Presented by

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Multi-Criteria Fire/Smoke Detector for Cargo Holds

THE FOURTH
AIRCRAFT FIRE AND CABIN SAFETY RESEARCH CONFERENCE
Lisbon, Portugal
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Introduction

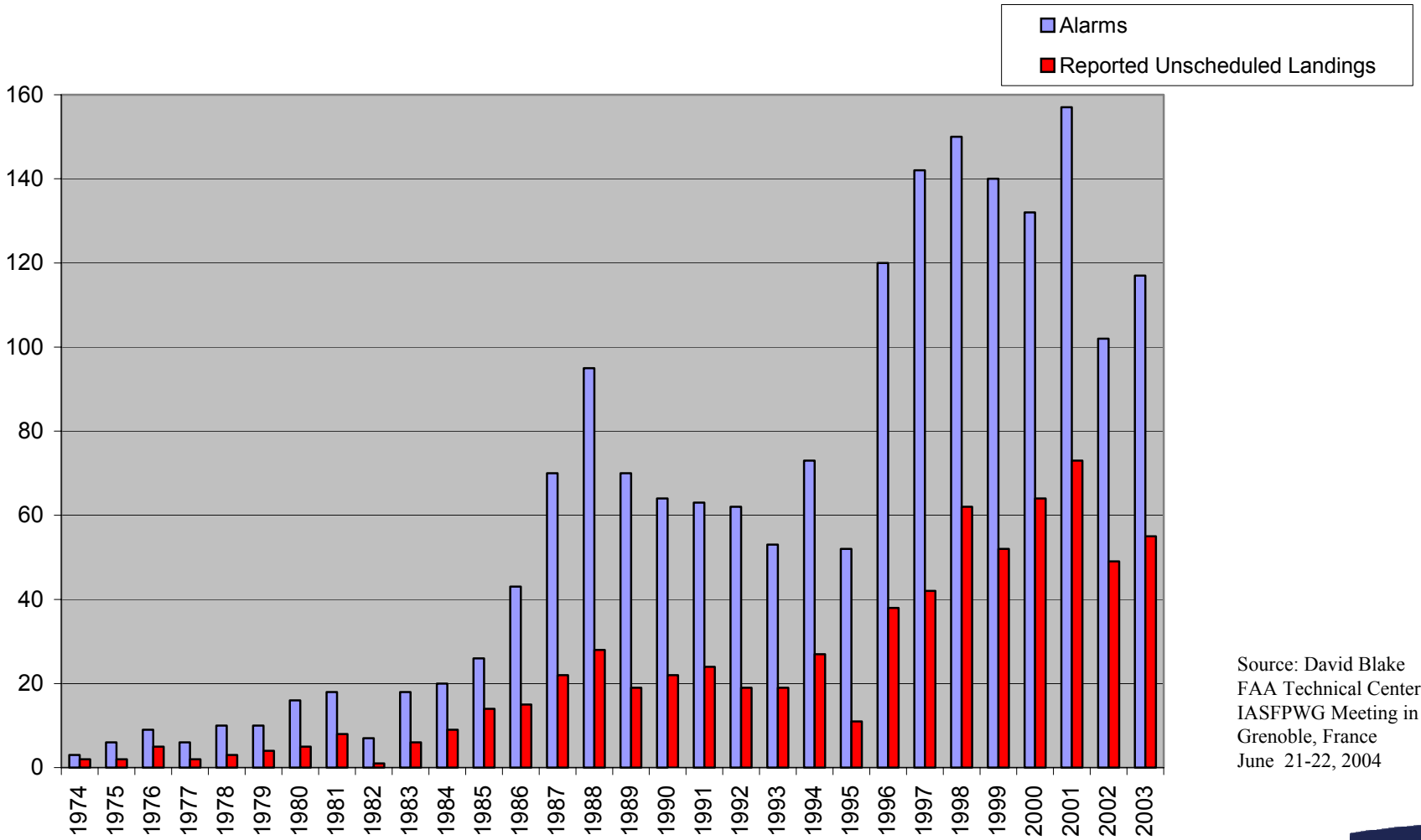
- Cargo compt. smoke warnings require to activate the fire suppression system and to land the aircraft ASAP

