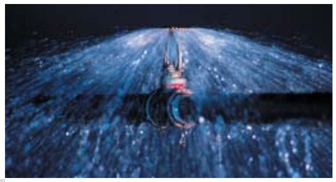
Understanding the Hazard



Dry-Pipe Sprinkler Systems Flushing Investigations

The Hazard

When adequately designed sprinkler systems operate properly, fires are controlled long enough to allow successful manual firefighting intervention, thus minimizing damage. Obstructions in sprinkler systems, on the other hand, can lead to an uncontrolled fire with significant property damage and interruption to your business operations.

For effective fire control, automatic sprinklers must receive an unobstructed flow of water. Although the overall performance record of automatic sprinklers has been satisfactory, numerous instances of impaired effectiveness have occurred because piping or sprinklers on dry-pipe sprinkler systems were plugged with pipe scale (rust formed in the sprinkler piping), mud, stones or other foreign material. If the first sprinklers to open in a fire are plugged, the fire in that area will not be controlled. The result could be greater fire damage, excessive sprinkler operation, and even a threat to the structural integrity of the building. Therefore, keeping the inside of sprinkler-system piping free of obstructing material is imperative to effective loss prevention.

During the past 20 years, properties insured by FM Global have averaged approximately seven losses per year in which a major factor was the presence of obstructing material in the sprinkler system. Dry-pipe sprinkler systems are involved in the majority of obstructions, and pipe scale is the most frequent cause of obstruction. These losses make it clear that the lack of sprinkler protection resulting from obstructed piping leads to more property damage than all other conditions combined.

Science of the Hazard

Dry-pipe sprinkler systems are common in areas where the ambient temperature may fall below 40 F (5 C). A dry-pipe sprinkler system relies on air pressure to work properly. Air pressure in the system maintains a dry-pipe clapper-valve mechanism normally closed, thereby preventing water from entering the sprinkler system. On most dry-pipe valves, the clapper mechanism is designed so that 1 psi (0.07bar) of air can hold back 6 psi (0.41 bar) of water. The air pressure is normally maintained through a connection from the facility's compressed air supply to the dry-pipe system or by a small air compressor at the dry-pipe valve.

Understanding the Hazard
This series of publications is designed to help you understand the everyday hazards present at your company's facilities. For more information on how you can better understand the risks your business and operations face everyday, contact your FM Global engineer, whose card is attached on the back page.

UTH topic categories:
- Construction
- Equipment Hazards
- Fire Protection
- Human Factors
- Process Hazards

Hazard or Risk?
Automatic sprinkler systems protect your facility against uncontrolled fires. Obstructions in the sprinkler piping can render these systems ineffective and result in property damage that could lead to lost production and present other risks to your organization. Your FM Global engineer can help you understand the risk your company may be facing as a result of this hazard.

What You Can Do in Your Facility

Now:

- Conduct dry-pipe valve-flushing investigations of any dry-pipe systems 15 years of age or older. Use FM Global's engineering services to help determine whether you can conduct this operation in-house or need to hire an outside contractor.
- Target dry-pipe sprinkler systems protecting important areas of the facility first. Give priority to systems that have either been converted to wet systems during warm weather or had a history of tripping (either accidental or planned).
- Evaluate the air supply feeding the dry sprinkler systems to determine whether the drying agent (if provided) for the air is fresh. Ensure that air supplies for the dry-pipe systems have intakes located where the atmosphere is cold and dry (avoid warm, damp areas).

Soon:

Establish a documented dry-pipe flushing investigation program that details the following:

- How a flushing investigation is conducted
- Which systems have been investigated
- When they were investigated
- The results of investigation
- Whether the system was successfully flushed as a result of the investigation

During a fire condition, heat from the fire operates the sprinklers directly over the point of ignition. If the sprinkler system was initially filled with water (a "wet" sprinkler system), discharge from the sprinklers would start to provide the cooling and wetting of combustibles needed to achieve fire control immediately.

