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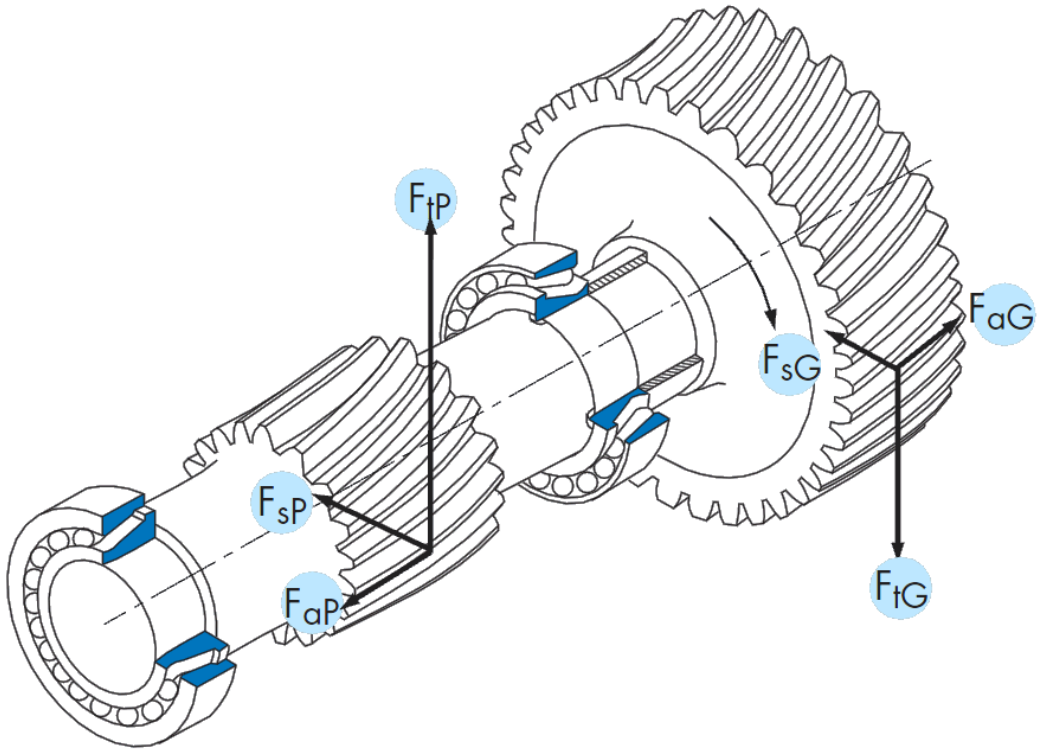
Bearing basics



Introduction to Anti-Friction Bearings

WHY DO WE USE A BEARING IN A MECHANIC SYSTEM?

THE 4 FUNCTIONS OF A BEARING ARE*

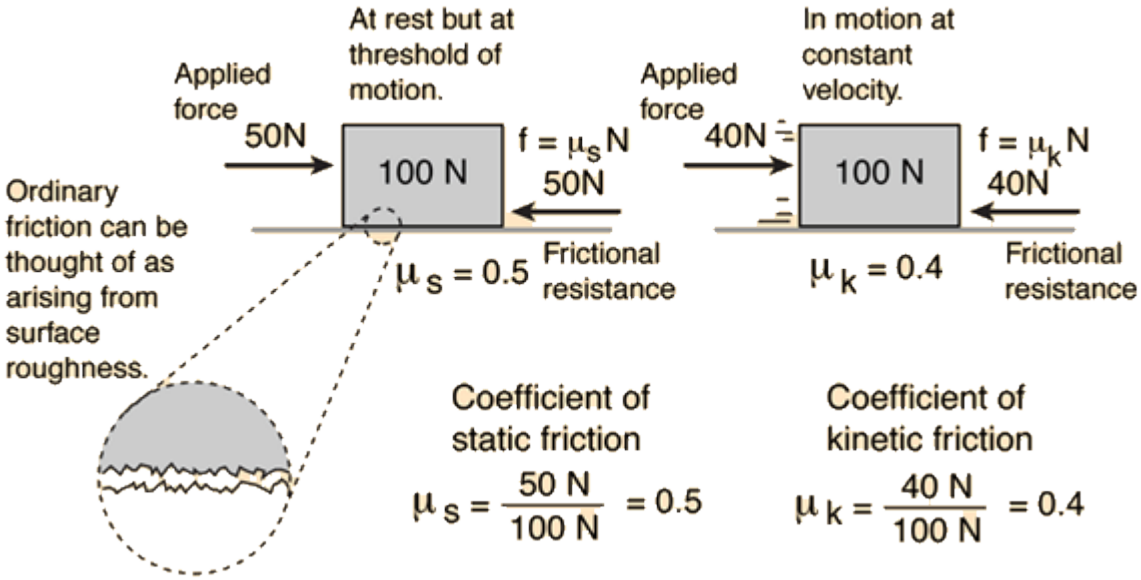
- to eliminate friction
- to radially support and align the shaft
- to carry & disperse loads
- to locate the shaft axially

Note:
* valid for any type

1. To eliminate friction

Friction induces problems of

- torque
- heat
- wear
- inefficiency, power loss



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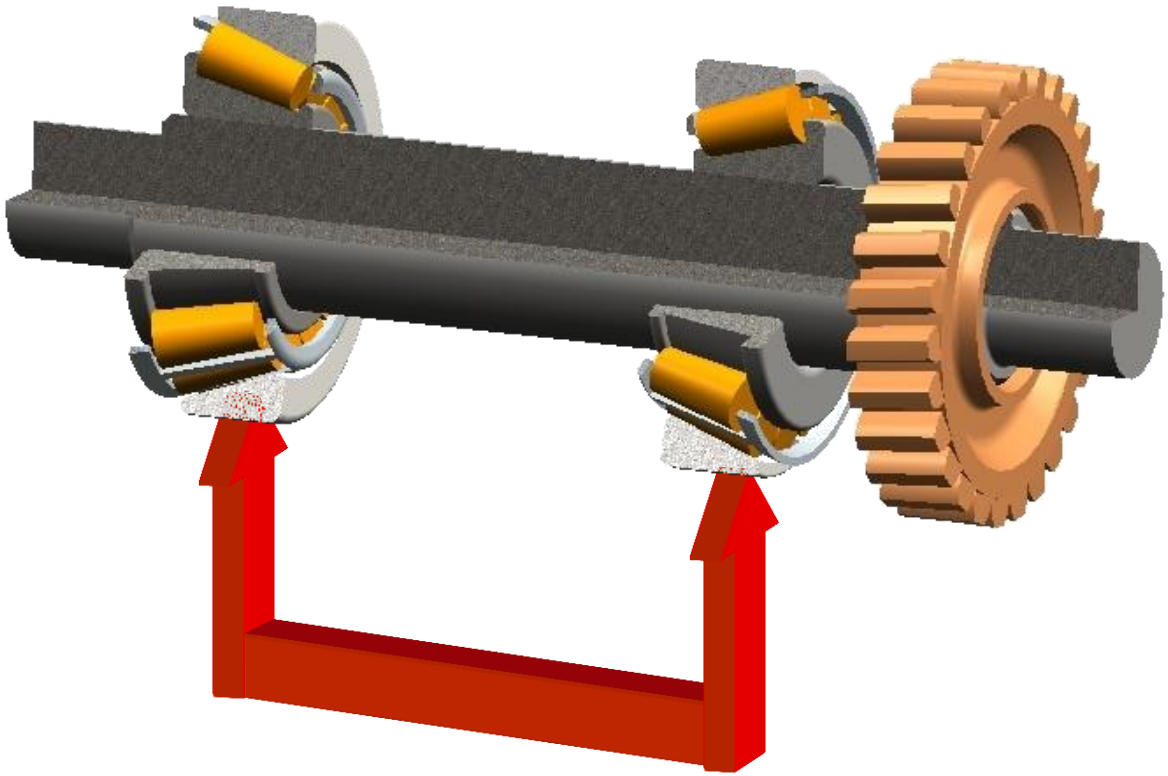
2. To radially support and align the shaft



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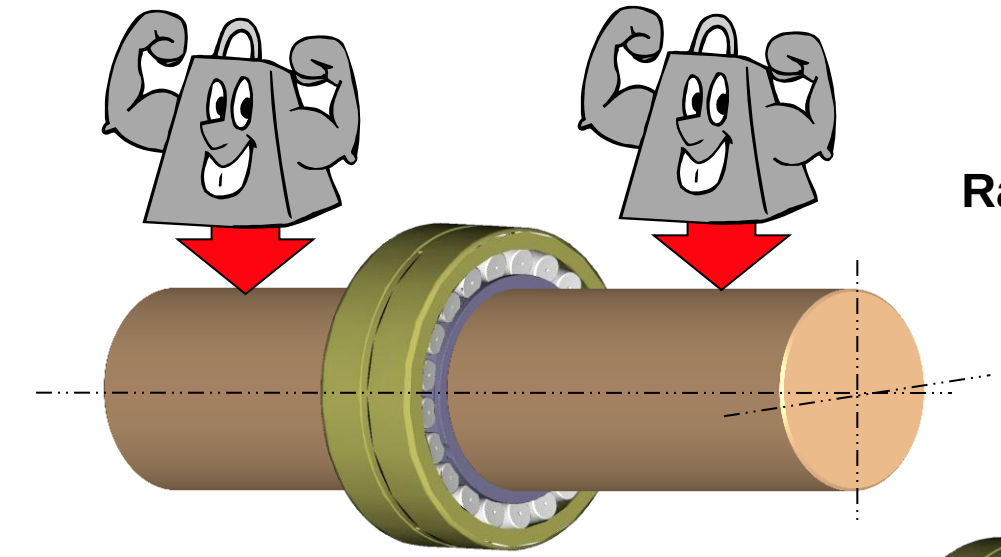
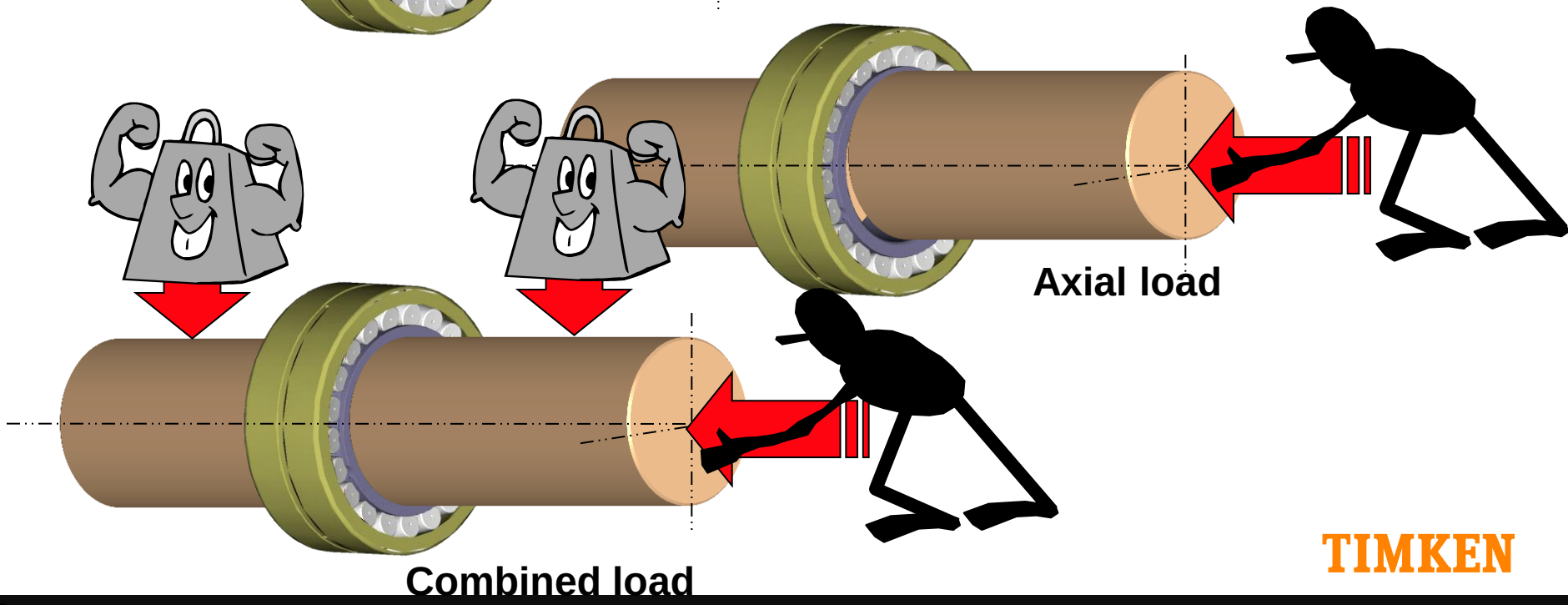
3. To carry & disperse loads



Radial load



Axial load

Combined load

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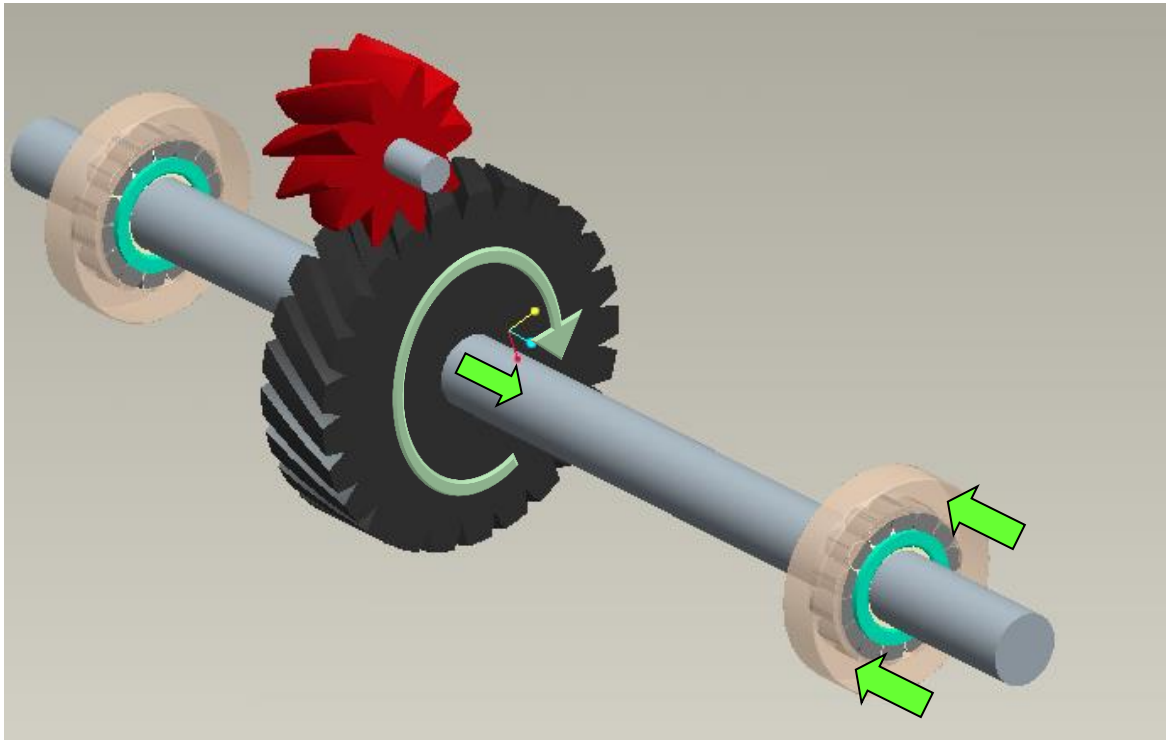
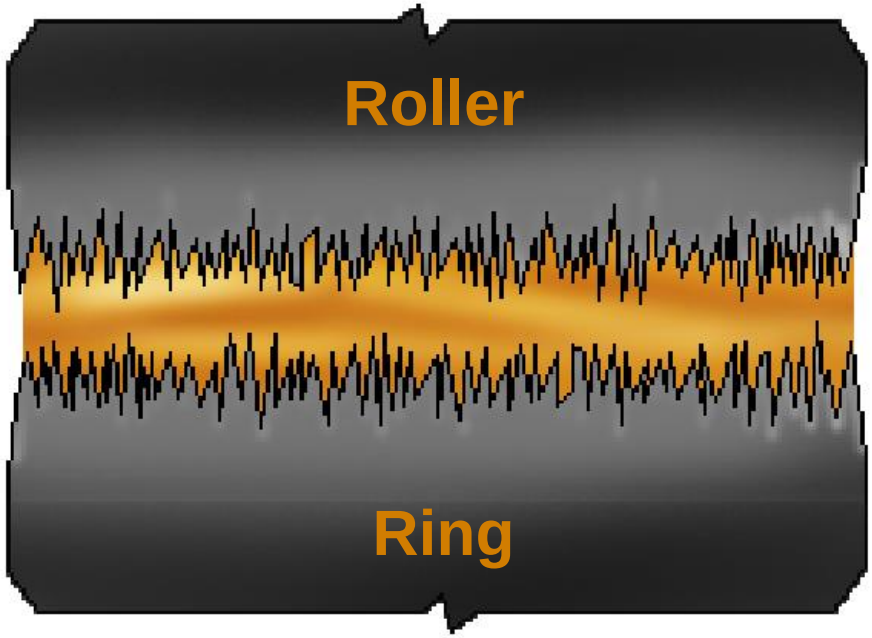
4.To locate the shaft axially



FRICTION

In a bearing, friction is affected by:

- Rolling element
- Surface finish
- Lubrication



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Friction Bearing

- **Bushings**
- **Plain Bearing**

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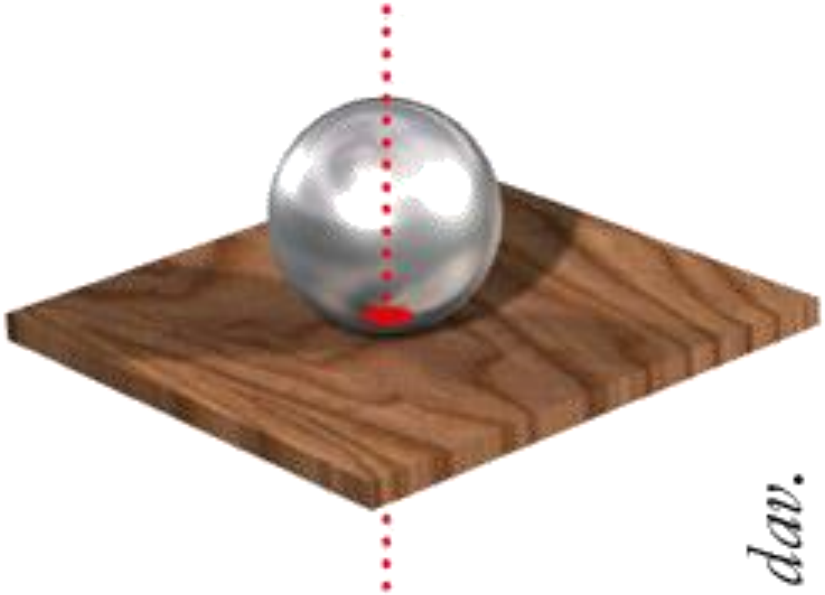
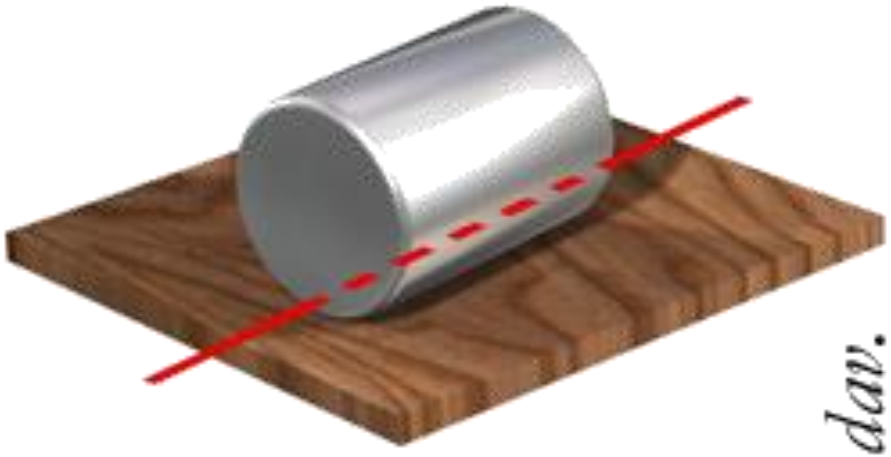
ROLLING FRICTION





Low friction

Low temperature

High speed

Light load

High friction

High Temperature

Low speed

High load

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Anti-friction bearings

Stronger.

Anti-Friction Bearings

- Tapered roller bearing
- Ball bearing
- Cylindrical roller bearing
- Spherical roller bearing
- Needle roller bearing

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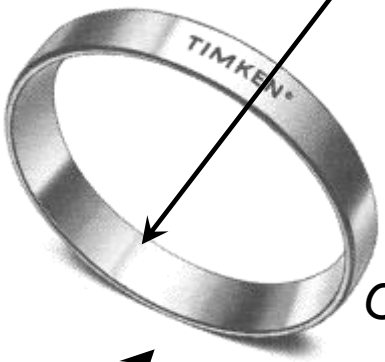
Anatomy of a anti-friction bearing

Rollers



Outer Ring

Raceway
outer ring

Cage

Tapered roller bearing

Inner Ring

Raceway
Inner ring

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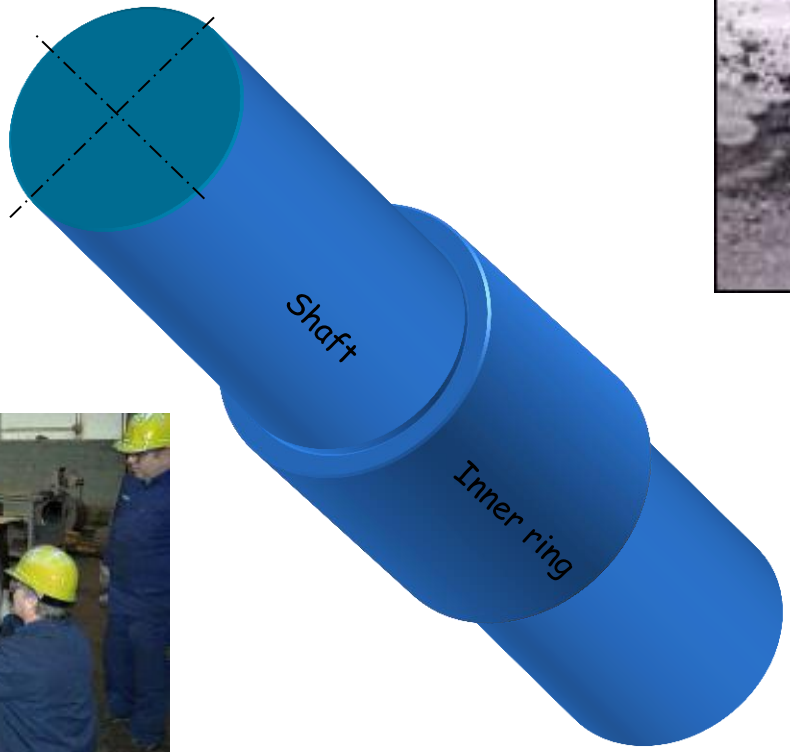
The bearing ring is used as a wear surface and is replaced when damaged; This allows to preserve the shaft from any damages.



