



Mining operations require the transport of vast amounts of water. Feeding water into a mine, the dewatering of groundwater out of it, and the recycling of used water all depend upon a network of reliable piping systems able to withstand mining's extreme environments, whether the mine is underground or on the surface. The importance of preventing water and other fluid filled pipes, as well as air-filled lines from freezing cannot be overstated. Water is involved at every stage in production: mining, downstream processing, and product conveyance. Large quantities of water are also used for cooling the cutting edges of machinery, heap leaching, dust suppression, general cleaning, fire sprinklers, and fresh drinking water. Air-filled lines are needed to supply critical power to pneumatic tools and mining equipment. The importance of preventing water and other fluid/liquid filled pipes, as well as air-filled lines from freezing cannot be overstated.

One burst or blocked pipe can bring an entire mining operation to a halt, resulting in punishing financial losses for stakeholders. In addition, lives can be put in jeopardy by the depressurizing of fire suppression systems, or by the flooding of tunnels. Another issue is the environment. Leaks of contaminated water containing heavy metals like

copper, lead and arsenic may spill into nearby waterways creating an ecological disaster. Besides water, most air-filled lines operating inside or outside a mine can freeze, even at temperatures as warm as +4 °C (+40 °F). As air pressure drops from 100 psi down to atmosphere, the compressed air, which is always at 100% humidity, super cools rapidly and can freeze up lines and seriously damage mining equipment.

In remote areas such as Alaska or Northwest Canada, pipes carrying water, slurry, tailings, chemicals, or other fluids/liquids can be subjected to dangerously cold temperatures. Unprotected pipes can easily freeze, expand, and then burst, no matter how strong the material they're made of. A freeze can also result in ice blockages in pipes that cripple production. The high cost of downtime stemming from a frozen or blocked pipe can be exacerbated by a lack of on-site replacement parts. Icy roads are often impassable in winter, leaving delivery of replacement parts limited to cargo planes or sea lifts. Logistics can become extremely complicated, as well as expensive, in remote arctic locations.

In this whitepaper we will address how an electric heat trace system provides mines with accurate process temperature maintenance and reliable freeze protection.

Emerson's Solution

With over 65 years of experience designing and delivering the most efficient and cost-effective systems available, Nelson™ Heat Trace Solutions by Emerson are installed on thousands of miles of water and other fluid filled pipes, all types of process maintenance equipment, hot water tanks, instrumentation, and many other applications around the globe.

The operating principle is simple; as temperatures drop, the cable's output automatically increases the flow of current to make up for heat lost to the atmosphere. Using Ohms' law, electricity is converted to heat energy by resistance. As ambient temperature increases, the current is reduced to provide less heat making the heat trace circuits more energy efficient. Electricity costs are minimal because our Nelson self-regulating cables and temperature controls apply heat only where and when it is needed.

Nelson heater cables, connection kits, and controllers offer unique cost-saving advantages, such as ease of installation and handling, field cut-to-length capabilities, low maintenance, energy efficiency, superior strength, and excellent electrical characteristics over long distances. Our customers are supported worldwide by Emerson's dedicated staff of Nelson engineering and technical professionals. Through a comprehensive network of global brands, including Appleton™ and SolaHD™, Emerson offers mining and mineral processors single source responsibility for keeping their operations running smoothly and profitably.

Protecting Pipes

Pipes installed in mining operations are made of materials appropriate to the duty required and are hung by chains from brackets typically attached to roof bolts. Steel pipes have long been the industry standard. However, lightweight, corrosion-resistant, and lower cost plastic pipes, such as PE (polyethylene) and HDPE (high-density polyethylene), are increasingly being deployed.

Along with the threats posed by harsh weather conditions, pipes installed in mines must withstand high external loads and surges in pressure, exposure to corrosive chemicals and abrasive slurries, steam purging, caustic acids, and accidental damage by moving equipment — all of which can weaken the pipe structure, making it more susceptible to bursting during freezing conditions. Hairline cracks could develop, causing leakage, and eventually breakage.



Emerson's Solution

Nelson Heat Trace Solutions by Emerson are the safe, reliable, field-proven solution for metallic and nonmetallic pipes, as well as valves and pumps. Rugged to withstand demanding mining environments, our Nelson self-regulating heater cables feature two jackets for extra dielectric strength, moisture resistance, and protection from impact and abrasion damage. The inner thermoplastic jacket is extruded over and bonded to the core material. A thermoplastic elastomer outer jacket is then extruded over the inner jacket. An optional overjacket of fluoropolymer or modified polyolefin can be specified when the heater cable is to be installed in wet or corrosive environments such as mines or mineral processing plants. Although built to industrial standards, the cables are also exceptionally lightweight, flexible and can be cut to length in the field to reduce installation cost. Our Nelson heater cables are tested and certified to ensure they operate effectively even in the harshest of environments.

