

DE Engineers Silo Operation Manual



be managed correctly for effective insect control Please take time to read this manual Information is included on.

Your health

Safety

Owners' responsibilities

Efficient fumigation

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1. Your health

Entering a silo is unnecessary. Dangerous gasses may be present. Cleaning must only be done through the access hatch in the bottom of the silo. Good grain storage as outlined in this manual (refer section 7) will ensure the grain flows out of the silo with no problems. The small amount remaining can be easily cleaned out with a brush or water hose while standing on the concrete pad with only the upper half of your body inside the silo. If grain has stuck to the walls make sure the top lids are open before entering the lower access hole to brush or hose out. Grain hanging on the walls indicates damp grain. This causes moulds to develop and the grain 'cakes'. Where there are moulds in a silo there can also be high levels of Carbon dioxide (CO₂). Entering silos from the top under these conditions without adequate ventilation has caused deaths. If the grain is not flowing out properly do not enter the silo. This could also indicate damp grain and it may have 'bridged'. Watch out for overhead power lines and use only a wooden or plastic probe to push the grain down from the top inspection hatch.

Wear a dust mask while working inside a silo. Grain dust can inflame an existing respiratory condition or particles may lodge in the lungs which can cause future problems. After a fumigation low levels of gas remain in the grain for a long time. Always allow time for the gasses to disperse before entering the silo. In the absence of sophisticated testing equipment allow the silo to vent naturally for 7 to 10 days, depending on wind conditions, before entering it. If you have to enter a silo containing grain always have a person outside the silo in case of emergency. Always use a rope tied to the exterior.

2. Safety

This silo is fitted with safety features designed to prevent accidents. These have been fitted in compliance with a 'Code of Practice' or Safety aspects in the design' for silo construction in States where these codes have been adopted. Removal of these devices may be illegal under legislation in some Australian States.

Precautions

As a silo owner you have a duty of care to your workers or any other person living at or visiting your property. Warn your family, employees and visitors of the dangers of grain. Tell them to stay out of grain bins silos and trucks. Also tell them not to ride on loads of grain and to keep clear of steep walls of grain. Persons who will operate this silo must be fully trained in safe working procedures.

External ladder

The silo is fitted either with a removable 'hook' ladder or a hinged barrier on the external fixed ladder. The purpose of these devices is to prevent children being able to climb the silo. The barrier must be in the locked position or the hook ladder removed when the silo is not being used.

Safety grids.

The upper access hatch is fitted with a safety grid this must be in position at all times. People die regularly in silo accidents throughout Australia. Experienced farmers can trap themselves but children and visitors seem to be at most risk from suffocation under grain. To them it seems harmless and they don't realise it can be dangerous under some circumstances. If the grain bulk starts flowing when a person is standing on it, they can be completely submerged within seconds, jammed in and unable to breathe. SUFFOCATED.

Please take time to read any pamphlets accompanying your silo purchase THEY COULD SAVE YOUR LIFE OR THAT OF SOMEONE CLOSE TO YOU.

LOOK UP, BE AWARE OF OVERHEAD POWERLINES WHEN WORKING ON TOP OF YOUR SILO. BE CAREFUL WHEN MOVING TALL EQUIPMENT AROUND BETWEEN SILOS.

Warning signs

This silo is fitted with appropriate warning signs. If these fade or fall off ask your manufacturer for replacements.

3. Owners Responsibilities

It is the responsibility of the owner to ensure this silo is set up correctly. Many problems result from incorrect preparation of the silo base pad. Silos have been mounted on plough discs, sleepers, poor quality concrete, un-reinforced concrete or even directly on the ground. The results of incorrect mounting have sometimes been total collapse of the silo.

Elevated silos are a fully stressed structure, engineered to support grain in a vertical plane with pressure exerted and distributed evenly around the base support frame. A pad that is not level will transfer the weight of the grain to the low side of the silo and place excessive stresses on the lower sheets of the silo. An uneven pad will also increase the pressure in one area, twisting the base frame deforming the silo. The effects may not be seen for some time, probably not until extra stress is placed on the silo wall when out loading product with a higher bulk density. This localised force may burst seams or compressed lower sheets causing the silo to tilt and possibly collapse. Check with your silo manufacturer if you are planning to store a commodity heavier than usual.

Elevated Silo Pad

The most important step in establishing a silo is to construct a good quality pad. The site selected for erection of the silos should be a stable, level site with no chance of erosion from water run off. Care must be taken in sitting the silo to avoid soft and expanding soils. Consult the local shire engineer for advice on the strength of the subsoil at the site. For establishment on a difficult site the farmer should engage the services of a consulting engineer.

