CAI-2004-07

UNITED STATES
DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION

COAL MINE SAFETY AND HEALTH

REPORT OF INVESTIGATION

Underground Coal Mine

Fatal Machinery Accident
April 3, 2004

Mercer Deep Mine
Brooks Run Mining Company, LLC
Erbacon, Webster County, West Virginia
I.D. No. 46-08875

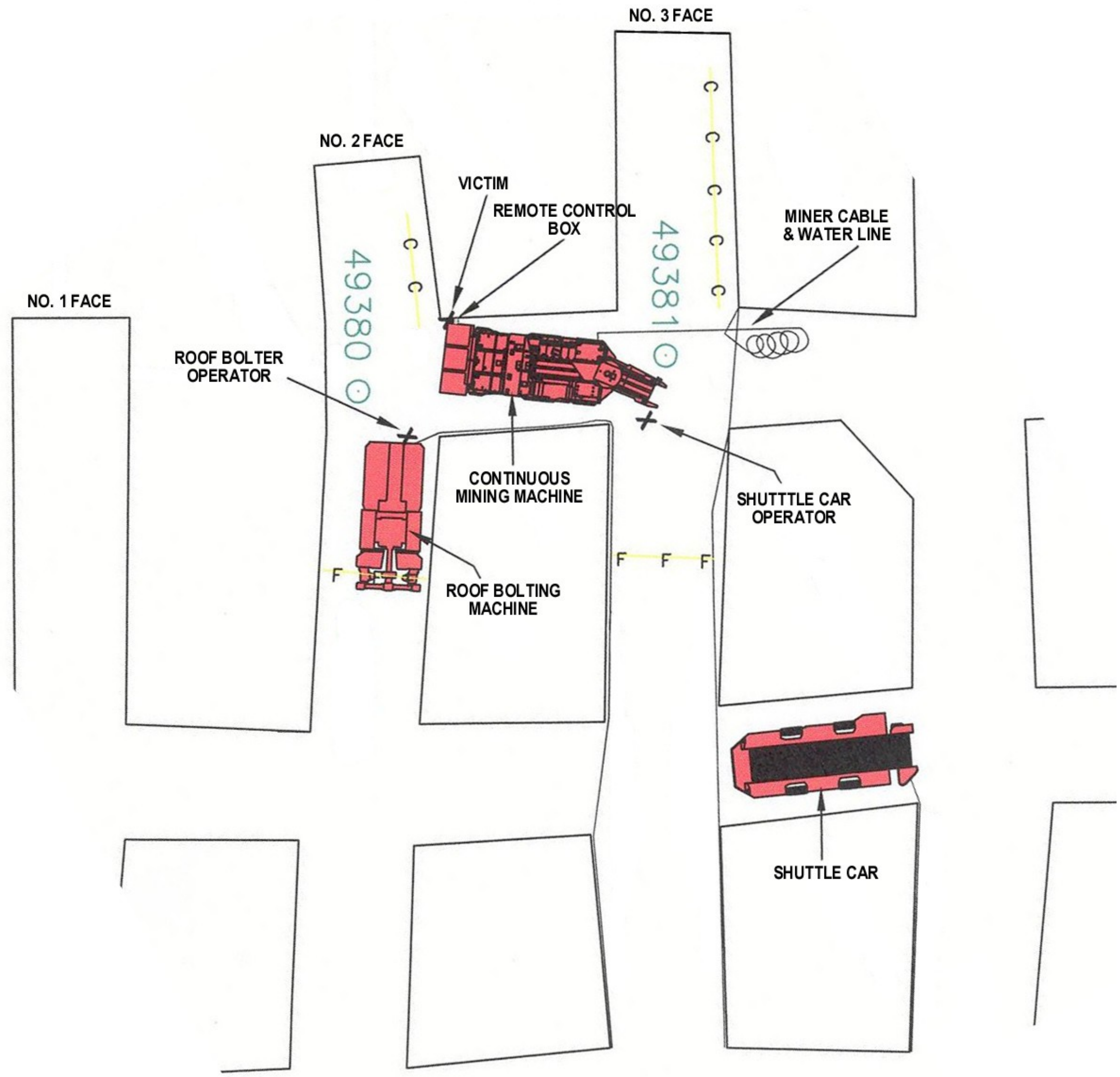
Accident Investigators

Roger D. Richmond
Accident Investigator/Coal Mine Safety and Health Inspector

William L. Sperry
Coal Mine Safety and Health Inspector (Electrical)

Originating Office
Mine Safety and Health Administration
District 4
100 Bluestone Road
Mt. Hope, West Virginia 25880
Jesse P. Cole, District Manager

TABLE OF CONTENTS



C - Check Curtain
F - Fly Curtain

Fatal No. 7
April 3, 2004
Brooks Run Mining Company LLC
Mercer Deep Mine
46-08875

Not to Scale

OVERVIEW

At 11:40 p.m., on Saturday, April 3, 2004, a 47-year old continuous mining machine operator with 29 years of mining experience was fatally injured at the Brooks Run Mining Company, LLC's Mercer Deep Mine. The accident occurred while William Brady, Continuous Mining Machine Operator, was tramming the continuous mining machine in high speed through the No. 3 left crosscut. Brady was positioned in a hazardous location and was pinned between the ripperhead of the continuous mining machine and the right (inby) coal rib of the No. 3 left crosscut.

The accident occurred because the victim was positioned in a hazardous location while tramming the continuous mining machine in high tram speed. The victim's position resulted from a failure to comply with approved roof control plan.

GENERAL INFORMATION

The Mercer Deep Mine is located in Webster County, south of the community of Erbacon, West Virginia. The mine extracts coal from the Upper Mercer coal seam. This is a one section mine, consisting of two Joy 12CM27 continuous mining machines, two dual-head Fletcher roof bolt machines, three 10SC32 shuttle cars, one S&S 602 scoop, one Fairchild scoop, one DBT 488 scoop, and one Stamler Feeder-Breaker.

The Lower Kittanning coal seam has been mined approximately 90 feet above the Mercer Deep Mine. The Upper Kittanning coal seam is approximately 190 feet above the Mercer Deep Mine.

The fatal machinery accident occurred on the No. 1, Fifth Left, North Mains working section. Access to the accident site is via track. The entries on the No. 1 section are being developed 50-feet apart, with crosscuts connecting the entries every 60-feet of entry length. Entries are normally 20 feet in width. The coal seam height is 124 inches in the No. 2 entry at the accident site.

The No. 1 section is ventilated by a single intake split sweeping the air from right (No. 8 entry) to left (No. 1 entry), across the faces. One continuous mining machine is permitted to mine coal at any given time when using this method of ventilation.

The principal officers for the Brooks Run Mining Company, LLC, at the time of the accident were:

Samuel R. Kitts, President
Eddie W. Keely, Secretary
John Pearl, Treasurer

Prior to the accident, the Mine Safety and Health Administration (MSHA) completed the last regular safety and health inspection on March 31, 2004.

The Non-Fatal Days Lost (NFDL) injury incidence rate for the mine in 2003 was 14.06, compared to the national NFDL rate of 5.93 in 2003 for underground coal mines.

DESCRIPTION OF ACCIDENT

On Saturday, April 3, 2004, at approximately 4:00 p.m., the No. 1 section evening shift crew entered the mine via the track entry, accompanied by the Section Foreman, Brian Carpenter. Carpenter and the crew traveled approximately 7,000 feet to the working section. Upon arriving, at approximately 4:20 p.m., the crew began working at their respective jobs.

The right side Continuous Mining Machine Operator, John A. Cochran, began mining a scrap cut in the No. 5 face. When Cochran finished mining in the No. 5 entry, William Brady, left side Continuous Mining Machine Operator, (victim) began mining in the No. 2 face. The crew followed a normal mining sequence until the accident occurred.

At 11:00 p.m., approximately 40 minutes prior to the accident, Brady backed the left continuous mining machine out of the No. 3 left crosscut and into the No. 4 left crosscut. Robert Williams, left side Roof Bolt Machine Operator, trammed the roof bolt machine into the No. 3 left crosscut where he and Lowell Carpenter, Roof Bolt Machine Operator Helper, began to install roof supports. When they were ready to install the last two rows of bolts, Brady assisted them by tramming the bolt machine forward. This allowed Williams and Carpenter to stay at their work positions on the walkthrough roof bolt machine. After installing the last row of bolts, Williams trammed the roof bolt machine around the corner outby the intersection in the No. 2 entry. (See sketch)

Positioned behind the left continuous mining machine, Brady trammed the machine into the No. 3 left crosscut. He stopped the machine about 8 feet from the No. 2 intersection. With the pump motor still running, Brady walked between the machine and the right rib to the No. 2 intersection. Williams and Carpenter were in the No. 2 face installing a section of line curtain along the right rib, inby the crosscut, for a distance of approximately 20 feet. Brady told Williams not to hang the curtain. Williams told Brady that he had to hang the curtain, but that he would fold the curtain up out of the way.

As Williams walked back to the roof bolting machine after he finished folding up the curtain, he heard the continuous mining machine pump motor shut off. Williams turned and saw Brady walking from the No. 2 entry around the inby corner of the crosscut, toward the continuous mining machine. Stephen Rider, Shuttle Car Operator, walked up the No. 3 entry and asked Brady if he was ready to start mining. Brady replied, "just a second old buddy." Williams and Rider heard the continuous mining machine start up and rumble three times, as though it was in fast speed and immediately shut off. Both men recalled that the machine did not run more than a couple of seconds.

Williams and Rider saw the continuous mining machine tram forward and pin Brady between the ripperhead and the right rib. Williams ran to Brady and checked for a pulse, but could not detect one. Unable to free Brady, Williams ran around the continuous mining machine and approached Brady from the other side of the machine. He wanted to use the remote control box to move the continuous mining machine to free Brady, but found it pinned between the ripperhead and Brady. Williams knocked the remote control box out of Brady's hands, but due to the damage sustained in the accident, it failed to operate the continuous mining machine.

At this time, B. Carpenter, section foreman, was operating a shuttle car in the number 5 entry, when he was notified that something was wrong. Williams went to the right side of the section and notifies Cochran, right continuous miner operator of the accident. Cochran then attempted to use the left continuous mining machine's manual controls in order to free Brady. He engaged one of the tracks, but the machine would not move. Cochran decided against engaging both tracks, because he was concerned with causing further injury to Brady.

B. Carpenter decided to use the shuttle cars and a chain to move the continuous mining machine away from Brady. The No. 1 shuttle car pulled the ripperhead end of the continuous mining machine while the No. 2 shuttle car pushed the boom end of the machine toward the right rib, slewing the machine away from the victim.

The victim was placed on a backboard and transported along the mine track to the surface, where the Webster County Ambulance Service was waiting. The victim was transported to the Webster County Hospital in Webster Springs, West Virginia, where he was pronounced dead at 12:44 a.m. by Dr. Kawi. The victim was then transported to the Charleston Medical Examiner's Office in Charleston, West Virginia.

INVESTIGATION OF THE ACCIDENT

MSHA was notified at 12:25 a.m. on April 4, 2004, that a serious accident had occurred. MSHA accident investigators were dispatched to the mine. A 103 (k) order was issued to insure the safety of all persons at the mine. The investigation was conducted in cooperation with the West Virginia Office of Miners' Health, Safety, and Training (WVMHST), with the assistance of the operator and employees.

An investigation of the physical conditions at the accident site was conducted. Photographs and relevant measurements were taken and a sketch of the accident scene was made.

The physical portion of the investigation was completed on April 8, 2004. Interviews were conducted with persons who had knowledge of the accident on April 5, 2004, at the Brooks Run Preparation Plant conference room, Erbacon, West Virginia. A list of those persons who participated, were interviewed, and/or were present during the investigation, can be found in Appendix A of this report.

DISCUSSION

Location of the Accident

The fatality occurred on the north main, off of the Fifth Left panel of the No. 1 working section, in the No. 3 left crosscut, between Survey Station Nos. 49380 and 49381, at approximately 11:40 p.m., on April 3, 2004.

Equipment Involved

The continuous mining machine involved in the accident was a Joy remote-controlled Model 12CM-27, Serial No. JM5370, MSHA Approval 2G-4023A-00.

The remote control unit being used for this continuous mining machine at the time of the accident was a Matric Limited permissible radio transmitter, Model TX3, P/N 100112672, Serial Number 75205A0033C, MSHA Approval 2G-4096-0.

The continuous mining machine involved in the accident was field tested for possible malfunctions on April 5, 2004. Additional tests of the machine's remote control system were conducted by Matric Limited, at Seneca, Pennsylvania, under the direction of the MSHA Approval and Certification Center, Triadelphia, West Virginia on May 25, 2004 and July 19, 2004. Testing revealed no malfunctions of equipment. Test results can be found in Appendix D of this report.

