MPZ

GENERAL CATALOGUE

Joint Stock Company
“Minsk Bearing Plant”

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Contents

Catalogue 007.E-2010

Introduction

About the enterprise

JSC “Minsk Bearing Plant” is one of the largest manufacturers of spherical roller bearings and it has been working on the world market for more than 60 years.

MPZ manufacturing program includes spherical roller bearings of 25–980 mm diameter and 200 g – 800 kg mass.

The high level of technology and personnel skills allows to ensure production of bearings according to ISO standards. It is proved by ISO 9001 compliance certificates acquired by the plant.

Bearing type and design groups correspond to the international standards requirements; they are interchangeable with the imported analogues and are competitive on the markets of both CIS and far-abroad countries.

The bearings with MPZ trademark have wider application by the consumers placing their stake on reliability and life of the equipment.

JSC “Minsk Bearing Plant” is one of the largest manufacturers of bearings in CIS and has over 50 years of experience in exploitation of own bearings.

The MPZ Quality Management System is certified with regard to compliance with ISO 9001 international standards.

All technical specifications for the bearings produced according to GOST 520-2002 correspond to ISO 492:2002 and ISO 199:2005 international standards.

MPZ mainline program

The foundation (basis) of our bearings delivery program is the main nomenclature program. A designer or operating consumer can obtain the information regarding our manufactured items' characteristics that is required in the course of development and exploitation of the bearing arrangements from our catalogue. For consultations on the specific subjects it is possible to contact the plant directly. The items included into the mainline program are manufactured in series on a regular basis depending on the studied demand that helps to ensure their continuous supply. 70% of the items can be delivered within one week since the payment date, 25% – within a month, the remaining 5% – within three month after obtaining the order. This simplifies consumers' acquisition planning regarding any period, supply and storage of the bearings, hence they get the opportunity to purchase or order items from all the broad assortment.

MPZ full program

In the cases when the bearings from the mainline program satisfy the consumer partially or are totally unsuitable, MPZ, being a multipurpose bearings manufacturer, supplies the items according to individual orders. These include: ball bearings, roller bearings, roller bearings with barrel-shaped, cylindrical and tapered rollers, needle ring bearings, with or without a cage, with one ring as well as ringless bearings, joint-type bearings, ball-shaped, roller-shaped and needle-roller-shaped free parts. Dedicated bearings design can account for the specific requirements regarding radial clearances, rotational accuracy, arrangement operating temperature, corrosive powers, optional coupling sizes, bearing retention on the shaft by means of sleeves, etc. MPZ items full program includes ball bearings with outside diameter 22–250 mm, roller – 52–980 mm, needle – 11–150 mm, joint-type – 47–160 mm.

MPZ manufactures and supplies free parts of rolling element bearings: balls of 5–35 mm diameter, cylindrical rollers of 4.5–30 mm diameter, needle rollers of 1.5–10 diameter.

Technological advancement program

Production and design of bearings is constantly improved. The plants' Test Centre ensures the conduct of bench and actual bearings tests for their compliance with the international standards (GOST), etc. Technical normative legal acts (TNLA). This catalogue contains a documentary record of the achieved quality enhancement.

Such basic bearings performance characteristics as static and dynamic load rating that determines the bearing arrangement's operating capacity and resource are calculated on the basis of the international norms and, which is the most important, subject to broad testing that is continuously held by MPZ.

Quality

JSC “Minsk Bearing Plant” features the Quality Management System (MPZ QMS) certified for compliance with DIN EN ISO 9001 requirements in the German accreditation system and STB ISO 9001 – in the national certification system.

All the management principles have been realized in MPZ QMS that allows to create all the conditions required for manufacturing competitive products and satisfying the interested parties. The Management Policy, Quality Guidelines, over 100 organization standards have been developed. The JSC “MPZ” top management is exercising efficient administration of MPZ QMS, is constantly monitoring the possesses and products quality, regularly undertaking the QMS analysis, timely taking necessary corrective, precautionary action and measures to improve it.

The work regarding further updating MPZ QMS, enhancing its effectiveness and productivity is being carried out.

JSC "MPZ" Management Policy

Being the leader in manufacturing spherical roller bearings, MPZ produces rolling element bearings for the CIS and far-abroad countries.

JSC "MPZ" Management Policy is aimed at manufacturing top-quality competitive products that allows to satisfy consumers and other interested parties on the basis of meeting their requirements and expectations, enhancing the organization's management system effectiveness and binding up long-standing relationships between the parties:

Major areas of activity:

1 Continuous **enhancement** of the Quality Management System and Environmental performance by complying with the international standards' requirements, customers' requirements and mandatory requirements.

2 ***Improvement*** *of planning and industrial organization methods.*

3 Ensuring the **growth** of the personnel's professional skills.

4 Efficient resource **management**.

5 ***Diminishing*** *the adverse effect on the environment.*

6 ***Development*** *and* ***implementation*** *of advanced facilities, design and technologies.*

7 ***Controlling*** *the processes as the customer-orientated system that quarantines quality of contractual obligations execution.*

These areas of activity make the basis for setting the Business Plan's objectives.

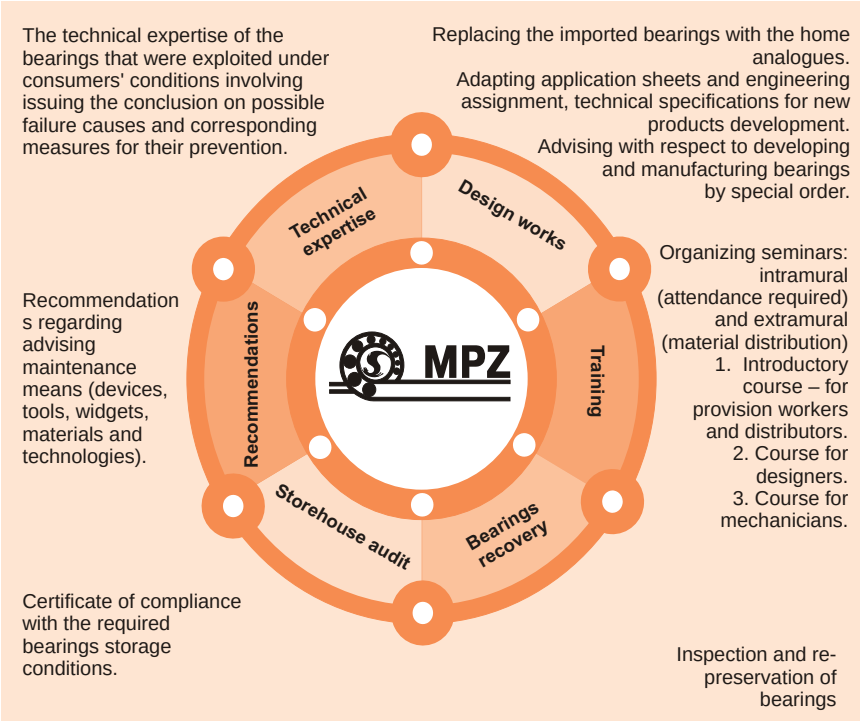
The policy is being brought to all the JSC "MPZ" personnel, is being analyzed for constant adequacy and presents the documented guide to action. The Director General is the one responsible for its realization.

Servicing

The goal of MPZ company servicing concept is to minimize consumers' losses caused by unscheduled equipment downtime due to early bearings breakage, to ensure enhanced operating capacity of each consumer's bearings and thus increase competitiveness of both the consumer-produced items and MPZ-produced items.

Collaboration with consumers regarding various subjects of application and servicing, evaluation of MPZ manufactured items is deemed an inherent element of our trade policy.

The consumers of MPZ products can choose the necessary service type according to their needs.

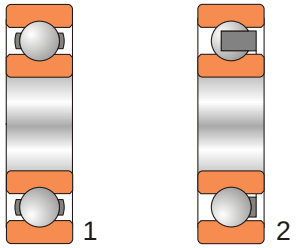


Bearings types

General information on bearings, choice and application

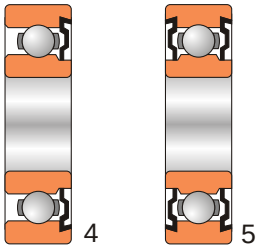
Bearings types

Deep groove radial ball bearings



Single row deep groove radial ball bearings (1, 2)

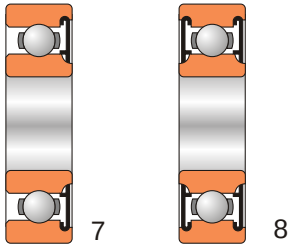
Single row deep groove radial ball bearings with outer ring groove (3)



Single row deep groove radial ball bearings with one shield (4)

Single row deep groove radial ball bearings with two shields (5)

Single row deep groove radial ball bearings with outer ring groove and one shield (6)

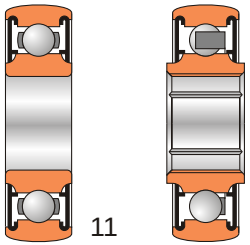


Single row deep groove radial ball bearings with one-side seal (7)

Single row deep groove ball radial bearings with double-sided seal (8)

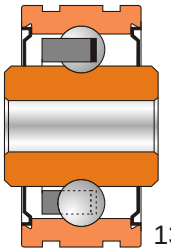
Single row deep groove radial ball bearings with outer ring groove and one-side seal (9)

Single row deep groove radial ball bearings with outer ring groove and filling slot (10)

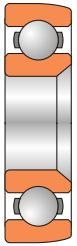


Single row radial ball bearing with double-sided seal and outer ring spherical outside surface (11)

Single row radial ball bearing with double-sided seal, outer ring spherical surface and hexahedral bore (12)

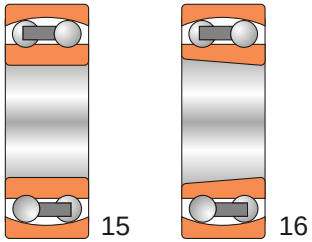


Single row radial ball bearings with two shields, special application (13)



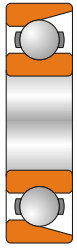
Single row radial ball bearings, special application (14)

Spherical radial ball bearings

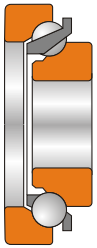


Double-row spherical radial ball bearings with cylindrical (15) or tapered bore (16)

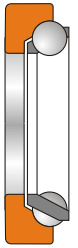
Angular contact ball bearings



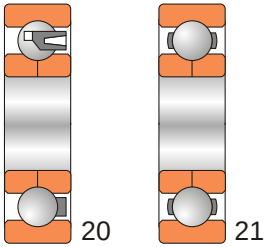
Single row angular contact ball bearings with bevel on outer ring (17)



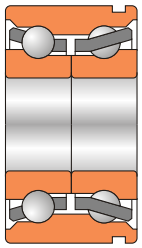
Single row angular contact ball bearings with demountable rings (18)



Single row angular contact ball bearings without inner ring (19)

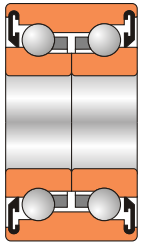


Three(20)- or four-point contact ball bearings with two-piece inner ring, single row (21)



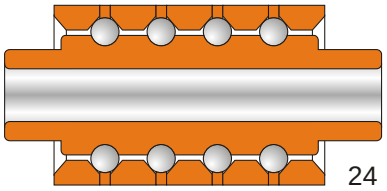
22

Double row angular contact ball bearings with two-piece inner ring (22)



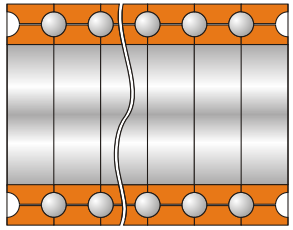
23

Double row angular contact ball bearings with two-piece inner ring and seals (23)



24

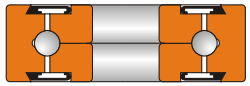
Multi row angular contact ball bearings (24)



25

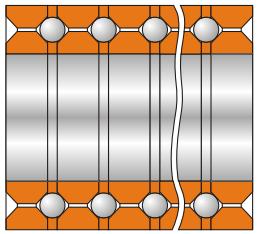
Multi row angular contact ball bearings (25)

Angular contact thrust ball bearings



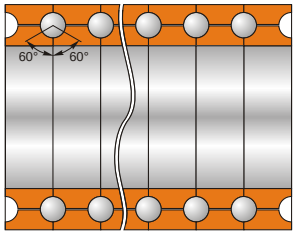
26

Angular contact thrust ball bearings with two-sided seal, single row (26)



27

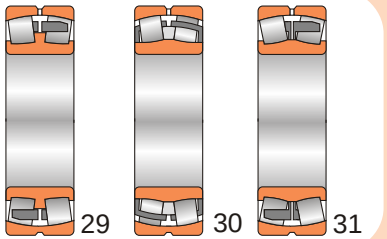
Angular contact thrust ball bearings, multi row (27)



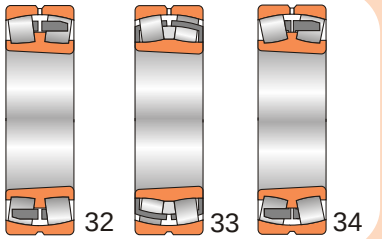
28

Angular contact thrust ball bearings, multi row (28)

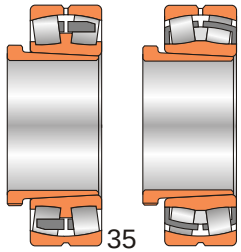
Spherical roller bearings, double row



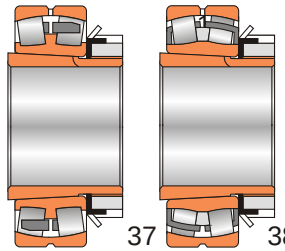
Spherical roller bearings
with cylindrical bore,
double row (29, 30, 31)



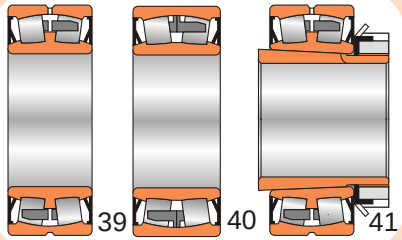
Spherical roller bearings
with tapered bore,
double row (32, 33, 34)



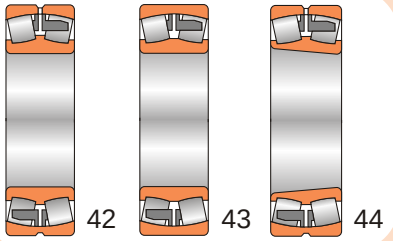
Spherical roller bearings
double row
on withdrawal sleeve (35, 36)



Spherical roller bearings
double row
on adapter sleeve (37, 38)

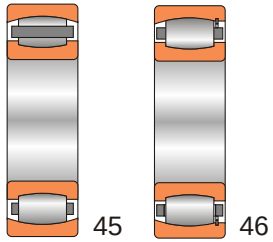


Spherical roller bearings,
double row
with two-sided seal (39, 40, 41)



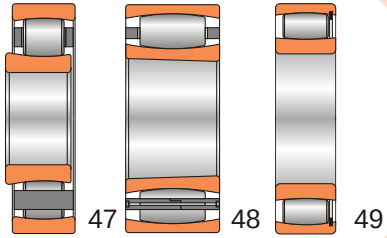
Spherical roller bearings
for vibratory applications
with cylindrical (42, 44)
and tapered bore (44)

Spherical roller bearings, single row



Spherical roller bearings,
single row (45, 46)

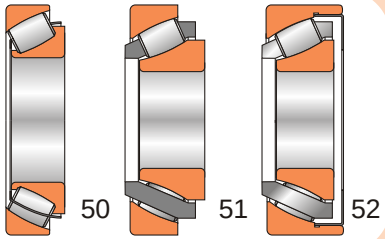
Toroidal roller bearings



Toroidal roller bearings,
single row with plastic (47),
brass (48) cages
and without cage (49)

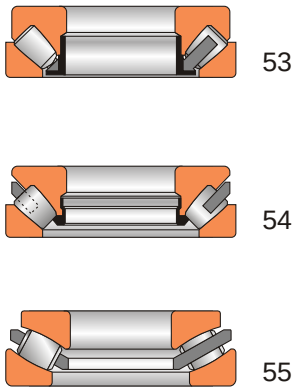
Bearings types

Taper roller bearings



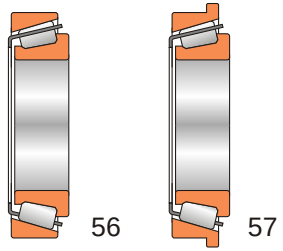
Single row taper roller bearings (50, 51, 52)

Spherical roller thrust bearings

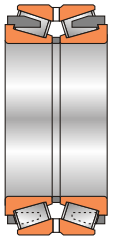


Spherical roller thrust bearings (53, 54, 55)

Taper roller angular contact bearings

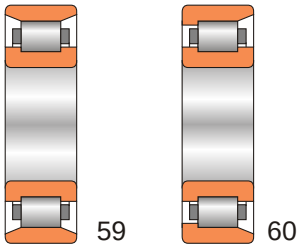


Taper roller angular contact bearings, single row (56) with flanged outer ring (57)

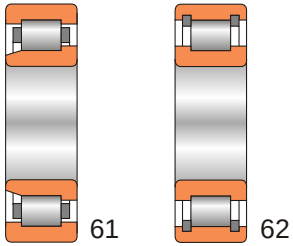


Taper roller angular contact bearings, double row (58)

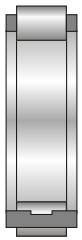
Roller radial bearings with short cylindrical rollers



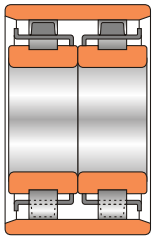
Roller radial bearings with short cylindrical rollers, single row without flanges (59) on outer ring or with one flanged outer ring (60)



Roller radial bearings with short cylindrical rollers, single row, with one flanged inner ring(61) or flangeless outer ring and with two snap rings (62)

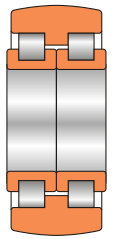


Roller radial bearings with short cylindrical rollers, single row without rings (63)



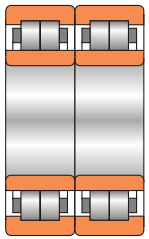
64

Roller radial bearings
with short cylindrical rollers,
double row, flangeless design
on the outer ring (64)



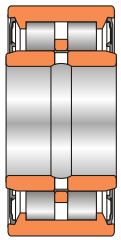
65

Cylindrical radial roller
bearings with short cylindrical
rollers, double row and spherical
surface of outer ring (65)



66

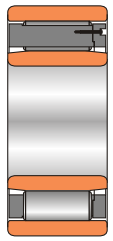
Roller radial bearings
with short cylindrical rollers,
double row, flangeless design
on inner ring, doubled (66)



67

Roller radial bearings
with short cylindrical rollers,
double row,
with two-sided seal (67)

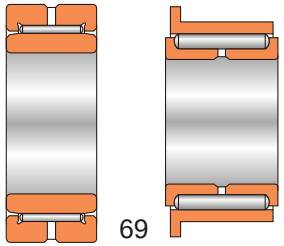
Roller radial bearings with short cylindrical rollers, single row



68

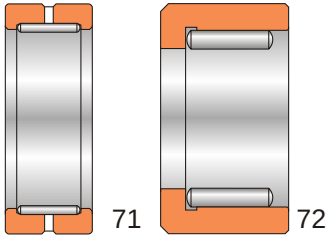
Roller radial bearings,
single row
with long cylindrical rollers (68)

Needle roller radial bearings



69 70

Needle roller radial bearings,
single row with outer and inner
rings without cage (69, 70)

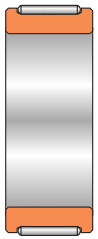


71 72

Needle roller radial bearings,
single row, without inner ring
and cage (71,72)

73

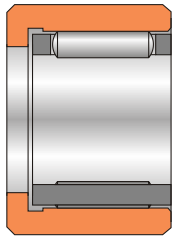
Needle roller radial bearings, single row, without inner ring and cage (73) for special applications



74

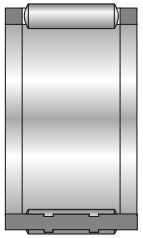
Needle roller radial bearings, single row, without outer ring and cage (74)

75



76

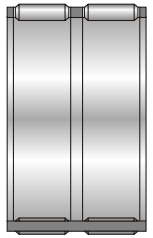
Needle roller radial bearings, single row, with inner and outer rings (75) or without inner ring, with cage (76)



77

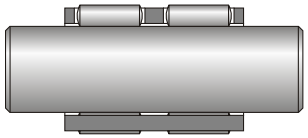
Needle roller radial bearings, single row, without rings (77)

Bearings types



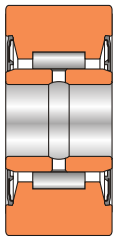
78

Needle roller radial bearings, double row, without rings (78)



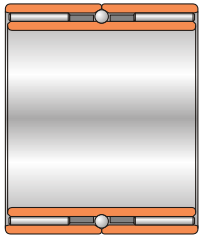
79

Needle roller radial bearings, double row with spindle (79)



80

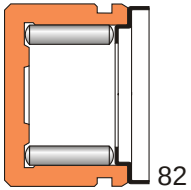
Support rollers (80)



81

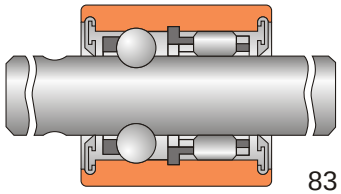
Needle roller radial bearings, double row with two-piece outer ring and balls (81)

Bearings types



82

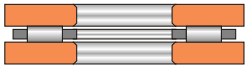
Cardan shaft radial needle roller bearings (82)



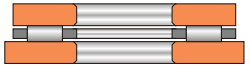
83

Combined radial bearings for special applications (83)

Roller thrust bearings



84



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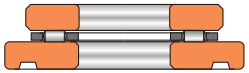


86

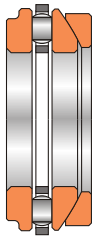
Roller thrust bearings, single row (84,85,86)

87

Roller thrust bearings, single row with housing (87)

88

Roller thrust bearings, single row without one ring (88)



89

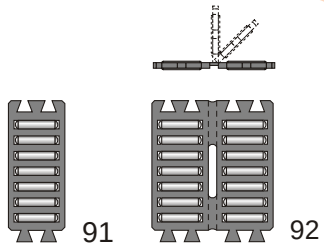
Roller thrust bearings, single row, for special applications (89)

90

Roller thrust bearings, single row without rings (90)

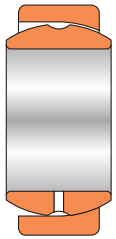
Bearings types

Linear motion needle roller bearings

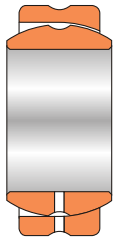


Linear motion
needle roller bearings (91, 92)

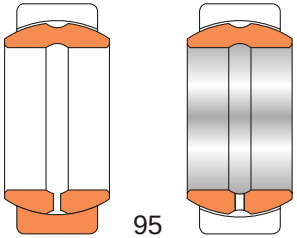
Joint-type bearings



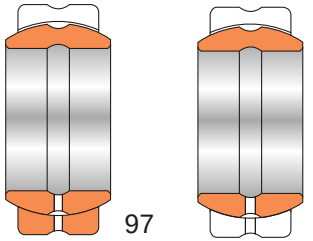
Joint-type bearings
with lubricating holes and
grooves on inner ring (93)



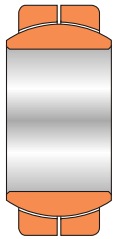
Joint-type bearings
with lubricating holes and
grooves on inner and outer
rings (94)



Joint-type bearings
with one (95) or two fractures
of outer ring, lubricating holes
and grooves in inner ring (96)



Joint-type bearings
with one (97) or two fractures
of outer ring, lubricating holes
and grooves in inner and
outer rings (98)



Joint-type bearings
with cut outer ring (99)

Choosing type and design of bearings

Choosing type and design of bearings

Rolling element bearings are classified according to: bearing load direction with respect to shaft axis (radial, angular contact and thrust); shape of rolling elements (ball, roller, needle); number of rolling element rows (single row, double row, etc.); self-alignment capability (self-aligning and not self-aligning) and other features.

The detailed classification can be found in the operating standards. Nevertheless, this classification is provisional to a certain extent; hence many bearing types can satisfy varied goals. Accordingly, there are no strict rules regarding the choice of a bearing type. Besides, a machine designer often has to take a decision under mutually exclusive requirements. So, bearing sizes as per the bore and outside diameter must be sometimes accepted according to a housing or shaft hole diameter.

Rating and direction of the load make the determining factor while choosing a bearing nominal size. Under small loads and with small shaft diameters ball bearings are used more widely; and under heavy loads and with big shaft diameters – roller bearings, since they can sustain more load with the sizes equal to that of ball bearings and have a higher stiffness factor. Roller needle bearings, bearings with cylindrical rollers and unflanged rings and toroidal take up only radial load. The rest of the radial bearings can sustain axial load to one extent or another.

Thrust bearings can take only axial load. Ball thrust single row bearings sustain single-direction axial load and double row bearings – double-direction axial load.

Angular contact ball and roller bearings with tapered rollers are primarily chosen for operation under the combined load. At this, the axial load value sustained by a bearing depends on a contact angle. While increasing a bearing contact angle its axial load rating is also rising.

If the axial load supersedes the radial load, it is practical to use four-point contact ball bearings or spherical roller thrust bearings.

Having axis misalignment of a shaft and a housing caused by engineering faults or the shaft whipping under the operating loads, spherical ball and roller or toroidal bearings are used. Besides, toroidal bearings can compensate significant shaft axial displacements. Sometimes radial ball bearings with spherical surface of outer ring, which are set in a housing spherical holes, are used for loose arrangements.

Choosing bearings must be fulfilled with allowance for the abovementioned factors. But for a quick choice of bearing types table 1 can be used; it assists, knowing loading conditions and operating requirements, in choosing the most suitable bearing design.

While exploiting bearings in the arrangements under high temperature the following principles must be observed.

The bearing support temperature rate is defined according to the rolling and sliding friction energy losses accompanied by heat generation in the support and to the outside temperature with account of heat generation by adjacent arrangements and machine's parts.

In the result of the temperature increase the bearing steel's hardness lowers, deformation of separate bearing parts takes place, lubricating materials' service life diminishes, operating capacity of the bearing's and seal's plastic parts drops down.

Rolling surfaces hardness notably lowers, if their operating temperature t_p approaches rings' and rolling elements' tempering temperature t_0. $t_0 - t_p \geq 50$°Ñ is the condition of bearings normal performance.

When temperature t_p of the standard application bearings equals or exceeds 125°Ñ, the operating surfaces hardness occurs; it is accounted for by introducing a temperature factor K_T into the equivalent load formula. The dedicated bearings with increased tempering temperature are manufactured for being used in operations under high temperature conditions. This bearing designation contains index T.

Ring tempering temperature t_0, °C	200	250	300	350	400
Additional designation	Ò	Ò2	Ò3	Ò4	Ò5
Operating temperature t_p, °C	150	200	250	300	350

If introducing K_T factor results in the equivalent load rise whereby the required dynamic load rating becomes unacceptably high (in view of the specific speed and sizing), the cooling system is designed.

A bearing's parts deformation is dangerous, as it leads to its inner clearances reduction and change of its alighting tensions. If the temperature on a bearing's inner ring is higher than on the outer one, it is advised to use bearings with enhanced clearances for operation under high temperature conditions. In order to avoid a bearing's pressing-out its shaft and housing must be made of the material having the same factor of thermal expansion as bearing steel ($\alpha = 12 \cdot 10^{-6}$ Ê$^{-1}$). Under considerable temperature disturbances it is necessary to avoid setting in bearings using “spacer” scheme. axial displacement possibility in a floating support must exceed the maximum shaft thermal extension, which is determined via $\Delta l = \alpha \Delta t l$ formula, where

Δl – the shaft thermal extension, mm

Δt – temperature change, °Ñ;

l – shaft length, mm.

If the parts deformations under maximum temperature is so excessive that the clearances broadening hampers the stability of the bearings operation in other working modes, elastic waisting of the bearings or implementing the cooling system can be applied.

In the course of designing the latter it is important to avoid the widespread mistake – lowering temperature on a less heated bearing. Hence, if the overheating is caused by the bearing's internal heat generation, the support housing cooling with the outer bearing ring can result in the bearing's jamming.

It is unpractical to use the bearings made of ØÕ15 steel under the temperature exceeding +300°Ñ.

For operation under these temperatures the bearings made of hot-working steel are applied. These bearings function under the temperature up to 450–500°Ñ.

At high temperatures functioning of rolling element bearings is often limited by a lubricant. A lubricant's losing its operational qualities leads to early breakage of a bearing.

Lowering of lubricating materials operating capacity in the course of temperature increase determines the choice of their brands, the system of their input into a bearing arrangement and their replacement age. It must be emphasized, that the increase of a semisolid lubricant temperature by 14—15° (within the acceptable temperature range) twice, on average, reduces its life. Hence, under high temperatures conditions the system with axifugal automatic discharge of semisolid lubricant, which allows refilling the lubricating material, is more preferable.

Choosing type and design of bearings

Choosing type and design of bearings

Level of bearings compliance with the operating conditions

Table 1

Suitability:

- ● very good
- ◕ good
- ◑ satisfactory
- ◔ limited
- ○ unsuitable
- → sustaining one-direction load

Types of bearings	Design: Dismountable design	Design: Tapered bore	Design: One- or two-sided seal	Can be used under: Radial load	Axial load	Combined load	High rotational speed	Enhanced rotational accuracy	High stiffness	Quietness	Low friction	Misalignment compensation	Compensation of the thermal expansion with respect to the shaft inside a bearing	Compensation of the thermal expansion with respect to the shaft in a bearing's clearance fit	Shaft axial fixation
– ball bearing															
single row deep groove radial	○	○	●	◕	◑	◕	●	◑	◑	●	●	◔	○	◑	◕
single row angular contact	○	○	○	◕	◕→	●	●	◑	◑	◕	◕	○	○	◑	●
double row angular contact, doubled	○	○	◑	◕	◕	◕	◑	◑	◕	◑	◑	○	○	◑	◕
four-point contact	◑	○	○	◔	◑	◑	◕	◔	◑	◑	◑	○	○	○	◕
double row self-aligning	○	●	●	◑	◔	◔	◕	○	◔	◑	◕	●	○	◑	◑
thrust, single row	●	○	○	○	◕→	○	◑	◕	◑	◔	◑	○	○	○	◑
angular contact thrust, single row	○	○	○	◔	◕→	◑	◕	◕	◑	◑	◑	◔	○	○	◕
angular contact thrust, multi row	●	○	○	◔	●	◔	◔	○	◕	○	◔	◔	○	○	◑
– roller bearing															
radial with short cylindrical rollers, fixed flanges	●	◑	○	●	◑	◑	●	◕	●	◑	◕	◔	○	○	◕
radial with short cylindrical unfixed rollers	●	○	○	●	○	◔	●	◑	●	◔	◕	◔	●	◑	○
radial with needle rollers	●	○	●	●	○	○	◑	◑	◕	◑	◔	○	●	○	○
radial toroidal	○	●	○	●	○	○	◑	○	◕	◑	◑	◔	●	○	○
radial spherical, single row	○	●	○	●	◑	◑	◑	○	◕	◔	◑	●	○	◑	◕
radial spherical, double row	○	●	◑	●	◑	◕	◑	○	◕	◔	◑	●	○	◑	◕
angular contact with tapered rollers	●	○	○	◕	◕→	●	◑	◕	◕	◔	◑	◔	○	◑	●
angular contact thrust spherical	●	○	○	○	●→	◔	◔	○	◕	○	◔	●	○	○	◕
thrust with cylindrical rollers	●	○	○	○	◔→	○	◔	◑	◕	◔	◔	○	○	○	◕

Bearing specification life calculation

To choose a rolling element bearing it is necessary to have knowledge of the set operating conditions, i.e. load and its direction; load application conditions; rotational speed of one or both rings; required specification life; the arrangement's operational speed and other requirements defined by the machine design.

A bearing's specification life is understood as the number of rotations made by one of the rings with respect to the other ring before the material fatigue destruction starts on one of the rings or rolling elements. It can be expressed in millions of rotations or working hours. The basic rating life is understood as the service life of the bearing batch, which contains no less than 90% of identical bearings under the same load and rotational speed must function without signs of metal fatigue on the operating surfaces. The basic bearings rating is the basic dynamic design load rating, denoted as C, represents the load that must be taken up by a rolling element bearing per one million of rotations. Depending on the design bearings dynamic load capacity calculated according to the recommendations of the International Organization for Standardization (ISO) regarding rolling element bearings is given in the tables of this catalogue.

The relationship between the basic specification life, dynamic design load rating and the load sustained by a bearing under rotational speed n>20 min-1 is defined using the formula as follows::

$$L_{10} = \left(\frac{C}{P}\right)^{p}, \qquad (1)$$

where
L_{10} – basic rating life, mln of rotations;
Ñ – basic dynamic design load rating, N;
Ð – equivalent dynamic load, N;
ð – exponent;
for ball bearings: ð = 3;
for roller bearings: ð=10/3

Basic (rating) life is more often expressed in working hours:

$$L_{10h} = \frac{1000000}{60n}\left(\frac{C}{P}\right)^{p}, (2)$$

where
L_{10h} – basic (rating) life, h;
n – rotational speed, min^{-1}.

For transportation vehicles the basic (rating) bearing life can be sometimes conveniently expressed in kilometers of the distance run:

$$L_{10S} = \frac{\pi D_1}{1000} L_{10}, \qquad (3)$$

where
L_{10s} – the basic rating life, mln km;
D_1 – wheel diameter, m.

If a bearing does not rotate but makes an oscillatory motion with relation to the mid position on the corner:

$$L_{10OSC} = \frac{180}{2\gamma} L_{10}, \qquad (4)$$

where
L_{10osc} – basic life, millions of cycles;
γ – amplitude of oscillation, degrees.

Under regular operating conditions the basic (rating) life (L10) estimated according to 90% reliability level satisfy the majority of bearings practical applications, since actual specification life is higher than rating life; and, in case of 50% reliability level, specification life (L50), as a rule, is five times higher than a basic (rating) life level (L10). In order to enhance bearing arrangements' compactability and lower their mass it is not advised to go far beyond their basic life. Nevertheless, in some engineering areas a different reliability level is required. Besides, the great effect of lubrication conditions on a bearing's specification life was determined in the result of research scientific works. Therefore ISO implemented the notion of the adjusted rating life that takes the form:

$$L_{na} = a_1 a_2 a_3 \left(\frac{C}{P}\right)^{p}, \qquad (5)$$

or

$$L_{na} = a_1 a_2 a_3 L_{10}$$

where
L_{na} – adjusted rating life, mln of rotations. Index n defines the difference between the set reliability and 100% (e.g. at 95% $L_{na}=L_{5a}$ reliability level))
a_1 – reliability factor;
$à_2$ – material factor;
$à_3$ – operating conditions factor.

Table 2

Reliability factor value

Reliability %	L_{na}	a_1
90	L_{10a}	1
95	L_{5a}	0,62
96	L_{4a}	0,53
97	L_{3a}	0,44
98	L_{2a}	0,33
99	L_{1a}	0,21

In case of the accepted 90% reliability, proper bearing steel quality and the lubricating conditions, which ensure the disjunction of contacting working surfaces within the recommended range, $à_1=à_2=à_3=1$ and the adjusted rating life equation (5) becomes identical to the main one (1).

If the calculation with regard to the bearings having higher than 90% reliability level is required, the a_1 reliability factor values are taken from table 2.

Nevertheless, it is practical to use a_1 factor only while $à_2$ and $à_3$ factors grow up, otherwise the calculation leads to a bearing's overall sizes and, consequently, to the reduction of its specific speed, the increase of the mass and delayed action of the rotating parts belonging to the machines connected to this bearing.

a_1 factor, being subsequent upon the probability theory, is presented in the international standard ISO 281/1. The right to set $à_2$ and $à_3$ factors is given to the manufacturers of bearings. a_2 factor is introduced as the reflection of the steel qualities changes, i.e. its quality enhancement. Besides, $à_2$ factor reflects the bearing design changes that increase or reduce the contact loads between the rolling elements and the rings.

$à_3$ operating conditions factor characterizes, essentially, a lubricant as well as misalignment, a shaft's and housing's stiffness, a installation scheme, a bearing's clearance. In view of the fact that application of the improved quality steel cannot cover the adverse effect of the lubricant material shortage, $à_2$ and $à_3$ factors merge into one denoted as $à_{23}$.

$à_{23}$ factor is chosen using table 3 according to the relation of the applied lubricant's rating and actual viscosity:

$$\chi = \frac{\nu}{\nu_1} \quad , \qquad (6)$$

where

χ – viscosity factor;

ν – actual kinematic viscosity of the grease applied in the assembly at the operating temperature in the assembly, mm^2/s;

ν_1 – rating minimum kinematic viscosity of the grease required for the lubricating conditions at the given speed, mm^2/s.

The values taken by the actual kinematic viscosity of the grease, i.e. kinematic viscosity of the grease at the set assembly operating speed, is determined using the alignment chart, fig. 1. To define the operating viscosity the knowledge of a bearing's temperature and the initial kinematic viscosity of the applied grease is required. For instance, if È-20À grease having ν = 23 mm^2/s kinematic viscosity at 50°Ñ is applied in an assembly at 90°Ñ, the kinematic viscosity at operating temperature is determined as follows: from the initial 23 mm^2/s viscosity and 50°Ñ temperature lines intersection point, following the arrow-marked line, one goes to 90°Ñ temperature line and the operating viscosity value of ν = 6.7 mm2/s is picked up on the axis of ordinates.

ν_1 rating kinematic viscosity values are defined according to the alignment chart compiled on the basis of the grease's elastohydrodynamic conditions, fig. 2. This provisional rating kinematic viscosity of grease is chosen depending on the contacting bodies' displacement speed that is determined in terms of the two bearing parameters: mean diameter and rotational speed. For example, to estimate ν_1 grease rating viscosity for a bearing having the rotational speed of n=200 min^{-1} and mean diameter dm=150 mm, it is necessary to come from the mean diameters' abscissa axis to the corresponding rotational speed, which is denoted by a slanting line, and take the respective n1 value (on fig.2 value 1=44 mm^2/s is indicated by an arrow) on the axis of ordinates.

The abovementioned method to determine the viscosity factor refers to liquid mineral grease. With regard to paste lubricants this factor is defined for a dispersive medium, i.e. according to the kinematic viscosity of the liquid base grease that is part of the paste lubricant. Nevertheless, the lubrication with paste lubricants has its peculiarities.

A projector normally knows the required specification life of machine units. If this information is unavailable, the basic (rating) life can be found using table 4.

Factor a_{23} value *Table 3*

Bearing type	Vacuum degassed steel				
	Factor value $\chi = \nu/\nu_1$				
	0,1-0,2	0,2-0,5	0,5-1	1-2	2-3
	Factor a_{23} value				
Ball radial, angular contact	0,1-0,3	0,3-0,7	0,7-1,0	1,0-1,5	1,5-2
Roller spherical bearings, double row	0,1-0,2	0,2-0,4	0,4-0,7	0,7-1	1-1,2
Roller bearings with short cylindrical or needle rollers	0,1-0,4	0,4-0,6	0,6-1	1-1,5	1,5-1,8
Roller angular contact thrust spherical bearings	0,1-0,2	0,2-0,4	0,4-0,7	0,7-1	1-1,2

Note:
1. In case of electroslag-remelted steel and pure lubricant application a_{23} factor can be increased at χ>2.
2. When the grease is largely polluted with solid particles or the lubrication material access is hampered, a_{23} factor is deemed equal to 0,1.

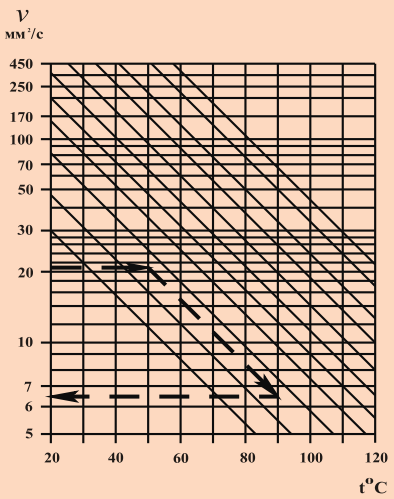


Fig. 1
The alignment chart for determining grease viscosity at operational temperature according to the known grease viscosity at base temperature (compiled for mineral grease).

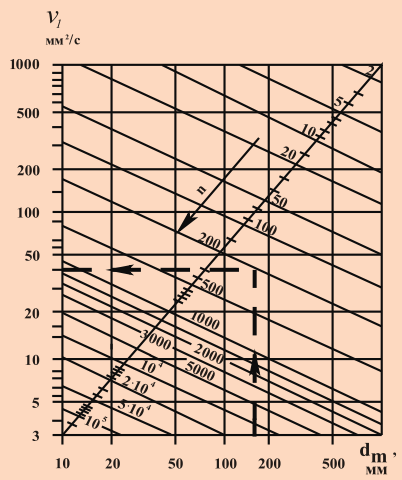


Fig. 2
The alignment chart for determining rating viscosity ν_1

The recommended values of the basic rating resource for various machines' types. *Table 4*

Machine and service type	L_{10h}, hour	L_{10s}, mln km.
Occasionally used devices and mechanisms, agricultural machinery, household appliances	500-4000	
Mechanisms used during short periods of time, creeper cranes, building machinery	4000-8000	
Heavy duty mechanisms operating with intervals (auxiliary mechanisms in power plants, line production conveyors, elevators, metal-working machinery)	8000-12000	
Part-loaded single shift machinery (static engines, reducing gears, grinders)	12000-20000	
Full-loaded single shift machinery (metal-cutting machines, woodworking machines), general engineering equipment. Hoisting cranes, vents, separators, centrifuges, printing equipment.	20000-30000	
Round-the-clock application machinery (compressors, pumps, shaft hoists, stationary electric machines, marine drives, rolling mills, textile machines)	40000-50000	
Hydroelectric plants, rotating furnaces, marine engines	60000-100000	
Heavy-duty continuous service machines (papermaking factories equipment, electric power plants, shaft pumps, marine screw shafts)	100000	
Car center bosses		0,2-0,3
Buses', industrial transportation vehicles' bosses		0,3-0,5
Freight cars' bearing boxes		0,8
Suburban trains', trams' bearing boxes		1,5
Passenger cars' bearing boxes		3,0
Locomotives' bearing boxes		3,0-5,0

Equivalent dynamic load calculation

The equivalent dynamic load (P) for radial and angular contact ball and roller bearings is the fixed radial load that, upon its application to a bearing with a rotating inner ring and static outer ring, ensures the same rating service life as under the actual loading and rotation conditions. For these types of bearings the equivalent loads is defined as:

$$P=(XVF_r+YF_a)K_\sigma K_T \ , \qquad (7)$$

where
Ð - equivalent dynamic load, N;
F_r - fixed in the direction and value radial load, N;
F_a - fixed in the direction and value axial load, N;
X - radial load factor;
Y - axial load factor;
V – rotation factor; in case of the outer ring rotation with respect to load direction V=1,2; in other cases – V=1.
$Ê_\sigma$ - loading factor;
$Ê_ò$ - temperature factor.

In case F_a/F_r?e,

$$P=F_rK_\sigma K_T \ , \qquad (8)$$

is accepted
where

å - the limiting value of F_a/F_r correlation that preconditions the choice of Õ and Y factors.

Õ, Y and e values are given in this catalogues.

Correspondingly, with respect to an angular contact thrust bearing the equivalent dynamic load (P) is the fixed actual axial load defined in the analogous way:

$$P=(XVF_r+YF_a)K_\sigma K_T \ , \qquad (9)$$

for a thrust bearing

$$P=F_rK_\sigma K_T \ , \qquad (10)$$

In some cases it is difficult to perform the exact calculation of the bearing loading. For instance, transportation vehicles rolling equipment's bearing boxes sustain not only railcar weight force load that is easy to estimate. In the course of moving at varied speed the bearings take up the shock load on rail joints, when passing turnouts, inertial loads on upturns and caused by emergency braking.

If the accurate calculation of these factors is impossible, it is advised to resort to the experience regarding the earlier made machines. On the basis of their work analysis the so-called $Ê_\sigma$ loading factor was defined. For quiescent loads without tremor in such mechanisms as low-duty kinematic reducing gears and drives, belt conveyors', jacks', creepers', hand winches', control drives' rollers and other similar mechanisms the loading factor is $Ê_\sigma$=1. The same value of this factor is taken, if there is confidence in the exact correspondence of the calculated load values and the actual values. The recommended values of $Ê_\sigma$ loading factor are given in table 6.

After the calculation of the equivalent load (P), the choice of the basic rating recourse (L_{10}), the basic rating dynamic load (C) is estimated and the required bearing nominal size is picked up using the catalogue according to the application table 1.

The net load F, which is sustained by a bearing, can be defined quite accurately according to the laws of motion, if the external forces are known. For example, the loads transferred onto the shafts by machine parts are estimated as the bearing reaction using the statics equations with regard to the beam. The shaft is considered as a simple beam with bearings in the support. Using the moment equation and the sum of forces applied to the beam, it is possible to determine the supports' reactions that, being taken with a reverse sign, represent the bearing load. The load can be created by the weight forces sustained by a bearing; the forces arising upon power transfer by gear or belt transmission; the cutting force in metal-working machinery; inertial forces, shock loads, etc. The net load taken up by bearing F that is directed angularly towards the bearing rotation axis can be factored into the radial (F_r) and axial (F_a) components. Sometimes the value of this load is quite difficult to determine due to the variety of force factors and accidental forces applications. Hence, any mathematical methods can be used for the calculation. For practical calculations some particular proven methods for the net force F estimation can be recommended.

If the force sustained by a bearing changes from P_{min} to P_{max} in conformity with the linear law (e.g. in case of the supports of drums with single-side coil), F value can be determined as:

$$F = \frac{P_{min}+2P_{max}}{3} \ , (11)$$

If the operation mode is alternating, i.e. during t_1 time at n_1 rotational speed F_1 load takes place, during t_2 time at n_2 rotational speed F_2 load takes place, etc. then F value is defined as:

$$F \left(\frac{n_1t_1F_1^{\ p} \ n_2t_2F_2^{\ p} \quad n_it_iF_i^{\ p}}{n_1t_1 \ n_2t_2 \quad n_it_i}\right)^{\frac{1}{p}}, (12)$$

where
ð = 3 for ball bearings,
ð=10/3 – for roller bearings

The estimation of load average values according to the abovementioned relationships not only is true with regard to radial, but also any other load with fixed operation direction against the bearing radial plane. In case of radial bearings the radial load is estimated and for thrust bearings – the load directed along the bearing axis. If the force caused by the load is applied angularly to the bearing radial plane, then the radial and axial components of the load are calculated. The equivalent load (radial for radial bearings and axial for thrust bearings) is estimated with provision for these components.

If a bearing sustains rotational load, the rotational force value is defined as

$$F = m\,r\,\omega^2 \quad , (13)$$

where
m - rotation body's mass, kg;
r - distance from the bearing axis to the rotation body's centre of gravity, m;
ω - rotation body's angular speed, rad/s.

K_T temperature factor value *Table 5*

Additional grading mark	Bearing operating temperature, °C	Temperature factor K_T
T	150	1,11
T2	200	1,25
T3	250	1,41
T4	300	1,67
T5	350	1,84

The values of K_σ loading factor depending on the loading type and the bearing application field *Table 6*

Type of loading	K_σ	Application field
Quiescent load (without tremor)	1,0	Low-duty kinematic reducing gears and drives. Belt conveyor rollers. Mechanisms of hand cranes and units. Jacks, creepers, hand winches. Control drives.
Light tremor; operating overloads up to 125% of the rating load	1,0-1,2	Precision gear transmissions. Metal-cutting machines (except for planning, grooving and grinding machines). Gyroscopes. Crane lifting mechanisms. Geared hoists. Small- and medium duty electric motors. Light-weight ventilators and air blasts.
Moderate tremor; vibration load; operating overloads up to 150% of the rating load	1,2-1,5	Gear units. Reducing gears of all types. Rail rolling equipment's bearing boxes. Traveling crab striking gears. Crane swiveling devices as well as boom reach changing mechanism. Grinding arbors. Electrospindles. Car, bus, motorcycle, scooter wheels. Agriculture machinery.
The same in the improved reliability conditions	1,5-1,8	Centrifuges and separators. Bearing boxes and electric locomotive driving motors. Crane swiveling devices. Lorry, tractor, heavy hauler, locomotive, crane and road machine wheels. Heavy-duty electrical machines. Power-generating equipment.
Loads with considerable tremor and vibrations; operating overloads up to 200% of the rating load	1,8-2,5	Gear wheels. Grinders and shock machines. Crank mechanisms. Ball and impact mills. Mill rollers. Heavy-duty ventilators and air exhausters.
Loads with strong tremor and operating overloads up to 300% of the rating load	2,5-3,0	Heavy forging machines. Gang mills. Refrigerating equipment. Operating roller conveyors of heavy section mills, blooming and slabbers. Hammer mills, grinders.

Equivalent static load calculation

In case of P load application life equation (1) is unsuitable for a quiescent bearing, Since at L=0 Ð=∞ , and a bearing cannot sustain the load of any large amount. At small rotational speed (n<10 min^{-1}) P values out to be excessive. Hence, for non-rotating or rotating at a low speed bearings, especially if shock loads take place, the acceptable load is defined by permanent deformations that appear in the spots of the rolling elements and rings contacts, not by the fatigue life. The bearing static load rating is deemed as the acceptable load that must be sustained by the bearing in order to visibly ignore the adverse effect of the permanent deformations. Accordingly, the pure radial or pure axial load, depending on radial or thrust bearings use, that cause the joint (ring-rolling element) permanent deformation not exceeding 0.0001 of the rolling element diameter is called basic static load rating and generally denoted as $Ñ_0$ or $Ñ_{0r}$ and $Ñ_{0à}$ accordingly for the radial and axial basic load rating. According to ISO standard this permanent deformation value is caused by the load inducing the rating value of the maximum contact loads of the most loaded rolling element equal to 4200 Ì Pà for ball bearing (apart from double row self-aligning bearings) and 4000 Ì Pà for roller bearings. The present catalogue contains the values of the basic static load rating estimated on the basis of these postulates.

While checking a non-rotating bearing for its static load rating regarding the application of any-direction load it is necessary to estimate the equivalent static load of the same direction that the bearing static load rating refers to and that causes the permanent deformations of the same value. For radial and angular contact ball and roller bearings the equivalent static load Ð0 value is defined as

$$P_0=X_0F_r+Y_0F_a, \qquad (14)$$

for angular contact thrust ball and roller bearings Ð0 value is determined as

$$P_0=F_a+2,3F_r\,tg\alpha \qquad (15)$$

where
$Ð_0$ - equivalent static load, N;
F_r - radial load or the radial component of the load sustained by a bearing, N;
F_a - axial load or the axial component of the load sustained by a bearing, N;
$Õ_0$- radial load factor;
Y_0- axial load factor;
α - bearing contact rating angle, degr.

Thrust ball and roller bearings (α=90°) can take up axial loads only. The equivalent axial static load for these bearing types is defined according to formula $P_0=F_a$.

The values of radial and axial load factors as well as the special cases of equations (14) are (15) given in the catalogues' tables.

It is required that the bearing actual load value must not exceed the basic static load rating $Ñ_0$ given in the tables. The deviations from this rule are based on experimental data. So, if static safety factor S_0 ($S_0=C_0/P_0$) notion is introduced, under quiescent load without tremor and vibrations, small rotational speed and low accuracy movement requirements overload up to S_0>0,5 can be accepted; in general engineering during normal operation S_0=1-1,5; under shock loads, periodic static loads and high accuracy requirements the load is limited up to S_0=1,5-2,5.

Limiting rotational speed

The accepted rotational speed is presented in the catalogue with regard to the two lubrication types: plastic lubrication and liquid grease lubrication. However, it does not mean that the maximum rotational speed is suitable for any type of load. In the field of high-speed operation modes (n_{rot}>0.6 n_{limit}) the loads of each bearing type are restricted by heat removal conditions and more often they are characterized by (Ð/Ñ≤ 0.06) correlation. The end speed-limiting factor is the temperature that depends on bearing friction as well as heat removal possibility. During operation at the rotational speed corresponding to the limiting, according to the catalogue, values, it is assumed that the operational radial clearance is sufficient to compensate the linear expansion difference of the inner and outer rings due to their diverse temperatures; stiff shafts and housings are used in the assembly; lubrication is appropriately chosen.

By changing the loading regime and lubrication conditions in particular cases it is possible to exceed the limiting rotational speed given in the catalogue to a certain degree. Herewith, the dosage of the appropriately chosen lubricating material must be strictly specified; and the removal of the heat evolved by heat friction must be ensured. The forthcoming significant surpassing of the indicated limiting rotational speed is connected to the bearing design improvement, separators firstly, mending lubrication conditions, etc. When having the problems in relation to the bearing exploitation at high rotational speed, it is advised to consult with MPZ.

At high rotational speed and big speeding-up the danger of ring frictional sliding against rolling elements arises. Hence, the minimum value of the radial load for radial bearings makes 0,02Ñ.

Sizes and accepted deviations

With only a few exceptions connected to the manufacturing of nonstandard design bearings meant for dedicated applications units, the bearings presented in this catalogue comply with ISO sizing system.

Tolerance on radial and angular contact bearings
Normal accuracy rating. Sizes, mkm
Inner ring

Table 7

Nominal diameter, mm over / up to including		**2,5 10**	**10 18**	**18 30**	**30 50**	**50 80**	**80 120**	**120 180**	**180 250**	**250 315**	**315 400**	**400 500**	**500 630**
Cylindrical bore	Δ_{dmp}	0 -8	0 -8	0 -10	0 -12	0 -15	0 -20	0 -25	0 -30	0 -35	0 -40	0 -45	0 -50
	V_{dsp} Width series 9	10	10	13	15	19	25	31	38	44	50	56	63
	V_{dsp} Width series 1, 7	8	8	10	12	19	25	31	38	44	50	56	63
	V_{dsp} Width series 2 (5), 3(6), 4	6	6	8	9	11	15	19	23	26	30	34	38
	V_{dmp}	6	6	8	9	11	15	19	23	26	30	34	38
Tapered bore 1:12	Δ_{dmp}	+22 0	+27 0	+33 0	+39 0	+46 0	+54 0	+63 0	+72 0	+81 0	+89 0	+97 0	+110 0
	Δ_{d1mp}-Δ_{dmp}	+15 0	+18 0	+21 0	+25 0	+30 0	+35 0	+40 0	+46 0	+52 0	+57 0	+63 0	+70 0
	V_{dsp}	9	11	13	16	19	22	40	46	52	57	63	70
Tapered bore 1:30	Δ_{dmp}					+15 0	+20 0	+25 0	+30 0	+35 0	+40 0	+45 0	+50 0
	Δ_{d1mp}-Δ_{dmp}					+30 0	+35 0	+40 0	+46 0	+52 0	+57 0	+63 0	+70 0
	V_{dsp}					19	22	40	46	52	57	63	70
	Δ_{Bs}	0 -120	0 -120	0 -120	0 -120	0 -150	0 -200	0 -250	0 -300	0 -350	0 -400	0 -450	0 -500
	V_{Bs}	15	20	20	20	25	25	30	30	35	40	50	60
	K_{ia}	10	10	13	15	20	25	30	40	50	60	65	70

Tolerance on radial and angular contact bearings

Normal accuracy rating. Sizes, mkm

Outer ring

Table 8

		6 18	18 30	30 50	50 80	80 120	120 150	150 180	180 250	250 315	315 400	400 500	500 630	630 800	800 1000
Δ_{Dmp}		0 -8	0 -9	0 -11	0 -13	0 -15	0 -18	0 -25	0 -30	0 -35	0 -40	0 -45	0 -50	0 -75	0 -100
V_{Dsp}	Width series 9	10	12	14	16	19	23	31	38	44	50	56	63	94	125
	1, 7	8	9	11	13	19	23	31	38	44	50	56	63	94	125
	2 (5), 3(6), 4	6	7	8	10	11	14	19	23	26	30	34	38	55	75
For housed bearings	2 (5), 3(6), 4	10	12	16	20	26	30	38							
V_{Dmp}		6	7	8	10	11	14	19	23	26	30	34	38	55	75
K_{ea}		15	15	20	25	35	40	45	50	60	70	80	100	120	140

The tolerances on Δ_{Cs} and V_{Cs} widths are identical to Δ_{Bs} and V_{Bs} tolerances of the due inner ring

Designations of sizing parameters with regard to radial and angular contact bearings

- Δ_{dmp} - deviation of the mean bore diameter in the singular plane (for a tapered bore it refers only to the smaller theoretical bore);
- V_{dsp} - variability of the bore diameter in the singular plane;
- V_{dmp} - variability of the mean bore diameter;
- Δ_{d1mp} - deviation of the mean tapered bore diameter in the singular plane from the side of the bigger theoretical bore;
- Δ_{Dmp} - deviation of the mean outside diameter in the singular plane;
- V_{dsp} - variability of the outside diameter in the singular plane;
- V_{dmp} - variability of the mean outside diameter;
- Δ_{Bs} - deviation of the inner ring's singular width;
- Δ_{Cs} - deviation of the outer ring's singular width;
- V_{bs} - variability of the inner ring width;
- V_{cs} - variability of the outer ring width;
- S_i - disalignment of the inner ring's raceway with respect to the ends of a radial and angular contact ball race.

Tolerances on roller tapered bearings

Normal accuracy rating. Sizes, mkm

Inner ring

Table 9

Nominal diameter, mm over / up to including	10 18	18 30	30 50	50 80	80 120	120 180	180 250	250 315	315 400
Δ_{dmp}	0 -12	0 -12	0 -12	0 -15	0 -20	0 -25	0 -30	0 -35	0 -40
V_{dsp}	12	12	12	15	20	25	30	35	40
V_{dmp}	9	9	9	11	15	19	23	26	30
Δ_{Bs}	0 -120	0 -120	0 -120	0 -150	0 -200	0 -250	0 -300	0 -350	0 -400
K_{ia}	15	18	20	25	30	35	50	60	70
Δ_{Ts}	+200 0	+200 0	+200 0	+200 0	+200 -200	+350 -250	+350 -250	+350 -250	+400 -400
Δ_{T1S}	+100 0	+100 0	+100 0	+100 0	+100 -100	+150 -150	+150 -150	+150 -150	+200 -200
Δ_{T2S}	+100 0	+100 0	+100 0	+100 0	+100 -100	+200 -100	+200 -100	+200 -100	+200 -200

Outer ring

Nominal diameter, mm over / up to including	18 30	30 50	50 80	80 120	120 150	150 180	180 250	250 315	315 400	400 500	500 630
ΔD_{mp}	0 -12	0 -14	0 -16	0 -18	0 -20	0 -25	0 -30	0 -35	0 -40	0 -45	0 -50
V_{dsp}	12	14	16	18	20	25	30	35	40	45	50
V_{Dsp}	9	11	12	14	15	19	23	26	30	34	38
K_{ea}	18	20	25	35	40	45	50	60	70	80	100

Tolerances on width deviation ΔC_s is identical to tolerance ΔB_s that belongs to the inner ring

Tolerances on actual width deviation (mounting height) ΔT_s, ΔT_{1s}, ΔT_{2s} are identical to deviations ΔT_s, ΔT_{1s}, ΔT_{2s}, that belong to the inner ring.

