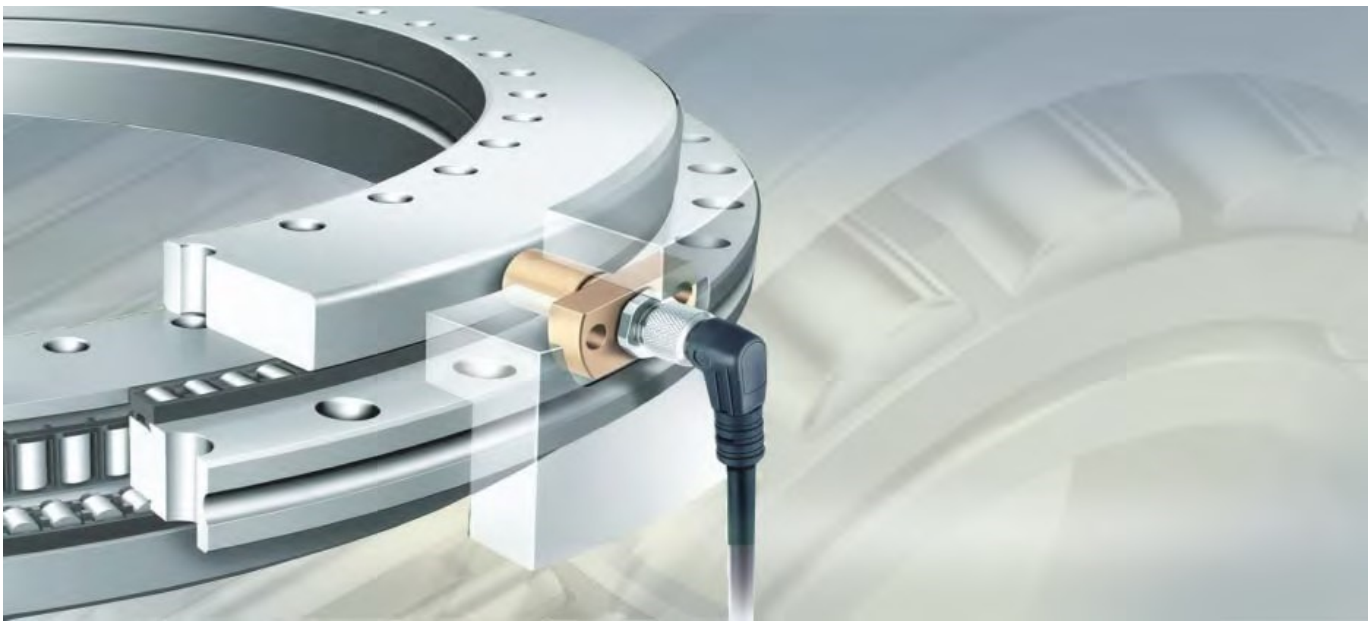


High precision bearings for combined loads

Axial/radial bearings
Axial angular contact ball bearings
Axial/radial bearings
with integral angular measuring system

High precision bearings for combined loads

Axial/radial bearings

Axial/radial bearings are double direction axial bearings for screw mounting, with a radial guidance bearing. These ready-to-fit, pregreased units are very rigid, have high load carrying capacity and run with particularly high accuracy. They can support radial forces, axial forces from both directions and tilting moments free from clearance. The bearings are available in several series.

For applications with low speeds and small operating durations, such as indexing tables and swivel type milling heads, the most suitable bearing is generally series YRT.

Where comparatively lower friction and higher speeds are required, RTC bearings can be used. For higher requirements in accuracy, these bearings are also available with restricted axial runout accuracy.

For the bearing arrangements of direct drive axes, there is the series YRT_{Speed}. Due to their high limiting speeds and very low, uniform frictional torque across the whole speed range, these bearings are particularly suitable for combination with torque motors.

Axial angular contact ball bearings

Axial angular contact ball bearings ZKLDF are low-friction, ready-to-fit, pregreased bearing units with high accuracy for very high speeds, high axial and radial loads and high demands on tilting rigidity.

Axial angular contact ball bearings are particularly suitable for precision applications involving combined loads. Their preferred areas of use are bearing arrangements in rotary tables, milling, grinding and honing heads as well as measurement and testing equipment.

Axial/radial bearings with integral angular measuring system

Axial/radial bearings with integral angular measuring system YRTM and YRTSM correspond in mechanical terms to the series YRT and YRTS but are additionally fitted with an angular measuring system. The measuring system can measure angles to an accuracy of a few angular seconds by noncontact, magneto-resistive means.

YRT

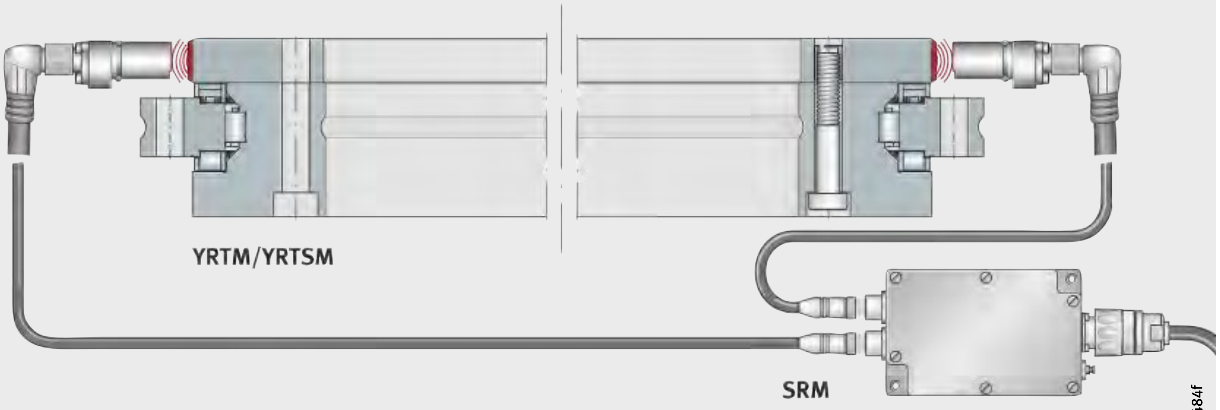
RTC

YRT_{Speed}

00014884

ZKLDF

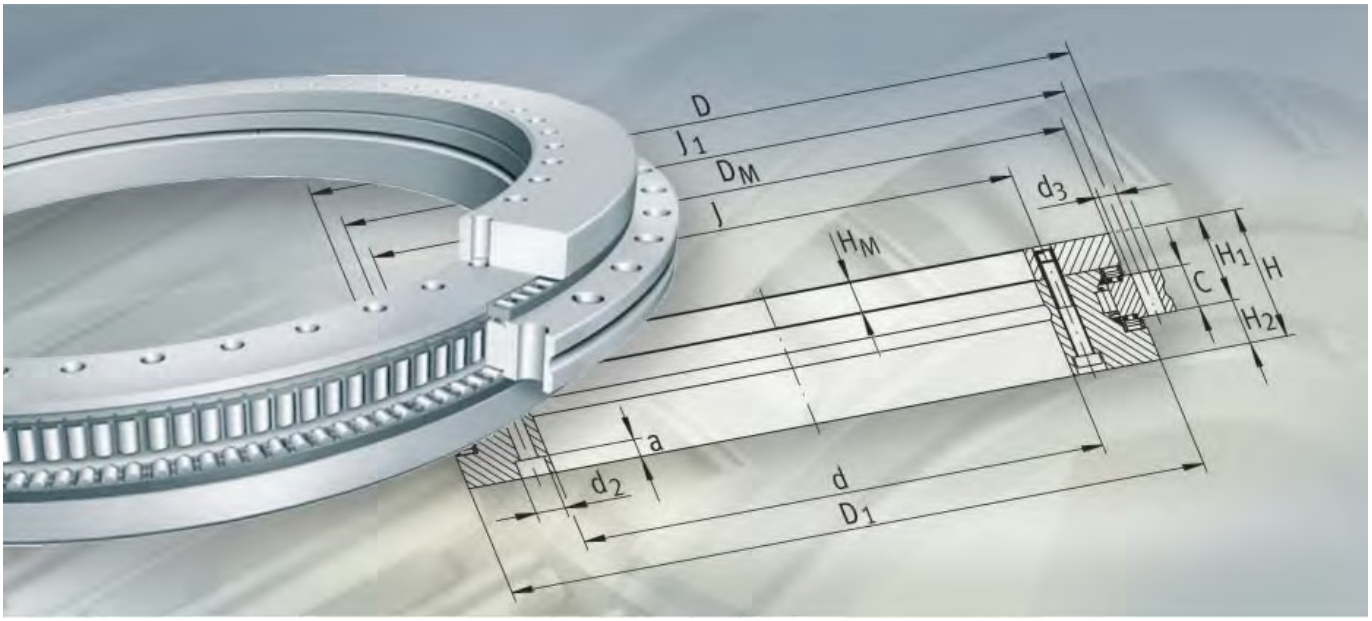
107 585



YRTM/YRTSM

SRM

0001484f



Axial/radial bearings
Axial angular contact ball bearings

Axial/radial bearings
Axial angular contact ball bearings

Product overview

Axial/radial bearings
Axial angular contact ball bearings

Axial/radial bearings

YRT

RTC

For higher speeds

YRT_{Speed}

Axial angular contact ball bearings

ZKLDF

Axial/radial bearings
Axial angular contact ball bearings

Features

Axial/radial bearings YRT, RTC and YRT_{Speed} and axial angular contact ball bearings ZKLDF are ready-to-fit high precision bearings for high precision applications with combined loads.
They can support radial loads, axial loads from both sides and tilting moments without clearance and are particularly suitable for bearing arrangements with high requirements for running accuracy, such as rotary tables, face plates, milling heads and reversible clamps.

Due to the fixing holes in the bearing rings, the units are very easy to fit.

The bearings are radially and axially preloaded after fitting.

The mounting dimensions of all series are identical.

With angular measuring system

Axial/radial bearings are also available with an angular measuring system. The measuring system can measure angles to an accuracy of a few angular seconds by non-contact, magneto-resistive means, see section Axial/radial bearings with integral angular measuring system, page 1144.

Axial/radial bearings
Axial angular contact ball bearings

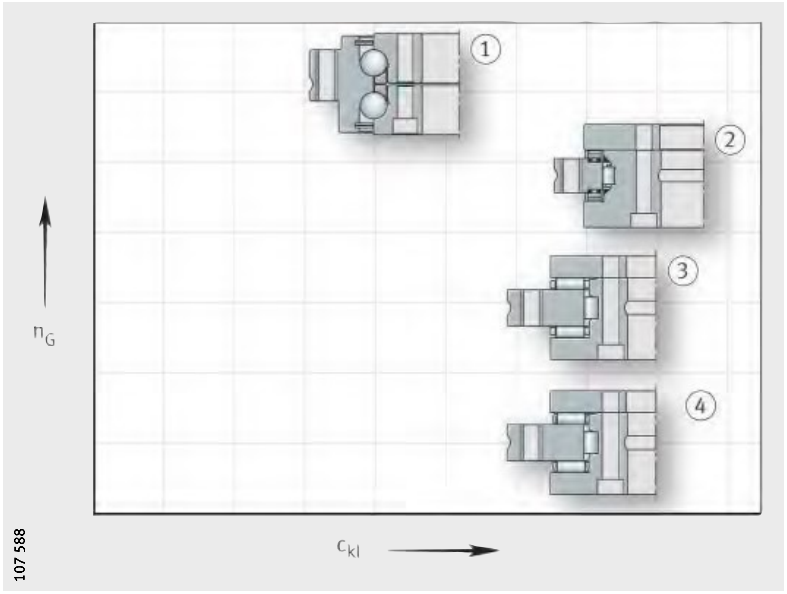
Areas of application

For standard applications with low speeds and small operating durations, such as indexing tables and swivel type milling heads, the most suitable bearing is generally series YRT, *Figure 1*. These bearings are available in two axial and radial runout accuracies.

Where comparatively lower friction and higher speeds are required, RTC bearings can be used, *Figure 1*. For higher requirements in accuracy, these bearings are also available with restricted axial runout accuracy.

For the bearing arrangements of direct drive axes, there is the series YRT_{Speed}. Due to their high limiting speeds and very low, uniform frictional torque across the whole speed range, these bearings are particularly suitable for combination with torque motors, *Figure 1*.

Axial angular contact ball bearings ZKLDF are particularly suitable for high speed applications with long operating duration, *Figure 1*. They are characterised by high tilting rigidity, low friction and low lubricant consumption.



① ZKLDF
② YRT_{Speed}
③ RTC
④ YRT
n_G = limiting speed
c_{kl} = tilting rigidity

Figure 1
Speed and tilting rigidity

Axial/radial bearings

Axial/radial bearings YRT, RTC and YRT_{Speed} have an axial component and a radial component.

The axial component comprises an axial needle roller or cylindrical roller and cage assembly, an outer ring, L-section ring and shaft locating washer and is axially preloaded after fitting.
The radial component is a full complement (YRT, RTC) or cage-guided, preloaded cylindrical roller set. The outer ring, L-section ring and shaft locating washer have fixing holes.

The unit is located by means of retaining screws for transport and safe handling.

Sealing

Axial/radial bearings are supplied without seals.

Lubrication

Bearings of series YRT and YRT_{Speed} are greased using a lithium complex soap grease to GA08 and can be lubricated via the outer ring and L-section ring.
Arcanol LOAD150 is suitable for relubrication.

