TIMKEN



TIMKEN SOLUTIONS FOR ABOVE GROUND MINING

TECHNOLOGY TO **MINE MORE**



SHOVEL

Timken shovel solutions simplify maintenance and operation with a wide variety of roller bearings used in the sheave, propel, hoist, crowd and swing drive positions. In one case, Timken improved the performance of swing gear drives by extending the lower swing shaft service life. Without changing the housing dimensions or overall package width, Timken designed a bearing that allowed a larger shaft diameter to reduce stress concentrations and improve shaft life. Customers report 1.5 to 3 times increase in shaft life.

With an abundance of bearings and gears in a shovel, predicting problems prior to catastrophic failure is critical. The Timken Online Intelligence System helps detect potential issues so they can be fixed before they lead to costly downtime and repairs.



Online Intelligence System

Tapered Roller Bearings

Cylindrical Roller Bearings

Spherical Roller Bearings

TIMKEN SOLUTION SUCCESS:

Higher Intelligence Increases Quadra Mining's Uptime

Quadra FNX Mining Ltd. has a smart, flexible monitoring solution that reduces its maintenance spending and lowers its cost of operation. That system, the Timken® Online Intelligence System, measures and analyzes data from various application points to detect potential problems before they cause a failure. The system is backed by highly trained Timken specialists who analyze the data to determine and address the root causes of problems.

At Quadra, the Online Intelligence System identified an issue with a boom point sheave bearing shortly after the bearing was replaced during routine maintenance. Data analysis and follow up by Timken experts confirmed damage and determined it was due to improper bearing storage before installation.

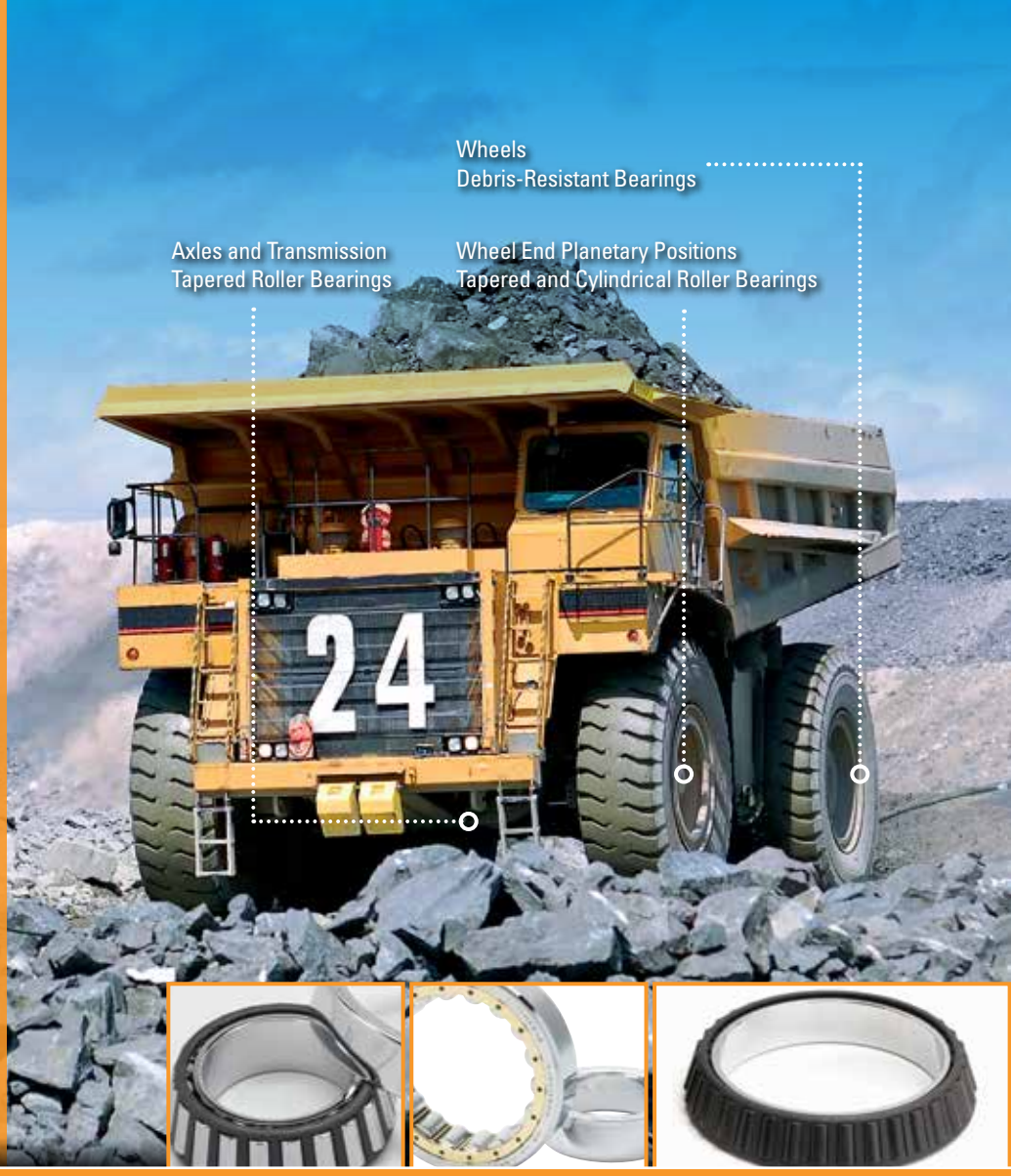
"Even though the bearing was removed early, it still proved that we can see anomalies in bearings at a very early failure stage," said Cary Brunson of Quadra Mining. "Where I see value in this find is the identification of a storage problem that we have since revised, which will save money for the life of the project."