- Δ_{Ts} - actual width deviation (mounting height) of a roller tapered bearing;
- Δ_{T1s} - the actual mounting height deviation of a roller tapered bearing' inner subassembly;
- Δ_{T1s} - the actual mounting height deviation of a roller tapered bearing' outer ring;

Tolerances on roller tapered bearings

Accuracy rating 6Õ. Sizes, mkm

Table 10

Inner ring

Nominal diameter, mm over / up to including	10 18	18 30	30 50	50 80	80 120	120 180	180 250	250 315	315 400
$\Delta_{d_{mp}}$	0 -12	0 -14	0 -16	0 -18	0 -20	0 -25	0 -30	0 -35	0 -40
$V_{d_{sp}}$	12	14	16	18	20	25	30	35	40
$V_{d_{mp}}$	9	11	12	14	15	19	23	26	30
Δ_{B_S}	0 -50	0 -50	0 -50	0 -50	0 -50	0 -50	0 -50	0 -50	0 -50
K_{ia}	15	18	20	25	30	35	50	60	70
Δ_{T_S}	+100 0	+100 0	+100 0	+100 0	+100 0	+150 0	+150 0	+200 0	+200 0
$\Delta_{T_{1S}}$	+50 0	+50 0	+50 0	+50 0	+50 0	+50 0	+50 0	+100 0	+100 0
$\Delta_{T_{2S}}$	+50 0	+50 0	+50 0	+50 0	+50 0	+100 0	+100 0	+100 0	+100 0

Outer ring

Nominal diameter, mm over / up to including	18 30	30 50	50 80	80 120	120 150	150 180	180 250	250 315	315 400	400 500	500 630
$\Delta_{D_{mp}}$	0 -12	0 -14	0 -16	0 -18	0 -20	0 -25	0 -30	0 -35	0 -40	0 -45	0 -50
$V_{D_{sp}}$	12	14	16	18	20	25	30	35	40	45	50
$V_{D_{mp}}$	9	11	12	14	15	19	23	26	30	34	38
Δ_{C_S}	0 -100	0 -100	0 -100	0 -100	0 -100	0 -100	0 -100	0 -100	0 -100	0 -100	0 -100
K_{ea}	18	20	25	35	40	45	50	60	70	80	100

Tolerances on actual width deviation (mounting height) ΔT_s, ΔT_{1s}, ΔT_{2s} are identical to deviations ΔT_s, ΔT_{1s}, ΔT_{2s}, that belong to the inner ring.

Tolerances on thrust and angular contact thrust bearings

Normal accuracy rating. Sizes, mkm

Stiff ring

Table 11

Diametro nominal, mm mas hasta, incluido	18	18 30	30 50	50 80	80 120	120 180	180 250	250 315	315 400	400 500	500 630	630 800	800 1000
$\Delta_{d_{mp}}$	0 -8	0 -10	0 -12	0 -15	0 -20	0 -25	0 -30	0 -35	0 -40	0 -45	0 -50	0 -75	0 -100
$V_{d_{sp}}$	6	8	9	11	15	19	23	26	30	34	38	55	75
S_i	10	10	10	10	15	15	20	25	30	30	35	40	45

Free ring

Diametro nominal, mm mas hasta, incluido	10 18	18 30	30 50	50 80	80 120	120 180	180 250	250 315	315 400	400 500	500 630	630 800	800 1000
$\Delta_{D_{mp}}$	0 -11	0 -13	0 -16	0 -19	0 -22	0 -25	0 -30	0 -35	0 -40	0 -45	0 -50	0 -75	0 -100
$V_{d_{sp}}$	8	10	12	14	17	19	23	26	30	34	38	55	75

Tolerances on thrust and angular contact thrust bearings

Accuracy rating 6Õ. Sizes, mkm

Stiff ring

Table 12

Diametro nominal, mm mas hasta, incluido	18	18 30	30 50	50 80	80 120	120 180	180 250	250 315	315 400	400 500	500 630	630 800	800 1000
$\Delta_{d_{mp}}$	0 -8	0 -10	0 -12	0 -15	0 -20	0 -25	0 -30	0 -35	0 -40	0 -45	0 -50	0 -75	0 -100
$V_{d_{sp}}$	6	8	9	11	15	19	23	26	30	34	38	55	75
S_i	5	5	6	7	8	9	10	13	15	18	21	25	30

Free ring

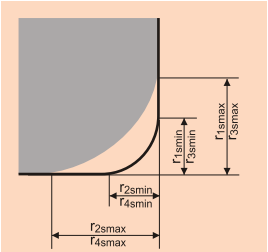
Diametro nominal, mm mas hasta, incluido	10 18	18 30	30 50	50 80	80 120	120 180	180 250	250 315	315 400	400 500	500 630	630 800	800 1000
$\Delta_{D_{mp}}$	0 -11	0 -13	0 -16	0 -19	0 -22	0 -25	0 -30	0 -35	0 -40	0 -45	0 -50	0 -75	0 -100
$V_{d_{sp}}$	8	10	12	14	17	19	23	26	30	34	38	55	75

Tolerances on thrust and angular contact thrust bearings' height

Table 13

Diametro nominal, mm mas hasta, incluido	18 30	30 50	50 80	80 120	120 180	180 250	250 315	315 400	400 500	500 630	630 800	800 1000
Δ_{T_S}	+20 -250	+20 -250	+20 -300	+25 -300	+25 -400	+30 -400	+40 -400	+40 -500	+50 -500	+60 -600	+70 -750	+80 -1000

Chamfer dimensions
Sizes, mkm



Symbols

r_{1s}, r_{3s} — single chamfer dimensions in radial direction

r_{2s}, r_{4s} — single chamfer dimensions in axial direction

r_{smin} — general symbols for minimum chamfer dimension: r_{1smin}, r_{2smin}, r_{3smin}, r_{4smin}

r_{1smax}, r_{3smax} — maximum chamfer dimensions in radial direction

r_{2smax}, r_{4smax} — maximum chamfer dimensions in axial direction

Chamfer dimensions of radial bearings

Table 14

r_{smin}	0,1	0,15	0,2	0,3		0,6		1		1,1		1,5		2			2,1		2,5			3		4	5	6	7,5	9,5	12	15	19
Nominal diameter, mm over					40		40		50		120		120		80	220		280		100	280		280								
up to including				40		40		50		120		120		80		220	280		100			280		280							
r_{1smax}	0,2	0,3	0,5	0,6	0,8	1	1,3	1,5	1,9	2	2,5	2,3	3	3	3,5	3,8	4	4,5	3,8	4,5	5	5	5,5	6,5	8	10	12,5	15	18	21	25
r_{2smax}	0,4	0,6	0,8	1	1	2	2	3	3	3,5	4	4	5	4,5	5	6	6,5	7	6	6	7	8	8	9	10	13	17	19	24	30	38

Chamfer dimensions of tapered bearings

Table 15

Inner ring

r_{smin}	0,3		0,6		1		1,5			2			2,5			3			4				5		6	
Nominal diameter, mm over		40		40		50		120	250		120	250		120	250		120	250	400		120	250	400		180		180	
up to including	40		40		50		120	250		120	250		120	250		120	250	400		120	250	400		180		180	
r_{1smax}	0,7	0,9	1,1	1,3	1,6	1,9	2,3	2,8	3,5	2,8	3,5	4	3,5	4	4,5	4	4,5	5	5,5	5	5,5	6	6,5	6,5	7,5	7,5	9
r_{2smax}	1,4	1,6	1,7	2	2,5	3	3	3,5	4	4	4,5	5	5	5,5	6	5,5	6,5	7	7,5	7	7,5	8	8,5	8	9	10	11

Outer ring

r_{smin}	0,3		0,6		1		1,5			2			2,5			3			4				5		6	
Nominal diameter, mm over		40		40		50		120	250		120	250		120	250		120	250	400		120	250	400		180		180	
up to including	40		40		50		120	250		120	250		120	250		120	250	400		120	250	400		180		180	
r_{3smax}	0,7	0,9	1,1	1,3	1,6	1,9	2,3	2,8	3,5	2,8	3,5	4	3,5	4	4,5	4	4,5	5	5,5	5	5,5	6	6,5	6,5	7,5	7,5	9
r_{4smax}	1,4	1,6	1,7	2	2,5	3	3	3,5	4	4	4,5	5	5	5,5	6	5,5	6,5	7	7,5	7	7,5	8	8,5	8	9	10	11

Chamfer dimensions of thrust bearings

Table 16

r_{smin}	0,1	0,15	0,2	0,3	0,6	1	1,1	1,5	2	2,1	3	4	5	6	7,5	9,5	12	15	19
r_{1smax}, r_{2smax}	0,2	0,3	0,5	0,8	1,5	2,2	2,7	3,5	4	4,5	5,5	6,5	8	10	12,5	15	18	21	25

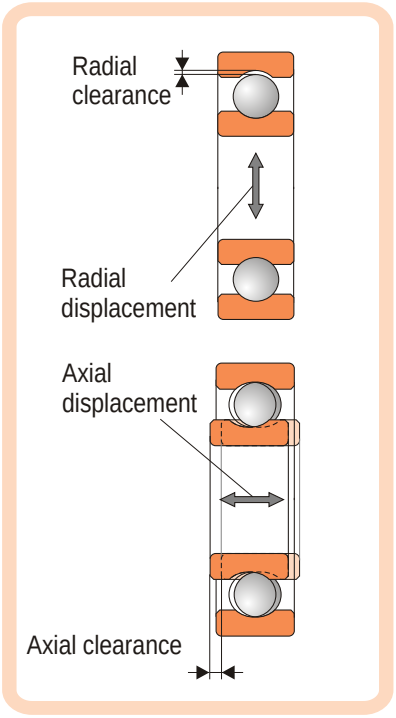
Bearing internal clearance

The bearing clearance is understood as the displacement value that appear in the result of one bearing ring shift against the other at definite minor metering load in radial direction (radial clearance) Gr and in axial direction (axial clearance) Ga.

There are three clearance types: initial, fitting and operating. The initial radial clearance is understood as the bearing clearance as received. Measuring of the radial clearance is performed using a dedicated device by displacing one of the bearing rings in its end position under the definite load. For some bearing design groups the radial clearance measuring is performed using method of selecting the probe corresponding to the width clearance. Various design groups of roller bearings have own groups (rows) of radial clearances. Each group is limited by the minimum and maximum values of the acceptable radial clearance and denoted by a number (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, normal).

The most widespread group of radial clearances is called normal. It does not have a number and is not fixed in a bearing designation. The major part of radial ball and roller bearings are manufactured with this clearance; in the majority of cases at regular fits they ensure bearing assembly satisfactory work.

The fitting radial clearance is understood as the clearance after bearing assemblage. The cause of its change is the rings reversible deformation induced by alighting tension and mounting seats form errors.



The fitting radial clearance is understood as the clearance that appeared after bearing assemblage. The cause of its change is the rings reversible deformation induced by alighting tension and mounting seats form errors.

The operating radial clearance is the bearing clearance under the fixed temperature and operating machine cycle. Herewith, due to temperature difference it can decrease or grow depending on which of the two rings is more heated.

The shaft thermal elongation can increase or reduce the clearance depending on the bearing design or its assemblage scheme. The clearance rises proportionally to the bearing load growth.

In view of the above mentioned, it is necessary to choose the corresponding group of the radial bearing clearance.

Radial clearance groups, radial clearance values for different bearing nominal sizes are given in tables 17, 19, 20.

Reducing the radial clearance of double row spherical roller bearings depending on the axial displacement on the tapered shaft or sleeve is given in table 18.

Presumably, the most favorable condition for radial ball bearings is the operating clearance close to zero or even minor tension. But if these bearings sustain only axial loads, they must have bigger clearance what allows to expand the operating contact angle and thus increase the axial load rating.

Roller bearings with cylindrical, tapered and spherical rollers, as a rule, must have the small operating clearance in the general assembly. But in certain cases they are set also with preload, as, for example, roller bearings with cylindrical rollers in precise main spindles or tapered roller bearings in the axle drive gear. For satisfactory operation spherical roller bearings must always have positive operating clearance.

A bearing with tapered bore has a little bigger initial radial clearance than a bearing with cylindrical bore. This is determined by the specific character of creating mandatory tension during fitting bearings on tapered shaft necks or on adapter or clamping sleeves.

Radial clearance of double row spherical roller bearings

Sizes, mkm
with cylindrical bore

Table 17

Nominal diameter, mm over / up to including		24	24 30	30 40	40 50	50 65	65 80	80 100	100 120	120 140	140 160	160 180	180 200	200 225	225 250	250 280	280 315	315 355	355 400	400 450	450 500	500 560	560 630	630 710	710 800	800 900	900 1000
C2 clearance group	min	10	15	15	20	20	30	35	40	50	60	65	70	80	90	100	110	120	130	140	140	150	170	190	210	230	260
	max	20	25	30	35	40	50	60	75	95	110	120	130	140	150	170	190	200	220	240	260	280	310	350	390	430	480
C0 (normal) clearance group	min	20	25	30	35	40	50	60	75	95	110	120	130	140	150	170	190	200	220	240	260	280	310	350	390	430	480
	max	35	40	45	55	65	80	100	120	145	170	180	200	220	240	260	280	310	340	370	410	440	480	530	580	650	710
C3 clearance group	min	35	40	45	55	65	80	100	120	145	170	180	200	220	240	260	280	310	340	370	410	440	480	530	580	650	710
	max	45	55	60	75	90	110	135	160	190	220	240	260	290	320	350	370	410	450	500	550	600	650	700	770	860	930
C4clearance group	min	45	55	60	75	90	110	135	160	190	220	240	260	290	320	350	370	410	450	500	550	600	650	700	770	860	930
	max	60	75	80	100	120	145	180	210	240	280	310	340	380	420	460	500	550	600	660	720	780	850	920	1010	1120	1220
C5 clearance group	min	60	75	80	100	120	145	180	210	240	280	310	340	380	420	460	500	550	600	660	720	780	850	920	1010	1120	1220
	max	75	95	105	130	160	185	230	260	300	350	390	430	470	520	570	630	690	760	840	910	980	1070	1160	1270	1410	1540

with tapered bore

Nominal diameter, mm over / up to including		24	24 30	30 40	40 50	50 65	65 80	80 100	100 120	120 140	140 160	160 180	180 200	200 225	225 250	250 280	280 315	315 355	355 400	400 450	450 500	500 560	560 630	630 710	710 800	800 900	900 1000
C2 clearance group	min	15	20	25	30	40	50	55	65	80	90	100	110	120	140	150	170	190	210	230	260	290	320	350	390	440	490
	max	25	30	35	45	55	70	80	100	120	130	140	160	180	200	220	240	270	300	330	370	410	460	510	570	640	710
C0 (normal) clearance group	min	25	30	35	45	55	70	80	100	120	130	140	160	180	200	220	240	270	300	330	370	410	460	510	570	640	710
	max	35	40	50	60	75	95	110	135	160	180	200	220	250	270	300	330	360	400	440	490	540	600	670	750	840	930
C3 clearance group	min	35	40	50	60	75	95	110	135	160	180	200	220	250	270	300	330	360	400	440	490	540	600	670	750	840	930
	max	45	55	65	80	95	120	140	170	200	230	260	290	320	350	390	430	470	520	570	630	680	760	850	960	1070	1190
C4clearance group	min	45	55	65	80	95	120	140	170	200	230	260	290	320	350	390	430	470	520	570	630	680	760	850	960	1070	1190
	max	60	75	85	100	120	150	180	220	260	300	340	370	410	450	490	540	590	650	720	790	870	980	1090	1220	1370	1520
C5 clearance group	min	60	75	85	100	120	150	180	220	260	300	340	370	410	450	490	540	590	650	720	790	870	980	1090	1220	1370	1520
	max	75	95	105	130	160	200	230	280	330	380	430	470	520	570	620	680	740	820	910	1000	1100	1230	1360	1500	1690	1860

Double row spherical roller bearings' radial clearance reduction depending on the axial displacement on the tapered shaft or sleeve.
Sizes mm

Table 18

Bearing nominal diameter d, mm over	up to including	Radial clearance before assemblage mm C(normal) min	C(normal) max	C3 min	C3 max	C4 min	C4 max	Radial clearance reduction mm min	Radial clearance reduction mm max	Shifting according to the tapered neck, mm (tapering 1:12)* Shaft min	Shaft max	Sleeve min	Sleeve max	Shifting according to the tapered neck, mm (tapering1:30)* Shaft min	Shaft max	Sleeve min	Sleeve max	The control value of the smallest radial clearance after assemblage C(norm) min	C3 min	C4 min
24	30	0,03	0,04	0,04	0,055	0,055	0,075	0,015	0,02	0,3	0,35	0,3	0,4	-	-	-	-	0,015	0,02	0,035
30	40	0,035	0,05	0,05	0,065	0,065	0,085	0,02	0,025	0,35	0,4	0,35	0,45	-	-	-	-	0,015	0,025	0,04
40	50	0,045	0,06	0,06	0,08	0,08	0,1	0,025	0,03	0,4	0,45	0,45	0,5	-	-	-	-	0,02	0,03	0,05
50	65	0,055	0,075	0,075	0,095	0,095	0,12	0,03	0,04	0,45	0,6	0,5	0,7	-	-	-	-	0,025	0,035	0,055
65	80	0,07	0,095	0,095	0,12	0,12	0,15	0,04	0,05	0,6	0,75	0,7	0,85	-	-	-	-	0,025	0,04	0,07
80	100	0,08	0,11	0,11	0,14	0,14	0,18	0,045	0,06	0,7	0,9	0,75	1	1,7	2,2	1,8	2,4	0,035	0,05	0,08
100	120	0,1	0,135	0,135	0,17	0,17	0,22	0,05	0,07	0,7	1,1	0,8	1,2	1,9	2,7	2	2,8	0,05	0,065	0,1
120	140	0,12	0,16	0,16	0,2	0,2	0,26	0,065	0,09	1,1	1,4	1,2	1,5	2,7	3,5	2,8	3,6	0,055	0,08	0,11
140	160	0,13	0,18	0,18	0,23	0,23	0,3	0,075	0,1	1,2	1,6	1,3	1,7	3	4	3,1	4,2	0,055	0,09	0,13
160	180	0,14	0,2	0,2	0,26	0,26	0,34	0,08	0,11	1,3	1,7	1,4	1,9	3,2	4,2	3,3	4,6	0,06	0,1	0,15
180	200	0,16	0,22	0,22	0,29	0,29	0,37	0,09	0,13	1,4	2	1,5	2,2	3,5	4,5	3,6	5	0,07	0,1	0,16
200	225	0,18	0,25	0,25	0,32	0,32	0,41	0,1	0,14	1,6	2,2	1,7	2,4	4	5,5	4,2	5,7	0,08	0,12	0,18
225	250	0,2	0,27	0,27	0,35	0,35	0,45	0,11	0,15	1,7	2,4	1,8	2,6	4,2	6	4,6	6,2	0,09	0,13	0,2
250	280	0,22	0,3	0,3	0,39	0,39	0,49	0,12	0,17	1,9	2,6	2	2,9	4,7	6,7	4,8	6,9	0,1	0,14	0,22
280	315	0,24	0,33	0,33	0,43	0,43	0,54	0,13	0,19	2	3	2,2	3,2	5	7,5	5,2	7,7	0,11	0,15	0,24
315	355	0,27	0,36	0,36	0,47	0,47	0,59	0,15	0,21	2,4	3,4	2,6	3,6	6	8,2	6,2	8,4	0,12	0,17	0,26
355	400	0,3	0,4	0,4	0,52	0,52	0,65	0,17	0,23	2,6	3,6	2,9	3,9	6,5	9	6,8	9,2	0,13	0,19	0,29
400	450	0,33	0,44	0,44	0,57	0,57	0,72	0,2	0,26	3,1	4,1	3,4	4,4	7,7	10	8	10,4	0,13	0,2	0,31
450	500	0,37	0,49	0,49	0,63	0,63	0,79	0,21	0,28	3,3	4,4	3,6	4,8	8,2	11	8,4	11,2	0,16	0,23	0,35
500	560	0,41	0,54	0,54	0,68	0,68	0,87	0,24	0,32	3,7	5	4,1	5,4	9,2	12,5	9,6	12,8	0,17	0,25	0,36
560	630	0,46	0,6	0,6	0,76	0,76	0,98	0,26	0,35	4	5,4	4,4	5,9	10	13,5	10,4	14	0,2	0,29	0,41
630	710	0,51	0,67	0,67	0,85	0,85	1,09	0,3	0,4	4,6	6,2	5,1	6,8	11,5	15,5	12	16	0,21	0,31	0,45
710	800	0,57	0,75	0,75	0,96	0,96	1,22	0,34	0,45	5,3	7	5,8	7,6	13,3	17,5	13,6	18	0,23	0,35	0,51
800	900	0,64	0,84	0,84	1,07	1,07	1,37	0,37	0,5	5,7	7,8	6,3	8,5	14,3	19,5	14,8	20	0,27	0,39	0,57
900	1000	0,71	0,93	0,93	1,19	1,19	1,52	0,41	0,55	6,3	8,5	7	9,4	15,8	21	16,4	22	0,3	0,43	0,64
1000	1120	0,78	1,02	1,02	1,3	1,3	1,65	0,45	0,6	6,8	9	7,6	10,2	17	23	18	24	0,32	0,48	0,7
1120	1250	0,86	1,12	1,12	1,42	1,42	1,8	0,49	0,65	7,4	9,8	8,3	11	18,5	25	19,6	26	0,34	0,54	0,77
1250	1400	0,94	1,22	1,22	1,55	1,55	1,96	0,55	0,72	8,3	10,8	9,3	12,1	21	27	22,2	28,3	0,36	0,59	0,84

* Valid only for a steel solid shaft and hollow sleeves with bore diameter not more than half of the diameter shaft.

The bearings with the radial clearance prior to assemblage lye in the upper half of the tolerance limit; they are assembled with a larger limit of the decreased radial clearance or axial displacement, bearings with radial clearance in the lower half of the tolerance limit – with smaller value of the decreased radial clearance or axial displacement.

Radial clearance of single row radial ball bearings

Sizes, mkm

Table 19

Nominal diameter, mm over / up to including		2,5 6	6 10	10 18	18 24	24 30	30 40	40 50	50 65	65 80	80 100	100 120	120 140	140 160	160 180
C2 clearance group	min	0	0	0	0	1	1	1	1	1	1	2	2	2	2
	max	7	7	9	10	11	11	11	15	15	18	20	23	23	25
C0 (normal) clearance group	min	2	2	3	5	5	6	6	8	10	12	15	18	18	20
	max	13	13	18	20	20	20	23	28	30	36	41	48	53	61
C3 clearance group	min	8	8	11	13	13	15	18	23	25	30	36	41	46	53
	max	23	23	25	28	28	33	36	43	51	58	66	81	91	102
C4clearance group	min		14	18	20	23	28	30	38	46	53	61	71	81	91
	max		29	33	36	41	46	51	61	71	84	97	114	130	147
C5 clearance group	min		20	25	28	30	40	45	55	65	75	90	105	120	135
	max		37	45	48	53	64	73	90	105	120	140	160	180	200

Radial clearance of single row spherical roller bearings

Sizes, mkm

with cylindrical bore

Table 20

Nominal diameter, mm over / up to including		30	30 40	40 50	50 65	65 80	80 100	100 120	120 140	140 160	160 180	180 225	225 250	250 280	280 315
C2 clearance group	min	2	3	3	4	5	7	10	15	20	25	30	35	40	40
	max	9	10	13	15	20	25	30	35	40	45	50	55	60	70
C0 (normal) clearance group	min	9	10	13	15	20	25	30	35	40	45	50	55	60	70
	max	17	20	23	27	35	45	50	55	65	70	75	80	85	100
C3 clearance group	min	17	20	23	27	35	45	50	55	65	70	75	80	85	100
	max	28	30	35	40	55	65	70	80	95	100	105	110	115	135
C4clearance group	min	28	30	35	40	55	65	70	80	95	100	105	110	115	135
	max	40	45	50	55	75	90	95	110	125	130	135	140	145	170
C5 clearance group	min	40	45	50	55	75	90	95	110	125	130	135	140	145	170
	max	55	60	65	75	95	120	125	140	155	160	165	170	175	205

Bearing materials

The steel and alloy grades assortment for manufacturing the rings and bearing rolling elements is quite broad. It is explained by the variety of bearing performance characteristics requirements from the consumers' point of view (high strength, fatigue and wear-out resistibility).

During rings and rolling elements manufacturing MPZ uses:

- for the bearings that operate without considerable shock loads – bearing steel of ØÕ15, ØÕ15ÑÃ and ØÕ20ÑÃ, 95Õ18Ø grades.
- for the bearings that are exploited at significant shock loads with enhanced contact voltages, low-carbon carburizing steel of 15Ã1 (for mass bearings' parts) è 20X2H4A (for big bearings) grades.

For manufacturing drilling bits' balls and rollers as well as turbodrill bearings' parts 55ÑÌ 5ÔÀ steel is used.

For manufacturing separators quality carbon structural steel of 08êï, 08ï ñ, 08þò grades, ËÖ40Ñ brass, ÀÊ9Ì 2 aluminum, etc. are used.

For manufacturing guideway rings Ñ×25 gray cast iron and Ï À-ÒÃðÄ material are used.

International classifier of bearing' steels ШХ15 and ШХ15СГ

Country	*Standard*		*Designation*	
Russia	ÃÎ ÑÒ 801		ØÕ15	ØÕ15ÑÃ
Germany	DIN 17230		100Cr6	100CrMn6
CUR	ASTM A295		52100	5195
Japan	JISG 4805		SUJ 2	SUJ 3
Sweden	SS 14.22.58		SKF3	SKF
France	NFA 35-565		100Ñ6	
Hungary	MSZ 17789		GO 3	GO 4
Bulgaria	ÁÄÑ 12781		ØÕ15	ØÕ15ÑÃ
Czechoslovakia	ÐSN41 4109	ÐSN41 4209	14109	14209
Yugoslavia	JUS Kiadvany		Ð.4146	Ð.4360
Poland	PN-74 H-84041		LH15	LH15SG
Romania	STAS 1456/1		RUL1	RUL2
ISO	ISO683/XVII		1	3

Bearing designation

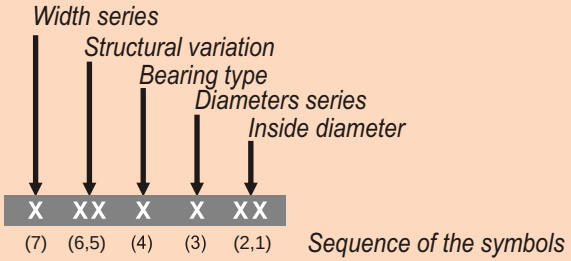
Bearings have designations the significance of which is described in the text of the catalogue before each structural group.

The system of bearing designation

Structure of bearing designation

The basic bearing designation consists of 7 basic symbols denoting the following parameters:
– dimensional series (diameter series and width series);
– type and basic structural design ;
– bore diameter.

The sequence of the bearings basic designation symbols is shown on the following scheme:



Additional designation symbols are located to the right (suffix) and to the left (prefix) of the basic designation.

Additional symbols on the right side start with the capital letter, and the additional symbols on the left side are separated from the basic designation by means of a hyphen.

The bearing designation consisting of basic and additional symbols is considered to be the complete bearing designation.

The basic designation is a particular case of the complete designation.

Bore diameter designation

The first two symbols of the scheme denominate bearing bore diameter.

Bore diameters that are divisible by 5 are designated with the quotient of this diameter value by 5

Dimensional series designation

Bearing dimensional series is a combination of diameter series and widths (heights) series determining the dimensions of the bearing.

The third symbol of the scheme designating the diameter series together with the seventh symbol designating the width (height) series denotes bearing dimensional series designation.

The width (height) series having the symbol 0 is not included in the designation.

The bearings that are non-standard in respect of their inside diameter or width shall be designated with the symbol 7 or 8 on the third place of the scheme if the diameter or width is non-standard. Such bearings do not have the seventh symbol in their designation (the width series).

Bearing type designation

The forth symbol in the bearing designation means the type of the bearing (direction of carrying load and rolling elements form).

0 Deep groove radial ball bearing
1 Spherical radial ball bearing
2 Roller radial bearing with short cylindrical rollers
3 Spherical radial roller bearing
4 Needle roller bearing or bearing with long cylindrical rollers
5 Radial roller bearing with spiral rollers
6 Angular contact thrust ball bearing
7 Taper roller bearing
8 Thrust or angular contact thrust ball bearing
9 Thrust or angular contact thrust roller bearing

Designation of the bearing basic structural design

The fifth and sixth symbols of the scheme denote bearing basic structural design.

Basic structural design for each bearing type is denoted by the figures from 00 to 99.

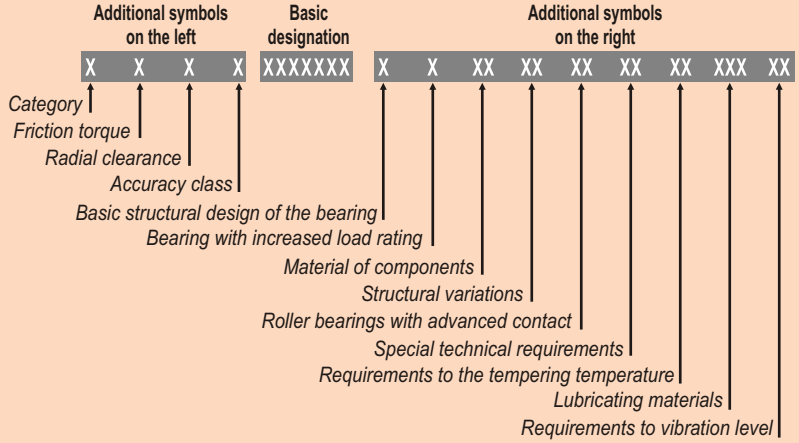
Designation of the width series, basic structural design and bearing type with the symbol 0 (00) to the left of the last significant figure is going down if the width series of the schemes is designated with the symbol 0. In this case the bearing designation will consist of two, three or four figures.

Symbols denoting additional requirements

Symbols denoting additional requirements are placed to the left and to the right of the basic designation.

Symbols designating accuracy class, radial clearance group, friction torque and bearing category are specified to the left side from the basic designation.

Symbols designating structural variations, lubrication, requirements to the level of vibration, details material and special technical requirements are specified to the right side of the basic designation.



Additional symbols denote the following:

– **Category** – denotes additional technical requirements specified in the technical conditions for bearings or in the design documentation approved in the prescribed order;

– **Friction torque** – denotes friction torque row;

– **Radial clearance** – denotes the group of radial clearances according to ISO 5753:1991;

– **Accuracy class** – denotes the class of accuracy according to ISO 492:2002, ISO 199:2005, ISO 494-94;

– **Bearing basic structural design** – letter Í denotes:

1) spherical roller radial double-row with grooves on the ring and lubricating holes
2) roller radial with short cylindrical rollers without inner or outer rings.
3) thrust roller single and double-row.

- **bearing with increased load rating** – letter A;
- **material of the components** – designations (figures denote the subsequent structural variants):

Þ, Þ1 ... — all bearing components or part of the components made of stainless steel.

X, X1 ... — rings and rolling elements or just rings (including one ring) made of carburizing steel;

Ð, Ð1 ... – bearing components made of hot-working (rapid machining) steel;

Ã, Ã1 ... — cage made of ferrous metal

Á, Á1 ... — cage made of tinless bronze

Ä, Ä1 ... — cage made of aluminum alloy

Ë, Ë1 ... — cage made of brasses

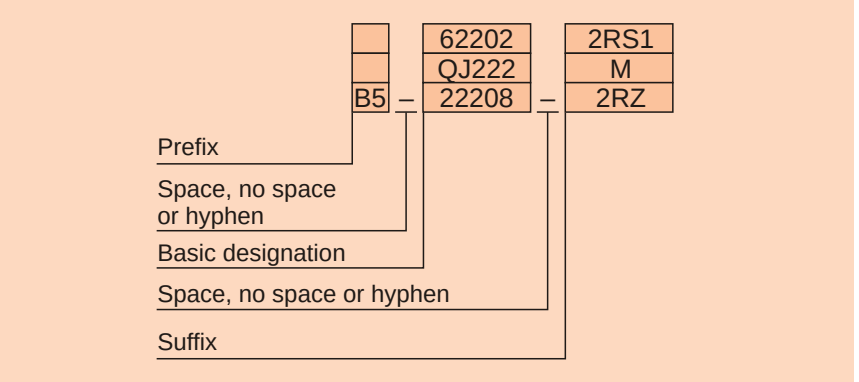
Å, Å1 .... — cage made of plastic materials.

- **structural variations** – designation Ê, Ê1...with letters in the order of realization.
- **roller bearings with advanced contact** – designation Ì , Ì 1... with letters in the order of realization.
- **special technical requirements** – designation Ó, Ó1... of special requirements (stricter requirements to roughness, rotational accuracy etc.).
- **requirements to the tempering temperature** – Ò ...Ò5, denotes temperature of stabilized temper.
- **lubricating materials** – designation Ñ1, Ñ2... – lubricating materials types.
- **requirements to vibration level** – Ø, Ø1...Ø5 – designation of vibration level. With increase of the numeric index the vibration level value is decreased..

Designation by the MPZ

Besides designation of the bearing according to GOST 3189 the JSC “MPZ” uses its proper bearings designation. Such bearings designation is represented by a combination of Latin letters and Arabic numerals.

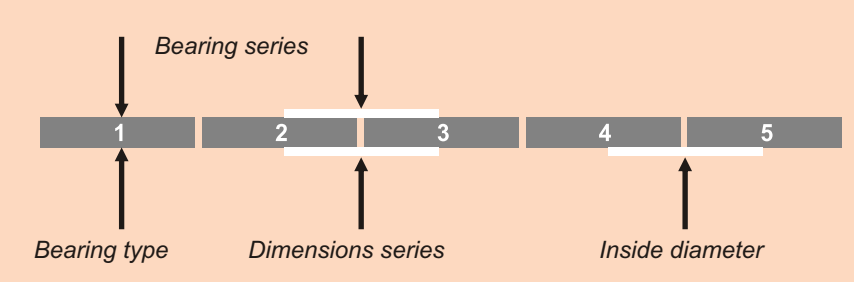
The complete designation of rolling element bearing by the “MPZ” consists of one or several additional designations. The structure of the complete designation by the “MPZ” is shown on the scheme.



Basic designation structure by the MPZ

The basic designation determines bearing type, standard design and dimensions.

Structure of the bearing basic designation is shown on the scheme.



The first numeral or letter (or combination of letters) in the basic designation refer to the bearing type.

Designation of bearing types is shown in the table:

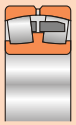
Basic designation by the "MPZ"	Bearing type name
1	Spherical radial ball bearing
2	Spherical radial roller bearing
3	Taper roller bearing
6	Taper ball bearing
7,QJ	Angular contact ball bearing
N, NJ, BC4B	Roller radial bearing with short cylindrical rollers
NA, NK, RNA, NKI	Roller radial bearing with long cylindrical rollers or needle
K, KZK	Needle bearing without rings (dxDxB)
AXK	Roller thrust bearing

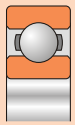
The second and third numbers denote series of dimensions corresponding to the standards ISO. Number 2 on the scheme means the width series (8, 0, 1, 2, 3, 4, 5, 6, 7 – in the order of width increasing), number 3 on the scheme denotes diameter series (7, 8, 9, 0, 1, 2, 3, 4 – in the order the size increasing).

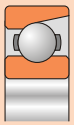
Comparison of the diameter series and the width series with designation according to ISO and basic designation by the "MPZ" is demonstrated in the table (identical numbers are not shown).

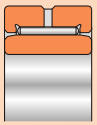
Designation of the diameters series	Basic designation by the "MPZ" ISO 15:1998, ISO 582:1995	7 0	0 1	8 8	9 9	0 1	1 7	2 2(5)	3 3(6)
Designation of the widths series	Basic designation by the "MPZ" ISO 15:1998, ISO 582:1995		0 7	0 7	0 7	0 7	0 7		

In some case the number denoting the bearing type and (or) the first number of the dimensions series is omitted. These numbers are shown in brackets on the figure.


222, 223
230, 231
240, 241


6(0)4
621
630
641


7(0)3
720
731
QJ226


NA
NK
RNA

The last two numbers of the basic designation denote the bearing size code calculated in the result of dividing the nominal bore diameter in millimeters by 5. The exceptions are:

- inside diameters from 1 to 9 mm represented by a whole number are denoted as equal to the nominal diameter;
- inside diameters 10, 12, 15, 17 mm are represented by numbers 00, 01, 02, 03 respectively;
- inside diameters from 500 to 2000 mm are represented by the number equal to the nominal diameter and is separated from the rest of the symbols of the basic designation by the division sign.

Structure of additional designation by the MPZ

Additional designation is placed before the basic designation (prefix) or after it (suffix).

Prefixes are meant for designating non-standard width of roller spherical bearings. Suffixes characterize basic design of bearings and are placed after the basic denomination in the following sequence:

- inside structure of the bearing components;
- outside structure of the bearing components;
- cage;
- other bearing characteristic features whether it is accuracy class, inside clearance, level of vibration, thermal treatment, type of lubrication etc.

Suffixes are written:

- after the basic designation without division determining inside structure, tapered bore (7312Â; 22314Ê);
- with a hyphen to denominate availability of shields, seals (6305-2Z);
- with spaces separating the suffixes from the basic designation or prior suffix, (6205-RS1 Ð Ð6).

Additional designations (suffixes) are specified in the description of the correspondent bearing group.

Bearing marking

Bearings shall be marked with their designation, designation of their manufacturing company and symbol of the year of manufacture.

Updating of the bearing designation is allowed by means of correction of separate marking signs.

Additional marking is allowed to be made on the bearings or designation of the analogue of foreign company can be done on packages, parcels or in the respective transportation documentation.

If the contract of delivery of the bearings for export contains requirements on marking it is possible to mark the bearings in accordance with the contract.

Marking is made on any of the bearing surfaces except for the surfaces of rolling elements, however marking shall not violate the technical requirements and accuracy standards.

For bearings with the surface of end face less than 2 mm:

- standard size designation and designation of the manufacturing company is marked on the outside diameter or on the package.
- marking of accuracy class, category, certain technical requirements, manufacturing country is made on the package and (or) is specified in the transportation documentation.

As for the bearings with shields and seals marking of manufacturing country can be made on the package or on the shields and seals.

Two-piece bearings with non-replaceable rings shall be marked so as to exclude the possibility of mixing up the bearing rings.

Two-piece ball and roller bearings except for ball bearings with diameter less or equal 10 mm with non-replaceable rings shall be marked with bearing basic designation on each ring. It is possible to mark just one of the rings; however, the possibility of mixing the bearing rings up shall be excluded.

In respect of bearings with one-side seal or one shield it is possible to use seal or shield with marking of the analogue bearings with two seals or shields. However, bearing type designation is marked on the outside ring or in the transportation documentation.

As for the bearings of the closed type it is possible to use the existing seals and washers in bearing modification. At that bearing type is marked on the outside ring or in the transportation documentation.

Significance of the year of modification

1980 - **Н**	1990 - **П**	2000 - **П**	2010 - **В**
1981 - **З**	1991 - **С**	2001 - **Т**	
1982 - **У**	1992 - **И**	2002 - **У**	
1983 - **Л**	1993 - **L**	2003 - **N**	
1984 - **1**	1994 - **К**	2004 - **V**	
1985 - **7**	1995 - **М**	2005 - **С**	
1986 - **S**	1996 - **Х**	2006 - **F**	
1987 - **U**	1997 - **Ч**	2007 - **Г**	
1988 - **Г**	1998 - **Н**	2008 - **Е**	
1989 - **Т**	1999 - **Э**	2009 - **Б**	

Bearing package

All bearings are supplied in individual or multiple packages.

Individual package

Bearings with the outside diameter less than 300 mm and weight less than 8 kg with the period of storage 6 years are supplied in individual packages – carton boxes (photo 1). Before packing in a carton box each bearing shall be wrapped in waxed paper and be hermetically welded in a polyethylene bag. Further boxes with bearings are placed in a container made of plywood and timber. Containers gross weight shall not exceed 60 kg.

Bearings with the outside diameter less than 300 mm and weight less than 8 kg with the period of storage 2 years are supplied in individual packages without containers. Each bearing shall be wrapped in waxed paper (photo 2).

Bearings with the weight 8-14 kg are wrapped around by polyethylene ribbon overlapping through the bore. Brand marking label is attached to each bearing (photo 3).

Bearings weighing more than 14 kg are wrapped around by polyethylene ribbon overlapping through the bore and then by a twill ribbon. On the outside diameter the bearing is pasted over with brand scotch tape and brand marking label and transportation document (passport) is attached to each bearing (photo 4).

In order to pack the bearings corrugated boxes with gross weigh not exceeding 35 kg (photo 5), wooden boxes with gross weigh not exceeding 70 kg (photo 6) or reusable containers are used. Bearings of large dimensions weighing more than 100 kg are placed in non-standard wooden boxes with skids (photo 7). Bearings of large dimensions with weight up to 100 kg are placed on the pallet according to the certain scheme. On top of the bearings a wooden grating is placed and the package is wrapped in polyethylene ribbon when delivered to the customer.

When purchasing the “MPZ” bearings it is necessary to pay attention to the fact that the package (container, mark label) shall be of brand colour – orange, there shall be the company trademark on the package, ISO 9001 (designation of correspondence to the international quality standard), bar code, http://www.mpz/com.

1


2


3


4

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6


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8

Multiple package

The “MPZ” bearings are also supplied in multiple packages wrapped in waxed or inhibited paper, 10 pieces in a roll (photo 8). Then the rolls are placed in shipping containers. A transportation document (passport) is enclosed in each shipping container.

Marking and shipping

Shipping containers are marked in accordance with GOST 14192-96. Marking is made on the label or directly on the box.

Bearings are shipped only in closed transport vehicles. Bearings are dispatched in corrugated boxes, wooden boxes, reusable metal containers, bearings of large dimensions in primary package (as agreed with the customer) are shipped by packets on the pallets. At that it is necessary to put a wooden grating on the upper layer of bearings and the package is wrapped with polypropylene ribbon. Corrugated and wooden boxes are also supplied in the packs on the pallets.

Application of bearings

Fits

Bearings efficient performance depends a lot on their fits, i.e. on the type of the bearing connection with the housing and shaft. Bearing fit regulates the position of inside and outside rings of the bearing in radial direction as well as prevents from cranking relative to the housing components. Fitting surface of the housing component shall be in close contact with the bearing surface, thus bosses, sharp edges or other roughness is not acceptable on it as it can lead to decrease of bearing load rating. In case of an unacceptable clearance between fitting surfaces of the bearing and the housing component there can be sliding between them causing rapid wear or damages to the fitting surface. The bearings shall be assembled in such a way that temperature changes do not cause their pinching or unacceptable clearances. This is achieved by the use of the bearing that is moveable ("floating") in axial direction. Finally, most of the vehicles require that the bearing be easy to be mounted and dismounted.

While selecting the fit consideration must be given to the direction of load in respect to the bearing ring. If the bearing ring is in the state of rest relative to the direction of load action, such load is commonly called local. If the bearing ring rotates relative to the direction of load action then such load on the ring is usually called circulating. In this case the ring takes up the load successive by the whole circular surface of the raceway. If the load on the bearing ring is simultaneously constant as to its direction (for example, weight force) and alternating (for example, rotating mass) this load is called racking. Thus, within the same direction of the load applied the inside and outside rings of the bearing experience different load depending on what ring is rotating. If the ring is exposed to circulating load for a certain period of time and the rest of the time – to local or racking load, this load is called undefined.

When the local load is applied to the ring the clearance fit is used if the interference fit is not required on the basis of other considerations. Excessive clearance growth does not lead to the ring cranking in the shaft or in the housing but worsens load distribution.

When circulation load is applied to the ring as well as racking and undefined load, the interference fit is used for rotating bearing rings. Strength of connection between the ring and the shaft or housing (interference fit) shall be greater as the operating conditions of the bearing are heavier, characterized by the ratio of the equivalent load and dynamic load rating, and the greater its dimensions are. As a rule roller bearings use tighter fits than ball bearings.

Rolling element bearings are mounted on the shafts in the system of bores with only difference that the tolerance on the basic size of the ring is negative in respect to the zero line, i.e. upper deviation always equals zero, see figure 3.

Range of tolerance for the bearing bore is designated as L_{dmp}, i.e. for the bearings with accuracy classes 0, 6, 5, 4, 2 the designations of the tolerance ranges of the bore diameter in the fit L0, L6, L5, L4, L2 shall be used. For example, fit of the bearing of the accuracy class 6 with bore diameter 30 mm for the shaft of the quality class h6 is designated as follows:

$\varnothing 30\frac{L6}{h6}$ (èëè $\varnothing$ 30 L6/h6)

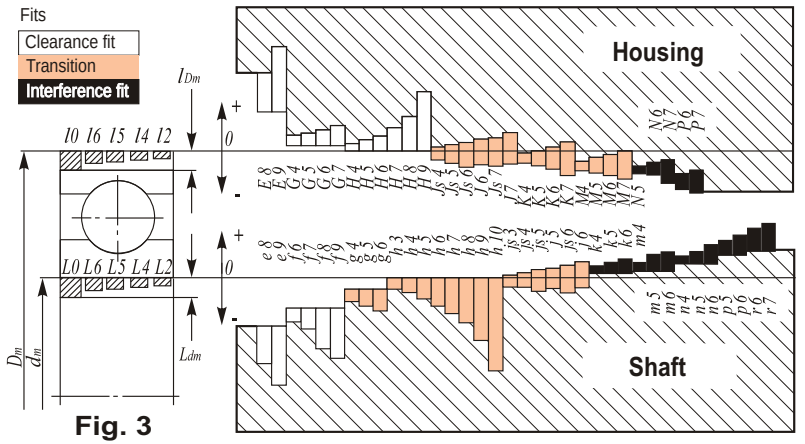


Fig. 3

Rolling element bearings are mounted in the housing bore in the system of the main shaft. Range of tolerance for the medium outside diameter of the bearing is designated as lDmp i.e. for different accuracy classes of bearings different designations of tolerance ranges of the outside diameter in fit 10, 16, 15, 14, 12 are used. For example, fit of the bearing with the outside diameter 72 mm of the accuracy class 6 in the bore of the 7-th quality class is designated.

$$\varnothing 72\frac{N7}{l6}$$ (èëè ∅ 72 N7/l6)

For the purpose of mounting on the shaft and in the housing the system of fits is used that is described on figure 3. Out of a vast range of fits on the shaft the following fits are used more often - g6, h6, j6, k6, m6, n6, ð6, r6 , under the conditions of high level of requirements to the rotation accuracy – h5, j5, k5, m5. For fits in the housing the most often used variants are G7, Í 8, Í 7, J7, Ê7, Ì 7, N7, Ð7, and considering the high requirements to rotation accuracy – J6, Ê6, Ì 6, N6, Ð6.

For the purpose of compatibility with the bearings having different accuracy classes the following quality classes of the shafts are used: for the bearings of the accuracy class 0 and 6 – the 6th quality class of the shaft; for accuracy classes 5 and 4 – the 5th quality class of the shaft; for accuracy class 2 – the 4th and 3d quality classes of the shaft.

For compatibility of the bearings having different accuracy classes the following quality classes for the bores are used: for the bearings of the accuracy class 0 and 6 – the 7th quality class of bore; for accuracy classes 5 and 4 – the 6th quality class of bore; for accuracy class 2 – the 5th and 4th quality classes of bore.

Operation mode of the bearings in respect of load intensity is nominally evaluated according to the ratio of the load to dynamic load rating as light (Ð≤ 0,07Ñ), normal (Ð≤0,15Ñ) and heavy (Ð>0,15Ñ). Fits for the bearings working under impact and vibration loads (in railway and tram boxes, in engine shafts, in crushing mill units, in press units, excavating machines etc.) are selected as for the heavy duty operation mode irrespective of the load value.

When selecting interference fit (part of transition and press fits) it is necessary to take into consideration that clearance in the bearing can be lessened from 50 to 80 % of the calculated interference depending on stiffness of the bearing rings and material of the adjacent components because of stretching of the inside rings and compression of the outside rings. This is particularly true about small non-rigid ball bearings having a slight radial clearance.

Thus in these cases it is desirable to accept fits with minimum interference or without it.

In thrust bearings rotating ring is mounted as with interference fit, and stationary ring – with clearance fit, however support surfaces of the adjacent components shall be perpendicular to its rotational axis so that the load is distributed evenly on all rolling elements. For angular contact spherical roller bearings that are exposed to axial load besides radial load the fits shall be selected according to the same parameters as in the case with the radial bearings.

Tables 21 and 22 contain recommendations on selection the fits according to the type of load and operation mode. In this case it is assumed that shafts are made of steel, housings – of steel and cast iron, shafts and housings are solid with thick walls (shafts and housings are considered to be steel and cast iron if the following ratios hold true for them: $d/d_2 \geq 1{,}25$ and $D_k/D \geq 1{,}25$, where d, d2 – diameters of the bearing bore and hollow shaft bore respectively; D_k, D – outside diameters of the housing and bearing); operating temperature of the bearings is <100°Ñ. When the housings of light alloys are used, tighter fits are necessary than for steel and cast iron as their hardness is less and their thermal expansion coefficient is greater. In some cases while mounting the bearings it is necessary to avoid shrink fits as it may lead to potential pinching of the outside ring and cause its deformation and incorrect distribution of loads in the bearing.

Selection of fits according to the experience by analogy with the existing bearing arrangements working under equal or similar conditions is the most widespread and approved practice. In general mounting and dismounting of the bearings with clearance fit is more convenient than with interference fit. However using this type of fit shall not be the reason not to use interference fit if such fit is required according to certain considerations.

Bearings with tapered bore are mounted directly on the tapered shaft or by means of clamping sleeves having the respective taper surface. Application of such structures facilitates mounting-dismounting procedures, mounting on sleeves allows fastening the bearings on the smooth shaft and occasionally regulating value of radial clearance.l.

Recommended bearing fits for solid steel shafts

Table 21

Type of load	Type of bearing	Shaft diameter	Character of loading	Examples of the recommended fits
Local load of the inner ring	Radial ball and angular contact, needle bearings	All diameters	Bearing with the sliding inner ring	*L0/g6,L6/g6, L5/g5*
			-	*L0/h6,L6/h6, L0/j6,L6/j6*
Circulating load on the inner ring or undefined load	Ball bearings	up to 40 mm	Normal load Ð<0,1Ñ	*L0/j6,L6/j6, L5(L4)/j5*
		up to 100 mm	Light load Ð<0,08Ñ	*L0/j6,L6/j6*
			Normal and heavy loads Ð>0,08Ñ	*L0/k6,L6/k6*
		up to 200 mm	Light load Ð<0,1Ñ	*L0/k6,L6/k6*
			Normal and heavy loads Ð>0,1Ñ	*L0/m6,L6/m6, L5/m5*
		over 200 mm	Normal load Ð<0,1Ñ	*L0/m6,L6/m6, L5/m5*
			Heavy loads, impacts	*L0/n6,L6/n6, L5/n5*
Circulating load on the inner ring or undefined load	Roller bearings, including needle bearings	up to 60 mm	Light load Ð<0,08Ñ	*L0/j6,L6/j6, L5(L4)/j5*
			Normal and heavy loads Ð>0,08Ñ	*L0/k6,L6/k6, L5(L4)/k5*
		up to 200 mm	Light load Ð<0,1Ñ	*L0/k6,L6/k6, L5(L4)/k5*
			Normal load Ð=(0,1-0,15)Ñ	*L0/m6,L6/m6, L5/m5*
			Heavy loads Ð>0,15Ñ	*L0/n6,L6/n6, L5/n5*
		up to 500 mm	Normal load Ð<0,15Ñ	*L0/m6,L0/n6, L6/m6,L6/n6*
			Heavy loads Ð>0,15Ñ	*L0/p6,L6/p6*
			Normal load Ð<0,2Ñ	*L0/n6,L6/n6*
			Heavy loads Ð>0,2Ñ	*L0/p6*
Local load on the tight ring	Spherical roller thrust bearings	all diameters		*L0/j6,L6/j6*
Circulating load on the tight ring		up to 40 mm		*L0/j6,L0/k6, L6/j6,L6/k6*
		over 200 mm		*L0/k6,L0/m6, L6/k6,L6/m6*

Recommended bearing fits for steel and cast iron housings

Table 22

Type of load on the outer ring	Additional characteristics	Recommended fit
Radial bearings		
Local load (the shaft is rotating)	Bearing with the inner ring that is able to move easily in an axial direction	*H7/l0, H7/l6*
Circulating load (housing is rotating) or undetermined load	High grade of accuracy is needed (the outer ring is able to move)	*H6/l5, js6/l5*
	The shaft is a thermal conductor	*G7/l0*
	Light load P?0.07C	*K7/l0, K7/l6*
	Normal and impact load P≤0.15C	*M7/l0, M7/l6*
	Heavy and impact load	*N7/l0, N7/l6*
	Normal and heavy impact load, thin wall housings P>0.15C	*P7/l0, P7/l6*
Thrust bearings		
Axial load	Spherical thrust roller bearings :	
	- normal load	*E8/l0, E8/l6*
	- heavy load	*G7/l0, G7/l6*
Combined load: - local on the free ring		*H7/l0, H7/l6*
- circulating on the free ring		*K7/l0, K7/l6*

Shafts tolerances for bearing fit for withdrawal and adapter sleeves

Table 23

Shaft diameter, mm d Nominal size over	up to including	Tolerances for diameter and form, mkm h9 Deviations upper	lower	t_1=IT5/2 max	h10 Deviations upper	lower	t_1=IT7/2 max
10	18	0	-43	4,0	0	-70	9,0
18	30	0	-52	4,5	0	-84	10,5
30	50	0	-62	5,5	0	-100	12,5
50	80	0	-74	6,5	0	-120	15,0
80	120	0	-87	7,5	0	-140	17,5
120	180	0	-100	9,0	0	-160	20,0
180	250	0	-115	10,0	0	-185	23,0
250	315	0	-130	11,5	0	-210	26,0
315	400	0	-140	12,5	0	-230	28,5
400	500	0	-155	13,5	0	-250	31,5
500	630	0	-175	14,0	0	-280	35,0
630	800	0	-200	16,0	0	-320	40,0
800	1000	0	-230	18,0	0	-360	45,0
1000	1250	0	-260	21,0	0	-420	52,5

Tolerances for various quality grades ISO

Table 24

Nominal size over	up to including	Quality class, mcm IT0	IT1	IT2	IT3	IT4	IT5	IT6	IT7	IT8	IT9	IT10	IT11	IT12
1	3	0,5	0,8	1,2	2,0	3	4	6	10	14	25	40	60	100
3	6	0,6	1,0	1,5	2,5	4	5	8	12	18	30	48	75	120
6	10	0,6	1,0	1,5	2,5	4	6	9	15	22	36	58	90	150
10	18	0,8	1,2	2,0	3,0	5	8	11	18	27	43	70	110	180
18	30	1,0	1,5	2,5	4,0	6	9	13	21	33	52	84	130	210
30	50	1,0	1,5	2,5	4,0	7	11	16	25	39	62	100	160	250
50	80	1,2	2,0	3,0	5,0	8	13	19	30	46	74	120	190	300
80	120	1,5	2,5	4,0	6,0	10	15	22	35	54	87	140	220	350
120	180	2,0	3,5	5,0	8,0	12	18	25	40	63	100	160	250	400
180	250	3,0	4,5	7,0	10,0	14	20	29	46	72	115	185	290	460
250	315	4,0	6,0	8,0	12,0	16	23	32	52	81	130	210	320	520
315	400	5,0	7,0	9,0	13,0	18	25	36	57	89	140	230	360	570
400	500	6,0	8,0	10,0	15,0	20	27	40	63	97	155	250	400	630
500	630	-	-	-	-	-	32	44	70	110	175	280	440	700
630	800	-	-	-	-	-	36	50	80	125	200	320	500	800
800	1000	-	-	-	-	-	40	56	90	140	230	360	560	900
1000	1250	-	-	-	-	-	47	66	105	165	260	420	660	1050
1250	1600	-	-	-	-	-	55	78	125	195	310	500	780	1250
1600	2000	-	-	-	-	-	65	92	150	230	370	600	920	1500
2000	2500	-	-	-	-	-	78	110	175	280	440	700	1100	1750

