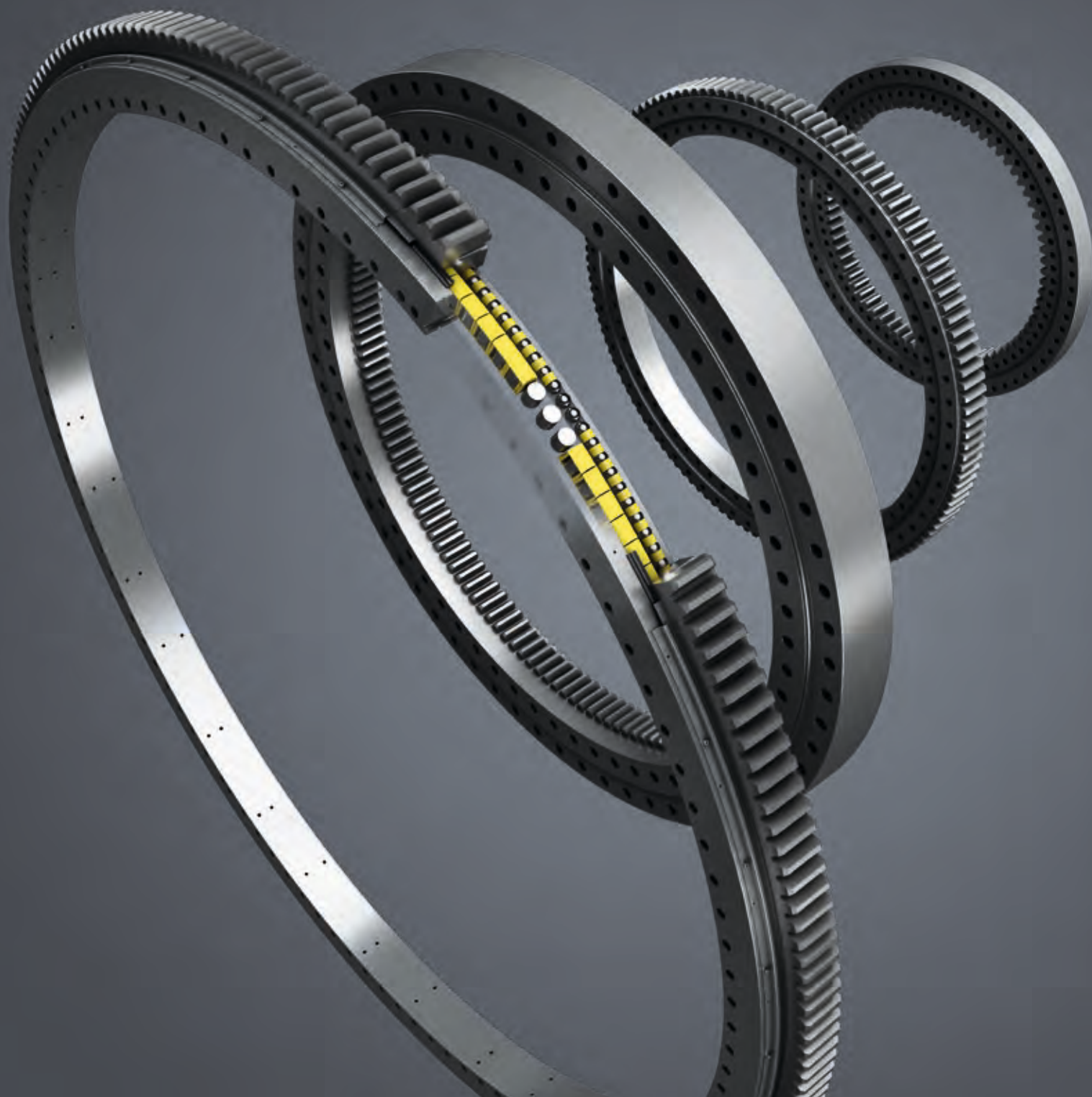


Product Catalogue
Slewing Bearings



LIEBHERR

Foreword and Disclaimer

This product catalogue provides information on the comprehensive, standard range of Liebherr slewing ring bearings for diameters between 800 mm and 6,000 mm. Diameters out of this range are available on request.

The content of this catalogue was compiled with the utmost care. However, no responsibility can be taken for the correctness, completeness and topicality of the disclosed information.

We reserve the right to make changes resulting from the further development of the product range.

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For the latest version of the Large Diameter Bearing Product Catalogue by Liebherr, please visit www.liebherr.com/components-downloads.

Please contact us for further information.

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1 High-quality slewing bearings for all applications

Liebherr is one of the leading global manufacturers of slewing bearings and has over 60 years of experience in the development, design and manufacturing of ball and roller bearings. Customers appreciate in particular the large product range, application-specific development and outstanding quality of large diameter bearings from Liebherr.

Extensive product portfolio

The current product range includes slewing ring bearings which may be single- or double-row four-point contact, triple-row roller or a combination of both ball and roller elements. In addition to standard types, a variety of customised and application specific special designs are available.

Liebherr manufactures slewing bearings for a wide range of applications. Liebherr can manufacture the bearing with external, internal or no gearing. The gears are available in common or uncommon modules.

Versatile applications

The areas of application in which the large diameter bearings from Liebherr are used are as diverse as the designs. These include construction machines such as excavators and drilling rigs, mining equipment, cranes such as construction, mobile and offshore, maritime applications, vehicles, machine tools and wind turbines.

System solutions from a single source

Liebherr provides system solutions from a single source. The slewing bearings are ideally combined with slewing drives and swivelling drives from Liebherr. Upon request, electric or hydraulic motors, as well as control technology, are also available as complimentary components. The selection is thus made simply and quickly for our customers.



Combination of slewing bearing and slewing drive



Combination of slewing bearing and swivelling drive

Quality and reliability

All components satisfy the very highest standards with respect to functional reliability and durability, even under extreme loads. World-class quality management and extensive analysis and test procedures are practised throughout the entire development and production process, guaranteeing reliability and long component service life.

Consistent quality management

Excellent quality is a trademark of Liebherr products. The quality management of Liebherr-Components Biberach GmbH is certified according to DIN EN ISO 9001. To achieve and maintain these high standards, Liebherr uses advanced Finite Element Methods (FEM) as well as Failure Mode Effects Analysis (FMEA). These high standards also continue with the choice of suppliers and through after-sale service.

All production and assembly processes are documented in a computer-supported operating data recording system. This is also used as a central quality management system that records production and assembly measurements. This allows comprehensive control, monitoring and traceability. The processes are continuously improved through diverse assessments.

Highest quality of raw materials

All individual components of the large diameter bearings are selected according to the application, and are subject to the highest quality standards. Raw parts and components are only supplied from qualified suppliers, who are audited regularly. For certain raw materials, such as rolled steel rings, our own company standards apply which go beyond the common industry standards.



CMM machine for slewing bearings



Quality check of slewing bearings using UV light

Use and features of application-specific materials

The design of each large diameter bearing is largely determined by the expected environmental conditions. In this respect, in addition to the usual 42CrMo4 alloy, Liebherr also uses steels with adapted alloy components as a base material for bearings in low temperature applications. Upon request from the customer, bearing cages made from steel or brass alloys can also be used in place of polymer spacers. The special sealing systems and coatings for reliable protection against corrosion and increased wear are in constant further development by Liebherr. The lubrication ports are arranged as required and depend on the adjacent structure interface. Gearing is predominantly designed as spur gearing, but helical and worm gears are also possible.

Certifications and classifications

Often times, classifications and certifications are required by certified bodies for specific applications. Some examples of these certifications are:

- Det Norske Veritas - Germanischer Lloyd (DNV GL)
- American Bureau of Shipping (ABS)
- Bureau Veritas
- Lloyds Register of Shipping
- American Petroleum Institute (API)



Quality check of slewing bearings

Liebherr is able to look back on a long-term collaboration with the certification bodies, which is characterised by the certification of complete systems with Liebherr components.

Depending on the requirement of the test and documentation scope, various certificates are provided in accordance with EN 10204.

For typical applications in machine and plant construction:

- Certificate of Compliance 2.1
- Factory Certificate 2.2
- Acceptance Certificate 3.1

For special requirements:

- Acceptance Certificate 3.2

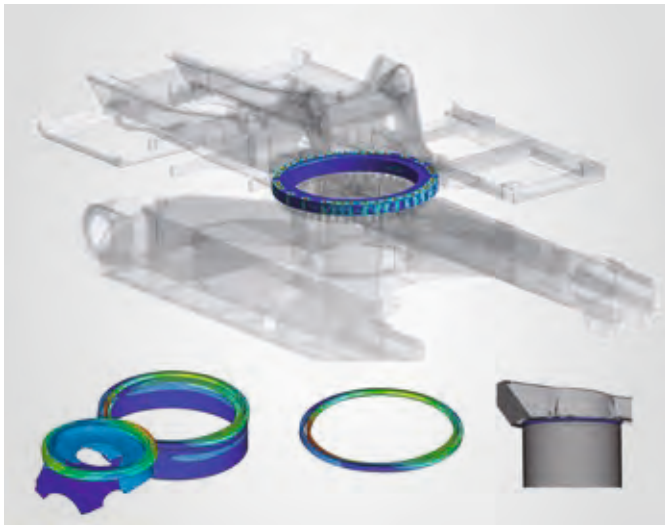
The certificates must be presented to the classification bodies within the framework of an inspection. If necessary, the certificates are provided by Liebherr.



Classification bodies

Production and sales

The slewing bearings are manufactured at Liebherr locations in Biberach an der Riß (Germany), Monterrey (Mexico) and Guaratinguetá (Brazil). The sale of components to customers outside the Liebherr Group is managed centrally by Liebherr-Components AG in Nussbaumen, Switzerland. Our customers are managed centrally from there.



Finite Element Method



Spacers, rolling elements, seals and lubricant



Slewing bearing in production



Gear milling

Production sites

Liebherr-Components Biberach GmbH

Liebherr-Components Biberach GmbH develops and manufactures high-performance components – such as electric machines, gearboxes and slewing bearings, rope winches and switchgears – both for the Liebherr Group and for external customers. The large diameter bearings supplied from Biberach are used in construction machines such as excavators and drilling rigs, mining equipment, cranes, maritime applications, vehicles, machine tools or wind turbines.

Facts and Figures:

- Founded: 1954 as Liebherr-Werk Biberach GmbH (foundation of Liebherr-Components Biberach GmbH in 2012)
- No. of employees: 1,430
- Plant premises: 345,657 m²
- Constructed area: 106,355 m²



Liebherr-Components Biberach GmbH, Germany

Liebherr Monterrey, S. de R.L. de C.V

The production company Liebherr Monterrey, S. de R.L. de C.V. manufactures high-quality and efficient single-row and multi-row ball and roller bearings as well as special rings in diameters up to 3,500 mm. These products are mainly used in wind turbines, construction machines and maritime applications, but also in mining equipment, vehicles or machine tools.

Facts and Figures:

- Founded: 2009
- No. of employees: 140
- Total area: 300,000 m²
- Constructed area: 90,000 m²



Liebherr Monterrey, S. de R.L. de C.V, Mexico

Liebherr Brasil Ltda.

Liebherr Brasil Ltda. manufactures excavators, wheel loaders, tower cranes, stationary mixing plants and truck mixers, as well as maritime cranes. The company also organises the sales, technical customer services and spare parts supply for other product lines of Liebherr in Brazil. Starting in 2016, large diameter bearings up to 4,500mm are being produced for use in wind turbines and industrial applications.

Further information

Visit our website bearings.liebherr.com and find out more about our products, current events, news and points of contact.

Facts and Figures:

- Founded: 1974
- No. of employees: 1,090
- Total area: 951,437 m²
- Constructed area: 56,672 m²



Liebherr Brasil Ltda. in Guaratinguetá, Brasil

2 Overview of bearing types

Standard types



Single-row four-point bearings – with external gear



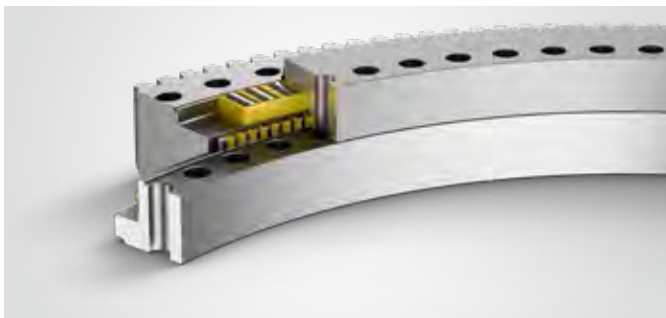
Single-row four-point bearings – with internal gear



Double-row four-point bearings – with external gear



Double-row four-point bearings – with internal gear



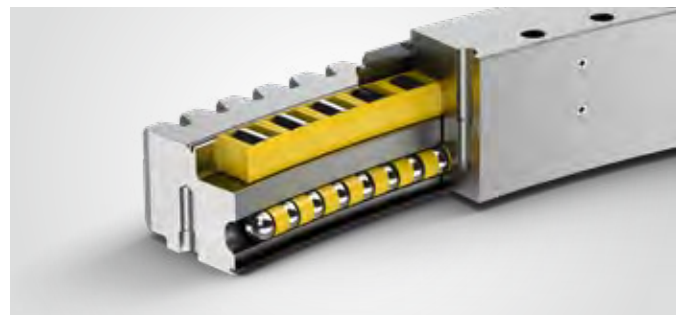
Triple-row roller bearings – with external gear



Triple-row roller bearings – with internal gear



Double-row ball bearings (double, axial ball bearings, double thrust bearings) – with external gear/with internal gear/no gear

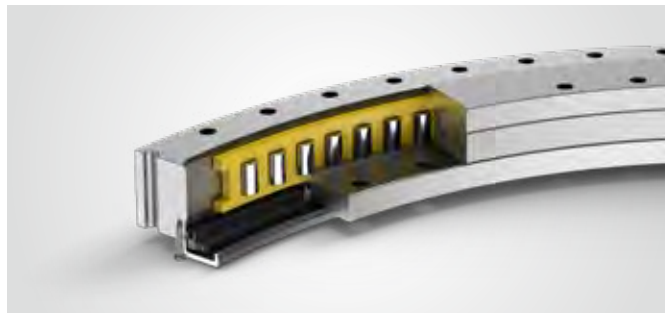


Combined roller and ball bearings – with external gear/with internal gear/no gear

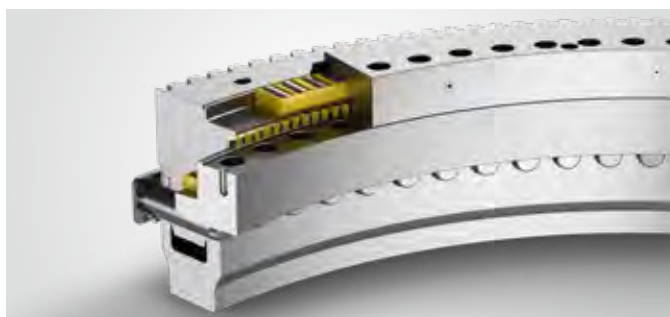
Other types



Cross roller bearings –
with external gear/with internal gear/no gear



Radial bearings –
with external gear/with internal gear/no gear



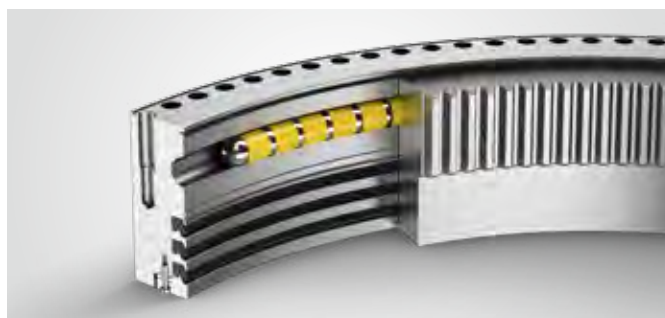
Roller bearings with bolt connection –
with external gear/with internal gear/no gear



Roller bearings with bayonet joint –
with external gear/with internal gear/no gear



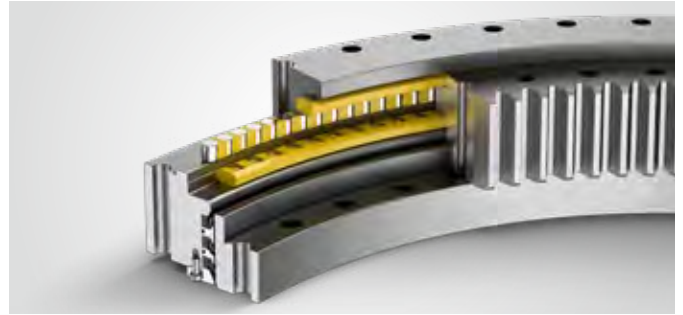
Tapered roller bearings –
with external gear/with internal gear/no gear



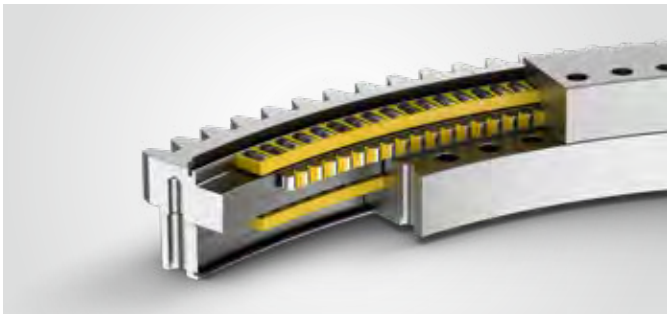
Single-row four-point bearings with special seals –
with external gear/with internal gear/no gear



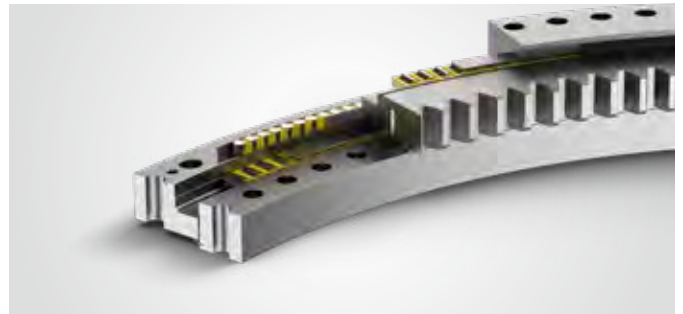
Double-row four-point bearings with special seals –
with external gear/with internal gear/no gear



Triple-row roller bearings with special seals –
with external gear/with internal gear/no gear



Segmented bearings with induction hardened raceways –
with external gear/with internal gear/no gear



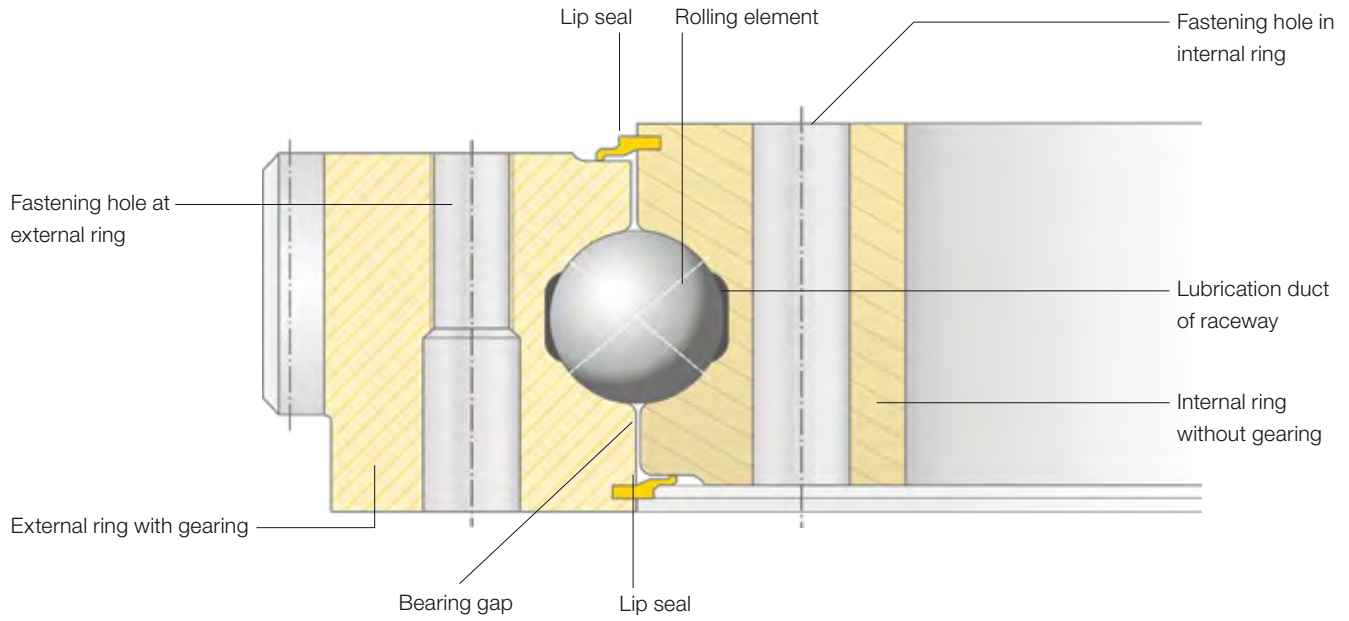
Segmented bearings with hardened insertion plates –
with external gear/with internal gear/no gear with insertion plates



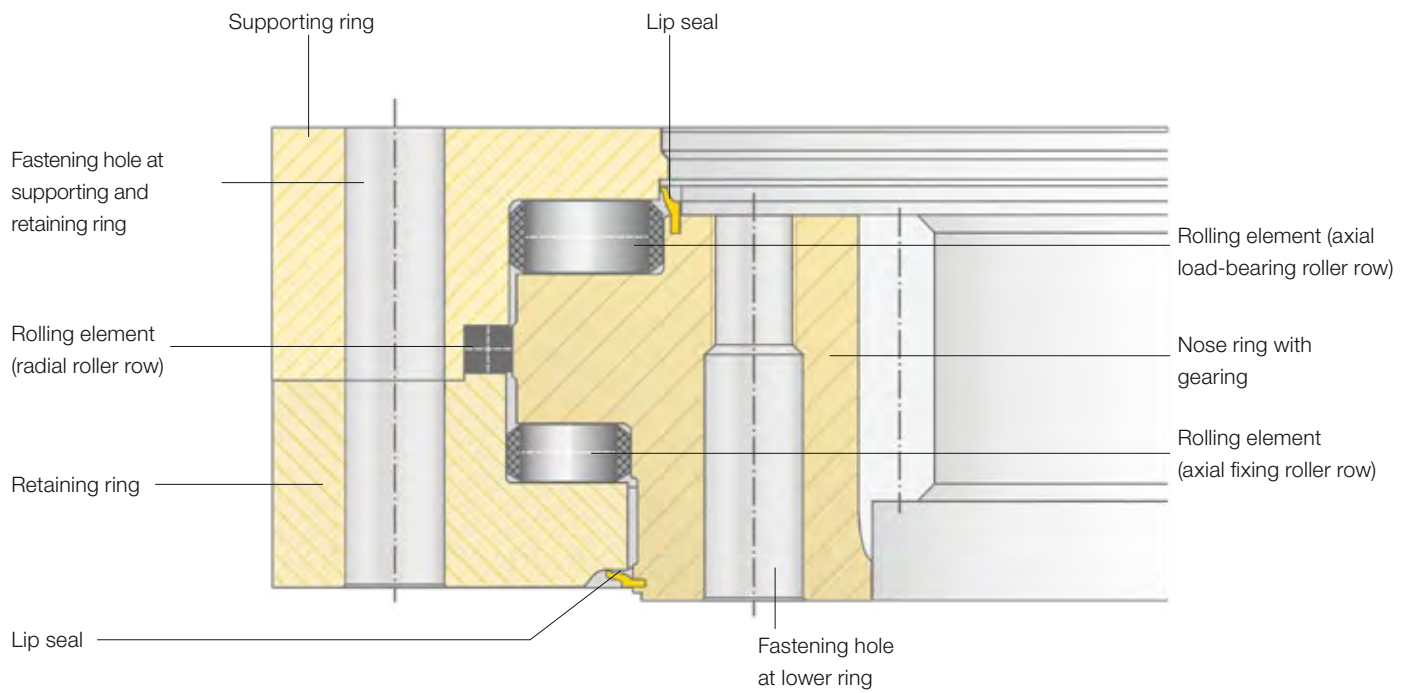
Gear rings –
with external gear/with internal gear

3 Structure of four-point bearings and roller bearings

■ Cross-section through a four-point bearing with external gear



Cross-section through triple-row roller bearing with internal gear



4 Materials

Bearing rings

Different materials are used for the bearing rings depending on the application and purpose of the Liebherr large diameter bearing. These are made from tempered alloy steel as standard, which is specified by our own company standards (LN), derived from DIN EN 10083-1. For applications needing additional properties, special materials are used such as chrome-nickel steels for low temperature environments.

The chemical composition, handling of the material during the formation of the raw parts, and the mechanical properties of the basic material through to the EN requirement are stipulated in the company standards. To ensure consistent quality,

each raw part is monitored during the manufacturing process based on test criteria, which are defined in the Liebherr standard. Regular audits at the suppliers ensure compliance with the delivery specifications.

Depending on the requirement of the test and documentation scope, various certificates are provided for the raw parts in accordance with DIN EN 10204.

Upon request, all documents required for the certification or classification of components or systems are provided.



Rolled ring on turning machine

Rolling element

Only balls and rollers made from hardened anti-friction bearing steel are used as rolling elements. The material is specified in our own company standards based on DIN 5401, DIN 5402 and ISO 3290-1. The chemical composition and the properties of the material are prescribed via the requirement of DIN/ISO.

To ensure consistent quality, each production batch is monitored during the manufacturing process based on defined test criteria.

Regular audits at the suppliers ensure compliance with the delivery specifications.

Spacers

The spacers and roller cages are made from specially developed polyamide and are responsible for guiding the rolling elements and keeping them equidistant during rotation. Keeping the rolling elements from colliding will ensure reliable operation. Consistently high quality is ensured through regular mechanical material testing.

For special applications cages or cage strips made from metal and plastic can be used.



Rolling elements



Polymer spacers

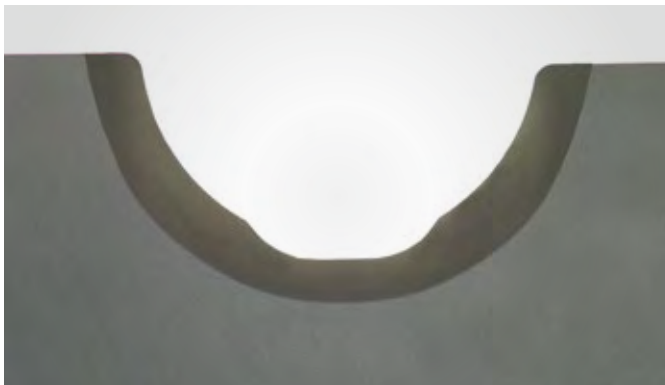
5 Raceway

For the manufacture of the rolling element raceways, Liebherr relies on its in-house manufacturing expertise to machine the raceway contours.



Manufacturing process - Turning

This is followed by the hardening of the raceway on separate induction hardening machines.

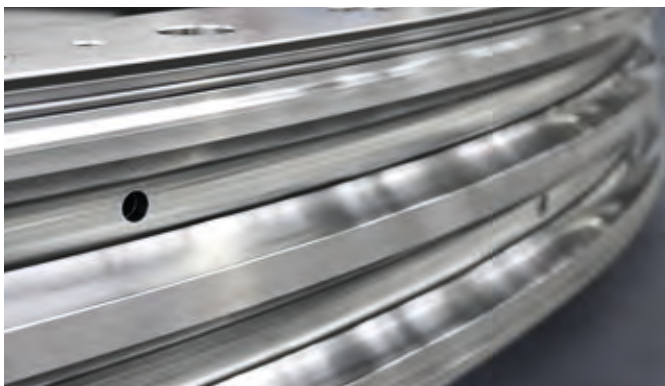


Grinding pattern of a ball bearing slewing ring with hardened case

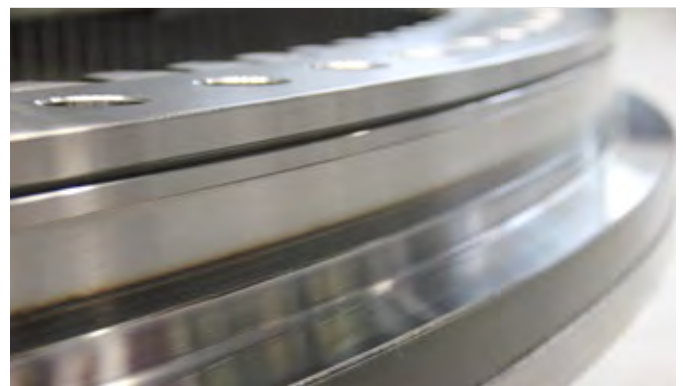


Grinding pattern of a roller bearing slewing ring with hardened case

To complete the raceway, it is ground after induction hardening to a surface finish of Ra 0.8 micrometers.



Fully processed ball raceway



Fully processed roller raceway

6 Seals

Slewing bearings from Liebherr are mostly designed with lip seals on both sides of the raceway system. These mainly have two tasks to fulfil:

- They prevent direct entry of moisture, dust and other foreign particles from outside into the bearing gap.
- They separate the raceway system from the surrounding area.

Various types and materials of seals are available. The type and material of the seals depends on the geometry, application and surrounding environmental conditions of the bearing.

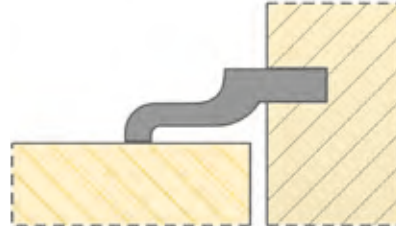
For applications in construction machines, as well as in general machine and plant construction, seals with a simple lip design have been highly successful. In special applications, however, different seal geometries are necessary. For example, a simple lip seal would not be effective in particle rich environments or keep grease from exiting the raceway.

Our seal materials are optimised in terms of the operating conditions. However, the seals are still subject to a certain amount of wear, for example by the effect of different environmental factors such as direct UV radiation and ozone influences. Therefore, they must be checked at regular intervals and replaced if necessary.

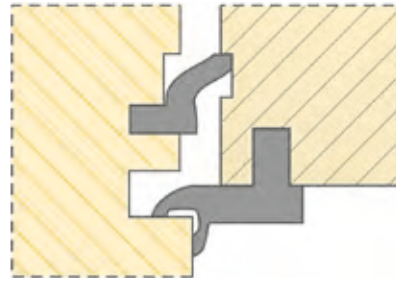
The surrounding area of the seals must be designed so that damage may not arise from assembly activities, or from the use of fastening tools.

It is also necessary to ensure during installation that an even grease collar is formed at the seal (see chapter 18 "Lubrication").

Examples for seals:



Lip seal

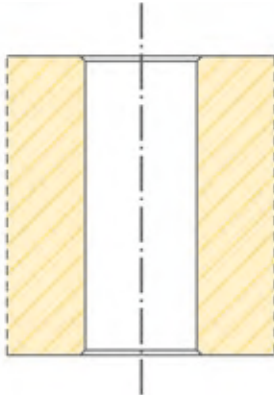


Double seal

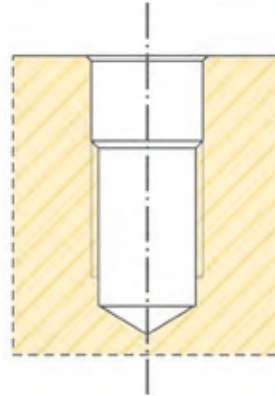
7 Bolt

Fastening bores

Fastening holes are available for securing the Liebherr slewing bearings at the adjacent construction. Depending on the application and the existing adjacent construction, they may either be designed as through or blind holes with all common thread types.



Through hole



Blind threaded hole

At the execution of the securing as a blind threaded hole, the thread is free drilled in most cases, to achieve the greatest possible grip length of screwing. In principle, all bore hole types are possible upon request.

Through holes for metric threads

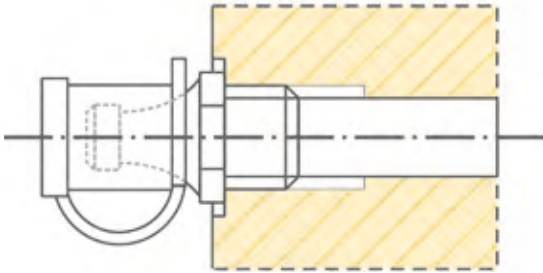
Metric ISO thread i.a.w. DIN 13-1	M10	M12	M14	M16	M18	M20	M22	M24	M27	M30	M33	M36	M39	M42	M45	M48	M52	M56	M60	M64
Through holes (DIN EN 20273, tol.cl. medium)	11	13.5	16	17.5	20	22	24	26	30	33	36	39	42	45	48	52	56	62	66	70

Through holes for imperial threads

Thread size of through hole i.a.w. ASME B18.2.8-1999, R2005	Through hole [Inch]	Through hole [mm]
7/16" – 14 UNC	15/32	12
1/2" – 13 UNC	9/16	14.5
5/8" – 11 UNC	11/16	17.5
3/4" – 10 UNC	13/16	21
7/8" – 9 UNC	15/16	24
1" – 8 UNC	1 3/32	28
1 1/8" – 7 UNC	1 7/32	31
1 1/4" – 7 UNC	1 11/32	34
1 3/8" – 6 UNC	1 1/2	38
1 1/2" – 6 UNC	1 5/8	41

Lubrication ports

Lubrication ports are available for lubricating the bearing raceway. Depending on the installation conditions, these are either arranged radially or axially and have a M10×1 thread as standard and are also sealed with a plastic plug.



Lubrication port with threaded nipple

Lubrication lines for central lubrication systems, lubricating nipples or continuous lubricant dispenser can be connected at the lubrication ports.

Upon request, conical grease nipples i.a.w. DIN 71412 Form A M10×1 can be mounted at the factory. The threads of the conical grease nipples are designed i.a.w. DIN 158 "M10×1 con. short version". These have plastic lids to provide protection against damage and dirt contamination.

Other lubrication ports such as flat lubricating nipples, imperial threads or other design sizes are available by request.

8 Gearing

Liebherr slewing bearings can be manufactured with internal and external gears. Both are mainly designed as a spur gearing. Special gearing, such as helical and worm gearing, are also available upon request. All our bearings are also available without gearing.



Gear milling

Diametral Pitch

Diametral Pitch, Pd, is the number of teeth per inch along the pitch circle diameter. It can be represented as follows for general pinions/and gears (d, z):

Conversion: Module to Diametral Pitch

$$P_d = \frac{z}{d} \quad \begin{array}{l} (z = \text{number of teeth}) \\ (d = \text{pitch circle diameter}) \end{array}$$

$$m = \frac{25.4}{P_d} \quad (m = \text{module})$$

Module

The module, m, depicts the size of the gear teeth. It is defined as the amount of circular pitch, p, per tooth. Module is related to pitch as follows: p and pi π:

$$m = \frac{p}{\pi} \quad \begin{array}{l} (p = \text{circular pitch}) \\ (\pi = \text{circular number}) \end{array}$$

or alternatively as the ratio of pitch circle diameter d and number of teeth z.

$$m = \frac{d}{z} \quad \begin{array}{l} (d = \text{pitch circle diameter}) \\ (z = \text{number of teeth}) \end{array}$$

Preferred module dimensions

Module in mm according to preferred dimensions i.a.w. DIN 780	1	1.25	1.5	2	2.5	3	4	5	6	8	10	12	16	20	25	32	40	50

Design and quality of the gearing

The standard version of the gearing is effected with involute toothing i.a.w. DIN 867 with the standard pressure angle $\alpha = 20^\circ$.

To optimise the gearing, profile displacement and modification of the root rounding are performed. I and II are used for the reference profile i.a.w. DIN 3972. Addendum reductions are also possible.

By default, the gear cutting quality of all Liebherr large diameter bearings is Q12:

- upper **tooth thickness** A_{sne} i.a.w. DIN 3967 (table 1) i.a.w. **deviation series b-e**.
- **Tooth thickness tolerance** T_{sn} i.a.w. DIN 3967 (table 2) i.a.w. **tolerance series 26-28**.

Other qualities or tolerance zones can be implemented upon request.

Design and calculation of gearing

The strength of the gearing is generally checked in accordance with ISO 6336. Here, the technical data such as dimensions, number of teeth, profile displacement, as well as material properties of the drive pinion, are taken into account.

Hardening of gearing

In most cases, the gear teeth are left in the natural state as the ring itself. The strength properties of the gear teeth are that of the base material. If the application calls for additional strength and wear properties, the gear teeth will undergo induction hardening. The hardening of the teeth will increase the wear and strength properties to the desired level.

Depending on the pitch circle diameter and module of the gearing, the teeth are treated by inductive hardening or spin hardening. In order to avoid metallurgical notches in the transition zone to the unhardened material, the teeth are hardened predominantly in the root of each tooth.

As well as improved flank load capacity, increased strength at the tooth root is also achieved.



Hardening microsection of tooth spacing hardening

Backlash

By adjusting the backlash between the teeth of the pinion and the teeth of the bearing, constraints of the gear pairing are avoided during operation.

With a fitted bearing, the backlash with the highest eccentricity of the gearing should not fall below the value of $0.03 \times \text{module}$ and should not exceed the value of $0.06 \times \text{module}$. For this purpose, this point is marked with a corresponding symbol:

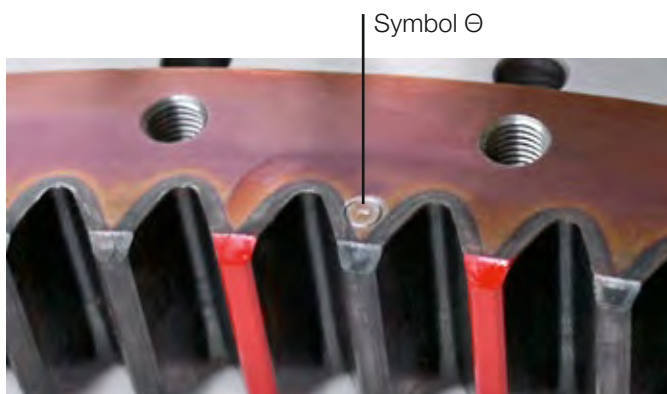
- **External gears:** Symbol \oplus
(largest available pitch circle diameter),
- **Internal gears:** Symbol \ominus
(smallest available pitch circle diameter).

The teeth on the left and right are marked in red.

The backlash can be adjusted by the following two measures:

- Move the large diameter bearing within the tolerances of the fastening holes
- Eccentric fastening of the drive pinion to change center distance at those teeth

The setting must be checked again after the fastener connection is tightened.



Marking of point of maximum eccentricity for internal gear

Drive pinion

With a recommended profile displacement of

$$V_{A,\text{pinion}} = +0.5 \times m$$

the number of teeth of the pinion should not be below twelve teeth.

The gearing width of the pinion should project over the tooth width of the bearing on both sides by approx. $0.5 \times \text{module}$.

The gear cutting quality of the drive pinion is adapted to the application (at least gear cutting quality **Q9**):

- Upper tooth thickness A_{sne} i.a.w. DIN 3967 (table 1) according to **deviation series b-e** and
- tooth thickness tolerance T_{sn} i.a.w. DIN 3967 (table 2) according to **tolerance series 26-28**

An addendum chamfer is therefore essential. Tip relief and flank line correction are recommended.

Tooth corrections are determined by Liebherr upon request.

We recommend a surface hardness of at least $HV_{\min} = 675$ at the pinion gearing. If a separate gearing calculation was performed, the hardness values must be taken from the calculation.

If a Liebherr slewing drive is also ordered for the bearing, Liebherr assumes the entire coordination of the components.

9 Geometric properties

Permissible dimensional deviations

Diameter tolerance of bearing, general tolerances

Outer and inner diameter [mm]	Tolerance range [mm]
400 to 1,000	± 0.80
1,000 to 2,000	± 1.20
2,000 to 4,000	± 2.00
4,000 to 6,000	± 3.00
> 6,000	± 4.00

Position tolerance of fastening holes

Nominal thread dimension or bore hole diameter	Permissible dimensional deviations i.a.w. Liebherr company standard LN 28-1 [mm]
M6	Ø 0.20
< M10	Ø 0.30
< M16	Ø 0.50
< M24	Ø 0.70
< M42	Ø 1.00
≥ M42	Ø 1.30

Run-out deviation of gearing

The run-out of the gearing depends on the play and run-out of the race-way system, in addition to the run-out deviation prescribed by the gearing standard.

Bearing clearance

Liebherr slewing bearings already have a precisely defined bearing clearance set ex works. This guarantees good running characteristics and the functional reliability of the bearing.

Constrictions in the raceway system, caused by possible deviations from the projection of the adjacent construction, may lead to constraints of the raceway system. As a result, it may cause stiffness and impermissibly high loads on the rolling elements and the raceway.

The play is adapted according to the application. Depending on the operating conditions, the bearing clearance may change during the operating time due to mechanical wear of the raceways and the rolling elements. The wear limit is reached from a certain dimension. It is dependent on the type and size of the bearing and the application. The bearing then has to be replaced.

Standard Liebherr bearing clearance

Bearing type	Bearing clearance when delivered [mm]
Ball bearing	0.00 to 0.50
Roller bearing	0.00 to 0.50

Bearing preload

For special requirements, for example in hydraulic excavators or wind turbines, bearings are customised to the respective application. They are also manufactured with a defined preload of the bearing raceways.

A bearing with play only has small frictional resistance. With the preload of the bearing raceways, the frictional resistance of the bearing increases, and then some when under load.

This must be taken into consideration in the design of the drive!

Furthermore, false brinelling is effectively prevented by the preload. False brinelling is mainly caused by constant vibrations when the bearing is at a standstill and leads to a reduction in the service life.

For bearings with different temperatures between external and internal ring the bearing clearance is set specifically.

10 Surface coating and corrosion protection

Liebherr slewing bearings can be coated to protect the outer metallic ring surfaces against corrosion. Various technologies are used here in accordance with DIN EN ISO 12944 and DIN EN ISO 2063.

Corrosion inhibiting wax or Liebherr base coat (primer) can be used.

Cleaning and blasting

Surfaces or prior coatings must be cleared of contaminants such as dust, grease, oil, salt or other dirt before the coating. All parts to be treated are cleaned thoroughly using a cleaning agent, degreased and dried with oil-free air. The wait time between cleaning and blasting is between two and four hours. The thermal spray process with zinc (TSC) is effected in accordance with DIN EN ISO 2063.

If the Liebherr primer is used, there is no need to remove the protective wax film.

Corrosion categories

Classification

Corrosion category	Requirement	Ambient conditions
C1	insignificant	–
C2	weak	Atmosphere with little pollution
C3	moderate	Urban atmosphere and industrial climate, moderate pollution by sulphur dioxide (IV); coastal areas with low salt concentration
C4	strong	Industrial climates and coastal areas with moderate salt concentration
C5-M	very strong	Coastal and offshore areas with high salt concentration

Layer structure

Corrosion category	Designation	Layer thickness [µm]
C1	1. GA1	50
	Total	50
C2	1. GA1	50
	1. DA2	80
	Total	130
C3	1. GA1	90
	1. DA2	70
	Total	160
C4	1. GA1	80
	2. GA1	120
	1. DA2	80
	Total	280
C5-M	1. GA1	80
	2. GA1	160
	1. DA2	80
	Total	320

GA1 = Primer

DA2 = Topcoat

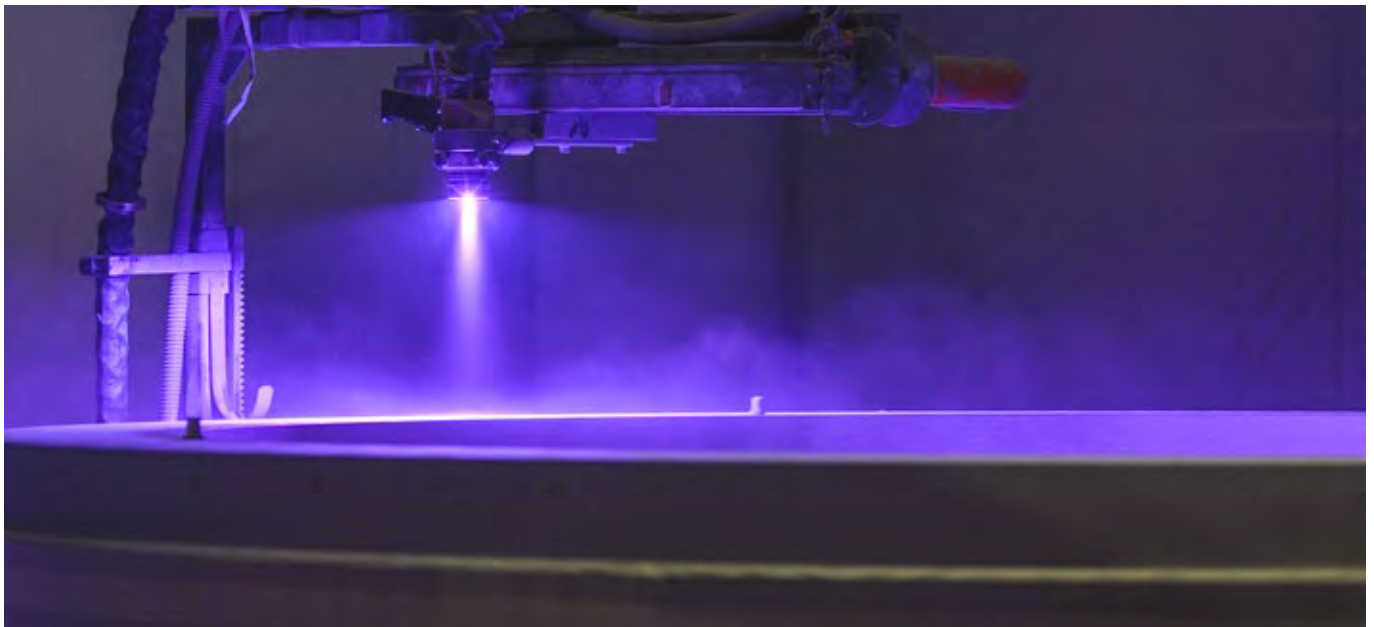
Thermal zinc spraying

Slewing bearings from Liebherr may also be protected with a special layer structure as an alternative to the standard layer structures shown in table "Layer structure". This surface protection achieves the protection class C5-M and thus corresponds to the highest protection needs.

The structure is made up of a combination of thermal zinc spraying (base coat) and paint (topcoat). As a base for the additional paint coating, the thermal zinc spraying i.a.w. DIN EN ISO 2063 provides additional cathodic corrosion protection of the surfaces by the 'self-restoring' effect of the zinc layer in the event of damage.

Liebherr sets standards in terms of surface protection thanks to the use of state-of-the-art equipment technology in the coating of components.

If the large diameter bearings are not protected against corrosion with a surface coating, the outer surfaces of the large diameter bearing are treated with corrosion inhibiting wax. This must be removed before installation.



Thermal zinc spraying

11 Operating temperature

The standard version of Liebherr slewing bearings is suitable for operating temperatures between -30°C and $+80^{\circ}\text{C}$.

If deviating operating or stagnation temperatures are planned or probable, the material properties and strength properties must be checked. This must be checked by Liebherr in each case.

12 Requirements of adjacent construction

Ideal adjacent construction

In relation to its diameter, the cross-section of large diameter bearings is very small. Therefore, the inherent stability is significantly lower than the stability and stiffness of the adjacent construction.

As a rule, bearings are not suitable for compensating instabilities and deformations of the adjacent construction. This is why the adjacent construction must be as homogeneous and rigid as possible and the external forces must be transferred as evenly as possible to the bearing.

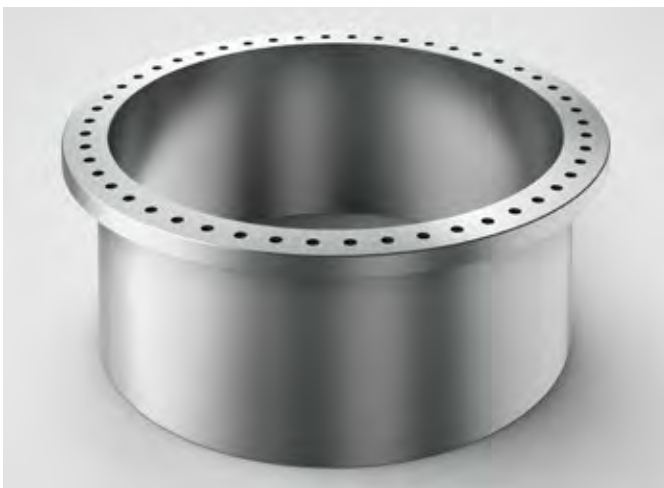
The bearing cannot be used to reinforce a structure! The average inner diameter of the adjacent structures diameter should be in the range of the raceway diameter.

