FAAST FLEX™ REFRIGERATED STORAGE DESIGN GUIDE

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Convention	Description
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Italics	Used to denote: references to other parts of this document or other documents. Used for the result of an action

The following icons conventions are used in this document.

Convention	Description
	Caution: This icon is used to indicate that there is a danger to equipment. The danger could be loss of data, physical damage, or permanent corruption of configuration details.
	Warning: This icon is used to indicate that there is a danger of electric shock. This may lead to death or permanent injury.
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Preface

This Design Guide provides guidelines for the most effective deployment and operation of the FAAST FLEX in refrigerated storage environments:

- Freezers -40°C to -15°C (-40°F to 5°F).
- Chillers -9°C to 2°C (16°F to 36°F).
- Coolers and Loading Bays 0°C to 18°C (32°F to 65°F).

Notes!

- FAAST FLEX Operation Temperature: -40 °C to 55 °C (-40°F to 131°F) and humidity 10-93% RH, non-condensing.
- The information contained in this Design Guide should be used in conjunction with local fire codes and standards and the FAAST FLEX Product Guide. Where applicable, industry practices should also be adhered to.
- Reliable operation of FAAST FLEX detectors may be compromised in refrigerated storage areas experiencing heavy icing. Proper assessment of the area should be undertaken prior to installing FAAST FLEX detector and pipe networks.

Contents

1 Background Information

1.1 Fire Safety Considerations in Refrigerated Storage Areas

Major fire risks in a refrigerated storage facility arise from the following:

- Electrical, mechanical faults in conveyor and other transport equipment
- Electrical equipment, wiring and other equipment housed in the roof space
- The lighting system
- Hot spots resulting from maintenance operations
- Arson

1.2 Performance-Based Design

The Performance-Based Design (PBD) approach enables fire protection systems to be tailored to the specific requirements of each refrigerated storage environment taking into consideration air change rates, temperature/humidity, and space shape/geometry. PBD provides evidence to justify divergence from prescriptive requirements, in cases where there are practical limitations or a need for an improved level of fire protection. For example, sampling holes location and spacing dictated by prescriptive codes, in a PBD approach, can be altered to meet particular design objectives.

Guidelines for using Performance-Based Design and risk management concepts include:

- AS/NZ 4360 Risk Management Standard.
- SFPE Handbook of Fire Protection Engineering.
- International Fire Engineering Guidelines.
- British Standard BS7974.
- SFPE Engineering Guide to Performance-Based Fire Protection.

Note!

The SFPE Code Officials' Guide to Performance-Based Design Review is a good source of information for Authorities Having Jurisdiction reviewing and assessing a PBD design for the FAAST FLEX system.

1.3 Key Design Considerations

The following should be considered when designing FAAST FLEX for refrigerated storage facilities:

- What level of protection is required and how will fire safety be managed?
- What temperature range are sampling pipes subject to?
- Are there likely to be future changes to the function of the area due to demand or operational needs?
- What are the airflow characteristics of the protected areas, entrances and loading bays?
- What effects might defrost cycles and associated condensation have on fire protection?

Note!

Reliable operation of FAAST FLEX detectors may be compromised in areas experiencing heavy icing. Proper assessment of the area should be undertaken prior to installing FAAST FLEX detectors.

1.4 Levels of Protection

1.4.1 Smoke Detection

Due to large fuel loads in refrigerated storage facilities, fires would produce toxic and corrosive smoke that would damage assets and endanger personnel. Further, highly flammable insulating panels would produce high intensity heat causing fires to spread quickly from one area to another. Table 1 provides guidelines for areas in a refrigerated storage facility that are essential to protect:

Table 1: Guidelines for areas to be protected

Area	Essential	Recommended	Optional
Freezers/Chiller Rooms	✓		
Coolers	✓		
Plant and Maintenance Areas	✓		
Return Air Grills		✓	
Loading Bays	✓		
Administration Areas			✓
Ceiling/Roof Voids	✓		
Within Racks			✓

1.4.2 Gas Detection

The VESDA Sensepoint XCL gas detector connects to the FAAST FLEX pipe network and provides multi-hole sampling for gas threats:

- Monitoring for refrigerant (NH_3, CO_2) leakage in chiller plants.
- Monitoring for vehicle emissions (CO, NO_2) in loading bays for occupant safety.

