welcome

TO THE WORLD OF

BEARINGS

What is a Bearing??????

A bearing is a machine element which reduces friction between two members, having relative motion with respect to each other.

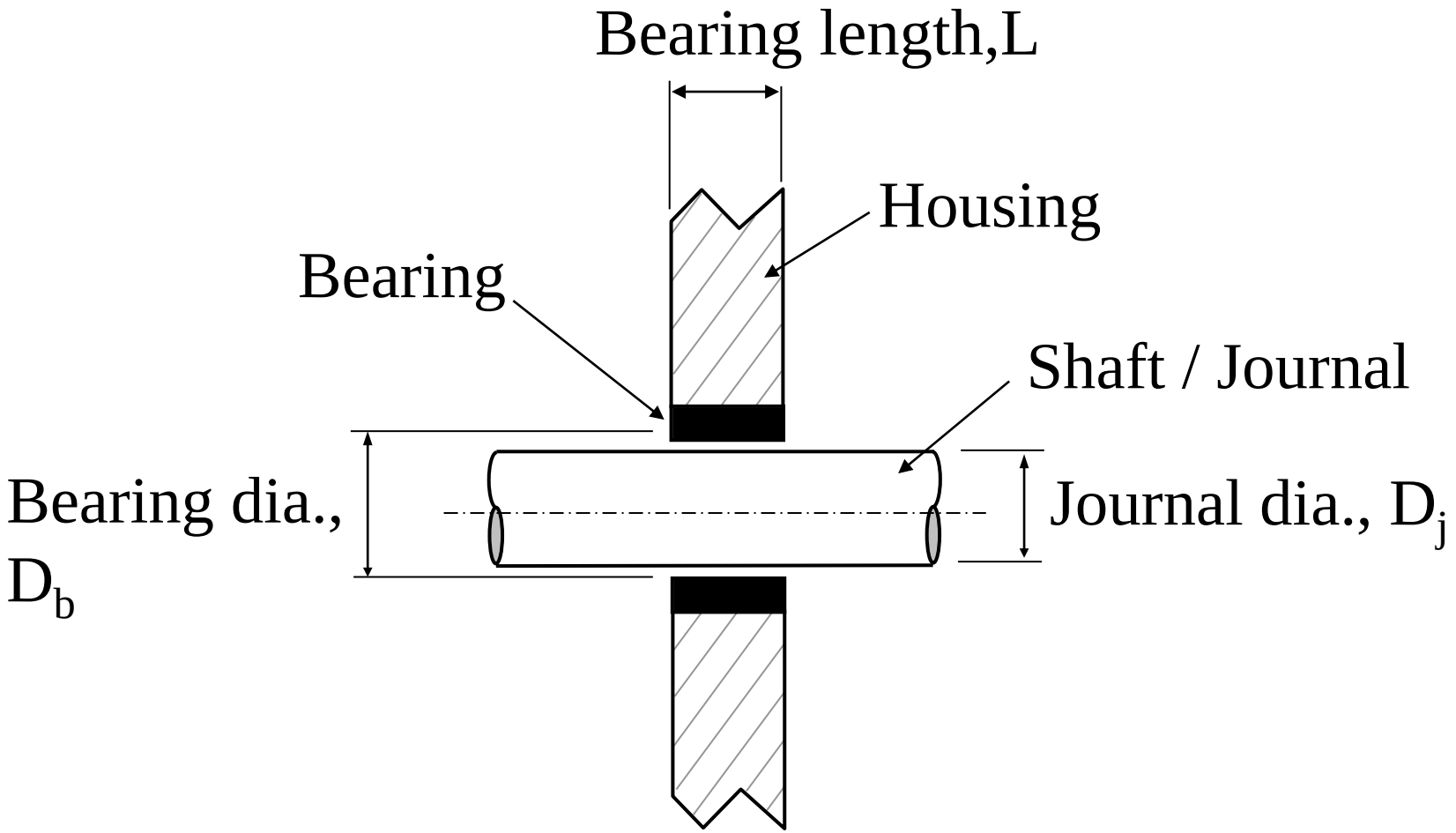
Purpose of Bearing??????

- To provide rigidity to the shaft in axial and radial direction.

- To reduce friction and wear out of components, which are having relative motion. Thereby, reducing the heat and sound generated.

- To carry loads at considerable speeds

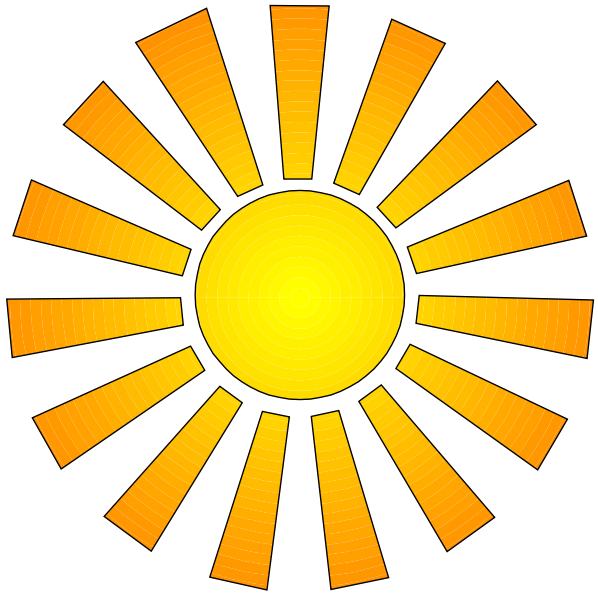
Bearing Geometry



Types of bearings

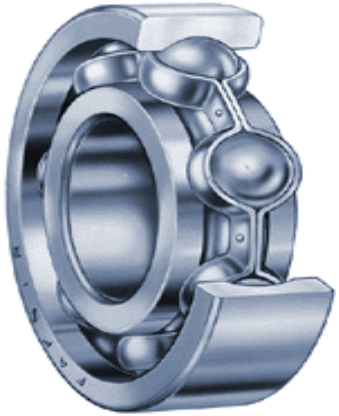
- Sliding Contact Bearings or Frictional Bearings

