INTER PLANT STANDARD IN STEEL INDUSTRY		
IPSS	**JOURNAL BEARING FOR GENERAL USE IN STEEL PLANT EQUIPMENT**	**IPSS:1-02-028-18 (First Revision)**
	Corresponding IS does not exist	Formerly : IPSS:1-02-028-85 (Shifted from IPSS 1:2)

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 1985. Lastly, this standard 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 assemblies used in steel plant equipment and accessories and provide guidance in intending stores or equipment (or while placing orders for additional requirements) 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 specifies the approximate dimensions, materials, different applications and other technical requirements of journal bearings used in various equipment of steel plants.

2. DIMENSIONS

The dimensions shall preferably be as given in Table 1, read with Fig. 1.

3. TYPES

Generally the bearings are two types.

However, in case of Type 2, the requirement of chamfer on inside or outside surface varies according to the assembly position. Accordingly, this is further divided into six types as shown in fig. 2.

TABLE 1 DIMENSIONS OF JOURNAL BEARINGS

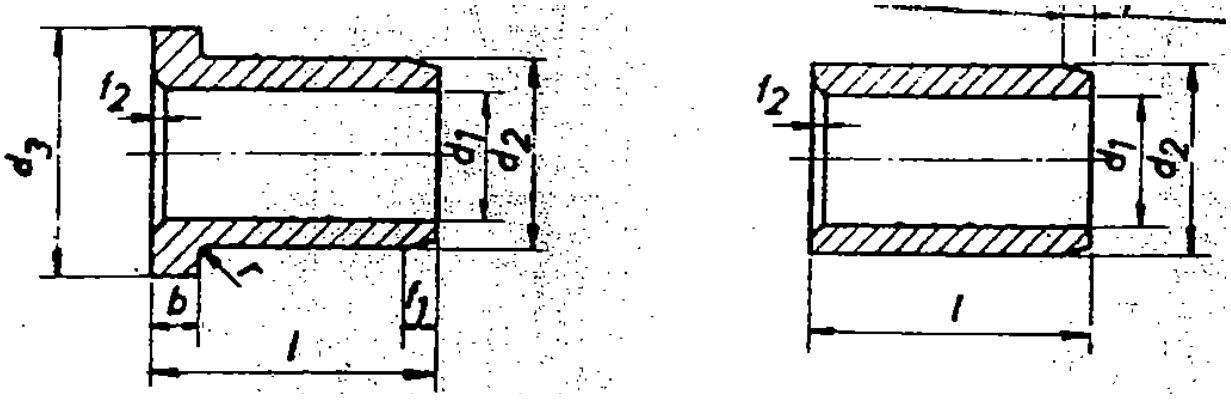
(All dimensions in mm)

d_1		10	12	14	16	18	20	22	25	28	30	32	35	36	38	40	42	45	48	50	52	56	60	63	65	66	70	72	75	80
d_2		16	18	20	22	25	26	28	32	36	38	40	45	45	48	50	52	56	58	60	63	68	72	75	78	80	82	85	90	95
d_3		20	22	25	28	30	32	35	40	44	46	48	50	52	55	56	60	64	66	68	70	75	84	86	90	92	95	98	105	110
$b(-0.2)$		3	4	5						6				7									8						10	
f_1		1					1.2			1.6				2									2.5							
f_2		0.8					1.2			2				2.5						3			4.5							
r_1, r_3		0.2			0.4					0.6																			0.8	
l	Permitted deviation	Weight in Kg/1000 pieces (Density = 8.6 Kg/dm^3)																												
4	±0.1	4.21																												
6		6.32	7.29	8.27	9.24																									
8			9.73			16.3	14.9	16.2																						
10		10.5		13.8	15.4				27.0																					
12	±0.15		14.6			24.4	22.4	24.3		41.5	44.1	46.7																		
14				19.3					37.7																					
16					24.8		29.8	32.4		55.3			66.5	73.8	92.9	97.3														
18						36.6					66.1	70.0					114	135												
20							37.3		53.9							122			143	149										
22	±0.2							44.6		76.1			119	108							188									
25									67.4		91.9	97.3			145	152	159	188				252	342	280	365					
26										96.8			151	138					200	208						336	440	386		
32	±0.25										118	124			186	195					273								535	567
36													195	177			229	270				362	494							
40															232	243			286	297				447	587	480	630	551		
45	±0.3																286	338			384	453							752	
50																			358	371			603	559	734					887
56	±0.4																				478	563				672	860	772		
63																							861	705	925				1053	1117
70																										840	1100	965		
80																													1337	1418

TABLE 1 DIMENSIONS OF JOURNAL BEARINGS (Contd.)

