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Jet Engine Powerloss in Ice Particle Conditions: An Aviation Industry Problem

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Since about the 1990, there have been in excess of 100 engine powerloss events in jet aircraft that have now been attributed to the ingestion of ice particles. These powerloss events are observed in essentially all engine types, and on all airframes. Almost all cases have occurred in the vicinity of deep convection usually associated with warm and moist atmospheres. Events have occurred all throughout the world, although there is a somewhat higher concentration in the area of southeast Asia. Powerloss can result from stall, surge, flameout and rollback events in the engine. Many are momentary, with engines relighting automatically, while others require a manual engine relight. In some cases, particularly in rollback cases on smaller commuter-transport aircraft, engine power has only been recovered by melting of ice buildup in the engine below the freezing level. There have been cases of multiple simultaneous engine powerloss, and one case of a landing with no engine power. The frequency of the events, and the potential for multiple-engine powerloss, has led the FAA to note that that these occurrences constitute a significant safety issue.

Analysis of the events using aircraft flight data recorder information, pilot interviews, standard meteorological radar and satellite data, and information from several past flight test programs, have led to the conclusion that the powerloss is due to ice buildup in the engine from high concentrations of ice particles in the atmosphere, and that supercooled LWC is not required. This is an unconventional form of icing that had not been previously considered possible by engine designers. The Engine Harmonization Working Group (EHWG), an industry-led committee composed of engine manufacturers, airframe manufacturers, regulators, and government agencies have been studying the powerloss issue since 2004, and have suggested a 4-part technical plan to resolve the issue, which includes improvement of instrumentation to measure high ice mass concentration, characterization of clouds containing these conditions, experimental testing to support ice accretion model development, and development of engine test requirements.

An overview of the engine-powerloss problem, and a summary of the current status of the EHWG technical plan will be given.