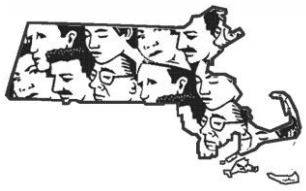
MA FACE
Occupational Fatality Report



Electrician Electrocuted while Troubleshooting Envelope Manufacturing Machine - Massachusetts

Release Date: October 30, 2013
Investigation: # 12-MA-007-01

Massachusetts Department of Public Health
Occupational Health Surveillance Program

SUMMARY

On April 4, 2012 a 53-year-old male electrician (victim) was electrocuted while troubleshooting a medium open-end envelope machine. The machine's blower was not working and the victim was working to repair it. The victim was reaching into the machine to access wiring for the blower contained in an electrical junction box when he was electrocuted. A co-worker noticed the victim was not moving and grabbed the sleeve of his shirt and pulled him away from the machine. The co-worker then yelled for help and another co-worker called emergency medical services (EMS). The local fire department was on site to inspect the sprinklers and were summoned and started to care for the victim. The local police and then the state police arrived at the incident location. The victim was transported to a local hospital where he was pronounced dead.

Contributing factors identified in this investigation included a lack of comprehensive standard operating procedures for lockout/tagout as part of an overall hazardous energy control, the location of the machine's electrical junction box that was both physically and visually inaccessible, and the victim working extended hours to limit the disruption of production.

The Massachusetts FACE Program concluded that to prevent similar occurrences in the future, employers should:

- **Ensure that electrical circuits and equipment are de-energized and that lockout/tagout standard operating procedures are implemented and enforced prior to beginning work;**
- **Provide and ensure that employees use appropriate personal protective equipment (PPE) and tools for troubleshooting live circuits;**
- **Develop, implement, and enforce an Injury and Illness Prevention Program that addresses hazard recognition and avoidance of unsafe conditions; and**
- **Ensure that work is scheduled to allow for sufficient rest periods between work shifts.**

In addition, machine manufacturers should:

- **Implement the concept of Prevention through Design (PtD) to ensure the safety and health of machine users, including machine operators and maintenance workers.**

INTRODUCTION

On April 5, 2012, the Massachusetts FACE Program was alerted by the local media that on the day before, April 4, 2012, a male worker at an envelope manufacturing facility was electrocuted while troubleshooting a machine. An investigation was initiated. On June 12, 2012, the Massachusetts FACE Program Director and a co-worker traveled to the company's office location and met with company representatives to discuss the incident. Photographs were taken of the envelope machine and the incident location. The state police report, death certificate, company information, and the OSHA fatality and catastrophe report were reviewed during the course of the investigation.

EMPLOYER

The employer is a manufacturer and printer of envelopes and stationery and has been in business for 24 years. The company has approximately 82 employees of whom about 60 work in the manufacturing department and 20 work in sales and office positions. Three employees made up the maintenance department in which the victim worked. Employees worked five days per week, Monday through Friday. There were two work shifts each day. The first shift was 7:00 a.m. – 3:00 p.m. and the second shift was 3:00 p.m. – 11:00 p.m., and reportedly there was usually opportunity to work extra hours. Saturday was a designated maintenance day for the machines, a downtime when machine setters could come in to adjust the machines. There was no union representation at the company.

WRITTEN SAFETY PROGRAMS AND TRAINING

The victim was the main health and safety representative and health and safety trainer for the company. At the time of the incident, the company did not have a comprehensive safety and health program. New hires were provided with an orientation that included training on multiple health and safety topics including, but not limited to, machine guarding, lockout/tagout, hazard communication, and powered industrial trucks. The company had workers' compensation insurance as required by law in Massachusetts (G.L. c. 152, Sec. 25A).

During the site visit it was reported that since the incident the company had started to develop a health and safety program and were holding weekly planning meetings of management and key production staff to develop a safety committee.

VICTIM

The victim had been employed with the company as an electrician for approximately seven years at the time of the incident. The victim held a valid master electrician license. The victim's normal work schedule was first shift, Monday through Friday. For the two months prior to the incident, the victim had been working extended hours in support of the company's relocation. It was reported that the victim had worked about 12 hours the day before the incident and was on site at 5:00 or 6:00 a.m. on the day of the incident.

