MATERIAL STANDARD

FOR

BEARINGS

FIRST EDITION

JULY 2004

This standard specification is reviewed and updated by the relevant technical committee on May 2015. The approved modifications are included in the present issue of IPS.

FOREWORD

The Iranian Petroleum Standards (IPS) reflect the views of the Iranian Ministry of Petroleum and are intended for use in the oil and gas production facilities, oil refineries, chemical and petrochemical plants, gas handling and processing installations and other such facilities.

IPS are based on internationally acceptable standards and include selections from the items stipulated in the referenced standards. They are also supplemented by additional requirements and/or modifications based on the experience acquired by the Iranian Petroleum Industry and the local market availability. The options which are not specified in the text of the standards are itemized in data sheet/s, so that, the user can select his appropriate preferences therein.

The IPS standards are therefore expected to be sufficiently flexible so that the users can adapt these standards to their requirements. However, they may not cover every requirement of each project. For such cases, an addendum to IPS Standard shall be prepared by the user which elaborates the particular requirements of the user. This addendum together with the relevant IPS shall form the job specification for the specific project or work.

The IPS is reviewed and up-dated approximately every five years. Each standards are subject to amendment or withdrawal, if required, thus the latest edition of IPS shall be applicable

The users of IPS are therefore requested to send their views and comments, including any addendum prepared for particular cases to the following address. These comments and recommendations will be reviewed by the relevant technical committee and in case of approval will be incorporated in the next revision of the standard.

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GENERAL DEFINITIONS

Throughout this Standard the following definitions shall apply.

COMPAN:

Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company and National Iranian Oil Refinery And Distribution Company.

PURCHASER:

Means the “Company” where this standard is a part of direct purchaser order by the “Company”, and the “Contractor” where this Standard is a part of contract document.

VENDOR AND SUPPLIER:

Refers to firm or person who will supply and/or fabricate the equipment or material.

CONTRACTOR:

Refers to the persons, firm or company whose tender has been accepted by the company.

EXECUTOR:

Executor is the party which carries out all or part of construction and/or commissioning for the project.

INSPECTOR:

The Inspector referred to in this Standard is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.

SHALL:

Is used where a provision is mandatory.

SHOULD:

Is used where a provision is advisory only.

WILL:

Is normally used in connection with the action by the “Company” rather than by a contractor, supplier or vendor.

MAY:

Is used where a provision is completely discretionary.

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1. SCOPE AND FIELD OF APPLICATION

This Standard specification gives the minimum requirements for selection, quality control and testing of general purpose steel rolling bearings to be used in Iranian Oil/Gas and Petrochemical Industries.

This Standard shall be used for the selection of the rolling bearings and also for the preparation of requisition or purchase orders.

Note 1:

This is a revised version of this standard, which is issued as revision (1)-2004. Revision (0)-1997 of the said standard specification is withdrawn.

Note 2:

This standard specification is reviewed and updated by the relevant technical committee on May. 2015. The approved modifications by T.C. were sent to IPS users as amendment No. 1 by circular No. 450 on May. 2015. These modifications are included in the present issue of IPS.

2. REFERENCES

Throughout this Standard the following standards are referred to. The editions of these standards that are in effect at the time of publication of this Standard shall to the extent specified herein, form a part of this Standard. The applicability of changes in standards that occur after the date of this Standard shall be mutually agreed upon by the Company and the Vendor/ Consultant.

ISO 15	"Rolling Bearing-Radial Bearings-Boundary Dimensions, General Plan"
ISO 104	"Rolling Bearings-Thrust Bearings-Boundary Dimensions, General Plan"
ISO 199	"Rolling Bearings-Thrust Bearings-Geometrical Product Specification (GPS) and Tolerance Values"
ISO 355	"Rolling Bearings-Tapered Roller Bearings-Boundary Dimensions and Series Designations"
ISO 492	"Rolling Bearings-Radial Bearings-Dimensional and Geometrical Tolerances"
ISO 582	"Rolling Bearings-Chamfer Dimensions-Maximum Values"
ISO 683-17	"Heat-Treated Steels, Alloy Steels and Free-Cutting Steels - Part 17: Ball and Roller Bearing Steels"
ISO 1132-1	"Rolling Bearings-Tolerances-Part 1: Terms and Definitions"
ISO 1132-2	"Rolling Bearings-Tolerance-Part 2: Measuring and gauging principles and methods"
ISO 1206	"Rolling Bearings-Needle Roller Bearings, Dimension Series 48, 49 and 69-Boundary Dimensions and Tolerances"
ISO 5593	"Rolling Bearings-Vocabulary"
ISO 5753-1	"Rolling Bearings-Internal Clearance-Part 1: Radial Internal Clearance for Radial Bearings"

ISO 5753-2	"Rolling Bearing-Internal clearance-Part 2: Axial Internal For four-point-contact ball bearings"
ISO 6507-1	"Metallic Materials-Vickers Hardness Test-Part 1: Test Method"
ISO 6507-2	"Metallic Materials-Vickers Hardness Test-Part 2: Verification and Calibration of Testing Machines"
ISO 6508-1	"Metallic Materials-Rockwell Hardness Test-Part 1: Test Method (Scales A, B, C, D, E, F, G, H, K, N, T)"

3. DEFINITIONS

For the purpose of this Standard the definitions mentioned in ISO 5593 shall apply.

4. CONFLICTING REQUIREMENTS

In case of conflict between the documents relating to the enquiry or purchase order the following priority of documents shall apply:

- First priority:	Purchase order (including attachments) and variations thereof.
- Second priority:	Data sheets.
- Third priority:	This Standard specification.

5. UNITS

This Standard is based on International System of Units (SI), as per IPS-E-GN-100 except where otherwise specified.

6. SPECIFIC REQUIREMENTS

6.1 Appearance

All essential portions of the rolling bearings shall be clean and free from visible defects such as porosity, burrs, cracks, grinding marks, indentations, rusks marks, etc. The finishing of all the surfaces shall be smooth.

6.2 Types of Steels to be Used and Their Chemical Compositions

6.2.1 Type of steels to be used

Rolling bearings shall be manufactured from four groups of wrought rolling bearing steels as listed in Table 1 namely:

a) Through hardening bearing steels:

Steels with about 1%C and 1 to 2%Cr which are referred to in this Standard as through hardening bearing steels. For bearing components having large cross sections steel alloyed with manganese and molybdenum are used because of their superior through hardening properties;

b) Case hardening steels:

Chromium-nickel and manganese chromium steels with a carbon content of approximately 0.15% are those casehardening steels most commonly used for rolling bearings;

c) Induction – hardening bearing steals:

Unalloyed steels with about 0.4% to o.6% C and alloyed steels with Chromium and

molybdenum which are referred to this standard as Induction hardening bearing steels.

d) Stainless bearing steels:

For bearings which come into contact with corrosive media during operation, chromium or chromium/- molybdenum stainless steels are used. Because of the reduced hardness of these steels, the bearings do not have the same high load carrying capacity as bearings made of conventional steels;

e) High temperature bearings steels:

If the operating temperatures are higher than 125°C the bearings must be subjected to a special heat treatment (stabilsation) so that inadmissible changes in dimensions shall not occur as a result of structural changes for bearings which are required to operate at temperatures in excess of 300 special steels with high hot hardness are required.

