12	10
AL 6D	38.5	17	32.6	M6×1	30	16	5	10	13	11
AL 8D	46	20	38.6	M8×1.25	36	19	6	13	16	14
AL 10D	56	26	46.3	M10×1.25	43	23	7	15.5	19	17
AL 10BD	56	26	52.3	M10×1.5	43	23	7	15.5	19	17

[Material]

Holder : A-1 alloy (see A-925)
Ball shank : Lightly Carburized Carbon Steel Ball:
650 Hv or higher
Shank S35C (20 to 28 HRC)
Chromate treatment
Boot : NBR special synthetic rubber

[Tolerance of the Mating Hole of the Ball Shank]

H10 is recommended.

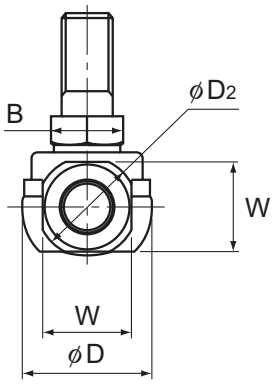
[Spherical Clearance]

Perpendicular to the axis : 0.02 to 0.06mm
Axial direction : 0.3mm or less

Model number coding

AL6 D L

- AL6: Model number
- D: With boot attached
- L: Left-hand thread

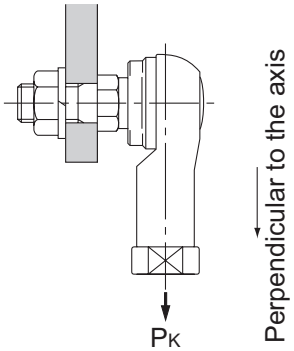


Unit: mm

	Ball shank dimensions						Ball diameter	Permissible tilt angles	Applied static load	Yield-point strength	Mass
	d_2 h9	M_1	M_2 ±0.3	ℓ_1	Hexagon B 0 −0.3	d_4	Da	2θ°	C_S N	P_K N	g
	4	15	7	6	7	8.1	7.938	40	4510	1370	7
	5	21	10	8	8	9.2	9.525	40	6470	2250	12
	6	26	11	11	10	11.6	11.112	40	9900	3920	18
	8	31	14	12	12	13.8	12.7	40	12500	6570	32
	10	37	17	15	14	16.2	15.875	40	18300	11300	65
	10	43	17	21	14	16.2	15.875	40	18300	11300	68

[Yield-Point Strength]

It indicates the strength in the direction shown in the figure below.



[Lubrication]

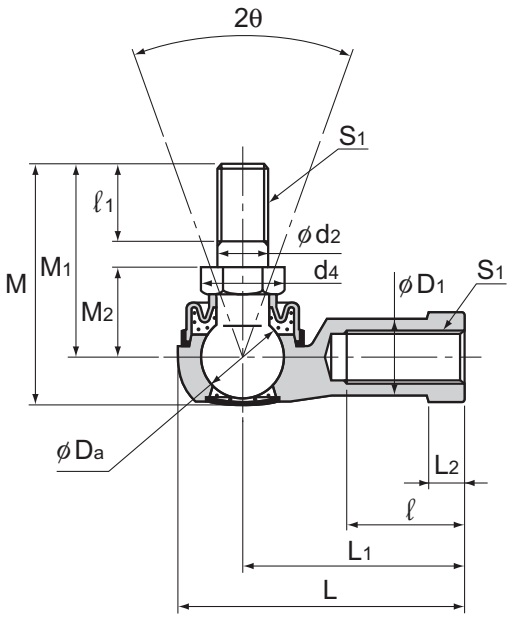
Lithium soap group grease No. 2 is contained in the boot and the cap.

[Identification of Left-hand Thread]

If the female threading is left-handed, its identification depends on the marking.

Threaded	Identification
	Cap marking
Right-hand	—
Left-hand	"L" mark

Model BL



Model No.	Outer dimensions			Threaded	Holder dimensions					
	Length	Diameter	Height	S_1	L_1	ℓ	L_2	D_1	D_2	W
	L	D	M	JIS Class 2						0 −0.3
BL 6D	38	16	32.6	M6×1	30	16	5	10	13	11
BL 8D	45.5	19	38.6	M8×1.25	36	19	6	12.5	16	14
BL 10D	55.5	25	46.3	M10×1.25	43	23	7	14.5	19	17
BL 10BD	55.5	25	52.3	M10×1.5	43	23	7	14.5	19	17
BL 12D	64.5	29	52.7	M12×1.25	50	26	8	17.5	22	19
BL 12BD	64.5	29	59.7	M12×1.75	50	26	8	17.5	22	19
BL 14D	74	34	68.4	M14×1.5	57	30	10	20	25	22
BL 14BD	74	34	74.4	M14×2	57	30	10	20	25	22
BL 16D	83	38	74	M16×1.5	64	34	11	22	27	24
BL 16BD	83	38	80	M16×2	64	34	11	22	27	24

[Material]

Holder : High strength zinc alloy (see A-926)
Ball shank : Lightly Carburized Carbon Steel Ball: 650 Hv or higher
Shank S35C (20 to 28 HRC)
Chromate treatment
Boot : NBR special synthetic rubber

[Spherical Clearance]

Perpendicular to the axis : 0.02 to 0.06mm
Axial direction : 0.3mm or less

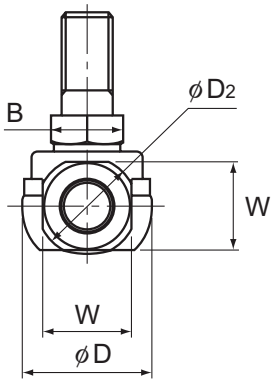
[Tolerance of the Mating Hole of the Ball Shank]

H10 is recommended.

Model number coding

BL6 D L

- BL6: Model number
- D: With boot attached
- L: Left-hand thread

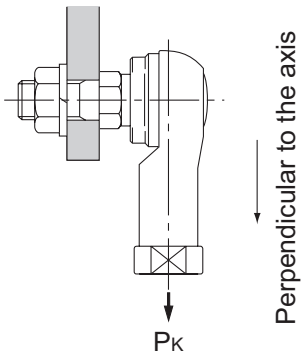


Unit: mm

	Ball shank dimensions						Ball diameter	Permissible tilt angles	Applied static load	Yield-point strength	Mass
	d_2 h9	M_1	M_2 ±0.3	ℓ_1	Hexagon B 0 −0.3	d_4	Da	2θ°	C_S N	P_k N	g
	6	26	11	11	10	11.6	11.112	40	9900	3920	26
	8	31	14	12	12	13.8	12.7	40	12500	6570	49
	10	37	17	15	14	16.2	15.875	40	18300	11300	87
	10	43	17	21	14	16.2	15.875	40	18300	11300	90
	12	42	19	17	17	19.6	19.05	40	26700	16400	143
	12	49	19	24	17	19.6	19.05	40	26700	16400	148
	14	56	21.5	22	19	21.9	22.225	40	36400	19800	235
	14	62	21.5	28	19	21.9	22.225	40	36400	19800	245
	16	60	23.5	23	22	25.4	22.225	30	36400	26900	315
	16	66	23.5	29	22	25.4	22.225	30	36400	26900	325

[Yield-Point Strength]

It indicates the strength in the direction shown in the figure below.



[Lubrication]

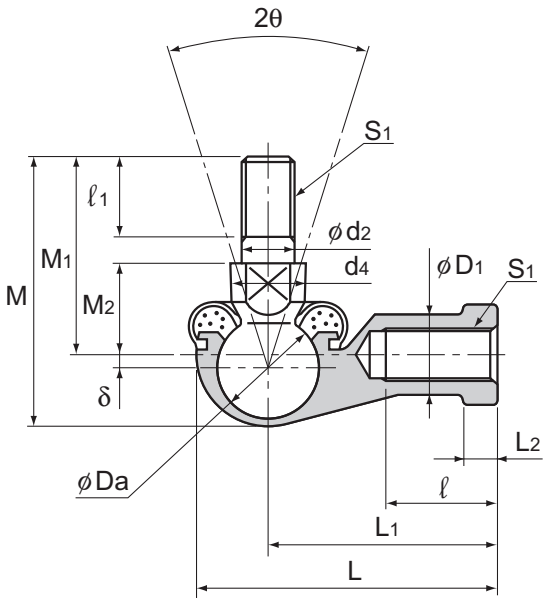
Lithium soap group grease No. 2 is contained in the boot and the cap.

