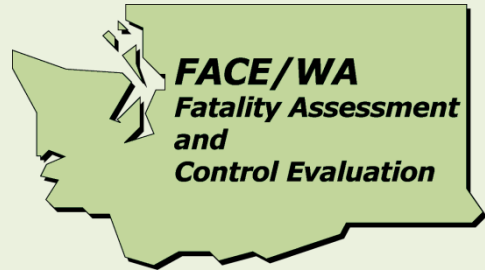


# Orchard Tractor Operator Dies when Run Over by Trailer-Mounted Water Tank Towed by Tractor



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## **SUMMARY**

In October of 2008, a 43-year-old male, Hispanic, foreign-born apple orchard tractor operator died when he was run over by the wheels of a water tank trailer. On the day of the incident during the harvest, he was performing one of his normal job tasks. This task involved the operation of a tractor pulling a trailer-mounted, stainless steel 1,000 gallon capacity water tank to dampen the orchard's compacted dirt and gravel roads to suppress dust while the apple pickers were working.

The orchard was located on a gradually sloping hill. After the victim finished his lunch break in the upper part of the orchard, he proceeded to drive the tractor with the attached nearly full water tank trailer downhill on an orchard road. The orchard road was constructed of dirt and gravel; it was straight, dry, and smooth with an approximate downgrade of 1%. He was not watering down the road at this time.

As the incident was unwitnessed, the incident investigators determined that the victim was operating the tractor downhill in a gear ratio that was too high based on the incident scene evidence. The incorrect gear ratio selected would have allowed the tractor and its attached water tank trailer to gather excessive speed. Because of the weight of the water tank trailer and the high speed at which the tractor was traveling, the brakes on the tractor would not have been sufficient to control the momentum of the tractor and water tank trailer. When he attempted to shift to a lower gear ratio, the gearshift became stuck (jammed) in the neutral position, thus allowing for an out of control descent. Following this the victim fell, jumped, or was knocked from the operator's seat. After landing on the ground, his right leg was run over by a tractor wheel followed by his chest and abdomen being run over by the water tank trailer wheels.

An orchard foreman summoned the orchard manager, who called 911. The manager arrived within a few minutes and administered CPR to the unresponsive victim until emergency services paramedics arrived. The county coroner arrived and pronounced the victim deceased at the scene.

Investigators found the water tank trailer separated from the tractor and lying on its side. The tractor was found resting upright against trees in the orchard. A piece of wire was used instead of a locking safety bolt on the trailer's coupler to hold it on the tractor's hitch. This piece of wire failed just before or just after the victim came off of the tractor. The use of the wire in place of the locking safety bolt allowed the water tank trailer to separate from the tractor. The tractor was determined to be in neutral (out of gear) when examined in the orchard after the accident. Investigators also noted that the tractor did not have a seat belt or rollover protective structure (ROPS).

## RECOMMENDATIONS

To prevent similar occurrences in the future, the Washington State Fatality Assessment and Control Evaluation (FACE) investigation team recommends that agricultural employers should follow these guidelines:

- **Train tractor operators to understand and recognize the hazards associated with operating tractors while traveling downhill towing trailers, implements, and equipment such as water tanks and sprayers. This training should include how to safely operate the tractor and emphasize the importance of reducing speed and downshifting to the appropriate gear for the slope and terrain.**
- **Maintain in a safe condition towing connections between tractors and all equipment including trailers, implements, and other attachments, and remove from service if in need of repair.**
- **Follow manufacturer's specifications for connecting tractors to trailers, implements, and other towed equipment.**
- **Ensure that tractors are equipped with a rollover protective structure (ROPS) and a seat belt.**

## **INTRODUCTION**

In October of 2008, the Washington FACE Program was notified by the Division of Occupational Safety and Health (DOSH) of the death of a 43-year-old male, Hispanic, foreign-born apple orchard laborer. The victim was driving a tractor pulling a trailer-mounted water tank downhill on an orchard road when he fell, jumped, or was knocked from the tractor and was run over by a tractor wheel followed by the trailer wheels.

In May of 2012, Washington State FACE investigators went to the company's office and interviewed one of the orchard's managers who is also the safety director. During the course of the investigation, documents reviewed included the victim's death certificate, autopsy report, and DOSH investigation file.

