FAAST FLEX™ LIFT/ELEVATOR SHAFT APPLICATION NOTE

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Preface

This Application Note outlines the use of FAAST FLEX Aspirating Smoke Detector (ASD) for lift/elevator shaft spaces. The information contained in this document will assist you when designing an FAAST FLEX ASD system for this type of application.

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Contents

1 Introduction

Lifts/elevators have contributed to the development of high-rise buildings by providing a safe and fast mode for people transportation. However, from a fire-engineering perspective lifts/elevators present a risk in the event of a fire by providing a ready path for the spread of heat, smoke and toxic gases to other floors of the building. Major fires such as the MGM Grand Hotel and Casino (1980) and First Interstate Building in the US (1988) started on lower floors but the majority of fatalities occurred at the upper floors where heat and smoke spread via the lift/elevator shafts.

The fire hazards to building occupants associated with the lifts/elevators design and operation are as follows:

- Lift/elevator shafts act as vertical channels for the spread of heat, smoke and toxic gases to other floors of the building.
- Transient pressures inside the shaft caused by elevator car motion “piston effect” will enable smoke to infiltrate the shaft and spread to other floors of the building.
- In the event of a fire lift/elevators might entrap occupants.

Increasingly, however, lifts/elevators are being considered both a means of timely evacuation for all building occupants (including disabled, mobility impaired, casualties) and a way of transporting fire fighters and emergency equipment closer to the fire incident for search & rescue and suppression efforts. This “evolution” in lifts/elevator utility can only be materialised through the introduction of innovative fire safety requirements such as shaft compartmentation, lift/elevator recall and smoke management to prevent smoke infiltration into the shaft and to other floors. In line with these requirements smoke detection system have been considered to actuate smoke relief equipment in shafts, recall cars before sprinkler actuation causes a shunt trip and provide recall feature to move cars away from a fire.

Lift/elevator shafts present a more challenging environment than that normally associated with a working environment within a building such as:

- Higher levels of dust and contamination exist that will affect the reliable operation of fire/smoke detection system.
- Maintenance of fire/smoke detection system installed in shafts require lifts/elevators to be non-operation mode which will affect service levels in the building.
- Airflows created by the piston effect, stack effect and wind effect will increase dispersion and dilution of smoke in the shaft making detection for point-type detectors a challenge.

Whether a prescriptive or Performance-Based design method is adopted, early and reliable detection of fire/smoke in the lift/elevator shaft it critical for the safe evacuation of building occupants.

2 Why Use FAAST FLEX?

The benefits of using a FAAST FLEX system for lift/elevator shaft protection are as follows:

- FAAST FLEX detector can be mounted external to the lift/elevator shaft providing direct access for maintenance and testing. This will allow for normal lift/elevator operation during maintenance, faster servicing times (lower servicing costs) and eliminates the need for having a lift technician on-site for fire system maintenance purposes.
- Continued reliable smoke detection by the FAAST FLEX system allows the possibility of using lifts/elevators as part of the evacuation process.
- The active aspiration system accommodates the varying air flows and pressure differentials.
- Particle filtration ensures reliable operation in high levels of contamination.
- Multiple sample holes (cumulative sampling) deliver increased flexibility and performance in detecting smoke in both stagnant and high airflow situations (i.e. moving elevator car).
- The FAAST FLEX ASD is blue-tooth enabled for remote configuration and monitoring.

3 Designing for Effective Fire Protection

Below are the primary elements to consider during the design process of a FAAST FLEX system in a lift/elevator shaft. Xtralis recommends the use of FAAST FLEX detector for reliable operation against high contamination levels.

3.1 Pipe Network / Sample Holes

For buildings up to 4 floors, it is recommended to place sample holes at the top of the shaft and upstream from smoke vents if present (Figure 1). Sample holes should have a 30° orientation to the direction of the air flow across the vent. For setup of “Maintenance Test Hole” refer to section 4 “Commissioning and Maintenance”.

