SAFETY GUIDE FOR THE MINING INDUSTRY

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Introduction

The mining industry is at the foundation of everything in our modern world. The manufacturers that produce consumer goods and industrial equipment rely heavily on raw materials extracted through mining. That extraction process is often taken for granted, but it is complex work with a number of inherent hazards that require careful controls. In fact, mining operations are so safety sensitive that the industry has its own dedicated safety administration tasked with providing oversight, the Mine Safety and Health Administration (MSHA).

Mining companies and the regulators who oversee them have done an impressive job of improving safety for miners. A century ago, working in the mines carried an incredibly high level of risk. Now, employees can show up on site with the confidence that they will make it safely through the day and get to go home at the end of their shift – just like workers in any other sector. There is, however, still room for improvement. Even with modern machinery, safety equipment, and industry best practices, there were 40 mining fatalities in 2023, with indications that 2025 is already on track to exceed that number. These improvements won't happen by accident – we need careful planning, control, monitoring, and enforcement to keep workers safe on the job.

Mining Safety: Then and Now

The first half of the 20th century was a busy time for mining in America. At the turn of the century, half a million miners worked in the industry, and the number climbed to nearly a million by the 1920s. The poor safety standards of the day and lack of regulation meant that inexperience abounded, injuries and fatalities were frequent, and failures were catastrophic.

With so many people placing their lives and health at risk to extract coal and other minerals, legislation was eventually put into effect to ensure the safety of those who reported to the mines. Thanks in part to public pressure, the Mine Safety and Health Act of 1977 was enacted, which built upon the Federal Coal Mine Health and Safety Act of 1969, extending regulations to metal and non-metal mining operations (MNM). It was the most stringent health and safety legislation in force at the time, and provided a framework for inspection, enforcement, and health protections for mine-related occupational illnesses such a "Black Lung Disease."

The Mine Safety and Health Administration (MSHA) was established under the US Department of Labor to administer and enforce the Mine Safety Act. It is tasked with attending to the unique safety needs of mining operations, particularly to address the prevalence of serious and fatal injuries.

MSHA's strategy is guided by four pillars:

- Training programs (including procedures and technical assistance)
- Inspections
- Incidents investigation
- Enforcement and penalties for non-compliance

The latter two are geared towards identifying a Pattern of Violations (POV) for specific mine operators and ensure accountability through enforcement. Such violations are classified according to the degree to which they are "Significant and Substantial" (S&S).

Statistics from the MSHA and the National Institute for Occupational Safety and Health (NIOSH) reveal the hazardous nature of mining work. The industry saw nearly 3,500 injuries in 2022, and this alarming number is, unfortunately, on-trend.

On the other hand, the general trend in fatal incidents over decades has seen a notable decline. Thanks to the joint efforts of safety managers and regulatory agencies, there has been vast improvement over the years. In 2023, there were 11 fatalities in the coal mining industry, which is both unfortunate and significant, but correcting for a tenfold reduction in the workforce over the years, fatalities have reduced from the high water mark of 476 fatalities per 100,000 workers in 1907 to 13 per 100,000 in 2023.

The history of mining safety is tragic but optimistic, marked by devastating events in the past that serve as lessons for how companies operate in the present. By ensuring that sites are managed properly, the right equipment is used, and workers are given the protection they need, we can continue to make strides in lowering fatality numbers and further reducing the risk of injury.

Major Mining Hazards and Controls

The nature of fatal incidents in mining involve both common workplace risks and causes unique to the industry. Incident reports have many of the same subcategories as other industrial professions, but notably add “engulfment”, “entrapment”, “carbon monoxide poisoning”, “inundation”, and “non-powered haulage.” These may not form a significant portion of the major incidents, and certainly aren’t entirely unheard of in other industries, but they reveal a profile of the kinds of hazards encountered on mining sites.

One of many categories MSHA inspections evaluate is the extent to which a mining operation has identified the risks associated with their activities and applied appropriate controls. Document review should reveal that safety activities are comprehensive, consistent, record-generating, showing complete implementation.

