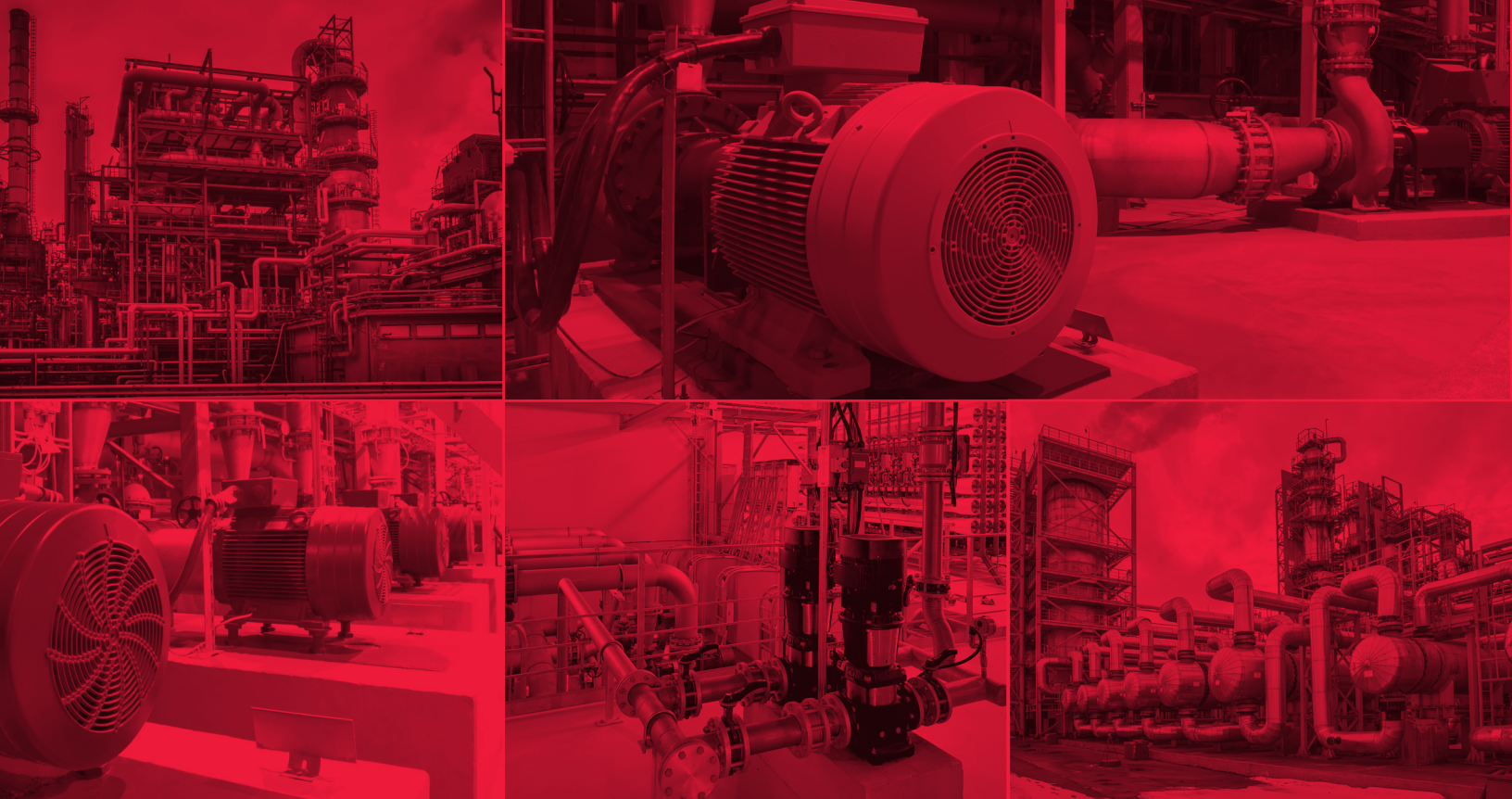


NSK

BEARINGS FOR PUMPS AND COMPRESSORS



STAY IN MOTION. STAY IN CONTROL.



A GLOBAL
PARTNER AND
SOLUTIONS
PROVIDER

As one of the world’s leading manufacturers of rolling bearings, linear technology components and steering systems, we can be found on almost every continent – with production facilities, sales offices and technology centres – because our customers appreciate short decision-making channels, prompt deliveries and local service.

PARTNERSHIP BASED ON TRUST – AND TRUST BASED ON QUALITY

Total Quality by NSK: The synergies of our global network of NSK Technology Centers.

Just one example of how we meet our requirements for high quality.

NSK is one of the leading companies with a long tradition in patent applications for machine parts. In our worldwide research centers, we not only concentrate on the development of new technologies, but also on the continual improvement of quality based on the integrated technology platform of tribology, material technology, analysis and mechatronics.

More about NSK at www.nskamericas.com or call us at 1.888.446.5675



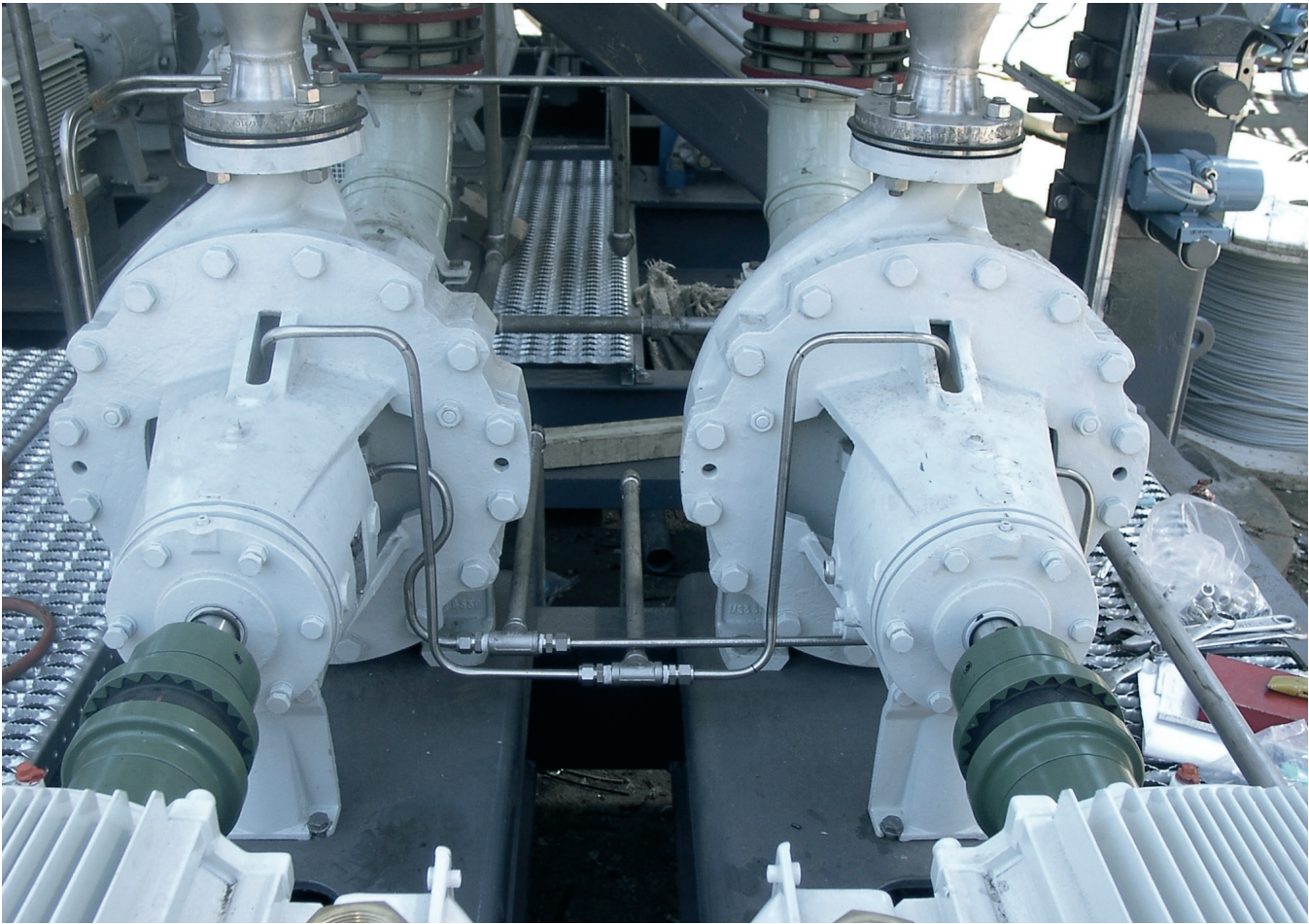
| | AMERICAS | EUROPE | ASIA |
|---------------------|----------|--------|------|
| Manufacturing Sites | 10 | 11 | 45 |
| Sales Locations | 15 | 17 | 80 |
| Technology Centers | 4 | 5 | 12 |

