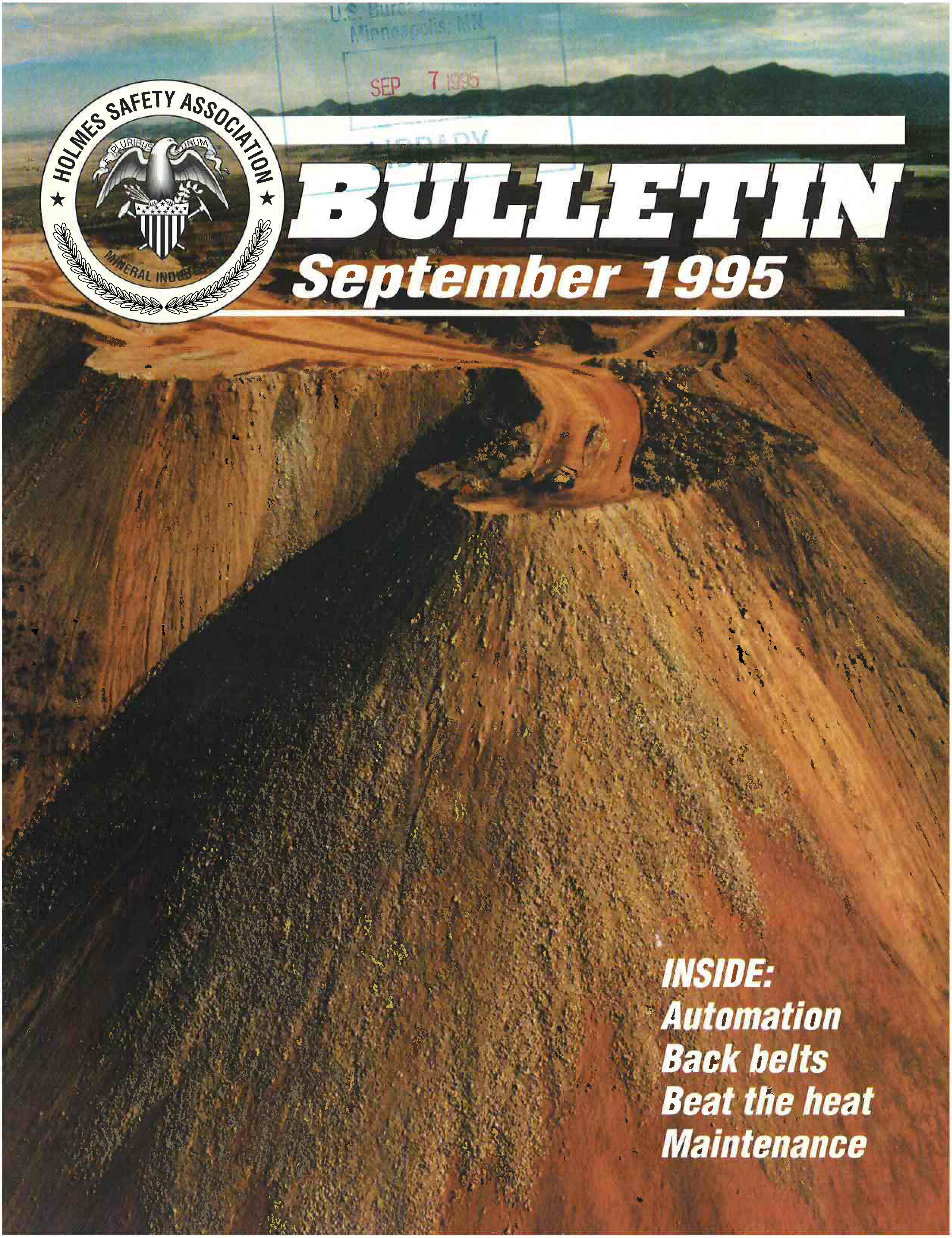
HOLMES SAFETY ASSOCIATION

BULLETIN

September 1995



INSIDE:
Automation
Back belts
Beat the heat
Maintenance

Joseph A. Holmes Safety Association Awards Criteria

Type "A" Award – For Acts of Heroism
The award is a medal with a Medal of Honor Certificate.

Type "A" Award – For Acts of Heroic Assistance
The award is a Certificate of Honor.

Type B-1 Award – For Individual Workers
(40 years continuous work experience without injury that resulted in lost workdays)
The award is a Certificate of Honor, a Gold Pin, and a Gold Decal.

Type B-2 Award – For Individual Officials
(For record of the group working under their supervision)
The award is a Certificate of Honor.

Type C Award – For Safety Records
(For all segments of the mineral extractive industries meeting adopted criteria)
The award is a Certificate of Honor.

Other Awards – For Individual Workers
(For 10, 20, or 30 years without injury resulting in lost workdays)
The awards are 30 years - Silver Pin and Decal, 20 years - Bronze Pin and Decal, 10 years - Decal bearing insignia.

Special Award – For Small Operators
(Mine operators with 25 employees or less with outstanding safety records)
The award is a Certificate of Honor.

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The *Holmes Safety Association Bulletin* contains safety articles on a variety of subjects: fatal accident abstracts, studies, posters, and other health and safety-related topics. This information is provided free of charge and is designed to assist in presentations to groups of mine and plant workers during on-the-job safety meetings.

PLEASE NOTE: The views and conclusions expressed in *Bulletin* articles are those of the authors and should not be interpreted as representing official policy or, in the case of a product, represent endorsement of the Mine Safety and Health Administration.

KEEP US IN CIRCULATION—PASS US ALONG

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Automation and safety of mobile mining equipment

By: Christopher M. Keran and Paul A. Hendricks; Keran is a research psychologist and Hendricks is an electrical engineer with the U.S. Bureau of Mines, Minneapolis, MN

More and more mines are automating certain areas of their operations. Although the influence of automation has touched virtually every aspect of the mine from ventilation and crushing to rescue and communications, the area that has received the most attention is mobile mining equipment in general, and haulage in particular.

The introduction of increasingly sophisticated equipment into a mine should help lower production costs and thus increase its ability to compete. Often this increased sophistication will be in the form of automating mobile equipment. Automation of mobile equipment can take several forms: line-of-sight remote control, teleoperation, and semi-autonomous (supervisory) control.

The implementation of automation, however, necessitates answering a host of safety questions that are both general to automated mobile equipment and specific to mining. As automation is implemented, the number of hazards that workers are exposed to gen erally decreases; however, the hazards that remain are typically rare yet catastrophic. For instance, removing a Load-Haul-Dump (LHD) operator from the machine removes the hazards that can occur to that operator (roof falls, collisions, jarring, etc.), but the hazards that the now-automated equipment is responsible for remain, such as striking another vehicle or mine worker.

A major thrust to automate mining has been underway in Canada during the past decade. The Canadian Center for Automation and Robotics in Mining (CCARM) was established in 1987 by the Mining Association of Canada (MAC) and the National Advisory Committee on Mining Automation (NACMA). CCARM has devoted its research efforts, in collaboration with industry, to studies of drill monitoring and control, digging and loading monitoring and control, blast fragmentation monitoring and

Photo courtesy of Gary Jessey of Acquire's **COAL TODAY**

Photo courtesy of Gary Jessey of Acquire's COAL TODAY

Minimucker, a small, six-wheel drive, skid-steered LHD developed by Foster-Miller Inc., Waltham, Mass., under contract with the Bureau of Mines. This prototype has a slide bucket to load muck onto the loading deck and push it out through the tailgate at the rear of the machine. Designed to be used in narrow-vein mines, the design allows tramming between an ore pass and a muckpile without turning around. The current prototype is operated using a radio remote control manufactured by Blackbox Controls Ltd.

optimization, communications, automated vehicle guidance, and rock breaker automation. Inco Ltd. created a research organization to bring new technology into hardrock underground mines. Inco's North Mine in Copper Cliff, Ontario, serves as a testbed. Examples of projects include: remote controlled roof bolting; automated down-the-hole drill rig monitoring and control; LHD vehicle monitoring; automated truck haulage; and underground mine-wide communications.

Noranda Minerals performs research involving remote vision on LHD units, ore trains, and other applications; automated loading functions of LHDs; underground vehicle guidance systems; remote cavity surveying; underground mine-wide communications; and continuous mining equipment. [See SOCCo's new remote controlled roof bolter on page 10 and the Noranda system on page 12 in this issue]

Advances in mobile haulage

Three levels of control sophistication for remotely controlled and automated mobile haulage equipment are currently in use or under development: line-of-sight, teleoperated and semi-autonomous. While these types of controls are discussed independently, in reality a particular system will often have overlapping levels.

Line-of-Sight Remote Control entails outfitting the operator with a portable unit that controls all or some of the operations of the vehicle. The operator is located at a safe distance from the vehicle yet close enough to view the operation. As in manual operation, operation by remote-control requires continuous human control of the machine. There are numerous implementations of remote-controlled LHDs in underground mines. Generally, LHDs are retrofitted with aftermarket remote control units. Companies that manufacture remote controls for LHDs include Black Box, Cattron, Moog, and Nautilus, among others.

Another implementation of line-of-sight remote control is the Minimucker, a small, six-wheel drive, skid-steered LHD developed by Foster-Miller Inc., Waltham, Mass., under contract with the Bureau of Mines. This prototype has a slide bucket to load muck onto the loading deck and push it out through the tailgate at the rear of the machine. Designed to be used in narrow-vein mines, the design allows tramming between an ore pass and a muckpile without turning around. The current prototype is operated using a radio remote control manufactured by Blackbox Controls Ltd.

Transmittable commands include motor on and off, open and close tailgate, raise and lower bucket, set and release brakes, learn-and-repeat, and tram forward, reverse, left, or right. These commands are issued by using the joysticks and switches located on the remote-control harness. This machine also incorporates an automatic guidance system, using ultrasonic ranging sensors to determine the distance from the rib on each side of the machine. The outputs from these sensors are fed into a guidance algorithm which prevents the machine from coming in contact with the rib. With this system, the operator is relieved of steering duties while tramming.