Site preparation

Clear vegetation from an area 1 m (3 ft) larger than the pad, grade it 100 mm (4") below ground level to provide a level area for the slab and adequate drainage away from the pad edges. A layer 30 - 50 mm (1 1/2 - 2") deep of good draining material (sand or blue metal dust) should be placed on the base and compacted by watering and rolling. Alternatively in a clay area place a plastic ground sheet on the

compacted soil to help prevent drying and cracking of the subsoil and pad. Construct the concrete pad exactly to manufacturer's instructions. Failure to adhere to instructions will void the warranty.

4. Manufacturers responsibilities

The manufacturer has produced this silo according to the Code of Practice as laid down by the statutory authority of the state and existing at the time of manufacture.

Safety features have been incorporated into the design and documented information provided that is needed for the safe installation operation and maintenance of the silo.

The design has taken into account most variations that can occur in the displacement of grain or other substances that may be stored in this silo and follows the relevant design codes and standards.

This silo has been designed to store specific products. Refer to the manufacturers instructions for the list of products.

Fertiliser in silos

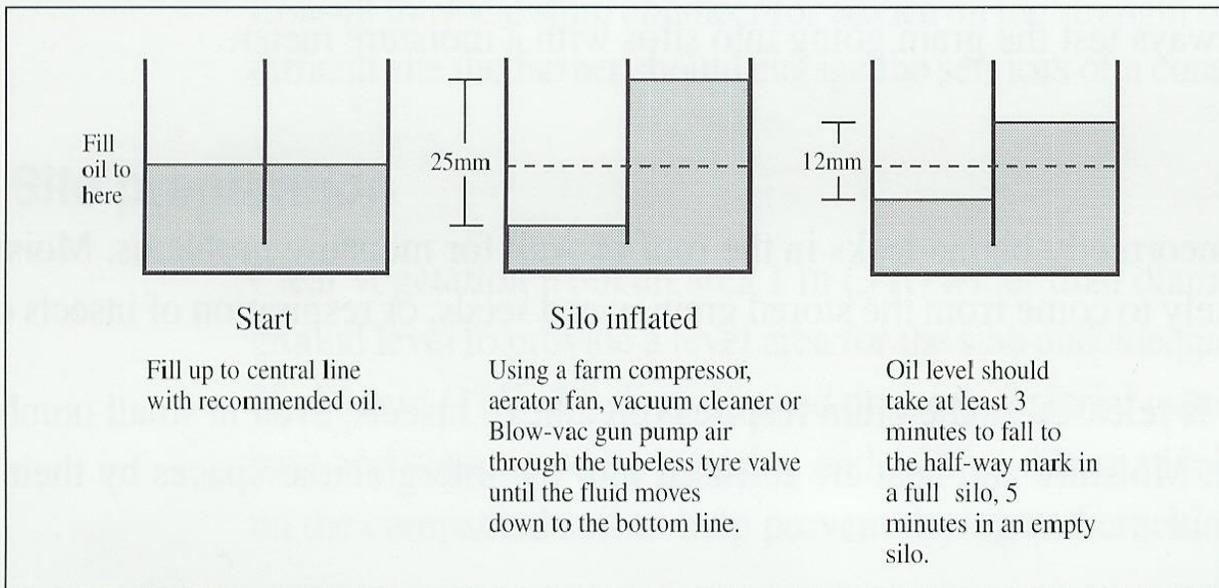
Standard silos will store most granulated fertiliser without the need for higher cone angles (the most common cause of bridging).

Storage Characteristics:

Not all fertilizers can be stored in silos. Those that can should only be stored for a short period of time. They should be ordered close to the time of intended use, and not stored from one season to the next. Many factors influence how well and for how long a fertilizer will store in a silo. One of these is the "Critical Relative Humidity" of the fertilizer. The Critical Relative Humidity is the relative humidity above which a fertilizer readily absorbs moisture from the atmosphere, and below which it will not absorb atmospheric moisture. Fertilizers with a high Critical Relative Humidity generally have good storage characteristics. If you are considering storing fertiliser in a silo, refer to the manufacturer for advice.

5. Checking seals

Once a year pressurise your sealed silo to check for leaks. If gas leaks out, the concentration of fumigant will be reduced, the fumigation will fail and there is a chance of insect survival. These insects will have undergone natural selection to a sub lethal atmosphere of phosphine and will have a resistance to the fumigant. Silos can be checked using a standard farm compressor attached to a tubeless tyre valve fitted to the silo wall or sealing plates. A vacuum cleaner or an industrial blow/vacuum gun can be used to compress the silo. The pressure needed to create a 25 mm difference in the valve is only 250 Pascals (1/4 of one kilopascal) first, check the oil level in the valve. Top up if necessary with a mineral oil only.