For further information refer to the Data Sheet (Doc. 35553) and Installation Manual (Doc. 35563).

Note!

VESDA Sensepoint XCL operating temperature −20 to 50 °C (−4 to 122 °F) and Humidity 0 to 99% (non-condensing)/ Flammable catalytic version 10 to 90% RH.

1.5 Pipe Material

Temperature range and thermal properties for different pipe materials is shown in Table 2.

Table 2: Properties and recommended applications for pipe materials

Material	Operating Temperature	Linear Thermal Contraction/Expansion
PVC	-18°C to 49°C (-40 to 120°F)	7.0 mm per 10 m per 10°C (0.28” per 32.8 ft per 18°F)
HFT	-40 to 140°C (-40 to 284°F)	7.0 mm per 10 m per 10°C (0.28” per 32.8 ft per 18°F)
ABS	-40 to 80°C (-40 to 176°F)	10.1 mm per 10 m per 10°C (0.4” per 32.8 ft per 18°F)
CPVC	-18 to 94°C (0 to 201°F)	6.7 mm per 10 m per 10°C (0.26” per 32.8 ft per 18°F)
PE-80	-50 to 60°C (-58 to 140°F)	20 mm per 10 m per 10°C (0.79” per 32.8 ft per 18°C)
PE-100	-50 to 60°C (-58 to 140°F)	13 mm per 10 m per 10°C (0.52” per 32.8 ft per 18°F)

1.6 Positioning Pipes and Sampling Holes

Sampling hole locations are represented by a grid like that shown below (Figure 1). The letter X represents the sampling hole spacing required according to local codes and standards.

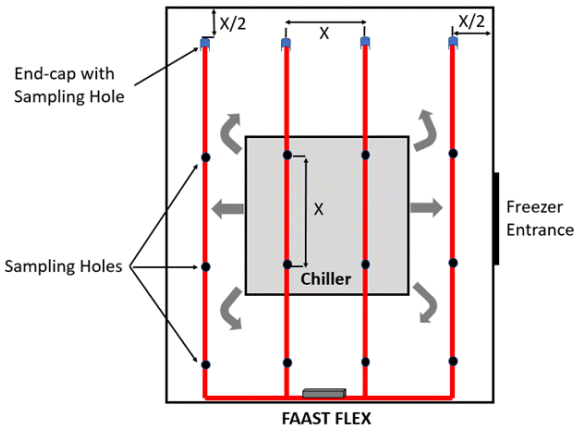


Figure 1: FAAST FLEX sampling holes grid layout

Depending on the effectiveness and frequency of defrosting management, ice will build up around chillers jet stream and entrances causing sampling holes to block. Ice build-up can be mitigated by the following:

- Placing sampling holes as far away from entrances as legally permitted by local codes / standards.
- Placing sampling holes away from the chillers jet streams.

Notes!

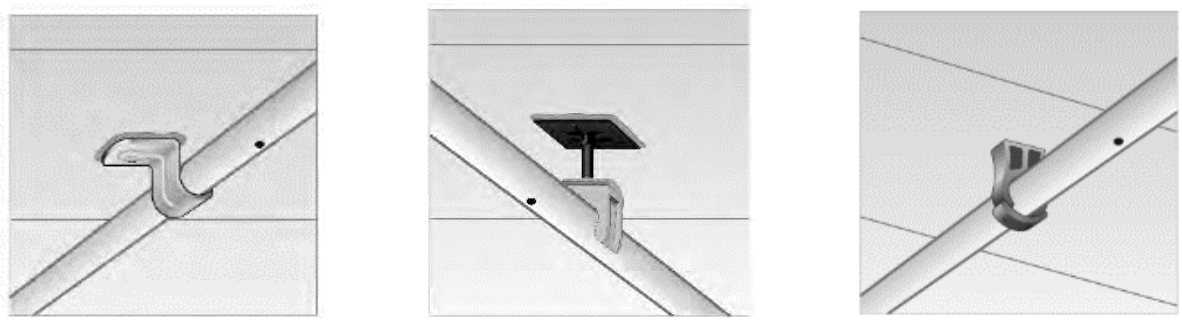
- FAAST FLEX pre-engineered pipe networks or PipeIQ shall be used for all pipe network designs.
- Sampling holes diameter MUST be larger than 3 mm (1/8 inch).

