

# ***Flowing Grain Dangers***

Developed by:

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## **Sponsors:**

**Indiana Grain and Feed Association**

**ISDA**

**Indiana Corn Marketing Council**

**Indiana Soybean Alliance**

**Indiana Rural Safety and Health  
Council**

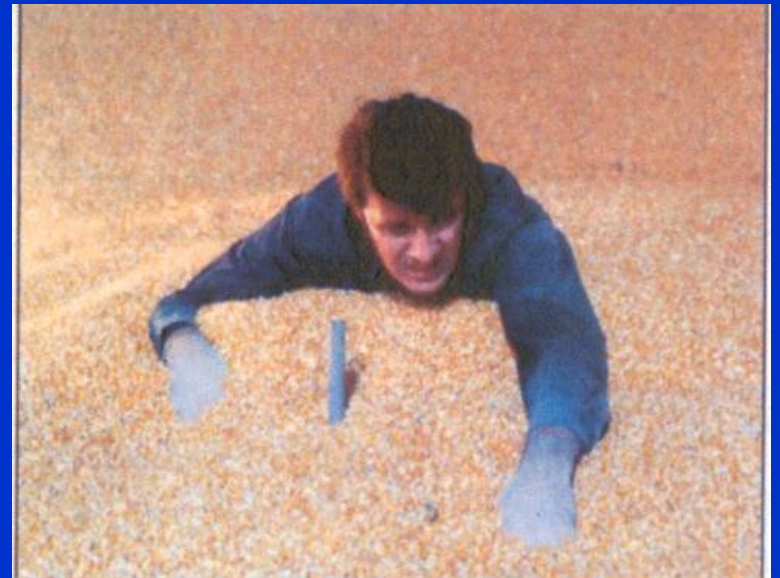
# ***Notice!***

- This lecture does NOT address current OSHA requirements for grain handling
- Meant for non-OSHA regulated agricultural worksites



# ***Outline***

- **Intro**
  - How big is the problem?
- **What do we know?**
  - Frequency
  - Medium
  - Sites Involved
  - Contributing Factors
- **Seven types of entrapment**
- **Responding to entrapment**
  - Steps to follow
  - Removing grain
  - Rescue tubes
  - Rescue hazards
- **Summary**
  - Key ways to prevent entrapment



# ***Definitions***

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- ***Flowable agricultural material*** – free flowing agricultural crops or material including grain
- ***Engulfment*** - events in which an individual is submerged, i.e. fully buried in agricultural flowable material, such as corn, small grains, or feed
- ***Entrapment*** - used in a broader way to describe events in which an individual is trapped, possibly due to engulfment, inside a structure considered a confined space such as a silo, bin, grain transport vehicle, outdoor pile, or bunker silo, where self extrication is not possible
- ***Confined Space*** – (in brief) an area large enough for a worker to enter to perform tasks, not designed for continuous employee occupancy

# ***How big is the problem?***

- Since 1964 Purdue University has recorded over 700 cases of flowing grain entrapment nationwide
- International cases have also been documented





