1 General Information

1.1 Spherical plain bearings

LDK radial spherical plain bearings have an inner ring with a spherical outside surface and an outer ring with a correspondingly spherical but concave inside surface. Their design makes them particularly suitable for bearing arrangements where alignment movements between shaft and housing have to be accommodated, or where oscillating or recurrent tilting or slewing movements must be permitted at relatively slow sliding speeds. **LDK** radial spherical plain bearings are available with different sliding contact surface combinations, i.e. the sliding surfaces of inner and outer rings are made from different materials. There are two main groups: spherical plain bearings requiring maintenance (steel-on-steel) and maintenance-free spherical plain bearings.

LDK radial spherical plain bearings requiring maintenance (steel-on-steel) have hardened sliding contact surface on both rings. The surfaces are treated with molybdenum disulphide and phosphated. It has characteristics of wear-resistance and wear-corrosion. Bearings with this sliding contact surface combination require regular relubricaion. The high strength of the sliding contact surfaces makes these bearings especially suitable for bearing arrangements where heavy loads of alternating direction, shock loads or heavy static loads have to be accommodated.

LDK maintenance-free spherical plain bearing sliding contact surfaces have three groups: steel-on-PTFE composite material, steel-on-PTFE fabric and steel-on-copper alloy. Dynamic load support capability of steel-on-PTFE fabric spherical plain bearings is higher than that of steel-on-PTFE composite material. They have very low friction and can be operated without maintenance. They are used for applications where long bearing lives are required without maintenance, or where operating conditions, such as inadequate lubrication or the absence of lubrication make the use of steel-on-steel bearing inadvisable.

1.2 Angular Contact Spherical Plain Bearings

The sphered sliding contact surfaces of angular contact spherical plain bearings are inclined at an angle to the bearing axis. They are therefore particularly suitable for carrying combined (radial and axial) loads. A single angular contact spherical plain bearing can only accept axial loads acting in one direction. Under radial loads, a force acting in the axial direction is produced in the bearing which must always be opposed by an equal force acting in the opposite direction. Therefore,the bearings are usually adjusted against a second bearing. When two angular contact spherical plain bearings are arranged so that their sphere centres coincide, a clearance-free radial spherical plain bearing is obtained which can accommodate heavy radial loads as well as heavy axial loads in both directions. LDK angular contact spherical plain bearings are available with different sliding contact surface combinations, i.e. the sliding surfaces of inner and outer rings are made from different materials. There are two main groups :steel-on-steel angular contact spherical plain bearings and maintenance-free angular contact spherical plain bearings.

LDK steel-on-steel angular contact spherical plain bearings are made of carbon chromium steel and are hardened and phosphated , it has characteristics of wear-resistance and wear-corrosion. The inner and outer rings sliding contact surface are treated with molybdenum disulphide. Bearings with this sliding contact surface combination require regular relubrication. To facilitate efficient lubrication, outer ring has an annular groove and two lubrication holes. The high strength of the sliding surfaces makes these bearings especially suitable for bearing arrangements where heavy loads alternating direction, shock loads or heavy static loads have to be accommodated.

LDK maintenance-free angular contact spherical plain bearings have sliding contact surface combinations steel-on-PTFE fabric, they have very low friction and can be operated without maintenance, any lubrication of the sliding contact surfaces will shorten bearing life. They are used for applications where long bearing lives are required without maintenance, or where operating conditions, such as inadequate lubrication or the absence of lubrication make the use of steel-on-steel bearing inadvisable. The maintenance-free bearings are primarily intended for applications where loads are heavy and have a constant direction.

1.3 Spherical Plain Thrust Bearings

LDK Spherical plain thrust bearings have sliding contact surfaces in the shaft and housing washers which are arranged at an angle to the bearing axis. They are primarily intended for axial loads although they can accommodate combined loads to a certain extent. LDK spherical plain thrust bearings are available with different sliding contact surface combinations, i.e. the sliding surfaces of shaft and housing washers are made from different materials. There are two main group : steel-on-steel spherical plain thrust bearings and maintenance-free spherical plain thrust bearings.

LDK steel-on-steel spherical plain thrust bearings are made of carbon chromium steel and are hardened and phosphated, the shaft and housing washers sliding contact surface are treated with molybdenum disulphide, it has characteristics of wear-resistance and wear-corrosion. Bearings with this sliding contact surface combination require regular relubrication. To facilitate efficient lubrication, housing washer have an annular groove and a lubrication hole. The high wear resistance of the sliding surfaces makes these bearings especially suitable for bearing arrangements where heavy loads of alternating direction, shock loads or heavy static loads have to be accommodated.

LDK maintenance-free spherical plain thrust bearings have sliding contact surface combinations steel-on-PTFE fabrics they have very low friction and can be operated without maintenance, any lubrication of the sliding contact surfaces will shorten bearing life. They are used for applications where long bearing lives are required without maintenance, or where operating conditions, such as inadequate lubrication or the absence of lubrication make the use of steel-on-steel bearing inadvisable. The maintenance-free bearings are primarily intended for applications where loads are heavy and have a constant direction.

