

UNIT 6



# CONFINED SPACES

*Ag Health 101*



**GREAT PLAINS**  
Center for Agricultural Health

# Chapter DISCUSSION QUESTIONS



## **Chapter 1. Introduction to Confined Spaces**

From pictures of manure storage, grain bins, or silo structures, discuss how entry and exits would limit our ability to rescue someone who is inside these confined spaces.

## **Chapter 2. Confined Space Safety: Best Practices**

Discuss whether/where you have seen any confined space entry signs (on the farm or elsewhere). Review the graphics in this chapter to discuss the wording differences on signs shown and discuss what wording is most clear.

## **Chapter 3. Grain Bin Engulfment**

Search the internet for a recent news story about grain bin engulfment (include the current year in your search). Discuss with a group what happened and identify similarities and differences in outcomes.

## **Chapter 4. Grain Bin Engulfment Prevention**

Think about how you would ask questions to assess someone's risk of grain engulfment on the farm. What questions would you ask to understand whether you need to probe more deeply into the need for a confined space program on a farm to address grain bin hazards?

## **Chapter 5. Grain Bin Rescue Tools**

What questions would you ask a farmworker about what resources are available to them to respond if someone became trapped in grain on their job? Think about equipment needed on site and what information they need to know if the local emergency responders have to rescue someone who is trapped in grain.

## **Chapter 6. Manure Storage Hazards**

Search the internet for a recent news story about manure pit entry fatality in the last 12 months. Discuss with a group what happened and identify similarities and differences in outcomes.

## CHAPTER 1

# Introduction to Confined Spaces

## Definition of a Confined Space

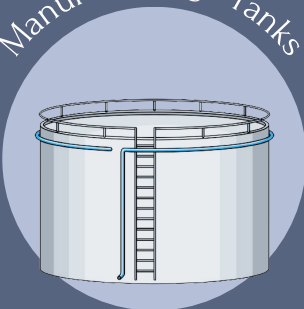
- 1** A space that is not "designed" for people to be in it.
- 2** The space is large enough for someone to enter and do a specific job, but it is **NOT** designed to be a work area.
- 3** The space has a limited or restricted way of getting into and out of it (often referred to as "restricted means for entry and exit).

## *Hazards to Consider*

### **When Entering a Confined Space**

- Is there a potential for the atmosphere to be hazardous?
- Does the space contain material that has the potential to engulf the person that goes in?
- Do the walls slope inward or the floors slope downward in a way that could trap the person that goes in?
- Are there any other safety or health hazards inside the space that could injure someone, such as unguarded machinery, exposed wires, or unprotected drains?

Manure Storage Tanks



Grain Bins



Silos



# CHAPTER 2

# Confined Space Safety

*Best Practices*



1

Identifying & restricting entry into confined spaces



2

Verification of "zero energy" in the system



3

Testing the air quality prior and during entry



4

Assigning an observer who can notify emergency services



5

Establishing an entry and extraction protocol



## CHAPTER 3

# Grain Bin Engulfment

## *Grain Bin Hazards*

### Flowing Grain

Never enter a grain bin while unloading grain - flowing grain can pull an individual in and bury them within seconds.

### Bridged Grain

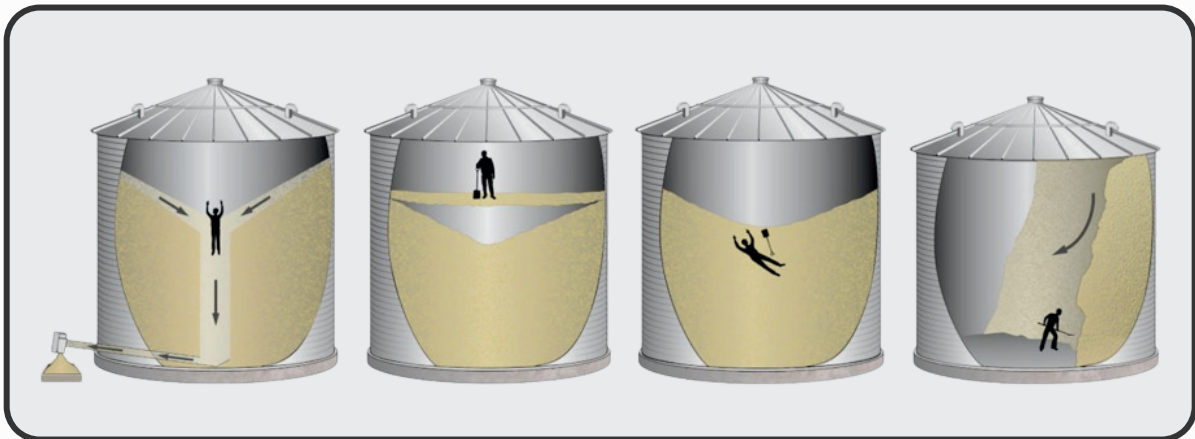
Grain kernels can stick together, forming a crust or bridge that isn't strong enough to support an individual's weight if there is a void or open space beneath the crust.

