

SAFETY FOCUS



The newsletter of the Mines and Aggregates Safety and Health Association

Pressurized air lines

When most people think of air, they think of the air they breathe. They know it's safe but are unable to feel it or see it. However, do they know under certain conditions air can be deadly?

This condition is compressed air and in the mining and aggregate industry it is found stored in high-pressure air lines. If compressed air is improperly released it can cause serious damage or injury.

"Air is compressible and [the air line] becomes a pressure vessel," Marc Carriere, Global Mining Manager for Victaulic, said, comparing the eruption to a bomb.

For workers, the eruption of a high-pressure pipeline can cause injury or even death. Not only can this include tearing of the skin but it can also send foreign objects into the blood stream. Compressed air is also capable of blowing out an eye as well as causing deafness. In the worst case scenario, it can be so powerful that workers can be killed by its fierce and uncontrollable pressure.

According to Carriere, compressed air can also cause damage to equipment, which can

be costly for companies to replace. The equipment used to compress the air is expensive to purchase and is expensive for companies to operate. There can be a loss involved for air piping systems that aren't running at 100 per cent. Any small hole which leaks air can cost a company.

"1/16 of an inch of a hole on an air line is [around] \$800 per year," Carriere said. And the cost only increases as any holes enlarge or others develop.

According to Carriere one of the biggest forms of air loss is because of improperly installed couplings. He recommends a

pre-lubricated gasket which helps to protect against a pinched gasket and having air loss. Equipment should be TSSA approved and have a Canadian Registration Number (CRN) which complies with standards set out by Canadian Standards Association (CSA).

Because of the high cost and hazards associated with air leaks in the pipelines, it is important for companies to keep up with their maintenance. Although this can protect against future incidents, maintaining air lines can be dangerous if precautions are not taken.

One of most important ways workers can keep themselves safe is by making sure to use lock out procedures when doing work on high-pressure pipelines. Not locking and tagging out can lead to someone mistakenly opening one of the valves, Carriere informed.

The lines should also be released of any remaining energy. By thoroughly "bleeding the lines" remaining energy can be safely removed from the piping. Lines should also be checked to make sure there is no energy blocked



Victaulic valve lockout system. Equipment should be TSSA approved and have a Canadian Registration Number (CRN) which complies with standards set out by Canadian Standards Association (CSA). Picture courtesy of Victaulic.

Continued on page three

The truth about trailing cable safety

Trailing cables are often used for underground and surface operations as a way to get power to mobile equipment. The electricity carried through these cables is often used an alternative for fuel and just like fuel powered equipment, electric trailing cables and equipment need to be maintained and carefully used.

Trailing cables are built to handle the everyday wear and tear industry can throw at them and are meant to endure flexing, heat, water and even the dynamics of mine floors. Although they seem almost indestructible, trailing cables are not resistant to being run over or other extreme acts of abuse. When not properly looked

after, damages to the cables can be fatal.

To help prevent injuries and fatalities caused by electrical trailing cables, any time cables are first installed or even moved it is best to have a qualified person test them. Continuity and insulation tests will help to ensure that they are safe to use and can point out any interior or exterior damage such as defective wiring or nicks and small cuts in the insulation. Both types of damage can be dangerous and may not be easy to spot with the naked eye.

According to Richard Riach, All Mines Mobile Fleet Coordinator for Vale Inco Limited, when working alongside trailing

cables some of the biggest risks for workers are the potential for shocks when handling damaged cable, the quick movement and tension in the cable when it is spooling in and out of the cable reel and the physical weight of larger trailing cables when being installed or handled.

To protect workers from energy hazards associated with trailing cables there are many things that companies can do. According to Riach, Vale stress that any damage to cables should be immediately reported to the supervisor.

"After a blast, workers are to walk the distance of the cable before powering up," Riach said.

Continued on page three

It's electrifying



Photograph of a dump box after being in contact with an electrical wire.

One of the most “electrifying” hazards large trucks face are overhead power lines.

Mining and aggregate worksites need large equipment, like trucks and loaders, to get jobs done. When operating any type of motorized vehicles visibility can become an issue. With large, heavy duty trucks it can be difficult for drivers to see what is behind them. This lack of visibility can lead to equipment backing up or raising buckets and extensions into live electrical power lines.

Not knowing where power lines are located is one of the most common reasons for electrical incidents on work sites. When trucks raise their boxes they are extremely tall and there is often zero visibility of power lines. Even after a vehicle contacts a line it can be difficult for the driver to tell since in comparison to a heavy truck the power lines are extremely light. The driver may not be aware that the vehicle has become energized.