In order to obtain more information when selecting the required type of steel refer to Appendix A.

6.2.2 Chemical composition of different types

Unless otherwise specified in data sheet or purchase order the chemical composition of the type of steel used in the manufacture of the rolling bearings shall fall in one of the categories listed in Table 1.

Permissible deviations from the ranges given in Table 1 shall be according to ISO 683-17 Table 4.

Other chemical compositions superior to this Standard are acceptable if the supplier obtains the written approval of the Company beforehand.

TABLE 1 - TYPES OF STEEL AND SPECIFIED CHEMICAL COMPOSITION (APPLICABLE TO CAST ANALYSIS)

Type of steel		Chemical composition [a, b] [%(*m/m*)]										
No.	Name	C	Si	Mn	P Max.	S Max.	Cr	Mo	Ni	V	W	Others
Through-hardening bearing steels												
B1	100Cr6	0.93 to 1.05[c]	0.15 to 0.35[d]	0.25 to 0.45	0.025	0.015[e]	1.35 to 1.60	max. 0.10				Al: max. 0.050
B2	100CrMnSi4-4	0.93 to 1.05[c]	0.45 to 0.75	0.90 to 1.20	0.025	0.015[e]	0.90 to 1.20	max. 0.10				Ca: [f]
B3	100CrMnSi6-4	0.93 to 1.05[c]	0.45 to 0.75	1.00 to 1.20	0.025	0.015[e]	1.40 to 1.65	max. 0.10				
B4	100CrMnSi6-6	0.93 to 1.05[c]	0.45 to 0.75	1.40 to 1.70	0.025	0.015[e]	1.40 to 1.65	max. 0.10				Cu: max. 0.30
B5	100CrMo7	0.93 to 1.05[c]	0.15 to 0.35	0.25 to 0.45	0.025	0.015[e]	1.65 to 1.95	0.15 to 0.30				
B6	100CrMo7-3	0.93 to 1.05[c]	0.15 to 0.35	0.60 to 0.80	0.025	0.015[e]	1.65 to 1.95	0.20 to 0.35				
B7	100CrMo7-4	0.93 to 1.05[c]	0.15 to 0.35	0.60 to 0.80	0.025	0.015[e]	1.65 to 1.95	0.40 to 0.50				O: max. 0.0015[g]
B8	100CrMnMoSi8-4-6	0.93 to 1.05[c]	0.40 to 0.60	0.80 to 1.10	0.025	0.015[e]	1.80 to 2.05	0.50 to 0.60				Ti: [h]
Case-hardening bearing steels												
B20	20Cr3	0.17 to 0.23	Max. 0.40	0.60 to 1.00	0.025	0.015[e]	0.60 to 1.00					
B21	20Cr4	0.17 to 0.23	Max. 0.40	0.60 to 0.90	0.025	0.015[e]	0.90 to 1.20					
B22	20MnCr4-2	0.17 to 0.23	Max. 0.40	0.65 to 1.10	0.025	0.015[e]	0.40 to 0.75					
B23	17MnCr5	0.14 to 0.19	Max. 0.40	1.00 to 1.30	0.025	0.015[e]	0.80 to 1.10					Al: max. 0.050
B24	19MnCr5	0.17 to 0.22	Max. 0.40	1.10 to 1.40	0.025	0.015[e]	1.00 to 1.30					Ca: [f]
B25	15CrMo4	0.12 to 0.18	Max. 0.40	0.60 to 0.90	0.025	0.015[e]	0.90 to 1.20	0.15 to 0.25				Cu: max. 0.30
B26	20CrMo4	0.17 to 0.23	Max. 0.40	0.60 to 0.90	0.025	0.015[e]	0.90 to 1.20	0.15 to 0.25				
B27	20MnCrMo4-2	0.17 to 0.23	Max. 0.40	0.65 to 1.10	0.025	0.015[e]	0.40 to 0.75	0.10 to 0.20				O: max. 0.0020[g]
B28	20NiCrMo2	0.17 to 0.23	Max. 0.40	0.60 to 0.95	0.025	0.015[e]	0.35 to 0.65	0.15 to 0.25	0.40 to 0.70			Ti: [h]
B29	20NiCrMo7	0.17 to 0.23	Max. 0.40	0.40 to 0.70	0.025	0.015[e]	0.35 to 0.65	0.20 to 0.30	1.60 to 200			
B30	18CrNiMo7-6	0.15 to 0.21	Max. 0.40	0.50 to 0.90	0.025	0.015[e]	1.50 to 1.80	0.25 to 0.35	1.40 to 1.70			
B31	18NiCrMo14-6	0.15 to 0.20	Max. 0.40	0.40 to 0.70	0.025	0.015[e]	1.30 to 1.60	0.15 to 0.25	3.25 to 3.75			
B32	16NiCrMo16-5	0.14 to 0.18	Max. 0.40	0.25 to 0.55	0.025	0.015[e]	1.00 to 1.40	0.20 to 0.30	3.80 to 4.30			

TABLE 1 (Continued)

