Under pressure: Innovation is key to safer mining tire service work

Autonomous systems, hydrogen fuel cells, electric and battery technologies—these are just some of the ways mining trucks are evolving, just as mines are expanding operations and more are opening. More new trucks meeting more demands—yet the advances in tooling and methodologies for servicing and maintaining mining tires have not kept pace and safety challenges are mounting.

From 2018 through 2023 alone, there were more than a dozen fatalities related to servicing mining tires. What can industry do to advance tire service innovation alongside truck innovation to protect tire technicians and meet the demands of modern mining operations?

As Kal Tire writes, collaborative research and development of tools, practices and systems are needed, and urgently, to reduce risk for those working closest to mining's biggest tires.

Servicing mining tires has always carried risk. The sheer weight and size of earthmover tires—combined with operating temperatures and pressures—means even basic tasks, such as inspections and rotations, are inherently dangerous.

Steps have been taken over the past 20 to 30 years to improve safety in tire service work. For example, through the introduction of tire pressure monitoring systems (TPMS), and tire technician competency requirements in countries such as Australia. But the risks are evolving quickly.

Today, rapid development in truck types and sizes, along with increased production targets mean that sites are pushing plant equipment and tire service tools to their operating limits. These factors, combined with a shortage of skilled workers, sees tire technicians working under increasing pressure, and the number of service-related safety incidents that occur regularly are evidence that more must be done to keep workers safe.

In an effort to make a 'step change' difference in tire service work, perhaps it is time to look at ways we can change the risks associated. If we challenge ourselves to look at eliminating risk, or consider changes to engineering controls, we can achieve that. Innovation – in the process, the tools, the equipment – may represent a way to make tire service work safer for everyone.

The risks of operating under pressure

Some of the most serious hazards that tire technicians face are associated with the energy that's stored within tires during operation. If the tire-hardware assembly is incorrectly installed, or the lock ring which secures the assembly fails, this can result in a catastrophic release of energy, separating the tire and its components into the trajectory zone where technicians could be located.

Tire fires and electrifications (vehicles hit by lightning, contacting power lines or run under incorrect conditions) pose another serious risk. Upon exposure to high heat, tires can undergo pyrolysis or decomposition of the rubber. This produces gases that increase the tire's internal pressure and could cause an explosion. These incidents can cause serious injuries or worker fatalities, and damage to nearby equipment.

Traditionally, identifying potentially unsafe conditions within a tire depends upon visual inspections by experienced technicians. Most signs of heat and pressure are invisible from the outside, so detection requires the technician to get close to the tire and use their eyes, ears, touch, even sense of smell, to determine whether a tire is safe to run.

The introduction of TPMS to mining in the early 2000s provided a critical safety breakthrough in this respect. With TPMS, sensors embedded in each tire provide remote real-time temperature and pressure readings to service teams. If tires become too hot, the system alerts drivers to stop and cool them, reducing the potential of fires and/or explosions.

However, TPMS technology can only read temperature and pressure inside the tire chamber – while some of the real hazards lie on the outside, as is the case in tread separations. There have been many documented cases of tire fires on mining vehicles that TMPS did not alert to. There is up to 18 cm of rubber from the tread to the inner lining, and with rubber being a great insulator, a fire can ignite before the temperate penetrates to the inner chamber.

As mines move toward autonomous equipment, how can inspections be performed safely and in a way that reduces technicians' exposure to trucks? In addition to TPMS, autonomous tire inspection technology has been developed to catch and react to critical issues early—all while keeping technicians at a safe distance. Without even needing to stop, the tires of passing trucks are scanned multiple times, revealing issues such as tread damage and hot spots, that are flagged, validated by a condition monitoring expert, and addressed when needed.

Tools to lighten heavy work
Other hazards relate to the size and weight of mining tires that stand up to 4-m tall and weigh up to 5-t each. Handling tires, along with associated rims and components, carries the risk of muscle and back strain, finger pinches and crushes.

Mechanization and advances in tooling have provided important safety improvements over the past 30 years. Noteworthy developments include tire handlers, lock ring support tools, tire preparation stands, automatic inflation/deflation units, ram drivers, bead breakers and jacking solutions.

However, many tire service tools/machines have changed little since their inception, and to be effective, they must be properly applied, inspected and maintained. Some machines, particularly large tire handlers, require training for safe use, and the level of rigor can vary from site to site.

The heavy hand tools used for certain service tasks, for instance, torque guns which can weigh up to 36-kilograms (80lbs), can also lead to cuts, bruises and strains.

The role of training and certification
Training and certification programs for tire technicians have also come a long way in recent years. In the past, technicians would learn on the job from people who did things their way, not necessarily the safest way. Potential bad habits were passed down, few procedures were available, and safety wasn't always a priority.

Today, in many regions, training is much more thorough and even standardized. In Australia, for example, tire technicians must be assessed as competent by a Registered Training Organization (RTO) or be under the direct supervision of someone who is. Demonstrating competency involves tasks such as removing and remounting different tire sizes. The Tire Industry Association also offers Earthmover Tire Service (ETS) training, including entry-level basic skills and safety learning and certification for experienced tire technicians. Some mining tire service companies also offer their own training and certification programs to ensure teams are competent to perform tasks safely and to the company's standard.

One way to guide consistency and with best practices across sites is with a dynamic Learning Management System that presents materials in multiple languages, pictorial safe work procedures, trainee tracking and continuous procedural updates.