Explosion Risks

Statistics from the Mine Safety and Health Administration (MSHA) indicate that mine explosions occur most often during colder months because of low barometric pressure and low humidity. ① In cold weather, coal dust can be dangerously suspended in dry cold atmospheres, increasing the hazard of explosion. Low barometric pressures help methane spread easily into active areas, further heightening the risk of explosion. Nonrated (non-certified) heat tracing cables can cause several kinds of hazards in mining operations. Any electrical device, even the on/off switching of heater cables can cause an arc flash. When this occurs in a classified (hazardous) area containing explosive dusts, gases, and/or vapors a powerful explosion can occur creating an arc blast. A low quality, malfunctioning heat tracing cable can even generate enough heat to set off an explosion in such a location.

Heater cables utilized in mining operations must be certified for the hazardous location where they are installed – period. It is extremely dangerous to trust the future of a mine and the lives of its employees to off brand heater cables that may or may not be engineered to the certifications they claim to carry.

Emerson's Solution

Nelson Heat Trace Solutions by Emerson meet the needs of the mining industry with heat trace cables, mechanical thermostats, and accessories with hazardous location certifications (NEC, ATEX, and/or IECEx) and the strength to provide that protection in ambient temperatures as low as -40 °C (-40 °F). Parallel bus wires apply voltage along the entire length of our Nelson heater cables. They derive their self-regulating characteristic from the inherent properties of the conductive core material. As the core material temperature increases, the number of conductive paths in the core material increases or decreases, it automatically adjusts the heat output. This occurs at every point along the length of the cable, adjusting the power output to the varying conditions along the pipe. The self-regulating effect allows the cable to be overlapped without creating hot spots or burnout. Because it is only producing heat when and where it is needed, it also limits the maximum sheath temperature and ensure the most efficient use of electrical power.

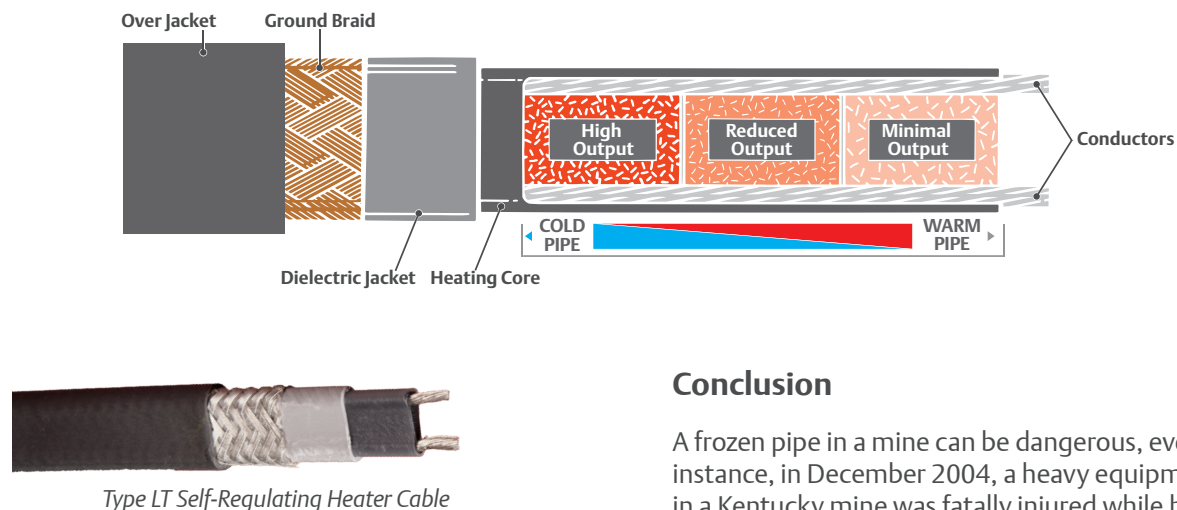
Long Distance Applications

Mining requires long pipelines and consequently, equally long heat tracing applications for freeze protection, viscosity control, and/or temperature maintenance. Many variables must be taken into consideration to achieve the most reliable solution for the targeted distance. These factors include cable type (self-regulating or constant wattage), supply voltage, minimum temperature at start-up, circuit breaker amperage, pipe diameter, and wire gauge, among many others. In determining heating cable length, the pipe length must be added to the junction box entry and end seal, the number of flanges, and the size and number of valves. Measuring from a few hundred yards to several miles, long distance systems typically require custom engineering.