1.7 Compensating for Sampling Pipe Contraction

To prevent pipe disconnections, make allowance for pipe contraction along the length of the pipes. Mounting clips, used to secure sampling pipes MUST not restrict longitudinal movement of the pipes as they expand or contract from temperature variations (Figure 2).

Notes!

Refer to Table 2 for the thermal properties of other commonly used pipe materials.



Saddle Clip *Offset Clip* *Pipe Clip (UK)*

Figure 2: Examples of pipe network support using mounting clips

Notes!

Pipe mounting clips MUST not be positioned next to pipe joiners and MUST be more than 0.3 m (1 ft) from end caps.

1.8 In-rack Protection

In most cases, placing a FAAST FLEX sampling pipe network on the ceiling is all that is needed. However, sampling pipes can also be positioned along the racks for localised detection (Figure 3).

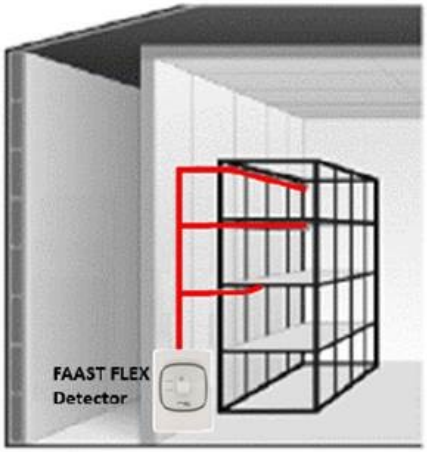


Figure 3: Example of in-rack air sampling

1.9 Ceiling Void Protection

Early smoke detection is essential in refrigerated storage ceiling voids to protect against fires in power distribution lines, refrigeration and mechanical equipment housed in these spaces. The sampling hole spacing is according to the grid presented in Figure 4.

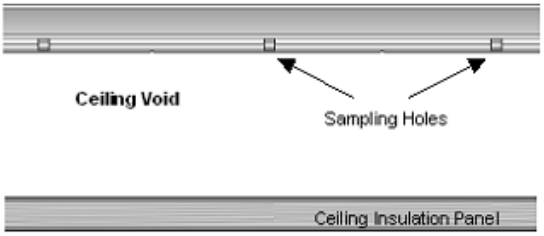


Figure 4: Example of ceiling void air sampling

FAAST FLEX detectors that protect the ceiling void MUST be configured as individual fire zones. Ceiling void pipes MUST NOT enter other areas, nor should ceiling void detectors be used to simultaneously monitor areas outside the ceiling void.

2 Preventing Ice Build-up

2.1 Ice Build-up on Sampling Pipe

Occasionally, ice may form on the exterior of sampling pipes close to entrances. This ice build-up has no adverse effect on the operation of the FAAST FLEX system, provided the sampling holes are not blocked. To remove ice build-up on sampling holes a blow-back method with compressed air is recommended – see section 3.2 Blow-Back Air System.

2.2 Ice Build-up Inside Sampling Pipes

To minimise ice plug formation inside sampling pipes, ensure sampling pipes are not installed in the direct path of the chiller's jet stream. If for practical reasons, this cannot be avoided, the pipe MUST be insulated as shown below (Figure 5).

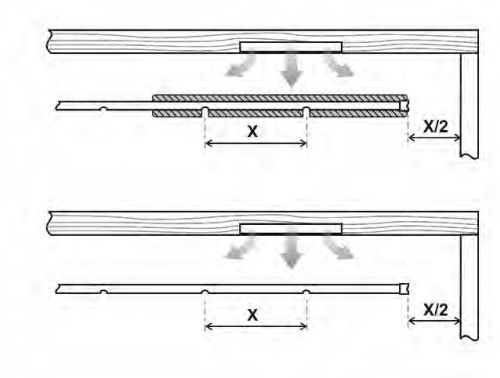


Figure 5: Example of pipe insulation within chiller jet stream (top is a good design)

Note!