INCIDENT LOCATION

The company was in the process of moving into a building that was built around 1900 and historically operated as a fabric mill. The building had been recently renovated to accommodate the envelope company. The entire building was over 300,000 square-feet and the company was going to occupy about half of that space. The machinery was being set up on the ground floor which was a large open space.

EQUIPMENT

The machine involved in the incident was a medium open-end envelope machine (Figure 1) that the company had owned for about 14 years. It was estimated that the machine was manufactured over 30 years ago and perhaps as early as the 1960's. The machine was configured to punch and install an address window on pre-sized sheets of paper, fold and glue the envelope into shape, and put on a strip of self-sealing glue with removable strip to seal the envelope.

The machine was equipped with a blower motor (Figure 2) that provided air flow to different sections of the machine through a series of hoses. The main function of the blower was to create negative air pressure on the underside of the transfer belts to keep the paper flat and in position as it passed from one process to the next. The blower motor was powered by 480 volts through a three-phase format, (three powered lines and a neutral line), which ran through conduit and a number of junction boxes from the main fuse panel (see Figure 3).

INVESTIGATION

At the time of the incident, the company had been moving its entire facility to the newly renovated factory building where the incident occurred. Reportedly the victim was playing a large role in this move, overseeing the breaking down, moving and setting up/reassembling of the approximately 15 manufacturing machines. The move had started the month prior to the incident with the machinery being moved in stages so that production could continue with limited downtime. A few of the machines had been split into two or three pieces and moved by a rigging contractor into the new facility. The victim had been working extra hours to direct the moving of the machines and disconnecting and reconnecting any electrical components affected by the move. The company contracted an additional electrician to help with this process.

The medium open-end envelope machine involved in the incident was one of the machines that had been split into two pieces for the move. Splitting this particular machine required removing plates which bridged the machine frame at approximately the mid point of the length of the machine, and disconnecting all wiring/conduit and other components which crossed this mid point (Figure 4). The machine had been moved, reassembled, and had been tested and running the evening prior to the incident.

The day of the incident, the machine setter/operator had been scheduled to resume work as the machine was ready to use. While making adjustments to the machine, the machine operator noticed he could not hear the blower motor running and reported the issue. The victim discovered during his initial troubleshooting that the blower may have been running at a reduced power, and perhaps one of the electrical lines had shorted or disconnected after being set up at the new facility. The victim then continued to further troubleshoot the motor wiring and had replaced some fuses in the main panel and apparently located a short in the wiring for the blower.

At the time of the incident, the victim was accessing a junction box located near the break in the machine at the floor level (Figure 5). It was unclear if the victim was voltage testing to ensure that the junction box was de-energized or if he was continuing to troubleshoot. It was while he was accessing this junction box that he came in contact with an energized component and was electrocuted. It is suspected the current traveled from one hand, through his torso, and out his other hand or perhaps another part of his body touching the machine. The machine operator noticed the victim looked like he

was straining while reaching into the machine and walked over to offer assistance. He realized the victim was being electrocuted and pulled on the victim's sleeve to move him away from the machine. The machine operator then yelled for help and another co-worker called emergency medical services (EMS).

The local fire department was at the site to inspect the fire alarm panel as part of the move into the renovated facility. A co-worker informed the fire department personnel of the incident and they started to care for the victim. The local police, additional fire department personnel, and then the state police arrived at the incident location. The victim was transported by ambulance to a local hospital where he was pronounced dead.

CONTRIBUTING FACTORS

Occupational injuries and fatalities are often the result of one or more contributing factors or key events in a larger sequence of events that ultimately result in the injury or fatality. The Massachusetts FACE team identified the following contributing factors in this incident.

- Lack of comprehensive standard operating procedures for lockout/tagout as part of an overall hazardous energy control program
- Layout of the machine and location of the junction box making it both physically and visually inaccessible
- Working extended hours to limit the disruption of production

CAUSE OF DEATH

The medical examiner listed the cause of death as electrocution.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that electrical circuits and equipment are de-energized and that lockout/tagout standard operating procedures are implemented and enforced prior to beginning work.

