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Examining the means to protect against fuselage burnthrough

J R Hoyes[1], P T Ireland[2], S F Jagger[1], H S Ledin[1] and A Mullender[2]

[1] Health & Safety Laboratory, Harpur Hill, Buxton, Derbyshire, UK.
[2] Rolls-Royce plc., Derby, UK.

In the event of exposure of an aircraft to a fuel fire, it is necessary to prevent flame penetration of the fuselage to the passenger compartment for a time sufficient to allow passenger evacuation from the passenger compartment. A standard test procedure (ISO2685) has been developed to assess materials and methodologies for achieving this objective. This comprises a pre-mixed propane burner adjusted to standard conditions using a thermocouple array and water flow calorimeter. Vertically oriented planar samples are exposed to this flame for a period of up to 15 minutes and observations made of smoke emissions and flame penetration.

This paper considers this situation and examines a range of solutions to providing satisfactory protection against fuselage burnthrough. Thus a range of test results is presented including:

- Testing with different materials including standard aerospace alloys, fibre-metal composites and carbon fibre composites both with and without fire retardants:
- Samples of varying thickness:
- Samples with one face tested under both positive and negative pressure:
- The use of surface coatings to alleviate the effects of burnthrough:
- The use of a cooling flow over the unexposed face:

Simple prescriptive rules are derived for prevention of burnthrough from these experimental results.

Analysis of the experimental tests has been carried out using a commercially-available computational fluid dynamics solver. Combustion, fluid flow and heat transfer processes are included by means of a conjugate heat transfer approach. The purpose of the modelling was to analyse the burnthrough process but it also reveals some details of the ISO 2685 test beyond those measured or observed in the experiments. In particular some variations between the calibration and actual output temperature and heat flux of the burner are predicted.

The model is used to simulate burnthrough on an aluminium plate and results are compared with the experimental data. Aluminium is relatively simple to analyse and can be investigated using a simple heat condition model. Other materials including fibre-metal and carbon fibre composites are more difficult to analyse and require specialist thermal degradation models.