SCHAEFFLER

High Precision Bearings for Combined Loads

Axial/radial bearings, axial angular contact ball bearings, axial/radial bearings with angular measuring system

Technical Product Information

Foreword

Focus on complete system

With trend-setting bearing arrangement solutions for feed spindles, main spindles, rotary tables and linear guidance units, Schaeffler has been at the forefront of the world market for decades. However, bearing components alone are often no longer the decisive factor for these machine subsystems.

Our customers are continuing to benefit from significant performance improvements and unique selling points. In order to optimise the entire machine tool system, however, it is also becoming ever more important to integrate important functions such as measurement, sealing, lubrication, and braking in the components themselves. This intellectual approach focusses on the complete system, including the bearing and bearing position. This means that you can access a product range that gives optimum coverage for all your applications in the machine tool.

Direct drives and mechatronic solutions

There is increasingly frequent usage of direct drives and mechatronic solutions in machine tools. We therefore have Schaeffler Industrial Drives as a further strong specialist in our provider network, which enables us to supply you from a single source with not only bearing elements but also components precisely matched to the drive system.

This opens up completely new technical and economic design possibilities for your requirements as well as significant advantages in the process chain.

In terms of products, we can offer you a comprehensive, precisely balanced range of precision technology and the highest product quality. In order to support your development stages as effectively as possible, we also have a worldwide network of engineers and service and sales technicians working for you and ensuring that we maintain close contact with you in your own location.

New solutions from the modular system concept

Regardless of whether high-speed, high-performance or high-precision solutions are required, Schaeffler customers can select exactly the right components for their rotary axes and rotary tables from a highly specialised modular concept. The 3 standard torque motor series from Schaeffler Industrial Drives can be combined as required with the axial/radial bearing series to permit the design of the most suitable solution for every machine used in machining processes.

Schaeffler tailors the optimal combination of components to meet customer requirements, perfectly matching them to the specific task as well as the required precision and dynamics.

Contents

1 Axial/radial bearings, axial angular contact ball bearings

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Axial/radial bearings YRTA, YRTC and YRTS as well as axial angular contact ball bearings ZKLDF are ready-to-fit, high-precision bearings for high-accuracy applications involving 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.

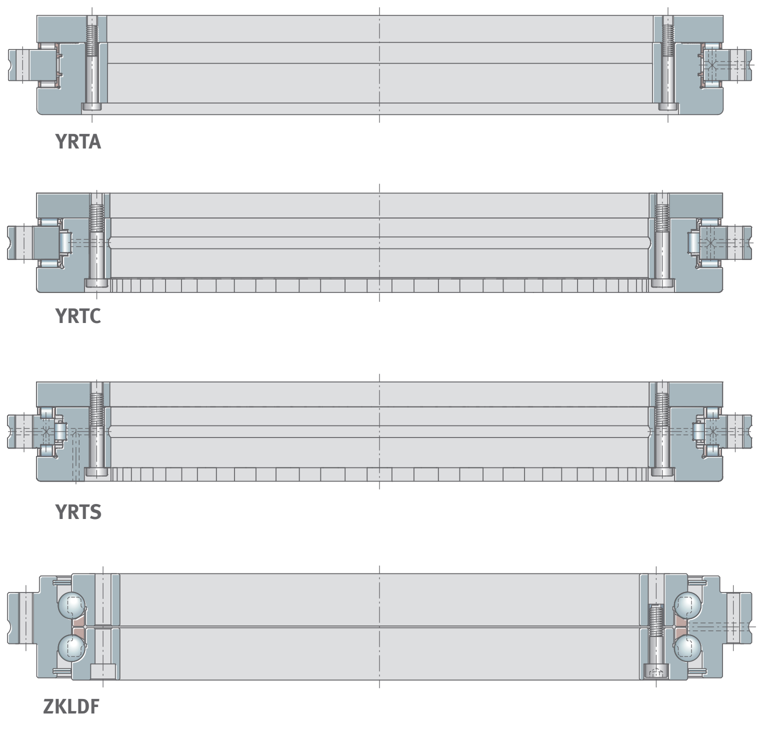
Fixing holes in the bearing rings make these units very easy to fit.

The bearings are radially and axially preloaded after mounting.

The mounting dimensions of all series are identical.

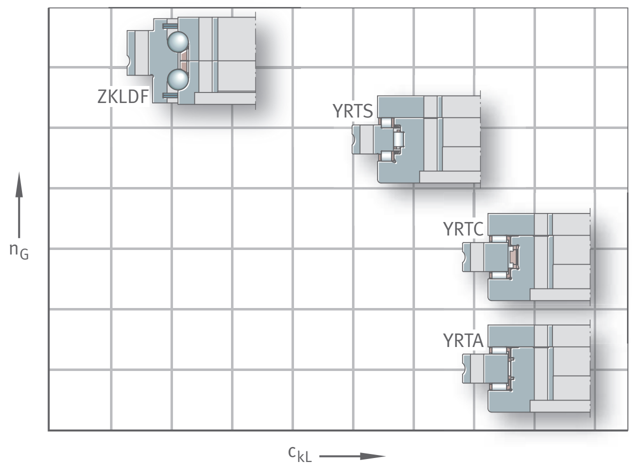
Axial/radial bearings are also available with an absolute value angular measuring system or have systems with pitch-coded reference marks. The measuring systems can measure angles to an accuracy of a few angular seconds by non-contact means.

1 Axial/radial bearings and axial angular contact ball bearings from Schaeffler



Schaeffler has an exceptionally large selection of rotary table bearings for a wide variety of machining processes, axis types, sizes, cutting forces and speed ranges. The axial/radial bearings YRTC and YRTS and the double row axial angular contact ball bearings ZKLDF represent the largest product range for rotary tables and rotary axes on the market. These bearings are geometrically interchangeable. The integral measuring system can be selected as an option for series YRTC and YRTS.

2 Speed and tilting rigidity

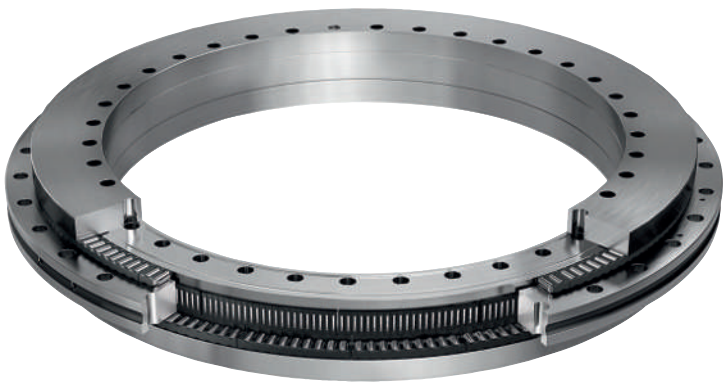


n_G	min^{-1}	Limiting speed
c_{kL}	Nm/mrad	Tilting rigidity of bearing position

Axial/radial bearings YRTA

- high precision and tilting rigidity for swivel applications with low dynamics
- cost-optimised solution for rotary axes, not just for machine tools
- applications include pallet changers and rotary storage systems

3 Axial/radial bearings YRTA



Axial/radial bearings YRT, YRTC

- Design using X-life
- Applications include highly loaded positioning axes, swivel type axes, and gear hobbing machines.

4 Axial/radial bearing YRT, YRTC

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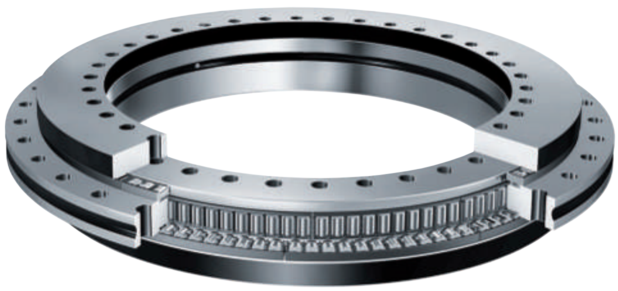
Axial/radial bearings for higher speeds YRTS

- as bearing arrangements for high-speed rotary axes and rotary tables
- for use in ultra-precision milling and grinding machines and in gear cutting machines

5 Axial/radial bearing YRTS



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Axial angular contact ball bearings ZKLDF

- For bearing arrangements with high duty cycles, such as rotary tables with a main spindle function.
- Applications include combined milling and turning operations, as well as milling, grinding or honing.

6 Axial angular contact ball bearing ZKLDF

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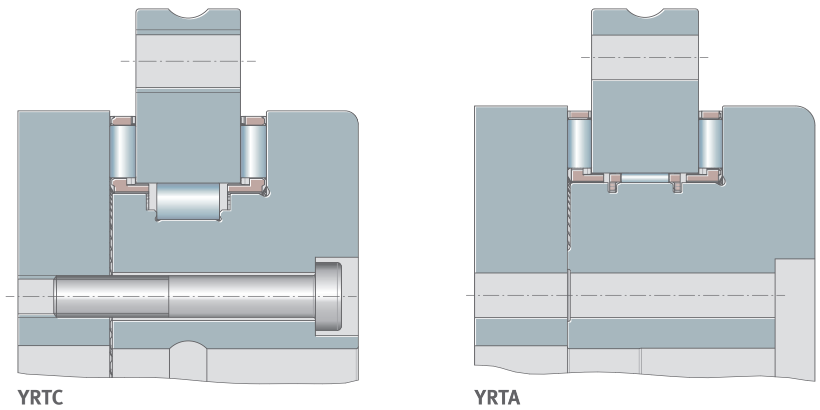
1.1 Bearing design

YRTA

In terms of their fundamental design, bearings in the YRTA series are based on the proven three-row YRTC roller bearing design and have been specifically optimised to meet the requirements of automation applications. These bearings are also suitable for classic driven rotary tables. Axial/radial bearings YRTA offer the technical advantages of the proven YRTC series, adapted for applications in machine tool peripherals, but also for applications in productronics and for classic rotary tables featuring swivel operation.

Bearings in the YRTA series have a radial cage. Fixing holes in the bearing rings make these units very easy to fit.

7 Adapted internal construction of series YRTA



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YRT, YRTC

The axial component and radial component are guided by a cage. Bearings of series YRTC either have a radial cage or are designed with a full complement cylindrical roller set, depending on the size. The outer ring, L-section ring and shaft locating washer have fixing holes.

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

YRTS

Axial/radial bearing YRTS has a low frictional torque and is therefore suitable for supporting direct drive axes operating at high speeds.

The axial component and radial component are guided by a cage. Bearings of series YRTS are ready-to-fit bearing units with a screw mounting facility.

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

ZKLDF

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 the bearing onto the adjacent construction.

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

1.2 Lubrication

Rotary axis bearings from all series are pre-lubricated with high-quality grease.

1.2.1 Relubrication

The speed capability, friction, rating life, functional capability and the time periods between relubrication intervals are influenced, in some cases significantly, by the grease used.

For a calculation of the relubrication quantities and intervals, taking into account the load spectrum and environmental conditions, please contact Schaeffler.

YRTA

These bearings can be relubricated via the outer ring.

YRT, YRTC

These bearings can be relubricated via the outer and inner ring.

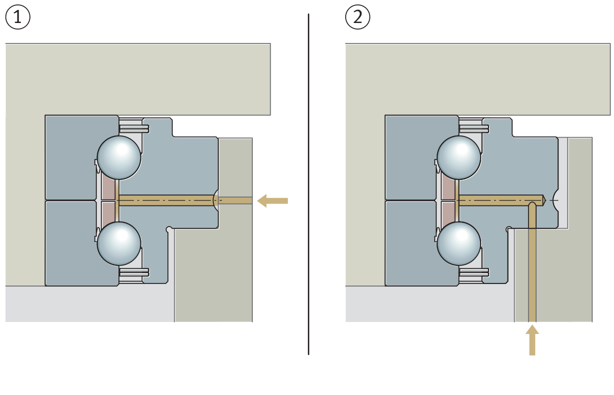
YRTS

These bearings can be relubricated via the outer and inner ring.

ZKLDF

These bearings can be relubricated via the outer ring.

8 Options for relubrication



1	Relubrication via the lubrication groove in the outer ring	2	Relubrication via the screw mounting surface on the outer ring

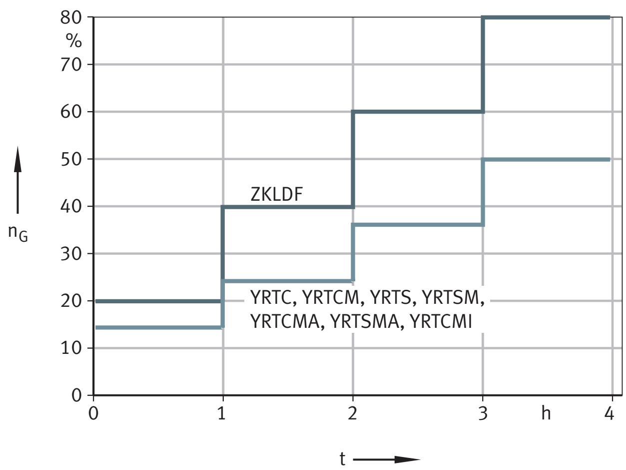
1 Grease for relubrication

Bearing	Grease
YRTA	Arcanol MULTITOP
YRTC	Arcanol MULTITOP
YRTS200 ... YRTS460	Arcanol LOAD150
YRTS580-XL ... YRTS650-XL	Arcanol SPEED2,6
ZKLDF	Arcanol MULTITOP

1.2.2 Overlubrication

Overlubrication increases the frictional torque at high speeds. A high frictional torque can lead to overheating, which may damage the bearing. Performing the running-in cycle restores the original frictional torque after unintentional overlubrication.

9 Running-in cycle for initial operation and after overlubrication



n_G	min^{-1}	Limiting speed
t	h	Time

1.2.3 Commissioning

Rolling bearings may exhibit increased frictional torque during commissioning, which can lead to overheating where there is immediate operation at high speeds.

! In order to prevent overheating of the bearing, the running-in cycle should always be carried out. The cycle may be shortened if there is appropriate monitoring of the bearing temperature. The bearing ring temperature must not exceed +60 °C.

Swivel axes operate at low speeds or with low duty cycles. As a result, the running-in cycle can be omitted for swivel axis applications.

1.3 Sealing

Axial/radial bearings are not sealed.

YRTA

Axial/radial bearings of the YRTA series are also optionally available with sheet metal covers and gap seals on both sides. The seal reduces the ingress of dust in automation applications.

ZKLDF

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

1.4 Speeds

The limiting speeds provided in the product tables must be observed ➤43 | 1.15.

The limiting speeds stated for these bearing series were determined on test rigs under the following conditions:

- grease distribution cycle according to the defined data
- maximum increase in bearing temperature of 40 K in the area of the raceway
- operating duration ED = 100 %, which means continuous operation at the limiting speed n_G
- bearing fully screw mounted on solid fixtures
- no external load, only preload and mass of the fixtures

! For applications with a high duty cycle ED or continuous operation at a speed parameter of $n \cdot d_M > 35000\ \text{min}^{-1} \cdot \text{mm}$ at an ED > 10 %, the series YRTS or ZKLDF should be selected in the bore range of 200 mm to 650 mm.

! 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, the stated limiting speeds must be checked.

In the event of a brief operating duration, please consult Schaeffler regarding the permissible limiting speed n_G.

YRTA

Axial/radial bearings YRTA are designed for swivel-type operation.

YRT, YRTC

Axial/radial bearings of series YRT and YRTC are designed for swivel-type operation and, depending on the size, are suitable for medium to high speeds. For rotary operation with a high duty cycle ED, the use of axial/radial bearings of series YRTS is preferred in the bore range of 200 mm to 460 mm.

YRTS

Axial/radial bearings YRTS are designed for high speeds.

ZKLDF

Axial angular contact ball bearings ZKLDF are suitable for the highest speeds.

1.5 Rigidity

The rigidity of a bearing position describes the magnitude of deflection from the ideal position under load. The static rigidity thus has a direct influence on accuracy.

The calculated rigidity values for the rolling element sets are for informational purposes only. They allow for comparison with other bearing designs.

The product tables give the rigidity values for the complete bearing position. These take account of the deflection of the rolling element set as well as the deformation of the bearing rings and the screw connections ➤43|1.15.

1.6 Temperature range

Axial/radial bearings and axial angular contact ball bearings are suitable for operating temperatures from –30 °C to +100 °C.

1.6.1 Temperature distribution in the rotary axis system

Rotary axes with a main spindle function, such as those used for combined milling and turning operations and driven directly by a torque motor, are systems with complex thermal characteristics.

The temperature distribution in the rotary axis system must be considered in greater detail during the design process:

- Asymmetrical rotary axis housings can undergo asymmetrical deformation due to heating.
- In turn, out-of-round bearing seats lead to additional bearing load, reduced life and a negative influence on running behaviour and running accuracy.
- Temperature management of the rotary axis in the form of targeted cooling and heating is generally necessary for high-performance rotary axes. Schaeffler offers high-performance simulation tools to assist with the simulation work.

! Where there is non-uniform temperature distribution between the inner ring and outer ring, rotary axis bearings with ball contact, such as series ZKLDF, exhibit more tolerant behaviour than rotary axis bearings with line contact, such as axial/radial cylindrical roller bearings or crossed roller bearings.

The specified bearing characteristics only apply if the bearing preload remains constant. The bearing preload can be altered by mechanical stresses, such as those caused by temperature differences or adjacent machine elements, for example via force-locking clamping connections.

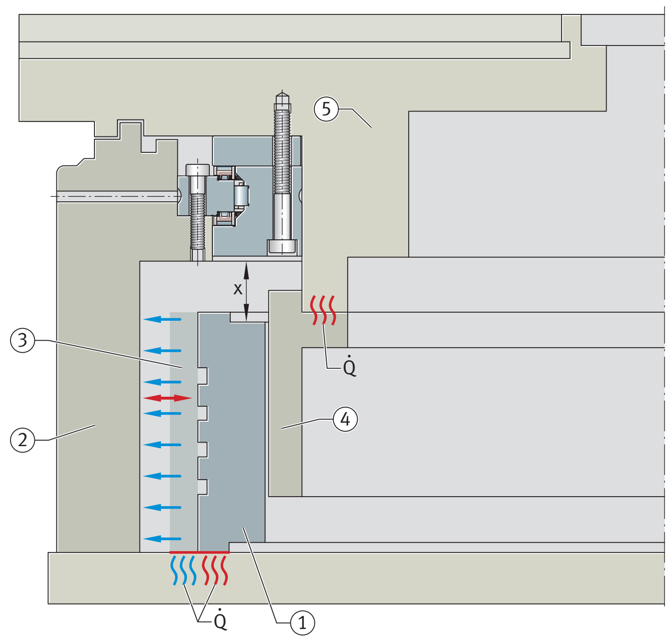
Design regulations for optimum temperature distribution must be observed ➤15 | 1.6.2.

1.6.2 Design regulations for optimum temperature distribution

Proven design regulations based on practical experience:

- In preference, flange mount the rotor of the torque motor on the rotary table plate to keep the flow of heat through the bearing to a minimum. Be aware of additional heat generation in the rotor in high-speed applications.
- The distance between the motor and the bearing should be as large as possible. A large distance reduces the transfer of heat from the rotor to the bearing. The stresses occurring between the components as a result of varying thermal expansion are reduced by the increased elasticity of the system. The heat gradient should be as low and constant as possible.
- The rotary table plate bearing must be centred with sufficient rigidity to allow the overall system to attain a high level of rigidity. The risk of deformation to the bearing seat due to the increase in the temperature of the rotor is also reduced.
- Use torque motors which are suitable for the requirements only, with low loss of power and a high motor constant. We recommend using torque motors from Schaeffler Industrial Drives.

10 Ideal rotary table, taking account of the occurring heat



1	Stator of the torque motor	2	Rotary table housing
3	Stator cooling	4	Rotor of the torque motor
5	Rotary table plate		

$\dot{Q}$	W	Heat flow
x	mm	Distance between motor and bearing

! Regulated cooling of the stationary and rotating components may be required in order to limit the temperature variations between the bearing inner ring and outer ring.

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1.7 Cages

YRTA

The axial component and the radial component are guided by a cage.

YRT, YRTC

In bearings of series YRT and YRTC, the axial roller set is cage-guided. Depending on the size, the radial component is either full-complement or cage-guided.

YRTS

The axial component and the radial component are guided by a cage.

1.8 Internal clearance

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

1.9 Dimensions, tolerances

YRTA

The tolerances for the main dimensions correspond to tolerance class 6 in accordance with ISO 492 (DIN 620-2).

The tolerances for concentricity and axial runout accuracy can be found in the dimensional tolerances.

2 Dimensional tolerances

d	$t_{\Delta dmp}$		D	$t_{\Delta Dmp}$	
	U	L		U	L
mm	mm	mm	mm	mm	mm
150	0	−0,018	240	0	−0,02
180	0	−0,022	280	0	−0,025
200	0	−0,022	300	0	−0,025
260	0	−0,025	385	0	−0,028
325	0	−0,03	450	0	−0,033
395	0	−0,03	525	0	−0,038
460	0	−0,035	600	0	−0,038
580	0	−0,04	750	0	−0,045
650	0	−0,05	870	0	−0,06

d	mm	Bore diameter
D	mm	Outside diameter
L	mm	Lower limit deviation
$t_{\Delta dmp}$	mm	Deviation of the mean value of the bore diameter from the nominal size in accordance with ISO 492
$t_{\Delta Dmp}$	mm	Deviation of the mean value of the outside diameter from the nominal size in accordance with ISO 492
U	mm	Upper limit deviation

The geometrical and positional tolerances correspond to tolerance class 4 in accordance with ISO 492 (DIN 620-2).

3 Mounting dimensions, axial runout and radial runout

d	H_1	$t_{\Delta H1s}$		H_2	t_1 [1)]
		U	L		
mm	mm	mm	mm	mm	μm
150	26	0,03	−0,03	14	6
180	29	0,03	−0,03	14	6
200	30	0,03	−0,03	15	6
260	36,5	0,04	−0,04	18,5	8
325	40	0,05	−0,05	20	8
395	42,5	0,05	−0,05	22,5	8
460	46	0,06	−0,06	24	8
580	60	0,25	−0,25	30	10
650	76	0,25	−0,25	44	10

1) for rotating inner ring and rotating outer ring

d	mm	Bore diameter
H_1	mm	Contact surface height, outer ring
H_2	mm	Contact surface height, outer ring
L	mm	Lower limit deviation
$t_{\Delta H1s}$	mm	Deviation of height from nominal size in accordance with ISO 492
$t_{\Delta H2s}$	mm	Deviation of height from nominal size in accordance with ISO 492
t_1	μm	Axial and radial runout, measured on fitted bearing with ideal adjacent construction
U	mm	Upper limit deviation

YRT, YRTC

The bearing bore may be slightly conical in the delivered condition. This bore shape is typical of the design and results from the preload forces of the radial bearing. The bearing will regain its ideal geometry when fitted.

The geometrical and positional tolerances correspond to tolerance class 4 in accordance with ISO 492 (DIN 620-2).

4 Dimensional tolerances

d	$t_{\Delta dmp}$		D	$t_{\Delta Dmp}$	
	U	L		U	L
mm	mm	mm	mm	mm	mm
50	0	−0,008	126	0	−0,011
80	0	−0,009	146	0	−0,011
100	0	−0,01	185	0	−0,02
120	0	−0,01	210	0	−0,015
150	0	−0,013	240	0	−0,015
180	0	−0,013	280	0	−0,018
200	0	−0,015	300	0	−0,018
260	0	−0,018	385	0	−0,02
325	0	−0,023	450	0	−0,023
395	0	−0,023	525	0	−0,028
460	0	−0,023	600	0	−0,028
580	0	−0,025	750	0	−0,035
650	0	−0,038	870	0	−0,05
850	0	−0,05	1095	0	−0,063
950	0	−0,05	1200	0	−0,063
1030	0	−0,063	1300	0	−0,08

d	mm	Bore diameter
D	mm	Outside diameter
L	mm	Lower limit deviation
$t_{\Delta dmp}$	mm	Deviation of the mean value of the bore diameter from the nominal size in accordance with ISO 492
$t_{\Delta Dmp}$	mm	Deviation of the mean value of the outside diameter from the nominal size in accordance with ISO 492
U	mm	Upper limit deviation

5 Mounting dimensions, axial runout and radial runout

d	H_1	$t_{\Delta H1s}$		H_2	$t_{\Delta H2s}$		t_1 [2)]
		U	L		U	L	
mm	mm	mm	mm	mm	mm	mm	µm
50	20	0,025	−0,025	10	0,02	−0,02	2
80	23,35	0,025	−0,025	11,65	0,2	−0,2	3
100	25	0,025	−0,025	13	0,02	−0,02	3
120	26	0,025	−0,025	14	0,2	−0,2	3
150	26	0,03	−0,03	14	0,02	−0,02	3
180	29	0,03	−0,03	14	0,025	−0,025	4
200	30	0,03	−0,03	15	0,025	−0,025	4
260	36,5	0,04	−0,04	18,5	0,025	−0,025	6
325	40	0,05	−0,05	20	0,025	−0,025	6
395	42,5	0,05	−0,05	22,5	0,025	−0,025	6
460	46	0,06	−0,06	24	0,03	−0,03	6
580	60	0,25	−0,25	30	0,25	−0,25	10
650	78	0,25	−0,25	44	0,25	−0,25	10
850	80,5	0,3	−0,3	43,5	0,3	−0,3	12
950	86	0,3	−0,3	46	0,3	−0,3	12
1030	92,5	0,3	−0,3	52,5	0,3	−0,3	12

2) for rotating inner ring and rotating outer ring

d	mm	Bore diameter
H_1	mm	Contact surface height, outer ring
H_2	mm	Contact surface height, outer ring
L	mm	Lower limit deviation
$t_{\Delta H1s}$	mm	Deviation of height from nominal size in accordance with ISO 492
$t_{\Delta H2s}$	mm	Deviation of height from nominal size in accordance with ISO 492
t_1	µm	Axial and radial runout, measured on fitted bearing with ideal adjacent construction
U	mm	Upper limit deviation

For a restricted version with bore diameters > 460 mm, please contact Schaeffler.

6 Mounting dimensions, axial runout and radial runout; restricted version

d	H_1	$t_{\Delta H1s}$ [3)]		H_2	$t_{\Delta H2s}$ [3)]		t_1 [4)]
		U	L		U	L	
mm	mm	mm	mm	mm	mm	mm	µm
50	20	0,025	−0,025	10	0,02	−0,02	1
80	23,35	0,025	−0,025	11,65	0,2	−0,2	1,5
100	25	0,025	−0,025	13	0,02	−0,02	1,5
120	26	0,025	−0,025	14	0,2	−0,2	1,5
150	26	0,03	−0,03	14	0,02	−0,02	1,5
180	29	0,03	−0,03	14	0,025	−0,025	2
200	30	0,03	−0,03	15	0,025	−0,025	2
260	36,5	0,04	−0,04	18,5	0,025	−0,025	3

d	H_1	$t_{\Delta H1s}$ [3]		H_2	$t_{\Delta H2s}$ [3]		t_1 [4]
		U	L		U	L	
mm	mm	mm	mm	mm	mm	mm	µm
325	40	0,05	−0,05	20	0,025	−0,025	3
395	42,5	0,05	−0,05	22,5	0,025	−0,025	3
460	46	0,06	−0,06	24	0,03	−0,03	3
580	60	0,075	−0,075	30	0,03	−0,03	5
650	78	0,1	−0,1	44	0,03	−0,03	5
850	80,5	0,12	−0,12	43,5	0,03	−0,03	6
950	86	0,3	−0,3	46	0,03	−0,03	6
1030	92,5	0,15	−0,15	52,5	0,03	−0,03	6

[3] special design with suffix H1 or H2

[4] for rotating inner ring and rotating outer ring, suffix PRL50

d	mm	Bore diameter
H_1	mm	Contact surface height, outer ring
H_2	mm	Contact surface height, outer ring
L	mm	Lower limit deviation
$t_{\Delta H1s}$	mm	Deviation of height from nominal size in accordance with ISO 492
$t_{\Delta H2s}$	mm	Deviation of height from nominal size in accordance with ISO 492
t_1	µm	Axial and radial runout, measured on fitted bearing with ideal adjacent construction
U	mm	Upper limit deviation

YRTS

The bearing bore may be slightly conical in the delivered condition. This bore shape is typical of the design and results from the preload forces of the radial bearing. The bearing will regain its ideal geometry when fitted.

The dimensional tolerances are derived from tolerance class 5.

7 Dimensional tolerances

d	$t_{\Delta dmp}$		D	$t_{\Delta Dmp}$	
	U	L		U	L
mm	mm	mm	mm	mm	mm
200	0	−0,015	300	0	−0,018
260	0	−0,018	385	0	−0,02
325	0	−0,023	450	0	−0,023
395	0	−0,023	525	0	−0,028
460	0	−0,023	600	0	−0,028
580	0	−0,025	750	0	−0,035
650	0	−0,038	870	0	−0,05

d	mm	Bore diameter
D	mm	Outside diameter
L	mm	Lower limit deviation
$t_{\Delta dmp}$	mm	Deviation of the mean value of the bore diameter from the nominal size in accordance with ISO 492
$t_{\Delta Dmp}$	mm	Deviation of the mean value of the outside diameter from the nominal size in accordance with ISO 492
U	mm	Upper limit deviation

The geometrical and positional tolerances correspond to tolerance class 4 in accordance with ISO 492 (DIN 620-2).

