Department of LABOR AND INDUSTRIES

SHARP
Safety & Health Assessment & Research for Prevention

FATALITY INVESTIGATION REPORT

Tractor Overturn Kills 16-Year-Old Farm Worker in Washington State.

Investigation No.: 99WA05601 **Release Date: July 31, 2001**

SHARP Report No.: 52-6-2001

FACE/WA
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SUMMARY

On August 23, 1999, a 16-year-old farm worker (the victim) died of injuries when the tractor he was driving overturned and crushed him. The victim was towing a small hay baler on a two-lane, public paved road. Just prior to the incident, a motorist observed the victim driving the tractor and baler with the "passenger-side" wheels of both the tractor and baler partially on the road's gravel shoulder. The tractor then turned right toward the road's steeply banked shoulder. As the tractor began to overturn down the bank, the victim attempted to jump from the tractor in the same direction as the overturn. The motorist who witnessed the incident found the victim pinned under the tractor. Emergency medical persons were called and responded to the incident. The victim died at the scene.

To prevent similar occurrences, the Washington State Fatality Assessment & Control Evaluation (FACE) Investigative team concluded that persons operating farm tractors should follow these recommendations:

- **All tractors should be equipped with Rollover Protective Structures (ROPS) and seat belts. ROPS should be installed as manufacturers' original equipment or retrofit per the manufacturers' guidelines.**

- **All personnel must wear a seat belt when operating a tractor equipped with a ROPS.**

- **All persons who drive tractors need to be trained, educated, and knowledgeable in all aspects of the safe operation of tractors, including the towing of implements, and be made aware of hazards related to their operation. Drivers should also be familiar with the tractor's operation manual.**

- **Extreme care should be used when operating tractors on or near sloped terrain, ditches, or embankments.**

- **When driving a tractor on a public road, the driver should maintain a safe and well-defined position on the road in the correct traffic lane. The tractor operator should not pull off the road to allow traffic to pass unless there is a safe and stable location to maneuver.**

INTRODUCTION

On August 25, 1999, the Washington State FACE Program was notified by WISHA* (Washington Industrial Safety & Health Administration) of the death of a 16-year-old farm worker, which occurred on August 23rd. The victim was killed in a roll over incident (also known as a tractor overturn incident) while driving a tractor on a rural paved road.

The Washington FACE Field Investigation team met with the regional WISHA representative assigned to this case. After reviewing the case at the regional satellite office, the WISHA Compliance Officer and the WA FACE investigator traveled to the incident site.

The victim was working on a neighbor's small family farm, consisting of approximately 1,300 acres with the majority of the land being leased. The farm primarily produced wheat, hay, and cattle. Most of the farm activities were performed by the family partners but occasionally they would hire temporary help.

The victim was a 16-year-old male high school student who had been hired during the summer as a temporary/part-time employee by the farm partnership. He was primarily hired to manually move irrigation sprinkler pipe to various locations in the hay and wheat fields. The irrigation needs of each field crop were determined by the farmer who gave daily sprinkler movement assignments to the victim. This was the victim's first farm employment experience and he had been on the job for approximately 3 months prior to the incident. The victim normally worked a 4-5 hour day but on limited occasions worked as many as 9 hours per day. He had worked 3 or 4 hours on the day of the incident before he was asked to drive a tractor and hay baler from a field to the farm complex via a public road.

According to the farm owners, the victim had driven the tractor in the field on a few occasions, but had no experience driving a tractor prior to his employment. The farmers indicated that they had provided on-the-job training complimented with visual observation until they felt comfortable that the victim could drive the tractor with minimal supervision.

INVESTIGATION

Prior to quitting work for the day on August 23, 1999, the victim was asked to drive a tractor and an attached hay baler back to the farm complex from a field via a black top road. This road would be only one of several black top, rural public roads that the victim would have to travel before completing the six-mile trip back to the farm. This was the victim’s first experience driving the tractor on a public road.

The road where the incident occurred was relatively flat and level, though the general terrain was hilly. When the county built the road, they cut through the tops of the hills and filled the valley areas between the hills to make the road relatively level. The fill also

* The OSHA State Plan program in Washington State.

took care of drainage for the road, as water would tend to wash out into the adjacent fields with heavy rains. The problem with designing/engineering the road to be level and accommodating good natural drainage for the roadway was that the materials used to fill the valleys created very steep slopes on both sides of the road. It was at one of these locations where the fatality took place.

The road was in good physical condition, but had some typical black top cracking/breakage along the edge of the pavement. The width of the paved two-lane road surface where the incident took place was 20 feet. A solid yellow centerline divided the lanes for two-way traffic. At the point of the incident (traveling east), the width of the black top from the yellow centerline to the right shoulder of the road was 9 feet 2 inches. The black top measured 10 feet 8 inches from the centerline to the opposite shoulder.

Both shoulders of the road were made of packed gravel and dirt. The right shoulder (as seen by the victim) measured 4 feet in width and the left shoulder measured 4 feet 1 inches in width (see Figure 1 and Photograph 1). At the point of the incident, the far right hand edge of the shoulder dropped steeply from road level to the field below. The drop to where the tractor was found was approximately 11 to 12 feet. The bank was covered with loose soil and light vegetation.

