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# Federal Aviation Agency

**AC NO:** 150/5345-10A CH 1

AIRPORTS

**EFFECTIVE:**

6/7/66

## ADVISORY CIRCULAR

## CHANGE

**SUBJECT:** CH 1 TO AC 150/5345-10A, SUBJECT: SPECIFICATION FOR L-828 CONSTANT CURRENT REGULATOR WITH STEPLESS BRIGHTNESS CONTROL

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1. PURPOSE. This advisory circular change is to inform recipients of the deletion of a detail requirement.

2. EXPLANATION OF CHANGE. The detail requirement for capacitors on page 7, paragraph 7.1 was changed to a performance requirement.

3. PAGE CONTROL CHART.

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| 7 | 12/8/65 | 7 | 6/7/66 |
| 8 | 12/8/65 | 8 | 12/8/65 |

Cole Morrow, Director
Airports Service

# Federal Aviation Agency

**ADVISORY CIRCULAR**

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| **AC NO:** | AC 150/5345-10A |
| | AIRPORTS |
| **EFFECTIVE:** | 12/8/65 |

**SUBJECT:** SPECIFICATION FOR L-828 CONSTANT CURRENT REGULATOR WITH STEPLESS BRIGHTNESS CONTROL

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1. PURPOSE. This circular describes the subject specification requirements and is published by the Federal Aviation Agency for the guidance of the public. The use of this specification is required for project activity under the Federal-aid Airport Program.

2. CANCELLATION. AC 150/5345-10, Specification for L-828 Saturable Reactor Type Constant Current Regulator With Stepless Brightness Control, is cancelled.

3. EXPLANATION OF REVISIONS. This circular adds requirements for a floating coil design constant current regulator and corrects the part number for the detented potentiometer used for control circuit.

4. SCOPE OF PUBLICATION. The specification requirements presented are for an oil-filled constant current regulator employing either a saturable reactor design or a floating coil design having stepless brightness selection without interrupting load current. The assembly consists essentially of an insulating transformer, current detecting system, lightning arresters, brightness selection control circuit, open-circuit and over-current protection, an instrument current transformer, and a transfer switch in the control circuit providing for local operation and transfer to remote operation. All parts shall be suitably enclosed for indoor and outdoor use and wired at the factory as a complete assembly.

5. SIZES. The regulator assembly shall be built in three basic sizes, and in all the sizes the primary shall be rated at 2400 volts, single phase, wye or delta, 60 cycles, and the secondary at 6.6 amperes. The three sizes shall be 10 KW, 20 KW, and 30 KW. Other sizes, input voltages, and frequencies, if required, may be ordered as provided for under paragraph 7r.

6. PERFORMANCE REQUIREMENTS.

a. Regulation. The regulator assembly shall be designed to permit stepless control of output current between 6.6 amperes and 2.8 amperes. The assembly shall be provided with automatic compensation for variations of input voltage. At all loads from no load to full load, it shall be capable of maintaining its nominal output current (as corrected in Table 3) within the limits set forth in Table 1 for the input voltage range shown. The assembly shall meet these same requirements when 10 percent of the load consists of open-circuited isolating transformers. When more than 10 percent of the isolating transformers in the load are open circuited, the output currents shall not rise above the limits specified in Table 1 but may fall below the limits specified therein.

TABLE 1. TRANSFORMER CHARACTERISTICS

| Nominal Output Current (Amperes) | Input Voltage Range (Volts) | Output Current Deviation From Nominal |
|---|---|---|
| 6.6 | 2280 - 2640 | ± 0.10 Ampere |
| 2.8 | 2280 - 2640 | ± 0.13 Ampere |

b. Efficiency. When supplied with 2400 volts and connected to a unity power factor load at 6.6 amperes, the measured efficiency at full load with the regulator at a temperature of 20° C. shall not be less than shown in Table 2 below.

TABLE 2. TRANSFORMER EFFICIENCY

| Regulator Size | Percent Overall Efficiency (Min.) |
|---|---|
| 10 KW | 88 |
| 20 KW | 90 |
| 30 KW | 92 |

c. Primary Power Factor. When operated as in 6b above, the uncorrected primary power factor shall be not less than 70 percent at full load for all sizes of regulators.

d. Temperature Rise. The winding temperature rise, as measured by the resistance method, shall not exceed 65° C. for continuous operation at full load at unity power factor. The maximum oil rise shall not exceed 55° C.

e. Temperature Limits. The unit shall be designed and constructed to operate at any ambient temperature from a minimum of -45° F. to a maximum of 120° F. at sea level.

