



ÁREA DE INGENIERÍA MECÁNICA

MACHINE THEORY

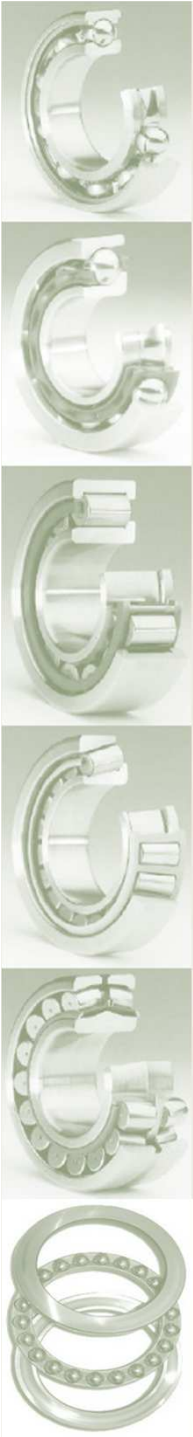
ROLLING BEARINGS

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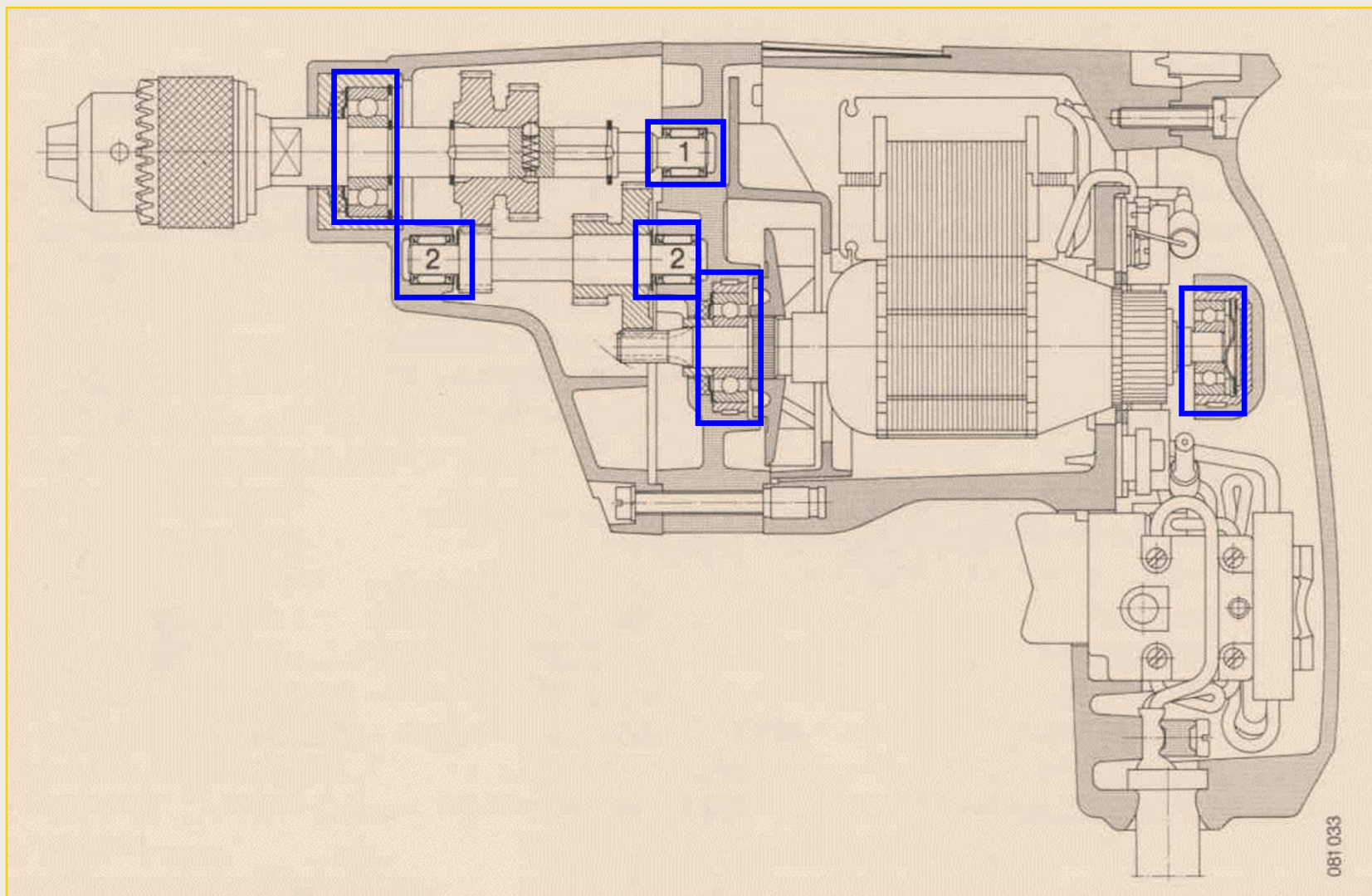
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Mauricio Alba Lucero

