

REPORT#: 23MI119

REPORT DATE: 11-20-2024

INCIDENT HIGHLIGHTS



DATE:

Summer 2023



TIME:

Between 8:20-8:30 p.m.



VICTIM:

23-Year-Old Farm Worker



INDUSTRY/NAICS CODE:

Hay Farming/111940



EMPLOYER:

Private Employer



SAFETY & TRAINING:

Informal/Hands On



SCENE:

Open Field



LOCATION:

Michigan



EVENT TYPE:

Entanglement in a Round
Baler

Farm Worker Found Entangled in Round Baler

SUMMARY

Late summer 2023, a 23-year-old male farm worker was employed to bale hay. The hay owner was not present when the worker started the job but spoke to him on the phone that night just after 8pm. The hay owner texted the worker asking he call when he finished that field, because there was another field to be done. When the hay owner arrived at the field, ... [READ THE FULL REPORT](#)> (p.3)

CONTRIBUTING FACTORS

Key contributing factors identified in this investigation include:

- Not disengaging the PTO and shutting off the tractor engine before inspecting, servicing, or unplugging a baler.
- Time pressure due to the incoming rain and need to get the hay baled.
- Risk tolerance driven history of unplugging without disengaging the PTO and shutting down the tractor.
- Not completing documented hazard recognition and control training including ability to operate under the conditions.
- Lack of engineering controls to provide for safe unclogging without total shut down. [LEARN MORE](#)> (p.7)

RECOMMENDATIONS

NIOSH investigators concluded that, to help prevent similar occurrences, farm equipment operators should:

- Disengage the PTO and shut off the tractor engine before inspecting, servicing, or unplugging a baler.
- Complete hazard recognition and control training for the operated equipment and demonstrate competency and ability to operate equipment under conditions of the work location.
- Develop and put in place written safe operating procedures for equipment. Provide training on the procedures... [LEARN MORE](#)> (p.7)





MICHIGAN

State **FACE** Program

Fatality Assessment & Control Evaluation

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Michigan Fatality Assessment and Control Evaluation (FACE) Program

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SUMMARY

Late summer, a 23-year-old male farm worker was employed to bale hay in a field leased by the hay owner. The hay owner asked the worker to bale the hay at a fixed rate per bale. Rain was predicted that day. The hay owner was not present when the worker started the job but spoke to him on the phone that night just after 8:00 pm. After the phone call, the hay owner stated he texted the worker asking he call when he finished that field, because there was another field to be done. The hay owner had called the worker while he was driving to the field from a location approximately 43 miles away. When the hay owner arrived at the field, the tractor was found stopped, but running high idle with the baler engaged. A nearby resident came out into the field and told the hay owner he had seen the worker 15–20 minutes earlier. The baler service door was found open. The hay owner turned off the power take off (PTO). The resident observed red fluid on a tire. Upon cracking the door to the baler, the farm worker was found entangled in the machine and unresponsive with no pulse. Emergency Medical Services (EMS) were called at 8:44 pm and arrived on scene at 8:51 pm. Death was pronounced at 8:58 pm. Based on these facts the time of the incident is estimated to have occurred between 8:20 pm and 8:30 pm.

INTRODUCTION

A 23-year-old farm worker was killed when he became entangled in a New Idea 4854 round baler in late summer 2023. The Michigan Fatality Assessment and Control program (MIFACE) learned of this incident upon receiving notification from the Michigan Occupational Safety and Health Administration (MIOSHA). Available records from police, EMS, the medical examiner, and MIOSHA were reviewed. MIFACE conducted phone interviews with the decedent's father, the hay owner, a round baler equipment manufacturer, and agricultural engineers and equipment experts at Michigan State University. Pictures used in the report are courtesy of the responding police department.

HAY OWNER

The hay owner leased the fields to grow hay for his horses. The hay owner told police another farm worker was scheduled to bale his field, but their equipment was not operable. Due to approaching rain, he reached out to the 23-year-old farm worker who replied he could do it. The employment arrangement entailed a fixed rate per bale. The farm worker provided his own family farm owned equipment and fuel and performed the work independently.



Photo 1: Tractor and baler as found during EMS response.
(Photo source: responding police department.)

FARM WORKER TRAINING and EXPERIENCE and WRITTEN PROGRAM

Written Safety Program

The hay owner and farm worker had no written safety and health programs related to the safe operation of the baler.

