RKB
BEARING INDUSTRIES

BEARINGS
PRODUCTION RANGE

No. BPR2010-A

RKB BEARING INDUSTRIES **Bearings Production Range**

Introduction

RKB is an international manufacturing organization operating in the bearing industry with headquarters in Switzerland. The experience gained over the years has allowed us to achieve outstanding performances, particularly in the production of technological bearings for heavy duty machineries and equipments, where we are recognized by both OEM and MRO/end-users as a preferential supplier within the top world-class manufacturers.

Nowadays the direct operations of our Group mainly concern Switzerland, Ireland, China, Italy, Japan, The Netherlands, Belgium, Vietnam and Mexico, with a worldwide distribution network and exports to more than 50 Countries.

We primarily specialize in three product segments: miniature and small size high precision bearings (T1 Segment up to 35 mm inner bore), general standardized antifriction bearings (T2 Segment up to 1800 mm outside diameter), and bearings and assemblies for heavy engineering applications (T3 Segment that also includes AOB - Application Optimized Bearings).

Today RKB total facilities assets exceed 88500 sqm, with monthly capacity up to 350 tons of production.

Thanks to our pioneer business model, based on a vertically integrated organization from raw material provision to after-sale service, we offer reliable cost-effective solutions in the long-run, with extreme flexibility and leading-edge service. In particular, our technology, know-how, expertise, engineering and R&D, with fully equipped laboratories and the Advanced Software Engineering Unit for mechanical design, permit us to provide technical value-added products, guaranteeing the reliability and sustainability proper of a consistent premium-class bearing source.

Our approach is opposite to the one pursued by the other major players that assign their own production on an item-by-item, plant-by-plant basis worldwide. RKB system is based on the concept of Single Universal Organization (SUO) in order to be more competitive in terms of quality, price and delivery. Moreover, our capital intensive strategic stock, among the largest in Europe, operated by RKB's registered and patent pending advanced software (RKB ASSM - Active Strategic Stock Management), enables us to offer core competitive advantages through drastically reduced time-to-market and full-scale global presence.

All RKB bearings are manufactured in conformity with the International Standards in our plants that are ISO 9001 and ISO 14001 certified, and audited and approved by several key-clients and independent bearing examination centers.

At RKB, we are aware that consistency is at the base of bearings reliability, and that our bearings reliability becomes a crucial part of our customers' reputation.

For all these reasons, as studied and analyzed in a 2004 working paper by the Tokyo Institute of Technology (University of Tokyo) and the Switzerland Economy Business School (USI), "RKB is the Real Alternative to the Big Marks".

This catalogue introduces RKB's overall capabilities and its main production range, with special attention to bearings for heavy engineering applications. With respect to materials, design, manufacturing methods and technological developments, RKB reserves the right to make continuous improvements in its products.

Contents

Deep groove ball bearings

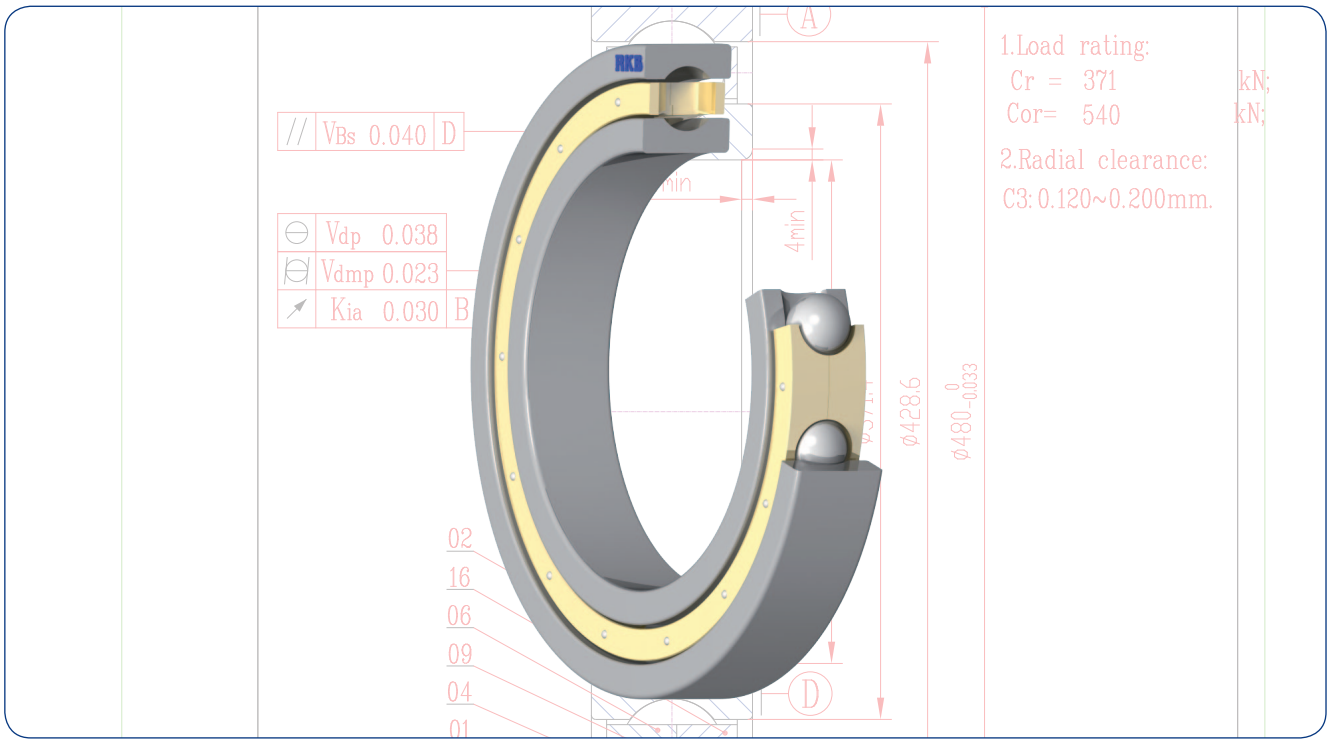
Non-separable, for operations at high speeds, of simple design and little maintenance, RKB deep groove ball bearings are the most versatile and popular bearings in rolling applications.

The internal designs are the Conrad assembly (the majority of the production) and the filling slot assembly (for special applications with cage or with full ball complement).
The single row deep groove ball bearings can take radial and double direction axial loads.
They have limited abilities to compensate for errors of misalignment. Because of the values, in order to avoid inadmissible high additional loads and noise increase as a result of complex relationships among several influencing factors, the permissible misalignments are considered those between 2 to 10 minutes of arc depending on the bearing series.

The basic design of RKB deep groove ball bearings is open type either with boundary metric dimensions in accordance with ISO 15:1988 or with inch dimensions as per American AFBMA specifications.
The version with a snap ring groove on the outer ring (suffix N) for the easy axial location in the housing is in accordance with ISO 464.

When required by the application, these ball bearings are also produced in the sealed and shielded versions that have the seal recesses in the outer rings (suffix 2RS and ZZ). In case of bearings with shields, there is a small interstice between the shield and the rib of the inner ring; in case of bearings with seals, the oil resistant elastic rubber lip runs on the groove on the side of the inner ring or directly on the outside surface of the inner ring.
Bearings sealed and shielded on both sides manufactured in series are delivered filled with normal lithium base grease of consistency NLGI 2 or with special grease suitable for specific applications.
Bearings with shields have been designed first of all for those cases where the inner ring rotates.

RKB single row deep groove ball bearings are produced as standard to normal tolerances P0. Higher precision bearings in accordance with ISO 492:2002 can be considered.
The radial clearance, according to ISO 5753, can be normal or in different classes as per international specifications.



The axial clearance is generally not standardized and depends on the values of the radial clearance, ball size and raceway radius.

The cage depends on the bearing series and size; RKB single row deep groove ball bearings are supplied with one of the following designs: ribbon type cage of steel or brass sheet, riveted type of steel or brass sheet and machined brass type centered on balls, inner ring or outer ring.

Large size bearings are also available in special executions such as lubrication grooves in the guiding surfaces of machined brass cage (suffix MAS or MBS) and/or one notch in the outer ring side face to prevent ring from rotating (suffix N1).

Non ISO standard dimensions (including special part numbers) can be manufactured on request.

Highlights

Part number:	6236 MP63A
Bore:	180 mm
Outside diameter:	320 mm
Width:	52 mm
Mass:	18,9 kg
Dynamic load carrying capacity:	225 kN
Static load carrying capacity:	238 kN
Application:	Traction Motors

Single row angular contact ball bearings

RKB single row angular contact ball bearings are designed to accommodate combined loads acting in radial and axial direction. They can take axial loads in one direction only.
When radially loaded, in the bearing occurs an axially acting load which has to be compensated. For this reason one bearing or paired bearings are mounted on each shaft end.
These bearings are not separable and their use at relatively high speed is allowed.
Manufactured in various constructive versions, they can be with different contact angles, depending on the application (suffix AC, A and B).

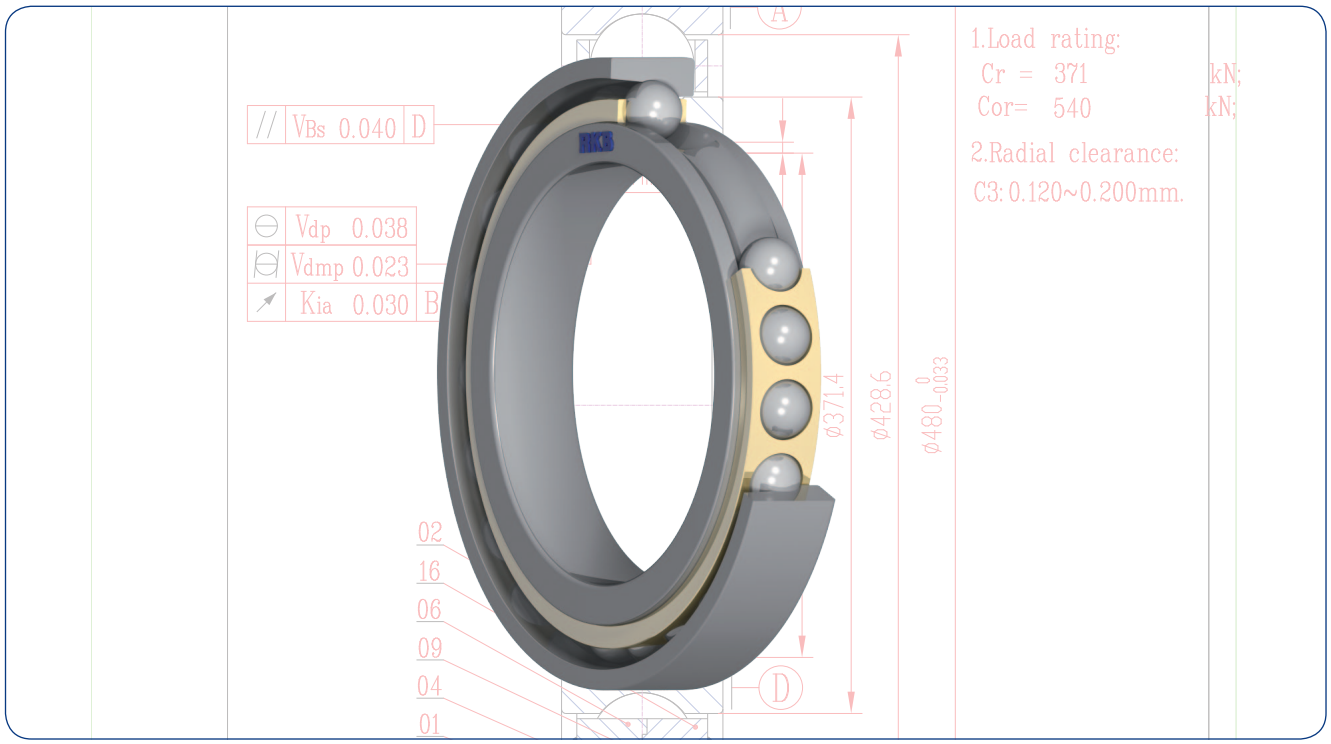
RKB produces two types of single row angular contact ball bearings: those of normal design and those intended for paired mounting (used respectively for tandem arrangement, DB and DF arrangements when axial loads have to be taken in both directions).

