HIGH CEILINGS, MODULAR DESIGN, AND PRE-ENGINEERED VS ENGINEERED

This document is intended to provide useful information regarding the design of HFC-227ea systems. This information regards critical design decisions and provides insight to what options are available for specific challenges. The approaches discussed in this guide are not the only way to deal with these issues, although they have been used with success on many installed systems.

HIGH CEILINGS (LAYERED NOZZLES)

Many fire hazards have a ceiling height greater than the UL Listed or FM Approved ceiling height and need a HFC-227ea fire suppression system to protect the hazard. Current listings and approvals require that the nozzles be mounted within 1 foot of the ceiling or the maximum ceiling height limitation. For instance, if the maximum ceiling height limit is 10 feet, the nozzle cannot be mounted any lower than 9 feet.

The most common solution for this issue is to use a layered nozzle approach. This approach allows the designer to place a nozzle 1 foot from the ceiling and then place another nozzle at or below the maximum ceiling height limitation. For instance, if a hazard had an 18 foot ceiling height and the HFC-227ea equipment had a 10 foot height limit, you would mount one nozzle at the 17 to 18 foot level and another nozzle at the 7 to 10 foot level. The important thing to remember is that you must have a nozzle no more than 10 feet off the floor, 1 foot from the ceiling, and no more than 10 feet between any two nozzles vertically. See figure 1 for a pictorial description.

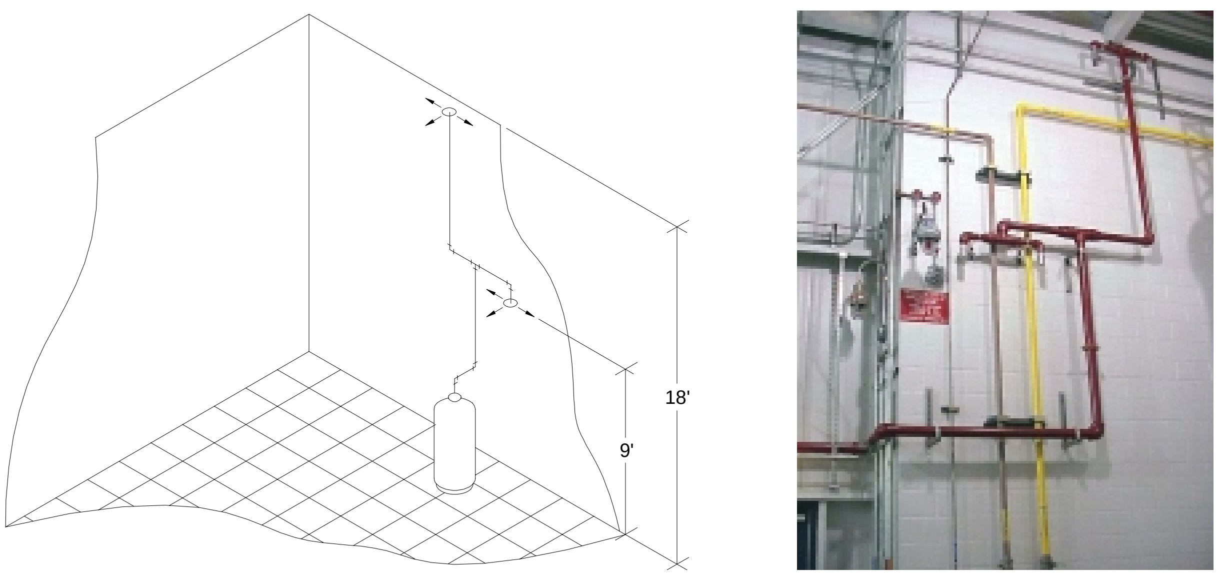

Figure 1
Layered HFC-227ea Nozzles

For this application, 180 degree nozzles should be used as often as possible. This allows the pipe runs to be against the walls, eliminating nozzle mounting concerns. The pipe network should be designed to use bullhead tees to flow the agent through. This helps in keeping the pipe network against the wall. Remember, listings and approvals mandate that the agent must always leave a tee in the horizontal plane.

MODULAR DESIGN

Modular design is a system design that utilizes one container and a single nozzle or group of nozzles to protect a hazard or portion of a hazard. Modular design is generally thought of as the protection of a small room with a single container or a single cylinder to a single nozzle (such as an inverted container). A modular system can actually consist of a 1000 pound container and six nozzles. When Halon 1301 was first introduced and there were no large storage cylinders, it was very common to protect hazards with several containers arranged in a modular design. As facilities got larger, more manufacturers started to use the "central storage concept". The central storage concept is storing a bank of cylinders that all discharge into a large pipe network, which directs the agent flow to the protected hazard(s). Due to the physical properties of Halon 1301, this was an effective means for designing the fire suppression systems. This was also effective because most fire suppression equipment manufacturers use mechanical valves with actuators that draw a large amount of precious power from the control panels. Having the cylinders stored close together allowed the manufacturers to actuate secondary cylinders pneumatically, saving them from power consumption issues.

In today's suppression market, the facilities are larger than ever and the clean agent, HFC-227ea, requires approximately 1.7 times the amount that Halon 1301 did. This means that facilities often need several containers to protect a single hazard.

The challenge with using the central storage approach for protection of large facilities is that HFC-227ea does not flow as well as Halon 1301 did, requiring more engineering time to perform the flow calculations. Because more HFC-227ea is required, the pipe sizes for protecting the same volume get larger making the pipe network much more expensive to install as well. Another concern with central storage systems is the additional cost of check valves that are required between each cylinder and the manifold.

