FEDERAL AVIATION AGENCY

Washington 25, D. C.

TECHNICAL STANDARD ORDER

Regulations of the Administrator

Part 514

SUBJECT: ENGINE-DRIVEN DIRECT CURRENT GENERATORS TSO-C56

Technical Standard Orders for Aircraft Materials, Parts, Processes, and Appliances

Part 514 contains minimum performance standards and specifications of materials, parts, processes, and appliances used in aircraft and implements the provisions of sections 3.18, 4a.31, 4b.18, 6.18 and 7.18 of the Civil Air Regulations. The regulation uses the Technical Standard Order system which, in brief, provides for FAA-industry cooperation in the development of performance standards and specifications which are adopted by the Administrator as Technical Standard Orders, and a form of self-regulation by industry in demonstrating compliance with these orders.

Part 514 consists of two subparts. Subpart A contains the general requirements applicable to all Technical Standard Orders. These provisions are summarized below for the convenient reference of the public. Subpart B contains the technical standards and specifications to which a particular product must conform, and each Technical Standard Order is set forth in the appropriate section of Subpart B. The subject Technical Standard Order is printed below. ANY TECHNICAL STANDARD ORDER MAY BE OBTAINED BY SENDING A REQUEST TO FAA, WASHINGTON 25, D. C.

SUBPART A--GENERAL

This subpart provides, in part, that a manufacturer of an aircraft material, part, process, or appliance for which standards are established in Subpart B, prior to its distribution for use on a civil aircraft of the United States, shall furnish a written statement of conformance certifying that the material, part, process, or appliance meets the applicable performance standards established in this part. The statement of conformance must be signed by a person duly authorized by the manufacturer, and furnished to the Chief, Engineering and Manufacturing Division, Bureau of Flight Standards, Federal Aviation Agency, Washington 25, D. C.

Subpart A also requires appropriate marking of materials, parts, processes, and appliances as follows:

(a) Name and address of the manufacturer responsible for compliance,

(b) Equipment name, or type or model designation,

(c) Weight to the nearest pound and fraction thereof,

(d) Serial number and/or date of manufacture, and

(e) Applicable Technical Standard Order (TSO) number.

In addition, Subpart A provides that no deviation will be granted from the performance standards established in Subpart B, and that the Administrator may take appropriate action in the event of noncompliance with Part 514.

§514.55 Engine-driven direct current generators for aircraft certificated under Part 4b - TSO-C56--(a) Applicability--(1) Minimum performance standards. Minimum performance standards are hereby established for engine-driven direct current generators which are to be used on civil aircraft of the United States certificated under Part 4b. New models of engine-driven direct current generators manufactured for use on civil aircraft on or after April 1, 1959, shall meet the minimum performance standards as set forth below.

(i) Test conditions. Unless otherwise specified in this section, each test shall be made under the following conditions:

(a) Mounting. The generator shall be mounted on a suitable drive stand capable of driving the generator continuously within the speed range. The longitudinal axis of the generator shall be horizontal.

(b) Excitation. The generator shall be self-excited and controlled by a suitable variable resistance in series with the shunt field. The shunt field current shall not be considered as part of the generator load current.

(c) Ambient temperature. The ambient temperature shall be 95° ± 9°F.

(d) Altitude. The tests shall be run at approximately sea level altitude.

(e) Location of load. The load for the generator shall be so located that it will not appreciably affect the ambient temperature or the blast-cooling air temperature (if blast cooling is used).

(f) Warm-up. Prior to the test, the generator shall be operated at continuous operating speed delivering rated load at rated voltage for sufficient time to reach a substantially constant temperature.

(ii) Test methods. (a) Manufacturer's declaration. The manufacturer shall declare the following generator ratings and characteristics. (These values are the "rated" and "declared" quantities referred to in subsequent paragraphs describing test methods.)

(1) Rated terminal voltage.

(2) Rated load current.

(3) Minimum blast cooling requirement (if blast cooling is to be used).

(4) Rated speed range.

(5) Continuous operating speed.

(6) Minimum speed for regulation.

(7) Maximum speed for regulation.

(8) Maximum overspeed.

(9) Minimum and maximum external field resistance in series with the shunt field.

(10) Maximum operating altitude.

(11) Allowable brush and commutator wear.

(12) Maximum static torque.

(13) Equalizing voltage (if provided) at rated load current.

(14) Overhang moment, with respect to the drive pad.

(b) Maximum speed for regulation. The generator shall not be given an operational warm-up prior to this test. The generator shall be operated at the maximum speed for regulation and it shall deliver the rated terminal voltage at no load with no more than the declared maximum external field resistance in series with the shunt field.

(c) Heating, commutation, minimum speed and equalizing voltage. Provisions shall be made for determining speed, terminal voltage, load current, field voltage, field current and the resistance in series with the shunt field. The declared minimum blast cooling requirement shall be supplied to the generator air inlet. The temperature of the cooling air shall be determined by means of a suitable temperature indicating device whose responsive element is located within the cooling air duct. While the generator is cold, the resistance and temperature of the shunt field shall be determined for use in calculating the field temperature rise (average) during continuous operation at the declared full load current. The generator shall be considered to have reached a continuous operating condition when the rate of rise of the shunt field temperature, above the then existing ambient temperature, does not exceed $2^{\circ}F.$ in five minutes.

(1) Heating. The ability of the generator to deliver the rated load current at rated terminal voltage at the declared continuous operating speed shall be demonstrated. Immediately following the above run, the ability of the generator to deliver rated load current at rated terminal voltage for both the minimum speed for regulation and the maximum rated speed shall be demonstrated. Following this test, the generator shall demonstrate its ability to deliver rated load current at minimum rated speed, at a terminal voltage not less than 85 percent of the rated terminal voltage.

