MIFACE INVESTIGATION: #01MI003

SUBJECT: Operator Crushed Between a Rotating Barrel and Its Hoist Support Bar

Summary

On January 20, 2001, an 18-year old male died from crushing head injuries sustained when he was pulled into the hoist support bar of a rotating barrel by the rotation of the barrel. He was the operator at the unload station of a barrel plating operation. The hoist supporting the barrel placed the barrel containing the plated parts onto a cart that transported the barrel from the last plating station to the unload station. Approaching the unload station from the right, a tab on the barrel contacted a wire on a limit switch that stopped the barrel rotation so that two doors on the barrel were facing the operator. He removed the two doors from the barrel and pushed two palm buttons on a control panel to the right of the station so the barrel continued, moving right to left, to a dump station. At the dump station the barrel rotated so the parts fell onto a conveyor belt through the door opening. After emptying, the barrel rotated clockwise to find its correct position for door replacement and returned to the operator's station. The tab on the barrel contacted the wire on the limit switch to stop the barrel's rotation for door replacement. Although this was an unwitnessed event, the following event sequence was based on the operator's resting position. As the barrel was returning to the operator's station after dumping the parts, the victim reached into the barrel to remove some parts that had not fallen out at the dump station before it had completely returned to the door replacement position and while it was still rotating. When he reached into the barrel, his left sweater sleeve caught on something inside the barrel. The limit switch apparatus did not function, so the barrel continued to revolve instead of stopping as it was supposed to. As the barrel continued to rotate, it pulled the victim between the barrel and the hoist support bar, crushing his head. The first person to notice something wrong saw the operator caught between the barrel hoist support bar and the barrel. Police and rescue personnel were called immediately. His body was pried out of the equipment and he was pronounced dead at the scene.

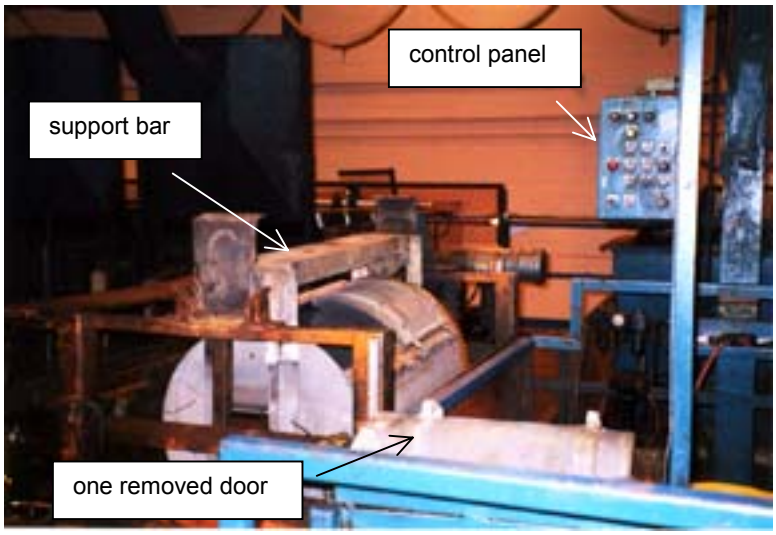

Figure 1
Operator's Workstation

RECOMMENDATIONS

- Review the design characteristics of the holes in the barrel to ensure that parts tumble out freely when it is tilted.

- Guard moving parts at equipment point of operation.

- Allow time at the beginning of each shift for the operator to perform a check of equipment to ensure that all machinery is operating correctly.

- Establish a written schedule for conducting preventive maintenance on critical parts of the system.

- Place a warning sign on the equipment depicting the potential danger of the body or clothing becoming entrapped in moving portions of the machinery.

- Do not allow operators to wear loose clothing while operating moving equipment.

INTRODUCTION

On January 20, 2001, an 18-year old male died from crushing head injuries sustained when he was pulled into the hoist support bar of a rotating barrel by the rotation of the barrel. On January 22, 2001, MIFACE investigators were informed by the Michigan Occupational Safety and Health Administration (MIOSHA) 24-hour fatality report system that a work-related fatal injury occurred on January 20, 2001. On February 28, 2001, the MIFACE researcher interviewed the company's Human Resource Manager. The manager accompanied the researcher into the plant, showed her the incident site and described the metal plating process while she watched the equipment operating. The manager described the events that were thought to have taken place resulting in the fatality.