Mechanical processing of connection surfaces

To avoid additional stress on the raceway system, the connection surfaces must have certain dimensional tolerances (cf. tables p. 30).

The contact surfaces must be machined. Ensure that connection surfaces which are already machined are not damaged or deformed by subsequent machining processes.

In the case of welding work, warpage is to be expected due to the introduction of heat. The dimensional tolerances must be checked after machining and if necessary the contact surfaces must be reworked.



Ideal adjacent construction (homogeneous and rigid)

Flatness of connection surfaces

In an unloaded state, the flatness of the connection surfaces cannot exceed the values in the tables listed below.

Flatness tolerance for four-point ball bearings

Raceway diameter [mm]	Flatness tolerance i.a.w. DIN EN ISO 1101 in mm for four-point ball bearing
to 1,000	0.15
to 1,500	0.20
to 2,000	0.23
to 2,500	0.25
to 3,500	0.30
to 4,500	0.35
to 6,000	0.40

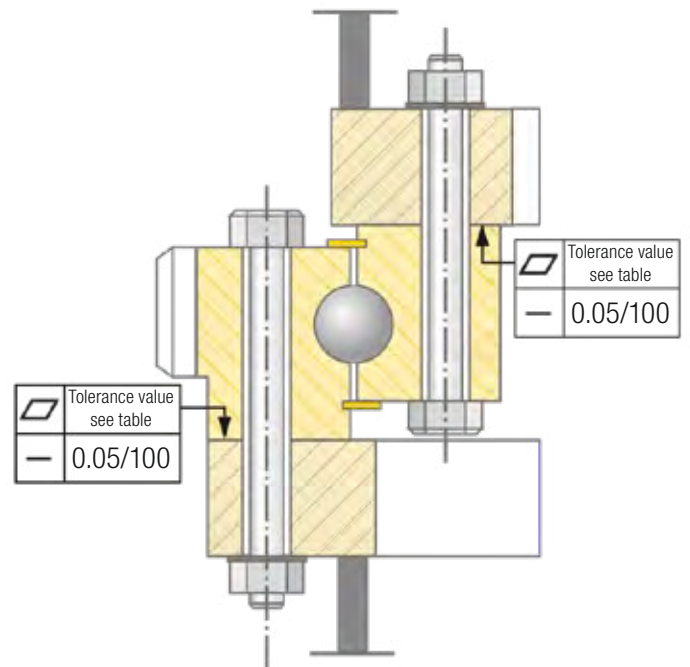
Flatness tolerance for roller bearings

Raceway diameter [mm]	Flatness tolerance i.a.w. DIN EN ISO 1101 in mm for roller bearing
to 1,000	0.10
to 1,500	0.13
to 2,000	0.15
to 2,500	0.18
to 3,500	0.21
to 4,500	0.25
to 6,000	0.30

For a measurement length of 100 mm, measured at any point on the contact surface, a tolerance of 0.05 mm is allowed.

The maximum value of the flatness deviation can only occur every 180°. The curve may only rise or fall evenly. If this requirement is satisfied, this does not have a significant effect on the service life of the bearing.

In order to balance corresponding unevenness, epoxy resin can be used, which is applied to the connection surfaces.

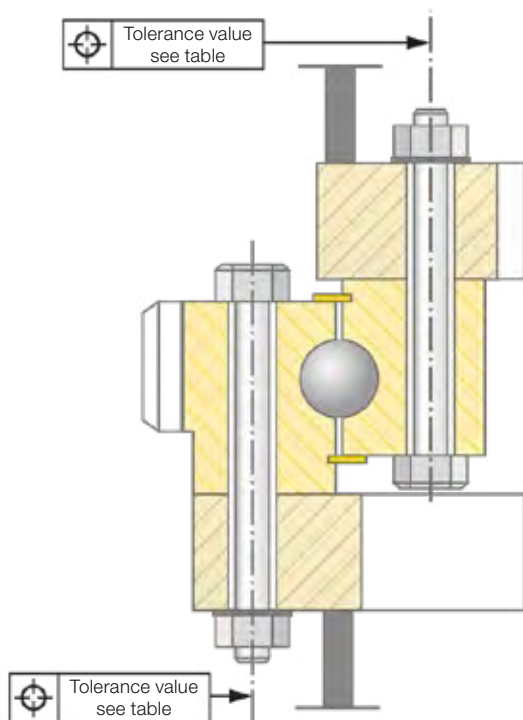


Flatness tolerances of connection surfaces

Assembly and serviceability of the adjacent construction

The following should be observed when designing the adjacent construction:

- The lubrication points of the bearing must be easily accessible.
- All fastening bolts must be easily accessible.
- Tightening and preloading using suitable devices must be possible without any obstructions (also for later checks and maintenance during operation).
- All bore hole patterns of connection surfaces and bearings are congruent.
- The through holes are designed according to DIN EN 20273 "medium".



Tolerances at bore hole pattern of connection surfaces

Thread sizes	Position tolerance [mm]
M6	0.2
≤ M10	0.3
≤ M16	0.5
≤ M 24	0.7
≤ M 42	1.0
> M 42	1.3

13 Influence of adjacent construction – K_{rep} factor

The adjacent construction which surrounds the bearing is also a deciding factor for the function of a large diameter bearing. In order to take into account its influence in the analytical calculation, the K_{rep} factor is used. This should consider the increase in load resulting from the adjacent construction on the rolling element. The values result from the assessment/years of experience of FE analyses and serve as guide values. In case of doubt, the exact values for the corresponding application must be calculated with our design or calculation department.

These load increases may occur due to reinforcements which are unfavourable for the bearing and geometries in the adjacent construction. For example, this may be stiffening ribs for hydraulic cylinders for cranes or excavators.

K_{rep} factor for adjacent construction

Application (extract)	K_{rep}
Homogeneous and rigid adjacent construction (ideal)	1.0
Wind turbine blade bearing	1.2
Wind turbine yaw bearing	1.2
Rudder propeller yaw bearing (thruster)	1.2
Maritime cranes (e.g. offshore crane, ship crane)	1.2
Tower crane	1.3
Tunnel Boring	1.3
Conveying technology (e.g. stacker/reclaimer)	1.3
Plant construction (e.g. bottle filling plant)	1.3
Hydraulic excavator	1.8
Special vehicles (e.g. turntable ladder vehicle)	1.8
Mobile crane	3.0

14 Finite Element Method

The analytical calculation of Liebherr slewing bearings is used for the preliminary design using the present loads and the installation conditions.

For the detailed design the large diameter bearings are calculated using the Finite Element Method (FEM). The adjacent construction provided by the customer is included in the FE model. Only this way can the load state in the bearing be determined more realistically.

Depending on the requirement and application, there are two methods available:

Method 1: In-house software "FastFEM"

With this software the bearing raceways of a large diameter bearing can be calculated in a short period with a high degree of automation.

With this method the following parameters are considered in the FE model:

- Adjacent construction from customer
- Bearing rings without details
- Non-linear stiffness of rolling element
- Exact raceway geometry taking into account the profile of the rollers (only for roller bearings) or osculation and raceway ends (only for ball bearings)

Results of FE calculation:

- Load distribution in bearing (force on rolling element)
- Pressure distribution in all rolling elements taking into account the tilting of the bearing raceways under load (only for roller bearings) or taking into account the force contact angle under load (only for ball bearings)
- Evidence of static and dynamic load capacity of bearing raceways
- Necessary case hardening depth

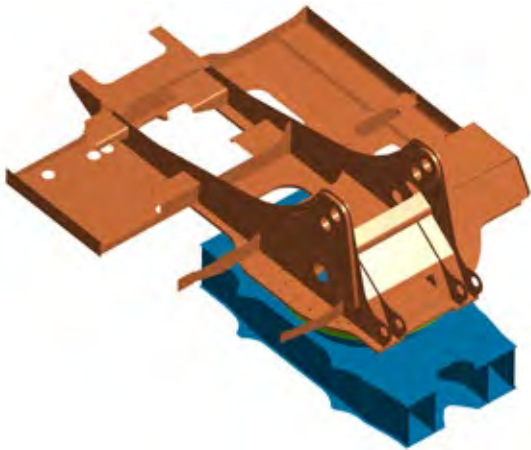
Method 2: Detailed FE calculation

With this method slewing bearings can be calculated with all necessary details. In addition to method 1, the following is considered:

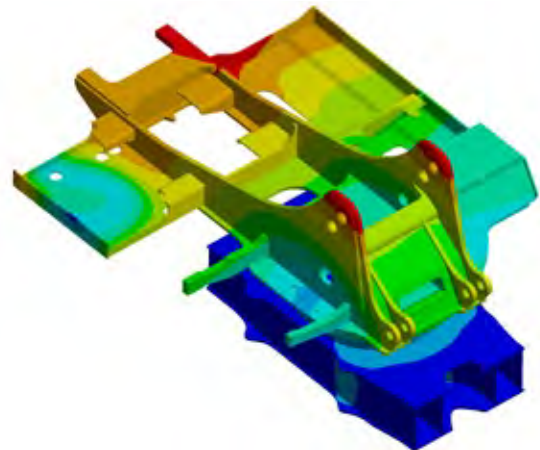
- The bolt connection modelled after VDI 2230
- All contact joints
- Details of the bearing rings such as bore holes

Results of the FE calculation in addition to method 1:

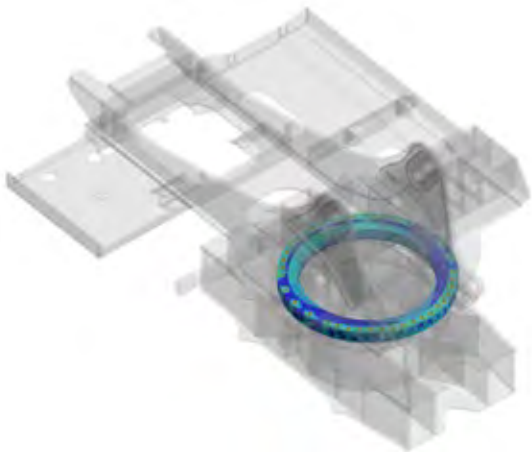
- Evidence of static and dynamic load capacity of bolt connection according to common rules
- Evidence of static and dynamic load capacity of bearing rings according to common rules
- Behaviour at contact joints (gaping, sliding)
- Deformations at the sealing gaps



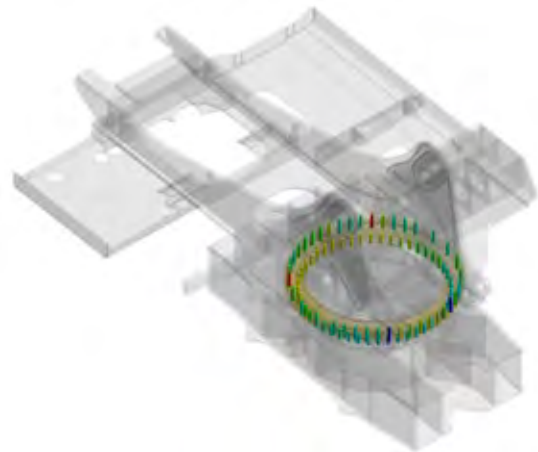
3D initial model for FE calculation



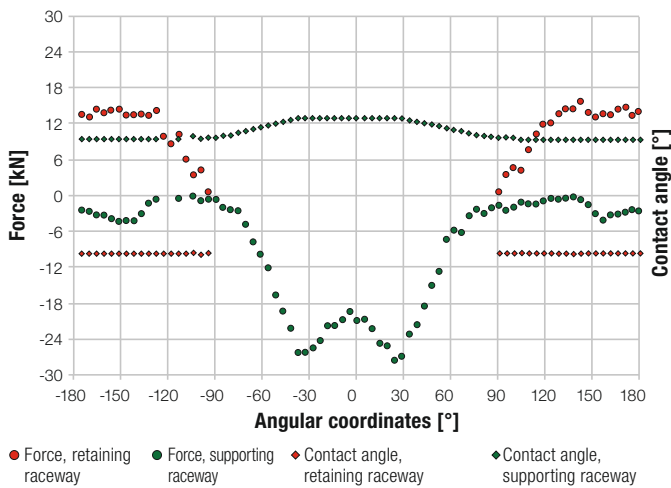
3D results chart of FE calculation



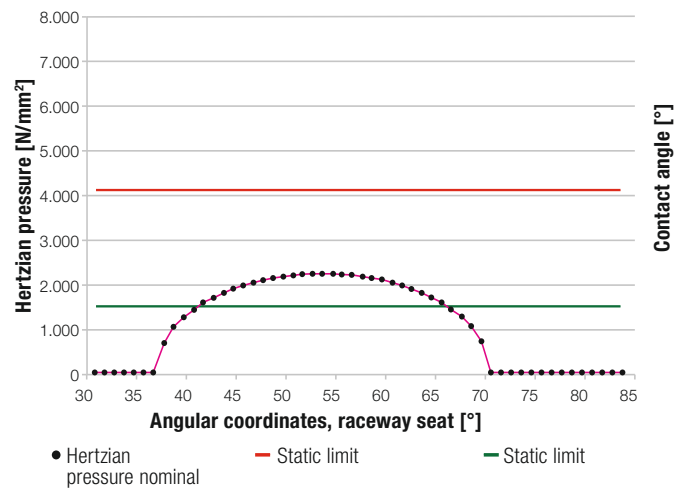
3D stress diagram for slewing bearing



3D stress diagram for bolts



Force distribution loading condition digging (hydraulic excavator)



Hertzian pressure curve loading condition digging (hydraulic excavator)

15 Assessment of the adjacent construction by Liebherr

The service life of the bearing is reduced with increasing deviation from the specified tolerances of the adjacent construction (in chapter 12). Using a calculation model developed especially by Liebherr it is possible to determine this reduction of the service life when the tolerances cannot be observed for technical or economic reasons. These special cases must be checked by Liebherr in detail.

The unevenness of an adjacent construction leads to tensi-
oning of the raceway and thus to a higher Hertzian pressure between the rolling element and raceway. This also has an effect on the load by external forces and torques, thus leading to preliminary wear of the bearing.

In the case of a smaller load in relation to the load rating, the influence of the unevenness is more pronounced than in the case of a larger load.

Based on the following data, Liebherr is able to make a statement about the service life reduction for four-point ball bearings and triple-row roller bearing.

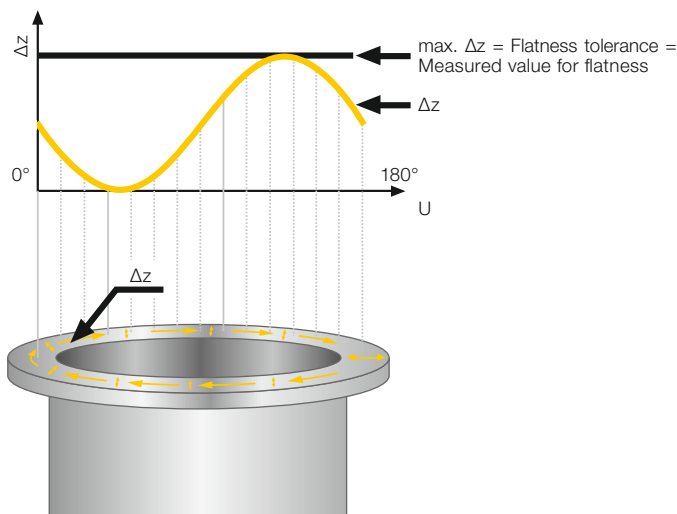
Relevant data of measured adjacent construction:

- Number of shafts across the circumference
- Double amplitude of unevenness idealised as sine curve

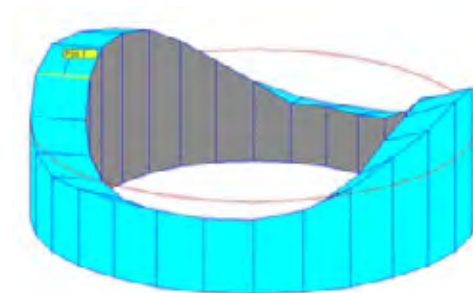
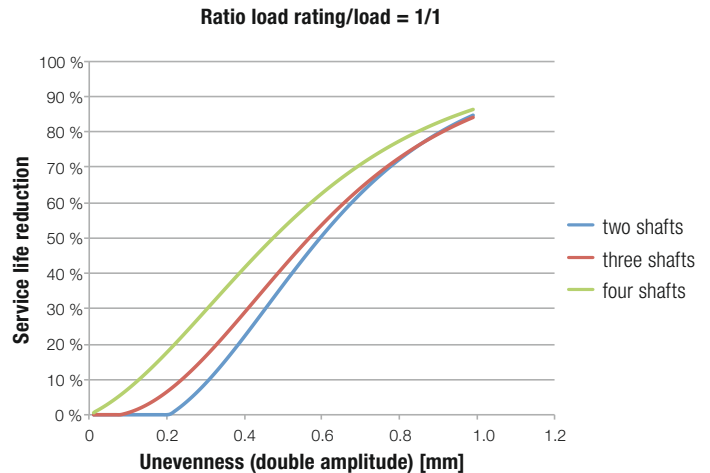
or

- measurement plot

From the result Liebherr is able to make a statement about the reduction of the service life of the bearing as a percentage.



Display of double-shaft circumference imperfection



Example of measurement result of connection surface in 3D diagram

16 Bearing mounting

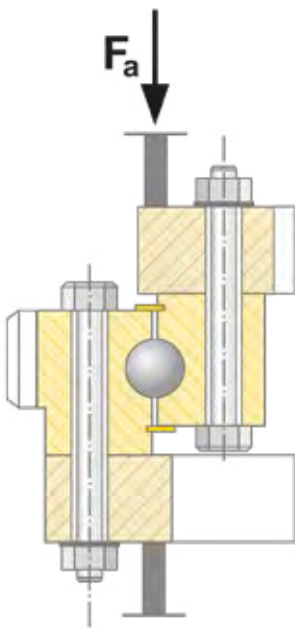
Slewing bearings are generally fastened to the adjacent construction. The following parameters must be taken into account when dimensioning the bolt connection and the assembly parameters:

Installation position of the large diameter bearing

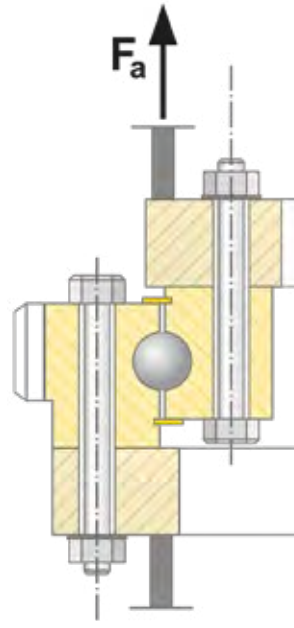
If the bearing is installed so that the axial load relieves the bolts, then this is called a supporting load. In contrast, if the bearing is installed so that the axial force puts an additional load on the bolts, then this is called a suspended load.

For the capacity of the Liebherr slewing bearings, according to the specified limiting load curves (see tables "Technical data"), it is assumed that there is a supporting load.

If the suspended installation position is selected, the bolt connection and the raceway design must be checked in each case by Liebherr.

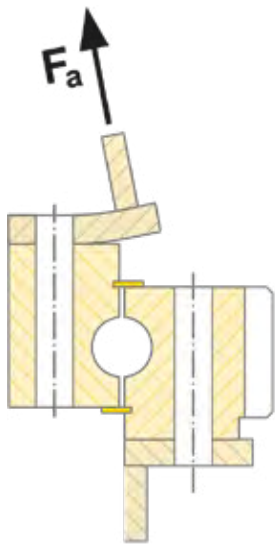


Arrangement of bearing with supporting load

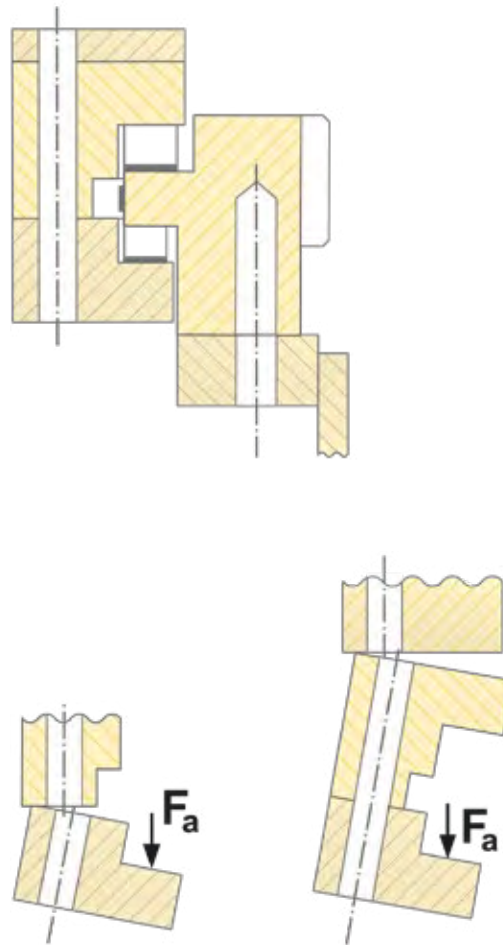


Arrangement of bearing with suspended mounting

The assembly preload force F_M must prevent the gapping of the joints and guarantee the frictional connection at the joining areas throughout the service life of the bearing. It should be noted that the preload force is reduced during operation by setting. Therefore, bolt connections must be tightened according to the installation and maintenance declarations, in order to balance the setting behaviour in the connection.



Example 1: Removal of adjacent construction from the joining area



Example 2: Gapping of bearing rings i.a.w. DNV GL

Assembly preload forces for bolts i.a.w. VDI 2230

Strength class Metric ISO thread	8.8		10.9		12.9	
	Tensioning force F _M [kN]	Maximum tightening torque M _A [Nm]	Tensioning force F _M [kN]	Maximum tightening torque M _A [Nm]	Tensioning force F _M [kN]	Maximum tightening torque M _A [Nm]
M10	29	54	42	79	49	93
M12	42	93	62	137	72	160
M14	58	148	84	218	99	255
M16	79	230	116	338	135	395
M18	99	329	141	469	165	549
M20	127	464	181	661	212	773
M22	158	634	225	904	264	1,057
M24	183	798	260	1,136	305	1,329
M27	240	1,176	342	1,674	400	1,959
M30	292	1,597	416	2,274	487	2,662
M33	363	2,161	517	3,078	605	3,601
M36	427	2,778	608	3,957	711	4,631
M39	512	3,597	729	5,123	853	5,994
M42	587	4,445*	836	6,331*	979	7,409*
M45	686	5,551*	978	7,906*	1,144	9,251*
M48	773	6,715*	1,101	9,565*	1,288	11,193*
M52	926	8,628*	1,319	12,289*	1,543	14,381*
M56	1,068	10,750*	1,522	15,311*	1,781	17,918*
M60	1,247	13,334*	1,776	18,991*	2,078	22,224*
M64	1,411	16,058*	2,010	22,871*	2,352	26,764*

*for bolt sizes greater than M42, the values must be proven with a strain measurement of the bolts.

The following applies for the table

"Assembly preload forces for bolts i.a.w. VDI 2230":

- Assembly preload forces F_M and tightening torques M_A for v= 0.9 for shaft bolts with metric coarse thread i.a.w. DIN ISO 724, DIN 13-19.
- Head dimensions of hexagon bolts i.a.w. DIN EN ISO 4014 to DIN EN ISO 4018.
- Bolts with hexalobular head i.a.w. DIN 34800 or cylinder bolts i.a.w. DIN EN ISO 4762 and bore hole "medium" i.a.w. DIN EN 20273.
- Friction values μ_G= μ_K= 0.14 at thread and contact surfaces.

The relevant parameters must be checked for each bolt connection. The tightening factors must be set up differently depending on the tightening process.

Tightening process i.a.w. VDI 2230	Tightening factor α_A	Variation
Torque-controlled tightening with torque wrench, signal generating wrench or motorised torque wrench with dynamic torque measurement.	1.4 to 1.6	$\pm 17\%$ to $\pm 23\%$
Limit-value controlled tightening, motorised or manual.	1.2 to 1.4	$\pm 9\%$ to $\pm 17\%$
Angle-controlled tightening, motorised or manual.	1.2 to 1.4	$\pm 9\%$ to $\pm 17\%$
Hydraulic tightening	1.1 to 1.4	$\pm 5\%$ to $\pm 17\%$

Tightening method

The fastening bolts can be tightened using different methods. The following descriptions of the individual methods are taken from VDI 2230.

The accuracy at which a desired preload force (minimum clamping force for pressing together fastened parts) is achieved depends on the tightening method used.

Hydraulic tightening

With hydraulic tightening the assembly preload force F_M is generated by axial elongation by means of a clamping cylinder. As the clamping cylinder is supported at the component, springback losses can be expected from the strain. Therefore, large clamp-length ratios ≥ 5 are recommended:

$$\frac{l_k}{d} = 5$$

l_k = Clamp length
 d = Bolt diameter

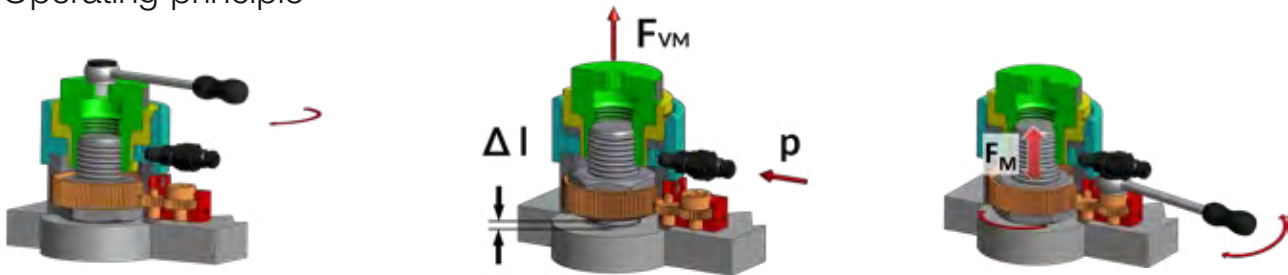
An advantage of this method is that the bolt is not affected by torsional or bending stress in comparison to other methods. The friction, which occurs for example with the torque-controlled method, is also eliminated here. As a result, the assembly preload force of the bolt can be achieved with a smaller variation.

Precise tightening of bolt connections of Liebherr slewing bearings with the ITH Stretch method

In order to guarantee the high product quality and long service life of Liebherr slewing bearings, the bolt connections must be preloaded precisely and evenly.

Liebherr recommends using the ITH Stretch method, as with this tightening method no frictional, bending or torsional loads occur in the bolt connection (hydraulic friction- and torsion-free tightening). The assembly preload force F_{VM} required is introduced axially to the bolt connection. This achieves the highest possible level of uniformity and precision.

Operating principle



1. Screwing

The interchangeable bush with internal thread of the ITH bolt tensioning cylinder is fastened onto the projecting thread.

2. Preloading

By applying a defined hydraulic pressure p the stud-bolt is extended axially (Δl). The assembly preload force F_{VM} is introduced to the bolt connection without any frictional, torsional and bending moments.

3. Nut

After the hydraulic pressure is reached the nut is arranged near the contact surface using a torque wrench. Then the pressure is released.

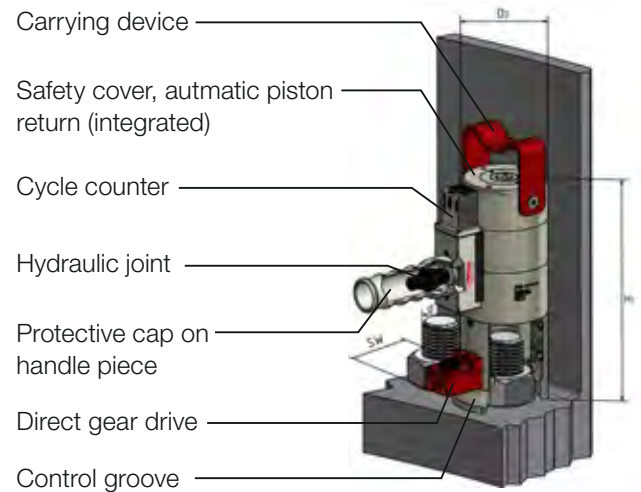
Advantages of the ITH Stretch method

- No friction between contact surface and nut, as well as internal thread and bolt thread.
- No bending and torsional loads in stud bolts, pure tensile load.
- High precision and repeat accuracy of target value of assembly preload force F_M as friction-free.
- Small αA values of up to 1.05* can be realised with the design of bolt connections.
- Large preload forces with small tool dimensions.
- Optimal for construction site installations thanks to compact assembly tools for bolts and nuts with small dimensions.
- Parallel and precise preloading of several bolts possible (ITH Multi Tensioning).
Ideal for large diameter bearing applications.
- Technology leader ITH Schraubtechnik, market leader in preloading of bolts for large diameter bearings, over 35 years of experience, over 200 international patents.

* for clamp length ratio $l_K/d \geq 5$ and mechanically machined connecting elements. ITH recommends ITH round nuts RMS/RMZ.

Bolt tensioning cylinder for Liebherr slewing bearings Type MSK, bolt quality 10.9

- Increased working speed – Flexible rotary sleeve, automated piston return and direct pinion accelerate the bolt fastening process.
- Precision – Preloading with no friction, torsion and bending moment, linear relationship between control parameter p and target parameter FM, as well as parallel preloading of several bolts possible at the same time (ITH Multi Tensioning), guarantee a precise result.
- Safety concept – Patented cycle counter, patented breaking load device and patented protective cover at handle piece increase occupational safety.
- Additional equipment – NIOX surface coating, ergonomic carrying device and handle piece round off innovative overall concept – leading in large diameter bearings.



Sizes of type MSK

Type	Order no.	Preload force		Nominal diameter Ø d		Bolt Width across flats SW		Outer diameter-Ø D ₃		Total height H ₁	
		[kN]	[lbs]	[mm]	["]*	[mm]	["]*	[mm]	["]*	[mm]	["]*
MSK 24 - 10.9	33,52791	308.5	69354	M 24×3	7/8	36	1 4/9	57.0	2.24	188.7	7.50
MSK 27 - 10.9	33,52792	401.5	90261	M 27×3	1	41	1 5/8	63.5	2.50	197.4	7.86
MSK 30 - 10.9	33,52793	485.5	109152	M 30×3.5	1 1/8	46	1 4/5	70.0	2.76	199.2	7.98
MSK 33 - 10.9	33,52794	606.3	136302	M 33×3.5	1 1/4	50	2	78.3	3.08	222.6	8.84
MSK 36 - 10.9	33,52795	708.3	159233	M 36×4	1 3/8	55	2 1/5	82.6	3.25	235.0	9.33
MSK 39 - 10.9	33,52796	842.2	189335	M 39×4	1 1/2	60	2 3/8	90.8	3.57	255.8	10.21
MSK 42 - 10.9	33,52797	974.4	219044	M 42×4.5	1 5/8	65	2 4/7	98.0	3.86	257.0	10.35
MSK 45 - 10.9	33,52798	1140.5	256396	M 45×4.5	1 3/4	70	2 3/4	105.0	4.13	274.0	10.98
MSK 48 - 10.9	33,52799	1288.4	289645	M 48×5	1 7/8	75	3	111.5	4.39	287.0	11.57
MSK 52 - 10.9	33,52800	1529.7	343899	M 52×5	2	80	3 1/8	122.0	4.80	301.2	12.09
MSK 56 - 10.9	33,52801	1785.0	401286	M 56×5.5	2 1/4	85	3 1/2	130.5	5.14	329.0	13.80
MSK 60 - 10.9	33,52802	2125.8	477892	M 60×5.5	2 3/8	90	3 3/4	140.8	5.54	336.0	13.46
MSK 64 - 10.9	33,52803	2336.8	525336	M 64×6	2 1/2	95	3 7/8	147.8	5.82	344.5	13.87
MSK 68 - 10.9	33,52804	2745.0	617103	M 68×6	2 3/4	100	4 1/4	159.8	6.29	375.8	14.86
MSK 72 - 10.9	33,52805	3041.2	683697	M 72×6	3	105	4 5/8	168.0	6.61	385.0	15.24
MSK 80 - 10.9	33,52806	3814.1	856746	M 80×6	3 1/4	115	5	182.0	7.16	439.0	17.28
MSK 90 - 10.9	33,52807	489.0	1045361	M 90×6	3 1/2	130	5 3/8	211.0	8.30	485.0	19.09
MSK 100 - 10.9	33,52808	6134.1	13790000	M 100×6	4	145	6 1/8	230.0	9.05	510.4	20.08

Other bolt/nut configurations can be purchased on request. *Increase in bolt thread for inch thread: 8 UN.

Liebherr recommends multilevel bolt tensioning cylinders of type MSK from the manufacturer ITH Schraubtechnik from Meschede, Germany. Single-level bolt tensioning cylinders can be purchased on request. The values indicated are designed for hexagon nuts i.a.w. DIN 4032.

Torque-controlled tightening

Torque-controlled tightening is effected by indicating or signal generating torque wrenches or torque screwdrivers. In addition to the torque, the angle of rotation from a certain torque value is generally also measured in order to monitor the procedure. This procedure is widely used due to the affordable equipment and simple handling.

The setting of the tightening devices should only be determined at the original part during trial turning. This is possible using three measured variables: breakaway torque, prevail torque or elongation measurement of the bolt. The preferred measurement of the elongation of the bolt should be done by ultrasound or mechanically. The preload force reached is calculated from the proportionate bolt flexibility.

For high-stress bolt connections tightening with impact screwdrivers is not recommended, as the tightening factors are very high in the elastic range. Special impulse wrenches with hydraulic cell offer smaller tightening factors, designed for the respective bolt connection.

Limit value controlled tightening

With limit value controlled tightening procedures, the bolt is tightened irrespective of the friction in the layer until the overall stress (torsional and tensile stress) roughly corresponds to the yield strength of the bolt. The bolt must be preloaded with a snug torque beforehand.

The calculation of the onset of yielding of the bolt is effected by measuring the torque and angle of rotation. The difference quotient of the two variables is synonymous with the increase of tangent, which is formed in the torque-angle of rotation curve. As soon as the bolt material is in the plastic deformation range, the difference quotient falls and triggers the shutdown signal.

An advantage vis-a-vis other tightening procedures is that a special design of the bolt for the largest possible assembly preload force is not required. With an increase of the assembly preload force due to less thread friction, the torsion content is also reduced accordingly.

Angle-controlled tightening

The angle-controlled tightening procedure is based on the (theoretically) proportional connection between the angle of rotation and length variation of the bolt above the pitch of the thread.

First of all, when tightening with a snug torque the bolt is preloaded so that there is complete contact with the joint faces. This is required, as for the measurement of the angle of rotation both the pressure deformations within the clamped parts and the elastic and plastic deformations occurring in the joint faces up to the complete surface contact are also measured. In addition to the angle of rotation, the torque is also nearly always measured in order to monitor the process.

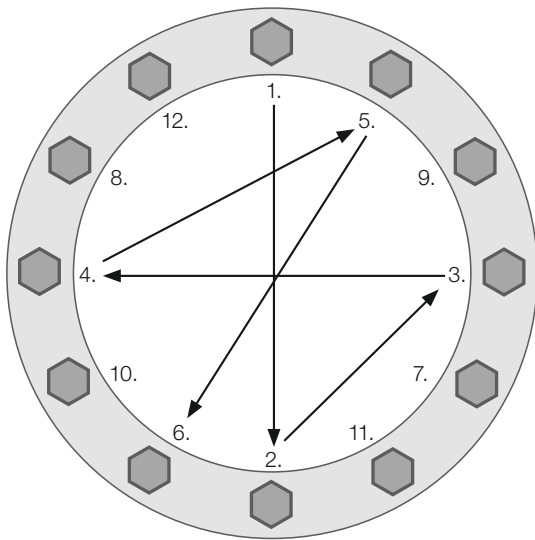
Experience has shown that the procedure only achieves its maximum precision in the super-elastic range, as angle errors are unlikely to have much of an effect.

The angle of rotation should be determined in tests on original components, in order to properly calculate the real flexibility of a structure.

As with this procedure the yield strength of the bolt is exceeded, the reusability of the bolts is no longer possible.

Arrangement of bolts

The bolts are normally distributed evenly over the pitch circle circumference. However, upon request bearings can also be realised with an uneven bolt distribution. The bolts are ideally tightened crosswise according to the diagram below.



Tightening of the bolt connection crosswise

Strength categories of bolts

The strength category of the bolts used is defined by default as 10.9. However, for special requirements bolts from other categories may also be used. The bolts which can be used are listed in the table "Mechanical properties of bolts". In a particular case, the deviation from the standard bolt must be clarified with Liebherr.

Mechanical properties of bolts i.a.w. EN ISO 898-1

Strength values	Strength category 8.8		Strength category 10.9	Strength category 12.9
	D ≤ M16	D > M16		
Tensile strength R_m	min. 800 N/mm ²	min. 830 N/mm ²	min. 1,040 N/mm ²	min. 1,220 N/mm ²
0.2% yield strength $R_{p0.2}$	min. 660 N/mm ²	min. 660 N/mm ²	min. 940 N/mm ²	min. 1,100 N/mm ²

Minimum bolt depth

The minimum bolt depth of threads for tolerance class "mid" after calculation of VDI 2230 amounts:

Minimum bolt depth of threads

Material adjacent construction/ Nut	Strength categories of bolts		8.8	8.8	10.9	10.9	12.9	12.9
	Thread fineness d/P		<9	≥9	<9	≥9	<9	≥9
S235			1.0 × d	1.25 × d				
S355, C45N			0.9 × d	1.0 × d		1.2 × d		1.4 × d
42CrMo4+QT, C45V			0.8 × d	0.9 × d		1.0 × d		1.1 × d

d = Thread Outer-Ø [mm]

Bolts with metric ISO-thread (regular thread)

P = Gradient of thread [mm]

up to M 30: d/P < 9

> M 30: d/P > 9

Clamping length

Liebherr recommends the insertion of a clamping length $l_k \geq 5 \times d$ (d describes bolt diameter) for minimizing the loss of pretension force.

Surface stress at the contact areas

The boundary surface stress of the contact areas must be observed. The assembly surface stress is roughly calculated as follows:

$$\sigma = \frac{1.1 \times F_M}{A_p}$$

F_M = Assembly preload force
 A_p = Bolt head or nut contact area

The contact area A_p is dependent on the type of bolt selected. The following values for the surface stress cannot be exceeded i.a.w. VDI 2230 (guide values):

Boundary surface pressures for bolt head contacts*

Material of contact surface	Boundary surface stress
S235	490 N/mm ²
S355	760 N/mm ²
42CrMo4+QT	1,070 N/mm ² (based on R_m , LN 180)
Cq45	770 N/mm ²
GJS 400	600 N/mm ²

*Guide values i.a.w. VDI 2230

If the boundary surface stress is exceeded, then larger head contact diameters may be used with corresponding washers, for example, i.a.w. DIN EN 14399-6.

Frictional connection

The connection points must be carefully cleaned of paint, contamination, welding beads and grease. The bearing rings must lay flat on all sides. In special cases suitable adhesives may be required to improve the frictional connection. As an alternative to adhesives, the contact area may also have a zinc spray coating, whereby the friction coefficient of the area is also increased.

A mechanical option to transfer radial forces to the bearing is the fitting of the bearing in a radial centring.

The design of the bearings with these radial centrings is generally possible, however it must be agreed with Liebherr in each case.

17 Production

Production process



1
Turning and drilling



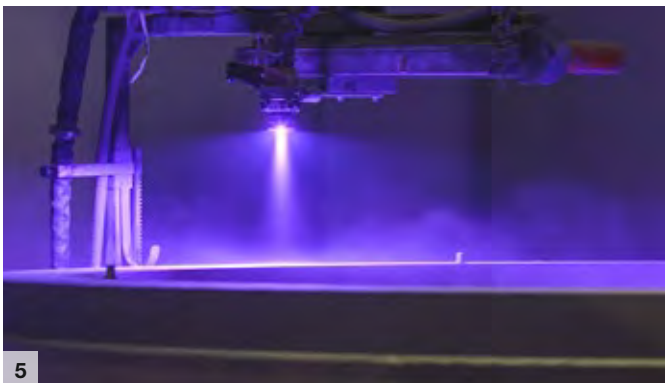
2
Gear milling



3
Induction hardening



4
Final assembly



5
Surface treatment



6
Completed large diameter bearing

Measurement/Quality control



1
Magnetic particle inspection



2
Hardness measurement



3
Measurement of hardness depth



4
Surface inspection (surface roughness)



5
Dimension checks and visual inspection

Induction hardening – A core competency of Liebherr

Liebherr provides various induction hardening machines in production. With individual machine configuration options, both hardness depths greater than 10 mm and hardness depths with minimum warpage can be realised.

The swivel-mounted machine benches can be positioned variably up to an inclination of 70°. This way optimal cooling behaviour of the workpiece of any contour is guaranteed.

The sensor-controlled position, together with a continuous temperature measurement, which is used both for the tooth flank hardening and the raceway hardening, ensures a consistently high quality and repeat accuracy.

The tool required for hardening, the inductor, is manufactured in-house at Liebherr, from the development to the design through to the manufacture.

This know-how guarantees quick and efficient realisation of solutions for new tasks and challenges.

The highest level of quality of the components is guaranteed using various test procedures, such as ultrasonic and magnetic particle inspection, which are carried out directly after the hardening of the finished workpieces. Regular checks of hardness samples in a separate metallurgical laboratory guarantee compliance with the required hardness parameters according to customer specifications, as well as our own quality standards.

Using two tempering furnaces, workpieces can be stress relieved or annealed at a temperature of up to 650°C.

Furthermore, Liebherr works very closely with well-known machine manufacturers in the area of induction hardening and therefore always uses the latest technology



Induction hardening at Liebherr

18 Lubrication

Lubrication of bearing raceways

Appropriate lubrication is the basic requirement for proper functioning and a long service life of the bearing raceways. In principle, the lubricant must fulfil the following tasks:

- Formation of a sufficiently firm film of lubricant at the contact areas through the use of lubricants with special additives.
- Reduction of the friction between rolling elements and raceways, as well as rolling elements and spacers.
- Sealing of the raceway system on the outside against dirt and moisture ingress and thus build-up of corrosion protection for the raceway system.

A bearing can generally be lubricated with oil or grease. Normally the lubrication of the bearing raceways is effected by grease supply via lubrication ports with nipples.

In Liebherr slewing bearings, only high-quality lubricants should be used which are suitable for the respective application. These must basically have the following characteristics:

- Sufficient temperature range of application
- Sufficient lubricating ability of the base oil
- Sufficient anti-corrosion properties i.a.w. DIN 51802
- Low tendency to absorb water i.a.w. DIN 51807
- Sufficient adherence
- Good ageing resistance

Initial lubrication

Liebherr slewing bearings are filled with Liebherr grease at the factory before delivery. The grease is a lithium soap grease of class KP2K-30 i.a.w. DIN 51825. The grease also has additives for corrosion protection.

The fill level of the bearing by means of the initial filling is based on the requirements of the respective application and is defined by Liebherr on a case by case basis.

Relubrication of bearing raceways

The bearing raceways of the large diameter bearings must be regreased at defined regular intervals. The intervals can be found in the maintenance schedule.

The relubrication intervals generally depend on the operating conditions, the prevailing environmental factors, as well as the type of bearing or the chosen type of sealing system. The following intervals may be used as a guide for the scheduled relubrication:

Guide values for relubrication periods

Operating conditions	Guide value for relubrication period
light	every 250 operating hours
normal	every 200 operating hours
extreme	every 100 operating hours

The values indicated in the table only serve as a guide.

Guide values for relubrication periods

In the case of operation in particularly climatic conditions (for example in the tropics) or where there is a particularly high accumulation of dust and dirt (for example in the mining area), as well as continuous rotation of the bearing, the lubrication cycles are shortened accordingly.

Unscheduled relubrication

In addition to the scheduled lubrication intervals explained in chapter 18, unscheduled relubrication must generally be effected in each of the following cases:

- Before and after extended breaks in operation (generally three months) or downtimes (for example crane or construction machines). Agree with Liebherr in the case of a specific application.
- Where there are high moisture levels, for example from spray or splashed water.

Relubrication process

The aim of relubrication is to fully replace the grease which has aged by the operation of the large diameter bearing with new grease. If there is no specific lubrication instruction, the raceways must be lubricated as follows: Via the lubricating nipple the large diameter bearing is filled with fresh grease by slowly turning the bearing until the grease is evenly distributed around the circumference and grease emerges under the sealing lips and forms a built-up grease collar.

For special applications, such as in material handling equipment or wind turbines, relubrication instructions tailored to the respective application must be applied.

Lubricant quantities

The required lubricant quantities for the initial lubrication and the relubrication are defined by Liebherr for each large diameter bearing based on the requirements.



Built-up grease collar at the bearing seal

Lubrication of gearing

The lubricants used in the bearing raceways of the Liebherr slewing bearings are also suitable for the lubrication of the gearing. The same or an adequate lubricant should be used for compatibility purposes (see table "Lubricants for slewing bearings").

The appropriate lubricant must be used according to the vehicle power level.



Lubricated gearing in operation

Initial lubrication before commissioning

The gearings of the Liebherr slewing bearings are protected against corrosion (anti-corrosion oil or paint) at the factory before delivery and must be lubricated intensively before the initial commissioning.

For the initial lubrication, greases with EP additives (Extreme Pressure) for open gearings are recommended. The vehicle power level of the lubricant i.a.w. ISO 14635-1 should also be at least 12. The Liebherr grease for gearing is generally recommended (see table "Lubricants for slewing bearings").

Relubrication of gearing

The relubrication periods for the gearing of the bearings depend to a large extent on the operating conditions and environmental factors in the application.

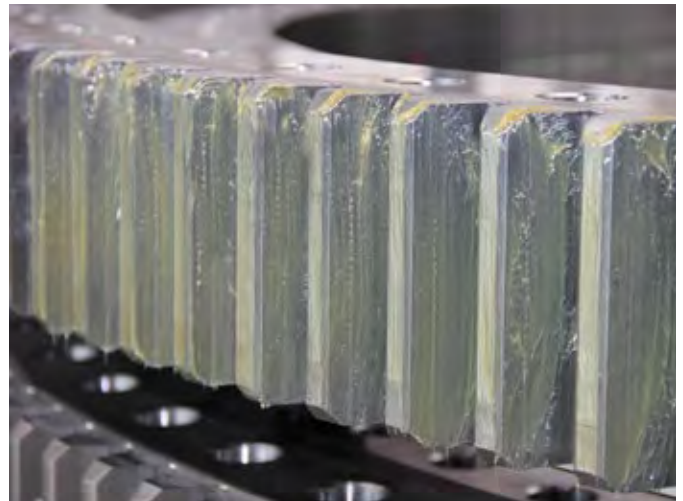
Relubrication intervals for gearing

Type of application/Frequency of use	Relubrication interval
Seldom and only rotated with light to medium loads	weekly to monthly
Intensive rotations under high load and frequent impacts	daily
Intensive rotations high load and frequent impacts during multi-shift operation	several times a day

Relubrication process and quantities

Grease must be coated or sprayed on the tooth flanks of the gearing. The application of the grease should be effected in thin and even layers. The contact areas at the tooth flanks of the gearing must always have a lubricating film.

Excessive lubricant quantities do not offer any benefits. Excessive grease should be removed again using a suitable tool or equipment.



Initial lubrication of gearing

Lubricants

In general, Liebherr recommends Liebherr lubricants for slewing bearings. If it is not possible to purchase Liebherr lubricants, the lubricants listed in the table "Lubricants for slewing bearings" may be used as an alternative. The suitability and use of non-Liebherr lubricants is based on the recommendation from the respective manufacturer.

For the automatic lubricant supply to the gearing, the use of lubricant dispensers or lubrication systems in conjunction with central lubrication systems is also possible.