Bearings of series RTC are greased with Arcanol MULTITOP.

Axial angular contact ball bearings

Axial angular contact ball bearings ZKLDF comprise a single-piece outer ring, a two-piece inner ring and two ball and cage assemblies with a contact angle of 60°. The outer ring and inner ring have fixing holes for screw mounting of the bearing on the adjacent construction.

The unit is located by means of retaining screws for transport and safe handling.

Sealing

Axial angular contact ball bearings have sealing shields on both sides.

Lubrication

The bearings are greased with a barium complex soap grease to DIN 51825–KPE2K–30 and can be lubricated via the outer ring.

Operating temperature

Axial/radial bearings and axial angular contact ball bearings are suitable for operating temperatures from –30 °C to +120 °C.

Suffixes

Suffixes for available designs: see table.

Available designs

Suffix	Description	Design
H_1 ...	Reduced tolerance on mounting dimension H_1 (postscript: H_1 with tolerance ± ...) Restricted tolerance value, see table, page 1131	Special design, available by agreement
H_2 ...	Reduced tolerance on mounting dimension H_2 (postscript: H_2 with tolerance ± ...) Restricted tolerance value, see table, page 1131	
–	Axial and radial runout tolerances restricted by 50% (additional text: axial/radial runout 50%)	

Design and safety guidelines

Basic rating life

The load carrying capacity and life must be checked for the radial and axial bearing component.

Please contact us in relation to checking of the basic rating life. The speed, load and operating duration must be given.

Static load safety factor

The static load safety factor S_0 indicates the security against impermissible permanent deformations in the bearing:

$$S_0 = \frac{C_{0r}}{F_{0r}} \text{ or } \frac{C_{0a}}{F_{0a}}$$

S_0 –
Static load safety factor

C_{0r}, C_{0a} N
Basic static load rating according to dimension tables

F_{0r}, F_{0a} N
Equivalent static load on the radial or axial bearing.

In machine tools and similar areas of application, S_0 should be > 4.

Static limiting load diagrams

The static limiting load diagrams can be used:

- for rapid checking of the selected bearing size under predominantly static load
- for calculation of the tilting moment M_k that can be supported by the bearing in addition to the axial load.

The limiting load diagrams are based on a rolling element set with a static load safety factor $S_0 \geqq 4$, as well as the screw and bearing ring strength.

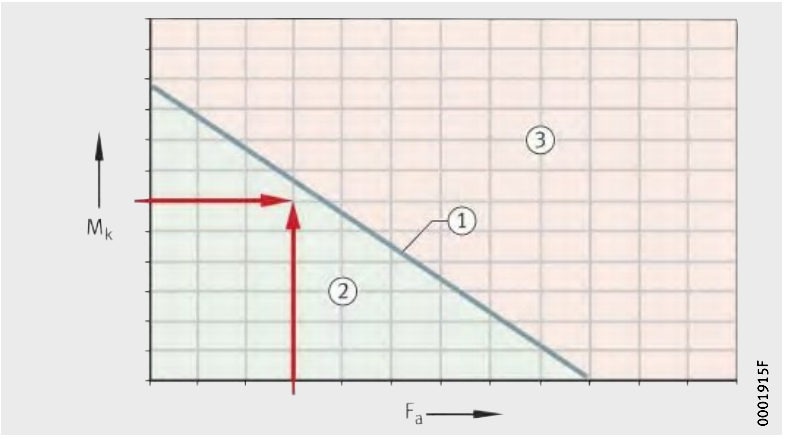
The static limiting load must not be exceeded when dimensioning the bearing arrangement. Example: see *Figure 2*.

Axial/radial bearings

The static limiting load diagrams for YRT, YRTS and RTC are shown in *Figure 3*, page 1117 to *Figure 9*, page 1119.

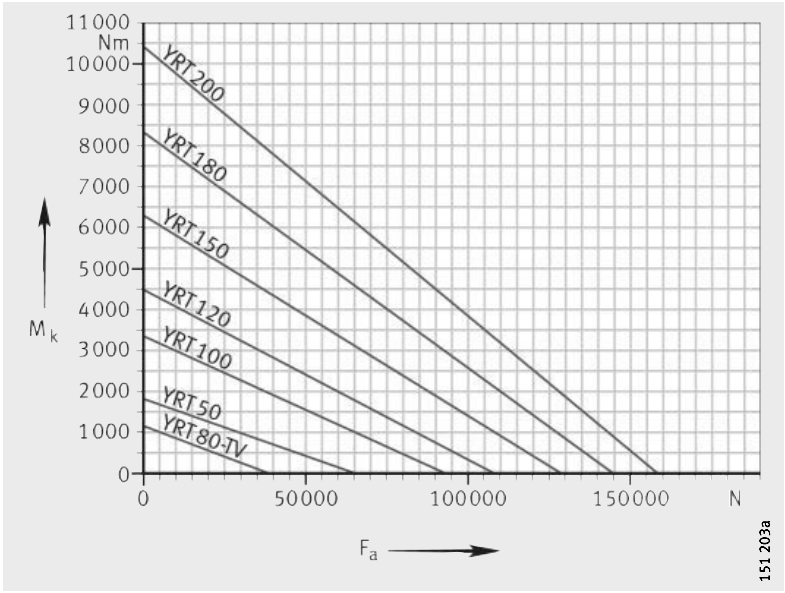
Axial angular contact ball bearings

The static limiting load diagrams for the series ZKLDF are shown in *Figure 10* and *Figure 11*, page 1119.



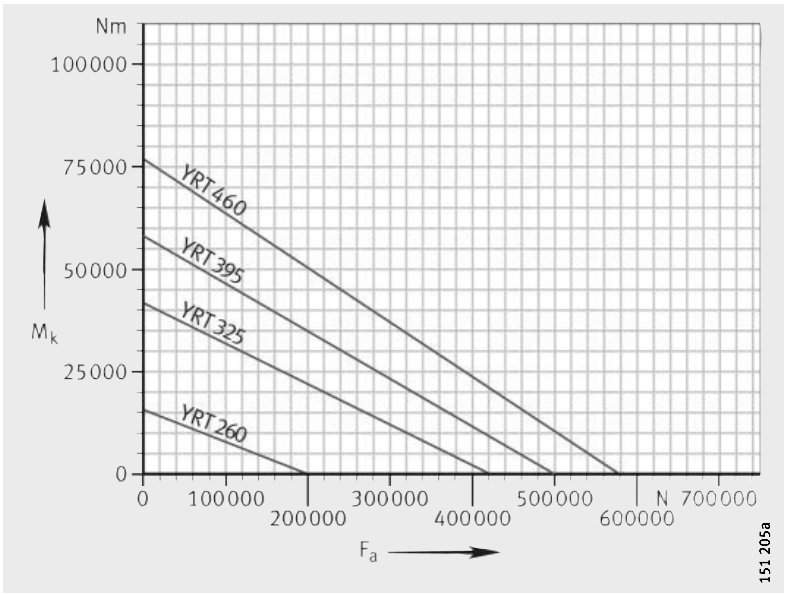
① Bearing, size
② Permissible range
③ Impermissible range
M_k = maximum tilting moment
F_a = axial load

Figure 2
Static limiting load diagram (example)



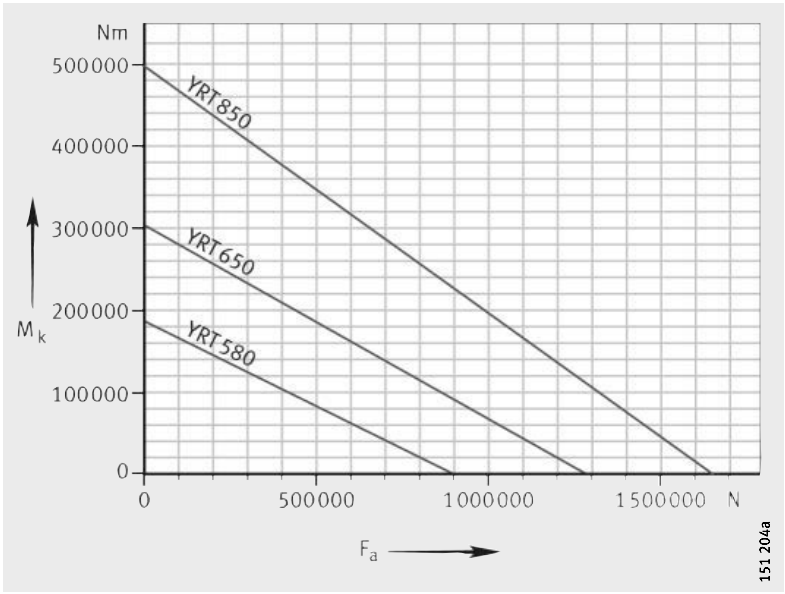
M_k = maximum tilting moment
F_a = axial load

Figure 3
Static limiting load diagram
YRT50 to YRT200



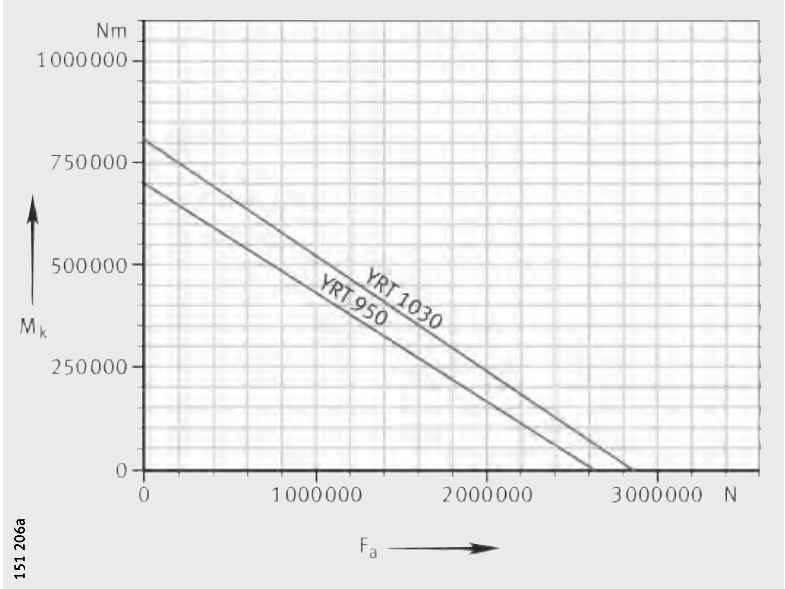
M_k = maximum tilting moment
F_a = axial load

Figure 4
Static limiting load diagram
YRT260 to YRT460



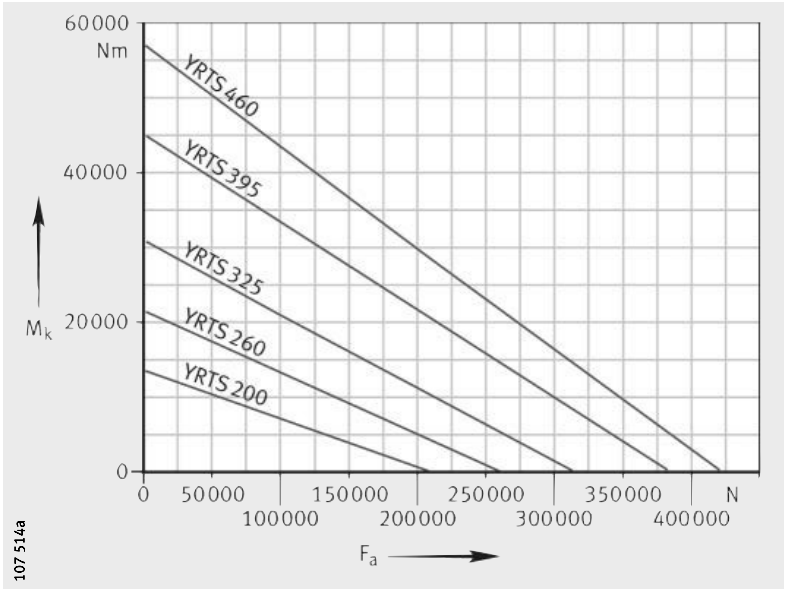
M_k = maximum tilting moment
F_a = axial load

Figure 5
Static limiting load diagram
YRT580 to YRT850



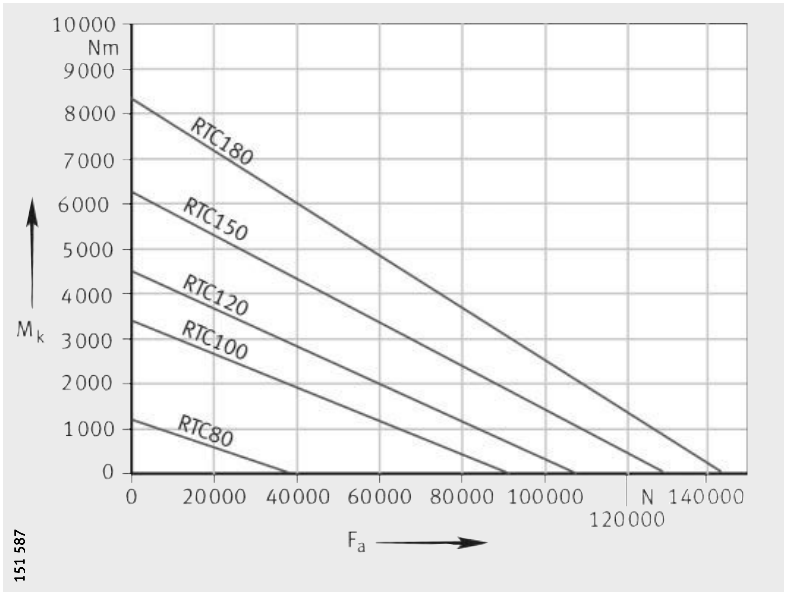
M_k = maximum tilting moment
F_a = axial load