### **Employer**

The employer grows apples and wine grapes. They have been in business since 1991. Fulltime year-round employees number about 50, with seasonal employees numbering between 400 and 550. At the time of the incident, which was apple harvest season, there were about 550 employees. There were about 15-20 other employees who had the victim's job title of "tractor operator."

### **Employer Safety Program and Training**

The employer had a formal, written Accident Prevention Program (APP), as required by law in Washington State. Training was provided verbally "on the job" by foremen and the orchard manager. Newly hired employees would be informed of the company safety policies. Task-based verbal instruction would then be given to employees. For example, foremen would verbally instruct tractor operators in the basics of tractor operation and maintenance. Employees would then be observed by a foreman to ensure that they were able to competently perform their assigned a task. The employer did not have written training materials, nor did they have written documentation of employee trainings.

As the primary language of the orchard workers is Spanish, the training is provided in Spanish only. The foremen and orchard manager are fluent in Spanish and English.

At the time of the incident, the orchard had an employee who assisted the orchard manager with the oversight of safety. The orchard manager estimated that at the time of the incident approximately 25% of his time and 75% of his safety assistant's time was devoted to safety management.

Safety meetings were conducted with employees about every two to three months, generally before a harvest or before pesticides were applied to the orchard. There were no regularly scheduled safety meetings.

## **Victim**

The victim was a 43-year-old Hispanic male born in Mexico. He was an apple orchard laborer employed fulltime year-round. His employer stated that his job title was “tractor operator.” The victim had worked for the employer for approximately 4 years. Previously he had worked as an orchard laborer for another U.S. employer for about 8 years. He was hired by the employer based on his previous experience as a tractor operator. His employer considered him to be a competent tractor operator and an excellent employee.

His job duties at the time of the incident included driving a 1-ton pumper truck to pick up waste from portable toilets located around the orchard and operating a tractor. Previously, he had also applied pesticides to the orchard.

He had lived for 8 years in a town near his place of employment. It is unknown how long he had resided in the United States. His citizenship and U.S. residency status is unknown, though the orchard manager stated that his “papers were in order.” He had some high school education, but he did not receive a diploma. It is unknown what his employment had been in Mexico. The victim spoke and read Spanish, which was his native language. He spoke very little English and did not read it.

On the day of the incident the victim was performing one of his normal job duties which involved operating a tractor pulling a trailer-mounted 1,000 gallon capacity water tank to water down the orchard’s dirt roads to suppress dust.

## **Equipment**

The equipment involved in this incident included a tractor with an attached trailer-mounted water tank. The tractor was an 80-horsepower utility “narrow” type tractor, which is designed for use in orchards, vineyards, and nurseries where it can more easily maneuver in cramped spaces (see photo 1). This type of tractor was designed to pull a variety of equipment or implements, including water tanks and sprayers. It was manufactured sometime between 1987 and 1992. It did not have a seat belt or a rollover protective structure (ROPS). According to the orchard manager, this tractor was considered a “spare” tractor that was used when other tractors were not available. The victim had previously operated this tractor. The DOSH investigation determined that before the incident the tractor was in good working condition.

Attached to the tractor was a single-axle, trailer-mounted, stainless steel 1,000 gallon capacity water tank (see photo 2). This type of water tank is also known as a “nurse tank.” It was used to dampen compacted dirt and gravel orchard roads to suppress dust while fruit pickers were working.



**Photo 1: Tractor involved in the incident. It did not have either a rollover protective structure (ROPS) or a seat belt installed.**



**Photo 2: 1,000-gallon capacity trailer-mounted water tank that was being towed by the tractor.**

## **Incident Scene**

The incident occurred on and adjacent to an apple orchard road composed of gravel and compacted dirt. The road, which ran along the edge of the orchard, had approximately a 1% grade. The road was straight and at the incident site appeared to be dry, smooth, and without ruts, potholes, or other obstructions. Graders were used to maintain the road surface. Between the road and the orchard was a grass and dirt shoulder on which the trailer-mounted water tank came to rest. Beyond the shoulder were rows of trellised apple trees running parallel to the road. The tractor penetrated the first row of trees and came to rest against trees in the second row. About 30 laborers were picking apples in the vicinity.