For buildings greater than 4 floors, it is recommended to place sample holes at the top of the shaft and at each floor level (Figure 2). Sample holes along the shaft should be placed at one corner of the shaft approximately 0.5m above the height of the elevator door.

Where dampers (top or bottom of shaft) or vents are used to relieve shaft pressure or remove smoke, the sample pipe should be placed upstream the damper or vent with sample holes at a 30° orientation to the direction of the air flow (Figure 3).

Where the machine room is separate from the lift/elevator shaft it is recommended the FAAST FLEX with 2 pipe inlets detector is employed for protection of both areas. The addressable features of the detector will ensure to pinpoint any event of fire (Figure 4).

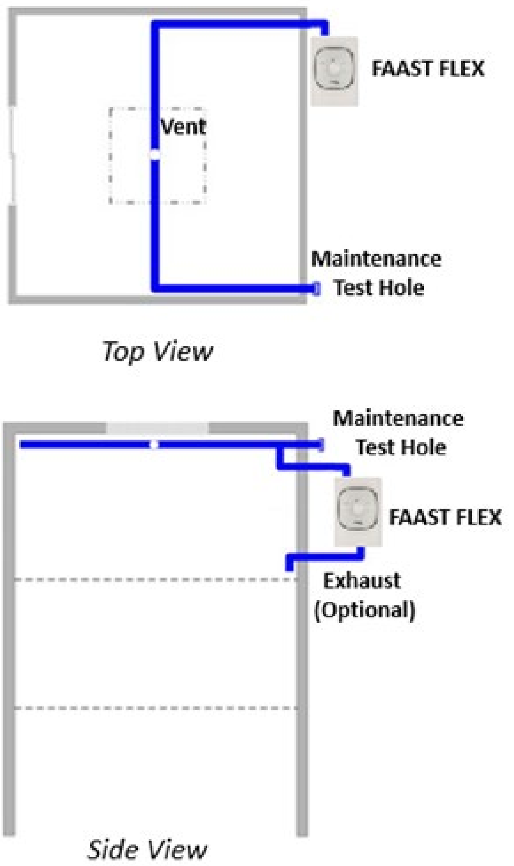


Figure 1: Shaft Protection (≤4 floors)

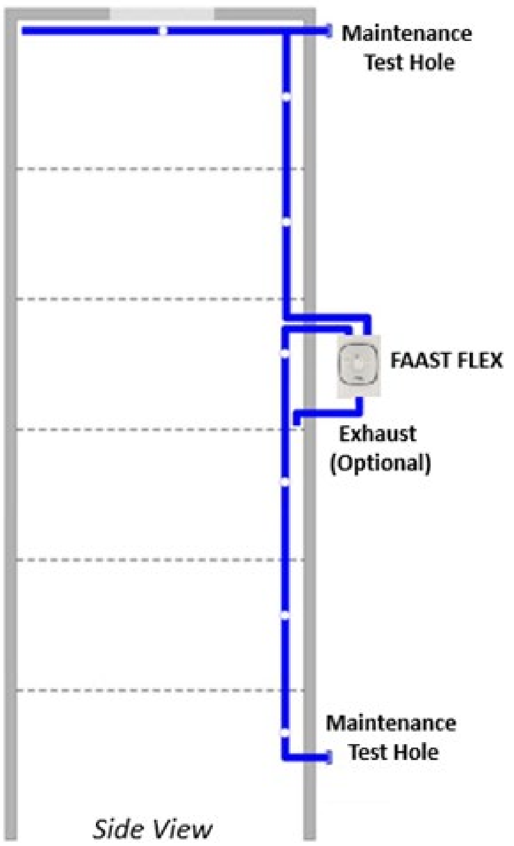


Figure 2: Shaft Protection (>4 floors)