Fits for the shaft

Table 25

Shaft Diameter d, mm Nominal size over	up to including	Bearing Deviations of the inside diameter, Δd_{mp}, mkm	Extreme deviation of the shaft, mkm For tolerance ranges d6	e6	f6	g5	g6	h5	h6	h7	h8	h9	h10	js5	js6	j5	j6	j7	k5	k6	k7	m5	m6	n6	p6	r6	r7
3	6	0	-30	-20	-10	-4	-4	0	0	0	0	0	0	+2,5	+4	+3	+6	+8	+6	+9	+13	+9	+12	+16	+20	+23	+27
		-8	-38	-28	-18	-9	-12	-5	-8	-12	-18	-30	-48	-2,5	-4	-2	-2	-4	+1	+1	+1	+4	+4	+8	+12	+15	+15
6	10	0	-40	-25	-13	-5	-5	0	0	0	0	0	0	+3	+4,5	+4	+7	+10	+7	+10	+16	+12	+15	+19	+24	+28	+34
		-8	-49	-34	-22	-11	-14	-6	-9	-15	-22	-36	-58	-3	-4,5	-2	-2	-5	+1	+1	+1	+6	+6	+10	+15	+19	+19
10	18	0	-50	-32	-16	-6	-6	0	0	0	0	0	0	+4	+5,5	+5	+8	+12	+9	+12	+19	+15	+18	+23	+29	+34	+41
		-8	-61	-43	-27	-14	-17	-8	-11	-18	-27	-43	-70	-4	-5,5	-3	-3	-6	+1	+1	+1	+7	+7	+12	+18	+23	+23
18	30	0	-65	-40	-20	-7	-7	0	0	0	0	0	0	+4,5	+6,5	+5	+9	+13	+11	+15	+23	+17	+21	+28	+35	+41	+49
		-10	-78	-53	-33	-16	-20	-9	-13	-21	-33	-52	-84	-4,5	-6,5	-4	-4	-8	+2	+2	+2	+8	+8	+15	+22	+28	+28
30	50	0	-80	-50	-25	-9	-9	0	0	0	0	0	0	+5,5	+8	+6	+11	+15	+13	+18	+27	+20	+25	+33	+42	+50	+59
		-12	-96	-66	-41	-20	-25	-11	-16	-25	-39	-62	-100	-5,5	-8	-5	-5	-10	+2	+2	+2	+9	+9	+17	+26	+34	+34
50	65	0	-100	-60	-30	-10	-10	0	0	0	0	0	0	+6,5	+9,5	+6	+12	+18	+15	+21	+32	+24	+30	+39	+51	+60	+71
		-15	-119	-79	-49	-23	-29	-13	-19	-30	-46	-74	-120	-6,5	-9,5	-7	-7	-12	+2	+2	+2	+11	+11	+20	+32	+41	+41
65	80	0	-100	-60	-30	-10	-10	0	0	0	0	0	0	+6,5	+9,5	+6	+12	+18	+15	+21	+32	+24	+30	+39	+51	+62	+73
		-15	-119	-79	-49	-23	-29	-13	-19	-30	-46	-74	-120	-6,5	-9,5	-7	-7	-12	+2	+2	+2	+11	+11	+20	+32	+43	+43
80	100	0	-120	-72	-36	-12	-12	0	0	0	0	0	0	+7,5	+11	+6	+13	+20	+18	+25	+38	+28	+35	+45	+59	+73	+86
		-20	-142	-94	-58	-27	-34	-15	-22	-35	-54	-87	-140	-7,5	-11	-9	-9	-15	+3	+3	+3	+13	+13	+23	+37	+51	+51
100	120	0	-120	-72	-36	-12	-12	0	0	0	0	0	0	+7,5	+11	+6	+13	+20	+18	+25	+38	+28	+35	+45	+59	+76	+89
		-20	-142	-94	-58	-27	-34	-15	-22	-35	-54	-87	-140	-7,5	-11	-9	-9	-15	+3	+3	+3	+13	+13	+23	+37	+54	+54
120	140	0	-145	-85	-43	-14	-14	0	0	0	0	0	0	+9	+12,5	+7	+14	+22	+21	+28	+43	+33	+40	+52	+68	+88	+103
		-25	-170	-110	-68	-32	-39	-18	-25	-40	-63	-100	-160	-9	-12,5	-11	-11	-18	+3	+3	+3	+15	+15	+27	+43	+63	+63
140	160	0	-145	-85	-43	-14	-14	0	0	0	0	0	0	+9	+12,5	+7	+14	+22	+21	+28	+43	+33	+40	+52	+68	+90	+105
		-25	-170	-110	-68	-32	-39	-18	-25	-40	-63	-100	-160	-9	-12,5	-11	-11	-18	+3	+3	+3	+15	+15	+27	+53	+65	+65
160	180	0	-145	-85	-43	-14	-14	0	0	0	0	0	0	+9	+12,5	+7	+14	+22	+21	+28	+43	+33	+40	+52	+68	+93	+108
		-25	-170	-110	-68	-32	-39	-18	-25	-40	-63	-100	-160	-9	-12,5	-11	-11	-18	+3	+3	+3	+15	+15	+27	+43	+68	+68
180	200	0	-170	-100	-50	-15	-15	0	0	0	0	0	0	+10	+14,5	+7	+16	+25	+24	+33	+50	+37	+46	+60	+79	+106	+123
		-30	-199	-129	-79	-35	-44	-20	-29	-46	-72	-115	-185	-10	-14,5	-13	-13	-21	+4	+4	+4	+17	+17	+31	+50	+77	+77
200	225	0	-170	-100	-50	-15	-15	0	0	0	0	0	0	+10	+14,5	+7	+16	+25	+24	+33	+50	+37	+46	+60	+79	+109	+126
		-30	-199	-129	-79	-35	-44	-20	-29	-46	-72	-115	-185	-10	-14,5	-13	-13	-21	+4	+4	+4	+17	+17	+31	+50	+80	+80
225	250	0	-170	-100	-50	-15	-15	0	0	0	0	0	0	+10	+14,5	+7	+16	+25	+24	+33	+50	+37	+46	+60	+79	+113	+130
		-30	-199	-129	-79	-35	-44	-20	-29	-46	-72	-115	-185	-10	-14,5	-13	-13	-21	+4	+4	+4	+17	+17	+31	+50	+84	+84
250	280	0	-190	-110	-56	-17	-17	0	0	0	0	0	0	+11,5	+16	+7	+16	+26	+27	+36	+56	+43	+52	+66	+88	+126	+146
		-35	-222	-142	-88	-40	-49	-23	-32	-52	-81	-130	-210	-11,5	-16	-16	-16	-26	+4	+4	+4	+20	+20	+34	+56	+94	+94
280	315	0	-190	-110	-56	-17	-17	0	0	0	0	0	0	+11,5	+16	+7	+16	+26	+27	+36	+56	+43	+52	+66	+88	+130	+150
		-35	-222	-142	-88	-40	-49	-23	-32	-52	-81	-130	-210	-11,5	-16	-16	-16	-26	+4	+4	+4	+20	+20	+34	+56	+98	+98
315	355	0	-210	-125	-62	-18	-18	0	0	0	0	0	0	+12,5	+18	+7	+18	+29	+29	+40	+61	+46	+57	+73	+98	+144	+165
		-40	-246	-161	-98	-43	-54	-25	-36	-57	-89	-140	-230	-12,5	-18	-18	-18	-28	+4	+4	+4	+21	+21	+37	+62	+108	+108
355	400	0	-210	-125	-62	-18	-18	0	0	0	0	0	0	+12,5	+18	+7	+18	+29	+29	+40	+61	+46	+57	+73	+98	+150	+171
		-40	-246	-161	-98	-43	-54	-25	-36	-57	-89	-140	-230	-12,5	-18	-18	-18	-28	+4	+4	+4	+21	+21	+37	+62	+114	+114
400	450	0	-230	-135	-68	-20	-20	0	0	0	0	0	0	+13,5	+20	+7	+20	+31	+32	+45	+68	+50	+63	+80	+108	+166	+189
		-45	-270	-175	-108	-47	-60	-27	-40	-63	-97	-155	-250	-13,5	-20	-20	-20	-32	+5	+5	+5	+23	+23	+40	+68	+126	+126
450	500	0	-230	-135	-68	-20	-20	0	0	0	0	0	0	+13,5	+20	+7	+20	+31	+32	+45	+68	+50	+63	+80	+108	+172	+195
		-45	-270	-175	-108	-47	-60	-27	-40	-63	-97	-155	-250	-13,5	-20	-20	-20	-32	+5	+5	+5	+23	+23	+40	+68	+132	+132
500	560	0	-260	-145	-76	-	-22	-	0	0	0	0	0	-	+22	-	-	-	-	+44	+70	-	+70	+88	+122	+194	+220
		-50	-304	-189	-120	-	-66	-	-44	-70	-110	-175	-280	-	-22	-	-	-	-	0	0	-	+26	+44	+78	+150	+150
560	630	0	-260	-145	-76	-	-22	-	0	0	0	0	0	-	+22	-	-	-	-	+44	+70	-	+70	+88	+122	+199	+225
		-50	-304	-189	-120	-	-66	-	-44	-70	-110	-175	-280	-	-22	-	-	-	-	0	0	-	+26	+44	+78	+155	+155
630	710	0	-290	-160	-80	-	-24	-	0	0	0	0	0	-	+25	-	-	-	-	+50	+80	-	+80	+100	+138	+225	+255
		-75	-340	-210	-130	-	-74	-	-50	-80	-125	-200	-320	-	-25	-	-	-	-	0	0	-	+30	+50	+88	+175	+175
710	800	0	-290	-160	-80	-	-24	-	0	0	0	0	0	-	+25	-	-	-	-	+50	+80	-	+80	+100	+138	+235	+265
		-75	-340	-210	-130	-	-74	-	-50	-80	-125	-200	-320	-	-25	-	-	-	-	0	0	-	+30	+50	+88	+185	+185

Fits in the housing

Table 26

Housing Diameter D, mm Nominal size over	up to	Bearing Deviations of the outside diameter, ΔD_{mp}, mkm	Deviations, mkm For tolerance ranges E6	F6	F7	G6	G7	H6	H7	H8	J6	J7	JS6	JS7	K5	K6	K7	M5	M6	M7	N5	N6	N7	P6	P7
10	18	0	+43	+27	+34	+17	+24	+11	+18	+27	+6	+10	+5,5	+9	+2	+2	+6	-4	-4	0	-9	-9	-5	-15	-11
		-8	+32	+16	+16	+6	+6	0	0	0	-5	-8	-5,5	-9	-6	-9	-12	-12	-15	-18	-17	-20	-23	-26	-29
18	30	0	+53	+33	+41	+20	+28	+13	+21	+33	+8	+12	+6,5	+10,5	+1	+2	+6	-5	-4	0	-12	-11	-7	-18	-14
		-9	+40	+20	+20	+7	+7	0	0	0	-5	-9	-6,5	-10,5	-8	-11	-15	-14	-17	-21	-21	-24	-28	-31	-35
30	50	0	+66	+41	+50	+25	+34	+16	+25	+39	+10	+14	+8	+12,5	+2	+3	+7	-5	-4	0	-13	-12	-8	-21	-17
		-11	+50	+25	+25	+9	+9	0	0	0	-6	-11	-8	-12,5	-9	-13	-18	-16	-20	-25	-24	-28	-33	-37	-42
50	80	0	+79	+49	+60	+29	+40	+19	+30	+46	+13	+18	+9,5	+15	+3	+4	+9	-6	-5	0	-15	-14	-9	-26	-21
		-13	+60	+30	+30	+10	+10	0	0	0	-6	-12	-9,5	-15	-10	-15	-21	-19	-24	-30	-28	-33	-39	-45	-51
80	120	0	+94	+58	+71	+34	+47	+22	+35	+54	+16	+22	+11	+17,5	+2	+4	+10	-8	-6	0	-18	-16	-10	-30	-24
		-15	+72	+36	+36	+12	+12	0	0	0	-6	-13	-11	-17,5	-13	-18	-25	-23	-28	-35	-33	-38	-45	-52	-59
120	150	0	+110	+68	+83	+39	+54	+25	+40	+63	+18	+26	+12,5	+20	+3	+4	+12	-9	-8	0	-21	-20	-12	-36	-28
		-18	+85	+43	+43	+14	+14	0	0	0	-7	-14	-12,5	-20	-15	-21	-28	-27	-33	-40	-39	-45	-52	-61	-68
150	180	0	+110	+68	+83	+39	+54	+25	+40	+63	+18	+26	+12,5	+20	+3	+4	+12	-9	-8	0	-21	-20	-12	-36	-28
		-25	+85	+43	+43	+14	+14	0	0	0	-7	-14	-12,5	-20	-15	-21	-28	-27	-33	-40	-39	-45	-52	-61	-68
180	250	0	+129	+79	+96	+44	+61	+29	+46	+72	+22	+30	+14,5	+23	+2	+5	+13	-11	-8	0	-25	-22	-14	-41	-33
		-30	+100	+50	+50	+15	+15	0	0	0	-7	-16	-14,5	-23	-18	-24	-33	-31	-37	-46	-45	-51	-60	-70	-79
250	315	0	+142	+88	+108	+49	+69	+32	+52	+81	+25	+36	+16	+26	+3	+5	+16	-13	-9	0	-27	-25	-14	-47	-36
		-35	+110	+56	+56	+17	+17	0	0	0	-7	-16	-16	-26	-20	-27	-36	-36	-41	-52	-50	-57	-66	-79	-88
315	400	0	+161	+98	+119	+54	+75	+36	+57	+89	+29	+39	+18	+28,5	+3	+7	+17	-14	-10	0	-30	-26	-16	-51	-41
		-40	+125	+62	+62	+18	+18	0	0	0	-7	-18	-18	-28,5	-22	-29	-40	-39	-46	-57	-55	-62	-73	-87	-98
400	500	0	+175	+108	+131	+60	+83	+40	+63	+97	+33	+43	+20	+31,5	+2	+8	+18	-16	-10	0	-33	-27	-17	-55	-45
		-45	+135	+68	+68	+20	+20	0	0	0	-7	-20	-20	-31,5	-25	-32	-45	-43	-50	-63	-60	-67	-80	-95	-108
500	630	0	+189	+120	+146	+66	+92	+44	+70	+110	-	-	+22	+35	-	0	0	-	-26	-26	-	-44	-44	-78	-78
		-50	+145	+76	+76	+22	+22	0	0	0	-	-	-22	-35	-	-44	-70	-	-70	-96	-	-88	-114	-122	-148
630	800	0	+210	+130	+160	+74	+104	+50	+80	+125	-	-	+25	+40	-	0	0	-	-30	-30	-	-50	-50	-88	-88
		-75	+160	+80	+80	+24	+24	0	0	0	-	-	-25	-40	-	-50	-80	-	-80	-110	-	-100	-130	-138	-168
800	1000	0	+226	+142	+176	+82	+116	+56	+90	+140	-	-	+28	+45	-	0	0	-	-34	-34	-	-56	-56	-100	-100
		-100	+170	+86	+86	+26	+26	0	0	0	-	-	-28	-45	-	-56	-90	-	-90	-124	-	-112	-146	-156	-190
1000	1250	0	+261	+164	+203	+94	+133	+66	+105	+165	-	-	+33	+52,5	-	0	0	-	-40	-40	-	-66	-66	-120	-120
		-125	+195	+98	+98	+28	+28	0	0	0	-	-	-33	-52,5	-	-66	-105	-	-106	-145	-	-132	-171	-186	-225
1250	1600	0	+298	+188	+235	+108	+155	+78	+125	+195	-	-	+39	+62,5	-	0	0	-	-48	-48	-	-78	-78	-140	-140
		-160	+220	+110	+110	+30	+30	0	0	0	-	-	-39	-62,5	-	-78	-125	-	-126	-173	-	-156	-203	-218	-265
1600	2000	0	+332	+212	+270	+124	+182	+92	+150	+230	-	-	+46	+75	-	0	0	-	-58	-58	-	-92	-92	-170	-170
		-200	+240	+120	+120	+32	+32	0	0	0	-	-	-46	-75	-	-92	-150	-	-150	-208	-	-184	-242	-262	-320
2000	2500	0	+370	+240	+305	+144	+209	+110	+175	+280	-	-	+55	+87,5	-	0	0	-	-68	-68	-	-110	-110	-195	-195
		-250	+260	+130	+130	+34	+34	0	0	0	-	-	-55	-87,5	-	-110	-175	-	-178	-243	-	-220	-285	-305	-370

Seals of bearing arrangements

Seals are used for protection of the bearings from dust and moisture. Besides theses seals prevent leakage of the lubricating material.

The correct choice of seals defines bearing operating efficiency in the whole. While choosing the type of sealing it is necessary to take into account:

- type of the lubricating material used (liquid or plastic) and its physicochemical properties;
- circumferential speed of the sealing edge in respect to the adjacent surface, surface characteristics (hardness, roughness);
- operating temperature of the bearing arrangement;
- position of the shaft (horizontal or vertical);
- possible distortion and shaft run out;
- environmental conditions;
- structural features of the bearing arrangement and the bearings mounted in it;
- characteristics of maintenance of the bearing arrangement etc.

Conditionally the seals are divided in two groups: noncontact seals and contact seals.

Noncontact seals function by direct pressure of the seal edge on the sealed surface.

Sealing effect of noncontact seals occurs due to tight clearances between rotating and fixed parts of the bearing arrangement and is achieved because of the effect of the centrifugal forces, hydrodynamic events etc.

Contact seals (gaskets, rubber-metal collars, split spring rings, end seals etc.) require the respective treatment of the sealing surface, lubricating the sealing edge, regulating load on the contact surfaces, rational selection of friction surface material; correct mounting.

Noncontact seals (groove seals, drive off ðåçüáû, crested seals, reflecting discs, traps of various kinds, labyrinth seals) do not practically wear out and their service life is unlimited. They are particularly useful for operating under the conditions of high speed and temperature.

Contact seals

Gaskets

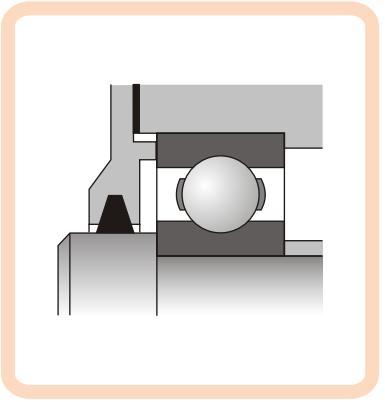
Gaskets are not recommended to be used in the conditions of high contamination of the environment and under the excessive pressure on one side of the seal. Their main disadvantage – increased wear-out together with the loss of sealing properties. Advantages – simplicity and low cost of the structure allowing to be used in the blocks of low-duty designation operating under the conditions of low circumferential speed (up to 4 m/s) and temperature (up to +90°Ñ) in combination with using plastic lubricating materials.

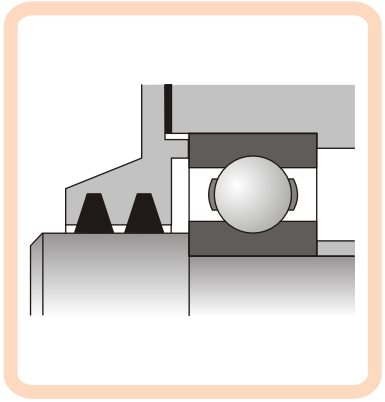
Gasket is a circular hollow space around the shaft filled with the sealing material. Cotton fabric, flock, felt and mostly felted fabric are used for filling.

Besides some fibrous materials are also used, synthetic rubber being the cohesive element. For efficient operation it is necessary that the height of the ring section is more than its width.

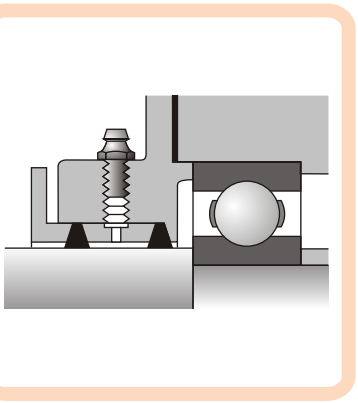
Prior to mounting the sealing rings are soaked during 23 hours in the heated mixture of grease lubricant (85%) and flaky graphite (15%) or other types of lubricating materials with greater viscosity then that of the lubricating material used for operation of the bearing arrangement.

In order to increase the seal reliability double gaskets are used. Further increase of the number of the rings adds considerably to rotating resistance, however, little increasing the seal efficiency.

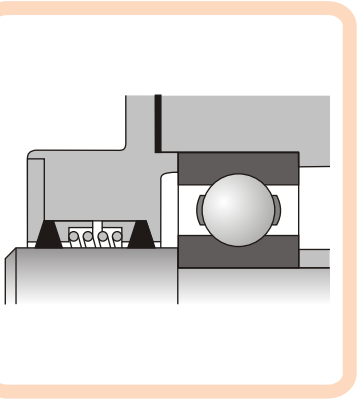




The gasket reliability is greatly increased if lubricating material is supplied as the coefficient of friction and heat generation decreases and impermeability is increased.



For the purpose of compensation of service wear tightening of the filling material is done, for example automatically by means of a spring.

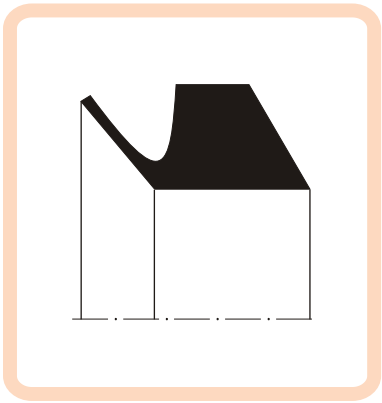


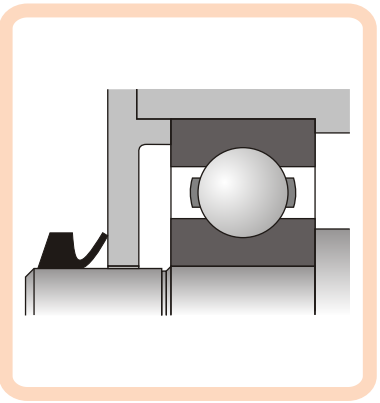
V-rings

V-rings completely made of flexible materials have been used extensively lately.

Sealing is achieved due to pressing the tapered flexible sponge to the end surface that is perpendicular to the shaft axis. V-rings are mounted on the shafts with interference and function as oil-catch rings.

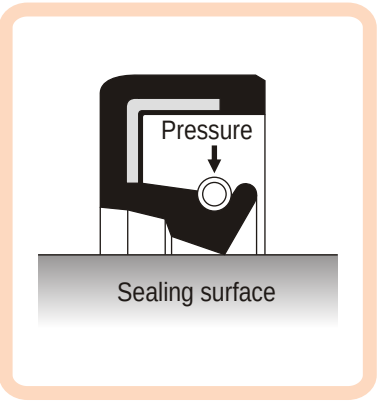
The main advantage of V-rings is in the simplicity of their mounting and replacement. The rings can be expanded, moved on the shaft through the adjacent components (flanges, sheaves); in some cases in order to avoid disassembling of a large number of components it may be practical to split the new ring and after its mounting on the shaft to weld the joint by means of spot curer. V-rings are often mounted in pairs. The first worn out ring is being cut and removed whereas the second one is moved to its place.



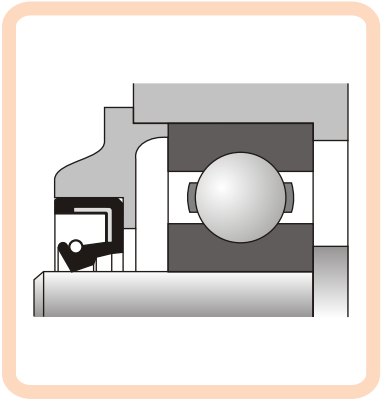


Rubber-metal cups

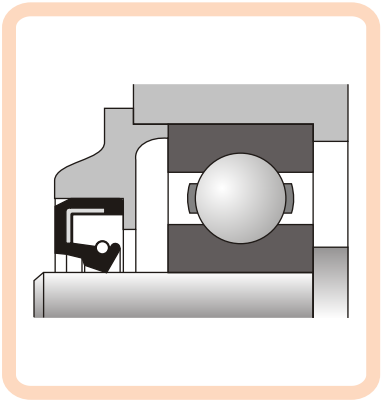
Radial cup seals with pressure spring under pressure difference 0.05-0.15 MPa have become widely used for sealing the bearing arrangements lubricated with fluid oil. In order to ensure constant contact of the seal edge with sealing surface the band spring creates additional radial load when seal is mounted on the shaft.



Cups are independent structures that can be mounted directly on the housing. If the main purpose of the seal is to protect the bearing from contamination with dirt from the outside, then the seal is mounted in the housing with its edge being turned to the outside.



If the main purpose is to prevent from leakage of lubrication from the housing, then the seal shall be mounted with its edge being turned to the inside.



Efficiency of cup seals is limited by the properties of flexible materials that are defined by the temperature range of application; ageing resistance; wearability; compatibility with different environments, as well as by the structure of the seal edges, conditions of the edge lubrication, condition of the adjacent surfaces and other specific factors of operation.

At the present time cups on the basis of butadiene-acrylo-nitroc rubber; silicon rubber, fluorine rubber; fluorine plastic started to have extensive application.

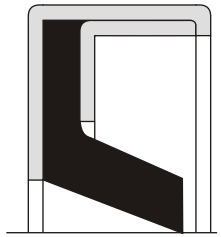
Owing to its relative low cost and acceptable combination of technical properties butadiene-acrylo-nitroc rubber is the most widely used and universal material for seals. It allows for short-term operation of the edges in dry conditions. The range of operating temperatures is from -50° to +100°C with short-term temperature increases to +120°C.

Silicone rubber has an expanded range of operating temperature (from -70° to +160°C) and is distinguished by the ability to adsorb lubrication thus decreasing friction. Slightly resistant to oxidizable oils and effect of some extreme pressure fits. Seals from this material can not work without lubrication and under the conditions of abrasive determination.

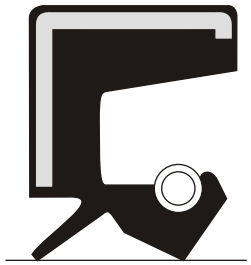
Fluorine rubber is characterized by high temperature and chemical stability. Resistant to ageing and ozone influence, slightly gas permeable. Operating temperature range from -70° to +200°C. Fluorine rubber is mineral acids resistant but incompatible with ether. Due to high level of the essential operational properties fluoride rubber is used extensively. The disadvantage of fluoride rubber is that it emits toxic gases when heated to the temperature over +300°Ñ.

Fluorine plastic is a thermoplastic element, its chemical and temperature resistance is much more superior to that of the described earlier seal materials. Range of operating temperatures is from -70° to +260°Ñ. The specific property of fluorine plastic is its high electric resistance that allows ensuring electrical insulation. Fluorine plastic has smooth surface that is resistant to contamination and provides low friction coefficient (0.05). Seals made from this material may operate under dry conditions. Overheating of fluorine plastic leads to the same consequences that overheating of fluoride rubber does. Its application as the seal material for extreme operating conditions of bearing arrangements is limited.

Cup seals without springs are used mainly for prevention of contamination with dust and for keeping grease lubricant in the supporting elements under the condition of the shaft rotating with moderate frequency.

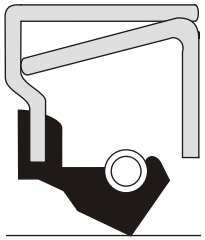


Cup seals may have additional edges – the so-called “dust collars” preventing from penetration of solid abrasive particles.

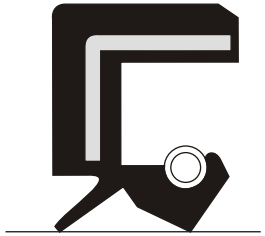


For hard working conditions the cups with higher radial stiffness due to additional supporting ring are used.

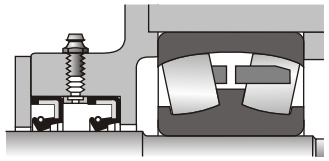
The advantage of cup seals with outer steel surface consists in simplicity of mounting and good center alignment. Its disadvantage – complexity of ensuring hermetic fit in the housing.



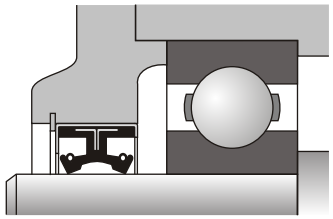
Hermetic fit in the housing ensures the use of the cup with fitting surface made of flexible material.



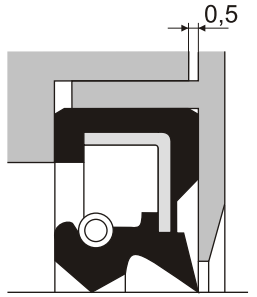
Increase of the seals efficiency is achieved due to mounting the seals according to the scheme “tandem”.



For simultaneous protection from contamination with dirt particles from outside and keeping lubrication material or in case of separation of two mediums the mounted seals are directed to the opposite sides or for the purpose of effective space utilization – double cups with oppositely directed edges are used.



In order that the cup is not pressured off the housing due to influence of various vibration loads it is fixed in the axial direction.



To preserve operating efficiency of cup seals of all types there are general requirements.

If circumferential speed on the sealing surface exceeds 4 m/s then the surface shall be polished, if the speed exceeds 8 m/s – the surface shall be reinforced (HRCa 45 no less); if the speed exceeds 15 m/s – the surface hardness shall be at least 55 HRCs and roughness no more than Ra = 0,63 µm.

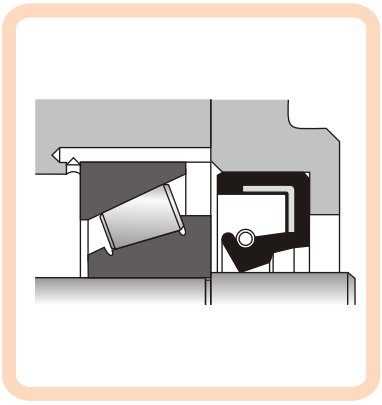
In order to avoid pumping effect of the grinding marks it is recommended to use polishing of the surface with cross-feed motion (penetration). It shall be noted that too small roughness (less than Ra=0,2µm) may lead to oil deficiency and overheating of the sealed edge.

The shaft surface shall not be damaged in any way: dimples, scratches, cracks, rust or galling. Shaft fillets shall have chamfers, fillets, housing bores and flat chamfers.

Axis misalignment of the shaft and the housing causes uneven distribution of the load on the edges thus leading to decrease of the seals efficiency.

Danger of great run out especially at high rotation frequency consist in the fact that the edges of cup seal due to their proper inertia and damping become unable to follow the conjugated surface of the shaft that leads to leakage of lubrication material.

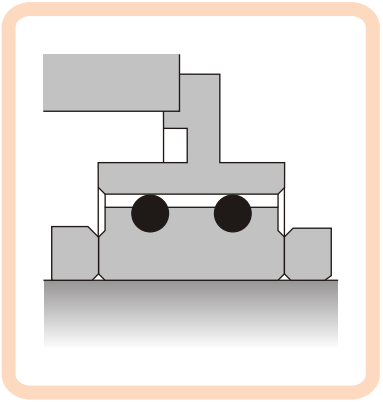
Some types of the rolling element bearings, for example angular contact ball bearings, taper roller bearings, spherical roller thrust bearings as well as gear wheels implement pump effect that depending on the arrangement structure leads either to deficiency or abundance of the lubricating material on the edge of the cup. In these cases at the stage of construction certain measures are taken to feed-in or feed-out the lubricating material from the seal by means of oil return channels, oil-catch rings etc.



Rubber rings

Sealing with rubber rings put into the shafts or intermediate sleeves channels is done by means of interference between the outer surface of the ring and the sleeve. Its application is limited because of rapid wear of rubber in the process of operation and undetermined pressing forces.

Most of all rubber rings are used as an element of complicated sealing systems for hermetic sealing of static surfaces while mounting.

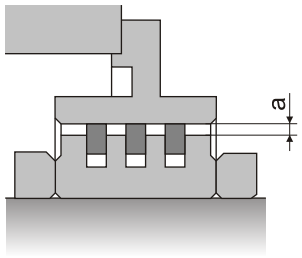


Split spring rings

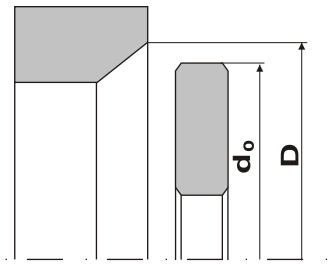
Sealing with split spring rings are used for protection of the bearings operating in the dirty, dusty and humid conditions. From the point of view of their structure these assemblies are more complicated; friction surfaces require low level of roughness, precise centering and alignment that leads to significant increase of their cost. However under the condition of precise manufacturing and detailed assembling these seals are reliable and practically do not need any special care. These rings are resistant to high temperatures and significant pressure difference, able to operate steady and continuously on high speed shafts, and if the materials are chosen correctly these shafts are durable.

Spring rings are manufactured from hardened steel, pearlitic cast iron, wrought bronze and are mounted in the shaft grooves or in the grooves of heat-treated steel housing with hardness at least HRCa 40...45 out of considerations of constructability and endurance. The outside sleeve of the seal is made of hardened cemented or nitrated steel. As a rule two or three rings are mounted, in case of significant pressure difference the number of rings is increased to 5.

The rings are fitted in the grooves with axial end clearance 0.05...0.1 mm. The space between the sleeve bore and the outside surface of the housing is made to be equal 0.1...0.5 mm.

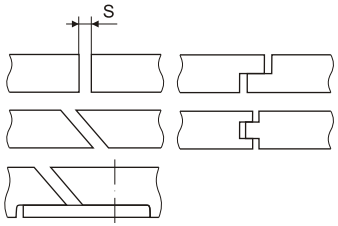


The rings are mounted with slight interference in respect to the sleeve, in order to do that the flat mounting chamber with diameter D exceeding the initial diameter do of the spring rings is made on the sleeve.

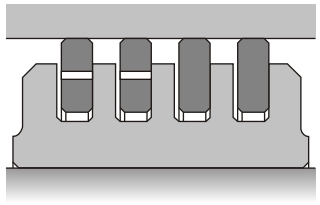


The line of the rings cutting – lock – is made in different ways.

Mostly the locks are manufactured as straight, and for large rings – bevel with the angle 45°. The width of the notch is determined under the condition that after the ring is placed in the sleeve a clearance is left. In case of the seals operating under the conditions of high temperature the clearance shall be increased by the thermal expansion of the ring. While disassembling the joint lines of the adjacent rings are displaced to some angle.



In multi-ring seals operating under the conditions of significant pressure difference the ring next to the pressurized hole is more loaded. For even distribution of the load among all the rings as well as for supply of oil to the friction surfaces discharge holes are done in the first or in the two front rings.

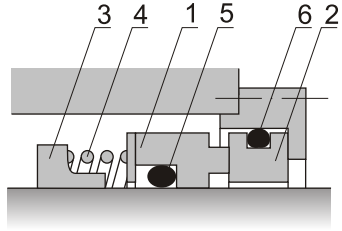


End face seals

End face seals are used for ensuring dynamic contact between the flat surfaces that are usually perpendicular to the axial shaft. The end seals have a number of advantages in comparison with other types of the sealing assemblies. They ensure more perfect hermetic sealing of the bearing arrangement, possess comparatively low level of response to bending and shaft run out, do not wear the shaft surface out.

Being slightly different in respect of the structure end seals include: sealing ring rotating with the shaft 1, fixed sealing ring (seating) 2, loading device 3 with the spring 4 and pressing elements 5 and 6.

The main advantage of the end face seals consist in the fact that the wear-out of the friction surfaces is compensated by moving the sealing ring in the axial direction under the influence of the spring.

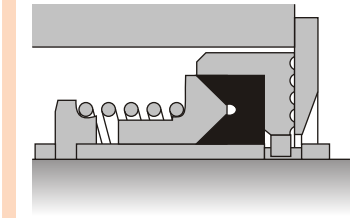


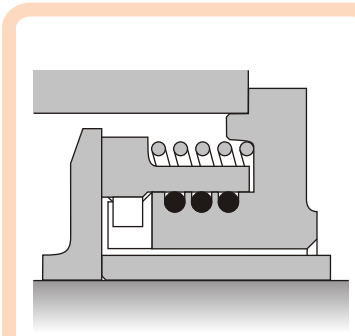
The end face seal is characterized by self conformability; if the material of the friction surfaces is chosen correctly and a small amount of lubrication is supplied the seal can work for a long period of time with good condition of the contact surfaces ensuring reliable sealing.

Depending on the environment the following antifriction pairs are used for friction end face surfaces: graphite-bronze, ceramics, nickel cast iron, satellite (water); graphite-corrosion-resisting steel, satellite, ceramics (weal acid solutions). The following pairs are also used: hardened steel-babbit, bronze, plastics.

Friction surfaces are polished till their roughness coefficient Ra = 0.16...0.32 μm. In order to improve sealing small grooves are made.

Mechanical bond between sealing rings and basic components prevents from twisting and malfunction of the flexible pressing components due to friction torque effect arising on the friction surfaces. Components fixation is done with the help of connectors, splines, set screws, pins and end teeth.

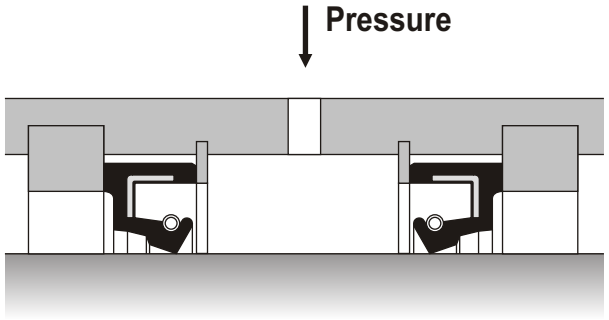




Seals with intermediate chamber

Seal of oil hollow chambers cause significant difficulties when the pressure in the hollow chamber exceeds greatly the pressure outside the seal. In these cases even contact seals often cannot prevent from leakage of oil to the low pressure space in the form of oil fog passing through the seal together with the air. A radical means is to use the double seals split by the intermediate chamber where the air is supplied. If the air is supplied under the excessive pressure in respect of the hollow space then leakage of oil through the seal is completely excluded.

In some cases concerning bearing arrangements located in the nearest proximity to the hollow spaces under vacuum condition it may be sufficient to supplied atmospheric air in he intermediate space between the bearing seals and vacuum hollow space.

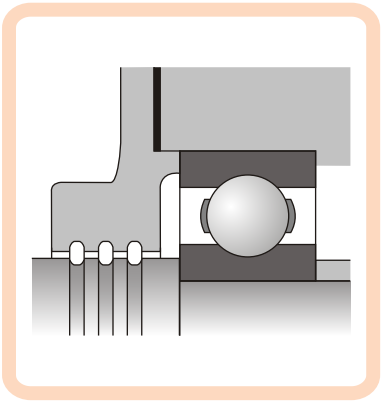


Noncontact seals

Groove seals

The simplest type of the noncontact seal is a groove seal between the shaft and the housing which sealing capacity is proportional to the length of the groove and inversely proportionate to the clearance size. This seal is not effective under the practical lengths of the groove and sizes of the clearance.

Groove seal efficiency is increased due to circular oil grooves on the shaft, in the housing (sleeve) or simultaneously on the shaft and in the sleeve. Grooves can have semicircular or trapezoidal section with 1…2 mm deep. This type of seal is used in the arrangements lubricated with grease lubricants with circumferential speed of the shaft rotation up to 5 m/s and operating temperature less than the temperature of lubrication melting. The main purpose is to protect the bearing from dry foreign particles.



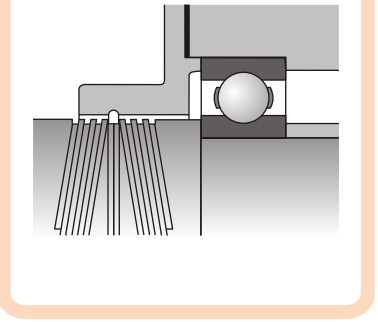
Driving off thread

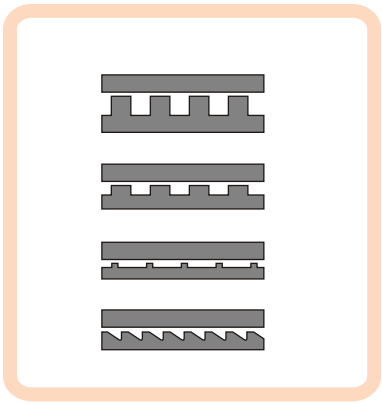
Driving off threads are used for protection of the bearings operating under clean environment condition. Effective for the circumferential speed at least 5 m/s. Multiple-start thread is done on the shaft or on the sleeve. The seal is non-reversible and consequently the thread direction shall be coordinated with the direction of rotation in such a way as to prevent oil (moisture) from penetrating into the housing (from the housing). In case it is needed to simultaneously protect the bearing from leakage of lubricant or penetration of moisture from the outside into the housing oppositely directed double-sided threaded grooves can be used.

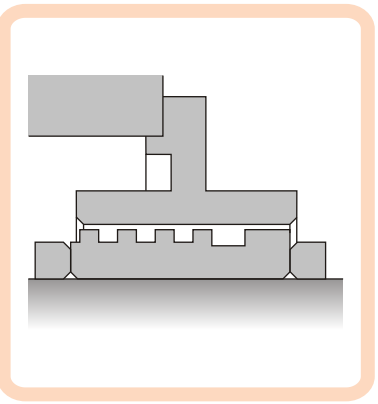
Sealing capacity of the driving off thread is largely dependant on the clearances between the coil crests and the bore walls. The seal works satisfactorily if the clearance does not exceed 0.05...0.06 mm; if the clearance is greater than 0.1 mm the seal becomes useless.

Different thread profiles are used. The best results are achieved by using small triangular thread with depth of thread 0.5...0.7 mm. Sealing capacity of the thread with trapezoidal profile is lower, sealing capacity of the thread with rectangular profile is twice lower. The optimal angle of elevation for the thread turns of triangle profile is 5... 10°, for rectangular profile 3.. .5°.

In order to increase the seal performance characteristics it is considered practical to close the screw opening after the last thread turns with cylindrical flat strip.

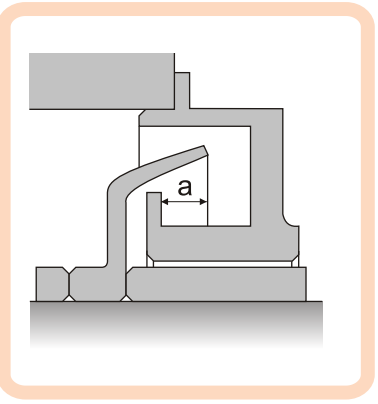






Reflective discs

Reflective discs are usually placed before groove seals. In the most rational structure groove seal has a bulge turned to the disc in the form of the cup. The disc overlaps the bulge on some value. Leaking oil is caught by the disc and is removed from the seal by the centrifugal force.



Labyrinth seal

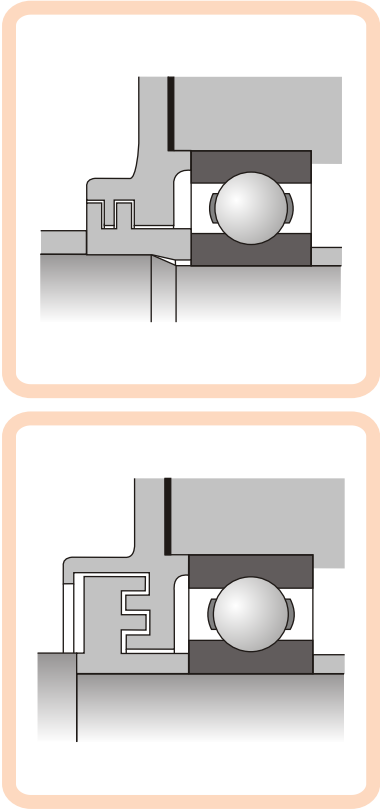
Labyrinth seal require high accuracy of manufacturing, they are sophisticated to be produced and relatively expensive, however they ensure effective protection of the bearings in difficult operational environment (mud, water, scale, vapour).

Labyrinth seals are characterized by complex form of the clearance between rotating and fixed unit parts.

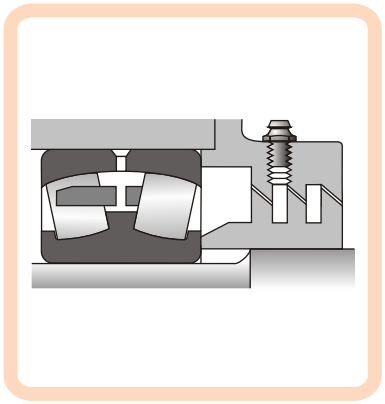
As for the split housings the clearances in the labyrinth seals can be positioned in radial direction.

As for the one-piece housings the clearances are positioned in axial direction.

The clearances are made as minimum as possible and shall be made with respect to the thermal vibrations in the unit, technical and operational mounting tolerances. If self-alignment bearings are used in the supporting structure the clearances shall be increased by 1.5 -2 folds in average. In cases where the shaft misalignment in respect to the housing is possible the labyrinth seals with inclined channels are used.



In the absolute majority of the cases in order to increase the efficiency of the labyrinth seals the clearances are filled with grease lubricant irrespective whether the bearing is operating with grease or liquid lubrication. In the seal structure a hollow space and channels for supplying the lubrication to the clearances by means of their injection under pressure are provided.

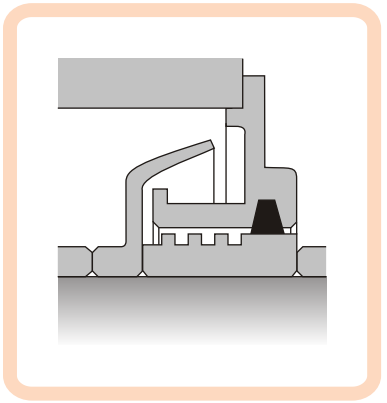


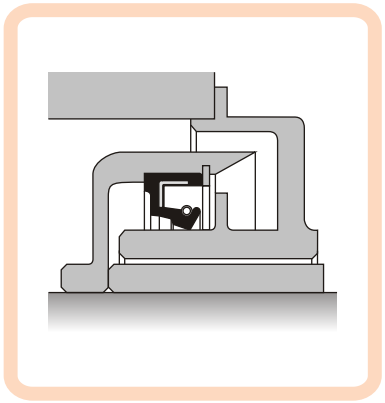
Composite seals

In practice it is very rare that only one type of the sealing assembly is used. In order to increase reliability two (or more) seals of different types are positioned.

Reflective disc, driving off thread and gasket complement each other and are integrated in one arrangement without significant adding to the dimensions.

The cup is mounted on the reflective disc and is rotating together with it. The cup sponge operates on the fixed sleeve of the oil catcher housing. During the course of operation the structure ensures reliable seal with the reflective disc (the cup sponge comes off the sleeve due to the influence of centrifugal forces and practically does not work). During shut-down periods seal is done with the cup.





Lubrication

Selection of lubricating material

Lubricating material is meant for reduction of friction, protection of the bearing from the wear and corrosion, protection from penetration of moisture and dirt from the outside.

The lubricating material creates a layer between working surfaces that cushions the impacts of rolling elements against the rings and cage and prevent from direct metal contact of the elements and raceways.

The factors defining the selection of lubricating material are: load, operating temperature range, rotation frequency, structural characteristics of the arrangements and the conditions of the environment.

For lubricating the rolling element bearings two types of bearings are mainly used: plastic and liquid. In some cases for high temperatures solid lubricants are applied.

The advantages of the plastic lubricants over liquid are in their relatively simpler, more reliable and economic structure of the bearing arrangement and the machine (equipment) as a whole.

Lubricating with liquid lubricants (oil) is recommended for rotational frequencies exceeding those acceptable for plastic liquid materials in the arrangements with reverse motion of the bearings in cases when it is necessary to remove heat from the bearings or lubricate the components adjacent to them (gear wheels, seals etc.) Oil lubricating is also recommended for arrangements with reverse motion with high speeds.

Lubricant film thickness effects to a great extent on the service life of the bearing and depends mainly on the rotation frequency, temperature and viscosity. At that viscosity is the main parameter determining the choice of the lubricant for effective lubrication of the bearing under the operation temperature.

Viscosity is determined by the ability of the fluid to flow. Viscosity unit of measurement is mm^2/c (cSt)

Consistency characterizes the level of hardness of the grease lubricant. In accordance with the norms NLGI (National Lubricating Grease Institute, USA), consistency measure is penetration and respectively NLGI class.

Fluid lubricants

The brand of the fluid lubricant (oil) is selected mainly on the basis of kinematic viscosity coefficient necessary for effective lubricating of the bearing under the operating temperature. Kinematic viscosity of the lubricating oil is measured at the certain temperature, more often t 50°Ñ or 100°Ñ. Kinematic viscosity depends on temperature: with temperature increasing viscosity is decreasing.

The greater viscosity coefficient of oil is the greater rupture load may take the oil film, at that viscous oils are more resistant to the components movement leading to increased energy consumption, decreased thermal exchange between oil and the bearing, etc.

Viscous oils can be used for the bearings operating under heavy loads with low speed of rotation. For high-speed bearings it is necessary to use low-viscosity oils. It shall be mentioned that under the low operating temperatures of the bearing low-viscosity oils shall be used, and under the high operating temperatures – high-viscosity oils.

Periodicity of oil replacement depends on the operating conditions and method of lubricating. If the method of oil bath is used than it is sufficient to change oil once a year, if the operating temperature of the bearings does not exceed 50°Ñ and the risk of contamination is low.

When the method of circulating lubricating is used the necessity to replace the oil is determined on the basis control of the oil quality, oil flow rate in the unit time and its cooling. The same holds true about the method of injection lubricating.

Table 27

Intermixibility of base oils

Base oil	Mineral oil	Oil on the basis of compound ethers	Polyglycol oil	Silicone (methyl) oil	Silicone (phenyl) oil	Polyphenyl -ether oil	Alkoxy -fluoride oil
Mineral oil		+	−	−	+	+	−
Oil on the basis of compound ethers	+		+	−	+	+	−
Polyglycol oil	−	+		−	−	−	−
Silicone (methyl) oil	−	−	−		+	−	−
Silicone (phenyl) oil	+	+	−	+		+	−
Polyphenyl -ether oil	+	+	−	−	+		−
Alkoxy -fluoride oil	−	−	−	−	−	−	

Can be mixed	Cannot be mixed
+	−

Table 28

Intermixibility of lubricants thickeners

Thickener	Li-soap	Na-soap	Al-complex	Ba-complex	Na-complex	Bentonites	Polyurea
Li-soap		−	▭	+	+	+	+
Na-soap	−		▭	+	+	+	+
Al-complex	−	▭		+	▭	▭	+
Ba-complex	+	+	+		+	+	+
Na-complex	+	+	−	+		−	+
Bentonites	+	+	▭	+	▭		+
Polyurea	+	+	+	+	+	+	

Can be mixed	Cannot be mixed
+	−

Grease lubricants

Grease lubricants are the complex colloidal system the main properties of which are determined by the properties of the basic oil, thickener and additive agents. Mineral or synthetic oils are used as base oil. Metallic soaps are usually used as a thickener (calcium, lithium, sodium, aluminum, barium).

The factors determining the grease lubricant properties are: base oil viscosity, consistency, operating temperatures range. While lubricating the rolling element bearings the base oil viscosity is usually in the range 15…50 mm^2/s measured at the temperature 40°Ñ. The value of viscosity is determined by the type and quantity of the thickener. The temperature range that the lubricant can be operated in depends on the type of the base oil, thickener and additives.

When grease lubricants are selected it is necessary to take into consideration the type of equipment, the bearing size, operating temperature, load on the bearing, rotation frequency, operating conditions (the shaft position, vibration etc.), cooling conditions, seal efficiency, environment influence.

Usually the bearing and free space of the housing of the bearing arrangements are filled with grease lubricating material only partially – from 30 to 50%. When lithium lubricants are used for the supporting elements that are not exposed to heavy vibration the free space is filled 90% without danger of excessive temperature increase.

The bearings operating under the high rotation frequencies and under the light-load mode Ð/Ñ<0,6, in order to limit the temperature of the bearing arrangements and decrease the effect of barbotage are filled with 20 or 35% of the free space of the bearing. As for the supporting elements exposed to heavy vibration in vibrating assemblies lubricating material shall fill no more than 60% of the free space.

The rolling element bearings shall be filled with grease lubricant only before the assembly of the unit except for the closed bearings and in cases when the bearings shall be heated before mounting.

The bearings shall be filled with grease lubricants by turning the ring and placing between the rolling elements.

Prior to mounting the lubricating material is supplied under pressure (by injection) in the hollow space of the bearing. Dosage and periodicity of adding the lubricant to the bearing depends on the unit structure and operational conditions.

The ideal conditions for the long service life of the lubricating material are: operating temperature 70°Ñ, load Ð/Ñ<0,1, absence of dirt and moisture, hermetic sealing of the bearing. These data are based on the experience of using standard lithium lubricant.

It shall also be taking into consideration that starting from 70°Ñ increase of the operating temperature of the bearing for each 15°Ñ reduces service life of the lubricant twice. Service life of the plastic lubricants is twice reduced in the supporting elements of the vertical shafts, 2-3 times reduced for reverse rotation under the condition of intermittent operation (long-term shutdown) and vibration impact.

Under the condition of high load Ð/Ñ>0,1 the determinant factor for the service life is the quantity of abrasive particles accumulated in the lubricant as a result of wear of the bearing working surfaces. Then the carrying capacity of the lubrication oil is increased due to extreme pressure (EP) additives.

Service life under high temperature depends on the properties of high temperature lubricating materials. In case of 150°Ñ the service life was in the range from 500 hours – for using the lubrication oil on the basis of mineral oil – to 5000 hours – for using the lubricant on the basis of synthetic oil. If the temperature is lower the service life is increased in accordance with the factor 15°Ñ.

Service life is reduced as a result of high rotation frequency. The lower the ratio n_{limit}/n, the lesser is service life.

While mixing the lubricant materials it shall be taken into account that some base oils cannot be mixed with each other thus excluding the possibility of homogeneous mixture. The same is true about the thickeners. If the lubricant with incompatible thickeners are mixed then the consistency of the mixture will be either lesser or greater than that of the original lubricating materials. Along with that performance characteristics are also changed.

Mounting and dismounting

Preparation for mounting

High rotation frequencies, heavy loads, small contact surfaces of the rolling elements and small length of the fit surfaces of the rings in respect to their diameters present certain requirements to the fits, fitting seats, assembly and disassembly of the bearings.

Prior to mounting and dismounting of the bearings it is necessary to fulfill a number of certain requirements.

Preliminary study of the assembling drawing of the bearing arrangement allows to learn the specific characteristics of the structure, define the consequence of fulfilling operations on mounting and dismounting, get information on the heating temperature, amount of efforts necessary for mounting and dismounting, quantity of the lubricant inserted in the bearing.

If mounting and dismounting of the bearings require special means the mechanics and specialists on mounting shall be provided with detailed instructions on mounting and dismounting describing the means of transportation, equipment for mounting and dismounting, possibility of heating application, measuring instruments, type and quantity of the lubricating material.

Prior to mounting the mechanics and specialists on mounting shall ensure that the bearing designation marked on the package corresponds to the designation specified in the assembly drawing. Thus the mechanics and specialists on mounting shall know the designation of all bearing symbols as standard as nonstandard.

All “MPZ” bearings shall be supplied in packages and treated with the preserving agent. This preserving agent shall not be removed before mounting as it is mixed with another lubricating material thus ensuring satisfactory lubrication of the bearing in the period of operation.

Directly before the mounting it is necessary to check the housing mounting surfaces (bores and end faces) and shafts (fitting surfaces and end faces) on the absence of dints, scratches, and deep marks from treatment, corrosion, burrs and dirt.

The shafts and housings surfaces conjugated with the bearings shall be thoroughly washed, cleaned, fried and lubricated with a thin layer of the lubricant. Channels for supplying the lubricant shall be blown and cleaned.

Mechanical treatment of components of the bearings is not allowed. Drilling out the bores for lubrication, mechanic treatment of the grooves for lubricating, chamfers etc. causes distortions of distribution of residual stress in the bearings rings that leads to the bearings malfunction. There is also a risk of cuttings and metal shavings penetration into the bearing.

Absolute purity is a significant factor that influences to a great extent the bearing treatment. Dust and moisture present great danger as even small particles penetrated into the bearing can destroy raceways. The area of assembling shall be clean, dry and free of working equipment. Cleaning with compressed air is not allowed.

All components of the bearing arrangement shall be thoroughly examined as for their sizes and forms. Non-compliance with accurate forms and sizes, roughness of the fitting surfaces lead to decreased efficiency of the bearing. Influence of such inaccuracies cannot always be evaluated and it may take a long time to find the reason of the bearing malfunction.

The shafts, for which the ratio of the length and the maximum diameter is more than 8, shall be checked for the axis straightness (absence of bending). It is practical to fulfill the examination when the shafts are rotating in the centers with the help of pointer instruments. Increase of eccentricity from section to section in the direction from the edge to the center points to the shaft bending.

It is necessary to check deviation and coincidence of axes of all fitting surfaces positioned on one axis for compliance with the norms specified in the technical documents.

When two bearings (radial ball, radial spherical and cylindrical) on one journal the difference between radial clearances shall not exceed 0.03 mm, and for the outside and inside diameter of the ring – no more than half of the tolerance range.

Fits made with respect of specific operating conditions in the cars, mechanisms and instruments are determined by the constructor.

The accepted efficiency of the bearing depends to a great extent on compliance of the fits with the assembly drawing of the unit.

The selection of the fit is determined by the machine operating conditions and design features of the bearing arrangement.

Rolling bearings are positioned on the shaft according to the scheme of the bores, and in the housing – according to the system of the shaft.

When the fit is determined it is necessary to stipulate the conditions in order to facilitate mounting and dismounting with absence of possibility to damage the components of the bearing arrangement.

Taking into account the fact that the friction torque tending to shift the bearing rings relative to fitting seats is much less then the friction torque on the friction surfaces it is advisable to avoid extreme large interferences.

For more efficient work of the bearing it is advisable that both of the rings have interference fit. However on practice it is not always possible as mounting and dismounting become difficult or even impossible in case of using the bearing as floating.

Interference fit causes expansion of the inner ring and compression of the outer ring that leads to decrease of the radial ring in the bearing. The amount of decrease of the radial clearance as a result of mounting shall be taken into consideration when selecting the interference fit.

Strength of joints in fits shall be sufficient so that the stationary rings do not move relative to their fitting seats.

As a rule the fits shall be as closer as harder the operation conditions are, that is the more its load, vibration range, changing speed and level of impact load is.

It is necessary to ensure the accurate forms of the raceways in the result of the interference fit. Generally it refers to the rotating inner ring the fit of which is made with greater interference as compared with non-rotating ring. When the ring bending stiffness is low and interference value is large deviations of the shaft form (housing bores) and fitting surface of the ring (especially out-of-roundness and cuttings of three edges) may transfer to the raceways distorting their form and causing the increased level of vibration and wear-out.

Interference fits prevent from cranking of the bearing rings on the fitting surfaces, crushing, breakdown and friction corrosion of the surfaces.

Cranking of the rings originally fixed as stable results from decrease of friction between the ring and fitting surface because of vibration, crushing of microroughness of the fitting surfaces under load as well as expansion of the housing while heating. This leads to decrease of rotation accuracy, imbalance, wear-out of the fitting surfaces and malfunctioning of the bearings.

For relatively small rotation frequencies of the loaded radial bearings and constant load in respect of its direction a small crank of the non-rotation ring about one turn in 24 hours is useful as it causes changing of the position of the bearing loading zone that leads to increase of its service life due to more even wear-out of the raceway of the rotating ring. In this case the rotating ring shall have loose fit that enables the possibility of its turning by hand in the unloaded conditions.

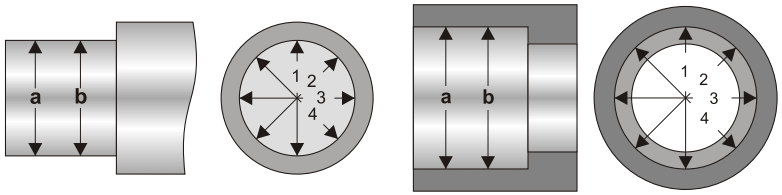
It is necessary to ensure accuracy of the bearing rings position in respect of the axis of rotation stipulated in general by the absence of distortions. Geometrical axes of the bearings rings in the result of mounting shall not significantly deviate in the direction from the axis of the shaft rotation.

The position of the rotating parts of the machines, mechanisms and instruments resulting from mounting in respect of the housing shall be stable in axial and radial directions in the course of the whole service life of the item.

Position of the rotating parts is determined by the initial clearances in the bearings, deformations in the places of contact, temperature deformations as well as stiffness of the components conjugated with the bearings and accuracy of mounting.

For the purpose of increasing the accuracy of the axial and radial clearances of the radial bearings sometimes it is enough to move axially one of the rings a little.

Measuring of the bearing fitting seat



Except for the cases specifically stipulated in the assembling drawing tolerance for cylindricity shall not exceed the half of the tolerance for diameter. Complete contact of the inner ring of the bearing on the tapered journal of the shaft requires precise correspondence of the fitting surfaces of the bearing and the shaft.

Reference rings serve for measuring of the tapered surfaces with the help of the simplest measuring devices.

Compliance of the shaft form is evaluated with the help of reference rings and paint. Incompliance of the shaft form shall be reworked till the reference ring is fully printed on the shaft form. The inner bearing ring shall not used as a reference ring.

Ensuring the compliance of the requirements to the fits is possible possible if the

requirements to roughness, size accuracy and fitting seats positions are met.

Ultimate deviations of the fitting diameter of the shaft and the housing bore shall correspond to the chosen accuracy of the fit.

Significant non-uniformity of the fits characterized by the difference of the maximum D_{max} and minimum D_{min} of interference and equal to the sum of tolerances for conjugated diameters of the bore d_A of the shaft d_B.

$$D_{max} - D_{min} = d_A + d_B$$

may turn out unacceptable for operation in the areas of extreme values of interferences and clearances. In this case the tolerance for interference is decreased due to selection and further development of the fitting seats of the shaft and housing (not violating the form accuracy).

Fitting surfaces for bearings and end face surfaces for the shaft fillets and the housings shall be treated well in order to avoid crushing and cut of microrough spots in the process of pressing and operation as well as corrosion.

Small values of the height of the microrough spots and their deformations allow simultaneous increasing of the accuracy of measuring the diameters with the help of point contact instruments.

Coincidence of axes of the fitting seats of the housing and the shaft in respect of the general axis shall correspond to the specified tolerances. Significant deviations of the coincidence of axes of the shaft and housing as well as their unfavorable combinations cause damages to the bearings and violate items assembling. The principle of mutual compensation of the radial run out according to which for the back support less accurate bearing is chosen, and the supports run out is positioned on one level and directed into one side used in mounting accurate shafts.

In the result of measuring the axial run out when the shaft or the housing components are rotating for 360° about axis the form of the shaft is revealed, as well as ridges or out-of-squareness to the axis (misalignment of the end face) out-of-flatness (incurvature or knob). In order to control flatness and the end faces of the shaft and housing fillets it is recommended to check it in individual cases with the help of master collection (visual inspection) or by the paint.

The fillet end face is an additional setting base to which the bearing rings are closely pressed with the help of fastening devices in order to increase stiffness of the bearing arrangements. Misalignment shifts the raceways thus increasing unevenness of the rolling element movement and creating additional pressure on separator connector dockets, its misalignment and crushing of the sockets. Quite often these events lead to destruction of the separator and jamming of the rolling elements by the fragments.

Accuracy of the end face fillet treatment is also connected with the necessity of sustaining the certain radius of rounding in the points of conjugation of end face and fitting surfaces (fillet radius) that shall be less than the radius of chamfer of the respective bearing ring.

Fitting surfaces shall have intake chamfers with small angle of taper to ensure smooth fit, decrease cut and eliminate microroughness.

The item design structure shall be adapted for ease assembling, accurate mounting and dismounting of the bearing arrangements: the height of the fillet shall be not less than the thickness of the bearing ring on the collars; longitudinal grooves adjacent to the fillets for puller legs shall be made on the shafts if necessary, in the housings – the bores for dismounting the outer rings; the housing bores shall not have ledges as far as possible.

