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Silo Fires: Prevention and Control Conventional and Sealed Silos[1]

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This manual was prepared to inform Tennessee farmers and firefighters about causes, prevention and control of silo fires. The information contained herein is believed to be accurate and up-to-date. However, the University of Tennessee Agricultural Extension Service will not be responsible for accidents, injuries nor any other losses resulting from the application of practices described in this publication.

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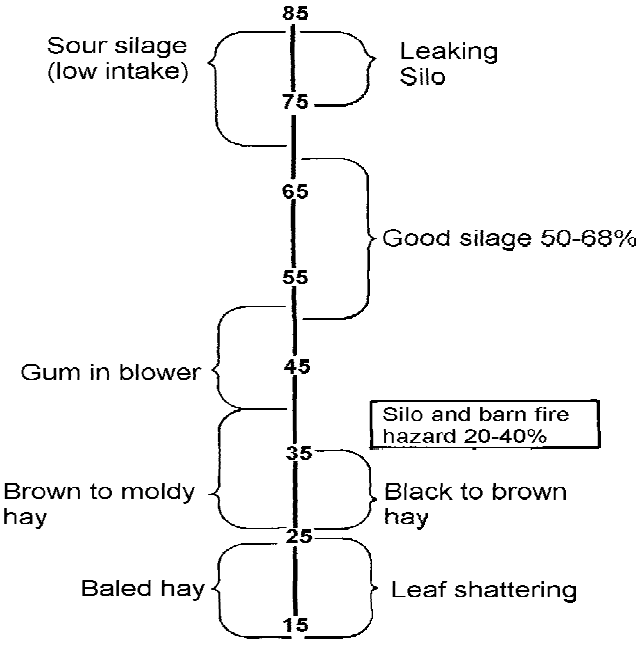
Occasionally, we hear reports of an upright or tower silo containing a fire. The majority of these silo fires are slow, smoldering ordeals that become a frustration to farmers and fire fighters. A few have resulted in raging fires or explosions, some with fire fighters being injured or killed.

A variety of conditions are possible when fires are in conventional silos. Often, the first sign of fire is a piece of burned door that falls down the chute. Other signs may be blackened or glowing red silage, smoke pouring out of the silo or a burnt odor around the silo.

Burning silage in silos can be hazardous. Know what the hazards are and act accordingly. Of course,

Table 1. Hay and Silage (Upright Silo) Moisture Levels



This chart shows results of storing alfalfa at different moisture contents. It should be drier than 68 percent moisture for upright silos. Greatest danger for silo and hay barn fires is between 30-40 percent moisture.

SOURCE: You Can Avoid Silo and Haymow Fires
Hoard's Dairyman, June 25, 1982

The University of Tennessee recommends a moisture content of 60-68 percent for silage crops stores in conventional upright silos. Consult the manufacturer for recommended moisture content if using an oxygen-limiting silo.

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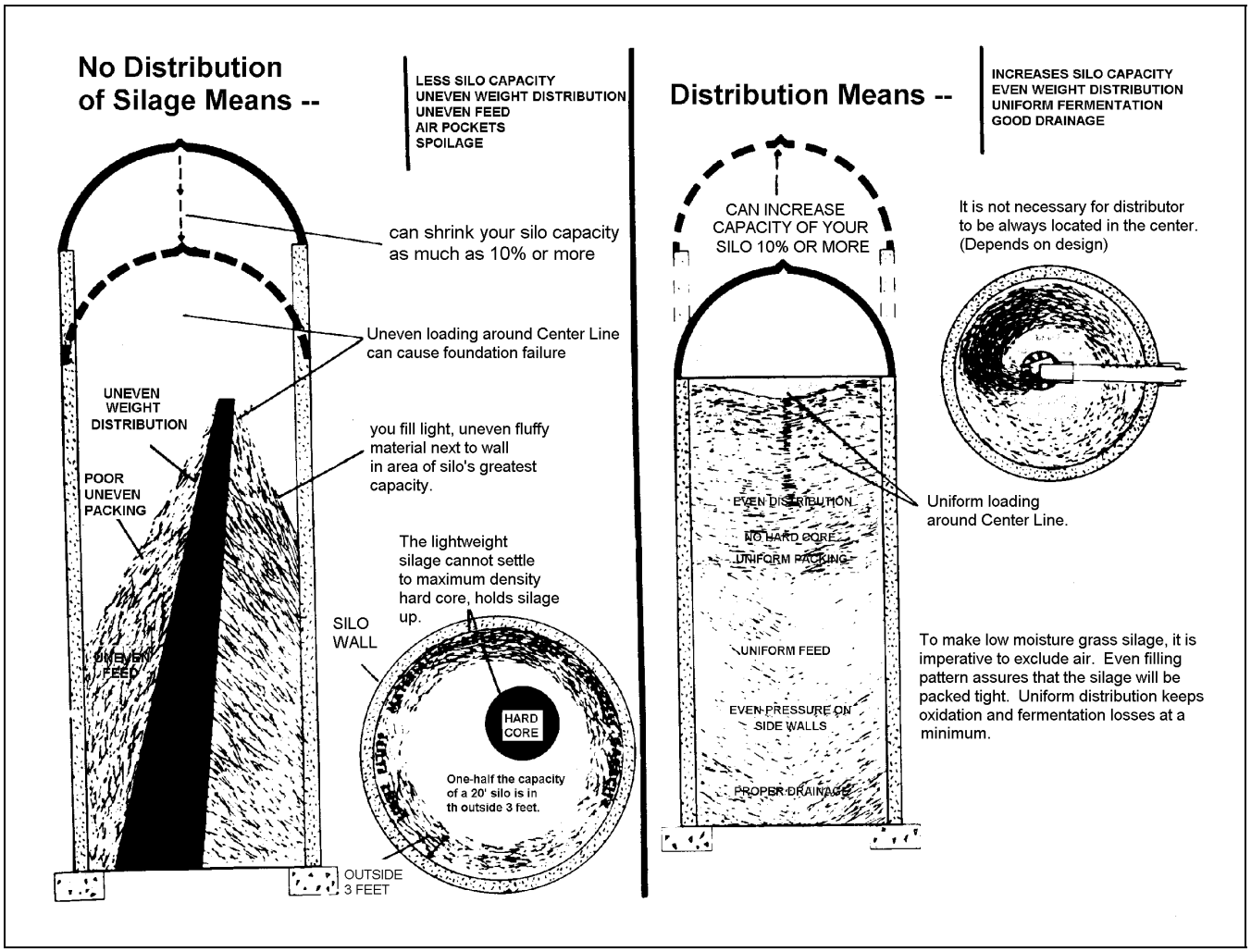


Figure 1. Proper distribution of silage reduces chances of a silo fire and results in more feed of a higher quality.

the best way of dealing with silo fires is by preventing them.

