It took more than 300 rescuers from the surrounding area another six hours to remove Piper from the grain bin while draining the structure of corn.

Wyatt Whitebread, 14, started screaming as the kernels moved past his chest, up his chin and over his head within a matter of seconds.

...while Lawton climbed a ladder inside the bin to go get help.

A 40-year-old male farmer entered...bin to clear corn that had clogged the unloading holes... He was standing on the grain with the augers running... He entered the grain bin from the top hatch and used a 20-foot long ½-inch pipe to clear the plugged hole. When the hole was cleared and the grain started flowing,... the victim was engulfed.

“He prayed for us to get out alive, he prayed for his family, for his siblings, then he said ‘all I ever wanted to do was watch my brothers graduate high school,’”... Then, reciting the Lord’s Prayer, Pacas asked Piper to hold his hand as corn climbed above his head...
Introduction

This Grain Bin Entry module is part of a curriculum series addressing hazards found in areas of grain handling facilities including grain bins and their surrounding area. It’s purpose is to assist participants to identify and abate hazards in the work place.
Disclaimers

This material was produced under grant number SH-22288SH1 from the Occupational Safety and Health Administration, U. S. Department of Labor. It does not necessarily reflect the views or policies of the U. S. Department of Labor, nor does mention of trade names, commercial products, or organizations imply endorsement by the U. S. Government.
Employee Rights

Employees are entitled to safe and healthy working conditions which DO NOT pose a risk of serious harm.

Workers are entitled to be fairly compensated for all hours worked in accordance with the law.
Employer Responsibility

Employers have the responsibility to provide a safe workplace.

More information about employer & employee rights can be found at www.osha.gov.
Learning Objectives

At the end of this module, participants will be able to:

- Identify at least 6 hazards to avoid when entering a grain bin.
- Describe grain conditions and their relationship to bin entry.
Learning Objectives (cont.)

- Explain the appropriate procedures that need to be followed prior to entering a grain bin.

- Explain the role and responsibilities of the observer.

- Describe difficulties encountered in practicing safe grain bin entry procedures.
Topics Covered

1. OSHA Grain Standard 1910.272 Application
2. Grain Facts
3. Hazards of Grain Bin Entry
4. Angle of Repose
5. Anchor Points, Fall Restraint, & Fall Protection
6. Procedures to Follow Before Grain Bin Entry
7. Procedures to Follow While In a Grain Bin
8. Barriers to Practicing Safe Grain Bin Entry
9. Common Errors & Preventive Measures
10. Learning Objective Review
OSHA Grain Standard
29 CFR 1910.272
1910.272 Grain Handling Standard - Highlights

- Minimum safe practices.
- Mainly addresses fires and explosion hazards.
- Not a “vertical standard”.
- 1910.272 takes precedence for specific grain hazards.
OSHA 1910.272 Highlights (cont.)

This standard applies to:

- Grain elevators
- Feed mills
- Rice mills
- Dust pelletizing plants
- Dry corn mills
- Soybean flaking operations
- Dry grinding operations of soy cake
Common Sources of Entanglement Hazards

Grain Facts
Background Information

Average 15-20 entrapments* per year. (40 years)  
Frequency increasing.  
74% of entrapments* resulted in death. (1964-2005)

Entrapments involving corn ≥ 45%.  
Many non-fatal incidents go unreported.  
In 2010, 51% of entrapments resulted in death.

*documented cases
Production increases since 1980
- Corn 93%
- Soybean 49%

Higher yields = more movement of stored grain

Increased production = increased exposure to risk
- Mechanical – entrapment, engulfment, entanglement, falls, etc.
- Biological – dusts, molds, toxins, etc.

73% of stored grain is corn.
Hazard Definition

Engulfment
- Total submersion in < 60 seconds
- Usually recovery of body
- Death caused by suffocation

Entrapment
- Portion of body submerged (Trapped)
- Over knees – cannot rescue self
- 5 seconds to helplessness
Grain Facts

Characteristics & Behavior
- Sink @ 12” on dry grain
- Cubic foot of grain = @ 50 lbs
- Average body volume = 5 to 7 cubic feet
- Only need body volume removed to be covered

Danger
- Flowing grain acts like quicksand
- Flowing grain removes body volume in @ 5 seconds
- Faster grain flows = faster submersion
- Effort required to extract person rises with depth of submersion
Entrapment Speed

In an entrapment you are in a race you CANNOT win!