Experience

The experience in this case is one of multi-generational family farming. The farm worker's father had 40 years of experience running farms and had learned farming in a multi-generational farming family. He stated at the time of the incident, his son (the farm worker) was working 10–12 hours a day as a crop manager for a dairy farm. He also stated his son routinely worked alone when running their small family farm, something he had been doing since he was 16 or 17. The family farm equipment included three tractors, one or more balers, and trailers to haul hay. The farm worker was using his family's tractor and round baler at the time of the incident.

The father stated the round baler involved in the incident was obtained used in 2022 and only used 3–4 times in the 2022 season by his son. He stated his son had been running the baler himself in 2023. It was not specified how many times prior to the incident. The last time the farm worker baled hay for the hay owner was about a year before using the round baler. The hay owner's understanding of the farm worker's experience and training was described as conversational—through meeting him and talking with him—he seemed to know how to do the work. The farm worker's father reported having multiple conversations with his son regarding shutting down the PTO before exiting the tractor for unclogging. The most recent time was approximately six weeks before the incident.

Training

The father described the farm worker's training as hands on training on various farm equipment from a young age, learning from his grandfather and father how to operate the farm equipment.

WORKER INFORMATION

The worker was 23 years old. Per his obituary information, he had worked with his father on their family farm for several years after high school graduation, and at another large farm as crop manager full time for the year prior to the incident.

WEATHER

The police report indicated weather at the time of the response to the field as light rain, 73 degrees Fahrenheit, relative humidity of 68%, winds west/north-west 10 mph. The police report referenced the weather source as Weather Underground, at time 2053 on the day of the incident. The hay owner stated it was not yet raining when he found the farm worker entangled.

INVESTIGATION

Timeline

The last communication between the hay owner and the 23-year-old farm worker was just after 8:00 pm by phone. The hay owner was not on scene but in transit to the field from another location. It is not known exactly when the hay owner arrived at the field. When he did arrive, he stated he found the tractor stationary but running on high idle and PTO engaged to the baler. Four bales had been completed prior to the incident. A nearby neighbor came out to meet the hay owner upon arrival and stated he had seen the farm worker about 15–20 minutes prior. Shortly after shutting the tractor down the two men discovered signs of blood and then opened the rear ejection door and found the farm worker inside the baler. The hay owner called for emergency services at 8:44 pm. Based on the witness seeing the farm worker 15–20 minutes before, the time of the incident was likely to be in the 8:20–8:30 pm time frame.

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Weather and Time Pressure

The hay owner requested the farm worker do the work due to the pending rain and unavailability of another farm worker who he had planned to use. A sense of urgency was conveyed. This included the hay owner sending a text requesting the farm worker let him know when the field was baled as there was another field to complete before the rain started, introducing a time pressure as a contributing factor.

Maintaining correct moisture content of baled hay is important. If moisture content is too high the baled hay can become moldy. At certain levels of higher moisture, the bale can be wrapped to prevent molding by excluding oxygen, similar to silage. However, sources indicate it is best to bale hay in the first 4–5 days after cutting to retain nutrients and quality of feed. Re-dried or over dry hay loses nutrient value. Although over-dry hay is rarely an issue in Michigan due to our higher humidity and moisture conditions. See [Making and Storing Quality Hay | MU Extension \(missouri.edu\)](#). Therefore, the timing of baling in relation to cutting is important for hay making and storage. In this case, the hay owner stated baleage was not desirable for horses, so getting the hay baled before rain was the goal.

Equipment and Controls

The equipment being used included a Model 4854 New Idea round baler and Model F806 Farm All 5500 tractor. The 4854 model is a twine wrapping round baler producing 4.8-foot diameter x 4-feet wide bales weighing up to 1000 pounds. The baler ran off a 540 revolutions per minute (rpm) PTO. Based on information available the baler was approximately 26 years old. The Farm All 5500, Model F806 was a diesel driven, 110 horsepower tractor, made between 1963 and 1967, weighing 8500 pounds. The PTO was dual speed independent at 540 and 1000 rpm ratings. The PTO is actuated by levers located near the right rear of the farm worker seat. The tractor was found in the field still running on high idle, with the PTO engaged.

