MILITARY SPECIFICATION

TRANSFORMER, POWER, STEPUP, 3 PHASE

1. SCOPE

1.1 This specification covers the requirements for a high power transformer, using single unit, 3-legged core construction, supplying rectified loads to be used in Navy shore transmitters. These units are sealed, metal encased with either separately fabricated headers and terminals or both.

2. APPLICABLE DOCUMENTS

2.1 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.

SPECIFICATIONS

FEDERAL

L-P-513	- Plastic Sheet and Insulation Sheet, Electrical (Laminated, Thermosetting, Paper-Base, Phenolic-Resin)
QQ-S-571	- Solder; Tin Alloy; Lead-Tin Alloy; and Lead Alloy

MILITARY

MIL-I-10	- Insulating Materials, Electrical, Ceramic, Class L
MIL-M-14	- Molding Plastics and Molded Plastic Parts, Thermosetting
MIL-C-104	- Crates, Wood: Lumber and Plywood Sheathed, Nailed and Bolted
MIL-W-583	- Wire, Magnet, Electrical
MIL-P-997	- Plastic Material, Laminated, Thermosetting, Electrical Insulation; Sheets Glass Cloth, Silicone Resin
MIL-P-15037	- Plastic Sheet, Laminated
MIL-P-15047	- Plastic-Material, Laminated Thermosetting, Sheets, Nylon Fabric Base, Phenolic-Resin
MIL-E-15090	- Enamel, Equipment, Light-Gray (Formula No. 111)

MIL-E-17555 -Electronic and Electrical Equipment, Accessories and Repair Parts: Packaging and Packing of

MIL-C-45662 -Calibration System Requirements

STANDARDS

MILITARY

MIL-STD-129 -Marking for Shipment and Storage

MIL-STD-130 -Identification Marking of US Military Property

MIL-STD-202 -Test Methods for Electronic and Electrical Component Parts

MIL-STD-454 -Standard General Requirements for Electronic Equipment

MIL-STD-810 -Environmental Test Methods

MIL-STD-1186 -Cushioning, Anchoring, Bracing, Blocking and Waterproofing: With Appropriate Test Methods

MIL-STD-1285 -Marking of Electrical and Electronic Parts

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

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

NATIONAL BUREAU OF STANDARDS

Handbook H28 - Screw-Thread Standards for Federal Services.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

TR1-1962 - Transformer, Regulators, and Reactors

(Application for copies should be addressed to National Electrical Manufacturers Association, 155 East 44th St., New York, N. Y. 10017).

3. REQUIREMENTS

3.1 First article sample. Prior to beginning production, a sample shall be tested as specified in 4.5 (see 6.3).

3.2 Temperature. The maximum operating temperature shall not exceed 105°C at a 50°C ambient.

3.3 Life Expectancy. The unit shall be capable of operating continuously for 10,000 hours.

3.4 Materials. The materials shall be as specified herein; however, when a definite material is not specified, a material shall be used which will enable the transformer to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

3.4.1 Substitution of materials. If the supplier desires to substitute another material for a specified material or fabricated part, he shall submit a statement to the Government describing the proposed substitution, together with evidence to substantiate his claims that such substitute is suitable. At the discretion of the Government, test samples may be required to prove the suitability of the proposed substitute. Before such substitutions are made, approval for each substitution shall be obtained in writing from the Government.

3.4.2 Flammable materials. Insofar as practicable, materials used in the construction of the transformer shall be nonflammable and nonexplosive.

3.4.3 Corrosive materials. Corrosive materials used in any of the manufacturing processes shall be removed or neutralized so that no corrosion will result from such use. Insofar as practicable, materials used in the construction of the transformer shall be noncorrosive.

3.4.4 Insulation material. The insulation material used shall be selected to assure that the temperature capabilities are at least 20° higher than the actual maximum operating temperature of 105°C.

3.4.4.1 Laminated phenolic. Laminated phenolic materials shall conform to MIL-P-997, L-P-513, MIL-P-15037, or MIL-P-15047. When electrical characteristics are involved, only natural uncolored materials shall be used.

3.4.4.2 Molded phenolic or melamine. Molded phenolic or melamine materials shall conform to MIL-M-14.

3.4.4.3 Ceramic (external use). Ceramic materials shall conform to MIL-I-10.

3.4.5 Wire.

3.4.5.1 Magnet wire. Magnet wire shall be of the types and sizes specified in MIL-W-583 and shall conform to the requirements of MIL-W-583. Government approval shall be required when other types and sizes of magnet wire are used.

3.4.6 Solder and soldering flux. Solder and soldering flux shall conform to requirement 5 of MIL-STD-454. Soldering types, other than those referenced in MIL-STD-454, shall conform to QQ-S-571. Government approval shall be required when other types of solder are used.

3.4.7 Screws, nuts and washers. All mounting and terminal screws, nuts, and washers shall be corrosion-resistant material or shall be protected against corrosion.

3.5 Design and construction. The transformer shall be cased, hermetically sealed, welded, oil filled and shall be mounted on a flat base. The base shall permit the transformer to be lifted and transported by fork lift truck.

