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Machinery and Equipment

Introduction

Many serious injuries and fatalities occur on farms as a result of contact with hazardous equipment and machinery. Some examples of equipment and machines commonly used in pork production operations include: tractors, augers, feed mixers/grinders, conveyors and their motors, power take offs (PTOs), fans, skid steer loaders, and others.

OSHA's Agricultural Standards

Agricultural operations fall directly under OSHA's 29 CFR 1928 standard. This standard requires specific protective measures to prevent injuries that occur from contact with agricultural machines and equipment. Specifically, the 29 CFR 1928 Standard includes the following parts that relate directly to machinery and equipment:

- 1928 Subpart A, General
- 1928.1, Purpose and scope
- 1928 Subpart B, Applicability of standards
- 1928.21, Applicability of standards in 29 CFR part 1910
- 1928 Subpart C, Roll-Over Protective Structures
- 1928.51, Roll-over protective structures (ROPS) for agricultural tractors - test procedures and performance requirements
- 1928.52, Protective frames for wheel-type agricultural tractors -- test procedures and performance requirements.
- 1928.53, Protective enclosures for wheel-type agricultural tractors -- test procedures and performance requirements
- Appendix A, Employee operating instructions
- Appendix B, Figures C-1 through C-16
- 1928 Subpart D, Safety for agricultural equipment
- 1928.57, Guarding of farm field equipment, farmstead equipment, and cotton gins

General Machine Guarding Requirements

There are additional OSHA standards that are not part of 29 CFR 1928 that have been cited in agricultural settings. For example, OSHA's general machine guarding standards have been used by inspectors as they look at hazards such as fans, and various types of mechanical drive systems (gears, chains, rotating shafts, etc.). These guarding standards can be found at:

http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10131

Tractors and OSHA Requirements

Tractors cause the largest number of deaths on farms of all types. The majority of tractor fatalities result from rollovers. This is where a tractor rolls either backward or sideways and pins and/or crushes the operator. OSHA standards require that tractors be equipped with a rollover protective structure (ROPS) and seatbelt to either reduce a rollover to 90 degrees, or to protect the operator if the tractor rolls beyond 90 degrees. Tractor ROPS must be able to withstand the forces of a rollover and must meet engineering standards from recognized entities (generally the American Society of Agricultural Engineers – now referred to as the American Society of Agricultural and Biological Engineers).

The OSHA standard also requires that all workers operating tractors be provided with these instructions by their employer when they are first assigned to operate a tractor, and then once per year after that:

1. Securely fasten your seat belt if the tractor has a ROPS.
2. Where possible, avoid operating the tractor near ditches, embankments, and holes.
3. Reduce speed when turning, crossing slopes, and on rough, slick, or muddy surfaces.
4. Stay off slopes too steep for safe operation.
5. Watch where you are going, especially at row ends, on roads, and around trees.
6. Do not permit others to ride.
7. Operate the tractor smoothly - no jerky turns, starts, or stops.
8. Hitch only to the drawbar and hitch points recommended by tractor manufacturers.
9. When the tractor is stopped, set brakes securely and use park lock if available.

Other OSHA Agricultural Standards

Beyond the issue of tractors, the OSHA agricultural standard also provides specific requirements for the protection of employees from hazards associated with moving machinery parts of farm field equipment, farmstead equipment, and other machines used in any agricultural operation.

OSHA Inspection Activities

From 2005 to 2006, the two most cited OSHA standards for pork production operations were the “general duty clause” and the 1928.57 standard that covers guarding of farm field equipment and farmstead equipment. Note that the guarding requirements have been applied broadly. Obviously, things like augers, PTOs and electrically-powered conveyors are covered. But, OSHA has also cited pork operations for failure to guard the drive systems of fans, and for other equipment that may not be considered a typical “farm machine.”

Definitions provided by OSHA in Their Farm Machine Guarding Standard:

Farm field equipment - means tractors or implements, including self-propelled implements, or any combination thereof used in agricultural operations.

Farmstead equipment - means agricultural equipment normally used in a stationary manner. This includes, but is not limited to, materials handling equipment and accessories for such equipment whether or not the equipment is an integral part of a building.

Ground driven components - are components which are powered by the turning motion of a wheel as the equipment travels over the ground.

Guard or Shield - is a barrier designed to protect against employee contact with a hazard created by a moving machinery part.

Power take-off shafts - are the shafts and knuckles between the tractor, or other power source, and the first gear set, pulley, sprocket, or other components on power take-off shaft driven equipment.

