Bearings

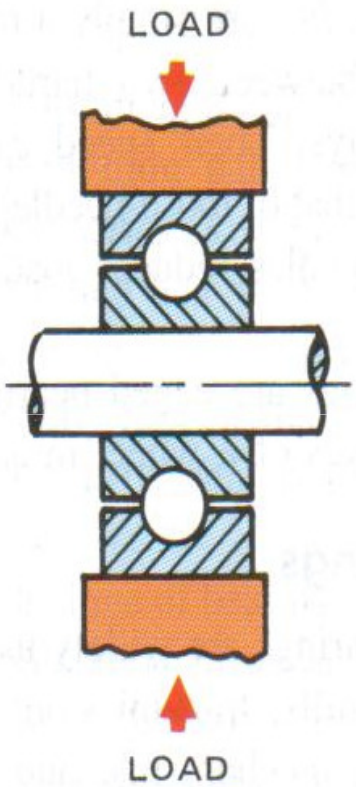
(YATAKLAR, KIZAKLAR)

BEARINGS

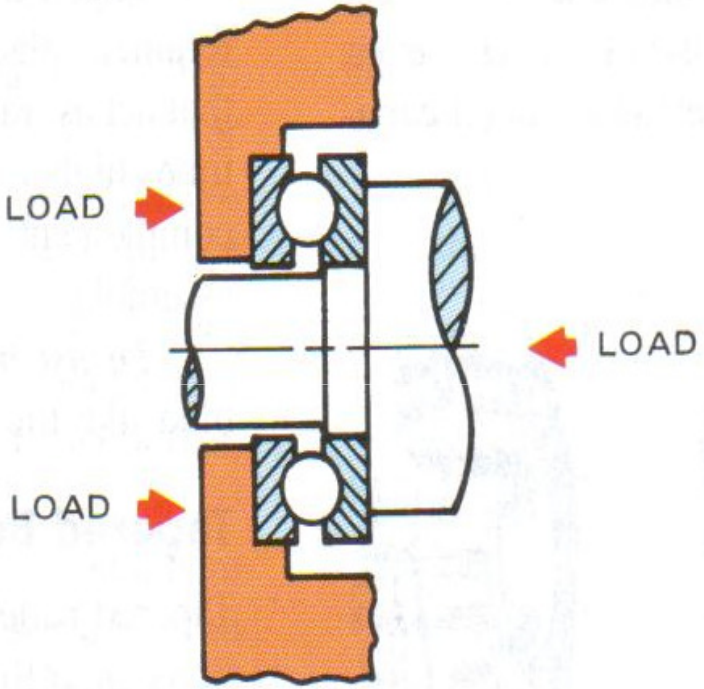
Bearings permit smooth, low-friction movement between two surfaces. The movement can be either rotary (a shaft rotating within a mount) or linear (one surface moving along another).

Bearings can employ either a sliding or a rolling action. Bearings based on rolling action are called **rolling-element bearings**. Those based on sliding action are called **plain bearings**.

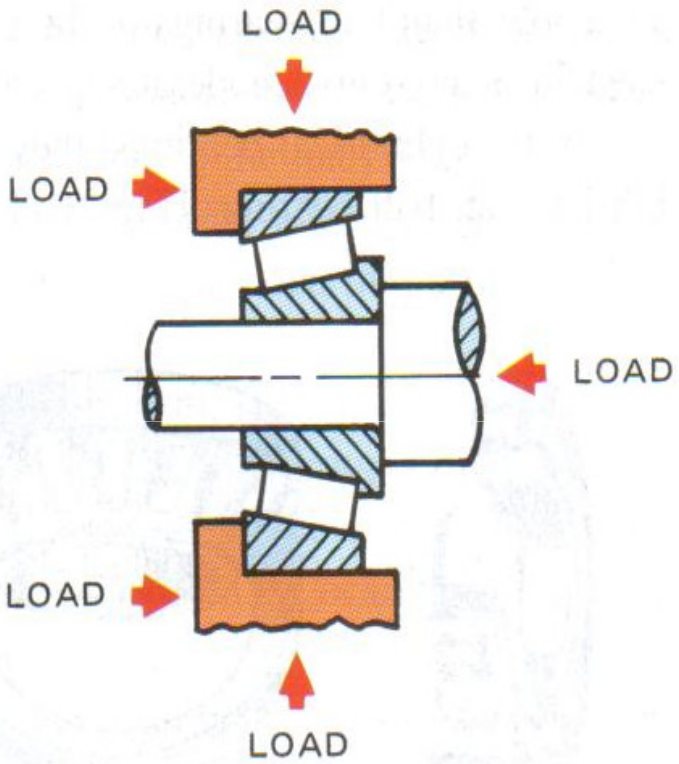
Types of bearing loads.



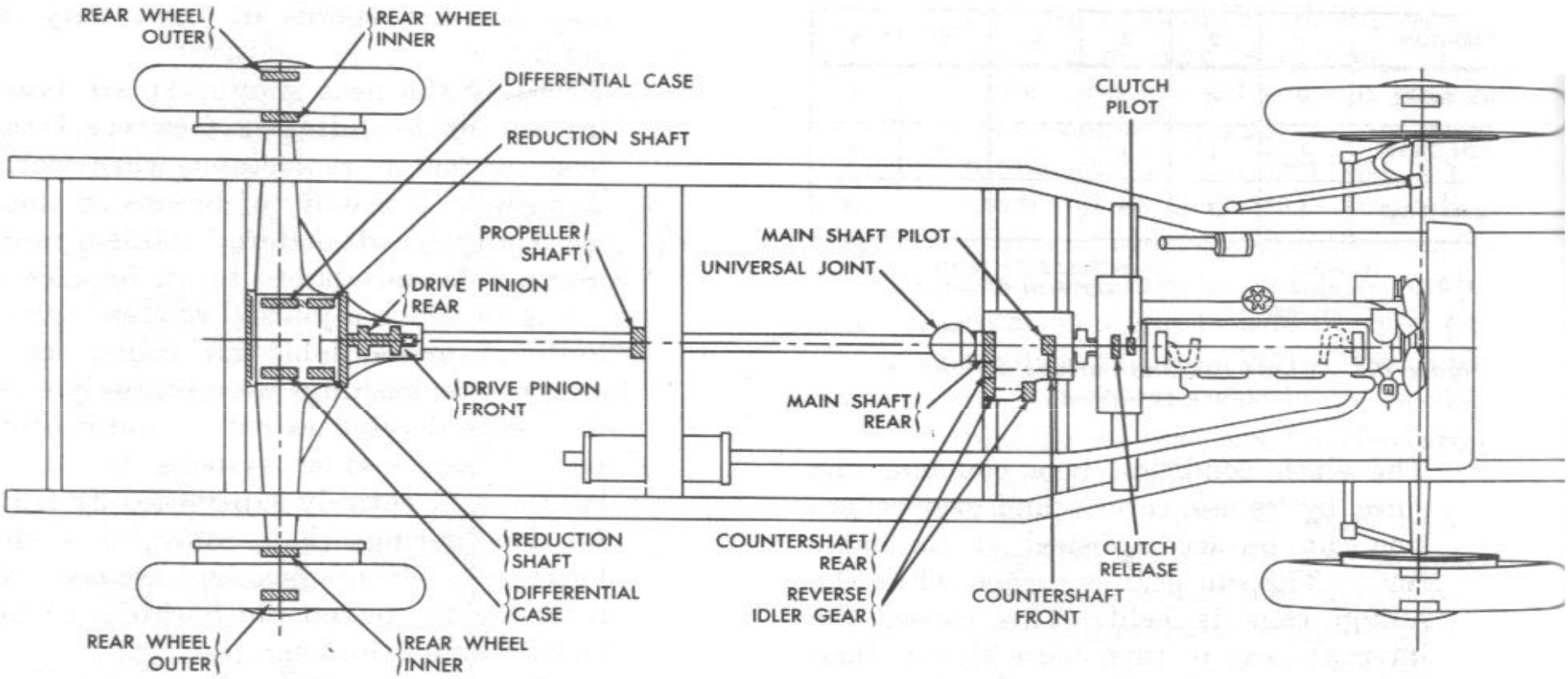
(A) RADIAL



(B) THRUST



(C) COMBINATION RADIAL AND THRUST



Locations of antifriction bearings in a truck power train.

Plain Bearings or Sleeve Bearings or Bushings

A plain bearing is any bearing that works by sliding action, with or without lubricant. This group encompasses essentially all types other than rolling-element bearings.

Plain bearings are often referred to as *sleeve bearings* or *thrust bearings*, terms that designate whether the bearing is loaded axially or radially.

Lubrication is critical to the operation of plain bearings, so their application and function are also often referred to according to the type of lubrication principle used. Thus, terms such as *hydrodynamic*, *fluid-film*, *hydrostatic*, *boundary-lubricated*, and *self-lubricated* are designations for particular types of plain bearings.

Although some materials have an inherent lubricity or can be lubricated by virtue of a film of slippery solid, most bearings operate with a fluid film—usually oil but sometimes a gas.

By far the largest number of bearings are oil-lubricated. The oil film can be maintained through pumping by a pressurization system, in which case the lubrication is termed **hydrostatic**. Or it can be maintained by a squeezing or wedging of lubricant produced by the rolling action of the bearing itself; this is termed **hydrodynamic** lubrication.

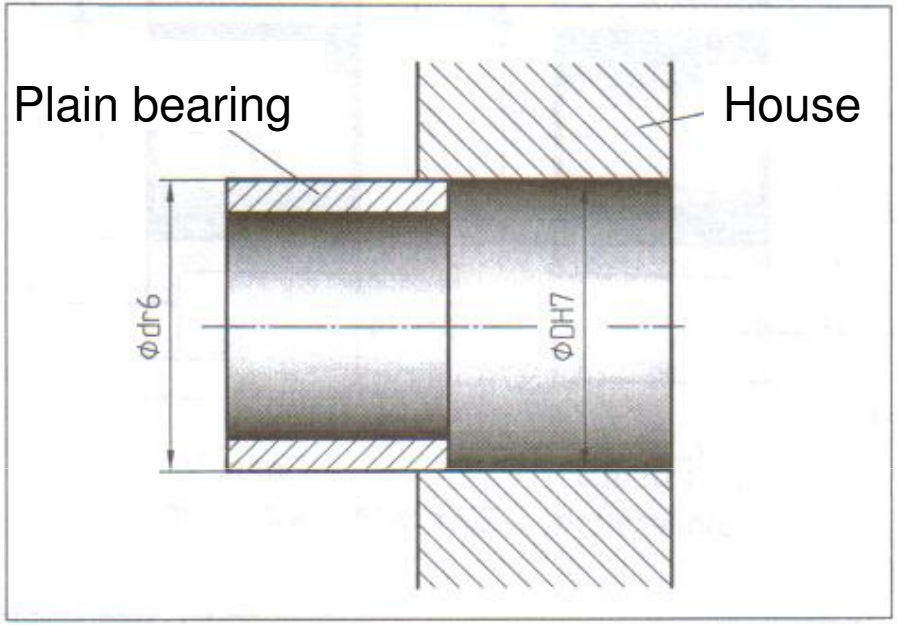
Bearing Types

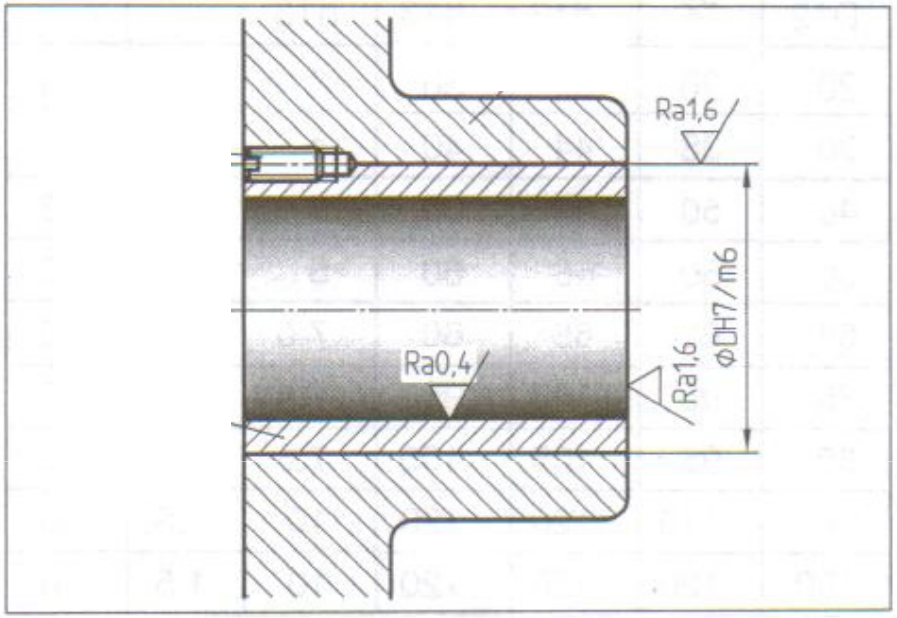
Journal or Sleeve Bearings There are cylindrical or ring-shaped bearings designed to carry radial loads
The terms *sleeve* and *journal* are used more or less synonymously since sleeve refers to the general configuration and journal pertains to any portion of a shaft supported by a bearing. In another sense, however, the term *journal* may be reserved for two-piece bearings used to support the journals of an engine crankshaft.

The simplest and most widely used types of sleeve bearings are cast-bronze and porous-bronze (powdered-metal) cylindrical bearings. Cast-bronze bearings are oil- or grease-lubricated. Porous bearings are impregnated with oil and often have an oil reservoir in the housing.

Plastic bearings are being used increasingly in place of metal. Originally, plastic was used only in small, lightly loaded bearings where cost savings was the primary objective. More recently, plastics are being used because of functional advantages, including resistance to abrasion, and because they are available in large sizes.