(All dimensions in mm)

	d_1	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200
	d_2	100	105	110	115	120	125	130	135	140	145	150	155	160	165	175	180	185	190	195	200	205	210	215	220
	d_3	115	120	125	130	135	140	145	150	155	160	165	170	175	180	195	200	205	210	215	220	225	230	235	240
	$b(-0.2)$	10																							
	f_1	2.5												3.2											
	f_2	4.5														5.5									
	r, f_3	0.8														1									
l	Perm. deviation	Weight in Kg/1000 pieces (Density = 8.6 Kg/dm^3)																							
36	±0.25	675	711																						
40				831	871	912																			
45	±0.3						1070	1120																	
50		937							1290	1340	1420														
56	±0.4		1106	1163								1620	1670	1730											
63					1372	1440	1500								2010	2810	2890	2980							
70		1312	1383					1710	1840										3400	3500	3590	3650			
80				1662	1743	1820				2150	2270	2310	2390										4320	4430	4540
90		1687	1778				2140	2230						2780	2870	4010									
100				2077	2178	2280			2580	2690	2840						4590	4730	4860	5000					
110							2620	2730				3180	3290								5650	5800	5940		
120									3100	3220	3410			3710	3830	5350	5512							6650	6810
140	±0.5											4040	4180	4330	4470			6620	6810	7000	7190	7380			
160																7130	7350	7570	7780				8550	8860	9040
180																				9000	9240	9480	9720		
200																								11100	11300
220																									
250																									



TYPE 1 : WITH COLLAR TYPE 2 :WITHOUT COLLAR

Fig. -1 (TYPE OF JOURNAL BEARINGS)

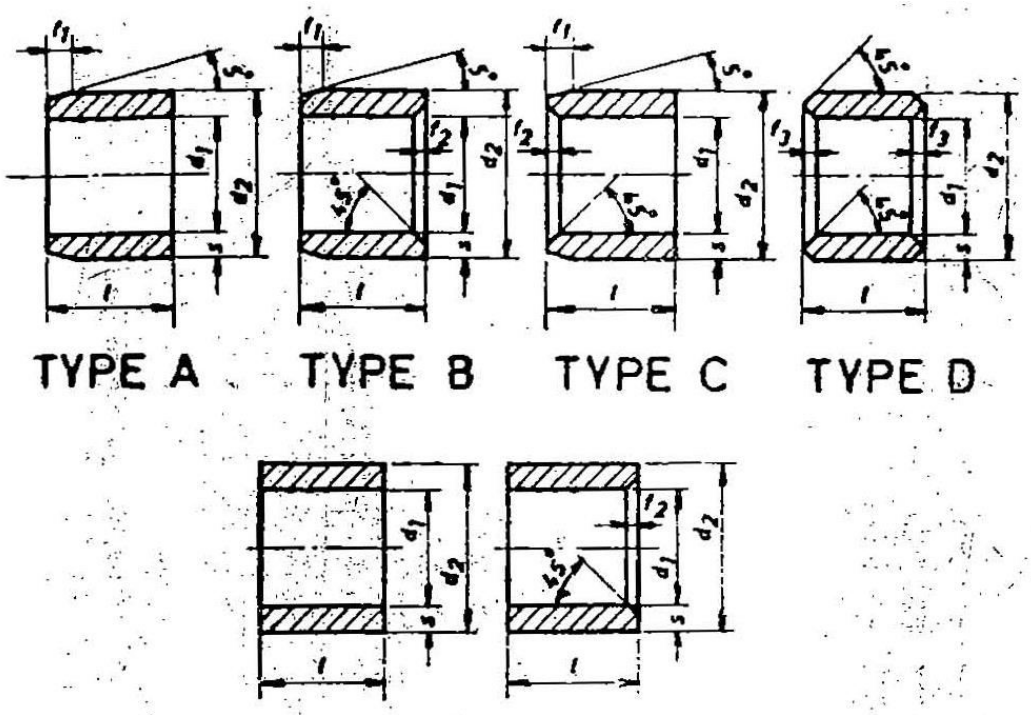


Fig. 2 : TUPE OF CHAMBERS IN JOURNAL BEARINGS

4. DESIGN CALCULATIONS

The journal size of the bore diameter of the bearing is calculated from the following relationship :

