

MAI-2016-3

**UNITED STATES
DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION
Metal and Nonmetal Mine Safety and Health
REPORT OF INVESTIGATION
Surface Nonmetal Mine
Limestone (crushed and broken)**

**Explosives and Breaking Agents
March 22, 2016**

**Martin Marietta Materials
Plant 862
Earlham, Madison County, Iowa
Mine I.D. No. 13-02123**

Investigators

**Thaddeus J. Sichmeller
Mine Safety and Health Inspector
Thomas H. Heft
Mine Safety and Health Inspector**

**Thomas Lobb
Senior Physical Scientist/Explosives and Blasting**

**Originating Office
Mine Safety and Health Administration
North Central District
515 W. First Street Room 323
Duluth, MN 55802
Christopher A. Hensler, District Manager**



OVERVIEW

Tracy L. Hockemeier, Leadman, age 42, was fatally injured on March 22, 2016, when he was struck by fly rock during blasting operations in the Winterset section of Plant 862. Hockemeier was sitting in a pickup truck, approximately 1,200 feet from the blast site, preventing others from entering the blast area. When the blast was initiated, fly rock was propelled upward, landing on and penetrating the roof of the truck and striking the victim.

The accident occurred as a result of multiple factors, including geology of the blast area, the condition of and loading of blast holes, and failure to communicate between the mine operator and contractor blasters. The mine operator and contractors failed to ensure that the blast area was cleared, or adequate shelter taken, prior to initiating the shot. The victim was not task trained for evaluating blast area clearance or blasting procedures.

GENERAL INFORMATION

Plant 862, a surface limestone mine operated by Martin Marietta Material (Martin Marietta), is located in Madison County, Earlham, Iowa. The principal operating official is Rick Sears, Plant Manager. The limestone is drilled and blasted at this operation. Shot rock is then transported by truck to the primary plant where it is crushed, sized and stockpiled. The finished product is sold for use in the construction trades. The mine employs approximately fifteen persons and operates a ten-hour shift, five days per week.

Martin Marietta contracted Wendling Quarries Inc. (Wendling) to drill blast hole patterns at the Winterset section of Plant 862. Jerico Services Inc. (Jerico) was the blasting contractor at the site and was responsible for handling, loading and detonating explosives.

At the time of the accident, the Mine Safety and Health Administration (MSHA) was conducting a regular mandated safety inspection of the mine.

DESCRIPTION OF THE ACCIDENT

On March 21, 2016, the day before the accident, Wendling began drilling a blast hole pattern previously laid out by Martin Marietta employees, Tracy Hockemeier and David Norman, Assistant Plant Manager. Wendling completed the drilling on the day of the accident, March 22nd. Due to water levels at the mine, Martin Marietta ran a de-watering pump to a nearby pond each day as drilling was performed.

On the day of the accident, Hockemeier reported to work at approximately 6:30 a.m., his normal starting time. Hockemeier met with Norman to discuss the day's events and then proceeded to the shop to supervise a crew doing plant maintenance work. Around 12:25 p.m., Norman received a call from Danielle Fiorini, Scale Clerk, asking him to come to the scale house. Upon arrival, he discovered Christopher Willett, MSHA Inspector, had arrived to conduct a regular safety inspection of the mine. Norman accompanied Willett on his inspection.

At approximately 1:05 p.m., Jerico arrived at the mine to load the drill holes. Hockemeier met with Jerico employees Brent Edgington, Lead Blaster, and Logan Edgington and Jarod Nehring, Blaster's Helpers. After their on-site mine training, the Jerico employees proceeded to the Winterset section of the quarry to view the blast layout. When attempting to access the blast site, B. Edgington discovered access was impassable for the explosives trucks due to muddy conditions.

At approximately 2:00 p.m., Hockemeier coordinated efforts to improve access for the explosives trucks. During this time, he discussed the general layout of the shot with B. Edgington. B. Edgington stated during the interview process, that when they entered the drilled out blast site, he recognized that there were unloadable holes. That due to water there would be muddy or collapsed holes.

At approximately 2:30 p.m., B. Edgington spoke in person with Ross Breeden, a Driller for Wendling, because he had not received a driller's log reflecting the holes drilled for the blasting pattern. Breeden told Edgington that there was hydraulic pressure in the blasting pattern and quite a bit of water was coming out of holes as he drilled out the blasting pattern.

