Bearing Service Company
IRD – Rolling Mill Bearings

KC LaCross

Bearing Service Company Overview

- Founded in 1933 – Pittsburgh, PA
- ISO 9001 Certified Bearing Manufacturer
  - 88,000 Sq Ft Manufacturing Center
  - Precision manufactured to ABMA standards (American Bearing Manufacturers Association)
  - Custom Designed Solutions
- Bearing Repair Specialists
  - Reclaim & Remanufacture
- Full Line Stocking Industrial Distributor

BSC Proudly Services

- United States Steel
- ArcelorMittal
- Charter Steel
- ATI
- Haynes International
- AK Steel
- Nucor
- Timken Steel
- Arconic
- SSAB
- SDI Steel Dynamics®
- Horsburgh & Scott – Delivering the Difference
- Aleris
- Glunt
- NLMK
- Novelis
- M-7 Technologies

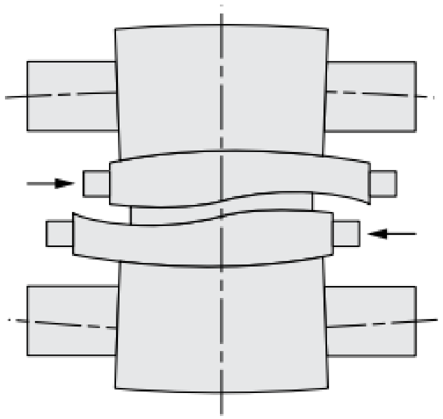
"The driving force behind Bearing Service Company has always been our customers. We are committed to helping you avoid downtime and increase profits."

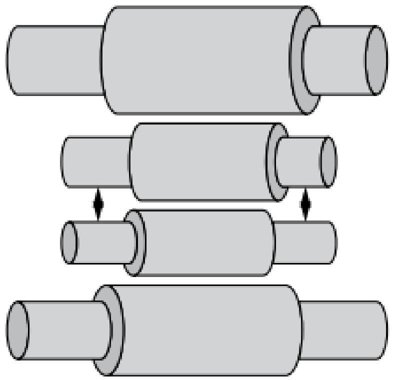
Questions to Answer

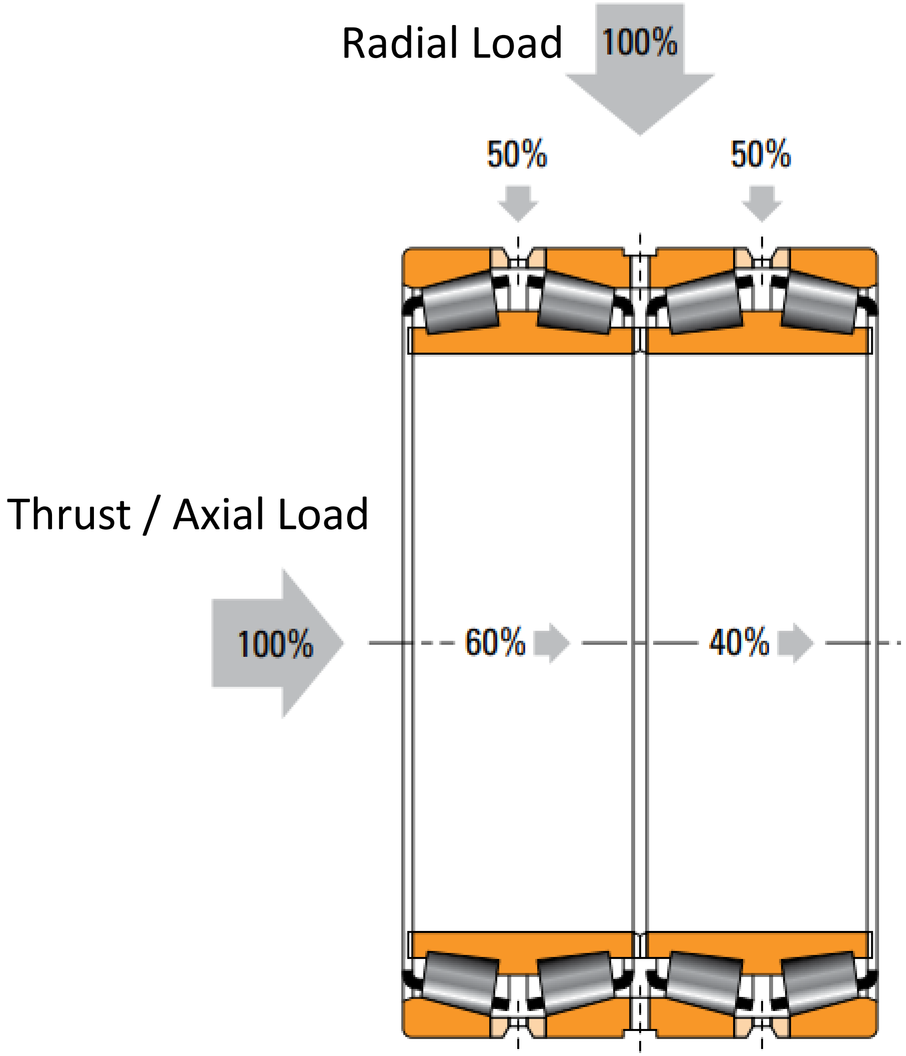
1. What types of bearings are used in rolling mills?
2. Why are these types of bearings used?
3. How is the bearing selected?
4. What affects the bearings life?
5. How can bearing life be improved?
6. What are some things to avoid?
7. Can my bearings be reused or repaired?
8. Will a repaired bearing last as long as a new bearing?

Load Directions Explained

- Radial Load Versus Thrust / Axial Load
- What causes thrust?
  - Flat Products
    - Axial Roll Shifting
    - Cross Rolling
  - Long Products
    - Asymmetrical Shapes
  - Misalignment
  - Roll Geometry

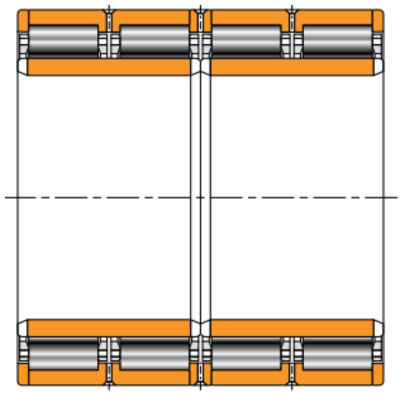


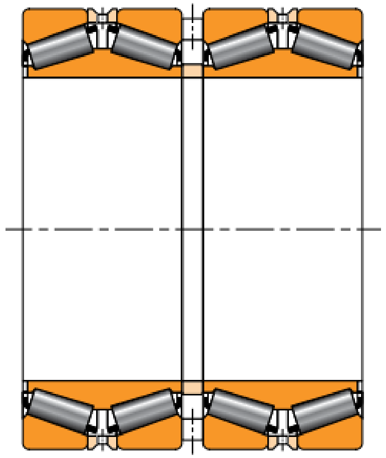


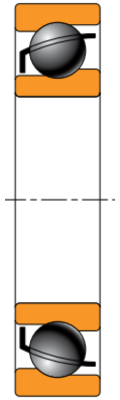


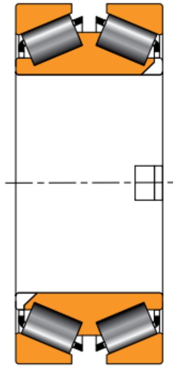
What types of bearings are used in rolling mills?

- 4-Row Cylindrical Roller Bearing
  - Maximized radial load capacity.
  - Typically seen in 2-Hi mills or in back up position.
- 4-Row Tapered Roller Bearing
  - Excellent radial and axial load capacity
  - Typically seen in work roll – hot mill / cold mill etc.
  - Roughing mill & hot mill backup positions.
- Thrust Roller Bearings
  - Typically used in combination with cylindrical roller bearing or oil-film bearing.
    - Locating Bearing
    - Thrust Bearing – Floating Chock
  - Also used in applications with unusually high thrust.



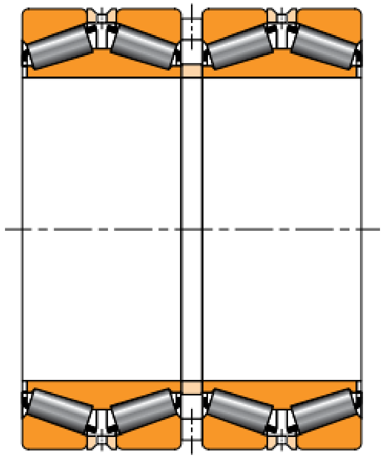




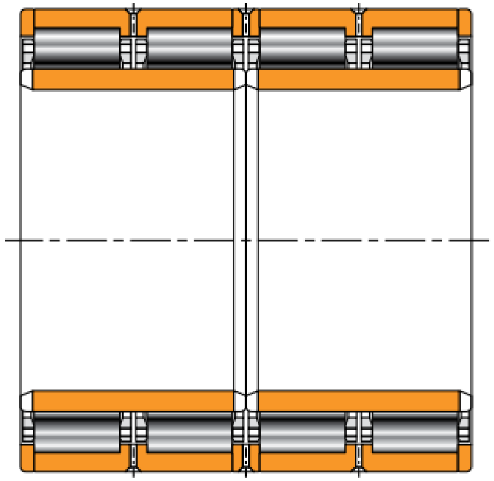


How is the bearing selected?

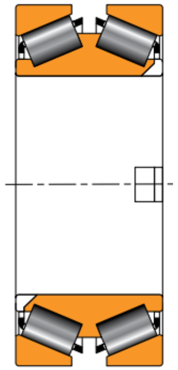
1. Dimensional Constraints
   1. Function of roll neck / body diameter and Chock outside dimensions.
2. Roll Speed
3. Load and Load Direction
4. Ease of Installation



Tapered Roller Bearing



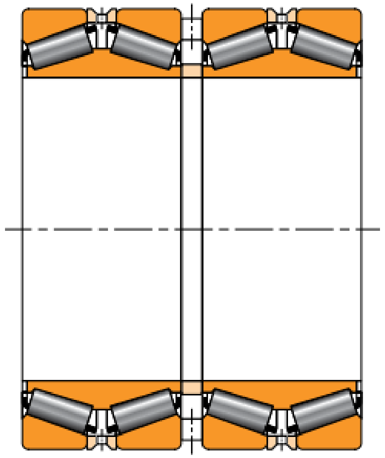
Cylindrical Roller Bearing



Thrust Bearing

Why are these types of bearings used?

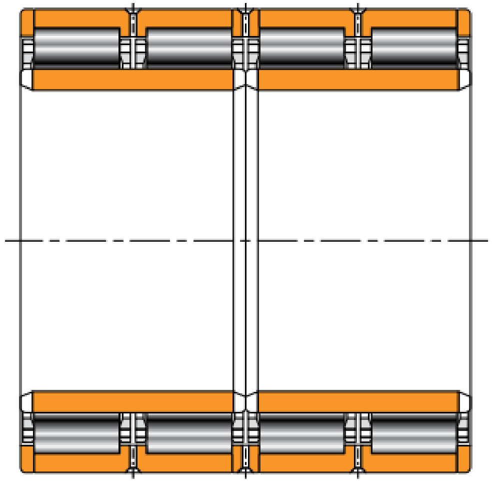
Tapered Roller Bearing



Points of Interest:

- Unitized Construction
- Protected Rolling Elements
- Handles Axial and Radial Loads
  - Thrust Bearing Generally Not Required
- Internal Clearance Axially Controlled Through Spacer Widths
- Enables More Compact / Simpler Mounting

Cylindrical Roller Bearing



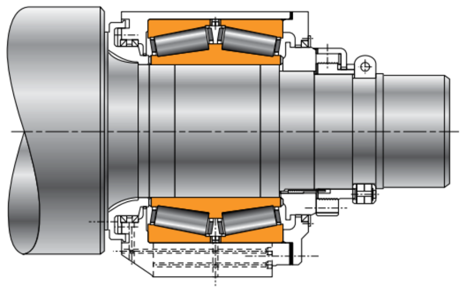
Points of Interest:

- Maximized Radial Capacity
- Limited Axial Load Capability
  - Thrust Bearing Required
- High Speed Capabilities
- Internal Clearance Radially Controlled
- Separable Inner and Outer Raceways
- Requires Larger Internal Clearance

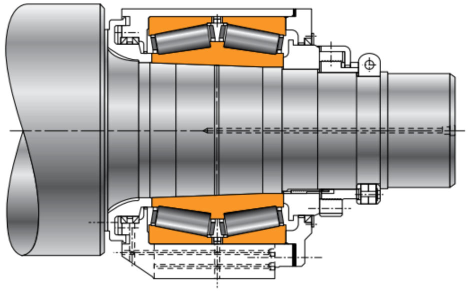
Rolling Mill – Long Products Bearing types

2-Hi: 2-Row Tapered Roller Bearing Design

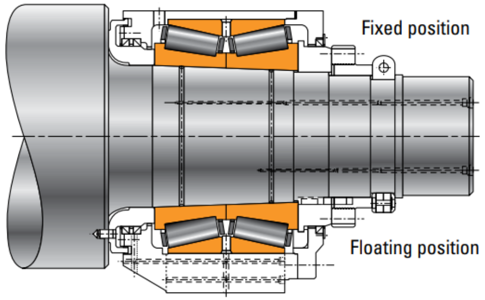
Work Roll Radial Position



TDIW (Low Speed Stands)