[Identification of Left-hand Thread]

If the female threading is left-handed, its identification depends on the marking.

Threaded	Identification
	Cap marking
Right-hand	—
Left-hand	"L" mark

Model RBL



Model No.	Outer dimensions			Threaded	Holder dimensions					
	Length L	Diameter D	Height M	S_1 JIS Class 2	L_1	L_2	ℓ	D_1	D_2	W $^{0}_{-0.3}$
RBL 5D	35	16	29	M5×0.8	27	4	14	9	11	9
RBL 6D	40	19	35.5	M6×1	30	5	14	10	13	11
RBL 8D	48	23	42.5	M8×1.25	36	5	17	12.5	16	14
RBL 10D	57	27	50.5	M10×1.25	43	6.5	21	15	19	17
RBL 10BD	57	27	56.5	M10×1.5	43	6.5	21	15	19	17
RBL 12D	66	31	57.5	M12×1.25	50	6.5	25	17.5	22	19
RBL 12BD	66	31	64.5	M12×1.75	50	6.5	25	17.5	22	19
RBL 14D	75	35	73.5	M14×1.5	57	8	26	20	25	22
RBL 14BD	75	35	79.5	M14×2	57	8	26	20	25	22
RBL 16D	84	39	79.5	M16×1.5	64	8	32	22	27	22
RBL 16BD	84	39	85.5	M16×2	64	8	32	22	27	22
RBL 18D	93	44	90	M18×1.5	71	10	34	25	31	27
RBL 20D	99	44	90	M20×1.5	77	10	35	27.5	34	30
RBL 22D	109	50	95	M22×1.5	84	12	41	30	37	32

Note) The model numbers in dimmed type indicate semi-standard types. We recommend using model BL on B-836 .

[Material]

Holder : High strength zinc alloy (see A-926)
Ball shank : Lightly Carburized Carbon Steel Ball: 650 Hv or higher
Shank S35C
Chromate treatment
Boot : NBR special synthetic rubber

[Spherical Clearance]

Perpendicular to the axis : 0.02 to 0.06mm
Axial direction : 0.3mm or less

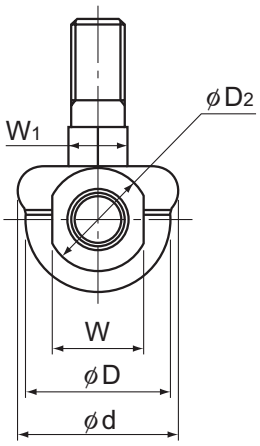
[Tolerance of the Mating Hole of the Ball Shank]

H10 is recommended.

Model number coding

RBL10 D L

Model number
With boot attached
Left-hand thread



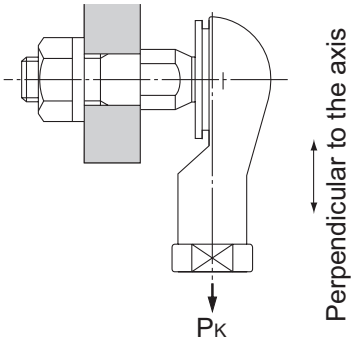
Unit: mm

	Ball shank dimensions						Boot	Eccen-tricity	Ball diameter	Permissible tilt angles	Applied static load	Yield-point strength	Mass
	d_2 h9	M_1	M_2 ±0.3	ℓ_1	W_1 0 −0.3	d_4	d	σ	Da	2θ°	C_s N	P_k N	g
	5	21	10	8	7	9	19	1	11.112	45	9220	2250	24
	6	26	11	11	8	10	20	1.2	12.7	45	12100	3530	37
	8	31	14	12	10	12	24	2	15.875	45	19100	6570	67
	10	37	17	15	11	14	30	2.5	19.05	45	27500	10700	110
	10	43	17	21	11	14	30	2.5	19.05	45	27500	10700	113
	12	42	19	17	17	19	32	2	22.225	45	37500	16400	165
	12	49	19	24	17	19	32	2	22.225	45	37500	16400	170
	14	56	21.5	22	17	19	38	2	25.4	45	48900	19800	255
	14	62	21.5	28	17	19	38	2	25.4	45	48900	19800	260
	16	60	23.5	23	19	22	44	2	25.4	35	48900	26900	335
	16	66	23.5	29	19	22	44	2	25.4	35	48900	26900	340
	18	68	26.5	25	20	23	48	4.5	28.575	35	61900	33300	465
	20	68	27	25	24	29	50	2	28.575	35	61900	45900	540
	22	70	28	26	24	27	54	5	31.75	27	75400	48000	715

Note) The permissible tilting angle of types without boot are greater by approximately 5°.

[Yield-Point Strength]

It indicates the strength in the direction shown in the figure below.



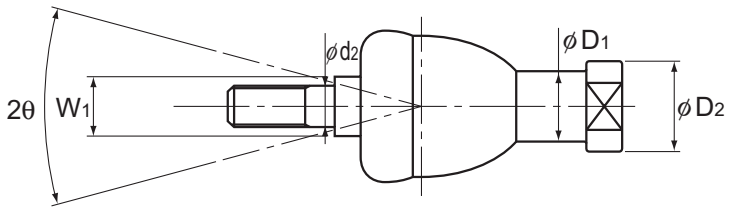
[Lubrication]

Lithium soap group grease No. 2 is contained in the boot.

[Identification of Left-hand Thread]

If the female threading is left-hand, symbol "L" is added. The actual product is marked with symbol "L" on the wrench flat.

Model RBI



Model No.	Outer dimensions		Threaded	Holder dimensions						Shaft diameter
	Length	Diameter	S_1	L_1	L_2	ℓ	D_1	D_2	W	d_2
	L	D	JIS Class 2						0 −0.3	h9
RBI 5D	46	17	M5×0.8	24	4	12	9	11	9	5
RBI 6D	55.2	20	M6×1	28	5	15	10	13	11	6
RBI 8D	65	24	M8×1.25	32	5	16	12.5	16	14	8
RBI 10D	74.5	28	M10×1.25	35	6.5	18	15	19	17	10
RBI 10BD	80.5	28	M10×1.5	35	6.5	18	15	19	17	10
RBI 12D	84	32	M12×1.25	40	6.5	20	17.5	22	19	12
RBI 12BD	91	32	M12×1.75	40	6.5	20	17.5	22	19	12
RBI 14D	103	36	M14×1.5	45	8	25	20	25	22	14
RBI 14BD	109	36	M14×2	45	8	25	20	25	22	14
RBI 16D	112	40	M16×1.5	50	8	27	22	27	22	16
RBI 16BD	118	40	M16×2	50	8	27	22	27	22	16
RBI 18D	130.5	45	M18×1.5	58	10	32	25	31	27	18
RBI 20D	133	45	M20×1.5	63	10	38	27.5	34	30	20
RBI 22D	145	50	M22×1.5	70	12	43	30	37	32	22

[Material]

Holder : High strength zinc alloy (see A-926)
Ball shank : Bearing steel ball Hardness: 650 Hv or higher
Shank S35C
Chromate treatment
Boot : NBR special synthetic rubber

[Spherical Clearance]

Perpendicular to the axis : 0.03mm or less
Axial direction : 0.1mm or less

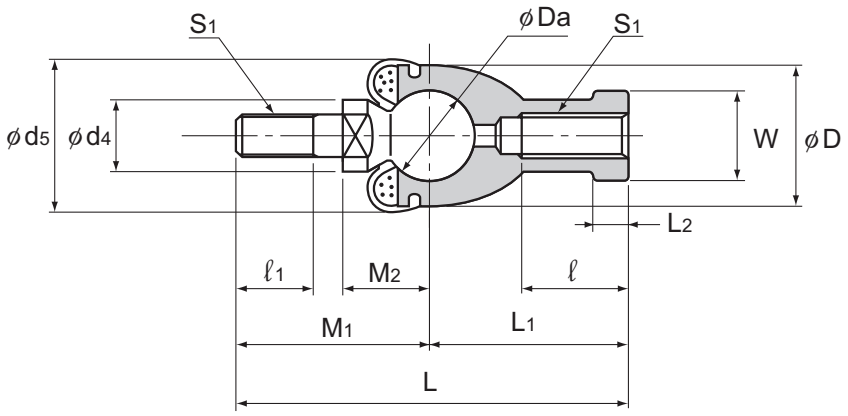
[Tolerance of the Mating Hole of the Ball Shank]

H10 is recommended.