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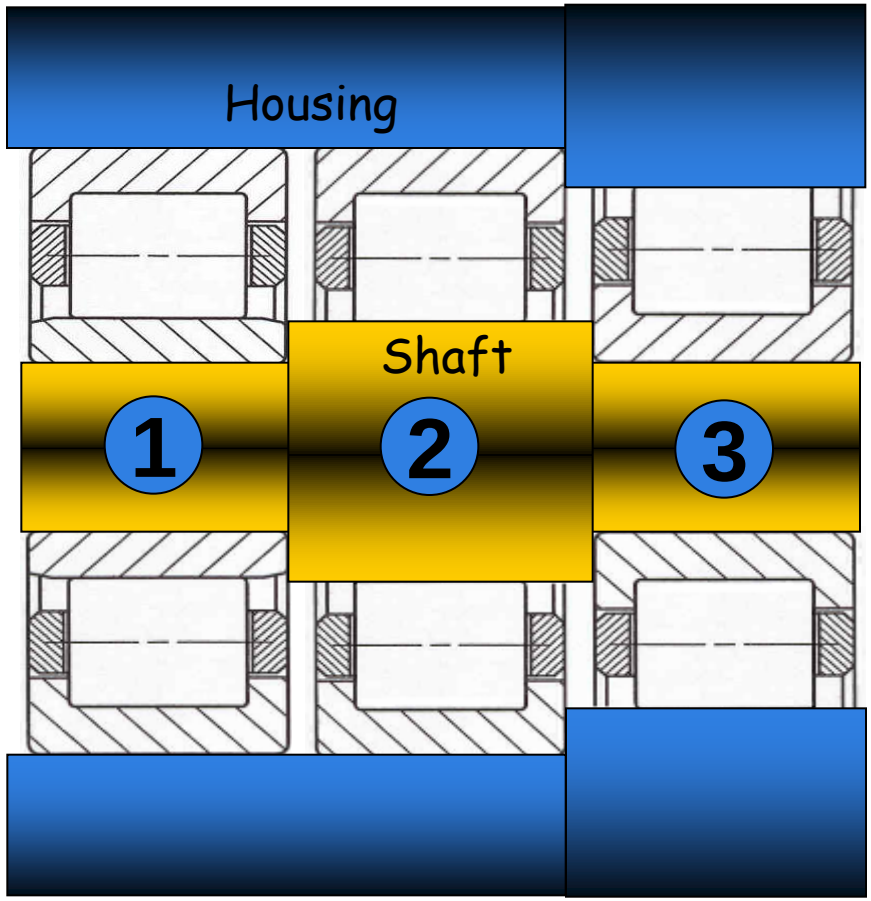
There are different ways to design a bearing arrangement.

The bearing is fitted on shaft and housing through the inner and outer ring (**position 1**).

The shaft can take the role of the inner ring (**position 2**).

The housing can take the role of the outer ring (**position 3**).

In this case, the customer needs to provide a surface equivalent to the appropriate ring quality.



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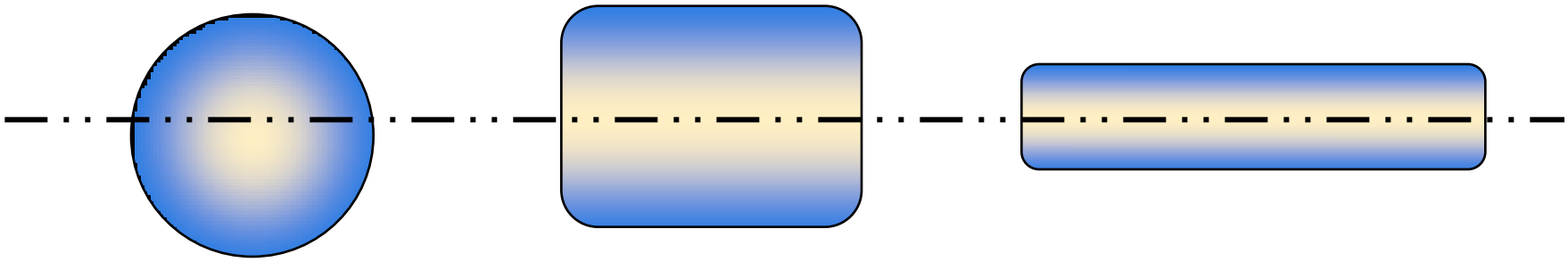
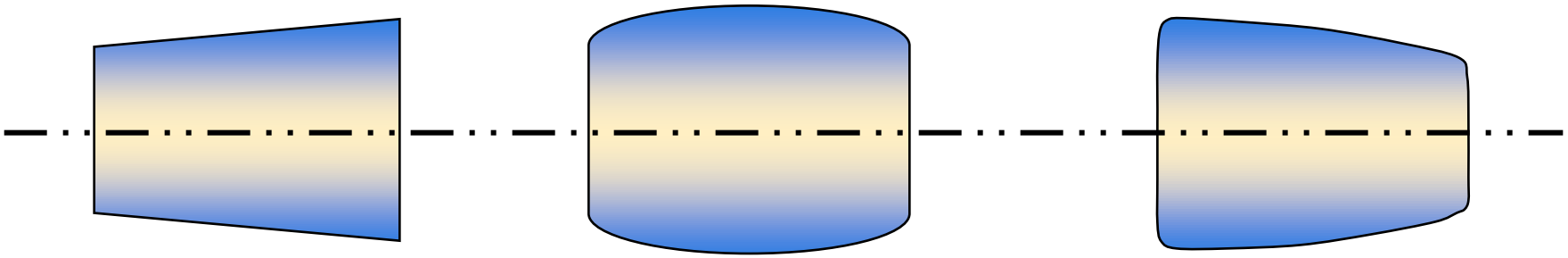
ROLLING ELEMENTS



Ball

Cylindrical roller

Needle roller



Tapered roller

Symmetrical barrel roller

Asymmetrical barrel roller

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Cage

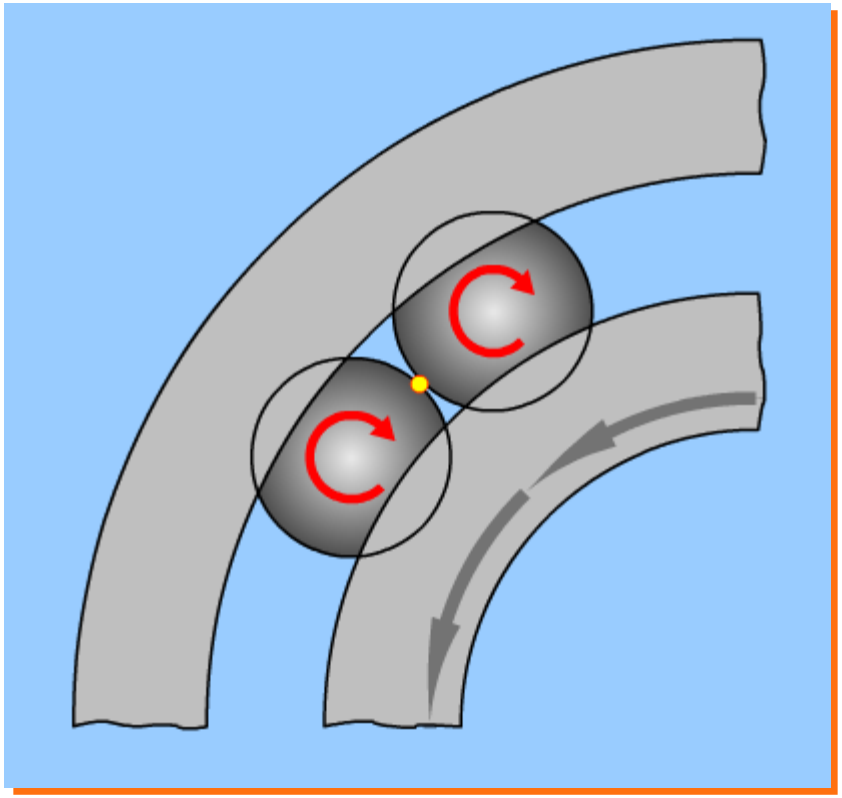
Functions:

- Separates rollers to prevent inter-roller rubbing
- Retains and guides the rollers
- Noise damping
- Increases space for lubricant

Effect of Contra-rotation on Rollers

Although all rollers are revolving the same way, at the contact point they are travelling in opposite directions (contra-rotation)

This results in friction, heat and wear



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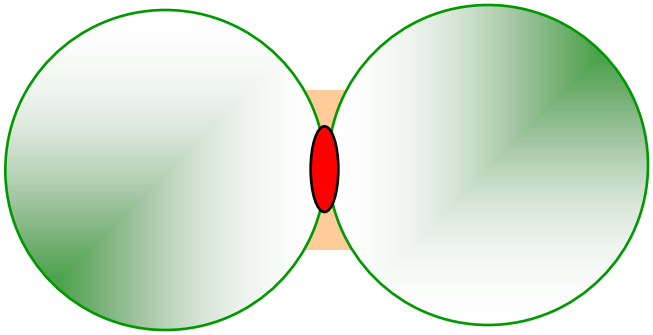
Inter-Roller Rubbing

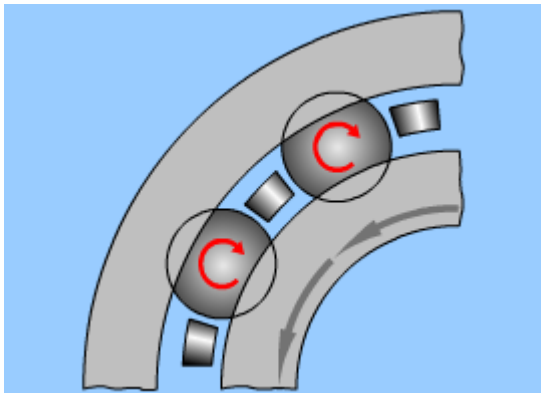


Non separated rollers gives inter-roller rubbing

Produces heat and expansion

Not suitable for high speed running

Cage separates rollers and lowers friction



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CAGES

- Pressed steel cages

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CAGES

- **Machined brass cages**

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Cages

- **Moulded polymer cages**

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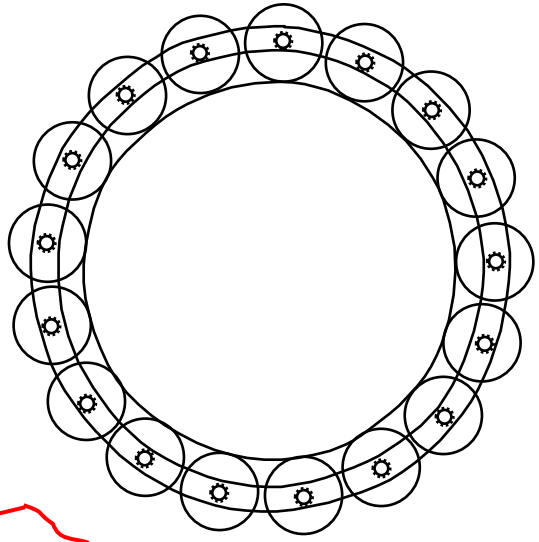
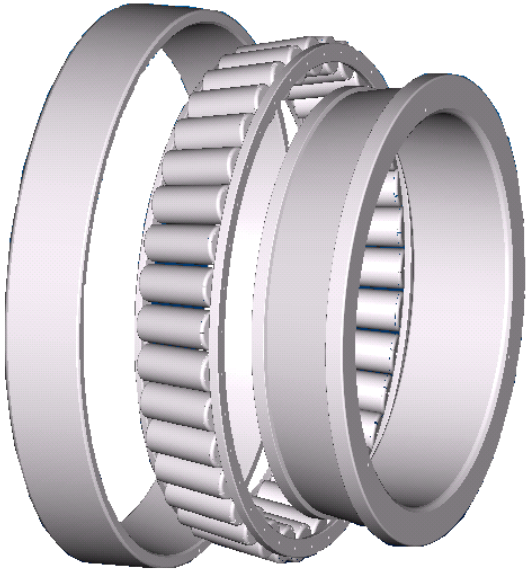
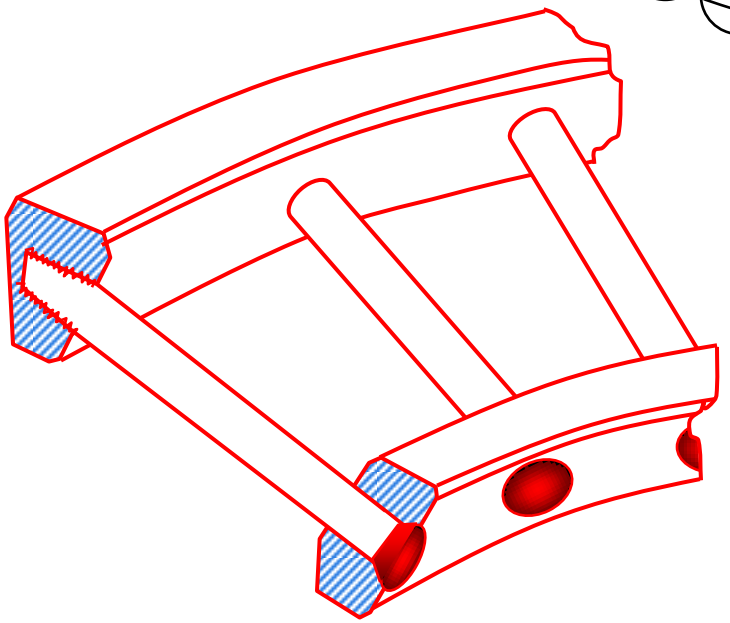
Cages

- **Pin type**







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Boundary dimensions

Bearing Industry Standards

- ANSI - American National Standards Institute
- ABMA - American Bearing Manufacturers Association
- ISO - International Standardization Organization
- DIN - Deutsches Institut für Normung
- JIS - Japanese Industrial Standards
- Bearing manufacturers internal specifications

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Where You Turn

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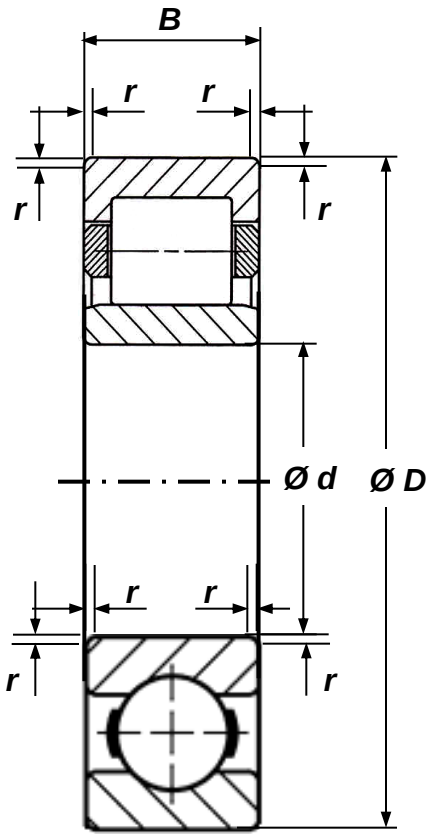
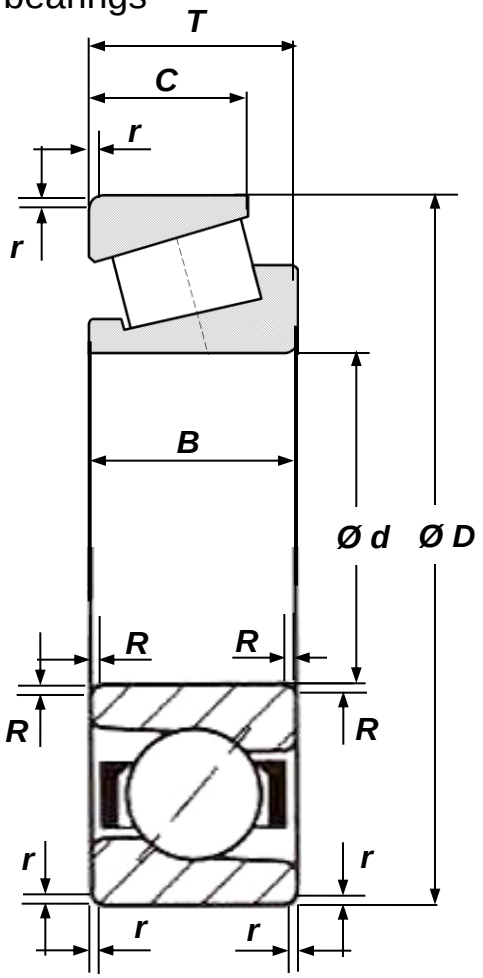
Boundary Dimensions

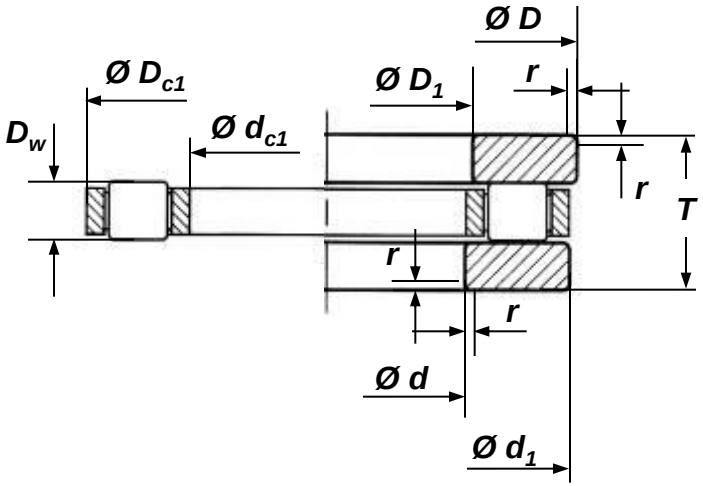
Radial ball & roller bearings

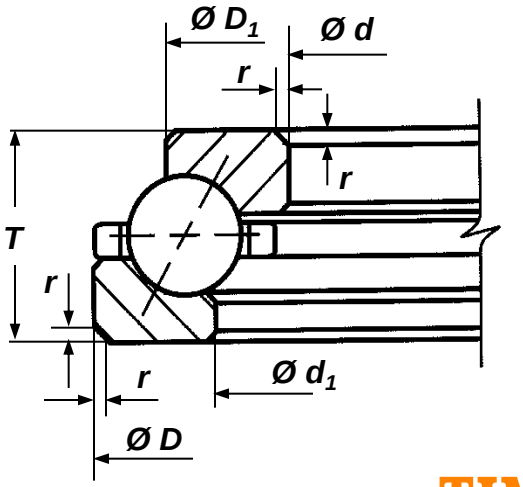


Angular contact ball & roller bearings



Thrust ball & roller bearings





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World Part Numbering system for Metric (ISO) bearings

Bearing serie codes

\#
or ##
or ###
or ####

Dimensions (Width & Diameter) serie codes

\# #

Bore size

\# #
or / ###
or / ####

Examples:

23292 → 2 | 32 | 92

NNU4980 → NNU | 49 | 80

240 / 800 → 2 | 40 | / 800

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Bearing serie codes and design types

Bearing family	Design type code	Design code + Width & Diameter series	Bearing type
Radial Ball Bearings	1	10; 12; 13	Self Aligning Ball Bearing
		112; 113	Self Aligning Ball Bearing with wider inner rings
		160; 161	Deep groove single row ball bearing
	2	22; 23	Self Aligning Ball Bearing
	6	60 618 62; 63; 64 622; 623	Deep groove single row ball bearing
Angular contact Ball Bearings	23	2344; 2347	Thrust double direction angular contact ball bearing
	3	32; 33	Double row angular contact ball bearing
	7	72; 73	Single row angular contact ball bearing
	76	7602; 7603	Thrust single direction angular contact ball bearing
	QJ	QJ2; QJ3	Four point contact ball bearing
Spherical Roller bearings	2	202; 203	Single row spherical roller bearings
		213 222; 223 230; 231; 232; 233; 239	Double row spherical roller bearings
		292; 293; 294	Thrust spherical roller bearing
Tapered Roller Bearings	3	302; 303 313 320; 322; 323, 329 330; 331;332	Single row tapered roller bearing (original ISO)
	J	JC; JD;JF; JN JP; JS; JT; JW	Single row tapered roller bearing (new metric)
	J	JL; JLM; JM; JHM; JH; JHH	Single row tapered roller bearing (metrified inch design)

Cylindrical Roller Bearings	N	N2; N3 NJ2; NJ3 NJ22; NJ23 NU10; NU19 NU2; NU22; NU23 NU3 NUP2; NUP22; NUP23 NUP3	Single row cylindrical roller bearing
		NCF18 NCF22; NCF29 NCF30 NJ23	Full complement single row cylindrical roller bearing
	NN	NN30 NNU49	Double row cylindrical roller bearing
		NNC49; NNF50	Full complement double row cylindrical roller bearing
Needle Roller Bearings	NA NKI or J	NA48; NA49; NA69 NKI or J + bore / width	Needle roller bearing with inner rings
	RNA NK	RNA48; RNA49; RNA69 NK + bore / width	Needle roller bearing without inner rings
	BK HK	BK + dia width HK + dia width	One closed end Drawn cup needle roller bearing Open ends drawn cup needle roller bearing
	K	K + dia x OD x width	Single & double row needle roller & cage radial assembly
	AXK	AXK + d D	Thrust needle roller & cage assembly
	FNT	FNTF- d D FNTK - d D FNTKF - d D	hrust unitized needle roller bearing assemb

Dimensions serie codes

Dimensions Series for Radial Bearings

ISO 15

(Radial Roller Bearings **EXCLUDING** TRBs)

- **First Number**
- **Width Series**
- 8, 0, 1, 2 , 3, 4, 5, 6
- Wider Bearing →
- Established within each Diameter Series

- **Second Number**
- **Diameter Series**
- 7, 8, 9, 0, 1, 2, 3, 4
- Larger OD →
- Standard Outside Diameters for each Bore Size Range

6

Dimension Series for Thrust Bearings

ISO 104

(Applies to Non-Tapered Thrust Bearings)

First Number
Height Series
7, 9, 1 →
Taller Bearings
Established Within Each Diameter Series

Second Number
Diameter Series
7, 8, 9, 0, 1, 2, 3, 4 →
Larger OD's
Standard Outside Diameters for Each Bore Size Range

- **Common** Thrust SRB Series: 92, 93 and 94

8

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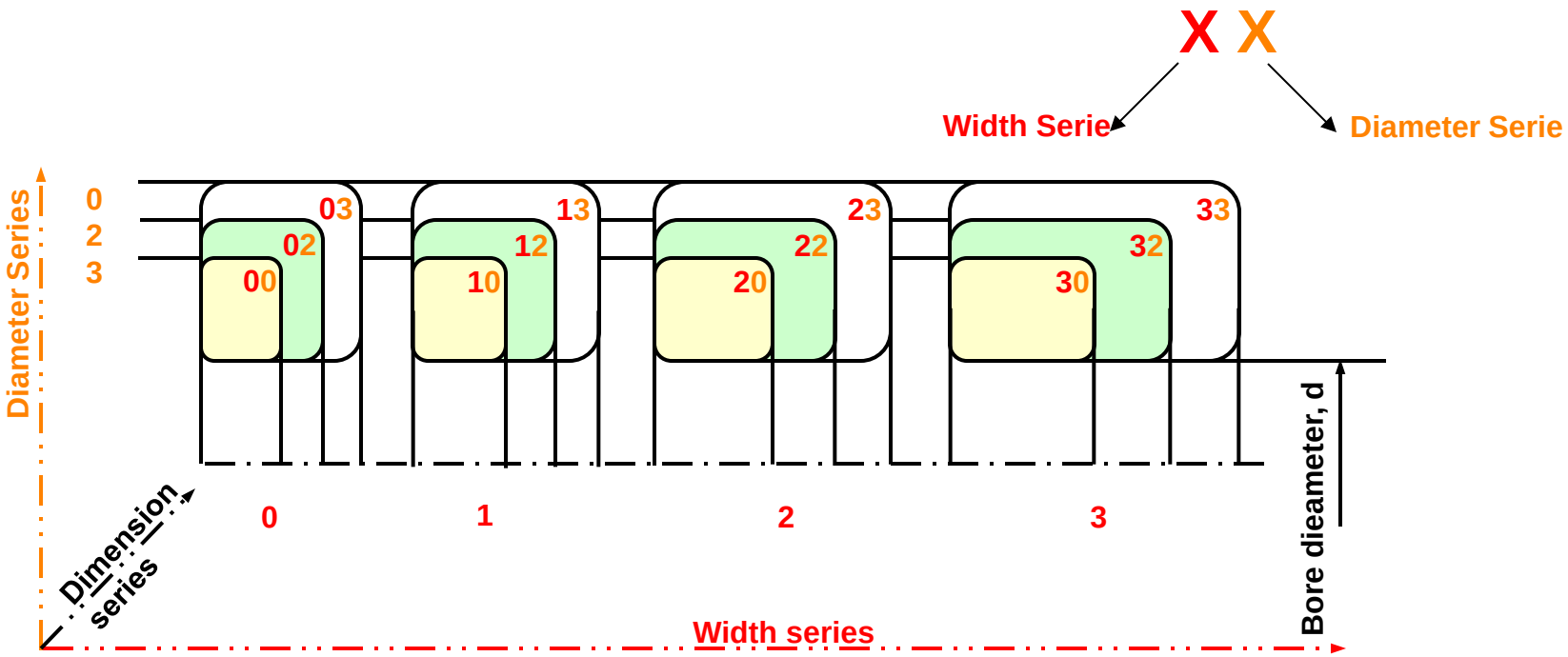
Dimensions serie code

