

UNITED STATES
DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION
Metal and Nonmetal Mine Safety and Health

REPORT OF INVESTIGATION

Underground Nonmetal Mine
Limestone (Crushed and Broken)

Fatal Powered Haulage Accident
November 17, 2008

Douds Stone Inc.
Lyle Underground Mine
Hedrick, Keokuk County, Iowa
Mine ID No. 13-02213

Investigators

Thaddeus J. Sichmeller
Mine Safety and Health Inspector

F. Terry Marshall
Mechanical Engineer

Originating Office
Mine Safety and Health Administration
North Central District
515 W. First Street, Room 333
Duluth, MN 55802-1302
Steven M. Richetta, District Manager



Victim working here.

OVERVIEW

Robert G. Gire, mechanic, age 67 was fatally injured on November 17, 2008, when he was struck by a front-end loader. Gire was repairing a bent gate post along a haul road leading to the underground mine portal. The front-end loader approached to assist in the repair work and went out of control, striking him.

The accident occurred because the front-end loader's service brake system was not being maintained in a functional condition. The service brakes on the front-end loader did not hold it on a grade. The policies and procedures were inadequate because examinations of the front-end loader failed to identify all safety defects.

Portions of the warning system for the on-board Electronic Monitoring System (EMS) of the front-end loader were inoperative. The audible fault alarm was disconnected and the main fault light located in the cab was not functional. The in-cab fault test panel was not tested to verify warning devices functioned prior to placing the loader in service. A properly operating EMS would have provided the loader operator a warning for the service brake condition. The front-end loader operator's manual requires immediate shutdown of operation to prevent injury to the operator when warned by the EMS.

GENERAL INFORMATION

Lyle Underground Mine, an underground limestone mine owned and operated by Douds Stone Inc., was located in Hedrick, Keokuk County, Iowa. The principal operating official was Gary L. Yates, president. The mine normally operated one, 10-hour shift a day, five days per week. Total employment was 14 persons.

Limestone was drilled, blasted, and loaded by a front-end loader into haul trucks. The material was hauled to a processing facility located on the surface. The material was crushed, sized, and stockpiled. The finished product was sold for various construction and agricultural purposes.

The last regular inspection at this operation was completed on October 15, 2008.

DESCRIPTION OF THE ACCIDENT

On the day of the accident, Robert G. Gire (victim) reported to work at 6:00 a.m., his normal starting time. Gire and Cory Warner, assistant mechanic, checked fluids and started the haul truck fleet. The day progressed with various tasks, lunch, and a safety meeting.

At approximately 2:30 p.m., Brian Campbell, foreman, told Gire and Warner that repairs needed to be made to a gate that wouldn't close properly because the post was bent. The gate post was bent on November 14, 2008, when it was struck by a front-end loader cleaning up the haul road leading to the underground entrance.

Gire and Warner went to the area in a service truck and Campbell traveled in another truck. Gire and Warner dug around the bent post, started heating it, and hooked the service truck's crane to the post. They then attempted to straighten the post by pulling it with the crane. Since this attempt was unsuccessful, they decided to use a front-end loader to steady the post while pulling it with the crane.

Campbell left to get a front-end loader that was parked near the office. Gire and Warner remained at the gate, continuing to heat the post.

Before Campbell arrived with the front-end loader, the torch Gire and Warner were using ran out of acetylene. Campbell returned to the gate area and then used the front-end loader to transport the empty acetylene cylinder to the shop. He picked up a full cylinder, returned to the area, and parked the front-end loader on the passenger side of the service truck. The acetylene cylinder was unloaded and connected to the torch.

Gire and Warner walked to the gate post. Gire resumed heating the post while Warner manned the controls of the crane. Campbell drove the front-end loader around the service truck and stopped to talk with Brian Veldhuizen, mine superintendent, who had just arrived. Campbell turned off the engine and kept the brake pedal depressed. He remained in the cab and talked briefly with Veldhuizen.