2. Temperature range:

LDK Rod ends and Spherical Plain bearings can be operated within the operating temperatures listed below:

Mating surfaces	Temperature Celsius	Temperature Fahrenheit
Steel/Special Brass	-50º to +200º	-58º to +392º
Steel/Bronze	-50º to +230º	-58º to +446º
Steel/PTFE liner	-50º to +200º	-58º to +392º
Steel/PTFE Glass fibre liner	-30º to +150º	-22º to +302º
Steel/Steel	-50º to +200º	-58º to +392º

Increase of operating temperature occurs a decrease of load capacity of the bearing therefore life will be reduced too. **LDK** can manufacture Rod ends and Spherical Plain bearings at a wider and higher temperature range according to customer's special request.

3. Load Rating

3.1 Dynamic Rating

Dynamic Rating is used for calculations when the spherical plain bearing is subjected to dynamic stress. It represents the load, constant in magnitude and direction, under which a basic rating service life, expressed as a sliding distance, will be attained for continuous oscillating movement at a defined sliding velocity and at room temperature. It presupposes that the load acting on radial and angular spherical plain bearings and on rod ends is purely radial and that the load acting on spherical plain thrust bearings is purely axial and acts centrically. Dynamic stresses occur when tiling, oscillatory or rotational movements are made under load as well as micro sliding movements under aleternating loads, e.g resulting from vibration, or loads which alternate at high frequency. The various types of dynamic stress often occur in combination.

The values of load ratings are always dependent on the definition used. It is therefore not always possible to make direct comparisons with load ratings published by other manufactures.

3.2 Static rating

The static load ratings is used when spherical plain bearings stand still under load(or make occasional alignment movements) and it should also be considered when dynamically loaded bearings are subjected to heavy shock loads. The static load rating represents the load which can be taken up by a spherical plain bearing when static contact stress of bearing contact surface reaches the material stress limit. It is valid at room temperature and it is presupposed that surrounding components prevent deformation of the bearing. At higher temperature, the static load rating must be multiplied by a temperature factor, depend on the sliding contact combination. The temperature factor is the same as for dynamically stressed bearing. It is also necessary to take into consideration the permissible temperature rang for the various sliding contact surface combinations.

For rod ends, it is the strength of the rod end housing under stationary load which is considered. The rod end static load ratings give a safety factor of 1.2 times the tensile strength of the rod end housings material.

The ultimate radial static load rating is measured as the failure point when a load is increasingly applied to a pin through the rod end's bore and pulled straight up while the rod end is fixtured. Note that **LDK**'s cataloged radial load ratings include a safety factor, and that insertion of a grease fitting into the radius of the rod end may reduce the load rating due to lesser cross-sectional material in the stressed point. The actual rating is determined by calculating the lowest of the following three values:

1.Race material compressive strength (R value):$R=E \times T \times X$

2.Rod end head strength(H Value, cartridge type construction):

$$H=\left[\left(\frac{T}{2}\sqrt{D^2-T^2}\right) + \left(\frac{D^2}{2} \times SIN^{-1}\frac{T}{2}\right) - (\text{O.D.of Bearing} \times T) \right] \times X$$

Angle of $\frac{T}{D}$ *expressed in radians*

3.Shank strength(S Value) Male threaded rod end:$S=[(\text{root diameter of thread}^2 \times .78) - (N^2 \times .78)] \times X$

Female threaded rod end:$S_1=[(J^2 \times .78) + (\text{major diameter of thread}^2 \times .78)] \times X$

Where: E= Ball Diameter

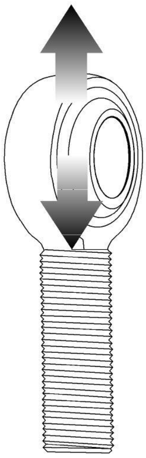
T=Housing Width

X=Allowable Stress (See Table Below)

D=Head Diameter

N=Diameter of Drilled Hole in Shank of Male Rod End

J=Shank Diameter of Female Rod End



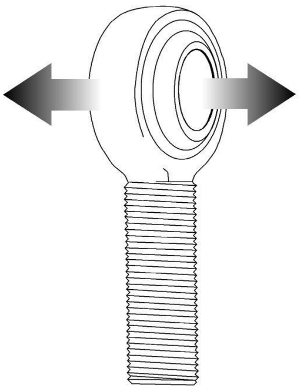
The axial static load capacity is measured as the force required to cause failure via a load parallel to the axis of the bore. Depending on material types and construction methods, the ultimate axial load is generally 10-20% of the ultimate radial static load. The formula does not account for the bending of the shank due to a moment of force, nor the strength of the stake in cartridge-type construction.

AXIAL STRENGTH (A Value): $A=.78[(E + .176T)^2 - E2] \times X$

Where: X =Allowable Stress (See Table)

E=Ball Diameter

T=Housing Width



MATERIAL	ALLOWABLE STRESS (PSI)
Brass	30,000
Aluminum	35,000
300 Series Stainless Steel	35,000
low Carbon Steel	52,000
Alloy Steel	140,000

4. SERVICE LIFE

The service life of the spherical plain bearings and rod ends operated under mixed or dry friction conditions is determined by the increase in bearing clearance or bearing friction caused by progressive wear of the sliding surfaces, plastic deformation of the sliding material or fatigue of the sliding surface. Depending on the application, the permissible wear or permissible increase in friction will be different. This means that under the same operating conditions the service life which can be obtained in practice will be different.

The service life of a spherical plain bearing is the number of oscillating movements, or the number of operating hours, which the bearing will service before a defined increase in bearing clearance or a defined increase in friction is reached.