3.5.1 Mounting and terminal screws and mounting inserts. Screw threads shall be class 2A or 2B, as applicable, in accordance with Handbook H28. External screw threads, class 2 fit, shall, after receiving a finish, be capable of accepting a nut of class 2B fit and internal screw threads, class 2 fit, shall, after receiving a finish, be capable of accepting a screw of class 2A fit with maximum installation torque in accordance with the following:

Screw Size	Torque (pound-inches)
4-40	3
6-32	5
8-32	6
10-32	8
1/4-20	8
1/4-28	8
5/16-18	8

Nuts shall run down to within two threads of mounting surface.

3.5.2 Screw terminals. External screw terminals shall be supplied with two nuts, two flat washers, and one lockwasher. For cased units, the height of the terminal assembly shall be the distance from the free end of the screw to the terminal mounting surface. The type of terminal, size of screw thread, and the exposed length of threads ±1/16 inch shall be as specified (see 6.2)

3.5.3 Internal wire leads. Internal wire leads shall be attached to the coils and other internal components and terminals or case by soldering, welding, brazing, or other method (that is, lead-sweating of nylon-coated wires) in such a manner as to provide adequate electrical connection and mechanical strength. Where soft solder is used to provide the electrical connection, wire leads shall be anchored mechanically.

3.5.4 Core and coil mounting. Cores and coils shall be secured rigidly to prevent any permanent change in the relative position of the parts. The means of securing the core and coil to the devices for mounting the transformer in the equipment (that is, studs, lugs, inserts, brackets and so forth) shall not depend on soft solder alone for mechanical strength, nor shall the transmission of the mechanical load of the core to the mounting device depend only on soft solder. The core shall be grounded to the case, or shall be electrically accessible.

3.5.5 Paint color. The color of the paint shall be light gray, semi-gloss, formula No. 111, as specified in MIL-E-15090. Unless otherwise specified, the manufacturer shall omit paint from the mounting area surface (see 6.2).

3.5.6 Potting, filling, or encapsulating material. The amount and coverage of potting, filling, or encapsulating material used shall be essentially the same for all units of a specific design. Potting, filling, or encapsulating material shall not flow from the case of the transformer during any of the applicable tests.

3.5.7 Mechanical construction. The mechanical construction of the transformer shall be as shown in figure 1.

3.6 Electrical characteristics. When transformers are tested as specified in 4.7.2 through 4.7.2.7 the electrical characteristics and tolerances shall be as follows:

3.6.1 Primary terminals. The terminals shall be stud type and shall be grouped to minimize misconnections. Each phase of the primary shall have 2 windings for series or parallel operation. Primary terminals shall be numbered as specified in table I.

Table I. Primary terminal numbers

Phase	Winding No. 1	Winding No. 2
A	1, 4, 7, 10, 13, 16	19, 22, 25, 28, 31, 34
B	2, 5, 8, 11, 14, 17	20, 23, 26, 29, 32, 35
C	3, 6, 9, 12, 15, 18	21, 24, 27, 30, 33, 36