# ***Frequency and outcome***

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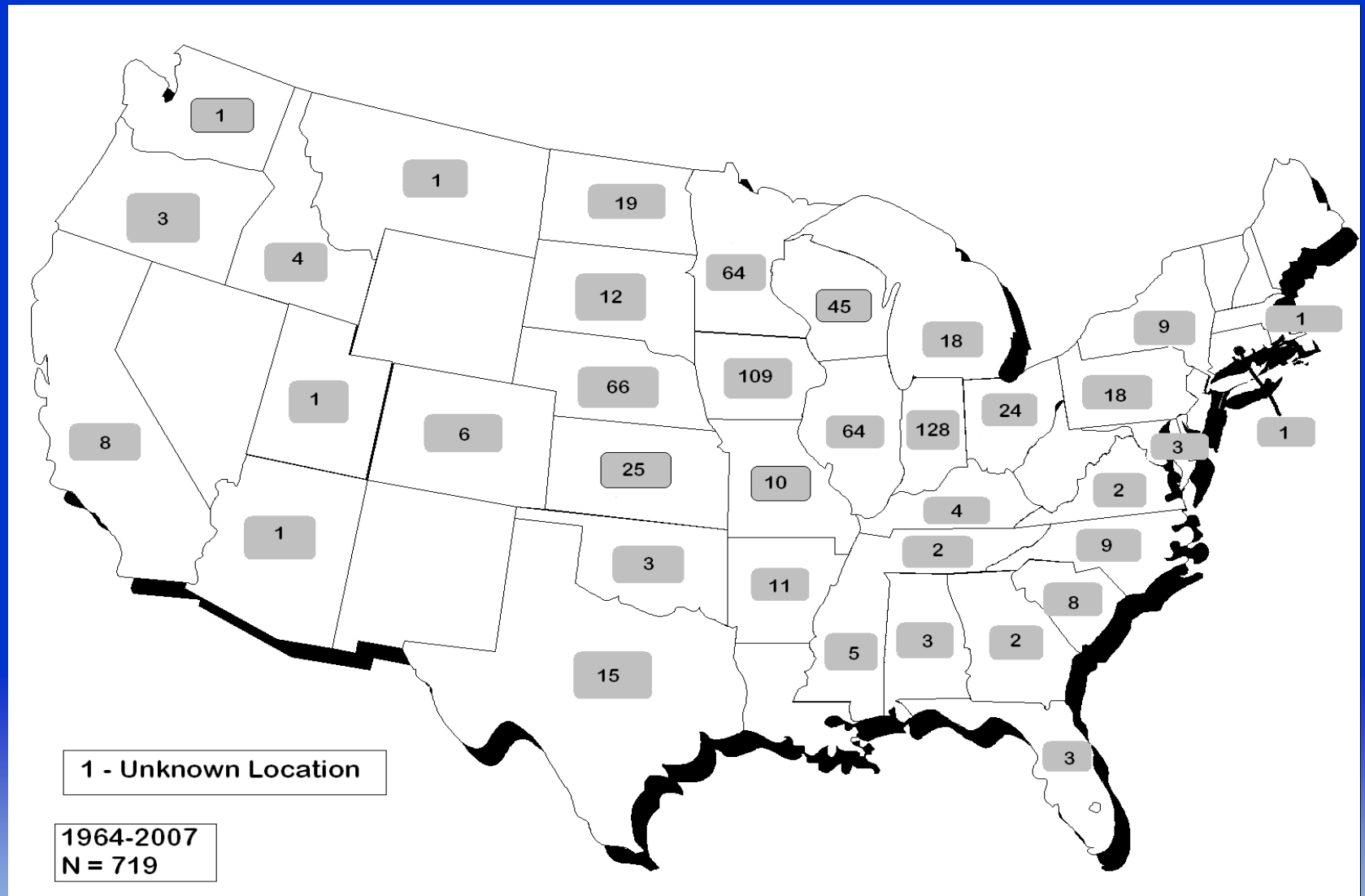
- Average between 15-20 documented entrapments per year over past 4 decades
- Frequency increasing
- In 2007 47% of documented grain entrapments resulted in death
- Many non-fatal incidents go unreported

# ***Mediums where entrapments occur***

- At least 45% of known entrapments involve corn
- Entrapments have been document in: soybeans, wheat, oats, sunflower, alfalfa seed, malted barley, milo, processed feed and rice



# ***Entrapments by geographic location***





# ***Documented contributing factors***

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- **#1 identified cause of entrapment was out-of-condition grain**
- **High capacity grain handling systems**
- **Working alone**
- **Relaxed compliance with workplace safety regulations**
- **Lack of knowledge concerning the risk**

# ***Types of documented entrapments***

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- 1) **Flowing grain**
- 2) **Collapse of horizontally crusted grain surface**
- 3) **Collapse of vertically crusted grain surface**
- 4) **Grain transport vehicles**
- 5) **Use of grain vacuum machines**
- 6) **Outdoor pile avalanche**
- 7) **Storage structure failure**

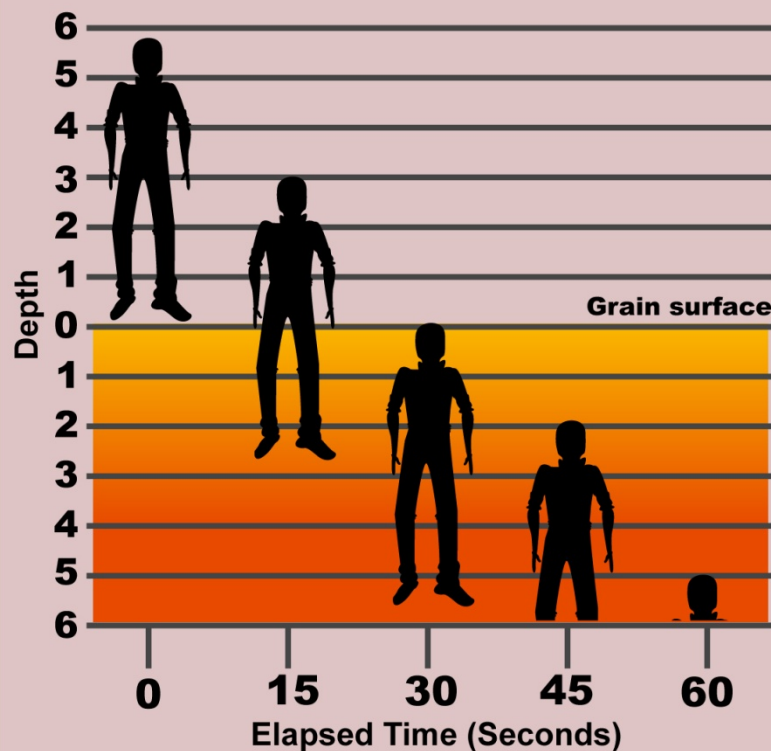
# Unloading Entrapment



Graphic used with permission from Liberty Rescue Systems

## Speed of Entrapment

Based on a 10- inch auger unloading  
at a rate of 4,086 bushels per hour



Data derived from Charles Schwab. Iowa State University

Graphic used with permission from Liberty Rescue Systems

# Bridging Entrapment



Graphic used with permission from Liberty Rescue Systems

# Avalanche Entrapment



Graphic used with permission from Liberty Rescue Systems

# **Entrapment in Free Standing Piles**



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## **Entrapment in Grain Transport Vehicle**