In the case of single row angular contact ball bearings the efforts between rings and rolling elements are transmitted at an angle to a plane perpendicular to the bearing axis. The value of this angle depends on the magnitude of the raceway radius, ball diameter and radial clearance in the bearing when the curvature centers of the raceway are in the same plane.

The main dimensions are in accordance with ISO/R 15. The values for the tolerance of the normal, P6 and P5 classes conform to ISO 492.
Internal axial clearance or preload is obtained only when the bearings are mounted in the assembly and depends on the location of the second bearing which assures the shaft axial guiding.

RKB single row angular contact ball bearings are fitted with a cage type depending on series and size: pressed steel sheet cage, machined brass cage guided on balls or on the inner ring and machined steel cage.

Large size paired 718 and 719 series bearings in DF and DB configuration for power transmission equipment are included in RKB production program.



FOUR-POINT ANGULAR CONTACT BALL BEARINGS

RKB four-point angular contact ball bearings are single row bearings where the raceway is designed to accommodate significant axial loads in both directions.
Generally they have contact angle of either 35° or 45°.
They need less axial space than double row or paired angular contact ball bearings.
The four-point contact ball bearings have a split two-part inner (bearing designation QJ) or outer (bearing designation Q) ring, allowing a large number of balls to be incorporated, thus providing a high load carrying capacity.
The bearings are of separable design of the parts.

To prevent rotation of the outer ring (when split inner ring) all the bearings with outside diameter over 160 mm are provided with locating slots (suffix N).

The main boundary dimensions are in accordance to ISO 15.
The tolerances have values conform to ISO 492 and the normal class is for RKB standard production.
The fitted cage is machined brass centered on outer ring for the standard common type QJ with split inner ring.
RKB produces these bearings with normal axial internal clearance measured before mounting under zero measuring loads, but most sizes can also be supplied with greater or smaller clearance to special order.

Highlights

Part number:	719/600 AMBP6DFA250-300
Bore:	600 mm
Outside diameter:	800 mm
Width:	180 mm
Mass:	250 kg
Dynamic load carrying capacity:	1170 kN
Static load carrying capacity:	3450 kN
Application:	Steel Industry

Double row angular contact ball bearings

RKB double row angular contact ball bearings are equivalent to two single row paired angular contact ball bearings in the arrangement back-to-back or face-to-face. So they can accept radial loads together with axial loads acting in both directions.
The width is narrower than the two equivalent single row bearings in pair.

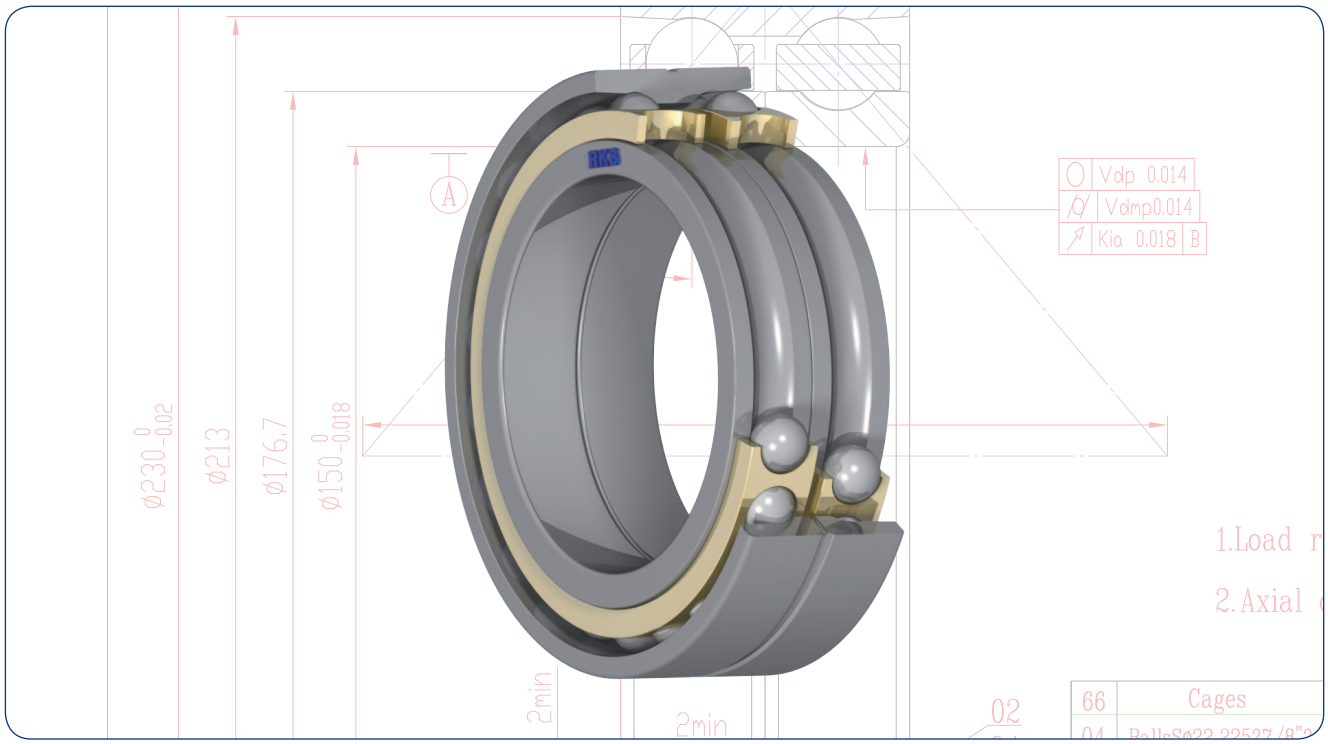
The large double row angular contact ball bearings of RKB production range include bearings specially designed for rolling mills (bearing designation series 305 followed by three numbers).

The standardized items of the series ISO 32 and 33 have the filling slot and are non-separable, thus single direction axial loads should be applied.

The special bearings with drawing number of series 305 can have either split two-part inner ring or split two-part outer ring. They are non-separable and usually are mounted with radial play in the housing.
In the bearings with split two-part inner ring the load lines refer to the back-to-back arrangement.
The load lines of the bearings with split two-part outer ring are in the face-to-face arrangement.

The main dimensions of bearing series 32 and 33 are as per ISO 15 specifications.
The dimensions of bearing series 305 do not follow any standards, but are internationally accepted and recognized in the rolling mill applications.
The manufacturing tolerances conform to ISO 492 for normal class specification, but running accuracy grade is in accordance with P6 at least.
These bearings are generally produced with a uniform axial internal clearance, but special values suitable for specific applications can be supplied on request.

The double row angular contact ball bearings in RKB production program are normally filled with two machined brass cage (one for each ball row).



Highlights

Part number:	305269 DP6
Bore:	280 mm
Outside diameter:	389,5 mm
Width:	92 mm
Mass:	34,1 kg
Dynamic load carrying capacity:	400 kN
Static load carrying capacity:	750 kN
Application:	Rolling Mill Stands/Steel Industry

Cylindrical roller bearings

RKB produces cylindrical roller bearings in various design styles, sizes and dimension series.

RKB heavy duty radial cylindrical roller bearings are designed to provide the highest possible radial capacity for the given cross section and to perform under heavy radial loads. These bearings incorporate improved internal proportions developed through computer assisted optimization studies, to make the maximum use of the total available cross-sectional area. The rollers have controlled contour to redistribute end stress concentration and provide more uniform distribution of the applied loads (suffix ZB). Their surface finishing maximizes lubricant film formation and optimizes rolling motion.

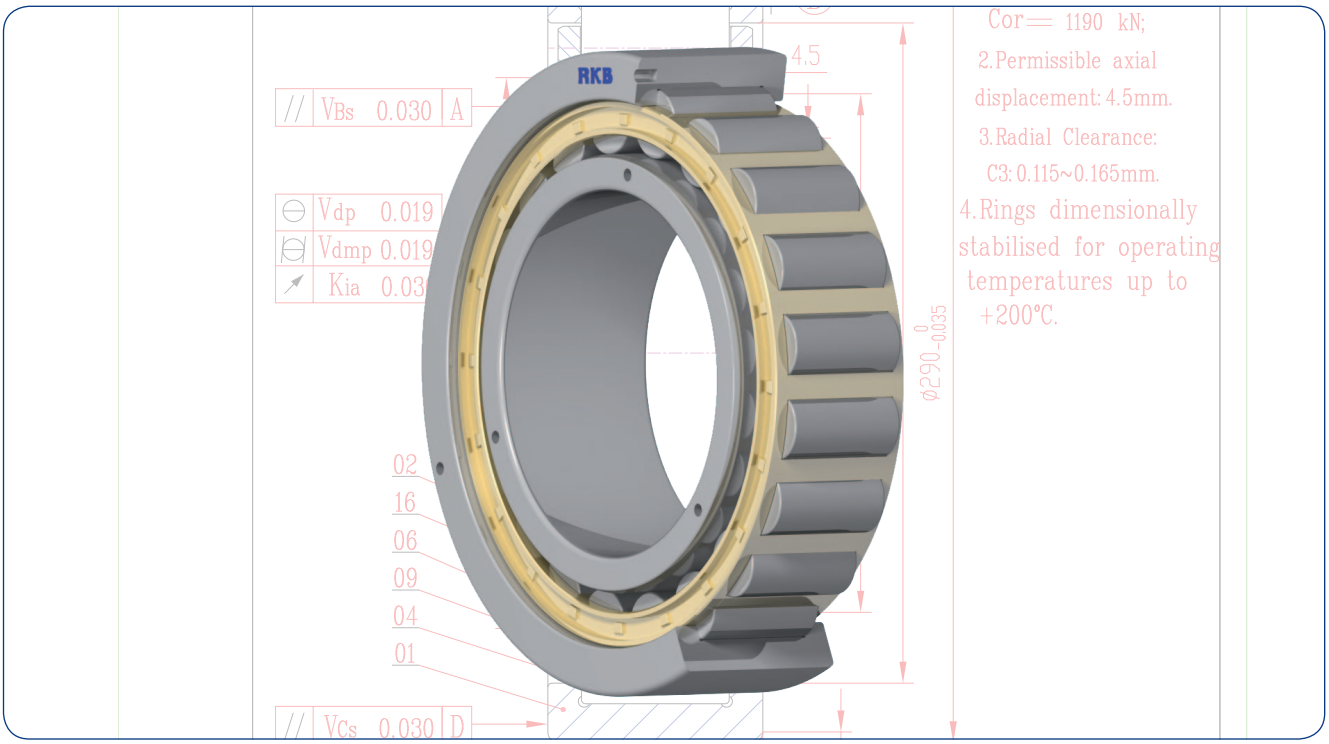
The standard ISO assortment of RKB production program includes single and double row bearings with a cage that can accommodate heavy radial loads and operation at high speeds.

A complete range in various executions of full complement of rollers suitable for more heavy loads at moderate speeds is also available.
Large size bearings can be supplied with surface treated rollers (suffix B).

In addition to the standard assortment, RKB cylindrical roller bearing range is comprehensive of open and sealed multi row for rolling mills in many executions and designes, backing bearings for cold rolling mills and indexing roller units for continuous furnace.

Besides to the inch dimension series as per AFBMA specifications, RKB offers the American style series 5200 and 5300 metric cylindrical roller bearings with enhanced radial capacity due to its internal design proportions, with double ribbed outer ring and with manufacturing tolerances established for the interchangeable components.

