



The National Institute for Occupational Safety and Health (NIOSH)

Promoting productive workplaces
through safety and health research **NIOSH**

Laborer Dies in Explosion

FACE 8830

INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying: the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On July 14, 1988, an 18-year-old male laborer died as a result of an explosion which occurred while he was making repairs on the interior of a tanker truck compartment.

CONTACTS/ACTIVITIES

The county coroner asked DSR to assist in the investigation of this case. On July 20, 1988, a DSR research team accompanied the county coroner and the state police fire marshal on a site visit, photographed the tanker truck, and interviewed employer representatives and witnesses.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The victim was one of seven employees of a truck and trailer repair shop. The shop had no written safety policy or safety program. All employees received on-the-job training. The victim had been employed full-time at the facility for 45 days.

SYNOPSIS OF EVENTS

A tanker truck's aluminum cargo tank had developed a crack in an interior compartment wall. The cargo tank was 16 feet long, divided into four interior compartments, and had a total tank capacity of 3,000 gallons. The interior compartments were of double wall construction with a dead air space between the walls. This configuration prevents liquid in one compartment from flowing into another should a single wall fail. Each compartment had an individual hatchway located on top of the tank. Each also had its own drain and shut-off valve connected by a manifold pipe to one common outlet (see Figure).

The crack had developed in a weld in compartment 3 on the wall located between compartments 3 and 4. Planned repairs involved welding a 20-inch-long piece of 3-inch structural aluminum angle over the crack.

on the morning of the incident, the truck was brought into the garage to have the compartment repaired. Compartment 3 was steam cleaned while the other three compartments were left sealed. The compartment atmosphere was not tested for toxicity or explosibility prior to entrance. The victim entered the compartment 3 and used an electric grinder to prepare the crack for welding. When the victim finished preparing the weld site, he left the facility to pick up the piece of aluminum angle to be used for the patch. When the victim returned, he and the supervisor ate lunch together but did not discuss the job. After lunch, the victim re-entered the compartment and began welding the patch over the crack.

The supervisor stated that at 2:10 p.m. the victim was using the grinder once again when an explosion occurred in compartment 2. The top sections of both walls separating compartments 2 and 3 were blown into compartment 3. The double wall wrapped around the victim's head, crushing his skull. The volunteer fire department was summoned. Firemen used an electric winch to pull the double wall away from the victim. Approximately 40 minutes after the explosion, the victim was removed from the tanker and pronounced dead at the scene by the county coroner.

The petroleum company's manifest was reviewed during the investigation. Immediately before the truck was brought in for service, compartments 1 and 2 had contained gasoline. It is assumed that a small quantity of gasoline was still present in compartments 1 and 2 and in the drainage system. The drains on all four compartments were open which may have allowed explosive vapors to accumulate in the drain lines.

The facts suggest at least two possible explanations for the explosion:

1. while the victim was dressing (preparing) the weld with the grinder, a piece of hot metal fell into the drain causing the gas vapors to ignite, or
2. explosive vapors entered the compartment through the drain opening and ignited. If ignition occurred in compartment 3, the source was either the grinder motor or electrical arcs created by electrical flow between bare conductors on the grinder power cord and the metal compartment.

In either case, the ignition spread through the drainage system to compartment 2, where an explosive concentration of vapors were enclosed.

CAUSE OF DEATH

The coroner listed the cause of death as blunt force trauma to the head.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: The employer should initiate a program of safe work practices and ensure that employees understand and follow specific prerequisites for entering a confined space. These should minimally include the following:

1. recognition of confined spaces and associated hazards
2. air quality testing to ensure adequate oxygen supply, adequate ventilation, and permissible levels of toxic and explosive contaminants
3. monitoring of the space to determine that safe atmospheres are being maintained
4. employee and supervisory training in confined space entry, in the selection and usage of required respiratory protection, and in emergency rescue procedures
5. availability, storage, and maintenance of emergency rescue equipment.

Discussion: The air quality was not determined before the worker entered the compartment and ventilation was not maintained. The air quality was not monitored for toxic air contaminants and oxygen level. If the atmosphere in the compartment had been tested prior to the beginning of work, it may have alerted the victim that a problem existed.

Recommendation #2: All containers, such as the truck compartments in this case, which have recently been used for storage, transport or dispensing of flammable liquids, should be emptied, thoroughly cleaned, and purged before initiating repairs to the container. The atmosphere within the compartment should be tested to determine that it is below the lower explosive limits if repairs involve potential ignition sources.

Discussion: Although two other compartments had contained gasoline, only the compartment in which work was to be performed was steam-cleaned. This created a dangerous situation since the drains leading to a common outlet were open in all four compartments. The possibility of an explosion would have been greatly reduced had all four compartments been steam-cleaned and the drains thoroughly flushed.

Recommendation #3: Employers should maintain portable handtools in safe operating condition.

Discussion: The power cord on the portable grinder had visible bare conductors. This created a condition which could have resulted in an arcing effect due to current flow from the conductor to the metal compartment, thereby producing an ignition source for the explosive atmosphere. Additionally, this hazardous condition exposed users of the grinder to potential contact with electrical energy which could result in injury or death.

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Last Reviewed: November 18, 2015

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