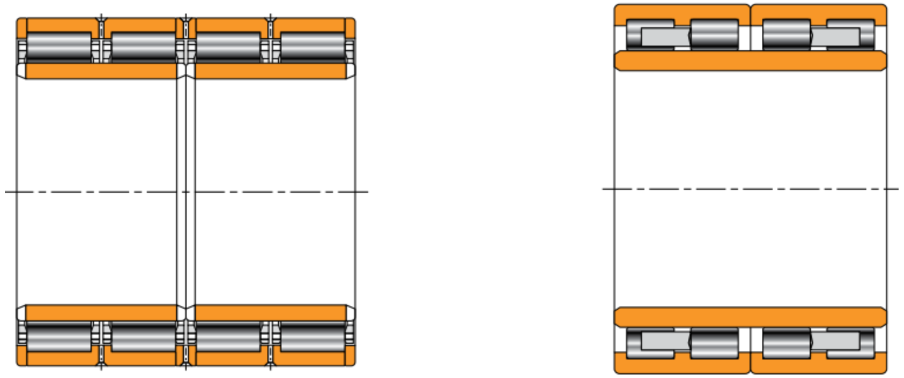
TDIT (High Speed Stands)



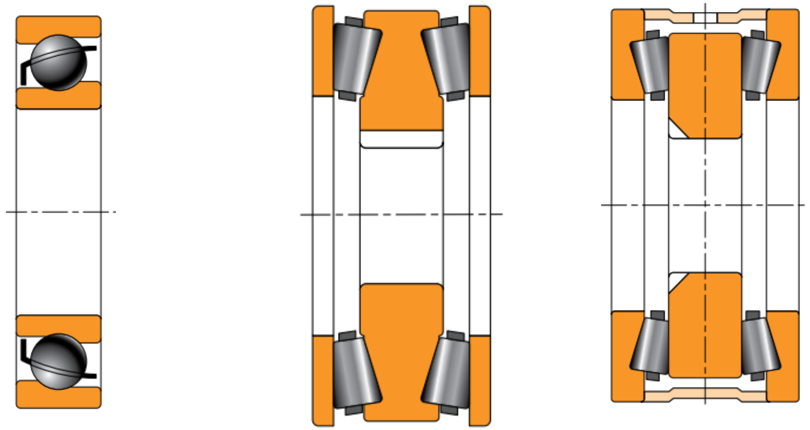
TDIT (High Speed Pre-Stressed)

2-Hi: 4-Row Cylindrical Roller Bearing Design

Work Roll Radial Position

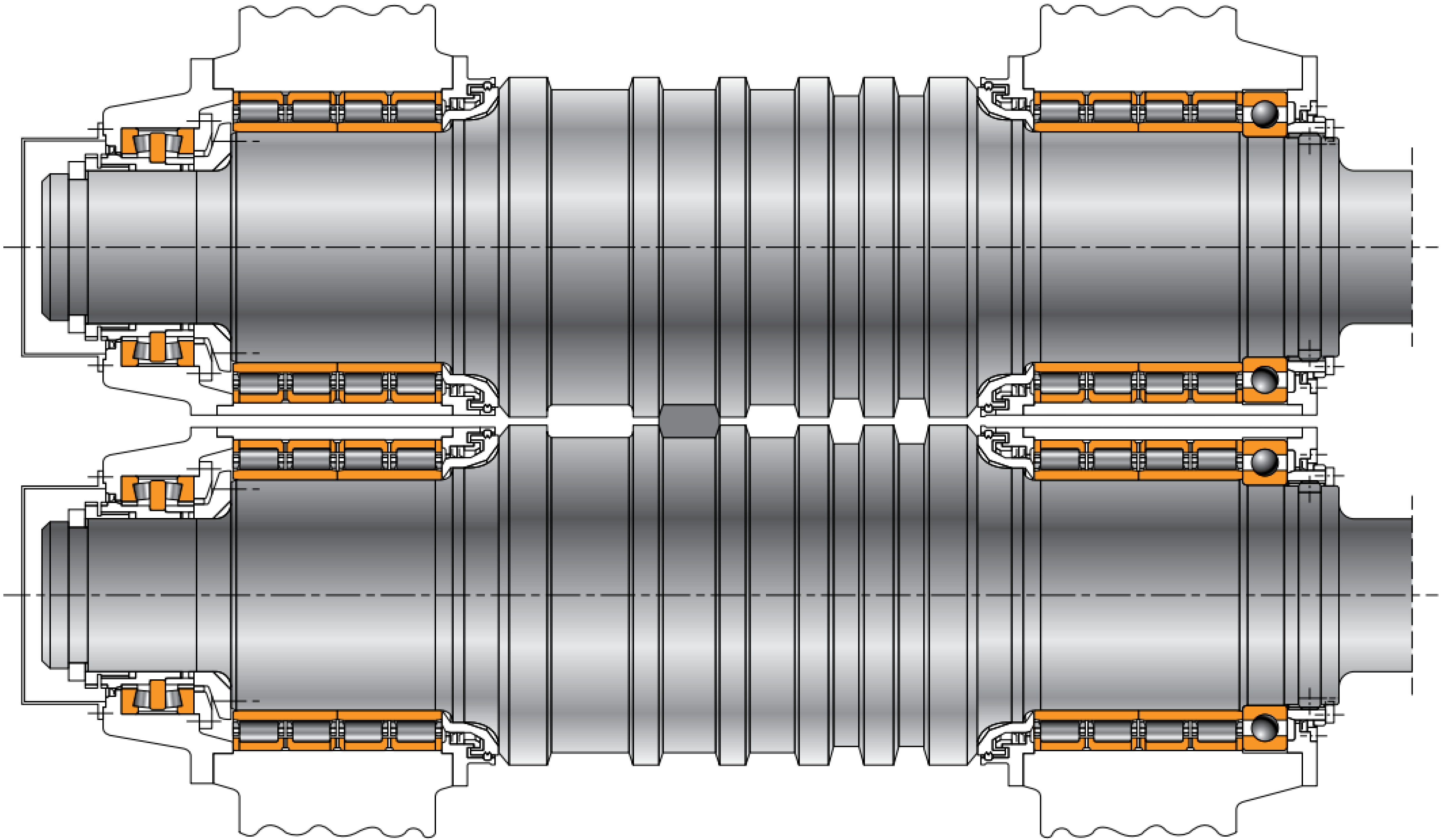


Work Thrust and/or Locating Position



BEARING SERVICE COMPANY

Bearing Manufacturing & Repair
Industrial Distribution



85+ Years
ounded in 1933

Bearing Selection Criteria – Long Product Work Rolls

1. Dimensional Constraints – Dictated by the work roll chocks and work roll neck in 2-Hi setup.
2. 4-Row Cylindrical w/ Separate Thrust OR 2 or 4-Row Tapered Roller Bearings
    1. 2-Row Taper often used when space limitations make it impossible to integrate a 4-Row assembly.
3. Roll Speed
4. Load and Load Direction
5. Ease of Installation

What affects bearing life?

1. Speed
    1. If speed is doubled, life is reduced by 1/2
2. Load
    1. If load is doubled, life is reduced by 90%
3. Clearance
4. Externalities

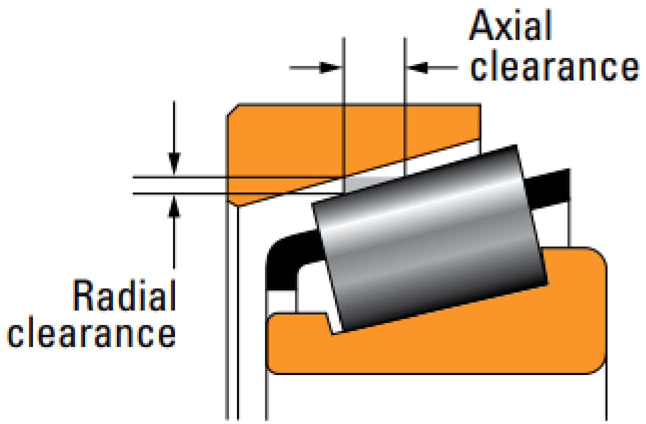
$$L_{10} = \left(\frac{C_r}{P_r}\right)^{10/3} \left(\frac{1 \times 10^6}{60n}\right) \text{ hours}$$

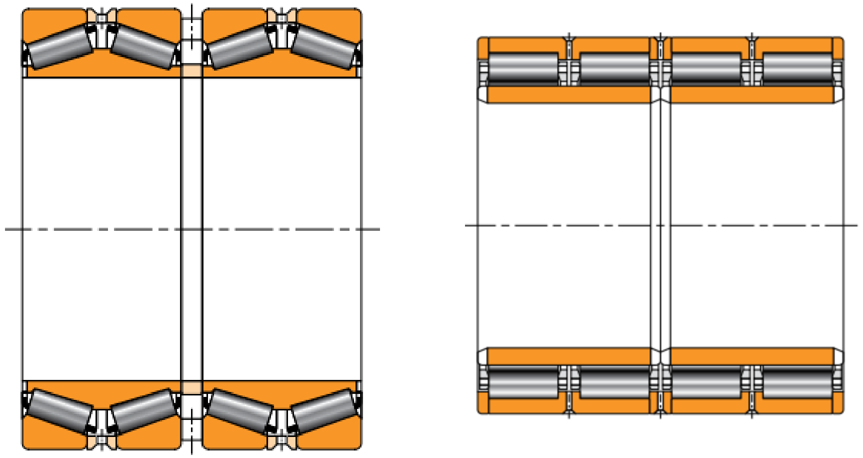
Cr = Bearing Capacity
Pr = Dynamic Equivalent Load
n = Revolutions Per Minute (RPM)

Bearings RARELY meet their calculated L10 life – Why?

Bearing Clearance

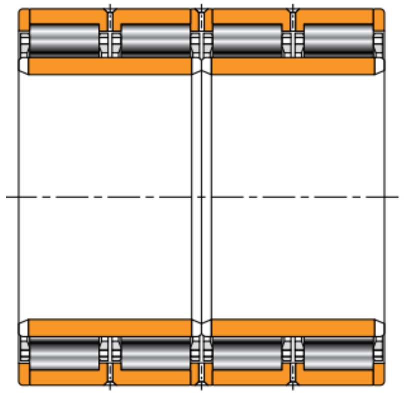
1. Tapered Roller Bearings – Axial Clearance
    1. Adjustable
    2. End Play versus Preload
    3. Controlled thru Spacers
2. Cylindrical Roller Bearings – Radial Internal Clearance
    1. Non-Adjustable
    2. Clearance Set by Manufacturer

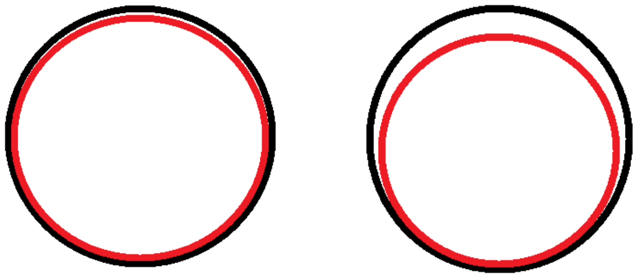


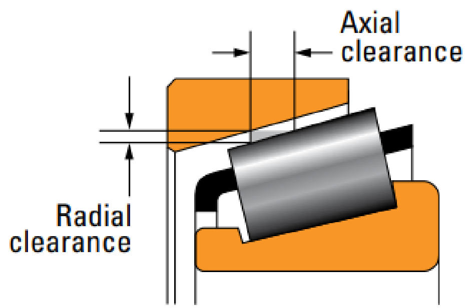


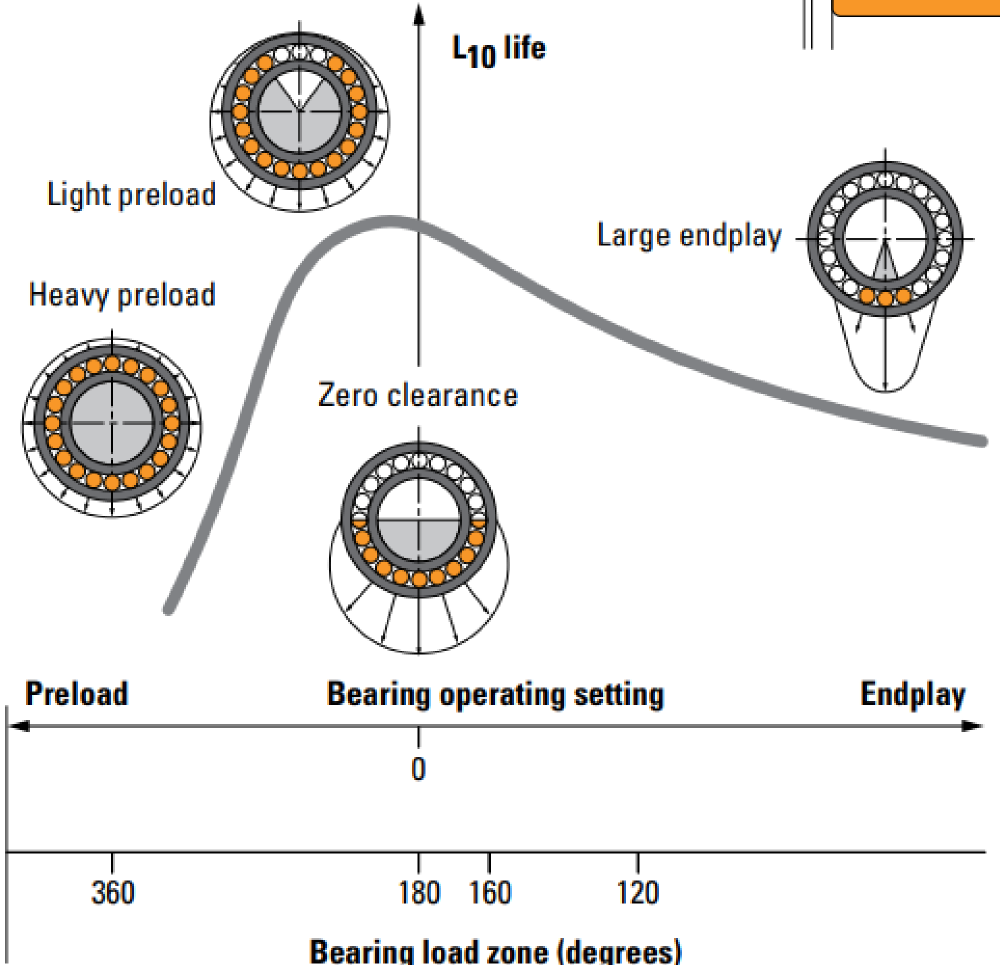
Why is Bearing Clearance Important?