- Rolling Contact Bearings or Anti-Friction Bearings

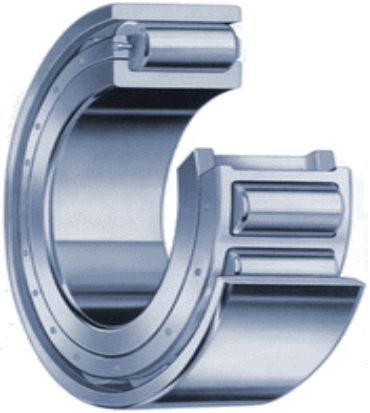


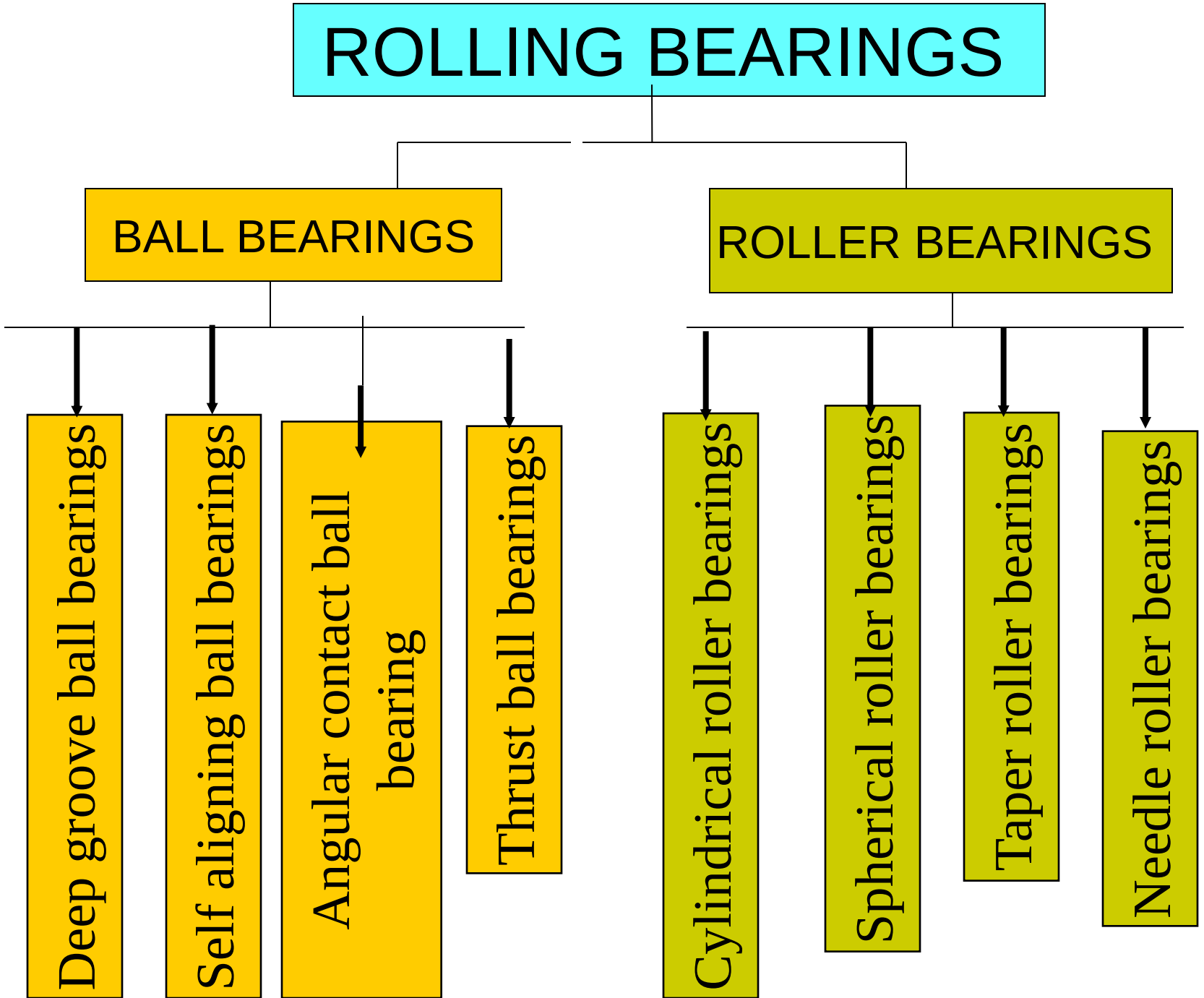
Rolling Contact Bearings

Ball Bearings



Roller Bearings



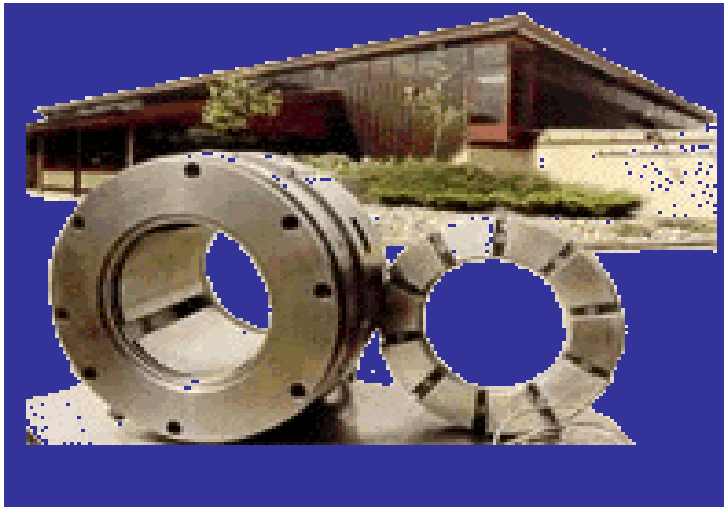

ROLLING BEARINGS
BALL BEARINGS
ROLLER BEARINGS
Deep groove ball bearings
Self aligning ball bearings
Angular contact ball bearing
Thrust ball bearings
Cylindrical roller bearings
Spherical roller bearings
Taper roller bearings
Needle roller bearings

FRICTIONAL BEARINGS

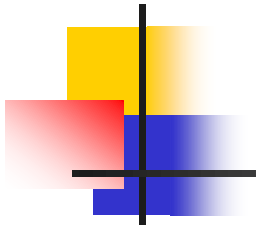
ARE OF TWO TYPES

1. BUSH BEARINGS

2. SLIDE OR
   SLEEVE BEARINGS
(ex. Journal bearing)



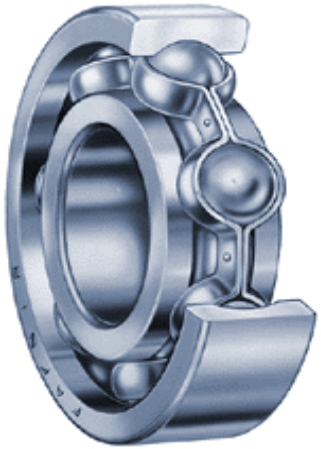
FEATURES OF JOURNAL BEARINGS



- JOURNAL BEARINGS ARE OF HYDRO DYNAMIC FILM OPERATED TYPE
- THESE ARE HIGH CAPACITY LOAD BEARING TYPE
- THERE IS NO CONTACT BETWEEN MOVING & NON MOVING ELEMENTS
- USES BABBIT METAL AS BEARING MATERIAL

