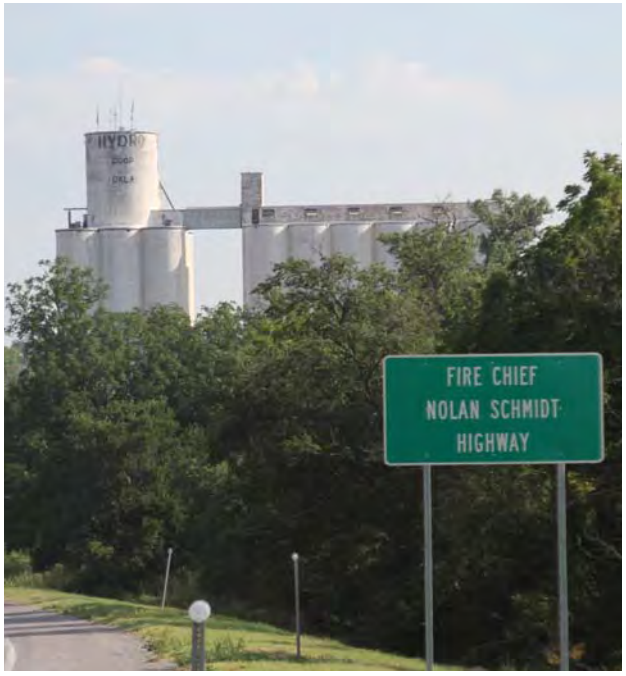

GRAIN BIN EMERGENCIES

AWARENESS

ABSTRACT

Agriculture operations by nature can be inherently dangerous. Avoiding accidents and surviving one, should it occur, both require training. This presentation enables you to recognize common hazards that exist during grain bin operations, understand steps that reduce or eliminate these hazards, and identify initial actions that should be taken in the event of an accident at a grain handling facilities.

Oklahoma State University – Fire Service Training

Grain Bin Emergencies – Awareness

Instructor Guide

Grain Bin Emergency Awareness
Student Syllabus

Overview

This is a one day course: with 4 hours of instruction. Grain Bin Rescue Awareness will give the participants the ability to recognize the hazards associated with grain bins and facilities.

Course Prerequisites

There are no prerequisites for this course.

Outcome Objectives

The outcome objectives for the course are based on OSHA 1910.272 requirements.

Text

The student manual provides a note taking guide

Course Schedule

A course schedule will be provided by the instructor at the first class session..

Course Evaluation

Pre-Course: This evaluation will consist of 10 true and false questions to evaluate the students understanding of the subject prior to the presentation.

Post-Course: This evaluation will consist of 20 multiple choice questions to evaluate the participants understanding after the 4 hours course of instruction.

Follow-up: This evaluation will consist of 10 questions which will be sent via email in a survey format, this is important information. Please help us by completing the survey as soon as you receive them.

Contact information for the instructor will be provided at the first class session. The goal of the instructor is to help you be successful during the course. You should immediately contact the instructor if you have any questions about the course or course work.

Instructor Name: (YOUR NAME and Information)

Instructor Agency
Instructor phone
email@instructor.edu

Attendance Policy

The student must attend 100% of the course for successful completion.

Academic Dishonesty Policy

Academic misconduct includes cheating, plagiarism, falsification of records, unauthorized possession of examinations, intimidation, and any and all other actions that may improperly affect the evaluation of a student's academic performance or achievement; assisting others in any such act; or attempts to engage in such acts. Any incident of academic misconduct will result in the student being dropped from the course and the student's sponsoring agency being notified of the incident.

Tips for Success

The course utilizes lecture, open discussions, and learning activities to achieve the learning objectives. Every student is expected to:

- Be prepared for each class session. This includes being rested, being to class on-time, etc.
- Get involved with the discussions and learning activities.
- Consider how the concepts and skills apply in your home department or organization.

Module 0
Plan of Instruction

Instructor Guide

Goal

To acquaint the instructor with the scope and format of the course, and other pertinent information required to deliver a course that meets the learning objectives, engages the participants, and prepares each participant for the role of grain bin emergency awareness.

Instructor Information

Welcome to the Grain Bin Rescue Awareness course. After completing this lesson, the student shall be able to recognize grain bin rescue incidents, associated hazards, become familiar with hazards associated with grain handling facilities and Oklahoma resources available to help mitigate a rescue incident.

As the course instructor, you have an essential role in ensuring the success of the training experience for each participant. Module 0 is intended to provide you with the background information required to be successful in your role as the instructor.

You are encouraged to review all the information in this plan of instruction and the other course units prior to delivering the course. In addition, you should read the grain handling facility requirements of OSHA 29 CFR 1910.272, as well as NFPA 61 so that you are familiar with all the content that is going to be presented.

General information

The participants in the course will come from a variety of backgrounds and professions including fire fighters, law enforcement officers, emergency medical technicians, Grain Handling Facility Workers, and Farmers and Farm Families. In some cases, the participants will not have experience as emergency responders. In summary, you must be prepared for a diversity of both experience and job duties.

The course is designed to meet specific objectives from the Occupational Safety & Health Administration 29 CFR 1910.272. The skills and knowledge from the course may very well save the lives of the emergency responders and citizens during rescue incidents.

This is a 4 hour course that needs every bit of the time allowed to deliver the content. In other words, you must stay on task to deliver all the content in the time allowed. If you tell war stories, take long breaks, and get off task, you will run out of time or be forced to skip some of the content. Both of those situations are unacceptable. Be prepared. Know the material. Stay on task.

The course is structured so that it can be delivered in one half-day session. You should work closely with the sponsoring organization to choose a schedule that will ensure maximum participation of emergency responders and grain handling workers in the area without sacrificing the quality of instruction.

If you have any questions about the course, please contact Oklahoma State University - Fire Service Training (OSU-FST) as soon as possible by calling 800.304.5727. Every effort will be made to answer your question or help you solve the issue for which you need help. Please keep in mind that the sooner you contact OSU-FST for assistance the more likely the help you require will be available.

Team Teaching

If you are team teaching the course with another instructor(s), take time to discuss the schedule at least two (2) weeks prior to the beginning of the course. During the meeting or discussion you should identify who will deliver each module, discuss the characteristics of the community or organization sponsoring the training, discuss any foreseeable challenges, and any other issues that may affect the delivery of the course.

Scope Statement

This course addresses the requirements of the Occupational Safety and Health Administration, 29 Code of Federal Regulations 1910.272, *Grain Handling Facilities,*

In addition, the course addresses the National Fire Protection Association (NFPA) 61, *Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities, 2013 Edition*

The target audience for this course is any worker or responder with the possibility of working in a grain bin or may respond to a grain bin rescue incident.

The target audience includes, but is not limited to, workers and emergency responders from the following disciplines and professions.

- Fire Service
- Emergency Medical Services (EMS)
- Law Enforcement
- Emergency Management
- Grain Facility
- Family Farms

Course Description

This is a one day course: with 4 hours of instruction. Grain Bin Rescue Awareness will give the participants the ability to recognize the hazards associated with grain bins and facilities. This knowledge is essential for the safety of both personnel who may respond to an emergency and for the general public who may be involved in the emergency event. This course is designed to provide generalized information for the participants as well as some basic skills needed to navigate in a grain handling environment.

Level of Learning

The level of learning for the overall course is *recognition.* The level of learning for each individual unit is listed in the instructor guide for that unit.

Instructor-to-Participant Ratio

The instructor-to-participant ratio may vary based on the experience of the participants and the ability of the instructor. However, a ratio of 1-24 is recommended for classroom instruction. For skills training and practice, a ratio of 1-12 is recommended. This smaller ratio will allow instructor to provide more feedback to each participant during the learning activities.

Practical Exercise Statement

There are no learning activities and skill applications in the course.

Evaluation Strategy

Evaluation of learning is accomplished by a combination of formal and informal methods. Formative evaluation is accomplished during each unit through questions by the instructor and responses to learning activities. The instructor guide for each unit lists specific questions to be asked which will evaluate participant understanding of the skills and concepts.

Resources Required

The following resources are required to delivery this course. It is the responsibility of the lead instructor to ensure all resources are obtained for his/her delivery.

- Grain Bin Rescue Awareness Instructors Guide
- Grain Bin Rescue Awareness Audiovisuals
- Grain Bin Rescue Awareness Student Manual (1 per student)
- Digital Projector
- Laptop computer or compatible PC with PowerPoint
- Projector Screen
- OSU-FST name tents (1 per student)
- OSU-FST Course Registration/Invoice (1 per student)

Student Manual

A student manual has been created for this course. The manual contains a note taking guide for each module, the learning activities, and other handouts that are appropriate for the course. All student materials, except the text, are contained in the student manual. If additional handouts are to be used to supplement the course, the instructor is responsible for making the needed copies. *Any supplemental materials distributed by an instructor must comply with all university, state, and federal copyright laws and policies.*

Course Outline

The following is the instructional overview (course outline) for the course. As mentioned previously, the course is delivered one 4 hr. session or based on the scheduling needs of the sponsoring organization.

Module	Unit Title	Suggested Time
1	Welcome and Course Overview • Pre-course Evaluation	40 minutes 15 minutes
2	Grain Quality	45 minutes
3	Pesticides Incident Priorities and Summary	1 hour 20 minutes
	• Post-course Evaluation	30 minutes

References

The following references were used during the development of the course and may be used by the instructor for background information on the course and its content.

Occupational Safety and Health Administration, *29 Code of Federal Regulations 1910.272*, United States Department of Labor, 2011

National Fire Protection Association, *61 Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food processing Facilities*, Quincy MA., 2013

National Fire Protection Association, *1670 Standard on Operations and Training for Technical Search and Rescue*, Quincy MA., 2014

National Fire Protection Association, *1006 Standard for Rescue technician Professional Qualifications*, Quincy MA., 2013

Learning Objectives

This course is uniquely designed to meet the learning objectives/performance objectives specified by OSHA 1910.272. (See Appendix A)

Means of achieving the performance goals in the standard (See Appendix B)

Appendix A

Grain Handling Facilities

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).

Note to paragraph (a): For grain-handling facilities in the marine-terminal industry only, 29 CFR 1910.272 is to be enforced consistent with the interpretations in OSHA Compliance Directive 02-00-066, which is available on OSHA's Web page at www.osha.gov.

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.

1910.272(c)
Definitions.

"Choked leg" means 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" means 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" means 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" means 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" means work involving electric or gas welding, cutting, brazing, or similar flame producing operations.

"Inside bucket elevator" means 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" means repeated starting and stopping of drive motors in an attempt to clear choked legs.

"Lagging" means a covering on drive pulleys used to increase the coefficient of friction between the pulley and the belt.

"Permit" means the written certification by the employer authorizing employees to perform identified work operations subject to specified precautions.

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.

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:

1910.272(e)(1)(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,

1910.272(e)(1)(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.

1910.272(f)
Hot work permit.

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

1910.272(f)(1)(i)
Where the employer or the employer's representative (who would otherwise authorize the permit) is present while the hot work is being performed;

1910.272(f)(1)(ii)
In welding shops authorized by the employer;

1910.272(f)(1)(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.

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:

1910.272(g)(1)(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.

1910.272(g)(1)(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.

1910.272(g)(1)(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.

1910.272(g)(1)(iii)(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.

1910.272(g)(1)(iii)(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.

1910.272(g)(1)(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.

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) 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.

1910.272(h)(2)(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.

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.

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.

1910.272(j)(2)(i)
Priority housekeeping areas shall include at least the following:

1910.272(j)(2)(i)(A)
Floor areas within 35 feet (10.7 m) of inside bucket elevators;

1910.272(j)(2)(i)(B)
Floors of enclosed areas containing grinding equipment;

1910.272(j)(2)(i)(C)
Floors of enclosed areas containing grain dryers located inside the facility.

1910.272(j)(2)(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.

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).

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:

1910.272(l)(2)(i)
Located outside the facility; or

1910.272(l)(2)(ii)
Located in an area inside the facility protected by an explosion suppression system; or

1910.272(l)(2)(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.

1910.272(m)
Preventive maintenance.

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

1910.272(m)(1)(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;

1910.272(m)(1)(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.

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.

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.

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:

1910.272(p)(1)(i)
Will shut-off the fuel supply in case of power or flame failure or interruption of air movement through the exhaust fan; and,

1910.272(p)(1)(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:

1910.272(p)(2)(i)
Located outside the grain elevator; or

1910.272(p)(2)(ii)
Located in an area inside the grain elevator protected by a fire or explosion suppression system; or

1910.272(p)(2)(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.

