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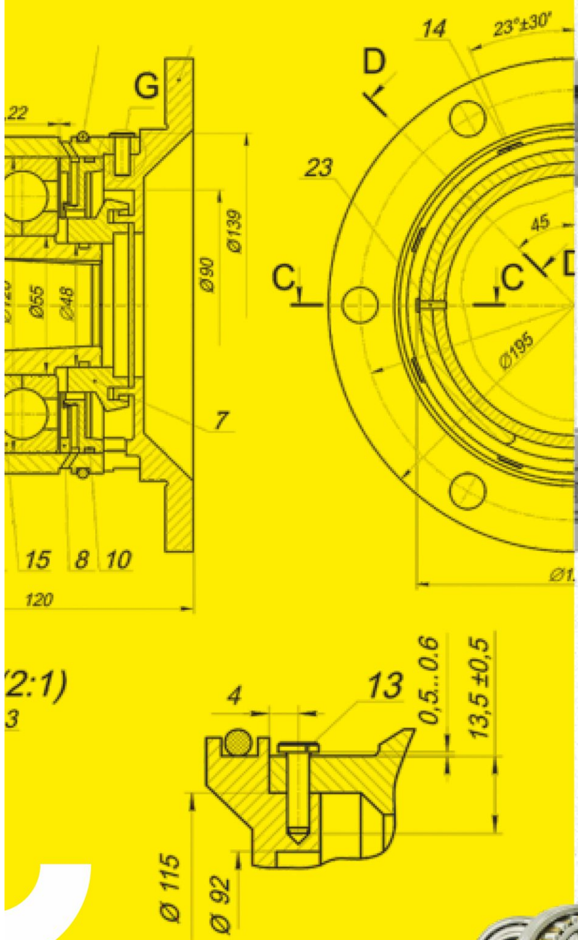

ROLLING BEARINGS

Friction & Temperature

2 WHEELERS | 3 WHEELERS | 4 WHEELERS | TRACTORS | LCV, HCV | INDUSTRIES | RAILWAYS | AEROSPACE

WINNER DEMING GRAND PRIZE

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CATALOGUE/TC-106, 01/2024

This version supersedes all previously published versions. All the bearing mentioned in this catalogue are manufactured with normal tolerance class. We can, however, supply other class bearing against specific requirement.

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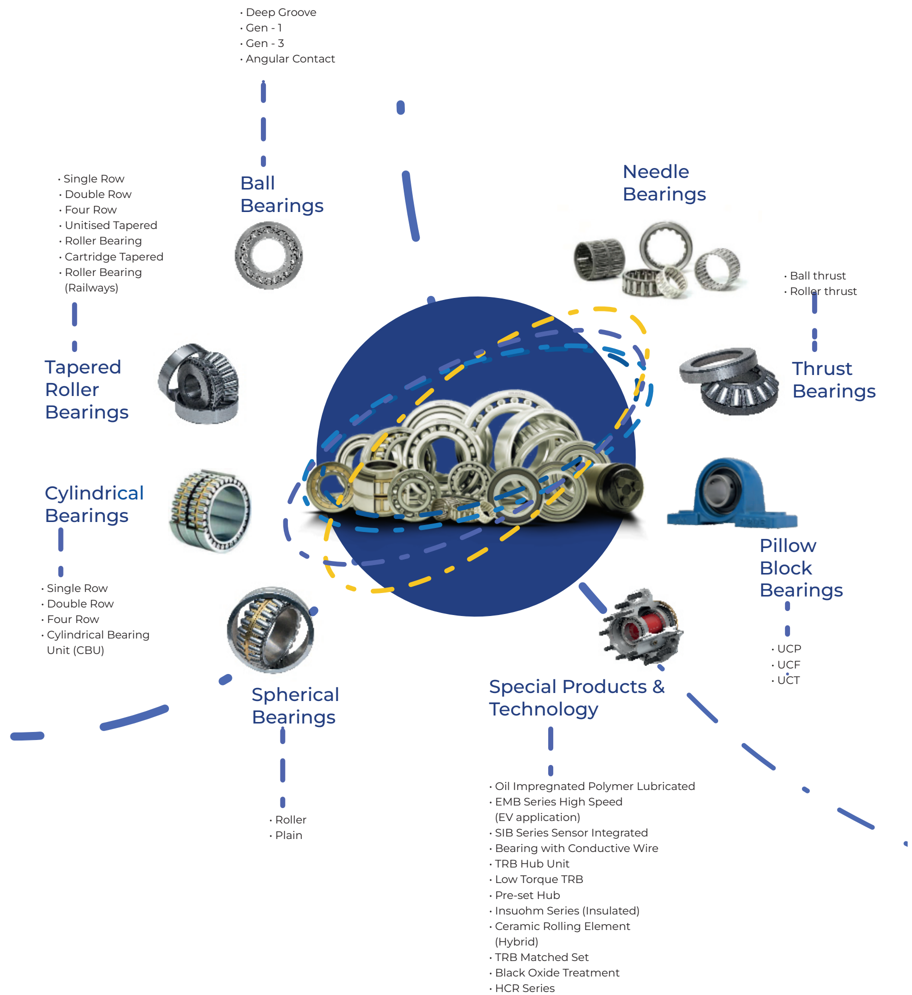
Founded in 1946, NBC is India's first bearings manufacturer and the last word in quality and durability. In 2020, the company acquired leading European manufacturer, Kinex Bearings to further boost its expertise.