HAUL TRUCK

Haul trucks are the work horses of above ground mining. They must withstand heavy debris, high operating temperatures and extreme loads, day in and day out.

Haul truck wheel ends benefit from Timken® tapered roller bearings, which offer high load-carrying capacity in a compact envelope. Through advanced surface coatings and finishes, these bearings also provide greater debris resistance and longer bearing life.

Many mine operators choose Timken debris-resistant bearings, which last up to 3.5 times longer than Timken standard options.



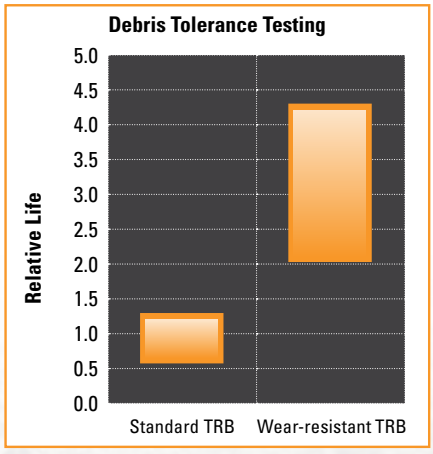
Tapered Roller Bearings

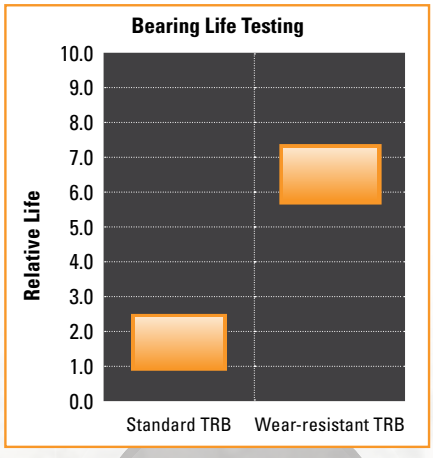
Cylindrical Roller Bearings

Debris-Resistant Tapered Roller Bearings

DEBRIS RESISTANCE AFFECTS BEARING LIFE

Standard tapered roller bearings were tested against wear-resistant tapered roller bearings for debris tolerance and bearing life. Testing showed wear-resistant bearings to be more debris tolerant and have up to 3.5 times longer life in low lubrication conditions compared to standard bearings.





*Standard product performance has been made relative to 1.0.

SOLUTION SUCCESS

DRAGLINE

Timken® tapered, cylindrical and spherical roller bearings reduce friction for greater operational efficiency in up to 200 positions, including critical locations like the swing system. Our innovative sealed lower swing bearings provide integral seals and features to reduce the time to assemble and set the spherical roller bearing package.

In high-speed or reversing applications for input positions in hoist, drag, swing or propel drives, Timken cylindrical roller bearings with one-piece brass cages resist bearing fatigue experienced by traditional two-piece designs. That leads to greater uptime and reduced maintenance costs.



