



The National Institute for Occupational Safety and Health (NIOSH)

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A Laborer for a Boring and Tunneling Company in Texas, Died When He Was Struck by a Hydraulic Hose

Investigation #98TX46801

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SUMMARY

On October 3, 1998, a 32-year-old laborer for a boring and tunneling company died when he was struck by a hydraulic hose coupling. The victim was part of a crew digging a tunnel. They were using a hydraulic jacking machine to push 54-inch diameter casing into the tunnel, one section at a time. The victim was standing next to one of the jacks. When pressure was applied to the hydraulic lines, the male end of the hydraulic hose coupling, attached to the jack, split in half, and the connection parted. The sudden release of hydraulic pressure caused the hose to whip and the female end of the connector on the end of the hose struck the victim in the abdomen.

The TX FACE investigator concluded that to reduce the likelihood of similar occurrences, employers should:

- Install straps (whip checks) to the hydraulic hose-ends at the connection points to restrain the lines from whipping if couplings fail
- Instruct workers to remain clear of hydraulic hose connections when hydraulic pressure is initially applied.
- Ensure that relief valves settings do not exceed the maximum manufacturer's recommended working pressure for couplings, hoses and other components of the hydraulic system.

INTRODUCTION

On October 3, 1998, a 32-year-old, male laborer died when he was struck in the abdomen by a hydraulic hose coupling. The TX FACE program officer was made aware of the incident by the area OSHA office on October 9, 1998. A visit to the site was made. Pictures of a similar coupling and the area were taken. The justice of the peace and EMS personnel were contacted.

The employer is a tunneling and boring company. The company employs 100 workers, 30 of whom perform the same duties as the victim. This company has been in business for 50 years. There were six other workers at the site at the time the incident occurred.

The safety program is managed by the company president. A written safety program is in place, but written procedures were not included for this particular task. The company conducts pre-employment physicals and drug screening. Safety meetings are conducted on a weekly basis. Refresher training is also conducted weekly. Task specific training is conducted on the job (OJT) at the job site.

The victim had been employed with the company for 1½ years. This was the first fatality experienced by the company.

INVESTIGATION

The victim and coworkers were in a trench digging a tunnel and inserting a 54-inch diameter pipe casing. They were using a custom-made, diesel-powered jacking unit supplying hydraulic fluid at 6500 psi to two jacking cylinders. The cylinders were connected to the machine's hydraulic pump by hoses and quick-disconnect couplings which were rated at 3500 psi working pressure. The day before the incident, new couplings had been installed and used on the jacking cylinders.

The tunnel was being excavated so a new water line could be put in place. The tunnel was constructed by positioning a section of casing against the face of the tunnel. Material was excavated by the workers using hand tools from within the casing. When enough material was removed another section of casing was put in place. The hydraulic jacks were set against the end of the new casing and against a stop anchored to a metal plate secured to the ground. The jacks were pressurized and the casing was advanced into the newly excavated opening. The excavation process was then repeated.

On the day of the incident the victim and coworkers were continuing the tunneling. Once enough material had been dug away, the workers lowered a piece of casing into position to be pushed into the tunnel. The jacking cylinders were laid into position and the hydraulic lines were connected.

The victim was standing next to one of the jacking cylinders when the operator of the hydraulic pump, located on the top of the trench, started to increase the pressure on the lines. This forced the ends of the jacking cylinders to extend out until they came into contact with the casing. When the end of the jacking cylinder contacted the casing, the pressure jumped to almost 3,000 psi instantly, according to the pump operator. This is normal for the hydraulic system. Within seconds of the hydraulic pump reaching the operating pressure, the male end of the coupling cracked in half, lengthwise and the connection parted. This sudden release of pressure caused the hose to whip around and the female end connector on the end of the hose struck the victim in the abdomen.

When the supervisor on top of the trench saw what happened, he called "911." However, due to his state of distress and with English as a second language, he was not able to describe what had happened to the operator. A passerby was stopped who was able to complete the notification to the fire department.

Emergency medical services personnel responded and removed the victim from the trench and transported him to the hospital where he was pronounced dead on arrival.

CAUSE OF DEATH

The medical examiners report stated the victim died from a puncture wound to the abdomen.

RECOMMENDATIONS

Recommendation #1 – Employers should install straps (whip checks) to the hydraulic hose-ends at the connection points to restrain the lines from whipping if couplings fail.

Discussion: The hydraulic line was pressurized to almost 3,000 psi. according to the pump operator. When the male end of the coupling broke, the hydraulic hose was thrown in the direction of the victim with enormous force. A strap or chain would have limited the distance the coupling was able to travel when the male end failed. Hydraulic hoses should be restrained against whipping when couplings fail by straps or chains attached to each hose end and secured to the frame or housing of

the component to which the hose is connected. Should a hose break or coupling fail, the distance a hose or coupling would travel would be limited to the length of the strap. It should be remembered that if the hoses burst, chains or straps allow hydraulic oil to spray. This hydraulic oil can be extremely hot if the operation is lengthy.

Recommendation # 2 – Employers should instruct workers to remain clear of hydraulic hose connections when hydraulic pressure is initially applied.

Discussion: The victim was standing adjacent to the jacking cylinder when hydraulic pressure was applied to the hose. In this incident it was a coupling that failed. The reason the coupling failed could not be determined. A similar situation may occur from a worker not securely attaching the hydraulic hose.

This particular coupling was a “quick disconnect” type. A spring loaded ring is released in order to connect/disconnect the coupling. In the center of the male and female ends are parts that are also spring loaded. They are depressed when the two ends are connected. A certain amount of force must be exerted to connect the two together. There is a possibility the ring or the two ends will not properly seat. If this occurs, when pressure is applied, the hose will be thrown through the air by the sudden release of hydraulic pressure.

Recommendation #3 – Ensure that relief valves settings do not exceed the manufacturer’s recommended working pressure for couplings, hoses and other components of the hydraulic system.

Discussion: After the incident, the relief valve which controls the system’s working pressure was tested to determine the pressure setting before it would activate. Test results revealed it was set at 6,500 psi.

In this incident, the coupling was rated for a working pressure of 3,500 psi. Hydraulic couplings are designed to withstand two to three times their rated working capacity. This is intended as a safety factor to compensate for wear and tear of the components and sudden unexpected increases in pressure. In this incident, the system was being operated at twice the working pressure of the couplings. When necessary to increase system pressure, couplings, hoses, and other components having increased pressure ratings should be substituted in the system. It could not be determined if there was a material failure of the coupling because the manufacturer declined to comment.

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