APPLICATION PROFILE

ECARO-25® MAXIMIZED PIPING

INTRODUCTION

Today, extending a system discharge time for fire protection is commonly used to compensate for room leakage and to maintain room concentration levels during system discharge. These particular type systems often have discharge times that extend three minutes or more. A good example is an automated storage tape unit that loads and unloads data storage tape. These units have open floors and require an extended discharge. Carbon dioxide systems are regularly designed for an extended discharge when protecting leaky enclosures or deep seated fire conditions where it is mandatory to hold an agent concentration over an extended period of time.

The extended discharge that will be discussed here is much different from traditional extended discharge applications, as described above. The discussion here will be based upon extending the discharge of a fire system in order to reuse the installed pipe network. More specifically, the intent is to retrofit a Halon 1301 fire system with Fike's ECARO-25 fire suppression system, utilizing DuPont™ FE-25™ fire extinguishing media, without modifying the piping system in any way. This document provides background for employing an extended discharge system and will assist in understanding the validity of the ECARO-25 Maximized Piping System.

TECHNICAL BACKGROUND

In order to decide if a Maximized Piping System is the proper approach for total flooding fire suppression systems, the following items were considered:

- Discharge Time
- Fire Extinguishing Performance
- Human Exposure
- ECARO-25 Flow Calculation Results

Each of these four items will be discussed in detail to provide an understanding of the ECARO-25 system and using the Maximized Piping System.

Discharge Time
The first task in developing the ECARO-25 Maximized Piping System was to determine the maximum discharge time. The system discharge time is important because it is critical that such a system maintains rapid fire extinguishment capabilities to not only prevent asset damage, but also prevent forming excessive levels of products of thermal decomposition. From extensive research and development, it was decided to limit the extended discharge time to a maximum of 20 seconds.

The other issue regarding discharge time is the ability to reuse existing Halon 1301 piping networks. DuPont FE-25 requires approximately 1.4 times the weight of Halon 1301 to protect the same volume of space. In most cases, replacing Halon 1301 systems with ECARO-25 will not require the use of the Maximized Piping System, although extending the discharge to 20-seconds nearly guarantees that all Halon 1301 systems can utilize a drop-in ECARO-25 system.

Fire Extinguishing Performance
After the maximum discharge time of 20-seconds was selected, it was vitally important to verify that the fire-extinguishing performance would not be disturbed. A series of fire tests were conducted to verify extinguishing performance utilizing an Maximized Piping System.

Fire tests were conducted at minimum extinguishing concentrations per Underwriters Laboratories and NFPA Standards. The targeted criterion was to establish an extinguishment time for the Maximized Piping System equal to or less than a system utilizing a 10-second discharge time. Fire extinguishment times were measured from the start of system discharge. After the series of tests were conducted, it was established that the Maximized Piping System requires an addition of 6% more FE-25 agent than a standard 10-second discharge system. This requirement was verified for all agent tests utilizing Class A and Class B fuels.

Adding an additional 6% of agent is important in maintaining the same average agent concentration for the duration of the test. For instance, if a system discharges 6.7% agent in 10 seconds, the protected hazard is essentially maintaining a 6.7% agent concentration shortly after system discharge (discharge time + room mixing time). To maintain the same level of protection, an Maximized Piping System would require an additional 6% agent. Therefore, a Maximized Piping System at 7.1% will perform equal to a 10-second discharge system at 6.7%.

Human Exposure
Another concern regarding extended discharge systems is to verify the safety of people. It was mentioned earlier that an additional 6% agent is added to maintain equal fire extinguishing performance. To address the human exposure concern, agent concentrations, and the development level of by-products from real-world fire tests must be examined.

The ECARO-25 system minimum design concentration is 8.0%. For an ECARO-25 Maximized Piping System, an additional 7 pounds of agent must be added for every 100 pounds of agent bringing the minimum design concentration to 8.5%. Increasing the minimum design concentration to 8.5% does not exceed safe concentration levels established for human occupancy. To address human exposure limitations for gaseous agents, the EPA approved PBPK method is utilized which verifies that humans can be exposed to concentrations up to 11.5% of ECARO-25 for up to 5-minutes with no exposure concerns.