- FAA investigations demonstrate that on N-registered transport aircraft (30 years period / all a/c types)
  - there is a significant rate of false cargo smoke warnings (120 / year)
  - there are much more smoke warnings than reported landings
  - there is an increasing trend of unscheduled landings (60 / year)

- Each emergency landing comprises additive risks etc. …..

In Service Experience with all US registered A/C's 1974 – 2003

Unscheduled Landings Caused by Cargo Compartment False Alarms



Source: David Blake
FAA Technical Center
IASFPWG Meeting in
Grenoble, France
June 21-22, 2004

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Reason for False Warnings

- An early detection of an in-flight cargo compartment fire/smoke is mandatory
  - But false warnings are critical as well (10-100 times more often)
- JAR/FAR 25.858 (a) requires
  The detection system must provide warning within one minute
- False Warning are mainly caused by the freight or specific environmental conditions (fog, condensation, dust, altitude change …)
- 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

Smoke Detector Installation - Example Lower Deck Cargo Hold

Detectors are exposed to

- Freight specific properties
- High rate of
  - temperature changes
  - humidity changes
- Dust
- Exhaust fumes from ground loading equipment

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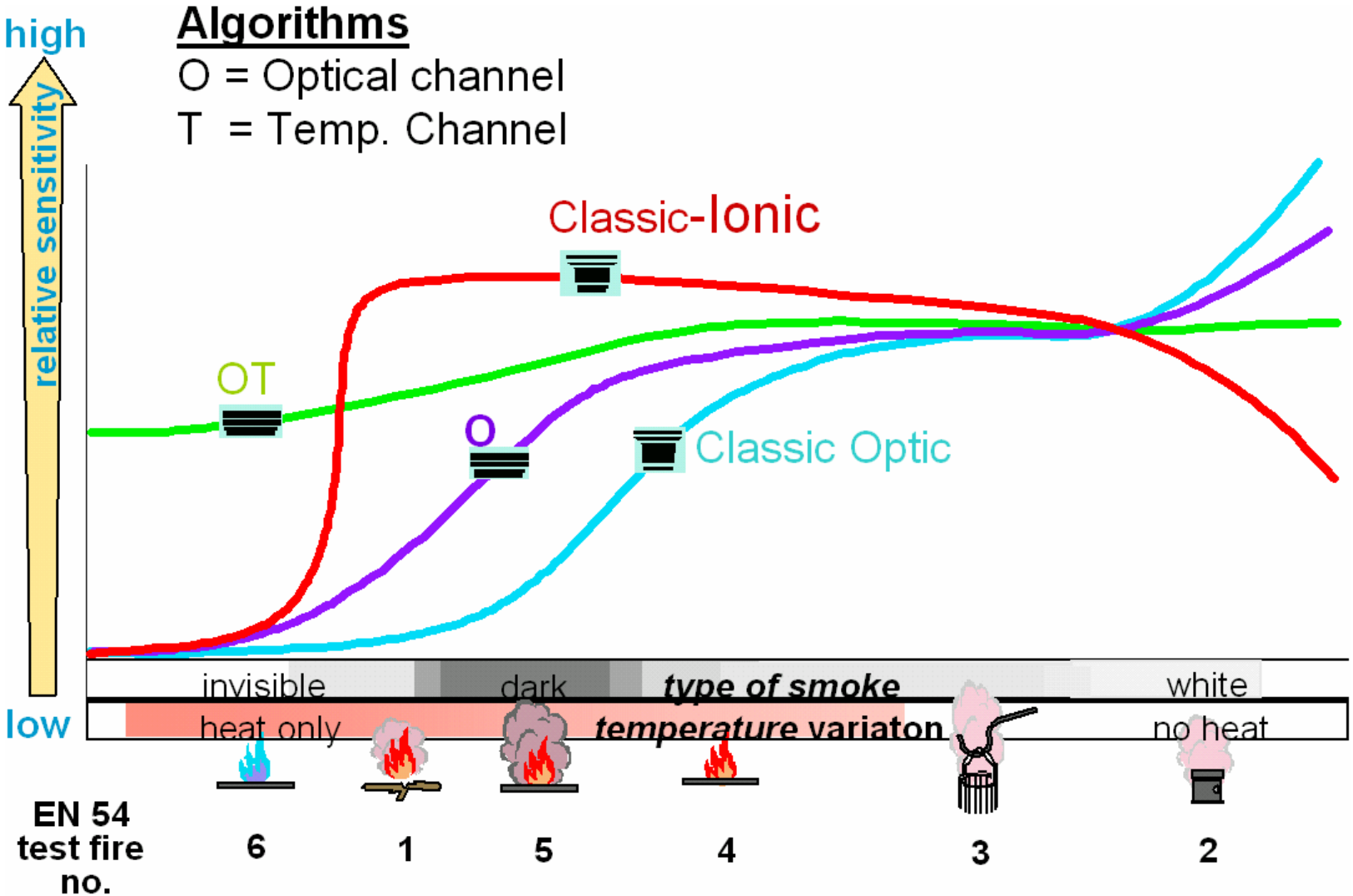
Detection characteristics in relation to detection technology