Tapered Roller Bearings | Cylindrical Roller Bearings | Spherical Roller Bearings | Sealed Lower Swing Bearing | Two-Row Tapered Roller Bearing

TIMKEN SOLUTION SUCCESS:

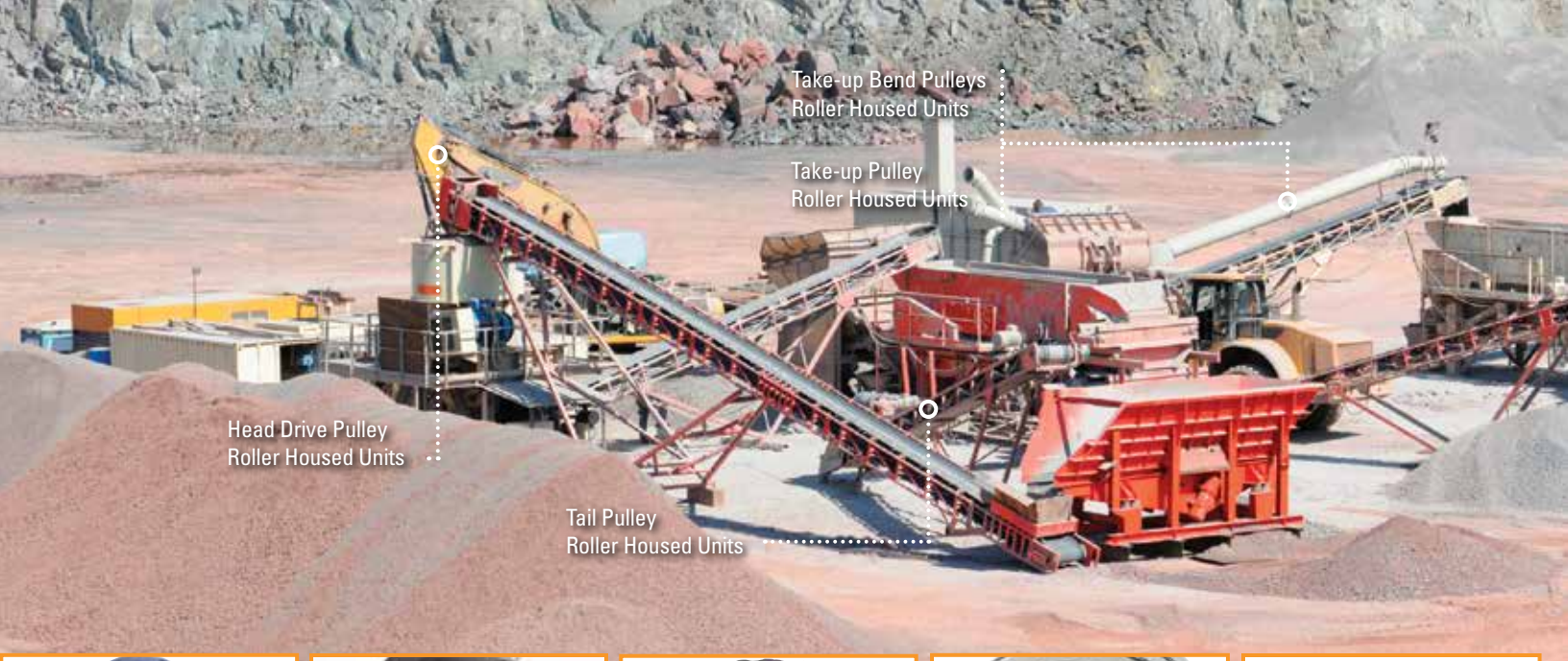
Lower Swing Bearing Saves Cloud Peak Mine Money, Improves Productivity

Cloud Peak's mine in Gillette, Wyoming, saves more than $35,000 a year in maintenance and grease disposal costs thanks to Timken® sealed lower swing bearings. The bearings also improve dragline uptime and productivity.

Plagued by lower swing bearings that were leaking lubrication, the mine's maintenance team asked Timken for help. Timken engineers discovered that the leaking was causing three other problems – premature bearing damage, risk of damage to the swing rack and greater grease usage and disposal costs.

Timken developed its sealed lower swing bearing to address the problem. Designed specifically for the lower swing position of the CAT 8750 dragline, it fits into the space occupied by standard bearings and labyrinth seals without any retrofitting. A seal and spherical roller bearing are integrated into a single unit and use special all-purpose grease. This patented technology keeps lubrication in the bearing cavity without requiring frequent lubrication.