About 3:30 p.m., Campbell started the front-end loader and traveled toward the post. He maneuvered the front-end loader around the driver's side of the service truck and then turned facing down the haul road where Gire was standing. Campbell noticed Gire still heating the post. He depressed the left service brake pedal but the front-end loader would not stop. Campbell tried depressing the right service brake pedal but the front-end loader would not stop. Campbell realized the front-end loader could not stop and was headed toward Gire and the bermed embankment. Warner yelled to Gire because he did not see the approaching front-end loader. Campbell steered away to the other side of the haul road but the front-end loader struck Gire.

Employees in the area called for assistance on the radio and tried to assist Gire but he was non-responsive. A scale operator heard the call on the radio and called for emergency medical assistance.

The Keokuk County Sheriff's Department and emergency medical services responded but found the victim non-responsive. Gire was pronounced dead by a responding paramedic. Death was attributed to blunt force trauma.

INVESTIGATION OF THE ACCIDENT

The Mine Safety and Health Administration (MSHA) was notified of the accident at 3:35 pm, November 17, 2008, by a telephone call to the National Call Center from Brian Veldhuizen, mine superintendent. George Schorr, special investigation supervisor, was notified and an investigation began the same day. An order was issued pursuant to Section 103(k) of the Mine Act to ensure the safety of the miners.

MSHA's accident investigation team traveled to the mine, conducted a physical examination of the accident scene, interviewed employees, and reviewed documents and work procedures relative to the accident. MSHA conducted the investigation with the assistance of mine management, employees, Altorfer personnel, and the State Medical Examiner's office.

DISCUSSION

Location of the Accident

The accident occurred on the surface along a haul road leading to the underground mine entrance. The road was approximately 25 feet wide and had a 12 percent grade. The road was well maintained and dry.

Front-end Loader

The front-end loader involved in the accident was a 1986 Caterpillar 950B equipped with an enclosed cab, a Caterpillar 3304 diesel engine, a loader bucket, and an automatic-type transmission with four speeds forward and reverse.

The front-end loader was equipped with an Electronic Monitoring System (EMS) in the operator's cab which consisted of an indicator panel with individual light indicators (see Photo No. 1), a fault light (see Photo No. 2), and an audible fault warning alarm. Sensors and/or switches provided feedback to the EMS to determine what type of fault was present and what the operating conditions were so the system could provide the appropriate fault warning level to the operator.

Three types of fault warning levels, warning levels 1, 2 and 3, were included in the system. A warning level 1 fault activated only the respective individual fault light indicator on the indicator panel. A warning level 2 fault activated the individual fault light indicator and the main fault light. A warning level 3 fault activated the individual fault light indicator, the main fault light, and an audible fault warning alarm.

The operator's manual stated that a warning level 3 fault "requires immediate shutdown of operation to prevent injury to the operator and/or severe damage to the system and/or vehicle".

The service brakes were hydraulically applied caliper disc brakes at all four wheel positions controlled by either of two foot pedals. The left foot pedal neutralized the transmission in addition to applying the service brakes while the right foot pedal only applied the service brakes. The system used a single circuit air system to control two air-over-hydraulic brake converters. One brake converter supplied hydraulic pressure to the front axle service brakes and the other converter supplied hydraulic pressure to the rear axle service brakes.

The service brake system had a 'brake oil pressure' fault indicator system which sensed if either of the two brake converters over-stroked while the service brakes were applied. This system was to alert the operator that the service brake

system had experienced a problem in the brake's hydraulic system that needed to be addressed. Each of the two brake converters had an over-stroke pin and switch arrangement to determine if an over-stroke condition was encountered (see Photo No. 3). Once the hydraulic master cylinder reached a stroke near its maximum stroke range, the over-stroke pin would manually actuate, causing the switch to cycle and trigger a warning level 3 fault with the engine running.

This warning level 3 fault included illumination of the "brake oil pressure" fault indicator, main fault light illumination and sounding of the audible warning alarm. The pin arrangement was designed for the pin to remain in the over-stroke position (and thus a warning level 3 fault with the engine running) until the pin was manually reset by pushing it back into the brake converter housing. Recurrence of an over-stroke condition after resetting the over-stroke pin would alert a person that further troubleshooting to the service brake's hydraulic system was necessary.

