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The Effects of Fuel on an Inert Ullage

A series of tests were performed by the FAA to determine the effect of oxygen dissolved in fuel on inerting demands for a vented fuel tank. A vented rectangular fuel tank was instrumented with fuel and ullage thermocouples as well as an oxygen and total hydrocarbon analyzer and tested in an altitude chamber. The tank was filled with fuel at different levels and the ullage space was inerted with Nitrogen to different oxygen concentrations. The effect of the fuel on the ullage oxygen concentration was examined using different agitation methods at sea level including heating, sloshing, and ullage recirculation. Tests were also performed at reduced pressures (altitude), examining the oxygen evolution from the fuel given different fuel loads, climb rates, and stimulation methods.

Results showed that under quiescent conditions fuel tends to evolve oxygen so slowly that even relatively high fuel loads have very little effect on the inert ullage. Some methods of stimulation proved effective in evolving oxygen from the fuel more rapidly, but these methods appear to be inconsistent with normal commercial transport flight and ground operations. Moderate to high fuel loads can have a profound effect on the fuel tank ullage given a method of stimulating the release of oxygen from the fuel into the inert ullage. Recent FAA/Boeing flight tests appear to verify that oxygen does not evolve rapidly from fuel during normal aircraft operations.