The effective service life is that life which will be attained by a given spherical plain bearing under actual operating conditions. It is determined by the magnitude an type of load, but also by several other factors, such as contamination, corrosion, high-frequency load and movement cycles, shock etc. Some of these factors are impossible to determine or can only be determined with difficulty.

5. ANGLE OF MISALIGNMENT

The maximum angel of the ball in a rod end or spherical bearing that can be maintained without interference is calculated as the angle of misalignment. It is defined as the angle between the ball centerline and the outer member centerline when the ball is aligned in its extreme position as allowed. The worst case limiting angle is determined by clevis-mounted assembly

as seen in Figure 1.Total misalignment under this condition, as cataloged by **LDK** for rod end applications, is twice the angle from one side of center to the opposite extreme position. Misalignment in a spherical bearing is limited by ball and race width, as functions of ball diameter, and is illustrated in Figure 3 on the right. This calculation is the basis for **LDK** catalogue angles of misalignment .Other mounting arrangements as shown in Figures 2-4 can also be used as guidelines in calculating the precise angle of misalignment depending on the mounting configuration, and are frequently referenced for metric usage.

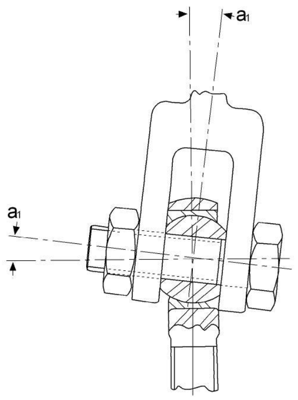


FIGURE 1

$$a^1=\sin^{-1}\frac{W}{D} - \sin^{-1}\frac{T}{D}$$

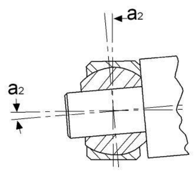


FIGURE 2

$$a^2=\sin^{-1}\frac{W}{A} - \sin^{-1}\frac{T}{A}$$

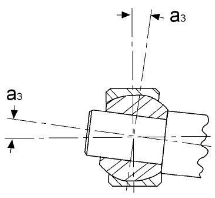


FIGURE 3

$$a^3=\sin^{-1}\frac{W}{E} - \sin^{-1}\frac{T}{E}$$

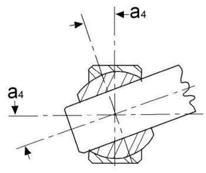


FIGURE 4

$$a^4=\cos^{-1}\frac{B}{E} - \cos^{-1}\frac{T}{E}$$

Reference Letters

B= Ball Bore

T = Housing Width

M= Outer Race Chamfer

A= $\sqrt{(D-2M)^2+T^2}$

D= Head Diameter of the outer Race Diameter

W = Ball Width

E =Ball Diameter

6. BEARING CONTACT PRESSURE

If an adequate operating life is to be achieved, a basic requirement is that the bearing contact pressure is compatible with the operating conditions. The bearing contact pressure identifies the surface pressure occurring in the bearing and is a decisive criterion for the assessment of a spherical plain bearing in each individual application.

$$p = k\cdot\frac{P_d}{C_d}$$

p=contact pressure N/mm²

k=contact pressure paraameter

C =Dynamic load rating kN

p=Equivalent dynamic bearing load kN

Contact surface combination	Value of load ratio C_a/P	Load factor k
Steel/steel	2	100
Steel/brone	2	50
Steel/PTFE fabric	1.75	150
Steel/PTFE composite material	2	100
Steel/copper alloy	2	100

7. TOLERANCE AND FIT

7.1 Tolerance & Fit for Radial spherical plain bearings

Inner ring (except for series GEBK...S*, GE...PW*) μm

d mm		Δdmp		Δdmp*		Vdp	Vdmp	Vdp *	Vdmp *	ΔBs		ΔBs *	
over	Incl.	max	min	max	min	max	max	max	max	max	min	max	min
-	18	0	-8	+18	0	8	6	18	14	0	-120	0	-180
18	30	0	-10	+21	0	10	8	21	16	0	-120	0	-210
30	50	0	-12	+25	0	12	9	25	19	0	-120	0	-250
50	80	0	-15	+30	0	15	11	30	22	0	-150	0	-300
80	120	0	-20	+35	0	20	15	35	26	0	-200	0	-350
120	180	0	-25	+40	0	25	19	40	30	0	-250	0	-400
180	250	0	-30	+46	0	30	23	46	35	0	-300	0	-460
250	315	0	-35	+52	0	35	26	52	39	0	-350	0	-520
315	400	0	-40	+57	0	40	30	57	43	0	-400	0	-570
400	500	0	-45	-	-	45	34	-	-	0	-450	-	-
500	630		-50	-	-	50	38	-	-	0	-500	-	-

The deviatiions in the columns with symbol * apply to spherical plain bearings of series of GEEW...ES.