A flowing column of grain will pull you down to knee level in seconds and bury you within a minute.
The effort required to pull someone from grain is a major hindrance to a quick rescue. Do not use mechanical devices to remove a victim from grain.
Physical Effects of Entrapment

- Chest expansion
  - Constricted
  - Can’t breathe

- Blood flow
  - Constricted to extremities
  - Feet, legs most affected

- Nitrous gas poisoning
  - Similar to Diver’s Disease

- Aspiration
  - Inhaling grain into the airways

- Ingestion
  - Grain getting into throat
Summary - Grain Facts

- **Entrapment** – partial submersion
- **Engulfment** (total submersion) = death
- **Extremely fast!**
  - 5 seconds person is helpless in flowing grain
  - 20 – 60 seconds to total engulfment
- **Weight of grain** – hinders extraction
- **Flowing grain** most dangerous – like quicksand
- **Increased yields** = increased exposure
- **Increased frequency** – Entrapments/engulfment
Group Activity
Common Hazards Of Grain Bin Entry
Common Grain Hazards

- Flowing Grain
- Plugged
- Grain Clinging to Side of Bin
- Bridged Grain
- Ground Piles & Flat Storage Structures
- Grain Condition
- Tower
- Pyramid (Cone Up) or Cone Down
Bin Conditions & Other Hazards

- Insufficient Lighting
- Dust Presence
- Atmosphere
- Temperature
- Rodents
- Employee Experience
Flowing Grain

NEVER ENTER A BIN WITH FLOWING GRAIN
A 6 inch auger can pull a person to his/her knees in only 6 seconds.
Unplugging Center Sump

Unplugging a sump

Alternative - Exterior opening to sump
Unplugging Grain – Incident Example

**Victim**
- 60 year old employee.
- 41 years of experience.
- Working alone.

**Hazard**
- 50,000 bushel bin.
- Estimated 15,000 bushels in bin at time of accident.
- Soybean pods plugged up the center reclaim hole.

**Manager**
- Thought the floor was exposed in the middle of the bin.

This is not the victim.
Incident Example (cont.)

- Employee entered bin from the side hole.
- Conveyor was still running.
- Employee used a rod to unplug the reclaim.

Reenactment

Side opening employee used for access was at grain level height
Incident Example (cont.)

- After clearing the plug, the employee was caught in the flowing grain.
- Grain depth was approximately 6 feet.
- Employee ended up with his left foot in the screw conveyor; he was completely submerged in the beans.
- Bill of his hat made an air pocket so he could breathe.
Incident Example (cont.)

- Rescue took 5 hours.
- Employee lost leg at mid-shin.
- Doctors amputated leg onsite to get him out!
- Did he survive?

Could this incident have been prevented?
Cling to Side/Pyramid

DANGER

Avalanche Potential
Stay above grain level
Alternatives - Grain Clinging to Side/Pyramid

- Always enter and work above grain level.
- Refill the bin within four feet of the top of the stuck grain.
  - Reenter with appropriate fall restraint system and attendant.
- Contact a company specializing in this type of reclaim operation.
Bridged Grain

Bridging – Grain clumps, forming a crust over an empty space.

DANGER!

Crust can collapse!
You can fall through and become entrapped!
Grain Suffocation Demonstration

http://www.youtube.com/watch?v=zqbUubNAVE0&feature=related
Ground Piles or Flat Storage

Moving/Flowing Grain

Tower/Pyramid

Tower could be 80’ – 100’ tall
Tower, Pyramid, Cones Down

- Grain Towers
- Grain Cones Up (Pyramids)
- Grain Cones Down
Grain Condition

Bad Grain Condition

- Hot temperature
- High moisture content
- Restricted movement – Slow, Clumps or Packed, Minimal Sinking
- Smell - Moldy, Musty, Fermented, Sour
- Striations, Towers, etc.

65 foot high striations
Grain Condition

Good Grain Condition
- Cool Temperature
- Low Moisture Content
- Rolling Movement
- Sweet Smell
- Natural Angle of Repose
Dust Presence & Insufficient Light

Dust presence

Insufficient lighting
Atmosphere

Test atmosphere **before** entry.

- Toxic air can cause death!
  - Oxygen level – minimum 19.5%

- 16% Oxygen = impaired judgment & breathing

- 8% Oxygen = death in 5 minutes
- 6% Oxygen = instant death

Ventilate - before and during entry.
Temperature & Rodents

- Inside can be 120° F or more.
- Heat related illness.

- Disease
- Contamination
- Destruction
  - Wires, Insulation
- Surprise - Misstep
Employee Experience

- **New Hires**
  - Cannot perform assessment - Do not know enough
  - Must be trained – Assessment, Entry
  - Not authorized to enter bin until trained

- **Experienced Employee**
  - “Have always done it this way without any problems.”
  - Appropriately Trained Personnel - Not always known
  - Must have annual training

- **Age** - 18 or older
Angle of Repose
Angle of Repose

- Natural angle grain lays at when stored.
- Assessment tool for potential hazards.
- Angle of repose
  - Corn - Approximately 21.5°
  - Soybean - Approximately 25°

Steep Angle of Repose

- Indicates potential problem with grain condition
- Indicates potential hazards
- Use additional precautions before entering
Group Exercise
Angle of Repose Hazard Analysis Exercise

**PURPOSE** - Use assessment tool to identify potential hazards in grain storage.

**DIRECTIONS** – Look at Angle of Repose in the following pictures. Determine if potential hazard(s) would be present if encountered in work environment.