As of October 2021

THE NSK COMPANY

NSK commenced operations as the first Japanese manufacturer of rolling bearings in 1916. From the outset, we have been continuously expanding and improving not only our product portfolio but also our range of services for various industrial sectors. In this context, we develop technologies in the fields of rolling bearings, linear systems, components for the automotive industry and mechatronic systems. Our research and production facilities in the Americas, Europe, and Asia are linked together in a global technology network. Here we concentrate not only on the development of new technologies, but also on the continuous optimization of quality – at every process stage.

At the core of our research activities is the development of advanced material and lubricant technologies, simulation applications using a variety of analytical systems, and technological innovation in the field of mechatronics.



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SPECIAL DEEP GROOVE BALL BEARINGS FOR PUMPS

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DECISIVE DESIGN SOLUTIONS AND IMPROVED EFFICIENCIES

Pumps and Compressors are used in a wide range of process industries where requirements are for bearings offering long life in order to increase Mean Time Between Failures (MTBF). Downtime in production processes leads to huge costs and loss of productivity. At the same time, Pump and Compressor manufacturers are looking for more compact machines leading to downsizing of bearings.

The combination of increased life time and downsizing places increasingly severe demands on ball and roller bearings; and satisfying those needs call for bearings of the highest quality and reliability.

For pump applications, depending on the pump type, bearings can run under axial loads, radial loads or combined loads; small to high speeds and different lubrication conditions. In any case, conditions are quite tough and the need for high MTBF is a challenge for bearings.

For compressor applications, bearings are subjected to high axial and radial loads. They play a key role as they have to ensure correct positioning of the rotors in the axial and radial direction. This is extremely important as good positioning of the rotors is directly linked to compressor efficiency. Therefore, axial and radial deflection of the bearings must be kept as small as possible.

All the products developed by NSK specifically for these applications, are featured in this brochure.

In addition to our standard product range, our research and development centres around the world continue to develop the next generation of application-dedicated products by understanding the unique requirements of our customers so that we can help them to continuously improve their machines. For screw compressors, we have developed cylindrical roller bearings and HPS angular contact ball bearings fitted with a patented plastic cage in Linear Poly-Phenylene Sulfide (L-PPS) offering superior characteristics compared to standard plastic cages.

Our team of application engineers, local to your operation, are in contact with OEM R&D teams helping them to find new bearing solutions at each stage of their projects. The experience accumulated after years of involvement in pump and compressor applications is the key for mutual success.

We invite you to have a look through our unique range of innovative problem solving products and if you have an interest in any of our products, please contact your NSK Sales office.



SINGLE ROW RADIAL BALL BEARINGS

- Available ranges: 600, 6800, 6900, 16000, 16100, 6000, 6200, 6300, 6400 Series
- › Standard and special applications
 - › Steel, brass or polyamide cage
 - › Low noise
 - › Full sealing options
 - › Wide range of greases
 - › Standard or special steels



DOUBLE ROW ANGULAR CONTACT BALL BEARINGS

- Available ranges: 3200 – 3300 / 5200 – 5300 Series
- › Steel or polyamide cage
 - › Open
 - › Shielded ZZ or 2Z
 - › Sealed DDU or 2RS



SINGLE ROW CYLINDRICAL ROLLER BEARINGS WITH BRASS CAGE, STEEL CAGE OR POLYAMIDE CAGE

- › Pressed steel cage series: EW
- › Polyamide cage series: ET
- › Machined brass cage series: EM



TAPERED ROLLER BEARING

- › Inch & metric sizes
- › Standard steel / carburized steel / HTF treatment
- › Custom made sets with spacers



SINGLE ROW ANGULAR CONTACT BALL BEARINGS*

- › Pressed steel cage series
- › Polyamide cage series
- › Machined brass cage series

*See also the new HPS range: page 16



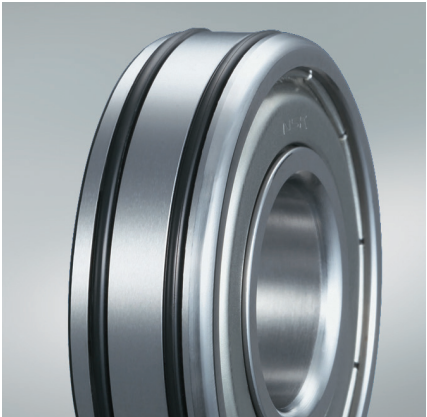
HPS SPHERICAL ROLLER BEARINGS

- › High load capacity
- › High limiting speed
- › High strength cage
- › Low noise and vibration

This is a non-exhaustive overview of NSK bearings used in Pumps & Compressors. If you require additional bearings, please contact NSK.



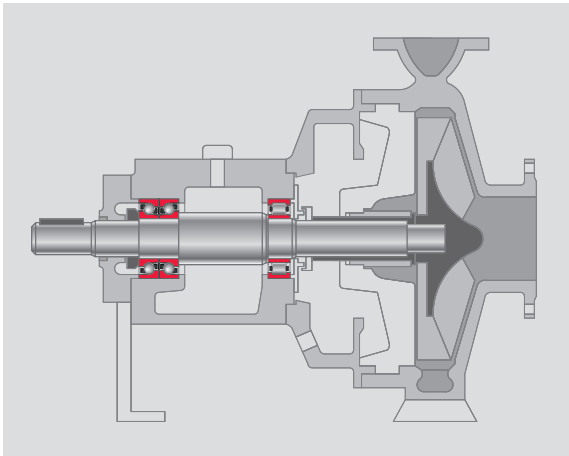
HPS Angular Contact Ball Bearings series



Creep-Free bearing



LNG pump bearing



CENTRIFUGAL PUMPS

Bearing Selection

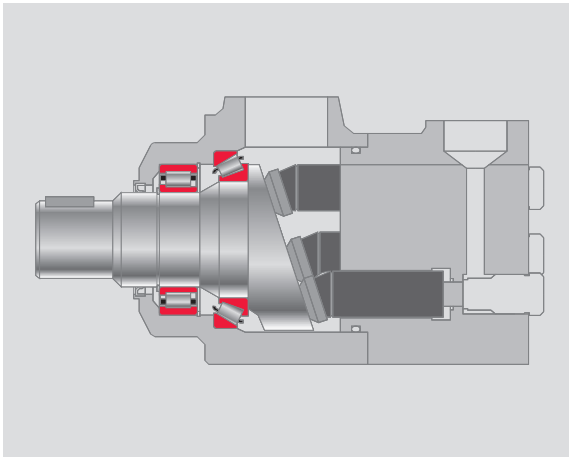
- › Cylindrical Roller Bearings
- › Angular Contact Ball Bearings
- › Double Row Angular Contact Ball Bearings
- › Deep Groove Ball Bearings – special: HR series*