Model number coding

RBI10 D L

- RBI10: Model number
- D: With boot attached
- L: Left-hand thread



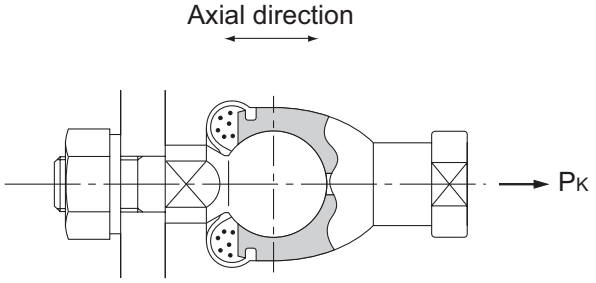
Unit: mm

	Ball shank dimensions					Boot	Ball diameter	Permissible tilt angles	Applied static load		Yield-point strength	Mass
	M_1	M_2 ±0.3	ℓ_1	W_1 0 −0.3	d_4	d_5	Da	2θ°	Tensile C_s N	Compressive C_s N	P_k N	g
	22	11	8	7	9	20	11.112	25	5690	11400	2840	25
	27.2	12.2	11	8	10	20	12.7	25	7450	14900	3730	40
	33	16	12	10	12	24	15.875	25	11700	23200	5880	75
	39.5	19.5	15	11	14	30	19.05	25	16800	33500	8430	120
	45.5	19.5	21	11	14	30	19.05	25	16800	33500	8430	123
	44	21	17	17	19	32	22.225	25	22800	45600	11400	185
	51	21	24	17	19	32	22.225	25	22800	45600	11400	190
	58	23.5	22	17	19	38	25.4	17	29800	59600	14900	275
	64	23.5	28	17	19	38	25.4	17	29800	59600	14900	280
	62	25.5	23	19	22	44	25.4	17	29800	59600	14900	360
	68	25.5	29	19	22	44	25.4	17	29800	59600	14900	370
	72.5	31	25	20	23	45	28.575	17	37700	75400	18900	535
	70	29	25	24	29	50	28.575	10	37700	75400	18900	570
	75	33	26	24	27	52	31.75	10	46600	93100	23500	755

Note) The permissible tilting angle of types without boot are greater by approximately 5°.

[Yield-Point Strength]

It indicates the strength in the direction shown in the figure below.



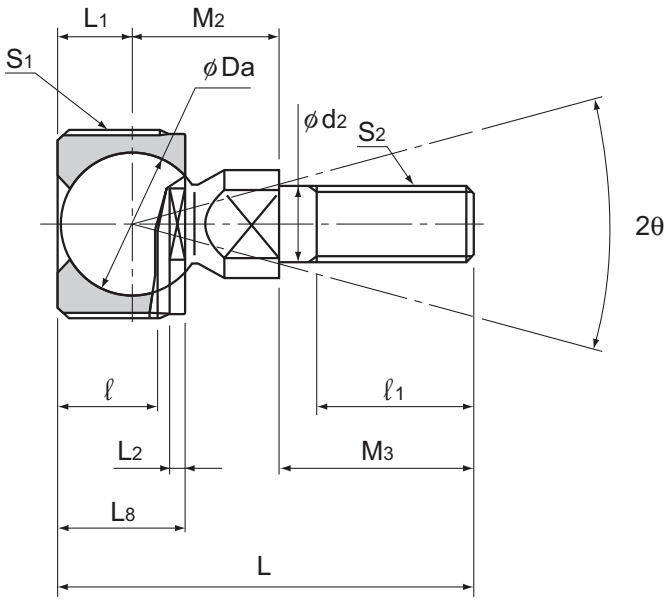
[Lubrication]

Lithium soap group grease No. 2 is contained in the boot.

[Identification of Left-hand Thread]

If the female threading is left-hand, symbol "L" is added.
The actual product is marked with symbol "L" on the holder.

Model TBS



Model No.	Outer dimensions		Holder dimensions					Shaft diameter	
	Threaded S_1 JIS Class 2	Length L	L_8	ℓ	L_1	L_2	W $^{0}_{-0.3}$	d_2 h9	Threaded S_2 JIS Class 2
TBS 6	M20×1.5	34.2	11.5	8	7	2	17	6	M6×1
TBS 8	M22×1.5	41.5	14.5	11	8.5	2	19	8	M8×1.25
TBS 10	M25×1.5	55.5	17	13.5	10	2	22	10	M10×1.5
TBS 12	M30×1.5	63	20	15.5	12	3	27	12	M12×1.75

[Material]

Holder : High strength zinc alloy (see A-926)
Ball shank : Bearing steel ball Hardness: 650 Hv or higher
Shank S35C
Chromate treatment

[Spherical Clearance]

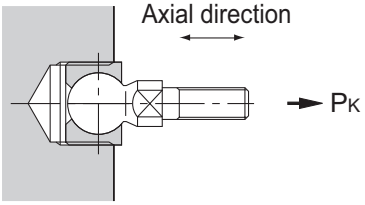
Perpendicular to the axis : 0.03mm or less
Axial direction : 0.1mm or less

[Female Threading for Attaching the Outer Ring]

JIS Class 2 thread

[Yield-Point Strength]

It indicates the strength in the direction shown in the Fig.1.



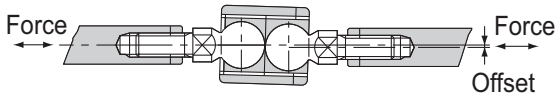
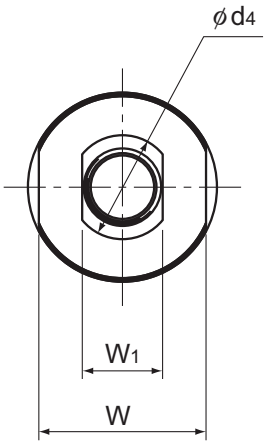


Fig.1



Unit: mm

	Ball shank dimensions					Ball diameter	Permissible tilt angles	Applied static load			Yield-point strength	Mass
								Perpendicular to the axis	Axial direction			
	d_4	M_2	M_3	ℓ_1	W_1 $^{0}_{-0.3}$	Da	2θ°	C_S N	C_{Sa} (Tensile) N	C_{Sa} (Compressive) N	P_k N	g
	10	12.2	15	11	8	12.7	30	13700	4900	12000	2450	30
	12	16	17	12	10	15.875	30	24600	10400	17600	5200	50
	14	19.5	26	21	11	19.05	30	32700	14400	25000	7250	80
	19	21	30	24	17	22.225	30	44000	18300	35000	9220	130

[Example of Installation]

As shown in the Fig.2 below, compared with the conventional installation using a frog-shaped joint, model TBS can be installed more compactly and more easily.

[Lubrication]

Since the holder has an oil pocket, it allows grease to be replenished as necessary.