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:

1910.272(q)(4)(i)
Mount bearings externally to the leg casing; or,

1910.272(q)(4)(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:

1910.272(q)(6)(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,

1910.272(q)(6)(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:

1910.272(q)(8)(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,

1910.272(q)(8)(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.

[52 FR 49625, Dec.. 31, 1987; 53 FR 17697, May 18, 1988; 61 FR 5507; Feb. 13, 1996; 61 FR 9227, March 7, 1996; 61 FR 9577, March 8, 1996; 67 FR 67965, Nov. 7, 2002; 76 FR 80740, Dec. 27, 2011]

Note: The following appendices to 1910.272 serve as non-mandatory guidelines to assist employers and employees in complying with the requirements of this section, as well as to provide other helpful information.

No additional burdens are imposed through these appendices.

Appendix B

Examples presented in this appendix may not be the only means of achieving the performance goals in the standard.

1. Scope and Application

The provisions of this standard apply in addition to any other applicable requirements of this Part 1910 (or Part 1917 at marine terminals). The standard contains requirements for new and existing grain handling facilities. The standard does not apply to seed plants which handle and prepare seeds for planting of future crops, nor to on-farm storage or feed lots.

2. Emergency Action Plan

The emergency action plan (§ 1910.38) covers those designated actions employers and employees are to take to ensure employee safety from fire and other emergencies.

The standard does not specify a particular method for notifying employees of an emergency. Public announcement systems, air horns, steam whistles, a standard fire alarm system, or other types of employee alarm may be used. However, employers should be aware that employees in a grain facility may have difficulty hearing an emergency alarm, or distinguishing an emergency alarm from other audible signals at the facility, or both. Therefore, it is important that the type of employee alarm used be distinguishable and distinct.

The use of floor plans or workplace maps which clearly show the emergency escape routes should be included in the emergency action plan; color coding will aid employees in determining their route assignments. The employer should designate a safe area, outside the facility, where employees can congregate after evacuation, and implement procedures to account for all employees after emergency evacuation has been completed.

It is also recommended that employers seek the assistance of the local fire department for the purpose of preplanning for emergencies. Preplanning is encouraged to facilitate coordination and cooperation between facility personnel and those who may be called upon for assistance during an emergency. It is important for emergency service units to be aware of the usual work locations of employees at the facility.

3. Training

It is important that employees be trained in the recognition and prevention of hazards associated with grain facilities, especially those hazards associated with their own work tasks. Employees should understand the factors which are necessary to produce a fire or explosion, i.e., fuel (such as grain dust), oxygen, ignition source, and (in the case of explosions) confinement. Employees should be made aware that any efforts they make to keep these factors from occurring simultaneously will be an important step in reducing the potential for fires and explosions.

The standard provides flexibility for the employer to design a training program which fulfills the needs of a facility. The type, amount, and frequency of training will need to reflect the tasks that employees are expected to perform. Although training is to be provided to employees at least annually, it is recommended that safety meetings or discussions and drills be conducted at more frequent intervals.

The training program should include those topics applicable to the particular facility, as well as topics such as: Hot work procedures; lock-out/tag-out procedures; bin entry procedures; bin cleaning procedures; grain dust explosions; fire prevention; procedures for handling "hot grain"; housekeeping procedures, including methods and frequency of dust removal; pesticide and fumigant usage; proper use and maintenance of personal protective equipment; and, preventive maintenance. The types of work clothing should also be considered in the program at least to caution against using polyester clothing that easily melts and increases the severity of burns, as compared to wool or fire retardant cotton.

In implementing the training program, it is recommended that the employer utilize films, slide-tape presentations, pamphlets, and other information which can be obtained from such sources as the Grain Elevator and Processing Society, the Cooperative Extension Service of the U.S. Department of Agriculture, Kansas State University's Extension Grain Science and Industry, and other state agriculture schools, industry associations, union organizations, and insurance groups.

4. Hot Work Permit

The implementation of a permit system for hot work is intended to assure that employers maintain control over operations involving hot work and to assure that employees are aware of and utilize appropriate safeguards when conducting these activities.

Precautions for hot work operations are specified in 29 CFR 1910.252(a), and include such safeguards as relocating the hot work operation to a safe location if possible, relocating or covering combustible material in the vicinity, providing fire extinguishers, and provisions for establishing a fire watch. Permits are not required for hot work operations conducted in the presence of the employer or the employer's authorized representative who would otherwise issue the permit, or in an employer authorized welding shop or when work is conducted outside and away from the facility.

It should be noted that the permit is not a record, but is an authorization of the employer certifying that certain safety precautions have been implemented prior to the beginning of work operations.

5. Entry Into Bins, Silos, And Tanks

In order to assure that employers maintain control over employee entry into bins, silos, and tanks, OSHA is requiring that the employer issue a permit for entry into bins, silos, and tanks unless the employer (or the employer's representative who would otherwise authorize the permit) is present at the entry and during the entire operation.

Employees should have a thorough understanding of the hazards associated with entry into bins, silos, and tanks. Employees are not to be permitted to enter these spaces from the bottom when grain or other agricultural products are hung up or sticking to the sides which might fall and injure or kill an employee. Employees should be made aware that the atmosphere in bins, silos, and tanks can be oxygen deficient or toxic. Employees should be trained in the proper methods of testing the atmosphere, as well as in the appropriate procedures to be taken if the atmosphere is found to be oxygen deficient or toxic. When a fumigant has been recently applied in these areas and entry must be made, aeration fans should be running continuously to assure a safe atmosphere for those inside. Periodic monitoring of toxic levels should be done by direct reading instruments to measure the levels, and, if there is an increase in these readings, appropriate actions should be promptly taken.

Employees have been buried and suffocated in grain or other agricultural products because they sank into the material. Therefore, it is suggested that employees not be permitted to walk or stand on the grain or other grain product where the depth is greater than waist high. In this regard, employees must use a full body harness or boatswain's chair with a lifeline when entering from the top. A winch system with mechanical advantage (either powered or manual) would allow better control of the employee than just using a hand held hoist line, and such a system would allow the observer to remove the employee easily without having to enter the space.

It is important that employees be trained in the proper selection and use of any personal protective equipment which is to be worn. Equally important is the training of employees in the planned emergency rescue procedures. Employers should carefully read 1910.134(e)(3) and assure that their procedures follow these requirements. The employee acting as observer is to be equipped to provide assistance and is to know procedures for obtaining additional assistance. The observer should not enter a space until adequate assistance is available. It is recommended that an employee trained in CPR be readily available to provide assistance to those employees entering bins, silos, or tanks.

6. Contractors

These provisions of the standard are intended to ensure that outside contractors are cognizant of the hazards associated with grain handling facilities, particularly in relation to the work they are to perform for the employer. Also, in the event of an emergency, contractors should be able to take appropriate action as a part of the overall facility emergency action plan. Contractors should also be aware of the employer's permit systems. Contractors should develop specified procedures for performing hot work and for entry into bins, silos, and tanks and these activities should be coordinated with the employer.

This coordination will help to ensure that employers know what work is being performed at the facility by contractors; where it is being performed; and, that it is being performed in a manner that will not endanger employees.

7. Housekeeping

The housekeeping program is to be designed to keep dust accumulations and emissions under control inside grain facilities. The housekeeping program, which is to be written, is to specify the frequency and method(s) used to best reduce dust accumulations.

Ship, barge, and rail loadout and receiving areas which are located outside the facility need not be addressed in the housekeeping program. Additionally, truck dumps which are open on two or more sides need not be addressed by the housekeeping program. Other truck dumps should be addressed in the housekeeping program to provide for regular cleaning during periods of receiving grain or agricultural products. The housekeeping program should provide coverage for all workspaces in the facility and include walls, beams, etc., especially in relation to the extent that dust could accumulate.

Dust Accumulations

Almost all facilities will require some level of manual housekeeping. Manual housekeeping methods, such as vacuuming or sweeping with soft bristle brooms, should be used which will minimize the possibility of layered dust being suspended in the air when it is being removed.

The housekeeping program should include a contingency plan to respond to situations where dust accumulates rapidly due to a failure of a dust enclosure hood, an unexpected breakdown of the dust control system, a dust-tight connection inadvertently knocked open, etc.

The housekeeping program should also specify the manner of handling spills. Grain spills are not considered to be dust accumulations.

A fully enclosed horizontal belt conveying system where the return belt is inside the enclosure should have inspection access such as sliding panels or doors to permit checking of equipment, checking for dust accumulations and facilitate cleaning if needed.

Dust Emissions

Employers should analyze the entire stock handling system to determine the location of dust emissions and effective methods to control or to eliminate them. The employer should make sure that holes in spouting, casings of bucket elevators, pneumatic conveying pipes, screw augers, or drag conveyor casings, are patched or otherwise properly repaired to prevent leakage. Minimizing free falls of grain or grain products by using choke feeding techniques, and utilization of dust-tight enclosures at transfer points, can be effective in reducing dust emissions.

Each housekeeping program should specify the schedules and control measures which will be used to control dust emitted from the stock handling system. The housekeeping

program should address the schedules to be used for cleaning dust accumulations from motors, critical bearings and other potential ignition sources in the working areas. Also, the areas around bucket elevator legs, milling machinery and similar equipment should be given priority in the cleaning schedule. The method of disposal of the dust which is swept or vacuumed should also be planned.

Dust may accumulate in somewhat inaccessible areas, such as those areas where ladders or scaffolds might be necessary to reach them. The employer may want to consider the use of compressed air and long lances to blow down these areas frequently. The employer may also want to consider the periodic use of water and hoselines to wash down these areas. If these methods are used, they are to be specified in the housekeeping program along with the appropriate safety precautions, including the use of personal protective equipment such as eyewear and dust respirators.

Several methods have been effective in controlling dust emissions. A frequently used method of controlling dust emissions is a pneumatic dust collection system. However, the installation of a poorly designed pneumatic dust collection system has fostered a false sense of security and has often led to an inappropriate reduction in manual housekeeping. Therefore, it is imperative that the system be designed properly and installed by a competent contractor. Those employers who have a pneumatic dust control system that is not working according to expectations should request the engineering design firm, or the manufacturer of the filter and related equipment, to conduct an evaluation of the system to determine the corrections necessary for proper operation of the system. If the design firm or manufacturer of the equipment is not known, employers should contact their trade association for recommendations of competent designers of pneumatic dust control systems who could provide assistance.

When installing a new or upgraded pneumatic control system, the employer should insist on an acceptance test period of 30 to 45 days of operation to ensure that the system is operating as intended and designed. The employer should also obtain maintenance, testing, and inspection information from the manufacturer to ensure that the system will continue to operate as designed.

Aspiration of the leg, as part of a pneumatic dust collection system, is another effective method of controlling dust emissions. Aspiration of the leg consists of a flow of air across the entire boot, which entrains the liberated dust and carries it up the up-leg to take-off points. With proper aspiration, dust concentrations in the leg can be lowered below the lower explosive limit. Where a prototype leg installation has been instrumented and shown to be effective in keeping the dust level 25% below the lower explosive limit during normal operations for the various products handled, then other legs of similar size, capacity and products being handled which have the same design criteria for the air aspiration would be acceptable to OSHA, provided the prototype test report is available on site.

Another method of controlling dust emissions is enclosing the conveying system, pressurizing the general work area, and providing a lower pressure inside the enclosed

conveying system. Although this method is effective in controlling dust emissions from the conveying system, adequate access to the inside of the enclosure is necessary to facilitate frequent removal of dust accumulations. This is also necessary for those systems called "self-cleaning."

The use of edible oil sprayed on or into a moving stream of grain is another method which has been used to control dust emissions. Tests performed using this method have shown that the oil treatment can reduce dust emissions. Repeated handling of the grain may necessitate additional oil treatment to prevent liberation of dust. However, before using this method, operators of grain handling facilities should be aware that the Food and Drug Administration must approve the specific oil treatment used on products for food or feed.

As a part of the housekeeping program, grain elevators are required to address accumulations of dust at priority areas using the action level. The standard specifies a maximum accumulation of 1/8 inch dust, measurable by a ruler or other measuring device, anywhere within a priority area as the upper limit at which time employers must initiate action to remove the accumulations using designated means or methods. Any accumulation in excess of this amount and where no action has been initiated to implement cleaning would constitute a violation of the standard, unless the employer can demonstrate equivalent protection. Employers should make every effort to minimize dust accumulations on exposed surfaces since dust is the fuel for a fire or explosion, and it is recognized that a 1/8 inch dust accumulation is more than enough to fuel such occurrences.

8. Filter Collectors

Proper sizing of filter collectors for the pneumatic dust control system they serve is very important for the overall effectiveness of the system. The air to cloth ratio of the system should be in accordance with the manufacturer's recommendations. If higher ratios are used, they can result in more maintenance on the filter, shorter bag or sock life, increased differential pressure resulting in higher energy costs, and an increase in operational problems.