Figure 6
Static limiting load diagram
YRT950 and YRT1030



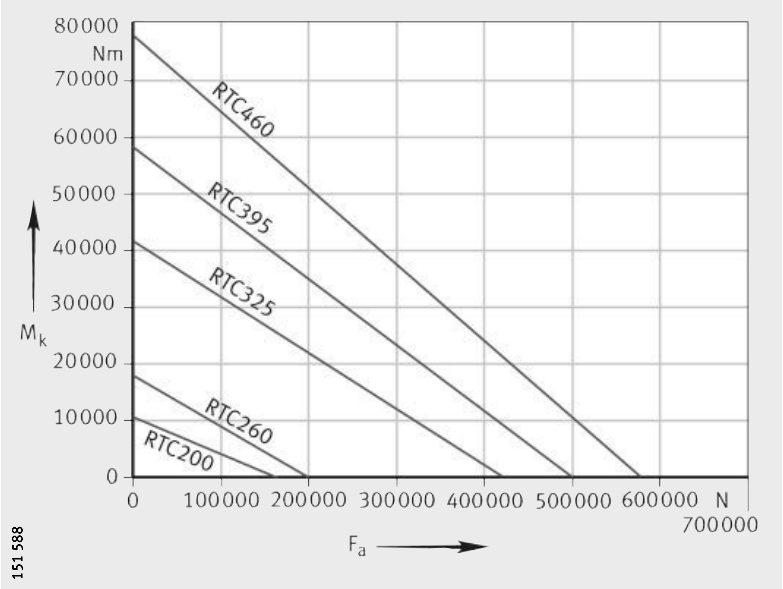
M_k = maximum tilting moment
F_a = axial load

Figure 7
Static limiting load diagram
$YRT_{Speed}200$ to $YRT_{Speed}460$



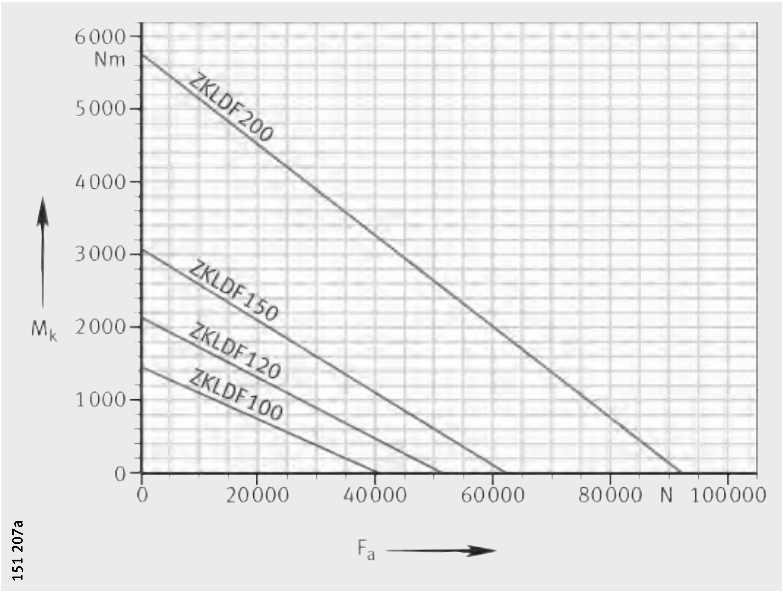
M_k = maximum tilting moment
F_a = axial load

Figure 8
Static limiting load diagram
RTC80 to RTC180



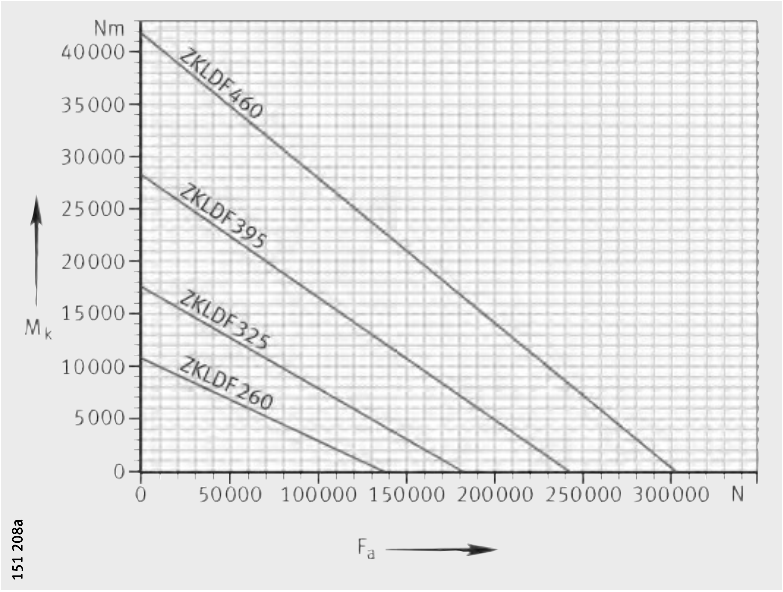
M_k = maximum tilting moment
F_a = axial load

Figure 9
Static limiting load diagram
RTC200 to RTC460



M_k = maximum tilting moment
F_a = axial load

Figure 10
Static limiting load diagram
ZKLDF100 to ZKLDF200



M_k = maximum tilting moment
F_a = axial load

Figure 11
Static limiting load diagram
ZKLDF260 to ZKLDF460

Axial/radial bearings
Axial angular contact ball bearings

Limiting speeds

The bearings allow the limiting speeds n_G given in the dimension tables. The operating temperatures occurring are heavily dependent on the environmental conditions. Calculation is possible by means of a thermal balance analysis based on frictional torque data.

If the environmental conditions differ from the specifications in relation to adjacent construction tolerances, lubrication, ambient temperature, heat dissipation or from the normal operating conditions for machine tools, checking must be carried out again. Please contact us.

Bearing preload

Once the bearings have been fitted and fully screw mounted, they are radially and axially clearance-free and preloaded.

Temperature differences

Temperature differences between the shaft and housing influence the radial bearing preload and thus the operating behaviour of the bearing arrangement.

If the shaft temperature is higher than the housing temperature, the radial preload will increase proportionally, so there will be an increase in the rolling element load, bearing friction and bearing temperature.

If the shaft temperature is lower than the housing temperature, the radial preload will decrease proportionally, so the rigidity will decrease to the point of bearing clearance and wear will increase.

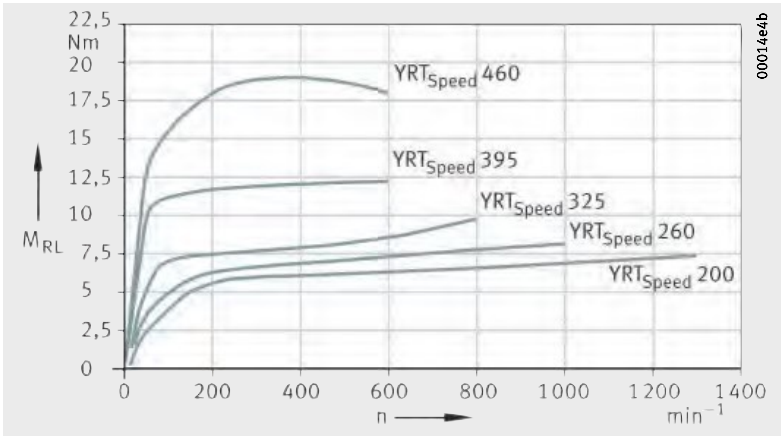
Frictional torque

The bearing frictional torque M_{RL} is influenced primarily by the viscosity and quantity of the lubricant and the bearing preload:

- The lubricant viscosity and quantity are dependent on the lubricant grade and operating temperature.
- The bearing preload is dependent on the mounting fits, the geometrical accuracy of the adjacent parts, the temperature difference between the inner and outer ring, the screw tightening torque and the mounting situation (bearing inner ring axially supported on one or both sides).

The frictional torques M_{RL} in the dimension tables are statistically determined guide values for bearings with grease lubrication (measurement speed $n_{const} = 5\ min^{-1}$). *Figure 12* shows measured frictional torques for mounting with an unsupported L-section ring for YRT_{Speed}.

Deviations from the tightening torque of the fixing screws will have a detrimental effect on the preload and the frictional torque.



M_{RL} = frictional torque
n = speed

Figure 12
Frictional torques as guide values for YRT_{Speed}, statistically determined values from series of measurements

Frictional energy and dimensioning of the drive

For YRT and RTC bearings, it must be taken into consideration that the frictional torque can increase by a factor of 2 to 2,5 with increasing speed.

For ZKLDF bearings, it must be taken into consideration that the starting frictional torque can be 1,5 times higher than the values M_{RL} in the dimension tables.

Lubrication

Axial/radial bearings YRT, RTC and YRT_{Speed} can be relubricated via the L-section ring and outer ring.

Axial angular contact ball bearings ZKLDF can be relubricated via the outer ring.

The initial greasing is compatible with lubricating oils having a mineral oil base.

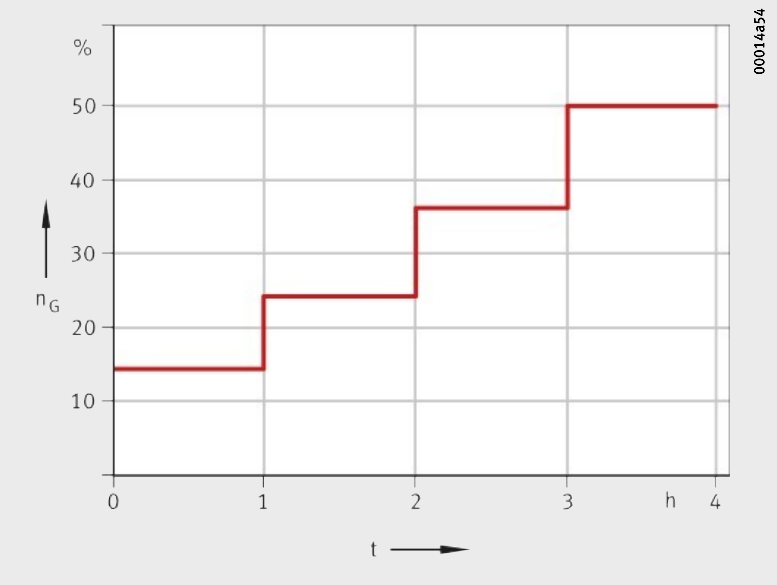
For calculation of the relubrication quantities and intervals based on a stated load spectrum (speed, load, operating duration) and the environmental conditions, please contact us.

Overlubrication

If the bearing is overlubricated, the bearing frictional torque and the temperature will increase.

In order to achieve the original frictional torque again, the running-in cycle in accordance with *Figure 13* should be carried out.

Further information on lubrication in the section Lubrication, page 76, must be observed.



n_G = limiting speed according to dimension tables
t = time

Figure 13
Running-in cycle after overlubrication

Grease Application Group GA08

Designation	Classification	Type of grease	Operating temperature °C	NLGI class	Speed parameter $n \cdot d_M$ $min^{-1} \cdot mm$	ISO VG class (base oil)[1)]
GA08	Grease for line contact	Lithium complex soap Mineral oil	–30 to +140	2 to 3	500 000	150 to 320

1) Dependent on bearing type.

Design of adjacent construction

YRT, RTC, YRT_{Speed} and ZKLDF have almost the same mounting dimensions.

Geometrical defects in the screw mounting surfaces and fits will influence the running accuracy, preload and running characteristics of the bearing arrangement. The accuracy of the adjacent surfaces must therefore be matched to the overall accuracy requirement of the subassembly. The tolerances of the adjacent surfaces must lie within the running tolerance of the bearing.

The adjacent construction should be produced in accordance with *Figure 14* and the tolerances must be in accordance with the tables starting on page 1126. Any deviations will influence the bearing frictional torque, running accuracy and running characteristics.

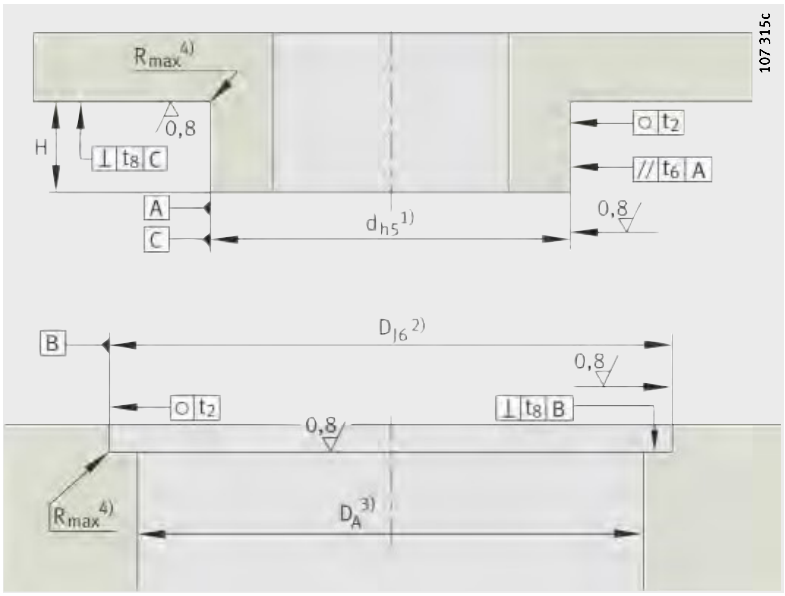


Figure 14
Requirements for the adjacent construction, YRT, RTC, YRT_{Speed}, ZKLDF

Legend to *Figure 14*

1) Support over whole bearing height.
It must be ensured that the means of support has adequate rigidity.