"They were aggressive in the redesign and delivery schedule," said Kelvin Kennedy, independent dragline and shovel Consultant for Cloud Peak. "This work improved installation and operations, and our relationship with Timken also led to better handling and assembly techniques overall."




Spherical Roller Bearing Housed Unit


Tapered Roller Bearing Housed Unit


Split Spherical Roller Bearing Housed Unit


Spherical Roller Bearing


Thrust Bearing

CRUSHING, SCREENING AND CONVEYING

Above ground material handling equipment must withstand changing weather, extreme temperature fluctuations, heavy loads and large amounts of dust, mud and grime. These challenges are quickly defeated with the full line of solid block and split block housed units from Timken. The durability of our tapered roller bearings, spherical roller bearings and ball bearings combined with innovative housings and seal design provide reliability and performance to improve productivity.

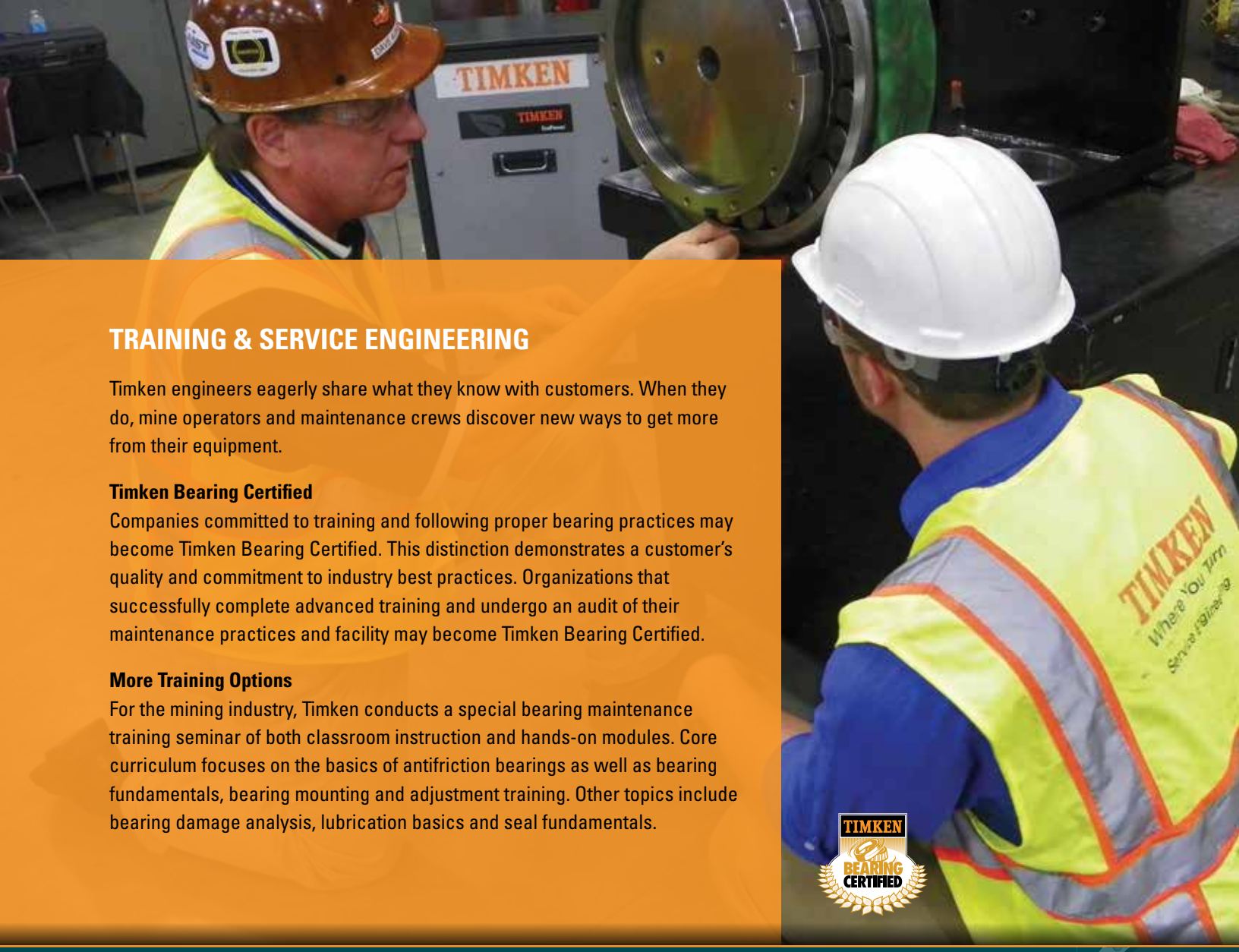
TIMKEN SOLUTION SUCCESS:

Out-of-the-Box Solution Improves Boxley's Conveyor Performance

In Mill Point, W. Va., Boxley's maintenance team doesn't have to worry about unexpected conveyor stoppages caused by premature bearing damage. That's because the quarry switched to Timken® Type E tapered roller bearing housed units after having trouble with a competing product.

"The old housed units lasted an average of six to nine months in our tougher applications," said Howard Walker, Mill Point quarry superintendent. "We wanted to lengthen that time and reduce the amount of unplanned downtime."

The Mill Point maintenance team installed Timken Type E housed units in the positions experiencing the most frequent failures. The conversion was easy since Timken Type E housed units are interchangeable with other brands. After testing the initial units, the quarry switched exclusively to Timken Type E housed units for its entire conveyor lineup.



TRAINING & SERVICE ENGINEERING

Timken engineers eagerly share what they know with customers. When they do, mine operators and maintenance crews discover new ways to get more from their equipment.

Timken Bearing Certified

Companies committed to training and following proper bearing practices may become Timken Bearing Certified. This distinction demonstrates a customer's quality and commitment to industry best practices. Organizations that successfully complete advanced training and undergo an audit of their maintenance practices and facility may become Timken Bearing Certified.

More Training Options

For the mining industry, Timken conducts a special bearing maintenance training seminar of both classroom instruction and hands-on modules. Core curriculum focuses on the basics of antifriction bearings as well as bearing fundamentals, bearing mounting and adjustment training. Other topics include bearing damage analysis, lubrication basics and seal fundamentals.

TIMKEN SOLUTION SUCCESS:

Back to School with Timken Bearing Certified

Understanding how to properly maintain mining equipment can mean the difference between gaining and losing time and money. Take the word of Marty Brown, maintenance training supervisor at Cloud Peak's Cordero Rojo Mine in Wyoming.

"Education is an invaluable investment," he said. "Without it, you are forced to learn from your mistakes, rather than avoiding them altogether. If you understand how a product or piece of equipment operates, you can keep it working instead of being on the clean-up crew."

Cloud Peak Energy participates in the Timken Bearing Certified Maintenance Program. Each year, Timken service engineers conduct a performance audit. Facilities that meet the criteria earn the Timken Bearing Certified designation, and additional training is provided where gaps are apparent.