- **Hazards**
  - Entrapment - capable of partially trapping an individual by surrounding with grain.
  - Engulfment - capable of submerging (completely covering) an individual in grain.
Hazard Presence?

Low Risk

Only if Auger is LOTO
Hazard Presence?

YES!
Entrapment Risk

YES!
Engulfment Risk

MUST Minimize Risk

HIGH RISK!
Hazard Presence?

Engulfment

HIGH RISK!

Minimize Risk

Entrapment
Hazard Presence?

LOW RISK ONLY if Auger is LOTO
Hazard Presence?

Out of condition grain
Possibility of bridging

Risk Unknown

YES! Engulfment Minimize Risk
Entrapment YES!
Hazard Presence?

Grain removed
Steep angle

YES!
Entrapment Risk
Engulfment Risk

HIGH RISK!
Minimize Risk!
Hazard Presence?

High Risk!

Engulfment!
Hazard Presence?

HIGH RISK!

Engulfment!

Avalanche Potential
Hazard Presence?

Guard Reclaim Hole

LOW RISK
ONLY if Auger is LOTO
Summary - Common Hazards

- **Grain Characteristics**
  - Flowing grain, bridging, pyramids, towers, cones, plugged draw off

- **Bin Conditions**
  - Dust, lighting, atmosphere, temperature, rodents

- **Grain Condition**
  - Indicates potential hazards if out of condition
  - Good condition = Dry, Sweet smelling, rolling

- **Employees**
  - New - Train in assessing potential hazards & bin entry
  - Experienced – Yearly Training, Attitudes

- **Angle of Repose = Assessment Tool**
  - Indicates potential hazards
Anchor Points, Fall Restraint and Fall Protection
Anchor Points

- Attachment points for components of lifeline & fall restraint systems.
- Anchors must withstand:
  - 3,000-5,000 pounds of force
  - Two times the anticipated force if engineered anchor.
- Inadequate anchor points include:
  - Ladder rungs
  - Cage around a ladder
  - Steps of stairs (if bin is so equipped)
  - Conduit or piping which may break
Fall Restraint & Fall Protection

- Fall restraint and fall protection systems
  - Very specialized
  - Should not be an afterthought
  - Purchase from reputable dealer
  - Require training for proper & safe use
  - Certified Inspector for used equipment

- Contact a professional
  - Information on lifelines, ropes, pulleys, harnesses, connectors and other necessary items
  - Recommend a system which can keep you safe
Procedures to Follow Before Grain Bin Entry
Procedures…Before Grain Bin Entry

- Company or Farm Safety Policy
- Permit
- Lock out/Tag out
- Atmosphere Testing
- Top Entry
- Availability of rescue equipment
- Assessment
- Alternatives
Procedures...Before Entry (cont).

**Company or Farm Safety Policy**
- Does NOT have to be complicated
- Minimal Procedures
  - LOTO
  - Housekeeping & maintenance
  - Grain Bin Entry
  - Emergencies
    - Entrapment
    - Fires
    - Chemical spill
    - Other injuries
Company or Farm Safety Policy, cont.

- Authorization - specific safety related functions
  - Lock Out/Tag Out
    - Who is Authorized to perform
    - All equipment MUST have a LOTO procedure
  - Grain Bin Entry – When, Where, Who
  - Harness Use - When, Where, Who
Procedures...Before Entry (cont).

**Company or Farm Safety Policy**, cont.

- **Owner and/or Manager Responsibility**
  - Ensure a written policy
  - Regularly review & update
  - Make it accessible
  - Communicate it to others

- **Employee Responsibility**
  - Know the safety policy & what it covers – LOTO, bin entry, emergencies, etc.
  - Know where to find it; who has it
  - **FOLLOW THE RULES!**
Procedures...Before Entry (cont.)

**Permit**
- Required in commercial grain industry
- Issued by the employer OR
- Authorized person ensures permit requirements met
  - Does not need to complete permit
  - Supervisor must be on site for no permit
- Best Practice – Fill out Permit
  - Minimum – Go through permit checklist
- Permit process –
  - Details in Confined Space Entry module
Bin, Silo and Tank Entry Permit and Checklist

Bin Identification: __________________________ Date: ________________ Time: ________________

Work Required: ________________________________________________________________

This permit signifies that all safety precautions have been complied with for the job described and will be kept on file until work is completed.