Outer ring μm

D mm		ΔDmp		VDp	VDmp	ΔCs	
over	Incl.	max	min	max	max	max	min
-	18	0	-8	10	6	0	-240
18	30	0	-9	12	7	0	-240
30	50	0	-11	15	8	0	-240
50	80	0	-13	17	10	0	-300
80	120	0	-15	20	11	0	-400
120	150	0	-18	24	14	0	-500
150	180	0	-25	33	19	0	-500
180	250	0	-30	40	23	0	-600
250	315	0	-35	47	26	0	-700
315	400	0	-40	53	30	0	-800
400	500	0	-45	60	34	0	-900
500	630	0	-50	67	38	0	-1000
630	800	0	-75	100	56	0	-1100
800	1000	0	-100	135	75	0	-1200

Tolerances for GEBK...S

Inner ring μm

d mm		Δdmp		ΔBs	
Over	Incl	max	min	max	min
-	6	+12	0	0	-100
6	10	+15	0	0	-100
10	18	+18	0	0	-100
18	30	+21	0	0	-100

Outer ring μm

D mm		ΔDmp		ΔCs	
Over	Incl.	max	min	max	min
10	18	0	-11	+100	-100
18	30	0	-13	+100	-100
30	50	0	-16	+100	-100
50	80	0	-19	+100	-100

Tolerances for GE...PW

Inner ring μm

d mm		Δ dmp		Δ Bs	
Over	Incl.	max	min	max	min
-	6	+12	0	0	-100
6	10	+15	0	0	-100
10	18	+18	0	0	-100
18	30	+21	0	0	-100

Outer ring μm

D mm		Δ Dmp		Δ Bs	
Over	Incl.	max	min	max	min
10	18	0	-11	0	-240
18	30	0	-13	0	-240
30	50	0	-16	0	-240
50	80	0	-19	0	-300

The symbols of dimensions and tolerance

d: Bearing bore diameter, nominal .

Δdmp: Single plane mean bore diameter deviation.

Vdp: Bore diameter variation in a single radial plane.

Vdmp: Mean bore diameter variation.

ΔBs: Deviation of a single width of the inner ring.

B: Width of the inner ring, nominal.

D: Bearing outside diameter, nominal.

ΔDmp: Single plane mean outside diameter deviation.

VDp: Outside diameter variation in a single radial plane.

VDmp: Mean outside diameter variation.

ΔCs: Deviation of a single width of the outer ring.

C: Width of outer ring, nominal.

ΔTs: Actual deviation of width of the angular contact spherical plain bearing.

ΔHs: Actual deviation of height of the spherical plain thrust bearing.

Δhs, Δh1s: Center height deviation of rod ends or ball joint rod ends.

7.2 Tolerance & Fits for Rod ends

Inner ring

The Ðdmp, ΔBs of SI...E, SI...ES, SA...E, SA...ES, SIR...ES, SIQ...ES, SK...ES, SF...ES, SI...C, SA...C,SI...ET-2RS, SA...ET-2RS are same as radial spherical plain bearings GE...E, GE...ES, GE...C, GE...ET-2RS

The Δdmp, ΔBs of SIGEW...ES are same as radial spherical plain bearings GEEW...ES. PHS..., POS..., PHSB..., POSB..., PHS...EC, POS...EC, PHS...HD, POS...HD, NPHS..., NPOS...,SPHS..., SPOS..., SPHS...EC, SPOS...EC, SCHS..., SCOS.

d mm		Δdmp		ΔBs	
Over	Incl.	max	min	max	min
-	6	+12	0	0	-150
6	10	+15	0	0	-150
10	12	+18	0	0	-150
12	18	+18	0	0	-200
18	30	+21	0	0	-200

Center height deviation mm

d		Δhs		Δh1s	
Over	Incl.	max	min	max	min
-	6	+0.80	-1.20	+0.65	-1.05
6	20	+0.80	-1.20	+0.80	-1.20
20	30	+1.00	-1.70	+1.00	-1.70
30	45	+1.40	-2.10	+1.40	-2.10
45	60	+1.80	-2.70	+1.80	-2.70
60	80	+2.25	-3.40	+2.25	-3.40
80	125	+2.70	-3.40	+2.70	-3.40
125	200	+3.20	-4.20	+3.20	-4.20

Tolerances for American size rod ends are indicated in each table enclosed.

8. Bearing Internal Clearance

Bearing internal clearance is defined as the total distance through which one ring can be moved radially (radial internal clearance) or axially (axial internal clearance) in relation to the other ring under a defined measuring load.

It is necessary to distinguish between the internal clearance of a bearing before it is mounted and the internal clearance of a mounted bearing when in operation (operational clearance). The initial clearance will always be greater than the operational clearance because the rings are expanded or compressed by interferences fits and as a result of the differences in thermal expansion of the bearing rings and mating components.

The bearing internal clearance referred to as normal has been selected so that when bearings are mounted generally recommended and operate under normal conditions a suitable operational will be obtained. For other conditions, e.g. where both rings are mounted with an interference fit or where unusual temperatures prevail, bearing with greater or smaller internal clearance than normal may be required.

8.1 Radial internal clearance of radial spherical plain bearings

Radial internal clearance of steel-on-steel radial spherical plain bearings

Series of GE…E,GE…ES,GE…ES-2RS,GEEW…ES,GEEM…ES,GEZ…ES,GEZ…ES-2RS, COM..
COMH…,COM…SS,MIB,AIB,SIB

d mm		Group C2 µm		Group Normal µm		Group C3 µm	
Over	Incl.	min	max	min	max	min	max
-	12	8	32	32	68	68	104
12	20	10	40	40	82	82	124
20	35	12	50	50	100	100	150
35	60	15	60	60	120	120	180
60	90	18	72	72	142	142	212
90	140	18	85	85	165	165	245
140	200	18	100	100	192	192	284
200	240	18	110	110	214	214	318
240	300	18	125	125	239	239	353