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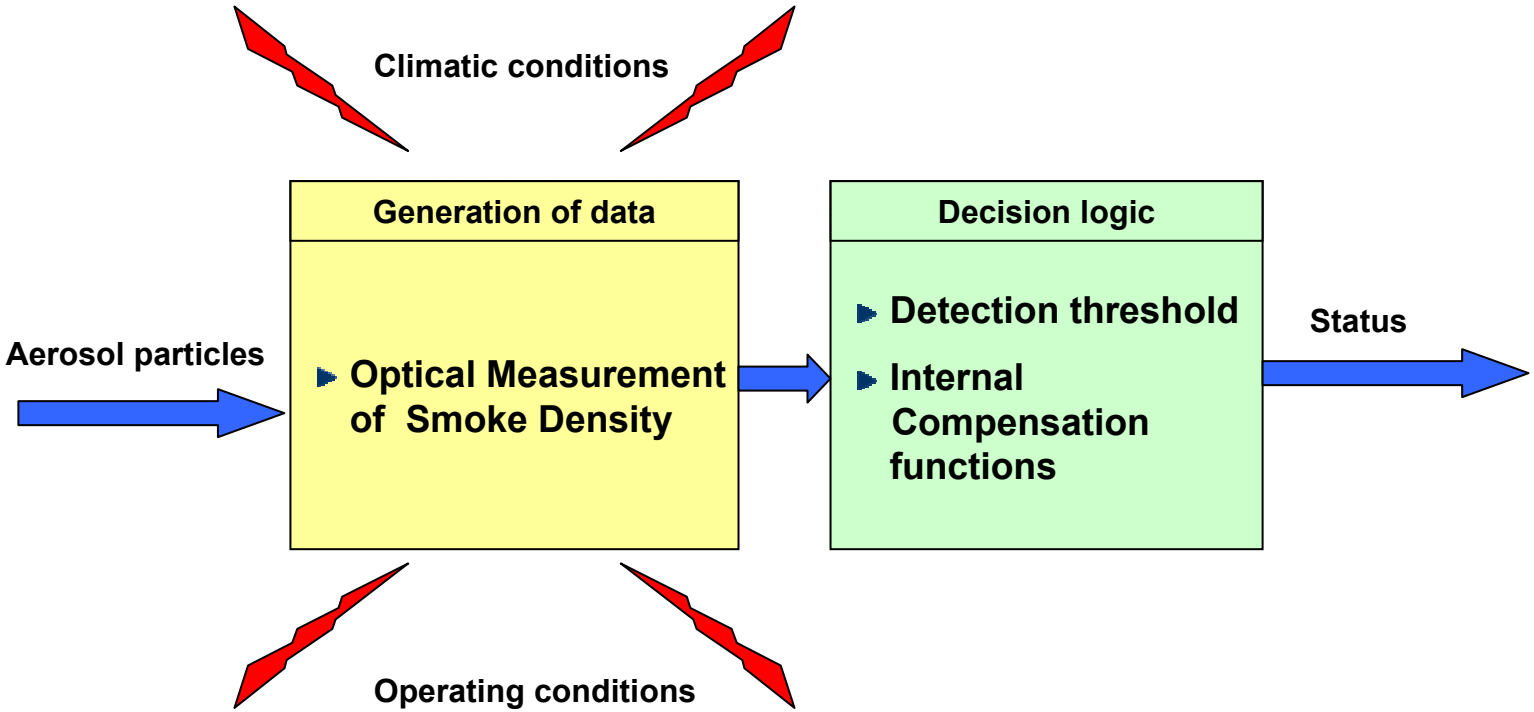
Conventional Smoke Detection – Principles and Performances

