

SME Technical Session Tuesday March 1st 3:55pm

Bearing Solutions for Harsh Environments in Mining Conveyor Applications

- › Presented by:
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Topics

- › 3D Concept

- › Bearing Failures - Mining Conveyor Applications

- › Solutions for the Industry
 - *Unique Steel Technology*

 - *Removable Seals*

 - *External Seal Advancements*

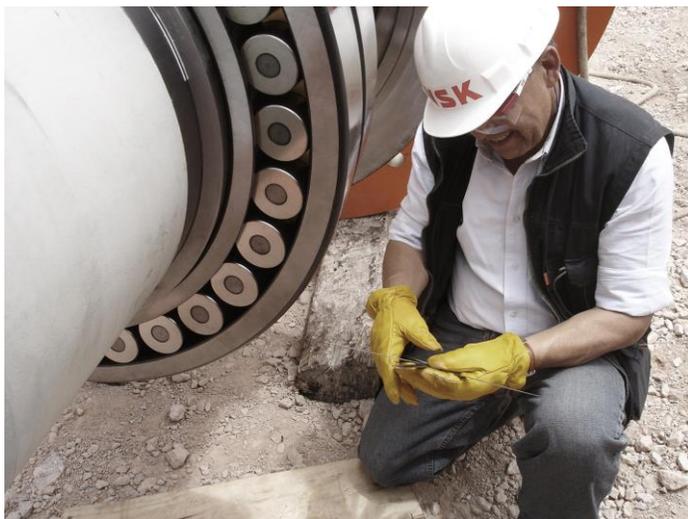
 - *Installation Practices*



3D (3 Layers of Defense) Concept

What role can bearings play in improving the efficiency of the mining industry?

- › Defense through *material*
- › Defense through *internal sealing*
- › Defense through *external sealing*
- › **BONUS:** Proper *installation and maintenance*



Conveyor Applications



Challenging Conditions

- › Grit and Contamination
- › Challenging Lubrication Conditions
- › High Loads
- › Misalignment
- › Shock/Vibration

Industry Requirements

- › Maximized Productivity
- › Minimized Unplanned Downtime
- › Significant Bearing Life Extension
- › Maintenance-Free Sealing
- › Reduced Total Cost of Operations

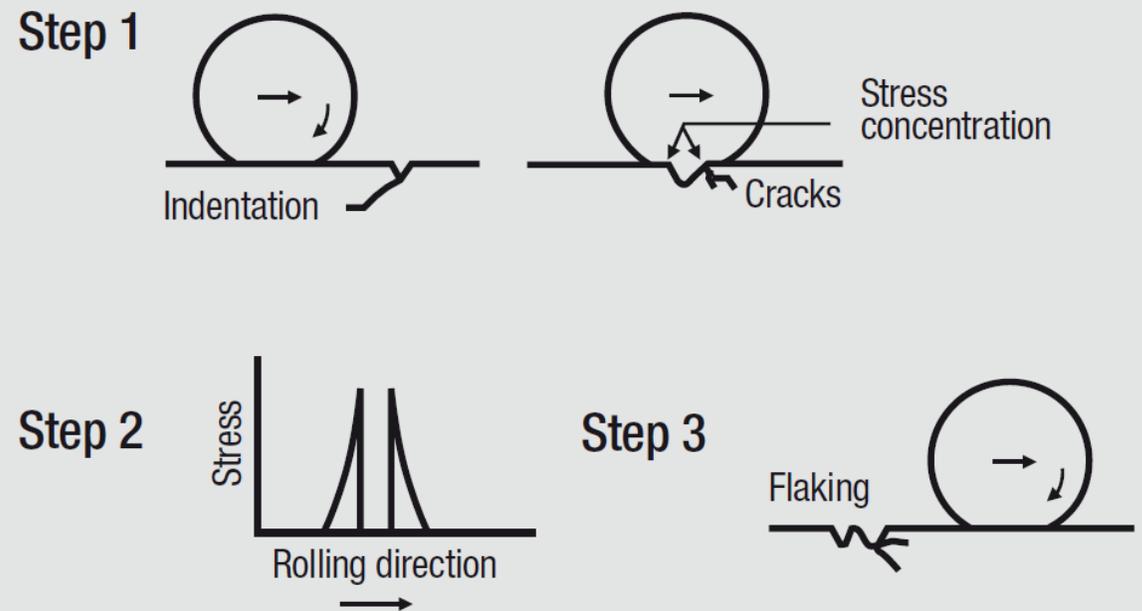
Additional Challenging Mining Applications

