SPHERICAL BUSHINGS

●Steel-on-steel Spherical Bushings
●Maintenance-free Spherical Bushings

Structure and Features

IKO Spherical Bushings are self-aligning spherical plain bushings that have inner and outer rings with spherical sliding surfaces, and can take a large radial load and a bi-directional axial load at the same time. There are many types of Spherical Bushings, but they are basically divided into steel-on-steel types and maintenance-free types according to the kind of sliding surfaces.

Steel-on-steel Spherical Bushings have inner and outer rings of high carbon chromium bearing steel, of which sliding surfaces are phosphate-treated and then dry-coated with molybdenum disulfide (MoS_2). They can, therefore, operate with low torque, and have excellent wear resistance and large load capacity. They are especially suitable for applications where there are alternate loads and shock loads. They have wide applications mainly in industrial and construction machinery.

Maintenance-free Spherical Bushings consist of an outer ring which has a special PTFE liner reinforced with copper alloy meshes on the sliding surface, and a spherical inner ring of which sliding surface has a hard chromium plating. Creep deformation due to compressive load is small, and wear resistance is superior. Thus, they are maintenance-free and can be used for extended periods of time without re-lubrication. They are especially suitable in cases where fixed directional loads are applied and are used mainly in food processing machines and construction machinery and in other applications in which the use of oil is undesirable or lubrication is not possible.

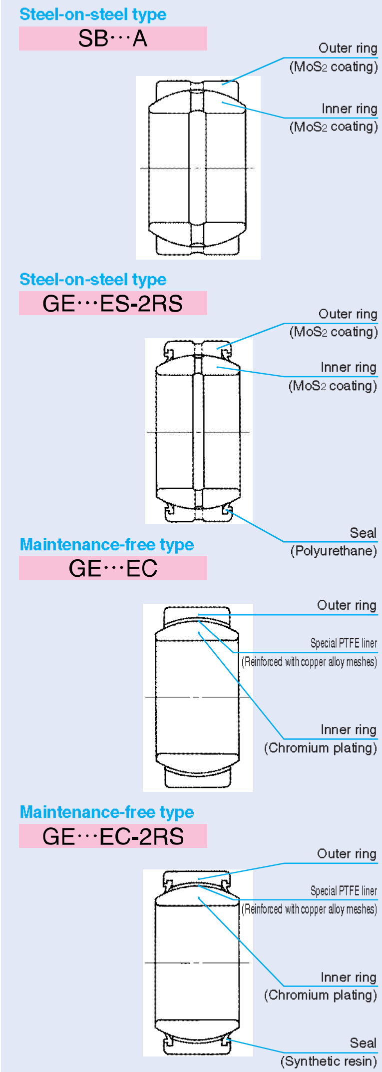
Types

Spherical Bushings are available in various types shown in Table 1.

Table 1 Type of bearing

Series \ Type	Steel-on-steel		Maintenance-free	
	Without seals	With seals	Without seals	With seals
Metric	SB	—	GE…EC	GE…EC-2RS
	SB…A	—		
	GE…E, ES	GE…ES-2RS		
	GE…G, GS	GE…GS-2RS		
Inch	SBB	SBB… -2RS	—	—

Structures of Spherical Bushings



K
SB
GE
SBB

Steel-on-steel Spherical Bushings SB

These bushings have an outer ring split into halves. The split outer ring and the inner ring are held together by a snap ring placed in the groove around the outer periphery of the outer ring.

Steel-on-steel Spherical Bushings SB…A

These bushings have an outer ring split only at one position, and therefore, the outer and inner rings will not separate. Handling before mounting and mounting to the housing are simple. The boundary dimensions are the same as those of the SB type.Therefore, SB and SB…A types are dimensionally interchangeable, but the radial internal clearances of the SB…A type are smaller than those of the SB type.

Steel-on-steel Spherical Bushings GE…E,GE…ES

The dimension series of these types conform to ISO standards and they can be used internationally. The outer ring is split at one position. The GE…E and GE…ES types are available. These are classified by bushing size.
The GE…ES type can be provided with seals, which are double-lip type polyurethane seals effective for prevention against grease leakage and dust penetration. The sealed type is indicated by the suffix "-2RS" at the end of the identification number.

Steel-on-steel Spherical Bushings GE…G,GE…GS

As compared with the GE…E and GE…ES types, these bushings have larger load capacities and larger permissible tilting angles. The dimension series also conform to ISO standards, and they can be used internationally. The outer ring is split at one position. The GE…G and GE…GS types are available. They are classified by bushing size.
The GE…GS type can be provided with seals, which are double-lip type polyurethane seals effective for prevention against grease leakage and dust penetration.

Steel-on-steel Spherical Bushings SBB

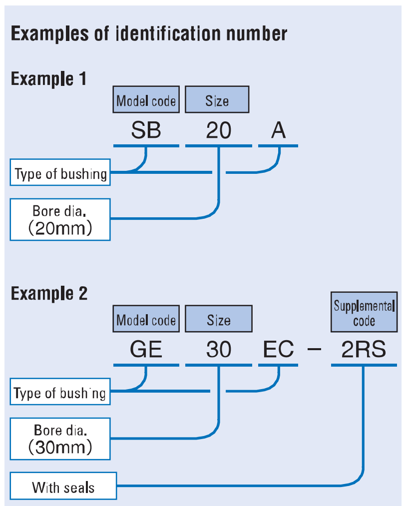
These are inch series bushings. The outer ring is split at one position.
These bushings can be provided with seals, which are double-lip type polyurethane seals effective for prevention against grease leakage and dust penetration.

Maintenance-free Spherical Bushings GE…EC

These bushings have the same boundary dimensions as the GE…ES type and can be used internationally. A special PTFE liner reinforced with copper alloy meshes is used on the sliding surface. Therefore, creep deformation due to compressive loads is small, and wear resistance is superior. These bushings are used as maintenance-free bushings.
These bushings can be provided with synthetic resin seals which are effective in preventing dust penetration. They are indicated by the suffix "-2RS" at the end of the identification number.
Spherical Bushings with superior rust prevention properties, which can be used in a corrosive environment or in an environment where water splashes, are also available on request. Please consult IKO.

Identification number

The identification number of Spherical Bushings consists of a model code, a size and any supplemental codes. Examples are shown below.



Accuracy

The tolerances of Steel-on-steel Spherical Bushings of the metric series is shown in Table 2.
The tolerances of the GE type are applicable to bushings before splitting the outer ring and after surface treatment.
The tolerances of the SB and SB…A types are applicable to bushings before splitting the outer ring and before surface treatment.
The tolerances of the GE…EC type are applicable to bushings before splitting the outer ring.
The tolerances of the Spherical Bushings of the inch series are shown in Table 3. The tolerances of the bore diameter are applicable to bushings after surface treatment, while other tolerances are applicable to bushings before splitting the outer ring and before surface treatment.
Although minor dimensional changes may occur during surface treatment, they have negligible influence on the overall performance.

Table 2 Tolerances of inner and outer rings of metric series (JIS Class 0) unit: μm

d or D (1) Nominal bore dia. or outside dia. mm		Δ_{dmp} Single plane mean bore dia. deviation		Δ_{Dmp} Single plane mean outside dia. deviation		Δ_{Bs} or Δ_{Cs} Deviation of a single inner ring width or outer ring width	
Over	Incl.	High	Low	High	Low	High	Low
2.5	6	0	− 8	—	—	0	−120
6	18	0	− 8	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	−35	0	−350
315	400	0	−40	0	−40	0	−400
400	500	0	−45	0	−45	0	−450

Note(1) d for Δ_{dmp}, Δ_{Bs} and Δ_{Cs} and D for Δ_{Dmp}, respectively.

Table 3 Tolerances of inner and outer rings of inch series SBB unit: μm

d or D (1) Nominal bore dia. or outside dia. mm		Δ_{dmp} Single plane mean bore dia. deviation		Δ_{Dmp} Single plane mean outside dia. deviation		Δ_{Bs} or Δ_{Cs} Deviation of a single inner ring width or outer ring width	
Over	Incl.	High	Low	High	Low	High	Low
—	50.800	0	−13	0	−13	0	−130
50.800	76.200	0	−15	0	−15	0	−130
76.200	80.962	0	−20	0	−15	0	−130
80.962	120.650	0	−20	0	−20	0	−130
120.650	152.400	0	−25	0	−25	0	−130
152.400	177.800	—	—	0	−25	0	−130
177.800	222.250	—	—	0	−30	0	−130

Note(1) d for Δ_{dmp}, Δ_{Bs} and Δ_{Cs} and D for Δ_{Dmp}, respectively.

Clearance

The radial internal clearances of Spherical Bushings are the values before splitting the outer ring, and are shown in Tables 4, 5 and 6. The radial internal clearances of the inch series are shown in the dimension table.
Clearances other than these can also be prepared on request. Please consult IKO.

Table 4 Radial internal clearance of SB and SB…A types (Steel-on-steel) unit: μm

<table>
<tr><th rowspan="2">d Nominal bore dia. mm</th><th colspan="2">SB type</th><th colspan="2">SB…A type</th></tr>
<tr><th>Min.</th><th>Max.</th><th>Min.</th><th>Max.</th></tr>
<tr><td>12</td><td rowspan="2">70</td><td rowspan="2">125</td><td>32</td><td>68</td></tr>
<tr><td>15</td><td rowspan="2">40</td><td rowspan="2">82</td></tr>
<tr><td>20</td><td rowspan="4">75</td><td rowspan="4">140</td></tr>
<tr><td>22</td><td rowspan="4">50</td><td rowspan="4">100</td></tr>
<tr><td>25</td></tr>
<tr><td>30</td></tr>
<tr><td>35</td><td rowspan="4">85</td><td rowspan="4">150</td></tr>
<tr><td>40</td><td rowspan="4">60</td><td rowspan="4">120</td></tr>
<tr><td>45</td></tr>
<tr><td>50</td></tr>
<tr><td>55</td><td rowspan="3">90</td><td rowspan="3">160</td></tr>
<tr><td>60</td><td rowspan="5">72</td><td rowspan="5">142</td></tr>
<tr><td>65</td></tr>
<tr><td>70</td><td rowspan="3">95</td><td rowspan="3">170</td></tr>
<tr><td>75</td></tr>
<tr><td>80</td></tr>
<tr><td>85</td><td rowspan="4">100</td><td rowspan="4">185</td><td rowspan="7">85</td><td rowspan="7">165</td></tr>
<tr><td>90</td></tr>
<tr><td>65</td></tr>
<tr><td>100</td></tr>
<tr><td>110</td><td rowspan="3">110</td><td rowspan="3">200</td></tr>
<tr><td>115</td></tr>
<tr><td>120</td></tr>
<tr><td>130</td><td rowspan="2">120</td><td rowspan="2">215</td><td rowspan="2">100</td><td rowspan="2">192</td></tr>
<tr><td>150</td></tr>
</table>

K
SB
GE
SBB

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

Table 5 Radial internal clearance of GE type (Steel-on-steel)

unit: μm

d Nominal bore dia. mm		Radial internal clearance	
GE…E GE…ES	GE…G GE…GS	Min.	Max.
4 5 6 8 10 12	— — — 6 8 10	32	68
15 17 20	12 15 17	40	82
25 30 35	20 25 30	50	100
40 45 50 60	35 40 45 50	90	120
70 80 90	90 70 80	72	142
100 110 120 140	90 100 110 120	85	165
160 180 200 220 240	140 160 180 200 220	100	192
260 280 300	240 260 280	110	214

Remark Also applicable to bushings with seals.

Table 6 Radial internal clearance of GE…EC type (Maintenance-free)

unit: μm

d Nominal bore dia. mm	Radial internal clearance	
	Min.	Max.
15 17 20	0	40
25 30 35	0	50
40 45 50 60	0	60
70	0	72

Remark Also applicable to bushings with seals.

Fit

The recommended fits for Spherical Bushings are shown in Tables 7 and 8.

Table 7 Recommended fits for Steel-on-steel Spherical Bushings

Condition	Tolerance class	
	Shaft	Housing bore
Normal operation	h6, j6	H7, J7
With directionally indeterminate load	m6, n6	M7, N7

Remark N7 tolerance is recommended for light metal housings.

Table 8 Recommended fits for Maintenance-free Spherical Bushings

Tolerance class of shaft	Tolerance class of housing bore
h6, j6	H7, J7, K7

Remark K7 tolerance is recommended for light metal housings.

Selection of Spherical Bushings

Selection between the steel-on-steel type and the maintenance-free type is made considering the operating conditions such as load, lubrication, temperature, and sliding velocity.

Load capacity

❶ Dynamic load capacity

The dynamic load capacity C_d is the maximum allowable load that can be applied on a spherical bushing under oscillating motion. It is obtained on the basis of the contact pressure on the spherical surfaces. The dynamic load capacity is also used for calculating the life of spherical bushings.

The recommended value of bushing load is obtained by multiplying the dynamic load capacity C_d by a numerical factor, which differs depending on the bushing type and the load condition. A guideline for selection is shown in Table 9.

Table 9 Guide for determination of load

Type of bushing	Load direction	
	Constant	Alternate
Steel-on-steel	$\leqq 0.3C_d$	$\leqq 0.9C_d$
Maintenance-free	$\leqq C_d$	$\leqq 0.5C_d$

When the magnitude of load exceeds the value given in Table 9, please consult IKO.

The dynamic load capacity C_{dt} considering the influence of bushing temperature can be obtained from the following equation using the temperature factor.

$$C_{dt} = f_t C_d \quad \cdots\cdots (1)$$

where, C_{dt} : Dynamic load capacity considering temperature increase N

f_t : Temperature factor (Refer to Table 10.)

C_d : Dynamic load capacity N (Refer to the dimension tables.)

Table 10 Temperature factor f_t

Type of bushing		Temperature ℃					
		−30 +80	+80 +90	+90 +100	+100 +120	+120 +150	+150 +180
Steel-on-steel	Without seals	1	1	1	1	1	0.7
	With seals	1	—	—	—	—	—
Maintenance-free	Without seals	1	1	0.9	0.75	0.55	—
	With seals	1	—	—	—	—	—

❷ Static load capacity

The static load capacity C_s is the maximum static load that can be applied on the spherical bushing without breaking inner and outer rings or causing any permanent deformation severe enough to render the bushing unusable.

It must be noted that if the magnitude of the applied load becomes comparable to the static load capacity of bushing, the stresses in the shaft or housing may also reach to their limits. This possibility must be taken into consideration in the design.

Equivalent radial load

Spherical Bushings can take radial and axial loads at the same time. When the magnitude and direction of loads are constant, the equivalent radial load can be obtained from the following formula.

$$P = F_r + YF_a \quad \cdots\cdots (2)$$

where, P : Equivalent radial load N

F_r : Radial load N

F_a : Axial load N

Y : Axial load factor (Refer to Table 11.)

Table 11 Axial load factor Y

Type of bushing \ F_a/F_r	0.1	0.2	0.3	0.4	0.5	>0.5
Steel-on-steel	1	2	3	4	5	Unusable
Maintenance-free	1	2	3	Unusable		

Life

The life of Spherical Bushings is defined as the total number of oscillating motions before the bushings cannot be operated normally because of wear, increase in internal clearance, increase in sliding torque, rise of operating temperature, etc.

As the actual life is affected by many factors such as the material of the sliding surface, the magnitude and direction of load, lubrication, sliding velocity, etc., the calculated life can be used as a practical measure of expected service life.

❶Life of Steel-on-steel spherical bushings

[1] Confirmation of pV value

Before attempting to calculate the life, make sure that the operating conditions are within the permissible range by referring to the pV diagram in Fig.1.

When the operating conditions are out of the permissible range, please consult IKO.