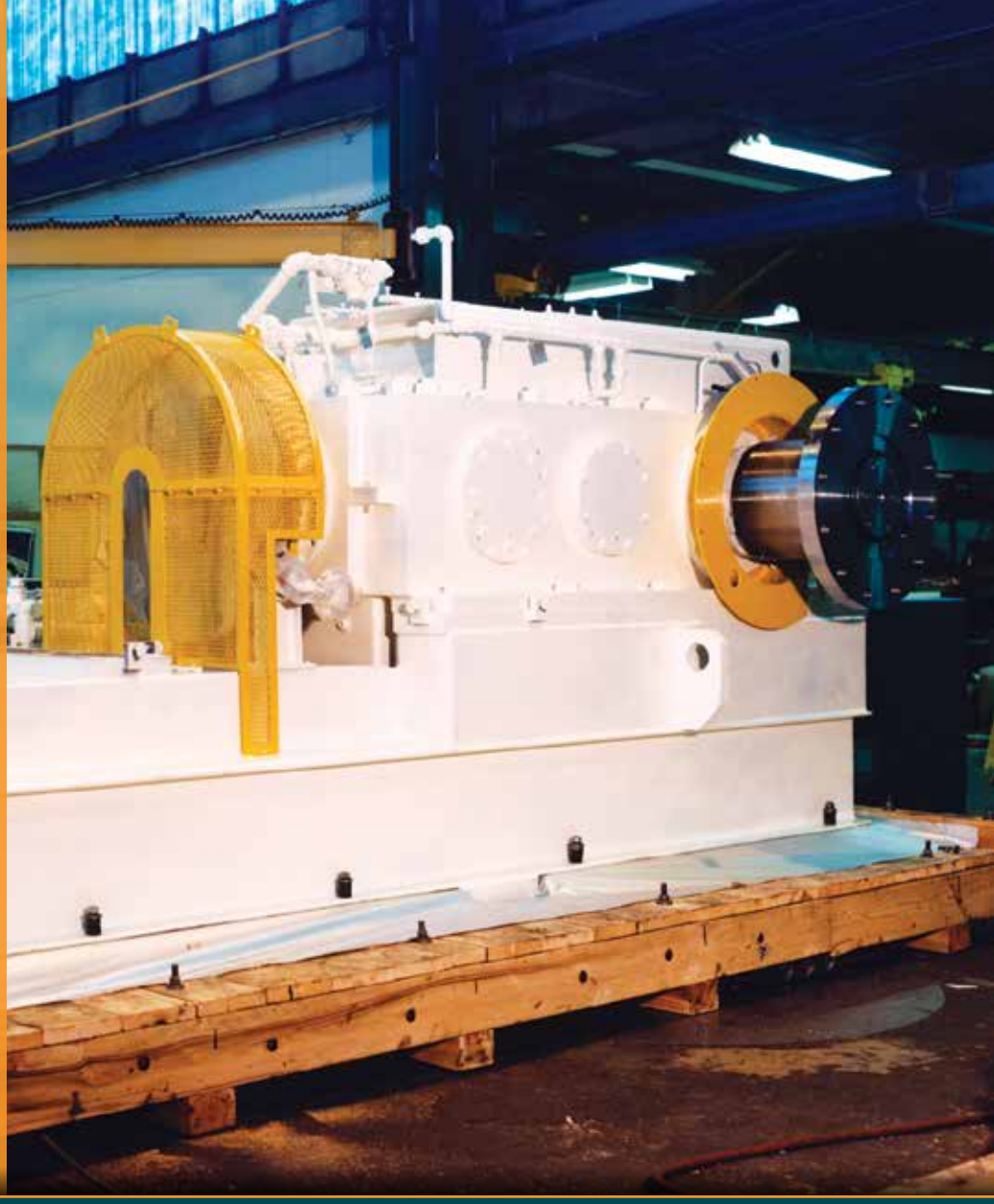
All Timken maintenance seminars are customized for each facility's requirements. Half-, full- or two-day seminars are created from an extensive list of topics and conducted on site or at a nearby location.

BEARING & GEARBOX REPAIR

Highly-engineered, massive mining equipment components like bearings and gears are expensive to replace. Why not save on lead times and budget by repairing and reusing existing components?

In the process of remanufacturing and repairing bearings, Timken can increase the life of the original bearing by up to three times and save you up to 60 percent off the cost of buying a new bearing. We perform repairs on any brand and type of bearing up to 2134 mm (84 in.) outside diameter.

Timken Power Systems also provides gearbox solutions used in coal, copper, iron ore and precious metals mining. That includes gearbox repairs and rebuilds by gearbox experts who have the same mission you do – to maximize your uptime and increase profits.



TIMKEN SOLUTION SUCCESS:

Repair Saves Time, and Time is Money

In steep angle slope and overland conveyors, an instantaneous reverse of tension can be fatal to the belt. Constantly replacing those belts is frustrating, time consuming and very expensive. Using its vast engineering expertise, Philadelphia Gear® – a Timken brand – improved belt reliability on the highest tension, steepest angle slope belt conveyor in the Americas.

Flywheels are typically used to prevent belt failure in the event of a power or prime mover failure. By mounting the flywheel on the high-speed shaft behind the first stage pinion, the gear services team was able to reduce the flywheel mass compared to those mounted to the intermediate or low-speed shaft.

In addition to improving belt reliability, this reconfiguration reduced the amount of required maintenance in two ways. First, it eliminated the need for another assembly to be mounted on its pillow block bearings. Second, the change eliminated a coupling connection and a set of support bearings, dramatically reducing the complexity of equipment alignment.



Tapered Roller Bearings

Not all bearings will face unforgiving conditions like huge payloads or high-contaminant environments. But when they do, Timken tapered roller bearings can handle the burden – with thousands of combinations in single-, double- and four-row configurations to manage both radial and thrust loads. Customized geometries, engineered surfaces and sealed versions can further enhance performance.