- › Crushers
- › Vibrating Screens
- › Sizing Mills
- › Compaction Equipment
- › Pumps

Bearing Failure in Contaminated Environments

- › Bearings in clean environments operate with clean grease or filtered oil lubrication and eventually fail due to subsurface fatigue.
- › Bearings subjected to a contaminated environment fail much quicker due to surface originated fatigue.
- › Debris in bearings is common for conveyor and other mining, aggregate and cement applications.
- › The debris will get pressed between the rolling element and the raceway, leaving dents
- › The corners of the dents are areas of high stress, where cracks form and eventually lead to flaking

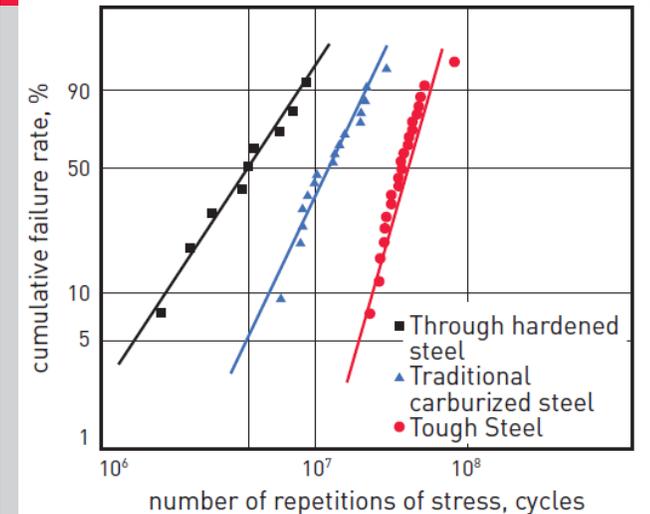
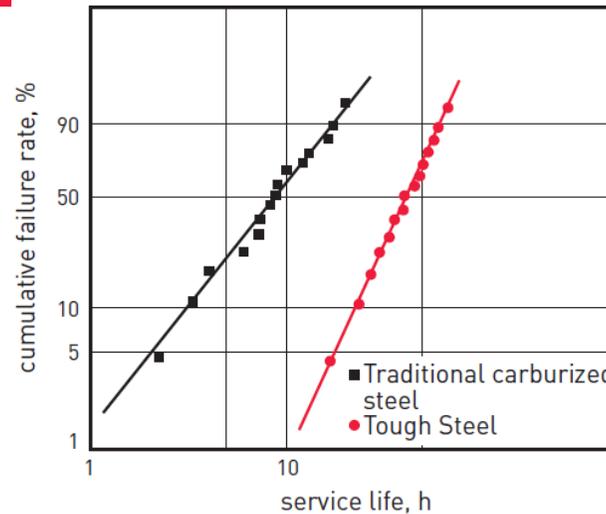
Figure 1: Origin of Surface Originated Flaking



Bearing Failures in Contaminated Environments

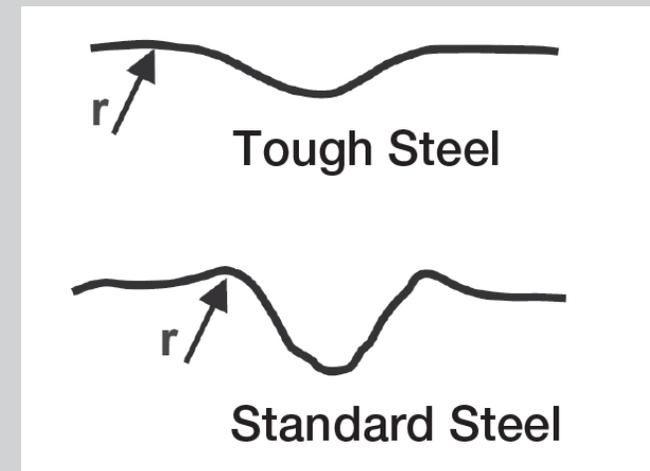
Using Bearing Steel Technology to Improve Life

