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GENERAL INFORMATION

Coal Mine Fatal Accident 2003-23



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|-----------------|------------------------------|
| Operator: | Twin Star Mining, Inc. |
| Mine: | No. 2 Surface Mine |
| Accident Date: | September 5, 2003 |
| Classification: | Exploding Vessel |
| Location: | District 5, Hurley, Virginia |
| Mine Type: | Surface |
| Employment: | 53 |
| Production | 2,000 tons/day |

OVERVIEW

Coal Mine Fatal Accident 2003-23

- At approximately 8:45 p.m., on Friday, September 5, 2003, a 28-year-old Utility Man with 10 years of mining experience was fatally injured during an exploding vessel accident.
- The fatally injured miner was holding an unlit oxygen/acetylene torch, through which he was delivering acetylene into an empty 55-gallon antifreeze drum when it prematurely exploded.
- Earlier in the day, the victim used a trail of starting fluid to ignite a bag filled with acetylene. At the time of the accident, he was intending to demonstrate a larger explosion to a new mine employee.
- A mechanic, who was standing next to the victim, and two other mine employees, who were approaching the bucket at the time of the explosion, were also injured.

OVERVIEW

Coal Mine Fatal Accident 2003-23



- The drum was placed inside an unattached Caterpillar, Model 992-G, front-end loader bucket, which concealed its view and shielded the blast from nearby buildings.
- The fatally injured victim received massive fatal head injuries when he was struck by debris from the explosion.
- The most likely ignition source was static electricity, which was generated by acetylene flowing from the torch tip. An electrostatic discharge likely occurred when the torch tip touched the grounded steel drum.

ACCIDENT DETAILS

- The evening shift began operation at 5:00 p.m., under the supervision of Glen Mullins, Evening Shift Foreman. Mullins began his shift on the Kentucky side of the mine, where he supervised the moving of a loader spread.
- Jason Layne, Mechanic, and James Estep, Contract Mechanic, went to an area approximately 200 feet south of the maintenance shop to work on a haul truck, located near two front-end loader buckets.