No.	Type of steel Name	Chemical composition [a, b] [%(m/m)] C	Si	Mn	P Max.	S Max.	Cr	Mo	Ni	V	W	Others
Induction - hardening bearing steels												
B40	C56E2	0.52 to 0.60	max. 0.40	0.60 to 0.90	0.025	0.015[e]						Al: max. 0.050
B41	56Mn4	0.52 to 0.60	max. 0.40	0.90 to 1.20	0.025	0.015[e]						Ca: [f]
B42	70Mn4	0.65 to 0.75	max. 0.40	0.80 to 1.10	0.025	0.015[e]						Cu: max. 0.30
B43	43CrMo4	0.40 to 0.46	max. 0.40	0.60 to 0.90	0.025	0.015[e]	0.90 to 1.20	0.15 to 0.30				O: max. 0.0020 [g] Ti: [h]
Stainless bearing steels												
B50	X47Cr14	0.43 to 0.50	max. 1.00	max. 1.00	0.040	0.015[e]	12.50 to 14.50					
B51	X65Cr14	0.60 to 0.70	max. 1.00	max. 1.00	0.040	0.015[e]	12.50 to 14.50	max. 0.75				
B52	X108CrMo17	0.95 to 1.20	max. 1.00	max. 1.00	0.040	0.015[e]	16.00 to 18.00	0.40 to 0.80				
B53	X89CrMoV18-1	0.85 to 0.95	max. 1.00	max. 1.00	0.040	0.015[e]	17.00 to 19.00	0.90 to 1.30		0.07 to 0.12		
High-temperature bearing steels												
B60	80MoCrV42-16	0.77 to 0.85	max. 0.40	0.15 to 0.35	0.025 [i]	0.015 [i]	3.90 to 4.30	4.00 to 4.50		0.90 to 1.10	max. 0.25	Cu: max. 0.30
B61	13MoCrNi42-16-14	0.10 to 0.15	0.10 to 0.25	0.15 to 0.35	0.015	0.010	3.90 to 4.30	4.00 to 4.50	3.20 to 3.60	1.00 to 1.30	max. 0.15	Cu: max. 0.10 [j]
B62	X82WMoCrV6-5-4	0.78 to 0.86	max. 0.40	max. 0.40	0.025	0.015	3.90 to 4.30	4.70 to 5.20		1.70 to 2.00	6.00 to 6.70	Cu: max. 0.30
B63	X75WCrV18-4-1	0.70 to 0.80	max. 0.40	max. 0.40	0.025	0.015	3.90 to 4.30	max. 0.60		1.00 to 1.25	17.50 to 19.00	Cu: max. 0.30

a Element not quoted should not be intentionally added to the steel without the agreement of the purchaser, other than for the purpose of finishing the heat. All reasonable precautions should be taken to prevent the addition, from scrap or other material used in manufacture, of such elements which affect the hardenability, mechanical properties and applicability.

b In the case of the grades with specified hardenability requirements (see Table 5 of ISO 683-17 (1999)), except for phosphorus and sulfur, insignificant deviations from the limits for cast analysis are permissible; these deviations shall, however, not exceed in the case of carbon ± 0.01% (m/m) and in all other cases the values according to Table 4 of ISO 683-17 (1999).

c Minimum limits lower than 0.93% C or maximum limits higher than 1.05% C may be agreed upon at the time of enquiry and order.

d By agreement max. 0.15% (m/m) Si for cold forming.

e Where machinability is of primary importance, max. 0.030% (m/m) sulfur may be agreed at the time of enquiry and order.

f Intentional additions of calcium or calcium alloys for deoxidation or inclusion shape control are not permitted unless specifically approved by the p urchaser.

g Oxygen content applies to product analysis.

h A maximum titanium content may be agreed upon at the time of enquiry and order.

i Max. 0.015% (m/m) phosphorus and max. 0.08% (m/m) sulfur may be agreed upon at the time of enquiry and order.

j Max. 0.20% (m/m) Cu may be agreed upon at the time of enquiry and order.

Note: Table 1 has been selected from ISO 683-17, Table 3.

6.2.3 Permissible deviations of chemical compositions

Reference shall be made to ISO 683-17-1999 Table 4.

6.3 Hardness

The hardness of steel used in the manufacture of rolling bearings shall be according to ISO 683-17.

6.3.1 Hardness limit of the case hardening and induction hardening steels

Refer to ISO 683-17, Table 5.

6.3.2 Hardness of the through hardening, the stainless and high temperature bearing steels

Refer to ISO 683-17, Table 6.

6.4 Types of Bearings

In this Standard in order to categorize the bearings dimension-wise they have been grouped according to the direction of supported load as follows:

a) Radial rolling bearings

This group comprises the following bearings:

- Deep groove ball bearings.
- Angular contact ball bearings.
- Self aligning ball bearings.
- Cylindrical roller bearings.
- Tapered roller bearings.
- Needle roller bearings.
- Spherical roller bearings.

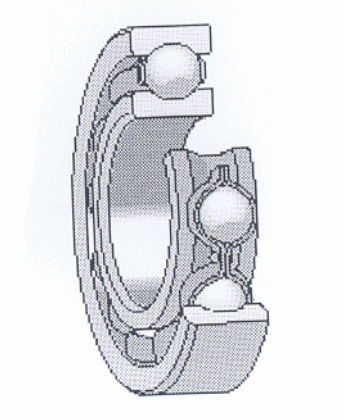
b) Thrust rolling bearings

This group comprises the following bearings:

- Thrust ball bearings.
- Cylindrical roller thrust bearings.
- Needle roller thrust bearings.
- Spherical roller thrust bearings.

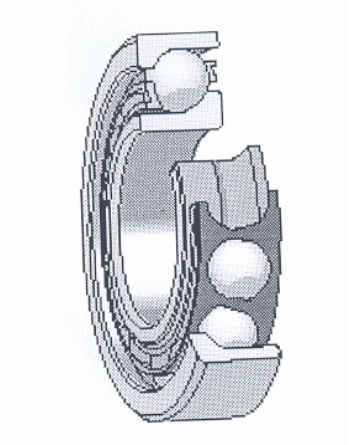
6.4.1 Radial rolling bearings

6.4.1.1 Deep groove ball bearings



Deep groove ball bearings are simple in construction as well as easy to operate and maintain. They can run at high speeds and can support both radial and axial loads, Furthermore they are robust, versatile and quiet running, deep groove ball bearings are available in single and double row designs. The single row bearings are also available in sealed versions; they are lubricated-for-life and maintenance-free, A wide variety of types and sizes can be supplied, including standard bearings for conventional as well as unconventional applications. The cost/performance ratio for deep groove ball bearings is excellent.

6.4.1.2 Angular contact ball bearings



Angular contact ball bearings have raceways in the inner and outer rings which are displaced with respect to each other in the direction of the bearing axis. This means that they are designed to accommodate combined loads, i.e. simultaneously acting radial and axial loads. Angular contact ball bearings are produced in a wide variety of designs and sizes. Those commonly used in general engineering and also for machine tools are:

Single row angular contact ball bearings

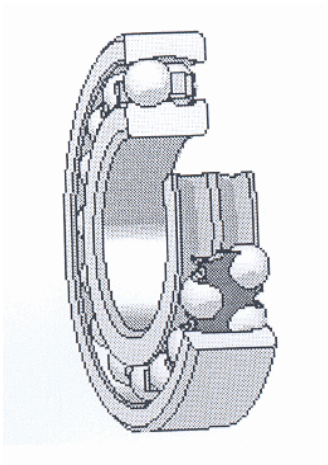
Precision single row angular contact ball bearings

Double row angular contact ball bearings

Fixed section single row angular contact ball bearings

Fixed section four-point contact ball bearings

6.4.1.3 Self-aligning ball bearings

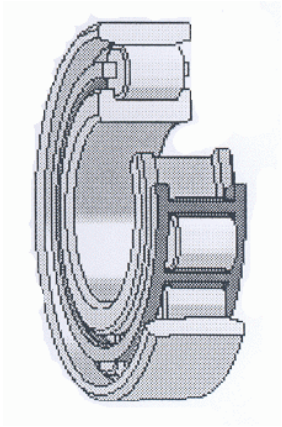


Self-aligning ball bearings have two rows of balls and a common concave sphered raceway in the outer ring. The bearings are consequently self-aligning and insensitive to angular misalignments of the shaft relative to the housing. They are therefore particularly suitable for applications where considerable shaft bending or errors of alignment are to be expected.

