

Presented by

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Multi Criteria Fire/Smoke Detector for Cargo Holds

International Aircraft Systems Fire Protection Working Group
Meeting in Phoenix AZ on March 26-27th, 2003

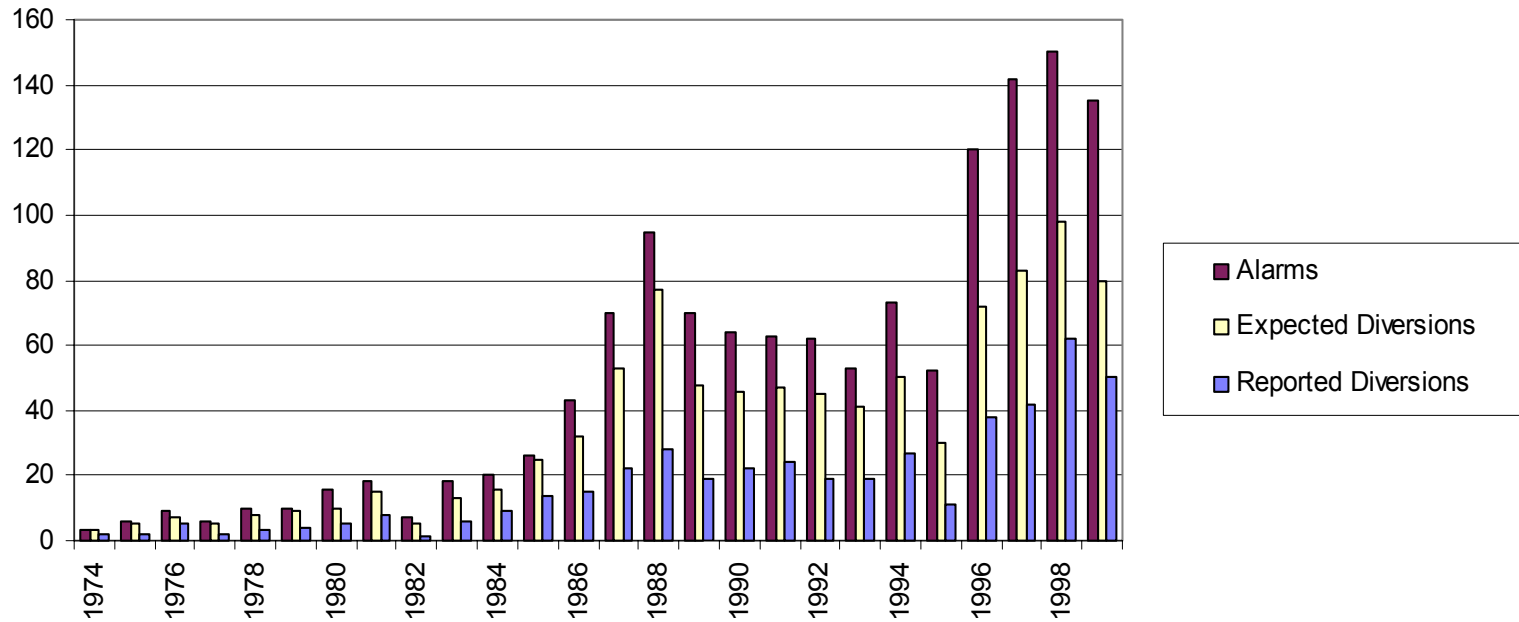
Introduction

- Cargo compt. smoke warnings require to activate the fire suppression system and to land the aircraft ASAP
- FAA investigations demonstrate that on N-registered transport aircraft (25 years period / all a/c types)
 - ▶ there was a not negligible rate of false cargo smoke warnings
 - ▶ there are more smoke warnings than expected diversions
- Each emergency landing comprises additive risks etc.
- False smoke warning are mainly caused by the freight or specific environmental conditions within the cargo holds

Background

- Diversions (all US reg. A/C's 1974 – 1999)

Diversions Caused by Cargo Compartment False Smoke Alarms



Source: FAA Report
DOT/FAA/AR-TN0029
June 2000

Reason for false cargo smoke warnings

Reason for False Warnings

- An early detection of an in-flight cargo compartment fire/smoke is mandatory to initiate the corrective action within an appropriate time
- JAR/FAR 25.858 (a) requires
The detection system must provide a visual indication to the flight crew within **one minute** after the start of the fire
- False Warning are mainly caused by the freight or specific environmental conditions within the cargo holds
- **With the 60 sec detection time requirement (FAR/JAR 25.858 (a) the system design is always a compromise between fast detection and signal reliability**