WHAT CAUSES SILO FIRES?

A few silo fires are caused by unloading equipment. Electrical problems, overheated bearings and slipping belts can ignite dust and dry materials on the equipment. Proper maintenance of the silo unloader will extend the service life of the equipment and reduce potential for fire. Refer to the equipment owner's manual for maintenance guidelines.

The more troublesome fires, however, are those resulting from spontaneous ignition within the stored silage. The leading cause of this type fire is low moisture silage and air leaks in the silo. Air enters the silo through cracks in the walls or around poorly fitting doors. Poor distribution of material during filling may result in poor compaction and contribute to fires.

Silage is formed when forage crops are allowed to ferment in the absence of air. The bacteria responsible for fermentation produce a certain amount of heat, thus silage will be fairly warm during this process. Low moisture content and the presence of oxygen may allow the microorganisms to reproduce too rapidly and generate heat faster than normal. The silage surrounding an area with excessive heat generation acts as insulation, so temperatures can climb quite high and combustion may occur.

PREVENTING SILO FIRES

The best method of dealing with silo fires is by prevention. Proper management of your forage system will prolong the useful life of the structures and equipment, produce a higher quality feed and prevent fires and other problems.

Silos should be inspected at least annually and any damage repaired. Look for structural weaknesses and

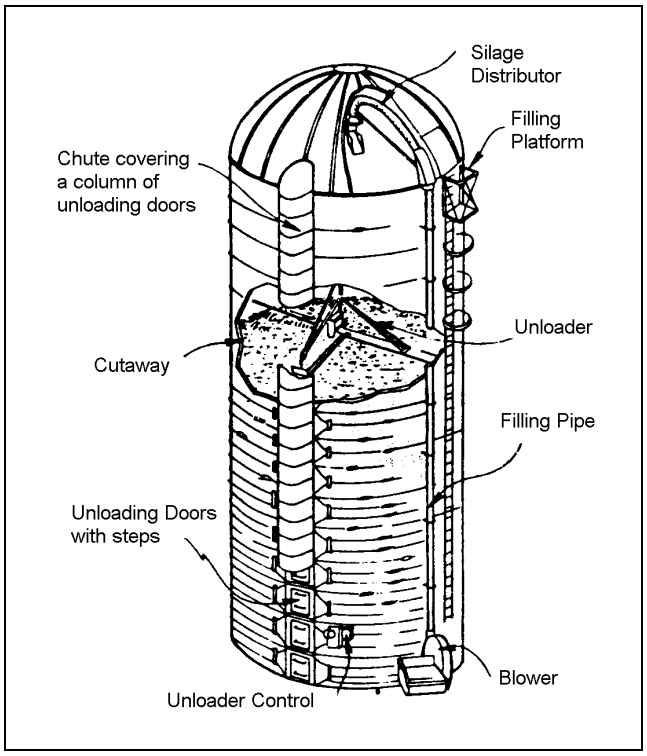


Figure 2. A typical top-unloading or conventional silo.

seal any cracks which could allow air to reach the ensiled crop materials. If the wall can be readily scratched with a coin or if scaling is detected have the wall treated or sealed. Don't forget to check the doors to see that they fit properly. Replace any doors showing signs of decay, as they could result in a fall should a step break loose when someone climbs the chute.

Harvest crops at the proper moisture content (see Table 1) and distribute the material properly inside the silo. Proper distribution results in better compaction and keeps air from reaching the feed. Proper distribution also increases silo capacity and places a more even load on the silo walls, avoiding possible structural damage (see Figure 1).

When the silo is empty, inspect and repair the unloader system. Check all belts, bearings, wiring and motors and repair any damage. Inspect and lubricate the unloader lift cable to prevent a dropped unloader. If the lift cable shows any indications of a kink, cut or corrosion, replace it immediately. Carefully examine the unloader power cable for damaged insulation and terminals. Nicks in the outer insulation may be safely repaired with electrical tape, but more serious damage will require replacement of the cable.

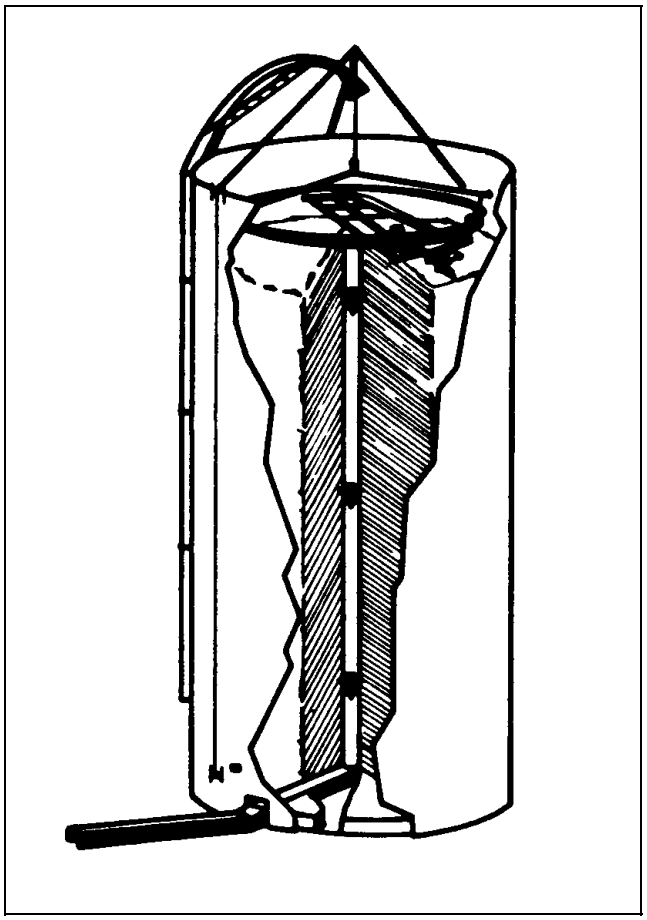


Figure 3. A conventional silo with a formed central chute leading to a conveyor at the bottom.