José Luis Pérez Díaz

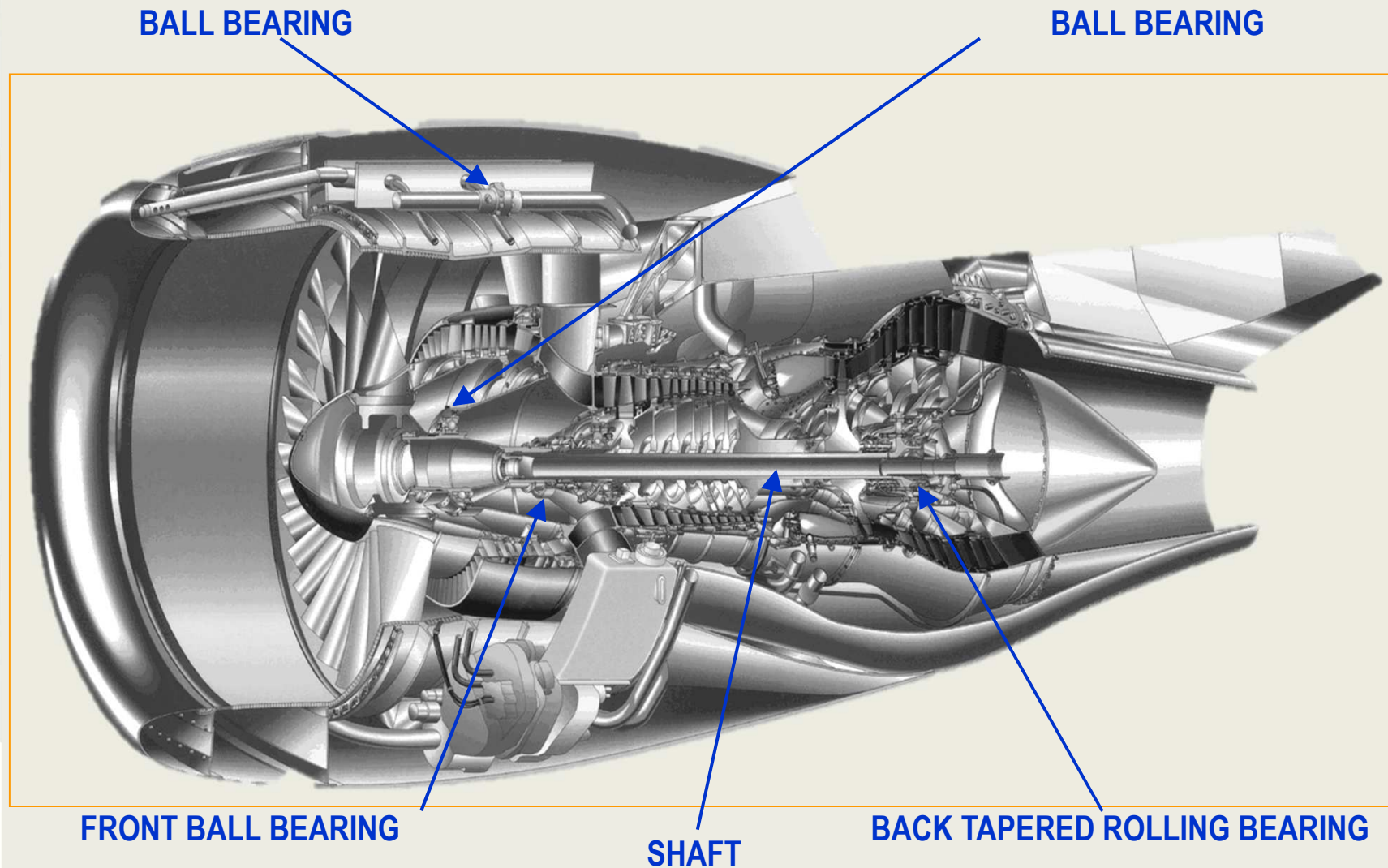


ROLLING BEARINGS



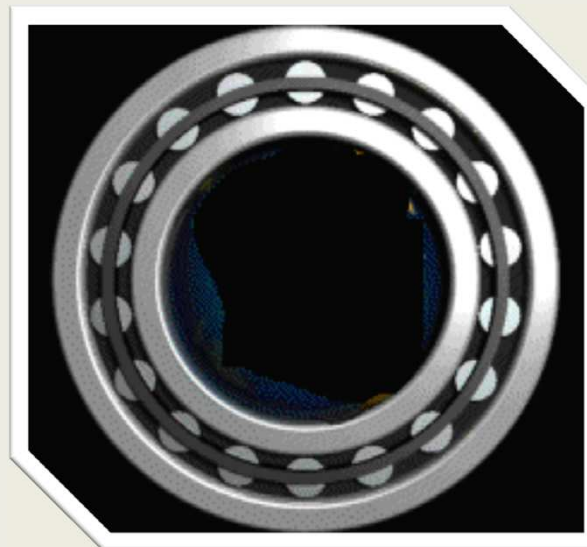
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ROLLING BEARINGS



DEFINITION OF ROLLING BEARINGS

"A rolling bearing is a mechanical element placed between two parts of a machine, with an common rotation axis in where one part can rotate in respesct to the other one."





CHARACTERISTICS OF ROLLING BEARINGS



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Very similar to sliding bearings in:

- ❑ Low friction.
- ❑ Very accurate Tolerances .
- ❑ Precise assembly needed.
- ❑ Sensible ot impacts, overloads, dust...
- ❑ Maintenance.

CHARACTERISTICS OF ROLLING BEARINGS



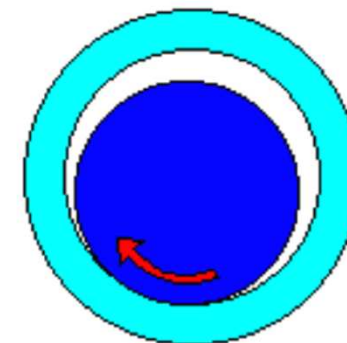
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Advantages in front of the sliding bearings:

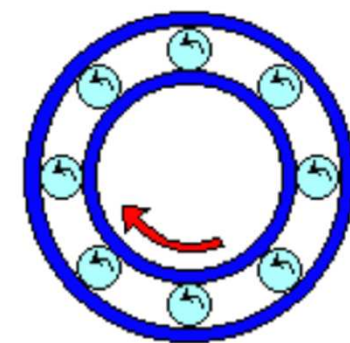
- ❑ Lower frictional coefficient independently of the rotational speed.
- ❑ Admite carga axial.
- ❑ Algunos tipos son autoalineables.

Some disadvantages:

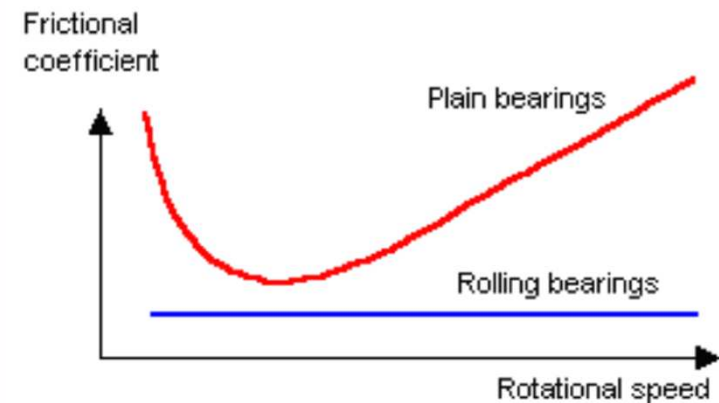
- ❑ Higher price.
- ❑ More complex assembly.