At approximately 4:00 p.m., the access road into the area improved, and the Jerico employees began loading the drill holes. As they loaded the pattern, Willett and Norman arrived at the blast site as part of the regular inspection. Willett reviewed the blasters' training records, inspected truck #049 and observed the loading cycle. He left with Norman to continue his inspection and the blasters continued loading holes. L. Edgington left the mine for the remainder of the day as loading continued.

At approximately 6:00 p.m., Willett returned to the Winterset section when he saw the blasters starting to wire the holes for the upcoming blast. He advised Norman that he wanted to observe the blast. Willett, Norman and Hockemeier left the pit area so the blasters could tie the blast lines to the lead line. Norman and Willett drove up the haul road, approximately 2,400 feet north of the blast site. At this time, Todd Cook, leadman of the onsite stripping crew, contacted Norman and advised him that everyone had left the mine site, including the driller, and that he was locking the gate at the mine entrance. Norman relayed Cook's comments to Hockemeier. Hockemeier sounded the blasting warning siren as he drove thru the quarry. Hockemeier initially headed west from the blast site, passing Nehring. He turned north heading up the haul road and stopped approximately 1200 feet from the blast site, roughly midway between the shot and Norman and Willett's location. Nehring was positioned in the blast shelter, approximately 396 feet from the blast, where he would initiate the blast. He could not see Hockemeier, Norman or Willett from his location. B. Edgington was positioned behind the bulk explosives truck, approximately 323 feet further west from Nehring's position (719 feet from the blast).

At approximately 6:30 p.m., using a handheld radio, Hockemeier called Nehring to tell him it was clear to shoot. Nehring responded with a verbal radio confirmation back to Hockemeier and then detonated the blast. Willett and Norman were unable to hear the communications between Hockemeier and Nehring (the handheld radio communications were exclusively between Hockemeier and Nehring), but saw the blast from their position.

After the shot, Nehring checked the blast area from his location and gave an all clear radio communication via the handheld radio but did not receive a response from Hockemeier. Nehring radioed again that the shot was clear. At this time, B. Edgington moved to Nehring's location and began retrieving items from the shot.

Willett and Norman waited approximately 10 minutes for someone to give the all clear. They could see Hockemeier's truck parked and could still hear the blasting warning siren. Norman and Willett proceeded to Hockemeier's truck and discovered him slumped over in the cab. A rock had penetrated the roof of the truck cab, striking him in the head. Discovering no vital signs, Norman called 911 at approximately 6:39 p.m.

Willet proceeded to the blasters' location to inform them of the accident and instructed them to remain in the pit area.

Emergency medical services arrived and confirmed that Hockemeier had no vital signs. The Madison County medical examiner arrived and pronounced Hockemeier dead at the scene. The death was attributed to a blunt force injury to the head.

INVESTIGATION OF THE ACCIDENT

David Norman, Assistant Plant Manager, notified MSHA of the accident at 6:55 p.m. on March 22, 2016, by a telephone call to the Department of Labor's National Contact Center (DOLNCC). The DOLNCC contacted David Schwab, Acting Supervisory Special Investigator for the North Central District, and an investigation began the same day. In order to ensure the safety of all persons, MSHA issued a 103(k) order under the Mine Act.

MSHA's accident investigation team traveled to the mine site, conducted a physical examination of the accident scene, reviewed documents, and interviewed employees, equipment and company procedures relative to the accident. MSHA conducted the investigation with the assistance of mine management, mine employees, drilling contractors, Wendling Quarries, Inc., and blasting contractors, Jerico Services, Inc.

DISCUSSION

Location of the Accident

The accident occurred along the main haul road leading into the quarry. The blast was initiated in the Winterset section of the quarry, approximately 1,204 feet from Hockemeier's parked truck.

Weather

The weather on the day of the accident was clear skies and no precipitation. Ambient temperatures were approximately 64 degrees Fahrenheit. Weather conditions were not deemed a factor in the accident.

Fly Rock

The fly rock was approximately 12 inches x 4 inches x 6 inches in size. It weighed approximately 20 pounds and separated into three pieces upon impact. The rock traveled in a high arch, without hitting the ground, prior to striking the cab of the pick-up truck. The fly rock would have been traveling at a high percentage of its terminal velocity, approximately 240 mph, at the time of impact. No additional fly rocks were discovered at the accident scene.