To address concerns regarding the level of by-product formation, Hughes Associates, Inc, Baltimore, Maryland conducted a series of tests to determine the safety of the agent. Test results showed that an ECARO-25 system employing an 8.7% design concentration provided rapid extinguishment of fire scenarios. Furthermore, these same tests also confirmed that by-product levels formed are well

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below the mammalian LC50 and human DTL. It was also shown that an ECARO-25 Maximized Piping System employing an 9.25% design concentration provided suppression efficiency and produced by-product levels well below the mammalian LC50 and human DTL. This testing confirmed that extending the discharge time with the ECARO-25 Maximum Piping System poses no safety risks. *

ECARO-25 Maximized Piping System Hydraulic Calculations
In the past, the only method of verifying if an extended discharge system operated as intended was to conduct a full-scale discharge test on the actual installed pipe network. The ECARO-25 Flow Calculation Software was verified to successfully pass all system tests per Underwriters Laboratories Standard UL 2166. A series of complex engineered piping systems were constructed and tested with all critical measurements taken. These tests confirmed that the ECARO-25 software accurately predicts system discharge time, mass flow rates, system nozzle pressures, and agent mass delivery. This allows system designers and end-users to have confidence that the Maximized Piping System will perform as designed.

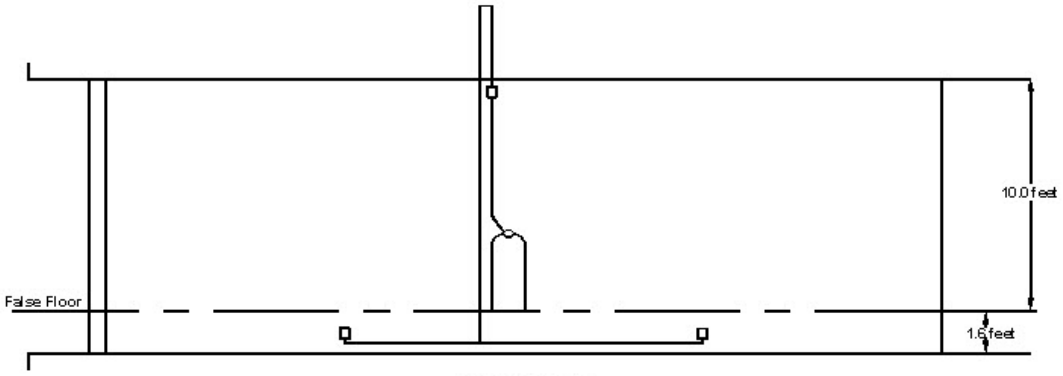
SUMMARY

Fike developed the ECARO-25 Maximized Piping System to support the need to replace existing Halon 1301 systems with an environmentally conscious, economical system that minimizes business interruption. Fike designed the US and foreign patent pending ECARO-25 Maximized Piping System for Halon 1301 retrofit where a standard 10-second discharge system cannot be utilized.

An ECARO-25 Maximized Piping System isn't always required when replacing an existing Halon 1301 system. However, in certain cases it will secure the fact that the only changes to occur to the existing fire protection system is the agent storage container and system nozzles. The ECARO-25 Maximized Piping System is designed to provide a maximum 20-second discharge with a minimum 8.5% design concentration. This unique system has been extensively tested by Fike Corporation and its design is incorporated into the ECARO-25 Flow Calculation Program.