Plain bearing



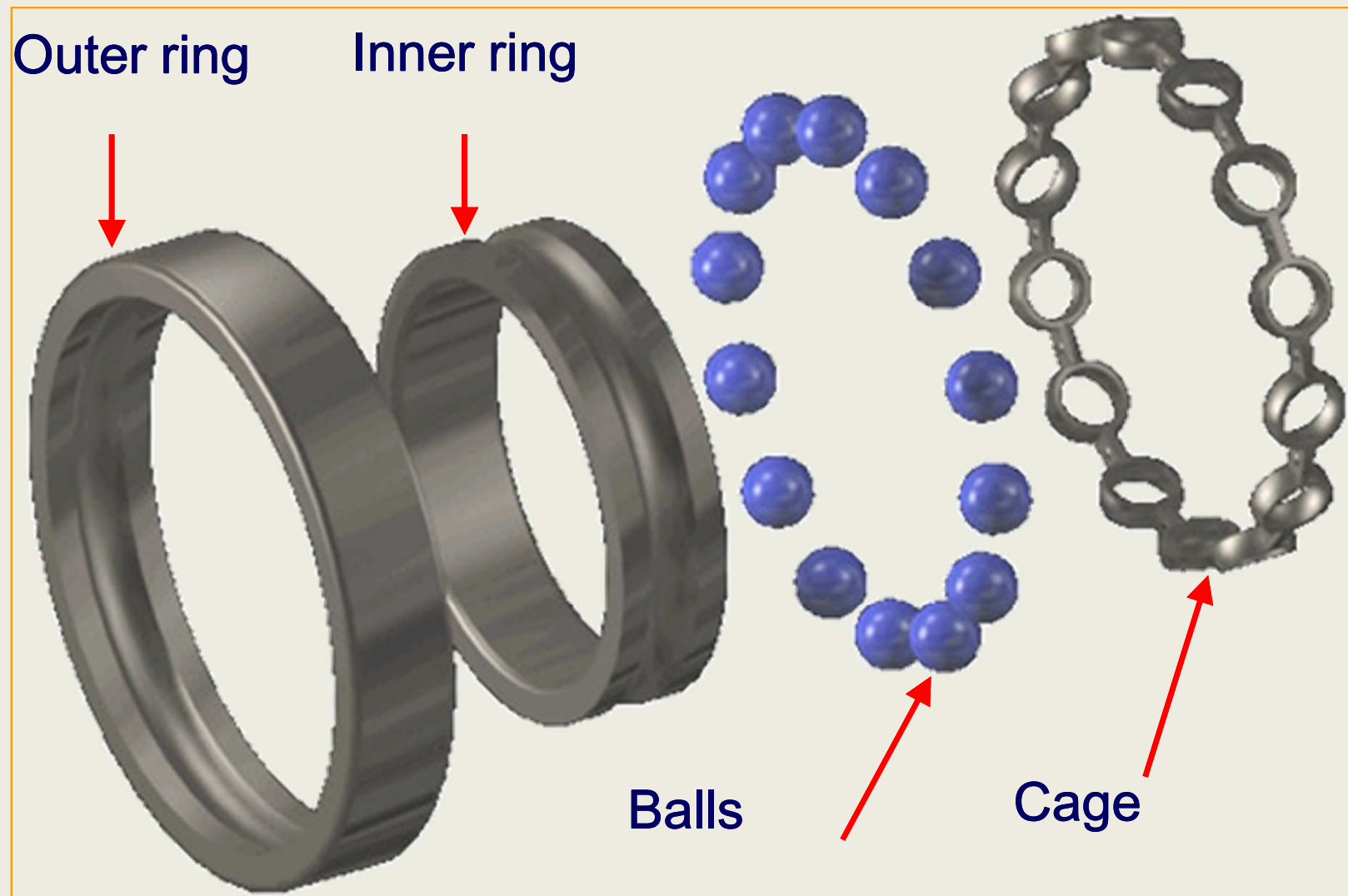
Rolling bearing



PARTS OF ROLLING BEARINGS



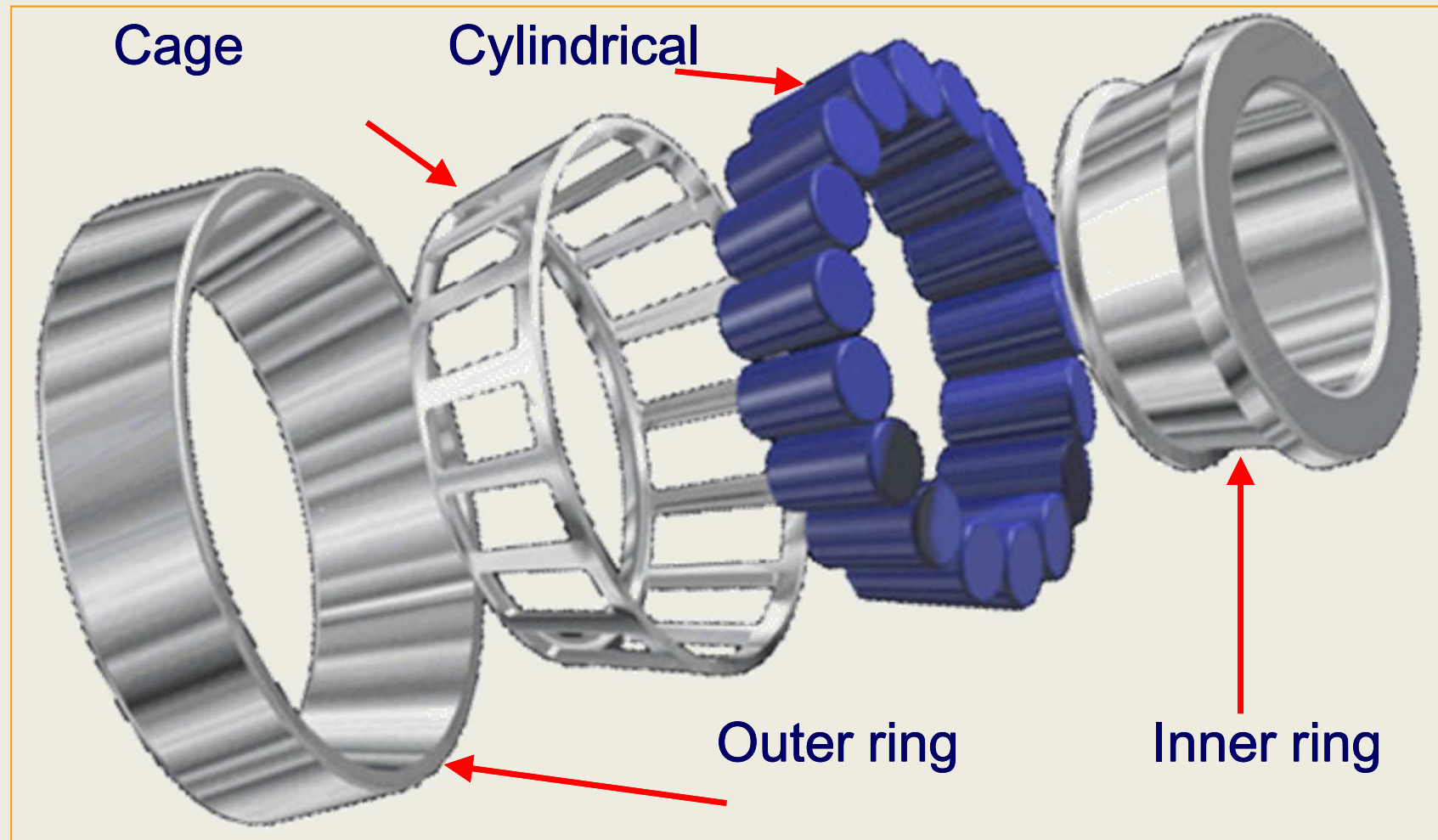
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PARTS OF ROLLING BEARINGS