$$d = \sqrt{\frac{W \times Cm}{P \epsilon}} \qquad \sigma b = \frac{W l}{2 \times 0{\cdot}1\, d^3} \qquad \epsilon = \sqrt{\frac{0{\cdot}2 \cdot \sigma b}{P}}$$

where

d = Bore diameter of bearing in cm,

= journal diameter,

W = Bearing load in kgf,

σb = Allowable bending stress of the material in kgf/cm^2,

$\epsilon = \frac{l}{d} = \frac{\text{Bearing length in cm}}{\text{Journal diameter in cm}}$, and

P = Allowable surface pressure of bearing in kgf/cm^2.

The ratio, and allowable surface pressure of bearings used in different machines are given in Table 2. This provides oil lubrication in all the cases.

TABLE - 2

ALLOWABLE SURFACE PRESSURE

Machinery	l / d	P		Machinery	l / d	P
Steam engines (Main bearing)	1.5 – 3.0	16		Machine tools	1-4	20
Steam turbines	1.0– 2.0	10-20		Shafting (self aligned bearings)	2-4	12
Railway cars (axial bearing)	1.9	35		Rolling mills	1-1.5	210
Gas and oil engines	0.6- 2.0	50-150		Centrifugal pumps motors and generators	1-2	7-14
Aircraft and automobile engines	0.7-2.0	60-300		Reciprocating compressors and pumps	1-2	20-70

Depending upon material, surface treatment of journal and bearing and the velocity of rotation, the surface pressure can be taken at maximum as below :

Surface hardened steel on hardened steel	150 kgf / sq. cm
Surface hardened Steel on Steel	120 kgf / sq. cm
Steel on Steel	100 kgf / sq. cm
Steel on Bronze	60 kgf / sq. cm
Steel on White metal	40 kgf / sq. cm
Steel on Cast iron	20 kgf / sq. cm

Note 1-: Increase in l/d ratio from the specified value increases the sensitivity of the entire bearing unit to shaft misalignment and may rupture the oil films at the ends and cause seizure.

Note 2-: A lower ratio increases the pressure in the bearing.

5. MATERIALS

5.1 The journal bearings are made of different materials like steel, cast iron, non ferrous materials, wood, rubber etc. The correct material is chosen according to service requirement. Steel and cast iron materials are selected for a velocity up to 45 m / min and they are used for guides, cam shafts etc. Non ferrous metals have got wide applications and a guide for selection of suitable materials is given in Table 3. Wood and rubber materials are required for very low surface pressures and their applications are also restricted to conveyors, pumps and turbines etc.

