

MIFACE INVESTIGATION #03MI005

SUBJECT: Worker Dies As a Result of Being Struck and Pinned Between Two Vehicles While Repairing Potholes

Summary

On Monday, January 13, 2003, at approximately 11:40 a.m., a 40-year old male worker repairing a road with cold patch was momentarily pinned between the cold patch truck he was shoveling cold patch from (Figure 1) and the backup vehicle



Figure 1. Cold Patch Truck

pulling the flasher board warning arrow signaling drivers to stay back from the work crew (Figure 2). He collapsed and died on January 15, 2003, at the hospital where he had been taken after his injury as he was preparing to leave the hospital.

RECOMMENDATIONS

- The employer should develop and provide periodic training that ensures that employees recognize the hazards associated with their work and the consequences of becoming complacent regarding those hazards.
- The employer should install after market devices (i.e., camera, radar, and sonar) on construction vehicles and equipment to help monitor the presence of workers on foot in blind areas.
- Employers should ensure that safe work procedures are in place for the use of mobile construction vehicles, a spotter is designated to direct movement of these vehicles, and drivers are in communication with workers on foot.

Keywords: Crushed, Road Repair, Highway Work Zone, Construction

INTRODUCTION

On Monday, January 13, 2003, at approximately 11:40 a.m., a 40-year-old worker repairing a road with cold patch was momentarily pinned between the cold patch truck and the backup truck pulling the flasher board with the warning arrow. He collapsed and



Figure 2. Backup Truck

died on January 15, 2003, at the hospital where he had been taken after his injury as he was preparing to leave the hospital. On January 16, 2003, MIFACE investigators were informed of the fatality by the Michigan Occupational Safety and Health Act (MIOSHA) personnel who had received notification of the death on their 24 hour-a-day hotline. On May 3, 2006, the MIFACE researcher interviewed the safety manager of the county for whom the decedent worked. During the writing of this report, the medical examiner's report, photographs taken by the county of the vehicles involved in the incident, copies of photos taken by the responding police department at the incident site, the police department report, and the MIOSHA file and citations were reviewed. Photographs are courtesy of the responding police department.

The County Department of Public Services, Roads Division (county) for whom the decedent worked had responsibility for maintenance and repair of county facilities, roadways and infrastructure. The county had been incorporated for approximately 50 years. It was divided into 6 districts for road maintenance purposes. The manager of the district assigned the road crews.

The county had a joint labor/management health and safety committee that met at least monthly. The county had a similar fatality three years before this fatality. At that time, it developed a written training program for the cold patch road repair task, but it was not implemented. At the time of the incident the foreman provided on-the-job cold patch training (OJT), but it is not known if the decedent received the training because no records were kept of OJT. The county had also indicated that they would test and install proximity sensing devices after the previous fatality, but none had been installed on any of the trucks in use.

The decedent was a member of the local municipal union. Each local union had a safety representative. The safety representative attended periodic labor/management safety meetings where common issues were discussed and the information was disseminated to the membership. The decedent had been hired by the county as a part time seasonal service worker five months before he was hired as a full time road maintenance worker. He worked full time as a road maintenance worker for three months before the incident. The driver of the backup vehicle that struck him had a valid Commercial Drivers License

(CDL) as required of all county drivers. The CDL training was done in-house with appropriate materials and demonstrations. The drivers took the state exam to obtain their license.

The MIOSHA Construction Safety and Health Division investigation resulted in one Serious and two Willful/Serious violations being issued to the company:

- Serious: GENERAL RULES, PART 1 Rule 114(1). The employer failed to maintain an adequate accident prevention program. The material in the employer's manual was outdated and ineffective.
- Willful/Serious: GENERAL RULES, PART 1, Rule 408.40114(2)(b). The employer failed to ensure that equipment operators had training that would allow them to recognize the exposure hazards associated with the backup vehicle operating too close to the lead vehicle.
- Willful/Serious: GENERAL RULES, PART 1, Rule 408.40114(2)(d). The employer failed to provide adequate training to pothole repair employees to recognize and minimize the hazards associated with doing pothole repair in the public right-of-ways.