The contact pressure p and the sliding velocity V are obtained from the following formulae.

$$p = \frac{100P}{C_{dt}} \quad \cdots\cdots (3)$$

$$V = 5.82 \times 10^{-4} d_k \beta f \quad \cdots\cdots (4)$$

where, p : Contact pressure N/mm²

P : Equivalent radial load N (Refer to Formula (2).)

C_{dt} : Dynamic load capacity considering temperature increase N (Refer to Formula (1).)

V : Sliding velocity mm/s

d_k : Sphere diameter mm (Refer to the dimension tables.)

2β : Oscillating angle degrees (Refer to Fig.2.)
when $\beta < 5°$, $\beta = 5$
when rotating, $\beta = 90$

f : Number of oscillations per minute cpm

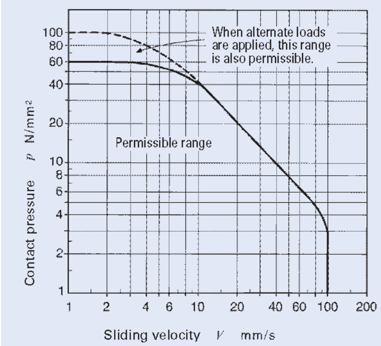


Fig.1 pV diagram of Steel-on-steel spherical bushings

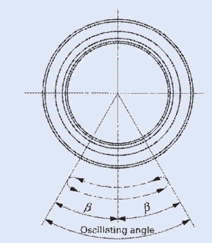


Fig.2 Oscillating angle

K

SB
GE
SBB

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

[2] Life calculation

The life of steel-on-steel spherical bushings can be calculated from the following formulae.

$$G=\frac{3.18b_1b_2b_3}{\sqrt{d_k\beta}}\left(\frac{C_{dt}}{P}\right)^2\times10^5 \quad\cdots\cdots(5)$$

$$L_h=\frac{G}{60f} \quad\cdots\cdots(6)$$

where, G : Life (Total number of oscillations)
b_1 : Load directional factor (Refer to Table 12.)
b_2 : Lubrication factor (Refer to Table 13.)
b_3 : Sliding velocity factor (Refer to Fig.3.)
C_{dt} : Dynamic load capacity considering temperature increase N (Refer to Formula (1).)
P : Equivalent radial load N (Refer to Formula (2).)
L_h : Life in hours h
f : Number of oscillations per minute cpm

Table 12 Load directional factor b_1 (Steel-on-steel)

Load direction	Constant	Alternate
Load directional factor b_1	1	5

Table 13 Lubrication factor b_2

Periodical lubrication	None	Regular
Lubrication factor b_2	1	15

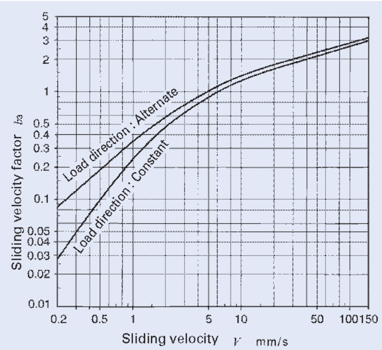


Fig.3 Sliding velocity factor

❷ Life of Maintenance-free spherical bushings

[1] Confirmation of pV value

Before attempting to calculate the life, make sure that the operating conditions are within the permissible range by referring to the pV diagram in Fig.4.

When the operating conditions are out of the permissible range, please consult IKO.

The contact pressure p and the sliding velocity V are obtained from Formulae (3) and (4) shown on page 439.

[2] Life calculation

The life of maintenance-free spherical bushings is obtained from the total sliding distance S which is given in Fig.5 for the contact pressure p obtained from Formula (3).

The total number of oscillations and life in hours can be obtained from the following formulae.

$$G=16.67\times b_1\frac{Sf}{V} \quad\cdots\cdots(7)$$

$$L_h=\frac{G}{60f} \quad\cdots\cdots(8)$$

where, G : Life (Total number of oscillations)
b_1 : Load directional factor (Refer to Table 14.)
S : Total sliding distance m (Refer to Fig.5.)
f : Number of oscillations per minute cpm
V : Sliding velocity mm/s
L_h : Life in hours h

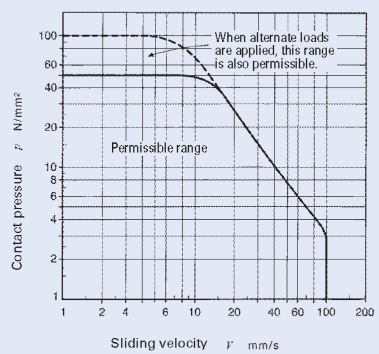


Fig.4 pV diagram of Maintenance-free spherical bushings

Table 14 Load directional factor b_1 (Maintenance-free)

Load direction	Constant	Alternate
Load directional factor b_1	1	0.2(1)

Note(1) This value is applicable when the load changes comparatively slowly. When the load changes rapidly, please consult IKO, as the factor degreases sharply.

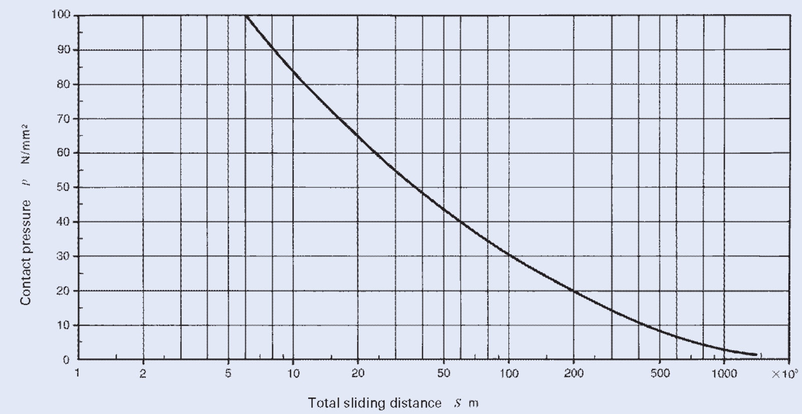


Fig.5 Total sliding distance against contact pressure of Maintenance-free spherical bushings

Lubrication

Steel-on-steel Spherical Bushings can be operated without lubrication when the magnitude of applied load is small and the sliding velocity of oscillation is small. However, in general, it is necessary to supply grease periodically. During initial operation, it is recommended to shorten the lubrication interval. Lithium soap base grease (NLGI consistency No.2) containing molybdenum disulfide (MoS_2) is widely used as the lubricating grease.

Maintenance-free Spherical Bushings can be used without lubrication. However, if lithium soap base grease is supplied before operation, the spherical bushings can be operated for an extended period of time. The spherical bushings can be effectively protected from dust and rust if the space around the bushings is filled with grease.

Oil Hole

The number of oil holes on inner and outer rings is shown in Table 15.

Table 15 Number of oil holes on inner and outer rings

Bushing type			Number of oil holes on inner and outer rings
Steel-on-steel Spherical Bushings	Metric series	GE…E GE…G	0
		SB, SB…A GE…ES, GE…GS	2
	Inch series	SBB	2
Maintenance-free Spherical Bushings	Metric series	GE…EC	0

Remark Types with oil holes are also provided with oil grooves on inner and outer rings.

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

Operating Temperature Range

The operating temperature range for Spherical Bushings with seals is -30℃～+80℃.
The maximum allowable temperature for Spherical Bushings without seals is +180℃ for the steel-on-steel type and +150℃ for the maintenance-free type.

Precautions for Use

Design of shaft

When the load is large, sliding may occur between the shaft and the inner ring bore of bushing. For such cases, it is necessary to prepare the shaft with a hardness of 58HRC or greater and surface roughness of 0.8 μmR_a or less.
Furthermore, attention must be paid to the strength of shaft because the shear and/or bending stresses in the shaft may surpass the allowable values even when the load is below the static load capacity of Spherical Bushings.

Design of housing

The housing should have sufficient rigidity to avoid harmful deformation under load.
When the housing shown in Fig.6 is used, it should be designed with sufficient strength as follows.

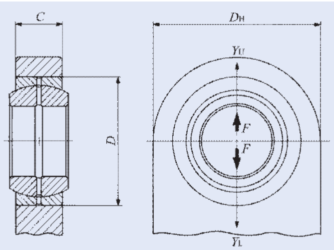


Fig.6 Shape of housing

❶When the load acts in the Y_L direction;
Select the housing material considering the compressive stress obtained from the following formula.

$$\sigma_1 = \frac{F}{CD} \quad \cdots\cdots(9)$$

where, σ_1 : Maximum compressive stress occurring in the housing bore N/mm²
F : Applied load N
C : Width of outer ring and housing mm
D : Outside diameter of outer ring mm

❷When the load acts in the Yu direction ;
Select the housing material considering the tensile stress obtained from the following formula.

$$\sigma_2 = \frac{F}{C\,(D_H - D)} k \quad \cdots\cdots(10)$$

where, σ_2 : Maximum tensile stress occurring in the housing bore N/mm²
F : Applied load N
C : Width of outer ring and housing mm
D_H : Outside diameter of housing mm
D : Outside diameter of outer ring mm
k : Stress concentration factor (Refer to Fig.7.)

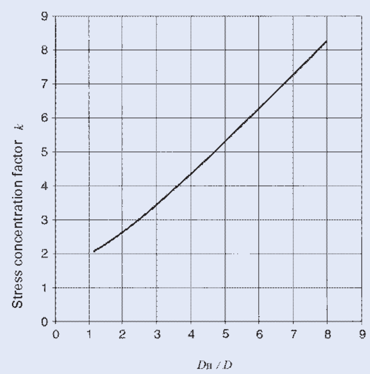


Fig.7 Stress concentration factor

Mounting

❶When mounting Spherical Bushings, pay attention to the location of the split plane of the outer ring. Set the split plane at right angles to the direction of load to avoid the application of load to the split plane as shown in Fig. 8.
❷The shoulder dimensions of shaft and housing are shown in the dimension tables.

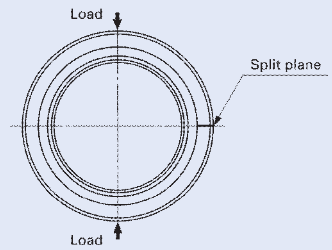


Fig.8 Relationship between the split plane and the loading direction

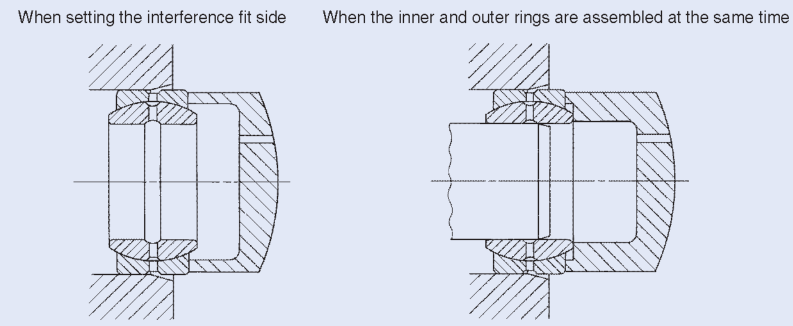


Fig.9 Mounting method

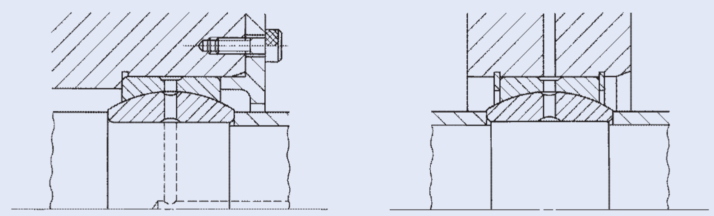


Fig.10 Mounting examples

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

SPHERICAL BUSHINGS

Steel-on-steel Spherical Bushings

Shaft dia. 12 — 100mm

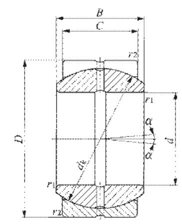
Shaft dia. mm	Identification number		Mass (Ref.) kg	Boundary dimensions mm d	D	B	C	d_k	$r_{s\,min}$ (1)	Permissible tilting angle degree α
12	SB 12A	SB 122211	0.019	12	22	11	9	18	0.3	7
15	SB 15A	SB 152613	0.028	15	26	13	11	22	0.3	6
20	SB 20A	SB 203216	0.053	20	32	16	14	28	0.3	4
22	SB 22A	SB 223719	0.085	22	37	19	16	32	0.3	6
25	SB 25A	SB 254221	0.116	25	42	21	18	36	0.3	5
30	SB 30A	SB 305027	0.225	30	50	27	23	45	0.6	6
35	SB 35A	SB 355530	0.300	35	55	30	26	50	0.6	5
40	SB 40A	SB 406233	0.375	40	62	33	82	55	0.6	6
45	SB 45A	SB 457236	0.600	45	72	36	31	62	0.6	5
50	SB 50A	SB 508042	0.870	50	80	42	36	72	0.6	5
55	SB 55A	SB 559047	1.26	55	90	47	40	80	0.6	5
60	SB 60A	SB 6010053	1.70	60	100	53	45	90	0.6	6
65	SB 65A	SB 6510555	2.05	65	105	55	47	94	0.6	5
70	SB 70A	SB 7011058	2.22	70	110	58	50	100	0.6	5
75	SB 75A	SB 7512064	3.02	75	120	64	55	110	0.6	5
80	SB 80A	SB 8013070	3.98	80	130	70	60	120	0.6	5
85	SB 85A	SB 8513574	4.29	85	135	74	36	125	0.6	6
90	SB 90A	SB 9014076	4.71	90	140	76	65	130	0.6	5
95	SB 95A	SB 9515082	6.05	95	150	82	70	140	0.6	5
100	SB 100A	SB 10016088	7.42	100	160	88	75	150	1	5

Notes(1) Minimum allowable value of chamfer dimensions r_1 and r_2

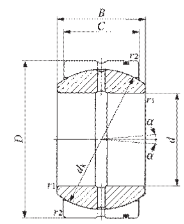
(2) When Spherical Bushings are used with full tilting angle, the shaft shoulder dimesion must be less than the maximum value of d_a.

Remarks1. The inner ring and the outer ring have an oil groove and two oil holes, respectively.

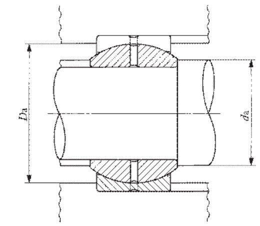
2. Not provided with prepacked grease. Perform proper lubrication for use.