(2) Commutation. Immediately following the above heat runs, with the generator hot, the commutation of the generator shall be observed over the rated speed range for no load, half load, and rated load current. There shall be no more than fine, pin-point sparking of the brushes during this test.

(3) Minimum speed. At no time during the above heat runs shall the required resistance external to the shunt field be less than the declared minimum external field resistance.

(4) Equalizing voltage. Where an equalizing voltage is provided, it shall be within 5 percent of the declared equalizing voltage when the generator is stabilized in temperature and operating at rated load current at the declared continuous operating speed. The declared minimum blast cooling requirement shall be supplied at the generator air inlet.

(d) Overspeed. This test shall be made while the generator is hot as a result of testing and shall be made at no load with the field circuit open and at the declared maximum overspeed. The generator shall demonstrate its ability to operate under overspeed conditions for five minutes without mechanical failure, throwing of varnish, or impairing electrical performance.

(e) Dielectric strength. While the generator is hot as a result of testing, it shall withstand the following test voltage at commercial frequency, applied between windings, and between each winding and frame, for the specified time:

500 volts (rms) for one minute, or
600 volts (rms) for one second.

(f) Ripple voltage. Ripple voltage shall be determined by means of a peak reading vacuum tube voltmeter in series with a 4.0 microfarad capacitor. The generator shall be operated at 120 percent of minimum rated speed at 50 percent of rated load current, with a manually operated field rheostat, and without a battery in parallel. Peak voltage readings shall be taken with the voltmeter successively connected for each of the two polarities and the higher of the two readings shall not exceed 1.5 volts.

(g) Humidity. The relative humidity for this test shall be 95 ± 5 percent. Subject equipment to test condition at 160° ± 4°F. for six hours. The heat source shall be turned off for 16 hours without changing total moisture content in the test space. During the 16-hour period, the temperature shall drop to 100°F. or less. The test shall be repeated ten times, allowing a two-hour period to stabilize to 160°F. Check for corrosion, distortion, and general deterioration. At the end of this test, the generator shall deliver rated load current at the declared continuous operating speed for two hours.

(h) Flexible drive. The flexible drive test shall be conducted on a universal joint torsional vibration machine which has a fly-wheel of at least 20 times the amount of inertia of the generator armature being tested. Testing procedure shall be as follows:

(1) 100 hours with ± 1 degree torsional amplitude input to drive shaft at critical frequencies. The flexible drive shall limit the armature amplitude within ± 5 degrees.

(2) 50 hours with ± 2 degrees torsional amplitude input to drive shaft at frequencies of 20 to 24 cps. The flexible drive shall limit the armature amplitude within ± 7 degrees.

(3) 15 minutes with ± 2 degrees torsional amplitude input to drive shaft at critical frequencies. The flexible drive shall limit the armature amplitude within ± 7 degrees.

(i) Performance of commutator, bearings, and brushes. The generator shall be operated under the following conditions. New brushes may be installed for this test.

(1) 100 hours at the declared continuous operating speed, at rated load current with the test conditions specified in subdivision (i) of this subparagraph.

(2) Four continuous cycles consisting of the following: 24 hours at the declared continuous operating speed and rated load current, at altitude conditions approximating 115 percent of the declared maximum operating altitude. The ambient temperature (and cooling air temperature, if blast cooling is used) shall be related to the test altitude by the formula $T = 104 - (.005)h$, (where T is the temperature in degrees F. and h is the test altitude in feet) except that the lower temperature limit, regardless of altitude, shall be -67°F.; at least one hour at the declared continuous operating speed and rated load current, with the test conditions specified in subdivision (i) of this subparagraph. The time interval between successive 24-hour runs at altitude shall not exceed two hours. The rate of change of altitude need not be controlled, but the temperature at any transition altitude shall be within 18°F. of that obtained from the temperature-altitude formula above.

(3) Two continuous cycles consisting of the following: Nine hours at the declared continuous operating speed and 75 percent rated load current, at altitude conditions approximating 115 percent of the declared maximum operating altitude. The ambient temperature (and cooling air temperature, if blast cooling is used) shall be related to the test altitude by the formula $T = 160 - (.004)h$ (where T is the temperature in degrees F. and h is the test altitude in feet); at least one hour at the declared continuous operating speed and 75 percent rated load current, with the test conditions specified in subdivision (i) of this subparagraph. The time interval prior to each nine-hour run at altitude shall not exceed two hours. The rate of change of altitude need not be controlled, but the temperature at any transition altitude shall be within 18°F. of that obtained from the temperature-altitude formula above.

(4) Evaluation of results of tests (1), and (2), and (3) above: Cumulative brush or commutator wear shall not exceed 20 percent of the declared allowable wear after tests (1) and (2) and shall not exceed 4 percent of the declared allowable wear after test (3). No mechanical failure or electrical malfunction shall occur during this test.

Drive shear section. Sufficient torsional force shall be applied to the drive shear section (or to the armature shaft itself, if no shear section is provided) to result in its failure. The necessary torque indicating instrumentation shall be provided. Failure shall occur at an applied torque of less than the declared maximum static torque.

(b) Marking. In addition to the marking required in §514.3, the nameplate shall contain the following information:

(1) Rated terminal voltage.

(2) Rated load current.

(3) Rated speed range.

(c) Data requirements. The manufacturer shall submit a tabulation of the declared generator ratings and characteristics (called for in paragraph (a)(1)(ii)(a) of this section to the Chief, Engineering and Manufacturing Division, Federal Aviation Agency, Washington 25, D. C., with the statement of conformance.

(d) Effective date. April 1, 1959.