The MIOSHA investigation resulted in four serious citations: emergency stop not within reach of the operator's station, guard revolving container where a hazard exists, provide guard for gears, and guard open-sided floor or platform four or more feet above adjacent level.

INVESTIGATION

On Saturday, January 20, 2001, an 18 year-old production worker died as a result of crushing head injuries sustained when he was caught by a rotating barrel and pulled into its supporting frame. On February 28, 2001, a MIFACE investigator visited the site and interviewed the Human Resources Manager, the person responsible for safety in the plant.

The metal finishing company where the fatality occurred had started as a family business. It was purchased from the family in the 60's by a steel-treating corporation that had been in business 40 years at the time of the purchase. The plant was moved to its present site in the 80's. This was the first fatality to occur in the corporation since 1927. The company employed 156 people, 100 of whom have the same job title, production worker, as the victim. On the day of the incident five salaried and sixteen hourly employees were at the site.

The company has an arrangement with a temporary manpower agency to hire its clients. If the worker performed satisfactorily on the job for approximately 90 days, then he/she may be hired by the company. The victim had been working at the plant for about three months and was about to be hired by the company. He was familiar with the operation he was running. He had received some safety training at the manpower agency. He received further safety training and on-the-job training related specifically to the equipment operation when he started working at the company.

The victim started work at 0700. The incident occurred at approximately 1000. No one saw or heard the incident occur. Noise levels in the plant require use of hearing protection devices. A fellow worker saw him caught between the hoist support bar of the barrel and the barrel at approximately 10:15 a.m. Police and rescue personnel were called immediately. His body was pried out of the equipment. He was pronounced dead at the scene at 10:31 a.m.

The operator worked at an unload station of a barrel plating operation. In this barrel plating operation, a barrel supported by a hoist dipped small parts into eight coating stations where the parts were coated by plating solution. In order to allow the plating solution to enter and exit the barrel without loss of the parts to be plated, holes are drilled along each side of the barrel. The holes are sized so the parts cannot fall out yet the plating solution can drain.

The barrel approached the operator's station from the right. The operator's workstation measures approximately 6 feet by 6 feet and was located 5 feet above the plant floor level. The barrel was approximately the size of a 55-gallon drum, 4 feet in length and 2 feet in diameter. Just before the barrel reached the operator's station, the hoist placed the barrel on a track that allowed a cart to move the barrel to the station. A ring gear on one end of the barrel engaged a drive motor that rotated it in a clockwise motion. The barrel approached the operator's station and rotated relatively slowly. Speed of operation was not an issue.

As the barrel reached the operator's station, a tab located on the barrel opposite the ring gear contacted a wire attached to a limit switch. The limit switch stopped the barrel's rotation so that two doors on the barrel faced the operator. Each of the two doors was approximately 18 inches square. The operator removed the doors by loosening four 5/8-inch nuts with an impact wrench and removing the nuts. He then lifted the doors off the barrel and set them onto a 28 inch square table to the left of the workstation. He pressed two palm buttons on a 12-inch square control panel located to the right of the workstation to activate the barrel to continue to a dump station eight feet further down the track to the left. The emergency stop for the equipment was located on this control panel.

At the dump station, the barrel rotated and dropped its coated parts onto a conveyor that carried the parts to a drying oven. The barrel continued to rotate to locate the door opening into the correct position for replacement of the doors as it returned to the operator. The limit switch was to have stopped the barrel with the opening for the doors facing the operator. The operator would have replaced the doors and nuts and sent the barrel to the next station by pressing the two buttons on the control panel.

Although no one saw the incident take place, it is presumed that the operator reached into the barrel to remove some parts that had not fallen out at the dump station as the barrel was returning to the operator's station. The barrel would have been rotating to find its position for the replacement of the doors. It is believed that his sweater became entangled on something inside the barrel, and he was not able to extricate himself. His sweater was torn on the left arm. Apparently the limit switch did not function to stop the barrel from rotating at the unload station. The left side of the victim's head was pulled into the hoist support bar and crushed between the bar and the rotating barrel. When the equipment was tested after the event, the limit switch did not stop the barrel rotation.

The following safety changes were made to the left side of the operator's station before the MIFACE investigation:

- A light curtain was installed, so that the equipment will shut down if anyone reaches through it into the path of the returning barrel.

- The rail guarding was extended so that an operator cannot reach into a barrel before it reaches the unload station.

- The position of the limit switch was moved further to the left of the unload station, so that the barrel stops rotating well before it reaches the unload station.