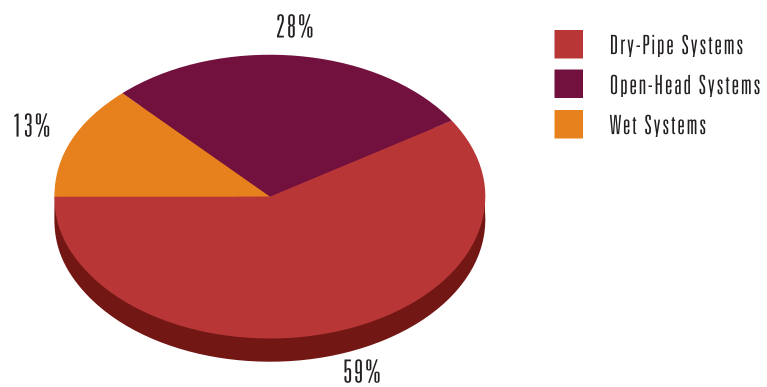
With a dry system, however, water discharge is not readily available, which means the fire could grow more quickly in intensity than with a wet sprinkler system. Water will not be discharged from the operated sprinklers until two conditions are satisfied: First, the air pressure in the sprinkler system must drop low enough to allow the dry-pipe clapper mechanism to be pushed open (tripped) by the water pressure beneath the clapper mechanism. Second, the water entering the sprinkler system must completely fill the entire sprinkler system so that water pressure can be established at the operating sprinklers. The time frame for water discharge from the opened sprinklers can range anywhere from a few seconds for very small dry-pipe systems to as much as a minute (maximum recommended by FM Global) for some of the larger sprinkler systems. This inherent delay allows the fire to grow unabated as well as open more sprinklers prior to water delivery. For the sprinkler system to control the fire, water delivery must not be excessively delayed and the water volume and pressure must not be impeded.

Noncoated ferrous metal (iron) is the most common material used for steel sprinkler-system piping. When the pipe is exposed to water and air, its internal walls will oxidize, forming a layer of pipe scale. Over time, this scale flakes off, allowing newly exposed metal to perpetuate the oxidation process. As this process is repeated, the amount of scale in the pipe increases. Eventually, the scale buildup can clog sprinkler orifices as well as sprinkler branch lines, preventing the discharge of water. Without proper water discharge in the early stages of a fire, a sprinkler system can be quickly overtaxed and become unable to control the fire.

Loss Experience

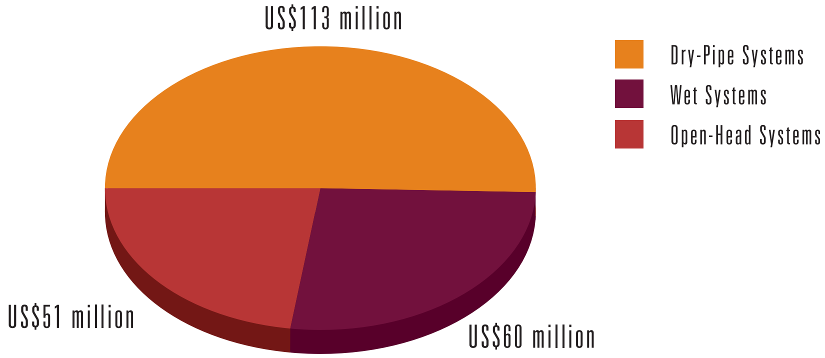
This analysis of FM Global's 20-year loss data (charts shown below and on next page) demonstrates that dry-pipe sprinkler systems are involved in the majority of obstructed sprinkler-system fire losses. Pipe scale was found to be the most frequent obstructing material.

Sprinkler Systems Involved in Obstructed-Pipe Fires:
(Losses reported to FM Global 1982-2001)



Source: Losses reported by FM Global customers

20-Year Gross Loss History Involving Obstructed-Pipe Fires:



Source: Losses reported by FM Global customers

System Investigation and Flushing

A dry-pipe sprinkler system flushing investigation is different from the flushing of a dry-pipe sprinkler system. The purpose of a flushing investigation, in essence, is to determine whether the sprinkler system needs a “full” flushing because of the type of obstructing material found during the flushing. A dry-pipe system flushing typically involves waterflow only through the system’s crossmains and a few selected branch lines. Water is discharged via the system’s flushing connection at the end of the crossmain with any obstructing material trapped typically by a burlap bag tied to the end of the discharge hose. In the event enough obstructing material is trapped within the burlap bag, a full flushing is recommended.