The single row cylindrical roller bearings are manufactured in various constructive versions, depending on the position of the ribs on the rings (e.g. bearing designation NU, NJ, NUP and N).



Depending on size and design, the bearings are equipped as standard with one of the following cages: unhardened pressed steel roller centered, one-piece window type brass inner or outer ring centered, two-piece machined brass roller centered (suffix M) or outer ring centered (suffix MA) or inner ring centered (suffix MB) and steel pin-type for pierced rollers.
Lubrication grooves in the guiding surfaces of machined brass cages are also available (suffix MAS and MBS).

RKB cylindrical roller bearings undergo a special heat treatment of stress relieving which allows them to be operated up to a temperature of +150° C.

The tolerances are in accordance with ISO 492:2002.
The radial internal clearance, even smaller or greater than normal, is in accordance with the range class of ISO 5793 measured for unmounted bearings under zero measuring loads.
The axial internal clearance for fixed design bearings, which can locate the shaft axially in both directions, is specified as per experienced rule.
Bearings with no standard radial clearance or with special stated values required by specific applications can be supplied to special order.

Bearings made of case hardened carburizing alloy steels can be produced for particular applications, where required (suffix HA1, HA2, HA3 and HA4).
Besides, special treatments for rings and rollers are available (e.g. bainite quenching hardened for rings - suffix HB1 -, anti-wear surface treatment etc.).

Highlights

Part number:	NU 18/900 MASP6ZBS1AVH
Bore:	900 mm
Outside diameter:	1090 mm
Width:	85 mm
Mass:	168 kg
Dynamic load carrying capacity:	2320 kN
Static load carrying capacity:	5950 kN
Application:	Azimuthal Retractable Thruster/Shipyard Industry

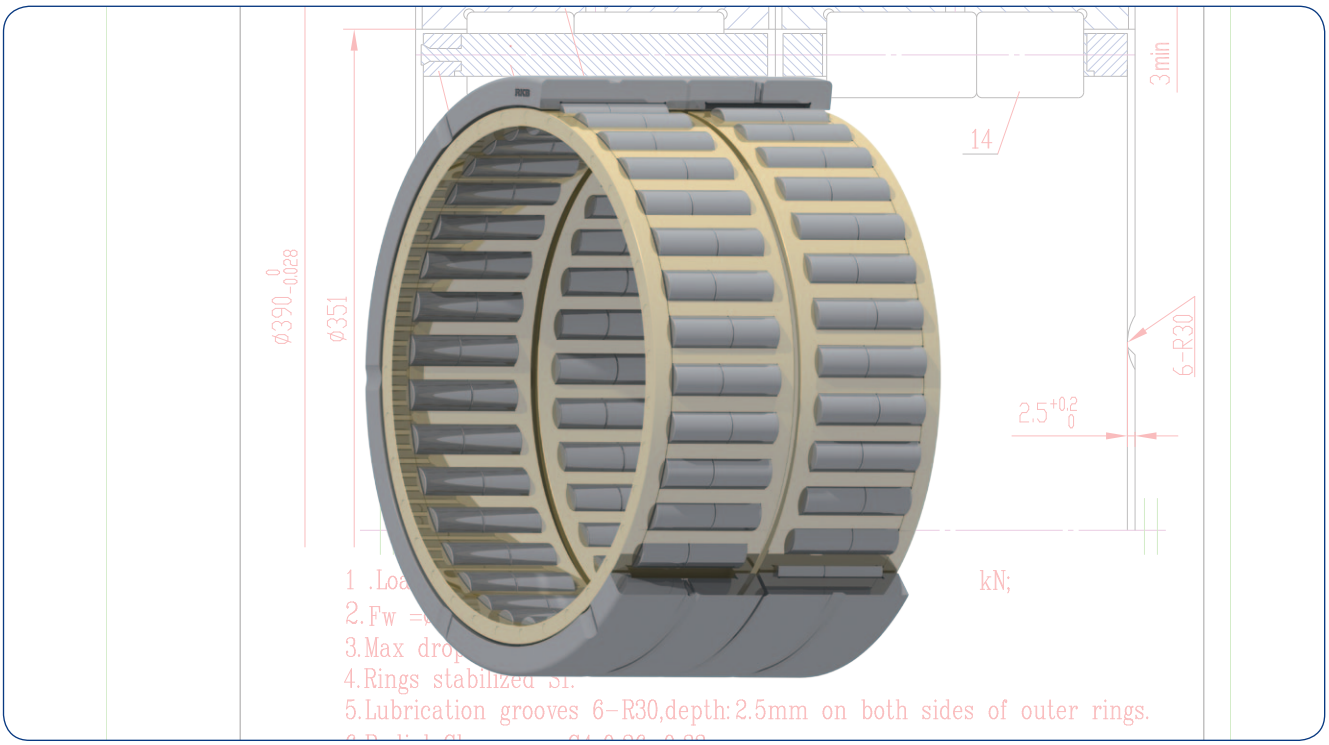
Multi row cylindrical roller bearings

RKB cylindrical roller bearings with four or six rows have low cross section, high load carrying capacity and stiffness, and are particularly used for metal rolling equipment in mills, where the equipment has been scaled down and jet loads remain high.
These bearings are only able to accommodate radial loads, therefore they are mounted together with deep groove or angular contact ball bearings or with taper roller bearings which take up the axial loads. The four-row cylindrical roller bearings are of separable design, which considerably simplifies mounting, maintenance and inspection.

RKB cylindrical roller bearings can tolerate moderate to high shaft speeds. The rollers and outer races are carefully matched to ensure the best load distribution.
Inner rings (designation L) are interchangeable with other assemblies (designation R). Moreover, RKB multi row bearings allow direct interchange with main premium competitor products.
RKB has a flexible manufacturing program of different styles (also special) and sizes for multi row bearings.
They have cylindrical bore and some sizes are also available with tapered bore as required by the application or by maintenance request.

The use of multi row cylindrical roller bearings in metal rolling mills exposes them to very heavy stresses, sometimes to impact loadings. The rings and rollers can be manufactured with very high quality case hardened carburizing alloy steels. Deep case depth and special heat treatment ensure superior size stability, fracture toughness and reliability.

Where the bearings are mounted with a loose fit on the roll neck, RKB multi row cylindrical roller bearings have C2 internal radial clearance and are supplied with a helical groove in the bore and/or lubrication grooves in the side faces of the bearing rings for the efficient lubrication of the mating parts (e.g. suffix AC).



To match the applications in the proper way, RKB produces the multi row cylindrical roller bearings in several construction designs within given geometric series.
The various designs differ basically in the number of inner and outer rings, in the number of loose or integral flanges on the outer ring, in the cage type, in the number of rollers in the cage pocket etc.
Furthermore, on order RKB can produce the four-row cylindrical roller bearings sealed at both sides by radial rubbing seals or with wider inner ring with concentric shoulder.

The boundary dimensions of these bearings are not standardized. However most of them have bore and outside diameter corresponding to ISO 15 series 9 and series 0. They are produced with the normal precision grade for roll neck bearings, which means tolerances conform to class P6 for dimensional and running accuracy with values as per ISO 492.

Highlights

Part number:	313822 GB2DXS1
Bore:	280 mm
Outside diameter:	390 mm
Width:	220 mm
Mass:	88 kg
Dynamic load carrying capacity:	2200 kN
Static load carrying capacity:	4900 kN
Application:	Rolling Mill Stands/Steel Industry

Spherical roller bearings

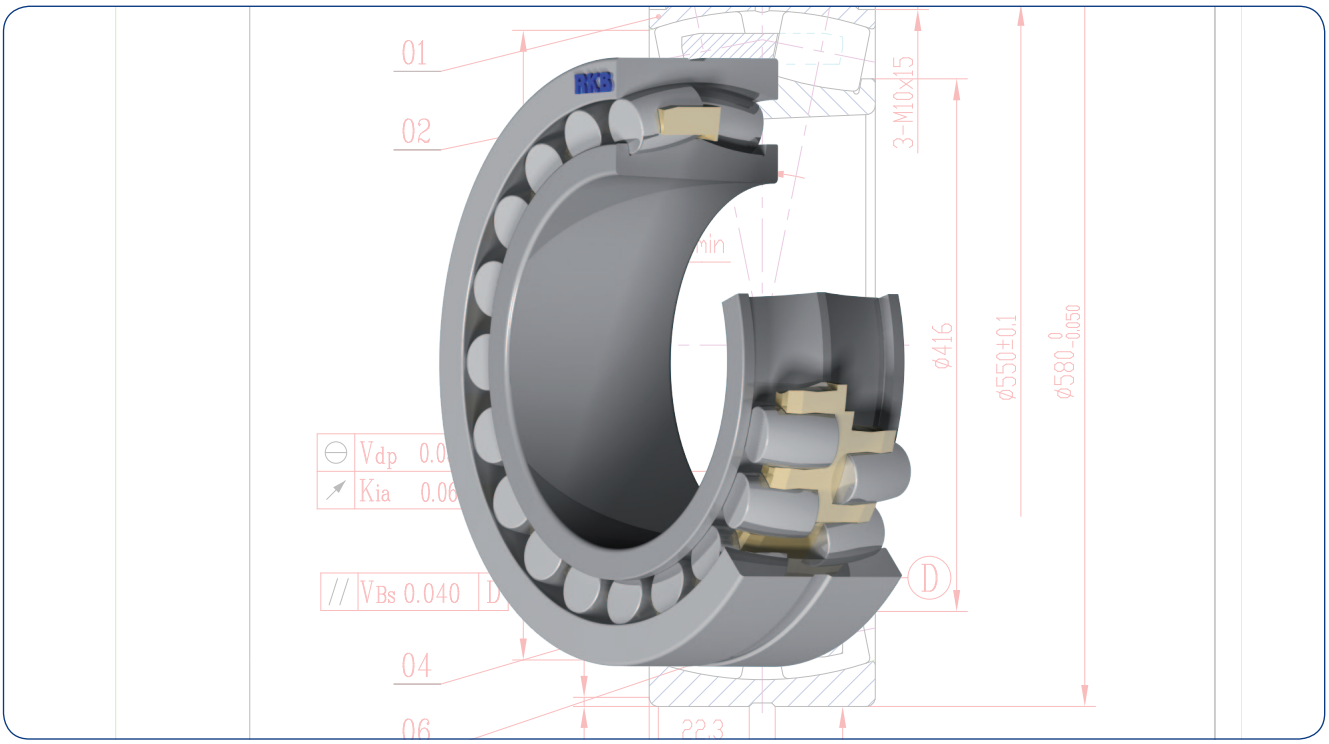
RKB spherical roller bearings are self-aligning and consequently insensitive to the misalignment of the shaft relative to the housing and insensitive to shaft deflection or bending. The permissible value is up to 3.5° approximately depending on bearing series and size.

These bearings have two rows of rollers with sphered raceway in the outer ring and two inner ring raceways inclined at the proper angle to the bearing axis.

Used to operate in arduous conditions, leading in design, RKB spherical roller bearings can accommodate, in addition to high radial loads, axial loads acting in both directions.

The production range of RKB spherical roller bearings comprises open bearings, sealed bearings (suffix 2CZ1) and bearings for vibratory applications (suffix ROVS).
Besides, RKB offers spherical roller bearings customized for specific applications, as, for instance, bearings with split outer ring for higher permissible misalignment (suffix WOR) or with increased width dimension and consequent larger rollers for milling applications (project designation SRB) or for the support of the rolls of cold rolling Pilger mills for tubes.