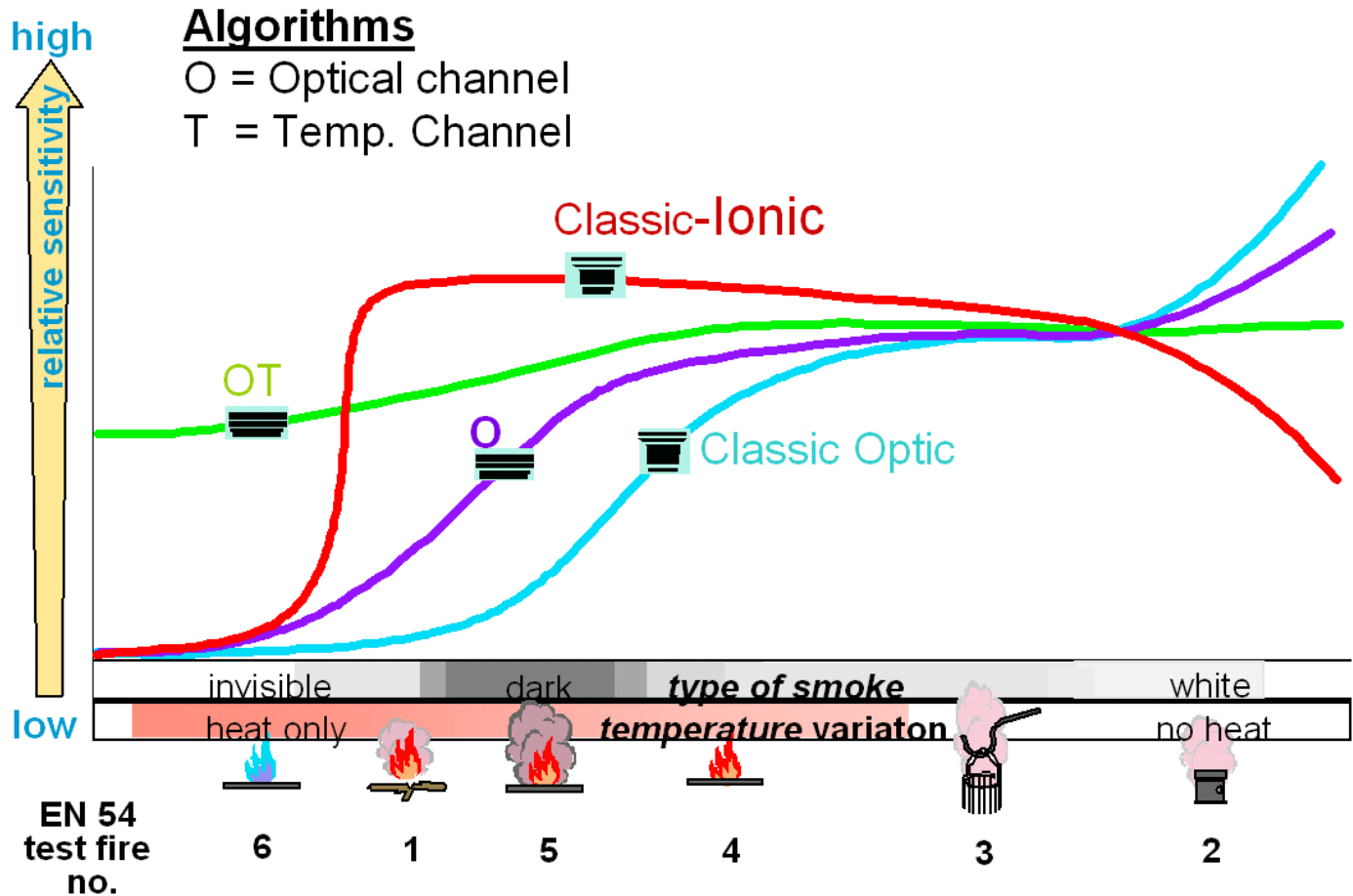
Air Freight (Palette Loading) - Lower Deck Cargo Hold



