

OSHA[®] FactSheet

Worker Entry into Grain Storage Bins

Engulfment and Suffocation Hazards

Grain storage bin entry is very dangerous and exposes workers to serious suffocation hazards - a leading cause of fatalities in this industry. Suffocation can occur when workers are engulfed (buried or covered) by grain or when bins develop hazardous atmospheres or a lack of oxygen.

Engulfment can occur when a worker does the following:

- Stands on moving/flowing grain (see figure 1) – The moving grain acts like “quick-sand” and buries the worker in seconds.
- Stands on or below a “bridging” condition (see figure 2) - “Bridging” occurs when grain clumps together, because of moisture or mold, creating an empty space beneath the grain as it is unloaded. If a worker stands on or below the “bridged” grain, it can collapse, either under the worker’s weight or unexpectedly, thus, burying the worker.
- Stands next to an accumulated pile of grain on the side of the bin (see figure 3) – The grain pile can collapse onto the worker unexpectedly or when the worker attempts to dislodge it.

The grain’s behavior and weight make it extremely difficult for a worker to get out of the grain without assistance. Tragically, incidents in grain bins often result in multiple fatalities because coworkers attempt rescue and fall victim as well. These fatalities are preventable if employers follow work practices and provide training and equipment as required by OSHA’s Inspection of Grain Handling Facilities standard, 29 CFR 1910.272.

Where Workers Enter Storage Bins, Employers Must:

- De-energize (turn off) and disconnect, lock-out and tag, or block off all mechanical, electrical, hydraulic and pneumatic equipment that presents a danger, *particularly grain-moving equipment*. Grain *must not* be emptied or moved into or out of the bin

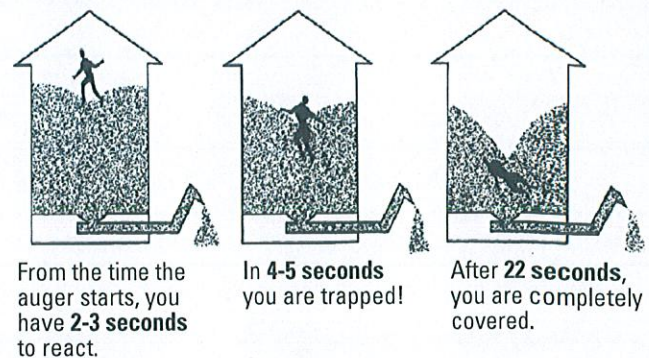


Figure 1. Flowing grain can bury a worker in seconds.

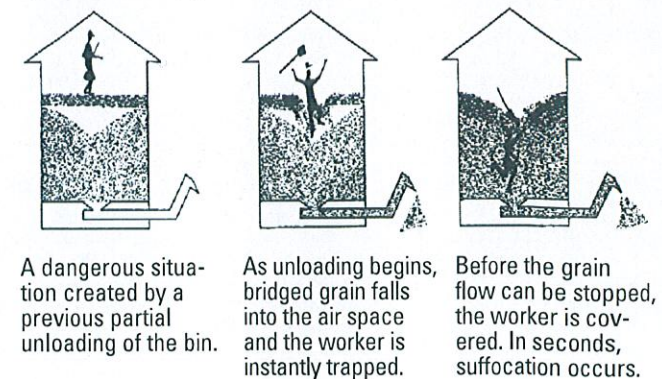


Figure 2. “Bridging” condition that results in engulfment.

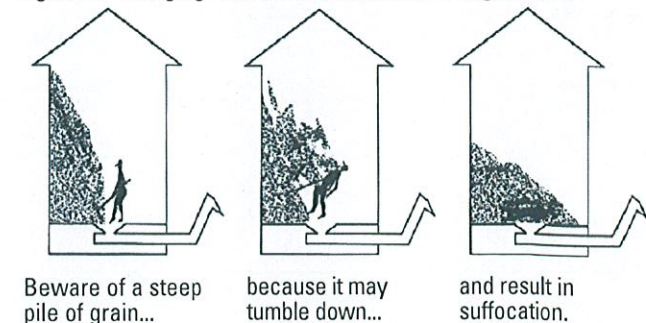


Figure 3. Accumulation on bin side that results in engulfment.

