A Self-Employed Welder Fatally Injured during an Explosion while Welding a Rim Wheel to Repair Air Leaks

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SUMMARY

On June 16, 1999, a 34-year-old male self-employed welder (the victim) was fatally injured while attempting to repair leaks in a skid-steer loader rim wheel by welding, and the wheel exploded. Prior to welding, the victim had used multiple 12-ounce cans of a flammable tire sealant/inflator in an unsuccessful attempt to seal holes in the leaking rim wheel. The explosion caused the pressurized tire to be blown off the rim and into the victim propelling both the victim and the tire approximately 15 feet into the air and landing approximately 24 feet away from the skid-steer loader. The owner of the loader and residents of the neighborhood heard the explosion and rushed to assist the victim. A call for emergency assistance was placed and the victim was transported to a local hospital where he was pronounced dead. The MA FACE Program concluded that to prevent similar occurrences in the future, employers including the self-employed should:

- **Never weld or perform other hot work activities on a rim wheel.**
- **Only use nonflammable tire sealant/inflator for field repair of leaking rim wheels.**
- **Develop a safety program that includes, but is not limited to, evaluating and preventing hazards that might exist before beginning a task.**

In addition, **tire sealant/inflator manufacturers** should:

- **Consider the use of only nonflammable propellant for the product.**

INTRODUCTION

On June 16, 1999, the MA FACE Program was notified by a police department through the 24-hour Occupational Fatality Hotline that on the same day, a 34-year-old male welder was fatally injured during an explosion. The explosion occurred while he was repairing a weld on a rim wheel of a skid-steer loader. An investigation was immediately initiated. The MA FACE

Program Director traveled to the site where the owner of the skid-steer loader and the victim's father were interviewed on June 17, 1999. The police report, death certificate, corporate information on tire sealant/inflators, OSHA fatality/catastrophe report, local newspaper articles, witness interviews, and photographs from the incident site were obtained during the course of the investigation. Once OSHA realized that the victim was self-employed, and outside of OSHA jurisdiction, the information they had collected was turned over to the FACE Program.

The victim was a certified welder and in business for himself approximately 9 months with no other employees. He did not have any type of a health and safety plan.

INVESTIGATION

The victim, a self-employed welder, was hired by a development company to modify the rim wheels of a skid-steer loader. On June 16, 1999, the victim was attempting to repair air leaks on a weld of a wheel he had previously modified. The owner of both the development company, who also owned the loader was onsite at the new residential development along with two of his laborers, but they were not in the immediate area of the victim at the time of the incident.

The developer wanted the skid-steer loader tracks replaced with wide treaded tires so the loader could be used in another area of the development. The tires to be used were wider than the standard tire for this machine and, therefore, would not fit on the standard rim wheel. The victim had a local machine shop cut and bend steel pieces to the appropriate diameter needed to widen the wheels. The machine shop also cut the wheels of the loader so the additional pieces of steel could be inserted into the wheels. The victim, using the equipment at the machine shop, welded the steel pieces into the cut wheels to make them wide enough for the tires. The tires were mounted onto the modified wheels and pressurized. Then the wheels were installed on the loader.

The tires were inflated to approximately 70 pounds per square inch (psi) and had deflated to approximately 50 psi around the time of the incident (pressures of the other three tires were measured after the incident). The recommended tire pressure for the tires was 35 psi as noted on the sidewall of the tire. The tire dimensions were also marked on the sidewall as 15 inches x 19.5 inches. The modified wheels measured 13.4 inches deep and a diameter of 19.5 inches. The additional pieces of steel that were inserted into the wheels measured 6 inches deep and a diameter of 17 inches.

When the tires were mounted and pressurized the modified wheels leaked at the new weld locations. The victim attempted to solve the problem at the incident site by using multiple 12-ounce cans of flammable aerosol tire sealant/inflator purchased at a local automobile parts store. This product was applied to the four tires but the wheels continued to leak. The victim started to mark the leaks along the welds by putting little "dings" in the rim wheels with a hammer at the leaking weld locations. The victim then ground away these sections of weld with a grinder to reveal the holes, and was attempting to seal the holes by welding. The development company

employees reportedly warned the victim several times about the flammable property of the aerosol tire sealant/inflator.

At the time of the incident, the skid-steer loader had a front-end loader attachment connected to it. The front-end loader attachment was positioned down against the ground to lift up the front two wheels of the loader for easier access. The victim was leaning into the right front wheel, which had a pressurized tire on it. He was wearing a welder's mask and gloves and was welding or beginning to weld when the explosion occurred. The tire was blown off the rim wheel and into the victim. The explosion propelled both the tire and victim approximately 15 feet in the air and threw the victim approximately 24 feet west of the loader and into a mailbox by the side of the road.