RKB program includes the spherical roller bearings with both cylindrical and tapered bore (1:12 or 1:30 depending on series). Tapered bore bearings can either be mounted on tapered shaft seats or with sleeve on cylindrical shafts.
Limiting load may result in lubrication problems, specially in the case of large bearings. So such bearings are provided with annular groove and lubrication holes in the outer and/or in the inner ring (suffix W33, W33X, W20, W26 etc.).
Depending on the bearing series, size and/or application, RKB spherical roller bearings are manufactured in different constructive internal design versions (e.g. CA, MB, MF, CC etc.).
RKB small and medium size spherical roller bearings are usually fitted with pressed steel cage or one-piece machined brass cage where the bearings have a central guide rib on the inner ring and symmetrical rollers with large dimensions for increased carrying capacity.
The bearings of normal design, with a central fixed rib, are fitted with machined brass or steel cage guided on the rollers or on the inner ring or outer ring raceway.



The main dimensions are in accordance with ISO 15.
The radial clearance can be normal, larger than normal (suffix C3, C4 and C5) or smaller than normal (suffix C2), measured on unloaded bearing in accordance with ISO 5753.

RKB spherical roller bearings of all series and sizes are stress relieved. They undergo a special heat treatment so that they can be used up to an operating temperature of +150° C for long periods without inadmissible dimensional changes occurring.

Some of RKB spherical roller bearings are also manufactured in the sealed version with contact seal on both sides. The seals are reinforced with steel sheet and made of an oil and wear resistant rubber (as nitrile butadiene for universal usage - suffix 2CZ1 - or fluoro base - suffix 2CZ - to withstand operating temperature up to about +200° C).

In order to locate the spherical roller bearings with the tapered bore onto a cylindrical seating, the adapter (designation H) or withdrawal (designation AH) sleeves are the most commonly used components with large shafts with h9 and h10 tolerance. They are easy-to-mount on smooth or stepped shafts and require no additional location.
Adapter sleeves are supplied along with lock nut and locking device (washer or clip).
For large sized bearings, both adapter and withdrawal sleeves are provided with oil grooves and oil duct at the threaded side to enable the oil injection method to be used for easy mounting and dismounting (designation OH and AOH).

All ISO series (also the outmoded series, such as 202 and 203) are in RKB manufacturing program with both straight bore (no suffix) and tapered bore (suffix K).

Highlights

Part number:	232/750 KCAC3W33XS1
Bore:	750 mm
Outside diameter:	1360 mm
Width:	475 mm
Mass:	2956 kg
Dynamic load carrying capacity:	19000 kN
Static load carrying capacity:	36000 kN
Application:	Mines and Minerals Industry

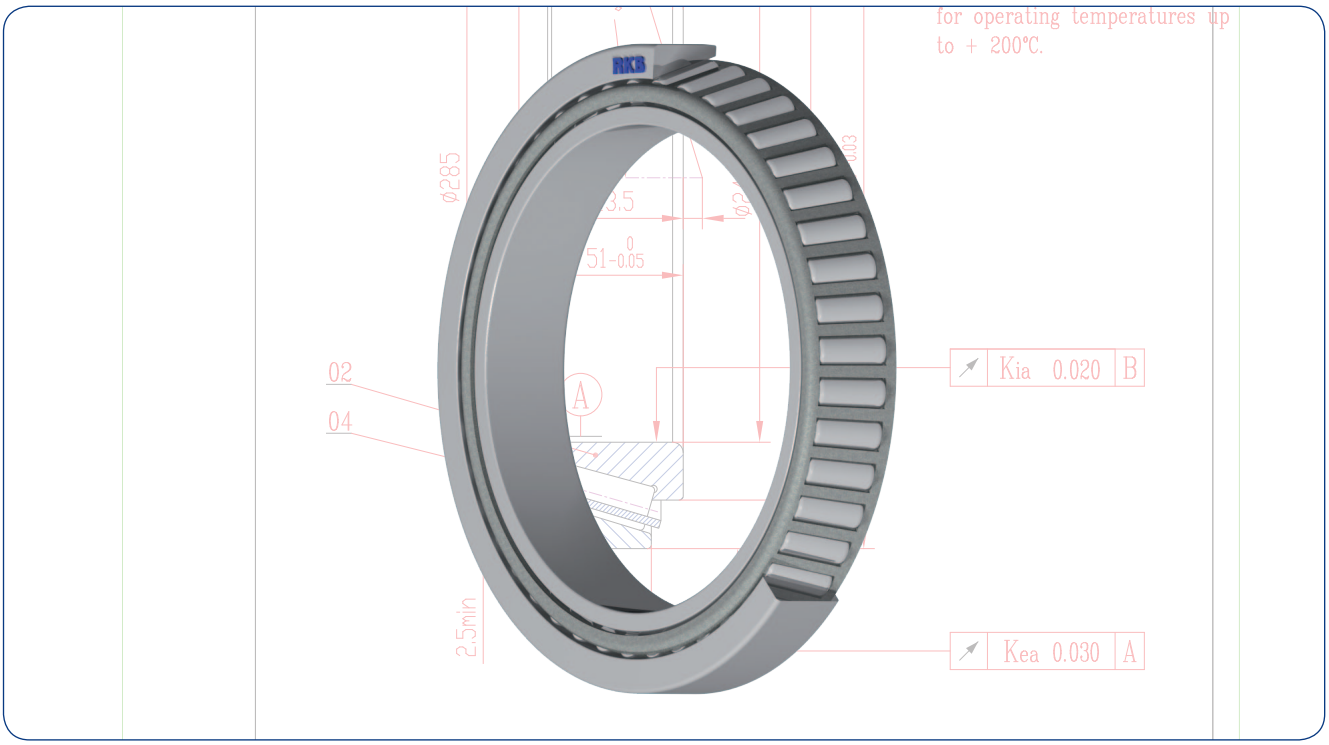
Single row taper roller bearings and matched paired sets

RKB taper roller bearings have the rolling elements under the form of frustum of cone. They roll on tapered surface which, if extended, converges towards a single point on the bearing axis.
The rollers are guided tangentially by the cage and axially by the big rib of the inner ring, on which they have contact. As between rollers and raceways there is linear contact, they can take heavy radial loads. They can also take heavy axial or combined loads, depending on the contact angle caused by the tapered elements.
The contact angle is the one of the outer raceway generatrix.

The single row taper roller bearings are of separable design, which means the outer ring/cup and the inner ring/cone with rollers and cage assembly can be separately mounted. The two parts are interchangeable.
RKB taper roller bearings are manufactured both in standardized (metric and inch sizes) and in non-standardized constructive version.

The metric single bearings have standardized dimensions as listed in ISO 355:1977 and those designated with prefix J conform to American AFBMA 19.1/1987.
The inch size bearings conform to American AFBMA 19/1974.

The taper roller bearings can carry only single direction axial loads. Under pure radial loads, an axial force is induced within the bearings so that they cannot be used singly and a second bearing is required.
A correct operational clearance or preload has to be identified for the correct performance and reliability of the application.
RKB taper roller bearings have pressed steel cage as standard. For large size and/or heavy engineering applications, the steel pin-type cage and case hardened carburizing alloy steels can be considered.
RKB single row taper roller bearings can also be produced with a rib on the outer cup as a flange to be used when the housing cannot be manufactured with shoulder, but only with a passed through hole so that, in this case, axial location can be provided by the bearing cup.



When the load carrying capacity of a single row is inadequate or where the load has to be located in both directions, RKB produces the single row taper roller bearings as ready-to-mount matched pairs.

The matched pairs, generally metric sized, in "O" back-to-back (designation DB) or "X" face-to-face (designation DF) arrangements, locate the shaft in both axial directions and the optimum axial play in the two bearings is adjusted and guaranteed after mounting.
In case of taper roller bearings, clearance should be in radial direction, but it is measured and adjusted in axial direction.

RKB paired matching sets are made to normal and CLN class tolerances as standard corresponding to ISO 492:1986.
The tolerances of the total width of the pair are not standardized, but an international common specification is applied.

The matched pairs of taper roller bearings incorporate pressed steel cages guided on rollers.

Highlights

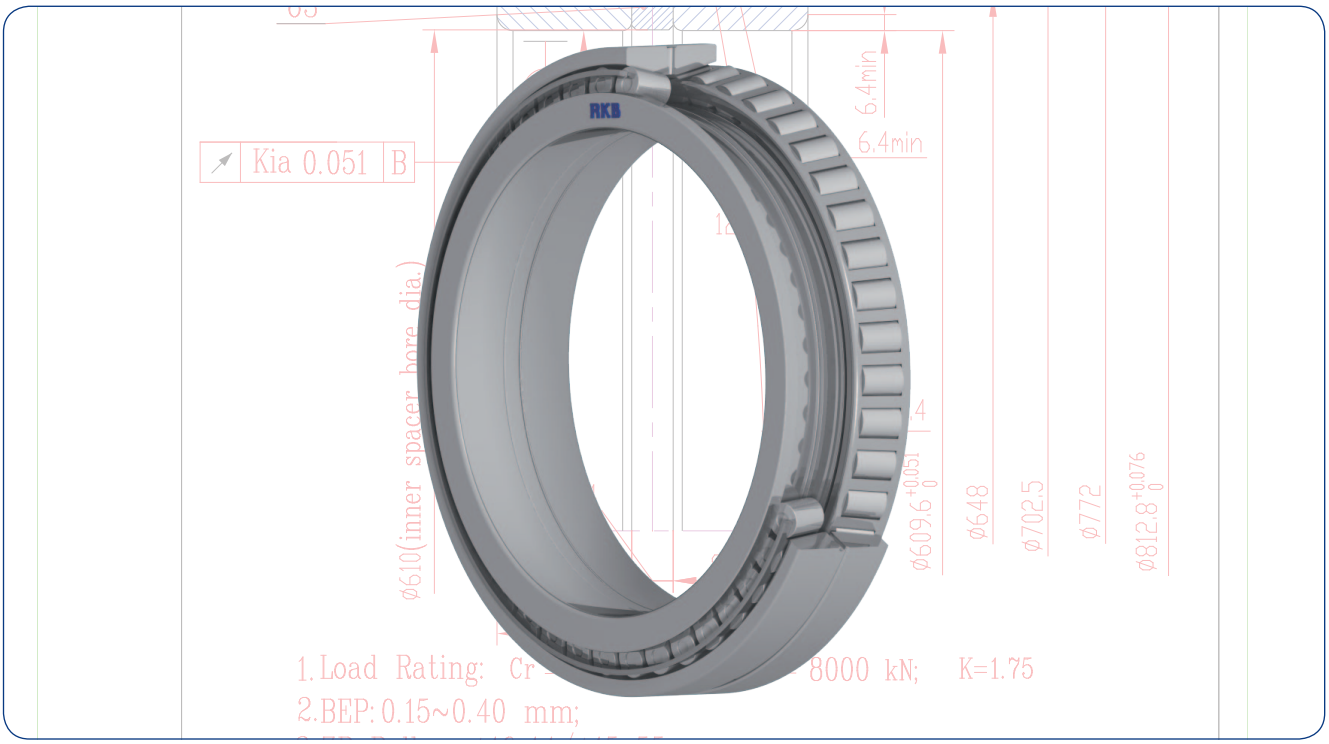
Part number:	LL 788349/310 HA1ZB
Bore:	1066,800 mm
Outside diameter:	1219,200 mm
Width:	65,088 mm
Mass:	106,5 kg
Dynamic load carrying capacity:	1550 kN
Static load carrying capacity:	4800 kN
Application:	Power Transmission Equipment for the Maltese Falcon Sailing Yacht (Dynarig Concept)

Double row taper roller bearings

RKB double row taper roller bearings can take up heavy loads and are stiff.
Suitable for combined radial and axial loads, they locate axially the shaft in both directions with the stated axial end play (also defined as BEP - Bench End Play) or given preload.
The basic styles are two-row converging TDI configuration and two-row diverging TDO configuration.