**Personnel shall not enter a bin from below bridged or hung-up material!**

**Before entering the bin, silo or tank, complete the following checklist:**

1. **Lock-out and tag of conveying equipment** ........................................................................ Yes  N/A

2. **Atmosphere of the bins, silo or tank:**
   a. **Oxygen content:**
      (1) Oxygen level is 19.5 percent or more (determined through testing); or ......................
      ................................................................. .................................................................
      (2) Ventilation (natural or forced air) provided before and during entry; or ......................
      ................................................................. .................................................................
      (3) Self-contained breathing apparatus provided .............................................................
      ................................................................. .................................................................
   b. **Combustible gases, vapors and toxic agents - if believed to be present:**
      (1) Atmosphere tested for suspected gases; or .................................................................
      ................................................................. .................................................................
Bin Entry Permit (cont.)

b. Combustible gases, vapors and toxic agents - if believed to be present:
   (1) Atmosphere tested for suspected gases; or ................................................................. ____ ____
   (2) If testing indicates:
      (a) Ventilation (natural or forced air) provided before and during entry, and atmosphere monitored during entry ................................................................. ____ ____
      (b) Appropriate personal protection provided ................................................................. ____ ____

3. Body harness and lifeline, or boatswain’s chair and lifeline provided ........................................ ____ ____

4. Person performing entry:
   a. Instructed on bin entry hazards .................................................................................... ____
   b. Trained on safety equipment operation ........................................................................... ____
   c. Trained on use of respiratory protection (if provided) ...................................................... ____
Bin Entry Permit (cont.)

5. Observer:
   a. Communications provided (voice, signal line, sight, walkie talkie, other) .................................  
   b. Trained in rescue procedures .................................................................  
   c. Knows how to obtain additional emergency help .....................................  

6. Rescue equipment available ................................................................. 

Not to be signed unless all lines of the checklist have been marked.
All equipment used for this job has been checked for performance and/or defects.

Signature______________________________
(Person entering bin) 

Signature______________________________
(Observer)  

Signature______________________________
(Manager or authorized rep.) 

Completed______________________________
Procedures...Before Entry (cont.)

**Lock Out/Tag Out**
- **ALL** energy sources.
- **ALL** conveying equipment.
- **Only** authorized/trained persons.
- **MUST** be done prior to entry!
- Protects from unexpected start-up.
- Prevents dangerous flowing grain.
- All equipment must have LOTO procedure.
Procedures…Before Entry (cont.)

NO LOTO
Leading factor in engulfments!

BEST PRACTICE for All!
LOCKOUT / TAGOUT PROCEDURE

Equipment or Process: **Dry Leg**

Type of lockout needed: **Pad Lock, and Tag**

All energy must be locked out before maintenance is to begin. To lockout the Dry Leg take the following steps:

**STEP 1** - PREPARE FOR SHUTDOWN, NOTIFY ALL AFFECTED EMPLOYEES RADIO OR DIRECT COMMUNICATION

**STEP 2** - IN NORTH ELECTRICAL SHED DISCONNECT ELECTRICAL MAIN LABELED “DRY LEG”. PLACE PADLOCK AND TAG ON THE MAIN SWITCH ARM

**STEP 3** - VERIFY THAT ENERGY IS ISOLATED BY ATTEMPTING TO START THE MACHINE.

**STEP 4** - BEGIN MAINTENANCE.

**STEP 5** - WHEN ACTIVITY IS COMPLETED, CLEAR ALL TOOLS, EQUIPMENT, AND PERSONNEL FROM AREA.

**STEP 6** - NOTIFY AFFECTED EMPLOYEES OF REACTIVATION.

**STEP 7** - REMOVE LOCKOUT DEVICES.

**STEP 8** - REACTIVATE MACHINE AND VERIFY NORMAL OPERATION.
Procedures...Before Entry (cont.)

Atmosphere Testing

Test for:
- Oxygen level – minimum 19.5%
- Toxic agents (fumigants) – less than TLV/PEL – if needed
- Combustible gases/vapors – less than 10% of lower explosive limit
- Hydrogen sulfide
- CO2 – Carbon dioxide
Procedures...Before Entry (cont.)

Atmosphere Testing

- Unsafe atmosphere
  - Ventilate to eliminate hazard
  - OR
  - Use self-contained breathing apparatus
    - MUST be trained in use
  - Retest
  - Continue ventilation
    - when recurrence of hazardous atmosphere is possible
Procedures...Before Grain Bin Entry (cont.)