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8 Mounting dimensions, axial runout and radial runout

d	H_1	$t_{\Delta H1s}$		H_2	t_1	
		U	L		Normal [5)]	Restricted [6)]
mm	mm	mm	mm	mm	µm	µm
200	30	0,04	−0,06	15	4	2
260	36,5	0,05	−0,07	18,5	6	3
325	40	0,06	−0,07	20	6	3
395	42,5	0,06	−0,07	22,5	6	3
460	46	0,07	−0,08	24	6	3
580	60	0,06	−0,11	30	10	5
650	78	0,11	−0,11	44	10	5

5) for rotating inner ring and rotating outer ring

6) for rotating inner ring only, suffix PRL50/IR

d	mm	Bore diameter
H_1	mm	Contact surface height, outer ring
H_2	mm	Contact surface height, outer ring
L	mm	Lower limit deviation
t_1	µm	Axial and radial runout, measured on fitted bearing with ideal adjacent construction
$t_{\Delta H1s}$	mm	Deviation of height from nominal size in accordance with ISO 492
U	mm	Upper limit deviation

ZKLDF

The geometrical and positional tolerances correspond to tolerance class 4 in accordance with ISO 492 (DIN 620-2).

9 Dimensional tolerances

d	$t_{\Delta dmp}$		D	$t_{\Delta Dmp}$	
	U	L		U	L
mm	mm	mm	mm	mm	mm
100	0	−0,01	185	0	−0,015
120	0	−0,01	210	0	−0,015
150	0	−0,013	240	0	−0,015
180	0	−0,013	280	0	−0,018
200	0	−0,015	300	0	−0,018
260	0	−0,018	385	0	−0,02
325	0	−0,023	450	0	−0,023
395	0	−0,023	525	0	−0,028
460	0	−0,023	600	0	−0,028

d	mm	Bore diameter
D	mm	Outside diameter
L	mm	Lower limit deviation
$t_{\Delta dmp}$	mm	Deviation of the mean value of the bore diameter from the nominal size in accordance with ISO 492
$t_{\Delta Dmp}$	mm	Deviation of the mean value of the outside diameter from the nominal size in accordance with ISO 492
U	mm	Upper limit deviation

10 Mounting dimensions, axial runout and radial runout

d	H_1	$t_{\Delta H1s}$		t_1
		U	L	Normal [7)]
mm	mm	mm	mm	µm
100	25	0,175	−0,175	3
120	26	0,175	−0,175	3
150	26	0,175	−0,175	3
180	29	0,175	−0,175	4
200	30	0,175	−0,175	4
260	36,5	0,2	−0,2	6
325	40	0,2	−0,2	6
395	42,5	0,2	−0,2	6
460	46	0,225	−0,225	6

7) for rotating inner ring and rotating outer ring

U	mm	Upper limit deviation
L	mm	Lower limit deviation
d	mm	Bore diameter
H_1	mm	Contact surface height, outer ring
$t_{\Delta H1s}$	mm	Deviation of height from nominal size in accordance with ISO 492
t_1	µm	Axial and radial runout, measured on fitted bearing with ideal adjacent construction

1.10 Structure of the ordering designation

11 Structure of the ordering designation for axial/radial bearings YRTA

YRTA 325 – 2Z

Designation
YRTA Axial/radial roller bearing, double direction, for screw mounting, for low accuracy requirements

Bore diameter
150 ... 650 Available bore diameters (150, 180, 200, 260, 325, 395, 460, 580, 650)

Sealing
2Z Available as an option with seals on both sides

001B3B94

12 Structure of the ordering designation for axial/radial bearings YRT

YRT 80 – TV – VSP – PRL50

Designation

YRT	Axial/radial roller bearing, double direction, for screw mounting

Bore diameter

50 ... 80	Available bore diameters (50, 80)

Cage

–	Standard cage (for YRT50)
TV	Cage made from glass fibre reinforced polyamide 66 (for YRT80)

L-section ring

–	For mounting with unsupported L-section ring
VSP	For mounting with axially supported L-section ring

Axial runout and radial runout

–	Standard design
PRL50	Restricted axial runout and radial runout tolerances for rotating inner ring and outer ring

13 Structure of the ordering designation for axial/radial bearings YRTC

YRTC 580 – XL – VSP – PRL50 – H1 – H2

Designation

YRTC	Axial/radial roller bearing, double direction, for screw mounting

Bore diameter

100 ... 1030	Available bore diameters (100, 120, 150, 180, 200, 260, 325, 395, 460, 580, 650, 850, 950, 1030)

Premium brand

XL	X-life

L-section ring

–	For mounting with unsupported L-section ring
VSP	For mounting with axially supported L-section ring

Axial runout and radial runout

–	Standard design
PLR50	Restricted axial runout and radial runout tolerances for rotating inner ring and outer ring Bore diameter > 460 mm: by agreement

Mounting dimension H1

–	Standard design
H1	Restricted version, with tighter mounting dimension tolerances

Mounting dimension H2

–	Standard design
H2	Restricted version, with tighter mounting dimension tolerances

14 Structure of the ordering designation for axial/radial bearings YRTS

YRTS 580 – XL – PRL50/IR

Designation

YRTS Axial/radial roller bearing, double direction, for screw mounting, for higher speeds

Bore diameter

200 ... 650 Available bore diameters (200, 260, 325, 395, 460, 580, 650)

Premium brand

XL X-life (for bore diameters 580 and 650)

Axial runout and radial runout

– Standard design

PLR50/IR Restricted axial runout and radial runout tolerances for rotating inner ring

001B3FE6

15 Structure of the ordering designation for axial/radial bearings ZKLDF

ZKLDF 325

Designation

ZKLDF Axial angular contact ball bearing, double direction, for screw mounting

Bore diameter

100 ... 460 Available bore diameters (100, 120, 150, 180, 200, 260, 325, 395, 460)

1.11 Dimensioning

1.11.1 Basic rating life

The load carrying capacity and life must be verified for the radial and axial bearing components.

For verification of the basic rating life, please contact Schaeffler, stating the speed, load and duty cycle.

1.11.2 Static load safety factor

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

1

$$S_0 = \frac{C_{0r}}{F_{0r}}$$

C_{0r}	N	Basic static load rating, radial
F_{0r}	N	Largest radial load present (maximum load)
S_0	–	Static load safety factor

1

ƒ2

$$S_0 = \frac{C_{0a}}{F_{0a}}$$

C_{0a}	N	Basic static load rating, axial
F_{0a}	N	Largest axial load present (maximum load)
S_0	–	Static load safety factor

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

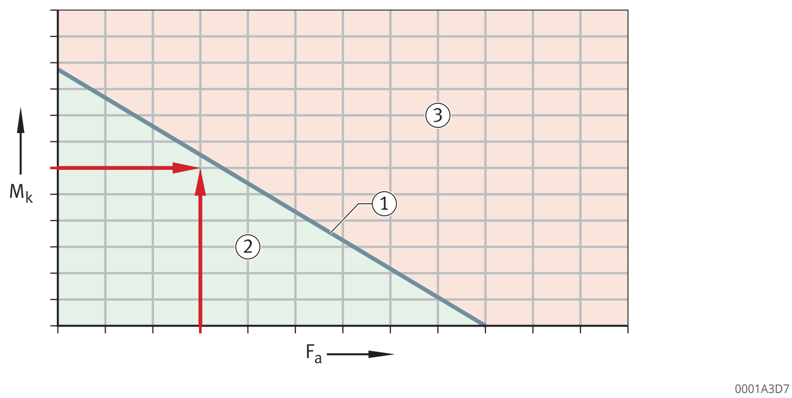
1.11.3 Static limiting load diagrams

The static limiting load diagram can be used for the following purposes:

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

The static limiting load diagram takes into account a static load safety factor S_0 ≥ 4 for the rolling element set, as well as the strength of the screws and the bearing ring.

16 Example of a static limiting load diagram



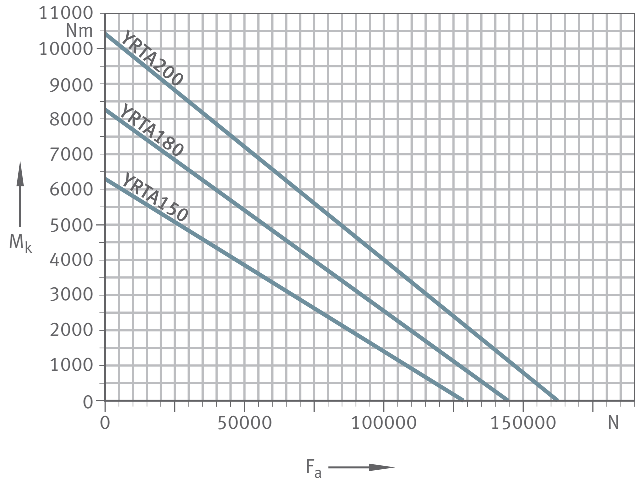
1	Bearing, size	2	Permissible range
3	Impermissible range		

M_k	Nm	Max. tilting moment
F_a	N	Axial load

! The static limiting load must not be exceeded when dimensioning the bearing arrangement.

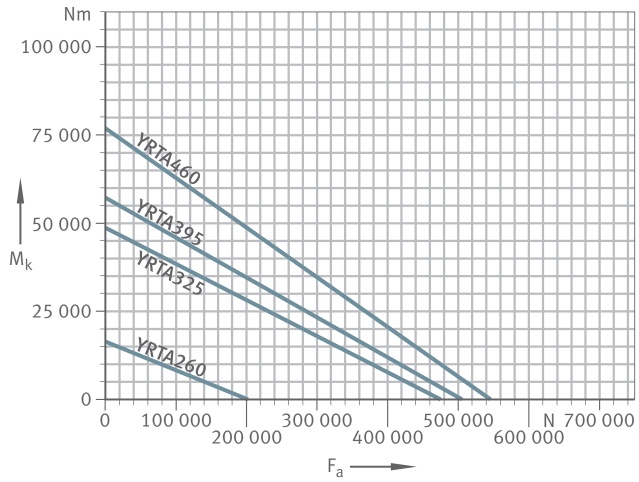
YRTA

17 Static limiting load diagram for YRTA150 to YRTA200



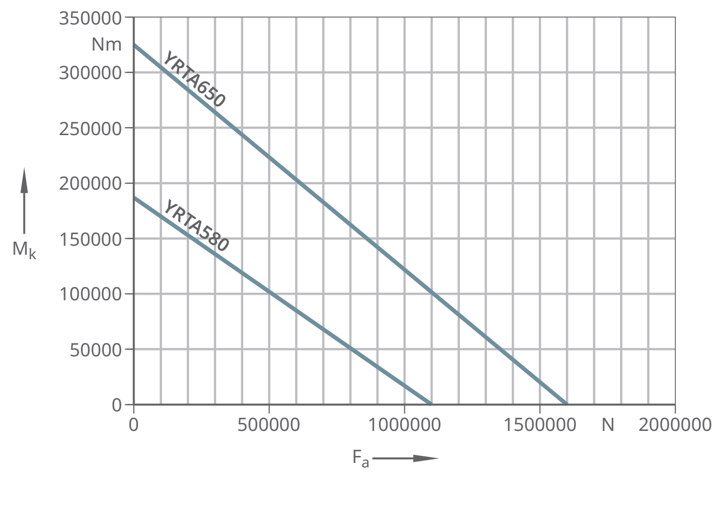
M_k	Nm	Max. tilting moment
F_a	N	Axial load

18 Static limiting load diagram for YRTA260 to YRTA460



M_k	Nm	Max. tilting moment
F_a	N	Axial load

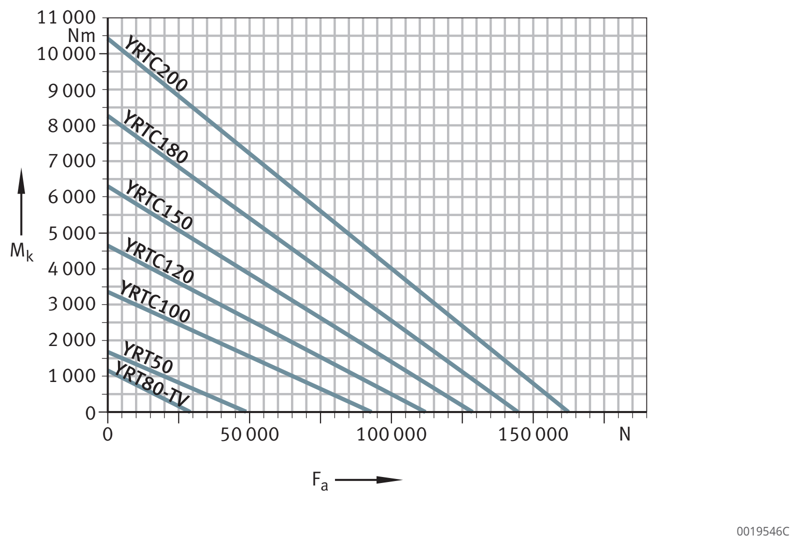
19 Static limiting load diagram for YRTA580 to YRTA650



M_k	Nm	Max. tilting moment
F_a	N	Axial load

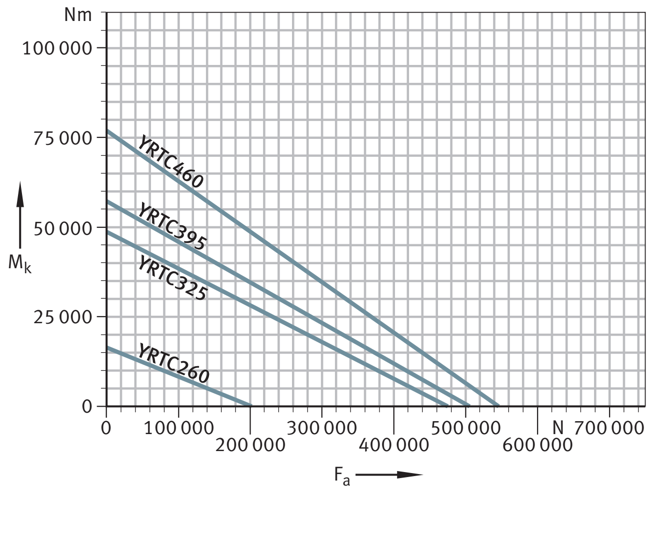
YRT, YRTC

20 Static limiting load diagram for YRT50 to YRTC200



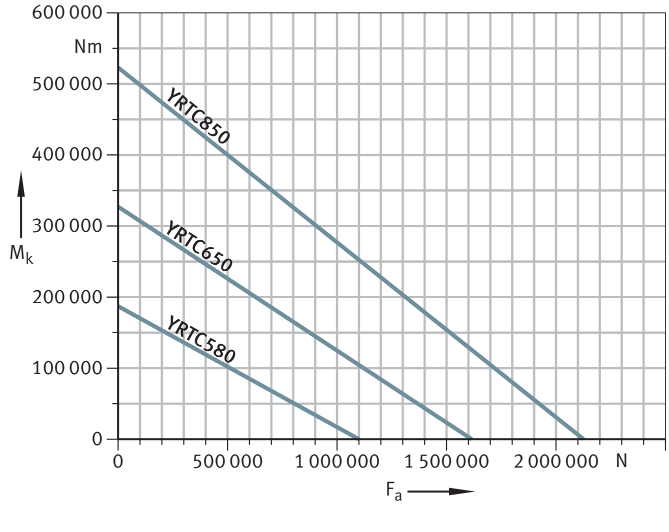
M_k	Nm	Max. tilting moment
F_a	N	Axial load

21 Static limiting load diagram for YRTC260 to YRTC460



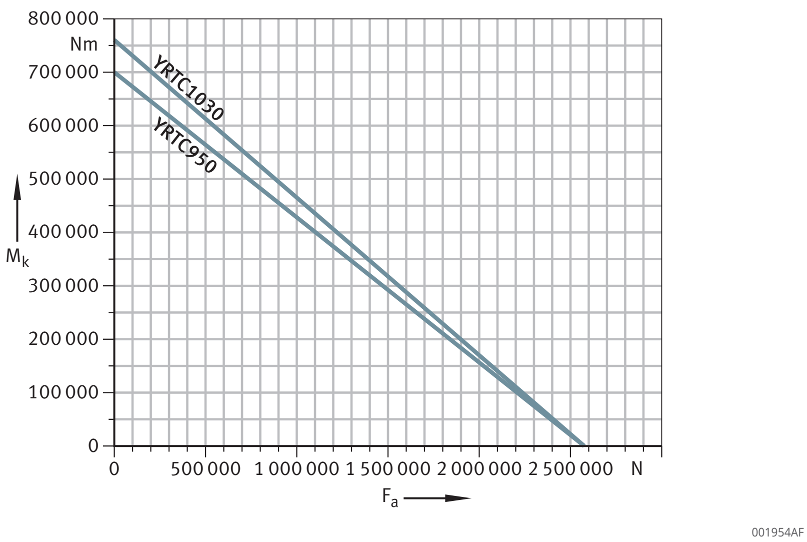
M_k	Nm	Max. tilting moment
F_a	N	Axial load

22 Static limiting load diagram for YRTC580 to YRTC850



M_k	Nm	Max. tilting moment
F_a	N	Axial load

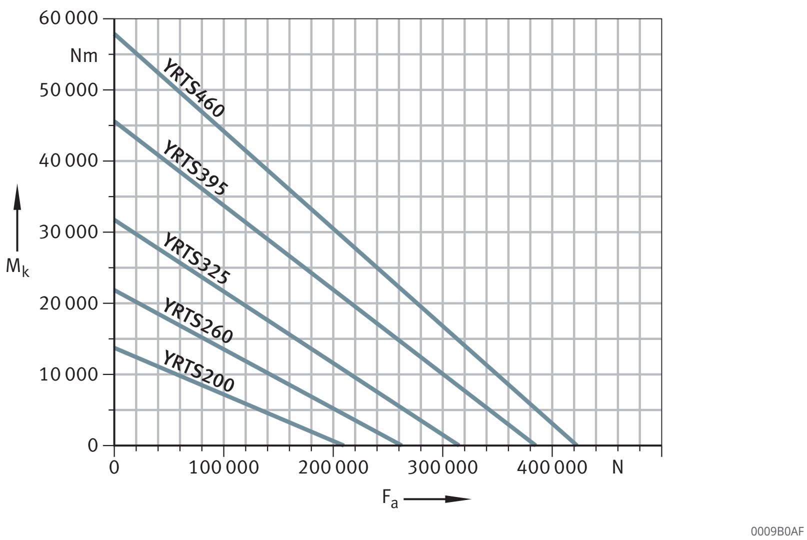
23 Static limiting load diagram for YRTC950 to YRTC1030



M_k	Nm	Max. tilting moment
F_a	N	Axial load

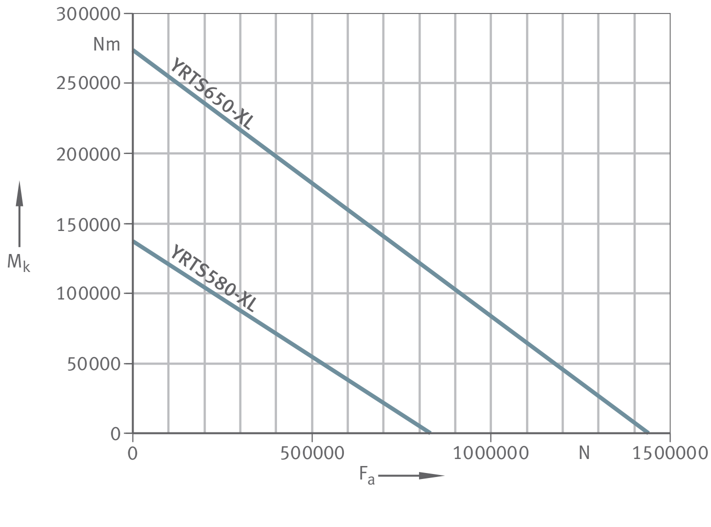
YRTS

24 Static limiting load diagram for YRTS200 to YRTS460



M_k	Nm	Max. tilting moment
F_a	N	Axial load

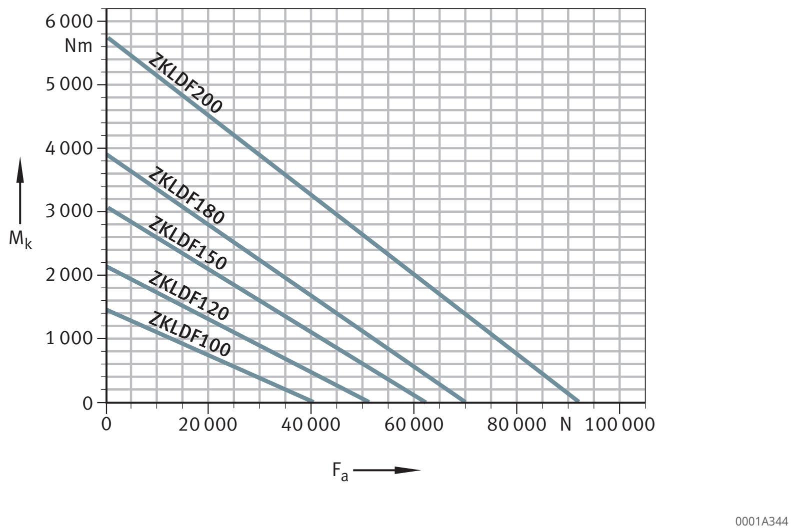
25 Static limiting load diagram for YRTS580-XL and YRTS650-XL



M_k	Nm	Max. tilting moment
F_a	N	Axial load

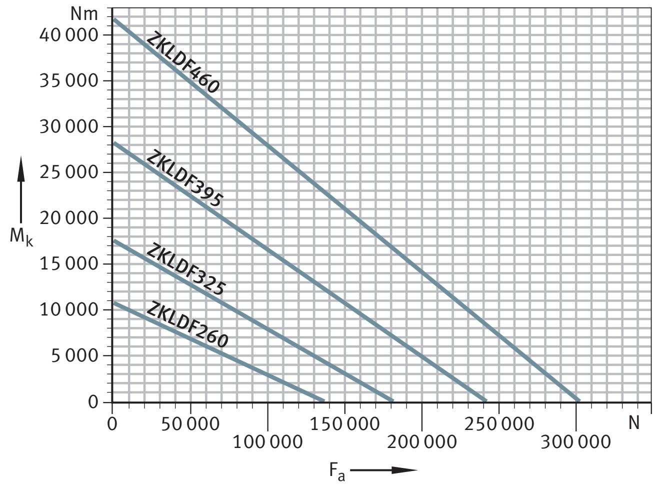
ZKLDF

26 Static limiting load diagram for ZKLDF100 to ZKLDF200



M_k	Nm	Max. tilting moment
F_a	N	Axial load

27 Static limiting load diagram for ZKLDF260 to ZKLDF460



M_k	Nm	Max. tilting moment
F_a	N	Axial load

1.11.4 Frictional torque

The frictional torque M_R is influenced by the lubricant viscosity, the quantity of lubricant and the bearing preload.

- The lubricant viscosity is dependent on the operating temperature and lubricant grade.
- When relubrication is carried out, the lubricant quantity temporarily increases until the grease has been distributed and the excess quantity has left the bearing.
- 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 tightening torque of the screws and the mounting situation.

During initial operation and after relubrication, bearing friction is increased until the lubricant has been distributed within the bearing.

YRTA

The guide values for the frictional torques for axial/radial bearings were determined at a measurement speed n = 5 min^{-1}.

YRT, YRTC

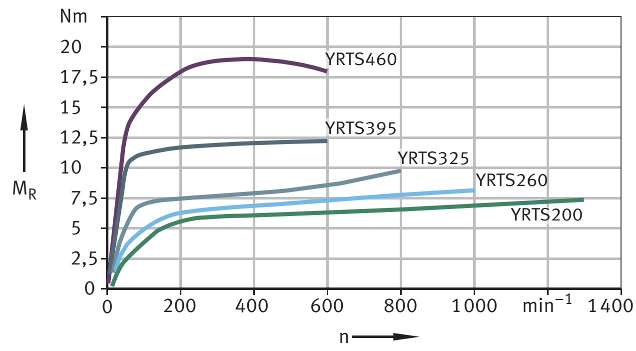
The guide values for the frictional torques for axial/radial bearings were determined at a measurement speed n = 5 min^{-1}.

! Variations in the tightening torque of the fixing screws will have a detrimental effect on the preload and the frictional torque. For YRT bearings, it must be taken into consideration that the frictional torque can increase by a factor of 2 to 2,5 with increasing speed.

YRTS

The stated frictional torques M_R are statistically determined guide values for bearings with grease lubrication measured after a grease distribution cycle and at an operating temperature ϑ = +50 °C.

28 Frictional torques as guide values for YRTS, statistically determined values from series of measurements



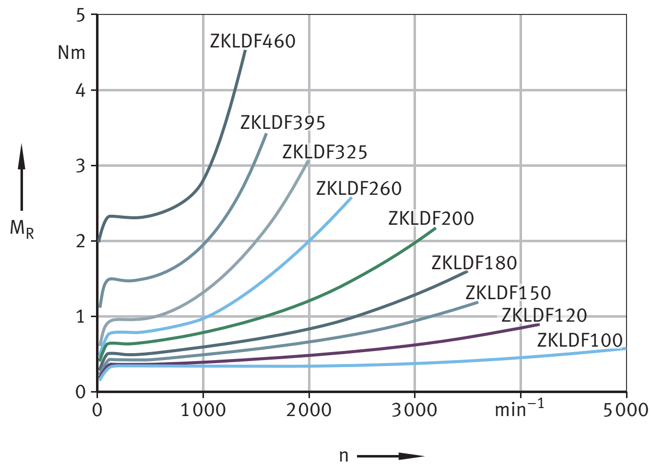
M_R	Nm	Frictional torque
n	min^{-1}	Speed

The guide values for the frictional torques for axial/radial bearings YRTS580-XL (21 Nm) and YRTS650-XL (42 Nm) were determined at a measurement speed n = 5 min^{-1}.

ZKLDF

The stated frictional torques M_R are statistically determined guide values for bearings with grease lubrication measured after a grease distribution cycle and at an operating temperature ϑ = +50 °C.

29 Frictional torques as guide values for ZKLDF, statistically determined values from series of measurements



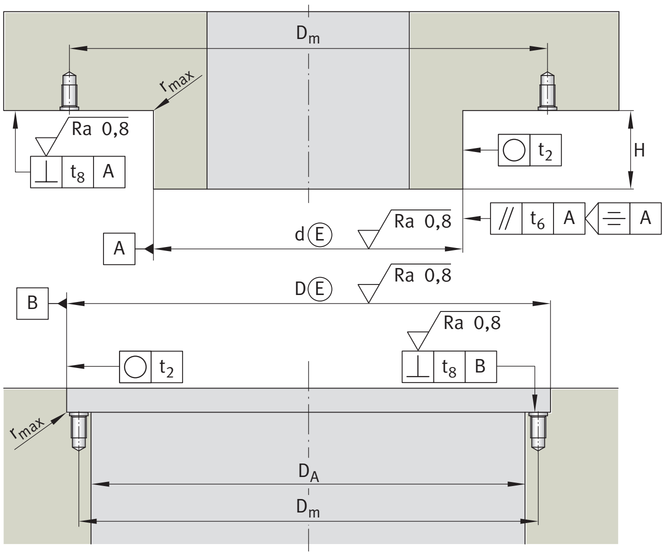
M_R	Nm	Frictional torque
n	min^{-1}	Speed

1.12 Design of the adjacent construction

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 accuracy requirement of the entire assembly.

Design adjacent construction in accordance with the requirements for the adjacent construction ➤32 | 30.

30 Requirements for the adjacent construction



001B6ADC

Maintain tolerances according to required geometrical and positional accuracy ➤35 | 1.12.6. Any deviations from the specified tolerances will influence the bearing frictional torque, running accuracy and running characteristics.

Select values for the maximum corner radii of the fit surfaces according to the required form and positional accuracy ➤35 | 13.

1.12.1 Fits

The selection of fits leads to transition fits, meaning that, depending on the actual dimension of the bearing diameter and mounting dimensions, either clearance fits or interference fits can arise.

The fit influences, for example, the running accuracy of the bearing and its dynamic characteristics. For easier matching of the adjacent construction to the actual dimensions, each bearing is supplied with a measurement record.

An excessively tight fit and the resulting increase in radial bearing preload can lead to the following disadvantages:

- Increased bearing friction, bearing temperature and stress on the raceway system, resulting in higher wear.
- Reduction in the achievable speed and service life.

1.12.2 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

! For very high running accuracy, the rotating bearing ring should ideally have a fit clearance of 0 and it should be ensured that the bearing has preload in operation.

1.12.3 Fit recommendations for shafts

If there are special requirements, the fit clearance must be further restricted within the stated tolerance zones.

Requirements for running accuracy

Where maximum running accuracy is required and the inner ring is rotating, the fit clearance should be as close as possible to 0. Otherwise, the fit clearance may increase the radial runout.

Requirements for dynamic characteristics

- For swivel-type operation ($n \cdot d_M < 35000\ min^{-1} \cdot mm$, duty cycle ED < 10 %) the shaft should be produced to tolerance class h5 Ⓔ.
- YRTC, ZKLDF: For higher speeds and longer duty cycles, the fit interference must not exceed 0,01 mm.
- YRTS: For higher speeds and longer duty cycles, the fit interference must not exceed 0,005 mm.
- ZKLDF: The fit dimension should be based on the inner ring with the smallest bore dimension in accordance with the measurement record supplied.