MIOSHA ACTIONS

MIOSHA initially opened an inspection and attended the site. MIOSHA later determined the case was not covered because a de minimus value was exchanged for services. A notice of no citation was issued. Unlike Federal OSHA, MIOSHA may conduct inspections of small farms with 10 or fewer employees using state funds. See MIOSHA instruction [MIOSHA-ADM-06-7.pdf](#) for details.



Photo 2: New Idea Model 4584 baler with inspection door found open. (Photo source: responding police department.)



Photo 3: New Idea 4854 baler pickup entry. (Photo source: responding police department.)

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Photo 4: New Idea 4854 baler entry looking into baler pickup entry from front.
(Photo source: responding police department.)



Photo 5: New Idea 4854 baler rollers and belts. View is from right rear.
(Photo source: responding police department.)

CAUSE OF DEATH

The medical examiner report stated cause of death was craniocerebral injury due to blunt head trauma. Manner of death was reported as accident. The Toxicology screening findings were positive for ethanol, blood alcohol content (BAC) 0.042 gram per 100 milliliters, which was below the legal limit of 0.08 grams per 100 milliliters for Michigan drivers (Michigan Section 257.625). At the time of the incident a half consumed open beer was noted in the tractor farm worker location, with another in a cooler. Contributing injury findings presented in the medical examiner's report included:

- Crushing injuries to the head and body
- Cerebral lacerations and multiple skull fractures
- Pulmonary and heart lacerations
- Bladder lacerations
- Multiple rib fractures
- Left clavicle fracture
- Pelvic fracture and dislocation

CONTRIBUTING FACTORS

Occupational injuries and fatalities are often the result of one or more contributing factors or key events in a larger sequence of events that ultimately result in the injury or fatality. The following hazards were identified as contributing factors in this incident:

- Not disengaging the PTO and shutting off the tractor engine before inspecting, servicing, or unplugging the baler.
- Not completing documented hazard recognition and control training including ability to operate under the conditions.
- Time pressure due to the incoming rain and need to get the hay baled.
- Risk tolerance history of unplugging without disengaging the PTO and shutting down the tractor.
- Lack of manufacturer or aftermarket engineering controls to provide for safe unlogging without total shut down.

While not a contributing factor, it is important to note that even small amounts of alcohol can reduce reaction time and impair fine motor skills.

RECOMMENDATIONS

Recommendation #1: Disengage the PTO and shut off the tractor engine before inspecting, servicing, or unplugging the baler.

Discussion

The baler in this incident was clearly labeled near the in-running nip point with a danger warning and recommended precautions. The tractor was found running on high idle with the PTO engaged to the baler. At an intake rate of 3-4 feet per second, reflexes of the worker can't be relied on to safely perform, without injury, clearing or adjustment at the in-running baler pickup roller splines. It should be noted that the in-running pick-up tines are normally unguarded in terms of physical guarding. The intake tines are normally guarded by location when the operator is in the seat of the tractor.

Agriculture regulations found in federal OSHA regulations at 29 CFR 1928.57(a)(6), are adopted in Michigan by Part 53, Section 408.45301. They require instructing operators to use safe operating practices including stopping the engine, disconnecting the power source, and waiting for all machine movement to stop before servicing, adjusting, cleaning, or unclogging the equipment. An exception is provided in the regulations for when the machine must be running to be properly serviced or maintained. In those cases, the steps and procedures necessary to safely service or maintain the equipment are to be used. This exception would require equivalent safety measures that do not include placing body parts in the danger zone of the in-running equipment with the PTO still engaged.

For prevention, in the absence of equivalent means to safely unclog, MIFACE requires following MIOSHA Part 53 regulations and manufacturer warnings. Specifically, ALWAYS disengage the PTO and shut down the tractor when unclogging, maintenance, or adjustment is needed.

An engineering control to prevent exposure to the engaged baler by shutting off the PTO, is a properly installed and adjusted after-market Operator Sensing Safety Device (OSSD) (reference: [Safety For Agricultural Field Equipment ANSI/ASABE S318.19 section 4.8 \[behind paywall\]](#)). These pressure sensing devices can be installed in the seat of the operator and can shut down power to selected equipment if the operator is absent from the control position. It is recommended the manufacturer, or a farm machinery qualified servicing entity be consulted as needed to determine proper design and installation compatibility for individual devices.