The parking brake was a spring applied air release drum brake acting on the driveline of the front-end loader. It was manually controlled by a push-pull control valve mounted below the steering wheel. The parking brake valve monitored the air system pressure and automatically applied the parking brake in the event the air pressure fell below 40 pounds per square inch (PSI).

Initial visual examination of the front-end loader revealed that the over-stroke pins for both the front and rear brake converters were extended and the "brake oil pressure" indicator was illuminated when the key was turned on without starting the engine. The indicator also stayed illuminated when the engine was running. Electrical tests on the "brake oil pressure" circuit indicated the over-stroke switch for the front axle service brakes was defective because it was electrically open regardless of the position of the switch (depressed or released). The electrical circuit for the indicator was configured that when a condition caused an electrically open circuit, the "brake oil pressure" light would illuminate and a warning level 3 fault would occur provided the engine was running.

Additionally with these conditions, a main fault light would illuminate and an audible warning alarm would sound in the cab.

The defective over-stroke switch for the front brake converter was electrically bypassed for testing purposes. With this condition, the over-stroke switch arrangement for the rear brake converter electrically functioned because it turned on the "brake oil pressure" indicator when the over-stroke pin was extended from the converter housing. The indicator was not illuminated when the over-stroke pin was manually reset (pushed back into the converter housing).

However, investigators determined that with the engine running, the main fault light did not illuminate and the audible warning alarm did not sound when a warning level 3 fault condition existed. Observations and tests indicated that the

bulb for the main fault light was defective and the audible warning alarm's wire harness was disconnected at the electrical connector for the alarm itself (see Photo No. 4). With the engine running and the "brake oil pressure" indicator on, power was being supplied by the bulb socket for the main fault light. The audible warning alarm sounded after the electrical plug was reconnected.

Observations indicated that the brake fluid reservoirs for the front and rear brake converters were approximately $\frac{2}{3}$ full and $\frac{1}{2}$ full of brake fluid, respectively. The hydraulic brake system did not have any external fluid leaks.

Pressure tests and visual observations of hydraulic brake system components indicated that both the front and rear master cylinders had internal problems which allowed both systems to intermittently lose hydraulic pressure, resulting in ineffective brake pressures for the respective axles.

When tested, the over-stroke pins for both the front and rear brake converters would extend when the service brakes were applied and held for extended periods of time. Hydraulic pressure in the front brake system typically bled down soon after brake application. Hydraulic pressure in the rear brake system typically maintained pressure for extended periods of time, even with the rear brake converter's over-stroke switch actuated.

During the hydraulic tests in which the brake converters did maintain pressure, the converters were achieving converter ratios of up to 15 to 1, slightly less than the 16 to 1 converter ratio, Caterpillar specifications, but within a range capable of producing effective braking. The conditions observed indicated that a loss of both the front and rear service brakes could occur simultaneously after the brakes were applied and held for an extended period of time. Prior to the accident and with this condition, the front-end loader was operating mainly with only the rear brakes whenever the service brakes (foot pedal brakes) were applied and held.

The master cylinders were removed from the loader and disassembled. Visual inspection of the internal components indicated there were no broken or missing components but some of the components showed visual signs of varying degrees of normal wear. These observations and the results of hydraulic pressure tests indicated that the intermittent failures of both master cylinders appeared to be due to varying degrees of normal wear which adversely affected the sealing capability of some of the pressure seals, allowing fluid to bleed back through the seal interfaces to cause a loss of effective hydraulic pressure.

Both the right and left service brake foot pedals moved throughout their ranges without sticking or binding, spring returned when released, and modulated the air pressure to the brake converters when tested.

The parking brake control was intact and cycled the parking brake when tested. Parking brake tests indicated that the parking brake held the loader on the 12 percent grade on the haul road in the accident area.

When tested, the parking brake control automatically applied the parking brake when the loader's air pressure fell to approximately 30 PSI, approximately 10 PSI below Caterpillar specifications of 40 PSI.

Tests indicated that the air system pressure would maintain between 90-110 PSI with the parking brake released, the engine running at low idle, and the service brakes applied using either the right or left foot pedals.

