

FLOWING GRAIN ENTRAPMENT

Storing and handling large volumes of grain or feed on farms is very common. Grain storage structures and handling equipment create hazardous work situations. Workers who work with grain – loading, unloading, or moving – must be aware of the hazards of flowing grain and ways to prevent a grain entrapment situation. Workers can become caught or trapped in grain in three different ways:

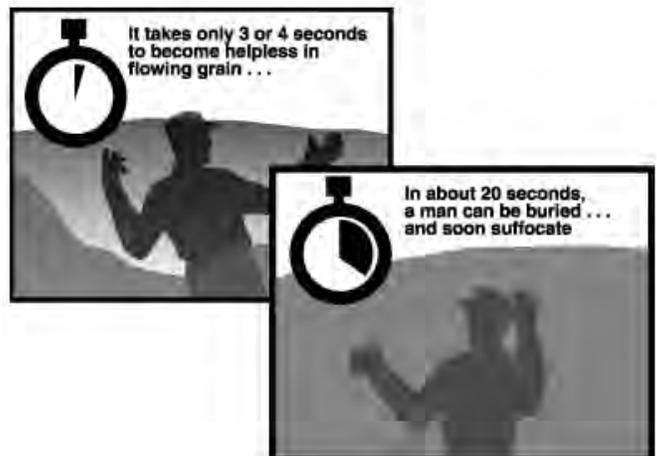
- Entrapment in flowing grain
- A grain bridge collapse
- The collapse of a vertical grain wall

Flowing Grain Hazard

Flowing grain is a term that is used to describe the movement (downward and out) of grain from a storage bin. During unloading, grain flows in a funnel-shaped path downward to the unloading auger. A conveyor at the bottom of the bin transports the grain out of the bin. This vortex of grain behaves very much like a water whirlpool. Velocity increases as grain flows from the bin wall at the top of the grain mass into a small, vertical column at the center of the bin.

Flowing grain acts very similar to quick sand. If a worker is pulled under, there is often little or no time to react (see **Figure 1**). Rate of inflow at the center top of a grain bin is so great that escape is impossible. Once engulfed in the grain flow, a victim is rapidly drawn down toward the bin floor. The few survivors of this type of entrapment say they deliberately covered their mouths and noses with their hands and did not panic. All expressed amazement at the tremendous speed of their engulfment.

Figure 1: Flowing grain



Source: North Dakota State University Agriculture and University Extension

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Preventing flowing grain entrapment

- Be sure to train family, employees, and visitors about the dangers of flowing grain
- Display prominent warning decals or signs on all entrances to the bin
- Turn off and lock out power controls to unloading conveyors before entering a bin
- Ensure worker uses a body harness connected to a lifeline secured to the outside of the bin – have two observers (or more) during bin entry
- Prevent unauthorized entry by securing the grain bin at all times

Entrapment in grain transport vehicles

Many entrapments and suffocations have occurred in high capacity grain transport equipment. Victims are either buried during loading from combine or storage, or drawn into the flow of grain as a vehicle is being unloaded. There is a higher victim rate of this type of accident with youth under 16 years of age – all children should be supervised at all times, don't allow children to enter grain transport equipment!

Collapse of a grain bridge (horizontal crusted grain surfaces)

A grain bridge is a thin surface-layer of crusted, spoiled grain which can conceal voids beneath the surface. If a worker walks on the crusted surface, the additional weight will cause the crust to break and collapse, and the worker will be partially or completely submerged immediately (see **Figure 2**). The worker could move 4 or 5 feet from the point of entry making locating the person difficult.

Preventing grain bridges

- To detect a grain bridge, look for an inverted cone or funnel after unloading from a bin
- Using a safety harness and lifeline, use a pole or a weighted line to free the bridge
- Never stand on the surface of the grain
- Use proper storage techniques to avoid conditions that cause spoilage

Figure 2: Grain bridge collapse



Source: North Dakota State University Agriculture and University Extension

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Collapse of a vertical grain wall

Grain that has spoiled can cake in large vertical columns. As grain is removed from the base of a caked mass, the potential for an avalanche and engulfment increases dramatically. If a worker tries to break up the grain by poking with a shovel (or other tool), the grain can break free and result in an avalanche, completely burying the worker (see **Figure 3**).

Preventing vertical grain walls

- Ensure workers are using a lifeline that is securely tied
- If entry is required, the worker should be lowered from the top of the bin, dislodging the grain as they descend into the bin (this keeps them above the vertical column)
- At all times, be prepared for the entire grain wall to break free and fall
- Use proper storage techniques to avoid conditions that cause spoilage

Grain Bin Rescue Procedures

Precautions for rescuers

1. Shut off the grain-moving machinery – stop the flow of grain
2. Always assume that an entrapped victim is alive
3. If possible, ventilate the bin using the drying fan without activating the heat source
4. If bin entry is required, the rescuer who goes into the structure should wear a body harness and be tied with a safety rope to at least two rescuers on the roof of the bin

Figure 3: Vertical grain wall



Source: North Dakota State University Agriculture and University Extension

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Completely submerged victim

1. Turn on bin aeration fans to provide as much air as possible to the victim (extra air has been credited with saving several lives in grain bin rescues)
2. Call the local rescue squad to get experienced help to the accident site
3. Remove grain from the bin in the most rapid and orderly manner possible
 - Attempts to ‘dig’ a buried victim free are generally unsuccessful, because of the substantial amount of material involved and the tendency of grain to back flow
 - Large openings should be cut uniformly around the base of the bin
 - Cut with an abrasive saw, air chisel, or cutting torch (if a torch is used, be alert for fire)
 - If suitable cutting equipment isn’t available, use the corner of a tractor loader bucket to force holes in the bin wall
4. Cut emergency openings four to six feet above ground to reduce the potential for a grain build-up around the outside of the bin – this would block the flow
 - Ideally, you should make semi-circular or v-shaped cuts 30 to 40 inches across to form valves which, when bent up, allow grain to flow freely
 - When bent back into place, they slow or stop the flow
 - This type of control protects rescue workers inside the bin, who otherwise might be drawn into rapid, uncontrolled flow of grain
5. Space openings uniformly around the bin to reduce the risk of structural collapse and make it easier to remove grain from around the base
6. Once the victim has been uncovered, the bin openings can be closed to allow safe access by rescuers

Figure 4: Grain bin rescue



Source: North Dakota State University
Agriculture and University Extension

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Partially submerged victim

1. If possible, lower a rescue squad member into the bin to reassure the victim and to attempt to attach a body harness or lifeline
 - Don't try to pull the victim free with the line - the tremendous drag of the grain could cause further injuries and is only intended to prevent further sinking
2. Check the victim's airway for grain
 - If he/she is experiencing breathing difficulties, administration of oxygen will help
 - Calm the victim to avoid panic and struggling
3. Construct a shield if there is danger of further grain collapse
 - A steel drum with both ends removed, plywood and pieces of sheet metal formed into a circle have all been used successfully
 - You may need to remove a portion of the bin's roof to get material inside
 - Once the shield is in place, it may be possible to free the victim by scooping grain from the inside of the shielded area
 - Use a board or sheet of plywood as a work platform

References

- National Ag Safety Database, Agricultural Tailgate Safety Training
- National Education Center for Agricultural Safety
- Ohio State University Extension, Agricultural Safety Topics
- North Dakota State University Agriculture and University Extension, "Caught in the Grain", AE-1102, December 1995

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