Introduction to Agricultural Safety

Student Workbook

Fact Sheets

Developed by the
Curriculum and Instructional Materials Center
for the Division of Agricultural Education
Oklahoma Department of Career and Technology Education

AG3049
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FARM & HOME SAFETY PLAN

Fill in the emergency telephone numbers for your area. Post copies—along with directions to your farm and home—near your telephone. Teach all family members and employees to call for help in an emergency.

EMERGENCY NUMBERS

<table>
<thead>
<tr>
<th>EMS</th>
<th>FIRE DEPARTMENT</th>
<th>POLICE DEPARTMENT</th>
<th>SHERIFF’S DEPARTMENT</th>
<th>POISON CONTROL</th>
<th>ELECTRIC COMPANY</th>
<th>GAS COMPANY</th>
<th>FAMILY PHYSICIAN</th>
<th>VETERINARIAN</th>
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FAMILY MEMBERS TO NOTIFY FIRST IN AN EMERGENCY

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<thead>
<tr>
<th>Name</th>
<th>Relationship</th>
<th>Telephone</th>
<th>Location (cell, work, home)</th>
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KEY CONTACT PERSON (who can contact others on your behalf)

Name: __________________________ Telephone: __________________________
DIRECTIONS TO YOUR FARM HOME

Note: A map and written directions to your farm or home will save you time in an emergency. You will not have to recall these directions under the pressure of an emergency situation.

1. In the box, draw a map to your home or farm.

OR

2. Attach a copy of a road map or Internet map here. Remember to:
   - Highlight the correct roads to take.
   - Identify familiar landmarks.
   - Include house numbers/mailbox numbers.

3. Write the directions to your farm or home, starting from the nearest town with a fire department or emergency medical service/rescue unit. Identify distances, if possible:

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

Agricultural Safety — UPFRONT
Student - vii
Agricultural production is the most hazardous occupation in America. Each year, accidents in agricultural work cause thousands of injuries and hundreds of deaths. For young agricultural workers age 15-17, the risk of fatal injury is four times the risk for young workers in other workplaces.

Health and safety hazards in agriculture include:

- chemicals/pesticides
- cold
- dust
- electricity
- grain bins
- hand tools
- highway traffic
- lifting
- livestock handling
- machinery/equipment
- manure pits
- mud
- noise
- ponds
- silos

Many of the hazards in agriculture are similar to hazards in other career fields. For example, workers in agriculture must be aware of the potential hazards of power tools and use them properly. As in other occupations where much of the work is done outdoors, workers in agriculture must protect themselves against heat and cold, and must recognize the symptoms of heat- and cold-related illnesses. Certainly, the agricultural workplace resembles many others in terms of the opportunities for sprains and strains and for slips, trips, and falls on the job. These kinds of hazards exist in agriculture, as well as in many workplaces.

The agricultural workplace is also unique from other workplaces. For many agricultural workers, the workplace is also their home. This often means that workplace safety issues must also address children and others who may be present. Because much of the work in agriculture takes place in rural areas, work-related accidents can have more serious consequences. Many rural communities may not have the same access to emergency medical services as in many non-rural areas.
In addition to many safety and health hazards that it shares with other occupations, agriculture also poses unique hazards. For example, *suffocation in grain bins* is a recognized hazard. Shortly after the grain starts flowing, a funnel-shaped flow pattern develops: grain from the surface flows to the center, then down to the floor in a column. A person entering the bin will be carried to the center and quickly drawn under in this column of grain. The flowing grain behaves like quicksand, making escape very difficult. Many agricultural operations also use *manure pits* or *tanks*. Manure pit systems are used primarily on livestock farms (including dairy operations) to allow for the easy cleaning of animal confinement buildings and the efficient underground storage of large amounts of raw manure.

Inside the pit, the manure undergoes anaerobic digestive fermentation to form fertilizer. The digestive process can generate four potentially dangerous gases: methane, hydrogen sulfide, carbon dioxide, and ammonia. As these gases accumulate within the confined space of the manure pit, an oxygen-deficient, toxic, and/or explosive environment results.

Most injuries and fatalities can be prevented with proper training, education, and awareness. This guide can expand your awareness of the potential hazards associated with agricultural work. Increasing your awareness of hazards can help protect you—and others—from accidents and situations that can lead to injury and even death.
Confining spaces have limited openings for entry and exit, have unfavorable natural ventilation, and are not designed for continuous occupancy by workers. Many workplaces involve working in confined spaces. Examples include manholes, pipelines, and storage tanks. Confined spaces common in agricultural work are manure pits and grain storage bins/silos.

Confined spaces pose special hazards for workers. These hazards can result in injury or death.