75 years since its beginning, NBC remains India's leading bearings manufacturer andexporter. NBC is also the world's only bearings manufacturer to receive the prestigious Deming Grand Prize for Total Quality Management.

- 1946 India's first bearing manufacturer
- 250+ million bearings manufactured/ annum
- 3100+ variants of bearings offered
- 5 manufacturing locations
- Leading exporter
- Happy customers in 30+ countries
- R&D and Innovation Centre
- 2800+People
- Automotive
- Industrial
- Railway
- Aerospace

Products from NBC

Since the challenges faced by industry are many, NBC offers a diverse range of exceptional bearings. NBC bearings are available in sizes from 04 mm bore to 2000 mm outer diameter.



* Products with special features like high temperature application, special heat treatment, coated roller/races and cage options are also available across product range.

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08 Friction and Temperature

8.1 Friction

Frictional resistance to motion in a rolling bearing arises from various sources; the following commonly predominate:

1. Rolling friction: Elastic hysteresis and deformation at raceway contacts.

2. Sliding friction: Sliding from unequal curvatures in contact areas, sliding contact of the cage with rolling elements and guiding surfaces, sliding between the ends of rollers and ring flanges, and seal friction;

3. Lubricant friction: Viscous shearing on rolling element, cage, and raceway surfaces; churning and working of lubricant dispersed within the bearing cavity.

For most normal operating conditions, the total frictional moment can be estimated with sufficient accuracy as load dependent using a constant coefficient of friction:

$M = 0.5 \times \mu \times P \times d$

Where,

M = bearing frictional moment, calculated at the bearing bore radius (N mm)

μ = coefficient of friction for the bearing (Table 8.1)

P = bearing load (N)

d = bearing bore diameter (mm)

The starting coefficient of friction can generally be taken as being about 60% higher than the running values given in Table 8.1. More accurate calculations of bearing friction are available which account for variations in the coefficient of friction with relative bearing load, bearing size, and cross section series.

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Table 8.1 Co-efficient of friction for rolling element bearing

Bearing Types	Approximate values of μ
Deep Groove Ball Bearings	0.0015[a]
Cylindrical Roller Bearings with cage	0.0011[b]
Cylindrical Roller Bearings full complement	0.002 [a,b]
Spherical Roller Bearings	0.0018
Tapered Roller Bearings	0.0018

Note: [a] Apply to unsealed bearing

[b] No appreciable axial load (Fa= 0)

8.2 Bearing operating temperature

Operating temperature bears important relations to bearing and seal friction, design of the bearing assembly, and especially lubrication considerations

Generally, all friction loss in a bearing is transformed into heat within the bearing itself and causes the temperature of the bearing to rise. The amount of thermal generation caused by friction moment can be calculated using the below equation.

$Q = 0.105 \times 10^{-6} \times M \times n$

where,

Q ∶ Thermal value, kW

M ∶ Friction moment, N.mm

n ∶ Rotational speed, rpm

Bearing operating temperature is determined by the equilibrium or balance between the amount of heat generated by the bearing and the amount of heat conducted away from the bearing. In most cases the temperature rises sharply during initial operation, then increases slowly until it reaches a stable condition and then remains constant. The time it takes to reach this stable state depends on the amount of heat produced, heat capacity/diffusion of the shaft and bearing housing, amount of lubricant and method of lubrication. If the temperature continues to rise and does not become constant, it must be assumed that there is some improper function.

Possible causes of abnormal temperature increase may be due:

- Bearing misalignment
- Moment load
- Incorrect installation
- Insufficient internal clearance
- Excessive pre-load, too much or too little lubricant.