



Standard catalog



myonic is an integral part of an international business. Its parent company, Minebea Co., Ltd., is the world's leading specialized manufacturer of miniature ball bearings and high precision components for the telecommunications, aerospace, automotive and electrical appliance industries.

The Minebea Group is comprised of 43 subsidiaries in 13 countries, and employs 50,000 people. In addition to its worldwide manufacturing capabilities, Minebea's vision is to lead the competition through extensive research and development of new methods and technologies.



Welcome to myonic a Minebea Company



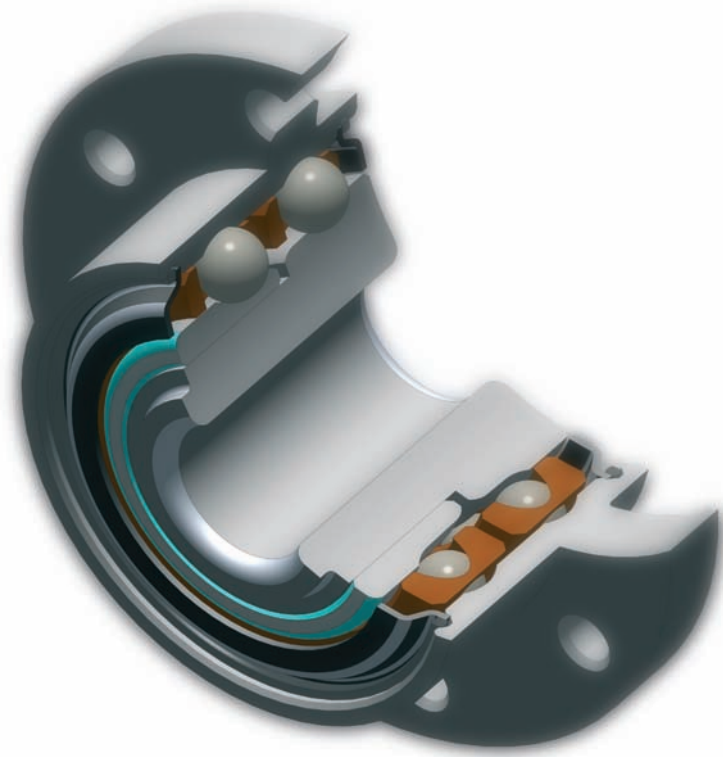
myonic GmbH
Leutkirch
Steinbeisstrasse



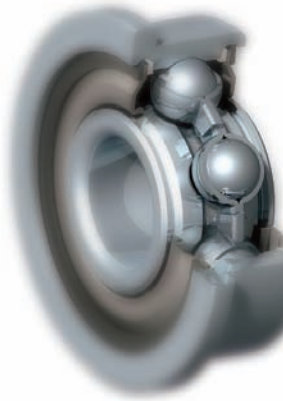
myonic GmbH
Leutkirch
Nadlerstrasse



myonic s.r.o.
Roznov
Czech Republic



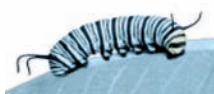
We started out small and have developed into a major market leader



Radial deep-groove ball bearing
Single-row, radial, deep-groove ball bearing with a flange



Radial deep-groove ball bearing
Single-row, radial, deep-groove ball bearing with an extended inner ring



Original size UL 103X

The early 1930s were difficult times for the Swiss clocks industry, but the people running the "La Champagne SA" clock factory in Biel/Bienne nevertheless quickly recognized the market potential in electricity, which was becoming increasingly important in daily life. This was because all electrical devices had one thing in common, and that was the fact that the way in which they worked was based on miniature ball bearings.

Consequently, in 1936 the company began to move successfully within the miniature world, quickly adopting the company name RMB. In 1969, a RMB miniature ball bearing took part in the moon landing - a giant leap not just for the company. In 1971, the "MKL-Miniaturkugellager GmbH Leutkirch" company that had been founded in 1969 was incorporated into RMB, and together they conquered the market.

Since December 2001, RMB has gone by the name "myonic", and in March 2009 the Minebea Group took over myonic as an independent company. Together with NHBB, myonic now represents a business unit within the Minebea Group. myonic is one of the world's leading suppliers in the fields of design, engineering, manufacture and assembly of precision ball bearings and system solutions. True to the motto:

myonic – more than a bearing

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myonic numbering system for bearings

Basic reference	Material	Features	Duplexed bearings	Ball cages	Precision grade	Radial play
UL 3006	X			-48	-A5P	-6/10
ULKZ 4008	X	.1c			-A7P	-
RKF 310	X	.1v			-P5P	-11/20
R 6190	X			-237HG	-P4P	-2/5
ULKU 8012	X			-48	-A9P	-2/10
RA 4012	X			-257HP	-A7P	
R 5160	X		.9d/1000			-16/20
Types listed Example :UL=type 3006=basic size of bearing bore and O.D in 1/32 of an inch or in millimeters for metric series	X=AISI 440 C Stainless steel > page 11	.1= 1 closure only .1c= 1 closure, flanged side .1v= 1 closure only, side opposite flange > page 12	Type of Mounting / Preload .9f= face to face .9d= back to back .9t= tandem 1000= preload of 10[N] > page 13	Type and material > page 14, 15	Dimensional and functional accuracy are according to ABEC or ISO Grades > page 16, 17	Lower/upper limits expressed in microns Standard radial play is 6/15 [µm] > page 18

Contact angle	Quietness	Torque	Coding of bores and outside dia	Special instruction	Lubrication
		-10/75D	-S2	-J...	-L23
					-G48
	-10/174				-G48/20
			-SB4/0C		G18/...mg
				-J...	-L96
-20/25°					-L23
			-S4/BB	-J...	-L23
Lower/upper limit Standard contact angle is 17/22° > page 18	10 $\hat{=}$ Limit 174 $\hat{=}$ measuring instrument	10 $\hat{=}$ limit [μ Nm] 75 $\hat{=}$ axial load [cN] D $\hat{=}$ starting torque > page 19, 20	Coding by dimensional groups > page 21	Letter J followed by a number refers to an internal document and covers any requirement that cannot be expressed by the preceding suffixes.	Lubrication code L = oil G = grease Example: -G48/20 = grease G48, dispersion 20% -G18/...mg = grease G18, dose...mg > page 22



CERTIFICATE OF APPROVAL

This is to certify that the Quality Management System of:

Myonic GmbH
Steinbeisstr. 4, 88299 Leutkirch
Nadlerstr. 6, 88299 Leutkirch
Germany

has been approved by Lloyd's Register Quality Assurance Limited, Coventry, UK, to the following Quality Management System Standards:

ISO 9001:2008
AS9100 Revision B

The certification has been performed in accordance with the requirements of EN 9104:2006

The Quality Management System is applicable to:

Development, production and sales of miniature ball bearings, micro precision and rotation systems.

This certificate forms part of the approval identified by certificate number KLN 4000606

Approval
Certificate No: KLN 4000807-18/A

Original ISO Approval: 1 April 2004

Original ASCS Approval: 23 March 2010

Current Certificate: 23 March 2010

Certificate Expiry: 22 March 2013

Issued by: Lloyd's Register Quality Assurance Limited



This document is subject to the provision on the reverse
71 Fenchurch Street, London EC3M 4BS United Kingdom, Registration number 1879370
This approval is carried out in accordance with the LRQA assessment and certification procedures and monitored by LRQA.
The use of the UKAS Accreditation Mark indicates Accreditation in respect of those activities covered by the Accreditation Certificate Number 001.
Macro Revision 13

Cleanliness is essential for proper performance of bearings but is particularly important for miniature bearings.

myonic achieves this cleanliness by:

- Complete temperature and humidity control and air filtration of all production departments.
- Ultrasonic cleaning of all components after each stage of manufacture.
- Cleaning of all component parts by our special methods, just prior to assembly.
- The assembly of bearings in class 10,000 clean rooms under class 100 laminar flow benches.
- Strict observation of clean room procedures for all personnel working therein.
- The cleaning of assembled product by processes specially designed and perfected by myonic for miniature bearings.
- The use of special filtered lubricants.
- The packing of finished bearings in clean pouches or tubes, hermetically sealed.

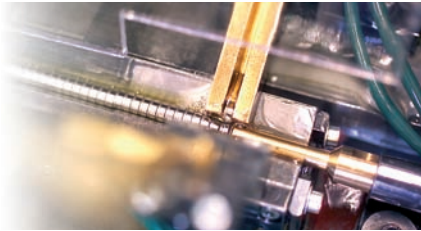
These examples give an indication of the effort myonic makes to supply their customers with bearings to the highest degree of cleanliness. Our customers also need to maintain this attention to detail. This may be achieved by observing the following points:

- All mating parts must be manufactured to correct tolerances as recommended in this catalog.
- The surface finishes of these parts must be satisfactory for the application in question and all components must be free of burrs, corrosion, etc.

- Any cleaning prior to final assembly should be done outside of the assembly area, with special attention paid to ensure the cleaned parts do not become contaminated during the transport process to the assembly area.
- The bearings should be assembled in a space arranged for this purpose and separate from other departments. It should, if possible, conform to clean room standards, with a dust free atmosphere and temperature and humidity control. Machining should not be done in the same room.
- The personnel employed in the assembly of miniature bearings should be subject to special rules of cleanliness. It is normal practice to equip them with coveralls or gowns and headress of special non-fibrous material. It should be strictly forbidden to smoke, eat, wear makeup, etc. within the confines of the clean room.
- Bearings should remain in their protective packaging until just prior to assembly. If the package contains several bearings, it should be opened in such a way that only one bearing may be taken out at a time.
- Bearings should be handled with tweezers or other special tools. One should never touch high precision miniature bearings with fingers unprotected by rubber or plastic finger cots or gloves.

Naturally, the more demanding the end application, the more stringently the guidelines above need to be enforced.

The markets are changing and we continue to consistently evolve



High-precision component production

myonic supports the customer at a very early product development stage with a highly qualified engineering team and the most modern equipment including laboratory, manufacturing and assembly. A dedicated and extremely flexible prototypemanufacturing cell provides short development cycles.

A consistently high quality is achieved by manufacturing critical components inhouse, and our semifinished component storage enables us to provide the highest flexibility and the shortest lead times in the market.



Clean-room assembly

The manufacturing area is located in a climate controlled environment, with the assembly in cleanrooms up to class 1000. We also offer our assembly competence as a service to a wide range of customers, with the keyword being: "Low cost assembly".

myonic evolves continuously through the development of strategic partnerships with market leaders and is thus the innovation partner for system solutions that are on the edge of technology – with the slogan:

"myonic – more than a bearing"



Monitoring and measuring facilities

The myonic bearings have ring materials per list below.

At myonic, all raw material batches used to manufacture every ball bearing component are inspected by the material laboratory manned by metallurgical and chemical engineers. This includes materials for rings, balls, cages, shields and seals. Each batch is analyzed and classified by its grain structure, homogeneity and microscopic cleanliness.

To assure the best raw material, myonic uses vacuum degassed steel and in many cases, double induction melted vacuum degassed steel. These steels are able to meet the highest degree of cleanliness and homogeneity.

myonic uses many different steels able to meet customer specific needs. Please contact our sales and technical engineers for assistance in selecting the correct material for your customized application.

Standard-Material

Suffix „X“

X105CrMo17 - DIN 1.4125 - AISI 440C

This is the standard material used mainly where corrosion resistance is an issue. The heat treatment of this material ensures a good hardness of 61 HRC, together with a corrosion resistance property.

Material on request

Suffix „XG“

X65Cr13 - DIN 1.4037

myonic introduced this stainless steel material many years ago, due to the particular microstructure of the grains. Tests at our internal R&D laboratory have shown that this material can, in many cases, ensure an improvement in the final noise level of the bearings, without any disadvantage in the corrosion resistance properties compared to the AISI 440 C.

Material on request

Suffix „V“

100Cr6 - DIN 1.3505 - AISI 52100

This chrome steel material, also known as bearing steel, is overall the most widely used material for manufacturing bearings of any size. Its composition corresponds to the AISI 52100 standard and assures a good uniform microstructure with a final hardness after heat treatment of 62 HRC.

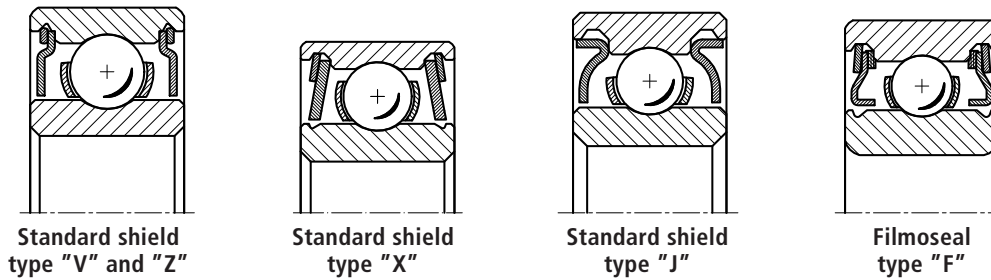
Material on request

Suffix „XA“

X30CrMoN15-1 - DIN 1.4108

This stainless steel contains a significant amount of nitrogen, which generates, together with the available carbon, a grain structure, which contains homogeneously distributed microglobular carbonitrides. The chromium content ensures corrosion resistance. The special microstructure provides improved macro mechanical abilities, especially with respect to hot hardness, ductility, bending fatigue limit and breaking elongation.

Please contact our application engineering department for suggestions on the most suitable steel for your application. For very demanding applications, our engineers will give you the right solution to your bearing application problems both by using standard myonic production steels or by employing exotic ones.



Closures in the form of shields or seals serve the basic purpose of:

- Excluding contamination during bearing handling or assembly.
- Protecting the internal features of the bearing during operation.
- Retaining and minimizing the loss of lubricant due to centrifugal effect.

myonic standard simple shields

myonic produces precision shields stamped from stainless steel material. These shields allow a basic protection against external contamination without contact with any bearing rotational part. This guarantees that there is no increased torque, noise level or operative temperature of the bearing. It should be noted that this type of closure does not guarantee complete protection against external dust contamination or penetration by fluids. Our simple shields are identified by one of the following suffixed: "V", "Z", "X" or "J". We can supply fixed or removable shields depending on the needs of your application.

Filmoseal by myonic a non-contact seal

A capillary seal, referred to as "Filmoseal" is an exclusive myonic design that is identified by the suffix "F" after the bearing type and before the size.

myonic developed this "Filmoseal" closure in order to have the advantage of a non-contact shield with the practical effect of a seal, by the capillary action of a film of oil. This is accomplished by the ingenious design of the shields and by the special groove in the inner ring.

This design considerably enhances circulation and reten-

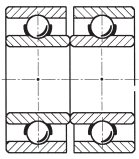
tion of lubricant within the bearing, avoiding external contamination. The fitting of an oil tight Teflon gasket in the outer ring further assists and prevents lubrication loss. This non-contact seal is recommended when either high speeds or contamination protection are required or when the bearing is subject to high centrifugal forces.

"Filmoseal" by myonic is particularly effective when the outer ring is rotating because the hermetic seal between shield and outer ring avoids any loss of lubricant without any increase of friction, noise or temperature.

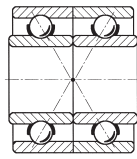
myonic special closures

myonic can develop special seals and shields to accommodate the highest customer demands. Please contact our sales engineers or technical staff for further assistance in this area.

**Mounting face to face (suffix .9f)
or X-configuration**

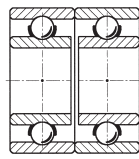


before mounting

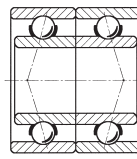


after mounting

**Mounting back to back (suffix .9d)
or O-configuration**

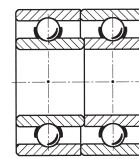


before mounting

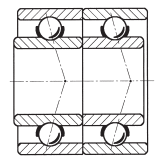


after mounting

Mounting in tandem (suffix .9t)



before mounting



after mounting

Preload and duplex mounting

Preloading radial or angular contact ball bearings is done to increase rigidity, improve running accuracy and avoid the skidding of balls at very high speed or during acceleration/deceleration. The preload of a ball bearing is generally achieved by an axial load acting on the bearing ring face generally applied by springs or by pre-defined fixed preloads built in during machining.

Spring Preload

A spring preload is achieved by using one or more spring washers acting with a predefined axial force against the outer ring or inner ring face of the sliding bearing. When the inner ring is rotating, the spring washer is applied on the outer ring (sliding fit) while when the outer ring is rotating, the spring washer is applied on the inner ring (sliding fit). myonic manufactures very high precision stainless steel spring washers for every standard bearing listed in our standard catalog. It is extremely important that the parallelism of the faces of the washers be held to very tight tolerances in order to ensure proper preload and prevent misalignment of the bearings.

Fixed Preload (Duplexing)

In order to preload two or more bearings with greater accuracy, it is necessary to manufacture the rings as shown in figures. The amount of the gap varies depending on the desired amount of preload. Once the ring faces are machined to allow for the gap, the bearings will be preloaded when clamped together in the final assembly.

“Face to face” or “X” preloading (suffix .9f)

In this arrangement, the contact lines converge so that the effective distance between the bearing centers is decreased. This configuration has the advantage to allow a better accommodation of the bearing set in the event precise alignment cannot be achieved. It is a more forgiving process but still allows for some rigidity in the system.

“Back to back” or “O” preloading (suffix .9d)

In this adjustment, the lines of contact angle diverge so that the effective bearing distance of the center is increased.

This configuration is mainly used when high speed is required and has the advantage of increasing the tilting moment when external radial forces are applied.

“Tandem mounting” (suffix .9t)

Bearings can also be matched in a tandem mounting arrangement. In this approach, the contact lines are parallel and the radial and axial external forces are shared. The advantage of this configuration is the higher axial capacity in one direction. Normally, another bearing or set of tandem bearings is used on the other end of the shaft to provide for any axial force in the reverse direction.

Principal cages produced by myonic



myonic standard tightly crimped two piece ribbon cage; Type "480"

This is a two-piece stamped ribbon cage. It is satisfactory in the majority of applications where demands are not extreme. It may be used where there are no requirements for low starting or running torque, in medium to high speed applications or when adequate lubrication is assured. This cage type is supplied as standard in most myonic radial miniature bearings where contamination, misalignment and high acceleration/ deceleration are not factors. When the speed factor exceeds $400,000 \frac{n \cdot D_m}{1}$ (n =speed in rpm; D_m =pitch diameter in mm) it is recommended that you contact our engineering department for further advice.



myonic type "48" loosely crimped two piece ribbon cage for low torque

A very light two-piece stamped ribbon retainer, which rides on the inner ring, it is excellent for eliminating the problem of low torque hang up. This cage type replaces and gives better performance than a spring separator, single piece crown or comb separator. myonic designed the cage "48" specifically for low torque and relative low speed applications because it virtually eliminates the risk of cage "hang-up". For speed factors above $5,000 \frac{1}{\text{min}}$, it is recommended you contact our engineering department.



myonic crimped two piece coated ribbon cage

The standard two piece ribbon type "480" as well as the Type "48" cage may be coated with a thin layer of Teflon, silver, gold or other materials providing self-lubrication when conventional lubricants cannot be used. Teflon coated cages are used in application requiring long term shelf life capabilities, in instruments operating in vacuum and in close proximity to optics. We strongly recommend you to consult our engineering department and/or make practical test on the final application before using any coated cages.