**Photo 3: Compacted dirt and gravel road along which the victim drove the tractor with the attached water tank trailer prior to the incident. The victim drove along the road in the upper left of the photo and turned right and traveled downhill several hundred yards.**





**Photo 4: Incident scene with overturned water tank trailer looking uphill along dirt and gravel orchard road.**

### **Weather**

The weather at the time of the incident was mostly cloudy with a temperature of 61 degrees Fahrenheit and a wind speed of 11 miles per hour with wind gusts of 16 mph. There had been no measurable precipitation that day or for the previous eight days.<sup>1</sup>

### **INVESTIGATION**

In October of 2008 on the day of the incident, during the apple harvest, the victim was performing one of his normal job duties. He was operating a tractor pulling a trailer-mounted water tank along the orchard's compacted dirt and gravel roads. He was applying water which was used to dampen the roads so as to keep down the dust for the apple pickers. After performing this task during the course of the morning he took a lunch break in the upper part of the orchard. The orchard is located on a gradually sloping hillside.

At approximately 11:50 am, the victim ended his break. He proceeded to drive the tractor with the attached water tank trailer east along an orchard road in the upper part

of the orchard. He was not watering the road at this time. He turned right and continued downhill along another road on the orchard's eastern perimeter. According to the orchard manager, it is unknown where he was headed. He had a cell phone, which he could use to contact his supervisor, but he had not done so, nor had his supervisor called him.

As the incident was unwitnessed, the following probable scenario of what happened next is speculation on the part of the orchard manager and the DOSH investigator based on the evidence at the incident scene.

As the victim continued to drive the tractor downhill, the tractor and attached water tank gathered speed. At this point, he had travelled several hundred yards downhill. The weight of the nearly full 1,000 gallon capacity water tank he was towing was, as a result of gathering momentum, causing the tractor to accelerate. He may have realized the tractor was going too fast for him to maintain control and, presumably, he would have attempted: (a) to apply the tractor brakes, (b) to shift the tractor into a lower gear. He would have found these efforts insufficient to slow the tractor and would have not been effective because of the speed and weight of the tractor and the water tank trailer. The tractor was found out of gear (in neutral), which means that it would have been accelerating, and out of control of the operator.

At approximately 11:55 am, the operator lost control of the tractor and water trailer while descending the roadway. At some time during the descent the victim fell, jumped, or was knocked from the operator's seat. It is unknown to which side of the tractor he came off. The orchard manager believes that just after the victim hit the ground, partially on the road and partially on the road shoulder, his right leg was run over by a tractor wheel followed by the water tank trailer wheels, which ran over his chest and abdomen.

The coupler on the water tank trailer tongue was missing a locking safety bolt. This bolt secures the coupler ensuring that it does not come off of the ball located on the tractor's hitch. Instead there was a piece of metal wire where the bolt should have been. If the trailer coupler comes off the tractor ball, then the trailer becomes separated from the tractor. That is what happened to the water tank trailer when the metal wire failed, either prior to the victim coming off the tractor or after he was run over. It is unknown whether the precipitating event was the trailer separating from the tractor or whether the victim jumped or was jolted from his seat. The tractor and water tank trailer now separated continued on downhill.

The tractor continued through the first row of trellised apples trees and came to rest upright against the second row of trees. The water tank separated from the tractor and rolled over and landed on its side on the shoulder of the road against the first row of

