THE UNIVERSITY OF IOWA

COLLEGE OF PUBLIC HEALTH
Department of Occupational and Environmental Health

TO: Director, National Institute for Occupational Safety and Health

FROM: Iowa FACE Program **Case No. 3IA35** **Report Date: March 9, 2004**

SUBJECT: Tractor Operator Run Over and Killed While Making Repairs

SUMMARY

During the summer of 2003, a 69-year-old worker was run over while making repairs to a tractor. He worked part-time as a handyman for a land developer, and routinely used this utility tractor for various jobs on the property. A front axle attachment had become loose, and needed repair. This axle had a "wishbone" bracket underneath the engine, attached to the frame of the tractor with three bolts. The victim was replacing these bolts, and needed to re-align the bracket before he could insert the third bolt. He had worked as a mechanic most of his working career, and had considerable experience with machinery. He was familiar with the run-over risk, and had warned others about it. The exact circumstances in this incident are not clear, but it appears that he may have attempted to use the front-end loader to raise the front of the tractor off the ground. This would release weight from the front wheels and the wishbone bracket, and allow easy insertion of the bolts. No jacks or jack stands were present. While standing on the floor to the right side of the tractor, the man started the engine, assuming the transmission was in neutral. However, the transmission was in first gear, and as the tractor started, it lurched forward and continued moving into the adjoining room of the machine shed, where it crashed into the exterior wall. The victim was run over by the right rear wheel of the tractor and he received severe internal injuries, which caused his death later that day in the hospital.

Photo 1 – Front / right side view of tractor involved in runover incident.

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RECOMMENDATIONS based on our investigation are as follows:

- *Tractor operators should be seated at the controls when starting a tractor.*
- *Tractors and self-propelled machinery should be equipped with interlock mechanisms that prevent starting the machine unless an operator is sitting at the controls and the drive train is disengaged.*
- *Hydraulic jacks and jack stands should be used to raise and support the tractor during repair, rather than using the front-end loader.*

INTRODUCTION

In the summer of 2003, a 69-year-old handyman was run over and killed while working on a tractor in a machine shed. The Iowa FACE program was notified of this incident through the Iowa Department of Public Health, and began an investigation. Information was gathered from the local Sheriff, and a site visit was scheduled with the owner of the tractor, who was also working in the machine shed when the run-over occurred. Two investigators from Iowa FACE interviewed the tractor owner and took photographs of the tractor.

The employer and tractor owner had retired from a manufacturing career, and was currently a land developer in northern Iowa. The victim, who was also retired, had worked for the developer part time for about six years, doing various jobs around the acreage. Prior to his retirement, he had worked as a farm machinery mechanic.

There was no safety program or written policies in place at this small land development. The victim was very familiar with tractors and other machinery, having worked with them most of his working career. He was very aware of machinery hazards, and had warned his employer about starting the tractor while in gear, even when doing so from the operator's seat.

INVESTIGATION

The utility tractor was about 40 years old and had been purchased used five years ago. It was used for grading, road work, snow removal, hauling, and general duties around the acreage. It was equipped with a factory-mounted front-end loader, and was in relatively good operating condition. The axle had a U-shaped "wishbone" bracket stabilizing the axle. This bracket was welded to the back side of the axle on both left and right sides, and the pivot point at the back of the wishbone was bolted to the tractor frame under the engine (see Photo 2).

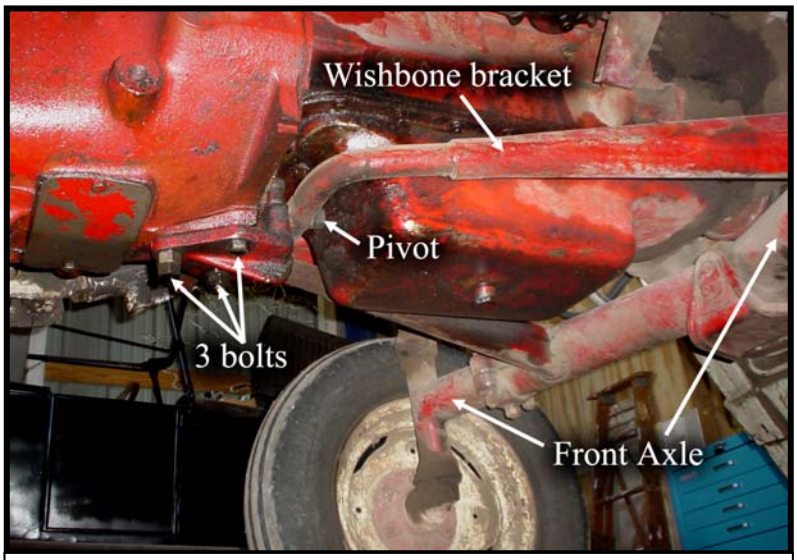

Photo 2 – Underside of tractor showing "wishbone" bracket and its attachment point, which was being repaired.