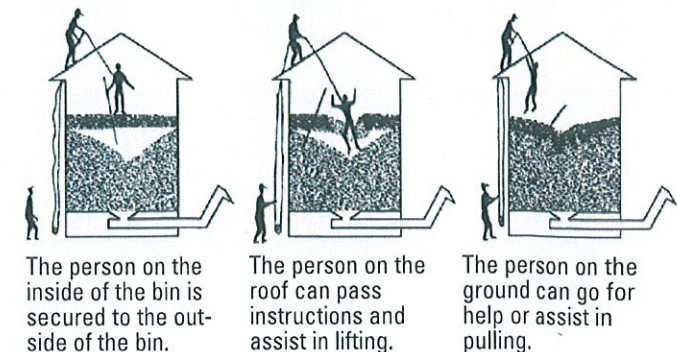


Figure 4. Illustration of successful rescue of worker during “bridging” condition.

while workers are inside because it creates a suction that can pull the worker into the grain in seconds.

- Prohibit walking down grain and similar practices where a worker walks on grain to make it flow.
- Prohibit entry onto or below a bridging condition, or where grain is built up on the side of the bin.
- Provide each worker entering a bin from a level at or above stored grain, or when a worker will walk or stand on stored grain with a body harness with a lifeline, or a boatswain's chair. Ensure that the lifeline is positioned and of sufficient length to prevent a worker from sinking further than waist-deep in grain.
- Provide workers with rescue equipment, such as winch systems that are specifically suited for rescue from the bin (see figure 4).
- Station an observer who is equipped to provide assistance and perform rescue operations outside the bin (see figure 4).
- Ensure that communications (visual, voice or signal line) are maintained between the observer and the workers who entered the bin.
- Test the air within a bin for oxygen content and the presence of hazardous gases before entry.
 - Provide and continue ventilation until any unsafe atmospheric conditions are eliminated.

- If toxicity or oxygen deficiency cannot be eliminated, workers must wear appropriate respirators.
- Issue a permit each time a worker enters a bin, unless the employer is present during the entire entry operation. The permit must certify that the above precautions have been implemented before workers enter the bin.

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Additional Guidance

- For additional information on safe work practices in grain handling facilities, please see:
 - 29 CFR 1910.272, Inspection of Grain Handling Facilities.
 - OSHA's Grain Handling Safety and Health Topics Page: www.osha.gov/SLTC/grainhandling/index.html.
- For additional information on safe work practices in confined spaces, see 29 CFR 1910.146, Permit-Required Confined Spaces.
- For additional information on respirators, see 29 CFR 1910.134, Respiratory Protection.
- For additional information on preparing young workers to work safely, please visit:
 - www.osha.gov/SLTC/teenworkers/index.html, and
 - www.osha.gov/SLTC/youth/agriculture/index.html

This is one in a series of informational fact sheets highlighting OSHA programs, policies or standards. It does not impose any new compliance requirements. For a comprehensive list of compliance requirements of OSHA standards or regulations, refer to Title 29 of the Code of Federal Regulations. This information will be made available to sensory impaired individuals upon request. The voice phone is (202) 693-1999; teletypewriter (TTY) number: (877) 889-5627.

For more complete information:



U.S. Department of Labor

www.osha.gov

(800) 321-OSHA

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SAFETY AND HEALTH TOPICS

Grain Handling

[Standards](#)[Hazards](#)[Evaluating and Controlling Exposure](#)[Other Resources](#)[Safety and Health Topics ▾](#)

OSHA has developed this webpage to provide workers, employers, and safety and health professionals useful, up-to-date safety and health information on grain handling facilities.

What are grain handling facilities?

Grain handling facilities are facilities that may receive, handle, store, process and ship bulk raw agricultural commodities such as (but not limited to) corn, wheat, oats, barley, sunflower seeds, and soybeans. Grain handling facilities include grain elevators, feed mills, flour mills, rice mills, dust pelletizing plants, dry corn mills, facilities with soybean flaking operations, and facilities with dry grinding operations of soyflake.

What are the hazards in grain handling facilities?

The grain handling industry is a high hazard industry where workers can be exposed to numerous serious and life threatening hazards. These hazards include: fires and explosions from grain dust accumulation, suffocation from engulfment and entrapment in grain bins, falls from heights and crushing injuries and amputations from grain handling equipment.

Suffocation is a leading cause of death in grain storage bins. In 2010, 51 workers were engulfed by grain stored in bins, and 26 died—the highest number on record, according to a report issued by Purdue University [193 KB PDF, 5 pages]. Suffocation can occur when a worker becomes buried (engulfed) by grain as they walk on moving grain or attempt to clear grain built up on the inside of a bin. Moving grain acts like "quicksand" and can bury a worker in seconds. "Bridged" grain and vertical piles of stored grain can also collapse unexpectedly if a worker stands on or near it. The behavior and weight of the grain make it extremely difficult for a worker to get out of it without assistance. OSHA has sent notification letters to approximately 13,000 grain elevator operators warning the employers to not allow workers to enter grain storage facilities without proper equipment, precautions (such as turning off and locking/tagging out all equipment used so that the grain is not being emptied or moving into the bin) and training.