A photohelic gauge, magnehelic gauge, or manometer, may be used to indicate the pressure rise across the inlet and outlet of the filter. When the pressure exceeds the design value for the filter, the air volume will start to drop, and maintenance will be required. Any of these three monitoring devices is acceptable as meeting paragraph (l)(1) of the standard.

The employer should establish a level or target reading on the instrument which is consistent with the manufacturer's recommendations that will indicate when the filter should be serviced. This target reading on the instrument and the accompanying procedures should be in the preventive maintenance program. These efforts would minimize the blinding of the filter and the subsequent failure of the pneumatic dust control system.

There are other instruments that the employer may want to consider using to monitor the operation of the filter. One instrument is a zero motion switch for detecting a failure of motion by the rotary discharge valve on the hopper. If the rotary discharge valve stops turning, the dust released by the bag or sock will accumulate in the filter hopper until the filter becomes clogged. Another instrument is a level indicator which is installed in the hopper of the filter to detect the buildup of dust that would otherwise cause the filter hopper to be plugged. The installation of these instruments should be in accordance with manufacturer's recommendations.

All of these monitoring devices and instruments are to be capable of being read at an accessible location and checked as frequently as specified in the preventive maintenance program.

Filter collectors on portable vacuum cleaners, and those used where fans are not part of the system, are not covered by requirements of paragraph (l) of the standard.

9. Preventive Maintenance

The control of dust and the control of ignition sources are the most effective means for reducing explosion hazards. Preventive maintenance is related to ignition sources in the same manner as housekeeping is related to dust control and should be treated as a major function in a facility. Equipment such as critical bearings, belts, buckets, pulleys, and milling machinery are potential ignition sources, and periodic inspection and lubrication of such equipment through a scheduled preventive maintenance program is an effective method for keeping equipment functioning properly and safely. The use of vibration detection methods, heat sensitive tape or other heat detection methods that can be seen by the inspector or maintenance person will allow for a quick, accurate, and consistent evaluation of bearings and will help in the implementation of the program.

The standard does not require a specific frequency for preventive maintenance. The employer is permitted flexibility in determining the appropriate interval for maintenance provided that the effectiveness of the maintenance program can be demonstrated. Scheduling of preventive maintenance should be based on manufacturer's recommendations for effective operation, as well as from the employer's previous experience with the equipment. However, the employer's schedule for preventive maintenance should be frequent enough to allow for both prompt identification and correction of any problems concerning the failure or malfunction of the mechanical and safety control equipment associated with bucket elevators, dryers, filter collectors and magnets. The pressure-drop monitoring device for a filter collector, and the condition of the lagging on the head pulley, are examples of items that require regularly scheduled inspections. A system of identifying the date, the equipment inspected and the maintenance performed, if any, will assist employers in continually refining their preventive maintenance schedules and identifying equipment problem areas. Open work orders where repair work or replacement is to be done at a designated future date as scheduled, would be an indication of an effective preventive maintenance program.

It is imperative that the prearranged schedule of maintenance be adhered to regardless of other facility constraints. The employer should give priority to the maintenance or repair work associated with safety control equipment, such as that on dryers, magnets, alarm and shut-down systems on bucket elevators, bearings on bucket elevators, and the filter collectors in the dust control system. Benefits of a strict preventive maintenance program can be a reduction of unplanned downtime, improved equipment performance, planned use of resources, more efficient operations, and, most importantly, safer operations.

The standard also requires the employer to develop and implement procedures consisting of locking out and tagging equipment to prevent the inadvertent application of energy or motion to equipment being repaired, serviced, or adjusted, which could result in employee injury. All employees who have responsibility for repairing or servicing equipment, as well as those who operate the equipment, are to be familiar with the employer's lock and tag procedures. A lock is to be used as the positive means to prevent operation of the disconnected equipment. Tags are to be used to inform employees why equipment is locked out. Tags are to meet requirements in 1910.145(f). Locks and tags may only be removed by employees that placed them, or by their supervisor, to ensure the safety of the operation.

10. Grain Stream Processing Equipment

The standard requires an effective means of removing ferrous material from grain streams so that such material does not enter equipment such as hammer mills, grinders and pulverizers. Large foreign objects, such as stones, should have been removed at the receiving pit. Introduction of foreign objects and ferrous material into such equipment can produce sparks which can create an explosion hazard. Acceptable means for removal of ferrous materials include the use of permanent or electromagnets. Means used to separate foreign objects and ferrous material should be cleaned regularly and kept in good repair as part of the preventive maintenance program in order to maximize their effectiveness.

11. Emergency Escape

The standard specifies that at least two means of escape must be provided from galleries (bin decks). Means of emergency escape may include any available means of egress (consisting of three components, exit access, exit, and exit discharge as defined in 1910.35), the use of controlled descent devices with landing velocities not to exceed 15ft/SEC., or emergency escape ladders from galleries. Importantly, the means of emergency escape are to be addressed in the facility emergency action plan. Employees are to know the location of the nearest means of emergency escape and the action they must take during an emergency.

12. Dryers

Liquefied petroleum gas fired dryers should have the vaporizers installed at least ten feet from the dryer. The gas piping system should be protected from mechanical damage. The employer should establish procedures for locating and repairing leaks when there is a strong odor of gas or other signs of a leak.

13. Inside Bucket Elevators

Hazards associated with inside bucket elevator legs are the source of many grain elevator fires and explosions. Therefore, to mitigate these hazards, the standard requires the implementation of special safety precautions and procedures, as well as the installation of safety control devices. The standard provides for a phase-in period for many of the requirements to provide the employer time for planning the implementation of the requirements. Additionally, for elevators with a permanent storage capacity of less than one million bushels, daily visual inspection of belt alignment and bucket movement can be substituted for alignment monitoring devices and motion detection devices.

The standard requires that belts (purchased after the effective date of the standard) have surface electrical resistance not to exceed 300 megohms. Test methods available regarding electrical resistance of belts are: The American Society for Testing and Materials D257-76, "Standard Test Methods for D-C Resistance or Conductance of Insulating Materials"; and, the International Standards Organization's #284, "Conveyor Belts, Electrical Conductivity, Specification and Method of Test." When an employer has a written certification from the manufacturer that a belt has been tested using one of the above test methods, and meets the 300 megohm criteria, the belt is acceptable as meeting this standard. When using conductive belts, the employer should make certain that the head pulley and shaft are grounded through the drive motor ground or by some other equally effective means. V-type drive belts should not be used to transmit power to the head pulley assembly from the motor drive shaft because of the break in electrical continuity to the motor ground.

Employers should also consider purchasing new belts that are flame retardant or fire resistive. A flame resistance test for belts is contained in 30 CFR 18.65.

[61 FR 9577, March 8, 1996; 67 FR 67965, Nov. 7, 2002]

Follow-up Assessment
Grain Bin Emergency Awareness

1. Which OSHA CFR standard outlines grain bin emergencies?
   A. 1910.272
   B. 1230.999
   C. 1400
   D. 1760.555
2. At what depth of grain does OSHA mandate harness/ life line use in grain bins?
   A. 1 foot
   B. 4 feet
   C. 8 feet
   D. 20 feet

3. A chemical commonly used in fumigating grain is
   A. Amine
   B. Aluminum Phosphide (Phosphine)
   C. Acetone
   D. Chlorine

4. Entrapments in grain handling can happen in- 4-5 seconds and buried in 20 seconds.
   A. True
   B. False

5. What is the maximum dust accumulation recommended for safety in priority areas of grain bin facilities?
   A. 2 inches
   B. 1 inch
   C. 1/8 inch
   D. 1 foot

6. The Permissible Exposure Limit (PEL) of Phosphine gas is
   A. 40 ppm
   B. 20 ppm
   C. 5 ppm
   D. 0.3 ppm

7. An issue of poor quality grain that results in a potential grain bin emergency where the grain packs, hardens and crusts, creating a void space underneath the layer is called?
   A. Grain canopy
   B. Grain table
   C. Grain bridge

D. Grain rot

8. If holes are cut in the side of the grain bin to rescue a trapped individual, grain will flow out how many times the height of the cut hole?
   A. 4 times
   B. 2 times
   C. 8 times
   D. 10 times

9. OSHA CFR 1910.272 mandates that anytime someone enters a bin they should have
   A. A Grain Bin Entry permit
   B. Id card
   C. Owner permission
   D. No mandate you can enter when you want

10. Keeping grain in good condition helps reduce grain bin entrapments.
    A. True
    B. False

Follow-up Assessment
Grain Bin Emergency Awareness
Answer Key

1. Which OSHA CFR standard outlines grain bin emergencies?
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   C. 1400
   D. 1760.555

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    A. True
    B. False

Activity 3.1
End of Course Assessment
Grain Bin Emergency Awareness

1. Which OSHA CFR standard outlines grain bin emergencies?
   A. 1910.272
   B. 1230.999
   C. 1400
   D. 1760.555

2. Which of the following is the goal for Grain Bin Emergency Awareness?
   A. To recognize common hazards that exist during grain bin operations
   B. Understand steps that reduce or eliminate hazards in grain bins
   C. Identify initial actions that should be taken in the event of a grain bin handling incident.
   D. All of the above

3. At what depth of grain does OSHA mandate harness/ life line use in grain bins?
   A. 1 foot
   B. 4 feet
   C. 8 feet
   D. 20 feet

4. The lock out tag out system should always be used on auger before entry into grain bin.
   A. True
   B. False

5. What is the maximum dust accumulation recommended for safety in priority areas of grain bin facilities?
   A. 2 inches
   B. 1 inch
   C. 1/8 inch
   D. 1 foot

6. Which idea does not belong in a “Culture of Safety”?
   A. Good cleaning practices
   B. Good aeration of bin and facilities
   C. Training and awareness before entering the bin
   D. Rushed work practices

7. A notable health effect of pesticides is
   A. Cancer
   B. Diabetes
   C. Birth defects
   D. All of the Above

8. A chemical commonly used in fumigating grain is
   A. Amine
   B. Aluminum Phosphide (Phosphine)
   C. Acetone
   D. Chlorine

9. The Permissible Exposure Limit (PEL) of Phosphine gas is
   A. 40 ppm
   B. 20 ppm
   C. 5 ppm
   D. 0.3 ppm

10. (blank) contain information on a products ingredients as well as outlines emergency procedures.
   A. Safety Data Sheets
   B. Weigh out bills
   C. Identification placards
   D. NFPA 704

11. Except fans and lighting, equipment shutdown and lockout tags should be placed on what prior to entry in grain bins?
   A. Heaters
   B. Augers
   C. Conveyer belts
   D. All of the above

12. An issue of poor quality grain that results in a potential grain bin emergency where the grain packs, hardens and crusts, creating a void space underneath the layer is called?
   A. Grain canopy
   B. Grain table
   C. Grain bridge
   D. Grain rot

13. What comes first in the process of incident priorities?
   A. Incident Stabilization
   B. Property Conservation
   C. Life Safety
   D. None of the above

14. If holes are cut in the side of the grain bin to rescue a trapped individual, grain will flow out how many times the height of the cut hole?
   A. 4 times
   B. 2 times
   C. 8 times
   D. 10 times

15. When doing air monitoring tests, the normal oxygen concentration reading is
    A. 24%
    B. 20.9%
    C. 18%
    D. 15%

16. Indicators of a possible dust explosion include all of the following **EXCEPT**
    A. Good airflow
    B. Bad sanitation practices
    C. Reclaim system malfunction or poor design
    D. Poor dust management

17. What gas is commonly produced with the fermentation of poor quality grain
    A. Oxygen
    B. Carbon Dioxide
    C. Carbon monoxide
    D. Hydrogen cyanide

18. OSHA CFR 1910.272 mandates that anytime someone enters a bin they should have
    A. A Grain Bin Entry permit
    B. Id card
    C. Owner permission
    D. No mandate you can enter when you want

19. From how many feet away should a 25 watt light bulb be seen to determine that there is not a combustible dust mixture?
    A. 5 feet
    B. 10 feet
    C. 1 foot
    D. 15 feet

20. Factors that contribute to Dust Explosions include all of the following **EXCEPT**
    A. Confinement
    B. Dispersion
    C. Ignition Source
    D. Abundant air flow and ventilation

Activity 3.1
End of Course Assessment
Grain Bin Emergency Awareness
Answer Key

1. A
2. D
3. B
4. True
5. C
6. D
7. D
8. B
9. D
10. A
11. D
12. C
13. C
14. A
15. B
16. A
17. B
18. A
19. B
20. D

Activity 1.2
Grain Bin Emergency Awareness
Pre Course Assessment

1. There are over 60 corporate grain handling facilities in Oklahoma.

    a. True

    b. False

2. People under 16 years old account for 5% total farm fatalities.

    a. True

    b. False

3. Keeping grain in good condition helps reduce grain bin entrapments.

    a. True

    b. False

4. If there is grain on fire in the grain storage bin you should make an entry attempt to extinguish the grain.

    a. True

    b. False

5. There are several chemical hazards that exist when responding to grain bin emergencies.

    a. True

    b. False

6. Grain Bins are the strongest when they are empty.

    a. True
    b. False

7. Dust accumulation is a problem when it becomes more than 1/8 inch deep.

    a. True
    b. False

8. Entrapments in grain handling can happen in- 4-5 seconds and buried in 20 seconds.

    a. True
    b. False

9. The normal oxygen level in the air is 19.5% for safety entry.

    a. True
    b. False

10. The death rate for complete submersion in a grain bin 92%.

    a. True
    b. False

Activity 1.2
Grain Bin Emergency Awareness
Pre Course Assessment

Answer Key

1. There are over 60 corporate grain handling facilities in Oklahoma.

    a. True
    b. False

2. People under 16 years old account for 5% total farm fatalities.

    a. True
    b. False 20%

3. Keeping grain in good condition helps reduce grain bin entrapments.

    a. True
    b. False

4. If there is grain on fire in the grain storage bin you should make an entry attempt to extinguish the grain.

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9. The normal oxygen level in the air is 19.5% for safety entry.

    a. True
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    b. False

Module 1
Introduction

Instructor Guide

Module 1 Goal

To recognize common hazards that exist during grain bin operations, understand steps that reduce or eliminate these hazards, and identify initial actions that should be taken in the event of an incident at a grain handling facilities.