Operating Conditions

- › Speed: 1500 rpm – 3000 rpm
- › Axial & radial loads

Bearing Requirements

- › Long life under high axial loads
- › Small axial free play



PISTON PUMPS

Bearing Selection

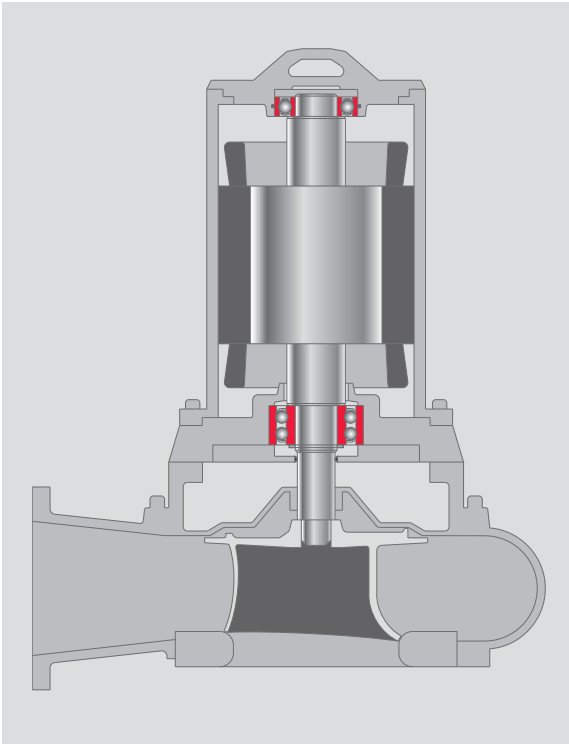
- › Cylindrical Roller Bearings – Special L-PPS cage
- › Tapered Roller Bearings – P6X accuracy – Carburized steel
- › Needle Roller Bearings

Operating Conditions

- › Heavy axial and radial load
- › Medium speed

Bearing Requirements

- › Reduced width tolerance for precise mounting
- › Oil compatibility with cage



SUBMERSIBLE PUMPS

Bearing Selection

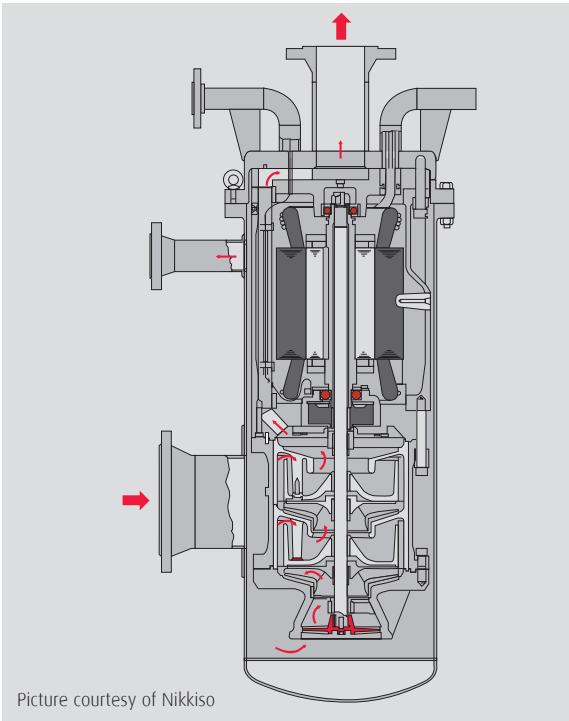
- › Cylindrical Roller Bearings
- › Angular Contact Ball Bearings
- › Double Row Angular Contact Ball Bearings
- › Deep Groove Ball Bearings – special: Creep-Free bearings*

Operating Conditions

- › Vertical shaft
- › Axial load
- › Large temperature difference between inner & outer rings

Bearing Requirements

- › Sealing performance
- › Prevent top bearing creeping in housing



LNG PUMPS*

Bearing Selection

- › Deep Groove Ball Bearings
- › Angular Contact Ball Bearings

Operating Conditions

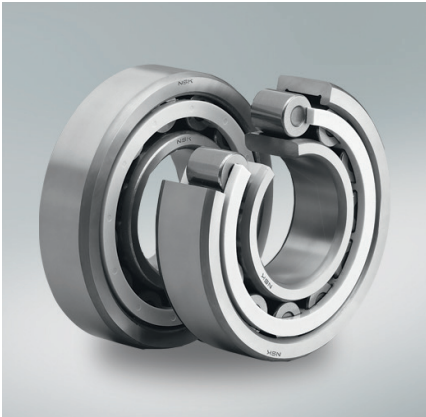
- › Speed: 1160 rpm – 3600 rpm
- › Gas temperature: –196 °C up to 0 °C
- › Mainly axial load
- › Very poor lubrication

Bearing Requirements

- › Self lubricating
- › Corrosion resistance

Picture courtesy of Nikkiso

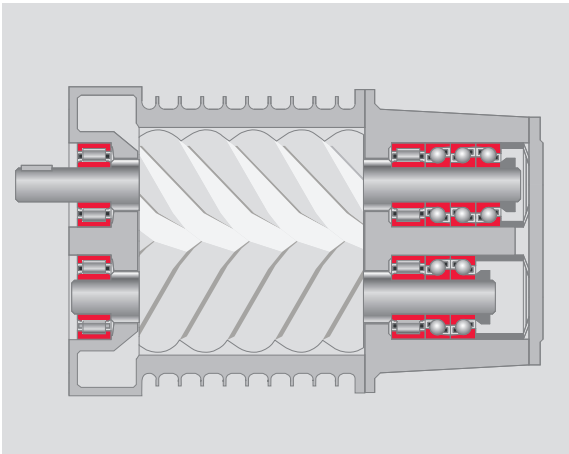
* See further information on page 12 to 15



High load capacity Cylindrical Roller Bearings with L-PPS cage



High load capacity HPS Angular Contact Ball Bearings with L-PPS cage



OIL INJECTED SCREW COMPRESSOR

Bearing Selection

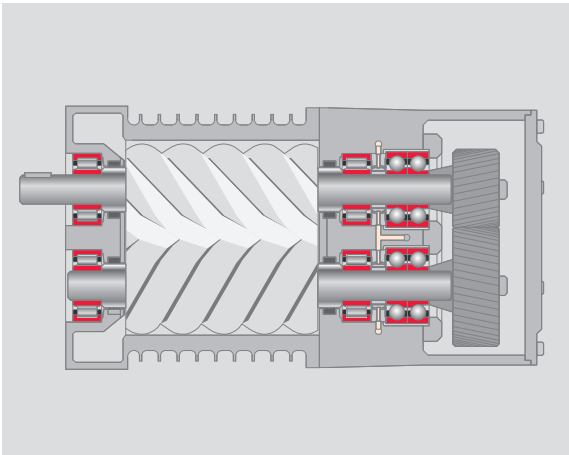
- › Cylindrical Roller Bearings – with L-PPS cage*
- › HPS Angular Contact Ball Bearings – with L-PPS cage*
- › Tapered Roller Bearings
- › Needle Roller Bearings

Operating Conditions

- › Medium speed
- › Large axial & radial loads
- › Oil circulation

Bearing Requirements

- › Specific axial & radial clearances to provide precise screw guidance
- › Plastic cage compatibility with special oils.