2) A precise fit is only necessary if radial support due to the load or a precise bearing position is required.

3) Note the bearing diameter D_1 according to the dimension tables.
Ensure that there is sufficient distance between the rotating bearing rings and the adjacent construction.

4) For values, see table Maximum corner radii of fit surfaces, page 1127.

Axial/radial bearings
Axial angular contact ball bearings

Fits

The selection of fits leads to transition fits which means that, depending on the actual dimensional position of the bearing diameter and mounting dimensions, clearance fits or interference fits can arise.

The fit influences, for example, the running accuracy of the bearing and its dynamic characteristics.

An excessively tight fit will increase the radial bearing preload. As a result:

- there is an increase in bearing friction and heat generation in the bearing as well as the load on the raceway system and wear
- there will be a decrease in the achievable speed and the bearing operating life.

For easier matching of the adjacent construction to the actual bearing dimensions, each bearing of series RTC and YRT_{Speed} is supplied with a measurement record (this is supplied by agreement for other series).

Axial and radial runout accuracy of the bearing arrangement

The axial and radial runout accuracy is influenced by:

- the running accuracy of the bearing
- the geometrical accuracy of the adjacent surfaces
- the fit between the rotating bearing ring and adjacent component.

In order to achieve very high running accuracy, the aim should be to achieve as close as possible to a fit clearance 0.

Recommended fits for shafts

The shaft should be produced to tolerance zone h5 and for series YRT_{Speed} in accordance with the table, page 1127.

If there are special requirements, the fit clearance must be further restricted within the tolerance zone h5:

- Requirements for running accuracy:
  For maximum running accuracy and with a rotating bearing inner ring, the aim should be to achieve as close as possible to a fit clearance of 0. The fit clearance may otherwise increase the bearing runout. With normal requirements for running accuracy or a stationary bearing inner ring, the shaft should be produced to h5.
- Requirements for dynamic characteristics:
  - For swivel type operation ($n \times d < 35\,000\ min^{-1} \cdot mm$, operating duration ED < 10%) the shaft should be produced to h5
  - For higher speeds and longer operating duration 0,01 mm the fit clearance must not be exceeded.
    For series YRT_{Speed} the fit clearance must not exceed 0,005 mm.

For series ZKLDF, the fit clearance should be based on the inner ring with the smallest bore dimension.

Recommended fits for housings

The housing should be produced to tolerance zone J6 and for series YRT_{Speed} according to the table Recommended fits, page 1127.

If there are special requirements, the fit clearance must be further restricted within the tolerance zone J6:

- Requirements for running accuracy:
  For maximum running accuracy and with a rotating bearing outer ring, the aim should be to achieve as close as possible to a fit clearance of 0.
  With a static bearing outer ring, a clearance fit or a design without radial centring should be selected.
- Requirements for dynamic characteristics:
  - For predominantly swivel type operation ($n \times d < 35\,000\ min^{-1} \cdot mm$, operating duration ED $< 10\%$) and a rotating bearing outer ring, the housing fit should be produced to tolerance zone J6
  - For higher speed and operating duration, the bearing outer ring should not be radially centred or the housing fit should be produced as a clearance fit with at least 0,02 mm clearance. This reduces the increase in preload when heat is generated in the bearing position.

Fit selection depending on the screw connection of the bearing rings

If the bearing outer ring is screw mounted on the static component, a fit seating is not required or a fit seating in accordance with the table Recommended fits for adjacent construction, page 1127, can be produced. If the values in the table are used, this will give a transition fit with a tendency towards clearance fit.
This generally allows easy fitting.

If the bearing inner ring is screw mounted on the static component, it should nevertheless for functional reasons be supported by the shaft over the whole bearing height. The shaft dimensions should then be selected in accordance with the tables starting on page 1126. If these values in the table are used, this will give a transition fit with a tendency towards clearance fit.

Axial/radial bearings
Axial angular contact ball bearings

Geometrical and positional accuracy of the adjacent construction

The values given in the following tables for geometrical and positional accuracy of the adjacent construction have proved effective in practice and are adequate for the majority of applications.

The geometrical tolerances influence the axial and radial runout accuracy of the subassembly as well as the bearing frictional torque and the running characteristics.

Geometrical and positional accuracy for shafts with YRT, RTC, ZKLDF

Nominal shaft diameter d mm		Deviation d	Roundness Parallelism Perpendicularity t_2, t_6, t_8
over	incl.	for tolerance zone h5 µm	µm
50	80	$^{0}_{-13}$	3
80	120	$^{0}_{-15}$	4
120	180	$^{0}_{-18}$	5
180	250	$^{0}_{-20}$	7
250	315	$^{0}_{-23}$	8
315	400	$^{0}_{-25}$	9
400	500	$^{0}_{-27}$	10
500	630	$^{0}_{-32}$	11
630	800	$^{0}_{-36}$	13
800	1 000	$^{0}_{-40}$	15
1 000	1 250	$^{0}_{-47}$	18

Geometrical and positional accuracy for housings with YRT, RTC, ZKLDF

Nominal housing bore diameter D mm		Deviation D	Roundness Perpendicularity t_2, t_8
over	incl.	for tolerance zone J6 µm	µm
120	180	$^{+18}_{-7}$	5
180	250	$^{+22}_{-7}$	7
250	315	$^{+25}_{-7}$	8
315	400	$^{+29}_{-7}$	9
400	500	$^{+33}_{-7}$	10
500	630	$^{+34}_{-7}$	11
630	800	$^{+38}_{-8}$	13
800	1 000	$^{+44}_{-12}$	15
1 000	1 250	$^{+52}_{-14}$	18

Recommended fits for shaft and housing bore with YRT_{Speed}

Axial/radial bearing	Shaft diameter d mm	Housing bore D mm
$YRT_{Speed}200$	$200^{-0,01}_{-0,024}$	$300^{+0,011}_{-0,005}$
$YRT_{Speed}260$	$260^{-0,013}_{-0,029}$	$385^{+0,013}_{-0,005}$
$YRT_{Speed}325$	$325^{-0,018}_{-0,036}$	$450^{+0,015}_{-0,005}$
$YRT_{Speed}395$	$395^{-0,018}_{-0,036}$	$525^{+0,017}_{-0,005}$
$YRT_{Speed}460$	$460^{-0,018}_{-0,038}$	$600^{+0,017}_{-0,005}$

Geometrical and positional accuracy for shafts with YRT_{Speed}

Axial/radial bearing	Roundness t_2 µm	Parallelism t_6 µm	Perpendicularity t_8 µm
$YRT_{Speed}200$	6	5	5
$YRT_{Speed}260$ to $YRT_{Speed}460$	8	5	7

Geometrical and positional accuracy for housings with YRT_{Speed}

Axial/radial bearing	Roundness t_2 µm	Perpendicularity t_8 µm
$YRT_{Speed}200$ to $YRT_{Speed}460$	6	8

Maximum corner radii of fit surfaces with YRT, RTC, YRT_{Speed}, ZKLDF

Bore diameter d mm	Maximum corner radius R_{max} mm
50 incl. 150	0,1
over 150 incl. 460	0,3
over 460 incl. 950	1

Mounting dimensions H_1, H_2

If the height variation must be as small as possible, the H_1 dimensional tolerance must conform to the tables on page 1131, page 1132 and *Figure 15*.

The mounting dimension H_2 defines the position of any worm wheel used, *Figure 15* and *Figure 16*, page 1129, L-section ring with support ring.

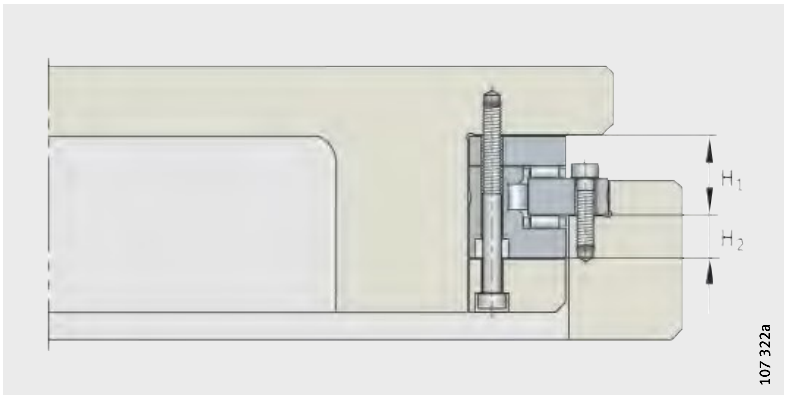


Figure 15
Mounting dimension H_1, H_2

L-section ring without support ring or with support ring

The L-section ring of bearings YRT and RTC can be mounted unsupported or supported over its whole surface, *Figure 16*. If the L-section ring is supported, the tilting rigidity is higher. The support ring (for example a worm wheel) is not included in the delivery.

Depending on the application, series YRT and RTC require bearings with a different preload match in order to achieve the same preload forces in the axial bearing.

For series YRT_{Speed} and ZKLDF, there is only one preload match. The increase in rigidity and frictional torque in YRT_{Speed} bearings is slight and can normally be ignored.

In bearings of series ZKLDF, the rigidity and frictional torque are not influenced by the support ring.

L-section ring without support ring

For the case “L-section ring without support ring”, the bearing designation is:

- YRT <bore diameter> or
  RTC <bore diameter>.

L-section ring with support ring

For the case "L-section ring with support ring", the bearing designation is:

- YRT <bore diameter> **VSP**
- RTC <bore diameter> **T52EB**.

For RTC with an additionally restricted axial runout, the bearing designation is:

- RTC <bore diameter> **T52EA**.

For bearing arrangements with a supported L-section ring, only bearings with the suffix VSP, EB or T52EA can be ordered.

If the normal design is mounted with a supported L-section ring, there will be a considerable increase in the bearing frictional torque.

The support ring should be at least twice as high as the shaft locating washer of the bearing.

YRT
RTC

YRT..VSP
RTC..T52EB
RTC..T52EA

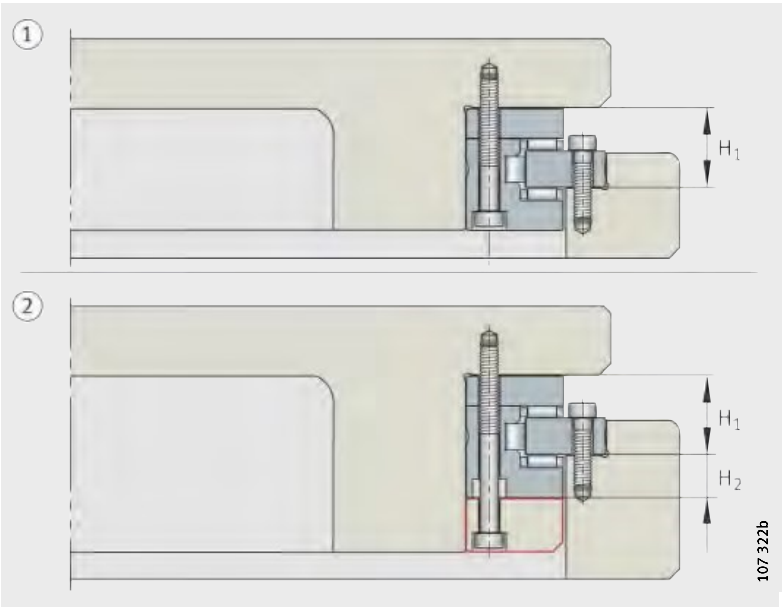


Figure 16
① L-section ring without support ring,
② L-section ring with support ring for YRT, RTC

Fitting

Retaining screws secure the bearing components during transport. For easier centring of the bearing, the screws should be loosened before fitting and either secured again or removed after fitting.

Tighten the fixing screws in crosswise sequence using a torque wrench in three stages to the specified tightening torque M_A, while rotating the bearing ZKLDF, *Figure 17*:

- Stage 1: 40% of M_A
- Stage 2: 70% of M_A
- Stage 3: 100% of M_A.

Observe the correct grade of the fixing screws.

Mounting forces must only be applied to the bearing ring to be fitted, never through the rolling elements.

Bearing components must not be separated or interchanged during fitting and dismantling.

If the bearing is unusually difficult to move, loosen the fixing screws and tighten them again in steps in a crosswise sequence. This will eliminate any distortion.

Bearings should only be fitted in accordance with TPI 103, Fitting and Maintenance Manual.

