

REPORT#: 15MI104

REPORT DATE: 1-16-19

INCIDENT HIGHLIGHTS



DATE:
Fall 2015



TIME:
2:00 p.m.



VICTIM:
Land caretaker in his 60s



INDUSTRY/NAICS CODE:
Real Estate & Rental &
Leasing/53



EMPLOYER:
Self-employed



SAFETY & TRAINING:
None



SCENE:
Wooded area



LOCATION:
Michigan



EVENT TYPE:
Machine

Caretaker of a Farm Held in Trust Died Due to a Tractor Overturn to the Rear While Moving Downed Tree

SUMMARY

In fall 2015 a male caretaker in his 60s of a farm held in trust died when he was pinned under an overturned, non-rollover protection structure (ROPS) equipped tractor. The property's woods had been logged; the logging firm took the saleable wood and left the tops of the trees. The decedent and a family member were planning to haul the tree tops from the logged area, but discovered an unharvested 16-inch diameter, 90-foot long tree had fallen. The decedent used a chain, looping one end on the 3-point top link pin just below his seat and the other end around the fallen tree. The tractor moved forward approximately two to three feet when it overturned to the rear... [READ THE FULL REPORT>](#) (p.3)

CONTRIBUTING FACTORS

Key contributing factors identified in this investigation include:

- Tractor did not have a ROPS and seatbelt.
- Decedent hitched the load high rather than low on the tractor
- Tree stump may have been partially hidden under brush. [LEARN MORE>](#) (p.6)

RECOMMENDATIONS

MIFACE investigators concluded that, to help prevent similar occurrences, employers should:

- Ensure older tractors are retrofitted with a manufacturer approved, certified, tractor specific rollover protection structure (ROPS) and seat belt.
- Ensure proper hitching techniques are utilized when using the tractor to pull loads..... [LEARN MORE>](#) (p.6)

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State **FACE** Program

Fatality Assessment & Control Evaluation

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Michigan Fatality Assessment and Control Evaluation (FACE) Program

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SUMMARY

In fall 2015 a male caretaker in his 60s of a farm held in trust died when he was pinned under an overturned, non-rollover protection structure (ROPS) equipped tractor. The property's woods had been logged; the logging firm took the saleable wood and left the tops of the trees. The decedent and a family member were planning to haul the tree tops from the logged area, but discovered an unharvested 16-inch diameter, 90-foot long tree had fallen. The decedent used a chain, looped one end on the 3-point top link pin just below his seat and the other end around the fallen tree. A tree stump was in the path of tractor movement. The sequence of events leading to the overturn is unknown. As the decedent drove the tractor forward, the tractor overturned to the rear, pinning him under the tractor. His family member was unsuccessful lifting the tractor from him and called for emergency response. The decedent was declared dead at the scene.

INTRODUCTION

In fall 2015, a male caretaker in his 60s died when his tractor overturned to the rear. MIFACE personnel contacted one of the decedent's family members, who placed MIFACE personnel in contact with another family member who was working with the decedent at the time of the incident. This family member agreed to an interview at the former home of the decedent. The family member took the MIFACE personnel to the location of the tractor involved in the incident. MIFACE reviewed the death certificate, medical examiner and police reports during the writing of this report. Pictures used in the report are courtesy of the responding police department and those taken at the time of the MIFACE site visit.

EMPLOYERS

The decedent was the caretaker for a 120-acre trust farm that, in the past, was an old dairy farm. Approximately three to four years ago, the decedent moved into the old farmhouse to take care of the property. The family member



Photo 1. Overview of incident scene

was unsure of exactly when, but knew that it was in the recent past, that the decedent contracted with a logging firm to clear trees and conduct the logging activity. The logging firm hauled the saleable logs away, but left all of the tree tops in the areas. The decedent and his family member were in the process of moving the tree tops left by the logging firm to permit sight lines for deer hunting. The tractor was owned by the trust and the decedent used it to perform various caretaking responsibilities.

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WRITTEN SAFETY PROGRAMS and TRAINING

Although a written health and safety program was not required by MIOSHA since there were no employees, having a written health and safety plan can help prevent work-related injuries and deaths. The family member did not know if the decedent had ever attended any meetings which included safety and health topics or if the family member had an operator's manual for the tractor.