Tests indicated that the "brake air pressure" indicator illuminated when the air system pressure fell to approximately 70 PSI, approximately 5 PSI higher than Caterpillar specifications. With a fully functional EMS warning system, a low air pressure condition would also provide a warning level 3 fault response with the engine running ("brake air pressure" fault indicator illumination, main fault light illumination and audible warning alarm).

Weather Conditions

The weather on the day of the accident was partly cloudy with an air temperature of 35 degrees Fahrenheit. Weather was not considered to be a factor in the accident.

Training and Experience

Robert G. Gire had 36 years of mining experience. He had 30 years of experience as a mechanic, previous experience in the military as a mechanic, and worked at this mine 12 years. Gire had been trained in accordance with 30 CFR, Part 48.

Brian Campbell had 11 years and 8 months of mining experience and was experienced in operating front-end loaders at the mine. He had been trained in accordance with 30 CFR, Part 48.

ROOT CAUSE ANALYSIS

A root cause analysis was conducted and the following root cause was identified:

Root Cause: Management policies and procedures were inadequate and failed to ensure that all braking systems on the front-end loader were maintained in a functional condition. Thorough inspections by the equipment operators were not conducted before the front-end loader was placed in operation.

Corrective Action: Procedures should be established to ensure that all mobile equipment is thoroughly inspected for defects before being placed in service each shift. Mobile equipment operators should be trained and knowledgeable in identifying safety defects. The procedures should require mobile equipment with safety defects to be removed from service until repairs have been made.

CONCLUSION

The accident occurred because the front-end loader's service brake system was not being maintained in a functional condition. The service brakes on the front-end loader did not hold it on a grade. The policies and procedures were inadequate because examinations of the front-end loader failed to identify all safety defects.

Portions of the warning system for the on-board Electronic Monitoring System (EMS) of the front-end loader were inoperative. The audible fault alarm was disconnected and the main fault light located in the cab was not functional. The in-cab fault test panel was not tested to verify warning devices functioned prior to placing the loader in service. A properly functioning EMS would have provided the loader operator a warning level for the service brake conditions encountered which, according to the operator's manual, "requires immediate shutdown of operation to prevent injury to the operator and/or severe damage to the system and/or vehicle".

ENFORCEMENT ACTIONS

Order No. 7840574 was issued on November 18, 2008, under the provisions of Section 103(k) of the Mine Act:

A fatal accident occurred at this operation on November 17, 2008 when a miner was struck by a Caterpillar 950B front-end loader. This order is issued to assure the safety of all persons at this operation. It prohibits all operation of the Caterpillar 950B front-end loader, Serial #22Z02524, until MSHA has determined that it is safe to resume operations with this loader. The mine operator shall obtain prior approval from an authorized representative for all actions to recover and/or restore operations in the affected machine.

The order was terminated on November 25, 2008, after conditions that contributed to the accident no longer existed.

Citation No. 6407174 was issued on January 26, 2009, under the provisions of Section 104(a) of the Mine Act for violation of 30 CFR 57.14100(a):

A fatal accident occurred at this mine on November 17, 2008, when a mechanic was struck by a front-end loader when its service brakes failed. The front-end loader was being positioned on a downhill grade to assist in repairing a bent gate post and struck the victim who was standing near the gate post. The front-end loader had not been adequately inspected prior to being placed in service that shift. The in-cab fault test panel was not tested prior to putting the front-end loader in service. The audible fault alarm was found disconnected. The main fault light located in the cab wasn't functional. The operator of the front-end loader and other miners stated that they did not use the in-cab fault test panel during pre-op checks and claimed that they had not been trained to utilize the fault test panel provided by the manufacturer as a safety feature.

The citation was terminated on February 3, 2009. Management reviewed with all persons the policy of conducting thorough pre-shift examinations of mobile equipment that includes checking all safety features provided by the manufacturer.

Citation No. 6407175 was issued on January 26, 2009, under the provisions of Section 104(a) of the Mine Act for violation of 30 CFR 57.14100(b):

A fatal accident occurred at this mine on November 17, 2008, when a mechanic was struck by a front-end loader when its service brakes failed. The front-end loader was being positioned on a downhill grade to assist in repairing a bent gate post and struck the victim who was standing near the gate post. The front-end loader was equipped with an electronic monitoring system that contained fault lights and an audible warning device to alert the equipment operator that the brakes were defective. The audible warning alarm was disconnected. The main fault light was inoperative. The defective warning light and disabled fault alarm were defects affecting safety that were not corrected in a timely manner.