The sprinkler system can be considered reasonably free of obstructing material and not in need of a full flushing if:

- less than half a cup (118 ml) of scale is washed from the crossmains;
- scale fragments are not large enough to plug a sprinkler orifice; and
- a full unobstructed flow is obtained from each branch line checked.

When other types of foreign material are found, investigators must use their judgment when considering whether the system is obstructed. Obstruction potential is based on the physical characteristics and source of the foreign material.

Other obstruction investigation methods, such as ultrasonic and x-ray examination, have been evaluated. Although they are successful at detecting larger obstructions in sprinkler piping, they are time-consuming, and mounting the sensing equipment requires direct access to the piping. These methods also only analyze portions of a sprinkler system, and obstructions could be in sections not examined. For most situations, these methods are no more economical or practical than the conventional flushing investigation method outlined above.

But What About . . .

…the cost of a dry-pipe sprinkler system flushing investigation?

The major cost of investigation is the labor involved. Necessary materials include a 2.5-in. (6.35-cm) hose connection to be fitted to the end of a sprinkler system’s crossmain; a few 1.5-in. (3.81-cm) hose connections to be fitted to the end of selected branchlines; fire hoses for each hose valve; and heavy burlap bags to catch obstructing materials.

Additional Steps

- Investigate dry-pipe systems (including preaction systems) thoroughly for obstructions from corrosion after they have been in service for 15 years and again at 25 years, and every 5 years thereafter.
- As long as the ambient temperatures do not exceed 130 F (54 C), make sure the internal piping of all new dry-pipe sprinkler systems uses hot-dipped, zinc-coated (galvanized) steel that is applied in accordance with American Society for Testing and Materials (ASTM) Standard A795.
- Keep dry-pipe systems with nongalvanized steel piping on air all year, instead of alternately on air or water, to inhibit formation of scale.
- Install a dedicated air supply equipped with an appropriate moisture-removing apparatus for the dry-pipe sprinkler system. As an alternative, maintain system air pressure by using an inert gas (such as nitrogen) to eliminate the oxidation process.
- Explore the possibility of providing enough heat to certain areas (minimum 40 F [5 C]) that would allow the conversion of an existing dry-pipe sprinkler system to a wet sprinkler system.

Need more Information?

Ask your FM Global representative about the following:

- Loss examples of how obstructing materials in dry-pipe sprinkler systems caused uncontrolled fires
- How to perform a dry-pipe sprinkler system flushing investigation to determine if the system needs a full flushing
- Options to lessen the likelihood that obstructions will form

Attach Business Card Here

For additional copies of Understanding the Hazard publications, contact your FM Global engineer or account team. All other FM Global brochures and educational materials can be found in the FM Global Property Loss Prevention Resource Catalog and ordered online at www.fmglobal.com/store.
Or, for personal assistance worldwide, contact our U.S.-based customer service team:

- *Toll-free: (877) 364-6726 (United States and Canada)*
- *By phone: (781) 255-6681*
- *By fax: (781) 255-0181*

…the time involved to conduct an investigation?

With proper planning, an investigation should take a few hours of set-up, which includes flooding the sprinkler system one or two days before, followed by less than an hour for the actual test, clean-up and system reset.

…the cost to use galvanized piping, as compared to noncoated ferrous metal piping?

The cost of galvanized metals will be more than normal noncoated ferrous metal piping, but generally not excessive. Internally galvanized sprinkler piping typically costs about 10 percent more. Although galvanized piping will not reduce the frequency of sprinkler system investigations, it should reduce the frequency (and cost) of full system flushings.

…the possibility of having to shut down operations while the investigation is conducted?

Most flushing investigations have little impact on operations. Take steps to ensure employees are aware of the sprinkler systems to be investigated, in case any alarms accidentally activate. A fire watch should be established for the affected areas. In addition, coordinate preplanning with the facility's emergency-response team. Operations involving inherent ignition sources or hazardous processes within affected areas should be stopped until sprinkler protection can be restored.

Don't Let This Happen to You…

This plywood mill crumpled into twisted metal, shattered glass and ashes, as a US$59.7 million fire swept through it. An obstructed sprinkler system allowed the fire to burn freely. Only a few buildings inside this large complex were left standing, and none of the raw material was salvageable. All production ceased indefinitely.

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