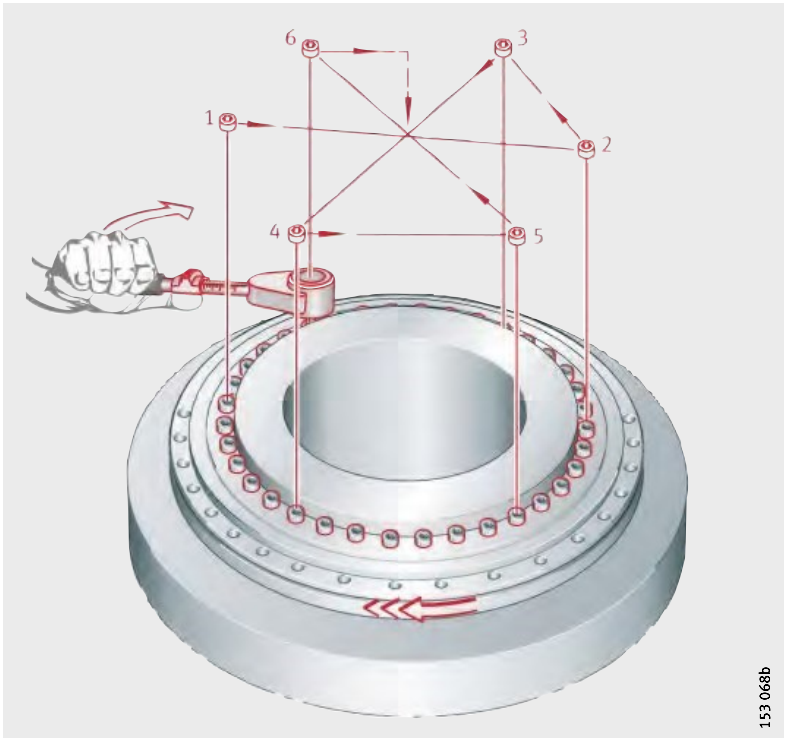


Figure 17
Tightening of fixing screws

Accuracy

The dimensional tolerances are derived from tolerance class P5. The diameter tolerances stated are mean values in accordance with ISO 1132.

The geometrical tolerances correspond to P4 in DIN 620, see table.

The bearing bore in the series YRT, RTC and YRT_{Speed} may be slightly conical when delivered. This is typical of the bearing design and is a result of the radial bearing preload forces. The bearing will regain its ideal geometry when fitted.

Dimensional tolerances, mounting dimensions, axial and radial runout for YRT, ZKLDF

Dimensional tolerances[1]				Mounting dimensions					Axial and radial runout[2]	
Bore		Outside diameter				Restricted[3]		Restricted[3]	Normal	Restricted[3]
d	Δ_{ds}	D	Δ_{Ds}	H_1	Δ_{H1s}	Δ_{H1s}	H_2	Δ_{H2s}		
mm	mm	mm	mm	mm	mm	mm	mm	mm	µm	µm
50	–0,008	126	–0,011	20	±0,125	±0,025	10	±0,02	2	1
80	–0,009	146	–0,011	23,35	±0,15	±0,025	11,65	±0,02	3	1,5
100	–0,01	185	–0,015	25	±0,175	±0,025	13	±0,02	3	1,5
120	–0,01	210	–0,015	26	±0,175	±0,025	14	±0,02	3	1,5
150	–0,013	240	–0,015	26	±0,175	±0,03	14	±0,02	3	1,5
180	–0,013	280	–0,018	29	±0,175	±0,03	14	±0,025	4	2
200	–0,015	300	–0,018	30	±0,175	±0,03	15	±0,025	4	2
260	–0,018	385	–0,02	36,5	±0,2	±0,04	18,5	±0,025	6	3
325	–0,023	450	–0,023	40	±0,2	±0,05	20	±0,025	6	3
395	–0,023	525	–0,028	42,5	±0,2	±0,05	22,5	±0,025	6	3
460	–0,023	600	–0,028	46	±0,225	±0,06	24	±0,03	6	3
580	–0,025	750	–0,035	60	±0,25	±0,075	30	±0,03	10	5[4]
650	–0,038	870	–0,05	78	±0,25	±0,1	44	±0,03	10	5[4]
850	–0,05	1 095	–0,063	80,5	±0,3	±0,12	43,5	±0,03	12	6[4]
950	–0,05	1 200	–0,063	86	±0,3	±0,12	46	±0,03	12	6[4]
1 030	–0,063	1 300	–0,08	92,5	±0,3	±0,15	52,5	±0,03	12	6[4]

1) The diameter tolerances stated are mean values (DIN 620).

2) For rotating inner and outer ring, measured on fitted bearing, with ideal adjacent construction.

3) Special design, YRT only.

4) By agreement only for rotating outer ring.

Dimensional tolerances, mounting dimensions, axial and radial runout for RTC

Dimensional tolerances						Mounting dimensions		Axial and radial runout[1]	Axial runout[1]
Bore		Outside diameter		Bearing height				Normal	Restricted
d	Δ_{ds}	D	Δ_{Ds}	H	Δ_{Hs}	H_1	Δ_{H1s}		
mm	mm	mm	mm	mm	mm	mm	mm	µm	µm
80	−0,009	146	−0,011	35	+0,025 −0,15	23,35	±0,025	3	1,5
100	−0,01	185	−0,015	38	+0,025 −0,15	25	±0,025	3	1,5
120	−0,01	210	−0,015	40	+0,025 −0,15	26	±0,025	3	1,5
150	−0,013	240	−0,015	40	+0,03 −0,175	26	±0,03	3	1,5
180	−0,013	280	−0,018	43	+0,03 −0,175	29	±0,03	4	2
200	−0,015	300	−0,018	45	+0,03 −0,2	30	±0,03	4	2
260	−0,018	385	−0,020	55	+0,04 −0,25	36,5	±0,04	5	3
325	−0,023	450	−0,023	60	+0,05 −0,3	40	±0,05	5	3
395	−0,023	525	−0,028	65	+0,05 −0,3	42,5	±0,05	5	3
460	−0,027	600	−0,028	70	+0,06 −0,35	46	±0,06	6	3

1) For rotating inner and outer ring, measured on fitted bearing, with ideal adjacent construction.

Dimensional tolerances, mounting dimensions, axial and radial runout for YRT_{Speed}

Dimensional tolerances				Mounting dimensions			Axial and radial runout[1]	
Bore		Outside diameter					Normal	Restricted[2]
d	Δ_{ds}	D	Δ_{Ds}	H_1	Δ_{H1s}	H_2		
mm	mm	mm	mm	mm	mm	mm	µm	µm
200	−0,015	300	−0,018	30	+0,04 −0,06	15	4	2
260	−0,018	385	−0,02	36,5	+0,05 −0,07	18,5	6	3
325	−0,023	450	−0,023	40	+0,06 −0,07	20	6	3
395	−0,023	525	−0,028	42,5	+0,06 −0,07	22,5	6	3
460	−0,023	600	−0,028	46	+0,07 −0,08	24	6	3

1) For rotating inner and outer ring, measured on fitted bearing, with ideal adjacent construction.

2) Restricted axial and radial runout only available for rotating inner ring.

Rigidity

Static rigidity

The overall rigidity of a bearing position is a description of the magnitude of the displacement of the rotational axis from its ideal position under load. The static rigidity thus has a direct influence on the accuracy of the machining results.

The dimension tables give the rigidity values for the complete bearing position, see page 1134 to page 1143.
These take account of the deflection of the rolling element set as well as the deformation of the bearing rings and the screw connections.

The values for the rolling element sets are calculated rigidity values and are for information purposes only. They facilitate comparison with other bearing types, since rolling bearing catalogues generally only give the higher rigidity values for the rolling element set.

Special designs

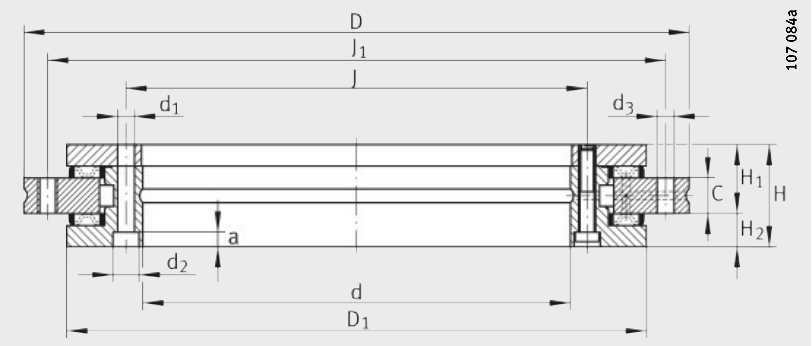
Available by agreement:
For YRT, axial and radial runout tolerance restricted by 50%.
Additional text: axial and radial runout 50%.

For RTC, axial runout tolerance restricted by 50%.
Additional text: axial runout 50%.

For YRT, closer tolerance on mounting dimension H_1 and H_2.
Additional text: H_1 with tolerance ± ..., H_2 with tolerance ± ...
For restricted tolerance value, see table, page 1131.

Axial/radial bearings

Double direction



YRT

Dimension table · Dimensions in mm

Designation	Mass	Dimensions									Fixing holes					
											Inner ring				Outer ring	
	m	d	D	H	H_1	H_2	C	D_1	J	J_1	d_1	d_2	a	Quantity[4]	d_3	Quantity[4]
	≈kg							max.								
YRT50	1,6	**50**	126	30	20	10	10	105	63	116	5,6	–	–	10	5,6	12
YRT80-TV[5)7)]	2,4	**80**	146	35	23,35	11,65	12	130	92	138	5,6	10	4	10	4,6	12
YRT100[5)]	4,1	**100**	185	38	25	13	12	161	112	170	5,6	10	5,4	16	5,6	15
YRT120	5,3	**120**	210	40	26	14	12	185	135	195	7	11	6,2	22	7	21
YRT150	6,2	**150**	240	40	26	14	12	214	165	225	7	11	6,2	34	7	33
YRT180	7,7	**180**	280	43	29	14	15	244	194	260	7	11	6,2	46	7	45
YRT200	9,7	**200**	300	45	30	15	15	274	215	285	7	11	6,2	46	7	45
YRT260	18,3	**260**	385	55	36,5	18,5	18	345	280	365	9,3	15	8,2	34	9,3	33

1) Including retaining screws or threaded extraction holes.

2) Tightening torque for screws to DIN 912, grade 10.9.

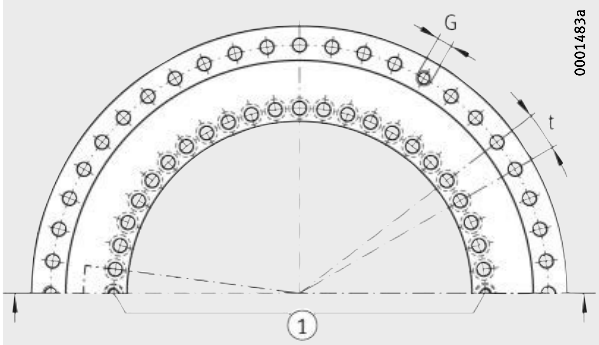
3) Rigidity values taking account of the rolling element set, the deformation of the bearing rings and the screw connections. For explanations, see page 1133.

4) Attention! For fixing holes in the adjacent construction. Observe the pitch of the bearing holes.

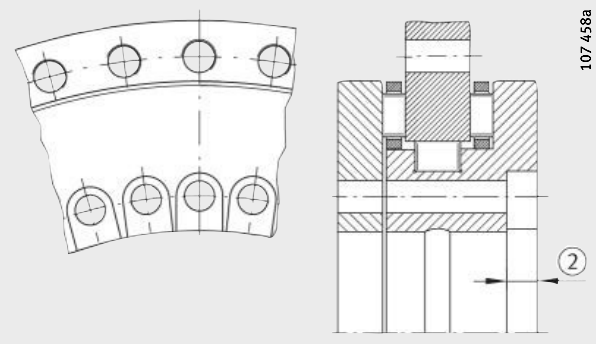
5) Screw counterbores in the L-section ring open to the bearing bore. The bearing inside diameter is unsupported in the area ②.

6) For high operating durations or continuous operation, please contact us.

7) Cages made from glass fibre reinforced polyamide 66.