ABATEMENT

The county was required to implement the following abatement measures:

1. Develop and implement an effective training program for cold patch repair crews and a tracking system for scheduling and documentation;
2. Train all road repair employees including summer-hired seasonal workers as well as fulltime workers in safe procedures for cold patch repair in a timely manner;
3. Use an observer/spotter (5th person added to crew) for cold patch repair to oversee operation and ensure appropriate procedures are being adhered to. This spotter is stationed between the trucks in the same area as the cold patch applicator;
4. Install proximity alarms on road repair vehicles and continue to test devices to find the most effective one for the conditions under which it will be used.

INVESTIGATION

On the day of the incident the weather conditions were clear and cold. The decedent was one of a crew of four workers applying cold patch to potholes. All members of the crew wear a high-visibility vest with 1-1/4 inch reflective tape, which they put on before they leave the yard and wear all day. The



Figure 3. Cold patch in lead truck

crew began work at 7:00 a.m. The incident occurred at 9:30 a.m. One worker drove the lead dump truck with the cold patch; one drove the backup truck pulling the flasher board with the arrow warning drivers to stay back; one cold patch applicator was inside the lead truck; and the decedent was applying cold patch to potholes. The workers applying the cold patch would occasionally trade off to let one ride because of the bitter cold weather. It is not known whether there had been a worker switch.

The tailgate of the lead truck was lowered and the bed was inclined so the workers could access the cold patch repair material (Figure 3). The trucks were proceeding at the normal pace, approximately three miles per hour. The backup vehicle was expected to stay approximately 50 feet behind the lead vehicle except in intersections where it pulled up closer to prevent cars from slipping between the two work vehicles. The vehicles had just passed an intersection moving southbound, so the backup vehicle was somewhat closer than it would normally have been. The road had six lanes (three northbound and three southbound) plus a median and a left turn lane. The speed limit was 35 miles per hour. The vehicles were in the left of the three southbound lanes next to a left turn lane (Diagram 1).

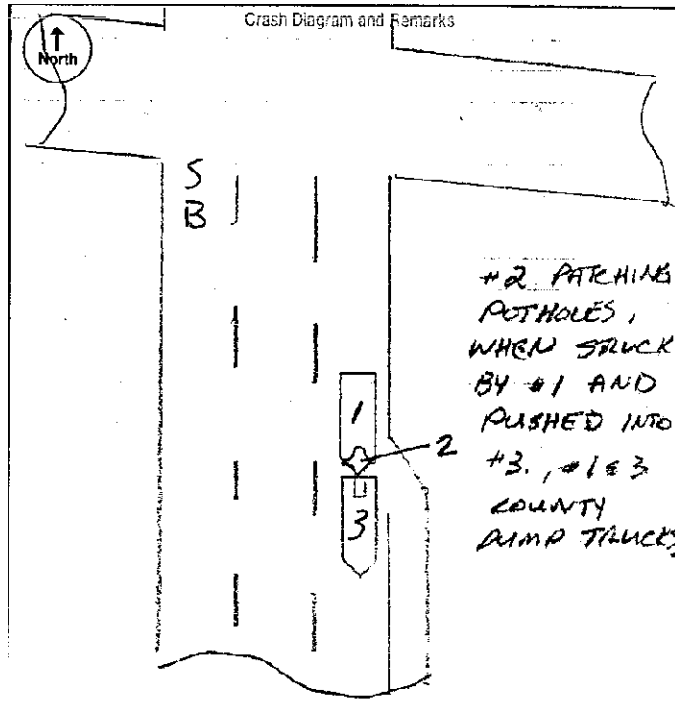


Diagram 1. Position of vehicles

The decedent was walking between the two vehicles filling pot holes with cold patch he shoveled from the back of the lead truck. The backup vehicle (Figure 4) struck the decedent, pushing him into the lead truck for a moment. The driver of the lead truck indicated he was waiting for the decedent to give him a signal to move forward when he felt a small bump. He looked



Figure 4. Front of backup vehicle

back and saw the decedent on the ground in the left turn lane. Both he and the coworker exited the vehicle to assist the decedent.

The driver of the backup truck stated to the responding police officers when they arrived on the scene that he had been watching a dark colored sport utility vehicle coming up behind the backup truck at a high rate of speed in his rear view mirrors. When he looked forward, he saw the decedent walk off to the side of the road and lie down. A witness to the incident stated that he had been stopped behind the patching crew for several minutes waiting to enter the left turn lane the crew was working adjacent to with his left turn signal activated. He was driving a blue work van. He said he observed the backup vehicle move forward several times. He observed it back up slightly and saw the decedent collapse in the left turn lane. He called 911.