### Grain Vacuums

When a grain vacuum is operated inside a grain bin, it can result in a fatal engulfment. When the nozzle is placed under the surface of the grain, a funnel develops, making footing unstable, which can result in a fall or cause an avalanche of grain to fall from above if the slope of grain is steep along the walls.

### Vertical Grain Wall Avalanche

Entering a grain bin when the grain on the wall is higher than the individual inside the bin is dangerous because the grain can suddenly break, fall to the bottom of the bin, and engulf the person inside.



## Prevention

### Avoid Spoilage

- 1 Maintain aeration equipment.
- 2 Prevent leaks in the structure.
- 3 Maintain correct moisture & temperature of stored grain.

### Work from Outside the Bin When Possible

For example, if crusts or clumps form & need broken up, use long poles to poke/knock clumps free.

### Restrict Access

- 1 Lock doors.
- 2 Post signs that warn of the potential for engulfment.
- 3 Signs should specify that entry must be done by workers trained to follow safety procedures.

## Entry

### Fall Arrest Equipment

Entrant must put on fall arrest equipment, which is a body harness attached to an anchored line.

### Maintain Communication

Entrant maintains communication with an attendant who stays outside of the entry area the entire time someone is inside.

### Monitor

Attendant monitors the space & any activities that may pose a hazard to the person inside the bin. A line of sight is maintained at all times.

### Prepared

Attendant is there to call for emergency rescue should grain shift, entrapment occur, or entrant be unable to communicate.

# CHAPTER 4 Grain Bin Engulfment Prevention

## Preparation

### Train Everyone on Hazards & Safe Practices

- 1 Train on the steps needed to be taken before entry, what safety equipment to use, & how to contact emergency responders.
- 2 Train at regular intervals, particularly before grain handling seasons.

### Develop an Emergency Rescue Plan & Follow It

- 1 Require cell phones in hand for anyone who enters a bin.
  - 2 Post emergency numbers.
- 3 Prevent anyone else from entering the bin for a "rescue" if not properly trained or protected.

### Lock-Out Tag-Out

Before entering a bin, all grain loading & unloading equipment must be shut off. It is recommended that each power source is locked out & tagged out to prevent equipment being turned back on while someone is in the bin.