Additional OSHA Requirements for All Types of Agricultural Machines

At the time of initial assignment and at least annually thereafter, the employer shall instruct every employee in the safe operation and servicing of all covered equipment with which he is or will be involved, including at least the following safe operating practices:

- Keep all guards in place when the machine is in operation;
- Permit no riders on farm field equipment other than persons required for instruction or assistance in machine operation;
- Stop engine (or motor), disconnect the power source, and wait for all machine movement to stop before servicing, adjusting, cleaning, or unclogging the equipment, except where the machine must be running to be properly serviced or maintained, in which case the employer shall instruct employees as to all steps and procedures which are necessary to safely service or maintain the equipment;
- Make sure everyone is clear of machinery before starting the engine, engaging power, or operating the machine;
- Lock out electrical power before performing maintenance or service on farmstead equipment.

Each employer shall protect employees from coming into contact with hazards created by moving machinery parts as follows:

- Through the installation and use of a guard or shield or guarding by location;
- Whenever a guard or shield or guarding by location is infeasible, by using a guardrail or fence.

Where guards are used to provide the protection required by this section, they shall be designed and located to protect against inadvertent contact with the hazard being guarded.

Guards and their supports shall be capable of withstanding the force that a 250 pound individual, leaning on or falling against the guard, would exert upon that guard.

Guards shall be free from burrs, sharp edges, and sharp corners, and shall be securely fastened to the equipment or building.

A component is guarded by location during operation, maintenance, or servicing when, because of its location, no employee can inadvertently come in contact with the hazard during such operation, maintenance, or servicing. Where the employer can show that any exposure to hazards results from employee conduct which constitutes an isolated and unforeseeable event, the component shall also be considered guarded by location.

If a hazard is guarded by a fence or guardrail, these barriers must be capable of protecting against employees inadvertently entering the hazardous area.

Whenever a moving machinery part presents a hazard during servicing or maintenance, the engine shall be stopped, the power source disconnected, and all machine movement stopped before servicing or maintenance is performed

OSHA Requirements for Equipment Used in Farm Fields

For farm field equipment, all power take-off shafts, including rear, mid- or side-mounted shafts, must be guarded either by a master shield or by other protective guarding.

All tractors must be equipped with an agricultural tractor master shield on the rear power take-off. The master shield must have sufficient strength so that it will not bend or deform when a 250 pound operator mounts or dismounts the tractor using the shield as a step.

Power take-off driven equipment must be guarded to protect against employee contact with rotating members of the power drive system. Where power take-off driven equipment is of a design requiring removal of the tractor master shield, the equipment must also include protection from that portion of the tractor power take-off shaft which protrudes from the tractor.

Signs must be placed at prominent locations on tractors and power take-off driven equipment specifying that power drive system safety shields must be kept in place.

On other power transmission components on machines, the mesh or nip-points of all power driven gears, belts, chains, sheaves, pulleys, sprockets, and idlers must be guarded. All revolving shafts, including projections such as bolts, keys, or set screws, must be guarded, except smooth shaft ends protruding less than one-half the outside diameter of the shaft and its locking means.

Ground driven components must be guarded if any employee may be exposed to them while the drives are in motion.

Functional components, such as snapping or husking rolls, straw spreaders and choppers, cutterbars, flail rotors, rotary beaters, mixing augers, feed rolls, conveying augers, rotary tillers, and similar units, which must be exposed for proper function, must be guarded to the fullest extent which will not substantially interfere with normal functioning of the component.

Guards, shields, and access doors must be in place when the equipment is in operation.

Where removal of a guard or access door will expose an employee to any component which continues to rotate after the power is disengaged, the employer must provide, in the immediate area, the following:

- A readily visible or audible warning of rotation; and
- A safety sign warning the employee to:
- Look and listen for evidence of rotation; and
- Not remove the guard or access door until all components have stopped.

OSHA Requirements for Farmstead Equipment

Requirements are as above for equipment use in farm fields, plus the following:

All revolving shafts, including projections such as bolts, keys, or set screws, must be guarded, with the exception of:

- Smooth shafts and shaft ends (without any projecting bolts, keys or set screws), revolving at less than 10 rpm, on feed handling equipment used on the top surface of materials in bulk storage facilities; and
- Smooth shaft ends protruding less than one-half the outside diameter of the shaft and its locking means.
- Functional components, such as choppers, rotary beaters, mixing augers, feed rolls, conveying augers, grain spreaders, stirring augers, sweep augers, and feed augers, which must be exposed for proper function, must be guarded to the fullest extent which will not substantially interfere with the normal functioning of the component.