The first police officer to arrive spoke to the decedent who was lying in the roadway in pain. The decedent indicated he was at the rear of the cold patch truck in order to fill his shovel with cold patch when he was struck in the back by the backup vehicle and pinned momentarily between the two trucks. The decedent was placed on a backboard and attended to by fire department rescue and ambulance paramedics. He complained of back and abdomen pain and was transported to the hospital where he was admitted for care and observation. Responding police took incident scene photographs, but did not take any incident scene measurements.

Two days after the incident, the decedent was being discharged from the hospital. He was in the corridor waiting to be released when he told a nurse that he was not feeling well. She told him to go back to bed, but before he could do so, he collapsed and died.

The driver of the backup vehicle was charged with negligent homicide. The charge was subsequently changed to reckless driving, and he was given a one-year probation during which time he was enrolled in a counseling program.

CAUSE OF DEATH

The cause of death as listed on the medical examiner's report was acute peritonitis due to mesenteric tear due to crush injury to the abdomen. Toxicology tests indicated the presence of drugs consistent with hospital medication.

RECOMMENDATIONS/DISCUSSION

- The employer should develop and provide to periodic training that ensures that employees recognize the hazards associated with their work and the consequences of becoming complacent regarding those hazards.

A similar incident that resulted in a fatality occurred in this county three years before this incident. After the first fatality the county developed a training program addressing the cold patch work procedures, but it was never effectively implemented. It reverted to on-

the-job training (OJT) given by the job foreman. The training developed following the second fatal incident is included as Appendix A.

Training that impacts worker attitudes and behaviors is the most difficult type of training to accomplish. Just because a worker knows how to safely perform a task does not mean a worker will perform that task safely 100 percent of the time. The importance of remaining focused on the task at hand at all times should be emphasized. Including in the training the consequences (two fatalities in the case of this county) of not performing the work safely may provide an incentive powerful enough to affect the attitudes and behaviors of the road repair crew workers.

- The employer should install after market devices (i.e., camera, radar, and sonar) on construction vehicles and equipment to help monitor the presence of workers on foot in blind areas.

At the time of the first fatality three years before this fatality, the county had indicated it would install and test proximity sensing/warning devices on its maintenance vehicles but had not done so. Following the second fatality the county requested and received proposals from collision warning system vendors. The county is using a radar-based warning system on a trial basis. This system was installed on several vehicles to detect and alarm the presence of personnel at a minimum of 15 feet in front of the backup vehicle in order to avoid any type of vehicular crush/pinch point incident. Several difficulties have been encountered implementing the system, but it seems reasonable to assume that they can be overcome with attention and follow-through on the part of the manufacturer and the county.

Emerging technology, such as sensor-based systems, rear-view cameras, and radio frequency identification (RFID) tags and tag readers are becoming available for construction equipment, though testing and demonstration at construction projects are still needed (1, 2, 3). Collisions between construction vehicles, equipment and workers have been attributed, in part, to limited visibility around the equipment. As new or existing monitoring technologies are proven to be effective on work sites, equipment manufacturers should offer these systems on new equipment.

- Employers should ensure that safe work procedures are in place for the use of mobile construction vehicles, a spotter is designated to direct movement of these vehicles, and drivers are in communication with workers on foot.

Safe work procedures should be developed and implemented for each roadway construction job. In this case, there was not a designated spotter. Protocols should include an assigned spotter and instruction that vehicle movement will not begin without an understandable signal from the spotter that it is safe to do so (3). In addition, operators of construction vehicles and equipment must come to a complete stop if contact with a spotter is lost, and operations should not resume until contact is re-established. All equipment operators and truck drivers, while in the construction site, should be aware of who the spotters are, and the established safe work protocol. To assist with making

themselves visible to the operators, all workers on foot (e.g., spotters, flaggers) should be required to wear a high visibility safety garment.

REFERENCES

MIOSHA standards cited in this report may be found at and downloaded from the MIOSHA, Michigan Department of Labor and Economic Growth (DLEG) website at: www.michigan.gov/mioshastandards. MIOSHA standards are available for a fee by writing to Michigan Department of Labor and Economic Growth, MIOSHA Standards Section, P.O. Box 30643, Lansing, Michigan 48909-8143 or calling (517) 322-1845.