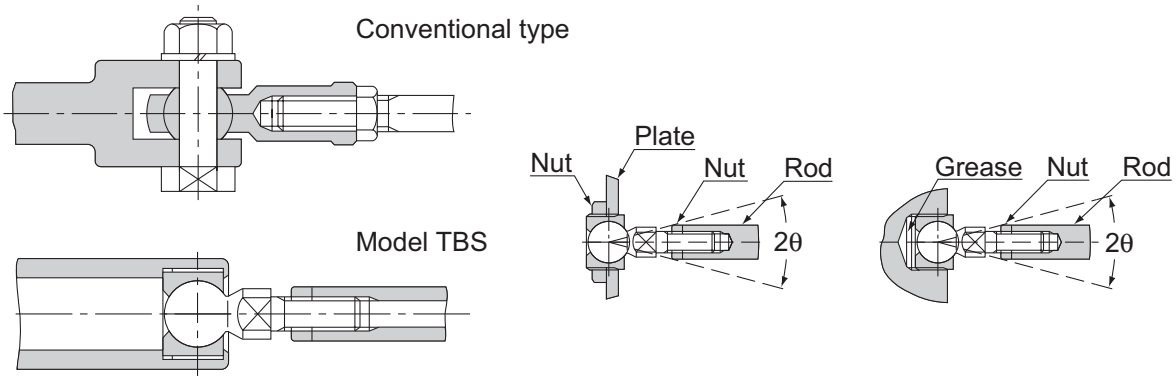


Fig.2

Rod End

THK General Catalog

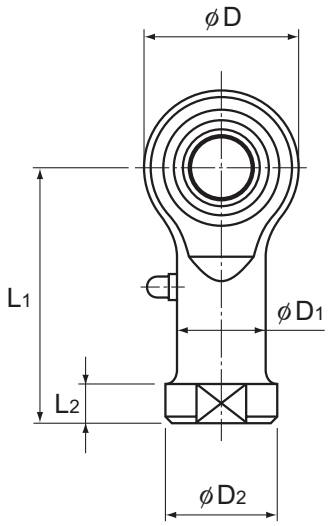
B Product Specifications

Dimensional Drawing, Dimensional Table

A Technical Descriptions of the Products (Separate)

* Please see the separate "A Technical Descriptions of the Products".

Model PHS (Female Threading Type)



Model No.	Outer dimensions			Threaded	Holder Dimensions			
	Length L	Diameter D	Width B_1 $^{0}_{-0.1}$	S_1 JIS Class 2	W $^{0}_{-0.2}$	D_1	D_2	B ±0.1
PHS 5	35	16	8	M5×0.8	9	9	11	6
PHS 6	39	18	9	M6×1	11	10	13	6.75
PHS 8	47	22	12	M8×1.25	14	12.5	16	9
PHS 10	56	26	14	M10×1.5	17	15	19	10.5
PHS 12	65	30	16	M12×1.75	19	17.5	22	12
PHS 14	74	34	19	M14×2	22	20	25	13.5
PHS 16	83	38	21	M16×2	22	22	27	15
PHS 18	92	42	23	M18×1.5	27	25	31	16.5
PHS 20	100	46	25	M20×1.5	30	27.5	34	18
PHS 22	109	50	28	M22×1.5	32	30	37	20
PHS 25	124	60	31	M24×2	36	33.5	42	22
PHS 30	145	70	37	M30×2	41	40	50	25

[Material]

Holder : S35C (Chromate treatment)
Spherical inner ring : SUJ2, 58 HRC or higher
(Hard chrome plated except for the inner surface of the inner ring)
Bush : Special copper alloy

[Fitting with the Shaft]

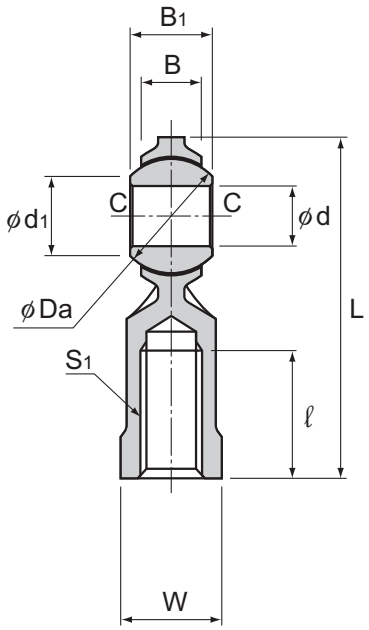
Condition	Dimensional tolerance of the shaft
Normal load	h7
Indeterminate load	p6

Model number coding

PHS10 L

Model number

Left-hand thread



Unit: mm

	L1	L2	ℓ	Grease nipple	Spherical inner ring dimensions d H7	Ball diameter Da mm (inch)	d1	C	Permissible tilt angles α1°	α2°	α3°	Static applied load Radial Cs N	Mass g
	27	4	14	PB107	5	11.112(7/16)	7.7	0.3	8	13	30	5590	16.5
	30	5	14		6	12.7(1/2)	9	0.3	8	13	30	6860	25
	36	5	17		8	15.875(5/8)	10.4	0.5	8	14	25	9800	43
	43	6.5	21		10	19.05(3/4)	12.9	0.5	8	14	25	13200	72
	50	6.5	24		12	22.225(7/8)	15.4	0.5	8	13	25	16700	107
	57	8	27		14	25.4(1)	16.9	0.7	10	16	24	20600	160
	64	8	33		16	28.575(1 1/8)	19.4	0.7	9	15	24	25000	210
	71	10	36		18	31.75(1 1/4)	21.9	0.7	9	15	24	29400	295
	77	10	40		20	34.925(1 3/8)	24.4	0.7	9	15	24	34300	380
	84	12	43		22	38.1(1 1/2)	25.8	0.7	10	15	23	41200	490
	94	12	48	A-M6F	25	42.862(1 11/16)	29.6	0.8	9	15	23	72500	750
	110	15	56		30	50.8(2)	34.8	0.8	10	17	23	92200	1130

[Clearance]

Unit: mm

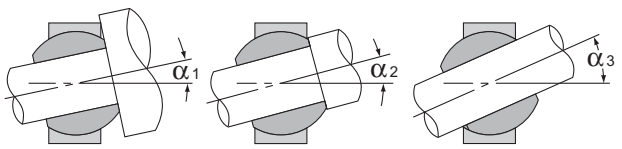
Radial clearance	0.035 or less
Axial clearance	0.1 or less

[Lubrication]

Apply lubricant before using the product. The holder has a greasing hole and an oil groove; they allow grease to be replenished through the grease nipple as necessary.

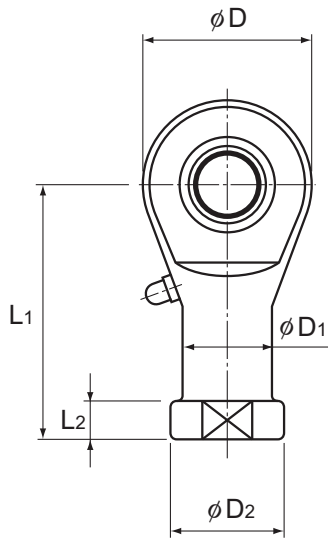
[Identification of Left-hand Thread]

If the female threading is left-hand, symbol "L" is added.
The actual product is marked with symbol "L" on the holder.



Permissible Tilt Angles

Model RBH (Die Cast, Low Price Type)



Model No.	Outer dimensions			Threaded	Holder Dimensions			
	Length L	Diameter D	Width B_1 $^{0}_{-0.1}$	S_1 JIS Class 2	W $^{0}_{-0.3}$	D_1	D_2	B
RBH 5	35.5	17	8	M5×0.8	9	9	11	6
RBH 6	39.7	19.5	9	M6×1	11	10	13	6.75
RBH 8	48	24	12	M8×1.25	14	12.5	16	9
RBH 10	57	28	14	M10×1.5	17	15	19	10.5
RBH 12	66	32	16	M12×1.75	19	17.5	22	12
RBH 14	75	36	19	M14×2	22	20	25	13.5
RBH 16	84	40	21	M16×2	22	22	27	15
RBH 18	93.5	45	23	M18×1.5	27	25	31	16.5
RBH 20	101.5	49	25	M20×1.5	30	27.5	34	18
RBH 22	111	54	28	M22×1.5	32	30	37	20

[Material]

Holder : High strength zinc alloy (see A-942)
Spherical inner ring : SUJ2, 58 HRC or higher
(Hard chrome plated except for the inner surface of the inner ring)

[Fitting with the Shaft]

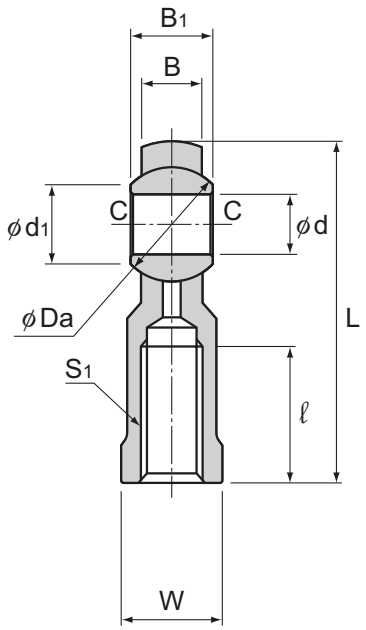
Condition	Dimensional tolerance of the shaft
Normal load	h7
Indeterminate load	p6