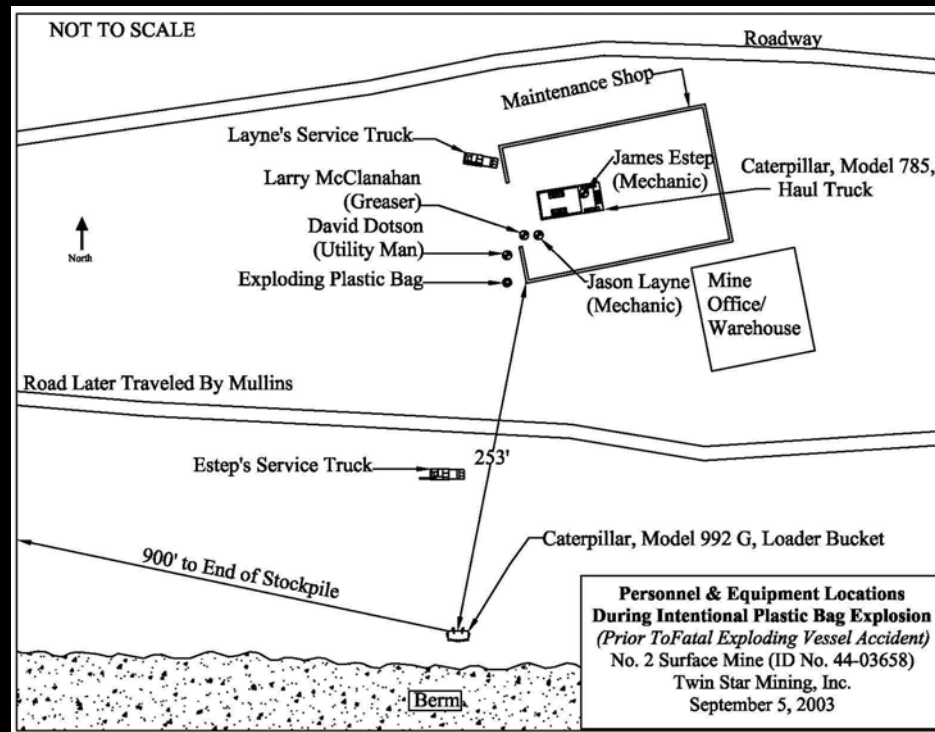


ACCIDENT DETAILS

- David Dotson, Utility Man and victim, and Larry McClanahan, Greaser, were greasing and fueling coal loaders on the Kentucky side of the mine. Dotson used his cellular phone to place a food order at a local restaurant. Dotson contacted Bruce Mounts, Haul Truck Operator/EMT, on the CB radio to set up a practical joke concerning McClanahan's tab at Bertha's.
- Dotson and McClanahan left in separate vehicles to service a water truck, located near the maintenance shop. While en route, Mounts called McClanahan on the CB radio and followed through with the joke. When Mounts finished talking with McClanahan, Dotson came back on the radio laughing.
- Dotson and McClanahan serviced the water truck and prepared to replenish the antifreeze in the C model trucks. Before loading the antifreeze in McClanahan's service truck, Dotson asked Layne and Estep if they would need the oil drained from the Caterpillar, Model 785, haul truck. They replied that it would, once the haul truck was in the maintenance shop.

ACCIDENT DETAILS

- Dotson, McClanahan, and Layne met in the maintenance shop while Estep was retrieving the haul truck. Dotson took an empty plastic bag to the opposite side of Layne's service truck and filled it with acetylene.
- When Estep arrived with the haul truck, Layne and McClanahan directed Estep into the maintenance shop. Meanwhile, Dotson placed the bag outside the shop, sprayed a trail of starter fluid to the bag, ignited the trail, and exploded the bag. Layne thought a tire on the haul truck had burst; Dotson reentered the maintenance shop laughing.



ACCIDENT DETAILS

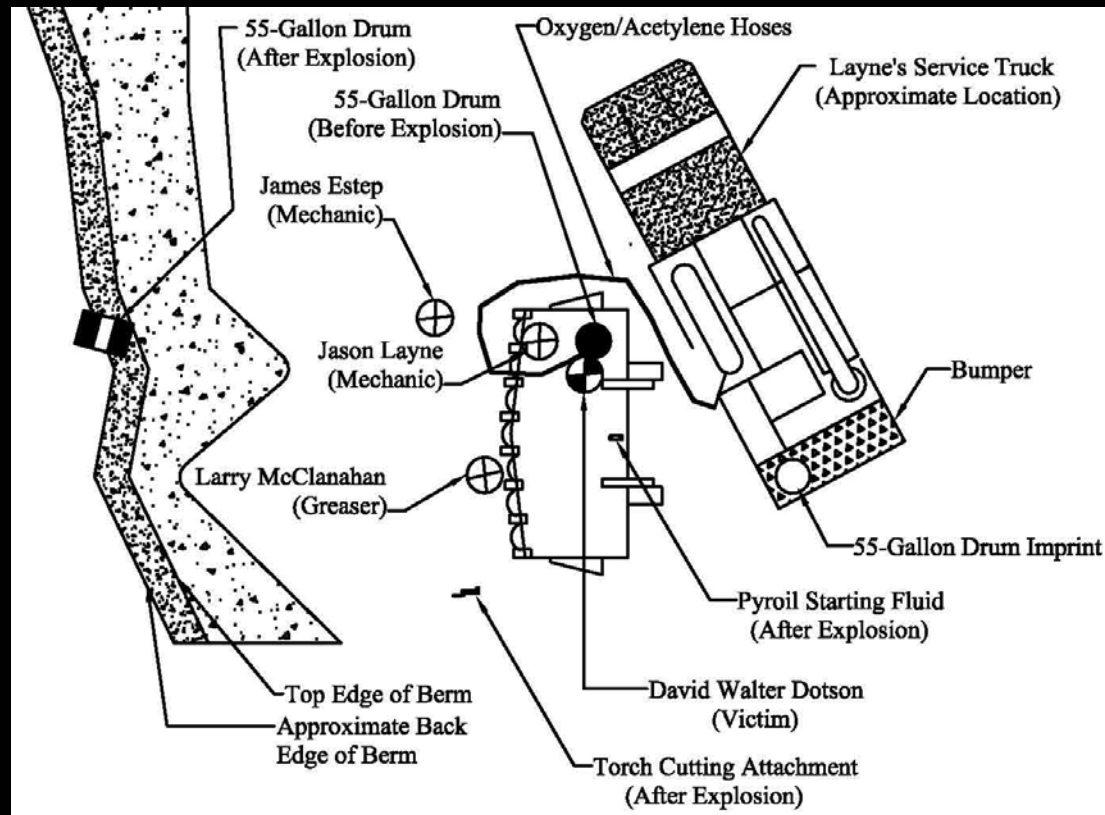
- Preparations were made to begin maintenance work on the haul truck. Estep prepared to drain the oil while Dotson and Layne obtained a 55-gallon drum from the maintenance shop and placed it on the bumper of Layne's truck, which Layne drove to the front-end loader bucket.
- McClanahan walked with Dotson to the loader bucket, while Dotson talked about placing acetylene in the drum and igniting the mixture. Meanwhile, Estep walked to his service truck, located between the loader bucket and the maintenance shop. Fearing that he might get in trouble, McClanahan immediately walked back to meet Estep at his service truck.
- Layne walked to the front of the bucket, where he smelled acetylene and saw Dotson standing in the bucket with the tip of a torch inserted through a hole in the drum lid.
- Dotson told Layne that he was "going to show the new boy what an acetylene explosion would do." McClanahan had only been employed at the mine for two weeks.

