

MILITARY SPECIFICATION

TRANSFORMERS, POWER, AUTOTRANSFORMERS AND STEP DOWN,
400 CYCLE

1. SCOPE

1.1 This specification covers 2 classes of transformers for aircraft 400-cycle systems:

- Class I - Transformer, 3 phase
- Class II - Autotransformer, single phase

2. APPLICABLE SPECIFICATIONS, STANDARDS, AND PUBLICATIONS

2.1 The following specifications, standards, and publication, of the issue in effect on the date of invitation for bids, form a part of this specification to the extent specified herein:

SPECIFICATIONS

MILITARY

MIL-D-5028	<i>Drawings and Data Lists; Preparation of (For Engines, Accessories and Other Auxiliary Equipment)</i>
MIL-E-5272	<i>Environmental Testing, Aeronautical and Associated Equipment, General Specification For</i>
MIL-P-6064	<i>Packaging of Lightweight Aircraft Accessories</i>
MIL-S-7742	<i>Screw Threads; Standard, Aeronautical</i>

STANDARDS

MILITARY

MIL-STD-129	<i>Marking of Shipments</i>
MIL-STD-130	<i>Identification Marking of U. S. Military Property</i>

PUBLICATION

AIR FORCE-NAVY AERONAUTICAL BULLETIN

1/3 Specifications and Standards; Use of

(Copies of specifications, standards, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring agency or as directed by the contracting officer.)

2.2 Other publication.- The following publication, of the issue in effect on date of invitation for bids, unless otherwise stated, forms a part of this specification:

AMERICAN STANDARDS ASSOCIATION BULLETIN

C6.1-1944 American Standards Terminal Markings for
Electrical Apparatus

(Copies of the American Standards Association Bulletin may be obtained from the American Standards Association, 29 West 39th Street, New York 18, New York.)

3. REQUIREMENTS

3.1 Material:

3.1.1 Specifications and standards.- Specifications and standards for all materials, parts, and Government certification and approval of processes and equipment, which are not specifically designated herein and which are necessary for the execution of this specification, shall be selected in accordance with Bulletin No. 143, except as provided in the following paragraph:

3.1.1.1 Standard parts.- AN or MIL Standard parts shall be used wherever they are suitable for the purpose, and shall be identified by their part numbers. Commercial utility parts such as screws, bolts, nuts, cotter pins, et cetera, may be used, provided they have suitable properties and are replaceable by the AN or MIL Standard parts without alteration, and provided the corresponding AN or MIL part numbers are referenced on the drawings and in the parts lists. In applications for which no suitable corresponding AN or MIL part is in effect on date of invitation for bids, commercial parts may be used provided they conform to all requirements of this specification.

3.1.2 Protective treatment.- When materials are used in the construction of the transformers that are subject to deterioration when exposed to climatic and environmental conditions likely to occur during service usage, they shall be protected against such deterioration in a manner that will in no way prevent compliance with the performance requirements of this specification. The use of any protective coating that will crack, chip, or scale with age or extremes of atmospheric conditions, shall be avoided.

3.2 Design and construction.- The transformer shall be as small and compactly built as practicable, and shall be designed and constructed so that no parts will work loose in service. It shall be built to withstand the strains, jars, vibrations, and other conditions incident to shipping, storage, installation, and service.

3.2.1 Continuous rating.- The continuous rating shall be the maximum kilovolt-amperes output which the transformer can deliver for an indefinitely long time at rated voltage under normal operating conditions.

3.2.2 Five minute rating.- The transformer shall be capable of delivering 150 percent of continuous rated kilovolt-amperes for cyclical operation of 5 minutes "on" and 15 minutes "off" for a period of 10 hours.

3.2.3 One minute rating.- The transformer shall be capable of delivering 250 percent of continuous rated kilovolt-amperes for cyclical operation of one minute "on" and 19 minutes "off" for a period of 10 hours.

3.2.4 Overvoltage.- The transformer shall be capable of continuous operation at an overvoltage of 10 percent.

3.2.5 Temperature rise.- With the transformer delivering rated kilovolt-amperes at rated voltage and frequency, the maximum temperature rise, as measured by the resistance method, shall not be more than 200°C above an ambient temperature of 25°C.

3.2.6 The kilovolt-ampere rating, phase, and rated primary and secondary voltages shall be as specified in Table I.

3.2.7 Items No. 2, 3, and 4 in Table I shall be capable of delivering rated kilovolt-amperes when used either as step-up or step-down transformers.

3.2.8 Frequency.- The nominal frequency of the transformer shall be 400 cycles. Satisfactory operation as specified herein, shall be obtained within the frequency range of 380 to 440 cycles.