3.6.1.1 Input voltages. The input voltages shall be 460/230 volts RMS ± 10 percent, 3-phase delta connected.

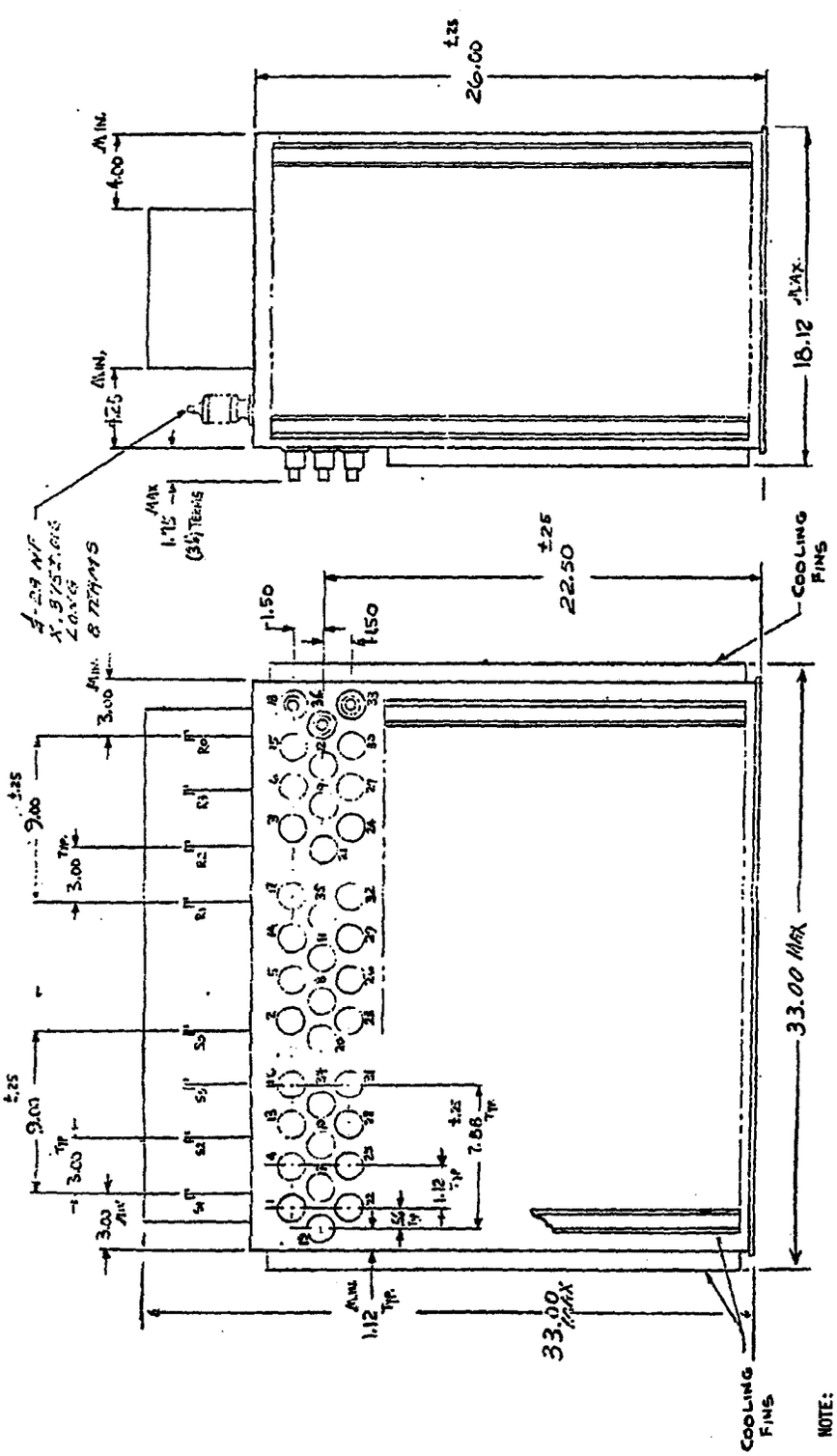
3.6.1.2 Primary taps. Each winding of the primary shall have ±5 percent and ±10 percent taps.

3.6.1.3 Frequency. The frequency shall be 50/60 Hertz (Hz) ±5 percent.

3.6.1.4 Working voltage. The primary winding to ground shall be 780 volts peak.

3.6.2 Secondary number 1. Terminals R_1, R_2, R_3, and R_0

3.6.2.1 Transformer impedance. The impedance from primary to secondary No. 1 shall be no greater than 10 percent.



NOTE:

1. Terminations for thermostatic switch, oil level switch and over pressure switch to be on this surface

Figure 1. Outline power transformer

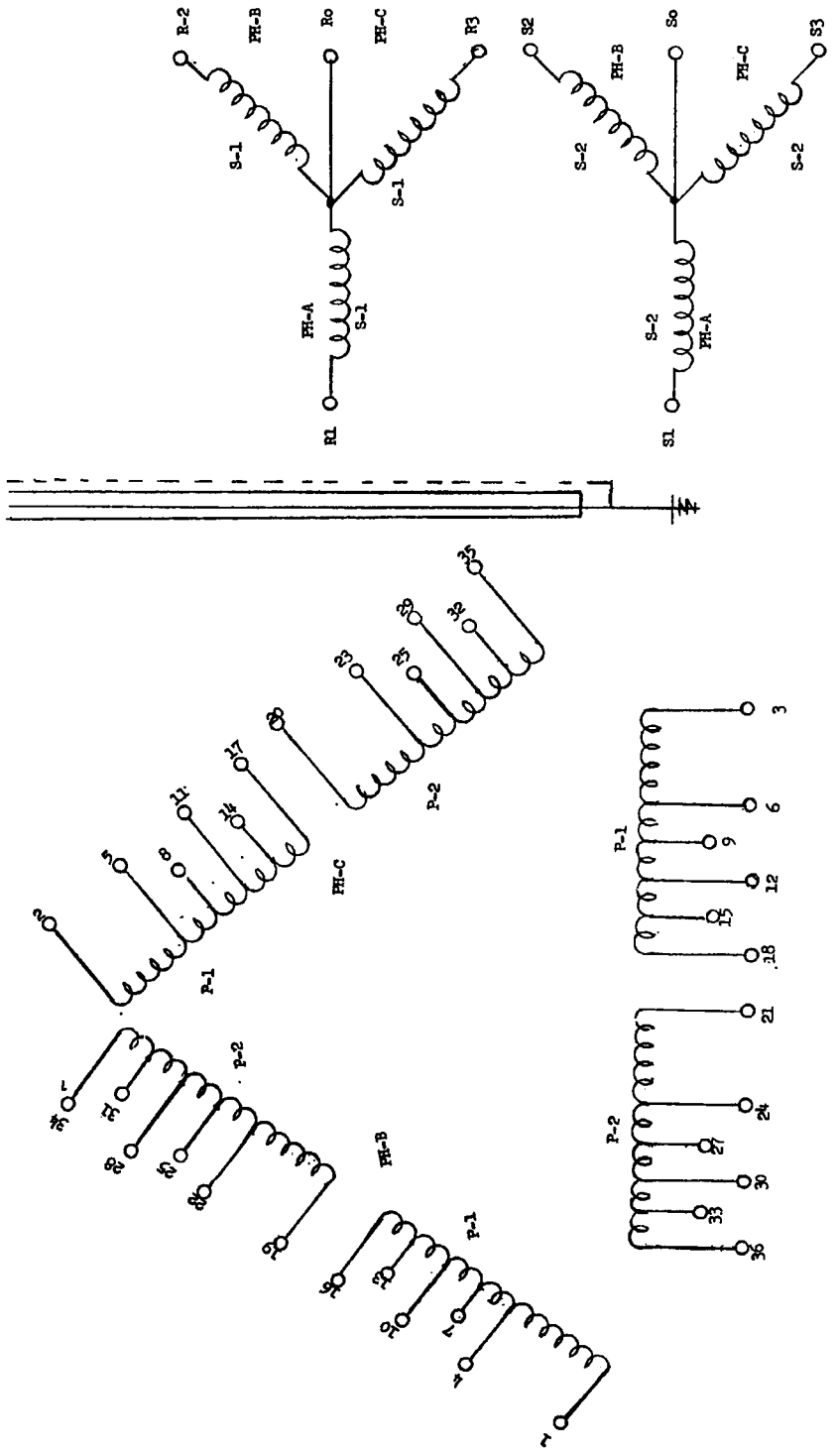


Figure 1. Outline power transformer (continued)

3.6.2.2 Output voltage. The output voltage shall be 3750/6500 volts RMS nominal with 460 volts RMS input across terminals 1 and 29, 2 and 30, 3 and 28.

3.6.2.3 Rated line current. The rated line current shall be 6.83 amps RMS per leg.

3.6.2.4 Working voltage. The working voltage shall be 13,600 volts peak.

3.6.2.5 Load. The load shall be a full wave silicon bridge rectifier with a choke input filter. Output of supply shall be 8.5 kVDC at 8 amps DC continuous. The transformer shall also be used to supply a half-wave, 3-phase rectifier with a 4.5 kVDC, 1.0 amp DC output.

3.6.3 Secondary number 2. Terminals S_1, S_2, S_3, and S_0 wye connected.

3.6.3.1 Transformer impedance. The impedance from primary to secondary No. 2 shall be no greater than 10 percent.

3.6.3.2 Output voltage The output voltage shall be 640/1100 volts RMS nominal with 460 volts RMS across terminals 1 and 29, 2 and 30, 3 and 28.

3.6.3.3 Rated line current. The rated line current shall be 7.67 amps RMS per leg.

3.6.3.4 Working voltage. The working voltage shall be 2860 volts peak.

3.6.3.5 Load. The load shall be a full wave silicon bridge rectifier with a choke input filter. Output of supply shall be 1.5 kVDC at 8.0 amps DC continuous.

3.6.3.6 After the short circuit and voltage impulse conditioning, (see 4.7.2.8 and 4.7.2.10), the excitation current, core loss and impedance measurements shall not vary more than 5 percent of the initial measurement values of these characteristics.

3.7 Terminals. The terminals shall be corona-free high voltage ceramic bushing for secondary. Primary terminals shall be stud type, ceramic bushings.

3.7.1 Terminal strength. When transformers are tested as specified in 4.7.3, there shall be no evidence of loosening or rupturing of the terminals, or other mechanical damage. There shall be no rotation of the terminals.

3.8 Dielectric withstanding voltage. When transformers are tested as specified in 4.7.4, there shall be no evidence of arcing, flashover, break-down of insulation, or damage.

3.9 Induced voltage. When transformers are tested as specified in 4.7.5, there shall be no evidence of continuous arcing or breakdown of insulation, nor shall there be any abrupt changes in the input current.

3.10 Insulation resistance. When measured as specified in 4.7.6 the minimum insulation resistance shall be 10,000 megohms.

3.11 Fungus. All external materials shall be nonnutrient to fungus growth or shall be suitably treated to retard fungus growth. The manufacturer shall certify that all external materials are fungus resistant (see 4.7.7), or shall perform the test specified in 4.7.7. There shall be no evidence of fungus growth on the external surfaces.

3.12 Corona discharge. When transformers are tested as outlined in 4.7.8 through 4.7.8.2 there shall be no corona present, or the extinction voltage shall not be less than 7750 volts for secondary number 1 and 1310 VRMS for secondary number 2.

3.13 Temperature rise. When transformers are tested as specified in 4.7.9, the temperature rise of any winding shall not exceed 55°C maximum above a 50°C ambient, and there shall be no evidence of physical or electrical damage.

3.14 Winding continuity. When transformers are tested as specified in 4.7.10, all windings shall be electrically continuous.

3.15 Switches. The following switches shall be capable of carrying 5 amperes at 28 VDC inductive.

3.15.1 Thermostatic switch. The thermostatic switch shall have double throw contacts. The switch contacts shall open when the actual internal temperature of the transformer increases to 105°C.

3.15.2 Oil level switch. The oil level switch shall have normally closed contacts. The switch contacts shall open when the oil level drops to a level so that any part of the coil is no longer submerged in oil.