Sweep arm material gathering mechanisms used on the top surface of materials within silo structures must be guarded. The lower or leading edge of the guard shall be located no more than 12 inches above the material surface and no less than 6 inches in front of the leading edge of the rotating member of the gathering mechanism. The guard must be parallel to, and extend the fullest practical length of, the material

gathering mechanism.

Exposed auger flighting on portable grain augers must be guarded with either grating type guards or solid baffle style covers as follows:

The largest dimensions or openings in grating type guards through which materials are required to flow must be 4 3/4 inches. The area of each opening shall be no larger than 10 square inches. The opening must be located no closer to the rotating flighting than 2 1/2 inches.

Slotted openings in solid baffle style covers shall be no wider than 1 1/2 inches, or closer than 3 1/2 inches to the exposed flighting.

OSHA Requirements for Electrical Disconnect Means

In all areas of a farm, the application of electrical power from a location not under the immediate and exclusive control of the employee or employees maintaining or servicing equipment must be prevented by:

- Providing an exclusive, positive locking means on the main switch which can be operated only by the employee or employees performing the maintenance or servicing; or
- In the case of material handling equipment located in a bulk storage structure, by physically locating on the equipment an electrical or mechanical means to disconnect the power.

OSHA Requirements for Circuit Protection Devices

To protect employees from an accidental “re-start” of an electrically powered machine when the worker is in a hazardous area, all circuit protection devices, including those which are an integral part of a motor, must be of the manual reset type, except where:

- The employer can establish that because of the nature of the operation, distances involved, and the count of time normally spent by employees in the area of the affected equipment, use of the manual reset device would be infeasible;
- There is an electrical disconnect switch available to the employee within 15 feet of the equipment upon which maintenance or service is being performed; and
- A sign is prominently posted near each hazardous component which warns the employee that, unless the electrical disconnect switch is utilized, the motor could automatically reset while the employee is working on the hazardous component.

Additional Hazards Associated with Driving/Motor Vehicles

Employees required to drive motor vehicles (trucks, cars, etc.) as part of a pork production operation on public highways face a major risk for injury from highway collisions. The following recommendations come from the National Institute for Occupational Safety and Health (NIOSH) and pertain to any situation where employees are required to drive as part of their job.

“Companies must rely on their own experience when establishing safety procedures. Any employer who is developing and implementing a comprehensive traffic safety program for the workplace must gather and analyze internal data so that the company’s program targets the problems that will reduce the crashes, deaths, and injuries. The recommendations presented here highlight the issues to keep in mind when developing these safety programs.

NIOSH recommends that employers take the following measures to prevent traffic-related deaths and injuries of workers from motor vehicle crashes:

- Conduct driver’s license background checks on prospective drivers before they are hired.
- Establish a written policy requiring drivers and passengers to use seat belts at all times. Make sure that employees are aware of and comply with this written policy.
- Provide a seat belt for the driver and each passenger in all employer-provided vehicles. Limit the number of passengers permitted in a vehicle to the number of seat belts available.
- Ensure that drivers comply with designated speed limits in all construction and maintenance zones and on all other roadways.

- Establish schedules that allow drivers to obey speed limits and limit their hours of service according to regulations. Do not permit workers to drive while fatigued or to exceed posted speed limits.
- Train drivers in safe driving practices and proper use of vehicle safety features. Make sure that this training is performance-based and periodically repeated.
- Establish written procedures to ensure the proper maintenance of all vehicle systems.
- Make sure that newly purchased vehicles are equipped with appropriate occupant protection such as shoulder and lap belts and air bags. Equip new vehicles with other safety features such as anti-lock brakes and daytime running lights where appropriate and feasible.
- Consider adopting U.S. Department of Transportation regulations for commercial motor carriers as part of your motor vehicle safety programs. Many of these regulations provide guidance on company policies for other vehicle types and other groups of drivers”

How can I make sure my equipment and machinery are safe?

1. Conduct an assessment of ALL mechanical and electrical hazards found on equipment including tractors, feeding equipment, and other moving parts that create a potential for injury to workers. Make sure to look at devices like fans, motors, and other moving parts that you might not think of as “farm equipment.”
2. Follow the requirements of OSHA as it relates to machine guarding, employee training, warnings, employee communication, and providing a safe means to disconnect power to protect people around any type of equipment.
3. Pay particular attention to OSHA’s tractor safety standards, as that’s where a large percentage of deaths occur. All tractors should be equipped with rollover protection and a seatbelt.
4. Also be sure to consider the safety of any employee who will be operating a truck, automobile, by following the recommendations cited above from NIOSH.

What are the forms, tools, and checklists to help me?