Here are some of the major risks, along with the measures that should be implemented to control them.

Silica

The Permissible Exposure Limit (PEL) for respirable crystalline silica was lowered in 2016, and new requirements for medical surveillance, dust control, and monitoring practices were rolled out. At metal and non-metal mining operations, the PEL for respirable quartz (silica) is 50 µg/m, 8-hour time-weighted average for a full shift. The MSHA has established an “action level” of 25 µg/m for a full shift exposure which requires additional monitoring. This was lowered in 2024 for the mining industry to provide greater protection to workers. Respirable silica is most often indicated as a cause of silicosis, pneumoconiosis (particularly with coal dust), lung cancer, and chronic conditions like emphysema.

Silica is nearly always present in mining operations, as it is generated by cutting, drilling, crushing, hauling, and other activities common in the industry.

Control methods can include:

Monitoring to keep track of exposure levels and ensure they do not exceed the permissible limits for the industry.

Dust collection systems to limit the amount of silica dust that becomes airborne during drilling, cutting, and other dust-producing activities.

Wet dust suppression systems to add moisture to would-be dust particles, bringing them down to the ground instead of allowing them to float in the air.

Ground Protection: consider ground protection systems to help prevent vehicles from pushing dust into the air.

Respirators to prevent the majority of respirable silica in the atmosphere from reaching workers’ lungs.

Fire and Explosion

Mining disaster data from NIOSH (ranging from 1839 to 2023) reveal that explosion and fire are the standout causes of catastrophic incidents in mines. The number of explosion-related incidents classified as “disaster” numbered 538 (74%), with the runner-up being fire at 79 (11%).

Fires and explosions, of course, have much crossover. Many of the recent explosion events started out as methane ignitions in unoccupied areas, which then spread to work areas. Even outside of the shockwave of an explosion, there are secondary hazards such collapsing support structures, hazardous gas that may proliferate through the site via the ventilation system, or the depletion of breathable oxygen.

Control methods can include:

Robust monitoring plans to detect the presence of flammable gases such as methane, even in areas where no work is being done.

Ventilation systems to prevent the accumulation of combustible gases in a concentrated area.

Rock dusting procedures, in which limestone is mixed to inert rock dust to make it less combustible.

Heavy Machinery

The U.S. Department of Labor reports that 5 out of 14 fatalities in 2023 were related to use of machinery (underground and surface combined). Common causes of these incidents include poor visibility, confined space, fatigued workers, and the massive blind spots for vehicle operators.

Given the massive size of the equipment used in mining operations, even a brief rollaway or a slow collision can carry a major risk.

Control methods can include:

Wheel chocks designed and manufactured for the purpose, with the size and weight of the vehicle in question. No makeshift chocks should ever be used. Having the right equipment in stock and available should be part of the work planning process.

Warning whips to improve the visibility of the vehicles on site.

In-vehicle camera/ monitor systems to provide visibility to the blind spots and swing zones of heavy equipment and provide a display/proximity warning to operators in the cab.

Hazardous Atmospheres

Fire and explosion aren't the only gas hazards present in mines – far from it. Depending on the region and type of mine, various types of toxic or asphyxiating gases may be present. In some cases, gases can be hazardous in multiple ways, such as H_2S, which is both flammable and toxic.

Other gases may also be in mines that are not conventionally "toxic" but may still cause harm by displacing oxygen. Gases like CO_2 (produced by both natural and human processes) and nitrogen can collect in enclosed spaces and result in an emergency. From 2011 to 2018, the Bureau of Labor Statistics reported that 129 workers lost their lives in "Underground mines, caves, tunnels" of which 39 cases were oxygen depletion.

Control methods can include:

Continuous monitoring to ensure that toxic gas exposure is kept below the Permissible Exposure Limit (PEL) and Lower Explosive Limit (LEL).

Ventilation systems to limit the concentration of toxic gases in any one area.