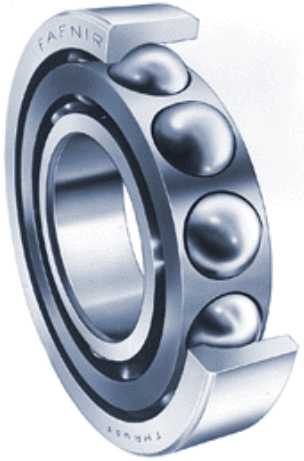
Types of Bearings

Single-row Radial Ball



Radial Roller

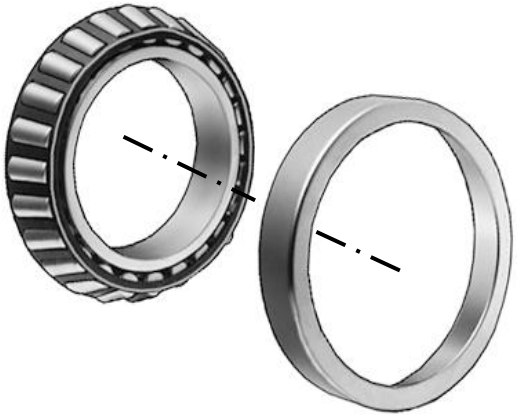
Angular Contact Ball



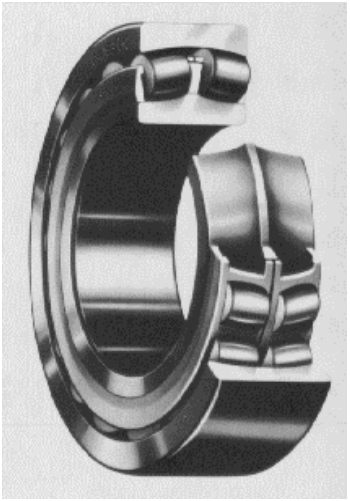
Angular Roller

Types of Bearings

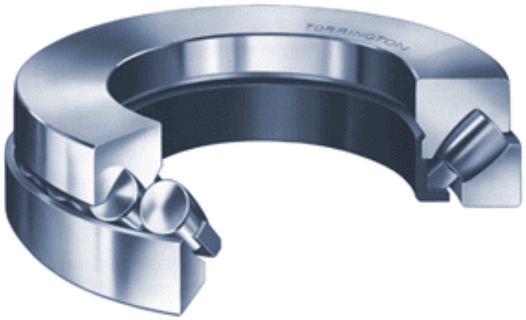
Tapered Roller



Spherical Roller

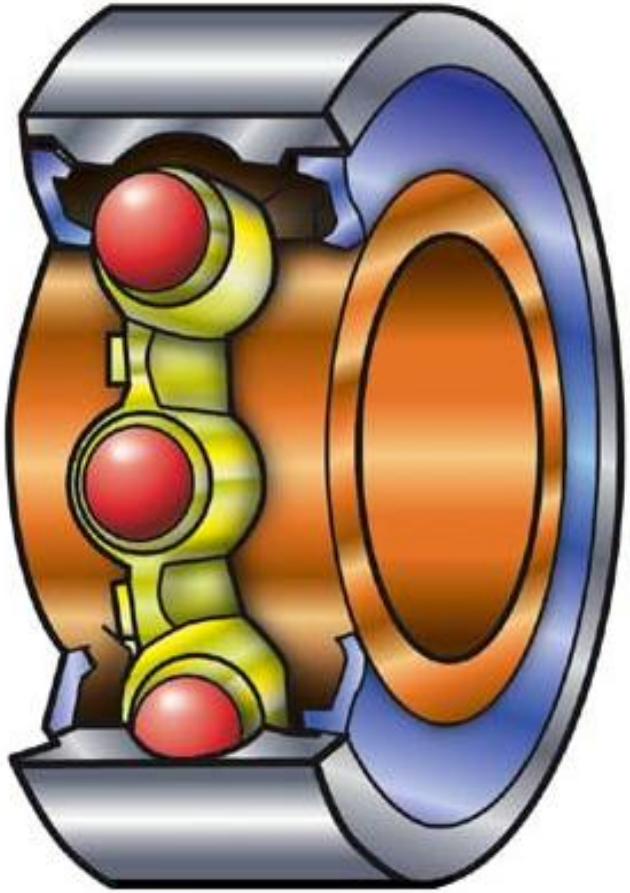


Thrust Roller



Needle roller

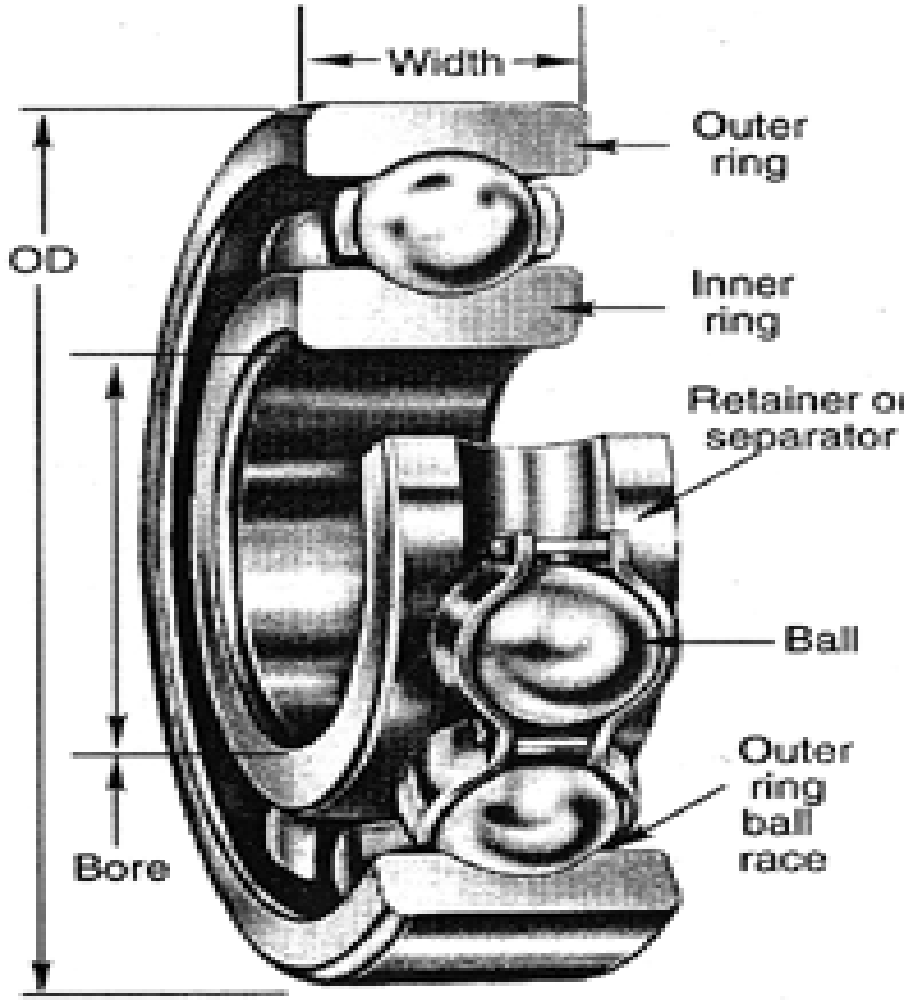