Hazardous Atmospheres

The atmosphere in a confined space can be extremely hazardous due to the lack of natural air movement. This can result in oxygen-deficient atmospheres, flammable atmospheres, and/or toxic atmospheres.

An oxygen-deficient atmosphere has less than 19.5% available oxygen. In a confined space, the oxygen level can decrease due to work being done—such as welding, cutting, or brazing—or due to chemical reactions (rusting) or bacterial action (fermentation). The oxygen level also decreases if another gas takes the place of the oxygen in the confined space. Total displacement of oxygen by another gas—such as by carbon dioxide—will result in unconsciousness, followed by death.

Hazardous Atmospheres

- Oxygen Deficient Atmosphere
  - Less than 19.5% available oxygen
  - Can decrease due to work being done
  - Result in unconsciousness, followed by death

Oxygen Scale

- 21% - Minimum for Safe Entry
- 19.5% - Impaired Judgement & Breathing
- 16% - Faulty Judgement
- 14% - Rapid Fatigue
- 6% - Difficult Breathing
  - Death in Minutes

A flammable atmosphere results from the oxygen in air and a flammable gas, vapor, or dust in the proper mixture. If a source of ignition—such as a sparking or electrical tool—is introduced into a space containing a flammable atmosphere, an explosion will result. In addition, an atmosphere that is oxygen-rich—above
Confined Spaces

21% available oxygen—will cause flammable materials to burn violently when ignited. As a result, a confined space should never be ventilated with pure oxygen. Ventilate with normal air.

A toxic atmosphere in a confined space can have three sources: products stored in the confined space; work performed in the confined space; or work performed in the immediate area of the confined space. Liquids, vapors, gases, mists, solid substances, and dusts are hazardous in a confined space and can create a toxic atmosphere.

Manure Pits

You may be unaware of the immediate danger posed by entry into manure pits. Like other types of confined spaces, manure pits present special problems regarding worker awareness of hazards. The dangerous atmospheric conditions may exist intermittently (on and off). The decomposition of waste that occurs in manure pits can create oxygen-deficient, toxic, and/or explosive atmospheres. The anaerobic bacterial action that breaks down the manure can generate methane, hydrogen sulfide, carbon dioxide, and ammonia. These gases may produce toxic effects. More importantly, they can displace oxygen in a confined space. Deaths can occur from lack of oxygen or from the toxic effects of these gases. In addition, methane and hydrogen sulfide may present an explosion hazard.

You should treat manure pits like any other type of confined space. This means:

- all manure pits should be ventilated;
- the atmosphere within the pit should be tested before entry;
- a standby person should be in constant contact and ready to lift you to safety with mechanical lifting equipment (winch, hoist, or pulley); and
- anyone entering a manure pit should wear a safety belt or harness with a lifeline tied to the mechanical lifting device.

In addition, a positive-pressure, self-contained breathing apparatus (SCBA) should be used by individuals entering the pit if an oxygen-deficient or toxic atmosphere is detected. If you are not trained to use SCBA equipment, you should never enter a manure pit unless absolutely necessary and only when proper safeguards have been taken! These safeguards include proper ventilation and proper isolation (lock-out, tag-out procedures).

Never enter a manure pit unless someone is standing by and maintaining constant contact. This standby person must:

- remain at the opening of the pit during the entire time the pit is occupied,
- have a mechanical device (winch, hoist, or pulley) in place to help remove the person from the pit.
• be physically capable of using the mechanical device to lift an unconscious victim from the pit without entering it,

• resolve all details of the rescue plan, including availability of rescue equipment, before anyone enters the pit, and

• remember that a delay of even a few minutes could be fatal in an emergency.

Always wear a harness or safety belt with a lifeline when entering a manure pit. Secure the end of this lifeline to the mechanical lifting equipment outside the pit. The use of a harness or safety belt with a lifeline is critical—it is the only safe means for a standby person to rescue a worker from the pit without proper respiratory protection (i.e., positive-pressure, self-contained breathing apparatus).

Never enter a manure pit to attempt a rescue without proper respiratory protection (i.e., positive-pressure, self-contained breathing apparatus). Rescuers who enter the pit without such equipment will almost certainly become victims. Instead, call the local fire department or rescue squad immediately. They have the training and equipment needed to accomplish such a rescue without endangering other lives.

A 43-year-old dairy farm owner (victim #1) and his 23-year-old son (victim #2) died from asphyxiation after entering one of two adjacent 8-foot-deep manure-waste pits that were connected by a tunnel. The pits were located under each half of the end of a dairy holding barn and were connected so that both pits could be pumped from one side. The incident was unwitnessed, but evidence suggests the following sequence of events. The two victims were pumping the manure from the pit into a manure spreader tank using a pump located outside the barn that was being driven by a tractor’s power take-off. The workers had pumped the manure from the pit containing the pump intake hose; however, the manure from the adjacent pit could not be pumped because the tunnel connecting the pits was obstructed. The father removed a steel grate cover and descended an aluminum ladder into the nearly empty pit. As he began to clear the tunnel of obstruction, the father was overcome. The son entered the pit in an attempt to rescue his father and was also overcome. The victims were discovered 22 hours later.