YRTA

The shaft should be produced to tolerance class h5 Ⓔ.

YRT, YRTC

The shaft should be produced to tolerance class h5 Ⓔ.

YRTS

11 Fit recommendation for shaft, series YRTS

Designation	d	$t_{\Delta dmp}$	
		U	L
	mm	mm	mm
YRTS200	200	–0,01	–0,024
YRTS260	260	–0,013	–0,029
YRTS325	325	–0,018	–0,036
YRTS395	395	–0,018	–0,036
YRTS460	460	–0,018	–0,038
YRTS580-XL	580	–0,02	–0,042
YRTS650-XL	650	–0,033	–0,058

d	mm	Bore diameter
$t_{\Delta dmp}$	mm	Deviation of the mean value of the bore diameter from the nominal size in accordance with ISO 492

U	mm	Upper limit deviation
L	mm	Lower limit deviation

ZKLDF

The shaft should be produced to tolerance class h5 Ⓔ.

1.12.4 Fit recommendations for housings

Requirements for running accuracy

Where maximum running accuracy is required and the outer ring is rotating, the fit clearance should be as close as possible to 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 ($n \cdot d_M$ < 35000 $min^{-1} \cdot mm$, duty cycle ED < 10 %) and a rotating bearing outer ring, the housing fit should be produced to tolerance class J6 Ⓔ.
- YRTS: For higher speeds and longer duty cycles, a thermal FE calculation of the assembly must be carried out.

YRTA

The housing should be produced to tolerance class J6 Ⓔ.

YRT, YRTC

The housing should be produced to tolerance class J6 Ⓔ.

YRTS

12 Fit recommendation for housing bore, series YRTS

Designation	D	$t_{\Delta Dmp}$	
		U	L
	mm	mm	mm
YRTS200	300	+0,011	–0,005
YRTS260	385	+0,013	–0,005
YRTS325	450	+0,015	–0,005
YRTS395	525	+0,017	–0,005
YRTS460	600	+0,017	–0,005
YRTS580-XL	750	+0,02	–0,005
YRTS650-XL	870	+0,024	–0,005

D	mm	Outside diameter
$t_{\Delta Dmp}$	mm	Deviation of the mean value of the outside diameter from the nominal size in accordance with ISO 492
U	mm	Upper limit deviation
L	mm	Lower limit deviation

! If thermal FE calculations of the assembly show a higher temperature at the shaft and bearing inner ring than at the bearing outer ring, it may be advantageous not to centre the bearing outer ring radially or to produce the housing fit as a clearance fit with at least 0,02 mm clearance. This will reduce the increase in preload that occurs where there is a temperature differential between the inner ring and outer ring of the bearing. However, if the temperature differential is too great, this may lead to overloading of the outer ring screw connections and the screw connection will start to slip. This may result in radial clearance in the bearing arrangement when the machine is cold.

If thermal FE calculations of the assembly at the bearing outer ring show an identical or higher temperature in relation to the inner ring, then the housing should be designed in accordance with the fit recommendations for the shaft and housing bore for YRTS.

ZKLDF

The housing should be produced to tolerance class J6 Ⓔ.

1.12.5 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 can be produced as stated. If the values in the table are used, this will give a transition fit with a tendency towards a clearance fit. This generally allows easy fitting.

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

1.12.6 Geometrical and positional accuracy of the adjacent construction

The values stated for the 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 assembly as well as the bearing frictional torque and the running characteristics.

13 Maximum undercut radius of fit surfaces for YRTA, YRTC, YRTS and ZKLDF

d		**r_a**
from	**up to**	**max.**
mm	**mm**	**mm**
50	200	0,1
200	580	0,3
460	1030	1

d	mm	Bore diameter
r_a	mm	Undercut radius

1

YRTA

14 Geometrical and positional accuracy for shafts for YRTA

Designation	t_2	t_6	t_8
	μm	μm	μm
YRTA150 ... YRTA200	9	5	9
YRTA260 ... YRTA460	12	7	12
YRTA580	13	7	13
YRTA650	15	8	15

t_2	μm	Roundness tolerance
t_6	μm	Parallelism tolerance
t_8	μm	Perpendicularity tolerance

15 Geometrical and positional accuracy for housings for YRTA

Designation	t_2	t_8
	μm	μm
YRTA150 ... YRTA200	9	9
YRTA260 ... YRTA460	12	12
YRTA580	13	13
YRTA650	15	15

t_2	μm	Roundness tolerance
t_8	μm	Perpendicularity tolerance

YRT, YRTC

16 Diameter tolerances and geometric tolerances for shafts for YRTC, tolerance class h5 Ⓔ

d				t_2	t_6	t_8
from	up to	U	L			
mm	mm	μm	μm	μm	μm	μm
50	80	0	–13	3	1,5	3
80	120	0	–15	4	2	4
120	180	0	–18	5	2,5	5
180	250	0	–20	7	3,5	7
250	315	0	–23	8	4	8
315	400	0	–25	9	4,5	9
400	500	0	–27	10	5	10
500	630	0	–32	11	5,5	11
630	800	0	–36	13	6,5	13
800	1000	0	–40	15	7,5	15
1000	1250	0	–47	18	9	18

d	mm	Bore diameter
U	mm	Upper limit deviation
L	mm	Lower limit deviation
t_2	μm	Roundness tolerance
t_6	μm	Parallelism tolerance
t_8	μm	Perpendicularity tolerance

17 Diameter tolerances and geometric tolerances for housings for YRTC, tolerance class J6 Ⓔ

D				t_2	t_8
from	up to	U	L		
mm	mm	μm	μm	μm	μm
120	180	+18	–7	5	5
180	250	+22	–7	7	7
250	315	+25	–7	8	8
315	400	+29	–7	9	9
400	500	+33	–7	10	10
500	630	+34	–10	11	11
630	800	+38	–12	13	13
800	1000	+44	–12	15	15
1000	1250	+52	–14	18	18

D	mm	Outside diameter
U	mm	Upper limit deviation
L	mm	Lower limit deviation
t_2	μm	Roundness tolerance
t_8	μm	Perpendicularity tolerance

YRTS

18 Geometrical and positional accuracy for shafts for YRTS

Designation	t_2	t_6	t_8
	μm	μm	μm
YRTS200	6	2,5	5
YRTS260 ... YRTS460	8	2,5	7
YRTS580-XL ... YRTS650-XL	10	4	10

t_2	μm	Roundness tolerance
t_6	μm	Parallelism tolerance
t_8	μm	Perpendicularity tolerance

19 Geometrical and positional accuracy for housings for YRTS

Designation	t_2	t_8
	μm	μm
YRTS200 ... YRTS460	6	8
YRTS580-XL ... YRTS650-XL	10	12

t_2	μm	Roundness tolerance
t_8	μm	Perpendicularity tolerance

ZKLDF

20 Diameter tolerances and geometric tolerances for shafts for ZKLDF, tolerance class h5 Ⓔ

d				t_2	t_6	t_8
from	up to	U	L			
mm	mm	μm	μm	μm	μm	μm
50	80	0	–13	3	1,5	3
80	120	0	–15	4	2	4
120	180	0	–18	5	2,5	5
180	250	0	–20	7	3,5	7
250	315	0	–23	8	4	8
315	400	0	–25	9	4,5	9

d				t_2	t_6	t_8
from	up to	U	L			
mm	mm	μm	μm	μm	μm	μm
400	500	0	–27	10	5	10
500	630	0	–32	11	5,5	11
630	800	0	–36	13	6,5	13
800	1000	0	–40	15	7,5	15
1000	1250	0	–47	18	9	18

d	mm	Bore diameter
U	mm	Upper limit deviation
L	mm	Lower limit deviation
t_2	μm	Roundness tolerance
t_6	μm	Parallelism tolerance
t_8	μm	Perpendicularity tolerance

21 Diameter tolerances and geometric tolerances for housings for ZKLDF, tolerance class J6 Ⓔ

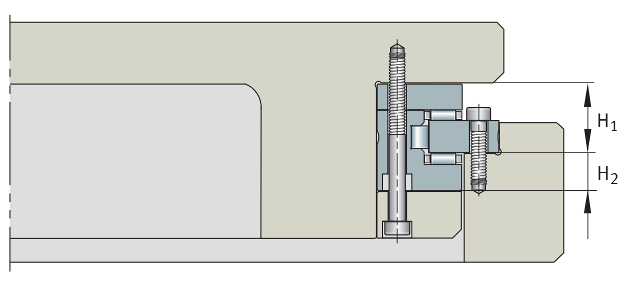
D				t_2	t_8
from	up to	U	L		
mm	mm	μm	μm	μm	μm
120	180	+18	–7	5	5
180	250	+22	–7	7	7
250	315	+25	–7	8	8
315	400	+29	–7	9	9
400	500	+33	–7	10	10
500	630	+34	–10	11	11
630	800	+38	–12	13	13
800	1000	+44	–12	15	15
1000	1250	+52	–14	18	18

D	mm	Outside diameter
U	mm	Upper limit deviation
L	mm	Lower limit deviation
t_2	μm	Roundness tolerance
t_8	μm	Perpendicularity tolerance

1.12.7 Mounting dimensions H_1, H_2

! If minimal variation in height is required, the H_1 dimensional tolerance must be observed. The mounting dimension H_2 defines the position of any worm wheel used.

31 Mounting dimension H_1, H_2



H_1	mm	Contact surface height, outer ring
H_2	mm	Contact surface height, outer ring

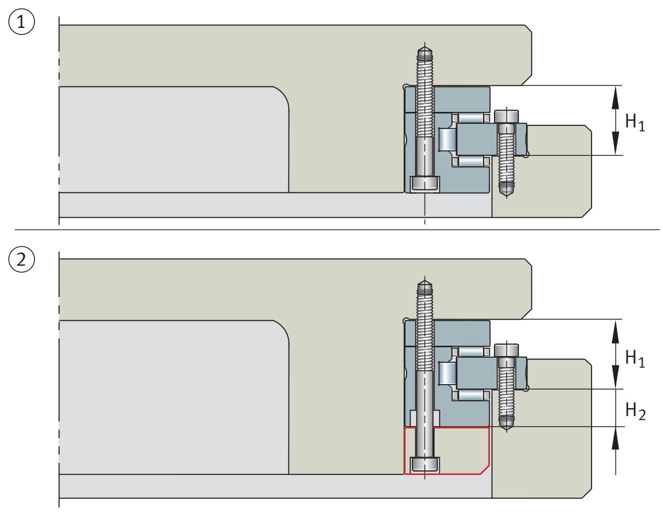
1.12.8 Unsupported or supported L-section ring

The outward-facing axial surfaces of the shaft-mounted bearing rings can be mounted with full-surface support on one or both sides. The support ring must be ordered separately.

For bearing series fitted with an L-section ring supported axially over its whole surface, there is an increase in axial rigidity in the direction of the support ring as a function of the support ring rigidity and in the tilting rigidity of the bearing position.

The shaft locating washer must be supported axially over its whole surface by the adjacent construction.

32 Mounting variants



1	Unsupported L-section ring YRTC	2	Supported L-section ring YRTC..-VSP

H_1	mm	Contact surface height, outer ring
H_2	mm	Contact surface height, outer ring

Any mounting variants that deviate from those suggested may impair the function and performance characteristics of the bearings. In case of deviating designs, please contact Schaeffler.

YRTA

Only one preload match exists for the series.

If the standard version of the series is fitted with a supported L-section ring, the frictional torque of the bearing will increase.

YRT, YRTC

A factory-defined preload match is required when fitting bearings with a supported L-section ring. In such cases, the suffix VSP must be specified.

If the standard version of the series is fitted with a supported L-section ring, the frictional torque of the bearing will increase.

The supported L-section ring must also be axially supported over its full surface in order to achieve the stated rigidity values.

! In the case of series YRTC, the height of the support ring should be at least equal to dimension H_2 of the bearing.

1

YRTS

Only one preload match exists for the series.

When fitting bearings with supported L-section rings, the increase in rigidity and frictional torque is minor and can generally be disregarded.

ZKLDF

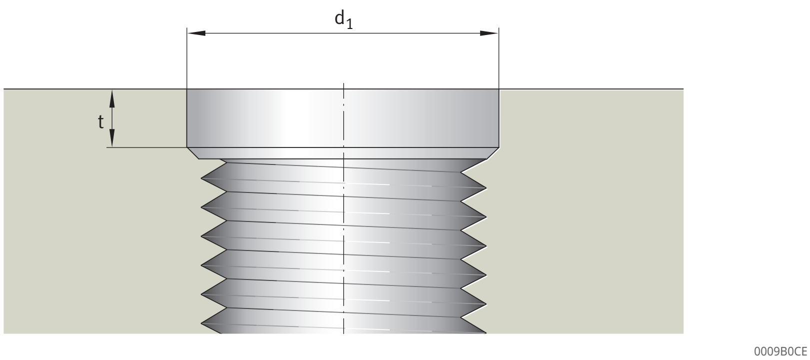
Only one preload match exists for the series.

When fitting bearings with supported L-section rings, the increase in rigidity and frictional torque is minor and can generally be disregarded.

1.12.9 Design of fixing threads in the adjacent construction

The threads in the adjacent construction must be designed with a cylindrical countersink to ensure the running accuracy of the bearings. If the cylindrical countersink is not applied, the surface may become deformed when the fixing screws are tightened.

33 Design of fixing threads in the adjacent construction



d_1	mm	Countersink diameter
t	mm	Countersink depth

22 Design of countersink

G	d_1	t
	mm	mm
M4	4,4	1
M5	5,5	1
M6	6,6	1
M8	8,8	1
M10	11	1
M12	13,2	1
M16	17,6	1

G	–	Thread
d_1	mm	Countersink diameter
t	mm	Countersink depth

1.13 Mounting and dismounting

Fixing holes in the bearing rings make these units very easy to fit.

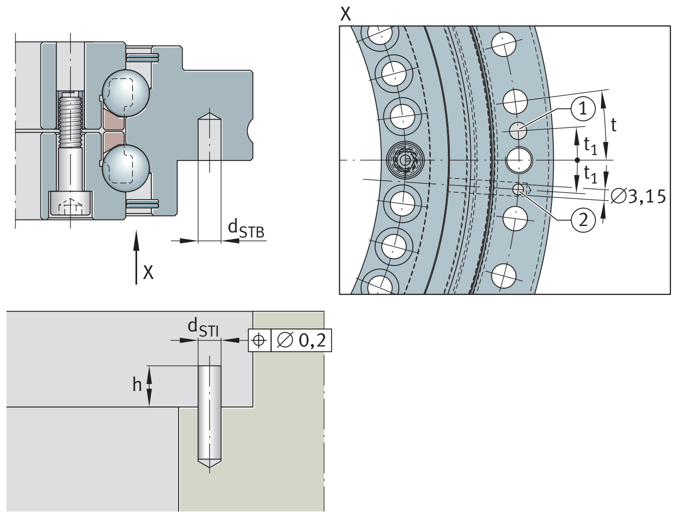
1

1.13.1 Improved ease of mounting

To ensure easy and error-free positioning of the lubrication hole in the bearing relative to the lubrication hole in the machine housing, the following bearing series are equipped with a pilot pin hole:

- YRTC580-XL to YRTC1030-XL
- YRTS
- ZKLDF

34 Improved ease of mounting with axial lubrication hole



1	Pilot pin hole for positioning of lubrication hole	2	Lubrication hole $t_1 = 0{,}5 \cdot t$

23 Pilot pin hole

d		h	d_{STI}	d_{STB}
from	up to	max.		min.
mm	mm	mm	mm	mm
–	460	4	4	5
460	580	6	6	8
580	–	8	8	10

d	mm	Bore diameter
h	mm	Pin height
d_{STI}	mm	Pin diameter
d_{STB}	mm	Pin hole

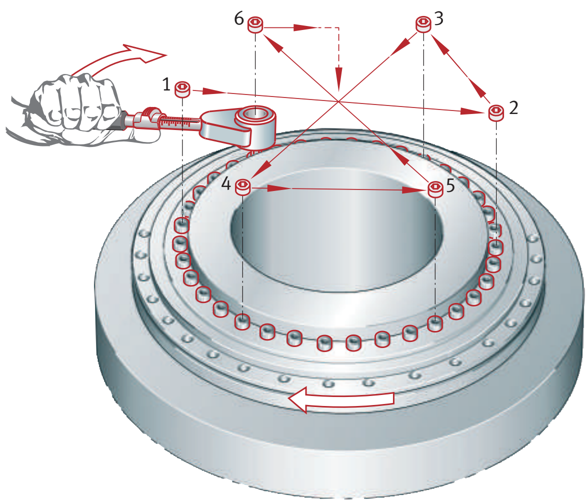
1.13.2 Mounting

Retaining screws secure the bearing parts for transport.

✓ Observe the strength class of the fixing screws.

1. Loosen the retaining screws before fitting in order to facilitate centring of the bearing.
2. Tighten the fixing screws in a crosswise sequence using a torque wrench to 40 % of the specified tightening torque M_A. For ZKLDF, rotate the bearing ring during this step.
3. Tighten the fixing screws in a crosswise sequence using a torque wrench to 70 % of the specified tightening torque M_A. For ZKLDF, rotate the bearing ring during this step.
4. Tighten the fixing screws in a crosswise sequence using a torque wrench to 100 % of the specified tightening torque M_A. For ZKLDF, rotate the bearing ring during this step.
5. After fitting, either secure or remove the retaining screws.

35 Tightening of fixing screws



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

! If the bearing is unusually difficult to move, loosen the fixing screws and re-tighten them in steps in a crosswise sequence to eliminate any stresses.

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

Further information

MON 100 | High-precision bearings for combined loads | https://www.schaeffler.de/std/2013

1.14 Further information

Further information can be found in the following publications:

HR 1 | Rolling Bearings | https://www.schaeffler.de/std/1D3D

MON 100 | High-precision bearings for combined loads | https://www.schaeffler.de/std/2013

1.15 Product tables

1.15.1 Explanations of the product tables

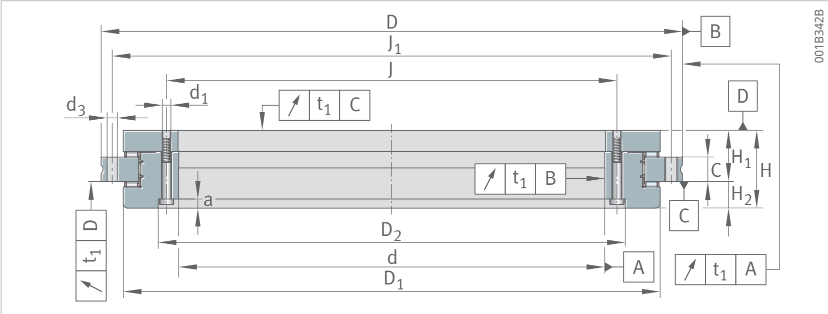
1	–	Two retaining screws
2	–	Screw counterbores in the L-section ring open to the bearing bore
3	–	Support surface, centring diameter
a	mm	Countersink depth
C	mm	Outer ring width
C_{0a}	N	Basic static load rating, axial
C_{0r}	N	Basic static load rating, radial
C_a	N	Basic dynamic load rating, axial
c_{aL}	N/μm	Axial rigidity of bearing position
c_{aW}	N/μm	Axial rigidity of rolling element set
c_{kL}	Nm/mrad	Tilting rigidity of bearing position
c_{kW}	Nm/mrad	Tilting rigidity of rolling element set
C_r	N	Basic dynamic load rating, radial
c_{rL}	N/μm	Radial rigidity of bearing position
c_{rW}	N/μm	Radial rigidity of rolling element set
d	mm	Bore diameter
D	mm	Outside diameter
d_1	mm	Diameter of fastening hole, inner ring
D_1	mm	Inner ring diameter
d_2	mm	Countersink diameter, fixing hole
D_2	mm	Diameter of undercut
d_3	mm	Diameter of fixing holes, outer ring
D_3	mm	Outside diameter
G	–	Extraction threads
H	mm	Height
H_1	mm	Contact surface height, outer ring
H_2	mm	Contact surface height, outer ring
J	mm	Pitch circle diameter of fixing holes, inner ring
J_1	mm	Pitch circle diameter of fixing holes, outer ring
m	kg	Mass
M_A	Nm	Tightening torque for fixing screws according to DIN EN ISO 4762, strength class 10.9
M_I	Nm	Tightening torque for inner ring screws according to DIN EN ISO 4762, strength class 10.9
M_R	Nm	Frictional torque
n	–	Number of screw mounting holes
n_A	–	Number of fixing screws, outer ring
n_G	min^{-1}	Limiting speed
n_{GA}	–	Number of extraction threads
n_I	–	Number of fixing screws, inner ring
t	°	Pitch angle of fixing holes

1

1.15.2 YRTA, main dimensions, performance data

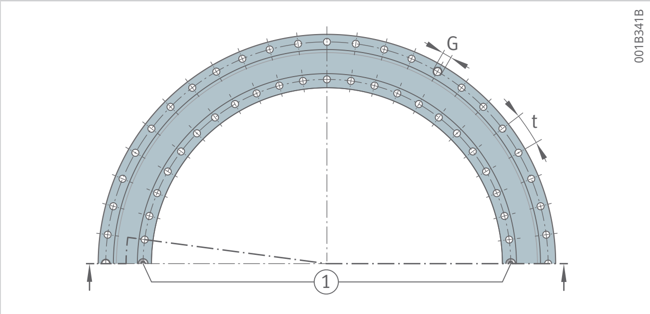
Double direction

For automation



YRTA

Designation	d	D	H	H_1	H_2	C	D_1 max.	J	J_1
–	mm	mm	mm	mm	mm	mm	mm	mm	mm
YRTA150	150	240	40	26	14	12	214	165	225
YRTA180	180	280	43	29	14	15	244	194	260
YRTA200	200	300	45	30	15	15	274	215	285
YRTA260	260	385	55	36,5	18,5	18	345	280	365
YRTA325	325	450	60	40	20	20	415	342	430
YRTA395	395	525	65	42,5	22,5	20	486	415	505
YRTA460	460	600	70	46	24	22	560	482	580
YRTA580	580	750	90	60	30	30	700	610	720
YRTA650	650	870	122	76	44	34	800	680	830



Hole pattern

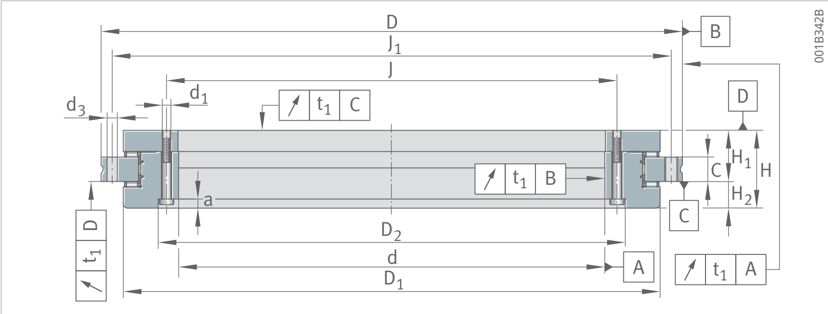
C_a	C_{0a}	C_r	C_{0r}	n_G	M_R
N	N	N	N	min^{-1}	Nm
113000	650000	23300	83000	210	8
119000	730000	24500	94000	190	9
130000	850000	28000	115000	170	11
149000	1090000	31500	147000	130	17
219000	1900000	46000	255000	110	24
234000	2190000	51000	305000	90	35
255000	2550000	55000	355000	80	45
510000	4450000	116000	720000	60	90
810000	6800000	119000	780000	55	105

1

1.15.3 YRTA, mounting dimensions, rigidity values

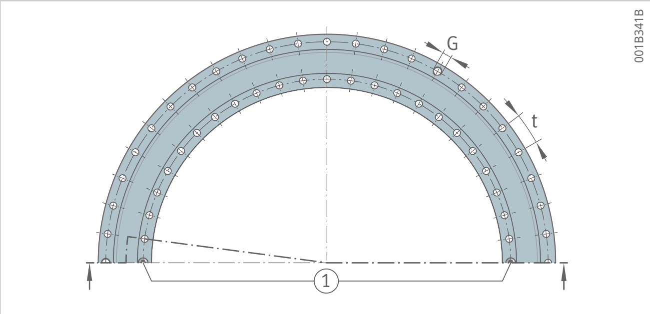
Double direction

For automation



YRTA

Designation	d_1	D_2	a	n_I	d_3	n_A	M_A
–	mm	mm	mm	–	mm	–	Nm
YRTA150	7	176,6	6,2	34	7	33	14
YRTA180	7	205,6	6,2	46	7	45	14
YRTA200	7	226,6	6,2	46	7	45	14
YRTA260	9,3	295,8	8,2	34	9,3	33	34
YRTA325	9,3	357,8	8,2	34	9,3	33	34
YRTA395	9,3	430,8	8,2	46	9,3	45	34
YRTA460	9,3	497,8	8,2	46	9,3	45	34
YRTA580	11,4	628	11	46	11,4	42	68
YRTA650	14	700	13	46	14	42	116



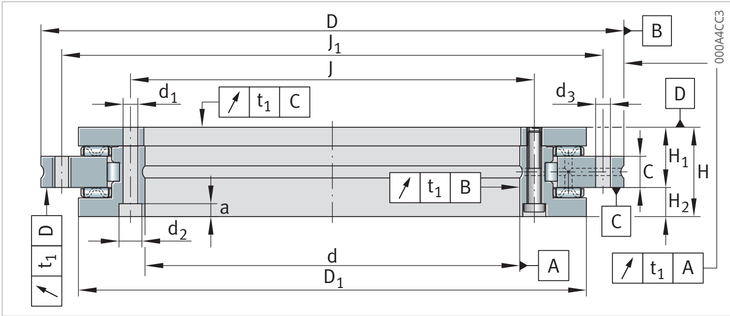
Hole pattern

n	t	G	n_{GA}	c_{aL}	c_{rL}	c_{kL}	c_{aW}	c_{rW}	c_{kW}
–	°	–	–	N/µm	N/µm	Nm/mrad	N/µm	N/µm	Nm/mrad
36	10	M8	3	3800	3200	18600	11100	6500	59000
48	7,5	M8	3	4700	3600	29000	13500	7700	80600
48	7,5	M8	3	4900	4100	40000	15500	10000	122000
36	10	M12	3	6900	5300	104000	19000	8500	244000
36	10	M12	3	7100	6300	159000	33000	20000	575000
48	7,5	M12	3	9900	5800	280000	37000	25000	909000
48	7,5	M12	3	12000	6500	429000	43000	30000	1420000
48	7,5	M12	6	11900	2900	735000	41800	37500	2570000
48	7,5	M12	6	20600	7300	1193000	52000	38500	3879000

1

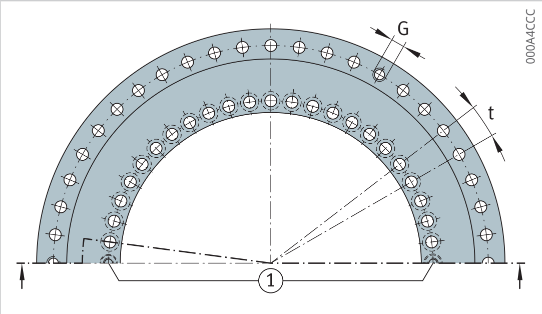
1.15.4 YRT, main dimensions, performance data

Double direction

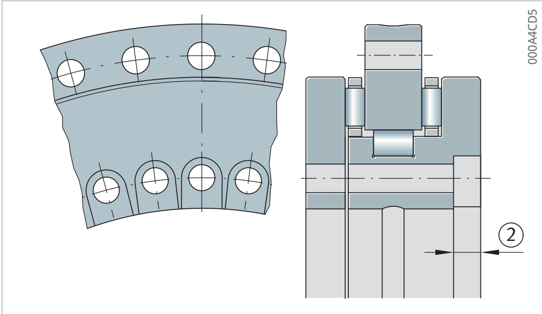


YRT

Designation	d	D	H	H_1	H_2	C	D_1 max.	J	J_1
–	mm	mm	mm	mm	mm	mm	mm	mm	mm
YRT50	50	126	30	20	10	10	105	63	116
YRT80-TV	80	146	35	23,35	11,65	12	130	92	138



Hole pattern



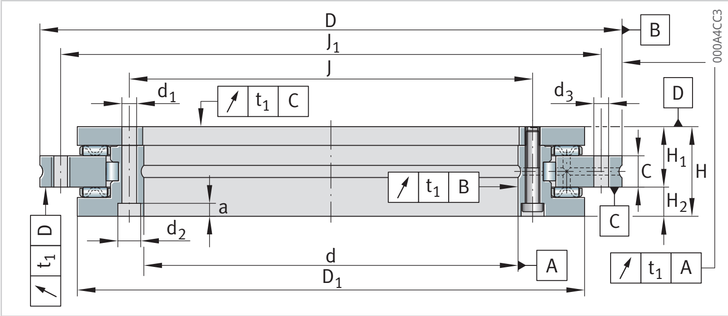
YRT80-TV

C_a	C_{0a}	C_r	C_{0r}	n_G	M_R	m
N	N	N	N	min^{-1}	Nm	kg
56000	280000	28500	49500	440	2,5	1,6
38000	158000	44000	98000	350	3	2,4