SB···A



SB

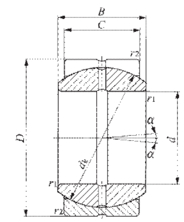


Mounting dimensions mm d_a Min.	d_a Max.(2)	D_a Max.	D_a Min.	Dynamic load capacity C_d N	Static load capacity C_s N
14	14	19.5	17	15 900	95 300
17.5	17.5	23.5	21	23 700	142 000
22.5	23	29.5	26	38 400	231 000
24.5	25.5	34.5	30	50 200	301 000
27.5	29	39.5	34	63 500	381 000
34.5	36	45.5	42	101 000	609 000
39.5	40	50.5	46.5	127 000	765 000
44	44	57.5	51.5	151 000	906 000
49.5	50.5	67.5	58	188 000	1 130 000
54.5	58.5	75.5	67	254 000	1 530 000
59.5	64.5	85.5	74.5	314 000	1 880 000
64.5	72.5	95.5	83.5	397 000	2 380 000
69.5	76	100.5	87	433 000	2 600 000
74.5	81.5	105.5	93	490 000	2 940 000
79.5	89.5	115.5	102	593 000	3 560 000
84.5	97.5	125.5	112	706 000	4 240 000
89.5	100.5	130.5	116	772 000	4 630 000
94.5	105.5	135.5	121	829 000	4 970 000
99.5	113.5	145.5	130	961 000	5 770 000
105.5	121.5	145.5	139	1 100 000	6 620 000

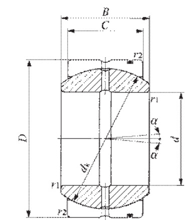
1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

SPHERICAL BUSHINGS

Steel-on-steel Spherical Bushings



SB···A



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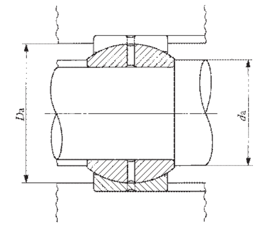


Shaft dia. 110 — 150mm

Shaft dia. mm	Identification number		Mass (Ref.) kg	Boundary dimensions mm d	D	B	C	d_k	$r_{s\,min}$ (1)	Permissible tilting angle degree α	Mounting dimensions mm d_a Min.	d_a Max.(2)	D_a Max.	D_a Min.	Dynamic load capacity C_d N	Static load capacity C_s N
110	SB 110A	SB 11017093	8.55	110	170	93	80	160	1	5	115.5	130	164.5	149	1 260 000	7 530 000
115	SB 115A	SB 11518098	10.3	115	180	98	58	165	1	5	120.5	132.5	174.5	152	1 380 000	8 250 000
120	SB 120A	SB 120190105	12.4	120	190	105	90	175	1	5	125.5	140	184.5	162	1 540 000	9 270 000
130	SB 130A	SB 130200110	13.8	130	200	110	95	185	1	5	135.5	148.5	194.5	171	1 720 000	10 300 000
150	SB 150A	SB 150220120	1.70	150	220	120	105	205	1	5	155.5	166	214.5	189	2 110 000	12 700 000

Notes(1) Minimum allowable value of chamfer dimensions r_1 and r_2

(2) When Spherical Bushings are used with full tilting angle, the shaft shoulder dimension must be less than the maximum value of d_a.

Remarks1. The inner ring and the outer ring have an oil groove and two oil holes, respectively.

2. Not provided with prepacked grease. Perform proper lubrication for use.

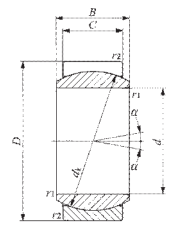
1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

K

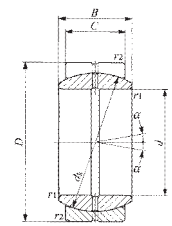
SB
GE
SBB

SPHERICAL BUSHINGS

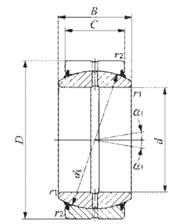
Steel-on-steel Spherical Bushings



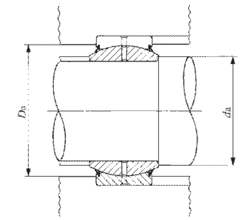
GE⋯E



GE⋯ES



GE⋯ES-2RS



Shaft dia. 4 — 100mm

Shaft dia. mm	Identification number: Without seals	Identification number: With seals	Mass (Ref.) kg	Boundary dimensions mm: d	D	B	C	d_k	$r_{1s\,min}$ (1)	$r_{2s\,min}$ (1)	Permissible tilting angle degree: α	α_1
4	GE 4E		0.003	4	12	5	3	8	0.3	0.3	16	—
5	GE 5E		0.004	5	14	6	4	10	0.3	0.3	13	
6	GE 6E		0.004	6	14	6	4	10	0.3	0.3	13	
8	GE 8E	—	0.008	8	16	8	5	13	0.3	0.3	15	—
10	GE 10E		0.012	10	19	9	6	16	0.3	0.3	12	
12	GE 12E		0.017	12	22	10	7	18	0.3	0.3	11	
15	GE 15ES	GE 15ES-2RS	0.032	15	26	12	9	22	0.3	0.3	8	5
17	GE 17ES	GE 17ES-2RS	0.049	17	30	14	10	25	0.3	0.3	10	7
20	GE 20ES	GE 20ES-2RS	0.065	20	35	16	12	29	0.3	0.3	9	6
25	GE 25ES	GE 25ES-2RS	0.115	25	42	20	16	35.5	0.6	0.6	7	4
30	GE 30ES	GE 30ES-2RS	0.160	30	47	22	18	40.7	0.6	0.6	6	4
35	GE 35ES	GE 35ES-2RS	0.258	35	55	25	20	47	0.6	1	6	4
40	GE 40ES	GE 40ES-2RS	0.315	40	62	28	22	53	0.6	1	7	4
45	GE 45ES	GE 45ES-2RS	0.413	45	68	32	25	60	0.6	1	7	4
50	GE 50ES	GE 50ES-2RS	0.065	50	75	35	82	66	0.6	1	6	4
60	GE 60ES	GE 60ES-2RS	1.10	60	90	44	36	80	1	1	6	3
70	GE 70ES	GE 70ES-2RS	1.54	70	150	49	40	92	1	1	6	4
80	GE 80ES	GE 80ES-2RS	2.29	80	120	55	45	105	1	1	6	4
90	GE 90ES	GE 90ES-2RS	2.82	90	130	60	50	115	1	1	5	3
100	GE 100ES	GE 100ES-2RS	4.43	100	150	70	55	130	1	1	7	5

Notes(1) Minimum allowable value of chamfer dimensions r_1 and r_2

(2) When Spherical Bushings are used with full tilting angle, the shaft shoulder dimension must be less than the maximum value of d_a.

Remarks1. GE⋯E has no oil hole. Others are provided with an oil groove and two oil holes on the inner ring and outer ring, respectively.

2. Not provided with prepacked grease. Perform proper lubrication for use.

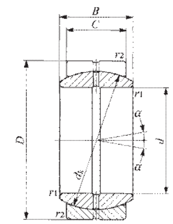
Mounting dimensions mm: d_a Min.	d_a Max.(2)	D_a Max.	D_a Min.	Dynamic load capacity C_d N	Static load capacity C_s N
6	6	9.5	8	2 350	14 100
7.5	8	11.5	10	3 920	23 500
8	8	11.5	10	3 920	23 500
10	10	13.5	13	6 370	38 200
12.5	13	16.5	15.5	9 410	56 500
14.5	15	19.5	17	12 400	74 100
17.5	18	23.5	22.5	19 400	117 000
19.5	20.5	27.5	26	24 500	147 000
22.5	24	32.5	30.5	34 100	205 000
29	29	37.5	37	55 700	334 000
34	34	42.5	41.5	71 800	431 000
39.5	39.5	49.5	48	92 200	553 000
44.5	45	56.5	54.5	114 000	686 000
49.5	50.5	62.5	60	147 000	883 000
54.5	65	69.5	66	181 000	1 090 000
65.5	66.5	84.5	79	282 000	1 690 000
75.5	77.5	99.5	91	361 000	2 170 000
85.5	89	114.5	130	463 000	2 780 000
95.5	98	124.5	112	564 000	3 380 000
105.5	109.5	144.5	127	701 000	4 210 000

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

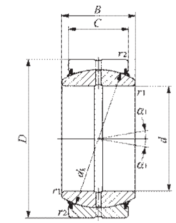
SPHERICAL BUSHINGS

Steel-on-steel Spherical Bushings

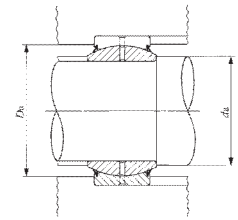
IKO



GE⋯ES



GE⋯ES-2RS



Shaft dia. 110 — 300mm

Shaft dia. mm	Identification number Without seals	Identification number With seals	Mass (Ref.) kg	Boundary dimensions mm d	D	B	C	d_k	$r_{1s\,min}$ (1)	$r_{2s\,min}$ (1)	Permissible tilting angle degree α	α_1
110	GE 110ES	GE 110ES-2RS	4.94	110	160	70	55	140	1	1	6	4
120	GE 120ES	GE 120ES-2RS	8.12	120	180	58	70	160	1	1	6	4
140	GE 140ES	GE 140ES-2RS	11.4	140	210	90	70	180	1	1	7	5
160	GE 160ES	GE 160ES-2RS	14.4	160	230	150	80	200	1	1	8	6
180	GE 180ES	GE 180ES-2RS	18.9	180	260	105	80	225	1.1	1.1	6	5
200	GE 200ES	GE 200ES-2RS	28.1	200	290	130	100	250	1.1	1.1	7	6
220	GE 220ES	GE 220ES-2RS	36.1	220	230	135	100	275	1.1	1.1	8	6
240	GE 240ES	GE 240ES-2RS	40.4	240	340	140	100	300	1.1	1.1	8	6
260	GE 260ES	GE 260ES-2RS	52.0	260	370	105	110	325	1.1	1.1	7	6
280	GE 280ES	GE 280ES-2RS	66.0	280	400	155	120	350	1.1	1.1	6	5
300	GE 300ES	GE 300ES-2RS	76.0	300	340	165	120	375	1.1	1.1	7	6

Notes(1) Minimum allowable value of chamfer dimensions r_1 and r_2

(2) When Spherical Bushings are used with full tilting angle, the shaft shoulder dimension must be less than the maximum value of d_a.

Remarks1. The inner ring and the outer ring have an oil groove and two oil holes, respectively.

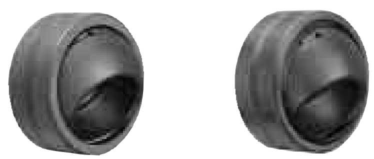
2. Not provided with prepacked grease. Perform proper lubrication for use.

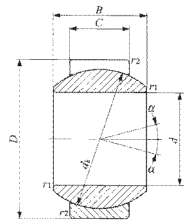
Mounting dimensions mm d_a Min.	d_a Max.(2)	D_a Max.	D_a Min.	Dynamic load capacity C_d N	Static load capacity C_s N
115.5	121	145.5	138	755 000	4 530 000
125.5	135.5	174.5	154	1 100 000	6 590 000
145.5	155.5	204.5	176	1 240 000	7 410 000
165.5	170	224.5	195	1 570 000	9 410 000
187	199	253	221	1 770 000	10 600 000
207	213.5	283	244	2 450 000	14 700 000
227	239.5	313	269	2 700 000	16 200 000
247	265	333	296	2 940 000	17 700 000
267	288	363	320	3 510 000	21 000 000
287	313.5	393	345	4 120 000	24 700 000
307	336.5	423	371	4 410 000	26 500 000

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

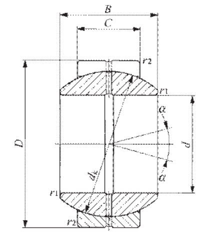
SPHERICAL BUSHINGS

Steel-on-steel Spherical Bushings

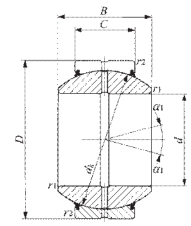




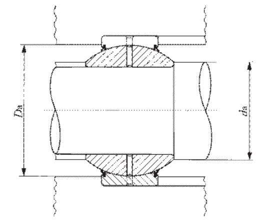
GE···G



GE···GS



GE···GS-2RS



Shaft dia. 6 — 120mm

Shaft dia. mm	Identification number: Without seals	Identification number: With seals	Mass (Ref.) kg	Boundary dimensions mm: d	D	B	C	d_k	$r_{1s\,min}$ (1)	$r_{2s\,min}$ (1)	Permissible tilting angle degree: α	α_1	Mounting dimensions mm: d_a Min.	d_a Max.(2)	D_a Max.	D_a Min.	Dynamic load capacity C_d N	Static load capacity C_s N
6	GE 6G	—	0.010	6	16	9	5	13	0.3	0.3	21	—	8.5	9	13.5	13	6 370	38 200
8	GE 8G	—	0.015	8	19	11	6	16	0.3	0.3	21	—	10.5	11.5	16.5	15.5	9 410	56 500
10	GE 10G	—	0.022	10	22	12	7	18	0.3	0.3	18	—	12.5	13	19.5	17	12 400	74 100
12	GE 12G	—	0.041	12	26	15	9	22	0.3	0.3	18	—	14.5	16	23.5	21	19 400	117 000
15	GE 15GS	GE 15GS-2RS	0.059	15	30	16	10	25	0.3	0.3	16	13	17.5	19	27.5	26	24 500	147 000
17	GE 17GS	GE 17GS-2RS	0.083	17	35	20	12	29	0.3	0.3	19	16	19.5	21	32.5	30.5	34 100	205 000
20	GE 20GS	GE 20GS-2RS	0.155	20	42	25	16	35.5	0.3	0.6	17	16	22.5	25	37.5	37	55 700	334 000
25	GE 25GS	GE 25GS-2RS	0.215	25	47	82	18	40.7	0.6	0.6	17	15	29.5	29.5	42.5	41.5	71 800	431 000
30	GE 30GS	GE 30GS-2RS	0.330	30	55	23	20	47	0.6	1	17	16	34	34	49.5	48	92 200	553 000
35	GE 35GS	GE 35GS-2RS	0.004	35	62	35	22	35	0.6	1	16	15	39.5	39.5	56.5	54.5	114 000	686 000
40	GE 40GS	GE 40GS-2RS	0.515	40	68	40	25	60	0.6	1	17	14	44.5	44.5	62.5	60	147 000	883 000
45	GE 45GS	GE 45GS-2RS	0.660	45	75	43	82	66	0.6	1	15	13	49.5	50	69.5	66	181 000	1 090 000
50	GE 50GS	GE 50GS-2RS	1.50	50	90	65	36	80	0.6	1	17	16	54.5	57	84.5	79	282 000	1 690 000
60	GE 60GS	GE 60GS-2RS	2.05	60	150	36	40	92	1	1	17	15	65.5	67	99.5	91	361 000	2 170 000
70	GE 70GS	GE 70GS-2RS	3.00	70	120	70	45	105	1	1	16	14	75.5	78	114.5	130	463 000	2 780 000
80	GE 80GS	GE 80GS-2RS	3.60	80	130	75	50	115	1	1	14	13	85.5	87	124.5	112	564 000	3 380 000
90	GE 90GS	GE 90GS-2RS	5.41	90	150	85	55	130	1	1	15	14	95.5	98	144.5	127	701 000	4 210 000
100	GE 100GS	GE 100GS-2RS	6.15	100	160	58	55	140	1	1	14	12	105.5	111	154.5	138	755 000	4 530 000
110	GE 110GS	GE 110GS-2RS	9.70	110	180	100	70	160	1	1	12	11	115.5	124.5	174.5	154	1 100 000	6 590 000
120	GE 120GS	GE 120GS-2RS	15.5	120	210	115	70	180	1	1	16	15	125.5	138.5	204.5	176	1 240 000	7 410 000

Notes(1) Minimum allowable value of chamfer dimensions r_1 and r_2

(2) When Spherical Bushings are used with full tilting angle, the shaft shoulder dimension must be less than the maximum value of d_a.

Remarks1. GE···G has no oil hole. Others are provided with an oil groove and two oil holes on the inner ring and outer ring, respectively.