ACCIDENT DETAILS

- Meanwhile, Mullins drove between Estep's service truck and the shop area while accompanying a loader spread move. He saw Estep and McClanahan conversing at Estep's service truck, but he did not notice Dotson or Layne.
- McClanahan told Estep that Dotson was going to do something with the drum and acetylene. Estep replied that he did not think they would do that. After he saw Mullins pass, Estep began wondering what was delaying Dotson from returning with the drum.
- Estep and McClanahan began walking toward the front-end loader bucket. As they rounded the corner of the loader bucket, to within approximately 8 feet of the drum, the acetylene/air mixture in the drum prematurely ignited, causing a loud explosion and a bright flash of light.

ACCIDENT DETAILS

- Dotson was struck by debris and was thrown approximately 6 feet, sustaining massive head trauma.
- Layne, was forced to the ground by the explosion and burned by flames from the torch body, which struck him in the neck.
- Estep's eyes were hit by debris, temporarily impeding his vision, and McClanahan was thrown to the ground.



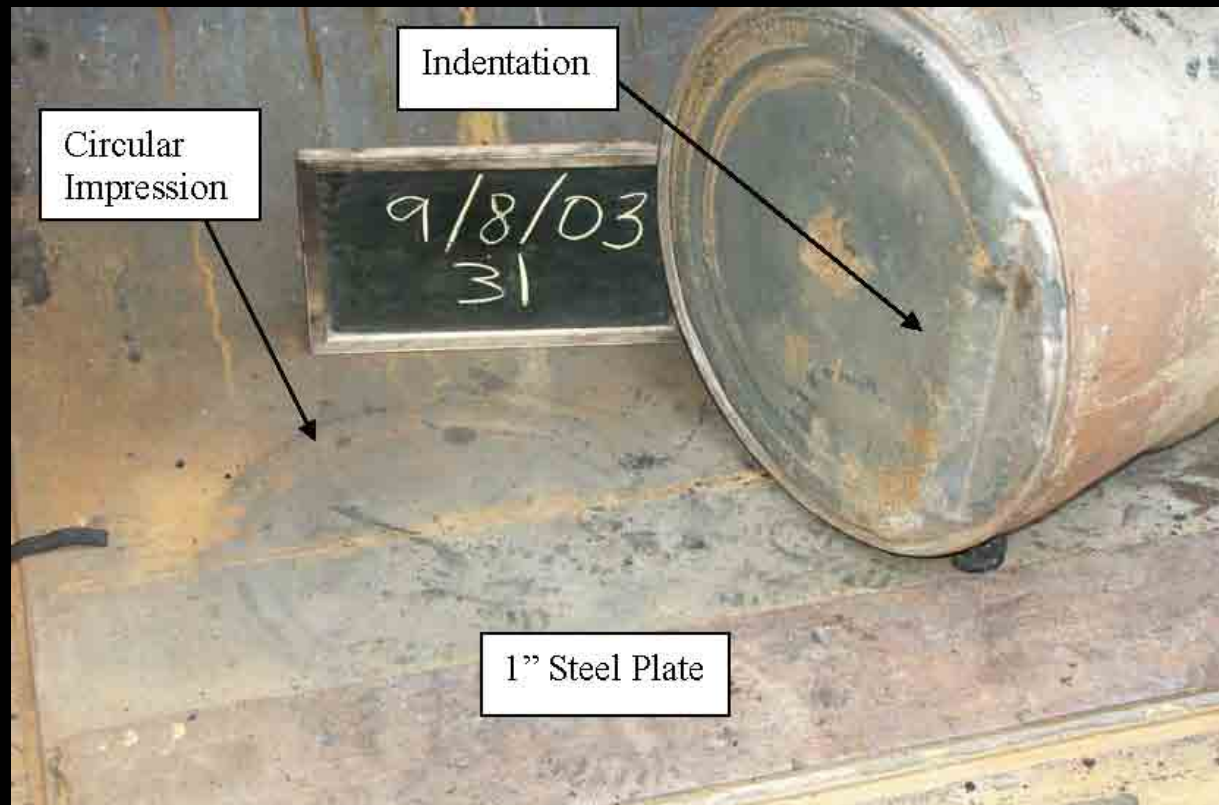
HUMAN FACTORS

Practical jokes and horseplay occurred on several occasions prior to the accident:

- Dotson contacted Mounts and told him to tell McClanahan he owed 200 dollars to Bertha's Diner and that he could not order anymore food until the tab was paid.
- Dotson had ignited acetylene in plastic bags several times prior to the accident. Witnesses stated that he enjoyed playing practical jokes and that "He was all the time cutting up."
- Mullins (management) was aware of previous horseplay in the form of "goosing" or putting a snake on an individual and had seen Dotson spray old filters with starter fluid and burn them. Mullins could not see Layne or Dotson in the loader bucket when he passed before the accident, as bucket faced away from the road.

ORIGIN, FLAME, & FORCES

The direction of explosive forces extended outward in all directions from the 55-gallon drum, which indicated that the explosion originated inside the drum. Its lid separated from the drum and impacted the top, inner surface of the loader bucket. The bottom of the drum was indented, but did not separate from the drum. The indentation in the bottom of the drum conformed to a one-inch thick, flat steel reinforcing plate in the bottom of the bucket..



ORIGIN, FLAME, & FORCES

- Forces of the explosion rebounded off the loader bucket and carried the drum for a distance of 30 feet, landing on a berm.