- › Through testing and development, NSK discovered that higher amounts of retained austenite with a carbo-nitrided heat treatment provides longer life in contaminated environments.
- › The “Tough” Steel material develops less severe dents and lower stress concentrations than standard bearing steel. The progress of fatigue is slower by delaying crack initiation and slowing down crack propagation.
- › The testing results show 7x life in contaminated lubrication conditions, 4.7x life in marginal lubrication conditions, and even 1.5x life in clean lubrication conditions.



Contaminated lubrication

Marginal lubrication



Sealed Spherical Roller Bearings



Spherical Roller Bearings (SRB) with Detachable Seals

- › Equipment used in highly contaminated environments like mining and quarrying conveyer applications, introduce particles into the bearing causing surface fatigue, reduced bearing life, and machine downtime
- › High performance removable seal design prevent contamination ingress
- › The removable seal allows measurement of internal clearance during installation to ensure proper mounting of the bearings. Traditional SRBs use fulling integrated seals which do not allow clearance verification.
- › Bearing external dimensions are interchangeable with standard ISO sizes
- › Bearings equipped with heavy-duty high precision machined brass cage, with contoured cage pockets to optimize roller guidance and lubrication distribution

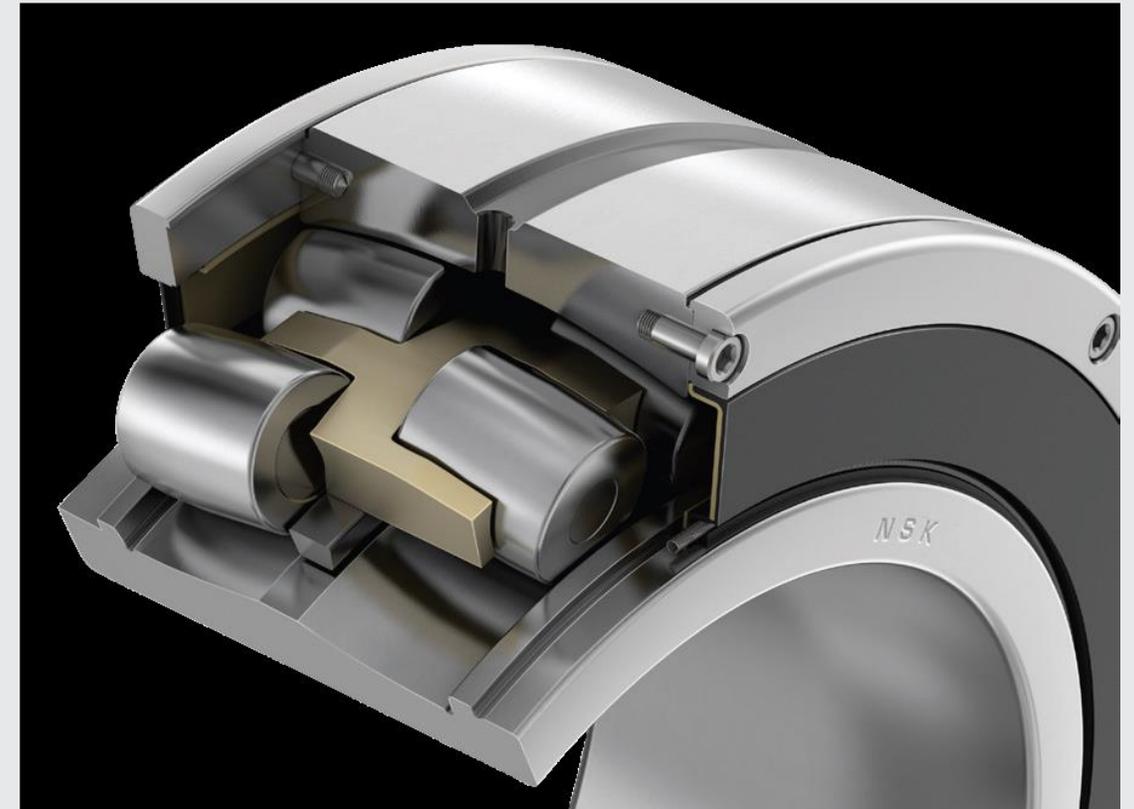


Sealed Spherical Roller Bearings

NSK

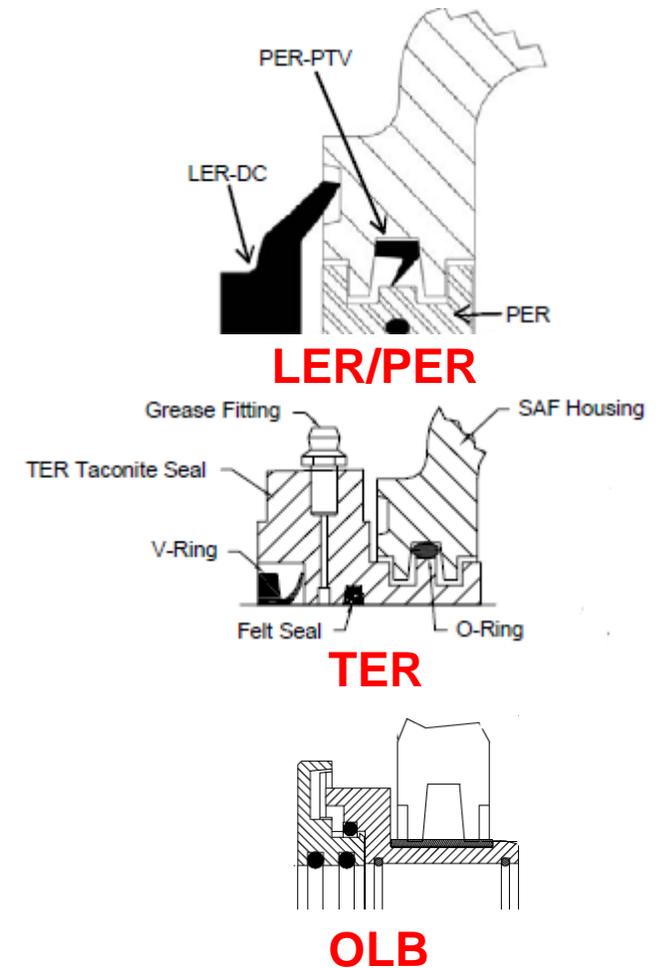
Spherical Roller Bearings (SRB) with Detachable Seals

- › High performance removable seal design prevent contamination ingress
- › The seal lip contacts the bearing inner ring with easy, bolt-fastened installation to the bearings outer ring
- › The seal garter spring ensures high sealing performance and the ability to compensate for bearing misalignment
- › Bearings are supplied without packed grease – selection and fill occurs during the time of installation.
- › Seal is made of hydrogenated nitrile butadiene rubber and suitable for operating temperatures up to 100°C