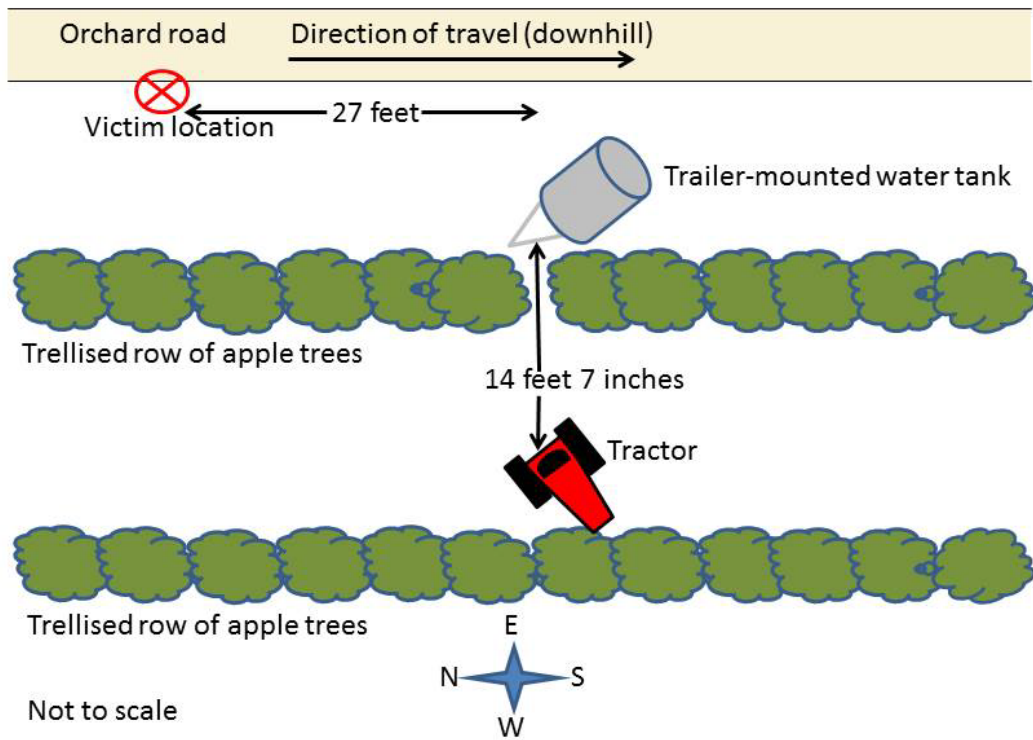
trees. The victim was located 27 feet uphill (north) from the water tank trailer. The tractor was found 14 feet 7 inches west of the water tank trailer.

There were about 30 pickers working nearby in the trellised rows that did not see the incident but heard the crash of the tractor and water tank trailer. Shortly after the incident, a foreman nearby in the orchard used his cell phone to contact the orchard manager. At approximately 12:10, the orchard manager called 911.

The manager then went from the company office located at the bottom of the orchard to the incident site where he administered CPR to the victim as directed by the 911 operator. About 10 minutes later emergency medical services paramedics arrived and took over CPR. A few minutes later personnel from county law enforcement and the coroner's office arrived. The coroner pronounced the victim deceased at the scene.



**Photo 5: View looking downhill at the incident scene showing where the victim was found and the water tank trailer lying on its side.**



**Figure 1: Approximate positions of victim, trailer-mounted water tank, and tractor at incident scene.**



**Photo 6: Water tank trailer tongue and coupler in foreground with tractor behind in orchard row at incident scene.**



**Photo 7: Rear of tractor showing trailer hitch and hitch ball at incident scene.**

## **CAUSE OF DEATH**

According to the death certificate, the coroner listed the cause of death as “multiple internal injuries due to or as a consequence of blunt impact to the chest and abdomen due to or as a consequence of tractor accident.” Postmortem toxicological tests were negative for alcohol and other drugs.

## 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. Washington FACE investigators identified the following factors that may have contributed to the death of the tractor operator who was run over by the trailer-mounted water tank being towed by his tractor:

- Operating a tractor in a gear ratio too high while traveling downhill towing a heavily laden trailer.
- Operating a tractor at too high of a speed for the slope and terrain and while towing a trailer.
- Tractor did not have a rollover protective structure (ROPS) and a seat belt.
- Operating tractor towing trailer with an improperly locked coupler.
- Trailer was not removed from service to replace a missing safety bolt used to lock the coupler on the trailer hitch.
- No formal company policy or procedures in place to remove defective equipment from service.

## RECOMMENDATIONS AND DISCUSSION

**Recommendation #1: Train tractor operators to understand and recognize the hazards associated with operating tractors while traveling downhill towing trailers, implements, and equipment such as water tanks and sprayers. This training should include how to safely operate the tractor and emphasize the importance of reducing speed and of downshifting to the appropriate gear for the slope and terrain.**

**Discussion:** Employers should train all employees whose job duties include operating farm tractors to recognize the hazards associated with driving a tractor while towing equipment down a hill or slope. This training should emphasize that failure to operate a tractor at a safe speed and in an appropriate gear while going downhill may result in an out of control descent, possibly resulting in the tractor and its attachment jackknifing, rolling over, or crashing into trees or terrain.

The training of tractor operators should include general principles of safe tractor operation and how tractors work. This training should be specific to the tractors the employees will be operating.