**Atmosphere Testing**, cont.

- Fumigants – (used at a facility)
  - Poisons & highly toxic
  - Test atmosphere where used
  - License & Fumigant Management Plan may be required
  - Consult Plan for locations & remediation

- Exception to Atmosphere Testing
  - Presence of continuous natural or forced ventilation
TOP Entry – above grain level

- Harness and lifeline **MUST** be worn
- Lifeline length – no further than waist deep.
- Use of alternative protection to 1910.272(g) (2) is possible
- Employer demonstrates no engulfment hazard present
  - Lifeline may be disconnected
  - 1910.272(g)(2) note.
Procedures...Before Entry (cont.)

**Rescue Equipment**
- MUST be available.
- Specifically suited for bin, silo, or tank.

- Grain rescue tube
- Grain retaining wall
Procedures…Before Entry (cont.)

Assess Need for grain bin entry
- Determine necessity
- Consider alternate methods

Alternatives to grain bin entry
- Temperature cables to track grain temps
- Ability to break up clumps from below using a tunnel
Summary – Procedures…
Before Grain Bin Entry

- Safety Policy
  - Every facility & farm should have one
  - Authorize personnel for specific safety tasks
  - Everyone knows what to do in an emergency
  - Know and **FOLLOW** it!

- Permit – Best Practice for all
  - Safety Precaution checklist

- Lock Out/Tag Out – Best Practice for all
  - Prevents equipment from unexpected start-up.
  - Reduces incidences of injury
Summary – Procedures…
Before Grain Bin Entry (cont.)

- Atmosphere Testing
  - *DO* if no continuous natural or forced ventilation
  - Ventilate *BEFORE* entry
  - Oxygen *MUST* be at least 19.5%

- Top Entry – Use harness, lifeline
  - Lifeline length – sink no further than waist deep
  - Limited exceptions

- Rescue Equipment – Must be available

- Consider Necessity & Alternatives to Entry
Procedures to Follow While in a Grain Bin
Procedures...In a Grain Bin

- Two or more people present
  - Maintain constant communication
  - Visual, verbal, radio or signal line

Entrant & observer must be trained in:
- Bin entry hazards
- Lifeline use
- Personal Protective Equipment
- Respiratory protection
- First aid and CPR
- Rescue procedures
Procedures...In a Grain Bin (cont.)

Observer MUST:

- Be present always.
- In communication at all times.
- Equipped to provide assistance in emergency.
- Maintain position of lifeline.
- Know where/how to get help & who to contact.
- Be stationed outside the bin.
Observer must **NEVER** leave position or take eyes off entrant.
Procedures...In a Grain Bin (cont.)

Prohibit
- Walking down grain
  - Other similar activity to make grain flow.

Prohibit
- *NO* entry below top of grain!

*NEVER* walk down the grain!
If An Entrapment Occurs

- Immediately get help.
- Initiate rescue procedure.
- Do not disturb the grain anymore than necessary.
- Stabilize the victim.
Best Practices for Farmers

- LOTO - No running unloading equipment!
- Wear Personal Protective Equipment
- Do not work alone
- Notify someone - Check in.
- Keep a cell phone with you.
- Harness & Lifeline
  - OR rope for a lifeline.
- Supervise all workers.

Closely supervise new, inexperienced & young workers!
Summary – Procedure in Bin

1910.272

LOTO – Don’t run unloading equipment

Use a Lifeline

2 or more people

DO NOT WORK ALONE!

Observer’s ONLY duty to observe

MUST be trained!

DO NOT WALK DOWN THE GRAIN!

Rescue Equipment Available
Common Sources of Entanglement Hazards

Barriers to Safe Practices
Barriers to Practicing Safe Bin Entry

- **Work Practices**
  - NO LOTO
  - Time Limitations
  - Work Alone
  - Poor storage habits

- **Structural Limitations**
  - Anchor points
  - Opening Size & height
  - Unloading systems

- **Cultural Attitudes**
  - Won’t happen to me
  - It’s a dangerous business
  - It’ll just take a minute

- **Lack of Lifeline use**
  - Structural
  - Assumptions
  - Equipment & training
Common Sources of Entanglement Hazards

Barriers, Common Errors & Preventive Measures
Common Errors

- No LOTO policy, procedures, or practices.
- Storing grain that is too wet.
- Merchandisers who won’t sell grain.
- Poor air – Lack of ventilation or lack of good circulation (less frequent).
Common Errors (cont.)