- Increased power density means more performance in a smaller, lighter bearing
- Rated among the highest in the industry for long life and low cost of ownership
- True rolling motion allows for higher speeds with minimum roller skewing or skidding
- Industry's broadest range of inch and metric sizes

Applications: haul trucks, shovels, gear drives, draglines

Debris-Resistant Bearings

- Timken debris-resistant bearings extend bearing life up to 3.5 times and are ideal for tough, dirty conditions
- Proprietary alloy heat-treatment modifications and diamond-like coating technology interrupt adhesive wear and can self-repair any microcracking
- Advanced manufacturing processes allow Timken to offer these bearings economically in both large and small quantities

Applications: haul trucks



Cylindrical Roller Bearings

Minimize drag. Reduce heat. And perform better, for longer, with less maintenance and downtime. These are the true tests of any bearing. Our expanded line of cylindrical roller bearings – including single-, double- and multi-row versions and full complement designs – can help extend equipment life and reduce maintenance costs.

- EMA high-performance series offers premium brass land-riding cages that help decrease operating temperatures
- Improved mounting capabilities in the four-row line for metal mills help avoid roller/ring damage during roll change for increased uptime
- ADAPT™ line combines cylindrical and spherical roller bearing designs into one easy-to-assemble, high-capacity configuration – ideal for applications with combined misalignment and axial displacement

Applications: shovels, haul trucks, draglines, crushers, gear drives



Spherical Roller Bearings

Misalignment. Contamination. High temperatures. Even extreme speeds or critical stresses can present extra challenges when managing high radial loads. Timken spherical roller bearings can handle it all, with innovations designed to extend bearing life and boost reliability.

- Run at consistently lower temperatures than same- size competitive bearings for greater realiability
- Multiple cage designs – including a wide range of both steel and brass options – help reduce stress at high shock loads or speeds and provide strong contaminant purge
- Optimized internal geometries deliver the highest load and speed ratings in the industry

Applications: shovels, conveyors, draglines, crushers, screens, gear drives



Type E Tapered Roller Bearing Housed Units

A new standard in performance, Type E tapered roller bearing housed units are ideal for fixed positions and can withstand the most demanding conditions with less downtime and maintenance.

- Seal provides industry-leading protection against contamination
- Optimized internal geometries offer the highest dynamic load ratings in the industry for improved bearing life and performance

Applications: conveyors



Spherical Roller Bearing Solid Block Housed Units

Cast steel housings with high-performance spherical roller bearings deliver outstanding durability in extreme conditions, including severe shock loads and vibration.

- Multiple sealing options provide protection from contaminants in the harshest environments
- Can be mounted and aligned in 15 minutes with a variety of available shaft-locking mechanisms
- Easily convert from fixed to float configurations in the field

Applications: conveyors



Split Block Housed Units

Timken split block units include a wide range of tough housing designs, seals and accessories for outstanding performance in a compact package.

- Units contain Timken spherical roller bearings with a unique design allowing them to run cooler and more efficiently
- Wide range of options provide effective sealing and lubrication for different operating conditions and speeds
- Readily convert the block from fixed to float by removing the stabilizing ring

Applications: conveyors, crushers



Ball Bearing Housed Units

Timken has delivered innovations that offer advanced performance, including wide inner ring bearing and ball bearing housed units. Easy installation, multi-seal design and multiple housing styles help ball bearing housed units support a wide range of demanding applications and conditions.

- Provide advanced protection against contaminants in a robust, compact unit
- Withstand static misalignment of +/- 3 degrees
- Effective grease retention and reduced debris and moisture ingress improve performance

Applications: conveyors

TIMKEN SOLUTIONS FOR ABOVE GROUND MINING



Advanced Bearing System Analysis

It's one of the most advanced bearing analysis tools available, with an unmatched, proprietary design that helps speed the system concept-to-design process with fewer test requirements. Our Syber Program analyzes bearing systems, helps optimize design and development, and predicts potential damage. And Timken customers also can perform base design analytics with their own version of this powerful software.



Bearinging Remanufacturing

Buying new bearings can be costly. But our remanufacturing service can return bearings – even other brands – to like-new condition, extending service life by up to three times, and saving up to 60% on the cost of replacement bearings. For the above ground mining industry, Timken repairs tapered, cylindrical and spherical bearings, shafts and housings used in haul trucks, shovels, draglines and conveyors.