Cages

The retainer, often referred to as "cage" or "separator" is the component of a ball bearing that keeps the balls separated around the pitch circle of the bearing. In order to optimize the performance of any given bearing, myonic has designed and developed many different types of retainers of many different types of materials. A universal ball retainer that would be capable of satisfying all possible requirements simply does not exist. For selecting the best possible retainer, the many requirements to be considered include:

- Starting and running torque.
- Rotational speeds.
- Acceleration and deceleration.
- Operating temperature.
- Lubrication type and amount.
- Application environment (vacuum, chemical agents, etc.).
- Noise requirements.
- External vibrations.
- Self lubricating characteristics.



myonic type "23" cage for high speed applications

This is a crown or comb type moulded retainer that can be machined or molded from a range of synthetic materials. With the correct type of base material, this type of retainer can be supplied either oil impregnated in order to achieve longer life or completely dry when environmental conditions do not permit lubrication with conventional lubricants. The cage "23" is used in myonic's high speed applications requiring speeds up to 1.3 million $n \cdot D_m$ (n =speed in rpm; D_m =pitch diameter in mm). When more extreme speeds are required we suggest you contact our technical office where you can get the best advice for the solution to your application.



myonic type "25" cage for high speed angular contact bearings

This is a solid, one-piece machined or molded cage. Cage type "25" has been expressly designed for the bearing series RA and RKA -Angular contact bearings. When possible this cage may be supplied oil impregnated in order to achieve longer life. The ball pockets are counter bored in order to retain the balls within the cage to allow the bearing to be separable. This design enables the removal of the inner ring from the bearing without any risk that the balls will fall out, allowing separate mounting of the two rings where appropriate. The cage "25" is used in myonic's bearings for applications requiring speeds up to 1.5 million $n \cdot D_m$ (n =speed in rpm; D_m =pitch diameter in mm).



myonic type "27" cage for high speed angular contact bearings

This retainer is very similar to the "25" cage with the exception that the ball pockets are through-bored. The balls are not retained in the cage if the inner ring is removed in this design. This cage type has the advantage of allowing a lower torque than the "25" cage type. The cage "27" is used in myonic's high-speed applications requiring speeds up to 1.6 million $n \cdot D_m$ (n =speed in rpm; D_m =pitch diameter in mm). When more extreme speeds are required we suggest you contact our technical office where you can get the best advice for the solution to your application and/or make practical test on the final application.

Cage Materials

myonic can offer many metals and synthetic materials for cages, including but not limited to:

- Phenolics, cotton based
- PI
- POM
- PEEK
- Nylasint
- Teflon
- Vespel
- resin fiber reinforced (per myonic patent)

Each of the above materials has its advantages and benefits depending on the application, lubrication and operating environment. We strongly recommend you contact your nearest myonic sales office or our technical staff who will assist you in determining the best retainer material for your application

myonic dedicated special cage design

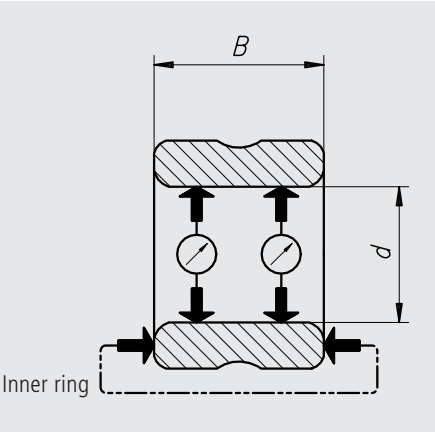
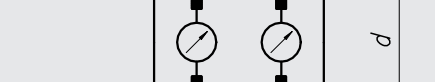

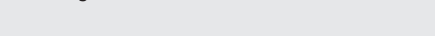
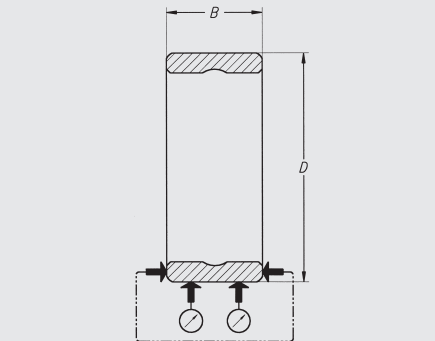
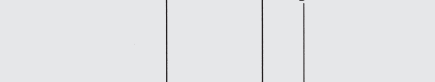
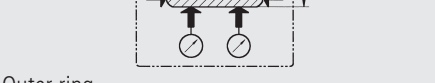
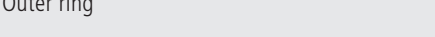
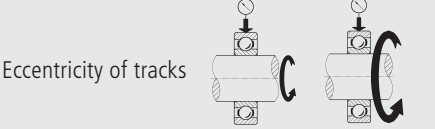
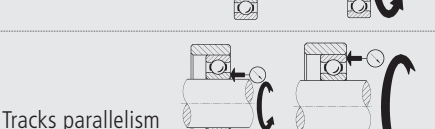
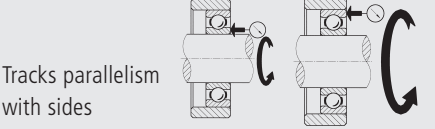
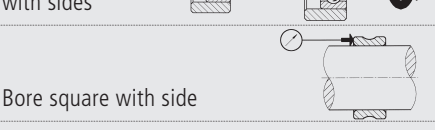
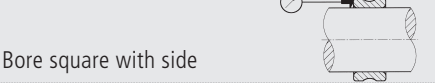
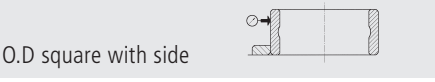
In the event that none of the above standard cage types satisfy the needs of the customer's application, myonic is also able to manufacture special and fully dedicated designs. Our R&D department is continually testing new innovative materials and cage design able to achieve peak performances. Please contact our sales engineers or our technical staff who will be glad to help select the proper solution to your application challenge.

Limits of dimensional and functional accuracy of radial bearings

Precision

All myonic miniature ball bearings are manufactured according to ISO and/or ABEC precision accuracy. The International Standard Organization (ISO) defines norms that are used for the accuracy of metric dimension bearings, while the Annular Bearings Engineers Conference (ABEC) are used generally for inch dimension bearings. myonic manufactures to both accuracy standards.

Limits of dimensional and functional accuracy of radial ball bearings in [μm]

	Grade ISO 492		2	4	
	ABEC	myonic suffix	P2	A9P	7P
 <p>Inner ring</p>	$\frac{d_{\text{max}} + d_{\text{min}}}{2} = d_m$	Δd_{mp}	max 0	max 0	max 0
			min -2.5	min -2.5	min -5*
	Absolute limits bore diameter d	Δd_s	max 0	max 0	max 0
			min -2.5	min -2.5	min -5*
	Deviation from roundness	V_{dsp}	bore max 0.8*	–	–
			raceway max 0.5	–	–
	Width B	ΔB_s	max 0	max 0	max 0
			min -25	min -25	min -40
	Deviation from parallelism	V_{B_s}	max 1.5	max 1.25	max 2.5
 <p>Outer ring</p>	$\frac{D_{\text{max}} + D_{\text{min}}}{2} = D_m$	ΔD_{mp}	max 0	max 0	max 0
			min -2.5	min 2.5	min -5*
	Absolute limits outside diameter D	ΔD_s	max 0	max 0	max 0
			min -2.5	min -2.5	min -5*
	Deviation from roundness		of d or D max 0.5	–	–
			raceway max 0.8*	–	–
	Width B	ΔC_s	max 0	max 0	max 0
			min -25	min -25	min -25
	Deviation from parallelism	V_{C_s}	max 1.5	max 1.25	max 2.5
 <p>Eccentricity of tracks</p>	Inner ring	K_{ia}	max 1.5	max 1.25	max 2.5
 <p>Outer ring</p>	Outer ring	K_{ea}	max 2*	max 1.25	max 5*
 <p>Inner ring</p>	Inner ring	S_{ia}	max 2*	max 1.25	max 2.5*
 <p>Outer ring</p>	Outer ring	S_{ea}	max 4*	max 1.25	max 5
 <p>Inner ring</p>	Inner ring	S_d	max 2*	max 1.25	max 2.5*
 <p>Outer ring</p>	Outer ring	S_D	max 2*	max 1.25	max 3.75

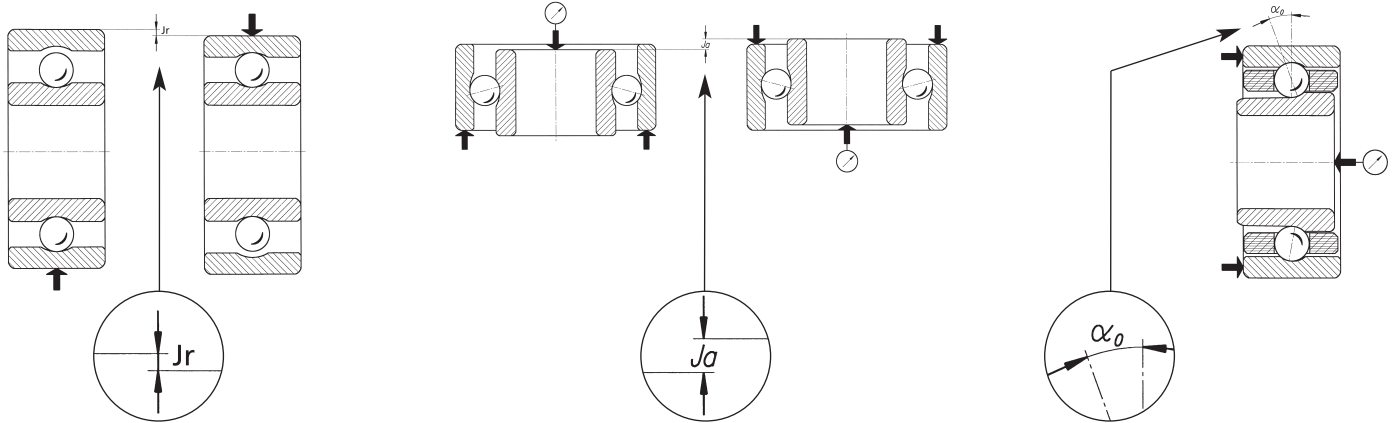
* deviating from standard

Limits of dimensional and functional accuracy of radial bearings

myonic's high precision manufacturing and assembly processes allow us to manufacture bearings from ISO 5P and/or ABEC 5P, through ISO2 and/or ABEC 9P.

For the most demanding applications, myonic manufactures bearings with stricter tolerances than required by the standards, even at their highest level. Our sales and technical engineers will guide you through the best solution for your application.

5		6		0		
5P		3		1		
P5P	A5P	P6	A3	–	A1	
0	0	0	0	0	0	Limits for the arithmetical mean of all the measurements taken in two planes (dm = mean inner diameter).
-5	-5	-7	-5	-8	-7.5	
0	0	+1	+2.5	+1	+2.5	Limits for the absolute value of the smallest and the largest inner diameter measured in two planes
-5	-5	-8	-7.5	-9	-10	
–	–	2	–	–	–	Maximum difference tolerated by myonic between the two concentric circles traced respectively inside and outside of the line of a polar diagram.
–	–	2	–	–	–	
0	0	0	0	0	0	Absolute upper and lower limits of the width of the inner ring
-25	-25	-40	-125	-40	-125	
5	5	12	–	12	–	Maximum difference between the smallest and the largest measured width.
0	0	0	0	0	0	Limits for the arithmetical mean of all the measurements in two planes. (Dm = mean outer diameter)
-5	-5	-7	-7.5	-8	-10	
0	0	+1	+2.5	+1	+2.5	Absolute upper and lower limits of the outer diameter measured in two planes.
-5	-5	-8	-10	-9	-12.5	
–	–	2	–	–	–	Maximum difference tolerated by myonic between the outlines of two concentric circles traced respectively inside and outside of the line of a polar diagram.
–	–	3	–	–	–	
0	0	0	0	0	0	Absolute upper and lower limits of the width of the outer ring.
-25	-25	-40	-125	-40	-125	
5	5	–	–	–	–	Maximum difference between the smallest and the largest measured width.
5*	3.75	5	5	10	7.5	Limits of total indicator deviation during one revolution of the inner ring, the outer ring remaining stationary.
5	5	8	10	15	15	Limits of total indicator deviation during one revolution of the outer ring, the inner ring remaining stationary.
7.5	7.5	–	–	–	–	Limits of the total indicator deviation during one revolution of inner ring, the outer ring remaining stationary. (Limits for the runout of the track in relation to the sides).
7.5	7.5	–	–	–	–	Limits of total indicator deviation during one revolution of the outer ring, the inner ring remaining stationary.
7.5	7.5	–	–	–	–	Limits of total indicator deviation during one revolution of the inner ring.
7.5	7.5	–	–	–	–	Limits of total indicator deviation during one revolution of the outer ring.



Radial play (J_r)

Radial play is not an indication of the quality of the bearing, but its selection is one of the most important parts of the bearing specifications. Without sufficient radial play, interference fits (press fits) and normal expansion of components cannot be accommodated, causing binding and potential early failure.

Radial play of the mounted bearing also influences the operative bearing contact angle, which will affect bearing radial and axial capacity, stiffness, life and other basic performance characteristics. Mounting considerations impacting radial play are noted in our section on shaft and housing tolerances.

Higher values of radial play are beneficial where high speeds create higher heat and where thrust loads predominate. Low values of radial play are better suited for predominately radial loads.

The standard radial play of myonic radial ball bearings is from 6 to 15 [μm] (.0002" to .0006"). On request, bearings may be supplied with reduced or greater radial play.

Please contact our sales engineers or technical staff to help you with the proper selection of radial play for your application.

	Groups			
Radial play [μm]	2 to 5	6 to 10	11 to 15	16 to 20
Suffix	2/5	6/10	11/15	16/20

Axial play (J_a)

The axial play of a bearing is equal to the total axial displacement of the inner ring relative to the outer ring under the effect of a small measuring force. Axial play is a function of the curvature of the races.

Contact angle (α_0)

The contact angle of a radial ball bearing or an angular contact ball bearing is the angle formed by the straight line perpendicular to the axis and that which passes through the contact points of the balls in the races after eliminating any radial play.

The contact angle is a function of the radial play, ball size and the radius of curvature of the ball races. It increases slightly when an axial external load is applied on the bearings.

The standard contact angle of myonic radial ball bearings is from 17° to 22°.

The greater the contact angle, the higher is the axial capacity of the bearings, this means the capability to support axial load is increased.

Please contact our technical application engineers who will be pleased to recommend the appropriate contact angle for your application.

	Groups				
Contact angle α_0	11° to 16°	14° to 19°	17° to 22°	20° to 25°	23° to 28°
Suffix	11/16°	14/19°	17/22°	20/25°	23/28°

Sensitivity

The criteria for bearing sensitivity are very complex and still the subject of study. Research and experience have established some of the essential factors on which sensitivity depends:

- The geometric precision, design and quality of the surface of the race way tracks.
- The geometric precision of the balls.
- The material used for balls and rings.
- The design, material and guidance of ball retainers.
- The characteristic, quantity, quality and disposition of lubricant.
- The precision of housing and shaft where the bearings are mounted.
- The fit tolerances and final play is taken up when mounting the bearings.
- The value and direction of external loads.
- The position of the bearing shaft.

Different projects for the standardization of this measurement are still under investigation. myonic have been guided by these in developing their own method which is based on practical experience on real application and test at its R&D department.

The sensitivity of the bearings is determined by the interpretation of the relative value of one or several of the following forces:

- Starting torque
- Running torque
- Hang-up resistance

In the majority of torque measuring instruments, the bearing to be measured is subjected to a pure axial load (which is principally distributed equally on all the balls of the bearing).

The axial load will be:

75 cN for bearings up to 10 mm outer diameter inclusive or .375" (9.525 mm) outer diameter inclusive for inch size bearings.

400 cN for bearings exceeding 10 mm outer diameter or .375" (9.525 mm) outer diameter for inch size bearings.

Starting torque value for instrument ball bearings

The maximum starting torque value listed below are those specified in AFBMA Standards for instrument bearings. They are valid for ABEC 7P quality bearings (open or closed) in both stainless steel AISI 440C or carbon chrome steel AISI 52100 fitted with a two piece ribbon cage and lubricated with instrument oil.

They are subjected to the specific definition and test condition defined in that standards. These values can be taken as the maximum which would apply to myonic bearings in this category.

Inner Ø d [inch]	Outer Ø D [inch]	Test load [N]	Maximum starting torque [µNm] Radial internal clearance		
			Tight-fit .0001"-.0003" 2-8 µm	Normal-fit .0002"-.0005" 5-12 µm	Loose-fit .0005"-.0008" 12-20 µm
.0400	.1250	.75	18	15	14
.0469	.1563	.75	18	15	14
.0550	.1875	.75	18	15	14
.0781	.2500	.75	18	15	14
.0938	.3125	.75	18	15	14
.1250	.2500	.75	18	15	14
.1250	.3125	.75	18	15	14
.1250	.3750	.75	20	16	15
.1250	.3750	4	50	45	42
.1250	.5000	4	50	45	42
.1563	.3125	.75	18	15	14
.1875	.3125	.75	18	15	14
.1875	.3750	.75	20	16	15
.1875	.5000	4	65	55	50
.2500	.3750	.75	18	15	14
.2500	.5000	4	60	52	48
.2500	.6250	4	70	60	55
.2500	.7500	4	80	70	65
.3750	.8750	4	110	95	90

Code for grading by dimensional groups

To facilitate fitting the bearings in the housing and on the shaft, bearings can be supplied with inner diameters and/or outer diameters graded in dimensional groups.

