MIFACE INVESTIGATION REPORT: #07MI122

Subject: Farmer Killed When He Became Entangled in Implement Drive Line/Posthole Auger

Summary

On October 13, 2007, a 56-year-old male farmer was killed when he became entangled in a posthole auger connection to the arm of the tractor attachment on his equine operation. The decedent and his spouse had been setting fence posts for a new area for their horses. The spouse left the decedent to look for their grandchild. As she was returning to the work area, she heard her husband cry out. She ran to the tractor and found him entangled in the auger. She stopped the tractor and attempted to untangle him, but was unable to do so. She attempted to call 911 using her cell phone. Unable to get a signal, she ran to their home and used the landline to call for emergency response. Returning to her husband, she found him not breathing. Emergency response arrived, and he was declared dead at the scene.

Figure 1. Tractor, posthole auger, and raised bucket arms supporting fencepost. Decedent's wrapped position around PTO shaft outlined in black

RECOMMENDATIONS

- Posthole auger drive elements should be guarded with all shielding in place and functional.
- Operators, and others, should stay clear when the posthole digger is in operation.
- Do not wear loose fitting, frayed, or clothing that dangles when working near operating machines and equipment.
- Isolate animals from the work area.
- Stop working if medical conditions potentially endanger the individual or coworkers.
- Work areas should be clear of slip, trip, and fall hazards.
- Prior to performing any excavation work, including digging postholes, MISS DIG (Michigan: 1-800-292-8989) should be contacted to identify the location of utilities in the area

- Map, measure and post in several locations, all farm-owned underground water and electric lines for future reference.
- Consider other options to perform the work, such as a power posthole driver.

INTRODUCTION

On October 13, 2007, a 55-year-old male who operated an equine facility was killed when he became entangled in a posthole auger. MIFACE became aware of this death via a newspaper clipping. On May 6, 2008, MIFACE researchers interviewed the decedent's wife at the horse farm. MIFACE was permitted to take pictures of the auger involved in the incident. In the course of writing this report, the death certificate, medical examiners report and police report were reviewed. Figures 1, 2 and 3 were taken by the responding police department. MIFACE has modified Figure 1 to maintain confidentiality. Figure 4 was taken by the MIFACE researchers at the time of the site visit.

The decedent's wife indicated that the decedent, prior to their moving to this location, had worked at another job full-time and also raised racing horses. After the decedent retired from his job, the couple sold the horse farm/house and moved to their present location. For additional retirement income, they planned to continue breeding and raising race horses as well as boarding horses. They had been at this location for five months.

INVESTIGATION

The tractor being used to power the posthole auger was a 4-wheel drive, Kubota L 2350. It was equipped with a front bucket, that was used to transport the fence posts and a power take off (PTO) shaft at the rear of the tractor. The PTO system had some, but not all of the recommended guards. Guarding consisted of a PTO master shield for the tractor PTO stub and an auger input shaft shield on the implement (Figure 2). The responding police agency stated in the police report that a safety guard that is used to cover the power take off shaft *(i.e. implement input driveline (IID) MIFACE clarification)* appeared to be missing.

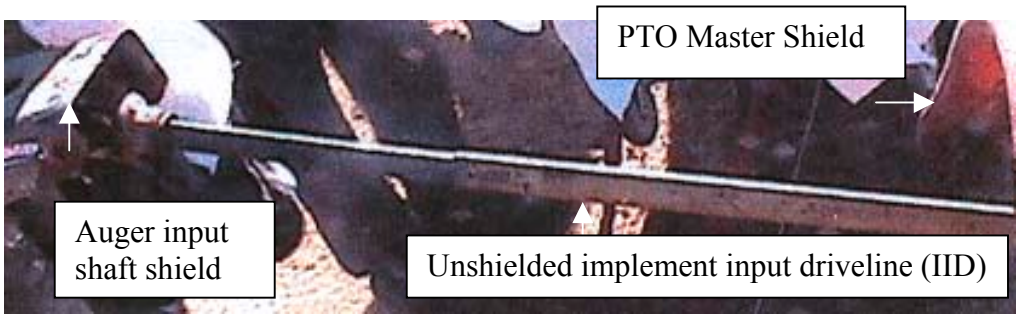


Figure 2. PTO System involved in incident

The decedent and his wife were working together to install fence posts on the west side of the barn to provide a closed off space for breeding. They began working at 10:00 a.m.