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



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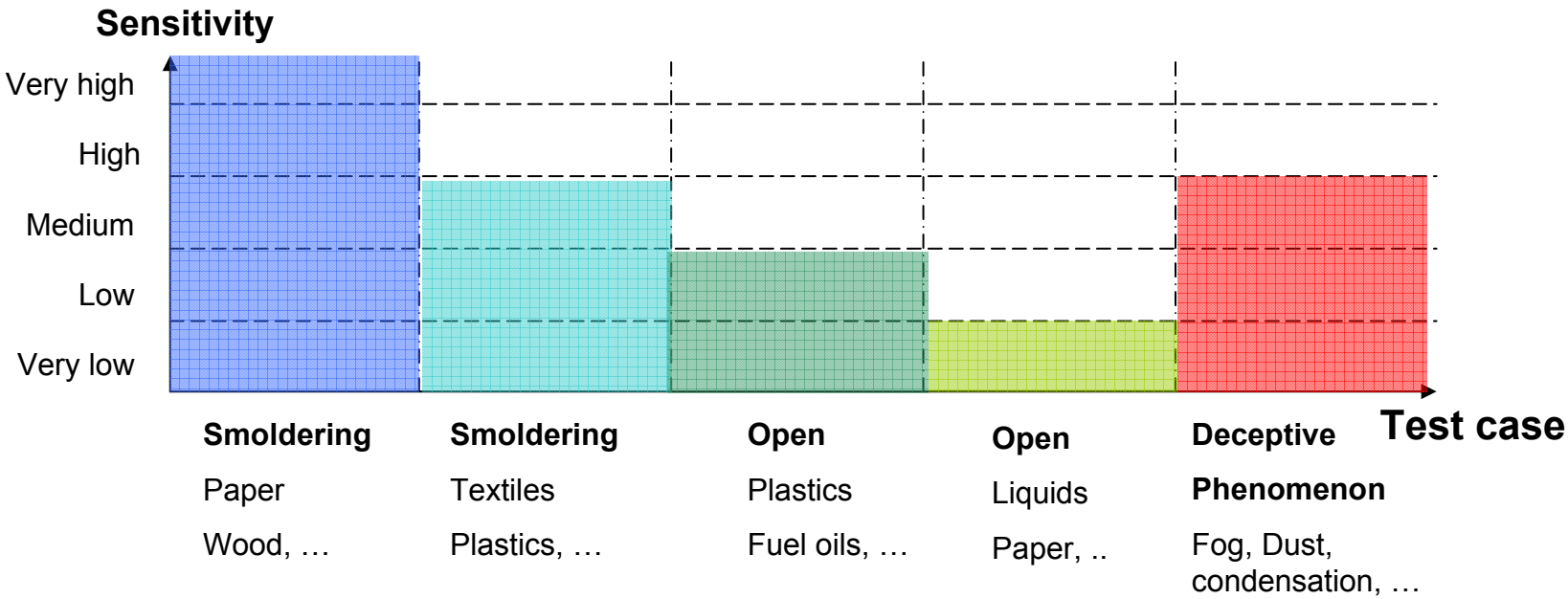
Conventional Smoke Detection – Principles and Performances