Coefficient of the linear expansion of the material of the conjugated components shall not significantly differ in order to avoid increased interferences and clearances when the temperature of the bearing arrangement operation changes. To exclude this effect steel sleeves are places in silumin housings.

Before mounting of the bearing it is necessary to examine the compliance of the appearance, easiness of rotation, clearances, and requirements of the normative and technical documentation.

Visually the bearings of the open type shall be examined in respect of dints, contamination marks, corrosion, and complete set of clenches, density of their installation or other connecting elements, complete set of the rolling elements, damages of the cage.

The bearings of the closed type shall be checked for damages of the seals or shields.

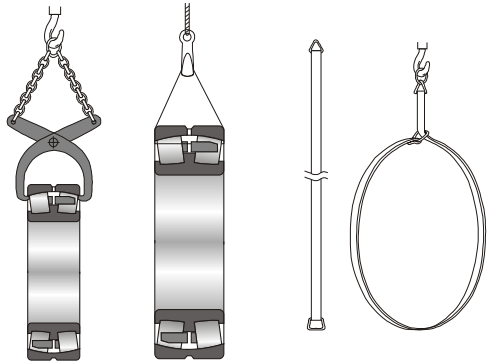
Simplicity of rotation of the bearing previously lubricated is checked by rotating the outer ring by hand. The bearing is being held by the inner ring in the horizontal position during the examination. The rings shall be rotated smoothly without rapid breakage. Under the conditions of the advanced requirements to the bearing the easiness of rotation is checked with the help of the instruments, for example, by means of retardation method.

In order to check radial clearance one of the bearing rings is fixed in the horizontal position of the axis and the clearance is determined with the

help of indicator by shifting the free ring under the pressure of the measuring force in radial direction in two diametrical opposite directions. The difference of the measured values corresponds to the radial clearance. Three measurements are taken by turning the free ring relative to the initial position of the bearing axis. Analogically the axial end clearance is measured but with the vertical position of the bearing axis. Fixing one of the rings the other is moved in the axial direction to the extreme two positions under the influence of measuring force and the difference of the indicator values is fixed.

Radial clearances in double-row spherical radial roller bearings and bearings with cylindrical rollers without flanges on the outer rings with diameter of the fitting bore over 60 mm may be measured with the help of the probe.

For the purpose of transportation of the bearings it is rational to use different devices: spring-loaded grippers, loops of flexible wire and ribbon. In order not to damage the surface of the bearings the ends of the gripping devices shall be wrapped in fabric.



Bearing mounting

Mounting of the bearings with interference require significant efforts that often leads to damages of the bearings and shifts. Besides operations on mounting are connected with idle time of the equipment. This peculiarity as well as others shall be taken into consideration while selecting a particular scheme of mounting and dismounting.

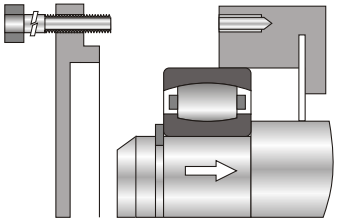
Mounting method is determined by the standard sizes of the bearing and conditions of mounting. There are mechanical, heat and hydraulic methods of mounting.

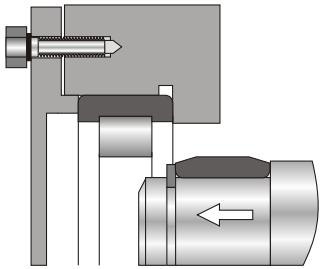
In all cases of the bearing operation it is prohibited to hammer the rings, rolling elements and cage of the bearing.

When one-piece bearings are mounted the pressing effort shall be transferred only through the pressuring ring which for this reason will be mounted first –through the inner ring while mounting on the shaft and through outer ring – while mounting on the housing.

If the bearing is simultaneously mounted on the shaft or in the housing, then the efforts are transferred on the end faces of the both rings. It is prohibited to perform mounting in such a way that the effort is transferred from one ring on to the other through the rolling elements.

Mounting of the two-piece bearings is easier as the both rings may be mounted separately. A slight turn of the shaft will help to avoid scratching.





Mechanical mounting

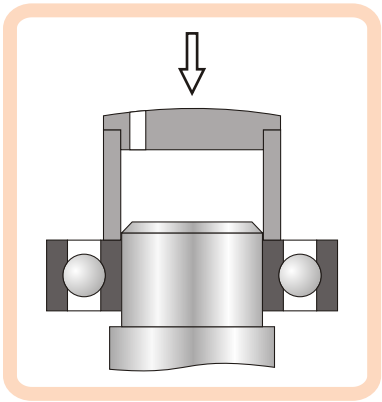
Mounting of the bearings with cylindrical bores

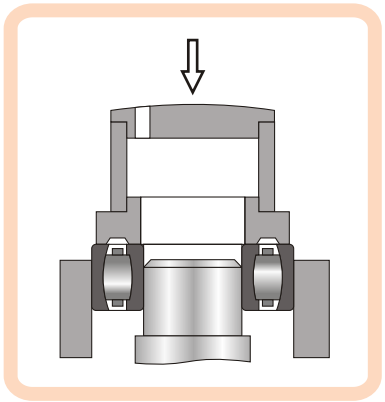
The bearings with the bores about 80 mm can be mounted without heat. It is recommended to use hydraulic press. If the press is not available it is possible to strike lightly the ring through the sleeve. It is not permitted to use mounting efforts towards cage.

The most practical methods of mounting are those that ensure simultaneous and even pressure on the whole circumference of the mounted ring. These methods do not cause misalignment of the mounted ring.

In order to implement the following methods sleeves made of soft metal are used the diameter of which is a little larger than the diameter of the ring bore, and the outside diameter is a little smaller than the outside diameter of the ring. On the free end of the sleeve it is necessary to mount blind plug with spherical outside surface to which the mounting efforts are administered.

If self-adjusting bearing is pressed on the shaft and inserted in the housing simultaneously the pressing disc shall support the outer ring. At that misalignment of the outer ring in respect of the housing bore is excluded.

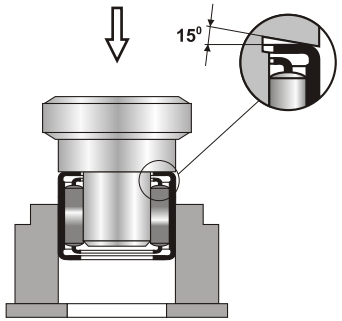


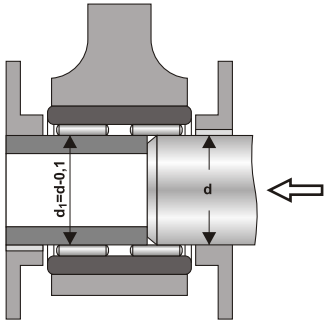


Mounting of needle bearings

The principles that are used for cylindrical roller bearings are applied in respect of the needle bearings with massive rings. The bearings mounted in the groups shall have clearances of one tolerance group for more even load distribution.

In order to facilitate mounting of the one ring needle bearings without cage the raceways of the outer or inner ring of the bearing depending on the support design shall be lubricated, and the needles are glued to that layer of lubricant. The bearing arrangement is assembled with the help of mounting jig with the outside diameter 0.1 – 0.3 mm less than the bearing size.

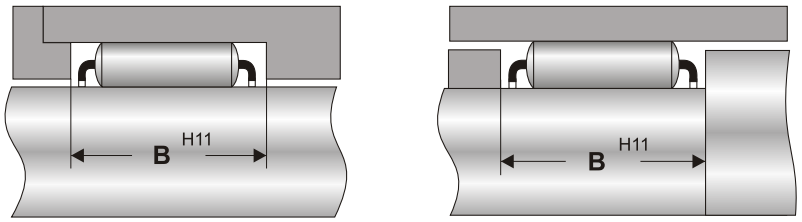




Ringless needle bearings have to be mounted between the shaft and the housing. In order to avoid scoring on raceways and rollers ringless needle bearings must be rotated slightly during installation and left with no load.

Ringless needle bearings can be fixed in axial direction within the housing or on the shaft. After clearance H11 protects the bearing against jamming.

Radial clearance of ringless needle bearing depends on machining tolerance for hardened and grinded raceways on the shaft and within the housing. Group mounted ringless needle bearings have to be installed with equal tolerance group rollers.



Mounting of Bearings with Tapered Bore

Bearings with tapered bore shall be mounted on tapered journal or on adapter or withdrawal sleeve if cylindrical shaft is used.

Oil film layer applied on the bearing bore, shaft and sleeve shall be thin enough. Too thick layer will reduce friction and consequently decrease pressing force but during further operation lubrication will be pressed out from the shaft under the influence of decreasing interference fit, ring and sleeve will hinge resulting in corrosion of bearing surface.

Inner ring expands and radial clearance accordingly decreases during insertion of bearing on taper journal. Therefore variation value of radial clearance may be used to estimate carrying out mounting with appropriate tension.

Radial clearance decrease shall be determined by radial clearance difference prior and after mounting. Radial clearance shall be continually checked during mounting. Specified amount of radial clearance decrease is determined in accordance with required interference fit.

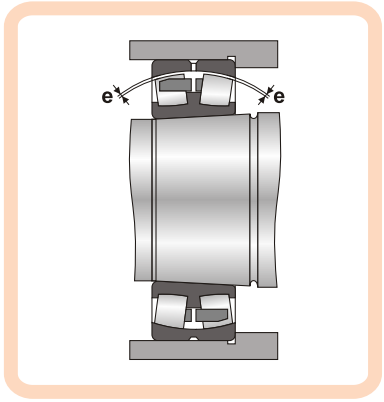
Required interference fit may be also determined by bearing displacement value towards shaft during insertion.

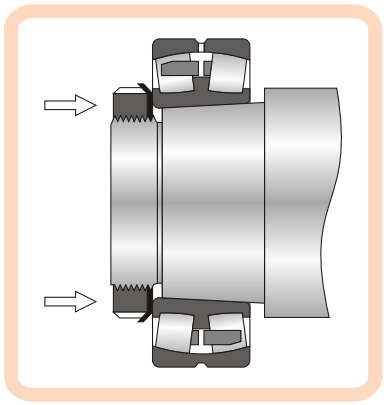
Axial displacement to radial clearance volume ratio for taper 1:2 shall be approximately 15:1. The ration includes influence of interference fits on radial clearance decrease.

Radial clearance shall be measured with clearance gages. Radial clearance of spherical roller bearings shall be measured on two rows simultaneously. Identity of clearance amount measured on two rows characterizes lack of axial displacement of inner ring towards outer ring axis. Leveling on rings end faces exclusively does not ensure lack of axial displacement resulted from ring width tolerances.

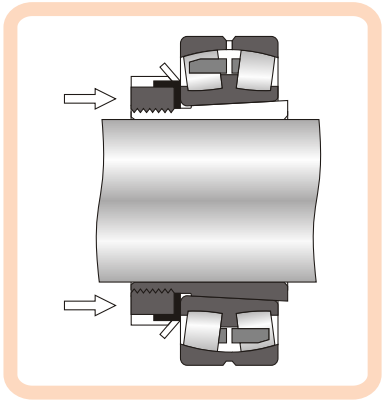
Roller cylindrical bearings provide separate ring mounting. Extend of inner ring may be estimated with micrometer.

Small and middle size bearings may be mounted on taper journal with nut on the shaft. Required insertion force is created by tightening of slotted nut with flare nut wrench.

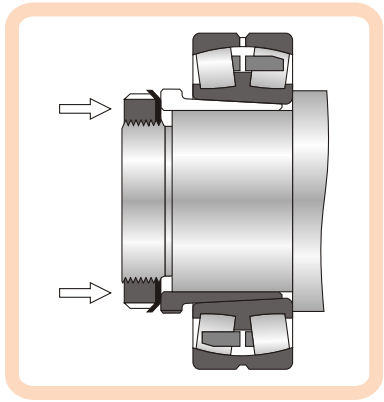




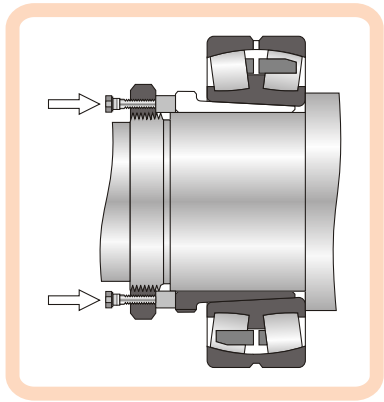
Nut on adapter sleeve and flare nut wrench may be used to mount bearing on adapter sleeve.



Nut on shaft may be also used to insert small size adapter sleeves between the shaft and bearing inner ring.



If nut tightening requires significant force, mounting may be simplified by mounting nut with pressure bolts.

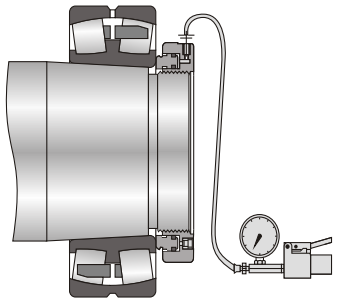


To avoid distortion of bearing and sleeve the nut shall be tighten regularly to provide support for sleeve end faces. Pressure bolts from hardened steel shall be equally located on mounting nut and diagonally tightened. Amount of bolts depends on required tightening force.

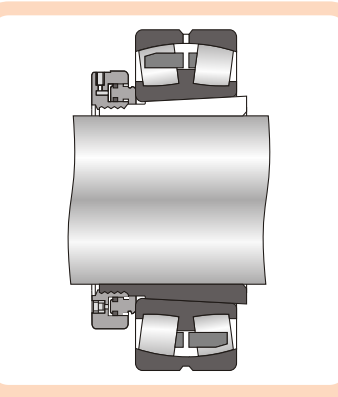
As far as taper connection of bearing and sleeve is self-locked, mounting nut may be removed after tightening had finished and replaced by lock nut. Such method can be used also to mount bearings on adopter sleeve or immediately on taper journal.

Hydraulic equipment is appropriate to be used to mount large bearings.

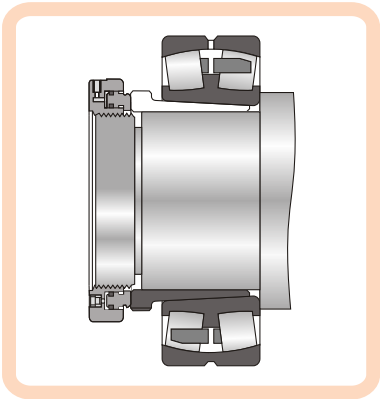
Bearing may be mounted immediately on taper journal by moving piston of hydraulic nut screwed on the shaft.



Bearings on adapter sleeve may be mounted by moving piston of hydraulic nut screwed on the shaft.



Bearings on withdrawal sleeve may be mounted by insertion of sleeve with piston of hydraulic nut screwed on the shaft.



Thermal Mounting

To mount open type bearings with cylindrical bore on shaft with tension, such bearing is appropriate to be preliminary heated.

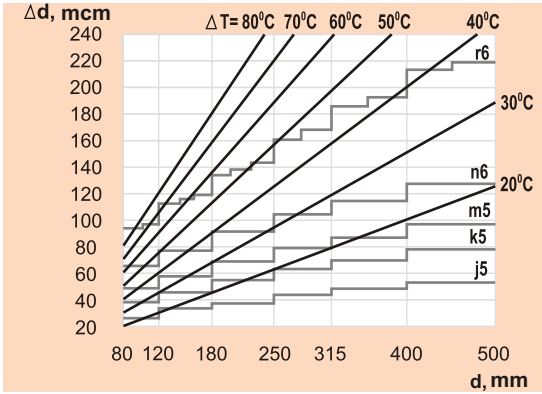
Heating temperature is 80-100°Ñ.

Bearing heating temperature shall be controlled. If the temperature exceeds 120°Ñ, metal structure may be changed which will result in decrease of hardness and dimensional consistency.

Heating of bearings with direct flame is prohibited.

Bearing with nylon cages shall have the same heating interval.

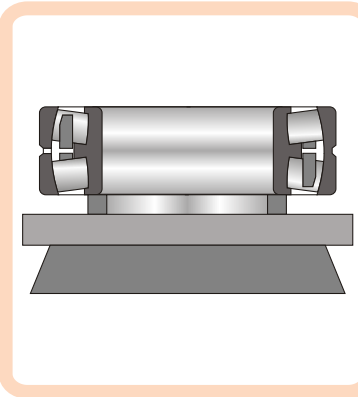
Bearings with shields and seals may be heated under induction heating method to temperature not above 80°Ñ.



Thermal expansion of bearing internal ring during heating for interference fit

Bearings may be heated with the electric heater which has thermostat to control heating. The bearing shall be regularly turned over to provide uniform heating.

If electric heater temperature is no more than 120°Ñ, nylon cage shall not be in contact with the electric heater. In this case intermediate ring shall be mounted between heater and inner ring.



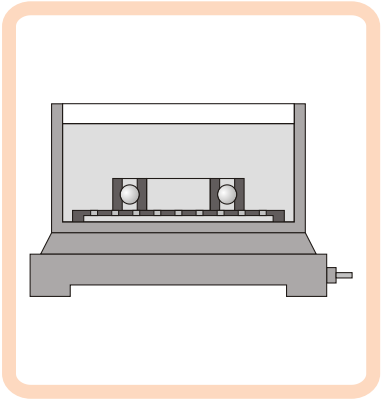
To provide uniform heating of the bearings they shall be dipped in oil bath with pure mineral oil with high flash temperature heated up to 80-90°Ñ and hold in the bath 15-20 min depending on their size. The bearing shall not be in immediate contact with heater. Wide-mesh screen shall be used to protect bearing from nonuniform heating and contaminations located on the bottom of the bath.

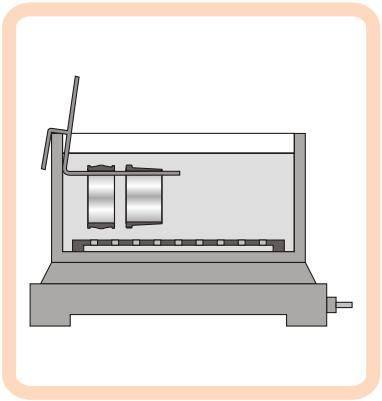
Bearings may be also hanged in the bath.

After bearings were taken out of bath, mineral oil shall be drained away. Mounting surfaces shall be rubbed dry.

Mounting of heated bearings requires some skills. Heated bearing is mounted on shaft and some force shall be applied to mount the bearing on its place. Bearing side with manufacturer mark shall be outside. Negligible rotation of mating parts simplifies mounting. Thermal protective gloves or unworn fabric pieces, except for cotton waste products, are appropriate to be used.

Method of bearings heating in electric heater with thermostat is safer heating method. Careful work excludes bearing contaminating. But heating of bearings with hot air requires considerably more time than heating with oil bath.





Use of heating devices is the quickest, safest and the most environmentally friendly heating method. Induction heaters are used for all kinds of bearings including cartridge type bearings with inserted lubrication.

Induction heaters are used to heat bearings with bore diameter no less than 20 mm.

Circular induction heaters are used to heat inner rings of roller tapered and needle bearings. Circular induction heaters are appropriate to be used to dismantle railway axle bearing and roll mill bearings which require repeated mounting and remounting on shaft. As far as heating is a rapid process, amount of heat transmitted to the shaft is minimized which provides shaft quality.

When induction heaters are used during mounting, possibility of rings overheating shall be eliminated. In heaters manuals shall be specified duration of heating and described use of such heaters for magnetic neutralization after heating is complete.

If bearings are interference fitted in housing, the housing shall be heated in the majority of cases. It may cause some problems for large size and weight bearings. In such cases it is recommended to cool the bearing with liquid nitrogen (-160°Ñ) or dry ice prior to the mounting. Cooling temperature shall not exceed -50°Ñ. Water condensate shall be completely removed by oil washing to prevent corrosion.

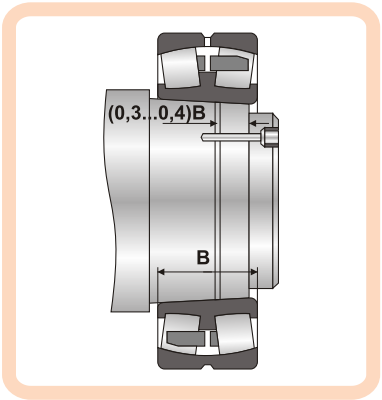
Hydraulic Mounting

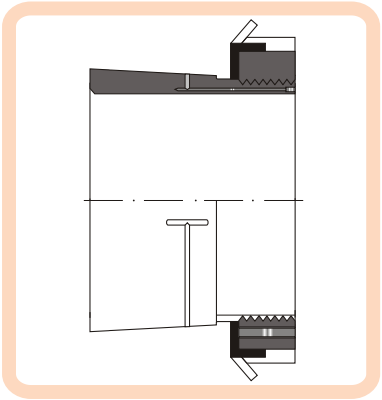
Hydraulic spacer providing correspondence quality of bearing mounting, absence of any damages of mounting surfaces and high productivity is the most appropriate to be used to mount large size bearings. This method is the most appropriate one to mount bearings with tapered bore with diameter of 120-150 mm.

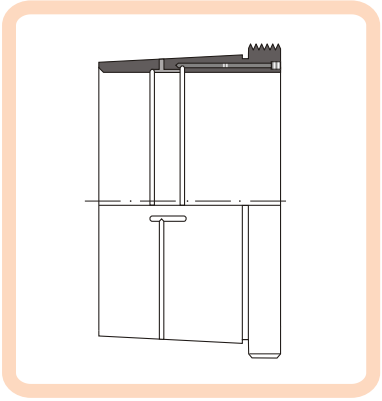
Hydraulic spacer is provided by the positive supply of oil between mating surfaces while mounting bearings are mounted according to hydraulic mounting methods. Use of oil with corrosion-preventive additives prevents fretting corrosion.

Oil-delivery grooves and tapped holes for pump connection shall be provided during producing shafts and sleeves.

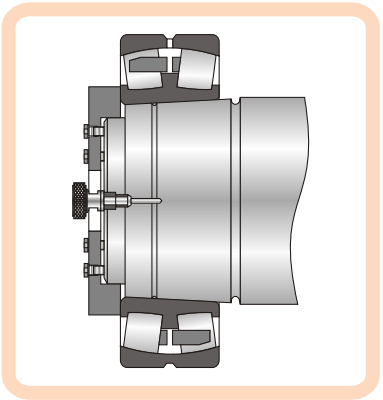
Viscosity of oil used for mounting shall not exceed 75 cSt at 20°Ñ.



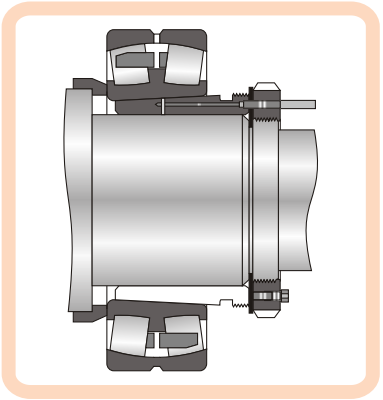




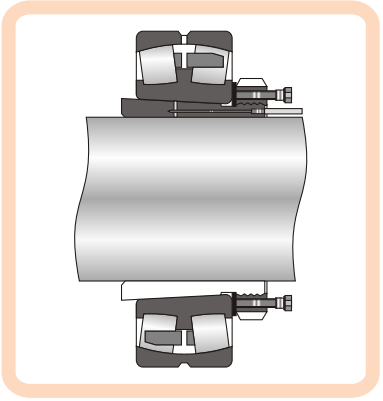
Bearing shall be mounted immediately on tapered journal by positive supply of pressurized oil between mating surfaces when bolt tightening force has an effect on bearing mowing it through intermediate part.



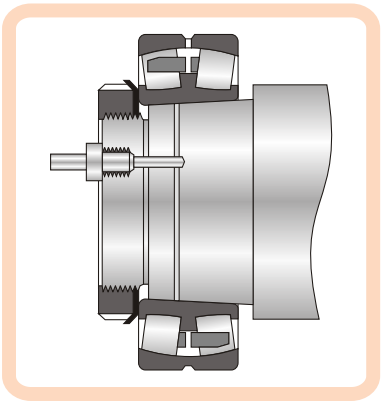
During insertion of withdrawal sleeve and mounting of bearing on adapter sleeve, bolt tightening force shall be transmitted through intermediate washer.



Bearing maybe also installed on tapered journal or on withdrawal sleeve immediately by positive supply of oil between mating surfaces with simultaneous use of slotted or hydraulic nut which has an effect on bearing mounting.



Nut tightening force has an effect on axial bearing displacement when using slotted nut. Positive supply of oil to mating surfaces of shaft and bearing simplifies screwing nut during its mounting.

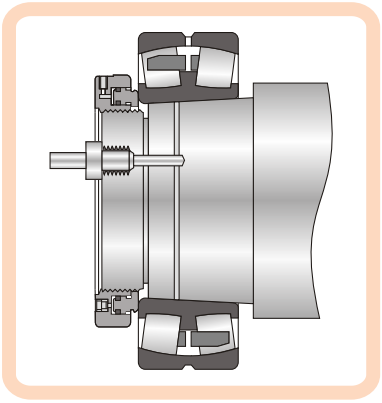


Use of hydraulic nut is the most effective. Hydraulic nut shall be threaded on shaft. Nut piston shall be mounted with stop on inner ring. The following positive supply of oil into the nut and mating surfaces of shaft and bearing releases the shaft providing bearing displacement towards appropriate location.

The nut shall be removed when mounting is completed and bearing shall be fixed on the shaft.

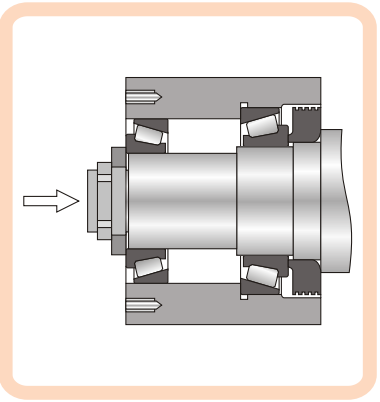
The bearing shall not be kept under oil pressure when radial clearance is changing.

After oil pressure reduced, the bearing shall be held by axial load within 10-30 min until all oil will be removed.



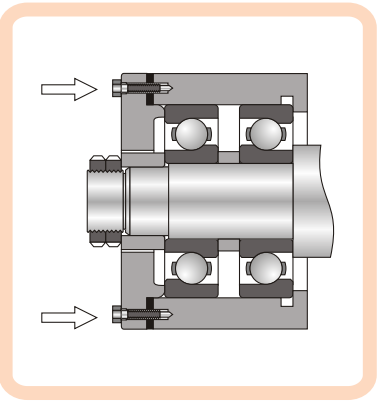
Mounting quality control

During bearing installation (especially bearings under axial forces) close and correct contact of bearing rings faces and fillet faces shall be verified, if possible, with clearance gage with thickness no less than 0.03 mm or with light slit. Similar test shall be applied to opposite bearing faces and faces holding them down towards axial direction.



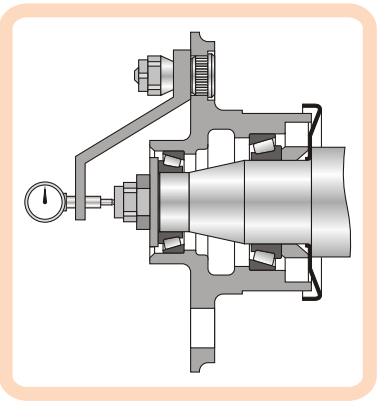
Correct mutual bracing of bearings in one shaft support shall be verified. The shaft shall be easily, free and steady rotated manually.

Axial clearance and tension in angular contact bearings shall be controlled by axial displacement of outer and inner rings with nuts, gage blocks and spacer sleeves.



To check axial clearance in mounted arrangement, plunger of the dial gage on rigid prop shall be advanced to the face of outlet end. Axial clearance shall be determined under difference of dial gage readings when shaft is in end axial points. Shaft shall be moved in axial direction until the full contact of rolling elements and rolling surface of appropriate outer ring is reached.

Bearings subject to vibration at low speed shall be mounted without clearance with light tension to exclude depletion of raceways resulted from brinelling.



To increase rotating accuracy particularly in high-speed arrangements, for example in grinding electrical spindles, clearances in angular contact bearings shall be chosen to provide stable tension on bearings. It is provided by applying axial force towards rotating ring of bearing through balance spring. In this case rolling elements are correctly fixed on raceways.

To prevent "biting" of large size bearings during mounting or operating prior to mounting of such bearings into two-piece casing, bore surfaces of connection may be aligned. Full contact of large size bearings and mounting seat in two-piece casing shall be checked with clearance gage and painting (painting print shall not exceed 75% of total mounting surface). Density and contact uniformity of cover base on two-piece casing shall be checked with clearance gage (clearance shall not exceed 0.03-0.05 mm).

Clearances between rotating and fixed parts of assembly shall be checked.

Particular attention shall be paid to clearances between faces of fixed parts and cage faces which in some circumstances may crush over surface of ring faces.

Grooves for lubrication supply in casing with lubrication holes in outer bearing rings shall be also checked.

After mounting is completed relative axial displacement of outer and inner ring rings of bearings with cylindrical rollers without flanges shall be checked. It shall not exceed 0.5-1.5 mm for bearings with short rollers and 1-2 mm for bearings with long rollers (large values are specified for large size bearings).

After assembly operations is completed and bearing arrangements are lubricated as provided by the technical documentation, quality of bearing mounting shall be checked by test runs at low speed and no load. For this purpose nose of rotating bearings shall be monitored with stethoscope or tubing.

Correctly mounted and well lubricated bearings shall operate with quiet, continuous and steady noise.

Hissing noise results from insufficient amount of lubrication and friction between contacting arrangement parts.

Clear metal sound may results from too close clearance in bearing.

Steady vibrating noise results from foreign particles in raceway of outer ring.

Occasional noise at constant rotation speed results from damage of rolling elements.

Noise appeared at rotation frequency change may result from damage of rings appeared as a result of mounting and fatigue chipping of rolling surfaces.

Hammering noise may result from bearing contamination.

Irregular loud noise may result from extensive damage of bearing.

Arrangement features and operating nose nature shall be taking into account while monitoring noise of bearing as far as abnormal noise may, for example, result from incorrectly produced gear drives, couplings and other or unfitted parts. Therefore final conclusion on abnormal noise reasons may be made only after detailed check and monitoring of operation of all parts of the assembly.

Temperature of bearing arrangement is another quality and stability index.

Bearing temperature at normal operating conditions shall not exceed ambient temperature more than in 30°Ñ.

Temperature of correctly mounted bearing shall not exceed 60-70°Ñ during their test runs without external heaters. The temperature shall be decreased after 2-3 operational hours especially when semisolid lubrication is in use when excess lubrication is mixed displaced from the bearing.

High temperature may results from close bearing clearance or extremely high tension, shortage of lubrication frictional torque increased as a result of depletion of bearing working surfaces or mutual distortion of rings. Besides, specified reasons may be combined.

It is necessary to know that bearing temperature is some decreased within 1-2 days after lubrication (as well as after re-lubrication).

Dismounting of Bearings

Bearing shall be dismounted in case of improper mounting as well as to replace disabled parts of bearing arrangement.

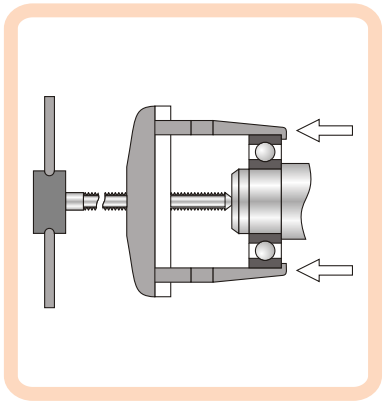
Parts appropriate for further use may be easily damaged during dismounting. Any faults are also may take place during remounting. That is why bearing arrangements shall be dismounted only if there are essential reasons for such dismounting and all tools are provided and mounting (dismounting) technologies shall be specified.

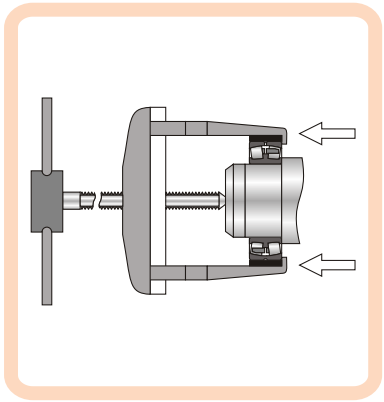
Usually, force required for dismounting exceeds force required for mounting because in course of time engagement of mating surfaces increases and even if bearings were mounted with clearance fretting corrosion may considerably complicate dismounting environment.

Dismounting shall be carried out with special tools and equipment.

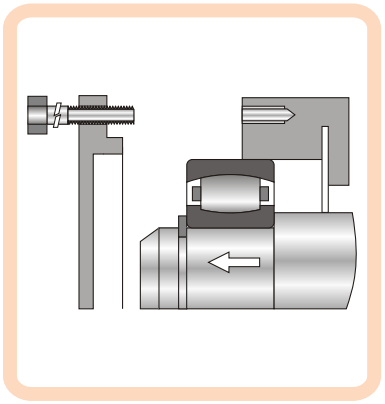
If bearing is assumed to be re-used, dismounting force shall not be transmitted through rolling element.

If dismounting of rolling element is necessary it is recommended to mount stainless steel sleeve on the outer ring with wall thickness ? from cross-section height of bearing. If bearing will be re-used dismounting shall be carried out by rotating grips when puller screw is fixed.

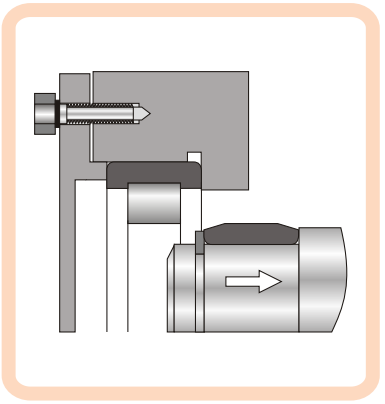




When dismounting one-piece sleeve bearings, clearance fit shall be demounted primarily.



Rings of two-piece bearing may be demounted separately.

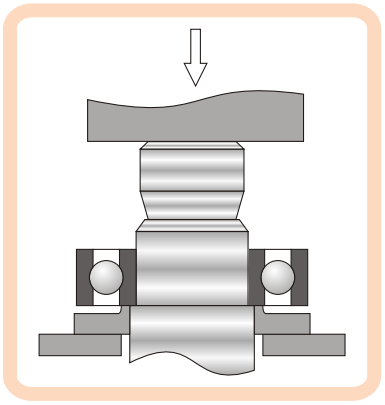


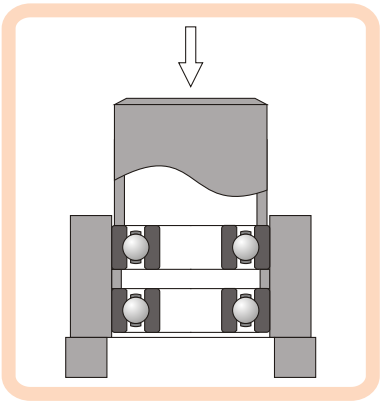
Mechanical Dismounting

Dismounting of bearings with cylindrical bore

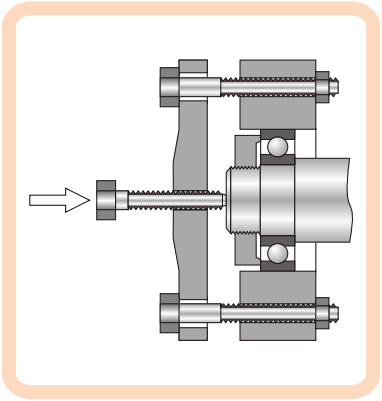
Small size bearings are usually dismounted with help of mechanical remover.

Bearings mounted with tension immediately on journal or in housing may be preferable dismounted with manual or hydraulic press. In this case dismounting force is transmitted to the bearing ring which was mounted with tension.

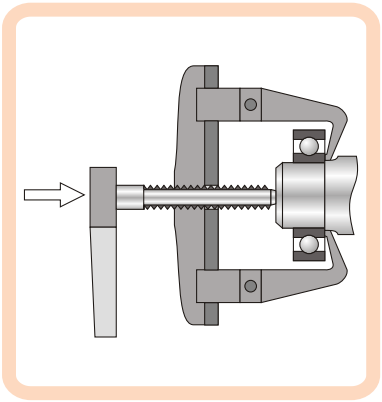




Device mounted on housing through holes provided for cover mounting may be used to dismount bearing arrangement. Dismounting force is transmitted through special nut to outer bearing ring pressing it and shaft out of housing.



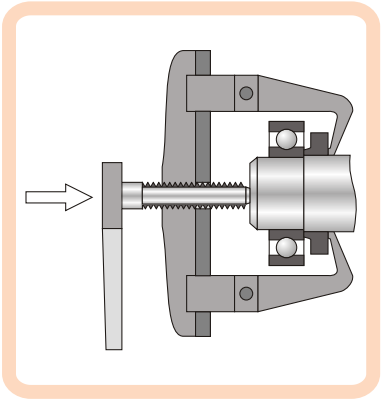
Bearing dismounting will be significantly simplified if shaft has caves for puller grip.

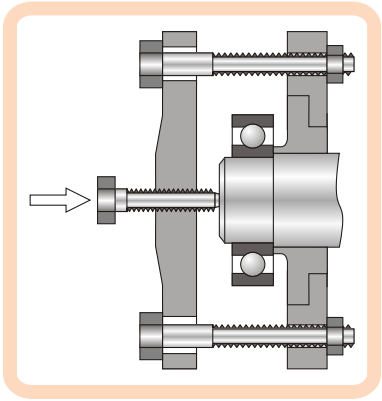


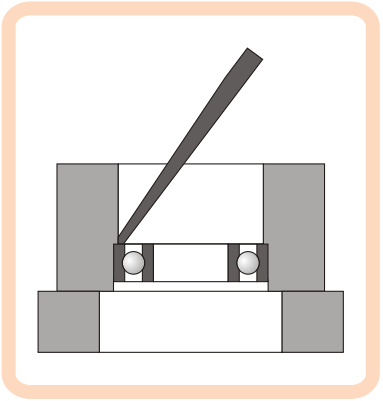
If puller grips fall out short of the face of inner bearing ring, dismounting force may be transmitted through neighboring part.

If reverse side of bearing has clearance, pullers connected with various auxiliary two-piece parts such as tightening semi-rings, brackets and ring clamps shall be used.

If bearing is thrust against fillet such bearing may be dismounted from housing with help of hammer and driftpin made from soft metal. All end faces of bearing surface shall be careful tapped.







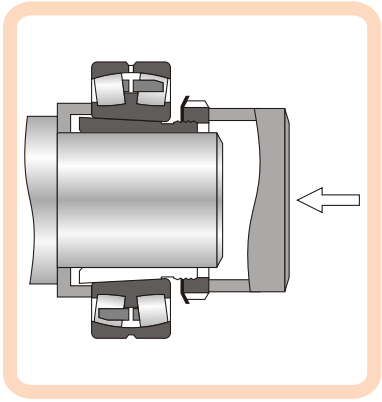
Dismounting of bearings with tapered bore

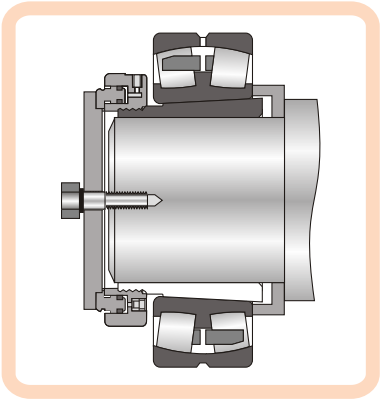
To dismount small size bearings mounted immediately on tapered journal or adapter sleeve lock nut shall be unlocked and released on several turns and than bearing shall be removed from adapter sleeve or shaft by tapping with hammer and driftpin made from soft metal or preferably with part of tubing.

If press is used instead of hummer, lock nut of adapter sleeve shall be used as a support.

If bearing adapter sleeve is mounted on the shaft end it may be dismounted with carrier sleeve.

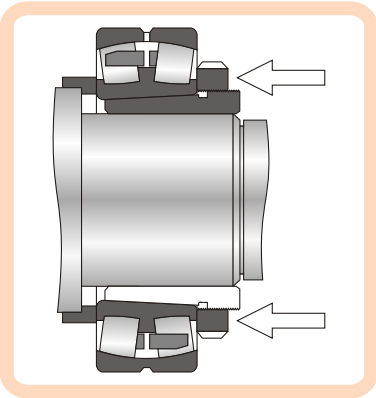
Bearings on adapter sleeve may be also dismounted with help of hydraulic nut.

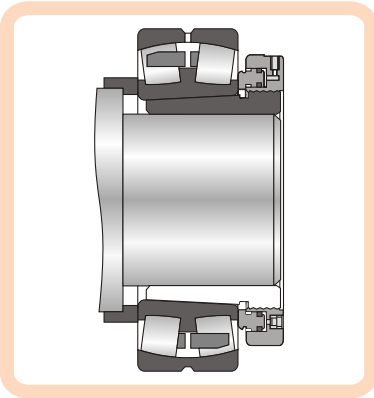




Bearings on withdrawal sleeve may be dismounted with help of slotted nut screwed with spanner wrench on sleeve thread.

If hydraulic nut is used, piston shall press on inner bearing ring displacing withdrawal sleeve in such a way that tension is eliminated and bearing may be easily dismounted.

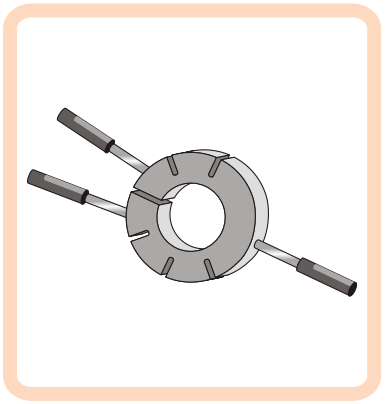


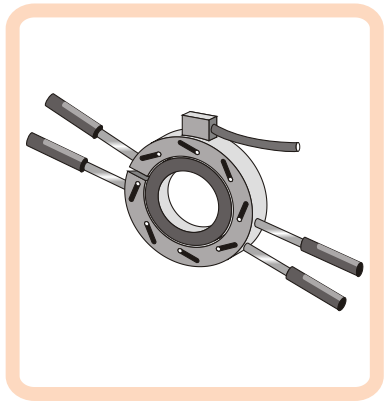


Thermal Dismounting

Heating rings are used to dismount inner rings of roller cylindrical and needle bearings without flanges or with one flange. Solid heating rings shall be produced from light alloy and have radial slots. Handles from isolation material provide easy dismounting.

Heating ring shall be heated on electric heater up to 200-300°Ñ than placed on dismounting ring and tightened with handles. Heat is quickly transmitted from heating ring to dismounting ring. When interference fit of dismounted ring and shaft is released both rings shall be tightened simultaneous. Ring dismounting in such a way shall be quickly removed from heating ring to prevent overheating. Heating rings are reasonable to be used for small and middle size inner bearing rings. Every size of bearing requires use of heating ring of particular size.



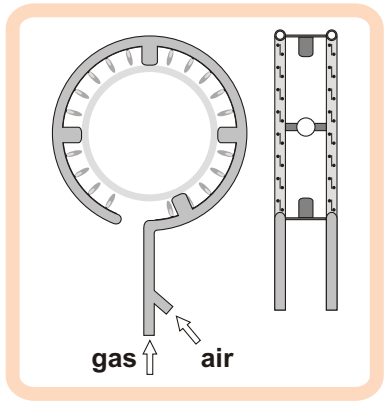


If oil supply grooves are not provided on shaft and inductive heaters cannot be used, inner rings of large size two-piece bearings may be dismounted with help of ring gas heater.

However, welding guns shall be used in no circumstances because it may results in possible overheating and nonuniform heating which may affect uniformity, high hardness and dimensional consistency of dismounting ring.

Gar heaters operating on a mixture of natural gas and air proved themselves as admissible solution to dismount bearings in difficult conditions. Operating principle of such heaters is based on forced supply of combustion gas and air and operated on method of swirling mixture of gas in nozzle output with ring flame in the form of conical pattern. Such heaters are practically safe in service and easy operated.

Nozzles of gas heater shall be located with distance 40-50 mm from ring surface. Standard nozzle diameter is 2 mm. Nozzles are located in staggered order with distance 20-40 mm from each other. Temperature and length of flame are regulated by air supply. Heater shall be held concentric towards ring and slowly and steady moved in axial direction.



Sometimes heavy contact corrosion or cold welding may result in impossibility to dismount rings without their destruction. In such cases ring shall be heated with welding gun up to 350°Ñ and watered. Safety measures shall be taken and working area shall be fenced to prevent accidents and injures resulted from quick break of ring.

Herewith, it is necessary to know that fluoride fibers which may content in lubrication oil or in sealing material at 300°Ñ evaporate vapor and gases which are hurtful to the health. Therefore, it is necessary to insure absence of fluoride fibers and to take necessary safety measures if there are any fluoride fibers.

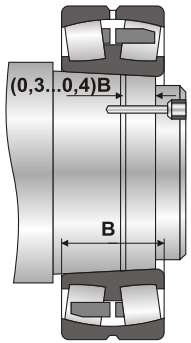
Hydraulic dismounting

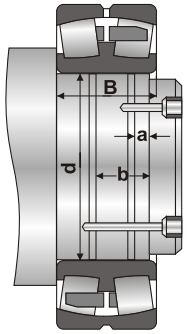
Hydraulic dismounting is widely used to dismount bearings with tapered and cylinder bore. In both cases oil supply channels, grooves and tapped holes shall be provided to connect hydraulic pump.

Location of grooves for cylindrical journey has the following dimensions:

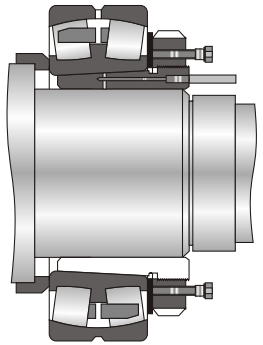
$a \approx \sqrt{d}$ at B<80 мм

$a \approx \sqrt{d}$, $b \approx$ (0,5-0,6)B at B>80 мм

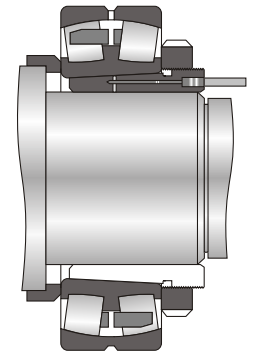




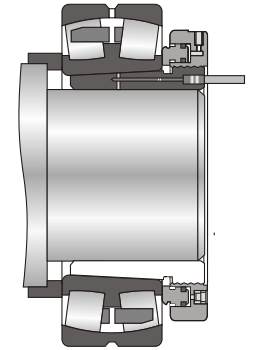
If bearing dismounting is difficult it may be simplified by use of pressure bolts. Such bolts shall affect bearings through intermediate washer.



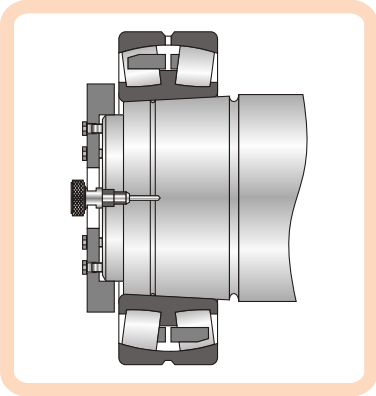
Hydraulic dismounting on withdrawal sleeve may be simplified by use of tightening slotted nut with hummer slugging wrench. Thread of withdrawal sleeve and end face of bearing shall be lubricated.

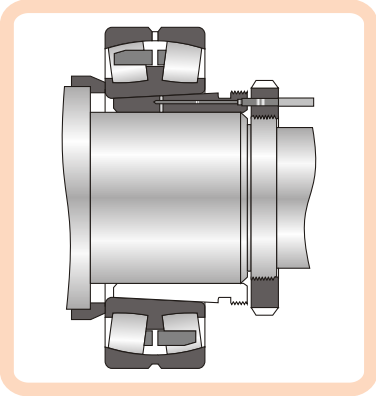


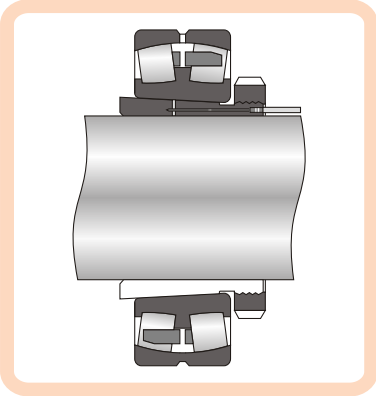
Dismounting of beatings on withdrawal sleeve is simplified by use of hydraulic nut with simultaneous oil supply to mating surfaces of bearing and sleeves.



Bearings with tapered bore shall be dismounted by positive supply of oil to mating surfaces. Mating surfaces are separated with sudden separation. Amount displacement of bearing and withdrawal sleeve at separation shall be limited.







Bearing Storage

Corrosion-proofing and package of bearings to protect bearings against corrosion shall be held under technical documentation of manufacturer on conservation and packing of bearings. Storage terms depend on corrosion-proofing method and package.

Bearing storage with care considerably determines fault-free operation of such bearings in machine parts. That is why storage shall meet requirements specifications of high quality bearing storage.

Insulated area (receiving room) shall be provided for motor vehicles entrance and bearing discharge. Boxes with bearings shall be stored in receiving room within 1-2 days to provide temperature equalization.

Bearings with outer diameter up to 300 mm are recommended to be stored on shelves. Bearings with large diameter are recommended to be stored in boxes.

Bearings wrapped with tape shall be stored in cages and boxes in prone position.

Distance between shelves and external walls shall be no less than 75 cm.

Stockpile height shall not exceed 2 m.

Distance between double bow rows shall provide approach for electric truck.

Approach to extra large size boxes shall be provided from two opposite sides.

Bearings shall be stored in such a way to provide bearings with more extended storage period to be distributed fro the storage. It will decrease scope of work and corrosion reproofing expenses.

Storage of bearings in package protects them from contaminations and corrosion. Bearings may be unpacked only in places prepared for inspection (check) or mounting immediately before operation.

Bearings shall be oiled with special corrosion inhibiting oil (preservative agent). Such oil may be used with industrial lubrications for rolling element bearings.

Bearings package protects them from negative influence of environmental factors.

Air temperature and humidity shall be controlled during storage. Bearings shall be stored in dry vibration-free place with constant air temperature and humidity. Air temperature range is +6 to 25°Ñ, short duration increases to 30°Ñ at daily temperature difference no more than 8°Ñ. Relative air humidity shall not exceed 65%.

During the storage bearings shall not be affected by corrosive environment such as gases, vapors or airborn acids, basic solutions and salts. Direct sun shall be also avoided.

Adherence to appropriate storage conditions provides safety of manufacturer corrosion proofed bearings within 5 years.

Bearings shall be selectively checked once per year. Extraordinary checks may be carried out in case of incidental damage of package, ingress of moisture, open air storage etc.

Inspection and corrosion proofing shall be carried out in insulated area.

If any corrosion is be found, bearings shall be corrosion reproofed on JSC "MBP" which shall be carried out as of the following:

- washing off previous corrosion proofing;
- removing corrosion by etching;
- applying new coating of corrosion proofing;
- packing bearings.

If bearing is contaminated but not corroded corrosion reproofing shall be carried out without etching.

If during selective check any corrosion of bearings was found (0.5% from total amount of bearings stored in different places), all bearings from bearings from checked batch shall be corrosion reproofed.

Previous corrosion proofing may be removed by washing bearings in gasoline (kerosine). But the most effective method of corrosion proofing remove is boiling of bearings in bath with water soap solution (90-110°Ñ) during 5-10 min including heating-up which takes 2-3 min. Bearing shall be briefly dipped in the bath three-five times followed by hanging on bearings to allow oil to run it off. After cooling bearings shall be washed with gasoline with 5-10% of light mineral oil and rub with tissue.

To apply new protective lubrication layer, bearing shell be dipped in bath with solution inhibited with corrosion reproof oil such as industrial oil È-20À GOST 20799 and 2-4% of MSDA inhibitor under technical specification 6-02-834. Bearings shall be hanged on hooks or in grid loaders and dipped in the bath two-three times during 30-60 sec and then oil shall be allowed to run off.

Bearings shall be packed in corrosion resistant paper under GOST 16295. Bearing shall not be touched during packing to prevent their rapid corrosion.

Corrosion may be removed from nonworking surfaces of bearings by etching only if all parts of bearing are made of steel. Washed bearings are degreased in solution including 10 g of caustic soda, 30 g of calcined soda and 1 l of water (within 5 min, solution temperature is 75-95°Ñ), than washed in hot flowing (80-90°Ñ) and dipped into solution of 150 g chromic anhydride, 85 g of phosphoric acid and 1 l of water (solution temperature is 80-90°Ñ, curing 26-60 min). After corrosion removed, bearings shall be washed in flowing water and corrosion proofing shall be applied as described above.

If specified storage period is exceeded bearings shall be checked for corrosion and availability for further use.

Storage period of bearings with shields and two-sided seals is limited by storage period of lubrication applied.

Main reasons of low working capacity of bearings

Factors which influence working capacity of bearings include the followings: load rate, load direction (radial, axial, combined); rotating frequency; bearing size; working medium (temperature, contaminations); lubrication (type and method); type and condition of seals; shaft aligning; mounting and dismounting technology; fit on shaft and in housing; rotating accuracy. Specified factors shall be checked if there are any difficulties to determine and remove cause of failure.

Lubrication shall be primarily checked. Improper application of lubrications is frequent because of a great deal of lubrications available.

Incompatible lubrications result in many bearing damages. To avoid use of incompatible lubrications requirements on type and amount of lubrications specified in operating manual shall be met. Specified requirement shall be met not only for viscous but for liquid lubrications too.

If lubrication amount is less than specified volume it results in risk of metal-to-metal contact. Amount of lubrication exceeding specified volume results in friction and heat release looses (excessive pushing of lubrication in bearing cavities).

In addition to level of liquid lubrication seal correctness of bearing arrangement shall be checked. Damaged seals are often results in leakage of lubrication which results premature depletion and bearing to be replaced.

Decrease of operating characteristics of lubrication results from contamination very often. Dirt, grains of sand and water are the most widespread contaminations. Acid and other corrosive agents may dissolve oil film which will decrease viscosity as well as corrode bearing surfaces which will destroy oil field and erode resulting in creation of many abrasive particles.

Dry and clean environment is prime precaution from contaminations. If such environment is not provided for operating, use of bearings with seals or shield shall be provided. Besides, if humidity level is too high, use of lubrication with good corrosion inhibitor shall be provided.

Influence of poor environment may be sometime decreased by more frequent change of lubrication. However, such method increases risk to lubricate bearings above specified rate.

Lubrication shall be analyzed in due time to determine concentration level of solid particles as well as their material and source.

Distortion of shaft and casing hole on which bearing is mounted is the other frequent reason of premature failure of bearings. Excessive angular displacement of part axes results in significant decrease of vibration and load.

If belt drive is used, excessive tension of belts results in angular displacement of part axes. Therefore belt tension shall be minimized to such value which will not cause belt slipping.

Regulation with thin gaskets of bearing arrangement housing will correct angular displacement of parts axes.

Deviations of geometric form of housing hole will significantly influence load rate and depletion of bearing. The same problem arises when housing is mounted on curved surface. Curved surface of bearing surface in its turn results in out-of-roundness of housing hole. If out-of-roundness of housing hole exceeds allowable amount, mounting surfaces shall be tested and corrected with thin gaskets package prior the new nearing will be mounted.

Undoubtedly, bearing shall be mounted with minimum clearance which will compensate thermal expansion of bearing parts. If size of inner clearance is not enough to compensate thermal expansion of bearing parts, generated heat will gradually exceed specified limits. Temperature affects viscosity of lubrication declining its properties or in worth scenario external friction will be decreased so much that bearing will be trigged.

Group of inner clearing of new bearing shall be similar with the bearing which was initially mounted. Interference fits on shaft immediately affects decreasing inner bearing clearance. If bearing is mounted on shaft with excessive tension, inner clearance may be entirely taken up prior to start of bearing arrangement operation.

Bearing mounting scheme usually consists of non-locating and locating bearing carriage. If bearing with non-locating bearing carriage does not provide suitable shaft extension it may result in additional axial loads as well as increase temperature of bearing arrangement.

Ability to take up compound loads is different for every type of bearings and may also depend on shaft rotation frequency and lubrication method.

Negligent mounting to integral seals and shields of bearings may result in their damage. Damaged seals and shields may cause troubles during rotation of cage and rolling elements which enable contamination penetration in the inside of the bearing. Specified mounting methods shall be followed while mounting to prevent destroy of seals of cartridge type bearing.

In most cases shaft rotates while housing of bearing arrangement is fixed. Inner ring of bearing has interference fit on shaft and outer ring has free fit.

Interference fit provides matching of bearing and shaft so they operate in block. Cohesion capacity at interference fit depends on interference rate, mating surface area and friction between mating parts.

Shaft on which bearing is mounted shall be produced under specified requirements on form and dimensions accuracy. Increase of shaft dimensions results in decrease of inner clearance. If shaft dimensions are less than specified dimensions, bearing will creep on shaft generating shaft and bearing bore depletion. Herewith, associated friction and heat generation increase temperature of bearing arrangement and contamination particles are generated.

If bearing is mounted on released fit or tapered journey, fit unfastening may show that bearing was incorrectly mounted. Inner bearing ring shall be prohibited form unspecified overload. If a shaft was roughly finished it shall be restored under specified accuracy requirements.

Specified reasons of lowered working capacity are the most widespread. But there are a lot of other factors resulting in lowering of bearings working capacity.

Automatic vibration monitoring systems (intermittent monitoring), diagnostics and forecasting of vehicles condition simplify diagnostics of bearing arrangement and allow proceeding from servicing under regulations to servicing and repairing according to their actual condition.

Monitoring and diagnostic systems provide high diagnostic and forecast reliability and do not require special training of operator as well as significantly increase production expenses by decreasing unregulated downtime.

