Certification of False Alarm Resistant Cargo Smoke Detectors

Presented to: International Aircraft Systems Fire Protection Working Group
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If certification with cargo or baggage compartment smoke or fire detection provisions is requested, the following must be met for each cargo or baggage compartment with those provisions:

- (a) The detection system must provide a visual indication to the flight crew within one minute after the start of a fire.
- (b) The system must be capable of detecting a fire at a temperature significantly below that at which the structural integrity of the airplane is substantially decreased.
- (c) There must be means to allow the crew to check in flight, the functioning of each fire detector circuit.
- (d) The effectiveness of the detection system must be shown for all approved operating configurations and conditions.
AC 25-9A, 1/6/1994

- Provides guidelines for the conduct of certification tests relating to smoke detection, penetration, and evacuation.
  - Provides a list of acceptable smoke generators for smoke detection tests.
  - Emphasizes that only a small amount of smoke should be generated to simulate a smoldering fire.
TSO-C1e describes Minimum Performance Standards (MPS) for cargo compartment fire detection instruments

- Requires new models of cargo compartment fire detection instruments meet MPS qualification requirements in SAE Aerospace Standard AS8036
• SAE AS8036 includes criteria for resisting false alarms from various sources

• Section 6. False Alarm Signals
  – Air Velocity
  – Dust
  – Insecticide
  – Ambient Light
  – Combined Temperature, Pressure and Humidity Cycling
Problem

- AS8036 false alarm conditions are similar to theatrical smoke aerosols
  - Detectors that are designed to not alarm for insecticide aerosols may also not alarm for theatrical smoke, thus proving difficult to certify with current smoke generators
Task Group Formation

• A task group was formed to discuss this issue and work together to develop smoke certification procedures that will cause all detectors to alarm, even those that are false-alarm resistant

• Task group met several times either in person or on Webex

• Ideal Smoke Generator Characteristics
  – Capable of producing aerosols in the 200-300nm size range with refractive index of 1.4
  – More consistent and repeatable, perhaps with control of mass flow rate of liquid
  – It was asked of the group to provide what type/brand of smoke generator is being used when testing/developing C1e complaint detectors
  – The group agreed that the most critical parameter of an artificial smoke source is the particle size
Task Group Update

- Task group met 11/2/2017 in Atlantic City
  - 36 Attendees
- Next meeting Tomorrow May 9 2018

Group Charter
- Development of parameters for generating smoke
  - Particle Size
  - Refractive Index
  - Quantity
  - Dynamics
- Focus on C1E detector certification
  - Optical detection including C1E compliant detectors Type 2 AS8036
- Class C, E compartments
- Develop standardized calibration methodology and definition of measurement parameters
Particle Size Measurement

- Met with representatives from TSI, inc for a demonstration of their particle sizing instruments:
  - Scanning Mobility Particle Sizer Spectrometer
  - Engine Exhaust Particle Sizer
  - Aerodynamics Particle Sizer
  - Laser Aerosol Spectrometer
Scanning Mobility Particle Sizer

- **SMPS**
  - Measurement range
    - 1 to 1,000 nm
  - Concentration range
    - 1 to 10,000,000 particles/cm³
  - Independent of refractive index of particle or fluid
  - Differential Mobility Analysis
    - The ability of a particle to traverse an electric field is fundamentally related to particle size
    - No calibration necessary (first principle measurement)
    - Sizing uncertainty of <2%

- **FAATC looking to procure SMPS for R&D Q3-4 2018**
  - Artificial smoke particle size
  - Water mist size measurement
  - Fire Suppression Aerosols
Related Research


- Improvements in Aircraft Fire Detection (Jim Milke, University of Maryland)

- Evaluation of response of C1e compliant detector to a variety of smoke sources (Matt Karp, FAATC)
Questions?

For Further Information

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