Next Generation Fire Test Burner for Powerplant Fire Testing Applications

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Title 14 of the Code of Federal Regulations (14 CFR) parts 23, 25, 27, 29, 33 requires that components located in designated fire zones in or adjacent to aircraft propulsion systems be either fireproof or fire resistant depending on the function and location of the component.

The CFRs do not define the exact severity of the fire, nor the detailed procedures for testing powerplant components for their fire performance. Typically, Advisory Circulars (ACs) are used to provide industry with an acceptable method of compliance. For fire testing of powerplant components, AC20-135, dated 2/6/90, provides the most current advisory material on powerplant component fire protection test methods. It contains information on the acceptable fire test burner configuration and refers back to Powerplant Engineering Report No. 3A (1978) for additional guidance. This report describes in detail three modified gun-type oil burners and the adjustments necessary to achieve performance similar to the original modified oil burner, which in 1978 was no longer commercially available. Since the time of writing of Powerplant Engineering Report No. 3A, the three equivalent burners described in the report have also gone out of production and can no longer be procured.

In addition to these four burners, AC20-135 introduces a propane-fueled burner (SAE 401) with a modified output to achieve a high heat flux. Previous research, however has determined that although the measured flame temperature and heat flux from this burner may be similar to the oil burner flame, the propane-fueled burner is not as severe as a jet fuel burner. As test specimens approach the flame temperature during testing they begin to emit thermal radiation due to the high surface temperature, losing heat to the surroundings. When engulfed in a virtually transparent propane flame, the net heat loss is considerable since the propane flame does not absorb significant amounts of radiative energy. In a jet fuel flame, however, the flame gasses participate in the radiative heat transfer, absorbing radiative energy and preventing the component from losing heat to the surroundings, resulting in a lower net heat loss and higher component temperatures. Research has indicated that components tested with a propane-fueled burner will have a longer time-to-failure than when tested with a jet fuel burner, resulting in a lower safety factor for a component tested with a propane burner.

As all of the oil-based burners are presently commercially unavailable, and the propane burner has been shown to not be an adequate burner for this type testing, the Fire Safety Team at the FAA Technical Center has initiated work to adapt the Next Generation Fire Test Burner (DOT/FAA/AR-TN09/23) for the testing of powerplant components. The successful application of this burner to the powerplants components testing requirements will result in an FAA-accepted jet fuel burner that will not go out of production and will be available to industry for the years to come.