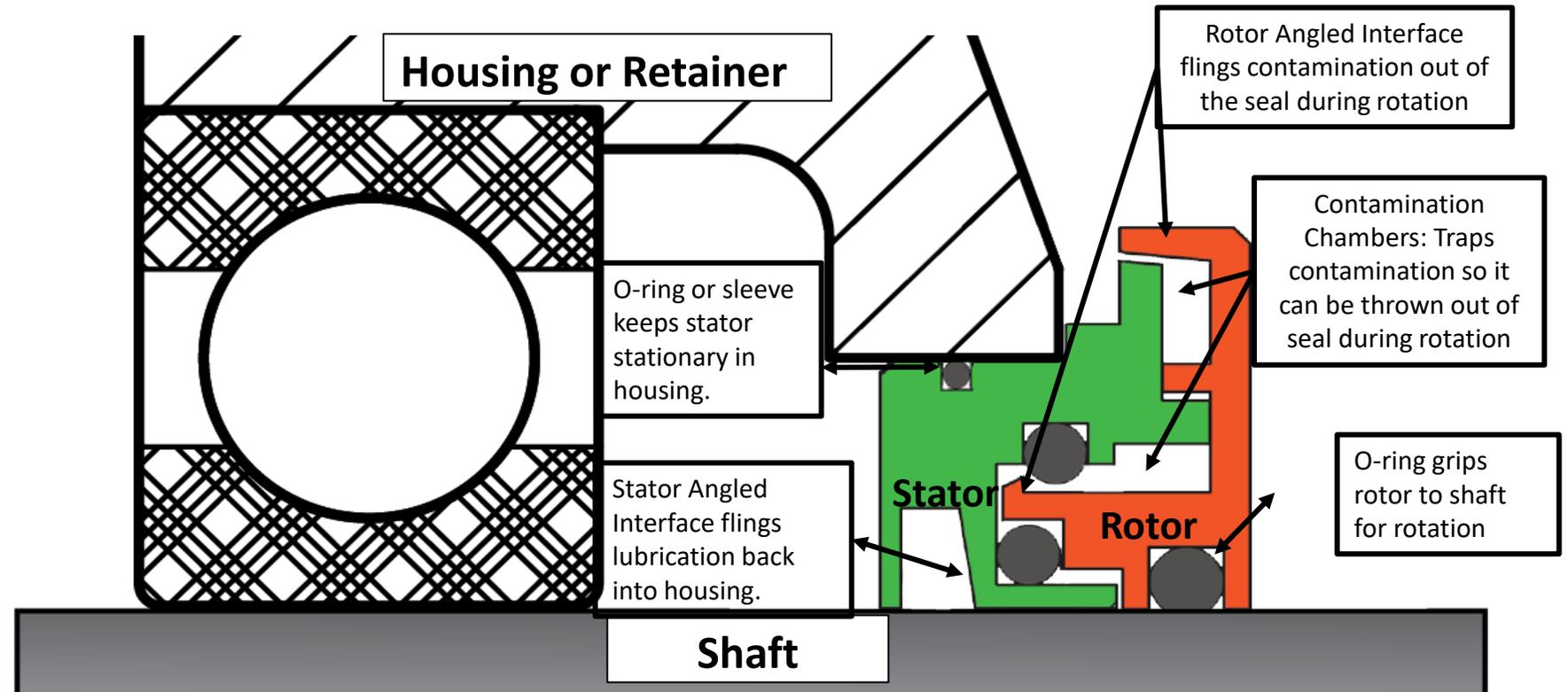
Types of External Seals

- › LER Standard
 - Comes with most housings
 - Labyrinth design: contamination works through cavities
- › TER Type Seal (Taconite)
 - Grease filled
 - Contamination works through labyrinth and grease barrier
- › End Cover (EPR)
 - Best option if shaft does not extend past housing
- › Orion Seal (OLB)
 - Stator and rotor mechanical design
 - No grease required



OLB Seal

- › 2-piece design; Aluminum stator and bronze rotor
- › The rotor rotates with the shaft and uses centrifugal force to fling contamination out and keep lubrication in