Deep Groove Ball Bearings

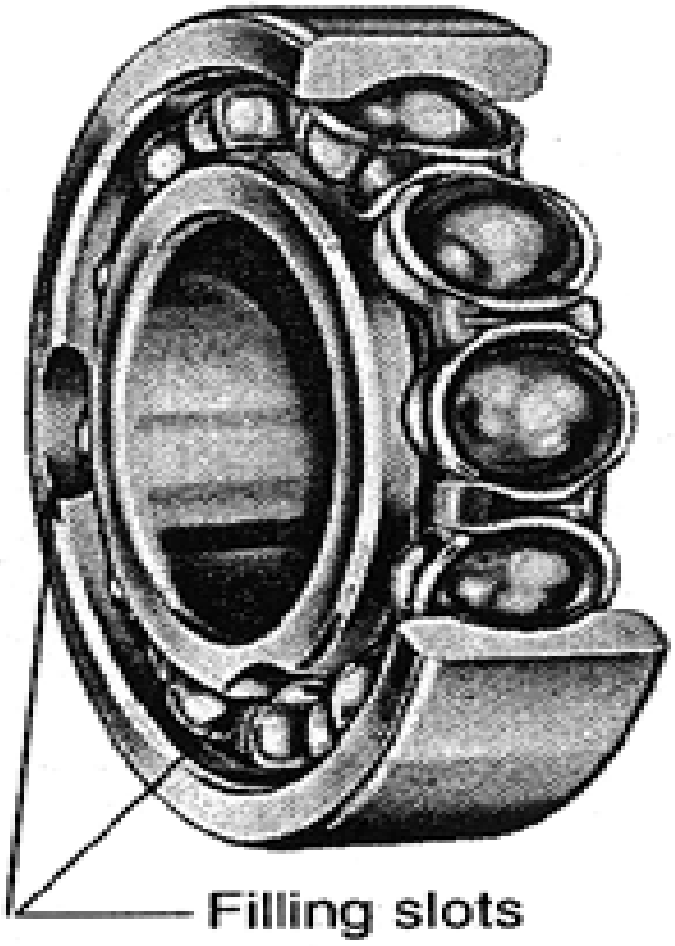


Self Aligned Ball Bearings

Taper roller bearings

Ball Bearings Detailed View



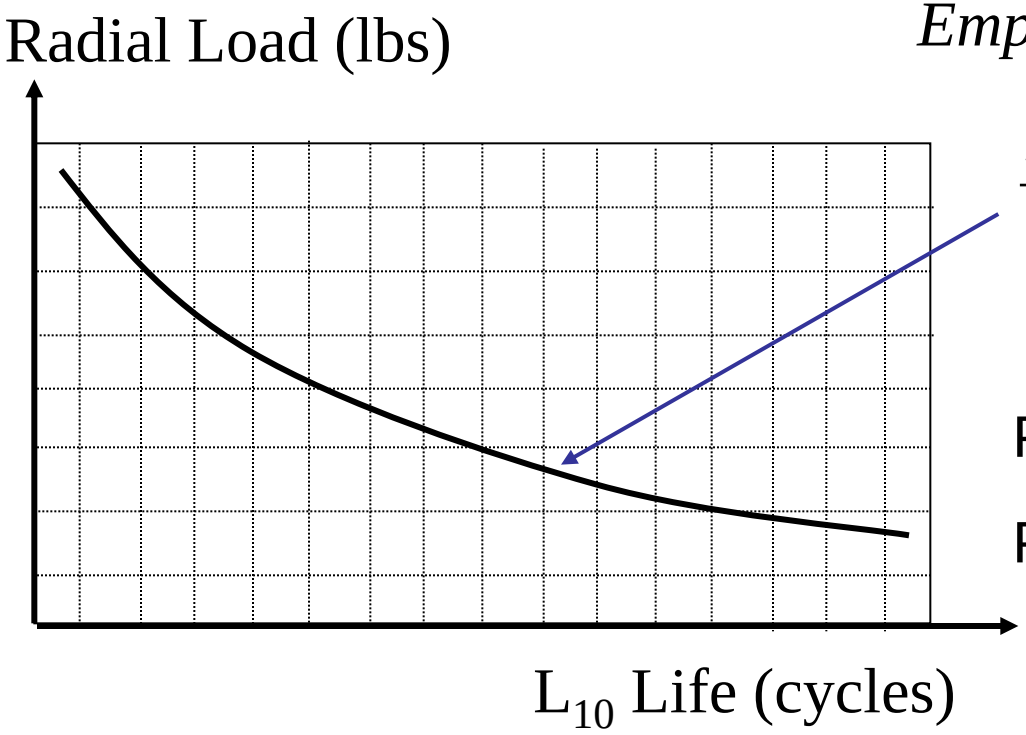


BEARING LIFE

Life of a bearing is defined as the number of revolutions which the bearing is capable of enduring before the first sign of fatigue (flaking, spalling and crack) occurs on one of its ring or rolling element