Teleoperated Control is a type of remote control in which the operator is provided with task feedback that allows control of the vehicle without having to directly observe its operation. The most

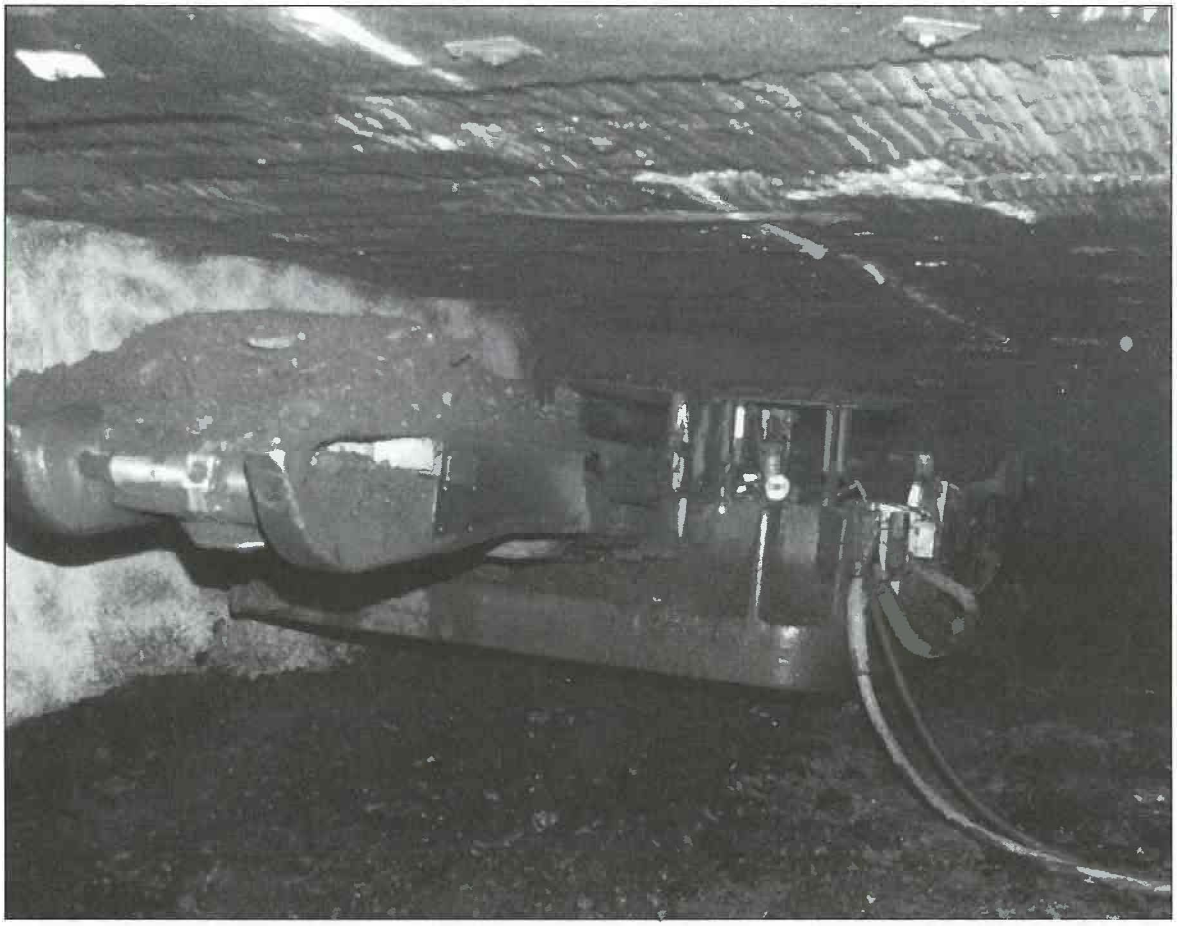

Photo courtesy of Gary Jessey of Acquire's COAL TODAY

common type of feedback presented is visual, although other modes of feedback (sound and force, for example) can also be provided. The operator is outfitted with a control unit, either portable or stationary, that is used to control all or some of the operations of the vehicle. Teleoperation, like manual control, requires continuous human control of the machine.

A teleoperated LHD, designed and manufactured by Nautilus, was tested at Inco's Birchtree mine. The LHD can be controlled either by line-of-sight or by remote video using a portable control station from Nautilus called the Powercam system. The battery-powered Powercam unit includes all of the controls and engine monitoring gauges necessary to fully operate the LHD from startup to shut-down. A 6-in., high-resolution color monitor, mounted in the Powercam unit, provides the operator view from the front or rear of the LHD, engine monitoring readings, and visual feedback of any function currently being activated (e.g. "Throttle 68%").

The LHD is outfitted with four cameras, two each at the front and rear, that can be remotely panned and tilted. Both pairs include a wide-angle lens, a zoom lens and a light for illumination. The operator can select the camera suitable for each task. The Nautilus system includes a laser tracking system which provides guidance and collision avoidance while the vehicle is automatically tramming. The LHD can also be outfitted with a hydraulic manipulator arm that could be used for miscellaneous tasks such as digging out a buried cable, attaching a towing cable to a disabled vehicle, or placing explosive charges. While still in prototype stage, this "Robot Arm" will be controlled by the Powercam unit.

A remotely controlled mine rescue vehicle has been developed for the coal industry by government, educational institutions and private industry in Australia. "Numbat," an eight-wheeled vehicle, collects information via a fiber-optic trailing cable about the atmosphere and physical conditions in the mine to help guide rescue efforts in case of accidents. The driver, situated above ground, can control Numbat using either video or radar-like acoustic images, and can monitor five mine gases—CO, CH_4, CO_2, O_2, and H_2—as well as airflow velocity and temperature in the mine. On-board microphones and loud speakers allow rescuers to communicate with trapped miners.

In 1987, a major program was launched by the Bureau of Mines to develop technology for a computer-assisted continuous miner for coal. To date, researchers have made significant progress in machine control, navigation, and coal-rock interface detection. A Joy 14CM was modified to serve as a research platform. Sensors were installed to provide information on the position of machine appendages, such as the cutting head, and an on-board computer network was assembled and programmed to provide control of the machine movements. A control room houses monitors for video display from machine-mounted cameras, computers and experimental controls.

Photo courtesy of Gary Jessey of Acquire's COAL TODAY

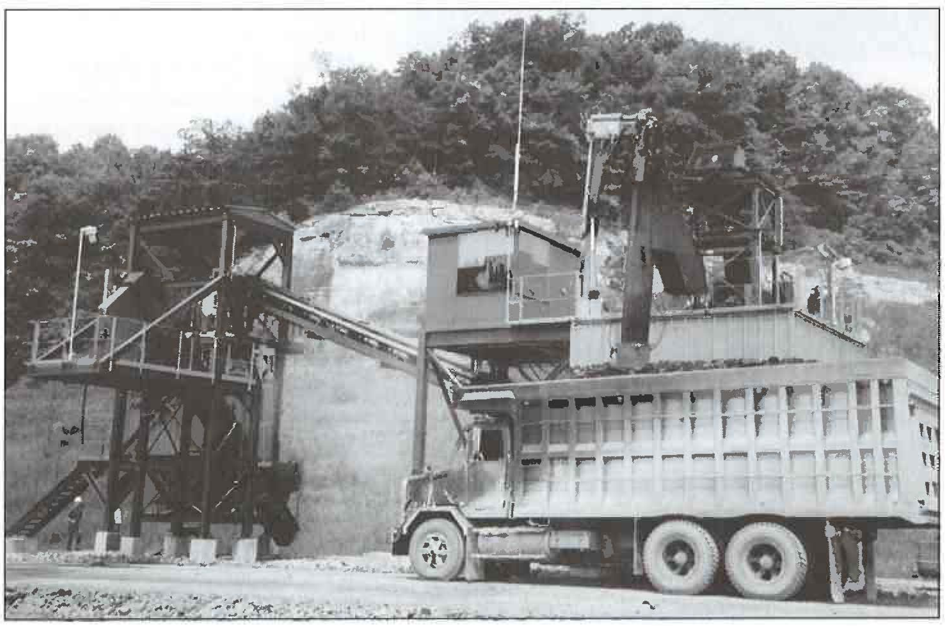

Photo courtesy of Gary Jessey of Acquire's COAL TODAY

Accurate knowledge of position and heading of the continuous miner is required so that machine movements can be planned and intelligent control of the miner can be achieved. Three navigation systems have been investigated: a laser scanning system (based on triangulation), a mechanical position and heading system (using line cord transducers), and a modular azimuth and positioning system (employing ring laser gyroscopes). Keeping the cutting head of a continuous miner within the desired boundaries of a coal seam, regardless of the geology encountered, is critical. The effectiveness of coal interface detection is dependent on measurable differences in some property of the coal and host rock. To detect these differences, several different concepts are being studied: natural gamma radiation, infrared thermography, vibration, spatial domain radar, motor currents, X-ray fluorescence, and electron spin resonance. This system, tested underground from January 1991 to January 1993, was the first successful implementation of an underground tele-operated and computer-controlled continuous miner for the extraction of coal.

Additionally, the Bureau has modified a remotely controlled fire-fighting vehicle, acquired from the U.S. Navy, to test the concept of remotely extinguishing underground mine fires. This vehicle is equipped with a video camera and a water hose that are both remotely operated from a portable control station tethered to the vehicle by a trailing cable.

Photo courtesy of Gary Jessey of Acquire's COAL TODAY

A teleoperated excavator under design by two Canadian companies, International Submarine Engineering Ltd. (ISE) and Finning Ltd., is intended for use in environments hazardous to machine operators (for example, near unsafe highwalls, uranium mining, or unstable ground). The excavator will be converted from diesel to electric and will use a trailing electrical cable to transmit power, control signals, and video to the control station.

Three color cameras will be mounted on the excavator. The primary camera will be located in the cab and will monitor the boom and bucket functions. A second camera, mounted on the side of the excavator, will provide another perspective of the operation. The third camera will be located on the rear of the cab and monitors the winch and trailing cable. The stationary operator console consists of two 9-in. color video monitors mounted above a single 13-in. color video monitor. The larger monitor will carry the primary operating display (signal from primary camera) while the smaller monitors will display the output from the second forwardlooking camera and the rear camera. Joysticks will control steering, stick/swing, boom/bucket and camera pan, tilt, focus, and autoheading slewing inputs. Two travel pedals on the console floor correspond to the pedals on the actual excavator. Part of the design will include "teach playback," which is a means to add automation to the excavator movements, such as loading. Teaching involves performing a task once, with the instructions from the operator being stored into memory. The system may then perform this task, or a very similar task, again with minimal aid from the operator. The system can account for the fact that each successive loading pass requires a slightly different trajectory.