1

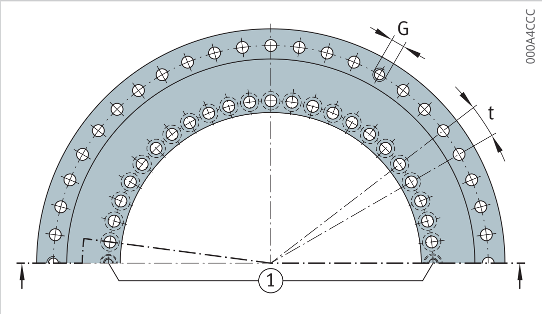
1.15.5 YRT, mounting dimensions, rigidity values

Double direction

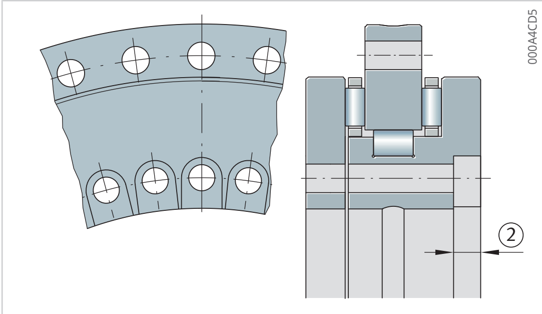


YRT

Designation	d_1	d_2	a	n_I	M_I	d_3	n_A	M_A
–	mm	mm	mm	–	Nm	mm	–	Nm
YRT50	5,6	–	–	10	–	5,6	12	8,5
YRT80-TV	5,6	10	4	10	4,5	4,6	12	8,5



Hole pattern

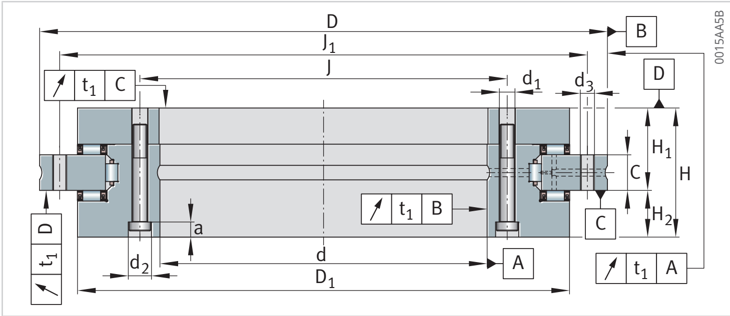


YRT80-TV

n	t	G	n_{GA}	c_{aL}	c_{rL}	c_{kL}	c_{aW}	c_{rW}	c_{kW}
–	°	–	–	N/μm	N/μm	Nm/mrad	N/μm	N/μm	Nm/mrad
12	30	–	–	1300	1100	1250	6200	1500	5900
12	30	–	–	1600	1800	2500	4000	2600	6300

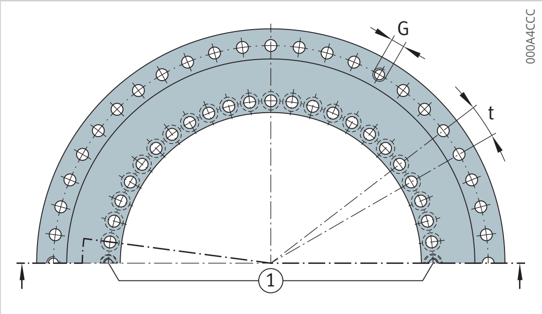
1.15.6 YRTC, main dimensions, performance data

Double direction



YRTC

Designation	d	D	H	H_1	H_2	C	D_1 max.	J	J_1
–	mm	mm	mm	mm	mm	mm	mm	mm	mm
YRTC100-XL	100	185	38	25	13	12	161	112	170
YRTC120-XL	120	210	40	26	14	12	185	135	195
YRTC150-XL	150	240	40	26	14	12	214,5	165	225
YRTC180-XL	180	280	43	29	14	15	245,1	194	260
YRTC200-XL	200	300	45	30	15	15	274,4	215	285
YRTC260-XL	260	385	55	36,5	18,5	18	347	280	365
YRTC325-XL	325	450	60	40	20	20	415,1	342	430
YRTC395-XL	395	525	65	42,5	22,5	20	487,7	415	505
YRTC460-XL	460	600	70	46	24	22	560,9	482	580
YRTC580-XL	580	750	90	60	30	30	700	610	720
YRTC650-XL	650	870	122	78	44	34	800	680	830
YRTC850-XL	850	1095	124	80,5	43,5	37	1018	890	1055
YRTC950-XL	950	1200	132	86	46	40	1130	990	1160
YRTC1030-XL	1030	1300	145	92,5	52,5	40	1215	1075	1255



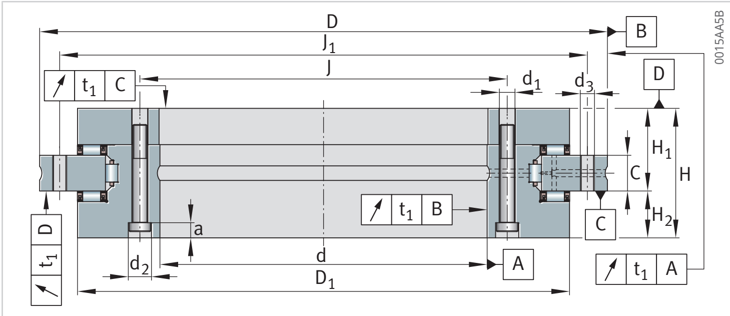
Hole pattern

C_a	C_{0a}	C_r	C_{0r}	n_G Continuous operation	n_G Swivel operation	M_R	m
N	N	N	N	min^{-1}	min^{-1}	Nm	kg
105000	455000	49500	88000	1200	–	2,5	3,65
112000	520000	69000	124000	900	–	4	4,61
128000	650000	74000	146000	800	–	4	5,4
134000	730000	100000	200000	600	–	5	7,2
147000	850000	123000	275000	450	–	6	9,2
168000	1090000	140000	355000	300	–	9	17,8
247000	1900000	183000	530000	200	–	13	24,7
265000	2190000	200000	640000	200	–	19	32,5
290000	2550000	265000	880000	150	–	25	45,2
580000	4450000	235000	730000	80	200	60	89
910000	6800000	455000	1300000	70	170	70	170
1020000	8500000	520000	1690000	50	125	130	253
1080000	9500000	550000	1890000	45	110	170	312
1140000	10300000	580000	2050000	40	100	250	375

1

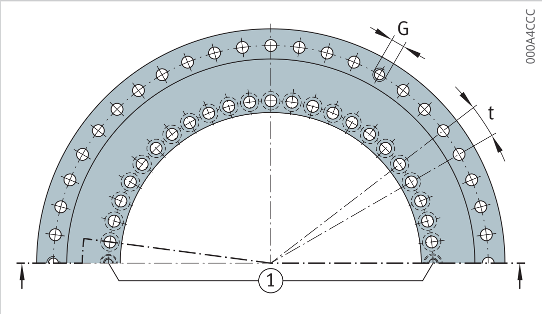
1.15.7 YRTC, mounting dimensions, rigidity values

Double direction



YRTC

Designation	d_1	d_2	a	n_I	d_3	n_A	M_A
–	mm	mm	mm	–	mm	–	Nm
YRTC100-XL	5,6	10	5,4	16	5,6	15	8,5
YRTC120-XL	7	11	6,2	22	7	21	14
YRTC150-XL	7	11	6,2	34	7	33	14
YRTC180-XL	7	11	6,2	46	7	45	14
YRTC200-XL	7	11	6,2	46	7	45	14
YRTC260-XL	9,3	15	8,2	34	9,3	33	34
YRTC325-XL	9,3	15	8,2	34	9,3	33	34
YRTC395-XL	9,3	15	8,2	46	9,3	45	34
YRTC460-XL	9,3	15	8,2	46	9,3	45	34
YRTC580-XL	11,4	18	11	46	11,4	42	68
YRTC650-XL	14	20	13	46	14	42	116
YRTC850-XL	18	26	17	58	18	54	284
YRTC950-XL	18	26	17	58	18	54	284
YRTC1030-XL	18	26	17	70	18	66	284



Hole pattern

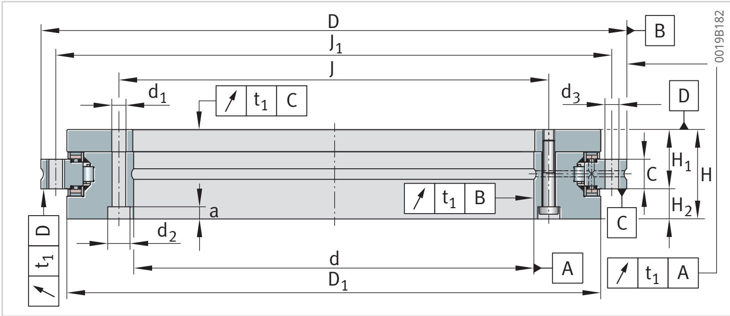
n	t	G	n_{GA}	c_{aL}	c_{rL}	c_{kL}	c_{aW}	c_{rW}	c_{kW}
–	°	–	–	N/μm	N/μm	Nm/mrad	N/μm	N/μm	Nm/mrad
18	20	M5	3	2650	2250	7500	8700	3700	23500
24	15	M8	3	2900	2600	11200	9800	4000	35500
36	10	M8	3	3800	3200	18600	12000	4800	61000
48	7,5	M8	3	4700	3600	29000	13500	5300	88500
48	7,5	M8	3	4900	4100	40000	15500	6200	128000
36	10	M12	3	6900	5300	104000	19000	8100	265000
36	10	M12	3	7100	6300	159000	33000	9900	633000
48	7,5	M12	3	9900	5800	280000	37000	13000	1002000
48	7,5	M12	3	12000	6500	429000	43000	17000	1543000
48	7,5	M12	6	11900	2900	735000	41800	11200	1960000
48	7,5	M12	6	20600	7300	1193000	51400	8200	3554000
60	6	M12	6	26500	11900	2351000	61900	12000	6772000
60	6	M12	6	31300	13800	3313000	72700	17900	11494000
72	5	M16	6	36400	11200	5400000	74900	14200	11165000

1

1.15.8 YRTS, main dimensions, performance data

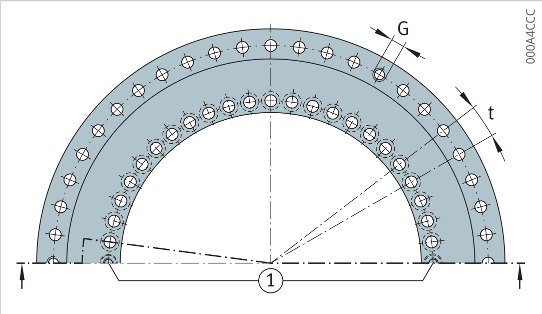
Double direction

For higher speeds

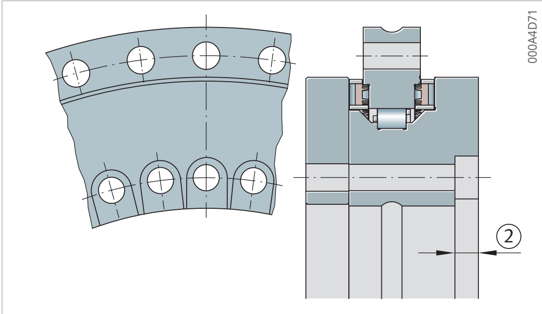


YRTS

Designation	d	D	H	H_1	H_2	C	D_1 max.	J	J_1
–	mm	mm	mm	mm	mm	mm	mm	mm	mm
YRTS200	200	300	45	30	15	15	274,4	215	285
YRTS260	260	385	55	36,5	18,5	18	347	280	365
YRTS325	325	450	60	40	20	20	415,1	342	430
YRTS395	395	525	65	42,5	22,5	20	487,7	415	505
YRTS460	460	600	70	46	24	22	560,9	482	580
YRTS580-XL	580	750	90	60	30	30	700	610	720
YRTS650-XL	650	870	122	78	44	34	800	680	830



Hole pattern



Countersunk screw holes for YRTS325

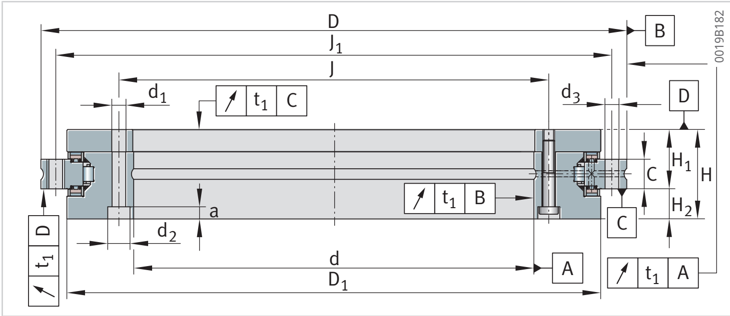
C_a	C_{0a}	C_r	C_{0r}	n_G	m
N	N	N	N	min^{-1}	kg
155000	840000	94000	226000	1160	9,7
173000	1050000	110000	305000	910	18,3
191000	1260000	109000	320000	760	25
214000	1540000	121000	390000	650	33
221000	1690000	168000	570000	560	45
590000	4050000	255000	820000	350	84
980000	6500000	480000	1390000	300	161

1

1.15.9 YRTS, mounting dimensions, rigidity values

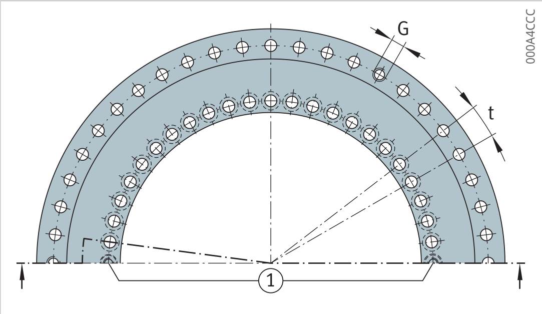
Double direction

For higher speeds

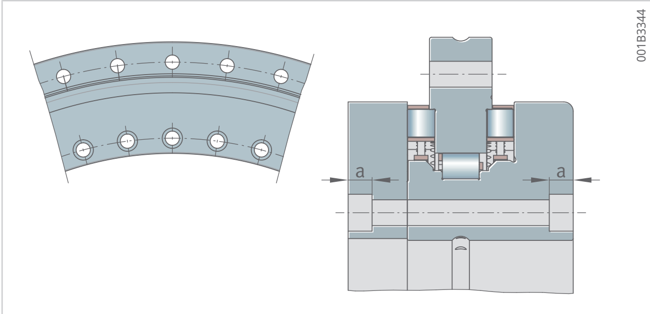


YRTS

Designation	d_1	d_2	a	n_I	d_3	n_A	M_A
–	mm	mm	mm	–	mm	–	Nm
YRTS200	7	11	6,2	46	7	45	14
YRTS260	9,3	15	8,2	34	9,3	33	34
YRTS325	9,3	15	8,2	34	9,3	33	34
YRTS395	9,3	15	8,2	46	9,3	45	34
YRTS460	9,3	15	8,2	46	9,3	45	34
YRTS580-XL	11,4	18	11	46	11,4	42	68
YRTS650-XL	14	20	13	46	14	42	116



Hole pattern



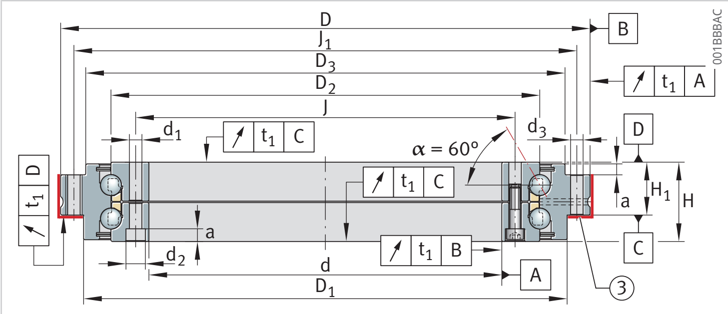
Countersunk screw holes for YRTS580-XL, YRTS650-XL

n	t	G	n_{GA}	c_{aL}	c_{rL}	c_{kL}	c_{aW}	c_{rW}	c_{kW}
–	°	–	–	N/µm	N/µm	Nm/mrad	N/µm	N/µm	Nm/mrad
48	7,5	M8	3	4000	1200	29000	13600	3900	101000
36	10	M12	3	5400	1600	67000	16800	5800	201000
36	10	M12	3	6600	1800	115000	19900	7100	350000
48	7,5	M12	3	7800	2000	195000	23400	8700	582000
48	7,5	M12	3	8900	1800	280000	25400	9500	843000
48	7,5	M12	6	9100	10100	533000	34300	12500	2000000
48	7,5	M12	6	12100	7800	975000	42850	12500	3333000

1

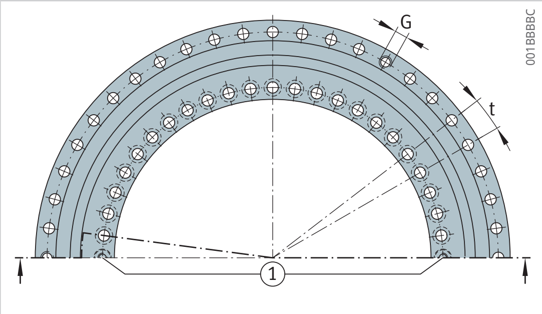
1.15.10 ZKLDF, main dimensions, performance data

Double direction

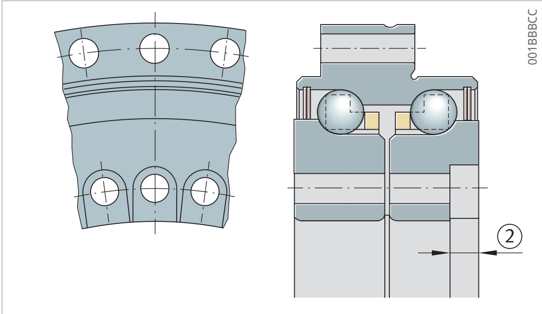


ZKLDF

Designation	d	D	H	H_1	D_1	D_2	D_3	J	J_1
–	mm	mm	mm	mm	mm	mm	mm	mm	mm
ZKLDF100	100	185	38	25	161	136	158	112	170
ZKLDF120	120	210	40	26	185	159	181	135	195
ZKLDF150	150	240	40	26	214	188	211	165	225
ZKLDF180	180	280	43	29	244	219	246	194	260
ZKLDF200	200	300	45	30	274	243	271	215	285
ZKLDF260	260	385	55	36,5	345	313	348	280	365
ZKLDF325	325	450	60	40	415	380	413	342	430
ZKLDF395	395	525	65	42,5	486	450	488	415	505
ZKLDF460	460	600	70	46	560	520	563	482	580



Hole pattern



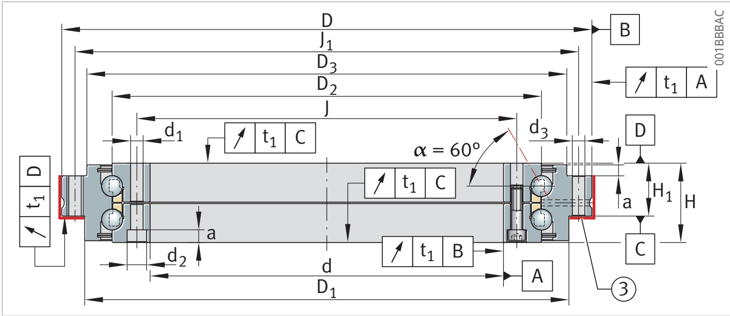
ZKLDF100, ZKLDF325

C_a	C_{0a}	C_{ua}	n_G	M_R	m
N	N	N	min^{-1}	Nm	kg
71000	265000	10300	5000	–	3,8
76000	315000	11500	4300	–	4,8
81000	380000	12600	3600	–	5,6
85000	440000	13500	3500	–	7,7
121000	610000	17900	3200	–	10
162000	920000	23800	2400	–	19
172000	1110000	26000	2000	–	25
241000	1580000	34000	1600	–	33
255000	1860000	37000	1400	–	47

1

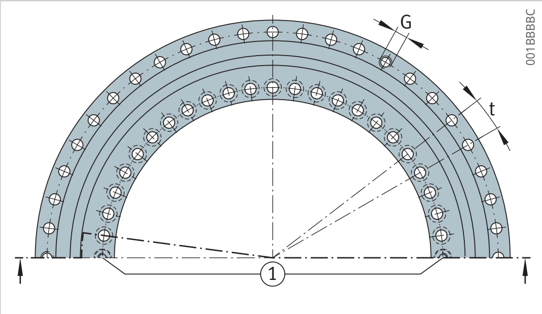
1.15.11 ZKLDF, mounting dimensions, rigidity values

Double direction

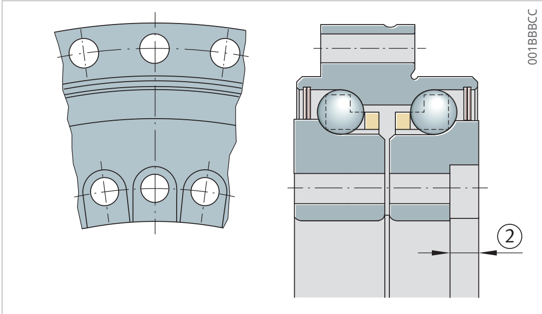


ZKLDF

Designation	d_1	d_2	a	n_I	d_3	n_A	M_A
–	mm	mm	mm	–	mm	–	Nm
ZKLDF100	5,6	10	5,4	16	5,6	15	8,5
ZKLDF120	7	11	6,2	22	7	21	14
ZKLDF150	7	11	6,2	34	7	33	14
ZKLDF180	7	11	6,2	46	7	45	14
ZKLDF200	7	11	6,2	46	7	45	14
ZKLDF260	9,3	15	8,2	34	9,3	33	34
ZKLDF325	9,3	15	8,2	34	9,3	33	34
ZKLDF395	9,3	15	8,2	46	9,3	45	34
ZKLDF460	9,3	15	8,2	46	9,3	45	34



Hole pattern



ZKLDF100, ZKLDF325

n	t	G	n_{GA}	c_{aL}	c_{rL}	c_{kL}	c_{aW}	c_{rW}	c_{kW}
–	°	–	–	N/μm	N/μm	Nm/mrad	N/μm	N/μm	Nm/mrad
18	20	M5	3	1200	350	3600	2200	350	5000
24	15	M8	3	1500	400	5500	2500	400	8000
36	10	M8	3	1700	400	7800	2900	400	12000
48	7,5	M8	3	1900	500	10700	2800	500	16000
48	7,5	M8	3	2500	600	17500	3700	600	26000
36	10	M12	3	3200	700	40000	4700	700	54000
36	10	M12	3	4000	800	60000	5400	800	90000
48	7,5	M12	3	4500	900	100000	6300	900	148000
48	7,5	M12	3	5300	1100	175000	7100	1100	223000

2

2 Axial/radial bearings with incremental angular measuring system

The bearing-integrated angular measuring system is intended for use in electrically driven, position-controlled machine tool axes for the purpose of recording actual angular values. It consists of the measuring system bearing and the measuring head.

Advantages of the integrated angular measuring system

- very good control characteristics (high control stability and high dynamics) due to the rigid mechanical connection to the adjacent construction
- extremely high system accuracies achieved with a single measuring head due to the use of precision components
- hollow shaft design; the centre of the axis is freely available for additional components
- non-contact and wear-free
- measurement unaffected by tilting or position
- unaffected by oils, greases, cooling lubricants and magnets
- easy to mount as adjustment of the measurement gap is not required
- no need for alignment of the bearing and a separate measuring system
- no additional mounting parts required; the resulting space saved can be used for the machine working area
- saves on components, overall design envelope and costs due to the compact, integrated design requiring fewer components
- compatible with all standard measuring system interfaces
- reference search run is not required with absolute measuring systems
- incremental measuring systems are electronically compatible with all common machine tool controllers

Advantages of the measuring system bearing

- very high tilting rigidity
- very low frictional torque
- high mechanical limiting speeds possible
- low heat generation in continuous operation
- maximum positioning accuracy achievable

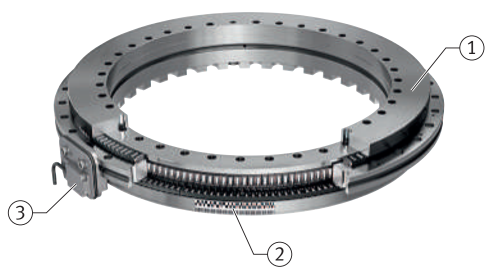
2.1 Bearing design

YRTCMA, YRTSMA

Axial/radial bearings YRTCMA and YRTSMA correspond in mechanical terms to series YRTC and YRTS, but are additionally equipped with an absolute angular measuring system.

The bearing-integrated angular measuring system consists of a measuring system bearing with a measurement ring mounted on the inner ring and the measuring head MHA, which is directly screw mounted onto the bearing outer ring of the respective measuring system bearing.

36 Bearing-integrated inductive measuring system, absolute



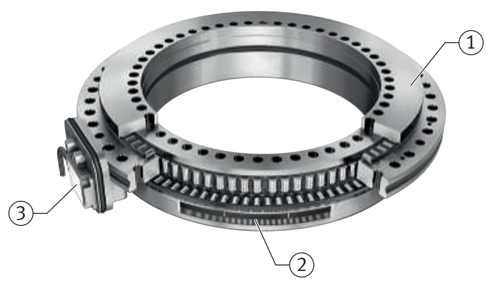
1	YRTCMA	2	Measurement ring
3	Measuring head MHA-0		

YRTCMI

Axial/radial bearings YRTCMI correspond mechanically to series YRTC, but are additionally equipped with an incremental angular measuring system.

The bearing-integrated angular measuring system consists of a measuring system bearing with a measurement ring mounted on the inner ring and the measuring head MHI, which is directly screw mounted onto the bearing outer ring of the respective measuring system bearing.

37 Bearing-integrated inductive measuring system, incremental



1	YRTCMI	2	Measurement ring
3	Measuring head MHI-0		

2.2 Integrated angular measuring system

The bearing-integrated angular measuring system is intended for use in electrically driven, position-controlled machine tool axes for the purpose of recording actual angular values. It consists of the measuring system bearing and the measuring head.

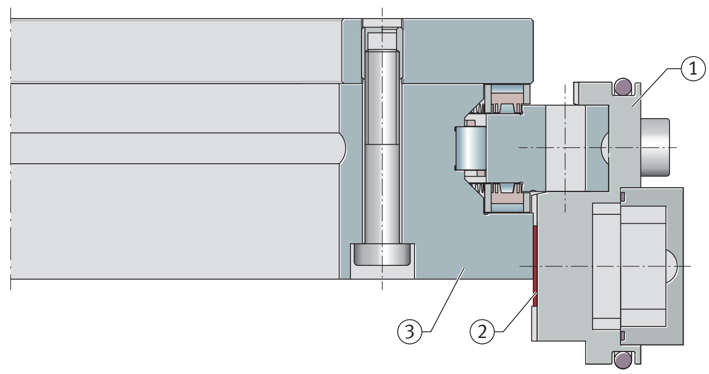
2.2.1 Measuring heads

The measuring head works according to the AMOSIN® measuring principle. The measuring head contains the primary and secondary coils for inductive scanning of the measurement ring, the electronic measuring head system, interfaces, line drivers and a cable with plug connector. AMOSIN® is a trademark of AMO GmbH.

The measuring heads can be screwed directly onto the respective outer ring of the measuring system bearing.

For YRTCMA, YRTSMA and YRTCMI, measuring heads are available in both radial screw mounting and axial screw mounting variants.

38 Absolute value angular measuring system



1	Measuring head	2	Measurement ring
3	Inner ring of axial/radial bearing		

The electronic evaluation system is integrated into the measuring head, allowing the system to be connected directly to the controller. The measuring head is configured such that no adjustment of the measurement gap is required and the rolling bearing chamber is protected against the egress and ingress of lubricants and other media. Other measuring head designs are available by agreement.

Radial measuring head MHA-0, MHI-0

In the variant suitable for radial screw mounting on the outer ring, no adjustment of the measurement gap is required and accessibility is very good. As a result, the time spent on mounting work is reduced.

39 Radial measuring head MHA-0

00194971

Axial measuring head MHA-2, MHI-2

In the variant suitable for axial screw mounting on the bearing outer ring, adjustment of the measurement gap is required. The axial measuring head is smaller than the radial measuring head.

40 Axial measuring head MHA-2

00194991

2.2.2 Operating principle

The AMOSIN® operating principle for scanning the angular pitch works on an inductive and non-contact basis. The planar coil structure built into the measuring head is unique and consists of multiple coil units arranged in a line in the direction of measurement, which in turn are composed of primary and secondary coils arranged on top of each other.

As a result of manufacturing the sensor unit on a flexible substrate using multilayer technology, the curvature of the coil structure is matched to the curvature of the measurement rings.

To perform inductive scanning of the measurement ring, the primary coils are excited with a high-frequency alternating voltage, generating alternating electromagnetic fields around the primary windings. These alternating electromagnetic fields are damped by the webs in the measurement ring and not damped by the gaps.

For the measurement ring attached to the inner ring with a rotation facility, the following applies: The inductive coupling factor between the primary and secondary coils is influenced and modulated with the movement of the measurement ring relative to the measuring head. A lower or higher alternating current is induced in the secondary windings depending on whether webs or gaps are facing the secondary coils. The positional value in the measuring head is determined from these differently modulated voltages.