Respirators to reduce exposure for individual workers.

Supplied air respirators to compensate for oxygen depletion in the working atmosphere.

Energy Isolation

Many recent mine disasters cited energy isolation as one of the causes of fire and explosion incidents.

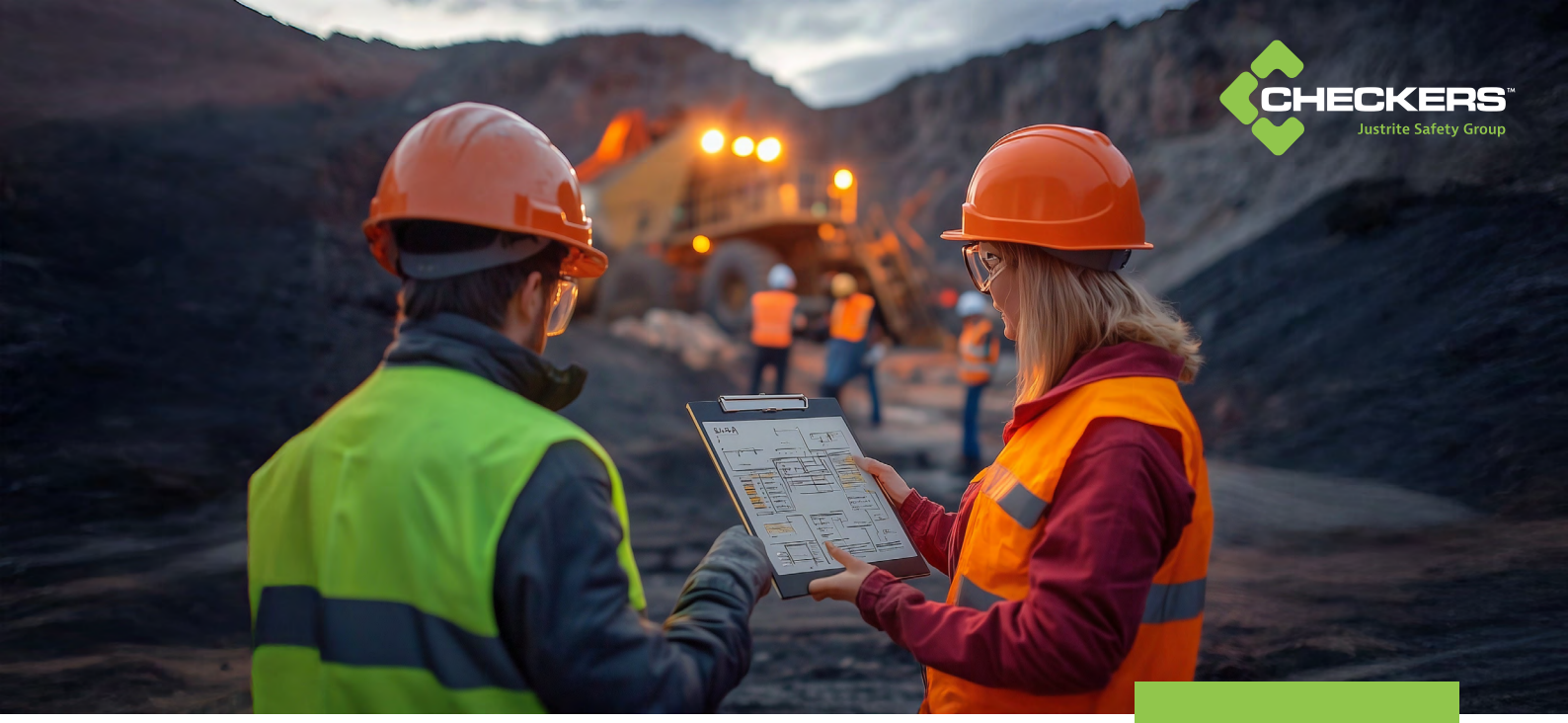
Additionally, a significant number of incidents happen while performing maintenance on powered haulage and conveyer systems. As with other incident types, these events predominantly affect the least experienced and, paradoxically, the most experienced workers for what is presumed to be completely different reasons. It may be that maintenance tasks are assigned preferentially to the youngest and oldest workers due to their relatively limited task capacity. This reflects an underestimation of the risk involved in such activities, and when risk is discounted, controls are not properly prioritized.