Bearing Rated Life

Test (fatigue) data



Empirical relationship:

$$\frac{L_2}{L_1} = \left(\frac{P_1}{P_2} \right)^k$$

- *k=3.0 (ball)*
- *k=3.33 (roller)*

P_1=Basic dynamic rated load, N

P_2=Equivalent dynamic load, N

Bearing Selection

- Determine the design life (in cycles)
- Determine the design load

$P_d = V\,R$

V=1 for inner race rotation

V=1.2 for outer race rotation

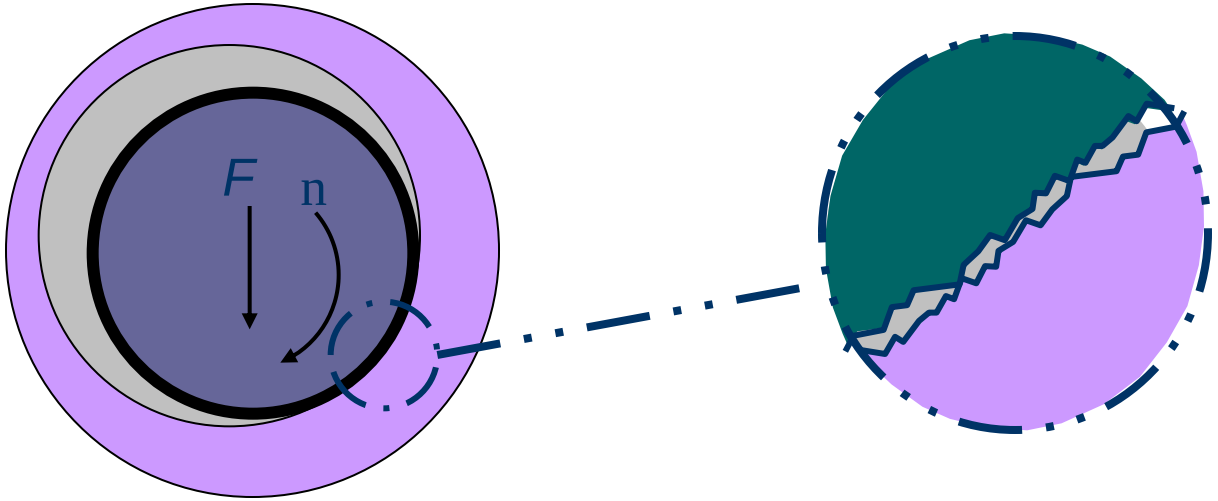
- Calculate the required basic dynamic load

$$C_{req'd} = P_d \left(\frac{L_d}{10^6} \right)^{\frac{1}{k}}$$

- Select a bearing with ($C > C_{req'd}$) and a bore that closely matches the shaft diameter.

Bearing Operation

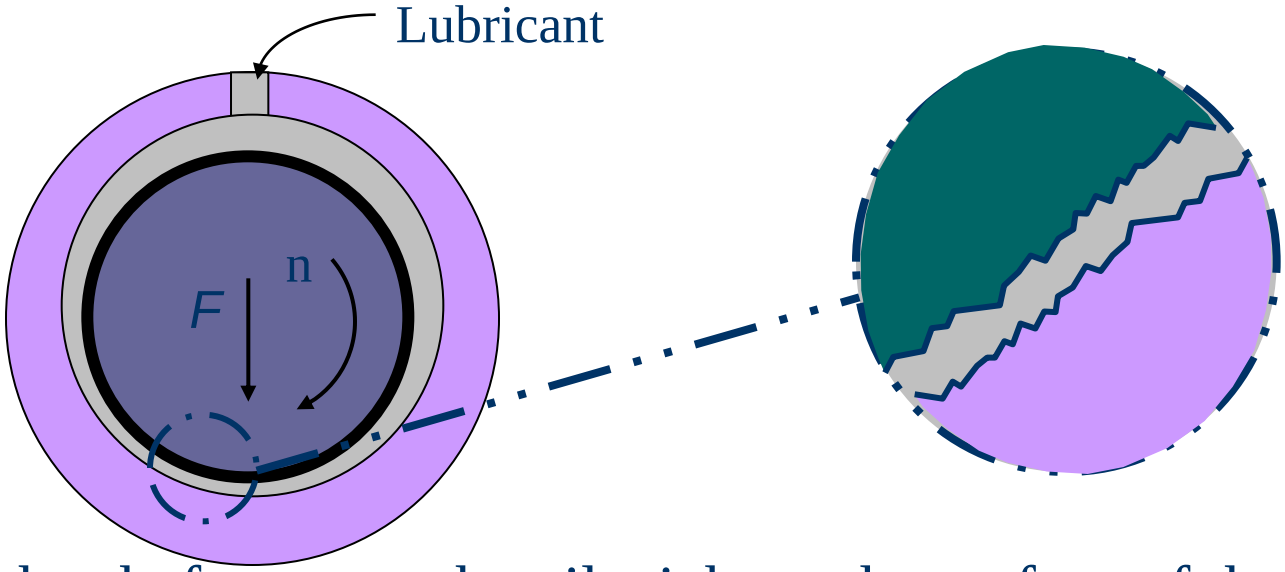
Boundary Lubrication



The oil fills in the volume in the troughs on the mating parts. There is extensive metal-to-metal contact of the peaks and a high rate of friction and wear.