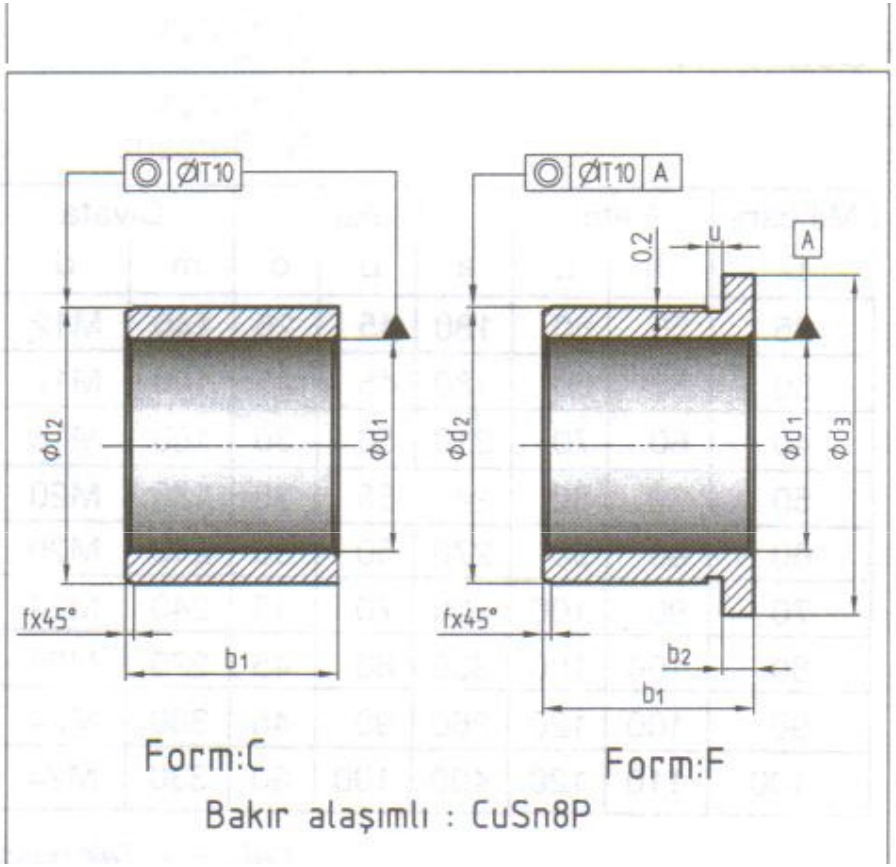
Thrust Bearings This type of bearing differs from a sleeve bearing in that loads are supported axially rather than radially


Plain bearing
House
Φdr6
ΦDH7


Ra1,6
Ra0,4
Ra1,6
ΦDH7/m6

Form G ve F DIN ISO 4379

d_1 E6	d_2 s6	d_3 d11	b_1 h13	b_2	f	u
20	26	32	20	3	0,5	1,5
30	38	44	30	4	0,5	2,0
40	50	58	40	5	0,8	2,0
50	60	68	50	5	0,8	2,0
65	80	88	60	7,5	1,0	2,0
75	90	100	70	7,5	1,0	3,0
80	95	105	80	7,5	1,5	3,0
90	110	120	80	10	1,0	3,0
100	120	130	100	10	1,0	3,0
120	140	150	120	10	1,0	3,0
140	160	170	150	10	2,0	4,0



Bakır alaşımlı : CuSn8P

Form S ve T DIN ISO 4379

d_1 G7	d_2 r6	d_3 js13	b_1 js13	b_2 js13	f	R
20	26	32	25	3	0,4	1,6
30	38	46	30	4	0,6	0,8
40	50	60	50	5	0,8	0,8
45	55	-	55	-	0,7	-
50	60	-	70	-	0,7	-
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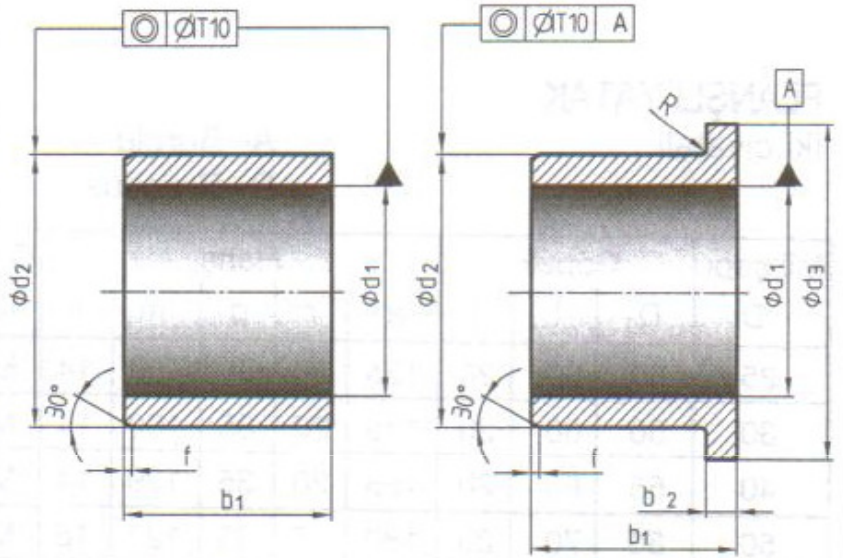
60	72	-	70	-	0,8	-

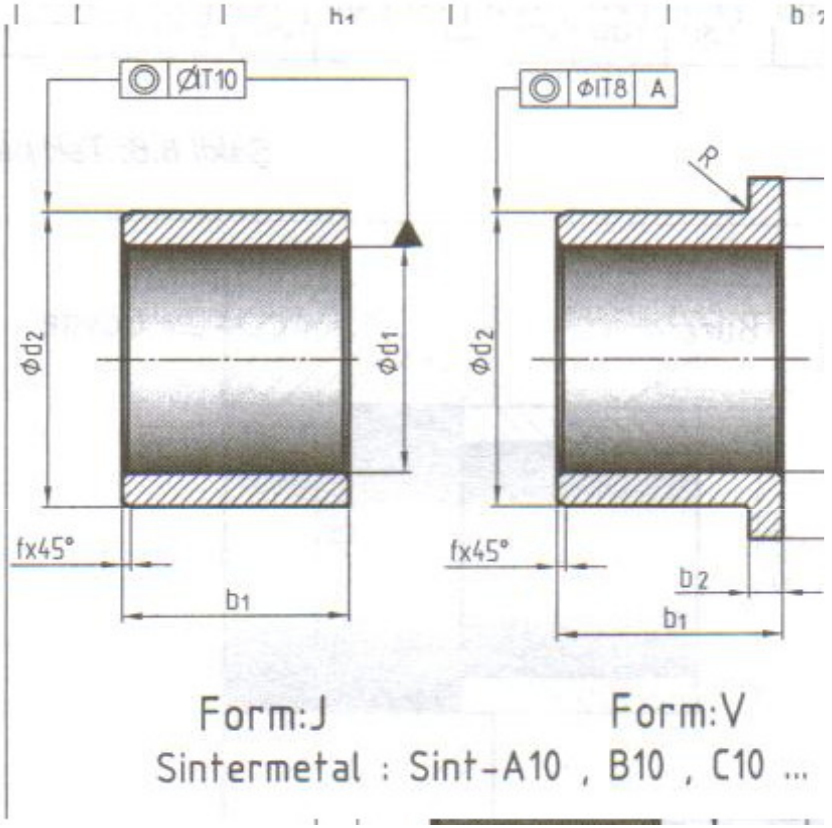


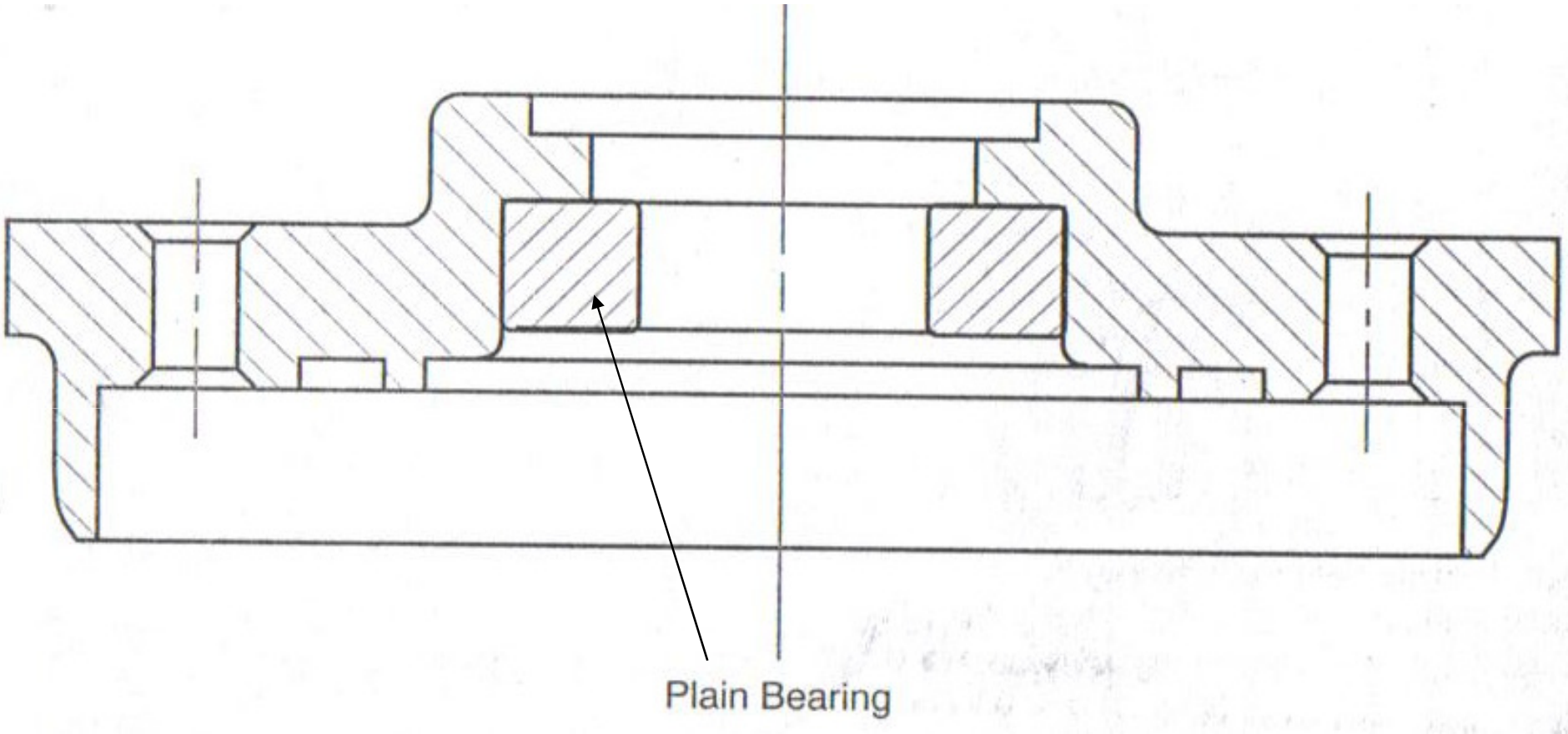
Form:S Form:T

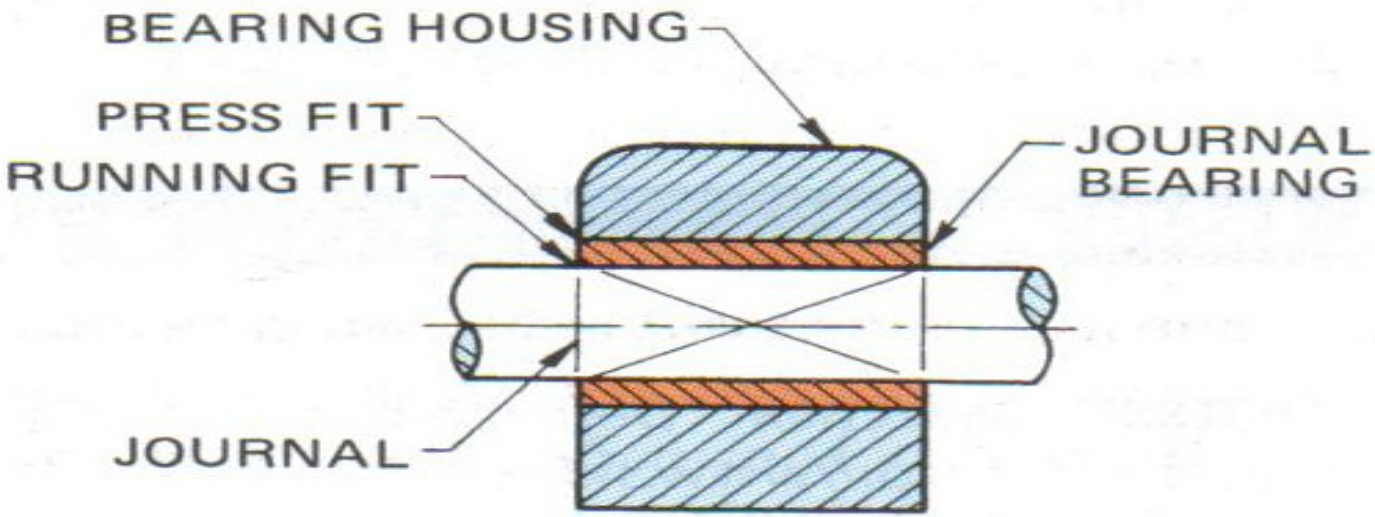
Termoplastik : PA,PE,POM

Form J ve V DIN ISO 4379

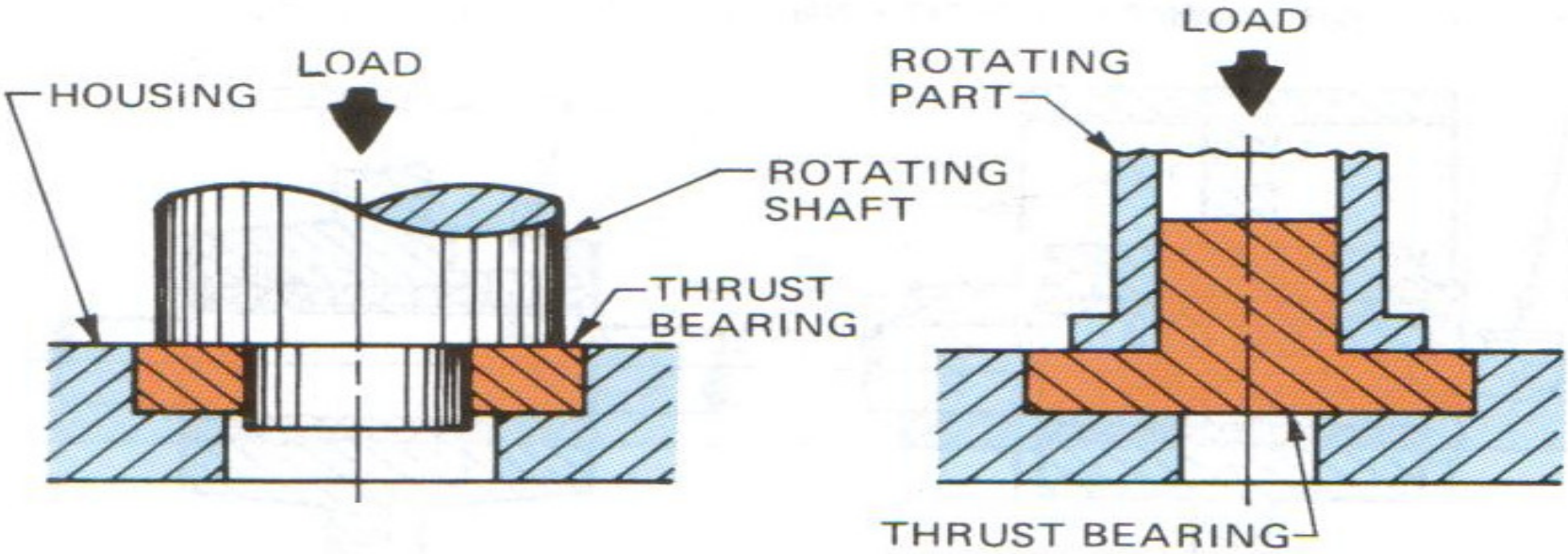
d_1 D12	d_2	d_3 d13	b_1 h13	b_2 h13	f	R
20	26	32	30	3	0,8	0,5
30	38	44	40	4	0,8	0,5
40	50	58	60	5	1,2	0,8
50	60	68	60	5	1,2	0,8
65	80	88	80	7,5	1,5	1,0
75	90	100	90	7,5	1,5	1,0
80	95	105	100	7,5	1,5	1,0
90	110	120	120	10	1,5	1,0
100	120	130	120	10	1,5	1,0