Semi-Autonomous (Supervisory) Control allows several of the various operational steps taken by a machine to complete its objective to be accomplished without operator intervention. The operator, however, is generally not totally eliminated from the machine operating sequence. For example, an operator loads an LHD by remote control, then the vehicle is trammed automatically.

In 1971 an automatic 6-st track was developed by Saab-Scania for underground use in the Rudtjebacken mine in Sweden. The truck was guided along a control cable (centrally located in the roadway) by forming an error signal that is proportional to the displacement between the center of the track and the cable. If this signal grew too large the truck would apply its brakes and operator intervention would be required to restart the system. Receivers mounted on the front and rear of the truck allowed tramming in forward or reverse. The speed of the truck was controlled by vehicle detectors located along the path which sent a signal to a central control unit, which in turn sent a command signal to the truck.

Safety concerns required access to the area of operation to be strictly controlled. Upon entering the area a person passed through a gate. When this gate was opened the truck automatically shut down. Between August 1971 and November 1972, the automatic truck transported approximately 20K metric tons (mt) of ore over a distance of 450-950 ft.

In 1974, Unit Rig in conjunction with Saab-Scania developed an automated control system for use with large surface haul trucks. Although currently not in use, the Automatic Truck Control (ATC) was designed to provide automatic control of all the vehicle functions normally accomplished by the operator. Vehicle guidance was provided via buried guidewire. A central controller provided predetermined signals to the onboard equipment for speed control, steering and auxiliary functions. This central controller also maintained vehicle spacing, system status, and provided truck location to a central display. If the ATC was used in operations which required flexibility, the trucks were then operated by either radio remote control or manually at the load and dump sites. The ATC equipment monitored oil pressure, water temperature, tire pressure, and other truck functions. The loss of valid commands or guidance signal initiated a fail-safe stop.

More recently, Komatsu has also developed an automated surface haulage truck. Guidance for the truck is provided through a combination of teach/playback and dead-reckoning utilizing position updates for tramming and radio remote control at loading and dumping areas. The vehicle is also equipped with obstacle-detection devices.

A 70-mt automatic haulage truck is successfully being used underground to haul 3,000 metric tons/day run-of-mine ore to crushing facilities at Inco's Little Stobie Mine. This system, in operation since May 1991, uses an overhead electric trolley system for power distribution to the vehicle and for steering. The vehicle can travel at 9 mi/hr; guidance is performed by reading deviation of the vehicle from the overhead trolley "T" beam using two angular transducers. The truck is operated from a control room that is also located underground. The control station consists of two data displays, two video monitors and push-button panels. Video cameras are situated such that the operator always has a view of the vehicle. Reported benefits of using this system include high capacity, high productivity, low cost and improved safety.

Another type of autonomous implementation of an underground truck is a laser-based system called "Opti-Trak," developed by Mintronics Systems Corp. The truck is equipped with front- and rear-mounted lasers which scan a reference strip mounted on the drift back and ribs. The vehicle follows this reference strip and, based on reflective bar codes mounted beside the reference strip, initiates certain functions (i.e., dump cycle, brake check, speed and directional change).

Safety and maintenance features include collision avoidance, automatic fire suppression, and machine health monitoring. Personnel and other vehicles are provided with transponders that send a stop signal to the truck when it comes within 50 ft of the transponder. When the transponder leaves the path, the vehicle sounds a warning horn and resumes operation. The Opti-Trak system continually monitors several parameters to judge the state of the machine's health. A shutdown occurs if any parameter exceeds a preset level.

These systems are only a sample of the equipment currently in use or under development. There are also efforts to automate underground rail haulage. Currently, there are over a half-dozen automated rail systems in operation around the world. Other automated systems include LHDs, developed in Sweden, capable of automatic tramming and dumping that are guided either optically or by buried cable and are currently in operation at the Zinkgruvan and Kiruna mines, respectively. Noranda Research Center, in cooperation with the Canadian Center for Automation and Robotics in Mining, is also developing an optically guided LHD.

Safety of automated vehicles

Automation provides its own unique safety concerns, including collision avoidance/personnel-proximity detection; vehicle health monitoring and fail/safe shutdown; and fire detection and suppression. As vehicle health monitoring and automatic fire detection and suppression have been sufficiently addressed elsewhere, this article focuses on advances in collision avoidance/personnel-proximity detection.

By searching the MSHA Accident data base, we determined that the number of mining accidents involving remote-control technology increased from 4 in 1983 to 53 in 1991. This does not imply that the technology is becoming more hazardous, but rather more of these systems are being used. Being struck by a moving machine accounted for 20% of these accidents.

In order to avoid collisions between automated vehicles and personnel, the vehicle must be able to detect personnel in its area of operation, or, access to the area of operation must be restricted. With the exception of Mintronic's Opti-Trak, all of the above systems require restricted access to the area of operation. While this is often an effective method of protecting personnel, it is not always practical. The automated system must also have a means of detecting obstacles, such as haulage spillage, and a means of collision avoidance.

The Bureau is currently developing a personnel-proximity detector for use with a continuous miner that will automatically shut down the machine when a person enters the protected area. The device consists of a transmitter installed on the continuous miner and a small receiver carried by the miner. By varying the signal strength and transmitter loop antennae configuration the protective area's shape and size can be modified. There is a need for a low-cost personnel detection and collision avoidance system to be utilized with underground haulage vehicles. The Bureau has initiated a project to develop systems to warn pedestrians of approaching vehicles and vehicle operators of the proximity of persons or of collision hazards.

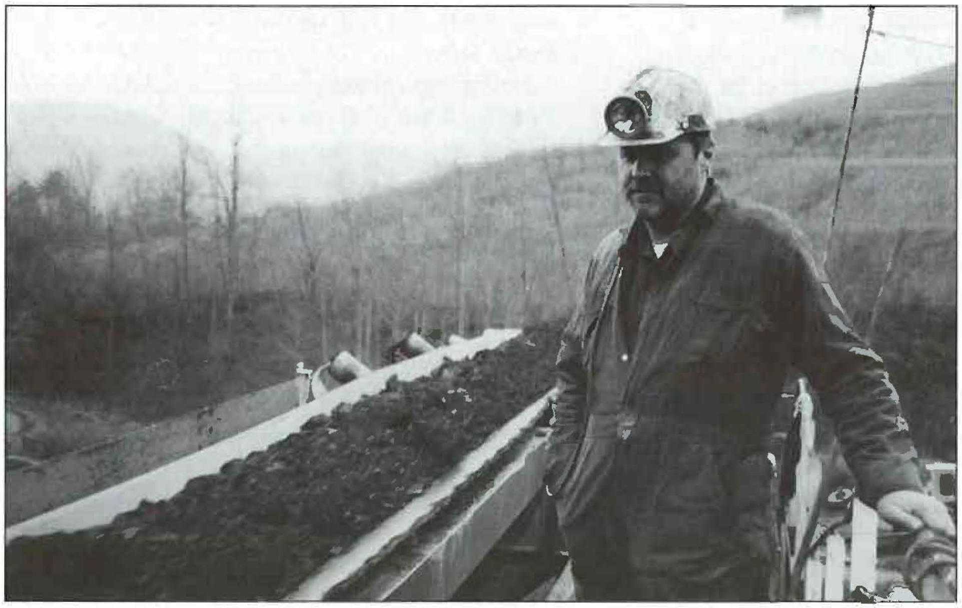

Photo courtesy of Gary Jessey of Acquire's ***COAL TODAY***

The Bureau also is conducting efforts to reduce surface haulage hazards. Included in these efforts is the development of technologies capable of monitoring the position of powered haulage equipment in relation to potential hazards such as dropoffs, dump points, roadway edges, and other equipment. The technologies include global positioning systems, radar, and microwave triangulation.

Two companies, Cegelec Project and Tokimec, have developed personnel detection systems. These systems were originally intended for use in surface mining or construction but may be applicable to underground mining. Cegelec's ReMINDER is capable of detecting personnel within a 50-ft radius. The system warns both the equipment operator and the unwary worker who has wandered too close. Personnel would be equipped with a UHF transmitter/LF receiver about the size of a pack of cigarettes. The mobile equipment, in contrast, has a LF transmitter/UHF receiver. When either receiver picks up the signal from the appropriate transmitter, it sounds an alarm. As the person moves closer to the vehicle the alarm intensity increases.

Tokimec has developed a similar system, although based on a different sensor. Its system, the ALS-100, is capable of warning both the equipment operator and personnel of a dangerous situation. The ALS-100 is also capable of detecting obstructions which pose a collision risk. The ALS-100 features an interactive transponder system. Personnel wear vests equipped with these transponders. The vehicle's ultrasonic detection system then determines the presence of a transponder and subsequently signals an alarm.

A major difference between the two systems is the zone of protection. The Cegelec ReMINDER has a circular protection zone with a radius of 50 ft. The ALS-100's protection zone is a conical area in front and back of the vehicle extending to 33 ft.

Emerging technologies

As advances in automated technology occur in other industries, the mining industry may benefit. Two promising areas of research are the *Semi-Autonomous Surrogate Vehicle (SSV)* project and the various *Intelligent Vehicle Highway Systems (IVHS)* being developed throughout the world.

The SSV project is being funded through the Advanced Research Projects Agency. The purpose of the SSV program is to develop a semi-autonomous vehicle capable of not only navigating over rough terrain but also of taking tactical decisions. While the SSV research is primarily for military applications, it may well prove applicable in the automation of mobile mining equipment.

IVHS is receiving research attention around the world. There are separate projects underway in Europe, Japan, and North America. Researchers are working on such systems as automatic speed control, automatic braking, collision avoidance and automatic guidance. While these concepts could be

Photo courtesy of Gary Jessey of Acquire's **COAL TODAY**

utilized in mobile mining equipment, the technology will need to be modified for harsh mining environments.