1. Load Zone
2. Bearing Fits
3. Thermal Expansion
4. Lube Film Thickness
5. Product Quality



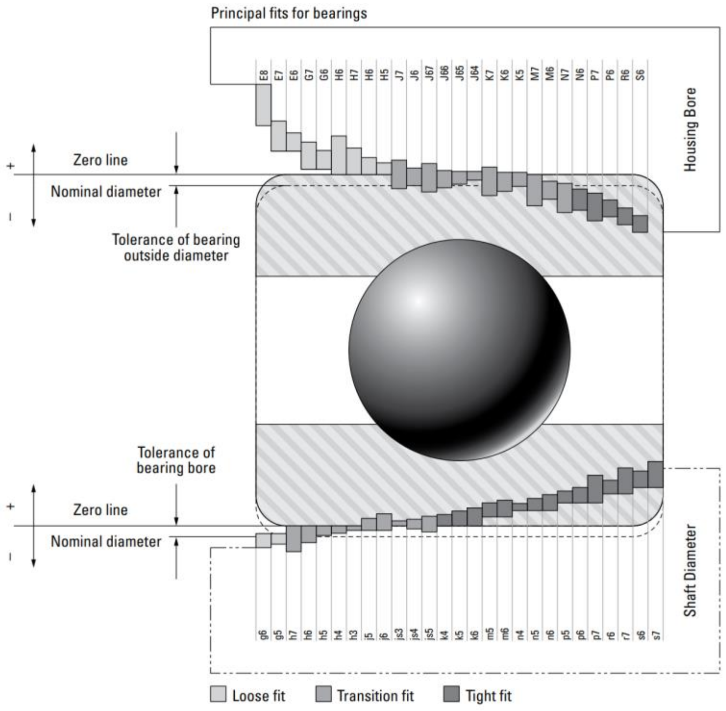


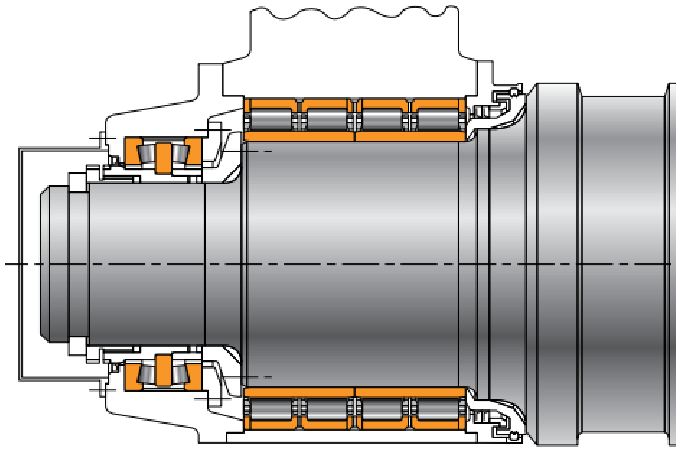




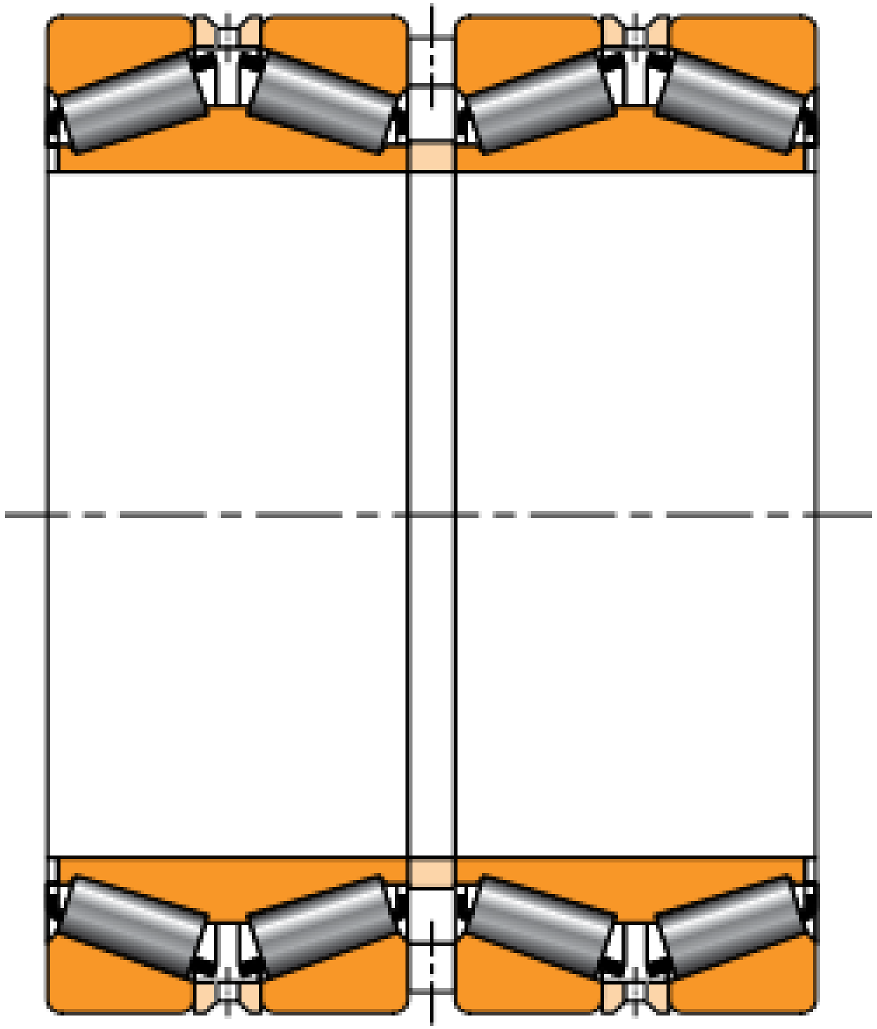
Fitting Practice

1. Bearings Prefer Tight Fit on Rotating Member
2. Rolling Mill Radial Bearings Generally Use Loose Fits – Ease of Installation
3. Cylindrical bearings can have tight fit inner that stays with the roll.
4. Higher speed mills require tight fits.





What would cause the clearance to change?



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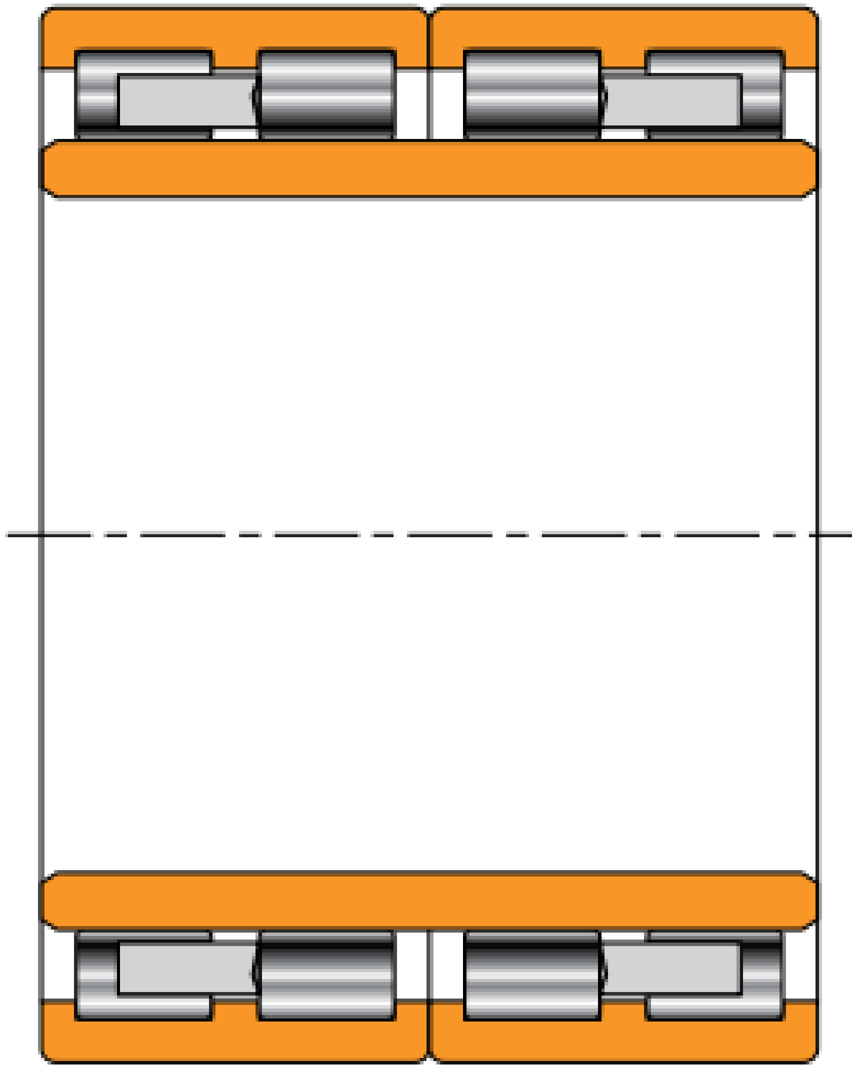
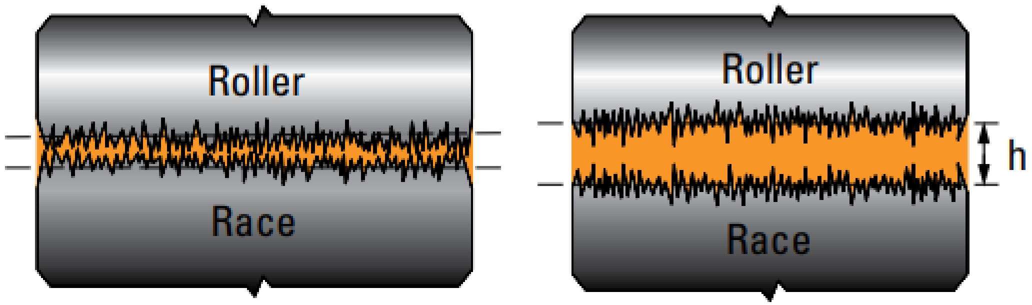


Externalities – Adjusted Life Factors

- Material Life Factor
- Debris Life Factor
- Load Zone Life Factor
- Lubrication Life Factor
- Misalignment Life Factor

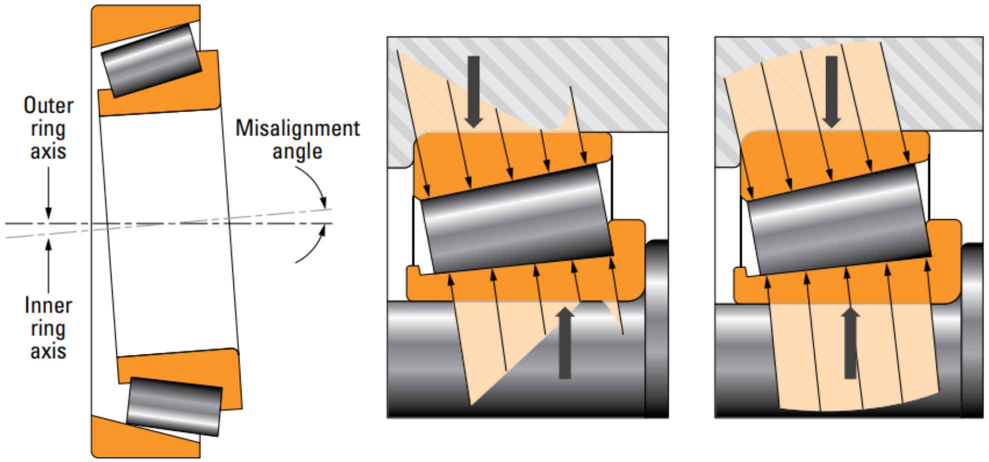


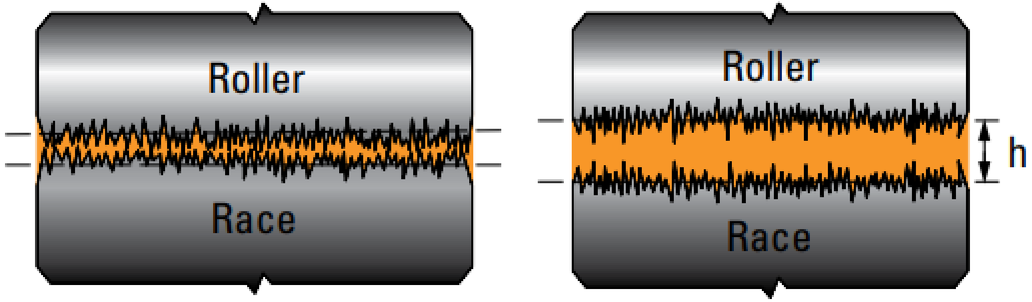
Todays Reality…

- Different Products / Materials
- Higher Speeds
- Higher Loads
- Limited Space
- Limited Funds $$
- Maintenance practices become more important…
- Unless we can completely redesign the mill, we have to work within the constraints we're given.