3.15.3 Overpressure switch. The overpressure switch shall open when the internal pressure exceeds normal maximum operating pressure by 20 percent of gage pressure.

3.16 Audible sound level. The transformer, when tested at rated levels, shall meet the requirements of NEMA specification TR1-1962 for audible sound level.

3.17 Marking Transformers shall be marked in accordance with MIL-STD-1285 and MIL-STD-130. Markings shall remain legible after all tests. Unless otherwise specified (see 6.2) the following information shall be included, the rated voltage and frequency of primary, rated voltages and currents of secondaries, working voltages to ground for each winding, working voltages between windings whenever they exceed any of the applicable working voltages to ground.

3.18 Workmanship. Workmanship shall be in accordance with requirement 9 of MIL-STD-454.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Test equipment and inspection facilities. The supplier shall establish and maintain a calibration system in accordance with MIL-C-45662.

4.2 Classification of inspection. The inspections specified herein are classified as follows:

(a) Materials inspection (see 4.3)

(b) First article inspection (see 4.6)

(c) Quality conformance inspection (see 4.7)

(1) Inspection of preparation for delivery

4.3 Materials inspection. Materials inspection shall consist of certification supported by verifying data that the materials listed in table II, used in fabricating the transformers, are in accordance with the applicable referenced specifications or requirements prior to such fabrication.

Table II. Materials inspection

Materials	Requirement paragraph	Applicable Specification
Insulating material:		
Laminated pheholic	3.4.4.1	MIL-P-997, L-P-513 MIL-P-15037, or MIL-P-15047
Molded phenolic or melamine	3.4.4.2	MIL-M-14
Ceramic (external use)	3.4.4.3	MIL-I-10
Wire:		
Magnet wire	3.4.5.1	MIL-W-583
Solder and soldering flux	3.4.6	MIL-STD-454 or QQ-S-571

4.4 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the general requirements of MIL-STD-202.

4.4.1 Test frequency. When a test frequency is specified herein, the frequency used shall be within ±2 percent of nominal value.

4.4.2 Test voltage. The rated RMS voltage at the minimum frequency of the specified frequency range shall be applied at the rated duty cycle (that is, transformers rated at 50/60 Hz shall be tested at 50 Hz). When rated primary voltages are specified with a tolerance, the test voltage shall be the rated voltage. For multitap primary windings where a range of voltages is specified, the test voltage shall be applied to the highest voltage in the range and applied to the appropriate terminals (that is, 105 to 125 volts shall be tested at 125 volts). For dielectric withstanding voltage tests, the peak of the voltage applied shall not exceed, by more than 5 percent, the peak of the pure sine voltage.

4.5 First article inspection. Unless otherwise specified (see 6.2), the first unit shall be required for first article inspection. First article inspection shall consist of all examination and testing necessary to determine compliance with the requirements of this specification. First article inspection shall be performed by the supplier, after award of contract and prior to production, at a location acceptable to the Government. First article inspection shall be performed on a unit which has been produced with equipment and procedures normally used in production. First article inspection shall include the tests specified in table III.

TABLE III First article inspection

Examination or test	Requirement paragraph	Method paragraph
Visual and mechanical examination (external)	3.4 to 3.4.4.3 incl 3.5 to 3.5.2 incl 3.5.5, 3.5.6, 3.15, 3.18 and 3.19	4.7.1.1, 4.7.11
Fungus 1/	3.11	4.7.7
Dielectric withstanding voltage	3.8	4.7.4
Induced voltage	3.9	4.7.5
Insulation resistance	3.10	4.7.6
Electrical characteristics		
DC resistance and resistive unbalance		4.7.2.3
Inductance and inductive unbalance		4.7.2.4
Center-tap balance at low levels (-20 to -80 dBm balance)		4.7.2.1
Corona discharge	3.12	4.7.8
Turns ratio		4.7.2.7
Polarity		4.7.2.1

TABLE III First article inspection (Continued)

Examination or test	Requirement paragraph	Method paragraph
Electrostatic Shielding		4.7.2.5
No load		4.7.2.1
Rated load		4.7.2.2
Temperature rise	3.13	4.7.9
Terminal strength	3.7.1	4.7.3.1.1
Oil leak		4.7.9.1
Insulation resistance	3.10	4.7.6
Winding continuity	3.14	4.7.10
Excitation current 2/		4.7.2.11
Core loss 2/		4.7.2.12
Impedance measurements 2/		4.7.2.13
Short circuit 3/ 4/		4.7.2.9
Voltage impulse 3/ 4/		4.7.2.10
Excitation current 3/ 4/		4.7.2.11
Core loss 3/ 4/		4.7.2.12
Impedance measurements 3/ 4/		4.7.2.13
Visual and mechanical examination (external)	3.4 to 3.4.4.3 incl 3.5 to 3.5.2 incl 3.5.5, 3.5.6, 3.15, 3.18 and 3.19	4.7.1.1, 4.7.11

1/ Test shall not be performed if the manufacture provides certification that all external materials are fungus resistant.
2/ Initial reading
3/ Conditioning measurements (see 3.6.3.6)
4/ These tests to be performed 5 times

4.6 Quality conformance inspection

4.6.1 Quality conformance inspection. Quality conformance inspection shall be made on every transformer offered for delivery. This inspection shall consist of the examinations and tests specified in table IV in the order shown.