6.4.1.4 Cylindrical roller bearings

Cylindrical roller bearings can carry heavy radial loads at high speeds.

Single row EC-design bearings have optimized internal geometry which increases their radial and axial load carrying capacity, reduces their sensitivity to misalignment and facilitates their lubrication. Full complement bearings incorporate the maximum number of rollers and have no cage. They are intended for very heavy loads and moderate speeds. They can be grouped as follows:



Single row cylindrical roller bearings

Double row cylindrical roller bearings

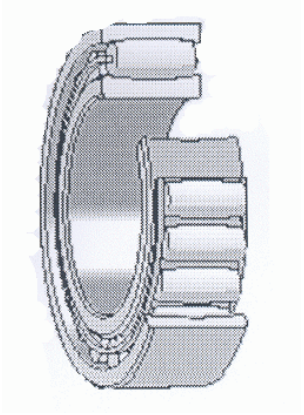
Single row full complement cylindrical roller bearings

Double row full complement cylindrical roller bearings

Multi-row full complement cylindrical roller bearings

6.4.1.5 Taper roller bearings

Taper roller bearings have tapered inner and outer ring raceways between which tapered rollers are arranged. Their design makes taper roller bearings particularly suitable for the accommodation of combined (radial and axial) loads. The axial load carrying capacity of the bearings is largely determined by the contact angle, which corresponds to the angle of the outer ring raceway. Taper roller bearings are generally of separable design, i.e. the inner ring with roller and cage assembly forms a unit which can be mounted separately from the outer ring. They can be grouped as follows:



Single row taper roller bearings

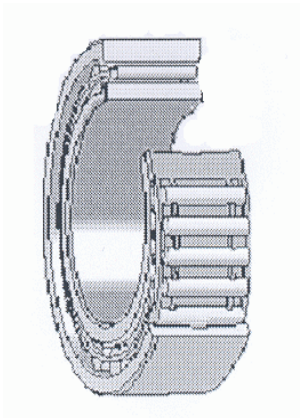
Paired single row taper roller bearings

Double row taper roller bearings

Four-row taper roller bearings

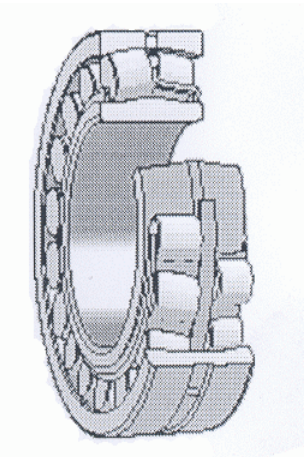
6.4.1.6 Needle roller bearings

Needle roller bearings are roller bearings with cylindrical rollers which are thin and long in relation to their diameter. ISO uses the definition that the roller length is 2,5 times the roller diameter or more. They are referred to as needle rollers. In spite of their low cross section the bearings have a high load carrying capacity and are thus extremely suitable for bearing arrangements where radial space is limited.



6.4.1.7 Spherical roller bearings

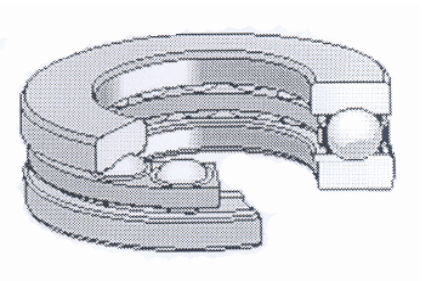
Spherical roller bearings are inherently self-aligning and very robust. The two rows of rollers make the bearings able to carry heavy loads. The present range of spherical roller bearings includes a wide range of sizes of several ISO dimension series and also includes special designs, for example, for vibrating screens and similar applications. More recently a range of sealed spherical roller bearings has been added to the assortment. Split spherical roller bearings are usually based on the standard bearings but can be customized as required.



6.4.2 Thrust rolling bearings

6.4.2.1 Thrust ball bearings

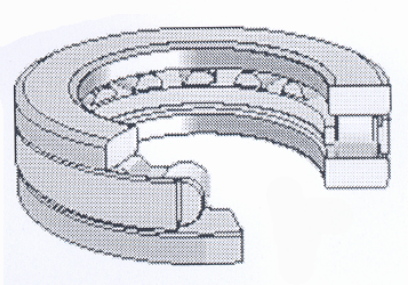
Thrust ball bearings are manufactured in single direction and double direction designs. They are only able to accept axial loads but can be operated at relatively high speeds. The bearings are separable. Mounting is therefore simple as the various bearing components (shaft washer, housing washer, ball and cage thrust assembly) can be installed separately. The benefits of using thrust ball bearings derive from their high running accuracy and high load carrying capacity. Single direction thrust ball bearings, as the name suggests, can accommodate axial loads in one direction and thus locate a shaft axially in one direction. They must not be subjected to radial load.



Double direction thrust ball bearings can accept axial loads acting in both directions and can thus serve to axially locate a shaft in both directions. They must not be subjected to radial load.

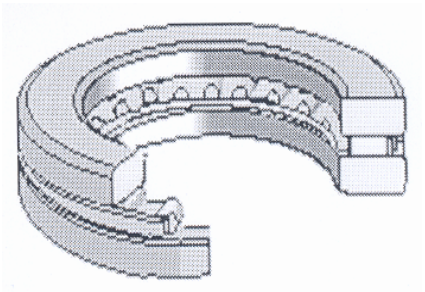
6.4.2.2 Cylindrical roller thrust bearing

Cylindrical roller thrust bearing can support heavy axial loads, are insensitive to shock loads and provide stiff bearing arrangements which require little axial space.



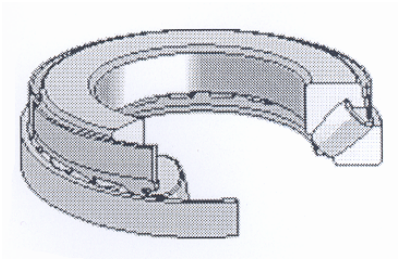
The cylindrical surface of the rollers is slightly relieved towards the ends the modified line contact thus produced ensures that damaging edge stresses will not occur. The bearing are of separable design; the individual components can be mounted separately.

