



Technical Standard Order

Subject: *Recorder Independent Power Supply*

1. **PURPOSE.** This Technical Standard Order (TSO) is for persons seeking a TSO authorization or letter of design approval. It tells them what minimum performance standards (MPS) their Recorder Independent Power Supply (RIPS) must first meet in order to obtain approval and be identified with the applicable TSO marking.

2. **APPLICABILITY.** This TSO is effective for new applications submitted after the effective date of this TSO.

3. **REQUIREMENTS.** New models of RIPS that are to be identified and manufactured on or after the effective date of this TSO must meet the MPS in appendix 1 of this TSO.

a. Functionality. The standards of this TSO apply to equipment intended to provide emergency power to an installed cockpit voice recorder or combination voice/data recorder.

b. Failure Condition Classification. We at the Federal Aviation Administration (FAA) have determined that failure of the function defined in paragraphs 3. and 3.a. of this TSO is a “minor” failure condition, and the applicant must develop the RIPS to at least the design assurance level commensurate with this failure condition classification.

c. Functional Qualification. Demonstrate the required performance under the test conditions specified in appendix 1.

d. Environmental Qualification. Subject the equipment to the test conditions specified in RTCA/DO-160D, “Environmental Conditions and Test Procedures for Airborne Equipment,” Change 4, dated July 29, 1997, or the most current revision. The standards for these test procedures are specified in appendix 1.

e. Deviations. We provide for using alternative or equivalent means of compliance to the criteria set forth in the MPS of this TSO. Applicants invoking these provisions shall demonstrate that an equivalent level of safety is maintained and apply for a deviation under 14 CFR § 21.609.

4. MARKING. Under 14 CFR § 21.607(d), mark articles manufactured under this TSO as follows:

a. Mark at least one major component must be permanently and legibly with all of the information listed in 14 CFR§ 21.607(d), except for the following:

(1) You may not substitute model designation for the name, type and part number, as stated in 14 CFR §21.607(d)(2), and

(2) You may not substitute the serial number for the date of manufacture, as stated in 14 CFR § 21.607(d)(3).

b. In addition to 14 CFR § 21.607(d), each separate component that is easily removable (without hand tools), each interchangeable element, and each separate sub-assembly of the article that the manufacturer determines may be interchangeable must be permanently and legibly marked with at least:

(1) The name of the manufacturer,

(2) The manufacturer's subassembly part number, and

(3) The TSO number.

c. If the component includes a digital computer, the part number must include hardware and software identification, or a separate part number may be used for hardware and software. Either approach must include a means of showing the modification status. Note that similar software versions, which have been approved to different software levels, must be differentiated by part number.

5. DATA REQUIREMENTS.

a. Application Data. Under 14 CFR § 21.605(a)(2), the manufacturer must furnish the Manager, Aircraft Certification Office (ACO), FAA, responsible for the manufacturer's facilities, one copy of the following technical data to support our design and production approval:

(1) Operating instruction and equipment limitations, with limitations sufficient to describe the operational capability of the equipment.

(2) Installation procedures and limitations, with limitations sufficient to ensure that the RIPS, when installed according to the installation procedures, continues to meet the requirements of this TSO. The limitations shall identify any unique aspects of the installation. Finally, the limitations shall include a note with the following statement:

The conditions and tests for TSO approval of this article are minimum performance standards. It is the responsibility of those

installing this article either on or within a specific type or class of aircraft to determine that the aircraft installation conditions are within the TSO standards. TSO articles must have separate approval for installation in an aircraft. The article may be installed only if performed under 14 CFR Part 43 or the applicable airworthiness requirements.

- (3) Schematic drawings as they apply to the installation Procedures.
- (4) Wiring diagrams as they apply to the installation procedures.
- (5) List of components by part number that make up the RIPS complying with the standards prescribed in this TSO. Manufacturers should include vendor part number cross-reference, when this applies.
- (6) Material and process specifications lists.
- (7) The quality control system description required by §§ 21.605(a)(3) and 21.143(a), including functional test specifications used to test each production article to ensure compliance with this TSO.
- (8) Manufacturer's TSO qualification test report.
- (9) Nameplate drawing providing the information required by paragraph 4 of this TSO.
- (10) A list of drawings and processes (including revision level) to define the article's design. For a minor change, any revisions to the drawing list need only be made available upon request.
- (11) An environmental qualification form as described in EUROCAE ED-14D, and RTCA Document DO-160D for each component of the system.
- (12) If the article includes a digital computer: Plan for Software Aspects of Certification (PSAC); Software Configuration Index; and Software Accomplishment Summary. We recommend that the PSAC be submitted early in the software development process. Early submittal allows timely resolution of issues, such as partitioning and determination of software levels.