WORKER INFORMATION

The decedent was working with his family member. The decedent was operating a Ford 3000 tractor while the family member was operating a 1970s-1980s SATOH BISON S-650G equipped with a blade in both front and back (See Photo 1 depicting incident scene) to push the smaller tree tops toward the grass pasture/edge of the woods.

INCIDENT SCENE

The decedent and family member were in a wooded area behind a grassy field. There were many logged tree tops from previously cut trees in the area. In the area that had been previously logged, another tree had fallen.

The tree stumps were not cut down to ground level (Photo 2). The woods had uneven terrain and there was a slight incline. There was understory plant material covering the ground and the stumps. The ground was dry.

The decedent was using a refurbished two-wheel drive, 1960s-era Ford 3000 tractor. The tractor did not have a rollover protection structure/seatbelt, a PTO master shield and stub shield, or a drawbar (Photo 3).

The tractor had an improperly displayed, non-permanently affixed slow moving vehicle (SMV) sign on the rear of the tractor; the SMV sign was wedged in an upside-down position in a metal compartment behind the tractor seat. Police photographs taken at the incident scene (Photo 5) show the SMV in the same position as in Photo 3 taken by the MIFACE researcher. It is unknown if the decedent drove the tractor on a public roadway. The family member did not know if the tractor had mechanical issues, such as the condition of the clutch or brakes. No maintenance records were made available to the MIFACE researchers.



Photo 2. Stump by tractor wheels



Photo 3. Placement of SMV sign behind tractor seat and no drawbar

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WEATHER

On the day of the incident, there were fair skies, with east-northeast winds at 16 mph, gusting to 22 mph. The temperature was 58°F. [[Weather Underground](#)].

INVESTIGATION

After lunch, the decedent and his family member drove the equipment to the area where the logging had previously taken place. After the logging activity had taken place, another tree had fallen, and the decedent wanted to haul the approximately 16-inch diameter, 90-foot long tree (Photos 4, 6) out of the woods prior to removing the tree tops. The decedent wrapped a chain around the trunk of the tree and around the 3-point top link pin at seat height, located approximately 33 inches above the ground.

The family member, who had a chain saw, asked the decedent “to let him cut the tree into smaller pieces”. The decedent declined. Although the family member was in the incident area, the family member did not witness the sequence of events leading up to the overturn.

The decedent drove the tractor forward approximately two to three feet. The tractor overturned to the rear, pinning the decedent under the tractor.

In the path of the tractor, near the front passenger side wheel was a tree stump partially hidden by undergrowth.

Several incident scenarios are possible: 1) The passenger side front tire of the tractor contacted a portion of the tree stump located in the path of the tractor. When the tire began to drive up on the stump the angle of pull was altered, thus moving the tractor’s center of gravity outside the rear stability baseline and the tractor overturned to the rear; and/or 2) The tree became entangled in the tree tops left by the logging firm, causing a greater resistance to the tractor. The load placed increased pressure of the rear tires against the ground. The rear wheels may not have rotated smoothly, and the torque applied by the axle caused the tractor chassis to rotate around the axle; and/or 3) The decedent may have attempted to drive forward too fast or in a higher gear and or did not properly time the clutch and brake release, causing the tractor to lunge forward, and due to the weight and resistance of the tree, caused the tractor to rotate on the axle and overturn. Each of these scenarios have one common factor contributing to the overturn: the improper hitching height (high vs. drawbar level).

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Photo 4. Overview of tree and chain placement on tree



Photo 5. Location of chain on tractor and SMV sign placement/orientation at time of incident

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The family member ran to the tractor and turned it off. The decedent was pinned against the ground in a sitting position. The steering wheel had struck the decedent's head. The family member was unable to lift the tractor from the decedent. The family member called for emergency response, who arrived approximately six minutes later. The decedent was declared dead at the scene.

CAUSE OF DEATH

The death certificate listed the cause of death as traumatic asphyxia due to or as a consequence of a motor vehicle accident. No autopsy was performed by the medical examiner. Post-mortem toxicology was negative for alcohol and drugs.



Photo 6. Location of chain on tree

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 following unrecognized hazards were identified as key contributing factors in this incident:

- The tractor did not have a rollover protection structure (ROPS) and seatbelt.
- The decedent hitched the load high rather than low on the tractor
- The tree stump may have been partially hidden under brush
- The weight and configuration of tree being moved.
- The uneven ground and the obstructed view due to brush in area.
- Possible tractor operation, eg starting tractor too fast, incorrect gear, clutch and brake timing

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Tractor owners should ensure older tractors are retrofitted with a manufacturer approved, certified, tractor specific rollover protection structure (ROPS) and seat belt.

