

Linear and Motion Solutions

# Heavy-duty rod ends



# Heavy-duty rod ends

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# Heavy-duty rod ends

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**Made in Germany**

# Heavy-duty rod ends

## Selection

Heavy-duty rod ends are robust, maintenance-free or low-maintenance bearing elements which, considering the selection criteria described hereafter, impress because of their outstanding working lives.

### Heavy-duty rod ends with integral self-aligning ball bearing, series BRM, BRF, PM, PF

This design is especially suitable for high speeds, large swivelling angles or rotating movements with relatively low or medium loads. Prominent technical features are the low bearing friction, long-term greasing as well as the sealing against rough dirt penetration by means of shields on both sides. Under normal operating conditions the rod ends are maintenance-free. Lubrication fittings are provided for lubrication in case of rough operations and maximum loads.

To avoid incompatibility with the production lubrication, we recommend lubrication with an aluminium-complex-soap-grease.

A special heat treatment procedure confers the rod end housing a raceway hardness adapted to the antifriction bearing, ensuring at the same time high stability with changing loads.

### Heavy-duty rod ends with integral self-aligning roller bearings, series BRTM, BRTF

The design based on the structure of a self-aligning roller bearing is preferably used for high speed, wide tilting angles or rotating movements under high loads. Compared to rod ends with self-aligning ball bearings, rod ends with self-aligning roller bearings have essentially higher basic load ratings. This design is equipped with a cage to minimize the rolling friction and heat built-up. These rod ends with long-term lubrication are maintenance-free under normal operating conditions. Lubrication fittings are provided for lubrication in case of rough operations and maximum loads.

To avoid incompatibility with the production lubrication, we recommend lubricating with an aluminium-complex-soap-grease. Shields on both sides prevent dirt particles from penetrating into the bearing. The rod ends with self-aligning roller bearings are, just as the design with self-aligning ball bearings,

subjected to a special heat treatment to obtain a raceway hardness adapted to the antifriction bearings, ensuring at the same time a high stability with changing loads.

### Heavy-duty rod ends with integral maintenance-free spherical plain bearings, series BEM, BEF, EM, EF

In many cases heavy-duty rod ends with integrated spherical plain bearings serve their purpose. They are above all used for small swivelling or tilting movements at low speeds. They stand out for their high loadability and can also be used for shock-like loads. The rod end ball slides on a bearing shell consisting of a glass fibre-filled nylon/teflon compound. This design ensures an absolutely maintenance-free rod end. Heavy-duty plain bearing rod ends have a slight initial stress and virtually no clearance. The compound used has the favourable secondary advantage to absorb any foreign particles and to enclose them that no damage may occur. The joint balls of heavy-duty rod ends with integrated spherical plain bearing are standardly fitted with a hard chrome plating. This reliable corrosion protection ensures that the function of the rod end will not be affected by a corroded ball surface under humid operating conditions.

## Basic load ratings

### Static basic load rating of antifriction bearing rod ends

The static basic load rating  $C_0$  of an antifriction bearing rod end corresponds to that of a static radial load causing a lasting overall deformation of 1/10.000 of the roller body diameter at the contact point most highly stressed between roller body and raceway.

### Static basic load ratings of plain bearing rod ends

The static basic load rating  $C_0$  of a plain bearing rod end corresponds to the static radial load that does not yet cause a lasting deformation at the weakest housing section. It contains at least a 1.2 fold security compared to the yield stress of the material used for the rod end housing.

### Dynamic basic load rating of antifriction bearing rod ends

The dynamic basic load rating  $C$  of an antifriction bearing rod end is the external radial load, unchangeable in size and direction, at which 90 % of a large quantity of obviously identical rod ends will reach or exceed 1 million of rotations or swivelling movements.

### Dynamic basic load ratings of plain bearing rod ends

The dynamic basic load rating  $C$  is the parameter for the calculation of dynamically loaded maintenance-free heavy-duty rod ends with integrated spherical plain bearing, in other words, making tilting, swivelling or rotating movements under load.

**Basic load ratings always depend on the definitions they are based on. For this reason it is not always possible to compare basic load rating data supplied by different manufactures.**

### Operating temperatures

Heavy-duty antifriction bearing rod ends can be used for operating temperatures between  $-45^{\circ}\text{C}$  and  $+120^{\circ}\text{C}$ .

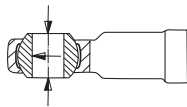
The temperature range of heavy-duty rod ends with integrated spherical plain bearings is between  $-30^{\circ}\text{C}$  and  $+60^{\circ}\text{C}$ , without affecting the loadability. Higher temperatures will reduce the loadability taken into account for the calculation of the working life under the temperature factor  $C_2$ .

### Loads

The decisive parameters for the selection and calculation of heavy-duty rod ends are size, direction and type of load.

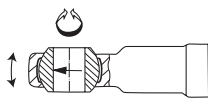
#### Radial or combined loads

The heavy-duty rod ends have been especially designed to adopt high radial loads. They can furthermore be used for combined loads. The axial load share of which does not exceed 20 % of the corresponding radial load.



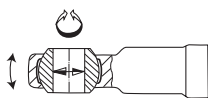
#### Unilaterally acting load

In this case the load acts only in the same direction, which means that the load area is always in the same bearing section.



#### Alternately acting load

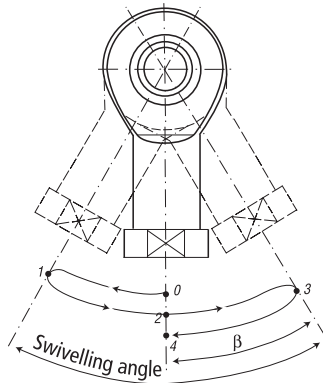
In case of alternating loads, the load areas facing each other are alternately loaded and/or relieved, which means that the load changes its direction constantly by approx.  $180^{\circ}$ .



### Swivelling angle

The swivelling angle is the excursion of the rod end from one final position to the other.

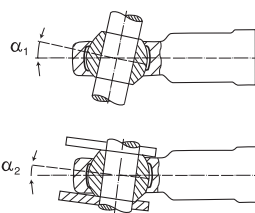
Half the swivelling angle  $\beta$  is used to calculate the service or working life.



### Angle of tilt

The angle of tilt, also called setting angle, refers to the possible excursion of the joint ball and/or the inner ring to the rod end axis in degrees. The tilting angle  $\alpha$  indicated in the table for the heavy-duty antifriction bearing rod ends corresponds to the max. possible excursion being limited by the shields on both sides. It is important that this tilting angle is not exceeded either during installation or operation, as otherwise the shields may be damaged. As far as heavy-duty plain bearing rod ends are concerned, distinction is made between the tilting angles  $\alpha_1$  and  $\alpha_2$ .

If the excursion is not limited by adjacent components, excursion angle  $\alpha_1$  can fully be used without affecting the rod end capacity. Tilting angle  $\alpha_2$  is the excursion limit when connecting a forked component.



### Nominal service life

The term »nominal service life« is used for heavy-duty antifriction bearing rod ends and represents the number of swivelling motions or rotations and/or the number of service hours the rod end performs before showing the first signs of material fatigue at the raceway or roller bodies. In view of many influence factors that are difficult or

impossible to assess, the service life of several obviously identical bearings differ under the same operating conditions. For this reason, the following method for the service life determination of heavy-duty antifriction rod ends results in a nominal service life being achieved or exceeded by at least 90 % of a larger quantity of identical rod ends.

### Working life

The term »working life« is used with heavy-duty plain bearing rod ends. It represents the number of swivelling motions or rotations and/or the number of service hours the heavy-duty plain bearing rod end performs before becoming unserviceable because of material fatigue, wear, increased bearing clearance or increase of the bearing friction moment. The working life is not only influenced by the size and the type of load, it is also affected by a number of factors, which are partially difficult to assess. A calculation of the exact servicelife is therefore impossible. Fieldexperienced standard values for the approximate working life can nevertheless be determined by using the following calculation procedure which is based on numerous results from endurance test runs and values from decades of experience. The values determined by this formula are achieved, normally even exceeded, by the majority of the heavy-duty rod ends.

The specific loading of rod ends and bearings differs in each application. Therefore general statements by a producer in a catalogue may not totally fit to the single application.

In all cases the user has to coordinate the theoretical selection criteria with the concrete installation situation and check the suitability of the rod end respectively bearing. In this context the user has to define sufficient security factors and maintenance intervals.

# Heavy-duty rod ends

## Calculations

### Antifriction bearing construction

#### Heavy-duty rod ends with integral self-aligning ball bearing series BRM, BRF, PM, PF

##### Nominal service life

rotating: 
$$L_{h_{rot.}} = 10^6 \frac{\left(\frac{C}{P}\right)^3}{60 \cdot n} \quad [h] \quad (1)$$

oscillating: 
$$L_{h_{osz.}} = 10^6 \frac{\left(\frac{C}{P \sqrt[3]{\frac{\beta}{90}}}\right)^3}{60 \cdot f} \quad [h] \quad (2)$$

**condition:**

swivelling angle  $\beta \geq 3^\circ$   
 For swivelling angles  $\beta \geq 3^\circ$   
 we recommend the use of  
 heavy-duty plain bearing  
 rod ends.

##### Static load

constant: 
$$P_o \leq C_o \quad [N] \quad (3)$$

#### Heavy-duty rod ends with integral self-aligning roller bearing series BRTF, BRTM

##### Nominal service life

rotating: 
$$L_{h_{rot.}} = 10^6 \frac{\left(\frac{C}{P}\right)^{3,333}}{60 \cdot n} \quad [h] \quad (4)$$

oscillating: 
$$L_{h_{osz.}} = 10^6 \frac{\left(\frac{C}{P \sqrt[3]{\frac{\beta}{90}}}\right)^{3,333}}{60 \cdot f} \quad [h] \quad (5)$$

**condition:**

swivelling angle  $\beta \geq 3^\circ$   
 For swivelling angles  $\beta \geq 3^\circ$   
 we recommend the use of  
 heavy-duty plain bearing  
 rod ends.

##### Static load

constant: 
$$P_o \leq C_o \quad [N] \quad (6)$$

# Heavy-duty rod ends Calculations

- $L_{h_{rot}}$  nominal service life for rotation [hours of operation]  
 $L_{h_{osz}}$  nominal service life for oscillating movement [hours or operation]  
 $C$  basic dynamic load rating [N], see tables  
 $C_o$  basic static load rating [N], see tables

$P$  dynamic equivalent load [N]

rod ends with integral self-aligning ball bearing:  $P = F_r + y \cdot F_a$  (7)

rod ends with integral self-aligning roller bearing:  $P = F_r + 9,5 \cdot F_a$  (8)

$P_o$  static equivalent load [N]

rod ends with integral self-aligning ball bearing:  $P_o = F_r + y_o \cdot F_a$  (9)

rod ends with integral self-aligning roller bearing:  $P_o = F_r + 5 \cdot F_a$  (10)

- $F_a$  axial load [N]  
 $F_r$  radial load [N]  
 $Y$  axial factor, dynamic, see tables  
 $Y_o$  axial factor, static, see tables  
 $\beta$  half the swivelling angle [degrees],  $\beta = 90^\circ$  should be used for rotation  
 $n$  rotation speed [ $\text{min}^{-1}$ ]  
 $f$  frequency of oscillation [ $\text{min}^{-1}$ ]

## Calculation example

At the rotating side of a crank mechanism, a heavy-duty antifriction bearing rod end should be installed. The expected service life amounts to at least 5,000 hours.