The air temperature was in the mid 30's, so they both wore coats. The coats had hoods with drawstrings and could be zipped. The decedent warned his wife to be careful and watch out so that the hood's drawstrings would not become entangled in the machinery.

There had been very little rain (approximately 0.10 inches) in the two weeks preceding the incident. Thus both the topsoil and subsoil moisture levels could be considered low or very low. Drier soil makes it more difficult for the auger to pull itself into the ground. In softer, wetter soil, the auger would pull itself deeper into the ground without additional downward pressure.

The length of the shear pin used to connect that auger to the output shaft of the gearbox was unknown. A pin that is too long or has protrusions could snag clothing and with the absence of guarding, the potential for an entanglement in this area of the posthole auger increases.

While the decedent and his wife were lying out and installing the fence posts, at least one of the horses stayed in the work area. While the decedent laid string and spotted the location of the auger, the decedent's wife sat in the tractor seat operating the tractor. The decedent's wife indicated that the horse would periodically come over to the work area and nudge the decedent with its head. The decedent kept "shooing" the horse away.

The decedent's wife indicated that the decedent had been having medical issues that day. His spouse indicated he was having "trouble with his legs." His legs were weak. They had buckled a few times and he had to catch himself on the tractor to avoid falling to the ground. He also needed assistance to get up from the ground.

The incident occurred at approximately 2:30 p.m., at which time the temperature was in the low 40s and wind gust ranged from 7 mph to 14 mph.

Previously, their grandson went across the street to play with some friends. The decedent's wife left the work area to go check on their grandson. The fatal incident event was unwitnessed. As she was returning to the work area, she heard her husband call out. She ran to the tractor and saw her husband wrapped around the implement driveline (Figure 1). She stopped the tractor and attempted to untangle him. She could not. She tried to call 911 on her cell phone, but did not have a clear signal. She ran to the house and called for emergency response on the telephone landline.

Figure 3. Auger gearbox/driveline where decedent's hood drawstring became entangled

His wife indicated that when emergency response personnel untangled him from the auger PTO shaft, she noted that the drawstring had become entangled in the gearbox area. It is unknown how the decedent

became entangled on the driveline. Several possible event scenarios have been developed: (a) the horse unexpectedly nudged him and he was pushed into the driveline/auger area, (b) he was using his body weight to hold down the implement support bar from the 3-point hitch and the drawstring became entangled, (c) his legs buckled as he was standing near the operating auger and he instinctively reached toward the unit to prevent a fall, or (d) he may have tripped over the nearby fence post, causing him to fall toward the operating equipment.

Emergency response arrived shortly after her phone call, and the decedent was declared dead at the scene. Responding police found a fence post laid across the tractor's bucket, which was in an elevated position. A post was also located nearby on the ground.

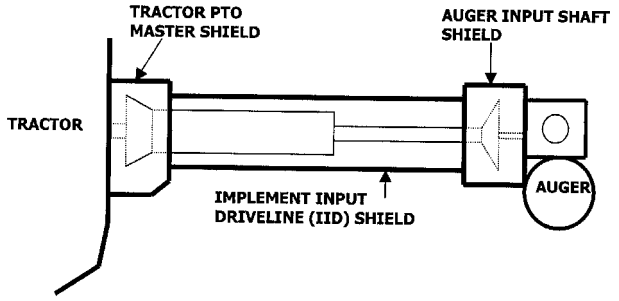
CAUSE OF DEATH

The cause of death as stated on the death certificate was asphyxia. Toxicology analyses were negative for alcohol and illicit drugs.

RECOMMENDATIONS/DISCUSSION

- Posthole auger drive elements should be guarded with all shielding in place and functional.

A tractor-powered posthole auger is a relatively inexpensive and common implement for digging holes for fence posts. It is attached to the three-point hitch of a tractor, which raises and lowers the auger. The digger's auger is powered from the tractor's power take-off (PTO) through a PTO shaft and a right angle gearbox.



