AC 150/5345-47

CHANGE 1

DATE 1/4/82

ADVISORY CIRCULAR

CHANGE

DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
Washington, D.C.

Subject: Change 1 to ISOLATION TRANSFORMERS FOR AIRPORT LIGHTING SYSTEMS--Revises Equipment Qualification Procedures

1. PURPOSE. This Change revises the procedures for obtaining equipment qualification approval as contained in paragraph 4.

2. EXPLANATION. Procedures for obtaining equipment qualification approval are now contained in AC 150/5345-1G, Approved Airport Lighting Equipment, and supersede those contained in paragraph 4 of this advisory circular.

3. FILING THIS CHANGE. This Change should be filed on the front of the advisory circular. Page changes to reflect this revision will be made at a later date.

Leonard E. Mudd

LEONARD E. MUDD
Director, Office of Airport Standards

Suggest filing this transmittal at the back of the AC. It will provide a reference authority for changes, a method of determining that all Changes have been received, and a check for determining if the AC contains the proper pages.

Initiated by: AAS-200

TAD-494.6

AC NO: AC 150/5345-47.

DATE: July 28, 1975

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: ISOLATION TRANSFORMERS FOR AIRPORT LIGHTING SYSTEMS

1. PURPOSE. This advisory circular contains specifications for series-to-series isolation transformers for use in airport lighting systems.

2. CANCELLATIONS. The following advisory circulars are canceled.

   a. AC 150/5345-22, Specification for L-834 Individual Lamp Series-to-Series Type Insulating Transformer for 5000 Volt Series Circuit, dated October 8, 1964.

   b. AC 150/5345-31A, Specification for L-833 Individual Lamp Series-to-Series Type Insulating Transformer for 600-Volt or 5000 Volt Series Circuits, dated April 24, 1970.

   c. AC 150/5345-33, Specification for L-844 Individual Lamp Series-to-Series Type Insulating Transformer for 5000 Volt Series Circuit 20/6.6 Amperes 200 Watt, dated January 13, 1965.

   d. AC 150/5345-34, Specification for L-839 Individual Lamp Series-to-Series Type Insulating Transformer for 5000 Volt Series Circuit 6.6/20 Amperes 300 Watt, dated January 13, 1965.

   e. AC 150/5345-41, Specification for L-855, Individual Lamp, Series-to-Series Type Insulating Transformer for 5000 Volt Series Circuit, 6.6/6.6 Amperes, 65 Watts, dated April 24, 1970.

3. REFERENCE. Publications that may be used in connection with this advisory circular are listed in paragraph 2 of this specification.

4. BACKGROUND. This advisory circular was written to include in one document all the various sizes of isolation transformers normally used in airport lighting systems. No changes have been made in the performance characteristics of the various transformers, but the physical lengths of

Initiated by: AAS-550

the leads have been changed to achieve standardization between civil and military users. Also, transformers rated at 50 Hz have been included.

4. HOW TO OBTAIN THIS CIRCULAR. Additional copies of this circular may be obtained, free of charge, from the Department of Transportation, Publications Section, TAD-443.1, Washington, D.C. 20590.

Bascom N. Lockett, Jr.

BASCOM N. LOCKETT, JR.
Acting Director, Airports Service

ISOLATION TRANSFORMERS FOR AIRPORT LIGHTING SYSTEMS

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers the requirements for series/series isolation transformers for use in airport lighting systems.

1.2 Classification. The transformers are designated as type L-830 for 60 Hz rating and type L-831 for 50 Hz rating with a numerical suffix to identify the particular wattage and current rating. The following transformers are covered by this specification.