Dimension Series for Radial Bearings



Note : For 02, 03, 04, the zero is ignored

Example: NJ 0315 becomes NJ315

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Bearing Bore Size (d)

d < 20 mm

- 00 = 10 mm
- 01 = 12 mm
- 02 = 15 mm
- 03 = 17 mm

20 mm ≤ d < 500 mm

- Last Two Digits x **5** = Bore (in mm)
- Examples

  04x**5** = 20 mm

  07x**5** = 35 mm

  10x**5** = 50 mm

  96x**5** = 480 mm

d ≥ 500 mm

- /Bore Size
- Examples

  /500 = 500 mm bore

  /750 = 750 mm bore

  /1120 = 1120 mm bore

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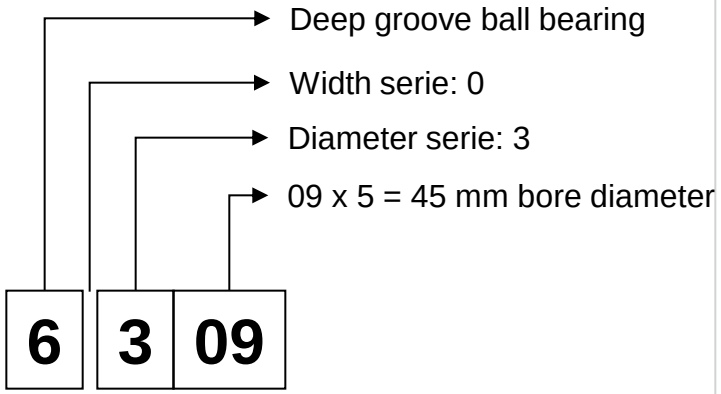
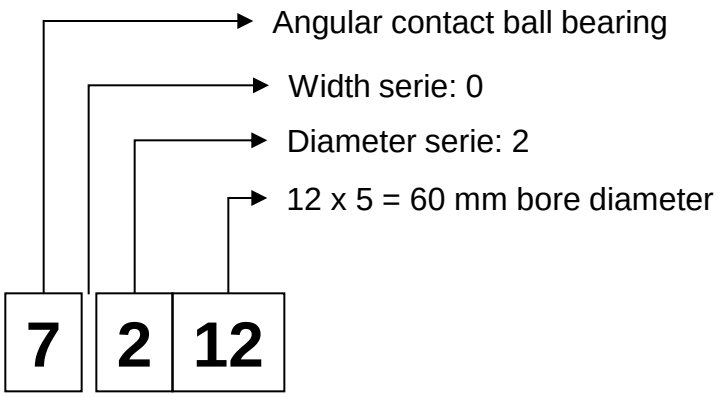
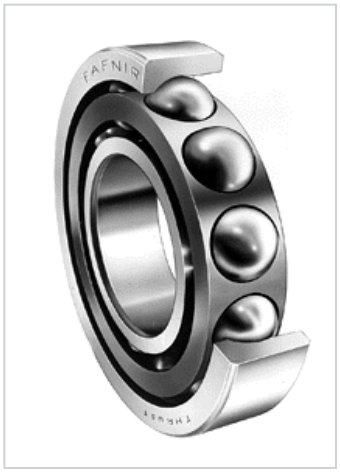
Examples







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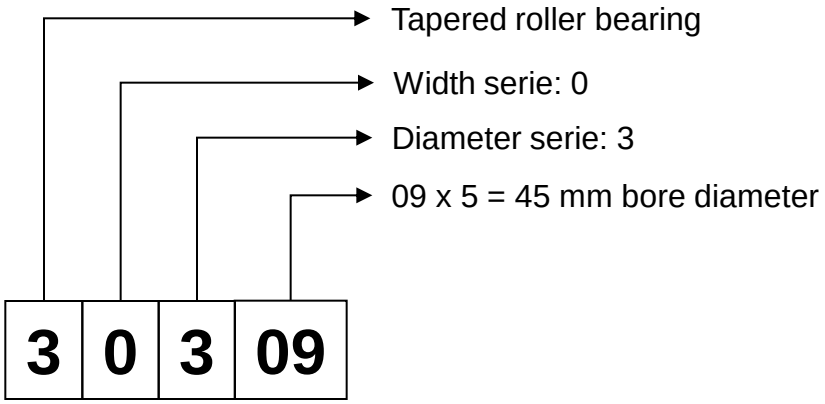
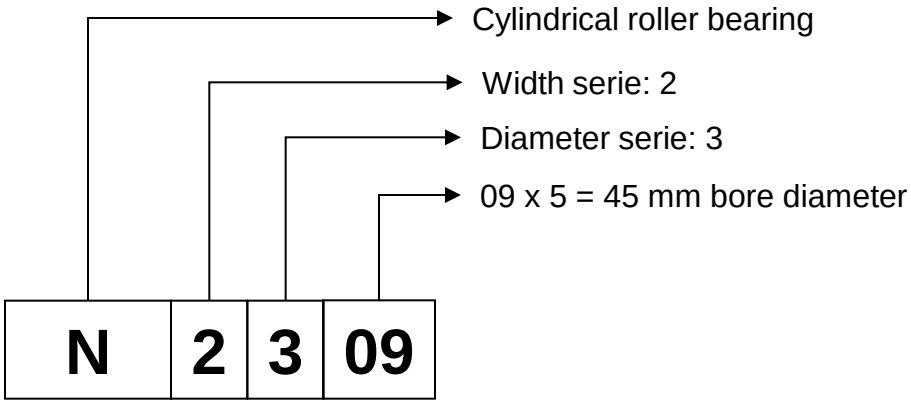
Examples





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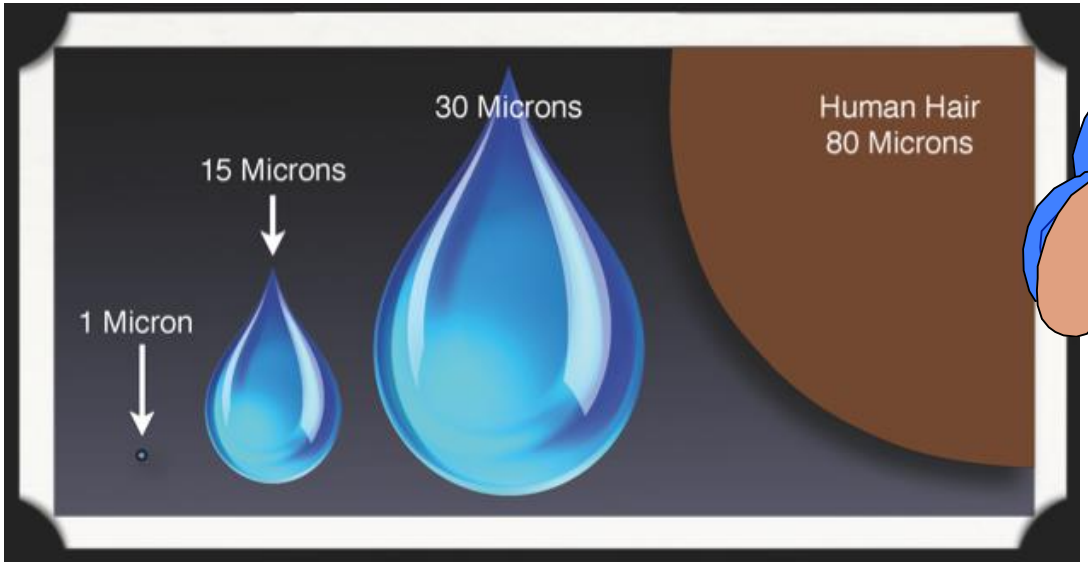
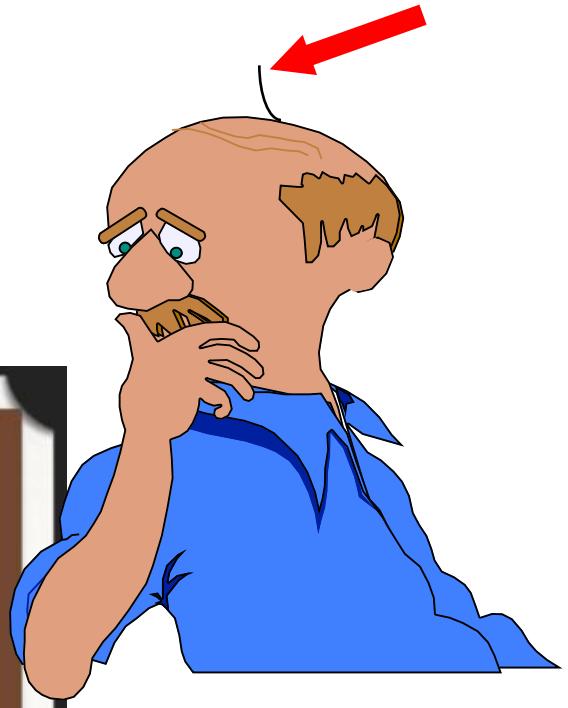
Precision Classes & Tolerances

Level of Precision

What does ONE (1) Micrometer look like?





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ISO and ABMA Tolerance Classes for Metric Roller bearings except TRB

ISO

- Normal
  (Designated P0 or without any indication)
- 6 - More Accurate than Normal
  (Designated P6)
- 5 - More Accurate than P6
  (Designated P5)
- 4 - More Accurate than P5
  (Designated P4)
- 2 - More Accurate than P4
  (Designated P2)

ABMA

- ABEC/RBEC 1 (≈ P0)
- ABEC/RBEC 3 (≈ P6)
- ABEC/RBEC 5 (≈ P5)
- ABEC/RBEC 7 (≈ P4)
- ABEC/RBEC 9 (≈ P2)

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Comparison with Metric TRB

CRB/SRB	
ISO	ABMA (metric)
P0	ABEC/RBEC 1
P6	ABEC/RBEC 3
P5	ABEC/RBEC 5
P4	ABEC/RBEC 7
P2	ABEC/RBEC 9

TRB		
ISO	ABMA (metric)	ABMA (inch)
Normal	K	4
6X	N	2
5	C	3
4	B	0
2	A	00
	AA	000

CRB/SRB Tolerances are NOT Equivalent to TRB Tolerances

Slide Intended to Show General Class Structure ONLY!

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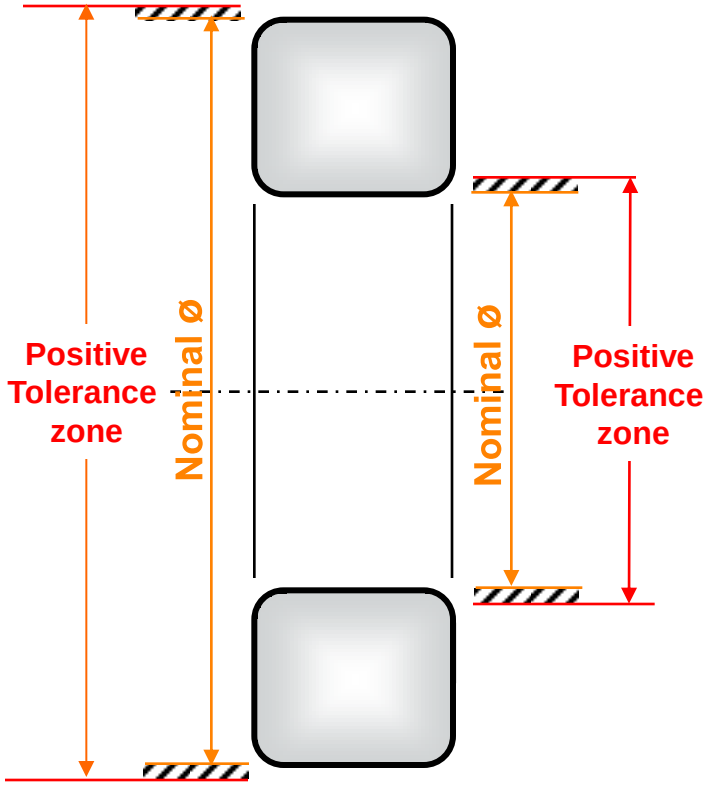
Radial tolerances

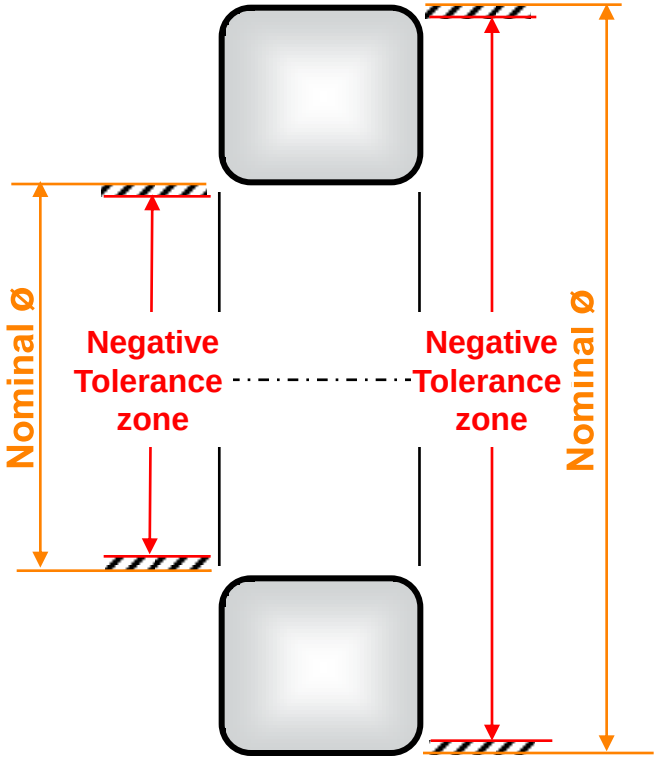
Inch design (ABMA) have

Positive tolerances



Metric designed (ISO) have

Negative tolerances



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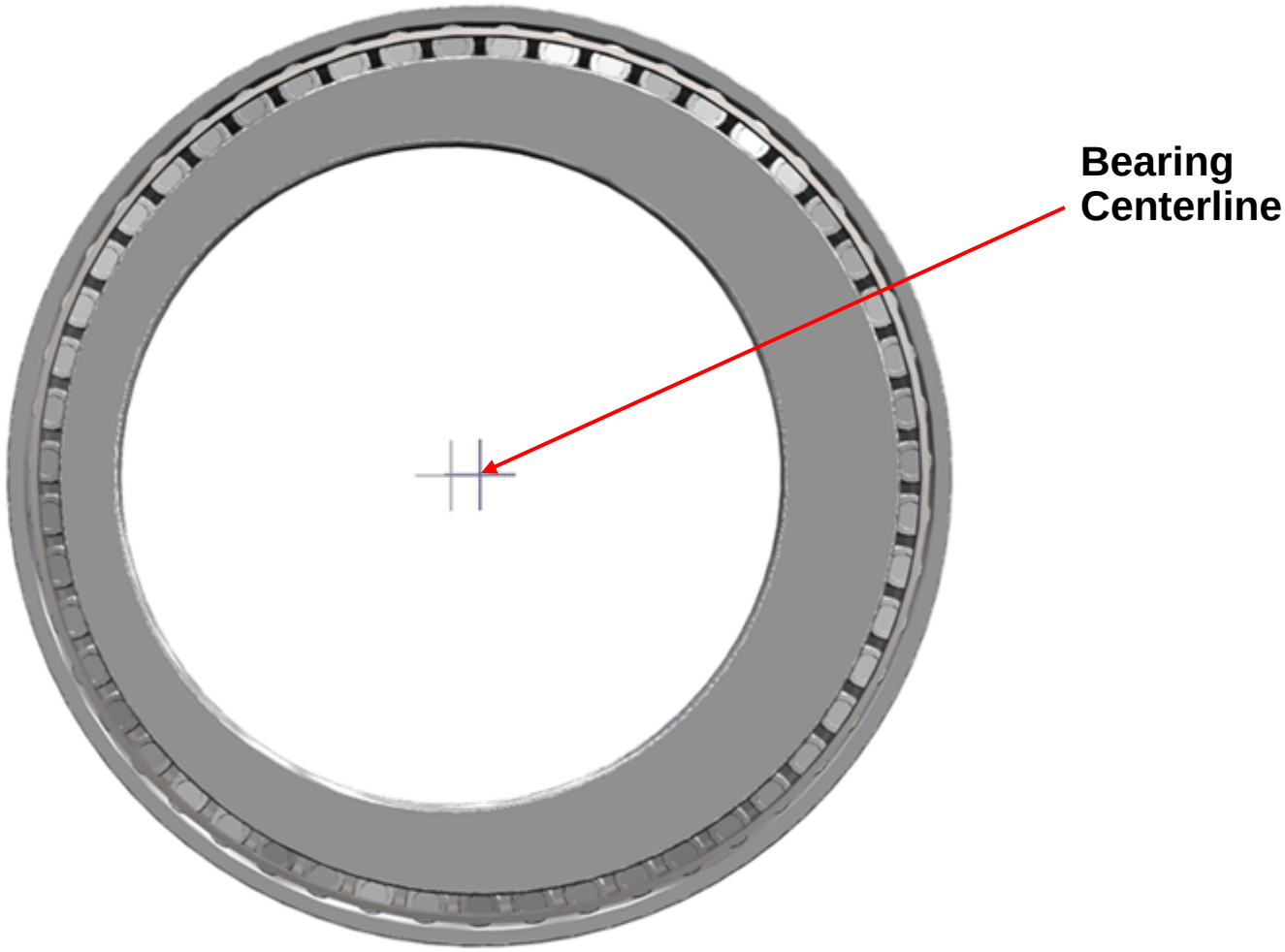
Radial Runout



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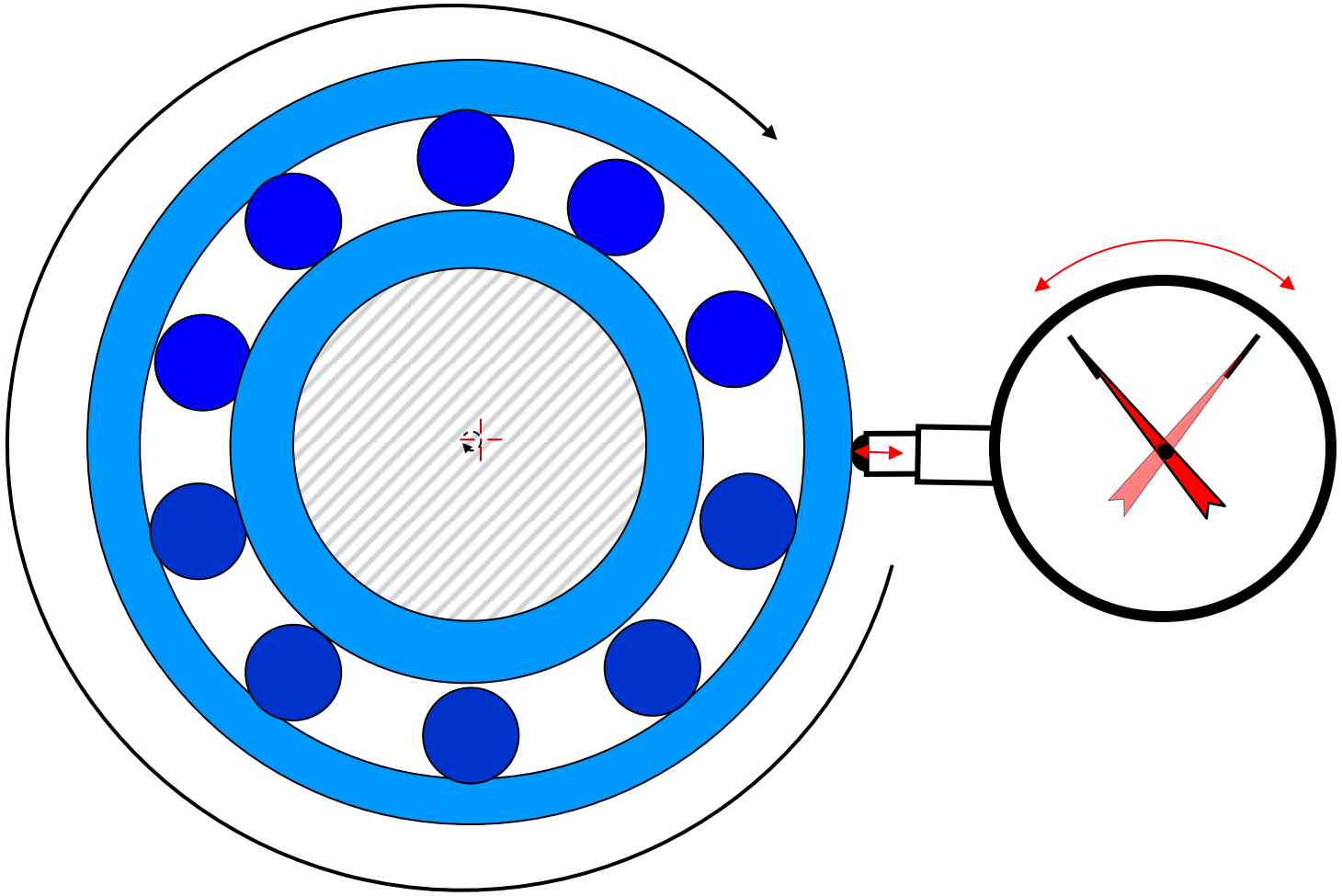
Radial Runout



Rotational precision of the assembled bearing.