The citation was terminated on February 3, 2009. Management reviewed with all persons the policy of checking for safety defects and timely repair of safety defects.

Citation No. 6407176 was issued on January 26, 2009, under the provisions of Section 104(a) of the Mine Act for violation of 30 CFR 57.14101(a)(1):

A fatal accident occurred at this mine on November 17, 2008, when a mechanic was struck by a front-end loader when its service brakes failed. The front-end loader was being positioned on a downhill grade to assist in repairing a bent gate post and struck the

victim who was standing near the gate post. The operator attempted to apply the brakes prior to striking the victim but components of the service brake system were defective. The master cylinders were exhibiting over-stroke conditions to indicate defects to the hydraulic side of the service brakes. This defect rendered the service brake system incapable of stopping and holding the front-end loader. An audible fault warning alarm located in the cab was disconnected. The main fault light located in the cab wasn't functional.

The citation was terminated on January 27, 2009. The front and rear master cylinders were replaced after the accident. The brakes on the front-end loader were tested and were capable of stopping and holding the equipment on the maximum grade it travels.

Approved by:

Date: February 17, 2009



Steven M. Richetta
District Manager
North Central District

LIST OF APPENDICES

APPENDIX A – Persons Participating in the Investigation

APPENDIX B – Photos

APPENDIX C – Accident Investigation Data-Victim Information Form

APPENDIX A

Persons Participating in the Investigation

Douds Stone Inc.

Carl McRoy	safety director
Brian Veldhuizen	mine superintendent
Brian Schultz	environmental technician
Cory Warner	assistant mechanic
Dustin Reyes	quality control

Altorfer, Inc.

Larry Shaull	mechanic
Stan Meader	mechanic

Iowa State Medical Examiner's Office

Dennis Klien	deputy state medical examiner
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Keokuk County Health Center

Lynn Reasor	Keokuk County medical examiner-investigator
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Mine Safety and Health Administration

Thaddeus Sichmeller	mine safety and health inspector
F. Terry Marshall	mechanical engineer