Lubricants for slewing bearings

Manufacturer	Rolling contact (KPF 2 N-25 or KPFHC 1 N-60)	Gearing contact (OGPF 2 S-30)
Liebherr	Universal Grease 9900 248 K to 423 K (-25°C to +150°C)	Universal Grease 9900
	Universal Grease Arctic 213 K to 413 K (-60°C to +140°C)	
	Liebherr 9610 265 K to 295 K (-20°C to +120°C)	
Aral	Aralub HLP 2 243 K to 393 K (-30 °C to +120 °C)	Castrol Molub-Alloy OG 936 SF Heavy 243 K to 373 K (-30 °C to +100 °C)
Castrol	Spheerol EPL 2 253 K to 413 K (-20 °C to +140 °C)	Castrol Molub-Alloy OG 9790/2500-0 253 K to 363 K (-20 °C to + 90 °C)
Klober	Centoplex EP 2 253 K to 403 K (-20 °C to +130 °C)	Grafl oscon C-SG 0 ultra 243 K to 473 K (-30 °C to +200 °C)
Lubritech	Lagermeister EP 2 253 K to 403 K (-20 °C to +130 °C)	Ceplattyn KG 10 HMF 263 K to 413 K (-10 °C to +140 °C)
Mobil	Mobilux EP 2 253 K to 393 K (-20 °C to +120 °C)	Mobilgear OGL 461 253 K to 393 K (-20 °C to +120 °C)
Shell	Gadus S2 V220 2 248 K to 403 K (-25 °C to +130 °C)	Gadus S2 OGH NLGI 0/00 263 K to 473 K (-10 °C to +200 °C)
Total	Multis EP 2 248 K to 393 K (-25 °C to +120 °C)	Copal OGL 0 248 K to 423 K (-25 °C to +150 °C)

Liebherr Universal Grease 9900 is suitable both for the raceway and the gearing.

19 Packaging, transportation and storage

Packaging and storage

Liebherr slewing bearings require careful handling during transportation and storage.

Liebherr slewing bearings are packaged at the factory on a standard transport pallet. The dimensions of the pallet, additional protective measures, as well as the necessary preservation, depend on the technical specifications of the product. This is checked together with the customer before the first shipment of a product in order to submit a packaging proposal.

Liebherr pursues the principle of the simplest packaging which is safe for transport. The packaging is manufactured by trained and qualified personnel, complies with current standards (e.g. phytosanitary measures) and is optimised in terms of minimal waste disposal.

Returnable packaging is also offered in order to return special packaging and guarantee consistently high packaging quality, as well as cost efficiency.

The large slewing bearings are treated with anti-corrosion agents as standard. This preservation allows the slewing bearings to be stored for up to six months in sheltered areas. In enclosed and tempered (temperature > 12° C) spaces the storage period is approximately 12 months. Outdoor storage is not permitted.

With special packaging this preservation may be extended to 5 years if necessary. Longer storage periods must be assessed by Liebherr.

In addition to the packaging and preservation for the transportation to the intended location, special pallets, special markings or handling equipment are also possible upon request in order to simplify logistics at the customer's premises.

For shipping to third countries, special markings and optional additional packaging (e.g. hatches) may be attached for customs inspection, which prevent damage to the anti-corrosion agent and guarantee a safe transport chain. Liebherr may make corresponding solution proposals depending on the product and intended location purpose.

Transport

Due to their dimensions and weights, large diameter bearings often place high requirements on the transportation company. If horizontal transportation of the product is difficult for logistical and/or road transport circumstances, Liebherr offers alternatives suitable for everyday use.

These include diagonal or vertical loading with the aid of skids, as well as special equipment made from wood, plastic or metal, which ensure smooth transportation.

Liebherr offers Free House Delivery as an option, which is based on years of experience and special conditions with select freight carriers.

Slewing bearings must always be moved during crane transportation using suitable hoists and lifting gears, which must be secured to the intended transport lifting holes with suitable lifting eyes. The number and arrangement of the lifting eyes are defined during the project planning stage.



Low-loader with diagonal mounting

20 Control/Inspection

Large diameter bearings must be serviced in specific cycles. This includes, for example, the relubrication, checking seals, tilting clearance measurement and also reduction measurement.

These measures serve to avoid possible wear of the bearings or detect wear at an early stage. This in turn prevents unnecessary repair costs and production downtimes. This is why we recommend regular bearing inspections and wear measurements.

Wear of the bearing raceway is generally noticeable by a reduction or change in the axial movement. Depending on the application, the wear development can be determined from a reduction or tilting clearance measurement.

Wear at the gearing depends to a large extent on the application.

Reduction measurement

If the load of the bearing is mainly in an axial direction (load centre within the raceway diameter of the bearing), it is recommended to perform a reduction measurement.

The reduction measurement is also effected between the lower adjacent construction and the bearing ring fastened to the upper adjacent construction.

For the reduction measurement the values from the tables in chapter 20 for the permissible bearing clearance increases apply.

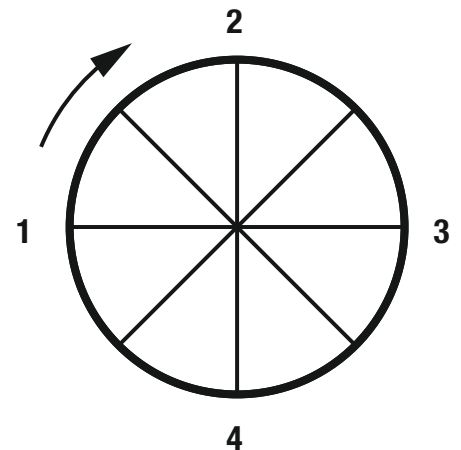
Tilting clearance measurement

In the case of bearings mainly loaded with tilting moments (e.g. cranes), it is recommended to measure the tilting clearance at the bearing.

The tilting clearance measurement is effected between the lower adjacent construction and the bearing ring fastened to the upper adjacent construction. The measuring point should be as close as possible to the raceway system, in order to keep the effect of deformations low.

Procedure for tilting clearance measurement:

- 1) Define position for the measurement during commissioning.
- 2) Perform reference measurement during commissioning.
- 3) Mark measuring points around the circumference (or measuring point every 90°).
- 4) Use dial gauges with a precision of at least 0.01 mm.
- 5) Apply maximum restoring moment in order to set the dial gauges to zero.
- 6) Generate forward tilting moment through load capacity.
- 7) Swivel the upper structure and repeat the measurements at the marked positions.



Procedure for reduction measurement:

- 1) Determine reference points similar to the tilting clearance measurement.
- 2) Mark measuring points from a defined position on the lower structure (or every 90°).
- 3) Perform control measurements at each of the marked measuring points at defined intervals.

Through regular reduction or tilting clearance measurements, progressive wear in the bearing can be detected early and affected components can be replaced.

Limit values for bearing clearances

For the tilting clearance measurement the production-related bearing clearances (see chapter 9 "Bearing clearance") are added. The specified permissible bearing clearance increases only apply for bearings with clearance.

Maximum permissible bearing clearance increases – single-row and double-row four-point ball bearings

Raceway diameter [mm]	Ball diameter										
	20	22	25	30	35	40	45	50	55	60	70
to											
1,000	1.5	1.5	1.5	1.6	1.8	2.0	2.2	2.6	2.6		
1,250	1.5	1.6	1.6	1.7	1.8	2.1	2.3	2.7	2.7	2.8	
1,500	1.6	1.7	1.7	1.8	1.8	2.1	2.4	2.7	2.8	2.9	3.0
1,750			1.8	1.8	1.9	2.2	2.4	2.8	2.9	3.0	3.1
2,000			1.8	1.9	2.0	2.3	2.5	2.9	2.9	3.0	3.2
2,250			1.9	2.0	2.1	2.4	2.6	3.0	3.0	3.1	3.3
2,500			1.9	2.0	2.1	2.4	2.7	3.0	3.1	3.2	3.3
2,750			2.0	2.1	2.2	2.5	2.7	3.1	3.2	3.3	3.4
3,000					2.3	2.6	2.7	3.2		3.3	3.5
3,250					2.4	2.7	2.9	3.3		3.4	3.6
3,500						2.8	3.0	3.3		3.5	3.6
3,750						2.9	3.1	3.4		3.6	3.7
4,000						3.0		3.4		3.7	3.8
4,500								3.6		3.9	4.0
5,000								3.8		4.1	4.2
5,500								4.0		4.3	4.4
6,000								4.2		4.6	4.7
6,500										4.7	4.8
7,000										4.9	5.0
7,500											5.1
8,000											5.4
>8,000											on request

Maximum permissible bearing clearance increases – triple-row roller bearing

Raceway diameter (retaining raceway) [mm]	Roller diameter [mm]										
	16	21	24	26	32	36	40	50	60	70	80
400	0.20	0.22	0.23	0.24							
500	0.21	0.23	0.24	0.25	0.28						
630	0.26	0.28	0.29	0.30	0.34	0.37	0.39				
800	0.26	0.28	0.29	0.30	0.34	0.37	0.39				
1,000	0.31	0.33	0.34	0.35	0.39	0.42	0.44				
1,250	0.41	0.43	0.44	0.45	0.49	0.52	0.54	0.61			
1,500	0.51	0.53	0.54	0.55	0.59	0.62	0.64	0.71			
2,000	0.60	0.63	0.64	0.65	0.69	0.72	0.74	0.81	0.91		
2,500	0.66	0.70	0.72	0.74	0.79	0.82	0.84	0.91	1.01	1.11	1.21
3,150	0.76	0.80		0.84	0.89	0.92	0.94	1.01	1.11	1.21	1.31
4,000				0.94	0.99	1.02	1.04	1.11	1.21	1.31	1.41
5,000					1.09		1.13	1.21	1.31		
6,000					1.19		1.24	1.31	1.41		
7,000								1.41	1.50		
8,000									1.61		
>8,000											on request

Maximum permissible bearing clearance increases – double-row ball bearing

Raceway diameter [mm] to	Ball diameter [mm]											
	18	20	22	25	30	35	40	45	50	60	70	
1,000	1.9	1.9	2.0	2.0	2.1	2.2	2.6	2.9				
1,250	2.0	2.0	2.1	2.1	2.2	2.3	2.7	3.0	3.5	3.7		
1,500		2.0	2.2	2.2	2.3	2.4	2.7	3.0	3.5	3.7		
1,750			2.3	2.3	2.4	2.5	2.9	3.1	3.6	3.8	4.1	
2,000				2.4	2.5	2.6	3.0	3.3	3.8	3.9	4.2	
2,250					2.6	2.7	3.1	3.4	3.9	4.0	4.3	
2,500						2.8	3.2	3.5	4.0	4.2	4.4	
2,750						2.9	3.3	3.6	4.1	4.3	4.5	
3,000							3.4	3.7	4.2	4.4	4.6	
3,250							3.5	3.8	4.3	4.5	4.7	
3,500							3.6	3.9	4.4	4.6	4.8	
3,750							3.6	3.9	4.5	4.7	4.9	
4,000								4.1	4.6	4.8	5.1	
4,500									5.0	5.2	5.5	
5,500									5.2	5.4	5.6	
6,000									5.4	5.6	5.8	
6,500										5.8	6.0	
7,000										6.0	6.2	
7,500											6.4	
8,000											6.6	
>8,000												on request

Further information and explanations can be found in the instruction manual.

21 Bearing selection

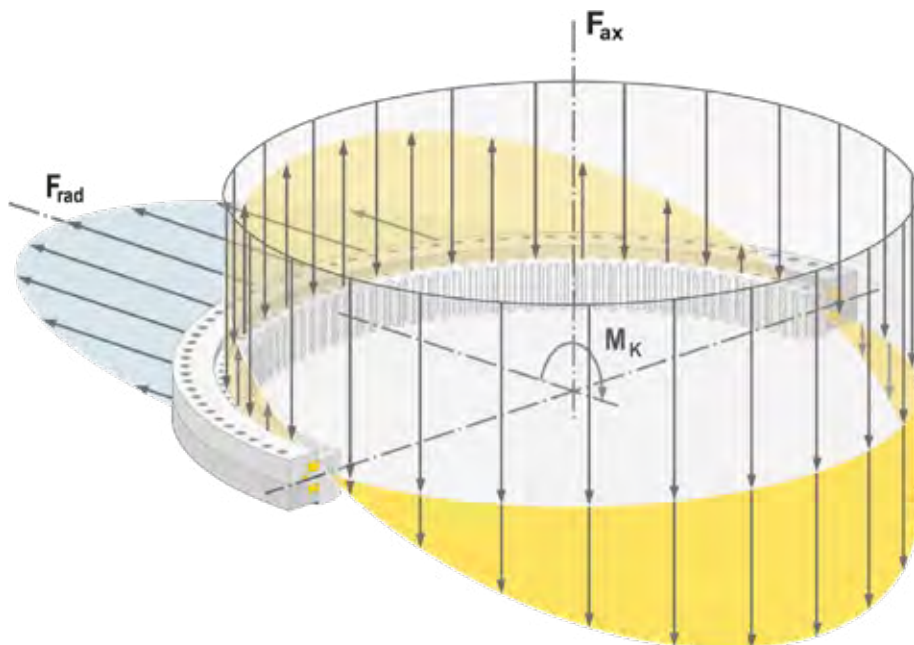
In general, the final and binding bearing selection is made by Liebherr, after the factors of the respective loading condition have been clarified.

The static load-bearing capacity must be checked in each case. For slewing bearings with frequent rotations, this evidence suffices. In all other cases, the dynamic load bearing capacity must also be checked.

The extreme load on the bearing is calculated from the combination of tilting moment, axial force and radial force on the bearing taking into account application-specific impact factors and safety factors. These must be set by the user if necessary or taken from the product pages.

Bearing loads

Load distribution in bearing



Load distribution in bearing

Axial force F_a

The direction of the axial force runs parallel to the rotary axis of the bearing. In the raceway system the axial force highlights a symmetrical pressure-force distribution to the rolling elements and the raceway. The size of the rolling element forces generally depends on the contact angle and the number of rolling elements.

For the roller bearing the contact angle in the raceway system is zero. There is only axial pressure-force distribution here (no radial force) to the raceway and the rolling elements.

Tilting moment M_k

An eccentric axial force F_a causes a tilting moment on the bearing by the lever arm. The resulting moment from all eccentric force applications is called tilting moment.

Depending on the eccentricity of the force application, different zones of the bearing are stressed. The pressure distribution to the raceway system is asymmetrical.

The highest pressure force affects the rolling element, which is located in the crest of the pressure-force distribution.

Radial force F_r

The direction of the radial force runs perpendicular to the rotary axis of the bearing. The level of the force direction is almost in the rolling element centre.

Existing radial bearing loads are however only considered during the check of the static load-bearing capacity, if the radial load exceeds the value

$$F_r = 0.25 \times F_a \text{ (for four-point ball bearings)}$$

$$F_r = 0.10 \times F_a \text{ (for roller bearings).}$$

In these cases the static load-bearing capacity is checked by Liebherr.

Graphic initial selection using the static limiting load curve

Each Liebherr large diameter bearing has an individual static limiting load curve depending on its dimensions, raceway geometry, type and number of rolling elements, as well as the ring material.

The static limiting load curve shows the maximum permissible values as a combination of axial force F_a and tilting moment M_k . This curve is simplified and shown as a straight line in the static limiting load diagram (abscissa: F_a ; ordinate: M_k).

The values of the expected static load bearing are entered in

the limiting load diagram. The bearing is then statically suitable if the load point $P_L (F_a, M_k)$ is below the static limiting load curve of the bearing selected by the user.

The limiting load curves are compiled as standard with bolts of strength category 10.9 i.a.w. DIN EN ISO 898-1 and a clamping length of $l_k = 5 \times d$. The tightening factor α_A is 1.6, the preload is 70 %.

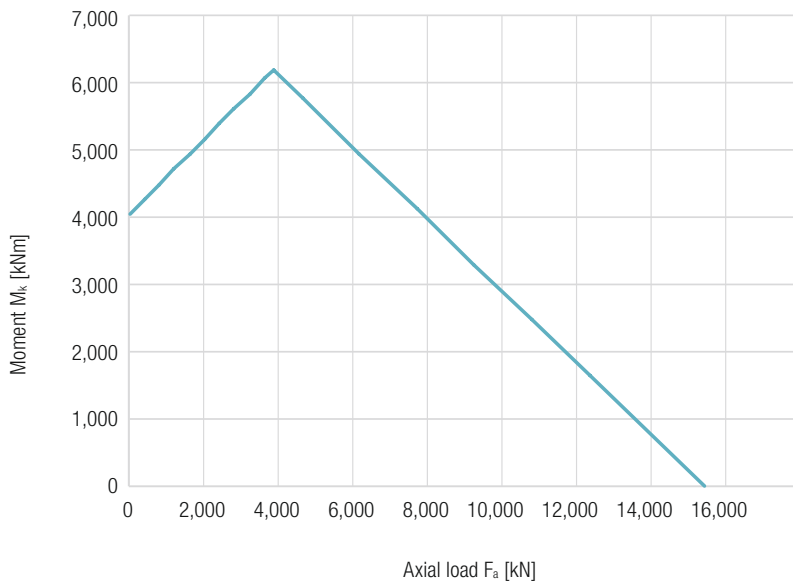


Image of a static limiting load diagram

The limiting load diagrams do not contain any reduction factors. They describe the performance of the bearing irrespective of the adjacent construction. It is assumed that an optimum installation situations is given.

Calculation of the equivalent bearing load

Following the initial bearing selection, the static safety of the selected slewing bearing can be calculated. Using the equivalent load bearing P_0 and the static load rating C_{stat} from the bearing tables for ball and roller bearing, these can be calculated using the following formulas.

Ball bearing

P_0 :	equivalent axial load	[kN]
K_{rep} :	Load increase factor (see chapter 13, table "Influence factor K_{rep} ")	
f_1 :	Load factor (see table "Load factor f_1 ")	
F_a :	Axial load	[kN]
F_r :	Radial load	[kN]
M_k :	Tilting moment	[kNm]
D_L :	Raceway diameter	[m]

$$P_0 = K_{rep} \times f_1 \left(F_a + 1.93 \times F_r + \frac{4 \times M_k}{D_L} \right)$$

Load factor f_1

	f_1
Single-row ball bearing	1.0
Double-row ball bearing	1.4

With the static load rating from the bearing tables the static safety can be calculated as follows:

$$S_0 = \frac{C_{stat}}{P_0}$$

Triple-row roller bearing (supporting raceway)

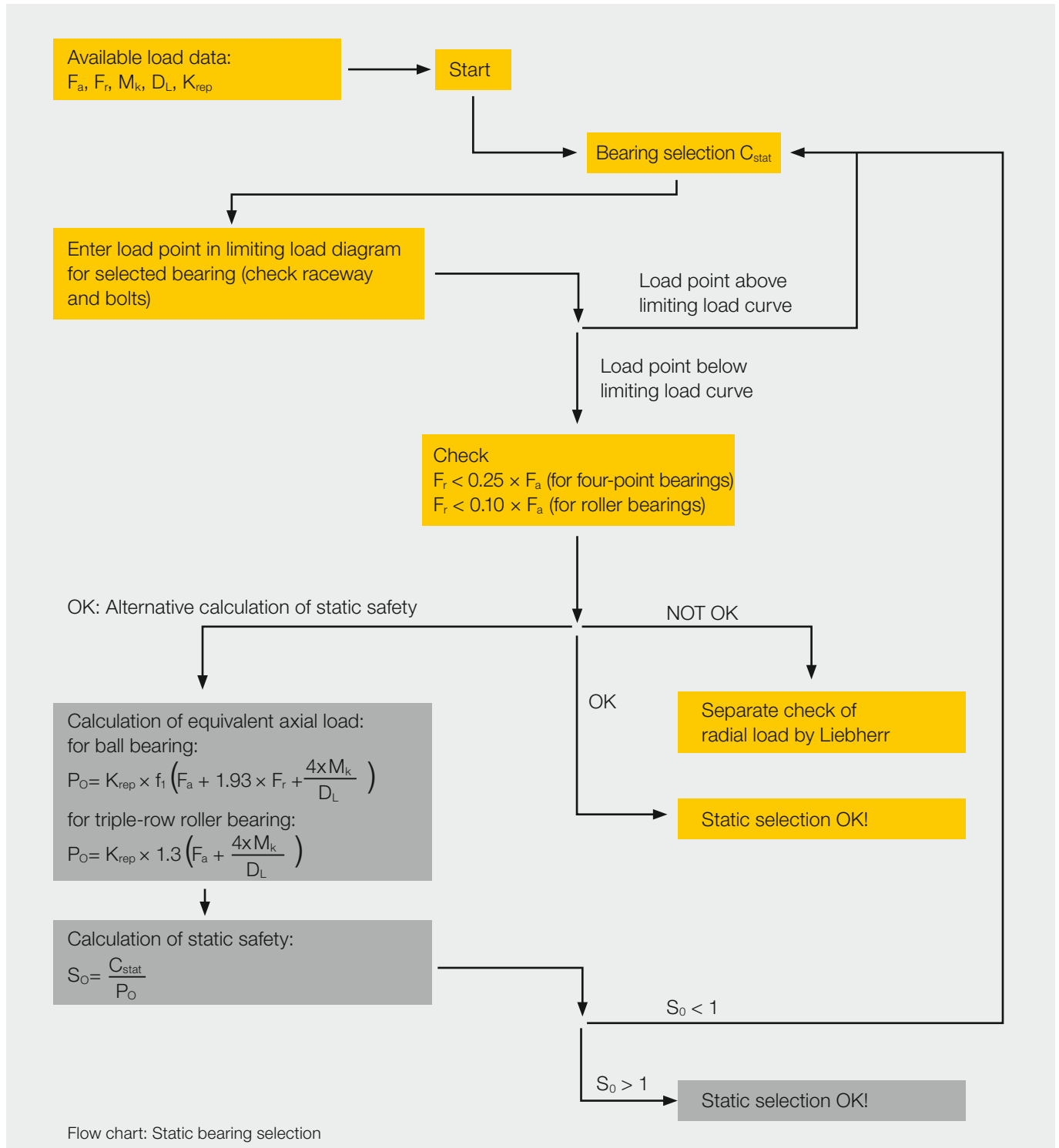
P_0 :	Equivalent axial load	[kN]
K_{rep} :	Load increase factor (see table "Influence factor K_{rep} ")	
F_a :	Axial load	[kN]
M_k :	Tilting moment	[kNm]
D_L :	Raceway diameter	[m]

$$P_0 = K_{rep} \times 1.3 \left(F_a + \frac{4 \times M_k}{D_L} \right)$$

With the static load rating from the bearing tables the static safety can be calculated as follows:

$$S_0 = \frac{C_{stat}}{P_0}$$

Example of static bearing selection



Step 1:

A four-point ball bearing with external gear (**KUD02130-050VA**) is stressed with the following static load. The application is a **tower crane**.

$$M_k = 3,750 \text{ kNm}$$

$$F_a = 2,000 \text{ kN}$$

$$F_r = 180 \text{ kN}$$

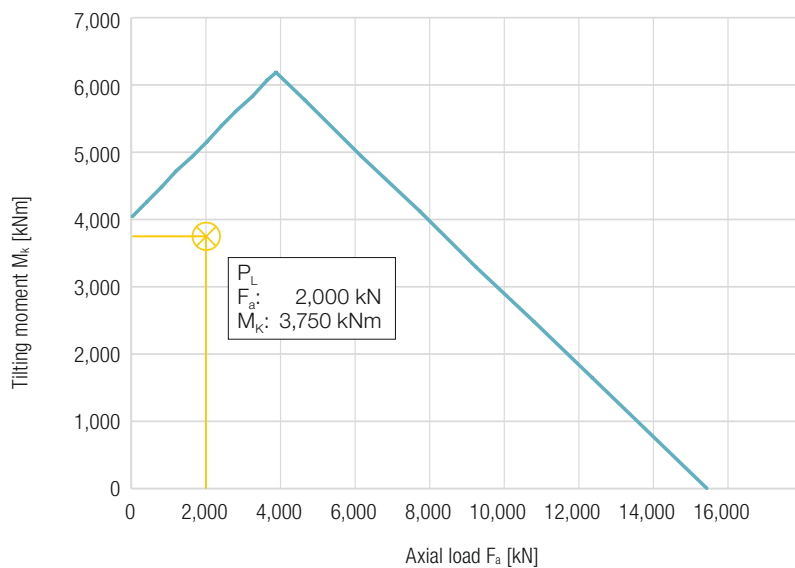
$$C_{\text{stat}} = 16,073 \text{ kN}$$

$$K_{\text{rep}} = 1.3$$

$$D_L = 2.13 \text{ m}$$

Step 2:

The load combination is entered in the limiting load diagram for four-point ball bearings with external gear. The axial force F_a is plotted on the abscissa, the tilting moment M_k at the ordinate. The intersection point of the axial force and tilting moment gives the static load point P_L .



Selection example: KUD02130-050VA (static limiting load curve)

Step 3:

Checking the radial load:

$$\frac{F_r}{F_a} = \frac{180 \text{ kN}}{2,000 \text{ kN}} = 0.09 \leq 0.25$$

In the present case $F_r < 0.25 \times F_a$.

→ A separate check of the radial force by Liebherr is not required.

The load point P_L is below the static limiting load curve.

The bearing is therefore sufficiently dimensioned for these static loads.

To calculate the static safety continue with Step 4.

Step 4:

Calculation of equivalent axial load:

$$P_0 = 1,3 \times 1,0 \times \left(2.000 \text{ kN} + 1,93 \times 180 \text{ kN} + \frac{4 \times 3.750 \text{ kNm}}{2,13 \text{ m}} \right) = 12.207 \text{ kN}$$

Step 5:

Calculation of static safety:

$$S_0 = \frac{16,073 \text{ kN}}{12,207 \text{ kN}} = 1.32$$

Result:

The load point found is below the static limiting load curve for the bearing **KUD02130-050VA** and the static safety of 1.32 is greater than 1.0. The bearing is suitable for these static loads.

22 Dynamic bearing service life

For sizing a large diameter bearing, the expected service life from the stress of the operating loads is decisive, in addition to checking the static load-bearing capacity. This step can be omitted for bearings only under static stress.

The dynamic equivalent bearing load is calculated from the combination of axial force F_a , tilting moment M_k and radial load F_r on the bearing during the operation of the plant. The individual load components, the available load spectrum data and the relevant proportions of the overall duty cycle must be used for this calculation.

If there are multistage stresses or stresses made up of load spectrums, then these may be traced back to a single-stage equivalent dynamic bearing load using the elementary Miner Rule.

The equivalent dynamic bearing load is calculated
$$P_{aqui} = \left(\frac{\sum P_{a,i}^p \times U_i}{U_{ges}} \right)^{\frac{1}{p}} \text{ [kN]}$$

with the respective equivalent axial loads of the individual load levels i:

for ball bearings:

$$P_{a,i} = K_{rep}^{0.66} \times \left(F_{a,i} + 0.63 \times F_{r,i} + \frac{2 \times M_{k,i}}{D_L} \right) \text{ [kN]}$$

for triple-row roller bearings:

$$P_{a,i} = K_{rep}^{0.66} \times 1.4 \times \left(F_{a,i} + \frac{2 \times M_{k,i}}{D_L} \right) \text{ [kN]}$$

$P_{a,i}$:	Amount of equivalent axial load in the respective load level i	[kN]
U_i :	Number of bearing rotations of load level i	
U_{ges} :	Total number of bearing rotations	
p :	Service life exponent, gradient of Wöhler curve (for ball bearings $p = 3$; for all other bearings $p = 10/3$)	
$F_{a,i}$:	Axial load in load level	[kN]
$F_{r,i}$:	Radial load in load level	[kN]
$M_{k,i}$:	Tilting moment in load level	[kNm]

Using the dynamic load rating and the equivalent bearing load, the bearing service life can be calculated for 10% probability of failure.

$$L_{10} = 10^6 \times \left(\frac{C_{dyn}}{P_{aqui}} \right)^p$$

C_{dyn} : Dynamic load rating (take value from bearing tables) [kN]

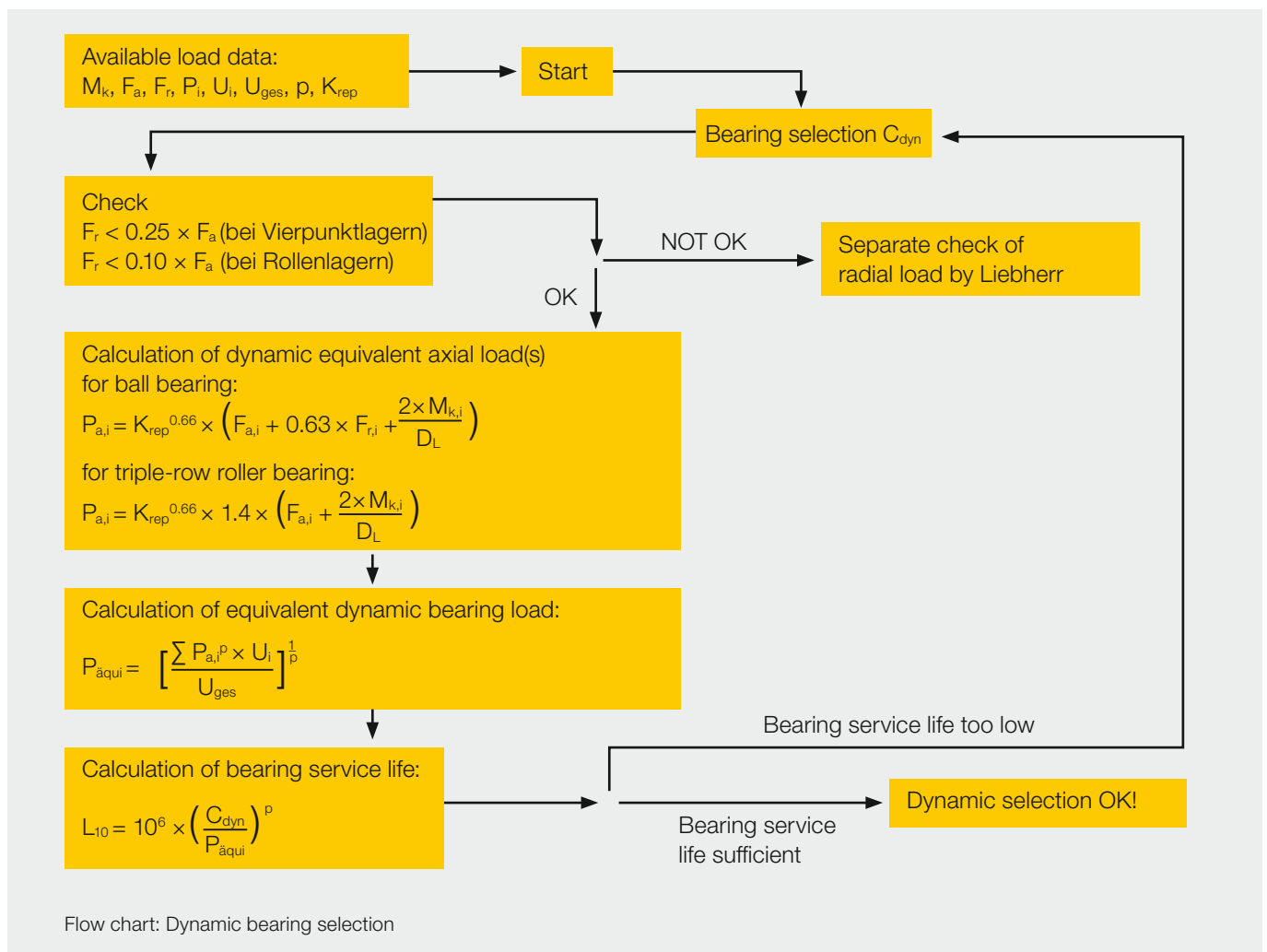
Influence of radial load

Existing radial bearing loads are however only considered during the check of the dynamic service life, if the radial load exceeds the value

$F_r = 0.25 \times F_a$ for four-point bearings or
 $F_r = 0.10 \times F_a$ for roller bearings

The dynamic service life is always also checked by Liebherr.

Sample calculation of dynamic bearing service life



Step 1:

A four-point bearing with external gear (**KUD02130-050VA**) is stressed with the following dynamic load (load spectrum with load levels $i=1$ and $i=2$). The application is a **tower crane**.

$M_{k,1}$	= 2,500 kNm	U_2	= 16,000
$F_{a,1}$	= 800 kN	U_{ges}	= 20,300
$F_{r,1}$	= 50 kN	C_{dyn}	= 1,244 kN
U_1	= 4,300	p	= 3
$M_{k,2}$	= 950 kNm	K_{rep}	= 1.3
$F_{a,2}$	= 700 kN	D_L	= 2.13 m
$F_{r,2}$	= 55 kN		

Step 2:

Checking the radial loads:

$$\frac{F_{r,1}}{F_{a,1}} = \frac{50 \text{ kN}}{800 \text{ kN}} = 0.06 \leq 0.25$$

$$\frac{F_{r,2}}{F_{a,2}} = \frac{55 \text{ kN}}{700 \text{ kN}} = 0.08 \leq 0.25$$

In the present case $F_r < 0.25 \times F_a$.

-> A separate check of the radial force by Liebherr is not required.

Step 3:

Calculation of equivalent axial load(s):

$$P_{a,1} = 1.3^{0.66} \times \left(800 \text{ kN} + 0.63 \times 50 \text{ kN} + \frac{2 \times 2,500 \text{ kNm}}{2.13 \text{ m}} \right) = 3,780 \text{ kN}$$

$$P_{a,2} = 1.3^{0.66} \times \left(700 \text{ kN} + 0.63 \times 55 \text{ kN} + \frac{2 \times 950 \text{ kNm}}{2.13 \text{ m}} \right) = 1,934 \text{ kN}$$

Step 4:

Calculation of equivalent dynamic bearing load:

$$P_{\dot{a}qui} = \left(\frac{P_{a,1}^p \times U_1 + P_{a,2}^p \times U_2}{U_{ges}} \right)^{\frac{1}{p}}$$

$$P_{\dot{a}qui} = \left(\frac{(3,780 \text{ kN})^3 \times 4,300 + (1,934 \text{ kN})^3 \times 16,000}{20,300} \right)^{\frac{1}{3}} = 2,578 \text{ kN}$$

Step 5:

Calculation of bearing service life:

$$L_{10} = 10^6 \times \left(\frac{1,244 \text{ kN}}{2,578 \text{ kN}} \right)^3 = 112,303 \text{ [rotations]}$$

Result:

The calculated bearing service life under the aforementioned operating conditions with 10% probability of failure is 112,303 rotations.

The bearing service life is thus above the prescribed 20,300 rotations, therefore the indicated load spectrum can be applied to this bearing.

Circumferential speed

Liebherr slewing bearings must be used up to a circumferential speed of 4 m/sec. For higher circumferential speeds, special rolling element guides or cages are required. Deviations must be clarified with Liebherr.

23 Rotation resistance of bearing

Like every anti-friction bearing, large diameter bearings also have frictional resistance. The resistance, which an anti-friction bearing offers to its rotation, is made up of rolling friction, dynamic friction and lubricant friction.

Rolling friction occurs when the rolling elements roll onto the raceways. The friction between the rolling elements and the raceway profile increases with narrowing osculation and load.

Dynamic friction occurs both at the contact surfaces of the rolling elements in the cage or at the spacers (for roller bearings also at the bearing ribs and the roller end faces) and at the seal running surfaces.

Under normal operating conditions and with sufficient lubrication, the frictional resistance is low. Inadequate lubrication, dirt contamination and high speeds may noticeably increase the dynamic friction and lead to increased wear.

The **lubricant** friction results, on the one hand, from the inner friction of the lubricant, and, on the other hand, from the flexing during the movement of the bearing.

The entire lubricant friction essentially depends on the viscosity and the quantity of the lubricant. The impact is small at low speeds.

The friction torque for an unloaded and unscrewed bearing is the assembly friction torque M_0 .

M_E describes the installation torque of the bearing (fastened together). It mainly results from the lubricant friction, the friction of the rolling elements, the friction of the spacers (or cages) and the seals, and essentially depends on the design and size of the bearing.

$$M_E = f_s \times W_R \times D_L^2$$

M_{RN} describes the load-dependent proportion of the overall friction torque. This part is dependent on the present load, the rotational velocity of the bearing, as well as the properties of the adjacent construction.

$$M_{RN} = k \times \mu \times f_A \times 0,95 \times e^{(0,15 \times n_{GWL})} \times \left(M_k + \frac{f_L \times F_R \times D_L}{2} + \frac{F_A \times D_L}{k} \right)$$

For the overall friction torque of the large diameter bearing, the following applies:

$$M_{Reib} = M_E + M_{RN}$$

Liebherr formula of friction moment:

$$M_{Reib} = f_s \times W_R \times D_L^2 + k \times \mu \times f_A \times 0,95 \times e^{(0,15 \times n_{GWL})} \times \left(M_k + \frac{f_L \times F_R \times D_L}{2} + \frac{F_A \times D_L}{k} \right) \text{ [kNm]}$$

f_s :	Bolt connection factor	see table "Bolt connection factors"
W_R :	Specific friction force	[kN/m] see table "Specific friction forces"
D_L :	Raceway diameter	[m]
k :	K-factor	see table "k-factors"
f_A :	Adjacent construction factor	see table "Adjacent construction factor"
n_{GWL} :	Speed of the large diameter bearing	[rpm]
f_L :	Raceway factor	$f_L = 1.73$ (constant)
μ :	Friction coefficient	see table "Friction coefficients"
F_A :	Axial load	[kN]
F_R :	Radial load	[kN]

Friction coefficients

Type of slewing bearing	Friction coefficient μ
KUD_V (four-point ball bearing)	0.003
KUD_W (double-row four-point ball bearing)	0.003
KUD_Z (double-row)	0.002
ROD_D (triple-row)	0.0015
RKD	0.0015

¹ All listed slewing bearings in this catalogue are carried out with spacers.

Factors for bolt connection

Type of slewing bearing	Bolt connection factor f_s
KUD_V (four-point ball bearing)	1.0
KUD_W (double-row four-point ball bearing)	1.0
KUD_Z (double-row)	1.0
ROD_D (triple-row)	1.0
RKD	1.0

Factors for the adjacent construction

Application	Adjacent construction factor f_A
Homogeneous and rigid adjacent construction (ideal)	1.0

In case of a not ideal adjacent construction (ideal adjacent construction see page 29) the factor f_A has to be customized depending on the application case.

Specific friction forces

Type of slewing bearing	specific friction force W_R [kN/m]
KUD_V (four-point ball bearing)	1.83
KUD_W (double-row four-point ball bearing)	1.96
KUD_Z (double-row)	1.74
ROD_D (triple-row)	1.53
RKD	1.53

k-factors

Type of slewing bearing	Factor k
KUD_V (four-point ball bearing)	1.25
KUD_W (double-row four-point ball bearing)	1.25
KUD_Z (double-row)	1.25
ROD_D (triple-row)	1.17
RKD	1.17

Values only apply to standard bearings with standard seals, for special bearings the values must be calculated in each case.

For unloaded bearings or bearings with low loads, the calculated values may deviate considerably from the actual values.

The necessary acceleration power, occurring wind loads and any inclined position of the bearing axis must also be considered in the sizing of the drive.

For special requirements of the rotation resistance of the large diameter bearing, corresponding adaptations can be made to increase or reduce the rotation resistance after consultation with Liebherr.

24 Drive torque required

In order to operate the selected large diameter bearing with the present load spectrum, the following torque is required at the pinion of the gearbox:

$$M_{\text{pinion, req.}} = M_{\text{friction}} \times i_{\text{pinion/bearing}} \times \eta_{\text{pinion/bearing}} \times 1,000 \text{ [Nm]}$$

$$i_{\text{pinion/bearing}}: \text{Transmission ratio pinion/bearing} = \frac{Z_{\text{pinion}}}{Z_{\text{bearing}}} \quad (\text{number of teeth})$$

$$\eta_{\text{pinion/bearing}}: \text{Efficiency of gearing pinion/bearing} = 0.99 \quad (\text{spur gearing})$$

On the basis of the value calculated above $M_{\text{pinion, req.}}$, a suitable slewing drive can be selected from the table "Technical data of the series designs DAT".

For the static selection of the drive, the maximum torque T_{Max} (includes 1.5x tooth fracture safety) from the table of Liebherr slewing drives must be used. A size for the gearbox can be determined here. For the dynamic selection of the drive, the dynamic output torque T_{FEM} is used. This value refers to the load spectrum M5/L2/T5 (max. 6,300 collective hours or 1,600 full-load hours) at 10 rpm from the "FEM 1.001 Calculation basis for cranes". Other load spectrums for other applications may reveal a different torque value for the gearbox. This must be checked by Liebherr in each case.



Technical data of the series designs DAT

	DAT 200	DAT 225	DAT 250	DAT 300	DAT 350	DAT 400
T_{FEM} [Nm]	5,000	8,000	11,000	18,000	30,000	44,000
T_{MAX} [Nm]	10,000	16,000	22,000	36,000	60,000	88,000

T_{FEM} = Reference torque T_{FEM} based on M5/L2/T5 at 10 rpm at the output

T_{MAX} = Security >1.5 against fracture

Inertia factor

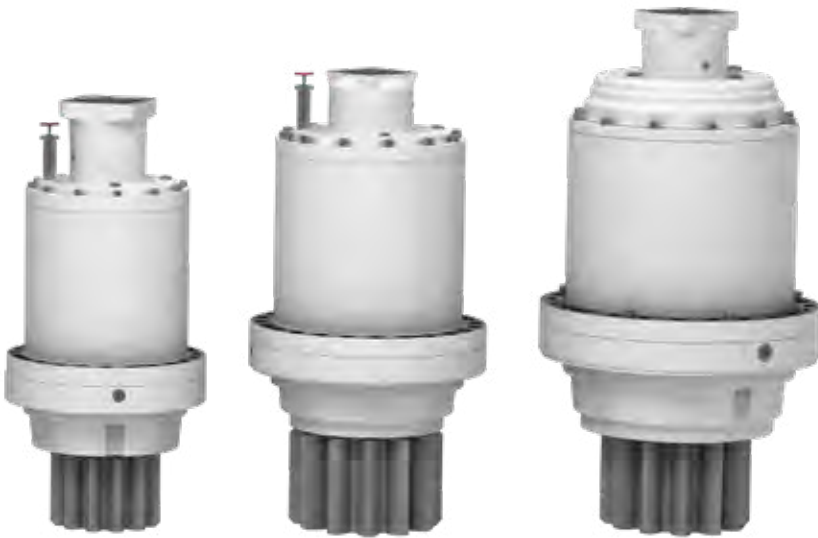
The inertia factor to be overcome P_B can be calculated:

$$P_B = M_{\text{Reib}} \times \omega \times \eta^{-1} = \frac{M_{\text{Reib}} \times n}{9.55 \times \eta} \text{ [kW]}$$

ω : Angular velocity $\omega = \frac{\pi \times n}{30}$ [s-1]

n : Required rotational velocity of large diameter bearing [rpm]

η : Efficiency of drive (gearbox with engine)



on request

DAT 450	DAT 500	DAT 600	DAT 700	DAT 800	DAT 1000
60,000	82,000	142,000	210,000	310,000	610,000
120,000	164,000	284,000	420,000	620,000	1,220,000

25 Glossary

KUD 00855 - 025 V A 15 - 900 - 000

Product group

- KUD - Ball bearing
- ROD - Roller bearing (cylindrical rollers)
- RKD - Combined roller and ball bearing

Raceway diameter (mm)

Roller element diameter (mm)

Type

- Z - double-row
- D - triple-row
- V - four-point bearing
- W - double-row four-point bearing

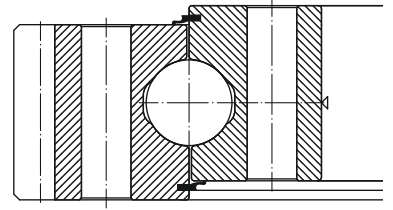
Gearing

- O - no gearing
- J - inner gearing
- A - outer gearing

Internal designation

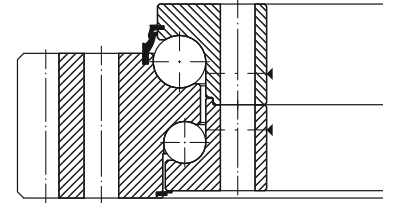
KUD_V

Ball bearings; four-point contact

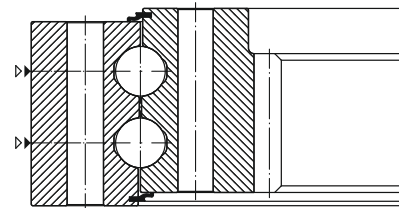


KUD_Z

Double-row ball bearings

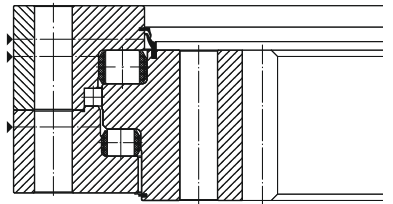


KUD_W

Double-row ball bearings;
four-point contact

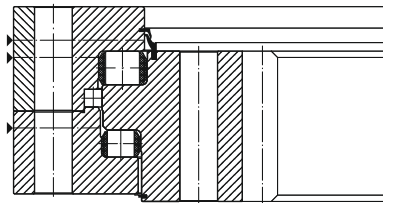
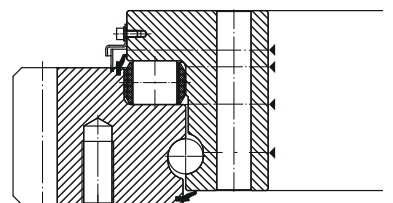
ROD_D

Triple-row roller bearings*



ROD_D

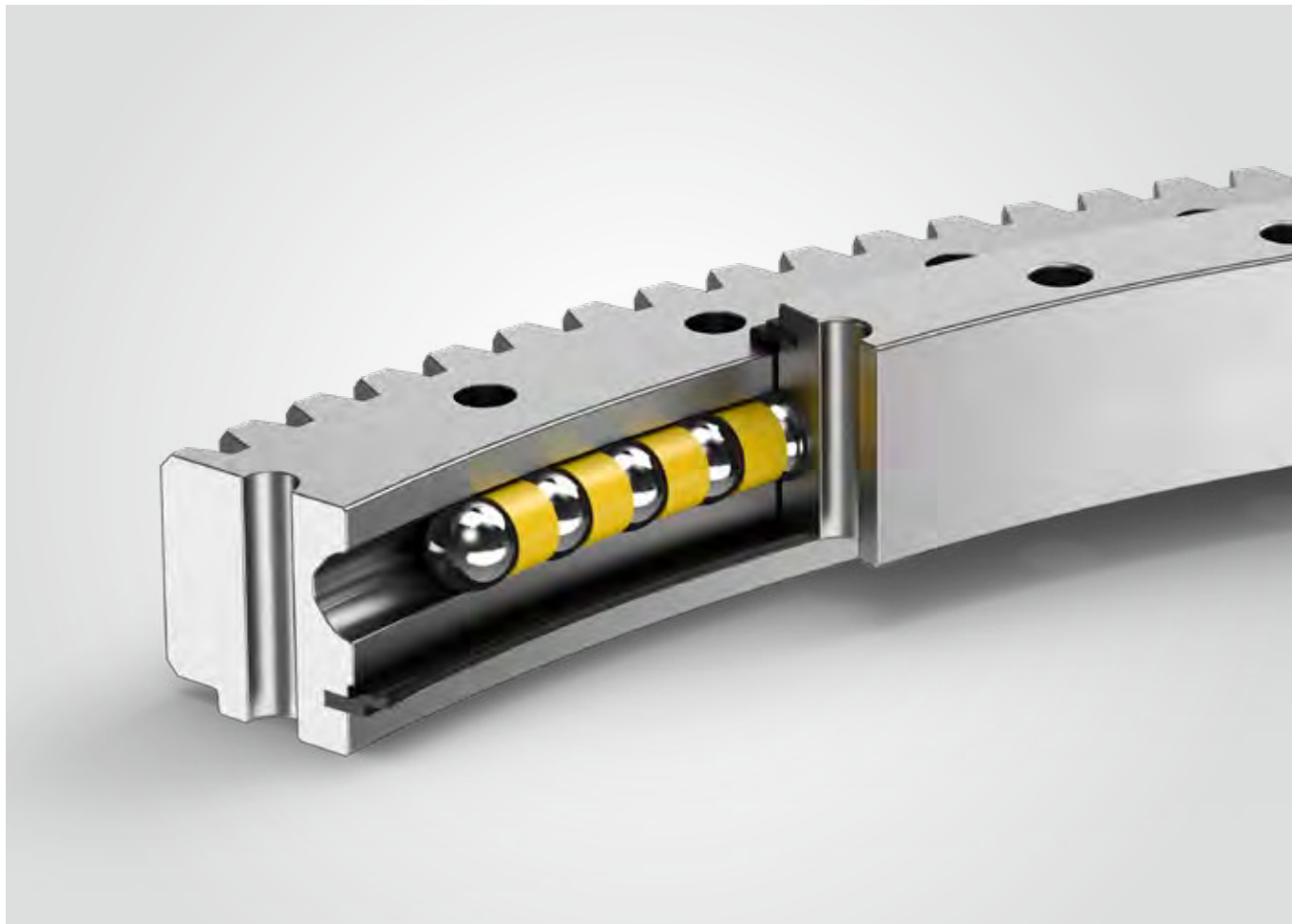
Triple-row roller bearings

RKD Combined roller
and ball bearings

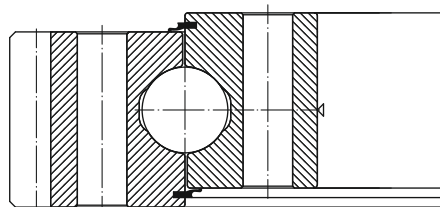
* Shorter delivery times can be realized.