Discussion: OSHA regulation 29 CFR 1910 Subpart S, *Electrical*, covers electrical safety in general industry.[1] In general, employers should not permit employees to work on powered or live circuits or in the proximity of live parts which they could come in contact with in the course of work. Lockout/tagout must be implemented (OSHA regulation 29 CFR 1910.147, *The control of hazardous energy*) to prevent contact with live parts.[2] Lockout/tagout standard operating procedures should outline how circuits and equipment are de-energized, tested to ensure they are de-energized and are not reenergized during the course of the work. Locks and/or tags must be attached to every location where equipment or circuits could be reenergized. Each individual working on the equipment and circuits should apply their own lock and/or tag and should be the only one to have the ability to remove the lockout/tagout device that they applied. In addition, the National Fire Protection Association (NFPA) 70E *Standard for Electrical Safety in the Workplace* also states that live parts to which an employee might be exposed shall be put into an electrically safe work condition before an employee works on or near them.[3]

In this case, the victim was handling wires in a junction box to troubleshoot a blower motor while some or all of the wires were energized. Prior to being handled, the wires should have been de-energized and tested using proper standard operating lockout/tagout procedures and testing equipment to ensure the components were totally de-energized. The power source then should have been tagged and locked to prevent anyone other than the victim from repowering the circuit. To ensure the effectiveness of these procedures, the employer must provide oversight to make sure that procedures are followed.

Recommendation #2: Employers should provide and ensure that employees use appropriate personal protective equipment (PPE) and tools for troubleshooting live circuits.

Discussion: In this incident, it was unclear if the victim was trying to troubleshoot with the circuit energized or if he believed the circuit was de-energized. As mentioned in recommendation #1, when working on high-voltage electrical equipment, employers should ensure that equipment is de-energized. There are a few general situations where work would be permitted on or near an energized circuit.[4] Two of these situations would be troubleshooting and testing of electric circuits that can only be performed with the circuit energized. Any permitted work on or near energized circuits must only be performed by a qualified worker.

Workers should be provided the appropriate PPE and tools and should be trained to never assume that a circuit is de-energized, or that electricity is not stored in a component, and should always test for the presence of electricity.[4,5,6] If work on energized circuits is absolutely necessary, then the qualified worker must use the sufficiently rated insulated tools, gloves, and other personal protective equipment provided by the employer to protect themselves. In this case, if protective equipment had been used, this incident may not have occurred. Also, because the junction box contained other connections, it is important to assume any of those other connections are live until tested and confirmed otherwise.

Recommendation #3: Employers should develop, implement, and enforce an Injury and Illness Prevention Program that addresses hazard recognition and avoidance of unsafe conditions.

Discussion: An Injury and Illness Prevention Program should include the systematic identification, evaluation and prevention or control of general workplace hazards and the hazards of specific jobs and tasks. The major elements of an effective program are management leadership, worker participation, hazard identification and assessment, hazard prevention and control, education and training, and program evaluation and improvement.[7] The program should also include an explanation of the worker's rights to protection in the workplace, outline safe work practices workers are expected to adhere to, specific safety protection for all tasks workers perform, how workers can identify and avoid hazards, and who workers should contact when safety and health issues or questions arise.

In this case, procedures should be developed for the proper operation and use of envelop and stationary manufacturing equipment and any tools and required personal protective equipment (PPE) needed to complete tasks. Specific lockout/tagout and safe electrical troubleshooting procedures should be included in the program, which will informed all employees about the hazards that these procedures aim to control. The program should also require that a hazard analysis is performed of any new processes, novel situations, such as disassembling and moving machinery, and where new hazards have the potential to arise.

When developing an Injury and Illness Prevention Program, employers should start by evaluating all tasks performed by employees for potential hazards and incorporate information about these identified hazards and their controls into the program.[7] Employers should also use their employees' expertise throughout the program development process by seeking employee input. Once the program is developed, employers should continue to seek employees' input during the routine updating of the program. The program should be updated when safety concerns arise and when new equipment and new tasks are introduced into the workplace.