Field Case Study – Mining Conveyor Solution



Coal Mine Conveyor Solution

> Background

- Mineral: Coal
- Application: Head pulley
- Location: Western USA

> Conditions

- Abrasive particle contamination

> Issues

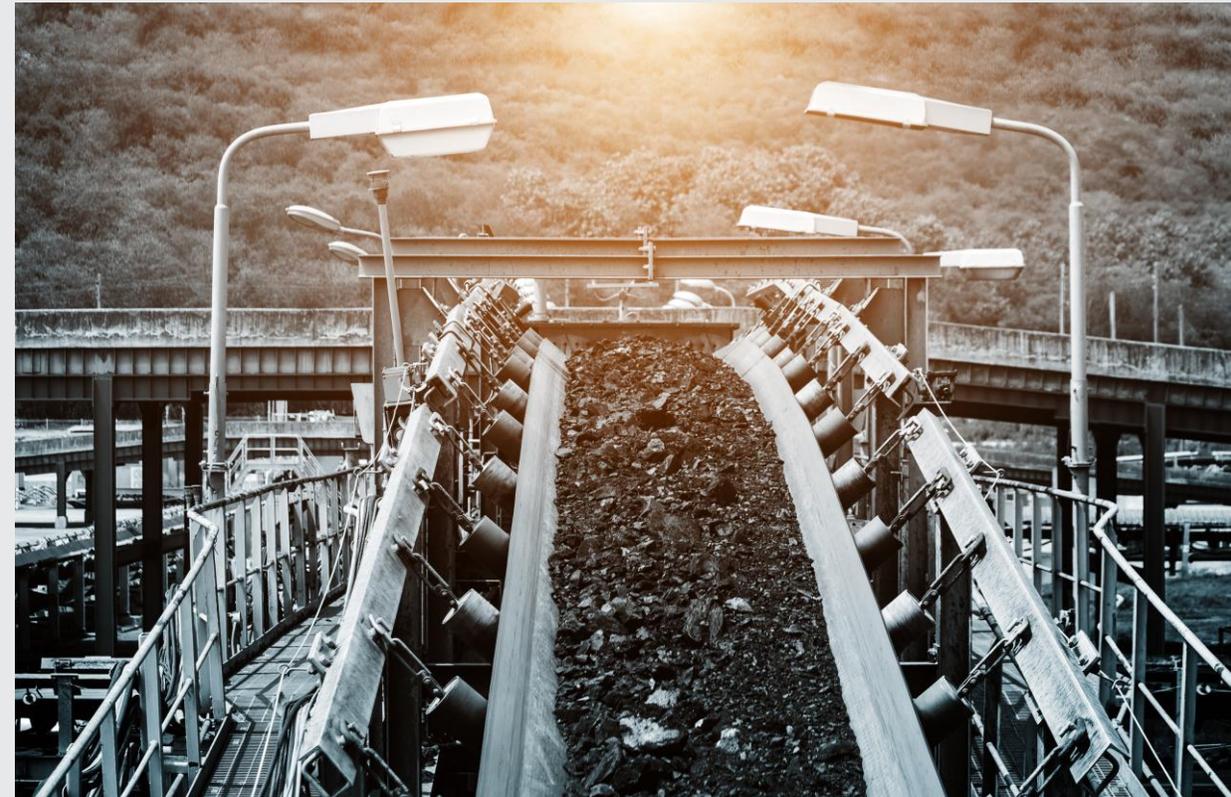
- Bearing failures every ~6 months due to contamination ingress on critical head pulley
- Lost production and increased maintenance time/costs incurred

> Solution

- Upgraded Tough Steel material on bearings

> Result

- Extended bearing life to 6+ years
- **Customer documented cost savings: \$5,050,880 USD**



Field Case Study – Mining Conveyor Solution



Iron Ore Mine Conveyor Solution

> Background

- Mineral: Iron Ore
- Application: Drive Pulley
- Location: Western USA

> Conditions

- Heavy ingress of iron ore in lubricant
- Severe material wear

> Issues

- Bearing failures every ~12 months due to contamination ingress on critical drive pulley
- Lost production and increased maintenance time/costs incurred

> Solution

- Upgraded Tough Steel material on bearings
- Upgraded to sealed spherical roller bearing

> Result

- Extended bearing life to 33+ months
- **Customer documented cost savings: \$73,000+ USD**



1. Basic Dimensions

- › Sealed SRBs have the same boundary dimensions as standard ISO SRBs, therefore no need to change mating components

2. Special Bearing Material & Heat Treatment

- › NSK uses Tough Steel for the ring material to prevent ear on the raceway under contaminated and poor lubrication conditions.

3. Seal Design

- › Removeable nitrile rubber seal with easy bolt-fastened installation to the bearing outer ring provides high sealing performance
- › Bearing clearance can be verified during installation prior to bolting of the seal to ensure proper mounting.
- › Adding external seals, like OLB seals, provides another layer of defense



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