26 Standard range - Technical data

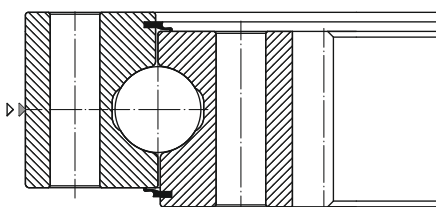
KUD_V Ball bearings; four-point contact



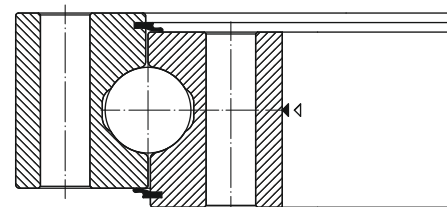
KUD_VA



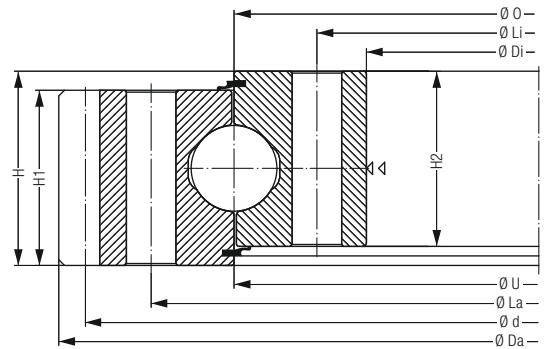
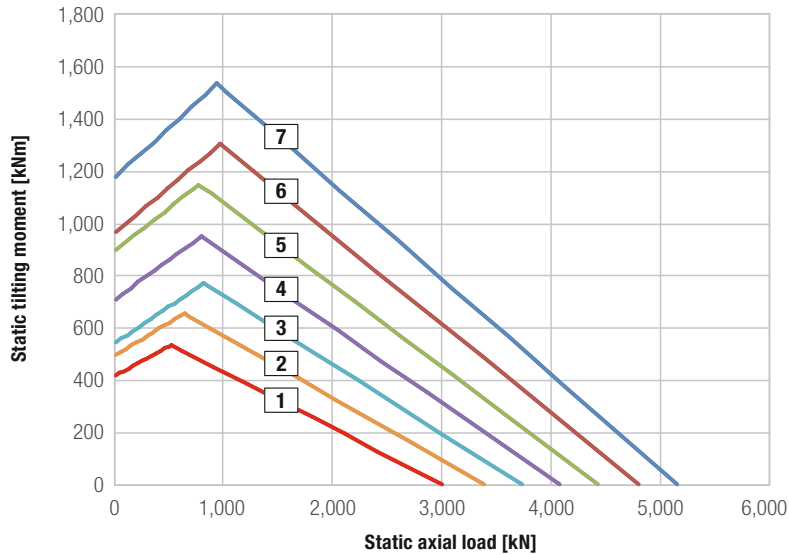
KUD_VJ



KUD_VO



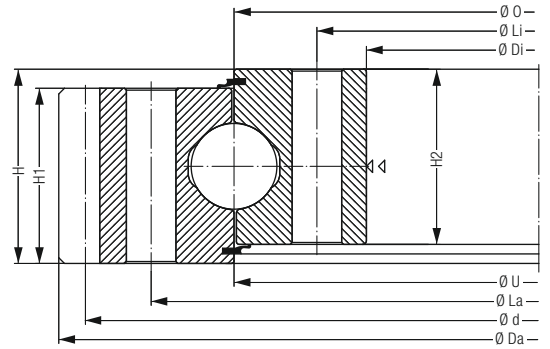
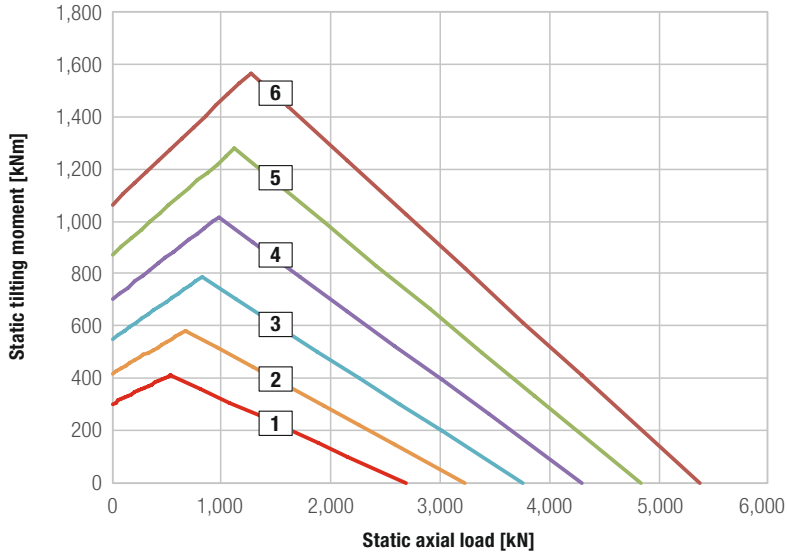
External gear KUD_25_VA



- 1 KUD00855-025VA15-900-000
- 2 KUD00955-025VA15-900-000
- 3 KUD01055-025VA15-900-000
- 4 KUD01155-025VA15-900-000
- 5 KUD01255-025VA15-900-000
- 6 KUD01355-025VA15-900-000
- 7 KUD01455-025VA15-900-000

Bearing type	Bearing data								Bolt data					Gear data						Load rating			
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}
1	141	997.2	755	80	855	855	71	54	916	795	28	20	4	981	9	109	-	-0.9	71	33.23	66.46	3,004	423
2	158	1,096.2	855	80	955	955	71	54	1,016	895	30	20	6	1,080	9	120	-	-0.9	71	33.23	66.46	3,383	443
3	172	1,198	955	80	1,055	1,055	71	54	1,116	995	30	20	6	1,180	10	118	-	-1.0	71	36.92	73.84	3,731	459
4	190	1,298	1,055	80	1,155	1,155	71	54	1,216	1,095	36	20	6	1,280	10	128	-	-1.0	71	36.92	73.84	4,079	474
5	204	1,398	1,155	80	1,255	1,255	71	54	1,316	1,195	42	20	6	1,380	10	138	-	-1.0	71	36.92	73.84	4,427	489
6	222	1,498	1,255	80	1,355	1,355	71	54	1,416	1,295	42	20	6	1,480	10	148	-	-1.0	71	36.92	73.84	4,806	505
7	236	1,598	1,355	80	1,455	1,455	71	54	1,516	1,395	48	20	6	1,580	10	158	-	-1.0	71	36.92	73.84	5,154	518

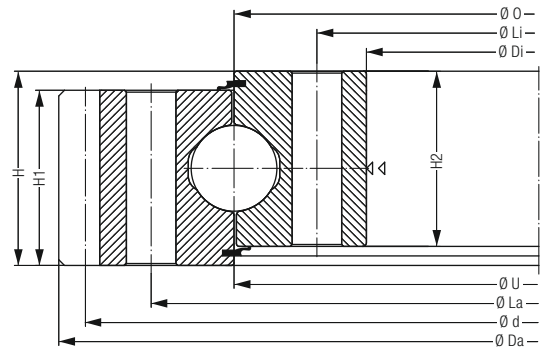
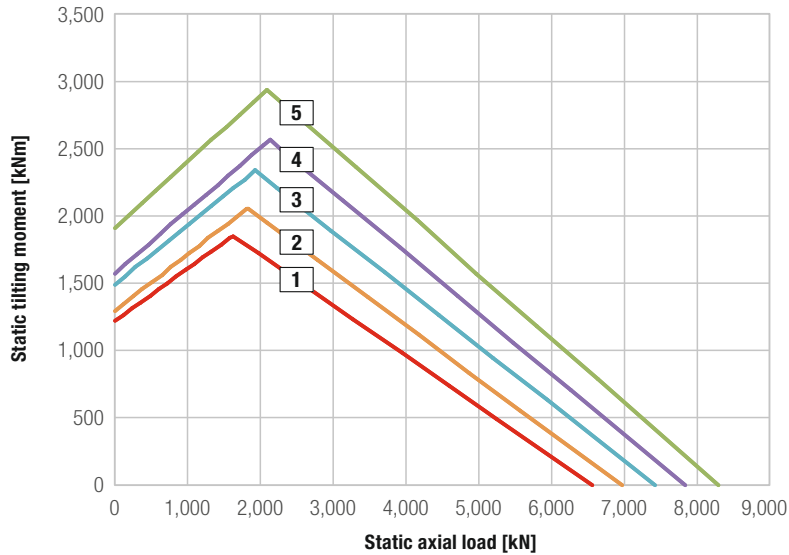
External gear KUD_25_VA



- 1 KUD00762-025VA15-900-000
- 2 KUD00914-025VA15-900-000
- 3 KUD01067-025VA15-900-000
- 4 KUD01219-025VA15-900-000
- 5 KUD01372-025VA15-900-000
- 6 KUD01524-025VA15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Diametral Pitch	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	Pd	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}
1	180.9	910.3	609.6	88.9	762	762	76.2	76.2	831.85	679.45	24/30	3/4"-10 UNC	4	894.08	2.5	88	-	-	76.2	40.91	81.82	2,751	413
2	218.6	1,062.7	762	88.9	914.4	914.4	76.2	76.2	984.25	831.85	28/32	3/4"-10 UNC	6	1,046.48	2.5	103	-	-	76.2	41.39	82.77	3,320	443
3	255.5	1,215.1	914.4	88.9	1,066.8	1,066.8	76.2	76.2	1,136.65	984.25	32/36	3/4"-10 UNC	6	1,198.88	2.5	118	-	-	76.2	41.75	83.50	3,889	471
4	300.0	1,367.5	1,066.8	88.9	1,219.2	1,219.2	76.2	76.2	1,289.05	1,136.65	36/40	3/4"-10 UNC	6	1,351.28	2.5	133	-	-	76.2	42.04	84.08	4,427	493
5	337.3	1,519.9	1,219.2	88.9	1,371.6	1,371.6	76.2	76.2	1,441.45	1,289.05	40/44	3/4"-10 UNC	6	1,503.68	2.5	148	-	-	76.2	42.27	84.54	4,996	516
6	363.6	1,672.3	1,371.6	88.9	1,524	1,524	76.2	76.2	1,593.85	1,441.45	44/48	3/4"-10 UNC	6	1,656.08	2.5	163	-	-	76.2	42.46	84.92	5,533	535

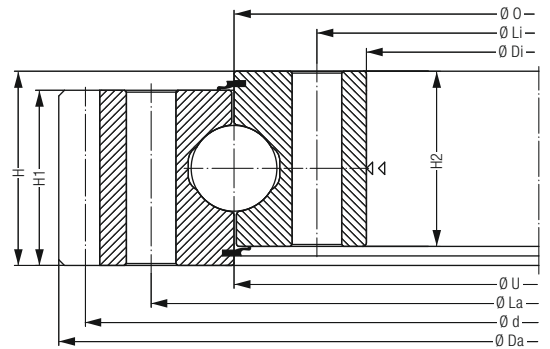
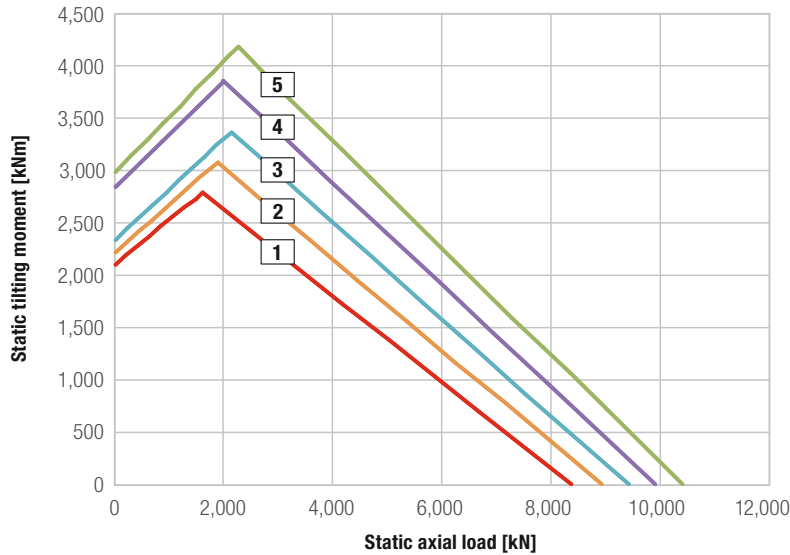
External gear KUD_30_VA



- 1 KUD01500-030VA15-900-000
- 2 KUD01600-030VA15-900-000
- 3 KUD01700-030VA15-900-000
- 4 KUD01800-030VA15-900-000
- 5 KUD01900-030VA15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]		[mm]	[mm]		[mm]	[mm]	[mm]	[kN]	[kN]	C_{stat}	C_{dyn}
1	308	1665,6	1392	84	1500	1500	72	72	1564	1436	48	20	6	1632	12	136	6	-1,2	72	79,3	158,61	6556	648
2	323	1761,6	1492	84	1600	1600	72	72	1664	1536	48	20	6	1728	12	144	6	-1,2	72	79,3	158,61	6966	662
3	357	1869,6	1592	84	1700	1700	72	72	1764	1636	52	20	7	1836	12	153	6	-1,2	72	79,3	158,61	7421	678
4	372	1965,6	1692	84	1800	1800	72	72	1864	1736	52	20	7	1932	12	161	6	-1,2	72	79,3	158,61	7831	691
5	383	2061,6	1792	84	1900	1900	72	72	1964	1836	60	20	8	2028	12	169	6	-1,2	72	79,3	158,61	8286	706

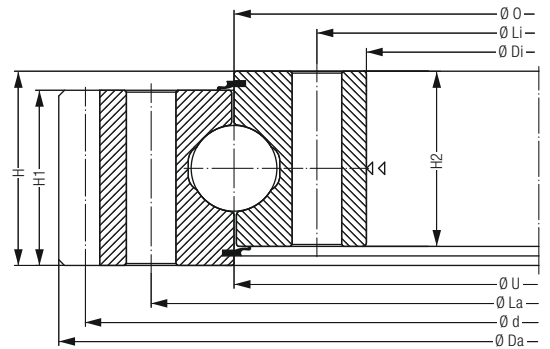
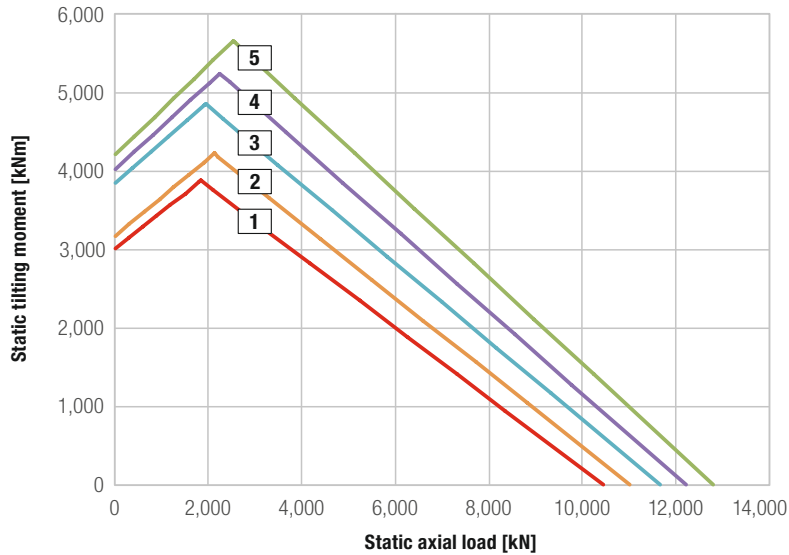
External gear KUD_35_VA



- 1 KUD01650-035VA15-900-000
- 2 KUD01750-035VA15-900-000
- 3 KUD01850-035VA15-900-000
- 4 KUD01950-035VA15-900-000
- 5 KUD02050-035VA15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}
1	437	1,833.6	1,523	94	1,650	1,650	82	82	1,725	1,575	52	24	7	1,800	12	150	6	-1.2	82	90.32	180.64	8,366	784
2	457	1,929.6	1,623	94	1,750	1,750	82	82	1,825	1,675	52	24	7	1,896	12	158	6	-1.2	82	90.32	180.64	8,924	804
3	502	2,037.6	1,723	94	1,850	1,850	82	82	1,925	1,775	52	24	7	2,004	12	167	6	-1.2	82	90.32	180.64	9,420	820
4	516	2,133.6	1,823	94	1,950	1,950	82	82	2,025	1,875	60	24	8	2,100	12	175	6	-1.2	82	90.32	180.64	9,915	835
5	577	2,251.2	1,923	94	2,050	2,050	82	82	2,125	1,975	60	24	8	2,212	14	158	7	-1.4	82	105.37	210.74	10,411	850

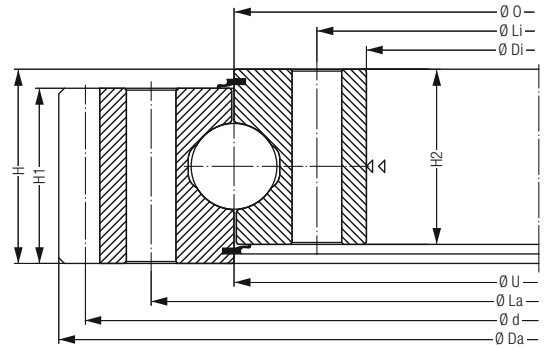
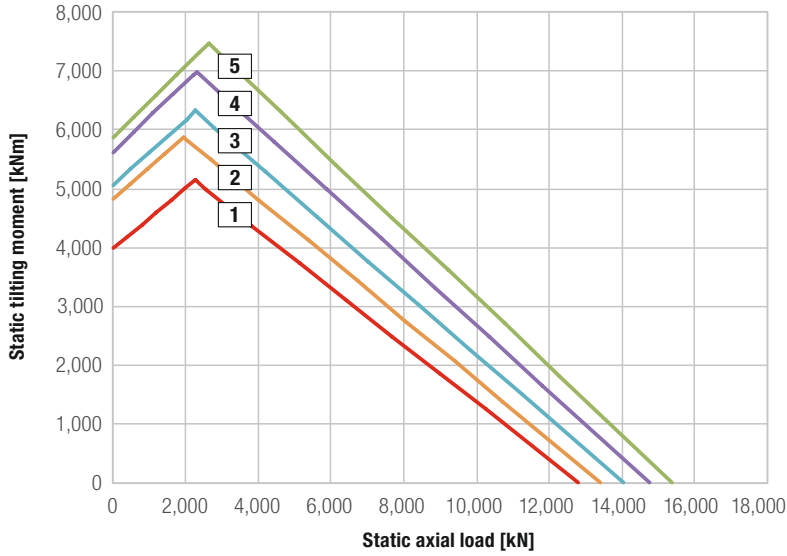
External gear KUD_40_VA



- 1 KUD01800-040VA15-900-000
- 2 KUD01900-040VA15-900-000
- 3 KUD02000-040VA15-900-000
- 4 KUD02100-040VA15-900-000
- 5 KUD02200-040VA15-900-000

Bearing type	Bearing data										Bolt data					Gear data							Load rating	
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic	
	[kg]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]		[mm]	[mm]		[mm]	[mm]	[mm]	[kN]	[kN]	C_{stat}	C_{dyn}	
1	596	2,001.6	1,655	104	1,800	1,800	92	92	1,885	1,715	52	27	7	1,968	12	164	6	-1.2	92	101.33	202.67	10,442	929	
2	622	2,097.6	1,755	104	1,900	1,900	92	92	1,985	1,815	52	27	7	2,064	12	172	6	-1.2	92	101.33	202.67	11,008	947	
3	669	2,209.2	1,855	104	2,000	2,000	92	92	2,085	1,915	60	27	7	2,170	14	155	7	-1.4	92	118.22	236.44	11,656	969	
4	700	2,307.2	1,955	104	2,100	2,100	92	92	2,185	2,015	60	27	8	2,268	14	162	7	-1.4	92	118.22	236.44	12,222	986	
5	730	2,405.2	2,055	104	2,200	2,200	92	92	2,285	2,115	60	27	8	2,366	14	169	7	-1.4	92	118.22	236.44	12,789	1,002	

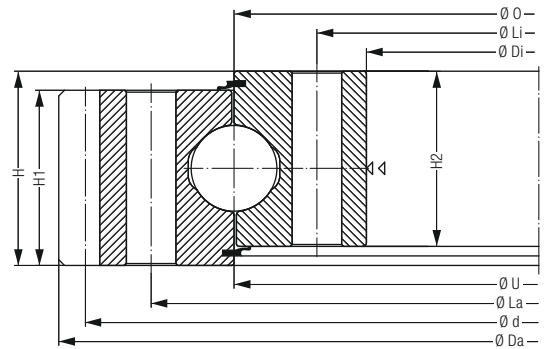
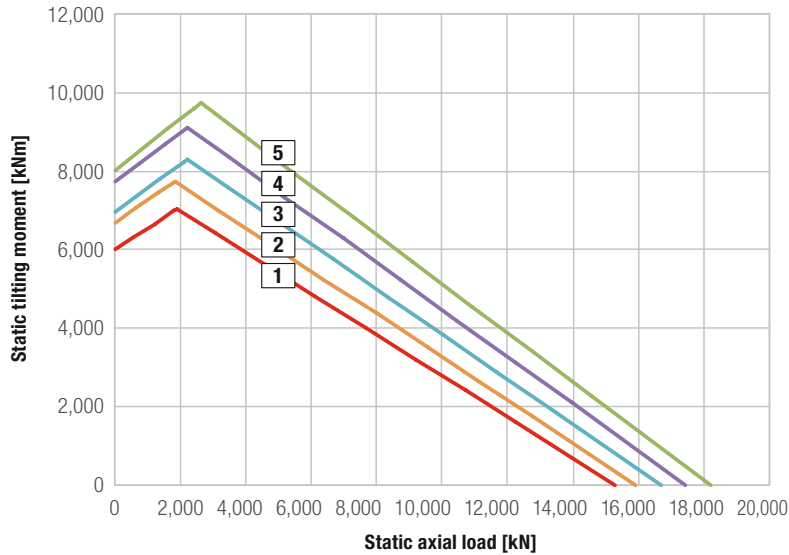
External gear KUD_45_VA



- 1 KUD01950-045VA15-900-000
- 2 KUD02050-045VA15-900-000
- 3 KUD02150-045VA15-900-000
- 4 KUD02250-045VA15-900-000
- 5 KUD02350-045VA15-900-000

Bearing type	Bearing data										Bolt data					Gear data							Load rating	
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic	
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b			C _{stat}	C _{dyn}	
1	789	2,169.6	1,789	114	1,950	1,950	102	102	2,045	1,855	52	30	8	2,136	12	178	6	-1.2	102	112.35	224.7	12,806	1,085	
2	839	2,279.2	1,889	114	2,050	2,050	102	102	2,145	1,955	60	30	8	2,240	14	160	7	-1.4	102	131.07	262.14	13,420	1,103	
3	877	2,377.2	1,989	114	2,150	2,150	102	102	2,245	2,055	60	30	8	2,338	14	167	7	-1.4	102	131.07	262.14	14,035	1,120	
4	909	2,475.2	2,089	114	2,250	2,250	102	102	2,345	2,155	64	30	9	2,436	14	174	7	-1.4	102	131.07	262.14	14,752	1,143	
5	947	2,573.2	2,189	114	2,350	2,350	102	102	2,445	2,255	64	30	9	2,534	14	181	7	-1.4	102	131.07	262.14	15,366	1,159	

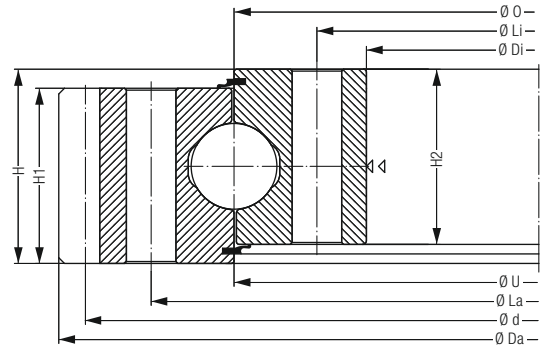
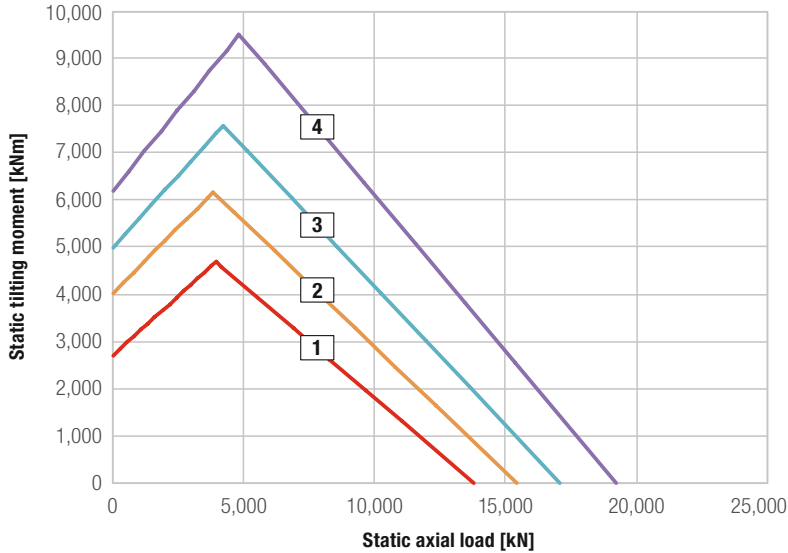
External gear KUD_50_VA



- 1 KUD02100-050VA15-900-000
- 2 KUD02200-050VA15-900-000
- 3 KUD02300-050VA15-900-000
- 4 KUD02400-050VA15-900-000
- 5 KUD02500-050VA15-900-000

Bearing type	Bearing data										Bolt data					Gear data							Load rating	
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic	
	[kg]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]		[mm]	[mm]		[mm]	[mm]	[mm]	[mm]	[kN]	[kN]	C_{stat}	C_{dyn}
1	1,029	2,349.2	1,924	124	2,100	2,100	112	112	2,204	1,996	60	33	8	2,310	14	165	7	-1.4	112	134.92	287.85	15,304	1,242	
2	1,068	2,447.2	2,024	124	2,200	2,200	112	112	2,304	2,096	64	33	8	2,408	14	172	7	-1.4	112	134.92	287.85	15,936	1,258	
3	1,114	2,545.2	2,124	124	2,300	2,300	112	112	2,404	2,196	64	33	8	2,506	14	179	7	-1.4	112	134.92	287.85	16,695	1,281	
4	1,152	2,643.2	2,224	124	2,400	2,400	112	112	2,504	2,296	68	33	10	2,604	14	186	7	-1.4	112	134.92	287.85	17,453	1,303	
5	1,197	2,741.2	2,324	124	2,500	2,500	112	112	2,604	2,396	68	33	10	2,702	14	193	7	-1.4	112	134.92	287.85	18,212	1,324	

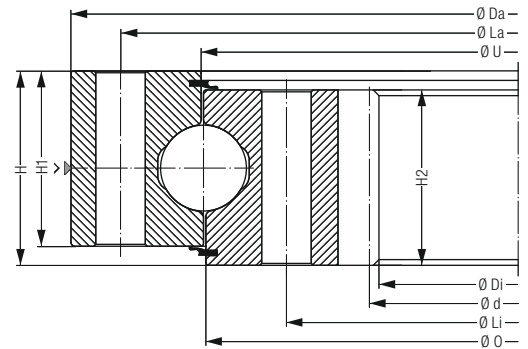
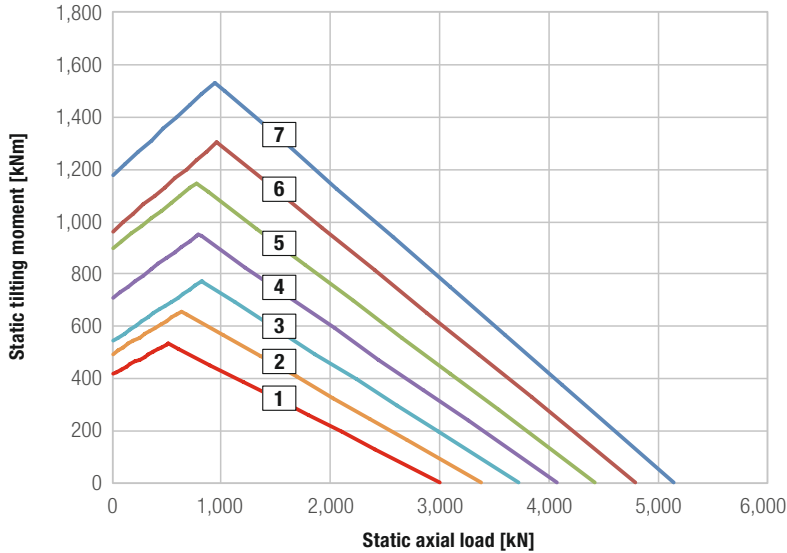
External gear KUD_50_VA



- 1 — KUD01900-050VA15-900-000
- 2 — KUD02130-050VA15-900-000
- 3 — KUD02355-050VA15-900-000
- 4 — KUD02645-050VA15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}
1	820.0	2,139.2	1,729	109	1,900	1,900	100	99	2,005	1,795	36	30	9	2,100	14	150	7	-1.4	100	128.5	257.0	13,787	1,193
2	931.0	2,380.8	1,959	109	2,130	2,130	100	99	2,235	2,025	48	30	8	2,336	16	146	8	-1.6	100	146.8	293.6	15,430	1,244
3	1,024.0	2,604.8	2,184	109	2,355	2,355	100	99	2,460	2,250	54	30	9	2,560	16	160	8	-1.6	100	146.8	293.6	17,074	1,291
4	1,142.0	2,891.8	2,474	109	2,645	2,645	100	99	2,750	2,540	60	30	12	2,848	16	178	8	-1.6	100	146.8	293.6	19,223	1,350

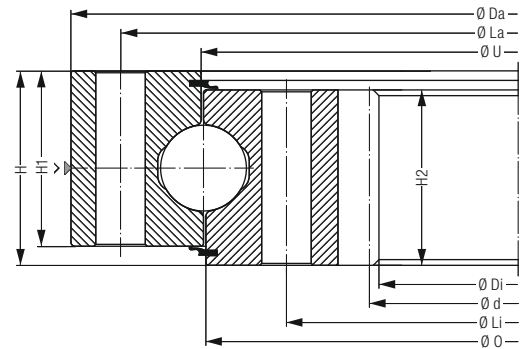
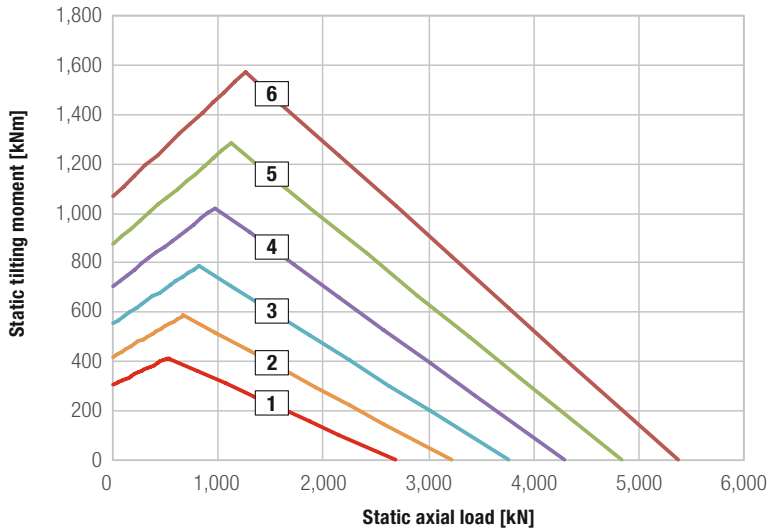
Internal gear KUD_25_VJ



- 1 KUD00855-025VJ15-900-000
- 2 KUD00955-025VJ15-900-000
- 3 KUD01055-025VJ15-900-000
- 4 KUD01155-025VJ15-900-000
- 5 KUD01255-025VJ15-900-000
- 6 KUD01355-025VJ15-900-000
- 7 KUD01455-025VJ15-900-000

Bearing type	Bearing data								Bolt data					Gear data						Load rating			
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}
1	133	955	710	80	855	855	71	54	915	794	28	20	4	730	10	-73	-	-	71	38.46	76.92	3,004	423
2	150	1,055	810	80	955	955	71	54	1,015	894	30	20	6	830	10	-83	-	-	71	38.46	76.92	3,383	443
3	166	1,155	910	80	1,055	1,055	71	54	1,115	994	30	20	6	930	10	-93	-	-	71	38.46	76.92	3,731	459
4	183	1,255	1,010	80	1,155	1,155	71	54	1,215	1,094	36	20	6	1,030	10	-103	-	-	71	38.46	76.92	4,079	474
5	198	1,355	1,110	80	1,255	1,255	71	54	1,315	1,194	42	20	6	1,130	10	-113	-	-	71	38.46	76.92	4,427	489
6	215	1,455	1,210	80	1,355	1,355	71	54	1,415	1,294	42	20	6	1,230	10	-123	-	-	71	38.46	76.92	4,806	505
7	229	1,555	1,310	80	1,455	1,455	71	54	1,515	1,394	48	20	6	1,330	10	-133	-	-	71	38.46	76.92	5,154	518

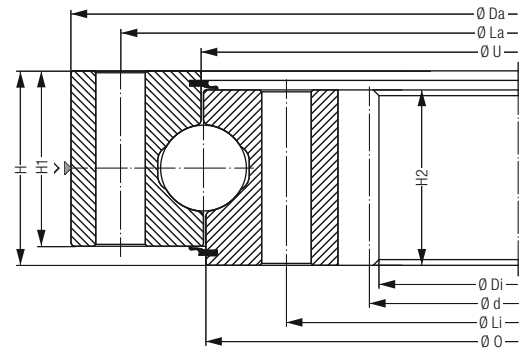
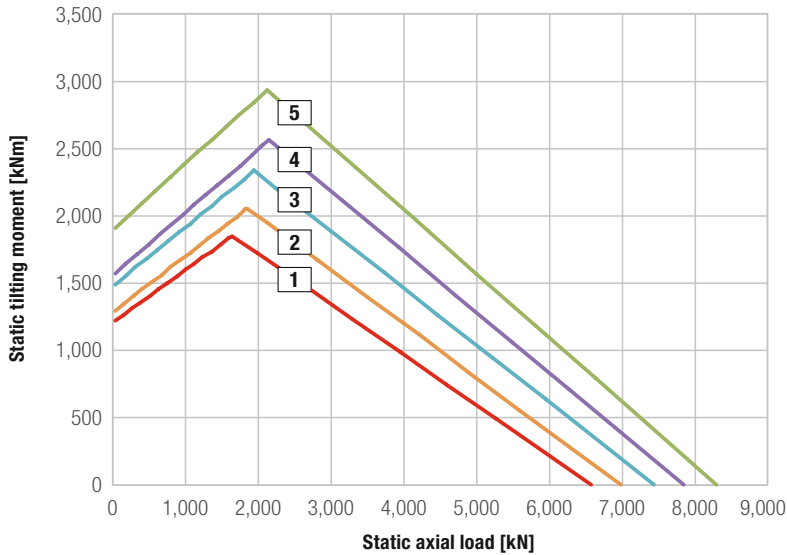
Internal gear KUD_25_VJ



- 1 KUD00762-025VJ15-900-000
- 2 KUD00914-025VJ15-900-000
- 3 KUD01067-025VJ15-900-000
- 4 KUD01219-025VJ15-900-000
- 5 KUD01372-025VJ15-900-000
- 6 KUD01524-025VJ15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Diametral Pitch	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	La/Li	[inch]		[mm]	[1/inch]		[mm]	[mm]	[mm]	[kN]	[kN]	C_{stat}	C_{dyn}
1	186.8	914.4	613.664	88.9	762	762	76.2	76.2	844.55	692.15	24/30	3/4"-10UNC	4	629.92	2.5	-62	-	-	76.2	48.45	96.90	2,751	413
2	235.0	1,066.8	766.064	88.9	914.4	914.4	76.2	76.2	996.95	844.55	28/32	3/4"-10UNC	6	782.32	2.5	-77	-	-	76.2	47.14	94.28	3,320	443
3	263.6	1,219.2	918.464	88.9	1,066.8	1,066.8	76.2	76.2	1,149.35	996.95	32/36	3/4"-10UNC	6	934.72	2.5	-92	-	-	76.2	46.30	92.61	3,889	471
4	313.2	1,371.6	1,070.864	88.9	1,219.2	1,219.2	76.2	76.2	1,301.75	1,149.35	36/40	3/4"-10UNC	6	1,087.12	2.5	-107	-	-	76.2	45.70	91.40	4,427	493
5	352.3	1,524.0	1,223.264	88.9	1,371.6	1,371.6	76.2	76.2	1,454.15	1,301.75	40/44	3/4"-10UNC	6	1,239.52	2.5	-122	-	-	76.2	45.25	90.49	4,996	516
6	382.7	1,676.4	1,375.664	88.9	1,524	1,524	76.2	76.2	1,606.55	1,454.15	44/48	3/4"-10UNC	6	1,391.92	2.5	-137	-	-	76.2	44.89	89.79	5,533	535

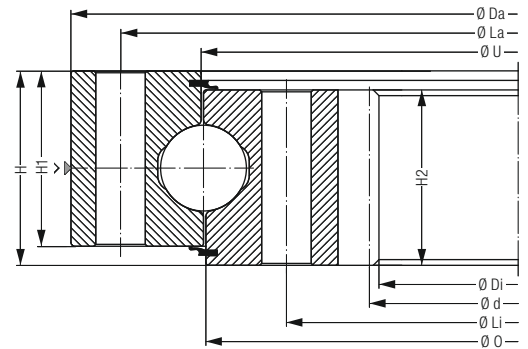
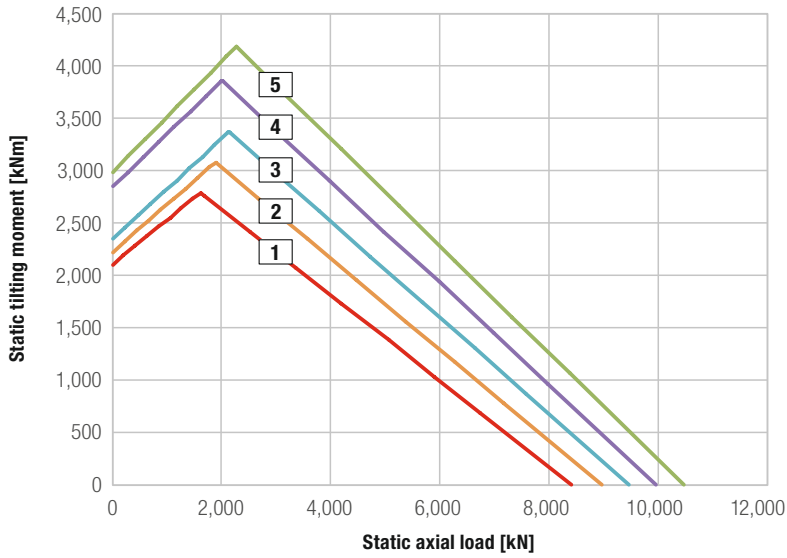
Internal gear KUD_30_VJ



- 1 KUD01500-030VJ15-900-000
- 2 KUD01600-030VJ15-900-000
- 3 KUD01700-030VJ15-900-000
- 4 KUD01800-030VJ15-900-000
- 5 KUD01900-030VJ15-900-000

Bearing type	Bearing data								Bolt data					Gear data						Load rating			
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}
1	300	1,608	1,334.4	84	1,500	1,500	72	72	1,564	1,436	48	20	6	1,344	12	-112	-6	-1.2	72	79.3	158.61	6,556	648
2	327	1,708	1,430.4	84	1,600	1,600	72	72	1,664	1,536	48	20	6	1,440	12	-120	-6	-1.2	72	79.3	158.61	6,966	662
3	336	1,808	1,538.4	84	1,700	1,700	72	72	1,764	1,636	52	20	7	1,548	12	-129	-6	-1.2	72	79.3	158.61	7,421	678
4	363	1,908	1,634.4	84	1,800	1,800	72	72	1,864	1,736	52	20	7	1,644	12	-137	-6	-1.2	72	79.3	158.61	7,831	691
5	387	2,008	1,730.4	84	1,900	1,900	72	72	1,964	1,836	60	20	8	1,740	12	-145	-6	-1.2	72	79.3	158.61	8,286	706

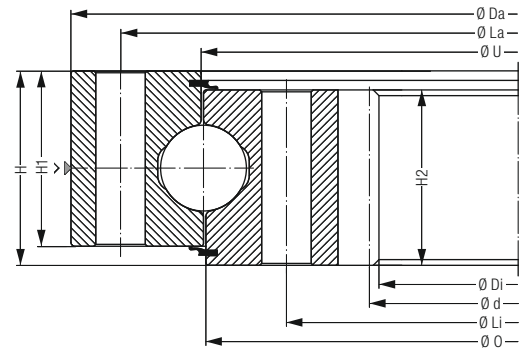
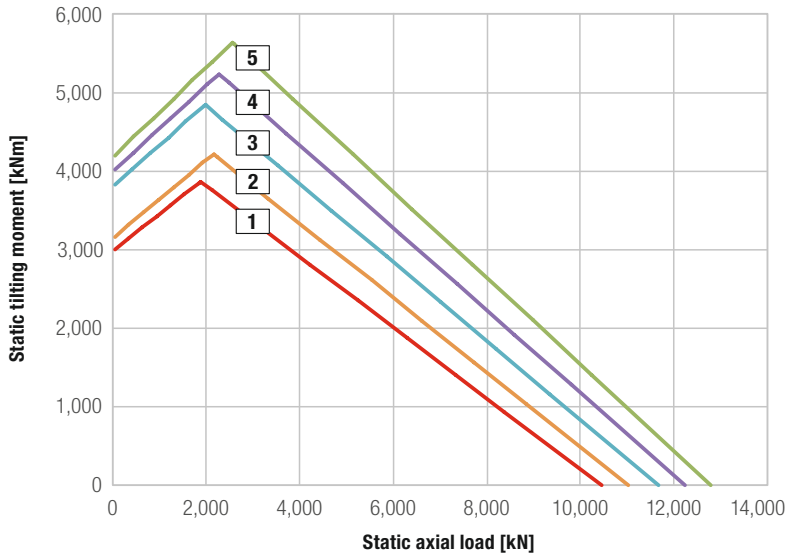
Internal gear KUD_35_VJ



- 1 KUD01650-035VJ15-900-000
- 2 KUD01750-035VJ15-900-000
- 3 KUD01850-035VJ15-900-000
- 4 KUD01950-035VJ15-900-000
- 5 KUD02050-035VJ15-900-000

Bearing type	Bearing data											Bolt data				Gear data							Load rating	
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic	
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}	
1	425	1,777	1,466.4	94	1,650	1,650	82	82	1,725	1,575	52	24	7	1,476	12	-123	-6	-1.2	82	90.32	180.64	8,366	784	
2	460	1,877	1,562.4	94	1,750	1,750	82	82	1,825	1,675	52	24	7	1,572	12	-131	-6	-1.2	82	90.32	180.64	8,924	804	
3	475	1,977	1,670.4	94	1,850	1,850	82	82	1,925	1,775	52	24	7	1,680	12	-140	-6	-1.2	82	90.32	180.64	9,420	820	
4	504	2,077	1,766.4	94	1,950	1,950	82	82	2,025	1,875	60	24	8	1,776	12	-148	-6	-1.2	82	90.32	180.64	9,915	835	
5	555	2,177	1,850.8	94	2,050	2,050	82	82	2,125	1,975	60	24	8	1,862	14	-133	-7	-1.4	82	105.37	210.74	10,411	850	

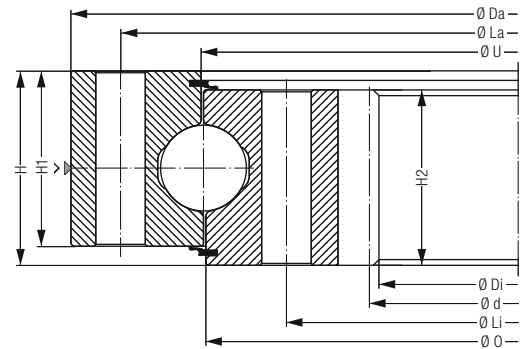
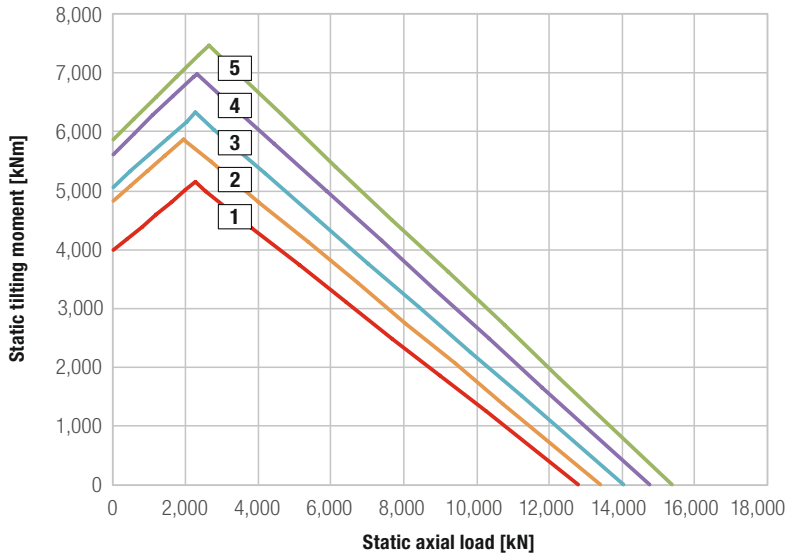
Internal gear KUD_40_VJ



- 1 KUD01800-040VJ15-900-000
- 2 KUD01900-040VJ15-900-000
- 3 KUD02000-040VJ15-900-000
- 4 KUD02100-040VJ15-900-000
- 5 KUD02200-040VJ15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}
1	581	1,945	1,598,4	104	1,800	1,800	92	92	1,885	1,715	52	27	7	1,608	12	-134	-6	-1,2	92	101,33	202,67	10,442	929
2	625	2,045	1,694,4	104	1,900	1,900	92	92	1,985	1,815	52	27	7	1,704	12	-142	-6	-1,2	92	101,33	202,67	11,008	947
3	644	2,145	1,794,8	104	2,000	2,000	92	92	2,085	1,915	60	27	7	1,806	14	-129	-7	-1,4	92	118,22	236,44	11,656	969
4	684	2,245	1,892,8	104	2,100	2,100	92	92	2,185	2,015	60	27	8	1,904	14	-136	-7	-1,4	92	118,22	236,44	12,222	986
5	725	2,345	1,990,8	104	2,200	2,200	92	92	2,285	2,115	60	27	8	2,002	14	-143	-7	-1,4	92	118,22	236,44	12,789	1,002