		Outer Diameter D						
Tolerance Range in μm		0 -2,5	-2,5 -5	0 -1,25	-1,25 -2,5	-2,5 -3,75	-3,75 -5	not graded
μm	Code	1	2	A	B	C	D	0
Inner Diameter d	0 -2,5	1	11 12	1A	1B	1C	1D	10
	-2,5 -5	2	S2	SN2-SB4			SN2	
	-0 -1,25	A	A1 A2	AA	AB	AC	AD	A0
	-1,25 -2,5	B	B1 B2	BA	BB	BC	BD	B0
	-2,5 -3,75	C	SN4-SB2	S4			SN4	
	-3,75 -5	D	C1 C2	CA	CB	CC	CD	C0
	not graded	0	D1 D2	DA	DB	DC	DD	D0
			01 02	0A	0B	0C	0D	no Suffix

Suffixes

S4	d = $\begin{matrix} 0 \\ -1.25 \end{matrix}$	1 st letter = A	}	group AC
	D = $\begin{matrix} -2.5 \\ -3.75 \end{matrix}$	2 nd letter = C		

S2	d = $\begin{matrix} 0 \\ -2.5 \end{matrix}$	1 st number = 1	}	group 12
	D = $\begin{matrix} -2.5 \\ -5 \end{matrix}$	2 nd number = 2		

Special cases

If one of the two diameters ("d" or "D") is not graded, this diameter is represented in the code by the numeral 0 for instance.

SB2	d = not graded = 0	}	group 01
	D = $\begin{matrix} 0 \\ -2.5 \end{matrix}$ = 1		

SN4	d = $\begin{matrix} 0 \\ -1.25 \end{matrix}$ = A	}	group A0
	D = not graded = 0		

Note: The dimensional group code number is shown on each package of coded bearings, myonic cannot undertake to supply all the bearings of one delivery in a single group.

For miniature ball bearings, the lubricant and method of lubrication is one of the most important factors that will determine the ultimate success of the design. Because of their size, miniature ball bearings may demonstrate significant performance differences from the use of one lubricant to another. The choice of lubricant, the amount and its placement within the bearing are critical factors and the following characteristics should be taken into consideration:

- Rotational speed of inner and / or outer ring.
- Operational rotation condition (intermittent, continuous, tilting etc...).
- External loads (axial, radial tilting).
- Bearings operational temperature and ambient temperature.
- Admissible noise level.

- Expected life time.
- Storage before use.
- Ambient environment where the bearings work (vacuum, chemical agents etc...).
- Starting and running torque required.

Our R&D department develops tests in conjunction with our lubricant suppliers to ensure consistency in the product we receive.

Hundreds of types of oils and greases together with solid lubricants have been tested and are available to meet the most demanding of applications.

Please contact our sales and technical application engineers who will offer the proper lubrication based on their years of experience in this area.

myonic Standard Lubricants

Stocks are normally available with the following standard lubricants

Radial ball bearings with closures, outside diameter <9 mm	L23
Radial ball bearings with, outside diameter \geq 9 mm	G48
Angular contact bearings	G48
Thrust bearings	G48

Lubricant information is tabulated on page 23.

Please note the operating criteria listed are obtained from the respective manufacturers' literature.

When working conditions cannot be exactly specified, practical lubricant tests are essential.

The list of lubricants should not be taken as exclusive. myonic will be pleased to supply other lubricants providing they are readily obtainable.

Characteristics of oils and greases most widely used by myonic

Oiles

Code	universal applications	high speed	high speed and high temperature	high temperature (>200°C)	low temperature (<30°C)	low starting torque	low noise
L2		x			x	x	x
L23	x		x				x
L25				x			

Reference	Code	Operating temperature range in °C	Peak temp. for short period in °C	Viscosity in [cSt] at 20°C	Flash point °C	Solidifying point in °C	Military specification USA
Isoflex PDP 38	L 2	-65 to + 100	-	23	+205	-70	-
Winsor L 245X	L23	-54 to + 177	+204	24	+216	-60	MIL-L-6085D
Krytox 143 AB	L25	-40 to + 232	-	230	+215	-40	-

Greases

Code	universal applications	high speed	high speed and high temperature	high temperature (>200°C)	low temperature (<30°C)	low starting torque	low noise	H1 approval
G21					x			
G48	x							
G58		x						
G79			x					
G86							x	
G90				x				
G100		x						
G144		x						
G163		x						x

Reference	Code	Operating temperature range in °C	base oil viscosity in [cSt]	Penetration according to ASTM at 25°C	Dropping point °C	thickener base	Military specification USA
Nye Instrument 704C (Aeroshell grease 7)	G21	-73 bis +150	3 / 100°C	290	+260	Bentone Clay	MIL-PRF-23827C
Turmogrease Li 802 EP plus	G48	-35 bis +140	82 / 40°C	265-295	> 190	synthetisch	-
Klüber Isoflex LDS 18 Special A	G58	-50 bis +120	15 / 40°C	280	+185	Lithium	-
Klüber Topas NB 52	G79	-50 bis +150	30 / 40°C	280	+240	Barium	-
Asonic GLY 32	G86	-50 bis +140	25 / 40°C	280	+190	Lithium	-
Klüber Barrierta	G90	-40 bis +260	400 / 40°C	280			
Nye Rheolube 740 S	G100	-30 bis +120	110 / 40°C	265	+240	Polyurea	-
myonic high speed lube	G144	-40 bis +200	46 / 40°C	340	> 200	Polyurea	-
myonic H1 high speed lube	G163	-40 bis +200	46 / 40°C	325	> 200	Polyurea	-

Correct mounting is of prime importance for the good performance of small bearings.

Experience has shown that the majority of cases of poor performance and undue wear are due to incorrect mounting. It is therefore recommended to take careful note of the following points:

The choice of fit

Good operation of bearings depends very largely on the quality of their fit. To obtain a satisfactory fit it is necessary to take into account:

- The quality of the surface finish and the geometric precision of the shaft and the housing. They influence the sensitivity and the noise level as well as the good running of a bearing intended for high speeds.
- Variations of temperature. In the case of a higher temperature, the radial expansion of a light metal housing loosens the outer ring while the radial expansion of a light metal shaft reduces radial play. On the other hand, the difference between the axial expansion of a steel shaft and a light metal casing may produce an additional axial load.
- The size, direction and the nature of loads. The load on a bearing at rest should not exceed its static load capacity.
- Axial, radial, combined and reversible loads, which cause elastic changes. These shock loads are very harmful to small bearings and should as far as possible be avoided.
- Relative movement of the inner and outer bearing rings
- The precision and the radial rigidity required for the complete assembly.

The two tables in the following pages indicate, in the central columns, one for shafts, the other for housings, the manufacturing tolerances best adopted to provide the most suitable mounting for:

- Left, the loads and speeds for the application in question
- Right, the degree of precision and radial rigidity which should be attained.

These tolerances are given in [μm] and are valid only when the material of the shafts and housings have the same coefficient of expansion as the steel of the bearing*

In all other cases, it is necessary to take account of the differences of expansion. In general, it is accepted that the mountings mentioned in the following tables are indicated as suitable for normal working temperatures while for exceptional temperatures, the press fit or play should not be excessive.

The best solution, due to the variables in bearings and mating parts, problems in the operating environments of bearings and the correct choice of the bearing, often can be proposed only after laboratory investigation has identified the source of the problem. The myonic laboratory is well equipped to conduct this type of investigation when conditions so warrant it.

To facilitate mounting, myonic bearings can be supplied with bore and/or outer diameter graded in dimensional groups.

*Coefficient of expansion of bearing steel: $11 \times 10^{-6} \text{ } ^\circ\text{C}^{-1}$

Shaft and housing tolerances

Shaft tolerances

Shaft and bearing of **identical** material; otherwise allowance must be made for different coefficients¹ of expansion $d_{shaft}=d+tol.$

Shaft	Load-Speed	Fit	Tolerance of bore d				Mounting precision	Typical applications	Inner-ring laterally
			0/-8 [μm]	0/-5 [μm]	Grade				
					0/- 2.5	-2.5/-5			
Revolving or fixed	Small loads Low to medium speeds No vibrations	sliding fit	Shaft				Standard precision without special requirements	Guides (films, strips etc)	fixed
			-5 -13	-5 -11	-5 -8	-8 -11			
Fixed	Medium loads Medium speeds High frequency vibrations	light press fit	0 -8	0 -6	0 -3	-3 -6	Precise radial guiding Radial rigidity	Gyro rotors	fixed
Revolving	Small loads Medium speeds Low frequency vibrations							Standard precision	Small motors Potentiometers Servo motors
Fixed	High loads High speeds High frequency vibrations	medium press fit	+4 -4	+4 -2	+4 +1	+1 -2	Press fit required particularly high speeds. Very rigid radially.	Gyro rotors Fan motors Electric motors Gear boxes	free
Revolving	Medium to high loads High speeds High frequency vibrations								

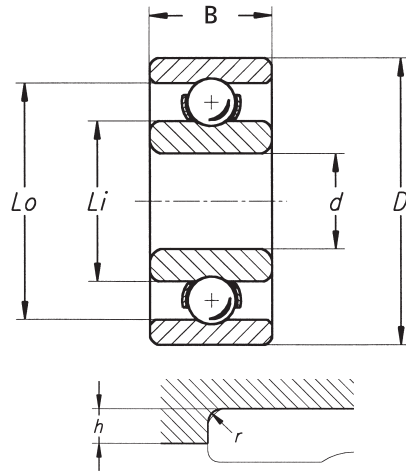
Housing tolerances

Housing and bearing of **identical** material; otherwise allowance must be made for different coefficients¹ of expansion. $d_{shaft}=d+tol.$

Outer ring	Load-Speed	Fit	Tolerance of outer D				Mounting precision	Typical applications
			0/-8 [μm]	0/-5 [μm]	Grade			
					0/- 2.5	-2.5/-5		
Revolving or fixed	Small loads Low to medium speeds No vibrations	sliding fit	Housing				Standard precision Without special requirements	Electric motors Servo motors Fan motors Potentiometers
			+5 -3	+5 -1	+5 +2	+2 -1		
Fixed	Medium loads Medium speeds High frequency vibrations	light press fit	0 -8	0 -6	0 -3	-3 -6	Precise radial guiding Outer ring must be fixed laterally	Synchro motors Gyroscope gimbals
Revolving	Small loads Medium speeds High frequency vibrations							Standard precision
Fixed	High loads High speeds High frequency vibrations	medium press fit	-4 -12	-3 -9	-3 -6	-6 -9	Press fit required particularly at high speeds. The outer ring must not necessarily be fixed laterally. Very rigid radially.	Pulleys Idlers Planetary gears
Revolving	Medium to high loads High speeds High frequency vibrations							

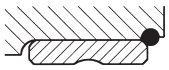
¹ Coefficient of expansion of bearing steel: $11 \times 10^{-6} / ^\circ\text{C}^{-1}$

The dimensions d, D, B (Bf), L_i, L_o, r_{max} and h_{min} given in the bearing tables enable designers to determine exactly the overall dimensions of small bearings

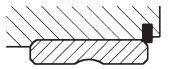


- d = Inner diameter
- D = Outer diameter
- B = Width of rings
- L_i = Minimum diameter of housing shoulder
- L_o = Maximum diameter radii of shaft or housing
- r_{max} = Maximum fillet radius of shaft or housing
- h_{min} = Minimum height of shoulder on shaft or housing

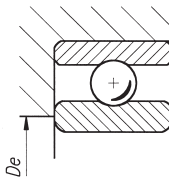
What to avoid



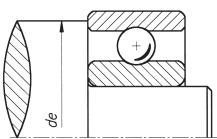
- Larger radii than r_{max} and shoulder heights of circlips lower than h_{min} .
Consequences: axial position uncertain and risk of ring deformation.



- Shoulder and circlips lower than h_{min} .
Consequences: same as above.

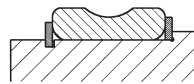


- Diameter D_e of housing shoulder smaller than L_i .
Consequences: shoulder touches the inner ring.

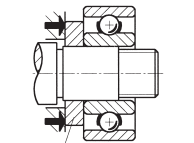


- Diameter d_e of shoulder on shaft larger than L_o .
Consequences: shoulder touches the outer ring.

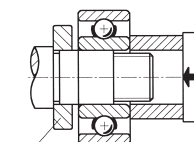
What to ensure



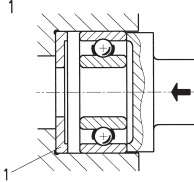
- Above all, the values L_i, L_o, r_{max} and h_{min} should be strictly observed.



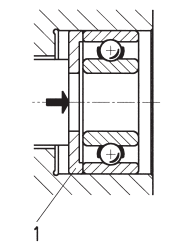
- The following diagrams on this page show how a bearing should normally be installed or removed.



- If for reasons of design the shoulder is unavoidably too small, a ground thrust ring should be provided between shoulder and bearing.



- Installing and removing of radial bearings requires special care in order to avoid any force being transmitted through the shaft to the opposite end bearing. Furthermore, the bearing opposite to the one which is being installed should be protected so as to avoid any load or shock on the balls.



- The load must be applied directly on the ring which is being installed or removed. For this reason shims 1 should be provided in order to facilitate removal. If such shims cannot be used, recesses should be machined on shoulders in housings or on shafts to permit the introduction of special dismantling tools.

Calculation of loads

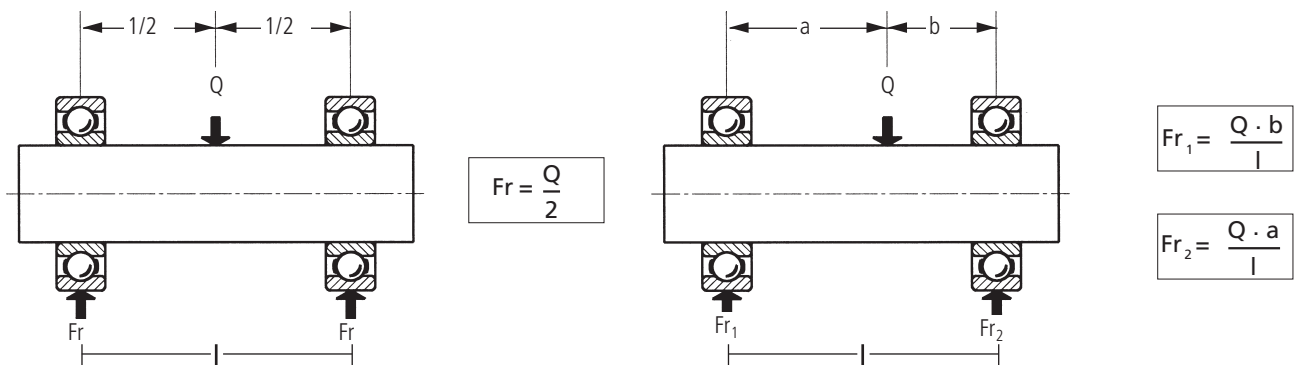
Small bearings are, most frequently, only subject to relatively low loads which nevertheless influence the length of their service life. For this reason, it is advisable to determine, as far as possible, the direction and the magnitude of these forces.

Loads to consider:

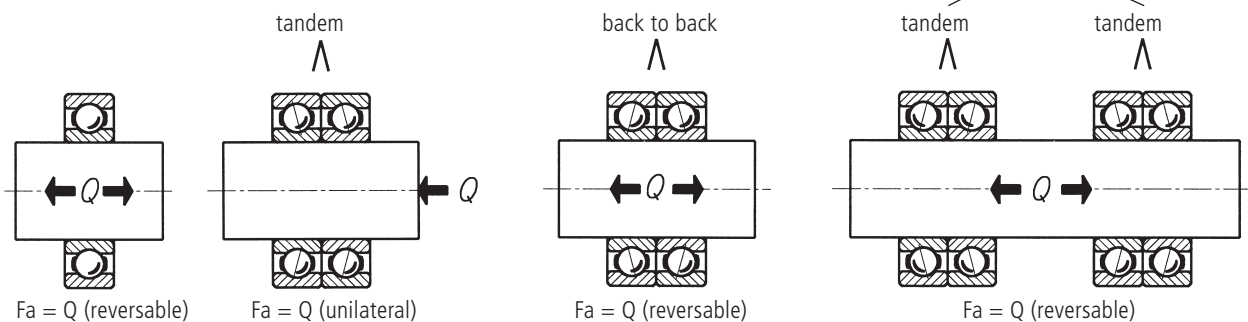
1. Weight of the moving part
2. Centrifugal force (unbalanced forces)
3. Dynamic load (acceleration, braking)
4. Force resulting from transmission of energy (pulley, gear etc)
5. Preload resulting from a duplex mounting¹

Direction and distribution of loads

Fr pure radial load

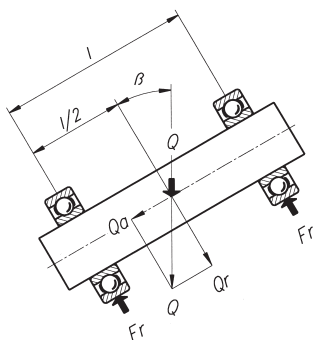


Fa pure axial load



Note: For an axial load to be supported by several bearings, it is essential that these should be paired¹, ring against ring or by means of very precise spacers.

Combined loads (radial and axial)



$$Q_r = \cos \beta \cdot Q$$

$$Q_a = \sin \beta \cdot Q$$

normal mounting

$$Fr = \frac{Q_r}{2}$$

$$Fa = Q_a \text{ (the axial load is supported by one bearing only)}$$

Duplex mounting in tandem (shim)

$$Fr = Q_r$$

$$Fa = Q_a$$

Preload Fap

Bearings mounted in duplex¹, back to back or face to face are subjected to a **preload** (F_{ap}) higher or lower than the axial load F_a . This **preload** F_{ap} should be determined in each case taking into account operational criteria and the life expectancy.

¹) see section "Duplex-mounting" on page 13

Calculation of the theoretical life expectancy of ball bearings

The theoretical life expectancy has no practical value unless the following conditions are scrupulously fulfilled:

- Strength and direction of constant loads carefully determined.
- Constant speed.
- Constant temperature not exceeding 100°C.
- Strict cleanliness in mounting and during running
- Careful choice and dosage of lubricant.
- Mounting strictly in accordance with the instructions given in page 24 – 25.

In all cases of complexity or doubt it is advisable to consult our technical staff.

For calculating the load capacity and the theoretical life of bearings we have used the formulae based on those of ISO and AFBMA standards.

1. Life expectancy of radial bearings and thrust bearings

$$L_{10} = \left(\frac{C}{P} \right)^3$$

Legend

L_{10}	=	Life expectancy in millions of revolutions
C	=	Dynamic load capacity in [N]
P	=	Equivalent dynamic load in [N]
C/P	=	Load ratio

2. Life expectancy in hours

$$L_{10h} = \frac{L \cdot 10^6}{60 \cdot n}$$

Legend

L_{10h}	=	Life expectancy in hours
n	=	Revolution in [rpm]

3. Definitions

L_{10}, L_{10h} = Number of millions of revolutions or hours at constant speed that 90% of a group of apparently identical bearings will attain or exceed before the first evidence of fatigue develops. The life which 40% of the group of ball bearings will complete or exceed is approximately five times this life expectancy.