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Why Bearings Fail

- Improper lubrication or lubricant failure 43%
  - Insufficient lubrication, either quantity or viscosity
  - Deterioration of lubricant; Improper relube interval or excess temperatures
  - Contamination of lubricant and/or bearing
  - Use of grease when oil was required
  - Incorrect grease selection for the application
- Improper mounting 27%
- Metal fatigue 9%
- Other causes 21%

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The Importance of Lubrication

- Permit to achieve the provided bearing life
  - Avoid metal/metal contact (reduce friction & wear)
  - Protect the bearing surfaces from corrosion and outside contaminants
  - Add an additional sealing barrier (grease)
- Transfer heat from the bearing surfaces (with oil)
- Separate the sliding contacts

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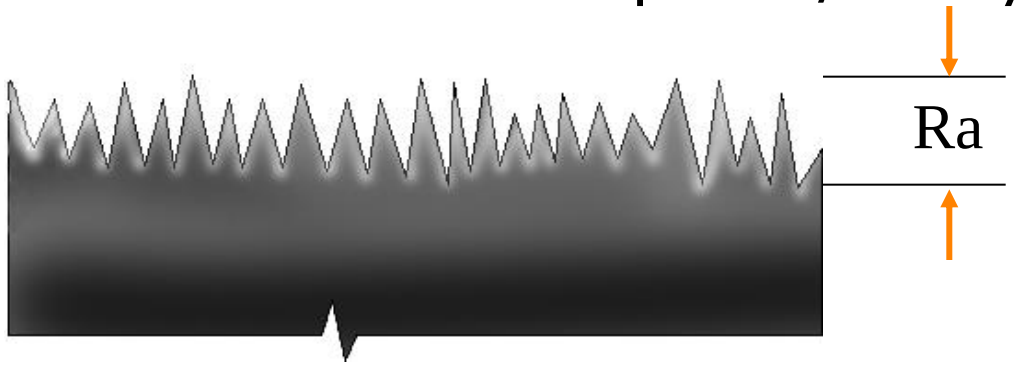
Surface finish

- Average Surface Roughness (Ra) is the average distance between surface peaks/valleys



Super finish	0.05 μm
Hone	0.070 à 0.250 μm
Grind	0.250 à 0.635 μm
Turn	>0.635 μm

Film thickness

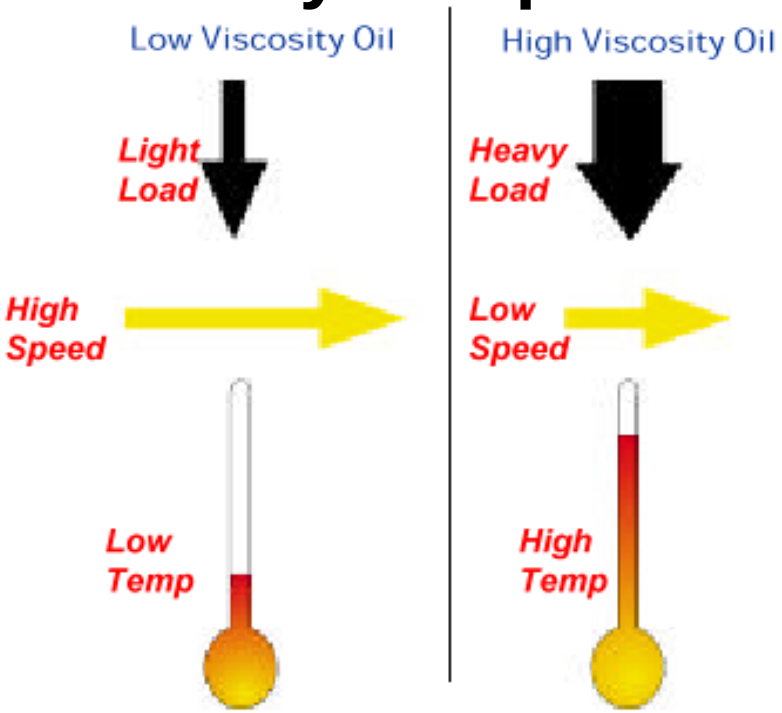
- Lubricant film thickness on raceway depends on the operating conditions
  - Surface velocity
  - Loads
  - Lubricant viscosity
  - Pressure/viscosity relationship
- Required minimum film thickness: 0.1 µm

Viscosity

The most important physical property of a lubricant

- Measure of the flow characteristics
- Varies inversely with temperature

Viscosity comparison



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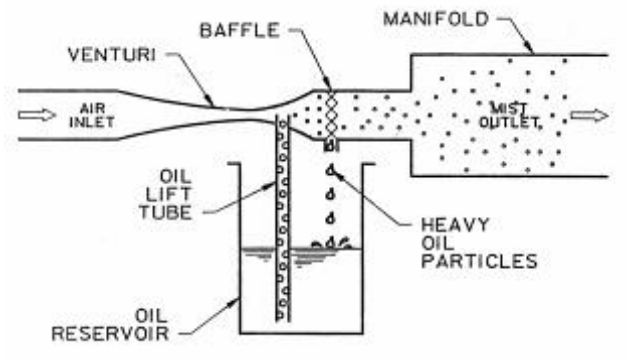
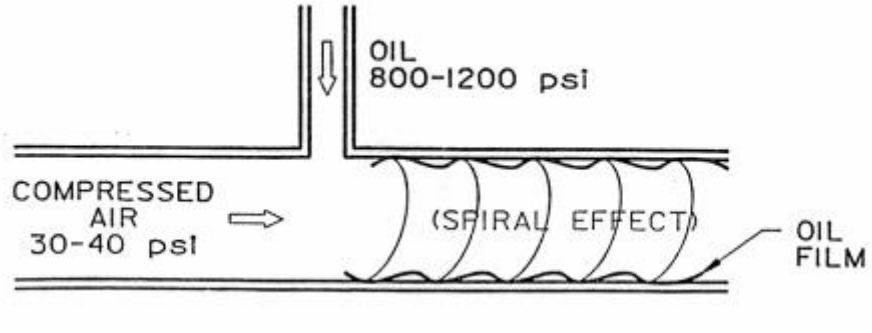
Basic methods of Lubrication

- Grease
- Oil - Mist
- Air- Oil
- Oil bath
- Circulating oil





TIMKEN

Dimensional Stability

- What is it?
  - Ability of a substance or part to retain its shape when subjected to varying degrees of temperature, moisture, pressure, or other stress-primarily temperature when talking about bearings
- What happens? -- Microstructure size increases and changes mechanical properties
  - Martensite is metastable - responds to heavy loading, pressure, heat, high cycles
  - Retained austenite changes at high temperatures and extreme cyclic loading

Maximum Operating Temperatures for Standard Timken Bearings-Guidelines

- The following are guidelines for how standard Timken bearings are generally produced.

Maximum Operating Temperatures for Standard Bearings

	Case Carburized	Through Hardened
Taper	**120°C (250°F)**	**120°C (250°F)**
Cylindrical (one row)	**120°C (250°F)**	**200°C (392°F)<300mm bore**
Spherical	**120°C (250°F)**	**200°C (392°F) <300mm bore**
Ball	**120°C (250°F)**	**120°C (250°F)**

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Maximum Operating Temperatures for Enhanced Dimensional Stability Timken Bearings

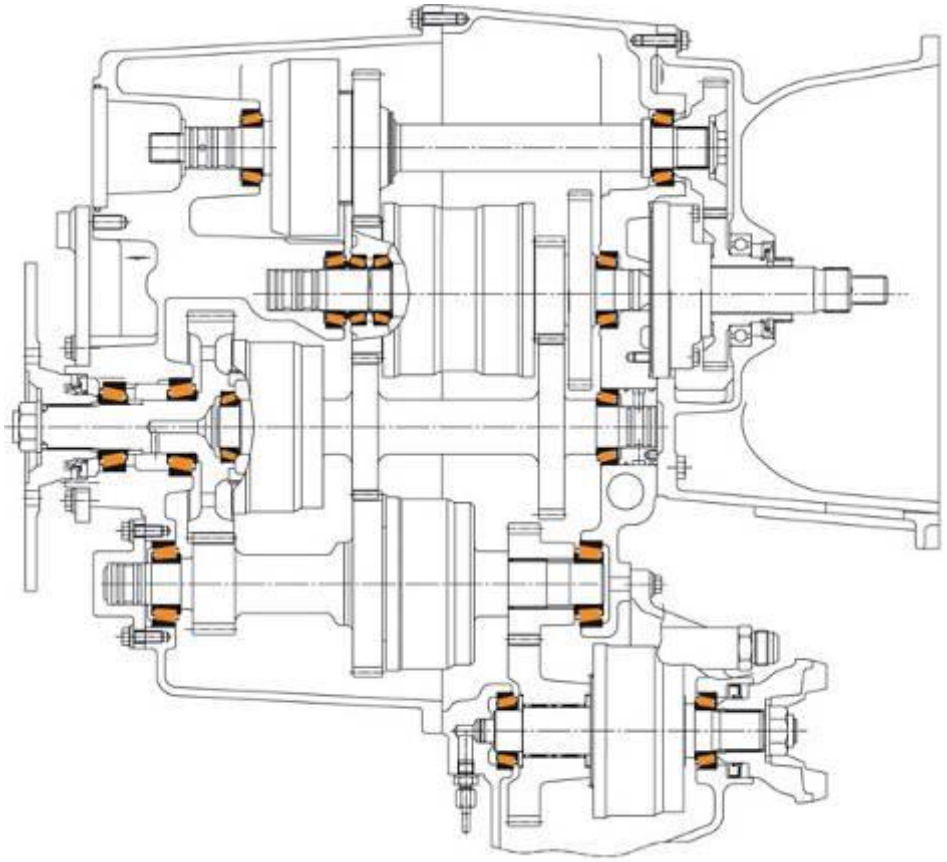
- Bearings with enhanced dimensional stability are available from Timken.
- These special bearings are made to DIN 623-1, Paragraph 3.3.6

SN	Rings or washers suitable for operation at service temperatures up to **120°C**
S0	Rings or washers suitable for operation at service temperatures up to **150°C**
S1	Rings or washers suitable for operation at service temperatures up to **200°C**
S2	Rings or washers suitable for operation at service temperatures up to **250°C**
S3	Rings or washers suitable for operation at service temperatures up to **300°C**
S4	Rings or washers suitable for operation at service temperatures up to **350°C**

- Enhanced Dimensional Stability bearings are marked with either the DIN code in the case of CRBs/SRBs/BBs (e.g. '–S2', '-S3') or a modified code in the case of Tapers.

TIMKEN

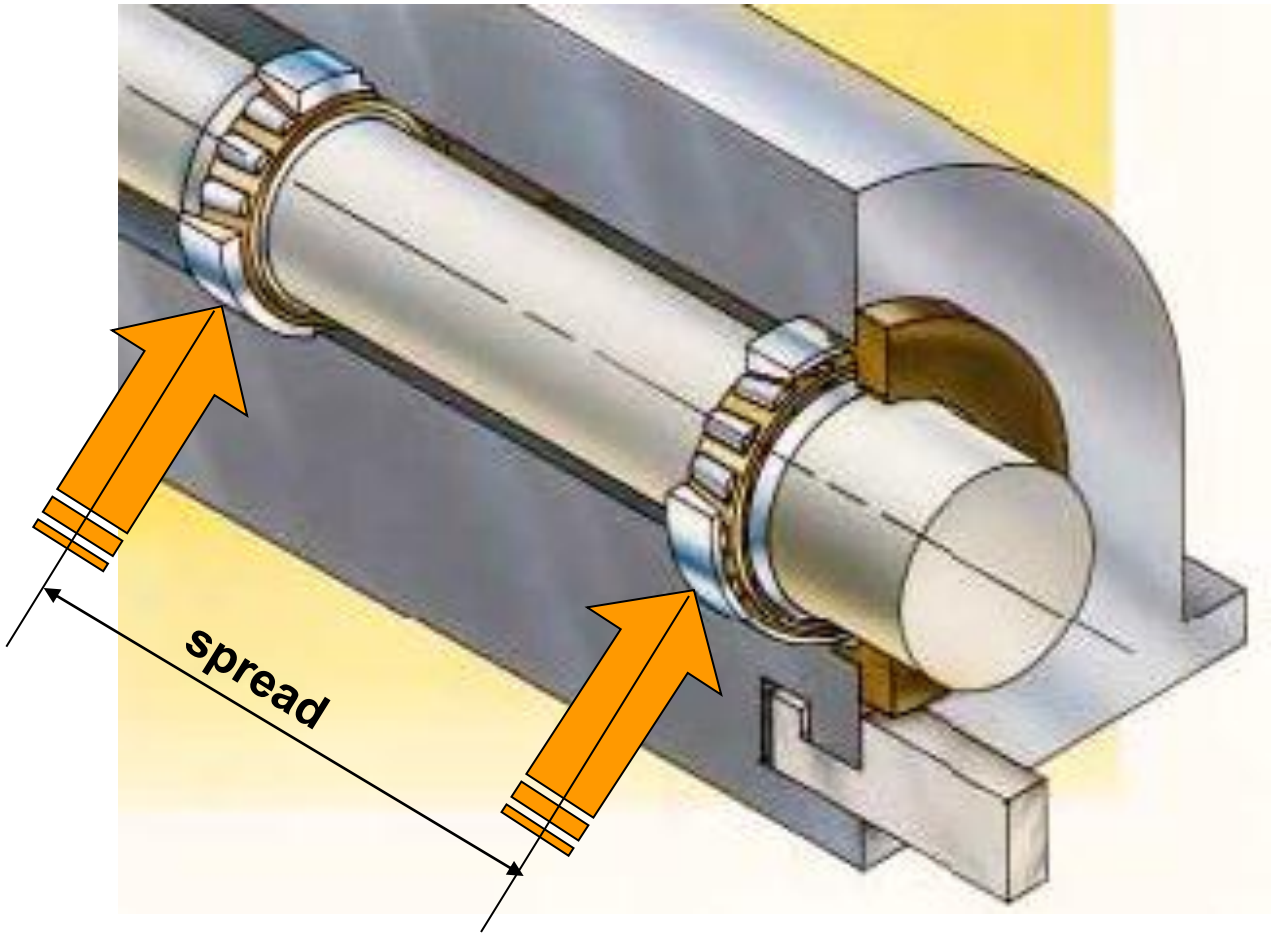
Mounting types



TIMKEN

Bearing arrangement

In order to guide and support a rotating shaft, at least **two bearings** are required which are arranged at a certain distance from each other that we call “spread”



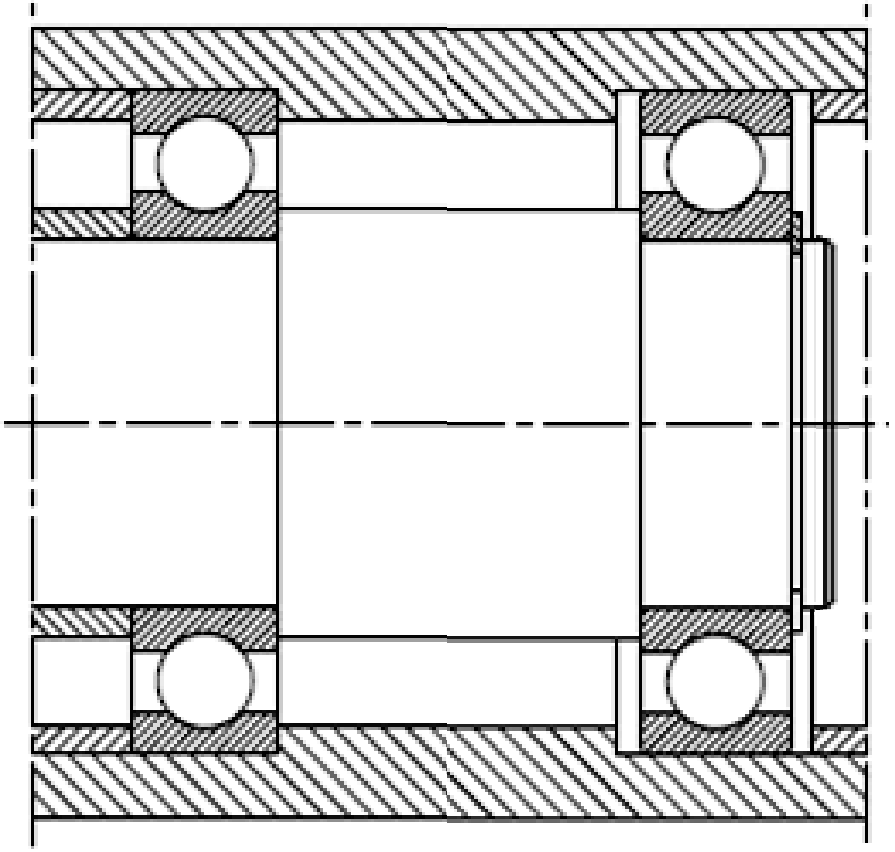
Bearing arrangement

- Depending on the types of bearing used and the application, different bearing arrangements can be selected:

1. with locating and floating bearings,
2. with adjusted bearings
3. with floating bearings

1. Locating-floating bearing arrangement

Locating or Fixed bearing



Non locating or Floating bearing

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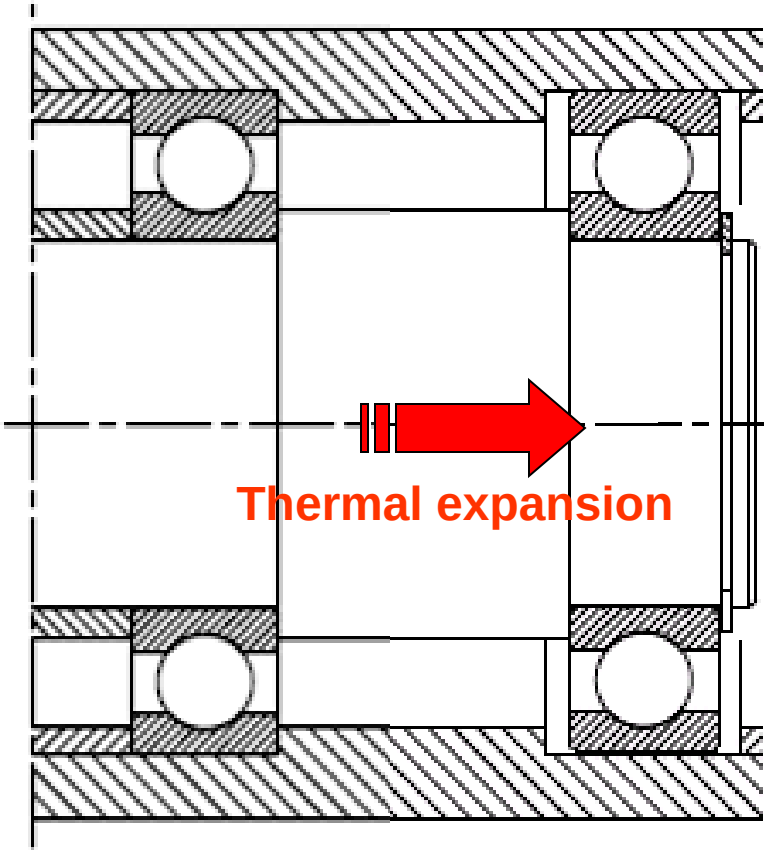
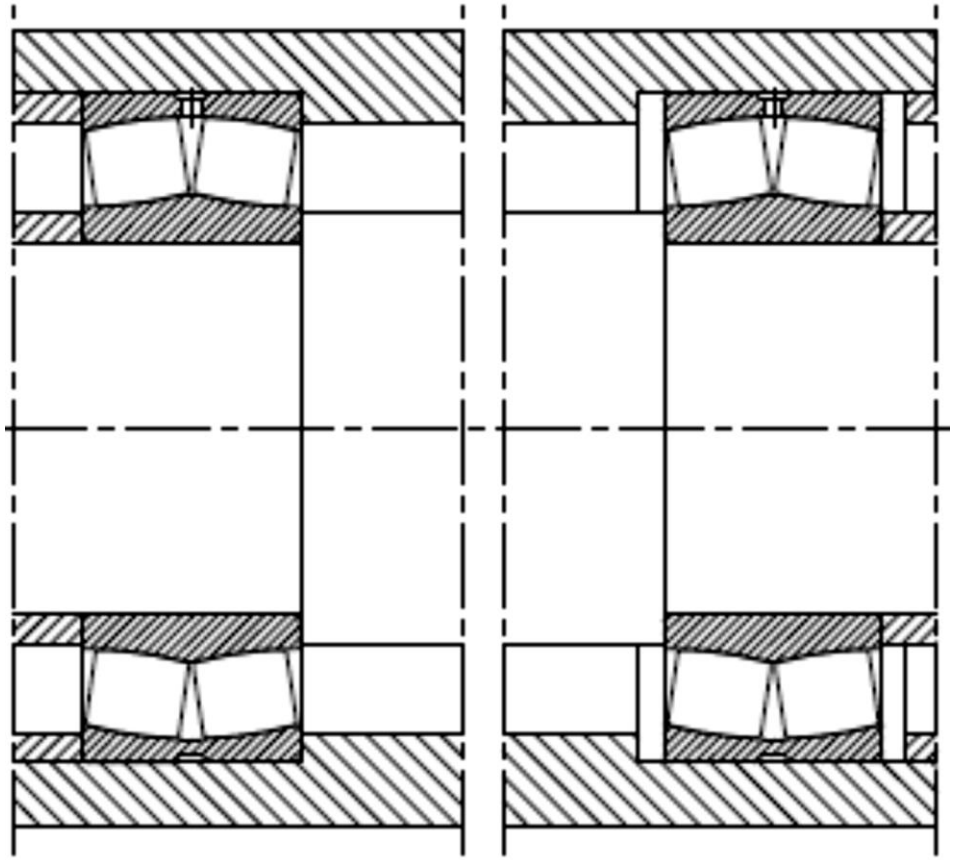
1. Locating-floating bearing arrangement



1. Locating-floating bearing arrangement



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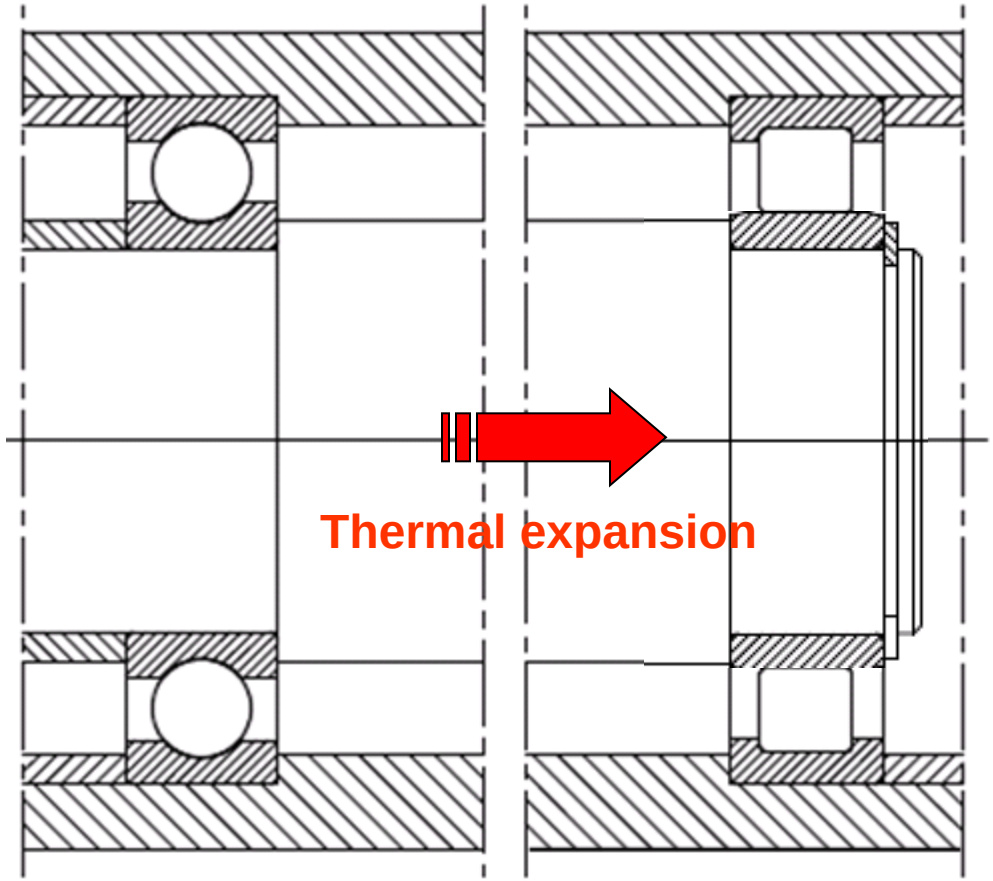
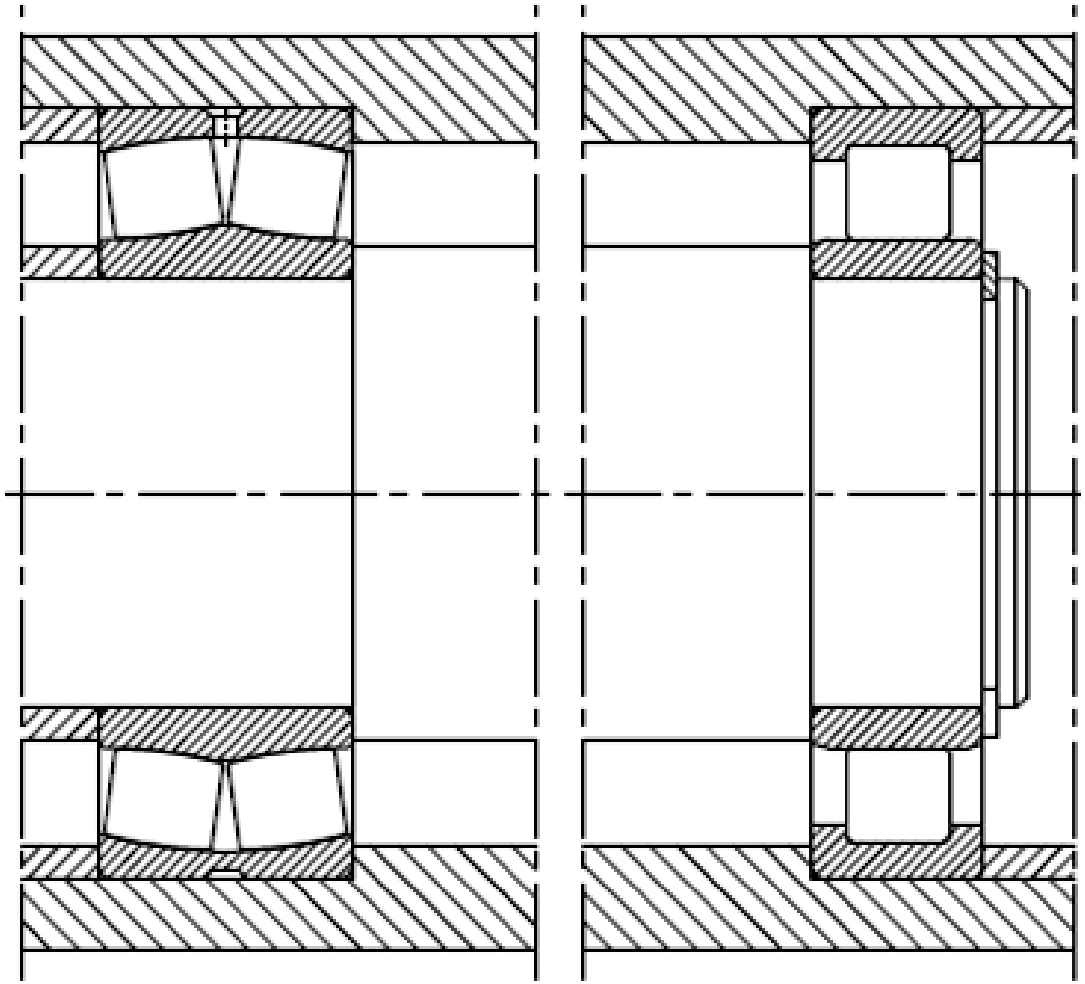
1. Locating-floating bearing arrangement