Overhead power lines are not insulated, making it dangerous when objects get too close or come into direct contact with them. Any conductive object that comes into contact with power lines can become energized. When electricity travels, it finds the best and easiest way to the ground. This could mean the trucks or sometimes the workers themselves become part of the current.

There are a few ways for workers to prevent contact with an overhead power line. According to the Electrical Safety Authority (ESA) website, the first thing workers should do is determine where the power lines are in the work area. After the location is determined, work needs to be relocated if there is a chance the equipment or workers could come into contact with the overhead power lines.

When relocation is not feasible, ESA suggests that workers need to find the safest distance to work from energized power lines by determining the voltage. When power lines have a high voltage the distance is going to be further away. Sometimes power lines can reach up to and beyond 150, 000 volts.

Mines and Mining Plants Regulation 854, Section 159, states when power lines reach 300 to 150, 000 volts workers should be at a three metres minimum distance. When the voltage reaches 150, 000 to 250, 000 workers need to be at least 4.5 metres away. For anything over 250, 000 volts, workers need to be a minimum of six metres away. According to Rick Banting, MASHA's electrical/mechanical specialist, MASHA

recommends a three metre clearance for any voltage between zero and 150, 000. Although the regulations state 300 volts, there is a risk of shock at lower voltages and mechanical damage to equipment or powerlines.

The final procedure the ESA recommends is that if relocation is not possible then the area needs to be marked for a “safe distance”. Only qualified workers should be performing any work near the power lines. There is also the option of having the lines de-energized by the electrical utility company in the area.

Job sites may require a person to guide an operator so the vehicle does not come into contact with overhead power lines. This person needs to be visible to the driver of the equipment. Section 105(1)(k) in the Mines and Mining Plants regulation 854 says that “where the motor vehicle is to be operated in reverse and the operator or another person may be endangered thereby, [the vehicle must] be operated only when another worker is stationed to direct and warn the operator of any hazard to himself or another person.” If equipment does come into contact with overhead power lines and becomes energized then workers should remain in the vehicle and use a radio or cell phone to call for help. If staying in the vehicle is not an option then workers should jump out of the vehicle without touching the vehicle and the ground at the same time. Once the worker has made it safely to the ground then he needs to shuffle his feet and keep both in constant contact with the ground.

When an incident like this occurs, the electricity may flow from the equipment through to the ground which causes a volting gradient creating a hazard known as Step Potential. By shuffling their feet, workers are helping to ensure that they are not the pathway for electricity. If they were to walk normally, they would face the possibility of a shock because the electricity would find its way through their body to an area with a less voltage.

Step Potential can also lead to injury or death for other workers in the vicinity of the “live” equipment. If there are other workers in the area at the time of the incident, they should stay away from anyone who may have been injured by the electricity. If the electrical current is flowing, it can be so strong that by moving in closer to the victim, they may be at risk for electrocution as well. The would-be rescuer is not only putting himself at risk but also making it more difficult for emergency workers. Instead, workers should immediately contact the utility company to turn off the power and wait until emergency personnel arrive.

Did you know?

A phenomenon called “tire pyrolysis” can occur when a rubber tired vehicle strikes a power line. In some cases the tire may conduct some electricity to the ground. The heat causes a change in the tire's composition. Tires have been known to catch fire or explode following a vehicle/power line contact. All vehicles which contact a power line should be quarantined for 48 hours. Emergency procedures should include an escape and/or rescue of an operator from a vehicle that has contacted an overhead power line.



About Safety Focus

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Pressurized air lines... Continued from page 1

within the piping. If there is, it can be extremely dangerous, as the blockage can release at any moment.

Any damaged or broken pipelines must be locked out and any air sources must be shut down before any work is done on the line(s).

Working directly on the lines is not the only risk. Carriers also recommended workers should use extra caution when using large machines near high pressure pipelines. Accidentally hitting the lines can cause them to be damaged or punctured.

To prevent air line incidents and injuries, companies should:

- Examine all high/low pressure systems. Identify airlines that are older or perhaps suspect. Prioritize and document a planned inspection. Ultrasonic thickness gauges determine the integrity of older vessels.
- Provide additional training for any employee who has to work with these systems. Workers should understand the hazards related to poor installations or the use of damaged parts.
- Instruct employees on the proper procedures related to routine and non-routine hazardous tasks regarding compressed air systems.
- Make sure that systems are properly marked off by signs or other means. Isolate or remove unused lines or equipment.
- Develop a process for evaluating installations, the integrity of existing systems, maintenance of valves, training and the supply and storage of parts and materials.
- Require standards for all purchases based on client needs.

True or False?

