UDC 621.822.6-218:621.753.1 November 1984

Rolling bearings

Mounting tolerances

General guidelines

DIN 5425 Part 1

Wälzlager; Toleranzen für den Einbau, allgemeine Richtlinien

Supersedes June 1978 edition of DIN 5425.

In keeping with current practice in standards published by the International Organization for Standardization (ISO), a comma has been used throughout as the decimal marker.

1 Scope and field of application

This standard is intended to give the user of rolling bearings information as to the tolerancing of shafts and housings, to ensure that standardized rolling bearings (dimensions as specified in DIN 616, tolerances as specified in DIN 620 Parts 2 and 3) can be suitably paired for the given operating conditions.

The general rules given in this standard shall apply for the mounting of rolling bearings with nominal bore diameters up to $d = 500$ mm.

Within the context of this standard, only general cases are covered. Therefore, the recommendations which are based on years of experience by the users shall only apply for cases where no specific requirements are made regarding running accuracy and smoothness, and operating temperature etc. Unless exceptions are expressly indicated, they shall apply to steel shafts and to steel, cast steel or flake graphite or nodular cast iron housings.

2 Selection of tolerance zone

2.1 Tolerance position

Basically, the tolerances on the shaft and housing shall be such that the bearing rings fit tightly. However, for operating and mounting reasons, loose fits are also necessary and other influences, such as type of construction and size of the bearing, type and degree of loading and temperature distribution induce different tolerance recommendations.

2.1.1 Loose bearing function, type of bearing

Different degrees of thermal expansion of the shafts and machine frames caused by the operating conditions lead to internal deformation of the bearing elements if one of the bearings is not arranged as a loose bearing with a clearance fit. In the case of cylindrical roller bearings with one ribless ring, the displacement may take place within the bearing (see figure 1).

2.1.2 Relative direction of external load

If one bearing is to be mounted so that it is displaceable, the clearance fit is to be selected for the bearing ring which remains stationary relative to the direction of the external load (point loading).

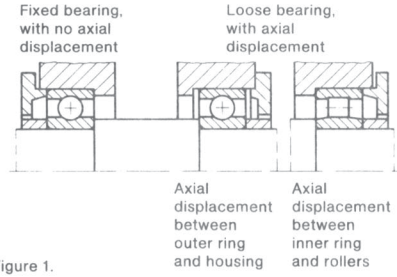

Figure 1.

2.1.3 Nature and magnitude of external load

Tighter fits are generally selected for impact or high loads than for medium and low loads.

2.1.4 Bearing size

As the size of the bearing increases, tight fits are selected to be increasingly tighter and loose fits to be increasingly looser.

2.1.5 Other influencing factors

Material, strength and thermal conductivity of shafts and housings, conduction path and rate of heat flow penetrating from outside or generated in the bearing, mountability and adjustability of the bearing elements also influence the selection of the tolerance position.

2.1.6 Tolerance positions

Table 1 (radial bearings) and table 2 (thrust bearings) show to what degree the individual influencing factors are to be taken into account when selecting the tolerance position.

For radial bearings, the load F is given as a function of C_r, as follows:

$F < 0{,}07 \cdot C_r$ (low load);

$F = 0{,}07$ to $0{,}15 \cdot C_r$ (medium loading);

$F > 0{,}15 \cdot C_r$ (high load);

where

F is the dynamic equivalent load;

C_r is the dynamic load rating (see ISO 281 Part 1).