2. Not provided with prepacked grease. Perform proper lubrication for use.

K

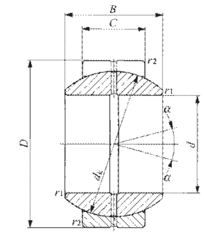
SB
GE
SBB

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

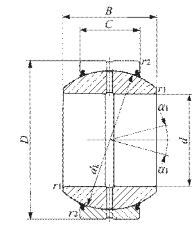
SPHERICAL BUSHINGS

Steel-on-steel Spherical Bushings

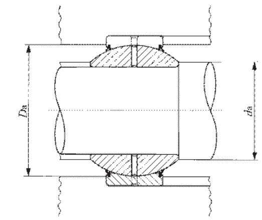
Shaft dia. 140 — 280mm



GE···GS



GE···GS-2RS



Shaft dia. mm	Identification number Without seals	With seals	Mass (Ref.) kg	Boundary dimensions mm d	D	B	C	d_k	$r_{1s\,min}$ (1)	$r_{2s\,min}$ (1)	Permissible tilting angle degree α	α_1
140	**GE 140GS**	**GE 140GS-2RS**	19.2	140	320	130	80	200	1	1	16	15
160	**GE 160GS**	**GE 160GS-2RS**	25.4	160	260	135	80	225	1	1.1	16	14
180	**GE 180GS**	**GE 180GS-2RS**	34.7	180	290	155	100	205	1.1	1.1	14	13
200	**GE 200GS**	**GE 200GS-2RS**	43.8	200	230	165	100	275	1.1	1.1	15	14
220	**GE 220GS**	**GE 220GS-2RS**	51.3	220	340	175	100	300	1.1	1.1	16	14
240	**GE 240GS**	**GE 240GS-2RS**	66.1	240	370	190	110	325	1.1	1.1	15	14
260	**GE 260GS**	**GE 260GS-2RS**	81.8	260	400	205	120	350	1.1	1.1	15	14
280	**GE 280GS**	**GE 280GS-2RS**	97.4	280	340	210	120	375	1.1	1.1	15	14

Shaft dia. mm	Mounting dimensions mm d_a Min.	d_a Max.(2)	D_a Max.	D_a Min.	Dynamic load capacity C_d N	Static load capacity C_s N
140	145.5	152	224.5	195	1 570 000	9 410 000
160	165.5	180	253	221	1 770 000	10 600 000
180	187	196	283	244	2 450 000	14 700 000
200	207	220	313	269	2 700 000	16 200 000
220	227	243.5	333	296	2 940 000	17 700 000
240	247	263.5	363	320	3 510 000	21 000 000
260	267	283.5	393	345	4 120 000	24 700 000
280	287	310.5	423	371	4 410 000	26 500 000

Notes(1) Minimum allowable value of chamfer dimensions r_1 and r_2

(2) When Spherical Bushings are used with full tilting angle, the shaft shoulder dimension must be less than the maximum value of d_a.

Remarks1. The inner ring and the outer ring have an oil groove and two oil holes, respectively.

2. Not provided with prepacked grease. Perform proper lubrication for use.

K

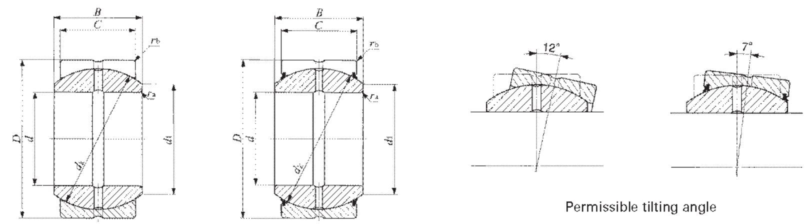
SB
GE
SBB

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

SPHERICAL BUSHINGS

Steel-on-steel Spherical Bushings Inch Series

Shaft dia. 12.700 — 63.500mm



SBB SBB…-2RS SBB SBB…-2RS

Shaft dia. mm (inch)	Identification number Without seal	Identification number With seals	Mass (Ref.) kg	Boundary dimensions mm(inch) d	D	B	C	d_k	Radial internal clearance mm Min./Max.	Mounting dimensions mm d_1	$r_{as\ max}$ (1) Max.	$r_{bs\ max}$ (1) Max.	Dynamic load capacity C_d N	Static load capacity C_s N
12.700 (1/2)	SBB 8		0.020	12.700 (1/2)	22.225 (7/8)	11.10 (.437)	9.52 (.375)	18 (.709)	0.05/0.15	14.0	0.2	0.6	16 800	101 000
15.875 (5/8)	SBB 10		0.036	15.875 (5/8)	26.988 (1 1/16)	13.89 (.547)	11.91 (.469)	23 (.906)	0.05/0.15	17.9	0.2	0.8	26 900	161 000
19.050 (3/4)	SBB 12	SBB 12-2RS	0.057	19.050 (3/4)	31.750 (1 1/4)	16.66 (.656)	14.27 (.562)	27.5 (1.083)	0.08/0.18	21.4	0.6	*0.8	38 500	231 000
22.225 (7/8)	SBB 14	SBB 14-2RS	0.088	22.225 (7/8)	36.512 (1 7/16)	19.43 (.765)	16.66 (.656)	32 (1.260)	0.08/0.18	25.0	0.6	*0.8	52 300	314 000
25.400 (1)	SBB 16	SBB 16-2RS	0.125	25.400 (1)	41.275 (1 5/8)	22.22 (.875)	19.05 (.750)	36 (1.417)	0.08/0.18	28.0	0.6	*0.8	67 300	404 000
31.750 (1 1/4)	SBB 20	SBB 20-2RS	0.234	31.750 (1 1/4)	50.800 (2)	27.76 (1.093)	23.80 (.937)	45 (1.772)	0.08/0.18	35.1	0.6	0.8	105 000	630 000
34.925 (1 3/8)	SBB 22	SBB 22-2RS	0.349	34.925 (1 3/8)	55.562 (2 3/16)	30.15 (1.187)	26.19 (1.031)	49 (1.929)	0.08/0.18	38.5	0.6	0.8	126 000	755 000
38.100 (1 1/2)	SBB 24	SBB 24-2RS	0.424	38.100 (1 1/2)	61.912 (2 7/16)	33.32 (1.312)	28.58 (1.125)	55 (2.165)	0.08/0.18	43.3	0.6	0.8	154 000	925 000
44.450 (1 3/4)	SBB 28	SBB 28-2RS	0.649	44.450 (1 3/4)	71.438 (2 13/16)	38.89 (1.531)	33.32 (1.312)	64 (2.520)	0.08/0.18	50.4	0.6	0.8	209 000	1 250 000
50.800 (2)	SBB 32	SBB 32-2RS	0.939	50.800 (2)	80.962 (3 3/16)	44.45 (1.750)	38.10 (1.500)	73 (2.874)	0.08/0.18	57.6	0.6	0.8	273 000	1 640 000
57.150 (2 1/4)	SBB 36	SBB 36-2RS	1.32	57.150 (2 1/4)	90.488 (3 9/16)	50.01 (1.969)	42.85 (1.687)	82 (3.228)	0.10/0.20	64.9	0.6	0.8	345 000	2 070 000
63.500 (2 1/2)	SBB 40	SBB 40-2RS	1.85	63.500 (2 1/2)	100.012 (3 15/16)	55.55 (2.187)	47.62 (1.875)	91 (3.583)	0.10/0.20	72.0	0.6	0.8	425 000	2 550 000

Note(1) Maximum allowable corner radius of the shaft or housing

Remarks 1. The value with mark * is applicable to types without seals. For types with seals, the value is 0.4 mm.
2. The inner ring and the outer ring have an oil groove and two oil holes, respectively.
3. Not provided with prepacked grease. Perform proper lubrication for use.

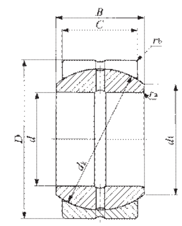
K
SB
GE
SBB

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

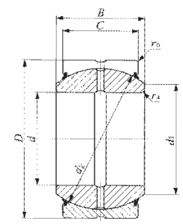
SPHERICAL BUSHINGS

Steel-on-steel Spherical Bushings Inch Series

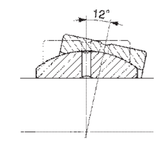
IKO

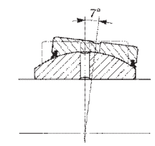


SBB



SBB⋯-2RS





Permissible tilting angle

SBB　SBB⋯-2RS

Shaft dia. 69.850 ─ 152.400mm

Shaft dia. mm (inch)	Identification number Without seal	Identification number With seals	Mass (Ref.) kg	Boundary dimensions mm(inch) d	D	B	C	d_k	Radial internal clearance mm Min./Max.	Mounting dimensions mm d_1	$r_{as\ max}$ (1) Max.	$r_{bs\ max}$ (1) Max.	Dynamic load capacity C_d N	Static load capacity C_s N
69.850 (2 3/4)	SBB 44	SBB 44-2RS	2.44	69.850(2 3/4)	111.125(4 3/8)	61.11(2.406)	52.37(2.062)	100(3.937)	0.10/0.20	79.0	0.6	0.8	514 000	3 080 000
76.200 (3)	SBB 48	SBB 48-2RS	3.12	76.200(3)	120.650(4 3/4)	66.68(2.625)	57.15(2.250)	110(4.331)	0.10/0.20	86.5	0.6	0.8	616 000	3 700 000
82.550 (3 1/4)	SBB 52	SBB 52-2RS	3.92	82.550(3 1/4)	130.175(5 1/8)	72.24(2.844)	61.90(2.437)	119(4.685)	0.13/0.23	94.1	0.6	0.8	722 000	4 330 000
88.900 (3 1/2)	SBB 56	SBB 56-2RS	4.83	88.900(3 1/2)	139.700(5 1/2)	77.77(3.062)	66.68(2.625)	128(5.039)	0.13/0.23	101.6	0.6	0.8	837 000	5 020 000
95.250 (3 3/4)	SBB 60	SBB 60-2RS	5.87	95.250(3 3/4)	149.225(5 7/8)	83.34(3.281)	71.42(2.812)	137(5.394)	0.13/0.23	108.4	0.6	0.8	609 000	5 760 000
101.600 (4)	SBB 64	SBB 64-2RS	7.07	101.600(4)	158.750(6 1/4)	88.90(3.500)	76.20(3.000)	146(5.748)	0.13/0.23	115.8	0.6	0.8	1 090 000	6 550 000
107.950 (4 1/4)	SBB 68	SBB 68-2RS	8.46	107.950(4 1/4)	168.275(6 5/8)	94.46(3.719)	80.95(3.187)	155(6.102)	0.13/0.23	122.6	0.8	1.1	1 230 000	7 380 000
114.300 (4 1/2)	SBB 72	SBB 72-2RS	9.94	114.300(4 1/2)	177.800(7)	100.00(3.937)	85.72(3.375)	164(6.457)	0.13/0.23	129.8	0.8	1.1	1 380 000	8 270 000
120.650 (4 3/4)	SBB 76	SBB 76-2RS	11.6	120.650(4 3/4)	187.325(7 3/8)	105.56(4.156)	90.47(3.562)	173(6.811)	0.13/0.23	136.8	0.8	1.1	1 530 000	9 210 000
127.000 (5)	SBB 80	SBB 80-2RS	13.5	127.000(5)	196.850(7 3/4)	111.12(4.375)	95.25(3.750)	183(7.205)	0.13/0.23	144.9	0.8	1.1	1 710 000	10 300 000
152.400 (6)	SBB 96	SBB 96-2RS	17.6	152.400(6)	222.250(8 3/4)	120.65(4.750)	104.78(4.125)	207(8.150)	0.13/0.23	167.5	0.8	1.1	2 130 000	12 800 000

Note(1) Maximum allowable corner radius of the shaft or housing

Remarks 1. The inner ring and the outer ring have an oil groove and two oil holes, respectively.

2. Not provided with prepacked grease. Perform proper lubrication for use.

K

SB
GE
SBB

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

SPHERICAL BUSHINGS

Maintenance-free Spherical Bushings

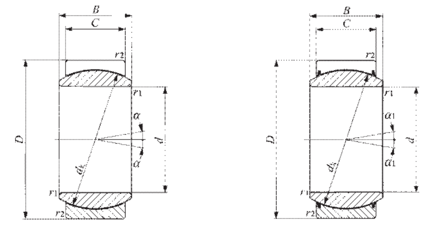
Shaft dia. 15 — 70mm

Shaft dia. mm	Identification number Without seals	With seals	Mass (Ref.) kg	d	D	B	C	d_k	$r_{1s\,min}$(1)	$r_{2s\,min}$(1)	Permissible tilting angle degree α	α_1
15	GE 15EC		0.032	15	26	12	9	22	0.3	0.3	8	
17	GE 17EC	—	0.049	17	30	14	10	25	0.3	0.3	10	—
20	GE 20EC		0.065	20	35	16	12	92	0.3	0.3	9	
25	GE 25EC	—	0.115	25	42	20	16	35.5	0.6	0.6	7	
30	GE 30EC	GE 30EC-2RS	0.160	30	47	22	18	40.7	0.6	0.6	6	4
35	—	GE 35EC-2RS	0.258	35	55	25	20	47	0.6	1	—	4
40		GE 40EC-2RS	0.315	40	62	28	22	35	0.6	1		4
45		GE 45EC-2RS	0.413	45	68	23	25	60	0.6	1		4
50	—	GE 50EC-2RS	0.065	50	75	35	82	66	0.6	1	—	4
60		GE 60EC-2RS	1.10	60	90	44	36	80	1	1		3
70		GE 70EC-2RS	1.54	70	105	49	40	92	1	1		4

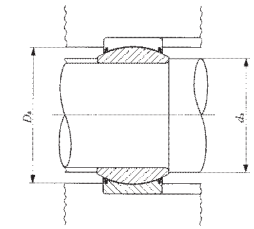
Notes(1) Minimum allowable value of chamfer dimensions r_1 and r_2

(2) When Spherical Bushings are used with full tilting angle, the shaft shoulder dimension must be less than the maximum value of d_a.

Remark No oil hole is provided.



GE…EC



GE…EC-2RS

Mounting dimensions mm d_a Min.	d_a Max.(2)	D_a Max.	D_a Min.	Dynamic load capacity C_d N	Static load capacity C_s N
17.5	18	23.5	21.5	19 400	48 500
19.5	20.5	27.5	42.5	24 500	61 300
22.5	24	32.5	28	34 100	85 300
29	29	37.5	34	55 700	139 000
34	34	42.5	41.5	71 800	180 000
39.5	39.5	49.5	48	92 200	230 000
44.5	45	65.5	54.5	114 000	286 000
49.5	50.5	62.5	60	147 000	368 000
45.5	65	69.5	66	181 000	453 000
65.5	66.5	84.5	79	282 000	706 000
75.5	77.5	99.5	91	361 000	902 000

K

SB
GE
SBB

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

PILLOBALLS

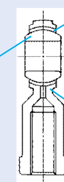
- ●PILLOBALL Spherical Bushings - Insert Type
- ●PILLOBALL Rod Ends - Insert Type
- ●PILLOBALL Rod Ends - Die-cast Type
- ●PILLOBALL Rod Ends - Maintenance-free Type

Structure and Features

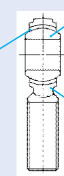
IKO PILLOBALLs are compact self-aligning spherical bushings that can support a large radial load and a bi-directional axial load at the same time.
These bushings are classified by sliding surface types, namely, insert type, die-cast type and maintenance-free type. In the insert type, a spherical inner ring makes contact with the special copper alloy bushing with superior run-in properties. In the die-cast type, a spherical inner ring makes direct contact with the bore surface of the body of special zinc die-cast alloy. In the maintenance-free type, a spherical inner ring makes contact with the special PTFE liner of maintenance-free type. Thus, a smooth rotational and oscillatory motion can be achieved with superior anti-wear and loading properties in each type.
PILLOBALL Rod Ends have either a female thread in the body or a male thread on the body, and they can be easily assembled onto machines.
PILLOBALLs are used in control and link mechanisms in machine tools, textile machines, packaging machines, etc. The maintenance-free type is especially suitable for loading in one direction and is the best choice for machines in which oil must be avoided such as food processing machines, or machines which cannot be re-lubricated.

