

## Grain Handling Facilities -- OSHA Standard 1910.272<sup>1</sup>

Carol J. Lehtola, Charles M. Brown, and William J. Becker<sup>2</sup>

### **The Impact of Safety on Florida Agriculture**

Florida agriculture, including forestry and fishing, made an annual economic impact of \$98 billion in 2004. More than 390,000 workers are directly employed in these industries in Florida, and another 380,000 people are employed in activities related to agriculture (Hodges 2006). The state's agricultural enterprises range from large citrus, vegetable, and cattle operations to small family-operated farms.

In spite of the popular images of agriculture, it is a highly mechanized, industrial profession with one of the highest injury and death rates among U.S. industries. The last study of death rates in Florida agriculture (Liller 2000) found 240 deaths from 1989 to 1998. For the U.S. as a whole, the Bureau of Labor Statistics (BLS 2005a) reported that death due to injury in agriculture was 31.4 deaths per 100,000 full-time workers, which was the highest rate among all major occupational groups and an increase of 14% over 2004. Also in 2005, the Bureau of Labor Statistics reported 6,100 injuries per 100,000 full-time workers (BLS 2005b).

Safety in Florida agriculture is challenging because:

- the state's agricultural enterprises are diverse,
- safety knowledge among workers varies,
- manual labor is used extensively,
- the climate creates year-round heat stress.

Therefore, it is vital to assist the public in learning about OSHA documents related to agriculture. More information about the OSHA Standards and agricultural safety is available at the following Web sites:

Florida AgSafe:

<<http://www.flagsafe.ufl.edu>>

OSHA Regulations:

<<http://www.osha.gov/comp-links.html>>

National Agricultural Safety Database:

<<http://www.cdc.gov/nasd/>>

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2. Carol J. Lehtola, associate professor and Extension Agricultural Safety Specialist; Charles M. Brown, coordinator information/publication services; William J. Becker, professor emeritus; Agricultural and Biological Engineering Department, Institute of Food and Agricultural Sciences, University of Florida, Gainesville.

## Overview

In 2006, over 400 million tons of grains of all kinds were produced in the United States, about one quarter of the world's production (USDA Crop Report, June 9, 2006). To handle this huge amount of material requires an efficient and extensive grain handling system. There are between 15,000 and 20,000 facilities in this system, including grain elevators, grain dryers, and mill facilities.

Grain in bulk presents several hazards that endanger the life and health of workers:

- Grain is handled in huge quantities, and the weight of material involved can lead to crushing or entrapment;
- Grain is a particulate which flows when handled in bulk, and there is potential to be submerged and suffocated, either by grain filling the mouth and throat and blocking the airway or by the weight of grain compressing the torso, thus making breathing impossible;
- Grain can generate toxic gases or dangerous molds;
- Milled grain or the fine dust associated with grain itself can become explosive under the right circumstances;
- Grain facilities present hazards related to working in open, multilevel structures, working with heavy machinery, and working closely with vehicles as they load and off-load.

This standard was the result of thorough investigations into several explosions in grain handling facilities during 1977 and 1978 that caused significant death and injury. Five such explosions in December 1977 alone caused 59 deaths and 49 injuries. The severity of grain elevator explosions is often intensified because an initial explosion will dislodge caked dust deposits and provide the fuel for a secondary explosion. Consider also that a grain elevator can be 30 feet in diameter and 100 feet or more high, providing a huge volume for fuel and a correspondingly large explosion.

Grain handling facilities are often formed of many interconnected chambers, mainly silos, which are dedicated to storing grain, and galleries, in which conveyor belts or other devices transport grain between silos and loading stations. Grain transfer galleries can carry fire or explosion to multiple silos very quickly.

If an explosion occurs, rescue operations are made difficult because workers that are scattered throughout a facility can be hard to locate. Workers that are in upper work areas can be too high for available equipment to reach. In the DeBruce Grain Elevator explosion of 1998, some workers had to wait for helicopters to lift them from the top of the structure.

An explosion in a grain elevator is caused when several factors are present at the same time: fuel (grain dust), oxygen, and an ignition source. Two of these --- fuel and ignition --- are within human control when proper equipment maintenance and housekeeping are observed.

For additional information on the full range of hazards presented by grain handling, visit the National Agriculture Safety Database at: <http://www.cdc.gov/nasd/>.