Module 1 Learning Objectives

Upon successful completion of this module, the student shall be able to:

1. *Identify the OSHA Regulations that directly affect Grain Bin Rescue.*
2. *Identify the NFPA Standards that directly affect Grain Bin Rescue.*
3. *List the potential hazards associated with grain bin operations.*
4. *Identify avenues to mitigate the risk of injury or death when working around grain bin operations.*
5. *Summarize what steps to take in the case of someone getting injured within a grain bin..*

Instructor Information

This is the Grain Bin Emergency Awareness program instructor's guide. The purpose of this guide is to provide the instructor with an understanding of the course information including the course schedule, expectations of the student, and requirements for the successful completion of Grain Bin Rescue Awareness through Oklahoma State University - Fire Service Training. This course is designed to assist employers and facility workers with meeting the requirements of OSHA 1910.272.

Generally, students will have many questions about the course and its requirements during this module. Take the time to answer all questions. You should anticipate specific questions about the following issues:

- requirements to pass the course
- attendance requirements
- course schedule
- personal Protective Equipment Required

The best source of information about the course is the course syllabus. Each student should have received a course syllabus prior to the first day of class. When discussing the course schedule and the course requirements, use the syllabus as a discussion guide.

Throughout the module, emphasize the following points to the students. Explain that these 'tips' are meant to help them succeed in the course.

- Be prepared for class. This includes being rested, being on time, and have a positive attitude about the day.
- Consider how the concepts apply to the home facility or department.
- View the concepts and skills as a facility worker or rescuer, not in the student's current position. This applies if the student is not yet on a rescue team.

To prepare for teaching this course, carefully review the course syllabus, the instructor guide (IG), the student manual (SM), and OSHA 1910.272. You should be familiar with the overall course prior to delivery so that you can answer questions about the course. Consider how the concepts in the course apply to each individual student and their community.

While teaching this module and other modules, it is important that you:

- stay on task and complete each section on time
- keep on-track with the instructor guide and student manual
- make all the concepts apply to the student's world
- actively engage the students in each activity
- challenge the students to think 'out of the box'

Prior to beginning the course, ensure the following materials and information is available:

- Grain Bin Rescue Awareness student manual is available for each student
- copies of the course syllabus
- audiovisuals for the course
- student handouts
- OSU-FST course registration forms
- Form 10 for each department represented in the course
- student roster from OSU-FST

Important instructor information is provided in shaded boxes throughout the lesson plan. Carefully review the instructor information before presenting the module. There is space provided in the left margin for personal notes.

Finally, there are cues listed in the left margin. **PowerPoint Slides** are illustrated by thumbnails of slides; **Flipchart** refers to information that is to be recorded on a flipchart or easel pad; **SM** refers to a page in the student manual; **P** refers to page(s) in the text; **Activity** refers to specific learning activity; and **Handout** refers to a student handout that is referenced during instruction.

Methodology

This module uses lecture, discussion, and a small group activity. The activity is designed to gain an understanding of the needs and backgrounds of each student. The level of learning is comprehension.

(Total Time: 50 minutes)

10 min.	Lecture/Discussion	
	Introduction to Course	IG 1-7
10 min.	Activity 1.1	
	Introductions	IG 1-13
15 min.	Activity 1.2	
	Pre-course Assessment	IG 1-13
10 min.	Lecture/Discussion	
	Standards and Regulations	IG 1-15
5 min.	Lecture/Discussion	
	Dangers and Summary	IG 1-18

Instructor-to-Participant Ratio

The Instructor-to-participant ratio for this module is 1 instructor for every 24 participants. There are no practical exercises with this module.

Evaluation Strategy

The evaluation strategy is accomplished with instructor questions during discussions and assessments within the activities.

Practical Exercise Statement

There are no practical exercises in this module.

Audiovisuals/Handouts

PowerPoint Presentation – Grain Bin Emergencies Awareness

Activity 1.2 – Pre-Course Assessment

Resource List

Digital Projector
Laptop computer with PowerPoint
Projection screen
OSU-FST name tents
OSU-FST Course Registration
Flipchart with markers
Grain Bin Emergency Awareness student manual (1 for each student)
Copies of the course syllabus
All student handouts
A form 10 for each department represented in the course
A student roster from OSU-FST

10 min.
Lecture/
Discussion

I. Introduction

The purpose of this section is to welcome the students to the course and to review emergency information. If possible, a representative from the host department should welcome the students and provide any pertinent information about the community, i.e. eating places, entertainment, etc. Welcome remarks should be no more than 5 minutes.

A. Welcome of Students

1. This course is being presented by Oklahoma State University - Fire Service Training
2. The department is hosting the training.
3. Brief introduction of instructor by the host.

You should provide some basic information to the host for your introduction. However, a detailed introduction will be done later in the unit. After the introduction thank the host for hosting the course and the students.

Emergency information should be gathered from the host department prior to the start of the course. Contact information should be listed on a whiteboard or flipchart. Encourage students to record the information in their student manuals and to then provide the information to their families or agencies.

B. Emergency Procedures

1. Emergency exits
2. Fire alarms
3. Severe weather information
4. Emergency contact phone numbers.
5. Procedures for receiving an emergency

C. Facility Information

1. Restrooms
2. Parking areas
3. Telephones
4. Refreshment areas
5. Smoking areas
6. Rules for refreshments in classroom

ASK: Are there any questions about the facility or emergency procedures?

Answer any question. If needed, refer the question to the host.

The purpose of this section is to identify the classroom rules for the course. Emphasize the importance of participation.

D. Course Rules

1. Be on time for class.
2. Be prepared for class.
3. Indicate cell phone, pager and radio preferences.
4. You will have a 10-15 minute break every 50-60 minutes.
5. The classroom must be cleaned and the trash dumped before students leave each day.

ASK: Are there any questions about the course rules?

Answer any question. If needed, refer the question to the host.

E. Grain Bin Emergencies Awareness

1. Read the following story to the students, before going on the next slide.

Read the following story to the participants before going on to the next slide.

NOTE: The next slide looks the same but it has a voice clip. Check your speakers.

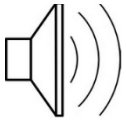
March 23, 2009 Nolan Schmidt, volunteer fire chief for the Hydro, Oklahoma fire department died fighting a fire inside a Hydro grain bin. Fire Chief Schmidt was one of at least five firefighters who climbed into a bin half full of burning soybeans. Fellow firefighters later cut through the side of the metal bin to remove Schmidt and four other colleagues, who were overwhelmed by thick smoke.

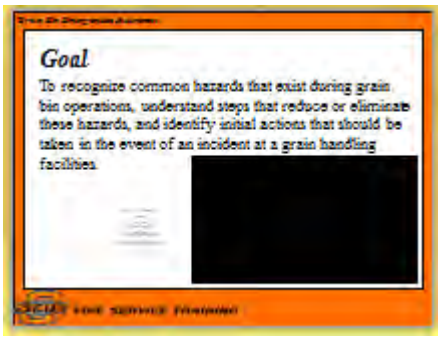
Chief Schmidt and the members of his fire department were dispatched to a report of a possible fire in a large grain bin. Firefighters entered the bin to investigate. Chief Schmidt ordered firefighters to exit the bin. In order to get out of the bin, firefighters had to climb up a long ladder. One of the firefighters in the bin was fatigued and could not complete the climb. Chief Schmidt entered the bin the assist the firefighter. Both firefighters subsequently lost consciousness. Firefighters on the exterior cut a hole in the metal wall of the bin and extricated the two firefighters. Chief Schmidt was transported to the hospital but was pronounced dead.

The cause of death was listed as asphyxiation due to probable carbon monoxide toxicity.

F. Grain Bin Emergencies Awareness

1. ***NOTE:*** This slide has a voice over clip



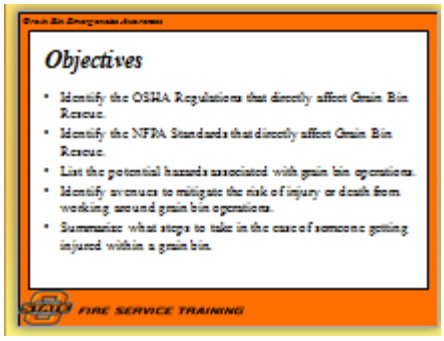


G. Module 1 Goal

1. Recognize common hazards that exist during grain bin operations
2. Understand steps that reduce or eliminate these hazards
3. Identify initial actions that should be taken in the event of an incident at a grain handling facility
4. The audio and video clips are taken from an episode of ABC's series In An Instant. The episode title is "Buried Alive" which originally aired on April 4, 2015.

Instructors are encouraged to watch this episode before delivering their first class and to share the link with students so they may view the video after their training.

://abc.go.com/shows/in-an-instant/episode-guide/season-01/06-in-an-instant-buried-alive



H. Module 1 Objectives

1. Identify the OSHA Regulations that directly affect Grain Bin Rescue.
2. Identify the NFPA Standards that directly affect Grain Bin Rescue.
3. List the potential hazards associated with grain bin operations.

4. Identify avenues to mitigate the risk of injury or death from work around grain bin operations.

5. Summarize what steps to take in the case of someone getting injured within a grain bin.

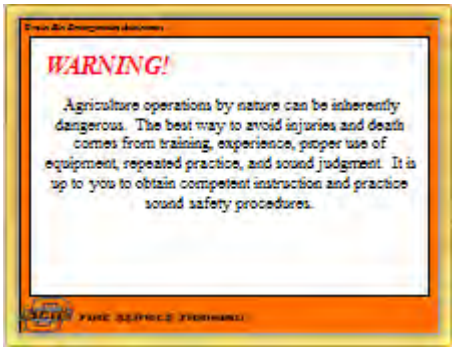
Answer any questions about the learning objectives or course goals.

Briefly review the information in the course syllabus. A syllabus is included in Module 1 of the student manual for reference. Answer any participant questions as they are asked.

II. Course Overview

1. Course Overview
2. Outcome Objectives
3. Text
4. Course Schedule
5. Course Evaluations

III. Warning (read slide)



Agriculture operations by nature can be inherently dangerous. The best way to avoid injuries and death comes from training, experience, proper use of equipment, repeated practice, and sound judgment. It is up to you to obtain competent instruction and practice sound safety procedures.

10 min. Activity

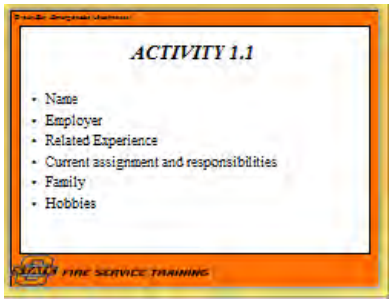
Activity 1.1
Student Introductions

Purpose

Learn about the background of each student.

Emphasize that the goal of the activity is to learn more about each other and to begin building working relationships for the course.
Allow 10 minutes for the students to complete the activity.

Directions to the Students



Share the following information with the class.