Types of Damages and their Possible Reasons

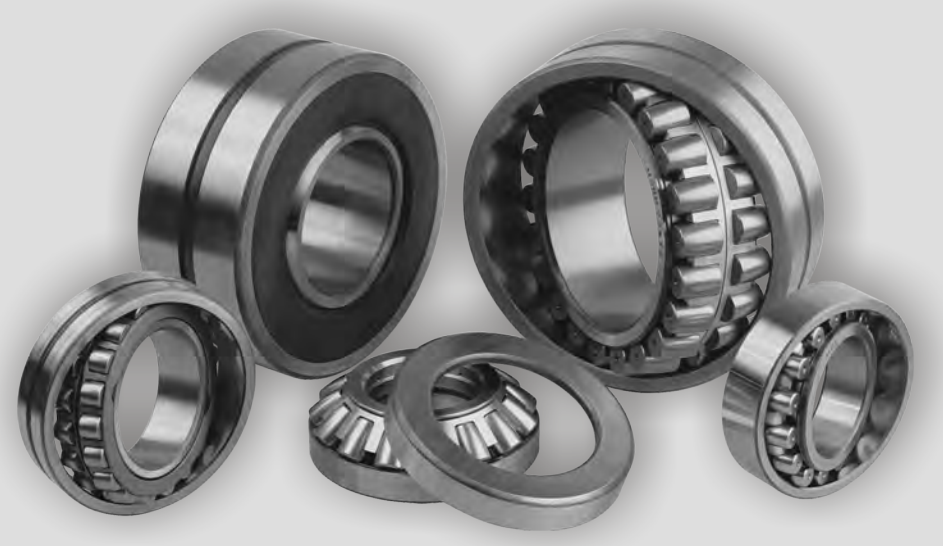
Possible reasons / Features of damage		Depreciation								Fatigue		Corrosion			Overload and enforced failure								
															Destruction, breakdown			Deformation			Crack		
		High depressiation	Abnormal rolling trace	Burrs and scratches	Frictional slidingtraces	Burrs and scourings	Depreciation in form of striations	Guttering, brinelling	Surface color deviation resulted from heating	Pittings	Crocking	General corrosion(rust)	Fretting corrosion (rust during rubbing)	Small surface melting in form of caves	Raceways and rolling elements destruction	Breakup, cracking	Localized chipping	Form deformation	Dimples	Tool marks	Cracking resulted from heat generation	Hardening cracks	Cracks resulted from incorrect reseating
Lubrication	Insufficient amount	●			●	●			●	●	●					●					●		
	Excess amount								●														
	Viscosity nonconformity	●			●	●			●	●	●					●					●		
	Quality nonconformity	●			●	●			●	●	●	●				●					●		
	Contaminations	●	●	●						●	●	●							●				
Operational environment	Overtolerance rate speed	●			●	●			●	●	●					●		●					
	Overtolerance load	●			●					●	●				●			●	●		●		
	Excessive circularity of loading	●		●	●	●				●	●					●							
	Vibration	●			●	●		●		●	●		●		●	●							
	Electric current transmission						●			●	●			●									

Types of Damages and their Possible Reasons
(continue)

Possible reasons \ Features of damage		Depreciation								Fatigue		Corrosion			Overload and enforced failure								
															Destruction, breakdown			Deformation			Crack		
		High depressiation	Abnormal rolling trace	Burrs and scratches	Frictional slidingtraces	Burrs and scourings	Depreciation in form of striations	Guttering, brinelling	Surface color deviation resulted from heating	Pittings	Crocking	General corrosion(rust)	Fretting corrosion (rust during rubbing)	Small surface melting in form of caves	Raceways and rolling elements destruction	Breakup, cracking	Localized chipping	Form deformation	Dimples	Tool marks	Cracking resulted from heat generation	Hardening cracks	Cracks resulted from incorrect reseating
Mounting	Poor electrical insulation						●		●	●	●			●									
	Inappropriate mounting technique					●				●	●			●	●	●	●	●	●	●			
	Overheating	●																●			●		
	Distortion	●				●				●	●							●					
	Unacceptable preload	●	●						●	●	●				●	●		●			●		
	Mutual collision in rotary mode	●	●													●		●					
	Incorrect casing	●	●		●					●	●				●		●	●			●		
	Uneven bearing surface	●	●							●	●		●		●			●					
	Incorrect fit	●	●						●	●	●		●					●			●		
Construction	Incorrect bearing type				●	●			●				●		●	●	●						
	Incorrect bearing size				●	●			●				●		●	●	●						

Types of Damages and their Possible Reasons
(continue)

	Features of damage / Possible reasons	Depreciation: High depressiation	Depreciation: Abnormal rolling trace	Depreciation: Burrs and scratches	Depreciation: Frictional slidingtraces	Depreciation: Burrs and scourings	Depreciation: Depreciation in form of striations	Depreciation: Guttering, brinelling	Depreciation: Surface color deviation resulted from heating	Fatigue: Pittings	Fatigue: Crocking	Corrosion: General corrosion(rust)	Corrosion: Fretting corrosion (rust during rubbing)	Corrosion: Small surface melting in form of caves	Overload and enforced failure: Destruction, breakdown: Raceways and rolling elements destruction	Destruction, breakdown: Breakup, cracking	Destruction, breakdown: Localized chipping	Deformation: Form deformation	Deformation: Dimples	Deformation: Tool marks	Crack: Cracking resulted from heat generation	Crack: Hardening cracks	Crack: Cracks resulted from incorrect reseating
Storage	Nonconformity with storage conditions											●											
	Strokes during transportation					●		●					●						●	●			
Production	Violation of heat treatment modes	●						●	●	●												●	
	Violation of grinding conditions																						●
	Nonconformance of surface roughness	●	●							●	●												
	Nonconformance of form accuracy	●	●						●	●	●				●		●						
Material	Structural defect									●	●				●								
	Incorrect material selection	●			●	●			●									●					



BEARING TABLES

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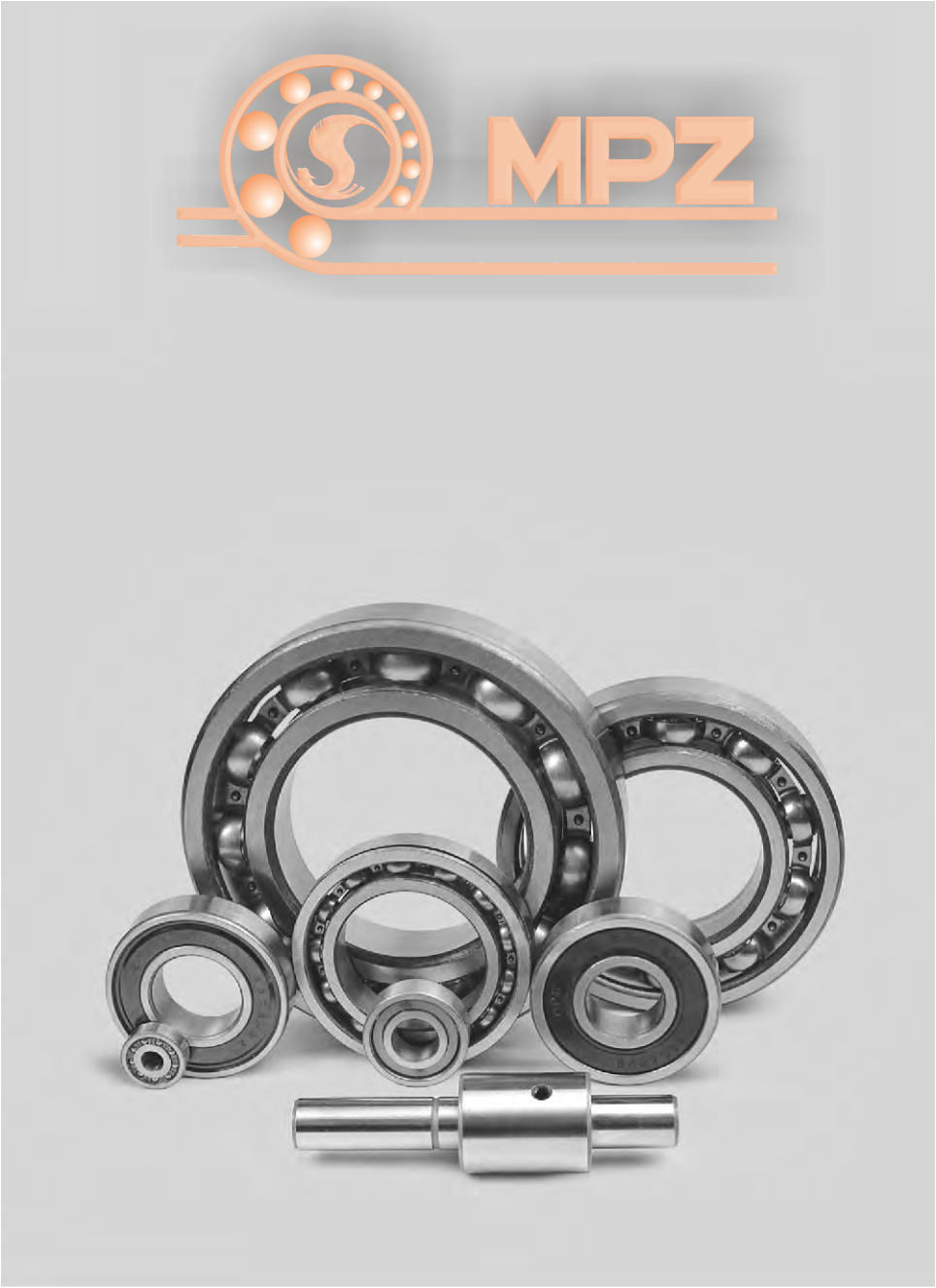


Deep Groove Radial Ball Bearings

Deep groove radial ball bearings are designed to bare radial loads but may also bare axial loads in both directions especially if radial clearances are increased. Manufactured produces both bearings with normal clearance group and decreased and increased clearances.

Deep groove radial ball bearings fix shaft position towards housing in both axial directions. Bearing may be produced with outer ring groove to simplify axial mounting.

Bearing ring distortion may cause local overload of balls and raceway as well as increase noise and vibration. That is why distortion value shall be minimal. Allowable distortion angle of axes of inner and outer bearing rings depends on radial clearance, size of interior structure of bearing and applied bearing load. Allowable angle of mutual operating distortion of ball bearing ring at radial load shall be over 6' at radial clearance of normal row, aver 8' at radial clearance of 7 row and over 10' at radial clearance of 8 rows.

Deep groove radial ball bearings are one-piece bearings. They are produced with steel shaped cage, cage from glass-nylon composite 6.6 and cages made of brass.

Apart from base version, bearings shall be produced with grooves for balls input, with flanged outer ring, spherical external bearing surface, one or two shields or contact seals as well as filled with consistent lubrication. In this case bearings are package with steel shields forming labyrinth sealing with flanged outer ring or with two rubber reinforced sealing contacting with inner ring, holding lubrication and preventing bearings from foreign particles.

Dynamic equivalent load applied on bearing shall be calculated according to the equation (7) and (8), i.e. $P=F_r XVK_\sigma K_T$ at $F_a/F_r<e$ and $P=(XVF_r+YF_a)K_\sigma K_T$ at $F_a/F_r>e$. **X** and **Y** indexes shall be selected taking into account F_a/C_{or} ratio.

X and Y indexes for bearings mounted with standard fit on shaft (from J6 to n6) in housing (J7) with radial clearance size of normal group (row) are specified in tables.

X and Y indexes for deep groove radial ball bearings

F_a/C_{or}	e	$F_a/F_r < e$		$F_a/F_r>e$	
		X	Y	X	Y
0,014	0,19	1	0	0,56	2,30
0,028	0,22	1	0	0,56	1,99
0,056	0,26	1	0	0,56	1,71
0,084	0,28	1	0	0,56	1,55
0,110	0,30	1	0	0,56	1,45
0,170	0,34	1	0	0,56	1,31
0,280	0,38	1	0	0,56	1,15
0,420	0,42	1	0	0,56	1,04
0,560	0,44	1	0	0,56	1,00

Note: Cor value at the stage of bearing selection is unknown. The value shall be preliminary selected and following correct calculation of bearing shall be made after final selection of bearing.

Static equivalent load on bearing shall be calculated according to the equation (14), where $X_0 = 0,6$, $Y_0 = 0,5$, i.e. equation has form $P_0=0,6F_r+0,5F_a$.

If according to the equation $P_0 < F_r$, $P_0 = F_r$ is assumed. Allowable variations of dimensions and beating are specified in tables.

Suffixes of additional specification of MPZ

P Solid cage of glass-nylon composite
M Solid cage of brass

N Groove for contact ring on outside surface outer ring

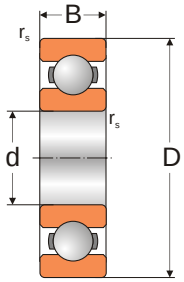
Z Shield on one side of bearing
2Z Shields on either side of bearing

RS1 Sealing made from chemical rubber, reinforced with steel sheet on one side of bearing
2RS1 Sealing made from chemical rubber, reinforced with steel sheet on either side of bearing

P6 Accuracy under 6 Class of ISO
P5 Accuracy under 5 Class of ISO

C1 Bearing clearance is less than Ñ2
C2 Bearing clearance is less than normal clearance
C3 Bearing clearance exceeds normal clearance
C4 Bearing clearance is less than Ñ4
C5 Bearing clearance is less than Ñ5

P63 Integrated accuracy and clearance specification (C is not specified)



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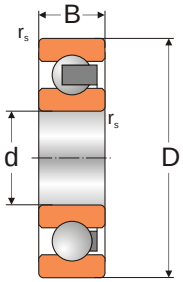
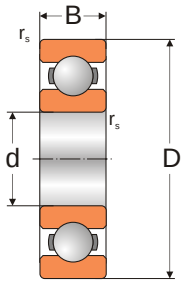


1000900

Single row deep groove radial ball bearings

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions	
d	D	Â	dyn. Ñ	stat. C_0	non-fluid	liquid	GOST	MPZ		d	r_{smin}
mm			kN		rpm		-		kg	mm	
12	32	10	6,8	3,1	22000	28000	**201AE**	**6201P**	0,035	**12**	0,6
15	35	11	7,8	3,7	19000	24000	**202AE**	**6202P**	0,039	**15**	0,6
17	40	12	9,6	4,7	17000	20000	**203AE**	**6203P**	0,059	**17**	0,6
20	47	14	12,7	6,2	15000	18000	**204**	**6204**	0,108	**20**	1,0
	52	15	16,0	7,8	13000	16000	**304K**	**6304**	0,148		1,1
25	52	15	14,0	7,0	12000	15000	**205A**	**6205**	0,129	**25**	1,0
	62	17	22,5	11,4	11000	14000	**305A**	**6305**	0,230		1,1
30	62	16	19,5	10,0	10000	13000	**206A**	**6206**	0,202	**30**	1,0
	72	19	28,1	14,8	9000	11000	**306A**	**6306**	0,350		1,1
35	55	10	10,3	5,6	11000	14000	**1000907E**	**61907P**	0,073	**35**	0,6
	72	17	25,5	15,3	9000	11000	**207AE**	**6207P**	0,252		1,1
	80	21	33,4	17,5	8500	10000	**307A**	**6307**	0,447		1,5
40	80	18	30,7	19,0	8500	10000	**208A**	**6208**	0,357	**40**	1,1
	90	23	41,0	24,0	7500	9000	**308A**	**6308**	0,635		1,5
45	85	19	32,7	20,5	8000	9500	**209A**	**6209**	0,406	**45**	1,1



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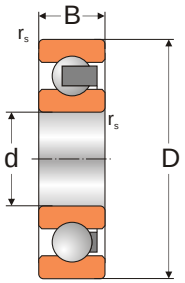
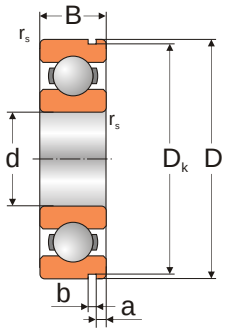


1000900

Single row deep groove radial ball bearings

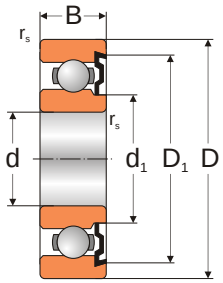
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions	
d	D	Â	dyn. Ñ	stat. C_0	non-fluid	liquid	GOST	MPZ		d	r_{smin}
mm			kN		rpm		-		kg	mm	
50	80	16	20,6	12,1	8500	10000	**110A**	**6010**	0,260	**50**	1,0
	90	20	35,1	23,2	7000	8500	**210A**	**6210**	0,454		1,1
	110	27	61,8	38,0	6000	7000	**310A**	**6310**	1,060		2,0
	110	27	61,8	38,0	6000	7000	**310AK**	**6310**	0,982		2,0
	130	31	87,1	52,1	5300	6300	**410A**	**6410**	1,910		2,1
55	100	21	43,6	25,0	6300	78500	**211A**	**6211**	0,597	**55**	1,5
60	110	22	52,4	36,0	6000	7000	**212A**	**6212**	0,771	**60**	1,5
	130	31	81,9	48,6	5000	6000	**312A**	**6312**	1,700		2,1
65	120	23	55,9	40,5	5300	6300	**213**	**6213**	0,995	**65**	1,5
70	150	35	104,1	63,5	4500	5300	**314AK**	**6314**	2,530	**70**	2,1
	180	42	135,7	95,7	3800	4500	**414A**	**6414**	4,720		3,0
75	115	20	40,0	33,0	5600	6700	**115A**	**6015**	0,614	**75**	1,1
85	150	28	83,3	53,3	4300	5000	**217A**	**6217**	1,800	**85**	2,0
105	145	20	46,4	44,8	4300	5000	**1000921AE**	**61921P**	0,790	**105**	1,1



50000

Single row deep groove radial ball bearings with outer ring groove

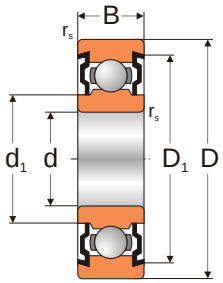
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions				
d	D	Â	dyn. Ñ	stat. C_0	non-fluid	liquid	GOST	MPZ		d	D_k	a	b	r_{smin}
mm			kN		rpm		-		kg	mm				
25	62	17	22,5	11,4	11000	14000	**50305A**	**6305N**	0,230	**25**	59,61	3,28	1,9	1,1
30	62	16	19,5	10	10000	13000	**50206A**	**6206N**	0,200	**30**	59,61	3,28	1,9	1,0
	72	19	28,1	14,8	9000	11000	**50306A**	**6306N**	0,350		68,81	3,28	1,9	1,1
35	72	17	25,5	15,3	9000	11000	**50207AE**	**6207NP**	0,284	**35**	68,81	3,28	1,9	1,1
40	90	23	41	24	7500	9000	**50308A**	**6308N**	0,630	**40**	86,79	3,28	2,7	1,5
50	80	16	20,6	12,1	8500	10000	**50110A**	**6010N**	0,260	**50**	76,81	2,49	1,9	1,0
	110	27	61,8	38	6000	7000	**50310A**	**6310N**	0,986		106,81	3,28	2,7	2,0
	130	31	87,1	52,1	5300	6300	**50410A**	**6410N**	1,880		125,22	4,06	3,4	2,1
65	120	23	57,2	34,2	5300	6300	**50213**	**6213N**	0,961	**65**	115,21	4,06	3,1	1,5
70	150	35	104,1	63,5	4500	5300	**50314AK**	**6314N**	2,500	**70**	145,24	4,90	3,1	2,1
	180	42	135,7	95,7	3800	4500	**50414A**	**6414N**	4,680		173,66	5,69	3,5	3,0
75	115	20	40	33	5600	6700	**50115A**	**6015N**	0,610	**75**	111,81	2,87	2,7	1,1



60000

Single row deep groove radial ball bearings with one shield

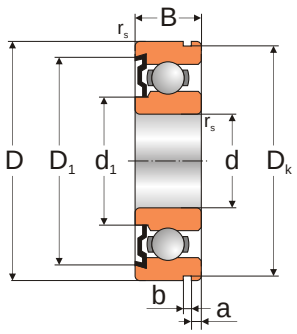
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)	Designation		Mass	Dimensions			
d	D	Â	dyn. Ñ	stat. C_0	non-fluid liquid	GOST	MPZ		d	d_1	D_1	r_{smin}
mm			kN		rpm	-		kg	mm			
12	32	10	6,8	3,1	22000	**60201AE**	**6201-ZP**	0,035	**12**	16,1	27,80	0,6
15	35	11	7,8	3,7	19000	**60202AE**	**6202-ZP**	0,038	**15**	18,5	31,10	0,6
17	40	12	9,6	4,7	17000	**60203AE**	**6203-ZP**	0,061	**17**	21,6	35,50	0,6
20	47	14	12,7	6,2	15000	**60204**	**6204-Z**	0,107	**20**	25,9	42,15	1,0
	52	15	16,0	7,8	13000	**60304K**	**6304-Z**	0,141		27,7	45,00	1,1
50	90	20	35,1	23,2	7000	**60210A**	**6210-Z**	0,441	**50**	58,0	82,80	1,1
	110	27	61,8	38,0	6000	**60310A**	**6310-Z**	1,080		62,0	99,00	2,0
70	150	35	104,1	63,5	4500	**60314AK**	**6314-Z**	2,330	**70**	87,0	135,00	2,0



80000

Single row deep groove radial ball bearings with two shields

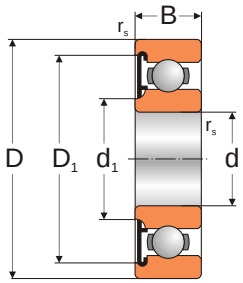
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)	Designation		Mass	Dimensions			
d	D	Â	dyn. Ñ	stat. C_0	non-fluid liquid	GOST	MPZ		d	d_1	D_1	r_{smin}
mm			kN		rpm	-		kg	mm			
15	35	11	7,8	3,7	19000	**80202AE**	**6202-2ZP**	0,038	**15**	19,2	31,50	0,6
17	40	12	9,6	4,7	17000	**80203AE**	**6203-2ZP**	0,061	**17**	21,6	35,50	0,6
20	47	14	12,7	6,2	10000	**80204**	**6204-2Z**	0,107	**20**	25,9	42,15	1,0
25	62	17	22,5	11,4	11000	**80305A**	**6305-2Z**	0,230	**25**	32,7	54,80	1,1
30	62	16	19,5	10,0	10000	**80206A**	**6206-2Z**	0,201	**30**	37,2	55,80	1,0
65	120	23	57,2	34,2	5300	**80213**	**6213-2Z**	0,968	**65**	75,0	110,00	1,5
70	150	35	104,1	63,5	4500	**80314AK**	**6314-2Z**	2,300	**70**	87,0	135,00	2,1



150000

Single row deep groove radial ball bearings with outer ring groove and one shield

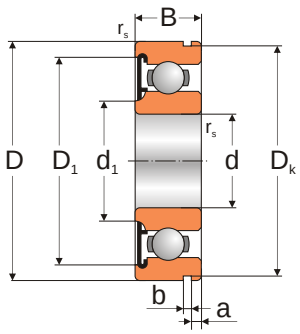
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)	Designation		Mass	Dimensions						
d	D	Â	dyn. Ñ	stat. C_0	non-fluid liquid	GOST	MPZ		d	d_1	D_1	D_k	a	b	r_{smin}
mm			kN		rpm	-		kg	mm						
60	110	22	52,4	36,0	6000	**150212A**	**6212-ZN**	0,733	**60**	68,8	102	106,81	3,28	2,7	1,5
65	120	23	57,2	34,2	5300	**150213**	**6213-ZN**	0,975	**65**	75,0	110	115,21	4,06	3,1	1,5



1160000

Single row deep groove radial ball bearings with one-side seal

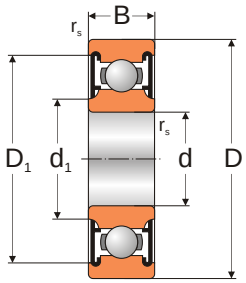
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)	Designation		Mass	Dimensions			
d	D	Â	dyn. Ñ	stat. C_0	non-fluid liquid	GOST	MPZ		d	d_1	D_1	r_{smin}
mm			kN		rpm	-		kg	mm			
20	52	18	16,0	7,8	9000	**1160304K**		0,171	**20**	26,9	44,4	1,1
25	62	21	22,5	11,4	7500	**1160305A**		0,284	**25**	32,7	54,8	1,1
30	72	19	28,1	14,8	6300	**160306A**	**6306-RS1**	0,340	**30**	41,0	62,5	1,1



550000

Single row deep groove radial ball bearings with outer ring groove and one-side seal

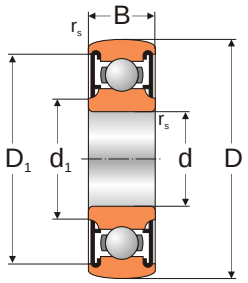
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)	Designation		Mass	Dimensions						
			dyn.	stat.											
d	D	Â	Ñ	C_0	non-fluid liquid	GOST	MPZ		d	d_1	D_1	D_k	a	b	r_{smin}
mm			kN		rpm	-		kg	mm						
40	90	23	41,0	24,0	5000	**550308A**		0,628	**40**	52,5	78,2	86,79	3,28	2,7	1,5



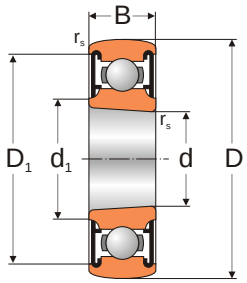
180000

Single row deep groove ball radial bearings with double-sided seal

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)	Designation		Mass	Dimensions			
d	D	Â	dyn. Ñ	stat. C_0	non-fluid liquid	GOST	MPZ		d	d_1	D_1	r_{smin}
mm			kN		rpm	-		kg	mm			
15	35	14	7,8	3,7	13000	**180502AE**	**62202-2RS1P**	0,054	**15**	18,5	31,10	0,6
20	47	14	12,7	6,2	15000	**180204**	**6204-2RS1**	0,108	**20**	25,9	42,15	1,0
	52	18	16,0	7,8	9000	**1180304K**		0,171		26,9	44,40	1,1
25	52	15	14,0	7,0	9000	**180205A**	**6205-2RS1**	0,124	**25**	30,1	46,50	1,0
	62	17	22,5	11,4	7500	**180305A**	**6305-2RS1**	0,217		32,7	54,80	1,1
	62	21	22,5	11,4	7500	**1180305A**		0,284		32,7	54,80	1,1
30	62	16	19,5	10,0	7500	**180206A**	**6206-2RS1**	0,209	**30**	37,2	55,80	1,0
	72	19	28,1	14,8	6300	**180306A**	**6306-2RS1**	0,340		41,0	62,50	1,1
	78	28	28.1	14.8	6300	**180706K**		0,550		41,0	66,00	1.1
	78	28	28,1	14,8	6300	**180706KE**		0,544		41,0	66,00	1,1
35	72	17	25,5	15,3	6300	**180207AE**	**6207-2RS1P**	0,258	**35**	43,3	62,90	1,1
40	80	23	30,7	19,0	5600	**180508A**	**62208-2RS1**	0,433	**40**	48,8	70,80	1,1
	90	23	41,0	24,0	5000	**180308A**	**6308-2RS1**	0,659		52,5	78,20	1,5
50	90	20	35,1	23,2	4800	**180210A**	**6210-2RS1**	0,435	**50**	57,6	81,20	1,1
65	120	23	57,2	34,2	3600	**180213**	**6213-2RS1**	1,000	**65**	78,5	105,30	1,5



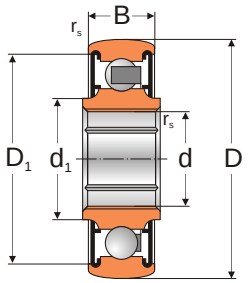
580000



580000K

Single row radial ball bearing with double-sided seal and outer ring spherical outside surface

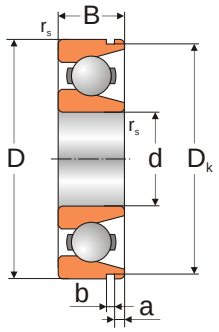
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)	Designation		Mass	Dimensions			
d	D	Â	dyn. Ñ	stat. C_0	non-fluid liquid	GOST	MPZ		d	d_1	D_1	r_{smin}
mm			kN		rpm	-		kg	mm			
40	80	23	32,4	20,0	5600	**580508AK**		0,399	**40**	48,8	70,8	0,6
55	100	21	43,6	25,0	4300	**580211A**		0,599	**55**	64,0	91,6	1,5



420000

Single row radial ball bearing with double-sided seal, outer ring spherical surface and hexahedral bore

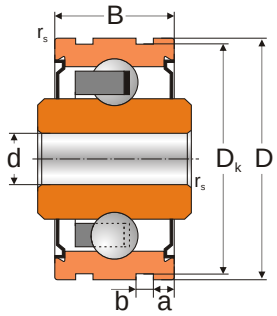
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions			
d	D	Â	dyn. Ñ	stat. C_0	non-fluid	liquid	GOST	MPZ		d	d_1	D_1	r_{smin}
mm			kN		rpm		-		kg	mm			
17,5	47	14/17,7	12,7	6,2		10000		**420303KE**	0,114	**17,5**	25,3	42,2	1,0
24,6	52	15	14,0	7,0		2000		**420205KE**	0,124	**24,6**	30,1	46,5	1,0



170000

Single row deep groove radial ball bearings with outer ring groove and filling slot

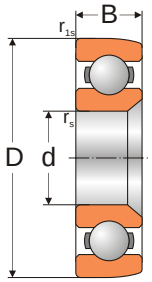
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions				
			dyn.	stat.										
d	D	Â	Ñ	C_0	non-fluid	liquid	GOST	MPZ		d	D_k	a	b	r_{smin}
mm			kN		rpm		-		kg	mm				
70	150	35	110,5	95,2	3200	4500	**170314Л**	**314NM**	3,150	**70**	145,24	4,9	3,1	2,1



3080000

Single row radial ball bearings with two shields, special application

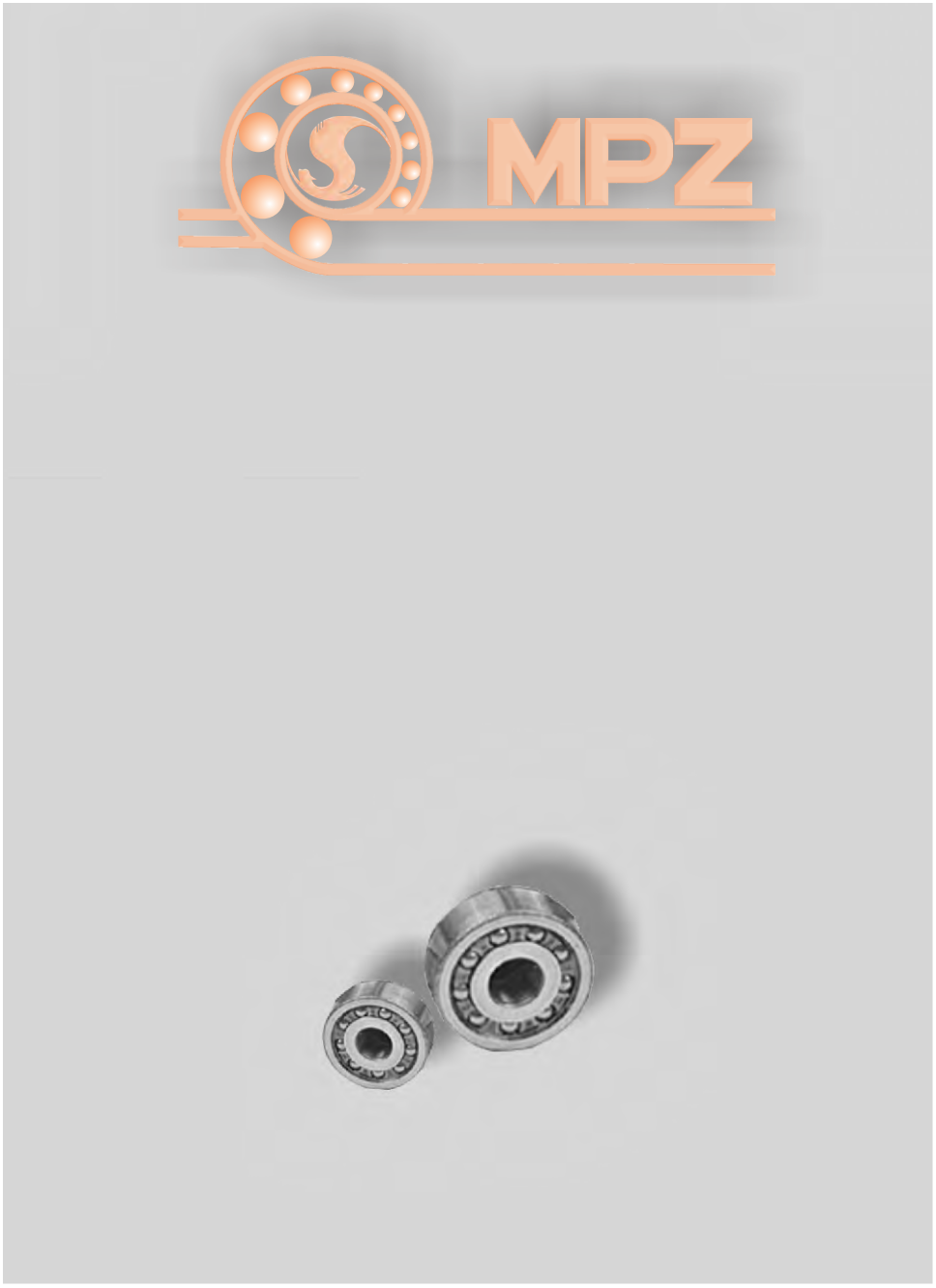
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)	Designation		Mass	Dimensions				
d	D	Â	dyn. Ñ	stat. C_0	non-fluid liquid	GOST	MPZ		d	D_k	a	b	r_{smin}
mm			kN		rpm	-		kg	mm				
6	28	14/18	5,2	2,1	1000	**3080036E**		0,046	**6**	27,00	2,5	2,0	0,5



260000

Single row radial ball bearings, special application

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions		
d	D	Â	dyn. Ñ	stat. C_0	non-fluid	liquid	GOST	MPZ		d	r_{smin}	r_{1smin}
mm			kN		rpm		-		kg	mm		
25	80	21	33,5	18,3	8500	16000	**260705AT**		0,511	**25**	1,8	0,7



Spherical radial ball bearings

Spherical radial ball bearings are used to bear radial loads. Considerable distortions of inner ring towards outer ring (2.5...3°) are allowable i.e. they are self-mounted. They are used in case of misalignment mounting seats or load shaft deflection.

MPZ produces double row spherical roller bearings with polyimide cage. Bearings may have cylindrical or tapered bore. Cylindrical bore provides mounting on smooth shafts without fillets (in conjunction with adapter sleeve).

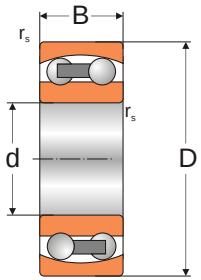
Dynamic equivalent load on bearing shall be calculated according to the equation (7) and (8); static equivalent load shall be calculated according to the equation (14).

X, X_0, Y, Y_0 indexes for spherical radial double row ball bearings

$F_a/(VF_r) < e$		$F_a/(VF_r) > e$		e
X	Y	X	Y	
1	0,42ctgα	0,65	0,65ctgα	1,5ctgα
X_0=1.0		Y_0=0,44ctgá		

Suffixes of additional specification of MPZ

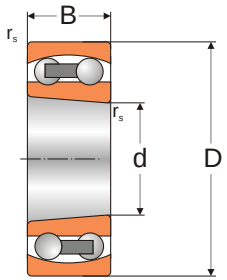
P	Solid cage from glass-nylon composite
E	Optimized interior structure
K	Tapered bore, taper is 1:12
P6	Accuracy under 6 Class of ISO
P5	Accuracy under 5 Class of ISO
C1	Bearing clearance is less than Ñ2
C2	Bearing clearance is less than normal clearance
C3	Bearing clearance exceeds normal clearance
C4	Bearing clearance is less than Ñ4
C5	Bearing clearance is less than Ñ5
P63	Integrated accuracy and clearance specification (C is not specified)



1000

Double-row spherical radial ball bearings with cylindrical bore

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)	Designation		Mass	Dimensions	
			dyn.	stat.						
d	D	Â	N	C_0	non-fluid liquid	GOST	MPZ		d	r_{smin}
mm			kN		rpm	-		kg	mm	
7	22	7	1,85	0,59	30000 36000	**1007KE**	**127P**	0,015	**7**	0,3
8	22	7	1,85	0,59	30000 36000	**1008KE**	**128P**	0,014	**8**	0,3



111000

Double-row spherical radial ball bearings with tapered bore

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions	
d	D	Â	dyn. N	stat. C_0	non-fluid	liquid	GOST	MPZ		d	r_{smin}
mm			kN		rpm		-		kg	mm	
45	85	19	22,0	10,0	7500	9000	**111209E**	**1209EKP**	0,435	**45**	1,1
50	90	20	22,9	11,0	7500	9000	**111210E**	**1210EKP**	0,497	**50**	1,1

Angular contact ball bearings

Bearings are used to bare radial and axial loads. Single row angular contact ball bearings may take axial load only in one direction so to fix shaft in both directions two bearing shall be mounted on shaft or on support. Runways on both rings of such bearing are made so to provide angle of contact which has different valued depending on the design. If angle of contact increase axial load capacity of bearing increases too.

Bearings shall be installed in bearing arrangement by pairs under O-scheme (narrow flanges of inner rings shall be mounted towards each other) an under tandem scheme (wide and narrow ring flanges towards each other). If bearings are mounted under O-scheme, angle of contact lines cross axial line of bearing in points with distance between such points exceeds distance specified in X scheme. So support made under O-scheme has increased toughness and may bear greater force moment in axial plane. Tandem scheme is used in bearings arrangement with significant axial loads when load capacity of one bearing is not enough.

Angular contact ball bearings are distortion responsive with allowable operating value of such distortion is within 3'30" if angle of contact of bearings is 26° and to 3' if angle of contact of bearings is 36°.

During mounting angular contact ball bearings tapered clearance shall be minimal or removed. Bearing may be mounted with preload depending on requirements on rotating arrangement accuracy, bearing mounting scheme and effect of temperature on shafts.

The bearing group includes also four-point contact bearings, i.e. angular contact ball bearings with raceway with groove profiles which allow bear axial loads to be applied in both directions. Due to two-pieces inner ring bearings contain more balls which results in higher load capacity and space saving.

Dynamic equivalent load on bearing shall be calculated according to the equation (7) and (8); static equivalent load shall be calculated according to the equation (14).

Indexes for equivalent load calculation depending on angle of contact are specified in table.

Indexes for angular contact ball bearings

Angle of contact α	e	$F_a/F_r < e$		$F_a/F_r > e$		X_0	Y_0
		X	Y	X	Y		
For one row bearings							
26°	0,68	1	0	0,41	0,87	0,5	0,37
36°	0,95	1	0	0,37	0,66	0,5	0,28
For four-point contact bearings or two-row bearings							
26°	0,68	1	0,92	0,67	1,41	1	0,74
36°	0,95	1	0,66	0,60	1,07	1	0,56
For multi row bearings							
45°	1,34	1	0,47	0,54	0,81	1	0,44

If two angular contact ball bearings are mounted under O and X scheme on shaft end which bears loads in the middle, thrust force of every bearing is mutually balanced. But if radial load on the first support where may be used large size bearing significantly exceeds radial load on the other support, thrust force of the first bearing shall be also considered as axial load on other bearing.

Allowable variations of dimensions and beating are specified in tables.

Suffixes of additional specification of MPZ

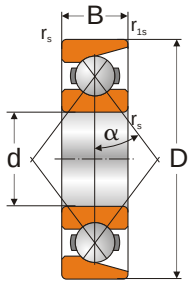
P Solid cage from glass-nylon composite
M Solid cage from brass

A Angle of contact is 26?
B Angle of contact is 36?

P6 Accuracy under 6 Class of ISO
P5 Accuracy under 5 Class of ISO

C1 Bearing clearance is less than Ñ2
C2 Bearing clearance is less than normal clearance
C3 Bearing clearance exceeds normal clearance
C4 Bearing clearance is less than Ñ4
C5 Bearing clearance is less than Ñ5

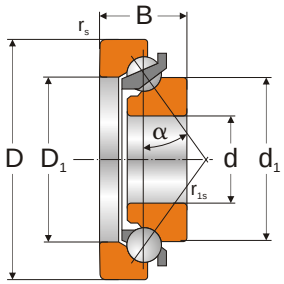
P63 Integrated accuracy and clearance specification (C is not specified)



46000
66000

Single row angular contact ball bearings with bevel on outer ring

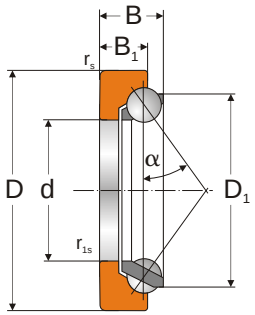
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions			Angle of contact
			dyn.	stat.									
d	D	Â	Ñ	C_0	non-fluid	liquid	GOST	MPZ		d	r_{smin}	r_{1smin}	á
mm			kN		rpm		-		kg	mm			deg
17	40	12	11,1	6,1	15000	20000	**46203AE**	**7203AP**	0,07	**17**	0,6	0,3	26
20	47	14	14,0	8,3	12000	17000	**46204E**	**7204AP**	0,10	**20**	1,0	0,6	26
60	130	31	93,6	58,9	4300	5600	**66312E**	**7312BP**	1,71	**60**	2,1	1,1	36
	130	31	100,0	65,5	4300	5600	**46312Л**	**7312AM**	2,01		2,1	1,1	26
	130	31	100,1	65,5	4300	5600	**46312E**	**7312AP**	1,72		2,1	1,1	26



916000

Single row angular contact ball bearings with demountable rings

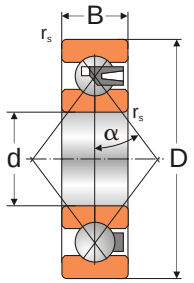
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation	Mass	Dimensions					Angle of contact
			dyn.	stat.										
d	D	Â	Ñ	C_0	non-fluid	liquid	**GOST**		d	d_1	D_1	r_{smin}	r_{1smin}	á
mm			kN		rpm		-	kg	mm					deg
20	62	17	14,5	9,6	9000	12000	**916904E**	0,21	**20**	41,0	40,0	1,0	0,6	45



996000

Single row angular contact ball bearings without inner ring

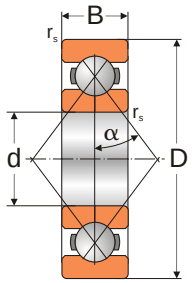
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation	Mass	Dimensions					Angle of contact
d	D	Â	dyn. Ñ	stat. C_0	non-fluid	liquid	GOST		d	D_1	B_1	r_{smin}	r_{1smin}	á
mm			kN		rpm		-	kg	mm					grado
40,1	56,5	9,692	9,7	7,8	9000	12000	**996908E**	0,06	**40,1**	54,0	7	1,0	0,5	45



126000

Three-point contact ball bearings with two-piece inner ring, single row

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation	Mass	Dimensions		Angle of contact
d	D	Â	dyn. Ñ	stat. C_0	non-fluid	liquid	**GOST**		d	r_{smin}	á
mm			kN		rpm		-	kg	mm		deg
25	62	17	24,9	13,1	13000	16000	**126805E1**	0,25	**25**	1,0	26

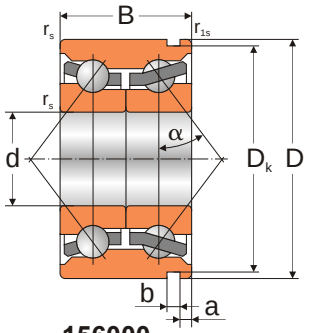


176000
1176000

Four-point contact ball bearings with two-piece inner ring, single row

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions		Angle of contact
d	D	Â	dyn. Ñ	stat. C_0	non-fluid	liquid	GOST	MPZ		d	r_{smin}	á
mm			kN		rpm		-		kg	mm		deg
110	200	38	250,0	264,9	3200	4000	**176222Л**	**QJ222M**	5,76	**110**	2,1	26
120	200	38	222,0	249,0	2800	3400	**1176724Л**		4,82	**120**	2,0	26
130	230	40	266,0	320,0	2800	3400	**176226Л**	**QJ226M**	7,81	**130**	3,0	26
140	250	42(45)*	307,0	410,5	2600	3200	**176228Л**	**QJ228M**	9,59	**140**	3,0	26

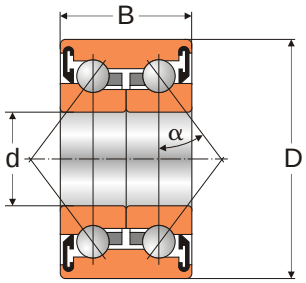
* - width of cage



156000

Double row angular contact ball bearings with two-piece inner ring

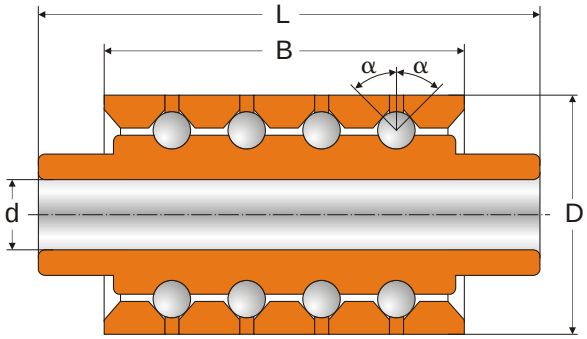
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation	Mass	Dimensions						Angle of contact
			dyn.	stat.											
d	D	Â	Ñ	C_0	non-fluid	liquid	**GOST**		d	D_k	a	b	r_{smin}	r_{1smin}	á
mm			kN		rpm		-	kg	mm						deg
20	50	20,6	21,3	14,2	8800	11000	**156704E2**	0,19	20	47,6	2,46	1,35	1,5	0,5	32,5



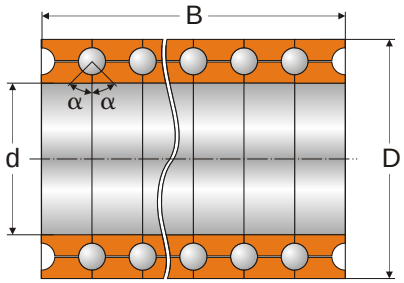
256000

Double row angular contact ball bearings with two-piece inner ring and seals

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation	Mass	Dimensions	Angle of contact
d	D	Â	dyn. Ñ	stat. C_0	non-fluid	liquid	GOST		d	á
mm			kN		rpm		-	kg	mm	deg
30	60	37,0	30,0	21,2	5600		**256706E2**	0,40	**30**	36,0
34	64	37,0	36,5	25,3	5600		**256907E2**	0,45	**34**	36,0
37	72	37,0	55,8	34,4	5600		**256908E5**	0,57	**37**	36,0



106000



296700
296700K

Multi row angular contact ball bearings

Basic dimensions				Load capacity		Maximum rotation speed (lubrication)		Designation	Mass	Dimensions	Angle of contact
d	D	Â	L	dyn. Ñ	stat. C_0	non-fluid	liquid	GOST		d	á
mm				kN		rpm		-	kg	mm	deg
14	45	75	185	18,9	16,6	1200		**106901K**	1,14	**1,14**	45
42	70	100		88,0	149,3	1500		**296708**	1,50	**1,50**	45
50	88	175		149,5	265,5	1500		**296710**	4,30	**4,30**	45
	88	306		172,0	290,0	1000		**296710K**	7,94	**7,94**	45
60	105	175		207,3	391,7	1200		**296712**	6,02	**6,02**	45

Angular contact thrust ball bearings

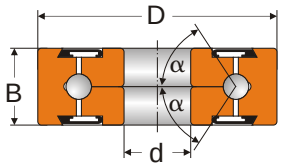
Angular contact thrust ball bearings are used to bear significant axial and radial loads.

MPZ produces one-row angular contact thrust ball sealed bearings used in suspension of light vehicles as well as wide range of multi row bearings for drilling equipment.

Multi row bearings series 128700, 128700Ê include raceways of outer and inner rings in the form of tapered bevel and angle of contact is 60°. Every row of main rings divided by distance rings. Bearings are designed in such a way that if any displacement of package of all inner rings occurs, load will be distributed on all ball rows. Advantage of modernized bearings series 128700Ì is increased load capacity and service life. Capacity and service life was increased by decreasing surface stresses between balls and raceways of bearing rings. Decrease of surface stresses resulted from change of raceways configuration and selection of optimum radius correlation of raceways and balls diameters.

Multi row angular contact thrust bearings are supplied to consumer assembled with help of mounting device. Mounting devices (washers, ties) provide possibility to fit bearings in shaft without dismounting.

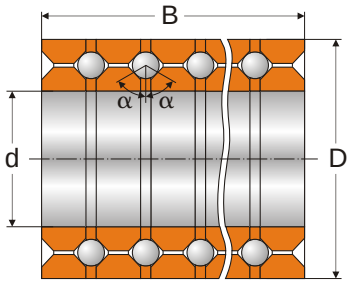
Dynamic equivalent load applied on bearing shall be calculated according to the equation $Ð_à = 0.92F_r + F_a$, and static equivalent load shall be calculated according to the equation $Ð_{0à} = 2.3F_r tgá + F_a$.



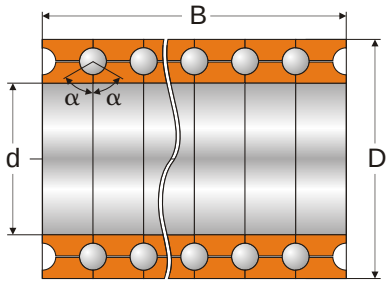
348000

Angular contact thrust ball bearings with two-sided seal, single row

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)	Designation	Mass	Dimensions	Angle of contact
d	D	Â	dyn. Ñ	stat. C_0	non-fluid	GOST		d	á
mm			kN		rpm	-	kg	mm	grado
14,5	52	14	12	25	5000	**348702K**	0,18	**14,5**	60



128700
128700K



128700M

Angular contact thrust ball bearings, multi row

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)	Designation	Mass	Dimensions	Angle of contact
d	D	Â	dyn. Ñ	stat. C_0	non-fluid	GOST		d	á
mm			kN		rpm	-	kg	mm	grado
65	128	351,5	199,1	169,6	1800	**128713**	24,2	**65**	60
80	148	363,0	260,0	310,0	1500	**128916M**	30,0	**80**	60
90	142	550,0	206,4	226,8	1500	**128718**	35,2	**90**	60
	142	550,0	230,0	253,0	1500	**128718M**	35,0		60
	142	451,0	230,0	269,0	1500	**128718KM**	29,6		60
105	165	505,5	272,5	300,0	1500	**128721K**	42,4	**105**	60
	165	505,5	323,2	405,0	1500	**128721M**	43,2		60
115	205	570,0	408,9	453,5	1500	**128723**	88,8	**115**	60
	205	570,0	560,0	610,0	1500	**128723M**	89,1		60
130	205	788,0	465,7	530,2	1200	**128726**	102,0	**130**	60
	205	788,0	630,0	690,0	1200	**128726M**	105,6		60

Spherical roller bearings, double row

Such bearings are used to bear radial loads, herewith radial load shall be bared by both roller rows. Spherical roller bearings may bear axial load equal to 25% of unapplied radial load. Mandatory requirement herewith is exclusion of work of one roller row, displacement of inner ring end face towards outer ring end face. Bearings fix shaft in axial direction with either sides within available axial clearances and compensate angle distortions of inner ring axis towards outer ring axis, resulted from load shaft deflection or from technologic inaccuracies of processing and mounting of arrangement. At normal load (Ñ/Ð>10) and normal operation conditions particularly at rotation of inner ring ($n_{rotation}$<0,6$_{max}$) angle distortion values specified in table are allowable. Angle distortion values are limited by requirement to keep all rollers in contact (the requirement is applied towards two row bearings in both rows) with raceway surface of outer ring. If two bearings are mounted in one support nearby such bearings loose their self-mounting feature.

Allowable Angle Distortion Values for Spherical Roller Bearings, Double Row

Dimensional series specification										
MPZ	21300	22200	22300	23000	23100	23200	23300	23900	24000	24100
GOST	3300	3500 53500 553500	3600 53600 553600	3003100	3003700	3003200 3553200	3003300 553300	3003900	4003100	4003700
Allowable angle distortion										
grado	1,0	1,5	2,0	1,5	1,5	2,5	1,5	1,5	2,0	2,5

Roller tapered bearings are produced both with cylinder and tapered bore (taper is 1:12 or 1:30) for mounting on adapter or withdrawal sleeve or immediately on tapered shaft surface. Initial radial clearance of bearings with tapered bore is some exceeds initial radial clearance of bearings with cylindrical bore. Decrease of radial inner clearance shall be used to provide interference between inner ring and shaft or sleeve during mounting.

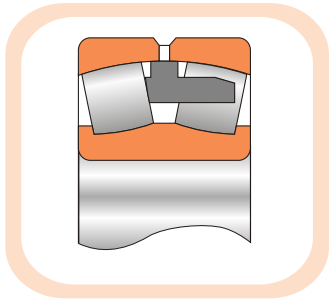
Inner structure has several modifications resulted from development of structure roller spherical bearings.

Equal dynamic and static load applied on bearing shall be calculated as of the following:
dynamic load: at $F_a<F_r<e$ $P=(VF_r+YF_a)K_\sigma K_T$,
at $F_a<F_r<e$ $P=(0,67VF_r+YF_a)K_\sigma K_T$,
static load: $P_0=F_r+Y_0F_a$.

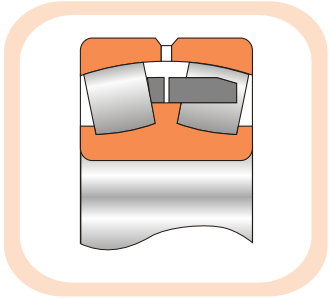
Spherical roller bearings design

Bearings with brass cage

Bearings with inner diameter about 60 mm have solid brass cage centering on spherical surface of outer ring. Inner ring has two end flanges. Middle flange is not provided. Bearing may be used both in standard arrangements and in arrangements operating in vibration conditions.

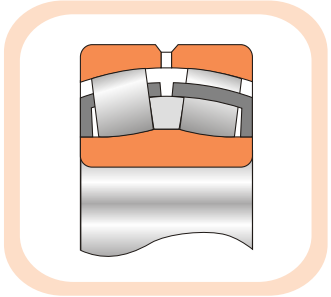


Bearings with inner diameter more than 60 mm are produced with brass cage consisting of two half-cages. Bearings have asymmetric barrel-type rollers, stiffened middle flange and two end flanges.



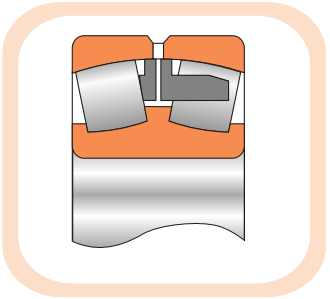
Bearings with steel shaped cage

Bearings are produced with symmetric barrel-type rollers and steel shaped cage. Inner ring has no flanges. Bearing has non-locating guide ring.



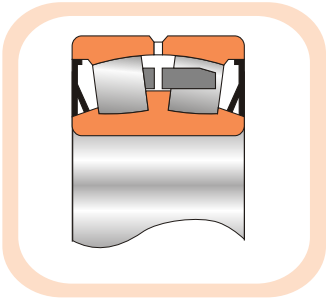
Bearings for arrangements operating in vibration conditions

Bearings are produced with brass cage consisting of two half-cages. Cage shall be centered on spherical surface of outer ring. Bearings have stiffened middle flange and two end flanges.



Bearings wit seals

Bearings with double -sided seal are provided to operate in contaminated environment. Double -sided double-edge sealing provides preventing from bearing contamination. Bearings are produced with brass cage, symmetric and asymmetric rollers.



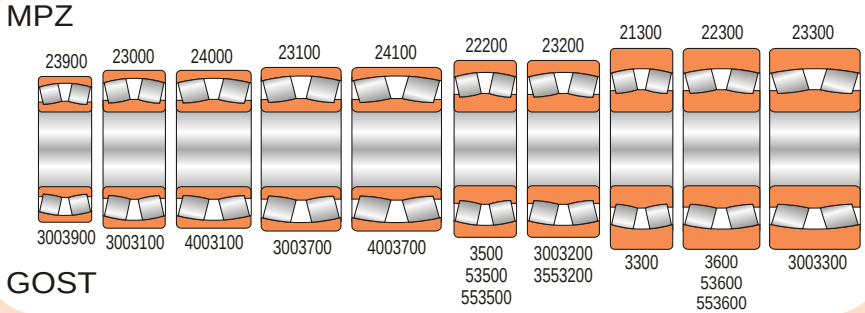
Spherical roller bearings, double row marking

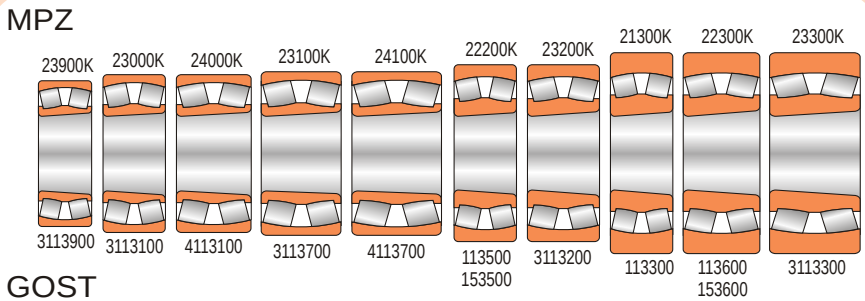
Marking of spherical roller bearings, double row approved by JSC "MPZ" includes base number identification and additional letter and number identifications. Letter identifications corresponds ISO identification but there is number of bearings which has letter identification under GOST 3189-89. So the catalogue has two columns in first of which bearings marking under GOST are specified and in the second one bearings marking under MPZ are specified.

Additional specifications are provided under number identification (prefix) and after such identification (suffix). Prefix is used to specify bearing parts (for example, updated width in spherical roller bearing with sealing). Suffix specifies bearing design as well as feature of construction of bearings produced previously.

Total bearing marking shall be applied in the end face of bearing ring.

Comparative base number identification of MPZ and GOST





Suffixes of additional identification of MPZ

A updated interior structure, increased load capacity
C modified contact of raceway with rollers

M reinforced brass cage made by lathe work
MB brass cage centering on inner ring
MA brass cage centering on spherical surface of outer ring

L cage made of aluminum
J reinforced shaped steel cage
JB reinforced shaped steel cage centering on inner ring
P cage made of glass-nylon composite

У stiffening parameter of accuracy

К tapered mounting bore, taper 1:12
К30 tapered mounting bore, taper 1:30

C1 radial clearance of bearing is less than standard clearance, corresponds first row on clearance under ISO 5753-1991*
C2 radial clearance is less than standard clearance, corresponds second row on clearance under ISO 5753-1991
C3 radial clearance exceeds standard clearance, corresponds third row on clearance under ISO 5753-1991
C4 radial clearance exceeds standard clearance, corresponds forth row on clearance under ISO 5753-1991
C5 radial clearance exceeds standard clearance, corresponds fifth row on clearance under ISO 5753-1991
* standard radial clearance shall not be specified in identification

P5 bearing accuracy class
P6 bearing accuracy class

W33 circular groove for lubrication and three lubrication holes on mounting surface of outer ring

Rings of bearing operating at high temperature shall be heat treated to stabilize their dimensions with the following parameters:
S0 – up to 150°Ñ
S1 – up to 200°Ñ
S2 – up to 250°Ñ
S3 – up to 300°Ñ
S4 – up to 350°Ñ

HA1 outer and inner ring of bearing made of steel subject to hardening and cementation

N groove for locking washer made on mounting surface of outer ring

HE bearing parts made of vacuum-treated steel

ACMB bearings with increased load capacity, which have modified contact of raceway with rollers, brass cage centering on inner ring

ACMA bearings with increased load capacity, which have modified contact of raceway with rollers, brass cage centering on outer ring

ACLB bearings with increased load capacity, which have modified contact of raceway with rollers, aluminum cage centering on outer ring

ACM bearings with increased load capacity, which have modified contact of raceway with rollers, reinforced brass cage centering on inner ring

ACKM bearings with increased load capacity, which have modified contact of raceway with rollers, reinforced brass cage centering on inner ring with tapered mounting bore of inner ring

Suffixes of additional identification under GOST

АМНУК bearings with increased load capacity, which have modified contact of raceway with rollers, reinforced brass cage centering on inner ring, stiffening parameter of accuracy of bearing parts (applied only with number identification under GOST)

АМНУ bearings with increased load capacity, which have modified contact of raceway with rollers, brass cage centering on inner ring, stiffening parameter of accuracy of bearing parts (applied only with number identification under GOST)

АМНУТ bearings with increased load capacity, which have modified contact of raceway with rollers, brass cage centering on inner ring, stiffening parameter of accuracy of bearing parts. Bearing operates at arrangement temperature above 2000

АМНУ1 bearings with increased load capacity, which have modified contact of raceway with rollers, brass cage centering on inner ring, stiffening parameter of accuracy of bearing parts. End face of inner ring has one key groove preventing rotation of inner ring

АМНУ2 bearings with increased load capacity, which have modified contact of raceway with rollers, brass cage centering on inner ring, stiffening parameter of accuracy of bearing parts. End face of inner ring has two key groove preventing rotation of inner ring

К means modified inner bearing structure (applied only with number identification under GOST)

АМНУ2К bearings with increased load capacity, which have modified contact of raceway with rollers, brass cage centering on inner ring, stiffening parameter of accuracy of bearing parts. End face of inner ring has two key groove preventing rotation of inner ring

У stiffening parameter of accuracy of bearing parts (applied only with number identification under GOST)

У1 stiffening parameter of accuracy of bearing parts. End face of inner ring has one key groove preventing rotation of inner ring

У2 stiffening parameter of accuracy of bearing parts. End face of inner ring has two key groove preventing rotation of inner ring

Sequence of symbols in identification of spherical roller bearings (MPZ designation)

Base number identification	Suffix								
	Inner structure	Groove for locking washer on mounting surface of outer ring	Taper	Cage	Bearing parts subject to cementation and hardening made of vacuum-treated steel	Accuracy	Clearance	Heat treatment	Groove on outer ring with lubrication holes
21300 22200 22300 23000 23100 23200 23300 23900 24000 24100	A C AC	N	K K30	M MA MB P L LA LB J JA JB	HA1 HE	P4 P5 P6	C1 C2 C3 C4 C5	S0 S1 S2 S3 S4	W33

Suffixes specifying bearing of standard accuracy class operating at temperature about 100°Ñ with standard radial groove shall not be specified in the identification of bearing

Marking of spherical roller bearings with double-sided seal

Spherical roller bearings produced by JSC "MBP" till 2005 are identified under GOST. As far as spherical roller bearings with seals have extended width, number identification shall include number “8”, for example, “83720”.