Table IV. Quality conformance inspection

Examination or test	Requirement paragraph	Method paragraph
Visual and mechanical examination (external)	3.4 to 3.4.4.3 incl 3.5 to 3.5.2 incl 3.5.5, 3.5.6, 3.15, 3.18 and 3.19	4.7.1.1 4.7.11
Dielectric withstanding voltage	3.8	4.7.4
Induced voltage	3.9	4.7.5
Insulation resistance	3.10	4.7.6

Table IV. Quality conformance inspection (Continued)

Examination or test	Requirement paragraph	Method paragraph
Electrical characteristics		
DC resistance and resistive unbalance		4.7.2.3
Inductance and inductive unbalance		4.7.2.4
Center-tap balance at low levels (-20 to -80 dBm balance)		4.7.2.1
Turns ratio		4.7.2.7
Polarity		4.7.2.1
Electrostatic shielding		4.7.2.5
No load		4.7.2.'
Rated load		4.7.2.2
Temperature rise	3.13	4.7.9
Terminal strength	3.7.1	4.7.3.1.1
Oil leak		4.7.9.1
Insulation resistance	3.10	4.7.6
Winding continuity	3.14	4.7.10
Excitation current		4.7.2.11
Core loss		4.7.2.12
Impedance measurements		4.7.2.13
Short circuit		4.7.2.9
Voltage impulse		4.7.2.10
Excitation current		4.7.2.11
Core loss		4.7.2.12
Impedance measurements		4.7.2.13
Corona discharge	3.12	4.7.8
Visual and mechanical examination (external)	3.4 to 3.4.4.3 incl 3.5 to 3.5.2 incl 3.5.5, 3.5.6, 3.15, 3.18 and 3.19	4.7.1.1, 4.7.11

4.6.2 Inspection of preparation for delivery. Sample packages or packs and the inspection of the preservation, packaging, packing, and marking for shipment and storage shall be in accordance with the requirements of section 5.

4.7 Methods of examination and test.

4.7.1 Visual and mechanical examination.

4.7.1.1 External. Transformers shall be examined to verify that the materials, external design and construction, physical dimensions, weight, marking, and workmanship are in accordance with the applicable requirements (see 3.4 to 3.4.4.3 inclusive, 3.5 to 3.5.2 inclusive, 3.5.5, 3.5.6, 3.18 and 3.19).

4.7.2 Electrical characteristics (see 3.6). The electrical characteristics shall be determined by the tests specified herein.

4.7.2.1 No-load. Rated voltage at the frequency or frequencies specified shall be applied to the primary with the secondary or secondaries open-circuited. The following will be determined:

(a) No-load RMS current (I_{nl}).
(b) No-load power (P_{nl}).
(c) Primary tap and secondary RMS voltages.
(d) Center-tap voltage unbalance in percent = $\frac{(V_1 - V_2)}{V_1} \times 100$.

The voltage unbalance shall be computed: V_1 and V_2 are the voltages of each part of the winding, and $V_1 \geq V_2$. The quantity $(V_1 - V_2)$ shall be measured directly by means of a bridge or equivalent method.

4.7.2.2 Rated load.

4.7.2.2.1 Rectified or unrectified outputs. Rectified or unrectified output secondary voltages shall be measured with the transformer primary excited with rated voltage at the specified frequency and with rated RMS load currents flowing in the secondary windings.

4.7.2.3 DC resistance and resistive unbalance. The DC resistance of the windings shall be measured at or corrected to 20°C. The resistive unbalance of center-tapped windings in percent $\frac{(R_1 - R_2)}{R_1} \times 100$ shall be computed.

R_1 and R_2 are the resistances of each part of the winding, and $R_1 \geq R_2$. For resistances under 1 ohm, measurements shall be made with a Kelvin bridge.

4.7.2.4 Inductance and inductive unbalance. The inductance of the windings shall be measured at the specified test voltage and frequency with the specified DC current applied. The inductive unbalance of center-tapped windings in percent $\frac{(L_1 - L_2)}{L_1} \times 100$ shall be computed. L_1 and L_2 are inductances of each part of the winding and $L_1 \geq L_2$.

4.7.2.5 Electrostatic shielding. With all windings short-circuited and those on the same side of the electrostatic shield connected together, using the circuit shown on figure 2 the voltage of the signal generator at the specified frequency shall be set to give a definite indication on the detector, with switch "S" open. With switch "S" closed, the generator voltage shall be increased so as to yield the same indication on the detector, and the ratio of the generator voltages shall be computed. The detector shall have a minimum input impedance of 1 megohm.