TYPE		WATTAGE	PRIMARY AMPS.	SECONDARY AMPS.
60 Hz	50 Hz			
L-830-1	L-831-1	30/45	6.6	6.6
L-830-2	L-831-2	30/45	20.0	6.6
L-830-3	L-831-3	65	6.6	6.6
L-830-4	L-831-4	100	6.6	6.6
L-830-5	L-831-5	100	20.0	6.6
L-830-6	L-831-6	200	6.6	6.6
L-830-7	L-831-7	200	20.0	6.6
L-830-8	L-831-8	300	6.6	20.0
L-830-9	L-831-9	300	20.0	20.0
L-830-10	L-831-10	300	6.6	6.6
L-830-11	L-831-11	300	20.0	6.6
L-830-12	L-831-12	500	6.6	20.0
L-830-13	L-831-13	500	20.0	20.0

2. APPLICABLE SPECIFICATIONS

2.1 General. The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein:

2.1.1 Military Specifications.

MIL-C-4921 Cable, Power, Electrical, Airport Lighting, General Requirements for

MIL-C-5136 Cable, Power, Electrical. Polychloroprene Sheathed, Buna Compound Insulated

MIL-I-7798 Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic

2.1.2 Military Standards.

MIL-STD-130 Identification Marking of U.S. Military Property

2.1.3 American Society for Testing Materials (ASTM) Standards.

D-2240 Indentation Hardness of Rubber and Plastic by Means of a Durometer

D-753 General Purpose Neoprene Sheath for Wire and Cable

2.1.4 Federal Aviation Administration (FAA) Advisory Circulars.

AC 150/5345-26 Specification for L-823 Plug and Receptacle, Cable Connectors

AC 150/5345-7 Specification for L-824 Underground Electrical Cables for Airport Lighting Circuits

Copies of FAA advisory circulars may be obtained from the Department of Transportation, Publications Section, TAD-443.1, Washington, D.C. 20590. ASTM standards may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103. Military specifications may be obtained from the Commanding Officer, Naval Supply Depot, 5801 Tabor Avenue, Philadelphia, Pa. 19120.

3. REQUIREMENTS

3.1 Component Parts. The transformers shall consist of primary and secondary coils wound upon a core and enclosed in a waterproof case with rubber connectors molded on the primary and secondary leads.

3.2 Materials. Materials shall be as specified herein. When materials are not specifically designated, they shall be of the best commercial quality and entirely suitable for the purpose.

3.3 Design and Construction. The transformers shall be designed and constructed so that no parts will work loose in service. They shall be built to withstand the strains, jars, vibrations and other conditions incident to shipping, storage, installation, and service. The exact shape and design of the transformers shall be optional provided all requirements specified herein are met and the maximum dimensions specified hereinafter are not exceeded.

3.3.1 Windings. The windings shall be insulated from each other and the core. Windings of the core assembly shall be tightly wound and secured prior to molding so as to reduce the possibility of turns becoming loose and being forced close to the outer surface during pressure-molding operations. The transformers shall be designed to operate indefinitely under load, short-circuit, or open-circuit conditions in the secondary with rated current and rated frequency in the primary. The transformers shall have sufficient capacity to allow for lamp aging, secondary lead losses, and contact losses.

The junction of the case with the sheath of the leads shall not crack or show evidence of damage when the transformer is carried by one lead, or when the leads are bent or twisted as they normally would be during testing and installation. The case shall form a permanent watertight junction with the leads. At the junction, the case compound shall provide a reinforcing area for the leads. At the case surface, the reinforcing shall be at least 25 percent greater than the outside diameter of the connecting leads. The reinforcing may be of a cone shape around individual leads or a continuous ridge enclosing all three leads, and shall form an integral bond with the entire cable sheath within this reinforcing cone or ridge. There shall be no improper molding or bonds as evidenced by bubbles, blisters, cracks, etc. The case of the completed transformer shall be firm to the touch at all points and show no indentation (except for compression of case compound) when subjected to pressure which can be exerted directly by the hands.

3.4.2 Transformer Leads. The transformer shall be provided with a two-conductor secondary lead and two single-conductor primary leads. Lead connections may be of the solder or of the solderless type. If solderless connectors are used in joining leads to the transformer windings, they shall be of a type designed for that application and properly applied. Care shall be exercised during molding to insure that proper clearance exists between these connections after the molding operation has been completed. All three leads shall emerge from one end of the transformer. Spacing and arrangement are optional, provided all other requirements are complied with. The leads shall be securely fastened to the transformer in such a manner that carrying by a single lead will not loosen the electrical connections or affect the water seal. The length of all transformer leads shall be measured from the connector face to the junction of the transformer case.