- Name
- Employer
- Related Experience
- Current assignment and responsibilities
- Family
- Hobbies

As introductions are being made, make a mental note of experiences Move through the class until all students have been introduced.

Summary

- View the class is a diverse group of experiences.
- The diversity will be used throughout the class to bring out varying viewpoints and ideas.

10 min.
Activity
5 min
Review

Activity 1.2
Pre-Course Assessment

Purpose

A preliminary assessment administered to determine a student's baseline knowledge or experiences prior to the course presentation

- Review the purpose of the activity with the participants
- Read the directions to the participants
- Answer any questions about the activity
- Insure that all of the students have a pre-course assessment
- Allow 10 minutes for the participants to complete the activity, the time includes review

Emphasize that the goal of the activity is to simply get an understanding of the participants knowledge of the subject

Directions to the Students

- Working individually, complete the 10 question pre-course assessment.
- Beginning with question #1 review the exam and allow the participants to grade their own assessment
- Have them place their name and the number of correct answers in the upper right-hand corner of the assessment

The instructor shall collect the assessments and insure that they are sent back to OSU-FST with the Sign–in sheet, registration, post-course assessment and evaluations

10 min. Lecture/ Discussion

IV. Standards and Regulations

Objective 2. Identify the OSHA Regulations that directly affect Grain Bin Rescue.

A. Standards – Are established for a rule of basis of comparison in measuring quantity, quality, etc. Standards are generally accepted guidelines and are considered reliable or authoritative.

B. Regulations – Are established by legislative authorities as a rule or law regulating conduct.

C. OSHA Regulations

1. Established by federal legislation – The Occupational Safety and Health Act of 1970.

2. Regulations are enforced by issuing citations for violations

D. OSHA 1910.272 Grain Handling Facilities

Objectives are created from the standards.

E. Other OSHA Regulations that affect Grain Handling Workers and Incidents.

F. NFPA Standards

1. Consensus Standards – recommendations established by an agreement of a broad variety of interest.

2. If adopted by an agency they can be enforced like regulations.

3. If not adopted by an agency they serve as a benchmark.

Benchmark – A point of reference for a measurement.

G. NFPA 1670 Standard on Operations and Training for Technical Search and Rescue Incidents (2014 Edition)

1. This standard identifies and establishes functional levels for rescue teams to be able to operate safely and effectively at technical rescue incidents. Those levels are:

   (a) Awareness – The minimum level of capability of organizations that provide rescue.

   (b) Operations – Capable of hazard recognition, equipment use, and techniques necessary to safely and effectively support and participate in technical rescue incidents. Activities could involve search, rescue, and recovery operations, usually

under the supervision of technician-level personnel.

(c) Technician – Capable of hazard recognition, equipment use, and techniques necessary to safely and effectively coordinate perform, and supervise a technical rescue incident. This level can involve search, rescue, and recovery.

H. Other Standard Setting Organizations

1. The National Institute of Occupational Safety and Health (NIOSH) www.cdc.gov/niosh

2. The American Society for Testing and Materials (ASTM) www.astm.org

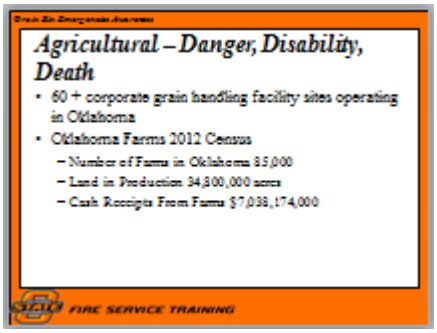
3. The American National Standards Institute (ANSI) www.ansi.org

4. American Society of safety Engineers (ASSE) www.asse.org

NFPA standards are available for purchase from most fire and rescue manual suppliers, Fire Protection Publications at www.ifsta.org or 800-654-4055 and on the NFPA website at www.nfpa.org

5 min.
Lecture/
Discussion

V. Agricultural – Danger, Disability, Death

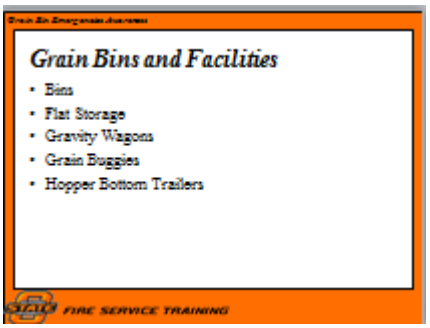


A. 60 + corporate grain handling facility sites operating in Oklahoma

B. Oklahoma Farms 2012 Census

1. Number of Farms in Oklahoma
2. Land in Production 34,800,000 acres
3. Cash Receipts From Farms $7,038,174,000

C. Farms are approximately 400 acres on average with no pre-plan or idea prior to arrival to the incident



D. Grain Bins and Facilities

1. Bins
2. Flat Storage
3. Gravity Wagons
4. Grain Buggies
5. Hopper Bottom Trailers

ASK: What are your responsibilities if you were to have a grain bin incident?
Briefly discuss the responses and try to promote discussion.

ASK: Are there any questions?
Answer any remaining questions. If you are on task it will be time for a 10 minute break.

Module 2
Good Grain Quality Equals Safety and Profit

Instructor Guide

Module 2 Goal

The Grain Bin Emergency Awareness responder will be able to accurately identify the presence of hazards associated with the characteristics of poor grain quality, hazardous structures and dust collection.

Module 2 Learning Objectives

Upon successful completion of this module, the student shall be able to:

1. *Identify the presence of hazards at grain bins and facilities*
2. *List the potential hazards associated with grain bin operations.*
3. *List the dangers of working around poor quality grain*
4. *Answer questions about engulfment*
5. *Understand what to look for on farms and at facilities*
6. *Identify the factors associated with dust explosions*
7. *Understand the method for creating a "Culture of Safety*

Instructor Information

The purpose of this module is to introduce the participant to the hazards associated with farming and promote safety and awareness when responding to incidents that involve the handling and storage of grain. The first responder or participant must be aware of the dangers involved when dealing with incidents on the farm or in grain bin facilities.

Whenever possible and appropriate, emphasize the follow key principles to the participants.

1. The first responder must be familiar with his/her community and the hazard locations

2. The first responder must be able to recognize containers and other signs that indicate the presence of hazards

3. The sooner the presence of hazards can be identified, the greater the safety of the emergency personnel and citizens.

Prepare for teaching this module by carefully reviewing the material and the student manual. Be prepared to answer questions about poor grain quality, dangers associated with grain storage, and dust accumulation.

While teaching this unit, it is important that you:

- stay on task and complete each section on time
- keep on-track with the instructor guide and student manual
- make all the concepts apply to the participants world
- remember to understand to concepts and teach the course with knowledge of the presentation
- remember to address your audience and do not “just read the slides”

Important instructor information is provided in shaded boxes throughout the lesson plan. Carefully review the instructor information before presenting the module. There is space provided in the left margin for personal notes.

Finally, there are cues listed in the left margin. **PowerPoint Slides** are illustrated by thumbnails of slides; **Flipchart** refers to information that is to be recorded on a flipchart or easel pad; **SM** refers to a page in the student manual; **P** refers to page(s) in the text; **Activity** refers to specific learning activity; and **Handout** refers to a student handout that is referenced during instruction.

Methodology

This module uses lecture and discussion. The level of learning is analysis.

(Total time: 45 minutes)

10 min	Lecture/Discussion	
	Introduction	IG 2-5
15 min	Lecture Discussion	
	Grain Handling	IG 2-8
15 min	Lecture Discussion	
	Dust Management	IG 2-15
5 min	Lecture and Discussion	
	Summary	IG 2-20

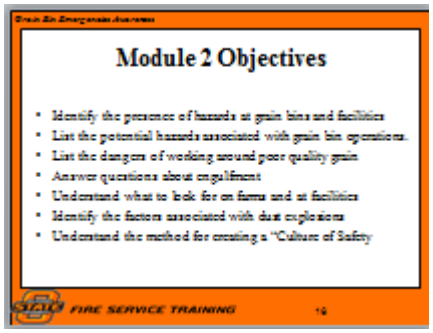
10 min.
Lecture/
Discussion

I. INTRODUCTION

The purpose of this module is to introduce the participant to the dangers involved in agriculture, specifically identifying the risks involved in grain storage and handling. Keep in mind that out of condition grain often causes workers to place themselves into situations that can lead to entrapment, engulfment, dismemberment and death. The ultimate goal is to educate first responders and workers of the dangers involved in the storage and handling of grain.

A. Module 2 Goal

1. The Grain Bin Emergency Awareness responder will be able to accurately identify the presence of hazards associated with the characteristics of poor grain quality, hazardous structures and dust collection

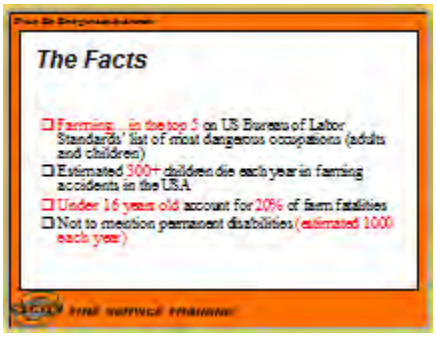


B. Module 2 Objectives

1. Identify the presence of hazards at grain bins and facilities
2. List the potential hazards associated with grain bin operations
3. List the dangers of working around poor quality grain
4. Answer questions about engulfment
5. Understand what to look for on farms and at facilities

6. Identify the factors associated with dust explosions

7. Understand the method for creating a "Culture of Safety



C. The Facts

1. Farming…in the top 5 on the US Bureau of Labor Standards' list of most dangerous occupations (adults and children)

   (a) Responsibilities are given to children at a young age

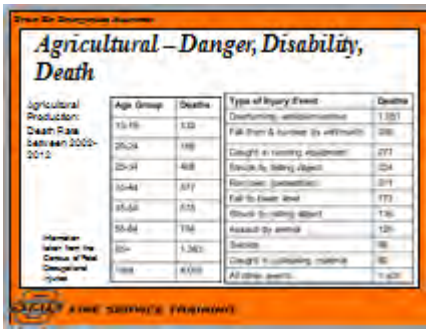
      (1) Children are more likely to fit into areas such as grain bins

2. Estimated 300+ children die each year in farming accidents in the USA

3. Under 16 years old account for 20% of farm fatalities and dismemberment

4. Not to mention permanent disabilities

   (a) Estimated 1000 each year



D. Agricultural – Danger, Disability, Death

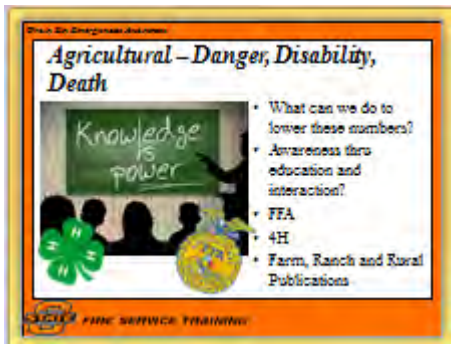
1. This slide depicts the agricultural – production death rate between 2002 – 2012

   (a) Types of injuries

   (b) Age Group

   (c) Number of Deaths

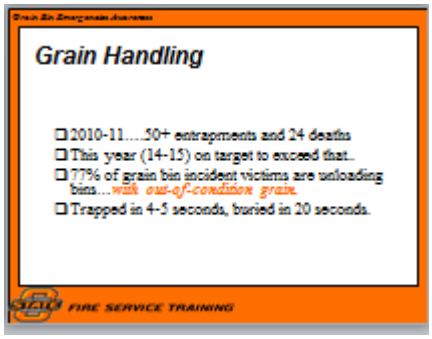
   (d) Totals



E. What can we do to lower these numbers

1. Knowledge is power
   (a) Agricultural industry is getting better
2. Education
   (a) Children and Spouses have influence when it comes to safety.
3. Interaction
4. FFA and 4-H
5. Farm, Ranch and Rural Publications

15 min. Lecture/ Discussion



II. GRAIN HANDLING

A. Grain Handling

1. 2010 - 11: 50+ entrapments and 24 deaths

   (a) The grains coming out of the fields in 2010 were wet due to the heavy rains that were received that year.

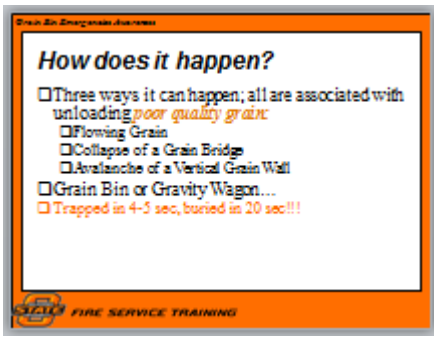
   (b) This increase in moisture also increased the probability of out of condition grain in facilities that could not control the moisture levels.