Bearing Operation

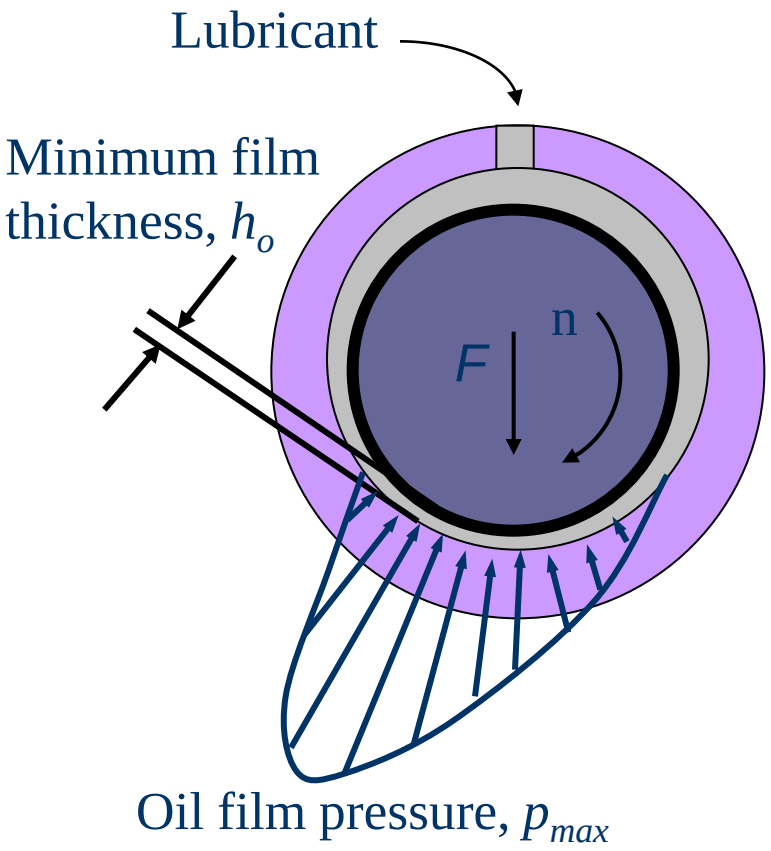
Full-film Lubrication



As the shaft rotates, the oil sticks to the surface of the shaft and a thin film is established between the bearing and the rotating shaft. There is no metal-to-metal contact and the shaft appears to float above the bearing.

Hydrodynamic Lubrication

Full-film lubrication



- Higher speeds
- Higher viscosity
- Lower loads

Bearing Lubrication

The Functions of Lubrication

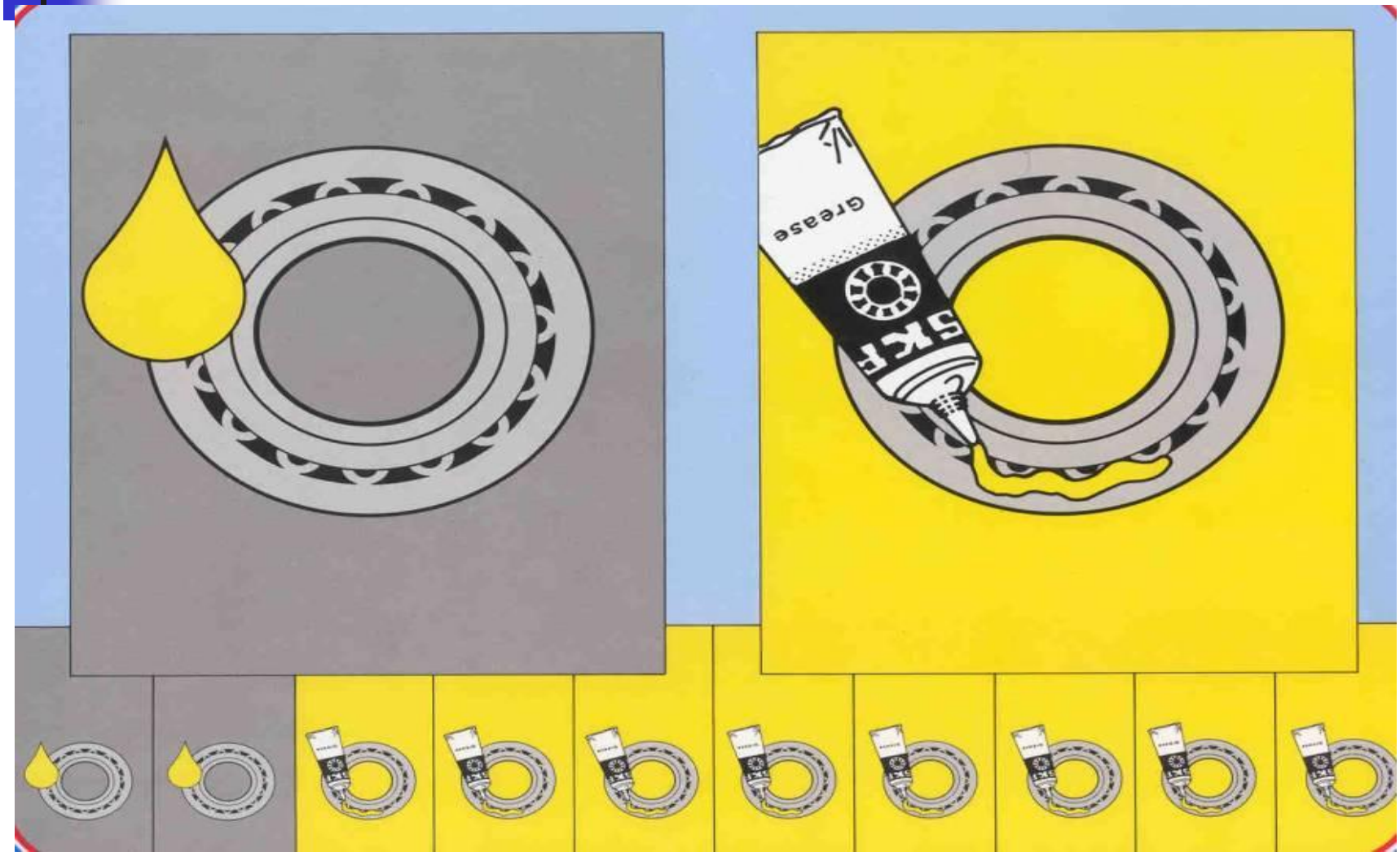
- Lubricants reduce wear and friction by
  - Lubricating all true rolling contacts elastohydrodynamically
  - Lubricating sliding contacts between the raceways and rolling elements
  - Lubricating sliding contact between the rollers and guiding elements

The Functions of Lubrication

- Lubricants also
  - Protect highly finished surfaces of rolling elements and rings from corrosion
  - Help prevent intrusion of foreign matter, (done with grease pack)
  - Provide a heat transfer medium

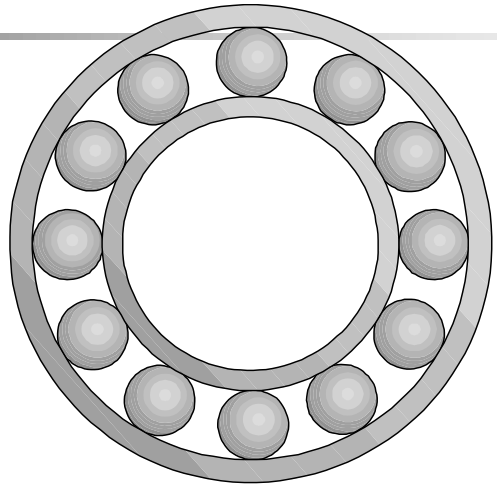
Lubricant Selection

Oil or Grease ?