Grain dust explosions are often severe, involving loss of life and substantial property damage. Over the last 35 years, there have been over 500 explosions in grain handling facilities across the United States, which have killed more than 180 people and injured more than 675. Grain dust is the main source of fuel for explosions in grain handling. Grain dust is highly combustible and can burn or explode if enough becomes airborne or accumulates on a surface and finds an ignition source (such as hot bearing, overheated motor, misaligned conveyor belt, welding, cutting, and brazing). OSHA standards require that both grain dust and ignition sources must be controlled in grain elevators to prevent these often deadly explosions.

Falls from height can occur from many walking/working surfaces throughout a grain handling facility. Examples of such surfaces include (but are not limited to) floors, machinery, structures, roofs, skylights, unguarded holes, wall and floor openings, ladders, unguarded catwalks, platforms and manlifts. Falls can also occur as workers move from the vertical exterior ladders on grain bins to the bin roof or through a bin entrance.

Mechanical equipment within grain storage structures, such as augers and conveyors, present serious entanglement and amputation hazards. Workers can easily get their limbs caught in improperly guarded moving parts of such mechanical equipment.

Highlights



[Download the Grain Handling Safety Poster](#)

[131 KB PDF*, 1 page]

With Lives at Risk in the Grain Industry, OSHA Launches Safety Initiative

Read the News Releases:

Wisconsin, Ohio, Kansas, Nebraska, Missouri, Illinois

- **Hazard Alert: Dangers of Engulfment and Suffocation in Grain Bins.** OSHA.
- **WARNING: Entering grain storage bins is EXTREMELY DANGEROUS!** [245 KB PDF*, 2 pages]. OSHA Wallet Card 3329-06-11N.

Other Related Topics

- **Agricultural Operations**
- **Sweep Auger Settlements**
 - Western Grain Marketing, LLC [92 KB PDF*, 8 pages]
 - Northern Grain Marketing, LLC [123 KB PDF*, 9 pages]

DeBruce Grain Elevator Explosion

Significant chapters from the report on the explosion of the DeBruce Grain Elevator that occurred June 8, 1998 Wichita, KS. This report

grain or fumigation. Workers may be exposed to unhealthy levels of airborne contaminants, including molds, chemical fumigants (toxic chemicals), and gases associated with decaying and fermenting silage. Fumigants are commonly used for insect control on stored grain and many have inadequate warning properties. Exposure to fumigants may cause permanent central nervous system damage, heart and vascular disease, and lung edema as well as cancer. These gases may result in a worker passing out and falling into the grain, thus becoming engulfed and suffocating or otherwise injuring themselves.

What can be done to reduce the hazards in grain handling facilities?

On August 4, 2010 and again on February 1, 2011, OSHA issued warning letters to the grain handling industry following a series of incidents including the recent suffocation of 2 teenagers in Illinois grain elevator. In response to the rising number of workers entrapped and killed in grain storage facilities, OSHA has also issued a new fact sheet, *Worker Entry Into Grain Storage Bins* [1 MB PDF*, 2 pages] in August 2010 for workers and employers emphasizing the hazards of grain storage bin entry and the safe procedures that all employers must follow. Additionally, OSHA issued a safety and health information bulletin (SHIB) entitled, *Combustible Dust in Industry: Preventing and Mitigating the Effects of Fire and Explosions*, and a Hazard Alert: *Combustible Dust Explosions* [790 KB PDF*, 2 pages] fact sheet.

The control of worker's exposure to hazards in grain handling facilities are addressed in the OSHA standard for grain handling facilities (29 CFR 1910.272), as well as in other general industry standards. These standards reduce the risk to workers by requiring that employers follow established, common sense safety practices when working in grain handling facilities.