Performances

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



Conventional smoke detectors have to be adjusted so as to early detect the fire types for which their detection sensitivity is the lowest

➢ **Lead to a high cross sensitivity to environmental conditions (fog, dust,…)**

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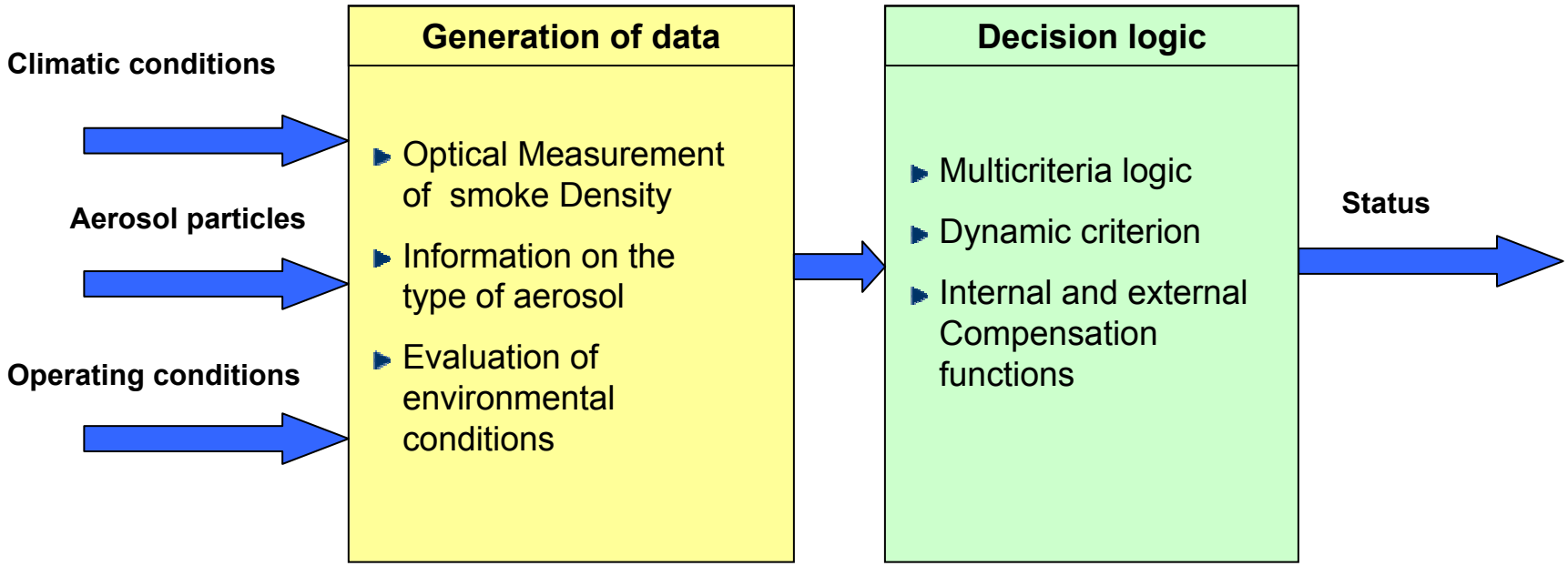
Multi-Criteria Smoke Detection – Principles and Performances