OIL FREE SCREW COMPRESSOR

Bearing Selection

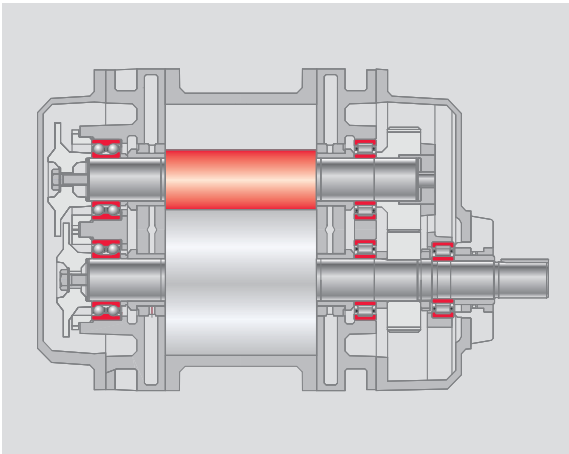
- › Cylindrical Roller Bearings – with outer ring guided brass cage, P6 or P5 accuracy
- › Angular Contact Ball Bearings – with outer ring guided brass cage, P6 or P5 accuracy
- › 4-point contact ball bearings – with outer ring guided brass cage, P6 accuracy, reduced axial clearance

Operating Conditions

- › High speed (0.7 M.dmN–1.4 M.dmN)
- › Moderate axial & radial loads
- › Oil jet lubrication

Bearing Requirements

- › Specific axial & radial clearances to provide precise screw guidance
- › High speed performance
- › Heat resistance



ROOTS BLOWER

Bearing Selection

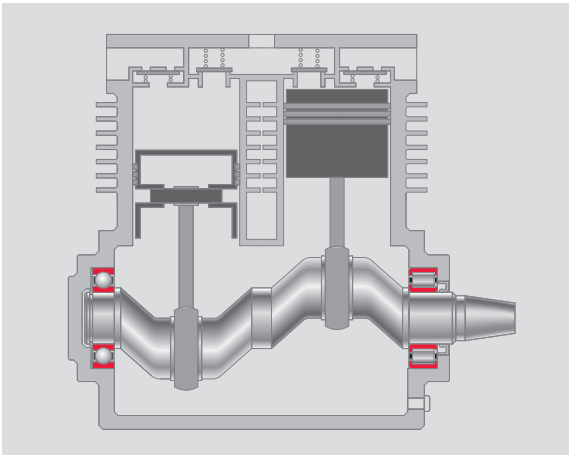
- › Cylindrical Roller Bearings
- › Angular Contact Ball Bearings
- › Double Row Angular Contact Ball Bearings
- › Deep Groove Ball Bearings

Operating Conditions

- › Oil-free
- › Medium to high temperature
- › Vibration

Bearing Requirements

- › Long life
- › Heat resistance



PISTON COMPRESSOR

Bearing Selection

- › Cylindrical Roller Bearings
- › High Capacity Deep Groove Ball Bearings
- › Needle Roller Bearings
- › Special bearing solution for oil free types

Operating Conditions

- › High radial load associated with reciprocating motion

Bearing Requirements

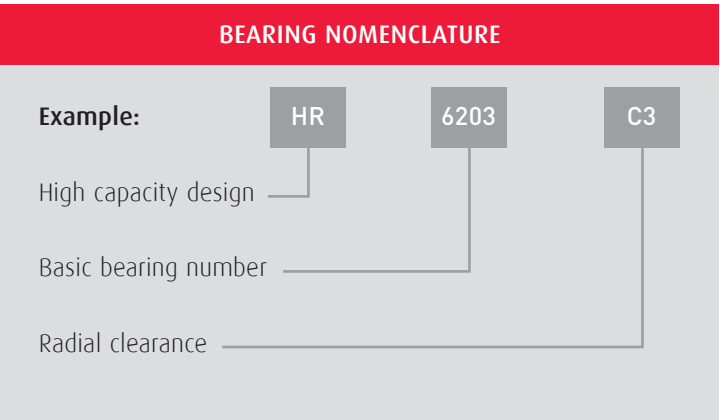
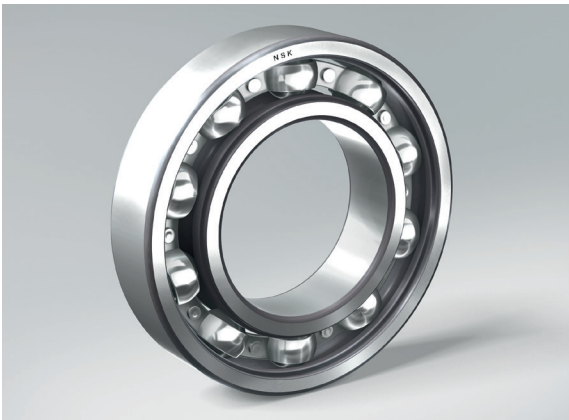
- › Long life under tough conditions

* See further information on page 20/21

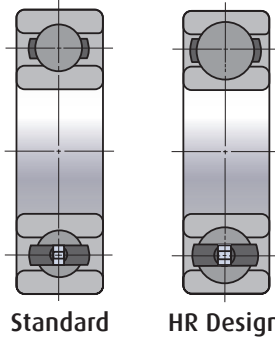
SPECIAL DEEP GROOVE BALL BEARINGS FOR PUMPS

HIGH CAPACITY DEEP GROOVE BALL BEARINGS

High capacity deep groove ball bearings (HR series) have bigger rolling elements than standard deep groove ball bearings. Typically this will provide a 7% to 19% increase in dynamic load rating, depending on size, resulting in a 22% to 68% increase in ISO L10 life. The HR series can dramatically improve the life of a machine or can be used to downsize existing machines.



Bigger rolling elements:
load capacity increased



| BORE DIAMETER (MM) | PARTS NO. | NEW HR SERIES | | STANDARD | | C _R INCREASED RATIO |
|-----------------------|-----------|-----------------------|-----------------|-----------------------|-----------------|-----------------------------------|
| | | Basic load rating (N) | | Basic load rating (N) | | |
| | | C _f | C _{or} | C _f | C _{or} | |
| 15 | 6202 | 8 550 | 3 950 | 7 650 | 3 750 | 1.12 |
| | 6302 | 13 300 | 5 900 | 11 400 | 5 450 | 1.17 |
| 17 | 6203 | 11 300 | 5 350 | 9 550 | 4 800 | 1.18 |
| | 6303 | 15 600 | 7 100 | 13 600 | 6 650 | 1.15 |
| 20 | 6304 | 18 200 | 9 050 | 15 900 | 7 900 | 1.14 |
| 25 | 6205 | 15 300 | 8 100 | 14 000 | 7 850 | 1.09 |
| | 6305 | 23 700 | 12 200 | 20 600 | 11 200 | 1.15 |
| 30 | 6206 | 23 300 | 12 800 | 19 500 | 11 300 | 1.19 |
| | 6306 | 29 800 | 15 800 | 26 700 | 15 000 | 1.12 |
| 35 | 6207 | 28 300 | 16 000 | 25 700 | 15 300 | 1.10 |
| | 6307 | 39 500 | 21 500 | 33 500 | 19 200 | 1.18 |
| 40 | 6208 | 32 500 | 19 900 | 29 100 | 17 800 | 1.12 |
| | 6308 | 47 000 | 26 200 | 40 500 | 24 000 | 1.16 |
| 45 | 6209 | 36 500 | 22 600 | 31 500 | 20 400 | 1.16 |
| | 6309 | 57 000 | 34 500 | 53 000 | 32 000 | 1.08 |
| 50 | 6210 | 39 000 | 25 800 | 35 000 | 23 200 | 1.11 |
| | 6310 | 66 500 | 40 500 | 62 000 | 38 500 | 1.07 |
| 55 | 6211 | 48 000 | 32 000 | 43 500 | 29 300 | 1.10 |
| | 6311 | 78 000 | 46 000 | 71 500 | 44 500 | 1.09 |
| 60 | 6212 | 58 000 | 38 000 | 52 500 | 36 000 | 1.10 |

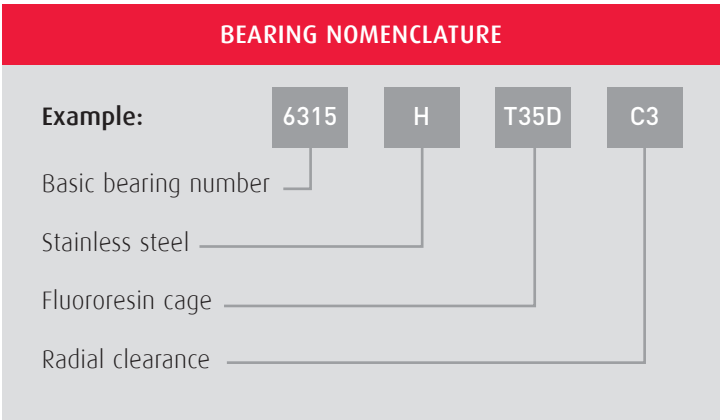
Standard HR series are open types. Shielded and sealed versions are also being produced. Please contact NSK.



