INTER PLANT STANDARD IN STEEL INDUSTRY		
IPSS	**GENERAL GUIDELINES FOR SELECTION OF FITS FOR MOUNTING ANTI-FRICTION BEARINGS**	**IPSS:1-02-019-18 (First Revision)**
	Corresponding IS does not exist	Formally : IPSS:1-02-019-84

0. FOREWORD

0.1 Interplant standardization in steel industry was initiated under the aegis of the Indian Standards Institution (ISI) and the Steel Authority of India Limited (SAIL). This IPSS was prepared by the standard committee on Mechanical Drives, IPSS 1:1 and adopted in March 1984. Lastly, this has been revised with first revision by the standard committee in **November, 2018** with the active participation of the representatives from major Indian steel plants and leading consultants.

0.2 This standard for steel industry primarily aim at achieving rationalization and unification of parts and sub-assemblies used in steel plant equipment and accessories and provide guidance in intending stores or equipment for existing or new installations by individual steel plants. For exercising effective control on inventories, it is advisable to select a fever number of sizes (or types) from among those mentioned in this standard for the purpose of company standards of individual steel plants. It is not desirable to make deviations in technical requirements.

1. SCOPE

1.1 This Inter Plant Standard covers the general guidelines for selection of fits between the anti-friction bearings and seatings of any equipment used in steel plants. However, this may also be selected as per manufacturer's Catalogue.

2. FACTORS EFFECTING SELECTION OF FITS

Selection of fits depends on factors like conditions of rotation, magnitude of the load, internal clearance, temperature conditions, requirement regarding running accuracy, design and material of shaft and housing, ease of mounting and dis-mountings and axial freedom of floating bearings.

However, out of all these factors, three major factors which form the basis of selection are:

a. Nature of load.

b. Simplicity of mounting and dis-mounting and

c. Axial freedom of floating bearings.

2.1 **Nature of Loads** – That is point load or circumferential load, whichever is effective shall be distinguished for the ball race, inner or outer and accordingly fit selected.

A load which is always directed towards the same point on the raceway of a bearing is defined as point load.

A load which keeps all the points on the raceway load in the course of one revolution is defined as circumferential load.

The difference between the point load and circumferential load is shown in Table-1

2.2 **Simplicity of Mounting and Dis-mounting** – For many applications, where down time is required to be kept to a minimum, bearings having clearance fits are preferred to facilitate ease of mounting and dis-mounting. When operating conditions necessitate the use of interference fits, ease of mounting and dis-mounting is also essential. In such a case separate bearings or bearings having tapper bore and an adapter sleeve may often provide a solution.

Usually shafts are machined to h7 or h8 for withdrawal sleeves and to h9 or h10 for adapter sleeves.

In general, shafts should be machined to ISO quality 6 and housing bores to quality 7 with the tolerance zone as given in Table 2.

2.3 **Axial Freedom of Floating Bearings** – It is best achieved with cylindrical bearings of the NU and N types, and with needle bearings. All other bearings needed to act as floating bearings call for a slide fit of inner or outer race. This fit is obtained by machining the shaft to g or h and the housing to G, H or J tolerances.

If a bearing calls for axial freedom the question arises as to which of the two rings should be provided with the slide fit. According to loading conditions, the fit may be selected from table 1.

3. SELECTION OF FITS

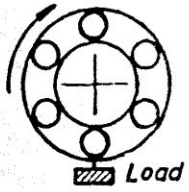
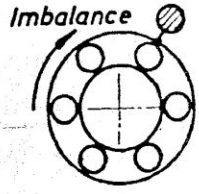
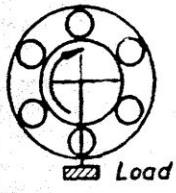
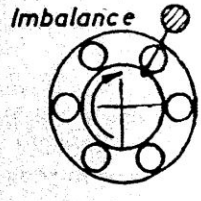
Table 3 is intended as guide in selecting the appropriate shaft and housing fit. The tolerance value are given in Tables 4 and 5.