EXTINGUISHING A SILO FIRE

DANGER: Oxygen-limiting silos may explode if water or foam is sprayed through the top hatch or if the hatch is opened. Refer to the section on oxygen-limiting silos for recommendations.

Conventional Silo

Conventional upright silos are typically constructed of concrete staves held together by pre-tensioned steel rods (see Figure 2). Some may be built of wood, reinforced concrete, glazed tile or brick. A few oxygen-limiting silos have been converted to conventional, top-unloading type. These silos are filled and unloaded from the top. The unloader rests on the feed surface and removes a layer of silage as it rotates. A blower sends the material out one of the doors and down the outside chute for feeding.

The wooden unloading doors typically have a latch mechanism and metal rungs which serve as a ladder

inside the chute. The typical chute is approximately 36 inches wide and 28 inches deep, so
movement with an air pack or a second person (accident victim) is difficult. Some conventional silos ave an inside chute which is formed as the silo is filled (Figure 3). The top unloader operates similarly to those in other conventional silos, except the silage drops down this inside chute to a conveyor at the bottom.

When a silo fire is detected, call the fire department immediately. After the fire department is notified, farmers should attempt to close the bottom of the chute to limit air movement through it until the fire department arrives. Air moving through the chute will fan the fire. Use select metal or other non-combustible materials to close the chute.

Remove livestock and machinery form exposed and adjacent buildings. Wet the area around the silo to keep the fire from spreading. Cover openings in nearby buildings with non-combustible materials to keep out sparks or embers.

Be alert to the presence of toxic gases inside silos (see Table 2). IF only light puffs of smoke are visible, it may be safe for inspection and temperature checks without a self-contained breathing apparatus (SCBA). If there is continuing smoke or glowing embers, have the first person who climbs the chute to assess the situation wear a SCBA.

Whether fire is suspected or evident, use a lifeline and never step directly on the silage surface. Place boards, pieces of plywood or ladders on the surface to distribute weight over a larger area. This will minimize the risk of falling into a burned out cavity.

Table 2. Characteristics of Dangerous Gases That May Be Present in Silos.

Gas	Health Effects		Exposure Level Maximums*			Physical properties			Flammable Properties
	Acute	Long Term	Immediately Dangerous to Life & Health	Short-Term Exposure**	8-hour Work Day	Density (Air=1)	Color	Odor	
Carbon Monoxide (CO)	Asphyxiant		1,500	400	50	.97	Colorless	odorless	Explosive between 12.5 % and 74% by volume of air mixture. auto ignites as 1128°F (609°C)
Carbon Dioxide (CO_2)	Asphyxiant		50,000	15,000	5,000	1.52	colorless	odorless	Non-flammable
Nitrogen Dioxide (NO_2)	Respiratory Irritant	Permanent Lung Damage	50	No standard presently in effect	3	1.16	reddish brown	strong pungent	Non-flammable but will support combustion
Nitric Oxide (NO)	Asphyxiant		100	35	25	1.53	colorless	strong pungent	Non-flammable but will support combustion

* *Numbers represent parts of gas per million parts of air (ppm).*
** *Fifteen-minute exposure, maximum four exposures per eight-hour day with 60-minute intervals between exposures.*

Carbon monoxide is formed in small quantities during fermentation. Once a fire starts, however, incomplete combustion of cellulosic materials (such as silage) forms larger quantities.

Carbon Dioxide is present in small quantities in a flaming fire or after complete combustion. Carbon dioxide is non-flammable and heavier than air. At low concentrations, it is non-toxic, but at higher concentrations, it displaces oxygen and acts as an asphyxiant.

Nitric Oxide and Nitrogen Dioxide are poisonous gases which form when nitrogenous organic compounds (such as silage) burn. These gases also occur as by-products of silage fermentation. The highest levels are present during the first 48 hours after the silage is put into the silo, but dangerous levels may persist for up to three weeks. Nitrogen dioxide is the most dangerous and most likely to be present in the silo.

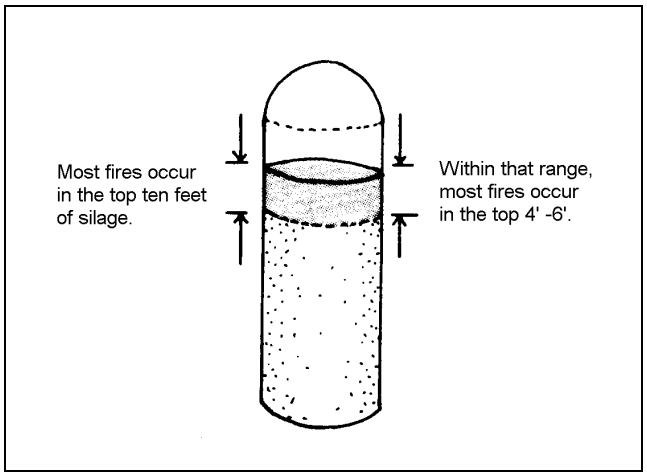


Figure 4. Location of most fires in conventional silos.

The lifeline should be tied as high as possible to a beam, hoop or other structural member of adequate strength. This can be a rope from a double bowline soling, a harness or upper "O" ring on the SCBA. Station a second person in the chute to observe and assist. Radio communication with the ground is recommended.

Auxiliary lighting is often needed in the silo. Lights can be positioned from the silo filling platform.

Step I - Size Up the Situation

Observe as many conditions as possible about the fire. The exact location may not be known. Although the fire may be anywhere within the silo, chances are it is near the top. The majority of fires occur in the top 10 feet of silage, and within this range, most occur in the top four to six feet (Figure 4). Fires often originate near the unloading doors where air leaks dry the silage, but can occur at any point where the material is too dry. The first indication of a fire is often the burning of an unloading door.

If considerable smoke is pouring out of the silo, farmers should not attempt to enter the silo or chute. This should be left to firefighters wearing full turnout gear and a self-contained breathing apparatus (SCBA).

Step 2 - Knockdown Surface Burning

By the time the fire department arrives, the silo fire may have well-established flames. Unloading doors may have burned through and flames may extend up the chute. As with any Class A fire, douse and ventilate. Water will cool the fire and keep flames from spreading.