Emerson's Solution

At Emerson, we are committed to finding the most cost-effective solution to your heat trace requirements, regardless of size or scope. Trained on the specialized requirements, our Nelson application and engineering team can design systems utilizing all major product technologies — self-regulating, parallel constant-wattage and series resistance heating products. Our expertise goes beyond just heat tracing; we can help you incorporate all your needs into a fully integrated package. From simple material selection to complete facility surveys, we can provide exactly the level of service your mining operation needs and demands. If you prefer to design your own long-distance system, the Nelson Design Suite is our web-based software tool for designing pipe and tank heating systems using an array of cable types and heating methods simplify your efforts.

Operating Principle of Self-Regulating Heater Cables



Fire Suppression in Mines

Ice blockage hinders the suppression abilities of a fire sprinkler system and can break pipes altogether. Frozen sprinkler pipes are dangerous in a commercial building, of course, but can amount to even a greater risk in a mining operation. In the event of an underground mine fire, it is critical to extinguish the fire in its early stages. Any delay in initiating firefighting activities can result in an uncontrolled fire. Unfortunately, just as sprinkler pipes can freeze, so can the mine's underground fire hydrants, fire hoses and surface water storage tanks – and should utilize freeze protection.

Often a sprinkler pipe doesn't freeze completely. Instead, the water will freeze, thaw, and freeze again when exposed to low temperatures. This phenomenon applies added stress to the pipe. Even if a pipe thaws out after a freezing event and appears stable, its integrity is compromised. Hairline cracks can be subtle and difficult to locate until too late.

Emerson's Solution

Nelson Heat Trace Self-Regulating Heater Cables by Emerson are listed and certified for freeze protection to ensure reliable fire suppression in unheated industrial facilities. Our Nelson Type CLT and LT Series heater cable contribute to improved fire safety since sprinkler systems can respond immediately without the need for antifreeze chemicals. These cut-to-length cables can be used in wet or dry environments. The LT Series is also approved for hazardous locations when used with appropriate Nelson connection kits.

Conclusion

A frozen pipe in a mine can be dangerous, even deadly. For instance, in December 2004, a heavy equipment operator in a Kentucky mine was fatally injured while he was trying to dislodge frozen slurry from a slurry pipeline that had iced over ②. More common is frozen water in pipes that lead to crippling issues ranging from improper functioning of equipment and premature parts failure, all the way to more costly damage caused by freeze-and-thaw issues or thermal shock. The implementation of an electric heat trace system helps maintain efficient system performance by providing mines with accurate process temperature maintenance and reliable freeze protection.



CM-1 Microprocessor Based Heater Cable Monitoring System



Emerson's Solution

Emerson's Nelson Heat Trace brand offers a broad range of heat trace cables, controls, monitors, and accessories to prevent water, compressed air, slurry, and other liquids from freezing in pipes and lines in the most demanding environments of your mining operation – protecting your property, people, and profits. Emerson's application and engineering team will optimize the most efficient, reliable, and cost-effective heat trace system possible based on your facilities individual requirements, including the design of custom solutions for extreme weather. Emerson, adding value at every step in mining and mineral processing. Learn more at www.nelsonheaters.com.

About Nelson

Nelson heat trace products and systems utilize the latest design philosophies and innovative technology to provide the highest level of efficiency and reliability for industrial pipelines. With the broadest range of heating cables, controls, monitors and accessories, along with the world's most advanced heat trace management software, the Nelson brand is known for ensuring optimum control and cost-efficient operation of pipelines in the most severe climates around the world.

About Emerson

Emerson (NYSE: EMR), headquartered in St. Louis, Missouri (USA), is a global technology and engineering company providing innovative solutions for customers in industrial, commercial and residential markets. Our Automation Solutions business helps process, hybrid and discrete manufacturers maximize production, protect personnel and the environment while optimizing their energy and operating costs. Our Commercial & Residential Solutions business helps ensure human comfort and health, protect food quality and safety, advance energy efficiency and create sustainable infrastructure.

Footnotes

1. Water scarcity: Addressing the growing lack of available water to meet children's needs, United Nations International Children's Emergency Fund (UNICEF), 2020
2. Coal Mine Safety and Health: Report of Investigation, United States Department of Labor, Mine Safety and Health Administration, December 28, 2002

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