

Aircraft Thermal/Acoustic Insulation Materials Functions and Requirements

Functions

Both thermal and acoustical insulation is required on passenger aircraft. Historically, both functions have been provided by the same material system, which has mostly been fiberglass batting encapsulated in a plastic pillowcase covering. Covering plastics have been predominantly PET (polyethylene terephthalate, which duPont calls Mylar), and a lesser quantity of polyvinyl fluoride (PVF), which duPont calls Tedlar). Kapton, a polyimide film made by duPont, was used in the L1011 program by Lockheed.

Thermal

The thermal environment outside an airplane produces fuselage skin temperatures from about -60F when in-flight at altitude to about +160F when parked in direct sunlight in the desert. The amount of insulation needed for the air conditioning/heating system to economically produce comfortable cabin temperatures varies with airplane type and location. However, except for a few places such as the crown area over the aft passenger cabin and the lower fuselage area below the passenger floor, acoustic requirements predominate. Therefore, except for those places, the amount of insulation present exceeds that needed for thermal requirements.

Acoustic

Outside noise is generated by aerodynamics and engines. Insulation is used to attenuate outside noise to allow reasonable levels of comfort and verbal communication inside the passenger cabin and flight deck. The acoustic attenuation needed varies from airplane to airplane, but is generally substantial and insulating material of very high acoustic efficiency is used to minimize the amount (weight, volume) required. Fiberglass batting, using a very small fiber diameter, is a highly efficient acoustic attenuator.

Fire Barrier

Currently, insulation using fiberglass batting will resist fire penetration in lower-intensity thermal environments. Cargo compartments are required to have liners that are fire barriers. In some compartments, the thermal insulation lining the fuselage provides the fire barrier. For these areas, the requirement involves a Bunsen burner test fiberglass batting easily passes.

The FAA has released information in press reports that it plans to propose a requirement that insulation be resistant to burnthrough in an intense thermal environment like that of a fuel-fed fire. All insulation material systems would have to be redesigned to meet this requirement.

Requirements

- Must perform acoustical, thermal, and fire barrier functions

- Must not be heavy

Any new insulation materials system must not substantially exceed the weight of existing systems, which averages about 0.1 lb/sqft.

Glass batting varies from 0.34 to about 1.5 lb/cuft, with lighter weights predominating. Batting thickness is about 5 inches in the crown area, 3 inches along the sides, and 1 inch below the passenger floor. Covering material varies from 0.5 to about 1.5 oz/sqyd, with 0.5 and 0.9 oz/sqyd predominating.

- Must not cause or promote corrosion to the aluminum fuselage structure
 - Must not be electrically conductive
 - Must not interfere with inspection of the fuselage structure for corrosion, cracks, etc.
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- Must meet regulatory flammability requirements
 - Must not absorb large amounts of water
 - Must not have adverse environmental and/or health/safety effects either during fabrication and installation, or in service use