

UNITED STATES
DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION

REPORT OF INVESTIGATION

Surface Nonmetal Mine
(Sand and Gravel)

Fatal Powered Haulage Accident

December 20, 2003

Scott Pit
Elmore Sand and Gravel, Incorporated
Elmore, Elmore County, Alabama
Mine I.D. No. 01-01138

Investigators

Walter E. Turner
Supervisory Mine Safety and Health Inspector

Harold J. Wilkes
Mine Safety and Health Inspector

Eugene D. Hennen
Mechanical Engineer

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Mine Safety and Health Specialist

Originating Office
Mine Safety and Health Administration
Southeast District
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Michael A. Davis, District Manager

OVERVIEW

Donnie L. Zeigler, haul truck operator, age 37, was fatally injured on December 20, 2003, when a raised bed on a haul truck lowered, pinning him against the frame of the truck.

Zeigler had dumped a load of material and pulled the truck forward with the bed in the raised position. He went under the raised bed to add brake fluid in the master cylinder because the brake light on the dashboard came on inside his truck.

The accident occurred because the safety prop provided to secure the bed, while in the raised position, had not been used. The wiring harness from the tractor to the trailer was damaged. This caused a malfunction in the electrical system that prevented the dump bed control switch from working properly. When the control lever was released after raising the bed, the hydraulic control valve would go to the float position and not return to the hold position as the system was designed. The malfunction allowed gravity to bring the bed down.

GENERAL INFORMATION

Scott Pit, a sand and gravel operation, owned and operated by Elmore Sand and Gravel, Incorporated, was located three miles north of Elmore, Elmore County, Alabama off highway I-43 North. The principal operating official was Billy R. Stanley, president. The mine normally operated one ten-hour shift a day, six days a week. Total employment was 33 persons.

The mine was a single bench sand and gravel operation. After the removal of overburden, the underlying material was transported by haul truck to the primary plant where it was washed, screened, sized, and stockpiled. The finished products were sold for construction material.

The last regular inspection at this operation was completed on September 30, 2003.

DESCRIPTION OF ACCIDENT

On the day of the accident, Donnie Zeigler (victim) reported to work at 7:00 a.m., his normal starting time. He and several co-workers were to work in the pit stripping and hauling overburden. Zeigler operated a haul truck and was hauling his first load of material from the pit to the dump area, approximately 150 yards away. At about 7:30 a.m., Derrell Sanders, haul truck operator, talked to Zeigler on the two-way radio. Zeigler told Sanders that the brake light kept coming on in the cab of his truck and he was going to check his brakes.

Zeigler drove his truck to the dump area at the east end of the pit and dumped his load. With the bed still in the raised position, he pulled the truck forward about 20 feet and stopped. Zeigler took a container of brake fluid that he kept in his cab and got up on the frame of the truck to add the brake fluid in the rear master cylinder. While he removed the reservoir cap, the bed slowly lowered, pinning Zeigler against the frame of the truck.

As Sanders was leaving the load out area, he saw the truck bed start going down and thought Zeigler was lowering the bed to leave the area. As he drove by the driver's side of Zeigler's truck, Sanders did not see him in the cab. He drove to the passenger's side of the truck and found Zeigler pinned under the bed. He went to Zeigler's truck, raised the bed, and checked on Zeigler who was nonresponsive.

Emmett Findley, excavator operator, saw Sanders beside the truck, motioning for him to come over to the truck. Findley used his cell phone to call for assistance. The local fire department transported Zeigler to a local hospital where he was pronounced dead as a result of crushing injuries.

INVESTIGATION OF THE ACCIDENT

MSHA was notified of the accident at 10:40 a.m., on December 20, 2003, by a telephone call from Mark Montgomery, safety director of Elmore Sand and Gravel, Incorporated, to Harry L. Verdier, assistant district manager. An investigation was started that day. An order was issued under the provisions of Section 103(k) of the Mine Act to ensure the safety of the miners. MSHA's accident investigators traveled to the mine, made a physical inspection of the accident scene, interviewed employees, and reviewed conditions and work procedures relevant to the accident. MSHA conducted the investigation with the assistance of mine management and employees.

DISCUSSION

Location of the Accident

The accident occurred at the dump site in the east area of the pit, approximately 150 yards from where the overburden was being removed. The area was relatively flat and dry.

Machine Information

The machine involved in the accident was a 2002 Terex 25 ton, Model TA25, articulated off-road haul truck. The truck had a Cummins 8.3 liter 6 cylinder diesel engine. The truck had 6 wheel drive and an automatic transmission with 6 speeds forward and 3 speeds in reverse. The truck had articulated steering.