C = Dynamic load rating. This is the constant radial load, stationary with respect to the outer ring, that a bearing can endure for a rating life of one million revolutions of the inner ring or 500 hours at 33 1/3 [rpm].

The dynamic load takes into account:

- Repeated deformation of several elements (tracks and balls) as a function of the mechanical resistance of their materials and of their materials and of their geometric form
- frequency of loads
- an empirical probability factor

P = Equivalent dynamic load which takes into account the distribution of axial and radial forces affecting different elements as a function of their elasticity and of their geometric form (radial play, tracks, and ball diameters).

C_0 = This is the pure radial load which affects the bearing under the following conditions:

- zero [rpm]
- very slow oscillating movements
- very low revolutions

This load is permissible when, distributed between balls and tracks, a permanent deformation of 1/10,000 of the ball diameter is not exceeded.

P_0 = Equivalent static load.

Newton / lb conversion

1 Newton $\hat{=}$ 0.225 lb
1 lb $\hat{=}$ 4.45 Newton

4. Calculation of Equivalent dynamic load

4.1 Radial ball bearings

$$P = X \cdot Fr + Y \cdot Fa$$

Legend

P = the Equivalent dynamic load in [N]
 Fr = effective radial load in [N]
 Fa = effective thrust load in [N]
 X = the radial factor of the bearing according to the table on page 32
 Y = the thrust factor of the bearing according to the table on page 32

4.2 Thrust bearings

$$P = Fa$$

5. static load capacity

$$Co = so \cdot Po$$

Legend

Co = static load capacity in [N]
 Po = static Equivalent load in [N]
 so = static load safety factor

The following value for the static load safety factor changes depending on applications of the ball bearing according to the following variations:

so = 0.5 to 0.7 for quiet and vibration free use
 so = 1.0 to 1.2 for normal use with minimum vibrations
 so = 1.5 to 2.0 for high demands and use with heavy shock loads

6. Calculation of Equivalent static load

6.1 Radial ball bearings

$$Po = Xo \cdot Fr + Yo \cdot Fa$$

Legend

Po = static Equivalent load in [N]
 Fr = maximum radial static load in [N]
 Fa = maximum thrust load in [N]
 Xo = the radial factor
 Yo = thrust factor
 If the result for Po, calculated according to this formula, is smaller than Fr, then use Po = Fr

Values for the coefficient Xo and Yo

Xo = 0.6 Yo = 0.5

6.2 Thrust bearings

$$Po = Fa$$

7. Duplex bearings

When two single row bearings are duplexed face to face, back to back, or in tandem arrangement, calculation of dynamic as well as Equivalent dynamic load should be considered.

7.1 Duplex installation face to face or back to back

Dynamic load capacity

$$Cd = (2 \cdot \cos \alpha_o)^{0.7} \cdot C$$

$$L_{10} = \left(\frac{Cd}{P} \right)^3$$

Legend

Cd = the dynamic load capacity for a pair of ball bearings in [N]
 α_o = contact angle
 C = dynamic load capacity for a single ball bearing in [N]
 L_{10} = life expectancy in millions of revolutions
 P = the Equivalent dynamic load in [N]

Equivalent dynamic load

$$P = X \cdot Fr + Y \cdot Fa$$

Legend

P = the Equivalent dynamic load in [N]
 Fr = effective radial load in [N]
 Fa = effective thrust load in [N]
 X = the radial factor of the bearing according to the table on page 32
 Y = the thrust factor of the bearing according to the table on page 32

Duplex mounting back to back or face to face with preload

$$Fa = 0.8 (Fap + Fa1)^*$$

Legend

Fa = effective axial load in [N]
 Fap = preload in [N]
 Fa1 = axial load on the duplex pair, in [N]

* Determine the preload Fap in relation to the axial load Fa1, in such a way that no bearing should be without load.

Within the range of play and contact angles considered by myonic, this condition will be realized when

$$Fap \geq 0,35 Fa1$$

Back to back or face to face assembly without preload or with residual axial play

Sometimes duplex bearings are assembled back to back or face to face with a residual axial play of a few [µm]. In those cases calculations are made using formulae mentioned in 7.1. Use factor X and Y from tables on page 27 taking care to include in the formula:

$$\frac{Fa}{2 \cdot Z \cdot Dw^2} \text{ (total number of balls in two bearings)}$$

7.2 Tandem assembly

Dynamic load capacity

$$C_t = C \cdot N^{0.7}$$

Legend

C_t = Dynamic load capacity of the tandem assembly in [N]
 C = Dynamic load capacity of a single bearing in [N]
 N = Number of bearings

To calculate the Equivalent dynamic load and the life, proceed as for a bearing with a single row of balls applying factors X, Y and referring to bearings with single row of balls according to table on page 32.

8. Examples of calculations

Example 1

To calculate the theoretical life L_h of a R 2570X bearing working under the following service conditions:

Radial charge $Fr = 5.7$ N
 Axial load $Fa = 2.8$ N
 Speed $n = 8000$ rpm
 Radial play $2/5$ μ m

For bearing R 2570X:

$C = 142$ N
 $Z \cdot Dw^2 = 8$
 $P = X \cdot Fr + Y \cdot Fa$

$$\frac{Fa}{Z \cdot Dw^2} = \frac{2.8}{8} = 0.35 \longrightarrow e = 0.12$$

$$\frac{Fa}{Fr} = \frac{2.8}{5.7} = 0.5 \text{ therefore } > e \text{ from which}$$

$X = 0.56$
 $Y = 2.77$
 $P = 0.56 \cdot 5.7 + 2.77 \cdot 2.8$
 $= 3.2 + 7.8 = 11$ N

$$\frac{C}{P} = \frac{142}{11} = 12.9$$

$$L_{10} = \left(\frac{C}{P}\right)^3 = 12.9^3 = 2147$$

$$L_{10h} = \frac{L \cdot 10^6}{60 \cdot n} = \frac{2147 \cdot 10^6}{60 \cdot 8000}$$

$$L_{10h} = 4473 \text{ h}$$

According to table on page 30, we also find $L_h = 4500$ h by interpolation

Example 2

To install a spin axis (of a gyroscope) with 2 preloaded RA bearings, as a duplex, back to back pair.

Radial load $Fr = 4$ N
 Axial load $Fa1 = 12$ N
 Speed $n = 24000$ rpm
 Contact angle $\alpha_o = 20^\circ$
 Design life $L_{10h} = 5000$ h
 Choice of bearing = ?

$$L_{10h} = \frac{L \cdot 10^6}{60 \cdot n} = 5000 \text{ h}$$

$$L_{10} = \left(\frac{Cd}{P}\right)^3 = 7200$$

$$\frac{Cd}{P} = \sqrt[3]{7200} = 19.3$$

or, according to table on page 31, by interpolation

$$\frac{Cd}{P} = 19.3$$

According to page 25 preload
 $F_{ap} \geq 0.35 \cdot Fa1 = 0.35 \cdot 12 = 4.2$ N

Assuming a preload $F_{ap} = 6$ N
 $Fa = 0.8 (F_{ap} + Fa1) = 0.8 (6 + 12)$
 $= 0.8 \cdot 18 = 14.4$ N

According to page 28

$\alpha_o = 20^\circ$
 $e = 0.50$

$$\frac{Fa}{Fr} = \frac{14.4}{4} = 3.6 \text{ therefore } > e \text{ from which}$$

$X = 0.70$
 $Y = 1.86$
 $P = X \cdot Fr + Y \cdot Fa = 0.70 \cdot 4 + 1.86 \cdot 14.4$
 $= 2.8 + 26.7 = 29.5$ N

$$\frac{Cd}{P} = 19.3$$

$Cd = 19.3 \cdot P = 19.3 \cdot 29.5 = 569$
 $Cd = (2 \cdot \cos \alpha_o)^{0.7} \cdot C$

$$C = \frac{Cd}{(2 \cdot \cos \alpha_o)^{0.7}} = \frac{569}{(2 \cdot \cos 20^\circ)^{0.7}} = \frac{569}{1.55} = 367 \text{ N}$$

The bearing RA 3100X. 9d/600-... with its dynamic load capacity $C = 332$ N (8 balls) is marginally too small. If space allows it a RA 4130X.9d/600-... will be selected

Determination of the service life expectancy (10^6 rpm), as a function of the load factor C/P

L_{10}	C/P	L_{10}	C/P	L_{10}	C/P
0.5	0.793	260	6.38	2400	13.4
0.75	0.909	280	6.54	2600	13.8
1.0	1.0	300	6.69	2800	14.1
1.5	1.14	320	6.84	3000	14.4
2	1.26	340	6.98	3200	14.7
3	1.44	360	7.11	3400	15.0
4	1.59	380	7.24	3600	15.3
5	1.71	400	7.37	3800	15.6
6	1.82	420	7.49	4000	15.9
8	2.0	440	7.61	4500	16.5
10	2.15	460	7.72	5000	17.1
12	2.29	480	7.83	5500	17.7
14	2.41	500	7.94	6000	18.2
16	2.52	550	8.19	6500	18.7
18	2.62	600	8.43	7000	19.1
20	2.71	650	8.66	7500	19.6
25	2.92	700	8.88	8000	20.0
30	3.11	750	9.09	8500	20.4
35	3.27	800	9.28	9000	20.8
40	3.42	850	9.47	9500	21.2
45	3.56	900	9.65	10000	21.5
50	3.68	950	9.83	12000	22.9
60	3.91	1000	10.0	14000	24.1
70	4.12	1100	10.3	16000	25.2
80	4.31	1200	10.6	18000	26.2
90	4.48	1300	10.9	20000	27.1
100	4.64	1400	11.2	25000	29.2
120	4.93	1500	11.4	30000	31.1
140	5.19	1600	11.7	35000	32.7
160	5.43	1700	11.9	40000	34.2
180	5.65	1800	12.2	45000	35.5
200	5.85	1900	12.4	50000	36.8
220	6.04	2000	12.6	55000	38.1
240	6.21	2200	13.0	60000	39.2

Calculation of the theoretical life expectancy of ball bearings

Radial factor X and axial factor Y to be used for calculating the equivalent dynamic load for radial single row ball bearings.

Contact Angle	$\frac{F_a}{Z \cdot Dw^2}$	$\frac{F_a}{F_r} \geq e$		
		X	Y	e
$\leq 5^\circ$	0.17	0.56	3.09	0.09
	0.35		2.77	0.12
	0.70		2.43	0.14
	1.05		2.23	0.15
	1.40		2.10	0.16
	2.10		1.92	0.18
	3.51		1.71	0.21
	5.27		1.56	0.23
7.03		1.44	0.24	
10°	0.17	0.46	2.20	0.25
	0.35		2.09	0.26
	0.70		1.94	0.28
	1.05		1.84	0.29
	1.40		1.77	0.31
	2.10		1.66	0.33
	3.51		1.53	0.35
	5.27		1.44	0.38
7.03		1.36	0.40	
15°	0.17	0.44	1.55	0.35
	0.35		1.51	0.36
	0.70		1.48	0.36
	1.05		1.42	0.38
	1.40		1.39	0.39
	2.10		1.34	0.41
	3.51		1.26	0.43
	5.27		1.20	0.45
7.03		1.16	0.47	
20°		0.43	1.14	0.50
25°		0.41	0.95	0.62
30°		0.39	0.81	0.75
35°		0.37	0.69	0.91
40°		0.35	0.60	1.08

When $\frac{F_a}{F_r} \leq e$ has to be calculated with X = 1, Y = 0

Determine X and Y factors relating to intermediate values of load and contact angle by linear interpolation.

F_a = Thrust load in [N]
 Z = Number of balls
 Dw = diameter of balls in mm

Radial factor X and axial factor Y to be used for calculating the equivalent dynamic load for duplex pairs of radial ball bearings contact angle 0° to 40°

Contact Angle	$\frac{F_a}{Z \cdot Dw^2}$	$\frac{F_a}{F_r} \leq e$			$\frac{F_a}{F_r} \geq e$		
		X	Y	X	Y	e	
0°	0.17	1	0	0.56	3.09	0.09	
	0.35				2.77	0.12	
	0.70				2.43	0.14	
	1.05				2.23	0.15	
	1.40				2.10	0.16	
	2.10				1.92	0.18	
	3.51				1.71	0.21	
	5.27				1.56	0.23	
7.03				1.44	0.24		
5°	0.17	1	3.69	0.78	5.02	0.17	
	0.35		3.30		4.49	0.19	
	0.70		2.89		3.94	0.22	
	1.05		2.66		3.63	0.24	
	1.40		2.50		3.41	0.25	
	2.10		2.29		3.12	0.27	
	3.51		2.04		2.78	0.31	
	5.27		1.86		2.53	0.34	
7.03		1.72		2.35	0.36		
10°	0.17	1	2.25	0.75	3.58	0.25	
	0.35		2.41		3.39	0.26	
	0.70		2.24		3.14	0.28	
	1.05		2.13		2.99	0.29	
	1.40		2.04		2.87	0.31	
	2.10		1.92		2.69	0.33	
	3.51		1.77		2.49	0.35	
	5.27		1.66		2.33	0.38	
7.03		1.57		2.21	0.40		
15°	0.17	1	1.74	0.72	2.52	0.35	
	0.35		1.70		2.46	0.36	
	0.70		1.66		2.41	0.36	
	1.05		1.59		2.31	0.38	
	1.40		1.56		2.25	0.39	
	2.10		1.50		2.17	0.41	
	3.51		1.42		2.05	0.43	
	5.27		1.35		1.96	0.45	
7.03		1.30		1.88	0.47		
20°		1	1.25	0.70	1.86	0.50	
25°		1	1.00	0.67	1.55	0.62	
30°		1	0.83	0.63	1.31	0.75	
35°		1	0.69	0.60	1.12	0.91	
40°		1	0.58	0.57	0.97	1.08	

Calculation of the theoretical life expectancy of ball bearings

L_{10h} in hours as a function of the load factor C/P, speed in [rpm]

L_{10h}	n [rpm]											
	10	40	100	160	200	250	320	400	500	630	800	1000
100	–	–	–	–	1.06	1.15	1.24	1.34	1.45	1.56	1.68	1.82
500	–	1.06	1.45	1.68	1.82	1.96	2.12	2.29	2.47	2.67	2.88	3.11
1000	–	1.34	1.82	2.12	2.29	2.47	2.67	2.88	3.11	3.36	3.63	3.91
1250	–	1.45	1.96	2.29	2.47	2.67	2.88	3.11	3.36	3.63	3.91	4.23
1600	–	1.56	2.12	2.47	2.67	2.88	3.11	3.36	3.63	3.91	4.23	4.56
2000	1.06	1.68	2.29	2.67	2.88	3.11	3.36	3.63	3.91	4.23	4.56	4.93
2500	1.15	1.82	2.47	2.88	3.11	3.36	3.63	3.91	4.23	4.56	4.93	5.32
3200	1.24	1.96	2.67	3.11	3.36	3.63	3.91	4.23	4.56	4.93	5.32	5.75
4000	1.34	2.12	2.88	3.36	3.63	3.91	4.23	4.56	4.93	5.32	5.75	6.20
5000	1.45	2.29	3.11	3.63	3.91	4.23	4.56	4.93	5.32	5.75	6.20	6.70
6300	1.56	2.47	3.36	3.91	4.23	4.56	4.93	5.32	5.75	6.20	6.70	7.23
8000	1.68	2.67	3.63	4.23	4.56	4.93	5.32	5.75	6.20	6.70	7.23	7.81
10000	1.82	2.88	3.91	4.56	4.93	5.32	5.75	6.20	6.70	7.23	7.81	8.43
12500	1.96	3.11	4.23	4.93	5.32	5.75	6.20	6.70	7.23	7.81	8.43	9.11
16000	2.12	3.36	4.56	5.32	5.75	6.20	6.70	7.23	7.81	8.43	9.11	9.83
20000	2.29	3.63	4.93	5.75	6.20	6.70	7.23	7.81	8.43	9.11	9.83	10.6
25000	2.47	3.91	5.32	6.20	6.70	7.23	7.81	8.43	9.11	9.83	10.6	11.5
32000	2.67	4.23	5.75	6.70	7.23	7.81	8.43	9.11	9.83	10.6	11.5	12.4
40000	2.88	4.56	6.20	7.23	7.81	8.43	9.11	9.83	10.6	11.5	12.4	13.4
50000	3.11	4.93	6.70	7.81	8.43	9.11	9.83	10.6	11.5	12.4	13.4	14.5
63000	3.36	5.32	7.23	8.43	9.11	9.83	10.6	11.5	12.4	13.4	14.5	15.6
80000	3.63	5.75	7.81	9.11	9.83	10.6	11.5	12.4	13.4	14.5	15.6	16.8
100000	3.91	6.20	8.43	9.83	10.6	11.5	12.4	13.4	14.5	15.6	16.8	18.2
200000	4.93	7.81	10.6	12.4	13.4	14.5	15.6	16.8	18.2	19.6	21.2	22.9

Calculation of the theoretical life expectancy of ball bearings

L_{10h} in hours as a function of the load factor C/P, speed in [rpm]

L_{10h}	n [rpm]										
	1250	1600	2000	2500	3200	4000	5000	6300	8000	10000	12500
100	1.96	2.12	2.29	2.47	2.67	2.88	3.11	3.36	3.63	3.91	4.23
500	3.36	3.63	3.91	4.2	4.56	4.93	5.32	5.75	6.20	6.70	7.23
1000	4.23	4.56	4.93	5.32	5.75	6.20	6.70	7.23	7.81	8.43	9.11
1250	4.56	4.93	5.32	5.75	6.20	6.70	7.23	7.81	8.43	9.11	9.83
1600	4.93	5.32	5.75	6.20	6.70	7.23	7.81	8.43	9.11	9.83	10.6
2000	5.32	5.75	6.20	6.70	7.23	7.81	8.43	9.11	9.83	10.6	11.5
2500	5.75	6.20	6.70	7.23	7.81	8.43	9.11	9.83	10.6	11.5	12.4
3200	6.20	6.70	7.23	7.81	8.43	9.11	9.83	10.6	11.5	12.4	13.4
4000	6.70	7.23	7.81	8.43	9.11	9.83	10.6	11.5	12.4	13.4	14.5
5000	7.23	7.81	8.43	9.11	9.83	10.6	11.5	12.4	13.4	14.5	15.6
6300	7.81	8.43	9.11	9.83	10.6	11.5	12.4	13.4	14.5	15.6	16.8
8000	8.43	9.11	9.83	10.6	11.5	12.4	13.4	14.5	15.6	16.8	18.2
10000	9.11	9.83	10.6	11.5	12.4	13.4	14.5	15.6	16.8	18.2	19.6
12500	9.83	10.6	11.5	12.4	13.4	14.5	15.6	16.8	18.2	19.6	21.2
16000	10.6	11.5	12.4	13.4	14.5	15.6	16.8	18.2	19.6	21.2	22.9
20000	11.5	12.4	13.4	14.5	15.6	16.8	18.2	19.6	21.2	22.9	24.7
25000	12.4	13.4	14.5	15.6	16.8	18.2	19.6	21.2	22.9	24.7	26.7
32000	13.4	14.5	15.6	16.8	18.2	19.6	21.2	22.9	24.7	26.7	28.8
40000	14.5	15.6	16.8	18.2	19.6	21.2	22.9	24.7	26.7	28.8	31.1
50000	15.6	16.8	18.2	19.6	21.2	22.9	24.7	26.7	28.8	31.1	33.6
63000	16.8	18.2	19.6	21.2	22.9	24.7	26.7	28.8	31.1	33.6	36.3
80000	18.2	19.6	21.2	22.9	24.7	26.7	28.8	31.1	33.6	36.3	39.2
100000	19.6	21.2	22.9	24.7	26.7	28.8	31.1	33.6	36.3	39.2	–
200000	24.7	26.7	28.8	31.1	33.6	36.3	39.2	–	–	–	–