Since 2005 all produced bearings shall have identification number different from identification number GOST.

Bearing identification number includes base number identification under ISO, prefix and suffixes.

Prefix is used to specify extended width of bearing. Suffix specifies design.

Width of bearing “B” is specified below.

Prefixes

B0 bearing width completely in coincidence with bearing width;

B5 bearing width is 5 mm more than standard bearing width;

B6 bearing width is 6 mm more than standard bearing width.

Suffixes

M solid brass cage;
2RZ double-sided rubber reinforced seal.

Marking of vibration proof spherical roller bearings

Marking shall include base number identification and additional number or letter identification.

Number identification shall correspond with ISO.

Suffixes

MA bras cage centering on spherical surface of outer ring

W33 circular groove for lubrication and three lubrication holes on mounting surface of outer ring

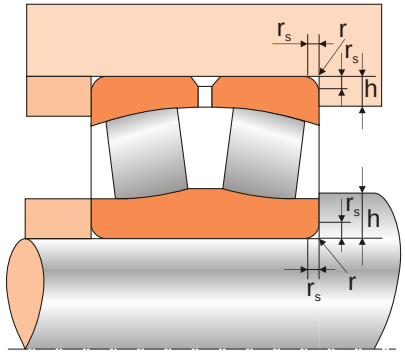
ACMA bearings with increased load capacity, which have modified contact of raceway with rollers, brass cage centering on outer ring

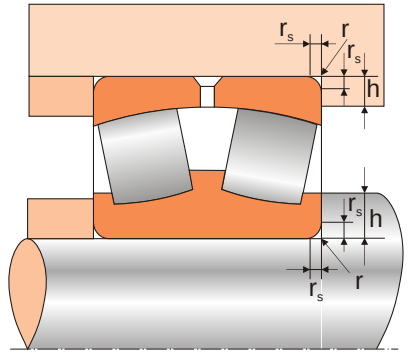
KMA tapered mounting surface of inner ring, brass cage centering on mounting surface of outer ring

Recommended mounting dimension for spherical roller bearings

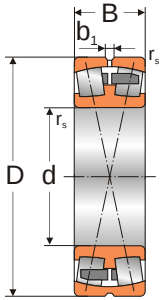
Bearing rings shall be completely supported by shaft and housing fillets rather than bars. So inner radius r of mating part shall be less than minimum size of chamfer coordinate rsmin of spherical roller double row bearing.

High fillet of mating part shall be so that bearing face of mounting chamfer could be enough even if mounting chamfer coordinate is maximum one. Maximum radius r and maximum fillet high h are specified in table.

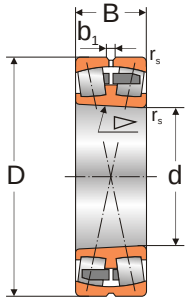




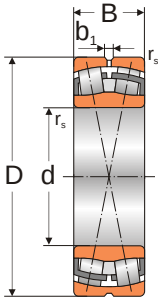
r_{smin}	r_{max}	h_{min} Bearing series 230 239 240	231, 213 241, 223 222, 233 232
mm			
1	1	2,3	2,8
1,1	1	3	3,5
1,5	1,5	3,5	4,5
2	2	4,4	5,5
2,1	2,1	5,1	6
3	2,5	6,2	7
4	3	7,3	8,5
5	4	9	10
6	5	11,5	13
7,5	6	14	16
9,5	8	17	20



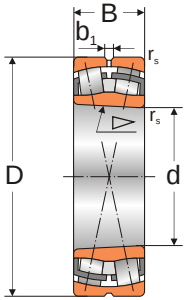
3000H
3003000H
3053000H
4053000H



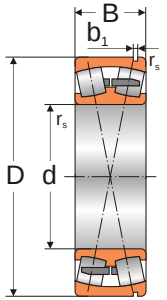
113000H ▻ **1:12**
3113000H ▻ **1:12**
3153000H ▻ **1:12**
4153000H ▻ **1:30**



53000H



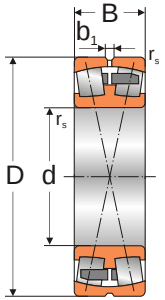
153000H ▻ **1:12**



22300ACNMB

Spherical roller bearings with cylindrical or tapered bore, double row

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions			Design factors			
			dyn.	stat.												
d	D	Â	Ñ	C_0	non-fluid	liquid	GOST	MPZ		d	b_1	r_{smin}	e	Y_1	Y_2	Y_0
mm				kN	rpm		-		kg	mm			-			
40	90	33,0	150	140	5800	7800	**53608H**	**22308 W33**	0,97	**40**	6,3	1,5	0,40	1,67	2,49	1,64
45	100	36,0	180	180	5200	6900	**53609H**	**22309 W33**	1,40	**45**	6,3	1,5	0,39	1,74	2,59	1,70
50	110	40,0	220	220	4600	6300	**53610H**	**22310 W33**	1,85	**50**	6,3	2,0	0,39	1,72	2,56	1,68
	110	40,0	220	220	4600	6300	**153610H**	**22310 KW33**	1,80		6,3	2,0	0,39	1,72	2,56	1,68
55	120	43,0	270	280	4200	5500	**53611H**	**22311 W33**	2,33	**55**	6,3	2,0	0,38	1,76	2,62	1,72
	120	43,0	270	280	4200	5500	**153611H**	**22311 KW33**	2,27		6,3	2,0	0,38	1,76	2,62	1,72
	120	43,0	270	280	4200	5500	**3611H**	**22311 MBW33**	2,31		6,3	2,0	0,38	1,76	2,62	1,72
	120	43,0	270	280	4200	5500	**113611H**	**22311 KMBW33**	2,28		6,3	2,0	0,38	1,76	2,62	1,72
60	110	28,0	150	160	5600	7400	**3512AH**	**22212 MBW33**	1,19	**60**	6,3	1,5	0,24	2,80	4,20	2,80
	110	28,0	150	160	5600	7400	**113512AH**	**22212 KMBW33**	1,43		6,3	1,5	0,24	2,80	4,20	2,80
	130	46,0	310	330	4000	5300	**53612H**	**22312 W33**	3,09		6,3	2,1	0,38	1,78	2,65	1,74
	130	46,0	310	330	4000	5300	**153612H**	**22312 KW33**	2,94		6,3	2,1	0,38	1,78	2,65	1,74
65	120	31,0	190	210	4200	6800	**3513AMH**	**22213 ACMBW33**	1,58	**65**	6,3	1,5	0,26	2,59	3,86	2,53
	120	31,0	190	210	4200	6800	**113513AMH**	**22213 ACKMBW33**	1,55		6,3	1,5	0,26	2,59	3,86	2,53
	140	48,0	330	360	3700	5000	**3613AMH**	**22313 ACMBW33**	3,63		8,0	2,1	0,37	1,80	2,69	1,76
	140	48,0	330	360	3700	5000	**113613AMH**	**22313 ACKMBW33**	3,47		8,0	2,1	0,37	1,80	2,69	1,76
	140	48,0	330	360	3700	5000		**22313 ACNMB**	3,65		3,1	3,0	0,37	1,80	2,69	1,76
70	125	31,0	200	230	4900	6600	**3514MH**	**22214 CMBW33**	1,72	**70**	6,3	1,5	0,27	2,51	3,74	2,46
	125	31,0	200	230	4900	6600	**113514MH**	**22214 CKMBW33**	1,68		6,3	1,5	0,27	2,51	3,74	2,46
	150	51,0	400	430	3400	4500	**53614H**	**22314 W33**	4,41		8,0	2,1	0,37	1,82	2,71	1,78
	150	51,0	400	430	3400	4500	**153614H**	**22314 KW33**	4,27		8,0	2,1	0,37	1,82	2,71	1,78
	150	51,0	400	430	3400	4500	**3614H**	**22314 MBW33**	4,29		8,0	3,5	0,37	1,82	2,71	1,78
	150	51,0	400	430	3400	4500	**113614H**	**22314 KMBW33**	4,22		8,0	2,1	0,37	1,82	2,71	1,78



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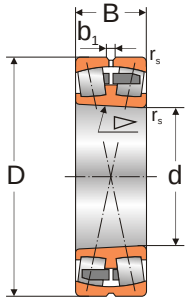

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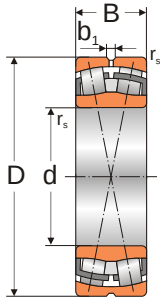
3113000H ▻ **1:12**
3153000H ▻ **1:12**
4153000H ▻ **1:30**



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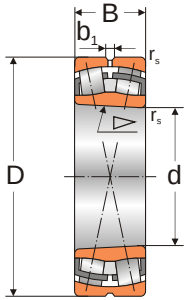
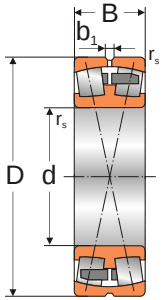


153000H ▻ **1:12**

Spherical roller bearings with cylindrical or tapered bore, double row

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions			Design factors			
			dyn.	stat.												
d	D	Â	Ñ	C_0	non-fluid	liquid	GOST	MPZ		d	b_1	r_{smin}	e	Y_1	Y_2	Y_0
mm				kN	rpm		-		kg	mm			-			
75	130	31,0	210	240	4800	6300	**3515AMH**	**22215 ACMBW33**	1,81	**75**	6,3	1,5	0,22	3,10	4,60	3,00
	130	31,0	210	240	4800	6300	**113515AMH**	**22215 ACKMBW33**	1,76		6,3	1,5	0,22	3,10	4,60	3,00
	160	55,0	430	470	3200	4300	**53615H**	**22315 W33**	5,41		8,0	2,1	0,36	1,85	2,76	1,81
	160	55,0	430	470	3200	4300	**153615H**	**22315 KW33**	5,31		8,0	2,1	0,36	1,85	2,76	1,81
	160	55,0	430	470	3200	4300	**3615H**	**22315 MBW33**	5,27		8,0	2,1	0,38	1,78	2,65	1,74
	160	55,0	430	470	3200	4300	**113615УН**		5,21		8,0	2,1	0,38	1,78	2,65	1,74
80	140	33,0	236	270	3200	4000	**53516HK**	**22216 W33**	2,10	**80**	6,3	2,0	0,23	2,91	4,33	2,84
	140	33,0	236	270	3200	4000	**153516HK**	**22216 KW33**	2,06		6,3	2,0	0,23	2,91	4,33	2,84
	140	33,0	230	270	3200	4000	**3516H**	**22216 MBW33**	2,17		6,3	2,0	0,25	2,68	4,00	2,62
	140	33,0	230	270	3200	4000	**113516H**	**22216 KMBW33**	1,90		6,3	2,0	0,25	2,68	4,00	2,62
	170	58,0	490	540	2000	2800	**53616H**	**22316 W33**	6,49		8,0	2,1	0,36	1,88	2,81	1,84
	170	58,0	490	540	2000	2800	**153616H**	**22316 KW33**	6,31		8,0	2,1	0,36	1,88	2,81	1,84
	170	58,0	480	540	2000	2800	**3616KH**	**22316 MBW33**	6,20		8,0	2,1	0,36	1,88	2,80	1,84
	170	58,0	480	540	2000	2800	**113616KH**	**22316 KMBW33**	6,20		8,0	2,1	0,36	1,88	2,80	1,84
85	150	36,0	285	320	4000	5600	**3517H**	**22217 MBW33**	2,70	**85**	6,3	2,0	0,26	2,65	3,94	2,59
	150	36,0	285	320	4000	5600	**113517H**	**22217 KMBW33**	2,60		6,3	2,0	0,26	2,65	3,94	2,59
	180	60,0	550	620	2800	3800	**3617H**	**22317 MBW33**	7,65		8,0	3,0	0,37	1,84	2,74	1,80
	180	60,0	550	620	2800	3800	**113617H**	**22317 KMBW33**	7,60		8,0	3,0	0,37	1,84	2,74	1,80



3000H
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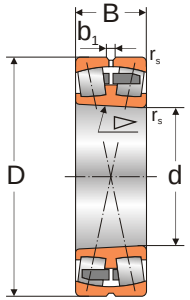

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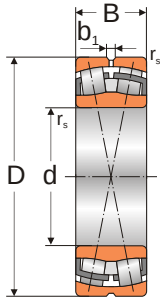
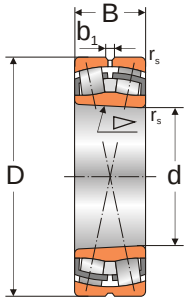
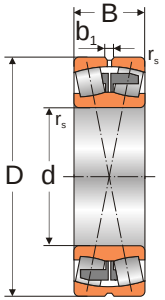
3113000H ▻ **1:12**
3153000H ▻ **1:12**
4153000H ▻ **1:30**



53000H



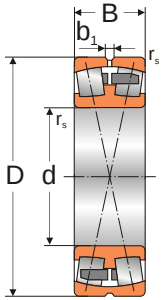
153000H ▻ **1:12**



3553000H

Spherical roller bearings with cylindrical or tapered bore, double row

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions			Design factors			
			dyn.	stat.												
d	D	Â	Ñ	C_0	non-fluid	liquid	GOST	MPZ		d	b_1	r_{smin}	e	Y_1	Y_2	Y_0
mm				kN	rpm		-		kg	mm			-			
90	160	40,0	320	370	3700	5300	**53518H**	**22218 W33**	3,44	**90**	6,3	2,0	0,25	2,73	4,06	2,67
	160	40,0	320	370	3700	5300	**153518H**	**22218 KW33**	3,37		6,3	2,0	0,25	2,73	4,06	2,67
	160	40,0	290	350	3600	5200	**3518H**	**22218 MBW33**	3,48		6,3	2,0	0,27	2,53	3,77	2,48
	160	40,0	290	350	3600	5200	**113518H**	**22218 KMBW33**	3,41		6,3	2,0	0,27	2,53	3,77	2,48
	190	64,0	610	695	2600	3600	**53618H**	**22318 W33**	8,80		11,0	3,0	0,36	1,90	2,83	1,86
	190	64,0	610	695	2600	3600	**153618H**	**22318 KW33**	8,60		11,0	3,0	0,36	1,90	2,83	1,86
	190	64,0	610	695	2600	3600	**3618AMH**	**22318 ACMBW33**	8,87		11,0	3,0	0,37	1,83	2,72	1,78
	190	64,0	610	695	2600	3600	**113618AMH**	**22318 ACKMBW33**	8,58		11,0	3,0	0,37	1,83	2,72	1,78
	190	73,0	620	753	2400	3400	**3553318НЛ**	**23318 MBW33**	9,80		11,0	3,0	0,39	1,71	2,55	1,67
95	170	43,0	380	450	2400	3200	**53519H**	**22219 W33**	4,17	**95**	8,0	2,1	0,25	2,69	4,01	2,63
	170	43,0	380	450	2400	3200	**153519H**	**22219 KW33**	3,97		8,0	2,1	0,25	2,69	4,01	2,63
	200	67,0	670	765	1700	2200	**53619H**	**22319 W33**	9,79		11,0	4,0	0,35	1,94	2,89	1,90
	200	67,0	670	765	1700	2200	**153619H**	**22319 KW33**	9,31		11,0	4,0	0,35	1,94	2,89	1,90
100	180	46,0	420	490	3300	4500	**53520H**	**22220 W33**	4,60	**100**	8,0	2,1	0,25	2,67	3,97	2,61
	180	46,0	420	490	3300	4500	**153520H**	**22220 KW33**	4,50		8,0	2,1	0,25	2,67	3,97	2,61
	180	46,0	420	490	3300	4500	**3520H**	**22220 MBW33**	5,00		8,0	2,1	0,27	2,47	3,67	2,41
	180	46,0	420	490	3300	4500	**113520H**	**22220 KMBW33**	4,95		8,0	2,1	0,27	2,47	3,67	2,41
	180	60,3	480	600	2400	3400	**3003220H**	**23220 MBW33**	6,93		8,0	2,1	0,35	1,92	2,86	1,88
	180	60,3	480	600	2400	3400	**3113220H**	**23220 KMBW33**	6,75		8,0	2,1	0,35	1,92	2,86	1,88
	215	73,0	815	950	2400	3000	**53620H**	**22320 W33**	13,20		11,0	3,0	0,35	1,91	2,85	1,87
	215	73,0	815	950	2400	3000	**153620H**	**22320 KW33**	12,57		11,0	3,0	0,35	1,91	2,85	1,87
	215	73,0	815	950	2400	3000	**3620AMH**	**22320 ACMBW33**	12,80		11,0	3,0	0,37	1,81	2,70	1,77
	215	73,0	815	950	2400	3000	**113620AMH**	**22320 ACKMBW33**	12,70		11,0	3,0	0,37	1,81	2,70	1,77



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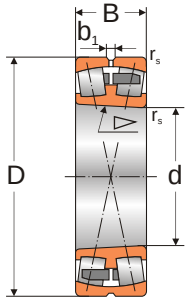

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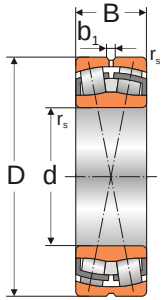
3153000H ▻ **1:12**
4153000H ▻ **1:30**



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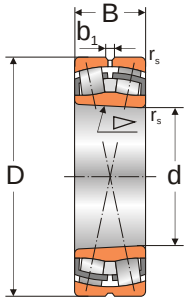
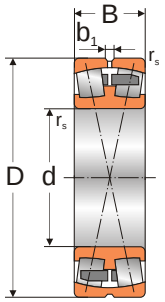


153000H ▻ **1:12**

Spherical roller bearings with cylindrical or tapered bore, double row

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions			Design factors			
			dyn.	stat.												
d	D	Â	Ñ	C_0	non-fluid	liquid	GOST	MPZ		d	b_1	r_{smin}	e	Y_1	Y_2	Y_0
mm				kN	rpm		-		kg	mm			-			
110	170	45,0	300	430	3300	4200	**3003122H**	**23022 MBW33**	3,78	**110**	8,0	2,0	0,25	2,69	4,01	2,63
	170	45,0	300	430	3300	4200	**3113122H**	**23022 KMBW33**	3,66		8,0	2,0	0,25	2,69	4,01	2,63
	200	53,0	560	640	3000	4000	**53522H**	**22222 W33**	7,10		8,0	2,1	0,28	2,43	3,62	2,38
	200	53,0	560	640	3000	4000	**153522H**	**22222 KW33**	6,95		8,0	2,1	0,28	2,43	3,62	2,38
	200	53,0	550	630	3000	4000	**3522H**	**22222 MBW33**	7,50		8,0	2,1	0,28	2,39	3,55	2,38
	200	53,0	550	630	3000	4000	**113522H**	**22222 KMBW33**	7,35		8,0	2,1	0,28	2,39	3,55	2,38
	200	69,8	600	760	2200	3000	**3003222AH**	**23222 MBW33**	9,90		8,0	2,1	0,36	1,89	2,82	1,85
	200	69,8	600	760	2200	3000	**3113222AH**	**23222 KMBW33**	9,60		8,0	2,1	0,36	1,89	2,82	1,85
	240	80,0	940	1110	1900	2700	**3622AMHK**	**22322 ACMW33**	19,02		14,0	3,0	0,37	1,83	2,72	1,79
	240	80,0	940	1110	1900	2700	**113622AMHK**	**22322 ACKMW33**	18,66		14,0	3,0	0,37	1,83	2,72	1,79
120	180	46,0	350	510	3200	4000	**3003124H**	**23024 MBW33**	4,41	**120**	8,0	2,0	0,26	2,61	3,89	2,55
	180	46,0	350	510	3200	4000	**3113124H**	**23024 KMBW33**	4,27		8,0	2,0	0,26	2,61	3,89	2,55
	215	58,0	630	760	2800	3700	**53524H**	**22224 W33**	8,70		11,0	2,1	0,27	2,51	3,74	2,45
	215	58,0	630	760	2800	3700	**153524H**	**22224 KW33**	8,60		11,0	2,1	0,27	2,51	3,74	2,45
	215	58,0	630	760	2800	3700	**3524H**	**22224 MBW33**	9,12		11,0	2,1	0,29	2,36	3,51	2,31
	215	58,0	630	760	2800	3700	**113524H**	**22224 KMBW33**	8,50		11,0	2,1	0,29	2,36	3,51	2,31
	215	76,0	690	940	2000	2800	**3003224H**	**23224 MBW33**	11,65		11,0	2,1	0,35	1,91	2,85	1,87
	215	76,0	690	940	2000	2800	**3113224H**	**23224 KMBW33**	11,35		11,0	2,1	0,35	1,91	2,85	1,87
	260	86,0	960	1120	2000	2600	**3624AMH**	**22324 ACMBW33**	23,00		14,0	3,0	0,37	1,82	2,71	1,78
	260	86,0	960	1120	2000	2600	**113624AMH**	**22324 ACKMBW33**	22,64		14,0	3,0	0,37	1,82	2,71	1,78



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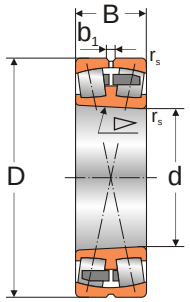

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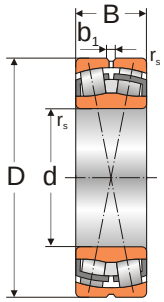

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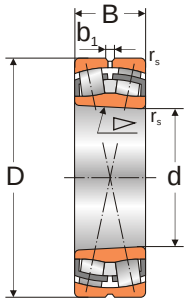
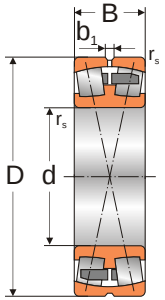


153000H ▻ **1:12**

Spherical roller bearings with cylindrical or tapered bore, double row

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions			Design factors			
			dyn.	stat.												
d	D	Â	Ñ	C_0	non-fluid	liquid	GOST	MPZ		d	b_1	r_{smin}	e	Y_1	Y_2	Y_0
mm				kN	rpm		-		kg	mm			-			
130	200	52,0	430	630	2800	3600	**3003126H**	**23026 MBW33**	6,30	**130**	8,0	2,0	0,25	2,73	4,08	2,67
	200	52,0	430	630	2800	3600	**3113126H**	**23026 KMBW33**	6,25		8,0	2,0	0,25	2,73	4,08	2,67
	210	64,0	560	780	2400	3200	**3003726H**	**23126 W33**	8,60		8,0	2,0	0,28	2,40	3,60	2,50
	210	64,0	560	780	2400	3200	**3113726H**	**23126 KW33**	8,50		8,0	2,0	0,28	2,40	3,60	2,50
	230	80,0	780	1140	1900	2500	**3053226НЛ**	**23226 MBW33**	14,20		11,0	3,0	0,33	2,10	3,10	2,00
	230	80,0	780	1140	1900	2500	**3153226НЛ**	**23226 KMBW33**	14,10		11,0	3,0	0,33	2,10	3,10	2,00
	230	64,0	735	930	1800	2400	**53526H**	**22226 W33**	10,80		11,0	3,0	0,28	2,45	3,65	2,35
	230	64,0	735	930	1800	2400	**153526H**	**22226 KW33**	10,50		11,0	3,0	0,28	2,45	3,65	2,35
	230	64,0	735	930	2500	3500	**3526H**	**22226 MBW33**	11,10		11,0	3,0	0,29	2,31	3,44	2,26
	230	64,0	735	930	2500	3500	**113526H**	**22226 KMBW33**	10,78		11,0	3,0	0,29	2,31	3,44	2,26
	280	93,0	1120	1320	1700	2400	**3626K**	**22326 MBW33**	29,09		16,0	4,0	0,37	1,84	2,74	1,80
140	210	53,0	460	680	2700	3300	**3003128H**	**23028 MBW33**	6,76	**140**	8,0	2,0	0,25	2,70	4,03	2,65
	210	53,0	460	680	2700	3300	**3113128H**	**23028 KMBW33**	6,50		8,0	2,0	0,25	2,70	4,03	2,65
	225	68,0	630	920	1600	2000	**3003728АМН**	**23128 ACMBW33**	11,26		11,0	2,1	0,27	2,50	3,70	2,40
	225	68,0	630	920	1600	2000	**3113728АМН**	**23128 ACKMBW33**	10,93		11,0	2,1	0,27	2,50	3,70	2,40
	250	68,0	710	930	2400	3100	**3528АМНК**	**22228 ACMW33**	14,18		11,0	3,0	0,29	2,35	3,50	2,30
	250	68,0	710	930	2400	3100	**113528АМНК**	**22228 ACKMW33**	13,88		11,0	3,0	0,29	2,35	3,50	2,30
	250	88,0	915	1220	1600	2300	**3053228НЛ**	**23228 MBW33**	18,70		11,0	3,0	0,36	1,90	2,89	1,83
	250	88,0	915	1220	1600	2300	**3153228НЛ**	**23228 KMBW33**	18,00		11,0	3,0	0,36	1,90	2,89	1,83
	250	68,0	710	930	2400	3100	**53528H**	**22228 W33**	14,20		11,0	3,0	0,27	2,52	3,76	2,52
	250	68,0	710	930	2400	3100	**153528H**	**22228 KW33**	13,14		11,0	3,0	0,27	2,52	3,76	2,52
	300	102,0	1290	1560	1700	2200	**3628АМНК**	**22328 ACMW33**	35,58		16,0	4,0	0,38	1,76	2,62	1,72
	300	102,0	1290	1560	1700	2200	**113628АМНК**	**22328 ACKMW33**	35,04		16,0	4,0	0,38	1,76	2,62	1,72



3000H
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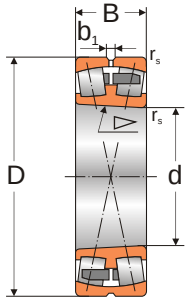
3053000H
4053000H



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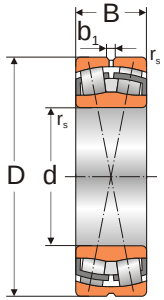
3153000H ▻ **1:12**
4153000H ▻ **1:30**



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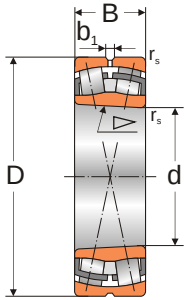
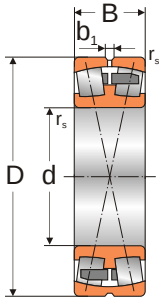


153000H ▻ **1:12**

Spherical roller bearings with cylindrical or tapered bore, double row

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions			Design factors			
			dyn.	stat.												
d	D	Â	Ñ	C_0	non-fluid	liquid	GOST	MPZ		d	b_1	r_{smin}	e	Y_1	Y_2	Y_0
mm				kN	rpm		-		kg	mm			-			
150	225	56,0	510	750	2400	3200	**3003130НК**	**23030 MW33**	8,22	**150**	11,0	2,1	0,22	2,70	4,00	2,65
	225	56,0	510	750	2400	3200	**3113130H**	**23030 KMBW33**	7,97		11,0	2,1	0,22	2,70	4,00	2,65
	250	80,0	830	1200	2000	2600	**3003730AH**	**23130 MBW33**	16,30		11,0	2,1	0,32	2,14	3,18	2,08
	250	80,0	830	1200	2000	2600	**3113730AH**	**23130 KMBW33**	15,81		11,0	2,1	0,32	2,14	3,18	2,08
	250	100,0	1000	1500	1400	2100	**4053730НЛ**	**24130 MBW33**	19,40		8,0	2,1	0,40	1,70	2,50	1,60
	270	73,0	850	1010	2200	3000	**53530H**	**22230 W33**	18,25		14,0	3,0	0,27	2,53	3,76	2,47
	270	73,0	850	1010	2200	3000	**153530H**	**22230 KW33**	17,87		14,0	3,0	0,27	2,53	3,76	2,47
	270	73,0	850	1010	2200	3000	**3530АМНК**	**22230 ACMW33**	17,80		14,0	3,0	0,29	2,35	3,50	2,30
	270	73,0	850	1010	2200	3000	**113530АМНК**	**22230 ACKMW33**	17,50		14,0	3,0	0,29	2,35	3,50	2,30
	270	96,0	1080	1460	1500	2100	**3003230H**	**23230 MBW33**	23,60		14,0	3,0	0,36	1,87	2,81	1,84
	270	96,0	1080	1460	1500	2100	**3113230H**	**23230 KMBW33**	23,10		14,0	3,0	0,36	1,87	2,81	1,84
	320	108,0	1450	1750	1600	2000	**3630АМНК**	**22330 ACMW33**	43,10		16,0	4,0	0,38	1,78	2,64	1,74
	320	108,0	1450	1750	1600	2000	**113630АМНК**	**22330 ACKMW33**	42,67		16,0	4,0	0,38	1,78	2,64	1,74
160	240	60,0	590	880	2400	3000	**3003132АМН**	**23032 ACMBW33**	9,96	**160**	11,0	2,1	0,25	2,71	4,04	2,65
	240	60,0	590	880	2400	3000	**3113132АМН**	**23032 ACKMBW33**	9,68		11,0	2,1	0,25	2,71	4,04	2,65
	270	86,0	980	1350	1700	2300	**3003732АМН**	**23132 ACMBW33**	20,30		14,0	2,1	0,32	2,13	3,17	2,08
	270	86,0	980	1350	1700	2300	**3113732АМН**	**23132 ACMBW33**	19,85		14,0	2,1	0,32	2,13	3,17	2,08
	290	80,0	1000	1300	2000	2800	**3532АМНК**	**22232 ACMW33**	23,62		14,0	3,0	0,29	2,29	3,40	2,24
	290	80,0	1000	1300	2000	2800	**113532АМНК**	**22232 ACKMW33**	23,18		14,0	3,0	0,29	2,29	3,40	2,24
	290	104,0	1220	1660	1400	2100	**3053232H**	**23232 MBW33**	30,20		14,0	3,0	0,37	1,84	2,74	1,80
	290	104,0	1220	1660	1400	2100	**3153232H**	**23232 KMBW33**	29,30		14,0	3,0	0,37	1,84	2,74	1,80
	290	80,0	1000	1300	2000	2800	**53532H**	**22232 W33**	23,50		14,0	3,0	0,27	2,52	3,76	2,52
	290	80,0	1000	1300	2000	2800	**153532H**	**22232 KW33**	22,90		14,0	3,0	0,27	2,52	3,76	2,52
	340	114,0	1600	1960	1500	1900	**3632АМНК**	**22332 ACMW33**	51,24		16,0	4,0	0,38	1,80	2,69	1,76
	340	114,0	1600	1960	1500	1900	**113632АМНК**	**22332 ACKMW33**	50,24		16,0	4,0	0,38	1,80	2,69	1,76



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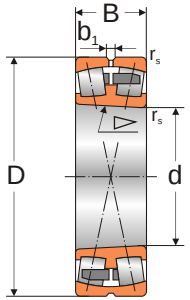

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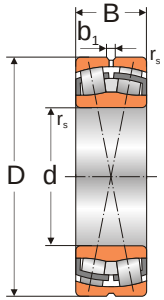
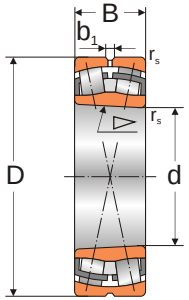
3113000H ▻ **1:12**
3153000H ▻ **1:12**
4153000H ▻ **1:30**



53000H



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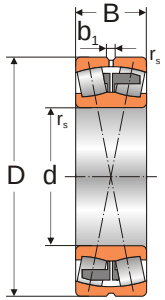
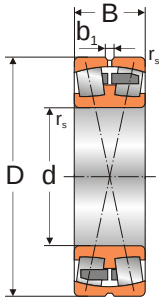


4553000H

Spherical roller bearings with cylindrical or tapered bore, double row

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions			Design factors			
			dyn.	stat.												
d	D	Â	Ñ	C_0	non-fluid	liquid	GOST	MPZ		d	b_1	r_{smin}	e	Y_1	Y_2	Y_0
mm				kN	rpm		-		kg	mm			-			
170	260	67,0	710	1050	2500	2800	**3003134H**	**23034 MBW33**	12,55	**170**	11,0	2,1	0,23	3,00	4,40	2,90
	260	67,0	710	1050	2500	2800	**3113134H**	**23034 KMBW33**	12,15		11,0	2,1	0,23	3,00	4,40	2,90
	260	90,0	930	1480	1400	2300	**4053134НЛ**	**24034 MBW33**	17,20		8,0	2,0	0,33	2,00	3,00	2,00
	280	88,0	1040	1540	1800	2400	**3053734НЛ**	**23134 MBW33**	21,20		16,0	2,1	0,31	2,16	3,22	2,11
	280	88,0	1040	1540	1800	2400	**3153734НЛ**	**23134 KMBW33**	21,02		16,0	2,1	0,31	2,16	3,22	2,11
	280	109,0	1200	1840	1200	1900	**4053734НЛ**	**24134 MBW33**	27,22		8,0	2,1	0,38	1,74	2,50	1,70
	310	86,0	1120	1450	1900	2500	**3534АМН**	**22234 ACMBW33**	28,71		16,0	4,0	0,30	2,27	3,37	2,21
	310	86,0	1120	1450	1900	2500	**113534АМН**	**22234 ACKMBW33**	27,91		16,0	4,0	0,30	2,27	3,37	2,21
	310	110,0	1380	1930	1300	2000	**3003234АН**	**23234 MBW33**	36,77		16,0	4,0	0,33	2,00	3,00	2,00
	360	120,0	1760	2160	1400	1800	**3634АМНК**	**22334 ACMW33**	59,80		16,0	4,0	0,37	1,81	2,69	1,77
	360	120,0	1760	2160	1400	1800	**113634АМНК**	**22334 ACKMW33**	58,60		16,0	4,0	0,37	1,81	2,69	1,77
180	280	74,0	830	1240	1900	2700	**3003136H**	**23036 MBW33**	15,79	**180**	14,0	2,1	0,26	2,56	3,81	2,50
	280	74,0	830	1240	1900	2700	**3113136H**	**23036 KMBW33**	15,49		14,0	2,1	0,26	2,56	3,81	2,50
	280	100,0	1080	1790	950	1300	**4553136НЛ**	**24036 MBW33**	23,30		8,0	2,1	0,37	1,80	2,70	1,80
	300	96,0	1090	1800	1500	2100	**3053736НЛ**	**23136 MBW33**	27,90		16,0	3,0	0,32	2,12	3,25	2,00
	300	96,0	1090	1800	1500	2100	**3153736НЛ**	**23136 KMBW33**	27,00		16,0	3,0	0,32	2,12	3,25	2,00
	320	86,0	1180	1570	1800	2700	**3536АМНК**	**22236 ACMW33**	30,47		16,0	4,0	0,28	2,37	3,56	2,32
	320	86,0	1180	1570	1800	2700	**113536АМНК**	**22236 ACKMW33**	29,79		16,0	4,0	0,28	2,37	3,56	2,32
	380	126,0	2000	2450	1300	1600	**3636АМНК**	**22336 ACMW33**	71,04		22,0	4,0	0,37	1,83	2,71	1,78
	380	126,0	2000	2450	1300	1600	**113636АМНК**	**22336 ACKMW33**	69,54		22,0	4,0	0,37	1,83	2,71	1,78



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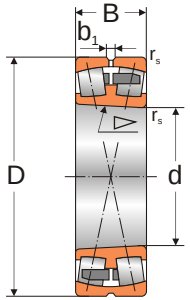

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3113000H ▻ **1:12**
3153000H ▻ **1:12**
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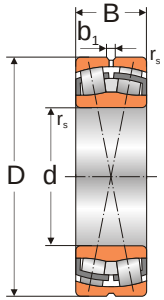

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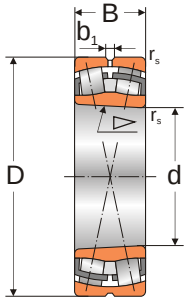
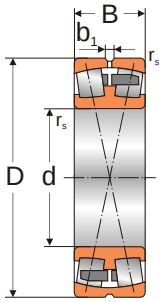


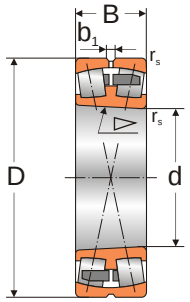
153000H ▻ **1:12**

Spherical roller bearings with cylindrical or tapered bore, double row

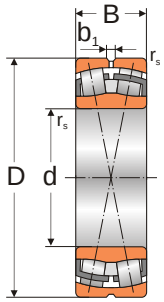
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions			Design factors			
			dyn.	stat.												
d	D	Â	Ñ	C_0	non-fluid	liquid	GOST	MPZ		d	b_1	r_{smin}	e	Y_1	Y_2	Y_0
mm				kN	rpm		-		kg	mm			-			
190	290	75,0	870	1350	1900	2400	**3053138НЛ**	**23038 MBW33**	18,00	**190**	14,0	2,1	0,25	2,69	4,00	2,68
	290	75,0	870	1350	1900	2400	**3153138НЛ**	**23038 KMBW33**	17,40		14,0	2,1	0,25	2,69	4,00	2,68
	320	104,0	1370	2080	1500	1900	**3053738H**	**23138 MBW33**	33,12		16,0	3,0	0,33	2,07	3,09	2,03
	320	104,0	1370	2080	1500	1900	**3153738H**	**23138 KMBW33**	33,02		16,0	3,0	0,33	2,07	3,09	2,03
	340	92,0	1270	1700	1700	2300	**3538НК**	**22238 MW33**	36,40		16,0	4,0	0,29	2,33	3,46	2,27
	340	92,0	1270	1700	1700	2300	**113538НК**	**22238 KMW33**	36,10		16,0	4,0	0,29	2,33	3,46	2,27
	400	132,0	2120	2660	1200	1800	**3638H**	**22338 MBW33**	80,73		22,0	5,0	0,36	1,85	2,75	1,81
	400	132,0	2120	2660	1200	1800	**113638H**	**22338 KMBW33**	78,48		22,0	5,0	0,36	1,85	2,75	1,81
200	310	82,0	1000	1520	1800	2100	**3003140H**	**23040 MBW33**	22,50	**200**	14,0	2,1	0,27	2,53	3,76	2,46
	310	82,0	1000	1520	1800	2100	**3113140H**	**23040 KMBW33**	21,80		14,0	2,1	0,27	2,53	3,76	2,46
	340	112,0	1600	2350	1400	1800	**3113740НЛ**	**23140 KMBW33**	43,24		16,0	3,0	0,32	2,14	3,18	2,09
	360	98,0	1460	2000	1600	2100	**3540AMH**	**22240 ACMBW33**	44,40		16,0	4,0	0,29	2,31	3,44	2,26
	360	98,0	1460	2000	1600	2100	**113540AMH**	**22240 ACKMBW33**	43,50		16,0	4,0	0,29	2,31	3,44	2,26
	420	138,0	2320	2900	1200	1500	**3640AMНК**	**22340 ACMW33**	93,80		22,0	5,0	0,36	1,87	2,78	1,83
	420	138,0	2320	2900	1200	1500	**113640AMНК**	**22340 ACKMW33**	90,00		22,0	5,0	0,36	1,87	2,78	1,83
220	340	90,0	1220	1860	1600	2000	**3003144НК**	**23044 MW33**	31,16	**220**	14,0	3,0	0,26	2,60	3,87	2,54
	340	90,0	1220	1860	1600	2000	**3113144НК**	**23044 KMW33**	29,95		14,0	3,0	0,26	2,60	3,87	2,54
	370	120,0	1800	2760	1300	1600	**3003744H**	**23144 MBW33**	54,70		16,0	4,0	0,34	1,80	2,69	1,77
	370	120,0	1800	2760	1300	1600	**3113744H**	**23144 KMBW33**	52,00		16,0	4,0	0,34	1,80	2,69	1,77
	370	150,0	2100	3380	900	1300	**4053744НК**	**24144 MBW33**	67,70		11,0	4,0	0,41	1,69	3,70	2,51
	400	108,0	1760	2400	1700	1900	**3544AMH**	**22244 ACMBW33**	60,20		16,0	4,0	0,28	2,42	3,60	2,37
	400	108,0	1760	2400	1700	1900	**113544AMH**	**22244 ACKMBW33**	60,00		16,0	4,0	0,28	2,42	3,60	2,37
	400	144,0	2300	3500	1100	1400	**3003244H**	**23244 MBW33**	83,20		16,0	5,0	0,39	1,72	2,59	1,68
	400	144,0	2300	3500	1100	1400	**3113244H**	**23244 KMBW33**	82,70		16,0	5,0	0,39	1,72	2,59	1,68
	460	145,0	2700	3450	1000	1400	**3644AMНК**	**22344 ACMW33**	124,70		22,0	5,0	0,35	1,95	2,90	1,91
	460	145,0	2700	3450	1000	1400	**113644AMНК**	**22344 ACKMW33**	124,20		22,0	5,0	0,35	1,95	2,90	1,91



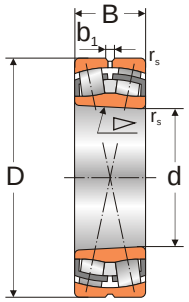
3000H
3003000H
3053000H
4053000H



113000H ▻ **1:12**
3113000H ▻ **1:12**
3153000H ▻ **1:12**
4153000H ▻ **1:30**



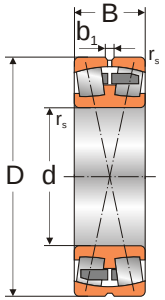
53000H



153000H ▻ **1:12**

Spherical roller bearings with cylindrical or tapered bore, double row

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions			Design factors			
			dyn.	stat.												
d	D	Â	Ñ	C_0	non-fluid	liquid	GOST	MPZ		d	b_1	r_{smin}	e	Y_1	Y_2	Y_0
mm				kN	rpm		-		kg	mm			-			
240	360	92,0	1290	2160	1500	1900	**3003148AMH**	**23048 ACMBW33**	34,10	**240**	16,0	3,0	0,25	2,75	4,10	2,69
	360	92,0	1290	2160	1500	1900	**3113148AMH**	**23048 ACKMBW33**	33,20		16,0	3,0	0,25	2,75	4,10	2,69
	440	120,0	2000	3000	1300	1700	**3548AMHK**	**22248 ACMW33**	83,26		22,0	4,0	0,27	2,50	3,70	2,50
	440	120,0	2000	3000	1300	1700	**113548AMHK**	**22248 ACKMW33**	81,56		22,0	4,0	0,27	2,50	3,70	2,50
260	400	104,0	1600	2540	1500	1900	**3003152AMH**	**23052 ACMBW33**	49,60	**260**	16,0	4,0	0,26	2,61	3,89	2,55
	400	104,0	1600	2540	1500	1900	**3113152AMH**	**23052 ACKMBW33**	48,37		16,0	4,0	0,26	2,61	3,89	2,55
	440	144,0	2530	3900	1100	1400	**3003752AMHK**	**23152 ACMW33**	93,56		22,0	4,0	0,33	2,02	3,04	1,77
	440	144,0	2530	3900	1100	1400	**3113752AMHK**	**23152 ACKMW33**	87,78		22,0	4,0	0,33	2,02	3,04	1,77
	480	130,0	2640	3560	1100	1600	**3552H**	**22252 MBW33**	101,20		22,0	5,0	0,30	2,28	3,40	2,23
	480	130,0	2640	3560	1100	1600	**113552H**	**22252 KMBW33**	100,50		22,0	5,0	0,30	2,28	3,40	2,23
	540	165,0	3550	4590	850	1000	**3652AMHK**	**22352 ACMW33**	192,42		22,0	6,0	0,33	2,01	3,00	1,97
	540	165,0	3550	4590	850	1000	**113652AMHK**	**22352 ACKMW33**	192,20		22,0	6,0	0,33	2,01	3,00	1,97
280	420	106,0	1730	2890	1200	1500	**3003156AMHK**	**23056 ACMW33**	54,18	**280**	16,0	4,0	0,25	2,70	4,02	2,64
	420	106,0	1730	2890	1200	1500	**3113156AMHK**	**23056 ACKMW33**	52,88		16,0	4,0	0,25	2,70	4,02	2,64
	460	146,0	2650	4250	1000	1200	**3003756AMH**	**23156 ACMBW33**	99,55		22,0	5,0	0,33	2,04	3,04	2,06
	460	146,0	2650	4250	1000	1200	**3113756AMH**	**23156 ACKMBW33**	96,45		22,0	5,0	0,33	2,04	3,04	2,06
	500	130,0	2680	3740	1100	1300	**3556AH**	**22256 MBW33**	120,70		22,0	5,0	0,28	2,39	3,56	2,34
	500	130,0	2680	3740	1100	1300	**113556AH**	**22256 KMBW33**	120,50		22,0	5,0	0,28	2,39	3,56	2,34
	580	175,0	4000	5280	750	1000	**3656AMHK**	**22356 ACMW33**	236,73		22,0	6,0	0,33	2,03	3,02	2,02
	580	175,0	4000	5280	750	1000	**113656AMHK**	**22356 ACKMW33**	232,21		22,0	6,0	0,33	2,03	3,02	2,02



3000H
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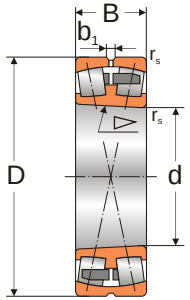
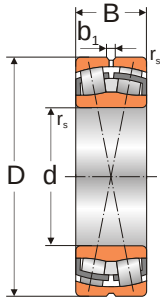
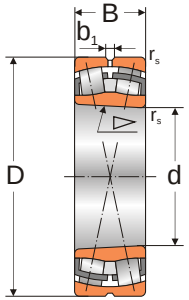
3053000H
4053000H



113000H ▻ **1:12**
3113000H ▻ **1:12**
3153000H ▻ **1:12**
4153000H ▻ **1:30**



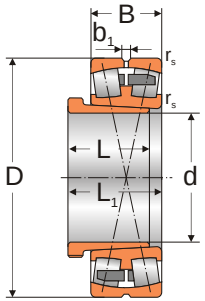
53000H



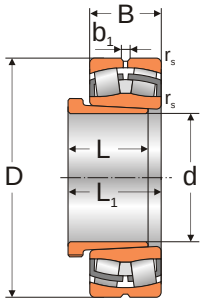
153000H ▻ **1:12**

Spherical roller bearings with cylindrical or tapered bore, double row

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions			Design factors			
d	D	Â	dyn. Ñ	stat. C_0	non-fluid	liquid	GOST	MPZ		d	b_1	r_{smin}	e	Y_1	Y_2	Y_0
mm				kN	rpm		-		kg	mm			-			
300	460	118,0	2100	3480	1100	1500	**3003160AMH**	**23060 ACMBW33**	73,59		22,0	4,0	0,25	2,64	3,93	2,58
	460	118,0	2100	3480	1100	1500	**3113160AMH**	**23060 ACKMBW33**	71,56		22,0	4,0	0,25	2,64	3,93	2,58
	500	160,0	3200	5150	940	1100	**3003760HK**	**23160 MW33**	127,60		22,0	5,0	0,36	1,90	2,83	1,86
320	480	121,0	2250	3750	1000	1300	**3003164AMHK**	**23064 ACMW33**	80,51	**320**	16,0	4,0	0,26	2,55	3,08	2,50
	480	121,0	2250	3750	1000	1300	**3113164AMHK**	**23064 ACKMW33**	78,26		16,0	4,0	0,26	2,55	3,08	2,50
	580	150,0	3600	5000	940	1250	**3564AMH**	**22264 ACMBW33**	180,10		22,0	5,0	0,27	2,55	3,80	2,55
	580	150,0	3600	5000	940	1250	**113564AMH**	**22264 ACKMBW33**	175,70		22,0	5,0	0,27	2,55	3,80	2,55
	580	208,0	4400	6900	700	980	**3003264AMHK**	**23264 ACMW33**	249,10		22,0	5,0	0,37	1,81	2,69	1,80
	580	208,0	4400	6900	700	980	**3113264AMHK**	**23264 ACKMW33**	241,80		22,0	5,0	0,37	1,81	2,69	1,80
340	520	133,0	2650	4580	950	1150	**3003168AMHK**	**23068 ACMW33**	108,30	**340**	22,0	5,0	0,26	2,55	3,08	2,50
	520	133,0	2650	4580	950	1150	**3113168AMHK**	**23068 ACKMW33**	105,22		22,0	5,0	0,26	2,55	3,08	2,50
360	540	134,0	2750	4850	930	1170	**3003172H**	**23072 MBW33**	112,90	**360**	22,0	5,0	0,26	2,60	3,87	2,54
	540	134,0	2750	4850	930	1170	**3113172H**	**23072 KMBW33**	109,90		22,0	5,0	0,26	2,60	3,87	2,54
400	600	148,0	3250	5700	850	1100	**3003180AMH**	**23080 ACMBW33**	153,14	**400**	22,0	5,0	0,25	2,69	4,00	2,68
	650	200,0	4650	7800	520	950	**3003780AMHK**	**23180 ACMW33**	267,32		22,0	6,0	0,31	2,17	3,24	2,12
	820	243,0	7500	10400	420	620	**3680AMHX**	**22380 ACMBHA1W33**	635,00		22,0	7,5	0,32	2,12	3,15	2,11
460	680	163,0	3900	7200	540	930	**3003192AMH**	**23092 ACMBW33**	208,20	**460**	22,0	6,0	0,23	2,95	4,39	2,89
530	780	185,0	5100	9700	430	750	**30031/530**	**230/530 MB**	312,31	**530**		6,0	0,22	3,03	4,51	2,98



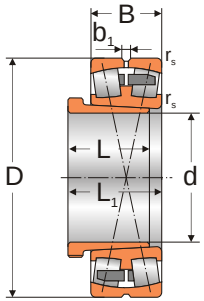
73000H
93000H
3753000H



753000H
953000H

Spherical roller bearings double row on withdrawal sleeve

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation			Mass bearing + sleeve	Dimensions					Design factors			
			dyn.	stat.			GOST	MPZ bearing											
d	D	Â	Ñ	C_0	non-fluid	liquid	-		sleeve		d	b_1	L	L_1	r_{smin}	e	Y_1	Y_2	Y_0
mm				kN	rpm		-			kg	mm					-			
50	120	43	270	280	4200	5500	**753610H**	**22311 KW33**	**AH2311X**	2,53	**50**	6,3	54	57	2,0	0,38	1,76	2,62	1,72
65	150	51	400	430	3400	4500	**753613H**	**22314 KW33**	**AH2314X**	4,88	**65**	8,0	64	68	2,1	0,37	1,82	2,71	1,78
70	160	55	430	470	3200	4300	**73614**	**22315 KMB**	**AH2315X**	5,76	**70**	-	68	72	2,1	0,38	1,78	2,65	1,74
	160	55	430	470	3200	4300	**753614H**	**22315 KW33**	**AH2315X**	5,67		8,0	68	72	2,1	0,36	1,85	2,76	1,81
75	170	58	490	540	2000	2800	**73615**	**22316 KMB**	**AH2316X**	7,15	**75**	-	71	75	2,1	0,36	1,88	2,80	1,84
85	190	64	610	695	2600	3600	**73617AMH**	**22318 ACKMBW33**	**AH2318X**	9,36	**85**	11,0	79	83	3,0	0,37	1,83	2,72	1,78
	190	64	610	695	2600	3600	**753617H**	**22318 KW33**	**AH2318X**	9,33		11,0	79	83	3,0	0,36	1,90	2,83	1,86
95	215	73	815	950	2400	3000	**73619AMH**	**22320 ACKMBW33**	**AH2320X**	13,75	**95**	11,0	90	94	3,0	0,37	1,81	2,70	1,77
	215	73	815	950	2400	3000	**753619H**	**22320 KW33**	**AH2320X**	13,47		11,0	90	94	3,0	0,35	1,91	2,85	1,87
115	260	86	960	1120	2000	2600	**73623AMH**	**22324 ACKMBW33**	**AH2324X**	24,32	**115**	14,0	105	109	3,0	0,37	1,82	2,71	1,78
135	300	102	1290	1560	1700	2200	**93627AMHK**	**22328 ACKMW33**	**AH2328X**	37,37	135	16,0	125	130	4,0	0,38	1,76	2,62	1,72
160	280	88	1040	1540	1800	2400	**3753732НЛ**	**23134 KMBW33**	**AH3134**	24,50	**160**	16,0	104	109	2,1	0,31	2,16	3,22	2,11



73000H
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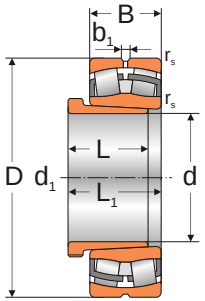
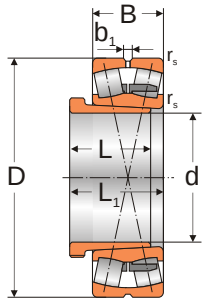
3753000H
4073000H



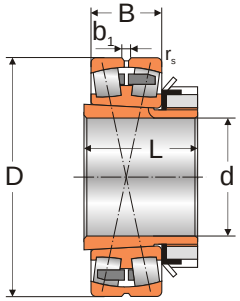
753000H
953000H



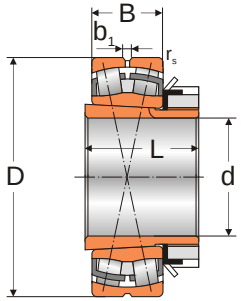
4753000H

Spherical roller bearings double row on withdrawal sleeve

Basic dimensions			Load capacity		Maximum rotation speed		Designation			Mass bearing + sleeve	Dimensions					Design factors			
			dyn.	stat.	(lubrication)		GOST	MPZ											
d	D	Â	Ñ	C_0	non-fluid	liquid		bearing	sleeve		d	b_1	L	L_1	r_{smin}	e	Y_1	Y_2	Y_0
mm				kN	rpm		-			kg	mm					-			
170	380	126	2000	2440	1300	1600	**73634AMHK**	**22336 ACKMW33**	**AH2336**	75,37	**170**	22,0	154	160	4,0	0,37	0,83	2,71	1,78
190	420	138	2320	2900	1200	1500	**73638AMHK**	**22340 ACKMW33**	**AH2340**	96,96	**190**	22,0	170	177	5,0	0,36	1,87	2,78	1,83
220	440	120	2000	3000	1300	1700	**73544AMHK**	**22248 ACKMW33**	**AH2248**	92,66	**220**	22,0	144	150	4,0	0,27	2,50	3,70	2,50
280	460	160	2331	4667	600	700	**4073156H**	**24060 K30MBW33**	**AH3160**	124,10	**280**	14,0	192	200	4,0	0,32	2,02	3,04	2,03
	500	200	3214	6106	360	450	**4073756H**	**24160 K30MBW33**	**AH2248**	183,80		16,0	224	232	5,0	0,41	1,72	2,48	1,59



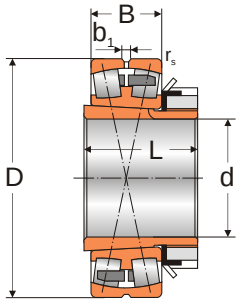
13000H
3013000H



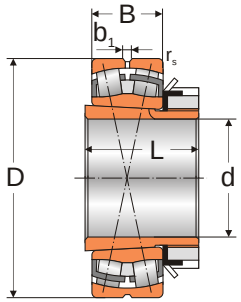
353000H

Spherical roller bearings double row on adapter sleeve

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation			Mass bearing + sleeve	Dimensions				Design factors			
			dyn.	stat.			GOST	MPZ										
d	D	Â	Ñ	C_0	non-fluid	liquid	-	bearing	sleeve		d	b_1	L	r_{smin}	e	Y_1	Y_2	Y_0
mm				kN	rpm		-			kg	mm				-			
50	120	43,0	270	280	4200	5500	**353610H**	**22311 KW33**	**H2311**	3,50	**50**	6,3	59,0	2,0	0,38	1,76	2,62	1,72
60	120	31,0	190	230	4200	6800	**13512AMH**	**22213 ACKMBW33**	**H313**	2,23	**60**	6,3	50,0	1,5	0,26	2,59	3,86	2,53
65	160	55,0	430	470	3200	4300	**353613H**	**22315 KW33**	**H2315**	6,36	**65**	8,0	73,0	2,1	0,36	1,85	2,76	1,81
70	140	33,0	236	270	3200	4000	**13514H**	**22216 KMBW33**	**H316**	3,20	**70**	6,3	59,0	2,0	0,25	2,68	4,00	2,62
	140	33,0	236	270	3200	4000	**353514H**	**22216 KW33**	**H316**	3,08		6,3	59,0	2,0	0,23	2,91	4,33	2,84
	170	58,0	490	540	2000	2800	**13614KH**	**22316 KMBW33**	**H2316**	7,38		8,0	78,0	2,1	0,36	1,88	2,80	1,84
	170	58,0	490	540	2000	2800	**353614H**	**22316 KW33**	**H2316**	7,46		8,0	78,0	2,1	0,36	1,88	2,81	1,84
80	160	40,0	320	370	3700	5300	**13516H**	**22218 KMBW33**	**H318**	4,77	**80**	6,3	65,0	2,0	0,27	2,53	3,77	2,48
	160	40,0	290	350	3600	5200	**353516H**	**22218 KW33**	**H318**	4,73		6,3	65,0	2,0	0,25	2,73	4,06	2,67
	190	64,0	610	695	2600	3600	**353616H**	**22318 KW33**	**H2318**	9,98		11,0	86,0	3,0	0,36	1,90	2,83	1,86
90	180	46,0	420	490	3300	4500	**13518H**	**22220 KMBW33**	**H320**	6,61	**90**	8,0	71,0	2,1	0,27	2,47	3,67	2,41
	180	46,0	420	490	3300	4500	**353518H**	**22220 KW33**	**H320**	6,19		8,0	71,0	2,1	0,25	2,67	3,97	2,61
	215	73,0	815	950	2400	3000	**13618AMH**	**22320 ACKMBW33**	**H2320**	14,91		11,0	97,0	3,0	0,37	1,81	2,70	1,77
	215	73,0	815	950	2400	3000	**353618H**	**22320 KW33**	**H2320**	14,70		11,0	97,0	3,0	0,35	1,91	2,85	1,87
100	200	53,0	560	640	3000	4000	**13520H**	**22222 KMBW33**	**H322**	9,53	**100**	8,0	77,0	2,1	0,28	2,39	3,55	2,38
	200	53,0	550	630	3000	4000	**353520H**	**22222 KW33**	**H322**	9,15		8,0	77,0	2,1	0,28	2,43	3,62	2,38
110	215	58,0	630	760	2800	3700	**13522H**	**22224 KMBW33**	**H3124**	11,20	**110**	11,0	88,0	2,1	0,29	2,36	3,51	2,31
	215	58,0	630	760	2800	3700	**353522H**	**22224 KW33**	**H3124**	11,30		11,0	88,0	2,1	0,27	2,51	3,74	2,45
	260	86,0	960	1120	2000	2600	**13622AMH**	**22324 ACKMBW33**	**H2324**	25,83		14,0	112,0	3,0	0,37	1,82	2,71	1,78