Factors that Contributed to the Accident

There were multiple factors that contributed to the accident, including geology, blast layout design and shot loading, and the lack of communication between the drillers, blasters and Martin Marietta employees. The blast had poor blast hole timing and poor geology, both of which increase the probability of fly rock.

1. Geology of the Winterset Section

A post blast examination (after the accident) found that the adjacent area had numerous cracks and voids. The stone horizon (Winterset) is located immediately under the top soil and is extremely weathered (croppy). This weathered condition left the open pit's highwall with an extreme amount of 'back break' due to the mud seams and fractures. Many accidents involving fly rock happen with this type of ground condition. Normal blasting design requires monolithic rock deposits. The less monolithic the rock formation (cracked, mud seams etc.), the more conservative the blast design must be and/or the larger the blast area must be.

2. Design and Layout of the Drill Pattern Blast

Norman and Hockemeier, Martin Marietta employees, designed the blast pattern and located and marked the blast hole drill locations. They created a 9 x 13 foot pattern and placed a painted "X" symbol at the intersection of the specified distances, which represented the drilling locations. The drill pattern resulted in a total of 113 drill holes, but due to excessive water conditions, only 100 of them could be loaded as discussed below under "Shot Loading and Firing."

3. Drill Holes

Wendling provided drilling services to Martin Marietta as a contractor. During a two-day period, Wendling drilled a total of 142, 3 ½ inch diameter holes, to an approximate depth of 11 feet per the blast pattern designed by Norman and Hockemeier. After drilling was completed, the driller went back to look at the blast holes and they were all full of water. Wendling's drill log indicated that the middle of rows 5, 6, and 7 had bad mud seams that appeared to run between holes; and that there were mud seams in 10, 11, and 12 areas. This resulted in the middle and the west side of the blast site pattern having 'bad seams' and all but 20 of the holes being extremely wet and muddy.

4. Shot Loading and Firing

Jerico, the blasting contractor, was responsible for loading the holes and detonating the blast. The blast consisted of 113 holes, 3 ½ inches in diameter, laid out in 11 rows on 9 by 13 foot burden and spacing. The holes were stemmed with 42 inches of road stone, sized at 1 inch (gravel loaded into the blast hole to confine the blast), and wired into a six circuit blast pattern. Due to wet and muddy conditions, however, only 100 of the holes were loaded with the 4495 total pounds of explosive product. Thirteen of the blast

holes either collapsed or filled with mud, which made them unloadable. Jerico employees loading the blast bypassed the 13 unloadable blast holes in the loading process. This practice causes the adjacent blast holes to be over confined, making vertical fly rock probable.

During the investigation, B. Edgington, Lead Blaster, stated that many of the blast holes were difficult to properly load. As drill holes were being filled with explosive product, voids or rock caves were encountered. As a result, they had to stop loading the explosive material into the holes to prevent over charging.

The timing for the blast holes was not done sequentially because the workers skipped the unloadable blast holes, thereby constructing an out-of-design, and an out of sequence, blast hole. Blast holes firing out of sequence can exhibit vertical type fly rock.

Training and Experience

Tracy L Hockemeier (victim) had a total of six years, thirty-six weeks of mining experience, having worked at multiple company sites. He previously worked as a truck driver and quality control inspector. Hockemeier became Leadman at Plant 862 in September 2015.

MSHA's review of training records and the company training plan revealed that Hockemeier did not receive task training for clearing a blast area or in blasting procedures in accordance with 30 CFR Part 46.

ROOT CAUSE ANALYSIS

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

Root Cause: Management's policies, procedures and controls failed to adequately assess the geology or material to be blasted; blast pattern, burden, depth, diameter, and angle of the holes; historical blasting experience at this mine; delay system, powder factor, and pounds per delay; type and amount of explosive material; type and amount of stemming and their inter-relationship with each other in properly determining the blast area.

Corrective Action: Management established updated blasting policies, procedures and controls to ensure persons are not exposed to fly rock. Management trained all affected mine employees so that that mine supervision and blasting personnel have better communication regarding variable blasting pattern conditions and avoid fly rock potential.

Root Cause: Management's policies, procedures and controls failed to ensure the blasting contractor complied with applicable mandatory standards of adequately assessing the potential for fly rock, by failing to communicate geological conditions effectively. Information regarding which drill holes were unloadable as a result of mud

seams or voids encountered in the drilling and loading process, the geological conditions, and water infiltration of holes would have provided critical knowledge to warrant an expanded security area for the blast.

