1. How to chose a bearing element or a bearing assembly

The selection respectively dimensioning of the bearing should be made before the beginning of the design work.

Parameters for the choice:
- Permissible dimension and requirements to the material of the bearing
- Loading with collective loads and pertinent time shares in %
- Number of revolutions respectively number of slewing motions and slewing angle per time unit
- Circumferential forces which are to be transferred by the gear
- Any other operating conditions such as temperature, vacuum, clean-room, humidity

(Please use the form on page 32.)

The catalogue serves to make an approximate selection of the bearing. All the necessary data are found on the corresponding page of the respective series.

1.2 Static and dynamical load capacity, calculation

The indications concerning static and dynamical load capacity given in the catalogue should be used for the pre-dimensioning. They are not sufficient for the precise final dimensioning. The given load rating applies to radial loads. For optimal dimensioning you need the static, axial, radial, and moment load rating, respectively the dynamical, axial, and radial load rating.
The axial values normally are higher by the factor 2. We recommend you to use the Franke calculation programme or to have the calculation made by us.

2. Assembly and adjustment of bearing elements.

Bearing elements are composed of two inner and two outer race rings and a multipart segmented cage with balls. The race rings are open and therefore their cross section can be elastically adapted when mounting.

The quality class of the balls is 3 (DIN5401). Only the balls which are contained in the Franke consignment are allowed to be used. If balls get lost all the balls have to be replaced.
The adjustment with preload is an important condition for longevity. It guarantees that all races carry load and that the balls run optimally in their defined track.

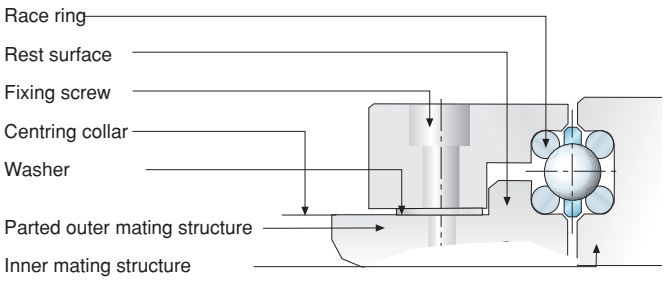
2.1 Adjustment by means of washers

Adjustment by means of washers is the most flexible and economically most efficient way of adjustment because it allows the user to change the rotational resistance subsequently. Washers can be ordered in different thicknesses depending on the screw diameter (see accessories on page 31).

Condition:

- Inner and outer structure have to be parted
- The height “mH7” on the side of the parted mating structure must be by 0.3 to 0.5mm smaller. The gap serves to take the washer.
- The parted side of the mating structure should be fixed by a centring collar to guarantee the parallelism of the races.

Mounting and adjustment



The race rings are inserted into the mating structure. The race ring beds can be coated with grease in order to keep the rings in their position during the mounting process. The joints of the race rings which are on the opposite side of the same part are turned by 180°. Afterwards the parted side of the mating structure is put into its provided position*. Then the cage segments with the balls are inserted and the bearing element is greased (see page 34: lubrication). Before the mating structure of the parted side is closed the washers are put on the holes for the fixing screws. Their thickness depends on the gap which is provided for them (see above). After tightening of the screws (see screws) the bearing assembly is turned 2 to 3 times by 360° and the rotational resistance is checked. If the measured value differs by more than 5-10% the thickness of the washers has to be changed and the procedure has to be repeated.

(* Applies to both adjustment methods 2.1 and 2.2)

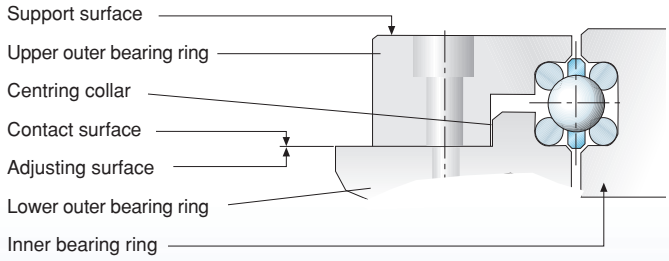
2.2 Massive adjustment

With the massive adjustment the dimensional determination of the adjustment surface is obtained by grinding. With this method the highest precision is reached because the separating surface of the parted side is form-fit and no tension bridges can be produced.

