CHEMETRON
Fire Systems™

FM-200

Application Bulletin

FM-200 FIRE SUPPRESSION —

Conversion or Replacement of Halon 1301 Suppression Systems with FM-200 Systems

Intro duction

Over a period of several decades, the use of Halon 1301 in automatic fire suppression systems for the protection of vital computer facilities became a “standard” Due to environmental concerns, the production of Halon 1301 has been stopped and a search for a replacement gas has identified FM-200 as the most practical alternative. Unfortunately, FM-200 is not a “drop-in” replacement for Halon 1301 and system replacement necessitates system redesign.

As they are taken out of service, the “bank” of existing Halon 1301 systems has, so far, provided a source of gas to refill Halon systems as they are discharged. However, long range planning dictates the need to evaluate a possible replacement of Halon in vital facilities.

Operations

The purpose of this bulletin is to provide insight as to what may be involved in changing out the Halon protection and replacing it with FM-200.

Given a comprehensive review, it is very likely that the existing detection, alarm and actuation system will also be capable of serving a new FM-200 system. So a look at the system suppression hardware and system piping arrangement is in order to understand what is involved in the switch of fire suppressing agents.

The use of FM-200 as a replacement for Halon 1301 will usually necessitate the following:

- Adding agent to meet FM-200 flooding requirements.
- The probable addition of cylinders with a reduced fill density in each.
- Relocation of agent storage to be closer to the hazard being protected.
- Use of simple (and more balanced) piping configurations with an avoidance of the need to run discharge piping long distances or to a higher elevation.
- Relocation and replacement of discharge nozzles.

CHEMETRON
Fire Systems™
A World of Protection

4801 Southwick Drive
Third Floor
Matteson, IL 60443
Telephone: 708/748-1503
Fax: 708/748-2847
email: info@chemetron.com

To help better understand the reasons for these we offer the following discussions on:

Laboratory approvals
Suppression agent comparison
- Suppression characteristics
- Physical characteristics

Equipment and systems options

Laboratory Approvals

In order to ensure that this type suppression system will, in fact, suppress the fire as intended when a properly designed system is used, system equipment and design methods are submitted to approval laboratories [including Underwriters Laboratories (UL) and Factory Mutual Research Corporation (FMRC) in the United States] for testing and approval.

The approval tests consist of extinguishing tests involving heptane pan fires and wood crib fires. These fires are located throughout the test enclosure (in the remote corners). Discharge tests are conducted until the fires are extinguished. The size of the enclosure in which the fires are built determined the geometry of the approval. The agent concentration used in the successful tests establishes the approved design concentration, which, in turn, establishes the required flooding factor (lbs/cu ft or kg/cm).

For FM-200 flooding systems, the test rooms used established that a single nozzle could cover an area of 1,412 sq ft (131 sq m) with a maximum ceiling height of 16 ft (4.88 m). Special FM-200 flooding nozzles (360° radial and 180° sidewall) were used to ensure gas reached all remote portions of the spaces tested.

These dimensions are not the same as was approved for Halon 1301, nor are the FM-200 nozzles the same as Halon 1301 nozzles. Thus it is necessary to use the FM-200 approved nozzle spacing with the FM-200 approved nozzles in a retrofit system to ensure proper agent distribution. FM-200 agent quantities must be at least the minimum established in the approval process.

Generally, the amount of FM-200 agent required is about 70% more than the amount of Halon 1301 needed, on a pound for pound basis.

Fire Suppression Agent Comparison

■ Suppression Characteristics

Halon 1301 agent suppressed a fire essentially by chemical means. While FM-200 has a chemical fire suppressing element, the extinguishing process is more physical than chemical. The result is that greater amounts of FM-200 are required to protect the same size space than with Halon 1301. Flooding factors for FM-200 are much different than those of Halon 1301. For example, to protect a 10,000 cubic foot space with Halon 1301 at 5% concentration would require a minimum of 206 pounds of agent. To protect the same size space with FM-200 at a 7% concentration would require 341 pounds of agent.

During the Halon 1301 era, it became standard practice to discharge Halon in the 5% to 6% range, with 5% most often used. This design was used irrespective of the fuels feeding the fire that had to be suppressed. In contrast, when carbon dioxide is used to protect unoccupied spaces, the concentration used varies depending on the fuel feeding the fire. Certain materials require a much higher concentration than the minimum required to suppress open burning.

Testing has shown that in this regard, FM-200 is more like CO_2 in that for certain combustibles, FM-200 concentrations should also be increased above those levels used to extinguish laboratory test fires. However, it should be noted that fires in computer type equipment have been successfully extinguished in actual installations at the design level established by the approvals. However, it is possible that higher concentrations for some materials may be established in the future. The Chemetron Fire Systems' Application Engineering Department should be consulted if there are any questions.