This document, a condensation of Section 1910.272 of the Occupational Safety and Health Act (29 CFR), is not intended to be totally inclusive but rather to highlight the information and requirements in the complete OSHA standard that owners and managers of agricultural businesses should understand. Refer to the OSHA Web site given above for the complete standard and for court interpretations of the standard.

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NOTE: Some sections of OSHA standards are labeled "Reserved." This label implies either that information has been deleted from the previous version of the standard or that additions to the standard are anticipated. Because standards often reference other standards, it is important that paragraph numbers remain consistent.

### **Section 1910.272(a) -- Scope**

This section contains requirements for the control of grain dust fires and explosions, and certain other safety hazards associated with grain handling facilities. It applies in addition to all other relevant provisions of Part 1910 (or Part 1917 at marine terminals).

### **Section 1910.272(b) -- Application**

**1910.272(b)(1)** -- Paragraphs (a) through (n) of this section apply to grain elevators, feed mills, flour

mills, rice mills, dust pelletizing plants, dry corn mills, soybean flaking operations, and the dry grinding operations of soycake.

**1910.272(b)(2)** -- Paragraphs (o), (p), and (q) of this section apply only to grain elevators.

### **Section 1910.272(c) -- Definitions**

**Choked leg** -- A condition of material buildup in the bucket elevator that results in the stoppage of material flow and bucket movement. A bucket elevator is not considered choked that has the up-leg partially or fully loaded and has the boot and discharge cleared allowing bucket movement.

**Flat storage structure** -- A grain storage building or structure that will not empty completely by gravity, has an unrestricted ground level opening for entry, and must be entered to reclaim the residual grain using powered equipment or manual means.

**Fugitive grain dust** -- Combustible dust particles, emitted from the stock handling system, of such size as will pass through a U.S. Standard 40 mesh sieve (425 microns or less).

**Grain elevator** -- A facility engaged in the receipt, handling, storage, and shipment of bulk raw agricultural commodities such as corn, wheat, oats, barley, sunflower seeds, and soybeans.

**Hot work** -- Work involving electric or gas welding, cutting, brazing, or similar flame-producing operations.

**Inside bucket elevator** -- A bucket elevator that has the boot and more than 20 percent of the total leg height (above grade or ground level) inside the grain elevator structure. Bucket elevators with leg casings that are inside (and pass through the roofs) of rail or truck dump sheds with the remainder of the leg outside of the grain elevator structure, are not considered inside bucket elevators.

**Jogging** -- Repeated starting and stopping of drive motors in an attempt to clear choked legs.

**Lagging** -- A covering on drive pulleys used to increase the coefficient of friction between the pulley and the belt.

**Permit** -- The written certification by the employer authorizing employees to perform identified work operations subject to specified precautions.

### **Section 1910.272(d) -- Emergency Action Plan**

The employer shall develop and implement an emergency action plan meeting the requirements "contained in 29 CFR 1910.38."

### **Section 1910.272(e) -- Training**

**1910.272(e)(1)** -- The employer shall provide training to employees at least annually and when changes in job assignment will expose them to new hazards. Current employees, and new employees prior to starting work, shall be trained in at least the following:

(i) -- General safety precautions associated with the facility, including recognition and preventive measures for the hazards related to dust accumulations and common ignition sources such as smoking; and,

(ii) -- Specific procedures and safety practices applicable to their job tasks including but not limited to, cleaning procedures for grinding equipment, clearing procedures for choked legs, housekeeping procedures, hot work procedures, preventive maintenance procedures and lock-out/tag-out procedures.

**1910.272(e)(2)** -- Employees assigned special tasks, such as bin entry and handling of flammable or toxic substances, shall be provided training to perform these tasks safely.

Note to paragraph (e)(2): Training for an employee who enters grain storage structures includes training about engulfment and mechanical hazards and how to avoid them.

### **Section 1910.272(f) -- Hot Work Permit**

**1910.272(f)(1)** -- The employer shall issue a permit for all hot work, with the following exceptions:

(i) -- Where the employer or the employer's representative (who would otherwise authorize the permit) is present while the hot work is being performed;

(ii) -- In welding shops authorized by the employer;

(iii) -- In hot work areas authorized by the employer which are located outside of the grain handling structure.