The automation of mobile mining equipment has several potential advantages: increased production rates, increased worker safety, and decreased costs associated with accidents. Although we expect to see an increase in the level of automation from line of sight remote control to semi-autonomous within the mining industry, and specifically with mobile equipment, safety concerns still exist such as collisions with personnel, other mobile equipment and stationary equipment. These safety concerns have at this point very limited solutions that are not yet fully implemented industry wide.

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Southern Ohio Coal's new roof bolters are first of kind in the industry

SOCCo's Tom Herbert inspects one of four new roof-bolting machines that were custom ordered for the Meigs No. 2 and 31 mines. Herbert is a roof bolter at the Meigs No. 2 mine. *Photo by AEP Service Corp.*

Wilkesville, Ohio, January 25, 1995—Southern Ohio Coal Company (SOCCo) has taken delivery of four new radio remote-controlled roof-bolting machines, the first of their kind in the industry.

Custom designed for AEP mining operations, they not only enhance operator safety, they also make maintenance faster and easier. The machines are used to secure the mine roof once the coal has been removed.

The four new machines are the first of six that will be put to use in SOCCo's Meigs No. 2 and Meigs No. 31 mines. They replace older machines that included a cab or a deck with a seat, requiring an employee to drive them from place to place in the mine, according to Randy Cooper, manager-machinery maintenance at the AEP Fuel Supply Department.

Because the operator sat low in the cab in the older machines, visibility was poor, requiring a second employee to direct him. The cab's small, cramped space also made working conditions uncomfortable for the operator.

Cooper was among a group of employees, including SOCCo's Tom Herbert, Dave Beckett, Don Goodson, Steve Addington and Ray Lieving, who—when it came time to place an order for new roof bolters—studied how the machines might be improved. Longwall mining equipment and continuous mining machines had been operated by remote control for several years, so why not roof-bolting machines, the group asked.

The new automated roof bolters are controlled by a hand-held remote control box. The remote control allows the operator to move the machine from a distance of up to 200 to

A hand-held remote control enables a roof bolter to move the machine from a distance of up to 200-300 feet in line of site. *Photo by AEP Service Corp.*

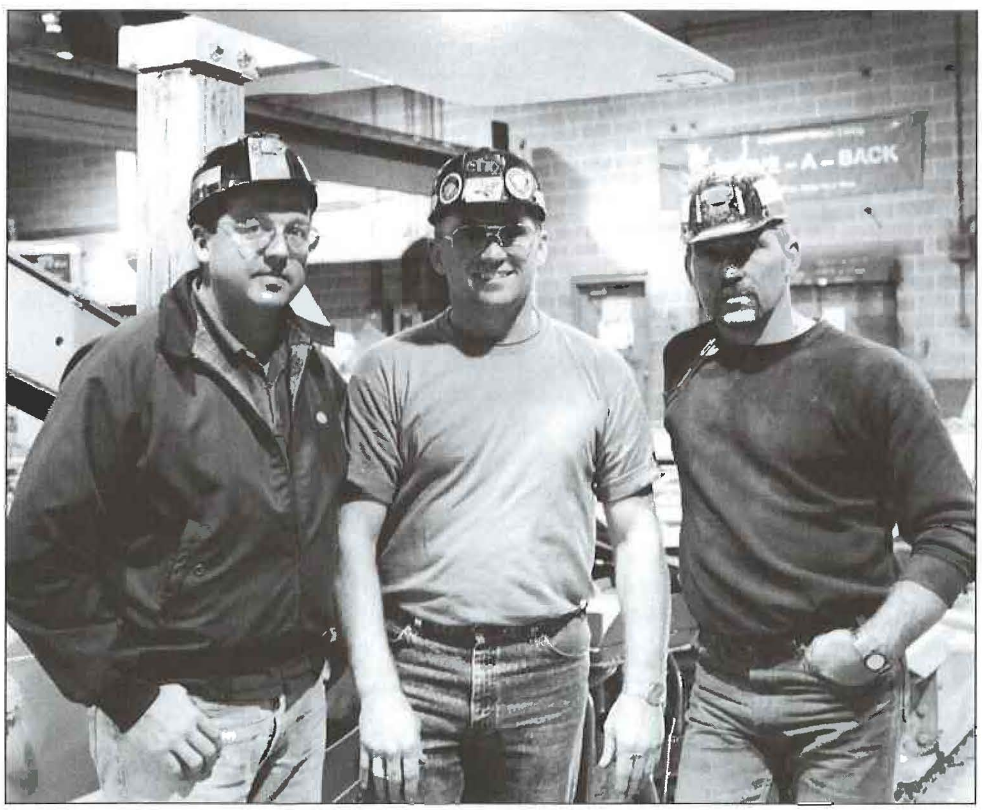
300 feet in the line of sight, enabling him or her to check out the conditions around it and ensure a clear pathway.

Eliminating the operator's cab left space to relocate the electric motors, hydraulic pumps and valve banks, and the cable reel, making inspections and maintenance faster and easier.

All of these enhancements will make working with the new roof bolters safer, easier and more cost effective, Cooper said. And the manufacturer—J.H. Fletcher & Company—is so pleased with the results that it is now marketing the machines to other companies.

"We are very excited about putting this new technology to work in our mines," said Jim Tompkins, vice president and general manager of SOCCo. "We are strong supporters of remote-control operation where applicable both for safety and ergonomic reasons."

From a press release of the American Electric Power Service Corporation, Fuel Supply Department, P.O. Box 700, Lancaster, OH 43130 Contact: Susan Porter, (614) 687-3026



A team approach was used to design the new remote controlled roof-bolting machines now being used at SOCCo. Pictured, left to right, are three members of that team: Randy Cooper, managermachinery maintenance in Mining Operations at Fuel Supply; Don Goodson, general maintenance supervisor at the Meigs No. 2 mine; and Tom Herbert, a roof bolter at the Meigs No. 2 mine. *Photo by AEP Service Corp.*

Noranda system aims to boost mine efficiency with automation

By: Oscar Rojo, reporter for the Toronto Star

Miners may one day work above ground to direct operations underneath.

New technologies developed by researchers of Noranda Minerals Inc. hold out the promise of automating operations and increasing mining efficiency in Canada and elsewhere in the world.

Including an automatic mine vehicle guidance system, the technologies have emerged in the past six years at the Noranda Technology Centre in Pointe Claire, Que., the Toronto-based company said.

"This new approach to mining will not only increase productivity and reduce operating and maintenance costs, but it will also provide significant improvements to safety and working conditions for our employees," said Michel Lefebvre, Noranda Minerals' senior vice-president of mining operations.

"In the near future, mining operators will control several pieces of equipment from a work station that could eventually be located on the surface," Lefebvre said in announcing the technological advances.

The Integrated Mining Automation System combines four primary technologies that, once installed, will provide underground mine operations with automatic guidance, tele-operation, telecommunications, and automatic loading systems, Noranda said. Eventually, mining automation is envisaged to cover several other activities such as drilling, blasting, backfilling, and rock bolting.

"Very soon, the Canadian mining industry will have access to pioneering technologies that will give them a considerable edge over their international competition," Lefebvre said. "These technologies will offset, to a certain extent, some of the competitive advantages offered by countries where labor, social, and environmental costs are lower."

In a major step, Noranda Minerals said it has signed a technology transfer agreement with STAS (Societe des Technologies Appliquees du Saguenay) to complete development work and marketing on Noranda's mining automation technologies.

The agreement is expected to enable Noranda to more readily transfer technology to its operations and ultimately to develop a global marketing strategy.

*Reprinted from page 3 of the Business section of the October 24, 1994, issue of the **Toronto Star**.*

Electrowinning with less

A way to produce copper with less electricity win be put to work at an Arizona pilot plant this summer. The U.S. Bureau of Mines (USBM) and an industry consortium are testing an alternative anode reaction for copper electrowinning that promises to cut energy costs and solve a serious on-the-job safety problem.

Electrowinning provides about one-third of the copper produced in the United States from new ore. Its use has grown steadily since the 1980s, in part because it allows American companies to process lower-grade material. But the technique, which uses electricity to recover copper from solutions, is energy-intensive and exposes workers to a fine mist containing sulfuric acid.

The electrochemical reaction that occurs at the anode in today's electrowinning cells is key to both problems. The proposed low-voltage anode reaction, which converts ferrous ion to ferric ion, cuts energy consumption by 50 percent and eliminates acid misting.

Working with technical guidance from USBM scientists, the consortium will try out the new reaction at a specially built pilot plant in Claypool, Ariz. Participating firms include Magma Copper Co., Cyprus Miami Mining Corp., Eltech Systems Corp. (an anode manufacturer), and Prosep Technologies, Inc. (a firm that provides sulfuric acid extraction technology for the electrowinning process).

Scientists believe that the planned six-month demonstration will give industry a solid basis for taking the technology further.

"If we succeed on this scale, there's a high probability of commercial adoption," said USBM researcher Scot Sandoval. "Using the new reaction could save energy, cut copper production costs, and help keep workers safe."

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A scientific look at back belts

By Sean Gallagher[1] and Christopher A. Hamrick[2]

Abstract

In recent years there has been a tremendous increase in the use of back belts by companies attempting to control back injury costs. Many claims have been made regarding the effectiveness of back belts; however, not many of these have been based on sound scientific evidence. In fact, there is contradictory information on the value of back belts. The U.S. Bureau of Mines (USBM) reviewed literature relating to the effectiveness of back belts in the workplace.

Introduction

A tremendous increase in the use of back belts by companies attempting to control back injury costs has been seen in recent years. Numerous belt designs are being made available to industry, based on the premise that they reduce the risk of low back pain. Many claims have been made regarding the effectiveness of back belts; however, not many of these have been based on sound scientific evidence. In fact, there is contradictory information on the value of back belts. Some studies have supported the use of belts, while others have suggested that workers would be better advised to refrain from their use. As part of its program to enhance safety for the underground mine worker, the USBM has reviewed evidence relating to the effectiveness of back belts and provided some suggestions relating to the use of back belts in the workplace. This paper is largely based on a review of back belt literature by the noted spinal biomechanist S.M. McGill (*11*).[3] There are several potential benefits and drawbacks associated with wearing back belts that should be considered before a responsible policy can be established. Let us first examine the hypothesized benefits associated with back belt usage and the related scientific evidence.