**Known:** rotation speed  $n = 300 \text{ min}^{-1}$ , radial load  $F_r = 750 \text{ N}$

**Selected:** BRF 8

$C = 4000 \text{ N}$

$$L_{h_{rot}} = 10^6 \frac{\left(\frac{C}{P}\right)^3}{60 \cdot n}$$

$$= 10^6 \frac{\left(\frac{4000}{750}\right)^3}{60 \cdot 300} = \underline{\underline{8428 \text{ h} > 5000 \text{ h}}}$$

# Heavy-duty rod ends

## Calculations

### Plain bearing construction

#### Working life

$$G = C_1 \cdot C_2 \cdot C_3 \cdot \frac{3}{d_8 \cdot \beta} \cdot \frac{C}{P} \cdot 10^8 \quad (11)$$

$$G_h = C_1 \cdot C_2 \cdot C_3 \cdot \frac{5}{d_8 \cdot \beta \cdot f} \cdot \frac{C}{P} \cdot 10^6 \quad (12)$$

- G** working life [number of oscillations or revolutions]
- G<sub>h</sub>** working life [hours of operation]
- C** basic dynamic load rating [N], see tables
- d<sub>8</sub>** joint ball diameter [mm]
- β** half the swivelling angle [degrees], β = 90° should be used for rotation
- f** frequency of oscillation [min<sup>-1</sup>]
- C<sub>1</sub>** load direction factor, see following table
- C<sub>2</sub>** temperature factor, see following table
- C<sub>3</sub>** material factor, see following table
- C<sub>4</sub>** factor for type of load, see following table
- P** equivalent dynamic load [N]

$$P = F_r + F_a \leq P_{zul.} \quad (13)$$

- F<sub>r</sub>** radial load component [N]
- F<sub>a</sub>** axial load component [N], condition:  $F_a \leq 0,2 \cdot F_r$
- P<sub>max.</sub>** maximum permissible rod end load [N]

$$P_{zul.} = C_0 \cdot C_2 \cdot C_4 \quad (14)$$

- C<sub>0</sub>** Basic static load rating, [N], see tables

### Load direction factor C<sub>1</sub>

Single load direction:

$$C_1 = 1,0$$

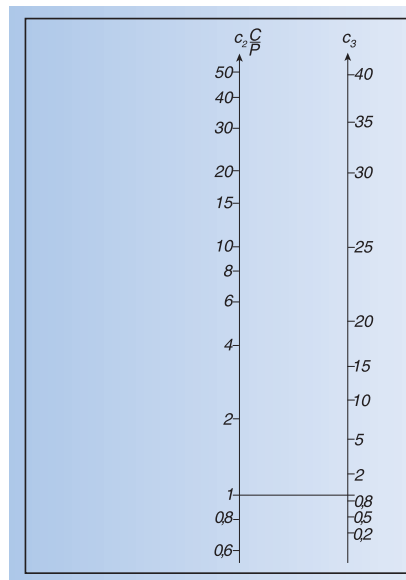
alternating load direction, at  $f < 30 \text{ min}^{-1}$ :  $C_1 = 0,25$

alternating load direction, at  $f > 30 \text{ min}^{-1}$ :  $C_1 = 0,125$

### Temperature factor C<sub>2</sub>

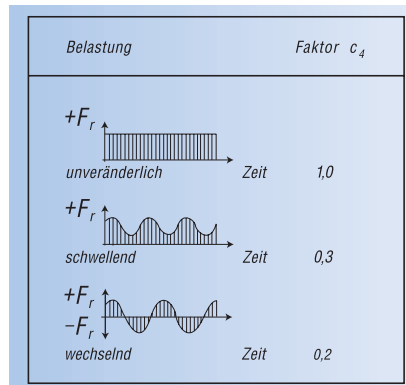
temperature	C <sub>2</sub>
up to 60° C	1,0
60° C to 80° C	0,8
80° C to 100° C	0,7
100° C to 110° C	0,6

### Material factor C<sub>3</sub>



Alignment chart for material factor C<sub>3</sub>

### Factor for type of load C<sub>4</sub>



### Static load

If heavy-duty rod ends support loads whilst stationary or with very little movement, the maximum permissible load is not a result of wear but a function of the material strength of the sliding layer or the rod end housing.

If static loads are a combination of radial and axial loads, the equivalent static bearing load will have to be calculated.

The Calculation is identical with that of the equivalent dynamic bearing load – see equation (13), page 8.

### Permissible sliding velocity

The permissible sliding velocity of heavy-duty rod ends depends mainly on the load and temperature conditions. Heat generated through friction in the rod end housing itself is the main limitation on sliding velocity. When selecting the rod end size, it is necessary to determine the sliding velocity and the pv-value, which is a product of the specific bearing load **p** [N/mm<sup>2</sup>] and the sliding velocity **v** [m/s].

The following standard values refer to swivelling and rotating movements. With satisfactory cooling, speeds may be increased.

#### Permissible

**pv-value** = 0,5 N/mm<sup>2</sup> · m/s

#### Permissible sliding velocity

**v<sub>max.</sub>** = 0,15m/s ≥ V<sub>m</sub>



## Specific bearing load

$$p = k \cdot \frac{P}{C} \quad (15)$$

- $p$  specific bearing load [N/mm<sup>2</sup>]
- $P$  equivalent dynamic load [N], see equation (13), page 8
- $C$  basic dynamic load rating [N], see tables
- $k$  specific load factor [N/mm<sup>2</sup>] for sliding contact surfaces steel on nylon/teflon/fibre glass  $k = 50 \text{ N/mm}^2$

## Mean sliding velocity

$$V_m = 5,82 \cdot 10^{-7} \cdot d_8 \cdot \beta \cdot f \quad (16)$$

- $V_m$  mean sliding velocity [m/s]
- $d_8$  joint ball diameter [mm], see tables
- $\beta$  half the swivelling angle [degrees],  $\beta = 90^\circ$  should be used for rotation
- $f$  frequency of oscillation [min<sup>-1</sup>]

## Calculation example

The rod assembly of a conveyor equipment calls for a heavy-duty rod end with a working life of 7000 hours in conjunction with an alternating acting load of 5000 N. 25 swivelling movements with a swivelling angle of 20° take place per minute. The operating temperature amounts to approx. 60°C. The choice is a heavy-duty rod end EF 15 with:  $C = 13400 \text{ N}$ ,  $d_8 = 22 \text{ mm}$ .

## Working life

$$G_h = c_1 \cdot c_2 \cdot c_3 \cdot \frac{5}{d_8 \cdot \beta \cdot f} \cdot \frac{C}{P} \cdot 10^6$$

$$c_1 = 0,25 \text{ (alternating load direction, } f = 25 \text{ min}^{-1} < 30 \text{ min}^{-1}\text{)}$$

$$c_2 = 1,0 \text{ (operating temperature } 60^\circ \text{ C)}$$

$$c_3 = c_2 \cdot \frac{C}{P} = 1,0 \cdot \frac{13400}{5000} = 2,68$$

see alignment chart page 8  $c_3 = 17$

$$d_8 = 22 \text{ mm}$$

$$f = 25 \text{ min}^{-1}$$

$$\beta = 10^\circ \text{ (half the swivelling angle: } 20^\circ : 2 = 10^\circ\text{)}$$

$$C = 13400 \text{ N}$$

$$P = 5000 \text{ N}$$

$$G_h = 0,25 \cdot 1,0 \cdot 12 \cdot \frac{5}{22 \cdot 10 \cdot 25} \cdot \frac{13400}{5000} \cdot 10^6$$

$$= \underline{\underline{7308 \text{ h} > 7000 \text{ h}}}$$

## Checking the permissible load of the rod end

$$P_{\max} = C_0 \cdot c_2 \cdot c_4$$

$$C_0 = 41000 \text{ N}$$

$$c_2 = 1,0 \text{ (operating temperature } 60^\circ \text{ C)}$$

$$c_4 = 0,2 \text{ (alternating load)}$$

$$P_{\max} = \underline{\underline{41000 \cdot 1,0 \cdot 0,2 = 8200 \text{ N} > 5000 \text{ N}}}$$

## Checking the permissible sliding velocity

$$V_m = 5,82 \cdot 10^{-7} \cdot d_8 \cdot \beta \cdot f = 5,82 \cdot 10^{-7} \cdot 22 \cdot 10 \cdot 25$$

$$= \underline{\underline{0,0032 \text{ m/s} < 0,15 \text{ m/s}}}$$

## Checking the $p \cdot v$ -value

$$p = k \cdot \frac{P}{C} = 50 \cdot \frac{5000}{13400} = 18,66 \text{ N/mm}^2$$

$$p \cdot V_m = 18,66 \cdot 0,0032$$

$$= \underline{\underline{0,06 \text{ N/mm}^2 \cdot \text{m/s} < 0,5 \text{ N/mm}^2 \cdot \text{m/s}}}$$

# Heavy-duty rod ends

## Tolerances

### Heavy-duty rod ends, series BRM, BRF, BRTM, BRTF, BEM, BEF

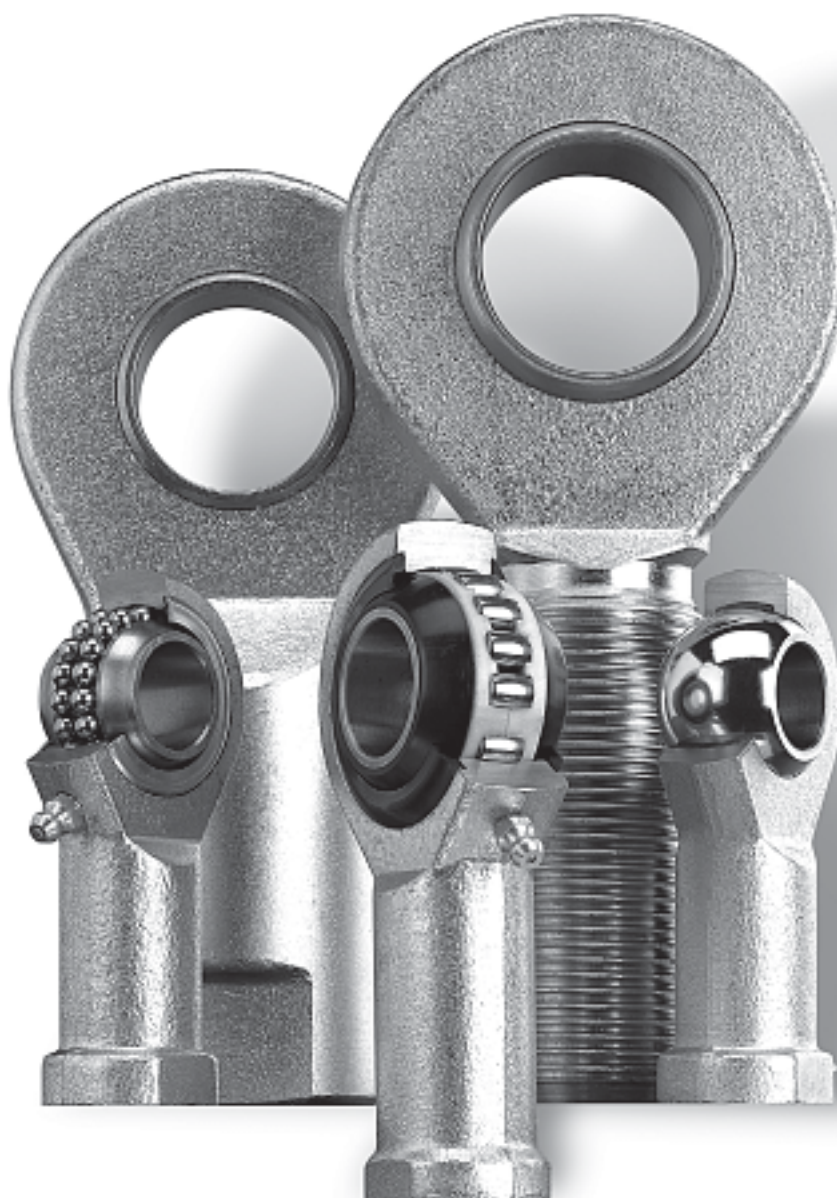
$d_1$		$\Delta d_{1mp}$		$V_{d1p}$	$V_{d1mp}$	$\Delta_{b1s}$		$\Delta_{hs, h1s, h2s}$	
over	incl.	tolerance limit		max.	max.	tolerance limit		tolerance limit	
		upper	lower			upper	lower	upper	lower
	6	+0,012	0	0,012	0,009	0	- 0,12	+1,2	-1,2
6	10	+0,015	0	0,015	0,011	0	- 0,12	+1,2	-1,2
10	18	+0,018	0	0,018	0,014	0	- 0,12	+1,2	-1,2
18	30	+0,021	0	0,021	0,016	0	- 0,12	+1,7	-1,7
30	50	+0,025	0	0,025	0,019	0	- 0,12	+2,1	-2,1

