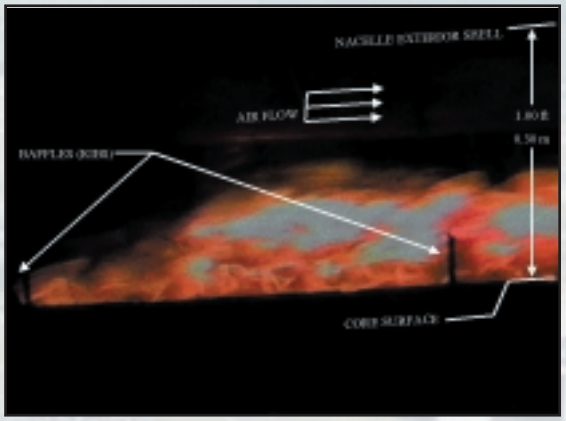
FAA Engine Nacelle Fire Simulator Building 205

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 William J. Hughes 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 needed 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 represent an engine nacelle environment, meeting the intent of the MPSE.

The simulation of a fire suppression event in an engine nacelle requires an engine nacelle geometry, an air flow, a fire scenario, and the delivery of a fire suppressant into the nacelle to challenge the fire.

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 (340 m^3) and a floor area of 4,000 square feet (372 m^2). 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 (24-m) 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 turbine fuel, at the desired temperature and quantity to the test section interior to produce the fire threat. The second component provides a gaseous fire suppressant to the test section interior for fire extinguishment, and the third component provides the control and data gathering functions for the entire simulation process.

The air flow supply equipment was designed to meet the MPSE. One such point is an air flow moving at 2.5 lbm/s (1.1 kg/s) at a bulk temperature of 100°F (38°C). The approach

ducting contains the air flow and is 3 feet (0.9 m) in diameter and approximately 40 feet (12 m) long. The approach houses airflow sensors and stream flow correcting mechanisms. The test section, measuring 18 feet (5.5 m) long, follows and is the heart of the simulator. It is two concentric tubes. The outer tube represents the nacelle exterior shell and has a diameter of 4 feet (1.2 m). The inner tube represents the engine core and has a diameter of 2 feet (0.6 m). The annular volume for the air flow is approximately 96 cubic feet (2.7 m^3). The test section also contains 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 (66°C) and up to 1 gallon per minute (3.8 lpm). 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. Three gaseous fire suppressants (HFC-125, HFC-227ea, and CF3I) are scheduled for evaluation.

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, at a minimum, a computer file containing sensor activity measuring temperatures, pressures, air flows, and ambient relative humidity; as well as a visual recording of the fire zone and its activity during the event. For certain tests, the record will be augmented with concentration data describing the diffusion behavior of the fire suppressant in the nacelle.

The FAA Engine Nacelle Fire Simulator is currently undergoing shakedown and characterization. Fire suppressant evaluation began in March of 2000. 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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