ECARO-25 MAXIMIZED PIPING SYSTEM EXAMPLE - DROP-IN HALON 1301 RETROFIT

This example shows a walk through of a Fike ECARO-25 Maximized Piping System retrofit process replacing an existing engineered Halon 1301 system that protects a computer room application. This application currently has two separate risks: sub-floor and main room. The total Halon agent protecting these risks is 162 pounds and the total volume of both risks equals 7,795.2 ft3. This example was chosen to show when a Maximized Piping System would be required. Due to the physical properties of Halon 1301, small diameter pipe could be utilized, much like the example system provided.



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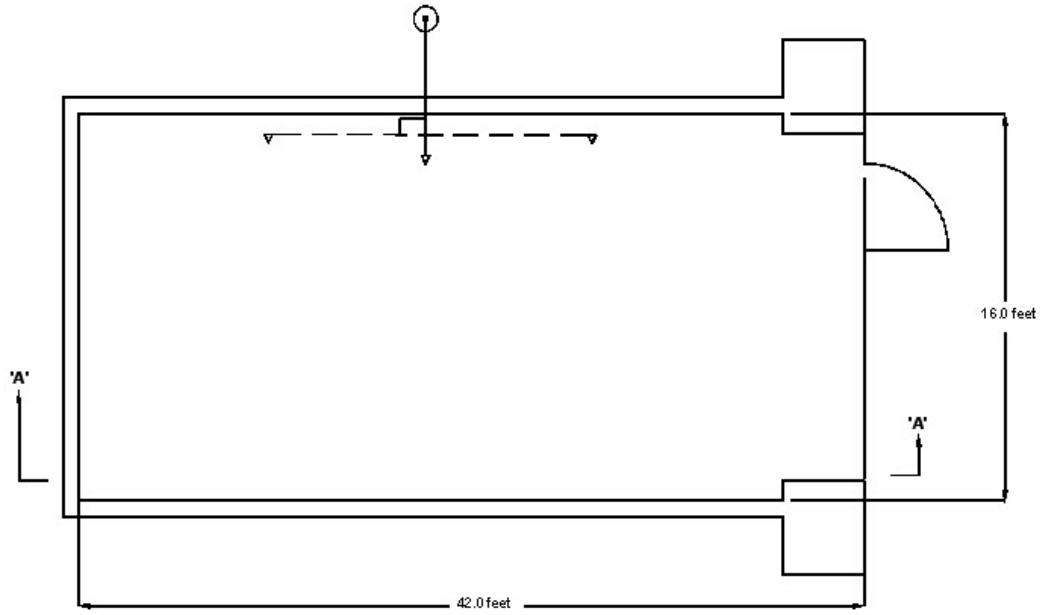
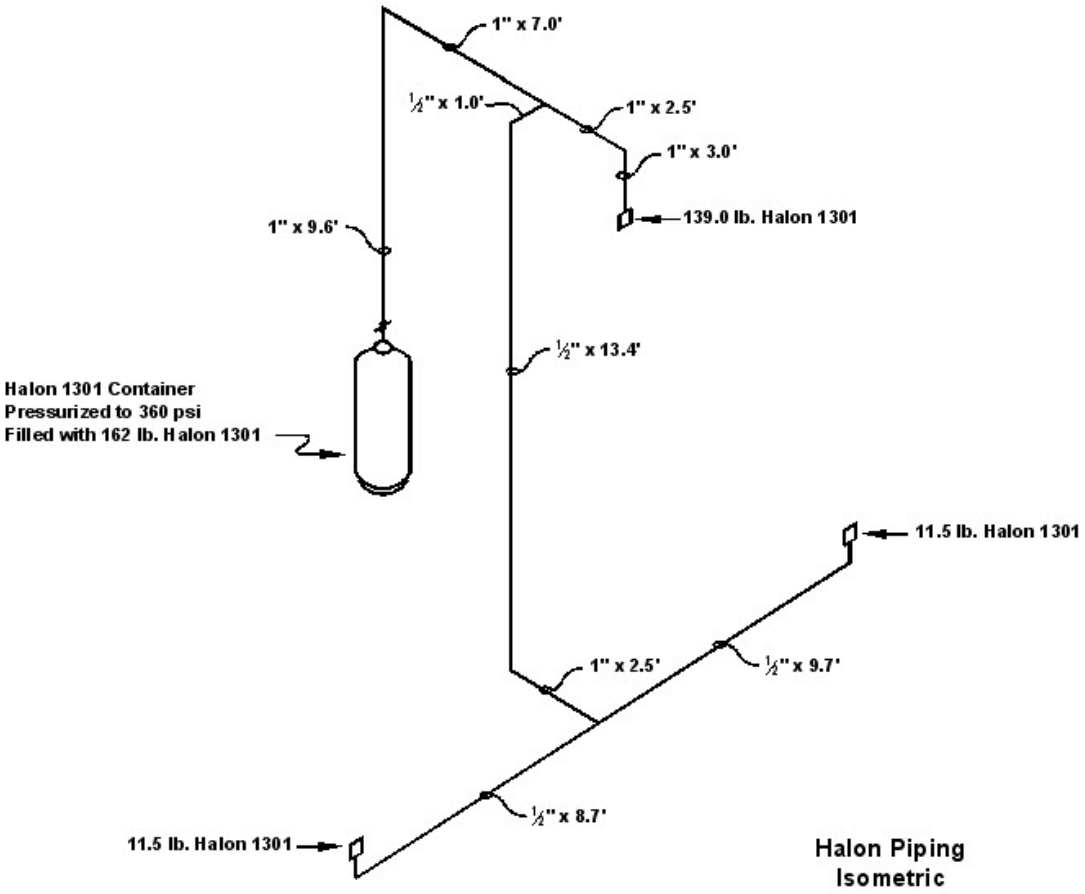