Victim's Actions

Brady was preparing to mine the No. 2 left crosscut, which was directly in front of the continuous mining machine. He was going to operate the machine from the face of the No. 2 entry which would reduce his exposure to the continuous mining machine and shuttle cars as the crosscut was mined. He was ready to tram the machine across the entry to begin mining when the pump motor shut down. He walked around the corner of the crosscut toward the machine, leaving his safe position, and was seen operating the remote controls in an apparent effort to restart the machine. When Brady was approximately 4 feet from the ripperhead, the machine started and trammed in a straight line, pinning him against the rib.

Continuous Mining Machine Operation

Speed

The tram speed of the continuous mining machine contributed to the accident. The design of the continuous mining machine allows the operator to select from three tram speeds. Williams and Rider both stated that they heard the machine start up and rumble three times as if it were in fast speed (Speed 3) and then immediately shut off after a couple of seconds. Design speeds for this machine are; 15 ft/min. in Speed 1, 30 ft/min. in Speed 2, and 85 ft/min. in Speed 3. If the machine were in fast speed, as witnesses Williams and Rider both believed it to be, Brady had little time to react.

In order to determine the machine's actual tramming speeds, the time for the machine to travel from its estimated starting point to ending point (approximately 4 feet) was measured as tabulated below:

Tram Condition	Time
Speed 1	12 seconds
Speed 2	5.5 seconds
Speed 3	2.5 seconds

Signal Loss

Williams heard the continuous mining machine pump motor shut off. A loss of transmission signal between the remote control unit and the continuous miner would cause the machine to shut down. It is not known why Brady left his safe location in the No. 2 entry, however, it is possible that he was attempting to restart the machine. Witnesses said that the machine unexpectedly shut down earlier in the shift when Brady was positioned on the left side of the machine. The cause of the shut down is unknown as are Brady's actions to restart the machine.

During performance testing of the machine after the accident, the pump motor inadvertently de-energized on one occasion. This was caused by loss of power to the remote control unit and was corrected by readjustment of the slider portion of the remote control power cord to the battery power take-off (PTO). The battery was located in the operator's coat pocket during the testing, which may have placed added strain on the connection. The Company Maintenance Superintendent indicated that the operators typically used yellow wire to secure the battery to the handles of the remote control. Yellow wire was found around the right side handle of the victim's remote control unit.

A battery recovered at the accident scene (believed to be the one used by the victim), when used with a spare remote control, operated the machine from around the corner where the victim was first positioned, without loss of signal.

Operator Disorientation

Operator disorientation was considered as a possible contributing factor during the investigation. Operator disorientation can occur as the operator moves to different locations around the machine.

Remote-controlled continuous mining machine operators normally operate from a position behind or to the side, looking toward the front of the machine. At the time of the accident, the victim was standing in front, looking toward the rear of the machine, creating the possibility of operator disorientation.

Operating the machine from the front can result in right or left machine movement that is opposite to what the operator intends.. Right and left movement of the machine is accomplished by splitting the tracks (one track moves forward, the other backward). From behind the machine, pushing the left lever forward, pulling the right lever backwards turns the machine to the operator's right. From in front, looking toward the rear of the machine, the same movement of the control levers moves the machine to the operator's left.

Operator disorientation is generally not as significant in forward and reverse machine movement. Pushing the levers forward always causes the machine to move forward, pulling the levers backward causes the machine to move in reverse, regardless of operator position.

There is no indication that operator disorientation contributed to the accident. Physical evidence and witness statements show that the continuous mining machine moved in a straight line toward the victim. This shows that Brady did not operate the controls in a manner to cause the machine to move right or left.

Victim's Operating Location

Brady's proximity to the machine violated the approved roof control plan which prohibited prohibiting persons from being near the continuous mining machine while tramming. The approved roof control plan general safety precautions, Page 5, Item No. 14 states:

> "Persons shall be in a safe location from the continuous mining machine while tramming in the remote mode, so miners will not be endangered by the machine."

Interviews with miners revealed that the requirements and safety precautions of the approved roof control plan were frequently discussed during weekly safety meetings. All miners interviewed were aware of, understood, and said they followed the safety precaution. The miners indicated that they had "never seen the victim place himself in an unsafe location."

ROOT CAUSE ANALYSIS

A root cause analysis was conducted to identify the most basic causes of the accident that were correctable through reasonable management controls. During the analysis, casual factors were identified that, if eliminated, would have either prevented the accident or mitigated its consequences.

Listed below are causal factors identified during the analysis and their corresponding corrective actions implemented to prevent a recurrence of the accident.

<u>Causal Factor</u>: The approved roof control plan was not being complied with when the continuous mining machine operator was positioned in a hazardous location and was pinned between the ripperhead of the continuous mining machine and the coal rib. The approved roof control plan requires persons to be in a safe location from the continuous mining machine while tramming in remote mode.

<u>Corrective Action:</u> Prior to resuming operations, training sessions were conducted by mine management, emphasizing adherence to the safety precaution. Management initiated a more stringent policy regarding the proximity of personnel to continuous mining machines. It states:

"No person shall be positioned between the continuous mining machine and the coal ribs when the continuous miner pump motor are enabled (on), including cutting and tramming and loading. The only exception to this policy is when maintenance and troubleshooting are necessary, and then the tram breakers shall be knocked, when possible. Additionally, no person shall position themselves within two (2) rows of roof bolts in front of the continuous mining machine cutting head. Section foreman duties will not include equipment operation on a regular basis."

Causal Factor: The continuous mining machine was being trammed in Speed 3 (High) at the time of the accident. This resulted in the victim having little time to react to the machine's movement due to his hazardous position.

Corrective Action: Training on the functions of the radio remote-control and machine speed settings was given to all persons by the chief electricians before production resumed.

CONCLUSION

The accident occurred because the victim was positioned in a hazardous location while tramming the continuous mining machine in high tram speed. The victim's position resulted from a failure to comply with approved roof control plan.

Approved By:

ORIGINAL SIGNED BY **OCTOBER 5, 2004**
Jesse P. Cole Date
District Manager

ENFORCEMENT ACTIONS

1. A 103(k) Order was issued to ensure the safety of all persons in the mine until the investigation was completed.

2. A 104(a) Citation No. 7226824, was issued to Brooks Run Mining Company, LLC, for a violation of 75.220(a)(1).

   Condition or Practice: Facts obtained during the investigation of a fatal machinery accident, that occurred on April 3, 2004, indicated that the approved roof control plan was not being complied with on the 001-0 working section. The approved roof control plan requires persons to be in a safe location from the continuous mining machine while tramming in the remote control mode. While standing in front of the continuous mining machine, the continuous mining machine operator attempted to tram the continuous miner by remote control, in the number 3-2 crosscut. The continuous mining machine operator was fatally injured when he was pinned between the cutting head of the continuous mining machine and the coal rib.

   Action to Terminate: The operator retrained and instructed all employees on the safe location of persons around mobile equipment, including continuous miners.

APPENDIX A

List of persons furnishing information and/or present during the investigation:

Brooks Run Mining Company, LLC

Richard Henderson ……………………………Mine Manager
Steve Haga ………………………….Maintenance Supervisor
Bobby Evans ……………………………….. .Chief Electrician
Brian Carpenter ……………. Second Shift Section Foreman
Richard A. Toler ………………………. Third Shift Foreman
David Hickman …………………………….... Superintendent
Steve Rider …………………………….. Shuttle Car Operator
Robert Williams …… ………… Roof Bolt Machine Operator

West Virginia Office of Miner's Health, Safety, and Training

Gary S. Snyder ………………. …………....Inspector-at-Large
Tom Harmon ……………………………...Electrical Inspector
Terry Casto …………….. … …………...Deep Mine Inspector
Lloyd Collins ……………………………Deep Mine Inspector
Mike Rutledge ………………….……………Safety Instructor

Mine Safety and Health Administration

John Pyles ……………………………Acting District Manager
Roger D. Richmond …Lead Accident Investigator/Inspector
Larry Cook ……………….. ……………..Electrical Supervisor
William L. Sperry ……………..………...Electrical Inspector
Paul Hess ……………….. …………….Field Office Supervisor
Harold Hayhurst …………...Accident Investigator/Inspector
Mike Woodrum ……………..………………………Tri-State
Joe Mackowiak …… Coal Mine Safety and Health Inspector
Chad Huntley ………………Approval & Certification Center
(Triadelphia, West Virginia)

APPENDIX B

List of Brooks Run Mining Company, LLC, personnel interviewed:

Brian Carpenter ………………………. Section Foreman
Robert Williams ………….Roof Bolt Machine Operator
Stephen Rider ……………………. Shuttle Car Operator
Nathan A. Lee ……………Roof Bolt Machine Operator
Daniel Brian Harper ……. Roof Bolt Machine Operator
Edward L. McCoin ………………. …Section Electrician
Gary Lee Brown ………………………...Scoop Operator
John A. Cochran ………… Continuous Miner Operator
Lowell Carpenter ……… Roof Bolt Machine Operator

APPENDIX C

Photographs

APPENDIX D

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

Investigative Report and Equipment Related Physical Factors for
a Fatal Accident at
Brooks Run Mining Co., LLC
Mercer Deep Mine
April 3, 2004

PAR No. 89880

Prepared By:
Chad Huntley, Electrical Engineer
August 24, 2004

-Originating Office-
Approval and Certification Center
Electrical Safety Division
David C. Chirdon, Chief
RR1, Box 251
Triadelphia, West Virginia 26059

Investigative Report and Equipment Related Physical Factors for a Fatal Accident at Brooks Run Mining Co., LLC Mercer Deep Mine

FIELD ACCIDENT INVESTIGATION PAR No. 89880

By
Chad Huntley, Electrical Engineer

LOCATION: Brooks Run Mining Co., LLC, Mercer Deep Mine, Mine I.D. No. 46-08875, Erbacon, West Virginia. This is an underground coal mine.

EMPLOYER OF ACCIDENT VICTIM: Brooks Run Mining Co., LLC

EQUIPMENT: Joy Remotely-Controlled Model 12CM, Serial No. JM5370, MSHA Approval 2G-4023A-00, Continuous Mining Machine

Remote Control System

Matric Limited Permissible Radio Transmitter, Model TX3, P/N 100112672, S/N 75205AD033C, MSHA Approval 2G-4096-0

Cap Lamp to Radio Transmitter power cord

Matric Limited Demultiplexer Panel, Model 500-200, P/N 100042863, S/N 68307AB001F, MSHA IA-457

Matric Limited Receiver, Type RX1, P/N 100016248, S/N 83808AD004D, MSHA IA-18528-0

Antenna Assembly, P/N 601843-0251, S/N 5040396-000

Koehler 5000 Series Battery

DATE OF ACCIDENT: April 3, 2004

DATES OF EQUIPMENT EVALUATION AND TESTING:
- Accident Site – April 5, 2004
- Approval and Certification Center (A&CC), Preliminary Inspection – May 19-24, 2004
- Matric Limited, Seneca, PA – May 25 and July 19, 2004 (Remote Control System)
- A&CC, Detailed Inspection – June 2-25, 2004

EQUIPMENT INVESTIGATORS:

Principal Investigator – Chad Huntley, Electrical Engineer, Electrical Safety Division, Approval and Certification Center

Wayne Colley, Electrical Engineer, Electrical Safety Division, Approval and Certification Center

Frank J. Prebeg, Electrical Engineering Technician, Electrical Safety Division, Approval and Certification Center

ACCIDENT SUMMARY: A 47-year old continuous mining machine operator with 29 years of mining experience was fatally injured when he was caught between the right side of the ripperhead and the coal rib. The machine was located between the No. 2 and No. 3 entries. The operator's intent was to mine the 2-1 crosscut straight on (not turning a crosscut). Witnesses indicated that the operator wanted to tram the machine forward, but that the pump turned off. It was believed by witnesses that the pump turned off due to a "loss of signal". At that point, the operator, who was in front of the machine around the corner, approached the machine. Witnesses indicated that the pump started and the machine began tramming in "high tram". The operator was then pinched between the ripperhead and rib.

PURPOSE OF EVALUATION: To determine if the radio remote control system components contributed to the fatality.

PHYSICAL FACTORS:

Accident Site Underground Investigation – April 5, 2004

The following persons were present during the underground investigation:

William Sperry – MSHA, Coal Mine Safety and Health, District 4
Larry Cook – MSHA, Coal Mine Safety and Health, District 4
Chad Huntley – MSHA, Technical Support
Tom Harmon – West Virginia Office of Miner's Health, Safety and Training
Bobby Evans – Chief Electrician, Brooks Run Mining Co., LLC
Steve Haga – Maintenance Superintendent, Brooks Run Mining Co., LLC

The continuous miner not involved in the fatal accident was in the No. 5 entry approximately 200 feet away. The continuous miner at the No. 5 entry was also using a Matric Type TX3 Remote Control Transmitter. The victim's remote control was not attempted to be used during underground testing because it was damaged. A spare TX3 Remote Control Transmitter obtained from the surface (S/N 75209AB025C) and the TX3 that was used with the continuous miner at the No. 5 entry (S/N 75211AC033D) were used during the underground testing.