Control methods can include:

Barricades to prevent entry to unsafe areas. Using visible, robust barriers and signage is an effective way to mark off the area clearly and unambiguously.

Lockout systems to isolate energy in equipment that has been powered down. This prevents any residual energy from activating parts of the equipment while it is being serviced or maintained.

While **cable protectors** aren't directly part of energy isolation, they play a key role in maintaining a safe environment during repairs or temporary work, helping prevent additional hazards in already high-risk situations.



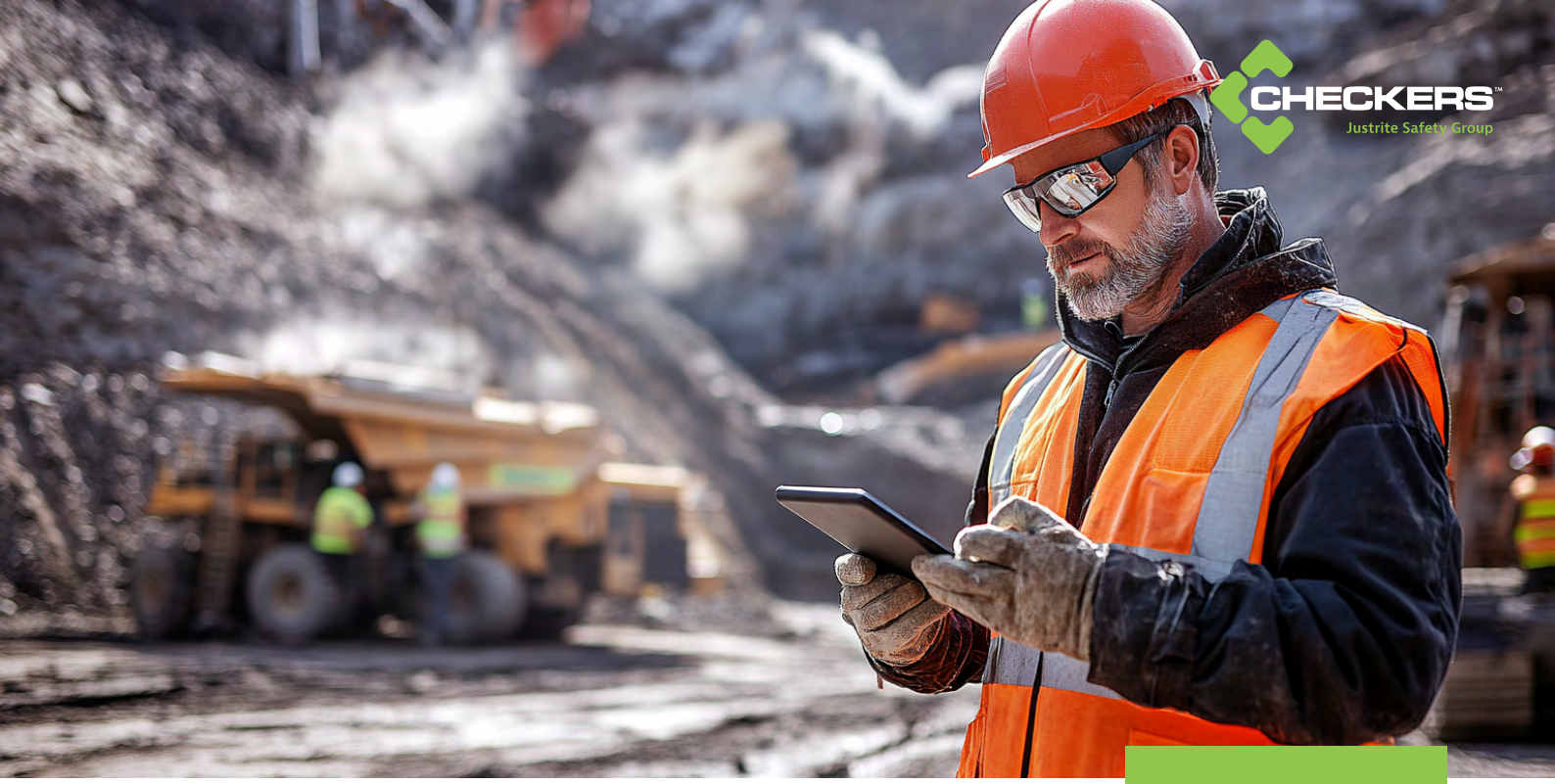
Building a Sustainable Safety Strategy for Mining Operations