Smoke Detector Installation Example - Lower Deck Cargo Hold



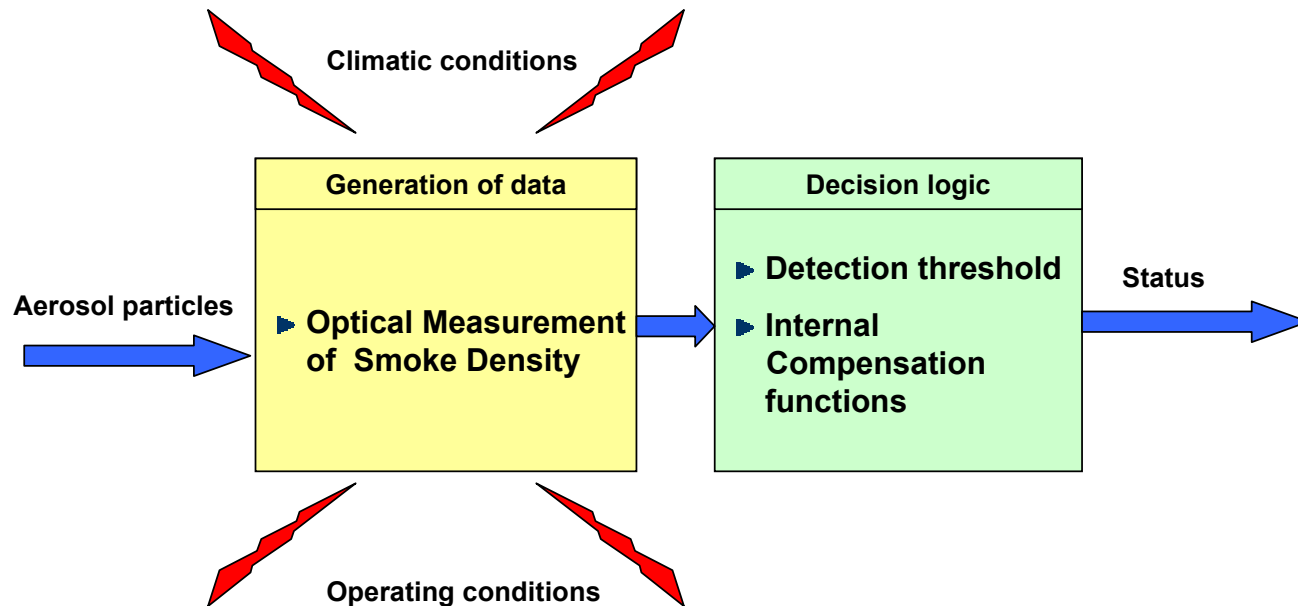
Detection characteristics in relation to detection technology



Conventional Smoke Detection – Principles and Performances

General Principle

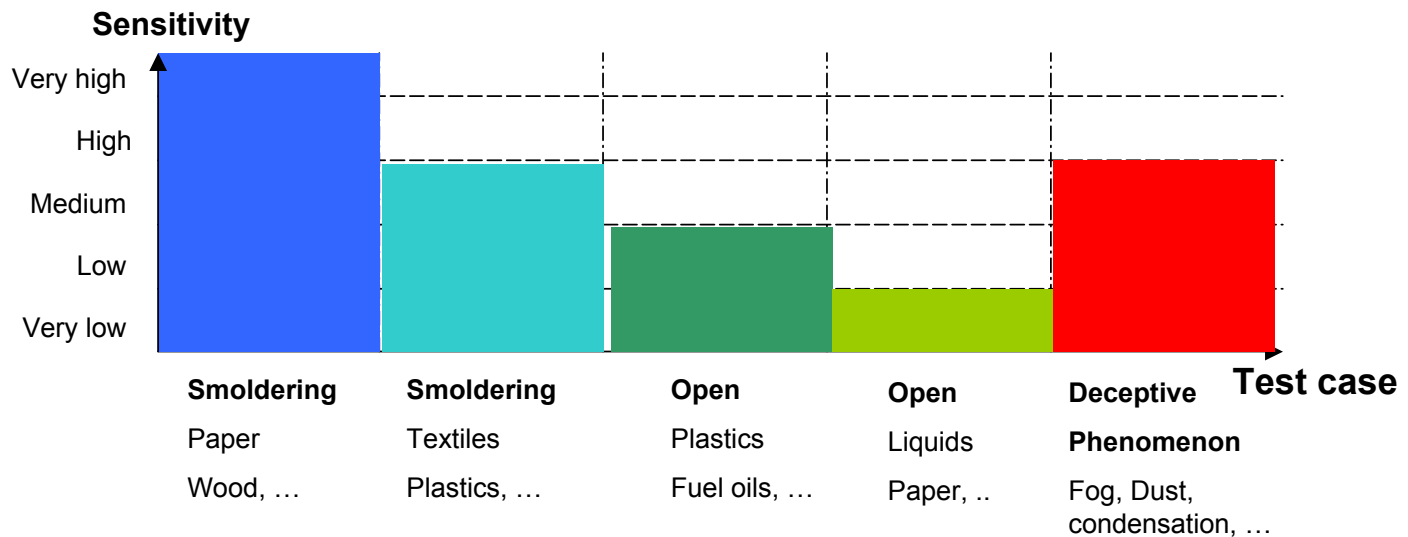
The smoke density is optically measured and compared to a threshold value for status determination, the measurements can be affected by Climatic or other operational conditions



