



AFRL

MIL-E-18927E(AS), GENERAL REQUIREMENTS FOR AIRCRAFT ENVIRONMENTAL CONTROL SYSTEMS (ECS): PROPOSED IMPROVEMENTS

OXYGEN STANDARDIZATION COORDINATING GROUP MEETING
27 AND 28 AUGUST 2025 (VIRTUAL)
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Overview

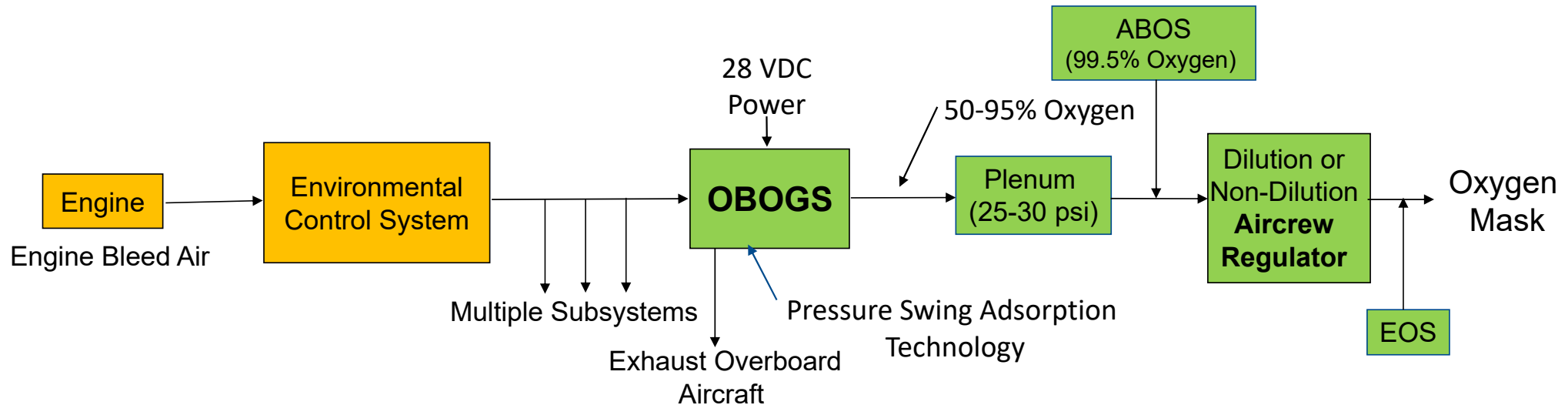
- Background
- Proposed Version 2 Improvements (Version 1 briefed at OSCG in 2023)
- Summary

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Background -- Typical OBOGS Approach



ABOS = Automatic Backup Oxygen System
EOS = Emergency Oxygen System

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Background

- On-Board Oxygen Generating Systems (OBOGS) and aircrew regulators are highly dependent on aircraft ECS air supply pressures
 - Fighter OBOGS typically need 1 to 4 pounds air/minute at minimum air pressure of 25-30 psig
 - ECS air supply low pressure transients have been observed and can cause OBOGS and aircrew regulator performance issues, such as, degraded oxygen and restricted breathing flow
 - OBOGS and aircrew regulators are 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 requirements**

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Background

- MIL-E-18927E(AS), “Military Specification: General Requirements for Aircraft Environmental Control Systems,” 18 Aug 1983
 - Lead Standardization Activity: 71, AF Sustainment Center, Oklahoma City
 - Preparing Activity: AS, Naval Air Systems Command
 - Navy Custodian: AS, Naval Air Systems Command
 - Document Date: 01 Jul 2019 (re-validated)
 - Next Review Due: 28 Jun 2029
 - Doc Category: Detail Specification

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Background

- MIL-E-18927E, “Military Specification: General Requirements for Aircraft Environmental Control Systems”:
 - 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.”

Note: Document includes anti-G suit systems but not OBOGS.



Background

- Briefed proposed Version 1 improvements to MIL-E-18927 at OSCG 2023 (01 August 2023)
- Submitted MIL-E-18927E(AS) proposed Version 1 improvements to NAWC-AD, System Standardization and PHS&T, Lakehurst NJ on 03 June 2024
- No indication NAWCAD initiated adjudication process
- Formed ECS/OBOGS IPT on 15 October 2024 -- 60 members from Government and industry (NAWCAD, AFRL, NAMRU-Dayton, AFLCMC/Aircraft Program Offices, AFSC, Netherlands MoD, and industry)
- Team meets every 2-3 months – conducted discussions and received input on proposed Version 1 improvements
- Prepared Version 2 proposed improvements, sent proposed improvements to IPT members (11 June 2025), and plan to discuss improvements at next IPT meeting (date TBD)
- **Current Goal: Complete IPT discussions on Version 2 proposed improvements and submit Version 2 improvements to NAWC-AD**

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Page 1:

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.

Rationale: OBOGS and aircrew regulator operation and performance are dependent on the ECS air supply pressure.

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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

Rationale: MIL-STD listed as reference document for physiological requirements.

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3.2.7 **System sizing.** The ECS shall be sized to provide the required heating and cooling capacity during all anticipated ground and flight operations. The cooling provisions for electronic equipment shall provide for an electronic heat dissipation load ~~25~~ **50 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~~ **50 percent** growth in electronic heat load (~~50~~ **100 percent** greater than that of the first production aircraft).

Rationale: Newer aircraft designs and avionics upgrades on existing aircraft increase heat loads, hence, an incremental increase in system sizing appears warranted. An increase in heat loads would result in increasing demand for cooling air and this increased demand could lower air pressures to the OBOGS.

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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, **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.

Rationale: Entrained liquid water can impact OBOGS performance and reliability by causing accelerated molecular sieve deactivation.

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Page 23: Add paragraph below.

3.4.10 OBOGS provision for air supply pressure. On the ground and in-flight the ECS air pressure (pounds/square inch gauge referenced to aircraft altitude pressure) delivered to the OBOGS inlet air connection shall be at or above the OBOGS inlet Pressure Reducing Valve (PRV) set point pressure.

Rationale: Inlet OBOGS air supply pressures at or above the PRV set pressure will ensure OBOGS and aircrew regulators have stable operation and performance. Adequate inlet air pressure is critical for OBOGS operation.

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Page 30: Add paragraph.

3.8.1 ECS components and piping in-service leakage rate inspection. Leakage rate of ECS components and piping shall be tested during periodic inspections and shall not exceed the manufacturer's maximum rate for acceptable ECS performance.

Rationale: ECS air leaks can impact pressures delivered to the OBOGS inlet and subsequently OBOGS and aircrew regulator performance. It appears in-service ECS leak checks are not conducted.

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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 aircraft life support system includes an OBOGS, the OBOGS and aircrew regulator/s shall be installed during ECS testing and testing shall be accomplished with the ECS operating at the estimated maximum air demand conditions.** 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.

Rationale: Testing with an OBOGS at estimated ECS maximum expected demands will assess whether adequate OBOGS inlet air pressures will be maintained under high ECS demand.

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Summary

- Aircraft OBOGS and aircrew regulators are highly dependent on the ECS air supply pressure for stable and 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
- Current Goal: After ECS/OBOGS IPT reviews proposed Version 2 improvements to MIL-E-18927E(AS) the improvement proposal will be submitted to NAWC-AD, Lakehurst NJ
- If anyone has additional suggestions for improvements, please send them to George Miller (george.miller.9@us.af.mil)

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Questions?