Pressure the silo to create a 25mm difference in the oil levels (See diagram 1.) Then watch the oil levels and check the time taken to fall to a 12mm difference. This should not be less than three minutes.

If the silo fails to hold the pressure for the specified period, check for leaks using soapy water. Maintain the pressure on the silo while spraying a soapy solution on all the outlets and seams. Bubbles will appear quickly if there is a leak.

6. Inspect silo sealing

Replace the rubber seals with a firm (high density closed cell) foam rubber strip. These can be obtained from industrial rubber suppliers or from the silo manufacturer. Any joint leaks can be repaired using flexible membrane acrylic paints. Alternatively use a silicone or acrylic gap sealant or a caulking compound (non-acetic, neutral cure).

7. Maintaining grain quality

Store only dry, clean grain to ensure quality is maintained and a good product is retrieved. Moisture control in farm stored grain is essential. Do not store grain above 12% moisture content. If the silo is fitted with aeration fans, a higher moisture content grain can be stored. Consult a storage specialist before putting high moisture product into long term storage. To avoid problems always test the grain going into silos with a moisture meter.

Moisture migration

Silo operators often consider leaks in the silo roof or wall have caused internal moisture problems. Provided only clean grain below 12% moisture content has been stored, the moisture found in a silo headspace at the start of winter has most likely come from the activity of insects or mites present in the grain. Any moisture that is present in a silo will usually be carried upwards by the convection currents of air operating in the silo. (See diagram 3 for a typical flow pattern under a summer to winter storage regime) These air currents are created by the temperature difference between the warm grain in the centre of the silo and the cool walls or vice versa. Any population of insects, even small numbers, adds a complicating factor. Moisture and heat are released into the inter-granular spaces by their activity and feeding.

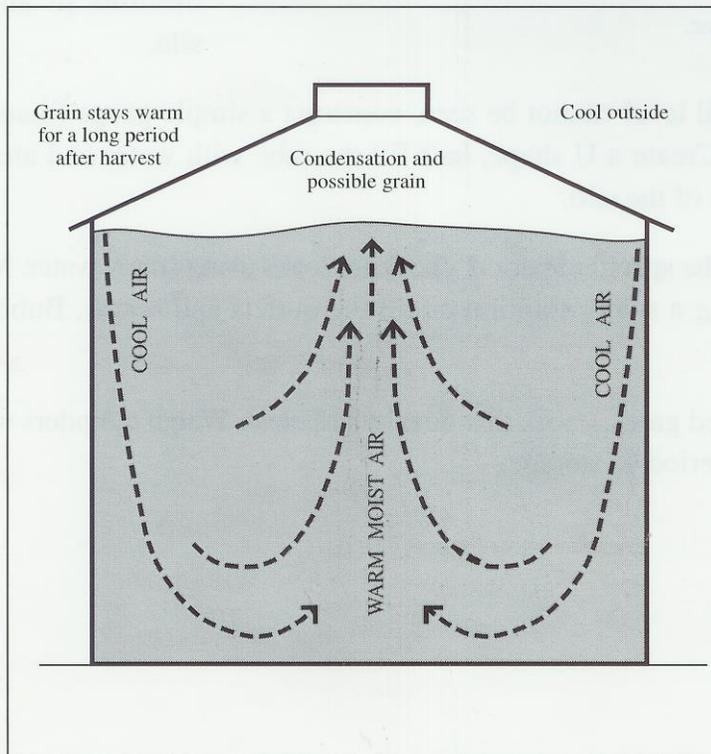


Diagram 2. Typical air circulation pattern

Moisture carried into the headspace may condense on a cold roof and drip back as free water onto the grain. This will sometimes cause a ring of germinating grain against the silo wall. Although there is always a degree of moisture migration in a silo, the increase in the upper layers is not significant if the grain is below 12% moisture content and grain insects have been controlled.

8. Loading and Unloading

Silos are designed to withstand uniform downward and significant uniform outward forces. Because of this they must only be loaded from the central

top hatch. Loading from a side hatch will unbalance the lateral forces on opposite sides of the silo. This may distort the shell of the silo, placing extreme pressure on the side of the silo holding the high side of the stack.

