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Book of Abstracts
November 2-5, 1998

Kellie Ann Beall, Editor

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Gaithersburg, Maryland 20899

United States Department of Commerce
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U.S. Department of Commerce
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Technology Administration
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Evaluation of Fire Detection Technology for Suitability in Aircraft Cargo Compartments[1]

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ABSTRACT

NIST is assisting the FAA in its research to improve fire detection in Class C and D aircraft cargo compartments. Class C and D compartments are inaccessible in flight. Class C compartments are required to have detection and suppression systems installed. Almost universally, the fire detection systems consist of either ionization or photoelectric smoke detectors. Class D compartments are small in volume (28.5 m^3 or less) and are not required to have detection and suppression. However, a proposed rule change will require that these compartments also be protected within the near future. The number of aircraft affected by this proposed change is about 3000, and the attendant increase in the number of protected spaces will rise threefold. Adding such a large number of spaces to be protected will certainly impact the implications fire detection has on aircraft operation. Assuming application of current technology, this implies a tripling in the number of false positives (false alarms) without any growth in passenger traffic. For commercial aircraft, the rate of false alarm to fire is estimated to be as high as 500:1 . Historically, the impact of false alarms in cargo compartments has ranged from inconvenience, to unnecessary release of halon and potentially dangerous diversion and emergency evacuation of the aircraft. Thus, elements to improve fire detection include reducing false alarms in addition to assuring detection of all fire events.

A literature survey of existing and emerging fire detection technologies potentially suitable for aircraft cargo environments was conducted. An environment inside a cargo compartment typically experiences fluctuations in ambient temperature, pressure during a flight. Variations in moisture and aerosol concentration are produced by external ambient conditions, and in some cases the cargo itself. Detection based on gas sensing, radiation sensing, and multi-sensor detection schemes were identified as emerging technologies which may be suited to cargo environments.

One hurdle to implementing any technology other than particulate smoke detectors is the current certification and system evaluation methods used for U.S. commercial aircraft. Current regulations require a detection system to alarm within 60 seconds from the start of a test fire. Fire testing takes place on the ground at various testing locations around the country. The fire source used in the testing is ill-defined in terms the material burned. The FAA is currently working on improving the fire source used in certification. Airborne testing is usually performed with a glycol aerosol generator which produces a smoke of sufficient quantity to cause particulate detectors to alarm. This smoke generator does not replicate all characteristics of combustion processes and would be useless for in-flight testing for detectors sensing something other than particulates. Computational fluid dynamics could conceivably play a role in design and certification of aircraft cargo detection systems allowing for a wider range of fire conditions and configurations to be examined.

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[1] Supported by FAA

There is no current standard for assessing a detector's immunity to false alarm. To confidently select a fire detection technology that will reduce false alarms in aircraft cargo compartments, a measure or estimate must be made of a detector's susceptibility to false alarm in the environment it will be exposed.
A methodology for assessing the performance of existing and emerging fire detection systems under realistic and simulated cargo environments with and without the presence of a growing fire will be detailed. For example, moisture and condensation play a role in some cargo compartment false alarm scenarios. Temperature, moisture and flow conditions experienced in a cargo compartment could be simulated in a laboratory setting (such as in the NIST Fire Emulator/Detector Evaluator) and specific detector sensitivities to various levels of moisture, temperature and flow could be quantified.

Reference

Grosshandler W.L., "Nuisance Alarms in Aircraft Cargo Areas and Critical Telecommunications Systems: Proceedings of the Third NIST Fire Detector Workshop", National Institute of Standards and Technology, Gaithersburg, NISTIR 6146, March 1998.