Repl. by 1A

AC NO: 25.981-1

DATE: 7/23/70

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: GUIDELINES FOR SUBSTANTIATING COMPLIANCE WITH THE FUEL TANK TEMPERATURE REQUIREMENTS

1. PURPOSE. This circular sets forth some general guidelines for substantiating compliance with fuel tank temperature airworthiness standards, Section 25.981.

2. BACKGROUND. Advances in electrical system sealing have made it possible to place electrical fuel system components such as pumps and gauge elements, as well as the wiring to these components, in immersed locations within fuel tanks. Additionally, fuel tank walls may be subjected to local "hot spots" by the proximity of compressor bleed air ducts which carry air at extremely high temperature. The possibility that the temperature of the fuel tank wall internal surface or the fuel system components within the fuel tank could exceed the autogenous ignition temperature of the aircraft fuel has necessitated the establishment of FAR Section 25.981.

3. INFORMATION. The autoignition temperature of JP-4 as determined by ASTM Test Method D286 is approximately 436°F at one atmosphere of pressure. By this method of testing, under the same atmospheric conditions, the autoignition temperature of kerosene is approximately 449°F; and of gasoline, approximately 800°F. The autoignition temperature of these fuels varies inversely with the ambient pressure. In view of this, factors affecting the pressure in the fuel tank should be taken into consideration when determining compliance.

4. OBJECTIVES.

   a. Establishment of a Safe Temperature Margin. There is general industry/FAA agreement that a temperature providing a safe margin is at least 50 degrees Fahrenheit below the lowest expected autoignition temperature of the fuel.

Initiated by: FS-140

b. Determining Maximum Component Temperature. Maximum component temperatures may be determined experimentally. Tests should be conducted long enough for the component to reach the maximum temperature. All likely failures and malfunctions of the fuel tank components (including those failures and malfunctions that could be undetected by the aircraft crew) should be considered when determining maximum temperatures. The electrical power supply need not exceed the rating of the circuit protection device. The following list, although it does not include all possible failure modes, suggests some conditions that could be explored as applicable:

(1) Normal operation.

(2) Single phase operation of three phase electrical components.

(3) Two phase operation of three phase electrical components.

(4) Dry operation of mechanical components including lack of lubrication.

(5) Wet operation of mechanical components with zero and reduced fluid flow.

(6) Moving mechanisms locked or seized.

(7) Pump impeller slippage.

(8) Failed bearings.

(9) Failed seals.

(10) Electrical defects which generate excessive heat.

(11) Foreign matter ingestion (including parts that come loose from the component itself) which generates excessive heat.

(12) Submerged heat exchangers operating under conditions of maximum heat rejection to the fuel.

c. Determination of Maximum Temperature of Fuel Tank Surface.

(1) Components mounted adjacent to the exterior surface of the fuel tank can create a high localized temperature at the inner surface of the tank. This can be investigated by laboratory tests which duplicate the installation, or by a heat transfer analysis using the maximum potential temperature of the component.

(2) Where electric wires are routed through conduits installed in a fuel tank, high surface temperature can be created by short circuits. A critical electrical wiring condition might be one in which the insulation is cracked, broken, or of low dielectric strength, allowing intermittent or constant arcing to occur without consuming enough power to cause the circuit protection device to open.

(3) When bleed air duct systems are routed near fuel tanks, an investigation could be made to determine the maximum temperature which can occur when failure, as well as normal operation, of the bleed air system causes heating of the fuel tank internal surface.

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