General Principle

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

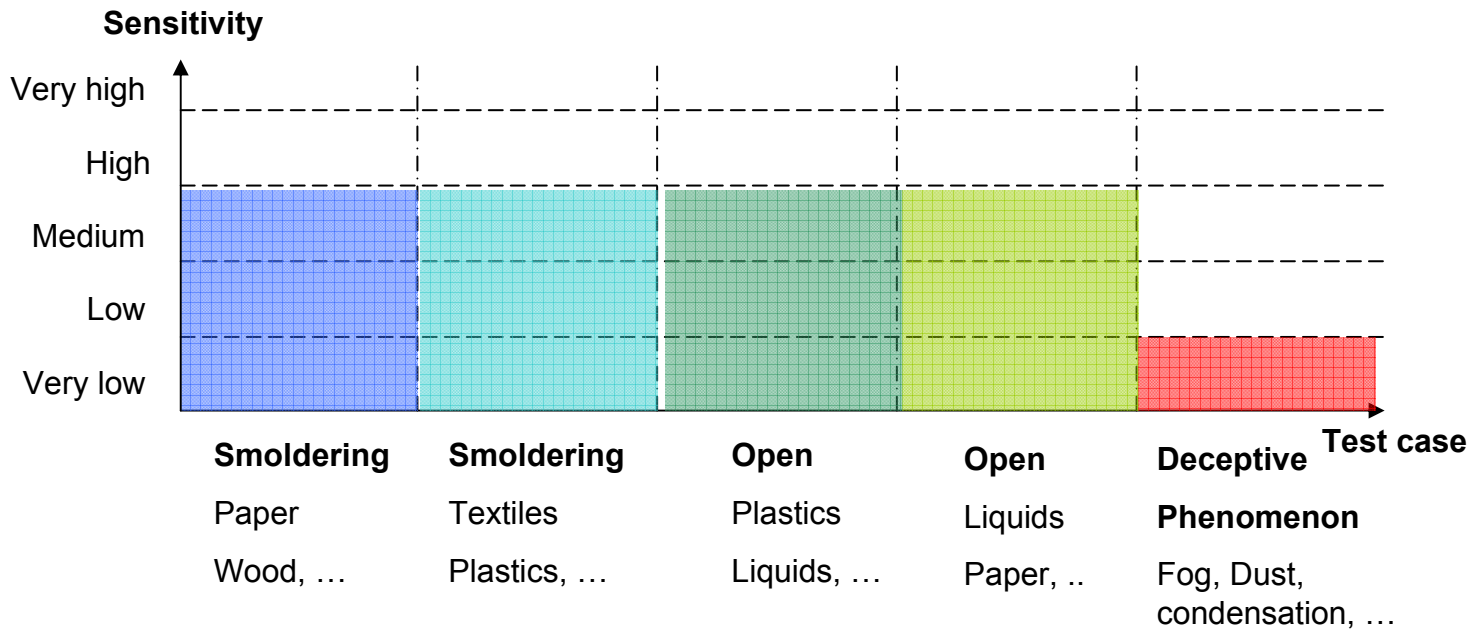


Principles are specifically developed and adapted to aircraft fire and non fire situations

Multi-Criteria 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.