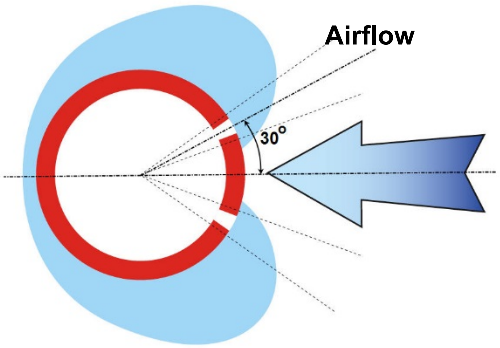


Figure 3: Sample Hole Orientation (30°) to airflow

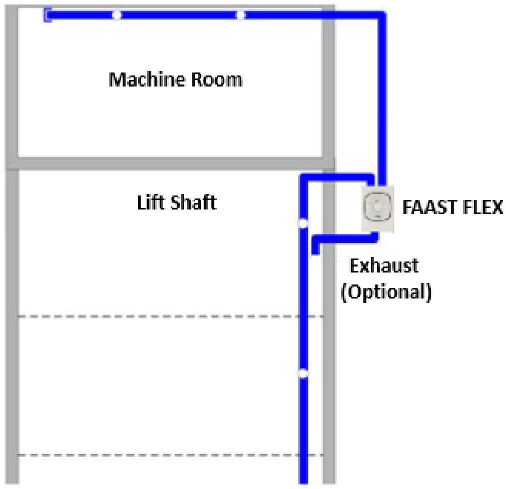


Figure 4: Machine Room / Shaft Protection

Sample holes are recommended to be placed at the shaft pit as this area normally consists of debris adding to the fuel load and inside elevator machine rooms to prevent fire damage to elevator machinery.

As shafts tend to experience higher contamination levels it is recommended sample holes be no smaller than 3 mm (1/8").

Notes!

- Consult local codes and standards on sample hole location, sitting and spacing.
- Pipe network designs must be verified by Xtralis pre-engineered designs or the Pipe Network Modelling Tool (PipeIQ). Smoke transport times should be within the requirements of national codes and standards.

3.2 Shaft Pressure Effects

Important factors to consider for reliable FAAST FLEX system operation include designing against transient pressure differentials caused by elevator piston effect, stack effect (normal, reversed), wind effect.

- *Stack effect*: caused by the temperature differential between the interior of the building and outside air. When it is cold outside there is an upward movement of air within shafts (normal stack effect). Downward flow of air occurs in air conditioned buildings when it is hot outside (reverse stack effect).
- *Wind effect*: the pressure from the wind causes a flow of air into the building on the windward side that might travel through the shaft.

To ensure reliable operation against these transient pressures it is recommended that:

- The FAAST FLEX detector exhaust pipe is directed back into the shaft with the open-end pipe facing downward.
- Applying a delay for the flow alarm signal (alarm delay determined on a case-by-case basis depending on speed of elevator car, presence of pressure relies vents, leakage).

3.3 Contamination

FAAST FLEX detector incorporate internal mesh filter to overcome the effect of contamination experienced in lift/elevator shaft and elevator machine rooms. In shafts that experience particularly high levels of contamination it is recommended that an Xtralis In-Line filter is used. For further information refer to the Xtralis In-Line Filter Application Note (Doc No. 17785).

The in-line filter should be placed in an accessible location for easy access for maintenance.

4 Commissioning and Maintenance

The Commissioning process is designed to check and validate the FAAST FLEX system such as the performance and sample pipe network integrity. Smoke tests are used to test the following:

- System performance – detection performance against large scale fire tests under various lift/elevator operational modes (stationary, in-motion).
- Verification of PipeIQ smoke transport times or pre-engineered designs.
- Alarm (Fire, fault) signal relay to Fire Indicating Panels (FIP).

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

One benefit of FAAST FLEX system is that maintenance of the system is performed at an accessible location (both for the detector and sample pipe network). With regard to sample pipe network, smoke transport time tests can be performed through a "maintenance test hole" at an accessible location by extending the sample pipe outside the shaft. The design concept is shown below (Figure 5). Two points are noted:

- Point 1 is the last sample hole during "normal operation".
- Point 2 is either:
  - A blocked end-cap fitted for the "normal operation" of the FAAST FLEX system.
  - The "maintenance test hole" (4 mm (5/32")) fitted for smoke transport time test.