When workers enter storage bins, employers must (among other things):

1. Turn off and lock out all powered equipment associated with the bin, including augers used to help move the grain, so that the grain is not being emptied or moving out or into the bin. Standing on moving grain is deadly; the grain can act like "quicksand" and bury a worker in seconds. Moving grain out of a bin while a worker is in the bin creates a suction that can pull the workers into the grain in seconds.
2. Prohibit walking down grain and similar practices where an employee walks on grain to make it flow.
3. Provide all employees a body harness with a lifeline, or a boatswains chair, and ensure that it is secured prior to the employee entering the bin.
4. Provide an observer stationed outside the bin or silo being entered by an employee. Ensure the observer is equipped to provide assistance and that their only task is to continuously track the employee in the bin. Prohibit workers from entry into bins or silos underneath a bridging condition, or where a build-up of grain products on the sides could fall and bury them.
5. Train all workers for the specific hazardous work operations they are to perform when entering and working inside of grain bins.
6. Test the air within a bin or silo prior to entry for the presence of combustible and toxic gases, and to determine if there is sufficient oxygen.
7. If detected by testing, vent hazardous atmospheres to ensure that combustible and toxic gas levels are reduced to non hazardous levels, and that sufficient oxygen levels are maintained.
8. Ensure a permit is issued for each instance a worker enters a bin or silo, certifying that the precautions listed above have been implemented.

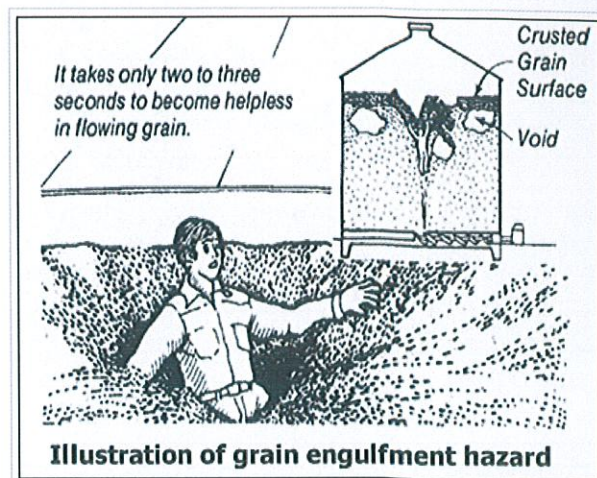
To prevent dust explosions and fires, employers must (among other things):

1. Develop and implement a written housekeeping program with instructions to reduce dust accumulations on ledges, floors, equipment and other exposed surfaces.
2. Identify "priority" housekeeping areas in grain elevators. The "priority" housekeeping areas include floor areas within 35 feet of inside bucket elevators, floors of enclosed areas containing grinding equipment and floors of enclosed areas containing grain dryers located inside the facility. Dust accumulations in these priority housekeeping areas shall not exceed 1/8th inch. Employers should make every effort to minimize dust accumulations on exposed surfaces since dust is the fuel for a fire or explosion, and it is recognized that a 1/8 inch dust accumulation is more than enough to fuel such occurrences.
3. Inside bucket elevators can undergo primary explosions. OSHA's grain handling standard requires that belts for these bucket elevators purchased after March 30, 1988 are conductive and have a surface electrical resistance not exceeding 300 megohms. Bucket elevators must have an opening to the head pulley section and boot section to allow for inspection, maintenance, and cleaning. Bearings must be mounted externally to the leg casing or the employer must provide vibration, temperature, or other monitoring of the conditions of the bearings if the bearings are mounted inside or partially inside the leg casing. These bucket elevators must be equipped with a motion detection device which will shut-down the elevator when the belt speed is reduced by no more than 20% of the normal operating speed.

investigation and cause of the explosion that killed 7 and injured 10 employees.

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All other documents, that are not PDF materials or formatted for the web, are available as Microsoft Office® formats and videos and are noted accordingly. If additional assistance is needed with reading, reviewing or accessing these documents or any figures and illustrations, please also contact OSHA's Directorate of Science, Technology and Emergency Management at (202) 639-2300.



include heat producing equipment such as motors, bearings, belts etc. Preventive maintenance is critical to controlling ignition sources. The use of vibration detection methods, heat sensitive tape or other heat detection methods can help in the implementation of the program.

5. Minimize ignition sources through controlling hot work (electric or gas welding, cutting, brazing or similar flame producing operations).
6. Install wiring and electrical equipment suitable for hazardous locations.
7. Design and properly locate dust collection systems to minimize explosion hazards. All filter collectors installed after March 1988 shall be located outside the facility or located in an area inside the facility protected by an explosion suppression system or located in an area that is separated from other areas by construction having at least a one hour fire resistance rating and which is located next to an exterior wall vented to the outside.
8. Install an effective means of removing ferrous material from grain streams so that such material does not enter equipment such as hammer mills, grinders and pulverizers.

For more information, see OSHA standard (29 CFR 1910.272).

How can OSHA help?

For other valuable worker protection information, such as Workers' Rights, Employer Responsibilities and other services OSHA offers, read OSHA's Workers page or OSHA's Small Business page.

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