**1910.272(f)(2)** -- The permit shall certify that the requirements contained in 1910.252(a) have been implemented prior to beginning the hot work operations. The permit shall be kept on file until completion of the hot work operations.

### **Section 1910.272(g) -- Entry into Grain Storage Structures**

This paragraph applies to employee entry into bins, silos, tanks, and other grain storage structures. Exception: Entry through unrestricted ground level openings into flat storage structures in which there are no toxicity, flammability, oxygen-deficiency, or other atmospheric hazards is covered by paragraph (h) of this section. For the purposes of this paragraph (g), the term "grain" includes raw and processed grain and grain products in facilities within the scope of paragraph (b)(1) of this section.

**1910.272(g)(1)** -- The following actions shall be taken before employees enter bins, silos, or tanks:

(i) -- The employer shall issue a permit for entering bins, silos, or tanks unless the employer or the employer's representative (who would otherwise authorize the permit) is present during the entire operation. The permit shall certify that the precautions contained in this paragraph (1910.272(g)) have been implemented prior to employees entering bins, silos or tanks. The permit shall be kept on file until completion of the entry operations.

(ii) -- All mechanical, electrical, hydraulic, and pneumatic equipment which presents a danger to employees inside grain storage structures shall be deenergized and shall be disconnected, locked-out

and tagged, blocked-off, or otherwise prevented from operating by other equally effective means or methods.

(iii) -- The atmosphere within a bin, silo, or tank shall be tested for the presence of combustible gases, vapors, and toxic agents when the employer has reason to believe they may be present. Additionally, the atmosphere within a bin, silo, or tank shall be tested for oxygen content unless there is continuous natural air movement or continuous forced-air ventilation before and during the period employees are inside. If the oxygen level is less than 19.5%, or if combustible gas or vapor is detected in excess of 10% of the lower flammable limit, or if toxic agents are present in excess of the ceiling values listed in Subpart Z of 29 CFR Part 1910, or if toxic agents are present in concentrations that will cause health effects which prevent employees from effecting self-rescue or communication to obtain assistance, the following provisions apply.

(A) -- Ventilation shall be provided until the unsafe condition or conditions are eliminated, and the ventilation shall be continued as long as there is a possibility of recurrence of the unsafe condition while the bin, silo, or tank is occupied by employees.

(B) -- If toxicity or oxygen deficiency cannot be eliminated by ventilation, employees entering the bin, silo, or tank shall wear an appropriate respirator. Respirator use shall be in accordance with the requirements of 1910.134.

(iv) -- Walking down grain and similar practices where an employee walks on grain to make it flow within or out from a grain storage structure, or where an employee is on moving grain, are prohibited.

**1910.272(g)(2)** -- Whenever an employee enters a grain storage structure from a level at or above the level of the stored grain or grain products, or whenever an employee walks or stands on or in stored grain of a depth which poses an engulfment hazard, the employer shall equip the employee with a body harness with lifeline, or a boatswain's chair that meets the requirements of subpart D of this part. The lifeline shall be so positioned, and of sufficient

length, to prevent the employee from sinking further than waist-deep in the grain. Exception: Where the employer can demonstrate that the protection required by this paragraph is not feasible or creates a greater hazard, the employer shall provide an alternative means of protection which is demonstrated to prevent the employee from sinking further than waist-deep in the grain.

Note to paragraph (g)(2): When the employee is standing or walking on a surface which the employer demonstrates is free from engulfment hazards, the lifeline or alternative means may be disconnected or removed.

**1910.272(g)(3)** -- An observer, equipped to provide assistance, shall be stationed outside the bin, silo, or tank being entered by an employee. Communications (visual, voice, or signal line) shall be maintained between the observer and employee entering the bin, silo, or tank.

**1910.272(g)(4)** -- The employer shall provide equipment for rescue operations which is specifically suited for the bin, silo, or tank being entered.

**1910.272(g)(5)** -- The employee acting as observer shall be trained in rescue procedures, including notification methods for obtaining additional assistance.

**1910.272(g)(6)** -- Employees shall not enter bins, silos, or tanks underneath a bridging condition, or where a buildup of grain products on the sides could fall and bury them.

## **Section 1910.272(h) -- Entry into Flat Storage Structures**

For the purposes of this paragraph (h), the term "grain" means raw and processed grain and grain products in facilities within the scope of paragraph (b)(1) of this section.