Plain Bearing



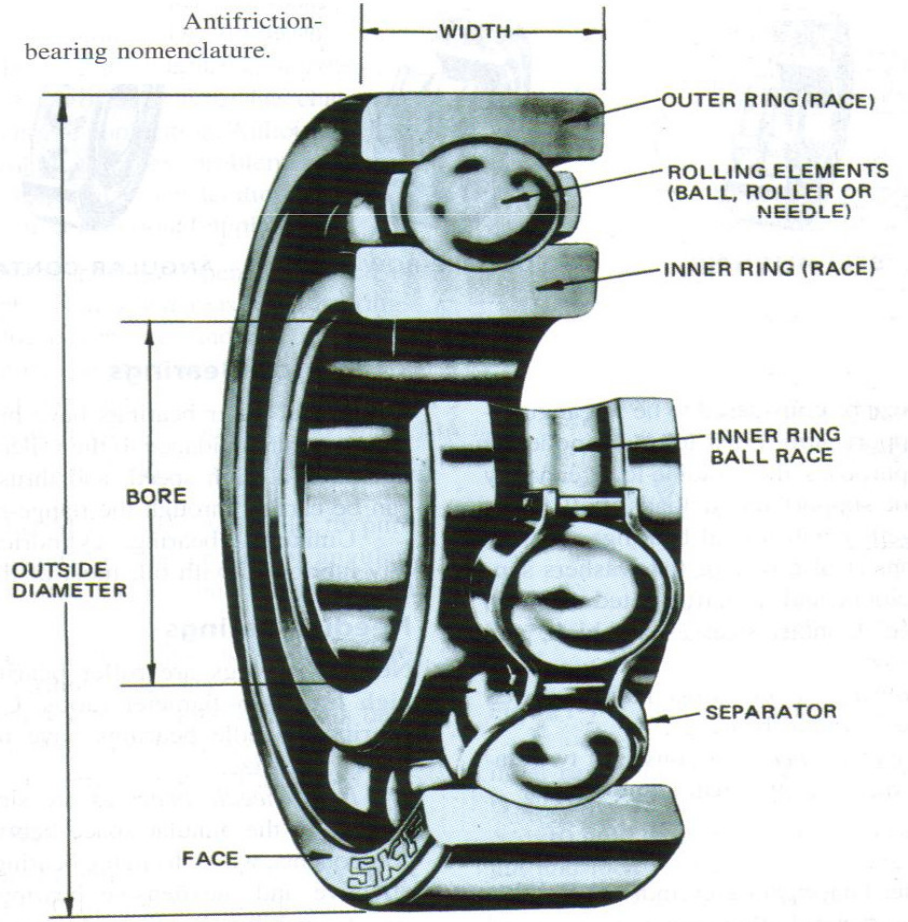
Journal or sleeve bearing.



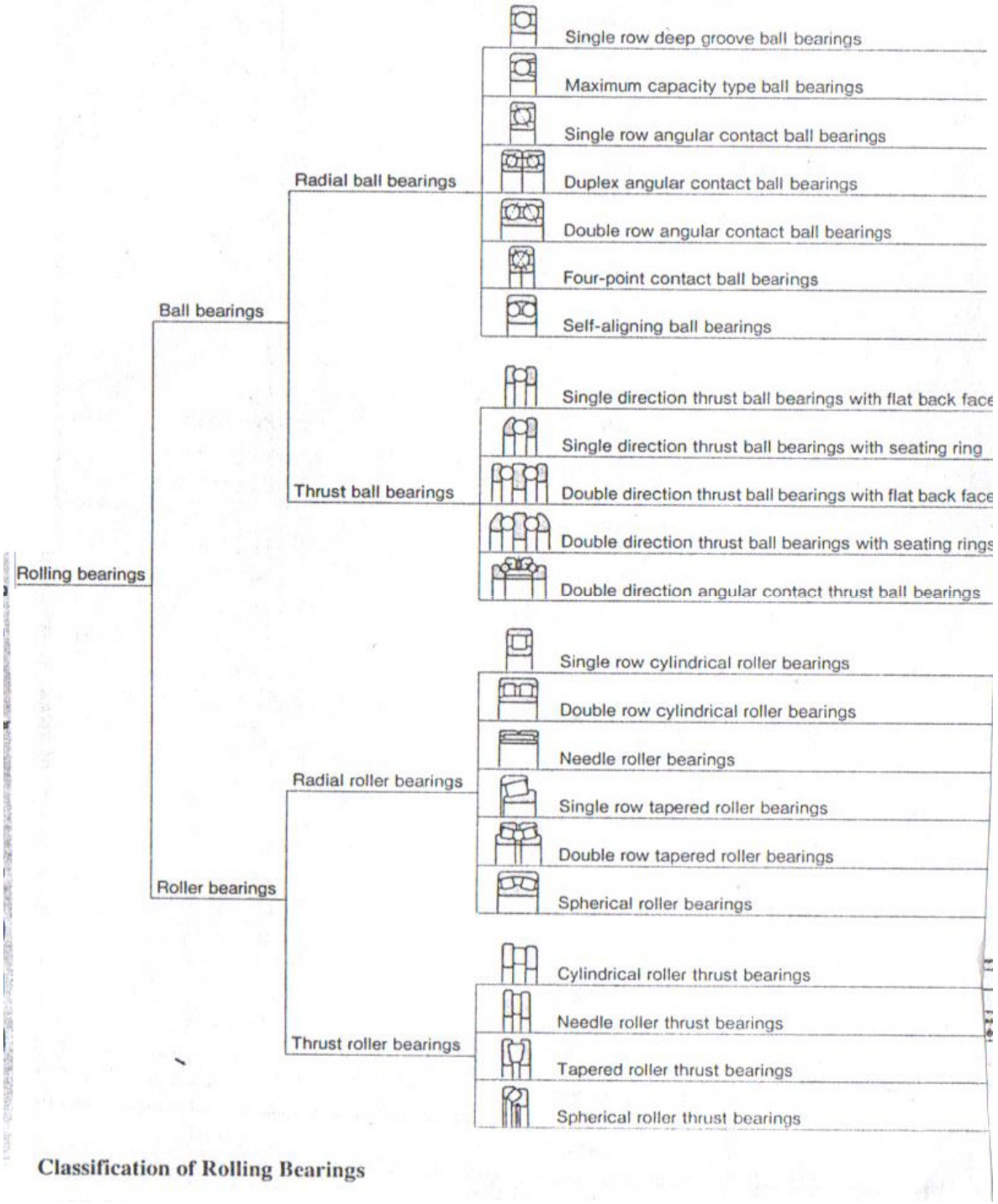
Thrust bearings.

ANTIFRICTION BEARINGS

Ball, roller, and needle bearings are classified as **antifriction bearings** since friction has been reduced to a minimum. They may be divided into two main groups: radial bearings and thrust bearings. Except for special designs, ball and roller bearings consist of two rings, a set of rolling elements, and a cage. The cage separates the rolling elements and spaces them evenly around the periphery (circumference of the circle).



Antifriction-bearing nomenclature.



Classification of Rolling Bearings

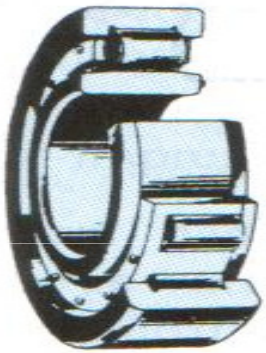
Ball Bearings

Ball bearings fall roughly into three classes: radial, thrust, and angular-contact. *Angular-contact bearings* are used for combined radial and thrust loads and where precise shaft location is needed. Uses of the other two types are described by their names: *radial bearings* for radial loads and *thrust bearings* for thrust loads

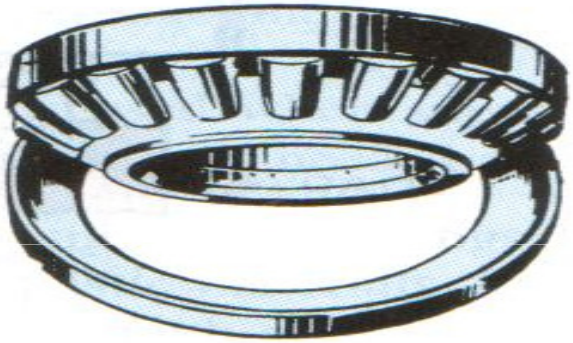
Ball bearings.

Roller Bearings

The principal types of roller bearings are cylindrical, needle, tapered, and spherical. In general, they have higher load capacities than ball bearings of the same size and are widely used in heavy-duty, moderate-speed applications. However, except for cylindrical bearings, they have lower speed capabilities than ball bearings