Using a cylindrical roller bearing

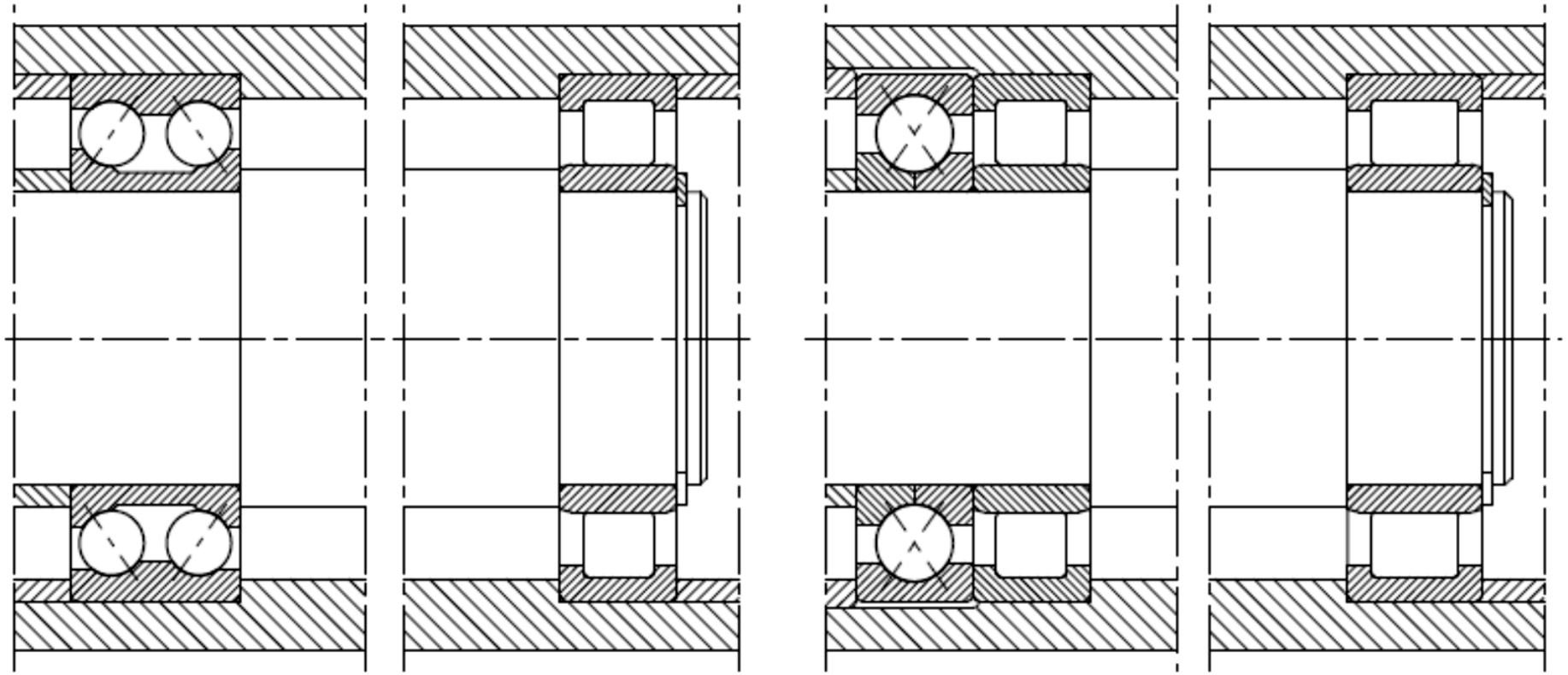


1. Locating-floating bearing arrangement

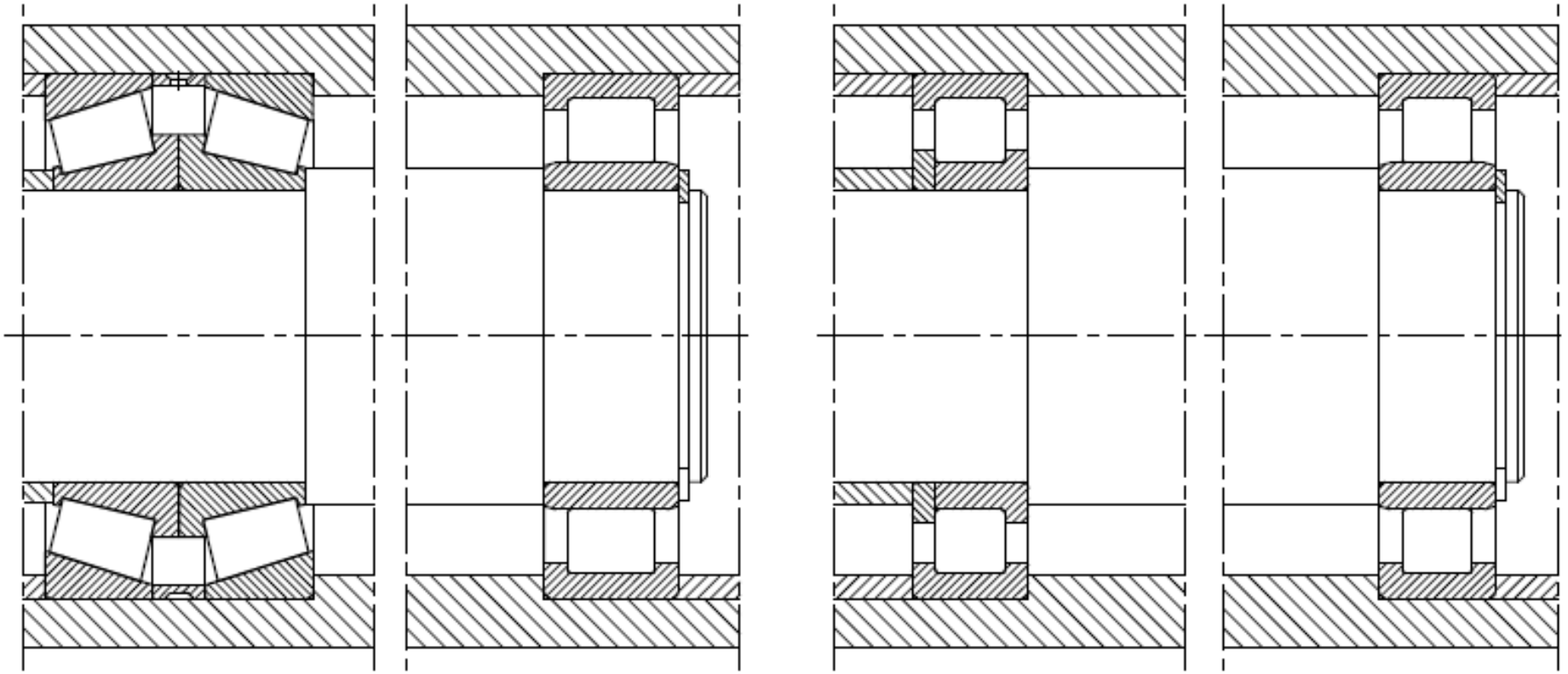


TIMKEN

1. Locating-floating bearing arrangement



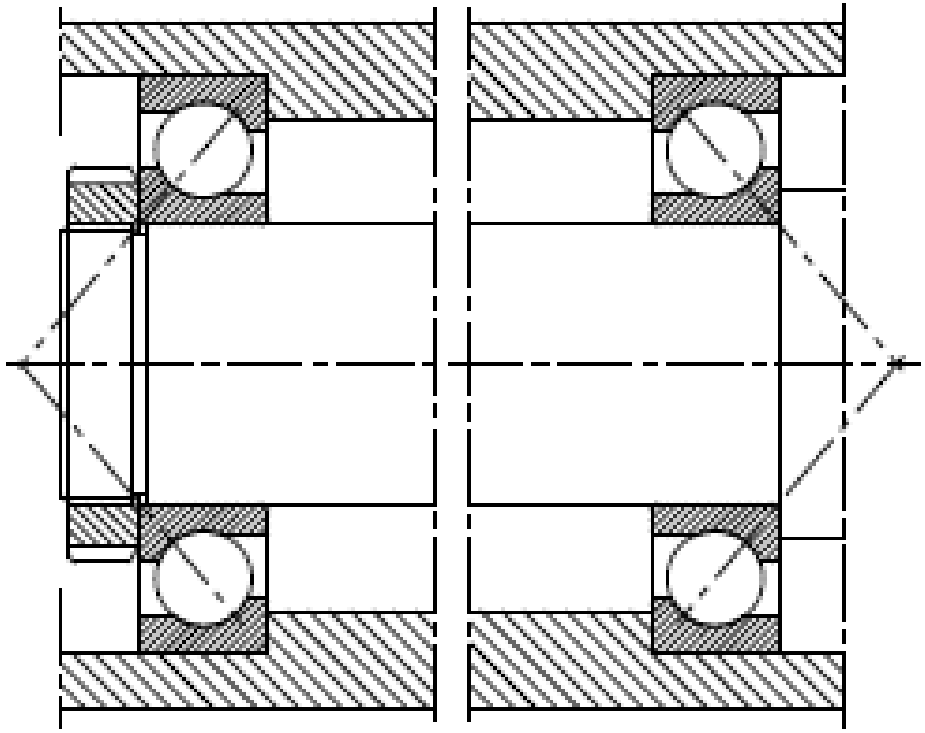
1. Locating-floating bearing arrangement

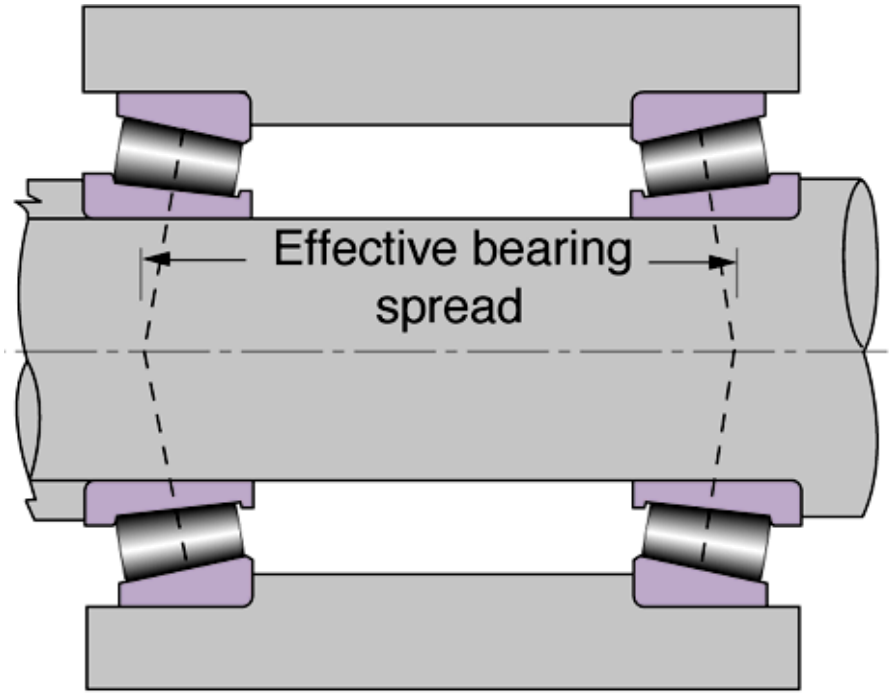


2. Adjusted bearings

As a rule, an adjusted bearing arrangement consists of two symmetrically arranged angular contact ball bearings or tapered roller bearings. During mounting, the required *bearing clearance* or the preload must be set.

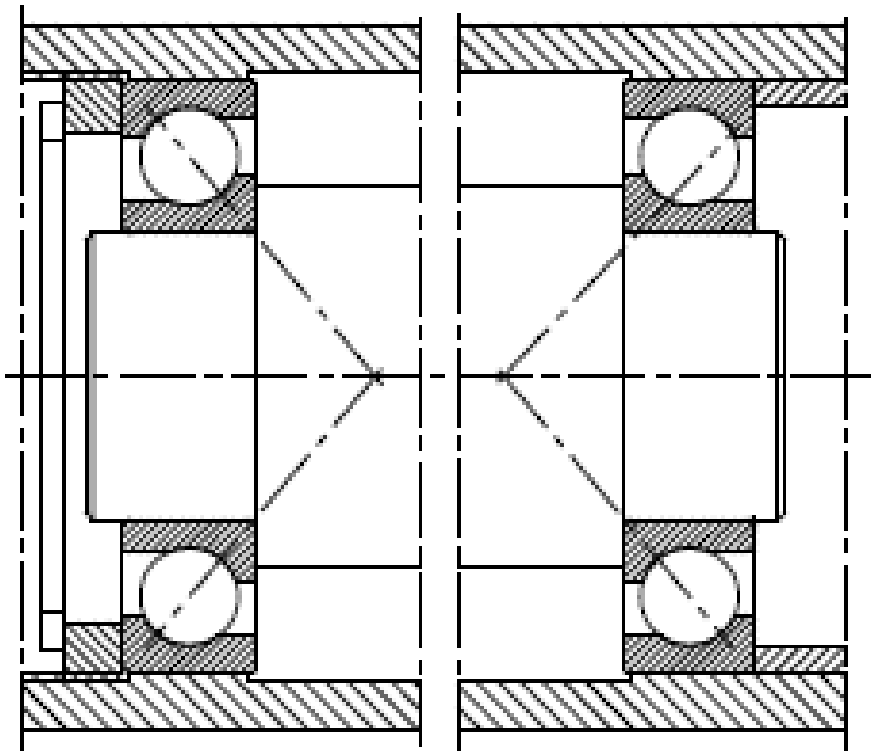
Indirect or “O” mounting

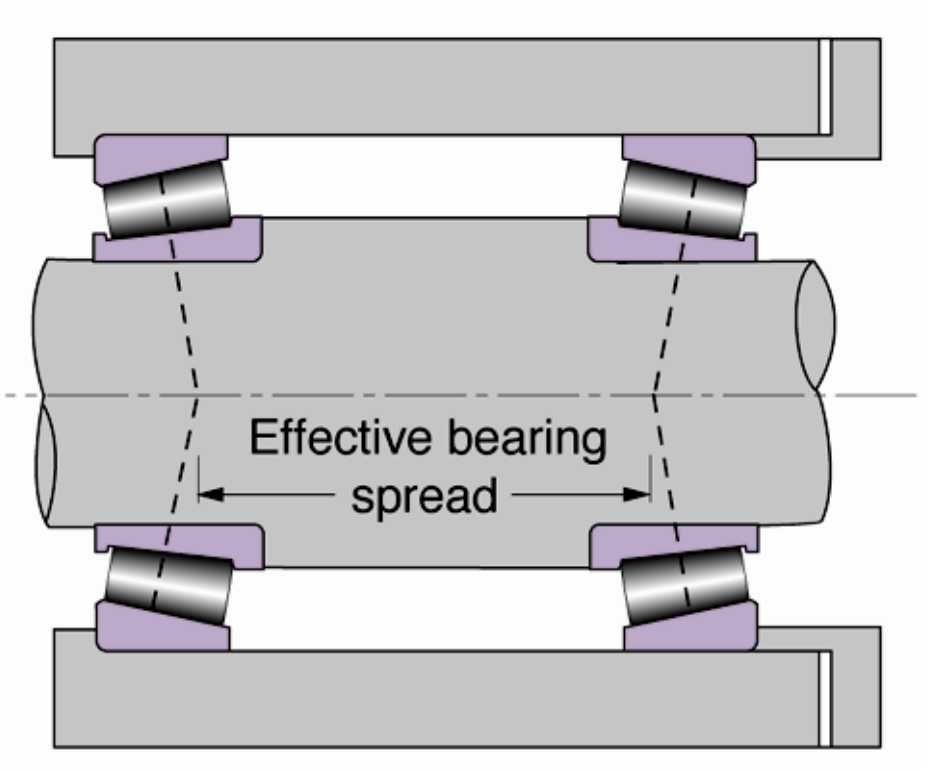




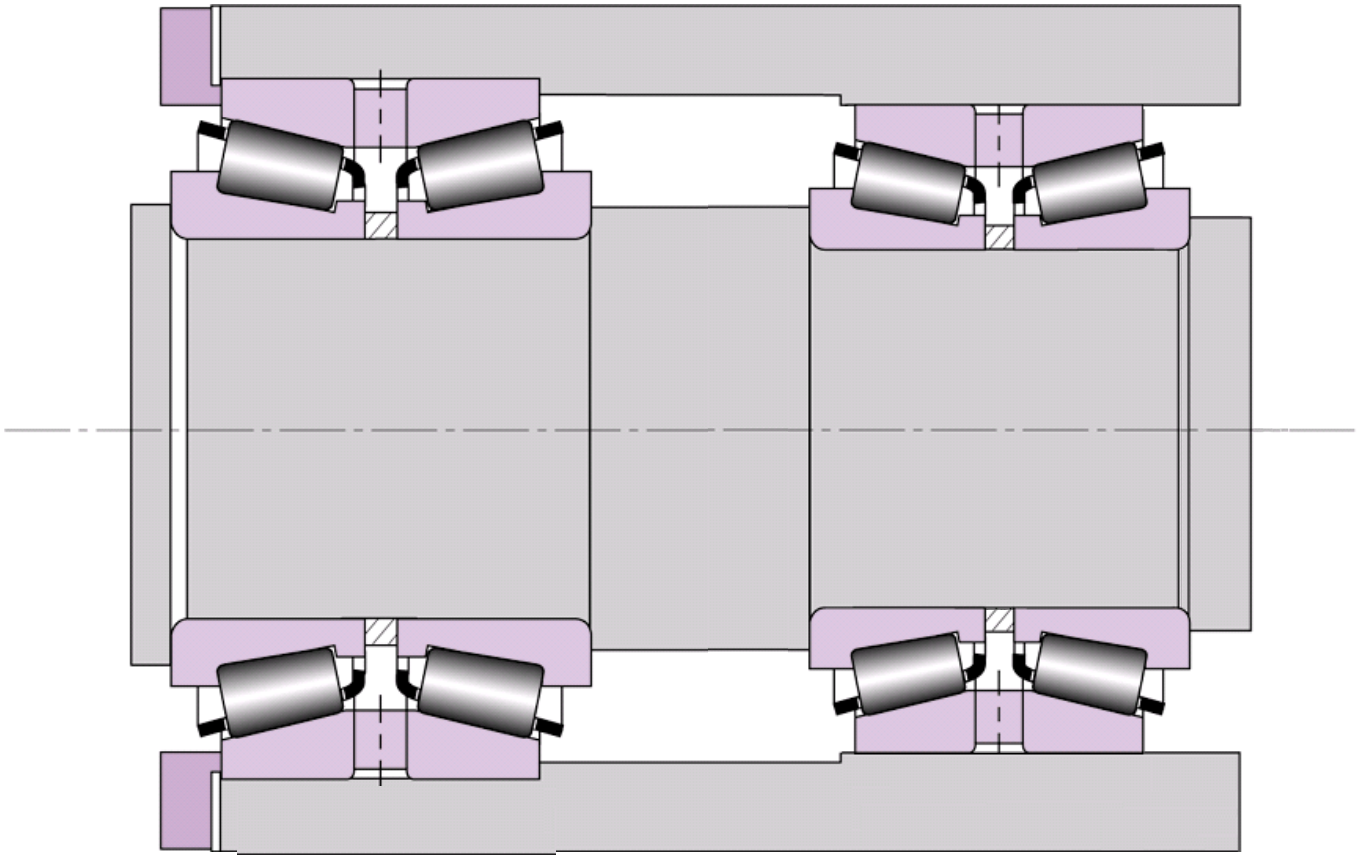
2. Adjusted bearings

Direct or “X” mounting





Double row Tapered bearing arrangement



TIMKEN

Bearing life

Stronger.

Performance

- Bearing life,
- Speed capability,
- Temperature,
- General environment,
- ...

Cost

- Bearing cost,
- Assembly, mounting,
- Existing, new product,
- Available product,
- ...

Some definitions:

Bearing life
In a broad sense, bearing life is the period during which bearings continue to operate and satisfy their required function.

Rolling fatigue life
Rolling fatigue life – also called “fatigue life” -- is defined by the number of revolutions before the bearing surface begins to flake due to stress.
The bearing surface is generally an inner ring and an outer ring raceway.

Bearing L_{10} Life

- Life that 90% of a group of apparently identical bearings will complete or exceed before the area of spalling reaches a defined limit.
  (Timken = 6 mm^2 or .01 in^2)
  - L = fatigue life of a rolling element bearing
  - 10 = 10% of population that failed criteria (reliability)

Timken L_{10} Life

$$L_{10} = \left(\frac{C_{90}}{P}\right)^{10/3} \times \left(90 \times 10^{6}\right) \text{ Revolutions}$$

$$L_{10} = \left(\frac{C_{90}}{P}\right)^{10/3} \left(\frac{1.5 \text{ x } 10^{6}}{S}\right) \text{ Hours}$$

- **2 X Load = 1/10 Life**
- **1/2 Load = 10 X Life**

- **2 X Speed = 1/2 Life**
- **1/2 Speed = 2 X Life**

Linear contact => Power = (10/3)
Point contact => Power = 3

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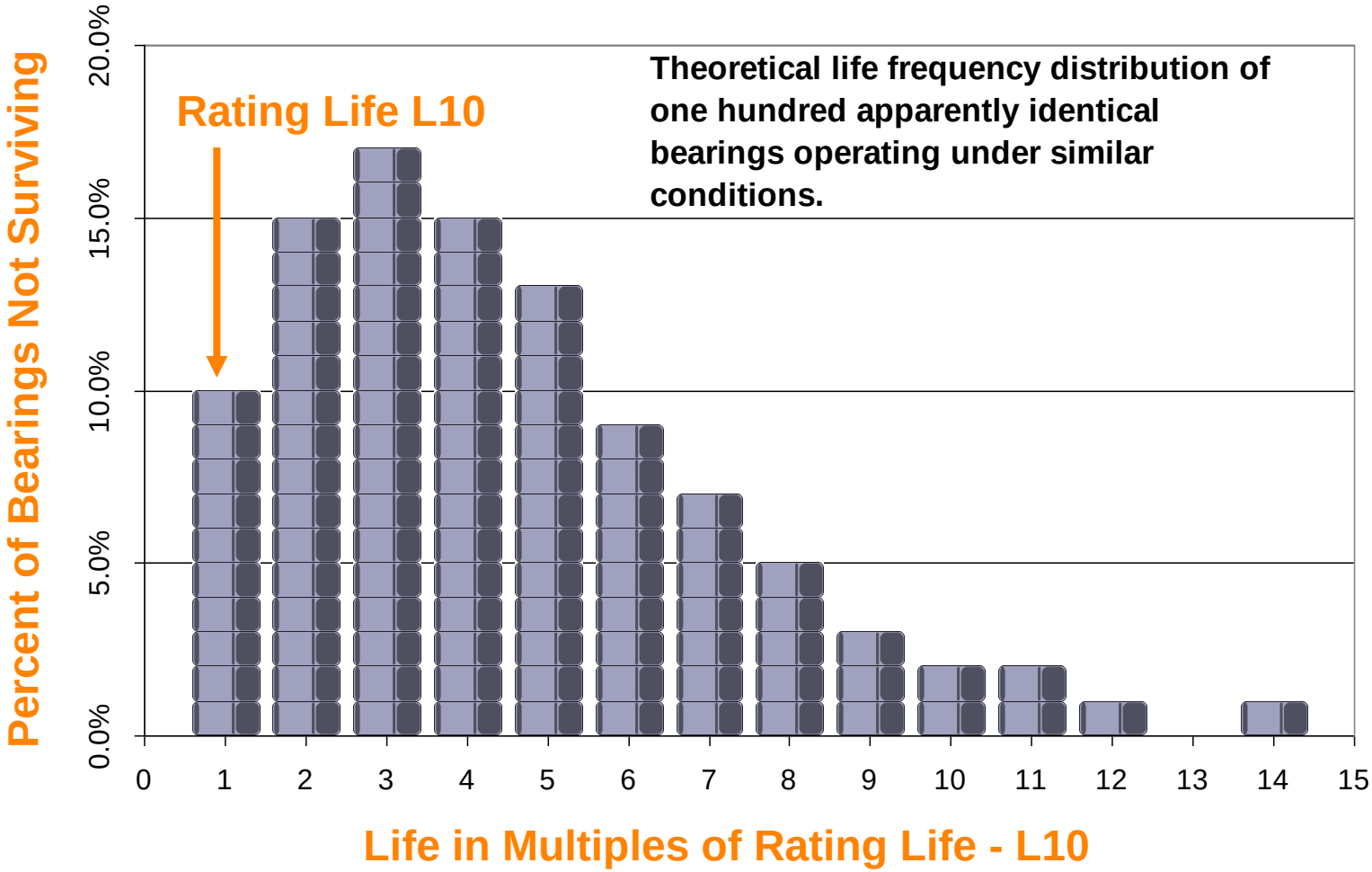
Weibull Distribution of Bearing Fatigue Life

For Timken bearings, the average or mean life is approximately 4 times L10. This is defined by a spall criteria which is very conservative for many applications.