1. Tools used for electrical testing must meet safety requirements set out by the Canadian Standards Association (CSA).

True – The standards associated with electrical testing tools can be found at www.csa.ca

2. Untreated clothing worn underneath Personal Protective Equipment (PPE) will not cause additional injury to an arc flash victim.

False – Synthetic material like nylon, polyester and rayon that are not treated can burn and melt onto the skin and further injure the victim. Any clothing, even underclothing, worn in areas where there is a risk of arc flash should be flame resistant (FR).

3. The six steps to lock-out are: identify all energy sources, isolate or neutralize all sources, attach lockout devices and tags, verify zero energy state, complete work and remove locks and power up after everyone is clear.

True – The six steps can be found in MASHA's The Pocket Lockout, which describes each step and associated regulations. The Safety Focus also includes a poster identifying the six steps which you can put up at your worksite as a reminder for all employees.

4. Compressed air and electricity are the only form of "hidden energy."

False – There are many types of hidden energy. There is also mechanical, thermal, chemical, radiation and hydraulic.

The Truth about Trailing Cable Safety...

Continued from page 1

This is done to make sure that there is no damage to the cable caused by the blast. After checking, the workers are safe to power up their equipment.

However, if there is damage they must report it to their supervisor. A qualified person must then go underground to determine what kinds of repairs need to be done to the cable. This could include replacing the entire cable, shortening the cable or splicing the cable. Any damage, no matter how small, should be reported and properly repaired before further use.

Companies can also protect themselves against trailing cable incidents by designing their machines so that the electrical cabinets are identified as safe for access by mechanics or trades people. Riach said this is done at Vale by signs that indicate the cabinets contain no more than 24 volts. If the voltage is higher, cabinet identification is also required to inform workers that the apparatus is for qualified personnel only.

Also, informed Riach, an extensive lockout procedure needs to be in place so that workers do not accidentally touch a live cable. Whenever there is work being done to any type of electrical equipment or hanging/moving a trailing cable it is important to lock out. Doing so not only informs other workers that someone is working on the equipment but this procedure saves lives. Proper lockout will ensure that others do not accidentally start up the machine. Workers are also required to put a tag at the lockout point. Doing so will inform others exactly who is working on the machine as well as the

The Six Steps to Lock-Out

1. Identify all Energy Sources
2. Neutralize Energy Sources
3. Lock and Tag
4. Verify Zero Energy
5. Remove Isolation Devices
6. Start Up



Trailing cables are used throughout the industry even in surface operations.

date and reason for the lockout.

Another important aspect regarding trailing cables is the requirement for ground fault protection. When trailing cables are damaged, either internally or externally, ground fault protection can come into effect and automatically shut down the electrical current being sent through the cable.

So how is it possible for ground fault protection to tell if there is something wrong inside a cable? The current being sent through a cable to

a piece of equipment is measured. When there is damage to a trailing cable, some current may leak to the ground. Ground fault protection is able to detect when the amount of current being fed to the equipment is not the same as the amount of current returning to the source and is referred to as the current being unbalanced. As soon as any difference is detected the ground fault protection immediately shuts off the power. In addition to the ground fault protection, the grounding conductor in the trailing cable is continuously monitored to ensure it is intact. If the grounding of the machine becomes undone or open the power is shut off.

Ground fault protection and ground conductor monitoring not only protect the electrical mobile equipment but they can save lives. However, the system must be installed and maintained correctly. Good electrical maintenance programs include a periodic inspection and test of these protective devices by a competent person.

Legislation

Regulation 854, Mines and Mining Plants

Section 160 – Locking and Tagging

Section 164 – Ground Fault Protection on Mobile Equipment

Standard

Canadian Standards Association (CSA) M421-00 "Use of Electricity in Mine" Section 3.3.2 Portable Trailing Power Cables



Arc Flash, Personal Protective Equipment and CSA Z462-08

The Canadian Standards Association (CSA) has recently published the new standard Z462-08, which provides workplaces with the accepted best practices when dealing with the possibility of electrical shocks and burns while handling live equipment.

CSA is a federally based association which sets voluntary standards for each province and territory. It is up to the Canadian government or the provinces and territory's regulatory authority if a standard is adopted as law. In Ontario, for example, it is the responsibility of the Ministry of Labour (MOL) to decide if a standard is going to be included in the provincial regulations. The new standard Z462-08 is now considered good practice in Ontario and could possibly be referred to by the MOL during an inspection.

The new standard is based on the United States National Fire Protection Association 70E Standard and focuses on establishing an electrically safe work condition, safe working limits and appropriate personal protective equipment (PPE) for working on or near energized apparatus. Although Canada often referred to the American standard, CSA created a standard which reflects the different needs this country has.

