

MIFACE INVESTIGATION REPORT #16MI149

SUBJECT: Farmer Died When Clothing Was Entangled in a Rotating Power Take Off Shaft

Summary

A 54-year old female farmer was killed in the fall of 2016 when her clothing became entangled in the unguarded rotating power take off (PTO) shaft of a tractor she was using to power a corn elevator. She and the owner were using a PTO driveline to power a corn elevator, which in turn was used to transfer corn from a wagon into a corncrib. Once the elevator was running and the decedent had begun to unload the corn from the wagon onto the elevator, she suggested to the owner that he go harvest more corn while she continued by herself. About 20 minutes after the owner returned to the field to continue harvesting corn, the owner's brother discovered the body of the decedent. The decedent's clothing had become caught in the gear of the rotating power shaft where it connected to the corn elevator, leading to further entanglement of the decedent and extensive trauma. No part of the PTO driveline was guarded or shielded. Emergency response was called and the decedent was declared dead at the scene.



Figure 1: The PTO-driven corn elevator and corncrib.

MIFACE identified the following key and possibly contributing factors:

- The entire power take off driveline, including the PTO stub on the tractor, the shaft, and the point of connection to the corn elevator were all unguarded during operation.
- Best safety practices regarding PTO operation were not observed; clothing with loose sleeves should not be worn and a task should not be performed while standing near and/or stepping over a rotating PTO shaft.

RECOMMENDATIONS

- Cover the entire power take off driveline, including the PTO stub on the tractor, the shaft, and the point of connection with shield or guards in good working condition whenever they are being operated.

- Workers operating the tractor, and/or the equipment being powered by the PTO, should not wear loose-fitting clothing, clothing items or shoes with hanging strings, or dangling jewelry.
- Farmworkers, family, or anyone else working with farm machinery should be educated regarding PTO-related safety issues and best practices.

BACKGROUND

A 54-year old female farmer was killed in the fall of 2016 when her clothing became entangled in the unguarded rotating power take off (PTO) shaft of a tractor she was using to power a corn elevator. MIFACE researchers were made aware of the fatality through the MIOSHA 24-hour ASAP reporting system. MIFACE contacted the farm owner, who agreed to be interviewed by MIFACE researchers. During the writing of this report, the death certificate, medical examiner and police reports, and the MIOSHA compliance file were reviewed. The pictures in this report are courtesy of the farm owner, who allowed the MIFACE investigators to take pictures of the farm as well as a reenactment of the scene of the incident.

The farm owner had been running the farm for 37 years, while the decedent had been living and working there for 7 years. The farm was approximately 200 acres in size, and grew corn, wheat, and hay. It also included structures for the raising of a small herd of about 40 cattle and several pigs. In the fall, the owner and the decedent would harvest the corn and load it into a corncrib using a power take off-driven corn elevator, where they would dry it and then use it as feed for the livestock (Figure 1). This task took four to six weeks to complete every year, and the decedent had performed this work every fall since she had been at the farm and was very familiar with the tasks involved.

The owner stated that he had cautioned the decedent about the hazards associated with power take off shafts (as well as with tractors generally) while teaching her to do associated tasks around the farm. There was no formal safety program or training on the farm.

The farm had also employed a farm hand until a couple of years before the incident. At the time of the incident, the farm owner and decedent were the only two individuals working on the farm. The brother of the owner was also present elsewhere on the property on the day of the incident, setting up a blind to hunt for deer.

Remediation

Following the incident, the owner had a custom sheath made of PVC pipe constructed and installed around the power take off shaft connected to the corn elevator (where the owner left it, only having connected and disconnected the shaft at the tractor end). The sheath was held in place and fixed at the height of the PTO connection via both a wooden post planted into the ground at the tractor end and an attachment to the corn elevator itself at the other end (Figure 2).



Figure 2: PTO shaft sheath

MIOSHA Citations

There was no employee-employer relationship established; therefore, MIOSHA did not have jurisdiction to issue citations in response to this fatality.

INVESTIGATION

The decedent and owner had started harvesting corn the morning of the incident, and it was the first day of this process for the fall of 2016. The corn was loaded into a wagon. Once the wagon was full, the farm owner positioned its discharge door directly above the base of a 1970's Model 176 New Idea corn elevator using a John Deere 990 Compact Utility tractor.