b. Manufacturer Data. In addition to those data requirements that you must furnish, you must have available for review by the manager of the ACO responsible for your facilities, the following technical data:

- (1) The functional qualification specification you will use to qualify each production article to ensure compliance with this TSO.
- (2) Equipment calibration procedures.

- (3) Schematic drawings.
- (4) Wiring diagrams.
- (5) Material Process Specifications.

c. Furnished Data. Send one copy of the data and information specified in paragraphs 5.a (1) through 5.a (12) of this TSO, and instructions for periodic maintenance and calibration necessary for continued airworthiness, to each person receiving for use one or more articles manufactured under this TSO. In addition, include a note with the following statement in installation procedures and limitations:

NOTE?

6. AVAILABILITY OF REFERENCED DOCUMENTS.

a. You may buy copies of RTCA Document Nos. DO-160D and DO-178B from RTCA Inc., 1140 Connecticut Avenue, NW, Suite 1020, Washington, D.C. 20036.

b. You may buy copies of Federal Aviation Regulations 14 CFR Part 21, Subpart O, from the Superintendent of Documents, Government Printing Office, Washington, DC 20402-9325.

c. You can obtain Advisory Circular (AC) 20-110, "Index of Aviation Technical Standard Orders," and AC -36, "Index of Articles Certified under to Technical Standard Order System, from the U.S. Department of Transportation, Subsequent Distribution Office, Ardmore East Business Center, 3341Q 75th Avenue, Landover MD 20785, telephone: (301) 322-4477 or fax (301) 386-5394.

David W. Hempe
Manager, Aircraft Engineering Division
Aircraft Certification Service

DRAFT

APPENDIX 1
FEDERAL AVIATION ADMINISTRATION
MINIMUM PERFORMANCE STANDARD FOR
COCKPIT VOICE RECORDER STANDBY POWER SUPPLIES

1. **PURPOSE.** This standard provides the Minimum Performance Standards (MPS) for a Recorder Independent Power Supply (RIPS).

2. **SCOPE.**

3. **DEFINITIONS.** The following definitions apply to this standard:

- Major part. A part whose failure might adversely affect the operational integrity of the unit
- Minor part. A part which is not a major part.
- Model. Each unique configuration of a specific RIPS type.
- Rated output. The approved electrical power, that is developed at standard sea level atmospheric conditions for a ten minute period of use.
- Substantiate. To prove by presentation of adequate evidence obtained by demonstration or analysis or both.
- Type. All of a series of units, each one of which was developed as an alternate configuration or refinement of the same basic unit.

4. **DETAIL REQUIREMENTS.**

a. Item Definition. The Recorder Independent Power Supply (RIPS) is a supplemental energy source that supplies direct current voltage to the aircraft Cockpit Voice Recorder, or to the combination voice/data recorder, for a specified time whenever the primary aircraft power is removed from the recorder. The intent is to ensure continued recording after a loss of primary power to the recorder. Since it is impractical to distinguish between normal shutdown and loss of electrical power from an emergency, the RIPS will experience frequent operational cycles.

b. Characteristics

c. Performance

(1) Aircraft Voltage. The RIPS shall be capable of operating from 115 V_{AC}, 400 Hz, or from 27.5 V_{DC} primary aircraft power, or both applied simultaneously. The RIPS shall be able to operate from the minimum supplied voltages specified in DO-160D paragraphs 16.5.1.1 and 16.5.2.1.

(2) Supplied Voltage. The RIPS shall supply a nominal 27.5 V_{DC} ± (average dc volts) to the recorder following the removal of the line voltage. The average voltage supplied by the RIPS shall remain in the range of 22.0 V_{DC} to 29.5 V_{DC} for the specified supply duration.

(3) Energy Requirements. The RIPS shall have a minimum capacity of [(11 minutes) (60 seconds/minute) (12 Watts)] 7920 Watt-seconds.