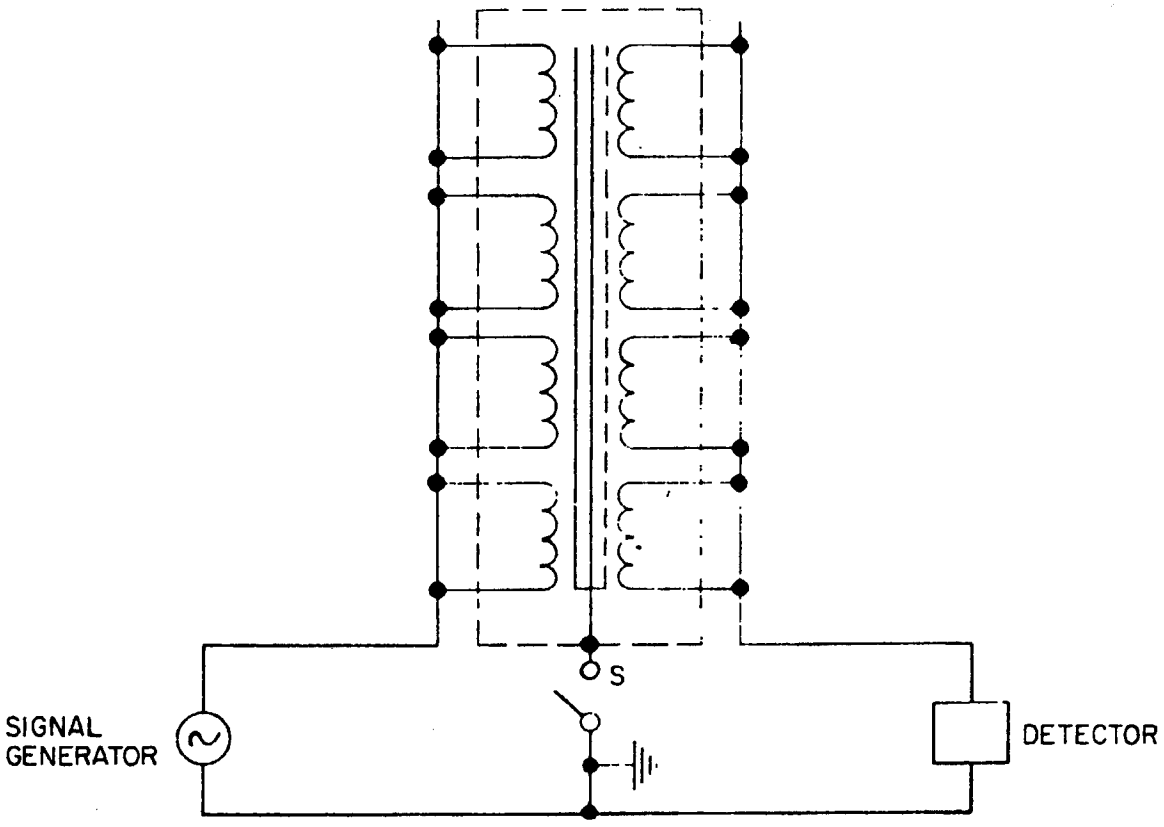


FIGURE 2. Electrostatic-shielding circuit.

4.7.2.6 Wave shape. With the source and load conditions as specified, the wave shape of the output shall be determined by means of an oscilloscope. The wave is sinusodial.

4.7.2.7 Turns ratio. The turns ratio shall be determined by the voltmeter method or any other suitable means.

4.7.2.8 The following tests shall be made:

(a) Exciting current (see 4.7.2.11)

(b) Core loss (see 4.7.2.12)

(c) Impedance measurements (see 4.7.2.13)

4.7.2.9 Short circuit. The transformer shall be undamaged after a full secondary short circuit for 6 full cycles when fed from a 460 VRMS source having an impedance of 10 percent on a 92 kVa base. Such operation occurs during normal operation due to crowbarring of the power supply.

4.7.2.10 Voltage impulse

4.7.2.10.1 Secondary number 1 The winding shall not be damged when tested for impulse at a level of 60,000 volts.

4.7.2.10.2 Secondary number 2. The winding shall not be damaged when tested for impulse at a level of 15,000 volts.

4.7.2.11 Excitation current. With primary winding connected in series (terminal 4 connected to terminal 19, terminal 5 connected to terminal 20, terminal 6 connected to terminal 21) apply 460 volts, 3-phase, 60 Hz across terminal 1 and 23, 2 and 24, and 3 and 22. The input line current shall be measured and recorded.

4.7.2.12 Core loss. With primary windings connected in series (terminal 4 connected to terminal 19, terminal 5 connected to terminal 20, terminal 6 connected to terminal 21) apply 460 volts, 3-phase, 60 Hz across terminal 1 and 23, 2 and 24, and 3 and 22. The core loss shall be measured and recorded.

4.7.2.13 Impedance measurements. Short circuit secondary high voltage windings and then with the primary connected as in 4.5.4 and 4.5.5, increase the current 3-phase until the current read is equivalent to the normal load current. At this time record the voltage and the current and the impedance will be the voltage divided by the current. Record this value in ohms.

4.7.3 Terminal strength (see 3.7). Transformers shall be tested as specified in 4.7.3.1.1. After each test, the terminals shall be examined for loosening and rupturing, and other mechanical damage. Unless otherwise specified, all terminals on each test sample shall be subjected to the following test, up to a maximum of four identical terminals per sample.