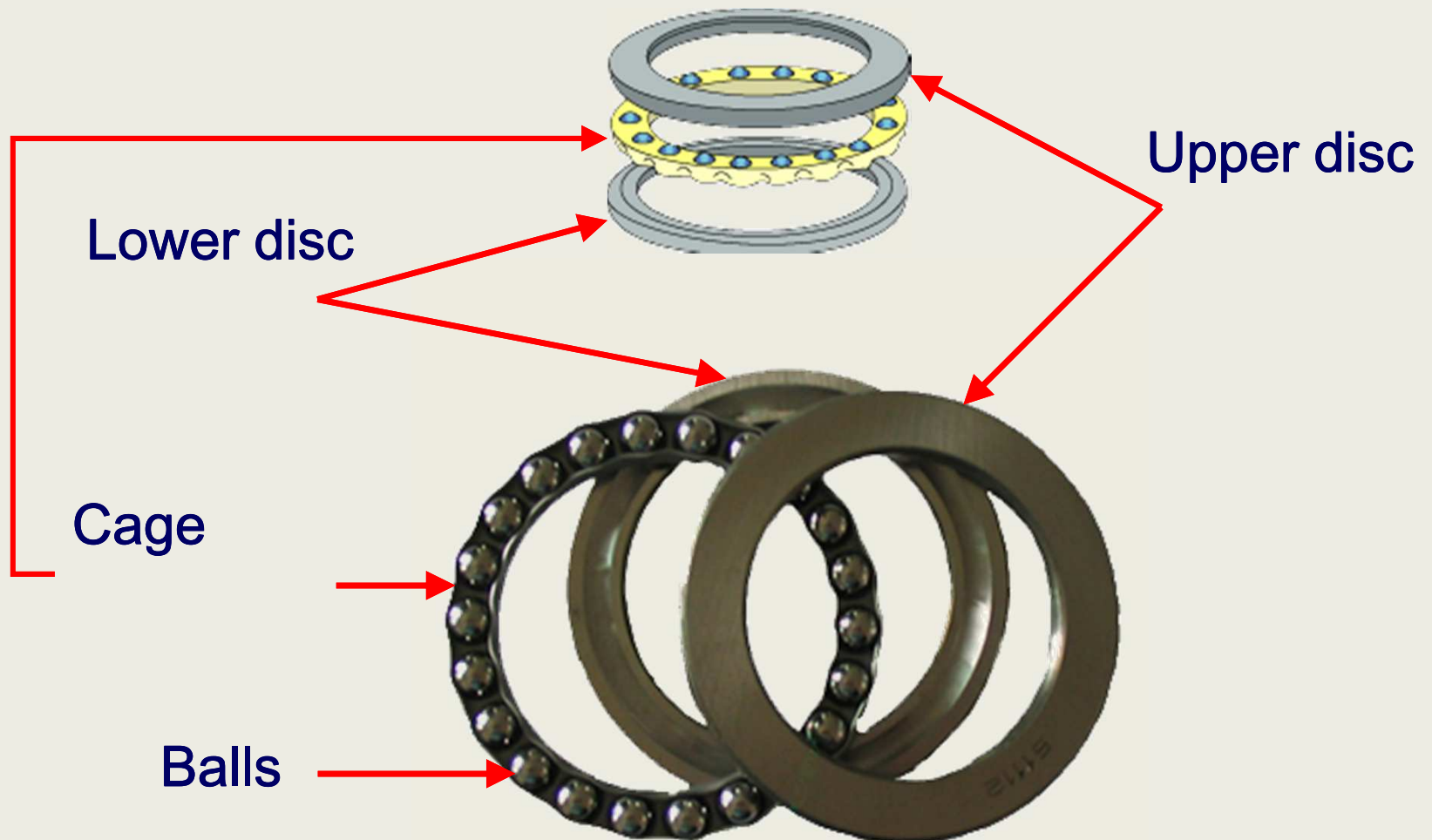
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PARTS OF ROLLING BEARINGS



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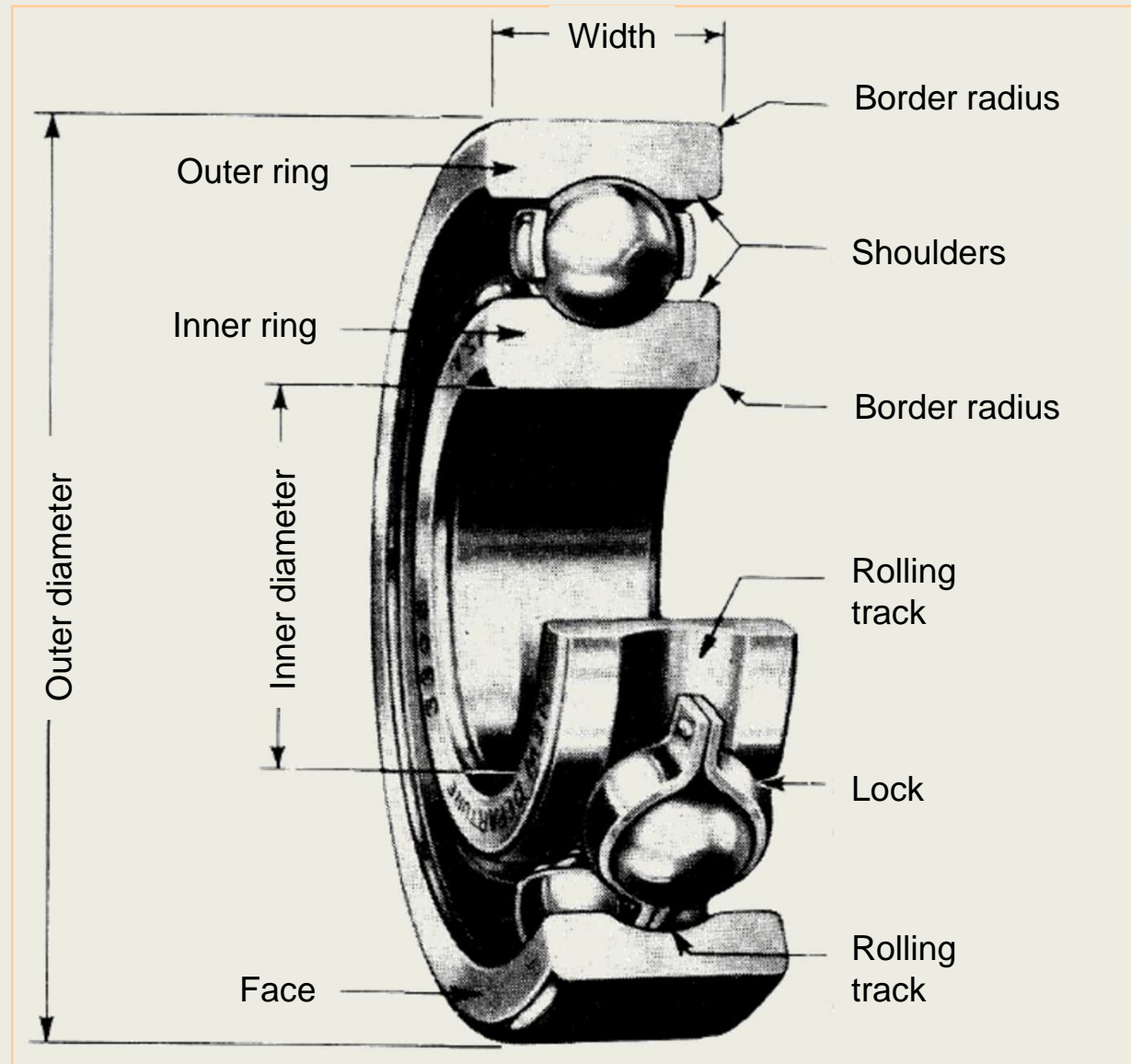