Determination of position with absolute angular measuring systems MHA

In absolute measuring systems, an angular pitch with absolute coding and an angular pitch with incremental coding are arranged on the measurement rings in a circumferential direction. Both angular pitches are scanned by dedicated primary and secondary coils.

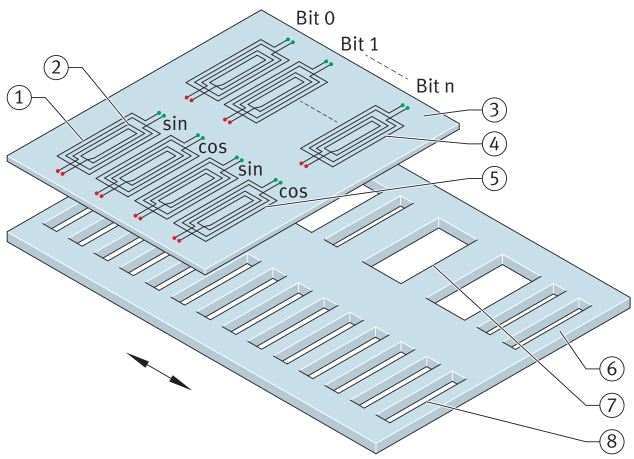
Immediately after the operating voltage is switched on, all primary coils are excited by alternating voltage. This leads to the generation of a unique bit pattern in the absolute secondary coils, from which the absolute angular position is determined by the measuring head for each pitch period.

SIN-COS-modulated voltages are also generated in the incremental secondary coils, on the basis of which exact positions are determined and more finely resolved within a pitch period.

The absolute actual angular position is calculated from the angular position per absolute pitch period and the high-resolution angular position within the incremental pitch period.

This actual angular position is transmitted to the controller via the serial data interface.

41 Operating principle of inductive, absolute AMOSIN® angular measuring systems



1	Primary windings	2	Secondary windings
3	Sensor substrate, micro coils	4	Absolute scanning
5	Incremental scanning	6	Measurement ring
7	Angular pitch with absolute coding	8	Angular pitch with incremental coding

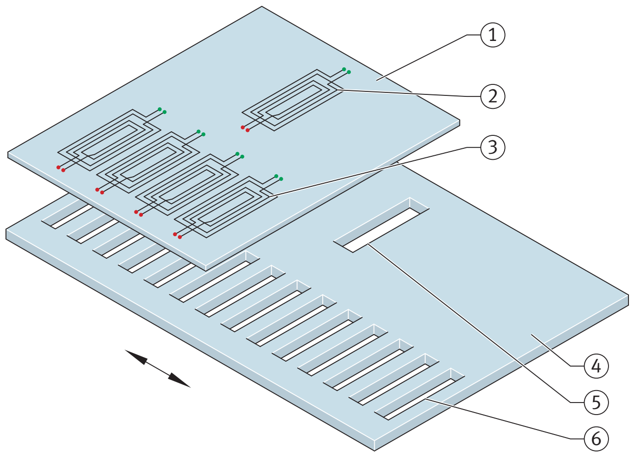
Determination of position with incremental angular measuring systems MHI

In incremental measuring systems, an angular pitch with incremental coding and several pitch-coded reference marks are arranged on the measurement rings in a circumferential direction. These two structures are scanned using dedicated primary and secondary coils.

Immediately after the operating voltage is switched on, all primary coils are excited by alternating voltage. As a result, SIN-COS-modulated voltages are generated in the incremental secondary coils, which are transmitted to the controller as analogue SIN-COS voltage signals. In the controller, the analogue voltage signals undergo A/D conversion and higher interpolation to generate the current incremental actual angular position.

The pitch-coded reference marks are scanned using the reference mark scanning movement. This requires a search run, during which the controller passes over at least two reference marks in order to determine the absolute actual angular position.

42 Operating principle of inductive, incremental AMOSIN® angular measuring systems



1	Sensor substrate, micro coils	2	Reference mark scanning
3	Incremental scanning	4	Measurement ring
5	Reference mark	6	Incremental angular pitch

2.2.3 Electronic interfaces

Absolute interface EnDat 2.2

The EnDat 2.2 interface is a digital, bidirectional interface for measuring devices. It is able to output positional values as well as read out and update information stored in the measuring device, or store new information. Due to the serial transmission of data, four signal lines are sufficient.

The data DATA are transmitted synchronously with the CLOCK signal provided by the electronic post-processor.

No analogue 1 Vpp signals are output in addition to the EnDat 2.2 command set.

The achievable clock frequency is determined by the length of the cable. With running time compensation in the electronic post-processor, clock frequencies of up to 16 MHz and cable lengths up to a maximum of 100 m are possible.

However, transmission frequencies up to 16 MHz in combination with long cable lengths place high technical demands on the cable.

Longer cable lengths are achieved with the 1 m-long measuring head and an extension cable. As a general rule, the entire transmission path must be designed for the respective clock frequency. For this reason, the sole use of extension cables specified and approved for the measuring system is recommended. Any interruptions in the signal line, due to slip rings for example, should also be avoided.

The digital interface is compatible with the following controllers:

- Heidenhain TNC 640
- Siemens Sinumerik 840D sl via the Siemens sensor module SMC40 from firmware versions 4,5 and 4,6

The measuring systems are self-configuring. No parameters specific to the measuring system have to be entered into the controller.

2

Absolute interface DRIVE-CLiQ®

The DRIVE-CLiQ® interface is a digital, bidirectional interface for measuring devices. It is able to output positional values as well as read out and update information stored in the measuring device, or store new information. Due to the serial transmission of data, four signal lines are sufficient.

The data DATA are transmitted synchronously with the CLOCK signal provided by the electronic post-processor.

Longer cable lengths are achieved with the 1 m-long measuring head and an extension cable. As a general rule, the entire transmission path must be designed for the respective clock frequency. For this reason, the sole use of extension cables specified and approved for the measuring system is recommended. Any interruptions in the signal line, due to slip rings for example, should also be avoided.

The digital interface is compatible with the following controllers:

- Siemens Sinumerik 840D sl

The measuring systems are self-configuring. No parameters specific to the measuring system have to be entered into the controller.

Absolute interface FANUC αi

The Fanuc05 interface (interface version High Resolution Type B) is a serial, digital interface used for outputting absolute positional values.

The data DATA are transmitted synchronously with the CLOCK signal provided by the electronic post-processor.

The measuring systems are not self-configuring, therefore parameters specific to the measuring system have to be entered into the controller.

Absolute interface SSI+1Vss

The SSI interface is a serial, digital interface for outputting absolute positional values.

The measuring system outputs two analogue voltage signals, SIN and COS, via the incremental 1 Vpp interface which can be highly interpolated in the electronic post-processor.

The sinusoidal incremental signals SIN and COS have an electrical phase-offset of 90° and a nominal amplitude of 1 V_{pp}.

The data DATA are transmitted synchronously with the CLOCK signal provided by the electronic post-processor.

In addition, 3 places are available for special bits (Error, Warning,Parity), where the Warning bit is inactive and constantly at 0. If an internal error is detected in the measuring head, the error bit is set to 1.

The SSI+1Vss interface is compatible with the following controllers via the sensor modules SMC20, SMC30, SME25 and SME125 from firmware version 2,4:

- Siemens Sinumerik 840D sl
- Siemens Sinamics S120

Incremental interface SIN COS 1Vss + REF

The measuring system outputs two analogue voltage signals, SIN and COS, via the incremental 1 Vpp interface which can be highly interpolated in the electronic post-processor, as well as a pitch-coded reference signal REF.

The sinusoidal incremental signals SIN and COS have an electrical phase-offset of 90° and a nominal amplitude of 1 V_{pp}.

The SIN COS interface is compatible with the following controllers via the sensor modules SMC20, SME20 and SME120:

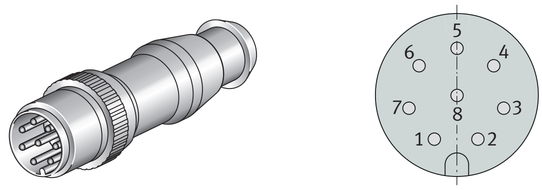
- Siemens Sinumerik 840D sl
- Siemens Sinamics S120

The incremental measuring systems SIN COS 1Vss are not self-configuring, therefore the parameters which are specific to the measuring system have to be entered into the controller and are made available to the user on request.

2.2.4 Connector assignment for interfaces

EnDat 2.2, DRIVE-CLiQ®, FANUC αi

43 Plug connection interface



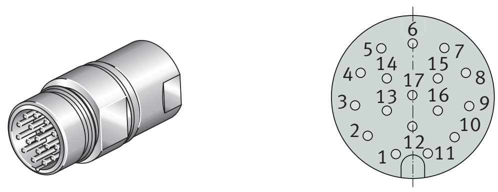
00192B60

24 Connector assignment

Parameters	Signal designation	PIN	Cable colour
Power supply	Up	8	Green/brown
	Sensor Up	2	Blue
	0 V	5	Green/white
	Sensor 0 V	1	White
Signals for absolute positional value	DATA+	3	Grey
	DATA–	4	Pink
	CLOCK+	7	Purple
	CLOCK–	6	Yellow

SSI+1Vss

44 Plug connection interface



00192B5D

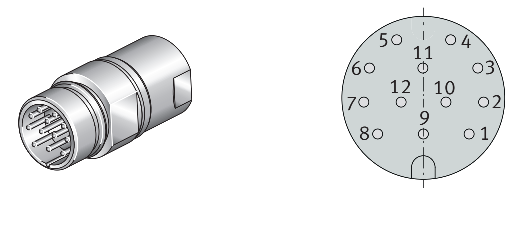
25 Connector assignment

Parameters	Signal designation	PIN	Cable colour
Power supply	Up	7	Green/brown
	Sensor Up	1	Blue
	0 V	10	Green/white
	Sensor 0 V	4	White

Parameters	Signal designation	PIN	Cable colour
Incremental signals	A+	15	Brown
	A-	16	Green
	B+	12	Grey
	B-	13	Pink
Signals for absolute positional value	DATA+	14	Red
	DATA–	17	Black
	CLOCK+	8	Violet
	CLOCK–	9	Yellow

SIN COS 1Vss + REF

45 Plug connection interface SIN COS 1Vss + REF



26 Connector assignment

Parameters	Signal designation	PIN	Cable colour
Power supply	Up	12	Green/brown
	Sensor Up	2	Blue
	0 V	10	Green/white
	Sensor 0 V	11	White
Output signals	A+	5	Brown
	A-	6	Green
	B+	8	Grey
	B-	1	Pink
	REF+	3	Red
	REF-	4	Black
Other signals	Diag+	7	Violet
	Diag–	9s	Yellow

2.2.5 Functional safety

The angular measuring systems with digital electronic interfaces EnDat 2.2, DRIVE-CLiQ® and with the analogue interface SIN COS 1Vss are intended for positional determination on rotary axes in applications with a safety focus. These angular measuring systems can be used under normal conditions and in authorised operation for safety-related positioning control loops in applications with a safety focus to IEC 61508 and DIN EN ISO 13849-1.

In addition to the electronic interface, the mechanical connection of the measuring device to the drive also has safety implications. In many cases, an error exclusion must be demonstrated for the loosening of mechanical connections, as such errors cannot necessarily be detected by the controller.

According to standard DIN EN 61800-5-2:2017, Table D.8, Electrical power drive systems with adjustable speed, loosening of the mechanical connection between the measuring system and the drive is listed as an error case that must be considered.

In order to be able to use the angular measuring system in a safety-focussed application, the user must use a suitable controller. The fundamental task of the controller is to communicate with the measuring system and reliably evaluate the measuring system data. For safety-related analyses of the entire system, safety parameters for the angular measuring systems, as well as error lists and error exclusions for motion sensors and position feedback sensors, in accordance with DIN EN 61800-5-2:2017, Table D.8, are available on request.

Responsibilities of the angular measuring system user

- correct implementation, on the machine side, of signal monitoring for digital interfaces and the SIN COS 1Vss analogue interface in accordance with safety integrity, e.g. specification and implementation of the evaluation circuit and evaluation logic.
- Evaluation of the safety integrity of the measuring system in its application environment, based on the technical data provided, e.g. MTTFd.
- Correct design, on the application side, of the adjacent construction of the measuring system bearing in accordance with the design specifications.
- Correct fitting and assembly of the measuring system bearing in accordance with the mounting manual.
- Correct fitting and assembly of the measuring head in accordance with the mounting manual.

Documentation for the intended use of the angular measuring system

- product information
- design specifications
- mounting instructions
- safety parameters of the angular measuring system
- error lists and error exclusions for motion sensors and position feedback sensors
- CE Declaration of Conformity (by agreement)
- specification of a reliable controller from the respective controller manufacturer
- datasheet for encoder system connection to sensor module

2.2.6 Structure of the ordering designation

MHA

46 Structure of the ordering designation for absolute measuring head MHA

MHA 325 – 0 – 0 – 1 – 4 – 0 – 1302 – 01,0M – 7 – 1 – A

Designation

MHA	Measuring head with integrated absolute value angular measuring system

Type

150 ... 1030	Matched to bearing types with bore diameters (150, 180, 200, 260, 325, 395, 460, 580, 650, 850, 950, 1030)

Mechanical variant

0	Suitable for radial screw mounting
2	Suitable for axial screw mounting

Electronic interface

0	SSI+1Vpp
2	DRIVE-CLiQ® (DQ)
7	Fanuc05 (FANUC αi)
6	EnDat 2.2

Absolute resolution per pitch period

1	10 bit (SSI+1Vpp)
3	14 bit (EnDat 2.2, FANUC αi, DQ)

Maximum input frequency

4	20 kHz (standard)

Absolute resolution per pitch period

0	Factor 1 (not subdivided) for SSI
N	EnDat 2.2, FANUC αi, DQ

Pitch periods, 360°

0672	For MHA150
0768	For MHA180
0860	For MHA200
1088	For MHA260
1302	For MHA325
1530	For MHA395
1760	For MHA460
2196	For MHA580
2508	For MHA650
3200	For MHA850
3540	For MHA950
3808	For MHA1030

Cable length in m

1	Standard

Electrical connection

7	17-pin M23 coupling, pin for SSI +1Vpp
8	8-pin M12 coupling, pin for EnDat 2.2, 7 Fanuc05 (FANUC αi), DQ

Direction of cable connection

1	Left (standard)

Circuit version

A	–

MHI

47 Structure of the ordering designation for incremental measuring head MHI

MHI 325 – 0 – 1 – 1 – 1 – 1302 – 01,0M – 1 – 1 – A

Designation

MHI	Measuring head with integrated incremental angular measuring system

Type

180 ... 460	Matched to bearing types with bore diameters (180, 200, 260, 325, 395, 460)

Mechanical variant

0	Suitable for radial screw mounting
2	Suitable for axial screw mounting

Electronic interface

1	SIN COS 1Vpp

Maximum input frequency

1	100 kHz

Analogue pitch factor

1	Factor 1 (not subdivided)

Pitch periods, 360°

0768	For MHA180
0860	For MHA200
1088	For MHA260
1302	For MHA325
1530	For MHA395
1760	For MHA460

Cable length in m

1	Standard

Electrical connection

1	12-pin M23 coupling, pins

Direction of cable connection

1	Left (standard)

Circuit version

A	–

2.2.7 Technical data

2.2.7.1 Angular resolution

The achievable angular resolution, i.e. the number of analogue output signal periods (pitch periods) for incremental measuring systems or the smallest possible resolvable angular step for absolute measuring systems with digital interfaces, depends on the diameter of the measuring system bearing. The system accuracy also depends on the diameter of the measuring system bearing.

Further influencing factors on angular resolution include:

- Pitch accuracy of the measurement ring.
- Positional deviations within a signal period.
- Scanning quality of the measuring head.
- Quality of the electronic signal processing system in the measuring head.
- Eccentricity of the bearing outer ring and measurement ring relative to the theoretical axis of rotation.
- Roundness of the bearing outer ring.

2

27 Angular resolution YRTCMA, YRTSMA

Designation	Pitch periods	Angular resolution	
		SSI+1Vss	EnDat 2.2, Fanuc05, DQ
	n/U	1/U	bit/U
YRTCMA150-XL	672	672×1024	23
YRTCMA180-XL	768	768×1024	23
YRTCMA200-XL, YRTSMA200	860	860×1024	23
YRTCMA260-XL, YRTSMA260	1088	1088×1024	24
YRTCMA325-XL, YRTSMA325	1302	1302×1024	24
YRTCMA395-XL, YRTSMA395	1530	1530×1024	24
YRTCMA460-XL, YRTSMA460	1760	1760×1024	24
YRTCMA580-XL	2196	2196×1024	25
YRTCMA650-XL	2508	2508×1024	25
YRTCMA850-XL	3200	3200×1024	25
YRTCMA950-XL	3540	3540×1024	25
YRTCMA1030-XL	3808	3808×1024	25

n	–	Quantity
U	–	Revolution

For the incremental measuring system bearings YRTCMI, the base pitch of the reference marks is also specified.

28 Angular resolution YRTCMI

Designation	Pitch periods	Basic pitch of the reference marks
	n/U	Pitch periods
YRTCMI180-XL	768	48
YRTCMI200-XL	860	86
YRTCMI260-XL	1088	64
YRTCMI260-XL	1302	62
YRTCMI395-XL	1530	90
YRTCMI460-XL	1760	80

n	–	Quantity
U	–	Revolution

2.2.7.2 System accuracy

The listed values for system accuracy without compensation are maximum approved values that will not be exceeded. Some of the influencing variables lead to reproducible error quotas and some to non-reproducible error quotas. The reproducible error quotas can be determined metrologically with the aid of reference marks, stored in the controller as a correction table and compensated for mathematically. The values listed in the “System accuracy with compensation” column can be achieved with the aid of this compensation method.

The following influencing variables are excluded from the system accuracy specification:

- mechanical deviations doe to mounting
- external electronic influences
- resolution of the positional regulator or controller

29 System accuracy YRTCMA, YRTSMA

Designation	Pitch periods	System accuracy	
		Without compensation	With compensation
	n/U	arcmin	arcmin
YRTCMA150-XL	672	±9,7	±3
YRTCMA180-XL	768	±9,3	±2,6
YRTCMA200-XL, YRTSMA200	860	±8,3	±2,3
YRTCMA260-XL, YRTSMA260	1088	±6,6	±1,8
YRTCMA325-XL, YRTSMA325	1302	±6	±1,5
YRTCMA395-XL, YRTSMA395	1530	±5,1	±1,3
YRTCMA460-XL, YRTSMA460	1760	±4,4	±1,1
YRTCMA580-XL	2196	±6,2	±1,3
YRTCMA650-XL	2508	±5,4	±1,1
YRTCMA850-XL	3200	±4,3	±0,9
YRTCMA950-XL	3540	±3,9	±0,8
YRTCMA1030-XL	3808	±3,6	±0,7

n	–	Quantity
U	–	Revolution

30 System accuracy YRTCMI

Designation	Pitch periods	System accuracy	
		Without compensation	With compensation
	n/U	arcmin	arcmin
YRTCMI180-XL	768	±11,9	±5,1
YRTCMI200-XL	860	±10,6	±4,6
YRTCMI260-XL	1088	±8,4	±3,6
YRTCMI260-XL	1302	±7,5	±3
YRTCMI395-XL	1530	±6,4	±2,6
YRTCMI460-XL	1760	±5,5	±2,2

n	–	Quantity
U	–	Revolution

2.2.7.3 Technical data for absolute measuring heads MHA

31 Technical data for MHA

Characteristics	Unit	EnDat 2.2	FANUC αi	DRIVE-CLiQ®	SSI+1Vss
Designation	–	EnDat 2.2	Fanuc05	DQ	SSI+1Vss
Interface	–	Digital	Digital	Digital	Digital and analogue
Grating period	μm	1000	1000	1000	1000
Maximum input frequency	kHz	20	20	20	20
Clock frequency	–	≤ 16 MHz	–	100 Mbit/s	≤ 1 MHz
Safety parameters	–	By agreement	Not applicable	By agreement	By agreement
Supply voltage range DC	V	3,6 … 14	3,6 … 14	10 … 36	3,6 … 14
Power consumption	W	1,5	1,5	2,1	1,5
Current consumption	mA	300 (at DC 5 V)	300 (at DC 5 V)	85 (at DC 24 V)	300 (at DC 5 V)

Characteristics		Unit	EnDat 2.2	FANUC αi	DRIVE-CLiQ®	SSI+1Vss
Cable	Sheath material	–	PUR	PUR	PUR	PUR
	Ends	–	4×0,09 mm² 4×0,14 mm²	4×0,09 mm² 4×0,14 mm²	4×0,09 mm² 4×0,14 mm²	6×2×0,09 mm²
	Length at measuring head	m	1+0,03	1+0,03	1+0,03	1+0,03
	Diameter	mm	4,5±0,1	4,5±0,1	4,5±0,1	4,5±0,1
	Bending radius (single bend)	mm	≥ 10	≥ 10	≥ 10	≥ 10
	Bending radius (continuous bend)	mm	≥ 50	≥ 50	≥ 50	≥ 50
Plug connection		–	M12, pins, 8-pin	M12, pins, 8-pin	M12, pins, 8-pin	M23, pins, 17-pin
Operating temperature range		°C	–10 ... +85	–10 ... +85	–10 ... +85	–10 ... +85
Storage temperature range		°C	–20 ... +85	–20 ... +85	–20 ... +85	–20 ... +85
Electrical protection type	MHA-0	–	IP68	IP68	IP68	IP68
	MHA-2	–	IP67	IP67	IP67	IP67
Axial/radial bearing		–	YRTCMA, YRTSMA	YRTCMA, YRTSMA	YRTCMA, YRTSMA	YRTCMA, YRTSMA

2.2.7.4 Technical data for incremental measuring heads MHI

32 Technical data for MHI

Characteristics		Unit	SIN COS 1Vss
Designation		–	SIN COS 1Vss
Interface		–	Analogue
Grating period		μm	1000
Maximum input frequency		kHz	100
Safety parameters		–	By agreement
Supply voltage range DC		V	4 ... 7
Power consumption		W	1,3
Current consumption		mA	260 (at DC 5 V)
Cable	Sheath material	–	PUR
	Ends	–	6×2×0,09 mm²
	Length at measuring head	m	1+0,03
	Diameter	mm	4,5±0,1
	Bending radius (single bend)	mm	≥ 10
	Bending radius (continuous bend)	mm	≥ 50
Plug connection		–	M23, pins, 12-pin
Operating temperature range		°C	–10 ... +85
Storage temperature range		°C	–20 ... +85
Electrical protection type	MHI-0	–	IP68
	MHI-2	–	IP67
Axial/radial bearing		–	YRTCMI

2.3 Lubrication

Lubrication information can be found in the sections for axial/radial bearings and axial angular contact ball bearings ➤11 | 1.2.

2.4 Sealing

Bearing sealing information can be found in the sections for axial/radial bearings and axial angular contact ball bearings ➤13 | 1.3.

2.5 Speeds

Speed-related information can be found in the sections for axial/radial bearings and axial angular contact ball bearings ➤13|1.4.

2.6 Rigidity

Bearing rigidity information can be found in the sections for axial/radial bearings and axial angular contact ball bearings ➤14|1.5.

2.7 Temperature range

Temperature range information can be found in the sections for axial/radial bearings and axial angular contact ball bearings ➤14|1.6.

2.8 Internal clearance

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

2.9 Dimensions, tolerances

Dimensional and tolerance information can be found in the sections for axial/radial bearings and axial angular contact ball bearings ➤16|1.9.

CAD files are available for all bearing and measuring head series, which can be provided upon request or downloaded from the Schaeffler website.

2.10 Structure of the ordering designation

48 Structure of the ordering designation for absolute measuring system bearings YRTCMA

YRTC MA 325 – 03 – 1302 – XL

Designation
YRTC Axial/radial roller bearing, double direction, for screw mounting

Measuring system
MA Absolute value angular measuring system

Bore diameter
150 ... 1030 Available bore diameters (150, 180, 200, 260, 325, 395, 460, 580, 650, 850, 950, 1030)

Pitch accuracy
03 ±3µm for YRTCMA150 to YRTCMA460
05 ±5µm for YRTCMA580 to YRTCMA1030

Pitch periods, 360°
0672 For YRTCMA150
0768 For YRTCMA180
0860 For YRTCMA200
1088 For YRTCMA260
1302 For YRTCMA325
1530 For YRTCMA395
1760 For YRTCMA460
2196 For YRTCMA580
2508 For YRTCMA650
3200 For YRTCMA850
3540 For YRTCMA950
3808 For YRTCMA1030

Premium brand
XL X-life

49 Structure of the ordering designation for absolute measuring system bearings YRTSMA

YRTS MA 325 – 03 – 1302

Designation
YRTS Axial/radial roller bearing, double direction, for screw mounting, for higher speeds

Measuring system
MA Absolute value angular measuring system

Bore diameter
200 ... 460 Available bore diameters (200, 260, 325, 395, 460)

Pitch accuracy
03 ±3µm

Pitch periods, 360°
0860 For YRTSMA200
1088 For YRTSMA260
1302 For YRTSMA325
1530 For YRTSMA395
1760 For YRTSMA460

50 Structure of the ordering designation for incremental measuring system bearings YRTCMI

YRTC MI 325 – 03 – 1302 – XL

Designation

YRTC Axial/radial roller bearing, double direction, for screw mounting

Measuring system

MI Incremental angular measuring system

Bore diameter

180 ... 460 Available bore diameters (180, 200, 260, 325, 395, 460)

Pitch accuracy

03 ±3µm

Pitch periods, 360°

0768 For YRTCMI180
0860 For YRTCMI200
1088 For YRTCMI260
1302 For YRTCMI325
1530 For YRTCMI395
1760 For YRTCMI460

Premium brand

XL X-life

2.11 Design of the adjacent construction

Information on the design of the adjacent construction can be found in the sections for axial/radial bearings and axial angular contact ball bearings ➤32 | 1.12.

2.11.1 Adjacent construction

Measuring head MHA-0, which is suitable for radial screw mounting, has a flange into which a circumferential groove, containing an O-ring, is incorporated. The purpose of this O-ring is to protect the interior of the rolling bearing against external environmental influences and to retain the rolling bearing grease.

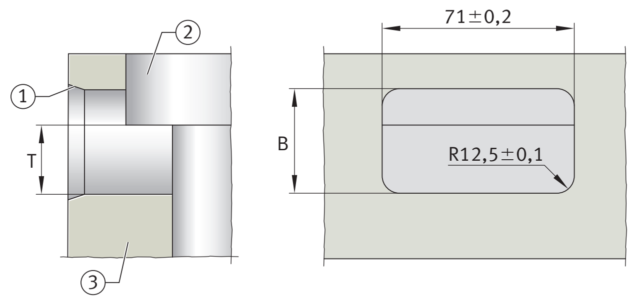
51 Measuring head suitable for radial screw mounting MHA-0

00194971

A suitable opening, with dimensions matched to this seal, can be milled into the axis housing.

2

52 Opening dimensions for measuring head suitable for radial screw mounting MHA-0



1	Joining bevel for O-ring	2	Observe installation position of the bearing and measuring head in the housing
3	Housing, customer side		

33 Opening dimensions for measuring head suitable for radial screw mounting MHA-0

Designation	T			B		
	–	U	L	–	U	L
	mm	mm	mm	mm	mm	mm
YRTCMA180-XL, YRTCMI180-XL	30,5	+0,1	−0,1	50	+0,1	−0,1
YRTCMA200-XL, YRTSMA200, YRTCMI200-XL	30,5	+0,1	−0,1	50	+0,1	−0,1
YRTCMA260-XL, YRTSMA260, YRTCMI260-XL	30,5	+0,1	−0,1	53	+0,1	−0,1
YRTCMA325-XL, YRTSMA325, YRTCMI325-XL	30,5	+0,1	−0,1	55	+0,1	−0,1
YRTCMA395-XL, YRTSMA395, YRTCMI395-XL	30,5	+0,1	−0,1	55	+0,1	−0,1
YRTCMA460-XL, YRTSMA460, YRTCMI460-XL	30,5	+0,1	−0,1	57	+0,1	−0,1
YRTCMA580-XL	34,5	+0,1	−0,1	69	+0,1	−0,1
YRTCMA650-XL	39,5	+0,1	−0,1	78	+0,1	−0,1

B	mm	Width
T	mm	Depth
U	mm	Upper limit deviation
L	mm	Lower limit deviation

2.12 Fitting and dismantling

Fitting information can be found in the sections for axial/radial bearings and axial angular contact ball bearings ➤40|1.13.