Hazard assessment and control are a cornerstone of any effective health and safety program, but it's only part of the picture. A well-formed safety management system should be knit into every operational function, from planning to completion.

Your organization's safety management system should be structured around the Plan-Do-Check-Act (PDCA) model, which allows for continual improvement and long term sustainability. Although it should adhere to all applicable regulations, it should not have regulatory compliance as its principal target. Instead, it should aim to establish and maintain a positive safety culture with improvements in safety performance.

Here are the four phases of the PDCA model in a nutshell:

1. **Phase 1: Plan** – Planning and strategy activities should have safety baked in, with budgeting for training and competency assessment, orientation, and safety equipment as key considerations.
2. **Phase 2: Do –** The implementation phase should include the performance of health and safety activities, communication, preparation, and the in situ conditions of task performance.
3. **Phase 3: Check** – Checking includes monitoring and measurement activities that gauge how well the planned activities are being performed and how consistently, then measuring their outputs.
4. **Phase 4: Act** – Key metrics and measurements are communicated to management to facilitate taking action on improvements. Rather than simply identifying areas of improvement, this phase involves assigning and executing on them so concrete steps are taken. The outputs of these actions then form the next cycle of planning and development.



Audit and Inspection

The MSHA inspects each underground mine four times per year, and each surface mine twice. Visits aren't announced in advance to ensure that inspectors get a snapshot of real day-to-day operations, not a well-prepared façade propped up for the auditors and quickly dismantled afterwards.

Each inspection includes a review of directive documentation and operational records, interviews with employees, along with an inspection of the physical work environment and equipment. The audit includes evaluation and special requirements for mining industry activity such as ventilation systems, and general requirements such as PPE and maintenance logs.

Audit of mining sites is one of the main activities through which the MSHA fulfills its mandate. Through boots-on-the-ground inspection and oversight, offenders can be dealt disciplinary action and penalties. Moreover, all mining operations get third-party identification of opportunities to improve. Auditing is fundamental to a well-run health and safety management system for any organization for this reason: it facilitates continual improvement. Organizations that embrace the process rather than treating it as an inconvenience can go beyond the bare minimum and work toward a safe and efficient worksite.

How Checkers Safety Solutions Help Mitigate Mining Risks

Sourcing high quality safety equipment is an important step to preventing incidents. When the procedures are established, workers trained, and the equipment is available and maintained, there is less chance that anyone will cut corners or use makeshift solutions.

Checkers Safety™ products are indispensable in high-hazard mining operations, providing effective solutions to some of the major hazards on the jobsite:

Wheel Chocks to secure heavy vehicles in place and prevent rollaways. Durable and lightweight chocks with high-visibility features ease of use and, with it being easy to see, a secondary check to make sure controls are in place.

Cable Protectors to prevent cables from coming into contact with equipment and foot traffic. With the prevalence of electric equipment in mining, a robust solution to manage and protect the cables running through the site is essential. Checkers' protectors use Urethane, making it 75% lighter than common alternatives so that it is less cumbersome to set up and use, and doesn't introduce a hazard of its own due to poor ergonomics.

