Actual Status on Test Procedure Development
In collaboration with University Duisburg-Essen

**SMOKE DETECTOR CHALLENGES**
- FIRE and SMOKE DETECTION
- Nuisance resistance

**CERTIFICATION**

**FALSE ALARM REJECTION RATIO**

\[ R = \frac{L_{O_{\text{amb}}} \text{ (False Alarm)}}{L_{O_{\text{amb}}} \text{ (Real Alarm)}} \]

**FIRE TESTING**
- EN54
- TF 2
- TF 5

**DUST TESTING**
- 2 air velocities: 0.2 m/s
  - 5.0 m/s
- 2 dust types: Domestic-dust + Synthetic

**AEROSOL TESTING**
- Deodorant smoke

**FOG TESTING**

**SUMMARY**
- SMOKE DETECTOR false alarm test procedures
- EUROPEAN STANDARDS #4195
- EN54 requirements
- Domestic and Synthetic
- Synthetic smoke tests
- E test protocol
SMOKE DETECTOR CHALLENGES

- False alarm correction and avoidance based on predictions
- Event alarm prioritization and minimization assessment in feedback and learning applications
- False alarm rejection ratio as an objective validation capability assessment
- Advanced classification setup and optimization flexibility

FIRE and SMOKE DETECTION

Nuisance resistance

CERTIFICATION

International
11 – 12
Smoke
Presented by
Dr. André
• False alarm rejection performance is not standardized.
• There is a demand for false alarm rejection assessment in aeronautics and building application
• False Alarm Rejection Ratio is an objective value for rejection capabilities assessment
• A standardized test setup and procedure is introduced.
Smoke Detection Flight Test in a class C MDCC
FALSE ALARM REJECTION RATIO

\[ R = \frac{LO_{\text{amb}} \text{ (False Alarm)}}{LO_{\text{amb}} \text{ (Real Alarm)}} \]

with:

- \( R \): False Alarm Rejection Ratio
- \( LO_{\text{amb}} \) (False Alarm): Externally (ambient) measured light obscuration (in %/m) at transit to alarm caused by false alarm scenario.
- \( LO_{\text{amb}} \) (Real Alarm): Externally (ambient) measured light obscuration (in %/m) at transit to alarm caused by real alarm scenario (e.g. EN54-7 test fire).
DUST TESTING

2 air velocities:
- 0.2 m/s
- 1 m/s

2 dust types:
- Dolomit <90μm
- Cellulose
Advantages

- Compact construction, light and portable
- Easy cleaning due to fast dismounting and small volume (32l)
- Extremely low amount of dust needed
- Controllable and reproducible dust supply
- Almost laminar airflow in the measuring zone
- Velocity and direction of inflow in the detector can be adjusted
- Airflow adjustable
2 dust types:
- Dolomite <90μm
- Cellulose

Dolomite 90 dust has a wider range of particle sizes compared to ISO Dust.
AEROSOL TESTING

- Dust chamber cannot be used for aerosol testing due to spray volatility
- It is challenging to define a standardized test procedure due to highly different smoke detector behaviour

Deodorant
Insecticide
Spray properties of many different aerosol cans were analysed and characterized.
An aerosol channel was designed
A computer controlled servo actuates the spray can.
FOG TESTING

Challenges:
- Instability of water particles
- Steam and water mist turning humid air after mixing with normal air
- Humid air turning into mist within a second (instantaneous condensation)
- Difficulty of realizing constantly increasing aerosol concentration
- Difficulty of controlling the concentration level
- Specialized duct type for steam and mist testing necessary
Challenges

• Instability of water particles
• Steam and water mist turn into humid air after mixing with normal air
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• Specialised duct type for steam and mist testing necessary
Summary

With the currently developed test procedure, the following smoke detector characteristics can be obtained:

8 dust indices:
2 dust types vs. 2 fire types vs. 2 air speeds

4 aerosol indices per spray interval:
2 aerosol types vs. 2 fire types
Conclusion/Outlook