



HAY STORAGE FIRES

HOSTA Task Sheet 3.7.2

NATIONAL SAFE TRACTOR AND MACHINERY OPERATION PROGRAM

Introduction

Barn fires destroy property, stored crops, livestock, as well as cause a loss of revenue. Thousands of dollars can be lost as a result of barn fires. Investigations pinpoint many causes of these fires. Barn fires are a result of “spontaneous combustion,” electrical malfunctions, poor housekeeping, and careless work habits.

Plant material (hay and straw) continues to respire (produce oxygen) for a short time after it is stored. Plant respiration and bacterial action creates heat as the plant oxygen is used up. Too much heat generated causes combustion.

This task sheet discusses recognizing hay fire risks and the proper handling of a hay crop as a means of preventing fires caused by spontaneous combustion.

The Chemistry of Hay Fires

Fresh cut forage crop cells continue to respire until the crop material dries or is cured. This chain of events occurring within the forage depends upon many factors. Moisture content is the most critical and is the only influence discussed from a fire safety standpoint.

Hay placed in storage should have a moisture content under 25%. Higher levels of moisture require

an oxygen limiting storage system. The heat generated by the crop plus the presence of oxygen increases the risk of a fire.

Drying or curing of the forage takes several weeks, but the risk of fire in stored hay usually occurs within two to six weeks of storage. Stored hay of normal moisture levels undergoes some heating, but the heat is normally less than 125 degrees F. See Table 3.7.2.a. on page 2 of this task sheet.

Some hay growers apply chemical or biological additives and preservatives to the hay at harvest time to increase the rate of field drying or to bale and store the hay at higher moisture levels. The hay may still heat in storage.

Note: Stored cured hay can become damp due to a leaky barn roof, from ground moisture, or from high humidity and can still burn due to spontaneous combustion.



Figure 3.7.2.a. Hay storage fires result in devastating damage. The building, crop, and livestock losses can be tremendous, as well as the loss of income-producing facilities.

Store baled hay when the hay has less than 20% moisture.

Learning Goals

- To understand that improperly stored hay can ignite by spontaneous combustion
- To learn how to prevent hay storage fires
- To understand what to do if stored hay is getting too hot.

Related Task Sheets:

Fire Safety	3.7
Fire Prevention and Control	3.7.1

Table 3.7.2.a. Critical temperatures, conditions, and actions to take with hot hay according to the NRAES-18 publication. See the Reference Section of this task sheet.

An experienced worker should monitor rising temperatures in hay storage, not a youth worker.

Temperature	Condition and Action
125°F	No action needed.
150°F	Temperature will most likely continue to rise. Check temperature twice daily. Move hay to allow air circulation to cool the hay.
160°F	Check temperature every few hours. Move hay to allow air circulation to cool the hay.
175-190°F	Hot spots or fire pockets are likely. Alert fire service of a possible hay fire incident. Stop all air movement around the hay. Remove hot hay with assistance of fire service personnel.
200°F or above	Fire is present at or near the temperature probe. Inject water to cool hotspots before moving the hay. Fire service should be prepared for hay to burst into flame when contacting the air.

Hazards of Hay Fires

Three potential hazards exist from hay fires. They are:

- Sudden flareups of flame with exposure to fresh air
- Burned-out cavities in the hay that present a fall or entrapment hazard
- Toxic gases

Let us examine each of these in more detail.

Flareup of flame:

At temperatures between 150 and 170 degrees F the potential for spontaneous combustion of hay increases. Hay in this temperature range should be moved to allow for cooling. At the higher end of this temperature range, moving the hay exposes the heated material to oxygen and a sudden flareup can

occur. Fire service officials should be notified if possible. Always have a charged water hose available.

Burned-out cavities in the hay:

Deep within the stored hay mass, temperatures may have reached levels where the hay has already burned. This burning has been a smoldering fire. Hollow cavities may have formed. These cavities can entrap a person who collapses the top of the hay pile by walking over it.

To prevent entrapment in burned-out cavities, place a wooden plank over the hay before walking over the area. A rope harness tied to a secure location is also recommended. Falls into a burned-out cavity may lead to broken bones, burns, and lung damage. Since the hay may have been chemically treated, a trained fire

service person with a self-contained breathing apparatus (SCBA) should be called upon to provide the assistance needed in solving the potential fire problem.

Toxic gas exposure:

Smoldering and burning hay can be the source of toxic gases. Carbon monoxide can be concentrated within the smoldering fire and surrounding area. Chemically preserved hay crops may produce toxic gas vapors. Deadly gases add to the fire risk.