### Air Quality Check

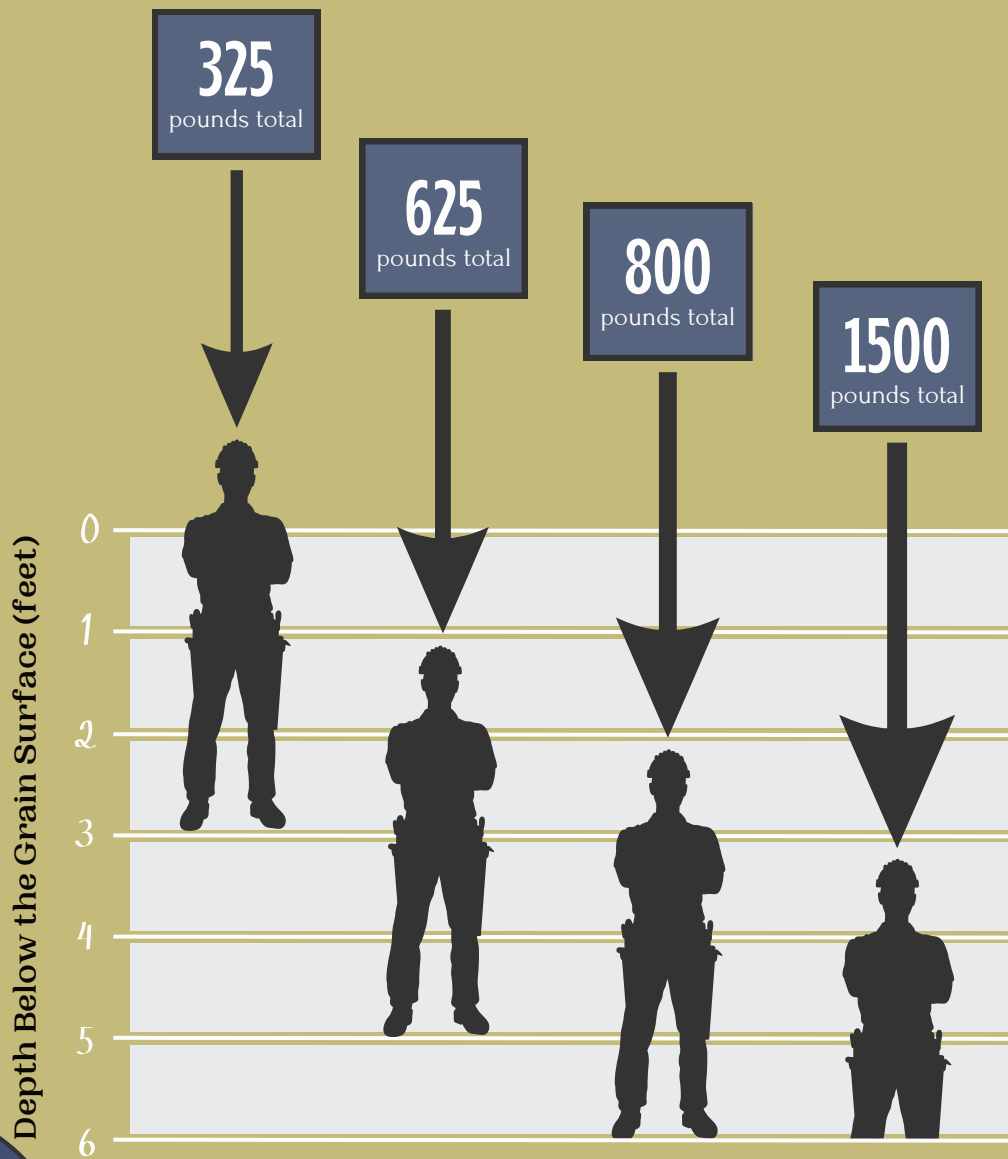
- 1 Is there enough oxygen?  
19.5% - 23.5%
- 2 Is carbon monoxide present?  
Danger if >25 ppm
- 3 Are there any toxic gases, particularly hydrogen sulfide, which indicates there is decaying or rotting materials inside?  
No Entry if >10 ppm
- 4 Is the dust level really high? If so, an N95 dust mask should be worn during work inside the bin.  
No Entry without N95 if you can't see >5 feet away



## CHAPTER 5

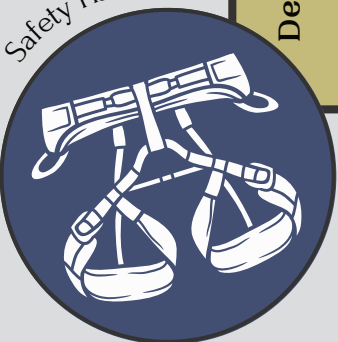
# Grain Bin Rescue Tools

Strength Needed to Rescue a 165-lb. Adult



Source: Iowa State University

Safety Harness



# CHAPTER 6

# Manure Storage Hazards

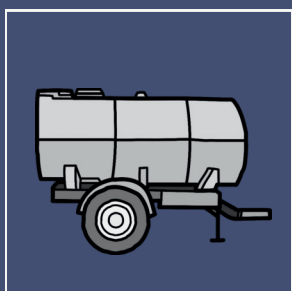
## Safe Work Practices

### General/Management



- Limit access to authorized personnel, & never work alone.
- Inspect periodically to ensure that storage structures never leak or overflow.
- Inspect manure structure ventilation system regularly & prior to entry.
- Keep access ladders in good repair & free from obstruction & debris to reduce slipping.
- Install barriers on piers & push-off platforms to prevent vehicles from falling into ponds & lagoons.
- Provide guardrails or metal grill covers for all trap doors, floor holes, & wall openings.
- Guard manure augers, chains & sprockets, belts/pulleys, cables/pulleys, & manure scrapers to prevent worker contact or entanglement.
- Follow lockout/tagout procedures for machinery, & shut off & remove agitation & pumping equipment before performing services or repair activities.
- Use lights at night.
- Use extra caution during hot weather as dangerous gases may increase.