Condition:

- Inner and outer structure has to be parted.
- An appropriate surface grinding machine has to be at disposal
- The dimension “mH7” on the side of the parted mating structure must be by 0,1 mm higher. This over measure is needed for adjustment.
- The parted side of the mating structure should be fixed by a centring collar which determines the parallelism of the raceways.

Mounting and adjustment
Procedure as described under 2.1) until *.



Afterwards the cage segments with the balls are inserted and the bearing assembly is closed with the second parted side of the mating structure (adjustment ring). The clearance should be measured by means of a dial gauge after securing of the screws according to the instructions (see under “screws”) and after turning of the bearing assembly two to three times by a full rotation of 360°. Now the adjustment ring is again detached and the measured value plus additional 0,02 to 0,03 mm is ground off by means of a flat grinding machine. (In order to guarantee the parallelism between this surface and the rest surface of the raceway the designer should provide a suitable rest surface beforehand!)
After the grinding dust has carefully been cleaned off the ring is mounted again as described, and the bearing is moved. Now the rotational resistance is measured. If this value differs by more than 5-10% the procedure has to be repeated. Finally the bearing assembly is greased via the provided lubrication holes (see “lubrication”).

Hint:

We recommend you to adjust a preload because tolerances which have to be compensated are always to be encountered, even with optimum machining

3. Mounting and installation of bearing assemblies

Franke bearing assemblies are completed bearings and ready for installation, no matter whether it is a standard bearing from the catalogue or a custom-made specific version. The defined running accuracy, the rotational resistance, the stiffness and the general features depend on the mating structure and the correctness of the data indicated when ordering. So please pay attention to this aspect.

3.1 Lubrication and maintenance

The bearing should always be provided with sufficient lubricant in order to keep the friction low and to avoid corrosion. All lubricants undergo an ageing process which limits the durability. The best durability is reached by fully synthetic lubricants. For the first lubrication of our bearings we use ISOFLEX TOAS NCA 52 (Special grease of the firm Klüber, designation according to DIN 51502: KHC2N-50). The durability of this lubricant is about 3 years. We recommend this grease also for our bearing elements.

As an alternative you can also use high-grade lithium soap greases on the basis of poly-alpha-olefin or greases on the basis of mineral oil, according to DIN 51825-K2K-40. Any questions regarding specific features e.g. miscibility, aggressiveness, extreme temperatures, disposal, or application fields of a lubricant should be cleared up with the lubricant producer.

3.2 First lubrication

The quantity of lubricant needed by an antifriction bearing is relatively low and adapts itself to the RPM. In cases where too much lubricant is used the flexing work increases the temperatures and consequently the lubricity could be reduced or completely lost.
This way the increased wear of the bearing reduces its longevity. The quantity of lubricant is determined according to the free space inside the bearing assembly. 20 to 30% of the calculated volume has to be filled with lubricant. With slewing bearings we recommend 30-40%.

3.3 Re-lubrication and lubrication periods

The lubricity decreases as a consequence of wear and ageing. Therefore it is necessary to complete lubricant or to exchange the total lubricant quantity (e.g. in case of heavy contamination). During the re-lubrication process the bearing has to be turned, the temperature should be the normal operating temperature.

The re-lubrication quantity is calculated as follows:
M = KKØ x h2/3 x X

h2 = height of bearing ring n mm (see page 20 resp. 24)
KK¯ = Ball pitch diameter in mm
m = Re-lubrication quantity
X = Factor according to table 1 in mm $^{-1}$

Re-lubrication periods:

The precise determination of the periods has to be based on the specific application and should therefore be defined by experiments. Approximate values are found in table 1. The factor X (table 2) is determined by the time value in relation to the operation time provided for your application.