Power was applied to both TX3s with a cap lamp battery obtained from the surface, and both were verified to be "Teach/Learned" to a frequency of 458.525 MHz, according to the TX3 Remote Operation Manual (one flash of the remote control's Frequency LED). The "Teach/Learn" process is explained in the TX3 Remote Operation Manual as being a process that sets the frequency of the remote station to the frequency of the receiver and establishes a secure communication link between the transmitter and receiver. The frequency indicated on the receiver was 458.600 MHz, therefore, both remote controls needed to be "Teach/Learned" to this frequency. Neither transmitter was able to start the machine when set to 458.525 MHZ. The spare TX3 was subjected to the "Teach/Learn" process and, after energizing the unit via the battery obtained from the surface, the transmitter was observed to be set to 458.600 MHz (four flashes of the remote control's Frequency LED). Attempts to create cross-activation of the miner at the accident scene with the two TX3 remote controls were unsuccessful as summarized below:

- The spare remote control, after being "Teach/Learned" to the accident scene receiver, was able to properly operate the continuous miner involved in the accident.

- The remote control used with the No. 5 entry continuous miner, in its original state, was not able to operate the continuous miner involved in the accident.

- The remote control used with the No. 5 entry continuous miner was then "Teach/Learned" to the continuous miner involved in the accident and set to a frequency of 458.600 MHz. This remote control was then able to properly operate the continuous miner involved in the accident.

- As soon as the remote control originally used with the No. 5 entry continuous miner and the spare remote control were transmitting at the same time, and at the same frequency, the machine pump would shut down. Interference between the two remote controls most likely caused the pump to shut down since both were transmitting approximately 10 feet from the machine's antenna.

These tests verified the remote control system would operate only with the desired transmitter and receiver. Therefore, cross-activation by the remote control transmitter for the continuous miner in the No. 5 entry was not a factor in the accident. No other sources of radio frequency (RF) signals were observed, or indicated to have been in use, near the accident scene at the time of the accident.

Matric Limited Permissible Radio Transmitter, Model TX3, 100112672, S/N 75205AD033C, MSHA Approval 2G-4096-0

The continuous mining machine, transmitter, power cord, and battery had been moved from their positions at the time of the accident to free the victim. Witnesses indicated that two shuttle cars, one pushing on the boom and another pulling on the ripperhead, were used to slew the continuous miner and free the victim. Witnesses indicated that they first attempted to use the onboard controls, but instead used two shuttles cars to free the victim. The onboard manual controls were verified to operate properly. The distance from the ripperhead to the rib after being slewed by the shuttle cars was 17.5 inches. From impressions in the mine floor, the continuous mining machine gathering pan appeared to have been slewed approximately 3 inches by the shuttle cars.

The only cap lamp battery found in the area, believed to be the victim's, was found on top of the right rear corner of the machine and not connected to the transmitter. It is uncertain whether this was the battery being used at the time of the accident. The battery measured 4.08 volts between pins C and F with no load. The transmitter was severely damaged. The top switch panel was buckled, and a large section of plastic on the bottom of the enclosure was missing, exposing the internal circuit board. A section of the harness, for carrying the remote control, was recovered at the scene. It appeared to have been cut, most likely to free the victim.

It was not possible to determine the position of each switch on the remote control at the time of the accident, since all switches return to the neutral position when released. Witnesses indicated that immediately after the accident the tram motors and pump motor were OFF, the machine lights were ON, and a red light on the transmitter was ON. The LEDs on the front panel of the transmitter, with colors indicated in parentheses, are as follows: TX Fault/Test (red), Low Batt (red), Frequency (green), Teach/Learn (green), On/Data (green), Speed 3 (red), Speed 2 (green), and Tram Enable (green).

<u>Matric Limited Demultiplexer Panel, Model 500-200, P/N 1000042863, S/N 68307AB001F, MSHA IA-457</u>

The Demultiplexer Panel was mounted in an explosion-proof enclosure. The Demultiplexer Panel appeared to be clean, undamaged, and unmodified. All connections to the terminal strips of the panel were verified to be secure.

<u>Matric Limited Receiver, Type RX1, P/N 100016248, S/N 83808AD004, MSHA IA-18528-0</u>

The RF Receiver and antenna appeared to be in good condition. The antenna was located at the right rear corner of the machine (same side victim was pinned, but opposite end). The coaxial cable connections at both the receiver and antenna were secure and internally clean when disconnected and inspected. The I.S. Supply connection was secure, but dirty when disconnected and internally inspected.

<u>Joy Remotely-Controlled Model 12CM, Serial No. JM5370, MSHA Approval 2G-4023A-00, Continuous Mining Machine</u>

The continuous mining machine was rebuilt by Joy Mining Machinery on 10/19/2001. Steve Haga indicated that the machine had been in service since December 2001. Steve indicated that the demultiplexer panel, firing package, SCRs, antenna, and contactors were all original. The receiver was indicated to have been replaced in August 2003, and the transmitters updated about a year ago, to update the method of sealing around the switches.

The forward and reverse contactors were inspected inside the explosion proof enclosure. The contactors appeared to be in good condition. The contactors were manually depressed, and verified to have adequate spring return.

The firing package and SCR connections were verified to be secure.

The machine's trailing cable was verified to have plenty of slack, and was not near the continuous miner crawlers.

The area lights and headlights were inspected. One area light on the side opposite the accident was found to be inoperable. The headlights were judged to not interfere with the operator's vision on the side of the machine the accident occurred on, and when facing towards the rear of the machine. The machine selector switch was found to be in the 'Headlight On' position.

<u>Radio Remote Control Functional Tests on the Joy Remotely-Controlled Model 12CM, Serial Number JM5370, MSHA Approval Number 2G-4023A-00, Continuous Mining Machine</u>

Due to the damage incurred on the victim's remote control during the accident, a spare remote control (S/N 75209AB025C), brought from the surface, was used for functional testing. All machine control functions, excluding Fire Suppression, Emergency Stop Override (ESO), and Methane Monitor failure Override (MMO), were tested on the remote control. All machine control functions tested, including the "Shutdown Bar," "Left Tram" and "Right Tram," were functional with no unintended machine motion or slewing. Activation of the "Shutdown Bar" and "Pump Start/Off" both (a) stopped machine movement and (b) turned the pump off, while the machine headlights remained on. Activation of the "CB Trip" stopped machine movement and removed power to the machine by activating the outby power center circuit breaker.

The machine is designed to operate at three speeds, Slow or 1st Speed (15 feet/minute), Fast or 2nd Speed (30 feet/minute), and High or 3rd Speed (85 feet/minute). The speeds are selected by the "Speed/Up" and "Speed/DN" switches. The speed can be "preselected" even with the pump deenergized. The selected speed is retained if the pump is turned off with the "Pump Start/Off" switch, but defaults to Slow speed if the power is lost to the remote control, or the "Shutdown Bar" switches are activated. The tram switches require the activation of the "Tram Enable" switch before they will operate, to prevent accidental activation. The tram enable switch was verified to have a two-second inactivity timer. The tram enable switch requires both tram switches to be in the neutral position in order for the timer to begin.

The tram controls are designed to produce "On-Off" (non-proportional), one speed operation, at the selected speed, as they are moved over their full range. When a single tram control is moved forward or backward, the selected tram motor will respond at the selected speed. The speed of the tram motors was not observed to be reduced when a single tram control was moved forward or backward. The tram controls of the remote control needed to be moved approximately halfway between the neutral and maximum position before activating.

When both tram controls are moved in opposite directions (split cat), the tram motor speed is reduced to the Fast speed (30 feet/minute) if the High speed has been selected. No reduction in speed occurs if Slow or Fast speeds have been selected, and the tram controls are split. The speed reduction is controlled by the tram motor firing package with outputs from the demultiplexer panel for two forward speeds, two reverse speeds, and one auxiliary output for High speed. The tram speed is also limited to Fast speed (30 feet/minute) when the cutter head is on, and the machine is tramming forward.

The machine was reportedly being trammed forward at the time of the accident. It was reported that the operator was positioned in a safe location, and was ready to tram forward to begin mining the 2-1 crosscut straight on. It was then reported that the pump turned off, and the victim approached the machine. The victim then apparently turned the pump back on and began tramming the machine when he became pinched between the ripperhead and the rib. The victim was pinched while facing towards the rear of the machine. It is estimated, from reports given by witnesses that the machine trammed approximately 4 feet forward, and the ripperhead ended up approximately 14.5 inches from the rib. Witnesses indicated that they thought the machine was being trammed in High speed

In order to determine the machine's tramming speeds, the time for the machine to travel from its estimated starting point to ending point (approximately 4 feet) was measured for the tram speeds, as tabulated below:

Tram Condition	**Time (seconds)**
Low Speed/1st Speed	12 seconds
Fast Speed/2nd Speed	5.5 seconds
High Speed/3rd Speed	2.5 seconds

In order to verify that the recovered battery had adequate capacity to operate the remote control, the battery and power cord were used for approximately 45 minutes during some of the machine performance testing. The recovered battery when used with the spare remote control was verified to operate the machine from around the corner where the victim was first positioned. The recovered battery when used with the spare remote control was also verified to have a line-of-sight transmission distance of approximately 390 feet, and approximately 75 feet around a pillar. The victim was reported to have been 7.5 hours into his shift, and had approximately 1.5 hours remaining. During testing with the recovered battery and power cord, a low battery indication was not observed.

During performance testing of the machine, Bobby Evans operated the continuous miner. During this testing, the pump motor was observed to inadvertently deenergize on one occasion. This was found to be corrected by adjusting the connection of the slider portion of the remote control power cord to the battery power take-off (PTO). The battery was located in Bobby Evans' coat pocket during the testing, which may have placed added strain on the connection. It was indicated by Steve Haga that the operators typically used yellow wire to secure the battery to the handles of the remote control. Yellow wire was found around the right side handle of the victim's remote control unit.

During performance testing, Bobby Evans was instructed to slew the machine away from the rib while facing the ripperhead of the machine. The machine was inadvertently slewed into the rib. Bobby Evans inadvertently pushed the left tram forward which slewed the machine's ripperhead into the rib. This was attributed to spatial disorientation due to the position of the tram levers in relation to the machine. The victim was found pinched against the rib, facing the rear of the machine.

Photographs were taken of the accident scene, the continuous mining machine, and the remote control equipment. These photographs are available on a CD-ROM in the investigation files at the Approval and Certification Center.

The radio transmitter, battery, and power cord were all taken into custody on April 5, 2004, for further evaluation and/or testing. The radio receiver, demultiplexer panel, and antenna assembly were recovered on April 8, 2004, by Roger Richmond.

Preliminary Inspection at the Approval and Certification Center –May 19-24, 2004

All components were inspected and photographed with no disassembly while noting coal dust accumulation, irregularities, and damage. The following is a description of the findings for each component:

Transmitter

Prior to inspection of the transmitter, the transmitter was externally sprayed with Modec Inc. MDF (Formulation For Mitigation and Decontamination of Chemical and Biological Agents) for the investigators' personal protection. The transmitter was in poor condition due to the damage apparently incurred during the accident. The recovered transmitter consisted of one section consisting of a majority of the entire enclosure, a piece of the transmitter enclosure that was broken off from the bottom of the transmitter, the approval plate which broke off from the transmitter, and a section of the nylon carrying harness. The top switch surface of the transmitter enclosure, including the metal switch plate, was buckled or "wavy" from the compression between the rib and the continuous mining machine. The left carrying handle was completely detached at the end nearest the operator. The left carrying handle included a loop of wire and electrical tape that appeared to be an attempted repair to damage in this area. The right carrying handle was completely detached at the end nearest the operator. There was electrical tape that appeared to be an attempted repair to damage in this area. Both handles appear to have been damaged prior to the accident since the fractured surfaces were contaminated with debris on both sides, unlike the clean fractured surfaces of the bottom piece of the enclosure. The top right corner of the right carrying handle was also wrapped in black electrical tape and had wire protruding from the tape, but did not appear to be separated from the enclosure. The right handle included yellow wire with a metal clasp, presumed to be for the carrying harness, attached to the wire. The 6-pin connector was detached from the enclosure, but still electrically connected. The lower left area of the transmitter enclosure was also fractured and separated into several pieces. The backsplash between the start switch and the left shutdown bar switch was completely broken off of the enclosure, and was not found at the accident scene.