How can bearing life be improved?

- Enhanced Material
  - Ultra-clean Steel
  - 52100 Vs Case Carburized
- Enhanced Raceway and Roller Profiles
- Enhanced Surface Finish Properties
- Increase Capacity
- Bearing Features – Installation / Removal
- Improved Maintenance Practices
  - Chock Maintenance
  - Roll Maintenance
  - Sealing
  - Lubrication



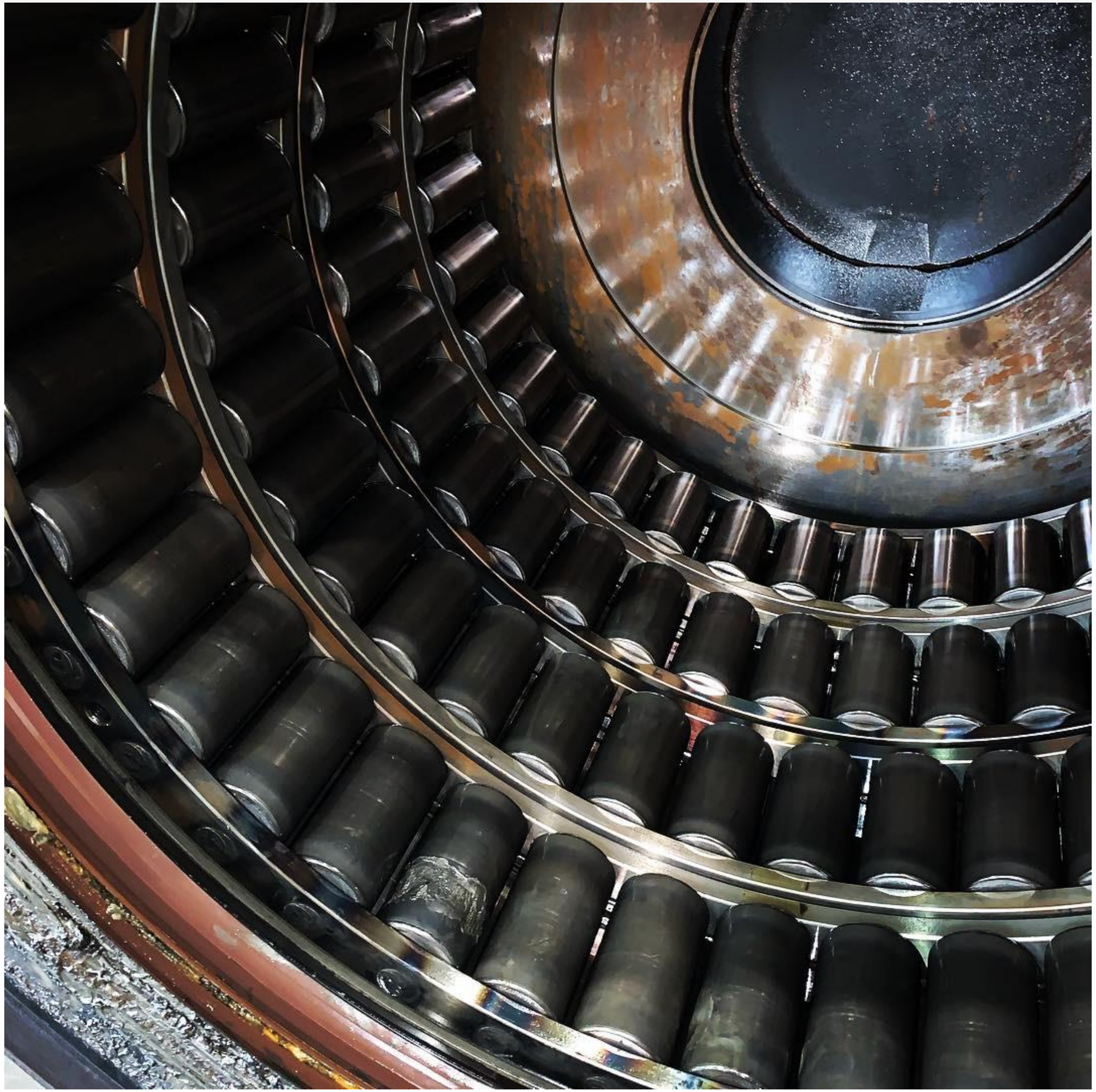


What are some things to avoid?

- Lack of Lubrication
- Overload
- Misalignment
- Undersized / Worn Journal / Inner Race
- Oversized / Worn Chock Bore
- Contamination
- Installation Damage
- The Bearing Itself
  - Clearance
  - Condition

What happened?

What happened?



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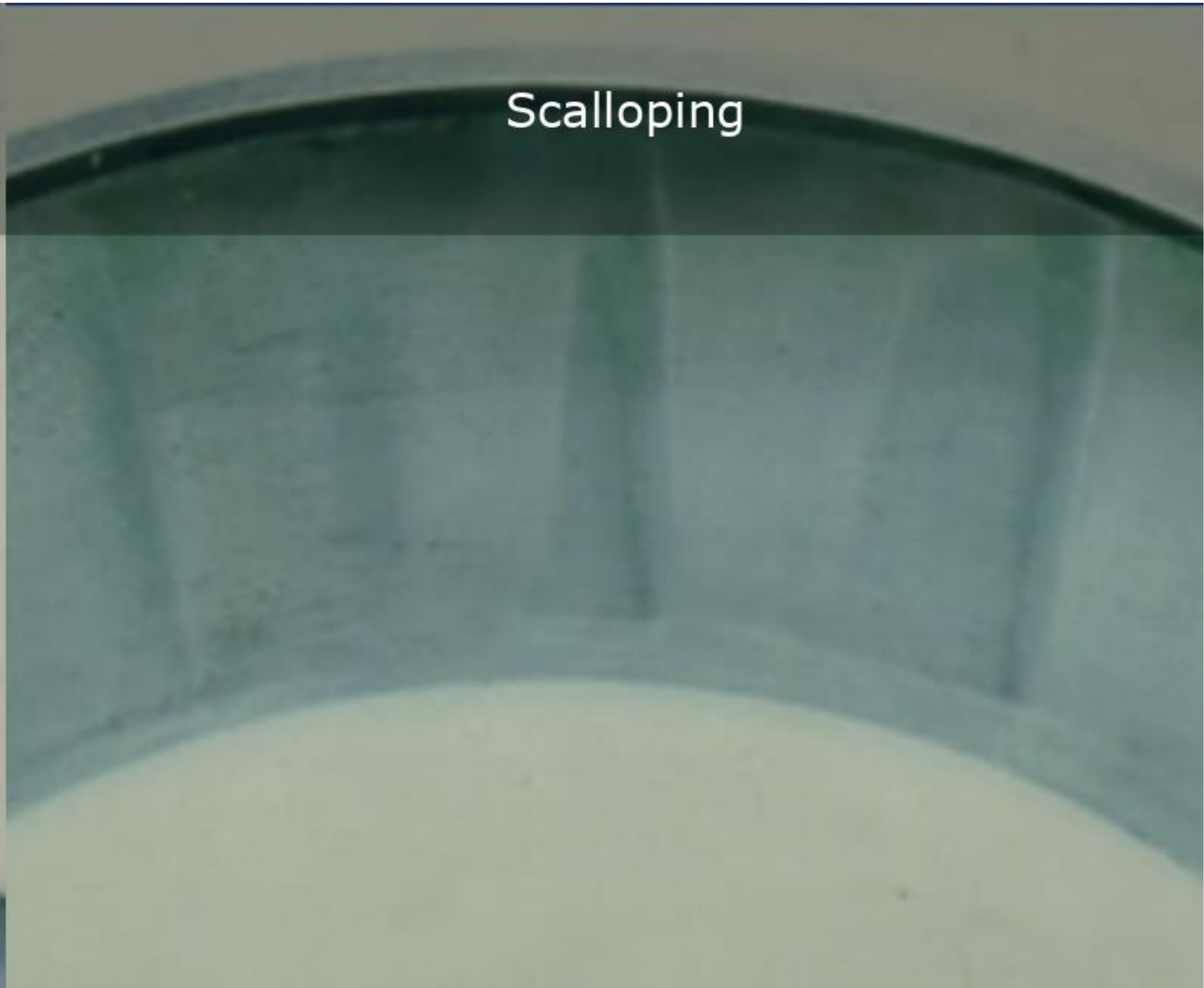

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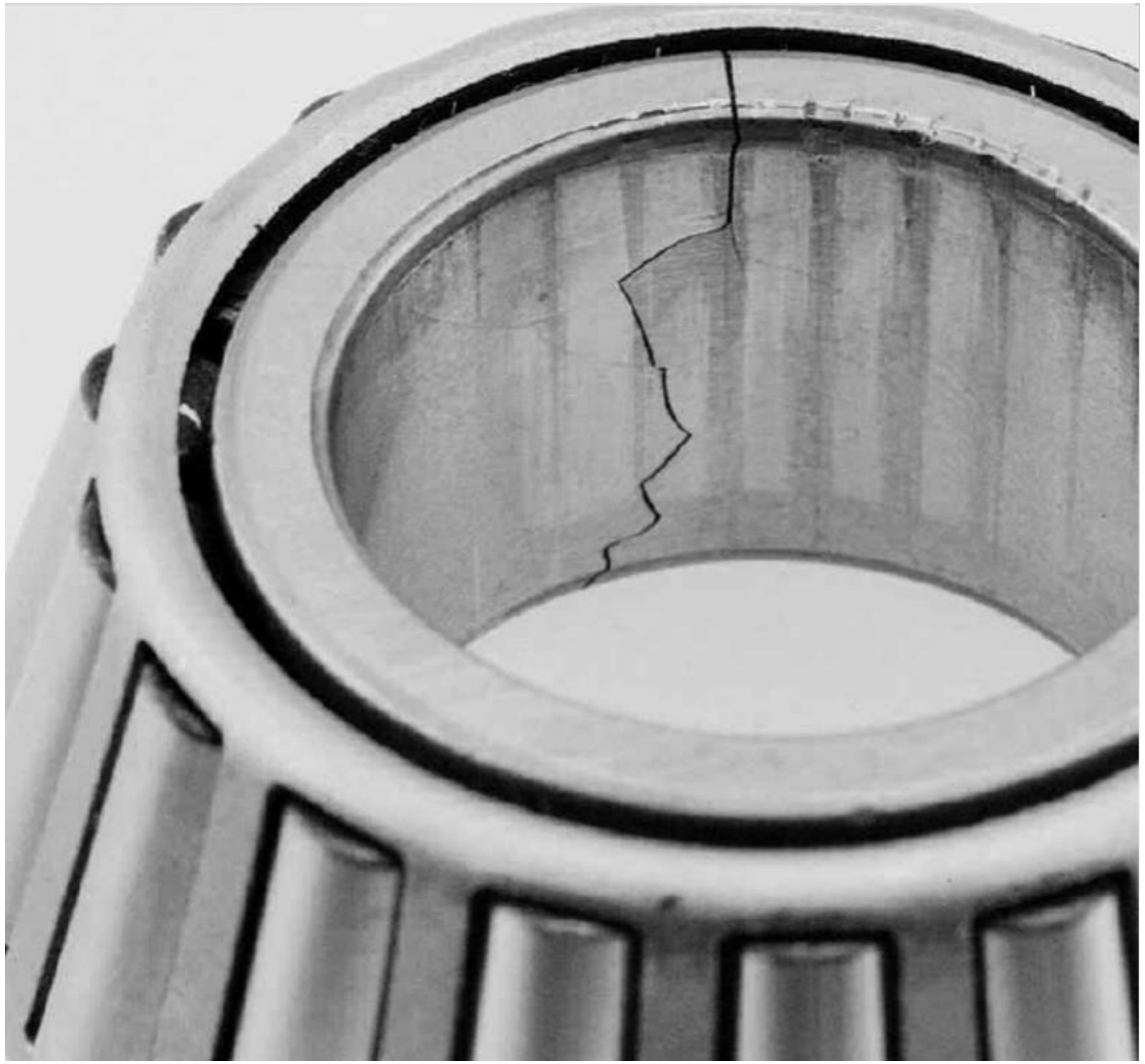
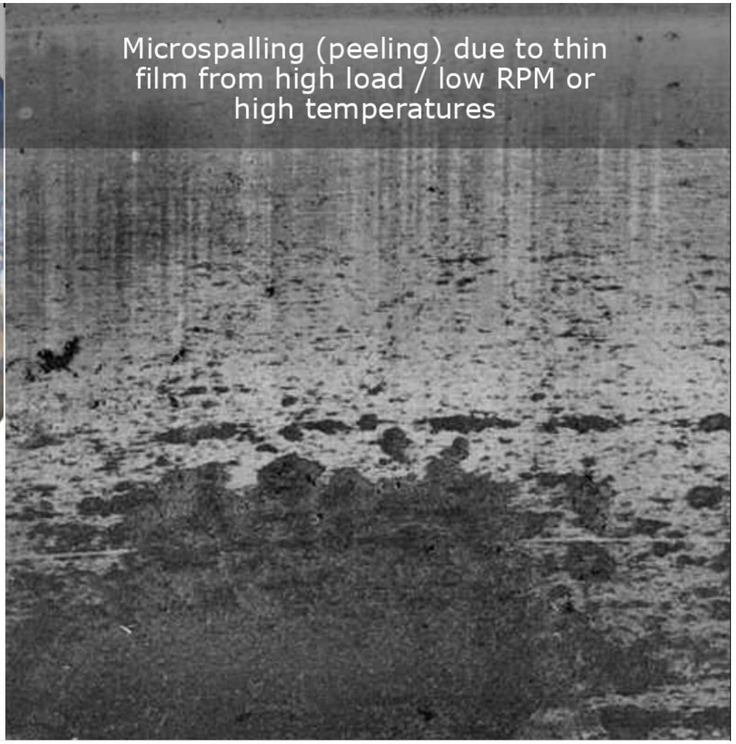