"[Canadians] felt that there was a need for a standard to increase the level of protection for electrical workers and provide guidance for safe work practices," Rick Banting, MASHA's electrical/mechanical specialist, said. Banting, who is also a Technical Committee member for the new standard, said that he believes the well established American document was an excellent seed document that contained all the necessary elements and more but there was a strong desire to "Canadianize" the terminology.

The Canadian standard offers a different format and layout but there was a great effort to ensure the technical information such as approach boundaries remain the same between the two standards. The standard makes references to the American and other related Canadian standards. It uses Canadian units and terms, making it easier for Canadian workers to relate to and use.

Arc Flash and PPE

An arc flash is the result of an electrical fault in which the electrical current is formed in the air between two conductors or a conductor and ground. Arc flashes can lead to a fiery blast, form temperatures of 20,000C and can be four times hotter than the sun's surface. This explosion can occur in less than a second after the initial flash and is so powerful it can throw a person across a room and melt or ignite clothing. Anyone exposed could sustain third degree burns as well as potential fatal burns to lungs from breathing in the hot air and molten metals.

According to an article by CSA for Electrical Safety Measures Supplements magazine, the standard outlines specific safety measures such as the proximity of workers relative to different levels of electrical hazards. Z462-08 informs readers how to determine how far away a worker needs to be so that chances of burns are limited.

Z462-08 outlines to workers how they can protect themselves against arc flash by wearing the appropriate PPE.

Depending on the fault current capacity, the nature of the electrical apparatus, the task being performed and the proximity of the worker to the energy point all can result in the need for different levels of PPE. The standard outlines the need to calculate the short circuit energy in all areas where there is the possibility of arc flash. Z462-08 gives workers direction on when to wear and use PPE in relation to the short circuit current, fault clearing time and protection boundary.

What Companies Can Do

Companies can prepare for the new standard by learning more about it. They can appoint someone to introduce the standard's practices to other employees. Companies can also make sure that anyone who performs energized electrical work such as metering, measuring or testing should wear a minimum level of flame resistant (FR) clothing. This can include FR approved shirt, pants or overalls, a hardhat with an arc rated face shield, safety glasses, rubber soled work boots, electrical gloves as well as untreated cotton undergarments. Any potential hazard which workers may be exposed to must be determined by calculating the maximum available short current at various locations throughout the system.

Labeling of circuit breakers, switch boards, motor control centres and meter socket enclosures is an important step to complete and then maintain. Labels usually indicate whether arc flash hazards exists, the flash hazard boundary, the potential energy incident level in calories per centimeter squared, the level of PPE



Arc flash can produce a powerful blast and extreme temperatures. The new CSA standard Z462-08 tells companies how to prevent and protect against arc flash in the workplace.

*The photo above is taken from a security video, and depicts an arc flash at an electrical cabinet.
Photo Source: www.esps.ca*

required, nominal voltage, limited or restricted boundaries and the location or name of the gear or feeder.

In addition to implementing features of Z462-08 companies can evaluate their electrical safety program (ESP). According to another article posted in Electrical Safety Measures Supplements magazine, reviewing an ESP can ensure the proper essentials to maintaining a higher level of safety. The article also stated that electrical safety plans should include important elements such as engineering, equipment, maintenance, procedures, training and PPE. A good program will also help workers identify and assess different electrical hazards in the workplace. Education, experience and training determines who would be considered qualified to perform hazardous tasks.

Part of the ESP can be performing an arc flash analysis, determining safe arc flash boundaries, safe "live" work conditions, as well as performing diagnostics such as measuring voltage.

Working on live equipment should be a last resort and should only be done when absolutely necessary. It may require the preparation of a non-routine hazardous task procedure.

A copy of the standard is available through the Canadian Standards Association website, www.csa.ca.

Legislation

Ontario Regulation 854

- 62.1 (1) This section applies with respect to tasks at a workplace that are determined to be non-routine hazardous tasks jointly by the employer and the joint health and safety committee or the health and safety representative, if any, for the workplace. O. Reg. 60/94, s. 4.
- (2) The employer and the joint health and safety committee or the health and safety representative shall jointly establish safe procedures for performing a non-routine hazardous task. O. Reg. 60/94, s. 4.
- (3) The employer shall ensure that the safe procedures are set out in writing. O. Reg. 60/94, s. 4.
- (4) The employer shall ensure that workers are informed that a task is a non-routine hazardous task and are informed about the procedures for performing it before beginning the task. O. Reg. 60/94, s. 4.
- (5) A worker performing a non-routine hazardous task shall follow the established procedures. O. Reg. 60/94, s. 4.