Without moving the switches, the boots for the following switches appeared to be damaged: Shear, Gathering Head, and Conveyor Start/Off-Rev/Off. The right and left tram switch boots were unable to be inspected due to the raised condition of the metal switch plate cover in the area of these switches. The circuit board was visible due to the missing section of the enclosure on the bottom. The board was slightly bent in a manner consistent with the distortion to the top surface of the transmitter enclosure. The printed circuit board contained several areas that appeared white in color due to the stress received from bending. Other than the bending stress received, there was no observable areas, such as loose or missing components or disconnected wires, that appeared to render the circuit board inoperable. The interior of the enclosure around the circuit board appeared clean and free of debris or water contamination.

<u>Receiver</u>

The receiver was in good condition, with no apparent damage. The enclosure consisted of a main compartment and a cover. The enclosure included three connectors (antenna, Teach/Learn, and I.S. Supply) which were all securely attached to the enclosure. The antenna was a coaxial type connector, and the other two were 6-pin connections. The enclosure had a plug/cap attached for the Teach/Learn connector that was not installed over the Teach/Learn port. The cover was securely attached via 14 Allen-head screws. There was a black gasket installed between the cover and main compartment of the enclosure that appeared intact and continuous around the entire perimeter. The left side of the enclosure included a sticker/seal that appeared to indicate "WARRANTY VOID BY OEM IF BROKEN 07/15/03". Labeling on the enclosure indicated among other things: "IA-18528-0", "FREQUENCY 458.600 MHz", "PART NO. 100016248", "SERIAL NO. 83808AD004D", AND "MODEL/TYPE NO. RX1". The receiver had a light amount of coal dust on its exterior, with the most concentrated around the gasket, and on the top (antenna connector side), right and left sides.

Demultiplexer Panel

The demultiplexer panel was in good overall condition. The demultiplexer enclosure had superficial dents and/or scratches in three areas: top left, top right, and lower left sides, when viewed from the top. The enclosure consisted of a top case and a bottom mounting plate for securing to the machine. The top case contained five terminal strips for connection of machine wiring. The bottom mounting plate contained six mounting slots that all showed wear consistent with mounting bolts. The enclosure contained six orange colored gaskets, one between the top case and bottom mounting plate, and one under each of the five terminal strips that all appeared to be intact and continuous around the entire perimeter. Labeling on the enclosure indicated among other things: "IA-457", and "Model 500-200." There were two adhesive Matric seals, one each on the upper left and upper right sides of the enclosure between top case and bottom mounting plate. The seals indicated "WARRANTY VOID BY OEM IF BROKEN 02/26/04". The enclosure also had the following etched in the bottom mounting plate on the lower left side: "P/N 100042863 S/N 68307AB001F." The enclosure had very little signs of coal dust on the exterior, with the heaviest concentration of coal dust under the lip of the gasket between the top case and bottom mounting plate. The top case and bottom mounting plate were securely attached via 28 Phillips-head screws.

Antenna

The antenna assembly consisted of a metal base and a plastic dome attached via four Allen-head screws. What appeared to be an antenna could be seen through the semi-transparent plastic dome. The antenna assembly was in good condition with no apparent external damage. The antenna assembly had a light layer of coal dust over the entire assembly with the heaviest amounts around the base of the plastic dome. The antenna assembly had the following markings on a white label located on the metal base "601843-0251, 5040396-000, 106-0030, F." The metal base contained two holes for mounting to the machine. The hole closest to the connector was filled solid with debris, while the hole closest to the label was free of debris and had the orange paint around it worn away.

Battery

The battery consisted of the red colored molded enclosure, and a metallic battery cover with PTO connector. No headpiece or cord was connected to the battery. The battery was leaking electrolyte. The battery contained no approval markings or an approval plate. The metallic battery cover contained two holes where the approval plate is normally attached. What appeared to be a silicone sealer was in the two holes where the approval plate would be expected to be attached, and also in the hole where the cord normally exits. The only dents or scratches on the battery could be attributed to normal use. When facing the cord entrance side of the battery, the Allen-head screw on the right was not fully engaged. The battery had a white label on the side nearest the PTO that indicated: "MINER 1 ST R". The battery had a light layer of coal dust over the entire exterior, with the largest accumulations at the top of the belt loops, at the bottom corners or "feet" of the battery, and around the perimeter of the metallic battery cover. The liquid electrolyte was at the proper level. Voltage readings were able to be obtained in areas on the exterior of the battery, such as between the large PTO screw and the metallic PTO plate; and between the large PTO screw and the metallic battery cover. Voltage should not be available in these areas.

<u>Battery to Transmitter Power Cord</u>

This consisted of a cord, "slider" connector at one end of the cord to attach to the battery PTO, and a 6-pin connector at the other end of the cord to attach to the transmitter. The cord and connectors were in good condition with no apparent damage other than that which could be attributed to normal wear. The cord measured approximately 46 inches in length. Both connectors were securely attached to the cable. The internal wiring and components inside the "slider" connector were all securely attached. The top of the plastic PTO contained a label that indicated "MERCER." Resistance measurements taken between internal portions of the "slider" connector and the 6-pin connector indicated that pins C and D were electrically connected, which was not typical. None of the cord conductors are intended to be internally connected within the cord. The PTO portion of the power cord contained a light layer of coal dust. The 6-pin connector end of the cord was clean internally.

<u>Connection Between Transmitter Power Cord and Battery</u>

The "slider" portion of the power cord was fully inserted into the PTO portion of the battery. The connection between the "slider" and the battery PTO felt secure and was judged to not be able to become accidentally disconnected if fully inserted. With the power cord attached to the battery, voltage measurements were taken between all 6 pins of the connector. No voltage readings were obtained between any pins except between F and C which was 4.02 volts and between F and D which was 4.01 volts. This was not typical, since only voltage should be obtained between pins F and C. The "slider" was then slowly removed from the PTO while measuring the battery voltage at the 6-pin connector. The point in which the "slider" became electrically disconnected from the battery was after approximately 4 mm of movement.

Testing at Matric Limited Facility, Seneca, Pennsylvania – May 25, 2004

Chad Huntley and Wayne Colley transported the radio transmitter, radio receiver, demultiplexer panel, antenna assembly, power cord, and cap lamp battery involved in the accident to the Matric Limited Facility for further testing. Photographs were taken at various stages of the testing. The following additional people were present to witness the testing:

William Sperry – MSHA, Coal Mine Safety and Health, District 4
Clint Glover - Joy Mining Machinery
David Thomas - Joy Mining Machinery
Gary Snider - Joy Mining Machinery
Doug Sturtz - Matric Ltd.
Tom Harmon - West Virginia Office of Miners' Health, Safety and Training
Bobby Evans - Chief Electrician, Brooks Run Mining Co. LLC

A system test was attempted to be conducted using the victim's remote control transmitter, radio receiver, antenna assembly, cap lamp battery, power cord, and demultiplexer panel, which had been removed from the machine involved in the accident. The victim's remote control transmitter powered on, but the TX Fault/Test (red in color) and On/Data LEDs (green in color) were both blinking, indicating a stuck button, even though no buttons appeared to be activated. In an attempt to remove the stuck button indication, the metal switch cover was removed and all switches were taken out one by one. After all switches were removed from the transmitter, the On/Data LED was still blinking.

In a second attempt to remove the stuck button indication, the printed circuit board was removed for inspection. The Matric technicians observed that the hall-effect sensors labeled U37 (Right Tram switch) and U20 (Aux. 2 On/Off switch) had obvious damage and that U16 (Cutter Start/Off switch), U17 (Speed Up/Dn switch), and U35 (Left shutdown switch) had less apparent damage. These five sensors were replaced with new ones, and the remote control was powered on again. This time the TX Fault/Test LED was blinking and the On/Data LED was illuminated continuously indicating the stuck button problem had been fixed. Two switch magnets were waved past the two sensors associated with the shutdown switches, and all LEDs illuminated and the frequency LED blinked four times indicating that the remote control was set to a frequency of 458.600 MHz. However, since another transmitter had been "Teach/Learned" to the receiver during the underground performance testing, this transmitter had to be "Teach/Learned" to the receiver again.

The victim's remote control was twice attempted to be "Teach/Learned" to the receiver, and the "Teach/Learn" LED did not blink and then illuminate continuously as designed. The problem was believed to have been lack of communication with the microprocessor. Finally with the aid of a frequency counter connected directly to the remote control's internal antenna connector, no RF output was obtained. It was then decided that further testing with the victim's damaged remote control transmitter was not beneficial.

A system test was then conducted with a functional transmitter provided by Matric (S/N 75207AC010D) along with all recovered equipment, and functions verified by observing the LEDs on the demultiplexer panel outputs. All switch control functions were tested on the remote control transmitter, which produced the expected outputs on the demultiplexer panel. To test the connection of the "slider" portion of the power cord to the battery PTO, the connection was loosened and the battery vigorously impacted numerous times against the test bench while observing the demultiplexer panel. The demultiplexer output LED for the pump was observed to turn off once as a result of the numerous impacts of the battery against the test bench with the "slider" portion intentionally loosened.

The antenna assembly was disassembled and verified to contain the correct Joy/Matric antenna. Continuity measurements between metal base, inside and outside center coax conductor, and inside and outside connector shell were made with an ohmmeter. These measurements verified there were no internal faults of the antenna assembly.

The receiver and demultiplexer panel of the remote control system removed from the machine involved in the accident were then taken to specifically designed Matric test stations for testing.

<u>Matric Limited Permissible Radio Transmitter, Model TX3, P/N 100112672, S/N 75205AD033, MSHA Approval 2G-4096-0</u>

The unit was opened, inspected, and found to be dry with no signs of environmental contamination except in the area of the cracked case. This contamination is believed to have been caused by the damage incurred during the accident. The area beneath the switches contained up to approximately 1/4" of fine coal dust. This coal dust can be attributed to the torn dust boots.

Matric Limited service records for the unit showed it to be newly shipped on May 29, 2002, and last serviced in August of 2002. The service report indicated that the customer comment was "Complaint," the service comments were the "current draw was over 300mA after tuning, replaced R9." The service report also indicated that the "unit passed all tests."

<u>Matric Limited Receiver, Type RX1, P/N 100016248, S/N 83808AD004D, MSHA IA-18528-0</u>

The receiver was "Teach/Learned" to a radio transmitter for a longwall shearing machine. All functions of the shearer transmitter were activated and observed to activate on a display connected to the receiver. The receiver was capable of receiving 9-10 packets of data per second, and did not experience any "drop outs" during this testing.

The receiver was then connected to a power supply and frequency generator for measurements. The receiver was tuned to within specifications at 458.600 MHz. The receiver passed Matric Limited's standard test procedure.

The receiver enclosure was opened and observed to be clean and dry with no sign of environmental contamination. Temperature stickers on the inside of the enclosure had no indication or darkening of the lowest temperature (38 degrees Celsius), meaning the inside of the enclosure had not reached 38 degrees Celsius. All connectors were verified to be tight.

Matric Limited service records for the unit showed it to be newly shipped on August 12, 2002, and last serviced July 2003. Matric Limited's service report indicated that the customer comment was "Warranty" and the repair text was "loose capacitor causing intermittent drop outs". The receiver passed testing during the July 2003 repair.

<u>Matric Limited Demultiplexer Control Panel, Model 500-200, P/N 100042863, S/N 68307AB001F, MSHA IA-457</u>

Functional tests were conducted on the demultiplexer control panel testing all outputs with a simulation of all possible inputs. These tests showed the unit to be functioning properly and passing Matric's standard test procedure. Data recorded by the unit's microprocessor indicated that the demultiplexer panel had been in operation for 462 hours, had reached minimum and maximum temperatures of 285 and 326 degrees Kelvin (11.85 and 52.85 degrees Celsius), had no "tags" or fault codes, and that the "CRC" or cyclic redundancy check was OK. The DC output was measured to be 81.8 volts which was indicated to be typical. The unit also passed the DC short, AC short, DC load and AC load tests.

The unit was opened, inspected, and found to be clean and dry with no signs of environmental contamination. Stickers on the inside of the demultiplexer indicated that the temperature reached 38 degrees Celsius, but did not reach 52 degrees Celsius.

Matric Limited service records for the unit showed it to be newly shipped on July 31, 2000, and last serviced in February 2004. The Matric service report indicated there were no customer comments on the unit and that it passed all tests and was working properly.

<u>Detailed Inspection at the Approval and Certification Center – June 2-25, 2004</u>

The detailed inspection included: observations of internal conditions that were not recorded during the preliminary inspection or when the components were first opened at Matric, measurements, tests, photographs, and a comparison of MSHA-approved equipment to the approval documentation on file at the A&CC.