Discussion: Rollovers occur when the tractor's center of gravity (CG) moves outside of the tractor's stability baseline. A rollover protection structure (ROPS) and seat belt do not prevent a tractor rollover but are effective in preventing death and serious injury in the event of a tractor overturn to help to keep the operator.

A tractor's CG is the point where all parts balance one another. Typically, for a two-wheel drive tractor sitting with all wheels on level ground, the CG is about 10 inches (25.4 cm) above and two feet (0.6 m) in front of the rear axle when looking from back to front, and in the center of the tractor body when looking left to right (Figure 1). Note that when adding weights to a tractor, the added weights can affect the CG.

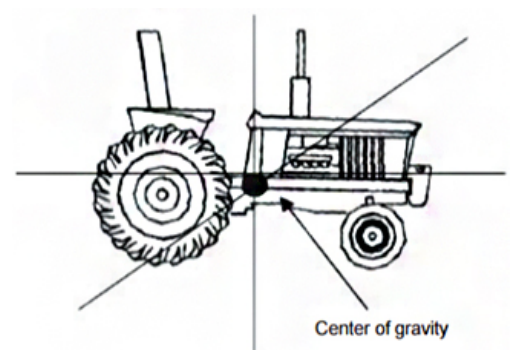


Figure 1. Location of center of gravity on two-wheel drive tractor

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The tractor stability baseline is determined when the tractor is sitting on level ground and is defined as the area within the points where the tractor’s wheels contact the ground (Figure 2). The base of stability depends upon the front and rear wheel spacing and the axle-to-axle spacing. To determine the tractor stability baseline, draw imaginary lines to connect all the wheels of the tractor. During tractor operation, the CG moves around. If the CG stays inside the stability baseline, the tractor will not overturn.

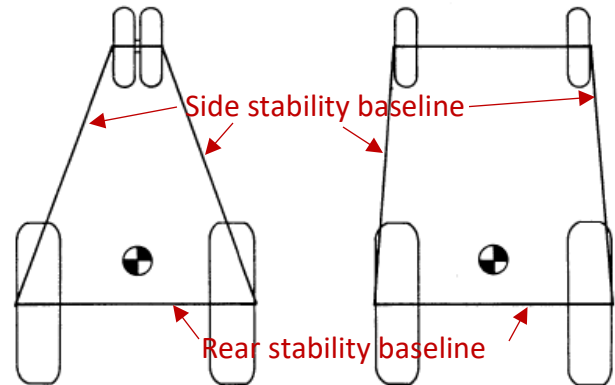


Figure 2. Rear and side stability baselines for narrow front and wide front tractors

When the CG moves outside of the stability baseline, the tractor overturns (Figure 3). In this incident, there were several possible reasons why the decedent’s tractor’s CG moved outside the stability baseline:

- The load was hitched high (not hitched to the drawbar).
- The tree may have had limbs embedded in the ground, hooked on a stump or other object, or even the vines were holding the fallen tree in place.
- Power was applied to the tractor’s rear wheels too quickly.
- The front passenger side wheel was not on level ground.

An overturn to the rear may also be caused by rear axle torque. Rear-axle torque relates to the energy transfer between the tractor’s engine and the rear axle of two-wheel drive tractors. When the operator engages the clutch, the result is a twisting force, called torque, to the rear axle. This torque is then transferred to the tractor tires. Under normal circumstances the rear axle (and tires) should rotate and the tractor will move ahead. However, if the rear axle is unable to move in response to the torque, the tractor chassis rotates about the axle. The energy transfer between the engine and the rear axle can result in the front-end of the tractor lifting off the ground until the tractor’s center of gravity passes the rear stability line. Once the center of gravity passes this point, the tractor continues rearward until it comes in contact with the ground.