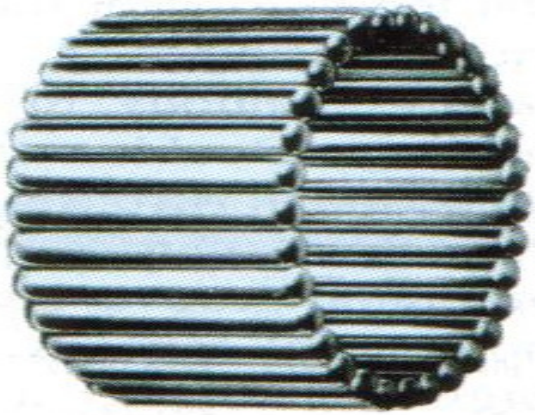


(A) CYLINDRICAL

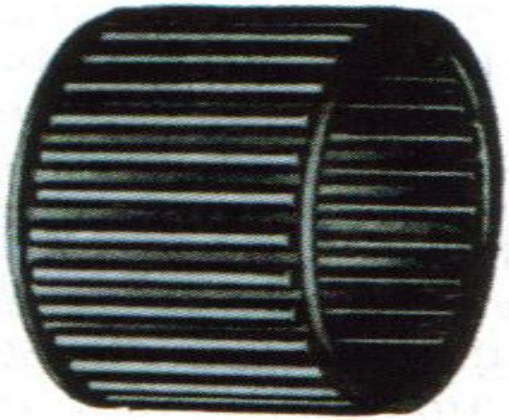


(B) TAPERED

(C) SPHERICAL

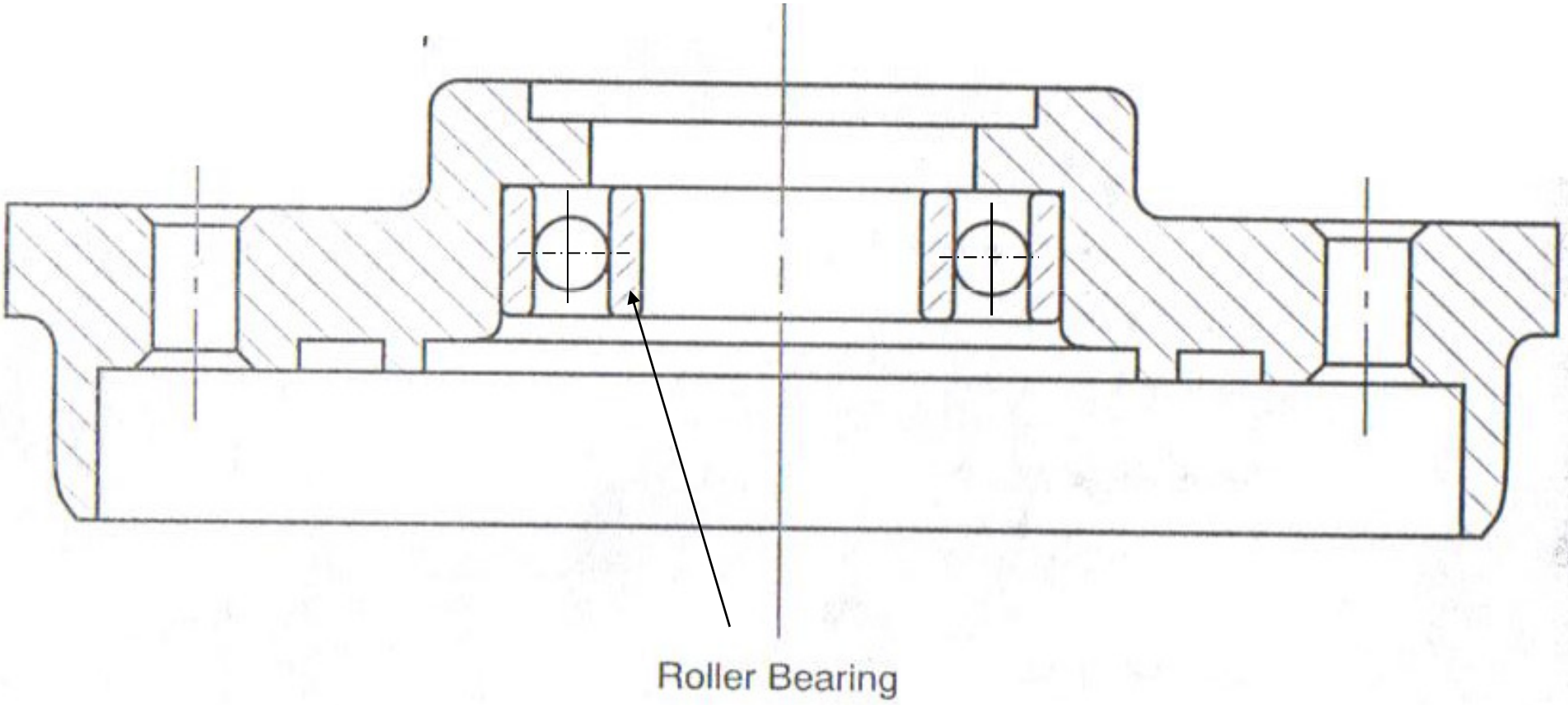


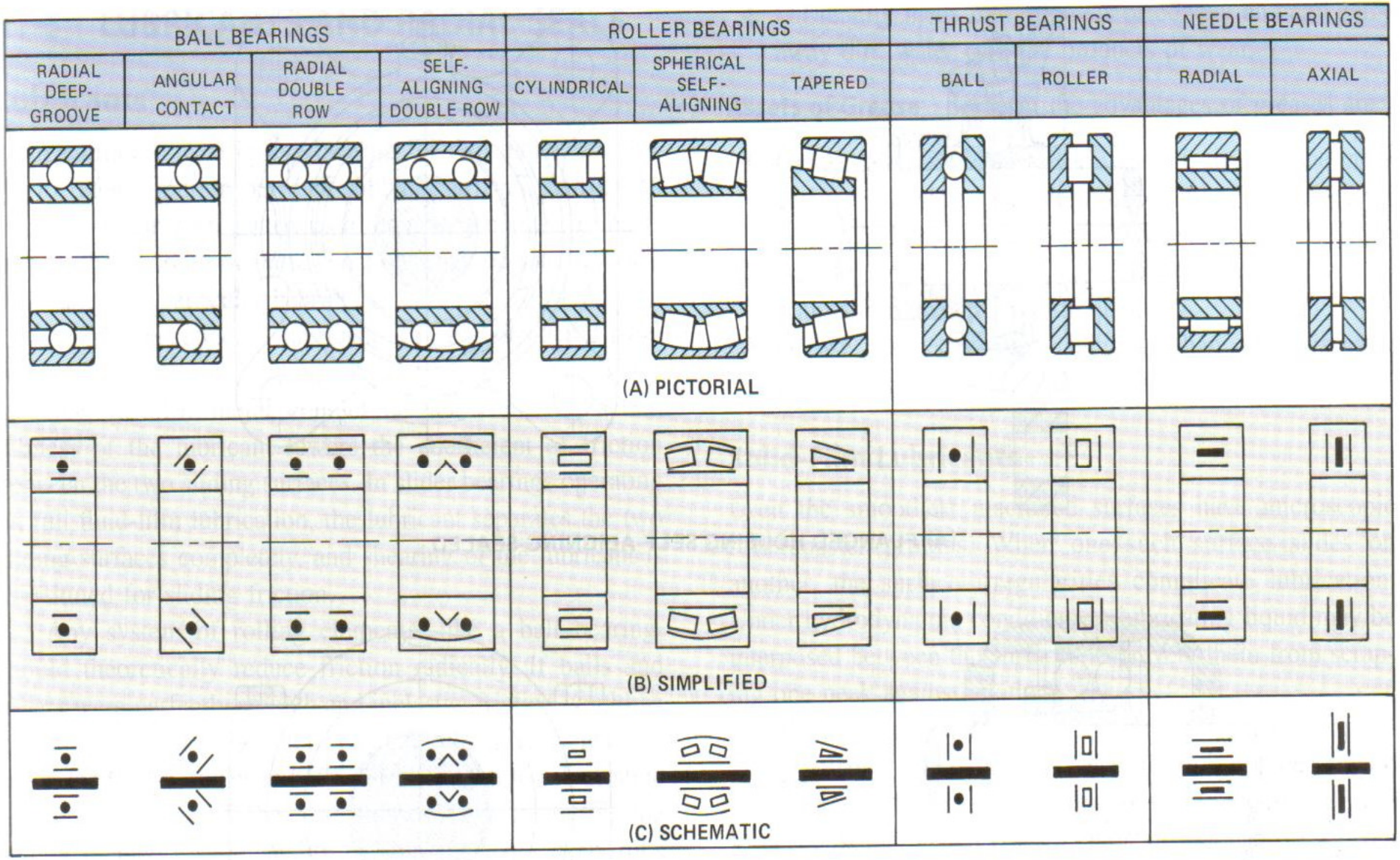
LOOSE



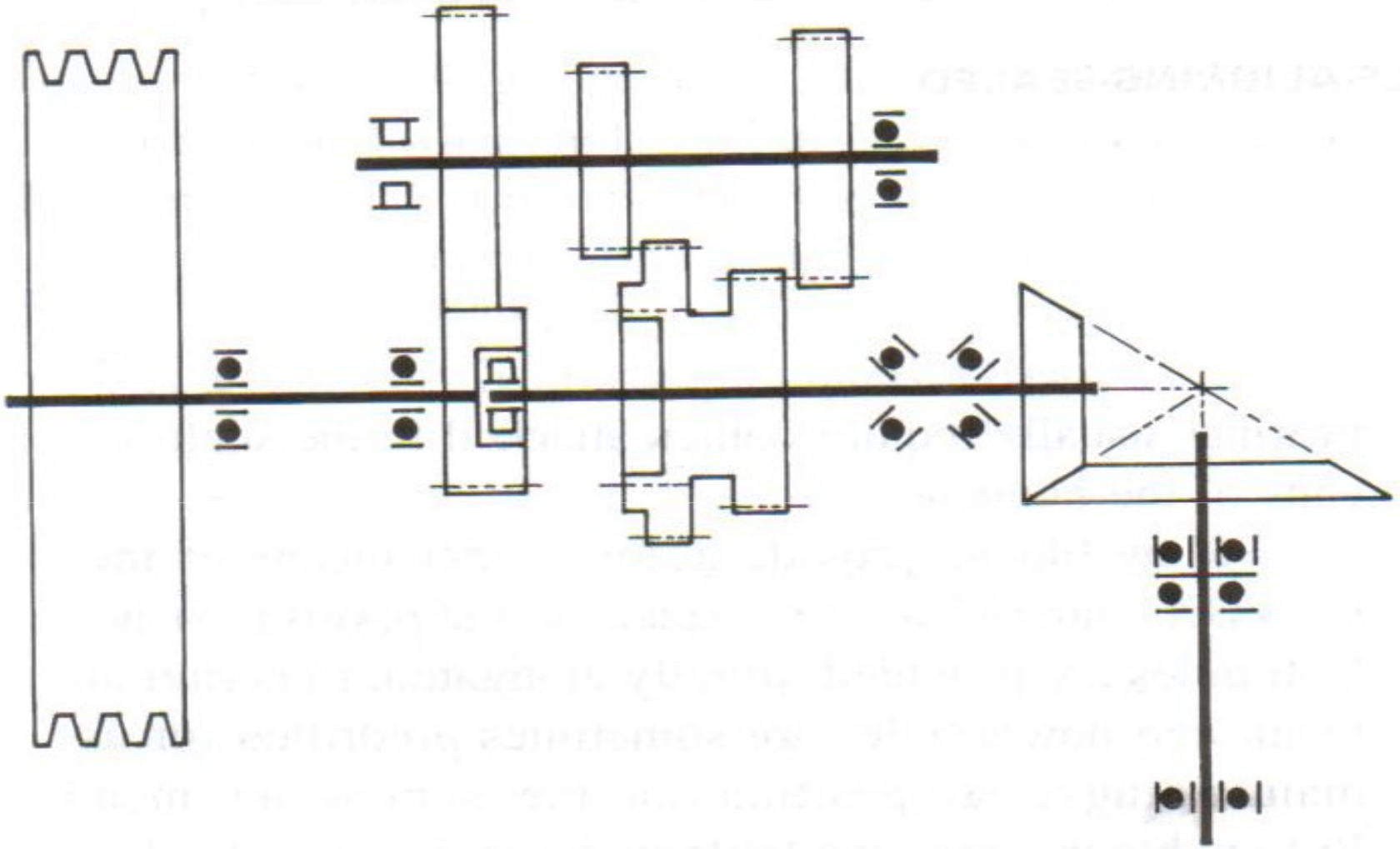
CAGED

(D) NEEDLE

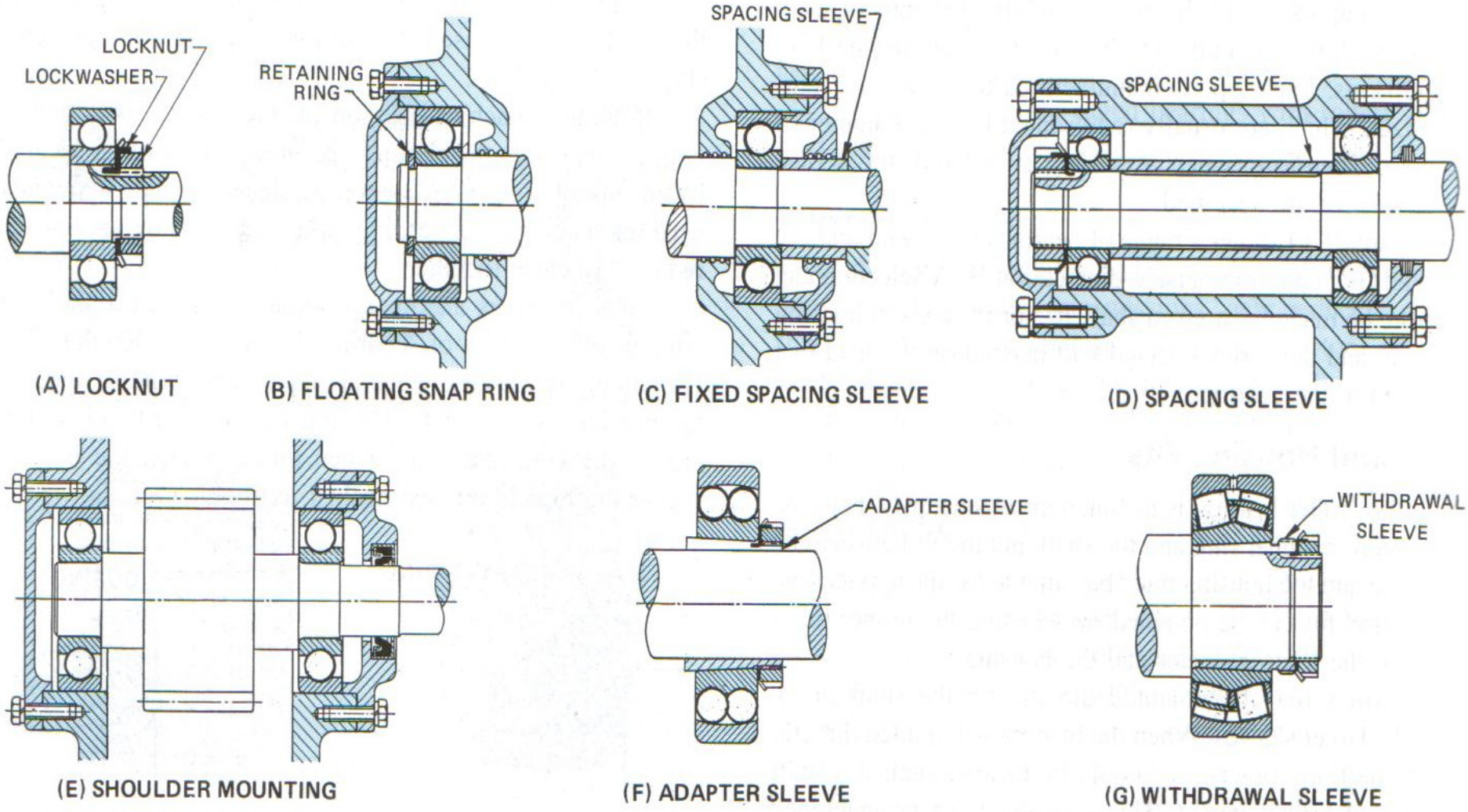

Roller Bearing



Representation of bearings on drawings.

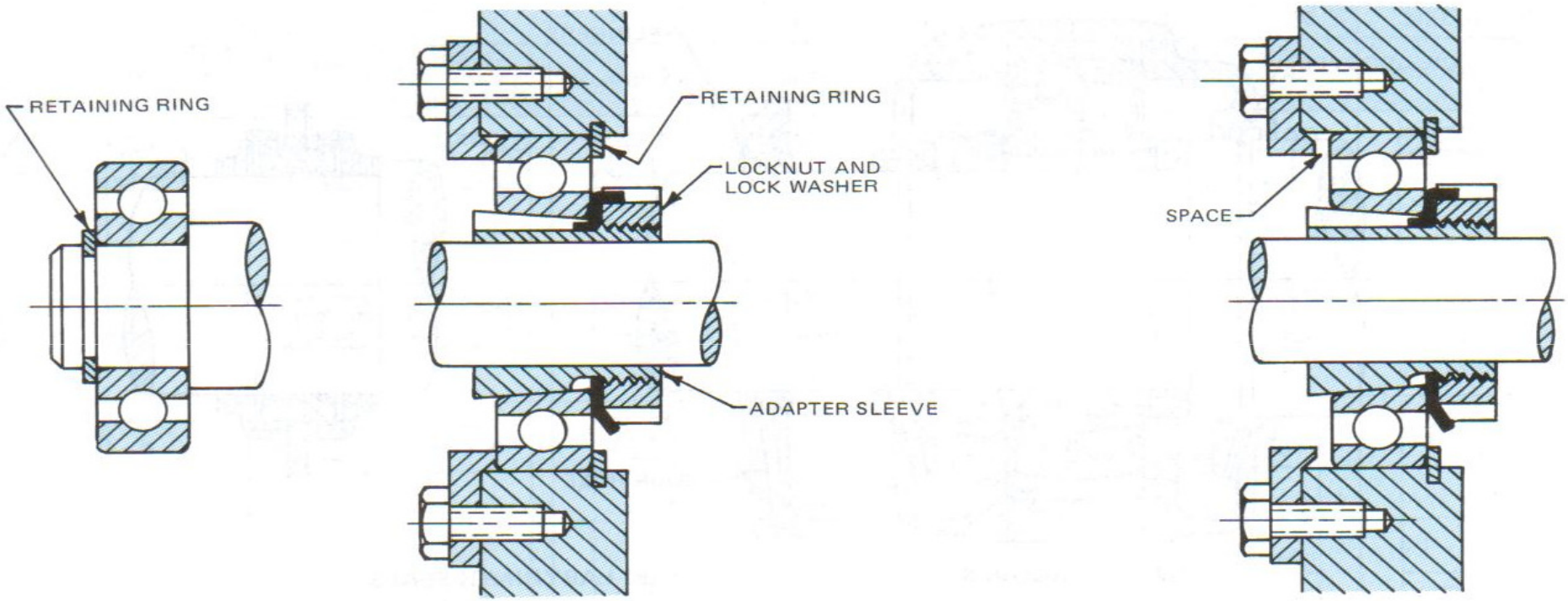


Schematic representation of bearings.