Recommendation #2: Farm equipment operators should complete hazard recognition and control training for the equipment they operate and demonstrate competency and ability to operate under conditions of the work location.

Discussion

MIOSHA regulations require hazard control training. The Michigan agriculture regulation in Part 53, Section 408.45301 adopted the federal OSHA regulations at 29 CFR 1928.57(a) through (c). The parts of the regulations that directly relate to this incident include:

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- A requirement at the time of initial assignment and at least annually, to instruct every employee in the safe operation and servicing of all equipment. The instruction is to include safe practices such as: *stopping the engine, disconnecting the power source, and waiting for all machine movement to stop before servicing, adjusting, cleaning, or unlogging the equipment.*
- The regulations also include an exception for situations when the machine must be running to be properly serviced or maintained. In those cases, the instruction is to include all steps and procedures which are necessary to safely service or maintain the equipment.



Photos 8/9: (Left) The location of the warning labels on the hay baler. (Right) An enlargement of the top warning label. (Photo source: responding police department.)

Additionally, farm equipment operators should be required to demonstrate comprehension of safe operating practices through a combination of written and hands-on testing. Although not applicable to agriculture, MIOSHA General Industry Safety Standard, Part 21 - Powered Industrial Trucks provides guidance for a farm owner regarding a practical test for an operator. Part 21 (Rule 2153) mandates that the hay owner test the employee before authorizing them to operate the powered industrial truck. The test should check employee knowledge of the equipment and their operating ability, that is - can they operate the powered industrial truck (farm equipment) through the functions necessary to perform the required work. This type of training would include instruction in hazards of the equipment and methods to control the hazards, including safely unlogging or adjustments to the baler or other equipment.

Training Sources

The Maryland Farm and Harvest video “How Do Round Balers Work?” is available on YouTube at [How Do Round Balers Work? | MD F&H](#). It provides a look at internal workings of how a round baler works including splines, belts, augers, feeder bar with tines, rollers and the wrapping and ejection functions.

Clemson University published an article “Farm Safety Considerations for Hay Season” April 14, 2021, by Marion Barnes, Senior County Extension Agent, at [Farm Safety: Safety Considerations for Hay Season – Livestock and Forages \(clemson.edu\)](#). This article specifically addresses hazards involved in hay harvesting and transportation. It describes pull

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in or wrap rates involved for typical PTOs (540 RPM, 7 feet per second); a baler (3 mph travel, 4 feet per second); and belts, chains, and pulleys (66 feet per second).

Equipment Operator Manual Review. Manufacturer operator manuals and maintenance manuals contain critical information on operating limits and safety hazards and recommended controls and practices in use. This information should be used to ensure adequate training of equipment operators to ensure understanding of site conditions in relation to the operational limits of the equipment, such as terrain, slope, turn radius, speed, and shut down requirements. Knowledge of these safety measures should be demonstrated prior to use.

There are historical online New Idea videos on YouTube for the 4800 series balers including [New Idea 4800 Series Variable Chamber Round Balers - Features and Benefits Promotional Video 1995](#).

Farm owners can utilize [national safe tractor and machinery operation program student manual](#), revised 3rd edition published by Penn State Extension. The publication contains a layout of the driving/skills test course as an example to ensure tractor operator's skill to safely and efficiently start a tractor and hitch to a wheeled or 3-point implement as well as to safely and efficiently drive a tractor pulling a two-wheel implement through a specified course with spaces and borders.

The National Ag Safety Database made available a set of Agricultural Tailgate Safety Trainings. One such training available is "[Using Hay Harvesting Equipment Safely](#)", developed by The Ohio State University Extension. This article addresses baling conditions including the need to conduct baling efficiently and quickly, as changing weather conditions can devalue crop. This training also refers to others in the series on tractor safety, cutter bar safety, and PTOs.

This [Farm-Related Machine Entanglements](#) Hazard Alert by Michigan State University, Office of Environmental and Occupational Medicine provides information on Michigan specific entanglement cases involving PTOs and other rotating components on a variety of equipment and emphasizes preventive actions.

Recommendation #3: Farms should develop and put in place written safe operating procedures (SOPs) for equipment and provide training on the procedures to any farm worker before being allowed to operate the equipment unsupervised.

