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MIL-E-18927E(AS), General Requirements for Aircraft Environmental Control Systems (ECS): Suggested Improvements

Oxygen Standardization Coordinating Group Meeting

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Overview: MIL-E-18927E(AS) Suggested Improvements

- Background
- Proposed Changes
- Summary

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Background

- On-Board Oxygen Generating Systems (OBOGS) are highly dependent on aircraft ECS air supply pressures and flow
 - Fighter OBOGS typically needs 1 to 4 pounds air/minute at minimum air pressure of 25-30 psig
 - ECS air supply low pressure transients can cause OBOGS performance issues, such as, degraded oxygen and restricted breathing flow
 - OBOGS is unable to maintain safe performance when inlet air supply pressures drop too low, even for short periods (a few seconds)
- MIL-E-18927E, “Military Specification: General Requirements for Aircraft Environmental Control Systems,” addresses design of ECS
 - OBOGS have been flying on military aircraft since the 80s
 - **Document does not mention OBOGS**

Background

- MIL-E-18927E(AS), “Military Specification: General Requirements for Aircraft Environmental Control Systems,” 18 Aug 1983, superseding MIL-E-18927D(AS) (29 Dec 1961) and MIL-H-18325B (04 May 1959)
 - Lead Standardization Activity: 71, AF Sustainment Center, Oklahoma City
 - Preparing Activity: AS, Naval Air Systems Command
 - Coordination: Limited
 - Navy Custodian: AS, Naval Air Systems Command
 - Status: Active
 - Document Date: 01 Jul 2019
 - Next Review Due: 28 Jun 2029
 - Doc Category: Detail Specification
 - Federal Supply Class (FSC)/Area: 1660
- MIL-E-18927E, Amendment 2, 19 Dec 1986 – admin updates
- MIL-E-18927E, Notice of Validation, 01 Jul 2019
 - Custodians: Navy - AS
 - Preparing Activity: Navy – AS
 - Reviewer Activities: DLA - GS

Background

- MIL-E-18927E, “Military Specification: General Requirements for Aircraft Environmental Control Systems”:
 - This specification is approved for use by the Naval Air Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.
 - Scope: “This specification establishes the general requirements for design and performance of aircraft Environmental Control Systems (ECS) required for occupied spaces and equipment. It includes pressurization, heating, cooling, ventilating, moisture control, bleed air system, ram air supply, **pressure and anti-G suit systems**, defogging, defrosting, anti-icing, rain removal, electronic/electrical equipment environment, boundary layer control and related systems.”

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1.1 Scope. This specification establishes the general requirements for design and performance of aircraft Environmental Control Systems (ECS) required for occupied spaces and equipment. It includes pressurization, heating, cooling, ventilating, moisture control, bleed air system, ram air supply, **On-Board Oxygen Generating System (OBOGS) air supply (if used)**, pressure and anti-G suit systems, defogging, defrosting, anti-icing, rain removal, electronic/electrical equipment environment, boundary layer control and related systems.

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- MIL-STD-1472 Human Engineering Design Criteria for Military Systems, Equipment and Facilities
- MIL-STD-2072 Survivability, Aircraft, Establishment and Conduct of Programs for
- MIL-STD-3050A DoD Design Criteria Standard, Aircrew Breathing System (ACBS)
- MS-16051 Coupling, Ground Cooling, Combat Type Aircraft

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3.2.7 System sizing. The ECS shall be sized to provide the required heating and cooling capacity **and air pressures and flows** during all anticipated ground and flight operations. The cooling provisions for electronic equipment shall provide for an electronic heat dissipation load 25 percent greater than the equipment heat load of the first production' aircraft. Enough clearance in the aircraft shall be provided to allow the ECS to enlarge to accommodate an additional 25 percent growth in electronic heat load (50 percent greater than that of the first production aircraft).

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3.4 Performance requirements.