Lubrication Problems



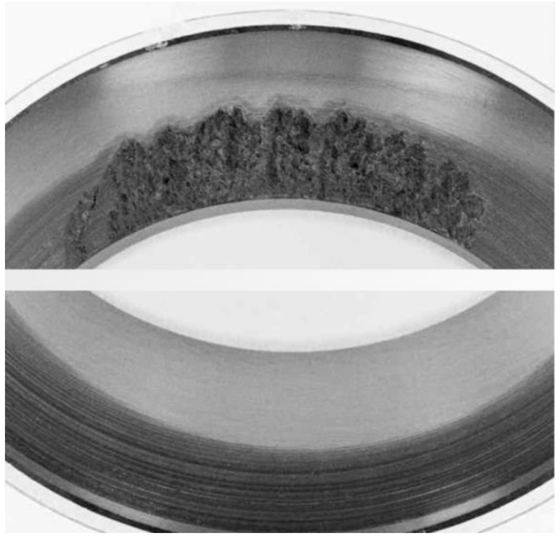
- Metal to Metal Contact
- Identified By:
  - Discoloration
  - Scoring
  - Peeling
- Causes:
  - Lubrication Starvation - Insufficient lube to sustain a film
  - Wrong kind of lubricant
  - Wrong grade of lubricant
- Can be mitigated through improved surface finish.

Overload

- Identified by peeling, fatigue spalling and discoloration.
- Can be mistaken for lack of lubrication.
- Possible Causes: Generally external to the bearing.
  - Bearing clearance or setting too tight
  - ‘Looseness’ or misalignment
  - Uneven bearing seat
    - Causes uneven load distribution.
  - Heavier Loads

Misalignment

- Misalignment causes roller ends to carry the load leading to points of high stress and early fatigue.
- Identified by irregular roller path concentrated to roller ends.
- Profiled rollers can help alleviate unavoidable misalignment.



PROFILE ENHANCEMENT EFFECT ON BEARING LIFE

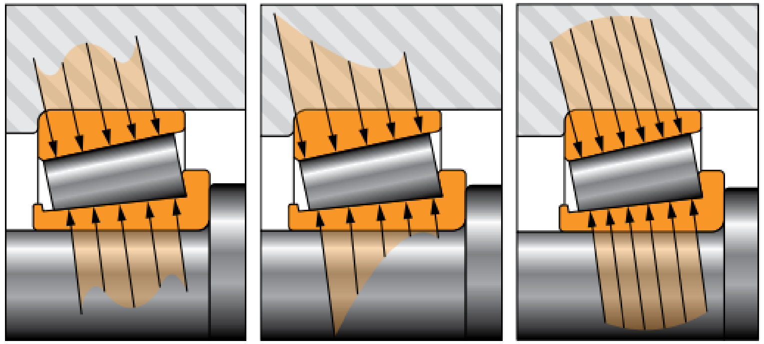
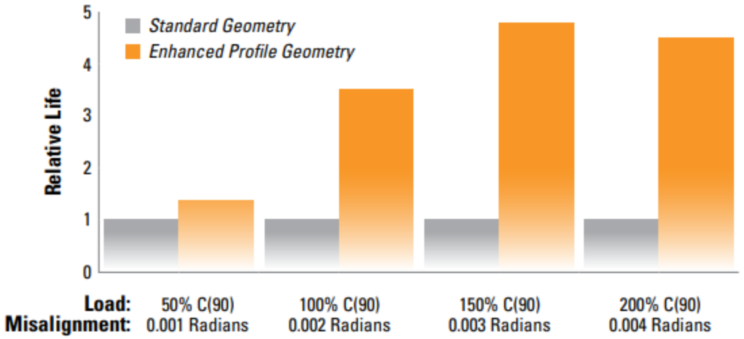


Fig. 173. Roller-race stress distribution under high load- standard profile.

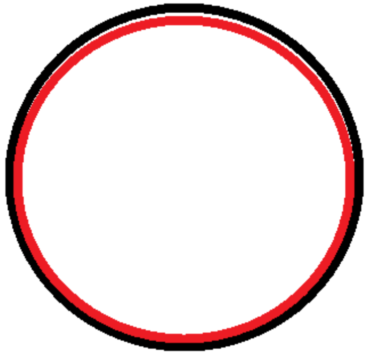
Fig. 174. Roller-race stress distribution with misalignment present – standard profile.

Fig. 175. Roller-race stress distribution with special profiling to minimize effect of edge loading.



Undersized / Worn Roll Neck

- Roll necks will wear over time causing them to become undersized or create an uneven bearing seat.
- Identified by:
  - Increased wear on bearing bore
  - Decreased load zone
  - Uneven load distribution
  - High stress concentration
- Avoid by:
  - Stay within wear and rework limits
  - Lubricate necks prior to installation to minimize neck and bearing bore wear.



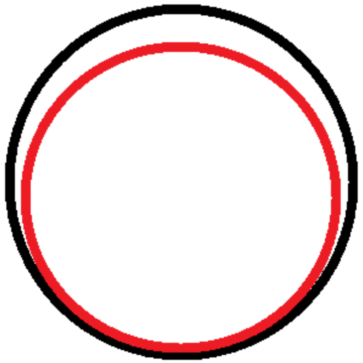
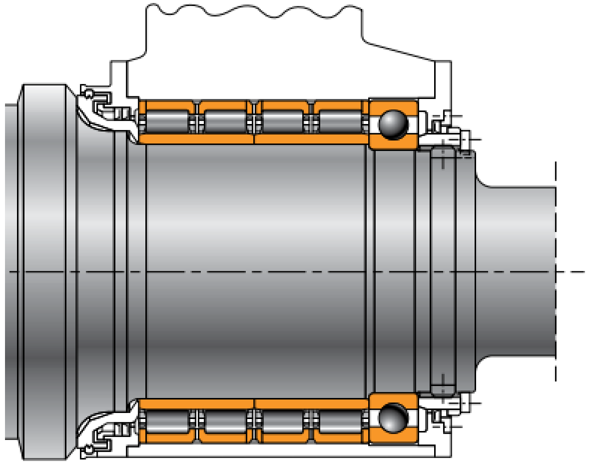


TABLE 15. ROLL NECK DIAMETER WEAR LIMITS WHEN USED WITH LOOSE-FIT INCH SYSTEM BEARINGS

Roll Neck Diameter Wear Limits					
Bearing Bore		Roll Neck Diameter Variance from Bearing Bore Nominal			Taper
		New		Reworked	
Over	Incl.	Min.	Max.	Min.	Max.
mm in.	mm in.	mm in.	mm in.	mm in.	mm in.
	127.0 5.00	-0.127 -0.0050	-0.102 -0.0040	-0.280 -0.0110	0.040 0.0015
127.0 5.00	152.4 6.00	-0.152 -0.0060	-0.127 -0.0050	-0.360 -0.0140	0.040 0.0015
152.4 6.00	203.2 8.00	-0.178 -0.0070	-0.152 -0.0060	-0.430 -0.0170	0.050 0.0020
203.2 8.00	304.8 12.00	-0.203 -0.0080	-0.178 -0.0070	-0.510 -0.0200	0.050 0.0020
304.8 12.00	609.6 24.00	-0.254 -0.0100	-0.203 -0.0080	-0.610 -0.0240	0.080 0.0030
609.6 24.00	914.4 36.00	-0.330 -0.0130	-0.254 -0.0100	-0.840 -0.0330	0.100 0.0040
914.4 36.00	1219.2 48.00	-0.406 -0.0160	-0.305 -0.0120	-1.120 -0.0440	0.130 0.0050
1219.2 48.00		-0.432 -0.0170	-0.305 -0.0120	-1.220 -0.0480	0.150 0.0060

Undersized / Worn Inner Race – 4-Row Cylindricals

- Press fit inner races usually stay with their respective rolls and are not replaced as frequently as the outer race roller assembly.
- Inner races will wear over time causing them to become undersized.
- Press fit inner races are sometimes reground with the roll which can lead to undersized inners.
- Identified by:
  - Increased wear
  - Decreased load zone
  - Uneven load distribution
  - High stress concentration



- Avoid by:
  - Remove high spots with 320 emery paper instead of regrinding inner race.
  - Maintain minimum inner race OD.

Oversized Worn Chock Bore

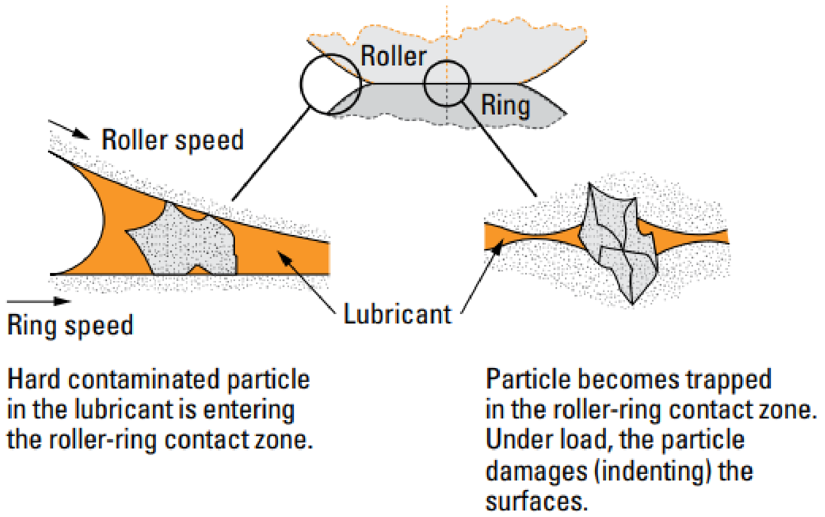
- Chock bores will wear over time causing them to become undersized or create an uneven bearing seat.
- Identified by:
  - Increased wear on bearing OD
  - Decreased load zone
  - Uneven load distribution
  - High stress concentration
- Avoid by:
  - Stay within wear and rework limits
  - Lubricate necks prior to installation
  - Re-bore chock
  - Sleeve

TABLE 13. CHOCK BORE REWORK LIMITS WHEN USING INCH TOLERANCE SYSTEM BEARINGS

Chock Bore Rework Limits						
Size Range Bearing O.D.		Chock Bore – Variance from Nominal Cup O.D.			Out of Round	Taper
		New		Reworked		
Over	Incl.	Min.	Max.	Max.	Max.	Max.
mm. in.	mm. in.	mm. in.	mm. in.	mm. in.	mm. in.	mm. in.
	304.8 12.00	**+0.051** +0.0020	**+0.076** +0.0030	**+0.200** +0.0080	**0.080** 0.0030	**0.040** 0.0015
304.8 12.00	**609.6** 24.00	**+0.102** +0.0040	**+0.152** +0.0060	**+0.380** +0.0150	**0.150** 0.0060	**0.050** 0.0020
609.6 24.00	**914.4** 36.00	**+0.152** +0.0060	**+0.229** +0.0090	**+0.580** +0.0230	**0.230** 0.0090	**0.080** 0.0030
914.4 36.00	**1219.2** 48.00	**+0.203** +0.0080	**+0.305** +0.0120	**+0.760** +0.0300	**0.310** 0.0120	**0.100** 0.0040
1219.2 48.00	**1524** 60.00	**+0.254** +0.0100	**+0.381** +0.0150	**+1.010** +0.0400	**0.380** 0.0150	**0.130** 0.0050
1524 60.00		**+0.305** +0.0120	**+0.432** +0.0170	**+1.220** +0.0480	**0.460** 0.0180	**0.150** 0.0060

Contamination

- Identified by:
  - Debris Denting
  - Circumferential Grooving
  - Etching and Corrosion
- Causes:
  - Seal Failure
    - 90% of seal wear happens in first 10% of seals life.
  - Misalignment
    - Causes roll neck to be pulled away from seal lip.
  - Oversized chock bore
  - Undersized journal
  - Groove worn in seal surface
  - Filtration
- Lubricate seals during installation.
- Replace worn seals.