- An emergency stop was installed on the left side of the unload station within the reach of the operator standing at the unload station.

CAUSE OF DEATH

The cause of death as stated on the death certificate was crushing head injuries. No alcohol or drugs of abuse were detected in the victim's blood and urine.

RECOMMENDATIONS/DISCUSSION

- Review the design characteristics of the barrel to ensure that parts tumble out freely when it is tilted.

Because of the possibility that the operator was trying to retrieve parts that had not fallen out of the barrel at the dump station, the barrel perforations and size of door opening should be reviewed to insure that the plated parts tumble out unimpeded.

- Guard moving parts at equipment point of operation

Guards must cover all moving parts in such a way that no part of the operator's body can come into contact with them. All rotating equipment parts have inherent dangers. Even slowly rotating equipment can grip material it contacts. Where there are protrusions, the potential for catching increases, and the travelling motion of a rotating piece of equipment is a cause for yet greater vigilance. This piece of equipment encompassed all three.

- Allow time at the beginning of each shift for the operator to perform a check of equipment to ensure that all machinery is operating correctly.

Even when management has with the best intentions tried to engineer out all potential safety hazards, situations will occur that require attention. Equipment should be checked by the worker following a safety checklist at the beginning of his/her shift to ensure all equipment is operating as it has been designed to operate. Operators should receive training on using the checklist and be instructed to report any equipment malfunction or repairs needed. Management should ensure that the job will not run until repairs to imminently dangerous conditions are addressed.

- Establish a written schedule for conducting preventive maintenance on critical parts of the system.

A good preventive maintenance plan includes inspection of equipment and machinery that might affect the safety of workers. In this case, the limit switch was a critical part in the system. It was

relied upon solely to stop the barrel rotation at the appropriate position for the removal and replacement of the barrel doors. Because of its importance in the operation, the limit switch should have been in top working condition. It is unknown if the limit switch had not functioned properly in the past and/or if the malfunction had not been corrected or inadequately repaired. Keeping records of the number of trouble reports on equipment can help determine the maintenance inspection schedule.

- Place a warning sign on the equipment depicting the potential danger of the body or clothing becoming entrapped in moving portions of the machinery.

The potential hazards of entrapment in rotating, travelling equipment are well-documented. In terms of hazard control, engineering and guarding are at the top of the hierarchy. Warning signs cannot be used in place of the engineering and guarding controls, yet pictorials have been used as safety reminders to workers of the dangers associated with their jobs. A well-designed warning sign depicting the danger of a part of the body or clothing becoming entangled in the equipment would serve as a reminder of the hazard.

- Do not allow operators to wear loose clothing while operating moving equipment.

As described above, the potential hazards of entrapment in rotating, travelling equipment are well-documented. Loose clothing, long hair, and jewelry are often cited as a cause of entanglement.

REFERENCES

1. Accident Prevention Manual for Business & Industry, Engineering and Technology, 11th Edition, National Safety Council, Chicago, 1997.

2. Concepts and Techniques of Machine Safeguarding, Occupational Safety and Health Administration, OSHA 3067, Washington, DC, 1992 (Revised).

3. Website - http://www.bls.gov/opub/cwc/1998/Winter/art6text.htm#Industry

4. MIOSHA Standards cited in this report can be found at the Consumer and Industry Services, Bureau of Safety and Regulation Standards Division website at <http://www.cis.state.mi.us/bsr/divisions/std/std_rule.htm>. The Standards can also be obtained for a fee by writing to the following address: Department of Consumer and Industry Services, MIOSHA Standards Division, P.O. Box 30643, Lansing, MI 48909-8143. MIOSHA phone number is (517) 322-1845.

MIFACE

Investigation Report # 01 MI 003

Evaluation

To improve the quality of the MIFACE program and our investigation reports, we would like to ask you a few questions regarding this report.

Please rate the following on a scale of:

Excellent	Good	Fair	Poor
1	2	3	4

What was your general impression of this MIFACE investigation report?

1 2 3 4

Was the report…

Objective?	1	2	3	4
Clearly written?	1	2	3	4
Useful?	1	2	3	4

Were the recommendations …

Clearly written?	1	2	3	4
Practical?	1	2	3	4
Useful?	1	2	3	4

How will you use this report? (Check all that apply)

- o Distribute to employees/family members
- o Post on bulletin board
- o Use in employee training
- o File for future reference
- o Will not use it
- o Other (specify) _____

Thank You!

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