Eddyfi Technologies

Beyond current

# MINING FOR SAFETY

DIGGING INTO ADVANCED INSPECTION SOLUTIONS TO BOOST MINING EFFICIENCY

WHITE PAPER

In today’s demanding industrial landscape, extending the lifespan of heavy equipment is crucial. With high costs and long lead times for new machinery, the focus has shifted to maximizing the service life of existing assets. However, subtle wear and tear can compromise both equipment performance and worker safety. Just as hidden corrosion can weaken structures, unnoticed degradation in mining equipment can lead to severe operational issues and pose significant risks to personnel.

## Underground Mining

Underground mining is used to extract ore from beneath the earth's surface safely, economically, and with minimal waste. Access to an underground mine may be through a horizontal or vertical tunnel, known as an adit, shaft, or decline.

## Underwater Mining

Underwater mining is necessary when the resource you've identified is located within an aquatic environment, such as the sea floor. This presents a unique challenge that requires a responsible approach, thoughtfully considering the local ecosystem.

## Open-pit

Open-pit mining is one of the most common methods and begins at the earth's surface, maintaining continuous exposure to the surface. The excavation has stepped sides for safety and a wide ramp for efficient equipment access and product removal.

## THE ROLE OF ADVANCED INSPECTION SOLUTIONS AMIDST GROWTH AND CHALLENGES

The mining industry is undergoing significant growth due to the rising demand for minerals and metals. Advanced inspection solutions are essential for maintaining the safety, efficiency, and longevity of mining operations.

However, the industry faces several challenges when implementing Non-Destructive Testing (NDT). The remote and harsh environments of mining sites complicate the deployment and upkeep of NDT equipment. Environmental factors such as dust, vibration, and extreme temperatures can further impact the accuracy of testing methods. Safety is a critical concern in mining operations, and effective NDT plays a crucial role in mitigating risks. By identifying potential defects and wear before they lead to failures, advanced inspection solutions help prevent accidents and equipment malfunctions that could pose serious safety hazards.

Eddyfi Technologies offers advanced inspection solutions specifically designed for the mining sector. These technologies are key to maintaining the integrity of mining equipment and infrastructure, optimizing operational efficiency, and complying with regulatory standards. Key inspection methods include Eddy Current Array (ECA), Phased Array Ultrasonic Testing (PAUT), and Alternating Current Field Measurement (ACFM).

For mining corporations, regular inspection of facilities and equipment is about maximizing up time, ensuring operational safety and minimizing revenue loss. Securing the right local partner for your NDT requirements is a key to success.


## GEARING UP: ENHANCING INSPECTIONS WITH EDDY CURRENT ARRAY

***"The tools that the Reddy offers in the field and ported to the desktop platform are precisely what is needed for the application of gear inspections. When we find crack indications on gear teeth, there are typically millions of dollars at stake. The software tools available in the field can be one of the factors that allow us to make the right decisions quickly."***

***Richard Malenfant***
*Founder, Malenfant Technical Services (MTS)*

Eddy Current Array (ECA) technology is essential for effective maintenance of equipment and infrastructure in the mining industry. It provides critical capabilities for detecting surface cracks, corrosion, and other defects in metal components, thereby preventing equipment failures and minimizing downtime. This is particularly important for monitoring gears—such as girth gears, pinions, and bull gears—that are vital to mining operations and are susceptible to surface-breaking cracks from operational stress.

Traditional inspection methods like Dye Penetrant Testing (PT) and Magnetic Particle Testing (MT) are often costly and time-consuming, involving complex preparation and post-inspection processes. In contrast, ECA offers a more efficient solution by delivering detailed, non-destructive inspections that improve safety and extend the life of gear components.

ECA stands out due to its sensitivity to small surface defects, surpassing the capabilities of MT, PT, and Ultrasonic Testing (UT). This sensitivity is attributed to the way eddy currents interact with conductive materials. Unlike PT, MT, and UT, which require extensive surface preparation and reapplication of lubricants, ECA simplifies the process. It uses multiplexed arrays of Eddy Current Testing (ECT) coils to scan wider surfaces more quickly, allowing comprehensive inspection of gear tooth flanks in a single pass.

Moreover, ECA complies with the Standard Practice for Examination of Mill and Kiln Girth Gear Teeth—Electromagnetic Method, ensuring that inspections meet industry standards for quality and reliability. By integrating ECA technology, the mining industry benefits from more efficient, accurate, and compliant gear inspections.


**Figure 1:** Reddy instrument with ECA gear probes.

**The Reddy® system is a game-changer for the mining industry, offering state-of-the-art electromagnetic NDT technology tailored for rapid crack and corrosion assessment. Designed to meet the demanding conditions of mining operations, Reddy combines advanced features in a robust, portable package. For the mining sector, where equipment integrity is paramount, Reddy delivers unmatched speed, accuracy, and ease of use, setting a new standard for electromagnetic NDT inspections.**


# THE FULL PAUT-TENTIAL: HOW PHASED ARRAY TESTING ELEVATES MINING EQUIPMENT SAFETY

Underground and open pit mining operations would not be possible without the heavy equipment relied on every day for excavation, transportation, crushing, sorting, and analysis. With the potential threats found in this industrial environment, it's especially pertinent to ensure the safe working operation of tools and machinery to prevent worker injury. The right NDT method can improve safety by detecting flaws and anomalies before catastrophic failure.