3.2.9 No load voltage:

3.2.9.1 With 110 to 120V, 390 to 420 cycles ac power applied to the primary of the 115/28V transformers, the open circuit secondary voltage shall remain within the limits of 26 to 29V.

3.2.9.2 With 190 to 210V, 390 to 420 cycles ac 3-phase power applied to the primary of the 200/115V transformers, the open circuit secondary voltages shall remain within the limits of 108.5 to 122.5V.

3.2.10 Voltage regulation.- The voltage regulation shall not be more than 8 percent for the transformers of less than 0.5 kva rating, and not more than 6 percent for the transformers of 0.5 kva rating or larger, at 0.8 PF and at normal operating temperatures while in air at an ambient temperature of 25°C.

3.2.11 Efficiency.- The efficiency of the transformers shall not be less than the value specified in Table I, when measured at normal operating temperatures while in air at an ambient temperature of 25°C.

3.2.12 Windings.- The windings of Class II transformers rated at 0.1 kva, or less, and windings of Class I transformers rated at 0.3 kva, or less, shall be protected from corrosion due to salt spray and moisture by impregnating with a moisture-resistant compound which will withstand the operating conditions specified herein.

TABLE I

ITEM NO.	DESCRIPTION	RATING (KVA)	PRIMARY	SECONDARY	PHASE	EFFICIENCY (PERCENT)	WEIGHT (POUNDS)
1	Transformer	0.30	200Y	115A	3	84	2.0
2	Autotransformer	0.005	115	28	1	75	0.7
3	Autotransformer	0.05	115	28	1	82	0.9
4	Autotransformer	0.10	115	28	1	86	1.0
5	Autotransformer	0.20	115	28	1	86	1.2
6	Autotransformer	0.50	115	28	1	86	1.9
7	Autotransformer	0.75	115	28	1	86	2.2
8	Autotransformer	1.0	115	28	1	92	2.6
9	Autotransformer	1.5	115	28	1	92	3.4
10	Autotransformer	2.0	115	28	1	92	4.1
11	Autotransformer	3.0	115	28	1	92	5.3
12	Autotransformer	5.0	115	28	1	92	7.5

3.3 Performance.- Unless otherwise specified, the transformer shall be capable of operating satisfactorily under the following conditions:

3.3.1 Temperature:

3.3.1.1 A minimum ambient temperature of $-65 \pm 2^{\circ}\text{C}$ from sea level to 50,000 feet altitude.

3.3.1.2 A maximum ambient temperature varying uniformly from $+71 \pm 2^{\circ}\text{C}$ at sea level to $0 \pm 2^{\circ}\text{C}$ at 40,000 feet and constant at 0°C from 40,000 to 50,000 feet altitude.

3.3.2 Altitude.- A pressure altitude range from sea level to 50,000 feet.

3.3.3 Humidity.- All conditions of relative humidity.

3.3.4 Fungi.- Moist fungi encountered in tropical and semi-tropical climates.

3.3.5 Sand and dust.- Exposure to airborne sand particles, as encountered in desert operation.

3.3.6 Salt spray.- Exposure to atmosphere containing salt-laden moisture.

3.3.7 Vibration.- Conditions of linear vibration incident to normal continuous use in aircraft.

3.3.8 Arid.- Exposure to conditions of high temperature and low humidity as encountered in desert operation.

3.4 Insulation.- The insulation shall be capable of withstanding a potential of 1500V rms, 60 cycle ac for a period of one minute at sea level.

3.5 Mechanical protection.- The transformer windings shall be adequately protected from mechanical damage which may result from installation adjacent to personnel in the cabin of a military airplane.

3.6 Life.- The insulation of the transformer shall be capable of withstanding the normal temperature rise of the transformer for 1000 hours of operation.

3.7 Mounting base.- The transformer shall be provided with a suitable base for mounting on a flat surface. The mounting base shall provide suitable grounding of transformer frame to the airplane structure.

3.8 Interchangeability.- All parts having the same manufacturer's part number shall be directly and completely interchangeable with each other with respect to installation and performance. Changes in manufacturer's part numbers shall be governed by the drawing number requirements of Specification MIL-D-5028.

3.9 Terminals:

3.9.1 The transformer shall be provided with suitable terminals of either the clamps or stud type, and arranged so that there will be no danger of short circuits occurring between terminals.

3.9.2 Terminal markings.- The terminals for Class II transformers shall be marked "HV" (high voltage) "LV" (low voltage) and "G" (common ground). Terminals for Class I transformers shall be marked in accordance with American Standards Associated Bulletin No. C6.1-1944.