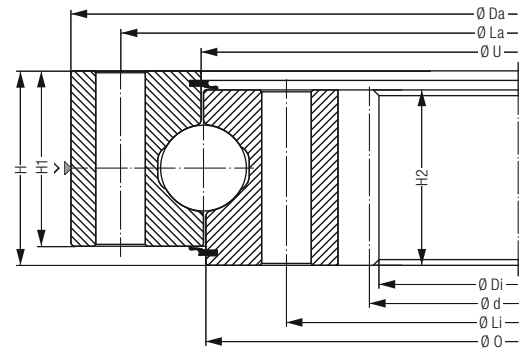
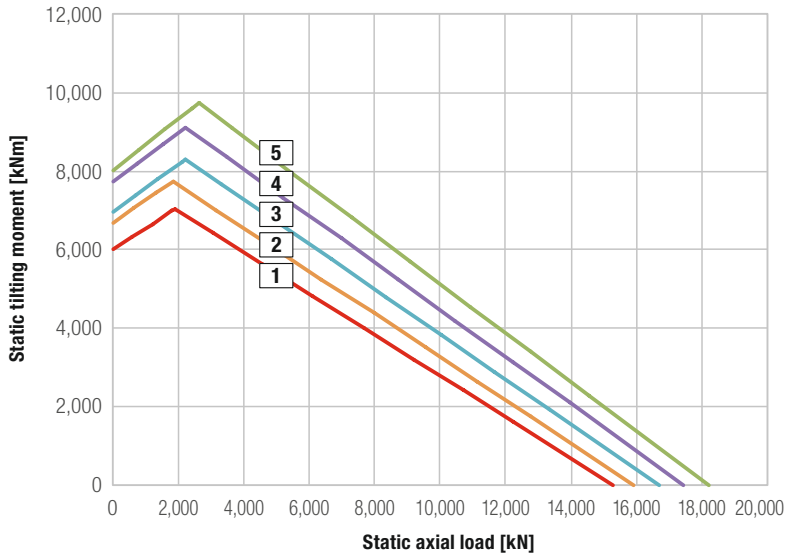
Internal gear KUD_45_VJ



- 1 KUD01950-045VJ15-900-000
- 2 KUD02050-045VJ15-900-000
- 3 KUD02150-045VJ15-900-000
- 4 KUD02250-045VJ15-900-000
- 5 KUD02350-045VJ15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}
1	770	2,111	1,730.4	114	1,950	1,950	102	102	2,045	1,855	52	30	8	1,740	12	-145	-6	-1.2	102	112.35	224.7	12,806	1,085
2	812	2,211	1,822.8	114	2,050	2,050	102	102	2,145	1,955	60	30	8	1,834	14	-131	-7	-1.4	102	131.07	262.14	13,420	1,103
3	861	2,311	1,920.8	114	2,150	2,150	102	102	2,245	2,055	60	30	8	1,932	14	-138	-7	-1.4	102	131.07	262.14	14,035	1,120
4	905	2,411	2,018.8	114	2,250	2,250	102	102	2,345	2,155	64	30	9	2,030	14	-145	-7	-1.4	102	131.07	262.14	14,752	1,143
5	955	2,511	2,116.8	114	2,350	2,350	102	102	2,445	2,255	64	30	9	2,128	14	-152	-7	-1.4	102	131.07	262.14	15,366	1,159

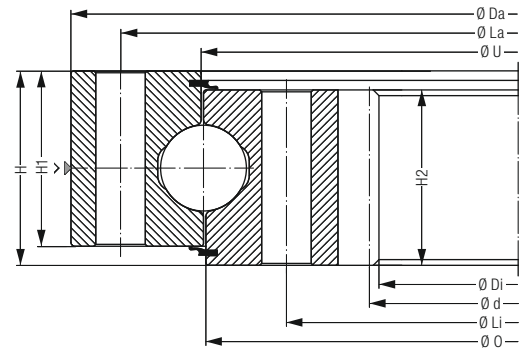
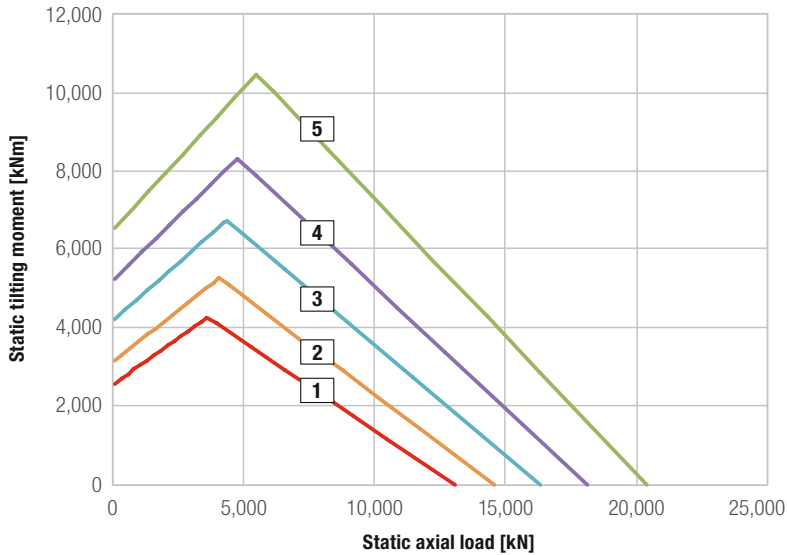
Internal gear KUD_50_VJ



- 1 KUD02100-050VJ15-900-000
- 2 KUD02200-050VJ15-900-000
- 3 KUD02300-050VJ15-900-000
- 4 KUD02400-050VJ15-900-000
- 5 KUD02500-050VJ15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da [mm]	Di [mm]	H [mm]	O [mm]	U [mm]	H1 [mm]	H2 [mm]	La [mm]	Li [mm]	n	M [mm]	n1	d [mm]	m [mm]	z	x*m [mm]	k*m [mm]	b [mm]	[kN]	[kN]	C _{stat} [kN]	C _{dyn} [kN]
1	999	2,276	1,850.8	124	2,100	2,100	112	112	2,204	1,996	60	33	8	1,862	14	-133	-7	-1.4	112	134.92	287.85	15,304	1,242
2	1,013	2,376	1,962.8	124	2,200	2,200	112	112	2,304	2,096	64	33	8	1,974	14	-141	-7	-1.4	112	134.92	287.85	15,936	1,258
3	1,070	2,476	2,060.8	124	2,300	2,300	112	112	2,404	2,196	64	33	8	2,072	14	-148	-7	-1.4	112	134.92	287.85	16,695	1,281
4	1,121	2,576	2,158.8	124	2,400	2,400	112	112	2,504	2,296	68	33	10	2,170	14	-155	-7	-1.4	112	134.92	287.85	17,453	1,303
5	1,180	2,676	2,256.8	124	2,500	2,500	112	112	2,604	2,396	68	33	10	2,268	14	-162	-7	-1.4	112	134.92	287.85	18,212	1,324

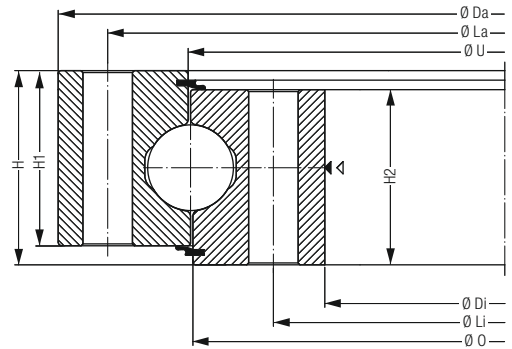
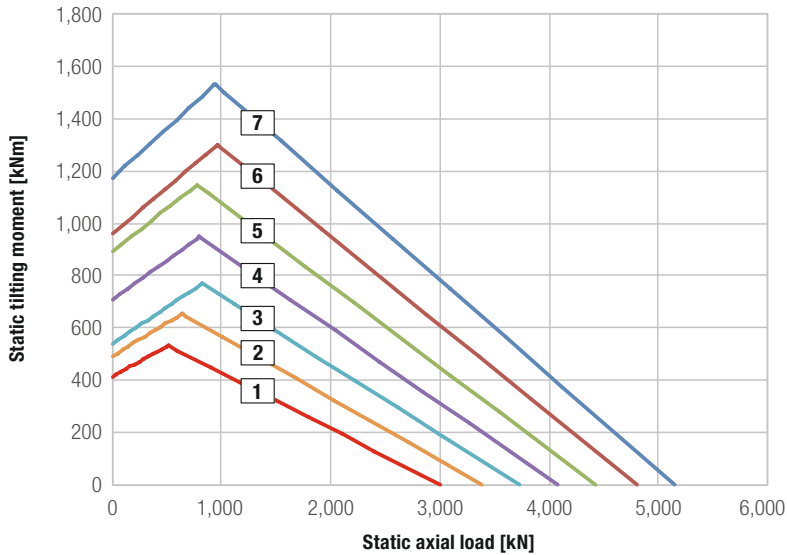
Internal gear KUD_50_VJ



- 1 KUD01800-050VJ15-900-000
- 2 KUD02000-050VJ15-900-000
- 3 KUD02240-050VJ15-900-000
- 4 KUD02490-050VJ15-900-000
- 5 KUD02800-050VJ15-900-000

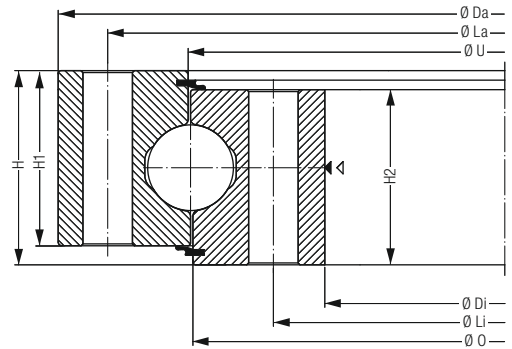
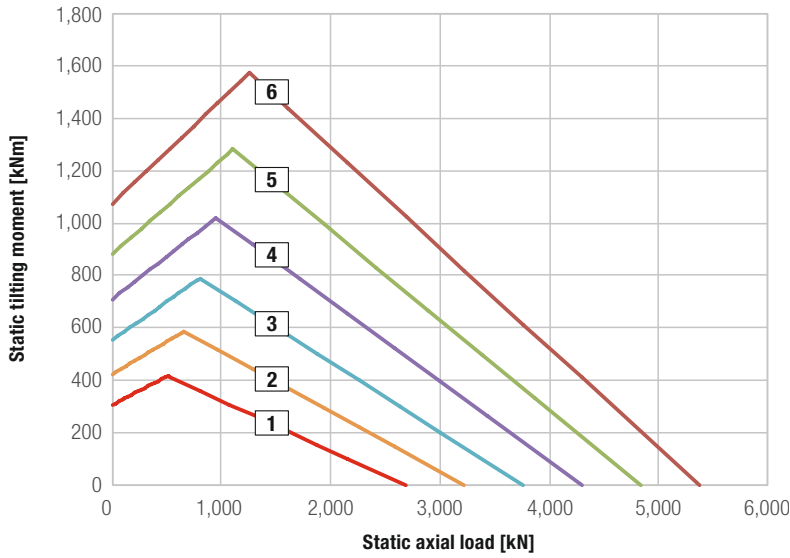
Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}
1	762	1,971	1,554	109	1,800	1,800	100	99	1,905	1,695	36	30	9	1,568	14	-112	-7	-	100	128.5	257.0	13,028	1,168
2	843	2,171	1,764	109	2,000	2,000	100	99	2,105	1,895	40	30	8	1,778	14	-127	-7	-	100	128.5	257.0	14,545	1,218
3	961	2,411	1,984	109	2,240	2,240	100	99	2,345	2,135	48	30	8	2,000	16	-125	-8	-	100	146.8	293.6	16,315	1,272
4	1,053	2,661	2,240	109	2,490	2,490	100	99	2,595	2,385	54	30	9	2,256	16	-141	-8	-	100	146.8	293.6	18,086	1,320
5	1,205	2,971	2,544	109	2,800	2,800	100	99	2,905	2,695	60	30	12	2,560	16	-160	-8	-	100	146.8	293.6	20,361	1,379

No gearing KUD_25_VO



- 1 KUD00855-025V015-900-000
- 2 KUD00955-025V015-900-000
- 3 KUD01055-025V015-900-000
- 4 KUD01155-025V015-900-000
- 5 KUD01255-025V015-900-000
- 6 KUD01355-025V015-900-000
- 7 KUD01455-025V015-900-000

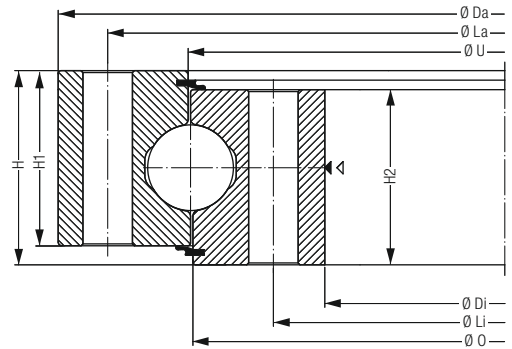
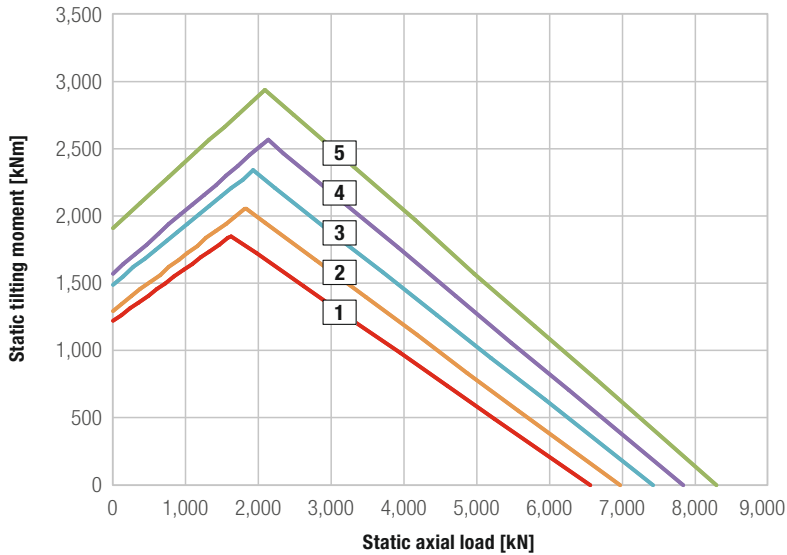
Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da [mm]	Di [mm]	H [mm]	O [mm]	U [mm]	H1 [mm]	H2 [mm]	La [mm]	Li [mm]	n	M [mm]	n1	d [mm]	m [mm]	z	x*m [mm]	k*m [mm]	b [mm]	[kN]	[kN]	C _{stat} [kN]	C _{dyn} [kN]
1	100	955	755	63	855	855	54	54	915	795	28	20	4	-	-	-	-	-	-	-	-	3,004	423
2	113	1,055	855	63	955	955	54	54	1,015	895	30	20	6	-	-	-	-	-	-	-	-	3,383	443
3	124	1,155	955	63	1,055	1,055	54	54	1,115	995	30	20	6	-	-	-	-	-	-	-	-	3,731	459
4	139	1,255	1,055	63	1,155	1,155	54	54	1,215	1,095	36	20	6	-	-	-	-	-	-	-	-	4,079	474
5	148	1,355	1,155	63	1,255	1,255	54	54	1,315	1,195	42	20	6	-	-	-	-	-	-	-	-	4,427	489
6	161	1,455	1,255	63	1,355	1,355	54	54	1,415	1,295	42	20	6	-	-	-	-	-	-	-	-	4,806	505
7	171	1,555	1,355	63	1,455	1,455	54	54	1,515	1,395	48	20	6	-	-	-	-	-	-	-	-	5,154	518



- 1 KUD00762-025V015-900-000
- 2 KUD00914-025V015-900-000
- 3 KUD01067-025V015-900-000
- 4 KUD01219-025V015-900-000
- 5 KUD01372-025V015-900-000
- 6 KUD01524-025V015-900-000

Bearing type	Bearing data								Bolt data					Gear data								Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter	Inner diameter	Height Outer ring	Height Inner ring	Pitch circle diameter	Pitch circle diameter	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Diametral Pitch	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic	
	[kg]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	La/Li	[inch]	n1	d	Pd	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}	
1	203,2	914,4	609,6	88,9	762	762	76,2	76,2	844,55	679,45	24/30	3/4" - 10 UNC	4	-	-	-	-	-	-	-	-	-	2,751	413
2	236,8	1,066,8	762	88,9	914,4	914,4	76,2	76,2	996,95	831,85	28/32	3/4" - 10 UNC	6	-	-	-	-	-	-	-	-	-	3,320	443
3	285,5	1,219,2	914,4	88,9	1,066,8	1,066,8	76,2	76,2	1,149,35	984,25	32/36	3/4" - 10 UNC	6	-	-	-	-	-	-	-	-	-	3,889	471
4	326,8	1,371,6	1,066,8	88,9	1,219,2	1,219,2	76,2	76,2	1,301,75	1,136,65	36/40	3/4" - 10 UNC	6	-	-	-	-	-	-	-	-	-	4,427	493
5	367,7	1,524,0	1,219,2	88,9	1,371,6	1,371,6	76,2	76,2	1,454,15	1,289,05	40/44	3/4" - 10 UNC	6	-	-	-	-	-	-	-	-	-	4,996	516
6	393,2	1,676,4	1,371,6	88,9	1,524	1,524	76,2	76,2	1,606,55	1,441,45	44/48	3/4" - 10 UNC	6	-	-	-	-	-	-	-	-	-	5,533	535

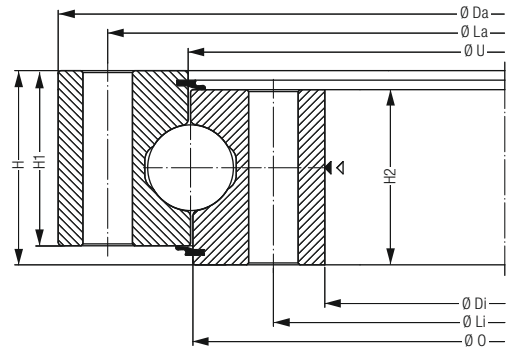
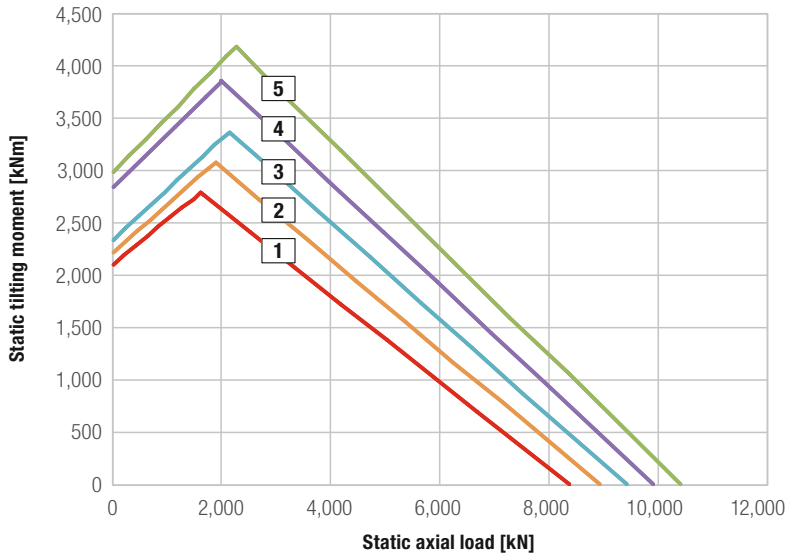
No gearing KUD_30_VO



- 1 KUD01500-030V015-900-000
- 2 KUD01600-030V015-900-000
- 3 KUD01700-030V015-900-000
- 4 KUD01800-030V015-900-000
- 5 KUD01900-030V015-900-000

Bearing type	Bearing data								Bolt data					Gear data								Load rating	
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b			C _{stat}	C _{dyn}
1	256	1,608	1,392	84	1,500	1,500	72	72	1,564	1,436	48	20	6	-	-	-	-	-	-	-	-	6,556	648
2	274	1,708	1,492	84	1,600	1,600	72	72	1,664	1,536	48	20	6	-	-	-	-	-	-	-	-	6,966	662
3	291	1,808	1,592	84	1,700	1,700	72	72	1,764	1,636	52	20	7	-	-	-	-	-	-	-	-	7,421	678
4	309	1,908	1,692	84	1,800	1,800	72	72	1,864	1,736	52	20	7	-	-	-	-	-	-	-	-	7,831	691
5	324	2,008	1,792	84	1,900	1,900	72	72	1,964	1,836	60	20	8	-	-	-	-	-	-	-	-	8,286	706

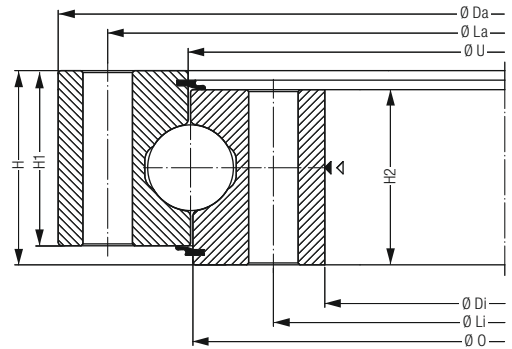
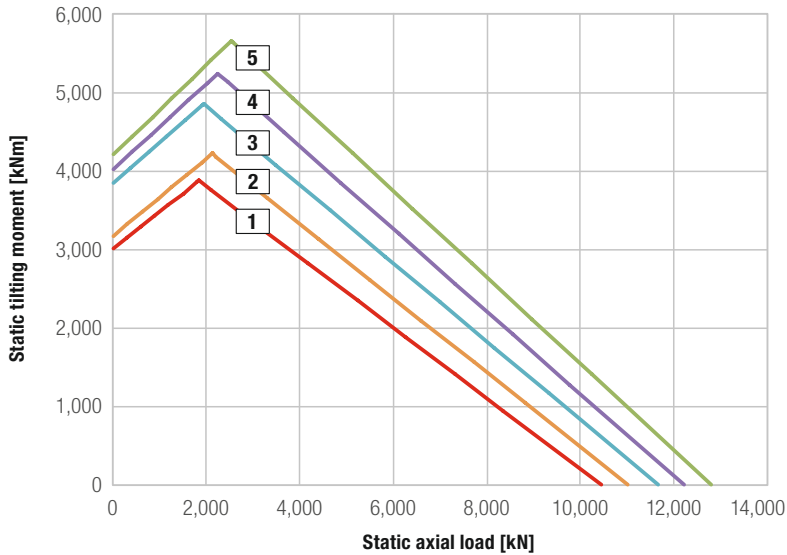
No gearing KUD_35_VO



- 1 KUD01650-035V015-900-000
- 2 KUD01750-035V015-900-000
- 3 KUD01850-035V015-900-000
- 4 KUD01950-035V015-900-000
- 5 KUD02050-035V015-900-000

Bearing type	Bearing data								Bolt data					Gear data								Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic	
	[kg]	Da [mm]	Di [mm]	H [mm]	O [mm]	U [mm]	H1 [mm]	H2 [mm]	La [mm]	Li [mm]	n	M [mm]	n1	d [mm]	m [mm]	z	x*m [mm]	k*m [mm]	b [mm]	[kN]	[kN]	C _{stat} [kN]	C _{dyn} [kN]	
1	372	1,777	1,523	94	1,650	1,650	82	82	1,725	1,575	52	24	7	-	-	-	-	-	-	-	-	-	8,366	784
2	397	1,877	1,623	94	1,750	1,750	82	82	1,825	1,675	52	24	7	-	-	-	-	-	-	-	-	-	8,924	804
3	421	1,977	1,723	94	1,850	1,850	82	82	1,925	1,775	52	24	7	-	-	-	-	-	-	-	-	-	9,420	820
4	441	2,077	1,823	94	1,950	1,950	82	82	2,025	1,875	60	24	8	-	-	-	-	-	-	-	-	-	9,915	835
5	465	2,177	1,923	94	2,050	2,050	82	82	2,125	1,975	60	24	8	-	-	-	-	-	-	-	-	-	10,411	850

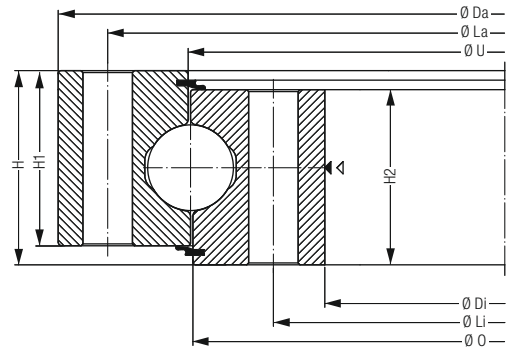
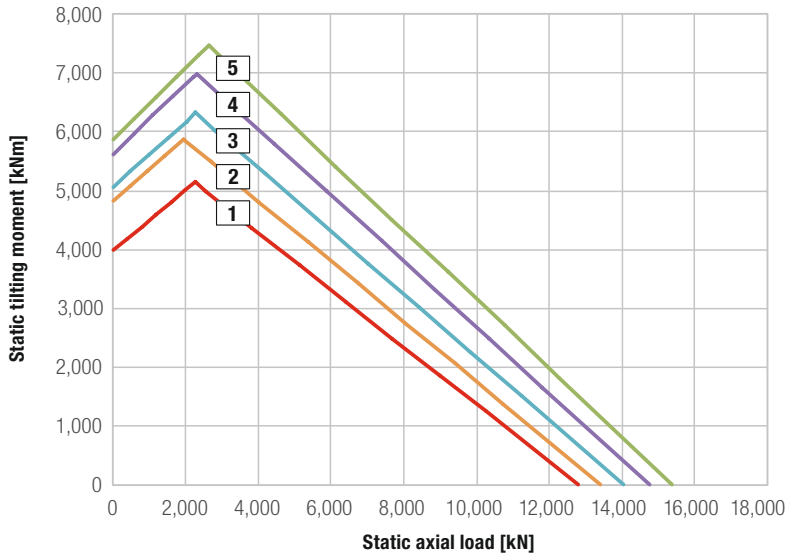
No gearing KUD_40_VO



- 1 KUD01800-040V015-900-000
- 2 KUD01900-040V015-900-000
- 3 KUD02000-040V015-900-000
- 4 KUD02100-040V015-900-000
- 5 KUD02200-040V015-900-000

Bearing type	Bearing data								Bolt data					Gear data								Load rating	
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da [mm]	Di [mm]	H [mm]	O [mm]	U [mm]	H1 [mm]	H2 [mm]	La [mm]	Li [mm]	n	M [mm]	n1	d [mm]	m [mm]	z	x*m [mm]	k*m [mm]	b [mm]	[kN]	[kN]	C _{stat} [kN]	C _{dyn} [kN]
1	516	1,945	1,655	104	1,800	1,800	92	92	1,885	1,715	52	27	7	-	-	-	-	-	-	-	-	10,442	929
2	548	2,045	1,755	104	1,900	1,900	92	92	1,985	1,815	52	27	7	-	-	-	-	-	-	-	-	11,008	947
3	571	2,145	1,855	104	2,000	2,000	92	92	2,085	1,915	60	27	7	-	-	-	-	-	-	-	-	11,656	969
4	603	2,245	1,955	104	2,100	2,100	92	92	2,185	2,015	60	27	8	-	-	-	-	-	-	-	-	12,222	986
5	635	2,345	2,055	104	2,200	2,200	92	92	2,285	2,115	60	27	8	-	-	-	-	-	-	-	-	12,789	1,002

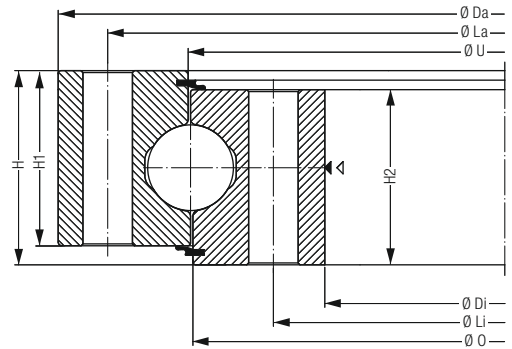
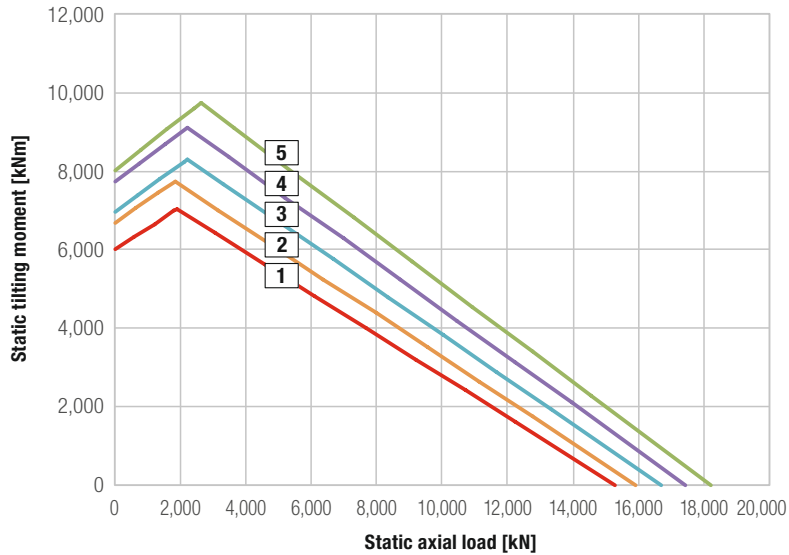
No gearing KUD_45_VO



- 1 KUD01950-045V015-900-000
- 2 KUD02050-045V015-900-000
- 3 KUD02150-045V015-900-000
- 4 KUD02250-045V015-900-000
- 5 KUD02350-045V015-900-000

Bearing type	Bearing data								Bolt data					Gear data								Load rating	
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b			C _{stat}	C _{dyn}
1	688	2,111	1,789	114	1,950	1,950	102	102	2,045	1,855	52	30	8	-	-	-	-	-	-	-	-	12,806	1,085
2	716	2,211	1,889	114	2,050	2,050	102	102	2,145	1,955	60	30	8	-	-	-	-	-	-	-	-	13,420	1,103
3	755	2,311	1,989	114	2,150	2,150	102	102	2,245	2,055	60	30	8	-	-	-	-	-	-	-	-	14,035	1,120
4	788	2,411	2,089	114	2,250	2,250	102	102	2,345	2,155	64	30	9	-	-	-	-	-	-	-	-	14,752	1,143
5	827	2,511	2,189	114	2,350	2,350	102	102	2,445	2,255	64	30	9	-	-	-	-	-	-	-	-	15,366	1,159

No gearing KUD_50_VO

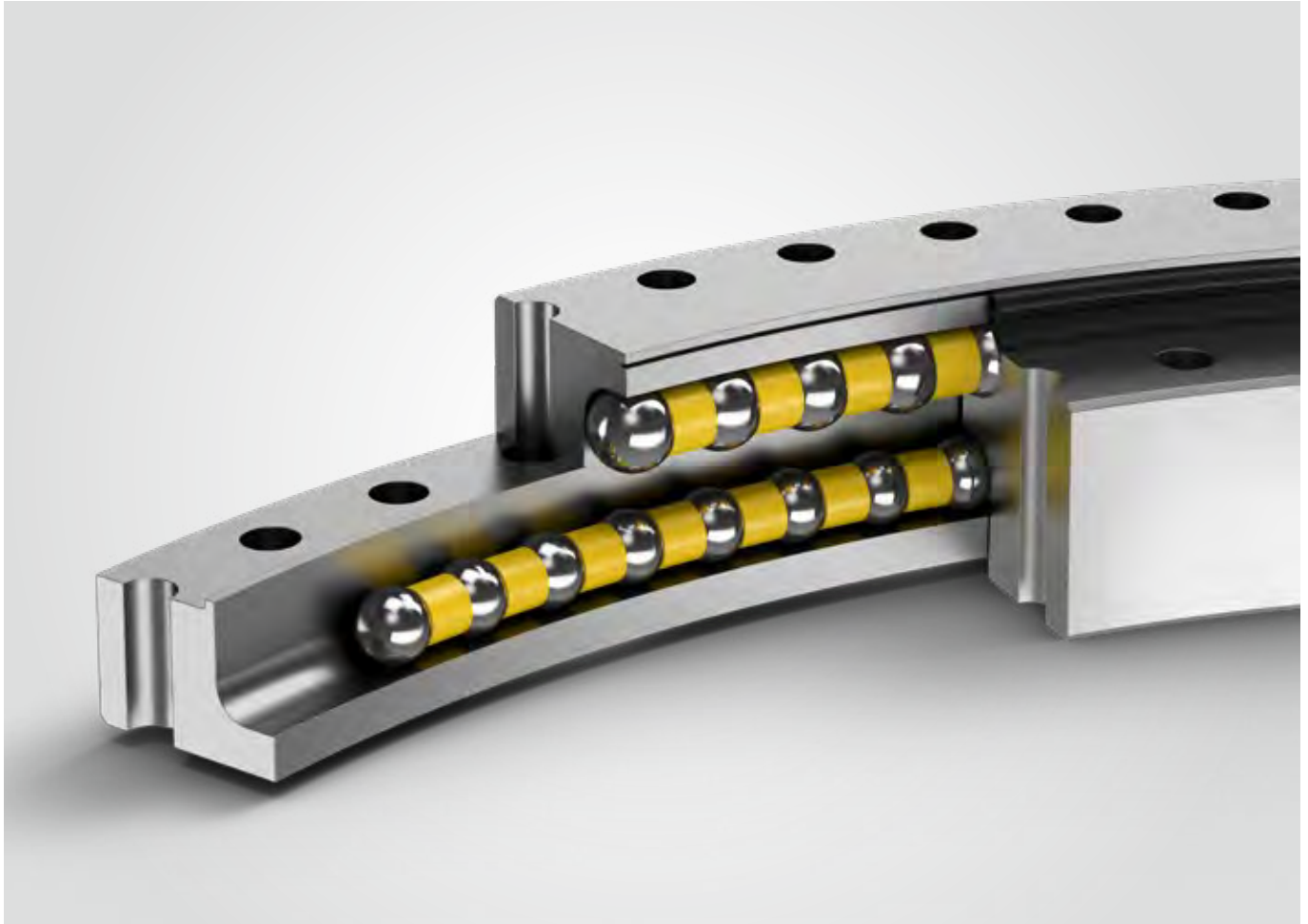


- 1 KUD02100-050V015-900-000
- 2 KUD02200-050V015-900-000
- 3 KUD02300-050V015-900-000
- 4 KUD02400-050V015-900-000
- 5 KUD02500-050V015-900-000

Bearing type	Bearing data								Bolt data					Gear data								Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter	Inner diameter	Height	Height	Pitch circle diameter	Pitch circle diameter	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic	
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b			C _{stat}	C _{dyn}	
1	873	2,276	1,924	124	2,100	2,100	112	112	2,204	1,996	60	33	8	-	-	-	-	-	-	-	-	-	15,304	1,242
2	913	2,376	2,024	124	2,200	2,200	112	112	2,304	2,096	64	33	8	-	-	-	-	-	-	-	-	-	15,936	1,258
3	960	2,476	2,124	124	2,300	2,300	112	112	2,404	2,196	64	33	8	-	-	-	-	-	-	-	-	-	16,695	1,281
4	999	2,576	2,224	124	2,400	2,400	112	112	2,504	2,296	68	33	10	-	-	-	-	-	-	-	-	-	17,453	1,303
5	1,046	2,676	2,324	124	2,500	2,500	112	112	2,604	2,396	68	33	10	-	-	-	-	-	-	-	-	-	18,212	1,324

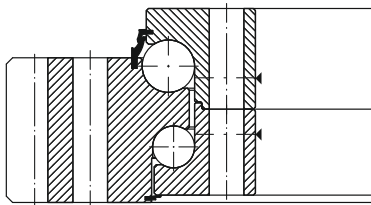
Technical data

KUD_Z Double-row ball bearings

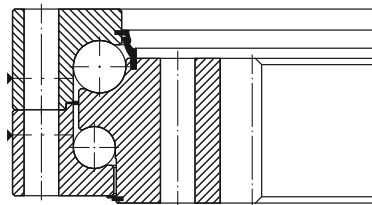


KUD_Z

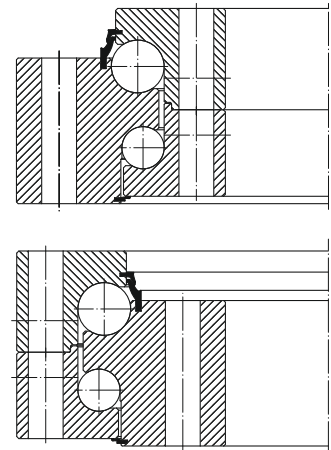
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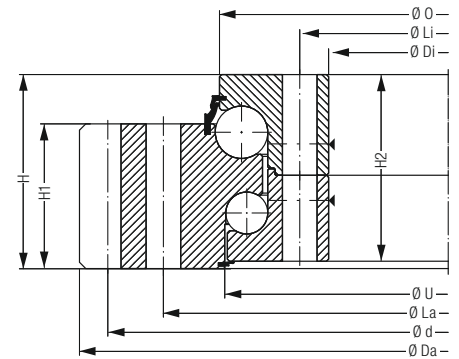
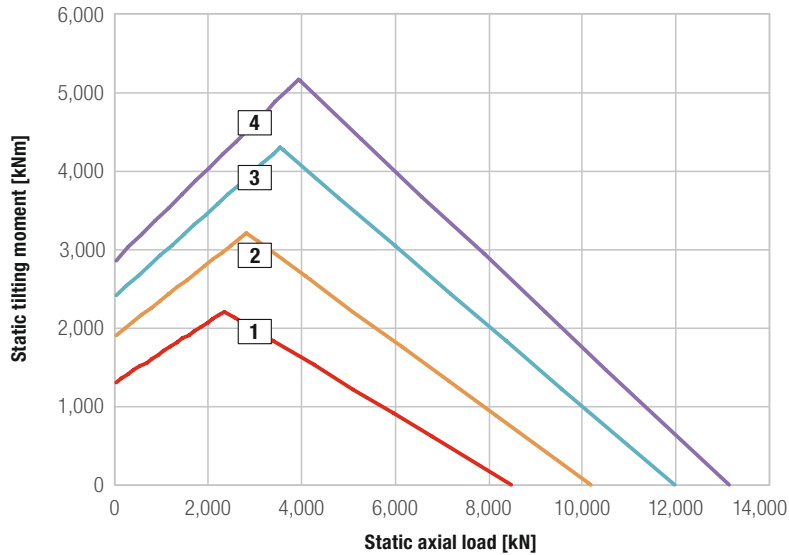
KUD_ZJ



KUD_ZO



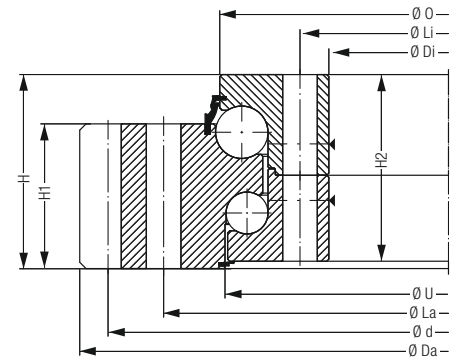
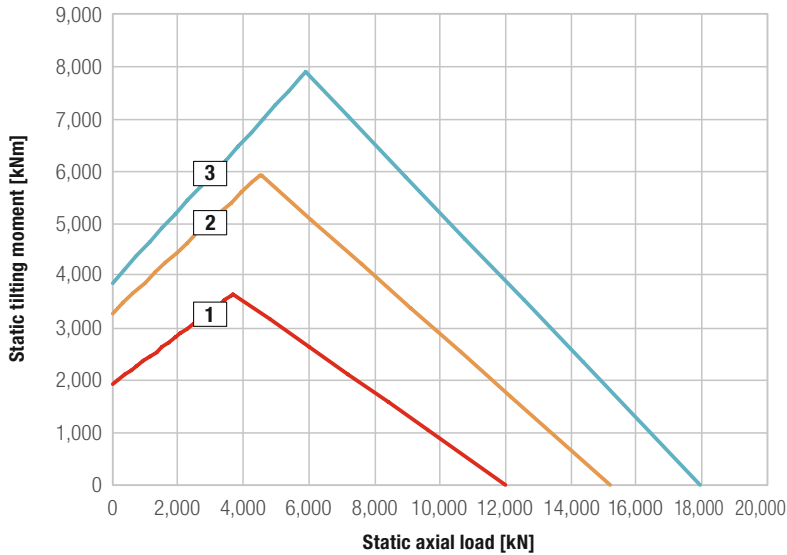
External gear KUD_30_ZA



- 1 — KUD01440-030ZA15-900-000
- 2 — KUD01734-030ZA15-900-000
- 3 — KUD02031-030ZA15-900-000
- 4 — KUD02235-030ZA15-900-000

Bearing type	Bearing data										Bolt data				Gear data						Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b			C _{stat}	C _{dyn}
1	520	1,653.6	1,320	120	1,469	1,460	91	114	1,545	1,365	36	24	3	1,620	12	135	6	-1.2	91	100.2	200.4	8,465	778
2	636	1,953.6	1,615	120	1,763	1,757	91	114	1,845	1,660	44	24	3	1,920	12	160	6	-1.2	91	100.2	200.4	10,182	832
3	755	2,253.6	1,910	120	2,060	2,054	91	114	2,140	1,955	48	24	4	2,220	12	185	6	-1.2	91	100.2	200.4	11,960	884
4	827	2,457.6	2,115	120	2,264	2,258	91	114	2,345	2,160	52	24	4	2,424	12	202	6	-1.2	91	100.2	200.4	13,125	914

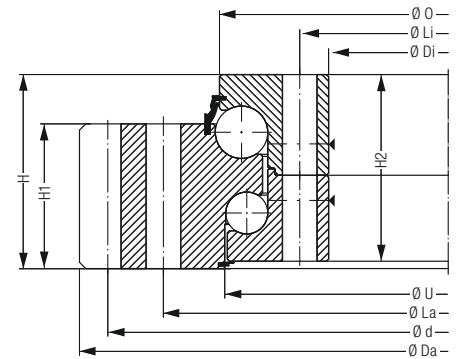
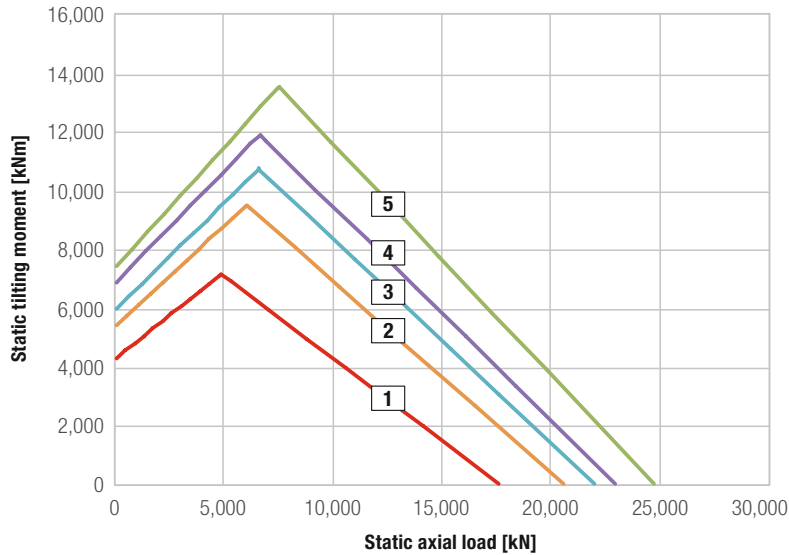
External gear KUD_35_ZA



- 1 — KUD01750-035ZA15-900-000
- 2 — KUD02220-035ZA15-900-000
- 3 — KUD02620-035ZA15-900-000

Bearing type	Bearing data								Bolt data					Gear data						Load rating			
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b			C _{stat}	C _{dyn}
1	789	1,985.2	1,620	138	1,784	1,779	104	132	1,860	1,670	44	24	3	1,946	14	139	7	-1.4	104	133.6	267.2	12,022	981
2	1,019	2,461.2	2,090	138	2,254	2,249	104	132	2,335	2,135	60	24	4	2,422	14	173	7	-1.4	104	133.6	267.2	15,194	1,068
3	1,244	2,876.8	2,490	138	2,654	2,649	104	132	2,735	2,540	60	24	6	2,832	16	177	8	-1.6	104	152.7	305.4	17,949	1,136

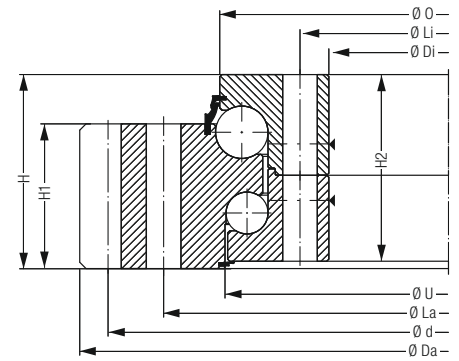
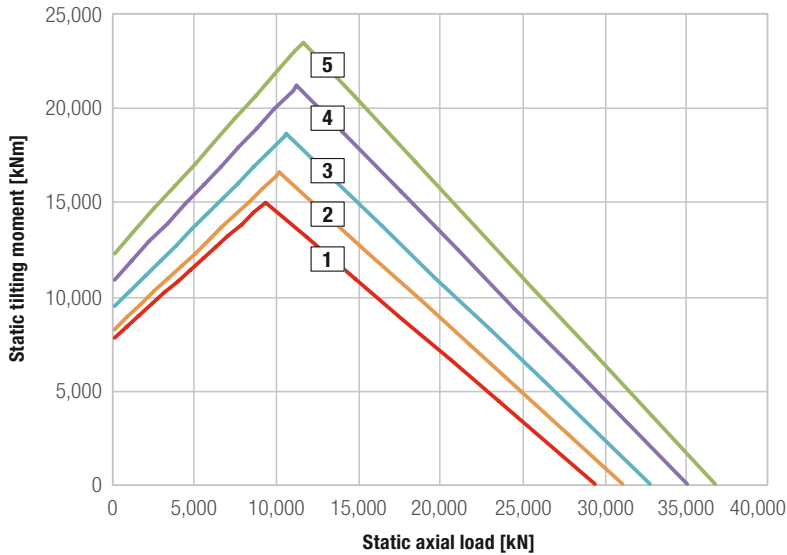
External gear KUD_40_ZA



- 1 KUD02240-040ZA15-900-000
- 2 KUD02619-040ZA15-900-000
- 3 KUD02795-040ZA15-900-000
- 4 KUD02915-040ZA15-900-000
- 5 KUD03150-040ZA15-900-000

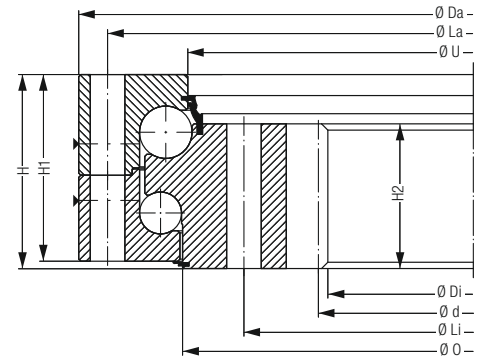
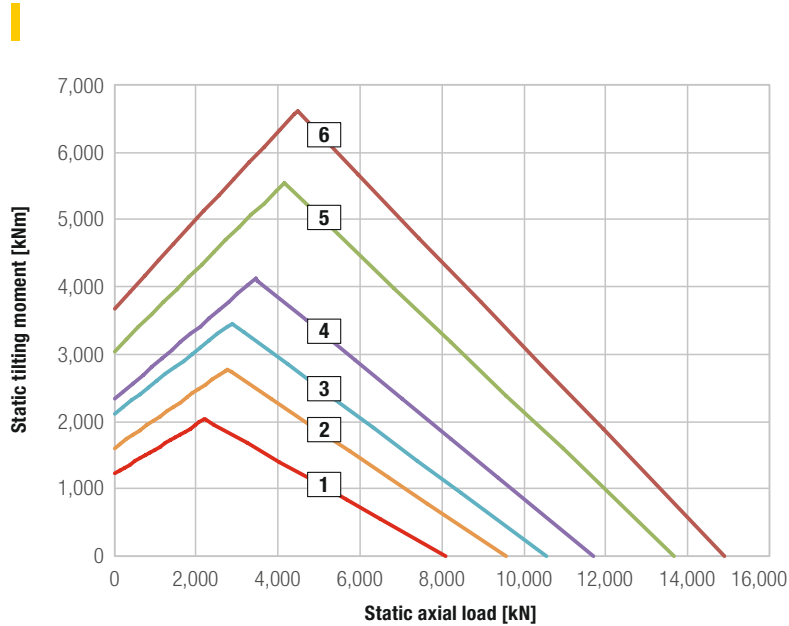
Bearing type	Bearing data								Bolt data						Gear data						Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b			C _{stat}	C _{dyn}
1	1,316	2,524.8	2,090	156	2,275	2,272	117	150	2,375	2,145	48	30	4	2,480	16	155	8	-1.6	117	162.7	325.5	17,556	1,232
2	1,615	2,912.4	2,465	156	2,654	2,651	117	150	2,755	2,520	52	30	6	2,862	18	159	9	-1.8	117	183.1	366.2	20,499	1,303
3	1,723	3,096	2,645	156	2,830	2,827	117	150	2,930	2,700	54	30	6	3,040	20	152	10	-2.0	117	203.4	406.8	21,917	1,337
4	1,790	3,216	2,765	156	2,950	2,947	117	150	3,050	2,820	60	30	6	3,160	20	158	10	-2.0	117	203.4	406.8	22,898	1,359
5	1,969	3,456	3,000	156	3,185	3,182	117	150	3,285	3,055	60	30	6	3,400	20	170	10	-2.0	117	203.4	406.8	24,642	1,394

