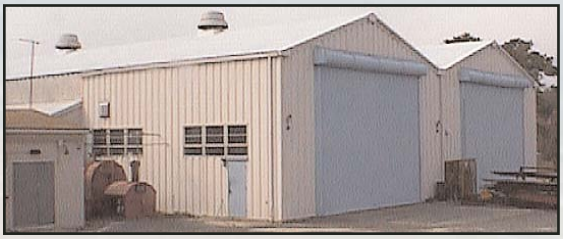
FAA William J. Hughes Technical Center

Engine Nacelle Fire Simulator, Building 205

R&D Facilities

The Engine Nacelle Fire Simulator is designed to mimic the environment found in today's modern high-bypass ratio turbofan engines. The Fire Safety Branch engineers use the simulator to evaluate halon substitute fire suppressants.



Halon replacement is an important issue for aviation. As a result of work sponsored by the Fire Safety Section, 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 MPSE, a basic engine nacelle simulator was fabricated to simulate the proper engine environment.

A fire suppression simulation requires an engine nacelle geometry, an airflow, a fire scenario, and a fire suppressant delivery system. To address each element of the simulation, various systems are used. All systems are housed in a test bay having a volume of nearly 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 component 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. The third component provides the simulator control and data-gathering functions for the entire process. The air supply equipment is capable of providing a 0.9-3.0 lbm/s airflow that is heated as high as 500°F. The approach ducting, 3 feet in diameter and approximately 40 feet long, contains the airflow. The approach houses airflow sensors and stream flow-correcting mechanisms. The test section, measuring 18 feet long and 4 feet in diameter, follows next 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 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 different pressures and temperatures. Two gaseous fire-extinguishing agents (HFC-125 and CF3I) are currently being evaluated and compared with Halon 1301, the currently used agent, under different engine fire scenarios.

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 that measures temperatures, pressures, airflows, and ambient relative humidity; and a visual recording of the fire zone and its activity during the event.

The Engine Nacelle Simulator will evaluate materials and technologies being considered as a halon replacement within the engine and APU compartments. 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.

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

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