The corn elevator, which transported the harvested corn into the corncrib, had been purchased in a used condition by the farm owner. The elevator was powered by the tractor's 58-inch power take off driveline. The farm owner backed the tractor and wagon so that the wagon was situated perpendicular to the end of the elevator, with the tractor facing south, the wagon to the



Figure 3: Recreation of incident scene and layout

north of the tractor, and the wagon's discharge door directly above the elevator to the west (Figure 3). To unload the corn, the farm owner and/or the decedent opened the wagon door, which was located on the side and center of the wagon. The wagon door was opened and closed through the rotating of a wheel via the pulling of a looped chain, which cranked the door open or closed along its tracks.

The PTO shaft, the elevator itself, and the tractor formed a small rectangular space with approximately 16 inches present between the shaft to the west and the wagon to the east. The PTO shaft, as well as the points of connection to both the tractor and the corn elevator, were unguarded. The owner stated that he was never in possession of guards for the shaft or the PTO stub on the tractor itself.

Once the PTO (rotating at 540 revolutions per minute) was connected to the elevator and powering its conveyor, the owner and the decedent began unloading the corn through the wagon door. The owner and the decedent then positioned themselves on the north side of the elevator facing the rear of the wagon, and began pushing corn out of the wagon with the help of a shovel-like instrument with a handle approximately 8 feet long.

At this time, the decedent suggested that the owner begin harvesting more corn while she finished unloading the wagon. After the owner expressed some trepidation at leaving the decedent, the decedent insisted that she could finish the task alone and the owner left to continue harvesting corn. The owner left her positioned on the north side of the elevator. At some point, the decedent repositioned herself to the south side of the elevator. It was unknown whether the decedent walked to the east around the wagon and tractor to get to the south side of the elevator, or walked under the elevator itself, although the latter was a more direct and likely route.

Approximately 20 minutes later, the owner's brother, who was using a deer blind located in a wooded part of the property, was walking back through the farm and discovered the decedent entangled in the PTO shaft on the south side of the elevator. He stopped the tractor and PTO and went to retrieve the owner, at which point they called emergency services on the way back to the location of the incident.

The weather on the day of the incident was sunny and without precipitation (nor had there been precipitation in the days prior to the incident). Police photographs do not suggest that the ground was muddy or slippery. However, the ground at the incident location was uneven and rutted, and several farm implements and tools were on the ground immediately around the elevator, any of which may have presented a trip hazard.

The farm owner suggested several plausible scenarios as to why the decedent may have moved from the north side to the south side of the corn elevator where the tractor and PTO shaft were located. These include:

- She had relocated to the other side to better retrieve the corn remaining in the wagon, as he estimated that the wagon was mostly empty at the time he returned to the location.
- She may have sought to retrieve corn from the ground around the base of the conveyor.

- She might have attempted to raise or lower the wagon door by pulling on the side of the loop of chain located nearest the PTO.

The owner said standing in this location, on the side of the elevator nearest the PTO, was not something they normally did during this task, owing to the recognized hazard of the PTO shaft and the much greater overall restriction compared to the space available on the side opposite the tractor.

It was difficult to tell from police photographs whether the decedent was originally within the small rectangular area bordered by the shaft, tractor, wagon, and elevator, or whether she was outside of it on the other side of the shaft when she first became entangled. The sleeves of the decedent's fleece sweatshirt and long-sleeved t-shirt that became caught in a gear located where the PTO shaft connected to the elevator. It is unclear whether the decedent had reached to steady or brace herself on the elevator while stepping over the shaft, or had reached instinctively to do the same after tripping somewhere in the area. Alternatively, the owner stated in the interview that the decedent had a condition that often caused her to lose her balance, become unsteady, and even fall, and that she had previously seen a neurologist to diagnose and treat this condition, but had not yet had success. The owner stated that she was not on any medication at the time of the incident.

CAUSE OF DEATH

The cause of death as listed by the medical examiner on the death certificate was multiple blunt force injuries. The decedent was found to have nicotine and caffeine in her blood; all other toxicological tests were negative.

RECOMMENDATIONS

- Cover the entire power take off driveline, including the PTO stub on the tractor, the shaft, and the point of connection with shield or guards in good working condition whenever they are being operated.

Each of the power take off driveline's components should be shielded and guarded during and between PTO operations. These include a PTO "master shield" for the PTO stub on the tractor itself, a shield for the full length of the PTO or implement input driveline shaft, and a shield for the input point on the equipment. Many older tractors and pieces of equipment either did not come with this type of shielding system (as in this incident), or may have had guards or shields that subsequently became broken or lost. Lost or broken shielding should be immediately replaced. There are many ways to retrofit older pieces of equipment with shielding systems. Shields and guards should be tested regularly to ensure they are not broken or malfunctioning.