4. DETERMINATION OF INTEFERENCE

The values of interference or clearance appearing in case of coincidence of the go-ends or not-go-ends of bearing and shaft or housing tolerances are to be considered as extremes. The actual interference or clearance is likely to be found in between. Most probably it will be near the go-end. From experience, the probable interference or clearance is assumed to be one-third away from the go-end of the tolerance field and is marked by a characteristics line as given in table 6.

TABLE 1 DIFFERENCE BETWEEN POINT LOAD AND CIRCUMFERENTIAL LOAD

(Clause 2.1)

Bearing Kinematics	Loading Conditions	Illustration	Fit	Example
Stationary inner race, rotating outer race. Constant load direction	i) Point load on inner race ii) Circumferential load on outer race		i) Inner race side fit ii) Outer race tight fit mandatory	Automative front wheel bearing, idler roll bearing
Stationary inner race, rotating outer race. Direction of load rotating with outer race at same speed	i) Point load on outer race ii) Circumferential load on inner race		i) Outer race slide fit possible ii) Inner race tight fit mandatory	Large imbalance rotating with outer race
Rotating inner race, stationary outer race. Constant load direction	i) Circumferential load on inner race ii) Point load on outer race		i) Inner race tight fit mandatory ii) Outer race slide fit possible	Load suspended from shaft
Rotating inner race, stationary outer race. Direction of load rotating with inner race at same speed	i) Circumferential load on outer race ii) Point load on inner race		i) Outer race tight fit mandatory ii) Inner race slide fit possible	Centrifuge vibrating screen bearings

Note 1 — With point load the fit may be slide or loose.

Note 2 — With circumferential load the fit has to be tight.

Note 3 — The load on a bearing inner race causes it to expand-resulting in an easing of the fit on the seating and under the influence of a circumferential load, creep may then develop. The amount of interference between the race and its seating shall therefore be related to the magnitude of the load.

TABLE 2 TOLERANCE ZONE FOR SHAFT AND HOUSING

(Clause 2.2)

Mounting Condition	Shaft						Housing				
	g	*h*	*j*	*k*	*m*	*n*	*H*	*J*	*K*	*M*	*N*
Assembly	Easy to slide on			Warming up of inner race to 100°C			Outer race to slide in		Light pressure or outer race	Perhaps heavy pressure necessary, housing to be warmed up or outer race to be super cooled	
Disassembly	With puller			With puller or pressurized oil process			With puller			With press	

TABLE 3 GUIDELINES FOR SELECTION OF FITS

Examples	Nature of load	Shaft Dia	Tolerance codes for shaft diameters															
			Radial Bearings										Thrust Bearings					
			1		2		3				4		5		6		7		8	
							 Sliding		Non-sliding											
			Normal	Heavy (unbalance)	Normal	Heavy (shocks)	Normal	Heavy (shocks)	Normal	Heavy (shocks)	Normal	Heavy (shocks)	Normal	Heavy (shocks)	Normal	Heavy	Normal	Heavy	Normal	Heavy
Runner-wheels, tension rollers, rope-sheaves, rail-vehicles, rolling-mills, gears, electric-motors, vibratory screens, pumps, blowers, beater-mills.	Point load on inner race	All ϕ	g6	h6	g6	h6	g6	h6	—	—	g6	h6	g6	h6	j6	j6	—	—	—	—
	Circum-ferential load on the inner race	up to 18	j6	j6	j6	j6	—	—	j6	k6	k6	k6	—	—	—	—	—	—	—	—
		over 18 up to 40					—	—				—		k6	—	—	—	—	—	—
		over 40 up to 65		k6			—	—	k6			m6	k6							
		over 65 up to 100	k6				—	—						m6	k6	k6	—	—	—	—
		over 100 up to 140			—	—	—	—	—	m6										
		over 140 up to 200		m6	—	—	—	—	—		m6	n6	m6	n6	m6	m6	—	—	—	—
		over 200	m6		—	—	—	—	—	n6	—	—					—	—	—	—
	Axial load only	All ϕ	j6		j6		j6		—		—		j6		k6		j6		m6	
		Housing type	Tolerance codes for housing bore diameters.																	
	Circum-ferential load on the outer race	Solid	K7	M7	J7	J7	—	—	K7	M7	M7	N7	M7	N7	J7	K7	—	—	—	—
	Point load on outer race	Solid	H7	J7	H7	J7	H7	J7	—	—	H7	J7	H7	J7	H7	J7	—	—	—	—
		Divided	H7	H7	—	—	—	—	—	—	H7	H7	H7	H7	—	—	—	—	—	—
	Axial load only	Solid	E9		E9		H7		—		—		H7		H7	J7	E9		E9	