Hole pattern
① Two retaining screws



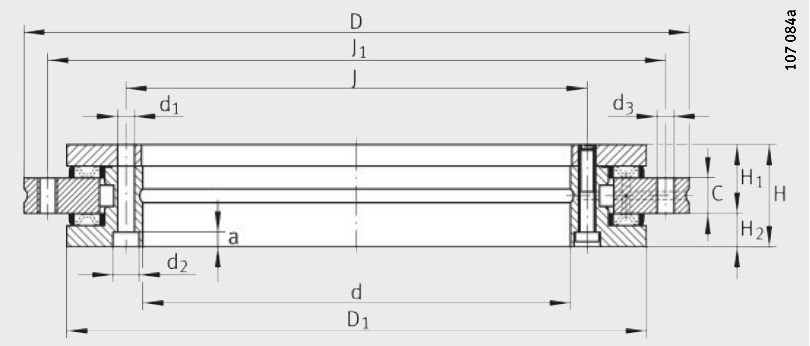
For YRT80-TV and YRT100:
② Screw counterbores open[5)]

Pitch $t^{1)}$	Threaded extraction hole		Screw tightening torque	Basic load ratings				Limiting speed[6)]	Bearing frictional torque
				axial		radial			
QuantityXt	G	Quantity	$M_A{}^{2)}$	dyn. C_a	stat. C_{0a}	dyn. C_r	stat. C_{0r}	n_G	M_{RL}
			Nm	N	N	N	N	min^{-1}	Nm
12X30°	–	–	8,5	56 000	280 000	28 500	49 500	440	2,5
12X30°	–	–	8,5/4,5	38 000	158 000	44 000	98 000	350	3
18X20°	M5	3	8,5	73 000	370 000	52 000	108 000	280	3
24X15°	M8	3	14	80 000	445 000	70 000	148 000	230	7
36X10°	M8	3	14	85 000	510 000	77 000	179 000	210	13
48X 7,5°	M8	3	14	92 000	580 000	83 000	209 000	190	14
48X 7,5°	M8	3	14	98 000	650 000	89 000	236 000	170	15
36X10°	M12	3	34	109 000	810 000	102 000	310 000	130	25

Designation	Rigidity					
	of bearing position[3)]			of rolling element set		
	axial	radial	Tilting rigidity	axial	radial	Tilting rigidity
	c_{aL} kN/µm	c_{rL} kN/µm	c_{kL} kNm/mrad	c_{aL} kN/µm	c_{rL} kN/µm	c_{kL} kNm/mrad
YRT50	1,3	1,1	1,25	6,2	1,5	5,9
YRT80-TV[5)7)]	1,6	1,8	2,5	4	2,6	6,3
YRT100[5)]	2	2	5	6,8	2,4	15
YRT120	2,1	2,2	7	7,8	3,8	24
YRT150	2,3	2,6	11	8,7	4,6	38
YRT180	2,6	3	17	9,9	5,3	57
YRT200	3	3,5	23	11,2	6,2	80
YRT260	3,5	4,5	45	13,7	8,1	155

Axial/radial bearings

Double direction



YRT

Dimension table (continued) · Dimensions in mm

Designation	Mass	Dimensions									Fixing holes					
											Inner ring				Outer ring	
	m	d	D	H	H_1	H_2	C	D_1	J	J_1	d_1	d_2	a	Quantity[4]	d_3	Quantity[4]
	≈kg							max.								
YRT325[5]	25	**325**	450	60	40	20	20	415	342	430	9,3	15	8,2	34	9,3	33
YRT395	33	**395**	525	65	42,5	22,5	20	486	415	505	9,3	15	8,2	46	9,3	45
YRT460	45	**460**	600	70	46	24	22	560	482	580	9,3	15	8,2	46	9,3	45
YRT580	89	**580**	750	90	60	30	30	700	610	720	11,4	18	11	46	11,4	42
YRT650	170	**650**	870	122	78	44	34	800	680	830	14	20	13	46	14	42
YRT850	253	**850**	1 095	124	80,5	43,5	37	1 018	890	1 055	18	26	17	58	18	54
YRT950[7]	312	950	1 200	132	86	46	40	1 130	990	1 160	18	26	17	58	18	54
YRT1030	375	**1 030**	1 300	145	92,5	–	40	1 215	1 075	1 255	18	26	17	70	18	66

1) Including retaining screws or threaded extraction holes.

2) Tightening torque for screws to DIN 912, grade 10.9.

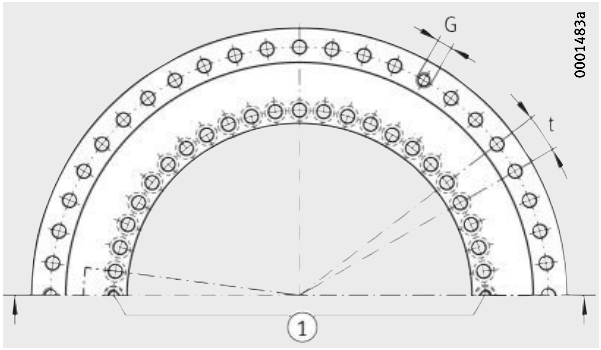
3) Rigidity values taking account of the rolling element set, the deformation of the bearing rings and the screw connections. For explanations, see page 1133.

4) Attention! For fixing holes in the adjacent construction. Observe the pitch of the bearing holes.

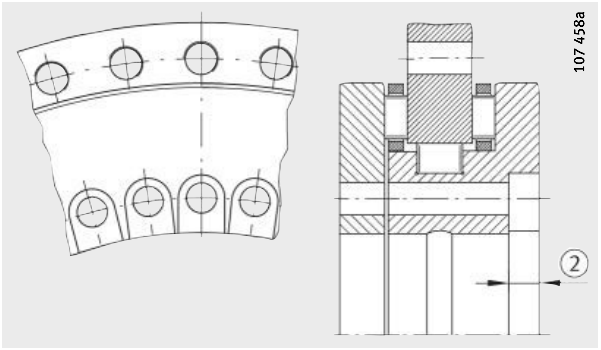
5) Screw counterbores in the L-section ring open to the bearing bore. The bearing inside diameter is unsupported in the area ②.

6) For high operating durations or continuous operation, please contact us.

7) Available by agreement only.



Hole pattern
① Two retaining screws



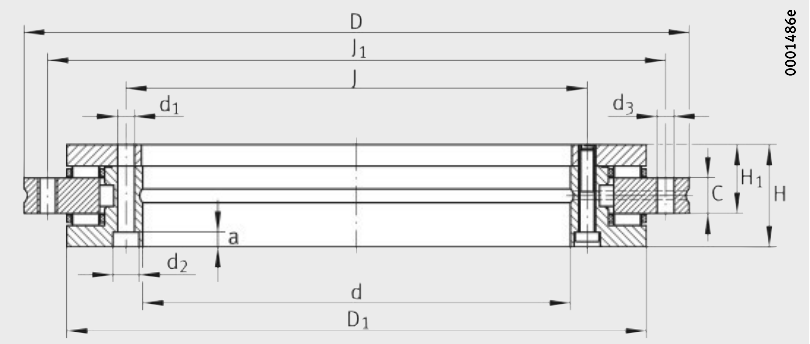
For YRT325:
② Screw counterbores open[5)]

Pitch t[1)]	Threaded extraction hole		Screw tightening torque	Basic load ratings				Limiting speed[6)]	Bearing frictional torque
				axial		radial			
QuantityXt	G	Quantity	M_A[2)]	dyn. C_a	stat. C_{0a}	dyn. C_r	stat. C_{0r}	n_G	M_{RL}
			Nm	N	N	N	N	min^{-1}	Nm
36X10°	M12	3	34	186 000	1 710 000	134 000	415 000	110	48
48X 7,5°	M12	3	34	202 000	2 010 000	133 000	435 000	90	55
48X 7,5°	M12	3	34	217 000	2 300 000	187 000	650 000	80	70
48X 7,5°	M12	6	68	390 000	3 600 000	211 000	820 000	60	140
48X 7,5°	M12	6	116	495 000	5 200 000	415 000	1 500 000	55	200
60X 6°	M12	6	284	560 000	6 600 000	475 000	1 970 000	40	300
60X 6°	M16	6	284	1 040 000	10 300 000	600 000	2 450 000	40	600
72X 5°	M16	6	284	1 080 000	11 000 000	620 000	2 650 000	35	800

Designation	Rigidity					
	of bearing position[3)]			of rolling element set		
	axial	radial	Tilting rigidity	axial	radial	Tilting rigidity
	c_{aL}	c_{rL}	c_{kL}	c_{aL}	c_{rL}	c_{kL}
	kN/µm	kN/µm	kNm/mrad	kN/µm	kN/µm	kNm/mrad
YRT325[5)]	4,3	5	80	26,1	9,4	422
YRT395	4,9	6	130	30,3	11,3	684
YRT460	5,7	7	200	33,5	13,9	1 049
YRT580	6,9	9	380	42,1	17,4	2 062
YRT650	7,6	10	550	58,3	13,7	3 669
YRT850	9,3	13	1 100	73,4	20,2	7 587
YRT950[7)]	10,4	14	1 500	74,5	16,4	9 692
YRT1030	11,2	16	1 900	79,7	18,8	12 025

Axial/radial bearings

Double direction



RTC

Dimension table · Dimensions in mm

Designation	Mass	Dimensions[7]								Fixing holes					
										Inner ring				Outer ring	
	m	d	D	H	H_1	C	D_1	J	J_1	d_1	d_2	a	Quantity[4]	d_3	Quantity[4]
	≈kg						max.								
RTC80[5]	2	**80**	146	35	23,35	12	130	92	138	5,6	10	5,7	12	4,6	12
RTC100[5]	4	**100**	185	38	25	12	161	112	170	5,6	10	5,7	15	5,6	18
RTC120	5	**120**	210	40	26	12	185	135	195	7	11	7	21	7	24
RTC150	5,8	**150**	240	40	26	12	214	165	225	7	11	7	33	7	36
RTC180	8	**180**	280	43	29	15	244	194	260	7	11	7	45	7	48
RTC200	9,3	**200**	300	45	30	15	274	215	285	7	11	7	45	7	48
RTC260	18	**260**	385	55	36,5	18	345	280	365	9,3	15	9,3	33	9,3	36
RTC325[5]	25	**325**	450	60	40	20	415	342	430	9,3	15	9,3	33	9,3	36
RTC395	33	**395**	525	65	42,5	20	486	415	505	9,3	15	9,3	45	9,3	48
RTC460	48	**460**	600	70	46	22	560	482	580	9,3	15	9,3	45	9,3	48

1) Including retaining screws or threaded extraction holes.

2) Tightening torque for screws to DIN 912, grade 10.9.

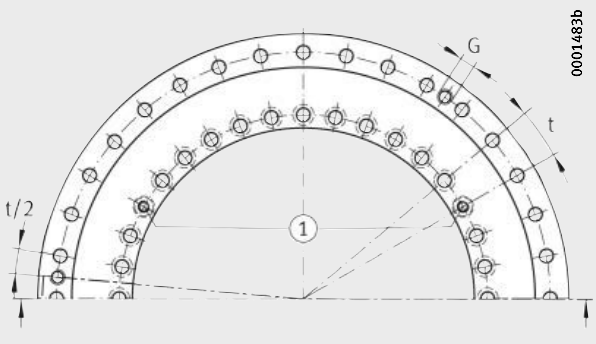
3) Rigidity values taking account of the rolling element set, the deformation of the bearing rings and the screw connections. For explanations, see page 1133.

4) Attention! For fixing holes in the adjacent construction. Observe the pitch of the bearing holes.

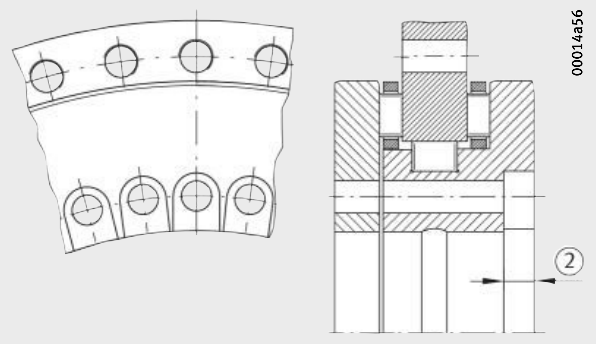
5) Screw counterbores in the L-section ring open to the bearing bore. The bearing inside diameter is unsupported in the area ②.

6) For high operating durations or continuous operation, please contact us.

7) Sizes d > 460 mm available by agreement.



Hole pattern
① Three retaining screws



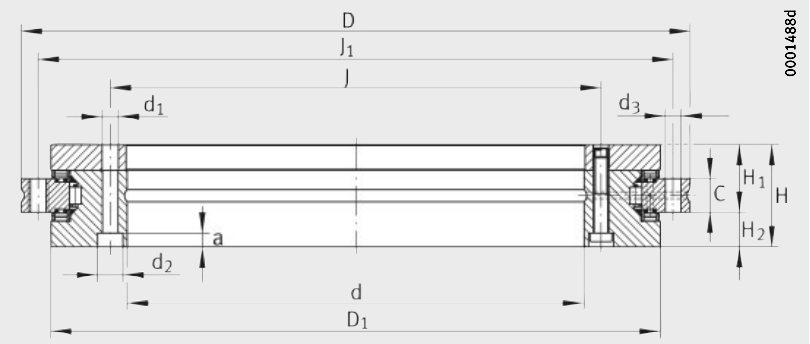
For RTC80, RTC100 and RTC325:
② Screw counterbores open[5)]

Pitch t[1)]	Threaded extraction hole		Screw tightening torque	Basic load ratings				Limiting speed[6)]	Bearing frictional torque
				axial		radial			
QuantityXt	G	Quantity	M_A[2)]	dyn. C_a	stat. C_{0a}	dyn. C_r	stat. C_{0r}	n_G	M_{RL}
			Nm	N	N	N	N	min^{-1}	Nm
12X30°	–	–	8,5	56 000	255 000	42 500	100 000	530	1
18X20°	M5	3	8,5	76 500	415 000	47 500	120 000	430	4
24X15°	M6	3	14	102 000	540 000	52 000	143 000	340	5
36X10°	M6	3	14	112 000	630 000	56 000	170 000	320	7
48X 7,5°	M6	3	14	118 000	710 000	69 500	200 000	280	9
48X 7,5°	M6	3	14	120 000	765 000	81 500	220 000	260	11
36X10°	M8	3	34	160 000	1 060 000	93 000	290 000	200	16
36X10°	M8	3	34	275 000	1 930 000	120 000	345 000	170	27
48X 7,5°	M8	3	34	300 000	2 280 000	186 000	655 000	140	42
48X 7,5°	M8	3	34	355 000	2 800 000	200 000	765 000	120	55