Structures of maintenance-free type PILLOBALLs

PHS···EC

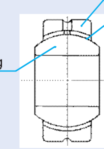


POS···EC

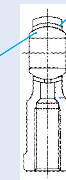


Structures of lubrication type PILLOBALLs

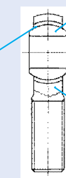
PB



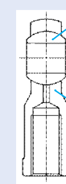
PHS·PHSB



POS·POSB



PHSA



Types

In PILLOBALLs, the types shown in Table 1 are available.

Table 1 Type

Type	Lubrication type			Maintenance-free type	
	Spherical Bushings	Rod end		Rod end	
		female thread	male thread	female thread	male thread
Insert type	PB	PHS·PHSB	POS·POSB	PHS···EC	POS···EC
Die-cast type	—	PHSA	—		

Lubrication Type PILLOBALL Spherical Bushings Insert Type PB

This type has superior anti-wear properties and high rigidity. It consists of a spherical inner ring, an outer ring, and a bushing of special copper alloy with superior run-in properties inserted in between. The spherical surface of the inner ring is chromium plated after heat treatment and grinding. This type is assembled with a shaft and a housing.
When especially large radial and/or axial loads are applied, Spherical Bushings with molybdenum disulfide (MoS_2) treated inner and outer rings are recommended. (See page J17.)

Lubrication Type PILLOBALL Rod Ends Insert Type PHS, POS, PHSB and POSB

This type has superior anti-wear and anti-corrosion properties as well as high rigidity. It consists of a spherical inner ring of which spherical surface is chromium-plated after heat treatment and grinding, a body with a zinc chromate treated outer surface, and an inserted bushing of special copper alloy having superior run-in properties. This type includes PHS and PHSB, which has a female thread in the body, and POS and POSB, which has a male thread on the body

Lubrication Type PILLOBALL Rod Ends Die-cast Type PHSA

The spherical inner ring of this type is mirror-finished after heat treatment and is built in a body of die-cast special zinc alloy. The sliding surfaces of the inner ring and body are in close contact with each other. Thus, this type is an economical rod end with superior anti-wear and loading properties.

Maintenance-free Type PILLOBALL Rod Ends PHS···EC, POS···EC

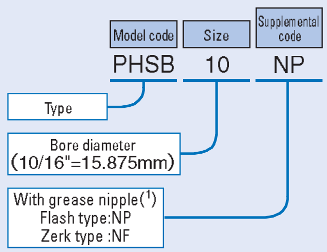
This type has superior anti-corrosion properties as the body is zinc chromate treated and the spherical inner ring is chromium plated on the sphere surface after heat treatment and grinding.
A special PTFE liner, reinforced with copper alloy meshes, which is superior in anti-wear properties with little creep deformation is used for lining on the sliding surface of the body, and this type is maintenance-free.
PHS···EC, which has a female thread in the body, and POS ···EC, which has a male thread on the body, are available.

Identification number

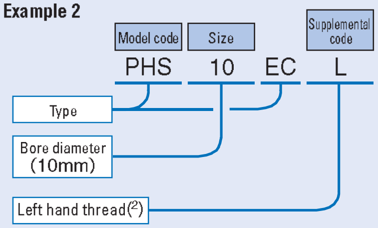
The identification number of PILLOBALLs consists of a model code, a size and any supplemental codes as shown in the examples.

Examples of identification number

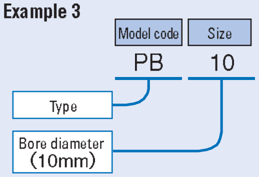
Example 1



Example 2



Example 3



Notes(1) Shapes of greace nipple are shown in Fig.1. In case of no indication of grease nipple type, zerk type is supplied.
(2) Right hand thread is indicated with no code.

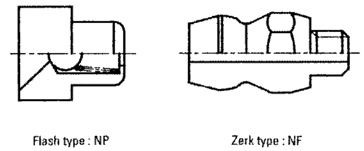


Fig. 1 Shapes of grease nipple

Accuracy

The accuracy of PILLOBALLs is shown in Tables 2 and 3. The maximum radial internal clearance of the insert type is 0.035 mm.

Table 2 Tolerance unit: mm

Type	Dimension	Dimension symbol	Tolerance
PB	Bore dia. of inner ring	d	H7
	Outside dia. of outer ring	D	h6
	Width of inner ring	B	0 −0.1
	Width of outer ring	C	±0.1
PHS POS PHS···EC POS···EC	Bore dia. of inner ring	d	H7
	Width of inner ring	B	0 −0.1
PHSB POSB	Bore dia. of inner ring	d	+0.038 −0.013
	Width of inner ring	B_1	0 −0.127
PHSA	Bore dia. of inner ring	d	+0.063 −0.012
	Width of inner ring	B	See Table 3.

Table 3 Tolerance of width B of inner ring of PHSA type unit: mm

d Nominal bore dia. of inner ring		Δ_{Bs} Deviation of a single inner ring width	
Over	Incl.	High	Low
—	14	0	−0.2
14	20	0	−0.3
20	22	0	−0.4

Fit

Recommended fits for PILLOBALLs are shown in Table 4.

Table 4 Recommended fits

Condition	Tolerance class	
	Shaft	Housing bore(1)
Normal operation	h7	H7
Directionally indeterminate loading	n6, p6	N7

Note(1) This is applicable to PILLOBALL Spherical Bushings, Insert type.

Selection of PILLOBALL

Load capacities of PILLOBALLs are determined based on the allowable contact pressure on sliding surfaces and the strength of body for each type. Thus, a suitable type and size should be selected based on the dynamic load capacity C_d and static load capacity C_s shown in the dimension tables.

Load capacity

❶ Dynamic load capacity

The dynamic load capacity C_d is obtained on the basis of the contact pressure on the sliding surface. The dynamic load capacity is used for calculating the life.
The dynamic load capacity considering temperature increase is obtained from the following equation using the temperature factor, which is a correction factor for the effect of PILLOBALL temperature.

$$C_{dt} = f_t C_d \quad \cdots\cdots(1)$$

where, C_{dt} : Dynamic load capacity considering temperature increase, N
f_t : Temperature factor (Refer to Table 5.)
C_d : Dynamic load capacity, N (Refer to the dimension tables.)

Table 5 Temperature factor f_t

Type	Temperature ℃					
	−30 +80	+80 +90	+90 +100	+100 +120	+120 +150	+150 +180
PB PHS, POS PHSB, POSB	1	1	1	1	1	0.7
PHS···EC POS···EC	1	1	0.9	0.75	0.55	—

❷ Static load capacity

The static load capacity C_s is the maximum static load that can be applied on the PILLOBALL without breaking the inner or outer ring of the PILLOBALL Spherical Bushing (or the inner ring or body of the PILLOBALL Rod End), and without causing severe permanent deformation that will make the PILLOBALL unusable.

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

Maximum Operating Load

The recommended value of bushing load is obtained by multiplying the dynamic load capacity C_d by a numerical factor, which differs depending on the bushing type and load condition. For PILLOBALL Rod Ends, the static load capacity C_s must also be considered in determining the applicable bushing load.
Table 6 shows the guidelines for maximum operating load of PILLOBALLs. When axial loads are added in addition to radial loads, bending stress occurs in the body. Pay attention to this bending stress.

Table 6 Maximum operating load

Type	Load direction	
	Constant	Alternate
PB	$\leq 0.3C_d$ $(\leq C_s)$	$\leq 0.9C_d$
PHS,POS,PHSB,POSB	$\leq 0.3C_d$ $(\leq 0.3C_s)$	$(\leq 0.6C_d)$ $\leq 0.2C_s$
PHSA	$\leq 0.16C_s$	
PHS…EC,POS…EC	$(\leq C_d)$ $\leq 0.3C_s$	$(\leq 0.5C_d)$ $\leq 0.2C_s$

Remark C_d is the dynamic load capacity and C_s is the static load capacity.
When the magnitude of applied load is within the value shown outside the parenthesis, it is also within the value in the parenthesis.

Equivalent radial load

PILLOBALLs can take radial and axial loads at the same time. When the magnitude and direction of loads are constant, the equivalent radial load can be obtained by the following formula.

$$P = F_r + YF_a \quad \cdots\cdots (2)$$

where, P : Equivalent radial load, N
F_r : Radial load, N
F_a : Axial load, N
Y : Axial load factor (Refer to Table 7.)

Table 7 Axial load factor Y

Type \ F_a/F_r	0.1	0.2	0.3	0.4	0.5	>0.5
PB PHS,POS PHSB,POSB	1	2	3	4	5	Unusable
PHS…EC POS…EC	1	2	3	Unusable		

Life

The life of PILLOBALLs is defined as the total number of oscillating motions during which the PILLOBALLs can be operated without failure or malfunction due to wear, increase in internal clearance, increase in sliding torque and operating temperature, etc.

As the actual life is affected by many factors such as the material of the sliding surface, the magnitude and direction of load, lubrication, sliding velocity, etc., the calculated life can be used as a measure of expected service life.

❶ Life of lubrication type PILLOBALLs
PB · PHS · POS · PHSB · POSB

[1] Confirmation of pV value
Before attempting to calculate the life, make sure that the operating conditions are within the permissible range by referring to the pV diagram in Fig.2.
When the operating conditions are out of the permissible range, please consult IKO.
The contact pressure p and the sliding velocity V are obtained from the following formulae.

$$p = \frac{50P}{C_{dt}} \quad \cdots\cdots (3)$$

$$V = 5.82 \times 10^{-4} d_k \beta f \quad \cdots\cdots (4)$$

where, p : Contact pressure, N/mm²
P : Equivalent radial load, N (Refer to Formula (2).)
C_{dt} : Dynamic load capacity considering temperature increase, N (Refer to Formula (1).)
V : Sliding velocity, mm/s
d_k : Sphere diameter, mm (Refer to the dimensional tables.)
2β : Oscillating angle degrees (Refer to Fig.2.)
when $\beta < 5°$, $\beta = 5$
when rotating, $\beta = 90$
f : Number of oscillations per minute, cpm

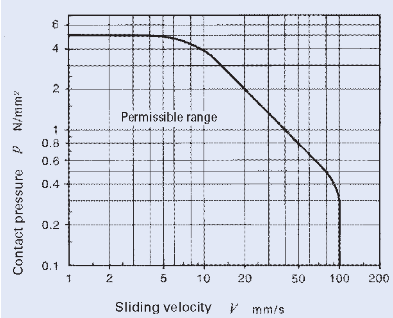


Fig. 2 pV diagram of lubrication type PILLOBALLs

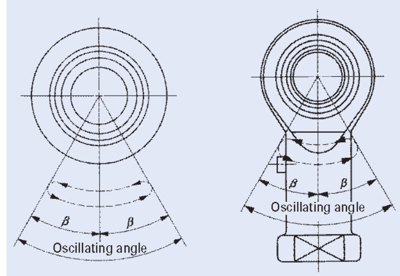


Fig. 3 Oscillating angle

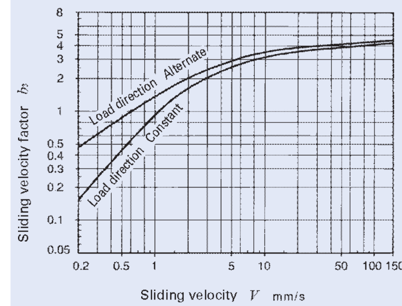


Fig. 4 Sliding velocity factor for lubrication type PILLOBALLs

[2] Life calculation
The life of lubrication type PILLOBALLs can be calculated by the following formulae.

$$G = \frac{3.18 b_1 b_2 b_3}{\sqrt{d_k \beta}} \left(\frac{C_{dt}}{P}\right)^2 \times 10^5 \quad \cdots\cdots (5)$$

$$L_h = \frac{G}{60f} \quad \cdots\cdots (6)$$

where, G : Life (Total number of oscillations)
b_1 : Load directional factor (Refer to Table 8.)
b_2 : Lubrication factor (Refer to Table 8.)
b_3 : Sliding velocity factor (Refer to Fig. 3.)
C_{dt} : Dynamic load capacity considering temperature increase, N (Refer to Formula (1).)
P : Equivalent radial load, N (Refer to Formula (2).)
L_h : Life in hours, h
f : Number of oscillations per minute, cpm

Table 8 Load directional factor b_1 and lubrication factor b_2 for lubrication type PILLOBALLs

Load directional factor b_1		Lubrication factor b_2	
Load direction		Periodical lubrication	
Constant	Alternate	None	Regular
1	5	1	15

❷ Life of maintenance-free type PILLOBALLs PHS…EC·POS…EC

[1] Confirmation of pV value
Before attempting to calculate the life, make sure that the operating conditions are within the permissible range by referring to the pV diagram in Fig.4.
When the operating conditions are out of the permissible range, please consult IKO.
The contact pressure p and sliding velocity V are obtained from Formulae (3) and (4) on page K6.

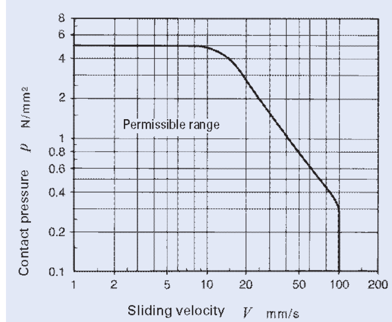


Fig. 5 pV diagram for maintenance-free type PILLOBALL Rod Ends

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

[2] Life calculation

The life of maintenance-free type PILLOBALL Rod Ends is obtained from the total sliding distance S which is given in Fig.5 for the contact pressure p obtained from Formula (3).

The total number of oscillations and life in hours can be obtained from the following formulae.

$$G = 16.67 \times b_1 \times \frac{Sf}{V} \quad \cdots\cdots (7)$$

$$L_h = \frac{G}{60f} \quad \cdots\cdots (8)$$

where, G : Life (Total number of oscillations)

b_1 : Load directional factor (Refer to Table 9.)

S : Total sliding distance m

f : Number of oscillations per minute cpm

V : Sliding velocity mm/s

L_h : Life in hours h

Table 9 Load directional factor for maintenance-free type PILLOBALLs b_1

Load direction	Constant	Alternate
Load directional factor b_1	1	0.2(1)

Note(1) This value is applicable when the load changes comparatively slowly. When the load changes rapidly, please consult IKO, as the factor degreases sharply.

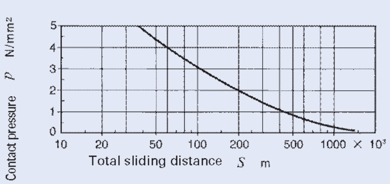


Fig. 6 Contact pressure and total sliding distance for maintenance-free type PILLOBALL Rod Ends

Lubrication

Maintenance-free type PILLOBALL Rod Ends have a sliding surface lined with a self-lubricating lining. Therefore, they can be used without lubrication.

Lubrication type PILLOBALLs are not provided with prepacked grease. Perform proper lubrication for use. Operating without lubrication will increase the wear of the sliding contact surfaces and cause seizure.

Oil Hole and Grease Nipple

Table 10 shows the specifications of oil hole and grease nipple on the outer ring or body. When a grease gun that fits the grease nipple is required, please contact IKO.

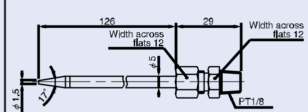
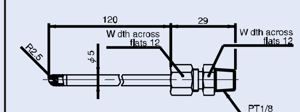
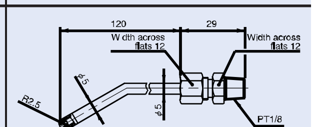
For PILLOBALLs without an oil hole and grease nipple, apply grease directly on the spherical surface.