TIMKEN

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Bearing Ratings

What is a Rating?

- Describes the expected life and performance of a product

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Bearing Ratings

- Used by customers to:
  - Select the right Timken bearing for their application
  - Compare bearings
  - Compare bearings with competitor bearings

Ratings are defined by:

- Roller diameter
- Contact length
- Contact angle
- Number of rollers
- Number of bearing rows

TIMKEN

Dynamic Ratings

Dynamic Load Rating

- Based on:
  - Stress cycles per revolution
  - Bearing life test empirical data
- Load ratings based on algorithms that are empirically tested.
  - Insures brand promise
- The load that 90% or more of a large group of bearings could survive for 90 million revolutions before a 0.01 in^2 (6mm^2) spall develops

C_{90} or C(90) = radial rating

C_{a90} or C_a(90) = thrust rating

Dynamic Radial Rating

- Rating equations: radial capacity

$$C_{90} = H\,M(Z\,L\cos\alpha)^{4/5}\;N^{7/10}\;D^{16/15}\;\text{(lbs.)}$$

C_{90} based on life of 90 million revolutions, or 3000 hours at 500 rev/min.

H = Geometry dependent factor
M = Material constant
Z = Number of bearing rows in assembly
L = Effective roller contact length
α = 1/2 Included cup angle
N = Number of rollers per rating row
D = Mean roller diameter

TIMKEN

Dynamic Load Rating

- Two-row bearing rating is not simply two times the single-row rating

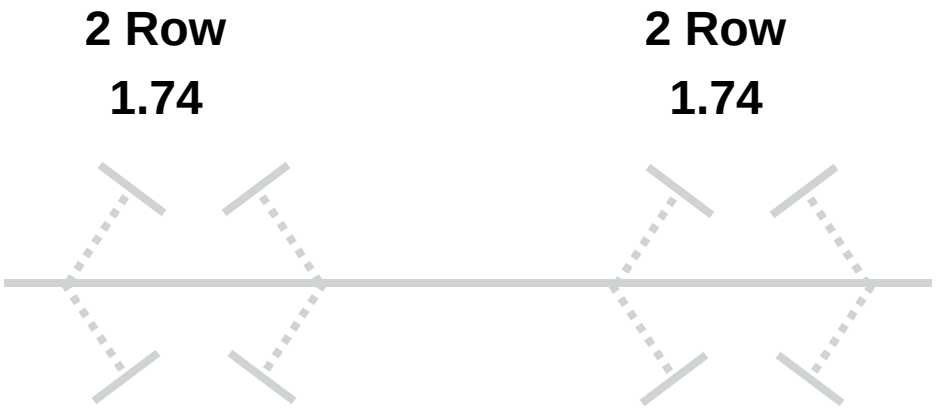
Since: $(Z\ L\ \cos\ \alpha)^{4/5}$ from rating equation, therefore $2^{.8} = 1.74$

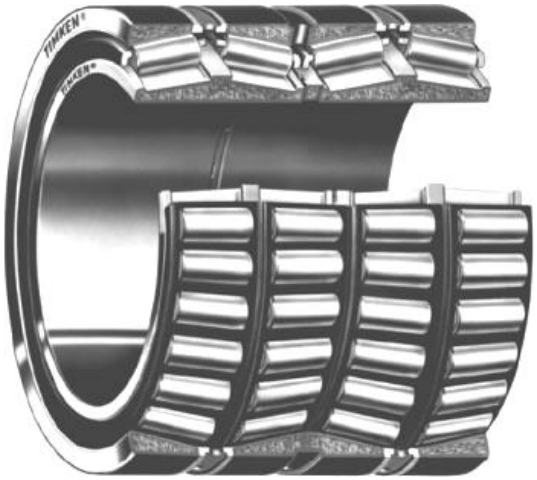
$$C(90)_2 = 1.74C(90)$$

TIMKEN

Dynamic Load Rating

- 4-Row radial ratings = 2 times the 2-row rating





$$\left(1.74\,C_{90}\right)\times 2$$

C1 Rating Equations

- Timken uses C90 (90 million revolutions) and C1 (1 million revolutions)
- To convert C_1 to C_{90}

$$C_1 = 90^{\frac{3}{10}} C_{90}$$

$$C_1 = 3.86 C_{90}$$

- Using C_1 in L_{10} equation

$$L_{10} = \left(\frac{C_1}{P} \right)^{10/3} \times \left(1 \times 10^6\right) \text{Revolutions}$$

TIMKEN

Bearing Ratings

- C_1 is a theoretical number.

The bearing should never be loaded to this magnitude.

- "Working" load range is 1/3 to 1/4 of the C rating for roller contact bearings.
- Ball products – "Working" load up to or <70% of the static rating (C0)

- Life testing for other bearing types done at C90 load levels.

Other Rating Equations

- Most organizations use C1
  - ISO (International Standards Organization)
  - ANSI (American National Standards Institute)
  - ABMA (American Bearing Manufacturers Association)
  - Competitors

- Ratings may differ from ISO / ABMA / ANSI ratings due to:
  - Different internal dimensions
  - Different material factors
  - Other factors

ISO 281 Bearing Rating – Roller Bearings

- C1: 1 million revolutions

$$C_1 = b_m f_c \left(iL_{we}\cos\alpha\right)^{\left(\frac{7}{9}\right)} Z^{\left(\frac{3}{4}\right)} D_{we}^{\left(\frac{29}{27}\right)}$$

b_m = material factor and manufacturing quality. Current factor is 1.1

f_c = geometry, accuracy, and material factor

i = number of rows in a bearing

L_{we} = effective roller length

α = nominal contact angle of a bearing [deg]

Z = number of rollers in a single/multi-row bearing

D_{we} = roller diameter

ISO 281 Bearing Rating – Ball Bearings

- C1: 1 million revolutions

$$C_1 = b_m f_c (i \cos\alpha)^{\left(\frac{7}{10}\right)} Z^{\left(\frac{2}{3}\right)} D^{\left(\frac{9}{5}\right)}$$

b_m = rating factor for contemporary, normally used material and manufacturing quality

f_c = geometry, accuracy, and material factor

i = number of rows in a bearing

α = nominal contact angle of a bearing [deg]

Z = number of rolling elements in a bearing

D = ball diameter

TIMKEN

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Static Load Ratings

Static Load Rating (ISO 76)

- Used to determine maximum permissible load that can be applied to a non-rotating bearing
  - Load that can be applied without altering the physical properties in a way that degrades bearing performance when it is rotated with a lesser load
  - Based on maximum contact stress of 580,000 psi (580 KSI or 4000 MPa) with a load zone of 180 degrees
  - Based on system stiffness – shaft/housing, the actual load may vary.
  - Static load ratings good for comparison from 1 part number to another or 1 bearing type to another.

C_0 = Radial

C_{0a} = Thrust

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Static Load Rating – TRB Bearings

- Radial capacity rating equation (lbs)

$$C_0 = 7850\ \mathrm{D\ L\ N}\left(\cos\ \alpha / \cos 2\nu\right)\left(\sin\ \beta / \sin\gamma\right)$$

- Thrust capacity rating equation (lbs)

$$C_{0a} = 34300\ \mathrm{D\ L\ N}\left(\sin\ \alpha / \cos 2\nu\right)\left(\sin\ \beta / \sin\gamma\right)$$

D = Mean roller diameter
L = Effective roller contact length
N = Number of rollers
α = 1/2 Included cup angle
2ν = Included roller angle
β = 1/2 Included cone angle
γ = Roller centerline angle

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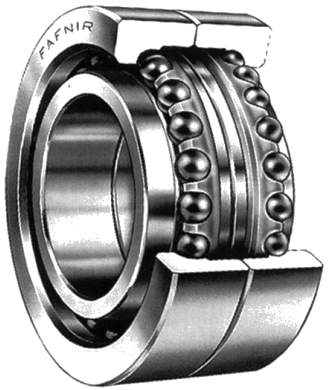
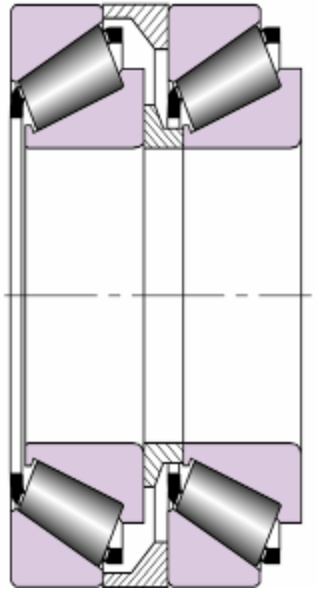
Static Load Rating

- Stacked bearings - radial and thrust
  - Static load ratings for 2 or more similar, single-row TRBs mounted side-by-side on the same shaft and operating in tandem, when manufactured and mounted for equal load distribution, equals the number of bearings times the rating of a single row bearing

Static Load Rating= # of bearings X single row rating





2TS-TM Assembly

TIMKEN

Static Load Rating

- For applications where sound, vibration, and rolling torque are critical to bearing performance, a rule of thumb is to load the bearing to no more than approximately 1/2 the static rating

Shock Load Rating

- Maximum allowable shock load that can be applied to a stationary bearing is 1/2 the static rating
  - Implies impact loading from “G” loading
  - Rule of thumb
- True for both radial and thrust loading
- Factor applicable for ball and roller bearings

TIMKEN

What create the load on a bearing?

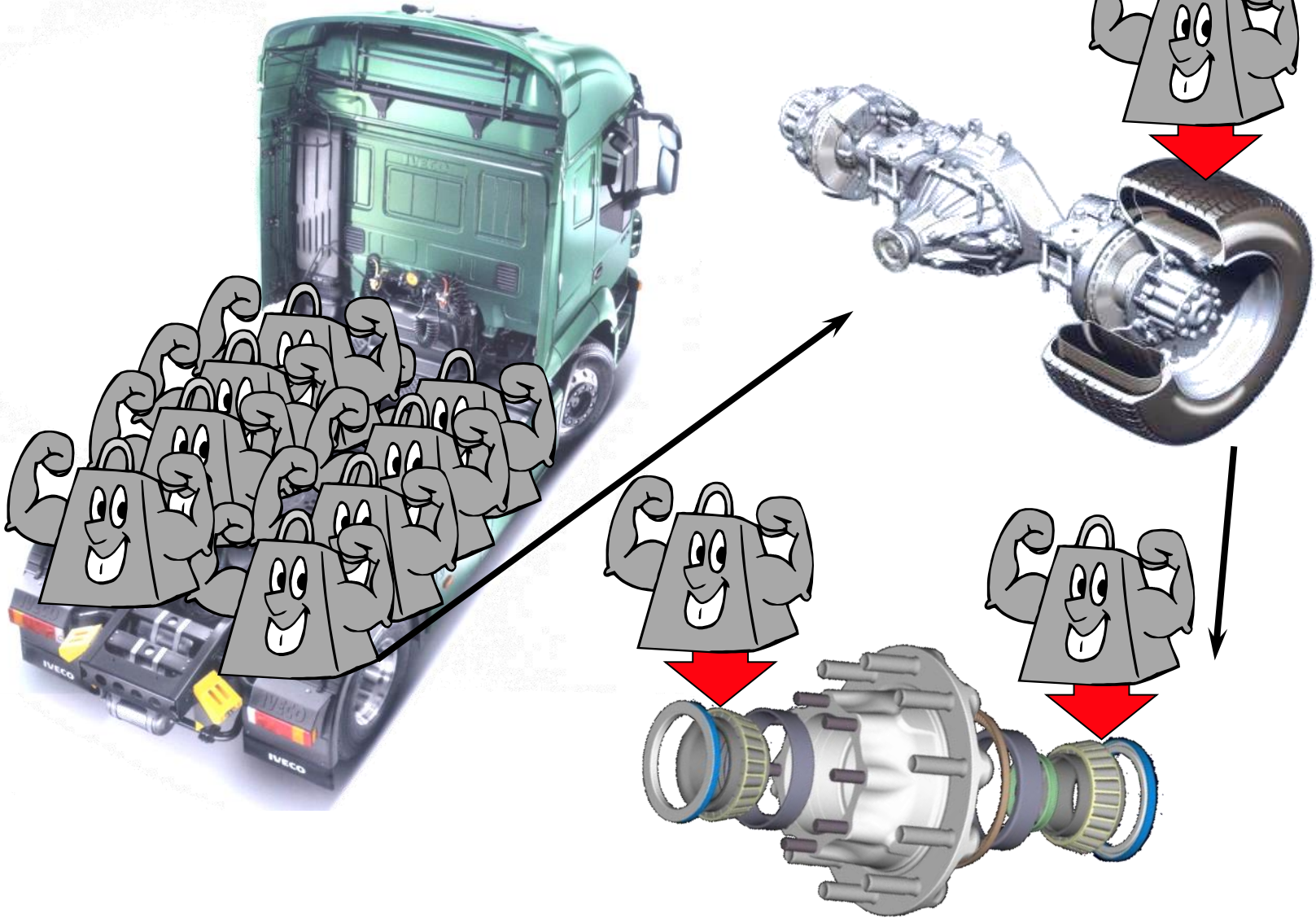
External Load of the bearing system

- Gear,
- Pulley,
- Wheel,
- Tool,
- Acceleration,
- Chocks
- …

Internal load of the system

- **Thermal expansion,**
- **System Preload,**
- **Induced load,**
- **…**

Loading condition



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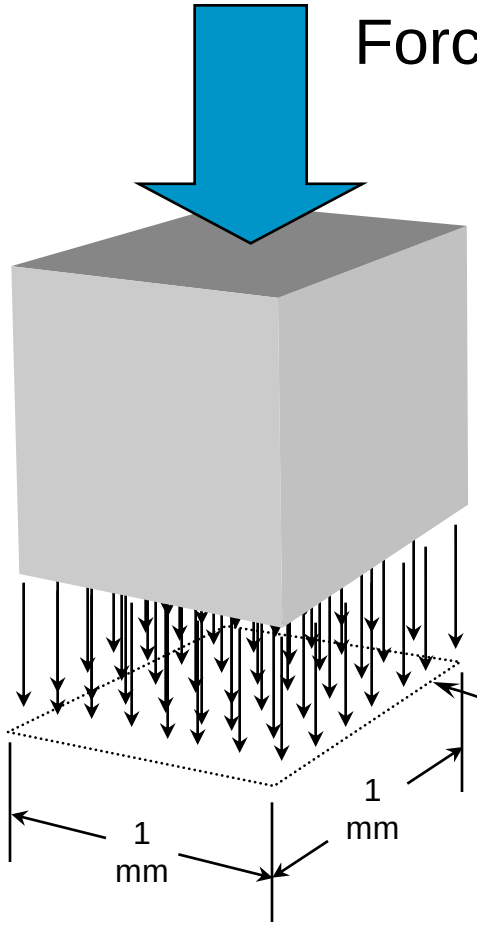
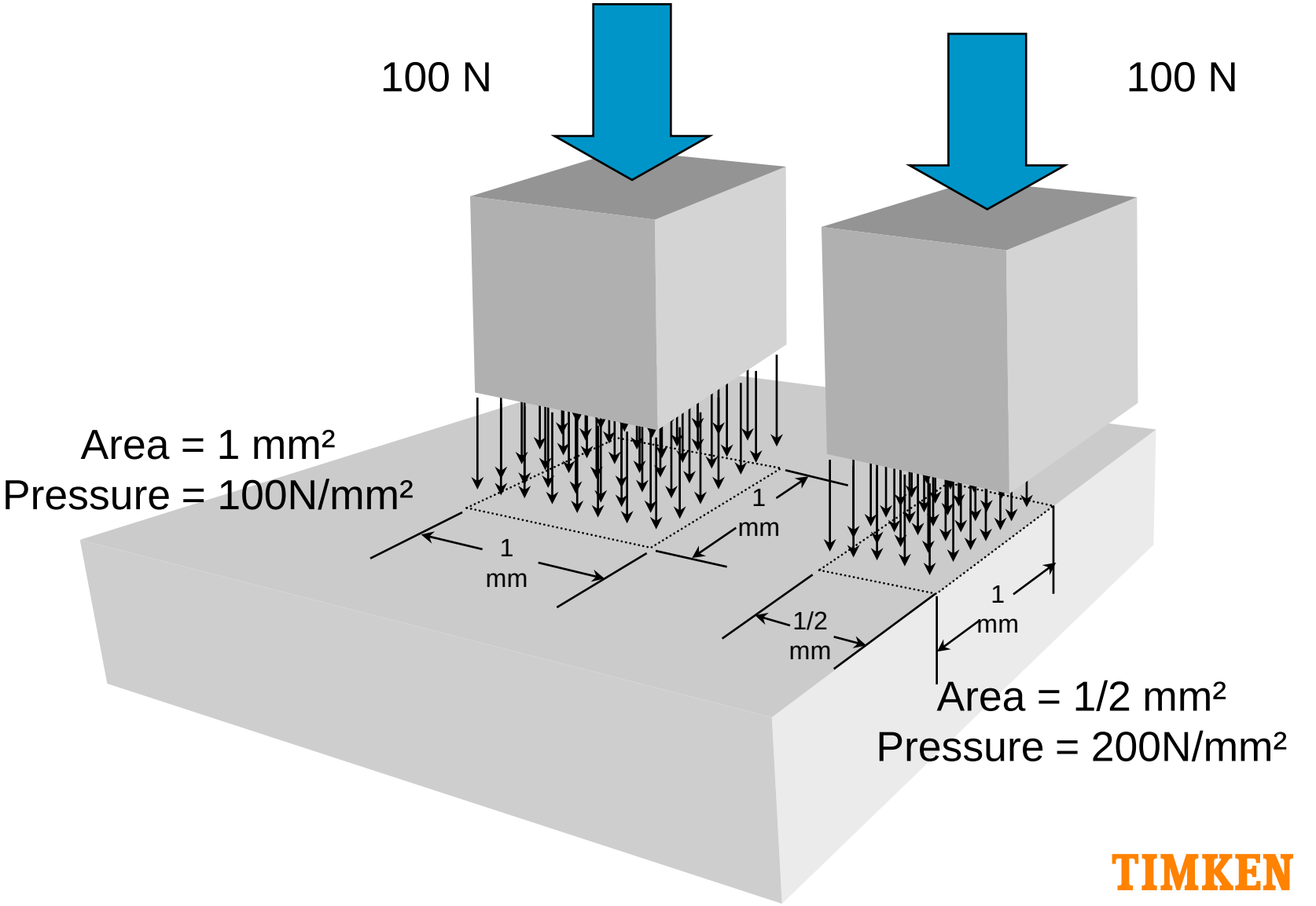
Load zone and contact pressure

Pressure



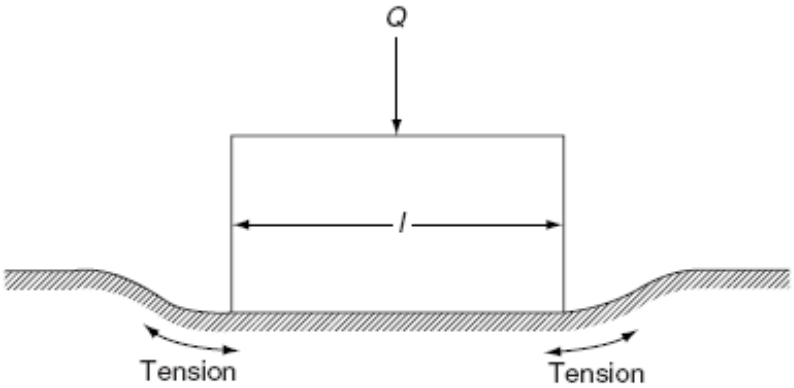
$$\text{Pressure} = \frac{\text{force}}{\text{area}}$$

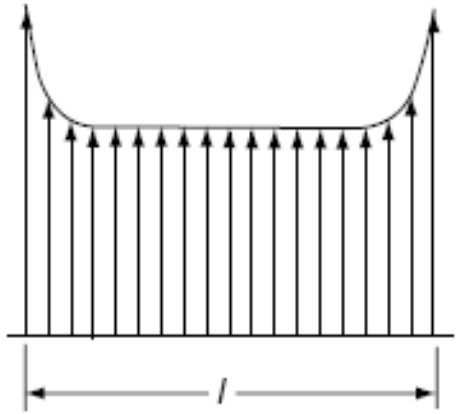
PRESSURE


100 N
100 N
Area = 1 mm²
Pressure = 100N/mm²
1
mm
1
mm
1/2
mm
1
mm
Area = 1/2 mm²
Pressure = 200N/mm²

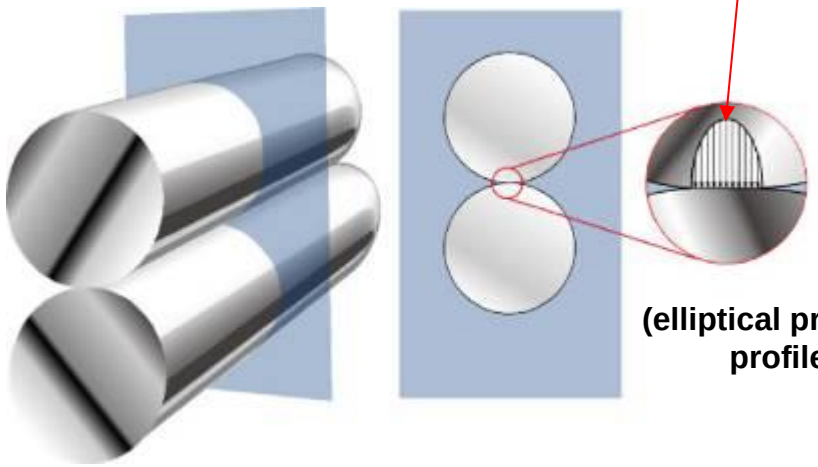
PROFILES

- Hertzian pressure creates elastic deformation





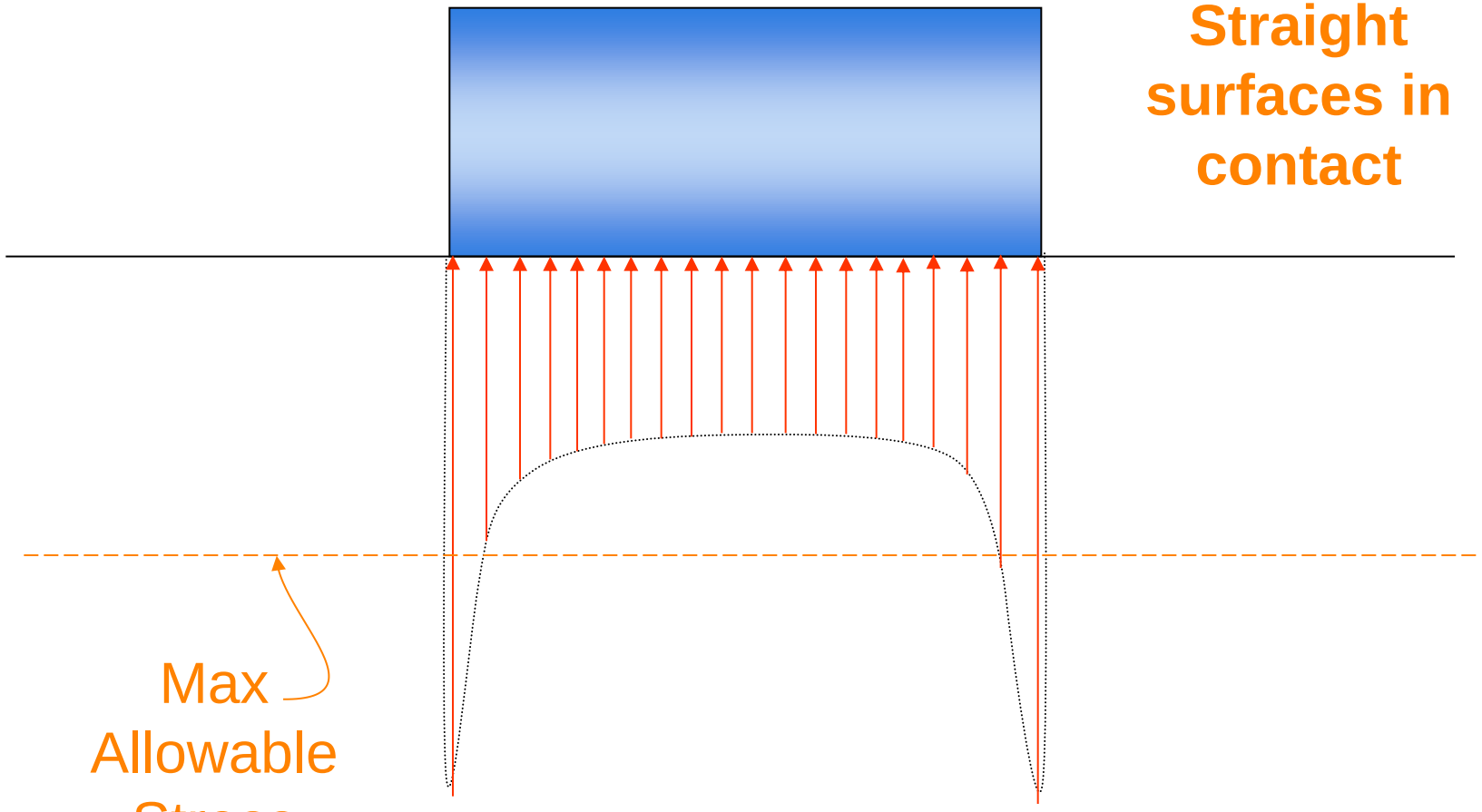
Amount of stress



Two cylinders pressed together under load form line contact.