Axial mounting of inner rings.

To hold the bearing inner ring axially on the shaft, a locknut and lockwasher are commonly used
Not only is this method effective and convenient, but nuts and washers specially made for the purpose are also readily obtainable. A tab in the bore of the lockwasher engages a slot in the shaft, and one of the many tabs on the periphery of the washer is bent over into one of the slots in the nut OD.



(A) FIXED

Outer ring mountings.

(B) FLOATING

Locking devices.

(A) LOCKWASHER AND LOCKNUT

(B) ADAPTER SLEEVE

(C) WITHDRAWAL SLEEVE

On long standard shafting it is impractical to apply bearings, with an interference fit, directly on the shaft. Therefore, they are applied with tapered adapter sleeves. The outer surface of the sleeve is tapered to match the tapered bore of the bearing inner ring. This will provide the required tight fit between the inner ring and the shaft. The adapter sleeve is slotted to permit easy contraction and is threaded at the small end to fit a locknut. When the sleeve is drawn up tight between the bearing and the shaft, a press fit is provided at both the shaft and the inner ring.

Bearing Selection

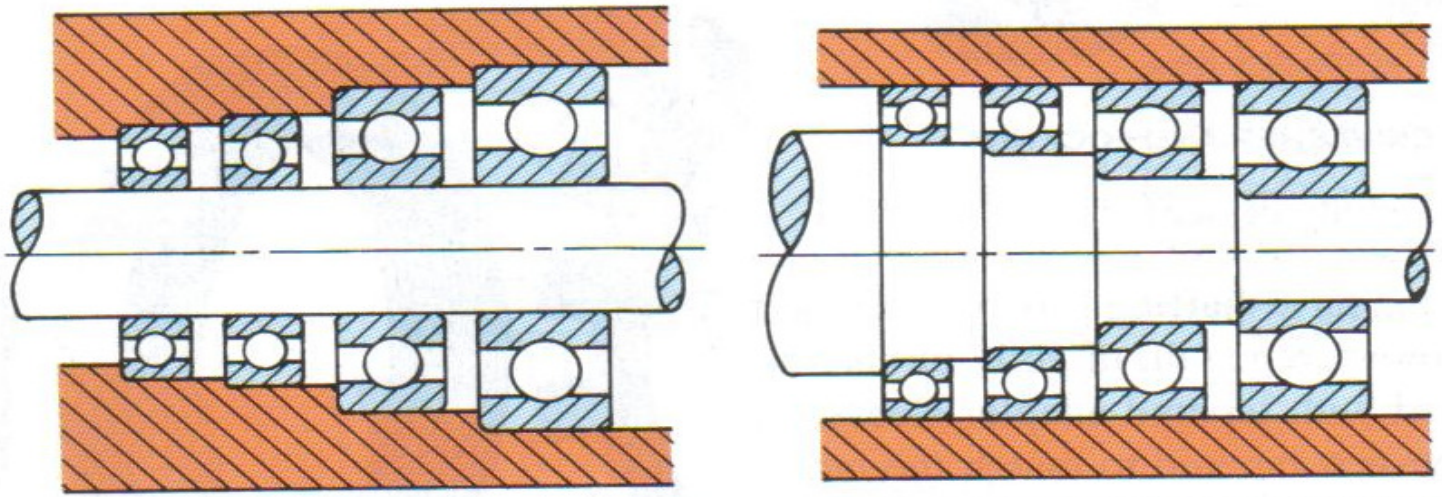
Machine designers have a large variety of bearing types and sizes from which to choose. Each of these types has characteristics that make it best for a certain application. Although selection may sometimes present a complex problem requiring considerable experience, the following considerations are listed to serve as a general guide for conventional applications.

1. Ball bearings are normally the less expensive choice in the smaller sizes and lighter loads, whereas roller bearings are less expensive for the larger sizes and heavier loads.
2. Roller bearings are more satisfactory under shock or impact loading than ball bearings.
3. If there is misalignment between housing and shaft, either a self-aligning ball or a spherical roller bearing should be used.
4. Ball thrust bearings should be subjected only to pure thrust loads. At high speeds, a deep-groove or angular-contact ball bearing will usually be a better choice even for pure thrust loads.
5. Self-aligning ball bearings and cylindrical roller bearings have very low friction coefficients.
6. Deep-groove ball bearings are available with seals built into the bearings so that the bearing can be prelubricated and thus operate for long periods without attention.

Shaft and Housing Fits

If a ball or roller bearing is to function satisfactorily, both the fit between the inner ring and the shaft and the fit between the outer ring and the housing must be suitable for the application. The desired fits can be obtained by selecting the proper tolerances for the shaft diameter and the housing bore.

Bearings may be mounted directly on the shaft or on tapered adapter sleeves. When the bearing is mounted directly on the shaft, the inner ring should be located against a shaft shoulder of proper height. This shoulder must be machined square with the bearing seat, and a shaft fillet should be used.



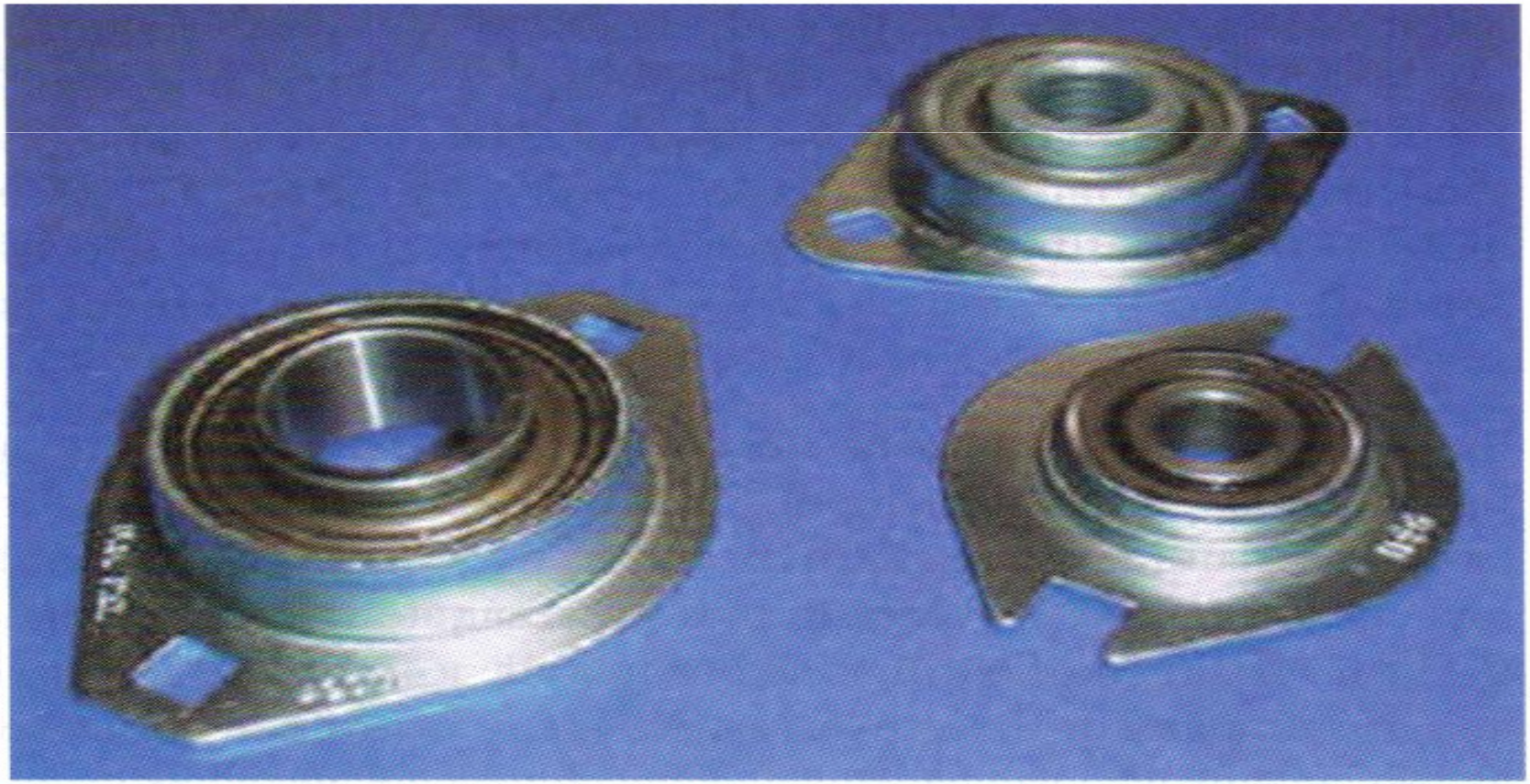
(A) COMMON BORE DIAMETER

(B) COMMON OUTSIDE DIAMETER

Standard bearing sizes.

PREMOUNTED BEARINGS

Premounted bearing units consist of a bearing element and a housing, usually assembled to permit convenient adaptation to a machinery frame. All components are incorporated within a single unit to ensure proper protection, lubrication, and operation of the bearing. Both plain and rolling-element bearing units are available in a variety of housing designs and for a wide range of shaft sizes,