6.4.2.3 Needle roller thrust bearings



Needle roller thrust bearings can support heavy axial loads, are insensitive to shock loads and provide stiff bearing arrangements which require a minimum of axial space. They are single direction bearings and can only accommodate axial loads acting in one direction. Particularly compact bearing arrangements can be made, taking up no more space than a conventional thrust washer, if the faces of adjacent machine components can serve as raceways for a needle roller and cage thrust assembly. For applications where adjacent components cannot serve as raceways, the assemblies can also be combined with washers of various designs. Because of all the possible combinations, all bearing components must be ordered separately.

6.4.2.4 Spherical roller thrust bearing



In spherical roller thrust bearings the load is transmitted from one raceway to the other at an angle to the bearing axis. The bearings are therefore suitable for the accommodation of radial loads in addition to simultaneously acting axial loads. Another important characteristic of spherical roller thrust bearing is their self-aligning capability. This makes the bearing insensitive to shaft deflection and errors of alignment of the shaft relative to the housing.

6.5 Dimensions and Tolerances

Dimensions and tolerances of the bearings for different type and series shall be as follows:

6.5.1 Rolling bearings

Reference shall be made to ISO 15 clause 4 symboles

Dimensions and tolerances of the rolling bearings for different type and series shall be as follows:

Diameter series 0 as per ISO 15, Table 4.

Diameter series 1 as per ISO 15, Table 5.

Diameter series 2 as per ISO 15, Table 6.

Diameter series 3 as per ISO 15, Table 7.

Diameter series 4 as per ISO 15, Table 8.

Diameter series 7 as per ISO 15, Table 1.

Diameter series 8 as per ISO 15, Table 2.

Diameter series 9 as per ISO 15, Table 3.

6.5.2 Needle roller bearings, dimension series 48, 49 and 69

Reference shall be made to ISO 1206: 2001 with Amendment 1: 2013 Clause 4- Symbols.

Dimensions:

Series 48: as per ISO 1206: 2001 with Amendment 1: 2013 Clause 5, Table 1.

Series 49: as per ISO 1206: 2001 with Amendment 1: 2013 Clause 5, Table 2.

Series 69: as per ISO 1206: 2001 with Amendment 1: 2013 Clause 5, Table 3.

Tolerances:

Inner ring: as per ISO 1206: 2001 with Amendment 1: 2013 Clause 6, Table 4.

Outer ring: as per ISO 1206: 2001 with Amendment 1: 2013 Clause 6, Table 5.

Needle roller complement bore diameter for bearings without inner ring:

as per ISO 1206: 2001 with Amendment 1: 2013 Clause 6, Table 6.

6.5.3 Metric tapered roller bearings

6.5.3.1 Dimensions of single row metric tapered roller bearings

Reference shall be made to ISO 355: 2007 with Amendment 1: 2012 Clause 4, Symbols and Clause 5 Table 1.

Contact angle series 2: Refer to ISO 355: 2007 with Amendment 1: 2012 Clause 6, Table 4.

Contact angle series 3: Refer to ISO 355: 2007 with Amendment 1: 2012 Clause 6, Table 5.

Contact angle series 4: Refer to ISO 355: 2007 with Amendment 1: 2012 Clause 6, Table 6.

Contact angle series 5: Refer to ISO 355: 2007 with Amendment 1: 2012 Clause 6, Table 7.

Contact angle series 7: Refer to ISO 355: 2007 with Amendment 1: 2012 Clause 6, Table 8.

6.5.3.2 Dimensions of double row metric tapered roller bearings

Reference shall be made to ISO 355: Clause 4, Symbols.

Contact angle series 2: Refer to ISO 355: Clause 6, Table 9

Contact angle series 3: Refer to ISO 355: Clause 6, Table 10

Contact angle series 4: Refer to ISO 355: Clause 6, Table 11

Contact angle series 7: Refer to ISO 355: Clause 6, Table 12

6.5.4 Thrust rolling bearings

For boundary dimensions of this type of bearings, with flat back faces reference shall be made to ISO 104: 2002 Clauses 5.

6.5.4.1 Single direction thrust rolling bearings:

Diameter series 0: Refer to ISO 104: 2002 Table 1.

Diameter series 1: Refer to ISO 104: 2002 Table 2.

Diameter series 2: Refer to ISO 104: 2002 Table 3

Diameter series 3: Refer to ISO 104: 2002 Table 4.

Diameter series 4: Refer to ISO 104: 2002 Table 5.

Diameter series 5: Refer to ISO 104: 2002 Table 6.

6.5.4.2 Double direction thrust rolling bearings:

Dimension series 22: Refer to ISO 104: 1979 Table 7.

Dimension series 23: Refer to ISO 104: 1979 Table 8.

Dimension series 24: Refer to ISO 104: 1979 Table 9.

6.6 Radial Internal Clearance (Gr.)

Bearing internal clearance is defined as the total distance through which one bearing ring can be moved relative to the other in the radial direction (radial internal clearance) or in the axial direction (axial internal clearance).

The radial internal clearance of a bearing is of considerable importance if satisfactory operation is to be obtained for paired single row angular contact ball bearings and taper roller bearings, double row angular contact ball bearings and four-point contact ball bearings, values for the axial internal clearance are given instead of radial clearance, as the axial clearance is of greater importance in application design for the bearing types (for further details reference may be made to ISO 5593, Sub-clause 05.08.01 and ISO 1132-1,2.

The values of radial internal clearance for the following types of rolling bearings shall comply with the requirement of ISO 5753:1981 as mentioned below:

6.6.1 For radial contact groove ball bearings with cylindrical bore, refer to Sub-clause 5.1, Table 1 of ISO 5753-1.

6.6.2 For double row self-aligning ball bearings with cylindrical bore, refer to Sub-clause 5.2, Table 2 of ISO 5753-1.

6.6.3 For double row self-aligning ball bearings with tapered bore, refer to Sub-clause 5.2, Table 3 of ISO 5753-1.

6.6.4 For cylindrical roller bearings with cylindrical bore, refer to Sub-clause 5.3, Table 4 of ISO 5753-1.

6.6.5 For toroidal roller bearings with Cylindrical bore , refer to sub -clause 5.4 , Table 6 of ISO 5753 -1.

6.6.6 For toroidal roller bearings with tapered bore, refer to sub clause 5.4, table 7 of ISO 5753-1.

6.6.7 For double row self-aligning roller bearings with cylindrical bore, refer to Sub-clause 5.5, Table 8 of ISO 5753-1.