- Small reclaim holes that plug up easily
- Unloading system that has or contains
  - Few reclaim holes; more allow greater grain flow out of bin
  - No tunnel; no easy way to unplug sumps
Preventive Measures

- Tunnels under bins
- Properly dried grain
- More sumps & closer
- Temperature cables
- Big center sumps
- More aeration
- Break peaks
Preventative Measures

- Core Bins
- One time coring
  - Eliminate grain peak
  - Remove core of fines
  - Improve airflow through center
  - Better monitor grain surface

![Diagram of grain bin with core bins and one-time coring features]
Summary – Common Errors & Preventative Measures

Common Errors leading to hazardous bin entry:

- No LOTO policy, procedures, or practices
- Failure to monitor grain quality
- Grain stored too wet
- Lack of proper ventilation or circulation
- Outdated unloading system
Summary – Common Errors & Preventative Measures

Preventative Measures

- LOTO
- Work Practices - Maintain Grain Quality
  - More aeration
  - Dryer grain
  - Core bins
- Equipment
  - Large/more sumps
  - Temperature cables
  - Tunnels
Learning Objectives Review

Hazards to Bin Entry

- Flowing Grain
- Plugged Draw Off
- Grain Clinging to Side
- Bridged Grain
- Tower
- Cone Up/Pyramid
- Cone Down

- Ground Piles/Flat Storage
- Grain Condition
- Dust Presence
- Insufficient Lighting
- Atmosphere
- Temperature
- Rodents
- Employee Experience
Learning Objectives Review

Procedures to Follow Before Bin Entry

1. Company/Farm Safety Policy
   - Know person authorized to perform
     - Lock Out/Tag Out
     - Bin Entry
   - Know Emergency Procedures
   - FOLLOW the Policy

2. Assess Potential Hazards
   - Angle of Repose
   - Grain Condition
   - Need for Entry
   - Possible Alternatives
3. Lock Out/Tag Out
   - Best Practice for all!
   - Commercial **MUST** do. **NO EXCEPTIONS.**
   - All unloading equipment.
   - Person authorized.
   - Prevents start-ups.
   - SMART for production.
   - NOT Costly!

4. Permit
   - Best Practice for all!
   - **MUST** for commercial facilities or exception rule applied.
   - Is a Pre-Entry Checklist.
   - Authorized person.
   - Don’t “cheat” – check!
Learning Objectives Review

Procedures to Follow Before Bin Entry

5. Atmosphere Testing
   - Best Practice for all.
   - MUST if no continuous ventilation.
   - Ventilate before & during entry.
   - Oxygen $\geq$ 19.5%.
   - Fumigant Management Plan.

6. Top Entry
   - Entry above grain level.
   - Commercial - MUST use harness & lifeline.
   - Lifeline length – No more than waist deep.
   - Exception ONLY when poses greater hazard.
**Learning Objectives Review**

**Procedures to Follow Before Bin Entry**

7. **Rescue Equipment**
   - Best Practice for all.
   - Commercial MUST be have. NO EXCEPTIONS.
   - Close to bin entry site.
   - Person trained.
   - Doesn’t have to be costly!

8. **Entrapment**
   - Get help!
   - Determine if person is conscious.
   - Keep airway clear.
   - Stabilize victim.
   - Trained rescue personnel.
Learning Objectives Review

Procedures In a Grain Bin

- At least 2 people
  - Best Practice for all
  - Entrant
  - Observer (Attendant)
- Constant Communication
  - Visual, verbal, radio, signal line

- Entrant & Observer MUST be trained in
  - Bin Entry hazards
  - Personal Fall Restraint
  - PPE
  - Respiratory protection
  - First Aid & CPR
Learning Objectives Review

Procedures In a Grain Bin, cont.

- Observer MUST
  - Be trained in rescue
  - Provide assistance
    - Lifeline
    - Entrapment
  - Get help (how & who)
  - Stationed outside bin
  - Must NOT be distracted

- Prohibited Practices
  - Walking down the grain
  - Other activities to cause grain to flow
  - Entering below top of grain
Learning Objectives Review

Barriers to Practicing Safe Bin Entry

- **Work Practices**
  - Keeping unloading equipment on – no LOTO
  - Time limitations – Get it done
  - Working alone
  - Grain Condition

- **Cultural Attitudes**

- **Physical Structures**
  - Anchor Points, height, opening size, strength
  - Lighting
  - Poor Unloading systems

- **Fall Restraint System**
  - Training
  - Complexity
Learning Objectives Review

Barriers to Practicing Safe Bin Entry

- **Errors**
  - NO LOTO
  - Grain Condition - wet
  - Unloading Systems
  - Poor ventilation or circulation

- **Preventive Measures**
  - LOTO
  - Unloading systems
    - Tunnels
    - Sumps
  - Grain Condition
    - Aeration
    - Coring
    - Moisture
  - Break up clumps before emptying
Module Summary
Module Summary

OSHA Grain Standard 1910.272

- Applies to commercial grain facilities - few exceptions.
- Takes precedence for specific grain hazards.
Module Summary

Grain Facts

- Increased production = increased risk
- Entrapments & engulfments continue to rise.
- Acts like quicksand; fills holes.
- Weight traps & causes other physical problems.
- 5 seconds a person entrapped is helpless to rescue self.
- <60 seconds to engulfment - generally death.
Module Summary