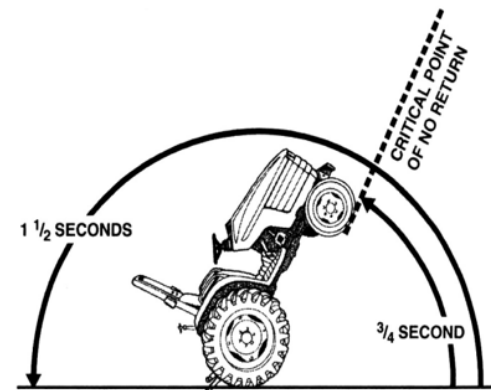


Figure 3. Critical point of no return for tractor overturn to the rear

A tractor may only have to raise up to about 75 degrees from a level surface before its CG passes the rear stability baseline and the tractor weight causes the tractor to continue to overturn to the rear. This position is commonly called the “point of no return.” This point can be reached more quickly than an operator can recognize the problem.

Research shows that rollover protective structures (ROPS), when used in combination with a seatbelt, are 98 percent effective in preventing death and serious injury in the event of a tractor overturn to the rear or side. To maintain the operator safety, tractor operators should ensure that all of their tractors are equipped with a tractor-specific ROPS and seatbelt certified or approved by the manufacturer. To maintain the zone of protection provided by the ROPS, the seatbelt must be used.

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The decedent was using an older model tractor manufactured prior to 1976. Tractors manufactured prior to 1976 did not come equipped with a ROPS by default; A ROPS could be ordered separately. To assist farmers in finding a ROPS for these older tractors, the University of Kentucky Extension program developed the Kentucky ROPS Guide, which can be used by any US or Canadian farmer to locate retrofit ROPS for older tractors or even “gray market” tractors (i.e., non-U.S. made tractors imported without manufacturer authorization). The guide is available online at <http://www.ca.uky.edu/rops>.

Recommendation #2: Ensure proper hitching techniques are utilized when using the tractor to pull loads.

Discussion: The decedent’s tractor did not have a drawbar. Drawbars are standard equipment and needed for most activities. However, the decedent’s type of tractor was regularly used with 3-point equipment and many of these types of equipment, e.g. mowers, required the drawbar to be removed. It is unknown if the decedent was aware of the increased risk of the tractor overturn to the rear when he:

- did not fit the tractor with an approved drawbar to pull the tree/tree tops to another location, and
- attached the pulling chain above drawbar height.

The decedent was using a two-wheel drive tractor to pull the tree. The decedent’s tractor’s rear tires were pushing against the ground while the tree, resting on the ground, was pulling back and down against the forward movement of the tractor. This backward and downward pull results in the rear axle becoming a pivot point, with the load acting as a force trying to tip the tractor rearward. An “angle of pull” is created between the ground’s surface and the point of attachment on the tractor. The heavier the load, and the higher the “angle of pull”, the more leverage the load has to tip the tractor rearward.

A tractor, including its drawbar, is designed to safely counteract the rearward tipping action of pulled loads. When loads are attached to a tractor at the drawbar, if the front end of the tractor lifts, the rear drawbar will lower, as the drawbar lowers, the angle of pull and the leverage the load has to tip a tractor rearward is also lowered.

If the load is hitched to a point higher than the drawbar, both the “angle of pull” and the leverage of a load is increased. As the tractor tips rearward, the angle of pull and load leverage are not lowered, the tractor continues to tip and the tractor’s CG reaches the rear stability baseline, and the tractor flips rearward. A higher hitch point also increases the pressure of the rear tires against the ground. If the rear tires don’t slip, rear axle torque will begin lifting the front end.

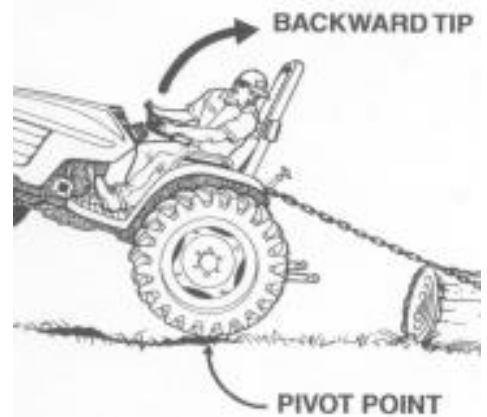


Figure 4. Angle of pull and leverage of load

The decedent hitched high, near seat height, which increased the angle of pull, the leverage of the tree being pulled, and the pressure of the rear tires against the ground. When loads are attached to a tractor at any point other than its designed location (drawbar or other hitch points recommended by the tractor manufacturer), the design of the tractor for pulling loads is defeated.

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Recommendation #3: Evaluate the terrain prior to beginning an operation with a tractor and ensure the working area is clear of obstructions and/or mark hazards for visibility.