SPECIAL DEEP GROOVE BALL BEARINGS FOR PUMPS

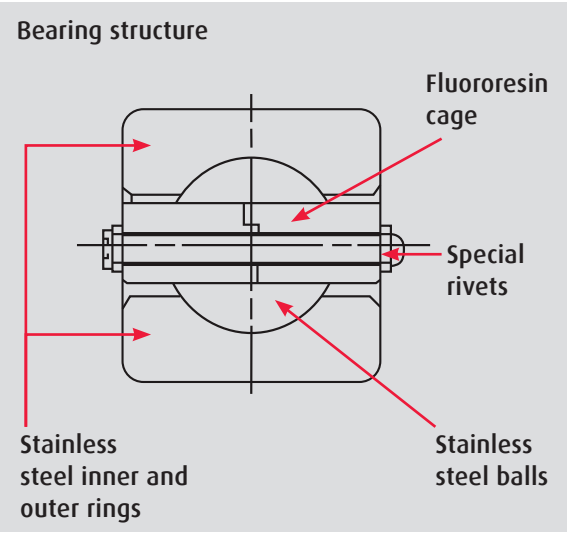
LNG PUMP BEARINGS

LNG pump bearings are employed as upper and lower support bearings on the mainshaft of a motor which drives the special pumps used for receiving and discharging LNG to road tankers and storage tanks. The bearings, immersed in Liquefied Natural Gas (LNG) at -162 °C, are using the cryogenic liquid as a lubricant while operating at speeds up to 3,600 rev/min.



To cope with these tough conditions, NSK developed deep groove* ball bearings using special materials. Rings and balls are made from martensitic stainless steel to provide corrosion resistance. The bearing cage is made from Fluororesin, a material that offers the extremely useful property of being self-lubricating, even at very low temperatures. This is significant because during operation, the cage – a two piece unit held together by special rivets – actually transfers a thin film of Fluororesin from the retainer pocket to the ball, and then to the raceway surface, maintaining good lubrication conditions. NSK LNG pump bearings extend service intervals in this very demanding environment.

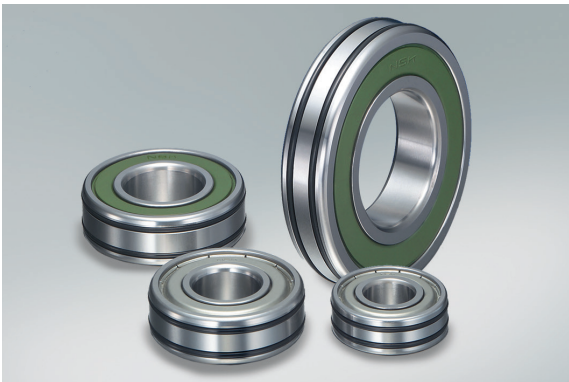
* Some sizes are also available as angular contact ball bearings.



SPECIAL DEEP GROOVE BALL BEARINGS FOR PUMPS
CREEP-FREE BEARINGS



NSK introduces a new bearing series that is indispensable in the pump free-end bearing position, and for any applications with creep problems. O-ring compression provides dramatically enhanced creep resistance. As the boundary dimensions are identical, the housing does not need to be reworked when replacing standard bearings. This results in reduced cost of the conversion.



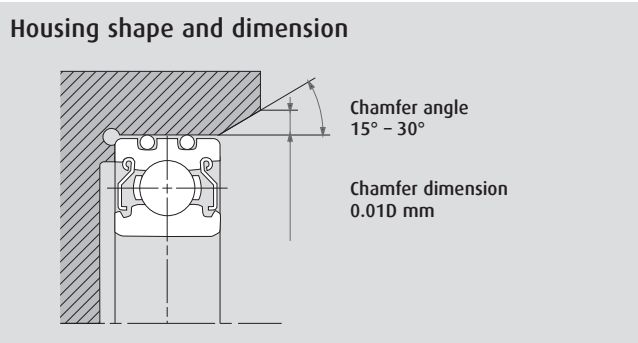
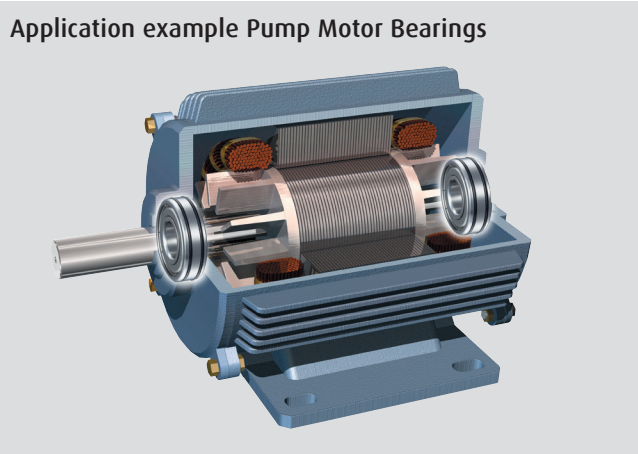
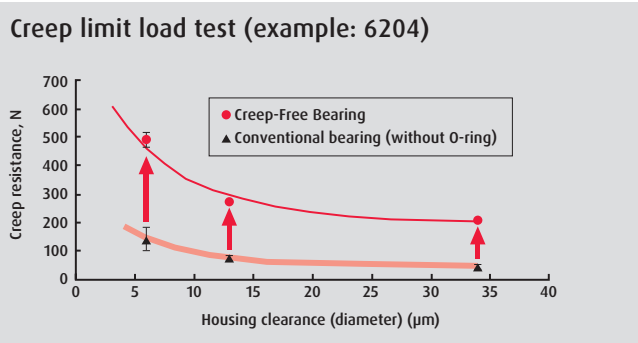
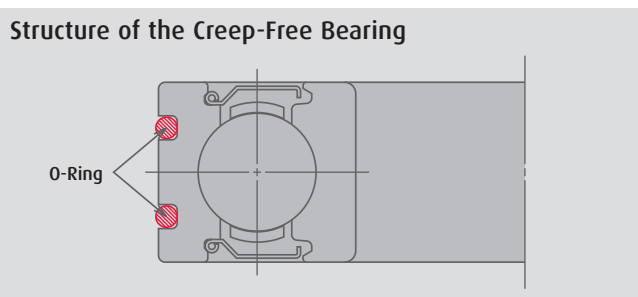
BEARING NOMENCLATURE

Example: CX 6203 ZZ C3

Creep-Free Bearing (with O-ring) points to CX
Basic bearing number points to 6203
Seal type points to ZZ
Radial clearance points to C3