Experience has shown that a straight tip nozzle is more effective than a fog or spray. The stream of water from a straight tip nozzle penetrates the pile and better extinguishes a fire that has become deep seated. A 3/8" tip is recommended. After the surface fire is extinguished, then procedures for extinguishing a subsurface fire are employed.

Remove unloading doors and coverings to allow hot gases, smoke and steam to escape.

Dousing is effective only if water reaches the fire, thus limiting its application to surface burning. One firefighter, in full turnout gear with lifeline and SCBA, dousing from the filling platform or from the chute is usually sufficient to extinguish all surface burning.

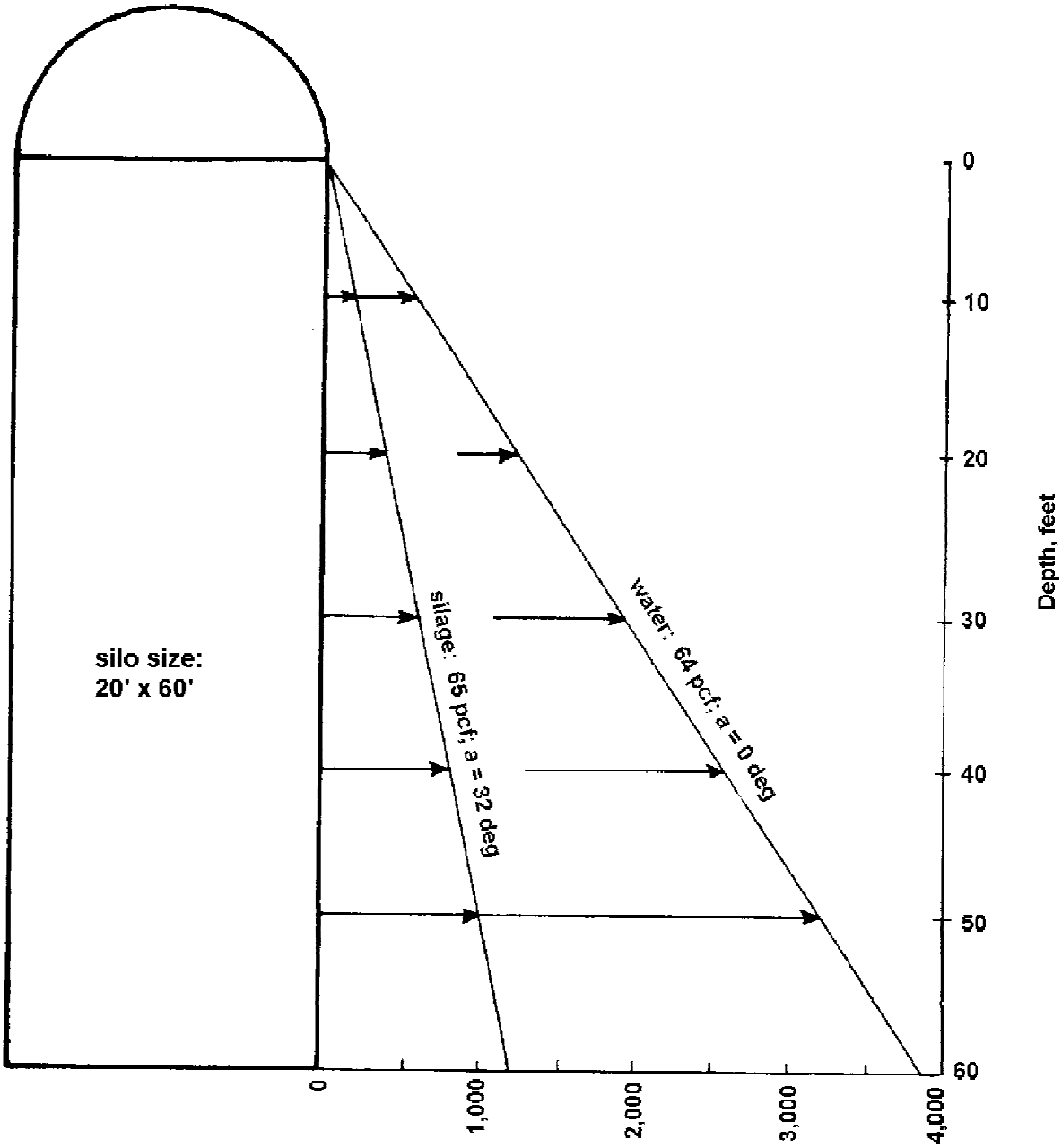
CAUTION: Do not attempt to extinguish a silo fire by pumping large quantities of water onto the surface of the silage, hoping it will soak in and cool the fire - it won't work. Water will not penetrate the silage well enough to control the fire in this manner. In addition, the silo cannot withstand the higher lateral pressure created by the water and structural damage may result (Figure 5).

Step 3 - Temperature Readings

One of the keys to extinguishing fires in a conventional silo is to find the exact location of the fire. This can be done with an easily constructed probe and a thermometer (Figure 6). Other temperature sensing devices are available which can be used alone or with the probe. Each fire department should have a probe and thermometers to locate hot spots in silage or hay.

A firefighter standing on a ladder, boards or plywood pushes the probe into a suspect area and lowers a thermometer into the probe using a light wire (Figure 7). After a few minutes the thermometer is retrieved and observed.

Make several temperature readings, starting near obvious hot spots and moving toward the silo walls at three foot intervals. If the fire is caught in its earliest stages only one hot spot may be present. However,



Lateral pressures calculated using Rankine's method of determining the equivalent fluid density, where:

L = (wh) tan (45-a/12) and;
w = material density, pounds per cubic foot
h = depth, feet
a = angle of internal friction, degrees

SOURCE: Midwest Plan Service Structures and Environment Handbook

Figure 5. Lateral pressures on silo walls for silage and water.