7. DETAILED REQUIREMENTS.

a. Rating. The regulator shall supply 6.6 amperes to a unity power factor load equal to its KW rating, down to 2.8 amperes, to the same connected load. The nominal primary voltage shall be 2400 volts, single phase, 60 cycles; and the regulator shall operate and meet the output current regulation requirements shown in Table 1 for primary voltages from 2280 to 2640 volts. The regulator shall automatically compensate for any input voltage variations within this range.

b. Constant Current System. The input power circuit of either regulator shall be completely isolated (electrically) from the output series circuit. The root mean square (RMS) value of the open-circuit voltage of either regulator shall not exceed 140 percent of the rated load voltage when operating at nominal input voltage. The constant current regulator shall consist of the following specified components applicable to the specific design.

(1) Saturable reactor design constant current regulator shall consist of transformers and saturable reactors utilizing a current detector and control circuit devices to produce a constant current of the values specified under paragraph 6a.

(2) Floating coil design constant current regulator shall consist of a transformer so constructed that the vertical axis of the floating coil coincides with the vertical axis of the fixed coil throughout its range of travel without the use of pivots. This design shall also incorporate a means for absorbing the shock of repeated de-energizing with the moving coil in the extreme upper position without damage to coils or other componenets. A control circuit shall be utilized with the transformer to produce a constant current of the values specified under paragraph 6a.

c. Control Equipment. The applicable control system, as specified below, shall be provided as part of the assembly to accomplish the required stepless brightness control. It shall be capable of completing its full travel cycle in not more than ten seconds. It shall be capable of stopping and holding at any output current within the range of 6.6 amperes to 2.8 amperes.

(1) Saturable Reactor Design. A saturable reactor regulator shall be provided with a motor-driven variable ratio auto transformer as a part of the assembly and its drive shall be controlled for local operation by means of a single pole, double throw (SPDT), momentary contact switch, mounted on the regulator control cabinet. For remote control of auto transformer's drive, a SPDT, polarized, open-center DC relay shall be used. This relay shall be actuated to raise or lower the regulator output by utilizing a detented potentiometer, equal to General Radio Company's Part No. 975KS5G1, at a remote station. The components required to control the regulator, including control power supply, shall be installed in the regulator control cabinet. The remote detented potentiometer is not a part of this specification.

(2) Floating Coil Design. A floating coil regulator shall be provided with a suitable adjusting device mounted on the regulator control cabinet to obtain stepless brightness control from local control. For remote control, a detented potentiometer equal to General Radio Company's Part No. 975KS5G1, installed at a remote station, shall be utilized in an AC control circuit not exceeding 120 volts to raise and lower the regulator output. The components required to control the regulator, including the control power supply, shall be accessible from within the regulator cabinet. The remote detented potentiometer is not a part of this specification.

d. Remote Control Output Current. The regulator shall be designed to supply an output current, when remotely controlled by a potentiometer equal to General Radio Company's Part No. 975KS5G1, within the limits listed in Table 3. These values are based on rated input voltage and load.

TABLE 3. TRANSFORMER CHARACTERISTICS

| Potentiometer Brightness Position | Nominal Output Current (Amperes) | Output Current Deviation from Nominal (Amperes) |
|---|---|---|
| 5 | 6.6 | + 0.1, -0.20 |
| 4 | 5.2 | ± 0.30 |
| 3 | 4.1 | ± 0.30 |
| 2 | 3.4 | ± 0.25 |
| 1 | 2.8 | ± 0.25 |

e. Control and External Power. Control power requirements to obtain stepless brightness shall be obtained internally. All other control power shall be obtained from an external 115 to 125 volt, 50/60 cycle source.

f. Open-Circuit Protection. An automatic open-circuit protective device shall be supplied to prevent damage or injury in the event that an open circuit develops in the secondary. The protective device shall only operate when the secondary circuit is open circuited and shall operate by opening the main primary control circuit in not more than two seconds after the open circuit occurs. It shall reset automatically within 1/10 second after the master control switch (not a part of the regulator assembly) is opened or after the remote and local control switch (a part of the regulator assembly) is returned to the "off" position.

g. Overcurrent Protection. An automatic overcurrent protective system, where required, shall be provided to protect the regulator load from overcurrent conditions. The overcurrent protection shall operate by opening the main primary control circuit when the output current exceeds the maximum allowable nominal output current by no less than 8 percent and no more than 12 percent. It shall have an instantaneous reset feature.

h. Remote and Local Control Switch. A three-position selector switch shall be provided for switching from remote to local control. This selector switch shall be suitably mounted on the regulator with the operating handle externally located for easy access to an operator. The three positions of the selector switch shall be marked and connected as follows:

(1) Remote. Remote control circuits connected and local control circuits open. (The remote control station shall not be furnished as part of this assembly).

(2) Off. Remote and local control circuits open.