Warning Whips to make smaller vehicles more conspicuous, allowing heavy equipment operators to see them more easily. This simple accessory can go a long way to preventing risky and costly collisions.

Ground Protection Mats to help control for the characteristics of natural terrain, such as shifting or unstable ground, mud, or the potential for silica to be kicked up into the air. In addition to making vehicle and personnel operations safer, ground mats also helps preserve the grade and terrain of the worksite to improve efficiency, prevent vehicles from getting stuck, and the necessity of recovery operations.

Wheel chocks

MC4011

Checkers MC4011 Ultra-Class Wheel Chock is the lightest ultra-class mining wheel chock available (as of 2025), engineered for 800-ton haul trucks with unmatched safety, durability, and single-person handling. It's 23% lighter than previous models, 7.5 inches shorter than competitors, and designed to meet strict NIOSH, OSHA, and MSHA guidelines.

MC3009

Checkers industrial wheel chocks MC3009 for ground vehicles are manufactured with highly durable, lightweight high-density polyethylene (HDPE) and they feature a larger base that makes them ideal for use with heavy equipment. MC3009 wheel chocks are designed for mine support equipment such as lubrication trucks and heavy maintenance vehicles. Rated for tire sizes up to 65 in. (165.1 cm) diameter and gross vehicle operating weight up to 245,000 lbs. (111,130 kg). A maximum rated payload of 70 tons.

MC3010

The Checkers™ heavy-duty MC3010 wheel chocks for ground vehicles are manufactured with highly durable, lightweight high-density polyethylene (HDPE) and feature a larger base that makes them ideal for use with heavy equipment such as haul trucks, loaders, and cranes. These chocks are for mine haul trucks with tire sizes up to 105 in. (266.7 cm) in diameter and gross vehicle operating weight up to 550,000 lbs. (249,476 kg). A maximum rated payload of 165 tons.

MC3012

Checkers heavy-duty MC3012 wheel chocks for ground vehicles are manufactured with highly durable, lightweight high-density polyethylene (HDPE) and they feature a larger base that makes them ideal for use with heavy equipment such as haul trucks, loaders, and cranes. MC3012 wheel chocks are for mine haul trucks with tire sizes up to 142" (241.3 cm) in diameter and gross vehicle operating weight up to 855,000 lbs. (725,748 kg). A maximum rated payload of 240 tons. This chock is designed for normal haul road grades.

Cable Protectors

5-Channel Yellow Jacket® Extreme Heavy-Duty Cable Protector - YJ5-400-Y/B

Yellow Jacket® 5-channel cable protector with hinged lid provides a safe crossing in high volume traffic areas while protecting valuable electrical cables and hose lines from damage. Heavy-duty modular interlocking design is ideal for use in industrial, commercial, and public applications.

1-Channel Yellow Jacket® Extreme Heavy-Duty Cable Protector for 5" Lines - YJ1-500-Y/B

Yellow Jacket® 1-channel cable protector with hinged lid protect valuable large electrical cables and hose lines that are up to 5 inches tall from damage while providing a safe crossing in high volume traffic areas. The modular interlocking design is ideal for extremely heavy-duty industrial areas.

10' Extreme Crossover System, Mining Cable Protector, 4.25" Dia. Cables, Type 4 - XO442-10

Checkers EXTREME CROSSOVER PADS provide protection for electrical cables used in mining and construction. Durable urethane construction withstands thousands of pounds of weight and endures constant pounding, impact, and abrasion caused by haul trucks and falling rocks. Extensively tested and proven to be oil, chemical, abrasion, cut/tear, and temperature resistant. Types 3 and 4 feature molded-in through-holes for tow chain attachment. Type 5 includes a heavy-duty chain handle on each side. Crossover sections can be fastened together for any length required. The use of crossover pads greatly improves safety and eliminates the cost and labor of burying, rerouting or stringing cables overhead.

