

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION R 281

ROLLING BEARINGS METHODS OF EVALUATING DYNAMIC LOAD RATINGS

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BRIEF HISTORY

The ISO Recommendation R 281, *Rolling Bearings—Methods of Evaluating Dynamic Load Ratings*, was drawn up by Technical Committee ISO/TC 4, *Ball and Roller Bearings*, the Secretariat of which is held by the Sveriges Standardiseringskommission (SIS).

Work, on this question by the Technical Committee began in 1952 and led, in 1959, to the adoption of a Draft ISO Recommendation.

In December 1959, this Draft ISO Recommendation (No. 278) was circulated to all the ISO Member Bodies for enquiry. It was approved by the following Member Bodies:

Austria	France	Poland
Belgium	India	Portugal
Burma	Italy	Romania
Chile	Japan	Spain
Colombia	Netherlands	Sweden
Czechoslovakia	New Zealand	Switzerland
Finland	Pakistan	U.S.A.
		Yugoslavia

Four Member Bodies opposed the approval of the Draft:

Germany, Hungary, United Kingdom, U.S.S.R.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in November 1962, to accept it as an ISO RECOMMENDATION.

ROLLING BEARINGS

METHODS OF EVALUATING DYNAMIC LOAD RATINGS

INTRODUCTORY NOTE

This ISO Recommendation covers methods of evaluating dynamic load ratings for

Radial ball bearings	see section 1, page 3,
Radial roller bearings	see section 2, page 8,
Thrust ball bearings	see section 3, page 11,
Thrust roller bearings	see section 4, page 14,

giving for each part the following items:

Definitions,
Calculation of basic load rating,
Calculation of rating life,
Calculation of equivalent load.

It is recognized that revisions of the calculations may be required from time to time as the result of improvements or new developments.

1. METHOD OF EVALUATING DYNAMIC LOAD RATINGS OF RADIAL BALL BEARINGS

1.1 Definitions

- 1.1.1** The *life* of an individual ball bearing is defined as the number of revolutions (or hours at some given constant speed) which the bearing runs before the first evidence of fatigue develops in the material of one of the rings or any of the rolling elements.
- 1.1.2** The *rating life* of a group of apparently identical ball bearings is defined as the number of revolutions (or hours at some given constant speed) that 90 per cent of that group of bearings will complete or exceed before the first evidence of fatigue develops.

1.1.3 The *basic load rating* is that constant stationary radial load which a group of apparently identical ball bearings with stationary outer ring can endure for a rating life of one million revolutions of the inner ring. In single-row angular-contact ball bearings, the basic load rating relates to the radial component of that load, which causes a purely radial displacement of the bearing rings in relation to each other.

1.1.3.1 Load ratings, if given for specific speeds, should be based on a rating life of 500 hours.

1.1.4 The *equivalent load* is defined as that constant stationary radial load which, if applied to a bearing with rotating inner ring and stationary outer ring, would give the same life as that which the bearing will attain under the actual conditions of load and rotation.

1.2 Calculation of basic load rating

The magnitude of the basic load rating C for radial- and angular-contact ball bearings, except filling-slot bearings, is given by the following formulae:

(a) with balls of diameter not larger than 25.4 mm or 1 in:

$$C = f_c (i \cos \alpha)^{0.7} Z^{2/3} D^{1.8}$$

(b) with balls of diameter larger than 25.4 mm, when kilogramme and millimetre units are used:

$$C = f_c (i \cos \alpha)^{0.7} Z^{2/3} \times 3.647 D^{1.4}$$

(c) with balls of diameter larger than 1 in, when pound and inch units are used:

$$C = f_c (i \cos \alpha)^{0.7} Z^{2/3} D^{1.4}$$

where i = number of rows of balls in any one bearing,

α = nominal angle of contact = nominal angle between the line of action of the ball load and a plane perpendicular to the bearing axis,

Z = number of balls per row,

D = ball diameter,

f_c = factor which depends on the units used, the geometry of the bearing components, the accuracy to which the various bearing parts are made and the material.

Values of f_c are obtained by multiplying

the values of $\frac{f_c}{f}$, from the appropriate column of Table 1,
by a factor f , covered in the note below.

NOTE. - Current tests of ball bearings of good quality, hardened ball-bearing steel, indicate that the value of the factor f is:

$f = 10$ when kilogramme and millimetre units are used,

$f = 7450$ when pound and inch units are used.

TABLE 1. — Factor $\frac{f_c}{f}$

$\frac{D \cos \alpha}{d_m} *$	$\frac{f_c}{f}$			
	for single-row, radial-contact, groove ball bearings and single- and double-row, angular-contact, groove ball bearings**	for double-row, radial-contact, groove ball bearings**	for self-aligning ball bearings	for single-row, radial-contact, separable ball bearings (magneto bearings)
0.05	0.476	0.451	0.176	0.165
0.06	0.500	0.474	0.190	0.177
0.07	0.521	0.494	0.203	0.189
0.08	0.539	0.511	0.215	0.199
0.09	0.554	0.524	0.227	0.210
0.10	0.566	0.537	0.238	0.219
0.12	0.586	0.555	0.261	0.239
0.14	0.600	0.568	0.282	0.258
0.16	0.608	0.576	0.303	0.276
0.18	0.611	0.579	0.323	0.294
0.20	0.611	0.579	0.342	0.311
0.22	0.608	0.576	0.359	0.327
0.24	0.601	0.570	0.375	0.343
0.26	0.593	0.562	0.390	0.358
0.28	0.583	0.552	0.402	0.372
0.30	0.571	0.541	0.411	0.386
0.32	0.558	0.530	0.418	0.397
0.34	0.543	0.515	0.420	0.406
0.36	0.527	0.500	0.421	0.412
0.38	0.510	0.484	0.418	0.415
0.40	0.492	0.467	0.412	0.417

* d_m = pitch diameter of the ball set.

For values of $\frac{D \cos \alpha}{d_m}$, other than given in Table 1, $\frac{f_c}{f}$ is obtained by linear interpolation.

- ** (a) When calculating the basic load rating for a unit consisting of two similar single-row radial-contact ball bearings in a duplex mounting, the unit is considered as one double-row radial-contact ball bearing.
- (b) When calculating the basic load rating for a unit consisting of two similar single-row angular-contact ball bearings in a duplex mounting, "face-to-face" or "back-to-back", the unit is considered as one double-row angular-contact ball bearing.
- (c) When calculating the basic load rating for a unit consisting of two or more similar single-row angular-contact ball bearings mounted "in tandem", properly manufactured and mounted for equal load distribution, the rating of the unit is the number of bearings to the 0.7 power times the load rating of a single-row ball bearing.
If for some technical reason the unit may be treated as a number of individually interchangeable single-row bearings, this paragraph (c) does not apply.

The values of factor $\frac{f_c}{f}$ given in Table 1 apply to bearings whose ring raceways have a cross-sectional radius not larger than,

- | | |
|--|-----------------------------------|
| in radial contact and angular contact groove ball bearing inner rings, | 52 per cent of the ball diameter |
| in radial contact and angular contact groove ball bearing outer rings, | 53 per cent of the ball diameter |
| in self-aligning ball bearing inner rings, | 53 per cent of the ball diameter. |

The basic load rating is not necessarily increased by the use of smaller groove radii, but is reduced by the use of larger radii than those given above.