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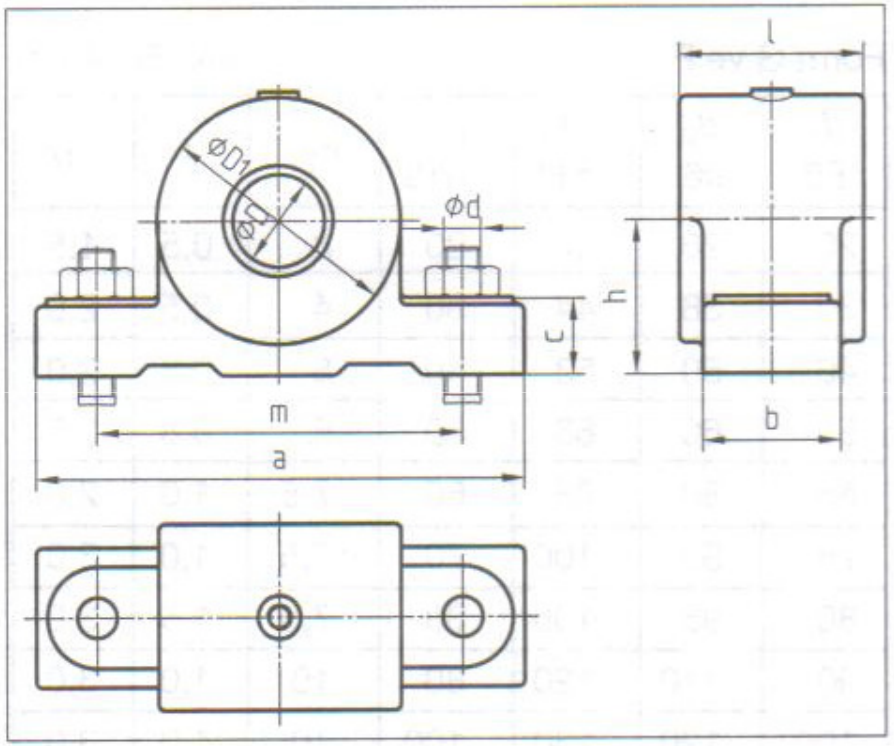
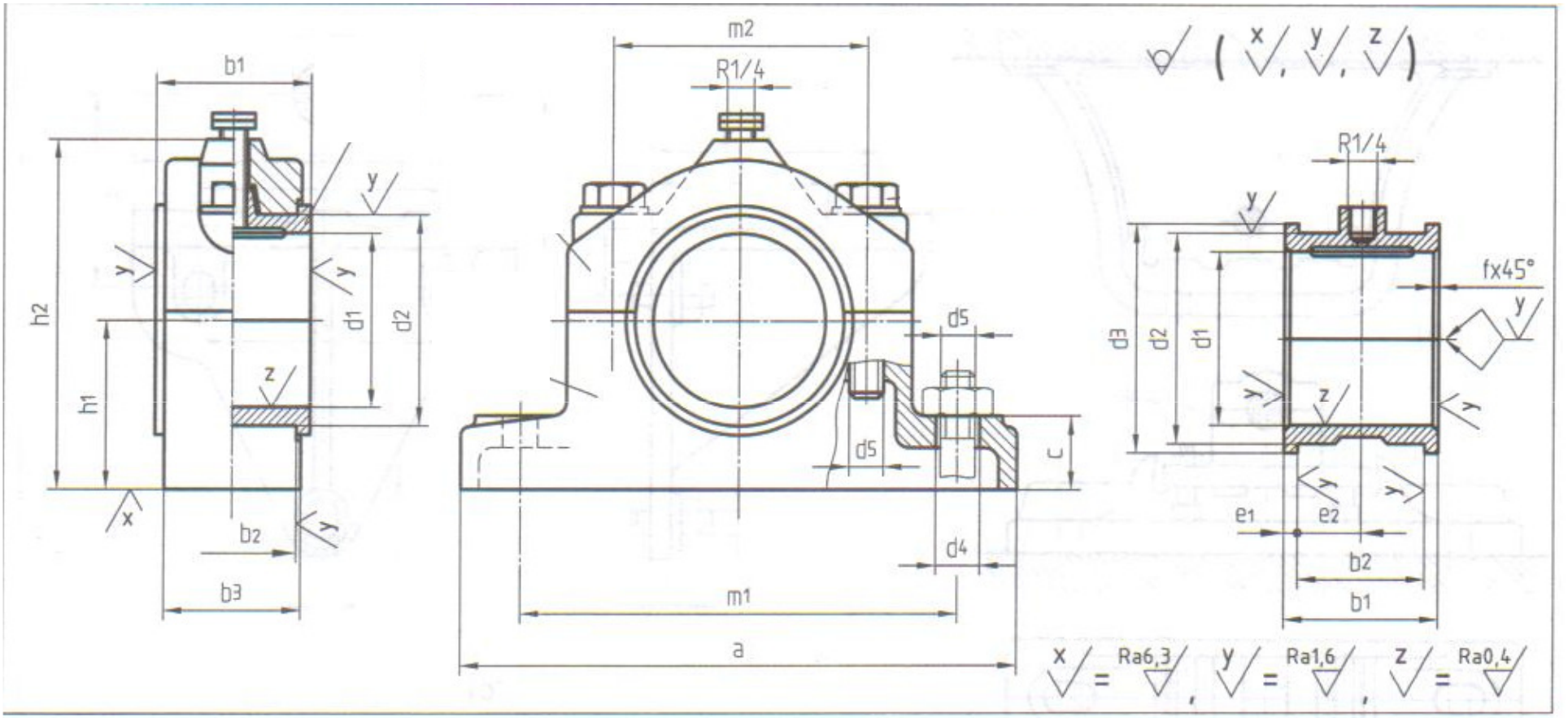
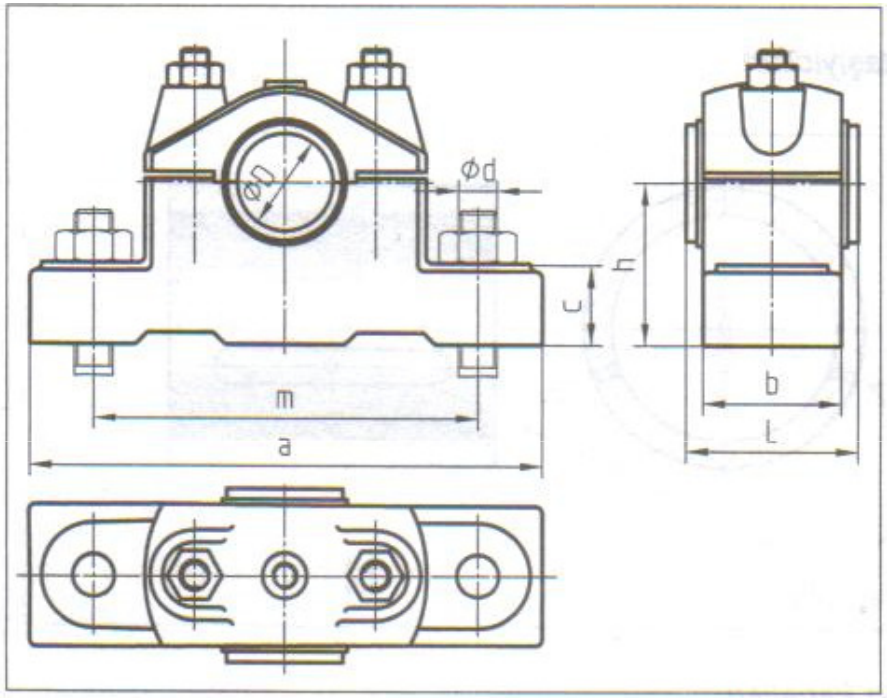
30	50	60	180	45	25	140	M12
40	60	70	210	50	30	160	M16
50	70	80	240	55	35	180	M20
60	80	90	270	60	35	210	M20
70	90	100	200	70	45	240	M24
80	100	100	330	80	45	270	M24
90	100	120	360	90	45	300	M24
100	110	120	400	100	50	330	M24



DIN 502-504


b1
h2
h1
d1
d2
b2
b3
x
y
z
m2
R1/4
d5
c
d4
m1
a
fx45°
d3
e1
e2
x = Ra6,3 , y = Ra1,6 , z = Ra0,4



D	h	L	D1	a	b	c	m	d
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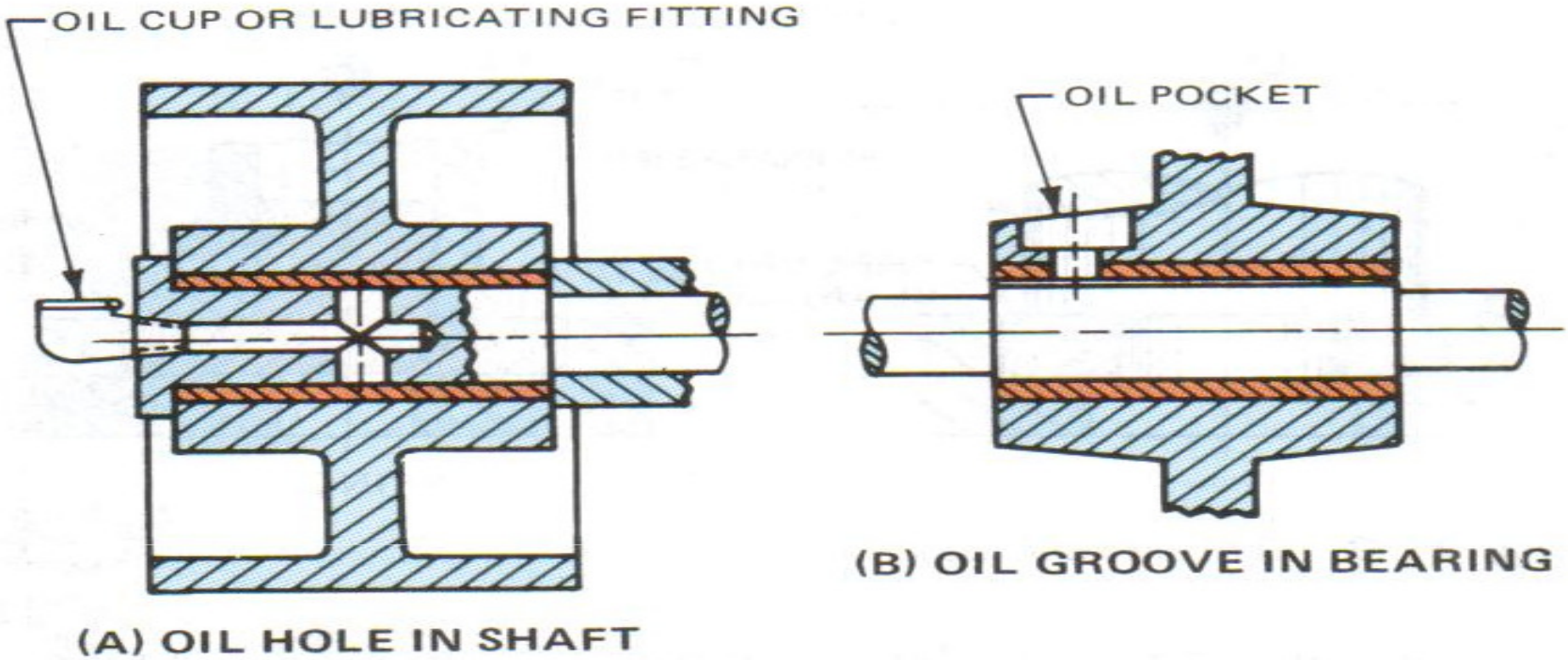
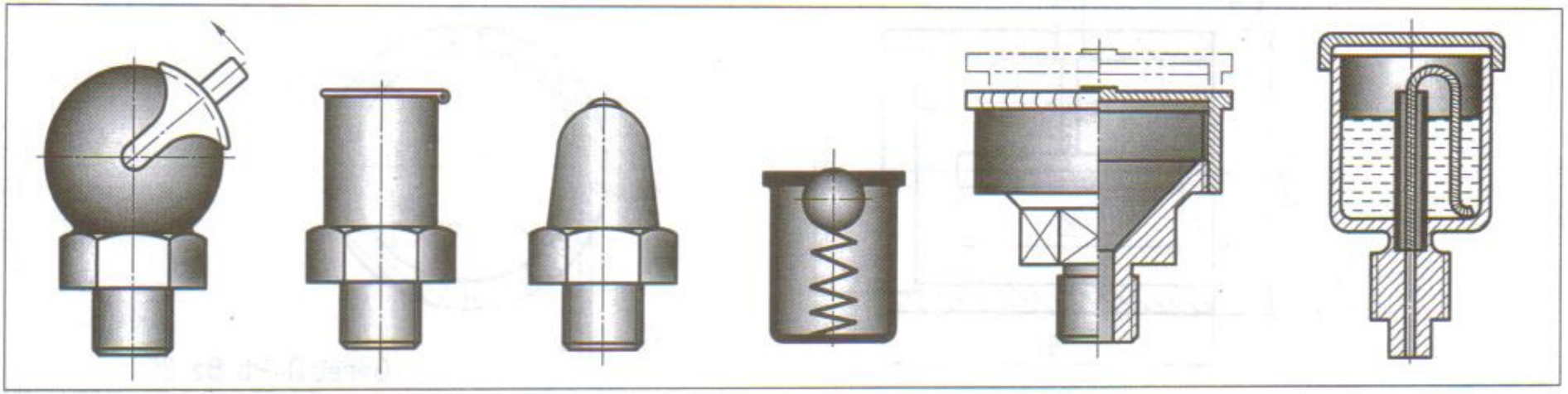
30	50	60	80	160	45	25	120	M12
40	60	70	90	190	50	30	140	M16
50	70	80	100	220	55	35	160	M20
60	80	90	120	240	60	35	180	M20
70	90	100	140	270	70	45	210	M22
80	100	100	160	300	80	45	240	M22
90	100	120	180	330	90	45	270	M22
100	110	120	200	360	100	50	300	M24

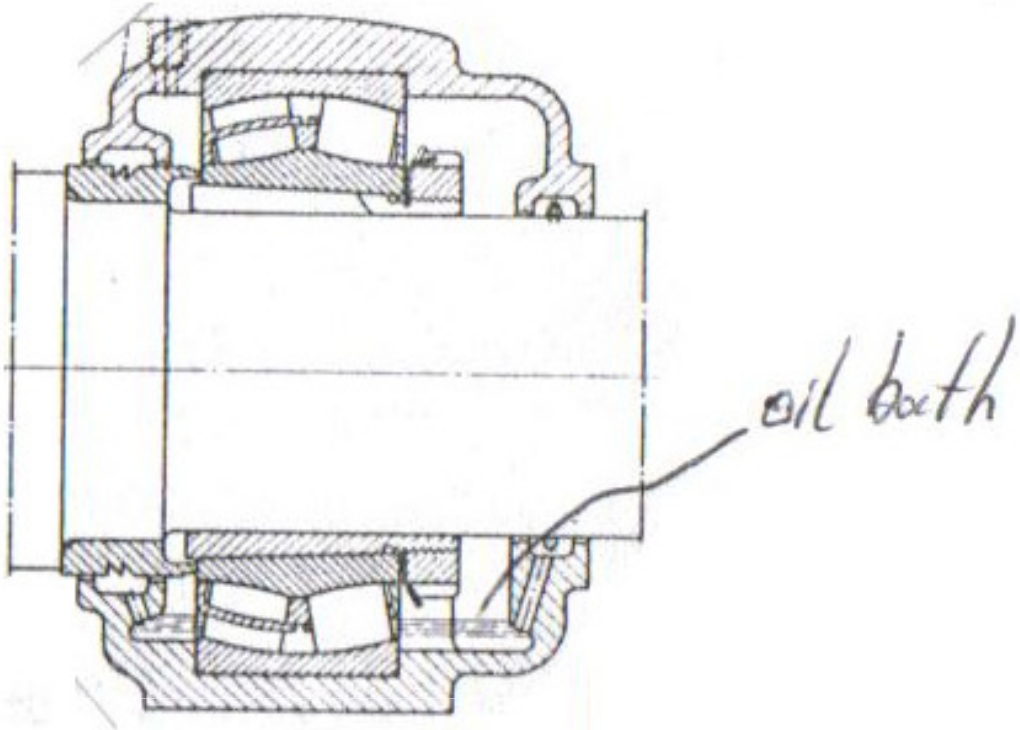
DIN 505

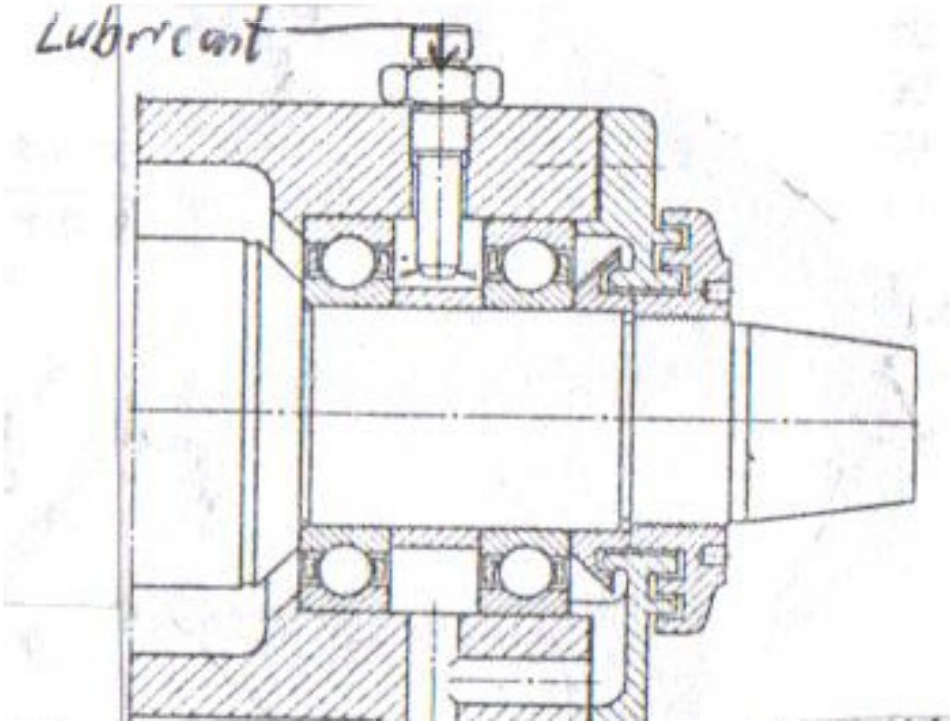
Lubricators

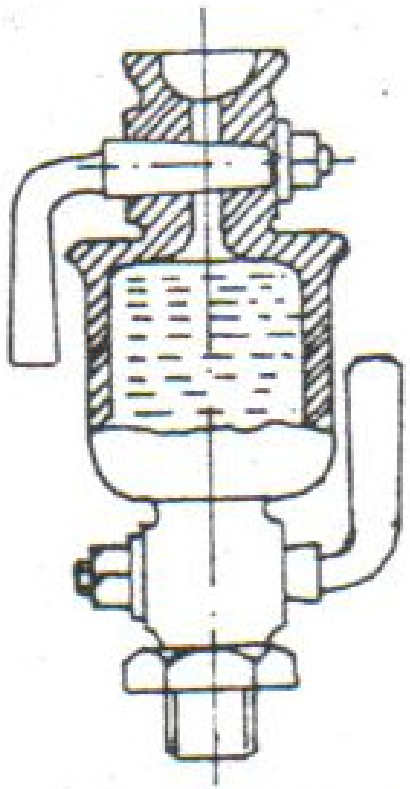


Common methods of lubricating plain bearings.