APPENDIX B

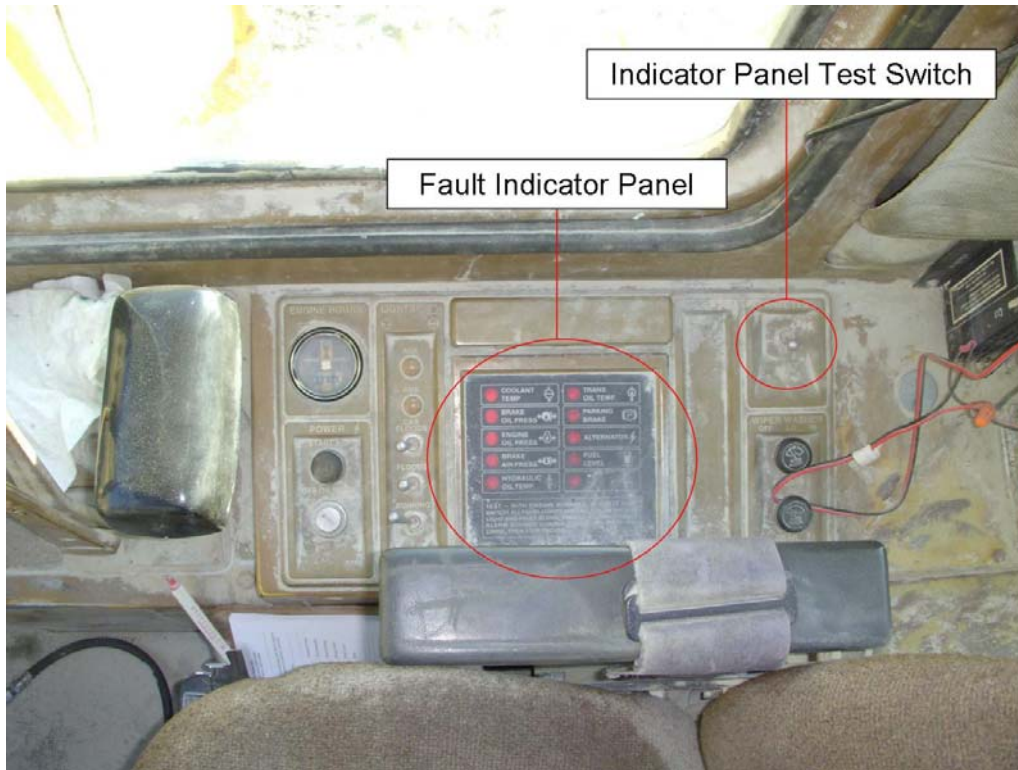


PHOTO No. 1: Fault Indicator Panel on Right Side of Operator's Seat



PHOTO No. 2: Main Fault Light in the Forward Right Area of the Operator's Compartment

APPENDIX B

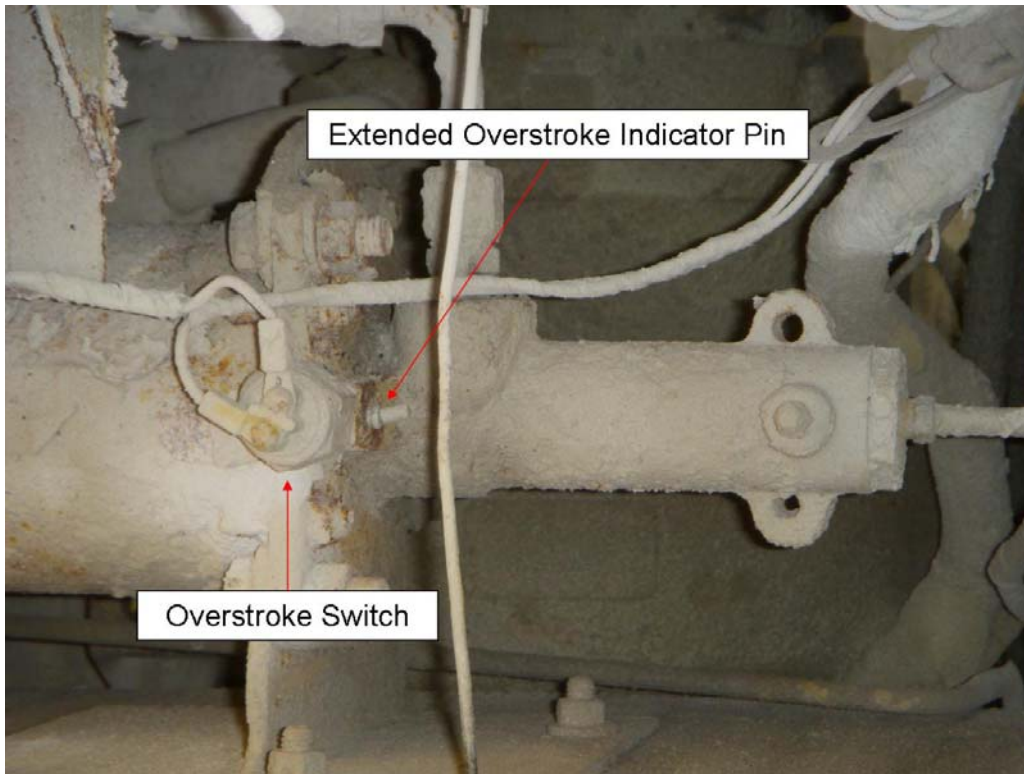


Photo No. 3: Example of Overstroke Arrangement on Brake Converter for "Brake Oil Pressure" Fault Indicator