The black top portion of the road was relatively flat and had little to no crown. There was a slight drop-off of between 1 and 2-inches from the edge of the black top to the gravel shoulder. The gravel shoulder had a slope of 7 degrees away from the black top. The slope from the far right edge of the shoulder quickly changed to between 50 and 60 degrees for 11 feet and then leveled out to 10 degrees for an additional 12 feet prior to reaching the flat field.

The victim was driving a 1976 International Harvester Hydro 100 tractor equipped with a bucket loader and was towing a Case 8555 baler (Figure 2 and Photograph 2). The tractor's length measured approximately 14 feet. The widest point of the tractor, which measured 8 feet, was across the rear tires. The width of the front of the tractor was 6 feet 4 inches, measured across the front tires. The length of the baler was 20 feet 4 inches, including the hitch connection to the tractor. The widest point on the baler measured 8 feet 7 inches across the hay pickup apparatus and the terrain tires. The hay pickup and terrain tires were located just behind the tractor under the baler end of the hitch. The next widest point on the baler was the baler's tires, which measured 6 feet 5 inches across.

The width of the tractor/baler was 7 inches less than the width of the travel lane. This provided very little margin of error for a driver to stay in his lane on the black top without driving slightly into the oncoming lane or the gravel road shoulder.

On day of the incident, the weather was warm, sunny, and clear and the road surface was dry. There appeared to be no environmental issues that would have affected the incident. The sun was high enough in the sky to not interfere with visibility.

A witness to the incident stated that he was driving down the same road and direction (heading east) that the tractor and baler were traveling. The witness first saw the tractor and baler approximately 200 yards ahead of him.

When the witness had approached to within 100 yards of the tractor/baler, he noticed dust and dirt blowing up from the right rear tires of both units. The witness felt from his observation that the tractor/baler tires were riding on the gravel shoulder generating the dust.

When the witness was approximately 60 yards behind the tractor/baler, he noticed that the tractor was starting to lean toward the right hand side of the road. Just at that point, in his opinion, he saw the driver try to jump from the tractor in the downhill direction.

The witness stated that the tractor slowly overturned off the right shoulder and then flipped down the slope into the field below.

The witness quickly stopped his vehicle and ran down the embankment to see if the driver needed help. When he reached the over-turned tractor and baler he found the young man pinned beneath the left fender of the tractor.

After an unsuccessful attempt to free the victim, the witness ran back up the road to a nearby pick up truck to get help. The truck was unoccupied but the witness found a CB radio and called for help. The witness then ran back to the victim and tried to dig him out from under the tractor.

Within moments, another person arrived and started to help dig from around the victim. Several more people arrived at the scene. This time instead of trying to dig the victim out, they tried to lift the tractor off the victim, but failed.

Paramedics arrived within ten minutes of the incident and terminated the rescue attempts after they determined that the victim was dead. The County Coroner and the police arrived shortly after the paramedics. The Coroner pronounced the victim dead at the scene.

CAUSE OF DEATH

The coroner listed the cause of death as crushing chest injuries due to a tractor (farm) roll over.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: All tractors should be equipped with Rollover Protective Structures (ROPS) and seat belts. ROPS should be installed as manufacturers' original equipment or retrofit per the manufacturers' guidelines.

Discussion: The tractor is probably the most common piece of equipment on farms today. This has been true for nearly a hundred years. Tractors are one of the more important investments that a farmer can make. Unfortunately, in agriculture, tractor-related injury incidents result in more serious, disabling injuries and fatalities than any other type of incident. Tractors are linked to more than half of all farm-related deaths[1]. Although there are many types of tractor related incidents, over 50% of tractor deaths were the result of tractor overturns. Tractor overturn fatalities and serious injuries can be prevented by the use of Roll Over Protective Structures (ROPS) in combination with seat belts and good tractor driving practices.

ROPS are specifically engineered frames or cabs that provide a safe environment for the tractor operator in the event of an overturn. ROPS are designed to provide a protective zone for the tractor operator in conjunction with the use of seat belts. Not all tractor cabs are designed as overturn protection. One should check with the supplier to make sure that the cab being purchased is a ROPS cab.

The first ROPS device was marketed for new tractors in 1965, but it was not until 1976 that the Occupational Safety & Health Administration (OSHA) established the Roll-Over Protective Structure Standard to try to decrease the number of farm tractor overturn deaths. The Standard requires that all tractors manufactured after October 25, 1976 have ROPS, though for some that deal with operations with overhead clearance issues, WAC 307 should be consulted.

The State of Washington has the same requirements as the federal ROPS Standard, but also requires tractors built on or before October 25, 1975, to have ROPS if, according to the manufacturer, the tractor was built with ROPS or it was designed to accommodate the ROPS. ROPS must also be commercially available.

One issue with phasing in new tractors with ROPS is the fact that farm tractors have a very long life span. It is estimated that more than half of all farm tractors currently in use were not equipped with ROPS at first purchase[1].

The tractor involved in this incident, the International Harvester Hydro 100, was manufactured in 1976 (just prior to the OSHA ROPS Standard) and did not have a ROPS installed when it was originally sold. There is however a ROPS retrofit that is available for this tractor and can be purchased and installed for less than $1000.

It is very important to use only the ROPS recommended by the manufacturer or tractor dealer. ROPS are engineered specifically for each tractor and must pass a series

of dynamic and static tests. ROPS must meet the test and performance requirements of OSHA 1928.52 CFR.