This bracket allowed lateral pivoting and stabilized the axle against other forces. The bracket had become loose 2-3 times over the years, and the victim was in the process of replacing the worn bolts with new bolts, using a thread-locking compound.

Photo 3 – Right side view of tractor with front bucket powered down to raise the front wheels off the floor.

The victim was the primary operator of this tractor, and had parked the tractor in the machine shed, which had a concrete floor. He had apparently left the transmission in first gear, which was his custom when working with the tractor around the acreage. Typically when parked outside, the tractor was shut off and left in gear, with the front bucket and/or rear blade down to keep the machine from rolling. The tractor had rear brakes, which could be set and locked in position, but these brakes were never thought to be a dependable method for securing the tractor.

The victim had replaced two of the wishbone bolts, but could not insert the last bolt because the hole was not aligned properly. To relieve pressure on the attachment members and align the bolt holes, the victim was apparently trying to raise the front wheels of the tractor off the floor by powering down with the front bucket (see Photo 3). Without tilting the bucket, the loader would raise the front wheels about 8 inches, and allow free movement of the axle and front wheels. There were no jacks or jack stands used to support the front axle at the time.

The victim was standing on the concrete floor to the right of the tractor. The tractor's keyed ignition was on the right side of the instrument panel, and the start button was close to the ignition more in the middle of the panel (see Photo 4). The tractor had a manual 5-speed transmission, and did not have a park position.

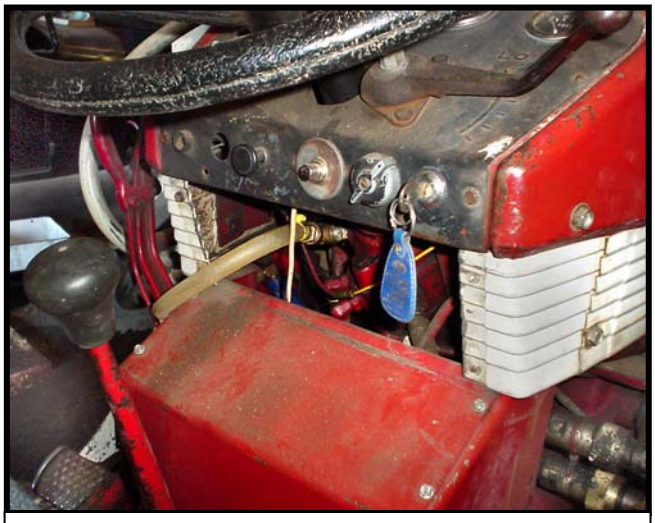

Photo 4 – View of tractor dashboard showing keyed ignition, start button, and other controls.

Apparently, the victim did not notice that the transmission was in gear. In first gear, the lever is nearly touching the newer retrofit seat of this tractor, while in neutral, the lever is a few inches away from the seat (see Photo 5). This would surely have been visible from where the man was standing, although not a very obvious sign that the transmission was in gear. When the tractor started, it immediately drove forward and ran over him causing severe internal injuries. The machine continued to move into the next room where it stalled against the exterior wall of the building. The tractor owner was also working in the next room at this time, but was not injured. He immediately ran to aid his friend; then called 911. Rescuers were on-site within ten minutes, however, the victim soon became unconscious, and died later that day from internal injuries.

CAUSE OF DEATH

The official cause of death, taken from the medical examiner's report was, *"blunt trauma to the head and thorax"*. An autopsy confirmed these findings.

RECOMMENDATIONS / DISCUSSION

Recommendation #1 -- *Tractor operators should be seated at the controls when starting a tractor.*

Discussion: Run-over is the second most common type of tractor fatality after overturn.[1] Many run-overs occur when the tractor is started while standing on the ground next to the tractor. In some situations it is more convenient to start a machine from the ground, rather than from the operator's seat. Examples might include connecting, disconnecting, repairing, maintaining, oiling/greasing, or adjusting implements, or anything that requires frequent mounting and dismounting of the tractor. Newer tractors have interlock mechanisms that prevent them from starting unless an operator is seated at the controls. But whether they are present or not, the operator should never attempt to start the tractor while standing on the ground.