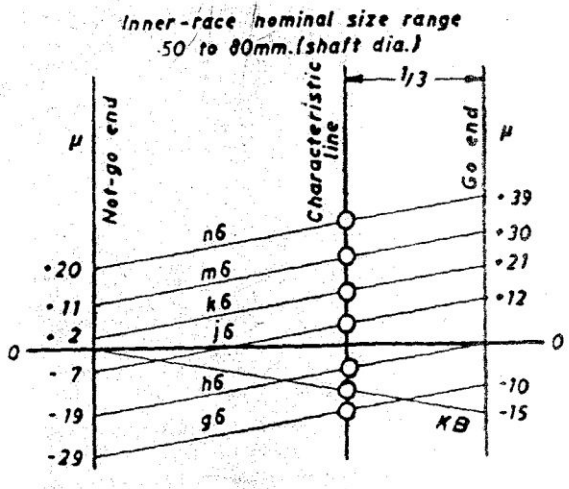
TABLE 4 RECOMMENDED FITS FOR SHAFT OUTSIDE DIAMETERS AND TOLERANCES IN MICRONS

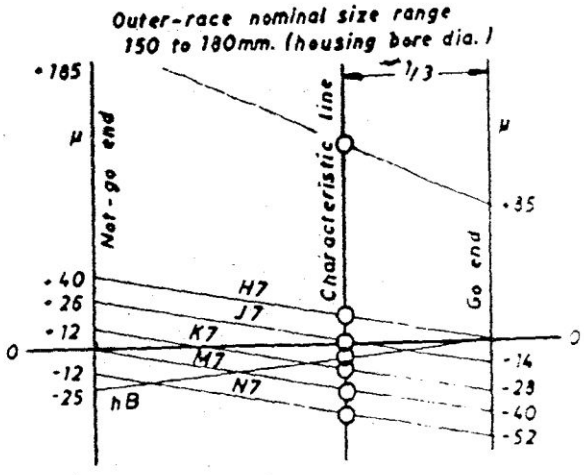
Type of Fit	Nominal Shaft Diameters in Millimetres														
	Over 3 Up to 6	6 10	10 18	18 30	30 50	50 80	80 120	120 180	180 250	250 315	315 400	400 500	500 630	630 800	800 1 000
g6	−4 −12	−5 −14	−6 −17	−7 −20	−9 −25	−10 −29	−12 −34	−14 −39	−15 −44	−17 −49	−18 −54	−20 −60	−22 −66	−24 −74	−26 −82
h6	0 −8	0 −9	0 −11	0 −13	0 −16	0 −19	0 −22	0 −25	0 −29	0 −32	0 −36	0 −40	0 −44	0 −50	0 −56
j5	+4 −1	+4 −2	+5 −3	+5 −4	+6 −5	+6 −7	+6 −9	+7 −11	+7 −13	+7 −16	+7 −18	+7 −20	— —	— —	— —
j6	+7 −1	+7 −2	+8 −3	+9 −4	+11 −5	+12 −7	+13 −9	+14 −11	+16 −13	+16 −16	+18 −18	+20 −20	+22 −22	+25 −25	+28 −28
k6	+ 9 + 1	+10 + 1	+12 + 1	+15 + 2	+18 + 2	+21 + 2	+25 + 3	+28 + 3	+33 + 4	+36 + 4	+40 + 4	+45 + 5	+44 0	+50 0	+56 0
m6	+12 + 4	+15 + 6	+18 + 7	+21 + 8	+25 + 9	+30 +11	+35 +13	+40 +15	+46 +17	+52 +20	+57 +21	+63 +23	+70 +26	+80 +30	+90 +34
n6	+16 + 8	+19 +10	+23 +12	+28 +15	+33 +17	+39 +20	+45 +23	+52 +27	+60 +31	+66 +34	+73 +37	+80 +40	+88 +44	+100 + 50	+112 + 56