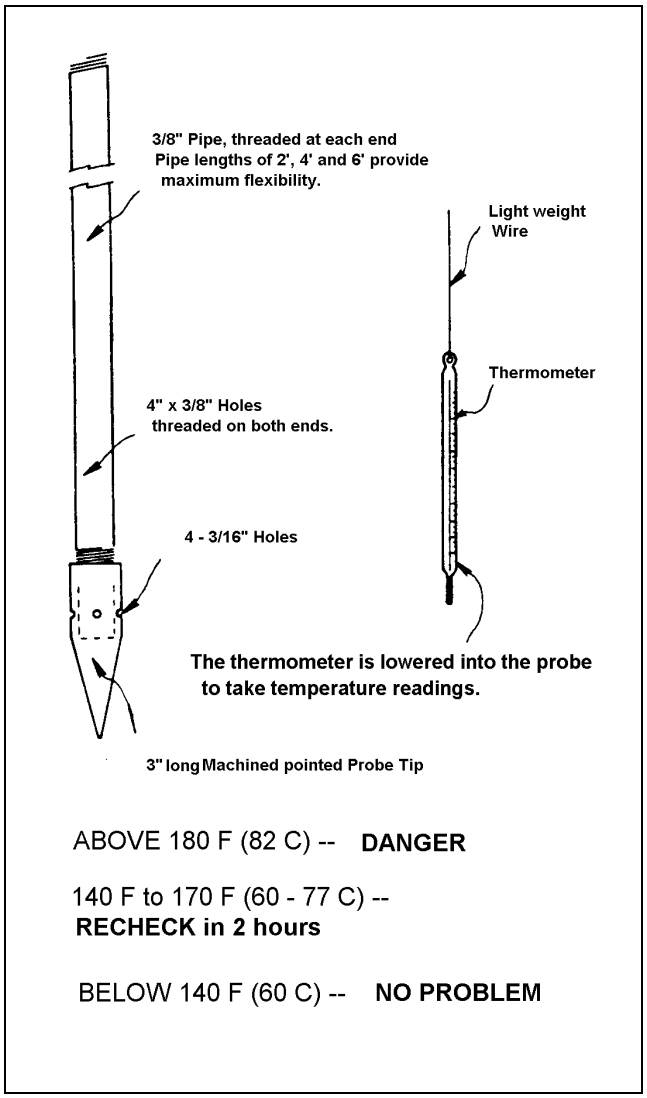


Figure 6. Probe and Thermometer

there may be several hot spots because the fire will follow air layette to support itself. Consequently, take several readings across the silage.

How deeply a probe can be pushed into the silage depends on the condition of the silage. A probe will penetrate easily into a charred or burned spot. On the other hand, it is difficult to push the probe more than 4 to 6 feet into packed, finely chopped silage.

Temperatures below 140°F indicate no particular heating problem. Temperatures of 140 to 170°F are difficult to interpret. Heat moves slowly through silage and silo walls, so readings in this range may indicate the silage is heating or it is gaining or losing heat from another hot spot. Repeat the temperature reading every two or three hours to check for dangerous heating. If the temperature is 180°F or

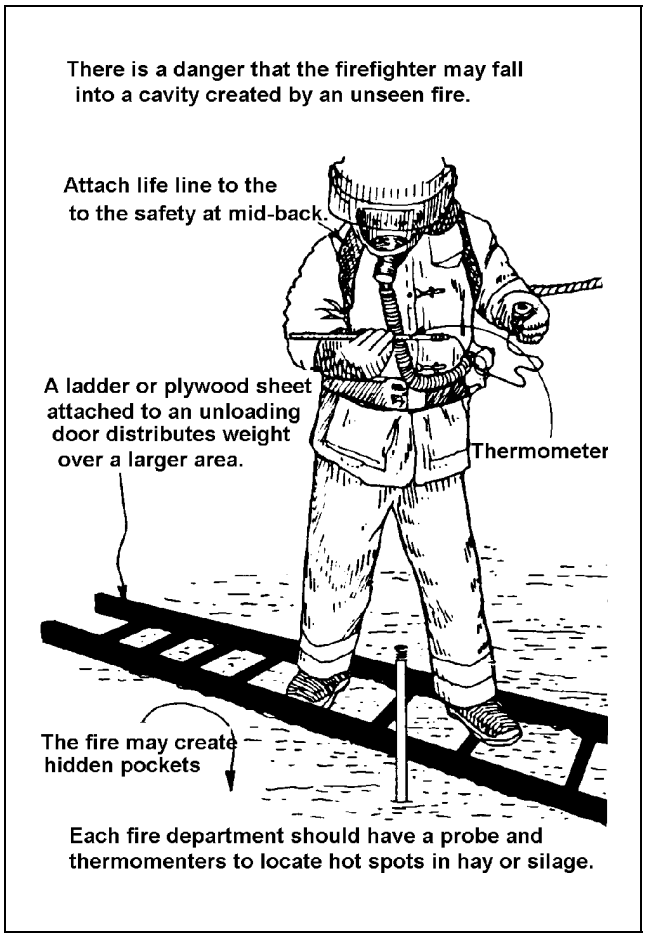


Figure 7. Probing for hot spots.

higher the silage will eventually char, smolder or burn.

Step 4 - Water Injection

After determining the location and extent of the fire, inject water directly into the hot areas using the probe. Work slowly and methodically. Leave the prove in place for several seconds to several seconds to several minutes, depending on the size and temperature of the hot spot. The goal is to cool and raise the moisture content of the hot spot to safe levels.

Water may be injected from the silo chute, especially when a door has burned through. Be prepared for considerable amounts of steam and smoke which may blow back.

The firefighters using the probe must wear full turnout gear and a lifeline. Station a second firefighter, also in full turnout gear, inside the chute to help handle the hose and assist as needed. This is especially important if the probe operator goes inside the silo.

A water gas explosion from injecting water into burning silage is not a realistic concern in conventional silos. The few explosions that have been reported from silage fires have all been in oxygen-limited silos where there was a build-up of explosive gases.

The water gas reaction occurs when water molecules react with very hot carbon to form hydrogen and carbon monoxide. The reaction is highly endothermic, or it absorbs heat, so the temperature of the material drops rapidly. Consequently, when water hits the hot silage, the instantaneous cooling effectively prevents the water gas reaction.

Another important factor practically prevents explosions in conventional silos. For an explosion to occur, there must be containment of the right proportion of air (or oxygen and an explosive gas (like carbon monoxide). There is no containment of gases in a conventional silo.