Service Brake System Design

The service brake consisted of air over hydraulic caliper disc brakes with a brake disc at each of the six wheels. Each of the wheels on the trailer had one caliper, totalling four calipers on the trailer. The tractor also had four calipers, with two calipers at each wheel. The pressure to engage the brake calipers was supplied by two air activated master cylinders. The master cylinder for the tractor brakes was located in the left rear corner of the engine compartment. The master cylinder for the trailer brakes was located between the frame rails on the front portion of the trailer. A brake valve, activated by the brake pedal, controlled the air supplied to the master cylinders. The brake valve had two

sections, which allowed separate and independent air circuits to the service brake system's tractor and trailer service brake master cylinders. When the brake pedal was pushed, the brake valve delivered air directly to the tractor service brake master cylinder and directed air to the relay valve. The relay valve controlled the air flow to the trailer service brake master cylinder.

Trailer Service Brake Evaluation

A check of the trailer master cylinder reservoir revealed one inch of fluid in the bottom. When the service brake was applied, most of the fluid in the reservoir went to the master cylinder. When the service brake was released, air bubbled out of the fluid in the master cylinder reservoir indicating air in the brake system. A check of the master cylinder overstroke indicator revealed the master cylinder piston was traveling to the end of the master cylinder bore. A 2,000 PSI pressure gauge was placed in the pressure check port in the hydraulic portion of the trailer service brake system. When the service brake was fully applied, the pressure in to the hydraulic brake calipers on the trailer axles was 100 PSI. Information from the truck manufacturer indicated the pressure to these calipers should have been 2300 PSI.

The trailer brake system was examined after an unsuccessful attempt to bleed the air out of the hydraulic portion of this system. During the examination, a leak was found in the fitting, which connected the brake line to the left rear caliper. A replacement fitting was not available at the mine site. A citation was issued as a result of this finding; however, it was determined this violation was not the cause of the accident.

In order to check the rest of the system, the brake line to the left rear caliper was plugged and the air was bled out of the remaining part of the circuit. After the successful bleeding of the trailer brake system, the service brake was slowly applied. The hydraulic pressure in the system rose to at least 2000 PSI (the maximum reading on the gage used).

Further examination of the trailer service brake system revealed that all of the brake discs were rough. The brakes for all the trailer wheels were more than 1/2 inch thick. Oil was leaking from the speed reducers for both of the wheels on the front trailer axle. The brake disc for the left side had oil from the leaking speed reducer on it. The brake disc on the right side did not have oil on it, but oil out of the speed reducer had leaked onto the inside of the rim.

Tractor Service Brake Evaluation

An evaluation of the tractor service brake system did not reveal any defects in the tractor service brake system. The items checked included the stroke

indicator for the tractor actuator assembly, the fluid in the master cylinder reservoir, the amount of lining material, and the front brake discs.

Safety Prop Design

The truck was equipped with a safety prop to prevent the raised truck bed from lowering when someone was working between the frame and the bed. The safety prop was pinned to and free to rotate in a clevis which was located between the frame rails on the trailer. When the safety prop was not being used, it rested in a trough between the frame rails. When the bed was raised, the safety prop could be rotated until it came to rest against a stop which held the prop in an upright position. When in the upright position, the safety prop would prevent the bed from lowering all the way to the frame.

Safety Prop Evaluation

The bed of the truck was raised until the lift cylinders were almost fully extended and the bed control was placed in the hold position. The safety prop was rotated until it came to rest against the stop which held it in the vertical position.

The bed lift control was placed in the float position and the bed was allowed to lower until it came into contact with the safety prop. The safety prop stopped the bed from lowering to the frame.

Dump Bed Lift Circuit Design

The dump bed was lifted by two hydraulic cylinders. The pressure to lift the bed was supplied by a hydraulic gear pump mounted on the transmission PTO. The flow from the pump went to a priority valve which directed the hydraulic flow to either the steering or the bed lift circuit as needed. In the bed lift circuit, flow was directed to a four position single section hydraulic valve. The four positions of the control valve were raise, hold, lower, and float. When operating as designed, the hold position of the control spool blocked the ports to the hydraulic cylinders which held the bed in position. In the float position, the ports to both the raise and lower side of the lift cylinder were connected together and to the hydraulic tank. When the hydraulic valve was in the float position, the weight of the bed caused it to lower. The service manual stated that when the truck was moving, the hydraulic valve had to be put in the float position to ensure the weight of the bed was resting on the frame of the truck and not the hydraulic cylinders. When the valve was in the lower position, hydraulic pressure powered the bed down.