ROPS must also be correctly installed to the supplier's specifications. The frame, hardware to mount the frame, and installation are all required components for establishing the integrity of the ROPS.

The National Farm Medicine Center in Marshfield, Wisconsin, has published a document entitled,"*A Guide to Agricultural Tractor Rollover Protective Structures*"[2], which lists information on ROPS suppliers for different tractor models. The guide also provides information on the type of ROPS that are available for most tractor models and in many cases an approximate cost.

All tractors should be equipped with ROPS and seat belts or be retrofitted with ROPS/seatbelts to help protect tractor operators in the event of an overturn.

Recommendation #2: All personnel must wear a seat belt when operating a tractor equipped with a ROPS.

Discussion: ROPS are an important part of a tractor's safety systems, but ROPS can only give some of the protection that the tractor operator needs. All operators of ROPS equipped tractors need to wear a seat belt.

Without a seat belt, the tractor operator will not be able to remain or be confined to the "protective zone" that is created by the Roll-Over Protective Structure. The young tractor operator (the victim) had neither a Roll-Over Protective Structure nor a seat belt to help prevent his fatal injuries. Without wearing a seat belt during an overturn, the operator of a tractor could be thrown from the protected area of the ROPS and subsequently crushed by the tractor.

There have been a number of deaths and severe injuries that have occurred when a tractor operator wasn't wearing a seat belt and was thrown from the seat during an overturn and struck by the ROPS. The ROPS may provide a false sense of security when operating without a seat belt. Seat belts in conjunction with ROPS are the safety package that tractor operators must have and use to prevent serious injury from an overturn.

Research noted by the Iowa State University Extension, in Ames, Iowa[3], state that there is a misconception that a human can react fast enough to avoid potential injury (i.e., jumping from an overturning tractor). They note that relying on reaction time alone cannot help avoid injury due to farm equipment.

It is very important to have all ROPS equipped tractor operators wear their seat belts. Almost all tractor overturn fatalities can be prevented by the use of these two pieces of equipment[4].

Recommendation #3: All persons who drive tractors need to be trained, educated, and knowledgeable in all aspects of the safe operation of tractors, including the towing of implements, and be made aware of hazards related to their operation. Drivers should also be familiar with the tractor's operation manual.

Discussion: Farming is one of the most hazardous occupations in the US[5]. Most serious injuries and fatalities on the farm are related to farm machinery and equipment, with the majority involving tractors.

The agriculture industry employs thousands of workers under the age of 18 each year to perform a variety of tasks. Unfortunately, a disproportionate number of these workers are injured or killed in farm work-related incidents. Most of these injuries and deaths are avoidable. Farm tractors are involved in more than 50% of these fatal injuries[6]. One element key to helping prevent these injuries and deaths is continuous, basic operator training, coupled with regular observation and supervision.

The victim in this tractor overturn incident had very limited tractor driving experience. He had worked on the farm for only a few months and most of his farm work did not involve driving tractors. He was also a new driver to the highways, as he had only received his motor vehicle operator's license earlier in the summer. All of these factors may have played a role in the chain of events that took place leading to the fatal incident.

It was noted by the farm owners that the young man was very big for his age and acted very mature. They said he was a hard worker and they would often forget that he was only 16-years old, but in reality, he was a 16-year-old with limited experience.

The victim had a driver's license and was allowed to drive a vehicle (including a tractor) on public roads. However, driving a car on a public road is very different from driving a tractor on a public road. The handling capability of a tractor and its center of balance are very different from that of a car. Older tractors like this one are generally more difficult to steer and maneuver and may be more prone to overturn.

Whenever a person is asked to operate a piece of equipment that is new to them, that person needs to be properly educated and trained in that equipment's safe operation.

The training should not only include skills development but a familiarity with the manufacturers' operating manual to better understand the vehicle that will be driven. The state agricultural extension offices and various farm associations should be contacted for tractor safety training materials. The Farm Safety Association has developed a publication titled, *"Farm Tractor Safety: A Guide to Safe Farm Tractor Operation*[7]*"*, that is an excellent resource to help teach the safe handling and operation of tractors. The publication includes tractor driving skills exercises, tests and quizzes, and recommendations for videos and other training materials.

Persons who supervise young farm workers need to recognize and evaluate the skills and limitations of those workers, especially for driving on public roads or other hazardous terrain. They need to coach, mentor, and lead their young workers to take the safest approach to the job they are doing.

In a situation where the individual has little or no experience driving on a public road, they should review the rules of the road pertaining to farm vehicles and faster moving traffic. Defensive driving is important for both the tractor driver and the other vehicles. Beyond verbal and text instruction, the supervisor and the new driver should travel the route together in a light truck or car, where the supervisor can point out appropriate driving techniques, such as when it is safe to pull over to allow traffic to pass, making proper turns, and avoiding hazardous travel areas.

All young drivers and anyone who has never driven a tractor should take an approved course in tractor safety and operation prior to driving out in the fields and public roadways. Knowing how to make good judgments while operating a tractor can prevent many injuries and deaths.

Recommendation #4: Extreme care should be used when operating tractors on or near sloped terrain, ditches, or embankments.

Discussion: A ROPS can only reduce the severity of injury after a tractor has overturned. It is best to prevent the overturn from happening in the first place. In order to help prevent an overturn, one needs to know how the tractor handles and have a clear understanding of the dynamics of how it responds when driven on different terrain.