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3.4.3 Leakage. All pressurized aircraft shall meet the following requirements.

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3.4.3.3 In-service leakage rate of ECS components and piping. Leakage rate of ECS (components and piping) shall be tested during aircraft phase inspections and shall not exceed the manufacturer's maximum rate to achieve acceptable ECS performance.

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3.4.5 Humidity control. The system shall be designed to prevent discharging air with entrained moisture onto windshields or into pressure suits, **into OBOGS**, occupied compartments, electronic equipment compartments, or forced cooled electronic equipment. Air forced directly over the surfaces of miniaturized or basic parts in electronic equipment shall, in addition, have dew point of 40 degrees F (4.4 degrees C) or less. All air delivered to the compartments or equipment by any means, including ram air shall meet these requirements, except where ram air is used as an emergency backup or where air is being supplied from a ground cart.

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3.4.7 Contamination. Adequate control of the contamination levels in the occupied compartment atmosphere, the occupant's breathing atmosphere, **and OBOGS air supply** shall be provided by the environmental control system. The system shall prevent the concentration of harmful or irritating substances in the occupied compartment atmosphere **and OBOGS air supply** from exceeding the maximum allowable concentration, as listed in AFOSH Standard 161-8.

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3.4.8 Controls.

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3.4.8.2 Pressure. Control of pressurized compartments **and the OBOGS air supply** shall be automatic with pressure regulators and safety valves. A control shall be provided for releasing **occupied compartment** pressure manually. The capacity of safety valves installed in combat type aircraft shall permit the differential pressure of occupied compartments to be reduced to two psi within the period of **4 ±2** seconds. The dump time of six seconds shall be fulfilled under the most critical combination of flight altitude and inlet air flow from the pressurizing system.

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3.4.9 Related systems

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3.4.9.10 OBOGS provisions for pressure, flow, and temperature

ECS shall ensure OBOGS air supply pressure, flow, and temperature requirements are in accordance with MIL-STD-3050A.

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3.4.9.10.1 Air pressure. ECS air supply pressure at OBOGS inlet port shall be at or above the OBOGS inlet pressure reducing valve (PRV) set point while on the ground and in-flight.

3.4.9.10.2 Air flow. ECS design air flow provision for OBOGS shall comply with the OBOGS specification.

3.4.9.10.3 Air temperature. Inlet air temperature for OBOGS, as measured at the OBOGS inlet, shall comply with the OBOGS specification.

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4.4 System performance tests. Specified performance of the ECS shall be demonstrated prior to installation in the airplane. System performance tests shall be conducted in conjunction with a mock-up of the pressure cabin with all distribution ducting and flow control devices installed. **If the ECS will supply an OBOGS with inlet air, an OBOGS shall be installed during these tests and a portion of the testing shall be accomplished with the ECS at the estimated maximum demand air flow conditions. Air supply delivered to the OBOGS shall meet conditions defined in Paragraphs 3.4.9.10.1-3.** Air flows, pressures and temperatures shall be recorded under simulated flight conditions. The system test data shall be compared to the system design analysis (see 3.12). All discrepancies must be resolved to the extent that the analytical system performance and laboratory test data are in reasonable agreement and demonstrate the performance requirements have been achieved. The report conditions of 3.12 apply.

Summary

- Aircraft OBOGS are highly dependent on the ECS air supply pressure for safe performance
- OBOGS have been flying on military aircraft since the 80's
- OBOGS is not mentioned in MIL-E-18927E(AS), ECS design standard
- Proposed changes to MIL-E-18927E(AS) will be submitted to NAWC-AD, Lakehurst NJ
- If anyone has additional changes, please send them to George Miller (george.miller.9@us.af.mil)
- Review of “DoD Joint Service Specification Guide, Air Vehicle Subsystems, JSSG-2009A (20 Nov 2015)” in planning – goal is to ensure this guidance document adequately addresses ECS air supply for OBOGS

Questions?