Series of GEG…E, GEG…ES, GEG…ES-2RS

d mm		Group C2 µm		Group Normal µm		Group C3 µm	
Over	Incl.	min	max	min	max	min	max
-	10	8	32	32	68	68	104
10	17	10	40	40	82	82	124
17	30	12	50	50	100	100	150
30	50	15	60	60	120	120	180
50	80	18	72	72	142	142	212
80	120	18	85	85	165	165	245
120	160	18	100	100	192	192	284
160	220	18	100	100	192	192	284
220	280	18	110	110	214	214	318

Series of GEBK…S

d mm		Group C2 µm		Group Normal µm		Group C3 µm	
Over	Incl.	min	max	min	max	min	max
2.5	6	4	34	10	50	42	70
6	10	5	41	13	61	52	88
10	18	6	49	16	75	64	107
18	30	7	59	20	92	98	150

Series of GE…C, GE...PW, COM...T, COM...H, COMSS...H, WSSB..., WSSB...V, NSSB..., NSSW...V, YSSB..., YSSB..V, MIB..., AIB..., SIB... .

d mm		Group Normal µm	
Over	Incl.	min	max
-	12	4	28
12	20	5	35
20	30	6	44

Series of GE…ET-2RS, GE...XT-2RS

d mm		Group Normal µm	
Over	Incl.	min	max
-	20	0	40
20	35	0	50
35	60	0	60
60	90	0	72
90	140	0	85
140	240	0	100
240	300	0	110

Series of GEG…ET-2RS, GEG...XT-2RS

d mm		Group Normal µm	
Over	Incl.	min	max
-	30	0	50
30	50	0	60
50	80	0	72
80	120	0	85
120	220	0	100
220	280	0	110

8.2 Radial intenal Clearance of Rod ends

Series of SI…E, SI…ES, SA…E, SA…ES, SIR…RS, SIGEW…ES, SIQ…ES, SK…ES, SF…ES,CM…, CF…, , JM…, JML…JF…, JFL…, RJM…, RJF…ALJM…, ALJF…, ALRSM…

d mm		Group C2 µm		Group Normal µm		Group C3 µm	
Over	Incl.	min	max	min	max	min	max
-	12	4	32	16	68	34	104
12	20	5	40	20	82	41	124
20	35	6	50	25	100	50	150
35	60	8	60	30	120	60	180
60	90	9	72	36	142	71	212
90	125	9	85	42	165	82	245
125	200	9	100	50	192	96	284

Series of SI…C, SA…C, SI…ET-2RS, SA…ET-2RS, CHS…, COS…, SCHS…, SCOS…, NPHS…, NPOS.., PHS…EC, POS..EC, SPHS…EC, SPOS..EC, SPHSB...EC,SPOSB...EC,CF…T, CM…T, SCF…T, SCM…T,, CMX…T, RJM…T, RRSMX…T, SJM…T, SRSM…T, SJF…T, HJMX…T, PMX…T, NJF…, NJM…, NXF…, NXM…, NEXF…, NEXM…, NAF…, NAM…, RSM…T, RSMX…T, HRSMX…T

d mm		Group C2 μm		Group Normal μm		Group C3 μm	
Over	Incl.	min	max	min	max	min	max
-	12	0	25	0	32	15	45
12	20	0	30	0	40	20	60
20	35	0	35	0	50	25	65
35	60	0	40	0	60	30	80
60	80	0	50	0	72	35	90

Series of PHS…, POS.., PHSB…, POSB…, PHS…HD, POS…HD, SPHS…, SPOS…, M…, F…

d mm		Group C2 μm		Group Normal μm		Group C3 μm	
Over	Incl.	min	max	min	max	min	max
2.5	6	2	34	5	50	21	72
6	10	3	41	7	61	26	88
10	18	3	49	8	75	32	107
18	30	4	59	10	92	39	120
30	50	5	71	13	112	49	150

8.3 Fits of radial spherical plain bearings

Shaft fits

Operating conditions	Sliding contact surface of combination	
	Requiring maintenance	Maintenance-free
Loads of all kinds, clearance or transition fit	h6, hardened shaft	h6, g6
Loads of all kinds, interference fit	m6	k6

Housing fit

Operating conditions	Sliding contact surface of combination	
	Requiring maintenance	Maintenance-free
Light loads, Axial displacement required	H7	H7
Heavy loads	M7	K7
Light alloy housings	N7	M7

Shaft diameter tolerances

Shaft diameter mm		Shaft diameter tolerances µm							
		g6		h6		k6		m6	
Over	Incl.	High	Low	High	Low	High	Low	High	Low
3	6	-4	-12	0	-8	+9	+1	+12	+4
6	10	-5	-14	0	-9	+10	+1	+15	+6
10	18	-6	-17	0	-11	+12	+1	+18	+7
18	30	-7	-20	0	-13	+15	+2	+21	+8
30	50	-9	-25	0	-16	+18	+2	+25	+9
50	80	-10	-29	0	-19	+21	+2	+30	+11
80	120	-12	-34	0	-22	+25	+3	+35	+13
120	180	-14	-39	0	-25	+28	+3	+40	+15
180	250	-15	-44	0	-29	+33	+4	+46	+17
250	315	-17	-49	0	-32	+36	+4	+52	+20