A 1991 study by A.G. Hunter[8], stated that most tractor overturn incidents occur because of the following factors: limitations of the tractor, misjudgments by the driver, steep slopes, high speed, and difficult or rough terrain.

Tractor operators need be aware that most tractors are sensitive to any shift in its center of gravity or its balance point. Different forces and practices can cause the stability of the tractor to change slowly or suddenly.

There is a very delicate relationship between the tractor’s characteristics, the type of terrain on which the tractor is driven, how it is driven, and how the driver reacts to his or her environment. Tractor overturn incidents are directly influenced by many factors, including the tractor's dimensions; the position of the tractor's center of gravity with respect to its tires; the dynamics of the tractor's operation such as the speed and turning radius; and also the proximity of the tractor to slopes, embankments, ditches, potholes, rocks etc. The slope and angle of travel that the tractor takes in relationship to the slope also influences the stability of the tractor. These characteristics also change when an implement is attached to the tractor and are influenced by the implement's own design and its position relative to the tractor.

In order to help prevent tractor overturn incidents, the operator needs to understand these relationships so they can make sound judgments on how he or she is going to maneuver the tractor in different work situations, on different terrain, and in various traffic situations and exposures.

One important thing for the tractor driver to attempt is to avoid operating the tractor on steep slopes, near ditches, embankments, deep ruts and depressions, and holes in the ground. Any or all of these terrain issues present the strong possibility for initiating sideways tractor overturns.

Recommendation #5: When driving a tractor on a public road, the driver should maintain a safe and well-defined position on the road in the correct traffic lane. The tractor operator should not pull off the road to allow traffic to pass unless there is a safe and stable location to maneuver.

Discussion: Driving a tractor on a public road is considerably different from driving one off-road or in farm field situations. There are many additional driving hazards presented the tractor driver on a public road, especially when towing equipment. These hazards are increased when the operator has little to no experience in performing the task, as was the case in the fatal incident.

Each year there are many collisions involving vehicles and tractors/farm equipment on public roads. One of the main reasons for these collisions is the large difference in speed between tractors and motor vehicles. Because of this difference, there can be a very short amount of time (closure time) for a motor vehicle to over-take a tractor. This may require one or both drivers to react quickly with little or no time for thought.

When driving a tractor, one needs to understand the limitations of the tractor and transfer that understanding to practice while traveling on public roads. This includes understanding when it is safe for the tractor to pull over to allow traffic to pass.

If the roadway exposure creates a hazard to the tractor driver, and pulling the tractor to the side of the road is not safe, then as a defensive driving measure, the tractor driver should wait and travel to a safe area to pull over. Operating partially on the blacktop surface and partially on the gravel shoulder can cause loss of control and result in a traumatic incident for the tractor operator and possibly for other vehicle drivers on the road.

In summary, there are far too many serious injuries and fatalities related to tractor overturn incidents in the United States. The agricultural industry also has a large population of young workers. These young workers are involved in many serious farm related incidents. It has been demonstrated that tractor overturn fatalities can be prevented with the combined use of ROPS and seat belts. Older tractors should be retrofitrd with ROPS and seat belts. An effort should be made to ensure that the seat belts are worn regardless of the age of tractor operator. All operators should have the training, skills, and qualifications to perform the job that they are asked to do. Farm safety must be an integral part of today's farm operations.

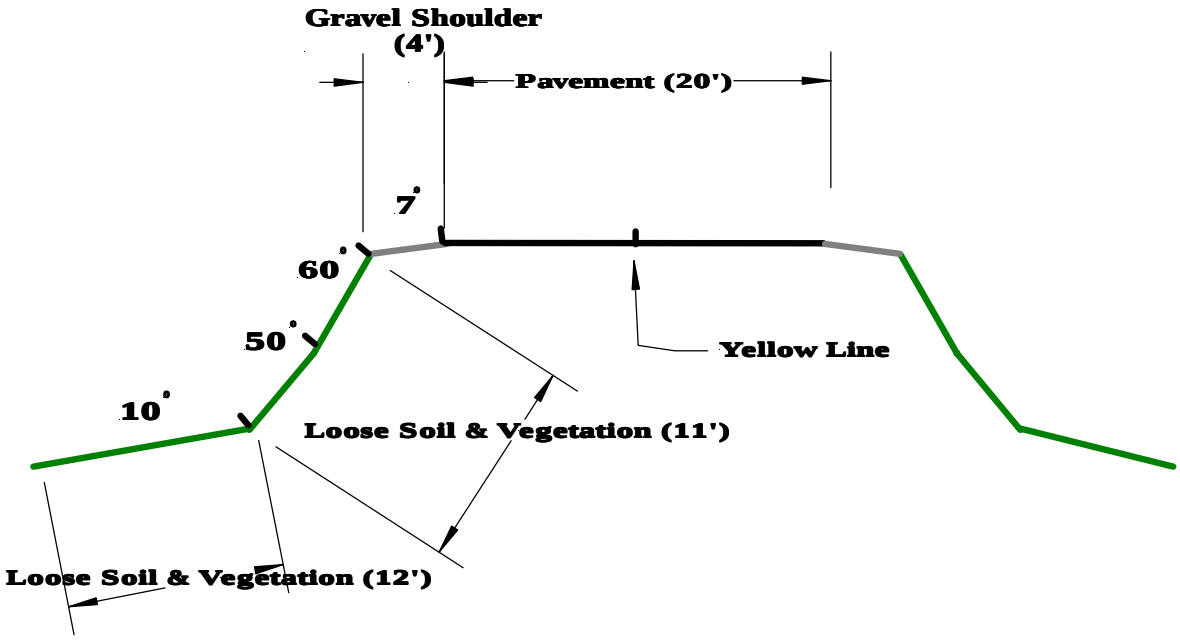


Figure 1. Cross-section of roadway near the incident.