1. Ruff, Todd M.[2003]. Evaluation of Systems to Monitor Blind Areas Behind Trucks Used in Road Construction and Maintenance - Phase 1. NIOSH Report of Investigations 9660 (DHHS Publication No. 2003-113), 16 pp.
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3. Pratt SG, Fosbroke DE, Marsh SM [2001]. Building Safer Highway Work Zones: Measures to Prevent Worker Injuries from Vehicles and Equipment Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health (Pub. No. 2001-128).
4. Accident Prevention Manual for Business & Industry, Engineering and Technology, 11th Edition, National Safety Council, Chicago, 1997.
5. MIFACE INVESTIGATION # 06MI096: Ground Man For Milling Operation Dies When Struck By Dump Truck Backing Into Work Zone. Internet Address: www.oem.msu.edu.

MIFACE (Michigan Fatality Assessment and Control Evaluation), Michigan State University (MSU) Occupational & Environmental Medicine, 117 West Fee Hall, East Lansing, Michigan 48824-1315. This information is for educational purposes only. This MIFACE report becomes public property upon publication and may be printed verbatim with credit to MSU. The author of this report is affiliated with Wayne State University. Reprinting cannot be used to endorse or advertise a commercial product or company. All rights reserved. MSU is an affirmative-action, equal opportunity employer. 9/12/2007

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APPENDIX A

D.P.S DIVISION OF ROADS

GUIDELINES FOR

BACK-UP / SHADOW VEHICLES

The intent of these guidelines is to give a basic understanding of where a shadow vehicle should be placed during work on active road systems. Roll ahead space distances will vary based on the traffic volume, type of road system, weather conditions, intersections, etc...

DEFINITIONS

Back-up vehicle: Any vehicle behind the shadow vehicle.

Close call: An incident that did not result in injury or property damage/loss.

Shadow vehicle: The vehicle directly behind the working vehicle.

Skips: The broken painted lines on the road. The distance from the start of one skip to the start of the next skip is 50 feet.

Working vehicle: The vehicle from which the work is being performed.

Should: Recommended.

Shall: Mandatory.

GENERAL SAFETY RULES

1. When being used as a back-up and/or shadow vehicle the truck should be loaded.
2. When possible, all vehicles should be stopped during patching operations.
3. When possible and safe, maintain a minimum of 2 skips roll ahead space. When circumstances dictate closer distances, a minimum of 30 feet should be maintained (If you can't see the patchers feet your probably too close).
4. Plow rams should be folded down and secured when not in use.
5. When stationary, the service brake shall be set and the front wheels turned away from traffic on back-up trucks.
6. Always ensure that the working vehicle does not accelerate more quickly than the back-up or shadow vehicle.
7. Ensure proper spacing is maintained by maintaining communication between vehicles drivers. Report ALL close calls to the foreman / crew leader so adjustments can be made when necessary.
8. When a C.B. radio is available, try to advise truck drivers of crews in the area.
9. Shadow vehicle drivers shall remain focused on their job at all times. No reading, cell phone calls, etc...
10. A copy of ABC guidelines should be maintained on all trucks.
11. Foremen or crew leaders shall review guidelines periodically or as needed.
12. Ensure lane changes are made properly. The last back-up should change first and the working vehicle should change last.
13. Working trucks should take the whole lane.
14. All warning devices (arrow boards, flashers, etc.) shall be checked for proper operation throughout each workday (at the beginning of shifts, at lunch or on breaks).

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SHADOW VEHICLES (stationary)

Weight Of Back-Up Vehicle (lbs)	Prevailing Speed (mph)	Roll Ahead Space (ft)
10,000 lbs	60-65 mph	100 ft
	50-55 mph	75 ft
	45 mph	50 ft
15,000 lbs	60-65 mph	75 ft
	50-55 mph	50 ft
	45 mph	50 ft
24,000	60-65 mph	50 ft
	50-55 mph	50 ft
	45 mph	50 ft

SHADOW VEHICLES (moving)

Weight Of Shadow Vehicle (lbs)	Prevailing Speed (mph)	Roll Ahead Space (ft)
10,000 lbs	60-65 mph	175 ft
	50-55 mph	150 ft
	45 mph	100 ft
15,000 lbs	60-65 mph	150 ft
	50-55 mph	125 ft
	45 mph	100 ft
24,000 lbs	60-65 mph	100 ft
	50-55 mph	75 ft
	45 mph	75 ft

* Shadow vehicles should be loaded at all times

Revised 01/21/03

SAFETY GUIDELINES FOR COLD PATCHING OPERATIONS

Prior to leaving the yard, Public Service Maintenance Workers shall –

1. Review and complete the vehicle pre-trip checklist. Special attention must be paid to warning lights, devices and air brakes.
2. Foreman and/or crew shall review the need for Personal Protective Equipment (PPE), {see Maintenance Memo 89-5}. Supply necessary PPE. All members of the crew shall review communication, such as hand signals.
3. Foreman and/or Supervisor shall make crew aware of safety concerns unique to the location of the work assignment.
4. All members of the crew shall identify responsibilities and assign roles to various members at this time.
5. Back-up trucks must be loaded appropriately.

