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**TO:** Director, National Institute for Occupational Safety and Health

**FROM:** Iowa FACE      Case No. 2005IA013      Report Date: 17 August 2007

**SUBJECT:** Tractor moving large round bale on loader forks overturned onto farmer

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## **SUMMARY**

A 51-year-old male farmer was moving a large round bale of hay from a delivery trailer to a hoop-style manger in his cattle yard. The tractor had a narrow front axle with a front-end loader attached to the tractor's frame. The tractor did not have a roll-over protective structure (ROPS) installed on it. The bale was held high by the homemade forks mounted to the loader's lift arms. The yard sloped downhill and to the right ahead of the tractor. The tractor's left rear wheel came off the ground as the tractor moved forward then tipped to the right and continued to overturn onto its top. The driver of the delivery truck, and the farmer's friend who was tending the gate to the cattle yard, rushed to extricate the farmer who was pinned face down in the muck under the left rear wheel of the overturned tractor. Emergency assistance was summoned immediately and law enforcement personnel arrived within ten minutes. Continued resuscitation efforts by emergency medical responders were unsuccessful and the farmer was pronounced dead at the scene.

## **RECOMMENDATIONS**

1. *Agricultural tractors should be equipped with roll-over protective structures (ROPS) or be used to perform tasks with negligible risk of an overturn.*
2. *ROPS should be designed and readily available for all makes and models of agricultural tractors in common use.*
3. *Front-end loaders should not be installed on narrow-front-axle tractors that do not have ROPS.*
4. *Tractor operators handling large round bales should follow manufacturer recommendations for proper equipment, installation, set up, ballasting, and safe operating practices.*

## **INTRODUCTION**

A 51-year-old farmer died on his farm in east central Iowa in the early spring of 2005 when the narrow front axle tractor with front-end loader he was operating overturned while moving a large round bale. The victim had worked in the manufacturing of farm equipment and at the same time

farmed for 28 years. The Iowa FACE program became aware of this incident through a local newspaper report two days after the incident. No onsite investigation was performed. Reports and photographs were obtained from the County Sheriff and Medical Examiner's office. Additional information was provided in telephone interviews and correspondence with relatives who responded to the scene within hours, served as intermediaries with those who witnessed the incident, and provided important details for this report.

## INVESTIGATION

The pickup pulling a goose-neck trailer with three or four large (2 m (6.5 ft)) diameter round bales on it had arrived. The bales needed to be unloaded from the trailer. The farmer's larger tractor with its 3-point-hitch bale handling equipment was not able to reach and unload bales from the trailer. So, the farmer opted to use his other tractor (Photo 1). It was a mid-1950's model with narrow front axle (tricycle configuration) and a high-capacity front-end loader mounted to its frame. It had a homebuilt fork attachment out front that could reach and lift the bales from the trailer. This tractor did not have a ROPS nor was it ballasted with fluid in the rear wheels or additional weight on the rear axle or in the hitch area. Its rear wheels were set to a narrow, less stable, wheel track setting. The tractor had chains on its rear wheels for better traction in the springtime mud.



**Photo 1** – Front quarter view of overturned tractor as it was being moved from the scene. The victim was pinned under the left rear wheel of the tractor.

The farmer maneuvered the tractor-loader combination, moving the forks into position, lifted one of the bales from the trailer and then headed toward the cattle yard where the bale was to be placed into a hoop-style manger. The muddy cattle yard sloped downhill and to the right as the farmer steered the tractor forward with the loader raised high. The bale was lifted to a height where its bottom was about even with the top of the hood of the tractor.

Tracks on the slope behind the tractor indicated the left rear wheel intermittently came off the ground over a distance of about 30 m (100 ft) of travel before it overturned. Approximately 45-60 m (150-200 ft) from the manger, the tractor tilted to the right and continued overturning onto its top. The farmer had reportedly managed to jump clear or been lucky enough to avoid injury in a couple of previous tractor overturns. Jumping again, or pitched from the operator's station by the forces of the overturning tractor, this time the farmer landed prone and the left rear wheel of the tractor came to rest across his upper back pressing his face into the muck.

The farmer's friend, who was tending the gate to the cattle yard, and the delivery pickup driver rushed to the scene but were not able to extricate the farmer from under the rear wheel of the tractor. Emergency assistance was summoned. Law enforcement personnel arrived in ten minutes to help with extrication and resuscitation efforts that were continued by arriving emergency medical services personnel until it was determined the victim was deceased.

## **CAUSE OF DEATH**

The autopsy reported the cause of death was due to positional asphyxia in combination with traumatic injuries to the upper torso.

## **RECOMMENDATIONS / DISCUSSION**

**Recommendation #1** – *Agricultural tractors should be equipped with roll-over protective structures (ROPS) or be used to perform tasks with negligible risk of an overturn.*

**Discussion:** ROPS are known to be highly effective in preventing deaths in overturns of tractors. Agricultural tractors offered for sale in the U.S. since the mid-1980's have ROPS and ROPS are commercially available, either from the tractor manufacturer or from aftermarket suppliers, for tractors built since 1970 and for some makes and models built before the 1970's. Nevertheless, about half of the tractors in productive use nationally today do not have a ROPS and seat belt installed on them (Myers and Synder, 1995). Research suggests that narrow front (tricycle) configuration, using a front-end loader, and moving over rough or sloping ground are very significant risk factors in tractor overturns. The tractor in this incident was a mid-1950's model with narrow front axle equipped with a front-end loader being operated on a slope. It was not originally marketed with ROPS and an aftermarket ROPS certified as meeting applicable standards (ASABE, 2004) is not commercially available for it. Therefore, an alternative tractor with ROPS and proper bale handling equipment should have been selected and used to perform this bale handling task. Tractors without ROPS should only be used to provide stationary powers, or in situations where the risk of an overturn is negligible. Loader work, roadside mowing, and transport at road speed are among the tasks that should not be performed with tractors that are not equipped with ROPS.