- Hazard Assessment
  - Grain Characteristics
    - Flowing Grain
    - How grain is shaped in bin
    - Grain Condition
    - Angle of Repose
  - Physical Bin & Environment

- Follow Safe Entry Procedures
  - Follow LOTO!!!!
  - Lifeline
  - 2 people always
  - Safety Plan & Rescue Equipment

- Preventive & Alternative Measures to Bin Entry

5 Steps to Safety
LOTO
Observer
Lifeline/Harness
Atmosphere Test
Trained
Common Sources of Entanglement Hazards

Pre-Test & Post-Test Answer Guide
1. Circle 3 “Best Practices” for grain bin entry:
   a. Stay away from the center of the bin.
   b. Use a full body harness and secured lifeline.
   c. Wear an air respirator to provide oxygen in case of entrapment.
   d. Have 2 people – one person to go inside and one person to watch.
   e. Lock out and tag out all unloading equipment.
2. A grain pile should have an angle somewhere around:
3. Circle 2 ways to tell if grain is out of condition:
   a. Can use their senses – sight, smell, touch or feel of the grain.
   b. A person will sink about ankle deep (or 12") if walking on it.
   c. It will clump together and be warm to the touch.
   d. It will smell bad and be cool to the touch.
4. A person can enter a bin with unloading equipment running to get grain to flow (such as unplugging a sump or breaking up chunks).

5. A grain bin entry checklist or permit will help identify hazards.
6. Correct procedure for bin entry is to shut off all unloading equipment before you enter.

7. Poor grain condition can indicate potential engulfment hazards.
8. Flowing grain is sometimes a hazard during bin entry. YES NO

9. An observer can temporarily leave if he can’t see any problems inside. YES NO

10. Bridged grain and grain towers are hazards. YES NO
Thank you to our Supporters

The Grain Handling Safety Coalition wishes to extend our thanks and appreciation for supporting our efforts by allowing us to use their photos and graphics to the following:

- Grain and Feed Association of Illinois
- The GSI Group, Inc.

Photos and Graphics are used with the permission of the owners.
Reference Citations

• Grain and Feed Association of Illinois  *Grain Elevator Safety Orientation,  2001*


• Load Cell Definition  Accessed May 13, 2012  
  – *en.wikipedia.org/wiki/Load_cell*

Reference Citations

• OSHA Fact Sheet: *Grain Bins: Worker Entry into Grain Storage Bins*

• OSHA Horizontal and Vertical Standards

  – http://www.squidoo.com/belaying
Additional Reference Material
Natural Ventilation

Use to explain ventilation if needed
Natural Ventilation

Natural ventilation
• Process of supplying and removing air through an indoor space without using mechanical systems.
• Flow of external air to an indoor space as a result of pressure or temperatures differences.

Two types of natural ventilation in buildings
• wind driven ventilation
• buoyancy-driven ventilation
  ➢ Directional buoyancy force resulting from temperature differences between the interior and exterior.[1]
Natural ventilation for high-rise buildings (termite model)

- warm air
- cool air

- vegetation, reduces sunlight heating
- chimneys direct hot air out of the building, hot air could be used for energy production if, for example, vertical axis wind turbines or sterling engines are mounted on the chimney
- heat core
- connection to heat core
- heat/accumulation box
- fans

[Diagram of natural ventilation system for high-rise buildings]
INSTRUCTOR NOTE

The following 5 slides are summarized on one slide (97). Use slide in module for discussion to draw out points that are on these slides during a training session or the instructor can choose to use these slides if time permits. These slides are also excellent subject matter for safety meetings, lunch box safety talks, etc.
Barriers to Practicing Safe Bin Entry

Work Practices

- Operating the unloading system
  - Gets grain flowing when plug cleared

- Time Limitations - Need to “get the job done”
  - May not assess hazard potential and/or ignore
  - Can’t afford to wait for grain to fall naturally
  - Need to make it flow – “walk the grain”

- Empty & fill more often

- Working alone, especially on farms

- Not keeping grain in good condition
Barriers...Safe Bin Entry (cont).

**Cultural Attitudes**

- “Accidents happen – it’s a dangerous business.”
- “Won’t happen to me – been doing it this way for years.”
- “It’ll just take a minute” – don’t want to wait for someone, take time for a harness, etc.
- Can’t afford all these “safety” things
- Not appreciating the risk
- No financial incentive for safety/upgrades
Physical Structure Limitations

- Inadequate anchor points
- Lack of tensile strength – especially older bins
- Inadequate unloading systems – increased plugs in sumps
- Poor lighting
- Control switches far away
- Height
- Opening Size
Barriers...Safe Bin Entry (cont).

**Lack of Lifeline Use**

- **Structural**
  - Anchor points – most bins do not have.
  - Circumference – Inappropriately installed lifeline is worthless.