Koehler 5000 Series Battery

The metallic battery top was removed to observe the wiring. The area under the metallic cover was covered with coal dust with the largest accumulation along the sides or bottom of the cover as installed. The red and black wires normally connected to the battery posts for powering the headpiece were cut off at the connectors. The wiring to the PTO was found to be in compliance with the approval documentation. The voltages being obtained between the large PTO screw and either the metallic battery top or metal PTO plate are attributed to the moist coal dust found under the cover on the rubber insulator and moistness around insulated bushings. Voltages to non-conductive parts, such as the rubber insulator and case, were also obtained. There was no damage to the wire insulation. It was also observed that the underside of the metallic cover, above the negative post, appeared blackened from heat.

When compared with applicable approval documentation, the following discrepancies were found:

Discrepancy	Drawing Reference
No headpiece or cord (cord entrance filled with what appears to be silicone)	N/A
No approval plate (holes normally used to secure approval plate to cover filled with what appears to be silicone)	5549 Rev. F
Missing item 7 grease washer	5000 Rev. Y
Incorrect address and arrangement of caution statement	5000 Rev. Y
Method of date stamping differs	7005 Rev. G
Width measured 1.795 inches	7004 Rev. F
Length measured 5.050 inches	7004 Rev. F
Rubber insulator length measured 4.9 inches	5019-2 Rev. A
Diameters of two approval plate securing holes measured 0.14 inches while documented as 0.065-0.067 inches	5555 Rev. A
A detent on the right side, when facing the cable entrance, shown on the drawing was not on the sample	5555 Rev. A
Drawing indicates “NIVEL DE LIQUIDO” which was not on the sample	7011 Rev. B

The metallic battery cover nut plate screws were of different lengths and one was not totally secured	Cap lamp assembly drawing such as 7100 Rev. A

The battery was charged overnight with a power supply set to 5.0 volts/4.0 amperes. Then, the battery was flash-current tested as shown on Test Sheet 1. The battery had a maximum open-circuit voltage of 4.492 volts, and a calculated minimum internal resistance of 0.088 ohms. The maximum calculated short-circuit current was 50.096 amperes. The short-circuit current and shape of the oscilloscope waveform are consistent with past samples of this battery type that have been tested.

The battery was then recharged and connected to a resistive load manually adjusted to draw 250mA for 10 hours as shown on Test Sheet 2. At the end of 10 hours, the battery voltage was 3.95 volts, which, from past test results on the TX3 transmitter, would not activate the low battery warning light. The low battery warning light is designed to come on at approximately 3.43 volts, and the transmitter will turn off at approximately 3.37 volts. After the battery recovered from this test with no load connected, the voltage measured 4.07 volts after 21 hours and 40 minutes and also 4.07 volts after approximately 145 hours of being disconnected from the load. The victim was approximately 7.5 hours into his shift with approximately 1.5 hours remaining. The no load battery voltage as measured at the accident scene approximately 37 hours after the accident was 4.08 volts.

Battery to Transmitter Power Cord

The "slider" end of the power cord was disassembled. Upon disassembly, bare-stranded conductors from one of the five wires were observed. The bare (uninsulated) strands of wire were verified with an ohmmeter to be connected to pin D of the 6-pin connector. The "slider" portion of the power cord could be reassembled, with the U shaped section contacting the bare-stranded conductors, resulting in connection of pins C and D. It was also observed that the bare-stranded wires were in close proximity (approximately 1/16 inch) to an uninsulated ring terminal that was connected to battery positive. A fault between the uninsulated wires electrically connected to the battery negative and the ring terminal connected to battery positive would result in a short circuit of the battery and a perceived "loss of signal". With the "slider" reassembled to have the uninsulated wires and ring terminal as close as possible and while pushing and pulling on the cable, no short circuit between the wires and ring terminal was observed.

The power cord was connected to the transmitter to verify connections. Using an ohmmeter, Pin C was verified to be connected to both connector J1, Position 3 and connector J2, Position 1 of the transmitter. Pin D was verified to be connected to connector J1, Position 4, and Fuse F1. Pin F was verified to be connected to connector J2, Position 2 of the transmitter. Power to the transmitter in the radio mode is only intended to be obtained from pins F (batt +) and C (batt -). Pin D, as indicated by Matric drawings with this cable, is only to be used as +10VDC input power when in the umbilical mode.

Note: The battery to transmitter power cord could not be compared to approval documentation since there are no drawings on file at the A&CC detailing its construction.

Type RX1 Receiver

The cover was removed from the receiver, and the screws securing the board to the enclosure were removed in order to view the underside. The circuitry under the metal shielding was not compared with approval documentation due to the chance of possible damage removing the shield.

When compared with applicable approval documentation, the following discrepancies were found:

Discrepancy	Drawing Reference
The wording and location of wording shown on sample differs from the drawing	MA001096-0028 Rev.1
A square component on the circuit board is not on the sample	MA001096-0028 Rev. 1
Resistor R38 was not populated on the sample	MA001096-0029 Rev. 1
The board was missing conformal coating around J1/LK1 on both sides of the board	MA001096-0029 Rev. 1
The board was missing conformal coating around the tabs of the metal shielding on the backside	MA001096-0029 Rev. 1
Fuse F1 was labeled as 62mA and is documented as 63mA	MA001096-0029 Rev. 1

Demultiplexer Panel

The demultiplexer panel case halves were separated and the cover over the I.S. Power Supply was removed for comparison to approval documentation. Only the component side of the I.S. Power Supply board was compared with approval documentation due to the chance of possible damage if the board was removed.

When compared with applicable approval documentation, the following discrepancies were found:

Discrepancy	Drawing Reference
Capacitor C14 on the sample was labeled “104” indicating 0.1uF, while the drawing indicates 1uF	MA205-1520 Rev. – (Sheets 1 and 2)

The link between "COM" and "EARTH" on the sample was labeled LK3 while the drawing indicates LK4	MA205-1520 Rev. – (Sheet 2)
Note 2 indicates to secure F1, F2, C7, C8, and C9 with silicone adhesive, while C16 is also secured with adhesive	MA205-1520 Rev. – (Sheet 2)
Transformer sample labeled "20-0134" instead of the indicated "20-134"	DD20-134 Rev. 2
The sample contained orange gaskets under each of the switch terminals and between case halves that were not indicated on the drawing	MA500-200 Rev. 3 (Sheet 3)
Transistors Q1 and Q2 on the sample were labeled "NDP6060" while the drawing indicates "NPD6060"	MA205-1520 Rev. – (Sheet 1)

TX3 Transmitter

Each switch function of the remote control transmitter was repeatedly tested and found to function properly, except the shear, conveyor start, and right tram switches. The shear switch did not have full travel in the reverse direction. The conveyor start switch did not have full travel in the reverse direction. The right tram switch had very little, if any, forward motion. The toggle switches are designed to be protected from environmental contamination by rubber boots. The rubber boots for the following switches were torn, with the torn area in parentheses: left tram (forward), cutter start (forward), start (right), right tram (forward and reverse), tram enable (left/enable side), conveyor swing (left and right), shear (forward and reverse), gathering head (forward), conveyor start (forward and reverse), and conveyor (forward). All switches were found to return to the neutral, centered, "off" position when released.

The conveyor start switch was removed from the enclosure and the underside of the switch was inspected. No apparent cause for the restricted movement was observed from the underside of the switch; therefore, the dust boot was removed. Upon removal of the dust boot, debris between the switch handle and switch enclosure in the 1/4" X 1/8" opening was observed in the reverse direction. The switch was attempted to be moved again in the reverse direction, and it was confirmed that the observed debris was blocking the switches reverse travel. The switch was operated approximately 10 times, and with each movement, the debris was grinded into a finer dust that became dislodged and the switch travel was no longer blocked.

The right tram switch was removed from the enclosure and the underside of the switch was inspected. No apparent cause for the blockage was observed from the underside of the switch; therefore, the dust boot was removed. Upon removal of the dust boot, debris and signs of blood between the switch handle and switch enclosure in the 1/4" X 1/8" opening were observed in the forward direction that restricted movement. It was noted that the switch had movement in both directions while installed in the transmitter at Matric, but switch movement was noted as being binding. It was also observed that the right tram switch handle was bent slightly in the forward direction. Prior to the testing at Matric, the switch handle was not observed to be bent. It was difficult to see the bend with the dust boot and top handle attached. While at Matric, technicians had to use pliers to remove the switch from the transmitter enclosure.

The movement of the shear switch was examined. The switch had full movement in both directions, but some resistance could be felt in the reverse direction while located in the enclosure cavity. The dust boot was removed, and the switch did not appear blocked in the 1/4" X 1/8" opening on either side of the switch handle. The switch was removed from the enclosure cavity, and the switch operated fully in both directions, but with some resistance in the reverse direction. Fine coal dust was observed to be falling out while moving the switch. The switch was returned to the enclosure cavity, and the movement then felt normal.

The dust boots protecting the transmitter switches were identified as Revision C dust boots. The design of the Revision C boot was such that toggling a switch caused the boot to pinch itself, which caused the boot to tear and crack. Joy modified the Revision C dust boot to improve the boot's wear resistance, and introduced the improved design in Revision D. Joy indicated in a Service Bulletin dated January 15, 2004 (see Appendix C), that all transmitters should be upgraded to the Revision D dust boots. The Revision C boots are no longer available from Joy.

It was unable to be determined if the transmitter was built according to drawing MA500-752 Revision 1 or Revision 2. The first table of discrepancies was assuming the transmitter was built according to Revision 1. The second table identifies the discrepancies assuming the transmitter was built according to Revision 2.

When compared with applicable approval documentation, the following discrepancies were found:

Discrepancy	**Drawing Reference**
Tape was found on the left and right handles that does not appear on the drawing	MA500-752 Rev. 1
Wire was found on the left handle that does not appear on the drawing	MA500-752 Rev. 1
The left and right handles of the transmitter were broken	MA500-752 Rev. 1
The antenna was fastened in 2 places with a tie wrap that does not appear on the drawing	MA500-752 Rev. 1
There is a hole in the left handle that does not appear on the drawing	MA500-752 Rev. 1
There is yellow wire on the right handle that does not appear on the drawing	MA500-752 Rev. 1

A clip that appeared to be for a carrying harness was attached to the yellow wiring on the right handle that does not appear on the drawing	MA500-752 Rev. 1
The connections to the J1 connector in the Connection Chart do not match the sample. Pin A was connected to J1-1, Pin B was connected to J1-2, Pin C was connected to J1-3, and Pin D was connected to J1-4, while the drawing indicates J1-3, J1-2, J1-4 and J1-1, respectively. These descriptions also disagree with drawing MA205-1629 Rev. 2, Sheet 3	MA500-752 Rev. 1 MA205-1629 Rev. 2, Sheet 3
The minimum wall thickness under the connector measured 0.13 inches, while the drawing indicates 0.15 inches	MA500-752 Rev. 1
The sample contained dust boots for each switch while the drawing does not indicate dust boots to be installed	MA500-752 Rev. 1
Not all of the approval information contained on the sample was contained on the drawing	MA500-752 Rev. 1
A Joy logo was imprinted in the bottom right corner on the top surface of the transmitter enclosure that does not appear on the drawing	MA500-752 Rev. 1
A sleeve was found covering the wires to the connector that do not appear on the drawing	MA500-752 Rev. 1
Note 6 indicates that "Enclosure connectors and switches are dust-tight" while varying amounts of dust were found in the sockets for the switch actuators.	MA500-752 Rev. 1
An adhesive strip was applied between the sensor side of the circuit board and the enclosure that is not documented on drawings	MA500-752 Rev. 1
Conformal coating was missing around connectors J1, J2, and J3	MA205-1629 Rev. 2
R1 on the sample indicated "4752" which would indicate 47.5K ohms, while the drawing indicates 4.75K ohms	MA205-1629 Rev. 3 (Sheet 3)
R42 on the sample indicated "224" which would indicate 220K ohms, while the drawing indicates 221K ohms	MA205-1629 Rev. 3 (Sheet 3)
The marking on U4 indicated "?C4066A" with the "?" being either a "C" or "H" and the drawing indicates "HC74HC4066D"	MA205-1629 Rev. 2 (Sheet 3)
Markings on U46-50 indicated "DS408 P0136AB FJ" while the drawing indicates "MAX338"	MA205-1629 Rev. 2 (Sheet 3)

Resistor R52 was populated on the sample while the drawing indicates "NP"	MA205-1629 Rev. 2 (Sheet 3)

Discrepancy	**Drawing Reference**
All of the above listed discrepancies	N/A
Actual approval plate indicates "250 milliamps min. accessory capacity", while drawing indicates "300 milliamps min. accessory capacity"	MA500-752 Rev. 2

<u>Antenna Assembly</u>

The assembly was disassembled and photographed. The antenna could not be compared to approval documentation since there are no drawings on file at the A&CC detailing its construction.