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## Unintended Release Entrapment



Graphic used with permission from Liberty Rescue Systems

# Entrapment Using a Grain Vacuum



Graphic used with permission from Liberty Rescue Systems

# ***Responding to Grain Entrapment***

- Partial entrapment
- Complete engulfment
- Entanglement in equipment





# ***Responding to complete engulfment***

1. **Stop – Do not enter structure**
2. **Shut down and lock out equipment**
3. **Activate local emergency fire rescue services**
4. **Turn on aeration fans**
5. **Assemble employees**
6. **Assess situation and resources**
7. **Implement situation-specific action plan**

***Source: Don't Go With the Flow, (NGFA)***



# ***Two primary rescue techniques***

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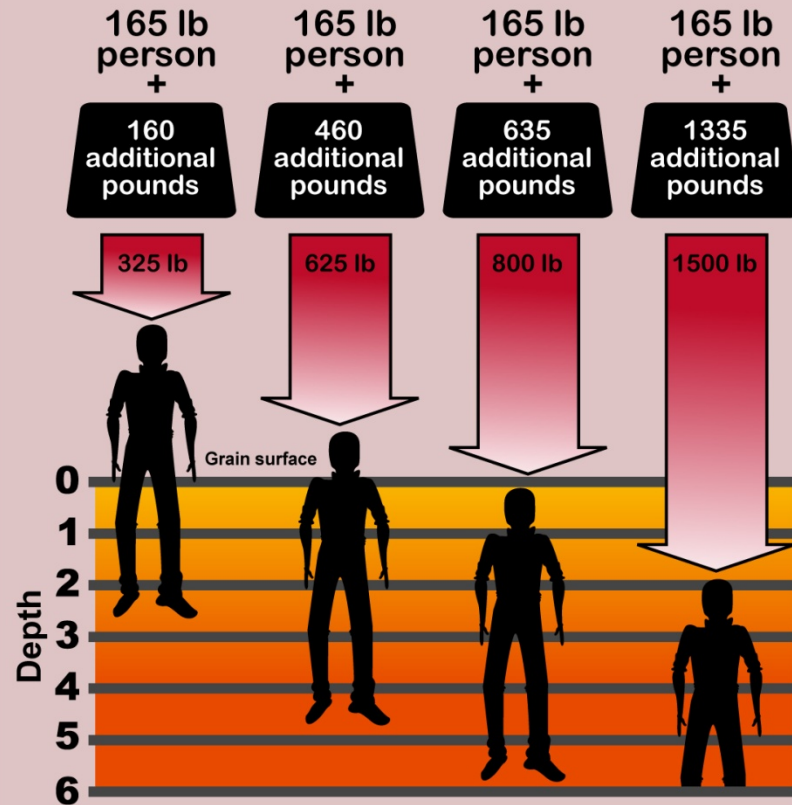
- Removing the grain from around the victim
- Utilize a grain retaining wall or rescue tube to extricate victim from grain mass

# ***Partial entrapment rescue***

- Don't jump into the bin, the victim could be buried deeper by inflowing grain
- Victim cannot be pulled free without injury



## Extrication Forces Required



Data derived from Charles Schwab. Iowa State University

Graphic used with permission from Liberty Rescue Systems



# ***Partial entrapment rescue***

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- Don't waste time digging without a grain retaining device
- Construct a grain retaining device or use a rescue tube; secure and stabilize victim



# ***Grain retaining device on-site materials***

- Backboards
- Plywood
- Metal roofing



# ***Liberty Rescue Tube***



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# ***Potential rescue hazards***

- Bin steps and ladders (350 Lb limit)
- Flowing grain, secondary entrapment
- Hazardous atmosphere, dust, and chemicals
- Overexertion
- Exposure to grain handling equipment





# ***Summary – Preventing Grain Entrapments***

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- (1) Never enter structure while unloading**
- (2) Only enter a structure with an observer present**
- (3) Do not enter bin if grain is bridged or caked on walls**
- (4) Ensure stored grain maintains quality**
- (5) Think before you act**

# *Questions?*

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# ***References***

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- D.E. Maier, W.E. Field, S.A. Freeman, 1999. Don't Go With the Flow Educational Resource Kit. National Grain and Feed Association, West Lafayette, IN.
- C.V. Schwab, 1982. Inflow Velocity and Forces Acting on a Person Trapped in Enveloping Flow of Granular Materials. Masters, University of Kentucky, Lexington.
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- Responding to Agricultural Emergencies, 1999 – NRAES