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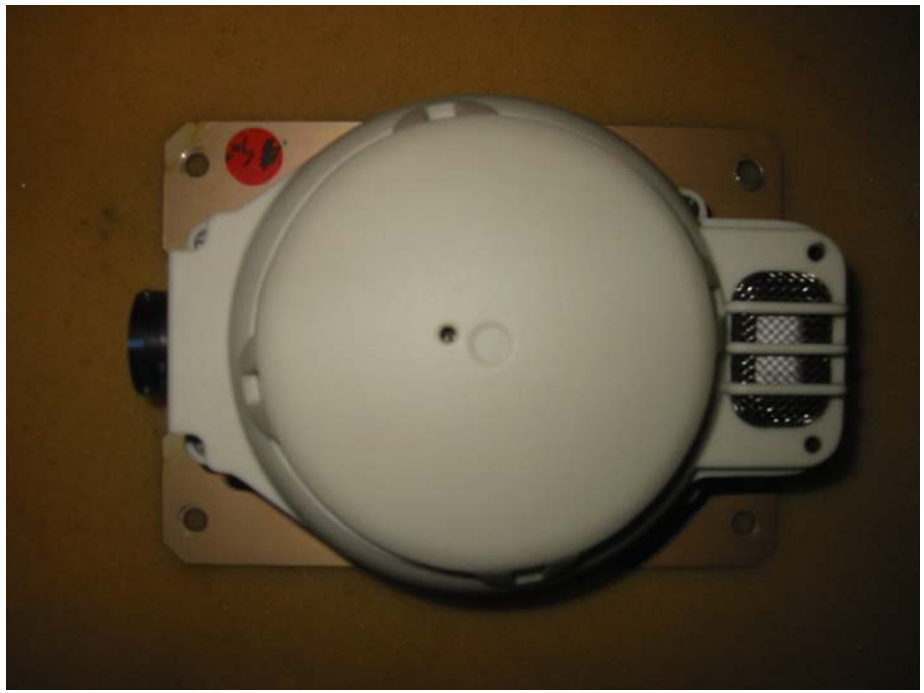
Multi-Criteria Fire/Smoke Detector(open area type)
- as used in Airbus A380 Lower Deck Cargo holds

The detector contains

- Optical measurement systems (using scattering light principle)
- Sensors to measure climatic conditions (e.g. humidity, …)
- Local processing unit for false alarm discrimination algorithms ….



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Smoke Detection System – Airbus qualification methodology

Qualification/Certification are split in several phases

- Performance tests in (fire) laboratories
  - Adequate sensitivity to fire parameter (ref. EN54 Part 7).
  - Adequate resistance to false alarm sources
  - Prove that all sensors/algorithm are operating correctly
  - Adequate stability of sensitivity w.r.t the conditions to be expected in the service environment (temperature/altitude variation, dust, fog, …)
- Environmental tests in Laboratories (RTCA Do 160 etc)
- Aircraft tests
  - Detection response time tests are needed to verify correct placement of detectors w.r.t. possible interferences from doors, air conditioning, lining, other installations ….
  - No performance tests to different fire loads are needed in the aircraft

A380 Multi-Criteria Fire/Smoke Detector
– Performance test in EN 54 test room at Siemens in Männedorf / CH

February 2004

With members of FAA fire Tech. Center, Siemens and Airbus

July 2004

With members of British CAA, Siemens and Airbus

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Smoke Detection System – EN 54-7 tests