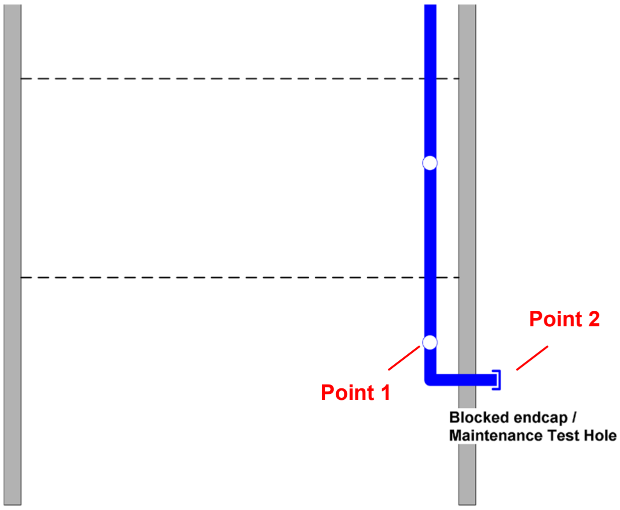


Figure 5: FAAST FLEX ASD pipe network – Maintenance

During commissioning two separate smoke transport time tests should be performed:

- At Point 1 (Point 2 comprises a blocked end-cap): This measurement validates the compliance of the "normal operation" of the FAAST FLEX system to regulatory requirements.
- At Point 2 (Point 2 comprises the maintenance test hole). This measurement is conducted during Commissioning and for subsequent Maintenance activities. Consistent smoke transport time measurements will indicate stable flow conditions and, thus, the compliance of the "normal operation" of the FAAST FLEX system to regulatory requirements.

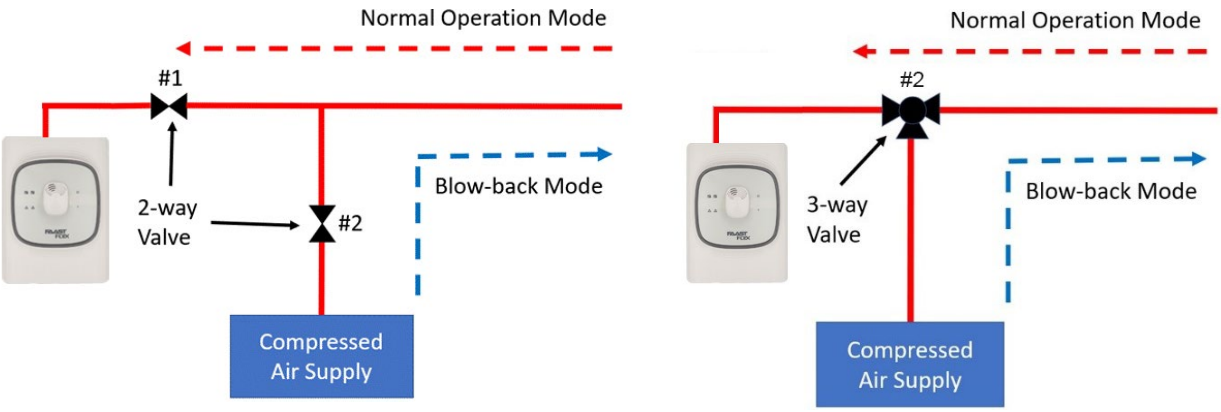
Sampling holes inside the shafts can be cleaned by with compressed air; the frequency of cleaning will depend on the contamination level of the shaft. Refer to section 4.1 "Blow-Back Air System".

4.1 Blow-Back Air System

Blow-back (compressed) air is used to remove dust 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 6).

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 6: 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 resort to the Normal Operation Mode at power failure.

The blow-back frequency will depend on the occurrence of dust 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.

Contact an Xtralis office or distributor for further information.

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