### Heavy-duty rod ends, series EM, EF, PM, PF

$d_1$		$\Delta d_{1mp}$		$V_{d1p}$	$V_{d1mp}$	$\Delta_{b1s}$		$\Delta_{hs, h1s, h2s}$	
over	incl.	tolerance limit		max.	max.	tolerance limit		tolerance limit	
		upper	lower			upper	lower	upper	lower
	18	0	- 0,008	0,008	0,006	0	- 0,12	+1,2	-1,2
18	30	0	- 0,010	0,010	0,008	0	- 0,12	+1,7	-1,7
30	50	0	- 0,012	0,012	0,009	0	- 0,12	+2,1	-2,1
50	80	0	- 0,015	0,015	0,011	0	- 0,15	+2,7	-2,7

### Dimension and tolerance symbols

- $d_1$  = nominal bore diameter of the inner ring or joint ball
- $\Delta d_{1mp}$  = mean bore diameter deviation in one plane, arithmetical mean of the largest and smallest bore diameter
- $V_{d1p}$  = bore diameter variation in one plane, difference between the largest and smallest bore diameter
- $V_{d1mp}$  = mean bore diameter variation, difference between the largest and smallest bore diameter of one inner ring or joint ball
- $b_1$  = inner ring or joint ball width
- $\Delta_{b1s}$  = single inner ring or joint ball width deviation
- $h, h1, h2$  = system length from inner ring or ball bore center to shank end
- $\Delta_{hs}, \Delta_{h1s}, \Delta_{h2s}$  = system length variation of a single rod end



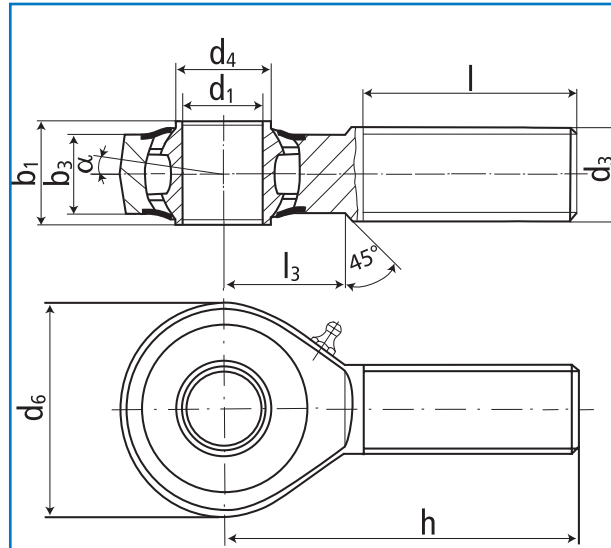
# Heavy-duty rod ends

## BRTM

male thread;  
long-term  
lubrication,  
low maintenance,  
shields,  
adapter sizes  
according to  
DIN ISO 12240-4,  
series K



### Heavy-duty rod ends with integral self-aligning roller bearing



**rod end housing:**  
forged steel, case-hardened bearing race, superfinished, rolled thread, surface galvanized, free of Cr VI

**inner ring:**  
ball bearing steel, hardened, superfinished

**lubrication:**  
aluminium-complex-soap-grease, temperature range -45 °C to +120 °C, approval according to USDA H1

**lubrication fitting:**  
DIN 71 412 H1

**bearing clearance:**  
10 - 30 µm radial

**tolerances:**  
see page 10

order number			measurements [mm]					
type	right hand thread	left hand thread	d <sub>1</sub>	d <sub>3</sub>	d <sub>4</sub>	d <sub>6</sub>	b <sub>1</sub>	b <sub>3</sub>
<b>BRTM 12 -01</b>	<b>-501</b>	<b>-502</b>	12	M 12	14,5	32	16	12
<b>BRTM 16 -03</b>	<b>-501</b>	<b>-502</b>	16	M 16	19,0	42	21	15
<b>BRTM 20 -00</b>	<b>-501</b>	<b>-502</b>	20	M 20 x 1,5	24,5	50	25	18
<b>BRTM 25 -00</b>	<b>-501</b>	<b>-502</b>	25	M 24 x 2	29,5	64	31	22
<b>BRTM 30 -00</b>	<b>-501</b>	<b>-502</b>	30	M 30 x 2	34,5	70	37	25

type	measurements [mm]				weight [kg]	rotational speed limit n <sub>max</sub> [min <sup>-1</sup> ]	basic load rating	
	h	l	l <sub>3</sub>	α [°]			dyn. C [N]	stat. C <sub>0</sub> [N]
<b>BRTM 12</b>	54	33	19	7,5	0,088	1125	10250	6600
<b>BRTM 16</b>	66	40	22	7,0	0,185	975	13300	8900
<b>BRTM 20</b>	78	47	28	7,0	0,340	825	17000	11700
<b>BRTM 25</b>	94	57	30	5,0	0,596	600	24900	18500
<b>BRTM 30</b>	110	66	35	7,5	0,912	450	32500	24850

### rod end housing:

forged steel, case-hardened bearing race, superfinished, surface galvanized, free of Cr VI

### inner ring:

ball bearing steel, hardened, superfinished

### lubrication:

aluminium-complex-soap-grease, temperature range -45 °C to +120 °C, approval according to USDA H1

### lubrication fitting:

DIN 71 412 H1

### bearing clearance:

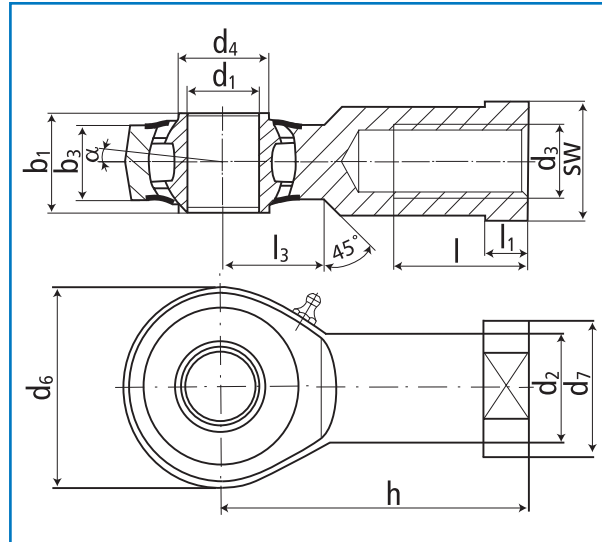
10 - 30 µm radial

### tolerances:

see page 10

## Heavy-duty rod ends with integral self-aligning roller bearing

female thread;  
long-term  
lubrication,  
low maintenance,  
shields,  
adapter sizes  
according to  
DIN ISO 12240-4,  
series K



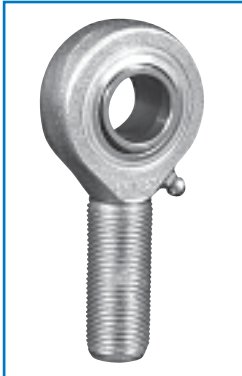
type	order number		measurements [mm]							
	right hand thread	left hand thread	d <sub>1</sub>	d <sub>2</sub>	d <sub>3</sub>	d <sub>4</sub>	d <sub>6</sub>	d <sub>7</sub>	b <sub>1</sub>	b <sub>3</sub>
<b>BRTF 12</b>	<b>-04 -501</b>	<b>-502</b>	12	17,5	M 12	14,5	32	22	16	12
<b>BRTF 16</b>	<b>-03 -501</b>	<b>-502</b>	16	22,0	M 16	19,0	42	27	21	15
<b>BRTF 20</b>	<b>-00 -501</b>	<b>-502</b>	20	27,5	M 20 x 1,5	24,5	50	34	25	18
<b>BRTF 25</b>	<b>-00 -501</b>	<b>-502</b>	25	30,0	M 24 x 2	29,5	64	35	31	22
<b>BRTF 30</b>	<b>-01 -501</b>	<b>-502</b>	30	40,0	M 30 x 2	34,5	70	50	37	25

type	measurements [mm]					weight [kg]	rotational speed limit n <sub>max</sub> [min <sup>-1</sup> ]	basic load rating	
	h	l	l <sub>1</sub>	l <sub>3</sub>	SW			dyn. C [N]	stat. C <sub>0</sub> [N]
<b>BRTF 12</b>	50	22	6,5	16	19	0,109	1125	10250	6600
<b>BRTF 16</b>	64	28	8,0	22	22	0,220	975	13300	8900
<b>BRTF 20</b>	77	33	10,0	26	30	0,361	825	17000	11700
<b>BRTF 25</b>	94	42	10,0	32	30	0,565	600	24900	18500
<b>BRTF 30</b>	110	51	15,0	35	41	1,000	450	32500	24850

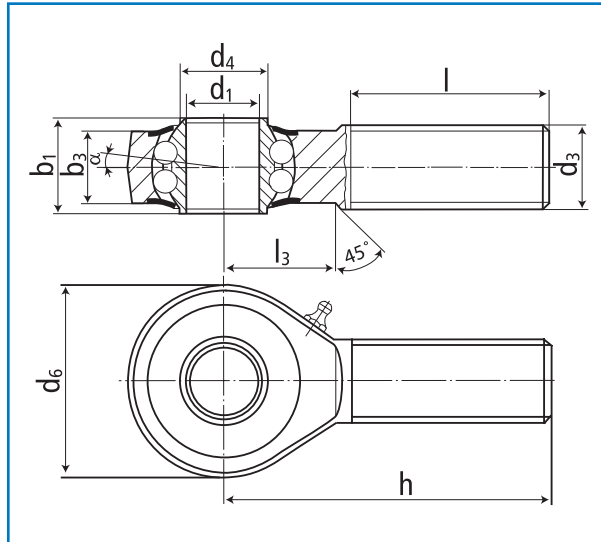
# Heavy-duty rod ends

## BRM

male thread;  
long-term  
lubrication,  
low maintenance,  
shields,  
adapter sizes  
according to  
DIN ISO 12240-4,  
series K



### Heavy-duty rod ends with integral self-aligning ball bearing



#### rod end housing:

forged steel, case-hardened bearing race, superfinished, rolled thread, surface galvanized, free of Cr VI

#### inner ring:

ball bearing steel, hardened, superfinished

#### lubrication:

aluminium-complex-soap-grease, temperature range -45 °C to +120 °C, approval according to USDA H1

#### lubrication fitting:

DIN 3405 D1/A (sizes 6 to 10)  
DIN 71 412 H1 (sizes 12 to 30)

#### bearing clearance:

10 - 30 µm radial

#### tolerances:

see page 10

order number				measurements [mm]						
type	right hand thread	left hand thread		d <sub>1</sub>	d <sub>3</sub>	d <sub>4</sub>	d <sub>6</sub>	b <sub>1</sub>	b <sub>3</sub>	h
BRM 06	-00	-501	-502	6	M 6	9,0	20	9	6,75	36
BRM 08	-00	-501	-502	8	M 8	10,5	24	12	9,0	42
BRM 10	-00	-501	-502	10	M 10	12,0	28	14	10,5	48
BRM 12	-00	-501	-502	12	M 12	14,5	32	16	12,0	54
BRM 14	-00	-501	-502	14	M 14	17,0	36	19	13,5	60
BRM 16	-00	-501	-502	16	M 16	19,0	42	21	15,0	66
BRM 18	-00	-501	-502	18	M 18 x 1,5	21,5	46	23	16,5	72
BRM 20	-00	-501	-502	20	M 20 x 1,5	24,5	50	25	18,0	78
BRM 22	-00	-501	-502	22	M 22 x 1,5	26,0	54	28	20,0	84
BRM 25	-00	-501	-502	25	M 24 x 2	29,5	64	31	22,0	94
BRM 30	-00	-501	-502	30	M 30 x 2	34,5	70	37	25,0	110

type	measurements [mm]			weight [kg]	calculation-factors		rotational speed limit n <sub>max</sub> [min <sup>-1</sup> ]	basic load rating	
	l	l <sub>3</sub>	α [°]		Y	Y <sub>0</sub>		C [N]	C <sub>0</sub> [N]
BRM 06	22	12	8,0	0,019	2,09	2,19	1350	2750	650
BRM 08	25	15	8,5	0,036	1,80	1,89	1300	4000	1000
BRM 10	29	15	8,0	0,060	1,90	1,81	1225	4450	1450
BRM 12	33	19	7,5	0,087	1,74	1,82	1125	4950	1800
BRM 14	36	20	6,0	0,135	2,36	2,48	1025	5600	2000
BRM 16	40	22	8,0	0,190	2,24	2,35	975	6250	2350
BRM 18	44	25	8,5	0,270	2,21	2,31	900	7100	2900
BRM 20	47	28	7,0	0,338	2,46	2,58	825	7900	3450
BRM 22	51	26	8,0	0,450	2,35	2,24	725	9300	3980
BRM 25	57	30	5,0	0,602	2,02	2,12	600	11030	5680
BRM 30	66	35	7,5	0,922	2,24	2,35	450	14150	7450