2.13 Product tables

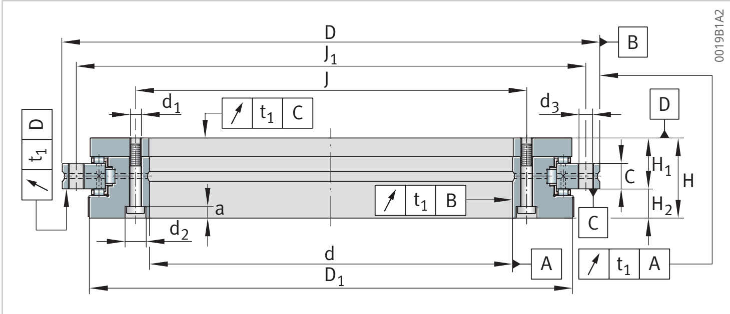
2.13.1 Explanations of the product tables

1	–	Two retaining screws
2	–	Screw counterbores in the L-section ring open to the bearing bore
a	mm	Countersink depth
C	mm	Outer ring width
C_{0a}	N	Basic static load rating, axial
C_{0r}	N	Basic static load rating, radial
C_a	N	Basic dynamic load rating, axial
c_{aL}	N/μm	Axial rigidity of bearing position
c_{aW}	N/μm	Axial rigidity of rolling element set
c_{kL}	Nm/mrad	Tilting rigidity of bearing position
c_{kW}	Nm/mrad	Tilting rigidity of rolling element set
C_r	N	Basic dynamic load rating, radial
c_{rL}	N/μm	Radial rigidity of bearing position
c_{rW}	N/μm	Radial rigidity of rolling element set
d	mm	Bore diameter
D	mm	Outside diameter
d_1	mm	Diameter of fastening hole, inner ring
D_1	mm	Inner ring diameter
d_2	mm	Countersink diameter, fixing hole
d_3	mm	Diameter of fixing holes, outer ring
G	–	Extraction threads
H	mm	Height
H_1	mm	Contact surface height, outer ring
H_2	mm	Contact surface height, outer ring
J	mm	Pitch circle diameter of fixing holes, inner ring
J_1	mm	Pitch circle diameter of fixing holes, outer ring
m	kg	Mass
M_A	Nm	Tightening torque for fixing screws according to DIN EN ISO 4762, strength class 10.9
M_R	Nm	Frictional torque
n	–	Number of screw mounting holes
n_A	–	Number of fixing screws, outer ring
n_G	min^{-1}	Limiting speed
n_{GA}	–	Number of extraction threads
n_I	–	Number of fixing screws, inner ring
t	°	Pitch angle of fixing holes

2.13.2 YRTCMA, main dimensions, performance data

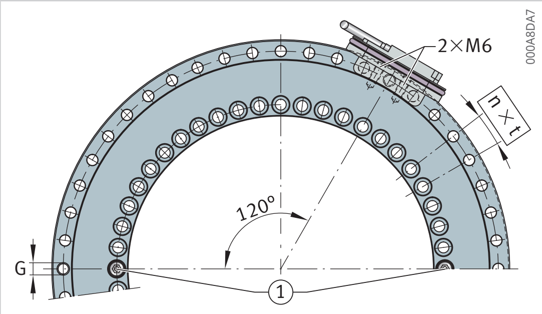
Double direction

With absolute value angular measuring system

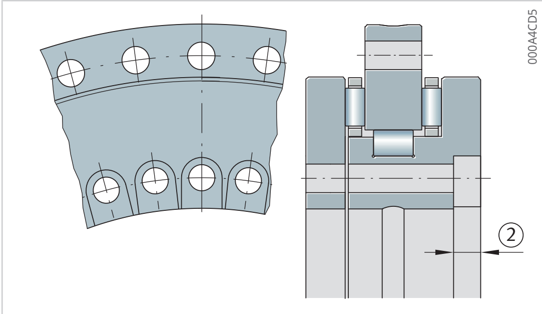


YRTCMA

Designation	d	D	H	H_1	H_2	C	D_1 max.	J	J_1
–	mm	mm	mm	mm	mm	mm	mm	mm	mm
YRTCMA150-XL	150	240	47	26	21	12	214,5	165	225
YRTCMA180-XL	180	280	50	29	21	15	245,1	194	260
YRTCMA200-XL	200	300	51	30	21	15	274,4	215	285
YRTCMA260-XL	260	385	57,5	36,5	21	18	347	280	365
YRTCMA325-XL	325	450	61	40	21	20	415,1	342	430
YRTCMA395-XL	395	525	65	42,5	22,5	20	487,7	415	505
YRTCMA460-XL	460	600	70	46	24	22	560,9	482	580



Hole pattern, measuring head suitable for radial screw mounting



YRTCMA325-XL

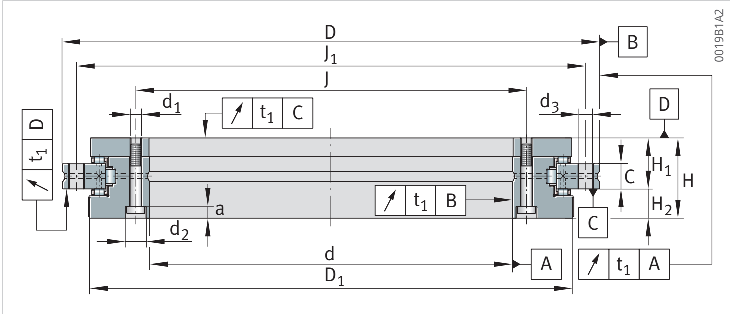
C_a	C_{0a}	C_r	C_{0r}	n_G	M_R	m
N	N	N	N	min^{-1}	Nm	kg
128000	650000	74000	146000	800	4	6,7
134000	730000	100000	200000	600	5	8,5
147000	850000	123000	275000	450	6	10,7
168000	1090000	140000	355000	300	9	18,7
247000	1900000	183000	530000	200	13	25
265000	2190000	200000	640000	200	19	33
290000	2550000	265000	880000	150	25	45

2

2.13.3 YRTCMA, mounting dimensions, rigidity values

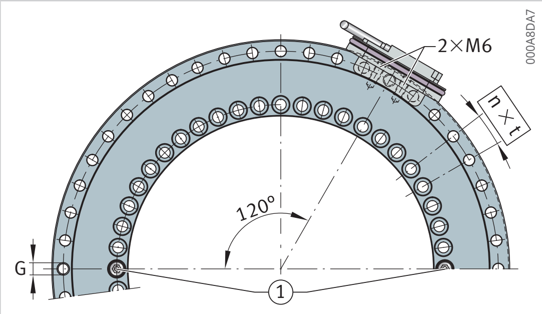
Double direction

With absolute value angular measuring system

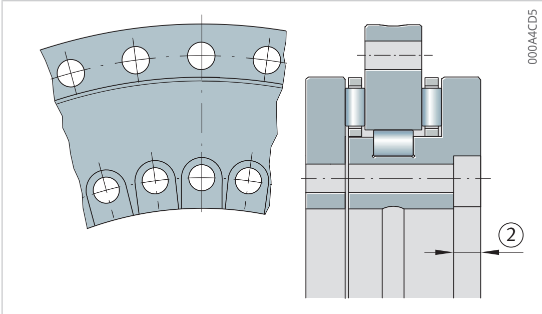


YRTCMA

Designation	d_1	d_2	a	n_I	d_3	n_A	M_A
–	mm	mm	mm	–	mm	–	Nm
YRTCMA150-XL	7	11	6,2	34	7	33	14
YRTCMA180-XL	7	11	6,2	46	7	45	14
YRTCMA200-XL	7	11	6,2	46	7	45	14
YRTCMA260-XL	9,3	15	8,2	34	9,3	33	34
YRTCMA325-XL	9,3	15	8,2	34	9,3	33	34
YRTCMA395-XL	9,3	15	8,2	46	9,3	45	34
YRTCMA460-XL	9,3	15	8,2	46	9,3	45	34



Hole pattern, measuring head suitable for radial screw mounting



YRTCMA325-XL

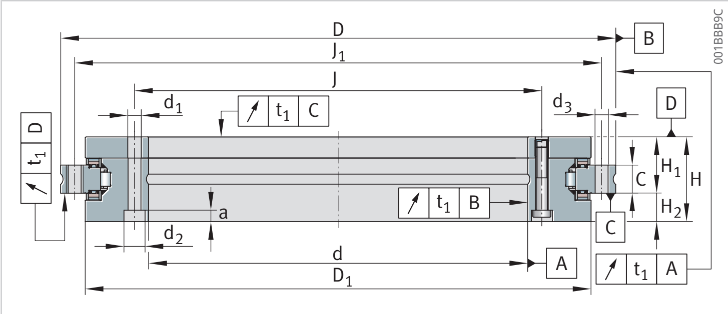
n	t	G	n_{GA}	c_{aL}	c_{rL}	c_{kL}	c_{aW}	c_{rW}	c_{kW}
–	°	–	–	N/μm	N/μm	Nm/mrad	N/μm	N/μm	Nm/mrad
36	10	M8	3	3800	3200	18600	12000	4800	61000
48	7,5	M8	3	4700	3600	29000	13500	5300	88500
48	7,5	M8	3	4900	4100	40000	15500	6200	128000
36	10	M12	3	6900	5300	104000	19000	8100	265000
36	10	M12	3	7100	6300	159000	33000	9900	633000
48	7,5	M12	3	9900	5800	280000	37000	13000	1002000
48	7,5	M12	3	12000	6500	429000	43000	17000	1543000

2

2.13.4 YRTSMA, main dimensions, performance data

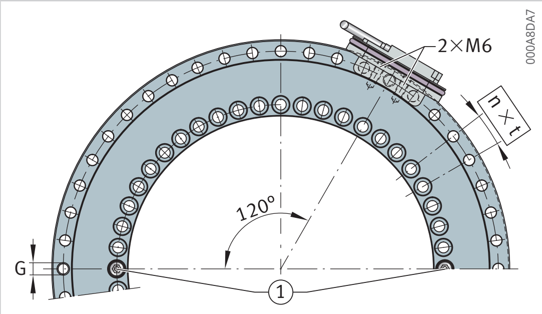
Double direction

With absolute value angular measuring system

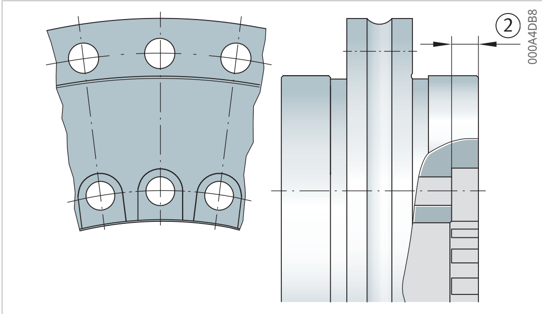


YRTSMA

Designation	d	D	H	H_1	H_2	C	D_1 max.	J	J_1
–	mm	mm	mm	mm	mm	mm	mm	mm	mm
YRTSMA200	200	300	51	30	21	15	274,4	215	285
YRTSMA260	260	385	57,5	36,5	21	18	347	280	365
YRTSMA325	325	450	61	40	21	20	415,1	342	430
YRTSMA395	395	525	65	42,5	22,5	20	487,7	415	505
YRTSMA460	460	600	70	46	24	22	560,9	482	580



Hole pattern, measuring head suitable for radial screw mounting



YRTSMA325

2

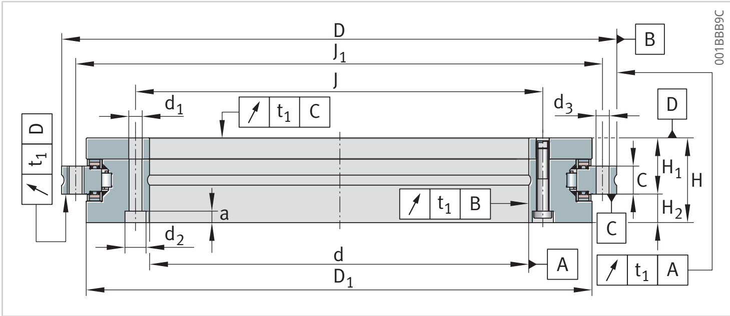
C_a	C_{0a}	C_r	C_{0r}	n_G	M_R	m
N	N	N	N	min^{-1}	Nm	kg
155000	840000	94000	226000	1160	–	10,7
173000	1050000	110000	305000	910	–	18,7
191000	1260000	109000	320000	760	–	25
214000	1540000	121000	390000	650	–	33
221000	1690000	168000	570000	560	–	45

2

2.13.5 YRTSMA, mounting dimensions, rigidity values

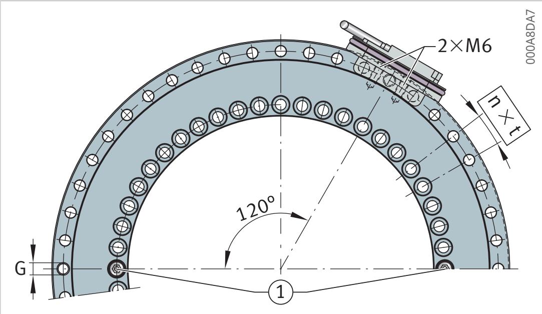
Double direction

With absolute value angular measuring system

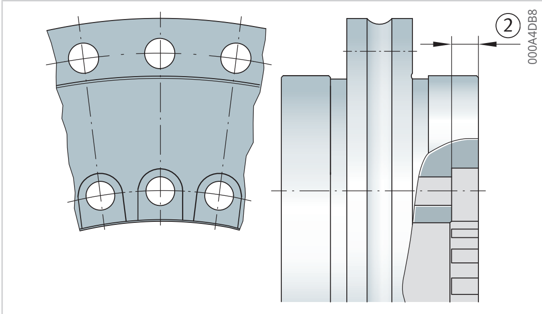


YRTSMA

Designation	d_1	d_2	a	n_I	d_3	n_A	M_A
–	mm	mm	mm	–	mm	–	Nm
YRTSMA200	7	11	6,2	46	7	45	14
YRTSMA260	9,3	15	8,2	34	9,3	33	34
YRTSMA325	9,3	15	8,2	34	9,3	33	34
YRTSMA395	9,3	15	8,2	46	9,3	45	34
YRTSMA460	9,3	15	8,2	46	9,3	45	34



Hole pattern, measuring head suitable for radial screw mounting



YRTSMA325

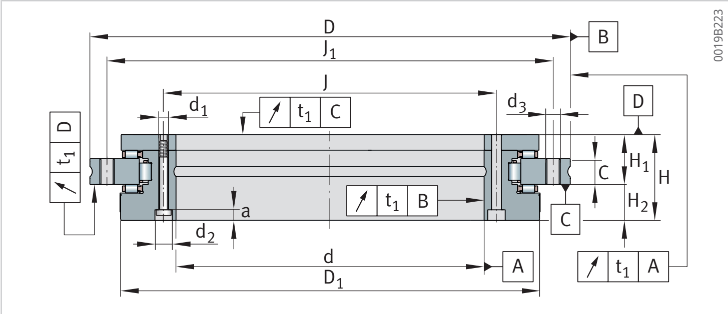
n	t	G	n_{GA}	c_{aL}	c_{rL}	c_{kL}	c_{aW}	c_{rW}	c_{kW}
–	°	–	–	N/µm	N/µm	Nm/mrad	N/µm	N/µm	Nm/mrad
48	7,5	M8	3	4000	1200	29000	13600	3900	101000
36	10	M12	3	5400	1600	67000	16800	5800	201000
36	10	M12	3	6600	1800	115000	19900	7100	350000
48	7,5	M12	3	7800	2000	195000	23400	8700	582000
48	7,5	M12	3	8900	1800	280000	25400	9500	843000

2

2.13.6 YRTCMI, main dimensions, performance data

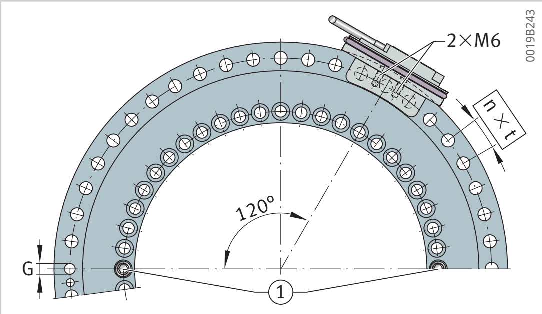
Double direction

With incremental angular measuring system



YRTCMI

Designation	d	D	H	H_1	H_2	C	D_1 max.	J	J_1
–	mm	mm	mm	mm	mm	mm	mm	mm	mm
YRTCMI180-03-0768-XL	180	280	50	29	21	15	245,1	194	260
YRTCMI200-03-0860-XL	200	300	51	30	21	15	274,4	215	285
YRTCMI260-03-1088-XL	260	385	57,5	36,5	21	18	347	280	365
YRTCMI325-03-1302-XL	325	450	61	40	21	20	415,1	342	430
YRTCMI395-03-1530-XL	395	525	65	42,5	22,5	20	487,7	415	505
YRTCMI460-03-1760-XL	460	600	70	46	24	22	560,9	482	580



Hole pattern

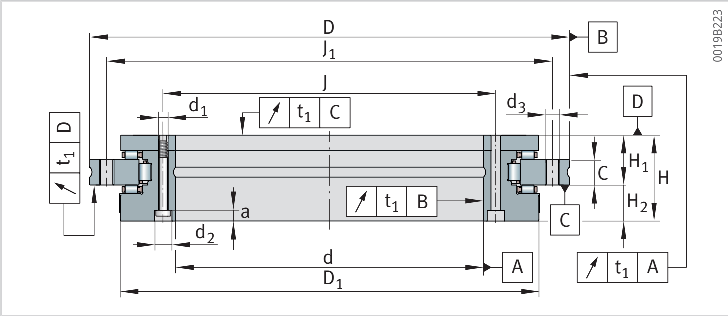
C_a	C_{0a}	C_r	C_{0r}	n_G	M_R	m
N	N	N	N	min^{-1}	Nm	kg
134000	730000	100000	200000	600	5	8,5
147000	850000	123000	275000	450	6	10,7
168000	1090000	140000	355000	300	9	18,7
247000	1900000	183000	530000	200	13	25
265000	2190000	200000	640000	200	19	33
290000	2550000	265000	880000	150	25	45

2

2.13.7 YRTCMI, mounting dimensions, rigidity values

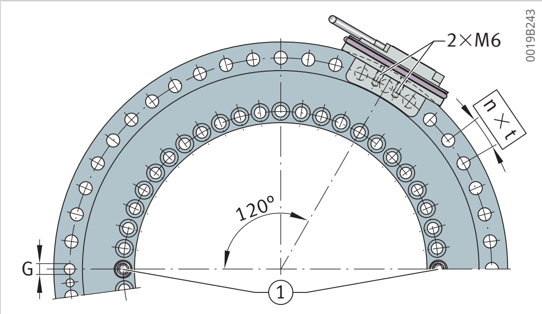
Double direction

With incremental angular measuring system



YRTCMI

Designation	d_1	d_2	a	n_I	d_3	n_A	M_A
–	mm	mm	mm	–	mm	–	Nm
YRTCMI180-03-0768-XL	7	11	6,2	46	7	45	14
YRTCMI200-03-0860-XL	7	11	6,2	46	7	45	14
YRTCMI260-03-1088-XL	9,3	15	8,2	34	9,3	33	34
YRTCMI325-03-1302-XL	9,3	15	8,2	34	9,3	33	34
YRTCMI395-03-1530-XL	9,3	15	8,2	46	9,3	45	34
YRTCMI460-03-1760-XL	9,3	15	8,2	46	9,3	45	34



Hole pattern

n	t	G	n_{GA}	c_{aL}	c_{rL}	c_{kL}	c_{aW}	c_{rW}	c_{kW}
–	°	–	–	N/μm	N/μm	Nm/mrad	N/μm	N/μm	Nm/mrad
48	7,5	M8	3	4700	3600	29000	13500	5300	88500
48	7,5	M8	3	4900	4100	40000	15500	6200	128000
36	10	M12	3	6900	5300	104000	19000	8100	265000
36	10	M12	3	7100	6300	159000	33000	9900	633000
48	7,5	M12	3	9900	5800	280000	37000	13000	1002000
48	7,5	M12	3	12000	6500	429000	43000	17000	1543000

3

3 Axial/radial bearings with absolute value angular measuring system

Axial radial bearings with angular measuring system comprise an axial/radial bearing YRTCM or YRTSM, each with a dimensional scale, an SRM electronic measuring system and signal leads SRMC.

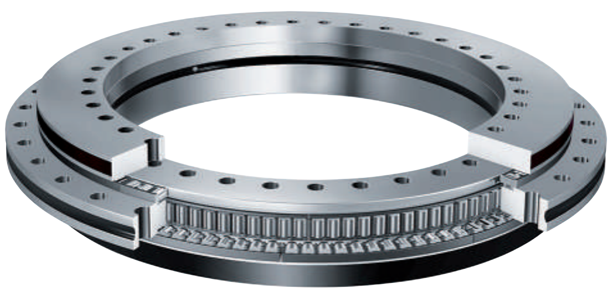
Advantages of the angular measuring system

- The rigid connection to the adjacent construction enables excellent control characteristics such as control stiffness and dynamic response. These characteristics make the angular measuring system particularly suitable for axes with torque motor drive.
- high maximum measuring speed 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
- automatically self-adjusting electronics
- has a self-centring function
- unaffected by lubricants
- Easy to fit, the measuring heads are easily adjustable, there is no need for alignment of the bearing and a separate measuring system.
- no additional mounting parts required
  - Dimensional scale and measuring heads are integrated into the bearing design or the adjacent construction.
  - The resulting space saved can be used for the machine working area.
- No issues with supply lines. The cables can be laid directly through the large bearing bore within the adjacent construction.
- Saves on components, overall design envelope and costs due to the compact, integrated design requiring fewer components.

3.1 Bearing design

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

53 Axial/radial bearings with magnetic dimensional scale YRTCM, YRTSM



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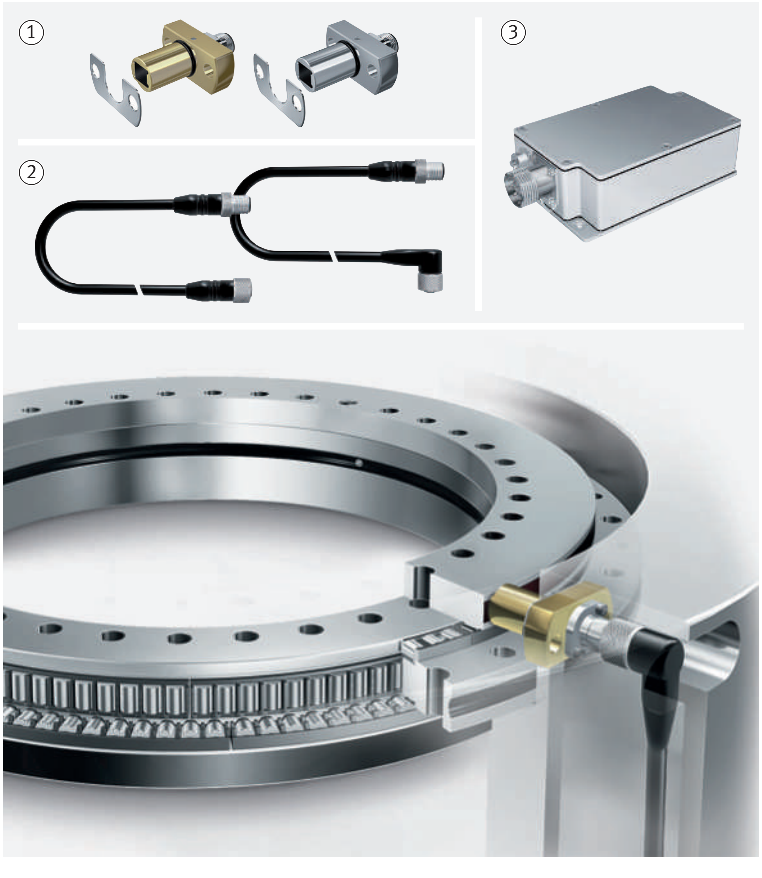
For the mechanical part of axial/radial bearings YRTCM or YRTSM, the information provided for axial/radial bearings and axial angular contact ball bearings applies ➤10|1.1.

3.2 Angular measuring system

54 Axial/radial bearing with incremental angular measuring system



1	Measuring heads with calibration shims	2	Connection cable SRMC
3	Electronic evaluation system		

The electronic measuring system SRM comprises two measuring heads, two stacks of calibration shims and an electronic evaluation system. The signal leads SRMC 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.

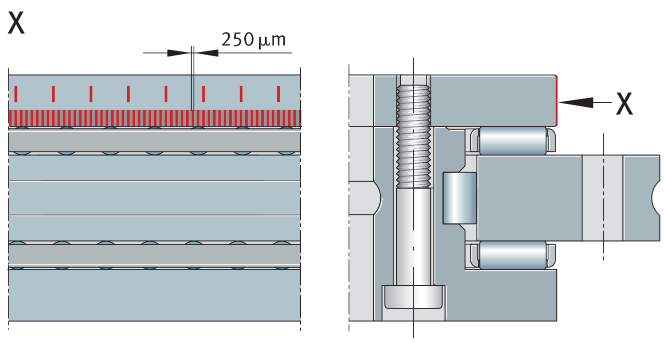
3.2.1 Dimensional scale

The dimensional scale is applied without seams or joins to the outside diameter of the shaft locating washer. The magnetically hard coating has magnetic poles at a pitch of 250 μm that serve as angle references.

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

3

55 Dimensional scale

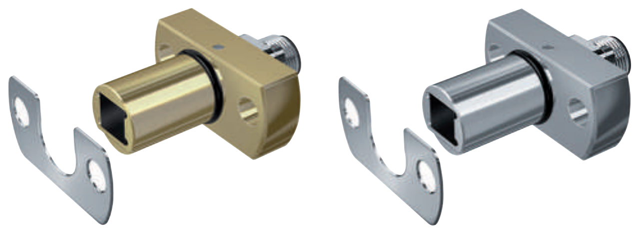


Reference marks

The system has pitch-coded reference marks in order to quickly create the absolute datum point. To achieve this, reference marks are applied at 15° intervals, allowing the absolute datum point to be determined after passing over two adjacent reference marks (maximum 30°).

3.2.2 Measuring heads

56 Measuring heads with calibration shims SRM



34 Magneto-resistive measuring heads

Colour	Measuring head	Function
White, silver	SRMH01-WH	Scanning the incremental track
Yellow, gold	SRMH01-YE	Scanning the incremental track and reference marks

The 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

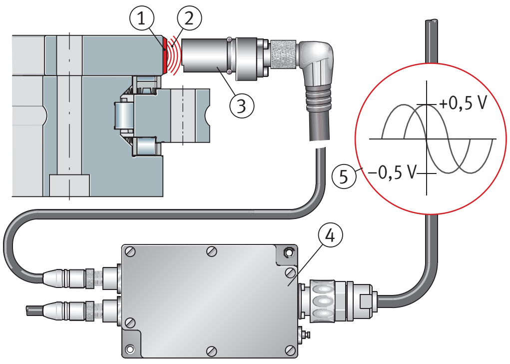
The small magnetic fields are detected as a result of the magneto-resistive effect (MR effect). Unlike magnetic heads, the MR sensors allow static measurement of magnetic fields, i.e. electrical signals are derived without movement, in contrast to magnetic heads.

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

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

Operating principle

57 Measurement principle



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

3.2.3 Measurement accuracy

The more accurate the angular measurement, the more accurately a rotary axis can be positioned. The accuracy of the angular measurement is influenced by various factors.

35 Influencing factors on angular measurement accuracy

Influencing factor	Relevance
Quality of the dimensional scale, scanning process and electronic evaluation system	Relevant for the bearing-integrated measuring system
Eccentricity of the dimensional scale relative to the bearing raceway system	Eliminated by the diametrical arrangement of the MR sensors
Runout deviation of the bearing arrangement	Minor relevance
Elasticity of the measurement system shaft and its linkage to the shaft to be measured	Minor relevance
Elasticity of the stator shaft and shaft coupling	Minor relevance

Positional deviations

Positional deviations within a revolution are the absolute measurement errors that occur over one revolution of the system.

36 Positional deviations over one revolution of the system

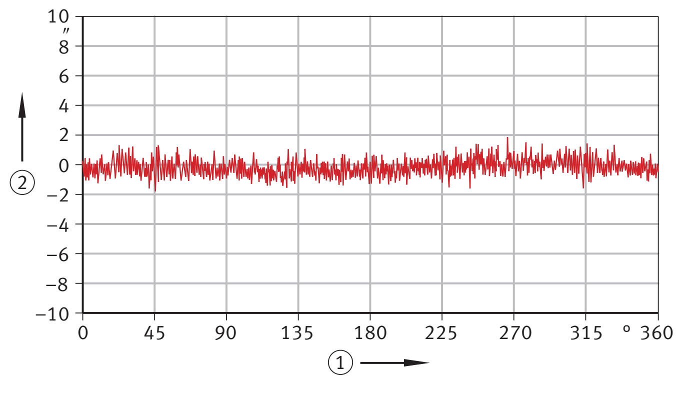
Axial/radial bearing	Positional deviation at +20 °C
	arcsec
YRTCM150-XL	±6
YRTCM180-XL	±5
YRTCM200-XL, YRTSM200	±3
YRTCM260-XL, YRTSM260	±3
YRTCM325-XL, YRTSM325	±3
YRTCM395-XL, YRTSM395	±3
YRTCM460-XL, YRTSM460	±3

Since the dimensional scale is connected directly to the rolling bearing, i.e. without any compensation elements, 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.

Measurement record

Each bearing with an angular measuring system is supplied with a measurement record. The accuracy is measured on the coded washer of bearing when the coding is applied and is documented. The measurement trace shows the pitch error of the coding.

58 Excerpt from a measurement trace, example: YRTSM395 – serial no. 03/09/004



1	Measurement travel in degrees	2	Deviation in angular seconds

3.2.4 Setting and diagnostic software MEKOEDS

The distance between the measuring heads and the outside diameter of the shaft locating washer is set using the setting and diagnostic software MEKOEDS. The software is also used to check the function of the fitted measuring system and to detect defects in the measuring system.