Table 1:

Vu [m/s]	Interval [h]
0 bis < 3	5000
3 bis < 5	1000
5 bis < 8	600
3 bis <10	200

Table 2:

interval	weekly	monthly	annually	2-3 years
X	0,002	0,003	0,004	0,005

Hint:

With standard bearings it is sufficient to attach one re-lubrication facility because the lubricant is evenly applied by the bearing motion. With slewing bearings you should provide at least 3 re-lubrication facilities (3X120¡). Generally it is possible to install a circular oil lubrication system. Please consult the lubricant supplier. For special applications (e.g. clean room or ultra high vacuum) we can manufacture lubricant-free bearings.

Calculation example:

Bearing assembly LDL, KKØ 500 mm, order no. 73105Y, circumferential speed 3m/s

Operation time approximately 16 hours per day

The re-lubrication period for 3m/s is 1000 hours (see table 1)
= 1000 (h) /16 (h/day) = 63 days ~ three months with an operation time of 16 hours per day.

Re-lubrication should be made every 3 months hence the factor X (table 2) is rounded and amounts to 0.0003. The dimension h2 is 42 mm (according to page 25 in this catalogue).

m = 500mm x 42/3mm x 0.003g = 21 g

Hence the quantity for re-lubrication amounts to 21g ISOFLEX TOPAS NCA52; it should be applied every 3 months. The durability of the lubricant is 3 years.

3.4 Lubrication and lubrication periods for the gear

We recommend an automatic lubrication device for the gear. With manual lubrication gear and pinion have to be sufficiently greased before being set to work. The lubrication period depends on the design and the circumferential speed and therefore it has to be considered individually.

3.5 Screws

Principally the number and diameter of screws to be used for fixing the bearing to the mating structure has to be checked. The fastening screws should be tightened crosswise by means of a moment key. The moment depends on the screw quality. (See table 3).

Table 3

	Quality	
	8.8 [Nm]	12.9 [Nm]
M6	10	17
M8	25	41
M10	49	83
M12	86	145
M16	210	355

To compensate settling effects the screws have to be re-tightened with the prescribed tightening moment. During the re-tightening process no other forces should be exerted on the screws. The control has to be made after 100 and after 600 operating hours. Where particular conditions occur (e.g. heavy vibrations) this period should be considerably reduced.

3.6 Rotational resistance

The preload of a bearing determines the rotational resistance. The preload depends on the respective series and on the ball pitch diameter (See respective diagrams). However these values are not irreversible but they can be adjusted individually according the application.
The stiffness of a bearing depends indirectly on the rotational resistance. The following thumb rule applies: the higher the rotational resistance the higher the stiffness.

The increase of the rotational resistance caused by the seal S10 (see accessories) is approx. 1Nm/m circumference per seal. This value can vary due to dry run or and depends also on the surface quality.

3.7 Gear

Normally we supply the straight-tooth type (material 42CrMo4V) unhardened without offset profile. Material, type and quality can be changed on request at any time.

The definition of the permissible circumferential forces in the catalogue is based on the permissible bending stress at the tooth root. The maximum forces are related to extreme loads which are to be encountered e.g. with short time shock loads which occur during starting and stopping. These are approximate values which can only be defined by a gear calculation on the basis of the data given for both components (bearing assembly and pinion).

3.8 Tolerances and precision

All tolerances and precision values are given on the respective catalogue pages. The highest possible precision is obtained, where the enclosing structural parts are designed in such a manner that all diameters and surfaces which correspond to each other can be machined in one chucking.

The running precision indicated in the catalogue refers to maximum values and can be improved by reducing of the tolerances.

The tolerance indication T=IT6 or T = IT7 is referred to the basic tolerances depending on the bearing diameter according to DIM ISO 286 (see table 4).

Table 4

Nominal dimensional range ..up to [mm]	Basic tolerances	
	[µm]	[µm]
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

DIN ISO 286 T1 (11.90)