- At the end of the loaded roller, the raceway deforms and create a tension generating stress concentration.

Edge Stress



Edge stresses are too high

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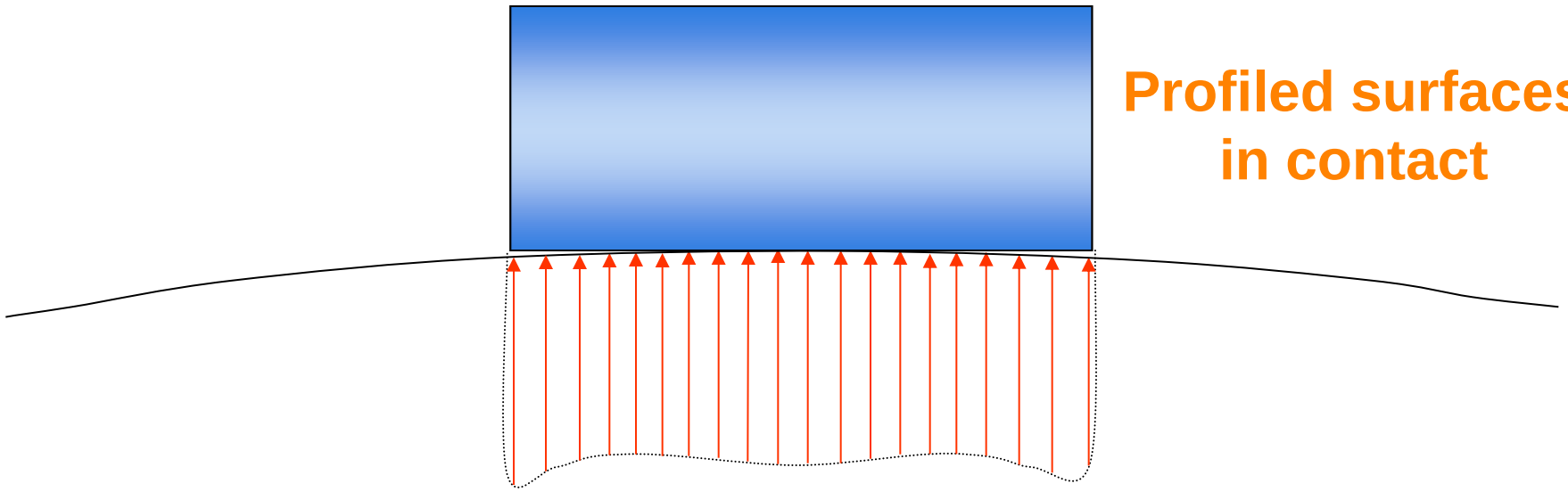
Edge Stress



Profiled surfaces in contact

Edge stresses are reduced to a reasonable level

Max Allowable Stress

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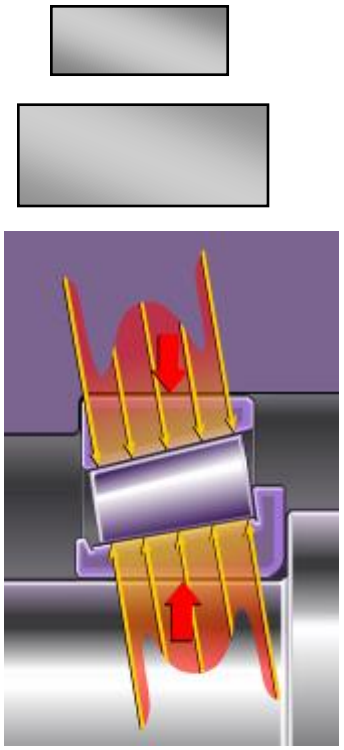
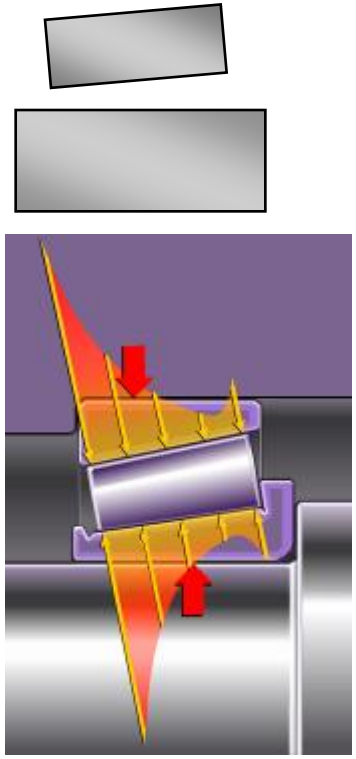
PROFILES

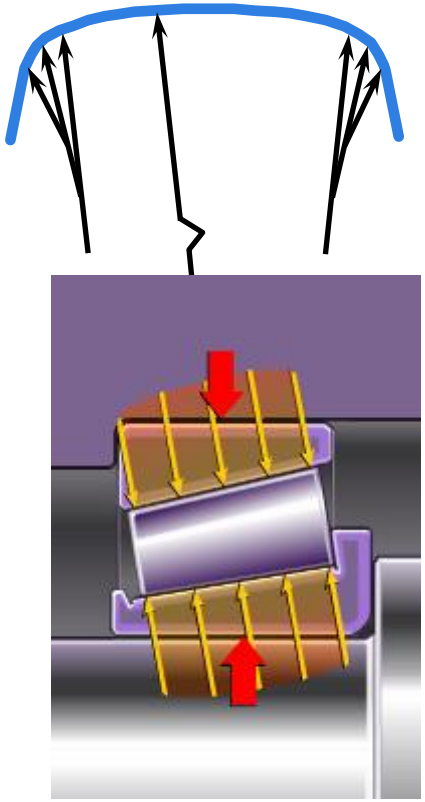
Objective : better stress distribution



Standard roller
under heavy load



Standard roller
under misalignment



Specific profile roller
under heavy load

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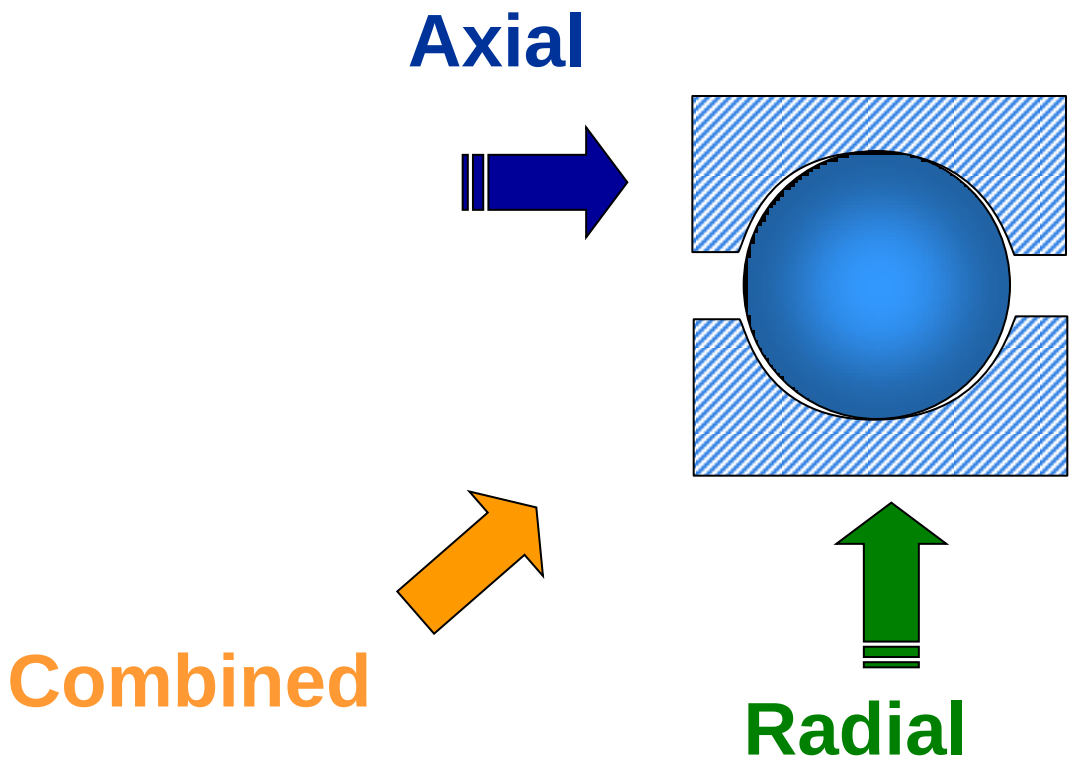
LOAD ZONE

- A bearing load can be radial, axial or combined.
- Each kind of bearing will tolerate these loads in different ways.



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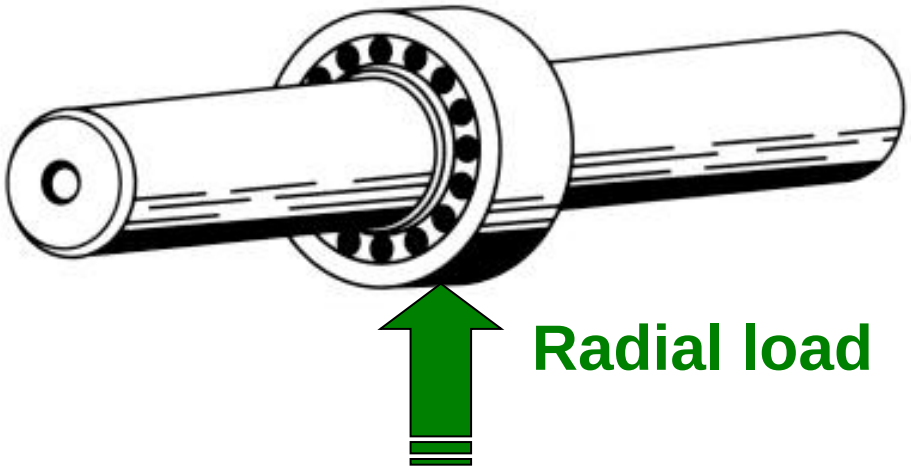
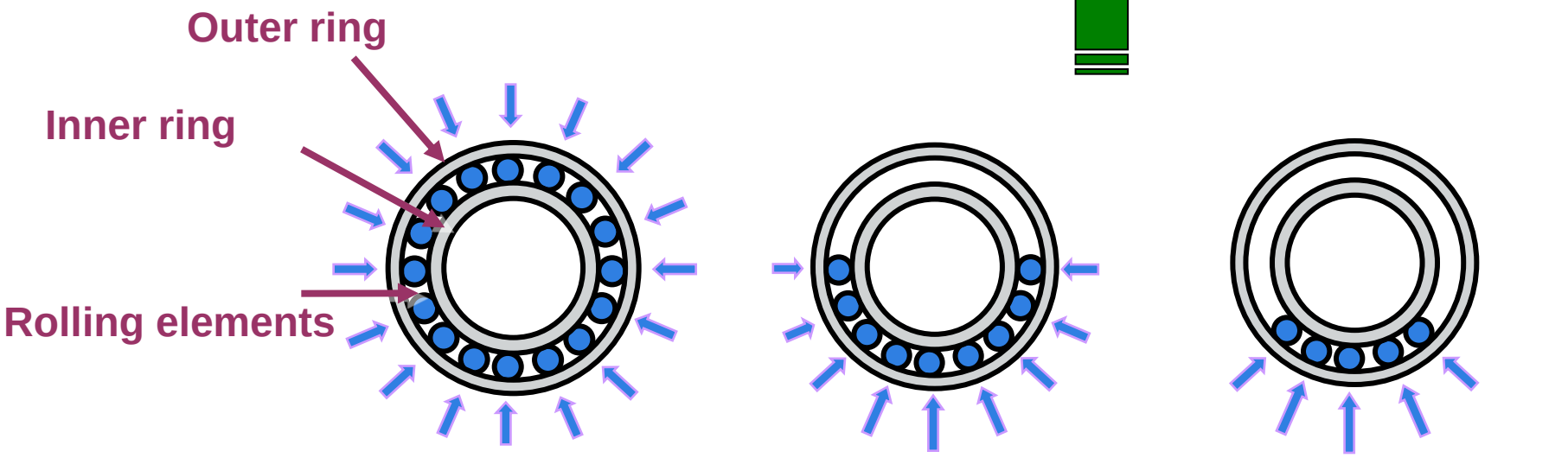
LOAD ZONE


Radial load

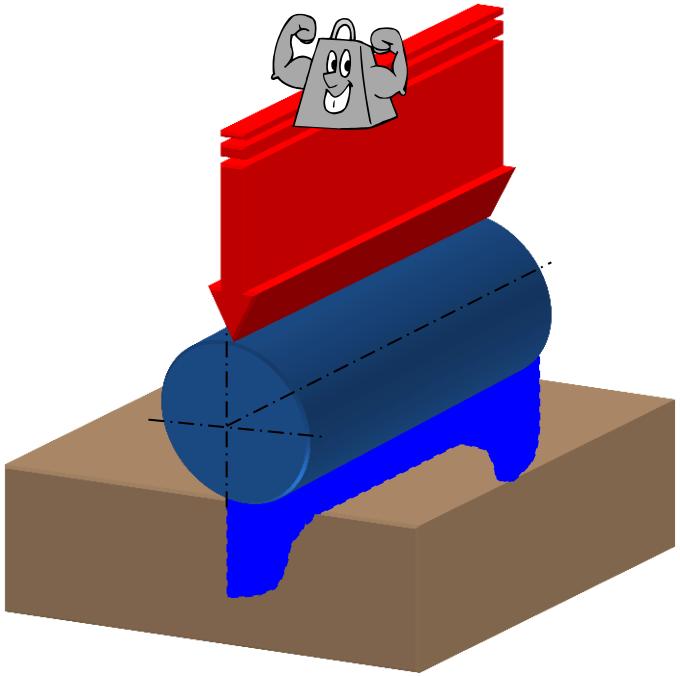

Outer ring
Inner ring
Rolling elements
Load zone 360°
Load zone 180°
Load zone 90°

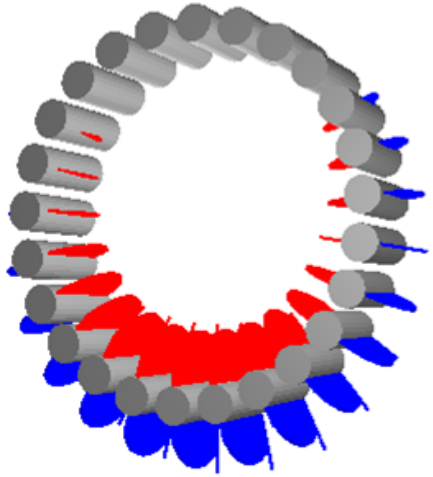
Load zone

General load distribution

In a ball or roller bearing, the rolling elements transmit the external load from one ring to the other.

The external force generally composed of a radial force and an axial force is always distributed over a number of rolling elements.





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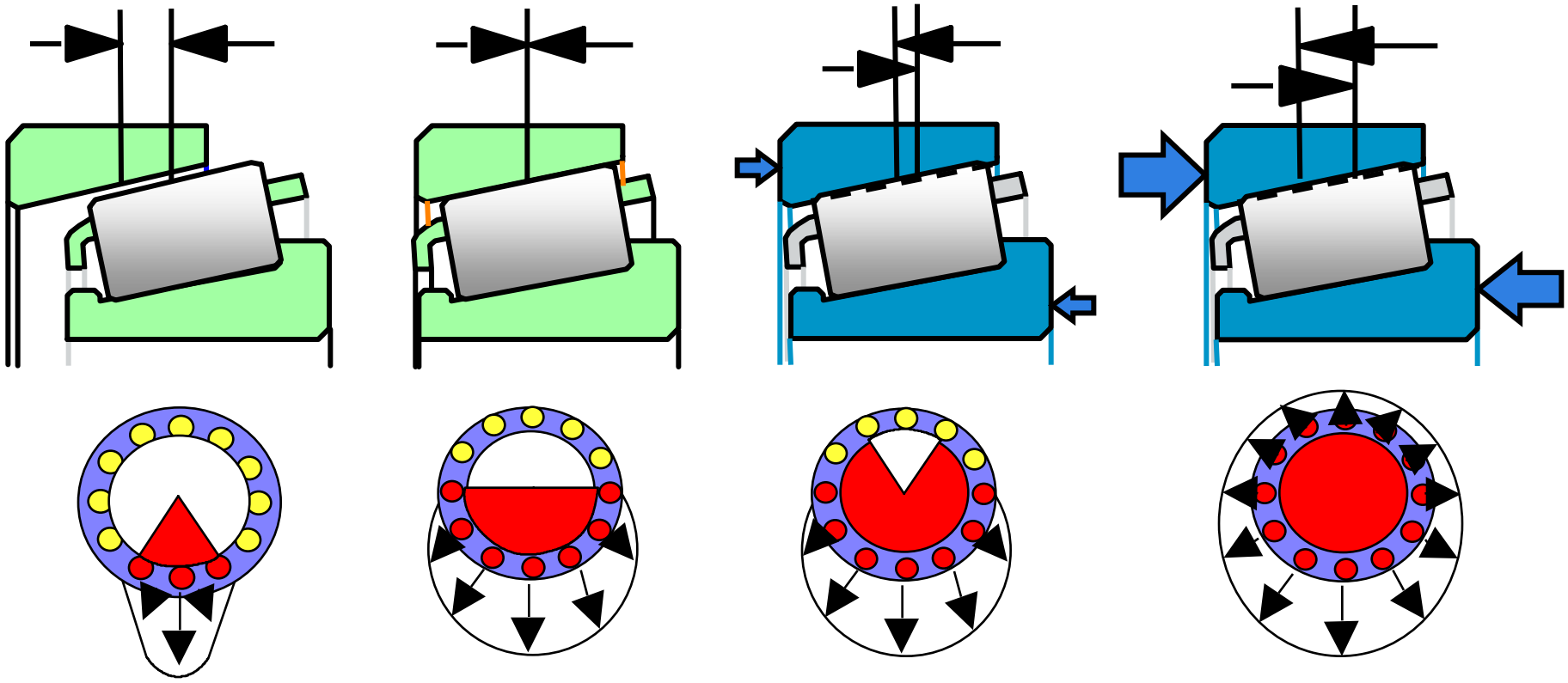
Load zone conditions



1) CLearance

2) Zero clearance

3) Light preload

4) Heavy preload

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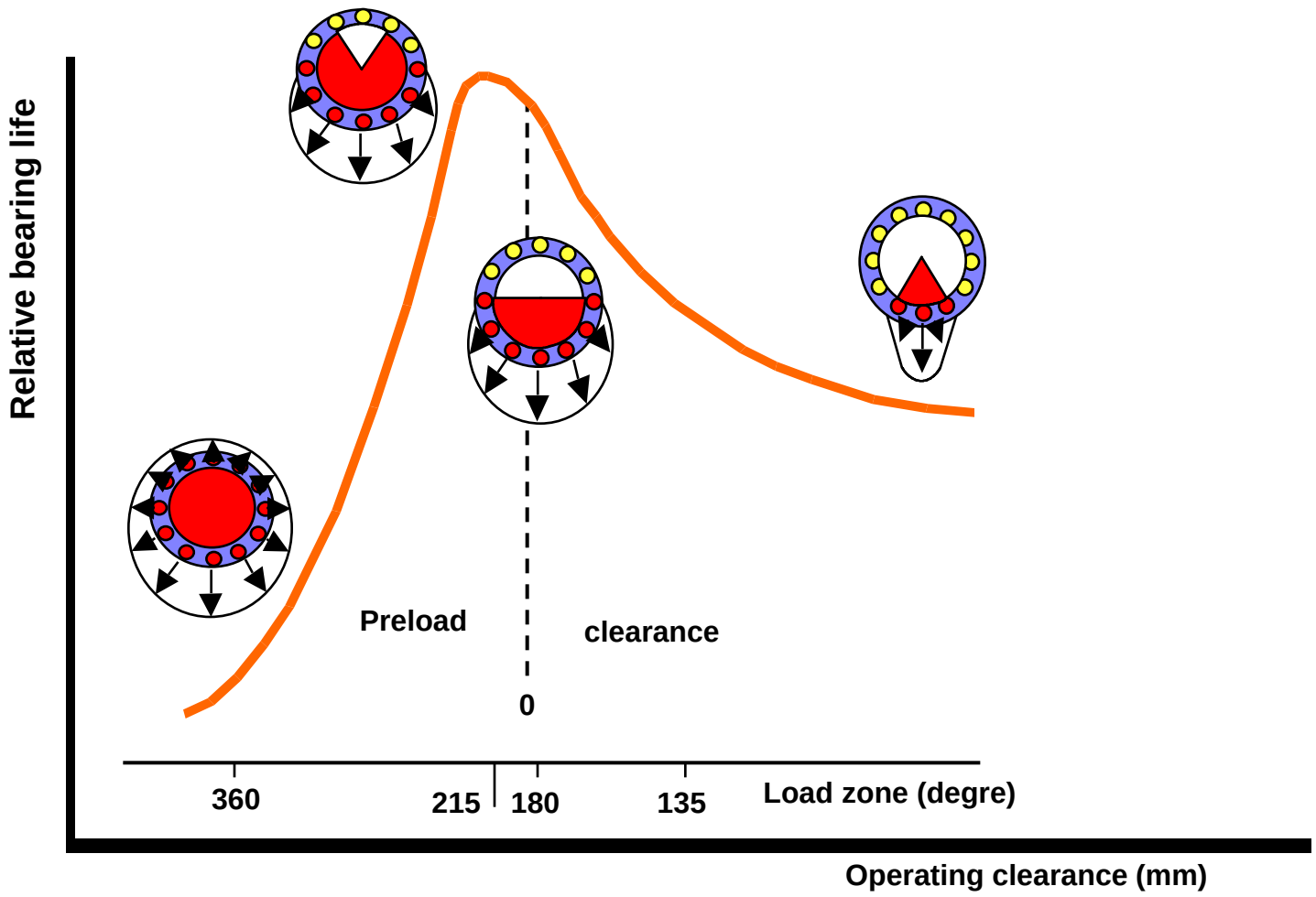
RELATIONSHIP OF SETTING TO BEARING LIFE



Note – the optimum setting is obtained at light preload value.

