Department of Transportation
Federal Aviation Administration
Aircraft Certification Service
Washington, D.C.

TSO-C56b

Effective
Date: 06/1/06

Technical Standard Order

Subject: ENGINE DRIVEN DIRECT CURRENT GENERATOR / STARTER GENERATORS

1. PURPOSE. This technical standard order (TSO) is for manufacturers applying for a TSO authorization or letter of design approval (LODA). In it, we (the Federal Aviation Administration, or FAA) tell you what minimum performance standards (MPS) your engine driven direct current generator/starter-generator (hereafter referred to as "article"), must first meet for approval and identification with the applicable TSO marking.

2. APPLICABILITY. This TSO affects new applications submitted after its effective date.

a. All prior revisions to this TSO are no longer effective. Generally, we will not accept applications against prior revisions after the effective date of this TSO. However, we may do so up to 6 months after it, if we know that you were working against the earlier MPS before this new revision became effective.

b. Articles approved under a previous TSO authorization may still be manufactured under the provisions of their original approval.

c. Major design changes to articles approved under this TSO require a new authorization. See Title 14 of the Code of Federal Regulations (14 CFR) § 21.611(b).

3. REQUIREMENTS. New models of articles identified and manufactured on or after the effective date of this TSO must meet the MPS of SAE International's Aerospace Standard (AS) 8020, *Engine Driven D.C. Generators/Starter-Generators and Associated Voltage Regulators*, dated January 1980 (and reaffirmed by SAE in August 1991) or the most current revision, as amended by this TSO.

a. Functionality. This TSO's standards apply to equipment for aircraft intended to either:

(1) Generate electrical direct current and regulate associated voltage; or

(2) Provide starting power to an engine, generate electrical direct current, and regulate the associated voltage.

b. Environmental Qualification. Test the equipment according to RTCA, Inc. document RTCA/DO-160E, *Environmental Conditions and Test Procedures for Airborne Equipment*, dated December 9, 2004 or the most current revision. Articles intended for use in small airplanes or normal category rotorcraft must be tested either:

(1) According to the RTCA document; or

(2) According to the RTCA document, but articles need not meet those requirements for emission of undesired radio frequency (RF) noise.

c. Software Qualification. If the article includes a digital computer, develop the software according to RTCA/DO-178B, *Software Considerations in Airborne Systems and Equipment Certification*, dated December 1, 1992 or the most current revision.

d. Electronic Hardware Qualification. If the article includes complex electronic hardware, develop the hardware in accordance with FAA Advisory Circular (AC) 20-152, *RTCA, Inc. Document RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware*. The hardware design assurance level should be consistent with the failure condition classification defined in RTCA/DO 178B.

e. Deviations. We have provisions for using alternate or equivalent means of compliance to the criteria in the MPS of this TSO. If you invoke these provisions, you must show that your equipment maintains an equivalent level of safety. Apply for a deviation under 14 CFR § 21.609 before submitting your data package.

4. MARKING.

a. Mark at least one major component of the article permanently and legibly with the following information in addition to the information specified in 14 CFR § 21.607(d):

(1) 14 CFR § 21.607(d)(2). Use the name, type, and part number. Do not use the optional model number; and

(2) 14 CFR § 21.607(d)(3). Use the date of manufacture. Do not use the optional serial number.

(3) Means of indicating if the article is a D.C. generator or a D.C. starter-generator;

(4) Nominal power output (electrical voltage and watts); and

(5) Mechanical power input requirements (pad requirements).

b. Also, mark the following permanently and legibly with at least the manufacturer's name, subassembly part number, and the TSO number:

(1) Each component that is easily removable (without hand tools);

(2) Each interchangeable element; and

(3) Each subassembly of the article that you determined may be interchangeable.

c. If the component includes a digital computer, then the part number must include hardware and software identification. Or, you can use a separate part number for hardware and software. Either way, you must include a means to show the modification status.

> **NOTE:** Similar software versions, approved to different software levels, must be differentiated by part number.

d. If applicable, identify deviations granted to the article by marking "Deviation. See installation/instruction manual (IM)" after the TSO number. You can abbreviate the marking to "(Dev. See IM)."

e. Articles not shown to comply with the RF noise requirements must be permanently and legibly marked, indicating that those articles have not been shown to comply; and

f. When applicable, identify the article as an incomplete system or state that the article performs functions beyond those described in paragraphs **3** and **3.a** of this TSO.