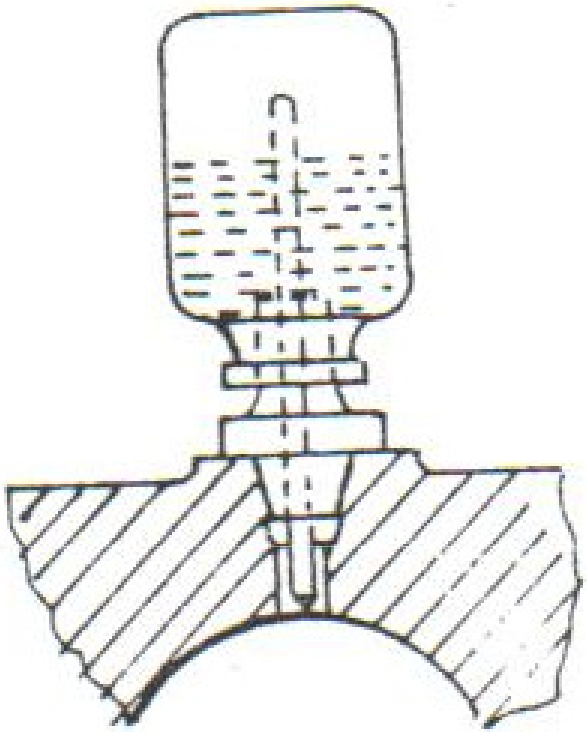

oil bath


Lubricant



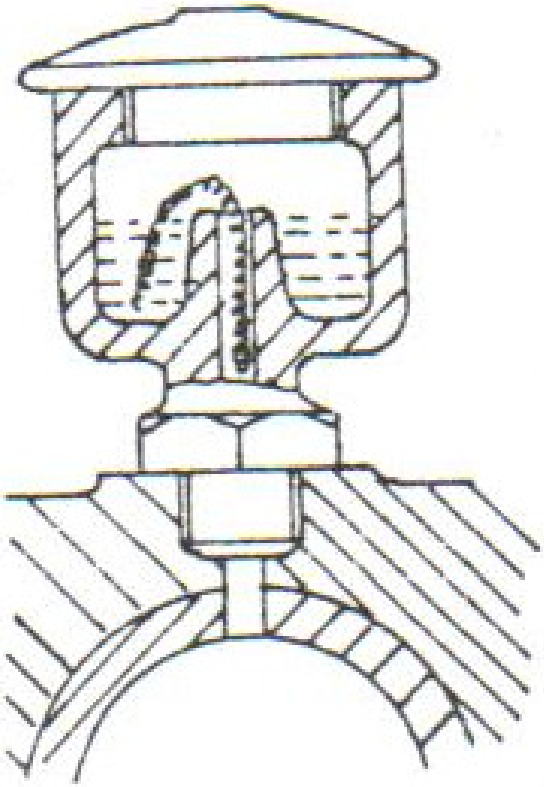
CYLINDER OIL CUP

Lower cock admits oil to the cylinder. The steam carries it to the piston and valve.



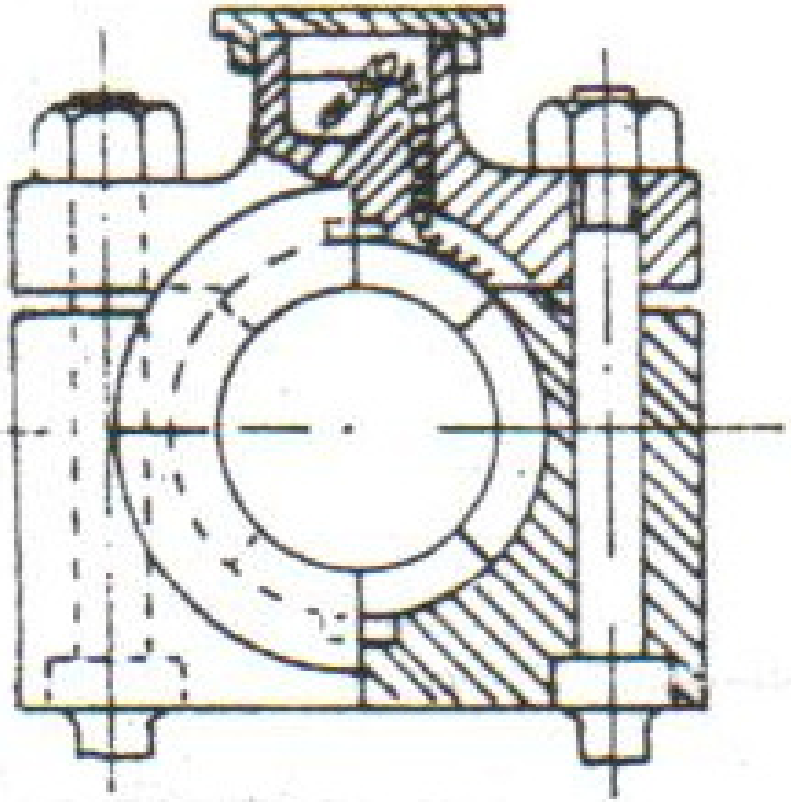
NEEDLE LUBRICATOR

The turning shaft vibrates the needle causing oil to descend.



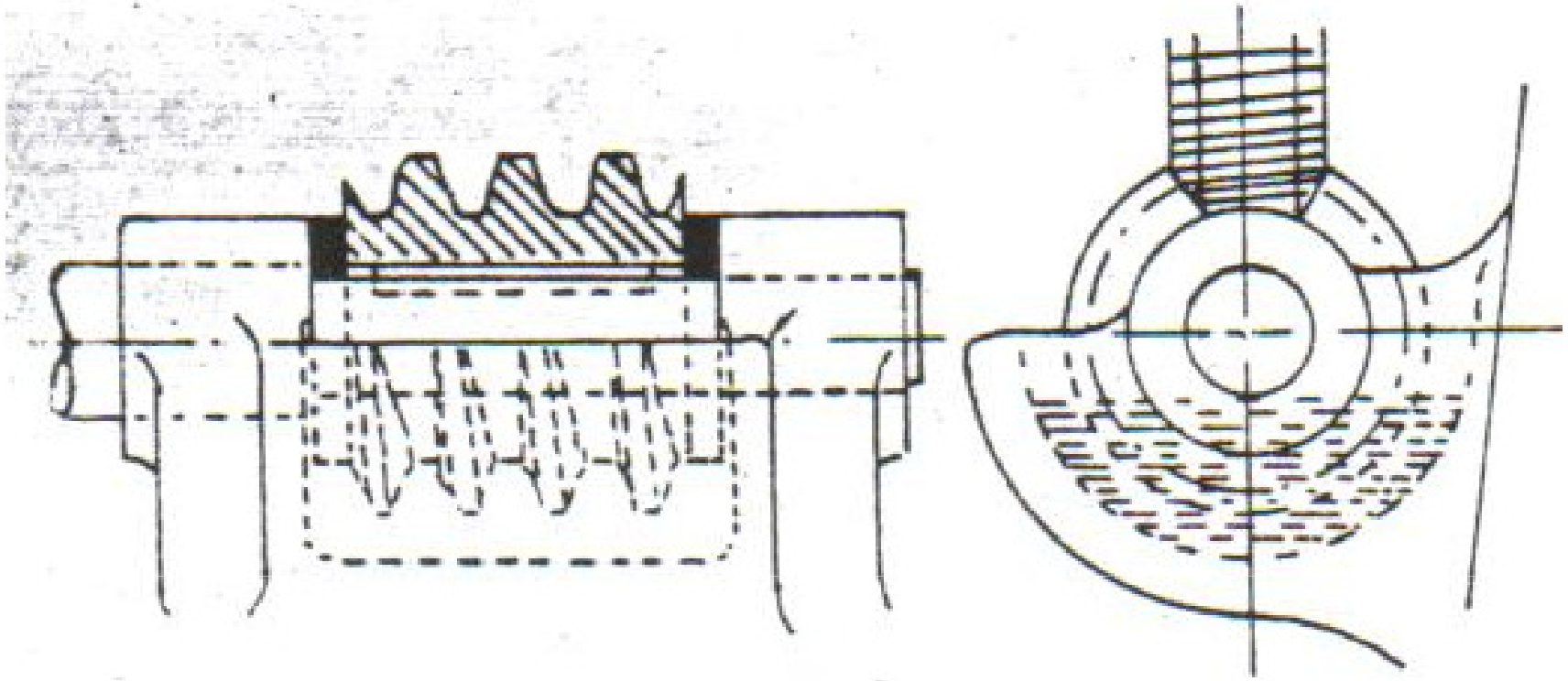
SYPHON LUBRICATOR

The lubricant is syphoned on to the bearing.



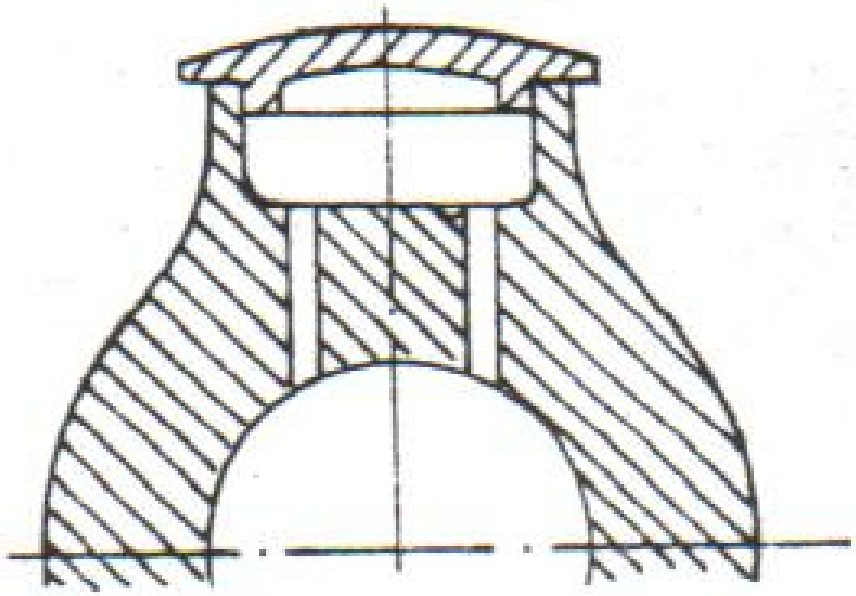
PAD LUBRICATION

Pads of wool replace part of the brass bushes.



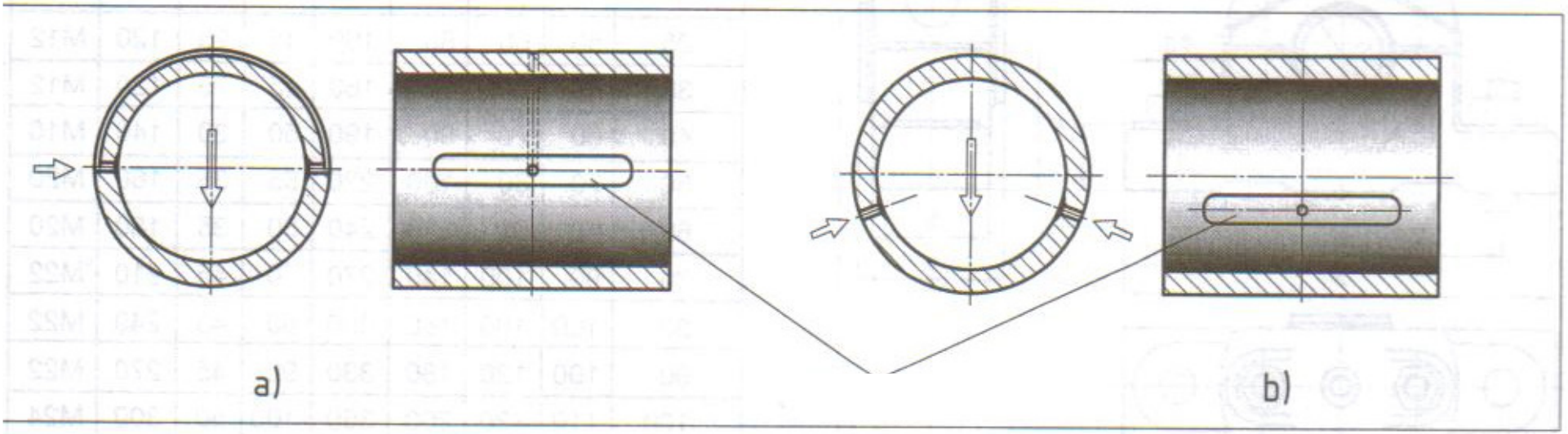
BATH LUBRICATOR

Used with a large worm.