Water Additives

Fire in a silo does not change the characteristics of chemicals that may be added to water as an aid for extinguishment. Chemicals that help water to absorb heat would do the same if used on a silo fire. If mixed according to the label, there are no adverse effects to the silage. Chemicals that reduce water friction do not hurt, but are of no particular help because large quantities of water are not generally used.

Gases, such as carbon dioxide or nitrogen, may be injected into conventional silo fires in a manner similar to injecting water. The expense of these materials and cold weather problems make water a better choice. In addition, gases do not correct the major cause of silo fires - dry material.

Step 5 - Unload the Silo

Unload the damaged silage because:

- overheated silage loses its nutritional value
- the wetted silage will spoil
- any hot spots which were missed or not cooled sufficiently may ignite

There is a section later in this manual which covers some of the problems or potential hazards to consider when unloading the silo.

Advanced Fires in Conventional Silos

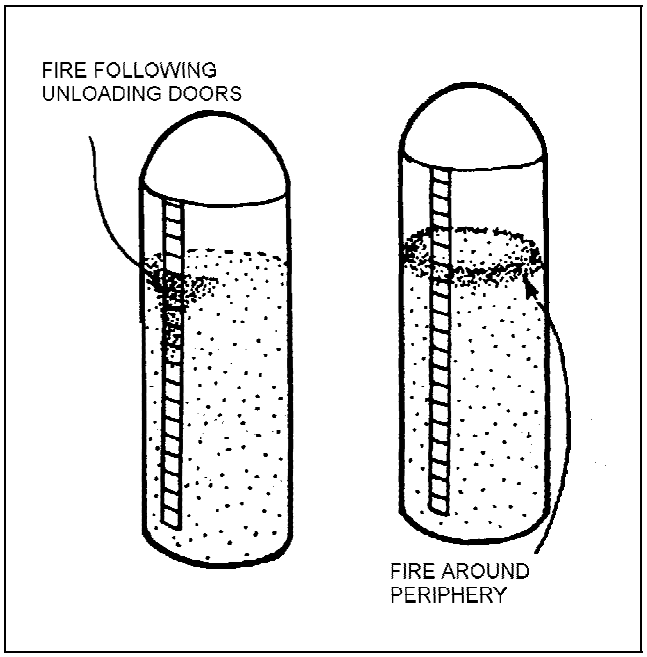


Figure 8. Typical types of advanced burning in conventional silos.

A silo fire may smolder or burn for days or even weeks before discovery. A silo fire in the advanced stages rarely remains below the surface or deep within the mass of silage. Instead, it travels horizontally toward the walls of the silo or vertically to the upper surface of the silage (Figure 8).

Silage shrinks as it dries and becomes excellent fuel for a fire. There may be an air space as much as several inches wide between the silage and the silo wall. Unloading doors in a conventional silo often leak air and permit a column of silage to dry and shrink for some distance down the silo. This leaves a column of dry fuel along the doors.

When fire reaches any of these areas of dry fuel and abundant air it burns freely rather than smoldering. If this occurs, attack the surface fire before attacking the subsurface fire.

Experience has shown that a straight tip nozzle is more effective than a fog nozzle on silo fires. The solid stream of water from a straight tip penetrates the burning material better. A 3/8 inch tip is recommended.

Fire Along the Unloading Doors

Fire along the column of dry silage behind the unloading doors is the most common example of advanced burning in a conventional silo. Attack these fires as follows:

1. Follow good safety practices. Wear full turnout gear, SCBA and a lifeline if possible. Do not enter the silo unless absolutely necessary. Instead, work from inside the chute.

2. Extinguish all surface burning through burned-out openings in the doors. The doors usually have openings that have burned through, allowing access to the fire. Chopping through a door that is not burned will be most difficult in the confines of the chute and is probably not necessary.

3. Extinguish all subsurface burning using short probes inserted in the silage in all directions. This, too, can be done through burned-out door openings.

4. After the fire is extinguished, replace burned doors with new or rebuilt ones. Backfill dampened silage into burned-out cavities and level the top surface of the silage so the farmer can immediately begin the unloading process.

NOTICE: In some cases the fire may be so advanced that extinguishing the fire is impractical. For example, if the fire started near the bottom of the silo and has progressed to the top of the chute as well as several feet back into the silage, it may be best to allow the fire to burn out on its own. It is possible to put out the fire, but it may reignite and unloading will be dangerous. If it is determined to allow the fire to burn out, take steps to prevent spread of the fire. Be aware that the fire may smolder for several weeks or months.

Fire in a Horizontal Pattern

The next most common example of an advanced fire is burning around the silo wall. The burn pattern is usually a trench-like burned area around the silo three or four feet deep. Attack these fires as follows:

1. Extinguish all surface burning using a straight tip nozzle. Start the knockdown just inside the nearest unloading door, advancing half way around the ring. Retrace your path and work your way around the other half of the ring until you reach the far side. You must:
   a. lay planks or other support to walk on
   b. wear full turnout gear and SCBA
   c. use lifelines

2. Extinguish all subsurface burning using probes.

3. Backfill with dampened silage and level the surface to prepare for unloading.

Oxygen-Limiting Silos

Oxygen-limiting or "sealed" silos are exactly what their name implies. Properly managed silos of this type contain very little, if any, oxygen. This is intended to keep spoilage to an absolute minimum, resulting in a higher quality feed. Oxygen-limiting silos have no outside chute and unload from the bottom (Figure 9). Top hatches and unloader doors are to remain closed except when they are being used. The most common brand of oxygen-limiting silo in Tennessee is Harvestore.

Spontaneous ignition fires in oxygen-limiting or "sealed" silos are rare, but they can occur with improper management. The basic rule for these silos is to keep all openings closed, except when filling the silo or operating the unloader. Excluding air preserves the silage and prevents fire. Even with drier silage at 45 percent moisture content, there is usually insufficient oxygen to support a fire after an oxygen-limiting silo is filled and sealed, A slow charring fire will sometimes suffocate due to insufficient oxygen.