Potential benefits of back belts

The following list details the major benefits that might be provided by back belts:

1. Decrease the load experienced by the low back.
2. Help to "stiffen" the spine to make it stronger.
3. Restrict spine mobility and prevent hazardous movements.
4. Provide a safety margin by increasing an individual's tolerance to heavy loads.
5. Decrease back injury incidence when used in industrial settings.

The following sections will address the scientific evidence related to these hypothesized benefits:

Do back belts decrease the load experienced by the low back?

One of our best methods for establishing the answer to this question is to examine muscle activity. If back belts decrease the load on the low back, we would expect to see a decrease in the electrical activity of the powerful back muscles. However, studies have convincingly shown that there is no difference in back muscle activity when wearing a belt compared with not wearing one (8, *13*). Thus, back belts do not appear to lessen the load experienced by muscles of the lumbar spine (low back).

Some have hypothesized that back belts help to reduce the load on the low back by increasing intra-abdominal pressure (IAP). Indeed, lifting while wearing a belt does appear to increase IAP (5, *9*). Years ago, higher IAP was thought to be beneficial by adding supporting forces to the low back (3, *14*). However, recent data have caused this theory to be reevaluated (12, *16*). It now appears that increased IAP has little, if any, effect that would decrease the load on the spine.

Do back belts help to stiffen the spine (make it stronger)?

While it is generally believed that increased IAP does not reduce the spinal load, the possibility exists that higher IAP may assist the low back by increasing the stiffness of the spine. Unfortunately, this is a difficult claim to test scientifically. Current thinking is that even if higher IAP does provide some additional stiffness, the advantage gained is probably fairly small (13, *19*). Thus, at the present time, most back injury experts feel that the justification for wearing belts based on increased IAP is probably not warranted.

Do back belts restrict spine mobility and hazardous movements?

There is evidence to suggest that certain types of belts restrict the amount of side-to-side bending and trunk twisting that a worker can perform (*19*). This may be in part responsible for the reported perception of increased stability of the trunk by wearers. However, belts currently available do not appear to restrict forward bending of the lumbar spine. This appears to be an important exception, because of the fact that the strength of the spine and its ability to tolerate loads are considerably lower when the worker is in a forward bent position (1). Furthermore, this posture is associated with increased risk of back injury (*15*). Therefore, while the reduction in side bending and twisting is viewed as generally positive, the fact that current belts do not restrict forward bending means that back belts still allow individuals to subject their spines to hazardous postures.

Do back belts improve an individual's load tolerance?

One possible benefit of back belts is that they might provide a "safety margin" by increasing the tolerance of individuals to heavy loads. However, data from recent studies have indicated that wearing a back belt does not increase an individual's ability to sustain additional loads in forward bending, side bending, or twisting (*19*). Thus, it does not appear that belts provide an additional safety margin by increasing a worker's tolerance to heavy loads.

Does use of back belts in industry decrease the incidence of back injuries?

Several recent studies have been performed that attempted to determine whether belts actually do reduce the incidence of injury (*2, 6, 18, 20*). Unfortunately, the studies performed thus far have been of widely varying quality. Only two back belt studies have been performed that use the method that provides the highest quality data (i.e., prospective studies using matched control groups). These studies were performed by Reddell (18) and Walsh (*20*).

The Walsh (*20*) study is the one pointed to most frequently by back belt proponents as evidence of the effectiveness of back belts. The investigators studied 81 workers in an industrial warehouse setting. Results of this study did, in fact, demonstrate a reduction in lost-time back injuries due to use of back belts, but careful scrutiny of the data indicates that the benefit was found *only* among workers who had experienced previous back injuries. No benefit was observed for previously uninjured employees.

The second of these studies examined the effectiveness of back belts, in which 642 airline baggage handlers were observed (18). These researchers found no differences in back injury incidence rates between groups using back belts and those not using belts. However, these researchers did discover a disturbing trend. Workers who started the study wearing back belts and dropped out (discontinued use of the belts) had a higher incidence of back injury than any other group. The researchers in this study concluded that back belt use may cause some physical dependency, leaving the back at increased risk when the device is withdrawn.

It is important to note that neither of the studies (18, *20*) demonstrated that belt use had any benefits for uninjured workers. However, it is noteworthy that belts did seem to help workers who had experienced prior back injuries. This indicates that belts may have some usefulness in the workplace under certain circumstances.

Potential drawbacks of back belts

The following arguments are typical of back belt detractors:

1. Back belts may lead to weakened back muscles (muscle atrophy).
2. Back belt use causes workers to develop a "false sense of security."
3. Increased IAP observed during back belt use may result in adverse physiological changes.

Let us examine the evidence with regard to these issues.

Do back belts cause back muscles to become weaker (atrophy)?

Several studies have examined this issue, and all of these studies seem to agree that back belts do not lead to a decrease in muscle strength, at least over the short term. This is consistent with the observation that back muscle activity is not decreased with belt use, as mentioned above. However, a recent Swedish study suggested that while back belt use does not result in loss of strength, muscular endurance may be decreased with prolonged belt use (6).

Do back belts create a false sense of security?

There is some evidence that belts may lead to a false sense of security in workers. As noted above, lifting belts does not appear to increase an individual's load tolerance. However, studies have indicated that workers are willing to lift up to 20% more weight when wearing a belt (10). Thus, it appears that workers who use belts appear willing to place higher strain on the back and, in fact, are willing to work at a higher percentage of their maximum load tolerance. Therefore, workers who wear belts may be working with a decreased safety margin with regard to the low back.

Do back belts result in adverse physiological changes?

Back belts do seem to cause certain unwanted physiological changes to occur. The most significant of these is the increase in blood pressure that has been observed when lifting using a belt. Blood pressure has been shown to be elevated almost 15 mm (mercury) when lifting with a belt (7). Any individuals with a history of heart problems or those with significant cardiovascular risk factors should consult a physician prior to donning a back belt. An increase in blood pressure by 15 mm may lead to serious health problems among those with a history of cardiovascular problems.

Summary and recommendations

The foregoing information indicates a somewhat mixed bag of evidence—some in support of back belts and some in opposition. Evidence supporting use of back belts includes some restriction in end-range motion of twisting and side bending, clinical evidence of a decrease in lost-time back injuries among those with prior back injuries, and a suggestion of increased trunk stiffness that may be of some benefit. Evidence in opposition of back belt use includes an increased risk of injury upon discontinuing belt use, increased blood pressure, and a false sense of security that may lead workers to overstrain their backs.

This review of the literature indicates that the following approach to use of back belts should be followed (*11*):

1. **Back belts should be treated as a prescription item** and should be provided only to individuals having had a previous back injury. These workers should be weaned from the belts as soon as it is appropriate.
2. **Back belts should *not* be universally distributed to all workers at a worksite**, given the lack of demonstrated effectiveness among uninjured workers and a potential increased risk of injury after discontinuation of use.
3. **Individuals considered for a back belt prescription should be screened for cardiovascular risk** because of the increased blood pressure associated with belt use.
4. **Individuals using back belts should be required to participate in a mandatory exercise program** and should continue in the program after being weaned from the belt during the period of increased back injury risk.
5. **Workers using back belts should be exposed to a mandatory education program** to ensure that the back belts are used properly.
6. **A full ergonomic assessment of the workplace should be performed** to reduce any physical hazards that may increase the incidence of back injuries.

The evidence presented in this paper suggests that back belts have a rather limited role to play in controlling the costs and incidence of back injuries. Reliance on back belts as a sole method of combatting this problem clearly does not provide an effective solution. Effective back injury control programs tend to emphasize job redesign, where the worker's job is changed to reduce the amount of manual lifting that has to be done (or the lifting that must be done is made easier) (*17*). Methods of job redesign applicable to the mining industry are contained in the USBM Information Circular 9235 (4). Employers who are interested in keeping the cost of back injuries down are encouraged to focus on job design as a primary method of injury control, and if back belts are to be used, careful consideration should be given to the factors discussed above.

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High protein diet

Proteins promise a new way to clean up wastewater and recover valuable metals. Scientists at the U.S. Bureau of Mines (USBM) are experimenting with proteins that remove metal ions from water and hold them tightly.

"Previous studies focused on binding metals, but we've looked for proteins that also release them," explained USBM chemist Ross Spears.

"The metals recovered could help pay for the treatment process," Spears points out. "You can also reuse the protein for additional water treatment."

Scientists start by chemically binding protein molecules to a solid support. The immobilized proteins selectively take metal ions out of solution and into their own molecular structure.

In addition to selective loading, the process also permits metal recovery by selective stripping. "Lowering the pH loosens the protein structure that holds the metals, and adding a weak chelating agent speeds up the kinetics of metal removal," Spears explained. "This combination concentrates the metals and provides a clean separation."

USBM scientists have used proteins to remove metals from both simulated and "real world" wastewater and processing solutions. Laboratory tests show that the treatment can recover chromium from electroplating wastes, strip copper contaminants from gold heap-leaching solutions, and cleanly separate nickel and cobalt from laterite leach solutions. Modeling studies suggest that proteins can also bind radioactive metals such as thorium, plutonium, and uranium.

"We see the technique as a cleanup step for recovering valuable metals from wastewater," Spears said. "Proteins may also provide a way to remove contaminants that are problematic or dangerous in even very small amounts."

The treatment produces very clean water, but researchers are concerned about its possible price. "The biggest obstacle is the cost of the protein and support material," Spears said.

Scientists hope to find a less expensive way to produce the protein used in the process. They also plan to study additional treatment applications and work on the operational problems involved in scaling up the procedure.

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Silicosis risk for office workers?

Significant exposure to some chemical toners used in photocopying can apparently cause silicosis. At least that was the finding of some researchers from the University of Granada in Spain. In an article in the British medical journal *The Lancet,* they reported that a female worker in a photocopying shop in Spain was diagnosed with siderosilicosis, a respiratory disease found primarily in miners and foundry workers who are exposed to iron and silica. An investigation found evidence of iron and silica (silicon dioxide) particles both in the copier toner dust and in the worker's lungs.

The victim had worked full-time in the shop for six years and could be assumed to have significantly more exposure than the average office worker. We'll keep you posted on any further studies which indicate at what levels toner dust becomes a problem.