Crop preservative Material Safety Data Sheet (MSDS) information should be available to fire service personnel.

Note: The young farm worker should not be assigned to monitor temperatures of hay in storage. This poses an unnecessary risk to the inexperienced worker.

Monitoring Hot Hay

Smoldering hay gives off a strong, pungent odor. This odor indicates that a fire is occurring. At this point, stay off the hay, as a burned-out cavity may be found beneath where you would be walking.

The first reaction is to remove the heated hay. The temperature of the hay must be known before removal occurs. At lower temperatures, removing hay helps to move heat away from the hay by normal ventilation. When stored hay reaches 175 degrees F, any increased ventilation could result in rapid combustion.

Hay temperatures must be monitored. An experienced person should do this. Close coordination with a local fire service is of importance should the hay temperatures continue to rise.

Preventing Hay Fires

To prevent hay fires in storage areas, follow these approved practices to reduce the potential for forage crops to heat in storage.

Harvest Practices:

To reduce crop moisture levels rapidly, mow the forage early in the morning to allow one or more full days of drying time before baling. Storing dry hay reduces the risk of overheating.

Conditioning Practices:

Although it is difficult to achieve, the best weather conditions for hay curing is less than 50% relative humidity with some wind move-

ment. Monitor the weather conditions and predictions to help schedule haymaking operations.

Hay mower conditioners, or crimpers, crush the forage stem and speeds the drying time of the crop. Windrow inverters, tedders, and hay rakes also speed the drying process. Each haying operation can shatter leaves from the stem and reduce the quality of the hay.

Chemical drying agents and preservatives may help to condition the forage crop. These materials can be used to speed up field drying rates. Most additives and preservatives increase the moisture level at which the forage can be safely preserved. Inoculant and acid-based preservatives increase the safe hay baling moisture levels to 25-30%. Spontaneous combustion ignition temperatures may be avoided when using these materials, but internal heating of the forage may cause heat-damaged protein. Heat-damaged protein reduces the nutritional value of the feed.

Baling Practices:

Bale the hay at 18-20% moisture to reduce the risk of conditions that support spontaneous combustion.

Storage Practices:

Store hay under cover to prevent rain damage and potential for heating. Leaky roofs and plumbing leaks can increase moisture levels of the stored forage to a point of reheating, which may lead to spontaneous combustion.

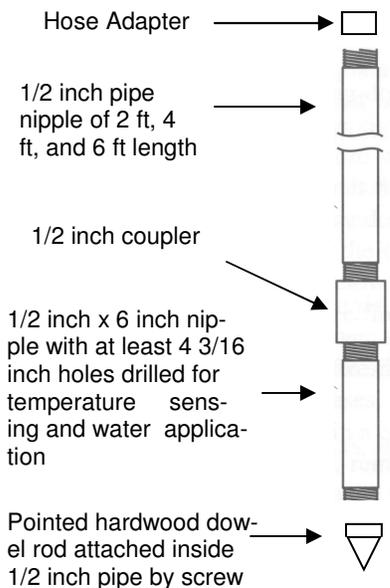


Figure 3.7.2.b. A homemade probe can be easily constructed.

Prevention of hay storage fires begins in the field with sound crop management.

Hay Loft—Top View

X	X	X
X	X	X
X	X	X

Figure 3.7.2.c. Use an organized pattern to monitor and record hay temperatures if overheating is suspected.

Safety Activities

1. Use a crop production reference to locate information about optimum moisture levels to harvest and store the major crops in your area. Make a chart to show what the moisture level should be for storage of those crops.
2. Contact your local agricultural chemical dealer to request brochures or labels for crop additives and preservatives. Write a report on these materials showing what they do.
3. Contact your local fire service personnel to ask about barn fires in your area. What were the causes? Were there hazardous chemicals involved? What special training do the fire service persons receive?
4. Develop a hay temperature monitoring kit of a probe, a thermometer and cord, and record sheet for use by farmers in your community.
5. Write a news release for your community farmers telling them about hay storage fire hazards.
6. Study silo fires, and write a report comparing a hay storage fire with a silo fire.

References

1. Extinguishing Fires in Silos and Hay Mows, NRAES-18, 2000, Cooperative Extension NRAES, 152 Riley-Robb Hall, Ithaca, NY 14853.
2. Visit www.cdc.gov/nasd/ Click on locate by topic/ Type in hay fires.

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