(4) Supply Duration. The RIPS shall supply the specified voltage to the recorder for a period of 10.0 ± 1.0 minutes.

(5) Operational Timing. The RIPS shall monitor the line voltage supplied to the recorder and start supplying the recorder load within 50 msec of the line voltage falling below the specified recorder minimum operating voltage. The RIPS shall include a timing function to start operation coincident with the removal of aircraft power. When the RIPS operation reaches the specified supply duration, the RIPS will stop powering the recorder, causing a recorder shutoff.

(6) Operational Reset. If aircraft power is restored before the supply duration expires, the RIPS shall resume monitoring the recorder line voltage.

(7) Recharging. After depletion of the energy source to a value at or below 3960 Watt-seconds, the RIPS must be ready to function within 15 minutes of the application of primary power.

(8) Built-in Monitoring. The RIPS shall be equipped with built in test equipment (BITE) to detect internal failures and monitor the condition of the unit. If maintenance is required based on any combination of the following items, it shall be monitored and internally logged. Manufacturer may add other operational aspects may be added as desired.

- Energy source life expiration, for example, the number of hours operating time until battery replacement.
- Other energy source failure
- Absence of energy source in the device
- Number of energy source cycles, that is, the number of power activations since the latest energy source replacement.

(9) Maintenance Warning. The RIPS shall issue a warning as a discrete output to alert to any inability to perform its intended function, or to indicate that maintenance is required. To perform this function, the RIPS shall provide an output discrete having the following characteristics:

- A fail condition is indicated by an open circuit..... $Z > 100,000$ ohms
- Normal operation is indicated by a standard ground... $V_{OUT} < 1$ VDC

(10) Aircraft Electrical Interface. The interconnection between the aircraft wiring and the RIPS shall be by means of a standard connector to be defined by ARINC Characteristic 757.

d. Environmental Conditions

(1) Altitude. The RIPS shall be capable of operating with specified performance at any pressure altitude within the range $-1,000$ feet through $+55,000$ ft.

(2) Operating temperature. The RIPS shall be capable of operating with specified performance at any temperature within the range -20 degrees Celsius through $+70$ degrees Celsius. For the electronics component without the energy source, the lower operating temperature shall be -55 degrees Celsius.

(3) Storage Temperature. Storage of the RIPS at temperature in the range -55 degrees Celsius through $+70$ degrees Celsius shall not degrade the performance.

(4) Temperature Variation. The RIPS shall be capable of operating with specified performance during exposure to temperature variation as specified in DO-160D, Section 5.0 for equipment category B.

(5) Overpressure. The RIPS shall be capable of withstanding an overpressure of 30 psia with no physical damage or alteration to its performance specifications.

(6) Decompression. The RIPS shall be capable of withstanding exposure to rapid decompression from an altitude of 8,000 ft to 55,000 ft with no physical damage or alteration to its performance specifications.

(7) Humidity. The RIPS shall be capable of operating with specified performance in a relative humidity environment of 0 to 95% at a temperature of 35 ± 5 degrees Celsius

(8) Operational Shock. The RIPS shall be capable of operating with specified performance following exposure to mechanical shocks of magnitude 10g. The applied shock shall be in accordance with Section 7.0 of DO-160D.

(9) Crash Safety Shock. The RIPS shall be retained by its specified mounting when exposed to a series of mechanical shocks of magnitude 20g. The applied shock shall be in accordance with Section 7.0 of DO-160D.

(10) Sinusoidal Vibration. The RIPS shall be capable of operating with specified performance while being exposed to the vibration spectrum defined by Curve Y, Figure 8.2, DO-160D.

(11) Random Vibration. The RIPS shall be capable of operating with specified performance while being exposed to spectrum defined by Curve C1, Figure 8-4, DO-160D.

(12) Explosion Proofness. The RIPS shall be designed for safe operation in an environment in which flammable mixtures can be expected to occur (DO-160D, Section 9, Environment II).

(13) Waterproofness. The RIPS shall be designed for operation in an environment in which exposure to falling water from condensation is expected.

(14) Fluids Susceptibility. The RIPS shall be designed to withstand the deleterious effects of exposure to fluids typically found in a commercial aircraft environment. These fluids are identified in DO-160D, Section 11, Table 11-1.