TABLE 5 RECOMMENDED FITS FOR HOUSING BORE DIAMETERS AND TOLERANCES IN MICRONS

Type of Fit	Nominal Housing Bore Diameters in Millimetres														
	Over 6 Up to 10	10 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 1 000
E9	+50 +20	+61 +25	+75 +32	+92 +40	+112 +50	+134 +60	+159 +72	+185 +85	+215 +100	+240 +110	+265 +125	+290 +135	+320 +145	+360 +160	+400 +170
G6	+5 +14	+6 +17	+7 +20	+9 +25	+10 +29	+12 +34	+14 +39	+14 +39	+15 +44	+17 +49	+18 +54	+20 +60	+66 +22	+74 +24	+82 +26
H7	0 +15	0 +18	0 +21	0 +25	0 +30	0 +35	0 +40	0 +40	0 +46	0 +52	0 +57	0 +63	0 +70	0 +80	0 +90
J7	−7 +8	−8 +10	−9 +12	−11 +14	−12 +18	−13 +22	−14 +26	−14 +26	−16 +30	−16 +36	−18 +39	−20 +43	—	—	—
K7	−10 +5	−12 +6	−15 +6	−18 +7	−21 +9	−25 +10	−28 +12	−28 +12	−33 +13	−36 +16	−40 +17	−45 +18	−70 0	−80 0	−90 0
M7	−15 0	−18 0	−21 0	−25 0	−30 0	−35 0	−40 0	−40 0	−46 0	−52 0	−57 0	−63 0	−96 −26	−110 −30	−124 −34
N7	−19 −4	−23 −5	−28 −7	−33 −8	−39 −9	−45 −10	−52 −12	−52 −12	−60 −14	−66 −14	−73 −16	−80 −17	−114 −44	−130 −50	−146 −56

TABLE 6 CHARACTERISTIC PICTURES





A. *Nominal shaft diameter in millimetres*

Over	3	6	10	18	30	50	80	120	180	250	315	400
to	6	10	18	30	50	80	120	180	250	315	400	500

Variation of bearing bore diameter in microns according to tolerance area (*KB*),

−8	−8	−8	−10	−12	−15	−20	−25	−30	−35	−40	−45
0	0	0	0	0	0	0	0	0	0	0	0

B. *Nominal housing bore diameter in millimetres*

Over	6	10	18	30	50	80	120	150	180	250	315	400
to	10	18	30	50	80	120	150	180	250	315	400	500

Variation of bearing outside diameter in microns according to tolerance area (*hB*),

0	0	0	0	0	0	0	0	0	0	0	0
−8	−8	−9	−11	−13	−15	−18	−25	−30	−35	−40	−45

Example:

go-end	+6	18	Interference or clearance in case of go-end coincidence.
Shaft dia 50 *j5*		10	Probable interference or clearance.
Not-go-end	−5	5	Interference or clearance in case of not-go-end coincidence.

Note 1 — With thin walled housing, light metal housing and hollow shafts, tighter fits than those given in Table 3 should be used.

Note 2 — Tighter fits than those metioned in Table 3 shall call for bearings with more internal clearance, say C3 or *C4*.

Note 3 — If the temperature of inner race is higher during operation than that of outer race because of heat transmission through shaft, for instance, bearings with internal clearance of *C4* or *C5* should be selected.

Note 4 — Heat treated bearings should be prescribed if operational temperature is more than 150°C.

Note 5 — For mounting magneto type ball bearings, fits of *j5*/*G6* should be used.

Note 6 — Split housings are not conductive to excessively tight fits because the bearing outer race may suffer detrimental pre-loading. The bore of split housings is generally machined to *H* or *J* tolerances.