Source: National Institute for Occupational Safety and Health

Grain Storage

Suffocation in grain bins usually occurs when a person is buried while the bin is being emptied. Flat-bottomed grain bins are usually emptied through the center of the bin floor. Shortly after the grain starts flowing, a funnel-shaped flow pattern develops in which grain from the surface flows to the center, then down to the floor in a column. A person entering the bin will be carried to the center and quickly drawn under in this column of grain. The flowing grain behaves like quicksand, making escape very difficult. While you usually only sink several inches to a foot in still grain, you can sink to your knees almost immediately in flowing grain. In 10 seconds or less, you will be thigh-
**Confined Spaces**

deep and unable to free yourself, since the moving grain cannot develop support. Typical unloading rates will completely bury a worker in less than a minute. In addition, some grains, such as flax and millet, cannot support a person, even when still.

In 1999, a 15-year-old worker suffocated in a corn bin while working on his family's farm. He entered a 20,000-bushel corn bin through a door at the top to scoop corn away from a lower door of the bin. The corn in the bin sloped from the sides to the center. The center portion of the bin was empty, and the corn at the sides was about 7 feet high. A co-worker opened the bin door, didn’t see the young worker, and assumed he had exited from the bin. About 30 minutes after the young worker entered the bin, two co-workers entered to check on him. They found him suffocated under approximately 4 feet of corn.

Source: Nebraska Department of Labor, cited in NIOSH ALERT: Preventing Deaths, Injuries, and Illnesses of Young Workers (DHHS/NIOSH Publication No. 2003-128)

Suffocation can also happen due to the build-up of deadly gases in storage bins. Fermenting silage produces nitric oxide (NO₂), nitrogen dioxide (NO₂), and nitrogen tetroxide (N₂O₄). NO₂ and N₂O₄ are respiratory irritants. Low concentrations of NO₂ can cause coughing, difficulty in breathing, or nausea. Higher concentrations may cause the lungs to fill with fluid, which can result in death. These symptoms may be immediate or may be delayed for several hours, for example, until night when the person is asleep.

The suffocation hazard can be eliminated by never entering a silage- or grain-storage structure when it is being loaded or unloaded. The power to all conveying equipment, automatic and manual, should be shut off, locked, and tagged to prevent unexpected operation.

**Examples of Lockout**

A permanent ladder on the inside of grain bins can help. If workers must enter the bin and unloading starts in spite of proper shut-off, lock-out precautions, they may be able to get to the ladder and climb to safety. Without a ladder, a victim's only hope for survival may be to keep walking around the perimeter of the bin to avoid being drawn to the center with the grain.
Caked or frozen grain or silage is also a suffocation or crushing injury threat. If a bin has been partially emptied below a crust of grain, someone who steps on the crust can fall through and become buried. You should always assume all surfaces are “bridged” with a surface crust. Break up surface crusts from outside the bin with a wooden pole—not a metal one—or a weighted line thrown through the bin door. Do not use metal poles, pipes, or lines—they are electrocution hazards, since they may contact overhead power lines near the grain bin.

Frozen or crusted material sticking to walls can fall on someone trying to break this material loose, crushing or suffocating the worker. It takes very little grain to entrap and suffocate a person. Never enter a storage structure below material that is sticking to the sides of the structure or caked on a wall. Break up this material from above.

A suffocation hazard also exists from the gases given off from spoiling grain. For example, the carbon dioxide ($CO_2$) given off is heavier than air and will collect above the grain surface. You cannot smell, see, or taste the $CO_2$. If enough gas has collected to decrease the oxygen concentration from the normal 21 percent to less than 19.5 percent, you will think less clearly, become drowsy, lose consciousness, or even die. Workers who fall through crusted grain can be killed by $CO_2$ that has collected under the crust, even if they are not completely buried.

If a grain bin must be entered, three people should be used:

- The person entering the structure should wear a safety belt or harness attached to a lifeline.
- A second person should remain at the bin entrance to watch the person inside the bin and keep tension on the lifeline at all times to prevent the worker in the bin from slipping under the grain.
Confined Spaces

- The third person should remain on the ground to go for help or assist in freeing the person in the bin, if necessary.

All of the unloading equipment should be turned off, locked, and tagged. If the bin has a ventilating fan, it should be turned on to thoroughly ventilate the bin before entry and should be left on as long as a person is in the bin.