**Recommendation #2** – *ROPS should be designed and readily available for all makes and models of agricultural tractors in common use.*

**Discussion:** Many tractors continue to be used without ROPS. The risk of an overturn injury or death is particularly elevated for operators who use less common tractors for which no ROPS is readily available to perform tasks where the risk of an overturn is not negligible. Efforts by manufacturers, dealers, and others regarding the importance of ROPS should continue to be persuasive, keep awareness of ROPS availability high, and discourage use of tractors without ROPS in performing tasks where there is risk of an overturn.

**Recommendation #3** – *Front-end loaders should not be installed on narrow-front-axle tractors that do not have ROPS.*

**Discussion:** Previous FACE cases have highlighted the particularly risky combination of a front-end loader mounted on a tractor which has a narrow (tricycle configuration) front axle. The popularity of narrow front axle tractors declined in the 1960s but many tricycle front-end tractors

are still in productive use today. They are more prone to overturn than wide front axle tractors and should not have front-end loaders or other attachments installed on them that can significantly and adversely change the center of gravity for the entire tractor and attachment combination. For example, a heavy load in a raised loader bucket shifts weight from the rear wheels of the tractor to the front and at the same time raises the center of gravity of the tractor-loader-load combination, adding to the risk and relative ease with which such a combination can overturn.

**Recommendation #4** – *Tractor operators handling large round bales should follow manufacturer recommendations for proper equipment, installation, set up, ballasting, and safe operating practices.*

**Discussion:** Tractor operators should be familiar with all safety messages in equipment operator manuals, safety signs on the tractor and equipment, and all safe operating practices applicable to the task (AEM, 1990; NASD, 2006). It is important that the loader be properly matched to the tractor: the tractor-loader combination should be suitable for the load. The installation of the loader and adjustments to it and the tractor, such as setting the rear wheel track width, should be according to manufacturers' recommendations with the proper ballast in place to counterbalance the maximum load to be lifted. Special bale handling equipment should be used and all safe operating practices, such as securing loads that can shift, having the load balanced well, and carrying loads low and slow, should be followed.

Several factors contributed to this overturn incident. The rear wheels were set to a narrow width. No ballast weight was in place on the tractor. A homebuilt set of forks was affixed to the loader instead of a grapple, spear, or other attachment typically recommended for handling large bales. The load was imbalanced as indicated by the loss of contact between the left rear wheel and the ground as the tractor moved forward down the grade. The load was carried high which raised the center of gravity for the tractor-loader-load combination.

## REFERENCES

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Murray D. Madsen, MBA  
Chief Trauma Investigator, IA FACE  
Associate Director, Great Plains Center (GPCAH)  
University of Iowa – Iowa City, IA

Risto Rautiainen, PhD  
Co-Investigator, IA FACE  
Deputy Director, GPCAH  
University of Iowa – Iowa City, IA

Adam L. Riss, MS, EMT-P  
Program Associate I, IA FACE  
University of Iowa – Iowa City, IA

# Fatality Assessment and Control Evaluation FACE

Fatality Assessment and Control Evaluation, FACE, is a program of the *National Institute for Occupational Safety and Health* (NIOSH), which is part of the *Centers for Disease Control and Prevention* of the *U.S. Department of Health and Human Services*. Nationally, the FACE program identifies traumatic deaths at work, conducts in-depth studies of select work deaths, makes recommendations for prevention, and publishes reports and alerts. The goal is to prevent occupational fatalities across the nation.

The NIOSH head office in Morgantown, West Virginia, carries out an intramural FACE case surveillance and evaluation program and also funds state-based programs in several cooperating states. In Iowa, *The University of Iowa* through its *Injury Prevention Research Center* works in conjunction with the *Iowa Department of Public Health* and its *Office of the State Medical Examiner* to conduct the Iowa FACE program.

Nationally, NIOSH combines its internal information with that from cooperating states to provide information in a variety of forms which is disseminated widely among the industries involved. NIOSH publications are available on the web at <http://www.cdc.gov/NIOSH/FACE/> and from the NIOSH Distribution Center (1-800-35NIOSH).

Iowa FACE also publishes its case studies, issues precautionary messages, and prepares articles for trade and professional publication. In addition to postings on the national NIOSH website, this information is posted on the Iowa FACE site, <http://www.public-health.uiowa.edu/FACE/>. Copies of FACE case studies and other publications are available by contacting Iowa FACE, too.

The Iowa FACE team consists of the following specialists from the University of Iowa: Craig Zwerling, MD, PhD, MPH, Principal Investigator; John Lundell, MA, Co-Investigator; Murray Madsen, MBA, Chief Trauma Investigator; and Co-Investigator/specialists Risto Rautiainen, PhD, and Wayne Sanderson, PhD, CIH. Additional expertise from the Iowa Department of Public Health includes Rita Gergely, Principal Investigator, and John Kraemer, PA, from the Office of the State Medical Examiner.

For additional information regarding this report or the Iowa FACE Program contact:

**Iowa FACE**  
**The University of Iowa**  
**100 Oakdale Campus, #203 IREH**  
**Iowa City, IA 52242-5000**

**Toll free within Iowa: 800-513-0998**  
**Phone: (319) 335-4481** **Fax: (319) 335-4290**  
**Internet: <http://www.public-health.uiowa.edu/FACE>**  
**E-mail: [murray-madsen@uiowa.edu](mailto:murray-madsen@uiowa.edu)**