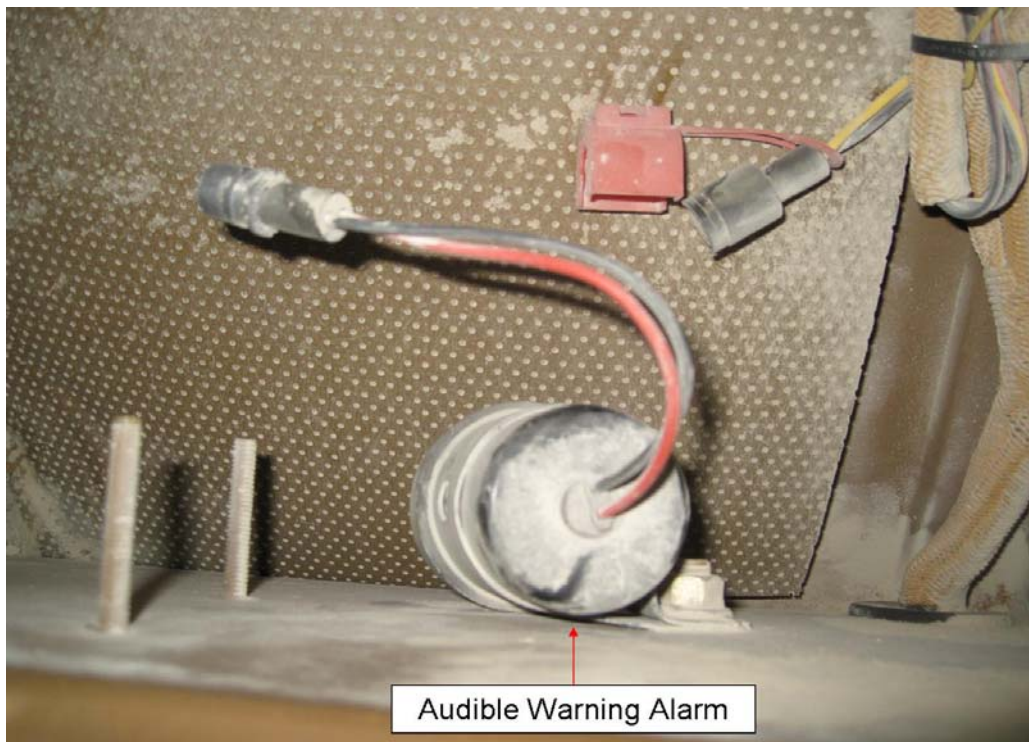


Photo No 4: Condition of Electrical Connection for Warning Level 3's Audible Alarm

APPENDIX C

Accident Investigation Data - Victim Information

U.S. Department of Labor
Mine Safety and Health Administration



Event Number:

7	0	1	2	6	3	8
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Victim Information: 1															
1. Name of Injured/Ill Employee: <i>Robert G. Gire</i>				2. Sex <i>M</i>		3. Victim's Age <i>67</i>		4. Degree of Injury <i>01 Fatal</i>							
5. Date(MM/DD/YY) and Time(24 Hr.) Of Death: <i>a. Date: 11/17/2008 b. Time: 16:00</i>								6. Date and Time Started: <i>a. Date: 11/17/2008 b. Time: 6:30</i>							
7. Regular Job Title: <i>004 Mechanic</i>				8. Work Activity when Injured: <i>032 Straightening gate post</i>				9. Was this work activity part of regular job? Yes <input type="checkbox"/> X No <input type="checkbox"/>							
10. Experience			a. This			b. Regular			c. This			d. Total			
Years	Weeks	Days	Years	Weeks	Days	Years	Weeks	Days	Years	Weeks	Days	Years	Weeks	Days	
30	0	0	30	0	0	12	0	0	36	0	0				
11. What Directly Inflicted injury or illness? <i>076 Front-end Loader</i>								12. Nature of Injury or Illness: <i>370 Blunt force trauma</i>							
13. Training Deficiencies:															
Hazard:				New/Newly-Employed Experienced Miner:				Annual:				Task:			
14. Company of Employment: (If different from production operator) <i>Operator</i>															
Independent Contractor ID: (if applicable)															
15. On-site Emergency Medical Treatment:															
Not Applicable:				First-Aid:		CPR:		EMT:		Medical Professional:		None:			
										X					
16. Part 50 Document Control Number: (form 7000-1)								17. Union Affiliation of Victim: <i>9999</i>							
<i>None (No Union Affiliation)</i>															