Sampling pipes MUST NOT run from a high temperature area into a lower temperature area. Separate FAAST FLEX detectors should be installed in the chiller, cooler, ceiling void, and loading bays.

2.3 Sampling Hole Clips

Sampling hole clips deliver reliable and accurate sampling hole sizes that are fast to install and easy to locate and identify. Each clip is colour-coded to indicate a specific hole diameter providing an instant visual guide and removing the need for closer inspection.

The sampling hole clips are suitable for temperatures down to -40°C (-40°F) and are designed to flex to remove ice build-up when subjected to compressed air. For further details on installation, refer to the Data Sheet (Doc No. 35192).

Figure 6: Sampling Hole Clips

Note!

For effective ice build-up removal apply 14KPa pressure inside the pipe through the sampling hole clip. Refer to section 3.2 Blow-Back Air System on setup specification.

3 Installation Considerations

3.1 Water Trap

The water trap is intended to capture water condensate (when refrigerated area is bought to ambient temperature) inside the sampling pipe and prevent it from entering the detector.

The water trap consists of a transparent pipe connected to a Tee section before the inverted detector. The transparent pipe provides a visual indication of the level of water and has a stop valve (or end cap) at the end to drain the water.

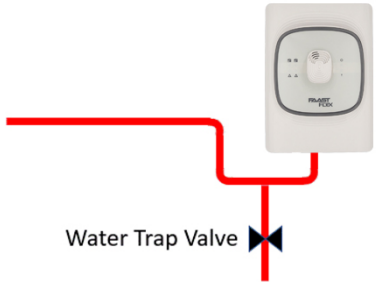


Figure 7: Example of a water trap

Note!

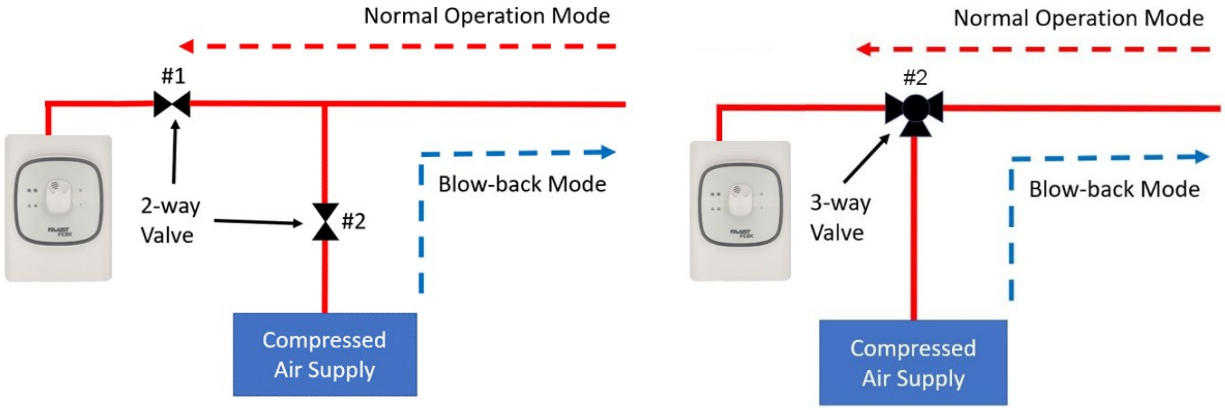
Water trap stop valves (or end caps) MUST be closed as soon as the water has been drained. Leaving the pipe open will compromise smoke detection.

3.2 Blow-Back Air System

Blow-back (compressed) air is used to remove ice build-up at sampling holes. The blow-back system comprises a compressed air supply (air compressor) connected to the pipe network. Two arrangements can be used: (i) 2 x 2-way valves, (ii) 3-way valve (Figure 8):

2 x 2-way valves Setup: Normal Operation Mode; valve #1 is open, valve #2 closed. Blow-back Mode; valve #1 closed, valve #2 open.