### rod end housing:

forged steel, case-hardened bearing race, superfinished, surface galvanized, free of Cr VI

### inner ring:

ball bearing steel, hardened, superfinished

### lubrication:

aluminium-complex-soap-grease, temperature range -45 °C to +120 °C, approval according to USDA H1

### lubrication fitting:

DIN 3405 D1/A (sizes 6 to 10)  
DIN 71 412 H1 (sizes 12 to 30)

### bearing clearance:

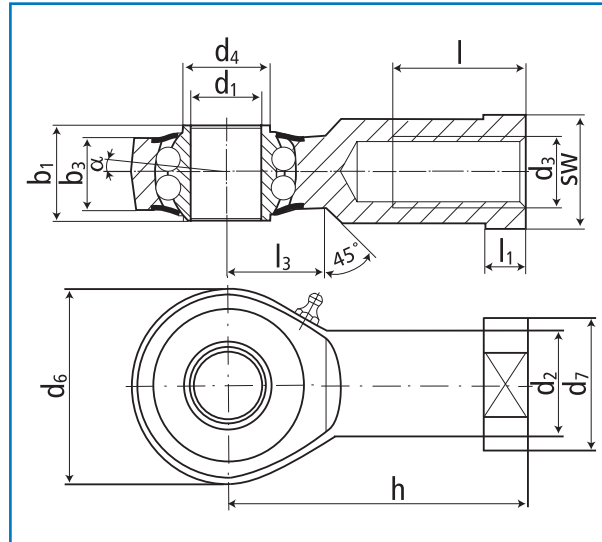
10 - 30 µm radial

### tolerances:

see page 10

## Heavy-duty rod ends with integral self-aligning ball bearing

female thread;  
long-term  
lubrication,  
low maintenance,  
shields,  
adapter sizes  
according to  
DIN ISO 12240-4,  
series K



order number				measurements [mm]								
type	right hand thread	left hand thread		d <sub>1</sub>	d <sub>2</sub>	d <sub>3</sub>	d <sub>4</sub>	d <sub>6</sub>	d <sub>7</sub>	b <sub>1</sub>	b <sub>3</sub>	h
BRF 06	-00	-501	-502	6	10,0	M 6	9,0	20	13	9	6,75	30
BRF 08	-00	-501	-502	8	12,5	M 8	10,5	24	16	12	9,0	36
BRF 10	-00	-501	-502	10	15,0	M 10	12,0	28	19	14	10,5	43
BRF 12	-00	-501	-502	12	17,5	M 12	14,5	32	22	16	12,0	50
BRF 14	-00	-501	-502	14	20,0	M 14	17,0	36	25	19	13,5	57
BRF 16	-00	-501	-502	16	22,0	M 16	19,0	42	27	21	15,0	64
BRF 18	-00	-501	-502	18	25,0	M 18 x 1,5	21,5	46	31	23	16,5	71
BRF 20	-00	-501	-502	20	27,5	M 20 x 1,5	24,5	50	34	25	18,0	77
BRF 22	-00	-501	-502	22	30,0	M 22 x 1,5	26,0	54	38	28	20,0	84
BRF 25	-00	-501	-502	25	30,0	M 24 x 2	29,5	64	35	31	22,0	94
BRF 30	-00	-501	-502	30	40,0	M 30 x 2	34,5	70	50	37	25,0	110

type	measurements [mm]				α [°]	weight [kg]	calculation-factors		rotational speed limit n <sub>max</sub> [min <sup>-1</sup> ]	basic load rating	
	l	l <sub>1</sub>	l <sub>3</sub>	SW			Y	Y <sub>0</sub>		C [N]	C <sub>0</sub> [N]
BRF 06	12	5,0	10	11	8,0	0,024	2,09	2,19	1350	2750	650
BRF 08	16	5,0	12	14	8,5	0,044	1,80	1,89	1300	4000	1000
BRF 10	20	6,5	15	17	8,0	0,072	1,90	1,81	1225	4450	1450
BRF 12	22	6,5	16	19	7,5	0,107	1,74	1,82	1125	4950	1800
BRF 14	25	8,0	20	22	6,0	0,160	2,36	2,48	1025	5600	2000
BRF 16	28	8,0	22	22	8,0	0,224	2,24	2,35	975	6250	2350
BRF 18	32	10,0	24	27	8,5	0,293	2,21	2,31	900	7100	2900
BRF 20	33	10,0	26	30	7,0	0,367	2,46	2,58	825	7900	3450
BRF 22	37	12,0	26	32	8,0	0,480	2,35	2,24	725	9300	3980
BRF 25	42	10,0	32	30	5,0	0,572	2,02	2,12	600	11030	5680
BRF 30	51	15,0	35	41	7,5	0,978	2,24	2,35	450	14150	7450

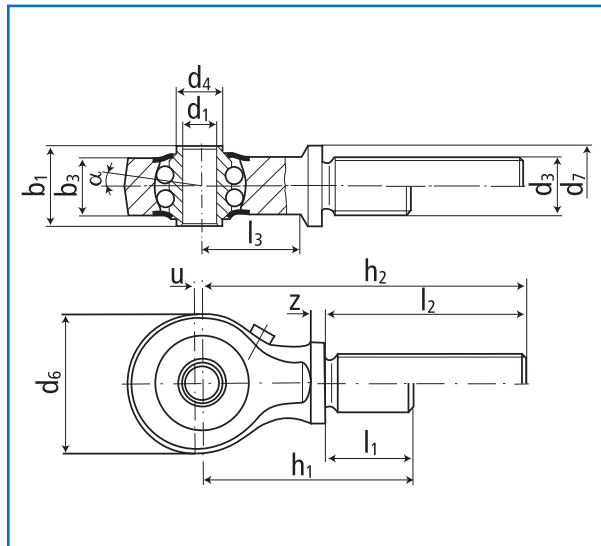
# Heavy-duty rod ends

## PM

male thread;  
long-term  
lubrication,  
low maintenance,  
shields



### Heavy-duty rod ends with integral self-aligning ball bearing



#### rod end housing:

forged steel, case-hardened bearing race, superfinished, rolled thread, surface galvanized, free of Cr VI

#### inner ring:

ball bearing steel, hardened, superfinished

#### lubrication:

aluminium-complex-soap-grease, temperature range -45 °C to +120 °C, approval according to USDA H1

#### lubrication fitting:

DIN 3405 D1/A

#### bearing clearance:

10 - 30 µm radial

#### tolerances:

see page 10

order number				measurements [mm]						
type	right hand thread	left hand thread		d <sub>1</sub>	d <sub>3</sub>	d <sub>4</sub>	d <sub>6</sub>	d <sub>7</sub>	b <sub>1</sub>	b <sub>3</sub>
PM 05 -00	-501	-502		5	M 8 x 1	7,5	19	12	12	8
PM 05 -01	-501	-502		5	M 8 x 1	7,5	19	12	12	8
PM 06 -00	-501	-502		6	M 10 x 1	8,5	24	14	14	10
PM 06 -02	-501	-502		6	M 10 x 1	8,5	24	14	14	10
PM 08 -00	-501	-502		8	M 12 x 1,5	11,0	30	17	15	10
PM 08 -02	-501	-502		8	M 12 x 1,5	11,0	30	17	15	10
PM 10 -00	-501	-502		10	M 14 x 1,5	13,5	36	19	20	14
PM 10 -03	-501	-502		10	M 14 x 1,5	13,5	36	19	20	14
PM 12 -00	-501	-502		12	M 16 x 1,5	15,0	40	21	20	14
PM 12 -02	-501	-502		12	M 16 x 1,5	15,0	40	21	20	14
PM 15 -00	-501	-502		15	M 20 x 1,5	18,5	42	26	20	14
PM 15 -02	-501	-502		15	M 20 x 1,5	18,5	42	26	20	14
PM 17 -00	-501	-502		17	M 20 x 1,5	21,0	48	26	22	16
PM 17 -01	-501	-502		17	M 20 x 1,5	21,0	48	26	22	16
PM 20 -00	-501	-502		20	M 24 x 1,5	24,0	56	30	24	18
PM 20 -02	-501	-502		20	M 24 x 1,5	24,0	56	30	24	18

type	measurements [mm]								weight [kg]	calculation-factors		rotational speed limit n <sub>max</sub> [min <sup>-1</sup> ]	basic load rating dyn. stat.	
	l <sub>1</sub>	l <sub>2</sub>	l <sub>3</sub>	h <sub>1</sub>	h <sub>2</sub>	u	z	α [°]		Y	Y <sub>0</sub>		C [N]	C <sub>0</sub> [N]
PM 05		39,5	13		57	1,5	2,5	7,0	0,037	1,51	1,58	1350	1610	480
PM 05	16		13	33,5		1,5	2,5	7,0	0,033	1,51	1,58	1350	1610	480
PM 06		42,5	17		64	1,5	2,5	10,5	0,062	1,28	1,34	1300	2445	765
PM 06	19		17	40,5		1,5	2,5	10,5	0,057	1,28	1,34	1300	2445	765
PM 08		46,5	20		72	2,0	2,5	8,5	0,097	1,9	1,81	1225	2605	985
PM 08	23		20	48,5		2,0	2,5	8,5	0,088	1,9	1,81	1225	2605	985
PM 10		49,5	28		82	2,5	2,5	9,5	0,168	1,69	1,77	1100	5120	1905
PM 10	26		28	58,5		2,5	2,5	9,5	0,154	1,69	1,77	1100	5120	1905
PM 12		53,5	31		90	3,0	2,5	7,5	0,226	1,81	1,90	1050	5345	2065
PM 12	29		31	65,5		3,0	2,5	7,5	0,204	1,81	1,90	1050	5345	2065
PM 15		62,5	30		100	3,0	2,5	6,5	0,310	2,07	2,17	975	5485	3270
PM 15	36		30	73,5		3,0	2,5	6,5	0,273	2,07	2,17	975	5485	3270
PM 17		62,5	36		105	3,5	2,5	7,0	0,401	2,35	2,46	875	5575	2680
PM 17	36		36	78,5		3,5	2,5	7,0	0,354	2,35	2,46	875	5575	2680
PM 20		68,5	41		117	3,5	3,0	5,5	0,587	2,76	2,90	775	6165	3140
PM 20	41		41	89,5		3,5	3,0	5,5	0,519	2,76	2,90	775	6165	3140



### rod end housing:

forged steel, case-hardened bearing race, superfinished, surface galvanized, free of Cr VI

### inner ring:

ball bearing steel, hardened, superfinished

### lubrication:

aluminium-complex-soap-grease, temperature range -45 °C to +120 °C, approval according to USDA H1