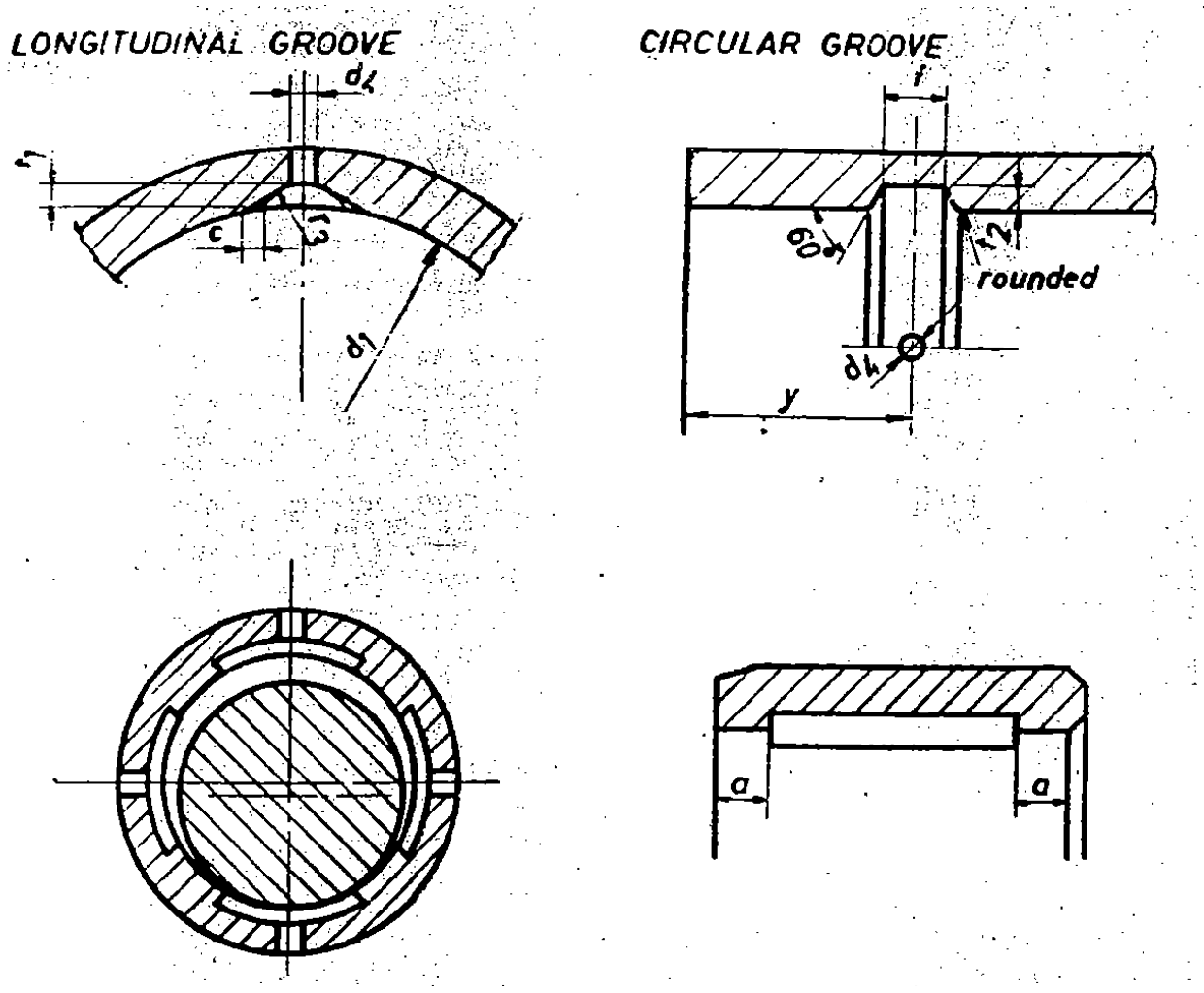


Fig. 3 : HYDROSTATIC JOURNAL BEARING WITH 4 - POCKETS

TABLE 3

MATERIALS, THEIR APPLICATIONS AND EQUIVALENT SPECIFICATIONS

(Clause 5)

IS	BS	ASTM	DIN	PROPERTIES AND USES
306 Gr 1	1400 Gr 1-C	B 143 Gr 1A	1705 RG 10	**GUN METAL** MEDIUM HARD TO HARD MATERIAL. Good wear resistance and little self lubricating properties. Used for slide bearings, bearing bushes of higher loads with surface pressures up to 500 kg/ cm2. Sliding plates, sliding trays and wearing liners of higher loads. Worm gear wheels of low to medium load, low speed. Slipper pads of medium loads. Spindle nuts of moderate loads.
28 PBZ 10	1400 PB 3 - C	B22 Gr B	1705 GSn BZ 12 GSn BZ 14	**PHOSPHER BRONZE** HARD AND TOUGH MATERIAL very good wear resistance. Used for high surface pressure with impact load. Slide bearings, bearing bushes of high loads up to 500kg/cm2. Sliding bars, wearing liners and slipper pads of high loads. Worm gear wheels of medium to high loads and high speed. 15-80kg/cm2 at continuous operation, 200-250 kg/cm2 at short time spindle nuts operated under load.
318 Gr 3	1400 LB 2-C	B 144 Gr 3A	1716 GSn Pb BZ-10	**TIN LEAD BRONZE** MEDIUM SOFT BRONZE With good antifriction and self lubricating properties, Good wear resistance. Used for bearing of high load and high edge pressure. Surface pressure up to 500 to 600 kg/cm2. Used also for hot rolling mills.
305 Gr 1	1400 AB 2-C	B 148 Gr 30	1714 GNIA1 BZS	**SPECIAL BRONZE** HARD MATERIAL. With high strength, good wear resistance and heat resistance properties, insufficient self lubrication. Used for slide bearings and bearing bushes for very high loads surface pressure up to 1200 kg/cm2. Worm gear wheels for high loads of small and medium speeds. **SPECIAL BRASS** HARD MATERIAL. With high static strength sufficient elongation, poor antifriction and self lubricating properties. Not to be used where dynamic loads and vibration come to play.
304 Gr 2	1400 HTB 2-C	B 147 Gr 88	1709 GSOMs F 60	Used for sliding bearings and spindle nuts (well lubricated). For shafts having hardened surface. Surface pressure 1200 kg/cm2, high stressed valve, cones, seats, pistons, cylinders.