Warning Whips

8' General-Purpose Warning Whip with Threaded Hex Base and 12" Orange Flag with White Reflective X - FS8X-O

General-purpose non-lighted warning whips with threaded hex base include a heavy duty Day Bright™® fluorescent nylon mesh flag with or without 3M®® Scotchlite®® reflective X, premium fiberglass resin whip, and your choice of base mount. Threaded hex base warning whips are available in 3, 5, 6, 8, 10 or 12-foot lengths and your choice of a orange, green, or yellow flag.

All-Purpose 8' Amber LED Wrapped Lighted Warning Whip, w/ Orange Flag and Amber Light - FSLEDA8OYA

Checkers All-Purpose LED-Wrapped Waterproof Warning Whips™ with stainless steel components sets the new standard for weather resistance in any working conditions. With multiple patent-pending features, these whips are ideal for extreme weather conditions such as coastal areas, corrosive environments, salt mines, and areas with high humidity.

5ft Super Whip Lighted Warning Whip with White LED and 12" Orange Flag with Yellow Reflective X - SW5W

Super Whips heavy-duty lighted warning whips with stainless steel threaded mounting base are designed without a lamp socket connection to eliminate failures often caused by socket corrosion. They include a sealed electrical connection with 18" pigtail, nylon-mesh flag, flexible fiberglass whip and an ultra heavy-duty spring, Day Bright™® fluorescent orange nylon mesh flag with yellow 3M®® Scotchlite®® reflective X, premium fiberglass resin whip, and these whips are wired with a high-quality power cable that is integrated directly into the whips, which eliminates potential breaks to the internal wires. They also include a polyolefin heat-shrink tubing to contain the fiberglass and prevent personal injury from fiberglass deterioration or fractures in the fiberglass whip. Super whips are engineered with a cold temperature rating of -75 C/-10° F.

Ground Protection

13'5" x 6'8" TuffTrak®XL Ultimate Heavy Duty Ground Protection Mat - TTXL

TuffTrak® XL is a heavy-duty composite mat built for mining's toughest jobs, offering unmatched strength, traction, and durability for haul trucks, rigs, and heavy equipment. Made from solid recycled UHMWPE, it's lighter to transport, resistant to punctures, and ideal for environmentally sensitive or rugged sites.

4' x 8' AlturnaMAT® Ground Protection Mat with Hand Holes, 120 Ton Capacity, Black - AM48HH8

AlturnaMAT® is a tough, flexible ground mat that supports up to 120 tons*, ideal for creating stable access over soft or uneven terrain. Lightweight and easy to deploy by hand, it's perfect for mining sites needing fast, durable surface protection without heavy equipment.

4' x 8' VersaMAT® Ground Protection Mat with Walking Tread, 95 Ton Load Capacity, Black - VM48

VersaMAT® offers tough ground protection with a pedestrian-friendly, slip-resistant surface and a 95-ton* load capacity for equipment. Lightweight, flexible, and made from recycled HDPE, it's ideal for mining sites needing safe access for both workers and vehicles on uneven terrain.

Setting the Bar Higher for Mining Safety

The mining industry is extremely high-hazard in both safety and health factors. There is a significant need for training, control, enforcement, monitoring, and safety equipment to make sure that the people working on mining projects can go home safely after each workday. The industry should continue to collaborate with governmental and industry organizations to share information, refine best practices, and build out better control strategies.