| BEARING BORE DIAMETER | BEARING OUTER DIAMETER | BEARING WIDTH | BEARING LOAD RATINGS | | RECOMMENDED HOUSING FITS* | BEARING NUMBER | | | |
|-----------------------|------------------------|---------------|----------------------|---------------------|---------------------------|----------------|-------------|---------------------|------------------|
| d mm | D mm | B mm | C _r (N) | C _{0r} (N) | | Open type | Shield type | Contact seal type** | Non-contact type |
| 10 | 26 | 8 | 4 550 | 1 970 | G6 or H7 | CX-6000 | | | |
| | 30 | 9 | 5 100 | 2 390 | | CX-6200 | ZZ | DDU | VV |
| | 35 | 11 | 8 100 | 3 450 | | CX-6300 | | | |
| 12 | 28 | 8 | 5 100 | 2 370 | | CX-6001 | | | |
| | 32 | 10 | 6 800 | 3 050 | | CX-6201 | ZZ | DDU | VV |
| | 37 | 12 | 9 700 | 4 200 | | CX-6301 | | | |
| 15 | 32 | 9 | 5 600 | 2 830 | | CX-6002 | | | |
| | 35 | 11 | 7 650 | 3 750 | | CX-6202 | ZZ | DDU | VV |
| | 42 | 13 | 11 400 | 5 450 | | CX-6302 | | | |
| 17 | 35 | 10 | 6 000 | 3 250 | | CX-6003 | | | |
| | 40 | 12 | 9 550 | 4 800 | | CX-6203 | ZZ | DDU | VV |
| | 47 | 14 | 13 600 | 6 650 | | CX-6303 | | | |
| 20 | 42 | 12 | 9 400 | 5 000 | | CX-6004 | | | |
| | 47 | 14 | 12 800 | 6 600 | | CX-6204 | ZZ | DDU | VV |
| | 52 | 15 | 15 900 | 7 900 | | CX-6304 | | | |
| 25 | 47 | 12 | 10 100 | 5 850 | | CX-6005 | | | |
| | 52 | 15 | 14 000 | 7 850 | | CX-6205 | ZZ | DDU | VV |
| | 62 | 17 | 20 600 | 11 200 | | CX-6305 | | | |
| 30 | 55 | 13 | 13 200 | 8 300 | | CX-6006 | | | |
| | 62 | 16 | 19 500 | 11 300 | | CX-6206 | ZZ | DDU | VV |
| | 72 | 19 | 26 700 | 15 000 | | CX-6306 | | | |
| 35 | 62 | 14 | 16 000 | 10 300 | | CX-6007 | | | |
| | 72 | 17 | 25 700 | 15 300 | | CX-6207 | ZZ | DDU | VV |
| | 80 | 21 | 33 500 | 19 200 | | CX-6307 | | | |
| 40 | 68 | 15 | 16 800 | 11 500 | | CX-6008 | | | |
| | 80 | 18 | 29 100 | 17 900 | | CX-6208 | ZZ | DDU | VV |
| | 90 | 23 | 40 500 | 24 000 | | CX-6308 | | | |
| 45 | 75 | 16 | 20 900 | 15 200 | | CX-6009 | | | |
| | 85 | 19 | 31 500 | 20 400 | | CX-6209 | ZZ | DDU | VV |
| | 100 | 25 | 53 000 | 32 000 | | CX-6309 | | | |

* Although the recommended fits are G6 or H7, G6 is specified when conditions prioritize location under light pre-load.
** Low-contact seal available for seal type bearings. Contact NSK for details.



1. STRUCTURE AND PERFORMANCE OF CREEP-FREE BEARINGS
- Compression of the O-rings, which are mounted in two grooves on the outer ring, improve creep prevention. No special machining is required; bearings can be used with the same housing as standard bearings. In creep limit load tests, the more housing clearance is reduced, the greater the improvement in creep prevention. This is due to the compression of the O-ring mounted in the outer ring.
2. FEATURES AND APPLICATIONS OF CREEP-FREE BEARINGS
- Prevents creeping
O-ring compression prevents creep.
 - No special machining of the housing is required
Bearings can be replaced since boundary dimensions are identical to standard bearings.
 - Easy to assemble
Assembly is easy since bearings can be fitted with a loose tolerance.
 - Reusable housing
Very little abrasion occurs on the bore surface of the housing, making reuse possible.

3. NOTE ON MOUNTING CREEP-FREE BEARINGS

Housing shape and dimension: the housing shape must be in accordance with sketch. We recommend a groove and a chamfer, chamfer angle being between 15° and 30°, and its minimum dimension being 0.01 x Bearing Outer Diameter. For more information, please see NSK brochure “Creep Free Bearings”.



Centrifugal pump in a waste water treatment plant – Angular contact ball bearings are widely used in centrifugal pumps and screw compressors. Original Equipment Manufacturers are looking for more compact design of their machines leading to increasing load conditions for the bearings. The answer to this is the new HPS Series of angular contact ball bearings

Continually developing products with greater strength and higher accuracy, NSK introduces HPS (High Performance Standard) angular contact ball bearings. These bearings fully incorporate the advantages of NSK's world-class design, materials, and manufacturing technology, setting a new standard for bearings. This allows premium performance in each feature you can expect from an angular contact ball bearing: high speed, high load capacity, excellent running accuracy, and high reliability.

SPECIAL FEATURES OF THE NEW HPS ANGULAR CONTACT BALL BEARINGS

- › **High load capacity:** 5% increase compared to previous series. Thanks to improved steel cleanliness, optimum internal design and manufacturing process, NSK HPS bearings achieve higher load ratings resulting in an extended life time (up to 18%) or the possibility to downsize.
- › **High rotating speed:** Between 15 and 20% more than conventional series. Permissible speed has been increased by 15-20%, due to internal design, precise processing and manufacturing technology.
- › **High precision:** Improved dimensional and running accuracy. New HPS series are manufactured with P5 (ISO Class 5) running accuracy, and P6 (ISO Class 6) dimensional accuracy
- › **Universal matching:** In standard, every HPS bearing is manufactured with universal design to be mounted in a pair, triplex or quad set
- › **Tight axial clearance/preload tolerance:**
From 8 to 12 μm enabling precise shaft positioning
- › **Three high performance cages available**
T85: Polyamide 4-6, for general purpose applications
T7: L-PPS (Linear Poly-Phenylene Sulphide), for oil-injected screw compressors
MR: Machined brass (ball guided) for high reliability applications (including API pumps)



BEARING NOMENCLATURE

Example:

7310

B

EA

T85

SU

CNB

Series and bore number

Contact angle 40°

High load capacity

CNB: standard axial clearance

GA: light preload

Single Universal

T85: polyamide cage

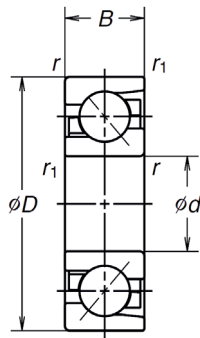
MR: ball guided brass cage

T7: L-PPS plastic cage

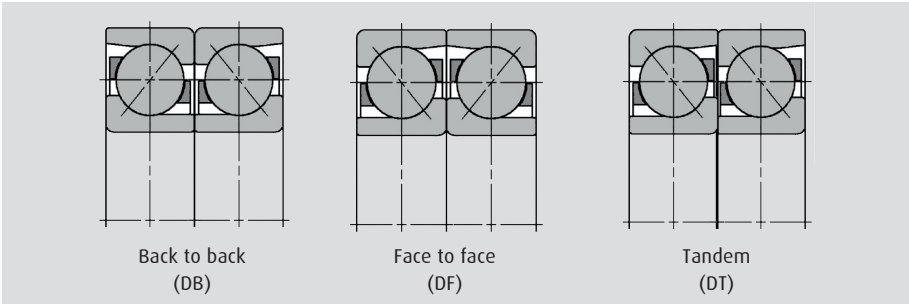
Matched Measured Axial Clearance (μm)

| BORE DIAMETER (MM) | | CNB | | GA | |
|--------------------|-------|------|------|------|------|
| over | Incl. | Min. | Max. | Min. | Max. |
| 12 | 18 | 17 | 25 | -2 | 6 |
| 18 | 30 | 20 | 28 | -2 | 6 |
| 30 | 50 | 24 | 32 | -2 | 6 |
| 50 | 80 | 29 | 41 | -3 | 9 |

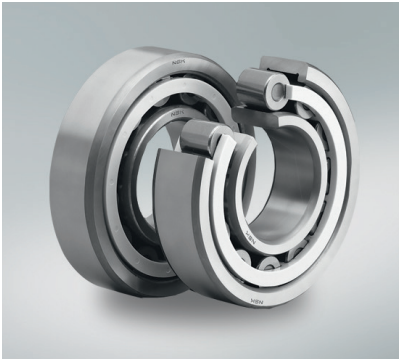
For DB and DF arrangements



Different possible arrangements: HPS bearings can be mounted in back-to-back pairs (DB) as well as face-to-face pairs (DF), or tandem (DT).