Model number coding

RBH10 L

Model number

Left-hand thread



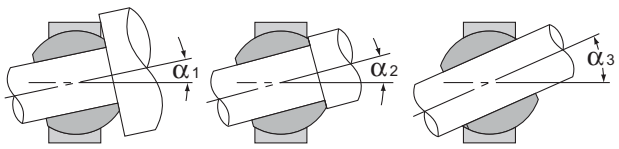
Unit: mm

					Spherical inner ring dimensions				Permissible tilt angles			Static applied load Radial	Mass
	L_1	L_2	ℓ	Grease nipple	d H7	Ball diameter Da mm (inch)	d_1	C	$\alpha_1°$	$\alpha_2°$	$\alpha_3°$	C_s N	g
	27	4	16	PB107	5	11.112(7/16)	7.7	0.3	8	13	30	5490	16
	30	5	16		6	12.7(1/2)	9	0.3	8	13	30	6760	21
	36	5	19		8	15.875(5/8)	10.4	0.5	8	14	25	9610	43
	43	6.5	23		10	19.05(3/4)	12.9	0.5	8	14	25	13000	68
	50	6.5	27		12	22.225(7/8)	15.4	0.5	8	13	25	16400	100
	57	8	30		14	25.4(1)	16.9	0.7	10	16	24	20200	142
	64	8	36		16	28.575(1 1/8)	19.4	0.7	9	15	24	24600	185
	71	10	40		18	31.75(1 1/4)	21.9	0.7	9	15	24	28800	265
	77	10	43		20	34.925(1 3/8)	24.4	0.7	9	15	24	33600	334
	84	12	47		22	38.1(1 1/2)	25.8	0.7	10	15	23	40400	454

[Clearance]

Unit: mm

Radial clearance	0.03 or less
Axial clearance	0.1 or less



Permissible Tilt Angles

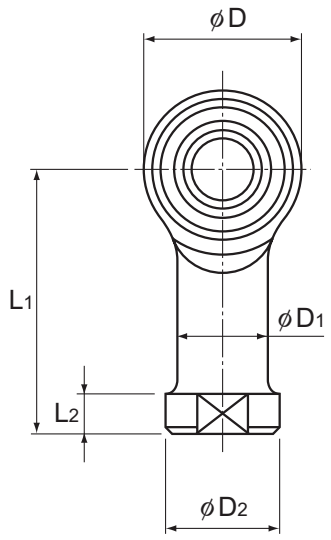
[Lubrication]

Apply lubricant before using the product. The holder has a greasing hole and an oil groove; they allow grease to be replenished through the grease nipple as necessary.

[Identification of Left-hand Thread]

If the female threading is left-hand, symbol "L" is added.
The actual product is marked with symbol "L" on the holder.

Model NHS-T (No Lubrication Type)



Model No.	Outer dimensions			Threaded	Holder Dimensions			
	Length L	Diameter D	Width B_1 $^{0}_{-0.1}$	S_1 JIS Class 2	W $^{0}_{-0.2}$	D_1	D_2	B $^{+0.1}_{-0.4}$
NHS 3T	27	12	6	M3×0.5	7	6.5	8	4.5
NHS 4T	31	14	7	M4×0.7	8	8	9.5	5.3
NHS 5T	35	16	8	M5×0.8	9	9	11	6
NHS 6T	39	18	9	M6×1	11	10	13	6.75
NHS 8T	47	22	12	M8×1.25	14	12.5	16	9
NHS 10T	56	26	14	M10×1.5	17	15	19	10.5
NHS 12T	65	30	16	M12×1.75	19	17.5	22	12
NHS 14T	74	34	19	M14×2	22	20	25	13.5
NHS 16T	83	38	21	M16×2	22	22	27	15
NHS 18T	92	42	23	M18×1.5	27	25	31	16.5
NHS 20T	100	46	25	M20×1.5	30	27.5	34	18
NHS 22T	109	50	28	M22×1.5	32	30	37	20

[Material]

Holder : S35C (Chromate treatment)
For NHS3T and NHS4T, S20C
Spherical inner ring : SUJ2, 58 HRC or higher
(Hard chrome plated except for the inner surface of the inner ring)
Bush : Self-lubricating synthetic resin

[Fitting with the Shaft]

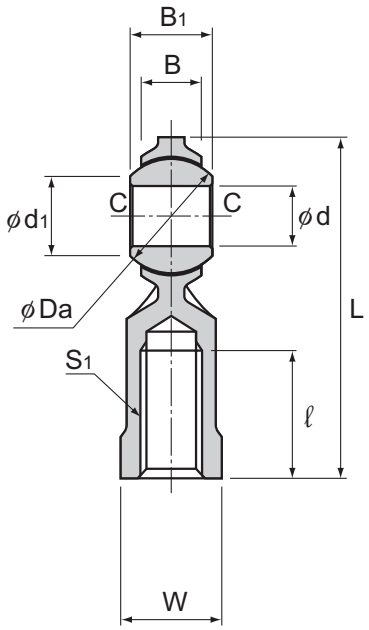
Condition	Dimensional tolerance of the shaft
Normal load	h7
Indeterminate load	p6

Model number coding

NHS10T L

Model number

Left-hand thread



Unit: mm

				Spherical inner ring dimensions				Permissible tilt angles			Static applied load Radial	Mass
	L_1	L_2	ℓ	d H7	Ball diameter Da mm (inch)	d_1	C	$\alpha_1°$	$\alpha_2°$	$\alpha_3°$	C_S N	g
	21	3	10	3	9.525(3/8)	7.4	0.3	8	10	42	1570	6.5
	24	4	12	4	10.319(13/32)	7.6	0.3	9	11	35	2250	10
	27	4	14	5	11.112(7/16)	7.7	0.3	8	13	30	3920	16.5
	30	5	14	6	12.7(1/2)	9	0.3	8	13	30	5000	25
	36	5	17	8	15.875(5/8)	10.4	0.5	8	14	25	7450	43
	43	6.5	21	10	19.05(3/4)	12.9	0.5	8	14	25	9410	72
	50	6.5	24	12	22.225(7/8)	15.4	0.5	8	13	25	11000	107
	57	8	27	14	25.4(1)	16.9	0.7	10	16	24	15200	160
	64	8	33	16	28.575(1 1/8)	19.4	0.7	9	15	24	20200	210
	71	10	36	18	31.75(1 1/4)	21.9	0.7	9	15	24	25200	295
	77	10	40	20	34.925(1 3/8)	24.4	0.7	9	15	24	27800	380
	84	12	43	22	38.1(1 1/2)	25.8	0.7	10	15	23	35900	490

[Clearance]

Unit: mm

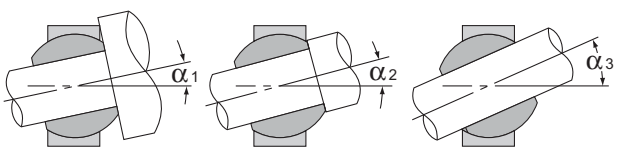
Radial clearance	0.035 or less
Axial clearance	0.1 or less

[Initial Lubrication]

This model can be used without lubrication. However, if desiring to provide initial lubrication, apply oil or grease to the spherical area.

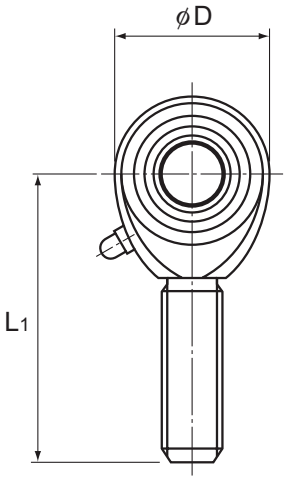
[Identification of Left-hand Thread]

If the female threading is left-hand, symbol "L" is added.
The actual product is marked with symbol "L" on the holder.