Employees should be instructed how to safely operate tractors while traveling downhill. The training should include instruction in tractor braking, clutching, and gear shifting. Instruction should also emphasize how towing equipment, trailers, and attachments can affect the operation of a tractor as it travels downhill.

The following are considerations that should be incorporated into safety training for tractor operators:

- When towing equipment consider how this will affect the operation of the tractor, especially when traveling downhill.
- Choose the appropriate gear for the slope and terrain.
- Reduce tractor speed to maintain control.
- When going down a slope, do not depress the clutch or try to change gears.
- Consult the tractor operator's manual for proper operation of the tractor when going down a slope.

As objects move downhill, such as the tractor and attached trailer-mounted water tank in this incident, they gather momentum. Momentum is a product of velocity and mass. To put it simply, in this incident the forward movement of the tractor with the attached tank containing nearly 1,000 gallons of water was affected by the speed at which they were traveling and their weight. The victim apparently failed to recognize the combined weight of the tractor and water tank by using a gear that was too high for him to maintain control.

The tractor brakes were not sufficient to slow the tractor because of the weight being applied and the speed of travel. When the victim attempted to downshift to a lower gear he was unable to do so, getting stuck in neutral, which allowed momentum to increase, causing the tractor to gather further speed and create an uncontrolled runaway situation. Investigators found the tractor out of gear. It is not known in what gear the victim was operating the tractor prior to the incident.

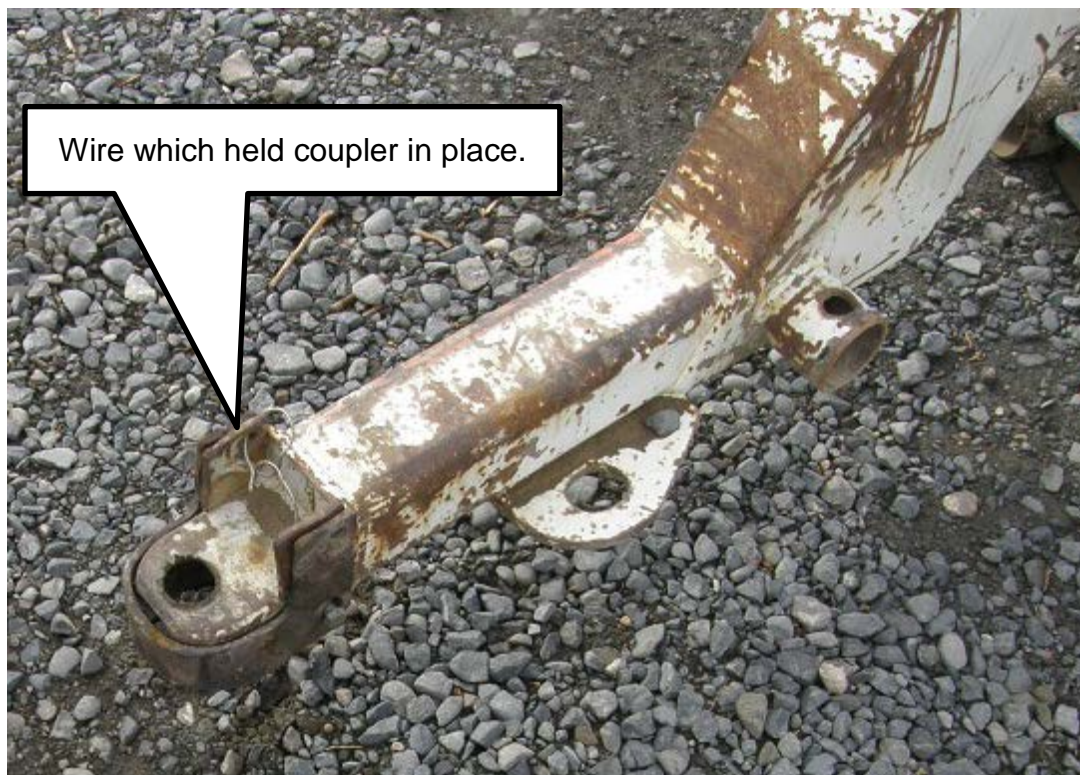
**Recommendation #2: Maintain in a safe condition towing connections between tractors and all equipment including trailers, implements, and other attachments, and remove from service if in need of repair.**

**Discussion:** As part of a walk-around inspection before use, the tractor operator should check that the connections between the tractor and the equipment to be towed are in good condition and properly secured.