Discussion

Written programs and procedures can establish documentation for safe work practices such as equipment inspection, job task safety, and safety training. There is no legal requirement in Michigan for a written safety plan in agriculture. However, a written safety plan can help identify factors that can contribute to an injury, illness, or fatality.

Round Baler Safe Work Practice: An example of a round baler specific safe work practice is available for free download as an editable Microsoft Word document ([SWP Round hay baler.doc](#)) from the Tasmanian government, Australia. This simple, one page document effectively addresses equipment inspection and maintenance safe practices and identifies dangerous practices in a succinct way.

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Other resources for development of written farm equipment Safe Work Practices:

- [“Safely Making and Handling Large Hay Bales”](#) August 17, 2022 by Penn State Extension. This article includes emphasis on avoiding entanglement hazards from PTO and Round Balers.
- [Farm Safety Starter Guide](#) from Australia provides templates for farm hazard mapping and examples and templates for risk assessment.
- [Michigan Farm Bureau's Agricultural Labor and Safety Services \(ALSS\) program](#) has many farm-related safety topics, including farm hazard assessment checklists, emergency preparedness plans, and links to other farm safety issues.
- [Farm Safety Planning Templates and Checklists](#), Iowa's Center for Agricultural Safety and Health.
- [National Safe Tractor and Machinery Operation Program](#). Penn State Extension.

DISCUSSION

Clogging

Clogging and the extent of effort needed to unclog is well known in the farming community. Functionally, a round baler is lifting a large volume of forage from the field and compressing it from thickness measured in feet down to a thickness of inches as it rolls the layers into a round bale at a rate of 3–4 feet per second.


Per the hay owner, who stated he has been baling hay since he was a child, clogging can happen even when there is a mainly dry field of hay if in one spot there is a heavy area of hay in the windrow. This heavy slug of hay can be moisture filled and more solid, and up to the size of a basketball. When the reel picks it up the slug will not pass to the rollers and begins a clog build up. The clog can be so tightly in place around the tines of the feeder, it is not easily removed and may require cutting tools. Due to the confined area and inability to turn the feeder once the equipment is disengaged, this becomes a tedious, manual, and time-consuming process.


The process of unclogging is often described by those who have done it as highly undesirable. The process often involves work lying under or reaching in the baler from the front, using manual or battery powered cutting and prying tools, such as a cordless saw, to cut and remove compressed sections of material from the confined area toward the rear of the feed tines. In addition, it is possible to encounter biting or stinging insects or even a snake caught up in the process from its field habitat.


(Your Business Name Here) – Safe Work Procedure
ROUND HAY BALER


DO NOT use this machine unless you have been instructed in its safe use and operation and have been given permission

PERSONAL PROTECTIVE EQUIPMENT


FOOT PROTECTION MUST BE WORN


EYE & HEARING PROTECTION MUST BE WORN


SUNSCREEN MUST BE WORN


PROTECTIVE CLOTHING MUST BE WORN

PRE-OPERATIONAL SAFETY CHECKS

- ✓ Locate and ensure you are familiar with all machine operations and controls.
- ✓ Ensure all guards are fitted, secure and functional. Do not operate if guards are missing or faulty.
- ✓ Drive shafts and other moving parts must be guarded. Inverted U-shaped guards are inadequate.
- ✓ Check for loose/missing nuts, bolts and screws. Tighten and/or replace as needed.
- ✓ Replace bent or missing pickup teeth to ensure effective feeding of material into the feed rolls.
- ✓ Inspect all belts or chains for evidence of wear or breakage. Maintain belt tension according to the manufacturer's recommendations.
- ✓ Match belt lengths to prevent slippage that can cause blockages and heat build-up.
- ✓ Before replacing a belt or chain, consult the manufacturer's recommendations for instructions on securing the upper chain or moving load from the belt tension springs.
- ✓ Check the slip clutch, roll scraper and rear gate latch to ensure they are adjusted and functioning according to the manufacturer's recommendations.
- ✓ Ensure the hydraulic hoses are clean, in good repair and hooked up correctly.
- ✓ Ensure the hay baler is attached according to manufacturer's recommendations.
- ✓ Check that the twine feeding and cutting mechanisms are working properly and that the twine is in good condition.