37 Setting and diagnostic software variants

Description	Ordering designation
Setting and diagnostic software	MEKOEDS

Scope of delivery

- USB stick with 5 m interface cable
- MEKOEDS
- Mounting manual MON 18, Axial/radial bearings with integral angular measuring system
- Mounting manual MON 100, High-precision bearings for combined loads

3.2.5 Cables for signal transmission

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

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

In the case of the 90° angled 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:

- Cables and plugs are shielded.
- Cable sheath is made of polyurethane (PUR), halogen-free and flame-resistant.
- Signal cables are free from halogens, silicones and PVC, as well as resistant to microbes and hydrolysis.
- Cables are resistant to oils, greases and cooling lubricants.
- Cables are suitable for dynamic use in drag chains. Ensure that the cables are laid correctly.

Bending cycles

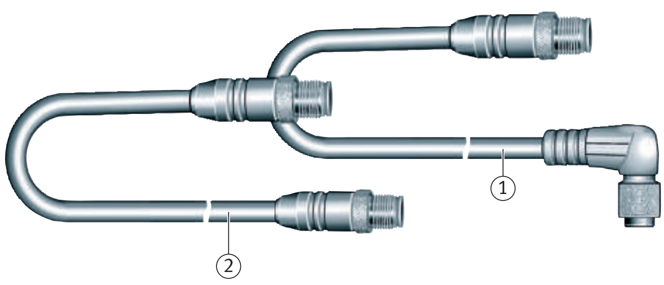
38 Test conditions for bending cycles in drag chain applications

Test condition	Unit	Value
Bending cycles	–	$\geq 2 \cdot 10^6$
Bending radius	mm	65
Acceleration	m/s^2	5
Travel velocity	m/min	200
Travel distance, horizontal	m	5

Connection cables

Measuring heads are connected using cables with 90° angled plugs or straight plugs.

59 Connection cable



1	SRMC..-A, straight plug, 90° angled plug	2	SRMC..-S, straight plug at both ends

39 Connection cable variants

Plug		Length	Ordering designation
Input	Output	m	
Straight plug	Straight plug	1	SRMC1-S
		2	SRMC2-S
		3	SRMC3-S
Straight plug	Angled plug, 90°	1	SRMC1-A
		2	SRMC2-A
		3	SRMC3-A

3

Other variants are available by agreement.

! Use cables of equal length to connect both measuring heads in a measuring system.

Plug connectors

The plug connectors are robust and designed for use in industrial environments. When connected, they meet protection class IP65 in accordance with DIN EN 60529.

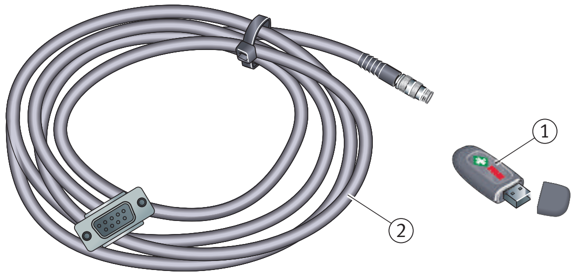
The large-area shielding connections inside the plugs ensure effective shielding.

Interface cable

The measuring system is connected to a PC via an interface cable and a serial interface. The interface cable is included in the delivery of MEKOEDS and has a length of 5 m. If the PC does not have a serial interface, Schaeffler recommends using a commercially available serial/USB converter. This converter is not included in the delivery.

The measuring data can be recorded, displayed in diagram form, printed and sent by e-mail to Schaeffler for evaluation.

60 MEKOEDS



1	USB stick	2	Interface cable

3.2.6 Error-free signal transmission

When fitted and operated as specified, the measuring system fulfils the requirements of Directive 2014/30/EU on electromagnetic compatibility (EMC).

40 Demonstrated compliance with the EMC Directive

EMC Directive	Standard	
EN 61000-6-2 Immunity	Electrostatic discharge	EN 61000-4-2
	Radiated electromagnetic fields	EN 61000-4-3
	Fast transient electric disturbances	EN 61000-4-4
	Surge voltages	EN 61000-4-5
	Conducted immunity	EN 61000-4-6
	Power-frequency magnetic fields	EN 61000-4-8
EN 55011-B Emission	Interference voltage	EN 55011-B
	Perturbing radiation	EN 55011-B

Electrical sources of interference in the transmission of measurement signals

Interference voltages are mainly generated and transmitted through capacitive or inductive coupling. Interference can occur through lines and equipment inputs and outputs.

Possible sources of interference in the transmission of measurement signals:

- Strong magnetic fields from transformers and electric motors.
- Relays, contactors and solenoid valves.
- High-frequency equipment, pulse devices and magnetic stray fields due to switched-mode power supply units.
- Power cables and supply lines.

! Interference in initial operation can generally be attributed to absent or inadequate shielding of the measurement leads or insufficient spacing between signal and power cables.

The overall design should be such that the function of the measuring system is not influenced by sources of electrical or mechanical interference.

3.2.7 Measures to protect against interference

! The high-precision bearing and measuring system must be handled with care.

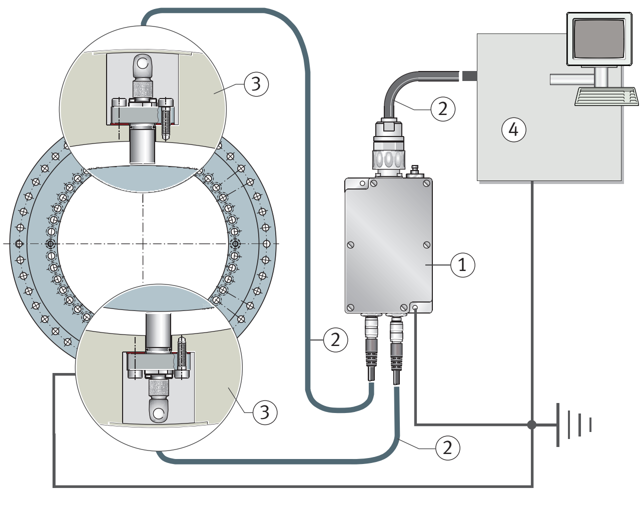
The dimensional scale and sensor surface of the measuring heads are unprotected once the protective covers have been removed.

Screw the electronic evaluation system firmly to the earthed machine frame. If screw mounting surfaces are non-conductive, one of the fixing screws should be connected by electrically conductive means over the largest possible cross-section and a short route with the machine frame; all components must have the same potential.

The bearing components must be connected by electrically conductive means with potential equalisation (PE).

Only shielded plug connectors and cables may be used for signal transmissions.

61 Shielding and electronic post-processing systems



1	Electronic evaluation system	2	Shielded plug connector and cable
3	Adjacent construction	4	Electronic post-processing system

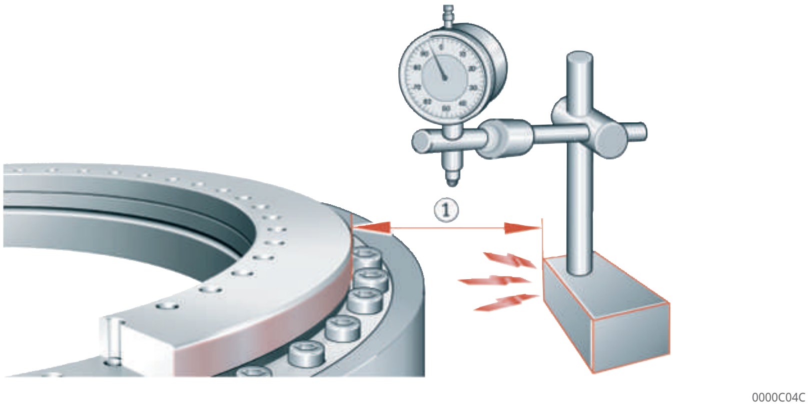
Protection against magnetic fields

Magnetic fields will damage or erase the magnetic dimensional scale, leading to partial measurement errors in the system.

! Sources of magnetism must be kept away from the magnetic scale on the outside diameter of the shaft locating washer. A field strength of approx. 70 mT or higher directly at the magnetic dimensional scale carries the risk of damage to the magnetic poles.

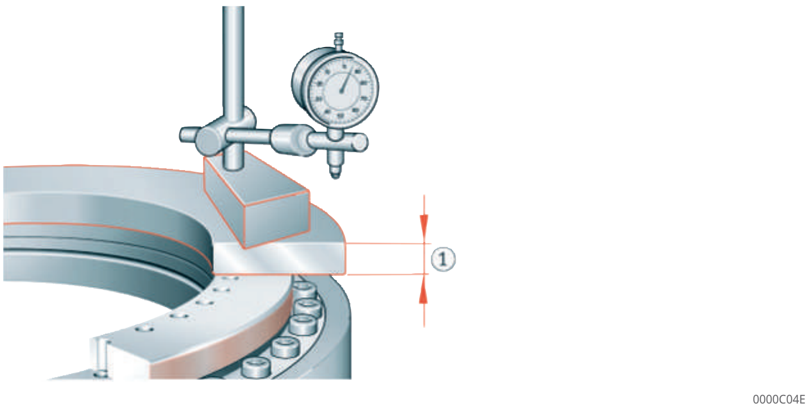
! Do not place magnetic dial gauge stands directly on the coded washer. Guide values: minimum air gap of 100 mm or 10 mm of unalloyed steel.

62 Minimum distance between magnetic dial gauge stand and shaft locating washer



1	Minimum distance > 100 mm

63 Shielding by unalloyed steel



1	Shielding > 10 mm

! Never touch the coding with magnetisable objects.

Prevent contact with magnetisable contaminants. These could otherwise be deposited on the magnetic coding and lead to impaired measurement accuracy.

Possible causes of magnetic contaminants:

- Contaminants in the lubricant, e.g. oil bath.
- Contaminants washed off by condensation (e.g. in conjunction with cooling devices).
- Magnetisable wear debris from gears.

Pressing down the measuring head by hand

In order to protect the sensor chip against damage, the measuring head can only be pressed against the dimensional scale by hand. Forces > 50 N can lead to sensor damage.

3.2.8 Laying signal cables

Do not lay cables in parallel or in close proximity to each other. An air gap of > 100 mm is recommended. If adequate spacing cannot be achieved, additional shielding or earthed metallic partition walls between the cables should be provided.

The requirement for spatial separation of cables also applies to typical sources of interference such as servo drives, frequency converters, contactors, solenoid valves and storage throttles.

41 Aspects to consider when laying signal cables

Aspect to consider	Description
Cable crossings	Avoid cable crossings. If cables must be crossed, this should be carried out at a 90° angle
Excess cable lengths	Avoid long signal cables. Looped excess lengths act like antennas and cause interference. Trim the cables to the required length.
Shield separations	Shield separations present a functional risk and should be avoided. If shield separations are unavoidable, these should be reconnected over as large an area as possible. Keep open wire ends to the connector terminal short.
Non-assigned wire ends	Avoid non-assigned wire ends in signal cables. Non-assigned ends should be connected on both sides to reference potential or ground potential.
Motor connectors	Do not lay any additional lines for data cabling within shielded motor cables or motor terminal boxes. Spatial separation is recommended.
Interference suppression filter	Connections between interference suppression filters and the emission source should be kept as short as possible and should be shielded.

3.2.9 Electronic evaluation system

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

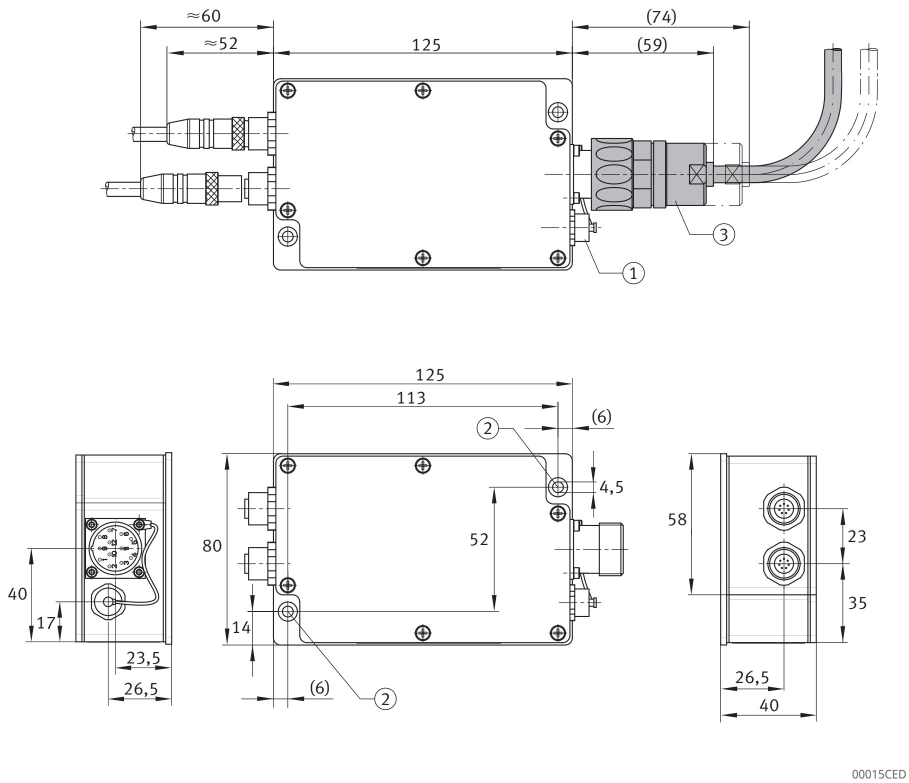
The input signals are digitised by an analogue/digital converter. The DSP automatically adjusts the sensor signals and calculates the effective angular value from the sensor signals by means of vector addition. Correction is carried out, for example, on the offset of the analogue signals. A digital/analogue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

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

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

3

64 Connections and dimensions of the electronic evaluation system



1	RS232 connector	2	Holes for M4×10 fixing screws according to DIN 912
3	Shielded plug connector with cable for electronic post-processing system		

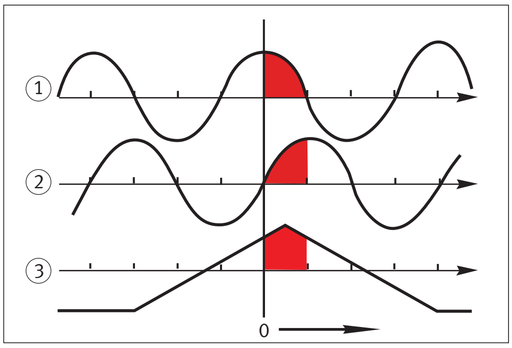
3.2.10 Functional principle for detecting the zero position

The connected CNC controller checks whether output signal A, output signal B and reference signal Z are positive.

When output signal A = MAX (90°) and output signal B = ZERO (0°), the zero position is reached.

The reference signal form has no influence. It is important to highlight slightly more than this one quadrant, but not more than one signal period.

65 Reference signal position



1	Output signal A	2	Output signal B, 90° phase-offset from A
3	Reference signal Z		

3.2.11 Compatibility

The analogue 1 V_{pp} output signals of the incremental track can be processed by most conventional CNC controllers.

For new applications, it must be checked whether the CNC controller can be parametrised in accordance with the technical data for YRTCM or YRTSM.

For most controllers, the input parameters can be requested from us.

Entering the line count

With many controllers, the line count can be entered directly ➤109 | ▦47.

In isolated cases, however, this is carried out using integer multiplication and division values. The line count cannot be entered exactly for the following sizes and must be corrected using other parameters:

- YRTCM200-XL
- YRTSM200
- YRTCM395-XL
- YRTSM395

Pitch-coded reference marks

Some controllers cannot record signals from pitch-coded measuring systems. In such cases, the electronic measuring system can be supplied as a single-reference-mark measuring system.

The differential pitch between two adjacent reference marks is 2 signal periods. In the zero transition area, the system design of the encoder leads to a greater difference. The controller must be capable of processing this aspect.

In swivel-type axes, the zero point of the measuring system, marked on the bearing by a drill bit, may be placed outside the scanning range of the yellow measuring head.

With continuous monitoring of the pitch-coded reference marks, the limiting speed n_G must not be exceeded during the reference run.

3.2.12 Functional testing according to standards

The functional capability has been tested under changing climatic conditions, under mechanical load and in contact with water, oil and cooling lubricants.

! In the case of different operating conditions, please contact Schaeffler.

The measuring system design has been tested in accordance with the following standards.

▦42 Climatic tests

Test	Standard	Test parameters	
Cold	IEC 60068-2-1	Storage temperature	–10±3 °C
		Dwell time	72 h
Dry heat	IEC 60068-2-2	Storage temperature	+70±2 °C
		Dwell time	72 h
Thermal cycling	IEC 60068-2-14	Lower storage temperature	–20±3 °C
		Upper storage temperature	+60±3 °C
		Change gradient	1 °C/min
		Dwell time at each limit temperature	3 h
		Number of cycles	5

3

Test	Standard	Test parameters	
Thermal shock	IEC 60068-2-14	Lower storage temperature	–5±3 °C
		Upper storage temperature	+55±3 °C
		Change duration	≤ 8 s
		Dwell time at each limit temperature	20 min
		Number of cycles	10
Humid heat, cyclic	IEC 60068-2-30	Lower storage temperature	+25±3 °C
		Upper storage temperature	+55±3 °C
		Change duration	3 h ... 6 h
		Cycle duration	24 h
		Number of cycles	6

43 Mechanical tests

Test	Standard	Test parameters	
General	DIN EN 60086-2-6	Condition B	
	MIL-STD-202, MIL-STD-204 C	–	
Vibration (measuring heads)	IEC 60068-2-6	Vibration type	Sinusoidal
		Frequency range	10 Hz ... 2 kHz
		Amplitude (10 Hz ... 60 Hz)	±0,76 mm
		Amplitude (60 Hz ... 2 kHz)	100 m/s^2
		Rate	1 oct/min
		Load duration	240 min per axis
		Number of frequency cycles per main axis	16
		Load directions	3 main axes
Shocks (measuring heads)	IEC 60068-2-27	Acceleration	30 g
		Shock duration	18 m/s
		Shock type	Semisine wave
		Number of shock cycles per main axis	6
		Load directions	3 main axes

44 IP protection class

Test	Standard	Test parameters	
Protection against water ingress	DIN EN 60529	Protection class (SRM)	IP67
		Protection class (MEKO/U)	IP65

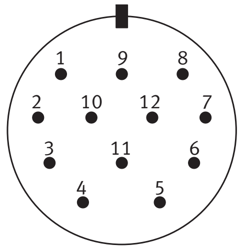
! Ingress protection testing is carried out with water as a medium and over a limited time period. All push-fit connections are fitted during testing. The measuring system should therefore be fitted with protection against cooling lubricants.

45 Chemical resistance (measuring heads)

Test	Test media	Test parameters	
Resistance to oil	Aral Degol BG 150, Mobilgear SHC XMP 150, Shell Omala EPB 150, Klübersynth GH 6-150	Storage temperature	+60 °C
		Storage duration	168 h
Resistance to cooling lubricant	Hosmac SL 145, Zubora 92F MR, Hycut ET 46, Hosmac S 558	Storage temperature	+35 °C
		Storage duration	168 h
		Concentration in water	5 %

3.2.13 Plug configuration

66 Plug configuration of 12-pin flanged plug



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The sensor lines are linked internally with the supply cables (2 with 12, 11 with 10). They are used by the motor controller as measurement lines to compensate for voltage drop on the supply cable (four-wire system). If this function is not supported by the controller used, the 5 V and 0 V lines can be connected in parallel to reduce voltage drop on the supply lead. The housing is shielded.

46 Plug configuration of 12-pin flanged plug

Pin	Signals		Voltage	Standard
5	Output signal	A	+	–
6			-	
8		B	+	
1			-	
3	Reference signal	Z	+	
4			-	
12	U_P	5 V	-	DIN EN 50178
10	U_N	0 V	-	
2	Sensor	5 V	-	–
11		0 V	-	
9	–	Free	-	
7	–	/	-	
/	–	Free	-	

3.2.14 Technical data

47 Technical data for SRM electronic measuring system

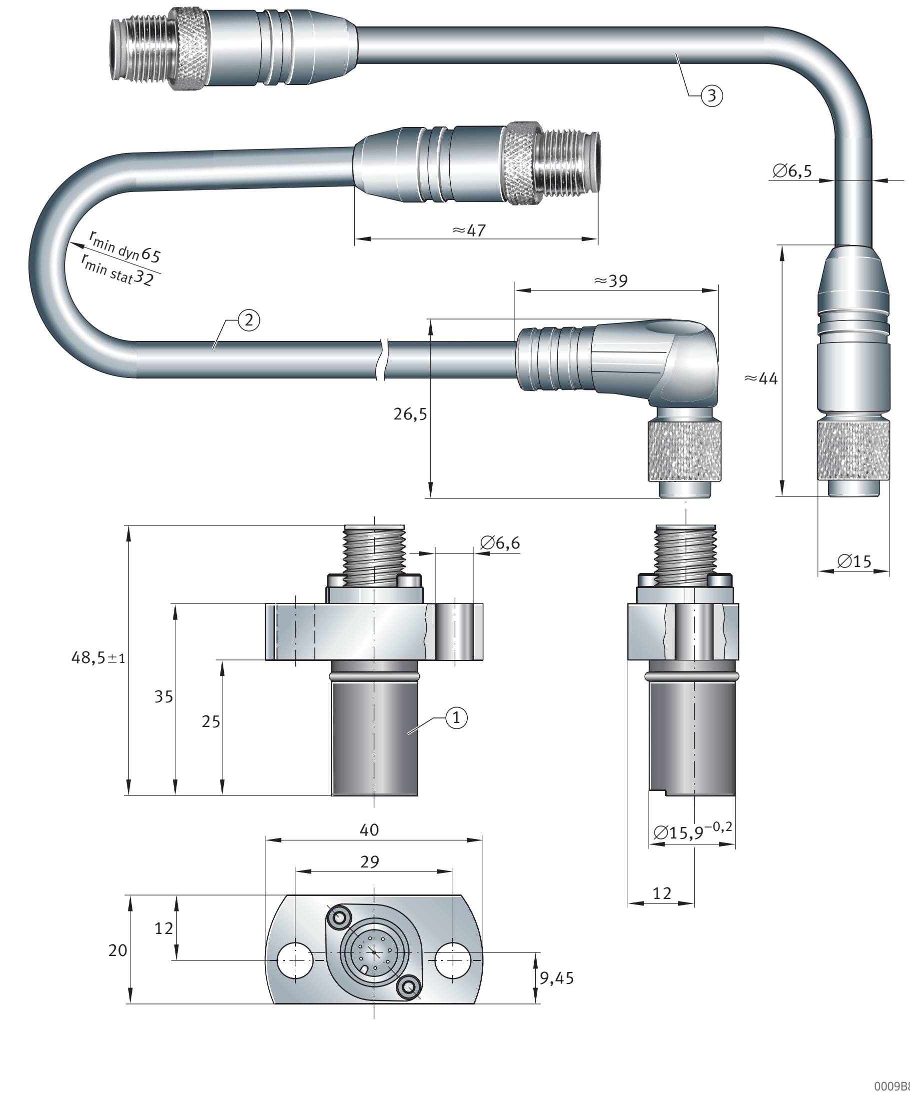
Data		Specification	Comment
Power supply		DC +5 V±10 %	–
Current consumption, electronic evaluation system with measuring heads		280 mA	SRMH01-YE, SRMH01-WH
Scale		Hard-magnetic coating	Periodic north-south pole pitch
Incremental signal		1 V_{pp}	–
Line count/accuracy	YRTCM150-XL	2688/±6 arcsec	At +20 °C
	YRTCM180-XL	3072/±3 arcsec	
	YRTCM200-XL, YRTSM200	3408/±5 arcsec	
	YRTCM260-XL, YRTSM260	4320/±3 arcsec	
	YRTCM325-XL, YRTSM325	5184/±3 arcsec	
	YRTCM395-XL, YRTSM395	6096/±3 arcsec	
	YRTCM460-XL, YRTSM460	7008/±3 arcsec	
Reference marks		24 marks, spacing 15°	Pitch-coded
Fixed reference mark pitch		30°	–
Differential pitch between two reference marks		2signal periods	–
Data interface		RS232C	–
Recommended measurement step		0,0001°	–

Data		Specification	Comment
Operating temperature		0 °C ... +70 °C	–
Protection class according to DIN EN 60529		IP67	When all connectors are plugged in
Weight	Measuring heads	38 g	–
	Electronic evaluation system	450 g	
Electrical connection	Measuring heads	PUR cable Ø6,5 mm	–
	Electronic post-processing system	Plug, Ø15 mm	Not included in the scope of delivery
		12-pin flanged plug, Ø28 mm	
Permissible cable length for electronic post-processor	maximum	100 m	–
Moisture	maximum	70 % relative humidity, non-condensing	–

48 SRM signal electronic measuring system

Data		Specification	Comment
Output signal load		100 Ω ... 120 Ω	Recommended CNC input resistance
Output signal A, B	typical	0,9 V_{pp}	Load resistance 120 Ω
	maximum	0,8 V ... 1 V	f = 100 Hz
Signal difference	typical	< 1 %	Difference in output signal amplitude between signals A and B f = 100 Hz
Output signal direct current voltage		2,4 V±10 %	Output signals A+, A–, B+, B–
Output signal offset voltage	typical	±10 mV	Direct current offset between A+ and A–, B+ and B–
	maximum	±50 mV	
Output signal frequency	maximum	DC 8 kHz	–
Width of reference signal Z	typical	230°	From centre of output signal period A, B at recommended reference movement speed
	maximum	180° ... 270°	
Reference signal midpoint voltage		2,4 V ±10 %	–
Reference signal level	typical	0,8 V_{pp}	Load resistance 120 Ω
	maximum	0,6 V ... 1 V	
	inactive	–0,4 V	
	active	+0,4 V	
System resolution	maximum	2500 steps per sine	–

67 Connection cable and measuring head dimensions



1	Measuring head	2	Connection cable SRMC..-A
3	Connection cable SRMC..-S		

3.3 Lubrication

Lubrication information can be found in the sections for axial/radial bearings and axial angular contact ball bearings ➤11|1.2.

3.4 Sealing

Bearing sealing information can be found in the sections for axial/radial bearings and axial angular contact ball bearings ➤13|1.3.

O-rings seal the measuring heads against oil leakage and fluid ingress.

3.5 Speeds

Speed-related information can be found in the sections for axial/radial bearings and axial angular contact ball bearings ➤13|1.4.

3.6 Rigidity

Bearing rigidity information can be found in the sections for axial/radial bearings and axial angular contact ball bearings ➤14 | 1.5.

3.7 Temperature range

Temperature range information can be found in the sections for axial/radial bearings and axial angular contact ball bearings ➤14 | 1.6.

3.8 Dimensions, tolerances

Dimensional and tolerance information can be found in the sections for axial/radial bearings and axial angular contact ball bearings ➤16 | 1.9.

CAD files are available for all bearing and measuring head series, which can be provided upon request or downloaded from the Schaeffler website.

3.9 Structure of the ordering designation

68 Structure of the ordering designation YRTCM

YRTC M 325 – XL

Designation
YRTC Axial/radial roller bearing, double direction, for screw mounting

Measuring system
M Magnetic dimensional scale

Bore diameter
150 ... 460 Available bore diameters (150, 180, 200, 260, 325, 395, 460)Dimensional scale

Premium brand
XL X-life

69 Structure of the ordering designation YRTSM

YRTS M 325

Designation
YRTS Axial/radial roller bearing, double direction, for screw mounting, for higher speeds

Measuring system
M Magnetic dimensional scale

Bore diameter
200 ... 460 Available bore diameters (200, 260, 325, 395, 460)

70 Structure of the ordering designation for the measuring system

YRTSM | 395 / SRM01 / 2× SRMC2-A

Designation

YRTCM	Axial/radial roller bearing, double direction, for screw mounting, magnetic dimensional scale
YRTSM	Axial/radial roller bearing, double direction, for screw mounting, for higher speeds, magnetic dimensional scale

Bore diameter

200 ... 460	Available bore diameters (200, 260, 325, 395, 460)

Electronic measuring system

SRM01	Electronic measuring system SRM01

Connection cable

SRMC1-S ... SRMC3-S	Connection cable Straight plug on both ends
SRMC1-A ... SRMC3-A	Connection cable Straight plug and 90° angled plug

3.10 Dimensioning

Dimensioning information for the bearing can be found in the sections for radial/axial bearings YRTC and YRTS ➤23 | 1.11.

3.11 Design of the adjacent construction

A lead chamfer of 1×30° must be provided in the locating bore for O-ring on the measuring head.

The measuring head should be centred in all planes relative to the shaft locating washer and secured against rotation by means of a locating face.