If towing connections such as hitches, hitch pins, locking bolts, couplers, drawbars, etc. are broken or otherwise not safe to use, remove from service immediately. Failure to do

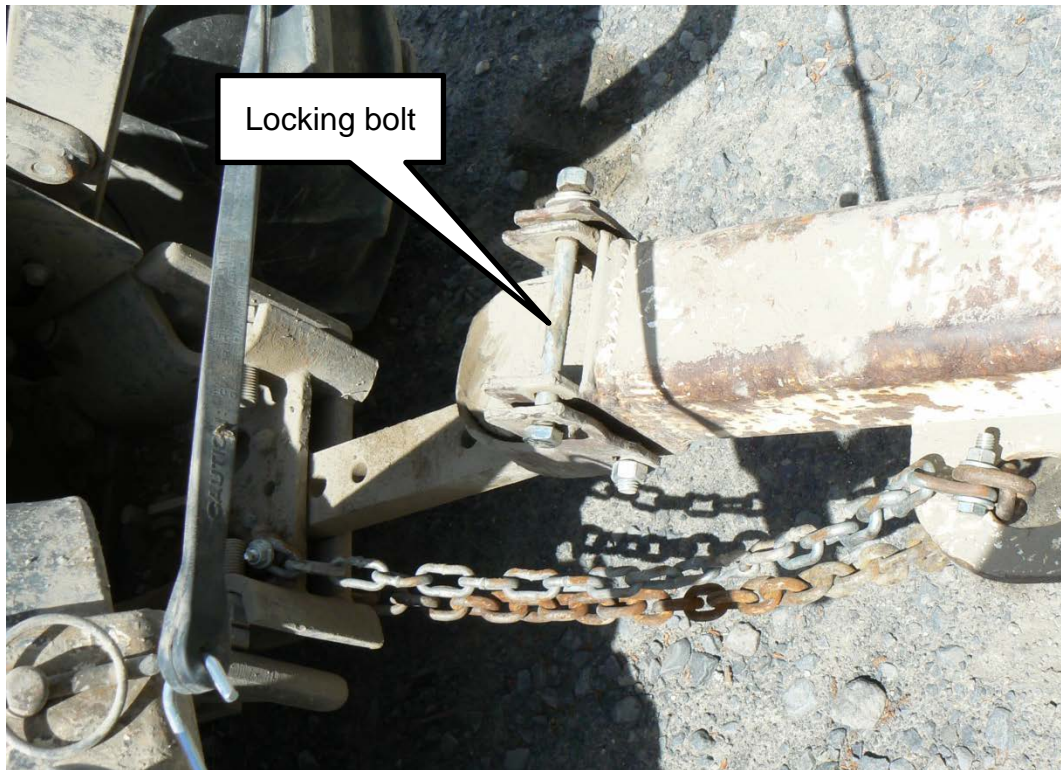
so may result in towed equipment separation from the tractor hitch. This could cause loss of control of the tractor and endanger the safety of the operator, as well as other employees in the vicinity who could be struck by the runaway equipment.

In this incident, the trailer became separated from the tractor. A piece of wire was used to replace a missing locking bolt on the coupler. As the tractor sped downhill, the wire broke under dynamic force either before or after the victim jumped, fell or was knocked from the tractor. This allowed the coupler to come off the ball on the tractor's hitch and caused the trailer-mounted water tank to become detached from the tractor.



**Photo 8: Coupler and water tank trailer tongue after the incident. A piece of wire was used to replace the missing locking bolt.**