Discussion: In the area of the woods where the decedent was working there was uneven terrain, a slight incline, and undergrowth which may have obscured ground hazards. It is unknown to what extent the decedent evaluated the work area for hazards. Police photographs (Photos 1,7) taken at the scene show he did not mark the location of the stump or clear out the area prior to hauling the large tree. MIFACE recommends that prior to operation of equipment that the work area is inspected, and hazards are identified, marked, or, to the extent possible, remediated.

Recommendation #4: When starting a tractor, especially when pulling a load, use tractor model-appropriate start-up procedures.

Discussion: The family member indicated that the tractor moved two to three feet forward, and then overturned to the rear. One possible scenario contributing to the overturn was the way in which the decedent started the tractor's forward movement when he began pulling the large tree. The family member did not know and the responding police did not specify the tractor gear the decedent was using to begin the pull. It is unknown if the brakes were "sticking", which could have contributed to the tractor's front end lifting off the ground, as the brakes would interfere with the transfer of energy of the axle rotation to the tires. Also unknown is whether the decedent disengaged the clutch pedal slowly and smoothly and simultaneously released the brake pedal, which would have started the tractor's forward motion slowly.



Photo 7. View of incident area, undergrowth, obstructions in path of tractor movement

Proper tractor starting procedures include: Start the engine with the brake and clutch fully depressed (ensures the transmission is disengaged). Depending upon the tractor make and model, place the tractor in "park" or in a neutral-start position. With the engine running, select a low starting gear, increase engine speed slightly, slowly let out the clutch pedal until the tractor begins to move, and then slowly let off the brake pedal at the same time.

Generally, when pulling a load, the operator should slowly take the "slack" out of the drawing mechanism and face forward before beginning movement. When starting a forward motion, ALWAYS begin moving slowly. Revving the engine and quickly releasing the clutch is one of the main ways that can cause a tractor to flip backwards. Looking back increases the likelihood of sudden movements that can cause overturns.

Recommendation #5: Ensure all tractor guards and safety features are correctly installed.

Discussion: Although not a factor in this incident, the decedent placed himself at risk when he operated the tractor without the PTO master shield and stub shield. Tractor operators should ensure that PTO shields are intact before use. Additionally, although unknown if the tractor was driven on a public roadway, the installation/configuration of the SMV sign did not comply with transportation signage requirements. Tractor owners should ensure that SMV signs are properly installed on equipment driven on a public roadway.

ADDITIONAL RESOURCES

- University of Kentucky College of Agriculture, Food, and Environment. *Kentucky ROPS Guide*.
http://rops.ca.uky.edu/?utm_medium=301&utm_source=www
- Preventing tractor overturn incidents. (2013). Farm and Ranch eXtension in Safety and Health (FReSH) Community of Practice. Retrieved from <http://www.extension.org/pages/68324/preventing-tractor-overturn-incidents>.
- State of New York, Department of Health. Fatality Assessment and Control Evaluation Program. Case Report: 02NY023 - *Part-Time Farm Worker Dies During Tractor Overturn*.
<https://www.health.ny.gov/environmental/investigations/face/docs/02ny023.pdf>
- Canadian Centre for Occupational Health and Safety. OSH Answers Fact Sheets: *Tractors – Roll-over Prevention*.
https://www.ccohs.ca/oshanswers/safety_haz/tractors/rollover.html
- Penn State Extension. *Tractor Stability and Instability*. <https://extension.psu.edu/tractor-stability-and-instability>
- National Ag Safety Database. *Safe Tractor Operation: Rollover prevention*
<http://nasdonline.org/7319/d002523/safe-tractor-operation-rollover-prevention.html>
- National Tractor Club. NTC Manual Library.
<http://www.ntractorclub.com/forums/manuals/manuals.htm#tractors>
- National Institute for Occupational Safety and Health. *NIOSH Warns: Improper Hitching to Tractors Can Be Fatal*.
<https://www.cdc.gov/niosh/updates/tractor1.html>
- The Ohio State University. *Agricultural Tractor Operator Training*. CFAES Safety & Health Coordinator–Kent McGuire, OSU Ag Safety and Health Content Review by D. Mann, OSU Ag Safety and Health Date: 5/22/2014

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ACKNOWLEDGEMENT

The Michigan FACE Program would like to acknowledge the decedent's family member for providing assistance and information for this investigation.