**White Paper**
October 2011

# Guidelines:
Successfully Deploying FAAST Fire Alarm Aspiration Sensing Technology®
**In Cold Storage Applications**

SYSTEM SENSOR®

## Introduction: Protecting Cold Storage Facilities

One of the most difficult environments to protect from fire and smoke damage is cold storage facilities. Very often, due to the low temperatures, the normal UL listings for many traditional detection devices do not allow them to be used in cold storage facilities. Humidity issues and high airflows can further complicate fire protection for these applications.

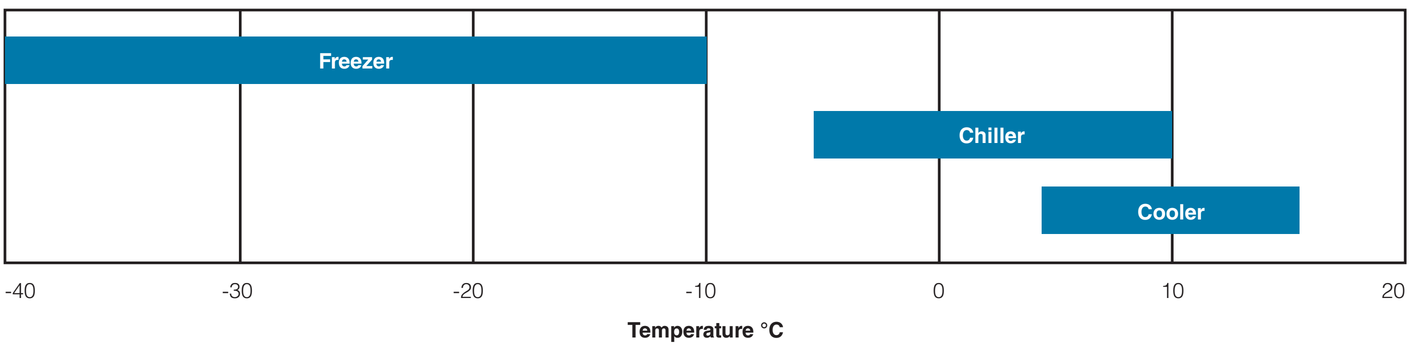
Aspirating smoke detectors, such as the System Sensor FAAST 8100, are often well-suited to hot, cold, or other extreme conditions because the sampling ports can be run through a pipe network into the difficult space while the device is mounted in a remote location protected from extreme conditions. In addition, because it actively samples the air, FAAST works well in high-airflow environments.

While aspirated smoke detectors, such as FAAST, can often be a solution for these cold storage spaces, temperature, airflow, condensation and pressure differential issues must be considered and resolved as necessary. This whitepaper provides guidelines for using the FAAST 8100 device to protect cold storage facilities, particularly for pipe selection and design.

## Cold Storage Overview

There are several types of cold storage applications. In fact, the temperatures within a cold storage facility can vary between -40°C and 18°C. The lowest of these temperatures can prove challenging for any smoke detector. Figure 1 provides temperature ranges for common cold storage applications.

*Figure 1 – Cold Storage Application Temperatures:*




## Pipe Material and Design

The sample pipe used for a cold storage application should be selected based on local codes and the lowest temperature expected for the space.

CPVC and PVC are commonly used for sample pipe materials outside of the cold storage space yet are not capable of withstanding the extreme subzero temperatures of freezers operating below -20°C. ABS, PE, copper and stainless steel pipe of appropriate size are all acceptable for cold applications due to their ability to withstand low temperatures. Copper and stainless pipe have the added advantage of enabling heat tracing cable to be used along the pipe outside the space (see "Heat Tracing" below for more information). All metallic pipe should be properly grounded to avoid static buildup that is common with continuous airflow. Plastic pipe must be used at the FAAST intake and exhaust ports for a proper seal with the FAAST unit. Never cement sample pipe to the FAAST unit itself.

*Figure 2 – Pipe Recommendations for Various Temperatures:*

| Pipe Material | Service Temperature |
|---|---|
| ABS | -40 to 80°C (-40 to 176°F) |
| PE-80 | -50 to 60°C (-58 to 140°F) |
| PE-100 | -50 to 60°C (-58 to 140°F) |
| CPVC | -26 to 93°C (-15 to 200°F) |
| PVC | -26 to 49°C (-15 to 120°F) |
| Copper | -150 to 110°C (-238 to 230°F) |

Once the proper pipe has been selected to suit the temperature of the cold storage application, there are several standards, codes and guidelines that should be followed when designing a sampling pipe network to work appropriately in cold storage applications.

Whatever the application, pipe condensation will occur on any surface that drops below dew point temperature. Condensation or frosting on the internal diameter (ID) of the pipe that can lead to clogging will only occur if the pipe experiences a drop in temperature to the dew point temperature somewhere along its length. This dew point temperature is often a few degrees below the cold space operating temperature. For this reason, every effort should be made to keep the pipe away from local temperature fluctuations within the space wherever possible.