**1910.272(h)(1)** -- Each employee who walks or stands on or in stored grain, where the depth of the grain poses an engulfment hazard, shall be equipped with a lifeline or alternative means which the employer demonstrates will prevent the employee from sinking further than waist-deep into the grain.

Note to paragraph (h)(1): When the employee is standing or walking on a surface which the employer demonstrates is free from engulfment hazards, the lifeline or alternative means may be disconnected or removed.

**1910.272(h)(2) --**

(i) -- Whenever an employee walks or stands on or in stored grain or grain products of a depth which poses an engulfment hazard, all equipment which presents a danger to that employee (such as an auger or other grain transport equipment) shall be deenergized, and shall be disconnected, locked-out and tagged, blocked-off, or otherwise prevented from operating by other equally effective means or methods.

(ii) -- "Walking down grain" and similar practices where an employee walks on grain to make it flow within or out from a grain storage structure, or where an employee is on moving grain, are prohibited.

**1910.272(h)(3) --** No employee shall be permitted to be either underneath a bridging condition, or in any other location where an accumulation of grain on the sides or elsewhere could fall and engulf that employee.

**Section 1910.272(i) -- Contractors**

**1910.272(i)(1) --** The employer shall inform contractors performing work at the grain handling facility of known potential fire and explosion hazards related to the contractor's work and work area. The employer shall also inform contractors of the applicable safety rules of the facility.

**1910.272(i)(2) --** The employer shall explain the applicable provisions of the emergency action plan to contractors.

**Section 1910.272(j) -- Housekeeping**

**1910.272(j)(1) --** The employer shall develop and implement a written housekeeping program that establishes the frequency and method(s) determined best to reduce accumulations of fugitive grain dust on ledges, floors, equipment, and other exposed surfaces.

**1910.272(j)(2) --** In addition, the housekeeping program for grain elevators shall address fugitive grain dust accumulations at priority housekeeping areas.

(i) -- Priority housekeeping areas shall include at least the following:

(A) -- Floor areas within 35 feet (10.7 m) of inside bucket elevators;

(B) -- Floors of enclosed areas containing grinding equipment;

(C) -- Floors of enclosed areas containing grain dryers located inside the facility.

(ii) -- The employer shall immediately remove any fugitive grain dust accumulations whenever they exceed 1/8 inch (.32 cm) at priority housekeeping areas, pursuant to the housekeeping program, or shall demonstrate and assure, through the development and implementation of the housekeeping program, that equivalent protection is provided.

**1910.272(j)(3) --** The use of compressed air to blow dust from ledges, walls, and other areas shall only be permitted when all machinery that presents an ignition source in the area is shut-down, and all other known potential ignition sources in the area are removed or controlled.

**1910.272(j)(4) --** Grain and product spills shall not be considered fugitive grain dust accumulations. However, the housekeeping program shall address the procedures for removing such spills from the work area.

**Section 1910.272(k) -- Grate Openings**

Receiving-pit feed openings, such as truck or railcar receiving-pits, shall be covered by grates. The width of openings in the grates shall be a maximum of 2 1/2 inches (6.35 cm).

**Section 1910.272(l) -- Filter Collectors**

**1910.272(l)(1) --** All fabric dust filter collectors which are a part of a pneumatic dust collection

system shall be equipped with a monitoring device that will indicate a pressure drop across the surface of the filter.

**1910.272(l)(2)** -- Filter collectors installed after March 30, 1988 shall be:

(i) -- Located outside the facility; or

(ii) -- Located in an area inside the facility protected by an explosion suppression system; or

(iii) -- Located in an area inside the facility that is separated from other areas of the facility by construction having at least a one hour fire-resistance rating, and which is adjacent to an exterior wall and vented to the outside. The vent and ductwork shall be designed to resist rupture due to deflagration.

### **Section 1910.272(m) -- Preventive Maintenance**

**1910.272(m)(1)** -- The employer shall implement preventive maintenance procedures consisting of:

(i) -- Regularly scheduled inspections of at least the mechanical and safety control equipment associated with dryers, grain stream processing equipment, dust collection equipment including filter collectors, and bucket elevators;

(ii) -- Lubrication and other appropriate maintenance in accordance with manufacturers' recommendations, or as determined necessary by prior operating records.