Rings and rollers are made of high chrome through hardening steels or case hardened carburizing alloy steels depending on the application.
Cages for RKB double row taper roller bearings are stamped pressed steel. A steel pin-type cage, which allows a larger complement of rollers for higher capacity, is also available.
This style of bearing set simplifies design and reduces the danger of bearing clearance changes due to axial shaft expansion.
It is important the definition of the proper internal play related to the application.

RKB bearings in TDI configuration have a double cone assembly and two single cups and they are generally supplied with a cup spacer.
The cup spacer of each bearing is face ground after accurate measurement of the distance between adjacent cup faces to obtain a predetermined internal play. Consequently, spacers or components may not be interchanged. An annular groove and lubrication holes are included in the spacer. The contact angle converges, so the use of these bearings will not appreciably increase the rigidity of the shaft mounting.
RKB also produces the taper roller steep contact angle TDIS version with higher thrust capacity (while the radial one is reduced) than the TDI type, normally used as back-up thrust bearings in rolling mills.
These TDIS bearings have combination of face slots (e.g. N, N1, N2 etc.) and bore key-way for locking the cone on the shaft.
Also helical groove in the bore and lubrication grooves in side faces of double cone and/or retention sleeve with annular groove and lubrication holes can be provided.



RKB bearings in TDO configuration have a double cup, two single cone assemblies and can be supplied with a shaft supported cone spacer.
The spacer for individual cones is face ground to obtain the desired internal play for the assembly.
So, also in this case, spacers and components may not be interchanged. An annular groove and oil holes are included in the cone spacer.
The TDO style bearings are mainly used in a floating cup mounting. So the counterbored hole in the cup is for a drilled dowel pin which prevents rotation of the loosely fitted double cup. Additional features of a lubrication groove and oil holes in the double cup for simplified lubrication through the outer ring are included (suffix CD). However, this style of bearings are usually lubricated through the shaft by use of oil holes and a groove in the cone spacer.
In the TDO type the contact angle diverges, so the rigidity of the shaft mounting is increased to resist overturning moments.

Bearing sets with steep contact angle and intermediate ring, pierced rollers and steel pin-type cage (TDOS design), bearing sets with extended inner rings which abut each other (TDONA and TDONASW designs), bearing sets with heavy wall cup (TNASWH design) and bearing sets with shields of pressed steel (TDO 4422 design) are also in RKB manufacturing program.

Most of TDI and TDO double row taper roller bearings are produced with inch dimensions as per American AFBMA 19/1974 and as per RKB standard practice, dimensional and running accuracy grade is in accordance with class 2 or 4.

Highlights

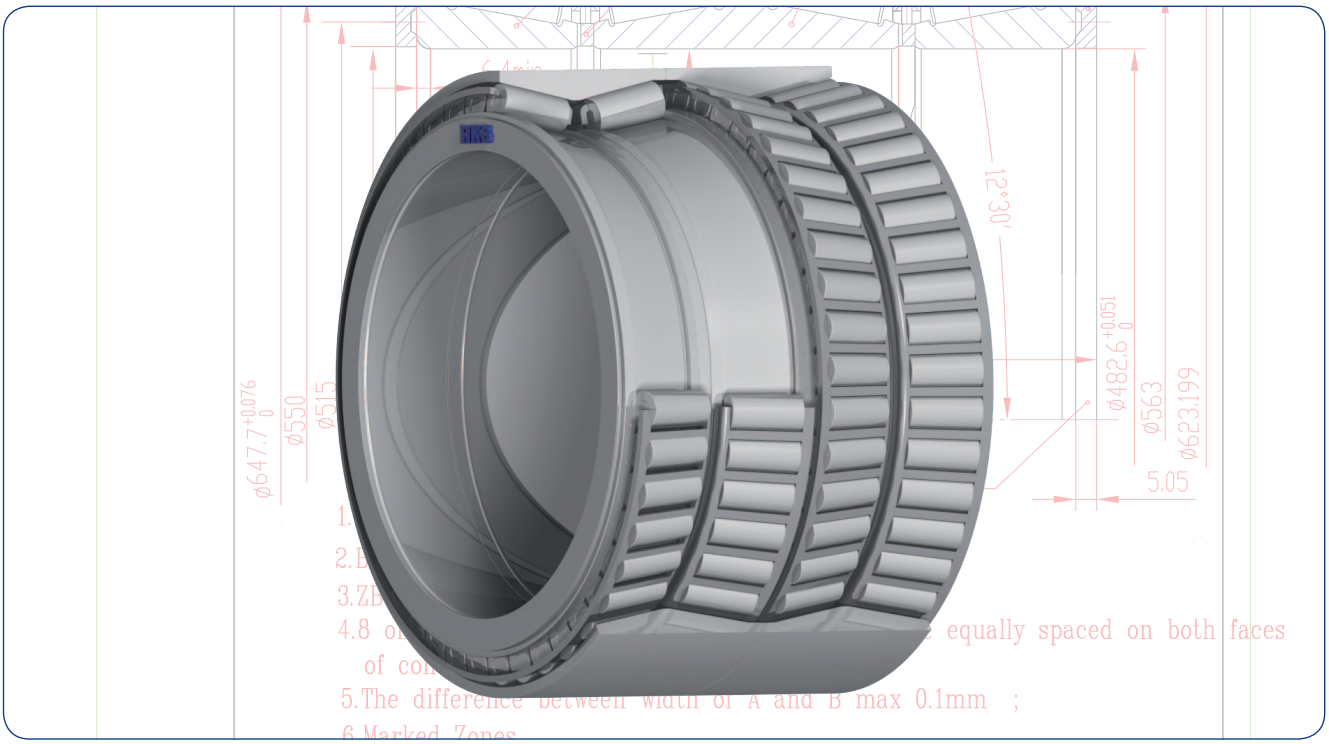
Part number:	TDO 331554 A7HA1ZBBT2B
Bore:	723,900 mm
Outside diameter:	914,400 mm
Width:	187,325 mm
Mass:	267 kg
Dynamic load carrying capacity:	3800 kN
Static load carrying capacity:	9650 kN
Application:	Power Transmission Industry

Four-row taper roller bearings

RKB four-row taper roller bearings are installed as complete assemblies and take axial loads in addition to heavy radial loads, so that generally it is not requested separate thrust bearings in such arrangements. They are commonly used in rolling mill applications.
For quick roll changes, the bearings have a loose fit on the roll necks, but there is the disadvantage that the inner rings wander on their seatings causing wear. To reduce these negative effects, RKB bearings have a helical groove in the bore and lubrication grooves in the side faces of the inner rings. These grooves enable lubricant to be supplied to the contact surfaces of the inner ring and seating.
Since wear and shock resistance under heavy rolling loads is a requirement for roll neck bearings, highest quality carburizing grade bearing alloy steels are normally used in RKB four-row taper roller bearings.
Besides, for large size bearings, pierced rollers and steel pin-type cage for maximum load ratings possible are applied.
The induced thrust resulting from radial loading is cancelled within the double cones and it eliminates excessive loads on clamping and spacing members.

RKB produces this style of bearings in two base designs, TQO and TQI configuration, where the main difference is the mutual arrangement of the roller complements and the number of inner and outer rings dictated by this.

The TQO type is composed in its standard configuration of two double cone assemblies, one central double cup, two single cups and factory adjusted cup and cone spacers.
The spacers of each bearing are face ground after accurate measurement of the distance between adjacent cups and cones to obtain the asked initial play (also defined as BEP - Bench End Play). So the bearing parts cannot be interchanged and they are individually marked for proper assembly.
Lubrication grooves and oil holes are provided in the cup spacers and in the double cup. Furthermore, lubricant slots in the cones side faces and cone spacer permit the lubricant to go through the bearing to the roll neck.
These bearings can be provided with lateral extension of the double cones used as sealing surface. This sealing feature offers better protection against hostile environment.
For high speed rolling mill requirements, the TQO bearing sets may have tapered bore with features of high capacity, compactness and a mounting system that guarantees a positive interference fit on the roll neck.



The TQI type is composed in its standard configuration of one double cone assembly, two single cone assemblies and two double cups.
A four-separated individual single cup configuration is also available. This design facilitates the reworking of the bearing.
These bearings are fitted with pressed steel cage or with pierced rollers and steel pin-type cage. The fact that contact angles diverge makes the bearings well suited to resist to warping and misalignment.
The version with tapered bore that, with its three-cone design, assures easy assembly and disassembly (designation TQIT and TQITE) is also available.

In RKB sealed TQOS type sets, four-row taper roller bearings have been developed to improve the lubrication in service. The incorporation of this type of bearing simplifies design, reduces grease consumption and routine maintenance requirements and attains longer service life.
The seals, fitted on both sides of the bearing set, are produced in several designs depending on bearing size and application needs; the most common ones are the integrated lateral unitized seals (European version), the integrated lateral narrow seals (compact seal concept) and the loose flange lateral unitized seals (Japanese version).
So the basic design with the garter seal, made by reinforced fluoro rubber and steel spring, is located in the integral external cups.
Alternatively, the separate seal carrier flanges are matched to the cups and a chock type seal runs on extended surface of inner rings.
Furthermore, RKB seals have been redesigned in new type to increase seal durability and efficiency: while maintaining an overall narrow profile, these seals optimize the available space by utilizing the area directly adjacent to or underneath the cage bore, with the result of the usage of longer rollers with consequent increased bearing capacity similar to open type version.

RKB sealed four-row taper roller bearings are usually provided also with O-rings in the outboard cup outside diameter to seal contaminants from the bearing outer diameter and/or with a cone seal set designed to accommodate relative motion between inner rings and to prevent build-up of negative pressure (anti-vortex system technology for longer bearing life and less lubricant deterioration).

Phosphate treatment for rings, rollers and spacers (suffix PT4) for anti-rust and anti-corrosion properties under water, alkalescent and acidescent working conditions is also available.

RKB produces special executions of TQO made of four single cups and two double cone assemblies (design without spacers).

Most of TQO and TQI four-row taper roller bearings are manufactured with inch dimensions as per American AFBMA 19/1974 and as per RKB standard practice, dimensional and running accuracy grade is in accordance with class 2 or 4.

Highlights

Part number:	TQO 331925 A2AHA1ZBBT4B
Bore:	609,600 mm
Outside diameter:	813,562 mm
Width:	479,425 mm
Mass:	695 kg
Dynamic load carrying capacity:	10500 kN
Static load carrying capacity:	30000 kN
Application:	Rolling Mill/Steel Industry

Thrust ball and roller bearings

RKB thrust ball bearings are manufactured in two versions: single and double direction. They can carry heavy axial loads, but they cannot take radial loads.

The single direction bearings consist of shaft washer, housing washer with flat support surface and ball cage assembly. The bearings are of separable design for a simple mounting of the parts.