The employees of the development company and the residents of the new development came to the aid of the victim after they heard the explosion. The wife of the owner of the development company called for emergency assistance. The victim was transported to a local hospital where he was pronounced dead.

CAUSE OF DEATH

The medical examiner listed the cause of death as multiple injuries.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers including the self-employed should never weld or perform other hot work activities on a rim wheel.

Discussion: As stated in the OSHA regulation for single piece rim wheels 29 CFR 1910.177 (f)(7)(g) (11) "No heat shall be applied to a single piece wheel." (12) "Cracked, broken, bent, or otherwise damaged wheels shall not be reworked, welded, brazed, or otherwise heated."

Welding or other hot work should never be performed on rim wheels. Rim wheels manufactured for the use with a pressurized tire have typically gone through a heat treatment process. The heat treatment process for rim wheels would consist of heating and quenching the metal to increase its hardness. This process involves changing the crystalline structure of the metal. Once a heat-treated rim wheel is manufactured if it is reheated or altered using heat, as in this case, this would cause additional changes to the crystalline structure of the metal in the location where the heat was applied. These additional changes in the metal's crystalline structure could cause a structure failure point, weakening the wheel and making it unsafe to use.

Recommendation #2: Employers including the self-employed should only use nonflammable tire sealant/inflator for field repair of leaking rim wheels.

Discussion: The victim was using the tire sealant/inflator as a quick fix for the leaking rim wheels at the work site. In this case, use of this product would not solve his problem because tire sealant/inflators will not seal rims. When a flat tire occurs on a work site due to a leak in the tire itself, then a nonflammable tire sealant/inflator could be used as a quick fix. The tire should then be properly repaired the same day or as soon as possible as stated on the can of the tire sealant/inflator product. There are a few manufacturers that are producing tire sealant/inflator with both a less flammable and a non-flammable propellant.

Recommendation #3: Employers including the self-employed should develop a safety program that includes, but is not limited to, evaluating and preventing hazards that might exist before beginning a task.

Discussion: The victim, a self-employed welder, did not have a safety and health program at the time of the incident. A safety program for a self-employed welder could consist of a checklist of precautions to run through before the start of a task. When developing a safety and health program for a self-employed welder available literature on such things as products and chemicals should be read. Available literature could include, but not be limited to OSHA Regulations, MSDSs on products and chemicals, safety manuals for equipment, and manufacturer's directions supplied with products.

In this case, it was clearly stated by the manufacturer on the canister of the tire sealant/inflator that it would not seal a wheel rim leak and the product should not be used near an open flame or at temperatures over 120°F. The manufacturer also included with each canister a sticker that should be adhered to the tire, which the sealant/inflator was used in. The sticker read "Attention: User must alert repairmen that this tire contains a highly flammable gas." Also, the sticker reads "Warning: This tire contains a highly flammable gas. Avoid sparks and open flame. Use extreme caution when ventilating gas. Do not weld on rim or use tire reamer until tire is removed from rim."

In addition, a safety manual is available from Equipment Manufacturers Institute (EMI) for skid-steer loaders, which states several warnings taken directly out of OSHA regulation 29 CFR 1910.177 that if followed, could have prevented this incident. The manual states:

- never cut or weld on a rim wheels with an inflated tire mounted on it
- never inflate tires with flammable gases
- new or replacement tires and rim wheels should always be checked for proper size before mounting
- tire pressure should always be maintained to the specified tire pressure
- over inflating a tire is extremely dangerous
- adding air to a tire should be performed from a distance, typically from behind the tire tread and using a long hose with a self attaching chuck

If a safety and health program was developed and followed the victim could have recognized the potential hazards in the way he was going to complete the task. Once potential hazards are identified, the task should be altered to increase the safe being of the worker.

Recommendation #4: Manufacturers of tire sealant/inflator should consider only using nonflammable propellant for this product.

Discussion: The tire sealant/inflator propellant is what makes this product flammable. The propellant pressurizes the canister and gives the contents of the canister the momentum required to exit the canister and enter the tire during use. Replacing the flammable propellant with a non-flammable propellant eliminates the threat of harm to a wide variety of people who will come in contact with this product. This would include but not be limited to employees of the manufacturing plant, employees at the distributor, the consumer, and employees of maintenance facilities.

REFERENCES

Code of Federal Regulations, Labor 29 Part 1910.177 Servicing Multi-Piece and Single Piece Wheels.

Equipment Manufacturers Institute, Skid-Steer Loader, Chicago, Illinois, Revised 1989.

Figure 1. Skid-steer loader involved in the incident.

Figure 2. Rim wheel of the skid-steer loader after the explosion.