Conventional Smoke Detection – Principles and Performances

Performances

The sensitivity of conventional smoke detectors strongly depends on the type of aerosol particles (for the same concentration)

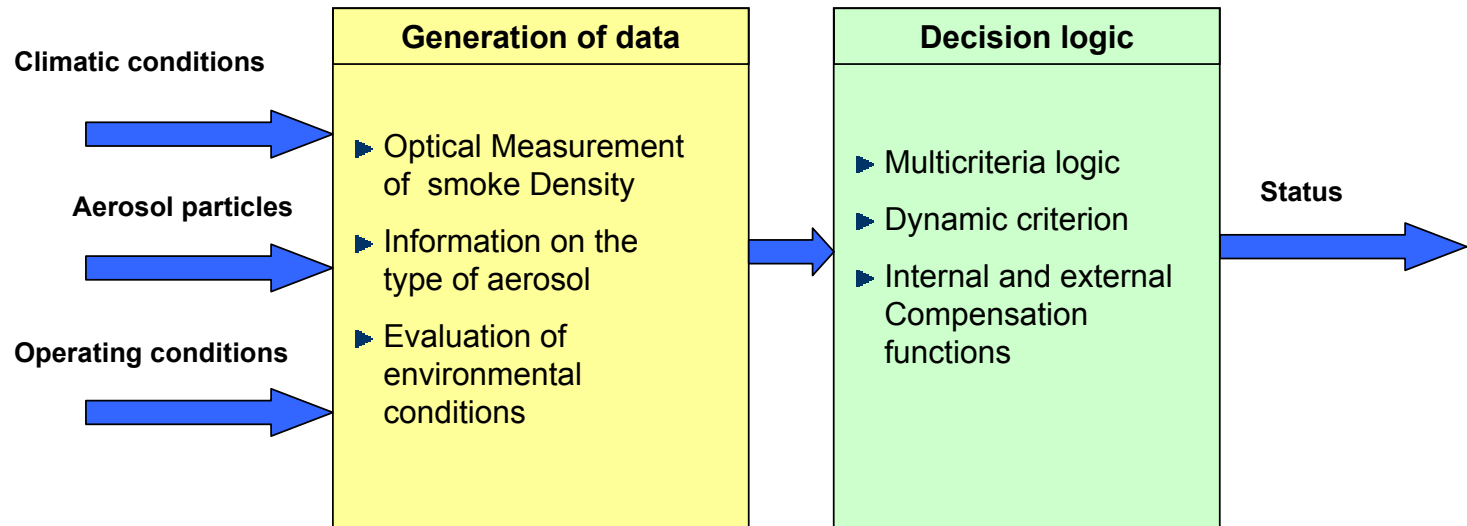


For current systems, the smoke detectors have to be adjusted so as to early detect the fire types for which their sensitivity is the lowest; making them also more sensitive to environmental conditions

Multi Criteria Smoke Detection – Principles and Performances

General Principle

Aerosol density and type are evaluated, relevant environmental conditions are determined and used in a multicriteria detection logic