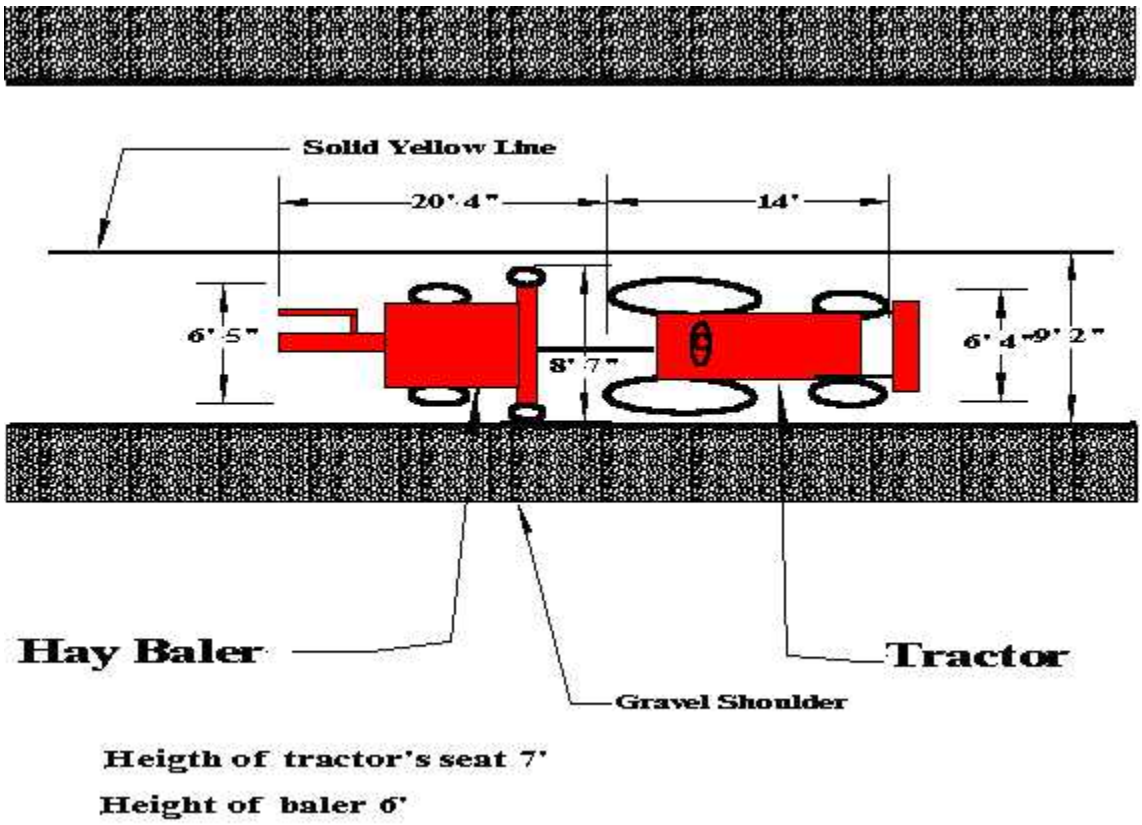
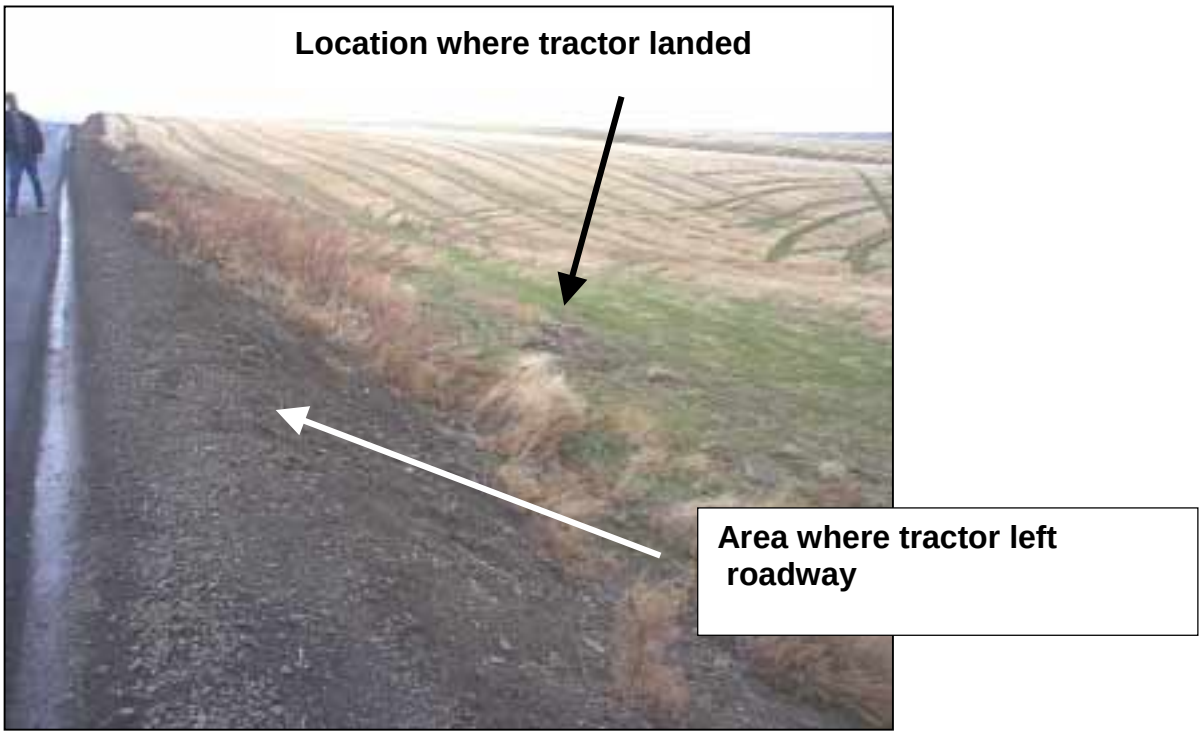
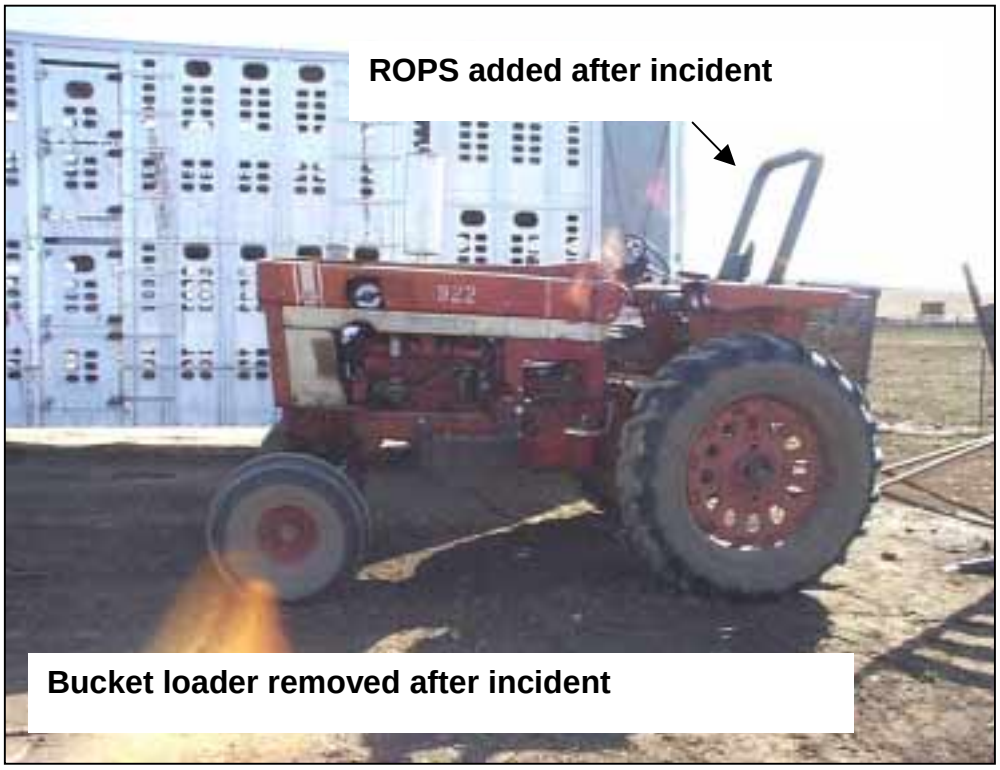