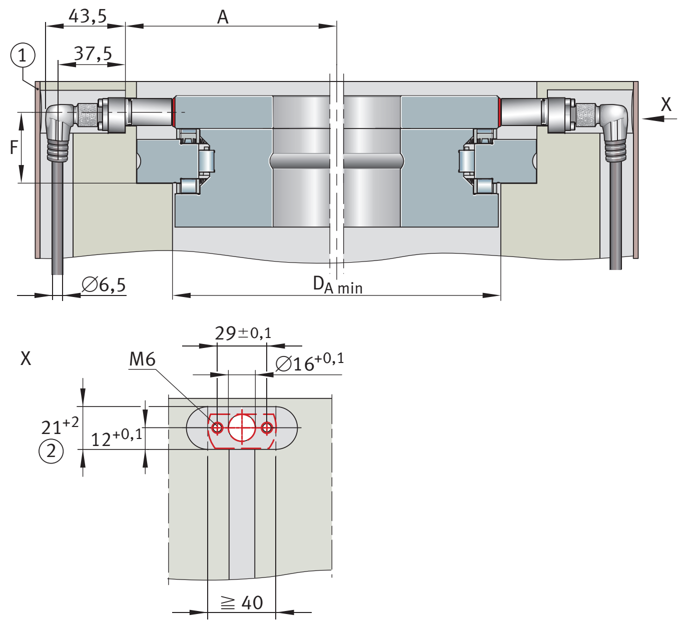
! For centring of the coded shaft locating washer, the bearing must be supported over its entire height by the adjacent construction of the shaft.

The following points must be checked:

- The depth of the slot for the measuring heads must conform to dimension A.
- The screw mounting faces for the measuring heads must be free from burrs and flat.
- The measuring heads must be arranged at 180±1°.
- To ensure a properly fitted bearing and reliably functioning measuring system, the minimum recess diameter D_A must be integrated into the adjacent construction.
- The distance F is must maintained after the measuring heads have been fitted.
- When using cables with 90° angled plugs, the cable exit direction must correspond to the drawing.
- Provide tension relief for cables at measuring head height. This is particularly important where 90° angled plugs are used, as tensile forces acting on the cables can overload the plugs.

3

71 Design of adjacent construction and diametrically opposed arrangement of measuring heads



1	Cover	2	Fitting of a measuring head rotated by 180° is not possible.

49 Recess diameter and distance

Axial/radial bearing	A	D_A	F
	–0,4	min	±0,1
	mm	mm	mm
YRTCM150-XL	132	215	22
YRTCM180-XL	147,2	245,5	25
YRTCM200-XL, YRTSM200	160,6	274,5	25
YRTCM260-XL, YRTSM260	196,9	345,5	29,75
YRTCM325-XL, YRTSM325	231,3	415,5	32,5
YRTCM395-XL, YRTSM395	267,5	486,5	33,75
YRTCM460-XL, YRTSM460	303,8	560,5	36,5

A	mm	Distance between sensor screw mounting surfaces and centre of bearing
D_A	mm	Recess diameter
F	mm	Distance

! If the measuring heads are located deep in the housing, they must be sufficiently accessible to allow setting of the measurement gap.

The measuring heads and cables must be protected with suitable covers against mechanical damage and long-term contact with fluids.

- The positional orientation of the measuring heads is determined by the locating face. Fixing screws alone are not sufficient for defining the positional orientation.
- observe the minimum bending radii for signal cables
- fluids must not be allowed to build up in the measuring head pockets (IP67)

3.12 Fitting and dismantling

Fitting information can be found in the sections for axial/radial bearings and axial angular contact ball bearings ➤40 | 1.13.

Due to the integrated dimensional scale and the small measuring heads designed for optimum use of available space, the measuring system is very easy to install.

3

3.12.1 Safety-related information about the measuring device under the terms of the Machinery Directive

The angular measuring system meets the described product characteristics when used correctly. The measuring system is not suitable for use in safety-related control loops and should not be used for this purpose. For systems with a safety focus, the higher-level system must check the positional value of the measuring device after power-on. The measuring device is not developed in accordance with IEC 61508 and no SIL classification exists.

Characteristics of the measuring device relevant to hazard analysis:

- The system does not have redundant functional elements.
- Software is involved in generating the output signals.
- After the initial operation procedure, the electronic evaluation system outputs a zero voltage signal in the event of the following events which can be detected as a fault by a suitable electronic post-processing system:
  - Fault in the power supply.
  - Error in plausibility testing of the two measuring head signals by means of quadrant comparison (detection of measuring head failure or loose connections, for example cable breakage).
  - Undershooting of the permissible minimum amplitudes (detection of measuring head failure, detection of an inadmissibly large increase in the measurement gap, for example after a machine crash).

3.12.2 Fitting guidelines for axial/radial bearings

The coded shaft locating washer is centred precisely during fitting via the shaft journal, which is accurately manufactured over the entire bearing height.

Loosen the retaining screws on the inner ring before fitting to allow the bearing inner ring and shaft locating washer with dimensional scale to align and centre without any force.

! Do not use magnetisable tools. The magnetic dimensional scale has a protective strip for transport and fitting. Do not remove the protective strip until after the bearing is fitted.

Further information

MON 100 | High-precision bearings for combined loads | https://www.schaeffler.de/std/2013

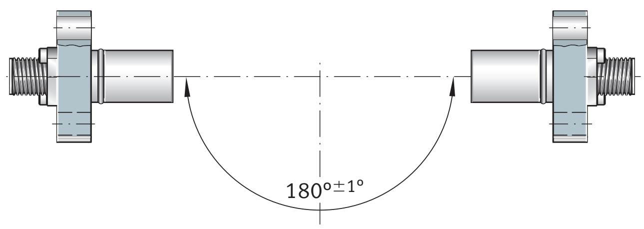
3.12.3 Fitting guidelines for measuring heads

The mounting position of the measuring heads is defined by the design of the locating pockets.

3.12.4 Diametrically opposed arrangement of measuring heads

The diametrical arrangement of the measuring heads of 180 ±1° must not be exceeded or fallen short of, otherwise any eccentricities of the shaft locating washer will affect the measurement accuracy.

72 Diametrically opposed arrangement of measuring heads



3.12.5 Fitting the measuring heads

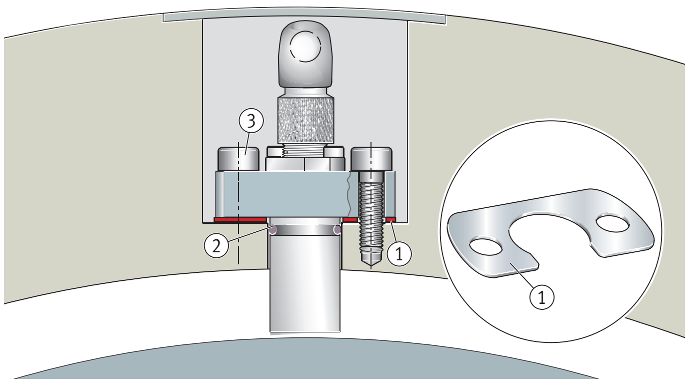
First, use the MEKOEDS software and the calibration shims supplied to set the correct distance from the measuring heads to the outside diameter of the shaft locating washer.

Then perform the teaching process using the MEKOEDSsoftware to match the measuring heads to the electronic evaluation system.

! Tighten the fixing screws carefully. Do not exceed an amplitude display of 80 % of the MEKOEDS software during setting. The sensor surface of the measuring head may only be subjected to load by hand pressure. Forces over 50 N may damage the sensor surface.

1. Visually inspect the screw mounting surface for the angular measuring head in the housing, removing any foreign bodies, contamination, grease and oil.
2. Degrease the screw mounting surface by suitable means and leaving no residue, ensuring that no degreasing agent or foreign bodies penetrate the measuring system bearing.
3. Fit the angular measuring head with the calibration shims in the correct position.

73 Fitting the measuring head



1	Calibration shim	2	Sealing ring
3	Fixing screws		

4. Fasten the angular measuring head in the housing, ensuring that the measuring head is correctly positioned.
5. Insert two new ISO 4762:2004-compliant cylinder head screws M6–8,8 into the mounting holes and screw until finger tight into the prepared threaded holes.
6. Set the measurement gap distance using the commissioning and diagnostics software.
7. Tighten both cylinder head screws to a tightening torque of 10 Nm using a calibrated torque wrench.
8. Use a suitable paint to secure the screw heads against inadvertent loosening.
9. Fasten the measuring head cable using suitable cable clamps to relieve the strain.

3.12.6 Cables and plugs for signal transmission

The plugs for the input signals to the electronic evaluation system are 8-pin.

During initial commissioning, the system automatically detects which measuring head is connected to which input.

! The measuring heads, plugs and cables must be protected against mechanical damage.

3.13 Spare parts

50 Spare parts for angular measuring system

Spare part	d mm	Description
WSM YRT200	200	Shaft locating washer, bearing with coding
WSM YRT260	260	
WSM YRT325	325	
WSM YRT395	395	
WSM YRT460	460	
SRMH01-YE	–	Measuring head with reference sensor, yellow

Spare part	d	Description
	mm	
SRMH01-WH	–	Measuring head with reference sensor, white
SS.SRM01-0010	–	Calibration shim for measuring heads
SRMB01	–	Electronic evaluation system

d	mm	Bore diameter

3.14 Further information

Further information can be found in the following publications:

HR 1 | Rolling Bearings |
https://www.schaeffler.de/std/1D3D

MON 100 | High-precision bearings for combined loads |
https://www.schaeffler.de/std/2013

3.15 Product tables

3.15.1 Explanations

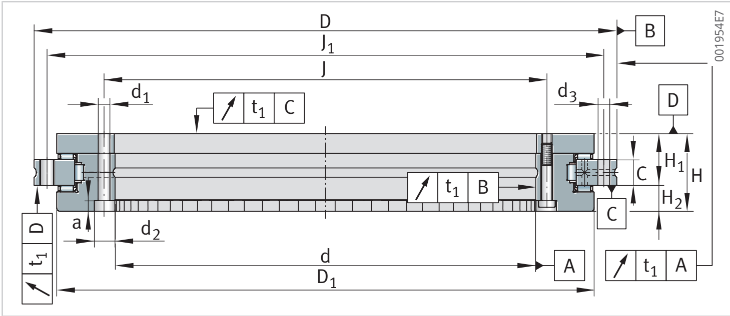
1	–	Two retaining screws
2	–	Screw counterbores in the L-section ring open to the bearing bore
a	mm	Countersink depth
C	mm	Outer ring width
C_{0a}	N	Basic static load rating, axial
C_{0r}	N	Basic static load rating, radial
C_a	N	Basic dynamic load rating, axial
c_{aL}	N/μm	Axial rigidity of bearing position
c_{aW}	N/μm	Axial rigidity of rolling element set
c_{kL}	Nm/mrad	Tilting rigidity of bearing position
c_{kW}	Nm/mrad	Tilting rigidity of rolling element set
C_r	N	Basic dynamic load rating, radial
c_{rL}	N/μm	Radial rigidity of bearing position
c_{rW}	N/μm	Radial rigidity of rolling element set
d	mm	Bore diameter
D	mm	Outside diameter
d_1	mm	Diameter of fastening hole, inner ring
D_1	mm	Inner ring diameter
d_2	mm	Countersink diameter, fixing hole
d_3	mm	Diameter of fixing holes, outer ring
G	–	Extraction threads
H	mm	Height
H_1	mm	Contact surface height, outer ring
H_2	mm	Contact surface height, outer ring
J	mm	Pitch circle diameter of fixing holes, inner ring
J_1	mm	Pitch circle diameter of fixing holes, outer ring
m	kg	Mass
M_A	Nm	Tightening torque for fixing screws according to DIN EN ISO 4762, strength class 10.9
M_R	Nm	Frictional torque
n	–	Number of screw mounting holes
n_A	–	Number of fixing screws, outer ring
n_G	min^{-1}	Limiting speed
n_{GA}	–	Number of extraction threads
n_I	–	Number of fixing screws, inner ring
t	°	Pitch angle of fixing holes

3

3.15.2 YRTCM, main dimensions, performance data

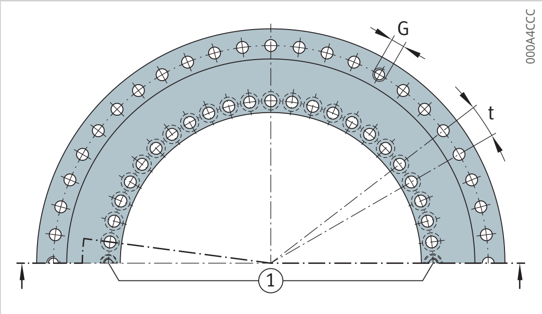
Double direction

With incremental angular measuring system

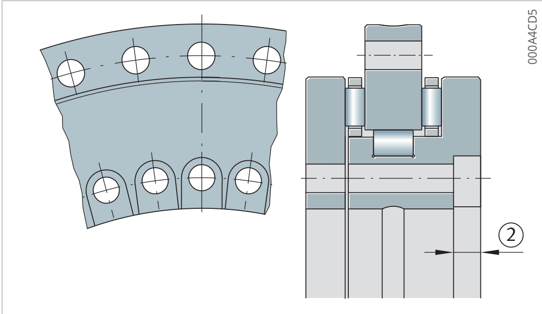


YRTCM

Designation	d	D	H	H_1	H_2	C	D_1 max.	J	J_1
–	mm	mm	mm	mm	mm	mm	mm	mm	mm
YRTCM150-XL	150	240	41	27	14	12	214,5	165	225
YRTCM180-XL	180	280	44	30	14	15	245,1	194	260
YRTCM200-XL	200	300	45	30	15	15	274,4	215	285
YRTCM260-XL	260	385	55	36,5	18,5	18	347	280	365
YRTCM325-XL	325	450	60	40	20	20	415,1	342	430
YRTCM395-XL	395	525	65	42,5	22,5	20	487,7	415	505
YRTCM460-XL	460	600	70	46	24	22	560,9	482	580



Hole pattern



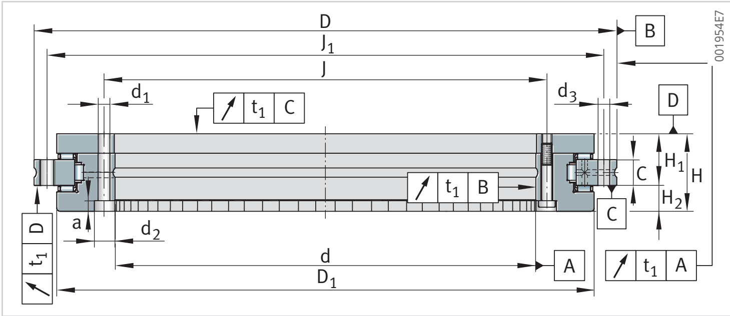
YRTCM325-XL

C_a	C_{0a}	C_r	C_{0r}	n_G	n_{Ref}	M_R	m
N	N	N	N	min^{-1}	min^{-1}	Nm	kg
128000	650000	74000	146000	800	–	4	6,4
134000	730000	100000	200000	600	–	5	7,7
147000	850000	123000	275000	450	–	6	9,7
168000	1090000	140000	355000	300	–	9	18,3
247000	1900000	183000	530000	200	–	13	25
265000	2190000	200000	640000	200	–	19	33
290000	2550000	265000	880000	150	–	25	45

3.15.3 YRTCM, mounting dimensions, rigidity values

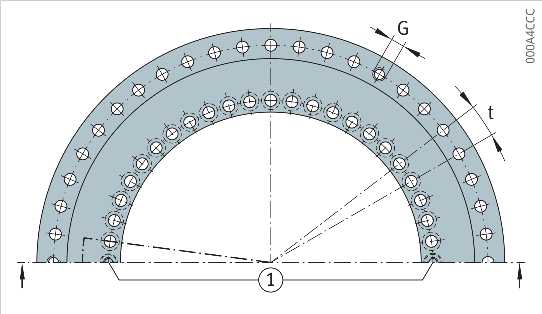
Double direction

With incremental angular measuring system

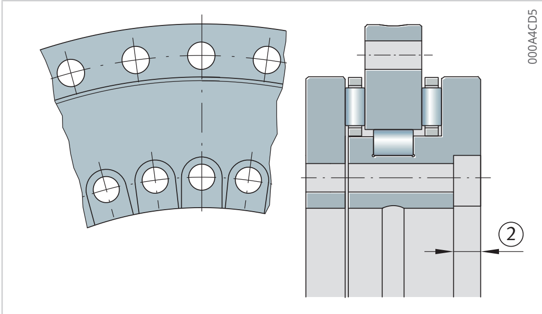


YRTCM

Designation	d_1	d_2	a	n_I	d_3	n_A	M_A
–	mm	mm	mm	–	mm	–	Nm
YRTCM150-XL	7	11	6,2	34	7	33	14
YRTCM180-XL	7	11	6,2	46	7	45	14
YRTCM200-XL	7	11	6,2	46	7	45	14
YRTCM260-XL	9,3	15	8,2	34	9,3	33	34
YRTCM325-XL	9,3	15	8,2	34	9,3	33	34
YRTCM395-XL	9,3	15	8,2	46	9,3	45	34
YRTCM460-XL	9,3	15	8,2	46	9,3	45	34



Hole pattern



YRTCM325-XL

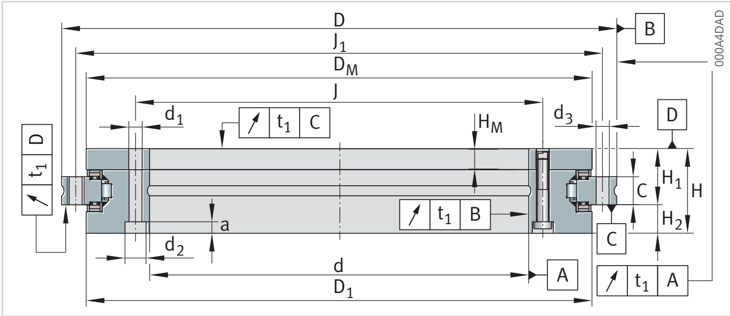
n	t	G	n_{GA}	c_{aL}	c_{rL}	c_{kL}	c_{aW}	c_{rW}	c_{kW}
–	°	–	–	N/μm	N/μm	Nm/mrad	N/μm	N/μm	Nm/mrad
36	10	M8	3	3800	3200	18600	12000	4800	61000
48	7,5	M8	3	4700	3600	29000	13500	5300	88500
48	7,5	M8	3	4900	4100	40000	15500	6200	128000
36	10	M12	3	6900	5300	104000	19000	8100	265000
36	10	M12	3	7100	6300	159000	33000	9900	633000
48	7,5	M12	3	9900	5800	280000	37000	13000	1002000
48	7,5	M12	3	12000	6500	429000	43000	17000	1543000

3

3.15.4 YRTSM, main dimensions, performance data

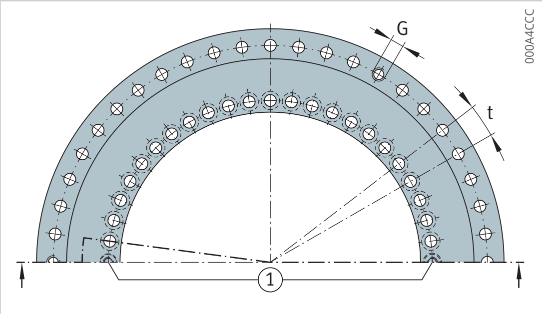
Double direction

With incremental angular measuring system

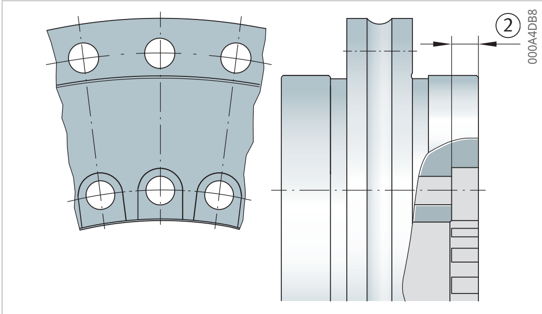


YRTSM

Designation	d	D	H	H_1	H_2	C	D_1 max.	J	J_1
–	mm	mm	mm	mm	mm	mm	mm	mm	mm
YRTSM200	200	300	45	30	15	15	274,4	215	285
YRTSM260	260	385	55	36,5	18,5	18	347	280	365
YRTSM325	325	450	60	40	20	20	415,1	342	430
YRTSM395	395	525	65	42,5	22,5	20	487,7	415	505
YRTSM460	460	600	70	46	24	22	560,9	482	580



Hole pattern



YRTSM325

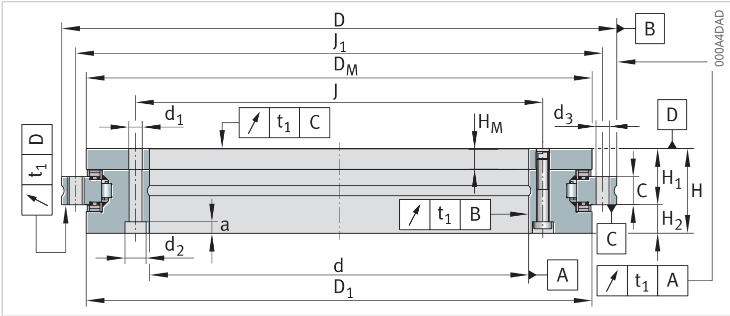
C_a	C_{0a}	C_r	C_{0r}	n_G	n_{Ref}	M_R	m
N	N	N	N	min^{-1}	min^{-1}	Nm	kg
155000	840000	94000	226000	1160	30	–	9,7
173000	1050000	110000	305000	910	25	–	18,3
191000	1260000	109000	320000	760	25	–	25
214000	1540000	121000	390000	650	15	–	33
221000	1690000	168000	570000	560	15	–	45

3

3.15.5 YRTSM, mounting dimensions, rigidity values

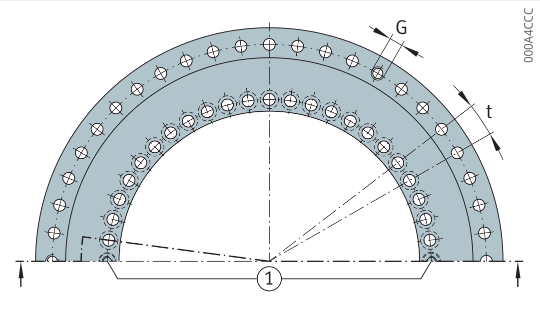
Double direction

With incremental angular measuring system

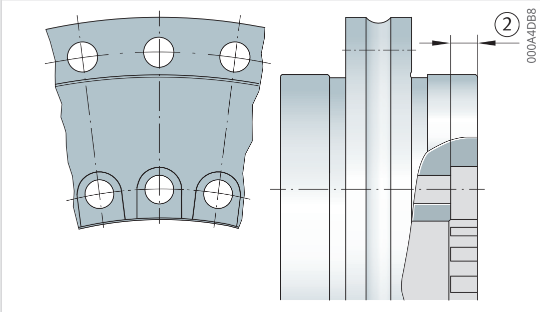


YRTSM

Designation	d_1	d_2	a	n_I	d_3	n_A	M_A
–	mm	mm	mm	–	mm	–	Nm
YRTSM200	7	11	6,2	46	7	45	14
YRTSM260	9,3	15	8,2	34	9,3	33	34
YRTSM325	9,3	15	8,2	34	9,3	33	34
YRTSM395	9,3	15	8,2	46	9,3	45	34
YRTSM460	9,3	15	8,2	46	9,3	45	34



Hole pattern



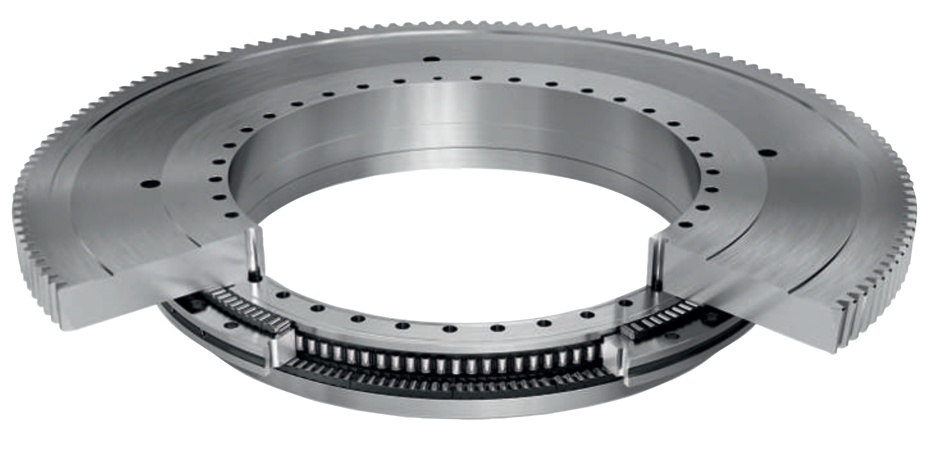
YRTSM325

n	t	G	n_{GA}	c_{aL}	c_{rL}	c_{kL}	c_{aW}	c_{rW}	c_{kW}
–	°	–	–	N/μm	N/μm	Nm/mrad	N/μm	N/μm	Nm/mrad
48	7,5	M8	3	4000	1200	29000	13600	3900	101000
36	10	M12	3	5400	1600	67000	16800	5800	201000
36	10	M12	3	6600	1800	115000	19900	7100	350000
48	7,5	M12	3	7800	2000	195000	23400	8700	582000
48	7,5	M12	3	8900	1800	280000	25400	9500	843000

4 Axial/radial bearings featuring shaft locating washer with helical gear teeth

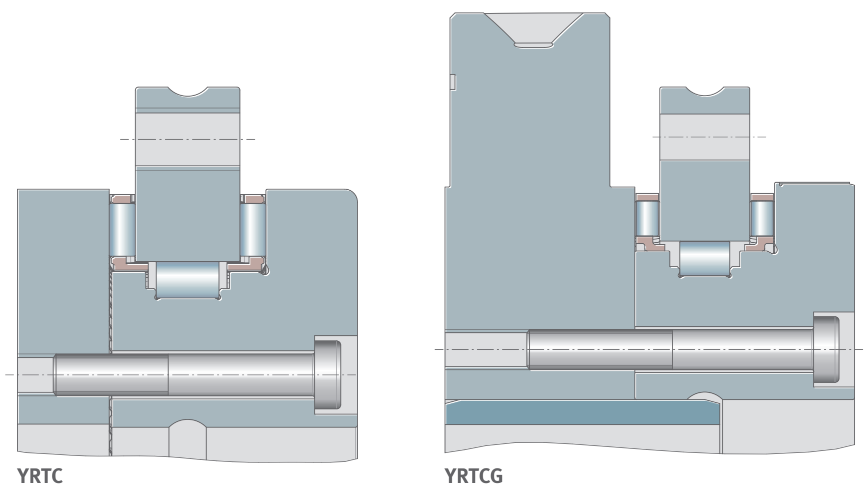
Axial/radial bearing YRTCG featuring shaft locating washer with helical gear teeth

74 Axial/radial bearing YRTCG featuring shaft locating washer with helical gear teeth



Axial/radial bearings YRTCG are based on the YRTC bearing design. This proven rotary axis bearing solution is available in bore diameters 150 mm to 580 mm as a new variant featuring a shaft washer with helical gear teeth.

75 Further development of the YRTC bearing construction to create YRTCG



Advantages

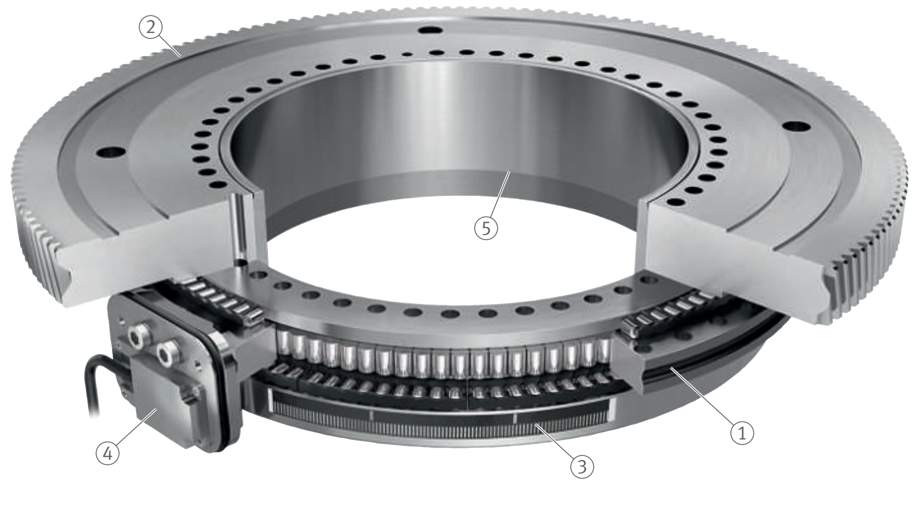
- high tilting rigidity combined with low bearing frictional torque
- new design options for increasing performance and saving costs
- large passage for cables and hoses
- reduction in the number of components, installation space and weight achieved through the omission of a gear wheel

- increased accuracy and improved dynamic characteristics of the entire system due to the smaller number of components
- reduced costs due to simplified assembly
- applications include rotary tables with gear teeth, milling heads

Axial/radial bearing YRTCGMA featuring shaft locating washer with helical gear teeth and inductive measuring system

A combination of YRTCG and absolute angular measuring system MHA is achieved with the variant YRTCGMA.

76 Axial/radial bearing YRTCGMA featuring shaft washer with helical gear teeth and inductive measuring system



1	Rotary table bearing YRTCGMA	2	Shaft washer with helical gear teeth
3	Measurement ring	4	Measuring head MHA-0
5	Centring sleeve		

4.1 Further information

Further information can be found in the following publications:

PDB 77 | Axial/Radial Bearings with Toothed Shaft Washer | https://www.schaeffler.de/std/201D

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