3.4.2.1 Primary Leads. Equip one primary lead (H1) with a plug type connector conforming to Figure 6(a) of AC 150/5345-26 (Spec. L-823). Equip the other primary lead (H2) with a receptacle conforming to Figure 6(b) of AC 150/5345-26 (Spec. L-823). Use No. 8 AWG, 19 strand, single-conductor cable insulated for not less than 5,000 volts and conforming to AC 150/5345-7 Type B (Spec. L-824) or MIL-C-4921. Extend each primary lead 24 inches ±3 inches (60 cm. ±7.5 cm.) beyond the housing, including the connector.

3.4.2.2 Secondary Leads. Equip the secondary lead with a receptacle conforming to Figure 1(c) of AC 150/5345-26 (Spec. L-823). The receptacle shall be so wired that the large contact will connect to the X1 lead of the transformer secondary and the smaller contact will connect to the X2 lead. Use No. 12 or No. 14 AWG two-conductor, 600 volts, secondary cable conforming to AC 150/5345-7, Type A, (Spec. L-824), MIL-C-5136, or type SO cable. Extend the secondary lead cable 48 inches ±3 inches (120 cm. ±7.5 cm.) beyond the housing including the cable connector.

3.4.2.3 Caps. A watertight cap shall be placed on each connector for protection during shipment and installation. The cap shall consist of a rubber or rubber-like compound plug (or receptacle) designed to protect the mating surfaces of the connector from moisture and dirt. Insulation tape at least 7 mils thick and 3/4 inch wide conforming to MIL-I-7798 shall be wrapped over the joining seam to hold the cap in place and to protect against dirt and moisture. The dimensions of the mating surface of the caps shall be in accordance with FAA L-823.

3.5 Weight. The weight of the transformers shall be held to the minimum consistent with good design.

3.6 Nameplate. The markings shall be molded on the case surface of the transformer. The transformer shall be marked for identification in accordance with MIL-STD-130, except the serial numbers need not be included.

Specification L-830- or L-831
Transformer Rating: Watts - Volts - Frequency
Federal Stock Number _____
Manufacturer's Part No. _____
Manufacturer's Name or Trade-mark _____
Made in U.S.A.
Transformer, Series-to-Series Volts 5000 Hz. _____
Primary Amperes _____
Secondary Amperes _____
Order/Contract No. _____

3.7 Workmanship.

3.7.1 General. The transformer, including all parts and accessories, shall be constructed and finished in a thoroughly workmanlike manner. Particular attention shall be given to neatness and thoroughness of soldering, wiring, impregnation of coils, freedom of case and leads from burrs and sharp edges, open pores in the case molding material, and firmness of case molding to transformer lead sheath.

4. QUALITY ASSURANCE PROVISIONS

4.1 Qualification Procedure. Requests for obtaining qualification and listing as an approved supplier under the Airport Development Aid Program (ADAP) should be directed to the Airports Engineering Division, Airports Service, Federal Aviation Administration, Washington, D.C. 20591.

4.2 Tests. The following tests shall be conducted on three random samples to prove compliance with this specification. Unless otherwise specified, all tests shall be made at room temperature (approximately 25° C. $\pm$ 5° C.),

TABLE I

ELECTRICAL CHARACTERISTICS

Type	Primary Watt	Primary Amperes	Primary Power Factor	% Efficiency	Secondary Amperes Full Load	Secondary Amperes Short Circuited	Secondary Load Ohms	Secondary Maximum Open Circuit Voltage - RMS
L830-1	30/45	6.6	95	80	6.53 - 6.67	6.6 - 7.1	1.15	25
L830-2	30/45	20.0	95	80			1.15	25
L830-3	65	6.6	95	80			1.60	30
L830-4	100	6.6	95	85			2.44	70
L830-5	100	20.0	95	85			2.44	70
L830-6	200	6.6	95	90			4.82	100
L830-7	200	20.0	95	90	6.53 - 6.67	6.6 - 7.1	4.82	100
L830-8	300	6.6	95	90	19.8 -20.2	20.0 - 22.0	0.90	70
L830-9	300	20.0	95	90	19.8 -20.2	20.0 - 22.0	0.90	70
L830-10	300	6.6	95	90	6.53 - 6.67	6.6 - 7.1	8.25	135
L830-11	300	20.0	95	90	6.53 - 6.67	6.6 - 7.1	8.25	135
L830-12	500	6.6	95	90	19.8 -20.2	20.0 - 22.0	1.35	70
L830-13	500	20.0	95	90	19.8 -20.2	20.0 - 22.0	1.35	70