Housing bore tolerances

Housing bore diameter(mm)		Housing bore tolerances µm							
		H7		K7		M7		N7	
Over	Incl.	High	Low	High	Low	High	Low	High	Low
10	18	+18	0	+6	-12	0	-18	-5	-23
18	30	+21	0	+6	-15	0	-21	-7	-28
30	50	+25	0	+7	-18	0	-25	-8	-33
50	80	+30	0	+9	-21	0	-30	-9	-39
80	120	+35	0	+10	-25	0	-35	-10	-45
120	180	+40	0	+12	-28	0	-40	-12	-52
180	250	+46	0	+13	-33	0	-46	-14	-60
250	315	+52	0	+16	-36	0	-52	-14	-66
315	400	+57	0	+17	-40	0	-57	-16	-73
400	500	+63	0	+18	-45	0	-63	-17	-80

Fits for rod ends

Shaft fits

Operating conditions	Tolerance
With indeterminate loads	n6, p6
Normal conditions	h6, h7

Thread

Male Thread	Female Thread
6g	6H
UNF-2A	UNF-2B
BSF-free	BSF-normal

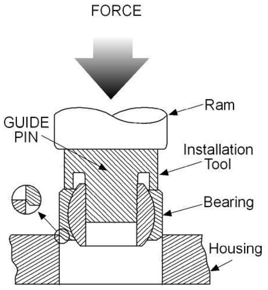
Shaft diameter tolerances

Shaft diameter mm		Shaft diameter tolerances							
		h6		h7		n6		p6	
Over	Incl.	High	Low	High	Low	High	Low	High	Low
3	6	0	-8	0	-12	+16	+8	+20	+12
6	10	0	-9	0	-15	+19	+10	+24	+15
10	18	0	-11	0	-18	+23	+12	+29	+18
18	30	0	-13	0	-21	+28	+15	+35	+22
30	50	0	-16	0	-25	+33	+17	+42	+26
50	80	0	-19	0	-30	+39	+20	+51	+32
80	120	0	-22	0	-35	+45	+23	+59	+37
120	180	0	-25	0	-40	+52	+27	+68	+43
180	250	0	-29	0	-46	+60	+31	+79	+50

9. Mounting

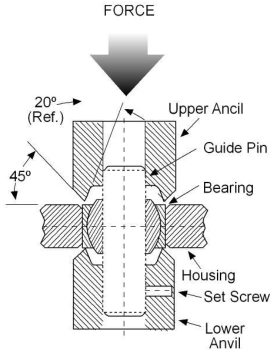
Proper press-fitting of spherical bearings into a housing fixture will result not only in smooth bearing performance, but also in better wear characteristics leading to longer life. **LDK** engineering recommends strict adherence to the following installation procedures in order to assure optimal spherical bearing performance and wear.

The spherical bearings and rod ends must be kept in their original packaging until shortly before their installation, so that they continue to be effectively preserved for as long as possible. Ensure during the installation process that foreign particles are on no account allowed to enter the outer ring of the bearing.



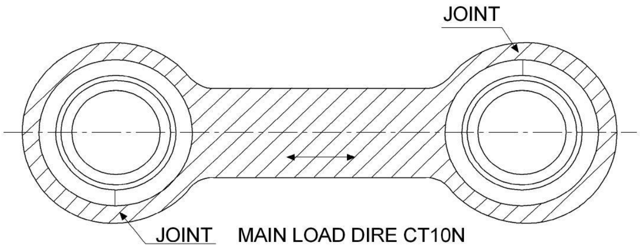
The use of a hydraulic press to apply constant pressure is recommended. Any other shocking-inducing device such as a hammer will result in damage and/or ultimate misfit. An installation tool such as that shown on the left is ideal. Here the guide pin aligns the ball's bore parallel to the race O.D., while all force is applied to the outer race surface only. The force required for installation and removal should on no account be transmitted from the spherical form to the bearing shells or raceways of the bearing outer ring.

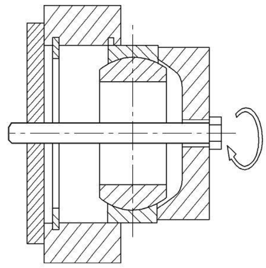
STAKING METHOD FOR V-GROOVED SPHERICAL BEARINGS

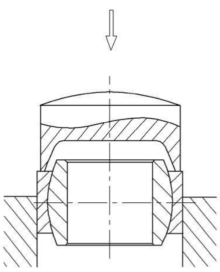


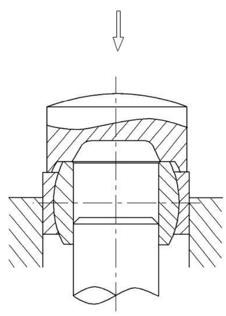
Customers often require a bearing with a specially formed "V"-shaped groove on the face of the outer rave, allowing for staking of the bearing into bearing into a fixed outer housing. This is accomplished by forcing the metal on the outside of the groove onto the fixture's face or into its chamfer. The use of hydraulic press for this operation is recommended, as is following the instructions for the initial installation of the bearing into the housing as described above.

LDK Engineering recommends an upper and lower anvil method for installation. Anvils should be aligned as shown, with guide pin in position. This pin should ideally be secured in the lower anvil by means of a set screw. A test assembly should be undertaken to assure that required axial (thrust) load requirements of the final product are maintained. Avoid excessive pressure which can result in distortion leading to premature failure or malfunction. When the test requirements are met, the assembly should be rotated at 90º maximum intervals, with pressure re-applied, to assure uniformity of the metal swaging process.