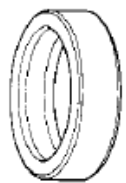




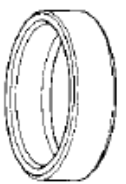

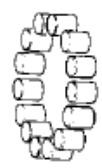

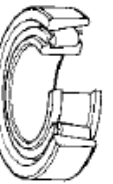
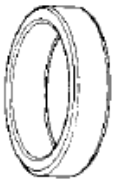




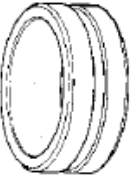




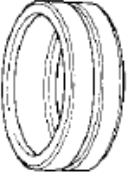
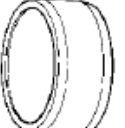


PARTS OF ROLLING BEARINGS



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ROLLING ELEMENTS

Bearing type	Finished part	Part			
		Outer ring	Inner ring	Rolling elements	Cage
Deep groove ball bearing					
Cylindrical roller bearing					
Tapered roller bearing					
Self-aligning roller bearing					
Needle roller bearing					

Source: NTN Rolling bearings handbook

MATERIALS OF ROLLING BEARINGS



- The rolling elements (ball or cylinder) and support elements (ring or disc) are manufactured in hard steel, high resistance to wear, and a hardness of 500-700° Brinell. Two kinds of steel:
 - Chromed steel (1 % of Carbon 1,5 % of Chrome).
 - Manganese-Chrome steel o Nickel steel (0,15 % of Carbon).

- The rolling element and the rolling tracks have a special surface treatment.

- The cages are manufactured in softer steels, polyamide, phenolic resin, brass or bronze.



CAGES



Metal sheet pressed cage



Polyamide mechanized cage



Molded polyamide cage



Mechanized bronze cage



Metal sheet pressed riveted cage



Massive brass riveted cage



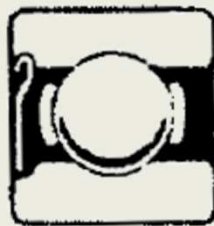
Massive brass riveted cage



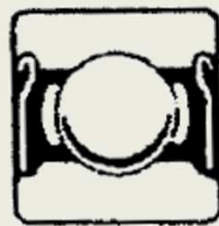
Mechanized brass riveted cage

AUXILIARY ELEMENTS

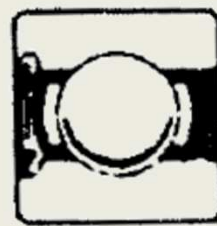
SEALING AND PROTECTIONS.



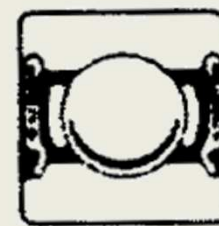
One
protection



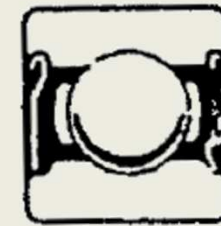
Two
protections



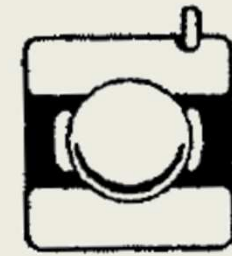
One
sealing



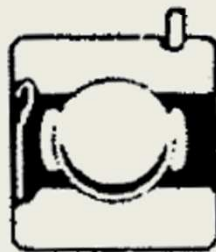
Two
sealings



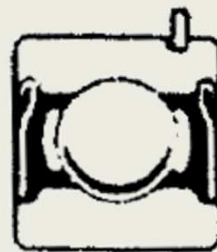
Sealing &
protections



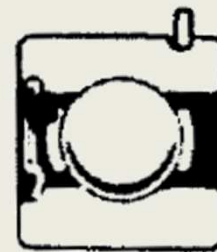
Ring &
spring



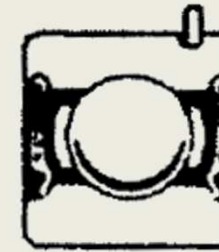
Ring,
spring
& protection



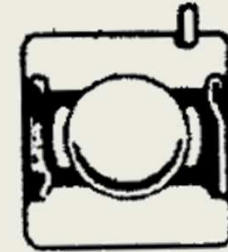
Ring,
spring & 2
protections



Ring,
spring &
sealing



Ring,
spring & 2
sealings

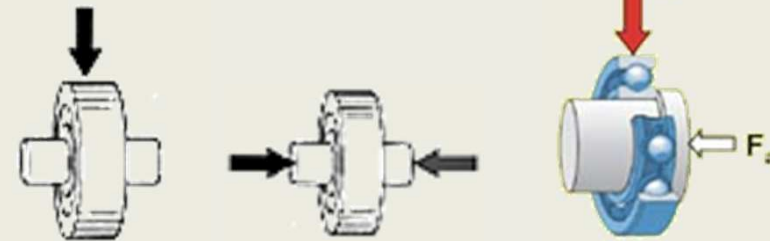


Ring,
spring,
protection &
sealing

CLASSIFICATION (I)

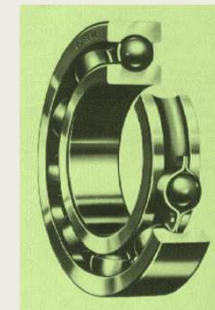
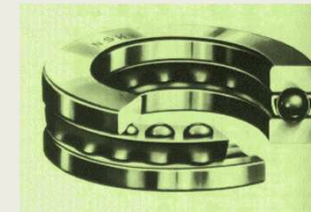
According to load direction.