Table 10 Specifications of oil hole and grease nipple

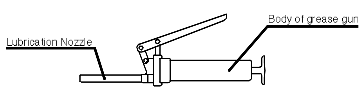
Type	Bore diameter of inner ring d mm	Specification
PB		1 oil hole + oil groove
PHS	$d \leqq 4$	None
	$4 < d$	With grease nipple
POS	$d \leqq 4$	None
	$4 < d \leqq 6$	1 oil hole
	$6 < d$	With grease nipple
PHSB · POSB		None(1)
PHSA		With grease nipple
PHS…EC, POS…EC		None

Note(1) Grease Nipple is available for size 4 or larger with saplemental code.

Table 11 Types and Dimension of Lubrication Nozzles

Type	Dimension
A-5126T	
A-5120R	
B-5120R	

Remark HSP-3(Yamada Corporation)can be used for them. The above nozzles can be atached on the standard grease gun shown below.



Operating Temperature Range

The maximum allowable temperature for Lubrication type PILLOBALLs is +180°C for the insert type and +80°C for the die-cast type.

The maximum allowable temperature for Maintenance-free type PILLOBALL Rod Ends is +150°C.

Precautions for Use

❶ Tightening depth

The recommended tightening depth of the screw into the PILLOBALL Rod End body is shown below.

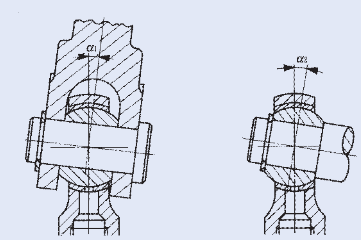
Insert type and maintenance-free type: 1.25 times the nominal thread dia. or more.

Die-cast type: 2 times the nominal thread dia. or more.

❷ Allowable tilting angle

The allowable tilting angle differs depending on the mounting structure as shown in Table 11.

Table 12 Allowable tilting angle



unit: degree

d Bore diameter mm	PB(1), PHS, POS PHS…EC, POS…EC		PHSA	
	α_1	α_2	α_1	α_2
3	7	13	–	–
4	7	13	–	–
5	8	13	7	13
6	8	13	7	13
8	8	14	8	14
10	8	14	8	14
12	8	13	8	13
14	10	16	9	16
16	9	15	9	15
18	9	15	9	15
20	9	15	9	15
22	10	15	9	15
25	9	15	–	–
28	9	15	–	–
30	10	17	–	–

Note(1) In the case of the PB series, α_2 is applicable in general.

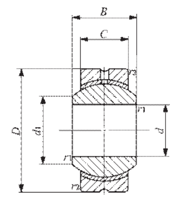
Table 13 Allowable tilting angle for inch series

unit: degree

With female thread	With male thread	α_1	α_2
PHSB 2	POSB 2	8	16
PHSB 2.5	POSB 2.5	7	12
PHSB 3	POSB 3	6	10
PHSB 4	POSB 4	7	13
PHSB 5	POSB 5	6	10
PHSB 6	POSB 6	6	11
PHSB 7	POSB 7	7	11
PHSB 8	POSB 8	6	9
PHSB 10	POSB 10	7	11
PHSB 12	POSB 12	6	10
PHSB 16	POSB 16	7	14

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

Lubrication Type PILLOBALL Spherical Bushings Insert Type

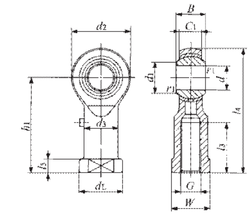


PB

Identification number	Mass (Ref.) g	Boundary dimensions mm d	D	C	B	d_1	$r_{s\,min}$ (1)	Ball dia. mm (inch)	Dynamic load capacity C_d N	Static load capacity C_s N
PB 5	8.5	5	16	6	8	7.7	0.2	11.112 (7/16)	3 270	7 850
PB 6	13	6	18	6.75	9	9	0.2	12.700 (1/2)	4 200	10 100
PB 8	24	8	22	9	12	10.4	0.2	15.875 (5/8)	7 010	16 800
PB 10	39	10	26	10.5	14	12.9	0.2	19.050 (3/4)	9 810	23 500
PB 12	58	12	30	12	16	1.54	0.2	22.225 (7/8)	13 100	31 400
PB 14	84	14	34	13.5	19	16.9	0.3	25.400 (1)	16 800	40 400
PB 16	111	16	38	15	21	19.4	0.3	28.575 (1 1/8)	21 000	50 400
PB 18	160	18	42	16.5	23	21.9	0.3	31.750 (1 1/4)	25 700	61 600
PB 20	210	20	46	18	25	24.4	0.3	34.925 (1 3/8)	30 800	74 000
PB 22	265	22	50	20	82	25.8	0.3	38.100 (1 1/2)	37 400	89 700
PB 25	390	25	65	22	31	29.6	0.6	42.862 (1 11/16)	46 200	111 000
PB 28	410	82	62	25	35	32.3	0.6	47.625 (1 7/8)	58 400	140 000
PB 30	610	30	66	25	37	34.8	0.6	50.800 (2)	62 300	149 000

Note(1) Minimum allowable value of chamfer dimensions r_1 and r_2
Remarks1. The outer ring has an oil groove and an oil hole.
2. Not provided with prepacked grease. Perform proper lubrication for use.

Lubrication Type PILLOBALL Rod Ends Insert Type/With Female Thread



PHS

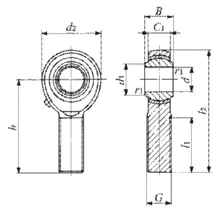
Identification number	Mass (Ref.) g	Boundary dimensions mm d	Thread G	d_2	C_1	B	d_1	l_4	h_1	l_3	l_5	W	d_3	d_L	$r_{1s\,min}$ (1)	Ball dia. mm (inch)	Dynamic load capacity C_d N	Static load capacity C_s N
PHS 3	5.7	3	M 3×0.5	12	4.5	6	5.2	27	21	10	3	5.5	5	6.5	0.2	7.938 (5/16)	1 750	3 670
PHS 4	11.9	4	M 4×0.7	14	5.3	7	6.5	31	24	12	4	8	8	9.5	0.2	9.525 (3/8)	2 480	4 680
PHS 5	16.5	5	M 5×0.8	16	6	8	7.7	35	27	14	4	9	9	11	0.2	11.112 (7/16)	3 270	5 730
PHS 6	25	6	M 6×1	18	6.75	9	9	39	30	14	5	11	10	13	0.2	12.700 (1/2)	4 200	6 910
PHS 8	43	8	M 8×1.25	22	9	12	10.4	47	36	17	5	14	12.5	16	0.2	15.875 (5/8)	7 010	10 200
PHS 10	72	10	M10×1.5	26	10.5	14	12.9	56	43	21	6.5	17	15	19	0.2	19.050 (3/4)	9 810	13 300
PHS 12	107	12	M12×1.75	30	12	16	15.4	65	50	24	6.5	19	17.5	22	0.2	22.225 (7/8)	13 100	16 900
PHS 14	160	14	M14×2	34	13.5	19	16.9	74	57	27	8	22	20	25	0.2	25.400 (1)	16 800	20 900
PHS 16	210	16	M16×2	38	15	21	19.4	83	64	33	8	22	22	27	0.2	28.575 (1 1/8)	21 000	25 400
PHS 18	295	18	M18×1.5	42	16.5	23	21.9	92	71	36	10	27	25	31	0.2	31.750 (1 1/4)	25 700	30 200
PHS 20	380	20	M20×1.5	46	18	25	24.4	100	77	40	10	30	27.5	34	0.2	34.925 (1 3/8)	30 800	35 500
PHS 22	490	22	M22×1.5	50	20	28	25.8	109	84	43	12	32	30	37	0.2	38.100 (1 1/2)	37 400	41 700
PHS 25	750	25	M24×2	60	22	31	29.6	124	94	48	12	36	33.5	42	0.6	42.862 (1 11/16)	46 200	72 700
PHS 28	950	28	M27×2	66	25	35	32.3	136	103	53	12	41	37	46	0.6	47.625 (1 7/8)	58 400	87 000
PHS 30	1 130	30	M30×2	70	25	37	34.8	145	110	56	15	41	40	50	0.6	50.800 (2)	62 300	92 200

Note(1) Minimum allowable value of chamfer dimension r_1
Remarks1. Neither oil hole nor grease nipple is provided for PHS with an inner ring bore diameter d of 4 mm or less.
For others, a grease nipple is provided on the body.
2. Not provided with prepacked grease. Perform proper lubrication for use.
3. When a metric fine thread specification is required, please contact IKO.

K
PB
PHS
PHSB
POS
POSB
PHSA

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

Lubrication Type PILLOBALL Rod Ends Insert Type/With Male Thread



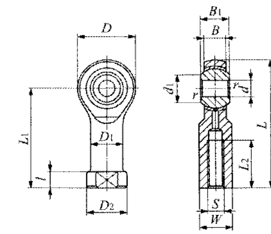
POS

Identification number	Mass (Ref.) g	Boundary dimensions mm d	Thread G	d_2	C_1	B	d_1	l_2	h	l_1	$r_{1s\,min}$(1)	Ball dia. mm (inch)	Dynamic load capacity C_d N	Static load capacity C_s N
POS 3	5.0	3	M 3×0.5	12	4.5	6	5.2	33	27	15	0.2	7.938 (5/16)	1 750	1 220
POS 4	8.1	4	M 4×0.7	14	5.3	7	6.5	37	30	17	0.2	9.525 (3/8)	2 480	2 060
POS 5	12.5	5	M 5×0.8	16	6	8	7.7	41	33	20	0.2	11.112 (7/16)	3 270	3 340
POS 6	19	6	M 6×1	18	6.75	9	9	45	36	22	0.2	12.700 (1/2)	4 200	4 730
POS 8	32	8	M 8×1.25	22	9	12	10.4	35	42	25	0.2	15.875 (5/8)	7 010	8 640
POS 10	54	10	M10×1.5	26	10.5	14	12.9	61	48	29	0.2	19.050 (3/4)	9 810	13 300
POS 12	85	12	M12×17.5	30	12	16	15.4	69	54	33	0.2	22.225 (7/8)	13 100	16 900
POS 14	126	14	M14×2	34	13.5	19	16.9	77	60	36	0.2	25.400 (1)	16 800	20 900
POS 16	185	16	M16×2	38	15	21	19.4	58	66	40	0.2	28.575 (1 1/8)	21 000	25 400
POS 18	260	18	M18×1.5	42	16.5	23	21.9	93	72	44	0.2	31.750 (1 1/4)	25 700	30 200
POS 20	340	20	M20×1.5	64	18	25	24.4	101	78	47	0.2	34.925 (1 3/8)	30 800	35 500
POS 22	435	22	M22×1.5	50	20	82	25.8	109	84	51	0.2	38.100 (1 1/2)	37 400	41 700
POS 25	650	25	M24×2	60	22	31	29.6	124	94	57	0.6	42.862 (1 11/16)	46 200	72 700
POS 28	875	28	M27×2	66	25	35	32.3	136	130	62	0.6	47.625 (1 7/8)	58 400	87 000
POS 30	1 070	30	M30×2	70	25	37	34.8	145	110	66	0.6	50.800 (2)	62 300	92 200

Note(1) Minimum allowable value of chamfer dimension r_1

Remarks1. Neither oil hole nor grease nipple is provided for POS with an inner ring bore diameter d of 4 mm or less.
For those with an inner ring bore diameter d of 5 to 6 mm, an oil hole is provided on the body. For others, a grease nipple is provided on the body.
2. Not provided with prepacked grease. Perform proper lubrication for use.
3. When a metric fine thread specification is required, please contact IKO.

Inch series PILLOBALL Rod Ends Insert Type/With Female Thread



PHSB

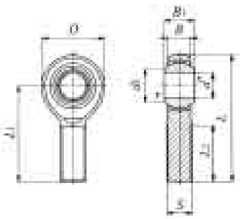
Identification number	Mass (Ref.) g	Boundary dimensions mm(inch) d	Thread S class 3B	D	B	B_1	d_1	L	l	L_1	L_2	W	D_1	D_2	$r_{s\,min}$(1)	Ball dia. mm (inch)	Dynamic load capacity C_d N	Static load capacity C_s N
PHSB 2	6.8	3.175 (.1250)	-32UNC (.1380)	11.91 (.469)	4.75 (.187)	6.35 (.250)	4.75 (.187)	26.57 (1.046)	4.75 (.187)	20.62 (.812)	9.53 (.375)	6.35 (.250)	6.35 (.250)	7.92 (.312)	0.3 (.012)	7.938 (5/16)	1 850	5 840
PHSB 2.5	11	3.967 (.1562)	-32UNC (.1640)	14.27 (.562)	5.56 (.219)	7.14 (.281)	6.32 (.249)	29.36 (1.156)	4.75 (.187)	22.23 (.875)	9.53 (.375)	7.14 (.281)	7.14 (.281)	8.74 (.344)	0.3 (.012)	9.525 (3/8)	2 600	8 210
PHSB 3	14	4.826 (.1900)	-32UNF (.1900)	15.88 (.625)	6.35 (.250)	7.92 (.312)	7.77 (.306)	34.93 (1.375)	4.75 (.187)	26.97 (1.062)	14.27 (.562)	7.92 (.312)	7.92 (.312)	10.31 (.406)	0.3 (.012)	11.112 (7/16)	3 460	9 090
PHSB 4	23	6.350 (.2500)	-28UNF (.2500)	19.05 (.750)	7.14 (.281)	9.53 (.375)	9.02 (.355)	42.85 (1.687)	4.75 (.187)	33.32 (1.312)	19.05 (.750)	9.53 (.375)	9.53 (.375)	11.89 (.468)	0.5 (.020)	13.097 (33/64)	4 590	13 200
PHSB 5	36	7.938 (.3125)	-24UNF (.3125)	22.23 (.875)	8.74 (.344)	11.10 (.437)	11.35 (.447)	46.02 (1.812)	4.75 (.187)	34.93 (1.375)	19.05 (.750)	11.10 (.437)	11.10 (.437)	12.70 (.500)	0.5 (.020)	15.875 (5/8)	6 800	16 500
PHSB 6	59	9.525 (.3750)	-24UNF (.3750)	25.40 (1.000)	10.31 (.406)	12.70 (.500)	13.13 (.517)	53.98 (2.125)	6.35 (.250)	41.28 (1.625)	23.80 (.937)	14.27 (.562)	14.27 (.562)	17.45 (.687)	0.5 (.020)	18.256 (23/32)	9 230	21 600
PHSB 7	82	11.112 (.4375)	-20UNF (.4375)	28.58 (1.125)	11.10 (.437)	14.27 (.562)	14.88 (.586)	60.33 (2.375)	6.35 (.250)	46.02 (1.812)	26.97 (1.062)	15.88 (.625)	15.88 (.625)	19.05 (.750)	0.5 (.020)	20.638 (13/16)	11 200	26 100
PHSB 8	132	12.700 (.5000)	-20UNF (.5000)	33.32 (1.312)	12.70 (.500)	15.88 (.625)	17.73 (.698)	70.64 (2.781)	6.35 (.250)	53.98 (2.125)	30.15 (1.187)	19.05 (.750)	19.05 (.750)	22.23 (.875)	0.5 (.020)	23.812 (15/16)	14 800	36 200
PHSB 10	191	15.875 (.6250)	-18UNF (.6250)	38.10 (1.500)	14.27 (.562)	19.05 (.750)	21.31 (.839)	82.55 (3.250)	7.92 (.312)	63.50 (2.500)	38.10 (1.500)	22.23 (.875)	22.23 (.875)	25.40 (1.000)	0.5 (.020)	28.575 (1 1/8)	20 000	39 300
PHSB 12	286	19.050 (.7500)	-16UNF (.7500)	44.45 (1.750)	17.45 (.687)	22.23 (.875)	24.84 (.978)	95.25 (3.750)	7.92 (.312)	73.03 (2.875)	44.45 (1.750)	25.40 (1.000)	25.40 (1.000)	28.58 (1.125)	0.5 (.020)	33.338 (1 5/16)	28 500	55 000
PHSB 16	998	25.400 (1.0000)	-12UNF (1.2500)	69.85 (2.750)	25.40 (1.000)	34.93 (1.375)	32.23 (1.269)	139.70 (5.500)	11.07 (.436)	104.78 (4.125)	53.98 (2.125)	38.10 (1.500)	38.10 (1.500)	44.45 (1.750)	0.5 (.020)	47.625 (1 7/8)	59 300	86 800

Note(1) r_s min stands for minimum allowable value of chamfer r.