Lubricant Selection

Oil or Grease ?



Grease:

+ Simple installation (**cheap!**)

+ Additional bearing **protection** (against dirt, moisture)

Oil:

+ Additional **cooling**

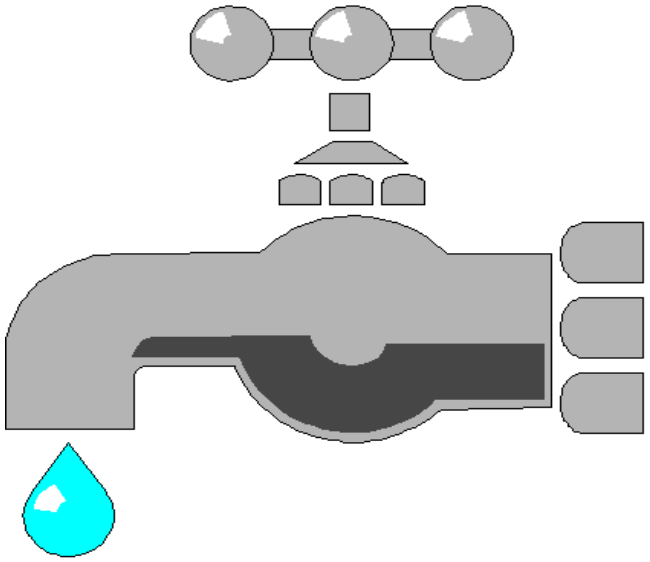
+ **Filtering** and quality control possible

80% of all bearings are grease lubricated

Lubricant Selection

Base Oil viscosity

VISCOSITY = "resistance to flow" of a fluid



Water: low viscosity
(1cSt at 20°C)

Honey: high viscosity
(~1200 cSt at 20°C)

Lubricant Selection

Base Oil viscosity

low viscosity:

+ low friction
- thin oil film

high viscosity:

+ thick oil film
- high friction

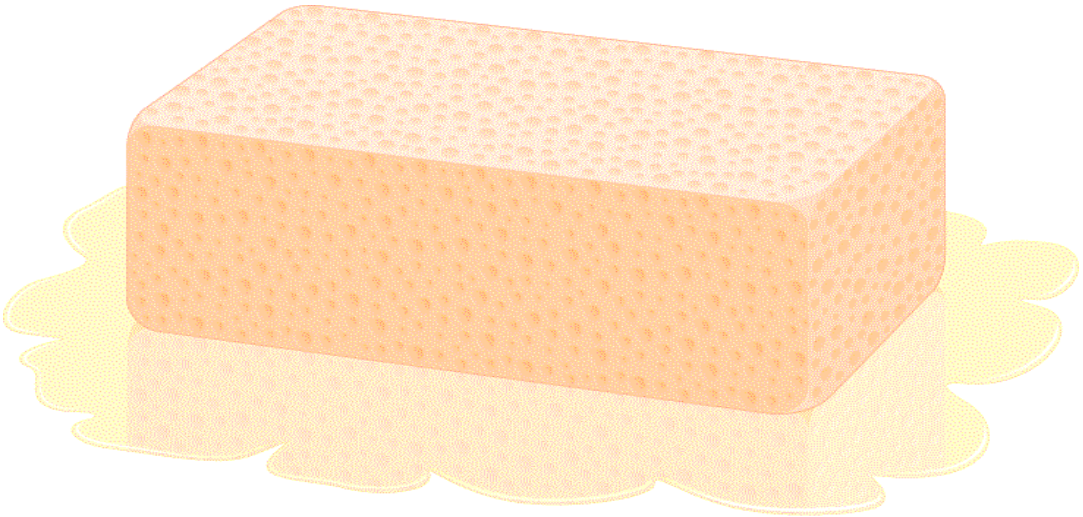
Finding the right balance

base oil viscosity changes with **temperature !**
(like with honey)

Lubricant Selection

Definition of Grease

A grease is 90 % oil held in a thickener (10 %)



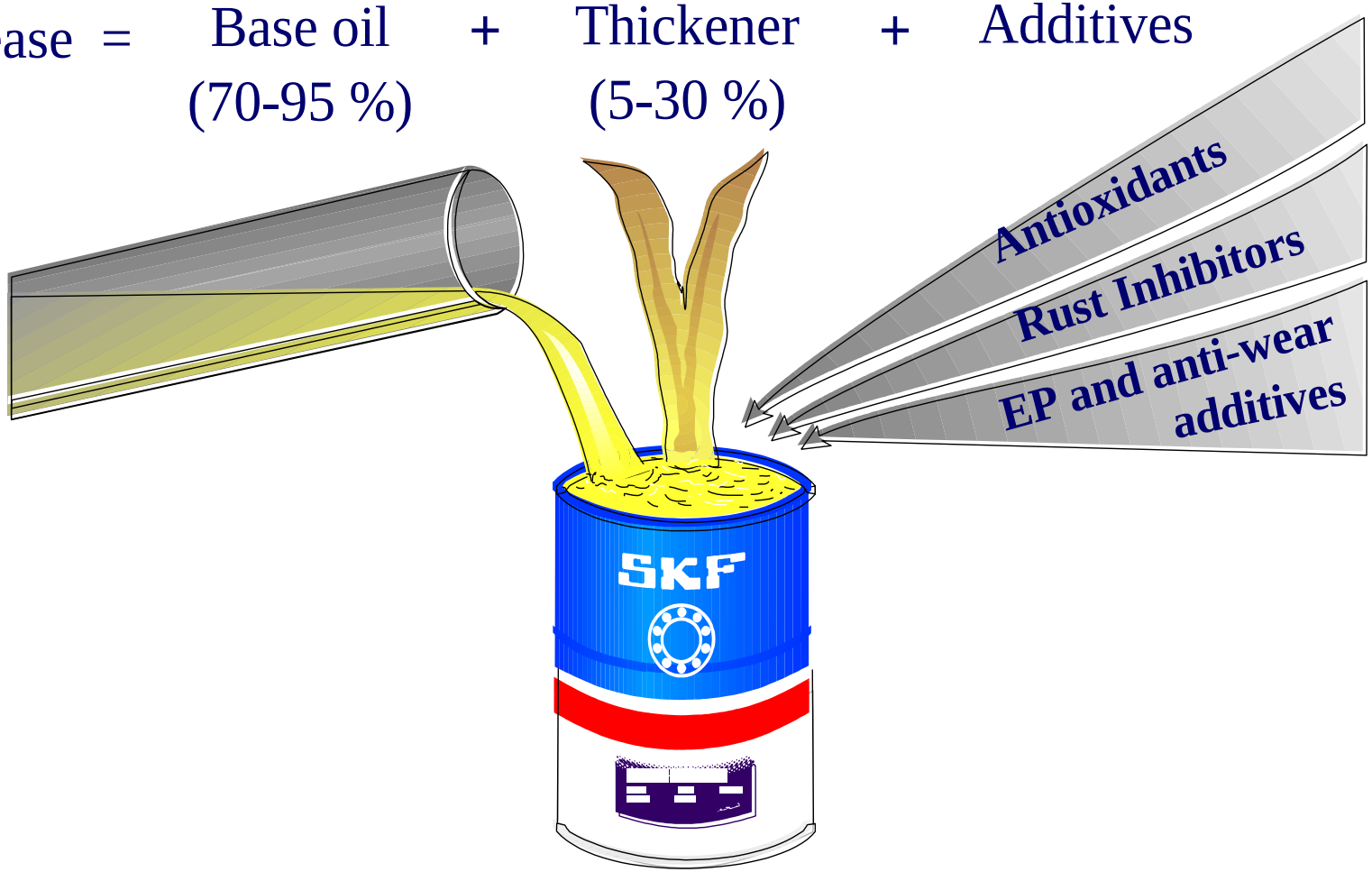
Think of the thickener as a sponge holding the oil