Employers should ensure that they have fully and effectively implemented their Injury and Illness Prevention Programs by routinely performing assessments of tasks and immediately addressing any observed unsafe conditions. As part of the program's implementation, training should be provided to all employees on program topics, including electrical procedures and hazard recognition and the avoidance of unsafe conditions. All training provided to employees should be documented. Documentation should include: who provided the training and their qualifications, the content of the training, workers who were trained, and any assessments of workers' comprehension of the training. When the program is updated, employers should then provide additional training on the new and updated safety and health program topics.

The Massachusetts Department of Labor Standards (DLS) offers free consultation services to help small employers improve their safety and health programs, identify hazards, and train employees. DLS can be contacted at 978-242-1351. More information about DLS can be found on their Web site at www.mass.gov/dos/consult.

The Massachusetts Department of Industrial Accidents (DIA) has grants available for providing workplace health and safety training to employers and employees. Any company covered by the Massachusetts Workers' Compensation Insurance Law is eligible to apply for these grants. More information about these DIA grants can be found on their Web site at www.mass.gov/dia/safety.

Recommendation #4: Employers should ensure that work is scheduled to allow for sufficient rest periods between work shifts.

Discussion: The NIOSH document *Overtime and Extended Work Shifts: Recent Findings on Illnesses, Injuries, and Health Behaviors* showed that in 16 of 22 studies addressing general health effects, extended work hours were associated with increased injury rates, poorer perceived general health, more illnesses, or increased mortality. A pattern of deteriorating performance on psychophysiological tests as well as injuries while working long hours was observed across study findings, particularly with very long shifts and when 12-hour shifts combined with more than 40 hours of work a week.[8]

The possibility that fatigue due to extended work hours was a contributing risk factor in this incident should be considered as a matter of prudent safety practice. The victim had been working extended hours for the two months prior to the incident supporting the company's relocation. It was reported that the victim had worked about 12 hours the day before the incident and was on site between 5:00 and 6:00 a.m. the morning of the incident. The incident occurred around 12:15 p.m., about six hours into the victim's shift that day.

In this case, working extended work days for a couple of months raises concern regarding the ability of the victim to be able to get sufficient rest. Whenever possible, work should be scheduled to provide workers with sufficient rest periods between shifts.

Recommendation #5: Machine manufacturers should implement the concept of Prevention through Design (PtD) to ensure the safety and health of machine users, including machine operators and maintenance workers.

Discussion: The concept of Prevention through Design (PtD), as it would relate to machine manufacturers, is addressing occupational safety and health needs during the design process to prevent or minimize hazards that could result in injuries, illnesses and fatalities to workers.[9] Appling PtD during the design phase would initiate the process of thinking about how the machine functions and all of the individuals that would come in contact or interact with the machine to identify potential hazards. Once hazards are identified, the machine's design can be altered to eliminate these hazards protecting machine operators, maintenance workers and others working in proximity.

The envelope machine involved in this incident was at least 30 years old, but this incident can still serve as an example for incorporating PtD. In this case, the junction box being accessed by the victim was both physically and visually inaccessible (Figure 5). The PtD process could have resulted in the junction box being placed in a location that was more accessible, which might have prevented this incident.

Note: it is not known if the blower motor and associated electrical components were original to the machine. End users and others who make modifications to machinery should also consider PtD while making upgrades and replacing components.

REFERENCES

1. Code of Federal Regulations. 29 CFR 1910 Subpart S (300-399) *Electrical.* Washington DC. U.S. Government Printing Office, Office of the Federal Register.

2. Code of Federal Regulations. 29 CFR 1910 147 *The control of hazardous energy (lockout/tagout).* Washington DC. U.S. Government Printing Office, Office of the Federal Register.

3. National Fire Protection Association (NFPA). *70E: Standard for Electrical Safety in the Workplace.* Quincy, MA.

4. Code of Federal Regulations. 29 CFR 1910.333 *Selection and use of work practices.* Washington DC. U.S. Government Printing Office, Office of the Federal Register.

5. Code of Federal Regulations. 29 CFR 1910.335 *Safeguards for personal protection.* Washington DC. U.S. Government Printing Office, Office of the Federal Register.

6. Code of Federal Regulations. 29 CFR 1910.332 *Training.* Washington DC. U.S. Government Printing Office, Office of the Federal Register.

7. DOL. OSHA. Injury and Illness Prevention Programs, Fact Sheet No. 3665. www.osha.gov/Publications/OSHA3665.pdf. Date accessed: September 5, 2013.