6.6.8 For double row self-aligning roller bearings with tapered bore, refer to Sub-clause 5.5, Table 9 of ISO 5753-1.

7. BEARING LUBRICANTS

7.1 Grease Type Lubricant

7.1.1 Factors expected from grease lubricants

a) Easily retained in the bearing housing.

b) Reduces the housing sealing requirements.

c) Helps prevent corrosive/abrasive media from entering the housing.

d) Convenient to handle and install.

e) Adheres to the bearing surfaces and provides some corrosion protection.

f) The grease type and consistency method to the required duty.

7.1.2 Selection of grease lubricant

Selection of grease lubricant shall be made with due consideration to operating temperature as given hereunder:

a) Operating temperature -30°C to + 120°C Lithium base grease of No. 2 to 3 consistency.

b) Operating temperature over 100°C Silicon base grease of medium consistency.

7.2 Oil type Lubricant

7.2.1 Factors expected from oil lubricants

a) Low frictional resistance if minimal quantity of low viscosity oil is used.

b) Greater lubrication reliability achievable specially at the higher operating temperatures.

c) Serves as a coolant for controlling bearing temperatures under combined conditions of heavy load and high speed.

7.2.2 Selection of oil lubricant

a) Mineral oil fortified against foaming and oxidation or synthetic oil for high speed or high temperature.

b) Oils with EP additive for heavy load working condition.

8. DOCUMENTS

If specified, the supplier shall submit the following documents at quotation stage for general purpose bearings:

a) Report of experience and annual sale for similar bearing(s).

b) Drawings and/or documents defining the technical data of the required bearing(s).

c) List of the tests executed on his product(s).

d) Guaranty policies.

e) Complaint and compensation policies.

f) Declaration of any certificate from any impartial laboratory if any.

9. TESTS

9.1 General

9.1.1 All measurements shall be carried out at reference temperature[1)]. The gages, measuring instruments and the parts to be tested shall be stabilized at this temperature before any test is carried out.

9.1.2 Unless otherwise specified by the Company all tests shall be carried out at the supplier's premises.

9.1.3 The Company may ask the Supplier to carry out the tests in the presence of his nominated representative who shall be informed at least four weeks prior to the date of the tests.

1) The bearings shall however operate perfectly at the ambient temperature mentioned in data sheet.

9.2 Required Tests

9.2.1 Hardness test

The hardness test shall be carried out according to the Pertinent ISO Standard(s). These standards are ISO 6507: Parts 1 and 2 and also ISO 6508.

9.2.1.1 Rings

The hardness test on rings shall be done on both rings of each bearing. The Rockwell hardness shall be measured on one of the side faces of the ring at both ends of two diameters perpendicular to each other. In each of the four checked areas two measurements giving compatible results shall be made.

9.2.1.2 Rollers

The hardness test on rollers shall be made on three rollers of each bearing. The Rockwell hardness shall be measured at one point on the surface of one end of the roller. In each checked area two measurements giving compatible results shall be made.

9.2.2 Examination of the appearance

The examination of the appearance shall be carried out visually i.e., without magnification.

9.2.3 Radial internal clearance

The radial internal clearance of the bearings (other than tapered roller bearings) shall be measured according method agreed between the Company and the Supplier. Depending on bearing design and measuring method some scatter of the results of repeated measurements may be experienced. Suppliers are expected to take such scatter into consideration by applying correspondingly reduced manufacturing tolerances.

10. GUARANTY

The Supplier shall guarantee his bearings during commissioning and for one year operation against the following defects:

a) All operational defects.

b) All material defects.

c) All design defects.

11. MARKING

11.1 Marking of the Bearings

As per manufacturer standards.

11.2 Marking of the Packages

Each package shall be legibly and permanently marked to show the following information:

a) Manufacturer's name, address and trade-mark,

b) Specification,

c) Type of bearings,

d) MESC number,

b) Purchase order No.,

f) Quantity of bearings in container,

b) Information and warning, if required.

12. PACKAGING

Unless otherwise specified by the Company the bearings shall be delivered greased or oiled and packaged to prevent corrosion or damage due to any reason. Packages shall carry the markings defined in Clause 11.2.

13. SHIPMENT

If the bearings are shipped, they shall be accompanied by the relevant documents stating the detailed description of the bearings for custom release.

APPENDICES

APPENDIX A

A GUIDE TO ROLLING BEARINGS DESIGNATIONS

In order to have enough information about bearings' designation when filling out data sheets the following material is provided.

The majority of bearing designations consist of five figures. Each of these figures is a code number providing certain information about the bearing.

Bearing Designation

5 Figures

× × × × ×

As a rule for bearings with bore diameter ranging from 20 to 490 mm, the first figure indicates the type of bearing involved. The second and third figures indicate the dimension series to which the bearing belongs. Thus the second figure represents the width or height series and the third figure the diameter series. The first three figures form the designation of the bearing series. Each bearing accordingly belongs to a particular bearing series. Finally the last two figures indicate the bore diameter divided by five. Consequently the bore diameter of each bearing expressed in mm is obtained by multiplying the last two figures by five.

For bearings of 10 to 20 mm bore size however the last two digits in the designation always indicate the bore diameter as follows:

00 = 10 mm

01 = 12 mm

02 = 15 mm

03 = 17 mm

04 = 20 mm

Bearings of bore diameter under 10 mm usually have designations consisting of three digits but sometimes there may be a 4th digit preceded by an oblique stroke. In each case the last digit shows the nominal bore diameter in mm.

To begin with bearing type 0, "Double Row Angular Contact Ball Bearings", the bearing series numbers are found to be 32 and 33. This means that the Fig. 0 indicating the type of bearing, has been dispensed with. The Figs. 32 and 33 then indicate the bearing series and the dimension series.

Self-aligning ball bearings have the Fig. 1 as their type number and are available in bearing series 12, 13, 22 and 23, which all have four-figure bearing numbers, and series 104 with five-figure bearing numbers. The type number 2 applies to all bearings with spherical rollers, i.e., single and double row spherical roller radial bearings and spherical roller thrust bearings.

Taper roller bearings, type number 3 have five-figure numbers which comply with the rules.