OPERATIONAL SAFETY CHECKS

- ✓ When doing maintenance work, disengage the PTO, turn off the tractor, lock the tractor brakes, and remove the ignition key. Check the baler wheels. Ensure all moving parts have completely stopped.
- ✓ Operate the machine at a safe speed.
- ✓ When operating over rough terrain or on hillsides, take care to avoid holes or obstacles that can tip a windrow or throw you from the machine.

✓ When ejecting a bale, ensure the area behind the baler is clear before raising the tailgate. Do not eject on a downward slope as the bale may continue to roll.

✓ If the tailgate must be opened for maintenance or repair, install a mechanical hydraulic cylinder lock out device to prevent accidental gate closing.

CLEANING UP

- ✓ Remove any foreign material from in and around moving parts.
- ✓ Clean the baler to remove accumulated crop debris.

POTENTIAL HAZARDS

- ⚠ Hair/clothing getting caught in moving machine parts.
- ⚠ Noise.
- ⚠ Thrown object hazards.
- ⚠ Crushing hazards.

DONT

- ✗ Do not use faulty equipment. Report suspect machinery immediately.
- ✗ Never remove blockages or make adjustments until you have disengaged the PTO and shut off the tractor engine.
- ✗ Never feed the material into the baler with your hands or feet.
- ✗ Never handfeed or remove twine from the machine while it is running.
- ✗ Never leave the tractor seat with the engine running, even if the PTO is disengaged.

This SWP does not necessarily cover all possible hazards associated with this equipment and should be used in conjunction with other references. It is designed as a guide to be used to complement training and as a reminder to users prior to equipment use.

This information is based on material published by the South Australian Department of Education and Children's Services.

Driving Factors Affecting Risk Tolerance

The recommendation to shut down the PTO and turn the tractor off before conducting maintenance including unclogging has been a consistent recommendation in 11 prior baler entanglement FACE reports (see the additional sources of information section). Nevertheless, baler entanglement fatalities continue to happen, mainly on older equipment. An effort was made by MIFACE to explore the issues that drive farm workers to continue to take operational risks and become entangled, and whether possible feasible measures or modifications exist for older machines that may improve safety.

It is believed the following factors contribute to farm worker risk tolerance in dealing with clogs without shutting down the PTO:

Factor 1: Preserving feed quality and preventing moisture ruin. Baling hay is often a task that involves a short window of time to reach low moistures for the prevention of mold growth. Introduction of severe clogs that take up to 60 minutes each to manually remove by pulling and cutting, especially multiple or repeated times, presents a clear motive to a farm worker to find ways to avoid such delays.

Factor 2: Unable to restart baler without dumping partially baled hay. It was reported that on many balers, if there is a certain amount of hay already rolled, the force of the weight of the bale on the system may be too great to be able to restart the baler once it is shut down for unclogging. In that case it would require dumping the round of hay in the current unbaled state out into the field. This means the bale would have to be manually pulled apart or unrolled and possibly raked or baled again. Time pressure is further compounded when already baled hay is dumped and worked manually or be a loss.

Factor 3: Unable to rotate feed mechanism to release bound material. Shutting down the PTO with the clog firmly compressed in the rotation of the feed mechanism means there is no way to rotate the feed mechanism to release the pressure on the bound-up material. This means once shut down the farm worker will be forced to manually pull and cut at the bound material compressed in the rear of the roller and tines.

Factor 4: Potential for mechanical damages to baler. Shutting down with the amount of force in play can lead to mechanical damages during either the shut down or attempt to restart, significantly adding to expense and time involved due to repairs while the crop is further damaged or becomes waste.

Alternative Solutions

Lack of incorporated engineering controls and persistence of the plugging issues on older equipment has led to individuals developing homemade alternatives. Due to possible inherent safety issues and lack of appropriate evaluation, MIFACE does not endorse these methods, and is not aware of any such solutions endorsed by manufactures or regulatory agencies.