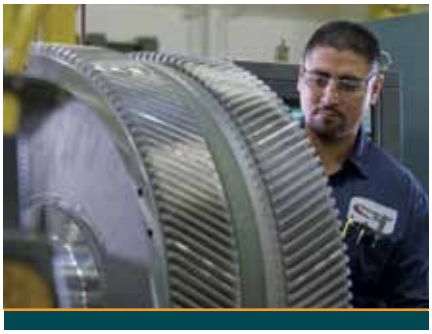
Service Engineering

Driven to keep equipment running efficiently, our service engineers thrive on overcoming challenges and seeking ways to prevent future problems. Tapping into data, testing and technical resources, these experts offer on-site problem solving, life cycle calculations, interface design options, and bearing inspections and evaluations to uncover new paths to greater efficiency and productivity.



Motor Repair

Expert motor and electrical engineers use advanced diagnostics and technologies to keep motors and generators operating smoothly. On-site electrical engineers can increase equipment performance with customized design solutions. With an extensive range of industrial equipment on-hand, Timken is ready to address a wide range of electric motor repairs.



Gearbox Repair

The Timken gear repair services team, including Philadelphia Gear, has an extensive knowledge base in the service of mission critical industrial gears, including crusher drives and variable speed drives. They are ready to handle the toughest repair challenges in the most demanding industries.



Training and Certification

Passing along more than a century of knowledge, our field service engineering network provides on-site training, end-user maintenance seminars and bearing certification programs to help optimize system performance. Our engineers tailor training – from bearing basics and proper installation to time-tested practices and the latest technology. And our certification programs help maintenance shops gain efficiencies and improve performance.



Couplings

Designed for high and low torques, and high and low speeds, Quick-Flex® couplings have the strength to handle tough challenges with little or no maintenance. Easy to install and requiring no lubrication, their life spans match those of rotating equipment to help keep the overall cost of ownership low.

- Transmit the same or more torque than a gear, grid or other elastomeric coupling with similar dimensions
- Replace coupling insert without moving hubs – maintenance takes minutes instead of hours
- Sized to fit virtually all needs – with multiple hub and shaft combinations for easy mounting

Chain

Manufactured to meet or exceed ANSI standards, Timken chain performs. Our precision roller chain, attachment chain and engineered chain products excel in tough, high-performance applications and can be custom-manufactured to meet specific needs.

- Wide-waisted link plates improve stress distribution for better performance
- Precision hole quality increases working load and pin retention
- Can withstand shock loads up to 50% of minimum ultimate tensile strength without premature elongation
- Extensive range of stainless steel and coated options



Seals

The ability to retain lubrication and block contaminants is critical to optimal bearing and system performance. Our complete line of industrial sealing solutions includes a variety of types and material options that provide resistance to extreme temperatures, pressure, debris and most chemicals.

- Contact and non-contact designs suit any application – with excellent sealing capability
- Durable materials can extend seal life and minimize maintenance
- Secondary seals, covers and endcaps provide extra protection in harsher environments



Lubricants and Lubrication Systems

Leveraging our expertise in tribology and anti-friction bearings, we've developed lubricants – including 27 formulations of grease – that help ensure smooth operation. Our single- and multi-point lubricators, in addition to Interlube automated lubrication delivery systems, dispense precise amounts of grease, saving time and money over manual application.

- High-temperature, anti-wear and water-resistant additives optimize consistent operation in even the most challenging environments
- Multifaceted delivery systems serve virtually any application – from simple, single-point needs to multi-point or progressive systems where an automated process can maximize uptime and reduce maintenance costs
- Patented chain lubrication systems inject oil where it's needed for reduced wear



Maintenance Tools

Beyond making world-class bearings, we offer the precision tools to install, remove and maintain them in the easiest, safest manner possible. Applying our engineering know-how to the design of a variety of induction heaters, impact fitting tools, and hydraulic and mechanical pullers, Timken develops the tools needed to maximize productivity and uptime, including offering hands-on field training on their use and maintenance.



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Above ground mining customers bring Timken their greatest challenges, and we deliver. The global Timken team leverages our engineering expertise and draws on our field experience to provide solutions that help you move mountains.

TIMKEN

The Timken team applies their know-how to improve the reliability and performance of machinery in diverse markets worldwide. The company designs, makes and markets high-performance mechanical components, including bearings, belts, gears, chain and related mechanical power transmission products and services.

Stronger. **Commitment.** Stronger. **Value.** Stronger. **Worldwide.** Stronger. **Together.** | **Stronger.** By Design.

www.timken.com