(3) Local. Local control circuits connected and remote control circuits open. A 3" x 5" cardholder shall be provided near the ammeter for the user's "current-brightness" calibration.

i. Instrument Current Transformer. The regulator assembly shall have a suitable current transformer with provisions for obtaining indication of output current through an indicating ammeter. The indicating ammeter (not less than three inches in diameter) shall be mounted flush on the side of the control cabinet or in the control cabinet door so that it can be read externally.

j. Terminal Board and Wiring. A suitable pressure-type terminal board, with terminals labeled as shown below, shall be provided in the control compartment.

(1) 71 - Control Neutral

(2) 72 - Control Power

(3) 73 - Remote Control Power

(4) 74 - Remote Oil Switch Control

(5) 75 - Primary Oil Switch Coil

(6) 81 - 83 Brightness Control

k. Tank and Control Cabinet. The reactors and/or the coils of the transformer shall be housed in a sheet metal steel tank. The tank shall be equipped with a removable gasketed cover held securely in place by bolts or clamps. The tank shall be set on a steel base plate with feet or channels and shall have a drain plug and sampling valve on the side of the tank not more than 2 inches above the bottom. The tank shall be provided with 4 stud terminals (2 labeled "input" and 2 labeled "output") suitable for the voltage involved. These terminals shall be protected from damage by a suitable shield. Lifting lugs shall be provided. A suitable sheet steel cabinet shall be permanently attached to the side of the tank for housing the relays, sensing device, protective relay,

control terminal board, and the control and transfer switch. Not less than four 1-inch i.p.s. threaded bosses shall be provided at suitable locations on the sides and bottom of the cabinet. The complete assembly shall be made weatherproof for installation outdoors.

(1) All low voltage control components shall be accessible by opening the cabinet door, and there shall be no high voltage (over 600 volts) within the control cabinet. The door shall be capable of being tightly fastened to minimize entrance of dust or insects. The knob of the control and transfer switch shall be accessible without opening the cabinet door. The exact shape of the tank and attached control cabinet is optional, provided that all other requirements are met. The regulator shall be shipped filled with oil ready for service. For all connections leaving the tank, means shall be provided to prevent oil siphoning. A clamp-type terminal lug shall be mounted on the outside of the regulator case for ground connections. An oil level gauge shall be installed in the tank.

(2) The overall physical dimensions of the regulator assembly for all sizes and types shall be such as to permit passage through a doorway 39 inches wide and 78 inches high.

l. Capacitors. Capacitors shall have a voltage rating at least 25 percent higher than the normal working voltage. Adequate *cooling shall be provided to insure long life. Capacitors shall be rated to perform at the temperature limits specified in paragraph 6e. *

m. Output Current Surge Limitation. The design of the regulator shall be such that any output surges caused by switching the regulator on and off, changing brightness steps, or shorting the load, shall not be great enough to damage a 6.6 ampere series incandescent lamp. Time delay, if incorporated, when switching the regulator on and off, shall not cause an interval of more than two seconds to elapse before the unit operates to deliver the current selected.

n. Wiring Diagram. A wiring diagram shall be permanently mounted inside the control cabinet. It shall be legible and readily accessible.

o. Painting and Finish. The inside and outside of the tank shall be given one prime coat and one finish coat of oilproof and weatherproof paint. The outside of the tank shall be given a touchup after final assembly.

p. Nameplate. A nameplate, permanently and legibly filled in with at least the following information, shall be securely attached to the outside front of the regulator housing.

(1) Constant Current regulator, single phase

(2) Input_____Volts_____Cycles_____Amperes

(3) Control_____Volts_____Cycles

(4) Output_____KW at 6.6 amperes_____Serial No.

(5) Output Current: 6.6 to 2.8 amperes. Gallons of oil_____

(6) Identification: FAA L-828

q. Parts List and Installation Instructions. A component parts list and installation and maintenance instructions shall be furnished with each regulator assembly. Sufficient drawings or illustrations shall be provided to indicate clearly the methods of installation and maintenance.

r. Special Provisions. In exceptional cases, special modifications to this specification may be required to meet local conditions. Listed below are modifications permitted:

(1) Input voltage may be specified other than 2400 volts, 60 cycle. In this event, the performance and testing requirements shall be adjusted proportionately.

(2) Rated output current may be specified to be 20 amperes rather than 6.6 amperes. Regulator ratings of not more than 90 KW will be permitted when 20 ampere output is specified. In this event, the performance and testing requirements shall be adjusted proportionately.

s. Lightning Arresters. Two lightning arresters shall be installed across the output terminals of the regulator, one connecting each of the two legs of the output circuit to ground. The ground side of the arresters shall be connected to the ground clamp on the regulator case. The arresters shall be sized to prevent lightning damage to the regulator. The arresters shall be disconnected for all high voltage testing of the regulator.

t. Warning. A plate or decal with the following legend shall be placed on the front of the regulator control cabinet door as a warning:

WARNING

TURN LOCAL CONTROL TO "OFF" POSITION BEFORE OPENING COMPARTMENT DOOR

8. TESTING.

a. Qualification Testing.