### Agitation, Pumping, Removal



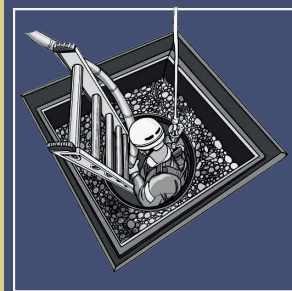
- Measure & monitor atmospheric conditions & know the warning signs of toxic gas exposure.
- Train workers to stay at a safe distance, as built-up gases can quickly overcome them if a crust-like surface opens.
- Remove workers & livestock from manure pits or buildings before agitation; allow gas to dissipate & test atmosphere using remote means before entering the structure.
- Agitate ponds & lagoons during windy conditions to allow gases to dissipate properly; assess wind direction & stay upwind.
- Operate fans during agitation & pumping to maximize ventilation.
- Wear a multi-gas monitor when performing agitation, pumping or removal.

### Fire/Explosion



- Identify ignition sources that may cause fire or explosion.
- Use intrinsically safe or explosion-proof ventilation equipment.
- Prohibit smoking or the use of open flames.
- Keep an ABC-type fire extinguisher near each exit & train workers to use them; otherwise, train workers to leave the area & contact first responders.
- Establish a permit system to control & monitor welding, brazing, or torch cutting.
- Complete a Job Hazard Analysis (JHA) & have each employee review it before conducting hot work.
- Ventilate & test atmosphere before, during, & after hot work.
- Cover manure pit slatted floors with flame-resistant tarps when performing hot work.

### Confined Space Access



- Develop & maintain a written confined space entry program where workers enter permit-required confined spaces.
- Post warning signs in the language of the worker at permit-required confined space entries.
- Never work alone. Have another person remain outside the tank or pit & maintain visual or verbal contact.
- Use powered ventilation systems suitable for use in a flammable environment to maintain safe air quality inside the tank or pit.
- Use a portable multi-gas detector in the tank or pit to test atmosphere before entering; wear a multi-gas monitor while working in the confined space.
- Train workers on how to use & maintain respiratory protection & other protective equipment.
- Wear a body harness & lifeline attached to a tripod & a winch for easy retrieval when working inside a tank.

### Emergency & Rescue



- Develop & maintain an emergency action plan.
- Review the emergency action plan with workers & perform drills; know emergency response time.
- Provide a working phone & post emergency contact numbers within 50 feet of a manure storage structure.
- Keep designated escape paths free of obstructions.
- Train in rescue operations; keep a rescue pole, rope, & other lifesaving equipment near ponds & lagoons to allow for non-entry rescues.
- Never attempt a rescue unless trained & wearing proper respiratory protection, such as a supplied air system or self-contained breathing apparatus.
- Rescuers must be physically capable of using a tripod retrieval system for confined space rescues.

**Leave the space immediately and seek help, if you experience:**

irritated eyes, nose, or throat • headache • dizziness • drowsiness • confusion • nausea or vomiting • rapid or difficulty breathing • increased heart rate



VIEW THESE LINKS FOR MORE INFORMATION &  
ADDITIONAL RESOURCES ON THE CONTENT  
PRESENTED IN THIS UNIT

# Confined Spaces

## *Resources*

### CHAPTER 1. INTRODUCTION TO CONFINED SPACES

Look at OSHA's topic: <https://www.osha.gov/confined-spaces>

- <https://nasdonline.org/1038/d000836/confined-spaces-hazards-a-threat-to-farmers>
- <https://gpcah.public-health.uiowa.edu/grain-engulfment-and-entrapment/>

### CHAPTER 2. CONFINED SPACE SAFETY: BEST PRACTICES

- <https://www.mysafetysign.com/grain-bin-safety-danger-sign/sku-s2-1491>
- <https://www.mysafetysign.com/deadly-manure-gases-do-not-enter-pit-without-equipment-sign/sku-s2-0391>
- <https://www.mysafetysign.com/deadly-manure-gases-possible-death-may-be-immediate-sign/sku-s-7874>
- [https://www.safetysign.com/products/1882/danger-authorized-personnel-sign?s=skfx1zsa9r9m&gclid=CjwKCAjw3POhBhBQEiaAqTCuBpATJl3xD2eA-ePAW-KxUXTyTy\\_uREoZ9TXytMRyxCW41P3tqhtlxBoCDcEQAvD\\_BwE](https://www.safetysign.com/products/1882/danger-authorized-personnel-sign?s=skfx1zsa9r9m&gclid=CjwKCAjw3POhBhBQEiaAqTCuBpATJl3xD2eA-ePAW-KxUXTyTy_uREoZ9TXytMRyxCW41P3tqhtlxBoCDcEQAvD_BwE)

