FAA William J. Hughes Technical Center

FAA Engine Nacelle Fire Simulator Building 205

The FAA Engine Nacelle Fire Simulator, Building 205, located in the Safety Research and Development area of the FAA William J. Hughes Technical Center, is designed to mimic the environment found in today's modern high-bypass ratio turbofan engines.

The simulator is used by the Fire Safety engineers at the Technical Center to evaluate substitutes for halon as fire suppressants.

Currently, halon replacement is an important issue for aviation. As a result of work sponsored by the Fire Safety Section, in the Airport and Aircraft Safety Research and Development Division, a document titled "The Minimum Performance Standard for the Engine and APU Compartments" (MPSE) was drafted. This document describes the geometry of an engine nacelle simulator, operational parameters, and testing requirements required to evaluate a material or technology being considered as a halon replacement within the engine or auxiliary power unit (APU) compartment. In support of this mission, a basic engine nacelle simulator was fabricated in Building 205. The simulator will simulate the proper engine environment, meeting the intent of the MPSE.

The total fire suppression simulation requires an engine nacelle geometry, an air flow, a fire scenario, and a fire suppressant delivery. To address each element of the simulation, various systems are used. All systems are housed in a test bay having a volume approaching 12,000 cubic feet and a floor area of 4,000 square feet. The control room is adjacent to the test bay and houses support personnel and control and data gathering equipment necessary to operate the simulator.

The simulator is an 80-foot-long duct containing the air supply equipment, approach and exhaust ducts, and a test section. Three additional components are required; the first provides different aviation-specific liquids, such as fuels, at the desired temperature and quantity to the simulator interior. The second component provides a gaseous fire suppressant to the simulator interior, and the third component provides the simulator control and data gathering functions for the entire process.

The air supply equipment is capable of 0.9-3.0 lbm/s air flows heated as high as 500°F. The approach ducting contains the air flow and is 3 feet in diameter and approximately 40 feet long. The approach houses airflow sensors and stream flow correcting mechanisms. The test section, measuring 18 feet long and 4 feet in diameter, follows and is the heart of the simulator. The test section contains geometry representing an engine compartment, hardware to produce two different fire scenarios, sensors to record the environmental data, and portals to visually record fire behavior. Two fire scenarios, either pool- or spray-based, are

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possible. The fires are fed by the external fuel supply system which is capable of delivering fuel at 150°F and up to 1 gallon per minute. The gaseous fire suppressants are delivered by piping from the agent extinguisher into the diffuser cone entrance of the test section. These fire suppressants can be stored in various quantities at differing pressures and temperatures. Four gaseous fire suppressants (Halon 1301, HFC125, HFC227ea, and CF_3I) are on site for near-term work.

Rounding out the capabilities of this facility is the ability to record the testing. For each test, a record is established describing the fire suppression event. The record will contain a concentration profile within the test section recorded by a Halonyzer gas analyzer for gaseous fire suppressant events; a computer file containing sensor activity measuring temperatures, pressures, air flows, and ambient relative humidity; and finally, a visual recording of the fire zone and its activity during the event.

The FAA Engine Nacelle Simulator was completed in 1997 and the test program to evaluate materials or technologies being considered as a halon replacement within the engine/APU compartments will be completed by December 1998. By using a simulator and not a true aircraft engine for the bulk of the halon replacement work, maintenance costs will be reduced. Additionally, the generic geometry of the simulator can be used to develop a better understanding of the fire suppression environment. The specific geometry of an existing engine nacelle may present a unique case which might cloud general understanding and inhibit widespread application of the generated data.

To find out more about the FAA Engine Nacelle Fire Simulator, contact:

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