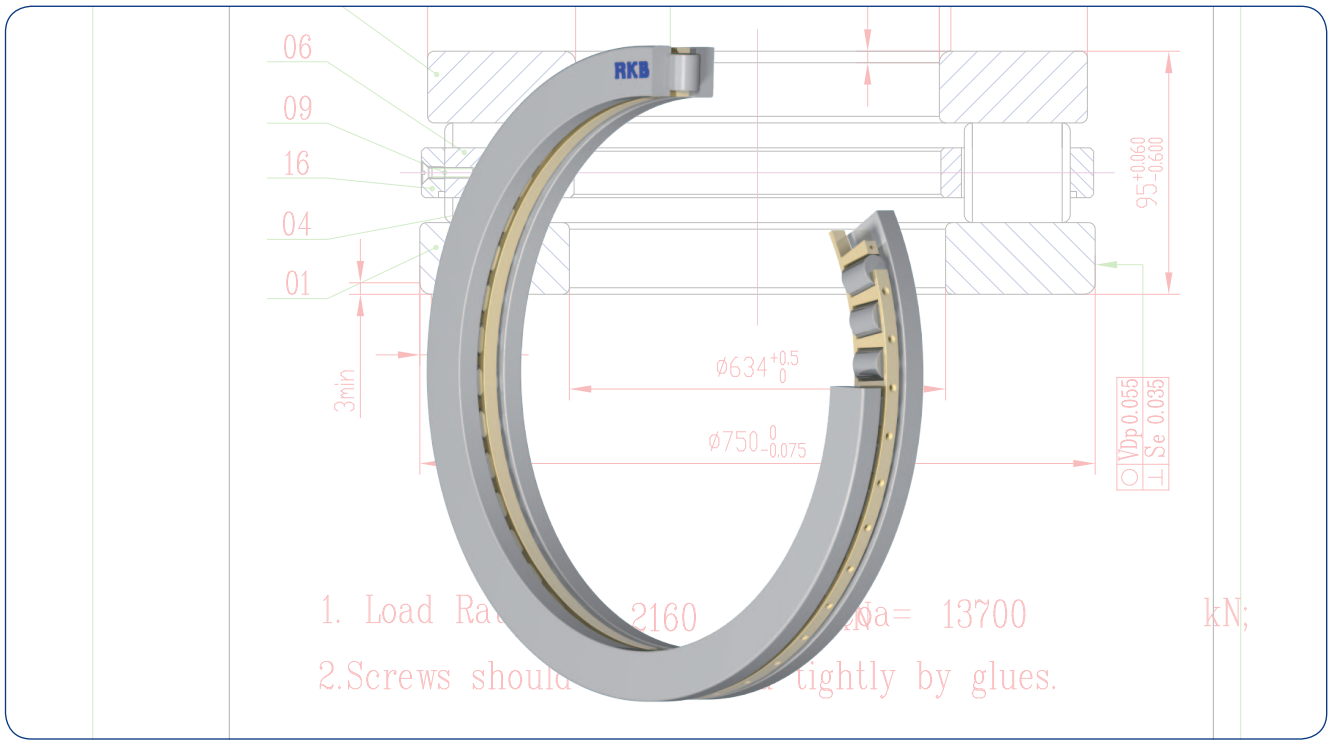
The double direction thrust ball bearings can take axial loads in both directions. Such a bearing consists of a shaft central washer, two housing washers and two ball cage assemblies. The bearings are of separable design and ball cage assemblies are interchangeable with the corresponding single direction bearings.

Thrust ball bearings with sphered housing washer can be used with sphered seating housing to compensate the misalignment between the support surface in the housing and in the shaft.

The boundary dimensions of RKB thrust ball bearings in metric size conform to ISO 104:1979 dimensional series 8.
They are produced to normal tolerance class in accordance with ISO 199:1997.

RKB big size thrust ball bearings are normally fitted with machined brass cage (suffix M). Machined steel cage (suffix F) is also available.

RKB cylindrical roller thrust bearings are generally used to take over heavy pure axial loads, to carry shock loads and to be stiff into a little axial space with simple design.
They are manufactured for the axial support of a shaft in one direction and are available as single or multi rows of rollers.
Double direction cylindrical roller thrust bearings can be easily obtained with assembly of the standard roller cage and washers together with an appropriately designed intermediate washer. If the support shaft shoulder is heat treated and ground, it can be used as a raceway for the roller cage assembly.



In case of more rows, the rollers have various lengths and are alternatively mounted.
To avoid side friction, one of the side of the roller can be crown profiled.

The boundary dimensions of RKB cylindrical roller thrust bearings conform to ISO 104:1979.
Angular misalignment between shaft and housing is not permitted.
In order to guarantee a proper arrangement of the rolling parts for the satisfactory operation, the cylindrical roller thrust bearings have always to be submitted to a given minimum load, specially when high speeds, high accelerations or rapid changes of load directions are involved.

Both machined brass and steel cages are available as standard.

RKB production range also includes inch size cylindrical roller thrust bearings, engineered up to 50 inches outside diameter in conformance with RBEC accuracy specifications.
Executions requiring antirotation devices on the plates, lifting holes and integral radial roller bearings are also available.
There are standard design variations of RKB inch series thrust bearings. Each design is based on a standard single acting with addition of special components to modify its function: the AT aligning type with sphered housing plate for a possible initial static misalignment up to 3°; the crane hook thrust type with the weather shed pressed on the rotating plate; the DT double acting thrust bearing and the DAT aligning style combination of DT and AT types; the SDT simplified double acting thrust with only one roller assembly and two thrust plates.

Highlights

Part number:	TCRB 431M2203A
Bore:	419,500 mm
Outside diameter:	571,400 mm
Height:	89,000 mm
Mass:	66,3 kg
Dynamic load carrying capacity:	1860 kN
Static load carrying capacity:	11200 kN
Application:	Mines and Minerals Industry

Spherical roller thrust bearings

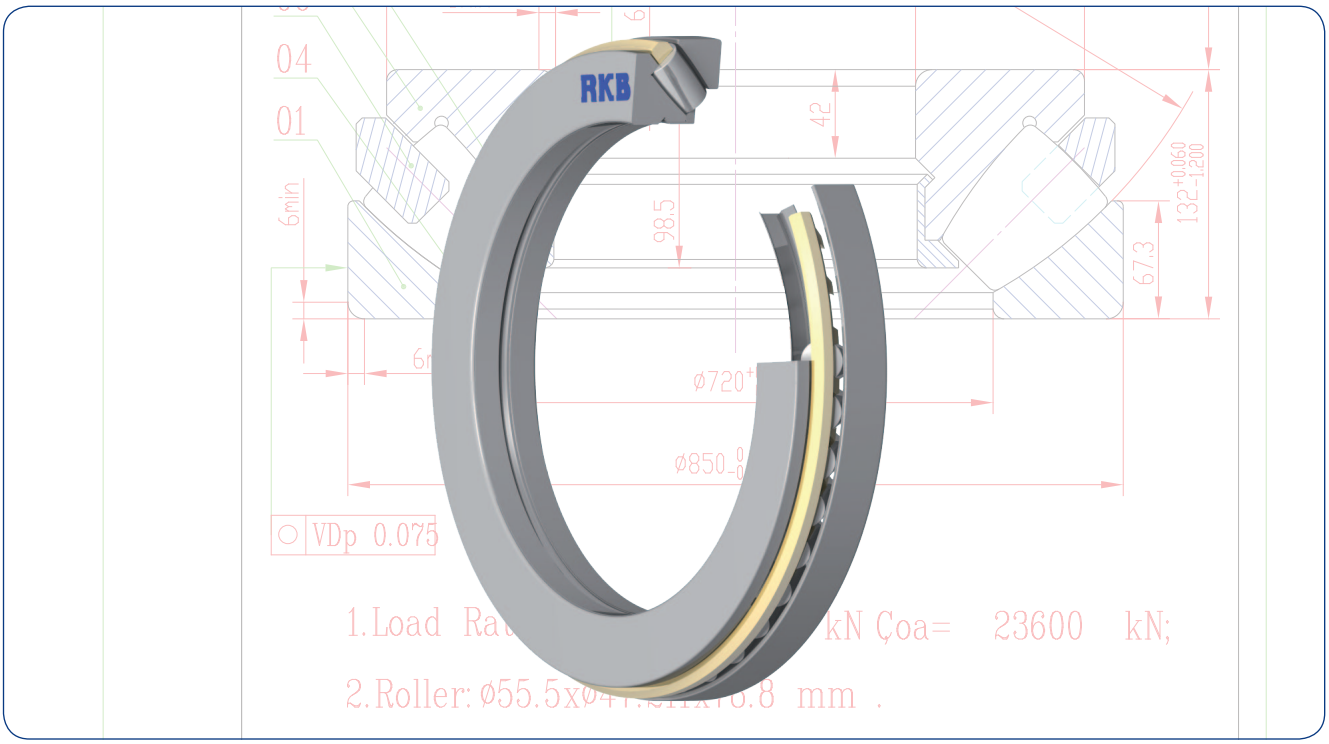
In RKB spherical roller thrust bearings the load is transmitted from one raceway to the other under an angle of about 50° related to the bearing axis.

They can take over heavy axial loads and simultaneously they can accommodate radial loads with values of up to 55% of the axial load magnitude.

An important feature of spherical roller thrust bearings is their self-aligning capability, thanks to the design of the housing and shaft washer raceways with a large number of asymmetrical rollers and the proper conformity with the paths.

RKB spherical thrust bearings have a machined brass cage guided by a sleeve clamped in the shaft washer bore (suffix EM). The shaft washer and the cage with rollers form a non-separable unit.
The overall dimensions of the spherical roller thrust bearings are in accordance with ISO 104:1979, so that they are interchangeable with different designs, even the earlier ones (suffix B).
Where the cage guiding sleeve also serves as a spacer sleeve, the spacer sleeve needed between the shaft washer and the shaft shoulder has to be checked and, if necessary, remachined when substituted with different bearing designs.

These RKB bearings as standard are manufactured to normal tolerance class as specified in ISO 199:1997. However the tolerance for the total height is tighter than that specified by ISO.



Highlights

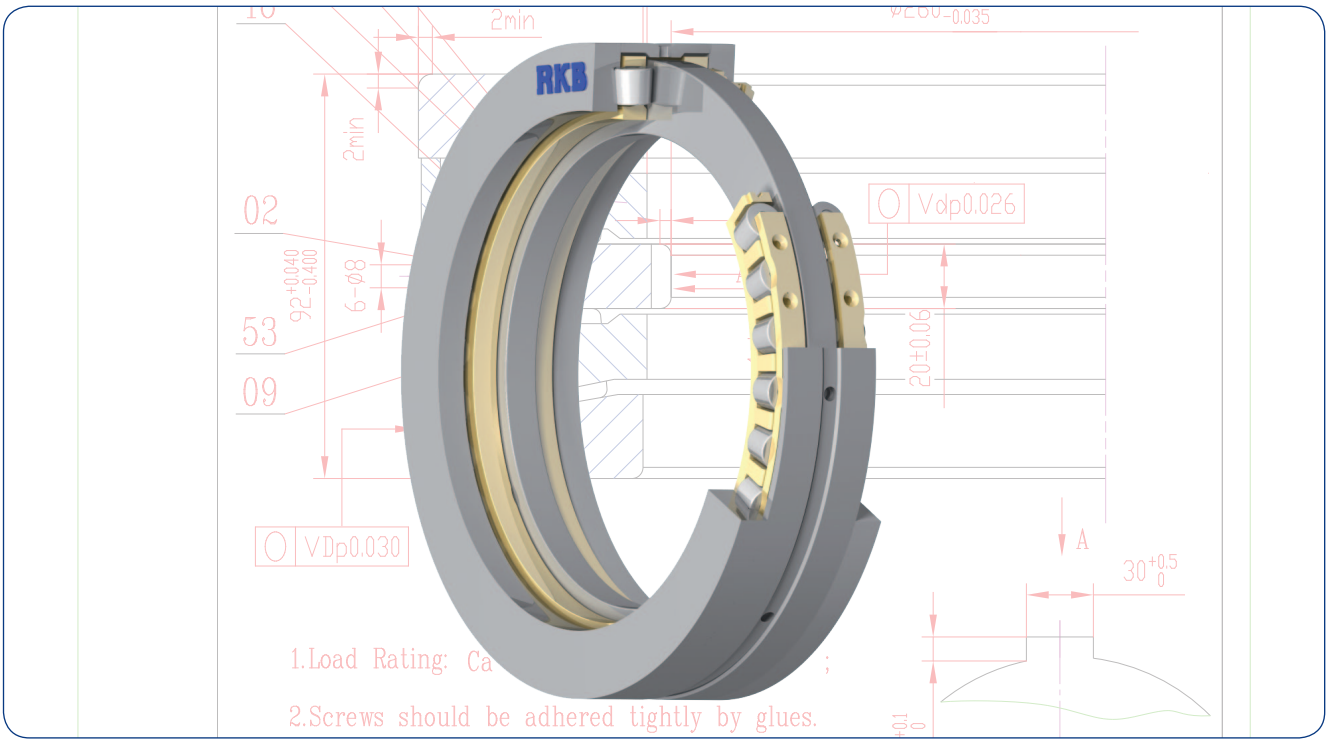
Part number:	294/670 EMN1EBEVO
Bore:	670 mm
Outside diameter:	1150 mm
Height:	290 mm
Mass:	1160 kg
Dynamic load carrying capacity:	16000 kN
Static load carrying capacity:	68000 kN
Application:	Plastic Industry

Taper roller thrust bearings

RKB taper roller thrust bearings have the following separable parts: shaft washer, housing washer and rolling element assembly.
RKB manufacturing program includes the single direction type, the double direction type and the screw-down special type.