## Sample Hole Spacing and Orientation

Local standards or codes commonly dictate sample hole spacing or coverage area for aspirated or spot smoke detection devices according to a specific level of protection. For example, NFPA 76 specifies spacing guidelines and threshold settings for "early warning" and "very early warning" fire protection. These same spacing requirements would apply within cold storage, yet as noted above, cold storage has a few more limitations related to condensation and frost conditions that can have an impact on pipe and sample hole locations. The following provides further guidelines for designing sampling pipe networks for cold storage applications:

- Position all sample holes facing sideways in freezer applications. Sample holes facing the floor are more prone to frost buildup and clogging in the event moisture collects within the pipe.
- Freezer thru-traffic and other conduits for added moisture can quickly raise RH levels, resulting in condensation and frost issues within a sub-zero application. This added moisture in the air will first and foremost show as frost around sample holes near the doorway or supply vent (areas to be avoided during pipe design).
- Space sample holes appropriately to avoid the warm, moist air entering from access doors. Sample holes nearest these locations should face away from the access door and be no smaller than 1/8-inch diameter.
- Sample piping should not be positioned anywhere in the supply air stream. The supply air for cold storage can be 20 degrees cooler than the cold space operating temperature. Pipes mounted in front of the cold air supply can experience frosting at sample hole locations. Any sample holes located within the vicinity of the supply air should be at least 1/8-inch diameter and face 90 degrees from the floor. Wrapping the pipe in insulation at this location can help avoid frost on the pipe ID. When installing the insulation, leave a 20 mm gap in the insulation at the sample hole location. The insulation must then be fastened in place with hose clamps to prevent it from moving and covering the sample hole. Sample holes in these locations should be no smaller than 1/8-inch diameter.
- Where possible, sample holes should be placed near the return air location of the cooling unit. The cooling unit will actively pull air over the sample hole. The sample holes should be positioned on the side of the pipe facing into the direction of flow.
- Capillary sample tubes should be avoided in cold storage due to smaller tube diameter and the downward facing sample holes.

### Pipe Traps

Pipe traps are often installed outside the space to protect against moisture buildup. Condensation rarely occurs on the inside surface of a pipe when it exits the cold space, however. When the cool, dry air is warmed outside the cold space, its dry bulb temperature is warming and moving further from the dew point temperature. The dew point temperature is based on the moisture content in the cold space and remains constant as the air warms along the length of the pipe. Condensation will only occur if the sample pipe experiences a drop in temperature below that of the cold space itself. This drop in temperature can happen if the sample pipe is located near an outside door in the winter months.

### Pre Heat

Sample pipes exiting cold storage must be long enough to raise the temperature to 0°C for the detector. Use of an external heater cable can be useful when the external pipe length is too short to warm the air prior to the detector or condensation on the exterior of the pipe is causing moisture related issues on the exterior of the pipe. Refer to the charts below to determine an approximate length of pipe required under ambient conditions.

*Figure 3 – CPVC:*

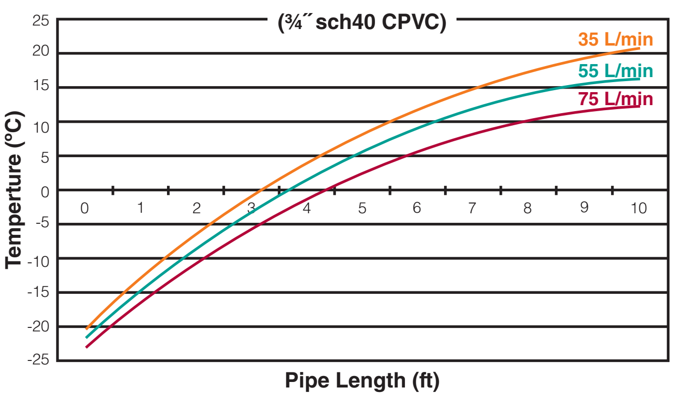
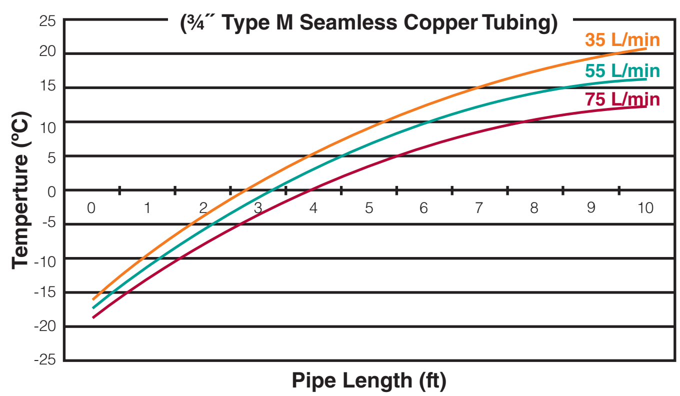



*Figure 4 – Seamless Copper Tubing:*




### Heat Tracing

Use of a heater cable on the pipe outside the space can help raise sample air temperature as well as minimize the amount of moisture condensing on the outside of the pipe. This excessive condensation can cause an unhealthy situation with slippery floors or fungus growth. The use of a low power heater cable can help minimize pipe length and potentially unhealthy condensation. One such cable is the Chromalox (SRL 5-1CT) self–regulating, low-power heater cable. This type of cable is capable of actively regulating power along its length based on pipe temperature. This can provide some added security against condensation, both inside and outside the pipe external to the cold space.