Permissible Tilt Angles

Model POS (Male Thread Type)



Model No.	Outer dimensions			Threaded	Holder Dimensions	
	Length L	Diameter D	Width B_1 $^{0}_{-0.1}$	S_1 JIS Class 2	B ±0.1	L_1
POS 5	41	16	8	M5×0.8	6	33
POS 6	45	18	9	M6×1	6.75	36
POS 8	53	22	12	M8×1.25	9	42
POS 10	61	26	14	M10×1.5	10.5	48
POS 12	69	30	16	M12×1.75	12	54
POS 14	77	34	19	M14×2	13.5	60
POS 16	85	38	21	M16×2	15	66
POS 18	93	42	23	M18×1.5	16.5	72
POS 20	101	46	25	M20×1.5	18	78
POS 22	109	50	28	M22×1.5	20	84
POS 25	124	60	31	M24×2	22	94
POS 30	145	70	37	M30×2	25	110

[Material]

Holder : S35C (Chromate treatment)
Spherical inner ring : SUJ2, 58 HRC or higher
(Hard chrome plated except for the inner surface of the inner ring)
Bush : Special copper alloy

[Fitting with the Shaft]

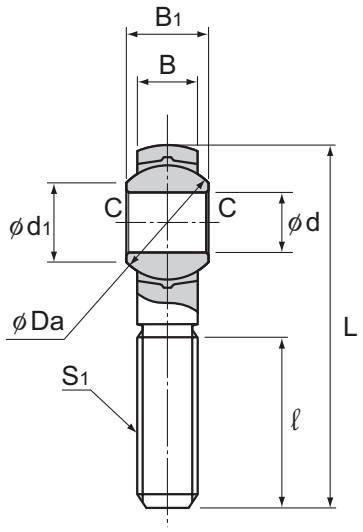
Condition	Dimensional tolerance of the shaft
Normal load	h7
Indeterminate load	p6

Model number coding

POS10 L

Model number

Left-hand thread



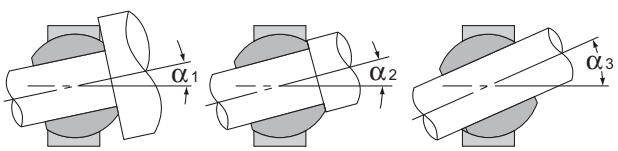
Unit: mm

	ℓ	Grease nipple	Spherical inner ring dimensions d H7	Ball diameter Da mm (inch)	d1	C	Permissible tilt angles α1°	α2°	α3°	Static applied load Radial Cs N	Mass g
	20	—	5	11.112(7/16)	7.7	0.3	8	13	30	3430	12.5
	22		6	12.7(1/2)	9	0.3	8	13	30	4900	19
	25	PB107	8	15.875(5/8)	10.4	0.5	8	14	25	6860	32
	29		10	19.05(3/4)	12.9	0.5	8	14	25	10800	54
	33		12	22.225(7/8)	15.4	0.5	8	13	25	16700	85
	36		14	25.4(1)	16.9	0.7	10	16	24	20600	126
	40		16	28.575(1 1/8)	19.4	0.7	9	15	24	25000	185
	44		18	31.75(1 1/4)	21.9	0.7	9	15	24	29400	260
	47		20	34.925(1 3/8)	24.4	0.7	9	15	24	34300	340
	51		22	38.1(1 1/2)	25.8	0.7	10	15	23	41200	435
	57	A-M6F	25	42.862(1 11/16)	29.6	0.8	9	15	23	72500	650
	66		30	50.8(2)	34.8	0.8	10	17	23	92200	1070

[Clearance]

Unit: mm

Radial clearance	0.035 or less
Axial clearance	0.1 or less



Permissible Tilt Angles

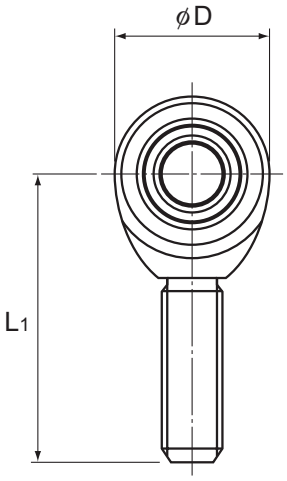
[Lubrication]

Apply lubricant before using the product. The holder has a greasing hole and an oil groove; they allow grease to be replenished through the grease nipple as necessary. To lubricate the product, replenish grease from the holder greasing hole for models POS5 and 6, or from the grease nipple for other models.

[Identification of Left-hand Thread]

If the male thread is left-hand, symbol "L" is added.
The actual product is marked with symbol "L" on the holder.

Model NOS-T (No Lubrication, Male Thread Type)



Model No.	Outer dimensions			Threaded	Holder Dimensions	
	Length L	Diameter D	Width B_1 $^{0}_{-0.1}$	S_1 JIS Class 2	B $^{+0.1}_{-0.4}$	L_1
NOS 3 T	33	12	6	M3×0.5	4.5	27
NOS 4 T	37	14	7	M4×0.7	5.3	30
NOS 5 T	41	16	8	M5×0.8	6	33
NOS 6 T	45	18	9	M6×1	6.75	36
NOS 8 T	53	22	12	M8×1.25	9	42
NOS 10 T	61	26	14	M10×1.5	10.5	48
NOS 12 T	69	30	16	M12×1.75	12	54
NOS 14 T	77	34	19	M14×2	13.5	60
NOS 16 T	85	38	21	M16×2	15	66
NOS 18 T	93	42	23	M18×1.5	16.5	72
NOS 20 T	101	46	25	M20×1.5	18	78
NOS 22 T	109	50	28	M22×1.5	20	84

[Material]

Holder : S35C (Chromate treatment)
For NOS3T and NOS4T, S20C
Spherical inner ring : SUJ2, 58 HRC or higher
(Hard chrome plated except for the inner surface of the inner ring)
Bush : Self-lubricating synthetic resin

[Fitting with the Shaft]

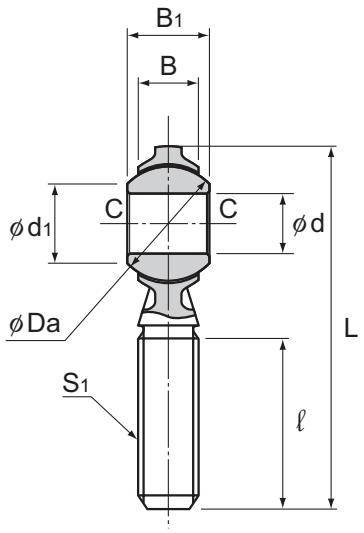
Condition	Dimensional tolerance of the shaft
Normal load	h7
Indeterminate load	p6

Model number coding

NOS10T L

Model number

Left-hand thread



Unit: mm

	Spherical inner ring dimensions				Permissible tilt angles			Static applied load Radial	Mass
	ℓ	d H7	Ball diameter Da mm (inch)	d_1	C	α_1°	α_2°	α_3°	C_s N	g
	15	3	9.525(3/8)	7.4	0.3	8	10	42	1570	4.5
	17	4	10.319(13/32)	7.6	0.3	9	11	35	2250	7
	20	5	11.112(7/16)	7.7	0.3	8	13	30	3430	12.5
	22	6	12.7(1/2)	9	0.3	8	13	30	4900	19
	25	8	15.875(5/8)	10.4	0.5	8	14	25	6860	32
	29	10	19.05(3/4)	12.9	0.5	8	14	25	9410	54
	33	12	22.225(7/8)	15.4	0.5	8	13	25	11000	85
	36	14	25.4(1)	16.9	0.7	10	16	24	15200	126
	40	16	28.575(1 1/8)	19.4	0.7	9	15	24	20200	185
	44	18	31.75(1 1/4)	21.9	0.7	9	15	24	25200	260
	47	20	34.925(1 3/8)	24.4	0.7	9	15	24	27800	340
	51	22	38.1(1 1/2)	25.8	0.7	10	15	23	35900	435

[Clearance]

Unit: mm

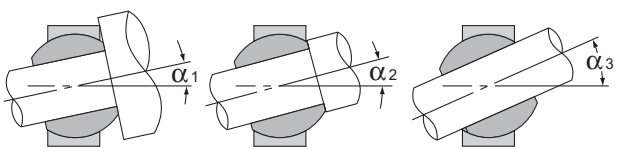
Radial clearance	0.035 or less
Axial clearance	0.1 or less

[Initial Lubrication]

This model can be used without lubrication. However, if desiring to provide initial lubrication, apply oil or grease to the spherical area.