Drawing 1. Recommended PTO System Shielding

PTO system shielding comprises three major areas: PTO stub shaft (tractor), implement input shaft shield (auger, in this incident) and implement input driveline (IID) shielding (Drawing 1). Contact with any moving machinery parts such as the auger, couplings, or driveline can lead to an entanglement, especially if guarding is missing, out of position, or not properly maintained. In this incident, it appears that there was no guarding around the implement input driveline, which may have contributed to this incident.

The decedent's wife stated that after the death of her husband another family member had removed the auger input shaft shielding so that the wife would not have to see the aftermath of the incident. The PTO master shield was in place and the implement input driveline shield (Figure 4) was not present at the time of the MIFACE site visit.

- Operators, and others, should stay clear when the posthole digger is in operation.

Operators, other workers, and bystanders may be tempted to get near the auger while it is running to perform a work activity. Operators may work in close proximity to the auger, such as when they apply downward pressure to assist the auger in penetrating hard ground or when clearing dirt from around the auger. Operators in particular could lose their balance or otherwise come in contact with the moving machinery.

To prevent entanglement, the PTO must be disengaged and the auger stopped before anyone approaches a posthole digger while it is in operation. Although the decedent had used the auger in the past, he did not disengage drive elements and shutoff the tractor's engine before leaving the operator's station. Tractor operator's manuals recommend disengaging power to machines, lowering suspended implements to their resting position, engaging parking brake and/or engaging the transmission's park position, and shutting off the tractor's engine before leaving the operator's station. While this recommendation may be less convenient for an operator in some task situations, such as positioning the auger or clearing dirt from around the rim of a posthole, it is effective in preventing entanglements in moving machinery parts because they are stopped when the operator approaches them.

- Do not wear loose fitting, frayed, or clothing that dangles when working near operating machines and equipment.

This recommendation is a general safe work practice that should always be followed by operators of equipment and machines where the risk of entanglement exists. The risk of entanglement in rotating shafts and machine components can be reduced if operators do not wear:

- Loose fitting, frayed clothing, including jackets and sweatshirts. *Work clothing should be well fitting and zippered or buttoned, not open.*
- Clothing that dangles, such as jewelry, scarves, jackets with drawstrings, and boots or shoes with long shoelaces.

Long hair and braids can also pose hazards when working around rotating shafts.

PTO stub shafts usually rotate at either 540 rpm or 1000 rpm. At 540 rpm, the shaft can pull in approximately 7 feet per second. As shown in Table 1, average human reaction time is ¾ (0.75) second. In that amount of time, a person can be wrapped around the shaft.

Table 1. Common entanglement hazards

Equipment	Average speed (feet/second)	What happens before you can react?* (feet)
PTO	7.0	5.25
Auger	10.0	7.5
Cornhead	12.0	9.0
Belt/Pulley	66.0	49.5
Rotary Lawnmower	52.0**	39.0**
Falling equipment	32.0***	9.0***

* This is the number of feet that can be entangled in the equipment during the average reaction time of .75 second.
** A lawnmower blade makes 52 rotations every second. By the time you can react, a single blade will have gone around 39 times.
*** Gravity moves falling objects at 32 feet/second/second. For example, equipment 9 feet in the air hits the ground in .75 second.
NOTE: This chart is based on estimated values. Conditions vary that can increase or decrease the values shown in chart.

Reference: Schwab et al. *Recognize Limitations to Avoid Injury*

- Isolate animals from the work area.

Animals roaming in the area of the auger provided an additional distraction to the decedent as he attempted to lay the string to mark posthole locations and as he was positioning the auger. To ensure safety of both the animal and human, animals should be moved to another area or restricted from the work area.

- Stop working if medical conditions potentially endanger the individual or coworkers.

The decedent, although having weakness in his legs causing a loss of balance and inability to get upright from sitting on the ground without help, continued to work around the operating machinery. His medical condition that day may have played a role in this fatality. If his legs buckled from under him, he may have grabbed as a support, the rotating PTO shaft or augur support arm as he fell. The weakness in his legs may also have not allowed him to withstand a nudge from the horse still in the pen. Even if his wife had been sitting on the tractor seat, her reaction time would not have been fast enough to keep him from becoming entangled around the implement drive train/auger.