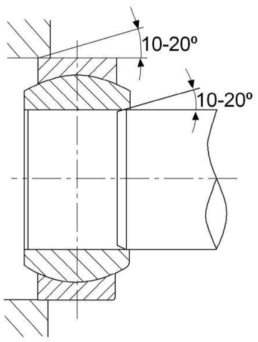








When mounting spherical plain bearings with a fractured or two-part outer ring, it is essential that the joint should be positioned at 90º to the main load direction, otherwise the service life will be shortened, particularly under heavy loads.



To facilitate mounting, the ends of pins or shafts and the edges of housing bores should have a lead chamfer of 10º to 20º ,The bearings can be more easily pushed into position and there is little risk of damage to the mating surfaces being caused by skewing of the bearing.

10. LUBRICATION AND MAINTENANCE

10.1 General instruction

The useful life of all spherical bearings and rod ends with metallic mating materials is greatly dependent on regular lubrication. A one-off initial grease filling is only adequate if operating loads are very low.

The effectiveness of lubrication is mainly dependent on the load, type of the load (constant, pulsating or alternating), the swivel and sliding speed. To ensure optimum and even distribution of the lubricant, initial and subsequent lubrication should be carried out with the spherical plain bearings or rod ends in an unloaded condition.

Note:

In order to avoid incompatibility of various lubricants that may be used by **LDK** and the customer, spherical bearings and rod ends are supplied only with an anticorrosive coating. For this reason, spherical bearings and rod ends which need maintenance should be given initial lubrication before commissioning or directly after installation. We recommend carrying out-initial lubrication after a running-in time of approx 1 hour. Whenever this lubrication is carried out, the bearing must be in an unloaded condition, so that the lubricant can spread without obstruction. Lubrication should continue until the lubricant emerges between the bearing outer ring and the inner ring. For rod ends with a female thread, it is also advisable to fill the space in the shank thread with lubricant up to the threaded connection journal before installation. This reduces the amount of work involved in lubricating with the lubricating nipple.

10.2 Lubrication & maintenance of spherical plain bearings

For spherical plain bearings requiring maintenance which are of the steel-on-steel type, the purpose of the lubrication is primarily to reduce wear, reduce friction and prevent scuffing. Also the grease serves to protect the bearings against corrosion. The frequency of relubrication of the bearing during its operation will appreciably extend the service life.

For steel-on-PTFE fabric spherical plain bearings, there is a transfer of PTFE from fabric to the opposing steel surface of the inner ring. Any lubrication of the sliding contact surfaces would disturb this transfer and shorten bearing life. Therefore, lubrication of these bearings is not advisable.

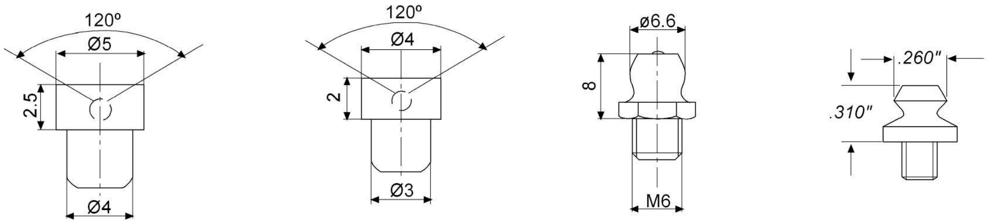
For steel-on-PTFE composite material spherical plain bearings, as a rule, it must not be lubricated. When operating conditions are such that enhanced sealing and protection against corrosion are required, it is recommended that the bearing or the space surrounding the bearing is filled with lithium base grease.

10.3 Lubrication & maintenance of rod ends

LDK steel-on-steel and steel-on-bronze rod ends have very wear-resistant. Sliding surface and perform well under conditions of lubricant starvation. Rod end with this sliding contact surface combition require regular relubrication.

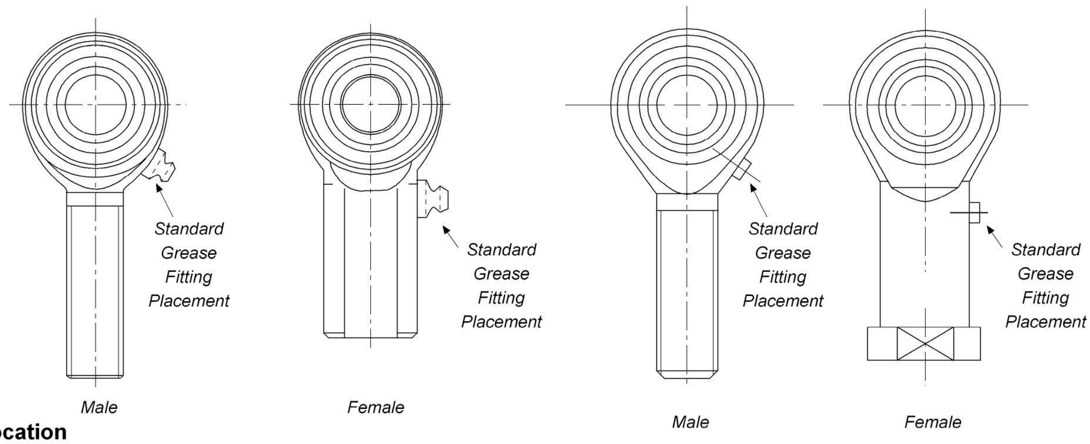
LDK maintenace-free rod ends sliding cotact surfaces have two groups. Steel-on-PTFE composite and steel-on-PTFE fabric. They have very low friction and can be operated without maintenance. Therefore. Labrication of these bearing is not advisable.