<u>Testing at Matric Limited Facility, Seneca, Pennsylvania – July 19, 2004</u>

Chad Huntley transported the radio receiver, demultiplexer panel, antenna assembly, power cord, and cap lamp battery involved in the accident to the Matric Limited Facility for further testing. This testing was to verify that there are no loose components within the receiver that could cause a perceived "loss of signal". Photographs were taken of the testing. The following additional people were present to witness the testing:

Clint Glover, Joy Mining Machinery
David Thomas, Joy Mining Machinery
Gary Snider, Joy Mining Machinery
Doug Sturtz, Matric Ltd.
Bobby Evans, Chief Electrician, Brooks Run Mining Co., LLC

A system test was conducted with a functional transmitter provided by Matric (S/N 75205AD031E) along with all recovered equipment, and functions verified by observing the LEDs on the demultiplexer panel outputs. With the pump, cutter motor, and conveyor outputs on, the receiver was impacted against the bench for approximately 1 minute. No "loss of signal" was observed with the recovered equipment. The output LEDs for the pump, cutter motor, and conveyor all remained on throughout the impact testing.

A display was then connected to the receiver in place of the demultiplexer panel. The display was capable of indicating the packets of data per second being exchanged, and the number of "drop outs". During approximately 1.5 minutes of impact testing with the display, the packets of data per second dropped from a maximum of 10 to a minimum of 7 during impacting, and then resorted back to a maximum of 10 after impact testing. During this impact testing, the display indicated there were 3 "drop outs". The Matric service technician indicated that this number of "drop outs" was acceptable, and that the unit passed testing and was acceptable for use.

<u>SUMMARY FINDINGS</u>:

1. Functional testing of the continuous miner demonstrated the machine to be functioning properly.

2. Testing revealed that two TX3 Remote Controls used in close proximity could not cause cross-activation of the continuous miner.

3. No unintended movement or stopping of the tram motors or tram function was experienced during on-site testing at the mine.

4. The remote control system with the recovered battery, but not with the victim's transmitter, was judged to have adequate transmission range. The system was found to operate up to approximately 390 feet line of sight, and approximately 75 feet around a pillar.

5. The recovered battery was determined to have adequate capacity to operate the transmitter. The battery voltage when recovered was 4.08 volts. Load testing verified the battery to be able to operate the transmitter for at least 10 hours. The low battery LED, as determined from previous tests of a TX3 transmitter, does not come on until 3.43 volts.

6. During underground testing of the machine, the continuous miner operator, while facing the rear of the machine as the victim was found, accidentally slewed the machine into the rib due to spatial disorientation.

7. Witnesses indicated that they believed the victim approached the machine due to a "loss of signal." The only signs of a "loss of signal" during the testing of the machine and components involved what appeared to be the PTO connection of the transmitter to the battery. Once during underground testing, the pump shut off unintentionally and the pump was able to be turned on again after adjusting the PTO connection. Also, on one occasion at Matric, the pump output on the demultiplexer panel was observed to shut off when the PTO connection was loosened and the battery was vigorously impacted against the test bench.

8. The fault in the power cord, between wires labeled in the 6-pin connector as C and D, is judged not to be significant. The fault resulted in the connection of these two wires, and provided two connections of battery negative to the remote control transmitter. Pin C is documented on Matric drawings to be the only point connected to battery negative. Pin D is indicated by the schematic diagram of the TX3 to normally be used for input power when the transmitter is used in an umbilical or

non-radio mode. The victim's power cord was used during both underground testing of the machine and during testing at Matric with no observable effects from the fault.

9. One area light on the opposite side of the machine in which the accident occurred was not functioning.

10. The battery was not maintained in a permissible condition. The battery did not have a headpiece and cord attached.

11. It was reported that the battery was typically attached to the transmitter handle rather than being worn on the belt. The manufacturer has recommended against this practice, for safety reasons. The transmitter handles both showed signs of being damaged prior to the accident, possibly due to the strain from the battery. These conditions may have placed added strain on the battery PTO connection causing loss of power to the transmitter. Loss of power to the transmitter could result in deenergization of the pump, and a perceived "loss of signal".

12. Numerous dust boots were found with tears and the right tram, shear, and conveyor start switches were found to have adequate amounts of debris under the dust boot and above the switch to restrict switch movement. The right tram switch was found during the detailed inspection phase of the investigation to jam, preventing forward motion. The shear switch was found during the detailed inspection phase of the investigation to jam, preventing full reverse motion. The conveyor start switch was found during the detailed inspection phase of the investigation to jam, preventing full reverse motion.

Appendix A – Photographs

Photographs of Equipment Recovered from the Brooks Run Mining Co., LLC
Mercer Deep Mine

Mine Site Photographs

Number indicates slide number in Microsoft PowerPoint presentation titled "Mercer mine site". The descriptive information regarding the individual photographs is included in the "speaker notes" accompanying each slide.

1. PowerPoint Title Slide.
2. Mine Site. Mine entrance.
3. Mine Site. Mine map.
4. Mine Site. Mine map.
5. Mine Site. Sketch of accident scene.
6. Mine Site. Transmitter.
7. Mine Site. Transmitter, power cord, and battery.
8. Mine Site. Transmitter, power cord, and battery.
9. Mine Site. Underside of transmitter and power cord.
10. Mine Site. Right, rear corner of continuous miner.
11. Mine Site. Right side of ripperhead.
12. Mine Site. Right side of ripperhead.
13. Mine Site. Right side of ripperhead.
14. Mine Site. Right, rear corner of machine.
15. Mine Site. Antenna assembly.
16. Mine Site. Red zone sticker on machine.
17. Mine Site. Red zone sticker on machine.
18. Mine Site. Boom end of machine and front of shuttle car.
19. Mine Site. Boom end of machine and front of shuttle car.
20. Mine Site. Left side of ripperhead.
21. Mine Site. Right side of ripperhead.
22. Mine Site. Bottom section of transmitter enclosure below right side of ripperhead.
23. Mine Site. Right side of gathering head.
24. Mine Site. Right side of ripperhead.
25. Mine Site. Curtain near right side of ripperhead.
26. Mine Site. Curtain near right side of ripperhead.
27. Mine Site. Curtain near right side of ripperhead.
28. Mine Site. Onboard e-stop switch on left side of machine.
29. Mine Site. Onboard e-stop switch on right side of machine.
30. Mine Site. Battery with "slider" loosened.
31. Mine Site. Battery with "slider" loosened.
32. Mine Site. Demultiplexer, firing package, SCR bridge, and contactor inspection.
33. Mine Site. Demultiplexer, firing package, SCR bridges, and contactor inspection.

34. Mine Site. Demultiplexer panel.
35. Mine Site. Firing package, SCR bridges, and contactors.

Preliminary Inspection Photographs

Number indicates slide number in Microsoft PowerPoint presentation titled "Mercer mine site". The descriptive information regarding the individual photographs is included in the "speaker notes" accompanying each slide.

1. PowerPoint Title Slide.
2. Slide Titled "Preliminary Inspection of Antenna Assembly"
3. Preliminary Inspection. Joy P/N 601843-0251 Antenna Assembly, as received.
4. Preliminary Inspection. Joy P/N 601843-0251 Antenna Assembly, as received.
5. Preliminary Inspection. Joy P/N 601843-0251 Antenna Assembly, as received.
6. Preliminary Inspection. Joy P/N 601843-0251 Antenna Assembly, as received.
7. Preliminary Inspection. Joy P/N 601843-0251 Antenna Assembly, as received.
8. Preliminary Inspection. Joy P/N 601843-0251 Antenna Assembly, as received.
9. Preliminary Inspection. Joy P/N 601843-0251 Antenna Assembly, as received.
10. Preliminary Inspection. Joy P/N 601843-0251 Antenna Assembly, as received.
11. Preliminary Inspection. Joy P/N 601843-0251 Antenna Assembly, as received.
12. Preliminary Inspection. Joy P/N 601843-0251 Antenna Assembly, as received.
13. Slide Titled "Preliminary Inspection of Demultiplexer Panel"
14. Preliminary Inspection. Joy P/N 100042863 Demultiplexer Panel, as received.
15. Preliminary Inspection. Joy P/N 100042863 Demultiplexer Panel, as received.
16. Preliminary Inspection. Joy P/N 100042863 Demultiplexer Panel, as received.
17. Preliminary Inspection. Joy P/N 100042863 Demultiplexer Panel, as received.
18. Preliminary Inspection. Joy P/N 100042863 Demultiplexer Panel, as received.
19. Preliminary Inspection. Joy P/N 100042863 Demultiplexer Panel, as received.
20. Preliminary Inspection. Joy P/N 100042863 Demultiplexer Panel, as received.
21. Preliminary Inspection. Joy P/N 100042863 Demultiplexer Panel, as received.
22. Preliminary Inspection. Joy P/N 100042863 Demultiplexer Panel, as received.
23. Preliminary Inspection. Joy P/N 100042863 Demultiplexer Panel, as received.
24. Preliminary Inspection. Joy P/N 100042863 Demultiplexer Panel, as received.
25. Slide Titled "Preliminary Inspection of Receiver"
26. Preliminary Inspection. Joy P/N 100016248 Receiver, as received.
27. Preliminary Inspection. Joy P/N 100016248 Receiver, as received.
28. Preliminary Inspection. Joy P/N 100016248 Receiver, as received.
29. Preliminary Inspection. Joy P/N 100016248 Receiver, as received.
30. Preliminary Inspection. Joy P/N 100016248 Receiver, as received.
31. Preliminary Inspection. Joy P/N 100016248 Receiver, as received.
32. Preliminary Inspection. Joy P/N 100016248 Receiver, as received.
33. Preliminary Inspection. Joy P/N 100016248 Receiver, as received.
34. Preliminary Inspection. Joy P/N 100016248 Receiver, as received.
35. Preliminary Inspection. Joy P/N 100016248 Receiver, as received.
36. Preliminary Inspection. Joy P/N 100016248 Receiver, as received.

37. Preliminary Inspection. Joy P/N 100016248 Receiver, as received.
38. Preliminary Inspection. Joy P/N 100016248 Receiver, as received.
39. Preliminary Inspection. Joy P/N 100016248 Receiver, as received.
40. Slide Titled "Preliminary Inspection of Koehler 5000 Series Battery"
41. Preliminary Inspection. Koehler 5000 Series Battery, as received.
42. Preliminary Inspection. Koehler 5000 Series Battery, as received.
43. Preliminary Inspection. Koehler 5000 Series Battery, as received.
44. Preliminary Inspection. Koehler 5000 Series Battery, as received.
45. Preliminary Inspection. Koehler 5000 Series Battery, as received.
46. Preliminary Inspection. Koehler 5000 Series Battery, as received.
47. Preliminary Inspection. Koehler 5000 Series Battery, as received.
48. Preliminary Inspection. Koehler 5000 Series Battery, as received.
49. Slide Titled "Preliminary Inspection of Power Cord"
50. Preliminary Inspection. Power Cord, as received.
51. Preliminary Inspection. Power Cord, as received.
52. Preliminary Inspection. Power Cord, as received.
53. Preliminary Inspection. Power Cord, as received.
54. Preliminary Inspection. Power Cord, as received.
55. Preliminary Inspection. Power Cord, as received.
56. Preliminary Inspection. Power Cord, as received.
57. Preliminary Inspection. Power Cord, as received.
58. Preliminary Inspection. Power Cord, as received.
59. Preliminary Inspection. Power Cord, as received.
60. Slide Titled "Preliminary Inspection of Power Cord Attached to Battery"
61. Preliminary Inspection. Koehler 5000 Series Battery with Power Cord attached.
62. Preliminary Inspection. Koehler 5000 Series Battery with Power Cord attached.
63. Preliminary Inspection. Koehler 5000 Series Battery with Power Cord attached.
64. Preliminary Inspection. Koehler 5000 Series Battery with Power Cord attached.
65. Preliminary Inspection. Koehler 5000 Series Battery with Power Cord attached.
66. Preliminary Inspection. Koehler 5000 Series Battery with Power Cord attached.
67. Preliminary Inspection. Koehler 5000 Series Battery with Power Cord attached.
68. Slide Titled "Inspection of Transmitter"
69. Preliminary Inspection. Type TX3 Transmitter after external decontamination; nylon harness section, as-received; approval plate, as-received; and separated transmitter enclosure section after external decontamination.
70. Preliminary Inspection. Type TX3 approval plate, as-received.
71. Preliminary Inspection. Type TX3 approval plate, as-received.
72. Preliminary Inspection. Type TX3 approval plate, as-received.
73. Preliminary Inspection. Type TX3 approval plate, as-received.
74. Preliminary Inspection. Type TX3 Transmitter separated enclosure section after decontamination.
75. Preliminary Inspection. Type TX3 Transmitter separated enclosure section after decontamination.