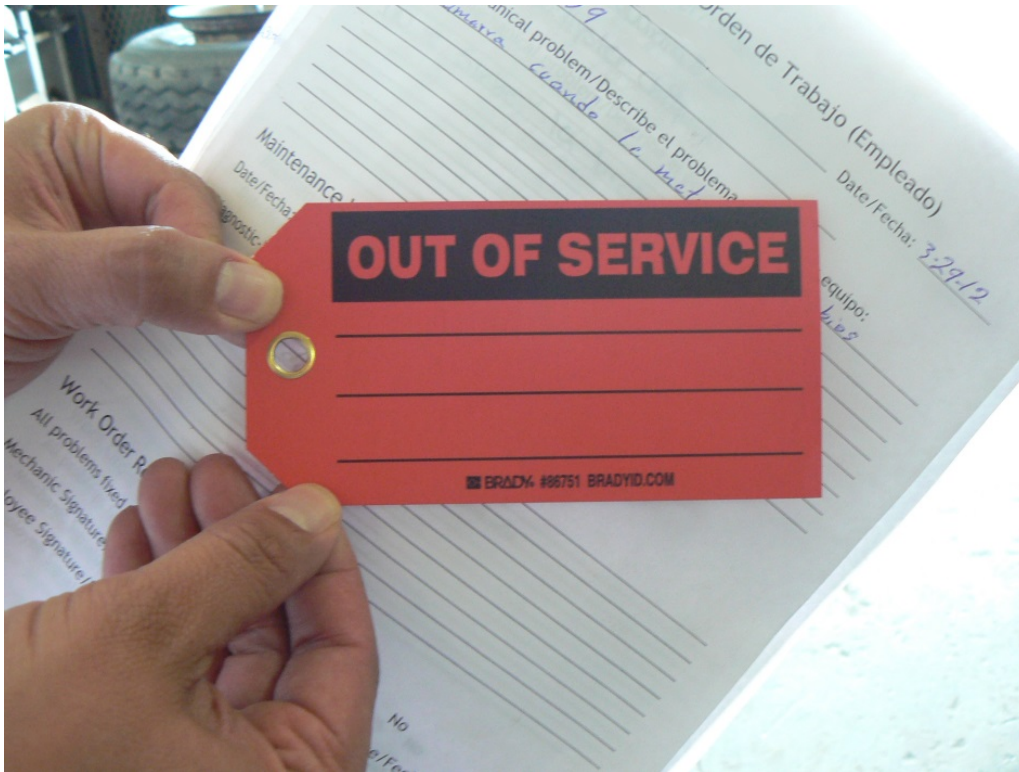




**Photo 9: Coupler properly attached to trailer hitch and ball using a locking bolt.**

The practice of using a piece of wire to replace the missing coupler bolt, such as in this incident, is not an uncommon practice on farms. The authors of a study of the use of agricultural hitch pins concluded that “a significant number of hitch pins in use on farms are non-standard, damaged, or inappropriately sized, with the potential for unexpected failure or disengagement that could lead to personal injury or property damage.”<sup>2</sup> Additionally, the study found that farmers did not adequately consider the benefit of replacing missing, worn, or damaged hitch pins with ones that were appropriate for the application.

At the time of the incident, the employer did not have a policy of removing defective equipment from service. After the incident, the employer created and enforces a policy that if equipment is in any way not working properly an employee should not use it, put an “out-of-service” tag on the equipment, and fill out a maintenance form describing what is in need of repair so that a mechanic can fix it.



**Photo 10:** Post-incident the employer created an “out-of-service” tag and maintenance form that employees are required to use for equipment in need of servicing.

**Recommendation #3:** Follow manufacturer’s specifications for connecting tractors to trailers, implements, and other towed equipment.

**Discussion:** Consult and follow the towing guidance provided by the manufacturer operator’s manual for all tractors, trailers, implements, and equipment. Proper hitching will prevent accidental release of towed equipment.

**Recommendation #4:** Ensure that tractors are equipped with a rollover protective structure (ROPS) and a seat belt.

**Discussion:** The incident tractor did not have a ROPS and a seat belt installed. While in this incident the tractor did not roll over, an out of control tractor traveling downhill is at high risk of rolling over. In the event of a rollover, a ROPS along with a seat belt would provide a protective zone for the tractor operator.

Washington State and Federal regulations require that agricultural tractors manufactured after October 25, 1976 have ROPS installed.<sup>3,4</sup> An agricultural tractor

manufactured before October 25, 1976 must be equipped with ROPS if the tractor was built or sold with a ROPS as an optional accessory or if the manufacturer designed the tractors to accommodate the addition of ROPS. Many older tractors do not have nor are they required by regulation to have ROPS. For these older tractors, it is recommended that owners contact the manufacturer or a dealer to see if ROPS can be installed. Also, the University of Kentucky provides an online national resource for locating dealers or suppliers who retrofit ROPS onto tractors.<sup>5</sup>

There are circumstances under which ROPS are not required on agricultural tractors, for example in orchards, vineyards, or agricultural buildings where vertical clearance would interfere with operations. But when the tractor is operated in an area where there are no vertical clearance concerns, then ROPS and seat belt must be used. The victim was operating a tractor on an orchard road with no overhead clearance issues. In this circumstance, Washington State and federal regulations require employers to have ROPS deployed on a tractor.