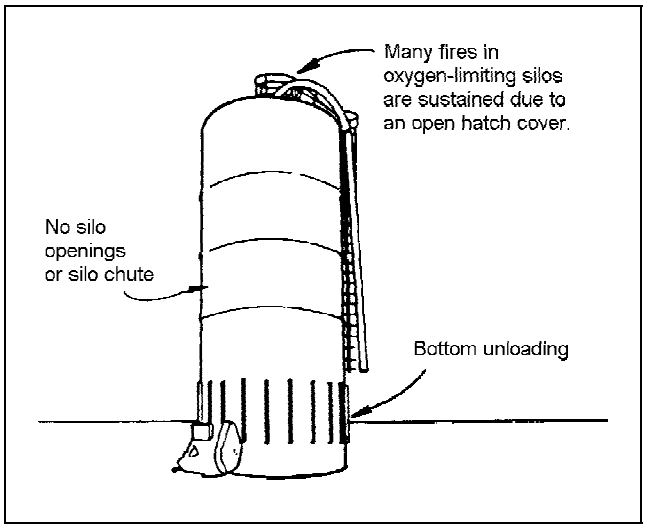


Figure 9. Oxygen-limiting or 'sealed' silos.

A fire in an oxygen-limiting silo is potentially very dangerous. There have been explosions when firefighters attempted to extinguish the fires. To prevent explosions, do nothing that could allow oxygen to enter the silo. Follow proper procedures for maximum safety.

The airspace above the silage in an oxygen-limiting silo will contain smoke and carbon monoxide along with other gases and some oxygen during a fire. Any action which introduces additional oxygen may produce an explosive atmosphere which may be ignited by the burning silage. If this occurs, the pressure created by the burning gases cannot be vented through the top hatch and an explosion will result.

DO NOT USE WATER OR FOAM to fight a fire in an oxygen-limiting silo. Opening the top hatch to apply water or foam will allow oxygen to enter. The stream of water or foam will carry large amounts of air into the silo. In addition, the steam formed when the water reaches the fire may also contribute to an explosion. Signs to warn of this danger are available (Figure 10).

Fires in oxygen-limiting silos are discovered if burnt or burning material comes out the unloader, or if smoke is escaping from the top hatch. When a fire is discovered, seal the unloader opening or hatch. Next, seal all openings such as manhole covers and drain caps used for maintenance.

Figure 10. Warning sign for oxygen-limiting silos.

If the silo is cool and quiet, and if minimal smoke is escaping, carefully climb the silo and close the top hatch or any other openings. Do not lock or latch the top hatch. Closing the hatch will prevent oxygen from entering the silo, yet pressure increases can be relieved safely.

Leave the silo closed for up to three weeks to allow the fire to use all oxygen and self extinguish. During this time, make temperature readings of weekly samples from the unloader to be sure the fire is extinguished.

If the silo is producing considerable smoke or steam, or if the silo is rumbling, leave the hatch alone. Closing the hatch on an active fire could bring carbon monoxide and air mixtures into the explosive range.

If sealing the silo does not extinguish the fire, inject nitrogen or carbon dioxide to displace oxygen and cool the fire. Be careful not to introduce additional oxygen. Most oxygen-limiting silos have pipe nipples for injecting these gases. These nipples should be inspected annually to insure they are open and useable. If nipples are not present, have the farmer install one or have one installed by the manufacturer or dealer. Table 3 lists the amounts of gas needed for various sized silos.

To Inject Gas Into a Sealed Silo

1. Remove cap from the pipe nipple.
2. Connect reducers, bushing, shut-off valve and other fittings as required to connect the silo nipple with the appropriate regulator using a number 88 hose.
3. For nitrogen use an 8-580 or IL-580 regulator. For carbon dioxide, use an 8-320 or IL-320 regulator.
4. Set the regulator to 40 psi. Open all valves and inject gas into the silo.

Depending on the quantity and quality of silage remaining, the silo may need to be emptied after the fire cools. With a small amount of poor quality silage, the fire may re-ignite after the carbon dioxide or nitrogen escapes. Fire is not likely to restart if a large amount of good quality silage remains. In any event, do not refill the silo until the silo has been inspected and any repairs made.

Table 3. CO_2 or N_2 Quantity Required to Extinguish Fires in Oxygen-Limiting Silos

Silo Size dia x ht (ft)	CO_2 no. 50 lb. cylinders	N_2 no. 50 lb. cylinders
20 x 60	20	40
20 x 70	22	44
20 x 80	30	60
24 x 60	30	60
24 x 70	35	70
24 x 80	40	80
30 x 60	45	90
30 x 70	50	100
30 x 80	60	120

SOURCE: NRAES-18, Extinguishing Silo Fires

AFTER ANY SILO FIRE

1. If safe to do so, unload spoiled or damaged feed and dispose of in an appropriate manner. Spreading in a safe area (such as a plowed field) with a manure spreader is one possibility.

2. Inspect the silo for damage which may have caused the fire or which may be a result of the fire.

3. If structural damage is suspected, have the manufacturer or dealer inspect the silo and follow their recommendations. Damaged bottom unloading silos could collapse during emptying unless strengthened first. Heavily damaged silos may have to be replaced.

4. Follow steps to insure that the forage system is managed properly to prevent future silo fires.

UNLOADING

Unload the damaged silage because:

1. Overheated silage loses its nutritional value.
2. Silage wetted during fire control measures will spoil.
3. Any missed hot spots may ignite and burning areas not cooled sufficiently may reignite.

HEAT DAMAGE

Silage that has been heated above 15O°F loses much of its nutritional damage. Any charred silage will have very little feeding damage. Smoke which permeates the feed will affect its aroma and taste. Cows may or may not eat heat or smoke damaged silage. The only way to determine the quality of silage is to have it tested. Contact your county Extension agent for information about forage testing.

Silage below the fire level probably will not be damaged and will not have lost any nutritional value.

WATER DAMAGE

Silage saturated with water will mold and spoil because much of the preserving acids produced during fermentation are leached out. Nutritional value of saturated silage is reduced and cows may refuse to eat it.

REIGNITION

It is possible to completely extinguish conventional silo fires, but it is also possible to miss some hot spots. If hot spots are missed or only partially cooled, they can dry out and ignite. Injecting water tends to loosen silage fibers and create air spaces within the silage. If the hot spot is only partially cooled, the extra air may help re-ignite the fire.

UNLOADING PRECAUTIONS

As layers of silage are removed, take additional temperature readings and examine the silage to determine its condition. In most cases, it has been necessary to unload silage to just below the unloading door that has burned through. Unloading below this level is necessary if there are hot spots, heat damaged silage or water damaged silage.

