MIFACE INVESTIGATION: #03MI193

SUBJECT: Farmer Died When Electrocuted While Welding Feed Bunker Wagon

Summary

On August 6, 2003, a 44-year-old male farmer was welding a feed bunker wagon when he was electrocuted. The portable 240-volt plug-in cord-connected Hobart welder was in disrepair. The power cord and the cables had damaged insulation exposing the conductors. The welder lead cables were at least 10 years old and were 12 feet long. The victim parked the feed bunker wagon near a wooden building that was filled with tools and junk metal. The victim had attached the ground cable to the feed bunker wagon. The welder was plugged into an outlet that had exposed conductors and, according to the police report, also had other items plugged into it. To allow the welding leads to reach the location of the feed bunker wagon, the victim connected two sets of welding cables and placed the un-insulated cable splices on bare dirt. The victim was lying on damp, bare ground and was sweating heavily, as indicated by his perspiration-soaked short sleeve shirt. An individual who had been previously working with the victim found the victim under the feed bunker wagon with the welder cables lying across his lap. The victim was wearing his welding helmet. He was not wearing gloves. The victim was sitting up under the trailer with his head resting on a metal support railing under the feed bunker wagon. According to the police report, the person who found the victim knelt down and put his hands on the soil and received a "large" shock. This individual turned off the welder and called for assistance. The victim was declared dead at the scene.

Figure 1. Welder in wooden building

RECOMMENDATIONS

- Maintain equipment in proper operating condition.
- Use appropriate personal protective equipment and ensure that it is in proper working order.
- Develop safe work procedures for welding operations, especially for splicing welding leads.
- Identify other potential safety issues, such as the need for a ground fault circuit interrupter (GFCI).

Keywords: Agriculture,
Electrocution, Welding

INTRODUCTION

On August 6, 2003, a 44-year-old male farmer was welding a feed bunker wagon when he was electrocuted. MIFACE learned of this incident from a newspaper clipping. On May 24, 2004, MIFACE researchers interviewed the deceased's caretaker and a family friend at the caretaker's home. After the interview, the caretaker escorted the MIFACE researchers to the deceased's residence and site of the fatal injury. MIFACE researchers were able to view both the welder and feed bunker wagon. The welding cables and leads had been previously removed from the shed. During the course of writing this report, the medical examiner's report, death certificate, police department report and pictures were obtained. MIFACE was unable to interview the individual who discovered the victim. Figure 1, Figure 2, and Figures 4-7 were taken at the scene by the responding police agency. MIFACE has removed personal identifiers from the pictures. Figure 2 was taken by MIFACE at the time of the site visit.

The victim had been a farmer all of his life, born and raised on the residence. The deceased had owned between 28-60 head of cows, raising them for beef on 140 planted acres. To supplement his farm income, he would go to estate sales, auctions, etc., and buy old farm equipment, fix it up, and resell it. According to his caretaker, the victim was very handy and innovative. The caretaker taught the victim the "art" of welding when the victim was eight years old and he welded on his own since he was twelve years old. The victim was a "stick" welder, technically known as a shielded metal arc welder. The victim did not have a written farm safety program and had not attended any farm safety classes.

Another family lived in a separate residence on the victim's property. They paid rent to the victim and helped him with the farm. An individual from this family is the person who discovered the victim. This family is not the "victim's caretaker" referred to in this report. According to the caretaker, the victim was functionally impaired. Due to his functional impairment, the victim usually worked closely with another person when performing any type of work task. When the victim's coworker would take a break, then both would take a break. The caretaker and family friend independently commented about the "reliability" and truthfulness of the individual who discovered the victim.

INVESTIGATION

The victim was wearing a short-sleeve shirt, work pants and tennis shoes. His caretaker stated that the victim had started working at approximately 5:00am to water and feed his cattle and perform other farm chores. He normally started the process of rebuilding equipment later in the day.

Figure 2. Feed bunker wagon

The victim was rebuilding a feed bunker wagon (See Figure 2). He backed the wagon into position with a

tractor, parking the wagon on sandy soil outside of a small wooden shed that contained junk metal, the welder, tools, electrical receptacle box, and other debris. The wagon was 18 feet long, six feet wide and the wagon bed was 28 inches from the ground. The front wheel where the victim was found was approximately 4 feet 6 inches from the front of the wagon. The beam under the hay wagon that the victim was resting against when he was found was 21 inches above the ground.

