Presentation Abstract

Modeling TCCs in a Cargo Compartment

By Andrew R Ferraro

A simulated model of a full-sized aircraft cargo compartment was used to determine the effect of active cargo containers. Physical testing in conjunction with the simulated cargo compartment was used to validate the accuracy of the Fire Dynamics Simulator model which included an artificial smoke generator. The artificial smoke generator is currently used in certification of smoke detectors in aircraft cargo compartments. It consisted of heaters that vaporize oil to create smoke.

Arranging cargo containers with the smoke generator gives a baseline for smoke movement in the compartment. The smoke was measured using lasers and light meters which were partially obscured by the moving smoke. Fans were added to the containers as a stand-in for temperature-controlled cargo containers (TCC), also called “active” cargo containers, that had condenser cooling fans.

Comparing the experimental test data to the simulated test data showed that the simulation is a good fit. The smoke trends between the tests are very similar and there was a difference in detection time typically less than 10 seconds over the entirety of the tests.

Using the Envirotainer RKN e1 as a typical TCC, an airflow of 35 CFM was used for the experimental testing. According to the testing and simulations, using TCCs with airflows of 17.5 or 35 CFM has an inconsistent effect on the smoke detection time, at the extremes, ±20

seconds, ±30% of detection time. At elevated airflow of 70 and 140 CFM, the time to smoke detection was almost always delayed, an average of 30 seconds (+50%) and at most up to 70 seconds (+110%). Delay of smoke detection could cause potentially dangerous conditions in the aircraft. Because of the delay, it is recommended to keep airflow of TCCs to below 70 CFM.