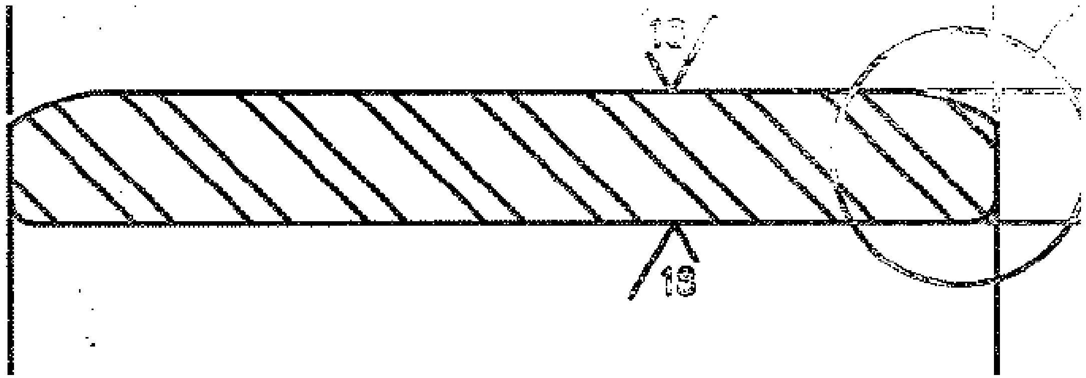


Installation / Removal Damage

- Bearings are precision components and are easily affected by impact marks or scoring that can occur during installation.
- Avoid removing bearings by pulling on the rollers or cage.
- Cylindrical roller bearings in rolling mills typically have a radial internal clearance between 0.010 to 0.030” and accept little to no misalignment.
  - Roll / chock alignment is critical during installation.
- Identified By:
  - Nicks / Dents
  - Point Surface Origin Spalling
  - Cage Damage
- Possible Causes:
  - Robotic Loading
  - Mishandling

Mitigating Installation Damage – Cylindricals

- Increase roller corner radius
- Modify inner ring edge profile
- Modify cage design w/ improved roller drop
- Case carburize rollers

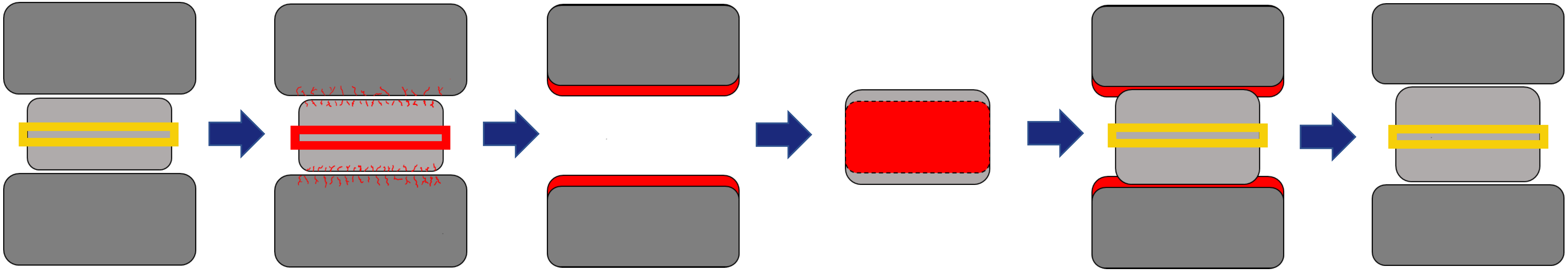


Bearing Inspection

1. Replace or send to BSC for repair if bearings show:
   1. Fatigue Spalling
   2. Heat Discoloration
   3. Rust
   4. Damaged Cage
   5. Noticeable Wear
2. Light rust, corrosion and surface high spots can be polished out with 320 grit emery paper and #10 scotch-brite.
3. Areas of concern should be placed out of the load zone.

Bearing Repair Process

New Bearing | Used Bearing (After Operation) | Machine Raceways | Make New Rollers | Reassemble | Repaired Bearing



Supplied with:

- Manufacturer / ABMA dimensions + specifications
- Predetermined clearance (C0, C3, etc..)

Operation Causes:

- Raceway fatigue
- Surface stress
- Spalling
- Brinelling
- Debris Denting
- Cage Damage

Machining Raceways:

- Removes stressed / fatigued material
- Removes surface damage
- Maintains raceway profiles and provides fresh rolling surface

Replace Rollers:

- Manufactured brand new by BSC
- Larger rollers used to maintain predetermined clearance after raceway machining

Reassemble:

- Replace cage
- Manufacturer / ABMA dimensions + specifications restored
- Predetermined clearance maintained (C0, C3, etc…)

Repaired Bearing

- Full useful life restored
- Larger rollers = higher bearing capacity

Benefits of Bearing Repair

- Repair saves 20-70% compared to the cost of a new bearing
- Repair lead time is significantly shorter than a new bearing
- Bearings are repaired back to OEM specification:
  - Repair is proven to restore full useful life of bearing
  - All manufacturers: Timken, SKF, FAG, NTN, NSK, ARB, BSC, etc…
- Quality control:
  - New BSC 12 month warranty applied
  - Serialized traceability w/ process routers
  - Analysis + inspection reports provided
- Opportunity to enhance OEM bearing design
  - Profile Rollers, install features, lubrication features, etc.

Example:

Cost of New Bearing		$20,000
Cost of Repair (50% of new)	-	$10,000
	=	$10,000
Quantity Per Year	x	10
Cost Savings Per Year	=	$100,000

STEEL IS ONE OF THE MOST REUSABLE AND REWORKABLE MATERIALS ON THE PLANET.
REPAIR YOUR BEARINGS. DON'T THROW AWAY GOOD STEEL!

Chock Inspection

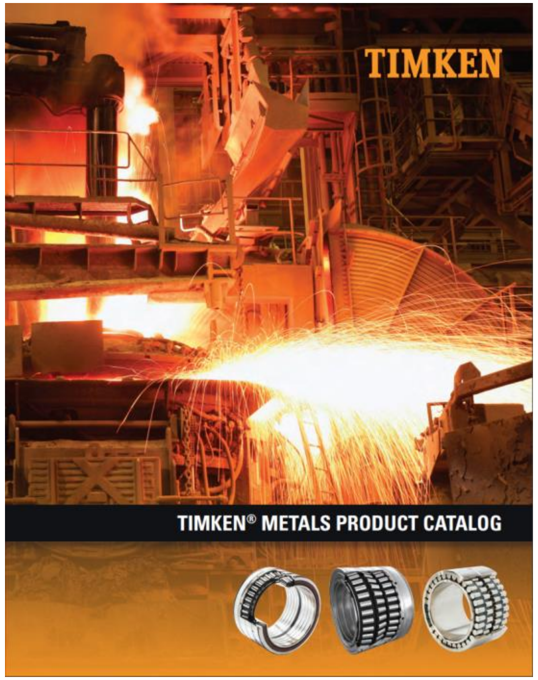
1. Check wear plates
2. Inspect chock bore
3. Thoroughly clean chock including vent holes
4. Polish out heavy corrosion or fretting in chock bore
5. Make sure all backing shoulders in chock are free of burrs
6. Thoroughly check all seals and replace any that are worn
7. Periodically check bore size and geometry to confirm they are within acceptable limits of size, roundness and taper
8. Chocks can be re-bored and sleeved by chock repair facilities

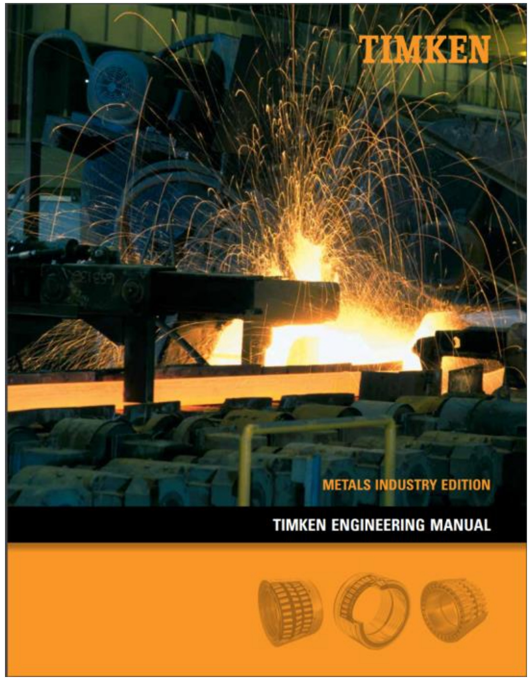
Roll / Inner Race Inspection

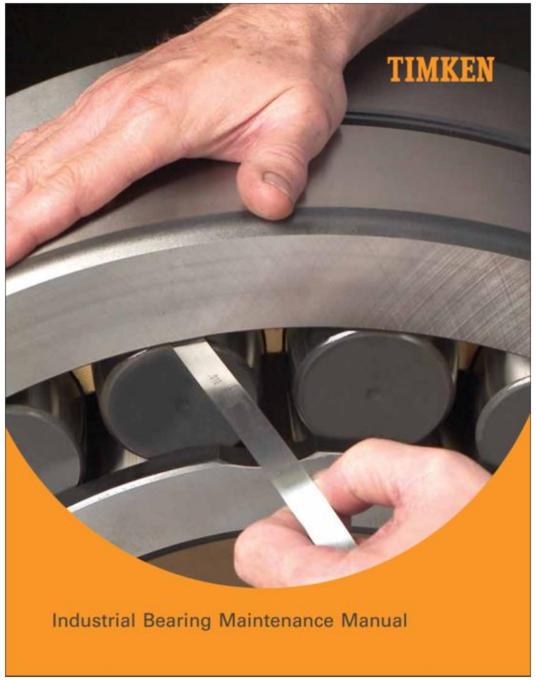
1. Clean and inspect
2. Polish out fretting and corrosion
3. Measure to verify within wear limits
4. Polish seal rubbing surface if required
5. Remove sharp edges that could cut the seal lip
6. Coat roll neck with lubricant
7. Carefully mount chock and bearing on roll neck avoiding seal or bearing damage

Resources

- Timken Metals Product Catalog
- Timken Metals Engineering Catalog
- Timken Industrial Bearing Maintenance Manual







Contact Information

KC LaCross – Director of Business Development

Phone: 216-903-3976

Email: kclacross@bearing-service.com

Grease Lubrication

- Advantages:
  - Lower System Cost
  - Additive Sealing Properties
  - Less Probability of Leakage
  - Improve Protection in Case of Extended Non-Running Periods
- Disadvantages
  - Speed Limitations
  - Heat Dissipation Capability
  - Retains Contamination Particles
  - Greater Maintenance Time for Cleaning
  - Disposal

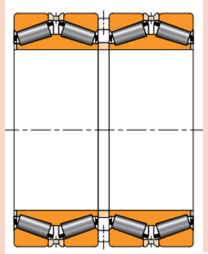
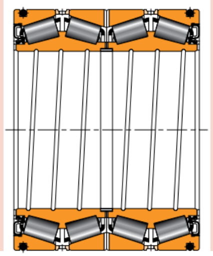
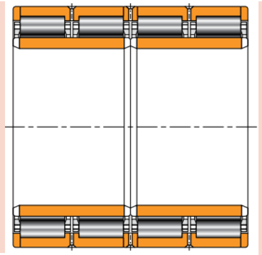
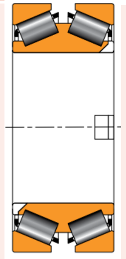
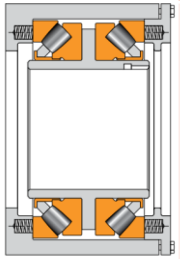
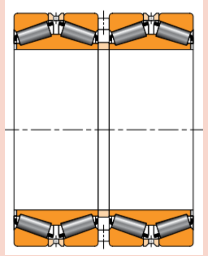
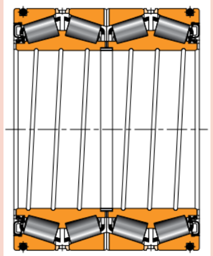
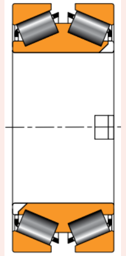
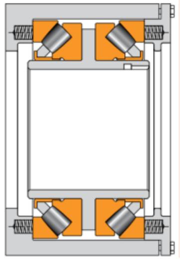
Oil Lubrication