Most unloaders are not intended for continuous operation and the motors will overheat unless allowed to cool every half hour. As silage is removed, exposing hot silage could cause a fire as well. While the unloader motor is cooling, probe for hot spots and inject water as needed.

STRUCTURAL DAMAGE

In most silo fires there is little, if any, structural damage. If the fire is allowed to rage out of control it is possible the concrete may crack, but this is usually not the case. Slow burning fires seldom damage concrete, but may damage the inside coating or lining.

Applying a water fog to the outside of a silo is not recommended by silo manufacturers. This practice causes more structural stress than natural cooling. The result could be more damage than doing nothing at all. It is said that there is no danger of structural collapse even when small areas of the silo become so overheated that they glow.

Always inspect a silo and repair damage after any silo fire. The silo dealer or manufacturer and your insurance agent can provide assistance.

FIRES OUTSIDE THE SILO

There is some question whether a fire outside the silo can ignite silage. This can happen with large, hot fires or if sparks manage to enter the top of the silo and ignite any dry material. Outside heat is not readily transferred to the silage inside. In many instances a silo and the silage can be saved, even though an adjacent barn is a total loss.

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Bruhn, H. D. and Koegel, R. G. 1985. You Can Avoid Silage and Haymow Fires; Hoard's Dairyman, June 10, 1985; pg. 653.

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Murphy, Dennis and Arble, William. 1986. Extinguishing Silo Fires; NRAES-18; Northeast Regional Agricultural Engineering Service, Riley Robb Hall, Cornell University, Ithaca, NY 14853.

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Professional Design Supplement to the MWPS Structures and Environment Handbook, MWPS-17, Fifth Edition. 1978. Midwest Plan Service, Iowa State University, Ames, IA 50011, pp 62-66.

Silo Operator's Manual. 1972. International Silo Association, Inc. (formerly National Silo Association, Inc.), 1163 E. Ogden, Suite 705-359, Napierville, IL 60540.

APPENDIX

Silo Capacity Chart

The amount of dry matter a silo holds depends somewhat on the kind of feed but more on fineness of chop, type of distribution and speed with which it is filled. For this reason, we have determined the average dry matter capacity of most size silos finely chopped and well distributed, with a given dry matter for a given size silo (see Table 4). The total tonnage in the silo depends largely on the moisture content.

For capacity at a different moisture content, use the following formula:

$$\frac{\textit{Tons Dry Matter (from chart)}}{1.00 - \textit{desired moisture content}} = \textit{Tons in silo at desired moisture content}$$

Example:

How may tons of 60% moisture silage in 24' x 60' silo?

$$\frac{228}{1.00 - .60} = 570 \textit{ tons } 60\% \textit{ moisture silage}$$

SOURCE: Silo Operator's Manual

Table 4. Silo Capacity Chart

Size	Cu. Ft.	Dry Matter	Approximate Tons Silage 50% Moisture	Approximate Tons Silage 65% Moisture	Size	Cu. Ft.	Dry Matter	Approximate Tons Silage 50% Moisture	Approximate Tons Silage 65% Moisture
12 x 30	3390	21	42	60	22 x 60	22800	192	384	549
12 x 40	4520	31	62	88	22 x 70	36600	241	482	690
12 x 50	5650	42	84	121	22 x 80	30400	299	598	853
14 x 30	4620	29	58	82	24 x 50	22600	174	348	497
14 x 40	6160	43	86	123	24 x 60	27120	228	456	651
14 x 50	7700	60	120	171	24 x 70	31640	288	576	823
14 x 55	8464	70	140	201	24 x 80	36160	360	720	1027
16 x 30	6030	38	76	109	26 x 50	26500	206	412	590
16 x 40	8040	56	112	161	26 x 60	31800	270	540	771
16 x 50	10050	76	152	218	26 x 70	37100	339	678	969
16 x 60	12060	101	202	288	26 x 80	42400	429	858	1226
18 x 40	10160	72	144	206	30 x 50	35300	270	540	771
18 x 50	12700	96	192	274	30 x 60	42360	363	726	1037
18 x 60	15240	128	256	365	30 x 70	49420	470	941	1344
18 x 65	147	294	421		30 x 80	56480	594	1188	1697
18 x 70	17780	161	322	459	30 x 90	63540	771	1542	2203
20 x 40	12560	90	180	256	36 x 60	61020	533	1066	1522
20 x 50	15700	118	236	339	36 x 70	71190	686	1373	1961
20 x 60	18840	158	316	452	36 x 80	81360	891	1782	2546
20 x 65	20410	183	366	523	36 x 90	91530	1041	2082	2974
20 x 70	21980	199	398	568	40 x 60	75360	679	1358	1939
20 x 80	25120	245	490	700	40 x 70	87920	859	1718	2455
22 x 40	15200	109	218	312	40 x 80	100480	1108	2216	3165
22 x 50	19000	151	302	433	40 x 90	113040	1301	2602	3717

SILO MANUFACTURERS

The following manufacturers are known to be currently active in Tennessee (as of Feb. 1, 1988). Several companies with structures in Tennessee have gone out of the silo business.

After any silo fire or other occurrence which may cause damage to the silo, such as a lightning strike, contact the manufacturer and your insurance agent for assistance.

Monteagle Silo Company, Inc.
Post Office Box 798
Monteagle, Tennessee 37356-0798
615-924-2241
(concrete stave silos)

Memphis Concrete Silo
Post Office Box 12636
Memphis, Tennessee 38112
901-452-5416
(concrete stave silos)

Mast-Lepley Silo Company, Inc.
10641 Highway 36
Covington, Georgia 30209
ATTN: Sam Hay, Jr.
404-786-3031

Clay and Lambert Mfg.
Highway 146 and 393 at 1-71
Buckner, Kentucky 40010
502-222-1411
(galvanized steel silos and a high-moisture grain bin sometimes used as an oxygen-limiting silo; makers of Herd King silos)

Dye Enterprises
855 Snowdoun Chambers Road
Montgomery, Alabama 36105
205-288-5348
(concrete stave silos)

George W. Whitesides Company, Inc.
3048 Muhammad Ali Boulevard
Louisville, Kentucky 40212
502-778-4493
(does not build silos, but manufactures silo coatings)

International Silo Association, Inc.
1163 E. Ogden
Suite 705-359
Napierville, Illinois 60540
312-369-4120
(industry association; source of information)