ABSTRACT

THE SCALABILITY OF SMOKE DENSITY
AND THE VIABILITY OF NEW
DETECTION METHODS IN AIRCRAFTS FROM XTRALIS BY HONEYWELL

Khaleel Rehman
Xtralis by Honeywell

Fire detection is a topic of interest in aircraft applications, specifically cargo compartments, given the unique operating environment and accessibility challenges in the event of a fire. The use of unit loading devices inside cargo compartments have also presented a delay in alarm challenge due to their enclosed nature. However, despite the importance of detection, there is yet to exist a standard testing and certification method for fire detection in cargo compartments. The current requirement for a cargo compartment detection system is that a fire has to be detected in 1 minute, and in that time be so small that the fire is not a significant hazard to the airplane. Nuisance alarms also plague the industry, with upwards of 90% of fire alarms being false warnings. These problems have been partially addressed through the analysis of smoke density and state of the art detection technology. Both flaming and smoldering fires were conducted using an array of materials such as heptane, polyurethane foam, shredded paper, wood chips, suitcase, baled cotton, and boiling water. The response of VESDA aspirating smoke detectors technology, were analyzed. It was found that small scale tests replicate large scale behavior, leading to the suggestion that detection testing could happen outside of cargo compartments and results be appropriately scaled. The response of aspirating smoke detector were found better performance than approved spot type detector to follow patterns similar to that of light obscuration measurements and were thus deemed viable options for use in cargo compartments.

Table 4.3: Comparison of VESDA ASDs and approved spot type detector response times.

	VLF % Faster	VEA % Faster	VLC % Faster
Cargo Shredded Paper #1	-5.7%	-4.8%	2.0%
Cargo Shredded Paper #2	64.0%	0.0%	115.8%
Cargo Suitcase	114.9%	0.0%	116.5%
ULD Shredded Paper #1	76.0%	69.8%	79.8%
ULD Shredded Paper #2	177.0%	0.0%	181.5%
ULD Suitcase	62.9%	0.0%	62.9%

Note: Comparison in response time is presented as a percent difference to the Spot Type detector. Positive percentages indicate the VESDA system alarmed before the Spot type detector while negative percentages indicate the VESDA system alarmed after the Spot type detector.

The ASDs were compared to a standard photoelectric spot detector , finding that they outperformed the Spot type detector in both response and response time. The VLF averaged a 77.0% faster response time than the Spot type detector, where it responded faster in 19 or the 20 tests. The VLC averaged a 81.3% faster response time than the Spot type detector, where it responded faster in all 20 tests. The VEA response times were more on par with the Spot type detector but exceled in responding while the Spot type detector did not respond at all for 55% of the tests. The VEA is identified as a potential solution for adding ULD detection in aircrafts due to its addressability and remote smoke testing features.

All new detection technologies were identified for their theoretical improvement in nuisance immunity. XCL Gas detection is identified as the outstanding detection technology and recommended for use over photoelectric detection in cargo compartments i.e. hidden space

Future Work

Future work should include conducting tests similar to the ones in this project to confirm the conclusions made. While the ASDs, dual wavelength, and gas detection systems show improved response times over the spot type detector, an additional value would be their improved ability to discriminate between nuisance and fire sources. For nuisance source testing, information on conditions in cargo compartments would be desired to replicate realistic scenarios.
Additional areas such as hidden spaces have historically had fires occur in that area and could benefit from fire detection. However, testing would need to occur in order to assess the viability of that notion