- Radials.
- Axials.
- Mixed.



According to support element.

- Rings.
- Discs.



According to the tilting of the shaft

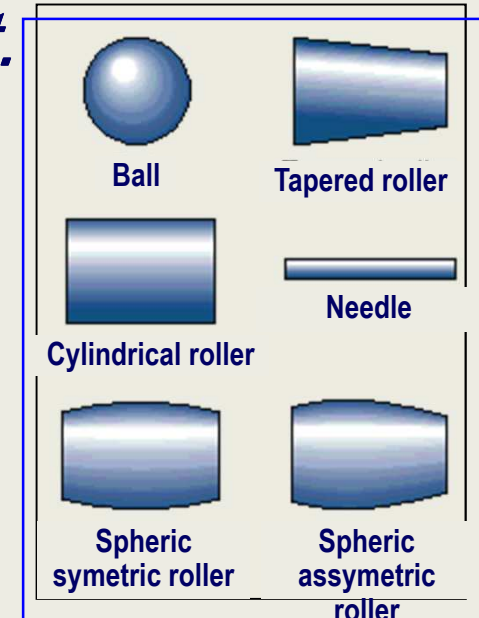
- Rigids.
- Pivotants (slight oscilation allowed).



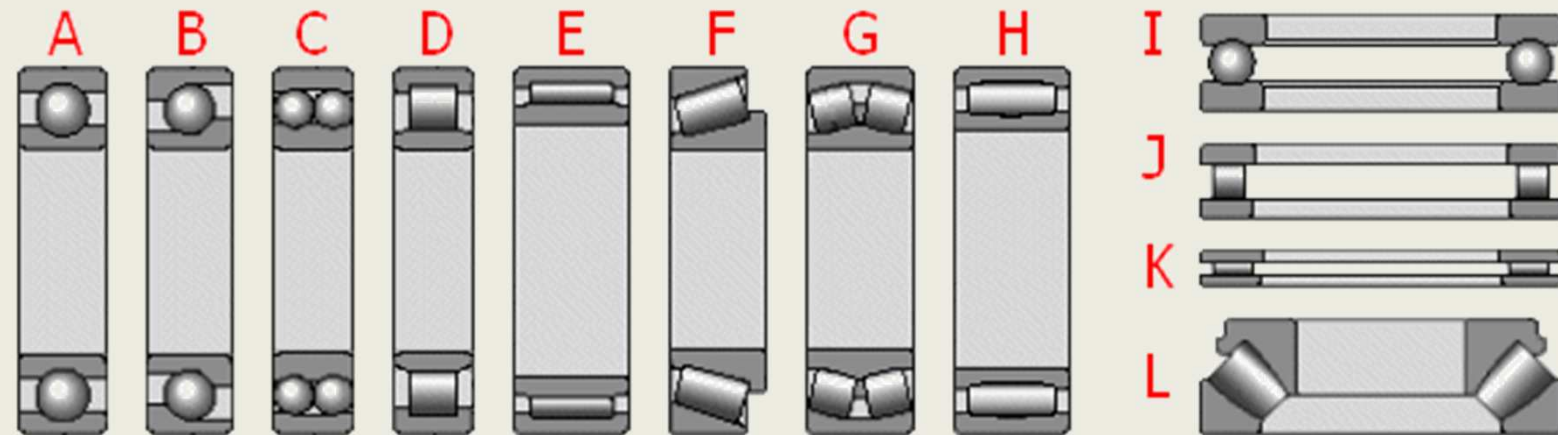
CLASSIFICATION(II)

According to the rolling element.

- Balls(punctual contact).
- Roller (lineal).
 - Tapered.
 - Cylindrical.
 - Needle (cylinder $L/d > 2,5$).
 - Spherical (barrel shaped).
 - Symmetric.
 - Asymmetric.