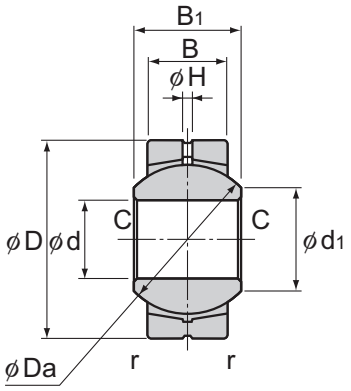
[Identification of Left-hand Thread]

If the male thread is left-hand, symbol "L" is added.



Permissible Tilt Angles

Model PB (Standard Type)



Unit: mm

Model No.	Main dimensions							Ball diameter	Permissible tilt angles			Static applied load Radial	Mass
	Inner diameter d H7	Outer diameter D h6	Outer ring width B ±0.1	Inner ring width B_1 $^{0}_{-0.1}$	d_1	H	C, r	Da mm (inch)	α_1°	α_2°	α_3°	C_S N	g
PB 5	5	16	6	8	7.7	1	0.3	11.112(7/16)	8	13	30	7840	8.5
PB 6	6	18	6.75	9	9	1	0.3	12.7(1/2)	8	13	30	9800	13
PB 8	8	22	9	12	10.4	1	0.5	15.875(5/8)	8	14	25	16700	24
PB 10	10	26	10.5	14	12.9	1.2	0.5	19.05(3/4)	8	14	25	23500	39
PB 12	12	30	12	16	15.4	1.5	0.5	22.225(7/8)	8	13	25	31400	58
PB 14	14	34	13.5	19	16.9	1.5	0.7	25.4(1)	10	16	24	40200	84
PB 16	16	38	15	21	19.4	2.5	0.7	28.575(1 1/8)	9	15	24	50000	111
PB 18	18	42	16.5	23	21.9	2.5	0.7	31.75(1 1/4)	9	15	24	61800	160
PB 20	20	46	18	25	24.4	2.5	0.7	34.925(1 3/8)	9	15	24	73500	210
PB 22	22	50	20	28	25.8	2.5	0.7	38.1(1 1/2)	10	15	23	88200	265
PB 25	25	56	22	31	29.6	3	0.8	42.862(1 11/16)	9	15	23	111000	390
PB 30	30	66	25	37	34.8	3	0.8	50.8(2)	10	17	23	148000	610

[Material]

Outer ring : S35C
Spherical inner ring : SUJ2, 58 HRC or higher
(Hard chrome plated except for the inner surface of the inner ring)
Bush : Special copper alloy

[Fitting with the Shaft]

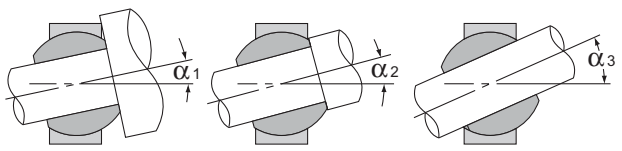
For the fitting between the shaft and the housing, the following values are recommended.

Condition		Shaft	Housing
Inner ring rotational load	Normal load	m6	H7
	Indeterminate load	n6	
Outer ring rotational load	Normal load	h7	M7
	Indeterminate load	k6	

[Clearance]

Unit: mm

Radial clearance	0.035 or less
Axial clearance	0.1 or less

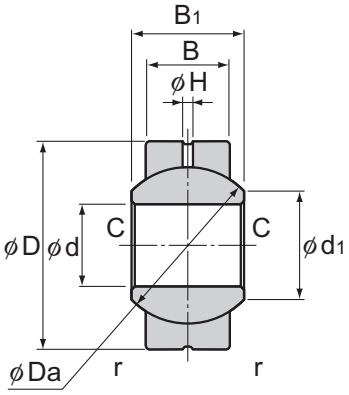


Permissible Tilt Angles

[Lubrication]

Apply lubricant before using the product.
The holder has a greasing hole and an oil groove; they allow grease to be replenished through the grease nipple as necessary.

Model PBA (Die Cast Type)



Unit: mm

Model No.	Main dimensions							Ball diameter	Permissible tilt angles			Static applied load Radial	Mass
	Inner diameter d H7	Outer diameter D h8	Outer ring width B ±0.1	Inner ring width B_1 $^{0}_{-0.1}$	d_1	H	C, r	Da mm (inch)	α_1°	α_2°	α_3°	C_s N	g
PBA 5	5	16	6	8	7.7	1	0.3	11.112(7/16)	8	13	30	7840	8.5
PBA 6	6	18	6.75	9	9	1	0.3	12.7(1/2)	8	13	30	9800	13
PBA 8	8	22	9	12	10.4	1	0.5	15.875(5/8)	8	14	25	16700	24
PBA 10	10	26	10.5	14	12.9	1.2	0.5	19.05(3/4)	8	14	25	23500	39
PBA 12	12	30	12	16	15.4	1.5	0.5	22.225(7/8)	8	13	25	31400	58
PBA 14	14	34	13.5	19	16.9	1.5	0.7	25.4(1)	10	16	24	40200	84
PBA 16	16	38	15	21	19.4	2.5	0.7	28.575(1 1/8)	9	15	24	50000	111
PBA 18	18	42	16.5	23	21.9	2.5	0.7	31.75(1 1/4)	9	15	24	61800	160
PBA 20	20	46	18	25	24.4	2.5	0.7	34.925(1 3/8)	9	15	24	73500	210
PBA 22	22	50	20	28	25.8	2.5	0.7	38.1(1 1/2)	10	15	23	88200	265

[Material]

Outer ring : High strength zinc alloy (see A-942)
Spherical inner ring : SUJ2, 58 HRC or higher
(Hard chrome plated except for the inner surface of the inner ring)

[Fitting with the Shaft]

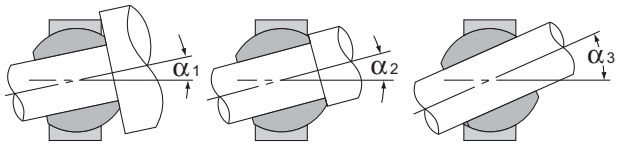
For the fitting between the shaft and the housing, the following values are recommended.

Condition		Shaft	Housing
Inner ring rotational load	Normal load	m6	H7
	Indeterminate load	n6	
Outer ring rotational load	Normal load	h7	M7
	Indeterminate load	k6	

[Clearance]

Unit: mm

Radial clearance	0.035 or less
Axial clearance	0.1 or less

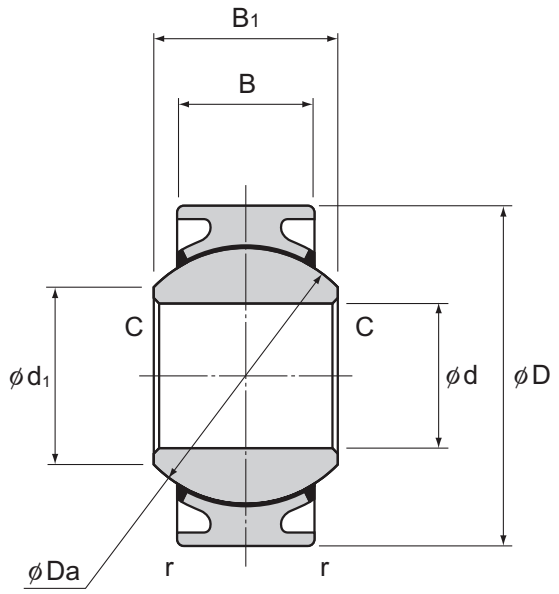


Permissible Tilt Angles

[Lubrication]

Apply lubricant before using the product.
The holder has a greasing hole and an oil groove; they allow grease to be replenished through the grease nipple as necessary.