Out of Condition Grain is also referred to as Bad Grain Condition. Grain that has one or more of the following characteristics: heating, crusting, a musty or sour odor, does not flow well, chunks, abnormal angle of repose, bridging, pyramids or other conditions that are not normal

2. 77% of grain bin incident victims were unloading bins ***with out-of-condition grain.***

3. ***Trapped in 4-5, seconds, buried in 20 seconds.***

At this point in the presentation it will make an impact on the class if you will count 1 – 2 – 3 – 4 – 5……and use the timer for 20 seconds. .



B. How does it happen?

1. Three ways it can happen; all associated with unloading ***poor quality grain:***

   (a) Flowing Grain

      (1) Auger is on

      (2) Walking down grain

   (b) Collapse of a Grain Bridge

      (1) Crust stays and grain runs out underneath leaving a “bridge with no support”, a void.

   (c) Avalanche of Vertical Grain Wall

      (1) Out of condition grain sticks to the side of the bin and can collapse, Ex: Vibrations from trucks

2. Grain Bin or Gravity Wagon

3. ***Trapped in 4-5 seconds, buried in 20 seconds!!***

C. Flowing Grain

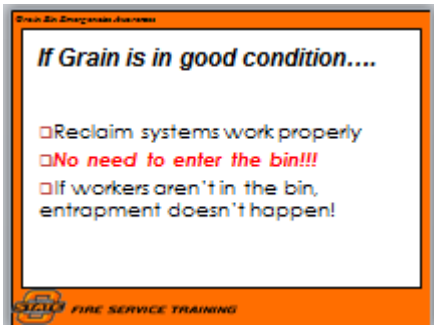
1. 2 – 3 seconds for engulfment
2. Auger is on
3. Why is this worker in the bin??
4. Kids walking down the grain with auger on, “Gone in 2 -3 seconds.
   (a) Why? Because kids fit…….
   (b) It’s a physically challenging job even for a young fit person.

D. Collapse of a grain bridge

1. ***Out of Condition Grain***
   (a) Victim may travel 5 feet or more and not always in a vertical direction.

E. Avalanche of grain wall

1. Vibration
2. ***Out of condition grain*** sticks to the bin wall.



F. If grain is in good condition….

1. Reclaim systems work properly
2. ***No need to enter the bin!!!***
3. If workers are not in the bin entrapment does not happen!

ASK: Are there any questions or comments about the condition of the grain or the circumstances in which a person could get trapped.

Encourage discussion, answer any questions and acknowledge comments.

G. Major Cause: ***Out of condition grain***

1. Picture 1: grain stuck to the side
2. Picture 2: monuments of grain
3. Picture 3(top): moldy
4. Picture 4(top): heat; caught on fire
5. Picture 5 (bottom right): shows a temperature cable

NOTE: Most of these problems require intervention.

H. What to look for…..

1. Poor grain quality when it is loaded into the bin
2. Quality ***never*** improves in storage
3. Management of temperature changes and moisture
   (a) Good storage facilities are able to control temperature and moisture

I. Moisture management problems

1. Large Temperature Fronts
    (a) 15 degree change in temperature can cause condensation
2. Moisture Migration
3. Hot Spots
4. Crusts/Spoilage
5. Insects
6. Over-Drying/Shrink
7. Moisture Imbalances
8. Condensation
9. Creates:
    (a) Mold and Mildew
    (b) Bacteria and Fungi
10. Insects can create “hot spots”
    (a) Excrement
11. Poor venting
    (a) Increases moisture

J. What to look for….

1. Leaky structures
   (a) Old structures: No aeration
   (b) Dusty and hot
2. Aeration systems not designed properly
3. Aeration system mismanagement
4. Temperature cable malfunctions
   (a) Workers may not be aware of a malfunction and hot spots will grow uncontrolled without intervention

K. Inadequate or plugged roof vents/exhaust fans

1. Not enough roof vents
2. Inadequate sizing of roof vents and exhaust fans

L. What to look for…

1. Insect Activity
2. Do you know your insects????
   (a) Some only feed on mold
   (b) Check for bad smells

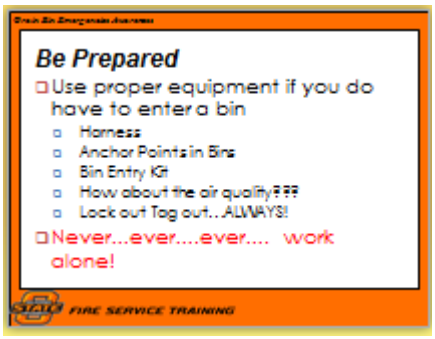
(c) Look at ladders and areas around bins for signs of insects

M. What to look for…

1. Poor sanitation practices
2. Reclaim system malfunction or poor design
3. ***Inadequate dust management***

(a) Leads to dust explosions

Hydro Oklahoma: The fire was on the outside and travelled to the inside of the bin. The responders entered the bin to extinguish the fire. It is important to emphasize that if a responder encounters a fire on the inside of a grain bin: Let it burn and do not spray water inside.
Warning: Entering a bin requires specialized training.



N. Be prepared

1. Use proper equipment if you do have to enter a bin

   (a) You must have proper training

   (b) Harness

   (c) Anchor points in bins

      (1) Old bins seldom have anchor points

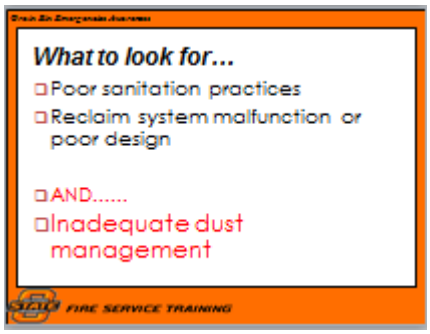
   (d) Bin entry kit

   (e) How about checking the air quality (air monitoring will be covered is Module 3)

   (f) Lock out Tag out…ALWAYS

2. ***Never…..ever…..ever work alone!***

15 min. Lecture/ Discussion



III. DUST MANAGEMENT

A. What to look for…

1. Poor sanitation practices
2. Reclaim system malfunction or poor design, AND
3. ***Inadequate dust management***

(a) **No dust accumulation over 1/8 “

B. Dust explosions?

**Industry has to adhere to standards but the family farms do not.

1. ALWAYS requires 5 things

(a) Fuel

(1) Grain dust, or

(2) Other combustible dust

(b) Ignition source

(1) Sparks, hot surfaces, open flame

(2) Welders, grinders, hot belts or bearings

(c) Dispersion of the fuel

(1) Combustible dust particles suspended in air

(2) In a quantity sufficient to support combustion

(d) Confinement

(1) Pressure – the combustion of dust within the confined space creates an explosive atmosphere.

i. A flash fire can occur outside of a confinement space but the process does not create an explosion

(e) Oxygen

(f) The normal concentration of oxygen air will support combustion

C. Conditions leading to dust explosions?

1. Dust settles on flat surfaces
2. Some event disturbs the settled dust and creates a cloud
3. Dust cloud is ignited and explodes

D. How do you know how thick the dust is?

1. 25 watt light bulb cannot be seen through ten feet of a combustible dust mixture.

E. What bulb????

1. Lights and electrical equipment need to be intrinsically safe for use in areas where there could be dust particles suspended in air

F. Digital Pictures…..

1. Dust particles show as spots in the photograph

G. The Remedy? Avoid Dust explosions by:

1. Keep it ***Clean!***
   (a) Pictures show areas of dust accumulation
   (b) Lights
   (c) Ladders and equipment

H. Dust Control

1. 1/8 “ maximum in priority areas
2. Vacuum preferred with unit located outside

3. Use compressed air and cleaning procedures that suspend dust in the air ONLY when ignition sources are removed or controlled

4. Can you see the heater?

I. Potential Ignition sources

1. Lightning strikes and open flames

2. Welding, cutting, grinding and arcs and sparks

3. Electrostatic discharges and friction

4. Smoking and hot surfaces

5. Self-heating, decomposition, and spontaneous combustion

6. Exothermic chemical reactions and mechanical impacts

J. The Remedy? Dust explosions can be avoided by:

1. ***Eliminate heat source***

2. Insure that sensors are in working order

   (a) Hot bearing sensors and stainless steel sensor housing – UL label

(b) Rub block display indicating temperature

(c) Belt alignment sensor

(1) May notify a worker if belt is out of alignment or it may shut down the system

K. The Remedy?

1. ***Eliminate heat source***

2. Motion probe on boot shaft

3. Dust collection, dust collectors and fan should be located outside of buildings and enclosures.

L. Dust Chamber

1. Creates an environment for grain dust to explode when an ignition source is introduced.

2. This demonstration simulates how a dust explosion would travel through a grain elevator

M. Dust chamber in slow motion. This entire process spanned 1/5th of a second.

1. The explosion can cause a daisy chain effect.

(a) First bin explodes and dislodges dust in next bin which creates a larger explosion. The vibrations

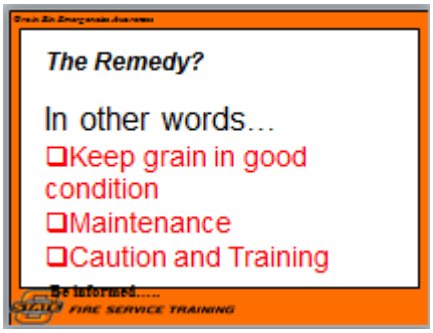
dislodge more dust in the next bins and more explosions occur

(b) Dust explosions can be devastating, such as the series of explosions that occurred June 8, 1998 in Wichita KS, killing seven and injuring ten employees.

ASK: Are there any questions or comments about dust management.
Encourage discussion, answer any questions and acknowledge comments.

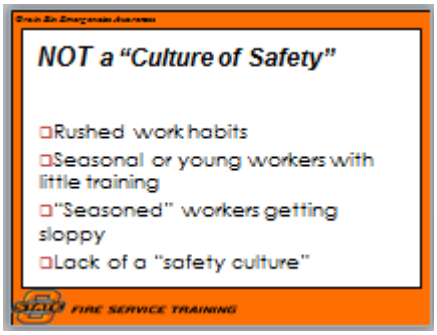
5 min.
Lecture/
Discussion

IV. Summary



A. The Remedy?

1. ***Keep grain in good condition***
2. ***Maintain equipment and the facility***
3. ***Use caution and train to know how to do your job safely***
   (a) "Build a "Culture of Safety"
   (b) Always think before making the decision to enter a grain bin



B. **Things that do not foster a Culture of Safety=**

1. Rushed work habits
2. Seasonal or inexperienced workers (such as youth) with little training
3. Workers getting sloppy with work habits
4. Lack of enforcing safe work practices

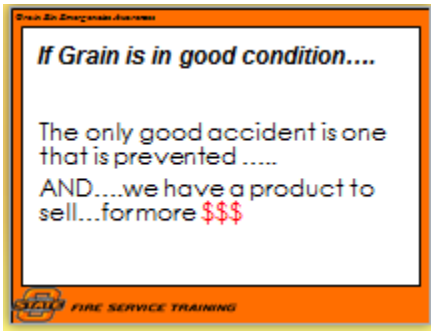
C. How do we fix it…..

1. Develop a **"Safety Always"** mindset
2. Follow Best Management Practices
3. Train yourself, workers and family
4. Brain storm and talk about "what ifs"

(a) Stop and take a ***"Safety Moment":*** This is a great way to start a safety meeting or table top discussion

D. How do we fix it…?

1. Focus on the details
2. Manage ***GRAIN QUALITY AND BE PREPARED*** through:
   (a) Communication
   (b) Teamwork
   (c) Training…its **Everyone's** job



E. If Grain is in good condition…

1. Accidents can be prevented
2. The only good accident is one that is prevented…
3. AND…we have a product to sell…for more **$$$**

F. QUESTIONS?

G. Dr. Carol L. Jones is currently an associate professor in the Biosystems and Agricultural Engineering Department at Oklahoma State University. Her appointment to the BAE faculty began in 2006 after 25+ years in the energy and agricultural fields. Her area of research, extension and teaching is in postharvest technology and material handling of biological products.