**1910.272(m)(2)** -- The employer shall promptly correct dust collection systems which are malfunctioning or which are operating below designed efficiency. Additionally, the employer shall promptly correct, or remove from service, overheated bearings and slipping or misaligned belts associated with inside bucket elevators.

**1910.272(m)(3)** -- A certification record shall be maintained of each inspection, performed in accordance with this paragraph (m), containing the date of the inspection, the name of the person who performed the inspection and the serial number, or other identifier, of the equipment specified in paragraph (m)(1)(i) of this section that was inspected.

**1910.272(m)(4)** -- The employer shall implement procedures for the use of tags and locks which will prevent the inadvertent application of energy or motion to equipment being repaired, serviced, or adjusted, which could result in employee injury. Such locks and tags shall be removed in accordance with established procedures only by the employee installing them or, if unavailable, by his or her supervisor.

### **Section 1910.272(n) -- Grain Stream Processing Equipment**

The employer shall equip grain stream processing equipment (such as hammer mills, grinders, and pulverizers) with an effective means of removing ferrous material from the incoming grain stream.

### **Section 1910.272(o) -- Emergency Escape**

**1910.272(o)(1)** -- The employer shall provide at least two means of emergency escape from galleries (bin decks).

**1910.272(o)(2)** -- The employer shall provide at least one means of emergency escape in tunnels of existing grain elevators. Tunnels in grain elevators constructed after the effective date of this standard shall be provided with at least two means of emergency escape.

### **Section 1910.272(p) -- Continuous-flow Bulk Raw Grain Dryers**

**1910.272(p)(1)** -- All direct-heat grain dryers shall be equipped with automatic controls that:

(i) -- Will shut-off the fuel supply in case of power or flame failure or interruption of air movement through the exhaust fan; and,

(ii) -- Will stop the grain from being fed into the dryer if excessive temperature occurs in the exhaust of the drying section.

**1910.272(p)(2)** -- Direct-heat grain dryers installed after March 30, 1988 shall be:

(i) -- Located outside the grain elevator; or

(ii) -- Located in an area inside the grain elevator protected by a fire or explosion suppression system; or

(iii) -- Located in an area inside the grain elevator which is separated from other areas of the facility by construction having at least a one hour fire-resistance rating.

### Section 1910.272(q) -- Inside Bucket Elevators

**1910.272(q)(1)** -- Bucket elevators shall not be jogged to free a choked leg.

**1910.272(q)(2)** -- All belts and lagging purchased after March 30, 1988 shall be conductive. Such belts shall have a surface electrical resistance not to exceed 300 megohms.

**1910.272(q)(3)** -- All bucket elevators shall be equipped with a means of access to the head pulley section to allow inspection of the head pulley, lagging, belt, and discharge throat of the elevator head. The boot section shall also be provided with a means of access for clean-out of the boot and for inspection of the boot, pulley, and belt.

**1910.272(q)(4)** -- The employer shall:

(i) -- Mount bearings externally to the leg casing; or,

(ii) -- Provide vibration monitoring, temperature monitoring, or other means to monitor the condition of those bearings mounted inside or partially inside the leg casing.

**1910.272(q)(5)** -- The employer shall equip bucket elevators with a motion detection device which will shut-down the bucket elevator when the belt speed is reduced by no more than 20% of the normal operating speed.

**1910.272(q)(6)** -- The employer shall:

(i) -- Equip bucket elevators with a belt alignment monitoring device which will initiate an alarm to employees when the belt is not tracking properly; or,

(ii) -- Provide a means to keep the belt tracking properly, such as a system that provides constant alignment adjustment of belts.

**1910.272(q)(7)** -- Paragraphs (q)(5) and (q)(6) of this section do not apply to grain elevators having a permanent storage capacity of less than one million bushels, provided that daily visual inspection is made of bucket movement and tracking of the belt.

**1910.272(q)(8)** -- Paragraphs (q)(4), (q)(5), and (q)(6) of this section do not apply to the following:

(i) -- Bucket elevators which are equipped with an operational fire and explosion suppression system capable of protecting at least the head and boot section of the bucket elevator; or,

(ii) -- Bucket elevators which are equipped with pneumatic or other dust control systems or methods that keep the dust concentration inside the bucket elevator at least 25% below the lower explosive limit at all times during operations.

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