### Wall Penetrations

All wall penetrations must be sealed well against any air leakage over the long term. Moist outside air will migrate into a freezer through the smallest of leaks, condense and cause ice formations to grow in these locations.

### Ceiling Penetrations

Vertical pipe penetrations should be avoided. Cold air leaving a freezer will carry airborne ice particles up through the vertical pipe. When the pipe warms outside of the freezer space, the ice particles will melt on the inside wall of the pipe. The melted ice will then drip down the inside surface of the pipe and back into the freezer where it will freeze and eventually create a pipe blockage condition.

## Capillary Sampling

Due to their ceiling penetration and relatively small diameter, capillary sample tubes should be avoided for risks of blockage.

## Defrost Cycle Effects

Defrost cycle time and frequency can vary at different cold storage locations. Generally, defrost cycles occur 1 or 2 times per day for a period of 20-30 minutes. The heat applied during the defrost cycle is local to the evaporating coil of the unit and therefore has little-to-no effect on the cold space itself or the performance of the FAAST unit.

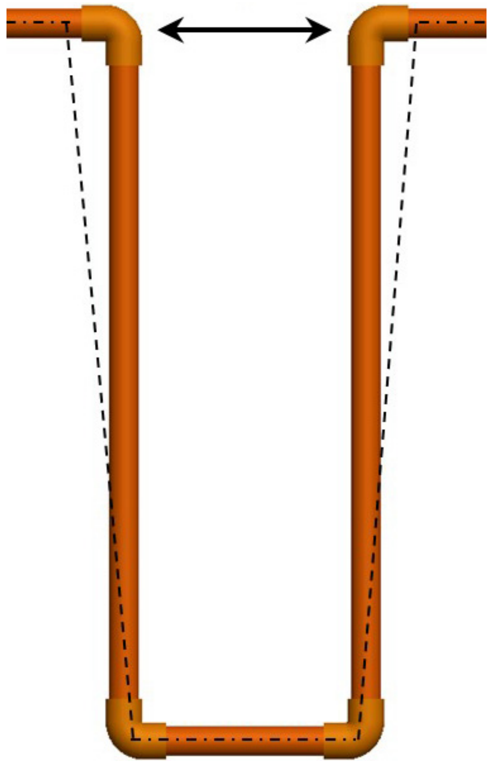
## Pipe Thermal Expansion

Thermal expansion of the pipe network must be considered in cold applications. Pipe hangers must allow the pipe to move freely wherever possible. Expansion joints or flexible pipe should be used in locations that would otherwise not allow for expansion or contraction. This would include areas that require the pipe to be clamped. Refer to the expansion joint shown below. The size of an expansion joint can be calculated and is based on the low temperature modulus for the pipe material being used. Refer to "Thermal Contraction and Expansion in Thermal Piping Systems" by the Plastics Pipe Institute for details concerning expansion joint design.

Example: A 50 m (164 ft) run of ABS pipe installed at 22°C (72°F) in a freezer that drops in temperature to -20°C (-4°F) would contract 205 mm (8.1 in).

This type of contraction can easily cause a leak in a pipe network if no provision is given for pipe movement. The final check for pipe integrity (leaks) should be done at operating temperature.

*Figure 5 – Joint Expansion*



## Pipe Support Spacing

The following chart provides pipe support spacing recommendations based on diameter and material.

*Figure 6 – Pipe Support Spacing*

| Pipe Material | CTE 1/°C (1/°F) | Resultant Pipe Expansion mm/10m x 10°C (in/100ft x 10°F) | Max Support Spacing m (ft) |
|---|---|---|---|
| ABS | 9.8 x 10-5 (5.5 x 10-5) | 9.8 (0.66) | 1.2 (4) |
| PE-80 | 20.0 x 10-5 (11.0 x 10-5) | 20.0 (0.41) | 1.2 (4) |
| PE-100 | 13.0 x 10-5 (7.3 x 10-5) | 13.0 (0.88) | 1.2 (4) |
| CPVC | 6.1 x 10-5 (3.4 x 10-5) | 6.1 (0.41) | 1.4 (4.5) |
| PVC | 7.0 x 10-5 (4.0 x 10-5) | 7.0 (0.48) | 1.4 (4.5) |
| Copper | 0.5 x 10-5 (0.9 x 10-5) | 0.5 (0.11) | 1.5 (5) |
| Stainless | 0.4 x 10-5 (0.7 x 10-5) | 0.4 (0.08) | 1.5 (5) |

For more information, please contact:
System Sensor
3825 Ohio Avenue
St. Charles, Illinois 60174
1-800-sensor2
www.systemsensor.com

SYSTEM SENSOR®