Figure 2. Tractor and baler on the roadway.



Photograph 1. The scene of the incident.



Photograph 2. The tractor involved in the incident, post retrofitting with a ROPS and removal of the bucket loader.

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Other Resources

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- Part 1928, Occupational Safety and Health Standards for Agriculture, U.S. Department of Labor, Occupational Safety & Health Administration.
- Part F, Rollover Protective Structures (ROPS) For Tractors, Chapter 296- 307 WAC, State of Washington, Department of Labor and Industries.
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APPENDIX

Other Safety Research

As part of the Washington State FACE Investigation process, we research different ideas and safety applications that currently may not be used by the industry in their operations. Some of that research is shared in the appendix below.

Note: *Neither SHARP/Washington State Department of Labor & Industries nor the NIOSH FACE program endorse the items or products listed in this appendix. The items are primarily presented in this appendix to stimulate discussion within the industry. Prior to the purchase of any device, the buyer should carefully investigate the claims made by the seller, and ensure that the product provides an extra measure of safety to the user and not create an additional hazard. All products must meet all regulatory guidelines.*

Vehicle Control Stabilizers and Slope Indicators (Inclinometers)

In researching a variety of safety applications that could be used to improve tractor stability or alert the tractor operator of unstable conditions, the Washington FACE team found a few items that could make tractor operation safer. These items were vehicle control stabilizers and slope indicators (inclinometers).