### lubrication fitting:

DIN 3405 D1/A

### bearing clearance:

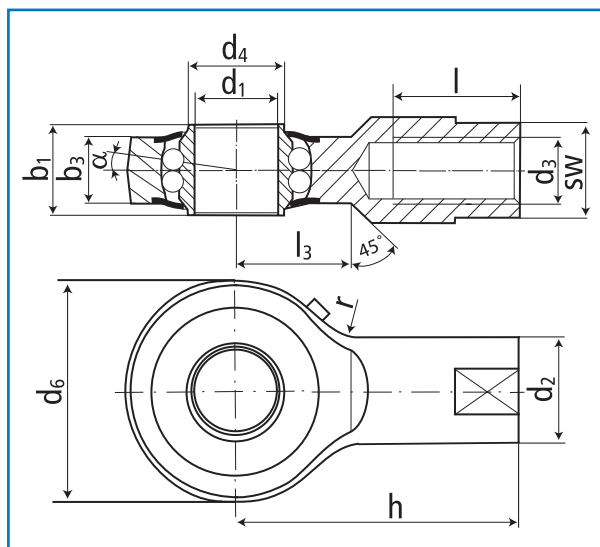
10 - 30 µm radial

### tolerances:

see page 10

## Heavy-duty rod ends with integral self-aligning ball bearing

female thread;  
long-term  
lubrication,  
low maintenance,  
shields



type	order number			measurements [mm]						
	right hand thread	left hand thread		d <sub>1</sub>	d <sub>2</sub>	d <sub>3</sub>	d <sub>4</sub>	d <sub>6</sub>	b <sub>1</sub>	b <sub>3</sub>
PF 10	-00	-501	-502	10	15	M 8	13,0	30	13,0	9
PF 15	-00	-501	-502	15	19	M 12	17,5	40	16,5	12
PF 20	-00	-501	-502	20	22	M 16	24,0	48	20,5	15

type	measurements [mm]					weight [kg]	calculation-factors		rotational speed limit n <sub>max</sub> [min <sup>-1</sup> ]	basic load rating	
	h	l	l <sub>3</sub>	r	SW		Y	Y <sub>0</sub>		C [N]	C <sub>0</sub> [N]
PF 10	38	17	14,5	10	13	0,063	1,90	1,81	1225	2605	985
PF 15	51	24	20,0	15	17	0,140	2,30	2,41	1025	5000	1890
PF 20	65	32	22,0	20	19	0,223	2,34	2,45	850	6105	2955

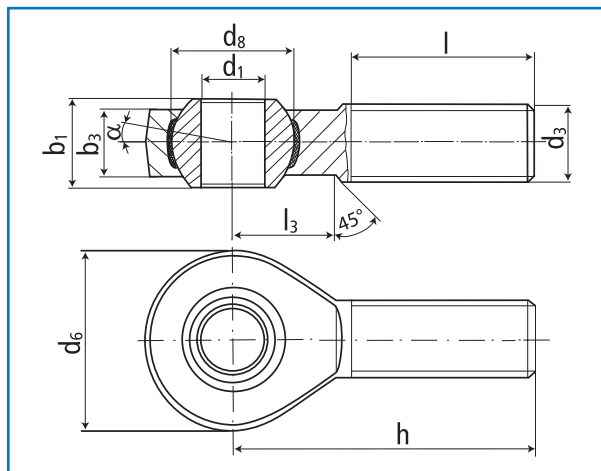
# Heavy-duty rod ends

## BEM

male thread;  
maintenance free,  
adapter sizes  
according to  
DIN ISO 12240-4,  
series K



### Heavy-duty rod ends with integral spherical plain bearing



**rod end housing:**  
forged steel, tempered, rolled thread,  
surface galvanized, free of Cr VI

**joint ball:**  
ball bearing steel, hardened and ground,  
surface superfinished and chromium  
plated

**race:**  
nylon / teflon / glass fibre compound

**tolerances:**  
see page 10

order number	type		measurements [mm]					
	right hand thread	left hand thread	d <sub>1</sub>	d <sub>3</sub>	d <sub>6</sub>	d <sub>8</sub>	b <sub>1</sub>	b <sub>3</sub>
BEM 05 -20	-501	-502	5	M 5	18	11,06	8	6,0
BEM 06 -20	-501	-502	6	M 6	20	12,65	9	6,75
BEM 08 -20	-501	-502	8	M 8	24	15,82	12	9,0
BEM 10 -20	-501	-502	10	M 10	28	19,00	14	10,5
BEM 12 -20	-501	-502	12	M 12	32	22,17	16	12,0
BEM 14 -20	-501	-502	14	M 14	36	25,35	19	13,5
BEM 16 -20	-501	-502	16	M 16	42	28,52	21	15,0
BEM 18 -20	-501	-502	18	M 18 x 1,5	46	31,70	23	16,5
BEM 20 -20	-501	-502	20	M 20 x 1,5	50	34,87	25	18,0
BEM 22 -20	-501	-502	22	M 22 x 1,5	54	38,05	28	20,0
BEM 25 -20	-501	-502	25	M 24 x 2	60	42,80	31	22,0
BEM 30 -20	-501	-502	30	M 30 x 2	70	50,75	37	25,0

type	measurements [mm]			weight		basic load rating	
	h	l	l <sub>3</sub>	α <sub>1</sub> <sup>1)</sup> [°]	α <sub>2</sub> <sup>1)</sup> [°]	C [N]	C <sub>0</sub> [N]
BEM 05	33	20	9	13,0	7,5	3910	5600
BEM 06	36	22	12	13,0	6,5	4590	7800
BEM 08	42	25	15	14,5	7,5	6965	14300
BEM 10	48	29	15	13,5	8,0	10420	22600
BEM 12	54	33	19	13,0	8,0	12425	32800
BEM 14	60	36	20	16,0	9,5	15440	41300
BEM 16	66	40	22	15,5	8,5	22410	56600
BEM 18	72	44	25	15,0	9,5	26325	69700
BEM 20	78	47	28	14,5	9,0	30805	82200
BEM 22	84	51	26	15,5	10,0	38230	95600
BEM 25	94	57	30	15,0	10,0	45350	118600
BEM 30	110	66	35	17,0	10,5	55010	145600

<sup>1)</sup> angle of tilt, see page 5

### rod end housing:

forged steel, tempered, surface galvanized, free of Cr VI

### joint ball:

ball bearing steel, hardened and ground, surface superfinished and chromium plated

### race:

nylon / teflon / glass fibre compound

### tolerances:

see page 10

## Heavy-duty rod ends with integral spherical plain bearing

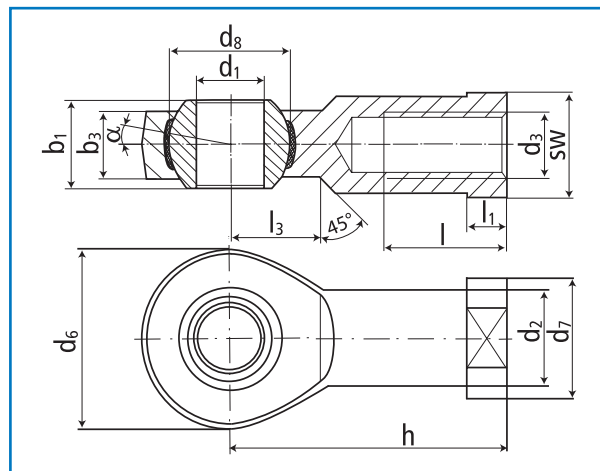
female thread; maintenance free, adapter sizes according to

DIN ISO 12240-4,

series K,

thread according to

ISO 8139



order number				measurements [mm]							
type	right hand thread	left hand thread		d <sub>1</sub>	d <sub>2</sub>	d <sub>3</sub>	d <sub>6</sub>	d <sub>7</sub>	d <sub>8</sub>	b <sub>1</sub>	b <sub>3</sub>
BEF 05	-20	-501	-502	5	9,0	M 5	18	11	11,06	8	6,0
BEF 05 SO	-22	-501	-502	5	9,0	M 4	18	11	11,06	8	6,0
BEF 06	-20	-501	-502	6	10,0	M 6	20	13	12,65	9	6,75
BEF 08	-20	-501	-502	8	12,5	M 8	24	16	15,82	12	9,0
BEF 10	-20	-501	-502	10	15,0	M 10	28	19	19,00	14	10,5
BEF 10 SO	-21	-501	-502	10	15,0	M 10 x 1,25	28	19	19,00	14	10,5
BEF 12	-20	-501	-502	12	17,5	M 12	32	22	22,17	16	12,0
BEF 12 SO	-22	-501	-502	12	17,5	M 12 x 1,25	32	22	22,17	16	12,0
BEF 14	-20	-501	-502	14	20,0	M 14	36	25	25,35	19	13,5
BEF 16	-20	-501	-502	16	22,0	M 16	42	27	28,52	21	15,0
BEF 16 SO	-21	-501	-502	16	22,0	M 16 x 1,5	42	27	28,52	21	15,0
BEF 18	-20	-501	-502	18	25,0	M 18 x 1,5	46	31	31,70	23	16,5
BEF 20	-20	-501	-502	20	27,5	M 20 x 1,5	50	34	34,87	25	18,0
BEF 22	-20	-501	-502	22	30,0	M 22 x 1,5	54	38	38,05	28	20,0
BEF 25	-20	-501	-502	25	33,5	M 24 x 2	60	42	42,80	31	22,0
BEF 30	-20	-501	-502	30	40,0	M 30 x 2	70	50	50,75	37	25,0
BEF 30 SO	-22	-501	-502	30	40,0	M 27 x 2	70	50	50,75	37	25,0

type	measurements [mm]				SW	weight		basic load rating		
	h	l	l <sub>1</sub>	l <sub>3</sub>		α <sub>1</sub> <sup>1)</sup> [°]	α <sub>2</sub> <sup>1)</sup> [°]	C [N]	C <sub>0</sub> [N]	
BEF 05	27	10	4,0	10	9	13,0	7,5	0,018	3910	10800
BEF 05 SO	27	10	4,0	10	9	13,0	7,5	0,018	3910	10800
BEF 06	30	12	5,0	10	11	13,0	6,5	0,024	4590	12800
BEF 08	36	16	5,0	12	14	14,5	7,5	0,045	6965	19200
BEF 10	43	20	6,5	15	17	13,5	8,0	0,074	10420	27400
BEF 10 SO	43	20	6,5	15	17	13,5	8,0	0,074	10420	27400
BEF 12	50	22	6,5	16	19	13,0	8,0	0,109	12425	33400
BEF 12 SO	50	22	6,5	16	19	13,0	8,0	0,109	12425	33400
BEF 14	57	25	8,0	20	22	16,0	9,5	0,155	15440	41300
BEF 16	64	28	8,0	22	22	15,5	8,5	0,233	22410	59600
BEF 16 SO	64	28	8,0	22	22	15,5	8,5	0,233	22410	59600
BEF 18	71	32	10,0	24	27	15,0	9,5	0,310	26325	69700
BEF 20	77	33	10,0	26	30	14,5	9,0	0,386	30805	82200
BEF 22	84	37	12,0	26	32	15,5	10,0	0,520	38230	95600
BEF 25	94	42	12,0	30	36	15,0	10,0	0,705	45350	118600
BEF 30	110	51	15,0	35	41	17,0	10,5	1,084	55010	145600
BEF 30 SO	110	51	15,0	35	41	17,0	10,5	1,084	55010	145600

<sup>1)</sup> angle of tilt, see page 5

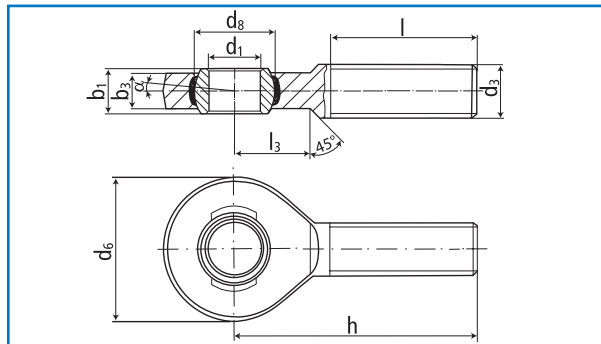
# Heavy-duty rod ends

## EM

male thread;  
maintenance free,  
adapter sizes  
according to  
DIN ISO 12240-4,  
series E / EH



### Heavy-duty rod ends with integral spherical plain bearing



#### rod end housing:

forged steel, tempered, rolled thread,  
surface galvanized, free of Cr VI

#### joint ball:

ball bearing steel, hardened and ground,  
surface superfinished and chromium  
plated