10.4 GREASE FITTING CONFIGURATION



Catalog load ratings are based on rod ends without grease fittings.
For adjusted load ratings with grease fittings consult LDK engineering.

10.5 GREASE FITTING CONFIGURATION



Location

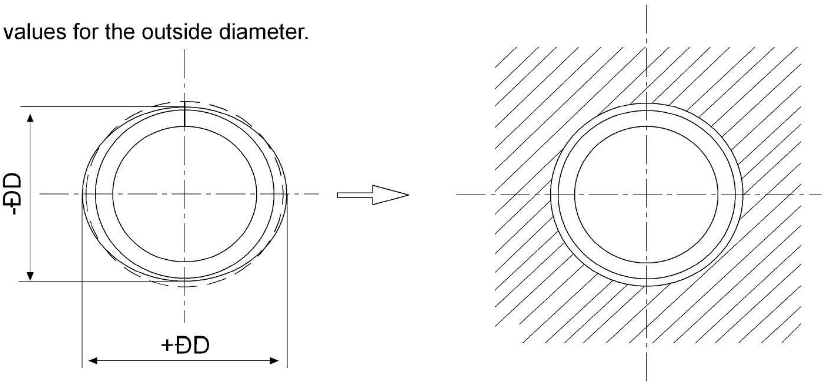
Standard grease fitting locations are illustrated at the right. Note that for a female configuration,once the male threaded component is fully engaged, the grease is forced through the hole at the top of the female shank to facilitate ball lubrication.

Standard Grease Fitting

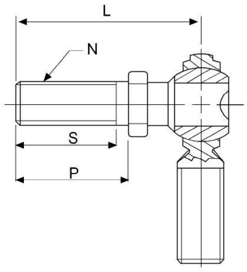
Order by adding the letter"z" to the completed number. example:CM8Z

11. ACCURACY

The tolerances apply to outer ring without surface treatment and splitting. The outer rings become slightly out of round due to splitting. The roundness of the outer ring is restored once it is fitted in a housing bore produced in accordance with the specifications (Figure1). Measurements taken of the outside diameter of the unfitted bearing cannot be used as the original actual values for the outside diameter.



12. STUD CONFIGURATION



ROD END PART SIZE	L LGTH.	P LGTH.	S LGTH.	N THD.
	+.015 -.015	REF.	MIN.	UNF 2A
3	1.016	.500	.437	10-32
4	1.031	.562	.500	1/4-28
5	1.219	.687	.593	5/16-24
6	1.562	.906	.812	3/8-24
7	1.750	1.062	.937	7/16-20
8	2.000	1.125	1.000	1/2-20
10	2.500	1.500	1.375	5/8-18
12	3.000	1.812	1.625	3/4-16

NOTE:

1. AVAILABLE ON ALL SERIES.
2. SUTD MATERIAL:LOW CARBON STEEL AND ALLOY STEEL(HEAT TREATED)-ZINC PLATED.
3. STUD MISALIGNMENT APPROX. +/-25º IN ANY DIRECTION.
4. TO SPECIFY RIGHT HAND STUD, ADD SUFFIX"Y"TO PART NUMBER. **EXAMPLE:**CM6Y
5. TO SPECIFY LEFT HAND STUD, ADD SUFFIX "YL"TO PART NUMBER. **EXAMPLE:**CM6YX
6. TO SPECIFY HEAT TREATED STUD, ADD SUFFIX"YX"TO PART NUMBER. **EXAMPLE:**CM6YX
7. FOR LOAD RAINGS WITH STUDS,PLEASE CONTACT LDK ENGINEERING DEPARTMENT.

13. WARRANTY & DISCLAIMER

13.1 Warranty

LDK warrants that the products well be free from defects in material and workmanship for one year from date of sale. **LDK** makes no other warranty of any kind, express or implied. **LDK** shall have no obligation under the foregoing warranty where the defect is the result of improper or abnormal use, negligence, vehicle accident, improper or incorrect installation or maintenance, nor when the product has been repaired or altered in any way so as (in our judgment) to affect its its performance. **LDK**`s liability in the case of defective products subject to the foregoing warranty shall be limited to the repair or replacement, at **LDK**`s option, of the defective products. Except expressly provide herein, **LDK** shall have no liability (on account negligence or otherwise) for, or in connection with, defects or deficiencies in the products and in no event shall **LDK** be liable for any incidental, special or consequential damages or commercial loss (including loss revenue or profits) of buyer or any other person, arising our of the use, or inability to use, the goods, or the failure or ineffectiveness of the goods.

13.2 DISCLAIMER

LDK reserves the right to substitute equal or stronger materials at their discretion. **LDK** reserve the right to change specifications and other information included in this catalog without notice. All information, data and dimension tables in this catalog have been carefully complied and thoroughly checked. However, no responsibility for errors or omissions can be assumed.

WARNING
Since the manufacturer is unable to determine all applications in which a part may e placed, it's the user's responsibility to determine the suitability of the part of its intended use. This is especially true where safety is a factor. Incorrect application or installation may result in property damage, bodily injury, or death. For technical assistance, please check with us.