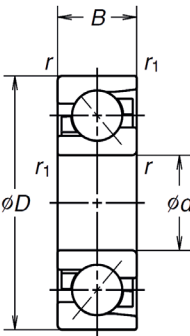
| BEARING NUMBERS | BOUNDARY DIMENSIONS (MM) | | | | | BASIC LOAD RATINGS (N) | | LIMITING SPEED (MIN ⁻¹) |
|-----------------|--------------------------|-----|----|---------|----------------------|------------------------|-----------------|-------------------------------------|
| | d | D | B | r (min) | r ₁ (min) | C _i | C _{0r} | |
| 7201BEA | 12 | 32 | 10 | 0.6 | 0.3 | 8 150 | 3 750 | 30 000 |
| 7301BEA | 12 | 37 | 12 | 1.0 | 0.6 | 11 100 | 4 950 | 26 000 |
| 7202BEA | 15 | 35 | 11 | 0.6 | 0.3 | 9 800 | 4 800 | 26 000 |
| 7302BEA | 15 | 42 | 13 | 1.0 | 0.6 | 14 300 | 6 900 | 22 000 |
| 7203BEA | 17 | 40 | 12 | 1.0 | 0.3 | 11 600 | 6 100 | 22 000 |
| 7303BEA | 17 | 47 | 14 | 1.1 | 0.6 | 16 800 | 8 300 | 20 000 |
| 7204BEA | 20 | 47 | 14 | 1.0 | 0.6 | 15 600 | 8 150 | 19 000 |
| 7304BEA | 20 | 52 | 15 | 1.1 | 0.6 | 19 800 | 10 500 | 18 000 |
| 7205BEA | 25 | 52 | 15 | 1.0 | 0.6 | 17 600 | 10 200 | 17 000 |
| 7305BEA | 25 | 62 | 17 | 1.1 | 0.6 | 27 200 | 14 900 | 15 000 |
| 7206BEA | 30 | 62 | 16 | 1.0 | 0.6 | 23 700 | 14 300 | 14 000 |
| 7306BEA | 30 | 72 | 19 | 1.1 | 0.6 | 36 500 | 20 600 | 13 000 |
| 7207BEA | 35 | 72 | 17 | 1.1 | 0.6 | 32 500 | 19 600 | 12 000 |
| 7307BEA | 35 | 80 | 21 | 1.5 | 1.0 | 40 500 | 24 400 | 11 000 |
| 7208BEA | 40 | 80 | 18 | 1.1 | 0.6 | 38 500 | 24 500 | 11 000 |
| 7308BEA | 40 | 90 | 23 | 1.5 | 1.0 | 53 000 | 33 000 | 10 000 |
| 7209BEA | 45 | 85 | 19 | 1.1 | 0.6 | 40 500 | 27 100 | 10 000 |
| 7309BEA | 45 | 100 | 25 | 1.5 | 1.0 | 62 500 | 39 500 | 9 000 |
| 7210BEA | 50 | 90 | 20 | 1.1 | 0.6 | 42 000 | 29 700 | 9 500 |
| 7310BEA | 50 | 110 | 27 | 2.0 | 1.0 | 78 000 | 50 500 | 8 000 |
| 7211BEA | 55 | 100 | 21 | 1.5 | 1.0 | 51 500 | 37 000 | 8 500 |
| 7311BEA | 55 | 120 | 29 | 2.0 | 1.0 | 89 000 | 58 500 | 7 500 |
| 7212BEA | 60 | 110 | 22 | 1.5 | 1.0 | 61 500 | 45 000 | 7 500 |
| 7312BEA | 60 | 130 | 31 | 2.1 | 1.1 | 102 000 | 68 500 | 6 700 |
| 7213BEA | 65 | 120 | 23 | 1.5 | 1.0 | 70 000 | 53 500 | 7 100 |
| 7313BEA | 65 | 140 | 33 | 2.1 | 1.1 | 114 000 | 77 000 | 6 300 |
| 7214BEA | 70 | 125 | 24 | 1.5 | 1.0 | 75 500 | 58 500 | 6 700 |
| 7314BEA | 70 | 150 | 35 | 2.1 | 1.1 | 124 000 | 87 500 | 6 000 |
| 7215BEA | 75 | 130 | 25 | 1.5 | 1.0 | 78 500 | 63 500 | 6 300 |
| 7216BEA | 80 | 140 | 26 | 2.0 | 1.0 | 87 500 | 70 000 | 6 000 |



FEATURES OF SCREW COMPRESSOR BEARINGS

- › **L-PPS plastic cage:** This plastic cage offers superior heat and wear resistance, cage strength, and chemical stability. These characteristics change little even if the bearing is exposed to compressor oil, refrigerants, or ammonia gas. L-PPS is greatly superior to traditional polyamide cage material.
- › **Increased load capacity:** The optimal bearing internal design associated with the L-PPS plastic cage provides higher bearing load ratings resulting in improved fatigue life.
- › **Increased axial load limit for angular contact bearings:** Higher load ratings result in increased axial load.
- › **Improved lubrication performance:** The optimised cage design is rolling element guided thereby allowing more internal free space, resulting in flow of lubricant improved.

Pictured (Upper): High load capacity Cylindrical Roller Bearings with L-PPS cage
Pictured (Lower): High load capacity HPS Angular Contact Ball Bearings with L-PPS cage

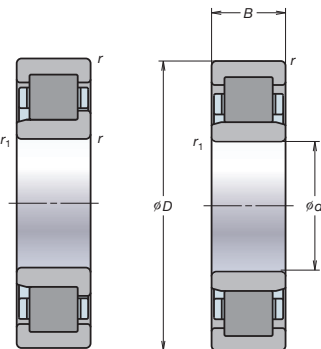


BEARING NOMENCLATURE (HPS ANGULAR CONTACT BALL BEARING)

Example: 7310 B EA T7 SU CNB

Series and bore number: 7310
Contact angle 40°: B
High load capacity: EA
L-PPS plastic cage: T7
SU: Single Universal
CNB: standard axial clearance GA: light preload

This screw compressor specification includes all HPS features, and L-PPS « T7 » cage.
Range: From 12 to 80 mm bore (7201BEA to 7216BEA))



BEARING NOMENCLATURE (HIGH LOAD CAPACITY CYLINDRICAL ROLLER BEARINGS)

Example: NU 310 E T7

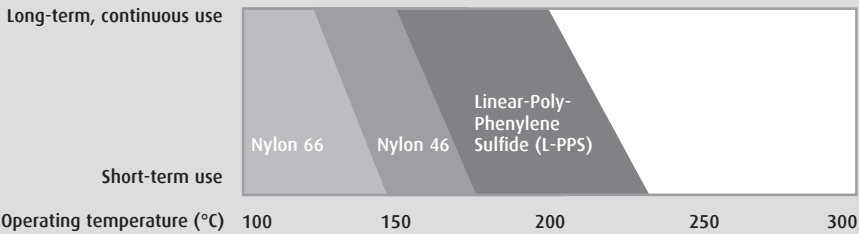
Bearing type: NU
Series and bore number: 310
High load capacity: E
L-PPS plastic cage: T7

This screw compressor specification includes high-capacity design, and L-PPS « T7 » cage.
Range: From 20 to 100 mm bore (NU204ET7 to NU2320ET7)

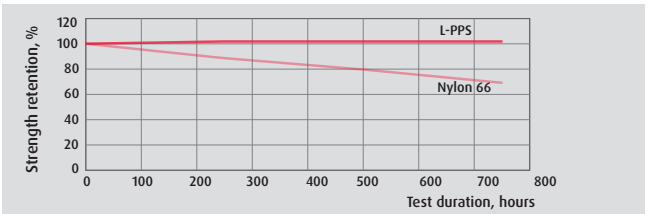
FEATURES OF CAGE MATERIAL

| Material | Nylon 66 | Nylon 46 | L-PPS |
|-----------------------|--------------------------|---|---|
| Features | › Standard cage material | › High crystallization rate provides superior high temperature strength › Superior heat resistance | › Greater heat resistance than nylon 46 › Superior resistance to oil and chemicals › Wear resistant › Good dimensional stability |
| Standard grade | › Contains fiberglass | › Contains fiberglass | › Contains fiberglass |
| Plastic melting point | › 262 °C | › 290 °C | › 280 °C |