- 5 Basic Types: Air-oil, oil-mist, oil bath, oil splash and forced-fed.
- Advantages:
  - Heat Dissipation Capability (Circulating)
  - Helps Remove Contamination
  - Controllable Oil Levels or Flows
  - Cooling and Filtering Possible
  - Oil Inlets Directed to Critical Locations
  - Higher Speed Capability
- Disadvantages
  - Higher System Cost
  - Need for Improved Sealing to Guard Leakage

Air Oil Lubrication

- Become popular solution for multi-row tapered and cylindrical neck bearings.
- Max Roll Speed = 2100 m/min (6900 ft/min)
- Advantage:
  - Supplies constant quantity of oil at all times.
  - Allows for very high oil viscosity for heavy loads / low speeds.
  - Designed to consume small quantities of oil.
  - Environmentally friendly.
- Disadvantages
  - Higher System Cost
  - Need for Improved Sealing to Guard Leakage

Flat Product – Plate and Hot Mill Roughing Stands

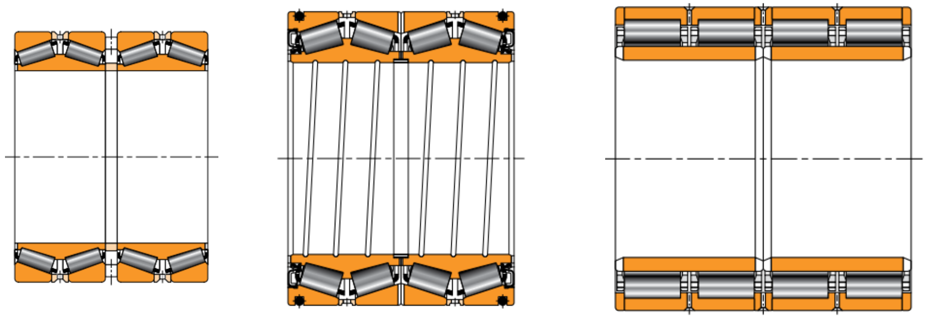
Position	Bearing Types Used	Comments
Backup Roll Radial Position	   Oil-Film Bearing	
Backup Roll Thrust Position	 	Thrust bearing required if cylindrical or oil film bearing is used in radial position.
Work Roll Radial Position	 	
Work Roll Thrust Position	 	Thrust bearing required in case of axial shift.

Rolling Mill – Flat Products Bearing Types

Plate and Hot Mill Roughing Stands

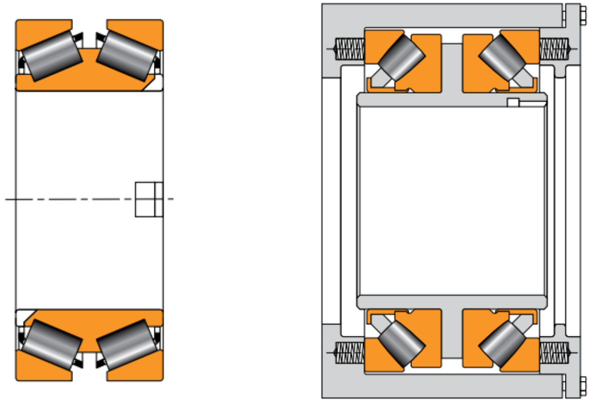
Mill Speed = < 300 m/min (1000 ft/min)

Backup Roll Radial Position

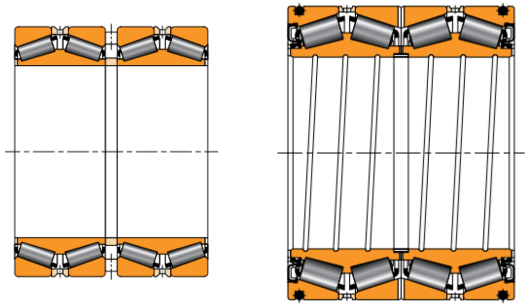


Oil-Film Bearing

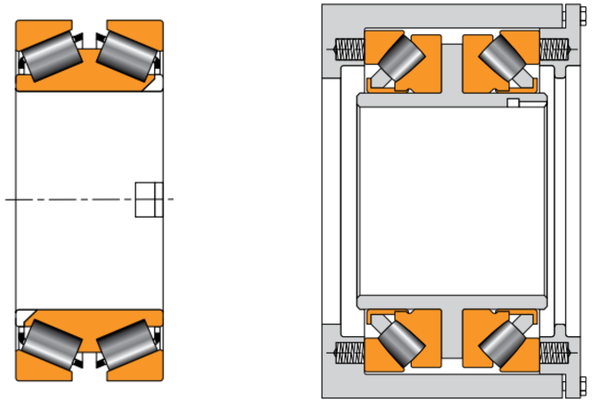
Backup Roll Thrust Position



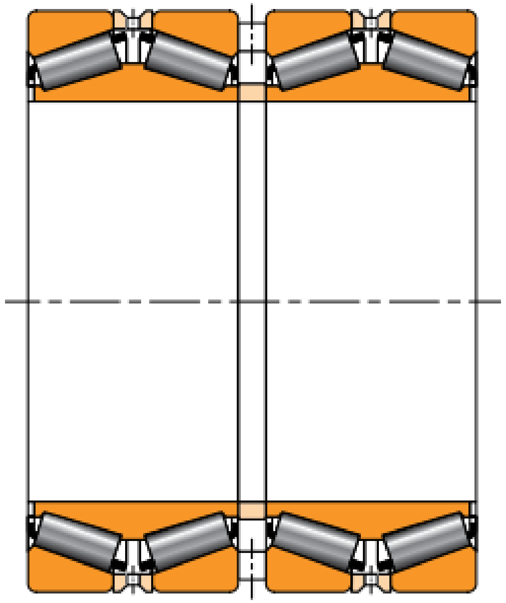
Work Roll Radial Position



Work Roll Thrust Position



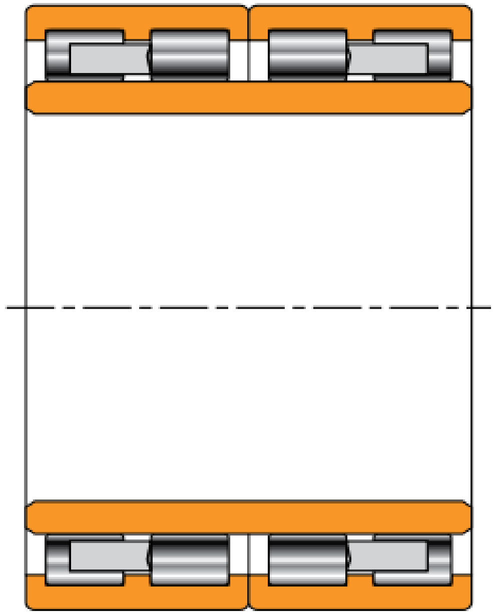
Application Considerations: 4-Row Tapers

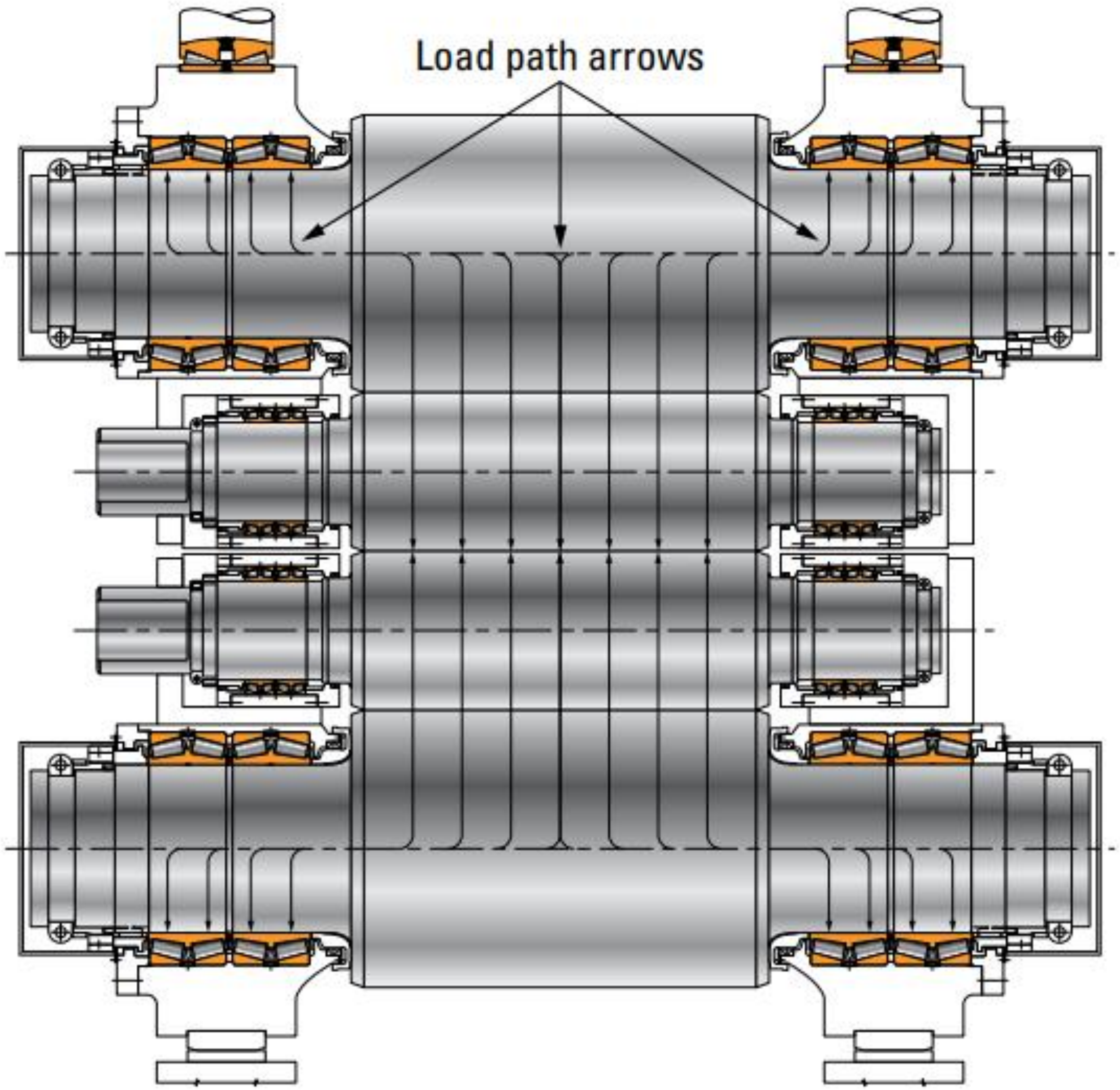


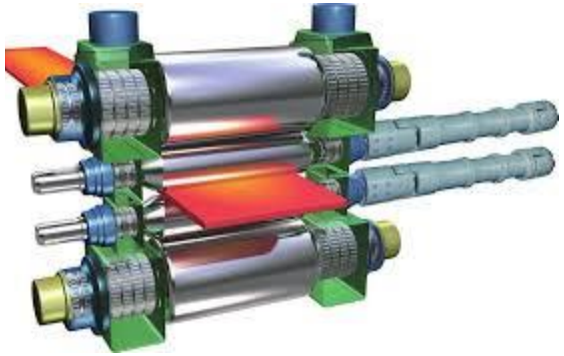
1. **Mounting Practice** – Frequent roll changes require loose fit on the roll neck. Creates natural tendency for creep.
   I. Axial clearance must be provided between cones and abutting faces to allow cones to creep freely and avoid face wear.
   II. Minimum roll neck diameter guidelines must be respected to avoid excessive neck wear due to creep.
2. **Neck Lubrication** – Neck must be lubricated to minimize roll neck scuffing due to creep.
3. **Unclamped Cones** – Cone contact faces should be hardened to approx. 55-60 HRC in order to help prevent excessive wear.
4. **Clamped Cups** – End cover must clamp the cups tightly in chock with specified bolt torque to ensure that established clearance in bearing is maintained.
5. **Roll Neck Hardness** – Preferred roll neck hardness level is 45 shore C (33HRC) to reduce wear at cone bore to roll neck interface.
6. **Roll Neck Undercuts** – Undercuts required beneath cone spacer to accommodate potential wear.
7. **Chock Bore Undercuts** – Only required on backup chocks. Undercuts required beneath the cup spacer to accommodate potential wear.
8. **Retaining Ring** – Fit must match bearing cone fitting practice.
9. **Fillet Ring Design** – Must have press fit on roll neck with minimum tight fit of 0.00025 x bearing bore. Length of cylindrical seat piloting fillet ring must prevent movement on the roll neck. Seal seat should plunge ground to designated surface roughness. Seal seat should be 35 HRC to reduce wear from lip pressure.
10. **Cone Backing** – Should be the maximum possible. Face hardness of both the fillet ring and retaining ring should have minimum hardness of 50 HRC. 55 to 60 HRC is preferred.
11. **End Covers** – Must be sized to resist induced axial load.
12. **Chock** Drainage (Sealed Roll Neck Bearings)

Application Considerations: 4-Row Cylindricals

1. **Fitting Practice** – Cylindrical bearings are generally mounted with a tight fit on the inner rings on the roll neck and a loose fit in the chock.
2. **Radial Internal Clearance** – Most metals applications use C4 or sometimes C3.
   1. RIC is established by the gap between the diameter under the rollers and the inner ring outer diameter.