Designation	Rigidity					
	of bearing position[3)]			of rolling element set		
	axial	radial	Tilting rigidity	axial	radial	Tilting rigidity
	c_{aL} kN/µm	c_{rL} kN/µm	c_{kL} kNm/mrad	c_{aL} kN/µm	c_{rL} kN/µm	c_{kL} kNm/mrad
RTC80[5)]	0,71	1,8	1,6	5,6	2,1	9
RTC100[5)]	1,2	2	5	9,1	3,5	21
RTC120	1,3	2,2	7	9,1	5,7	29
RTC150	1,5	2,6	11	10,6	7,1	45
RTC180	1,7	3	17	11,6	6,3	67
RTC200	1,8	3,5	23	12,2	5,8	88
RTC260	2,1	4,5	45	17,4	7,5	201
RTC325[5)]	2,8	5	80	25	6,5	429
RTC395	3,4	6	130	28,9	11,9	698
RTC460	3,9	7	200	32,6	13,7	1 020

Axial/radial bearings

Double direction



YRT_{Speed}

Dimension table · Dimensions in mm

Designation	Mass	Dimensions									Fixing holes					
											Inner ring				Outer ring	
	m	d	D	H	H_1	H_2	C	D_1	J	J_1	d_1	d_2	a	Quantity[3]	d_3	Quantity[3]
	≈kg															
YRTS200	9,7	**200**	300	45	30	15	15	274	215	285	7	11	6,2	46	7	45
YRTS260	18,3	**260**	385	55	36,5	18,5	18	345	280	365	9,3	15	8,2	34	9,3	33
YRTS325[5]	25	**325**	450	60	40	20	20	415	342	430	9,3	15	8,2[5]	34	9,3	33
YRTS395	33	**395**	525	65	42,5	22,5	20	486	415	505	9,3	15	8,2	46	9,3	45
YRTS460	45	**460**	600	70	46	24	22	560	482	580	9,3	15	8,2	46	9,3	45

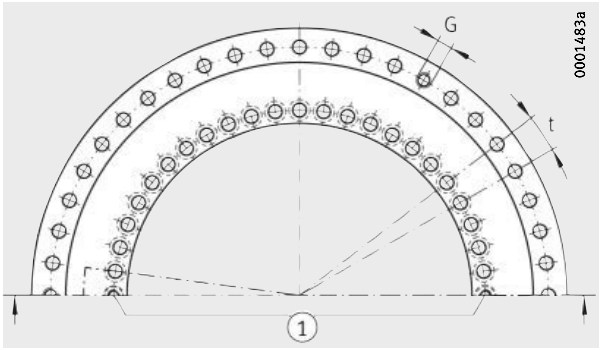
1) Including retaining screws or threaded extraction holes.

2) For screws to DIN 912, grade 10.9.

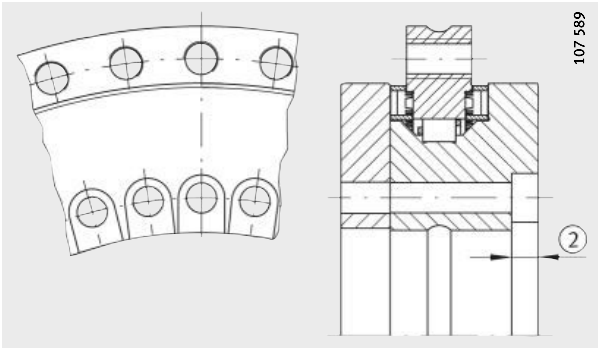
3) Attention!
For fixing holes in the adjacent construction.
Observe the pitch of the bearing holes.

4) Rigidity values taking account of the rolling element set,
the deformation of the bearing rings and the screw connections.
For explanations, see page 1133.

5) Screw counterbores in the L-section ring open to the bearing bore.
The bearing inside diameter is unsupported in the area ②.



Hole pattern
① Two retaining screws



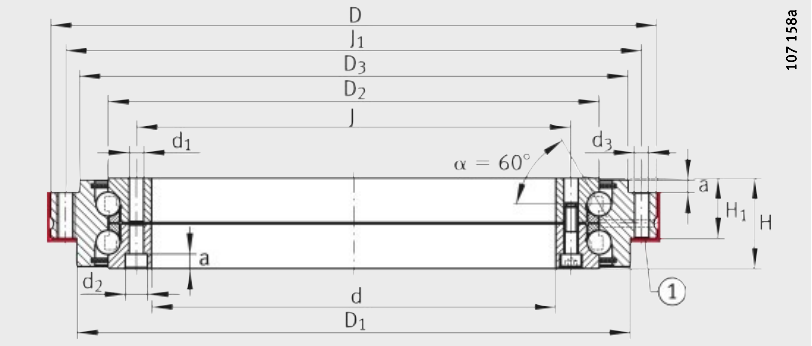
For YRTS325:
② Screw counterbores open[5)]

Pitch t[1)]	Threaded extraction hole		Screw tightening torque	Basic load ratings				Limiting speed	Mass moment of inertia for rotating	
				axial		radial			inner ring IR	outer ring AU
QuantityXt	G	Quantity	M_A[2)]	dyn. C_a	stat. C_{0a}	dyn. C_r	stat. C_{0r}	n_G	M_M	
			Nm	N	N	N	N	min^{-1}	$kg \cdot cm^2$	$kg \cdot cm^2$
48X 7,5°	M8	3	14	155 000	840 000	94 000	226 000	1 160	667	435
36X10°	M12	3	34	173 000	1 050 000	110 000	305 000	910	2 074	1 422
36X10°	M12	3	34	191 000	1 260 000	109 000	320 000	760	4 506	2 489
48X 7,5°	M12	3	34	214 000	1 540 000	121 000	390 000	650	8 352	4 254
48X 7,5°	M12	3	34	221 000	1 690 000	168 000	570 000	560	15 738	7 379

Designation	Rigidity					
	of bearing position[4)]			of rolling element set		
	axial	radial	Tilting rigidity	axial	radial	Tilting rigidity
	c_{aL}	c_{rL}	c_{kL}	c_{aL}	c_{rL}	c_{kL}
	kN/µm	kN/µm	kNm/mrad	kN/µm	kN/µm	kNm/mrad
YRTS200	4	1,2	29	13,6	3,9	101
YRTS260	5,4	1,6	67	16,8	5,8	201
YRTS325[5)]	6,6	1,8	115	19,9	7,1	350
YRTS395	7,8	2	195	23,4	8,7	582
YRTS460	8,9	1,8	280	25,4	9,5	843

Axial angular contact ball bearings

Double direction



ZKLDF
① Contact surface/centring diameter

Dimension table · Dimensions in mm

Designation	Mass	Dimensions[6]										Inner ring		
	m	d	D	H	H_1	D_1	D_2	D_3	J	J_1	a	Fixing screws		
												d_1	d_2	Quantity[4]
	≈kg													
ZKLDF100[5]	4,5	**100**	185	38	25	161	136	158	112	170	5,4	5,6	10	16
ZKLDF120	6	**120**	210	40	26	185	159	181	135	195	6,2	7	11	22
ZKLDF150	7,5	**150**	240	40	26	214	188	211	165	225	6,2	7	11	34
ZKLDF200	11	**200**	300	45	30	274	243	271	215	285	6,2	7	11	46
ZKLDF260	22	**260**	385	55	36,5	345	313	348	280	365	8,2	9,3	15	34
ZKLDF325[5]	28	**325**	450	60	40	415	380	413	342	430	8,2	9,3	15	34
ZKLDF395	39	**395**	525	5	42,5	486	450	488	415	505	8,2	9,3	15	46
ZKLDF460	50	**460**	600	70	46	560	520	563	482	580	8,2	9,3	15	46

1) Including retaining screws or threaded extraction holes.

2) Tightening torque for screws to DIN 912, grade 10.9.

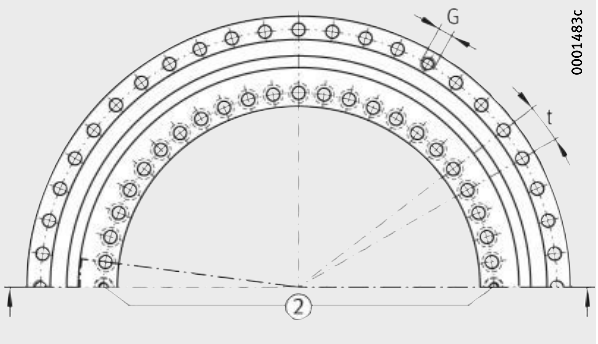
3) Rigidity values taking account of the rolling element set, deformation of the bearing rings and the screw connections. For explanations, see page 1133.

4) Attention! For fixing holes in the adjacent construction. Observe the pitch of the bearing holes.

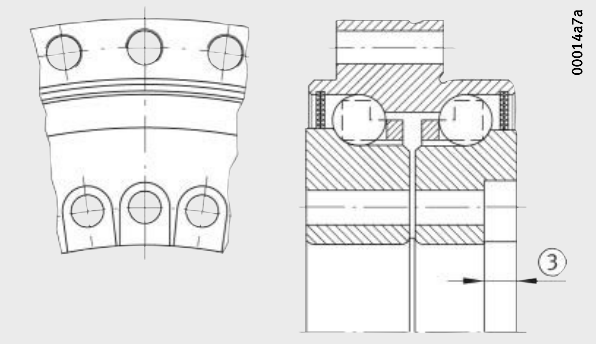
5) Screw counterbores in the L-section ring open to the bearing bore. The bearing inside diameter is unsupported in the area ③.

6) Sizes d > 460 mm available by agreement.

7) Valid for matched adjacent construction.



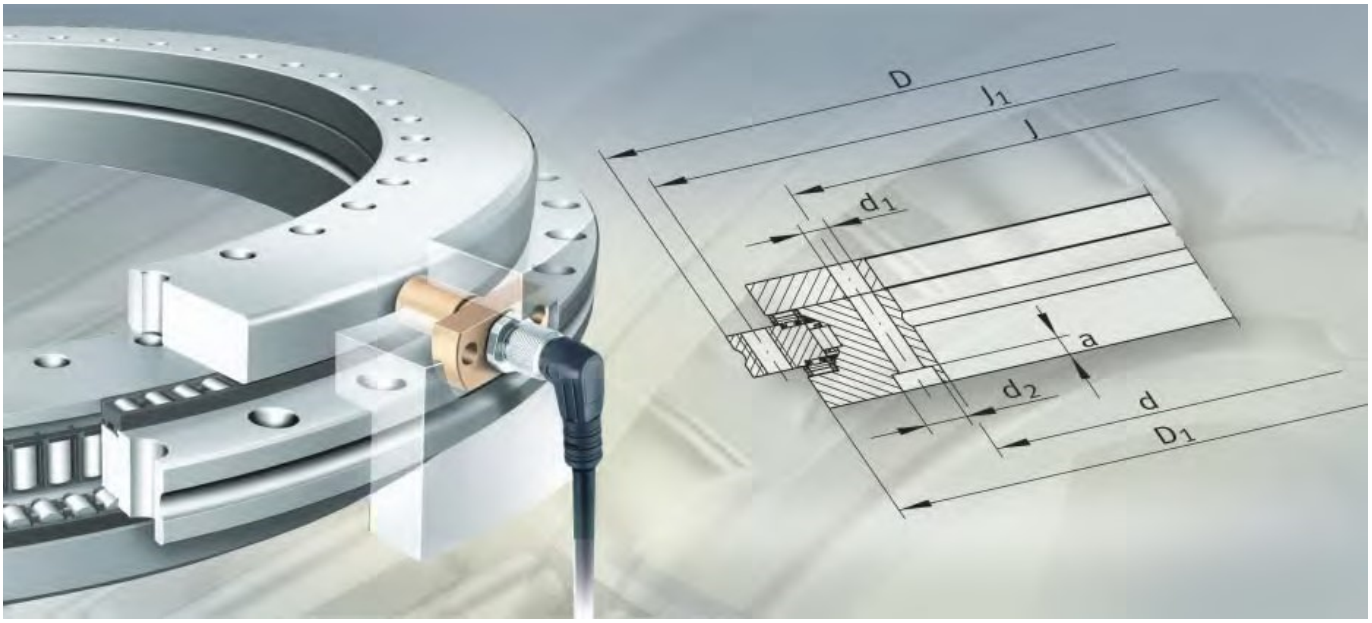
Hole pattern
② Two retaining screws



For ZKLDF100, ZKLDF325:
③ Screw counterbores open[5)]

Outer ring				Pitch $t^{1)}$	Screw tightening torque	Basic load ratings		Limiting speed[7)]	Bearing frictional torque
Fixing screws		Threaded extraction hole				axial			
d_3	Quantity[4)]	G	Quantity	QuantityXt	M_A[2)]	dyn. C_a	stat. C_{0a}	n_G	M_{RL}
					Nm	N	N	min^{-1}	Nm
5,6	15	M5	3	18X20°	8,5	71 000	265 000	2 800	1,6
7	21	M8	3	24X15°	14	76 000	315 000	2 400	2
7	33	M8	3	36X10°	14	81 000	380 000	2 000	3
7	45	M8	3	48X 7,5°	14	121 000	610 000	1 600	4,5
9,3	33	M12	3	36X10°	34	162 000	920 000	1 200	7,5
9,3	33	M12	3	36X10°	34	172 000	1 110 000	1 000	11
9,3	45	M12	3	48X 7,5°	34	241 000	1 580 000	800	16
9,3	45	M12	3	48X 7,5°	34	255 000	1 860 000	700	21