Model NB-T (No Lubrication Type)



Unit: mm

Model No.	Outer dimensions						Ball diameter	Permissible tilt angles			Static applied load Radial	Mass
	Inner diameter d H7	Outer diameter D h7	Outer ring width B ±0.1	Inner ring width B_1 $^{0}_{-0.1}$	d_1	C, r	Da mm (inch)	α_1°	α_2°	α_3°	C_s N	g
NB 14T	14	34	13.5	19	16.9	0.7	25.4(1)	10	16	24	20200	84
NB 16T	16	38	15	21	19.4	0.7	28.575(1 1/8)	9	15	24	25200	111
NB 18T	18	42	16.5	23	21.9	0.7	31.75(1 1/4)	9	15	24	30800	160
NB 20T	20	46	18	25	24.4	0.7	34.925(1 3/8)	9	15	24	36900	210
NB 22T	22	50	20	28	25.8	0.7	38.1(1 1/2)	10	15	23	44800	265

[Material]

Outer ring : S35C
Spherical inner ring : SUJ2, 58 HRC or higher
(Hard chrome plated except for the inner surface of the inner ring)
Bush : Self-lubricating synthetic resin

[Fitting with the Shaft]

For the fitting between the shaft and the housing, the following values are recommended.

Condition		Shaft	Housing
Inner ring rotational load	Normal load	m6	H7
	Indeterminate load	n6	
Outer ring rotational load	Normal load	h7	M7
	Indeterminate load	k6	

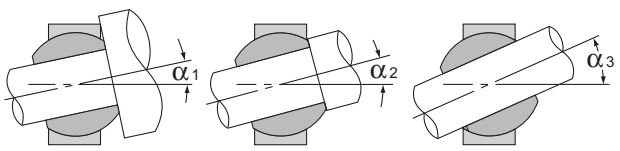
[Clearance]

Unit: mm

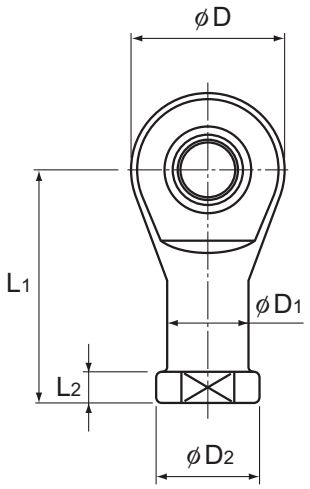
Radial clearance	0.035 or less
Axial clearance	0.1 or less

[Initial Lubrication]

This model can be used without lubrication. However, if desiring to provide initial lubrication, apply oil or grease to the spherical area.



Permissible Tilt Angles



Model No.	Outer dimensions			Threaded	Holder Dimensions					
	Length L	Diameter D	Width B_1 $^{0}_{-0.1}$	S_1 JIS Class 2	W $^{0}_{-0.3}$	D_1	D_2	B	L_1	L_2
HS 5	35.5	17	8	M5×0.8	9	9	11	6	27	4
HS 6	39.7	19.5	9	M6×1	11	10	13	6.75	30	5
HS 8	48	24	12	M8×1.25	14	12.5	16	9	36	5
HS 10	57	28	14	M10×1.5	17	15	19	10.5	43	6.5
HS 12	66	32	16	M12×1.75	19	17.5	22	12	50	6.5

[Material]

Holder : Aluminum alloy
Spherical inner ring : SUJ2, 600 Hv or higher (corrosion resistant coated)
Bush : Special fluorine resin with fiber

[Fitting with the Shaft]

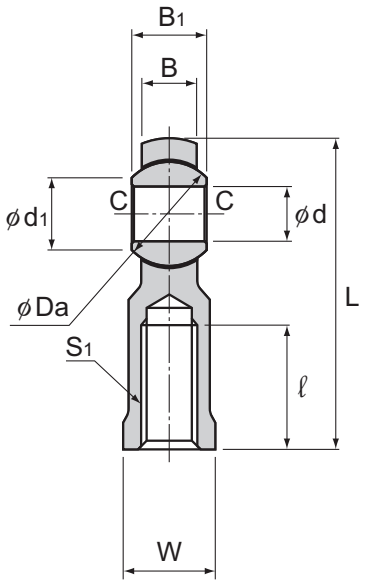
Condition	Dimensional tolerance of the shaft
Normal load	h7
Indeterminate load	n6, p6

Model number coding

HS10 L

Model number

Left-hand thread



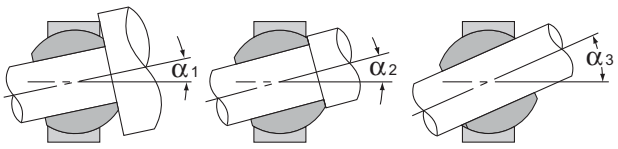
Unit: mm

		Spherical inner ring dimensions				Permissible tilt angles			Static applied load Radial	Yield-point strength	Mass
	ℓ	d G7	Ball diameter Da mm (inch)	d_1	C	α_1°	α_2°	α_3°	C_s N	P_K N	g
	16	5	11.112(7/16)	7.7	0.3	7	13	30	5590	3920	9
	16	6	12.7(1/2)	9	0.3	7	13	30	6860	5290	15
	19	8	15.875(5/8)	10.4	0.5	8	14	25	9800	8330	26
	23	10	19.05(3/4)	12.9	0.5	8	14	25	13200	10800	41
	27	12	22.225(7/8)	15.4	0.5	8	13	25	16700	14700	60

[Clearance]

Unit: mm

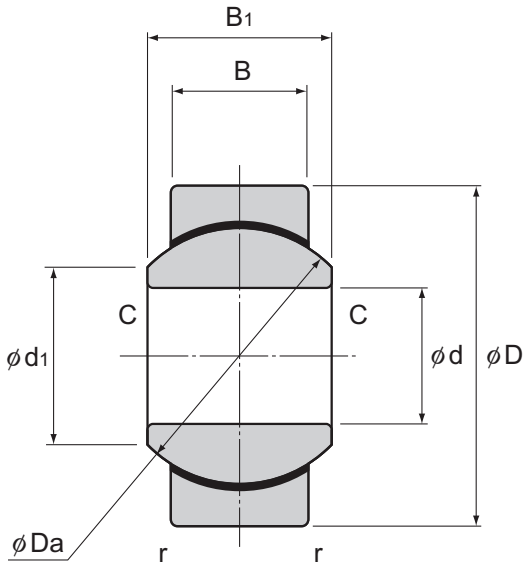
Radial clearance	0.03 or less
Axial clearance	0.1 or less



Permissible Tilt Angles

[Identification of Left-hand Thread]

If the female threading is left-hand, symbol "L" is added.
The actual product is marked with symbol "L" on the holder.



Unit: mm

Model No.	Outer dimensions						Ball diameter	Permissible tilt angles			Static applied load Radial	Mass
	Inner diameter d G7	Outer diameter D h7	Outer ring width B ±0.1	Inner ring width B_1 $^{0}_{-0.1}$	d_1	C, r	Da mm (inch)	α_1°	α_2°	α_3°	C_s N	g
HB 5	5	16	6	8	7.7	0.3	11.112(7/16)	7	13	30	13100	8.5
HB 6	6	18	6.75	9	9	0.3	12.7(1/2)	7	13	30	16900	13
HB 8	8	22	9	12	10.4	0.5	15.875(5/8)	8	14	25	28000	24
HB 10	10	26	10.5	14	12.9	0.5	19.05(3/4)	8	14	25	39200	39
HB 12	12	30	12	16	15.4	0.5	22.225(7/8)	8	13	25	52500	58

[Material]

Outer ring : Zinc alloy
Spherical inner ring : SUJ2, 600 Hv or higher (corrosion resistant coated)
Bush : Special fluorine resin with fiber

[Fitting with the Shaft]

For the fitting between the shaft and the housing, the following values are recommended.

Condition		Shaft	Housing
Inner ring rotational load	Normal load	m6	H7
	Indeterminate load	n6	
Outer ring rotational load	Normal load	h7	M7
	Indeterminate load	k6	

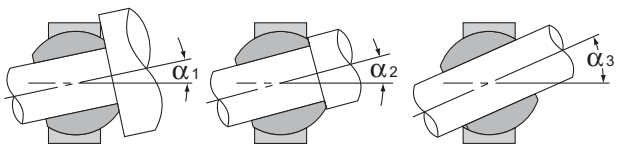
[Clearance]

Unit: mm

Radial clearance	0.03 or less
Axial clearance	0.1 or less

[Initial Lubrication]

This model can be used without lubrication. However, if desiring to provide initial lubrication, apply oil or grease to the spherical area.



Permissible Tilt Angles