Load path arrows



BEARING SERVICE COMPANY

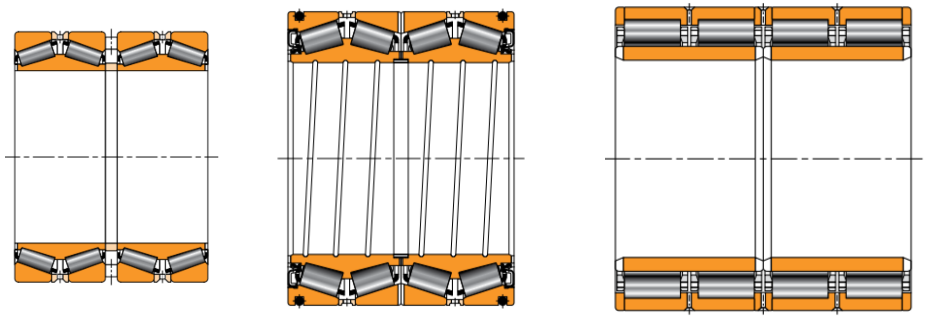
Bearing Manufacturing & Repair
Industrial Distribution

Rolling Mill – Flat Products Bearing Types

Hot Mill

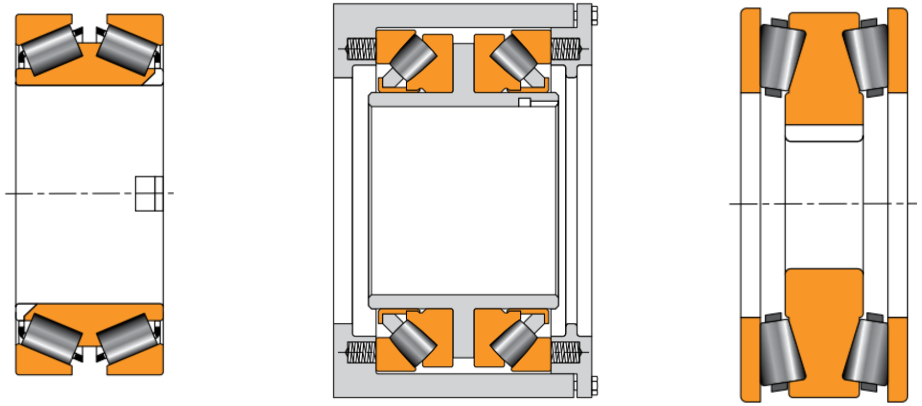
Mill Speed = Generally < 1000 m/min (3300 ft/min)

Backup Roll Radial Position

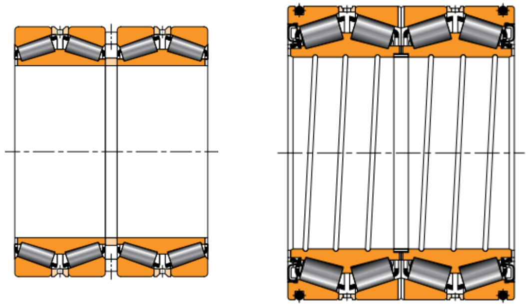


Oil-Film Bearing

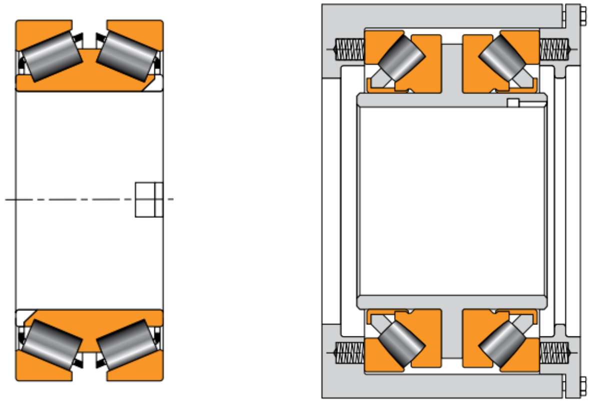
Backup Roll Thrust Position



Work Roll Radial Position



Work Roll Thrust Position



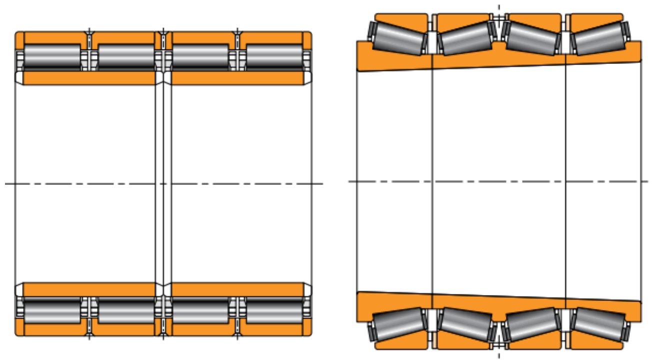
85+ Years
Founded in 1933

Rolling Mill – Flat Products Bearing Types

Cold Mill

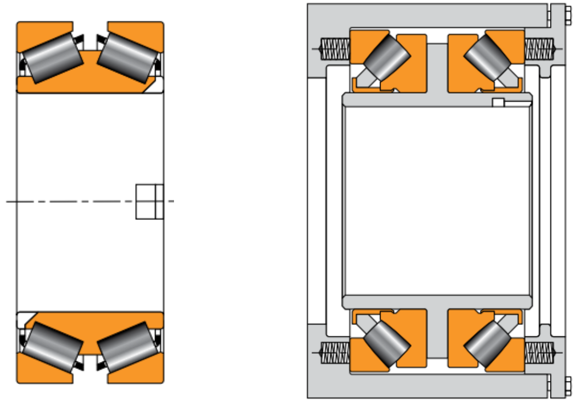
Mill Speed = 1000 m/min (3300 ft/min) to above 2000 m/min (6500 ft/min)

Backup Roll Radial Position

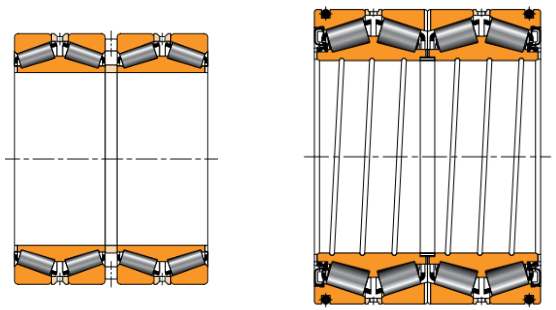


Oil-Film Bearing

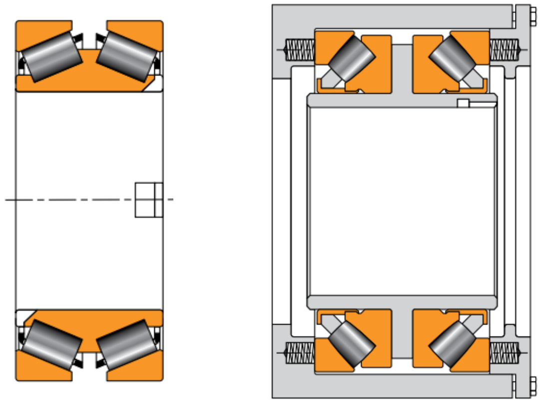
Backup Roll Thrust Position



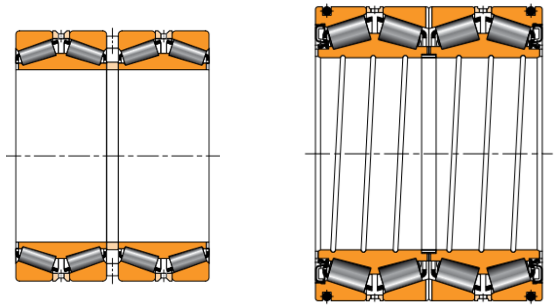
Intermediate Roll Radial Position



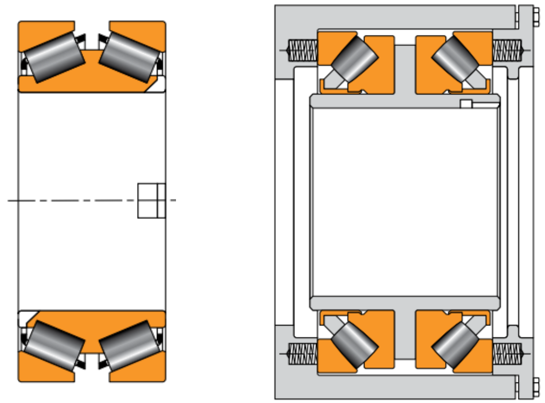
Intermediate Roll Thrust Position



Work Roll Radial Position



Work Roll Thrust Position

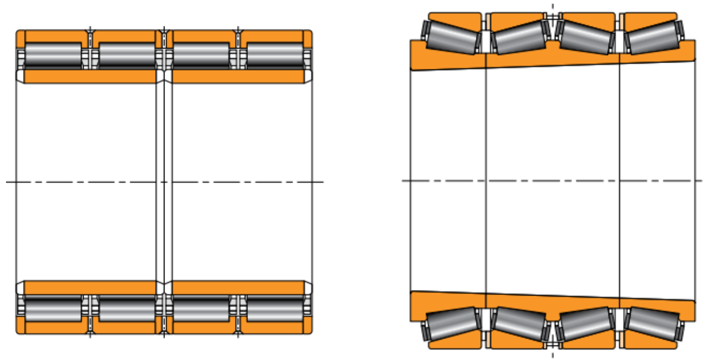


Rolling Mill – Flat Products Bearing Types

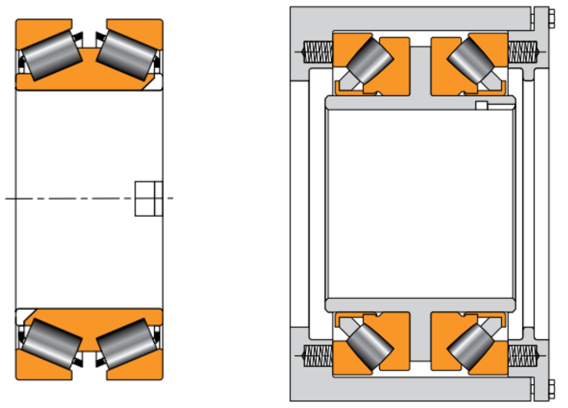
Temper Mill

Mill Speed = Generally < 1200 m/min (3950 ft/min)

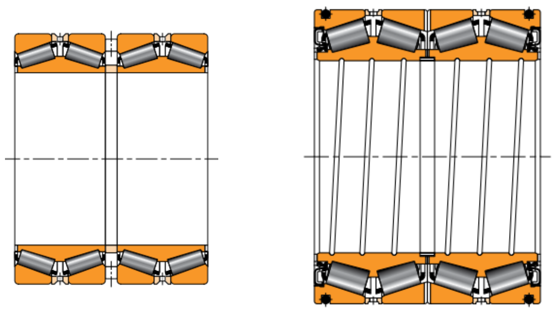
Backup Roll Radial Position



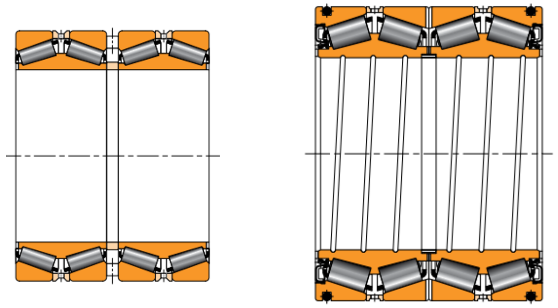
Backup Roll Thrust Position



Intermediate Roll Radial Position



Work Roll Radial Position



Bearing Selection Criteria – Flat Product Work Rolls

1. Dimensional Constraints – Min Bore / Max OD / Position of Rows
    1. Roll Neck Diameter – Bearing bore per roll neck size requirement.
    2. Chock Outside Dimensions – Bearing OD per chock section requirement.
        1. Analyze space available between mill pass line and backup roll chock.
    3. Position of Balancing / Bending
2. Roll Speed
3. Load and Load Direction
4. Ease of Installation

Bearing Selection Criteria – Backup Rolls

1. Initial bearing selection is based on envelop requirements.
2. Following parameters dictate space available:
    1. Ratio of roll neck diameter to maximum roll body size.
    2. Roll body size (minimum diameter).
    3. Allowable roll neck stresses.
    4. Distance between mill screwdowns.
3. Roll Speed
4. Load and Load Direction
5. Ease of Installation

Example:

Select either cylindrical or TQITS solution for a cold strip mill running at 1000 m/min. rolling speed, having a maximum backup roll body diameter of 1200 mm and 10 percent roll body turndown.

Step 1: Calculate minimum allowable roll neck diameter at 60 percent of maximum roll body diameter:

Roll neck diameter (minimum) = 0.6 x 1200 mm = 720 mm

Step 2: Calculate maximum allowable bearing O.D. based on a minimum roll body diameter at 10 percent turndown

Minimum roll body @ 10 percent turndown = 0.9 x 1200 = 1080 mm

Bearing O.D. (maximum) = 1080 mm / 1.075 = 1000 mm

Step 3: Select bearing from product tables

For this cold mill example, both the TQITS type or cylindrical-type assembly are viable alternatives.