Plan View



In accordance with the ECARO-25 FM approval, a minimum design concentration of 8.0% is used to protect Class A hazard areas. However, when a Maximized Piping System is implemented, a minimum design concentration of 8.5% is required to maintain equal fire extinguishing performance. Per Fike design, a flooding factor of 0.0293 lb/ft3 is multiplied by the room volume in cubic feet (ft3) to calculate the amount of agent required to achieve a 8.5% concentration. The minimum quantity ECARO-25agent required to protect both of the risks, with a 8.5% design concentration is 230 lb.

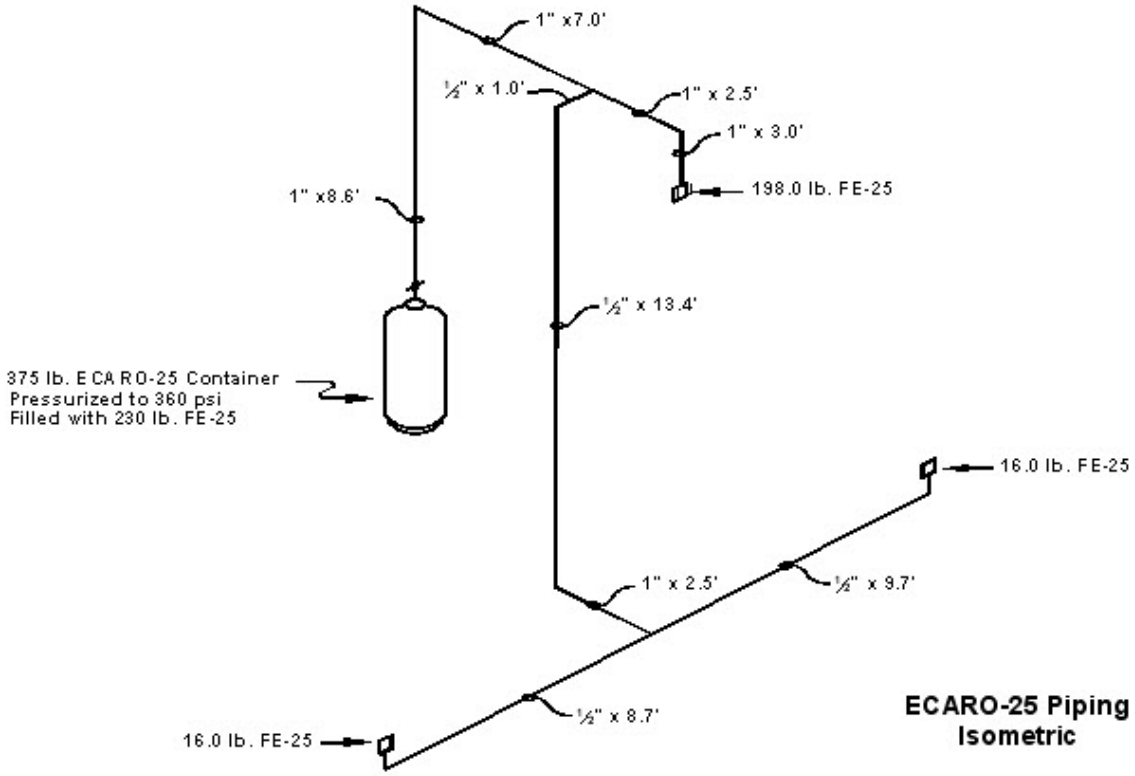
During a retrofit design it is ideal to utilize the existing pipe network to reduce cost and operation downtime. After collecting the existing pipe data and determining the minimum quantity of FE-25 agent needed, it is time to utilize the ECARO-25 Flow Calculation Program. The ECARO-25 Flow Calculation Software will verify if the existing pipe network can remain as is.