3.9.3 The neutral of the 3-phase Wye-delta connected transformers shall be brought out and connected to a terminal marked "G".

3.10 Weight.- The weight of the transformer shall not exceed the value specified in Table I.

3.11 Screw threads.- Screw threads shall be in accordance with Specification MIL-S-7742.

3.12 Identification of product.- Equipment, assemblies, and parts shall be marked for identification in accordance with Standard MIL-STD-130.

3.13 Workmanship:

3.13.1 General.- The transformer, including all parts and accessories, shall be fabricated and finished in a workmanlike manner. Particular attention shall be given to freedom from blemishes, defects, burrs, and sharp edges; accuracy of dimensions and marking of parts and assemblies; thoroughness of soldering, brazing, painting, and wiring; alignment of parts and tightness of assembly screws and bolts; et cetera.

3.13.2 Dimension.- Dimensions and tolerances not specified, shall be as close as is consistent with the best shop practices. Where dimensions and tolerances may affect the interchangeability, operation, or performance of the transformers, they shall be held or limited accordingly.

3.13.3 Cleaning.- The transformer shall be thoroughly cleaned of loose metal chips, and other foreign material after final assembly. Burrs and sharp edges shall be removed.

4. SAMPLING, INSPECTION, AND TEST PROCEDURES

4.1 Classification of tests.- The inspection and testing of transformers shall be classified as follows:

4.1.1 Qualification tests.- Qualification tests are those tests accomplished on samples submitted for qualification as a satisfactory product.

4.1.2 Inspection tests.- Inspection tests are those tests accomplished on transformers submitted for acceptance under contract.

4.2 Test conditions.- Unless otherwise specified, the transformer shall be tested at an ambient temperature of approximately 25°C, an atmospheric pressure (approximately 29.92 inches Hg) rated voltage and frequency, and with rated kilovolt-ampere load at unity power factor.

4.3 Qualification tests:

4.3.1 Prior qualification.- Unless otherwise specified by the Procuring Agency, transformers which have not previously passed a qualification test, or which have passed the qualification test and have been modified in any manner, shall satisfactorily pass a qualification test prior to the acceptance of any transformer.

4.3.2 Qualification test samples.- Qualification test samples shall consist of 2 transformers. Samples shall be appropriately identified with the manufacturer's own part number and any additional identification required by the authorizing letter.

4.3.3 The qualification test shall consist of the following test and those specified under the inspection tests and shall be conducted in the following order:

Transformer No. 1

Examination of product
No load voltage
Voltage regulation
Efficiency
Temperature rise
Altitude
Low temperature
Vibration
Insulation
Salt spray
Life

Transformer No. 2

Examination of product
No load voltage
Voltage regulation
Efficiency
Temperature rise
Humidity
Mildew resistance

4.3.3.1 Altitude.- The transformer shall be placed in an altitude chamber and maintained for a period of 6 hours at a pressure altitude of 50,000 feet and an ambient temperature of 0°C. During the last 2 hours of the test, electrical power shall be connected and a temperature rise test conducted with the transformer carrying rated kilovolt-ampere load at unity power factor. The temperature of the windings measured by the resistance method shall not exceed 225°C.

4.3.3.2 Low temperature.- The transformer shall be subjected to a low temperature test in accordance with Procedure I of Specification MIL-E-5272. There shall be no cracking of insulation, loosening of parts, or other damage to the transformer as a result of this test.

4.3.3.3 Vibration test.- The transformer shall be subjected to a vibration test in accordance with Procedure I of Specification MIL-E-5272. After completion of the test, the transformer shall show no signs of damage or loosening of parts and shall satisfactorily withstand the following tests in the order listed:

Voltage regulation
Efficiency
Temperature rise

4.3.3.4 Humidity.- The transformer shall be subjected to a humidity test in accordance with Procedure I of Specification MIL-E-5272. After completion of the test, the transformer shall not show signs of excessive corrosion and shall satisfactorily withstand the following tests in the order listed:

Voltage regulation
Efficiency
Temperature rise
Insulation test using a potential of 500V
in lieu of 1500V.