76. Preliminary Inspection. Type TX3 Transmitter separated enclosure section, as-received.
77. Preliminary Inspection. Type TX3 Transmitter nylon harness section, as-received.
78. Preliminary Inspection. Type TX3 Transmitter nylon harness section, as-received.
79. Preliminary Inspection. Type TX3 Transmitter after external decontamination.
80. Preliminary Inspection. Type TX3 Transmitter after external decontamination.
81. Preliminary Inspection. Type TX3 Transmitter after external decontamination.
82. Preliminary Inspection. Type TX3 Transmitter after external decontamination.
83. Preliminary Inspection. Type TX3 Transmitter after external decontamination.
84. Preliminary Inspection. Type TX3 Transmitter after external decontamination.
85. Preliminary Inspection. Type TX3 Transmitter after external decontamination.
86. Preliminary Inspection. Type TX3 Transmitter after external decontamination.
87. Preliminary Inspection. Type TX3 Transmitter after external decontamination.
88. Preliminary Inspection. Type TX3 Transmitter after external decontamination.
89. Preliminary Inspection. Type TX3 Transmitter after external decontamination.
90. Preliminary Inspection. Type TX3 Transmitter after external decontamination.
91. Preliminary Inspection. Type TX3 Transmitter after external decontamination.
92. Preliminary Inspection. Type TX3 Transmitter after external decontamination.
93. Preliminary Inspection. Type TX3 Transmitter after external decontamination.
94. Preliminary Inspection. Type TX3 Transmitter after external decontamination.

<u>Matric Limited Photographs</u>

Number indicates slide number in Microsoft PowerPoint presentation titled "Mercer Matric". The descriptive information regarding the individual photographs is included in the "speaker notes" accompanying each slide.

1. PowerPoint Title Slide
2. Matric Testing. Complete system test setup.
3. Matric Testing. Complete system test setup.
4. Matric Testing. Complete system test setup.
5. Matric Testing. Type TX3 transmitter with switch cover plate removed.
6. Matric Testing. Type TX3 transmitter with switch cover plate removed.
7. Matric Testing. Type TX3 transmitter with switch cover plate removed.
8. Matric Testing. Type TX3 transmitter with switch cover plate removed.
9. Matric Testing. Type TX3 transmitter with switch cover plate removed.
10. Matric Testing. Type TX3 transmitter with switch cover plate removed.
11. Matric Testing. Type TX3 transmitter with switch cover plate removed.
12. Matric Testing. Type TX3 transmitter with switch cover plate removed.
13. Matric Testing. Type TX3 transmitter with switch cover plate removed.
14. Matric Testing. Type TX3 transmitter with switch cover plate removed.
15. Matric Testing. Type TX3 transmitter with switch cover plate removed.
16. Matric Testing. Type TX3 transmitter with switch cover plate removed.
17. Matric Testing. Type TX3 transmitter with switch cover plate removed.

18. Matric Testing. Type TX3 transmitter with switch cover plate removed.
19. Matric Testing. Type TX3 transmitter with switch cover plate removed.
20. Matric Testing. Type TX3 transmitter with switch cover plate removed.
21. Matric Testing. Type TX3 transmitter with switch cover plate removed.
22. Matric Testing. Type TX3 transmitter with switch cover plate removed.
23. Matric Testing. Type TX3 transmitter with switch cover plate removed.
24. Matric Testing. Type TX3 transmitter with switch cover plate removed.
25. Matric Testing. Type TX3 transmitter with switch cover plate removed.
26. Matric Testing. Type TX3 transmitter with switch cover plate removed.
27. Matric Testing. Type TX3 transmitter with switch cover plate removed.
28. Matric Testing. Type TX3 transmitter with switch cover plate removed.
29. Matric Testing. Type TX3 transmitter with switch cover plate removed.
30. Matric Testing. Type TX3 transmitter with switch cover plate removed.
31. Matric Testing. Type TX3 transmitter circuit board.
32. Matric Testing. Type TX3 transmitter circuit board.
33. Matric Testing. Type TX3 transmitter enclosure section.
34. Matric Testing. Type TX3 transmitter circuit board.
35. Matric Testing. Type TX3 transmitter circuit board.
36. Matric Testing. Type TX3 transmitter circuit board.
37. Matric Testing. Type TX3 transmitter circuit board.
38. Matric Testing. Type TX3 transmitter circuit board.
39. Matric Testing. Type TX3 transmitter circuit board.
40. Matric Testing. Type TX3 transmitter circuit board.
41. Matric Testing. Type TX3 transmitter circuit board.
42. Matric Testing. Rebuilt sample of Type TX3 transmitter.
43. Matric Testing. Antenna assembly with protective cover removed.
44. Matric Testing. Antenna assembly with protective cover removed.
45. Matric Testing. Antenna assembly with protective cover removed.
46. Matric Testing. Antenna assembly with protective cover removed.
47. Matric Testing. Demultiplexer panel wired for individual component testing.
48. Matric Testing. Internal view of demultiplexer panel.
49. Matric Testing. Internal view of demultiplexer panel temperature stickers.
50. Matric Testing. Receiver wired for individual component testing.
51. Matric Testing. Receiver with cover plate removed.
52. Matric Testing. Receiver with cover plate removed.
53. Matric Testing. Internal view of receiver.
54. Matric Testing. Internal view of receiver temperature stickers.
55. Matric Testing. Oscilloscope trace of receiver signal during testing.
56. Matric Testing. Oscilloscope trace of receiver signal during testing.
57. Matric Testing. Impact testing of receiver.
58. Matric Testing. Impact testing of receiver.
59. Matric Testing. Impact testing of receiver.
60. Matric Testing. Impact testing of receiver.
61. Matric Testing. Impact testing of receiver.

62. Matric Testing. Impact testing of receiver.

Detailed Inspection Photographs

Number indicates slide number in Microsoft PowerPoint presentation titled "Mercer mine site". The descriptive information regarding the individual photographs is included in the "speaker notes" accompanying each slide.

1. PowerPoint Title Slide.
2. Detailed Inspection. Under the battery metallic cover.
3. Detailed Inspection. Under the battery metallic cover.
4. Detailed Inspection. Under the battery metallic cover.
5. Detailed Inspection. Under the battery metallic cover.
6. Detailed Inspection. Under the battery metallic cover.
7. Detailed Inspection. Under the battery metallic cover.
8. Detailed Inspection. Under the battery metallic cover.
9. Detailed Inspection. Metallic battery cover retaining clip and screws.
10. Detailed Inspection. PTO trap plate.
11. Detailed Inspection. PTO trap plate.
12. Detailed Inspection. PTO trap plate and receptacle housing.
13. Detailed Inspection. PTO wiring.
14. Detailed Inspection. PTO wiring.
15. Detailed Inspection. Power cord wiring.
16. Detailed Inspection. Power cord wiring.
17. Detailed Inspection. Receiver circuit board.
18. Detailed Inspection. Receiver enclosure.
19. Detailed Inspection. Receiver circuit board.
20. Detailed Inspection. Receiver circuit board.
21. Detailed Inspection. Internal view of demultiplexer panel.
22. Detailed Inspection. Internal view of demultiplexer panel.
23. Detailed Inspection. Internal view of demultiplexer panel.
24. Detailed Inspection. ISC Power Supply and Data Coupler.
25. Detailed Inspection. Internal view of demultiplexer panel.
26. Detailed Inspection. Internal view of ISC Power Supply and Data Coupler.
27. Detailed Inspection. Internal view of ISC Power Supply and Data Coupler.
28. Detailed Inspection. Battery discharge testing.
29. Detailed Inspection. Battery discharge testing.
30. Detailed Inspection. Battery discharge testing.
31. Detailed Inspection. Transmitter switches.
32. Detailed Inspection. Transmitter switches.
33. Detailed Inspection. Transmitter switches.
34. Detailed Inspection. Transmitter switches.
35. Detailed Inspection. Transmitter switches.
36. Detailed Inspection. Blocked conveyor start switch.

37. Detailed Inspection. Blocked conveyor start switch.
38. Detailed Inspection. Blocked right tram switch.
39. Detailed Inspection. Blocked right tram switch.
40. Detailed Inspection. Blocked right tram switch.
41. Detailed Inspection. Blocked right tram switch.
42. Detailed Inspection. Transmitter circuit board.
43. Detailed Inspection. Transmitter circuit board.
44. Detailed Inspection. Transmitter circuit board.
45. Detailed Inspection. Transmitter connector.
46. Detailed Inspection. Transmitter circuit board.
47. Detailed Inspection. Transmitter circuit board.
48. Detailed Inspection. Transmitter circuit board.
49. Detailed Inspection. Transmitter switch cover plate.
50. Detailed Inspection. Transmitter switch cover plate.
51. Detailed Inspection. Transmitter antenna.
52. Detailed Inspection. Left transmitter handle.
53. Detailed Inspection. Left transmitter antenna.
54. Detailed Inspection. Receiver circuit board.
55. Detailed Inspection. Receiver circuit board.
56. Detailed Inspection. Receiver circuit board.
57. Detailed Inspection. Antenna assembly.
58. Detailed Inspection. Antenna assembly.
59. Detailed Inspection. Antenna assembly.
60. Detailed Inspection. Antenna assembly.
61. Detailed Inspection. Shear switch.
62. Detailed Inspection. Shear switch.
63. Detailed Inspection. Transmitter shear switch location.
64. Detailed Inspection. Transmitter wall thickness under connector.
65. Detailed Inspection. Transmitter wall thickness under connector.
66. Detailed Inspection. Transmitter enclosure fracture.
67. Detailed Inspection. Transmitter left handle fracture.
68. Detailed Inspection. Transmitter left handle fracture.
69. Detailed Inspection. Transmitter right handle fracture.
70. Detailed Inspection. Transmitter right handle fracture.
71. Detailed Inspection. Transmitter left handle fracture.

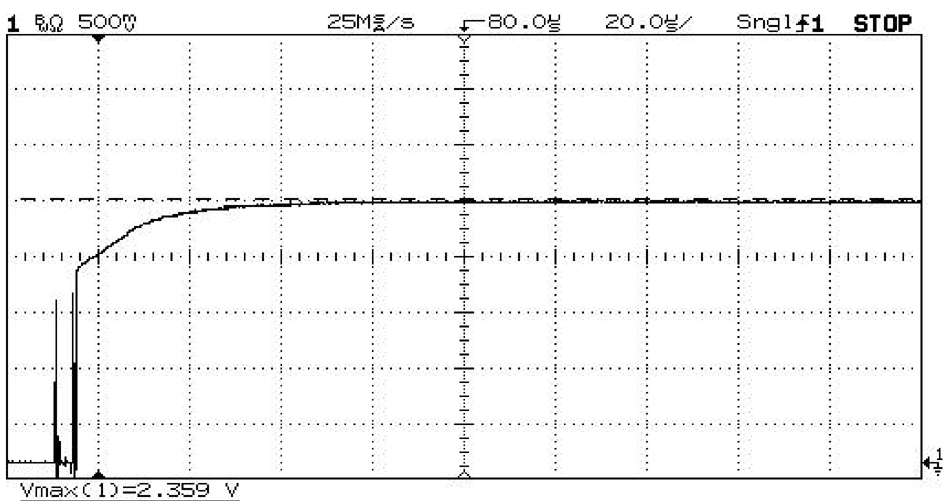
United States Department of Labor
MSHA
Mine Safety and Health Administration

DATA SHT NO.	2
INV. NO.	N/A
TEST SHT NO.	1
PAR NO.	89880
COMPANY	Koehler
TESTER	Chad Huntley
ASTP NO.	2002
RESULTS	NA
DATE	6/3/04

BATTERY FLASH CURRENT TESTING

Battery (Pack) Tested Information: Exhibit CDH-3 (After Charge)

Koehler	Manufacturer
5000 Series	Part Number
Lead Acid	Chemistry Type
4	Nominal Voltage
N/A	Freshness Date



Highest V_{open}	Lowest $R_{internal}$
4.492	0.088

Test Equipment:

1. Fluke 8842A MM (Cal. Due 08-31-04)
2. HP 54615B Oscilloscope (Cal. Due 08-31-04)
3. Fluke Model 2170A (Cal. Due 08-31-04)

Conclusions and Comments:

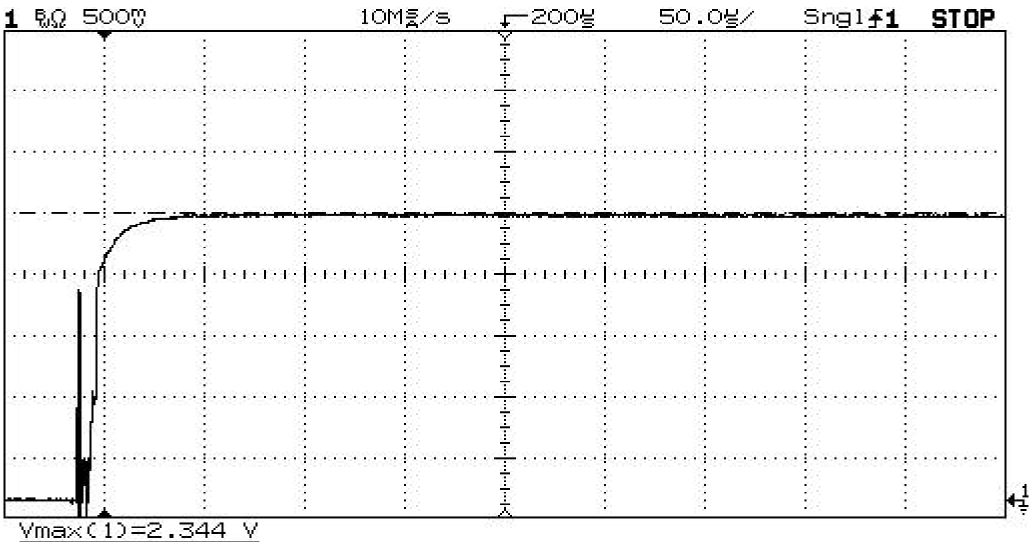
Ambient Temperature = 21.6 ºC, battery charged for 14 hours & 55 minutes prior to test.