Vehicle Control Stabilizers

In conducting our research of the tractor overturn fatality, the FACE team found a forklift stabilizing system that had been developed by Toyota Industrial Equipment. Toyota has a trade marked technology called System of Active Stability™ (SAS) which is an electronic control system designed to monitor and control a variety of key forklift functions. According to Toyota, when the control system senses instability, the SAS reacts helping to reduce the risk for lateral tip overs, falling cargo, and personal injury.

Toyota's SAS electronic control system can detect and respond to changes in forklift operation. The SAS reacts through two key systems, the active control rear stabilizer and the active mast control function.

The active control rear stabilizer is designed to monitor the load height and weight, truck travel speed, and tipping rate (yaw) to ensure that all four tires remain on the ground. When the system senses instability, it instantly engages a swing lock cylinder to stabilize the rear axle, creating the lateral stability needed to help reduce the risk of tip over.

Other system sensors monitor the loading stability of the forklift. Depending on the weight and height of a load, the SAS controls the mast angle and speed, making it more difficult to spill a load or create an unstable situation that might cause the forklift's center of balance to tilt forward.

Although the SAS technology is specific to the forklift, we feel that there could be various applications of the technology to other types of mobile equipment including farm tractors. Our recommendation is that this type of stabilization system technology be reviewed to see if it could be applied to farm tractors to help in the prevention of both lateral and rear tractor overturns.

Slope Indicators (Inclinometers)

A number of different slope indicators or alarms were found that could potentially provide important stability information to the tractor operator. The instrumentation ranges from a very basic needle gauge indicator to digital LCD readout with remote sensors. All units were modest in cost and not difficult to install.

Some of the models show the American National Standards Institute (ANSI) guidelines of slope and indicate caution and danger points for farm and utility tractor overturn prevention. Many of the models can be equipped with an audible and/or visual alarm which goes off when a specific danger point has been reached. At least one gauge shows both side-to-side and front-to-back tilt stability on the same indicator. Having information on both types of tilting could be an important safety measure when operating a farm or utility tractor.

It has been demonstrated that the slope on which the tractor is driven has a significant bearing on the safety of the operator. While having a ROPS equipped tractor and wearing a seat belt are more important factors in saving lives in the event of an overturn, the alarms and slope indicator gauges can play a role in <u>preventing</u> the tractor from rolling over in the first place.

NIOSH Studies Related to Tractor Overturns

The National Institute of Safety and Health (NIOSH) has been working on several research projects relating to tractor overturns. The research has focused on ROPS design for older tractors, an overturn sensor, and automatically deployed ROPS.

Investigation of ROPS For Older Tractors

The Department of Chemical and Biosource Engineering at Colorado State University has been funded by NIOSH to design and evaluate ROPS for older tractors. They have been using computer modeling to design ROPS and conducting laboratory and field tests to develop suitable guidelines for building and installing ROPS.

Development of an Overturn Sensor

NIOSH is developing a sensor that would detect tractor instability. Current work involves the development of a tractor computer simulation to verify overturn parameters and

algorithms and initial development of prototype sensor circuitry. NIOSH has already demonstrated the concept of a deployable roll-bar design for use on small tractors.

Development of Automatic ROPS

In conjunction with the overturn sensor, NIOSH is developing an automatic ROPS deployment mechanism. This project is using computer-aided design to develop retractable ROPS with a mechanism that will automatically deploy the ROPS to achieve tractor operator protection during an overturn incident. A prototype is being developed specifically for agricultural tractor operations that are performed in low clearance areas such as orchards and in barn work.

Highway Safety/Sharing the Road with Farm Equipment

In the FACE investigation report, it was noted that there are many serious incidents that take place each year involving tractors and other farm equipment when they share public roads with passenger/commercial vehicles. Based on this fact and others surrounding this incident, we recommend that further research be conducted on the topic of public road development, especially in rural areas where farm vehicles routinely share public roads. Issues for further research should include: establishing turn-out areas for farm equipment; extending the black top surface onto the shoulder; adding “rumble” strips to the shoulder in hazardous areas; setting up delineator posts or similar devices on the shoulder in hazardous areas; and set up guard-rails in areas when the hazard warrants this type of highway safety device.

Turn-Out Areas/Turn-Out Area Signage

In rural areas where it is common to have farm equipment travel on public roads, we recommend that planned turnout areas be incorporated into the road systems design. On many roads with steep uphill grades, you can find passing lanes or turnout lanes to allow slower vehicles to pull over, allowing traffic traveling at the posted speeds to pass. We recommend similar turnout lanes/areas be developed on rural roads with slow moving farm vehicles. The turnout areas should not be grade dependent but be established based on the prevalence of slow moving farm equipment on the road.

One of the most common types of vehicle collisions that occur on rural roads is when an approaching motorist hits a farm vehicle from behind. This happens because there is a large difference in speed between the two vehicles. For example, if a vehicle traveling 55 miles per hour approaches a tractor, traveling at 15 miles per hour, the vehicle closes the distance between the tractor at 59 feet per second. The vehicle would travel the length of a football field in 5 seconds. When other vehicles are approaching a tractor, the tendency is for the tractor operator to drive their equipment as far to the right hand side of the road as possible to accommodate the passing vehicle. Though pulling over to the shoulder may not be the safest driving maneuver. We feel that strategically placed turnout areas would provide the best degree of safety for all drivers on the road.