(1) One sample regulator shall be supplied as required for the tests to be performed.

(2) The regulator shall be subjected to the electrical and physical tests described below, the applicable detail requirements under paragraph 7, and the tests described in paragraph 8b.

(a) The preproduction model shall be tested by energizing at 2400 volts (nominal), at 2640 volts (plus 10 percent), and at 2280 volts (minus 5 percent) to determine that it meets the regulation requirements of paragraph 6a. Tests shall be performed at one-half and at full load as outlined below. The tests shall be made using the control set for local operation with the regulator output current adjusted to 6.6 and 2.8 amperes respectively (no transformers open circuited) and with input voltage at 2400 volts. With the regulator so set, the input voltage shall be varied to determine the regulator's ability to compensate for input voltage and to meet regulation requirements. The tests shall then be repeated with the equivalent of 10 percent of the isolating transformers open circuited.

(b) With control set for remote operation, the regulator shall be tested using a detented potentiometer equal to General Radio Company's Part No. 975KS5G1 to determine compliance with the requirements of Table 3. In this test, the regulator shall be connected to the remote control potentiometer by simulated 100-foot lengths of No. 12 AWG wire (a resistance equal to 0.16 ohms per wire) and by simulated 10,000-foot lengths of No. 19 AWG telephone wire (a resistance equal to 87 ohms per wire and a capacitance between any two wires of 0.16 microfarads).

(c) The temperature rise shall be determined by the resistance method at full load unity power factor for a minimum of eight hours continuously.

(d) With 2400 volts connected to the primary and with a unity power factor load operating at the 6.6 ampere position, the overall efficiency and power factor at rated full load shall not be less than the values specified in paragraphs 6b and 6c.

(e) Additional inspections and tests shall be made as deemed necessary by the Federal Aviation Agency, Airports Service, Washington, D.C. 20553, to determine compliance with this specification.

(f) The manufacturer shall certify that all components and materials will operate satisfactorily within the ambient temperature limits specified.

b. Production Testing. The following tests shall be made on each regulator after final assembly, and each regulator shall successfully withstand the tests.

(1) Dielectric Test. The circuits of all sizes shall withstand the following RMS 60-cycle test voltages for one minute without failure:

(a) Input circuit to ground - 19,000 volts

(b) 120 volt control circuits to ground - 1000 volts

(c) 48 volt control circuits to ground - 500 volts

(d) Output circuit to ground - 19,000 volts

(2) Performance Test. Each regulator assembly shall be tested for output currents at the maximum and minimum output of the assembly. When supplied with any voltage from 2280 volts to 2640 volts, the output current shall not exceed 6.7 amperes on the high side with a connected unity power factor load equal to the KW rating of the regulator. For the same voltage supply conditions, the output current shall not fall below 2.67 amperes on the low side when tested with the output short circuited through an ammeter.

(3) Protective and Control Device Tests. All control and protective devices shall be tested for proper operation as specified in paragraph 7c and 7h. This shall include tests to determine that the open-circuit voltage does not exceed 140 percent of the rated load voltage, as specified in paragraph 7b.

(4) Leakage Test. Each regulator assembly shall be tested to determine that all welds and gasketed seals are oiltight and weathertight.

9. QUALIFICATION. Any material submitted for approval shall be sent to the Federal Aviation Agency, Airports Service, Washington, D.C. 20553.

   a. The manufacturer shall furnish a sample regulator to an independent testing laboratory to be tested as described herein to obtain certification regarding the ability to manufacture regulators meeting the requirements of this specification. The independent testing laboratory shall be acceptable to the Federal Aviation Agency, Airports Service. The manufacturer shall furnish two copies of the testing laboratory's reports for review and approval consideration. Upon approval of the test reports which show satisfactory certification of compliance, the Airports Service will list the name of the qualified manufacturer and a description of their fixture in Advisory Circular 150/5345-1, Approved Airport Lighting Equipment. The cost of testing shall be borne by the manufacturer offering the material for qualification.

   b. If the manufacturer has satisfactory laboratory facilities, the tests may be performed at the factory and such tests shall be witnessed by a representative of the Federal Aviation Agency, Airports Service. The manufacturer shall furnish written reports of these tests.

   c. Parts list, installation instructions, drawings, and theory of operation of all components installed as part of the regulator shall be submitted for review and approval.

10. HOW TO GET THIS CIRCULAR. Obtain additional copies of this circular, AC 150/5345-10A, Specification for L-828 Constant Current Regulator With Stepless Brightness Control, from the Federal Aviation Agency, Printing Branch, HQ-438, Washington, D.C. 20553.

Charles F. Bowers
for Cole Morrow, Director
Airports Service