8. NIOSH. *Overtime and Extended Work Shifts: Recent Findings on Illnesses, Injuries, and Health Behaviors* (2004). U.S. Department of Health and Human Services. www.cdc.gov/niosh/docs/2004-143/pdfs/2004-143.pdf. Date accessed: July 1, 2013.

9. NIOSH Program Portfolio: Prevention Through Design. www.cdc.gov/niosh/topics/ptd. Date accessed: July 9, 2013.

Figure 1 – Medium open-end envelope machine
View from the front end

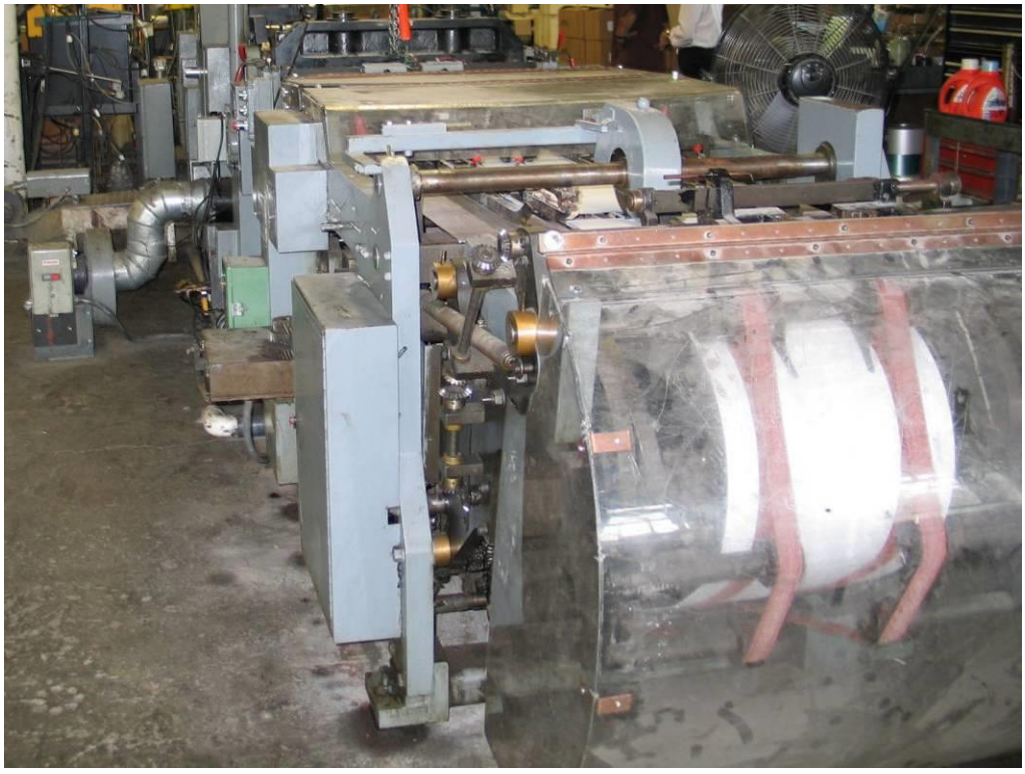


Figure 2 – Envelope machine's blower motor

Figure 3 – Envelope machine's blower motor power supply
Approximate pathway of conduit, drawing shows view from above

