Experimental investigation of the repeatability of direct damage induced by lightning strikes on metallic panels

Christine Espinosa[1], Iman Alhossen*[1], Anis Hor[1], Estelle Pierré[2], Stéphane Vilcocq[2], Rémy Chieragatti[1], Thomas Montel[1], and Oscar Gnangnon[1]

[1]ICA, Université de Toulouse, ISAE-SUPAERO, IMT MINES ALBI, UTIII, INSA, CNRS, Toulouse, France – Université de Toulouse, CNRS, INSA, ISAE-SUPAERO, Mines Albi, UPS, Toulouse France – France

[2]DGA Techniques Aéronautiques – Ministère des Armées – France

Résumé

Metallic parts of aircrafts used for fuel tanks areas or even for the fuselage can suffer from severe direct damage due to lightning strikes. Metallic aircrafts are naturally protected against current flows because of their high electrical conductivity. But at the arc attachment location, there is a major risk of perforation which can result in a dramatic explosion due to fuel tank ignition. A lightning strike is a current discharge between opposite charge locations inside clouds and on the ground. Currents under considerations here are D+B+C* current waveforms prescribed by the standard regulations and reproduced in by specific current delivery devices at DGA-Ta lightning lab. It is well known that the risk to perforate a metallic panel directly increases with the duration of the C* component, mainly because of heat transfer at the arc root. But it is nevertheless not well understood how the variability of the test parameters of the electrical charge and the electro-thermo-mechanical behaviour of the structure influence the variability of the critical perforation point.

This paper presents the analysis synthesis of experimental investigations on the risk of perforation of a metallic panel to a laboratory prescribed D+B+C* lightning strike. A sensitivity analysis compares different tests campaigns and gives insight into the damage patterns related to perforation risk grades. The effect of the variability of some lab test parameters is reported. It is shown that a linear but not monotonously increasing relationship exists between the damaged zone in the panel and the delivered current charge. The perforation risk is shown to be not proportional to the current charge but rather to damage instability.

*Intervenant

sciencesconf.org:htpp15ups:211797