Figure 3. Damaged insulation on electrical cord

The welder was an old Hobart brand A.C. arc welder (See Figure 1). The welder's power cord covering and insulation was damaged which exposed the conductors (See Figure 3). The welder cables were not available to the MIFACE researchers. The condition of the cable insulation is unknown. The caretaker explained that they had been stolen shortly after the incident. The researchers were told that the first set of welding cables were approximately 10 years old and approximately 12-feet long. The second set of welding cables that were "spliced" to the first set was also not available for inspection. The victim welded with rods that were obtained as discards from other businesses or bought by the victim at auction. The welding rods were stored in the shed in open containers, on open shelves or on the floor.

Figure 4. Un-insulated splice

According to the victim's caretaker, the victim would conduct welding operations the same way each time due to his functional disability. The victim's normal work procedure was to "splice" two sets of welding cables together and lay them down on the ground on a 2-inch x 12-inch piece of wood (See Figures 4-5). He would not insulate the splices for protection. The victim would wear a welding helmet and welding gloves during the welding operation. He would lay and/or stand on a blue rigid foam insulation board. The victim would position all equipment, turn on the welder (90 amps), and weld.

On the day of the incident, the victim appeared to be working on the last sections of the wagon. According to the police report, he was lying approximately 200 feet from the main power box for the welder that was located inside of the shed. The outlet the welder was plugged into had no cover plate, had visible exposed conductors, and had other items plugged into it. The medical examiner report stated that the victim was lying on damp ground. A nearby weather station had recorded 0.03 inches of rain the day of the incident. Over the past 7 days, nearly 3.5 inches of rain had

Figure 5. Un-insulated splice on bare ground

fallen, although within the previous three days, only 0.04 inches had fallen.

Although it is unknown how the victim would usually "splice" the cables, on the day of the incident, he attached the electrode holder directly to the cable wire. The un-insulated connection was lying on bare ground.

The police report stated that the victim had attached the ground lead to the feed bunker wagon frame. The individual who found the victim gave the following account to the responding police. He had been working with the deceased as he welded on the wagon. He left the victim to work alone while he checked on another family member. He checked on the victim every 5-10 minutes to make sure that the victim was okay. When he came back the last time, he called out the victim's name and the victim didn't answer. He found victim not breathing, sitting up under the feed bunker wagon with his head resting on a metal railing. The welding rod and cables were lying across the victim's lap. He could not see the victim's face because the welding helmet was covering his head. He spoke several times to the victim and leaned over and touched the victim; the victim did not respond. Because the victim did not respond, he knelt down and placed his hands on the ground, presumably to help the victim. When his hands touched the ground, he stated he received a "large" shock. At this point, he turned off the welder and called for the victim's caretaker. The caretaker arrived, called 911, and unplugged the welder from the electrical outlet. Emergency response arrived and the victim was declared dead at the scene.

The individual who found the victim told the police that in the past when the victim was welding, he would say "ouch" when he was operating the welder, indicating the victim might have received an electrical shock during the welding process.

Figure 6. Stinger on mat, unused welding rods

Figure 7. Flexible mat under feed bunker wagon

According to his caretaker, some atypical circumstances were present on the day of the incident. The victim had not placed the spliced cables on the 2-inch x 12-inch piece of wood (See Figures 4-5). He was not wearing his welding gloves and he was not welding while lying on the rigid mat under him. He was working alone, which was highly unusual for him. Spare rods were lying next to the victim's location (See Figure 6). He had placed the welding rod in the stinger but the rod had not been lit, indicating the victim had not been in the process of welding when he was electrocuted. The police report did not indicate that there were used rods found near the victim.

The police pictures taken at the time of the incident show a flexible foam mat was present under the feed bunker wagon; pictures indicate the victim was probably not lying on the mat while he was under the wagon (See Figure 7).

Although the air temperature was only 75 degrees, the victim had been sweating heavily as indicated by his perspiration–soaked short sleeve shirt. According to the police report and medical examiner report, there was no evidence of entrance and exit wounds from the electricity.