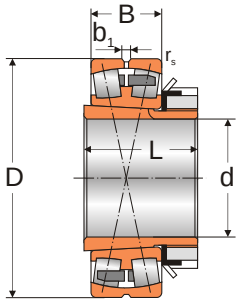
13000H
3013000H



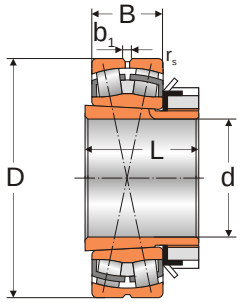
353000H

Spherical roller bearings double row on adapter sleeve

Basic dimensions			Load capacity		Maximum rotation speed		Designation			Mass bearing + sleeve	Dimensions				Design factors			
			dyn.	stat.	(lubrication)		GOST	MPZ										
d	D	Â	Ñ	C_0	non-fluid	liquid		bearing	sleeve		d	b_1	L	r_{smin}	e	Y_1	Y_2	Y_0
mm				kN	rpm		-			kg	mm				-			
115	230	64,0	735	930	2500	3500	**13523H**	**22226 KMBW33**	**H3126**	14,17	**115**	11,0	92,0	3,0	0,29	2,31	3,44	2,26
	230	64,0	735	930	2500	3500	**353523H**	**22226 KW33**	**H3126**	14,70		11,0	92,0	3,0	0,28	2,45	3,65	2,35
125	210	53,0	460	680	2700	3300	**3013125H**	**23028 KMBW33**	**H3028**	10,53	**125**	8,0	82,0	2,0	0,25	2,70	4,03	2,65
	250	68,0	710	930	2400	3100	**13525AMHK**	**22228 ACKMW33**	**H3128**	18,22		11,0	97,0	3,0	0,29	2,35	3,50	2,30
	250	68,0	710	930	2400	3100	**353525H**	**22228 KW33**	**H3128**	18,34		11,0	97,0	3,0	0,27	2,52	3,76	2,52
140	290	80,0	1000	1300	2000	2800	**13528AMHK**	**22232 ACKMW33**	**H3132**	30,46	**140**	14,0	119,0	3,0	0,29	2,29	3,40	2,24
	290	80,0	1000	1300	2000	2800	**353528H**	**22232 KW33**	**H3132**	30,60		14,0	119,0	3,0	0,27	2,52	3,76	2,52
150	310	86,0	1120	1450	1300	2000	**13530AMH**	**22234 ACKMBW33**	**H3134**	34,90	**150**	16,0	122,0	4,0	0,30	2,27	3,37	2,21
	360	120,0	1760	2160	1400	1800	**13630AMHK**	**22334 ACKMW33**	**H2334**	68,80		16,0	154,0	4,0	0,37	1,81	2,69	1,77
160	320	86,0	1180	1577	1800	2700	**13532AMHK**	**22236 ACKMW33**	**H3136**	39,30	**160**	16,0	131,0	4,0	0,28	2,37	3,56	2,32
	380	126,0	2000	2440	1300	1600	**13632AMHK**	**22336 ACKMW33**	**H2336**	80,89		22,0	161,0	5,0	0,37	1,83	2,71	1,78
170	340	92,0	1270	1700	1700	2300	**13534HK**	**22238 KMW33**	**H3138**	46,90	**170**	16,0	141,0	4,0	0,29	2,33	3,46	2,27
	400	132,0	2120	2675	1200	1800	**13634HK**	**22338 KMW33**	**H2338**	91,98		22,0	169,0	5,0	0,36	1,85	2,75	1,81
180	360	98,0	1460	2016	1600	2100	**13536AMH**	**22240 ACKMBW33**	**H3140**	55,60	**180**	16,0	150,0	4,0	0,29	2,31	3,44	2,26
	420	138,0	2320	2900	1200	1500	**13636AMHK**	**22340 ACKMW33**	**H2340**	106,20		22,0	176,0	5,0	0,36	1,87	2,78	1,83
200	340	90,0	1220	1860	1600	2000	**3013140HK**	**23044 KMW33**	**H3044**	41,88	**200**	14,0	128,0	3,0	0,26	2,60	3,87	2,54
	400	108,0	1760	2472	1700	1900	**13540AMH**	**22244 ACKMBW33**	**H3144X**	74,68		16,0	161,0	4,0	0,28	2,42	3,60	2,37



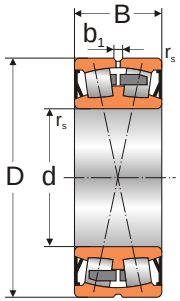
13000H
3013000H



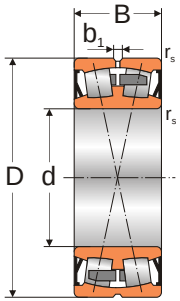
353000H

Spherical roller bearings double row on adapter sleeve

Basic dimensions			Load capacity		Maximum rotation speed		Designation			Mass bearing + sleeve	Dimensions				Design factors			
			dyn.	stat.	(lubrication)		GOST	MPZ										
d	D	Â	Ñ	C_0	non-fluid	liquid		bearing	sleeve		d	b_1	L	r_{smin}	e	Y_1	Y_2	Y_0
mm				kN	rpm		-			kg	mm				-			
240	400	104,0	1600	2540	1500	1800	**3013148AMH**	**23052 ACKMBW33**	**H3052X**	64,90	**240**	16,0	147,0	4,0	0,26	2,61	3,89	2,55
	440	144,0	2530	3900	1100	1400	**3013748AMHK**	**23152 ACKMW33**	**H3152X**	109,73		22,0	190,0	4,0	0,33	2,02	3,04	1,77
	480	130,0	2640	3520	1100	1600	**13548H**	**22252 KMBW33**	**H3152X**	122,80		22,0	190,0	5,0	0,30	2,28	3,40	2,23
260	420	106,0	1730	2897	1200	1500	**3013152AMHK**	**23056 ACKMW33**	**H3056**	74,70	**260**	16,0	152,0	4,0	0,25	2,70	4,02	2,64
280	460	118,0	2100	3430	1100	1500	**3013156AMH**	**23060 ACKMBW33**	**H3060**	92,31	**280**	22,0	168,0	4,0	0,25	2,64	3,93	2,58



83000H



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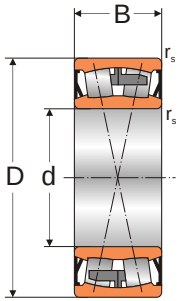

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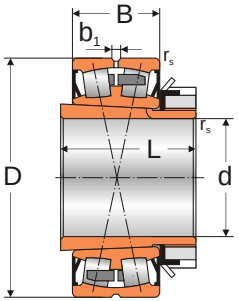
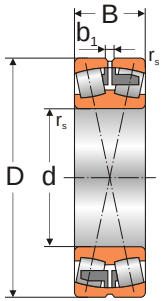


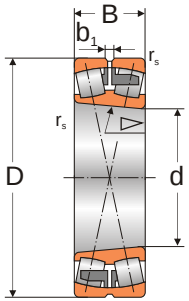
183000H

Spherical roller bearings, double row with two-sided seal

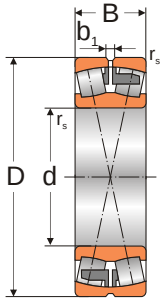
Basic dimensions			Load capacity		Maximum rotation speed	Designation			Mass	Dimensions				Design factors			
			dyn.	stat.	(lubrication)	GOST	MPZ										
d	D	Â	Ñ	C_0	non-fluid liquid		bearing	sleeve		d	b_1	L	r_{smin}	e	Y_1	Y_2	Y_0
mm				kN	rpm	-			kg	mm				-			
40	80	28,0	80	90	5300		**B5-22208-2RZ**		0,69	**40**			1,1	0,29	2,20	3,41	2,24
60	110	34,0	153	180	4000		**B6-22212M-2RZ**		1,38	**60**	6,3		1,5	0,24	2,80	4,20	2,80
75	150	51,5	214	290	2800	**183715H**	**183715H**	**H2317**	5,13	**75**	7,0	82,0	2,0	0,26	2,65	3,94	2,59
85	150	51,5	214	290	2800	**83717H**	**83717H**		3,09	**85**	7,0		2,0	0,26	2,65	3,94	2,59
90	190	64,0				**83718H**	**83718H**			**90**							
100	200	71,0	413	556	2000	**183720H**	**183720H**	**H2322**	11,50	**100**	9,0	105,0	2,1	0,28	2,38	3,55	2,38
	215	87,0	605	752	1200	**83720H**	**83720H**		14,65		11,0		3,0	0,37	1,81	2,70	1,77
110	200	71,0	413	556	2000	**83722H**	**83722H**		8,13	**110**	9,0		2,1	0,28	2,38	3,55	2,38
150	270	87,0	730	1040	1100	**83730H**	**83730H**		19,35	**150**	11,0		3,0	0,29	2,35	3,50	2,30



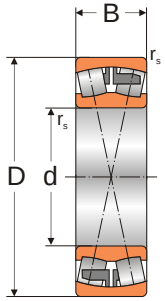
3000HK5



113000HK5 ▻ **1:12**



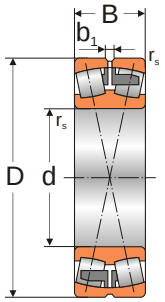
553600H



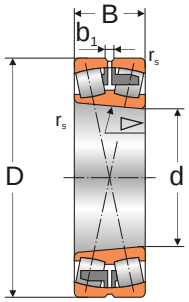
553000
553300
3553200

Spherical roller bearings for vibratory applications with cylindrical and tapered bore

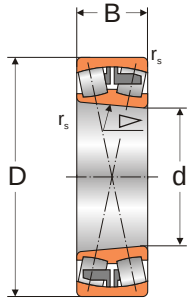
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions			Design factors			
d	D	Â	dyn. Ñ	stat. C_0	non-fluid	liquid	GOST	MPZ		d	b_1	r_{smin}	e	Y_1	Y_2	Y_0
mm				kN	rpm		-		kg	mm			-			
25	52	20,6	43	41	8500	11000	**3553205**	**23205 MA**	0,20	**25**		1,0	0,41	1,64	2,44	1,60
35	72	23,0	86	85	9000	12000	**553507**	**22207 MA**	0,45	**35**		1,1	0,33	2,03	3,03	1,99
40	80	23,0	80	90	5300	6800	**553508**	**22208 MA**	0,57	**40**		1,1	0,29	2,20	3,41	2,24
45	85	23,0	102	98	7500	10000	**553509**	**22209 MA**	0,64	**45**		1,1	0,25	2,60	3,90	2,50
	100	25,0	125	127	6300	8500	**553309**	**553309 MA**	1,05			1,5	0,23	2,98	4,45	2,92
50	90	23,0	88	106	7000	9500	**553510**	**22210 MA**	0,68	**50**		1,1	0,25	2,60	3,97	2,60
55	100	25,0	105	125	6300	8500	**553511**	**22211 MA**	0,91	**55**		1,5	0,23	2,98	4,45	2,92
60	110	28,0	150	180	5600	7400	**3512HK5**	**22212 MAW33**	1,21	**60**	6,3	1,5	0,24	2,80	4,20	2,80
	130	46,0	310	330	4800	6300	**553612H**	**22312 MAW33**	3,05		6,3	2,1	0,38	1,78	2,65	1,74
65	140	48,0	330	360	3700	5000	**3613AMHK5**	**22313 ACMAW33**	3,71	**65**	8,0	2,1	0,37	1,80	2,69	1,76
70	150	51,0	311	380	2400	3200	**3614HK5**	**22314 MAW33**	4,53	**70**	8,0	2,1	0,37	1,82	2,71	1,78
80	170	58,0	490	540	2000	2800	**3616HK5**	**22316 MAW33**	6,66	**80**	8,0	2,1	0,36	1,88	2,80	1,84
90	190	64,0	610	695	2600	3600	**3618AMHK5**	**22318 ACMAW33**	9,08	**90**	11,0	3,0	0,37	1,83	2,72	1,78
100	215	73,0	815	950	2400	3000	**3620AMHK5**	**22320 ACMAW33**	13,41	**100**	11,0	3,0	0,37	1,81	2,70	1,77



3000HK5
3003000HK5



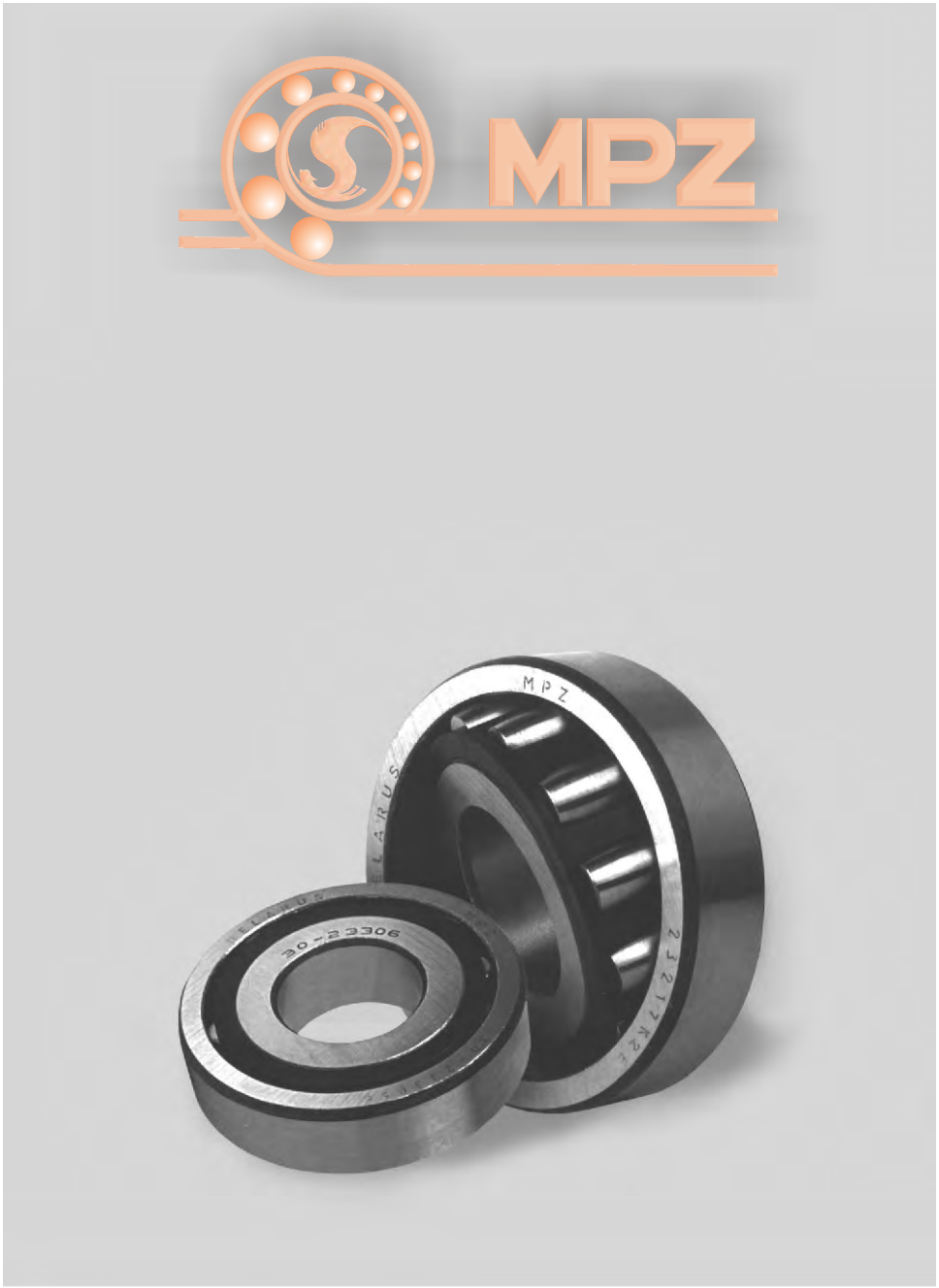
113000HK5 ▻ **1:12**



3153000 ▻ **1:12**

Spherical roller bearings for vibratory applications with cylindrical and tapered bore

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions			Design factors			
			dyn.	stat.												
d	D	Â	Ñ	C_0	non-fluid	liquid	GOST	MPZ		d	b_1	r_{smin}	e	Y_1	Y_2	Y_0
mm				kN	rpm		-		kg	mm			-			
110	240	80,0	940	1110	1900	2700	**3622AMHK5**	**22322 ACMAW33**	19,62	**110**	14,0	3,0	0,37	1,83	2,72	1,79
120	260	86,0	960	1120	2000	2600	**3624AMHK5**	**22324 ACMAW33**	24,13	**120**	11,0	3,0	0,37	1,82	2,71	1,78
	260	86,0	960	1120	2000	2600	**113624AMHK5**	**22324 ACKMAW33**	23,78		14,0	3,0	0,37	1,82	2,71	1,78
130	230	64,0	735	930	2500	3500	**3526HK5**	**22226 MAW33**	11,54	**130**	11,0	3,0	0,29	2,31	3,44	2,26
	230	64,0	735	930	2500	3500	**113526HK5**	**22226 KMAW33**	11,30		11,0	3,0	0,29	2,31	3,44	2,26
	280	93,0	1120	1320	1700	2400	**3626HK5**	**22326 MAW33**	29,60		14,0	4,0	0,37	1,84	2,74	1,80
140	300	102,0	1290	1560	1700	2200	**3628AMHK5**	**22328 ACMAW33**	36,10	**140**	16,0	4,0	0,38	1,76	2,62	1,72
150	270	73,0	850	1110	2200	3000	**3530AMHK5**	**22230 ACMAW33**	18,24	**150**	14,0	3,0	0,29	2,35	3,50	2,30
	320	108,0	1450	1760	1600	2000	**3630AMHK5**	**22330 ACMAW33**	44,64		16,0	4,0	0,38	1,78	2,64	1,74
160	340	114,0	1600	1960	1500	1900	**3632AMHK5**	**22332 ACMAW33**	52,60	**160**	16,0	4,0	0,38	1,80	2,69	1,76
170	260	67,0	735	1200	2500	2800	**3003134HK5**	**23034 MAW33**	13,20	**170**	11,0	2,1	0,23	3,00	4,40	2,90
	360	120,0	1760	2160	1400	1800	**3634AMHK5**	**22334 ACMAW33**	61,50		16,0	4,0	0,37	1,81	2,69	1,77
	360	120,0	1760	2160	1400	1800	**113634AMHK5**	**22334 ACKMAW33**	59,00		16,0	4,0	0,37	1,81	2,69	1,77
180	320	112,0	1300	2200	900	1200	**3153236Л1**	**23236KMA**	40,70	**180**		4,0	0,38	1,79	2,67	3,42
	380	126,0	2000	2440	1300	1600	**3636AMHK5**	**22336 ACMAW33**	71,04		22,0	4,0	0,37	1,83	2,71	1,78
190	400	132,0	2120	2675	1200	1800	**3638HK5**	**22338 MAW33**	86,60	**190**	22,0	5,0	0,36	1,85	2,75	1,81
	400	132,0	2120	2675	1200	1800	**113638HK5**	**22338 KMAW33**	84,80		22,0	5,0	0,36	1,85	2,75	1,81
260	540	165,0	3550	4590	850	1000	**3652AMHK5**	**22352 ACMAW33**	199,40	**260**	22,0	6,0	0,33	2,01	3,00	1,97
	540	165,0	3550	4590	850	1000	**113652AMHK5**	**22352 ACKMAW33**	199,00		22,0	6,0	0,33	2,01	3,00	1,97



Spherical roller single row bearings

Spherical roller single row bearings are designed to bear radial load primary. Such bearings are self mounted. At normal operating conditions (**C/P > 10**, $n_{rot}<0,6n_{max}$) such bearings provide compensation of angle distortions of shaft and housing up to 2°. So such bearings are not recommended to be used in arrangements with insufficient load capacity of self-mounted spherical roller double row bearings and use of radial spherical double row bearings is inappropriate due to the higher costs of such bearings.

Bearings fix shaft in axial direction in both sides. If two bearings are mounted in one support they loose their self-mounting feature.

Mounting scheme of spherical roller single row bearings in arrangement is simultaneous to mounting schemes of deep groove radial ball and Spherical roller double row bearings.

Bearings produced by MPZ with cylindrical bore but also bearings with tapered bode may be produced (taper 1:12) for mounting on tapered journal or on adapter or withdrawal sleeve. Bearings are produced with cage from glass-nylon composite.

Size of radial clearance is specified in table 8.

Dynamic equivalent load is $P=(VF_r+9,5F_a)K_\sigma K_T$.

Static equivalent load is $P_0=F_r+5F_a$.

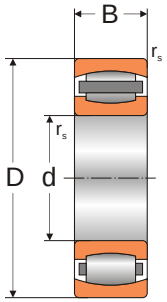
Allowable variation of dimensions and beating are specified in tables.

Marking of spherical roller single row bearings

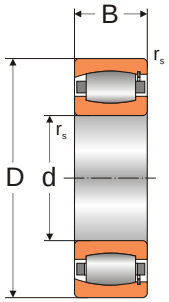
Suffixes

E cage made of glass-nylon composite.

K2E ring limiting bearing distortion and simplifying mounting in arrangement mounted on spherical surface of outer ring. Cage made of glass-nylon composite.



23000E



23000K2E

Spherical roller single row bearings

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation	Mass	Dimensions	
			dyn.	stat.						
d	D	Â	Ñ	C_0	non-fluid	liquid	GOST		d	r_{smin}
mm				kN	rpm		-	kg	mm	
30	72	19	53	48	4300	5000	**23306E**	0,385	**30**	1,1
35	72	19	53	48	4300	5000	**23707E**	0,362	**35**	1,1
85	150	28	156	171	1900	2400	**23217K2E**	1,830	**85**	2,0

Toroidal roller bearings, single row

Toroidal bearings are self-mounted roller bearings. Toroidal bearings combine features of three types of rolling element bearings such as:
- cylindrical roller bearings enabling axial displacement of bearing rings;
- needle bearings which have little cross section;
- spherical radial bearings enabling self-mounting and arrangement operating capacity at mounting and operating distortion up to 0,5°.

Toroidal bearings are designed to bear only radial load and do not bear axial load.

Toroidal bearings are produced with cylinder and tapered bore (taper 1:12) for mounting on tapered journey or on adapter or withdrawal sleeve.

Toroidal bearings have flangeless rings, one row of long barrel rollers and window type cage. Cases for small standard size of bearings are made of glass-nylon composite, cages for middle and large bearings are made of brass. Identifying feature of such structure is large radius of rollers and ring raceways element. It provides possibility of axial displacement of rings within ±10% range of ring width. Large surface of contact surfaces provides toroidal bearing with maximum bearing capacity among all bearing types with similar cross section.

Bearing shows high operating capacity in supports of long length shafts to compensate heat displacement of shaft, in reduction gears and transmissions under requirements of high bearing capacity and insensitivity to angle distortions.

Minimal load shall be continuously applied on bearings to provide fail-safe operation of bearings. It is especially important when bearings rotate at high sped and grease lubrication is used. In such conditions inertial force of bearings and cages as well as friction in lubrication results in sliding of bearings, damage of raceways, depreciation with increase of radial clearance.

Minimal static load shall be calculated according to the formula: $F_{rmin}=0,007C_0$.

Equivalent dynamic load applied to bearing is $P=F_r$.

Equivalent static load applied to bearing is $P_0=F_r$.

Amount of radial inner clearances in toroidal bearings is specified in tables.

Marking of toroidal roller bearings, single row

Marking of toroidal bearings produced by MBP includes base number identification, additional identifications, prefix and suffixes.

Special toroidal bearings have base number identification under GOST. Special toroidal bearings have identification under GOST; prefix “C” is not specified.

Prefixes

C toroidal bearing

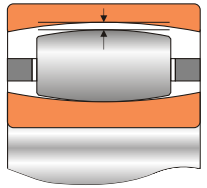
Suffixes

E cage from glass-nylon composite
EK cage from glass-nylon composite, inner structure is modified
M solid brass cage
V cageless bearing

T2 bearing is designed to operate in arrangement at temperature up to 200°Ñ

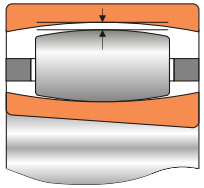
C2-C5 inner radial clearance

Amounts of radial inner clearance of toroidal roller bearings with cylindrical bore

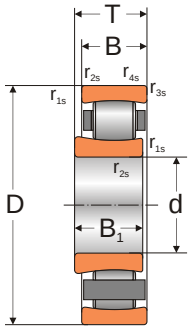


Bore diameter d		Radial inner clearance C2		Normal		Ñ3		Ñ4		Ñ5	
above	to	min	max	min	max	min	max	min	max	min	max
mm		mkm									
18	**24**	15	27	27	39	39	51	51	65	65	81
24	**30**	18	32	32	46	46	60	60	76	76	94
30	**40**	21	39	39	55	55	73	73	93	93	117
40	**50**	25	45	45	65	65	85	85	109	109	137
50	**65**	33	54	54	79	79	104	104	139	139	174
65	**80**	40	66	66	96	96	124	124	164	164	208
80	**100**	52	82	82	120	120	158	158	206	206	258
100	**120**	64	100	100	144	144	186	186	244	244	306
120	**140**	76	119	119	166	166	215	215	280	280	349
140	**160**	87	138	138	195	195	252	252	321	321	398
160	**180**	97	152	152	217	217	280	280	361	361	448
180	**200**	108	171	171	238	238	307	307	394	394	495
200	**225**	118	187	187	262	262	337	337	434	434	545
225	**250**	128	202	202	282	282	368	368	478	478	602
250	**280**	137	221	221	307	307	407	407	519	519	655
280	**315**	152	236	236	330	330	434	434	570	570	714
315	**355**	164	259	259	360	360	483	483	620	620	789
355	**400**	175	280	280	395	395	528	528	675	675	850
400	**450**	191	307	307	435	435	577	577	745	745	929
450	**500**	205	335	335	475	475	633	633	811	811	1015
500	**560**	220	360	360	518	518	688	688	890	890	1110
560	**630**	245	395	395	567	567	751	751	975	975	1215
630	**710**	267	435	435	617	617	831	831	1075	1075	1335
710	**800**	300	494	494	680	680	920	920	1200	1200	1480
800	**900**	329	535	535	755	755	1015	1015	1325	1325	1655
900	**1000**	370	594	594	830	830	1120	1120	1460	1460	1830
1000	**1120**	410	660	660	930	930	1260	1260	1640	1640	2040
1120	**1250**	450	720	720	1020	1020	1380	1380	1800	1800	2240

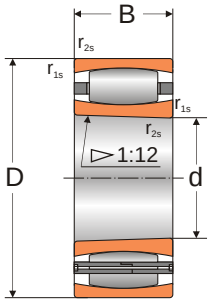
Amounts of radial inner clearance of toroidal roller bearings with tapered bore



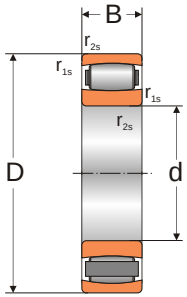
Bore diameter d		Radial inner clearance C2		Normal		Ñ3		Ñ4		Ñ5	
above	to	min	max	min	max	min	max	min	max	min	max
mm		mkm									
18	24	19	31	31	43	43	55	55	69	69	85
24	30	23	37	37	51	51	65	65	81	81	99
30	40	28	46	46	62	62	80	80	100	100	124
40	50	33	53	53	73	73	93	93	117	117	145
50	65	42	63	63	88	88	113	113	148	148	183
65	80	52	78	78	108	108	136	136	176	176	220
80	100	64	96	96	132	132	172	172	218	218	272
100	120	75	115	115	155	155	201	201	255	255	321
120	140	90	135	135	180	180	231	231	294	294	365
140	160	104	155	155	212	212	269	269	338	338	415
160	180	118	173	'173	238	238	301	301	382	382	469
180	200	130	193	193	260	260	329	329	416	416	517
200	225	144	213	213	288	288	363	363	460	460	571
225	250	161	235	235	315	315	401	401	511	511	635
250	280	174	258	258	344	344	444	444	556	556	692
280	315	199	283	283	377	377	481	481	617	617	761
315	355	223	318	318	419	419	542	542	679	679	848
355	400	251	350	350	471	471	598	598	751	751	920
400	450	281	383	383	525	525	653	653	835	835	1005
450	500	305	435	435	575	575	733	733	911	911	1115
500	560	335	475	475	633	633	803	803	1005	1005	1225
560	630	380	530	530	702	702	886	886	1110	1110	1350
630	710	422	590	590	772	772	986	986	1230	1230	1490
710	800	480	674	674	860	860	1100	1100	1380	1380	1660
800	900	529	735	735	955	955	1215	1215	1525	1525	1855
900	1000	580	814	814	1040	1040	1340	1340	1670	1670	2050
1000	1120	645	895	895	1165	1165	1495	1495	1875	1875	2275
1120	1250	705	975	975	1275	1275	1635	1635	2055	2055	2495



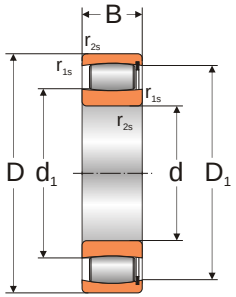
43000E
43000EK



3143000



C2200M



C2200V

Toroidal roller bearings, single row

Basic dimensions				Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions				
				dyn.	stat.										
d	D	Â	T	N	C_0	non-fluid	liquid	GOST	MPZ		d	B_1	$r_{1,2smin}$	r_{3smin}	r_{4smin}
mm				kN		rpm			-	kg	mm			-	
25	52	14	16	27,2	23,6	9000	12000	**43205E**		0,13	**25**	16	0,3	1,0	1,0
	62	16	18	42	37	8000	10000	**43305EK**		0,24		17	0,3	1,1	2,3
60	110	28		166	190		2800		**C2212V**	1,16	**60**		1,5		
70	125	31		212	228,0		2400		**C2214V**	1,55	**60**		1,5		
90	160	40		282	380		1500		**C2218M**	3,62	**90**		2,0		
100	180	46		357	465	3600	4800		**C2220M**	5,26	**100**		2,1		
140	250	68		725	1060	2400	3400		**C2228M**	15,66	**140**		3,0		
260	440	144		2520	4274	800	1000	**3143752T2**		89,30	**260**		4,0		

Single row taper roller bearings

Taper roller bearings series 263000 correspond requirement of GOST 520, ISO 139-97, ISO 492-94 and ISO 494-94

Bearings are designed to bear radial and axial loads

Single row taper roller bearings are self-mounted bearings providing compensation of angle of distortion of inner ring towards outer ring up to 2°.

Regulation of axial play of single row taper roller bearing is simultaneous to regulation of axial play of tapered bearing and shall be made during mounting immediately.

Bearings produced with shaped cage and cage of glass-nylon composite. Some crush of cage shall be taken into account during mounting bearing on shaft to exclude force transfer to the cage at mounting and bearing seizure at high shaft collar.

Calculation of equivalent loads for bearings 263000 shall be simultaneous with calculation of equivalent loads for taper roller single row bearings. Equivalent load applied to bearings 263000Å shall be calculated as follows:

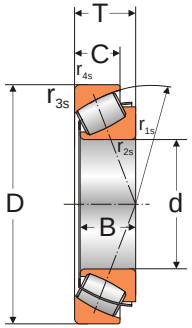
Dynamic load:

$P=F_rVK_\sigma K_T$ at $F_a/F_r<e$;

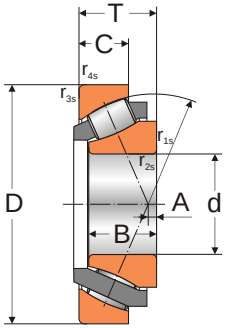
$P=(0,4VF_r+YF_a)K_\sigma K_T$ at $F_a/F_r>e$.

Static load:

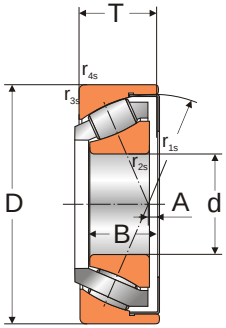
$P_0=0,5F_r+Y_0F_a$; if $P_0<F_r$, where $P_0=F_r$.



263000



263000E



263707EC17

Single row taper roller bearings

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation	Mass	Dimensions								Design factors		
d	D	Â	dyn. Ñ	stat. C_0	non-fluid	liquid	GOST		d	B	C	r_{1smin}	r_{2smin}	r_{3smin}	r_{4smin}	A	e	Y	Y_0
mm				kN	rpm		-	kg	mm								-		
30	72	21	44,6	52,3	4200	5900	**263706E**	0,36	**30**	18	15	1,3	1,3	1,3	1,3	0,15	0,70	0,86	0,47
35	80	25	63,0	66,0	4100	5800	**263707EC17**	0,59	**35**	21	25	1,5	2,0	1,5	1,5	2,5	0,80	0,75	0,41
60	110	23,75	112,0	122,0	3400	4400	**263212A**	0,82	**60**	22	19	2,0	2,0	1,5	1,5	-	0,46	1,31	0,72
75	130	27,25	140,0	174,0	2800	3800	**263215**	1,37	**75**	25	22	1,5	1,5	1,5	1,5	-	0,43	1,39	0,77

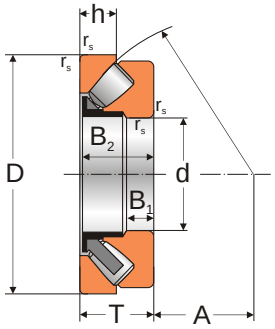
Spherical roller thrust bearings

Bearings are designed generally to bear axial loads but can also bear radial load with load rate defined as of $F_r<0,55F_a$. Bearings shall be lubricated with liquid lubrication only because of large contact surfaces. Viscous lubrication may be used only at little loads and speed providing that there is sufficient lubrication film between roller end faces and flange. As well as raceway of free ring is spherical one, bearing in self-mounted and enable angle of distortion up to 3°. Because of influence of centrifugal and gyroscopic forces on the bearings minimal constant load $F_{amin}=1,3\cdot10^{-3}C_0$ is required to be applied on the bearings. If under operating conditions bearing is frequently unloaded, specified minimal load shall be provided with springs. During transmission of axial load it is aspired to minimal use of end face surface of tight ring i.e. the best scenario is when support shaft collar contacts at full width of tight ring.

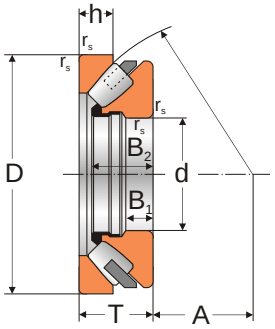
Dynamic equivalent load is determined under equation $P=(F_a+1,2F_r)K_\sigma K_T$ at $F_r<0,55F_a$. When Fr has greater value, angular contact thrust ball bearings are not used.

Static equivalent load is determined by $P_0=F_a+2,7F_r$ at $F_r<0,55F_a$.

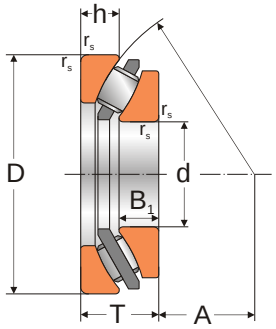
Solid cage of the bearing is made of brass. Allowable variations of ring dimensions and beating are specified in tables.



9039000



9039000M



9039000K2

Spherical roller thrust bearings

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)	Designation		Mass	Dimensions					
d	D	Â	dyn. Ñ	stat. C_0	liquid	GOST	MPZ		d	B_1	B_2	h	r_{smin}	A
mm				kN	rpm	-		kg	mm					
60	130	42	312	814	2300	**9039412K2**	**29412**	2,47	**60**	22,0	-	20	1,8	60,272
70	150	48	411	1035	2200	**9039414**	**29414**	4,31	**70**	17,0	45,5	23	2,3	44
75	160	51	507	1290	2000	**9039415**	**29415**	5,24	**75**	18,0	48,0	24	2,0	47
80	170	54	511	1400	2000	**9039416**	**29416**	6,24	**80**	19,0	51,0	26	2,5	50
85	180	58	588	1650	1800	**9039417**	**29417**	7,45	**85**	21,0	55,0	28	2,5	54
100	210	67	784	2300	1600	**9039420**	**29420**	10,90	**100**	24,0	64,0	32	3,0	62
130	270	85	1390	4060	1200	**9039426M**	**29426M**	22,30	**130**	35,5	61,0	41	5,0	81
170	340	103	1784	6000	950	**9039434**	**29434**	45,50	**170**	37,0	99,0	50	4,7	104
180	360	109	2038	6700	850	**9039436**	**29436**	53,90	**180**	39,0	105,0	52	4,7	110

Taper roller angular contact bearings

The bearings are used to bear compound loads such as radial and unilateral axial loads. If dual-sided axial loads are applied, two simultaneous reverse locating bearings shall be used. Tapered roller bearings are two-piece bearings. Inner ring completed with rollers and cage as well as outer ring shall be mounted separately. Tapered rollers and raceways of rings have mutual taper point on bearing shaft to provide moving of bearings on raceways without sliding.

Tapered bearings as well as angular contact ball bearings are mounted under "O" and “X” scheme. If bearings are mounted in support in pairs, maximum rotation frequency of such bearings is less than maximum rotation frequency of single bearings because of decrease of lubrication and heat removal conditions. Axial load capacity depends on angle of contact. If the angle increases, its axial loading capacity also increases but radial loading capacity decreases. Angle of contact of most tapered roller bearings is 10...17° but if loads acting primary in axial direction, tapered roller bearings with angle of contact 25...30° shall be applied.

MPZ produces bearings with steel shaped window type cage and solid comb-shaped cage made of brass. Along with standard bearings, bearings with flanged outer ring type 67000 which simplifies structure of bearing arrangement enabling open-ended housing boring without creation of fillets. Angular contact roller tapered bearings are responsive to angular distortions of shaft and housing. To provide normal shaft operation amount of distortions shall be limited to 1'...2'.
Initial regulation of axial play shall be made immediately during mounting and adjustment shall be made during its operation. Except for particular cases bearings shall have positive even though even very small clearance. Lack of clearance may result in impermissible overheat of parts.

Dynamic equivalent load for single bearings shall be determined as $\mathbf{P=F_rVK_\sigma K_T}$ at $\mathbf{F_a/F_r \leq e}$ and $\mathbf{P = (0,4VF_r + YF_a)K_\sigma K_T}$ at $\mathbf{F_a/F_r > e}$.

Statistical equivalent load for single bearings shall be determined as $\mathbf{P_0=0,5F_r+Y_0F_a}$. At $\mathbf{P_0<F_r}$ where $\mathbf{P_0=F_r}$.

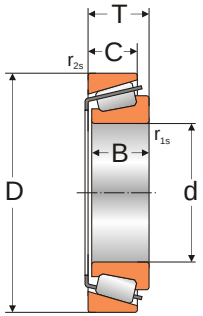
Suffixes of additional specification of MPZ

B Angle of contact more then angle of contact of standard bearing

R Bearing with flanged outer ring

P6 Accuracy under 6 Class
P5 Accuracy under 5 Class

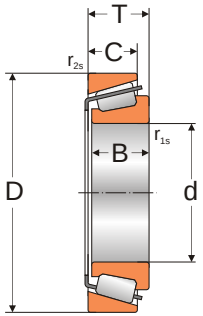
P63 Integrated accuracy and clearance specification (C is not specified)



7000
27000
2007000
3007000

Taper roller angular contact bearings, single row

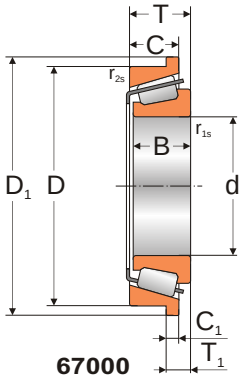
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions					Design factors		
			din.	estat.													
d	D	T	Ñ	C_0	non-fluid	liquid	GOST	MPZ		d	B	C	r_{1smin}	r_{2smin}	e	Y	Y_0
mm			kN		rpm		-		kg	mm					-		
19,058	45,25	15,494	28	33	2800	3380	**7804У**		0,13	**19,058**	16,64	12,07	1,0	1,5	0,3	2,0	1,1
26	57,15	17,462	40	51	2800	3400	**7805У**		0,23	**26**	17,46	17,46	4,0	2,0	0,4	1,7	0,95
35	72	24,25	70	83	4700	5600	**7507A1**	**32207**	0,46	**35**	23	19	1,5	1,5	0,38	1,6	0,88
	80	32,75	101	115	4380	5250	**7607A**	**32307**	0,75		31	25	2,0	1,5	0,31	1,9	1,10
40	90	35,25	114	140	3900	4700	**7608A**	**32308**	1,08	**40**	33	27	2,0	1,5	0,35	1,74	0,96
45	100	38,25	140	169	3400	4100	**7609A**	**32309**	1,46	**45**	36	30	2,0	1,5	0,35	1,74	0,96
50	110	42,25	186	236	3200	3800	**7610A**	**32310**	1,90	**50**	40	33	2,5	2,0	0,35	1,74	0,96
60	110	29,75	137	176	2960	3550	**7512A**	**32212**	1,17	**60**	28	24	2,0	1,5	0,36	1,48	0,82
	130	48,50	234	297	2600	3200	**7612A**	**32312**	2,94		46	37	3,0	2,5	0,35	1,74	0,96
65	140	36,00	180	230	2400	2900	**27313A1**	**30313B**	2,56	**65**	33	28	3,0	2,5	0,55	1,10	0,60
	140	51,00	252	364	2420	2910	**27613A1**	**32313B**	3,79		48	39	3,0	2,5	0,55	1,10	0,60
70	150	54,00	298	382	2300	2700	**7614A**	**32314**	4,30	**70**	51	42	3,0	2,5	0,35	1,74	0,96
80	170	61,50	370	531	2000	2400	**27616A1**	**32316B**	6,65	**80**	58	48	3,0	2,5	0,55	1,10	0,60
90	140	39,00	222	367	2160	2600	**3007118A**	**33018**	2,23	**90**	39	32,5	1,5	1,5	0,27	2,23	1,23
	160	42,50	248	335	2000	2410	**7518A**	**32218**	3,42		40	34	2,5	2,0	0,42	1,43	0,79
	160	49,50	284	420	2000	2400	**7718A**		4,05		46	40,5	4,0	4,0	0,39	1,53	0,84



7000
27000
2007000
3007000

Taper roller angular contact bearings, single row

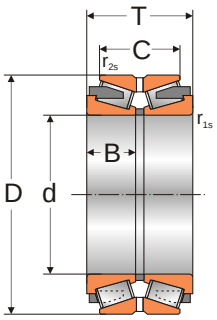
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions					Design factors		
			din.	estat.													
d	D	T	Ñ	C_0	non-fluid	liquid	GOST	MPZ		d	B	C	r_{1smin}	r_{2smin}	e	Y	Y_0
mm			kN		rpm		-		kg	mm					-		
100	180	49,0	340	480	1800	2200	**7520A**	**32220**	5,07	**100**	46	39	3,0	2,5	0,42	1,43	0,79
110	200	56,0	427	618	1610	1930	**7522A**	**32222**	7,31	**110**	53	46	3,0	2,5	0,42	1,43	0,79
	240	84,5	728	1000	1440	1700	**7622A**	**32322**	17,70		80	65	4,0	3,0	0,35	1,74	0,96
120	180	38,0	249	419	1660	2000	**2007124A**	**32024X**	3,20	**120**	38	29	2,5	2,0	0,46	1,31	0,72
	215	61,5	500	757	1500	1800	**7524A**	**32224**	9,07		58	50	3,0	2,5	0,44	1,38	0,76
	260	90,5	870	1234	1320	1580	**7624A**	**32324**	22,70		86	69	4,0	3,0	0,35	1,74	0,96
160	240	51,0	396	669	1300	1800	**2007132АКЛ**		7,95	**160**	51	41	3,0	2,5	0,46	1,31	0,72
220	340	76,0	803	1413	890	1070	**2007144АЛ**	**32044XM**	24,50	**220**	76	57	4,0	3,0	0,43	1,39	0,77
240	360	76,0	840	1533	830	1000	**2007148АЛ**	**32048XM**	26,60	**240**	76	57	4,0	3,0	0,46	1,31	0,72
280	420	87,0	1100	2048	710	860	**2007156АЛ1**	**32056XM**	41,10	**280**	87	65	5,0	4,0	0,46	1,31	0,72



67000
627000

Taper roller angular contact bearings, single row with flanged outer ring

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions								Design factors		
			din.	estat.																
d	D	T	Ñ	C_0	non-fluid	liquid	GOST	MPZ		d	D_1	T_1	C_1	B	C	r_{1smin}	r_{2smin}	e	Y	Y_0
mm			kN		rpm		-		kg	mm								-		
60	110	29,75	137	176	2960	3550	**67512A**	**32212R**	1,18	**60**	116	10,75	5,0	28	24	2,0	1,5	0,36	1,48	0,82
65	140	51,00	252	364	2870	3440	**627613A1K**		3,90	**65**	150	16,0	6,0	48	41	3,0	2,5	0,55	1,10	0,60



2097000

Taper roller angular contact bearings, double row

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation	Mass	Dimensions					Design factors			
			din.	estat.													
d	D	T	Ñ	C_0	non-fluid	liquid	**GOST**		d	B	C	r_{1smin}	r_{2smin}	e	Y_1	Y_2	Y_0
mm			kN		rpm		-	kg	mm					-			
280	420	188	1870	4070	710	860	**2097156АЛ1**	91,52	**280**	87	154	5,0	2,0	0,46	1,5	2,2	1,44

Roller radial bearings with short cylindrical rollers

Roller radial bearings with short cylindrical rollers are generally designed to bear only radial loads. Such bearings in relation to deep groove radial ball bearings of different size have significantly larger radial load capacity and toughness because of a little elastic deformation. Due to comparatively inconsiderable friction high rotation speed is allowable, though speed characteristics of such bearings are lower than of speed characteristics of ball bearings. Bearings have various designs depending on availability and location of flanges on outer and inner rings. Bearings series 2000, 12000, 42000 have two-piece bearing construction and allow axial displacement of rings during its operation neutralizing shaft thermal extension. Inner ring completed with rollers and cages may be mounted separately from outer ring. But to keep required radial clearance in bearing mutual exchange of rings shall be avoided during arrangement mounting. Bearings with two flanged rings bear limited axial load. Allowable load rate depends not on fatigue properties of material but on form of sliding surfaces of end face and flanges of roller as well as on lubrication.

Roller radial bearings with short cylindrical rollers, single row are produced by MBP with steel shaped cage and cage from glass-nylon composite 6.6. Cage centers on rolling elements.

Roller radial bearings with short cylindrical rollers, single row require accurate axiality of mounting seats. If such axiality is not provided flanged pressure of rollers on raceways of rings appears and operating life of bearings decreases. Bearings are produced with rings and rollers with modified contact (bevels and narrow rolls). Axial distortion of mounting seats shall not exceed 4'.

Roller radial bearings with short cylindrical rollers, single row shall be preferably mounted on short two-bearing shafts.

Dynamic equivalent load is $\mathbf{P=F_rVK_\sigma K_T}$, static equivalent load is $\mathbf{P_0=F_r}$.

Radial clearance of this bearing group is specified in tables.

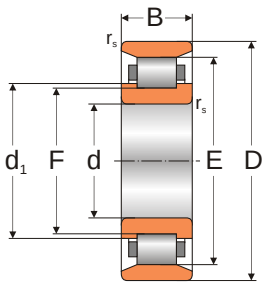
Allowable variations of dimensions and beating are specified in tables.

Suffixes of additional specification of MPZ

P6 Accuracy under 6 Class of ISO
P5 Accuracy under 5 Class of ISO

C1 Bearing clearance is less than Ñ2
C2 Bearing clearance is less than normal clearance
C3 Bearing clearance exceeds normal clearance
C4 Bearing clearance is less than Ñ4
C5 Bearing clearance is less than Ñ5

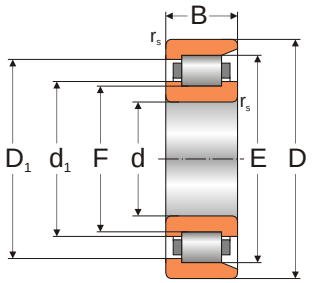
P63 Integrated accuracy and clearance specification (C is not specified)



2000

Roller radial bearings with short cylindrical rollers, single row without flanges on outer ring

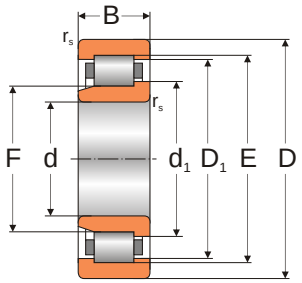
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions				
			dyn.	stat.										
d	D	Â	Ñ	C_0	non-fluid	liquid	GOST	MPZ		d	d_1	F	E	r_{smin}
mm				kN	rpm		-		kg	mm				
30	62	16	23	22,4	9500	12000	**2206KM**	**N206**	0,20	**30**	42,0	38,5	53,5	0,6



12000

Roller radial bearings with short cylindrical rollers, single row with one flanged outer ring

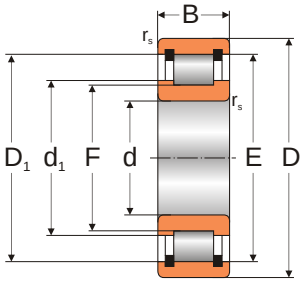
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions					
d	D	Â	dyn. Ñ	stat. C_0	non-fluid	liquid	GOST	MPZ		d	d_1	D_1	F	E	r_{smin}
mm				kN	rpm		-		kg	mm					
75	115	20	58	70,8	5300	6300	**12115ЕМУШ1**		0,66	**75**	89,5	101,4	85,0	105,0	1,1



42000

Roller radial bearings with short cylindrical rollers, single row, with one flanged inner ring

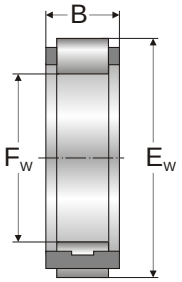
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions					
d	D	Â	dyn. Ñ	stat. C_0	non-fluid	liquid	GOST	MPZ		d	d_1	D_1	F	E	r_{smin}
mm				kN	rpm		-		kg	mm					
60	110	22	74	83	5300	6300	**42212KM**	**NJ212**	0,86	**60**	77,7	92,0	73,5	97,5	1,5



102000

Roller radial bearings with short cylindrical rollers, single row, with flangeless outer ring and with two snap rings

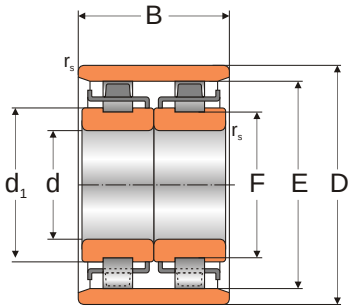
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation	Mass	Dimensions					
			dyn.	stat.										
d	D	Â	Ñ	C_0	non-fluid	liquid	GOST		d	d_1	D_1	F	E	r_{smin}
mm				kN	rpm		-	kg	mm					
30	62	16	34	35	2500	3000	**102206M**	0,20	**30**	42,0	53,5	38,5	53,5	0,6
35	80	21	64,4	63	2000	2500	**102307M**	0,48	**35**	51,4	70,0	46,0	70,0	1,1
40	90	23	80,9	78	2000	2500	**102308M**	0,66	**40**	58,9	77,7	53,7	77,7	1,5



822000

Roller radial bearings with short cylindrical rollers, single row without rings

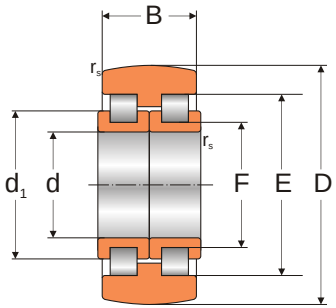
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)	Designation	Mass
d	D	Â	dyn. Ñ	stat. C_0	non-fluid liquid	GOST	
mm				kN	rpm	-	kg
35	55	25	61	61,5	2900	**822707Д**	0,15



212000

Roller radial bearings with short cylindrical rollers, double row, flangeless design on the outer ring

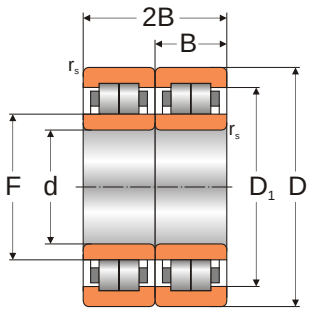
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation	Mass	Dimensions				
			dyn.	stat.									
d	D	Â	Ñ	C_0	non-fluid	liquid	**GOST**		d	d_1	F	E	r_{smin}
mm				kN	rpm		-	kg	mm				
30	60	34	42,5	53,8	3000	4000	**212206KM**	0,37	**30**	42,0	38,5	53,5	0,7



982000

Roller radial bearings with short cylindrical rollers, double row and spherical surface of outer ring

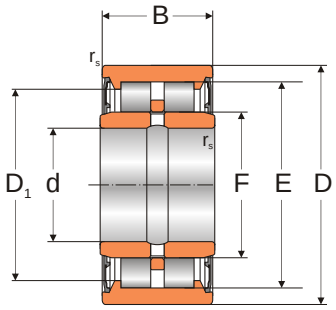
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation	Mass	Dimensions				
			dyn.	stat.									
d	D	Â	Ñ	C_0	non-fluid	liquid	**GOST**		d	d_1	F	E	r_{smin}
mm				kN	rpm		-	kg	mm				
35	77,1	34	85	80	2000	2500	**982807M**	0,78	**35**	49,0	45,0	65,0	1,0



92600/000

Roller radial bearings with short cylindrical rollers, double row, flangeless design on inner ring, doubled

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions				
			dyn.	stat.										
d	D	Â	N	C_0	non-fluid	liquid	GOST	MPZ		d	d_1	F	E	r_{smin}
mm				kN	rpm		-		kg	mm				
500	720	200	8000	20950	200	300	**92621/500**	**BC4B322066**	571,0	**500**	650.0	550.0	670.0	0.6



862000

Roller radial bearings with short cylindrical rollers, double row, with two-sided seal

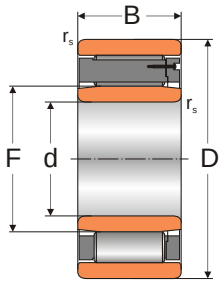
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation	Mass	Dimensions				
			dyn.	stat.									
d	D	Â	N	C_0	non-fluid	liquid	GOST		d	d_1	F	E	r_{smin}
mm				kN	rpm		-	kg	mm				
20	52	28	47,4	59	3000	4000	**862704M**	0,31	**20**	39,6	28,9	43,9	1,1

Roller radial bearings with long cylindrical rollers

Roller radial bearings, single row with long cylindrical rollers are designed to bear only radial load. They have high load capacity and allow some axial displacement of inner ring towards outer ring.

Bearings have brass cage and flangeless outer and inner rings.

Bearings shall be mounted without distortion of outer ring towards inner ring. Allowable distortion shall not exceed 3?.



3004200

Roller radial bearings with long cylindrical rollers, single row

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation	Mass	Dimensions		
			dyn.	stat.							
d	D	Â	N	C_0	non-fluid	liquid	**GOST**		d	F	r_{smin}
mm				kN	rpm		-	kg	mm		
220	400	144	1890	3200	1050	1250	**3004244M**	88,7	**220**	269	4,0

Needle roller radial bearings

Bearings are designed to bear only radial load and do not limit axial displacement of shaft. They have high load capacity combined with smaller dimensions in radial direction in comparison with bearings of other structural groups though they have bore with similar diameter.

MPZ produces Needle roller bearings with two turned rings and cage; with one outer ring; cage packages and one and two row needle rollers without rings; with complete fitting with two and single ring including closed from one side (cardanic).

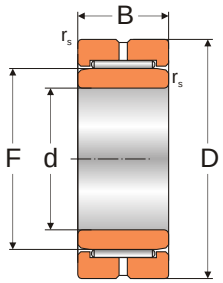
Generally outer rings provided with ring groove and bores for lubrication supply to rolling elements. End faces of needle rollers are spherical more frequently. This is most preferable if possible distortion of roller occurs. In some cases end faces of rollers are flat or tapered.

Cage of needle bearings is made of non-ferrous metals, glass-nylon composite 6.6 as well as shaped from steel sheet. Shaped cage may have line or M-shape profile.

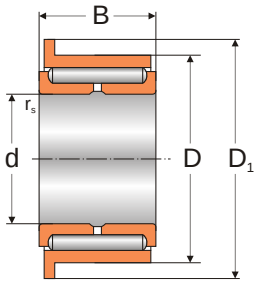
Cageless needle bearings have increased load capacity may bear loads, strikes and vibration. Speed of such bearings is less than speed of bearings with cage but they are characterized by safe operation in rolling conditions.

Clearance in needle bearings without inner rings and needle bearings without rings is made by corresponding choice of shaft (housing) tolerances providing recommended clearance. Working surfaces of shafts (housings) replacing correspondent bearing rings shall have high hardness (more than HRC 60) at depth no less than 0.5 mm, surface roughness Ra<0.32 mkm. Out-of-roundness and taper of bearing shall not exceed 50% of chosen tolerance on diameter.

Dynamic equivalent load of radial needle roller bearing is $P=F_rVK_\sigma K_T$ static equivalent load is $P_0=F_r$.