Lupins and Other round Grains

Lupins present a different management problem because of their lower angle of repose and the different forces they apply. The rounded seeds exert higher than normal pressures on the walls. When transferred to the lower sections of the silo wall, these forces have caused a crimping or pleating effect in older style silos not designed to withstand these loads.

9. Fumigation

Fumigation must only be carried out in a tested, well sealed silo.

Be careful with phosphine

Phosphine is lethal to all forms of life.

Read the label and follow the manufacturer's instructions carefully.

Open the phosphine container in the open air - not in a shed or silo.

Wear PVC gloves and a full face respirator fitted with particulate (P1) and phosphine gas filter cartridge (canister), when handling phosphine tablets. Have another person standing by when you are fumigating.

Do the job from the outside. Do not enter a silo unless you have to, and never enter after phosphine has been applied. Clearly mark all areas under fumigation with 'DANGER - POISON GAS - KEEP AWAY' signs. Warn all personnel on the property (particularly children) of the dangers.

Enclosed area

Wear an air supplied respirator when fumigating or working in an enclosed area that has been fumigated and not ventilated. Care must be taken when entering a silo that has been treated with phosphine.

Australian Standard 2865-1986 requires that operators must not work unprotected in an atmosphere containing in excess of 0.3ppm. Phosphine levels must be checked with gas indicator monitors.

Before entering a silo, open the top hatch and remove or loosen the lower sealing plates. Allow 7 to 10 days with through-flow ventilation to clear the gas. This is dependant on wind conditions and size of silo. Forced ventilation using aeration fans if fitted, reduces the period needed to clear the gas.

Fumigation chamber

A sealed silo is an excellent fumigation chamber. Its design enables it to hold a lethal concentration of gas long enough to control insects at all stages of their life cycle (egg, larvae, pupae, and adult).

Fumigation will fail if the silo leaks. When wind blows against a leaky silo, the "chimney effect" caused by the pressure differences draws the gas out of the silo.

Adult insects may die because they are susceptible to low concentrations of phosphine. Most eggs and larvae will survive because they are more tolerant to phosphine.

Sufficient time must be allowed to circulate the gas released from the tablets. The gas must remain concentrated for 7 - 10 days, depending on grain temperature to eliminate all life stages of the grain insect. Above 25°C, an exposure period of seven days is enough. Between 15 and 25°C, a period of 10 days is needed. Do not fumigate when grain temperatures are below 15°C or when grain moisture content is below 9. If fumigation is essential in grain below 9 moisture content, be cautious when open

the silo after fumigating. The low atmospheric moisture content may be insufficient to liberate fully, the gas from the tablets or sachets. In a silo sealed to the standard outlined in this manual, a dose rate of 1.5 grams per cubic metre of SILO CAPACITY is recommended. For example, a 100 cubic metre silo (2,750 bushel) will require a dose of 150 tablets for **EVERY** fumigation. If the silo contains only one tonne of grain the dose rate is the same -150 tablets.

10. Silo Modifications

Silo modifications, such as installing aeration must not be attempted without taking the advice of the manufacturer. Any modifications void the manufacturer's responsibility to this silo.

11. Aerating sealable silos.

When aerating grain in a sealable silo, remove the top hatches or open the exhaust vents before turning on the aeration fans. Isolate automatic aeration controllers, if they are fitted, when the silo is sealed up for fumigating. Fit sealing covers over the fan inlets and exhaust vents when testing or gassing the silo.

Six Steps to Safe Sensible Grain Storage

1 Strong, cleanable silo pad construction.

Adhere strictly to manufacturers instructions, (refer sections)

2 Clean out the silo and check annually before the new harvest.

Repair damaged or compressed rubber seals, (refer sections 5&6)

3 Store only sound dry grain.

It is vital to store grain below 12 moisture content in this silo. Cool stored grain retains its quality for longer. Use a moisture meter, (refer section 7)

4 Load only by the top hatch.

Do not load through the top side inspection hatch (if fitted) off centre loading causes uneven wall loadings. Silos not specifically designed for these loads may collapse.

5 Fumigate only in a well sealed silo. Fumigate when loading is complete or a new batch of grain is added.

Grain handling equipment is the most likely source of insect infestation. Spread phosphine tablets in a tray on top of the grain or hang sachets of phosphine in the headspace. Do not dose the grain stream or probe tablets into grain. Use the full dose rate calculated on the silo capacity every time you fumigate failure to fumigate properly allows insect survival. Fumigation is not effective in an unsealed silo.

If using CO₂ or other gasses refer to suppliers instructions (refer section 9)

6 Check the grain at monthly intervals through the top hatch.