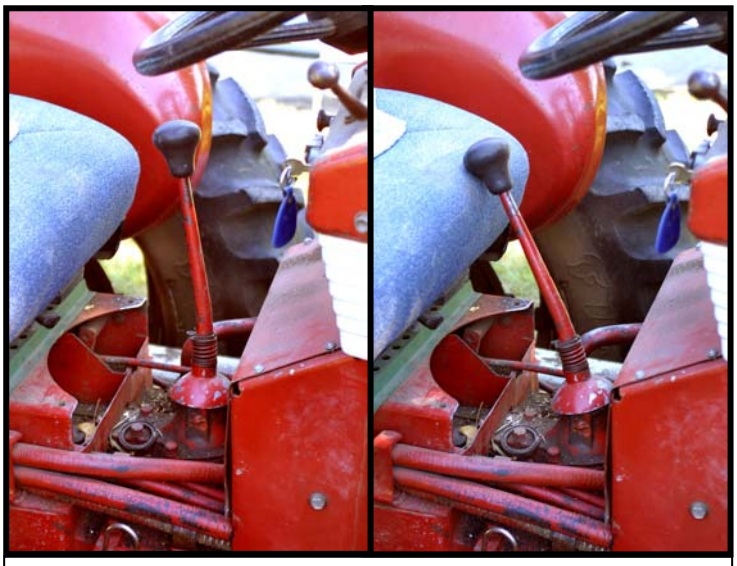

Photo 5 – Right side view of gear shift lever, in neutral position (left image) and first gear position (right image).

If the engine starts in gear, there is no time to react and avoid serious injury. Even if the transmission is in neutral, power take-off or hydraulically-driven machines can move suddenly and cause injury. Tractor controls are designed to be operated when sitting in the operator's seat, and in many cases, cannot even be reached while standing on the ground. Therefore, it is never safe to start the machine while standing on the ground. Most tractors are usually left in gear when parked, and older machines often have problems with brakes, especially parking brakes. When starting any machine, it is necessary to sit in the operator's seat, check that all controls are in neutral position, and confirm that no one is hazardously near the machine. Even when it is safe to start the machine, operators must be properly seated and prepared to control any unexpected machine movements that might occur while starting.

Recommendation #2 -- *Tractors and self-propelled machinery should be equipped with interlock mechanisms that prevent starting the machine unless an operator is sitting at the controls and the drive train is disengaged.*

Discussion: Manufacturers have designed safety systems aimed at reducing the run-over hazard. Interlock mechanisms may require that the gear is in neutral or park position, clutch pedal is pressed, or the operator is sitting in the operator's seat, before the engine can be started. These interlocks greatly reduce the risk of injury from unintentional starting in gear. Older tractors as the one in this case may not have these interlocks, either because they were not manufactured at the time, or because they were broken, or intentionally disabled. Interlocks that are built as an internal part of

the transmission or clutch mechanisms are effective, as they are difficult to disable. Operator presence sensors in the seat are much easier to disable, and this is often done in older lawn mowers, skid-steer loaders, and other self-propelled machinery. While the interlocks can be effective in many situations, it's still a good habit for operators to never attempt to start a tractor while standing on the ground.

Recommendation #3 -- ***Hydraulic jacks and jack stands should be used to raise and support the tractor during repair, rather than using the front-end loader.***

Discussion: Front-end loaders may provide a quick way for raising tractor front wheels off the ground during repair or maintenance. However, hydraulic leaks, inadvertent movement of hydraulic controls, or losing hydraulic pressure for any reason can cause the front-end loader to fail. It is not safe to rely on front-end loader to support the front end of the tractor during maintenance. Jacks and jack stands are designed for that purpose, and should be used instead of the front-end loader. In this case, using the front-end loader for this purpose likely introduced another hazard. It is assumed from the circumstances in this case that using the front end loader was the reason to start the tractor, which was done in an unsafe manner, leading to the death of the operator.

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Reference:

[1] -- NSC, National Safety Council, Injury Facts, 2003 Edition, Itasca, Illinois.

Fatality Assessment and Control Evaluation

FACE

FACE is an occupational fatality investigation and surveillance program of the *National Institute for Occupational Safety and Health* (NIOSH). In the state of Iowa, *The University of Iowa*, in conjunction with the *Iowa Department of Public Health* carries out the FACE program. The NIOSH head office in Morgantown, West Virginia, carries out an intramural FACE program and funds state-based programs in Alaska, California, Iowa, Kentucky, Massachusetts, Michigan, Minnesota, Nebraska, New Jersey, New York, Oklahoma, Oregon, Washington, West Virginia, and Wisconsin.

The purpose of FACE is to identify all occupational fatalities in the participating states, conduct in-depth investigations on specific types of fatalities, and make recommendations regarding prevention. NIOSH collects this information nationally and publishes reports and Alerts, which are disseminated widely to the involved industries. NIOSH FACE publications are available from the NIOSH Distribution Center (1-800-35NIOSH).

Iowa FACE publishes case reports, one page Warnings, and articles in trade journals. Most of this information is posted on our web site listed below. Copies of the reports and Warnings are available by contacting our offices in Iowa City, IA.

The Iowa FACE team consists of the following from the University of Iowa: Craig Zwerling, MD, PhD, MPH, Principal Investigator; Wayne Johnson, MD, Chief Investigator; John Lundell, MA, Coordinator; Risto Rautiainen, PhD, Co-Investigator, Martin L. Jones, PhD, CIH, CSP, Co-Investigator, and John Kraemer, PA. From the Office of The State Medical Examiner.

Additional information regarding this report or the Iowa Face Program is available from:

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