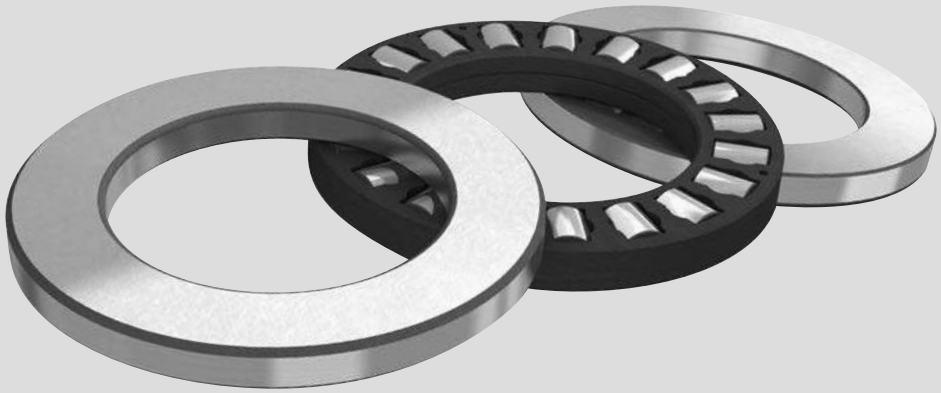

# 11 Cylindrical roller thrust bearings

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## More information




*SKF bearing maintenance handbook* ISBN 978-91-978966-4-1


SKF cylindrical roller thrust bearings (**fig. 1**) are designed to accommodate heavy axial loads and impact loads. They must not be subjected to any radial load. The bearings are very stiff and require little axial space.

## Bearing features

- **Separable design**
  Shaft washer, housing washer, cylindrical roller and cage thrust assembly can be mounted separately.

- **Extended bearing service life**
  To prevent stress peaks, the roller ends are relieved slightly to modify the line contact between the raceway and rollers.

**Fig. 1**

**Cylindrical roller thrust bearing**

# Designs and variants

SKF supplies cylindrical roller thrust bearings in different series (**fig. 2**):

- 811 and 812 series bearings with one row of rollers
  They are mainly used in applications where thrust ball bearings do not have sufficient load carrying capacity.
- 893 and 894 series bearings with two rows of rollers

## Single direction bearings

As standard, cylindrical roller thrust bearings are available as single direction bearings (**fig. 2**) and can accommodate axial loads in one direction only.

## Double direction bearings

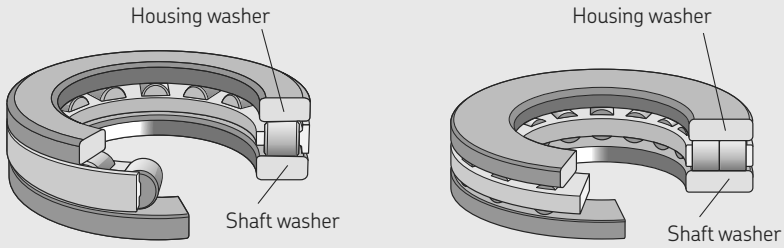
- can accommodate axial loads in both directions
- can be created by combining two cylindrical roller and cage thrust assemblies and two bearing washers with an intermediate washer
  Depending on the design, an intermediate washer can be shaft or housing centred (**fig. 3**).

Intermediate washers must have the same surface finish and hardness as bearing washers. SKF does not supply intermediate washers, but provides material specifications and dimensional data on request.

For additional information, refer to *Design considerations*, **page 885**.

**Fig. 2**

**Single direction bearings**

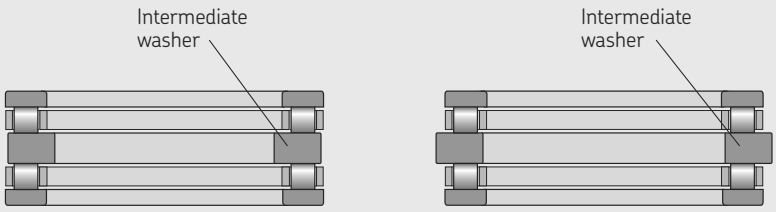



Single row, 811 and 812 series

Double row, 893 and 894 series

**Fig. 3**

**Double direction bearings**




Shaft centred

Housing centred

# Cylindrical roller and cage thrust assemblies

- are identified by the prefix K (**fig. 4**)
- can accommodate axial loads in one direction only
- can be combined with washers in the WS, GS and LS series (*Bearing washers*)
- can be used without washers in applications where:
  - adjacent components can serve as raceways
  - bearing arrangements with a low axial section height are required

# Bearing washers

SKF can also supply the components of cylindrical roller thrust bearings also separately. Additional to cylindrical roller and cage thrust assemblies the included bearing washers (**fig. 5**) are listed in the **product table**, **page 888**).

## Shaft washers

- are identified by the prefix WS
- are made of hardened carbon chromium bearing steel
- have a precision-ground raceway surface
- have a ground bore

## Housing washers

- are identified by the prefix GS
- are made of hardened carbon chromium bearing steel
- have a precision-ground raceway surface
- have a ground outside surface

SKF recommends using both of these washers in high-speed applications where accurate centring of the bearing washers is required.

## LS series universal washers

- can be used as both shaft or housing washers for bearings in the 811 series
- are used for applications where accurate centring of the bearing washers is not necessary
- are used where low speeds are involved

For additional information about LS series washers, refer to *Needle roller thrust bearings*, **page 895**.

**Fig. 4**

**Cylindrical roller and cage thrust assembly**

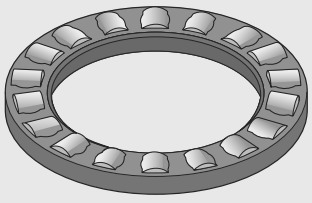
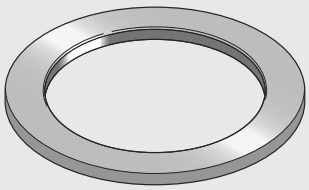
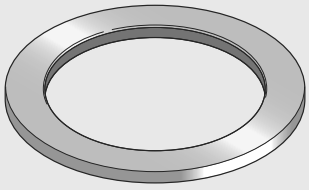


**Fig. 5**

**Bearing washers**



Shaft washer



Housing washer

# Cages

SKF cylindrical roller thrust bearings are fitted with one of the cages shown in **table 1**.

When used at high temperatures, some lubricants can have a detrimental effect on polyamide cages. For additional information about the suitability of cages, refer to *Cages*, **page 187**.

**Table 1**

**Cages for cylindrical roller thrust bearings**

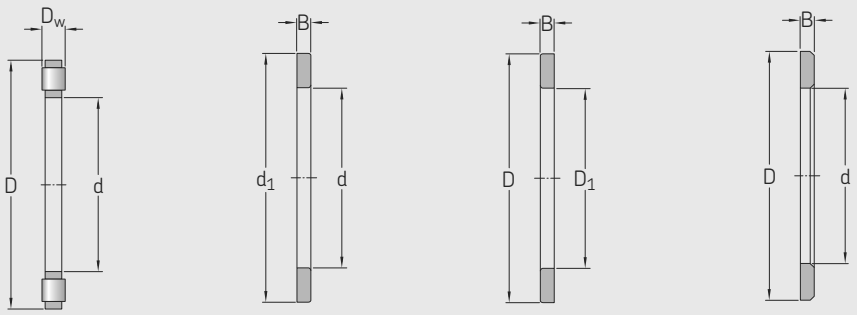
| | | |
|---|---|---|
| |  |  |
| **Materials** | Glass fibre reinforced PA66 | Machined brass |
| **Suffix** | TN | M |

# Bearing data

| | |
|---|---|
| **Dimension standards** | Boundary dimensions: ISO 104 |
| **Tolerances** | Normal<br>Check availability of P5 tolerance class for larger bearings<br>Values: ISO 199 (**table 10**, **page 46**) |
| For additional information<br>→ **page 35** | Except for components (**table 2**, **page 882**):<br>• Values (**table 3**, **page 883**)<br>• Variation of gauge lot diameter of the rollers: ISO 12297 |
| **Permissible misalignment** | Cannot tolerate any misalignment. |

Table 2

**Tolerances for cylindrical roller thrust bearing components**




K WS GS LS

| Bearing component<br>Dimensions | | Tolerance, tolerance class[1], standard |
|---|---|---|
| **Cylindrical roller and cage thrust assemblies, K** | | |
| Bore diameter | d | E11 |
| Outside diameter | D | a13 |
| Roller diameter | $D_w$ | ISO 12297 |
| **Shaft washers, WS** | | |
| Bore diameter | d | Normal, ISO 199 |
| Outside diameter | $d_1$ | – |
| Thickness | B | h11 |
| Axial run-out | $s_i$ | Normal, ISO 199 |
| **Housing washers, GS** | | |
| Outside diameter | D | Normal, ISO 199 |
| Bore diameter | $D_1$ | – |
| Thickness | B | h11 |
| Axial run-out | $s_e$ | Normal, ISO 199 |
| **Universal washers, LS** | | |
| Bore diameter | d | E12 |
| Outside diameter | D | a12 |
| Thickness | B | h11 |
| Axial run-out | $s_i$ | Normal, ISO 199 |

[1] The envelope requirement (symbol Ⓔ from ISO 14405-1) is not shown but applies to all tolerance classes.

**Table 3**

**ISO tolerance classes**

| **Nominal dimension** | | **a12**Ⓔ Deviations | | **a13**Ⓔ Deviations | | **E11**Ⓔ Deviations | | **E12**Ⓔ Deviations | | **h11**Ⓔ Deviations | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| > | ≤ | U | L | U | L | U | L | U | L | U | L |
| mm | | µm | | µm | | µm | | µm | | µm | |
| **–** | **3** | – | – | – | – | – | – | – | – | 0 | –60 |
| **3** | **6** | – | – | – | – | – | – | – | – | 0 | –75 |
| **6** | **10** | – | – | – | – | – | – | – | – | 0 | –90 |
| **10** | **18** | – | – | – | – | +142 | +32 | +212 | +32 | 0 | –110 |
| **18** | **30** | –300 | –510 | –300 | –630 | +170 | +40 | +250 | +40 | 0 | –130 |
| **30** | **40** | –310 | –560 | –310 | –700 | +210 | +50 | +300 | +50 | – | – |
| **40** | **50** | –320 | –570 | –320 | –710 | +210 | +50 | +300 | +50 | – | – |
| **50** | **65** | –340 | –640 | –340 | –800 | +250 | +60 | +360 | +60 | – | – |
| **65** | **80** | –360 | –660 | –360 | –820 | +250 | +60 | +360 | +60 | – | – |
| **80** | **100** | –380 | –730 | –380 | –920 | +292 | +72 | +422 | +72 | – | – |
| **100** | **120** | –410 | –760 | –410 | –950 | +292 | +72 | +422 | +72 | – | – |
| **120** | **140** | –460 | –860 | –460 | –1 090 | +335 | +85 | +485 | +85 | | |
| **140** | **160** | –520 | –920 | –520 | –1 150 | +335 | +85 | +485 | +85 | – | – |
| **160** | **180** | –580 | –980 | –580 | –1 210 | +335 | +85 | – | – | – | – |
| **180** | **200** | –660 | –1 120 | –660 | –1 380 | +390 | +100 | – | – | – | – |
| **200** | **225** | – | – | –740 | –1 460 | +390 | +100 | – | – | – | – |
| **225** | **250** | – | – | –820 | –1 540 | +390 | +100 | – | – | – | – |
| **250** | **280** | – | – | –920 | –1 730 | +430 | +110 | – | – | – | – |
| **280** | **315** | – | – | –1 050 | –1 860 | +430 | +110 | – | – | – | – |
| **315** | **355** | – | – | –1 200 | –2 090 | +485 | +125 | – | – | – | – |
| **355** | **400** | – | – | –1 350 | –2 240 | +485 | +125 | – | – | – | – |
| **400** | **450** | – | – | –1 500 | –2 470 | +535 | +135 | – | – | – | – |
| **450** | **500** | – | – | –1 650 | –2 620 | +535 | +135 | – | – | – | – |
| **500** | **630** | – | – | –1 900 | –3 000 | +585 | +145 | – | – | – | – |
| **630** | **800** | – | – | –2 100 | –3 350 | – | – | – | – | – | – |

# Loads

| | |
|---|---|
| **Minimum load**<br><br>For additional information<br>→ page 106 | $F_{am} = 0{,}0005\ C_0 + A\left(\frac{n}{1\ 000}\right)^2$ |
| **Equivalent dynamic bearing load**<br><br>For additional information<br>→ page 91 | $P = F_a$ |
| **Equivalent static bearing load**<br><br>For additional information<br>→ page 105 | $P_0 = F_a$ |

**Symbols**

- $A$ minimum load factor (page 888)
- $C_0$ basic static load rating [kN] (page 888)
- $F_a$ axial load [kN]
- $F_{am}$ minimum axial load [kN]
- $n$ rotational speed [r/min]
- $P$ equivalent dynamic bearing load [kN]
- $P_0$ equivalent static bearing load [kN]

# Temperature limits

The permissible operating temperature for cylindrical roller thrust bearings can be limited by:

- the dimensional stability of the bearing washers and rollers
- the cage
- the lubricant

Where temperatures outside the permissible range are expected, contact SKF.

## Bearing washers and rollers

The bearings are heat stabilized up to at least 120 °C *(250 °F)*.

## Cages

Brass cages can be used at the same operating temperatures as the bearing washers and rollers. For temperature limits of polymer cages, refer to *Polymer cages*, page 188.

## Lubricants

For temperature limits of SKF greases, refer to *Selecting a suitable SKF grease*, page 116.

When using lubricants not supplied by SKF, temperature limits should be evaluated according to the SKF traffic light concept, page 117.

# Permissible speed

The speed ratings in the product table, page 888 indicate:

- the **reference speed**, which enables a quick assessment of the speed capabilities from a thermal frame of reference
- the **limiting speed**, which is a mechanical limit that should not be exceeded unless the bearing design and the application are adapted for higher speeds

For additional information, refer to *Operating temperature and speed*, page 130.

# Design considerations

## Abutment dimensions

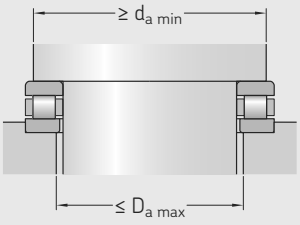
Abutment dimensions should fulfil the following:

- Support surfaces in housings and on shafts should be at right angles to the shaft axis and provide uninterrupted support over the entire washer face.
- The abutment diameter on the shaft should be ≥ $d_{a\ min}$ and in the housing ≤ $D_{a\ max}$ (**fig. 6**). Values for $d_{a\ min}$ and $D_{a\ max}$ are listed in the **product table**, **page 888**
- Shafts and housings should be manufactured to suitable tolerance classes (**table 4**) to provide satisfactory radial guidance for the individual thrust bearing components.
  - Housing centred washers require a radial gap between the shaft and washer bore.
  - Shaft centred washers require a radial gap between the washer and the housing bore.

Cylindrical roller and cage thrust assemblies are generally centred radially by the shaft to reduce the circumferential speed at which the cage slides against the guiding surface. This is particularly important for higher-speed applications. The guiding surface should be ground.

**Fig. 6**

**Abutment diameters**




## Raceways on shafts and in housings

- should have the same hardness, surface finish and axial run-out as a bearing washer, if the load carrying capacity of a cylindrical roller and cage thrust assembly is to be fully exploited
- should be designed using the dimensions $E_a$ and $E_b$ (**product table**, **page 888**), which take radial displacement of the roller set into consideration

For additional information, refer to *Raceways on shafts and in housings*, **page 179**.

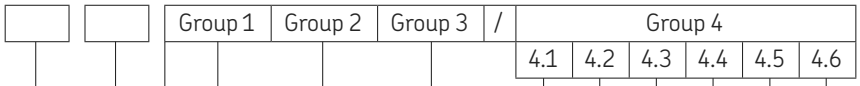
**Table 4**

**Shaft and housing tolerance classes**

| Bearing component | Prefix | Tolerance class[1)] Shaft centred | Housing centred |
|---|---|---|---|
| **Cylindrical roller and cage thrust assemblies** | K | h8 | – |
| **Shaft washers** | WS | h8 | – |
| **Housing washers** | GS | – | H9 |

[1)] The envelope requirement (symbol Ⓔ from ISO 14405-1) is not shown but applies to all tolerance classes.

# Designation system




**Prefixes**

**GS** Housing washer
**K** Cylindrical roller and cage thrust assembly
**WS** Shaft washer

**Basic designation**

Listed in **table 4**, **page 30**

**LS..** Universal washer, the number following identifies the bore and outside diameter

**Suffixes**

**Group 1: Internal design**

**Group 2: External design (seals, snap ring groove, etc.)**

**Group 3: Cage design**

**M** Machined brass cage
**TN** Glass fibre reinforced PA66 cage

**Group 4.1: Materials, heat treatment**

**HA1** Case-hardened shaft and housing washers
**HB1** Bainite-hardened shaft and housing washers

**Group 4.2: Accuracy, clearance, preload, quiet running**

**P5** Dimensional and geometrical tolerances to class P5

**Group 4.3: Bearing sets, matched bearings**

**Group 4.4: Stabilization**

**Group 4.5: Lubrication**

**Group 4.6: Other variants**