In the mining industry, advanced non-destructive testing (NDT) techniques, such as Phased Array Ultrasonic Testing (PAUT) and Total Focusing Method (TFM), are vital for maintaining equipment integrity and safety. PAUT is known for delivering high-resolution, detailed images that allow for accurate detection and assessment of defects. TFM enhances this by providing even greater sensitivity and clarity, enabling the detection of smaller or more complex defects. These techniques are crucial for inspecting essential components like welds, ball studs, and gear teeth, which are exposed to significant wear and stress.

The benefits of PAUT include its ability to detect and size defects with high accuracy, even in challenging access areas. For instance, PAUT's detailed imaging can identify cracks in ball studs connecting steering linkages and assess bore and lug components effectively, even under operational constraints. Additionally, it complements other inspection methods, such as eddy current arrays, by enhancing the detection of internal and sub-surface defects in gear teeth.

Automated monitoring solutions play a crucial role in supplementing PAUT by offering continuous and consistent inspection of components like storage tanks. These systems provide real-time data, enabling early detection of issues and reducing the need for manual inspections. This not only enhances data accuracy but also supports proactive maintenance, minimizing downtime and improving equipment reliability.

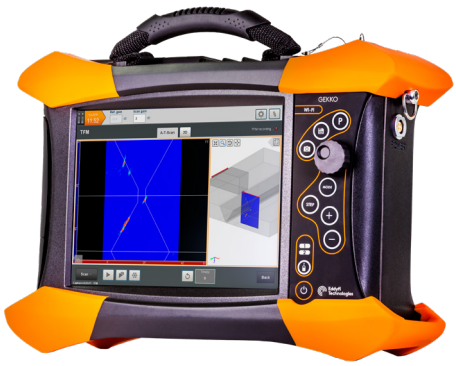


**Figure 2:** Gekko instrument designed for IP66 with a drop test rating in accordance with MIL-STD-810G, the rugged enclosure can withstand the harshest site conditions.

**The Gekko® is a portable flaw detector offering PAUT, TFM, conventional UT, and Time of Flight Diffraction (TOFD), with user-friendly software that speeds up weld inspections and corrosion mapping.**

**In mining operations, critical components like TKY joints—where metal pieces are joined at an angle or perpendicularly—require regular integrity assessments. The Gekko's software, Capture™, includes an application that helps operators define these geometries and accurately position ultrasonic echoes, improving the interpretation of visual results.**

***"Where confined space entry limits visual inspection, Eddyfi Technologies' remote camera systems shine with its evolving design capabilities to be smaller and go further than industry norms. Our proven technology provides downhole video and visual access to otherwise inaccessible locations. Whether a routine assessment or emergency response situation, our inspection cameras provide critical data in real-time from tight spaces."***

***Craig Senych***
*General Manager, Robotics*

## FINDING CLARITY IN REMOTE INSPECTIONS

Remote Visual Inspection (RVI) has become a critical tool for maintaining safety and operational efficiency. As mining operations become more complex and extend into challenging environments, RVI provides a crucial means to monitor equipment, infrastructure, and working conditions without the need for personnel to enter hazardous areas. This technology is essential for identifying potential issues early, ensuring that problems are addressed before they escalate into costly failures or safety hazards.

Eddyfi Technologies offers advanced camera and inspection crawler systems designed for these demanding conditions. Our solutions include both standard components and custom options for inspecting confined or inaccessible areas. Engineered for high-quality visual inspections, our products provide miners with clear, actionable insights in some of the harshest environments.

For instance, at the Escondida mine in Chile, a vital slurry pipeline—responsible for transporting 8% of the world's copper production—required thorough inspection. The pipeline, stretching 170 kilometers (105 miles) from the mine to the Pacific port, presented significant challenges. Technology and Engineering Services for Radical Advancement (TESRA), responsible for the inspection, required a highly reliable solution to detect any potential flaws. They chose the VersaTrax™ long-range inspection crawler equipped with the Spectrum™ camera. This setup, featuring built-in lasers, provided real-time visual data and a thorough report on the pipeline's condition, meeting the stringent reliability standards required by the client.