Manufacturer Engineering Improvements

In the past 8–10 years, manufacturers of round balers have incorporated engineering solutions into design and safety criteria for newer equipment specifically for clearance of clogs during operation not requiring a full shut down. This substantial improvement in newer baler design is a form of recognition that clogs routinely occur, and the ability to clear them without total shut down is a significant improvement in function and safety. See the article [The Real Deal: Round](#)

[baler intake blockage measures - | Ag Proud](#). The article describes an array of engineering design features that have been developed by manufacturers to address the known operational issue of clogging. These significant design safety improvements include the following features:

- An easily removable, no tool wind guard.
- Closely spaced wind guard rods provide better material control and work with pickup tines to ensure smooth flow.
- Roller wind guards to “pre-densify” the crop before it gets to pick up tines, keeping material moving into the bale chamber.
- Standard main-drive slip clutches.
- Rotor feeders can be reversed.
- Lowering the drop floor – If a blockage occurs, the cutting floor and knives can be lowered from the tractor cab.
- A main driveline clutch design that allows the operator to leave the PTO engaged, dropping the engine RPMs to increase torque, which expels plugging in combination with a dropped floor, creating a temporary larger throat for the plug to pass through.
- A hand clutch that allows disengaging of the intake system and manual wrench reversing of the rotor feeder to back up the intake and dislodge the clog.
- Hydraulically opening the baler floor from the cab to clear plugs and move material back into the chamber.
- Providing wider pickups to handle wider, thinner windrows, reducing blockage chances.

These functions allow the farm worker to clear any plugs more easily and more quickly, often from the farm worker position on the tractor. This not only greatly enhances work efficiency, but directly addresses the factors that drive risk tolerance. After many years, the manufacturers of hay balers have recognized these risk tolerance factors and have built in engineering modifications to provide nuanced unclogging options that are operational in nature and not limited to total shutdown for every clog. MIFACE interviewed an international baler manufacturing company representative with 37 years’ experience and product safety stewardship responsibilities. The representative indicated these engineering features to facilitate operational clearing of clogs without total shut down of the tractor and PTO began to be incorporated by all major manufacturers of round balers about 8–10 years ago. Balers before that time frame would likely not have these features, so manufacturer operation manuals would only advise shutting down the tractor and PTO for unclogging. Additionally, the international manufacturers now must meet the International Standards Organization (ISO) requirements which require extensive hazard analysis as part of product development, leading to the identification and addressing of issues like clogging and farm worker safety.

Infeasibility of Older Unit Aftermarket Modifications

There are currently no known aftermarket modifications available, and development appears infeasible. Older balers similar to the one involved in this incident do not have engineering design features to allow removal of the plug safely without shutting down the unit and are valued in the \$2000 to \$4000 range. Used balers in the 8- to 10-year-old range (2014–2024) with anti-clog design technology included, are substantially higher in price ranging from \$19,000 to \$68,000.

MIFACE attempted to address the feasibility of aftermarket modification of older round balers to allow clearing of clogs without total shut down from a technical and cost feasibility basis. Based on consult with multiple sources including a

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manufacturer product safety representative with 37 years of experience, the Michigan State University Farms Service Center, and Michigan State University Biosystems and Engineering, an aftermarket modification, even if technologically possible, is likely not feasible due to the following reasons:

- *Cost Feasibility:* cost of the modification is likely to be close to the total purchase value of an older machine, making it unlikely to be invested in by owners.
- *Technical Feasibility:* differences in design and function between machine manufacturers would likely require development of multiple designs and not be feasible.
- *Legal Feasibility:* liability associated with multiple designs that affect operation of machines and possible failure outcomes most likely precludes such an effort.

REFERENCED STANDARDS

MIOSHA standards may be found at and downloaded from the MIOSHA, Michigan Department of Labor and Economic Opportunity (LEO) website at: www.michigan.gov/mioshastandards. MIOSHA standards are available by writing to: Michigan Department of Labor and Economic Opportunity, MIOSHA Standards and FOIA Section, P.O. Box 30643, Lansing, Michigan 48909-8143 or calling (517) 284-7740.

- MIOSHA Administrative Rule Part 11 - Recording and Reporting of Occupational Injuries and Illnesses
- MIOSHA General Industry Safety Standard, Part 21 – Powered Industrial Trucks.
- [MIOSHA Agricultural Safety Standard](#)
 - Part 51 – Agricultural Tractors
 - Part 53, which adopts OSHA 1928.57 Guarding of Farm Field Equipment, Farmstead Equipment, and Cotton Gins.
- [ANSI/SAE S318.19 OCT2022](#): Safety For Agricultural Field Equipment