1. https://ceat.okstate.edu/deans-building-leaders-initiative

Module 3
Hazard Recognition

Instructor Guide

Module 3 Goal

The First Responder – Grain Bin Awareness level will understand his/her role and responsibilities as an emergency responder associated with chemicals, pesticides, and will be able to discuss the dangers involved with grain bin entry

Module 3 Learning Objectives

Upon successful completion of this module, the student shall be able to:

1. *Identify the presence of hazards at grain bins and facilities*
2. *List the potential hazards associated with pesticides*
3. *Answer questions about grain bin entry permits*
4. *Define Lock out/Tag out*
5. *Discuss the differences: Entanglement, Entrapment and Engulfment*
6. *Identify incident priorities*
7. *Understand the emergency procedures of you are trapped*

Instructor Information

The purpose of this module is to introduce the participant to the hazards associated with farming and promote safety and awareness when responding to incidents that involve the handling and storage of grain. The initial responders, both workers and emergency first responders, must be aware of the dangers involved when dealing with incidents on the farm or in grain bin facilities.

Whenever possible and appropriate, emphasize the follow key principles to the participants.

1. Emergency first responders must be familiar with their community and it's hazard locations

2. Workers and emergency first responder must be able to recognize containers and other signs that indicate the presence of hazards

3. The sooner the presence of hazards can be identified, the greater the safety of the emergency personnel and the public.

Prepare for teaching this module by carefully reviewing the material and the student manual. Be prepared to answer questions about poor grain quality, dangers associated with grain storage, and dust accumulation.

While teaching this unit, it is important that you:

- stay on task and complete each section on time
- keep on-track with the instructor guide and student manual
- make all the concepts apply to the participants world
- remember to understand to concepts and teach the course with knowledge of the presentation
- remember to address your audience and relate the information to the students, do not "just read the slides"

Important instructor information is provided in shaded boxes throughout the lesson plan. Carefully review the instructor information before presenting the module. There is space provided in the left margin for personal notes.

Finally, there are cues listed in the left margin. **PowerPoint Slides** are illustrated by thumbnails of slides; **Flipchart** refers to information that is to be recorded on a flipchart or easel pad; **SM** refers to a page in the student manual; **P** refers to page(s) in the text; **Activity** refers to specific learning activity; and **Handout** refers to a student handout that is referenced during instruction.

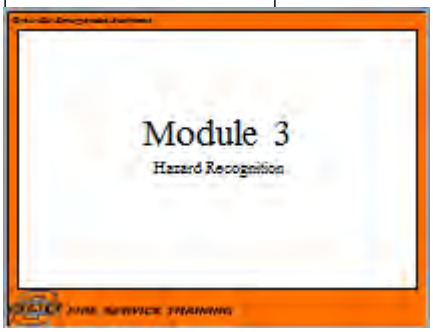
Methodology

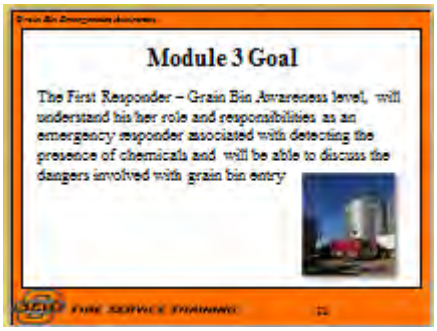
This module uses lecture and discussion. The level of learning is analysis.

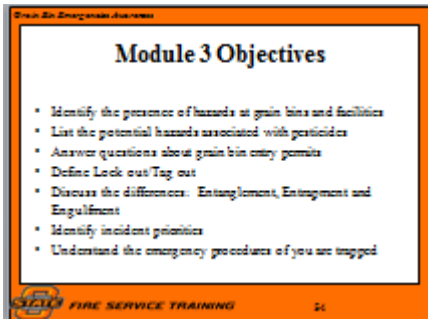
(Total time: 1 hour 50 minutes)

5 min	Lecture/Discussion Introduction	IG 3-5
15 min	Lecture Discussion Pesticides	IG 3-6
15 min	Lecture Discussion Other Hazards	IG 3-10
15 min	Lecture and Discussion Entanglement…..	IG 3-15
15min	Lecture Discussion Grain Bin Rescue	IG 3-17
15min	Lecture Discussion Summary	IG 3-23
30 min	End of Course Assessment	IG 3-25

5 min.
Lecture/
Discussion







I. INTRODUCTION

The purpose of this module is to introduce the participant to the dangers involved in agriculture, specifically identifying the risks involved in working in and around grain storage facilities. Pesticides, chemicals and poor air quality is an identifiable hazard with education. The module also identifies the steps to take in case of an emergency situation

A. Module 3 Goal

1. The First Responder – Grain Bin Awareness level will understand his/her role and responsibilities as an emergency responder associated with chemicals, pesticides, and will be able to discuss the dangers involved with grain bin entry

2. Workers are an important part of the initial response and must also understand how their actions support an effective response

B. Module 3 Objectives

1. Identify the presence of hazards at grain bins and facilities
2. List the potential hazards associated with pesticides
3. *Answer questions about grain bin entry permits*
4. *Define Lock out/Tag out*
5. *Discuss the differences: Entanglement, Entrapment and Engulfment*

6. *Identify incident priorities*
7. *Understand the emergency procedures if you are trapped*
8. *Identify the role of the initial responders trained to the awareness level*

Answer: Questions about the Goal and Objectives.

15 min. Lecture/ Discussion

II. Pesticides

A. Pesticides

1. NASS (National Agricultural Statistics Service) survey shows only 15% of grain was treated

   (a) Conducts Agricultural Surveys

2. PDP (Pesticide Data Program)surveys show 80-91% of the treated grain had detectable residues

   (a) The purpose of the PDP is to make scientific statements about the distribution of certain pesticide residues in particular commodities

B. Pesticides

1. Aluminum Phosphide

   (a) Insecticidal fumigant used to kill insects, insect larvae and eggs

2. Chlorpyrifos-methyl (Reldan)

(a) Stored grain insecticide spray and dusts

3. Lindane

(a) Seed treatments

4. Diatomaceous earth

5. Pesticides

(a) What are the potential health effects of pesticides?

(1) Alzheimer, Asthma and Birth defects

(2) Cancer, Diabetes, and Learning Disabilities

(3) Parkinson's, reproductive and

(4) Death

6. Chemical Hazards

(a) Fumigation for Insects

(1) Warning signs

(2) Danger/Poison Gas Sign/Label

(b) NFPA 704

(1) Stored Products

(c) SDS's

(1) Safety Data Sheets

(d) Labels

(1) Will have a Signal Word and the name of the gas

ASK: How can you identify chemical hazards on the family farm? In an Industrial Setting?
Briefly discuss the responses and try to promote discussion.

C. Aluminum Phosphide

1. Moisture Activated

(a) Always follow the instructions on the label

(b) Proper PPE required

(c) Do not use bare hands, use cotton gloves

(d) Tablets used in grain bins

(e) Gases for a closed loop

(1) Fumitoxin

(2) PhosFume

(3) Phostoxin

(4) Weevil-Cide

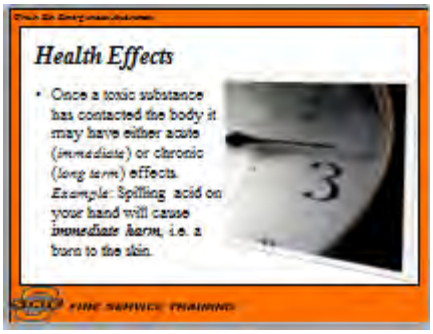
WARNING: The active ingredient in these products is Aluminum Phosphide. Aluminum Phosphide when exposed to ***moisture*** releases ***PHOSPHINE GAS***.

D. Phosphine Gas

1. Permissible Exposure Limit (PEL) is the maximum amount a person can tolerate without becoming life threatening unless using Personal Protection Equipment (PPE) for the particular product.

2. (PEL) Permissible Exposure Limit for phosphine is 0.3 ppm

NOTE: These products can be used at a strength of 200 – 250 ppm, or more, for insects and the application has to remain for 100 hours, approximately 4 days



E. Health Effects

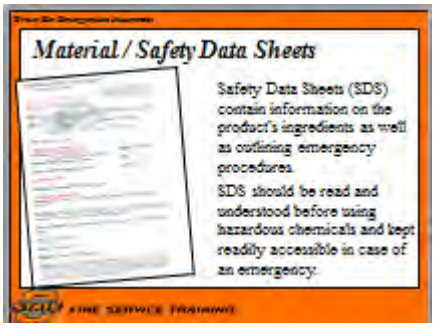
1. Once a toxic substance has contacted the body it may have:

   (a) Acute: immediate effects

      (1) Example: Headache, burning eyes, skin

   (b) Chronic: long term effects

      (1) Example: Lung disease or cancer



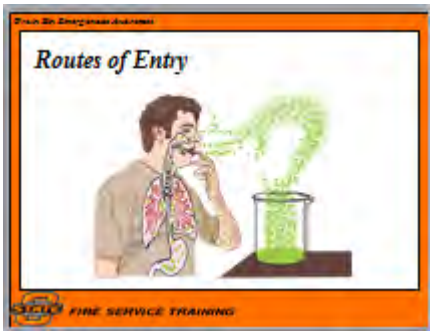
F. Material / Safety Data Sheets

1. Safety Data Sheets (SDS) contain information on the products ingredients as well as emergency procedures

2. SDS should be read and understood before using hazardous chemicals and

they should be kept readily accessible in case of an emergency.

3. Take the time to review the SDS on a "Phostoxin"



G. Routes of Entry

1. Inhalation
2. Ingestion
3. Absorption
4. Injection

WARNING: Exposure may require decontamination

15 min. Lecture/ Discussion

III. Other Hazards

A. Electrical Hazards

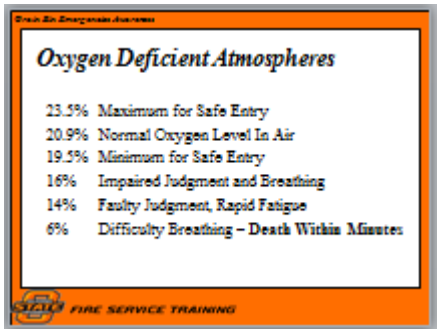
1. Electrical wires and boxes may not be maintained.
2. Overloaded circuits
3. Old elevators constructed in the 1950's to 1970's commonly have insufficient electrical systems
4. Electrical equipment in a flammable environment
5. Dust Build-up

B. Fall Hazards

1. Belt Manlifts: a device for moving passengers between floors of a building
2. Lack of appropriate hand rails
3. Poorly constructed or maintained ladders
4. Cage Lifts

C. Grain Moving Equipment

1. Openly exposed drive shafts and moving parts:
   (a) PTO's
   (b) Belts
   (c) Chains
   (d) Pulley's



D. Oxygen Deficient Atmospheres – create a extreme hazard to workers that may only be detected through air monitoring

1. 23.5% Maximum for safe entry (Oxygen enriched – extreme fire hazard)
2. 20.9% Normal oxygen level in air
3. 19.5% Minimum for safe entry
4. 16% Impaired judgment and breathing

5. 14% Faulty Judgment, Rapid Fatigue
6. 6% Difficulty Breathing – ***Death Within Minutes***

Test the air within a bin prior to entry for the presence of combustible and toxic gases. Determine if there is an oxygen deficiency within the bin. If monitoring equipment is unavailable. Aeration of the bin must be conducted long enough to ensure the air in the bin has been completely replaced with fresh outside air. Aeration must continue throughout the entry.

Most multi-gas air monitors within the Fire Service are not equipped with CO_2 sensors.

E. Testing the Atmosphere

1. Never trust your senses!
2. Many toxic gases are odorless and cannot be seen.
3. The level of oxygen present cannot be determined without a monitoring device
   (a) Air monitoring requires training above an awareness level
4. Test from Outside – Top to Bottom
   (a) Some gases are lighter than air and rise but most gases are heavier than air and will sink towards the floor.
   (b) The level of CO_2 (carbon dioxide) increases with fermentation of grain and increase of insect population, requires a monitor specifically equipped to detect CO_2

F. Bin Aeration Systems

1. Grain bins are commonly equipped with aeration systems which:
   (a) Cool grain for safe storage

(b) Dry grain

(c) Prevent moisture accumulation

(d) Reduce loss due to insect damage

EXPLAIN how the differences between temperature inside and outside the bin affect moisture content, moisture movement, and condensation on bin walls. Relate this information to the caking, clumping, and molding of the grain. If outside air is 10°F below the grain temperature aeration should be used to lower the temperature of the grain.

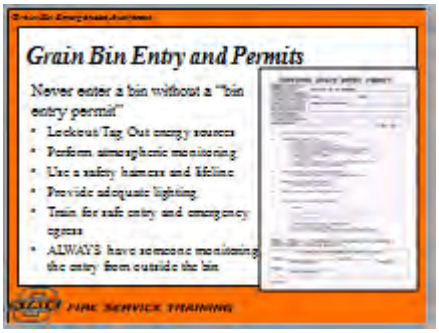
Aeration can also equalize temperatures within the bin; prevent migration and condensation, and control bacteria, insects, mold, and mites.