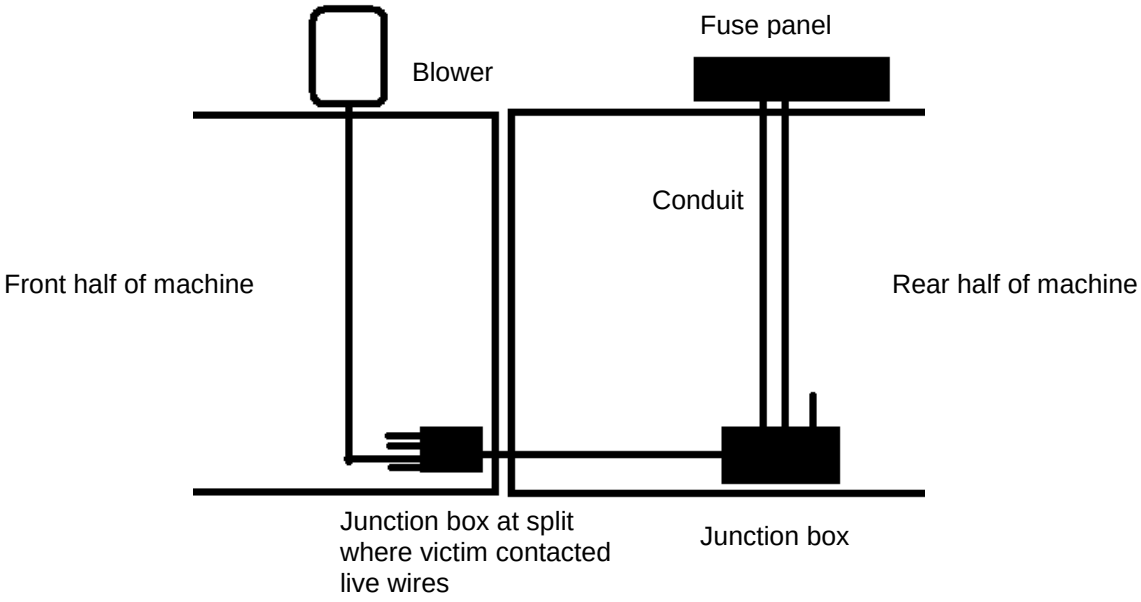


Figure 4 – Bridge plates at envelope machine split point

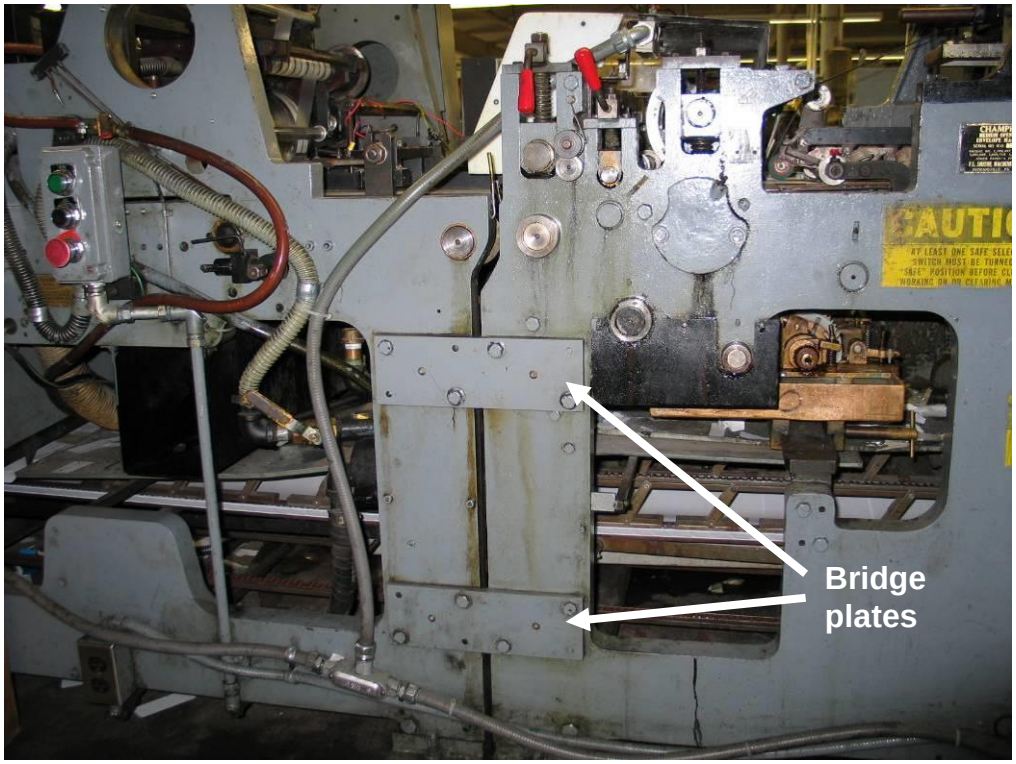


**Figure 5 – Envelope machine's junction box where worker contacted live wire
View from left and right of bridge plate**