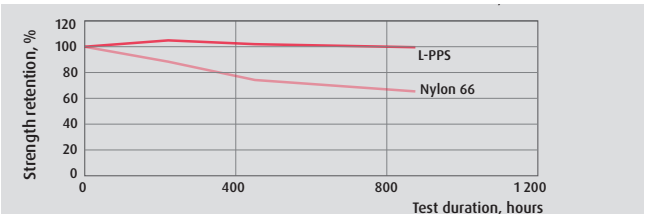
Target for heat resistance



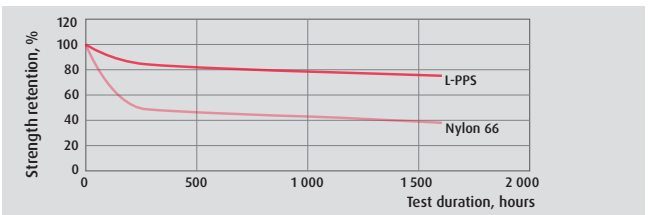
Performance of L-PPS cage material



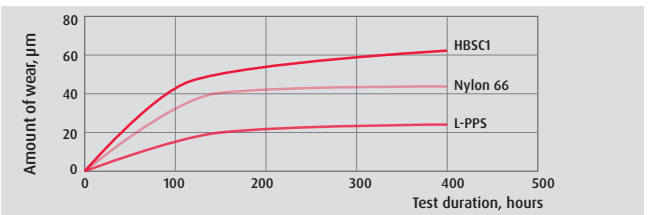
Resistance to compressor oil | Tensile strength – compressor oil at 150 °C



Heat resistance | Heat resistance at 180 °C



Resistance to gear oil | Tensile strength – gear oil at 180 °C



Wear resistance (µm)

PREVENTING CREEP ON SUBMERSIBLE PUMPS BEARINGS

Submersible pumps are widely used in a variety of applications such as construction, waste water, mining, agriculture and general industry. Most submersible pumps comprise of a vertical electric drive motor coupled directly to the impeller. They are required to operate for long periods with the minimum amount of maintenance.

BEARING ARRANGEMENT

The bottom, locating bearing, is generally a double row angular contact ball bearing or a pair of angular contact bearings. This reacts the axial load and radial load generated by the pumped fluid. The bearing is heavily loaded and needs to be correctly selected to reach target life. The top free bearing, is generally a deep groove ball bearing. This takes a light radial load. C3 clearance is generally used to compensate for clearance reduction due to heat generation from the electric motor.

CREEP PHENOMENON ON TOP BEARINGS

The lightly loaded top bearing should, theoretically, have a very long life. However, its life is sometimes drastically reduced by creep. The combined effect of light radial load and loose fit in the housing can result in creep between outer ring and housing. Creep is a phenomenon where relative slippage occurs between fitted surfaces. Creep produces a polish on the bearing ring surface, occasionally accompanied by scoring or wear.

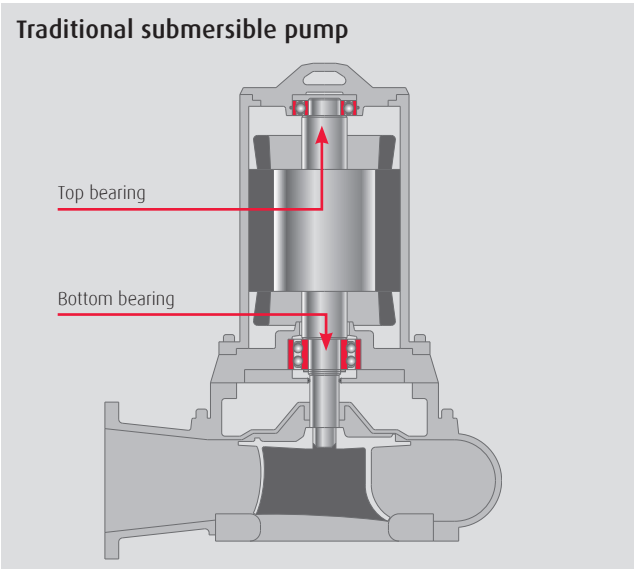
COUNTERMEASURE

One popular countermeasure used by pump manufacturers is to machine an annular groove in the housing bore and to insert an O-ring. The O-ring prevents creep between bearing outside diameter and housing.

NSK SOLUTION

NSK Creep-Free bearings offer more: with their integrated double O-rings, they provide better creep prevention. They provide submersible pump manufacturers with the following advantages:

- › Very good creep prevention
- › Easy assembly. The Creep-Free bearings can be fitted with a loose housing bore tolerance
- › Housing is re-usable as very little abrasion occurs on the housing bore
- › Cost reduction. Pump manufacturers do not need to machine a groove in the housing bore and insert their own O-ring.



Creep-Free bearing

REFRIGERANT SCREW COMPRESSORS WORKING WITH AMMONIA

Refrigerant compressors are designed specifically for air conditioning, heat pumping, and industrial refrigeration. Refrigerant compressors are specifically designed to be the heart of an industrial cooling or air-conditioning system (HVAC). They are integral components of the refrigeration cycle, in which refrigerant gases are cyclically evaporated and condensed. There are three main types of refrigerant compressors: scroll, screw, and piston.

BEARING ARRANGEMENT

Refrigerant screw compressors comprise of two screws in mesh. Gas enters at the inlet side and is gradually compressed along the screw. Compressed gas leaves through the outlet port. At the inlet, a cylindrical roller bearing is used on both male and female screw to carry the radial load. At the outlet, a cylindrical roller bearing is also used for radial loads. However, it is combined with a set of angular contact ball bearings which reach the high axial load associated with the compression. The common refrigerant gases such as Chlorofluorocarbons (CFCs) are now banned substances. New compressors are now exposed to Hydrochlorofluorocarbons (HCFCs) or Hydrofluorocarbons (HFCs). The problem of global warming and ozone layer depletion is driving the use of “natural” refrigerants such as carbon dioxide (CO2) or ammonia (NH3).

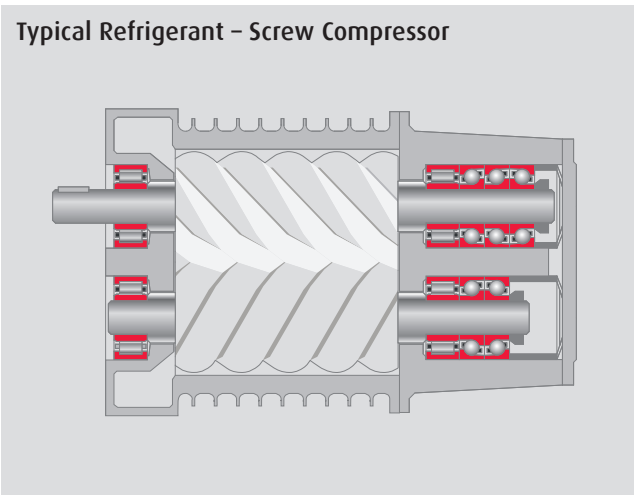
TROUBLES WITH CAGES WHEN USING AMMONIA

When using ammonia as a refrigerant, the oil used for lubrication should be miscible with ammonia. Consequently synthetic oils are necessary. Polyamide cages which are quite popular in screw compressors bearings are not suitable when operating above 70 °C with synthetic oils (which could contain additives). Ammonia also has an adverse effect on polyamide. There is a rapid ageing of the cage and a decrease in the strength which can lead to cage failure. Brass cages

show corrosion crack when in contact with ammonia. In the past, cages made of cast iron were used for ammonia compressors. Cast iron cages show good results but are not popular and are quite expensive.

NSK SOLUTION

For refrigerant screw compressors NSK offers its L-PPS cage for both cylindrical roller bearings and angular contact ball bearings. The L-PPS cage provides superior heat and wear resistance, cage strength and chemical stability characteristics that change little, even if exposed to compressor oil, refrigerants or ammonia gas.





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