External gear KUD_50_ZA



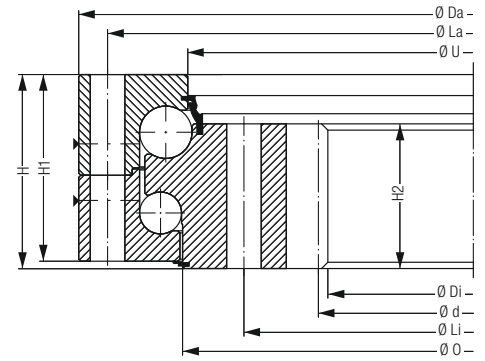
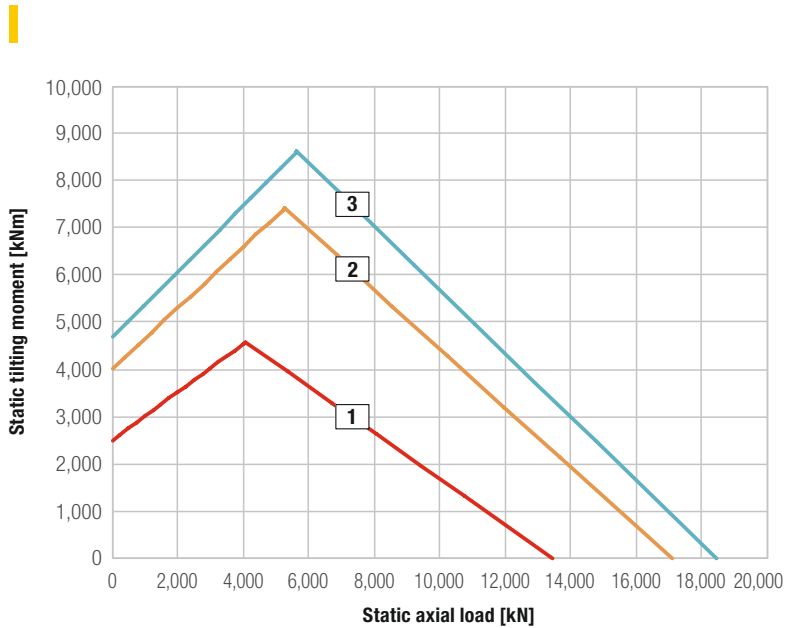
- 1 KUD02987-050ZA15-900-000
- 2 KUD03167-050ZA15-900-000
- 3 KUD03347-050ZA15-900-000
- 4 KUD03567-050ZA15-900-000
- 5 KUD03747-050ZA15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}
1	2,288	3,290.4	2,820	185	3,029	3,019	138	178	3,130	2,880	66	30	6	3,240	18	180	9	-1.8	138	216	432	29,305	1,726
2	2,431	3,470.4	3,000	185	3,209	3,199	138	178	3,310	3,060	66	30	6	3,420	18	190	9	-1.8	138	216	432	31,008	1,761
3	2,566	3,650.4	3,480	185	3,389	3,379	138	178	3,490	3,240	72	30	6	3,600	18	200	9	-1.8	138	216	432	32,712	1,795
4	2,702	3,866.4	3,400	185	3,609	3,599	138	178	3,710	3,460	78	30	6	3,816	18	212	9	-1.8	138	216	432	34,926	1,839
5	2,837	4,046.4	3,580	185	3,789	3,779	138	178	3,890	3,640	84	30	6	3,996	18	222	9	-1.8	138	216	432	36,630	1,871



- 1 KUD01381-030ZJ15-900-000
- 2 KUD01630-030ZJ15-900-000
- 3 KUD01800-030ZJ15-900-000
- 4 KUD01995-030ZJ15-900-000
- 5 KUD02330-030ZJ15-900-000
- 6 KUD02538-030ZJ15-900-000

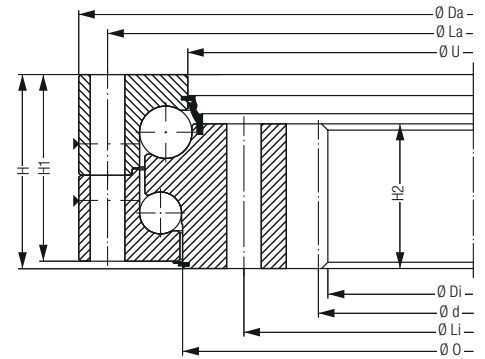
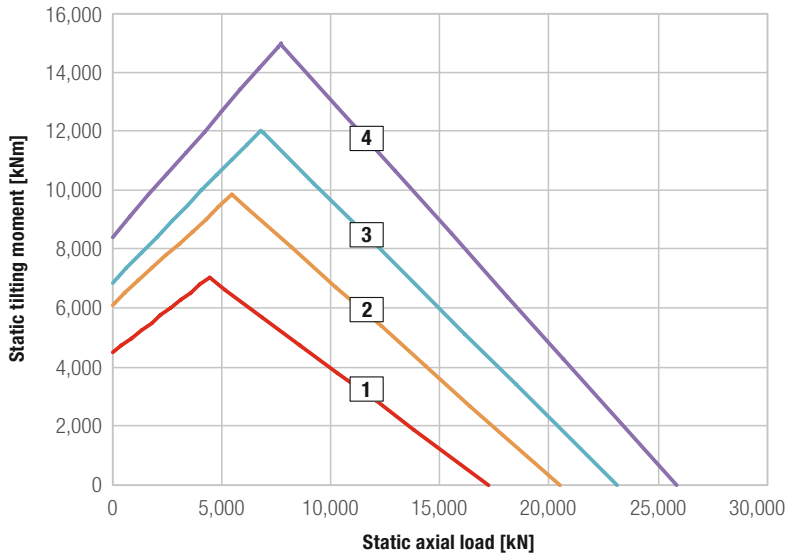
Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da [mm]	Di [mm]	H [mm]	O [mm]	U [mm]	H1 [mm]	H2 [mm]	La [mm]	Li [mm]	n	M [mm]	n1	d [mm]	m [mm]	z	x*m [mm]	k*m [mm]	b [mm]	[kN]	[kN]	C _{stat} [kN]	C _{dyn} [kN]
1	474	1,500	1,164	120	1,358	1,352	114	91	1,455	1,275	36	24	3	1,176	12	-98	-6	-	91	100.2	200.4	8,097	765
2	558	1,750	1,416	120	1,610	1,602	114	91	1,705	1,525	40	24	4	1,428	12	-119	-6	-	91	100.2	200.4	9,568	814
3	643	1,920	1,568	120	1,777	1,771	114	91	1,875	1,695	48	24	3	1,582	14	-113	-7	-	91	116.9	233.8	10,550	843
4	716	2,115	1,764	120	1,972	1,966	114	91	2,070	1,890	48	24	4	1,778	14	-127	-7	-	91	116.9	233.8	11,715	876
5	839	2,450	2,100	120	2,307	2,301	114	91	2,405	2,225	54	24	4	2,114	14	-151	-7	-	91	116.9	233.8	13,677	928
6	963	2,660	2,288	120	2,515	2,509	114	91	2,615	2,430	60	24	6	2,304	16	-144	-8	-	91	133.6	267.2	14,904	958



- 1 — KUD01960-035ZJ15-900-000
- 2 — KUD02500-035ZJ15-900-000
- 3 — KUD02690-035ZJ15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b			C _{stat}	C _{dyn}
1	851	2,090	1,722	138	1,931	1,926	132	104	2,045	1,850	52	24	4	1,736	14	-124	-7	-	104	133.6	267.2	13,441	1,022
2	1,112	2,630	2,254	138	2,471	2,466	132	104	2,585	2,385	66	24	6	2,268	14	-162	-7	-	104	133.6	267.2	17,114	1,116
3	1,225	2,820	2,432	138	2,661	2,656	132	104	2,775	2,580	72	24	6	2,448	16	-153	-8	-	104	152.7	305.4	18,449	1,148

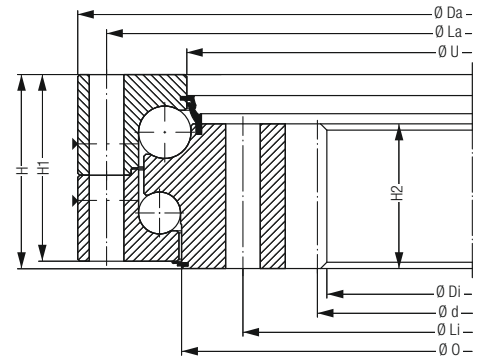
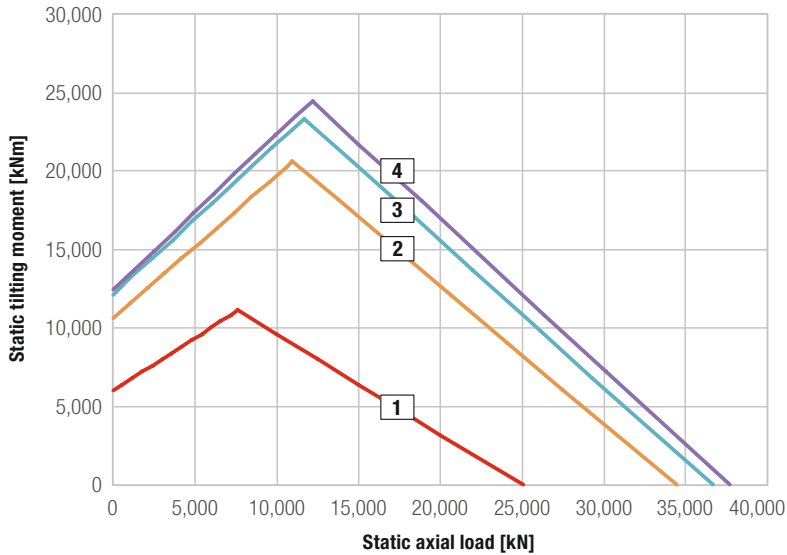
Internal gear KUD_40_ZJ



- 1 KUD02199-040ZJ15-900-000
- 2 KUD02622-040ZJ15-900-000
- 3 KUD02950-040ZJ15-900-000
- 4 KUD03300-040ZJ15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da [mm]	Di [mm]	H [mm]	O [mm]	U [mm]	H1 [mm]	H2 [mm]	La [mm]	Li [mm]	n	M [mm]	n1	d [mm]	m [mm]	z	x*m [mm]	k*m [mm]	b [mm]	[kN]	[kN]	C _{stat} [kN]	C _{dyn} [kN]
1	1,238	2,350	1,920	156	2,168	2,164	150	117	2,295	2,065	52	30	4	1,936	16	-121	-8	-	117	162.7	325.5	17,229	1,223
2	1,495	2,770	2,336	156	2,590	2,587	150	117	2,715	2,485	60	30	6	2,352	16	-147	-8	-	117	162.7	325.5	20,499	1,303
3	1,764	3,100	2,646	156	2,918	2,915	150	117	3,045	2,815	60	30	6	2,664	18	-148	-9	-	117	183.1	366.2	23,116	1,363
4	1,935	3,450	3,006	156	3,268	3,265	150	117	3,395	3,165	66	30	6	3,024	18	-168	-9	-	117	183.1	366.2	25,842	1,419

Internal gear KUD_50_ZJ

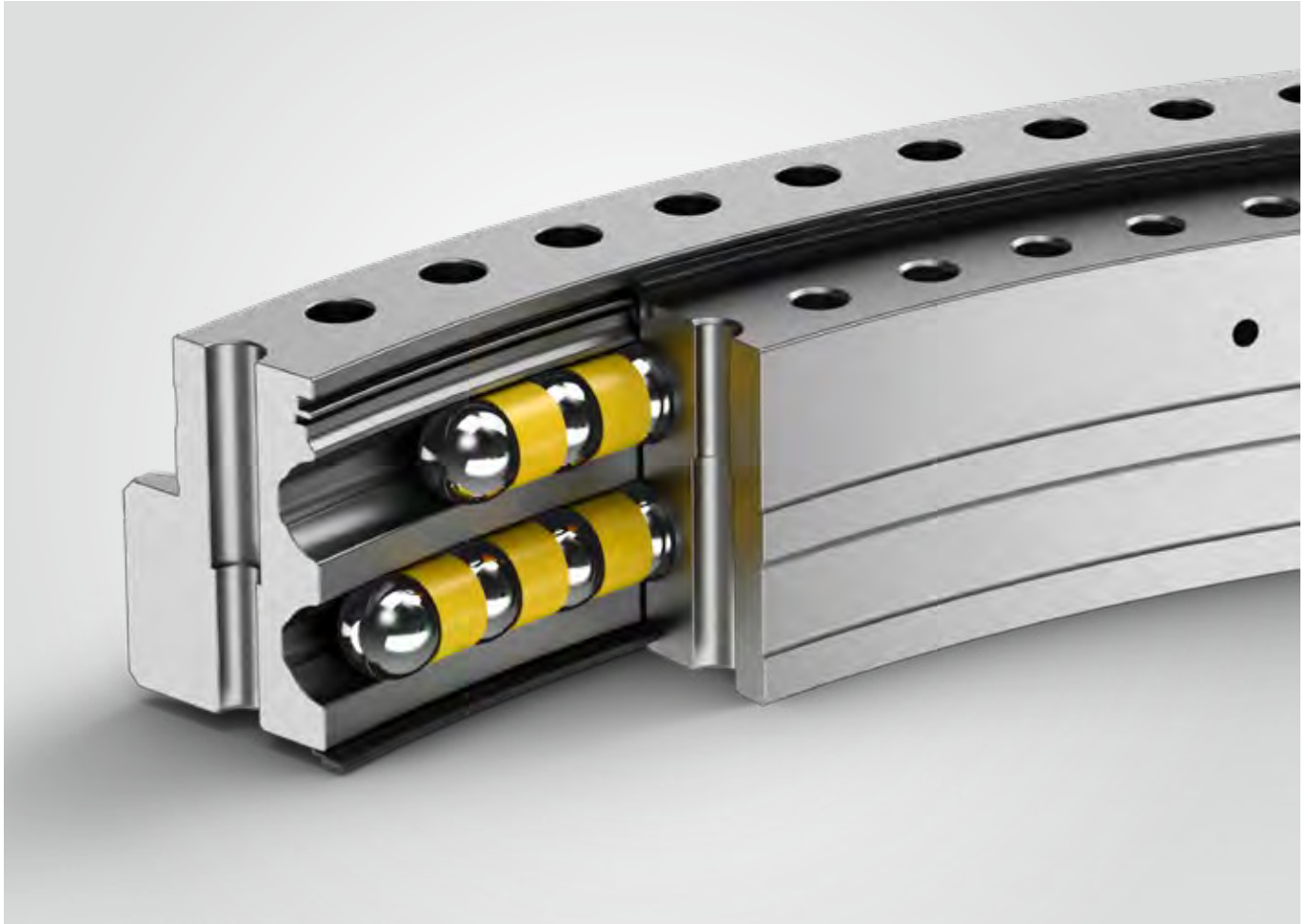


- 1 KUD02559-050ZJ15-900-000
- 2 KUD03520-050ZJ15-900-000
- 3 KUD03739-050ZJ15-900-000
- 4 KUD03839-050ZJ15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}
1	1892	2725	2250	185	2524	2522	178	138	2670	2410	60	30	6	2268	18	-126	-9	-	138	216	432	25046	1628
2	2657	3685	3200	185	3485	3482	178	138	3630	3370	78	30	6	3220	20	-161	-10	-	138	240	480	34415	1829
3	2823	3905	3420	185	3704	3701	178	138	3850	3590	84	30	6	3440	20	-172	-10	-	138	240	480	36630	1872
4	2905	4005	3520	185	3804	3801	178	138	3950	3690	84	30	6	3540	20	-177	-10	-	138	240	480	37652	1892

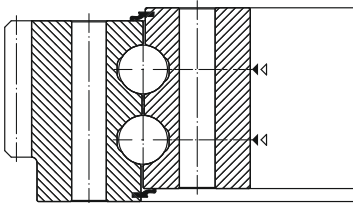
Technical data

KUD_W Double-row ball bearings, four-point contact

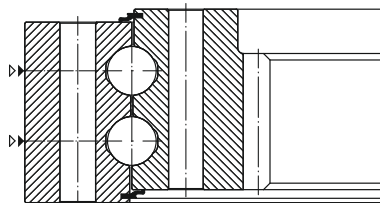


KUD_W

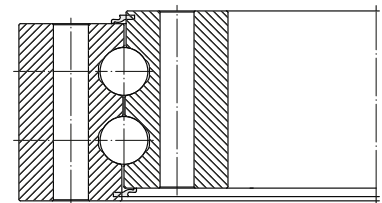
KUD_WA



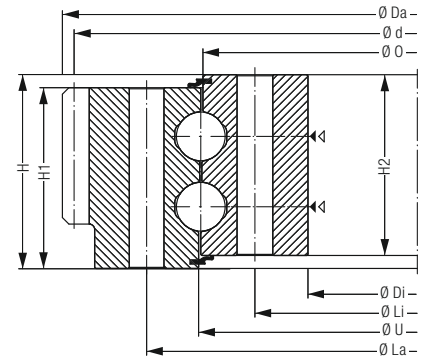
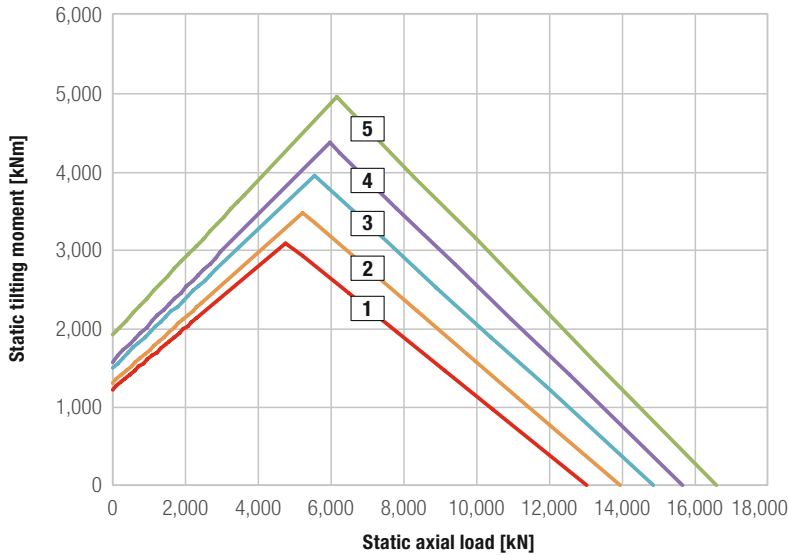
KUD_WJ



KUD_WO



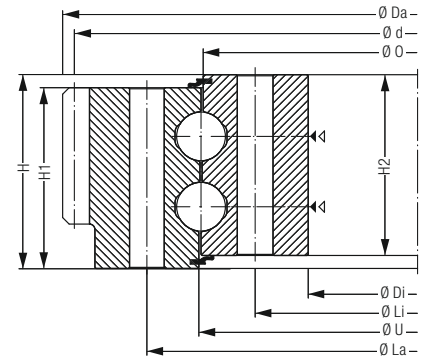
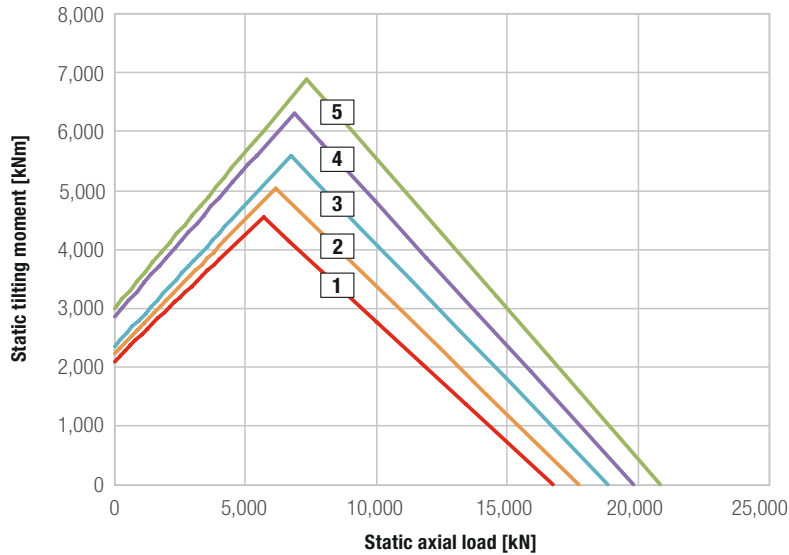
External gear KUD_30_WA



- 1 KUD01497-030WA15-900-000
- 2 KUD01597-030WA15-900-000
- 3 KUD01697-030WA15-900-000
- 4 KUD01797-030WA15-900-000
- 5 KUD01897-030WA15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}
1	499	1,665.6	1,383	123	1,495	1,499	111	111	1,564	1,427	48	20	6	1,632	12	136	6	-1.2	111	128.7	257.4	13,022.0	1,048.0
2	525	1,761.6	1,483	123	1,595	1,599	111	111	1,664	1,527	48	20	6	1,728	12	144	6	-1.2	111	128.7	257.4	13,932.0	1,075.0
3	577	1,869.6	1,583	123	1,695	1,699	111	111	1,764	1,627	52	20	7	1,836	12	153	6	-1.2	111	128.7	257.4	14,842.0	1,102.0
4	602	1,965.6	1,683	123	1,795	1,799	111	111	1,864	1,727	52	20	7	1,932	12	161	6	-1.2	111	128.7	257.4	15,662.0	1,123.0
5	620	2,061.6	1,783	123	1,895	1,899	111	111	1,964	1,827	60	20	8	2,028	12	169	6	-1.2	111	128.7	257.4	16,572.0	1,147.0

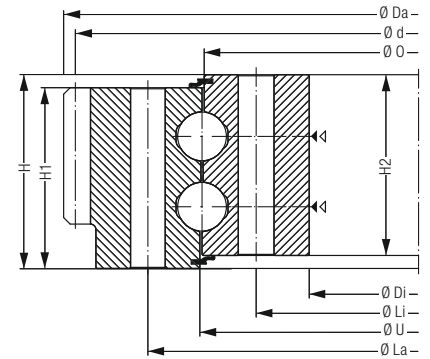
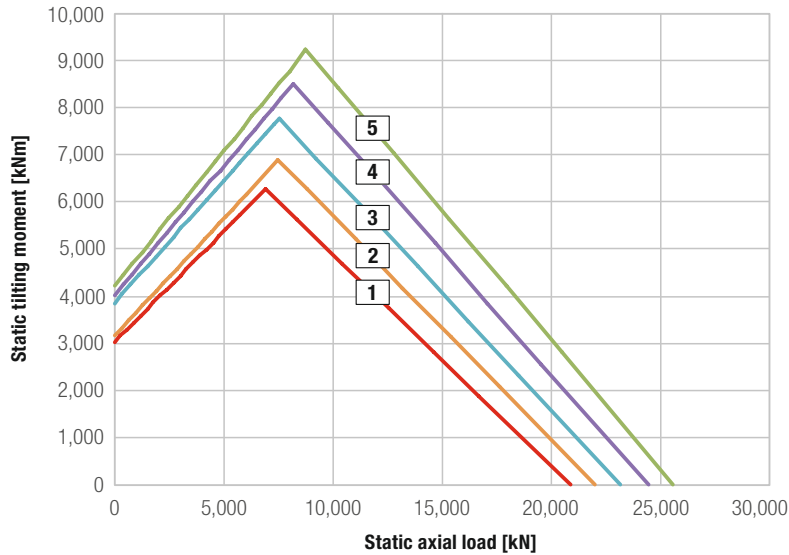
External gear KUD_35_WA



- 1 KUD01647-035WA15-900-000
- 2 KUD01747-035WA15-900-000
- 3 KUD01847-035WA15-900-000
- 4 KUD01947-035WA15-900-000
- 5 KUD02047-035WA15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da [mm]	Di [mm]	H [mm]	O [mm]	U [mm]	H1 [mm]	H2 [mm]	La [mm]	Li [mm]	n	M [mm]	n1	d [mm]	m [mm]	z	x*m [mm]	k*m [mm]	b [mm]			C _{stat} [kN]	C _{dyn} [kN]
1	691	1,833.6	1,514	137	1,645	1,649	125	125	1,725	1,566	52	24	7	1,800	12	150	6	-1.2	120	139.1	278.3	16,732.0	1,274.0
2	724	1,929.6	1,614	137	1,745	1,749	125	125	1,825	1,666	52	24	7	1,896	12	158	6	-1.2	120	139.1	278.3	17,724.0	1,300.0
3	793	2,037.6	1,714	137	1,845	1,849	125	125	1,925	1,766	52	24	7	2,004	12	167	6	-1.2	120	139.1	278.3	18,839.0	1,332.0
4	817	2,133.6	1,814	137	1,945	1,949	125	125	2,025	1,866	60	24	8	2,100	12	175	6	-1.2	120	139.1	278.3	19,830.0	1,357.0
5	916	2,251.2	1,914	137	2,045	2,049	125	125	2,125	1,966	60	24	8	2,212	14	158	7	-1.4	125	160.6	321.3	20,822.0	1,381.0

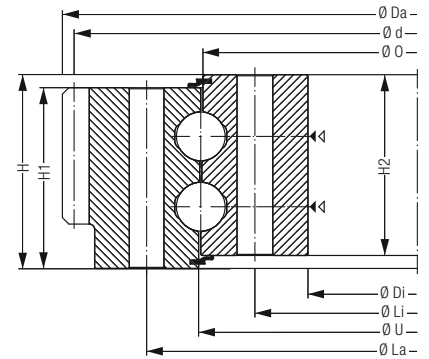
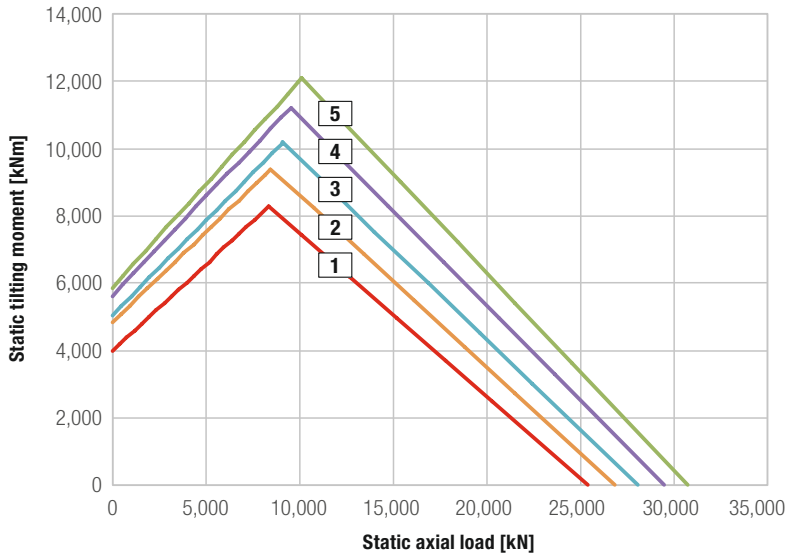
External gear KUD_40_WA



- 1 KUD01797-040WA15-900-000
- 2 KUD01897-040WA15-900-000
- 3 KUD01997-040WA15-900-000
- 4 KUD02097-040WA15-900-000
- 5 KUD02197-040WA15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b			C _{stat}	C _{dyn}
1	939	2,001.6	1,646	154	1,795	1,799	142	142	1,885	1,706	52	27	7	1,968	12	164	6	-1.2	120	132.2	264.3	20,884.0	1,510.0
2	982	2,097.6	1,746	154	1,895	1,899	142	142	1,985	1,806	52	27	7	2,064	12	172	6	-1.2	120	132.2	264.3	22,017.0	1,539.0
3	1,073	2,209.2	1,846	154	1,995	1,999	142	142	2,085	1,906	60	27	7	2,170	14	155	7	-1.4	140	179.9	359.8	23,149.0	1,568.0
4	1,123	2,307.2	1,946	154	2,095	2,099	142	142	2,185	2,006	60	27	8	2,268	14	162	7	-1.4	140	179.9	359.8	24,444.0	1,602.0
5	1,172	2,405.2	2,046	154	2,195	2,199	142	142	2,285	2,106	60	27	8	2,366	14	169	7	-1.4	140	179.9	359.8	25,577.0	1,628.0

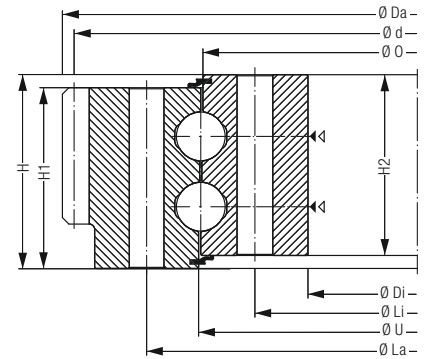
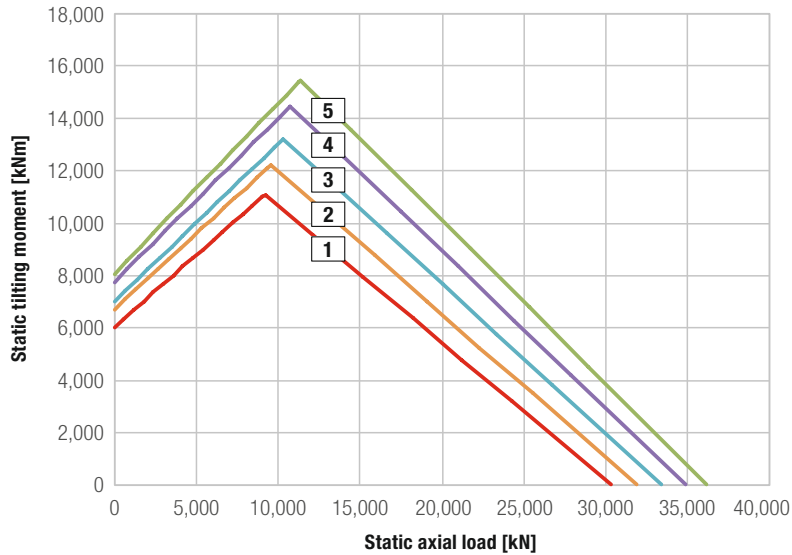
External gear KUD_45_WA



- 1 KUD01947-045WA15-900-000
- 2 KUD02047-045WA15-900-000
- 3 KUD02147-045WA15-900-000
- 4 KUD02247-045WA15-900-000
- 5 KUD02347-045WA15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da [mm]	Di [mm]	H [mm]	O [mm]	U [mm]	H1 [mm]	H2 [mm]	La [mm]	Li [mm]	n	M [mm]	n1	d [mm]	m [mm]	z	x*m [mm]	k*m [mm]	b [mm]	[kN]	[kN]	C _{stat} [kN]	C _{dyn} [kN]
1	1,232	2,169.6	1,780	170	1,945	1,999	158	158	2,045	1,846	52	30	8	2,136	12	178	6	-1.2	120	132.2	264.3	25,407.0	1,754.0
2	1,329	2,279.2	1,880	170	2,045	2,049	158	158	2,145	1,946	60	30	8	2,240	14	160	7	-1.4	140	179.9	359.8	26,841.0	1,793.0
3	1,391	2,377.2	1,980	170	2,145	2,149	158	158	2,245	2,046	60	30	8	2,338	14	167	7	-1.4	140	179.9	359.8	28,070.0	1,824.0
4	1,443	2,475.2	2,080	170	2,245	2,249	158	158	2,345	2,146	64	30	9	2,436	14	174	7	-1.4	140	179.9	359.8	29,298.0	1,849.0
5	1,504	2,573.2	2,180	170	2,345	2,349	158	158	2,445	2,246	64	30	9	2,534	14	181	7	-1.4	140	179.9	359.8	30,732.0	1,884.0

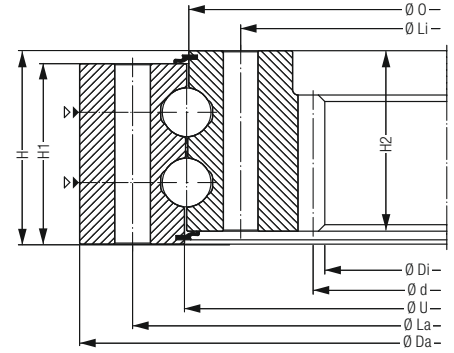
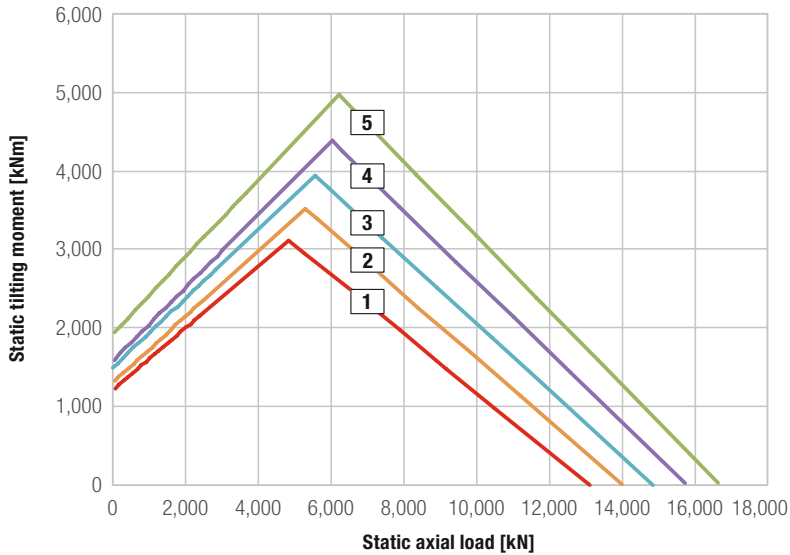
External gear KUD_50_WA



- 1 KUD02097-050WA15-900-000
- 2 KUD02197-050WA15-900-000
- 3 KUD02297-050WA15-900-000
- 4 KUD02397-050WA15-900-000
- 5 KUD02497-050WA15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da [mm]	Di [mm]	H [mm]	O [mm]	U [mm]	H1 [mm]	H2 [mm]	La [mm]	Li [mm]	n	M [mm]	n1	d [mm]	m [mm]	z	x*m [mm]	k*m [mm]	b [mm]	[kN]	[kN]	C _{stat} [kN]	C _{dyn} [kN]
1	1,594	2,349.2	1,915	184	2,095	2,099	172	172	2,204	1,987	60	33	8	2,310	14	165	7	-1.4	140	170.4	340.9	30,355.0	2,007.0
2	1,657	2,447.2	2,015	184	2,195	2,199	172	172	2,304	2,087	64	33	8	2,408	14	172	7	-1.4	140	170.4	340.9	31,872.0	2,045.0
3	1,731	2,545.2	2,115	184	2,395	2,399	172	172	2,404	2,187	64	33	8	2,506	14	179	7	-1.4	140	170.4	340.9	33,389.0	2,082.0
4	1,793	2,643.2	2,215	184	2,395	2,399	172	172	2,504	2,287	68	33	10	2,604	14	186	7	-1.4	140	170.4	340.9	34,907.0	2,118.0
5	1,865	2,741.2	2,315	184	2,495	2,499	172	172	2,604	2,387	68	33	10	2,702	14	193	7	-1.4	140	170.4	340.9	36,171.0	2,142.0

Internal gear KUD_30_WJ

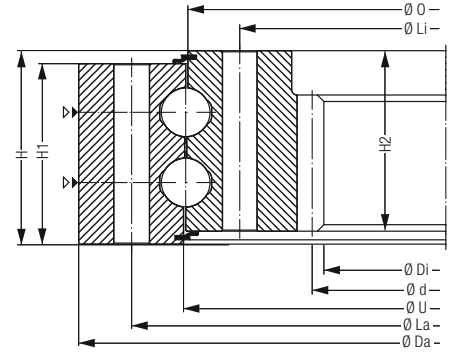
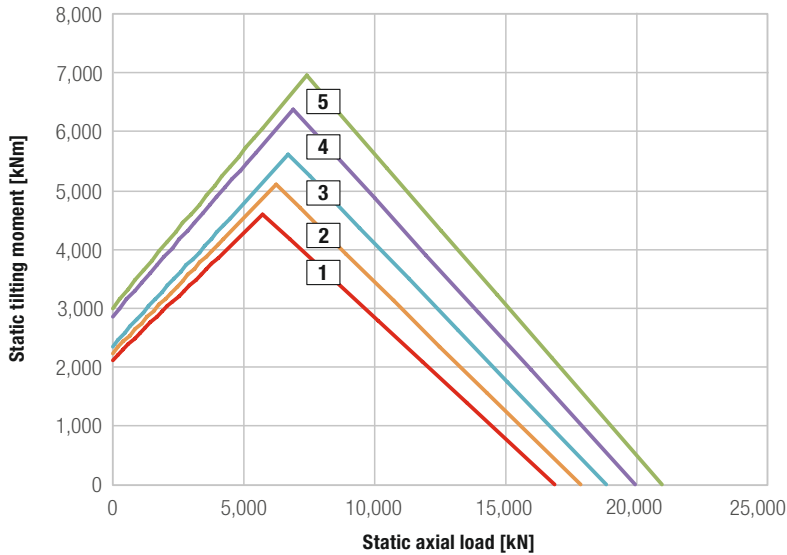


- 1 KUD01506-030WJ15-900-000
- 2 KUD01606-030WJ15-900-000
- 3 KUD01706-030WJ15-900-000
- 4 KUD01806-030WJ15-900-000
- 5 KUD01906-030WJ15-900-000

KUD_W

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da [mm]	Di [mm]	H [mm]	O [mm]	U [mm]	H1 [mm]	H2 [mm]	La [mm]	Li [mm]	n	M [mm]	n1	d [mm]	m [mm]	z	x*m [mm]	k*m [mm]	b [mm]	[kN]	[kN]	C _{stat} [kN]	C _{dyn} [kN]
1	488	1,617	1,334.4	123	1,504	1,508	111	111	1,573	1,436	48	20	6	1,344	12	-112	-6	-1.2	111	128.7	257.4	13,113.0	1,051.0
2	531	1,717	1,430.4	123	1,604	1,608	111	111	1,673	1,536	48	20	6	1,440	12	-120	-6	-1.2	111	128.7	257.4	14,023.0	1,078.0
3	547	1,817	1,538.4	123	1,704	1,708	111	111	1,773	1,636	52	20	7	1,548	12	-129	-6	-1.2	111	128.7	257.4	14,842.0	1,100.0
4	590	1,917	1,634.4	123	1,804	1,808	111	111	1,873	1,736	52	20	7	1,644	12	-137	-6	-1.2	111	128.7	257.4	15,753.0	1,125.0
5	630	2,017	1,730.4	123	1,904	1,908	111	111	1,973	1,836	60	20	8	1,740	12	-145	-6	-1.2	111	128.7	257.4	16,663.0	1,150.0

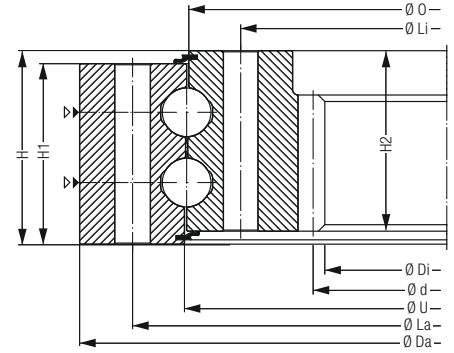
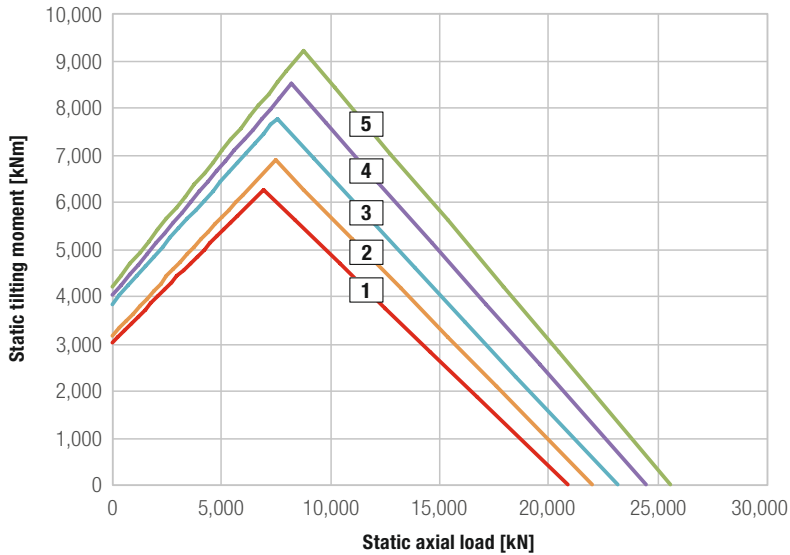
Internal gear KUD_35_WJ



- 1 KUD01656-035WJ15-900-000
- 2 KUD01756-035WJ15-900-000
- 3 KUD01856-035WJ15-900-000
- 4 KUD01956-035WJ15-900-000
- 5 KUD02056-035WJ15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}
1	678	1,786	1,466.4	137	1,654	1,658	125	125	1,734	1,575	52	24	7	1,476	12	-123	-6	-1.2	120	139.1	278.3	16,856.0	1,278.0
2	732	1,886	1,562.4	137	1,754	1,758	125	125	1,834	1,675	52	24	7	1,572	12	-131	-6	-1.2	120	139.1	278.3	17,848.0	1,304.0
3	758	1,986	1,670.4	137	1,854	1,858	125	125	1,934	1,775	52	24	7	1,680	12	-140	-6	-1.2	120	139.1	278.3	18,839.0	1,330.0
4	804	2,086	1,766.4	137	1,954	1,958	125	125	2,034	1,875	60	24	8	1,776	12	-148	-6	-1.2	120	139.1	278.3	19,954.0	1,361.0
5	888	2,186	1,850.8	137	2,054	2,058	125	125	2,134	1,975	60	24	8	1,862	14	-133	-7	-1.4	125	160.6	321.3	20,946.0	1,385.0

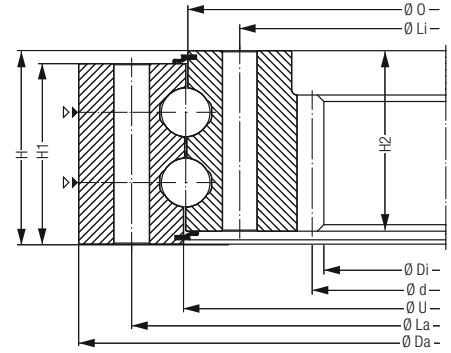
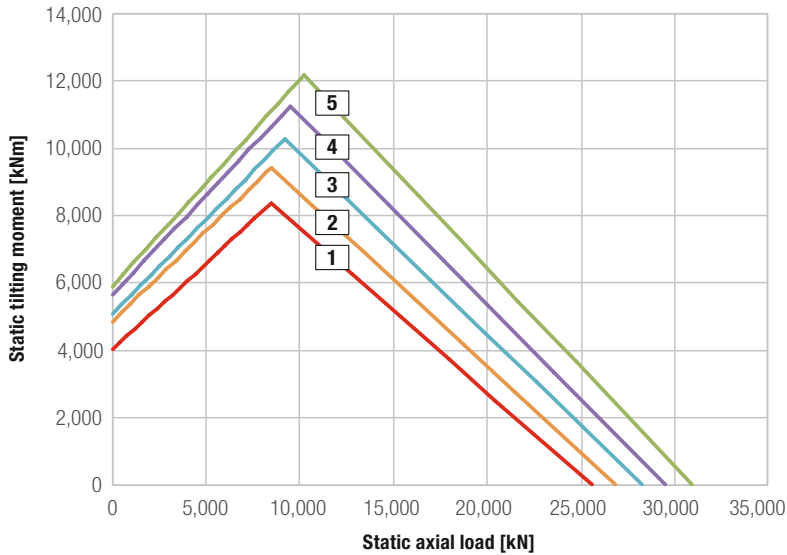
Internal gear KUD_40_WJ



- 1 KUD01806-040WJ15-900-000
- 2 KUD01906-040WJ15-900-000
- 3 KUD02006-040WJ15-900-000
- 4 KUD02106-040WJ15-900-000
- 5 KUD02206-040WJ15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da [mm]	Di [mm]	H [mm]	O [mm]	U [mm]	H1 [mm]	H2 [mm]	La [mm]	Li [mm]	n	M [mm]	n1	d [mm]	m [mm]	z	x*m [mm]	k*m [mm]	b [mm]	[kN]	[kN]	C _{stat} [kN]	C _{dyn} [kN]
1	925	1,954	1,598.4	154	1,804	1,808	142	142	1,894	1,715	52	27	7	1,608	12	-134	-6	-1.2	120	132.2	264.3	21,045.0	1,516.0
2	991	2,054	1,694.4	154	1,904	1,908	142	142	1,994	1,815	52	27	7	1,704	12	-142	-6	-1.2	120	132.2	264.3	22,178.0	1,545.0
3	1,041	2,154	1,794.8	154	2,004	2,008	142	142	2,094	1,915	60	27	7	1,806	14	-129	-7	-1.4	140	179.9	359.8	23,311.0	1,573.0
4	1,104	2,254	1,892.8	154	2,104	2,108	142	142	2,194	2,015	60	27	8	1,904	14	-136	-7	-1.4	140	179.9	359.8	24,444.0	1,600.0
5	1,169	2,354	1,990.8	154	2,204	2,208	142	142	2,294	2,115	60	27	8	2,002	14	-143	-7	-1.4	140	179.9	359.8	25,577.0	1,626.0

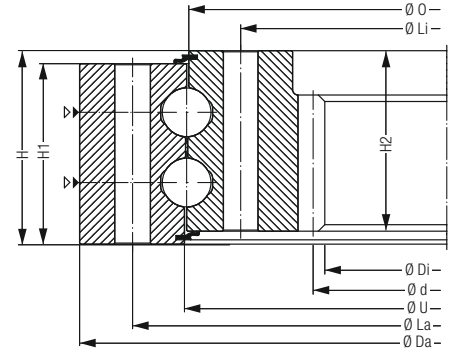
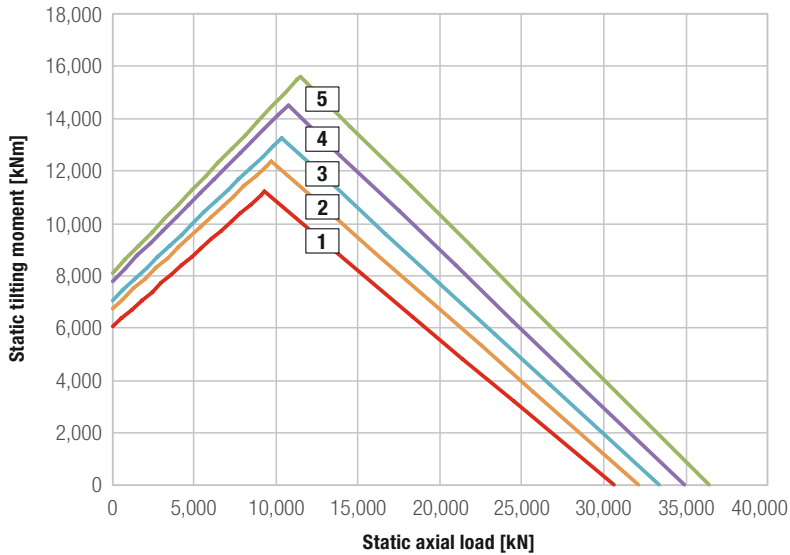
Internal gear KUD_45_WJ