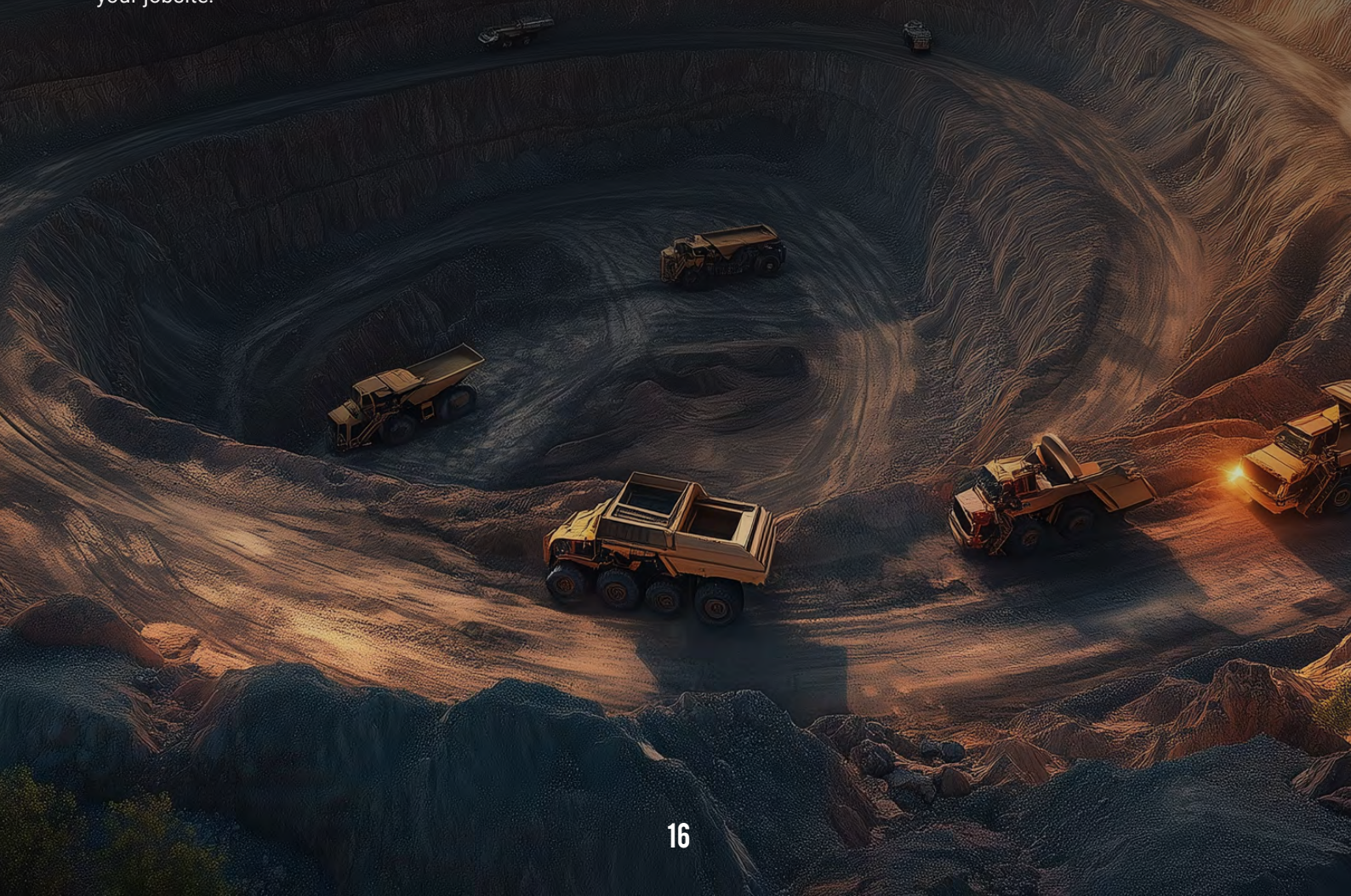
Taken as a whole, the history of mining safety has been a resounding success. Although many serious hazards still remain, mining is no longer the deadly operation it once was.

It's up to everyone involved – from supervisors and employers to regulators and legislators – to ensure that mining is done safely. We have come a long in reducing injuries and fatalities in the industry, but there is still much left to be done.

Safety Solutions You Can Trust

Checkers Safety offers proven, high-quality safety products designed to make your site safer and keep projects running smoothly.

Visit **checkers.justrite.com** to learn more, or get in touch with one of our safety experts to discuss the right solutions for your jobsite.



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