NOTE 1 - Voltage ratings shall be: Primary - 5,000 Volts Secondary - 600 Volts
NOTE 2 - Table also applies to type L-831 Transformers

3.3.2 Operating Conditions. The transformers shall be constructed for continuous outdoor service at any ambient temperature from a minimum of -55° C. (-67° F.) to a maximum of +65° C. (+149° F.). They shall operate properly when submerged in the ground with up to 5,000 volts on the primary winding.

3.3.3 Frequency. The transformers shall be designed to operate satisfactorily at rated frequency.

3.3.4 Electrical Characteristics. The electrical characteristics of the transformers shall be as shown in Table I.

3.4 Details of Components.

3.4.1 Case. The transformers shall be enclosed in permanently sealed cases in such a manner as to produce a completely watertight assembly. No portion of the case shall be less than 1/4-inch thick, and it shall be free of cracks, blisters, holes, etc., which would be detrimental to transformer service life. Sharp corners and edges of the core and coil assembly shall be eliminated or adequate provisions made so that they will not cut the case if the transformer is dropped or handled roughly. The case shall be constructed so that moisture accidently getting into the leads or connectors cannot be conducted through the leads into the windings of the transformer. The case shall be composed of material formed directly on the core and coil assembly or preformed and compound filled. The material shall meet the physical requirements of ASTM D-753. The minimum strength requirements shall be at least the following:

- Tensile strength - 1200 psi (84 kg/cm 2)
- Tensile strength after 96 hours oxygen bomb test - 1000 psi (70 kg/cm 2)
- Tensile strength after 168 hours in an oven test at 157° F. - 159° F. (69° - 71°) 1000 psi (70 kg/cm 2)
- Durometer hardness shall be 65 ± 10 as measured in accordance with ASTM D-2240

Insofar as practicable, internal air pockets shall be eliminated and the assembly shall be sufficiently rugged to withstand rough handling. The case shall be capable of withstanding exposure to sun, oil, gasoline, moisture, acid, and alkaline soils. The case shall be designed so that the transformer may be installed upright or lying on any side. The dimensions of the transformer shall be such that the transformer shall fit easily into a space defined as a cylinder, 8 inches in diameter by 10 inches in height.

using a suitable sine wave power source with primary current maintained at the specified values by means of an auto-transformer. If it is necessary for water bath temperature to be substantially different from limits set above, the proper temperature coefficient for the compound being used may be applied when computing insulation resistance values. It will be the manufacturer's responsibility to furnish proof that the coefficient used is correct. Proof shall be in the form of a certified test report furnished by the manufacturer. Joints between transformer leads, and between transformer leads and test leads, will not be taped during any of the dielectric or insulation resistance tests required by paragraphs 4.2.3 and 4.3.2 herein. All test lead connectors shall be checked with a "go," "no go" prior to use to assure proper watertight seal.

4.2.1 Characteristics Test. The samples shall be tested to show that their electrical characteristics are as specified in Table 1. All corrections necessary to compensate for meter-power consumption shall be applied. The transformers shall be operated in air at room temperature with rated load connected to the secondary until the transformer windings have reached normal operating temperature at which time the measurements will be taken.

4.2.2 Shock Test. The sample transformers shall be dropped twice from a height of 6 feet (2 meters) on a smooth hardware floor; once so they hit on a bottom corner or location where the most damage is likely to occur due to the core cutting into the case, and once so they hit on a side or location where the most damage is likely to occur to the windings. Lead rigidity shall be tested by securing (just below the connector) each lead one at a time, in a clamp fastened to a support, elevated a distance in excess of the length of leads and then releasing the transformers for a free fall from the clamp elevation. The lead clamp used shall be such as to not cause damage to the lead at the point of attachment. After the completion of these tests, the transformers shall be tested to insure that they meet the secondary current requirements at rated load. A change of more than one percent from the results obtained in the test specified in paragraph 4.2.1 or evidence of damage to the case and attaching leads shall be cause for rejection.