Hydraulic pilot pressure, directed to the bed control valve through electrical solenoid valves located in the end caps on both sides of the valve, controlled the position of the spool. The pilot pressure solenoid valves were controlled by an electrical joystick on a control panel located to the right of the operator seat.

The joystick control had four straight line positions which corresponded to the four positions in the control valve. The joystick position, all the way forward, was a detented position, which put the control valve in the float position. The hold position was the third position from the front. The second position from the front was bed lower position and the fourth position from the front was bed raise position. To raise or lower the bed, the operator had to hold the joystick in position. When operating properly, the joystick control was designed to automatically go to the hold position, when released, while the bed was being raised or lowered. The pilot pressure for the lift circuit was supplied by an accumulator, which was charged with the pressure between the priority valve and the bed control valve.

Dump Bed Lift System Evaluation

An evaluation of the bed lift circuit was conducted to determine if it was operating properly. When the bed lift control was placed in the raise position, the bed raised to the full upright position. After the control was released, the bed stayed in the upright position. After approximately 20 seconds, the bed started moving and lowered all the way to the frame without the operator moving the control. In subsequent tests, when the bed was put in the full upright position and the control was released, the bed stayed up. Further testing showed that when the bed was lowered from being fully raised, it did not stop as it should have when the bed lift control was released and allowed to go to the hold position. The bed continued to lower as if the control had been put in the float position rather than the hold position.

It was noticed that all of the electrical wires between the tractor and the trailer were detached from each other in the articulation area. After these wires were reattached, the bed lift system was re-examined. With the wires reconnected, the bed would stop when it was being lowered if the control was allowed to go into the hold position.

The truck involved in the accident had a light on the dashboard, which came on when the bed was in the raised position. The switch, which controlled this light, was mounted on the trailer. The light did not work until the wires between the tractor and the trailer were reconnected. The manufacturer indicated the electrical circuit for the bed lift control was designed so that when the wire to the bed raised warning light was detached from the corresponding switch, the bed control valve would go into float position rather than the hold position when the joystick control was released. This explains why the bed would not stop lowering when tests were conducted before the wire to the bed raised warning light switch was reconnected.

The truck manufacturer was contacted to determine why the bed did not stay in the fully upright position when the control was in the float position during the first test conducted after the accident. However, the bed stayed in place in all of the identical subsequent tests. Information obtained from the truck manufacturer revealed that the center of gravity of the bed was slightly behind the pivot point between the bed and the frame when the bed lift cylinders were fully extended. The fact that the center of gravity was behind the pivot point explains why the bed normally stayed in the fully raised position even when the control valve was in the float position. The manufacturer stated since the center of gravity of the bed was close enough to the pivot point between the bed and the truck frame, vibrations from the truck running or pressure against the bed caused by wind could cause the bed to lower if the control valve was in the float position when the bed was fully raised.

Examination of Detached Electrical Wires

An examination was conducted to determine why the electrical wires to the trailer were detached from wires on the tractor. Interviews conducted during the accident investigation revealed the trailer had overturned a few days prior to the fatal accident and the electrical wires between the tractor and the trailer were broken. The electrical wires from the tractor to the trailer were in one bundle with a plastic sleeve covering the bundle. The electrical wires had been repaired using plastic covered electrical connectors. The connectors for all of the wires were in the same location. An examination of the detached wires showed that they were detached in the area where the previous repair had been made. Interviews also indicated the victim was having problems with the electrical circuits on the day of the accident.

An examination of the ends on the detached wires showed that the wires did not match. Portions of the wires on the tractor side of the repair had been cut and removed and could not be found. An examination of the ends of the wires on the trailer side showed that the wires from the tractor side had been pulled out of the connectors. A determination could not be made of when or how the wires on the tractor side of the hitch were cut. Since the sections of the tractor side wires could not be found, the length of these wires could not be determined. Tests conducted to determine if the earlier repair resulted in shortened wires, that pulled loose when the truck articulated, were not conclusive.

Weather

Weather on the day of the accident was clear and cold. Winds were light and variable.

Training and Experience

Zeigler had received training in accordance with 30 CFR, Part 46. He had a total of 9½ months mining experience, the last eight months as a truck driver.

ROOT CAUSE ANALYSIS

A root cause analysis was conducted and the following causal factors were identified:

Causal Factor: A miner positioned himself under the raised bed of his truck to add brake fluid to the rear master cylinder. The safety prop provided on the dump bed trailer was not utilized to secure the bed from lowering.

Corrective Action: Company procedures were in place requiring raised truck beds to be blocked and secured against lowering while employees were making repairs. Steps should be implemented to monitor work practices on a regular basis to reinforce safe work procedures.