#### race:

nylon / teflon / glass fibre compound

#### tolerances:

see page 10

type	order number			measurements [mm]						
	right hand thread	left hand thread		d <sub>1</sub>	d <sub>3</sub>	d <sub>6</sub>	d <sub>8</sub>	b <sub>1</sub>	b <sub>3</sub>	h
EM 06	-20	-501	-502	6	M 6	20	10,0	6	4	36
EM 08	-20	-501	-502	8	M 8	23	13,0	8	5	42
EM 10	-20	-501	-502	10	M 10	28	16,0	9	6	48
EM 12	-20	-501	-502	12	M 12	32	18,0	10	7	54
EM 15	-20	-501	-502	15	M 14	38	22,0	12	9	63
EM 17	-20	-501	-502	17	M 16	44	25,0	14	10	69
EM 20	-20	-501	-502	20	M 20 x 1,5	51	29,0	16	12	78
EM 25	-20	-501	-502	25	M 24 x 2	62	35,5	20	16	94
EM 30	-20	-501	-502	30	M 30 x 2	70	40,7	22	18	110
EM 35	-20	-501	-502	35	M 36 x 3	82	47,0	25	20	140
EM 40	-20	-501	-502	40	M 42 x 3	92	53,0	28	22	145
EM 40 SO	-21	-501	-502	40	M 39 x 3	92	53,0	28	22	150
EM 45	-20	-501	-502	45	M 45 x 3	102	60,0	32	25	165
EM 45 SO	-22	-501	-502	45	M 42 x 3	102	60,0	32	25	163
EM 50	-20	-501	-502	50	M 52 x 3	112	66,0	35	28	195
EM 50 SO	-22	-501	-502	50	M 45 x 3	112	66,0	35	28	185
EM 60	-20	-501	-502	60	M 60 x 4	135	80,0	44	36	225
EM 60 SO	-21	-501	-502	60	M 52 x 3	135	80,0	44	36	210

type	measurements [mm]		weight		basic load rating	
	l	l <sub>3</sub>	α <sub>1</sub> <sup>1)</sup> [°]	α <sub>2</sub> <sup>1)</sup> [°]	C [N]	C <sub>0</sub> [N]
EM 06	22	11	13,0	6,5	0,014	2500 6400
EM 08	25	12	15,0	8,0	0,024	4200 11000
EM 10	29	15	12,0	6,0	0,041	6400 16800
EM 12	33	15	10,5	5,0	0,067	9200 23000
EM 15	36	18	8,5	4,5	0,110	13400 39600
EM 17	40	23	10,0	5,5	0,163	19200 54100
EM 20	47	25	9,0	4,5	0,270	25200 76700
EM 25	57	32	7,5	3,5	0,508	42400 119100
EM 30	66	35	6,0	3,0	0,785	54000 141800
EM 35	92	38	6,5	3,5	1,330	70400 180800
EM 40	94	42	7,0	3,5	1,890	86000 222600
EM 40 SO	99	42	7,0	3,5	1,785	86000 222600
EM 45	100	50	7,5	4,0	2,620	107000 276200
EM 45 SO	98	50	7,5	4,0	2,430	107000 276200
EM 50	120	60	6,5	3,0	3,865	132000 339200
EM 50 SO	110	60	6,5	3,0	3,225	132000 339200
EM 60	140	70	6,5	3,5	6,400	208000 532100
EM 60 SO	125	70	6,5	3,5	5,430	208000 532100

<sup>1)</sup> angle of tilt, see page 5

**rod end housing:**

forged steel, tempered, surface galvanized, free of Cr VI

**joint ball:**

ball bearing steel, hardened and ground, surface superfinished and chromium plated

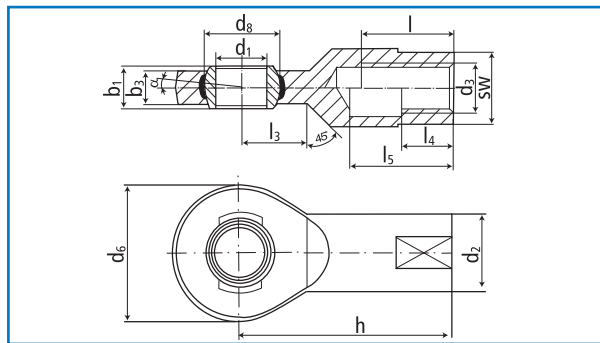
**race:**

nylon / teflon / glass fibre compound

**tolerances:**

see page 10

## Heavy-duty rod ends with integral spherical plain bearing



female thread;  
maintenance free,  
adapter sizes  
according to  
**DIN ISO 12240-4,**  
series E / EH



type	order number			measurements [mm]								
	right hand thread	left hand thread		d <sub>1</sub> d <sub>2</sub>	d <sub>3</sub>	d <sub>6</sub>	d <sub>8</sub>	b <sub>1</sub>	b <sub>3</sub>	h		
EF 06	-20	-501	-502	6	10	M 6	20	10,0	6	4	30	
EF 08	-20	-501	-502	8	13	M 8	23	13,0	8	5	36	
EF 10	-20	-501	-502	10	16	M 10	28	16,0	9	6	43	
EF 10 SO	-22	-501	-502	10	16	M 10 x 1,25	28	16,0	9	6	43	
EF 12	-20	-501	-502	12	19	M 12	32	18,0	10	7	50	
EF 12 SO	-22	-501	-502	12	19	M 12 x 1,25	32	18,0	10	7	50	
EF 15	-20	-501	-502	15	22	M 14	38	22,0	12	9	61	
EF 17	-20	-501	-502	17	25	M 16	44	25,0	14	10	67	
EF 20	-20	-501	-502	20	28	M 20 x 1,5	51	29,0	16	12	77	
EF 25	-20	-501	-502	25	35	M 24 x 2	62	35,5	20	16	94	
EF 30	-20	-501	-502	30	42	M 30 x 2	70	40,7	22	18	110	
EF 35	-20	-501	-502	35	50	M 36 x 3	82	47,0	25	20	125	
EF 35 SO	-22	-501	-502	35	50	M 36 x 2	82	47,0	25	20	130	
EF 40	-20	-501	-502	40	58	M 42 x 3	92	53,0	28	22	145	
EF 40 SO	-22	-501	-502	40	52	M 39 x 3	92	53,0	28	22	142	
EF 45	-20	-501	-502	45	67	M 45 x 3	102	60,0	32	25	165	
EF 45 SO	-21	-501	-502	45	58	M 42 x 3	102	60,0	32	25	145	
EF 50	-20	-501	-502	50	70	M 52 x 3	112	66,0	35	28	195	
EF 50 SO	-21	-501	-502	50	62	M 45 x 3	112	66,0	35	28	160	
EF 60	-20	-501	-502	60	82	M 60 x 4	135	80,0	44	36	225	
EF 60 SO	-21	-501	-502	60	71	M 52 x 3	135	80,0	44	36	175	

type	measurements [mm]					SW	α <sub>1</sub> <sup>1)</sup> [°]	α <sub>2</sub> <sup>1)</sup> [°]	weight [kg]	basic load rating	
	l	l <sub>3</sub>	l <sub>4</sub>	l <sub>5</sub>	C [N]					C <sub>0</sub> [N]	
EF 06	12	11				9	13,0	6,5	0,017	2500	10600
EF 08	16	12				11	15,0	8,0	0,031	4200	13100
EF 10	20	13				14	12,0	6,0	0,054	6400	18800
EF 10 SO	20	13				14	12,0	6,0	0,054	6400	18800
EF 12	22	15				17	10,5	5,0	0,086	9200	28000
EF 12 SO	22	15				17	10,5	5,0	0,086	9200	28000
EF 15	25	18				19	8,5	4,5	0,142	13400	41000
EF 17	28	20				22	10,0	5,5	0,208	19200	57900
EF 20	33	23				24	9,0	4,5	0,290	25200	76700
EF 25	42	30				30	7,5	3,5	0,573	42400	119100
EF 30	51	32				36	6,0	3,0	0,908	54000	141800
EF 35		38	36	61		41	6,5	3,5	1,230	70400	180800
EF 35 SO		38	41	66		41	6,5	3,5	1,230	70400	180800
EF 40		42	42	71		50	7,0	3,5	2,075	86000	222600
EF 40 SO		42	39	66		46	7,0	3,5	1,880	86000	222600
EF 45		50	45	76		55	7,5	4,0	3,085	107000	276200
EF 45 SO		50	42	66		50	7,5	4,0	2,500	107000	276200
EF 50		60	52	89		60	6,5	3,0	3,975	132000	339200
EF 50 SO		60	45	69		55	6,5	3,0	3,200	132000	339200
EF 60		70	60	103		70	6,5	3,5	7,300	208000	532100
EF 60 SO		70	52	71		60	6,5	3,5	5,900	208000	532100

<sup>1)</sup> angle of tilt, see page 5

male thread;  
long-term  
lubrication,  
low maintenance,  
shields,  
adapter sizes  
according to  
DIN ISO 12240-4,  
series K

### Heavy-duty rod ends with integral self-aligning ball bearing in stainless steel

**rod end housing:**  
stainless steel 1.4034, hardened, bearing race superfinished, rolled thread

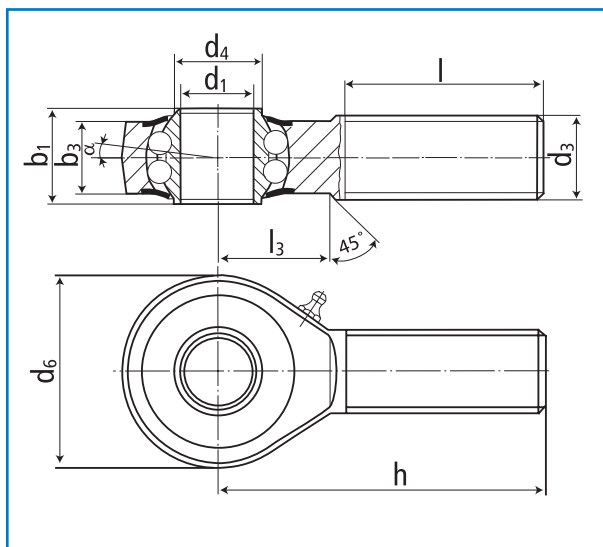
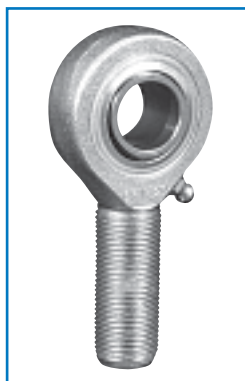
**inner ring:**  
stainless steel, hardened, surface superfinished

**lubrication:**  
aluminium-complex-soap-grease, temperature range -45 °C to +120 °C, approval according to USDA H1

**lubrication fitting:**  
DIN 3405 D1/A (sizes 6 to 10)  
DIN 71 412 H1 (sizes 12 to 20)

**bearing clearance:**  
10 - 30 µm radial

**tolerances:**  
see page 10



order number				measurements [mm]						
type	right hand thread	left hand thread		d <sub>1</sub>	d <sub>3</sub>	d <sub>4</sub>	d <sub>6</sub>	b <sub>1</sub>	b <sub>3</sub>	h
BRM 06	-60	-501	-502	6	M 6	9,0	20	9	6,75	36
BRM 08	-60	-501	-502	8	M 8	10,5	24	12	9,0	42
BRM 10	-60	-501	-502	10	M 10	12,0	28	14	10,5	48
BRM 12	-60	-501	-502	12	M 12	14,5	32	16	12,0	54
BRM 16	-60	-501	-502	16	M 16	19,0	42	21	15,0	66
BRM 20	-60	-501	-502	20	M 20 x 1,5	24,5	50	25	18,0	78

type	measurements [mm]		α [°]	weight [kg]	calculation-factors		rotational speed limit n <sub>max</sub> [min <sup>-1</sup> ]	basic load rating	
	l	l <sub>3</sub>			Y	Y <sub>0</sub>		C [N]	C <sub>0</sub> [N]
BRM 06	22	12	8,0	0,019	2,09	2,19	1350	1900	450
BRM 08	25	15	8,5	0,036	1,80	1,89	1300	2800	700
BRM 10	29	15	8,0	0,060	1,90	1,81	1225	3100	1000
BRM 12	33	19	7,5	0,087	1,74	1,82	1125	3450	1250
BRM 16	40	22	8,0	0,190	2,24	2,35	975	4250	1600
BRM 20	47	28	7,0	0,338	2,46	2,58	825	5350	2300

