

<p style="text-align: center;">TOWNSHIP FIRE DEPARTMENT CHAPTER 2: STANDARD OPERATING GUIDELINES</p>
<p>Part 1: Response Guidelines Subject: Silo Fires Page 1 of 4 Effective Date: 05-01-96</p> <p style="text-align: right;">Section: 2-1-22 Revised Date:</p>

Part 1: Response Guidelines

Subject: Silo Fires

Page 1 of 4

Effective Date: 05-01-96

Section: 2-1-22

Revised Date:

22.01 Purpose. To provide a written guideline for handling silo fires.

22.02 Goal. To provide a safe method for firefighters to fight silo fires.

22.03 Equipment Response. A single station response, Code 1, unless a structure fire is indicated.

22.04 Rationale.

- A) Plant material continues to "breathe" for a short time after cutting. This respiration produces some heat in storage. Then organisms, in the process of producing acids necessary to ensile the material in a silo, produce heat as well. Due to this process and the right moisture content, spontaneous combustion occurs in a corn filled silo.

- B) A hay crop that is placed too dry (below 40% moisture) into a silo will rapidly heat. If the silo is so large that heat loss is restricted, the internal temperature will rise. As the temperature rises above 130 degrees, a chemical reaction called the Maillard Reaction occurs and may sustain itself. The heat kills the micro-organisms at 250 to 400 degrees and begins to break down the hay crop by chemical reaction called pyrolysis. The Maillard Reaction does not require oxygen, but the flammable gases produced by pyrolysis are at a temperature above their ignition point. These gases will ignite when they come in contact with oxygen.

- C) Fire usually occurs approximately 10 - 20 feet below the surface of the stored material.

22.05 Size-Up.

- A) Locate silo.

- B) Determine type.

Subject: Silo Fires

Page 2 of 4

Date: 05-01-96

- C) Determine silo location in relation to other buildings.
- D) Firefighters in full turnout gear and functioning SCBA should attempt to locate fire.
- E) Be aware of the possible presence of silo gas.
- F) If the fire is not on top of the filled material DO NOT put water in the silo.
- G) If the fire is not visible, the location must be obtained before attempting extinguishment.
- H) Observe cracks along unloading doors to see if fire is visible.
- I) Whether a fire is known to exist or just suspected, do not step directly onto silage. Instead lay a ladder across the silage with one end on the unloading door frame. The ladder will distribute weight over a larger area and minimize the risk of falling into a cavity the fire may have created.
- J) Tie any person entering the silo to a rope or harness with the life line attached to the beam or structure above. Also station a person on the silo blower platform or chute to observe the silo interior.
- K) Find the exact fire location with a probe and thermometer. Mark off the surface in one (1) foot squares. Insert the probe and thermometer in each square. When hot spots are found inject a small amount of water.
- L) If temperature readings are near 180 degrees or higher, the material will eventually burn. Temperature readings of 140 to 170 degrees may indicate that the silage is heating or it may indicate residual heat from a hot spot that is conducting through the silage.

22.06 Extinguishing the Fire.

- A) When hot spots are found, a small amount of water is injected through the hay probe, one or two quarts at a time.
- B) Wait until the rumbling quits and then inject another one or two quarts of water.

- C) If there is no rumbling, move the probe to another square and repeat the process.
- D) This process is continued until the entire surface of the material has been probed.
 - 1. Water expands 1700 times as it converts to steam.
 - 2. Too much water and heat in a confined space will cause a BLEVE.

Example: One (1) gallon of water converted to steam will produce 1700 gallons of steam.

- 3. Convert this to cubic feet:
 - a) Seven and one-half gallons of water equals one cubic foot.
 - b) One cubic foot of water equals 1700 cubic feet of steam or a volume equal to 10' x 10' x 17'.
 - c) Two quarts of water converted to steam will fill a space equal to 113.33 cubic feet.
 - d) Two quarts of water times 1700 equals 850 gallons of steam.
 - e) 850 gallons of steam equals 133.33 cubic feet or a container approximately 2 feet by 10 feet by 5.5 feet in size.
 - f) A 16 foot by 60 foot silo has a capacity of 12,063.74 cubic feet.
 - g) If 2000 gallons of water were pumped into a silo in an attempt to extinguish the fire, it would create 453,333.32 cubic feet of steam or 37 times the silo capacity.
 - h) The dangers of explosion are obvious, therefore extreme caution must be exercised in fighting this type of fire.

22.07 Oxygen Limiting Silos.

- A) A fire in a oxygen-limiting silo is potentially very hazardous. If improper extinguishing techniques are attempted, a devastating explosion could result. In this type of silo fire there is containment of explosive gases, and there may be sufficient heat or flame to ignite the gas. In all likelihood, the only thing preventing an explosion is insufficient oxygen.

Subject: Silo Fires

Page 4 of 4

Date: 05-01-96

- B) Nothing should be done that might increase the level of oxygen inside the silo. Opening the top hatch cover to dump water or foam might allow enough oxygen to be pulled in to put the gases into their explosive range. Even air entrained within water droplets and foam particles can increase the danger.

- C) Liquid nitrogen or carbon dioxide may be injected to displace oxygen and cool the fire. A small hole drilled in the silo wall and a tube or probe hooked to the gas line will allow the nitrogen or carbon dioxide to enter the silo. Be careful that additional oxygen is not pulled into the silo by this process. Some silos have valves specifically designed to inject gases for fire control. If a fire should occur in an oxygen-limiting silo, call the dealer immediately for assistance.

- D) Leave and open roof hatch alone if there is any smoke or steam coming out of the top or if the silo is shaking or rumbling. If the silo is quiet and there has been no visible smoke for several hours, it should be safe to close the top hatch cover. Do not tie the cover down though. If gas pressure subsequently builds beyond the relief capacity of the breather valve, the cover can lift to relieve the pressure.