Continued on pages 2 to 5

Table 1. **Radial bearings**

Cylindrical bore												
Relative movements			Inner ring/shaft					Outer ring/housing				
Description	Diagram	Typical examples	Load case	Fit	Load F	Tolerance position [1] for shaft		Load case	Fit	Load F	Tolerance position [1] for housing	
						Ball bearings	Roller bearings				Ball bearings	Roller bearings
Inner ring rotates, outer ring remains stationary, direction of loading does not change.		Cylindrical gears, electric motors	Peripheral load for inner ring	Tight fit required	$< 0{,}07 \cdot C_r$	h k	k m	Point load for outer ring, split housing possible	Loose fit permissible	Any	J [2] H G [3] F [3]	
Inner ring remains stationary, outer ring rotates, direction of loading follows outer ring.		Hub-type bearing elements with great unbalance			0,07 to 0,15 · C_r	j k m	k m n p					
					$> 0{,}15 \cdot C_r$	m n	n p r					
Inner ring remains stationary, outer ring rotates, direction of loading does not change.		Impellers with stationary axis, rope pulleys	Point load for inner ring	Loose fit permissible	Any	j h g f		Peripheral load for outer ring, only solid housing	Tight fit required	$< 0{,}07 \cdot C_r$	J	K
Inner ring rotates, outer ring remains stationary, direction of loading follows inner ring.		Shaking screens, unbalanced vibrators								0,07 to 0,15 · C_r	K M	M N
										$> 0{,}15 \cdot C_r$	–	N P
Combination of different relative movements or changing relative movements		Crank mechanisms	Undetermined	Fit and tolerance position for the shaft are determined by the dominating load case and mountability and adjustability of the bearing elements				Undetermined	Fit and tolerance position for the housing are determined by the dominating load case, mountability and adjustability of the bearing elements			

Tapered bearing bore		
Bearing mounting	Tolerance zone for shaft [4]	
With withdrawal sleeve as specified in DIN 5416	h7/IT 5 h8/IT 6	–
With adapter sleeve as specified in DIN 5415	h7/IT 5 h8/IT 6 h9/IT 7	

[1] The sequence of the tolerance positions (from top to bottom) corresponds to the increase in bearing size (see also subclause 2.1.4).
[2] Not for split housings.
[3] Tolerance positions G and F are also used if heat is supplied from the shaft.
[4] IT (5, 6, 7) means that a cylindricity tolerance assigned to the corresponding (tolerance) grade is recommended in addition to the appropriate dimensional tolerance (see also subclause 3.1).

Table 2. **Thrust bearings**

Type of load	Type of bearing	Shaft ring/shaft			Housing ring/housing		
		Load case	Fit	Tolerance position [1] for shaft	Load case	Fit	Tolerance position [1] for housing
Combined load	Angular contact thrust ball bearings, self-aligning thrust roller bearings, tapered roller thrust bearings	Peripheral load	Tight fit required	j k m	Point load	Loose fit permissible	H J
		Point load	Loose fit permissible	j	Peripheral load	Tight fit required	K M
Purely axial load	Thrust ball bearings, axial roller bearings	–		h j k	–		H G E

[1] The sequence of the tolerance positions (from top to bottom) corresponds to the increase in bearing size (see also subclause 2.1.4).

2.2 Accuracy

The tolerance grade to be specified depends mainly on the requirements made regarding running accuracy and smoothness. Closer tolerances on rolling bearings only apply if the bearing seats are machined with corresponding accuracy.

Shaft tolerances shall generally be assigned to grade 6 as specified in DIN 7160. Lower grades are to be used for more stringent requirements.

Figure 2. Shaft fits

Housing tolerances are generally assigned to grade 7. Lower grades are to be used for more stringent requirements. Grade 8 may be considered adequate for less stringent requirements (pedestal bearings in general engineering).

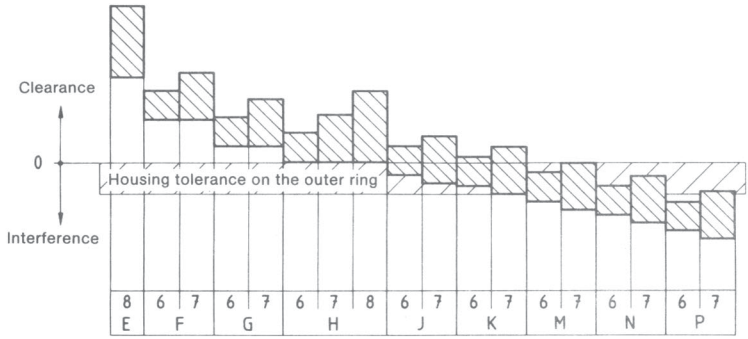

Figure 3. Housing fits

2.3 Functional fits

The required fits result from a combination of the rolling bearing tolerance zones and the appropriate fitting surface tolerance zones for each particular application.

There is a certain amount of play in the selection of these tolerance zones because of the many influences involved (operating conditions, requirements, experience). Therefore, this standard does not include detailed recommendations.