RKB single direction taper roller thrust bearings are manufactured in two constructive versions, with tapered raceway on both washers or on only one.
The rollers are radially guided by the rib of one washer. They have controlled contour to redistribute end stress concentration and provide more uniform distribution of the applied loads (suffix ZB).
These bearings can also be produced in the version without the cage to obtain the maximum axial load carrying capacity (suffix V).
The most common series are T type, TK type and 351 type.
Bearings made of case hardened carburizing alloy steels can be produced for particular applications where required.

RKB double direction taper roller thrust bearings are normally used in the rolling mill applications associated with a multi row cylindrical roller bearing.
RKB produces this type of bearing in two constructive versions, either with central plane shaft washer and taper raceways in both housing washers or with both plane housing washers and taper raceways in the central shaft washer.
A special sleeve is arranged between the two housing washers, so that, when mounting, no special adjustment of the bearing is required.
As the double direction taper roller bearings are usually mounted with loose fit on the roll neck, the shaft washer is normally provided with one or two locating slots that, engaged with key-way or similar devices, prevent the shaft washer from rotating on the seating.
If the load carrying capacity is not adequate to the expected life, TDIS type can be used in alternative.
The most common series are 350 type, 351 type, 353 type and TTK type.



RKB screw-down bearings are a special design of the single direction taper roller thrust bearings used for rolling mill arrangements.
They are generally produced with case hardened carburizing alloy steels and with full complement of long rollers of large diameter to accommodate very heavy axial loads and shocks.
In order to accept the angular movements of the screw spindle with respect to the support without detrimental effects on bearing performance, the bearings have one sphered washer that could be either the shaft or the housing washer. An additional concave sphered pressure plate can be supplied with the bearing.
Usually screw-down bearings are custom-made to meet the specific requirements of different applications.

The dimensions of taper roller thrust bearings are not standardized.
The main boundary dimensions are produced with normal tolerances according to ISO 199:1979.

Highlights

Part number:	350981 C
Bore:	260 mm
Outside diameter:	360 mm
Height:	92 mm
Mass:	25,8 kg
Dynamic load carrying capacity:	575 kN
Static load carrying capacity:	2660 kN
Application:	Rolling Mill/Steel Industry

RKB Europe SA
Limited Warranty
Edition December 2007

Limited Warranty and Limitation of Liability: RKB Europe SA, for itself and its related companies and subsidiaries (hereinafter described collectively as "RKB"), warrants that all RKB products sold will be free of defects in materials and workmanship for a period of twelve (12) months from date of delivery. The foregoing twelve (12) month warranty shall not be extended or changed by RKB furnishing any replacements, additions, attachments, accessories or repairs to the product subsequent to the date of delivery or acceptance. The foregoing warranty is the sole and exclusive warranty of RKB regarding the product.

Disclaimer of other warranties: other than the foregoing warranty, there are no express or implied warranties or any affirmations of fact or promises by RKB with respect to the product. RKB disclaims any warranties, express, implied or statutory, not specifically set forth above. Without limiting the generality of the foregoing, RKB expressly disclaims any implied warranties of merchantability, fitness for any particular purpose, infringement or any representations of fact or quality not expressly set forth herein.

Limitation of liability and remedies: RKB's sole responsibility and liability incurred as a result of the sale and/or use of the product, and the purchaser's exclusive remedy against RKB under any warranty shall be limited to the repair or replacement, at RKB's option, of product components not conforming to the warranty. The total liability of RKB shall in no event exceed the amount actually paid to RKB by purchaser with respect to the product. This limitation of remedy is intended by the parties to survive even if the remedy is claimed to have failed of its essential purpose. Purchaser's full and complete performance of all obligations of purchaser recited in this agreement is a condition precedent to RKB's warranty obligations and liabilities herein.

Purchaser's damages and limitations: in no event shall RKB be liable to purchaser, its assigns or agents, for economic loss, incidental or consequential damages, in contract or in tort, including but not limited to, any damages for lost profits, down-time, lost production, failure to meet purchaser's sales contracts, or defects in purchaser's materials or workmanship arising directly or indirectly from the use of the product.

RKB Europe SA
General Condition of Contract
Edition November 2008

In this document RKB Europe SA is also referred to as "the Company".

1 Scope of Applicability

1.1 These General Terms and Conditions apply to all contracts of sale of any type of good and or services, unless otherwise expressly agreed in writing with the Customer.

1.2 Any General Terms and Conditions of the Customer shall apply only if and to the extent to which the Company has expressly consented thereto in writing. An express rejection of the Customer's general conditions is not required.

2 Contract Formation

2.1 The Customer's order must be in writing and validly signed.

2.2 A Customer's order shall always be subject to the Company's written confirmation ("acceptance" or "confirmation of order") and the contract shall be deemed to have been concluded only upon such written confirmation ("acceptance" or "confirmation of order") by the Company.

2.3 A purchase shall also be considered concluded by delivering the ordered goods in case where no written confirmation ("acceptance" or "confirmation of order") was issued by the Company.

2.4 Any price list, illustration, catalogue, brochure, circular, advertisement, and other descriptive document constitute no offer, but only an approximate guide and shall be binding on the Company only upon written confirmation ("acceptance" or "confirmation of order") stating a limited acceptance period. Where no acceptance period is specified for the time-limited offer, a 30 days period, starting with the first notice (i.e. "information delivery"), will apply. Where the Company places a time-limited offer, the duly signed Customer's acceptance must reach the Company within the mentioned time-limit in order to be binding for the Company. Any time-limited offer for prompt delivery is subject to prior sales ("first come, first served").

2.5 Where special materials are ordered, the Company reserves the right to ship and charge 10% more or less than the quantity ordered. The Company shall call Customer attention on the difference between the quantity ordered and the quantity to be delivered by the Company, without any interference on contract formation between the parties and for the quantity unilaterally accepted by the Company. Unless otherwise agreed in writing the Company does not accept any restriction of its right to manufacture, sell or offer to any other Customers, goods which may be manufactured specially for a specific Customer or Customers or goods of like pattern.

2.6 The Company reserves right to cancel any uncompleted order, or to suspend delivery, should any of the Customer's commitments to the Company not be met.

3 Contract Amendments

3.1 No subsequent agreement, understanding alterations or amendments of a contract in any way altering these terms and conditions shall be binding upon the Company unless made in writing and validly signed by an authorized officer of all parties.

4 Price

4.1 For Customers with registered offices in the Swiss Confederation and Customers with registered offices outside the European Union, Company's prices include, except for Value Added Tax (VAT), such other taxes and duties payable in the Swiss Confederation. Duties payable outside the Swiss Confederation are for the Customer's account.

4.2 For Customers with registered offices within the European Union, Company's prices include, except for Value Added Tax (VAT), such other taxes and duties payable in the European Union area.

4.3 Prices include normal packing for both domestic and export markets. Unless otherwise expressly agreed upon in writing, the contract price does not include performances such as, however not limited to, installation, start up, training of Customer's operation and maintenance employees or engineers.

4.4 Shipping costs are for the buyer's account (see below: EXW clause 6.2) .

4.5 The Company may make appropriate price increases after contract formation if raw material suppliers have raised their prices significantly between contract formation and delivery date.

5 Payment

5.1 Unless otherwise agreed, payment shall be net cash and made within 30 days from the date of shipment delivery. Any payments must be made in full without any deduction. Whatever the means of payment used, payment shall not be deemed to have been effected before the Company's account has been fully and irrevocably credited.

5.2 If the Customer fails to pay by the stipulated date, the Company shall be entitled to interest from the day on which payment was due. The rate of interest shall be 8% above the rate of the main refinancing facility on the European Central Bank in force on the due date of payment. After having notified the Customer in writing, the Company may also suspend its contract performance (i.e. future deliveries and/or warranties) until the Company's account has been fully and irrevocably credited.

5.3 If the Customer has not paid the amount due within three months the Company shall be entitled to terminate the contract by notice in writing to the Customer and to claim compensation for the loss it has incurred.

5.4 If, in the space of time in-between contract formation and product shipment, circumstances affecting the general credit of the customer arise, the company shall have the right to deliver only after receipt of full and unconditional payment.

6 Delivery

6.1 The INCOTERMS (see: www.incoterms.com) in their respectively valid version shall apply for interpreting standard trade terms.

6.2 Unless agreed upon differently in writing, deliveries

6.2.1 to Customers with registered offices within the territory of the Swiss Confederation or a non European Union country ("third country") will be made ex works (EXW) Balerna (Via Primo Agosto, CH-6828 Balerna – Switzerland)

6.2.2 to Customers with registered offices within the territory of the European Union will be made ex works (EXW) Milano (Via Ernesto Teodoro Moneta 41, I-20161 Milano – Italy)

6.3 Unless agreed upon differently in writing, "delivery period" is 10 months and shall run from the date of contract formation.

6.4 Unless otherwise expressly agreed upon in writing, delivery dates stated by the Company or delivery dates in the end of a "delivery period" are approximate and shall not be deemed "fixed" under article 102 para. 2 of the Swiss Code of Obligations. In case of non-delivery at delivery date (stated by the Company or in the end of a "delivery period"), the Customer must exhort the Company and set a reasonable time limit ("grace period") to the Company (article 107 para. 1 of the Swiss Code of Obligations).

6.5 Compensation for damages in accordance with article 97 para. 1 ("non-delivery") of the Swiss Code of Obligations, is excluded in case of slight negligence by the Company or its employees or any auxiliary person (article 100 para. 1 Swiss Code of Obligations). Analogically, compensation for damages in accordance with article 107 para. 2 ("late delivery") of the Swiss Code of Obligations, is also excluded in case of slight negligence by the Company or its employees or any auxiliary person.

6.6 The presumption of article 190 of the Swiss Code of Obligations shall not apply.

6.7 The Company shall have the right to part deliveries, unless the Customer suffers unreasonable or inequitable harm thereby.

7 Warranty

7.1 The Company warrants that at the time of delivery the goods sold hereunder shall be free from defects in material and workmanship. The Customer is obliged to promptly examine the goods upon delivery and shall notify in writing defects without undue delay to the Company. The notification must detail the goods and the defects. If the Customer fails to comply with these obligations, the goods shall be deemed to have been accepted as faultless. The Company reserves the right to reject all claims for shortage made without undue delay and in any event every claim reaching the Company later that fourteen days after shipment delivery.

7.2 The same waiver of redhibitory action (annulment) or impairment ("actio quanti minoris"), in accordance to art. 205 para. 1 of the Swiss Code of Obligations, shall apply post-delivery. During a period of 12 months after the goods have been put into operation, but not exceeding 18 months after the passing of risks under clause 6.2 (or differing agreement), the Company warrants that the goods shall be free from defects in material and workmanship. During this time period the Company shall, at its own choice, replace or repair goods or issue credit for goods becoming "objectionable". If the daily use of the goods exceeds that which is agreed, this period shall be reduced proportionately.