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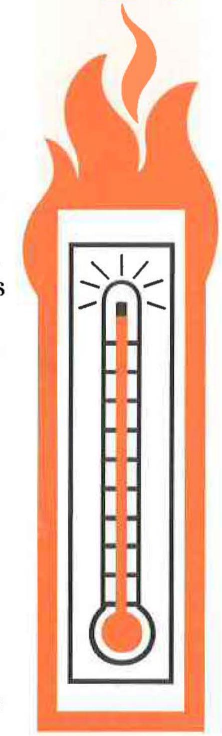
Canary mine messenger system wins award

VLF Magnetic Systems Inc. recently received another award for its Canary Mine Messenger System. This time it was an Award of Excellence from Southam Inc. for the most innovative health and safety product or service of 1994. As reported in a previous issue, this system provides through the earth electronic transmissions from the surface to underground miners no matter where they might be in the mine. The U.S. Bureau of Mines called the system "one of the most significant advances in mine safety of the century." Previously, mines had to rely on introducing stench gas into the ventilation system to warn miners of an emergency situation.

*Reprinted from the February 1995 issue of Ontario [Canada's] Natural Resource Safety Association's **Health & Safety RESOURCE.***

Let's beat the heat



Our bodies are like our car engines. They both have a need for a cooling fluid to assist in dissipating the heat. If the temperature is kept within reasonable limits, the internal parts last longer and the engine doesn't lock up and quit running. In the body sweat glands dispense warm liquids to cool internal parts. Radiators permit collected heat to be reduced so vital parts will not exceed the no-return temperature. In our body sweat glands also function to lower the core temperature. If the radiator or its connecting conducting path malfunctions, the engine is damaged.

The radiator is part of the cooling system for the internal combustion engine. The sweat glands are an integral component of the excretory system. The radiator represents several square feet of exposed area. There are 400 to 2,800 sweat glands per square inch over much of the body.

Excessive heat

Life and health depend on the body releasing excessive heat.

Exposure to extremes of heat is one of the major causes of shock. The shock may be revealed as a dazed look, pale color, upset stomach and/or vomiting, thirst, and dilated pupils. Disorientation, confusion and even unconsciousness may be present.

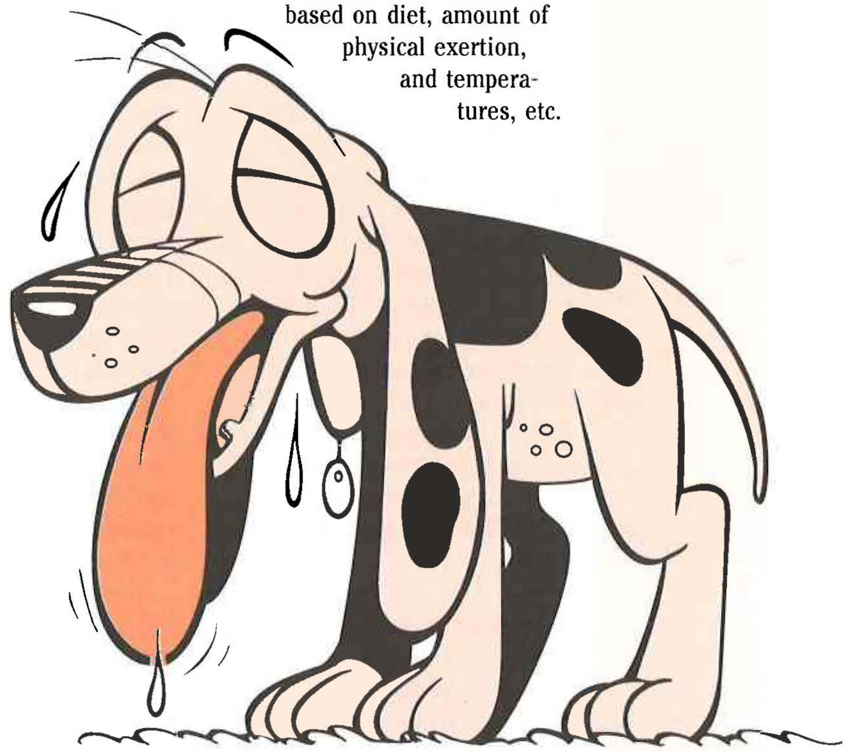
Both low and high levels of stress, due to heat, may cause discomfort and fatigue, and result in impairment of work performance. Exceeding the heat tolerance of any individual may be a health hazard. Exposure to excessive heat represents an extra load on the circulation of blood and other body functions. For instances, during high heat conditions, the blood has to carry oxygen to living cells, collect waste, and serve as a cooling fluid. With this extra load, the heart rate increases with a potential decrease in the physical work capacity.

Mental and intellectual performances deteriorate when the temperature exceeds the ability of an individual to adjust to the presented condition. Seldom, if ever, can one tolerate temperatures exceeding 95°F without an impairment to physical and mental capacity. Those not used to heat may suffer from reduced capacity at lesser temperatures. It requires a high level of motivation to counteract the detrimental effects of heat.

Associated with high temperatures are high sweat rates. Excessive loss of body fluids can initiate dehydration (known as anhydration, deaquatin, and hypohydration). Voluntary dehydration results when thirst does not stimulate sufficient replacement of water loss. Endurance is defined as the ability to withstand hardship or adverse stress. The standardized maximum exercise load is definitely reduced due to dehydration. It may be possible to temporarily handle a large work load but continued exposure will yield a reduced working ability.

Many ways have been proposed to establish safe guidelines on dehydration. However, there is a simple method of determining whether the fluid intake has been adequate. Weigh at different times during the work cycle and compare the weight differences. Even a small reduction of one to two percent may account for a difference in performance and health.

To minimize the effects of dehydration, the fluid loss should be replaced rapidly, perhaps as much as several times per hour under severe conditions. Fluid, such as water, is more favorably accepted if it is under 60°F. Since water doesn't contain electrolytes it's usage may need to be supplemented with salt tablets. The salt requirements may frequently range from 5 to 15 grams per day based on diet, amount of physical exertion, and temperatures, etc.



Age
Heat tolerance as a factor of age has to be taken in account. Older individuals do not sweat as fast as their younger counterparts. In addition, it takes longer for their body temperatures to return to normal.

Physical conditioning and acclimation
Trained workers adjust faster to heat than untrained. Physical training enhances the ability to utilize the sweating functions. Exposure to a hot environment is necessary in order to develop a tolerance to heat. The exposure yields an increased sweat production resulting in a lower skin temperature and reduced heart rate. This acclimatization process gained through exposure permits one to adapt to new temperatures, altitudes or climates. Acclimatizing permits the sweat gland to produce more sweat than under ordinary circumstances.

Acclimatizing
Acclimatizing many workers efficiently and rapidly poses practical problems. Daily exposure for even an hour for one week will account for some acclimatization. However, it generally requires 8 to 10 days exposure of up to at least half the shift before the person is acclimatized. Weekends and holidays makes this proposal very difficult to implement.

Physical response assessment
Various ways have been proposed to evaluate where heat is the major stress for industrial work places. However, because of the multitude of variables which includes sex, age, body dimensions, health, fuel and oxygen intake, motivation, and nature of the work, it is not simply possible to produce an accurate and universally applicable heat index. There is no single physical index involving a heated environment that includes all the workers all the time. Heart rates, oral and core temperatures, conditioning, skin temperature, sweat rate, and relative humidity are additional variables needing to be considered.

Since each individual is different, it is probably easier to weigh individuals several times a day and establish base line data from which decisions can be made. Dehydration based on actual body weight is easier than attempts to comprehend the entire spectrum of all parameters. Acute observations is frequently more revealing than absolute faith on theory.

Extraneous cooling measures
Air conditioning and air movement devices may be considered for cooling. However, taking rest breaks, working in the shade, and/or supplying cool drinking fluids may also achieve substantial improvements. Before trying water-cooled hoods and Buck Roger's suits, utilize easier solutions. Maybe it is only necessary to provide shields from the heat source; introduce mechanical aids to eliminate strenuous physical work near the heat. The key points are to: (1) avoid conditions that prolong intense heat exposure leading to profuse sweating; (2) replace body fluids before they are lost; and (3) have the worker leave the workplace hydrated, not dehydrated.

Physical fitness
Maintaining a high level of physical fitness can provide more tolerance for working in the heat. A fit individual places less stress on their heart and produces smaller changes in their core temperatures.

Effect of respirators and face masks
In the performance of jobs such as firefighting or dusty atmosphere work some workers wear respirators or face masks. These devices increase the potential of heat stress even when used by trained personnel. Careful monitoring is necessary to prevent difficult or labored respiration.

Heat stress
Heat stress indicates the body is not removing sufficient heat. Several conditions can promote this phenomenon. A worker may be

working at a rate which exceeds the dispersal of heat. The temperature and/or the humidity can be so high that the body can not rid itself of the excessive heat. Clothing worn to protect one against the cold or other environment may prevent the evaporation of sweat.

No one is exempt from heat stress. Anyone can get it. People that are overweight, people having a high fat content, and people suffering from a hangover are all potential victims. But anyone can get stressed from heat—even athletes. Those having recent immunization shots, infections, or other illnesses are definitely at a risk.

Illnesses from heat

If one cannot get rid of produced heat, the body temperature has to rise. Heat exhaustion is the condition where the heart rate increases until there is not enough elapsed time to completely refill the heart. This results in not enough blood being pumped to the brain so the affected person experiences "heat exhaustion collapse." This is commonly referred to as "fainting" or "black out." Blood flow is restored by getting blood out of the skin and back into the central circulating system. Using cold water and massaging the legs and arms are helpful in restoring normal blood flow.

Exhaustion from dehydration

Dehydration exhaustion indicates the body is losing more water than is being replaced. Severe cases result in the victim collapsing. Heat stroke is a severe condition marked by dry skin, vertigo, headache, thirst, nausea, and muscular cramps. The body temperature may be dangerously elevated. If the temperature stays high long enough, permanent damage or death can result.

Heat cramps indicate the body has lost enough salt so that the muscles begin to get sore and cramp. These muscle cramps may occur in several muscles at the same time. Drinking lightly salted water or electrolytically-enhanced commercial beverages is one way to prevent heat cramps.