2.4 Radial internal clearance

Tight fits result in a reduction of the radial internal clearance caused by the expansion of the inner ring or the contraction of the outer ring. Therefore, depending on the type of fit selected, it is to be checked whether the radial internal clearance remaining after mounting is suitable for the particular application. This shall apply particularly for fits which are tighter than in the case of tolerance position k for shafts and K for housings.

3 Geometrical tolerances for mating and seating surfaces

3.1 Cylindricity tolerance

The cylindricity tolerance as specified in DIN 7184 Part 1 for mating surfaces on shafts and in housings shall generally be at least one grade lower than the grade specified for the tolerance on diameter for the cylindrical surface, e.g. diameter 150 m6 or $150^{+0,040}_{+0,015}$, i.e. grade 6 corresponds here to a tolerance of 25 µm. The associated grade 5 then corresponds to a tolerance of 18 µm, relative to the diameter. The cylindricity tolerance would then be given as $\boxed{/\bigcirc/\ 0{,}009}$.

By way of exception, cylindricity tolerances assigned to grade 5 are usually recommended for general engineering purposes for mating surfaces of adapter and withdrawal sleeves.

3.2 Perpendicularity tolerance

The perpendicularity tolerance as specified in DIN 7184 Part 1 for axial seating surfaces for rolling bearing rings or washers shall be at least one grade lower than the tolerance on the diameters of the associated shaft or housing; for seating surfaces of pairing rings which are free of radial loads as a result of being able to rotate freely, it should however be not wider than IT 5.

4 Roughness of mating surfaces

The roughness of the mating surfaces is of less significance to the functioning of the bearing elements than is the grade to which the tolerances on diameter and form are assigned. However, it is of importance for maintaining the character of the fit (loose bearing clearance fit: surface without defects, less risk of crevice corrosion; interference fit: less settling if the mating surfaces are relatively smooth). Therefore, relatively high roughness values are permitted for subordinate bearing applications, but if the accuracy requirements are higher, smaller roughness values as specified in table 3 are desirable.

Table 3. **Recommended values for the roughness of mating surfaces**

Shaft or housing diameters, in mm		Grade to which the tolerances on the diameters of the shaft or housing mating surfaces are assigned								
		IT 7			IT 6			IT 5		
		Surface roughness [1]) as specified in DIN 4768 Part 1, in µm								
Over	Up to	R_z	R_a Ground	R_a Turned	R_z	R_a Ground	R_a Turned	R_z	R_a Ground	R_a Turned
–	80	10	1,6	3,2	6,3	0,8	1,6	4	0,4	0,8
80	500	16	1,6	3,2	10	1,6	3,2	6,3	0,8	1,6
500	1250	25	3,2	6,3	16	1,6	3,2	10	1,6	3,2

[1]) Either R_a or R_z shall be used, following agreement, for establishing the surface roughness.

Standards referred to

DIN 616	Rolling bearings; general plans for external dimensions
DIN 620 Part 2	Rolling bearings; tolerances for radial bearings
DIN 620 Part 3	Rolling bearings; tolerances for thrust bearings
DIN 4768 Part 1	Determination of surface roughness values R_a, R_z, T_{max} by means of electrical stylus instruments; basic data
DIN 5415	Adapter sleeves with nut and retainer for rolling bearings
DIN 5416	Withdrawal sleeves for rolling bearings
DIN 7160	ISO tolerances and deviations for external dimensions (shafts), for nominal dimensions from 1 to 500 mm
DIN 7184 Part 1	Tolerances on form and position; concepts, indications on drawings
ISO 281 Part 1	Rolling bearings; dynamic load ratings and rating life; calculation methods

Other relevant standards and documents

DIN 620 Part 4	Rolling bearings; radial internal clearance
DIN 720	Rolling bearings; tapered roller bearings
Supplement to DIN 4768 Part 1	Determination of roughness values R_a, R_z, R_{max} by means of electrical stylus instruments; conversion of R_a to R_z and vice versa
DIN 5418	Mounting dimensions for rolling bearings
DIN 7161	ISO tolerances and deviations for internal dimensions (bores), for nominal dimensions from 1 to 500 mm

Previous editions

DIN 5425: 03.56, 06.78

Amendments

The following amendments have been made in comparison with the June 1978 edition of DIN 5425:

a) the standard has been revised both editorially and with regard to its material content.

b) in order to increase the applicability, DIN 5425 has been changed to DIN 5425 Part 1.

International Patent Classification

F 16 C 19-49