(15) Fungus Resistance. The RIPS shall be designed to be resistant to the growth of fungi.

(16) Magnetic Effect. The RIPS shall be designed to produce a deflection of a compass needle of 1° or less at a distance of 1 meter.

e. Design and Construction

(1) Materials, Processes and Parts. Materials, processes and parts used in the construction of this assembly shall conform to best commercial practices as used in the aircraft industry. Electronic components shall be industrial grade or better.

f. Electromagnetic Compatibility, Susceptibility and Radiation

(1) Power Input. The RIPS shall be designed to conform to the requirements for Category A equipment as defined in Section 16.0 of DO-160D.

(2) Voltage Spike. The RIPS shall be designed to conform to the requirements for Category A equipment as defined in Section 17.0 of DO-160D.

(3) Audio Frequency Conducted Susceptibility – Power Inputs. The RIPS shall be designed to conform to the requirements for Category A equipment as defined in Section 18.0 of DO-160D.

(4) Induced Signal Susceptibility. The RIPS shall be designed to conform to the requirements for Category Z equipment as defined in Section 19.0 of DO-160D.

(5) Radio Frequency Susceptibility (Radiated and Conducted). The RIPS shall be designed to conform to the requirements for Category V equipment as defined in Section 20.0 of DO-160D.

(6) Emission of Radio Frequency Energy. The RIPS shall be designed to conform to the requirements for Category L equipment as defined in Section 21.0 of DO-160D.

(7) Lightning Induced Transient Susceptibility. The RIPS shall be designed to conform to the requirements for Category A2C3 equipment as defined in Section 22.0 of DO-160D.

4. **TESTS.**

a. General ?

b. Design Changes. Notification of design changes shall be per 14 CFR § 21.611.

c. Qualification. The manufacturer is responsible for the performance and reporting of the following qualification tests. The tests may be performed using hardware chosen by the manufacturer:

(1) Temperature and Altitude. Test according to Section 4.0 of DO-160D for equipment category D2, except that the operating high altitude shall be 55,000 ft.

(2) Temperature Variation. Test according to DO-160D, Section 5.0 for equipment category B. The control electronics shall be tested over the entire temperature range; the energy source shall be tested from a lower test limit of -20 degrees Celsius to the upper test limit.

(3) Overpressure. Test according to Section 4.6.3 of DO-160D for equipment category Ax.

(4) Decompression. Test according to Section 4.6.2 of DO-160D for equipment category Ax.

(5) Humidity. Conduct tests according to Section 6.0 of DO-160D for equipment category B.

(6) Operational Shocks and Crash Safety. For operational shocks, test according to Section 7.0 of DO-160D for Category B equipment, except that the magnitude of the applied shock shall be as defined in Paragraph 7.2.7.8 (??)0 or Paragraph 7.2.7.9 (?)0, as applicable.

(7) Vibration. Test according to Section 8.0 of DO-160D for Category U and T equipment, except the magnitude and test envelopes shall be as defined in paragraphs 7.2.2.100 and 7.2.2.11(?)0.

(8) Explosion Proofness. Test according to Section 9.0 of DO-160D for equipment category E for equipment intended for use in Environment II.

(9) Waterproofness. Test according to Section 10.0 of DO-160D for equipment category W.

(10) Fluids Susceptibility. Test according to Section 11.0 of DO-160D for equipment category F.

(11) Fungus Resistance. Test or make declarations according to Section 13.0 of DO-160D for equipment category F.

(12) Magnetic Effect. Test according to Section 15.0 of DO-160D for equipment category A.

(13) Power Input. Test according to Section 16.0 of DO-160D for equipment category A, for ac and dc supply.

(14) Voltage Spike. Test according to Section 17.0 of DO-160D for equipment category A.

(15) Audio Frequency Conducted Susceptibility – Power Inputs. Test according to Section 18.0 of DO-160D for equipment category A.

(16) Induced Signal Susceptibility. Test according to Section 19.0 of DO-160D for equipment category Z.

(17) Radio Frequency Susceptibility (Radiated and Conducted). Test according to Section 20.0 of DO-160D for equipment category V.

(18) Emission of Radio Frequency Energy. Test according to Section 21.0 of DO-160D for equipment category L.

(19) Lightning Induced Transient Susceptibility. Test according to Section 22.0 of DO-160D for equipment category A2C3.