Following this incident, the owner had an inexpensive shield designed for the PTO driveline shaft out of PVC piping (see Figure 1, above), propped up by (and bolted to, to prevent the shield itself from spinning) a wooden post on the end to be connected to the tractor PTO stub and an attachment to the corn elevator itself on the other end. Though this new shield provided protection from the PTO driveshaft, it still left the connection points to the tractor and elevator (Figure 4) mostly unguarded. Notably, since it appeared that the decedent's sleeves became caught at the point where the driveshaft connected to the elevator, making sure such connection points are fully shielded is important to preventing similar accidents from occurring in the future. MIFACE researchers mentioned to the farm owner that this connection point should also be shielded; he agreed and indicated he would do so. Additionally, the shaft on the base of the elevator on the south side was also not shielded. This was pointed out to the farm owner; he hadn't recognized the potential entanglement hazard and immediately indicated he would take care of the issue.



Figure 4: Unprotected PTO-elevator connection point with new PTO shaft shielding

- Workers operating the tractor, or the equipment being powered by the PTO, should not wear loose-fitting clothing, clothing items or shoes with hanging strings, or dangling jewelry.

A PTO rotating at 540 RPM can wrap up 7 feet of fabric in only 1 second. It is essential that farmers and their family members, coworkers, or employees not wear any loose or dangling clothing, strings, or jewelry that can get caught or wrapped up in any part of the PTO system when operating PTO-driven equipment. Work clothing should be well-fitting and zippered or buttoned, not open. Frayed or loose-fitting clothes, jackets, and sweatshirts with drawstrings and boots or shoes with long shoelaces should be avoided. Long hair should be secured under a hat with bands or clips. In this incident, it is presumed that the decedent's fleece sweatshirt and long-sleeved shirt had baggy enough sleeves or cuffs that they became caught in the rotation of the PTO without her touching any of the driveline components directly.

- Farmworkers, family, or anyone else working with farm machinery should be educated regarding PTO-related safety issues and best practices.

On farms where hazardous machinery, including PTO-driven equipment, are used, anyone that might operate the equipment or work on a task involving the equipment should be educated

regarding the hazards present and the controls and practices that best mitigate the associated risks. This includes the above points regarding PTO shielding and precautions about loose-fitting clothing. Everyone should be instructed to never operate an unshielded PTO, and to always disengage the PTO, shut off the tractor, and apply the parking brake before attempting any adjustments to the equipment or any other service, repair, or cleaning. It should also be emphasized how important it is to never step over or reach across or under a rotating PTO shaft, and that walking around the entirety of the PTO driveline is the only safe option. In this instance, the extraction of corn from the wagon while the PTO was running and powering the corn elevator should only be completed using a long-handled instrument or rake that allows the operator to stand away from the PTO, and any adjustments to the wagon or its door, or any attempts to recover corn that had fallen onto the ground, that require walking or reaching near the PTO should only be attempted with the tractor powered off and PTO stopped. Alternatively, equipment should be used that allows these tasks to be completed without approaching the running PTO (collecting corn off the ground using the same instrument used to extract the corn from the wagon, for example). It is possible that if these messages were delivered explicitly and repeatedly, the decedent may have decided not to attempt whichever part of her task required her to relocate to the area immediately adjacent to the PTO driveline.

KEY WORDS: Agriculture, Machine, Power Take Off, Tractor, Entanglement

RESOURCES

MIOSHA standards cited in this report may be found at and downloaded from the MIOSHA, Michigan Department of Licensing and Regulatory Affairs (LARA) website at: www.michigan.gov/mioshastandards. MIOSHA standards are available by writing to: Michigan Department of Licensing and Regulatory Affairs (LARA), MIOSHA Regulatory Services Section, Stevens T. Mason Building, 530 W. Allegan Street, Lansing, Michigan 48933, calling (517) 284-7740, or by FAX (517) 284-7735.

- [MIOSHA Agricultural Safety Standard, Part 53, Farm Field Equipment.](#)

More information regarding the hazards associated with PTOs and other rotating farm machinery, as well as a list of further resources, can be found in [this hazard alert](#) disseminated via the MIFACE program, as well as from the following resources:

- [Shield Yourself from PTO Dangers. National Ag Safety Database, Michigan State University Extension.](#)
- [Power Take-Off \(PTO Safety\). Penn State Extension.](#)

Other MIFACE investigations involving similar fatalities:

- [Farm Youth Died When He Became Entangled in an Unguarded PTO Shaft](#)

- [Farm Laborer Killed When He Became Entangled in an Unguarded PTO Shaft.](#)

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