4.2.3 Insulation Resistance. The sample transformers shall be subjected to a continuous 20-cycle test as follows:

4.2.3.1 Mating Connectors. Mating connectors that were gauged with "go" and "no go" gauges shall be installed in the three connectors of the transformers. The mating connectors shall not be removed before completion of the 20-cycle testing. If they are removed for any reason, tests shall be repeated so that the transformers and their connectors satisfactorily pass 20 continuous cycles. One cycle shall consist of the sequence of operation specified in paragraphs 4.2.3.2, 4.2.3.3, and 4.2.3.4.

4.2.3.2 Transformer. The transformers shall be operated, with mating connectors installed, for a minimum of 6 hours in air at room temperature with rated current flowing in primary coils. The secondaries of the transformers shall be open-circuited. The procedure of this paragraph shall hereinafter be referred to as "the heating cycle."

4.2.3.3 Water Immersion Test. Immediately following the heating cycle,the transformers, with leads and connectors, shall be completely submerged in water, which is grounded, at room temperature. Care should be taken to insure that all molded connections, on transformer leads and test harness, are completely immersed in water during this test. Immediately after immersion, the insulation resistance of each coil and lead assembly shall be measured. The time period between interruption of the heating cycle and start of the measurement shall not exceed 3 minutes.

4.2.3.4 Soaking. The transformers and their connectors shall be soaked in water, at room temperature, for not less than 12 hours, and the insulation resistance measurements repeated.

4.2.3.5 Resistance Measurements. Measurements of dielectric and insulation resistance shall be made with direct current. The test voltage shall be applied for 1 minute between each coil and ground with the other coil grounded and its connectors submerged in water. The insulation resistance at the test voltage indicated shall equal or exceed the minimum values specified in Table 2. Zero and maximum readings of the test instrument shall be periodically checked by touching the high voltage lead to the water surface and suspending it in air. After instrument needle settles down following current inrush, it shall remain steady without fluctuations.

Table 2

Coil	DC Test Voltage	Minimum Insulation Resistance in Megohms			
		Cold	ELC*	Hot	ELC*
Secondary	5,000	750	6.7	300	17.0
Primary	15,000	2,000	7.5	750	20.0

* Equivalent Leakage Current (Microamps)

4.2.4 Temperature Rise. The temperature rises of the transformers shall be determined by the resistance method and shall not exceed 55° C. when the transformers are operated in air under each of the following conditions with rated current flowing in the primary:

A. Rated Load
B. Short Circuit
C. Open Circuit

The temperature test shall be conducted in accordance with the applicable requirements of the American Standard Test Code for transformers. Temperature rise shall be computed from the following formula:

$$\text{Temperature Rise } (^{\circ}C) = (234.5 + 0_o)\ \frac{(R_1 - R_o)}{R_o}$$

Where 0_o = Temperature ($^{\circ}C$) corresponding to Cold Resistance

R_o = Cold Resistance

R_1 = Hot Resistance

4.3 Production Testing. All transformers offered for delivery shall be subjected to the tests specified in 4.3.1 through 4.3.4.

4.3.1 Ratio Test. Test each transformer for current ratio at rated frequency of current on the primary and rated load on the secondary. The secondary current of each transformer must conform to the limits specified in Table I.

4.3.2 Dielectric Testing. Subject each transformer to one complete cycle of the test specified in 4.2.3. The transformers may be heated to a temperature known to equal or exceed that obtained in the 6-hour open circuit conditions.

4.3.3 Test for Voids. The maximum pressure which can be exerted directly with the hands shall be applied to all parts of the transformer cases. Any evidence of voids beneath the surface of the case shall be cause for rejection.

4.3.4 Additional Inspection and Tests. Additional inspection and tests will be made as deemed necessary for the FAA, Airports Service, Washington, D.C. 20591, or by the procuring agency as spelled out in procurement documentation.

5. PREPARATION FOR DELIVERY

5.1 Packaging and/or Packing. The most applicable commercial practice will be followed unless specified in procurement documents.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
Washington, D.C. 20591

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