7.3 Notice of defects shall be given immediately and, under no circumstances, later than fourteen days after the expiry of the periods set forth under clause 7.2. If the Customer fails to notify the Company in writing of a defect within the time limits set forth, he loses his right to have the defect remedied. Where the defect is such that it may cause damage, the Customer shall immediately inform the Company. The Customer shall bear the risk of damage resulting from his failure so to notify.

7.4 Warranty applies, provided the allegedly "objectionable good" is returned for examination and our inspection demonstrates the good not to be free from defects in materials and workmanship (i.e. objectionable). Warranty doesn't apply if the Company's inspection demonstrates that the product was not properly mounted, lubricated or used. The allegedly "objectionable goods" may be returned at the expense of the Company only upon receipt by the Customer of definite shipping instructions from the Company.

7.5 If the Customer submits a warranty claim and no defect is found for which the Company is liable, the Company shall be entitled to compensation for the costs it has incurred as a result of the notice.

7.6 Once the Company, based on its examination, decides in favour of warranty according to clause 7 it shall repair the defect at its own cost and without undue delay or proceed to the shipment of a good free from defects in material and workmanship. If, within a reasonable time, the Company fails to fulfil its warranty obligations, the Customer may by written notice exhort the Company and set a time limit (grace period) for completion of the warranty. If, within such final time period, the Company fails to fulfil its obligations, the Customer may proceed with a replacement of the "objectionable good" by a third party. Reimbursement by the Company for reasonable costs incurred shall be in full settlement of the Company's liabilities for the said defect and shall in no event exceed the contractual value of the good subject to warranty.

7.7 In the event the Company determines that it is unable to remedy by repair or replacement of any "objectionable good", the Company's sole and exclusive remedy shall then be refund of the purchase price, or so much of the purchase price as has been paid by the Customer.

7.8 When a defect in a part of the delivered product has been remedied, the Company shall be liable for defects in the repaired or replaced part under the same terms and conditions as those applicable to the original product for a period of 12 months. For the remaining parts of the product the period set forth under clause 7.3 shall be extended only by a period equal to the period during which the product has been out of operation as a result of the defect.

7.9 The Customer shall at his own expense arrange for any dismantling and reassembly of equipment to the extent that this is necessary to remedy the defect. No dismantling or reassembly of the defective part is performed by the Company. The Company has fulfilled his obligations in respect of the defect when it delivers to the Customer a duly repaired or replaced part. Necessary transport of the product and or parts thereof from the Company to the Customer in connection with the remedying of defects for which the Company is liable shall be at expense of the Company.

7.10 Defective parts which have been replaced shall be property of the Company.

7.11 Specific qualities of the goods or fitness for particular purposes shall be deemed to have been warranted only if expressly stated in writing.

7.12 In addition to what explicitly stated under clause 7.1-7.11, no warranty shall apply:

7.12.1 To defects arising out of material provided, or out of a design furnished, by the Customer;

7.12.2 To defects due to causes arising after the risk has passed under clause 6.2 (or differing agreement);

7.12.3 To defective parts delivered by third parties, however the Company shall be obliged to assign to the Customer its corresponding claims against third parties;

7.12.4 To faults or damage by abnormal use or arising in consequence of faulty maintenance, fault repair by the Customer, alterations carried out without the Company's written consent, negligence or improper handling or storage of the goods by the Customer or his agents;

7.12.5 To consequences for any inexpert alterations or repairs carried out by unauthorised persons;

7.12.6 For the sale of used goods;

7.12.7 To goods not in the plant of the original Customer;

7.12.8 If and as long as the Customer fails to comply with his obligations under the contract, unless his failure to comply is negligible or the Customer is legally entitled to refuse performance.

7.13 The remedies under clause 7 shall be Customer's exclusive remedies for breach of this warranty or other claims for defects in goods. The Company makes no warranties, either express or implied (including, without limitation, warranties of merchantability or fitness for a particular purpose), other than those above set forth. The full purpose of this exclusive remedy shall be to provide the Customer with repair and replacement of defective goods in the manner provided for. This exclusive remedy shall not be deemed to have failed of its essential purpose so long as the Company is willing and able to repair and replace defective goods in the described manner.

8 Consequential damages and losses

8.1 Company's responsibility for any claims, damages, losses or liabilities arising out of or related to its performance of this contract or the goods covered hereunder, including but not limited to, any repair or replacement of goods under the warranty shall not exceed the sales price of the particular individual product which is the source of buyer's claim.

8.2 In no event shall the Company be liable for any special, indirect, consequential, or punitive damages of any character, including but not limited to, loss of use of productive facilities or equipment, loss of profits, loss of production, loss of use, loss of contracts or for any other consequential or indirect loss whatsoever, whether suffered by buyer or any third party, irrespective of whether such claims or actions for damages are based upon contract, warranty, negligence, strict liability or otherwise.

8.3 Article 1 of the Swiss Product Liability Law ("Legge federale sulla responsabilità per danno da prodotti" [LRDP]; "Produktehaftpflichtgesetz" [PrHG]), outlaws the exclusion of liability for damages to a person or damages resulting out of the private use or consumption of the good. Swiss Product Liability Law shall not apply to goods leaving the territory of the Swiss Confederation in case where a foreign "strict liability" ("responsabilità causale", "Kausalhaftung") of the same nature is less stringent.

9 "Force majeure"

9.1 Either party shall be entitled to suspend performance of his obligations to the extent that such performance is impeded or made unreasonably onerous by any of the following circumstances: industrial disputes and any other circumstance beyond the control of the parties such as fire, war, extensive military mobilization, insurrection, requisition, seizure, embargo, restrictions in the use of power and defects or delays in deliveries by sub-contractors caused by any such circumstances.

9.2 A circumstance referred to in this clause, whether occurring prior to, or after the formation of the contract, shall give a right to suspension or delivery extension only if its effect on the performance of the contract could not be foreseen at the time of the formation of the contract.

9.3 The party claiming to be affected by "force majeure" shall notify the other party in writing without delay on the intervention and on the cessation of such circumstance.

9.4 If either party suffers unreasonable or inequitable harm by a delay due to "force majeure", the respective party shall have the right to rescind the contract after giving notice in writing.

10 Retention of Proprietary Rights

10.1 The goods delivered, including technical documents, shall remain property of the Company until the Company's claims against the Customer have been satisfied in full.

10.2 The Customer must notify the Company without delay of any attachment or other violation of the ownership of the Company by third parties.

10.3 If and to the extent the Company has claims against the Customer arising from transactions or dealings of any nature with the same Customer other than those referred to at the above clause 10.1, all goods supplied to the Customer shall remain property of the Company until all Company's claims against the Customer from all such transactions or dealings have been satisfied in full. If the value of the security provided exceeds the claims to be secured by more than twenty percentage points the Company shall be obliged to release the security of its choice at the Customer's request.

10.4 If the Customer fails to make any payment when due, he shall be obliged to return the goods that are subject to the Company's ownership rights after notice has been given by the Company, without affecting other rights. The Customer shall, in such event, be obliged to ship back theses goods to the Company at his own risk and expense. The Customer shall be obligated to insure the goods delivered at his own expenses as long as they remain property of the Company.

10.5 If the goods with respect to which title has been retained become part of a new item by way of connection or is built-in and if such item is owned by the Customer, it is hereby agreed that the Customer transfers co-ownership to the new item to the Company and acts as bailee without compensation for such item. The Company's co-ownership share shall be determined by the relationship of the value of the goods with respect to which title was retained to the value of the new item. The Customer hereby assigns to the Company all claims against Company's Customers resulting from the sale of the goods with respect to which title was retained. If the goods with respect to which title was retained are sold together with other goods that are not owned by the Company, then the Customer assigns to the Company such part of the claim resulting from the sale that is equal to the invoiced amount for the goods with respect to which title was retained. If an item with respect to which title was retained is only partially owned by us and is sold, the part of the claim resulting from the sale that is assigned to the Company will be equal to the company's percentage of ownership in the goods with respect to which title was retained. The Company grants authority to the Customer to collect any claims resulting from the further sale of the retained goods. If requested, all Customer must deliver to the Company all information and documents required to enforce the Company's rights.

10.6 If the law of the country where the goods are situated after delivery does not permit to the Company to retain the property of the goods, the Company shall be entitled to rights as closely related to the Company's rights stated above, as the law permits. The Customer shall give to the Company every assistance in taking any measure required to protect Company's rights of property or such other rights as aforesaid.

10.7 The retention of title under clause 10.1-10.6 shall not affect the passing of risk under clause 6.2 (INCOTERMS).

11 Intellectual Property Rights

11.1 The Company shall not be liable if the manufacturing of the goods supplied is based on specifications or drawings provided by the Customer or if the application of the goods infringes third party rights.

11.2 The Customer agrees to indemnify and hold the Company harmless for any loss, cost, liability or expense resulting from infringement, or claimed infringement, of Intellectual Property Rights in connection with goods manufactured by the Company in accordance with Customer's specifications..

12 Regulation (EC) No. 1334/2000

12.1 Regulation (EC) No. 1334/2000 sets up a Community regime for the control of exports of dual-use items and technology. "Dual-use" items are goods, including software and technology, which can be used for both civil and military purposes.

12.2 According to the regulation CE 1334/2000, the Company declares that all the products it handles as per business scope are generic mechanical components and therefore intended for civil purposes only."

12.3 The Customer agrees to indemnify and hold the Company harmless for any loss, cost, liability or expense resulting from infringement, or claimed infringement, of Regulation (EC) No. 1334/2000.

13 Confidentiality

13.1 The Customer shall keep strictest secrecy about and may not disclose the contents of technical documents or any know-how to any third party. The Customer may not use such technical data or know-how for any purpose other than those envisaged by the contract.

13.2 This confidentiality obligation shall remain in force also after the expiration of the sale contract.

14 Severability

14.1 Even if an individual provision herein is or becomes invalid the remaining provisions of the contract or of the General Conditions shall remain valid. This also applies to issues the parties intended but failed to address.

15 Drawings and other documents

15.1 The Company reserves all property rights and copyrights for cost estimates, drawings and other documents provided to the Customer. Those documents may not be utilised for purposes other than those specified by the Company or otherwise disclosed to third parties.

16 Applicable Law and Jurisdiction

16.1 The validity, construction and interpretation of all documents relating to this sale, and the rights and duties of the parties thereto shall be governed by the laws of the Swiss Confederation, excluding the provisions of the United Nations Convention on Contracts for the International Sale of Goods dated 11 April 1980 (CISG).

16.2 For all disputes arising out of or in connection with the contractual relationship between the Company and its contractual counterpart (the Customer), where the amount in controversy, excluding court fees and legal expenses, is below CHF 200'000.—, the competent jurisdiction shall be Lugano (Switzerland).

16.3 Where the amount in controversy, excluding court fees and legal expenses, is beyond CHF 200'000.—, all disputes arising out of or in connection with the contractual relationship between the Company and its contractual counterpart (the Customer), shall be finally settled in arbitration under the Rules of Arbitration of the International Chamber of Commerce (ICC), by three arbitrators appointed in accordance with the said Rules. The place of arbitration shall be Zurich (Switzerland). The language of the arbitration shall be English. Any Party shall have the right to have recourse to and shall be bound by the pre-arbitral referee procedure of the International Chamber of Commerce (ICC) in accordance with its Rules for a Pre-Arbitral Referee Procedure. Neither party shall be prevented from having recourse to a court of competent jurisdiction for the purpose of seeking urgent conservatory or interim measures, being specified that the arbitral tribunal shall also have the power to order such measures.

16.4 Any dispute arising out of or in connection with the interpretation of clause 16.2 and/or clause 16.3 shall be finally settled in arbitration under the Rules of Arbitration of the International Chamber of Commerce (ICC), by three arbitrators appointed in accordance with the said Rules. The place of arbitration shall be Zurich (Switzerland). The arbitral tribunal shall resolve about its competency, according to the amount in controversy. Specifics under clause 16.3 shall apply.

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