IS	BS	ASTM	DIN	PROPERTIES AND USES
25 Gr 5	3332/8	B 23 Gr 8	1703 LgPbSn5 WM5	**BEARING METALS (WHITE METAL)** MATERIAL HAVING GOOD SLIDING AND LOAD CARRYING PROPERTIES. Used for mill shaftings, railways carriage and wagon bearings can be well deposited on cast steel and also on cast iron.
25 Gr 84	3332/2	B 23 Gr 3	1702 LgSn 80 WM30	MATERIAL HAVING GOOD SOLDERING AND CASTING PROPERTIES. Used for high speed bearings, petrol and diesel engine bearings. Can withstand high impact load.

6. TECHNICAL REQUIREMENTS

a) Surface Machining – The bearings are to be machined to have the surface quality as given in Fig. 1 and 2.

b) Tolerances – Recommended ISO tolerances are given in Table 4

TABLE 4

RECOMMENDED ISO TOLERANCES

(Clause 6)

Bore diameter (d1) of bearing before assembly	E9	C11
Corresponding shaft (journal) diameter (d)	F7, e9	H9, h11
Outside diameter of bearing (d2)	R6	R6
Housing diameter for mounting the bearing	H 7	H7
Permissible deviation in concentricity	IT - 8	-

The diametric clearances in microns for shaft diameters up to 160 mm are given in Table 5.

TABLE 5

THE DIAMETRAL CLEARANCE

d1 Tolerance on Shaft Diameter	Tolerance on Bore Diameter							
	Up to 60 mm				Above 60 mm and up to 160 mm			
	E 9		C 11		E 9		C 11	
	Min	Max	Min	Max	Min	Max	Min	Max
f7	28	181	-	-	35	240	-	-
e9	58	255	-	-	67	-	-	-
h9	-	-	78	391	-	-	117	532
h11	-	-	78	507	-	-	117	632

Note 1: The bearing clearances for other different diameters are determined by interpolation method.

Note 2: In case semi-finished bearings are required, the supplier shall supply the items with the following tolerance :

On d1 – 0.3

-- 0.5

and

on d2 +0.4

+ 0.2

The length L and collar diameter, d2 are to be supplied as finished diameters.

c) **Oil Distributing Grooves and Pockets**- The oil distributing grooves are generally arranged in the region of maximum pressure. To ensure a more effective supply of oil to the operating zone, the internal surface of the bearing shells are provided with beveled grooves called oil pockets. These are used as auxiliary reservoirs. (see Fig. 3)

Oil distributing grooves and pockets are always made on the surface of the stationary parts. If the bearing revolves round the shaft, oil grooving are made on the surface of the shaft and for the same reasons oil grooving are made on the bearing surface with resolving shafts.

The circular groove should be used only in exceptional cases because these grooves materially reduce the load carrying capacity. Where grease lubrication is provided, circular grooves are used along with longitudinal grooves.

7. DESIGNATION

Designation of a journal bearing sizes as given in Table 1 shall be written as (type X bore dia housing tolerances X length and then oil grooving).

Journal bearing type – 28 32 E9 x 25 provided with 2 longitudinal grooves and 1 circular groove according to sizes given in Table 6 of this standard.

Material according to indenter's order.

TABLE 6 : OIL DISTRIBUTION GROOVES

Diameter d1	r3	t1	o	d2	t2	f	a	j
16 to 25	2.5	0.8	0.8	3	0.8	2	3	6
Over 25 up to 36	4	1	1	3	1	2	3	6
Over 36 up to 56	6	1.3	1.2	4	1.2	2.6	4	8
Over 72 up to 100	12	2	2	6	1.8	4.3	6	12
Over 100 up to 150	20	2.5	33	8	2.2	7.5	8	16
Over 150 up to 200	28	3.5	4	10	2.7	11	10	20

8. TEST CERTIFICATE

Every consignment of the non-ferrous bearings shall be accompanied by a test certificate confirming to this standard.