Dehydration

As inferred previously, one percent weight loss may indicate dehydration. Dehydration can occur in one shift or be a cumulative process. Painting the town red at night can contribute greatly to dehydration. The greater the weight loss, the more the damage. Dehydration exhaustion may occur with 5% loss and heat stroke with total incapacitation from a 10% loss is likely.

Physical work restriction

Maximum oxygen uptake is the ability of the body to deliver oxygen to the muscles. Heat stress establishes physiological limits to this uptake.

As a worker becomes hotter during a given task, more energy is required. The usual recourse is to slow down. The activity rate has to be reduced under severe condi-tions to prevent heat exhaustion.

Clothing vs heat stress

The thickness of the clothing and the air space between the skin and the outer environment insulate the wearer. The higher the value of insulation the less heat emitted to the environment. Ideally, sweat should evaporate but if it doesn't, the producer can become uncomfortable with consequential reduction of work output.

Thirst vs drinking

Thirst is not an adequate measure to indicate fluid is needed. Some individuals have lost 6 to 8% of their body weight before becoming thirsty. To be safe, take frequent cool drinks. Frequent drinks are more effective than taking only a single large drink.

Practical solutions for heat stress

Before large expenditures of time and money, review simple adjustments which can yield relief. Any measure that can reduce the work load and the heat stress should be considered. Some basic solutions would include:

- Provide shade
- Sit—if standing is not necessary
- Wear lighter colored and less clothing
- Wear less impermeable materials
- Provide cool drinking liquids close to the worksite
- Schedule harder jobs for cooler times
- Plan on rest breaks
- Acclimatize
- Use auxiliary cooling
- Warm up gradually
- Cool down by slowing down

Simple rule

The longer your shadow, the safer you are.

When one's shadow is less than their height, it is time to consider using protection against the sun's rays. When the sun is directly overhead, there is no shadow. The smaller the shadow, the greater the amount of ultraviolet radiation (UV) that reaches the earth. As the shadow increases in length, the sun's rays must penetrate more of the earth's atmosphere, including ozone.

Potential acclimatization schedule

The U.S. Department of Health, Education and Welfare recommends acclimatizing employees for 6 days. On the first day the worker starts with a work load of 50 percent and on each succeeding day an additional 10 percent load is added. This schedule results in a 100 percent exposure on the sixth day.

Acclimatize employees missing at least nine days of work. They should start with a 50 percent work load exposure on their first day back to work. The second, third and fourth day exposures are 70, 90, and 100%, respectively. Workers experiencing four consecutive days of sickness should undergo the same acclimatization program.

Home hazard inspection form

A home hazard inspection is conducted by walking through each of the areas in your home that are listed on this form. Please look for the possible hazards in each room of your home and then check the correct answer. A "No" answer means a hazard is present and corrective action is necessary.

Before you begin your search for home hazards, it is extremely urgent that you test every smoke detector in your home. You should have a *WORKING* smoke detector on every level of your home and also a smoke detector outside of every sleeping area. Are you in compliance with all applicable state and county laws?

Now it is time to begin your "hazard search!"

EACH bedroom and bathroom

1. Is a 9-1-1 sticker (or emergency telephone numbers) placed on the telephone? .... Yes ☐ No ☐
2. Is there a list of important phone numbers next to the phone? .... Yes ☐ No ☐
3. Are matches, lighters, and prescription medicine stored above a child's reach? .... Yes ☐ No ☐
4. Are all medicines and cosmetics kept out of sight of children? .... Yes ☐ No ☐
5. Do you prohibit smoking in bed? .... Yes ☐ No ☐
6. Have the smoke detectors been tested—do they function properly? .... Yes ☐ No ☐
7. Does your family conduct periodic exit drills?. Yes ☐ No ☐

Living area

1. Are electrical extension cords used sparingly? .... Yes ☐ No ☐
2. Does the fireplace have a screen or glass cover in front of it? .... Yes ☐ No ☐
3. Are objects that could catch fire away from the fireplace? .... Yes ☐ No ☐
4. If the home has small children, are safety latches installed on drawers, cupboards, and medicine cabinets? .... Yes ☐ No ☐
5. Does each area have two acceptable means of escape? .... Yes ☐ No ☐

The kitchen

1. Are appliance cords kept on the counter to prevent them from being pulled down by a young child? .... Yes ☐ No ☐
2. Are small appliances unplugged when not in use? .... Yes ☐ No ☐
3. Is the stove clean of grease and oil? .... Yes ☐ No ☐
4. Is there a fire extinguisher (Class ABC) mounted **in or near** the kitchen? .... Yes ☐ No ☐
5. Do all family members know how to cool a burn with cold water? .... Yes ☐ No ☐

Storage areas and work areas

1. Is the water heater set **below** 120° F? .... Yes ☐ No ☐
2. Has the furnace or heating unit been checked once each year to ensure proper functioning? .... Yes ☐ No ☐
3. Is all gasoline stored in approved safety cans? .... Yes ☐ No ☐
4. Are all chemicals and paints kept in their original containers?. .... Yes ☐ No ☐
5. Is the dryer lint trap cleaned after each use? .... Yes ☐ No ☐

Outside the home

1. Has the chimney been cleaned at least once each year? .... Yes ☐ No ☐
2. Are electrical connections snug? .... Yes ☐ No ☐
3. Are propane or butane cylinders stored outside of the home? .... Yes ☐ No ☐
4. Are house numbers visible from the street? .... Yes ☐ No ☐
If an apartment, is the building number visible on the building? ... . Yes ☐ No ☐
5. Is the nearest fire hydrant free from obstructions, grass or brush? .... Yes ☐ No ☐
6. Swimming Pool:
Is the gate to the pool self-closing and self-latching? .... Yes ☐ No ☐
Is the gate locked when not in use? .... Yes ☐ No ☐
Are lifesaving flotation devices in view and in good condition? .... Yes ☐ No ☐
Is there a fence that separates the pool from the house? .... Yes ☐ No ☐
Do you know CPR? . Yes ☐ No ☐

Pet safety

1. Are toys, pins, needles, yarn, and other objects kept away from pets? .... Yes ☐ No ☐
2. Are garbage container lids tight at all times? .... Yes ☐ No ☐

Reprinted from the March 1995, Vol. 7, No. 1 issue of ***SAFETYLINE SIGNALS****, Official publication of Maryland's Montgomery County Volunteer Fire-Rescue Association and Auxiliary Fire and Injury Prevention Committee.*

Maintenance keeps the coal coming

by Foy McDavid

Maintenance of coal-mining equipment is a major, varied task that means top-notch lubrication and supplies.

AnDek Corporation's maintenance of equipment lubrication, for example, is an indefinite lasting service that clients can depend on, says Debbie Ledford in AnDek's Belmont, North Carolina office between Charlotte and Gastonia. Andek's "salesmen check back periodically" for clients' maintenance needs. They include Perma brand automatic lubricator—the single-point system for conveyor belts and mining's "remote locations"—plus Lube USA grease and oil systems. "We serve the entire southeast" and AnDek was **COAL TODAY**'s September Business of the Month, Ledford adds.

Serving national maintenance needs is PLI, Inc. of Racine, Wisconsin. PLI's Electro-Luber self-contained automated single point lubricator can even help a bulldozer's maintenance, says PLI vice president Donald Groetzinger. PLI's "200 different lubricants made to order" cap a 20-year-old business.

Groetzinger says what's unique is the Electro-Luber's inert-nitrogen-in-hermetically-sealed "diaphragm" with "six little dip switches" atop the lubricator that are months-timed to slowly, continuously feed grease or oil. Also unusual is a see-through "reservoir" container of grease or oil in the Electro-Luber so an equipment operator immediately knows lubrication levels, timed to the equipment. There's a two-year shelf life for lubrication supplies.

Similar to lubricators, electric supply houses like State Electric Supply Company of Pikeville, Kentucky work with customers using parts warranties. There are no maintenance contracts. State Electric, with an electronics store in Charleston, West Virginia, sells electric cables, replacement parts and other items to Appalachian mines, according to State Electric manager John Yagodich. In Grundy, Virginia, lubricating mine maintenance comes from Buchanan Oil Corporation. It sells motor oil, several greases, hydraulic and diesel fuel, mostly to surface mines. Buchanan Oil also supplies underground mines, says chief sales representative Scott Brown.

Further down in southwest Virginia at Bristol is Sandvik Rock Tools, which sells drill bits, resins and sealants for continuous miners, longwall equipment and road paving. Sandvik's mine bolt resin, mine sealant, cable resin and pumpable grout is good for the life of the mine, offers Ken Monyak, manufacturing engineering manager. From Bristol headquarters and warehouses in Whitesburg and Madisonville, Kentucky, Sandvik's market is "the world," Monyak says, citing South Africa, Chile, Sweden and Norway. Asia? "Not yet," Monyak replies.

Back up the valley in Bluefield, Virginia, Charlie Whalen, plant manager for Bluefield Manufacturing Inc., says his firm's brattice cloth goes through distributors to underground mines as ventilation canvas. That brattice is used in eastern Kentucky through Virginia to Maryland's mines, Whalen says. No maintenance is needed in Bluefield Corporation's "consumable products," including DC battery plugs and receptacles.

Foy McDavid is editor of County Newsletter in Knoxville, Tennessee

Reprinted from the December 1994 issue of Acquire's ***COAL TODAY***

1995 Pennsylvania Ground Control Seminar

The Pennsylvania Bureau of Deep Mine Safety and MSHA will be co-hosting the 1995 Pennsylvania Ground Control Seminar for underground metal and nonmetal mines.

Presentations by well-known industry experts will cover topics such as: Design of Roof Systems for Underground Limestone Mines; Factors Affecting Ground Instabilities; Techniques to Detect and Monitor Roof Movements; and more.

The seminar will be held at the Ramada Inn, Pa. Turnpike exit 10, Somerset, PA, on November 1, 1995.

A registration fee of $15.00 will include seminar materials, refreshment breaks, and buffet luncheon. Registration for the seminar should be received by October 15, 1995.

Accomodations at the Ramada Inn are available for $52.00 for a single and $62.00 for double occupancy and participants should contact the hotel directly at (814) 443-4646.