Calculation of the theoretical life expectancy of ball bearings

L_{10h} in hours as a function of the load factor C/P, speed in [rpm]

L_{10h}	n [rpm]								
	16000	20000	25000	32000	40000	50000	63000	80000	100000
100	4.56	4.93	5.32	5.75	6.20	6.70	7.23	7.81	8.43
500	7.81	8.43	9.11	9.83	10.6	11.5	12.4	13.4	14.5
1000	9.83	10.6	11.5	12.4	13.4	14.5	15.6	16.8	18.2
1250	12.4	11.5	12.4	13.4	14.5	15.6	16.8	18.2	19.6
1600	11.5	12.4	13.4	14.5	15.6	16.8	18.2	19.6	21.2
2000	12.4	13.4	14.5	15.6	16.8	18.2	19.6	21.2	22.9
2500	13.4	14.5	15.6	16.8	18.2	19.6	21.2	22.9	24.7
3200	14.5	15.6	16.8	18.2	19.6	21.2	22.9	24.7	26.7
4000	15.6	16.8	18.2	19.6	21.2	22.9	24.7	26.7	28.8
5000	16.8	18.2	19.6	21.2	22.9	24.7	26.7	28.8	31.1
6300	18.2	19.6	21.2	22.9	24.7	26.7	28.8	31.1	33.6
8000	19.6	21.2	22.9	24.7	26.7	28.8	31.1	33.6	36.3
10000	21.2	22.9	24.7	26.7	28.8	31.1	33.6	36.3	39.2
12500	22.9	24.7	26.7	28.8	31.1	33.6	36.3	39.2	–
16000	24.7	26.7	28.8	31.1	33.6	36.3	39.2	–	–
20000	26.7	28.8	31.1	33.6	36.3	39.2	–	–	–
25000	28.8	31.1	33.6	36.3	39.2	–	–	–	–
32000	31.1	33.6	36.3	39.2	–	–	–	–	–
40000	33.6	36.3	39.2	–	–	–	–	–	–
50000	36.3	39.2	–	–	–	–	–	–	–
63000	39.2	–	–	–	–	–	–	–	–
80000	–	–	–	–	–	–	–	–	–
100000	–	–	–	–	–	–	–	–	–
200000	–	–	–	–	–	–	–	–	–

Packaging has the function of protecting the bearings during transportation and during storage periods before use in the final application.

myonic packaging is designed to ensure protection against:

- Contamination
- Humidity
- Transportation impact
- Deterioration of bearings lubricant

According to the bearings type and technical characteristics myonic packages bearings with the most suitable package type in order to ensure the above protection.

Unless otherwise specified by the customer, myonic bearings are packaged in small synthetic plastic pouches hermetically sealed with vacuum by heat sealing in a quantity per pouch depending on the bearing type, characteristic and dimension. Typically there are

quantities of 40, 20, 10 and 5 pieces per pouch, depending from the size of the bearings.

The plastic pouches are delivered in resistant carton boxes to protect against mechanical influence during transportation.

Apart from the above standard package, myonic can deliver bearings in the following packages:

- Plastic transparent strips with each pocket separated by heat sealing.
- Individually packaged by single strip pocket heat sealed.
- Individually packaged by metallic pouches.

Should any other packaging method be desired it is advisable to consult our technical department

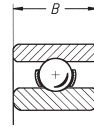
Ball bearings



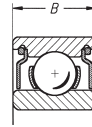
Radial single row ball bearings



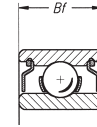
R/UL
open



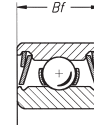
RV/ULV
with shields



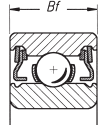
ULZ
with shields



RX
with shields



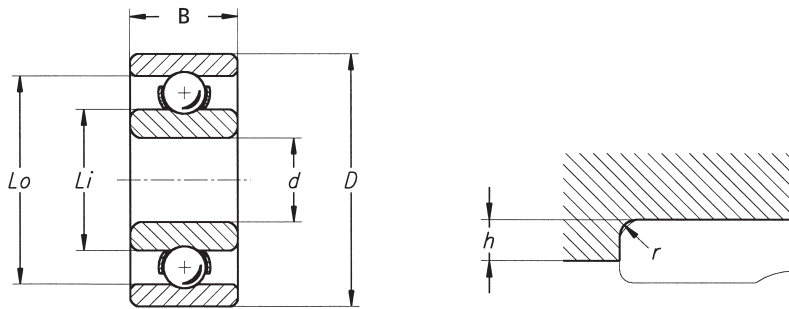
RF
with filmoseals



Metric series

Actual sizes	d [mm]	D [mm]	B [mm]	Bf [mm]	Reference open bearings	Reference shielded bearings
	1	3	1		UL 103X	
	1.5	4	1.2	2	UL 154X	ULZ 154X
	1.5	5	2	2	R 1550X	RX/RF 155X
	2	4	1.2		UL 204X	
	2	5	1.5	2.3	UL 205X	ULZ 205X
	2	6	2.3	2.3	R 2060X	RX/RF 206X
	2.5	5	1.5		UL 255X	
	2.5	6	1.8	2.6	UL 256X	ULZ 256X
	2.5	7	2.5		R 2570X	RV 257X
	2.5	8	2.8	2.8	R 2580X	RF 258X
	3	6	2	2.5	UL 306X	ULZ 306X
	3	6	2			ULV 306X
	3	7	2	3	UL 307X	ULZ 307X
	3	8	3	4	R 3080X	RF 308X
	3	8	3			RV 308X
	3	10	4	4	R 3100X	RX/RF 310X
	4	7	2	2.5	UL 407X	ULZ 407X
	4	7	2			ULV407X
	4	9	2.5	4	UL 409X	ULZ 409X
	4	10		4		RX/RF 410X
	4	11	4		R 4110X	RV 411X
	4	13	5	5	R 4130X	RX/RF 413X
	4	16	5		R 4160X	RV416X
	5	8	2	3	UL 508X	ULZ 508X
	5	8	2			ULV 508X

Radial single row ball bearings



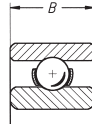
Metric series

B DIN Reference	Bf DIN Reference	Li [mm]	Lo [mm]	r max. [mm]	h min. [mm]	Balls n x Ø [mm]	load ratings	
							dynamic C [N]	static Co [N]
618/1	-	1.60	2.40	0.08	0.3	7 x 0.500	38	6
618/1.5	638/1.5	2.12	3.38	0.1	0.3	6 x 0.794	87	17
619/1.5	619/1.5	2.68	3.97	0.15	0.4	7 x 0.794	100	21
617/2	-	2.48	3.55	0.05	0.25	7 x 0.700	84	18
618/2	638/2	2.86	4.14	0.1	0.4	7 x 0.794	101	22
619/2	619/2	3.16	4.75	0.15	0.5	7 x 1.000	165	38
617/2.5	-	3.15	4.40	0.08	0.3	8 x 0.794	111	25
618/2.5	638/2.5	3.54	5.02	0.15	0.5	7 x 1.000	167	40
619/2.5	-	3.95	5.53	0.15	0.6	8 x 1.000	184	47
60/2.5	60/2.5	4.22	6.23	0.15	0.6	7 x 1.250	258	65
617/3	-	3.75	5.26	0.08	0.35	8 x 1.000	183	46
617/3	-	3.75	5.26	0.08	0.35	8 x 1.000	183	46
618/3	638/3	4.14	5.85	0.15	0.5	8 x 1.150	247	66
619/3	639/3	4.40	6.61	0.15	0.6	7 x 1.450	335	86
619/3	-	4.40	6.61	0.15	0.6	7 x 1.450	335	86
623	623	5.33	7.87	0.15	0.7	7 x 1.588	407	110
617/4	-	4.75	6.25	0.08	0.35	9 x 1.000	200	55
617/4	-	4.75	6.25	0.08	0.35	9 x 1.000	200	55
618/4	638/4	5.33	7.87	0.15	0.5	7 x 1.588	407	110
-	-	5.33	7.87	0.15	0.7	7 x 1.588	407	110
619/4	-	5.90	9.10	0.15	0.7	6 x 2.100	667	189
624	624	6.65	10.35	0.2	0.8	6 x 2.381	920	290
634	-	8.00	13.08	0.3	1	6 x 3.175	1192	329
617/5	637/5	5.75	7.25	0.08	0.4	11 x 1.000	226	71
617/5	-	5.75	7.25	0.08	0.4	11 x 1.000	226	71

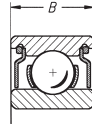
Radial single row ball bearings



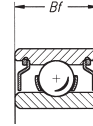
R/UL
open



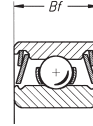
RV/ULV/ULZT
with shields



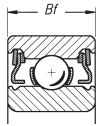
ULZ
with shields



RX
with shields



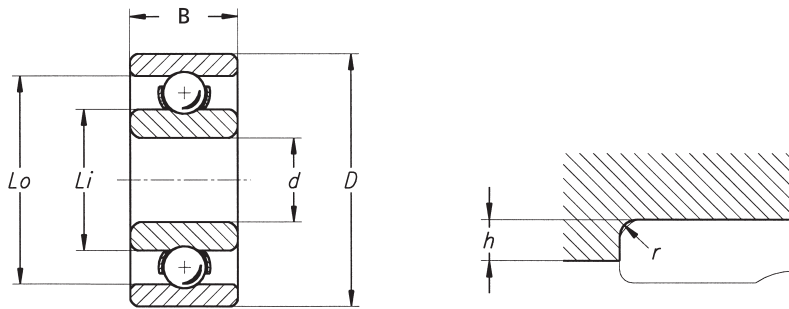
RF
with filmoseals



Metric series

Actual sizes	d [mm]	D [mm]	B [mm]	Bf [mm]	Reference open bearings	Reference shielded bearings
	5	11	3	5	UL 511X	ULZ 511X
	5	13	4		R 5130X	RV 513X
	5	16	5		R 5160X	RV 516X
	5	19	6		R 5190X	RV 519X
	6	10	2.5	3	UL 610X	ULZ 610X
	6	13	3.5	5	UL 613X	ULZ 613X
	6	15	5		R 6150X	RV 615X
	6	19	6		R 6190X	RV 619X
	7	11	2.5	3	UL 711X	ULZ 711X
	7	14	3.5	5	UL 714X	ULZ 714X
	7	19	6		R 7190X	RV 719X
	7	22	7		R 7220X	RV 722X
	8	12	2.5		UL 812X	
	8	16	4		UL 816X	
	8	16	5			ULZT 816X
	8	16		6		ULZ 816X
	8	22	7		R 8220X	RV 822X
	9	14	3		UL 914X	
	9	17	4	6	UL 917X	ULZ 917X
	10	15	3		UL 1015X	
	10	19	5		UL 1019X	ULV 1019X
	10	19		7		ULZ 1019X

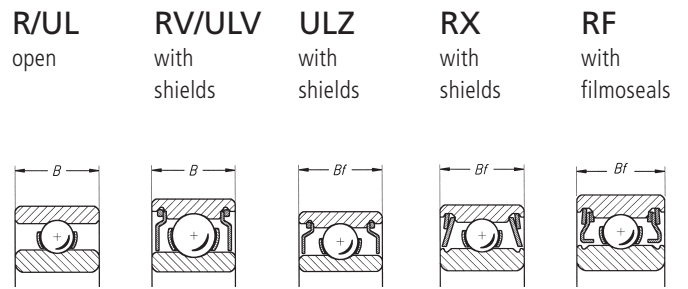
Radial single row ball bearings



Metric series

B DIN Reference	Bf DIN Reference	Li [mm]	Lo [mm]	r max. [mm]	h min. [mm]	Balls n x Ø [mm]	load ratings	
							dynamic C [N]	static Co [N]
618/5	638/5	6.69	9.32	0.15	0.7	8 x 1.750	524	152
619/5	-	7.40	11.00	0.15	0.7	7 x 2.381	824	237
625	-	8.00	13.08	0.3	1	6 x 3.175	1192	329
635	-	9.75	14.84	0.3	1	7 x 3.175	1377	415
617/6	-	7.00	9.00	0.1	0.45	10 x 1.250	330	107
618/6	628/6	7.90	11.11	0.15	0.7	8 x 2.100	726	219
619/6	-	8.79	12.24	0.15	0.8	7 x 2.500	1027	327
626	-	9.75	14.84	0.3	1	7 x 3.175	1377	415
617/7	-	8.00	10.00	0.1	0.45	12 x 1.250	368	132
618/7	628/7	8.90	12.11	0.15	0.7	8 x 2.100	731	226
607	-	9.75	14.84	0.3	1	7 x 3.175	1377	415
627	-	11.75	18.05	0.3	1	7 x 3.969	2154	698
617/8	-	9.00	11.00	0.1	0.5	13 x 1.250	382	146
618/8	-	10.20	13.81	0.2	0.8	9 x 2.381	992	329
-	-	10.20	13.81	0.2	0.8	9 x 2.381	992	329
-	638/8	10.20	13.81	0.2	0.8	9 x 2.381	992	329
608	-	11.75	18.05	0.3	1	7 x 3.969	2154	698
617/9	-	10.23	12.77	0.1	0.6	12 x 1.588	281	223
618/9	638/9	11.20	14.81	0.2	0.8	10 x 2.381	1065	374
61700	-	11.23	13.77	0.1	0.6	13 x 1.588	606	245
61800	-	12.32	16.68	0.3	1	9 x 2.778	1314	455
-	63800	12.32	16.68	0.3	1	9 x 2.778	1314	455

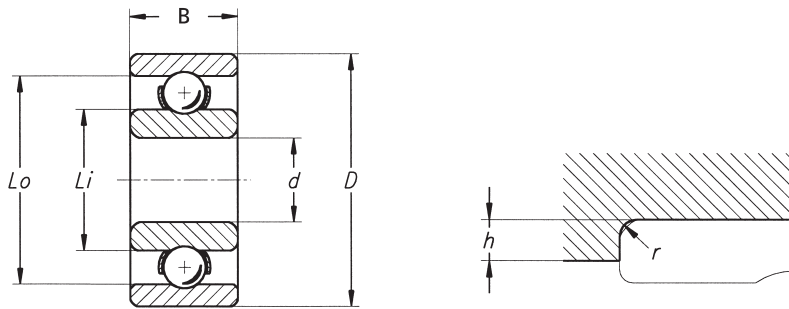
Radial single row ball bearings



Inch series

Actual sizes	d [mm] [inch]	D [mm] [inch]	B [mm] [inch]	Bf [mm] [inch]	Reference open bearings	Reference shielded bearings
	1.016 .0400	3.175 .1250	1.191 .0469		UL 1304X	
	1.191 .0469	3.969 .1563	1.588 .0625	2.381 .0938	UL 1505X	ULZ 1505X
	1.397 .0550	4.763 .1875	1.984 .0781	2.778 .1094	R 1706X	RX/RF 1706X
	1.984 .0781	6.350 .2500	2.381 .0938	3.572 .1406	R 2508X	RX/RF 2508X
	2.381 .0937	4.763 .1875	1.588 .0625	2.381 .0938	UL 3006X	ULZ 3006X
	2.381 .0937	7.938 .3125	2.778 .1094	3.572 .1406	R 3010X	RX/RF 3010X
	3.175 .1250	6.350 .2500	2.381 .0938		UL 4008X	ULV 4008X
	3.175 .1250	6.350 .2500		2.778 .1094		ULZ 4008X
	3.175 .1250	7.938 .3125	2.778 .1094	3.572 .1406	R 4010X	RX/RF 4010X
	3.175 .1250	9.525 .3750	3.969 .1563	3.969 .1563	R 4012X	RX/RF 4012X

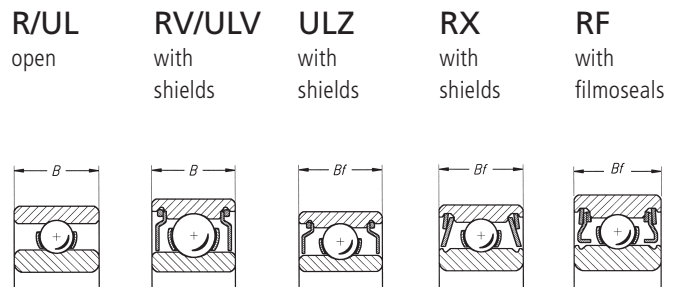
Radial single row ball bearings



Inch series

US reference	Li [mm] [inch]	Lo [mm] [inch]	r max. [mm] [inch]	h min. [mm] [inch]	Balls n x Ø [mm] [inch]	load ratings	
						dynamic C [N]	static Co [N]
R 09	1.60 .0630	2.40 .0945	0.08 .003	0.3 .012	7 x 0.500 .0197	38	6
R 0	1.93 .0760	3.18 .1252	0.13 .005	0.4 .016	6 x 0.794 .03125	85	16
R 1	2.35 .0925	3.83 .1508	0.13 .005	0.4 .016	6 x 1.000 .0394	138	29
R 1-4	3.16 .1244	4.75 .1870	0.13 .005	0.5 .020	7 x 1.000 .0394	165	38
R 133	2.86 .1126	4.14 .1630	0.13 .005	0.4 .016	7 x 0.794 .03125	101	22
R 1-5	4.13 .1626	6.67 .2626	0.13 .005	0.5 .020	6 x 1.588 .0625	351	86
R 144	3.95 .1555	5.53 .2177	0.13 .005	0.5 .020	8 x 1.000 .0394	184	47
R 144	3.95 .1555	5.53 .2177	0.13 .005	0.5 .020	8 x 1.000 .0394	184	47
R 2-5	4.13 .1626	6.67 .2626	0.13 .005	0.5 .020	6 x 1.588 .0625	351	86
R 2	5.33 .2098	7.87 .3098	0.13 .005	0.7 .028	7 x 1.588 .0625	407	110