Corrective Action: Management established updated blasting policies, procedures and controls to ensure persons are not exposed to flyrock. Management trained all affected mine employees so that that mine supervision and blasting personnel, including contractors, have better communication of variable blasting pattern conditions and reduce fly rock potential.

Root Cause: Hockemeier was not task trained to assess the geology or material to be blasted; blast pattern, burden, depth, diameter, and angle of the holes; historical blasting experience at this mine; delay system, powder factor, and pounds per delay; type and amount of explosive material, type and amount of stemming and their inter-relationship with each other in properly determining the blast area so persons were not exposed to flyrock.

Corrective Action: Management established updated blasting policies, procedures and controls to ensure persons are not exposed to fly rock. Management established policies to train persons to properly assess blast sites and trained all affected mine employees so that that mine supervision and blasting personnel have better communication of variable blasting pattern conditions and reduce fly rock potential.

CONCLUSION

The accident occurred because of multiple factors leading to an increased risk of fly rock including geology of the blast area, condition of the blast holes, loading of the blast holes, and the fact that company and the blasting contractor failed to communicate the geological conditions effectively in order to determine the correct blast area. Given the conditions of the blast area, the operator and contractors failed to clear a large enough blast area or ensure adequate shelter was taken prior to initiating the shot. The victim was not task trained for evaluating blast area clearance or blasting procedures.

ENFORCEMENT ACTIONS

Issued to Martin Marietta Materials

Order No. 8894330 - Issued on March 22, 2016, under the provisions of Section 103K of the Mine Act:

A fatal accident occurred at this operation on March 22, 2016 when the mine operator ignited a blast in the pit area. This order is issued to assure the safety of all persons at this operation. It prohibits all activity south of where the haul road turns south to the pit area and equipment located in this area until MSHA has determined that it is safe to resume normal mining operations in the area. The mine operator shall obtain prior approval from an authorized representative for all actions to recover and or restore operations to the affected area.

This order was modified on March 25, 2016 to release all mobile equipment and the pit area. The order will remain in effect to prevent any further blasting activities in the pit area until the operating company has developed policies and procedures to ensure that all persons will be protected during blasting activities.

This order was terminated on April 28, 2016, when the company developed additional Standard Operating Procedures for Open Pit Blasting at the Quarry, and provided training on the new procedures with employees as well as blasting contractors hereby terminating the order.

Citation No. 8889511 - Issued on April 28, 2016, under the provisions of 104(a) of the Mine Act for a violation of 30 CFR Part 56.6306(e):

A fatal accident occurred on March 22, 2016, when the leadman was struck by fly rock during planned blasting operations at the mine. The leadman was parked, sitting in a company truck at a location to prevent anyone from entering the area during the blast. The leadman was approximately 1,200 feet from the blast site when he was struck in the head and killed by flyrock from the blast.

The mine operator failed to ensure that either the operator or the blasting contractor designated a safe distance from the blast site as a "blast area" to be cleared of persons prior to the blast. The mine operator also failed to ensure that either the operator or the blasting contractor adequately assessed and considered several of the factors listed in 30 C.F.R. § 56.2 in determining the boundaries of the "blast area" as that term is used in 30 C.F.R. § 56.6306(e). Those factors included, but were not limited to, the poor geologic conditions of the blast site and the material to be blasted; the loose rock; the voids, cracks and mud seams encountered during the drilling and loading process; the excessive water and mud infiltration into the blast holes, and the loss of loadable drilled holes due to excessive mud and water; powder factors; stemming issues; the operator's blasting experience; and the effect of these factors on the potential distance of fly rock. Proper and adequate consideration of such factors would have led a reasonable and prudent operator and blaster to

determine that the safe boundary of the blast area should have been further away from the blast site than the approximately 1,200 feet that the leadman was positioned from the blast site at the time of the blast.

The citation was terminated on April 28, 2016 when Standard Operating Procedures were developed by the mine operator and incorporated into their blasting policies and procedures.

Citation No. 8889512 – Issued on April 28, 2016, under the provisions of 104(a) of the Mine Act for a violation of the 30 CFR Part 46.7(a), which is a Rules To Live By Standard:

A fatal accident occurred on March 22, 2016 when the leadman was struck by fly rock during blasting operations. The leadman had cleared personnel from the pit and was parked, sitting in a truck at a location to prevent anyone from entering the blast area. The leadman was sitting in the truck approximately 1200 feet from the blast. The leadman was not task trained or experienced in proper blasting procedures.