Roadways that have serious overturn potential, as in the case reported in this document, would be good candidates to have turnouts incorporated into their design. There should be a hazard/risk assessment of the topography of the roadway/terrain and the roadway traffic characteristics.

Signs should be placed at designated and strategic locations along the roadway informing all travelers of approaching turnout areas. The signs can reduce a driver's need to pass tractors or other farm equipment in areas where it is not safe for the farm equipment operator to pull over.

Black Top/Expand the Road Shoulder

One of the issues in this incident was the gravel shoulder of the road. Traveling with half of the vehicle's tires on black top and the other half on a gravel surface, as was the case in this incident, can reduce one's ability to maneuver a tractor. Driving on different surfaces becomes even more difficult when towing another piece of equipment, such as the baler. Our recommendation for this section of road would be to extend the black top surface a minimum of 18 to 20 inches onto the shoulder. This would just accommodate the width of the rear tractor tires, which are 18.4 inches wide. To be even safer it would be best to black top the entire 3 to 4 feet of gravel shoulder and in reality expand the shoulder to accommodate the width of an average vehicle. The standard “white fog line” should be painted along both sides of the road to provide good visual orientation separating the road from the shoulder areas.

Rumble Strips

Another recommendation in conjunction with expanding the black top area onto the shoulder is to put down rumble strips along the edge of the shoulder. Rumble strips would provide an audible warning to the driver when they where getting too close to the edge and indicate that they need to move back toward the established driving zone.

Delineator Posts/Shoulder Edge Marking

Delineator posts or breakaway or flexible stanchions are other hazard warning devices that could be used along the shoulder of the road. These are relatively inexpensive and easy to install, though are not protective like guardrails.

Delineator posts or similar roadside marking devices can be easily placed along roadway shoulders to mark hazards such as ditches and establish the maximum safe area that a vehicle could travel onto that shoulder. They also can provide a line of visual perspective that shows where the shoulder ends and where the hazard, such as the slope, begins.

Delineator posts and similar devices are designed to bend or break when struck and do not inflict damage to a vehicle when struck. The posts are generally made of a variety of weather resistant plastics with a reflecting surface so they are visible at night.

These types of devices are hazard warning devices only, and are not preventive in design. Under the right circumstances, they can help people avoid serious incidents by allowing them to better see an upcoming roadside hazard.

Guardrails

Guardrails may be considered the ultimate device in preventing vehicles from leaving the roadway. They are often set up along a slope or severe drop-off near the road surface. Guardrails are more costly and more difficult to install than the hazard warning devices but are more durable and require little routine maintenance once they have been installed. Guardrails can be constructed of post and wire or be made of steel beam construction. There are also a variety of concrete barriers that are available that can be used for certain roadway applications.

Guardrails are not necessarily designed to prevent injury, but to prevent a vehicle from accessing a specific roadway hazard zone. Under a variety of impact conditions there is still a possibility that serious injury and even death can occur when colliding with guardrails. In general, guardrails can prevent a vehicle from entering into a zone where the probability of death and serious injury are much higher if there were no guardrail present.

Applicable Regulations

In reviewing the WISHA standards, there are defined requirements that deal with farm and tractor safety. Although the investigation of this incident was not regulatory in nature, we offer the following code requirements for information and reference purposes. This is not intended to be a complete list of regulatory guidelines that address these issues:

Rollover protective structures (ROPS) for tractors.
WAC 296-307-080

All agricultural tractors manufactured after October 25, 1976, must meet the requirements of WAC 296-307-080. An agricultural tractor manufactured on or before October 25, 1976, must meet the requirements of WAC 296-307-080 if:
(1) The tractor was built or sold with rollover protective structures (ROPS) as an optional accessory; or
(2) According to the manufacturer, the tractor was designed to accommodate the addition of ROPS.
WAC 296-307-08003

Requirements for seatbelts used with ROPS on agricultural tractors.
(1) Where ROPS are required by WAC 296-307-080, you must:

(a) Provide each tractor with a seatbelt;
(b) Require that each employee use the seatbelt while the tractor is moving; and
(c) Require that each employee tighten the seatbelt sufficiently to confine the employee to the ROPS protected area.
(2) Each seatbelt and seatbelt anchorage must meet the requirements of ANSI/SAE J800 April 1986, Motor Vehicle Seat Belt Assemblies.
WAC 296-307-08012

Employee training requirements.
(1)You must ensure that every employee who operates an agricultural tractor is informed of the operating practices listed below and of any other practices dictated by the work environment. You must provide the information at the time of initial assignment and at least annually thereafter.
(2) You must ensure that every employee who operates an agriculture tractor is trained specifically in the operation of the tractor to be used. The training must include an orientation of the operator to the topographical features of the land where the tractor will be operated. Training must emphasize safe operating practices to avoid rollover.
(3) The tractor training program must be described in the written accident prevention program required by WAC 296-307-030.
WAC 296-307-08018

Accident prevention program
(1) You must instruct all employees in safe working practices at the beginning of employment. Your instruction must be tailored to the types of hazards to which employees are exposed.
(2) You must develop a written accident prevention program tailored to the needs of your agricultural operation and to the types of hazards involved.
WAC 296-307-030

An on-the-job review of the practices necessary to perform job assignments in a safe and healthful manner.
WAC 296-307-030(3)(f)