Mail your registration fee of $15 made payable to "1995 Safety Seminar" to: *Pennsylvania Bureau of Deep Mine Safety, Fayette County Health Center, 100 New Salem Rd., Uniontown PA 15401, ATTN: Robert McGee.*

For further information contact Robert McGee at (412) 439-7469.

Chemically induced hearing loss?

Exposure to loud noise may not be the only thing in your workplace that can cause hearing loss. According to researchers at the U.S. National Institute for Occupational Safety and Health (NIOSH), there may be a link between hearing loss and exposure to organic solvents. A study of print and paint industry workers showed that those exposed to noise had a four-times greater risk of hearing loss than a non-exposed control group. But those workers exposed to solvents alone had a five-times greater risk; and those exposed to a combination of noise and solvents (in this case, toluene) had an eleven-times greater risk.

More study needs to be done, including a look at other types of chemicals. But if these findings prove to be generally applicable, we may have to consider chemical exposure along with noise in our hearing protection strategies.

*Reprinted from the February 1995 issue of Ontario [Canada's] Natural Resource Safety Association's **Health & Safety RESOURCE.***

Let them eat cyanide

Mining companies closing down precious metals heap leach operations may already "own" the solution to one of their most pressing problems-handling cyanide-contaminated wastes.

Scientists at the U.S. Bureau of Mines (USBM) have identified bacteria that eat cyanide. These organisms already live in water at the mines where they're needed.

"The problem is that there aren't enough bacteria present to make a difference," explained USBM scientist Richard Lien. That "differences is vital when heap leach operators want to close their mines.

The heap leach process uses solutions containing small amounts of cyanide to dissolve gold and silver from large piles of low-grade ore. The process is a "closed loop" in which the Cyanide solutions are recovered and Bused.

Mining companies take precautions to keep cyanide out of the environment. But the long-term fate of the cyanide that remains in waste piles and leftover processing solutions is a concern when mining stops.

USBM scientists discovered bacteria in processing waters that feed on cyanide, getting some nutrients from it while breaking it down into harmless compounds. By adding other inexpensive nutrients such as yeast extract, researchers can increase the bacterial population and speed up the rate at which the organisms destroy cyanide.

Field tests at two Nevada gold mines show that bacteria effectively lower the cyanide content of processing solutions. Work at a third Nevada mine will begin this summer.

"Our next step will be to try the approach on a spent heap," Lien said.

*Reprinted from the February 1995 issue of the U.S. Bureau of Mines' Mineral news and features **TIPSHEET.***

Mingo-Logan wins mine rescue contest

The Mingo-Logan Coal Company Mountaineer Mine "A Team" finished first in the Kanawha Valley District Council of the Joseph A. Holmes Safety Association Mine Rescue Contest on June 3, 1995. The contest was held adjacent to the Cannelton (WV) Little League baseball field.

Mingo-Logan team members are: Brad Justice, Don Walker, Mark Taylor, Darin Lester, Dan Fleenor, Randy Cross, George Gibson, Don Sparkman, captain, and Matthew Murray, trainer.

Massey Coal Company, "Elk Run Team" placed second. Team members are: Terry Reeves, Keith Amick, Clyde Stepp, Wayne Persinger, Rick Stewart, Mike Stone, Frank Foster, and Johnny Robertson, captain and trainer.

Cyprus Amax Corporation, "WV Operations Team" finished third. Team members are: Lennox Proffit, Jim Griswold, McKennis Browning, Billy Gill, Gary Acord, Preston Toney, Bill Kell, captain, and Ott Jackson, trainer.

Mountaineer Mine Rescue Association, Incorporated's "State Team" finished fourth. Team members are: Tim Lyons, Fred Bennett, Jeff Hartley, John Click, Barry Mullens, Gerald Lucas, Robert Hill, captain, and Phil Adkins, trainer.

Special appreciation is extended to the following:
Low Places, Inc., Hill Enterprises, The Montgomery Herald, Holmes Safety Association, Cypress Amax Coal Company, Mingo-Logan Coal Company, Elk Run Coal Company, Mountaineer Mine Rescue, Valley Emergency Medical Services, UMWA Local Union 8843, Mine Safety and Health Administration, Upper Kanawha Valley Little League, West Virginia Office of Mine Safety, Health, and Training, and Mr. Jimmy Thompson of Cannelton Industries, Inc.

Submitted by, J. W. Vencill, Jr., 19 June 1995

May 6, 1926; Randolph Colliery (anthracite); Port Carbon, PA; 5 killed

A gangway being driven from the tunnel that connected the coal beds had reached a distance of 200 feet from the tunnel without a second opening and was ventilated by compressed air. About 2 pm, the shot firer was preparing a charge of 40% dynamite to shoot a hole in the face when an explosion killed him and 4 others at considerable distances, and severely burned another 4. Apparently gas had been forced back from the face and was ignited when the detonator was set off by contact with a dry-cell battery or ignited by a match, setting off the dynamite.

Reprinted from BuMines ***Bulletin 586***

24 THE LAST WORD...

By trying we can easily learn to endure adversity—another man's I mean.—Mark Twain

The good things of prosperity are to be wished; but the good things that belong to adversity are to be admired.—Seneca

Gossip is always a personal confession either of malice or imbecility.—Josiah Gilbert Holland

That which is everybody's business is nobody's business.—Izaak Walton

Genius is an infinite capacity for taking life by the scruff of the neck.—Christopher Quill

Prosperity is a great teacher; adversity is a greater. Possession pampers the mind; privation trains and strengthens it.—William Hazlitt

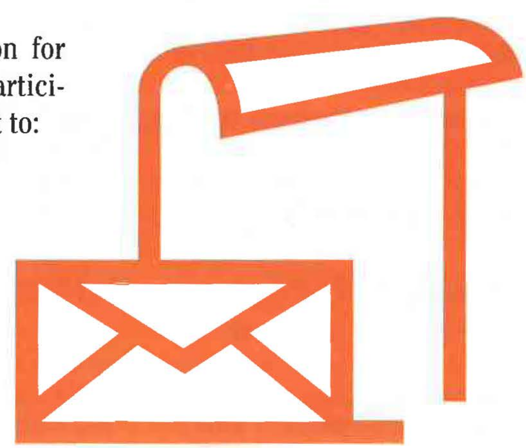
Hasten slowly.—Augustus Caesar

It is the privilege of genius that to it life never grows commonplace as to the rest of us.—James Russell Lowell

Don't play for safety—it's the most dangerous thing in the world.—Hugh Walpole

NOTICE: We welcome any materials that you submit to the Holmes Safety Association Bulletin. We DESPERATELY need color photographs suitable for use on the front cover of the *Bulletin.* We cannot guarantee that they will be published, but if they are, we will list the contributor(s). Please let us know what you would like to see more of, or less of, in the Bulletin.

REMINDER: The District Council Safety Competition for 1995 is underway—please remember that if you are participating this year, you need to mail your quarterly report to:



Mine Safety & Health Administration
Educational Policy and Development
Holmes Safety Association Bulletin
P.O. Box 4187
Falls Church, Virginia 22044-0187

Please address all editorial comments to the editor, Fred Bigio, at the above address. Phone: (703) 235-1400

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1994-1995

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*Cover photo of the Joy 14CM10 continuous miner courtesy of **Joy Technologies Inc.** We welcome any materials that you submit to the Holmes Safety Association Bulletin. We especially need color photographs (8" x 10" or larger—color negatives are acceptable) for our covers. We cannot guarantee that they will be published, but if they are, we will list the contributor(s).*

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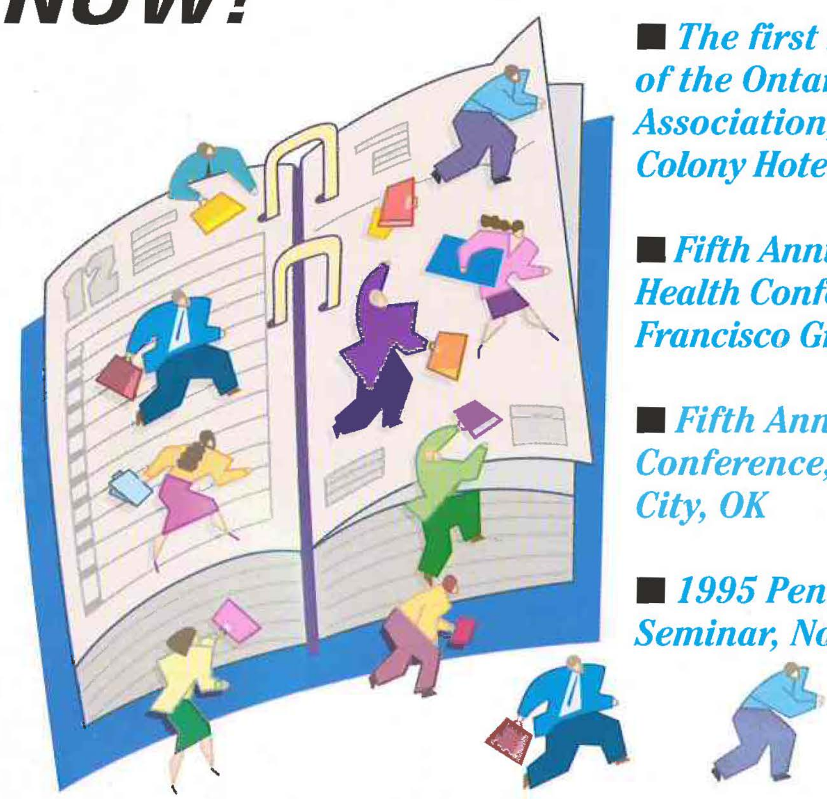

Coming events:

- *The first Health and Safety Conference of the Ontario Natural Resources Safety Association, Sept. 18-20 at the Toronto Colony Hotel, Toronto*

- *Fifth Annual International Mine Safety & Health Conference & Expo, Sept. 27-29 at Francisco Grande Resort, Casa Grande, AZ*

- *Fifth Annual Mine Health & Safety Conference, Oct. 31-Nov. 2 at Oklahoma City, OK*

- *1995 Pennsylvania Ground Control Seminar, Nov. 1 at Somerset, PA*