Designation	Rigidity					
	of bearing position[3)]			of rolling element set		
	axial	radial	Tilting rigidity	axial	radial	Tilting rigidity
	c_{aL} kN/µm	c_{rL} kN/µm	c_{kL} kNm/mrad	c_{aL} kN/µm	c_{rL} kN/µm	c_{kL} kNm/mrad
ZKLDF100[5)]	1,2	0,35	3,6	2,2	0,35	5
ZKLDF120	1,5	0,4	5,5	2,5	0,4	8
ZKLDF150	1,7	0,4	7,8	2,9	0,4	12
ZKLDF200	2,5	0,6	17,5	3,7	0,6	26
ZKLDF260	3,2	0,7	40	4,7	0,7	54
ZKLDF325[5)]	4	0,8	60	5,4	0,8	90
ZKLDF395	4,5	0,9	100	6,3	0,9	148
ZKLDF460[6)]	5,3	1,1	175	7,1	1,1	223



Axial/radial bearings
with integral angular measuring system

Axial/radial bearings with integral angular measuring system

Product overview

Axial/radial bearings with integral angular measuring system

Axial/radial bearings

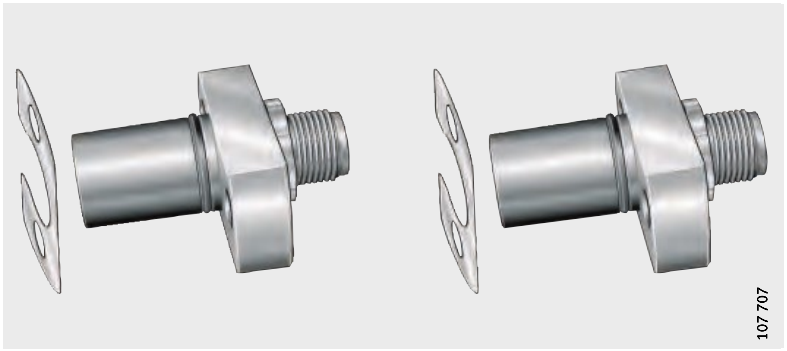
With magnetic dimensional scale

YRTM, YRTSM

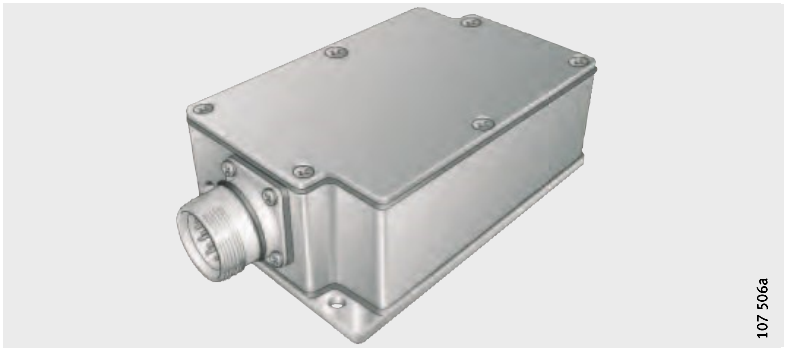
Electronic measuring system

Measuring heads with shims

SRM



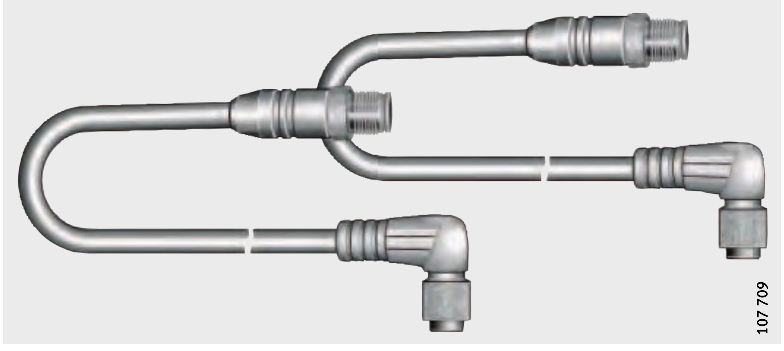
Electronic evaluation system



Connection cable

For measuring heads and electronic measuring system

SRMC



Axial/radial bearings with angular measuring system

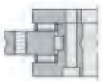
Features

Axial/radial bearings with integral angular measuring system comprise:

- an axial/radial bearing YRTM or YRTSM with a dimensional scale, an SRM electronic measuring system and signal leads SRMC. The electronic measuring system SRM comprises two measuring heads, two stacks of shims and an electronic evaluation system. The signal leads for connecting the measuring heads to the electronic evaluation system can be ordered individually in various designs. The electronic measuring system MEKO/U will continue to be available but should no longer be used for new designs.

Bearings of series YRTM or YRTSM correspond in mechanical terms to axial/radial bearings YRT or YRTS but are additionally fitted with a magnetic dimensional scale. The measuring system can measure angles to an accuracy of a few angular seconds by noncontact, magneto-resistive means.

For the mechanical part of axial/radial bearings YRTM or YRTSM, please refer to the information from page 1113 to page 1133.

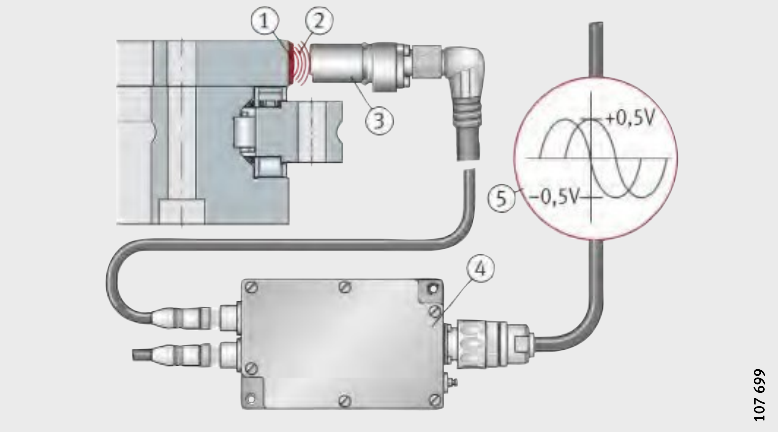


Axial/radial bearings with angular measuring system

Advantages of the angular measuring system

The measuring system, *Figure 1*:

- allows, due to the rigid connection to the adjacent construction, very good control characteristics (control stability and dynamics) and is therefore particularly suitable for axes with torque motor drive
- offers a high maximum speed of up to 16,5 m/s
- operates by non-contact means and is therefore not subject to wear
- carries out measurement irrespective of tilting and position
- has automatically self-adjusting electronics
- has a self-centring function
- is unaffected by lubricants
- is easy to fit, the measuring heads are easily adjustable, there is no need for alignment of the bearing and a separate measuring system
- requires no additional parts
  - the dimensional scale and measuring heads are integrated in the bearing and adjacent construction respectively
  - the resulting space saved can be used for the machining area of the machine
- does not give any problems relating to supply cables. The cables can be laid within the adjacent construction directly through the large bearing bore
- gives savings on design envelope size and costs due to the compact, integrated design requiring fewer components.



① Magnetic scale
② Magnetic field lines
③ Measuring head with magneto-resistive sensor
④ Electronic evaluation system
⑤ Analogue signals at output

Figure 1
Measurement principle

Axial/radial bearings with integral angular measuring system

Dimensional scale

The dimensional scale is applied without seams or joins to the outside diameter of the shaft locating washer. Magnetic poles are present as angle references, *Figure 2* on the magnetisable, electroplated coating at a pitch of 250 µm.

The angular position is measured incrementally, i.e. by counting the individual increments. For a fixed datum point for the angular position after the machine is switched on, an additional reference mark is therefore also required.

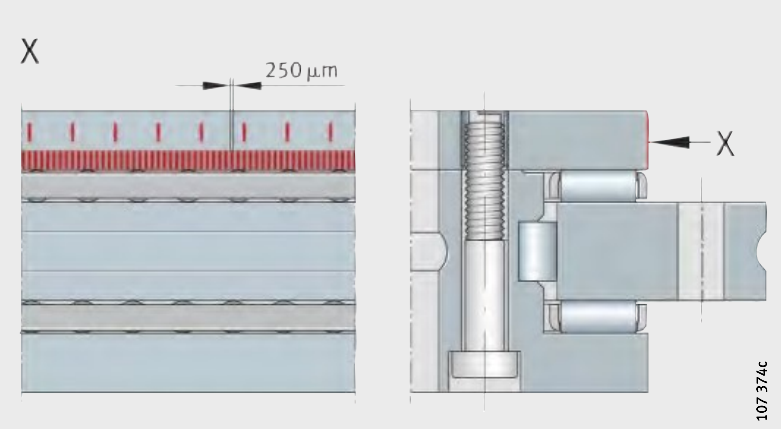


Figure 2
Dimensional scale

Reference marks

The system has pitch-coded reference marks in order to quickly create the absolute datum point. Every 15°, reference marks are applied with defined different pitches, so that the absolute datum point is achieved by passing over two adjacent reference marks (maximum 30°).

Axial/radial bearings with angular measuring system

Measuring heads with magneto-resistive sensors

The measuring heads are colour coded:

- the silver measuring head (white) scans the incremental track
- the gold measuring head (yellow) scans the incremental track and the reference marks.

The two measuring heads are designed for optimum use of space. They are fixed in a slot in the adjacent construction by means of two fixing screws.

MR effect

The small magnetic fields are detected as a result of the magneto-resistive effect (MR effect). Compared with magnetic heads, the MR sensors allow static measurement of magnetic fields, i. e. electrical signals are derived without movement, in contrast to magnetic heads.

The resistance layer of the MR sensors is designed such that the resistance changes when a magnetic field is perpendicular to the current flow.

When the magnetic pitch moves past the MR sensor, two sine wave signals with a phase offset of 90° are generated with a period length of 500 µm.

O rings for sealing

The measuring heads have O rings to seal against the egress of oil and the ingress of fluids such as cooling lubricants.

Electronic evaluation system

The electronic evaluation system operates with the aid of a digital signal processor (DSP).

The input signals are digitised by an analogue/digital converter. The high performance processor (DSP) automatically compares the sensor signals and calculates the effective angular value from the sensor signals by means of vector addition. Correction is carried out, for example, on the offset of the analogue signals.
A digital/analogue converter generates synthetic analogue signals as a 1 V_{SS} value.

The electronic evaluation system can be positioned at any location or within the adjacent construction. It is connected to the controller by means of a conventional 12-pin extension cable.

The lead for transmitting the voltage signals from the electronic evaluation system to the electronic post-processor can be up to 100 m long.

Cables for signal transmission

The signal cables for connecting the measuring heads to the electronic evaluation system are available in the lengths 1 m, 2 m and 3 m, see table.

The connection side for the electronic evaluation system has a straight plug. The connection side to the measuring head is suitable for straight plugs or 90° elbow plugs.

In the case of the elbow plug, the cable outlet direction is defined in relation to the mounting position of the measuring heads.

Advantages

The cables are suitable for use in machinery and plant for chip-forming machining:

- the cables and plugs are shielded
- the cable sheathing is made from polyurethane (PUR), halogen-free and flame-resistant
- the signal cables are free from halogens, silicones and PVC as well as resistant to microbes and hydrolysis
- the cables are resistant to oils, greases and cooling lubricants, see TPI 154, Integral angular measuring system
- the cables are suitable for dynamic use in flexible trunking (it must be ensured that they are laid correctly).

Bending cycles

When laid in flexible trunking, the cables can achieve ≧ 2 million bending cycles under the following test conditions:

- bending radius 65 mm (10×D)
- acceleration 5 m/s^2
- travel speed 200 m/min
- travel distance 5 m, horizontally.

Plug connectors

INA plug connectors are robust and designed for use in industrial environments. When connected, they conform to protection grade IP 65 (EN 60 529).

The large sheathed areas of the plugs ensure effective shielding.

Connection cables

Plug design	Cable length m	Ordering designation
Straight plugs on both ends	1	**SRMC 1-S**
	2	**SRMC 2-S**
	3	**SRMC 3-S**
Straight plug and 90° elbow plug	1	**SRMC 1-A**
	2	**SRMC 2-A**
	3	**SRMC 3-A**

Axial/radial bearings with angular measuring system

Measurement accuracy

The more accurate the angular measurement, the more accurately a rotary axis can be positioned. The accuracy of angular measurement is essentially determined by:

① the quality of the dimensional scale
② the quality of scanning
③ the quality of the electronic evaluation system
④ the eccentricity of the dimensional scale to the bearing raceway system
⑤ the runout deviation of the bearing arrangement
⑥ the elasticity of the measurement system shaft and its linkage to the shaft to be measured
⑦ the elasticity of the stator shaft and shaft coupling.

For the measuring system integrated in the bearing, only points ① to ③ are relevant.

The eccentricity in point ④ is completely eliminated by the diametrically opposed arrangement of the MR sensors.

Points ⑤ to ⑦ play only a very minor role in the INA measuring system.

Positional deviations

Positional deviations within a revolution are the absolute measurement errors over one revolution of the system (measured at +20 °C ambient temperature):

- YRTM150 ≦ ±6″
- YRTM180 ≦ ±5″
- YRT(S)M200, YRT(S)M260, YRT(S)M325, YRT(S)M395, YRT(S)M460 ≦ ±3″.

Since the dimensional scale is directly connected, i.e. without any compensation elements, with the rolling bearing, deflections in the bearing raceway system due to machining forces could affect the measurement result. This effect is eliminated by the diametrically opposed arrangement of the measuring heads in the electronic evaluation system.