As computer room fire suppression systems require more FM-200 than was required for Halon 1301, more storage cylinders will likely be required. And, as discussed below, it may be necessary to lower the fill density (less gas in the same size cylinder) in the storage cylinders.

■ Physical Characteristics

Liquified compressed gasses (both Halon 1301 and FM-200), are compounds that at atmospheric pressure are gasses, but when compressed can be liquified to provide efficient storage. The physical characteristics of each gas dictate its storage conditions.

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When these gasses are liquified, the pressure in the storage container is provided by the vapor in the space above the liquid. This is called the “vapor pressure” and for some gasses it is quite high. For example, with CO_2 it is approximately 830 psi at 70°F (5,722 kPa at 21°C). However, for Halon 1301 it is only 200 psi at 70°F (1,379 kPa at 21°C) and for FM-200 it is 44.1 psi at 70°F (304 kPa at 21°C). In the case of CO_2, this pressure is high enough to act as an expellant in a fire suppression system piping network. Because Halon’s vapor pressure was not high enough to act as an expellant, the Halon gas was superpressurized with nitrogen to 360 psi (2,482 kPa). Nitrogen does not liquify at normal storage temperatures. The combination of the Halon vapor and the Nitrogen was sufficient at 360 psi storage to allow design of most of the piping systems needed to properly distribute the gas. A 600 psi system was also available for more elaborate piping requirements, but this system required spun steel cylinders and much more equipment.

In selecting the system configuration for FM-200, it was obviously desirable to use the same system equipment that was designed for Halon 1301. Therefore, a 360 psi pressurization level as also selected for FM-200.

When these Halon or FM-200 cylinders are pressurized with nitrogen, some nitrogen dissolves in the fire extinguishant liquid. When the pressure drops upon discharge, this gas “boils” off to act as a pressurizing agent throughout the discharge.

Unfortunately, the expellant gas available when a cylinder is filled with FM-200 and pressurized by nitrogen to 360 psi is less than that available with Halon 1301. Hence, there is less “push” to get the fire extinguishant out through the piping and nozzles. However, a maximum 10 second discharge is mandated for both. The result is that less piping must be used with FM-200. To get more push, a lower fill density (less FM-200 in the same size cylinder) can be used, making room for more nitrogen expellant.

Another system design concern is the performance of the gas in the pipes when a discharge takes place. Both of these agents create a 2-phase flow in the pipe –2-phase being a combination of vapor and liquid. Since the vapor has a much lower density than the liquid, a pipe flowing vapor will transport much less agent than the same size pipe flowing liquid. Turbulence in the pipe, mixing the vapor and liquid, is necessary if we are to be able to accurately calculate the flow in a piping array.

Most Halon systems for computer rooms were multiple nozzle systems with nozzles in the room(s), the underfloor spaces, and sometimes in the false ceilings and/or equipment enclosures. Each nozzle needed to be sized to flow just the right amount of gas required to protect the part of the hazard assigned to that nozzle. With a lot of expellant force, as was the case with Halon 1301, this was relatively easy. With FM-200 it is much more difficult. Simple piping configurations in a more evenly balanced arrangement and with a minimum of piping elevation change helps the design.

The result is that existing 1301 piping systems will probably not be properly arranged for use with FM-200 and some repiping will be needed. Professional evaluation is mandatory and Chemetron’s Application Engineering group is available to help.

Equipment and System Options

The Chemetron Beta and Gamma cylinders are suitable for both Halon 1301 and FM-200, and there is a possibility that all or a portion of a Halon system’s equipment could be reused. However, evaluation on a system-by-system basis will be necessary. Usually, if existing equipment can be used, additional equipment must also be added as described above.

Using Chemetron’s proprietary FM-200 flow calculation software program, we can evaluate if some of the existing Halon system piping can be reused. Our software normally picks the optimum pipe size for each segment of the piping array in the hazard, but we can force in the characteristics of existing pipe to see if a viable calculation can be run using same. This may save some repiping.

Chemetron’s customer service or sales department can provide names of local distributors who can help with such evaluations.

SUMMARY

While fire experience in the computer and other high-tech environments has been very good and improved technology has allowed for detection and location of fires in the earliest stages of development, the importance of the vital business and scientific missions of the modern computer grows every day.

Therefore, having the capability of handling a fire of any magnitude is more important today than ever. This is the motivation behind upgrading and modernizing fire suppression systems. While the changes described herein may appear somewhat complicated, they are, in fact, well within the capability of the fire system professional to accomplish in a cost effective manner.