It is not: – a thick oil
– a solid oil (wax)

Lubricant Selection

What's inside a grease?

Grease = Base oil (70-95 %) + Thickener (5-30 %) + Additives



How do Bearings Fail?

Not always due to Natural Causes

Only

34 %

of bearings fail

due to Fatigue,

which is the basis

of life calculation.

How do Bearings Fail?

Poor Lubrication

is the reason for

36 %

of premature

bearing failures

How do Bearings Fail?

Contamination

is the reason for

14 %

of premature

bearing failures

How do Bearings Fail?

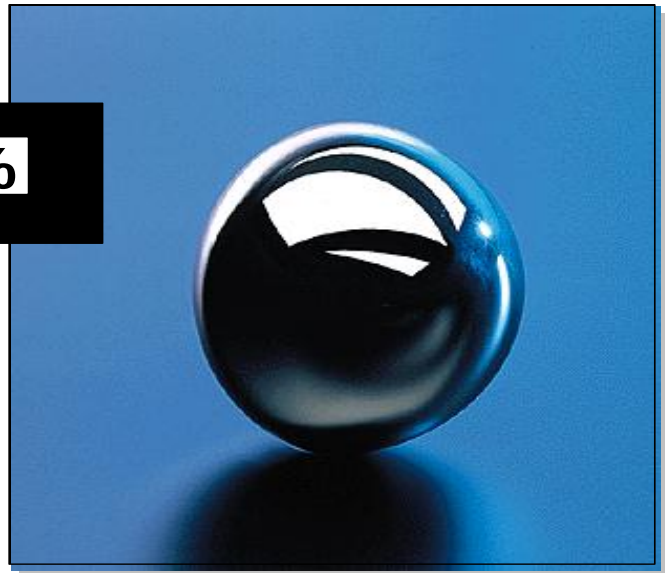
Poor Installation

is the reason for

16 %

of premature

bearing failures



Bearing Failures & Their Causes

Unusual operating behaviour indicating damage :Subjective damage recognition

In the vast majority of bearing applications it is sufficient when machine operators watch out for uneven running or unusual noise in the bearing system

Bearing Failures & Their Causes

Unusual operating behaviour indicating damage : Subjective damage recognition

Symptoms	Sources of Trouble	Examples
Uneven running	Damaged ring or rolling elements	Motor vehicles: * More and more wheel wobbling * Increased tilting clearance * Vibration of steering system
	Contamination	Fans: * Growing vibration
	Excessive bearing clearance	Saw Mills : * More knocks and blows on connecting rods

Bearing Failures & Their Causes

Unusual operating behaviour indicating damage : Subjective damage recognition

Symptoms	Sources of Trouble	Examples
Reduced working accuracy	Wear due to * Contamination or * Insufficient Lubrication	Lathe: * Gradual development of chatter marks on work piece
	Damaged rings or rolling elements	Grinders: * Weavy ground surface
	Change in adjustment: * Clearance or * Preload	Cold Rolling Mills : * Periodic surface defects on rolled material e.g., stretcher strains or ghost lines

Bearing Failures & Their Causes

Unusual operating behaviour indicating damage : Subjective damage recognition

Symptoms		Sources of Trouble	Examples
Unusual Running Noise	Whinning or Squealing noise	Insufficient operating clearance	Electric Motors Gears
	Rumbling or Irregular noise	Excessive Clearance Damaged contact areas Contamination Unsuitable Lubricant	
	Gradual change in running noise	Change in operating clearance due to temperature Damaged running track due to contamination or fatigue	

DOs & DON'Ts with Bearings

DO s

•.Keep the bearings in protective packing till they are mounted.

•.Cover the assembled bearings appropriately to avoid dust ingress.

•.Store the bearings in dry area.

•.Use tubes, Pullet, Hydraulic nuts, and other tools for removal / fixing of the bearings.

•.Use correct amount of specified lubrication at right time in correct procedure.

DOs & DON'Ts with Bearings

DO's

•Prevent the penetration of external contaminants into the bearings.

•Maintain the fits between the bearings with mating shaft / housing.

•Align the members properly to avoid unnecessary load on the bearings.

•Check the operating condition of the bearings by feeling the noise, temperature and sensing vibration through touch.

•Fill the bearings with right grease while assembling.

DOs & DON'Ts with Bearings

Dont's

- Over lubrication is a silent killer for bearings. Do not over lubricate.
- Never allow welding at bearings that will damage the contact surfaces.
- Do not apply direct blows on the bearing while mounting / dismantling.
- Do not keep the bearings in a dusty area.
- Don't let the bearing stand upright, store them flat on their sides.

DOs & DON'Ts with Bearings

Dont's

- Do not allow water to enter the bearings / lubricant.
- Do not use water to clean the bearings.

THAN…’Q’