- **Cumbersome**
  - Assume it is too time consuming to do it right.

- **Equipment & Training**
  - Cost prohibitive for some.
  - Assume high level rope skills, etc. training needed.
  - Difficult to find training.
Summary - Barriers to Practicing Safe Bin Entry

Combination of factors leads to not following safe bin entry procedures.

- Work Practices
  - Time limitations
  - Working Alone
- Cultural Attitudes
- Physical Structure of Bins
- Personal Fall Restraint
Lockout Tagout

Mini Module
Lock Out/Tag Out

- OSHA 1910.147
- Protects Employees
- Written Procedures
- Affordable preventive measure
- Best Practice for farm – not difficult
Lock Out/Tag Out

- Prevents release of hazardous energy.
- Power sources “isolated and rendered inoperative”.
- Includes stored or residual energy.
- De-energizes machines & equipment.
- Uses energy isolating devices.

**Energies** – electrical, mechanical, hydraulic, pneumatic, chemical, thermal, gravity, and others.
Lock Out/Tag Out

Protects Employees & You:

- From injury.
- From unexpected startup.
- During service & maintenance work.
- Working near exposed electrical conductors & parts of electrical equipment.

Keeps others from turning machines on!
Lock Out/Tag Out Requirements

- ONLY authorized employees perform LOTO.
- ALL Employees must be trained.
- Use proper locks and tags.
- Written LOTO procedures.
- Review procedures annually.
- Follow LOTO each time – every time.
Lock Out Requirements

**Lock Out** - isolation of energy from the system (a machine, equipment, or process) which physically locks the system in a safe mode.
Tag Out Requirements

Tag Out – Labeling process to indicate why LOTO is required & equipment being controlled cannot be operated until tag is removed.
Lock out/Tag out – Try Out!

All Procedures include:

- **Tell how to use procedures.**
- **Specific steps**
  - To shut down, isolate, block, & secure machine.
  - Safely place, remove, & transfer of LOTO devices
  - To test machine & verify energy is Locked out.
- **Identify responsible person for LOTO.**
Lock Out/Tag Out - Try Out!

1. Prepare for shutdown –
   - Notify affected persons of LOTO.
2. Shut down machine.
   - Release or restrain stored energy.
3. Disconnect or isolate ALL energy sources.
4. LOTO - Install locks on energy sources & tag machines.
5. Tryout – test LOTO by attempting to start.
Lock Out/Tag Out - Try Out!

6. Begin maintenance/service work.
   - Complete work.
   - Clean up area of tools.

7. Notify persons of intended start-up.
   - Ensure people are safe distance.

8. Start – up.
   - Remove lock out devices.
   - Start-up & verify working normally.
   - Remove tags.
Lock Out/Tag Out Example

- 1. Out of Service Tag
- 2. Isolation point
- 3. Safety hasp
- 4. Safety lock
- 5. Danger tag
Type of LOTO Locks

- Pole Breaker Lockout
- Wall Switch Lockout
- Padlock
- Breaker Lockout
- Valve Lockout

Why LOTO for Farms

- Father & son discussed need to check a cross auger on top of a bin.
- No responsibility assigned.
- Dad checked auger; did not like what he heard.
- Dad got on top of bin & stuck his arm in the auger.
- Son decided to check the auger.
- Father lost his forearm.
Why LOTO for Farms

If they had a system in place — dad would still have his arm and son wouldn’t have his GUILT.

What a farm can do:
- Put a tag on it – Warning.
- Use locks.
- Use a hairpin cotter key.

Use of OSHA procedures is strongly recommended.
LOCKOUT / TAGOUT PROCEDURE

Equipment or Process: Dry Leg

Type of lockout needed: Pad Lock, and Tag

All energy must be locked out before maintenance is to begin. To lockout the Dry Leg take the following steps:

STEP 1 - PREPARE FOR SHUTDOWN, NOTIFY ALL AFFECTED EMPLOYEES RADIO OR DIRECT COMMUNICATION

STEP 2 - IN NORTH ELECTRICAL SHED DISCONNECT ELECTRICAL MAIN LABELED "DRY LEG". PLACE PADLOCK AND TAG ON THE MAIN SWITCH ARM

STEP 3 - VERIFY THAT ENERGY IS ISOLATED BY ATTEMPTING TO START THE MACHINE.

STEP 4 - BEGIN MAINTENANCE.

STEP 5 - WHEN ACTIVITY IS COMPLETED, CLEAR ALL TOOLS, EQUIPMENT, AND PERSONNEL FROM AREA.

STEP 6 - NOTIFY AFFECTED EMPLOYEES OF REACTIVATION.

STEP 7 - REMOVE LOCKOUT DEVICES.

STEP 8 - REACTIVATE MACHINE AND VERIFY NORMAL OPERATION.