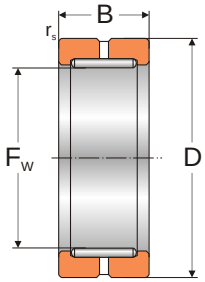
0074000



284000

Needle roller radial bearings, single row, with inner and outer rings without cage

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions			
			dyn.	stat.									
d	D	Â	Ñ	C_0	non-fluid	liquid	GOST	MPZ		d	F	D_1	r_{smin}
mm				kN	rpm		-		kg	mm			
17	35	18	22,5	38,0	6700	8500	**4074103**		0,097	**17**	24		0,3
20	37	17	18,5	39,7	6300	8000	**4074904**		0,095	**20**	25		0,3
	42	22	56,0	33,2	9000	15000	**4074104**		0,176		28		0,6
25	42	17	13,6	13,5	5000	6300	**4074905**		0,112	**25**	30		0,3
30	55	25	45,6	96,7	4500	5600	**4074106**		0,311	**30**	40		1,1
	55	25	45,6	96,7	4500	5600	**4074106У1**		0,311		40		1,0
35	62	27	53,0	123,2	4000	5000	**4074107**		0,419	**35**	46		1,1
40	68	28	55,5	138,7	3400	4300	**4074108**		0,495	**40**	52		1,1
45	75	30	63,5	172,0	3200	4000	**4074109**		0,631	**45**	58		1,1
50	80	30	68,3	184,0	2600	3200	**4074110**		0,687	**50**	62		1,1
60	95	35	79,0	242,6	2200	2800	**4074112**		1,130	**60**	75		1,3
65	100	35	83,2	259,0	2000	2600	**4074113**		1,180	**65**	80		1,3
67	102	58	176,4	540,9	2000	2600	**284913**		1,985	**67**	51,2	117	0,3



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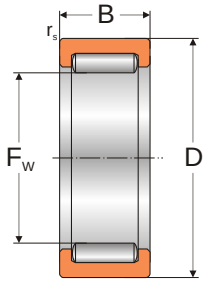

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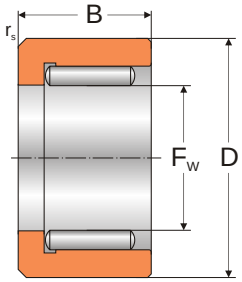
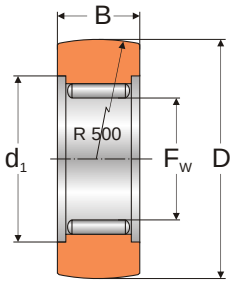


144000

Needle roller radial bearings, single row, without inner ring and cage

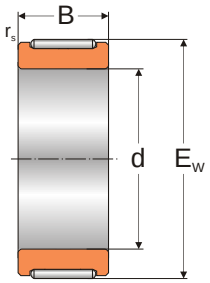
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation	Mass	Dimensions	
			dyn.	stat.						
F_w	D	Â	Ñ	C_0	non-fluid	liquid	GOST		d	r_{smin}
mm				kN	rpm		-	kg	mm	
18	28	11,5	8,0	9,5	11000	21000	**144903**	0,029	**18**	0,3
24	35	18,0	23,0	38,0	6700	8500	**4024103**	0,064	**24**	0,3
28	42	22,0	31,0	59,6	6300	8000	**4024104**	0,124	**28**	0,7
28,7	42	22,0	32,0	61,3	6300	8000	**4084104**	0,119	**28,7**	0,7
40	55	25,0	46,0	96,7	4500	5600	**4024106**	0,202	**40**	1,1
40,1	55	25,0	46,0	97,0	4500	5600	**4084106**	0,201	**40,1**	1,1
46	62	27,0	53,0	123,2	4000	5000	**4024107**	0,272	**46**	1,1
50	60	25,0	53,0	134,8	4000	5000	**6024809**	0,134	**50**	0,6
52	68	28,0	55,5	138,7	3400	4300	**4024108**	0,306	**52**	1,1
57,38	72	30,0	69,0	188,0	2600	3200	**124911K**	0,319	**57,38**	1,0
58	75	30,0	63,5	172,0	2600	3200	**4024109**	0,385	**58**	1,0
62	80	30,0	68,0	184,0	2600	3200	**4024110**	0,440	**62**	1,1
62,1	80	30,0	68,0	184,0	2600	3200	**4084110**	0,439	**62,1**	1,0
75	95	35,0	79,0	242,6	2200	2800	**4024112**	0,691	**75**	1,3
80	100	35,0	83,0	259,0	2000	2400	**4024113**	0,727	**80**	1,3



824000

Needle roller radial bearings, single row, without inner ring and cage for special applications

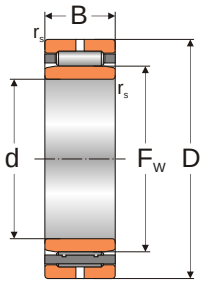
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation	Mass	Dimensiones	
			dyn.	stat.						
F_w	D	Â	Ñ	C_0	non-fluid	liquid	GOST		d	d_1
mm				kN	rpm		-	kg	mm	
24	52	20,0	26,0	44,5	6000	7500	**824904**	0,231	**24**	35,0



274700

Needle roller radial bearings, single row, without outer ring and cage

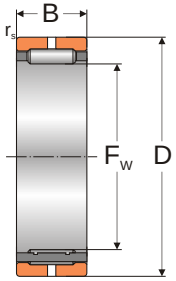
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation	Mass	Dimensions	
			dyn.	stat.						
d	E_w	Â	Ñ	C_0	non-fluid	liquid	GOST		d	r_{smin}
mm				kN	rpm		-	kg	mm	
35	50	27,0	51,4	118,0	4000	5000	**274707**	0,194	**35**	1,0



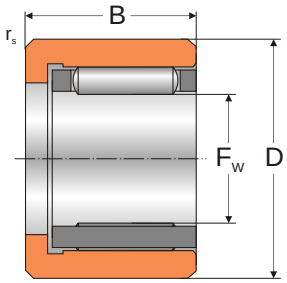
0244000

Needle roller radial bearings, single row, with inner and outer rings, with cage

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions		
			dyn.	stat.								
d	D	Â	Ñ	C_0	non-fluid	liquid	GOST	MPZ		d	F_w	r_{smin}
mm				kN	rpm		-		kg	mm		
15	28	13,5	12,0	15,2	12000	22000	**244702**		0,023	**15**	19,4	0,3
17	30	13	11,5	15,1	12000	19000	**4244903**	**NA4903**	0,039	**17**	22	0,3
20	32	16	15,0	22,3	6300	18000	**5244804**	**NKI 20/16**	0,048	**20**	24	0,3
50	72	22	44,6	78,9	4800	7000	**4244910**	**NA4910TN**	0,300	**50**	58	0,6
70	100	30	83,0	157,6	3600	5300	**4244914E**	**NA4914TN**	0,780	**70**	80	1,0



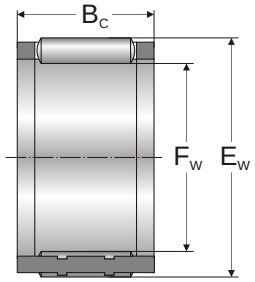
0254000
524000
ИКВ F_w x D x B



154000

Needle roller radial bearings, single row, without inner ring, with cage

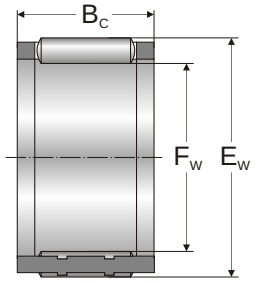
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass	Dimensions	
			dyn.	stat.							
F_w	D	Â	Ñ	C_0	non-fluid	liquid	GOST	MPZ		d	r_{smin}
mm				kN	rpm		-		kg	mm	
12	22	16	9,6	10,4	16000	26000	**154901E**		0,025	**12**	0,3
20	28	13	12,0	15,8	13000	20000	**254703E**	**RNA 4902**	0,015	**20**	0,3
25	37	17	18,0	23,0	10000	17000	**254705E**	**RNA 4904**	0,056	**25**	0,3
32	42	20	25,0	39,2	8500	14000	**524706KE**	**NK 32/20**	0,061	**32**	0,3
38	48	20	25,5	45	8000	13000	**ИКВ38х48х20Д**		0,0763	**38**	0,3
45	55	16	22,0	40,0	6300	9500	**ИКВ45х55х16Е**		0,066	**45**	0,3
48	62	22	41	65	6000	8500	**4254908**	**RNA 4908**	0,149	**48**	0,6
50	62	20	31,2	61,7	5600	8500	**ИКВ50х62х20**		0,081	**50**	0,6
	62	25	30,0	55,0	6000	8500	**154910E**		0,145		0,6
58	72	22	44,6	78,9	4800	7600	**4254910E**	**RNA 4910**	0,174	**58**	0,6



464000
864000
K F_w x E_w x B_c
KBK F_w x E_w x B_c
KCK F_w x E_w x B_c

Needle roller radial bearings, single row, without rings

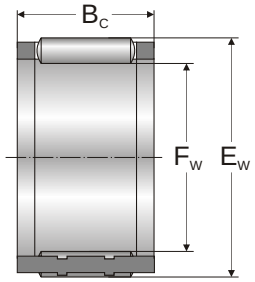
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass
			dyn.	stat.					
F_w	E_w	$Â_c$	Ñ	C_o	non-fluid	liquid	GOST	MPZ	
mm				kN	rpm		-		kg
8	11,0	10,0	3,1	3,0	19000	32000	**464098У**	**K8x11x10**	0,0024
	12,0	10,0	4,7	4,3	19000	32000	**K8x12x10E**	**K8x12x10TN**	0,0019
10	14,0	13,0	6,7	7,3	17000	29000	**K10x14x13E**	**K10x14x13TN**	0,0030
12	15,0	10,0	4,9	6,1	17000	27000	**K12x15x10E**	**K12x15x10TN**	0,0015
	16,0	13,0	7,6	8,8	16000	26000	**KBK12x16x13Д**	**K12x16x13**	0,0044
	16,0	13,0	8,0	9,4	17000	27000	**K12x16x13E**	**K12x16x13TN**	0,0035
	16,0	16,0	8,5	10,0	17000	27000	**KBK12x16x16Д**	**K12x16x16**	0,0053
14	18,0	10,0	7,1	8,5	15000	25000	**K14x18x1 0Д**	**K14x18x10**	0,0050
	18,0	17,0	8,8	10,9	15000	25000	**KBK14x18x17Д**	**K14x18x17**	0,0058
	18,0	20,0	11,0	14,4	15000	25000	**K14x18x20Д**	**K14x18x20**	0,0074
	18,0	25,0	13,6	19,0	15000	25000	**K14x18x25Д**	**K14x18x25**	0,0095
16	22,0	12,0	10,0	11,0	13000	23000	**K16x22x12У**	**KZK16x22x12**	0,0122
	22,0	12,0	10,0	11,0	13000	23000	**KCK16x22x12Г1**	**KZK16x22x12**	0,0122
17	21,0	10,0	5,7	7,5	13000	22000	**K17x21x10Д**	**K17x21x10**	0,0065
18	22,0	8,2	6,0	7,0	13000	22000	**464703E1**	**K17,8x22x8,2TN**	0,0030
18	22,0	10,0	6,1	7,4	13000	22000	**464804У**	**K18x22x10**	0,0043
	24,0	13,0	12,4	14,0	13000	22000	**KCK18x24x13Г**	**KZK18x24x13**	0,0130
	22,0	21,8	14,5	22,3	13000	22000	**464803Г**	**K18x22x21,8**	0,0142
19	25,3	19,8	19,0	24,8	13000	22000	**464904E**	**K19,3x25,3x19,8TN**	0,0143



464000
864000
K F_w x E_w x B_c
KBK F_w x E_w x B_c
KCK F_w x E_w x B_c

Needle roller radial bearings, single row, without rings

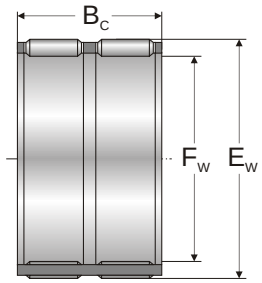
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass
			dyn.	stat.					
F_w	E_w	Âc	Ñ	C_0	non-fluid	liquid	GOST	MPZ	
mm				kN	rpm		-		kg
20	24,0	13,0	8,5	12,5	13000	20000	**К20х24х13Е**	**К20х24х13TN**	0,0045
	26,0	17,0	15,3	18,9	13000	20000	**КСК20х26х17Д**	**KZK20x26x17**	0,0145
21	27,0	16,0	15,3	19,0	13000	20000	**К21х27х16Д**	**К21х27х16**	0,0128
22	26,0	10,0	6,0	8,7	12000	19000	**464604У**	**К22х26х10**	0,0051
	26,0	10,0	7,0	9,0	12000	19000	**К22х26х10Д**	**К22х26х10**	0,0051
	26,0	10,0	7,0	9,4	12000	19000	**К22х26х10Е**	**К22х26х10TN**	0,0022
	30,0	22,0	20,7	24,6	10000	17000	**К22х30х22Д**	**К22х30х22**	0,0264
25	30,0	13,0	12,3	17,2	10000	17000	**К25х30х13Е**	**К25х30х13TN**	0,0082
	31,0	18,7	19,0	25,5	10000	17000	**КСК25х31х18,7Г**	**KZK25x31x18,7**	0,0220
	31,0	18,7	19,0	25,5	10000	17000	**464805Д**	**К25х31х18,7**	0,0187
30	35,0	13,0	13,0	22,0	8500	14000	**К30х35х13Е**	**К30х35х13TN**	0,0100
	42,0	29,7	55,0	71,5	8500	14000	**864906КЕ**	**К30х42х30TN**	0,0835
32	37,0	13,0	15,0	25,0	8500	14000	**464906Е**	**К32х37х13TN**	0,0127
	37,0	13,0	15,0	25,0	8500	14000	**К32х37х13Е**	**К32х37х13TN**	0,0127
	37,0	27,0	23,6	43,0	8500	14000	**464706Е1**	**К32х37х27TN**	0,0220
33	45,0	18,0	25,1	27,1	8000	12000	**К33х45х18Д**	**К33х45х18**	0,0501
39	55,0	26,0	51,4	59,5	6000	10000	**К39х55х26Д**	**К39х55х26**	0,1318
50	60,8	24,0	49,4	74,0	5600	8500	**864710Е**	**К49,8х60,8х24TN**	0,0735
	55,0	30,0	39,0	97,0	5600	8500	**464810**	**К50х55х30**	0,0487



464000
864000
K F_w x E_w x B_c
KBK F_w x E_w x B_c
KCK F_w x E_w x B_c

Needle roller radial bearings, single row, without rings

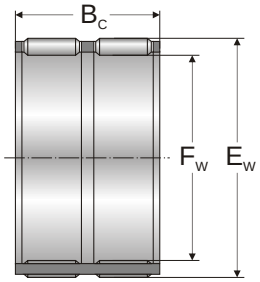
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass
			dyn.	stat.					
F_w	E_w	Â$_c$	Ñ	C_0	non-fluid	liquid	GOST	MPZ	
mm				kN	rpm		-		kg
55	63,0	20,0	37,3	66,0	5000	7500	**K55x63x20E**	**K55x63x20TN**	0,0460
60	65,0	20,0	29,5	72,0	5300	8000	**K60x65x20E**	**K60x65x20TN**	0,0310
75	83,0	23,0	49,0	105,0	3800	5600	**3K75x83x23E**	**K75x83x23TN**	0,0730
79	90,0	22,0	44,0	110,0	4000	6000	464916Å	**K79x90x22TN**	0,1070
80	88,0	30,0	64,0	150,0	3600	5300	**3K80x88x30E**	**K80x88x30TN**	0,1090
85	93,0	40,0	75,0	212,0	3600	5300	**3KK85x93x40Д**	**K85x93x40ZW**	0,1700
89	100,0	22,0	65,2	127,0	3000	4500	**464818Д**	**K89x100x22**	0,1420
140	150,0	43,0	121,3	367,2	1800	3000	**K140x150x43Д**	**K140x150x43ZW**	0,3970



664000
KK F_w x E_w x B_c

Needle roller radial bearings, double row, without rings

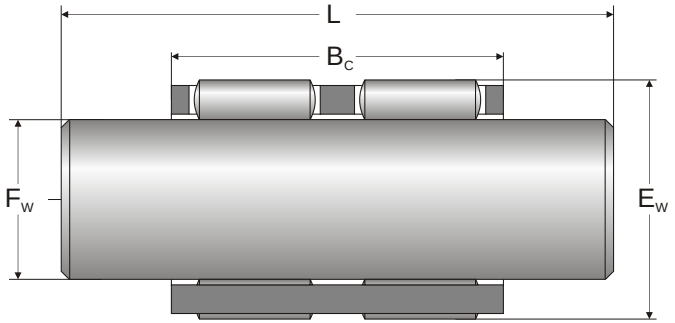
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass
			dyn.	stat.					
F_w	E_w	$\hat{A}_c$	N	C_0	non-fluid	liquid	GOST	MPZ	
mm				kN	rpm		-		kg
20	26,0	34,0	23,0	31,6	13000	20000	**3KK20x26x34E**	**K20x26x34ZWTN**	0,0220
28	33,0	27,0	23,3	41,0	9000	16000	**3KK28x33x27E**	**K28x33x27ZWTN**	0,0190
30	35,0	46,0	30,0	56,8	8500	14000	**3KK30x35x46E**	**K30x35x46ZWTN**	0,0270
35	43,0	35,0	47,0	88,7	8000	12000	**3KK35x43x35E**	**K35x43x35ZWTN**	0,0629
37	42,0	26,0	24,2	52,5	7000	11000	**3KK37x42x26E**	**K37x42x26ZWTN**	0,0168
	42,0	31,0	34,0	70,0	7000	11000	**3KK37x42x31E**	**K37x42x31ZWTN**	0,0183
42	47,0	30,0	33,5	76,0	7000	11000	**3KK42x47x30E**	**K42x47x30ZWTN**	0,0215
50	57,0	36,0	58,0	115,5	5600	8500	**3KK50x57x36E**	**K50x57x36ZWTN**	0,0720
52	60,0	39,0	76,5	165,0	5300	8000	**664910E**	**K52x60x39ZWTN**	0,1020
55	63,0	50,0	76,0	150,0	5300	8000	**3KK55x63x50Д**	**K55x63x50ZW**	0,1490
62	70,0	31,0	52,7	108,4	4500	6700	**664913E**	**K62x70x31ZWTN**	0,1080
	70,0	52,0	93,7	226,4	4500	6700	**3KK62x70x52E**	**K62x70x52ZWTN**	0,1880
	70,0	52,0	93,7	226,4	4500	6700	**KK62x70x52E**	**K62x70x52ZWTN**	0,1600
65	73,0	47,0	80,0	210,0	4300	6300	**3KK65x73x47Д**	**K65x73x47ZW**	0,1700
	73,0	47,0	80,0	210,0	4300	6300	**3KK65x73x47E**	**K65x73x47ZWTH**	0,1600
	73,0	47,0	86,8	205,8	4300	6300	**664613E**	**K65x73x47ZWTN**	0,1600



664000
KK F_w x E_w x B_c

Needle roller radial bearings, double row, without rings

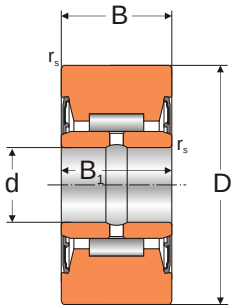
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass
			dyn.	stat.					
F_w	E_w	$\hat{A}_c$	N	C_0	non-fluid	liquid	GOST	MPZ	
mm				kN	rpm		-		kg
70	76,0	46,0	66,3	186,0	4000	6000	**3КК70x76x46Д**	**K70x76x46ZW**	0,1235
	78,0	31,0	58,6	131,3	4000	6000	**664514Д**	**K70x78x31ZW**	0,1130
72	82,0	45,0	88,5	180,0	4000	6000	**3КК72x82x45E**	**K72x82x45ZWTN**	0,1760
	83,0	42,5	93,0	213,0	4000	6000	**664714Д**	**K72x83x42,5ZW**	0,2248
	83,0	42,5	97,0	199,0	4000	6000	**664714E**	**K72x83x42,5ZWTN**	0,2250
75	83,0	40,0	71,0	190,0	3800	5600	**3КК75x83x40Д**	**K75x83x40ZW**	0,1510
	83,0	46,0	81,0	226,0	3800	5600	**3КК75x83x46E**	**K75x83x46ZWTN**	0,1620
	83,0	46,0	81,0	226,0	3800	5600	**3КК75x83x46Д**	**K75x83x46ZW**	0,1920
	86,0	40,0	100,4	209,0	3800	5600	**664915E**	**K75x86x40ZWTN**	0,2250
79	90,5	42,7	108,4	251,1	3600	5300	**664715Д1**	**K78,5x90,5x42,7ZW**	0,2990
81	92,0	42,5	102,3	223,0	3600	5300	**664916E**	**K81x92x42,5ZWTN**	0,2122
	92,0	42,5	102,3	223,0	3600	5300	**664916Д**	**K81x92x42,5ZW**	0,2520
	92,0	50,5	105,0	240,0	3600	5300	**664816E**	**K81x92x50,5ZWTN**	0,2250
85	93,0	40,0	75,0	212,0	3600	5300	**3КК85x93x40Д**	**K85x93x40ZW**	0,1700
	93,0	50,0	90,0	266,0	3600	5300	**3КК85x93x50Д**	**K85x93x50ZW**	0,2200
89	100,0	42,7	112,0	253,5	3000	4500	**664818Д**	**K89x100x42,7ZW**	0,2770
95	103,0	50,0	93,8	294,0	3000	4500	**3КК95x103x50Д**	**K95x103x50ZW**	0,2507



664000E0
2527/00E0

Needle roller radial bearings, double row with spindle

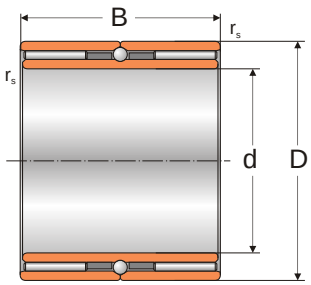
Basic dimensions				Load capacity		Maximum rotation speed (lubrication)		Designation	Mass
				dyn.	stat.				
F_w	E_w	$Â_c$	L	Ñ	C_o	non-fluid	liquid	GOST	
mm				kN		rpm		-	kg
30	42,0	59,0	101	96,0	143,0	8500	14000	**664706E3**	0,717
	42,0	59,0	113	96,0	143,0	8500	14000	**664706E5**	0,681
32	52,0	50,0	94	109,0	127,4	7500	13000	**2527/32E5**	0,801
34	46,0	59,6	96	95,1	146,0	7000	12000	**664907KE3**	0,835



874000

Support rollers

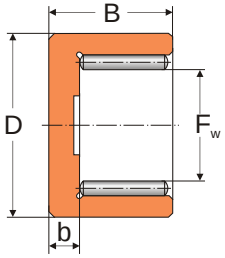
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)	Designation	Mass	Dimensions		
d	D	Â	dyn. N	stat. C_0	non-fluid	GOST		d	B_1	r_{smin}
mm			kN		rpm	-	kg	mm		
14	48	20,8	24,5	33,6	6000	**874902XC17**	0,276	**14**	21	0,6
20	55	28	44,0	55,4	5000	**874804XC17**	0,390	**20**	30	1,1
	55	30	45,0	55,0	4000	**884804XC17**	0,392		28	1,1



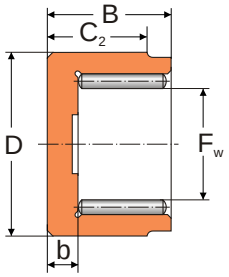
654000

Needle roller radial bearings, double row with two-piece outer ring and balls

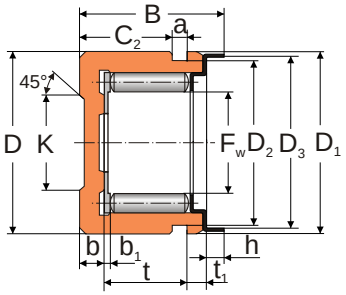
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation	Mass	Dimensions	
			dyn.	stat.						
d	D	Â	N	C_0	non-fluid	liquid	GOST		d	r_{smin}
mm			kN		rpm		-	kg	mm	
140	180	155	340,0	880,0	2000	4200	**654728**	11,0	**140**	2,0



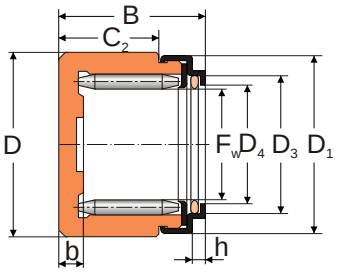
904700У



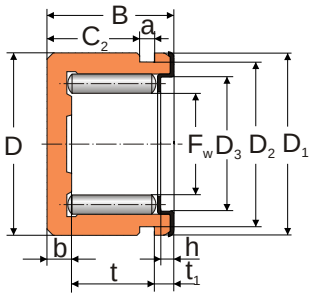
904902У



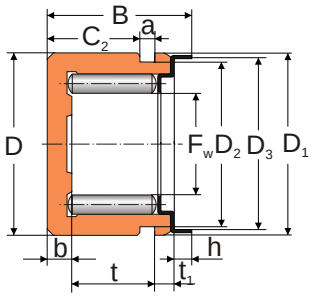
704702К5



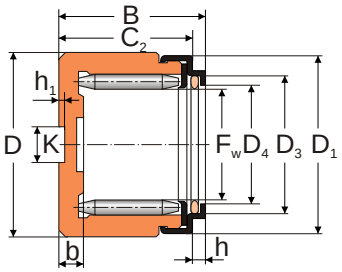
804704К4



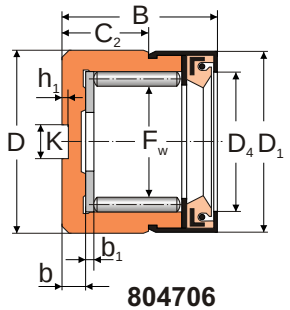
704902У1



704702К2
704702К3



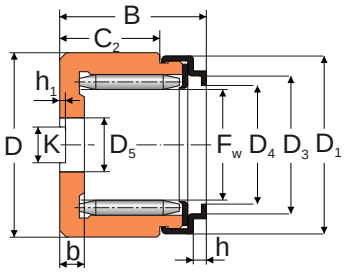
804704К1



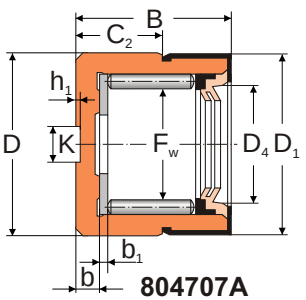
804706

Cardan shaft radial needle roller bearings

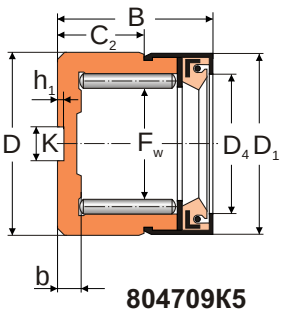
Basic dimensions			Load capacity		Designation	Mass	Dimensions													
			dyn.	stat.																
F_w	D	Â	Ñ	C_0	GOST		d	C_2	D_1	D_2	D_3	D_4	D_5	b	b_1	t	t_1	a	h	h_1	K
mm			kN		-	kg	mm														
10,005	19,0	9,0	6	7	**904700У**	0,014	**10,005**							2,30							
14,723	23,84	13,1	15	19	**904902У**	0,026	**14,723**	10,1						2,04							
15,235	28,0	20,0	17	22	**704902У1**	0,056	**15,235**	12,45	27,9	25,3	19,3			4,45		11,0	4,3	3,0	3,35		
16,305	30,0	25,0	18	29	**704702К2**	0,073	**16,305**	13,6	30,0	27,2	27,6			4,10		12,5	4,5	3,0	4,0		
	30,0	25,0	22	28	**704702К3**	0,073		13,6	30,0	27,2	27,6			4,10		12,5	4,5	3,0	4,0		
	30,0	25,1	16	25	**704702К5**	0,074		13,6	30,0	27,2	27,6			4,10	1,02	4,5	3,0	4,0	0,9	18,0	
22,000	35,0	26,5	27	41	**804704К1**	0,099	**22,000**	15,9	34,79		27,0	23,25		4,00				3,4	1,6	10,0	
	35,0	26,5	27	41	**804704К4**	0,093		15,9	34,79		27,0	23,25		4,00				3,4			
31,455	47,0	36,0	47	92	**804706**	0,230	**31,455**	21,5	45,5			36,0		4,00	2,02						



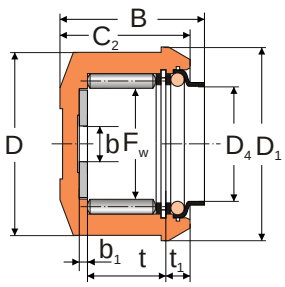
804907K3



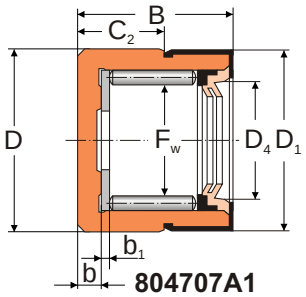
804707A



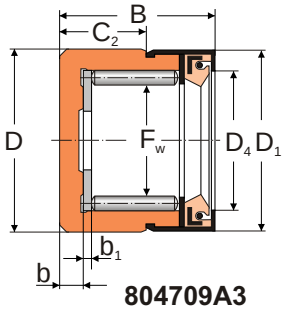
804709K5



804711A



804707A1



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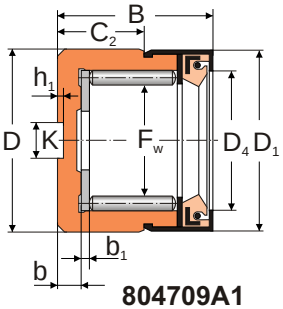
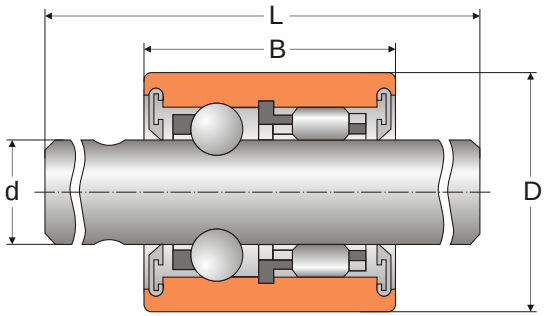


804709A1
804709A2

Cardan shaft radial needle roller bearings

Basic dimensions			Load capacity		Designation	Mass	Dimensions												
F_w	D	Â	dyn. Ñ	stat. C_0	GOST		d	C_2	D_1	D_2	D_3	D_4	D_5	b	b_1	t	t_1	h	h_1	K
mm			kN		-	kg	mm													
33,635	50,0	25,1	34	63	**804907K3**	0,205	**33,635**	17,0	49,4		40,0	34,0	18	4,00				1,6	1,5	9,0
	50,0	37,0	60	104	**804707A**	0,310		30,6	49,35			37,5		4,00	2,02				1,5	9,0
	50,0	37,0	60	104	**804707A1**	0,310		30,6	49,35			37,5		4,00	2,02					
45,000	62,0	37,0	62	122	**804709A1**	0,340	**45,000**	21,5	61,3			52,0		4,00	2,02				1,5	9,0
	62,0	37,0	62	122	**804709A2**	0,340		21,5	61,3			52,0		4,00	2,02				1,5	9,0
	62,0	37,0	62	122	**804709A3**	0,350		21,5	61,3			52,0		4,00	2,02					
	62,0	37,0	68	137	**804709K5**	0,350		21,5	61,3			52,0		4,00					1,5	9,0
49,425	72,0	46,6	102	180	**804710A**	0,450	**49,425**	38,8	71,35			55,0		6,00	2,52					
51,600	83,0	72,0	168	263	**804711A**	1,580	**51,600**	66,0	90,0			62,5		8,00	3,60	44,5	13,5			



4224000

Combined radial bearings for special applications

Basic dimensions				Load capacity		Maximum rotation speed (lubrication)	Designation	Mass
F_w	E_w	$Â_c$	L	dyn. Ñ	stat. C_0	non-fluid	GOST	
mm				kN		rpm	-	kg
16	30	39	92	11,5/4,6*	7,3/2,6*	5000	**4224703E**	0,23
	30	39	115	11,5/4,6*	7,3/2,6*	5000	**4224903E**	0,27

* - roller row / ball row

Roller thrust bearings

Roller thrust bearings are designed to bear significant axial and impulse load applied along axis of rotation of bearing. Such bearings allow much less rotation frequency in comparison with other bearing types. It provided by greater roller sliding resulted from difference of speed on its ends.

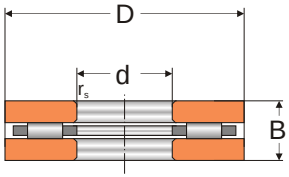
Roller thrust bearings consist of two flat rings (one tough ring mounted on shaft and one non-fixed ring mounted in housing) and cage completed with cylindrical rollers.

MPZ produces roller thrust bearings with cage from glass-nylon composite 6.6. Design of produced bearings includes: ringless bearings, bearings with rings on various size depending on outer diameter; bearings in protective housing with inserted lubrication.

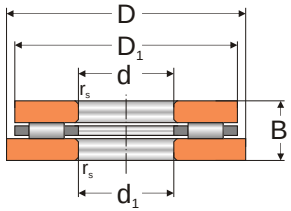
Primary area of application of such bearings is small size bearing arrangement such as lifting screws, power steerings, supports of truck front suspension group etc.

Dynamic equivalent load applied on bearing is $\mathbf{P=F_aK_\sigma K_T}$, static equivalent load applied on bearing is $\mathbf{P_0=F_a}$.

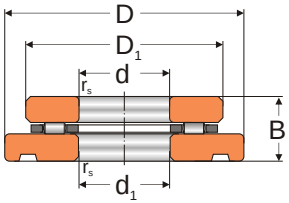
Allowable variation of dimensions and beating are specified in tables.



9000



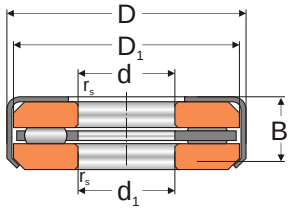
819000



959000

Roller thrust bearings, single row

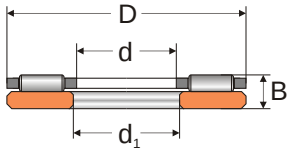
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation	Mass	Dimensions			
			dyn.	stat.								
d	D	Â	N	C_0	non-fluid	liquid	GOST		d	d_1	D_1	r_{smin}
mm			kN		rpm		-	kg	mm			
15	28,0	8,0	14,4	28,5	2750	11000	**9102KE**	0,0226	**15**			0,3
	28,0	9,0	14,4	28,5	2750	11000	**9102E**	0,0263				0,3
20,2	38,0	12,0	23,5	48,5	2125	8500	**9104K1E**	0,0530	**20,2**			0,5
25,0	63,0	16,0	23,0	95,0	1700	2400	**819705E**	0,2200	**25,0**	25,2	52,0	0,3
25,4	41,9	6,0	13,1	57,0	2200	3200	**819805E**	0,0310	**25,4**	25,4	41,9	1,6
40,0	68,0	13,0	107,0	256,0	2500	4400	**959108E**	0,1542	**40,0**	40,2	60,0	0,6



129000E

Roller thrust bearings, single row with housing

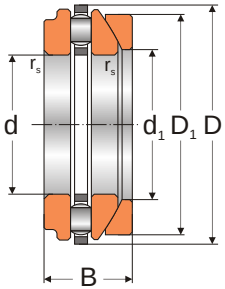
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)	Designation	Mass	Dimensions		
			dyn.	stat.						
d	D	Â	N	C_0	non-fluid	GOST		d	d_1	r_{smin}
mm			kN		rpm	-	kg	mm		
50,4	81,0	22,8	61,0	311,0	1200	**129710E**	0,460	**50,4**	55,0	1,5
80,2	145,0	45,0	210,0	390,0	**700**	**129316E**	3,020	**80,2**	85,0	2,5



109000

Roller thrust bearings, single row without one ring

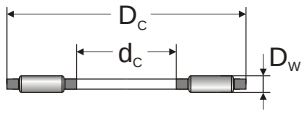
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation	Mass	Dimensions		
			dyn.	stat.							
d	D	Â	Ñ	C_0	non-fluid	liquid	**GOST**		d	d_1	r_{smin}
mm			kN		rpm		-	kg	mm		
40,3	60,0	6,0	19,8	77,5	4200	5900	**109708E**	0,0440	**40,3**	42,0	0,5



969000K

Roller thrust bearings, single row, for special applications

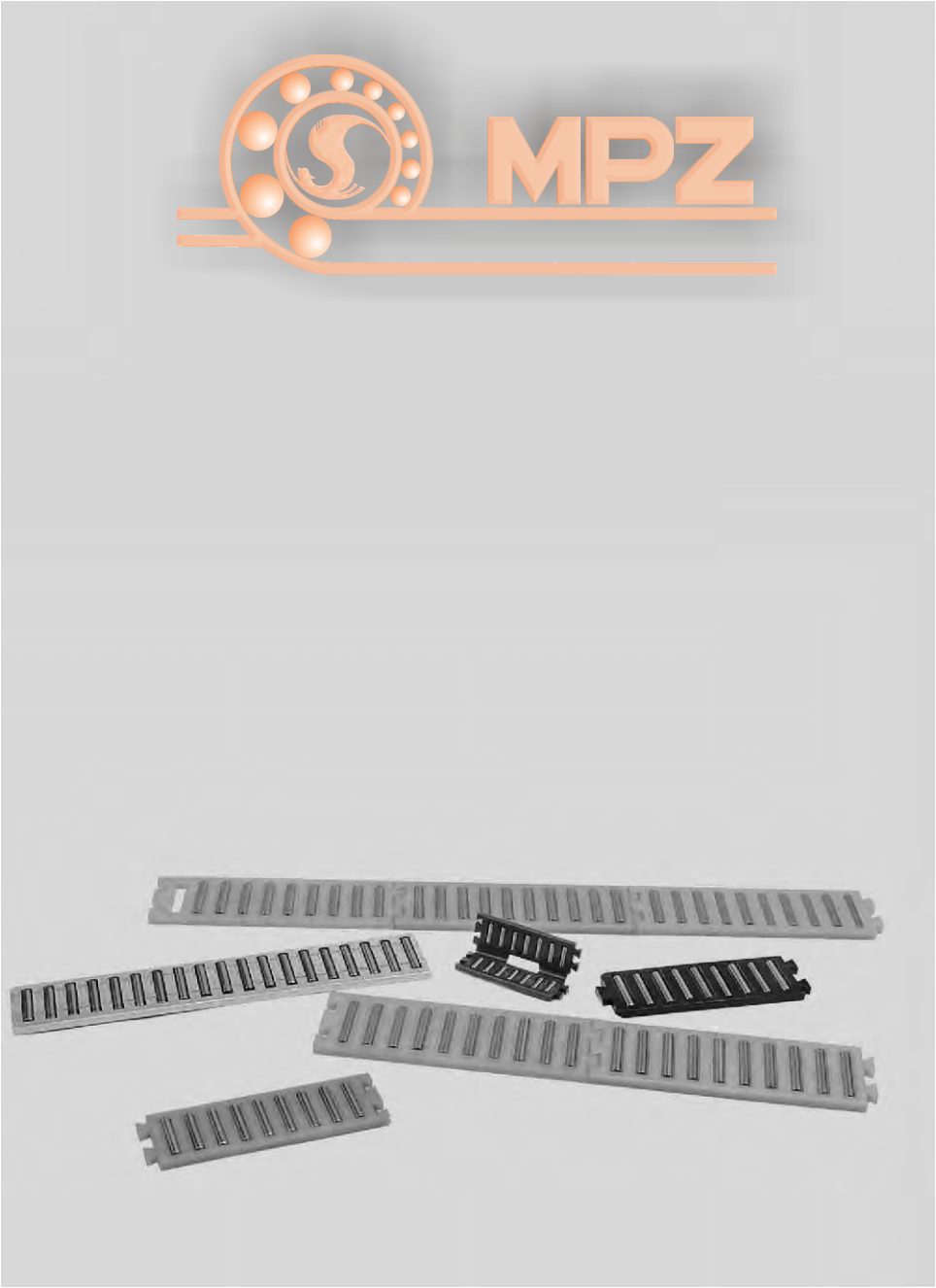
Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation	Mass	Dimensions			
			dyn.	stat.								
d	D	Â	N	C_0	non-fluid	liquid	GOST		d	d_1	D_1	r_{smin}
mm			kN		rpm		-	kg	mm			
26,1	44,0	18,5	23,0	64,8	2000	3000	**969905KE**	0,092	**26,1**	28,0	40,0	0,5



999000

Roller thrust bearings, single row without rings

Basic dimensions			Load capacity		Maximum rotation speed (lubrication)		Designation		Mass
			dyn.	stat.					
d_c	D_c	D_w	N	C_0	non-fluid	liquid	GOST	MPZ	
mm			kN		rpm		-		kg
15,0	28,0	2,0	8,5	20,0	4000	10000	**999702E**	**AXK 1528**	0,0023



Linear motion needle roller bearings

Linear motion needle roller bearings (NRB) are bearings consist from flat cage and package of needle rollers.

Bearings may have two types depending on cage structure:

à) one row

b) two row

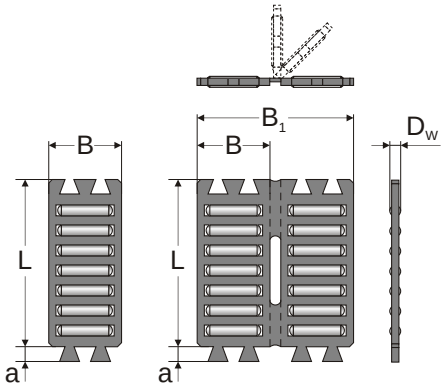
Linear motion needle roller bearings with cages made from nylon plastic have dovetailed grooves at their ends which allow to connect any bearings amount and to get required length.

Double-row NRB have non-rigid connector which enables two rows of needle rollers to bend towards each other which allows to use the function as so called “angle bearing”.

Operating temperature of NBR with cage made of nylon plastic is 100°Ñ.

Machine tool industry is an area where NBR are widely and large scale used as rolling-contact bearings on flat guides in machine and instrument units etc.

Dynamic equivalent load on bearing shall be determined as $\mathbf{P=F_aK_\sigma K_T}$, static equivalent load on bearing shall be determined as $\mathbf{P_0=F_a}$.



РИП 0000К **РИП 0000КК**

Linear motion needle roller bearings

Basic dimensions			Load capacity		Designation		Mass	Dimensions		
B	B_1	L	dyn. Ñ	stat. C_0	GOST	MPZ		d	a	D_w
mm			kN		-		kg	mm		
10		32	8,4	18	**РИП 2010К**	**FF 2010**	0,0018	**10**	2,0	2,0
10	25	32	14,2	35	**РИП 2025КК**	**FF 2025 ZW**	0,0036	**10**	2,0	2,0
20		60	30,6	72	**РИП 3020К**	**FF 3020**	0,0104	**20**	3,0	3,0
25		75	48,2	125	**РИП 3525К**	**FF 3525**	0,0190	**25**	3,2	3,5

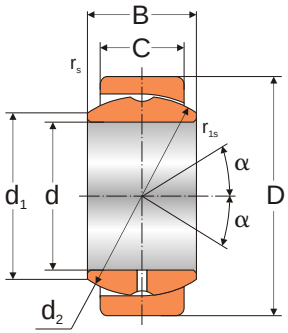
Joint-type bearings

Joint-type bearings – are sliding bearings. They include inner and outer rings and do not have rolling elements. Inner ring has spherical outer surface, outer ring has spherical inner surface. Joint-type bearings are designed to bear radial and combined loads in sliding and fixed connections. These bearings may be produced with one fractures of outer ring (ØÑÏ type) or with two fractures of outer ring (ØÑË type). Bearings with movable connection operate with mutual displacement of one ring towards the other in vibrating MIDI mode generally with angle up to 45°. Herewith angle of distortion up to 4...22° is allowable depending on construction. Bearings with fixed connection operate with frequent singular displacement of one ring towards the other and are designed generally to compensate axis misalignment of shaft and housing. Bearings for movable connections are produced with bores and grooves for lubrication supply provided both in outer and inner rings (ØÑ...Ê type), as well as in inner ring only (ØÑ type). Bearings for fixed connections are produced without any bores or grooves for lubrication supply (Ø type).

Bearing are produced to operate steel-to-steel. Viscous lubrications 1-13, ÖÈÀÒÈÌ -201 and liquid lubrication oils are used to lubricate such bearings.

Extreme deviation of dimensions and form of surfaces of bearing rings as well as method to determine equivalent radial load are approved under GOST 3635-78.

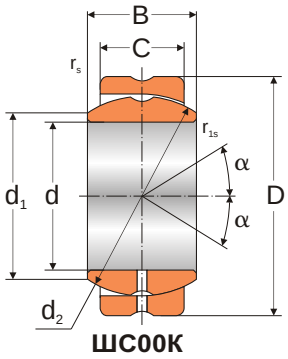
Allowable radial loads at repeated loading not exceeding 5000



ШС00
0ШС00

Joint-type bearings with lubricating holes and grooves on inner ring

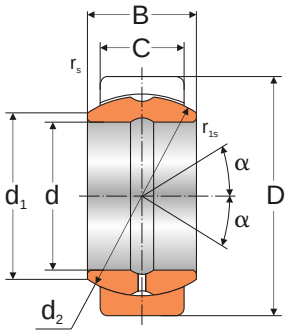
Basic dimensions				Admissible radial loads at repetitive loading number no more than 5000	Designation	Mass	Dimensions					Angle of contact
d	D	B	Ñ	C_0	GOST		d	d_1	d_2	r_{smin}	r_{1smin}	á
mm				kN	-	kg	mm					deg
20	47	26	15	128	**2ШС20**	0,19	**20**	23,0	35,0	0,6	0,5	22
25	42	20	16	137	**ШС25**	0,12	**25**	29,0	35,0	0,6	0,5	7
30	47	22	18	176	**ШС30**	0,14	**30**	33,0	40,0	0,6	0,5	6
35	55	26	21	241	**ШС35**	0,24	**35**	39,0	47,0	1,0	0,5	6
40	62	28	22	285	**ШС40**	0,31	**40**	45,0	53,0	1,0	0,5	7
50	75	35	28	453	**ШС50**	0,56	**50**	55,0	66,0	1,1	0,5	6



ШС00К

Joint-type bearings with lubricating holes and grooves on inner and outer rings

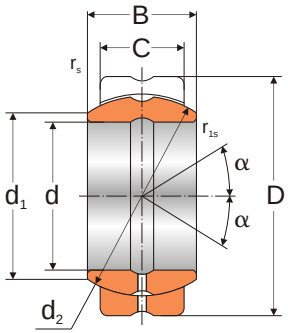
Basic dimensions				Admissible radial loads at repetitive loading number no more than 5000	Designation	Mass	Dimensions					Angle of contact
d	D	B	Ñ	C_0	GOST		d	d_1	d_2	r_{smin}	r_{1smin}	á
mm				kN	-	kg	mm					deg
40	62	28	22	285	**ШС40К**	0,31	**40**	45,0	53,0	1,0	0,5	7



ШСП00

Joint-type bearings with one fracture of outer ring, lubricating holes and grooves in inner ring

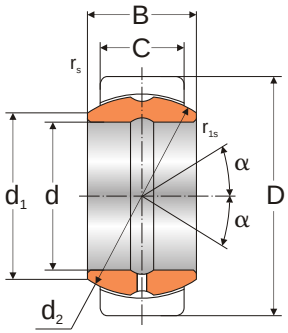
Basic dimensions				Load capacity		Designation	Mass	Dimensions					Angle of contact
d	D	B	Ñ	dyn. C	stat. C_0	GOST		d	d_1	d_2	r_{smin}	r_{1smin}	á
mm				kN		-	kg	mm					deg
20	35	16	12	30	146	**ШСП20**	0,06	**20**	24,0	29,0	0,6	0,5	9
25	42	20	16	48	240	**ШСП25**	0,12	**25**	29,0	35,0	0,6	0,5	7
30	47	22	18	62	310	**ШСП30**	0,14	**30**	33,0	40,0	0,6	0,5	6
35	55	26	21	87	438	**ШСП35**	0,24	**35**	39,0	47,0	1,0	0,5	6
50	75	35	28	156	780	**ШСП50**	0,56	**50**	55,0	66,0	1,1	0,5	6



ШСП00К

Joint-type bearings with one fracture of outer ring, lubricating holes and grooves in inner and outer rings

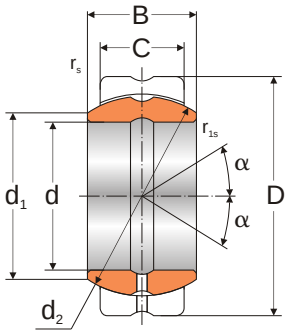
Basic dimensions				Load capacity		Designation	Mass	Dimensions					Angle of contact
d	D	B	Ñ	dyn. C	stat. C_0	GOST		d	d_1	d_2	r_{smin}	r_{1smin}	á
mm				kN		-	kg	mm					deg
25	42	20	16	48	240	**ШСП25К**	0,12	**25**	29,0	35,0	0,6	0,5	7
30	47	22	18	62	310	**ШСП30К**	0,14	**30**	33,0	40,0	0,6	0,5	6
35	55	26	21	87	438	**ШСП35К**	0,23	**35**	39,0	47,0	1,0	0,5	6
40	62	28	22	100	500	**ШСП40К**	0,31	**40**	45,0	53,0	1,0	0,5	7
42	62	25	22	110	550	**ШСП42К**	0,30	**42**	46,8	53,0	1,0	0,5	7
50	75	35	28	156	780	**ШСП50К**	0,54	**50**	55,0	66,0	1,1	0,5	6



ШСЛ00

Joint-type bearings with two fractures of outer ring, lubricating holes and grooves in inner ring

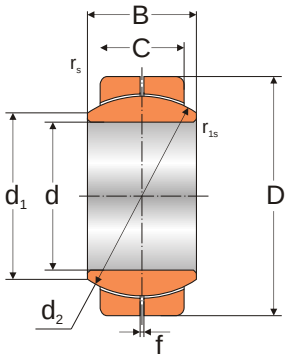
Basic dimensions				Load capacity		Designation	Mass	Dimensions					Angle of contact
d	D	B	Ñ	dyn. C	stat. C_0	GOST		d	d_1	d_2	r_{smin}	r_{1smin}	á
mm				kN		-	kg	mm					deg
70	105	49	40	315	1560	**ШСЛ70**	1,59	**70**	77,9	92,0	1,1	0,5	6



ШСЛ00К

Joint-type bearings with two fractures of outer ring, lubricating holes and grooves in inner and outer rings

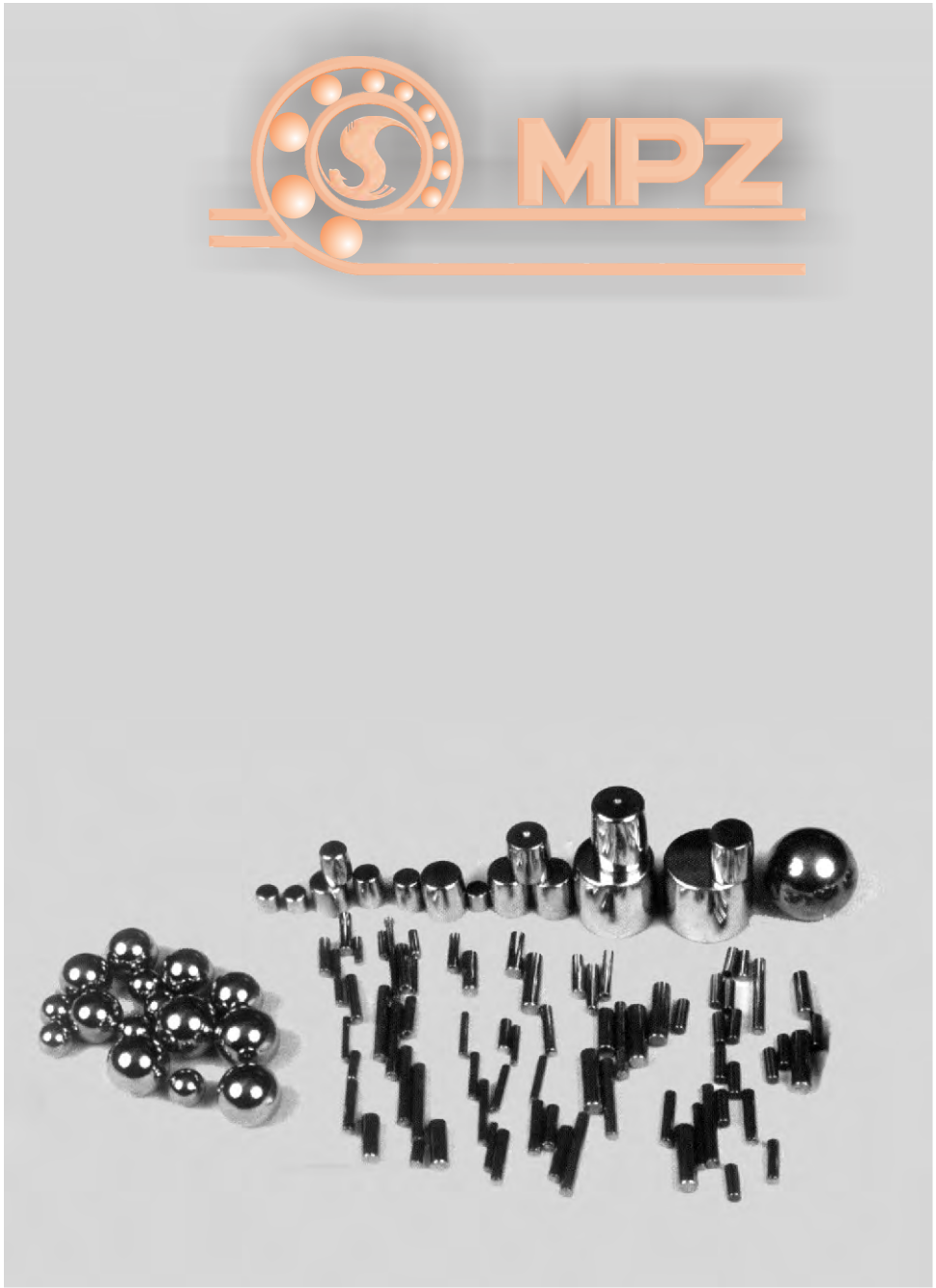
Basic dimensions				Load capacity		Designation	Mass	Dimensions					Angle of contact
d	D	B	Ñ	dyn. C	stat. C_0	GOST		d	d_1	d_2	r_{smin}	r_{1smin}	á
mm				kN		-	kg	mm					deg
60	90	44	34	250	1225	**ШСЛ60К**	0,96	**60**	66,8	80,0	1,1	0,8	6
70	105	49	40	315	1560	**ШСЛ70К**	1,56	**70**	77,9	92,0	1,1	0,8	6



ШСР00

Joint-type bearings with cut outer ring

Basic dimensions				Admissible radial loads at repetitive loading number no more than 5000	Designation	Mass	Dimensions					
d	D	B	Ñ	C_0	GOST		d	d_1	d_2	r_{smin}	r_{1smin}	f
mm				kN	-	kg	mm					
35	55	26	21	210	**ШСР35**	0,24	**35**	39,0	47,0	1,0	0,5	1,5
50	75	35	28	430	**ШСР50**	0,55	**50**	55,0	66,0	1,1	0,5	1,5



Rolling elements

Balls

Balls as free parts are produced under ISO 3290-1:2000 from chrome carbon steel type ØÕ15 heat treated to hardness up to 62...66 HRC. Under consumer request balls may be produced of steel of other grades with different hardness. Balls of one accuracy degree are grouped with very high tolerances on diameter. Every grouped shall be packed in separate box. Size of sorted ball group is specified in box marking.

Under ISO 3290-1:2000 there are 10 accuracy grades specified with decreasing numbers 3, 5, 10, 16, 20,... 200. Allowable extreme deviations of balls are specified in table.

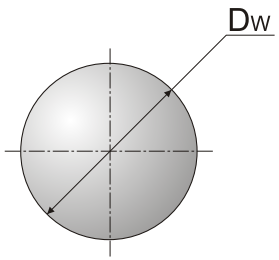
Identification code of balls used as free parts includes nominal diameter specified in mm, accuracy grade and standard identification for example:
Ball 12.7-40 ISO 3290-1:2000.

Identification code of balls used in rolling element bearings has letter “H” prefixing nominal diameter, for example:
Ball Í 11,112-10 ISO 3290-1:2000.

Identification code of balls which are not separated under diameter shall has letter “Á” prefixing nominal diameter, for example:
Ball Á9.525-100 ISO 3290-1:2000.

Allowable extreme deviation of balls

Accuracy degree	Nominal diameter Dw, mm		Allowable variations of effective diameter of balls used as free parts Dwm	Dimensional difference of balls under diameter in one batch Vdw1	Inconstancy of individual diameter Vdws	Deviation from the spherical form Δ	Roughness	
	from	to					Ra	Rz
3	0,25	12	±5	0,13	0,08	0,08	-	0,100
5	0,25	12	±5	0,25	0,13	0,13	0,020	0,100
10	0,25	25	±9	0,50	0,25	0,25	0,020	0,100
16	0,25	25	±10	0,80	0,40	0,40	0,032	0,160
20	0,25	38	±10	1,00	0,50	0,50	0,040	0,200
28	0,25	38	±12	1,40	0,70	0,70	0,050	0,250
40	0,25	50	±16	2,00	1,00	1,00	0,080	0,400
60	0,25	80	±30	3,00	1,50	1,50	0,100	0,500
100	0,25	120	±40	5,00	2,50	2,50	0,125	0,600
200	0,25	150	±60	10,00	5,00	5,00	0,200	0,800



Balls

Diameter D_w mm	D_w inch	Mass of 1000 pcs, kg	Diameter D_w mm	D_w inch	Mass of 1000 pcs, kg
5,556	7/32	0,705	14,288	9/16	12,000
5,953	15/64	0,867	15,081	19/32	14,100
7,144	9/32	1,500	15,875	5/8	16,400
7,938	5/16	2,060	16,669	21/32	19,000
8,731	11/32	2,730	18,256	23/32	25,000
9,525	3/8	3,550	19,050	3/4	28,400
10,000		4,110	19,844	25/32	32,100
11,112	7/16	5,640	22,225	7/8	45,100
11,509	29/64	6,260	24,606	31/32	61,200
12,000		7,100	25,400	1	67,300
12,303	31/64	7,650	28,575	1,125	95,800
12,700	1/2	8,420	33,338	1,34375	152,000

Rollers

MPZ produces cylindrical needle and short rollers from high carbonic chrome steel ØÕ15 and ØÕ15ÑÃ type. Rollers have different end faces, size, accuracy and surface quality.

Cylindrical needle rollers (L>3D) and short rollers are made by heat treatment to hardness up to 61...66 HRC.

Needle bearings have three accuracy grades depending on accuracy of dimensions, from and roughness parameters which are specified with decreasing numbers 2, 3, and 5. Allowable extreme deviations of specified values are regulated by ISO 3096:1996.

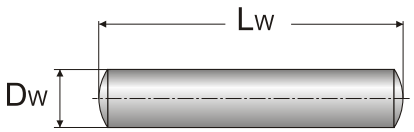
Needle bearings of one accuracy grade are grouped and packed in separate boxes with marking.

Identification code of needle bearings used as free parts includes nominal diameter and length specified in mm, modification, accuracy grade and standard, for example:
Roller 2x15,8 A3 ISO 3096:1996.

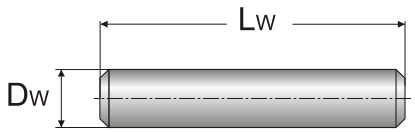
As agreed upon with consumer, needle bearings may be made with extreme deviations along the length up to h13. Identification code of such needle bearings shall have letter “K” prefixing nominal diameter, for example:
Roller Ê2õ13.8 A3 ISO 3096:1996.

Identification code of needle bearings of separate selected group (with deviation from effective diameter up to 4.5-7.5 mkm may be as of the following:
Roller 2x15.8 A3 4.5/-7.5Ó ISO 3096:1996.

Rollers shall be grouped depending on their diameter and length. As agreed upon with consumer rollers nay be supplied without sorting.



Version A



Version B

Rollers

Dimensions D_w mm	L_w	Mass of 1000 pcs, kg
1,5	6,8	0,095
1,6	11,8	0,190
1,7	10,0	0,170
2,0	7,8	0,190
	9,8	0,240
	11,8	0,290
	12,8	0,320
	15,8	0,390
	17,8	0,450
	19,8	0,490
2,1	6,0	0,130
2,5	7,8	0,300
	9,8	0,380
	11,8	0,450
	13,8	0,530
	15,8	0,610
	17,8	0,690
	19,8	0,750
	21,8	0,830
	23,8	0,920

Dimensions D_w mm	L_w	Mass of 1000 pcs, kg
3,0	8,0	0,441
	9,8	0,540
	11,8	0,650
	13,8	0,760
	15,8	0,870
	17,8	0,990
	19,8	1,100
	21,8	1,220
	23,8	1,320
3,5	11,0	0,850
	13,8	1,050
	23,8	1,800
4	6,0	0,580
	15,8	1,500
	19,8	1,970
	21,8	2,150
	25,8	2,610
	29,8	2,950
	34,8	3,450
4,5	5,5	0,680
	15,8	1,980

Dimensions D_w mm	L_w	Mass of 1000 pcs, kg
5	8,0	1,210
	27,8	4,120
	29,8	4,620
	44,8	6,940
	49,8	7,500
5,5	15,8	2,926
	16,0	2,800
6	8,5	1,870
	12,0	2,610
	23,8	5,280
	27,8	6,120
	41,8	9,300
6,04	9,0	1,980
6,5	11,0	2,850
7,0	20,0	6,040
	26,0	7,800
7,5	7,5	2,540
8	12,0	4,650
	14,0	5,490
	16,0	6,270

Dimensions D_w mm	L_w	Mass of 1000 pcs, kg
8	20,0	7,840
	25,0	9,500
10	16,0	9,800
	20,0	12,200
	25,0	15,310
	30,0	18,300
11	35,0	25,930
12	12,0	10,400
12,5	22,0	21,000
	25,0	23,918
15	30,0	41,300
20	19,4	47,800
24	23,4	83,000
30	29,4	160,000
36	35,4	280,000
42	41,4	450,000

Notes