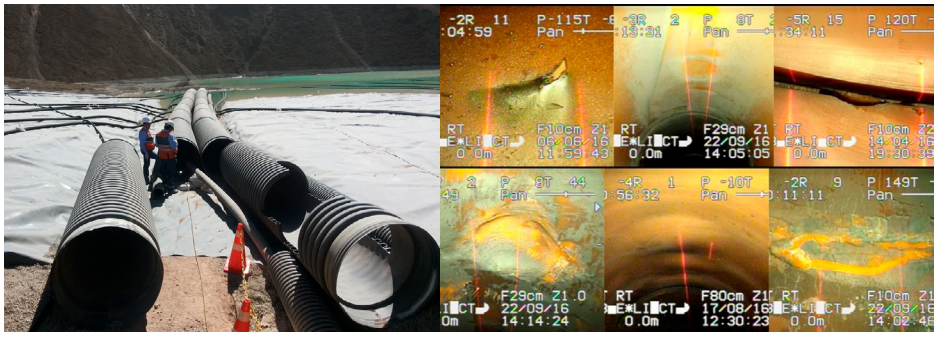

**Figure 3:** Copper mine pipeline remote visual inspection with VersaTrax.

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DISCOVER OUR RVI MINING SUCCESS STORIES


## THE VERSATILITY OF ACFM® FOR EQUIPMENT INTEGRITY

Alternating Current Field Measurement (ACFM®) was originally developed for the oil and gas industry to detect and size surface-breaking cracks with minimal surface preparation. This technique, now widely adopted across various industries, offers an effective alternative to traditional magnetic particle and dye penetrant inspections. Eddyfi Technologies' ACFM solutions are engineered for versatility, enabling their application across a broad range of components, from large structural elements to smaller machinery parts.

In the mining industry, ACFM technology is proving invaluable for inspecting critical equipment such as axles, bogies, skips, and cages. These components are essential to mining operations, where their reliability and safety are paramount. By integrating ACFM into routine inspections, mining operators benefit from precise defect detection and characterization, ensuring the continued integrity and performance of their equipment.

For instance, cranes, which play a crucial role in lifting and transporting materials in mining environments, can be effectively inspected using ACFM. This technology provides high sensitivity and accuracy while being non-destructive, allowing for thorough inspections without interrupting operations or compromising equipment.

**Figure 4:** From left to right - Critical welds to be inspected on typical dockside crane, typical weld geometries on crane, dock crane.

**Figure 5:** From left to right - Amigo™ 2 intrument, Sensu 2 Compliant Array, and Pencil Probe.

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WATCH OUR RELATED INSTALLED SENSORS VIDEO

## MINING SMART: THE BENEFITS OF REAL-TIME DATA AND INSTALLED SENSORS

The application of Installed Sensors is gaining momentum, offering significant benefits for safety, efficiency, and cost-effectiveness. These sensors enable continuous monitoring of critical equipment and infrastructure, facilitating real-time data collection and analysis. This capability is crucial for the early detection of potential issues, significantly reducing the need for manual inspections and minimizing operational downtime.

One of the primary advantages of Installed Sensors is their ability to provide real-time monitoring. This continuous data stream allows for proactive maintenance, identifying problems before they escalate into serious failures. This not only enhances the operational efficiency of mining operations but also extends the lifespan of the equipment.

From a cost perspective, automated monitoring systems reduce the reliance on manual inspections, thereby lowering labor costs. The precise and reliable data provided by sensors also enable informed maintenance decisions, further contributing to cost savings and operational efficiency.

Moreover, the environmental impact of mining operations can be mitigated through the use of installed sensors. By optimizing maintenance schedules and preventing equipment failures, these sensors help reduce the environmental footprint of mining activities.

A real-world example of Installed Sensors in action is to monitor slurry lines in mining operations. Slurry lines, which transport a mixture of water and finely ground ore, are critical to mining operations but are prone to wear and tear due to the abrasive nature of the slurry. By installing sensors along the slurry lines, mining companies can continuously monitor the thickness of the pipes and detect any signs of wear or potential failures. This early detection allows for timely maintenance and replacement, preventing costly and disruptive pipeline failures.

***"Remotely tracking the growth of these individual pits and general corrosion rates in a buried pipeline is a perfect application for our technology coupled with remote client access to the data through our web portal."***

***Dr. James Barshinger***
*Director, R&D*

**Figure 6:** smartPIMS® and matPIMS™ for slurry line monitoring.

## ADVANCED INSPECTION SOLUTIONS FOR A SAFER, MORE EFFICIENT MINING INDUSTRY

As the mining industry continues to expand in response to the growing demand for minerals and metals, the role of advanced inspection solutions becomes increasingly critical. By leveraging technologies such as Eddy Current Array (ECA), Phased Array Ultrasonic Testing (PAUT), and Alternating Current Field Measurement (ACFM), mining operators can proactively identify and address potential issues, ensuring the integrity and longevity of their equipment and infrastructure. Ultimately, these advanced inspection methods are essential for safeguarding operations, preventing costly failures, and promoting a safer working environment in the mining industry.

For more information on how Eddyfi Technologies can support your mining operations with advanced inspection solutions, contact us today. Let us help you enhance safety, efficiency, and equipment integrity.

MINING FOR SAFETY

**EXCLUSIVE WORKSHOP: NDT IN MINING**

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Beyond current

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