3-way valve Setup: A 3-way valve is used to direct the flow between *Normal Operation* and *Blow-back* modes. The Automatic Purging Unit F-BO-AFE70 can be used in-lieu of the 3-way valve. For further information refer to Data Sheet (Doc. no. 32976).



2 x 2-way valves *3-way valve*

Figure 8: Blow-back arrangement

Notes!

- The pipe ends must be solvent glued onto the valve's end connectors. The valves should provide a non-restrictive path to the air flow. This can be verified by ensuring the internal effective diameter (not ports) of the valves is similar to the internal diameter of the sampling pipe. A deviation less than 10% is accepted.
- The blow-back system can be setup for manual or automatic operation. For automatic operation, the de-energised state of valve(s) should default to the Normal Operation Mode at power failure.

The blow-back frequency will depend on the occurrence of ice build-up. The following steps will assist in identifying the appropriate blow-back frequency:

1. Following 1 month in Normal Operation, perform a smoke transport time test and note the time to detector response.
2. Set pipe network to Blow-Back Mode.
3. Apply compressed air (300 to 500kPa) for a 4min period.
4. Set pipe network to Normal Operation Mode.
5. Perform a smoke transport time test and note the time to detector response.
6. A deviation in excess of 15% in smoke transport time between Step 1 and 5 results will denote the appropriate interval for the blow-back activity. If deviation is less than 15% repeat above steps ensuring that with each repeat the duration of the FAAST FLEX system operation is increased by a one month interval. For example: 2 months for the first repeat, 3 months for the second repeat, etc.

Note!

Compressed air can introduce moisture in the pipe resulting in the formation of ice plugs. To prevent ice plug formation, the air intake for compressed air should be taken directly from the refrigerated area. If this is not possible, the compressed air can be dehumidified with a regenerative air dryer – it is recommended the conditioned air dew point temperature is 10°C (18°F) below the coldest temperature in the refrigerated area.

3.3 System Commissioning

For new refrigerated storage facility, it is preferable the FAAST FLEX detectors powered up and running while the refrigerators are being commissioned. This allows the detectors to gradually adjust to the lower temperatures.

Once the FAAST FLEX system has been installed, perform smoke transport time test at the operating temperature of the refrigerator storage facility.

Note!

It may be necessary to construct enclosures around detectors to protect them from mechanical damage.

3.4 Service and Maintenance

The FAAST FLEX system shall be serviced and maintained according to both the local codes and standards and the instructions provided in the Maintenance section of the FAAST FLEX Product Guide.

The frequency of sampling pipe inspection and testing can be determined by the rate of ice build-up to ensure that sampling holes do not become blocked.

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4 References

- FAAST FLEX Product Guide (Document no. 36639).
- NFPA Fire Analysis & Research Division (2003) Selections from the U.S. fire problem overview report. Leading causes and other patterns and trends Storage properties excluding dwelling garages.
- Australian Standard AS/NZ 4360 Risk Management Standard.
- SFPE Handbook of Fire Protection Engineering, 4th Edition.
- International Fire Engineering Guidelines.
- British Standard BS 7974 Application of Fire Safety Engineering Principles to the Design of Buildings – Code of Practice.
- SFPE Engineering Guide to Performance-Based Fire Protection Analysis and Design of Buildings.
- SFPE & ICC The Code Officials' Guide to Performance-Based Design Review.
- The Plastics Pipe Institute, Inc. Suggested Temperature Limitations for the Operation and Installation of Thermoplastic Pipes in Non-pressure Applications, TN-11/99. http://www.plasticpipes.org.
- PPFA Information & Technical Guide – ABS Pipes & Fittings, www.ppfahome.org.
- Clipsal HFT Conduits & Fittings, www.clipsal.com.
- Fisher, G. Planning Fundamentals Industrial Piping Systems, www.piping.georgefisher.com.
- ASHRAE Psychometric Chart, http://www.ashrae.com.

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