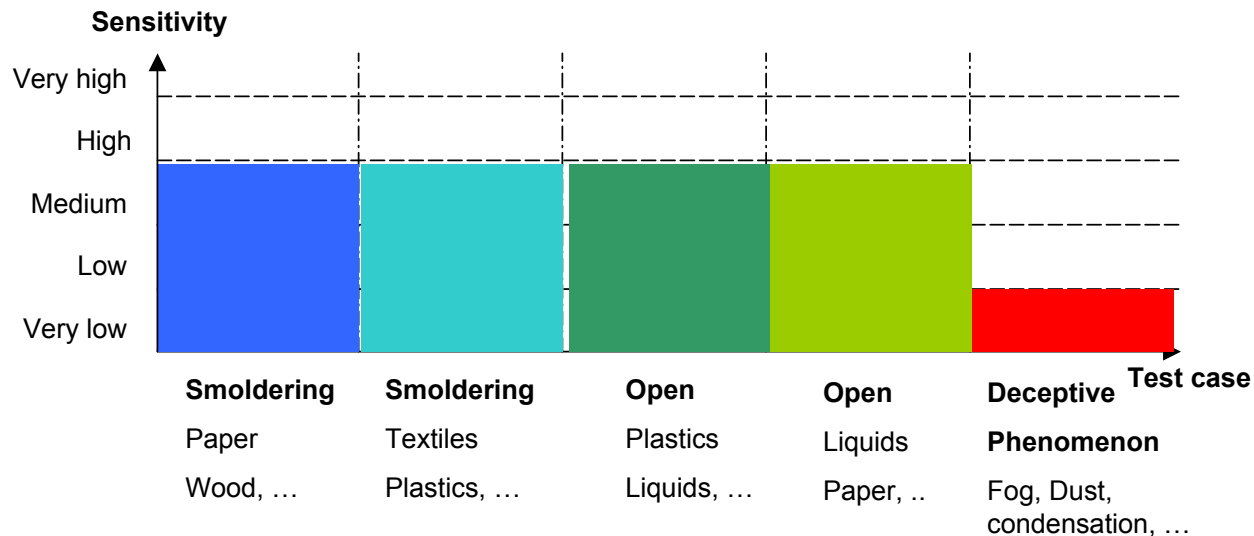


Principles are specifically developed and adapted to aircraft fire and non fire situations

MultiCriteria Smoke Detection – Principles and Performances

Performances

- Balanced response to all type of fires.
- High immunity to fog and condensation.
- Suppression of deceptive phenomenon according to new algorithm.
- Redundant measurement



The use of MultiCriteria Fire/Smoke Detectors within cargo compartments

- ▶ will enhance false alarm immunity
- ▶ could provide a more sensitive fire/smoke detection
- ▶ may need specific to type test methods on aircraft level
- ▶ requires early involvement of airworthiness authorities
- ▶ needs carefully developed & verified algorithms
- ▶

**Airbus has decided to use
MultiCriteria Fire/Smoke Detectors in A380 cargo holds**

Appendix: - EXAMPLE 1 – OPEN WOOD FIRE

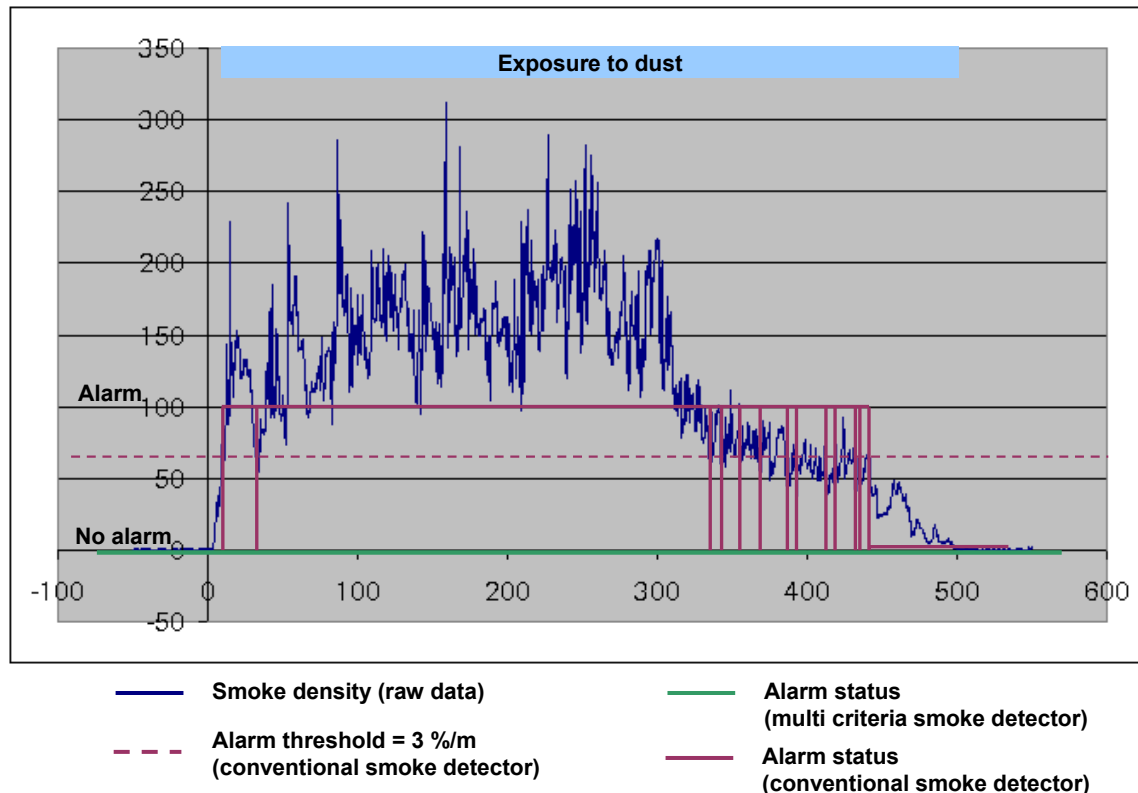
Test description Test rig dimensions = Wide body Aircraft cargo compartment
A flaming wood fire is ignited. Alarm status of smoke detector and multi criteria fire detector are reported.