The event was apparently unwitnessed. A possible sequence of events is that while the welder was turned on, the victim placed the welding rod into the stinger. To gain some slack in the welding cables, he pulled the cables toward him and over his legs. If there was damage to the cable insulation and the conductor was exposed, as he dragged the energized conductor over his legs, the current could have gone to ground anywhere his body was in contact with the ground or through the wagon beam and ground connection to ground.

CAUSE OF DEATH

The cause of death as stated on the death certificate was electrocution. Toxicology performed indicated that the victim had elevated levels of an enzyme that is released when muscles are damaged, consistent with an electrocution.

RECOMMENDATIONS/DISCUSSION

Note: This incident happened on a privately owned farm that does not fall under the Michigan Occupational Safety and Health Administration (MIOSHA) jurisdiction. Even though a business may not be subject to MIOSHA jurisdiction it is recommended that MIOSHA guidelines be followed to enhance safety in the workplace.

- Maintain equipment in proper operating condition.

Maintaining equipment is integral to safe operation of the equipment so that it can provide the protection it was designed to do. It is unknown if the victim was able to make an association between the "ouch" he was receiving and the poorly maintained condition of the arc welder and cable leads. The individual who lived on the property and worked the farm with the victim permitted the victim to continue to use the defective welder. It is imperative that when items are known to be in need of repair that the items are taken out of service, repaired or scrapped. A new welder had been purchased, but was not being used. Insulation on welding cable leads must be maintained to ensure the integrity of the leads and to ensure that workers are not exposed to electrical current

- Use appropriate personal protective equipment and ensure that it is in proper working order.

Electricity follows an uninterrupted path to ground. If the body becomes part of the path, electricity will pass through it. Even though dry hands and feet offer more resistance to electrical current than do wet hands or feet, the current can be lethal whether hands and feet are dry or wet. This is especially true if the electricity passes through vital organs, such as the heart or lungs. It

appears the victim was both sweating and lying directly on damp ground, decreasing his body's resistance level.

The victim was not using the appropriate personal protective equipment for the welding operation. While the victim was wearing the appropriate eye protection (welding helmet), he was not adequately protecting his hands, skin and feet. His hands and arms were not adequately protected from the ultra-violet light and hot metal; he was not wearing gauntlet leather welding gloves/protective sleeves or a long sleeve shirt with buttonable cuffs, made from heavyweight, tightly woven 100% wool or cotton or other protective items, such as a leather apron, jacket, or leg chaps to protect him. He did not protect his feet by wearing high top leather boots to prevent any sparks from entering into the boot. The Michigan Occupational Safety and Health Act (MIOSHA) General Industry Standard Part 33, Personal Protective Equipment provides guidance to individuals regarding the proper selection and use of personal protective equipment while conducting a welding operation.

Rigid foam building insulation sheets, although possibly somewhat an electrical insulator, are not intended for such use. To provide a greater degree of protection, an insulated electrical safety mat should be used and laid on the ground to provide a surface to work on as well as provide additional protection – the safety mat is nonconductive and provides protection for the individual on the mat to prevent an individual from being a "path" for the electrical current to ground. Several sources of safety mats can be found on the Internet using the search term of "non-conductive mat". One non-conductive mat source identified by MIFACE had a mat of 4'x10' retailing for under $275.00.

- Develop safe work procedures for welding, especially for splicing welding leads.

General Industry Standard, Part 12, Welding and Cutting, addresses many of the other safety issues inherent in a welding operation.

To prevent the risk of injury and death, the development of safe work procedures can identify the risks that may exist and the steps that can be taken to prevent them. Safe work procedures identify the risks present that may involve the welding equipment itself, the lack of required personal protective equipment; the environment the welding is taking place in, and the object of the welding operation.

Welding equipment includes the welder, the leads, the stingers, and the welding rods. All welding equipment should always be inspected before use. Check to see that the welder and its receptacle are properly grounded. Make certain that the electrode holder and all electrical connections and cables are properly insulated – do not use if insulation is damaged or missing, or if there are loose cable connections on the electrode holders. Avoid using electrode holders with defective jaws. Make sure welding cables are dry and free of grease and oil. Keep welding cables away from power supply cables. Keep the cables from coming in contact with hot metal and sharp edges. Do not drive over cables.