4.3.3.5 Fungus resistance.- The transformer shall be subjected to a fungus resistance test in accordance with Procedure I of Specification MIL-E-5272. After completion of the test, the transformer shall show no appreciable growth of fungi and shall satisfactorily withstand the following tests in the order listed:

Voltage regulation
Efficiency
Temperature rise
Insulation test, using a potential of 500V
in lieu of 1500V

4.3.3.6 Salt spray.- The transformer shall be subjected to a 50-hour salt spray test in accordance with Specification MIL-E-5272. After completion of the test, the transformer shall not show signs of excessive corrosion and shall satisfactorily withstand the following tests in the order listed:

Voltage regulation
Efficiency
Temperature rise
Insulation test, using a potential of 500V
in lieu of 1500V

4.3.3.7 Life.- The transformer shall be subjected to 500 hours of operation at rated kilovolt-amperes and 110 percent of rated voltage. After completion of the test, the transformer shall satisfactorily withstand the following test in the order listed:

Voltage regulation
Efficiency
Temperature rise
Insulation test, using a potential of 500V
in lieu of 1500V

4.4 Inspection tests:

4.4.1 Individual tests.- Each transformer shall be subjected to the following tests:

4.4.1.1 Examination of product.- Each transformer shall be inspected to determine compliance with the requirements specified herein with respect to material, workmanship, and marking.

4.4.1.2 No load voltage:

4.4.1.2.1 A potential of 110V shall be applied to the primary of the 115/28V Class II transformer and the frequency varied from 390 to 420 cps. The test shall be repeated using a potential of 120V. During these 2 tests, the open circuit secondary voltage shall remain within the limits of 26 to 29V.

4.4.1.2.2 A potential of 190V shall be applied to the primary of the 200/115V Class I transformer and the frequency varied from 390 to 420 cps. The test shall be repeated using a potential of 210V. During these 2 tests, the open circuits secondary voltage shall remain within the limits of 108.5 to 122.5V.

4.4.1.3 Insulation.- The transformer shall be subjected to a potential of 150V rms, 60 cycle ac for a period of one minute, between the terminals and core and also between primary and secondary windings of the Class I transformer. The transformer shall withstand this test without breakdown of insulation.

4.4.2 Sampling tests.- Five transformers shall be selected at random from every 500 or fraction thereof produced and subjected to the following tests:

4.4.2.1 When sampling tests are specified on a number of items that are selected from a production run and one or more of this number fails to meet the specified tests, acceptance of all items still on hand and subsequent production will be withheld until the extent and cause of failure is determined. For operational reasons, individual tests may be continued pending investigation of a sampling test failure. However, final acceptance of the items on hand and subsequent production is contingent upon the inspector's decision regarding the overall conformance of the product to specification requirements. When corrective action has been accomplished, all necessary tests shall be repeated. If investigation indicates that the defects may exist in items previously accepted, full particulars concerning the defects, including recommendations for correction, will be furnished to the contracting officer.

4.4.2.2 Voltage regulation.- The voltage regulation shall be measured after the transformer has reached a constant temperature at rated kilovolt-ampere load. The voltage regulation shall not exceed the voltage regulation requirements specified in Section 3.

4.4.2.3 Efficiency.- The efficiency shall be measured after the transformer has reached a constant temperature at rated kilovolt-ampere load. The efficiency shall not be less than the efficiency requirement specified in Section 3.

4.4.2.4 Temperature rise.- The temperature rise of the windings shall be measured by the resistance method with the transformer mounted on a suitable asbestos board. The maximum temperature rise thus measured shall not exceed 200°C above an ambient temperature of 25°C.

4.5 All parts, specimens, or assemblies destroyed in making tests required by this specification or drawings, to determine compliance with the specification or drawings, shall be in addition to the quantity specified in the contract or purchase order and shall be furnished without increasing the cost of the contract or order.

5. PREPARATION FOR DELIVERY

5.1 General.- The packaging, packing, and marking requirements specified herein apply only to direct purchases by, or direct shipments to the Government

5.2 The transformer shall be packaged in accordance with Group II of Specification MIL-P-6064 in a Type II, Class I container.

5.3 Marking of shipments.- Interior packages and exterior shipping containers shall be marked in accordance with Standard MIL-STD-129. The nomenclature shall be as follows:

Transformer, Power, * Autotransformer "or" * Step Down,
400 Cycle, * Volts Input and Output, * KVA, Single
"or" Three Phase
Specification MIL-T-9219
Mfr's. Part No. *

*Applicable data shall be entered by the contractor.

6. NOTES

6.1 The transformers covered by this specification are intended for use in 400-cycle ac power systems for aircraft.

6.2 Definitions:

6.2.1 Transformer.- The word "transformer" shall be construed as covering transformer or autotransformer.

6.2 Qualification tests.- In the procurement of products requiring qualification, the right is reserved to reject bids on products that have not been subjected to the required tests and found satisfactory for inclusion on a Qualified Products List. The attention of suppliers is called to this requirement, and manufacturers are urged to communicate with the Wright Air Development Center and arrange to have the products that they propose to offer to the Air Force tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from the Commander, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, Attention: WCLE.

NOTICE: When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.