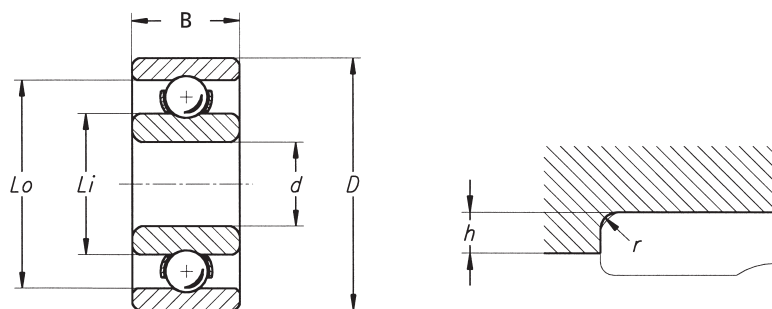
Radial single row ball bearings



Inch series

Actual sizes	d [mm] [inch]	D [mm] [inch]	B [mm] [inch]	Bf [mm] [inch]	Reference open bearings	Reference shielded bearings
	3.969 .1563	7.938 .3125	2.778 .1094	3.175 .1250	UL 5010X	ULZ 5010X
	4.763 .1875	7.938 .3125	2.778 .1094	3.175 .1250	UL 6010X	ULZ 6010X
	4.763 .1875	9.525 .3750	3.175 .1250	3.175 .1250	UL 6012X	ULZ 6012X
	4.763 .1875	12.700 .5000	3.969 .1563		R 6016X	RV 6016X
	4.763 .1875	12.700 .5000		4.978 .1960		RX/RF 6016X
	6.350 .2500	9.525 .3750	3.175 .1250	3.175 .1250	UL 8012X	ULZ 8012X
	6.350 .2500	12.700 .5000	3.175 .1250	4.763 .1875	UL 8016X	ULZ 8016X
	6.350 .2500	15.875 .6250	4.978 .1960	4.978 .1960	R 8020X	RX/RF 8020X
	7.938 .3125	12.700 .5000	3.969 .1563	3.969 .1563	UL 10016X	ULZ 10016X
	9.525 .3750	22.225 .8750	7.144 .2813	7.144 .2813	R 12028X	RZ 12028X
	12.700 .5000	19.050 .7500		4.978 .1960		ULZ 16024X

Radial single row ball bearings



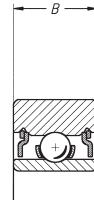
Inch series

US reference	Li [mm] [inch]	Lo [mm] [inch]	r max. [mm] [inch]	h min. [mm] [inch]	Balls n x Ø [mm] [inch]	load ratings	
						dynamic C [N]	static Co [N]
R 155	4.98 .1961	6.82 .2685	0.13 .005	0.5 .020	8 x 1.150 .0453	250	69
R 156	5.57 .2193	7.10 .2795	0.13 .005	0.5 .020	9 x 1.000 .0394	198	58
R 166	5.95 .2343	8.35 .3287	0.13 .005	0.6 .024	8 x 1.588 .0625	450	130
R 3	7.00 .2756	10.70 .4213	0.30 .012	0.8 .031	7 x 2.381 .09375	1028	346
R 3	7.00 .2756	10.70 .4213	0.30 .012	0.8 .031	7 x 2.381 .09375	1028	346
R 168	7.22 .2843	8.77 .3453	0.13 .005	0.6 .024	11 x 1.000 .0394	220	74
R 188	7.90 .3110	11.11 .4374	0.13 .005	0.6 .024	8 x 2.100 .0827	726	219
R 4	9.26 .3646	12.96 .5102	0.30 .012	0.8 .031	8 x 2.381 .09375	1145	435
R 1810	9.23 .3634	11.40 .4488	0.13 .005	0.6 .024	11 x 1.588 .0625	555	199
R 6	13.21 .5201	18.87 .7429	0.40 .016	0.8 .031	7 x 3.969 .1562	2183	719
-	14.90 .5866	17.10 .6732	0.20 .008	0.8 .031	14 x 1.588 .0625	608	275

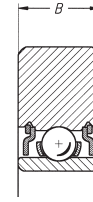
Radial single row ball bearings with modified outer ring dimension



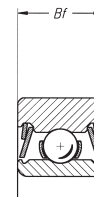
MV
with
shields



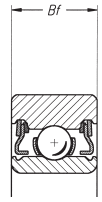
MVT
with
shields



MX/MZ
with
shields



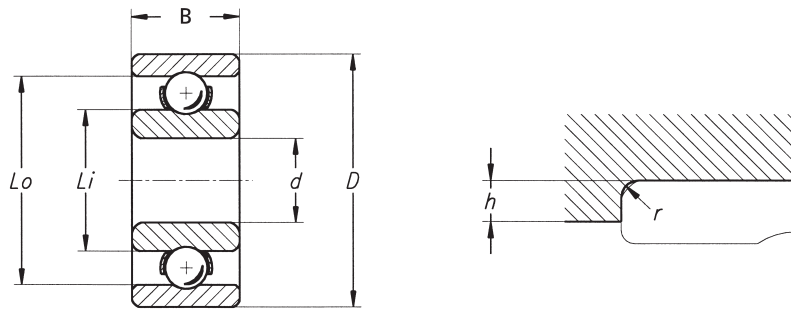
MF
with
filloseals



Inch series

Actual sizes	d [mm] [inch]	D [mm] [inch]	B [mm] [inch]	Bf [mm] [inch]	Reference shielded bearings	Reference shielded bearings	
	3.175 .1250	7.938 .3125	2.778 .1094		MV 40100X		
	3.175 .1250	9.525 .3750		3.572 .1406		MF 40120X	MX 40120X
	3.175 .1250	10.414 .4100	2.381 .0938			MVT 40131X	
	3.175 .1250	10.414 .4100	2.778 .1094		MV 40131X		
	3.175 .1250	10.795 .4250	2.778 .1094		MV 40136X		
	3.175 .1250	12.70 .5000		4.366 .1719			MX 40160X
	4.763 .1875	9.525 .3750	2.778 .1094		MV 60120X		
	4.763 .1875	10.414 .4100	2.778 .1094		MV 60131X		
	4.763 .1875	12.70 .5000	2.778 .1094	3.969 .1563	MV 60160X		MZ 60160X

Radial single row ball bearings with modified outer ring dimension



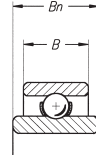
Inch series

Li [mm] [inch]	Lo [mm] [inch]	r max. [mm] [inch]	h min. [mm] [inch]	Balls n x Ø [mm] [inch]	load ratings	
					dynamic C [N]	static Co [N]
3.95 .1555	5.53 .2177	0.10 .004	0.40 .016	8 x 1.000 .0394	184	47
4.13 .1626	6.67 .2626	0.13 .005	0.50 .020	6 x 1.588 .0625	351	86
3.95 .1555	5.53 .2177	0.13 .005	0.50 .020	8 x 1.000 .0394	184	47
5.57 .2193	7.10 .2795	0.20 .008	0.70 .028	9 x 1.000 .0394	198	58
5.57 .2193	7.10 .2795	0.20 .008	0.70 .028	9 x 1.000 .0394	198	58
5.33 .2098	7.87 .3098	0.20 .008	0.70 .028	7 x 1.588 .0625	407	110
5.57 .2193	7.10 .2795	0.10 .004	0.60 .024	9 x 1.000 .0394	198	58
5.57 .2193	7.10 .2795	0.20 .008	0.70 .028	9 x 1.000 .0394	198	58
5.95 .2343	8.35 .3287	0.13 .005	0.60 .024	8 x 1.588 .0625	450	130

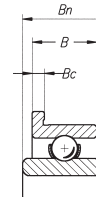
Standard and flanged radial single row ball bearings with extended inner ring



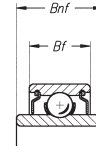
RU/ULU
open



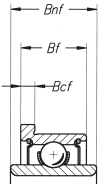
RKU/ULKU
open



ULUZ
with shields



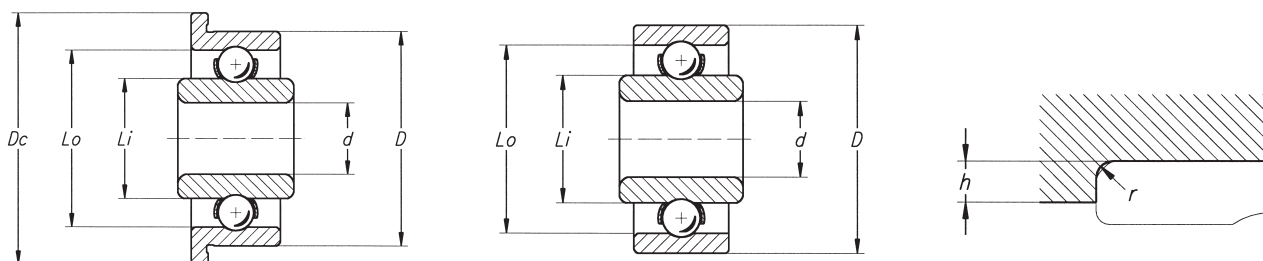
ULKUZ
with shields



Inch series

Actual sizes	d [mm] [inch]	D [mm] [inch]	B [mm] [inch]	Bf [mm] [inch]	Reference open bearings		Reference shielded bearings	
	1.191 .0469	3.969 .1563	1.588 .0625		ULU 1505X	ULKU 1505X		
	1.397 .0550	4.763 .1875	1.984 .0781		RU 1706X	RKU 1706X		
	2.381 .0938	4.763 .1875	1.588 .0625		ULU 3006X	ULKU 3006X		
	2.381 .0938	7.938 .3125	2.778 .1094		RU 3010X	RKU 3010X		
	3.175 .1250	6.350 .2500	2.381 .0938	2.778 .1094	ULU 4008X	ULKU 4008X	ULUZ 4008X	ULKUZ 4008X
	3.175 .1250	7.938 .3125	2.778 .1094		RU 4010X	RKU 4010X		
	4.763 .1875	7.938 .3125		3.175 .1250			ULUZ 6010X	ULKUZ 6010X
	4.763 .1875	9.525 .3750	3.175 .1250	3.175 .1250	ULU 6012X	ULKU 6012X	ULUZ 6012X	ULKUZ 6012X
	6.350 .2500	9.525 .3750	3.175 .1250	3.175 .1250	ULU 8012X	ULKU 8012X	ULUZ 8012X	ULKUZ 8012X
	6.350 .2500	12.700 .5000		4.763 .1875			ULUZ 8016X	ULKUZ 8016X

Standard and flanged radial single row ball bearings with extended inner ring



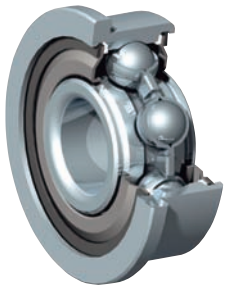
Inch series

Bn	Dc ¹	Bc ²	Bcf ²	Bnf	Li	Lo	r max	h min	Balls n x Ø	load ratings	dynamic	static
[mm] [inch]	[mm] [inch]	[mm] [inch]	[mm] [inch]	[mm] [inch]	[mm] [inch]	[mm] [inch]	[mm] [inch]	[mm] [inch]	[mm] [inch]	[mm] [inch]	C [N]	Co [N]
2.381 .0938	5.156 .2030	0.330 .0130			1.93 .0760	3.18 .1252	0.13 .005	0.4 .016	6 x 0.794 .03125	85	16	
2.778 .1094	5.944 .2340	0.584 .230			2.35 .0925	3.83 .1508	0.13 .005	0.4 .016	6 x 1.000 .0394	138	29	
2.381 .0938	5.944 .2340	0.457 .0180			2.86 .1126	4.14 .1630	0.13 .005	0.4 .016	7 x 0.794 .03125	101	22	
3.572 .1406	9.119 .3590	0.584 .0230			4.13 .1626	6.67 .2626	0.13 .005	0.5 .020	6 x 1.588 .0625	351	86	
3.175 .1250	7.518 .2960	0.584 .0230	0.787 .0310	3.572 .1406	3.95 .1555	5.53 .2177	0.13 .005	0.5 .020	8 x 1.000 .0394	184	47	
3.572 .1406	9.119 .3590	0.584 .0230			4.13 .1626	6.67 .2626	0.13 .005	0.5 .020	6 x 1.588 .0625	351	86	
	9.119 .3590		0.914 .0360	3.969 .1563	5.57 .2193	7.10 .2795	0.13 .005	0.5 .020	9 x 1.000 .0394	198	58	
3.969 .1563	10.719 .4220	0.584 .0230	0.787 .0310	3.969 .1563	5.95 .2343	8.35 .3287	0.13 .005	0.6 .024	8 x 1.588 .0625	450	130	
3.969 .1563	10.719 .4220	0.584 .0230	0.914 .0360	3.969 .1563	7.22 .2843	8.77 .3453	0.13 .005	0.6 .024	11 x 1.000 .0394	220	74	
	13.894 .5470		1.143 .0450	5.556 .2187	7.90 .3110	11.11 .4374	0.13 .005	0.6 .024	8 x 2.100 .0827	726	219	

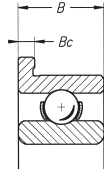
¹ Tolerance for Dc: 0 0
-125 µm -.005"

² Tolerance for Bc and Bcf: 0 0
-50 µm -.002"

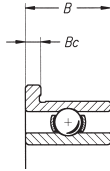
flanged radial single row ball bearings



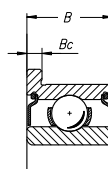
RK
open



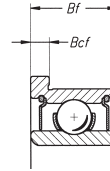
ULK/ULKW
open



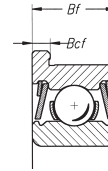
RKV
with
shields



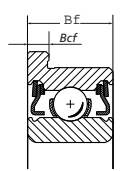
ULKZ
with
shields



RKX
with
shields



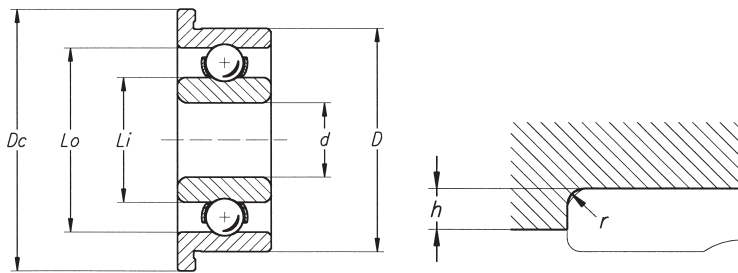
RKF
with
filmoseals



Metric series

Actual sizes	d [mm]	D [mm]	B [mm]	Bf [mm]	Reference open bearings	Reference shielded bearings
	1.5	4	1.2	2	ULK 154X	ULKZ 154X
	2	5	1.5	2.3	ULK 205X	ULKZ 205X
	2	6	2.3	2.3	RK 2060X	RKX/RKF 206X
	2.5	6	1.8	2.6	ULK 256X	ULKZ 256X
	2.5	8	2.8	2.8	RK 2580X	RKF 258X
	3	7	2	3	ULK 307X	ULKZ 307X
	3	8	3	4	RK 3080X	RKF 308X
	3	10	4	4	RK 3100X	RKX/RKF 310X
	4	9	2.5	4	ULK 409X	ULKZ 409X
	4	10	-	4		RKX/RKF 410X
	5	11	3	5	ULK 511X	ULKZ 511X
	5	13	4	-	RK 5130X	RKV 513X
	6	13	3.5	5	ULKW 613X	ULKZ 613X
	6	13	3.5	-	ULK 613X	
	7	14	3.5	5	ULK 714X	ULKZ 714X
	8	16	4	6	ULK 816X	ULKZ 816X
	9	17	-	6		ULKZ 917X
	10	19	5	7	ULK 1019X	ULKZ 1019X

flanged radial single row ball bearings



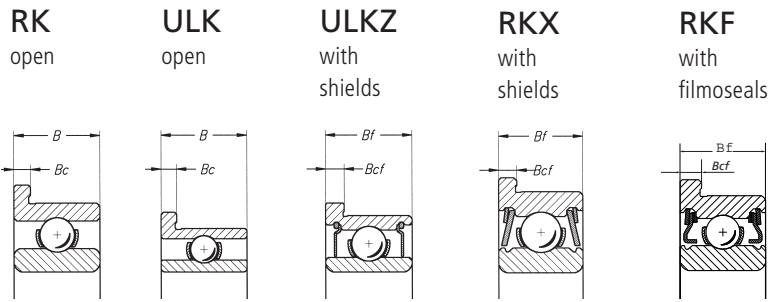
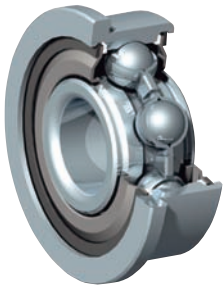
Metric series

B DIN Reference	Bf DIN Reference	Dc ¹ [mm]	Bc ² [mm]	Bcf ² [mm]	Li [mm]	Lo [mm]	r max. [mm]	h min [mm]	Balls n x Ø [mm] [inch]	load ratings dynamic C [N]	static Co [N]
618/1.5R	638/1.5R	5	0.4	0.6	2.12	3.38	0.1	0.4	6 x 0.794	87	17
618/2R	638/2R	6.1	0.5	0.6	2.86	4.14	0.1	0.4	7 x 0.794	101	22
619/2R	619/2R	7.5	0.6	0.6	3.16	4.75	0.2	0.5	7 x 1.000	165	38
618/2.5R	638/2.5R	7.1	0.5	0.8	3.54	5.02	0.1	0.5	7 x 1.000	167	40
60/2.5R	60/2.5R	9.5	0.7	0.7	4.22	6.23	0.2	0.6	7 x 1.250	258	65
618/3R	638/3R	8.1	0.5	0.8	4.14	5.85	0.1	0.5	8 x 1.150	247	66
619/3R	639/3R	9.5	0.7	0.9	4.40	6.61	0.2	0.6	7 x 1.450	335	86
623R	623R	11.5	1	1	5.33	7.87	0.2	0.7	7 x 1.588	407	110
618/4R	638/4R	10.3	0.6	1	5.33	7.87	0.1	0.5	7 x 1.588	407	110
-	-	11.5	-	1	5.33	7.87	0.2	0.7	7 x 1.588	407	110
618/5R	638/5R	12.5	0.8	1	6.69	9.32	0.2	0.7	8 x 1.750	524	152
619/5R	619/5R	15	1	-	7.40	11.00	0.2	0.7	7 x 2.381	824	237
618/6R	628/6R	15	1	1.1	7.90	11.11	0.2	0.7	8 x 2.100	726	219
618/6R	-	14.5	0.7	-	7.90	11.11	0.2	0.7	8 x 2.100	726	219
618/7R	628/7R	16	1	1.1	8.90	12.11	0.2	0.7	8 x 2.100	731	226
618/8R	638/8R	18	1	1.3	10.20	13.81	0.2	0.8	9 x 2.381	992	329
-	638/9R	19	-	1.3	11.20	14.81	0.2	0.8	10 x 2.381	1065	374
61800R	63800R	21	1	1.5	12.32	16.68	0.3	1	9 x 2.778	1314	455