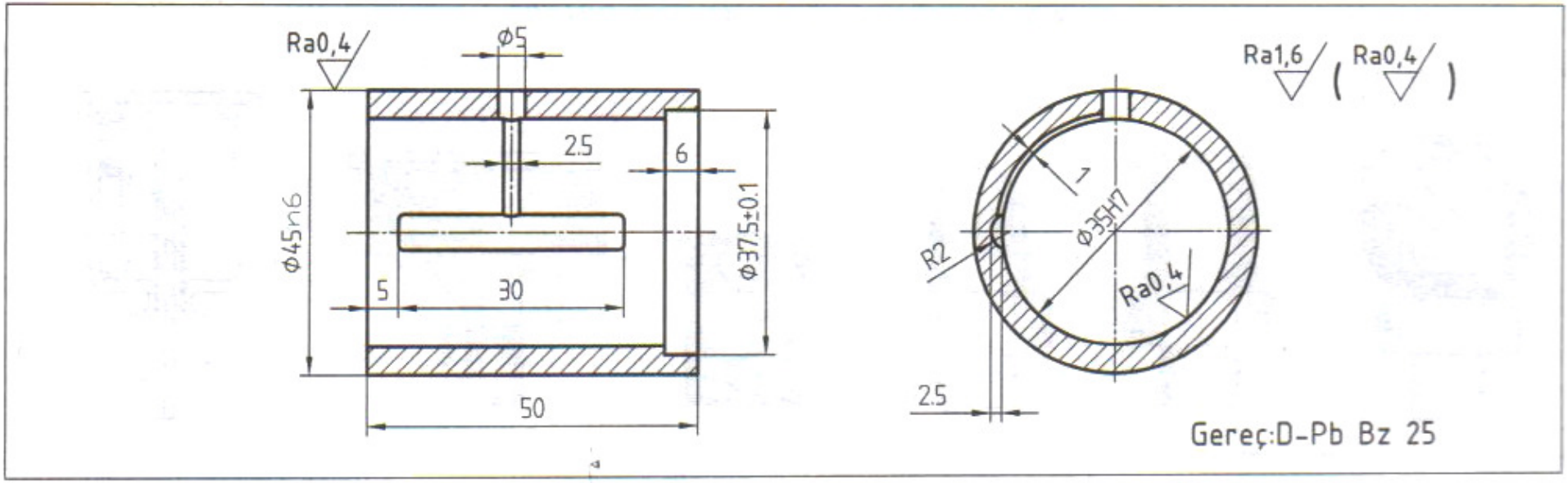


OIL CUP AND LID

Simple oil flow from cup

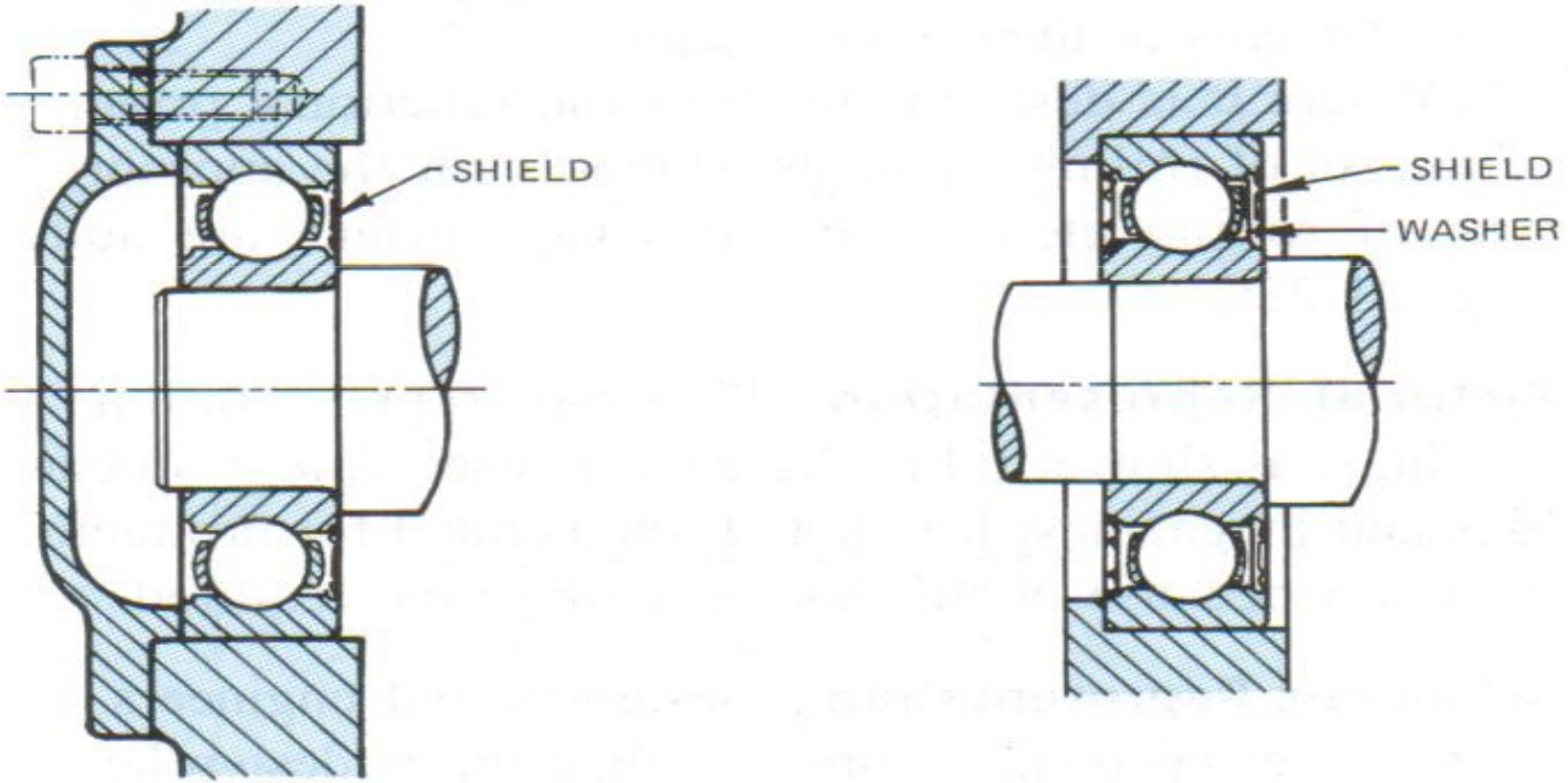


Lubricating channels

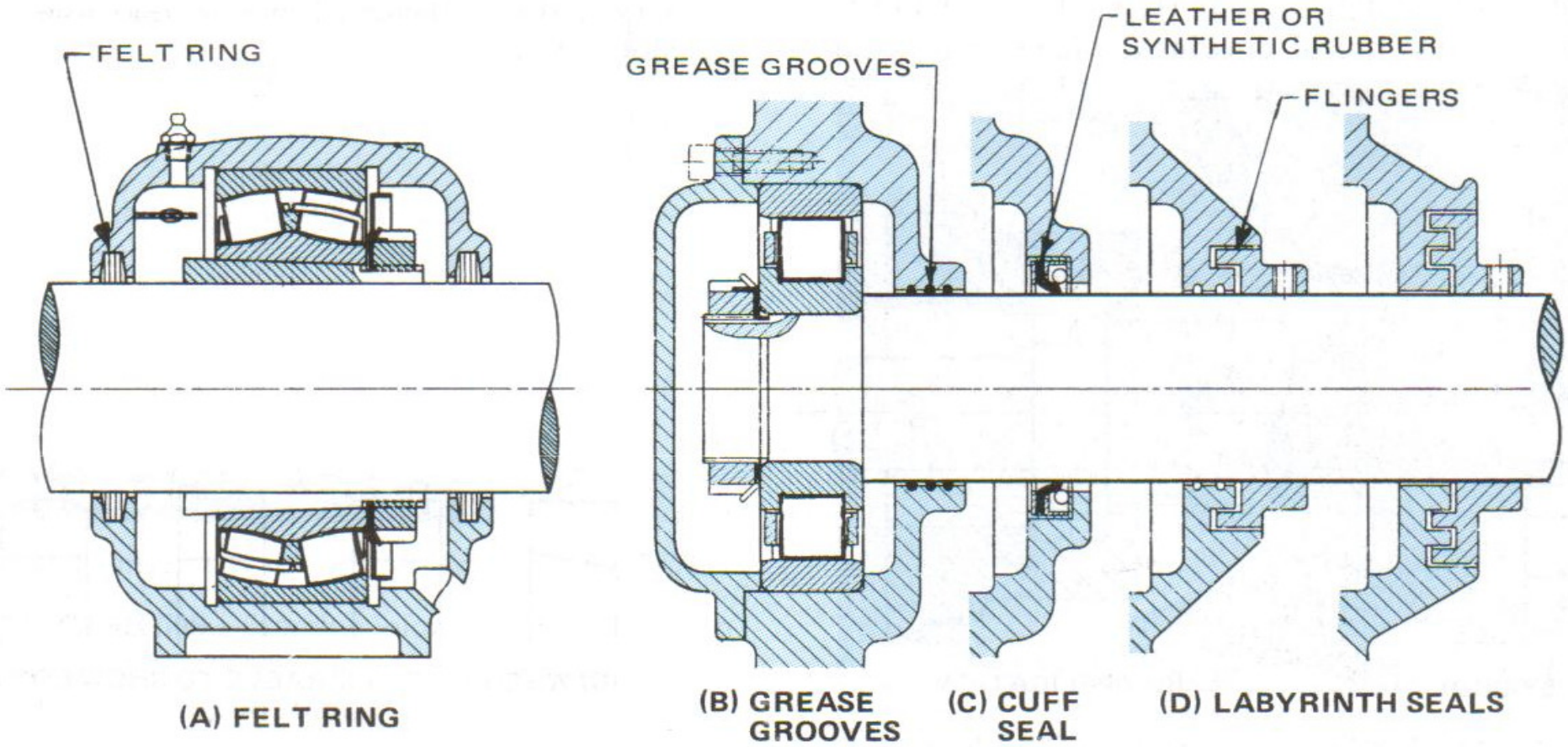


Seals for Grease Lubrication

For ball or roller bearings to operate properly, they must be protected against loss of lubricant and entrance of dirt and dust on the bearing surfaces. In its simplest and least space-requiring form, this is accomplished in some types of bearings by the use of a thin steel shield on one or both sides of the bearing, fastened in a groove in the outer ring and reaching almost to the inner rings, All other types of bearings require a seal between the bearing housing and the shaft;



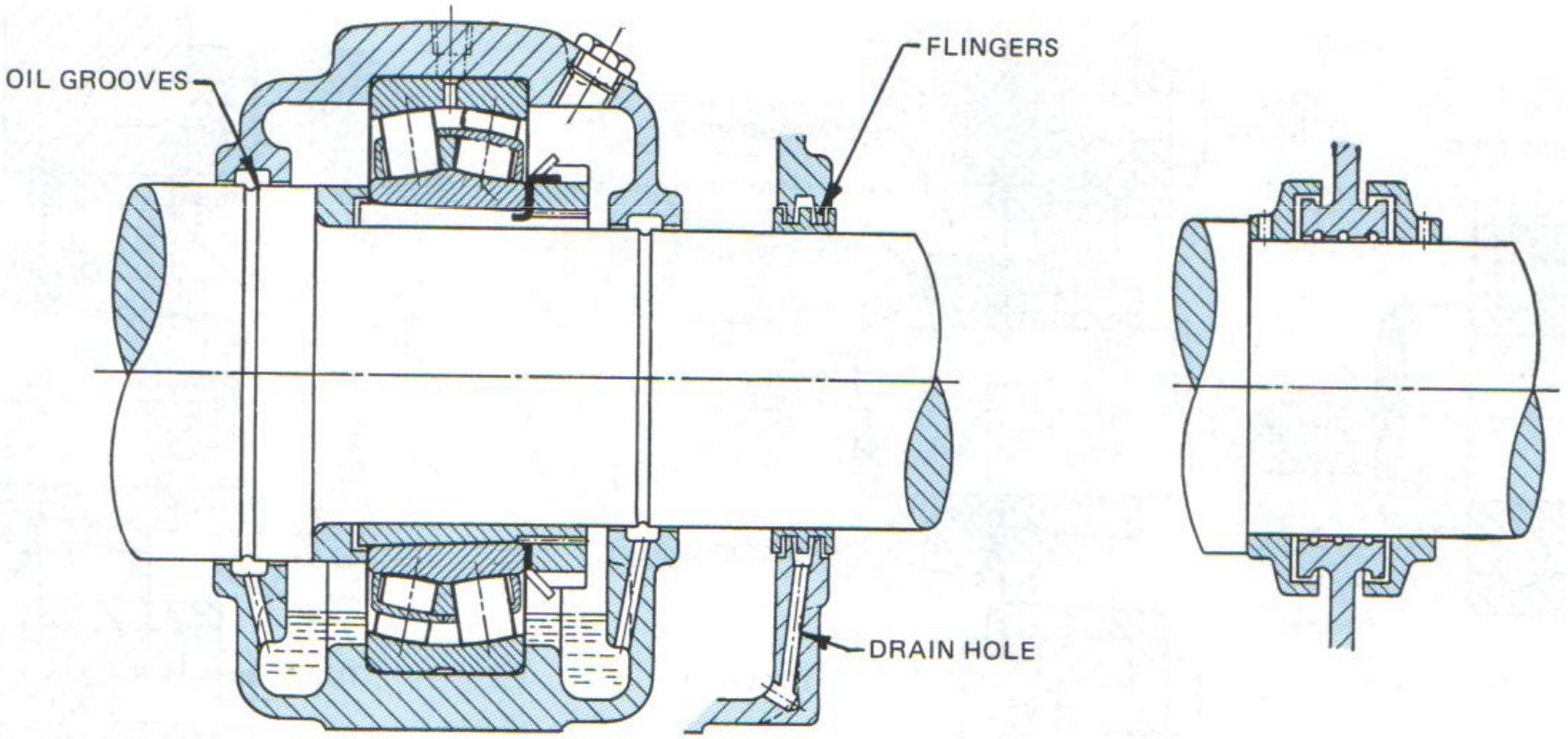
Bearing seals for grease lubrication.



Housing seals for grease lubrication.

Seals for Oil Lubrication

With oil lubrication, **seals** have the double function of protecting the bearing against contamination and retaining the lubricant in the housing. Protection is obtained by means of friction seals or flingers, as when grease lubrication is used. The essential feature for retaining the oil is a groove in the rotating shaft, or a rotating ring or collar from whose edges the oil is thrown by centrifugal force.



Housing seals for oil lubrication.