- The victim's injuries were consistent with Layne's statement that Dotson's was holding the torch with the tip in the hole of the 55-gallon drum at the time of the accident.
- The oxygen/acetylene combination-cutting torch assembly was broken into at least 3 pieces: the torch base, the cutting attachment, and the tip. The base was still connected to the hoses, which in turn, were connected to the regulator assemblies on the gas cylinders mounted on the service truck. After the accident, the cutting attachment was approximately 7 feet from the bucket, but the torch tip and tip nut were not found.



ORIGIN, FLAME, & FORCES

- The threads on the tip were stripped but no impact marks were present, indicating that the threads were protected from impact by the tip, and that the tip was attached at the time of the accident. The impact was likely caused by either the torch being struck by the drum lid or the torch being forced into the front surface of the bucket.
- Damage to the threads connecting the cutting attachment to the base indicated that a prying action stripped the attachment from the base, possibly caused by the same lateral force that twisted the attachment.
- The rate of pressure rise for acetylene can be as much as 25 times faster than methane, which can cause damage consistent with that observed at the accident site.



POTENTIAL FUEL SOURCES

- **Acetylene** - Acetylene was the fuel source for the explosion. This gas is inherently unstable and may explode when subjected to heat or a mechanical shock. An explosion hazard exists if acetylene is released in a confined space. Acetylene-air mixtures have a wide flammability range, ignitable at concentrations between 2.5% and 81%. The flash point for acetylene is 32°F and the auto ignition temperature is 581°F. The minimum ignition energy for acetylene ranges from approximately 17 micro joules (μJ) in air, down to 0.2 μJ in pure oxygen (as compared to 300 μJ to 3 μJ for methane). The supply valves on the regulators for both the acetylene and oxygen were found in the open position.
- **Antifreeze** - Antifreeze residue in the drum would not have been subjected to sufficient heat to generate flammable vapors. Therefore, the original contents of the drum were not likely to have provided fuel for the explosion.
- **Starting Fluid** - Cline removed an aerosol can of starting fluid from Dotson's right front pants pocket while providing first aid. Dotson used the can of starting fluid to make a "wick" along the ground to ignite a bag of acetylene from a distance. However, none of the aerosol contents were detected in the drum sample, making it unlikely that Dotson discharged starter fluid into the drum prior to the accident.