REFERENCED RESOURCES

- [Making and Storing Quality Hay | MU Extension \(missouri.edu\)](#)
(<https://extension.missouri.edu/publications/g4575>)
- [New Idea 4800 Series Variable Chamber Round Balers - Features and Benefits Promotional Video 1995.](#)
(https://www.youtube.com/watch?v=6AW_809TnPk)
- [National safe tractor and machinery operation program student manual](#)
(<https://extension.psu.edu/national-safe-tractor-and-machinery-operation-program-manual>)
- [NASD - Using Hay Harvesting Equipment Safely \(nasdonline.org\)](#) (<https://nasdonline.org/178/d001700/using-hay-harvesting-equipment-safely.html>)
- [Farm-Related Machine Entanglements in Michigan](#)
(<https://oem.msu.edu/images/Alerts/RotatingMachineryHazardAlert.pdf>)
- [SWP Round hay baler.doc](#) (<https://worksafe.tas.gov.au/topics/Health-and-Safety/safety-forms-and-guides/sample-safe-work-procedures-swp>)

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- [Safely Making and Handling Large Hay Bales](https://extension.psu.edu/safely-making-and-handling-large-hay-bales) (<https://extension.psu.edu/safely-making-and-handling-large-hay-bales>)
- [Farm Safety Starter Guide](https://icash.public-health.uiowa.edu/wp-content/uploads/2018/01/farm_safety_starter_guide_1349-Australia.pdf) (https://icash.public-health.uiowa.edu/wp-content/uploads/2018/01/farm_safety_starter_guide_1349-Australia.pdf)
- [Michigan Farm Bureau's Agricultural Labor and Safety Services \(ALSS\) program](https://www.michfb.com/agriculture/farming-resources/labor) (<https://www.michfb.com/agriculture/farming-resources/labor>)
- [Farm Safety Planning Templates and Checklists](https://icash.public-health.uiowa.edu/programs/seasonal-campaigns/farm-safety-planning/), Iowa's Center for Agricultural Safety and Health. (<https://icash.public-health.uiowa.edu/programs/seasonal-campaigns/farm-safety-planning/>)
- [National Safe Tractor and Machinery Operation Program. Penn State Extension](https://extension.psu.edu/national-safe-tractor-and-machinery-operation-program#section-4) (<https://extension.psu.edu/national-safe-tractor-and-machinery-operation-program#section-4>)
- [The Real Deal: Round baler intake blockage measures - | Ag Proud](https://www.agproud.com/articles/34029-the-real-deal-round-baler-intake-blockage-measures) (<https://www.agproud.com/articles/34029-the-real-deal-round-baler-intake-blockage-measures>)

BALER ENTANGLEMENT HISTORICAL FACE INVESTIGATIONS

For more information and possible resources, see the below additional historical FACE reports within the national and state FACE report archive (<https://www.cdc.gov/niosh/face/topics/index.html>). These case studies provide further related insight and reenforce similar or identical hazards and previous recommendations made:

- Farmer caught in compression rollers of hay baler, [Iowa FACE Report No. 09IA037](#) (2012)
- Farmer Died When He Was Crushed Within a Hay Baler, [Oklahoma FACE Report No. 01OK036](#) (2001)
- Farm Worker Dies of Burn-Related Injuries while Trapped in a Burning Hay Baler, [Oklahoma FACE Report No. 98OK025](#) (1998)
- Tractor/Baler Operator Killed in Entanglement, [Kentucky FACE Report 97KY044](#) (1997)
- Farmer Dies of Burn-Related Injuries After Being Trapped in a Burning Hay Baler, [Oklahoma FACE Report No. 97OK028](#) (1997)
- Farmer Dies After Becoming Entangled In The Rotating Drive Mechanism Of A Baler, [Minnesota FACE Report No. 96MN076](#) (1997)
- Farmer Killed When Caught in Hay Bale, [Kentucky FACE Report No. 96KY07101](#) (1996)
- Farmer Crushed in Hay Baler, [Kentucky FACE Report No. 95KY055](#) (1995)
- Farmer Killed While Working On Square Hay Baler, [Missouri FACE Report No. 95MO073](#) (1995)
- Farmer Dies After Becoming Entangled In Hay Baler, [Minnesota FACE Report No. 94MN044](#) (1994)
- Farmer Dies After Becoming Entangled in Hay Baler, [Minnesota FACE Report No. 93MN063](#) (1993)



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