Self-employed individuals performing hazardous work should make an honest assessment each day to determine if they are physically able to perform the work and seek medical evaluation before attempting such work.

- Work areas should be clear of slip, trip, and fall hazards.

The presence of the fence post on the ground near the auger introduced potential additional risks in the work environment. Its presence may have introduced a tripping hazard for the decedent, either while he was approaching the rotating auger or if he was nudged by the horse toward the fencepost in the direction of the tractor. To minimize the tripping hazard risks, work areas should be kept clear of slip, trip, and fall hazards.

- Prior to performing any excavation/digging work, including digging postholes, MISS DIG (Michigan: 1-800-292-8989) should be contacted to identify the location of utilities in the area.

Utilities to the private residence and barn location may have been located underground. Although the presence of utilities did not contribute to the fatality, they do present a potential hazard when digging postholes. Although underground utilities may initially be buried several feet below ground, over time, the pipelines, electrical lines, phone lines, etc. may result in being closer to the surface.

Farmers should call MISS DIG to identify all utility company underground utilities in the area where work is to be performed before beginning any excavation work, including digging postholes.

- Map, measure and post in several locations, all farm-owned underground water and electric lines for future reference.

Private/owner placed underground utilities, such as underground water and electric lines need a measured map to building and known witness reference points for future locating efforts when excavation/digging activities take place.

- Consider other options to perform the work, such as a power post driver.

Posthole augers are rotating pieces of machinery and pose entanglement risks (Figure 4). Although commonly used, their hazards need to be recognized.

There are several equipment options for an individual who would like to be able to dig a posthole. Hydraulic post drivers can be attached to a tractor or attached to another power source to "pound" the post into the ground. As with any piece of equipment, the manufacturers' instructions should be followed to avoid injury when in use. There are also powered one-man posthole augers that are contained in one unit.

Figure 4. Auger and unprotected IID in barn

REFERENCES

- MIFACE Investigation Report: #06MI004 - 29-Year-Old Male Hispanic Landscape Laborer Dies When Nine Foot Deep Trench Collapses. http://www.oem.msu.edu/MiFace/Investigation%20Report%2006MI004.pdf
- Iowa FACE Case Report #05IA075 – Farmer Fatally Injured in Tractor Posthole Auger Entanglement. http://www.cdc.gov/niosh/face/stateface/ia/05ia075.html
- Minnesota FACE Investigation #02MN049 – Farmer Dies After Becoming Entangled in Silo Unloading Auger. http://www.cdc.gov/niosh/face/stateface/mn/02mn049.html
- National Agricultural Safety Database. http://www.cdc.gov/nasd/
- Schwab C., Shouse S. and Miller, L. *Recognize Limitations to Avoid Injury*. Fact Sheet Pm-1563j. Iowa State University, University Extension. December 1994. http://www.cdc.gov/nasd/docs/d001001-d001100/d001079/d001079.html
- Farm and Ranch Safety Management, Fourth Edition. Deere & Company, Moline IL.
- Portable Auger Safety Manual. Farm and Industrial Equipment Institute. 410 N. Michigan Ave, Chicago IL 60611

Key Words: Tractor, Entanglement, Posthole Auger

MIFACE
Investigation Report #07 MI 122
Evaluation

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

Please rate the report using a scale of:	**Excellent**	**Good**	**Fair**	**Poor**
	1	2	3	4

What was your general impression of this MIFACE investigation report?

Excellent	**Good**	**Fair**	**Poor**
1	2	3	4

Was the report…	**Excellent**	**Good**	**Fair**	**Poor**
Objective?	1	2	3	4
Clearly written?	1	2	3	4
Useful?	1	2	3	4

Were the recommendations …	**Excellent**	**Good**	**Fair**	**Poor**
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)

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

Thank You!

Please Return To:

MIFACE
Michigan State University
117 West Fee Hall
East Lansing, MI 48824
FAX: 517-432-3606

Comments:

_____

_____