- 1 KUD01956-045WJ15-900-000
- 2 KUD02056-045WJ15-900-000
- 3 KUD02156-045WJ15-900-000
- 4 KUD02256-045WJ15-900-000
- 5 KUD02356-045WJ15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}
1	1,216	2,120	1,730.4	170	1,954	1,958	158	158	2,054	1,855	52	30	8	1,740	12	-145	-6	-1.2	120	132.2	264.3	25,612.0	1,761.0
2	1,298	2,220	1,822.8	170	2,054	2,058	158	158	2,154	1,955	60	30	8	1,834	14	-131	-7	-1.4	140	179.9	359.8	26,841.0	1,790.0
3	1,374	2,320	1,920.8	170	2,154	2,158	158	158	2,254	2,055	60	30	8	1,932	14	-138	-7	-1.4	140	179.9	359.8	28,274.0	1,827.0
4	1,443	2,420	2,018.8	170	2,254	2,258	158	158	2,354	2,155	64	30	9	2,030	14	-145	-7	-1.4	140	179.9	359.8	29,503.0	1,855.0
5	1,521	2,520	2,116.8	170	2,354	2,358	158	158	2,454	2,255	64	30	9	2,128	14	-152	-7	-1.4	140	179.9	359.8	30,732.0	1,882.0

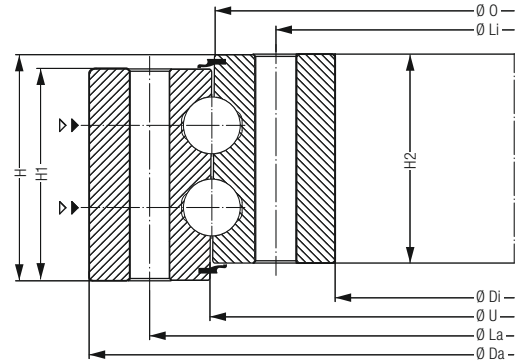
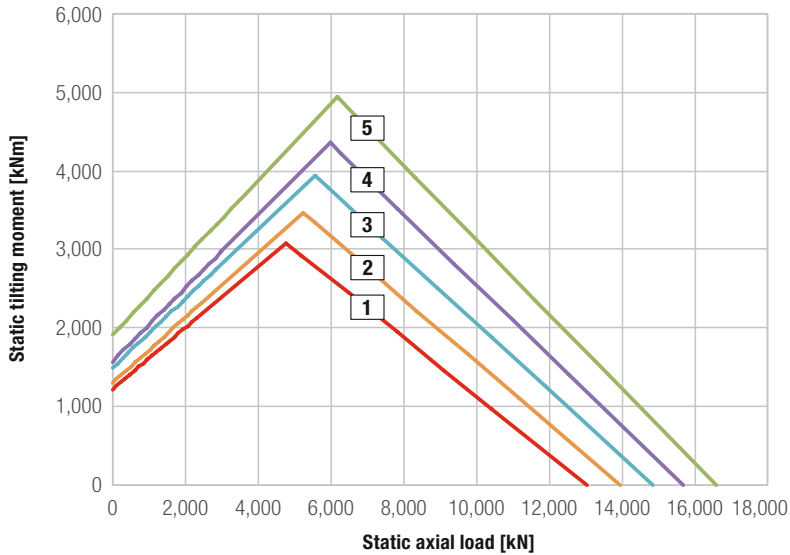
Internal gear KUD_50_WJ



- 1 KUD02106-050WJ15-900-000
- 2 KUD02206-050WJ15-900-000
- 3 KUD02306-050WJ15-900-000
- 4 KUD02406-050WJ15-900-000
- 5 KUD02506-050WJ15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da [mm]	Di [mm]	H [mm]	O [mm]	U [mm]	H1 [mm]	H2 [mm]	La [mm]	Li [mm]	n	M [mm]	n1	d [mm]	m [mm]	z	x*m [mm]	k*m [mm]	b [mm]	[kN]	[kN]	C _{stat} [kN]	C _{dyn} [kN]
1	1,564	2,285	1,850.8	184	2,104	2,108	172	172	2,213	1,996	60	33	8	1,862	14	-133	-7	-1.4	140	170.4	340.9	30,608.0	2,016.0
2	1,595	2,385	1,962.8	184	2,204	2,208	172	172	2,313	2,096	64	33	8	1,974	14	-141	-7	-1.4	140	170.4	340.9	32,125.0	2,054.0
3	1,683	2,485	2,060.8	184	2,304	2,308	172	172	2,413	2,196	64	33	8	2,072	14	-148	-7	-1.4	140	170.4	340.9	33,389.0	2,080.0
4	1,760	2,585	2,158.8	184	2,404	2,408	172	172	2,513	2,296	68	33	10	2,170	14	-155	-7	-1.4	140	170.4	340.9	34,907.0	2,115.0
5	1,850	2,685	2,256.8	184	2,504	2,508	172	172	2,613	2,396	68	33	10	2,268	14	-162	-7	-1.4	140	170.4	340.9	36,424.0	2,150.0

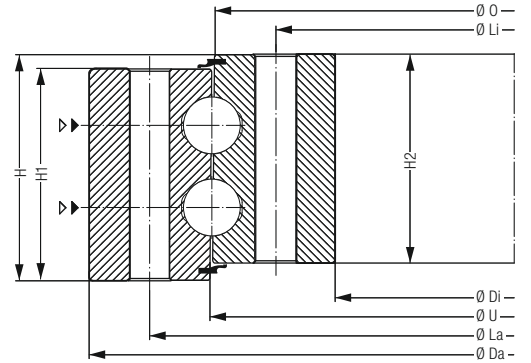
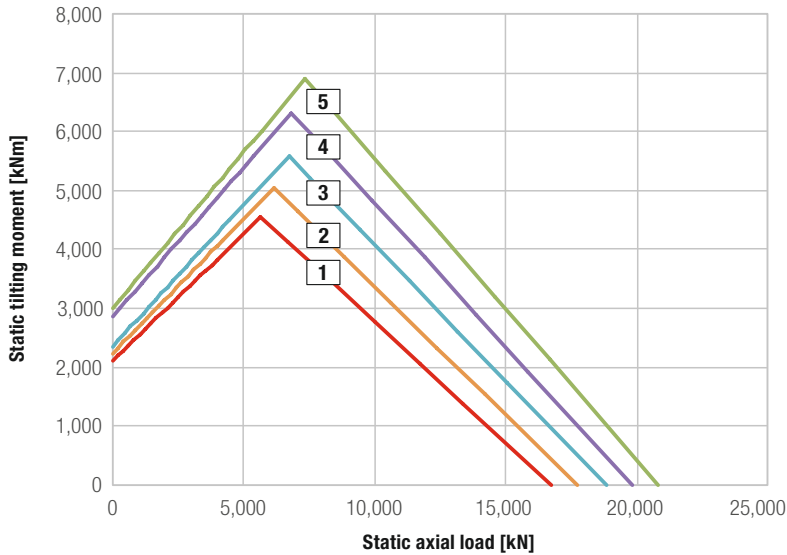
No gearing KUD_30_WO



- 1 KUD01497-030W015-900-000
- 2 KUD01597-030W015-900-000
- 3 KUD01697-030W015-900-000
- 4 KUD01797-030W015-900-000
- 5 KUD01897-030W015-900-000

Bearing type	Bearing data								Bolt data					Gear data								Load rating	
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b			C _{stat}	C _{dyn}
1	418	1,608	1,383	123	1,495	1,499	111	111	1,564	1,427	48	20	6	-	-	-	-	-	-	-	-	13,022.0	1,048.0
2	448	1,708	1,483	123	1,595	1,599	111	111	1,664	1,527	48	20	6	-	-	-	-	-	-	-	-	13,932.0	1,075.0
3	475	1,808	1,583	123	1,695	1,699	111	111	1,764	1,627	52	20	7	-	-	-	-	-	-	-	-	14,842.0	1,102.0
4	505	1,908	1,683	123	1,795	1,799	111	111	1,864	1,727	52	20	7	-	-	-	-	-	-	-	-	15,662.0	1,123.0
5	530	2,008	1,783	123	1,895	1,899	111	111	1,964	1,827	60	20	8	-	-	-	-	-	-	-	-	16,572.0	1,147.0

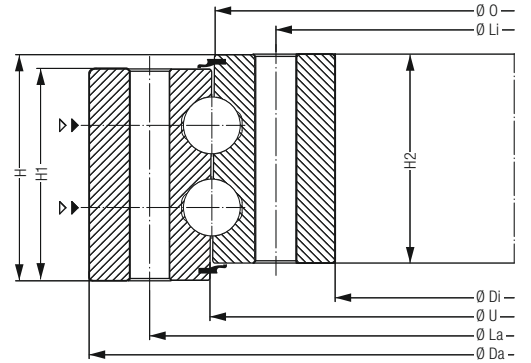
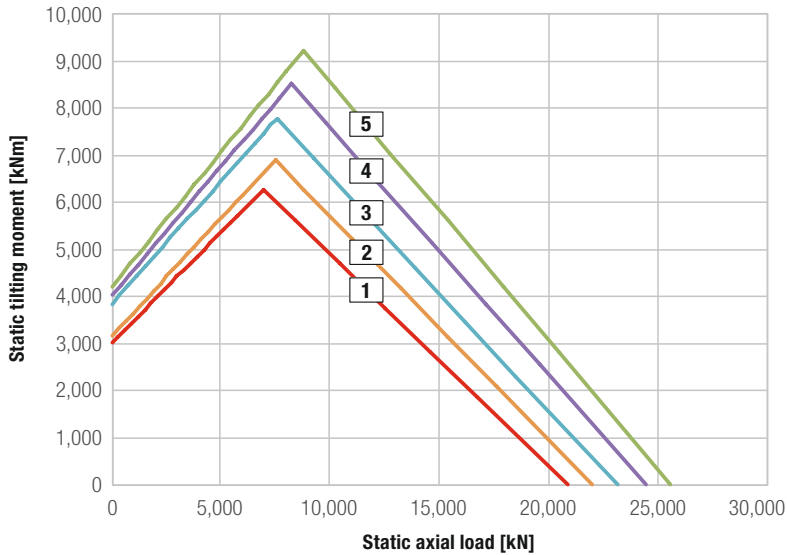
No gearing KUD_35_WO



- 1 KUD01647-035W015-900-000
- 2 KUD01747-035W015-900-000
- 3 KUD01847-035W015-900-000
- 4 KUD01947-035W015-900-000
- 5 KUD02047-035W015-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b			C _{stat}	C _{dyn}
1	597	1,777	1,514	137	1,645	1,649	125	125	1,725	1,566	52	24	7	-	-	-	-	-	-	-	-	16,732.0	1,274.0
2	636	1,877	1,614	137	1,745	1,749	125	125	1,825	1,666	52	24	7	-	-	-	-	-	-	-	-	17,724.0	1,300.0
3	676	1,977	1,714	137	1,845	1,849	125	125	1,925	1,766	52	24	7	-	-	-	-	-	-	-	-	18,839.0	1,332.0
4	707	2,077	1,814	137	1,945	1,949	125	125	2,025	1,866	60	24	8	-	-	-	-	-	-	-	-	19,830.0	1,357.0
5	746	2,177	1,914	137	2,045	2,049	125	125	2,125	1,966	60	24	8	-	-	-	-	-	-	-	-	20,822.0	1,381.0

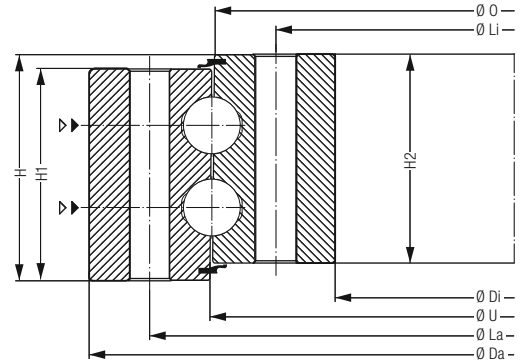
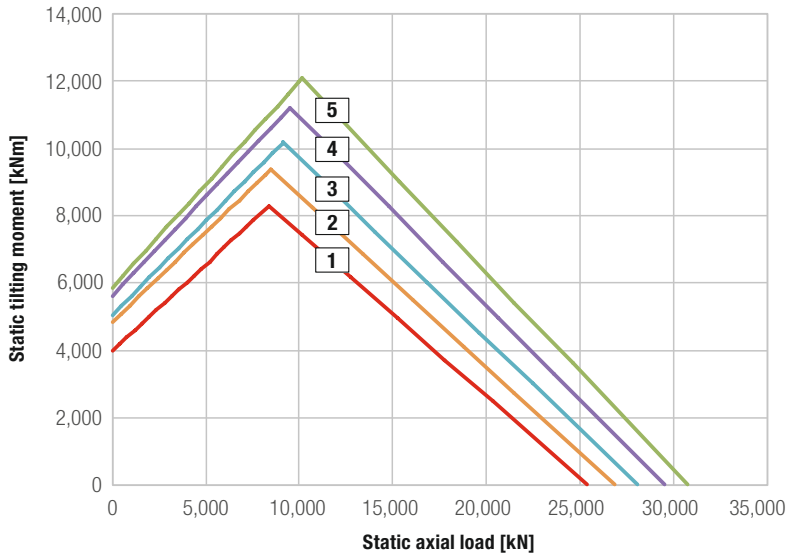
No gearing KUD_40_WO



- 1 KUD01797-040W015-900-000
- 2 KUD01897-040W015-900-000
- 3 KUD01997-040W015-900-000
- 4 KUD02097-040W015-900-000
- 5 KUD02197-040W015-900-000

Bearing type	Bearing data								Bolt data					Gear data								Load rating	
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b			C _{stat}	C _{dyn}
1	835	1,945	1,646	154	1,795	1,799	142	142	1,885	1,706	52	27	7	-	-	-	-	-	-	-	-	20,884.0	1,510.0
2	886	2,045	1,746	154	1,895	1,899	142	142	1,985	1,806	52	27	8	-	-	-	-	-	-	-	-	22,017.0	1,539.0
3	925	2,145	1,846	154	1,995	1,999	142	142	2,085	1,906	60	27	8	-	-	-	-	-	-	-	-	23,149.0	1,568.0
4	976	2,245	1,946	154	2,095	2,099	142	142	2,185	2,006	60	27	8	-	-	-	-	-	-	-	-	24,444.0	1,602.0
5	1,027	2,345	2,046	154	2,195	2,199	142	142	2,285	2,106	60	27	9	-	-	-	-	-	-	-	-	25,577.0	1,628.0

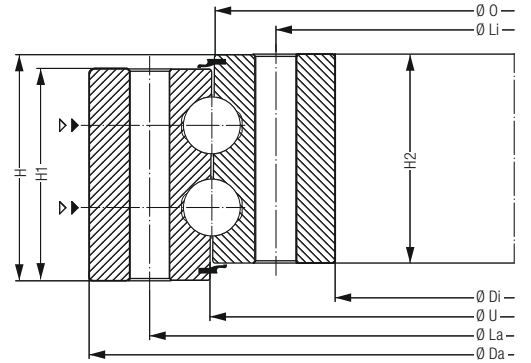
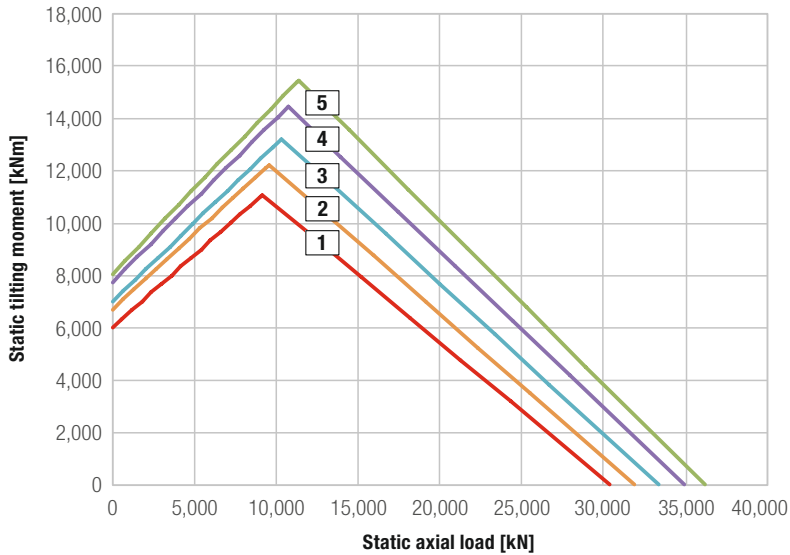
No gearing KUD_45_WO



- 1 KUD01947-045W015-900-000
- 2 KUD02047-045W015-900-000
- 3 KUD02147-045W015-900-000
- 4 KUD02247-045W015-900-000
- 5 KUD02347-045W015-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b			C _{stat}	C _{dyn}
1	1,114	2,111	1,780	170	1,945	1,949	158	158	2,045	1,846	52	30	8	-	-	-	-	-	-	-	-	25,407,0	1,754,0
2	1,160	2,211	1,880	170	2,045	2,049	158	158	2,145	1,946	60	30	8	-	-	-	-	-	-	-	-	26,841,0	1,793,0
3	1,223	2,311	1,980	170	2,145	2,149	158	158	2,245	2,046	60	30	8	-	-	-	-	-	-	-	-	28,070,0	1,824,0
4	1,277	2,411	2,080	170	2,245	2,249	158	158	2,345	2,146	64	30	9	-	-	-	-	-	-	-	-	29,298,0	1,849,0
5	1,340	2,511	2,180	170	2,345	2,349	158	158	2,445	2,246	64	30	9	-	-	-	-	-	-	-	-	30,732,0	1,884,0

No gearing KUD_50_WO

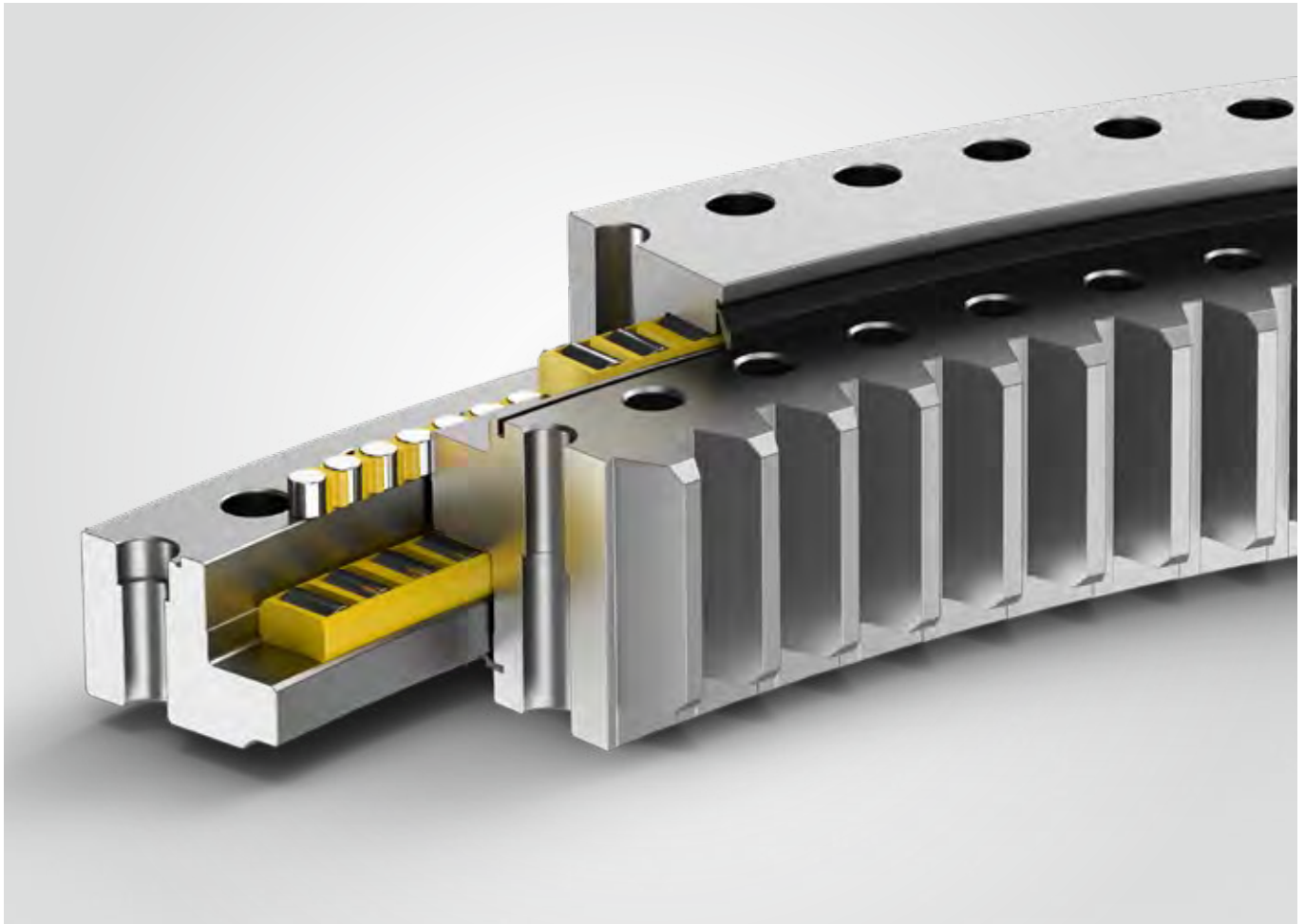


- 1 KUD02097-050W015-900-000
- 2 KUD02197-050W015-900-000
- 3 KUD02297-050W015-900-000
- 4 KUD02397-050W015-900-000
- 5 KUD02497-050W015-900-000

Bearing type	Bearing data								Bolt data					Gear data								Load rating	
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[kN]	[kN]	C_{stat}	C_{dyn}
1	1,399	2,276	1,915	184	2,095	2,099	172	172	2,204	1,987	60	33	8	-	-	-	-	-	-	-	-	30,355.0	2,007.0
2	1,463	2,376	2,015	184	2,195	2,199	172	172	2,304	2,087	64	33	9	-	-	-	-	-	-	-	-	31,872.0	2,045.0
3	1,538	2,476	2,115	184	2,295	2,299	172	172	2,404	2,187	64	33	9	-	-	-	-	-	-	-	-	33,389.0	2,082.0
4	1,601	2,576	2,215	184	2,395	2,399	172	172	2,504	2,287	68	33	10	-	-	-	-	-	-	-	-	34,907.0	2,118.0
5	1,676	2,676	2,315	184	2,495	2,499	172	172	2,604	2,387	68	33	10	-	-	-	-	-	-	-	-	36,171.0	2,142.0

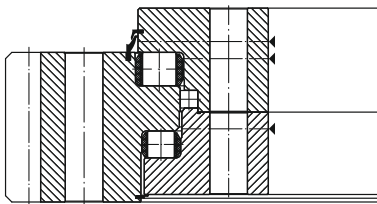
Technical data

ROD_D Triple-row roller bearings*

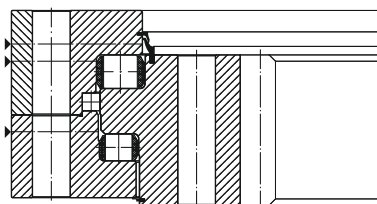


ROD_D*

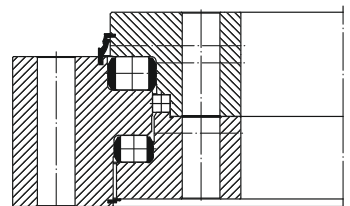
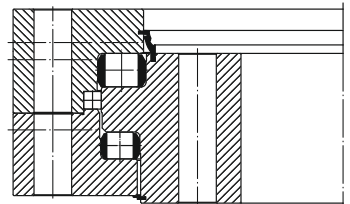
ROD_DA*



ROD_DJ*

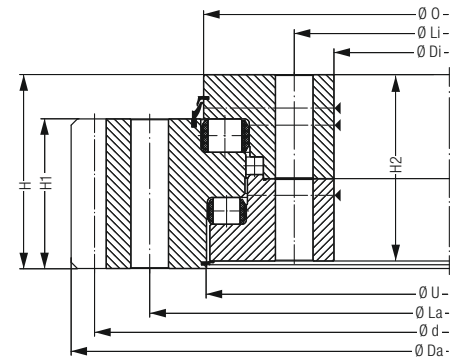
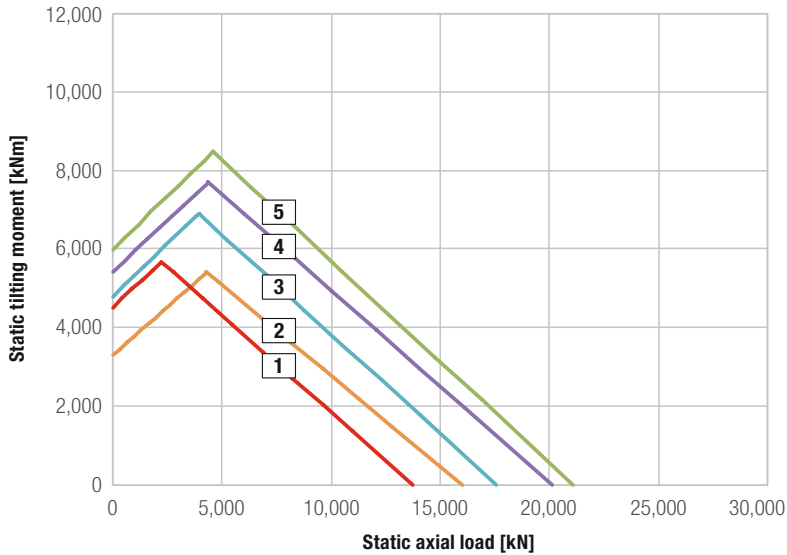


ROD_D*



* Shorter delivery times can be realized.

External gear ROD_15/18_DA*

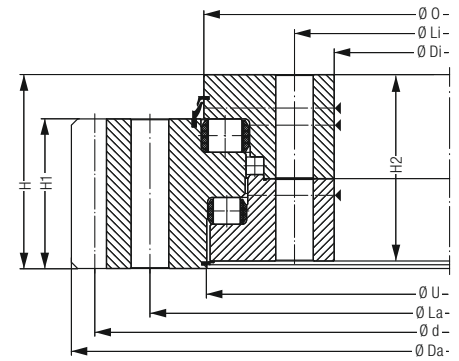
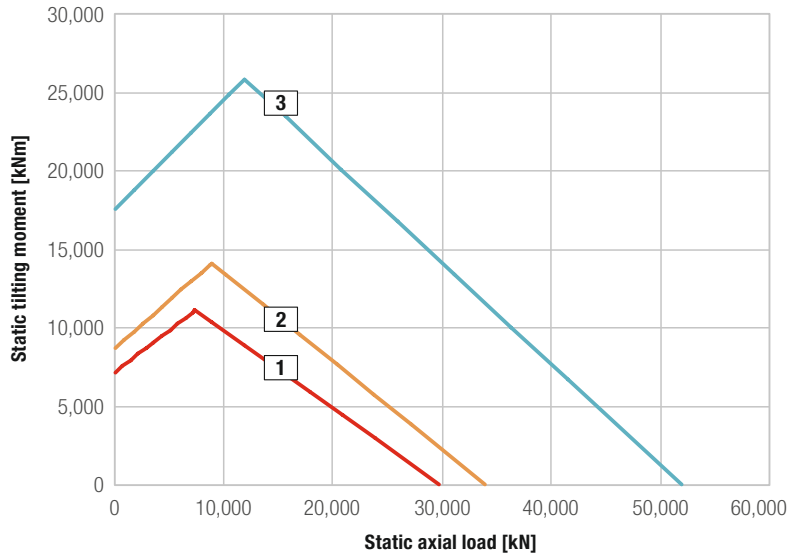


- 1 ROD01847-015DA15-900-000
- 2 ROD02025-015DA15-900-000
- 3 ROD01957-018DA15-900-000
- 4 ROD01972-018DA15-900-000
- 5 ROD02053-018DA15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b			C _{stat}	C _{dyn}
1	579	2,050.2	1,704	102	1,879	1,865	80	93	1,955	1,761	72/73	24	4	2,025	9	225	4.5	-0.9	75	65	130	16,006	1,419
2	662	2,247.0	1,882	104	2,057	2,056	82	97	2,133	1,939	96	24	6	2,212	14	158	7.0	-1.4	77	104	208	17,560	1,490
3	748	2,176.2	1,792	115	1,990	1,985	90	109	2,071	1,861	72/70	30	6	2,160	9	240	0.0	-0.9	75	65	130	20,297	1,858
4	704	2,176.2	1,816	109	2,013	1,993	88	104	2,084	1,870	108	22	6	2,151	9	239	4.5	-0.9	88	77	153	20,446	1,369
5	732	2,261.7	1,900	114	2,081	2,081	90	108	2,166	1,960	90	27	6	2,232	9	248	6.8	-0.9	90	78	157	21,263	1,904

* Shorter delivery times can be realized.

External gear ROD_26/32_DA*

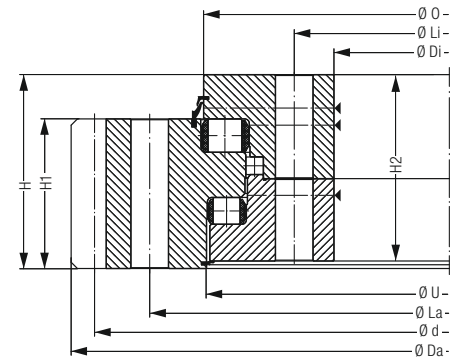
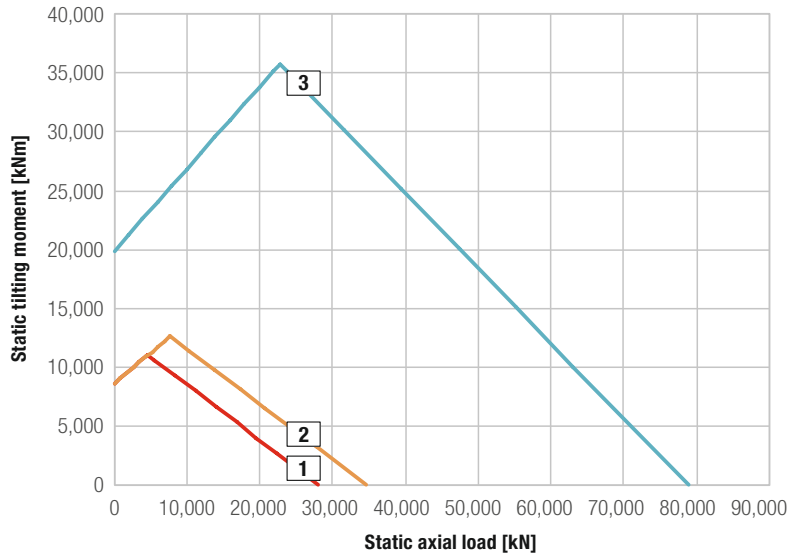


- 1 ROD01986-026DA15-900-000
- 2 ROD02260-026DA15-900-000
- 3 ROD02578-032DA15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b			C _{stat}	C _{dyn}
1	1,312	2,275	1,790	158	2,035	2,016	124	152	2,130	1,860	90	30	6	2,224	16	139	9.5	-	124	182	364	30,263	3,093
2	1,760	2,560	2,046	178	2,309	2,290	142	156	2,404	2,130	80	33	8	2,528	16	158	-	-	142	209	417	34,466	3,313
3	2,750	2,948.4	2,330	212	2,639	2,614	145	204	2,776	2,428	84	42	8	2,880	18	160	18.0	-1.8	145	240	479	52,003	4,944

* Shorter delivery times can be realized.

External gear ROD_40/50_DA*

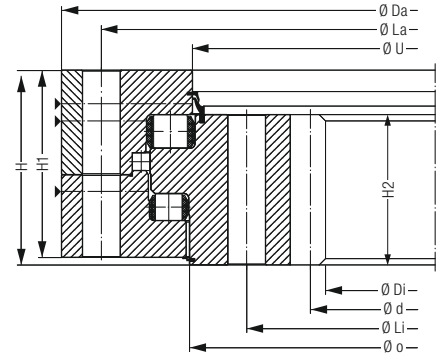
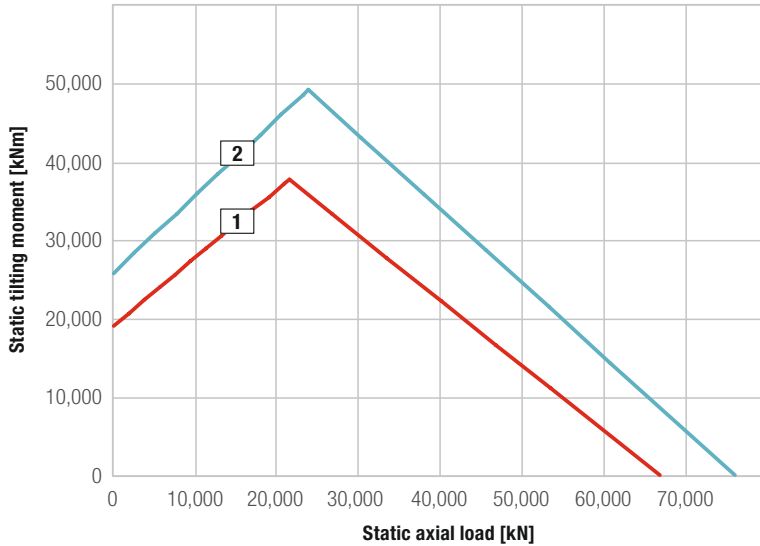


- 1 ROD02547-040DA15-900-000
- 2 ROD01900-040DA15-900-000
- 3 ROD01876-050DA15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}
1	4,714	2,995	2,230	260	2,644	2,591	208	255	2,784	2,344	72	48	8	2,934	18	163	14.4	-1.8	180	282	563	78,925	7,744
2	2,538	2,217	1,640	280	1,964	1,945	217	233	2,055	1,735	56	42	8	2,160	15	144	15.0	-1.5	217	283	566	28,006	3,728
3	3,180	2,232	1,610	322	1,950	1,925	259	273	2,055	1,705	56	42	8	2,175	15	145	15.0	-1.5	259	338	676	34,609	4,980

* Shorter delivery times can be realized.

Internal gear ROD_32_DJ*



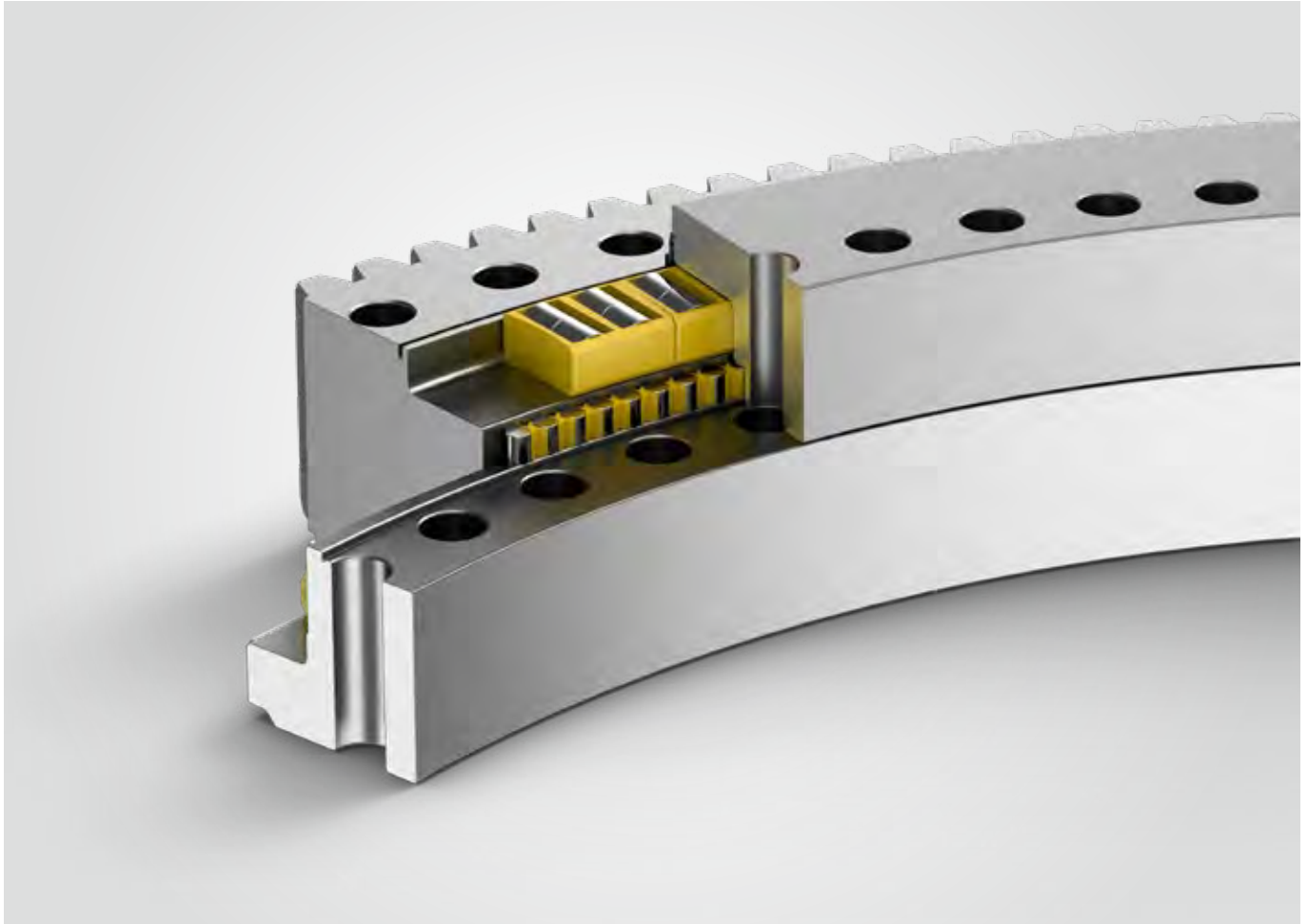
- 1 — ROD03312-032DJ15-900-000
- 2 — ROD03762-032DJ15-900-000

Bearing type	Bearing data								Bolt data					Gear data						Load rating			
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}
1	3,665	3,550	2,984	220	3,268	3,250	205	180	3,466	3,162	100	36	10	3,000	20	-150	-10.0	-2.0	180	313	626	66,899	5,648
2	4,200	4,000	3,424	220	3,718	3,700	205	180	3,916	3,612	120	36	12	3,440	20	-172	-10.0	-2.0	180	313	626	76,108	6,048

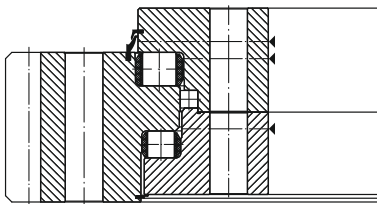
* Shorter delivery times can be realized.

Technical data

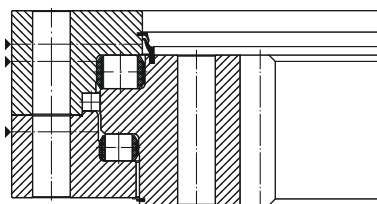
ROD_D Triple-row roller bearings



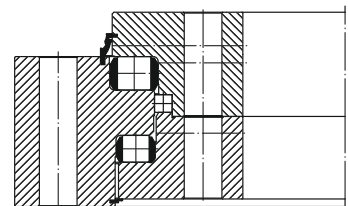
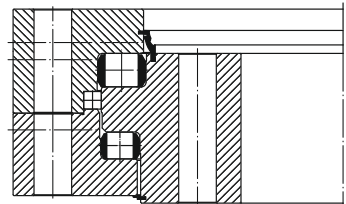
ROD_DA



ROD_DJ

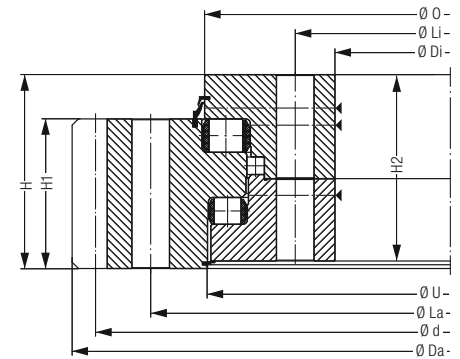
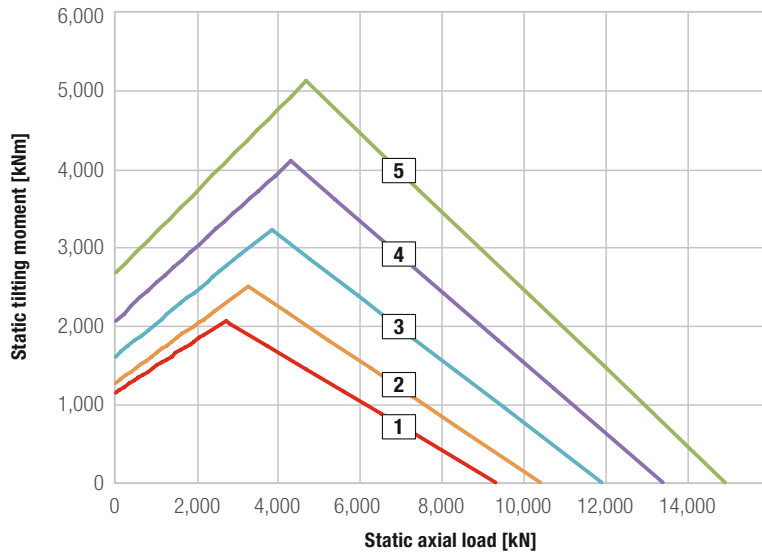


ROD_DO



ROD_D

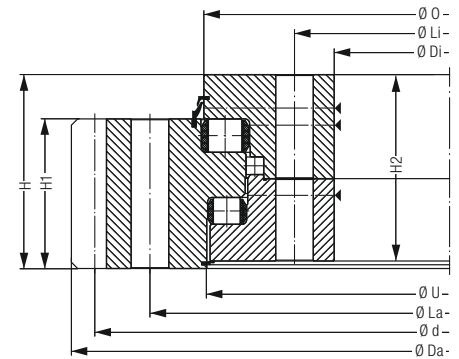
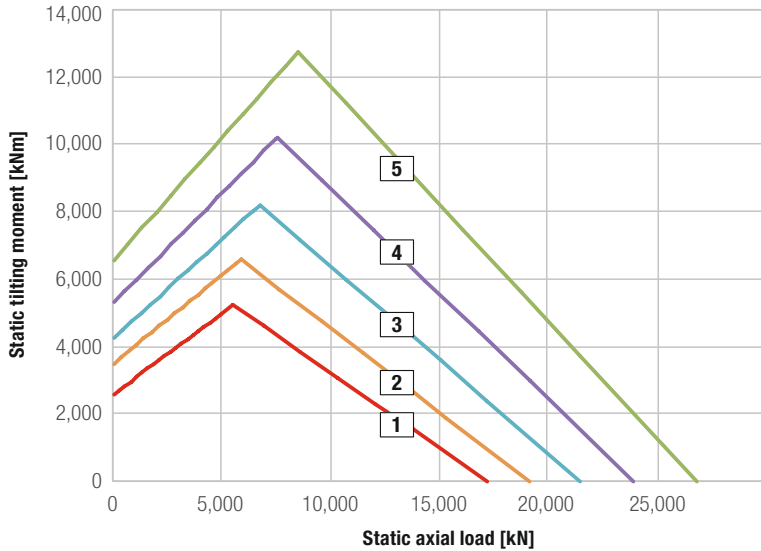
External gear ROD_21_DA



- 1 ROD01250-021DA15-900-000
- 2 ROD01400-021DA15-900-000
- 3 ROD01600-021DA15-900-000
- 4 ROD01800-021DA15-900-000
- 5 ROD02000-021DA15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter	Inner diameter	Height	Height	Pitch circle diameter	Pitch circle diameter	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}
1	542	1,461.6	1,103	132	1,282	1,280	106	123	1,355	1,155	36	24	3	1,428	12	119	6	-1.2	106	116.7	233.4	9,282	1,234
2	646	1,635.2	1,253	132	1,432	1,430	106	123	1,505	1,305	36	24	3	1,596	14	114	7	-1.4	106	136.2	272.4	10,375	1,308
3	731	1,831.2	1,453	132	1,632	1,630	106	123	1,705	1,505	40	24	4	1,792	14	128	7	-1.4	106	136.2	272.4	10,876	1,405
4	844	2,044.8	1,653	132	1,832	1,830	106	123	1,905	1,705	46	24	5	2,000	16	125	8	-1.6	106	155.8	311.2	13,378	1,496
5	912	2,236.8	1,853	132	2,032	2,030	106	123	2,105	1,905	54	24	5	2,192	16	137	8	-1.6	106	155.8	311.2	14,879	1,583

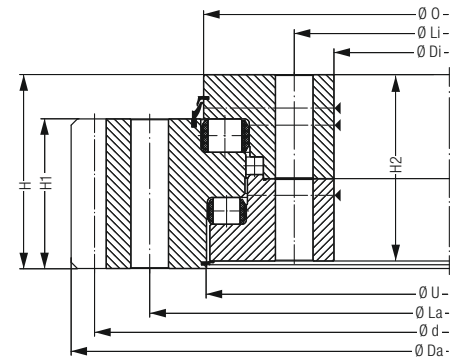
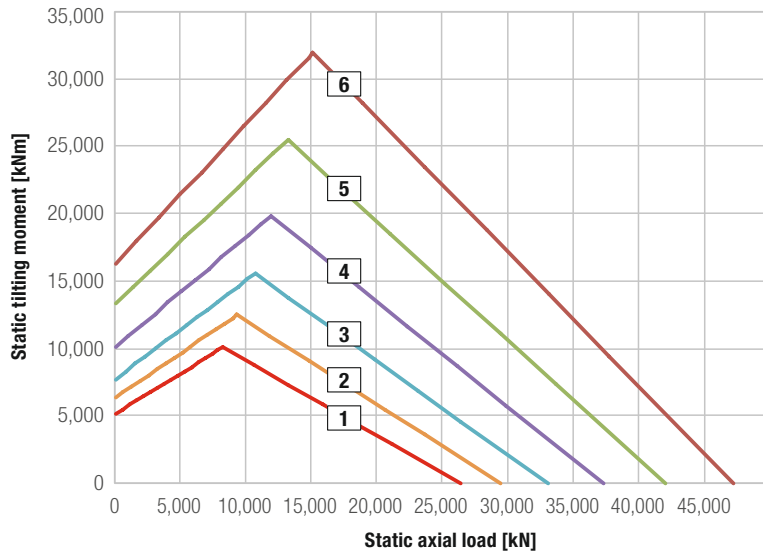
External gear ROD_26_DA



- 1 ROD01800-026DA15-900-000
- 2 ROD02000-026DA15-900-000
- 3 ROD02240-026DA15-900-000
- 4 ROD02500-026DA15-900-000
- 5 ROD02800-026DA15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}
1	1,126	2,076.8	1,619	147	1,836	1,826	117	138	1,925	1,685	36	30	6	2,032	16	127	8	-1.6	117	162.7	325.4	17,148	2,039
2	1,216	2,268.8	1,819	147	2,036	2,026	117	138	2,125	1,885	44	30	7	2,224	16	139	8	-1.6	117	162.7	325.4	19,065	2,156
3	1,378	2,516.4	2,059	147	2,276	2,266	117	138	2,366	2,125	48	30	8	2,466	18	137	9	-1.8	117	183.1	366.2	21,409	2,294
4	1,567	2,786.4	2,319	147	2,536	2,526	117	138	2,625	2,385	54	30	6	2,736	18	152	9	-1.8	117	183.1	366.2	23,858	2,428
5	1,785	3,096	2,619	147	2,836	2,826	117	138	2,925	2,685	60	30	10	3,040	20	152	10	-2	117	203.4	406.8	26,734	2,578