The ECARO-25 Flow Calculation Software also generates new nozzle specifications to replace the existing Halon 1301 nozzles. The selection of nozzles is generally determined by the amount of ECARO-25 agent required (flow rate) versus the flow rate capabilities of the nozzle(s). Additional factors such as area coverage, nozzle placement, discharge path obstructions, etc. will have an impact on this decision as well. Nozzle area coverage must also be considered when designing an ECARO-25 system. Each nozzle type (180° or 360°) has been FM approved for the maximum area coverage specified in the ECARO-25 Design, Installation, and Maintenance Manual. P/N 06-285. For this sample system, adding additional nozzles will not be required.

The ECARO-25 Flow Calculation Software will conclude that a straight drop-in replacement can not adequately protect the risk area with a 10-second discharge, essentially due to flowing approximately 1.5 times more agent through the existing pipe network. Replacing Halon 1301 systems with an ECARO-25 system will require more agent, but the least amount as compared to other Halon alternatives. Approximately 1.4 times more ECARO-25 agent will be required when designing an Maximized Piping System using the minimum design concentration of 8.5%. Depending on the Halon system pipe network, delivering 1.4 times more mass in the same time frame as the existing Halon 1301 discharge time may not always be possible. The solution to this issue is to either increase the system pipe diameters or extend the discharge time allowing the additional agent to be delivered to the discharge nozzles. To reduce downtime, labor, and overall replacement costs to retrofit the Halon 1301 system, an ECARO-25 Maximized Piping System can be employed to keep the existing pipe network.

A larger volume storage container will be required to compensate for the increase in ECARO-25 agent. The preliminary agent quantity determination requested a total of 230 lb. ECARO-25 agent. After performing the system flow calculation, the quantity of ECARO-25 agent remained at 230 lb. and is stored in one (1) 375 lb. (153 liter) ECARO-25 container assembly.

Due to the small pipe diameters of the existing Halon 1301 piping the system discharge time was calculated to 16 seconds, which is in accordance with Fike Corporation Maximized Piping System design requirements. The piping isometric below shows the new ECARO-25 system. As you can see, the only change from the previous Halon 1301 system is a new ECARO-25 container assembly and new ECARO-25 discharge nozzles. Simply removing the Halon 1301 nozzles and replacing them with new ECARO-25 engineered discharge nozzles was achieved.



ECARO-25 Piping Isometric

Form No. CAAP 013, August 2010. Specifications are subject to change without notice.