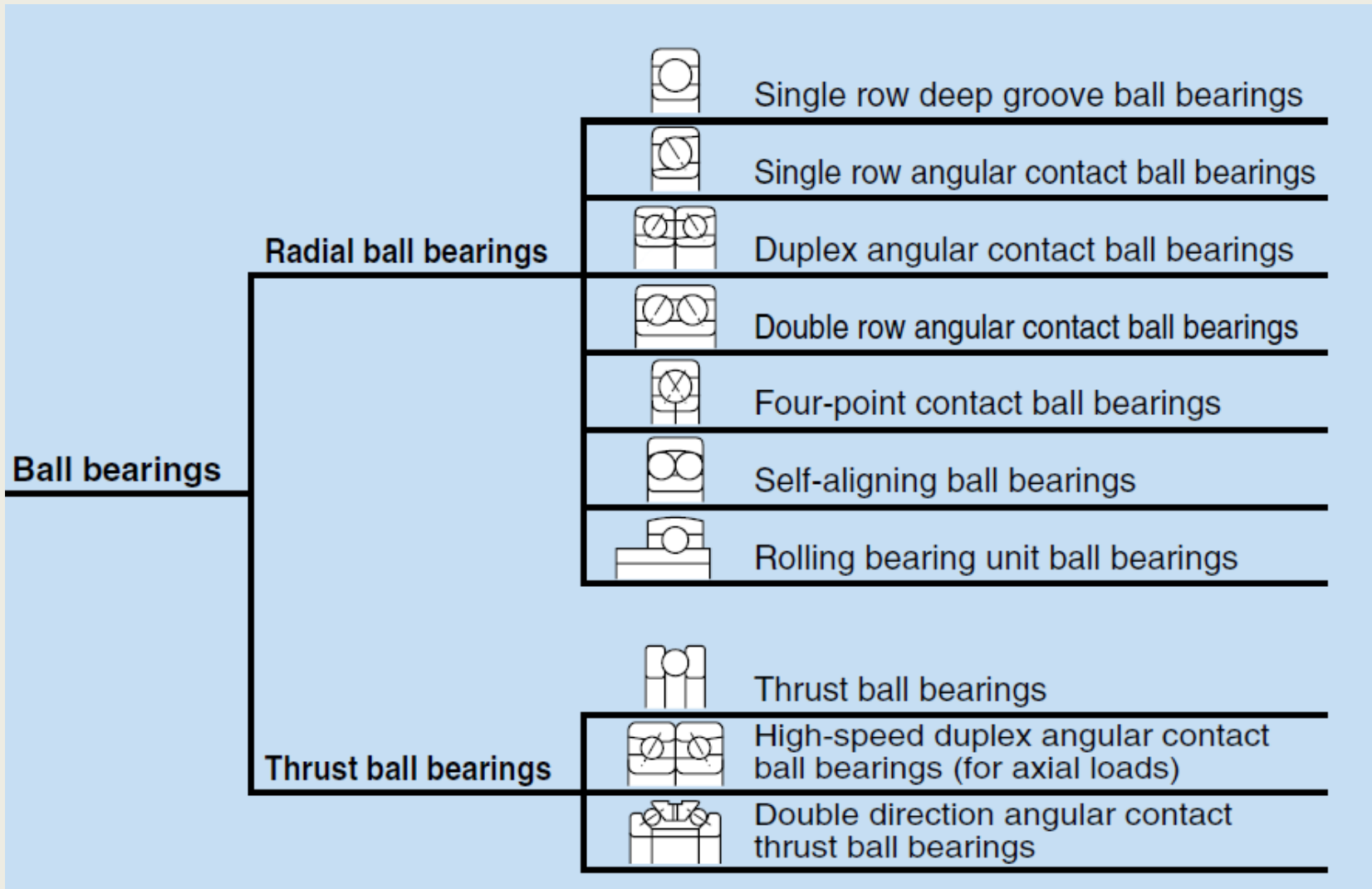
TYPES OF ROLLING BEARING



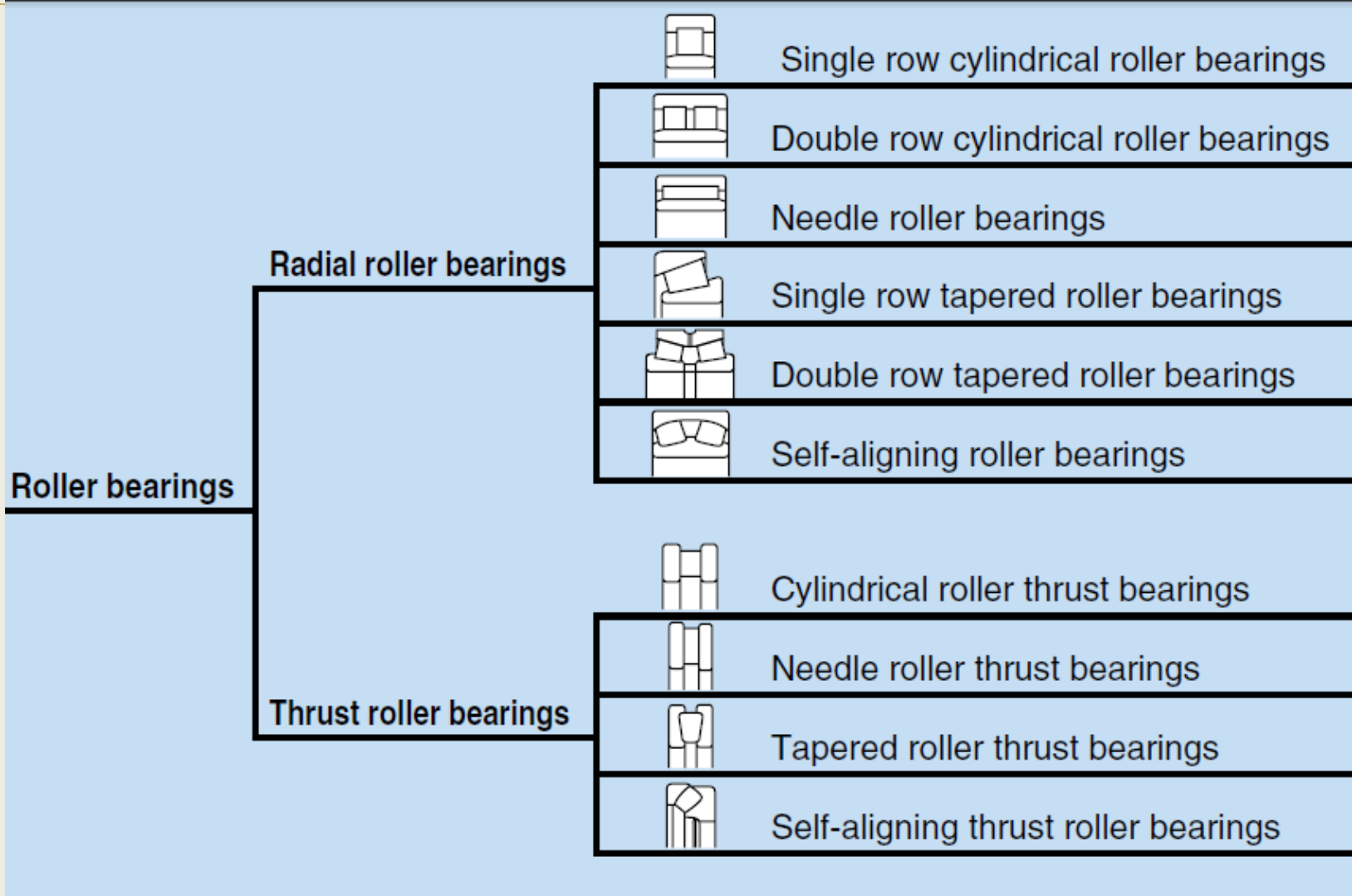
TYPES OF ROLLING BEARING



BALL BEARINGS



ROLLER BEARINGS



Source: NTN Rolling bearings handbook

TYPES AND PERFORMANCES OF ROLLING BEARINGS



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Bearings types	Deep groove ball bearings	Angular contact ball bearings	Cylindrical roller bearings	Needle roller bearings	Tapered roller bearings	Self-aligning roller bearings	Thrust ball bearings
Characteristics							
Load carrying capacity							
High speed rotation ^①	☆☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆	☆☆☆	☆☆	☆
Low noise/vibration ^①	☆☆☆☆	☆☆☆	☆	☆			☆
Low friction torque ^①	☆☆☆☆	☆☆☆	☆				
High rigidity ^①			☆☆	☆☆	☆☆	☆☆☆	
Allowable misalignment for inner/outer rings ^①	☆					☆☆☆	★
Non-separable or separable ^②			○	○	○		○

Source: NTN Rolling bearings handbook

BALL OR ROLLER BEARING?