On the Job -

1. The job, number and size of back-up trucks shall be in accordance with the ABC Guidelines. (See Maintenance Memo 97-1)
2. No distractions, such as cell phones, headphones, newspapers, video games, etc., shall be used during patching operations.
3. Workers shall exit vehicle on the side away from traffic when possible.
4. Before patchers step between the vehicles, all crew members shall agree to the position and distance between the patch truck and the back-up truck.
5. Patchers shall not step between the vehicles until they receive confirmation from the driver that the back-up truck is properly distanced, put in neutral and the air brake applied.
6. Back-up truck shall turn their wheels towards the shoulder or curb.
7. In rolling operation, patchers shall be aware of the traffic and potential "crush zones."
8. The driver of the back-up truck shall be aware of the crew at all times.
9. All drivers shall respond to the patcher and/or spotter according to predetermined signals.
10. Rolling operation speed shall be set in order to allow patchers to keep up with the vehicle, i.e., "casual walking speed."

SAFETY GUIDELINES FOR COLD PATCHING OPERATIONS
(DRIVERS)

1. Review and complete the vehicle pre-trip checklist. Special attention must be paid to warning lights, safety devices and air brakes.
2. Back up trucks must be loaded appropriately and plow rams should be folded down and secured.
3. All drivers on crew shall identify responsibilities and assign roles prior to starting operation. (such as back-up, shadow, or working vehicles)
4. All drivers on crew will review and synchronize all communications prior to start. (such as hand signals or verbal commands etc.)
5. Shadow truck driver will make sure shadow truck is properly spaced, put in neutral, air brakes applied and tires turned away from traffic before signaling the worker to step between the trucks.
6. During rolling operations drivers shall be aware of the traffic and potential crush zones (turn lanes, intersections, drive ways etc.) so as to make adjustments in spacing when necessary.
7. All drivers will ensure proper spacing is maintained by actively communicating between vehicles drivers.
8. All drivers shall remain focused on their job and be aware of workers at all times and shall not be distracted by cell phones, headphones, or be engaged in any distracting conversation while in a work mode.
9. All drivers shall respond to the patcher and or spotter according to predetermined signals.
10. The speed in rolling operations shall be controlled by the workers not the drivers
11. All warning devices (arrow boards, flashers, etc.) shall be checked for proper operation throughout each workday.

Trainer _____ Date: _____

Trainee _____ Date: _____

Yard _____

SAFETY GUIDELINES FOR COLD PATCHING OPERATIONS
(PSMW's and LABORERS)

1. All crew members will have on Personal Protective Equipment. (vest, gloves etc.)
2. All patch crews will have a spotter at all times during cold patch operations. (spotter must remain alert at all times.)
3. Spotter should be the first to exit and the last to inter the vehicle.
4. All workers on crew shall identify responsibilities and assign roles to crew members prior to starting operation.(Such as spotters or patchers ect.)
5. All workers on crew will review and synchronize all communications prior to start (such as hand signals or verbal commands)
6. Workers shall exit vehicle's on the side away from traffic when possible.
7. Workers shall not step between the vehicles until they receive confirmation from the driver that the back-up truck is properly distanced, put in neutral, air brakes applied and the tires turned away from traffic.
8. In rolling operations workers shall be aware of the traffic and potential crush zones (turn lanes, intersections, drive ways etc.)
9. Workers should work from between the patch and back-up trucks when possible
10. Workers should work an area of no more then a lane and a half when possible
11. The speed during rolling operations shall be controlled by the workers not the drivers. (casual walking speed)
12. Workers shall not be distracted by cell phones, headphones, or be engaged in any distracting conversation while out of the truck in a work mode.

Trainer _____

Date: _____

Trainee _____

Date: _____

Yard _____