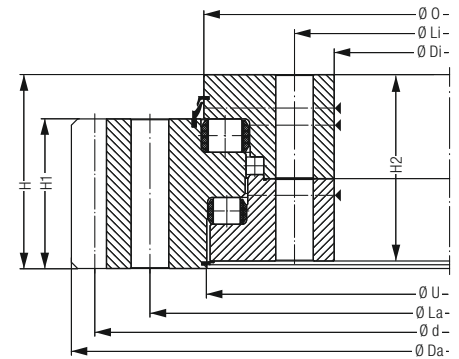
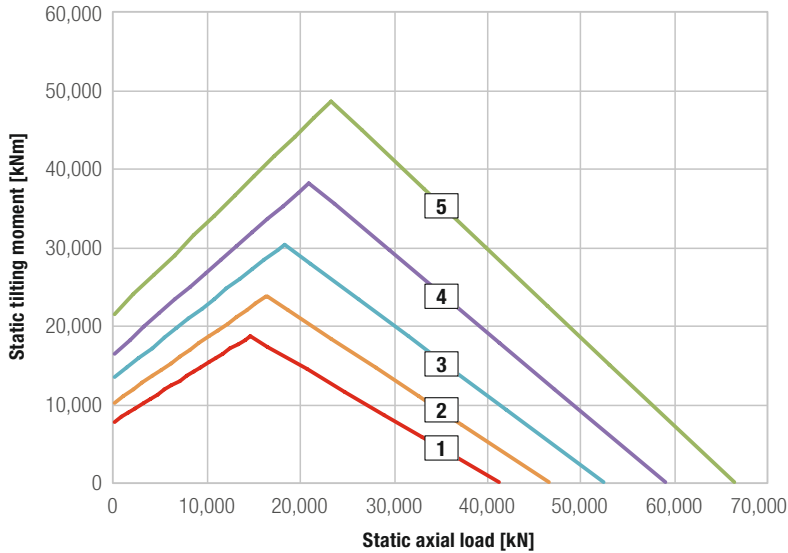
External gear ROD_32_DA



- 1 ROD02240-032DA15-900-000
- 2 ROD02500-032DA15-900-000
- 3 ROD02800-032DA15-900-000
- 4 ROD03150-032DA15-900-000
- 5 ROD03550-032DA15-900-000
- 6 ROD04000-032DA15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}
1	1,975	2,552.4	2,022	181	2,281	2,270	139	172	2,395	2,100	40	36	8	2,502	18	139	9	-1.8	139	217.6	435.2	26,326	3,018
2	2,260	2,822.4	2,282	181	2,541	2,530	139	172	2,655	2,360	44	36	7	2,772	18	154	9	-1.8	139	217.6	435.2	29,414	3,201
3	2,576	3,136	2,582	181	2,841	2,830	139	172	2,955	2,660	48	36	8	3,080	20	154	10	-2.0	139	241.7	483.4	32,989	3,402
4	2,828	3,476	2,932	181	3,191	3,180	139	172	3,305	3,010	56	36	7	3,420	20	171	10	-2.0	139	241.7	483.4	37,214	3,627
5	3,249	3,889.6	3,332	181	3,591	3,580	139	172	3,705	3,410	66	36	8	3,828	22	174	11	-2.2	139	265.9	531.8	41,927	3,863
6	3,752	4,351.6	3,782	181	4,041	4,030	139	172	4,155	3,860	72	36	9	4,290	22	195	11	-2.2	139	265.9	531.8	47,127	4,106

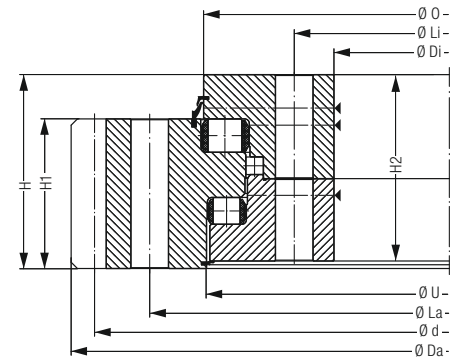
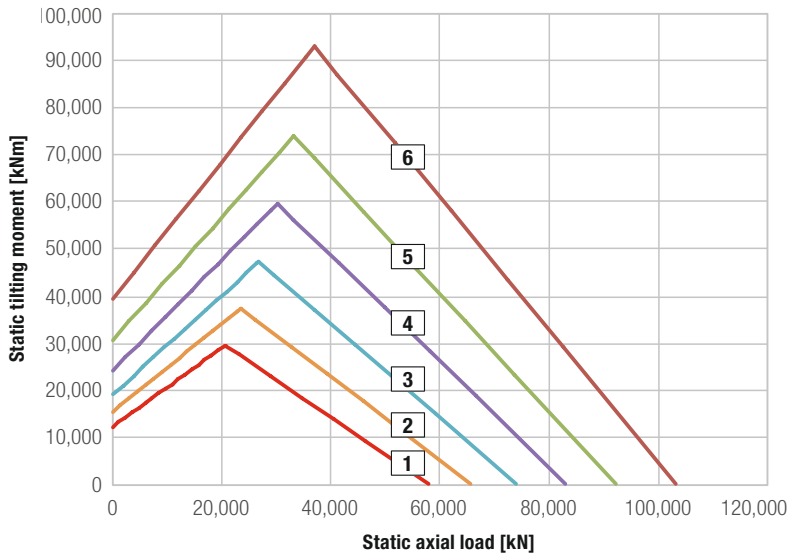
External gear ROD_40_DA



- 1 ROD02800-040DA15-900-000
- 2 ROD03150-040DA15-900-000
- 3 ROD03550-040DA15-900-000
- 4 ROD04000-040DA15-900-000
- 5 ROD04500-040DA15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da [mm]	Di [mm]	H [mm]	O [mm]	U [mm]	H1 [mm]	H2 [mm]	La [mm]	Li [mm]	n	M [mm]	n1	d [mm]	m [mm]	z	x*m [mm]	k*m [mm]	b [mm]	[kN]	[kN]	C _{stat} [kN]	C _{dyn} [kN]
1	3,267	3,136	2,562	220	2,850	2,837	170	210	2,965	2,640	48	36	8	3,080	20	154	10	-2.0	170	295.7	591.4	41,245	4,752
2	3,812	3,515.6	2,912	220	3,200	3,187	170	210	3,315	2,990	56	36	7	3,454	22	157	11	-2.2	170	325.2	650.4	46,591	4,880
3	4,255	3,911.6	3,312	220	3,600	3,587	170	210	3,715	3,390	66	36	8	3,850	22	175	11	-2.2	170	325.2	650.4	52,447	5,193
4	4,805	4,363.2	3,762	220	4,050	4,037	170	210	4,165	3,840	72	36	9	4,296	24	179	12	-2.4	170	354.8	709.6	59,066	5,529
5	5,410	4,867.2	4,262	220	4,550	4,537	170	210	4,665	4,340	84	36	14	4,800	24	200	12	-2.4	170	354.8	709.6	66,450	5,884

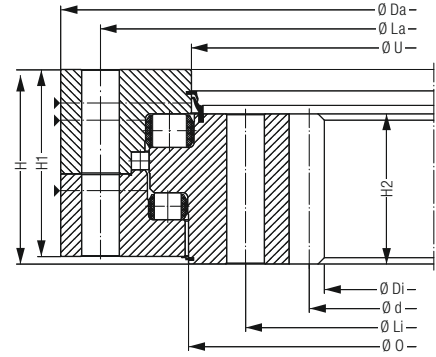
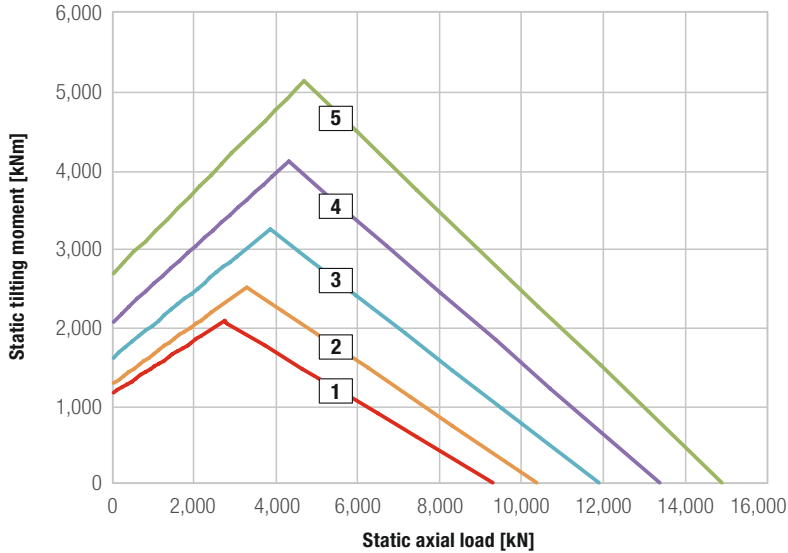
External gear ROD_50_DA



- 1 ROD03150-050DA15-900-000
- 2 ROD03550-050DA15-900-000
- 3 ROD04000-050DA15-900-000
- 4 ROD04500-050DA15-900-000
- 5 ROD05000-050DA15-900-000
- 6 ROD05600-050DA15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b			C _{stat}	C _{dyn}
1	5,298	3,571.2	2,885	268	3,210	3,196	203	258	3,350	2,975	48	42	8	3,504	24	146	12	-2.4	203	423.6	847.2	58,080	6,544
2	5,830	3,955.2	3,285	268	3,610	3,596	203	258	3,750	3,375	54	42	9	3,888	24	162	12	-2.4	203	423.6	847.2	65,638	6,985
3	6,578	4,411.2	3,735	268	4,060	4,046	203	258	4,200	3,825	60	42	10	4,344	24	181	12	-2.4	203	423.6	847.2	73,992	7,442
4	7,456	4,915.2	4,235	268	4,560	4,546	203	258	4,700	4,325	68	42	11	4,848	24	202	12	-2.4	203	423.6	847.2	83,142	7,912
5	8,259	5,419.2	4,735	268	5,060	5,046	203	258	5,200	4,825	78	42	13	5,328	24	223	12	-2.4	203	423.6	847.2	92,291	8,358
6	9,448	6,019.2	5,335	268	5,660	5,646	203	258	5,800	5,425	90	42	15	5,952	24	248	12	-2.4	203	423.6	847.2	103,430	8,877

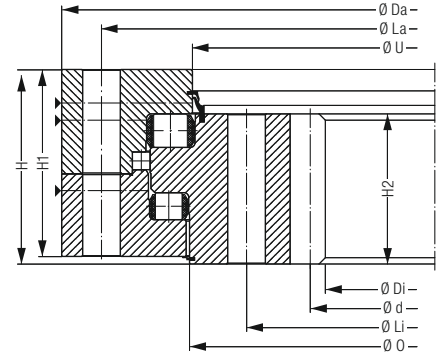
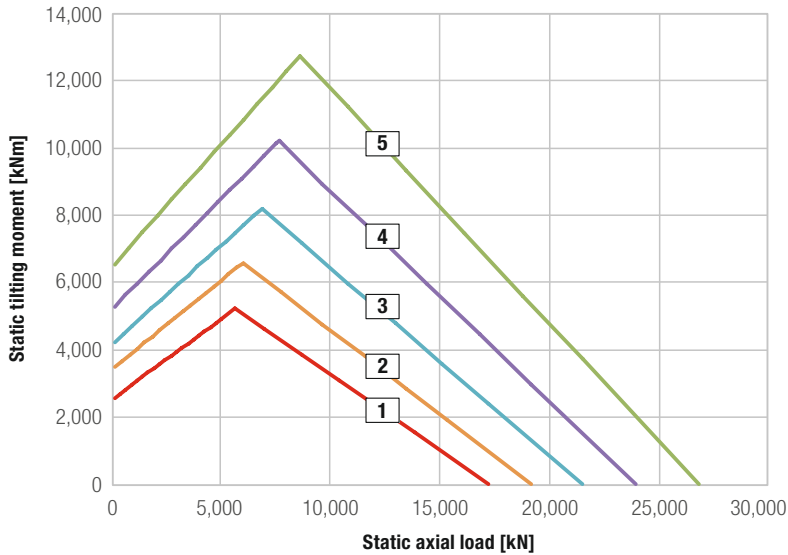
Internal gear ROD_21_DJ



- 1 ROD01250-021DJ15-900-000
- 2 ROD01400-021DJ15-900-000
- 3 ROD01600-021DJ15-900-000
- 4 ROD01800-021DJ15-900-000
- 5 ROD02000-021DJ15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b	[kN]	[kN]	C _{stat}	C _{dyn}
1	539	1,397	1,032	132	1,219	1,218	123	106	1,345	1,145	36	24	3	1,044	12	-87	-6	-	106	116.7	233.4	9,282	1,234
2	630	1,547	1,162	132	1,369	1,368	123	106	1,495	1,295	36	24	3	1,176	14	-84	-7	-	106	136.2	272.4	10,375	1,308
3	705	1,747	1,372	132	1,569	1,568	123	106	1,695	1,495	40	24	4	1,386	14	-99	-7	-	106	136.2	272.4	10,876	1,405
4	829	1,947	1,552	132	1,769	1,768	123	106	1,895	1,695	46	24	5	1,568	16	-98	-8	-	106	155.8	311.2	13,378	1,496
5	902	2,147	1,760	132	1,969	1,968	123	106	2,095	1,895	54	24	5	1,776	16	-111	-8	-	106	155.8	311.2	14,879	1,583

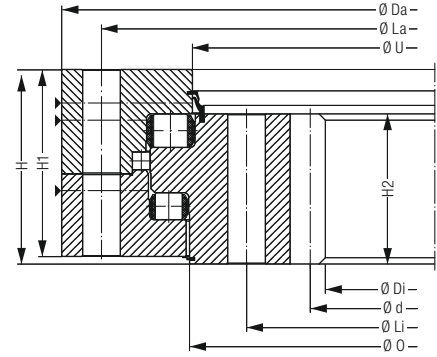
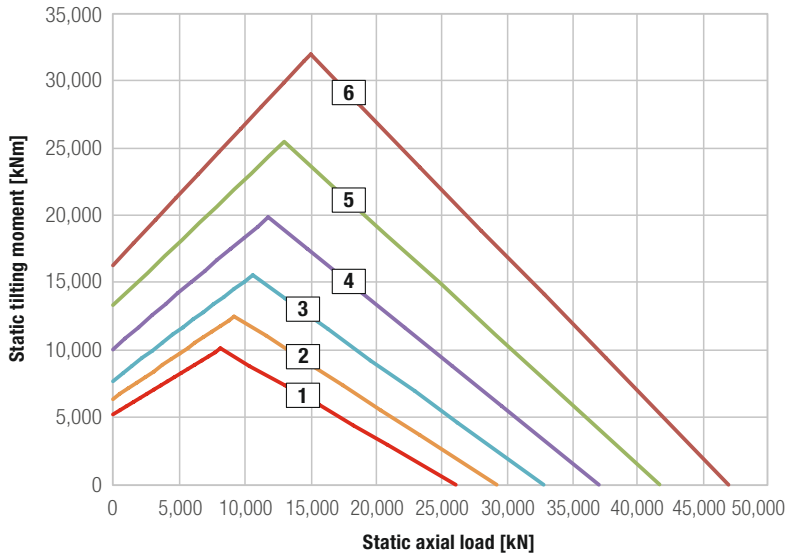
Internal gear ROD_26_DJ



- 1 ROD01800-026DJ15-900-000
- 2 ROD02000-026DJ15-900-000
- 3 ROD02240-026DJ15-900-000
- 4 ROD02500-026DJ15-900-000
- 5 ROD02800-026DJ15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da [mm]	Di [mm]	H [mm]	O [mm]	U [mm]	H1 [mm]	H2 [mm]	La [mm]	Li [mm]	n	M [mm]	n1	d [mm]	m [mm]	z	x*m [mm]	k*m [mm]	b [mm]	[kN]	[kN]	C _{stat} [kN]	C _{dyn} [kN]
1	1,101	1,981	1,520	147	1,774	1,763	138	117	1,915	1,675	36	30	6	1,536	16	-96	-8	-	117	162.7	325.4	17,148	2,039
2	1,202	2,181	1,728	147	1,974	1,963	138	117	2,115	1,875	44	30	7	1,744	16	-109	-8	-	117	162.7	325.4	19,065	2,156
3	1,406	2,421	1,944	147	2,214	2,203	138	117	2,355	2,115	48	30	8	1,962	18	-109	-9	-	117	183.1	366.2	21,409	2,294
4	1,545	2,681	2,214	147	2,474	2,463	138	117	2,615	2,375	54	30	6	2,232	18	-124	-9	-	117	183.1	366.2	23,858	2,428
5	1,767	2,981	2,500	147	2,774	2,763	138	117	2,915	2,675	60	30	10	2,520	20	-126	-10	-	117	203.4	406.8	26,734	2,578

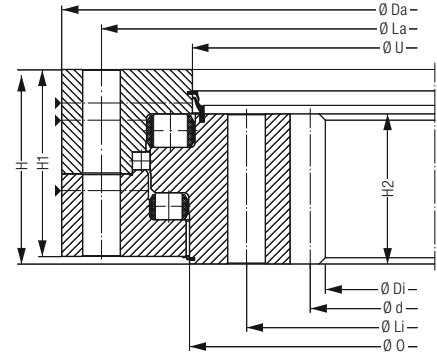
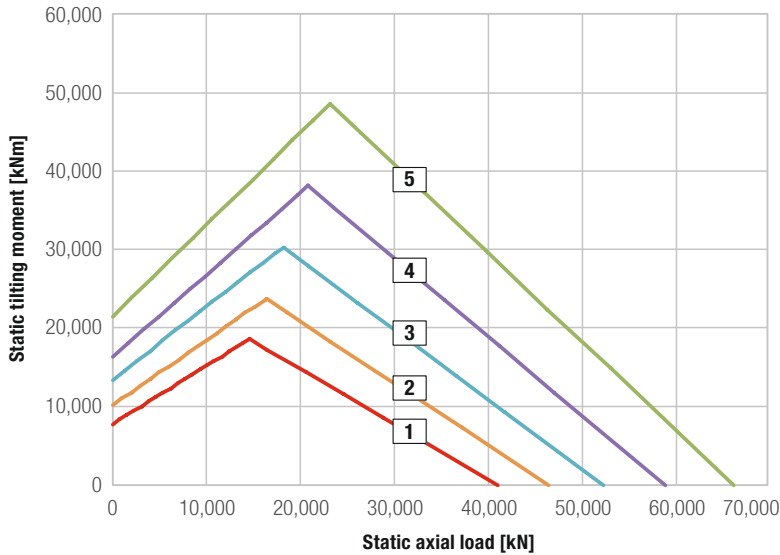
Internal gear ROD_32_DJ



- 1 ROD02240-032DJ15-900-000
- 2 ROD02500-032DJ15-900-000
- 3 ROD02800-032DJ15-900-000
- 4 ROD03150-032DJ15-900-000
- 5 ROD03550-032DJ15-900-000
- 6 ROD04000-032DJ15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da [mm]	Di [mm]	H [mm]	O [mm]	U [mm]	H1 [mm]	H2 [mm]	La [mm]	Li [mm]	n	M [mm]	n1	d [mm]	m [mm]	z	x*m [mm]	k*m [mm]	b [mm]	[kN]	[kN]	C _{stat} [kN]	C _{dyn} [kN]
1	1.980	2.458	1.908	181	2.210	2.199	172	139	2.380	2.085	40	36	8	1.925	18	-107	-9	-	139	217,6	435,2	26.326	3.018
2	2.210	2.718	2.178	181	2.770	2.459	172	139	2.640	2.345	44	36	7	2.196	18	-122	-9	-	139	217,6	435,2	29.414	3.201
3	2.542	3.018	2.460	181	2.770	2.759	172	139	2.940	2.645	48	36	8	2.480	20	-124	-10	-	139	241,7	483,4	32.989	3.402
4	2.807	3.368	2.820	181	3.120	3.109	172	139	3.290	2.995	56	36	7	2.840	20	-142	-10	-	139	241,7	483,4	37.214	3.627
5	3.302	3.868	3.190	181	3.520	3.509	172	139	3.690	3.395	66	36	8	3.212	22	-146	-11	-	139	265,9	531,8	41.927	3.863
6	3.664	4.218	3.652	181	3.970	3.959	172	139	4.140	3.845	72	36	9	3.674	22	-167	-11	-	139	265,9	531,8	47.127	4.106

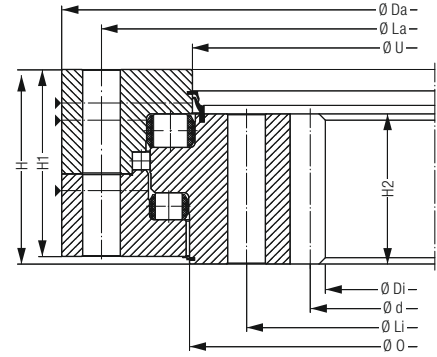
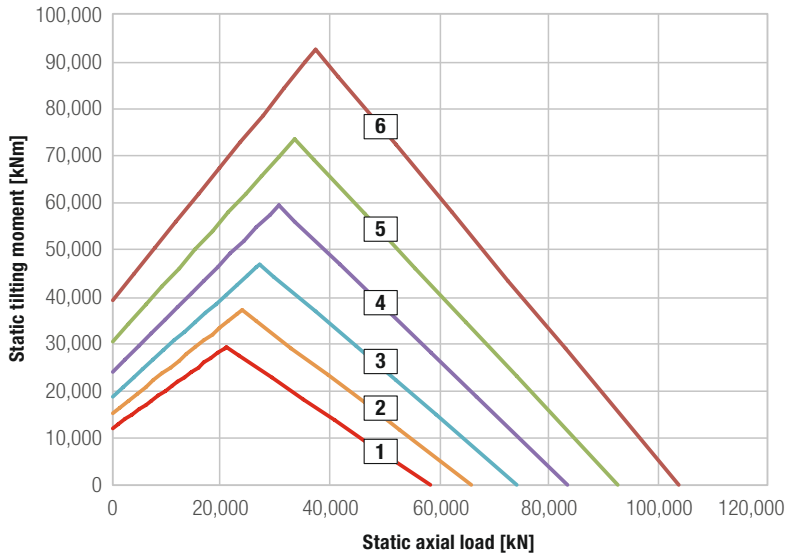
Internal gear ROD_40_DJ



- 1 ROD02800-040DJ15-900-000
- 2 ROD03150-040DJ15-900-000
- 3 ROD03550-040DJ15-900-000
- 4 ROD04000-040DJ15-900-000
- 5 ROD04500-040DJ15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da [mm]	Di [mm]	H [mm]	O [mm]	U [mm]	H1 [mm]	H2 [mm]	La [mm]	Li [mm]	n	M [mm]	n1	d [mm]	m [mm]	z	x*m [mm]	k*m [mm]	b [mm]	[kN]	[kN]	C _{stat} [kN]	C _{dyn} [kN]
1	3,213	3,038	2,460	220	2,763	2,750	210	170	2,960	2,635	48	36	8	2,480	20	-124	-10	-	170	295.7	591.4	41,245	4,752
2	3,683	3,388	2,794	220	3,113	3,100	210	170	3,310	2,985	56	36	7	2,816	22	-128	-11	-	170	325.2	650.4	46,591	4,880
3	4,171	3,788	3,190	220	3,513	3,500	210	170	3,710	3,385	66	36	8	3,212	22	-146	-11	-	170	325.2	650.4	52,447	5,193
4	4,810	4,238	3,624	220	3,963	3,950	210	170	4,160	3,835	72	36	9	3,648	24	-152	-12	-	170	354.8	709.6	59,066	5,529
5	5,367	4,738	4,128	220	4,463	4,450	210	170	4,660	4,335	84	36	14	4,152	24	-173	-12	-	170	354.8	709.6	66,450	5,884

Internal gear ROD_50_DJ

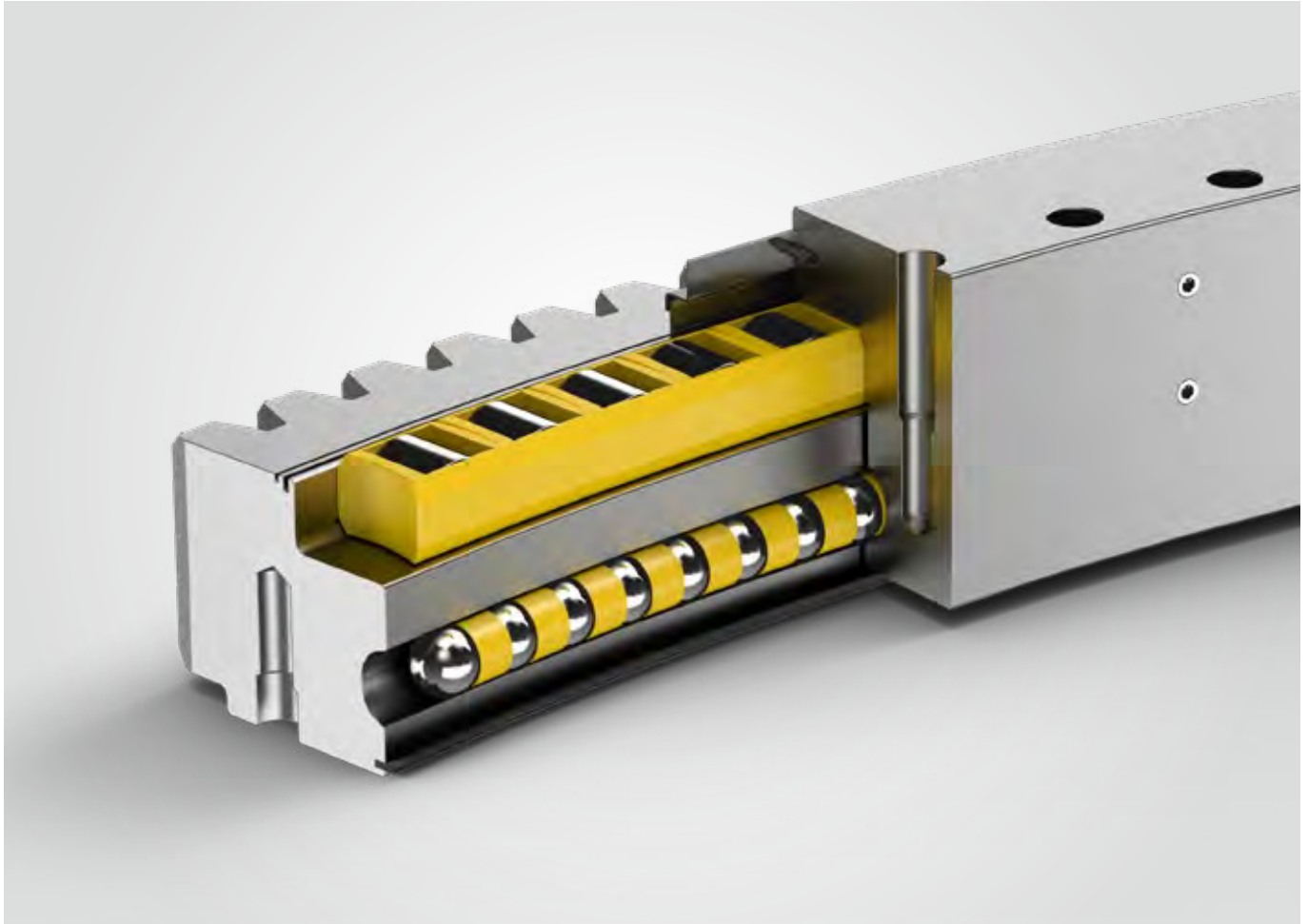


- 1 — ROD03150-050DJ15-900-000
- 2 — ROD03550-050DJ15-900-000
- 3 — ROD04000-050DJ15-900-000
- 4 — ROD04500-050DJ15-900-000
- 5 — ROD05000-050DJ15-900-000
- 6 — ROD05600-050DJ15-900-000

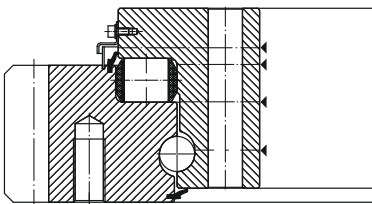
Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da [mm]	Di [mm]	H [mm]	O [mm]	U [mm]	H1 [mm]	H2 [mm]	La [mm]	Li [mm]	n	M [mm]	n1	d [mm]	m [mm]	z	x*m [mm]	k*m [mm]	b [mm]	[kN]	[kN]	C _{stat} [kN]	C _{dyn} [kN]
1	5,128	3,415	2,736	268	3,104	3,090	258	203	3,325	2,950	48	42	8	2,760	24	-115	-12	-	203	423.6	847.2	58,080	6,544
2	5,916	3,815	3,120	268	3,504	3,486	258	203	3,725	3,350	54	42	9	3,144	24	-131	-12	-	203	423.6	847.2	65,638	6,985
3	6,623	4,265	3,576	268	3,954	3,940	258	203	4,175	3,800	60	42	10	3,600	24	-150	-12	-	203	423.6	847.2	73,992	7,442
4	7,427	4,765	4,080	268	4,454	4,440	258	203	4,675	4,300	68	42	11	4,104	24	-171	-12	-	203	423.6	847.2	83,142	7,912
5	8,182	5,265	4,584	268	4,954	4,940	258	203	5,175	4,800	78	42	13	4,608	24	-192	-12	-	203	423.6	847.2	92,291	8,358
6	9,317	5,865	5,184	268	5,554	5,540	258	203	5,775	5,400	90	42	15	5,208	24	-217	-12	-	203	423.6	847.2	103,430	8,877

Technical data

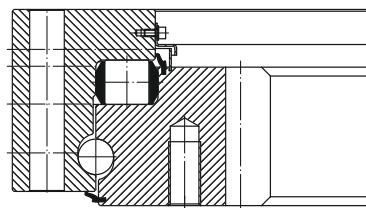
RKD Combined roller and ball bearings



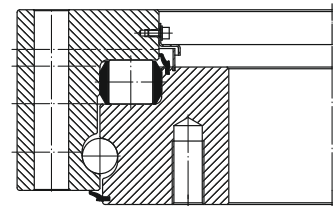
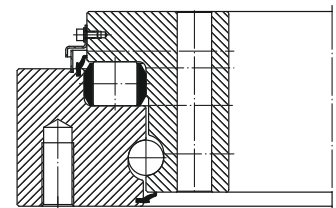
RKD_ZA



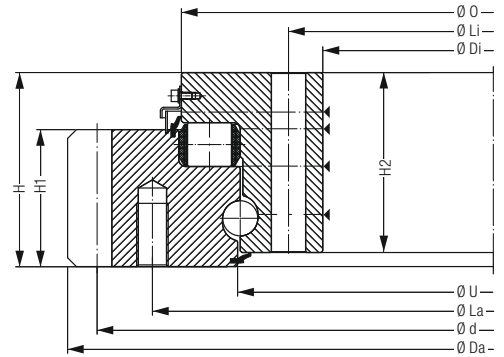
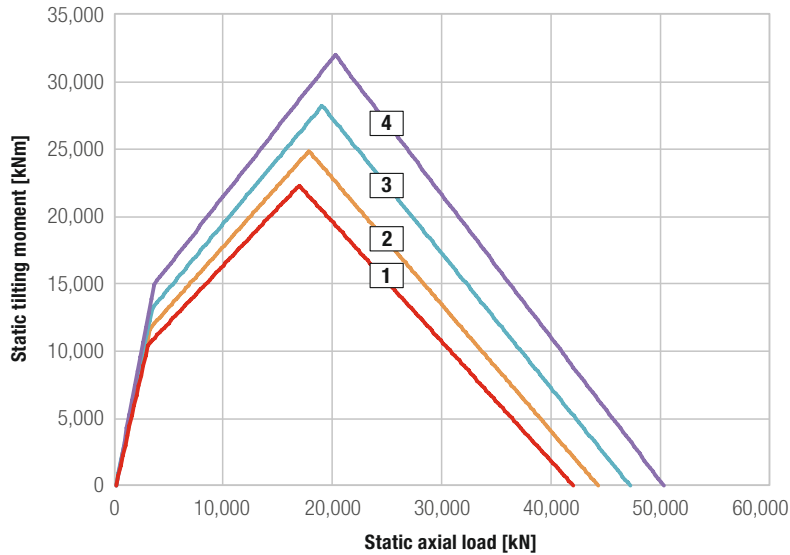
RKD_ZJ



RKD_ZO



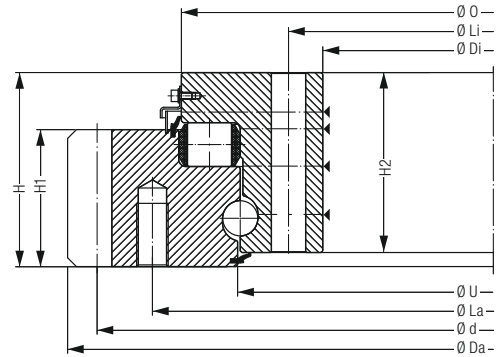
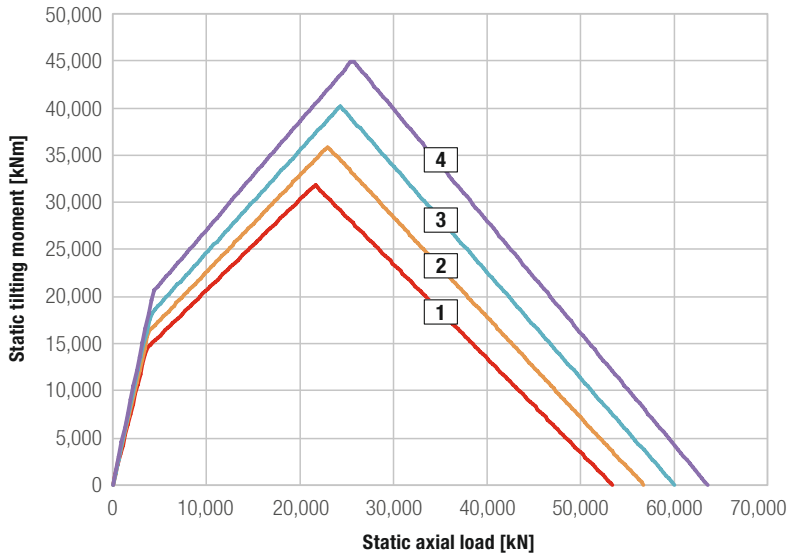
External gear RKD_32_ZA



- 1 — RKD03550-032ZA15-900-000
- 2 — RKD03750-032ZA15-900-000
- 3 — RKD04000-032ZA15-900-000
- 4 — RKD04250-032ZA15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da [mm]	Di [mm]	H [mm]	O [mm]	U [mm]	H1 [mm]	H2 [mm]	La [mm]	Li [mm]	n	M [mm]	n1	d [mm]	m [mm]	z	x*m [mm]	k*m [mm]	b [mm]			C _{stat} [kN]	C _{dyn} [kN]
1	2,028	3,773	3,358	159	3,597	3,509	109	143	3,638	3,418	76	27	10	3,712	16	232	16	-1.6	109	160	320	41,927	3,863
2	2,186	3,981	3,558	159	3,797	3,709	109	143	3,846	3,618	80	27	10	3,936	16	246	8	-1.6	109	160	320	44,202	3,970
3	2,278	4,221	3,808	159	4,047	3,959	109	143	4,086	3,868	84	27	12	4,176	16	261	8	-1.6	109	160	320	47,127	4,106
4	2,455	4,477	4,058	159	4,297	4,209	109	143	4,342	4,118	90	27	12	4,416	16	276	16	-1.6	109	160	320	50,215	4,249

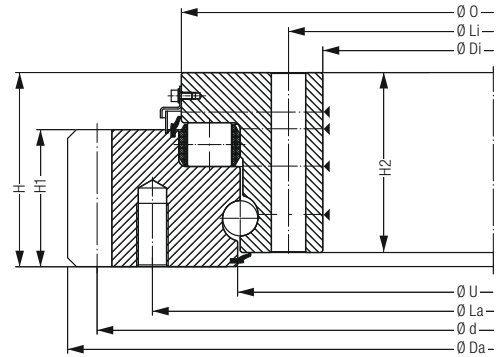
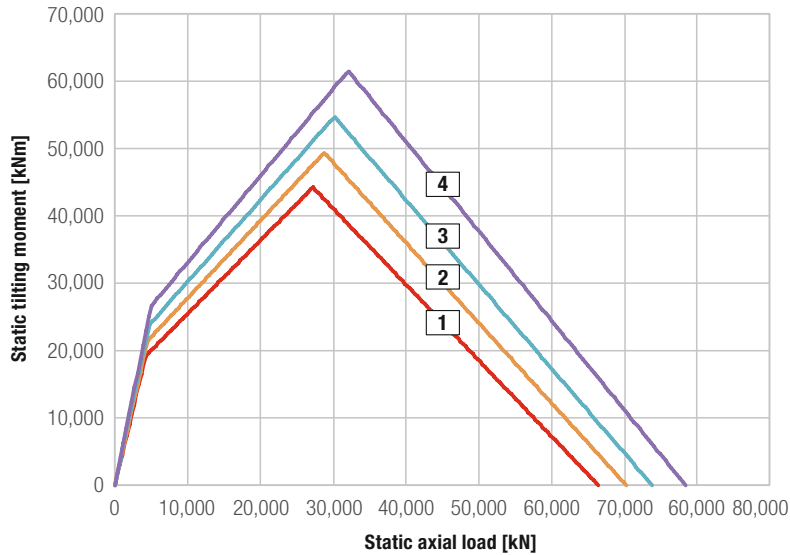
External gear RKD_36_ZA



- 1 — RKD04000-036ZA15-900-000
- 2 — RKD04250-036ZA15-900-000
- 3 — RKD04500-036ZA15-900-000
- 4 — RKD04750-036ZA15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b			C _{stat}	C _{dyn}
1	2,792	4,244	3,792	175	4,051	3,955	125	159	4,095	3,858	76	30	12	4,176	18	232	18	-1.8	125	195.6	391.2	53,457	4,830
2	2,981	4,496	4,042	175	4,301	4,205	125	159	4,347	4,108	80	30	12	4,446	18	247	9	-1.8	125	195.6	391.2	56,772	4,985
3	3,173	4,748	4,292	175	4,551	4,455	125	159	4,599	4,358	84	30	14	4,698	18	261	9	-1.8	125	195.6	391.2	60,087	5,136
4	3,363	5,000	4,542	175	4,801	4,705	125	159	4,851	4,608	90	30	14	4,950	18	275	9	-1.8	125	195.6	391.2	63,610	5,297

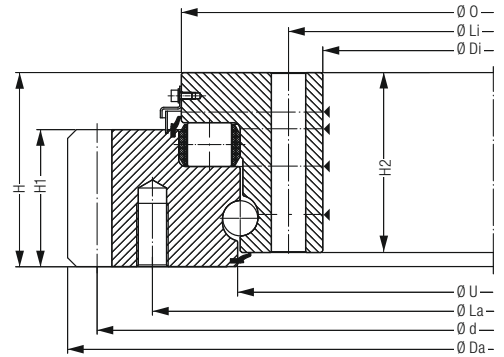
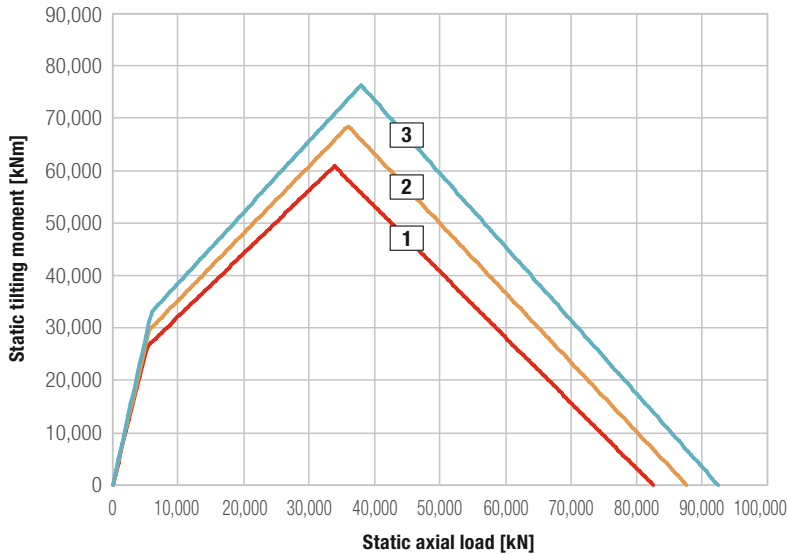
External gear RKD_40_ZA



- 1 — RKD04500-040ZA15-900-000
- 2 — RKD04750-040ZA15-900-000
- 3 — RKD05000-040ZA15-900-000
- 4 — RKD05300-040ZA15-900-000

Bearing type	Bearing data								Bolt data					Gear data								Load rating	
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da [mm]	Di [mm]	H [mm]	O [mm]	U [mm]	H1 [mm]	H2 [mm]	La [mm]	Li [mm]	n	M [mm]	n1	d [mm]	m [mm]	z	x*m [mm]	k*m [mm]	b [mm]	[kN]	[kN]	C _{stat} [kN]	C _{dyn} [kN]
1	3,673	4,776	4,276	183	4,556	4,450	133	167	4,612	4,348	72	33	14	4,720	20	236	10	-2	133	231.3	462.6	66,450	5,884
2	3,796	5,016	4,526	183	4,806	4,700	133	167	4,852	4,598	76	33	14	4,960	20	248	10	-2	133	231.3	462.6	70,269	6,062
3	4,082	5,276	4,776	183	5,056	4,950	133	167	5,112	4,848	80	33	16	5,220	20	261	10	-2	133	231.3	462.6	73,833	6,220
4	4,329	5,576	5,076	183	5,356	5,250	133	167	5,412	5,148	84	33	16	5,520	20	276	10	-2	133	231.3	462.6	78,416	6,424

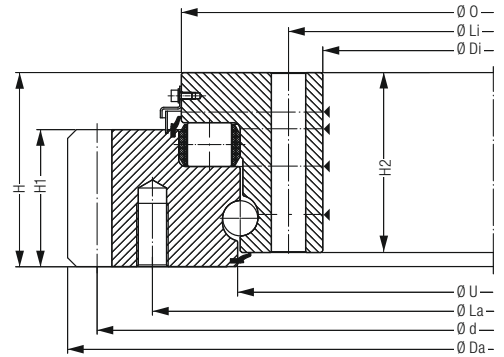
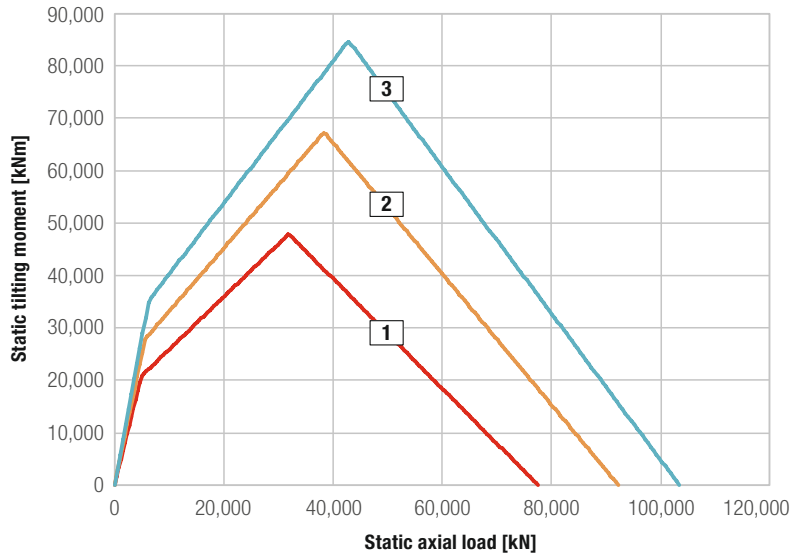
External gear RKD_45_ZA



- 1 — RKD05000-045ZA15-900-000
- 2 — RKD05300-045ZA15-900-000
- 3 — RKD05600-045ZA15-900-000

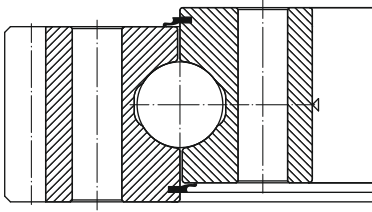
Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da [mm]	Di [mm]	H [mm]	O [mm]	U [mm]	H1 [mm]	H2 [mm]	La [mm]	Li [mm]	n	M [mm]	n1	d [mm]	m [mm]	z	x*m [mm]	k*m [mm]	b [mm]	[kN]	[kN]	C _{stat} [kN]	C _{dyn} [kN]
1	5,201	5,297.6	4,747	203	5,063	4,945	153	187	5,117	4,825	76	36	16	5,236	22	238	11	-2.2	153	292.6	585.2	82,544	7,339
2	5,602	5,605.6	5,047	203	5,363	5,245	153	187	5,425	5,125	80	36	16	5,544	22	252	11	-2.2	153	292.6	585.2	87,663	7,563
3	5,764	5,891.6	5,347	203	5,663	5,545	153	187	5,711	5,425	84	36	18	5,830	22	265	11	-2.2	153	292.6	585.2	92,462	7,781

External gear RKD_50_ZA



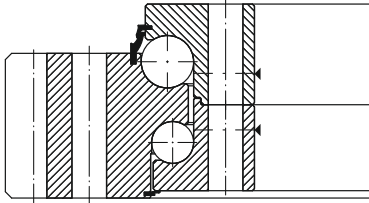
- 1 — RKD04200-050ZA15-900-000
- 2 — RKD05000-050ZA15-900-000
- 3 — RKD05600-050ZA15-900-000

Bearing type	Bearing data								Bolt data					Gear data							Load rating		
	Weight	Outer diameter	Inner diameter	Total height	Outer diameter Inner ring	Inner diameter Outer ring	Height Outer ring	Height Inner ring	Pitch circle diameter Outer ring	Pitch circle diameter Inner ring	Number of bores per ring	Bolt diameter	Number of grease nipples per level	Pitch circle diameter	Module (metric)	Number of teeth	Profile shift	Tip reduction	Tooth width	Tooth forces (standard)	Tooth forces (maximum)	static	dynamic
	[kg]	Da	Di	H	O	U	H1	H2	La	Li	n	M	n1	d	m	z	x*m	k*m	b			C _{stat}	C _{dyn}
1	4,798	4,531.2	3,942	221	4,268	4,140	156	205	4,330	4,020	72	36	12	4,464	24	286	12	-2.4	156	325.5	651	77,572	7,627
2	5,711	5,323.2	4,742	221	5,068	4,940	156	205	5,130	4,820	80	36	16	5,256	24	219	12	-2.4	156	325.5	651	92,291	8,358
3	6,397	5,923.2	5,342	221	5,668	5,540	156	205	5,730	5,420	90	36	18	5,856	24	244	12	-2.4	156	325.5	651	103,430	8,877



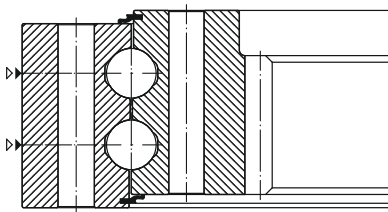
KUD_V

Ball bearings; four-point contact



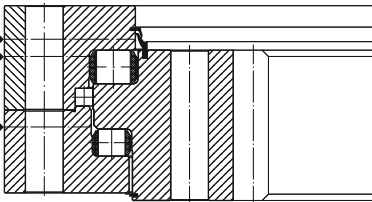
KUD_Z

Double-row ball bearings



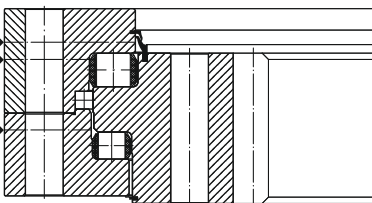
KUD_W

Double-row ball bearings;
four-point contact



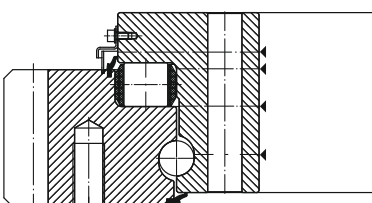
ROD_D

Triple-row roller bearings*



ROD_D

Triple-row roller bearings



RKD

Combined roller
and ball bearings

- Klapper-
Verkürzte Seite

Liebherr Components



Gas engines



Diesel engines



Fuel injection systems



Axial piston hydraulics



Hydraulic cylinders



Slewing bearings



Gearboxes and winches



Electric machines



Remanufacturing



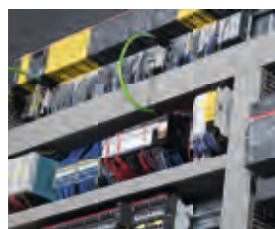
Human-machine interfaces and gateways



Control electronics and sensor technology



Power electronics



Control cabinets



Software

From A to Z – the components division of the Liebherr Group offers a broad range of solutions in the area of mechanical, hydraulic, electric and electronic drive system and control technology. The efficient components and systems are produced at a total of ten production sites around the world to the highest standards of quality. Central contact persons for all product lines are available to our customers at Liebherr-

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