Welding rods should be stored in sealed containers and in a dry location. The victim stored his welding rods in unsealed containers and open to the environmental conditions. These rods may have absorbed moisture causing the flux to develop cracks, and thus did not effectively shield the arc. This may have resulted in a poor quality weld and poor arc control during the welding process.

Establish safe work procedures when you need to "splice" a welding lead. The victim used an unsafe practice when he attached the electrode holder to the wire cable. Splices should be accomplished using only approved components and commercially manufactured welding "cable connectors" that can be found in welding supply stores and some farm supply stores.

The need for selecting and using the appropriate personal protective equipment was discussed in the previous recommendation. Additional precautions to protect your health may be needed depending upon where the welding operation is taking place. A respirator may be considered necessary depending on the type of work to be done, the nature of the contaminants, whether there is good ventilation at the welding site, and the concentration of the fume to which you are exposed. Noise may also be an issue and hearing protection may be required.

It appears that the victim changed the electrodes with his bare hands. This unsafe practice should be forbidden. Never change electrodes with bare hands or wet gloves. When welding, avoid wrapping electrode cables around your body.

Take care to look at the environment the welding will be taking place in. Are there flammable or combustible materials close by? Keep a fire extinguisher nearby for emergencies. Is the ground under the welder or where you are welding damp or wet?

The object being welded should be assessed for potential risks. Connect the ground cable as close as possible to the area where welding is being conducted. Make sure the ground clamp is connected on clean metal (no rust, paint, or coating). Metal that is rusty, painted or coated can affect the circuit and the integrity of the ground. When welding is completed, do not dip the electrode holder in water to cool it because this practice may result in electrical shock. Never weld in damp locations because of the shock hazard.

- Identify other potential safety issues, such as the need for a ground fault circuit interrupter (GFCI).

When looking at your equipment or environment, other potential safety issues, such as the need for a portable ground fault circuit interrupter (GFCI) may be identified. GFCIs are available for 240-volt electrical equipment. The electrical equipment plugs into the GFCI, and the GFCI plugs into the wall. An unintentional electric path between a source of current and a grounded surface is referred to as a "ground fault". Ground faults occur when fault current is flowing, in effect, electricity is going to ground. Fault currents can occur when there is bad insulation, nicks, cuts or cracks. A person's body can provide a path to ground for this current.

According to the police report, the outlet the welder was plugged into had no cover plate, had visible exposed conductors, and had other items plugged into it. It is likely that the victim's welding setup would not have functioned with a 240-volt GFCI due to the exposed conductors on the electrical cable/plug attaching the welder to the wall receptacle (See Figure 3). Although GFCIs are not normally used with welders in farm settings, a GFCI would have detected if there were a current leakage in the electrical cable between the welder and the electrical outlet. The electrical circuit would have been interrupted and the welder would have turned off, indicating to the victim that the power to the welder was "unsafe". NOTE: A GFCI may provide protection from the "wall to the welder". A GFCI will not protect you from faults between the "welder and the work". Because a GFCI cannot protect you from faults between the "welder and the work" using proper welding technique and personal protection equipment while welding is crucial.

REFERENCES

MIOSHA standards cited in this report may be found at and downloaded from the MIOSHA, Michigan Department of Labor and Economic Growth (MDLEG) website at: www.michigan.gov/mioshastandards. Also, 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.

Michigan Occupational Safety and Health Act (MIOSHA), General Industry Standard, Part 33, Personal Protective Equipment

Michigan Occupational Safety and Health Act (MIOSHA), General Industry Standard, Part 12, Welding and Cutting

National Ag Safety Database (NASD), www.cdc.gov/nasd, Topic Area: Electrical Safety

NASD- Grounding Electricity, Ohio State University Extension's Agricultural Tailgate Safety Training Series

NASD – Arc Welding Safety, Ohio State University Extension's Agricultural Tailgate Safety Training Series

NASD - Agricultural Engineering Safety Lesson Plan: Arc, TIG, and MIG Welding Safety

Safe Operating Procedure, Electric Arc and MIG Welding, University of Nebraska-Lincoln. UNL Environmental Health and Safety. Internet Address: http://ehs.unl.edu

MIFACE
Investigation Report # 03 MI 193
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Please rate the following on a scale of:

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1	2	3	4

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