¹ Tolerance for Dc: 0
-125 µm

² Tolerance for Bc and Bcf: 0
-50 µm

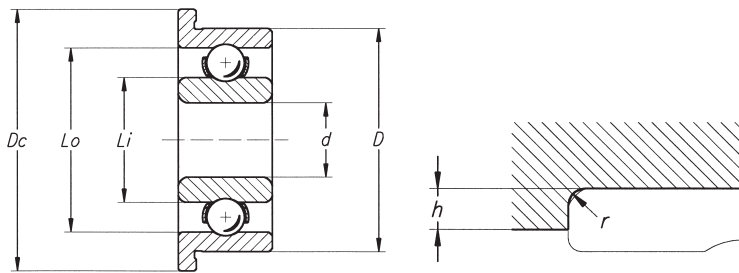
flanged radial single row ball bearings



Inch series

Actual sizes	d [mm] [inch]	D [mm] [inch]	B [mm] [inch]	Bf [mm] [inch]	Reference open bearings	Reference shielded bearings
	1.016 .0400	3.175 .1250	1.191 .0469		ULK 1304X	
	1.191 .0469	3.969 .1563	1.588 .0625	2.381 .0938	ULK 1505X	ULKZ 1505X
	1.397 .0550	4.763 .1875	1.984 .0781	2.778 .1094	RK 1706X	RKX/RKF 1706X
	1.984 .0781	6.350 .2500	2.381 .0938	3.572 .1406	RK 2508X	RKX/RKF 2508X
	2.381 .0938	4.763 .1875	1.588 .0625	2.381 .0938	ULK 3006X	ULKZ 3006X
	2.381 .0938	7.938 .3125	2.778 .1094	3.572 .1406	RK 3010X	RKX/RKF 3010X
	3.175 .1250	6.350 .2500	2.381 .0938	2.778 .1094	ULK 4008X	ULKZ 4008X
	3.175 .1250	7.938 .3125	2.778 .1094	3.572 .1406	RK 4010X	RKX/RKF 4010X
	3.175 .1250	9.525 .3750	3.969 .1563	3.969 .1563	RK 4012X	RKX/RKF 4012X

flanged radial single row ball bearings



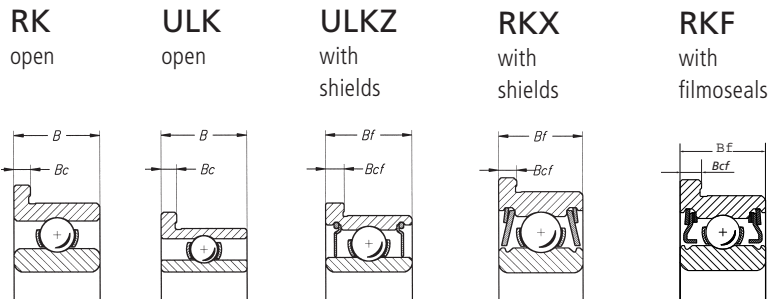
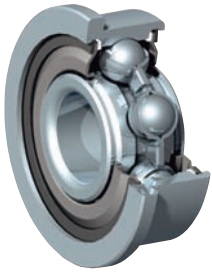
Inch series

US reference	Dc ¹ [mm] [inch]	Bc ² [mm] [inch]	Bcf ² [mm] [inch]	Li [mm] [inch]	Lo [mm] [inch]	r max. [mm] [inch]	h min [mm] [inch]	Balls n x Ø [mm] [inch]	Load ratings dynamic C [N]	static Co [N]
FR 09	4.343 .1710	0.330 .0130		1.60 .0630	2.40 .0945	0.10 .004	0.3 .012	7 x 0.500 .0197	38	6
FR 0	5.156 .2030	0.330 .0130	0.787 0.310	1.93 .0760	3.18 .1252	0.13 .005	0.4 .016	6 x 0.794 .03125	85	16
FR 1	5.944 .2340	0.584 .0230	0.787 .0310	2.35 .0925	3.83 .1508	0.13 .005	0.4 .016	6 x 1.000 .0394	138	29
FR 1-4	7.518 .2960	0.584 .0230	0.787 .0310	3.16 .1244	4.75 .1870	0.13 .005	0.5 .020	7 x 1.000 .0394	165	38
FR 133	5.944 .2340	0.457 .0180	0.787 .0310	2.86 .1126	4.14 .1630	0.13 .005	0.4 0.16	7 x 0.794 .03125	101	22
FR 1-5	9.119 .3590	0.584 .0230	0.787 .0310	4.13 .1626	6.67 .2626	0.13 .005	0.5 .020	6 x 1.588 .0625	351	86
FR 144	7.518 .2960	0.584 .0230	0.787 .0310	3.95 .1555	5.53 .2177	0.13 .005	0.5 .020	8 x 1.000 .0394	184	47
FR 2-5	9.119 .3590	0.584 .0230	0.787 .0310	4.13 .1626	6.67 .2626	0.13 .005	0.5 .020	6 x 1.588 .0625	351	86
FR 2	11.176 .4400	0.762 .0300	0.762 .0300	5.33 .2098	7.87 .3098	0.30 .012	0.7 .028	7 x 1.588 .0625	407	110

¹ Tolerance for Dc: 0 0
-125 µm -.005"

² Tolerance for Bc and Bcf: 0 0
-50 µm -.002"

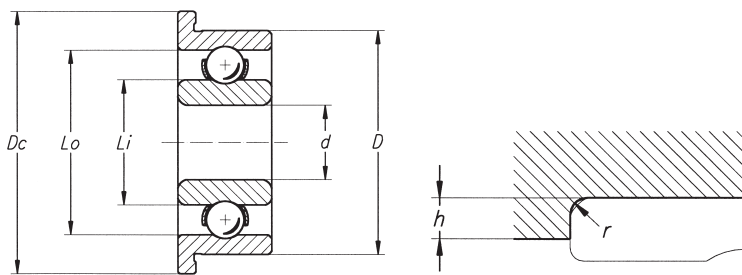
flanged radial single row ball bearings



Inch series

Actual sizes	d [mm] [inch]	D [mm] [inch]	B [mm] [inch]	Bf [mm] [inch]	Reference open bearings	Reference shielded bearings
	3.969 .1563	7.938 .3125	2.778 .1094	3.175 .1250	ULK 5010X	ULKZ 5010X
	4.763 .1875	7.938 .3125	2.778 .1094	3.175 .1250	ULK 6010X	ULKZ 6010X
	4.763 .1875	9.525 .3750	3.175 .1250	3.175 .1250	ULK 6012X	ULKZ 6012X
	4.763 .1875	12.700 .5000	4.978 .1960	4.978 .1960	RK 6016X	RKX/RKF 6016X
	4.763 .1875	12.700 .5000	3.969 .1563		RKT 6016X	
	6.35 .2500	9.525 .3750	3.175 .1250	3.175 .1250	ULK 8012X	ULKZ 8012X
	6.35 .2500	12.700 .5000	3.175 .1250	4.763 .1875	ULK 8016X	ULKZ 8016X
	6.35 .2500	15.875 .6250	4.978 .1960	4.978 .1960	RK 8020X	RKX/RKF 8020X
	7.938 .3125	12.700 .5000	3.969 .1563	3.969 .1563	ULK 10016X	ULKZ 10016X
	9.525 .3750	22.225 .8750	7.144 .2813	7.144 .2813	RK 12028X	RKZ 12028X

flanged radial single row ball bearings



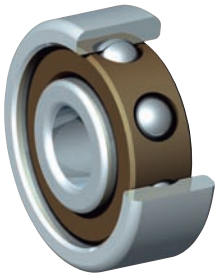
Inch series

US reference	Dc ¹ [mm] [inch]	Bc ² [mm] [inch]	Bcf ² [mm] [inch]	Li [mm] [inch]	Lo [mm] [inch]	r max. [mm] [inch]	h min [mm] [inch]	Balls n x Ø [mm] [inch]	Load ratings dynamic C [N]	static Co [N]
FR 155	9.119 .3590	0.584 .0230	0.914 .0360	4.98 .1961	6.82 .2685	0.13 .005	0.5 .020	8 x 1.150 .0453	250	69
FR 156	9.119 .3590	0.584 .0230	0.914 .0360	5.57 .2193	7.10 .2787	0.13 .005	0.5 .020	9 x 1.00 .0394	198	58
FR 166	10.719 .4220	0.584 .0230	0.787 .0310	5.95 .2343	8.35 .3287	0.13 .005	0.6 .024	8 x 1.588 .0625	450	130
FR 3	14.351 .5650	1.067 .0420	1.067 .0420	7.00 .2756	10.70 .4213	0.30 .012	0.8 .031	7 x 2.381 .09375	1028	346
FR 3	14.351 .5650	1.067 .0420		7.00 .2756	10.70 .4213	0.30 .012	0.8 0.31	7 x 2.381 .09375	1028	346
FR 168	10.719 .4220	0.584 .0230	0.914 .0360	7.22 .2843	8.77 .3453	0.13 .005	0.6 .024	11x1.000 .0394	220	74
FR 188	13.894 .5470	0.584 .0230	1.143 .0450	7.90 .3110	11.11 .4374	0.13 .005	0.6 .024	8 x 2.100 .0827	726	219
FR 4	17.526 .6900	1.067 .0420	1.067 .0420	9.26 .3646	12.96 .5102	0.30 .012	0.8 .031	8 x 2.381 .09375	1145	435
FR 1810	13.894 .5470	0.787 .0310	0.787 .0310	9.23 .3634	11.40 .4488	0.13 .005	0.6 .024	11 x 1.588 .0625	555	199
FR 6	24.613 .9690	1.575 .0620	1.575 .0620	13.21 .5201	18.87 .7429	0.40 .016	0.8 .031	7 x 3.969 .1563	2183	719

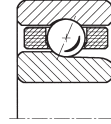
¹ Tolerance for Dc: 0 0
 -125 µm -0.005"

² Tolerance for Bc and Bcf: 0 0
 -50 µm -0.002"








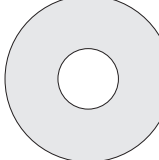
Angular contact separable ball bearings



RA
open



Metric series

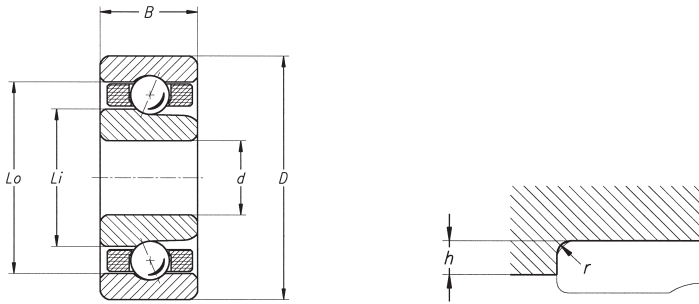
Actual sizes	d [mm]	D [mm]	B [mm]	Reference
	2	6	2.3	RA 2060X
	2.5	8	2.8	RA 2580X
	3	10	4	RA 3100X
	4	13	5	RA 4130X
	4	16	5	RA 4160X
	5	16	5	RA 5160X
	6	19	6	RA 6190X
	8	22	7	RA 8220X

These bearings are available:

- with solid retainer of synthetic material (page 15).
- with a contact angle of 17° to 22° (page 18).
- to the limits of quality P5P or higher (pages 16, 17).

The number of balls printed in **bold figures** indicates standard execution (page 57).

Angular contact separable ball bearings



Metric series

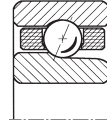
B DIN 616	Li [mm]	Lo [mm]	r max [mm]	h min [mm]	Balls n x Ø [mm]	Load ratings for $\alpha_o = 20^\circ$		
						dynamic C [N]	static Co [N]	axial Coa [N]
719/2	3.16	4.68	0.20	0.5	6 x 1.150	190	43	78
					7 x	210	50	91
70/2.5	3.95	6.23	0.20	0.6	6 x 1.588	338	81	148
					7 x	375	95	173
723	5.63	7.87	0.20	0.7	6 x	356	92	167
					7 x 1.588	394	107	195
					8 x	431	123	224
724	6.88	10.35	0.20	0.8	7 x 2.381	780	217	394
					8 x	853	248	451
734	7.62	12.38	0.30	1.0	6 x 3.175	1145	311	566
					7 x	1268	362	659
725	7.62	12.38	0.30	1.0	6 x 3.175	1145	311	566
					7 x	1268	362	659
726	9.92	14.68	0.30	1.0	7 x 3.175	1333	401	730
					8 x	1457	458	833
708	11.81	17.60	0.30	1.0	7 x 3.969	1984	618	1125
					8 x	2168	706	1285

standard ballset bold





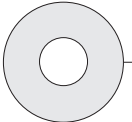
Angular contact separable ball bearings



RA
open



Inch series

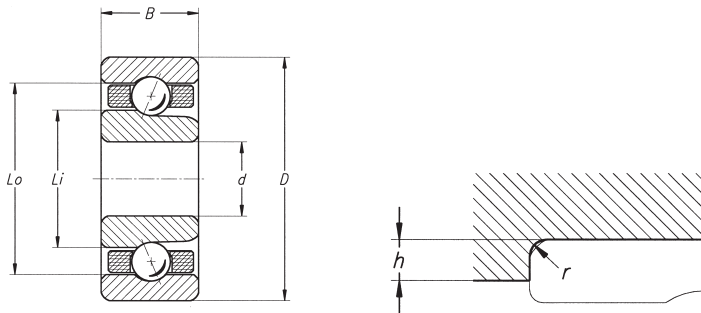
Actual sizes	d [mm] [inch]	D [mm] [inch]	B [mm] [inch]	Reference
	1.984 .0781	6.35 .2500	2.381 .0938	RA 2508X
	2.381 .0938	7.938 .3125	2.778 .1094	RA 3010X
	3.175 .1250	9.525 .3750	3.969 .1563	RA 4012X
	4.763 .1875	12.70 .5000	3.969 .1563	RA 6016X
	6.35 .2500	15.875 .6250	4.978 .1960	RA 8020X

These bearings are available:

- with solid retainer of synthetic material (page 15).
- with a contact angle of 17° to 22° (page 18).
- to the limits of quality PSP or higher (pages 16, 17).

The number of balls printed in **bold figures** indicates standard execution (page 59).

Angular contact separable ball bearings

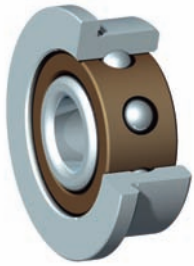


Inch series

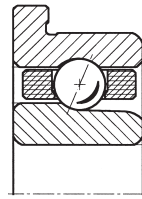
US reference	Li [mm] [inch]	Lo [mm] [inch]	r max [mm] [inch]	h min [mm] [inch]	Balls n x Ø [mm] [inch]	Load ratings for $\alpha_o = 20^\circ$		
						dynamic C [N]	static Co [N]	axial Coa [N]
R1-4B	3.16	4.68	0.13	0.5	6 x { 1.150	190	43	78
	.1244	.1843	.005	.020	7 x { .0453	210	50	91
R1-5B	3.95	6.23	0.13	0.5	6 x { 1.588	338	81	148
	.1555	.2453	.005	.020	7 x { .0625	375	95	173
R2B	5.08	7.32	0.30	0.7	6 x { 1.588	353	89	162
	.2000	.2882	.012	.028	7 x { .0625	391	104	189
R3B	6.88	10.35	0.30	0.8	7 x { 2.381	780	217	395
	.2709	.4075	.012	.031	8 x { .09375	853	248	451
-	9.48	12.96	0.30	0.8	8 x { 2.381	878	274	499
	.3732	.5102	.012	.031	9 x { .09375	950	308	561

standard ballset bold



Flanged angular contact separable ball bearings





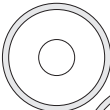
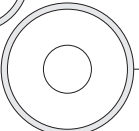
RKA
open



Metric series

Actual sizes	d [mm]	D [mm]	B [mm]	Reference	Dc [mm]	Bc [mm]	Li [mm]	Lo [mm]
	2	6	2.3	RKA 2060X	7.50	0.60	3.16	4.68
	2.5	8	2.8	RKA 2580X	9.50	0.70	3.95	6.23

Inch series

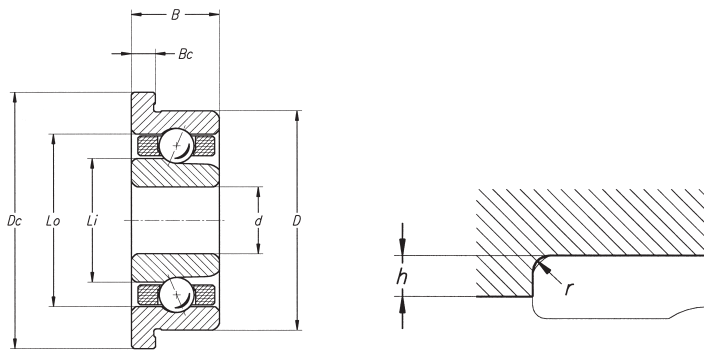
Actual sizes	d [mm] [inch]	D [mm] [inch]	B [mm] [inch]	Reference	Dc [mm] [inch]	Bc [mm] [inch]	Li [mm] [inch]	Lo [mm] [inch]
	2.381 .0938	7.938 .3125	2.778 .1094	RKA 3010X	9.12 .3590	.584 .0023	3.95 .1555	6.23 .2453
	3.175 .1250	9.525 .3750	3.969 .1563	RKA 4012X	11.18 .4401	.762 .030	5.08 .2000	7.32 .2882
	4.763 .1875	12.70 .5000	3.969 .1563	RKA 6016X	14.35 .5649	1.067 .0420	6.88 .2709	10.35 .4075
	6.35 .2500	15.875 .6250	4.978 .1960	RKA 8020X	17.53 .6830	1.067 .0420	9.48 .3732	12.96 .5102

These bearings are available:

- with solid retainer of synthetic material (page 15).
- with a contact angle of 17° to 22° (page 18).
- to the limits of quality PSP or higher (pages 16, 17).

The number of balls printed in **bold figures** indicates standard execution (page 61).