**rod end housing:**  
stainless steel 1.4034, hardened, bearing  
race superfinished

**inner ring:**  
stainless steel, hardened,  
surface superfinished

**lubrication:**  
aluminium-complex-soap-grease,  
temperature range -45 °C to +120 °C,  
approval according to USDA H1

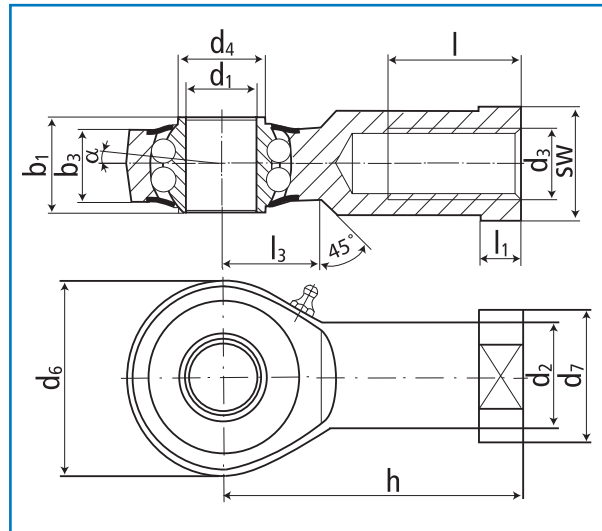
**lubrication fitting:**  
DIN 3405 D1/A (sizes 6 to 10)  
DIN 71 412 H1 (sizes 12 to 20)

**bearing clearance:**  
10 - 30 µm radial

**tolerances:**  
see page 10

**Heavy-duty rod ends with integral  
self-aligning ball bearing  
in stainless steel**

female thread;  
long-term  
lubrication,  
low maintenance,  
shields,  
adapter sizes  
according to  
DIN ISO 12240-4,  
series K



order number				measurements [mm]								
type	right hand thread	left hand thread		d <sub>1</sub>	d <sub>2</sub>	d <sub>3</sub>	d <sub>4</sub>	d <sub>6</sub>	d <sub>7</sub>	b <sub>1</sub>	b <sub>3</sub>	h
<b>BRF 06 -60 -501</b>		<b>-502</b>		6	10,0	M 6	9,0	20	13	9	6,75	30
<b>BRF 08 -60 -501</b>		<b>-502</b>		8	12,5	M 8	10,5	24	16	12	9,0	36
<b>BRF 10 -60 -501</b>		<b>-502</b>		10	15,0	M 10	12,0	28	19	14	10,5	43
<b>BRF 12 -60 -501</b>		<b>-502</b>		12	17,5	M 12	14,5	32	22	16	12,0	50
<b>BRF 16 -60 -501</b>		<b>-502</b>		16	22,0	M 16	19,0	42	27	21	15,0	64
<b>BRF 20 -60 -501</b>		<b>-502</b>		20	27,5	M 20 x 1,5	24,5	50	34	25	18,0	77

type	measurements [mm]			SW	α [°]	weight [kg]	calculation- factors		rotational speed limit n <sub>max</sub> [min <sup>-1</sup> ]	basic load rating	
	l	l <sub>1</sub>	l <sub>3</sub>				Y	Y <sub>0</sub>		dyn. C [N]	stat. C <sub>0</sub> [N]
<b>BRF 06</b>	12	5,0	10	11	8,0	0,024	2,09	2,19	1350	1900	450
<b>BRF 08</b>	16	5,0	12	14	8,5	0,044	1,80	1,89	1300	2800	700
<b>BRF 10</b>	20	6,5	15	17	8,0	0,072	1,90	1,81	1225	3100	1000
<b>BRF 12</b>	22	6,5	16	19	7,5	0,107	1,74	1,82	1125	3450	1250
<b>BRF 16</b>	28	8,0	22	22	8,0	0,224	2,24	2,35	975	4250	1600
<b>BRF 20</b>	33	10,0	26	30	7,0	0,367	2,46	2,58	825	5350	2300

male thread;  
maintenance free,  
adapter sizes  
according to  
DIN ISO 12240-4,  
series K

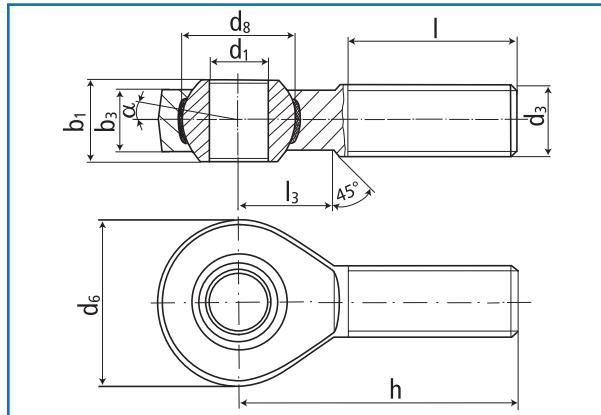
### Heavy-duty rod ends with integral spherical plain bearing in stainless steel

**rod end housing:**  
stainless steel 1.4301, rolled thread,  
surface with pickling treatment

**joint ball:**  
stainless steel, hardened and ground,  
surface superfinished

**race:**  
nylon / teflon / glass fibre compound

**tolerances:**  
see page 10



type	order number		measurements [mm]						
	right hand thread	left hand thread	d <sub>1</sub>	d <sub>3</sub>	d <sub>6</sub>	d <sub>8</sub>	b <sub>1</sub>	b <sub>3</sub>	
BEM 05	-60	-501	-502	5	M 5	18	11,06	8	6,0
BEM 06	-60	-501	-502	6	M 6	20	12,65	9	6,75
BEM 08	-60	-501	-502	8	M 8	24	15,82	12	9,0
BEM 10	-60	-501	-502	10	M 10	28	19,00	14	10,5
BEM 12	-60	-501	-502	12	M 12	32	22,17	16	12,0
BEM 14	-60	-501	-502	14	M 14	36	25,35	19	13,5
BEM 16	-60	-501	-502	16	M 16	42	28,52	21	15,0
BEM 18	-60	-501	-502	18	M 18 x 1,5	46	31,70	23	16,5
BEM 20	-60	-501	-502	20	M 20 x 1,5	50	34,87	25	18,0
BEM 22	-60	-501	-502	22	M 22 x 1,5	54	38,05	28	20,0
BEM 25	-60	-501	-502	25	M 24 x 2	60	42,80	31	22,0
BEM 30	-60	-501	-502	30	M 30 x 2	70	50,75	37	25,0

type	measurements [mm]			weight		basic load rating		
	h	l	l <sub>3</sub>	α <sub>1</sub> <sup>1)</sup> [°]	α <sub>2</sub> <sup>1)</sup> [°]	C dyn. [N]	C <sub>0</sub> stat. [N]	
BEM 05	33	20	9	13,0	7,5	0,014	2400	3500
BEM 06	36	22	12	13,0	6,5	0,020	2820	4900
BEM 08	42	25	15	14,5	7,5	0,038	4280	8800
BEM 10	48	29	15	13,5	8,0	0,060	6400	14000
BEM 12	54	33	19	13,0	8,0	0,092	7600	20300
BEM 14	60	36	20	16,0	9,5	0,127	9480	27600
BEM 16	66	40	22	15,5	8,5	0,202	13760	37700
BEM 18	72	44	25	15,0	9,5	0,250	16160	46500
BEM 20	78	47	28	14,5	9,0	0,327	18960	54800
BEM 22	84	51	26	15,5	10,0	0,440	23480	63600
BEM 25	94	57	30	15,0	10,0	0,630	27860	79100
BEM 30	110	66	35	17,0	10,5	1,015	33800	97100

<sup>1)</sup> angle of tilt, see page 5



**rod end housing:**

stainless steel 1.4301, rolled thread, surface with pickling treatment

**joint ball:**

stainless steel, hardened and ground, surface superfinished

**race:**

nylon / teflon / glass fibre compound

**tolerances:**

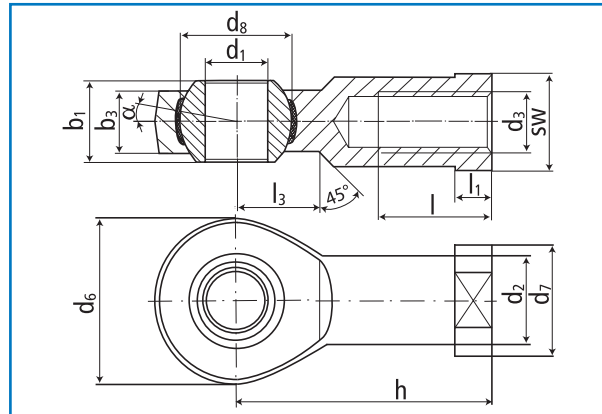
see page 10

**Heavy-duty rod ends with integral spherical plain bearing in stainless steel**

female thread; maintenance free, adapter sizes according to

**DIN ISO 12240-4, series K,**

**thread according to ISO 8139**



type	order number			measurements [mm]							
	right hand thread	left hand thread		d <sub>1</sub>	d <sub>2</sub>	d <sub>3</sub>	d <sub>6</sub>	d <sub>7</sub>	d <sub>8</sub>	b <sub>1</sub>	b <sub>3</sub>
BEF 05	-60	-501	-502	5	9,0	M 5	18	11	11,06	8	6,0
BEF 05SO	-61	-501	-502	5	9,0	M 4	18	11	11,06	8	6,0
BEF 06	-60	-501	-502	6	10,0	M 6	20	13	12,65	9	6,75
BEF 08	-60	-501	-502	8	12,5	M 8	24	16	15,82	12	9,0
BEF 10	-60	-501	-502	10	15,0	M 10	28	19	19,00	14	10,5
BEF 10SO	-61	-501	-502	10	15,0	M 10 x 1,25	28	19	19,00	14	10,5
BEF 12	-60	-501	-502	12	17,5	M 12	32	22	22,17	16	12,0
BEF 12SO	-61	-501	-502	12	17,5	M 12 x 1,25	32	22	22,17	16	12,0
BEF 14	-60	-501	-502	14	20,0	M 14	36	25	25,35	19	13,5
BEF 16	-60	-501	-502	16	22,0	M 16	42	27	28,52	21	15,0
BEF 16SO	-61	-501	-502	16	22,0	M 16 x 1,5	42	27	28,52	21	15,0
BEF 18	-60	-501	-502	18	25,0	M 18 x 1,5	46	31	31,70	23	16,5
BEF 20	-60	-501	-502	20	27,5	M 20 x 1,5	50	34	34,87	25	18,0
BEF 22	-60	-501	-502	22	30,0	M 22 x 1,5	54	38	38,05	28	20,0
BEF 25	-60	-501	-502	25	33,5	M 24 x 2	60	42	42,80	31	22,0
BEF 30	-60	-501	-502	30	40,0	M 30 x 2	70	50	50,75	37	25,0
BEF 30SO	-61	-501	-502	30	40,0	M 27 x 2	70	50	50,75	37	25,0