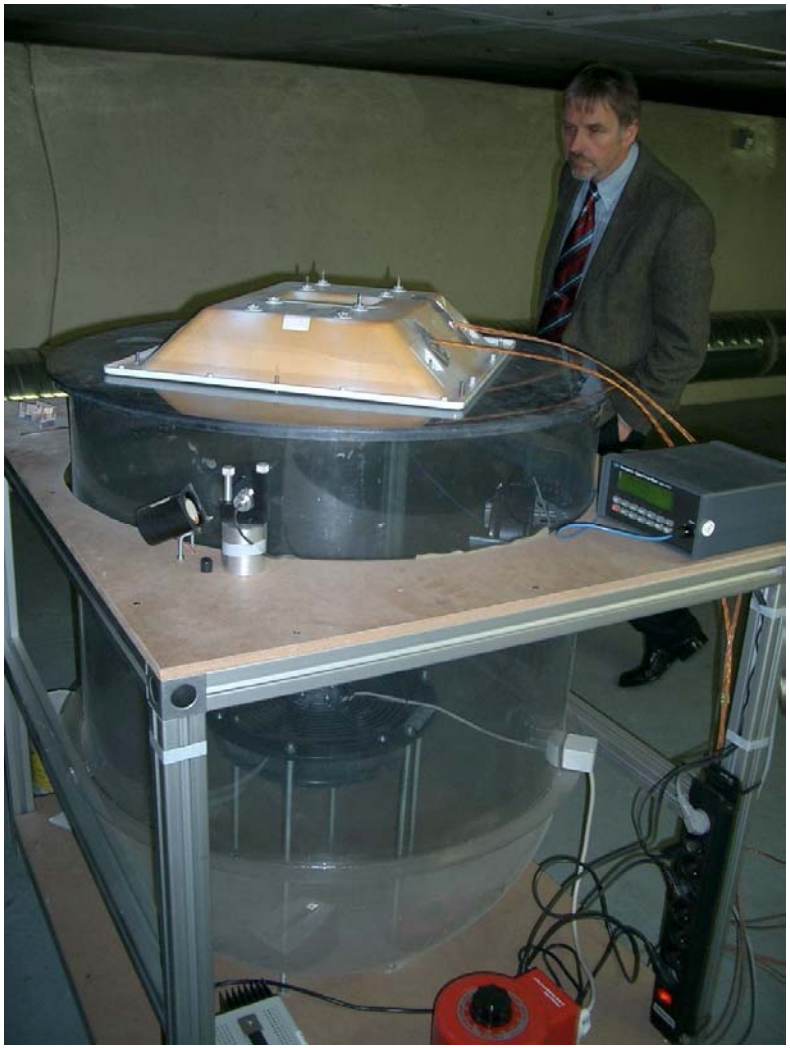
Sensitivity assessment

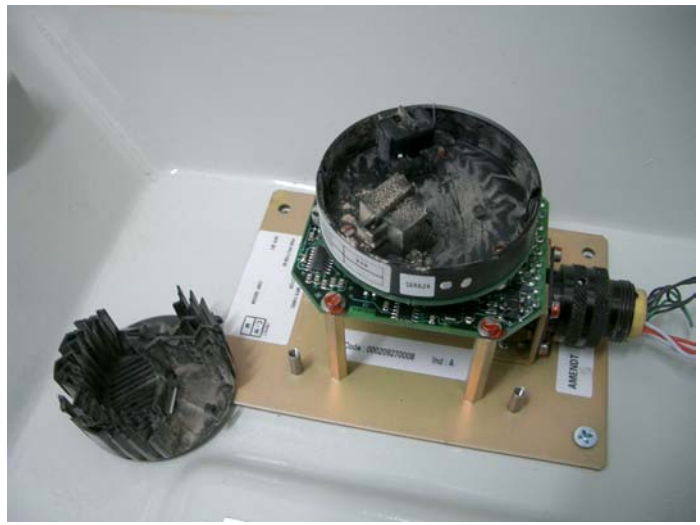
Basic response tests

EN 54-7 tests as used by Airbus take into account

- Sensitivity assessment (e.g. Fire sensitivity tests).
- Comparative sensitivity test – measurement of sensitivity to the chosen fire parameter
- Basic response tests. (e.g. direction, reproducibility)
- Response to sensor specific conditions

A380 Multi-Criteria Fire/Smoke Detector Qualification – False alarm rejection test with std. test dust (ISO 12103-1, A2)





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A380 Multi-Criteria Fire/Smoke Detector Qualification – False alarm rejection test with ultrasonic humidity generation

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Conclusion / Outlook

The use of MultiCriteria Fire/Smoke Detectors within cargo compartments

- will enhance false alarm immunity
- could provide a more sensitive fire/smoke detection
- need adapted and new qualification test methods
- may need enhanced test methods on aircraft level
- requires early involvement of airworthiness authorities
- needs carefully developed & verified algorithms
- ……

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The Fourth Triennial International Aircraft Fire and Cabin Safety Research Conference