Flanged angular contact separable ball bearings



Metric series

DIN 616	r max [mm]	h min [mm]	Balls n x Ø [mm]	dynamic C [N]	Load ratings for $\alpha_o = 20^\circ$	
					static Co [N]	axial Coa [N]
719/2R	0.20	0.5	6 x 1.150	216	52	94
			7 x 1.150	216	52	94
70/2.5R	0.20	0.6	6 x 1.588	338	81	147
			7 x 1.588	375	95	173

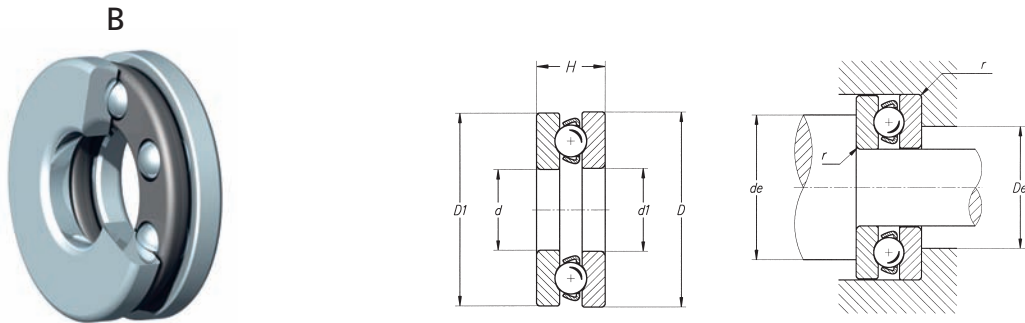
standard ballset bold

Inch series

US reference	r max [mm] [inch]	h min [mm] [inch]	Balls n x Ø [mm] [inch]	dynamic C [N]	Load ratings for $\alpha_o = 20^\circ$	
					static Co [N]	axial Coa [N]
R1-5B	0.13 .005	0.5 .0200	6 x 1.588	338	81	147
			7 x .0625	375	95	173
R2B	0.30 .012	0.7 .0280	6 x 1.588	353	89	162
			7 x .0625	391	104	189
R3B	0.3 .012	0.8 .3100	7 x 2.381	780	217	395
			8 x .09375	853	248	451
-	0.30 .012	0.8 .3100	8 x 2.381	878	274	499
			9 x .09375	950	308	561

standard ballset bold

Thrust ball bearings



Metric series

d [mm]	D [mm]	H [mm]	Reference	d1 [mm]	D1 [mm]	de min [mm]	De max [mm]	r max [mm]	Balls n x Ø [mm]
3	8	3.5	B 308X	3.2	7.8	6	5	0.10	6 x 1.588
4	10	4	B 410X	4.2	9.8	7.5	6.5	0.10	6 x 1.588
5	12	4	B 512X	5.2	11.8	9	8	0.10	8 x 1.588
6	14	5	B 614X	6.2	13.8	10.5	9.5	0.15	7 x 2.381
7	17	6	B 717X	7.2	16.8	13	11	0.15	8 x 2.778
8	19	7	B 819X	8.2	18.8	14.5	12.5	0.25	8 x 3.175
9	20	7	B 920X	9.2	19.8	15.5	13.5	0.25	8 x 3.175

d [mm]	D [mm]	H [mm]	Reference	n max [rpm]	dynamic C [N]	Load ratings axial static Co [N]
3	8	3.5	B 308X	15000	602	611
4	10	4	B 410X	15000	602	611
5	12	4	B 512X	13000	640	815
6	14	5	B 614X	10000	1275	1559
7	17	6	B 717X	10000	1830	2435
8	19	7	B 819X	8000	2343	3191
9	20	7	B 920X	8000	2393	3191

The bearings are manufactured according to ISO P5 (ABEC 5) precision accuracy or better.

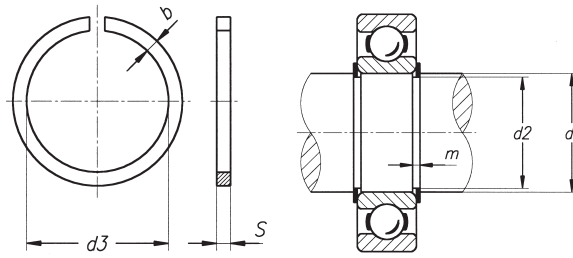
Precision	Ø d	Ø D		H	Axial runout	
		≤17mm	≥19 mm			
P5P	0 / -8 µm	0 / -11 µm	0 / -13 µm	0 / -100 µm	3 µm	Recommended tolerances: shaft: +4 / -4 µm Housing: +8 / 0 µm
P4P	0 / -7 µm	0 / -11 µm	0 / -13 µm		2 µm	



circlips for shafts
circlips for housings

precision spring washers
precision shims

WSR



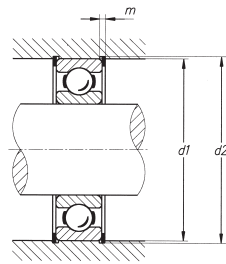
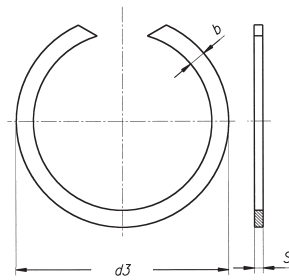
Reference	Shaft		Circlips b ±0.10 [mm]	s* [mm]	Grooves		Suitable for bearings with bore diameter	
	Ø d1 [mm]	d3 max [mm]			d2 -0.05 [mm]	m +0.03 [mm]	[mm]	[inch]
WSR 3	3	2.60	0.50	0.30	2.70	0.33	3	.1250
WSR 4	4	3.60	0.50	0.30	3.70	0.33	4	.1563
WSR 5	5	4.50	0.70	0.40	4.60	0.44	5	
WSR 6	6	5.45	0.70	0.40	5.60	0.44	6	.2500
WSR 7	7	6.45	0.70	0.40	6.60	0.44	7	
WSR 8	8	7.35	0.90	0.50	7.50	0.55	8	.3125
WSR 9	9	8.30	0.90	0.50	8.50	0.55	9	
WSR 10	10	9.25	0.90	0.50	9.50	0.55	10	

Material: stainless steel

* tolerance of «s»

thickness [mm]	tolerance [mm]
< 0,4	± 0,015
< 0,6	± 0,02

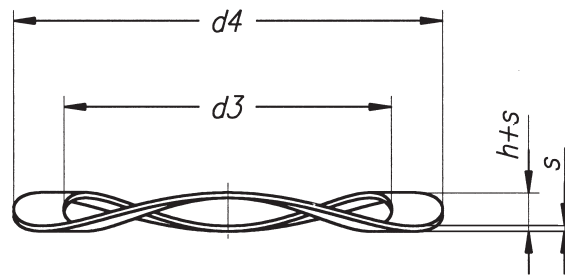
BSR



Reference	Housing		Circlips		Grooves		Suitable for bearings with outside diameter	
	Ø d1 [mm]	d3 min [mm]	b ±0.10 [mm]	s* [mm]	d2 +0.05 [mm]	m +0.03 [mm]	[mm]	[inch]
BSR 4	4	4.40	0.50	0.30	4.30	0.33	4	.1563
BSR 5	5	5.45	0.50	0.30	5.30	0.33	5	
BSR 6	6	6.45	0.50	0.30	6.30	0.33	6	
BSR 7	7	7.50	0.50	0.30	7.30	0.33	7	
BSR 8	8	8.60	0.70	0.40	8.40	0.44	8	.3125
BSR 9	9	9.60	0.70	0.40	9.40	0.44	9	
BSR 10	10	10.65	0.70	0.40	10.40	0.44	10	
BSR 11	11	11.65	0.70	0.40	11.40	0.44	11	
BSR 12	12	12.75	0.90	0.50	12.50	0.55	12	
BSR 13	13	13.75	0.90	0.50	13.50	0.55	13	
BSR 14	14	14.80	0.90	0.50	14.50	0.55	14	
BSR 15	15	15.80	0.90	0.50	15.50	0.55	15	
BSR 16	16	16.85	0.90	0.50	16.50	0.55	16	
BSR 17	17	17.85	0.90	0.50	17.50	0.55	17	
BSR 19	19	20.00	1.10	0.60	19.60	0.66	19	.7500

Material: stainless steel

* tolerance of «s»
 thickness [mm] tolerance [mm]
 < 0,4 ± 0,015
 < 0,6 ± 0,02
 < 0,8 ± 0,025



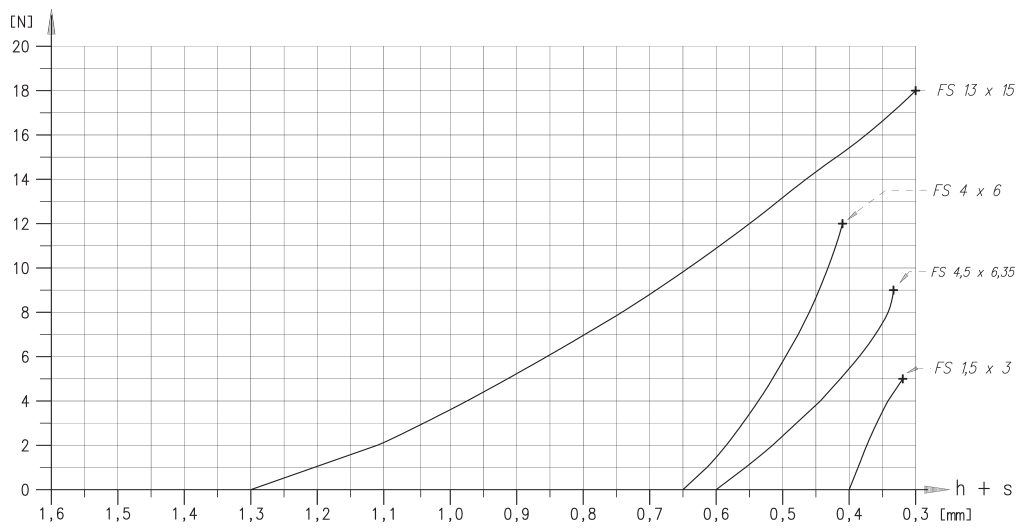
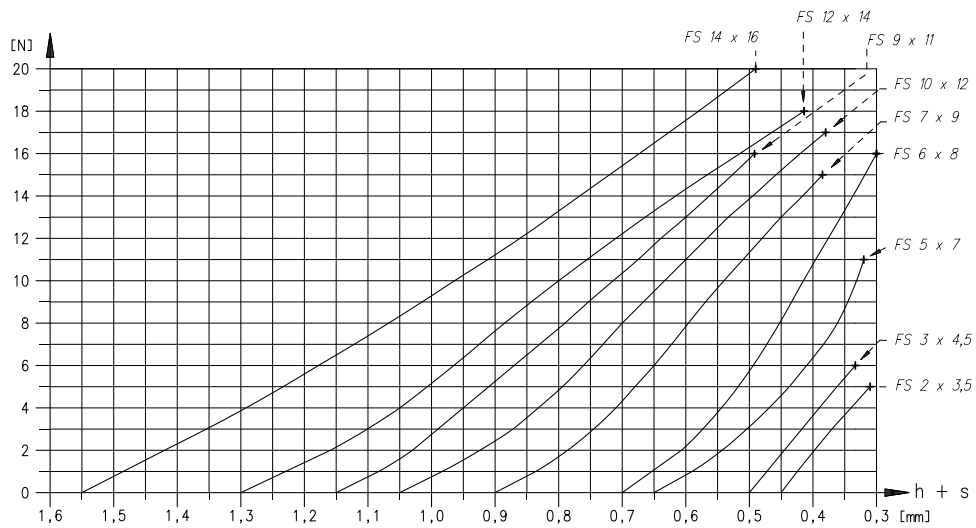
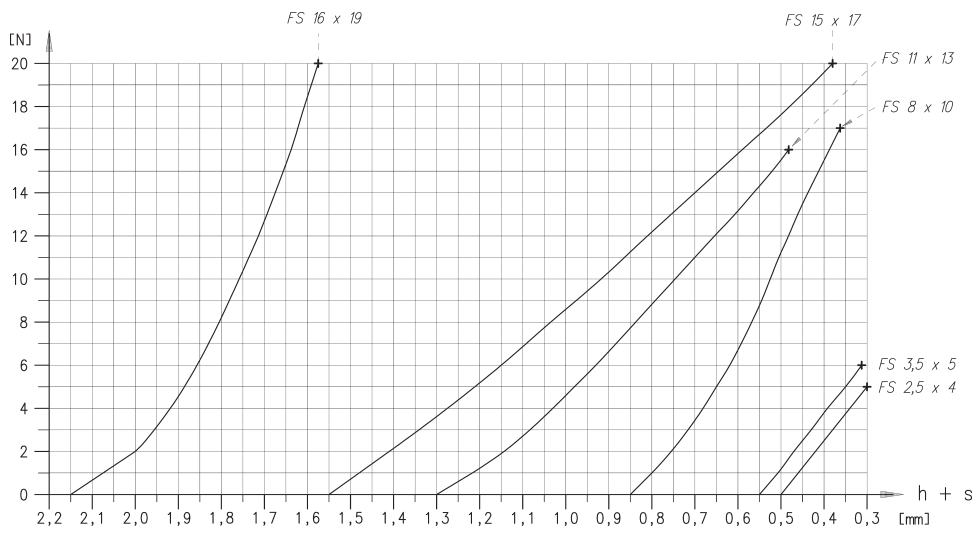
Reference	h+s ±0.05 [mm]	s* [mm]	d3 [mm]	d4 [mm]	Suitable for bearings with			
					bore Ø [mm]	[inch]	outer Ø [mm]	[inch]
FS 1.5 X 3	0.40	0.08	1.60	2.90	-	-	3	-
FS 2 X 3.5	0.45	0.08	2.15	3.10	2	-	-	.1250
FS 2.5 X 4	0.50	0.08	2.70	3.80	2.5	-	4	.1563
FS 3 X 4.5	0.50	0.10	3.20	4.30	3	.1250	-	-
FS 3.5 X 5	0.55	0.10	3.70	4.80	-	-	5	-
FS 4 X 6	0.65	0.12	4.20	5.75	4	.1563	6	-
FS 4.5 X 6.35	0.60	0.12	4.80	6.10	-	.1875	-	.2500
FS 5 X 7	0.65	0.12	5.20	6.75	5	-	7	-
FS 6 X 8	0.70	0.15	6.20	7.75	6	-	8	.3125
FS 7 X 9	0.90	0.15	7.20	8.70	7	-	9	-
FS 8 X 10	0.85	0.18	8.20	9.70	8	.3125	10	-
FS 9 X 11	1.15	0.18	9.20	10.70	9	-	11	-
FS 10 X 12	1.05	0.20	10.20	11.70	10	-	12	-
FS 11 X 13	1.30	0.20	11.20	12.70	-	-	13	-
FS 12 X 14	1.30	0.22	12.20	13.70	-	-	14	-
FS 13 X 15	1.30	0.22	13.20	14.70	-	-	15	-
FS 14 X 16	1.55	0.25	14.20	15.65	-	-	16	-
FS 15 X 17	1.55	0.25	15.20	16.65	-	-	17	-
FS 16 X 19	2.15	0.30	16.20	18.55	-	-	19	.7500

Material: stainless steel

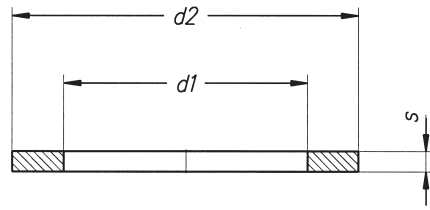
* tolerance of «s»

thickness [mm]	tolerance [mm]
< 0,2	± 0,01
< 0,3	± 0,012
< 0,4	± 0,015

Precision spring washers stiffness



$h+s$ at $F=0N$ measured with $0,35N$



PS

Reference	s ±0.01 [mm]	d1 [mm]	d2 [mm]	Suitable for bearings with			
				bore Ø [mm]	[inch]	outer Ø [mm]	[inch]
PS 1.5 X 3	0.08 0.10	1.68	2.97			3	
PS 2 X 3.5	0.08 0.10	2.25	3.20	2			.1250
PS 2.5 X 4	0.08 0.10	2.80	3.90	2.5		4	.1563
PS 3 X 4.5	0.08 0.10 0.12	3.30	4.40	3	.1250		
PS 3.5 X 5	0.08 0.10 0.12	3.80	4.90			5	
PS 4 X 6	0.10 0.12 0.15	4.30	5.85	4	.1563	6	
PS 4.5 X 6.35	0.10 0.12 0.15	4.90	6.20		.1875		.2500
PS 5 X 7	0.10 0.12 0.15	5.30	6.85	5		7	
PS 6 X 8	0.12 0.15 0.18	6.30	7.85	6		8	.3125
PS 7 X 9	0.12 0.15 0.18	7.30	8.80	7		9	

Order reference must include thickness «s»

Example: PS 8 X 10 X 0.18

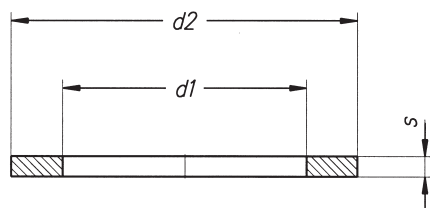
Material: Flat stainless steel

Features: Edges radiused

Heat treated surface

Fine finished surface

PS



PS

Reference	s* [mm]	d1 [mm]	d2 [mm]	bore Ø [mm]	Suitable for bearings with	
					outer Ø [mm]	outer Ø [inch]
PS 8 X 10	0.15	8.30	9.80	8	.3125	10
	0.18					
	0.20					
PS 9 X 11	0.15	9.30	10.80	9		11
	0.18					
	0.20					
PS 10 X 12	0.18	10.30	11.80	10		12
	0.20					
	0.22					
PS 11 X 13	0.18	11.30	12.80			13
	0.20					
	0.22					
PS 12 X 14	0.20	12.30	13.80			14
	0.22					
	0.25					
PS 13 X 15	0.20	13.30	14.80			15
	0.22					
	0.25					
PS 14 X 16	0.22	14.35	15.80			16
	0.25					
	0.30					
PS 15 X 17	0.22	15.35	16.80			17
	0.25					
	0.30					
PS 16 X 19	0.25	16.40	18.80			19
	0.30					
	0.35					

* tolerance of «s»
 thickness [mm] tolerance [mm]
 < 0,2 ± 0,01
 < 0,3 ± 0,012
 < 0,4 ± 0,015

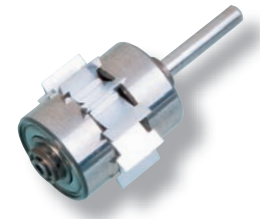
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