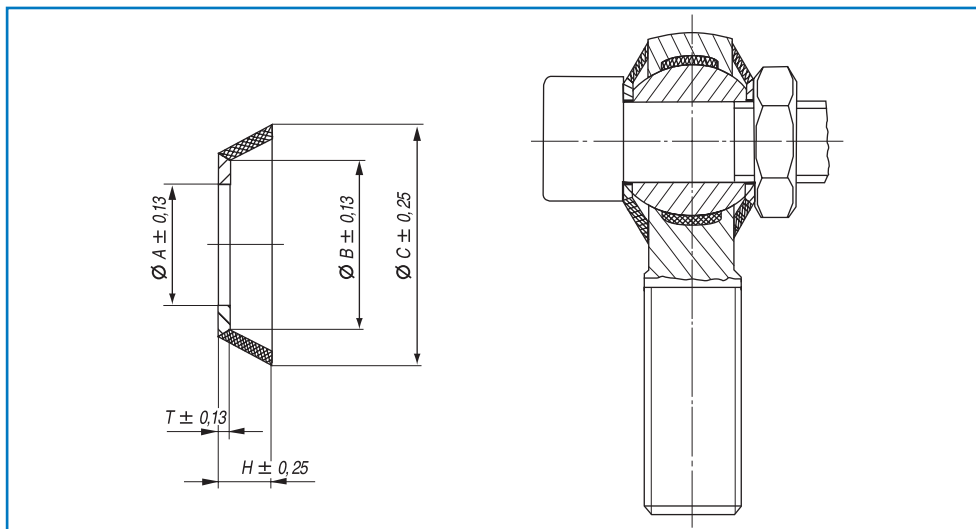
type	measurements [mm]					SW	α <sub>1</sub> <sup>1)</sup> [°]	α <sub>2</sub> <sup>1)</sup> [°]	weight [kg]	basic load rating dyn. stat.	
	h	l	l <sub>1</sub>	l <sub>3</sub>	C [N]					C <sub>0</sub> [N]	
BEF 05	27	10	4,0	10	9	13,0	7,5	0,018	2400	7200	
BEF 05SO	27	10	4,0	10	9	13,0	7,5	0,018	2400	7200	
BEF 06	30	12	5,0	10	11	13,0	6,5	0,024	2820	8500	
BEF 08	36	16	5,0	12	14	14,5	7,5	0,045	4280	12800	
BEF 10	43	20	6,5	15	17	13,5	8,0	0,074	6400	18300	
BEF 10SO	43	20	6,5	15	17	13,5	8,0	0,074	6400	18300	
BEF 12	50	22	6,5	16	19	13,0	8,0	0,109	7600	22300	
BEF 12SO	50	22	6,5	16	19	13,0	8,0	0,109	7600	22300	
BEF 14	57	25	8,0	20	22	16,0	9,5	0,155	9480	27600	
BEF 16	64	28	8,0	22	22	15,5	8,5	0,233	13760	39700	
BEF 16SO	64	28	8,0	22	22	15,5	8,5	0,233	13760	39700	
BEF 18	71	32	10,0	24	27	15,0	9,5	0,310	16160	46500	
BEF 20	77	33	10,0	26	30	14,5	9,0	0,386	18960	54800	
BEF 22	84	37	12,0	26	32	15,5	10,0	0,520	23480	63600	
BEF 25	94	42	12,0	30	36	15,0	10,0	0,705	27860	79100	
BEF 30	110	51	15,0	35	41	17,0	10,5	1,084	33800	97100	
BEF 30SO	110	51	15,0	35	41	17,0	10,5	1,084	33800	97100	

<sup>1)</sup> angle of tilt, see page 5

**Washers**

**seal:**  
neoprene rubber

**washer:**  
stainless steel

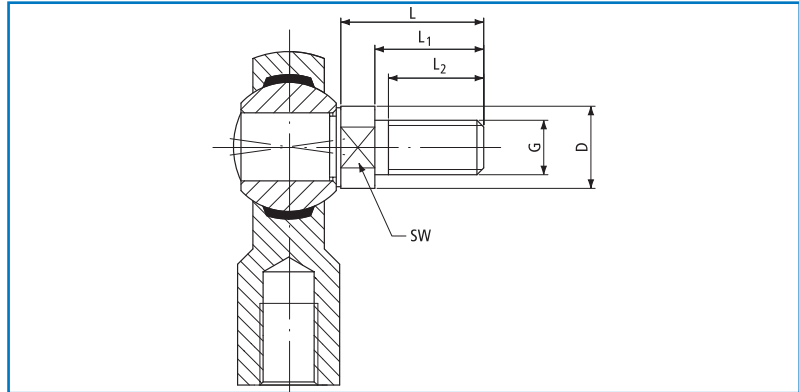


order number type	measurements [mm]				
	A $\pm 0,13$	B $\pm 0,13$	C $\pm 0,25$	H $\pm 0,25$	T $\pm 0,13$
<b>DDG 05 -00 -100</b>	5,25	8,28	11,22	2,41	0,50
<b>DDG 06 -00 -100</b>	6,25	9,53	12,7	3,05	0,69
<b>DDG 08 -00 -100</b>	8,25	12,37	17,78	5,08	1,20
<b>DDG 10 -00 -100</b>	10,25	13,46	20,32	5,59	1,20
<b>DDG 12 -00 -100</b>	12,25	18,54	28,58	6,35	1,20
<b>DDG 14 -00 -100</b>	14,25	20,32	29,21	6,86	1,20
<b>DDG 16 -00 -100</b>	16,25	22,40	31,7	6,80	1,20
<b>DDG 18 -00 -100</b>	18,25	22,60	32,69	8,25	1,20
<b>DDG 20 -00 -100</b>	20,25	25,15	38,10	10,16	1,20
<b>DDG 25 -00 -100</b>	25,25	33,80	53,30	12,70	1,50
<b>DDG 30 -00 -100</b>	30,25	35,56	55,88	13,97	1,53

# threaded bolt & rod linkage Mountings

## Threaded Bolt

In addition to the heavy-duty rod ends series K Nadella supplies a threaded bolt. The bolt can be supplied already fixed to the required rod end.



order number		measurements [mm]					SW	weight [g/bolt]
type	size	L	L <sub>1</sub>	L <sub>2</sub>	G	D		
<b>BOK</b>	<b>06</b>	18,5	13	10	M 6	9,0	8	10
<b>BOK</b>	<b>08</b>	23,5	17	13	M 8	10,5	8	12
<b>BOK</b>	<b>10</b>	28,0	21	17	M 10	13,0	12	25
<b>BOK</b>	<b>12</b>	32,5	25	20	M 12	15,0	14	40
<b>BOK</b>	<b>14</b>	37,5	29	22	M 14	17,0	14	65
<b>BOK</b>	<b>16</b>	42,5	33	24	M 16	19,0	17	90

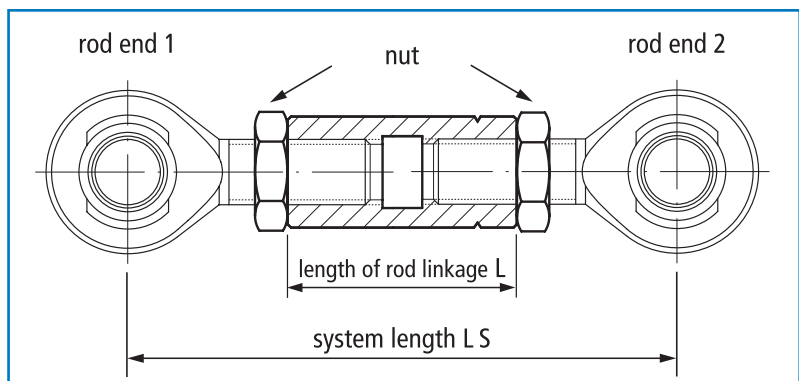
When ordering this constellation please use the catalogue designation of the required rod end along with the type of the fitting threaded bolt.

**Example:** you need a integral spherical plain bearing BEM 10 incl. threaded bolt:  
text of order: **BEM 10-20-501 + BOK 10**

## Rod Linkage

To simplify installation you can use already mounted rod linkages.

Please define the desired system as described in the table below:



Heavy duty rod end 1	length of rod linkage L	system length LS	Heavy duty rod end 2

Upon your request you will receive the rod linkage with male thread respectively pipe construction to reduce weight.

DIN ISO-rod ends & DIN ISO-rod bearing



**... with integral spherical plain bearing**

maintenance-free,  
also in stainless steel

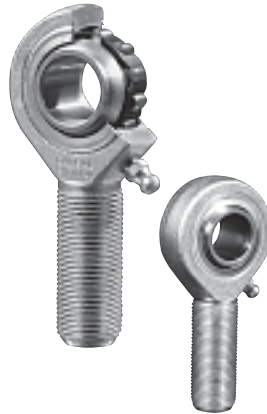


**... with integral self-aligning ball bearing**

also in stainless steel



**... with integral self-aligning roller bearing**



**... Special rod ends and rod end systems for customerspezifications**







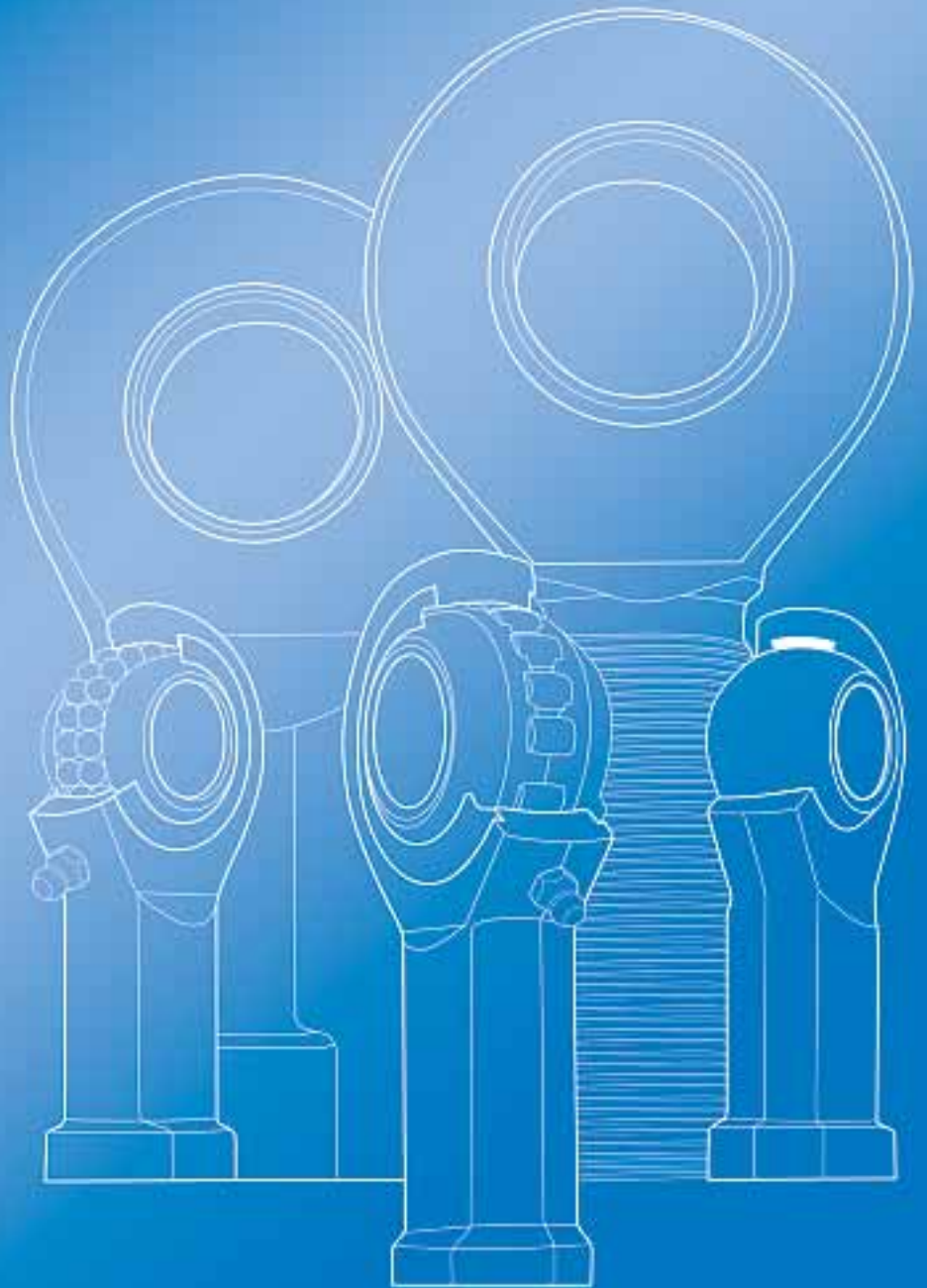
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**NADELLA**