



The National Institute for Occupational Safety and Health (NIOSH)

Promoting productive workplaces
through safety and health research



Maintenance Mechanic Electrocuted While Touching Damaged Power Cord

FACE 89-19

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 December 22, 1988, a 37-year-old male maintenance mechanic was electrocuted when he grasped a power cord with damaged insulation and contacted an exposed energized conductor.

Contacts/Activities:

State officials notified DSR of this fatality and requested technical assistance. On February 8, 1989, a research team consisting of a safety specialist and an epidemiologist discussed this case with state officials, met with company officials, and photographed the incident site.

Overview of Employer's Safety Program:

The employer is a meat-packing plant which has been in operation for 53 years and currently has 1500 employees. Ten workers are maintenance mechanics, whose work involves general mechanical repair of the various pieces of equipment used in the plant. The company has a formal safety program with written safety policies and procedures. Some specialized safety training in general safety and health and electrical safety is also provided to maintenance personnel. The victim had been employed by the company for 3 months at the time of the incident. He had received the general safety and health training but had not yet attended the electrical safety training program. The victim had completed a 4-year vocational mechanics program and had worked as a maintenance mechanic for several years prior to the incident.

Synopsis of Events:

At the time of the incident the plant was at the end of a normal production shift. Standard practice calls for personnel from the maintenance shop to go to the plant floor at the end of each shift, unplug two strapping machines (used for packaging meat), and move the machines to the maintenance shop for the night. The plant floor is then washed down and cleaned. The strapping machines are inspected the following morning and then returned to the plant floor for the following day's production.

Each strapping machine is a portable wheel-mounted stainless steel unit. Strapping material is fed to the machine from a fiberglass spool mounted on top of the machine cabinet. The strapping machine has a flexible power cord equipped with a twist-lock male plug which plugs into a receptacle at the end of a flexible cord extending down from the ceiling. These cords supply 480 volts to the machine.

On the day of the incident the strapping machines had been taken from the maintenance shop and placed in use at approximately 6:00 a.m. The machines were used throughout the day. Apparently the power supply cord on one machine repeatedly came in contact with the edge of the rotating fiberglass spool on top of the machine. The point of contact was approximately 2 1/2 inches from the male plug. Friction from the constant rotation of the spool gradually wore a small 1/2-inch-long hole through the outer cover of the flexible cord and through the insulation on one of the inner conductors, exposing a small section of energized wire. The floor of the room where the machine was located was wet from both the brine solution used in the packing operation and from water used periodically throughout the day to clean the area. The damage to the power cable went unnoticed as the non-conductive fiberglass spool, which caused the damage, served as an insulator and kept the machine from becoming energized and the operator from receiving electrical shock.

At approximately 5:00 p.m. the victim entered the room to unplug and move the strapping machine to the maintenance shop. The victim, wearing a damp pair of worn leather work boots, was standing in water when he reached out to unplug the strapping machine.

As he grasped the male plug, the ring finger of his right hand made contact with the damaged section of the cable and the bare 277-volt conductor. A "path to ground" was established from the victim's right hand through his body to his feet in contact with the wet floor, resulting in his electrocution.

A foreman and four workers from the department where the incident occurred were in the area and observed the victim in contact with the power cable. The foreman, who had received electrical burns 2 years previously, recognized that the victim was in contact with electricity and attempted to free the victim's hand from the cord with a plastic scoop. When this failed, the foreman struck the electrical plug above the victim's hand, knocking it loose from the cable. The supervisor and the workers in the area helped the victim to a chair in a nearby office and summoned both the company nurse and the local rescue squad. The victim then lost consciousness. The company nurse initiated cardiopulmonary resuscitation (CPR) on the victim. Upon their arrival, members of the rescue squad attempted defibrillation but were unsuccessful.

The victim was pronounced dead at the scene approximately 1 hour and 15 minutes after the incident.

Cause of Death:

The medical examiner gave the cause of death as accidental electrocution.

Recommendations/Discussion:

Recommendation #1: Permanent fixed wiring should be used wherever possible. When such wiring is not practical, armored or protected cable should be used when the potential for contact between the cable and any moving parts exists.

Discussion: In this case both the power supply cable and the machine power cord had only a standard plastic covering over the insulated conductors. When the plastic covering on the power cord was exposed to friction from contact with the rotating spool of the strapping machine, it wore through, exposing the energized conductors. If permanent wiring (with a short power supply cord for the machine located where it could not contact any moving parts) or armored cable had been used, this incident might have been prevented.

Recommendation #2: Strain relief should be provided where connections on power cords are subject to being pulled apart.

Discussion: The wiring and equipment cords used in the facility had no form of stress relief as required by the National Electrical Code (NEC) 400-10. The constant strain during the operation of the strapping machine and the repeated connection and disconnection could easily result in damage to these cords, with the potential for exposing workers to an electrical hazard.

Recommendation #3: Disconnect devices should be located close to equipment. If the possibility of confusion exists, the disconnects should be marked to indicate which devices they control.

Discussion: The electrical disconnect for the strapping machine was located in a room remote from the work floor instead of being readily accessible as required by NEC 380-8. The disconnect was part of a large bank of circuit breakers which were not labeled to identify what area or equipment they served as required by NEC 110-22. As a result power to the involved machine could not be quickly disconnected, and the victim was freed from electrical contact only after the twist-lock connection was physically knocked from the energized line. This created a delay which could have contributed to the fatality, while at the same time endangering the co-workers attempting to rescue the victim. A company policy which calls for de-energizing equipment prior to unplugging it could prevent future incidents like this from occurring.

Recommendation #4: Electrical safety training should be provided to all employees likely to be exposed to energized equipment.

Discussion: While company policy calls for electrical safety training for all maintenance mechanics, the victim had not received the training in the 3 months he had been with the company.

Recommendation #5: Periodic safety inspection of all electrically-powered equipment should be performed to detect and correct any problems.

Discussion: Although the strapping machine was “inspected” by mechanics at the start of each shift, a visual examination of the damaged power cord revealed places where the outer covering had been previously abraded. Although no injury or serious damage to the cord had resulted from this previous damage, the problem should have been detected and investigated. Action could then have been taken which may have prevented this death.

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