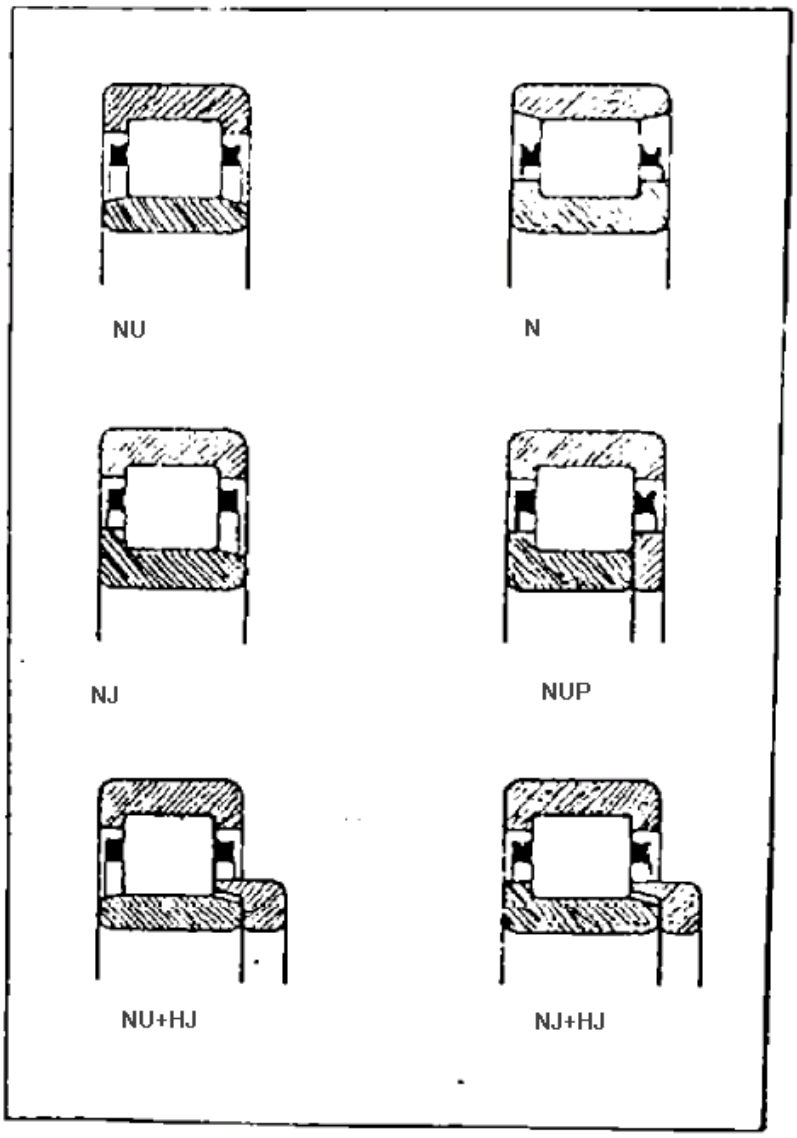
Double row deep groove ball bearings have the type number 4 and their Series designations 42 and 43 according to the rules, must be 422 and 423.

All single row thrust ball bearings have five-figure numbers, the type number being 5 and the series designations 511, 512, etc.

The type number 6 applies to single row deep groove ball bearings. The most common series are designated 60, 62, 63 and 64 and have four-figure bearing numbers. The width series Fig. 0, is omitted from these designations. There are, in addition, Series 618 and 619 with five-figure bearing numbers. Deep groove ball bearings for small diameter shafting have three-figure numbers, the last figure of which represents the bore diameter.

Single row angular contact ball bearings have the type number 7. In common with deep groove ball bearings, they have three-four-and five-figure numbers. The most common series are designated 72 and 73.

The designations of cylindrical roller bearings commence with one or more letters. These letters indicate the design of the bearing and are followed by three or four figures. Examples of these signs are shown opposite.



Supplementary designations

The complete designations of rolling bearings consist of the basic designation and may include one or more supplementary designations. Generally, the basic designation consists of an identification of the type of bearing (figure, letter or combination of letters), the series designation and the bore diameter identification, e.g., 23216 or NU 212. The supplementary designations are placed either in front of the basic designation (prefix) or after the basic designation (suffix).

Prefixes serve to identify bearing components. Suffixes are used to identify designs (variants) which differ in some way from the original design or which differ from the design which is the current production standard. The more commonly used supplementary designations are listed in the following and their meaning explained.

Prefixes

GS Housing washer of a cylindrical roller thrust bearing.

Example: GS 81107-housing washer of cylindrical roller thrust bearing 81107.

K Roller and cage assembly of a cylindrical roller thrust bearing .

K- Inner ring with roller and cage assembly (cone) or outer ring (cup) of a taper roller bearing belonging to an AFBMA standard series and generally having inch dimensions.

Example: K-09067-cone of taper roller bearing of series 09000

K-09195- cup of taper roller bearing of series 09000

K-09067/K-09195-complete taper roller bearing comprising cone

K-09067 and cup K-091967

L Removable inner or outer ring of a separable bearing.

Example: LNU 207-inner ring of cylindrical roller bearing NU 207.

L 30207-outer ring of taper roller bearing 30207.

R Separable bearing without removable inner or outer ring.

Example: RNU 207-outer ring with roller and cage assembly of cylindrical roller bearing NU 207.

R 30207-inner ring with roller and cage assembly of taper roller bearing 30207.

WS Shaft washer of a cylindrical roller thrust bearing.

Bearing Data-General

Suffixes

Where several suffixes are included in a product designation they are written in the order dictated by the following groupings (internal design, external design, cage, other bearing features). The suffixes of the fourth group (other bearing features) are always preceded by an oblique stroke which separates them from the basic designation or the preceding suffix.

Internal Design

A Deviating or modified internal.

B Design, specific feature.

Example: 7205 B-single row identifies angular contact ball with modified internal design.

C Increased axial load capacity.

Example: NU 205 EC-single row cylindrical roller bearing with reinforced roller and cage assembly and increased axial load carrying capacity.

D Bearing with a contact angle of 40° and a reinforced ball and cage assembly.

External Design

CA Single row angular contact ball.

CB Bearing for paired mounting in.

CC Random order (tandem, back-to-back or face-to-face). When arranged back-to-back or face-to-face, the bearings will have a small (CA), normal (CB) or larger than normal (CC) axial internal clearance before mounting.

-2F Flingers at both sides of the bearing (Y-bearings).

-2FF Flocked flingers at both sides of the bearing (Y-bearings).

G Single row angular contact ball bearings for paired mounting in random order (tandem, back-to-back or face-to-face). When arranged back-to-back or face-to-face, the bearings will have a certain axial internal clearance before mounting.

GA Single row angular contact ball.

GB Bearings for paired mounting in.

GC Random order (tandem, back-to-back or face-to-face). When arranged back-to-back or face-to-face, the bearings will have a light (GA), medium (GB) or heavy preload (GC) before mounting .

K Tapered bore, taper 1:12 on diameter.

K30 Tapered bore, taper 1:30 on diameter.

-LS Land riding seal (rubbing seal) at one side of the bearing, inner ring without seal recess.

-2LS LS seals at both sides of bearing.

N Snap ring groove in outside cylindrical surface of outer ring.

NR As N, but with snap ring.