Causal Factor: The electrical wiring between the tractor and the dump bed trailer had been previously damaged and was not connected at the time the accident occurred. This caused the bed lift hydraulic valve to go into the float position, instead of the hold position, allowing the bed to come down.

Corrective Action: Mobile equipment should be inspected thoroughly before being placed in operation. Safety defects should be repaired to restore components to the manufacturer's design. The electrical wires should have been examined to determine if they would stay connected when the truck articulated.

Causal Factor: A fitting that connected the brake line to the left rear caliper was found to be defective and allowed brake fluid to leak from the brake system. When the brake fluid in the master cylinder was nearly depleted, the service brake light on the dashboard of the truck would alert the driver. The pre-operational inspection of this truck was deficient in that it failed to accomplish the prompt repair of the brake line fittings.

Corrective Action: Ensure adequate pre-operational checks are conducted on all self-propelled mobile equipment and that any defects found are promptly corrected. Management should conduct follow-up evaluations to reinforce the importance of these examinations with miners who operate mobile equipment.

CONCLUSION

The accident occurred because the safety prop had not been positioned between the raised bed and the truck frame before the miner climbed on the trailer frame to add brake fluid to the master cylinder. The wiring harness from the tractor to the trailer was damaged. This caused a malfunction in the electrical system that prevented the dump bed control switch from working properly. Due to the electrical malfunction, when the control lever was released after raising the bed, the hydraulic control valve would go to the float position and not return to the hold position, allowing the bed to come down. The pre-operational examination of this haul unit failed to identify the defective brake line fitting resulting in the operator having to routinely add brake fluid.

VIOLATIONS

Order No. 6093289 was issued on December 20, 2003, under the provisions of Section 103(k) of the Mine Act:

A fatal accident occurred at this operation on December 20, 2003, when a miner was crushed between the frame rail structure and the truck bed that he had been operating. This order prohibits the Terex TA25 haul truck from being operated until MSHA determines that it is safe to resume normal operations in the area. The mine operator shall obtain prior approval from an authorized representative for all actions to recover and/or restore operations in the affected area.

This order was terminated on January 20, 2004. Conditions that contributed to the accident have been corrected and normal mining operations can resume.

Citation No. 6093106 was issued on January 12, 2004, under the provisions of Section 104(a) of the Mine Act for violation of 30 CFR, 56.14211(c):

A fatal accident occurred at this operation on December 20, 2003, when a truck driver was pinned between the frame of the truck and the dump bed of a Terex TA 25 haul truck. The truck driver was on the frame of the truck with the bed in the raised position when the

bed of the truck unexpectedly lowered. The safety bar had not been utilized to prevent the bed from lowering.

This citation was terminated on January 22, 2004. All miners received additional training addressing haul trucks and the use of the safety bar and scotch blocks when the truck bed is in the raised position.

Citation No. 6093107 was issued on January 12, 2004, under the provisions of Section 104(a) of the Mine Act for violation of 30 CFT 56.14100(c):

A fatal accident occurred at this operation on December 20, 2003, when a truck driver was pinned between the frame of the truck and the dump bed of a Terex TA25 haul truck. The wiring harness from the tractor to the dump bed trailer was damaged, causing a short in the electrical system that prevented the dump bed control switch from working properly. Due to the electrical short, when the control lever was released after raising the bed, the hydraulic control valve would not return to the hold position, allowing the bed to come down.

This citation was terminated on January 22, 2004. The wiring harness from the tractor to the bed on the Terex TA25 haulage truck was replaced. When tested, the dump bed control switch operated properly.

Approved by: _____ Date: _____
Michael A. Davis
District Manager

APPENDICES

- A. Persons Participating in the Investigation
- B. Persons Interviewed

APPENDIX A

Persons Participating in the Investigation

Elmore Sand and Gravel, Incorporated

David Gadd	general manager
Erick Hyler	mechanic

State of Alabama

Don A. Keith	mine inspector
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Mine Safety and Health Administration

Walter E. Turner	supervisory mine safety and health inspector
Harold J. Wilkes	mine safety and health inspector
Eugene D. Hennen	mechanical engineer
James Hackworth	mine safety and health specialist

APPENDIX B

Persons Interviewed

Elmore Sand and Gravel, Incorporated

Bill Stanley	president
Mark Montgomery	safety director
Lewis Johnson, Jr.	foreman
Derrell L. Sanders	haul truck operator
Emmett A. Findley	excavator operator
Henry Baxter	excavator operator
Jonas Hall	equipment operator
Jack L. Burns	mechanic