The citation was terminated on April 28, 2016 when Standard Operating Procedures were developed by the mine operator and incorporated into training for the mines training program for leadmen and other persons affected.

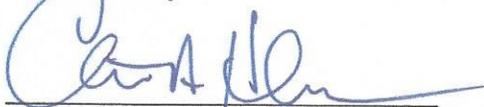
Issued to Jerico Services, Inc.

Citation No. 8889510 – Issued on April 28, 2016, under the provisions of 104(a) of the Mine Act for a violation of 30 CFR Part 56.6306(e):

A fatal accident occurred on March 22, 2016 when the Leadman for the mine was struck by fly rock during blasting operations. The leadman had cleared personnel from the pit and was parked, sitting in a truck at a location to prevent anyone from entering the blast area. The leadman was approximately 1200 feet from the blast when he was struck by fly rock. The victim was not cleared from the blast area nor protected by a blasting shelter.

The citation was terminated on May 20, 2016 when the contractor completed training on newly established policies and procedures addressing the clearing of persons from a blast area with blasters and blaster helpers.

Approved by:



Christopher A. Hensler
District Manager, North Central District

Date:

8/12/2016

APPENDIX A

Persons Participating in the Investigation

MARTIN MARIETTA MATERIALS

Michael Hunt	Vice President of Safety and Health
Thomas Nelson	Director of HR
Dale Hittle	HR/Safety
Rick Sears	Plant Manager
David Norman	Assistant Plant Manager
Scott Gerbes	Operations Manager

JERICO SERVICES INC.

Steven Long	President
Brent Edgington	Lead Blaster
Jarod Nehring	Blaster's Helper

WENDLING QUARRIES INC.

Johnathan Kulper	Safety
Ross Breeden	Driller

VIBRA-TECH

Phyllis Hasser	Vice President/Area Manager
Douglas Rudenko	Vice President/Northeast Regional Manager

MINE SAFETY AND HEALTH ADMINISTRATION

Thaddeus Sichmeller	Mine Safety and Health Inspector
Thomas Lobb	Senior Physical Scientist / Explosives & Blasting
Thomas Heft	Mine Safety and Health Inspector
Christopher Willett	Mine Safety and Health Inspector

APPENDIX B

Victim Information: 1

1. Name of Injured/Ill Employee: <i>Tracy L. Hoeckmeier</i>			2. Sex <i>M</i>	3. Victim's Age <i>42</i>		4. Degree of Injury: <i>01 Fatal</i>																									
5. Date (MM/DD/YY) and Time (24 Hr.) Of Death: <i>a. Date: 03/22/2016 b. Time: 19:05</i>				6. Date and Time Started: <i>a. Date: 03/22/2016 b. Time: 06:30</i>																											
7. Regular Job Title: <i>149 Leadman</i>			8. Work Activity when Injured: <i>003 Blasting</i>			9. Was this work activity part of regular job? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>																									
10. Experience		Years		Weeks		Days		Years		Weeks		Days		Years		Weeks		Days													
a. This Work								b. Regular						c. This				d. Total													
Activity		<i>0</i>		<i>27</i>		<i>3</i>		Job Title		<i>0</i>		<i>27</i>		<i>3</i>		Mine		<i>0</i>		<i>27</i>		<i>3</i>		Mining		<i>6</i>		<i>38</i>		<i>3</i>	
11. What Directly Inflicted Injury or Illness? <i>089 Fly Rock</i>						12. Nature of Injury or Illness: <i>140 Blunt Force Trauma to the Head</i>																									
13. Training Deficiencies:																															
Hazard: <input type="checkbox"/>			New/Newly-Employed			Experienced Miner: <input type="checkbox"/>			Annual: <input type="checkbox"/>			Task: <input type="checkbox"/>																			
14. Company of Employment: (If different from production operator)																															
Independent Contractor ID: (if applicable)																															
15. On-site Emergency Medical Treatment:																															
Not Applicable: <input checked="" type="checkbox"/>			First-Aid: <input type="checkbox"/>			CPR: <input type="checkbox"/>			EMT: <input type="checkbox"/>			Medical Professional: <input type="checkbox"/>			None: <input type="checkbox"/>																
16. Part 50 Document Control Number: (form 7000-1) <i>220160890010</i>												17. Union Affiliation of Victim: <i>9999 No Union Affiliation</i>																			