When ROPS are required on agricultural tractors employers must:<sup>3,4</sup>

- Provide each tractor with a seat belt.
- Require that each employee use the seat belt while the tractor is moving.
- Require that each employee tighten the seat belt sufficiently to confine the employee in the ROPS protected area.

Tractor operators should only wear seat belts in tractors where ROPS are present. Do not wear a seat belt without ROPS. It is the combination of ROPS and seat belt that restrains the operator and provides a protective area in the event of a tractor overturn or rollover.

If the tractor had been equipped with a ROPS and a seat belt, and the operator had securely fastened it, the victim might possibly have survived by staying in the operator's seat in this incident.

In Washington State during the period of 2000-2010 seven tractor operators working in orchards died when the tractors they were operating without ROPS rolled over.<sup>6</sup> In each of these incidents the victims were operating tractors in orchard areas where there were no overhead clearance obstructions that would have prevented the use of ROPS. Employers and tractor operators should realize that when they are operating in areas where there are no overhead clearance issues that using a tractor equipped with a ROPS and seat belt may save a life.

## REFERENCES

1. Weather Underground.  
<http://www.wunderground.com/weatherstation/WXDailyHistory.asp?ID=MSDMW1&month=10&day=14&year=2008>
2. Deboy G.R., Knapp W.M., Field W.E., Krutz G.W., Corum C.L. (2012). *Establishing the need for an engineering standard for agricultural hitch pins*. Journal of Agricultural Safety and Health, 18(2):141-154.  
<http://www.ncbi.nlm.nih.gov/pubmed/22655523>
3. U.S. Code of Federal Regulations. CFR 1928.51 Occupational Safety and Health Standards for Agriculture, Subpart C, Employee Operating Instruction, Rollover Protective Structures (ROPS) for Tractors Used in Agricultural Operations.  
[https://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=10957](https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10957)
4. Washington Administrative Code, Chapter 296-307 Safety Standards for Agriculture, Part F, Rollover Protective Structures (ROPS) for Tractors.  
<http://www.lni.wa.gov/wisha/rules/agriculture/HTML/part-f.htm>
5. University of Kentucky. The Kentucky ROPS Guide: Your Guide to Available Retrofit ROPS for Agricultural Tractors Nationwide.  
<http://warehouse.ca.uky.edu/rops/ropshome.asp>
6. Washington State Fatality Assessment and Control Evaluation (FACE) Program. Unpublished data.

## Investigator Information

**Todd Schoonover** has a PhD in Industrial Hygiene from the University of Illinois at Chicago. He is a Certified Industrial Hygienist (CIH) and Certified Safety Professional (CSP). Todd is currently the Principle Investigator for the WA FACE Program.

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## Washington State FACE Program Information

The Washington State Fatality Assessment and Control (WA FACE) program is one of many workplace health and safety programs administered by the Washington State Department of Labor & Industries' Safety & Health & Research for Prevention (SHARP) program. It is a research program designed to identify and study fatal occupational injuries. Under a cooperative agreement with the National Institute for Occupational Safety and Health (NIOSH grant# 5 U60 OH008487-09), WA FACE collects information on occupational fatalities in WA State and targets specific types of fatalities for evaluation. WA FACE investigators evaluate information from multiple sources. Findings are summarized in narrative reports that include recommendations for preventing similar events in the future. These recommendations are distributed to employers, workers, and other organizations interested in promoting workplace safety. NIOSH-funded, state-based FACE programs include: California, Iowa, Kentucky, Massachusetts, Michigan, New Jersey, New York, Oregon, and Washington. WA FACE does not determine fault or legal liability associated with a fatal incident. Names of employers, victims and/or witnesses are not included in written investigative reports or other databases to protect the confidentiality of those who voluntarily participate in the program.

Additional information regarding the WA FACE program can be obtained from:

[Washington State FACE Program](#)

[www.lni.wa.gov/Safety/Research/FACE/default.asp](http://www.lni.wa.gov/Safety/Research/FACE/default.asp)

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- Federal FACE Program management (NIOSH)
- Safety & Health Assessment & Research for Prevention (SHARP)