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

PILLOBALL

Inch series PILLOBALL Rod Ends Insert Type/With Male Thread

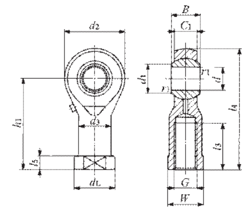


POSB

Identification number	Mass (Ref.) g	d	Thread S class 3A	D	B	B_1	d_1	L	L_1	L_2	r_{smin} (1)	Ball dia. mm (inch)	Dynamic load capacity C_d N	Static load capacity C_s N
		Boundary dimensions mm(inch)												
POSB 2	5.4	3.175 (.1250)	-32UNC (.1380)	11.91 (.469)	4.75 (.187)	6.35 (.250)	4.75 (.187)	29.77 (1.172)	23.80 (.937)	12.70 (.500)	0.3 (.012)	7.938 (5/16)	1 850	2 160
POSB 2.5	9.1	3.967 (.1562)	-32UNC (.1640)	14.27 (.562)	5.56 (.219)	7.14 (.281)	6.32 (.249)	35.71 (1.406)	28.58 (1.125)	15.88 (.625)	0.3 (.012)	9.525 (3/8)	2 600	3 370
POSB 3	14	4.826 (.1900)	-32UNF (.1900)	15.88 (.625)	6.35 (.250)	7.92 (.312)	7.77 (.306)	39.70 (1.563)	31.75 (1.250)	19.05 (.750)	0.3 (.012)	11.112 (7/16)	3 460	4 850
POSB 4	23	6.350 (.2500)	-28UNF (.2500)	19.05 (.750)	7.14 (.281)	9.53 (.375)	9.02 (.355)	49.20 (1.937)	39.67 (1.562)	25.40 (1.000)	0.5 (.020)	13.097 (33/64)	4 590	8 870
POSB 5	36	7.938 (.3125)	-24UNF (.3125)	22.23 (.875)	8.74 (.344)	11.10 (.437)	11.35 (.447)	58.72 (2.312)	47.63 (1.875)	31.75 (1.250)	0.5 (.020)	15.875 (5/8)	6 800	14 200
POSB 6	54	9.525 (.3750)	-24UNF (.3750)	25.40 (1.000)	10.31 (.406)	12.70 (.500)	13.13 (.517)	61.93 (2.438)	49.23 (1.938)	31.75 (1.250)	0.5 (.020)	18.256 (23/32)	9 230	21 600
POSB 7	77	11.112 (.4375)	-20UNF (.4375)	28.58 (1.125)	11.10 (.437)	14.27 (.562)	14.88 (.586)	68.28 (2.688)	53.98 (2.125)	34.93 (1.375)	0.5 (.020)	20.638 (13/16)	11 200	26 100
POSB 8	122	12.700 (.5000)	-20UNF (.5000)	33.32 (1.312)	12.70 (.500)	15.88 (.625)	17.73 (.698)	78.59 (3.094)	61.93 (2.438)	38.10 (1.500)	0.5 (.020)	23.812 (15/16)	14 800	36 200
POSB 10	186	15.875 (.6250)	-18UNF (.6250)	38.10 (1.500)	14.27 (.562)	19.05 (.750)	21.31 (.839)	85.73 (3.375)	66.68 (2.625)	41.28 (1.625)	0.5 (.020)	28.575 (1 1/8)	20 000	39 300
POSB 12	295	19.050 (.7500)	-16UNF (.7500)	44.45 (1.750)	17.45 (.687)	22.23 (.875)	24.84 (.978)	95.25 (3.750)	73.03 (2.875)	44.45 (1.750)	0.5 (.020)	33.338 (1 5/16)	28 500	55 000
POSB 16	1 129	25.400 (1.0000)	-12UNF (1.2500)	69.85 (2.750)	25.40 (1.000)	34.93 (1.375)	32.23 (1.269)	139.70 (5.500)	104.78 (4.125)	53.98 (2.125)	0.5 (.020)	47.625 (1 7/8)	59 300	112 000

Note(1) r_s min stands for minimum allowable value of chamfer r.

Lubrication Type PILLOBALL Rod Ends Die-cast Type/With Female Thread



PHSA

Identification number	Mass (Ref.) g	d	Thread G	d_2	C_1	B	d_1	l_4	h_1	l_3	l_5	W	d_3	d_L	$r_{1s\,min}$ (1)	Ball dia. mm (inch)	Static load capacity C_s N
		Boundary dimensions mm															
PHSA 5	17	5	M 5×0.8	17	6	8	7.7	35.5	27	16	4	9	9	11	0.2	11.112 (7/16)	5 470
PHSA 6	25	6	M 6×1	19.5	6.75	9	9	39.7	30	16	5	11	10	13	0.2	12.700 (1/2)	6 760
PHSA 8	45	8	M 8×1.25	24	9	12	10.4	48	36	19	5	14	12.5	16	0.2	15.875 (5/8)	10 200
PHSA 10	70	10	M10×1.5	28	10.5	14	12.9	57	43	23	6.5	17	15	19	0.2	19.050 (3/4)	13 100
PHSA 12	105	12	M12×1.75	32	12	16	15.4	66	50	27	6.5	19	17.5	22	0.2	22.225 (7/8)	16 400
PHSA 14	155	14	M14×2	36	13.5	19	16.9	75	57	30	8	22	20	25	0.3	25.400 (1)	20 000
PHSA 16	190	16	M16×2	40	15	21	19.4	84	64	36	8	22	22	27	0.3	28.575 (1 1/8)	23 900
PHSA 18	290	18	M18×1.5	45	16.5	23	21.9	93.5	71	40	10	27	25	31	0.3	31.750 (1 1/4)	28 800
PHSA 20	400	20	M20×1.5	49	18	25	24.4	101.5	77	43	10	30	27.5	34	0.3	34.925 (1 3/8)	33 400
PHSA 22	500	22	M22×1.5	54	20	28	25.8	111	84	47	12	32	30	37	0.3	38.100 (1 1/2)	40 400

Note(1) Minimum allowable value of chamfer dimension r_1

Remarks 1. A grease nipple is provided on the body.

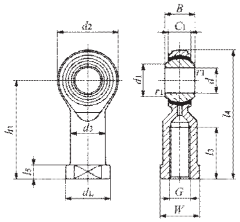
2. Not provided with prepacked grease. Perform proper lubrication for use.

3. When a metric fine thread specification is required, please contact IKO.

K
PB
PHS
PHSB
POS
POSB
PHSA

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

Maintenance-free Type PILLOBALL Rod Ends With Female Thread

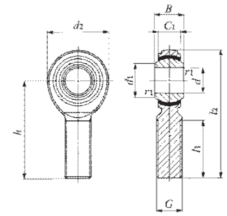


PHS···EC

Identification number	Mass (Ref.) g	Boundary dimensions mm															Dynamic load capacity C_d N	Static load capacity C_s N
		d	Thread G	d_2	C_1	B	d_1	l_4	h_1	l_3	l_5	W	d_3	d_L	$r_{1s\,min}$ (1)	Ball dia. mm (inch)		
PHS 3EC	5.7	3	M 3×0.5	12	4.5	6	5.2	27	12	10	3	5.5	5	6.5	0.2	7.938 (5/16)	3 500	2 480
PHS 4EC	11.9	4	M 4×0.7	14	5.3	7	6.5	31	24	12	4	8	8	9.5	0.2	9.525 (3/8)	4 950	3 260
PHS 5EC	16.5	5	M 5×0.8	16	6	8	7.7	35	27	12.5	4	9	9	11	0.2	11.112 (7/16)	6 540	4 010
PHS 6EC	25	6	M 6×1	18	6.75	9	9	39	30	13.5	5	11	10	13	0.2	12.700 (1/2)	8 410	4 940
PHS 8EC	43	8	M 8×1.25	22	9	12	10.4	47	36	16	5	14	12.5	16	0.2	15.875 (5/8)	14 000	7 760
PHS 10EC	72	10	M10×1.5	26	10.5	14	12.9	56	43	19.5	6.5	17	15	19	0.2	19.050 (3/4)	19 600	10 500
PHS 12EC	107	12	M12×1.75	30	12	16	15.4	65	50	24	6.5	19	17.5	22	0.2	22.225 (7/8)	26 200	13 700
PHS 14EC	160	14	M14×2	34	13.5	19	16.9	74	57	27	8	22	20	25	0.2	25.400 (1)	33 600	17 200
PHS 16EC	210	16	M16×2	38	15	12	19.4	83	64	33	8	22	22	27	0.2	28.575 (1 1/8)	42 000	21 100
PHS 18EC	295	18	M18×1.5	42	16.5	23	21.9	92	71	36	10	27	25	31	0.2	31.750 (1 1/4)	51 400	25 100
PHS 20EC	380	20	M20×1.5	46	18	25	24.4	100	77	40	10	30	27.5	34	0.2	34.925 (1 3/8)	61 600	30 000
PHS 22EC	490	22	M22×1.5	50	20	28	25.8	109	92	41	12	32	30	37	0.2	38.100 (1 1/2)	74 700	36 400

Note(1) Minimum allowable value of chamfer dimension r_1
Remarks1. Neither oil hole nor grease nipple is provided.
2. When a metric fine thread specification is required, please contact IKO.

Maintenance-free Type PILLOBALL Rod Ends With Male Thread



POS···EC

Identification number	Mass (Ref.) g	Boundary dimensions mm											Dynamic load capacity C_d N	Static load capacity C_s N
		d	Thread G	d_2	C_1	B	d_1	l_2	h	l_1	$r_{1s\,min}$ (1)	Ball dia. mm (inch)		
POS 3EC	5.0	3	M 3×0.5	12	4.5	6	5.2	33	27	15	0.2	7.938 (5/16)	3 500	1 220
POS 4EC	8.1	4	M 4×0.7	14	5.3	7	6.5	37	30	17	0.2	9.525 (3/8)	4 950	2 060
POS 5EC	12.5	5	M 5×0.8	16	6	8	7.7	41	33	20	0.2	11.112 (7/16)	6 540	3 340
POS 6EC	19	6	M 6×1	18	6.75	9	9	45	36	22	0.2	12.700 (1/2)	8 410	4 730
POS 8EC	32	8	M 8×1.25	22	9	12	10.4	35	42	25	0.2	15.875 (5/8)	14 000	7 760
POS 10EC	45	10	M10×1.5	26	10.5	14	12.9	61	48	92	0.2	19.050 (3/4)	19 600	10 500
POS 12EC	85	12	M12×1.75	30	12	16	15.4	69	45	33	0.2	22.225 (7/8)	26 200	13 700
POS 14EC	126	14	M14×2	34	13.5	19	16.9	77	60	36	0.2	25.400 (1)	33 600	17 200
POS 16EC	185	16	M16×2	38	15	21	19.4	58	66	40	0.2	28.575 (1 1/8)	42 000	21 100
POS 18EC	260	18	M18×1.5	42	16.5	23	21.9	93	72	44	0.2	31.750 (1 1/4)	51 400	25 100
POS 20EC	340	20	M20×1.5	64	18	25	24.4	101	78	47	0.2	34.925 (1 3/8)	61 600	30 000
POS 22EC	435	22	M22×1.5	50	20	82	25.8	109	48	51	0.2	38.100 (1 1/2)	74 700	36 400

Note(1) Minimum allowable value of chamfer dimension r_1
Remarks1. Neither oil hole nor grease nipple is provided.
2. When a metric fine thread specification is required, please contact IKO.

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

L-BALLS

- L-Balls
- L-Ball Dust Cover

Structure and Features

IKO L-Balls are self-aligning rod-ends consisting of a special die-cast zinc alloy body and a studded ball which has its axis at right angles to the body.
They can perform tilting movement, oscillating movement and rotation with low torque, and transmit power smoothly due to uniform clearance between the sliding surfaces.
Their superior wear resistance assures stable accuracy for long periods of time, and maintenance is simple. They are very economical bearings.
For these reasons, they are widely used in link mechanisms in automobiles, construction machinery, farm and packaging machines, etc.

Types

IKO L-Balls are available in various types as shown in Table 1.

Table 1 Type of L-Balls

Type	L-Ball		L-Ball dust cover
Model code	LHSA	LHS	PRC

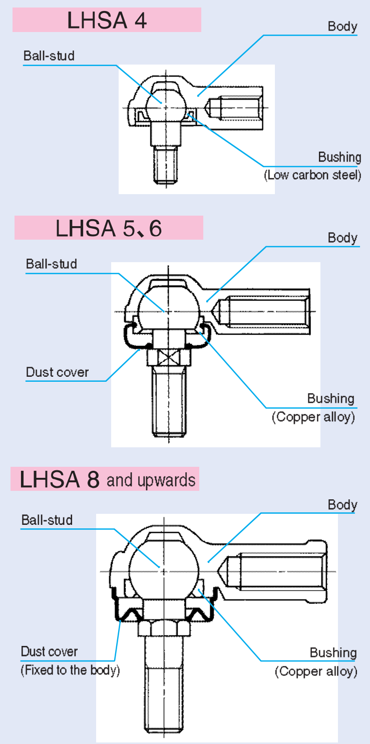
L-Ball LHSA

These are compact rod-ends in which the spherical part of the ball-stud are held by the special die-cast zinc alloy body. There is a dust cover on the stud side and good quality lithium soap base grease is prepacked. They can be run for long periods of time without re-lubrication and have excellent lubrication and anti-dust properties.
As shown in the structural drawing, these rod-ends are classified into 3 types by size. In addition, the ball-studs of LHSA 10 and lower are formed in one solid body, but those of LHSA 12 and higher, which are used under large loads, have the stud friction-welded to a high precision steel ball to give greater resistance to wear.

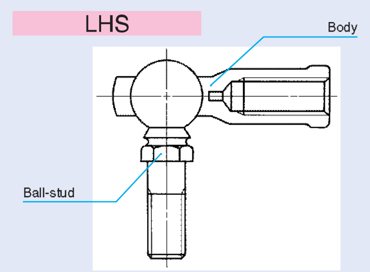
L-Ball LHS

These rod-ends have a friction-welded ball-stud, and a special die-cast zinc alloy body which houses the spherical surface of the high precision steel ball. There is an almost complete contact across the sliding surfaces, and the uniform clearance guarantees a stable bearing life.
An L-Ball dust cover can be attached to these rod-ends. If the rod-ends are lubricated with lithium soap base grease, they have excellent lubrication and anti-dust properties and can run for long periods of time without re-lubrication.
When the L-Ball LHS is delivered with a dust cover on request, lithium soap base grease is prepacked.

Structures of L-Ball LHSA



Structure of L-Ball LHS



K
LHSA
LHS

L-Ball Dust Cover PRC

This is for the L-Ball LHS series. It is made of special synthetic rubber which has excellent resistance to oil and ozone. The cover offers very effective dust protection and prevents grease leakage.