— Smoke density (raw data) — Alarm status (multi criteria smoke detector)
- - - Alarm threshold = 3 %/m (conventional smoke detector) — Alarm status (conventional smoke detector)

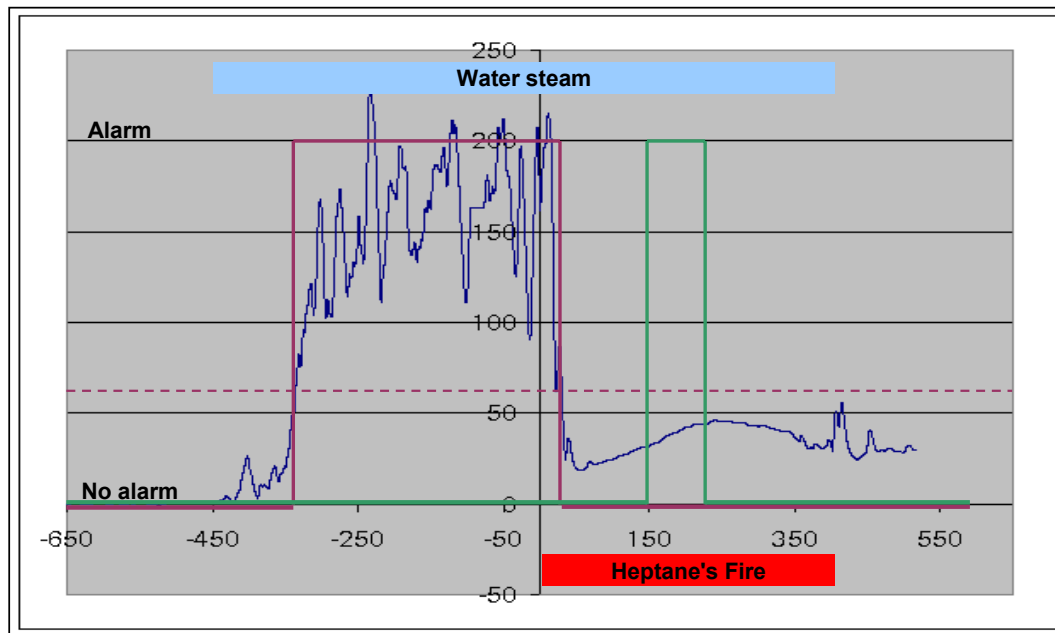
Appendix: - EXAMPLE 2 – DUST TEST

Test description Composite dust is blown at the vicinity of the detectors. Alarm status of smoke detector and multi criteria fire detector are reported.



Appendix: - EXAMPLE 3 – WATER VAPOR + LIQUID FIRE

Test description A dense water steam is first generated at the vicinity of the detectors, after few minutes a small heptane fire ($\varnothing_{\text{pan}} = 30 \text{ cm}$) is ignited. Alarm status of smoke detector and multi criteria fire detector are reported.



- Smoke density (raw data)
- Alarm status (multi criteria smoke detector)
- - - Alarm threshold = 3 %/m (conventional smoke detector)
- Alarm status (conventional smoke detector)

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