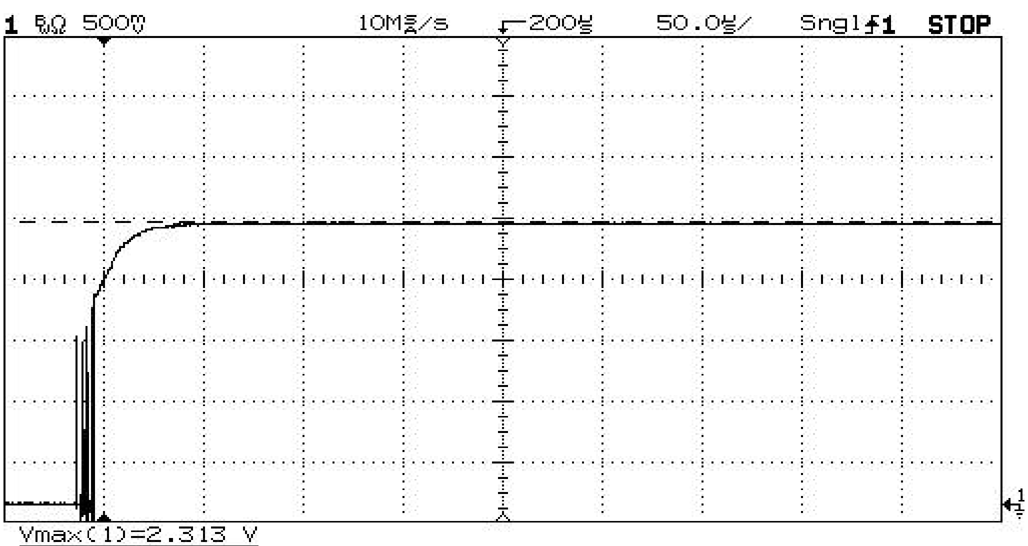
DATA SHT NO.	2
INV. NO.	N/A
TEST SHT NO.	1.1
PAR NO.	89880
COMPANY	Koehler
TESTER	Chad Huntley
ASTP NO.	2002
RESULTS	NA
DATE	6/3/04

Koehler, Lead Acid, 4 volt, Part Number 5000 Series

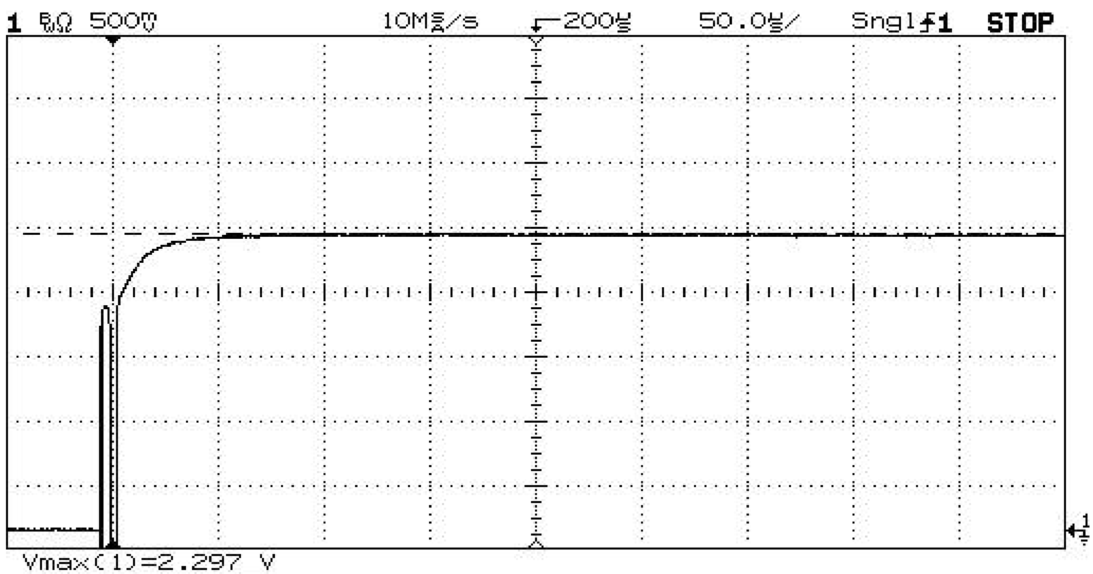
R_{load}	R_{test}
0.104	0.108

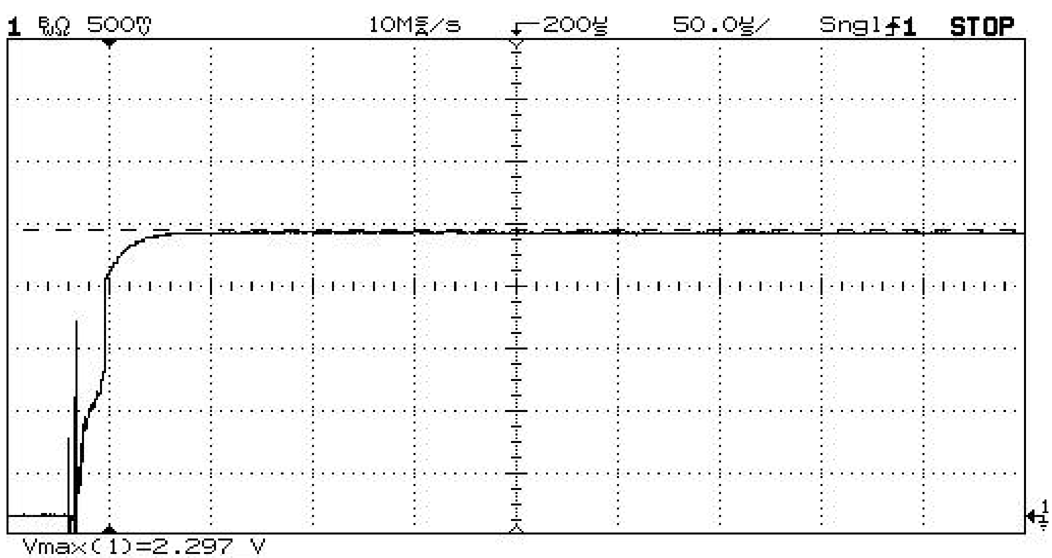
Sample	V_{open}	V_{flash}	I_{flash}	$R_{internal}$	I_{short}
acflash1	4.492	2.359	22.683	0.090	49.891
acflash2	4.425	2.344	22.538	0.088	50.096
acflash3	4.394	2.313	22.240	0.090	49.057
acflash4	4.368	2.297	22.087	0.090	48.659
acflash5	4.347	2.297	22.087	0.089	48.943





DATA SHT NO.	2
INV. NO.	N/A
TEST SHT NO.	1.2
PAR NO.	89880
COMPANY	Koehler
TESTER	CDH
ASTP NO.	2002
RESULTS	N/A
DATE	6/3/04





SHT NO.	2
INV. NO.	N/A
TEST SHT	2
PAR NO.	89880
COMPANY	Koehler
TESTER	C.D.H.
ASTP NO.	N/A
RESULTS	N/A
DATE	6/9/2004

Battery 250mA Load Test

Real Time (hours)	Elapsed Time (hours)	Current Draw (mA)	Battery Voltage (volts)
8:34am	N/A	0 (No Load)	4.55
8:35am	0	253.2	4.38
9:05am	0.5	250.3	4.01
9:35am	1.0	250.7	4.01
10:05am	1.5	250.7	4.01
10:35am	2.0	250.6	4.01
11:05am	2.5	250.5	4.01
11:35am	3.0	250.5	4.01
12:05pm	3.5	250.3	4.01
12:35pm	4.0	250.1	4.00
1:05pm	4.5	N/A	N/A
1:35pm	5.0	N/A	N/A
2:05pm	5.5	250.6	3.99
2:35pm	6.0	250.4	3.99
3:05pm	6.5	250.1	3.99
3:35pm	7.0	251.5	3.98
4:05pm	7.5	251.3	3.98
4:35pm	8.0	250.8	3.97
5:05pm	8.5	250.6	3.97
5:35pm	9.0	250.1	3.96
6:05pm	9.5	251.4	3.96
6:35pm	10.0	251.1	3.95

Equipment:Current readings taken with Fluke 25MM (S/N 3655488) and voltage readings taken with Fluke 25MM (S/N 3710188) both cal. Due 8/31/04.

Comments: battery was fully charged prior to test using P.S. set to 5.0v/4.0 amps.

Appendix C – Quality Assurance Records Related to Joy TX3 Dust Boots

JOY MINING MACHINERY
A Joy Global Inc. Company

JOY SERVICE BULLETIN

Number	**0FGJ-0243**
Issued	**15 JANUARY 2004**
Revised	
Product	**MINER GENERAL**
Type	**ALL WITH "LIGHTWEIGHT" RADIO REMOTE**
Approval	**JCG/JJS/SAM/TAS/LJL**

REVISION "D" LIGHTWEIGHT RADIO REMOTE STATIONS

An upgrade to "D" specifications of the LightWeight Radio Remote Station is now available. As noted in previous bulletins, the revision level is determined by looking at the last character of the station's serial number. If it is a number only or a number and the letter A, B, or C then the station should be returned for updating. If the last character of the serial number is the letter "D", then your station is already upgraded to include the improvements described below and does not need to be returned.

The revision "D" upgrade provides a number of significant improvements:

1) The rubber switch boots have been redesigned to provide significantly longer usable life. The new boots are far more flexible resulting in a greatly reduced activation force; the change will significantly improve the ergonomics of the lightweight station.
2) The extended TRAM knobs decrease the required activation force by approximately 50% and, when used in combination with the new boots, make the station much easier to use.
3) The station LED lenses (light pipes) will be sealed with a better adhesive to reduce the possibility of moisture and dust contamination into the unit.
4) A new faceplate has been designed because the new boots are significantly larger than previous versions. The holes for the boots and switches are enlarged and the text has been moved to accommodate these new boots.

END

JOY MINING MACHINERY
A Joy Global Inc. Company

JOY SERVICE BULLETIN

Number 0FGJ-0244
Issued **15 JANUARY 2004**
Revised
Product **MINER GENERAL**
Type **ALL WITH "LIGHT-WEIGHT" RADIO REMOTE**
Approval **JCG/JJS/SAM/TAS/LJL**

LIGHTWEIGHT RADIO REMOTE STATION UPGRADE KIT

A kit is now available to upgrade the LightWeight Remote Station's switch boots to the new improved longer lasting, flexible version. This upgrade can be easily performed in the field.

Joy P/N 100157289 Upgrade Kit for LightWeight Remote Station P/N 100112672 includes:
- Joy P/N 100157286 Knob
- Joy P/N 100157287 Boot
- Joy P/N 100157288 Faceplate

Joy P/N 100157624 Upgrade Kit for LightWeight Remote Station P/N 100069220 includes:
- Joy P/N 100157286 Knob
- Joy P/N 100157287 Boot
- Joy P/N 100157623 Faceplate

The upgrade kit must be initially installed on the station. Once installed, new switch boots can be purchased for ongoing maintenance by ordering the Joy part number for boots listed above.

Note: If your unit has the "D" upgrade, indicated by the letter "D" following the serial number, you already have the latest design of boots and you will not need the kits listed above.

Units without the "D" upgrade will be automatically updated when they are returned for repair.

END