5. APPLICATION DATA REQUIREMENTS. As a TSO manufacturer-applicant, you must give the FAA aircraft certification office (ACO) manager responsible for your facilities a statement of conformance, as specified in 14 CFR § 21.605(a)(1). Also, give the ACO manager one copy each of the following technical data to support our design and production approval. (Under 14 CFR § 21.617(a)(2), LODA applicants submit the same data through their civil aviation authority.)

a. Operating instructions and equipment limitations, in an IM, sufficient to describe the equipment's operational capability. Describe any deviations in detail. If needed, identify equipment by part number, version, revision, and criticality level of software, classification for use, and environmental categories.

b. Installation procedures and limitations, in an IM, sufficient to ensure that the article, when installed according to the installation procedures, still meets this TSO's requirements. Limitations must identify any unique aspects of the installation. Finally, the limitations must include a note with the following statement:

> The conditions and tests for TSO approval of this article are minimum performance standards. Those installing this article, on or in a specific type or class of aircraft, must 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 according to 14 CFR part 43 or the applicable airworthiness requirements.

c. Schematic drawings of the installation procedures.

d. Wiring diagrams of the installation procedures.

e. List of components, by part number, that make up the article complying with the standards in this TSO. Include vendor part number cross-references, when applicable.

f. A component maintenance manual, covering periodic maintenance, calibration, and repair, for the continued airworthiness of installed article. Instructions should include recommended inspection intervals and service life.

g. Material and process specifications list.

h. The quality control system (QCS) description required by 14 CFR §§ 21.143 and 21.605(a)(3), including functional test specifications. The QCS should ensure that you will detect any change to the equipment that could adversely affect compliance with the TSO MPS, and reject the item accordingly. (Not required for LODA applicants.)

i. Manufacturer's TSO qualification test report.

j. Nameplate drawing with the information required by paragraph **4** of this TSO.

k. List of all drawings and processes (including revision level) that define the article's design. For a minor change, follow the directions in 14 CFR § 21.611(a). Show any revisions to the drawing list only on our request.

l. An environmental qualifications form as described in RTCA/DO-160E or the most current revision for each component of the article.

m. Installation procedures and limitations (required by paragraph **5.b**) must explain the article's non-compliance with RF noise requirements (see paragraph **3.b**) and the necessity for finding equivalent level of safety upon installation.

n. If the article includes a digital computer: a plan for software aspects of certification (PSAC), software configuration index, and software accomplishment summary. We recommend that you submit the PSAC early in the software development process. Early submittal allows us to quickly resolve issues, such as partitioning and determining software levels.

o. If the article includes a complex custom micro-coded component: a plan for hardware aspects of certification (PHAC), hardware verification plan, top level drawing, and hardware accomplishment summary. We recommend that you submit the PHAC early in the software development process. Early submittal allows us to quickly resolve issues.

6. <u>MANUFACTURER DATA REQUIREMENTS</u>. Besides the data given directly to us, have the following technical data available for review by the responsible ACO:

a. The functional qualification specifications for qualifying each production article to ensure compliance with this TSO.

b. Equipment calibration procedures.

c. Corrective maintenance procedures within 12 months after TSO authorization or LODA.

d. Schematic drawings.

e. Wiring diagrams.

f. Material and process specifications.

g. Results of the environmental qualification tests conducted per RTCA/DO-160E or the most current revision.

h. If the article includes a digital computer, the appropriate documentation defined in RTCA/DO-178B or the most current revision, including all data supporting the applicable objectives in RTCA/DO-178B Annex A, *Process Objectives and Outputs by Software Level.*

7. FURNISHED DATA REQUIREMENTS. If furnishing one or more articles to one entity (an operator or repair station), provide the following for each article manufactured under this TSO:

a. One copy of the data in paragraphs **5.a** through **5.f** of this TSO. Add any other data needed for the proper installation, certification, use, or for continued airworthiness of the article.

b. One copy of the data in paragraph **5.l** through **5.m** if the article performs functions beyond those described in paragraphs **3** and **3.a** of this TSO.

8. HOW TO GET REFERENCED DOCUMENTS.

a. Order RTCA documents from RTCA Inc., 1828 L Street NW, Suite 805, Washington, D.C. 20036. Telephone (202) 833-9339, fax (202) 833-9434. You can also order them online at www.rtca.org.

b. Order SAE documents from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001. Telephone (724) 776-4970, fax (724) 776-0790. You can also get copies through the SAE Internet website at www.sae.org.

c. Order copies of 14 CFR parts 21 and 43 from the Superintendent of Documents, Government Printing Office, P.O. Box 37154, Pittsburgh, PA 15250-7954. Telephone (202) 512-1800, fax (202) 512-2104. You can also get copies from the Government Printing Office (GPO), Internet website at www.access.gpo.gov. Select "Access," then "Online Bookstore." Select "Aviation," then "Code of Federal Regulations."

d. You can find a current list of technical standard orders on the FAA Internet website Regulatory and Guidance library at www.airweb.faa.gov/rgl. You will also find the TSO Index of Articles at the same site.

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