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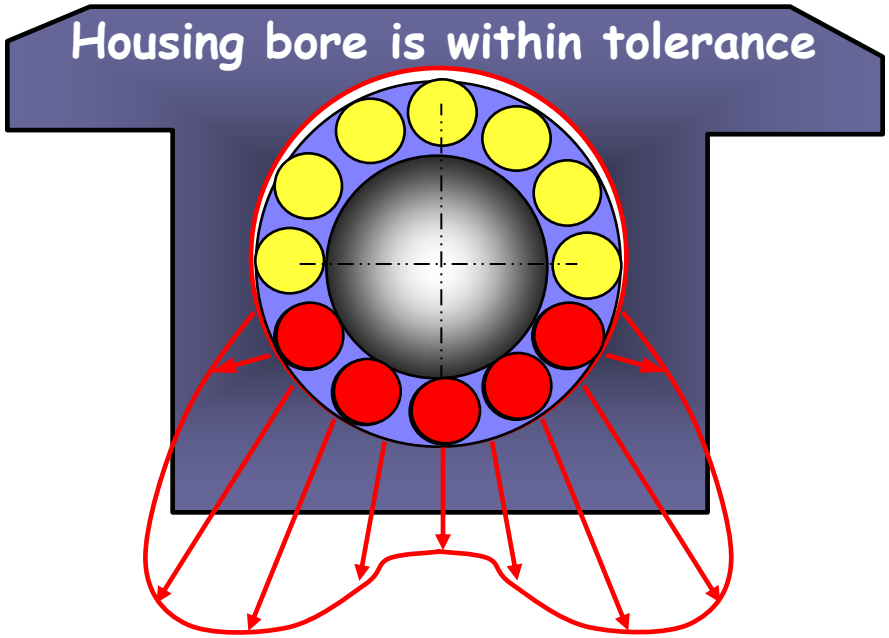
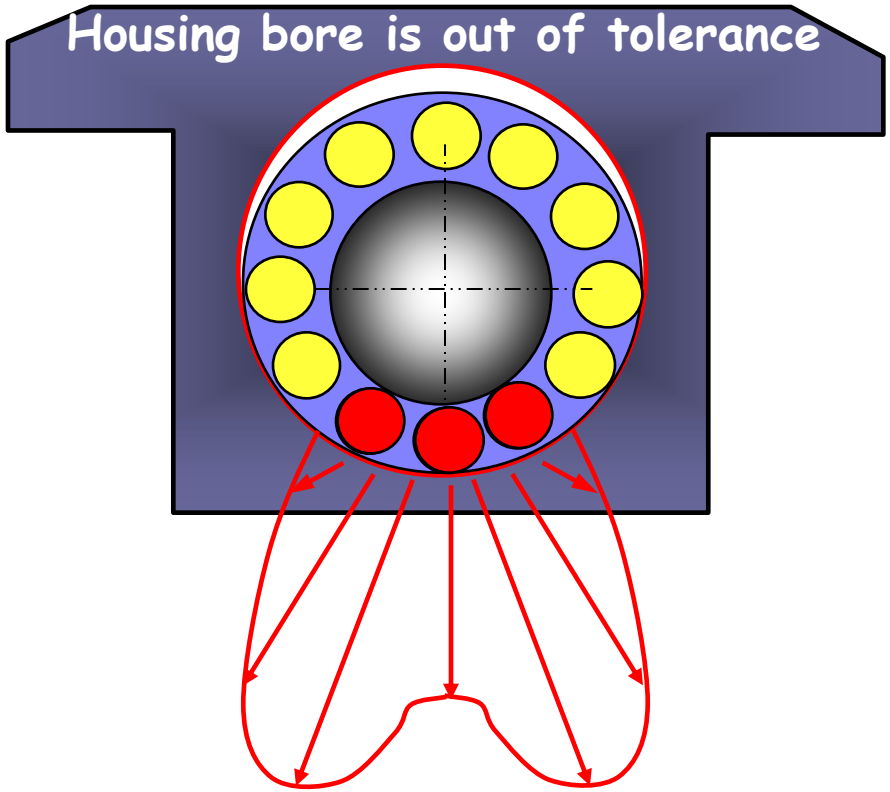
Relationship of setting to bearing life
Related to housing geometry



Large load zone



Small load zone

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Select Bearing Type

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Bearing setting

- Adjustable bearings

  By moving the raceways

- Non-adjustable bearings

  Tight fits

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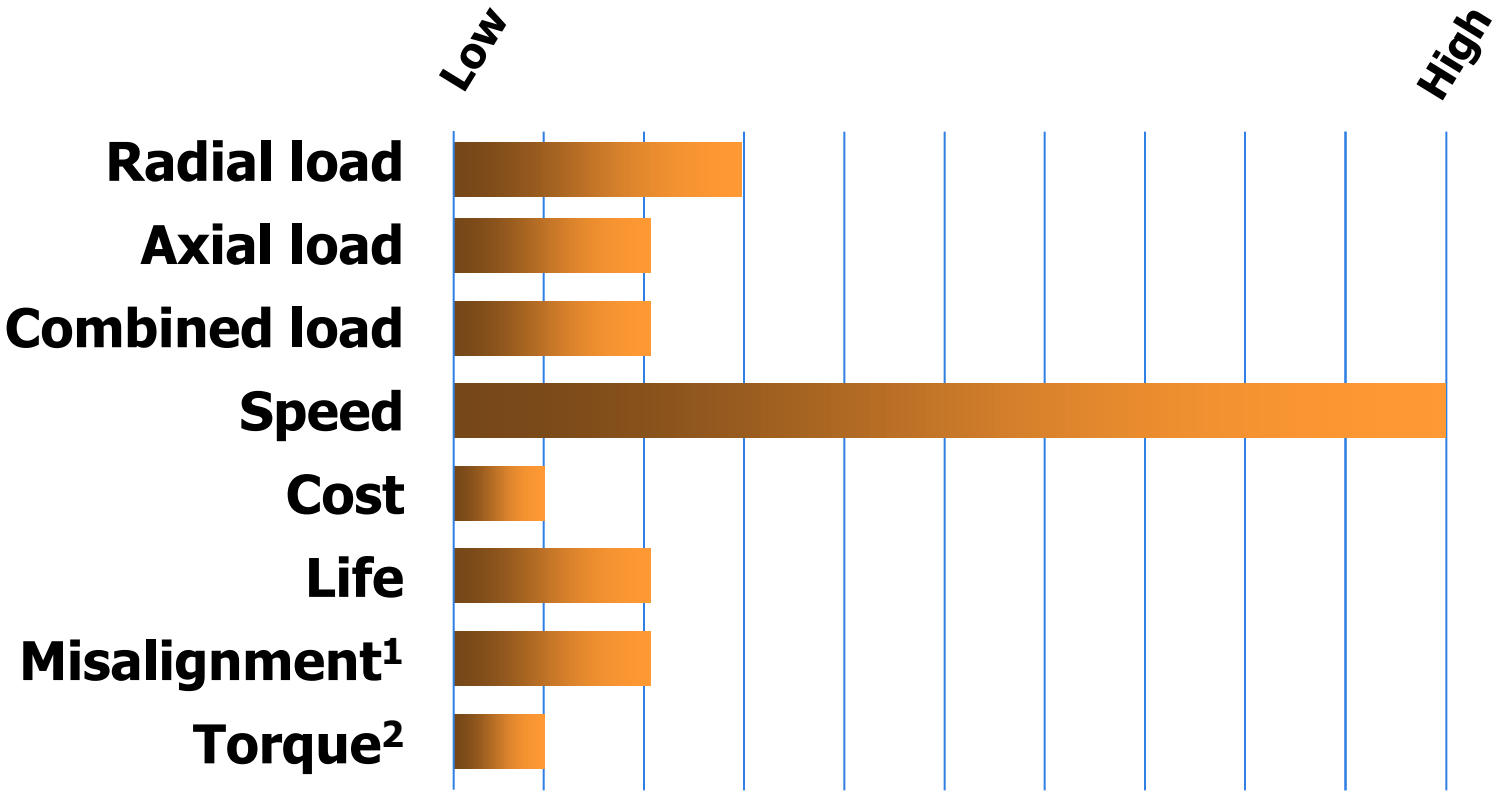
BALL BEARING PERFORMANCE



1) A low performance indicates a bearing life reduction due to misalignment

2) A low performance indicates a low torque level

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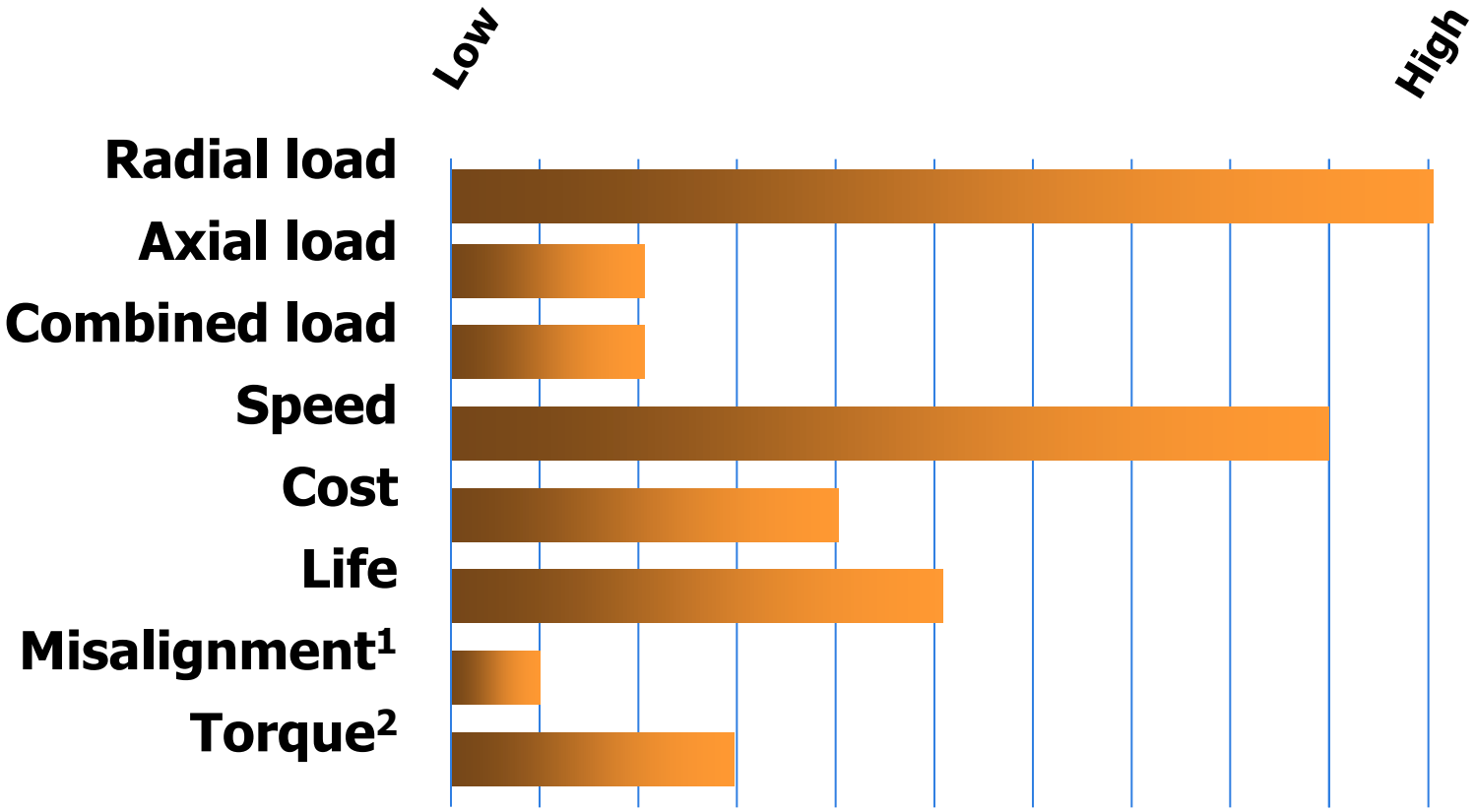
CYLINDRICAL ROLLER BEARING PERFORMANCE



1) A low performance indicates a bearing life reduction due to misalignment

2) A low performance indicates a low torque level

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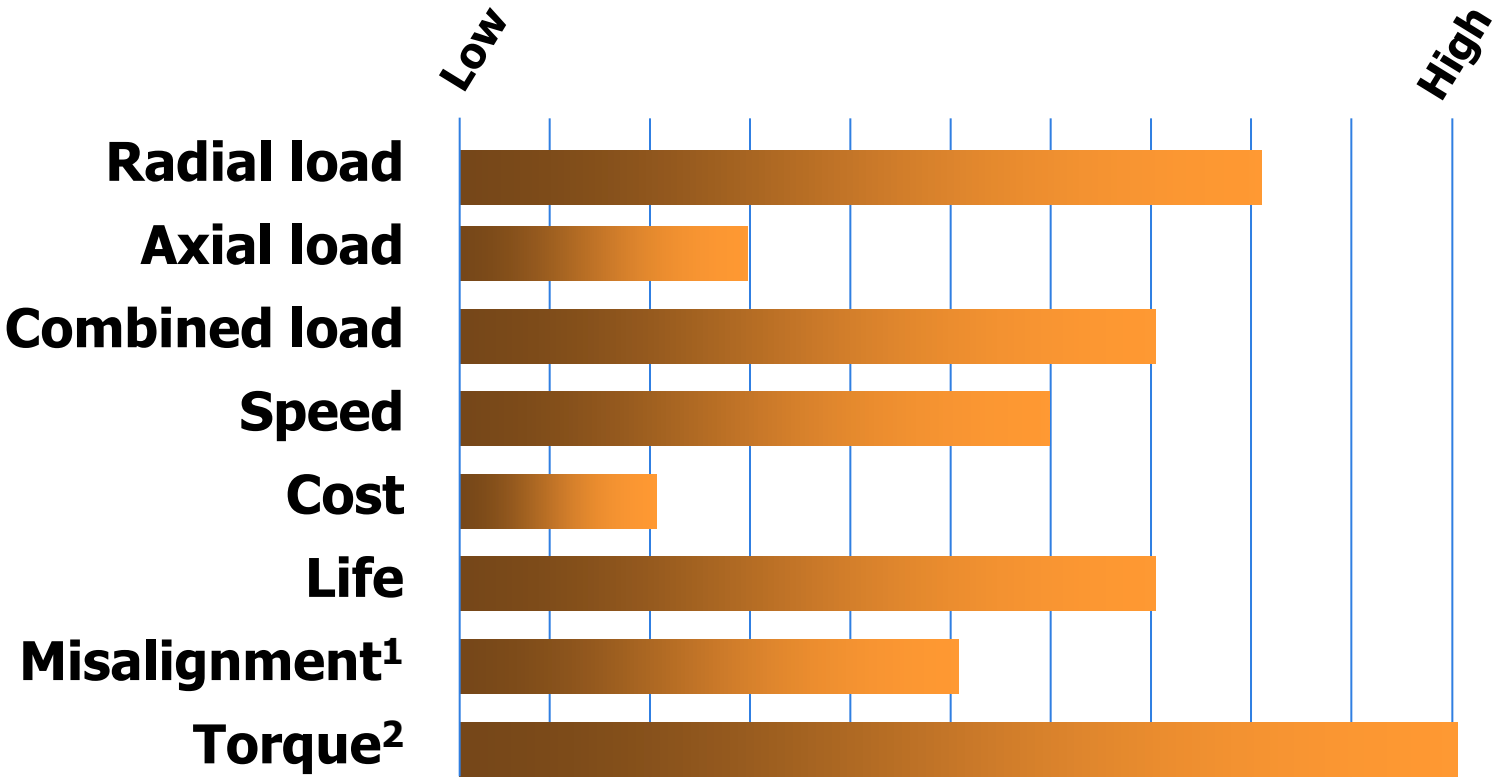
SPHERICAL ROLLER BEARING PERFORMANCE



1) A low performance indicates a bearing life reduction due to misalignment

2) A low performance indicates a low torque level

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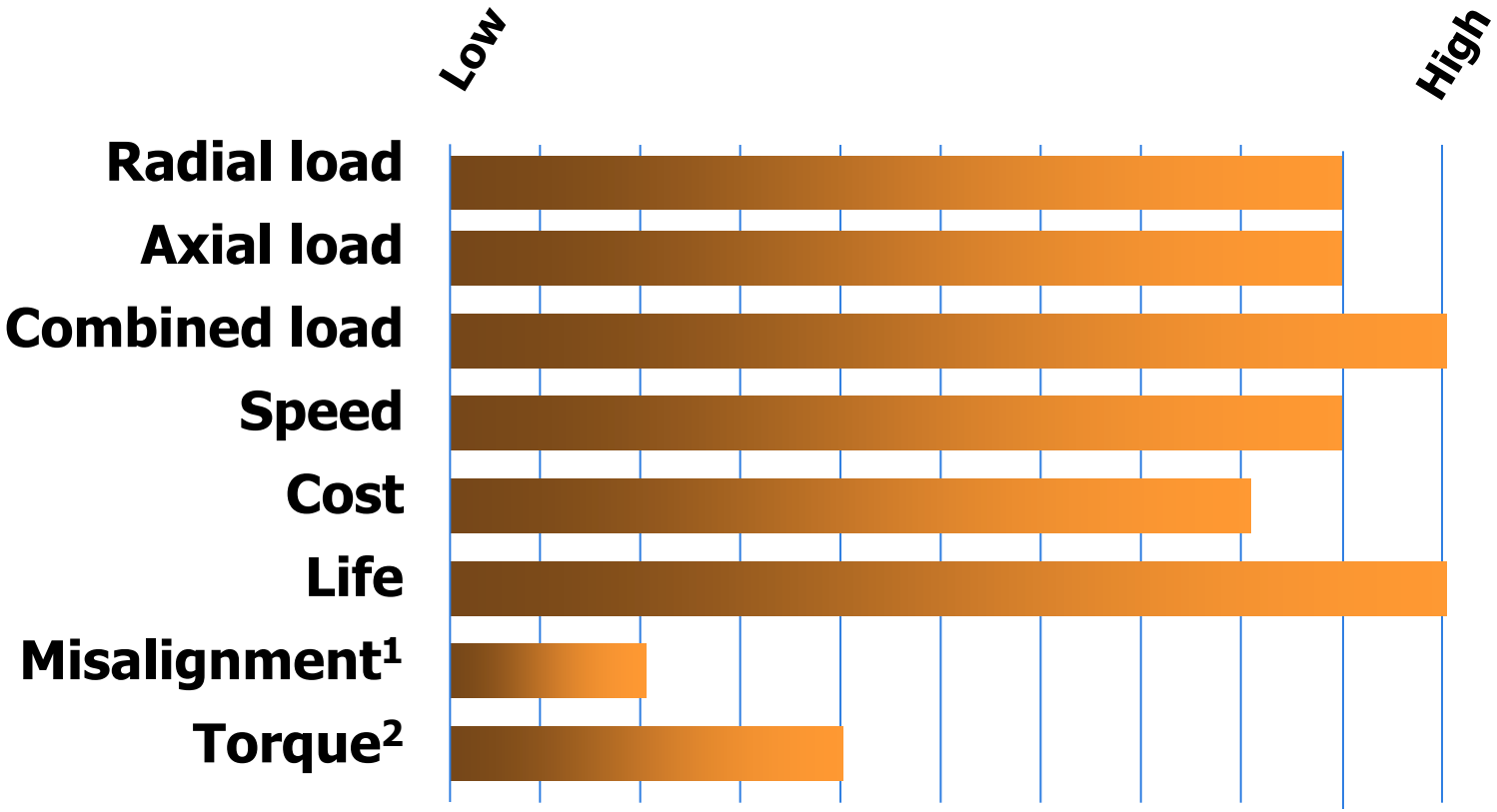
TAPERED ROLLER BEARING PERFORMANCE



1) A low performance indicates a bearing life reduction due to misalignment

2) A low performance indicates a low torque level

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Example of Overload

Example of Overload

Example of Overload

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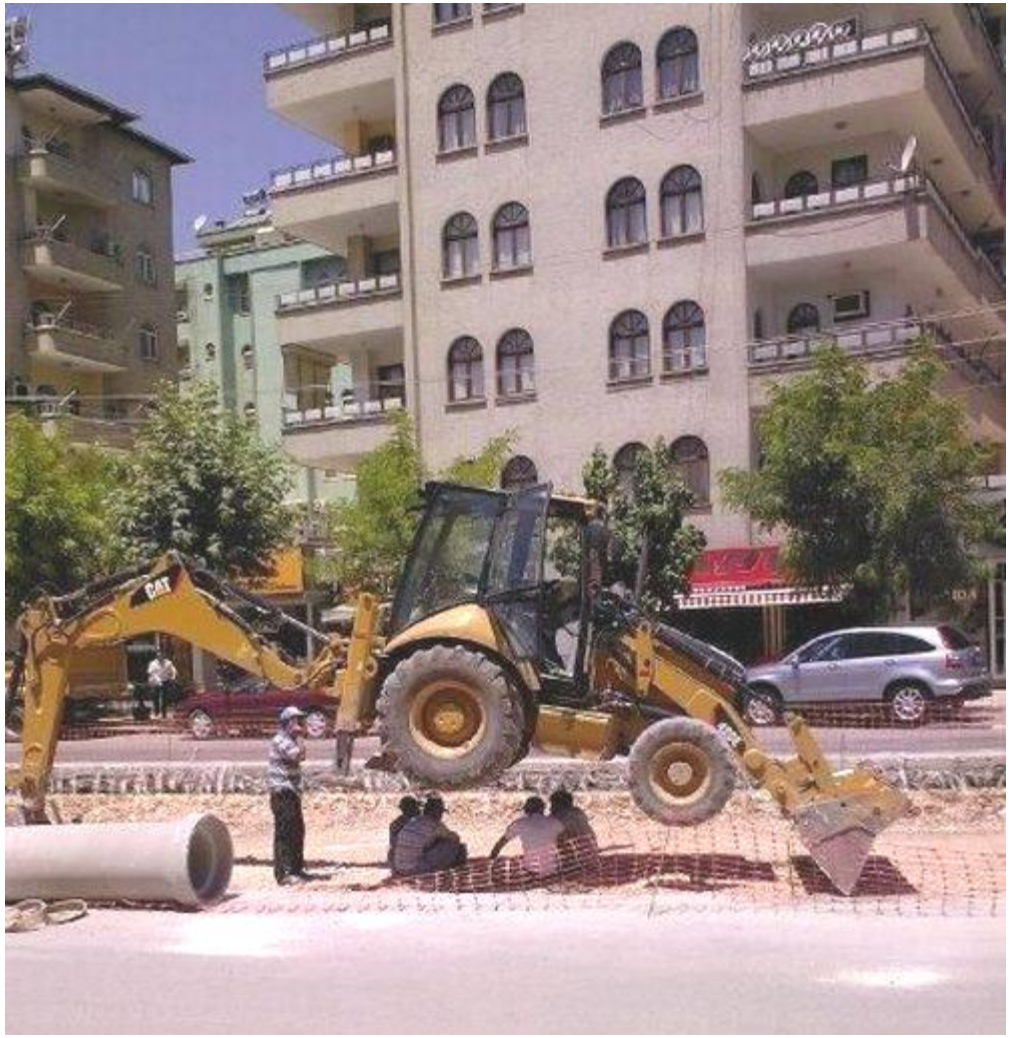
And Reliability...



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QUESTIONS

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