POTENTIAL IGNITION SOURCES

- All potential ignition sources were identified and evaluated during the investigation. Potential sources included:
 - Smoking materials
 - Cell phones
 - Striker
 - Chemical reaction of substances with pure oxygen
 - Static electricity
- The most likely source of ignition energy was the build up of a static electrical charge on the torch caused by the discharging acetylene. The human body can accumulate a static charge that is approximately 1000 times greater than the energy needed to ignite acetylene. If a torch operator is sufficiently insulated and the tip subsequently contacts a grounded object (in this case the drum was effectively grounded by sitting in the loader bucket), an electrostatic spark could occur with sufficient energy to ignite the acetylene.

MINE SAFETY PROGRAM

- The portion of the mine training plan addressing visitors to mine property makes a reference to the prohibition of horseplay. However, no plan provisions existed addressing the mine employees concerning the prohibition of horseplay.
- No documentation of policy or requirements prohibiting horseplay was found during the investigation. The operator of this mine had not posted a program with respect to the safety regulations and procedures to be followed at the mine. Also, such a program had not been distributed to each employee. The lack of safety documentation and/or programs creates a safety deficiency per 30 CFR 77.1708.

ROOT CAUSE ANALYSIS

Causal Factor: A safety program, adequate to deter horseplay and misuse of equipment, was not in place.

Corrective Actions: An adequate safety program, which will satisfy the requirements given in 30 CFR 77.1708, will be implemented, posted at the mine site and distributed to each individual mine employee. The program will include adequate stipulations to prohibit horseplay and misuse of equipment. All employees will be trained in the provisions of the new program. The training plan will be revised to assure these provisions are taught during annual refresher, new miner and newly employed experienced miner training.

Causal Factor: The victim introducing acetylene/oxygen into the 55-gallon drum apparently without fear of reprisal on the company's part.

Corrective Actions: The aforementioned safety program should be enforced in a manner that conveys the company's stance concerning the prohibition of horseplay and misuse of equipment.

CONCLUSION

The accident occurred due to the explosion of an acetylene-oxygen-air mixture inside the 55-gallon drum. Forces and heat from the explosion injured four miners, one of whom died from his injuries. Ignition energy was most likely an electrostatic charge that built up on the torch tip from the rapid release of acetylene through the tip orifices. At the time of the accident, the fatally injured miner was using the unlit torch to intentionally fill an empty antifreeze drum with acetylene, and possibly oxygen, to demonstrate an explosion to a new employee. During this process, the torch tip neared the surface of the drum, which was grounded by contact with the front-end loader bucket, permitting an electrostatic arc that prematurely ignited the gas mixture inside the drum. Contributing to the accident was mine management's failure to establish, maintain, and enforce an effective safety program addressing horseplay and other hazards associated with mining activities, such as those related to the use of acetylene.

ENFORCEMENT ACTIONS

A Section 104(a) Citation was issued for a violation of 30 CFR 77.1708

The operator of this mine had not posted a program with respect to the safety regulations and procedures to be followed at the mine. Also, such a program had not been distributed to each employee. On September 5, 2003, horseplay in the form of misuse of cutting torches, acetylene gas, and compressed oxygen resulted in an explosion at this mine that injured four miners, one of whom died from his injuries. Prior to the fatal accident, smaller acetylene/oxygen explosions and misuse of starting fluid was prevalent at the mine. Safety procedures were not communicated effectively enough to indelibly establish management's prohibition of horseplay. Adherence to this regulation would have reduced the likelihood of this type of occurrence.

BEST PRACTICES

- Ensure that employees do not engage in horseplay.
- Require that compressed gases are used properly for their intended purpose.
- Ensure proper handling and use of torches.
- Train employees on dangers associated with improper use of acetylene.
- Never attempt to transfer acetylene gas into any other container.
- Ensure familiarity with Material Safety Data Sheets (MSDS) of all materials on mine property, especially the flammability and combustibility characteristics.