Right now, the onus is with mining companies to ensure their service providers apply best practices. Going forward, global standardization in training, which would require industry and regulator collaboration, would go a long way toward improving safety standards across the sector.

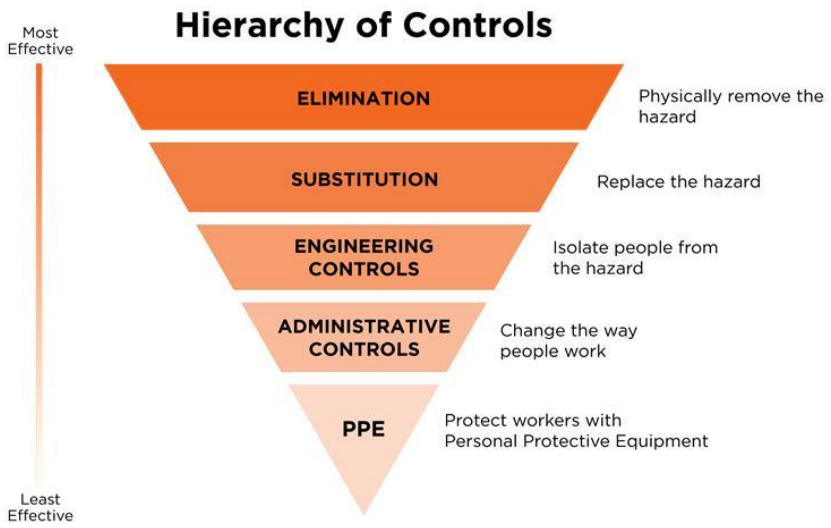
The work of tire technicians needs both standards of certification and greater recognition for its contribution. Today, while automotive mechanics require certification in some countries, it's assumed that mining tire technicians perform tasks that require a lower level of due diligence—but those in mining know that tire work is also complex and dangerous. Highly skilled and universally certified technicians could only help to protect technicians and everyone on site.

Throughout the industry and as part of training, there needs to be greater awareness of the risks of servicing mining tires—and the serious consequences that can occur when the right steps aren't taken, or the right tooling isn't used.

Beyond PPE: Focusing on the most effective controls

In mining, time is money, and for technicians who are under pressure to get machines back into service, there's often a potential conflict between doing a job quickly and doing it safely. While technologies, tools and training each have a part to play in keeping technicians safe, to be truly effective, they must be implemented and focused on in the manner of a hierarchy.

Dan Allan, Senior VP of Kal Tire's Mining Tire Group, explained: "Implementing high level controls tends to be more effective than those at the lower end of the control hierarchy. Frequently in mining, rules or personal protective equipment (PPE) are used for *mitigating* hazards, but these aren't enough. It's time to think about *eliminating* hazards through new processes, or using engineering controls, like innovative tooling, to guard against hazards more effectively."



Rather than just focusing on PPE, it's time to rethink our approach and look to eliminate risk, either through a different process or through innovation. While administrative controls and PPE will always be a key part of safe working, these are simple controls, and the onus is on technicians to apply them consistently. Meanwhile, the processes which underpin tire service work have not changed significantly in years. Reinventing work—rather than adding more rules and routines—is more challenging, but the results are likely to be more effective and permanent, and, thus, worthy of greater attention.

The need for collaborative tooling innovation

Allan believes that ongoing investment in innovation is critical to eliminating tire service hazards, rather than working around them. "That's why Kal Tire established its Innovation Center in 2015 – to get to the heart of the underlying issues to make our work around the wheel as safe as possible," he said.

One result of this investment is Kal Tire's GATR (Gravity Assist Tooling Rig) which was developed through feedback from the company's technicians. Anti-gravity tools like GATR ease the physical burden for technicians by supporting the weight of tools. "They're essential in reducing finger pinches, fatigue and strain when mounting OTR tires, especially ultra-class models," says Allan.

Kal Tire uses a web-based safety tracking system to record incidents, injuries and near misses for its global operations. This information informs the development of new safety solutions and helps quantify their effectiveness, such as reduced pinched fingers across all sites since adopting a new tool for the removal of spring locks, for example.

How data can be leveraged for a safer future

In the future, insights generated by tire data management systems could be used to optimize the planning and execution of tire service work against different business drivers, including safety, and to quantify the impact of these activities. For example, at a mine in British Columbia served by Kal Tire's Mining Tire Group, a trial was conducted focusing on automating tire pressure data collection from TPMS into TOMS, the company's Tire & Operations Management System. Trial insights showed a reduced inspection time, lowering technicians' exposure to tires by 40%.

Robotics and automation could also play an increasing role in safe practices. Automation is already commonplace in processes like retread production. Most manual work in buffing, building and grooving has been eliminated, and these risks could be mitigated further if robotics take over remaining tasks, like feeding rubber into extruders.

"As automated systems become more economical and feasible, there are so many opportunities to use automation in the tire service space to eliminate hazards and risk," says Allan. "The only limit to the applications of these automated systems is our own imagination."

Safety is a moving goal

In summary, prevailing pressures mean that safety-related challenges will continue to mount in mining tire service work.

For service tools, practices and systems to keep pace with the challenges posed by an increasingly dynamic industry, ongoing, targeted investments and collaborative research and development are required.

Allan added: "To achieve safer tire servicing, mining companies need to work closely with their teams, service providers, OEMS, training bodies and more. We'll get there faster and more effectively if we work together."