### CHAPTER 4. GRAIN BIN ENGULFMENT PREVENTION

ASABE Anchor Standard: <https://www.grainnet.com/article/188662/grain-bin-access-standard-asabe-issues-guidelines-for-access-and-anchorage-points-on-steel-tanks>

- <https://www.feedandgrain.com/blog/tips-for-safely-entering-grain-bins>

Grain Handling Safety Coalition: <https://grainsafety.org>

### CHAPTER 5. GRAIN BIN RESCUE TOOLS

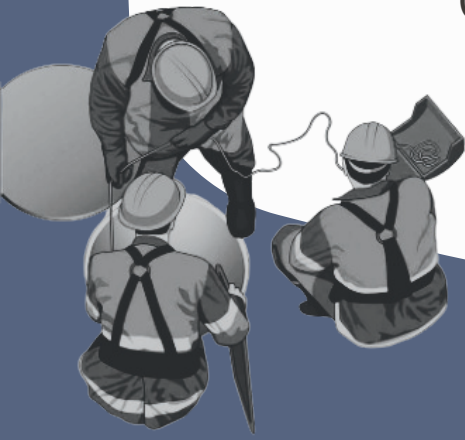
- <https://scafcograin.com/language/en/grain-bin-safety-entrapment-prevention-kits/>

Peosta Grain Entrapment Rescue, from FarmHer: <https://youtu.be/ppUu0FCB7dU>

Grain Handling Safety Coalition: <https://grainsafety.org>

### CHAPTER 6. MANURE STORAGE HAZARDS

- [https://extension.usu.edu/smallfarms/files/ManureStorage\\_Type\\_s.pdf](https://extension.usu.edu/smallfarms/files/ManureStorage_Type_s.pdf)
- <https://extension.psu.edu/confined-space-manure-storage-hazards>
- <https://wyoextension.org/agsafety/structures/manure-pits/>
- <https://www.osha.gov/sites/default/files/publications/OSHA4166.pdf>



## BONUS CHAPTER

# Gas Monitor Use in Confined Spaces

### Monitor Maintenance

Gas monitors come with sensors specific to the chemicals intended to be measured. These sensors age, which is why manufacturers indicate a shelf life for them.

Every time this sensor is used - when one's life is dependent on the sensor letting them know that the air is safe (or unsafe) - it is critical to confirm that the sensor is still responding to the chemical. For this reason, it is recommended that a **bump test is performed EVERY day this monitor is used** to protect someone's life.

In the case of agriculture, it is recommended that the sensor is checked a few weeks prior to the time it is needed. Typically, if the sensor is not used often or it is not stored in a clean area, it may not work when it is needed.

### Monitor Use

- ☒ When pumping manure, inside and outside of buildings
- ☒ After pumping is complete, inside buildings
- ☒ During pressure washing
- ☒ Inside full and empty manure storage pits
- ☒ In unvented spaces with decaying materials
- ☒ When hauling and land-applying

### Performing a Bump Test

- (1) Obtain a container of the gas that matches the sensor (H<sub>2</sub>S or CH<sub>4</sub>), and put the gas directly on the sensor.
- (2) Look at the displayed concentration and look to see if the monitor signaled an alarm.
- (3) If the sensor does not detect the gas, complete a full calibration or simply order a new monitor.
- (4) If the sensor took longer than 1 minute to respond, it has a limited lifespan left (can use it, but with caution). The caution for a slow responding monitor is that the user recognizes the need to move slowly through the space to make sure that "zero" readings accurately reflect no presence of the gas.

View this link for the equipment needed to perform a bump test:

<https://gpcah.public-health.uiowa.edu/wp-content/uploads/2019/09/Equipment-used-in-bump-testing-6.pdf>

FarmSafe Podcast: <https://gpcah.public-health.uiowa.edu/gas-monitors/>

View this link to the GPCAH's Manure Gas page (look at the Monitor Maintenance section and the table that provides videos & handouts on calibrating several monitors):

<https://gpcah.public-health.uiowa.edu/outreach-2/topics/2-0/>