G. Characteristics of a Confined Space

1. Oxygen level less than 19.5%
2. Present/Potential flammable, combustible or explosive atmosphere
3. Engulfment by loss material (grain)
4. Area not protected against entry of substances which create possible hazards, e.g., a bin that has been fumigated but left unsecure.
5. Poor natural ventilation
6. Inability to self-evacuate
7. Restricted entry for rescue

H. Lockout/Tagout

1. Turn off and lock out all powered equipment
   (a) Heaters
   (b) Augers
      (1) Insure that grain is not being emptied or moving out or into the bin
   (c) Conveyer belts
   (d) Other grain moving Equipment
   (e) Fan and lights may also need to be turned off if they present a hazard
2. Fans and lights may assist in response and may be left on or turned on, if doing so does not create a hazard



I. Grain Bin Entry and Permits

1. Entry permits work as a *SAFETY* checklist. Just as a pilot follows a checklist before flying, grain workers should follow a checklist to insure their safety before entering a bin.
2. Never enter a bin without a “bin entry permit”
3. Lockout/Tag Out energy sources

4. Perform atmospheric air monitoring
5. Use a safety harness and lifeline
6. Provide adequate lighting
7. Train for safe entry and emergency egress
8. **ALWAYS** have someone monitoring the entry from outside the bin
   (a) The observer must be equipped to provide assistance and continuously track the worker in the bin.
   (b) The observer must be able to see and hear the worker inside the bin at all times
9. Individual farms should follow safety guidelines.
   (a) Many individuals may not have the equipment but should still turn off all moving equipment
   (b) Place someone on the outside capable of getting help quick, with the ability to call 911
   (c) Bin fans can be turned on and with adequate time allowed to replace the inside are with fresh outside air
   (d) Ensure adequate lighting

Save Lives

Even the individual farm should follow basic safety precautions established by the Confined Space Entry Permit process. This is for safety…not because they have to, because they want to!

Teens and youth do not have the experience, or qualifications to provide the help you would need and may become a victim.

ASK: Prompt participants to name a hazard encountered in grain handling operations and provide a solution the hazard.
ASK: Participants if they have any questions about other hazards associated with Grain Bins
Briefly discuss the responses and try to promote discussion.

15 min. Lecture/ Discussion

"*The environment does not improve when it entraps a person*"

IV. Entanglement, Entrapment and Engulfment

A. Entanglement

1. When a person body or clothing becomes tangled or intertwined with moving equipment.

   (a) PTO shafts

   (b) Auger

   (c) Belt and chain drive

B. Entrapment

1. When a person becomes submerged in grain to the point they cannot get out without assistance

   (a) This can happen when trying to walk on crusted grain over a void (grain bridge)

(b) Moving grain inside a bin can create suction and can act like “quicksand”.

2. Prohibit walking on grain to make it flow or “walking down the grain” and similar practices

3. Don’t forget the dangers of playing in grain trucks

C. Grain Bin Engulfment

1. Most occur during unloading

2. Most bins have an auger

3. Grain flow is from the top and down the center

4. Complete entrapment may occur in a few seconds if auger is running

(a) Bin entry should never be made underneath a grain bridging condition or where a build-up of grain on the sides could fall and bury the worker

D. **How does it happen?**

1. How fast does it happen?

2. What does it take to pull out a 165 lb. person

(a) The grain acts as a suction and you could literally pull them in half if improper techniques are used

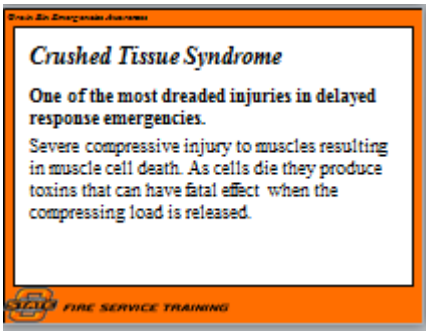
3. ***You can't save yourself.***

(a) Time is of the essence-if you're engulfed. It takes only 90 seconds *for* you to die. Therefore, never every risk your or anyone else's life with a shortcut. Follow proper entry procedures

15 min. Lecture/ Discussion

V. Grain Bin Rescue: Information only

A. Crushed Tissue Syndrome



1. Usually occurs with large muscle mass in lower extremities with prolonged compression of 4+ hours. However cases have been documented in one hour on smaller extremities or anywhere blood circulation is compromised. Signs and symptoms are few until extrication then it may be too late. Death can occur within minutes, swelling and shock may be delayed, distal pulse may or may not be present. Represents the truest of Advance Life Support (ALS) emergencies. As first responders we should maintain airway, treat for shock and if practical postpone the extrication until ALS is on the scene.

B. Incident Priorities (LIP)

1. Life Safety

   (a) Who's Life Safety

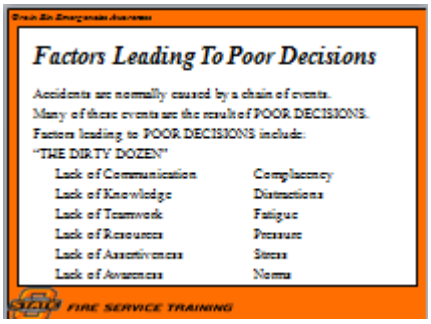
      (1) Mine

      (2) My Buddy

      (3) Everyone Else

2. Incident Stabilization

3. Property Conservation



C. Factors Leading to Poor Decisions

1. The human mind is fallible and error can occur for many reasons, for example, from a misheard message, from memory slip, or from incorrect appreciation of the situation.

2. These are twelve of the most common human errors or conditions that can act as precursors, to accidents or incidents. These twelve elements influence people to make mistakes. The Dirty Dozen is a concept developed by Gordon Dupont, with Transport Canada in 1993.

3. For each element on The Dirty Dozen list there are countermeasures that can reduce the possibility of human error causing a problem.

Instructors may find additional information on “The Dirty Dozen” and other human errors at http://www.skybrary.aero/index.php/Human_Error_Types.

D. Mode of Operation

1. If an incident occurs, responders must understand the situation and their mode of operation

2. Rescue – Recovery – Unknown

   (a) Mode of Operation will determine the level of risks responders may take and the hurriedness of the operation

3. Check Six- observe your surroundings What else could go wrong?

   (a) One of the “Dirty Dozen” is failure to observe our surroundings. Combat flyers have a phrase “Check Six.” The term comes from the need to check your blind spots (“Six” being six o’clock, behind you). When operating in dangerous environments it can be all too easy to get tunnel vision. In a rescue situation, we can easily become focused on the victim and forget to look up and see the 500

lb. clump of grain stuck to the wall over our head. Observe the entire environment. Other hazards may be waiting for us. Don't leave blind spots, Check Your Six!

E. Emergency Actions if you are Trapped

1. If you are sinking up to your chest – cross your arms in front of your chest so that you can breath
2. Placing a light cloth over your face to keep grain and dust out of your airway
3. Do not continue to struggle against grain. Additional movement can pack the grain tighter around your body
4. Stay calm and listen for the arrival of help
5. Use a hard hat or shirt to cover mouth

Ask: What are your responsibilities at an incident requiring rescue?
Briefly Discuss the answers from each of the various participants.

F. Emergency Actions if someone else is trapped.

1. Make sure there is a person trapped, they may have just left the area

2. Turn off all augers, off-loading equipment, and heaters
3. Call 911 and summon any help near you
4. If bin fans are on, leave them on
5. **DO NOT** enter the bin alone

G. Rescue Procedure:

1. Be sure that auger is off – we probably wouldn't be needed if it were off.
2. Ventilate the bin with bin ventilation fan
3. Turn on fan only, if it is safe to do so
4. Don't activate heat source
5. Trapped victims may survive total submersion

H. Awareness Level Personnel should:

1. Prepare the area around the bin to expedite rescue operations
2. If possible, move vehicles, equipment, and other objects away from the outside of the bin that may impede rescuers or the removal of grain from the bin
3. If equipment is available (frontend loaders, shovels, scoops, etc.) that would assist in moving grain away from the bin, attempt to have them on-site and ready upon the arrival of emergency responders

4. If a call must be made to obtain these items, make it

Ask: What policies does your organization have that address your role and responsibilities during a grain bin emergency
Briefly Discuss the answers from each of the various participants.

I. Rescue Procedures

1. Prevent further pressure on victim by:

   (a) Staying away from area around victim

   (b) Use a ladder, plywood, or other materials to distribute the weight of the rescuers

2. Rescuer protection should be a primary concern

   (a) Provide safety lines

   (b) Consider respiratory protection

J. Rescue Procedures

1. If grain cannot be hand scooped

   (a) Cut semi-circular or V-shaped holes in bin on two opposite sides

(b) 30-40 inches across within the bolt lines

(c) Cut just below the victim who is submerged and as low as possible if the victim is not visible.

(d) **DO NOT JUST START MAKING CUTS!!**

(e) ***Danger***: These actions can cause the grain bin to collapse.

(1) The collapse zone for grain bin operations is 4x the height of the grain.

(2) The grain is solid and flows like a fluid and will take a person down with it.

(3) Bins are the strongest when they are full

K. Remember:

1. Each facility warrants individual pre-planning because not all layouts are the same.

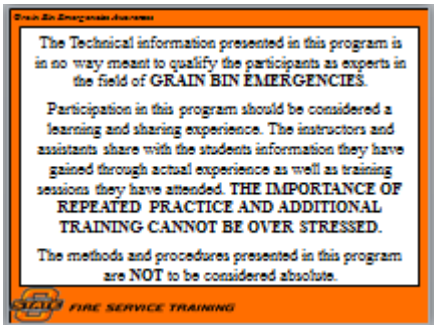
2. Be Prepared

15 min.
Lecture/ Discussion
y

L. Stored Products Research and Educational Center – Grain Bin Rescue

1. Click on television to play video approx. 18 minutes

2. Allow time for credits



M. **Training Disclaimer**:

1. The Technical information presented in this program is in no way meant to qualify the participants as experts in the field of GRAIN BIN EMERGENCIES. Participation in this program should be considered learning and sharing experience. The instructors and assistants share with the students' information they have gained through actual experience as well as training sessions they have attended. THE IMPORTANCE OF REPEATED PRACTICE AND ADDITIONAL TRAINING CANNOT BE OVER STRESSED. The methods and procedures presented in this program are NOT to be considered absolute.

N. Summary

1. Avoid entering grain bins whenever possible! If entry must be made:

    (1) TURN OFF and lock out all grain moving equipment and dryers

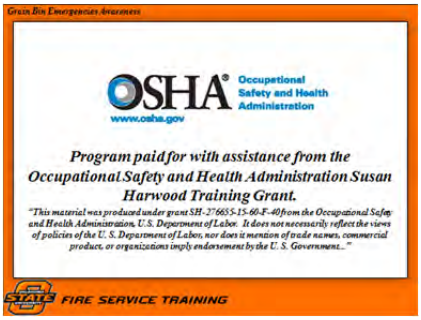
    (2) Use a body harness and anchored lifeline

    (3) Test the bin's air (oxygen flammability toxic)

    (4) DO NOT walk down grain

    (5) DO NOT enter below bridged grain or wall build ups

    (6) HAVE a trained/equipped observer outside



O. Program paid for with assistance from the Occupational Safety and Health Administration Susan Harwood Training Grant

P. *"This material was produced under grant SH-276655-15-60-F-40 from the Occupational Safety and Health Administration, U.S. Department of Labor. It does not necessarily reflect the views of policies of the U. S. Department of Labor, nor does it mention of trade names, commercial product, or organizations imply endorsement by the U. S. Government..."*

Q. Oklahoma State University – Fire Service Training.

25 min. **Activity** **5 min Review**

Activity 3.1

End of Course Assessment

Purpose

An end of course assessment is administered to measure the participants understanding of Grain Bin Emergencies after participating in the course.

- Review the purpose of the activity with the participants
- Read the directions to the participants
- Answer any questions about the activity
- Insure that all of the students have a pre-course assessment
- Allow 10 minutes for the participants to complete the activity, the time includes review

Emphasize that the goal of the activity is to simply get an understanding of the participants knowledge of the subject

Directions

- Working individually, complete the 20 question end of course assessment.
- Beginning with question #1 review the exam and allow the participants to grade their own assessment
- Have them place their name and the number of correct answers in the upper right-hand corner of the assessment

The instructor shall collect the assessments and insure that they are sent back to OSU-FST with the Sign–in sheet, registration, post- course assessment and evaluations
Follow-up Assessment: Please Read Encourage the students to participate in the follow up assessment that will be sent to them by e-mail a few months after the Grain Bin Awareness course to assess subject matter retention.