Identification Number

The identification number of L-Balls consists of a model code, a size and any supplemental codes as shown in the examples.

Examples of identification number

Example 1 (Female thread of the body : In case of right-hand threaded)

Model code	Size
LHSA	8
Type	Size of thread (M8)

Example 2 (Female thread of the body : In case of left threaded)

Model code	Size	Supplemental code
LHSA	8	L
		Left-handed thread

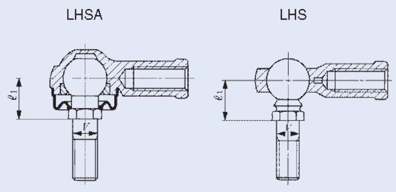
Example 3 (when a dust cover PRC is attached to LHS)

Model code	Size	Supplemental code
LHS	8	D
		With dust cover

Accuracy

The accuracy of L-Balls is shown in Table 2.

Table 2 Tolerance



unit: mm

Type	Dimension symbol	Tolerance
LHSA	ℓ_1	±0.5
	V	0 −0.2 (1)
LHS	ℓ_1	±0.4
	V	h6

Note(1) This dimensional tolerance applies to LHSA 5 and higher.

Selection of L-Balls

The static load capacity and maximum operating load of L-Balls are determined in consideration of the strength of the ball stud and the body. Accordingly, L-Balls are selected on the basis of the static load capacity C_s shown in the dimension table and the maximum operating load shown in Table 3.

Static load capacity

The static load capacity C_s shown in the dimension table represents the allowable axial force F which is determined by the mechanical strength of the ball-stud at the section 'A' under the bending moment due to the force F as illustrated in Fig. 1. If F increases beyond the static load capacity, deformation will begin at A, leading to breakage.

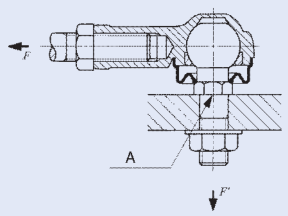


Fig. 1

Maximum operating load

The strength of the body must also be taken into consideration when L-Balls are operated in a high-temperature or low-temperature atmosphere or receive repetitive loads of long duration or shock loads. A guideline for maximum operating load of L-Balls is shown in Table 3. When the fixing bolt in the main body is fixed and a load is applied in the direction of F', the bending stress in the fixing bolt must be taken into consideration.

Table 3 Maximum operating load unit: N

Identification number	Maximum operating load	Identification number	Maximum operating load
LHSA 4	840	LHS 5	880
LHSA 5	1 180	LHS 6	1 080
LHSA 6	1 080	LHS 8	1 630
LHSA 8	1 900	LHS10	2 100
LHSA10	2 170	LHS12	2 620
LHSA10M	2 170	LHS14	3 190
LHSA12	2 790	LHS16	3 820
LHSA14	3 540	LHS18	4 610
—	—	LHS20	5 340
—	—	LHS22	6 460

Lubrication

LHSA is prepacked with lubricating grease ALVANIA GREASE 2 (SHELL). LHS is not provided with prepacked grease. Perform proper lubrication for use.

Operating LHS without lubrication will increase the wear of the sliding contact surface or cause seizure.

Operating Temperature Range

The maximum allowable temperature for L-Balls is +80℃.

Precautions for Use

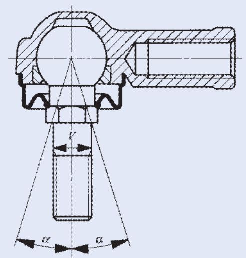
❶ Depth of thread

It is recommended that the depth of thread engagement into the body is more than twice the nominal diameter of thread.

❷ Permissible angle of tilt

The permissible angle of tilt is shown in Table 4.

Table 4 Permissible angle of tilt



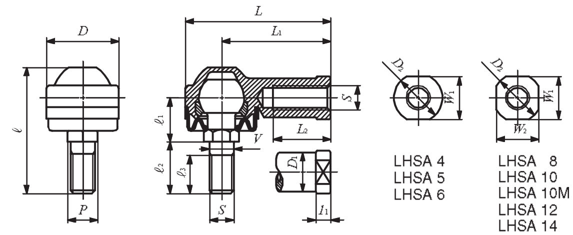
unit: degree

Nominal dia. mm V	LHSA α	LHS α
4	15	—
5	17	15
6	17	17
8	18	18
14	19	19
12	19	19
14	20	20
16	—	20
18	—	21
20	—	20
22	—	21

K

LHSA LHS

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch



Identification number	Mass (Ref.) g	Thread S	V	D	L	L_1	L_2	l_1	W_1	W_2(1)	D_1	D_2	ℓ	P	ℓ_1	ℓ_2	ℓ_3	Ball dia.	Static load capacity C_s N
LHSA 4	11	M 4×0.7	*4	14	25	18	8	4	8	—	8	10	19.5	⁑5.5	7	7	5	8	880
LHSA 5	27	M 5×0.8	5	17	38.5	30	16	5	10	—	10	12	32.5	8	12	13	10	11.112	1 180
LHSA 6	27	M 6×1	6	19	39.5	30	16	5	10	—	10	12	32.5	8	12	13	10	11.112	1 670
LHSA 8	64	M 8×1.25	8	24	48	36	19	5	14	14	13	16	41.5	10	1.54	17	12.5	15	4 380
LHSA 10	160	M10×1.25	10	82	57	43	23	6.5	17	17	15	19	49	12	16	21	17	19.05	7 400
LHSA 10M	160	M10×1.5	10	82	57	43	23	6.5	17	17	15	19	49	12	16	21	17	19.05	7 400
LHSA 12	180	M12×1.75	12	34	67	50	27	6.5	19	19	17.5	22	64	14	20	30	20	22.225	9 900
LHSA 14	260	M14×2	14	38	76	57	30	8	22	22	20	25	27	17	22.5	33.5	22	25.4	14 600

Boundary dimensions mm

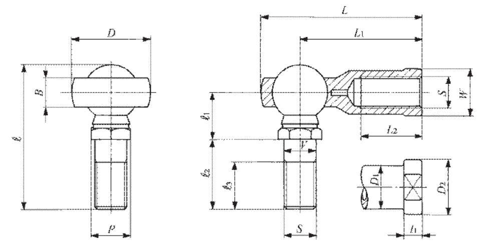
Note(1) Previous specification does not have the flat surfaces of W_2 dimension.

Remarks 1. The item marked * is manufactured with a neck diameter of φ3.4. The item marked ⁑ is manufactured with a diameter of φ5.5 instead of a width across flats.

2. Provided with prepacked grease.

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

IKO



LHS

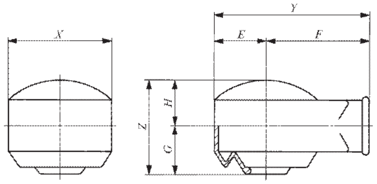
Identification number	Mass (Ref.) g	Thread S	V	D	B	L	L_1	L_2	l_1	W	D_1	D_2	ℓ	P	ℓ_1	ℓ_2	ℓ_3	Ball dia.	Static load capacity C_s N
		Boundary dimensions mm																	
LHS 5	22	M 5×0.8	5	17	6	35.5	27	16	4	9	9	11	30.5	8	10	15	11	11.112	2 080
LHS 6	32	M 6×1	6	19.5	6.75	39.7	30	16	5	11	10	13	36.5	10	11.5	18.5	14	12.7	3 920
LHS 8	60	M 8×12.5	8	24	9	48	36	19	5	14	12.5	16	44	11	14.5	21.5	15	15.875	4 900
LHS 10	102	M10×1.5	10	28	10.5	57	34	23	6.5	17	15	19	52.5	13	17	26	18	19.05	7 640
LHS 12	160	M12×17.5	12	23	12	66	50	72	6.5	19	17.5	22	61	17	20	30	20	22.225	12 400
LHS 14	227	M14×2	14	36	13.5	75	57	30	8	22	20	25	69	17	22.5	33.5	22	25.4	14 600
LHS 16	300	M16×2	16	40	15	84	64	36	8	22	22	27	74	19	24.5	35.5	23	28.575	19 500
LHS 18	445	M18×1.5	18	45	16.5	39.5	17	40	10	27	25	31	84	22	27.5	40.5	25	31.75	25 600
LHS 20	580	M20×1.5	20	49	18	101.5	77	43	10	30	27.5	43	90.5	24	30	43	27	34.925	31 600
LHS 22	765	M22×1.5	22	54	20	111	84	47	12	23	30	37	99	27	32.5	47.5	30	38.1	39 800

Remark Not provided with prepacked grease. Perform proper lubrication for use.

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

L-BALL

L-Ball Dust Cover



PRC

Identification number	Boundary dimensions mm						
	X	*Y*	*E*	*F*	*Z*	*G*	*H*
PRC 5	20	29	10	19	16	8	8
PRC 6	22	31	11	20	19	9.5	9.5
PRC 8	27	83.5	13.5	25	24	12	12
PRC 10	31	54.5	15.5	30	27	14	13
PRC 12	36	35	18	35	32	16.5	15.5
PRC 14	40	60	20	40	36.5	19	17.5
PRC 16	44	68	22	46	40	2.05	19.5
PRC 18	49	74.5	24.5	50	64	32.5	22.5
PRC 20	54	82	27	55	50	25.5	42.5
PRC 22	59	89.5	29.5	60	53.5	27.5	26

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

SUPER FLEXIBLE NOZZLES

Structure and Features

IKO Super Flexible Nozzle is a compact nozzle for use on a machine tool to supply and spray cutting oil exactly at the required positions.

The angle of the nozzle can be changed easily and freely. Therefore, oil supply can be concentrated upon the working area, and cooling and lubrication can be performed effectively. As a result, cutting resistance is reduced and superior finish is obtained, achieving high machining accuracy. Also, tool life is longer.

The Super Flexible Nozzle is used in many places such as at the spindle end of Machining Center and at the tool holder of N/C lathe.

The features of Super Flexible Nozzle are as follows.

❶ A spherical bushing is incorporated to adjust the tilting angle of nozzle easily.

❷ The Super Flexible Nozzle is compact in size, and the design on parts around the spindle and tool can be made simple.

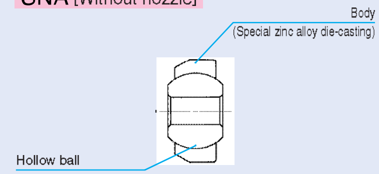
❸ The nozzle length is short, and winding of cutting chips around the nozzle will not occur.

❹ By using a number of Super Flexible Nozzles, cutting oil can be supplied and cutting chips can be removed more effectively.

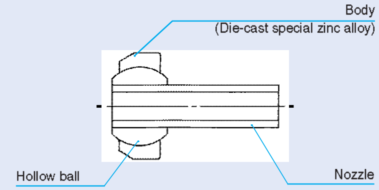
❺ The press fitting type and screw fitting type are available. The press fitting type is economical.

Structures of Super Flexible Nozzles

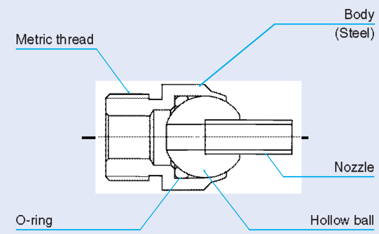
SNA [Without nozzle]



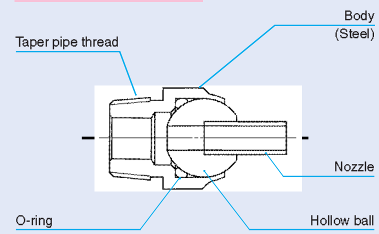
SNA [With nozzle]



SNM



SNPT



Types

Super Flexible Nozzles shown in Table 1 are available.

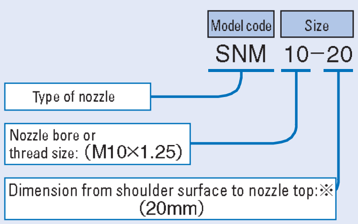
Table 1 Type of Super Flexible Nozzle

Type		Model code
Press fitting type	Without nozzle	SNA
	With nozzle	
Screw fitting type	With metric threads	SNM
	With taper pipe threads	SNPT

Identification Number

The identification number of Super Flexible Nozzle consists of a model code and a size. An example is shown as follows.

Example of identification number



※In case of press fitting type without nozzle, this dimension is not indicated.

Precautions for Use

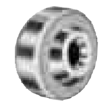
When the press fitting type Super Flexible Nozzle is used, a ϕ 15 (H8) $^{+0.027}_{0}$ bore for fitting hole must be prepared and fitting is made from the 30° chamfered end of the outer body. In this case, the body portion should be pushed for press fitting.
When the screw fitting type Super Flexible Nozzle is used and prevention of oil leakage from the fitting part is required, it is recommended to wind sealing tape on the thread portion or use rubber packing for the shoulder face of the outer body.
The direction of lubrication can be adjusted by inserting a screwdriver, etc. in the bore of the nozzle.

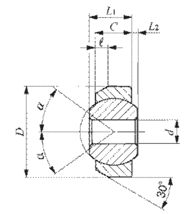
Special Specifications

Super Flexible Nozzles with special length are also available. In this case, specify the necessary nozzle length in units of 1 mm, but do not exceed the maximum length shown in the dimension table as "L".
Super Flexible Nozzles with curved nozzle end or with special bore diameter are also available. In this case, please contact IKO by preparing a drawing or sketch with necessary specifications.

SUPER FLEXIBLE NOZZLE

Press Fitting Type Without Nozzle

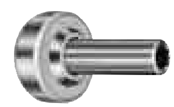


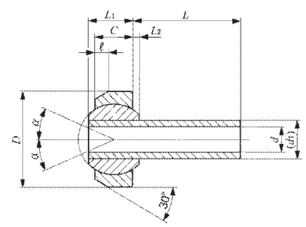


SNA

Identification number	Boundary dimensions mm						Ball dia. mm (inch)	Allowable tilting angle α degree
	d	D	L_1	L_2	C	ℓ		
SNA 4	4	15	7	1	6	2	11.112 (7/16)	36
SNA 6	6							24

Press Fitting Type With Nozzle





SNA

Identification number	Boundary dimensions mm								Ball dia. mm (inch)	Allowable tilting angle α degree
	d	D	L	L_1	L_2	C	ℓ	d_1		
SNA 3-*L*	3	15	6 15 32	7	1	6	2	6	11.112 (7/16)	24
SNA 4-*L*	4		6 16 40							

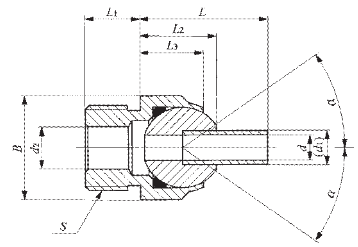
K
SNA
SNM
SNPT

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

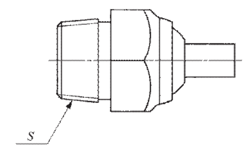
IKO

SUPER FLEXIBLE NOZZLE

Screw Fitting Type



SNM



SNPT

Identification number	Boundary dimensions mm										Ball dia.	Allowable tilting angle
	d	Thread S	L	L_1	L_2	L_3	d_1	d_2	Width across flats B	Width across corners (Ref.)	mm (inch)	α degree
SNM 10-*L*	4	M10×1.25	20 40 60	9	13	10.5	6	6	17	19.6	12.700 (½)	35
SNPT 1/4-*L*		PT 1/4										
SNM 20-*L*	6	M20×1.5	30 50 70	13	18	15	8	10	24	27.7	19.050 (¾)	
SNPT 3/8-*L*		PT 3/8										
SNM 24-*L*	8	M24×2.0	40 60 80	18	23	19	10	12	32	37	25.400 (1)	
SNPT 1/2-*L*		PT 1/2										

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch