## 1 Choice of Antifriction Bearings

It is best to select and size the bearing before design begins.

### 1.1 Parameters for Choosing Bearings

- Permitted dimensions and material information of the bearing.
- Loads with load spectrums and associated time slices in %.
- Rotary speed and number of rotating motions and rotating angle per time unit.
- Peripheral forces to be borne by the gear.
- Other operating conditions, such as temperature, vacuum, clean room, moisture ...

An approximate choice of bearing is possible using the catalogue. All relevant data are to be found on the pages for the individual types.

### 1.2 Static and Dynamic Load Capacity, Calculation

The figures given in the catalogue for the static and dynamic load ratings are for a preliminary design, but are insufficient for exact sizing. The load ratings given correspond to the radial load ratings. Exact sizing requires the static axial, radial and torque load ratings and the dynamic axial and radial load ratings. The axial values are approximately higher by a factor of 2. Franke will perform the calculation on request.

## 2 Installation and Set-Up of Bearing Elements

Bearing elements consist of two inner and two outer race rings and a multipart, segmented cage with balls. The race rings are divided and can, thus, be used flexibly in the diameter for installation.

The balls correspond to quality grade 3 (DIN 5401). Only the supplied balls may be used. If balls are lost, all the balls must be exchanged to ensure the race characteristics of the bearing are not impaired.

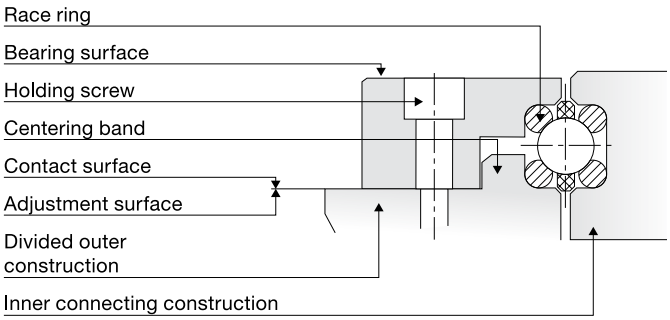
Setting the preload is an important requirement for a long lifetime. This guarantees that all raceways are sharing the load and the balls are running perfectly in the predetermined positions.

### 2.1 Setting with Washers

Setting using washers is the most cost-effective and flexible method, as this still allows readjustment of the adjustment later on. You can order the washers by screw diameter in different thicknesses (see accessories p. 55).

Requirements:
- Spacing of the inner or outer design.
- The height of the race ring bed is 0.3 to 0.5 mm smaller on the side of the divided mating structure. This gap is needed to insert the washers.
- The divided side of the mating structure should be fixed with a centering collar. This is the only way to guarantee the parallelism.

Installation and set-up:




The race rings are laid in the mating structure.
The race ring beds can be greased to hold the race rings in position during installation. The points of impact of the opposite race rings in the same section, are installed at an angle of approx. 180°. Afterwards, the divided side of the mating structure is brought to the intended position.* Then, you insert the cage segments with the balls and grease the bearing element (see 4.1 Lubrication). Before the mating structure of the divided side is closed, arrange the washers on the screw borings of the holding screws. The thickness depends on the in-built gap (see above). Once the screws are tightened (see 4.5 Screws) and the bearing assemblies have been turned about 2 to 3 times through 360°, check the adjustment. If the values differ by more than 5 to 10 %, the thickness of all washers must be changed and the process repeated.

*Applies for both installation methods 2.1 and 2.2

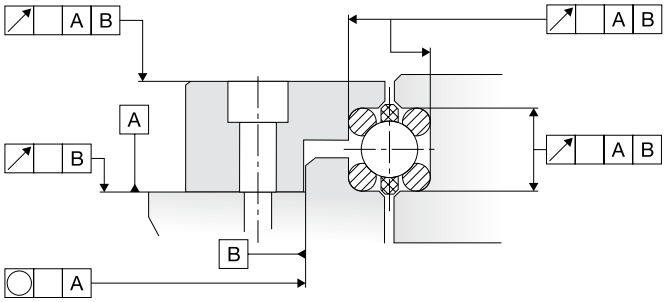
### 2.2 Setting through Massive Adjustment

When setting using massive adjustment, the adjustment surface is brought to the correct level by subsequent grinding. The best accuracy is achieved with this method, as the joint face

between the divided side of the mating structure is form-fit and no tension bridges can build up.

Requirement:
- Spacing of the inner or outer design.
- Surface grinding machine of suitable size.
- The height of the race ring bed is 0.1 mm larger on the side of the divided mating structure. This oversize is necessary for the adjustment.
- The divided side of the mating structure should be fixed with a centering collar. This determines the parallelism of the two raceways.

Installation and set-up:




Then insert the cage segments with the balls and close the bearing assembly with the two divided sides of the mating structure (adjustment ring). Once the screws have been tightened properly (see 4.5 Screws) and the bearing assembly has been turned 2 to 3 times through 360°, measure the space between the inner and outer ring using a test gauge. Then the adjustment ring is taken off again and the determined value plus 0.02 to 0.03 mm is ground off with the grinding machine.

To ensure the parallelism is maintained between this surface and the raceway, a suitable bearing surface should already be chosen during design.

After thorough removal of the ground dust, the ring is refitted as described and the bearing moves. Then check the adjustment. If this value differs by more than 5 to 10 %, the procedure must be repeated. Finally, the bearing assembly is greased via the in-built grease borings (see 4.1 Lubrication).

Note:
Setting the preload is advisable, as there are tolerances that need to be compensated even with the best production.

## 3 Installation and Set-Up of Slim Bearings

Slim bearings of the LDD type are highly loadable, pre-finished bearing elements, which can be fitted very easily in a small installation space. With slim bearings the bearing element (four ball race rings with ground raceway and a plastic band cage with retained balls) is embedded in a steel inner and outer casing. The casings are peripherally divided and form a pre-finished bearing, which is integrated directly in each design.

In contrast to standard, closed and ground slim bearings, the play on Franke slim bearings is not dependent on the fit of the outer and inner rings. As a result, fitting and removing are easier and require no special tools or thermal treatment.

The bearings are suitable for permanent operation at temperatures between –10 °C and +70 °C – and briefly for use up to +120 °C. Peripheral speeds of 10 m/s with fat lubrication and 12 m/s with oil lubrication can be achieved.

Setting the preload is an important requirement for a long lifetime of the slim bearing. This guarantees that all raceways are sharing the load and the balls are running perfectly in their predetermined positions. The preload is set correctly when the adjustment corresponds to the values in the diagram at point 6 without seal.

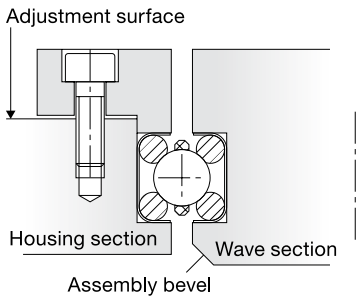
Note:
Setting the preload is advisable, as there tolerances that need to be compensated even with the best production.

### 3.1 Settings with Washers

Setting using washers is the most cost-effective and flexible method, as this still allows readjustment of the adjustment later on. You can order the washers by screw diameter in different thicknesses (see accessories p. 55).

Requirements:
- Spacing of the inner or outer design.
- The height of the race ring bed is 0.3 to 0.5 mm smaller on the side of the divided mating structure. This gap is needed to the insert the washers.
- The divided side of the mating structure can be fixed with a centering collar to improve the parallelism of the raceways.

Installation suggestion A:



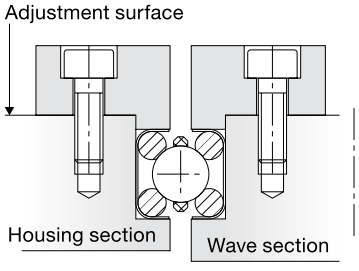

The slim bearing is laid in the mating structure.
Before the mating structure of the divided side is closed, arrange the washers on the screw borings of the holding screws. The thickness depends on the in-built gap (see above). Once the screws are tightened (see 4.5 Screws) and the bearing assemblies have been turned about 2 to 3 times through 360°, check the adjustment. If the values differ by more than 5 to 10 %, the thickness of all washers must be changed and the process repeated.

### 3.2 Setting through Massive Adjustment

When setting using massive adjustment, the adjustment surface is brought to the correct level by subsequent grinding. The best accuracy is achieved with this method, as the joint face between the divided side of the mating structure is form-fit and no tension bridges can build up.

Requirement:
- Spacing of the inner or outer design.
- Surface grinding machine of suitable size.
- The height of the wire ring bed is 0.1 mm larger on the side of the divided mating structure. This oversize is necessary for the adjustment.
- The divided side of the mating structure can be fixed with a centering collar. In this way the parallelism of the two raceways is improved.

Installation and set-up:




The slim bearing is inserted into the mating structure and the bearing is closed with the two divided sides of the mating structure (adjustment ring). Once the screws have been tightened properly (see 4.5 Screws) and the bearing has been turned 2 to 3 times through 360°, measure the space between the inner and outer ring using a test gauge.

Then the adjustment ring is taken off again and the determined value plus 0.02 to 0.03 mm is ground off with the grinding machine. To ensure the parallelism is maintained between this surface and the raceway, a suitable bearing surface should already be chosen during design. After thorough removal of the ground dust, the ring is refitted as described and the bearing moves. Then check the adjustment. If this value differs by more than 5 to 10 %, the procedure must be repeated.

## 4 Installation and Set-Up of Bearing Assemblies

Franke bearing assemblies are pre-finished complete bearings – regardless of whether they are standard bearings from the catalogue or a customer-specific version. The preset or defined race accuracy, adjustment, stiffness and general characteristics are dependent on the mating structure and on the accuracy or completeness of the data supplied. Therefore, particular attention must be paid.

### 4.1 Lubrication and Maintenance

To keep friction low and to protect the bearing from corrosion in the long run, ensure use of sufficient lubrication. All lubricants undergo an ageing process, which limits the service life. The best ageing stability is achieved with fully synthetic lubricants. ISOFLEX TOPAS NCA52 (special grease from Klüber, designation in accordance with DIN 51502: KHC2 N-50) is used as the initial lubrication on Franke bearings. The ageing stability of this lubricant is for approx. three years. This lubricant is also recommended for the use of bearing elements.

High quality lithium soap fats based on polyalpha-olefin or mineral oils and in accordance with DIN 51825-K2 K-40 are suitable as an alternative. Questions on lubricants, such as miscibility, aggressiveness, extreme temperatures, removal, areas of use etc., must be clarified with the relevant lubricant manufacturer.

### 4.2 First or Relubrication

The amount of lubricant that an Antifriction Bearing needs for lubrication is relatively low and is dependent on the rotary speed. Because of the flexing work, too much lubricant causes increased temperatures, which limit or prevent lubricity. The

bearing's lifetime is substantially reduced due to the increased wear. The amount of lubricant is determined by the calculated play inside the bearing assembly. The calculated volume must be filled with 20 to 30 % lubricant. The recommendation is 30 to 40 % for slewing bearings.

### 4.3 Relubrication and Lubrication Periods

The lubricity reduces due to mechanical loads and ageing. Therefore, it is necessary to supplement or completely replace the existing lubricant (e.g. in the event of heavy soiling). The bearing must be rotated during relubrication. Relubrication should be effected at operating temperatures as far as possible.

The amounts for relubrication are calculated as follows:
m = Ø KK x h2/3 x X
h2 = bearing ring height in mm
Ø KK = ball pitch diameter in mm
m = amount of lubricant in g
X = factor according to table 1 in $mm^{-1}$

Relubrication periods:
Exact determination of the periods is usage-specific and, therefore, can only be correctly determined by trial and error (guide values see table 1). To determine the X factor (table 2), use the read time value in reference to the operating time of the application.

Note: for standard bearings applying one lubrication application is sufficient, as the lubricant is evenly distributed by the bearing rotation. For slewing bearings at least three relubrication applications are needed (3x120°).

| Vu<br>m/s | Frequency<br>h |
|---|---|
| 0 to < 3 | 5000 |
| 3 to < 5 | 1000 |
| 5 to < 8 | 600 |
| 3 to <10 | 200 |

Table 1: Relubrication Periods

| Frequency | weekly | monthly | yearly | 2-3 years |
|---|---|---|---|---|
| X | 0.002 | 0.003 | 0.004 | 0.005 |

Table 2: Relubrication Intervals

Circular oil lubrication is possible in principle and should be discussed with the relevant lubricant manufacturer. Lubricant-free bearings are available for special applications (e.g. clean room or ultrahigh vacuum).

Calculation example:
bearing assembly of type LDL, Ø KK 500 mm, order no. 73105Y
Peripheral speed 3 m/s
Operating time approx. 16 hrs/day

Relubrication period for 3 m/s is 1000 hrs (see table 1)
= 1000 (hrs) / 16 (hrs/day) = 63 days ~ 3 months for 16 hrs/day operating time

Relubrication should be effected quarterly. The X factor (table 2) is rounded off and is 0.003. The h2 measurement is 42 mm (see catalogue page 40).

m = 500 mm x 42/3 $mm^{-1}$ x 0.003 g = 21 g

Thus, relubrication of 21 g of ISOFLEX TOPAS NCA52 should be applied every three months. The lubricant has a shelf life of three years.

### 4.4 Lubrication and Lubrication Periods for the Gear

Automatic gear lubrication is recommended. With manual lubrication, the gear and the pinion must be sufficiently lubricated before start-up. The lubrication period depends on the design and peripheral speed and, therefore, must be determined individually.

### 4.5 Screws

The number of screws and the diameter for fixing to the mating structure should be checked in principle. The spacing X from holding screw to holding screw should not exceed 125 mm to avoid formation of bridges. The fixing screws are tightened crosswise with a torque wrench in relation to the screw quality – according to the figures in table 3.

| | Quality | |
|---|---|---|
| | Nm<br>8,8 | Nm<br>12,9 |
| M6 | 10 | 17 |
| M8 | 25 | 41 |
| M10 | 49 | 83 |
| M12 | 86 | 145 |
| M16 | 210 | 355 |

Table 3: Starting Torque

The screws need to be retightened with the prescribed tightening moment to resolve settling phenomena. This process should be effected as far as possible when the screws are free of additional forces. They must be checked after around

100 and then every 600 operating hours. This period can also be much shorter for special applications (e.g. heavy vibrations).

### 4.6 Gear

Franke supplies straight gear without hardening as standard (material 42CrMo4V) and special gears on request. The material, design and quality can be changed at any time on request.

The catalogue figures with regard to permitted peripheral forces were determined using the permitted bending stress in the tooth foot. The maximum forces relate to extreme loads, which occur in the event of brief impact loads such as starting and braking. These values are for guidance purposes only and can only be determined through a gear calculation, including both components pinion and bearing assembly.

### 4.7 Tolerance and Accuracy

All tolerances and accuracies are given on the relevant page of the catalogue. The greatest possible accuracy is achieved when the constructive design of the encapsulating parts is effected in such a way that machining of all related diameters and surfaces can be performed in a clamp.

The run accuracy values in the catalogue are maximum values and can be improved further by limiting the tolerances.

The tolerance values T = IT6 or T = IT7 relate to the diameter-dependent basic tolerances in accordance with DIN ISO 286 see table 4).

| Nominal size range mm over … to | | Basic tolerances µm IT6 | µm IT7 |
|---|---|---|---|
| 80... | 120 | 22 | 35 |
| 120... | 180 | 25 | 40 |
| 180... | 250 | 29 | 46 |
| 250... | 315 | 32 | 52 |
| 315... | 400 | 36 | 57 |
| 400... | 500 | 40 | 63 |
| 500... | 630 | 44 | 70 |
| 630... | 800 | 50 | 80 |
| 800... | 1000 | 56 | 90 |
| 1000... | 1250 | 66 | 105 |
| 1250... | 1600 | 78 | 125 |

Table 4: Tolerances DIN ISO 286 T1 (11.90)

## 5 Rotary Tables

Franke Rotary Tables have a high load capacity and are ideally suited for assembly, measuring and inspecting tasks. All Rotary Tables have a compact aluminium housing with integrated Franke components. A worm gear pair guarantees high accuracy also for permanent loading. The Rotary Tables are extremely tip-resistant with a low own weight. Precise technical details are on the relevant pages in the catalogue.

### 5.1 Load Capacity

The recommended safety for Franke Rotary Tables is SST ≥ 3 for simple loading and SST ≥ 6 for dynamically changing loading and lifting. Franke will perform calculations on loading and lifetime on request.

### 5.2 Temperature Range

The Rotary Tables can be used at an operating temperature of –10 °C to + 80 °C . Expanded temperature ranges are possible on request.

### 5.3 Lubrication

In general, all standard Rotary Tables ex works have long-term lubrication with the Antifriction Bearing grease Isoflex Tops NCA52. It is recommended that Franke Rotary Tables – depending on usage – are relubricated twice a year to once a year (see also 4.1 Lubrication and maintenance).

| Lubrication point | Relubrication amount per lubrication point g front side |
|---|---|
| LTA100 | 1 |
| LTA200 | 1 |
| LTB125 | 3 |
| LTB175 | 3 |
| LTB265 | 3 |
| LTB400 | 1 |

### 5.4 Options

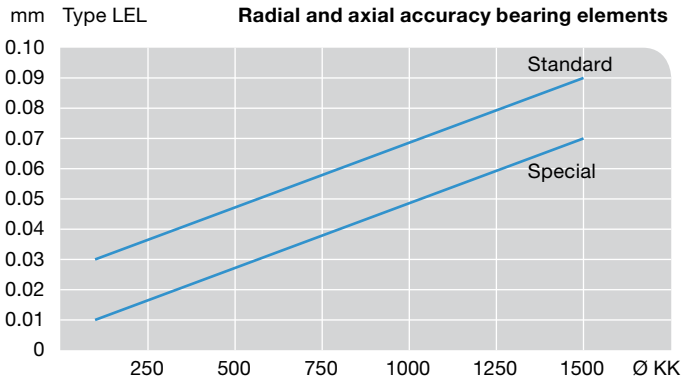
- One or two inductive proximity switches, integrated inside the table
- Freely positionable trips
- Adaptor sets for motors at customer's request
- Motorisation depending on application with step or servo motors
- Rotary encoder on the second shaft extension of the worm shaft
- Complete automation solutions

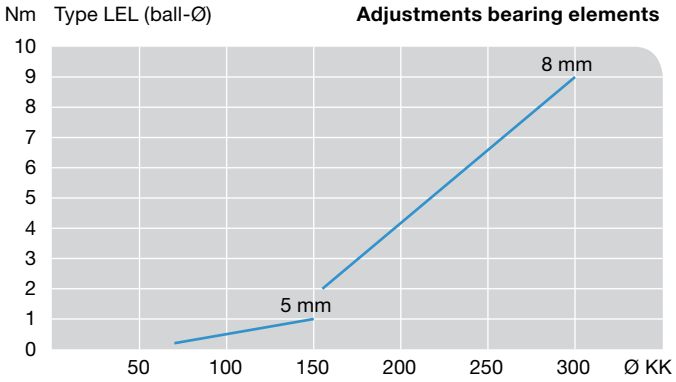
**Please follow assembly and maintenance instructions. They are included with every delivery.**

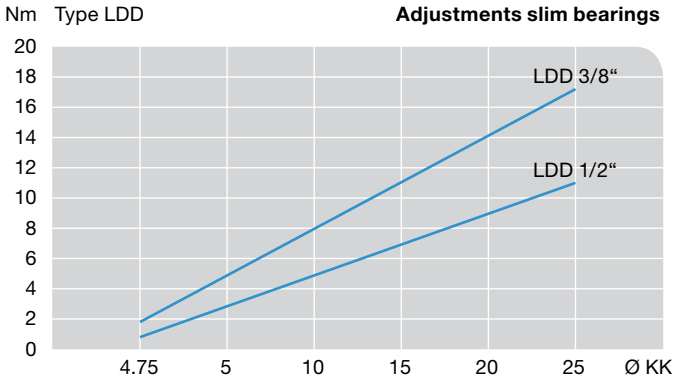
## 6 Adjustment Values and Accuracy

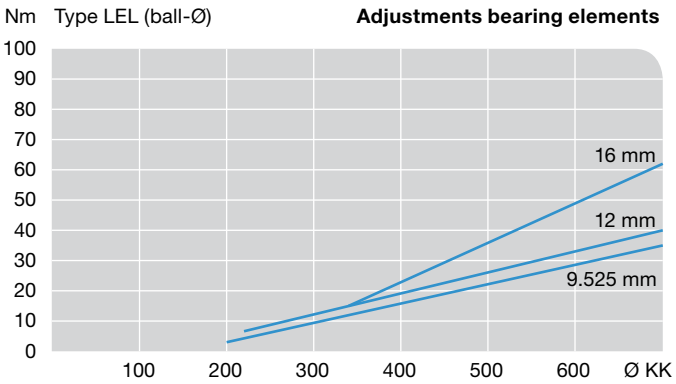
The adjustment gives information on the preload of the bearing assembly. It depends on the individual type and the rolling circle (see 6. Adjustments of individual types). However, these values are not definitive and, therefore, can be adjusted individually depending on the application.

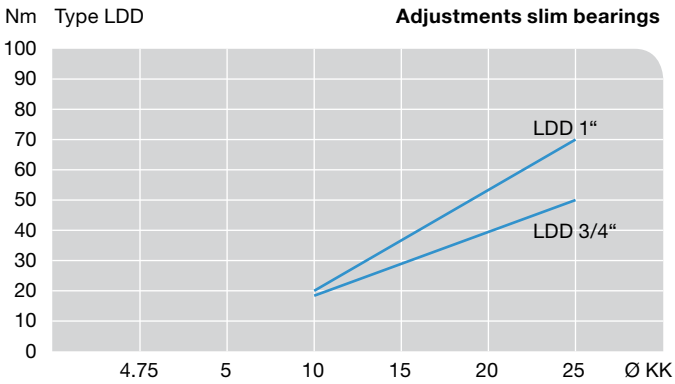
The stiffness is indirectly related to the adjustment. The rule of thumb: the higher the adjustment, the higher the stiffness. The adjustment increase by the seal S10 (see Accessories page 55) amounts to approx. 1 Nm/m circumference and sealing side. This value can fluctuate depending on dry running or surface quality.

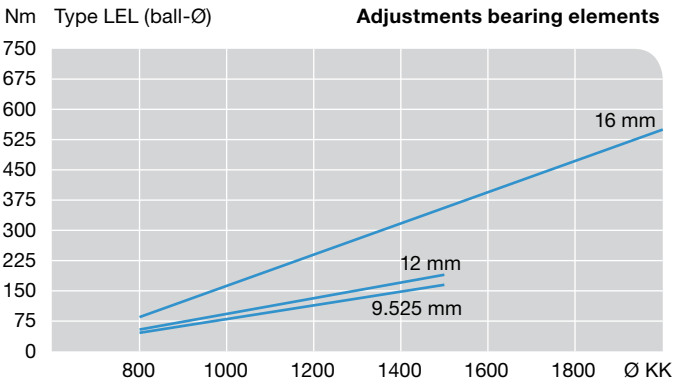


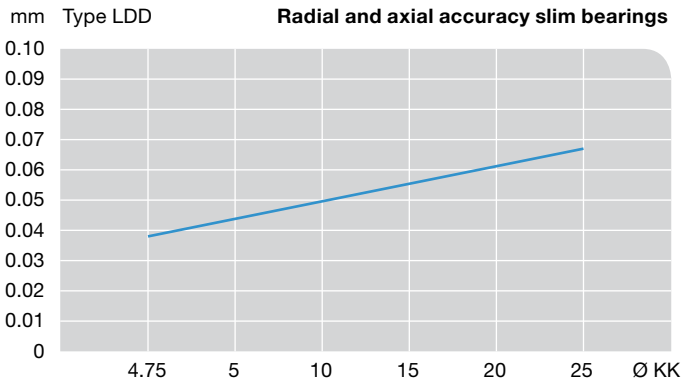



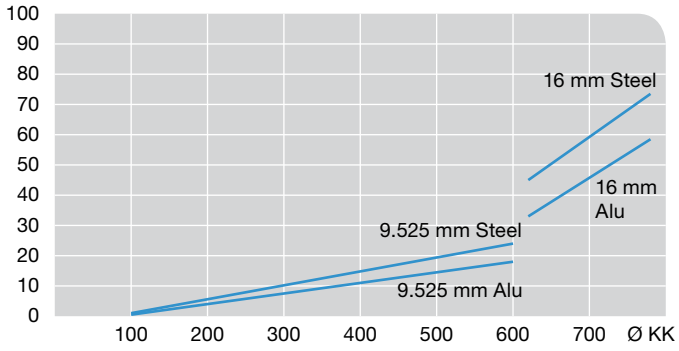



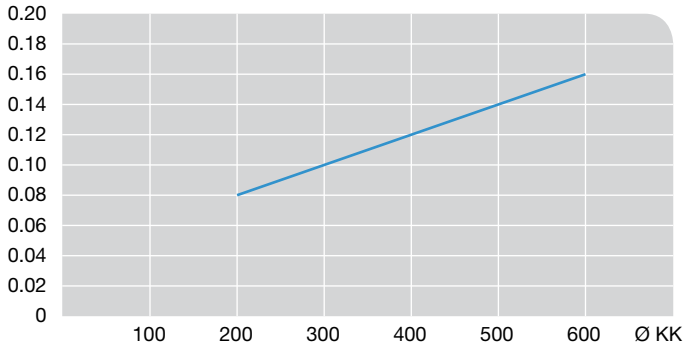



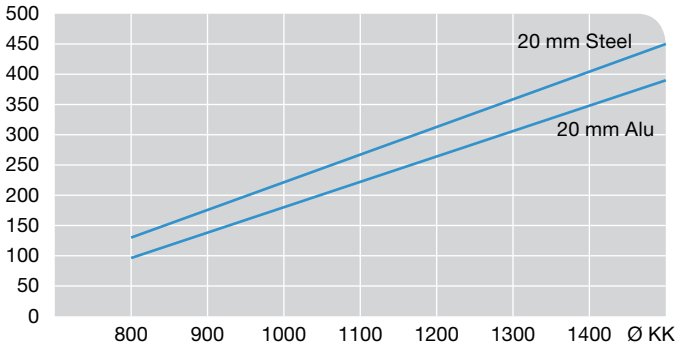
Nm Type LDL (ball-Ø) **Adjustments bearing assemblies**



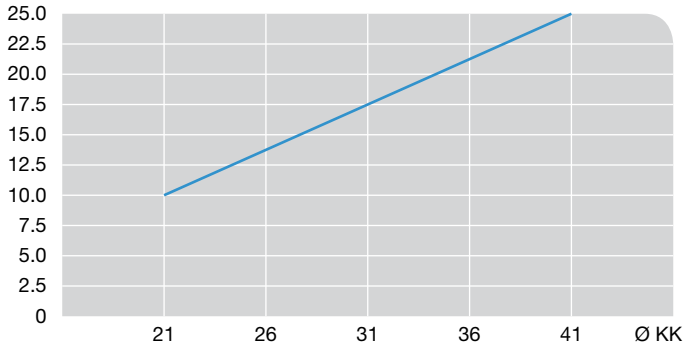

mm Type LDV **Radial and axial accuracy bearing assemblies**



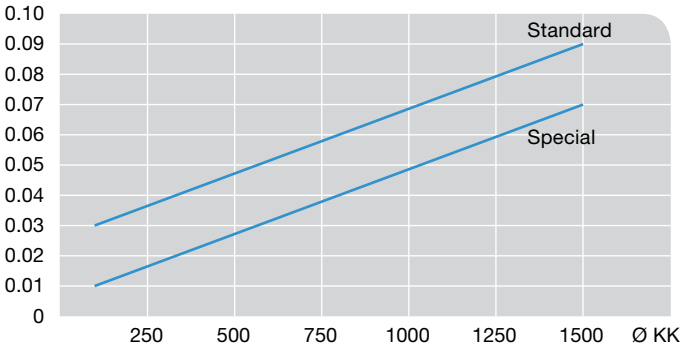

Nm Type LDL (ball-Ø) **Adjustments bearing assemblies**



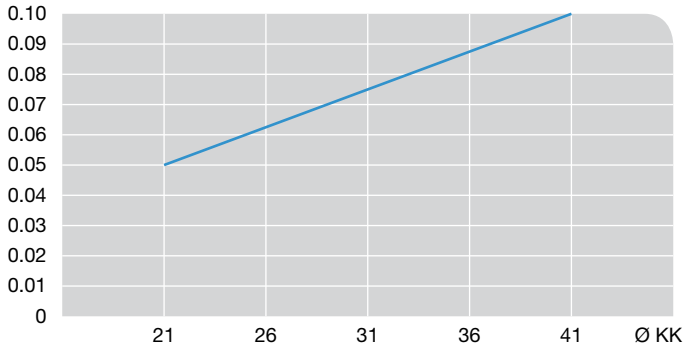

Nm Type LDH **Adjustments bearing assemblies**




mm Type LDL **Radial and axial accuracy bearing assemblies**




mm Type LDH **Radial and axial accuracy bearing assemblies**




Nm Type LDV **Adjustments bearing assemblies**