

SILO SAFETY

A silo is a structure used in agriculture to store bulk materials, such as grain or fermented feed known as silage. They are most commonly used for bulk storage of grain, cement, woodchips, food products, and sawdust.

Silo Hazards

Silos are an important part of many farming operations; however, they are also the location of many accidents to farmers and workers. Confined spaces, falls, electrocutions, hazardous atmospheres (e.g., silo gas, mould, etc.), and machine-related injuries (e.g., entanglement in augers), and silo collapses are all potential hazards from silos.



Silo Gas

Silos can contain deadly gases. These gases are formed by the natural fermentation of chopped silage shortly after it is placed in the silo (Note: These gases can also be formed in a forage box if left overnight). Gas collects in upright silos within a few hours after new material (feed) is added. As fermentation occurs, a variety of gases are released during this process.

The type of silo in which the forage is stored is important in determining which gas will be predominant. For instance, in sealed silos both nitrogen dioxide (NO₂) and carbon dioxide (CO₂) gases are created but carbon dioxide is produced in far greater amounts. This is desirable because high carbon dioxide levels help to maintain high quality silage. A variety of gases are also formed in conventional or open-top silos with nitrogen dioxide being the most abundant. Nitrogen dioxide is harmful because it causes severe irritation to the nose, throat and chest and may lead to inflammation in these areas.

Carbon dioxide displaces the oxygen in the silo; it is invisible and has no odour, therefore, there is no way to sense a life-threatening oxygen-deficient atmosphere. Oxygen deficient silos can create a serious confined space hazard. Entering a silo with air containing insufficient oxygen can cause an individual to collapse within seconds and die within a matter of minutes.

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Potentially lethal levels of nitric oxide (NO), nitrogen dioxide (NO₂), and nitrogen tetroxide (N₂O₄), can also be produced in the silage process. These gases start forming soon after loading chopped plant material into the silo. Exposure to nitric oxide can result in chemical burns, permanent lung damage, and even death.

If you suspect you have been exposed to silo gas, seek medical attention immediately. Get to fresh air immediately if you start coughing or experience throat irritation.

Mould

Mould spores produced by spoiled hay or silage can also create a dangerous situation. When inhaled, these mould spores can irritate the tissues in the mouth and nose. The reactions can be harsh enough to cause hospitalization. A respirator that can filter fine dust particles should be worn at times when around mouldy hay or silage, but only when in an area in which the air has enough oxygen in it and no other toxic gases or vapours. Prevent mould growth by following proper filling and chopping techniques. To prevent mouldy dust from becoming airborne, wet the top layer of silage down before moving anything. By handling dusty materials mechanically, it may keep you far enough away or create less dust.

Silo Collapse

From time to time, older tower silos collapse. Structural components can be weakened by seepage and the corrosive effects of silage acids. If damage is not repaired and routine maintenance is neglected, silo collapse is a distinct possibility.

The following is a checklist of silo components that need to be assessed during a silo inspection.

- Check wooden doors for rot and physical damage
- Check bolts and bolt heads for tightness and degree of corrosion
- Evaluate corrosion and physical damage to door steps and latches
- Cast iron hinge eyes should be tightened and assessed for corrosion
- Concrete door frames should be checked for deterioration and physical damage
- Doors must seat properly in their frames for latch systems to work effectively
- Replace wire rope on the unloader (if signs of wear and tear are evident)
- Ensure that all ladders are in good condition
- Outside ladders should be fitted with structurally sound safety cages to prevent falls

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Safety Guidelines for Silos

It is important to work safely in and around silos. Be alert for silo gas odours and/or fumes in or near the silo. The greatest danger from nitrogen dioxide gas is in silage during the first 12 to 60 hours after filling. Take care to avoid possible exposure for 10 days after filling the silo, and when opening the silo for feeding.

- Ventilate the silo room adequately for at least two weeks after filling
 - Open the windows and outside doors of the silo room and use fans if necessary
 - If the silo adjoins a barn (or other building), use portable exhaust fans to blow air into the feed room to dissipate some of these vapours or gases. Air would then be expelled through the feed room rather than the reverse
 - A box duct connected over the inside of the fan and extending down to 150mm above the feed room floor will ensure silo gas is effectively removed
 - Keep all doors closed and the roof panel open for more effective ventilation
- Post all appropriate warning signs. Oxygen-limiting silos require a sign that warns people of the absence of oxygen
- Barricade enclosed silo areas to prevent anyone from entering the silo
- Keep a hatch door open close to the level of silage in the silo
- When filling or emptying, never allow people in or around the silo

Before Entering a Silo

Never enter a silo unless it is absolutely necessary. Seek professional help from persons who are knowledgeable, trained, and qualified to make confined space entries. Confined space procedures should be followed for every entry. Do not enter the silo for 4 to 6 weeks after filling stops, since this is the most dangerous time. Test the air for oxygen levels and hazardous gases and vapours before entering. Always wear a self-contained breathing apparatus. In addition to the breathing apparatus, when entering a silo, you should always use a rope and safety harness and a person must be stationed outside to summon help if needed.

Train all personnel about the hazards and safety procedures you have implemented for working around silos and other confined spaces on your farm. Allow only properly trained employees to enter the silo or other confined spaces. If you hire someone to work in your silo, like a contractor or service provider, make sure they have received appropriate safety training, equipment, and entry procedures are in place.

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Respiratory Protection

Respirators can be broadly classified into two groups: air supplying respirators and air purifying respirators.

Air supplying respirators are for use in oxygen-deficient areas such as manure pits; silos containing silo gas, airtight silos, or bins containing high moisture grain. The two main types of air supplying respirators are the hose mask with blower and emergency air supply, and the self-contained breathing apparatus (SCBA).

Air purifying respirators remove contaminants from the air, but can be used only in an environment that has enough oxygen to sustain life. Do not use air purifiers to provide protection from the dangers of oxygen deficient environments such as silos.

Resources

- Department of Labour and Industries, Washington State
- WA Fatality Assessment and Control Evaluation (FACE) Program, WA Dept. of Labor & Industries, Silos and Silo Gas Hazards
- Occupational Health and Safety, Government of Saskatchewan
- NASD (National Agricultural Safety Database)
- Ohio State University Extension, Silo Safety

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