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"Hot Surface Ignition Temperature of Aircraft Fluids"

The risk of aircraft engine fire is due to the inevitable occurrence of fuel and engine oil leaks in the vicinity of hot engine surfaces and compressor bleed air ducts. To minimize such occurrences, designers ventilate the nacelle and insulate the hot surfaces – the latter requires a good knowledge of Hot Surface Ignition Temperatures (HSIT). Reliable values for HSITs are not available for they depend on many variables and there is no standard method for measuring them (unlike the case of Auto Ignition Temperature, AIT). In fact, previous investigators have reported HSIT values that varied by hundreds of degrees and have found that determining the "minimum" HSIT for a given liquid and configuration to be elusive. These shortcomings are mainly due to the changes in surface temperature as it is quenched by the evaporating liquid during the ignition process. To minimize this quenching effect, we performed tests (1) using a hot surface which has a very high thermal diffusivity and thermal inertia and (2) injecting small liquid droplets and small metered streams of liquid. Tests on n-decane and Jet A show a U-shape relationship between the volume of the injected liquid and HSIT. As the volume is decreased, HSIT first decreases (as anticipated due to reduced quenching) to a minimum but then increases significantly. This latter increase in HSIT is attributed to the vaporizing liquid dispersing (in the buoyant plume over the hot surface) faster than it is replenished such that ignition occurs in a fuel lean regime. We measured minimum HSITs that are much lower than what has been reported in the past for n-decane and Jet A. Accordingly, the old safety rule of assuming that the minimum HSIT is about 200C higher than AIT needs to be revised to better serve the designers and improve safety.