From OSHA’s Small Business website, a checklist on general machine guarding and lock-out/tag-out provisions (note – this information is NOT specific to the agricultural work setting)

GENERAL MACHINE GUARDING CHECKLIST

- Is there a training program to instruct employees on safe methods of machine operation?
- Is there adequate supervision to ensure that employees are following safe machine operating procedures?
- Is there a regular program of safety inspection of machinery and equipment?
- Is all machinery and equipment kept clean and properly maintained?
- Is sufficient clearance provided around and between machines to allow for safe operations, set up and servicing, material handling and waste removal?
- Is equipment and machinery securely placed and anchored to prevent tipping or other movement that could result in personal injury?
- Is there a power shut-off switch within reach of the operator’s position at each machine?
- Can electric power to each machine be locked out for maintenance, repair, or security?
- Are the noncurrent-carrying metal parts of electrically operated machines bonded and grounded?
- Are foot-operated switches guarded or arranged to prevent accidental actuation by personnel or falling objects?
- Are manually operated valves and switches controlling the operation of equipment and machines clearly identified and readily accessible?
- Are all emergency stop buttons colored red?
- Are all pulleys and belts within 7 feet (2.1336 meters) of the floor or working level properly guarded?
- Are all moving chains and gears properly guarded?
- Are splash guards mounted on machines that use coolant to prevent the coolant from reaching employees?

- Are methods provided to protect the operator and other employees in the machine area from hazards created at the point of operation, ingoing nip points, rotating parts, flying chips and sparks?
- Are machine guards secure and arranged so they do not cause a hazard while in use?
- If special hand tools are used for placing and removing material, do they protect the operator's hands?
- Are revolving drums, barrels and containers guarded by an enclosure that is interlocked with the drive mechanism so that revolution cannot occur unless the guard enclosure is in place?
- Do arbors and mandrels have firm and secure bearings, and are they free from play?
- Are provisions made to prevent machines from automatically starting when power is restored after a power failure or shutdown?
- Are machines constructed so as to be free from excessive vibration when the largest size tool is mounted and run at full speed?
- If machinery is cleaned with compressed air, is air pressure controlled and PPE or other safeguards utilized to protect operators and other workers from eye and body injury?
- Are fan blades protected with a guard having openings no larger than 1/2 inch (1.2700 centimeters) when operating within 7 feet (2.1336 meters) of the floor?
- Are saws used for ripping equipped with anti-kickback devices and spreaders?
- Are radial arm saws so arranged that the cutting head will gently return to the back of the table when released?

GENERAL LOCKOUT/TAGOUT PROCEDURES

- Is all machinery or equipment capable of movement required to be de-energized or disengaged and blocked or locked out during cleaning, servicing, adjusting, or setting up operations?
- If the power disconnect for equipment does not also disconnect the electrical control circuit, are the appropriate electrical enclosures identified and is a means provided to ensure that the control circuit can also be disconnected and locked out?
- Is the locking out of control circuits instead of locking out main power disconnects prohibited?
- Are all equipment control valve handles provided with a means for locking out?
- Does the lockout procedure require that stored energy (mechanical, hydraulic, air, etc.) be released or blocked before equipment is locked out for repairs?
- Are appropriate employees provided with individually keyed personal safety locks?
- Are employees required to keep personal control of their key(s) while they have safety locks in use?
- Is it required that only the employee exposed to the hazard can place or remove the safety lock?
- Is it required that employees check the safety of the lockout by attempting a startup after making sure no one is exposed?
- Are employees instructed to always push the control circuit stop button prior to re-energizing the main power switch?
- Is there a means provided to identify any or all employees who are working on locked-out equipment by their locks or accompanying tags?
- Are a sufficient number of accident prevention signs or tags and safety padlocks provided for any reasonably foreseeable repair emergency?
- When machine operations, configuration, or size require an operator to leave the control station and part of the machine could move if accidentally activated, is the part required to be separately locked out or blocked?
- If equipment or lines cannot be shut down, locked out and tagged, is a safe job procedure established and rigidly followed?

This checklist covers regulations issued by the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) under the agricultural standard 29 CFR 1928.57. It applies to hazards associated with moving machinery parts of farm field equipment and farmstead equipment.

<http://0-www.cdc.gov.mill1.sjlibrary.org/niosh/docs/2004-101/chklists/r1n23a~1.htm>

Additional Resources

1. Preventing injury and death from skid steer loaders. (CDC/NIOSH) <http://www.cdc.gov/niosh/pdfs/98-117sum.pdf>
2. Fork lifts (CDC/NIOSH) <http://www.cdc.gov/niosh/pdfs/2001-109.pdf>
3. Motor vehicles (CDC/NIOSH) <http://www.cdc.gov/niosh/pdfs/98-142sum.pdf>

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