When designing large HFC-227ea systems, do not forget the modular design concept. Because of the benefits of the Fike hardware a modular system is a very efficient method for protection of large facilities. One of the benefits of the Fike hardware is the 1000 pound HFC-227ea container. The 1000 pound container allows the designer to cover up to 29,000 ft^3 with a single container. The other benefit of the 1000 pound cylinder is that it is sized perfectly to use 3" pipe. The difference in the installation cost from 3" to 4" pipe is extremely large and using 3" pipe makes the system more cost effective. A typical modular system for a large telecommunication facility would have a 1000 pound cylinder with up to 6 nozzles.

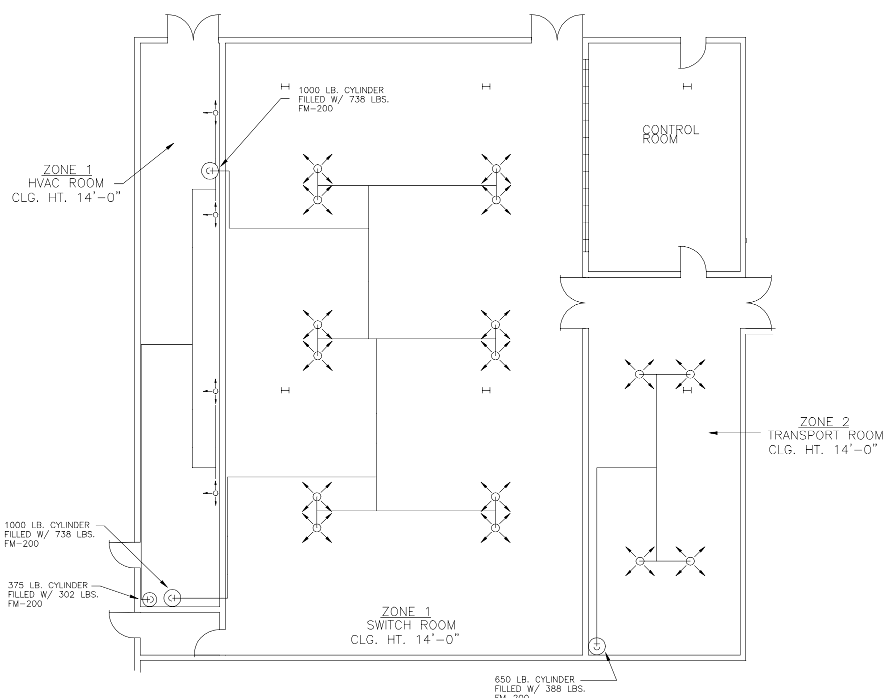

Figure 2
Modular HFC-227ea System

Another benefit of the Fike Hardware is the Fike Agent Release Module (ARM). The ARM is a device that operates the actuator on a Fike Clean Agent System. The ARM allows up to 10 containers to be released from the same releasing circuit of the control panel. The ARM's are wired in parallel giving the system the greatest reliability. Because the ARM's are connected with wire they can be electrically supervised and can be mounted far apart, unlike pneumatic actuators that must be mounted close to the pilot cylinder and each other.

The modular design isn't always the best approach but it should be considered when designing systems for very large facilities.

PRE-ENGINEERED VS ENGINEERED

There are many benefits of using an engineered HFC-227ea system over a pre-engineered system. However there are also reasons for using a pre-engineered system as well. This section will discuss the trade-offs of using each design methodology.

The pre-engineered design concept uses specific pipe sizes, tee orientations, nozzles, and number of nozzles for a given cylinder size. The pre-engineered design uses a maximum of 1 container, 1 to 4 nozzles, and always uses a balanced pipe network. The pre-engineered system limitations were determined by actual tests under worst case situations. This means that all pipe networks are designed to be capable of flowing the maximum amount of agent using the maximum sized HFC-227ea container for that network. To verify a system design, the designer must perform a simple hand calculation to determine total pressure drop through a system.

The Engineered system allows the designer to use a single container or bank of containers to protect multiple hazards of various volumes. In an engineered system the designer creates a pipe network and uses custom drilled nozzles to flow the required amount of gas into each hazard. The engineered system design utilizes a computer program to determine the performance of the pipe network, nozzles, and verifies that it meets UL and FM requirements. The engineered system guidelines were determined by running multiple tests under different conditions and verifying that the computer program could accurately predict the system results. Although the engineered is more flexible than the pre-engineered system, it still has its limitations. As mentioned before, pre-engineered systems are used mostly for protecting a single hazard and using a balanced pipe network to flow the agent through. This document will discuss when and why a designer would want to take a balanced system and engineer it (run flow calculations on the system).

The benefits of a pre-engineered system design are reduced engineering design time, no need for custom drilled nozzles, and no minimum distance from tees to fittings. The pre-engineered design is most useful when you have a small room with a minimal length of pipe and number of nozzles.

The biggest benefit of an engineered system over a pre-engineered system when working with balanced pipe networks is the flexibility of pipe sizes. An engineered system design will generally allow the use of smaller pipe sizes to flow the agent. For instance, the pre-engineered design mandates that a two nozzle system with 170 pounds of HFC-227ea must have a 2" main and 1-1/2" pre-engineered nozzles. Under the same conditions, the engineered system would allow for a 1-1/2" main and 1" nozzles for the same system. The ability to use smaller pipe sizes helps the installation cost in labor as well as material. If you were putting in several balanced systems in the same facility then it would be a wise decision to engineer the system to save money on the installation labor and material. Engineering time spent on a balanced engineered system will not be significant enough to effect the cost of the job.

The down sides of using the engineered system approach are having to order custom drilled nozzles and having 10 pipe diameters before and after a tee before a direction change can be made. Although, with proper planning in the design and installation phase these concerns can be eliminated.

If you are working on a simple project where you feel you can save money by engineering the system but are not sure, call the Fike Technical Services Group.

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