For the same size of the bearing:

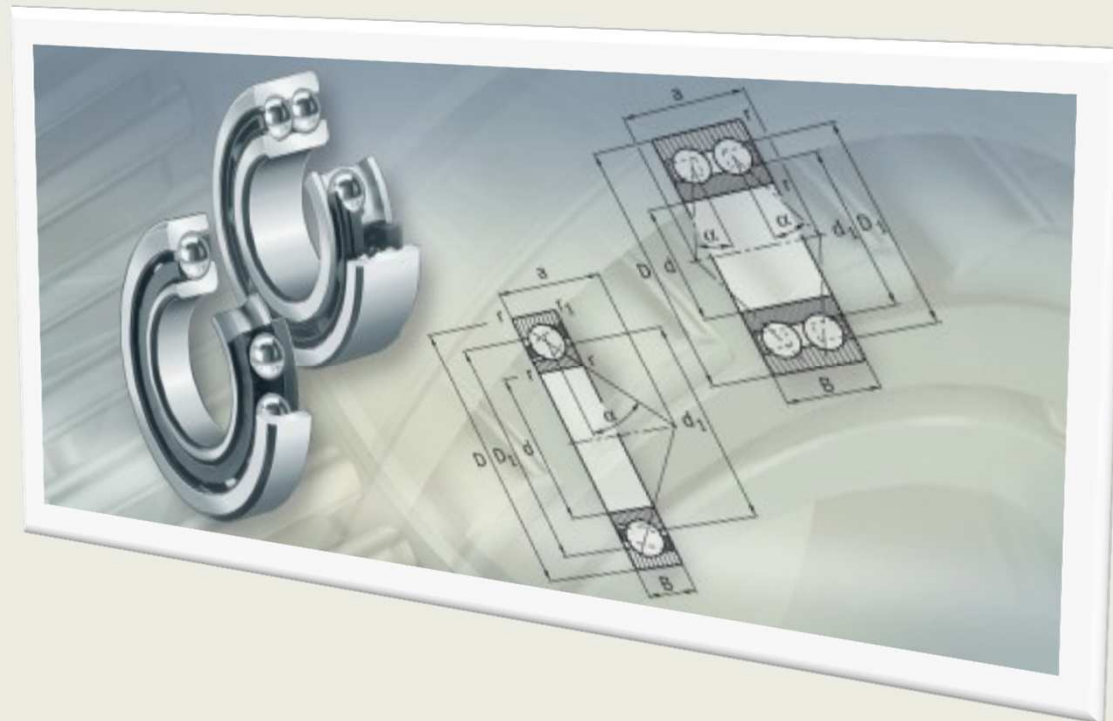
- ❑ Roller bearing allow higher radial loads.
- ❑ Ball bearings can achieve higher speeds.
- ❑ Ball bearing can support higher combined (axial + radial) loads.

Moreover:

- ❑ Roller bearing need better tolerances in the manufacture of the tracks because no mis-alignment is allowed.
- ❑ Spherical roller bearing collect the best characteristics of the ball and roller bearings and also they can be self-aligning.
- ❑ Angular contact ball bearings allows axial loads in both directions.

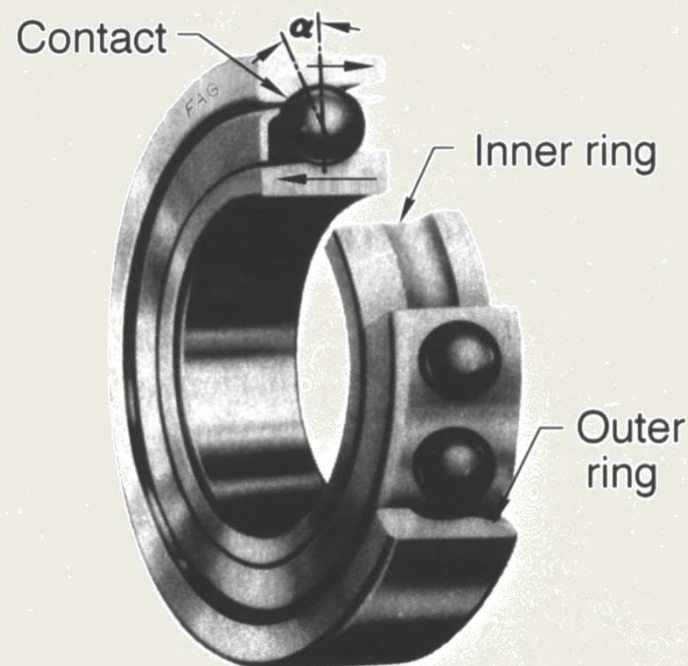
ANGULAR CONTACT BEARING

- Holds combination of axial and radial load .
- The line that joins the two points of contact with the tracks is tilted in respect to the radial plane.



ANGULAR CONTACT BEARING

- For the same size they can have more rolling elements.
- Single row angular contact bearing can only allow one axial load direction. Thus, usually two or more angular contact bearing are mounted or double row ones.
- Higher speeds and accuracy.



- Standards angular contacts are 15° , 25° , 35° and 40° .
 - For higher accuracy or speed commonly 15° is chosen.
 - Higher degrees are chosen for higher loads.



COMBINATION OF ANGULAR CONTACT BEARINGS

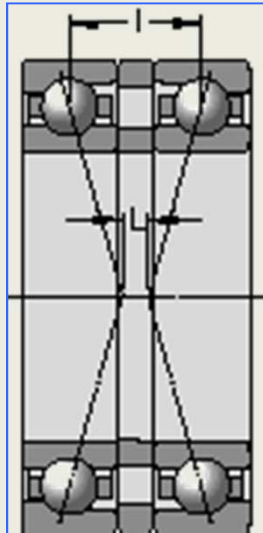


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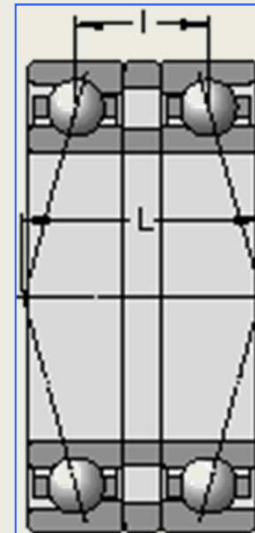


- ❑ Angular contact bearing are mounted in couples.
- ❑ In the space is limited doble row ones are mounted.
- ❑ When the couple is used one is for each direction of the axial loads.
- ❑ This assembly increases the total rigidity of the system.

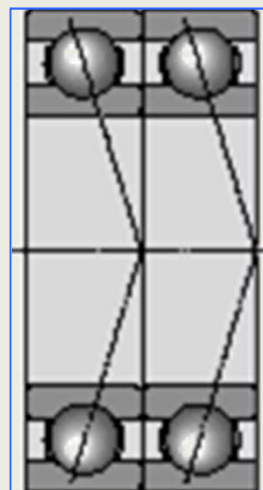
ARRANGEMENT OF ANGULAR CONTACT BEARINGS



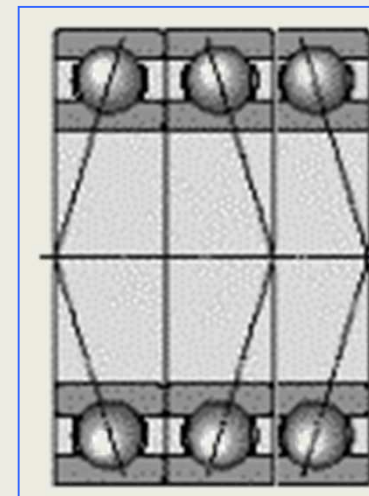
X arrangement



O arrangement



T arrangement



O-T arrangement