N2 Two locating slots (at 180°) in outer ring.

PP Rubbing seals at both sides of bearing (support rollers, cam followers).

RS Rubbing seal of synthetic rubber or polyurethane at one side of the bearing (needle roller bearings).

-RS1 Rubbing seal of synthetic rubber with sheet steel reinforcement at one side of the bearing.

-2RS1 RS1 seals at both sides of bearing .

-2RS RS seal at both sides of bearing (needle roller bearings).

-RZ Low-friction seal of synthetic rubber with sheet steel reinforcement at one side of bearing.

-2RZ RZ seals at both sides of bearing.

X 1. Boundary dimensions altered to conform to ISO Standards.

2. Cylindrical runner surface (support rollers, cam followers).

-Z Shield (non-rubbing seal) at one side of bearing.

-2Z Z shields at both sides of bearing .

-ZN Z shield at one side of bearing and snap ring groove in outer ring of bearing at opposite side.

-2ZN Z shields at both sides of bearing and snap ring groove in outer ring.

-ZNR As-ZN, but with snap ring.

-2ZNR As-2ZN, but with snap ring.

Cage

F Machined cage of steel or special cast iron.

J Pressed cage of sheet steel.

L Machined cage of light alloy.

M Machined cage of brass.

MP Machined cage of brass, window type.

P Moulded cage of glass fiber reinforced polyamide 6, 6.

TN Moulded cage of plastic.

Y Pressed cage of sheet brass.

To indicate how the cage is guided in the bearing, the suffix identifying the cage may be followed by letters A or B. A indicates that the cage is centered in the outer ring, B: that it is centered on the innerring. The absence of an additional letter indicates that the cage is centered on the rolling elements.

Example: MA-machined cage of brass, outer ring centered The cage suffixes may also be followed by figures indicating different designs or materials.

Example: TN9-moulded cage of glass fiber reinforced polyamide 6,6.

V Full complement bearing (without cage).

VH Full complement bearing with non-separable roller complement (cylindrical roller bearings).

Other Bearing Features

The oblique stroke which must precede the suffixes of this group is not shown in the following:

Accuracy

CLN	Corresponds to ISO tolerance class 6X for taper roller bearings (metric), (reduced width tolerances)
CLO	Corresponds to ISO tolerance class O (inch-size taper roller bearings).
CL3	Corresponds to ISO tolerance class 3 (inch-size taper roller bearings).
CL7A	Standard taper roller bearing quality for pinion bearing arrangements.
CL7C	Special taper roller bearing quality for pinion bearing arrangements.
P4	Dimensional and running accuracy to ISO tolerance class 4 (more accurate than P5).
P4A	Dimensional accuracy to ISO tolerance class 4 and running accuracy to AFBMA class ABEC 9*.
P5	Dimensional and running accuracy to ISO tolerance class 5 (more accurate than P6).
P6	Dimensional and running accuracy to ISO tolerance class 6.
PA9A	Dimensional and running accuracy to AFBMA class ABEC 9.
PA9B	Dimensional accuracy to AFBMA class ABEC9, running accuracy better than PA9A.
SP	Dimensional accuracy approximately to P5, running accuracy approximately to P4.
UP	Dimensional accuracy approximately to P4, running accuracy better than P4.
*****	See ANSI B 3.14-1972 Sub-clause 4.3.

Bearing Data-General

Internal Clearance

C1	Clearance less than C2.
C2	Clearance less than normal.
C3	Clearance greater than normal.
C4	Clearance greater than C3.
C5	Clearance greater than C4.

When in combination with suffixes P4, P5 or P6 (for accuracy), the letter C is omitted from the clearance suffix.

Example: P6 + C2 = P62

Quality

Q Optimized internal geometry and surface finish (taper roller bearings).

Q66 Vibration level lower than normal, vibration peaks lower than normal.

QE5 Special electric motor quality, dimensional and running accuracy to P6, exceptionally quiet running.

QE6 Standard electric motor quality, quiet running .

Bearing Sets

DB Two matched single row deep groove ball bearings, single row angular contact ball bearings or single row taper roller bearings for arranging back-to-back. The letter(s) following immediately after DB indicate the magnitude of the axial internal clearance or the preload of the bearing before mounting:

A light preload (angular contact ball bearings).

B preload greater than A (angular contact ball bearings).

C preload greater than B (angular contact ball bearings).

CA small axial internal clearance (deep groove and angular contact ball bearings).

CB axial internal clearance larger than CA (deep groove and angular contact ball bearings).

CC axial internal clearance larger than CB (deep groove and angular contact ball bearings).

CG "zero" clearance (taper roller bearings).

C... special axial internal clearance (the figures following C give the magnitude of the axial clearance in µm).

GA light preload (deep groove ball bearings).

GB preload greater than GA (deep groove ball bearings).

G... special preload (the figures following G give the magnitude of the preload in daN).

Example: 6208/DBGA-two matched deep groove ball bearings 6208 arranged back-to-back with light preload.

DF Two matched single row deep groove ball bearings, single row angular contact ball bearings or single row taper roller bearings for arranging face-to-face. DF can be followed by the same letters as DB.

DT Two matched single row deep groove ball bearings, single row angular contact ball bearings or single row taper roller bearings for arranging in tandem.

Heat Treatment

The bearing rings (or washers) are dimensionally stabilized for use at the following operating temperatures:

S0 up to 150°C

S1 up to 200°C

S2 up to 250°C

S3 up to 300°C

S4 up to 350°C

Relubrication

W No relubrication facility.

W20 Three lubrication holes in outer ring.

W33 Lubrication groove and three holes in outer ring.

W33X Lubrication groove and six holes in outer ring.

Lubricants

The suffixes used to identify the grease with which a bearing is filled comprise a letter combination signifying the temperature range followed by a two-figure number which identifies the actual grease. The following letter combinations are used:

HT Grease for high temperatures (-20 to +130°C)

LHT Grease for low and high temperatures (-40 to +140°C)

LT Grease for low temperatures (-50 to +80°C)

MT Grease for medium temperatures (-30 to +110°C).

An MT suffix is used only if the grease is not the Standard grease for a particular bearing. Grease quantities which differ from the Standard fill (25 to 35% of the free space in the bearing) are identified by an additional letter:

A grease quantity less than standard.

B grease quantity greater than standard.

C grease quantity greater than B.

Example: 6210-2Z/HT51B-deep groove ball bearing 6210 with two shields having a larger quantity than standard fill of a grease suitable for high temperatures.

Other Features

Combinations of the letter V with another letter (e.g., VA) and a three-figure combination identify differences from the Standard design which are not covered by other established suffixes.

VA201 Bearings for kiln trucks

VA301 Cylindrical roller bearings for traction motors