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AMENDMENT 1
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Rolling bearings — Static load ratings

AMENDMENT 1: Annex A (informative) — Discontinuities in the calculation of basic static load ratings

Roulements — Charges statiques de base

AMENDEMENT 1: Annexe A (informative) — Discontinuités dans le calcul des charges statiques de base

Reference number
ISO 76:1987/Amd.1:1999(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Amendment 1 to ISO 76:1987 was prepared by Technical Committee ISO/TC 4, *Rolling bearings*, Subcommittee SC 8, *Load ratings and life.* It constitutes a possibility of more accurately calculating and comparing static load ratings for radial and thrust angular contact ball bearings.

Amendment 1 to ISO 76:1987 comprises annex A to ISO 76:1987 and is for information only.

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Rolling bearings — Static load ratings

AMENDMENT 1: Annex A (informative) — Discontinuities in the calculation of basic static load ratings

A.1 Discontinuities in the calculation of basic static load ratings for radial and thrust angular contact ball bearings

The factors used for calculation of basic static load ratings C_{0r} and C_{0a} according to ISO 76 are slightly different for radial and thrust angular contact ball bearings.

Therefore there is a discontinuity in the calculated static axial load rating (C_{0a}) when a bearing with the contact angle $\alpha = 45°$ is first regarded as a radial bearing ($C_{0a} = C_{0r}/Y_0$) and then as a thrust bearing.

This annex explains why the load rating factors are different, and shows how the load ratings can be re-calculated in order to bring about correct comparisons under the same conditions.

A.2 Symbols

The same symbols are used as in ISO 76:1987. Additional symbols are:

- C_{0ar} is the adjusted basic static axial load rating for a radial bearing ($\alpha \leqslant 45°$), in newtons;
- C_{0aa} is the adjusted basic static axial load rating for a thrust bearing ($\alpha > 45°$), in newtons;
- r_i is the cross-sectional raceway groove radius of inner ring, in millimetres;
- r_e is the cross-sectional raceway groove radius of outer ring, in millimetres.

A.3 Different factors for calculating the static load rating for radial and thrust angular contact ball bearings

*Angular contact **thrust** ball bearings*

In the calculation of C_{0a} the osculations between balls and raceways are

$r_i/D_w \leqslant 0{,}54$ and $r_e/D_w \leqslant 0{,}54$

*Angular contact **radial** ball bearings*

In the calculation of C_{0r} the osculations between balls and raceways are

$r_i/D_w \leqslant 0{,}52$ and $r_e/D_w \leqslant 0{,}53$

A.4 Comparing adjusted basic static axial load ratings, C_{0ar} and C_{0aa}, for radial and thrust angular contact ball bearings

For certain applications angular contact ball bearings with contact angles $\alpha \leqslant 45°$ and $\alpha > 45°$ are manufactured with the same osculation between balls and raceways, and sometimes there is a need to calculate and also to compare their true axial load ratings.

The basic static load ratings C_{0r} and C_{0a} can be calculated with the aid of ISO 76 or taken from a bearing catalogue, if they are available there.

However, as was described in clause A.3, C_{0r} and C_{0a} are calculated with different osculations for radial and thrust bearings. If a correct calculation and comparison is to be made, C_{0r} and C_{0a} have to be re-calculated to adjusted basic static axial load ratings C_{0ar} and C_{0aa}, based upon the same osculation.

The re-calculation can be performed with the aid of the equations (A.1) to (A.4) for two different osculations – radial bearing osculation and thrust bearing osculation as defined in ISO 76.

The comparisons are made for thrust ratings only, since this is most convenient.

The contact angle α is assumed to be constant, independent of the axial load, which means that the accuracy is reduced for bearings with small contact angles, subjected to heavy loads.

A.4.1 Angular contact ball bearings with *radial* bearing osculation

($r_i/D_w \leqslant 0,52$ and $r_e/D_w \leqslant 0,53$)

$$C_{0ar} = C_{0r}/Y_0 \qquad \text{(A.1)}$$

$$C_{0aa} = 1{,}43 C_{0a} \qquad \text{(A.2)}$$

A.4.2 Angular contact ball bearings with *thrust* bearing osculation

($r_i/D_w \leqslant 0,54$ and $r_e/D_w \leqslant 0,54$)

$$C_{0ar} = 0{,}7 C_{0r}/Y_0 \qquad \text{(A.3)}$$

$$C_{0aa} = C_{0a} \qquad \text{(A.4)}$$

A.5 Examples

A.5.1 Bearing with $\alpha = 45°$

Compare the adjusted basic static axial load ratings of an angular contact ball bearing with $\alpha = 45°$, when it is regarded as a radial bearing and as a thrust bearing. For the selected bearing $(D_w \cos \alpha)/D_{pw} = 0{,}16$. The bearing has radial bearing osculation.

With $f_0 = 14{,}9$ from ISO 76, Table 1 and $C_{0r} = K f_0 \cos \alpha$ from ISO 76, subclause 4.1

$$C_{0r} = K \times 14{,}9 \times \cos 45° = 10{,}54K$$

K is a constant, which includes all parameters that are the same for radial and thrust bearings.

$Y_0 = 0{,}22$ according to ISO 76, Table 2.

By inserting C_{0r} and Y_0 in equation (A.1)

$$C_{0ar} = 10{,}54 \times K/0{,}22 = 47{,}9K$$

According to equation (A.2), with f_0 = 48,8 from ISO 76, Table 1 and $C_{0a} = K f_0 \sin \alpha$ from subclause 5.1

$$C_{0aa} = 1{,}43 \times K \times 48{,}8 \times \sin 45° = 49{,}3K$$

After the re-calculation of the basic static load ratings $C_{0ar} \approx C_{0aa}$, which confirms that the discontinuity no longer remains.

A.5.2 Basic static axial load ratings of two angular contact ball bearings with 40° and 60° contact angle

Calculate the basic static axial load ratings of two angular contact ball bearings, one with 40° and the other with 60° contact angle. Both bearings have the same thrust bearing osculation. D_w / D_{pw} = 0,091, ball diameter D_w = 7,5 mm and the number of balls Z = 27.

For the 40° bearing $(D_w \cos 40°) / D_{pw} = 0{,}091 \times \cos 40° = 0{,}07$, and then f_0 = 16,1, according to ISO 76, Table 1. From ISO 76, Table 2, Y_0 = 0,26.

According to ISO 76, subclause 4.1

$$C_{0r} = f_0 Z D_w^2 \cos \alpha = 16{,}1 \times 27 \times 7{,}5^2 \times \cos 40° = 18\,731$$

According to equation (A.3)

$$C_{0ar} = 0{,}7 \times 18\,731/0{,}26 = 50\,430$$

$$C_{0ar} = 50\,400 \text{ N}$$

For the 60° bearing $(D_w \cos 60°) / D_{pw} = 0{,}091 \times \cos 60° = 0{,}046$, and then f_0 = 57,82 according to ISO 76, Table 1. From ISO 76, subclause 5.1

$$C_{0a} = f_0 Z D_w^2 \sin \alpha = 57{,}82 \times 27 \times 7{,}5^2 \times \sin 60° = 76\,049$$

According to equation (A.4)

$$C_{0aa} = 76\,049$$

$$C_{0aa} = 76\,000 \text{ N}$$

Bibliography

[1] ISO 281:1990, *Rolling bearings — Dynamic load ratings and rating life.*