4.7.3.1 Torque

4.7.3.1.1 Screw-thread terminals. Transformers shall be tested in accordance with method 211 of MIL-STD-202, test condition E.

4.7.4 Dielectric withstanding voltage (see 3.8). Transformers shall be tested in accordance with 4.7.4.1.

4.7.4.1 Points of application of test voltage:

(a) Primary winding shall withstand test voltage of 2,500 VRMS between terminals and case
(b) Secondary winding shall be grounded to case for this test.

(1) Secondary number 1 winding shall withstand a test voltage of 20,100 VRMS between its terminals and case. The primary and secondary number 2 windings shall be grounded to the case for the test.

(2) Secondary number 2 winding shall withstand a test voltage of 5,000 VRMS between its terminals and case. The primary and secondary number 1 windings shall be grounded to the case for the test.

4.7.5 Induced voltage (see 3.9) Transformers shall be subjected to a voltage sufficient to cause twice the rated voltage to appear across any winding. The test voltage shall be applied to any winding. Windings should be grounded as they would be in service. The test frequency shall be as selected by the manufacturer and shall be remote from any resonant frequency.

4.7.6 Insulation resistance (see 3.10). Transformers shall be tested in accordance with method 302 of MIL-STD-202. The following details and exceptions shall apply:

(a) Test-condition letter - B

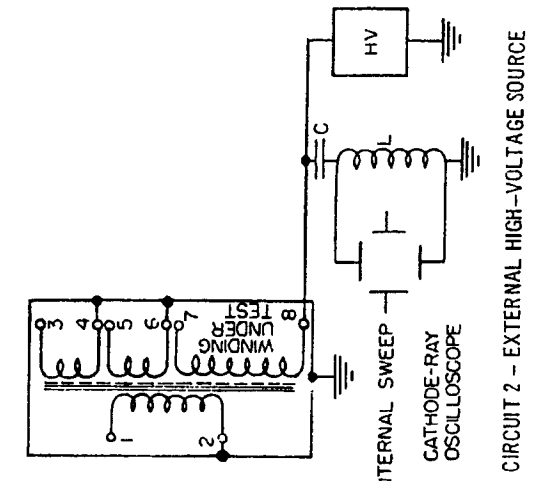
(b) Points of measurement:

(1) Winding to case or core - The potential shall be applied between each winding and the case or core with all windings not under test grounded to the case. The measurements may be made at any temperature above 20°C and at ambient room humidity, but rejections shall be based on measurements made at 25° + 10°C, -5°C and at a relative humidity not greater than 80 percent.

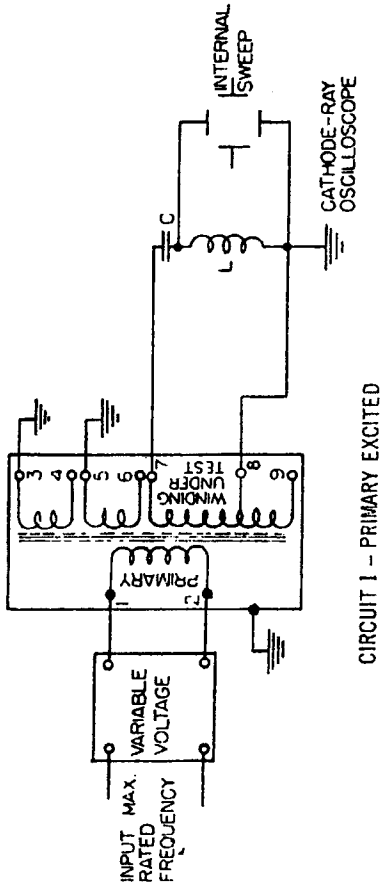
(c) Electrification time - 1 minute maximum.

4.7.7 Fungus (see 3.11). Unless certification is provided, transformers shall be tested in accordance with method 508 of MIL-STD-810.

4.7.8 Corona (3.12). The transformer shall be tested for corona using the applicable test circuit (see figure 3) and in accordance with the following:

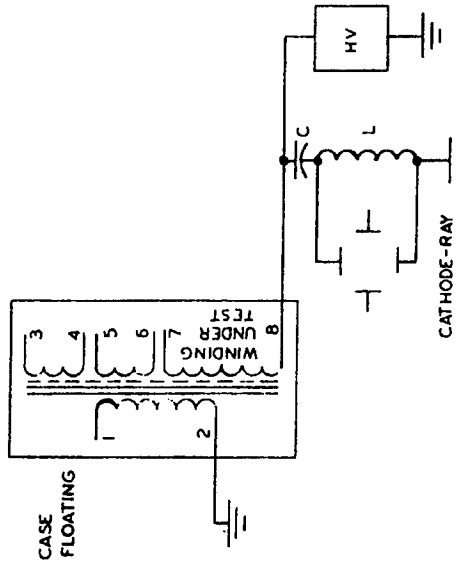


CIRCUIT 2 – EXTERNAL HIGH-VOLTAGE SOURCE



CIRCUIT 1 – PRIMARY EXCITED

NOTES:
1. When using circuits 1 and 2, ground the case of the transformer and all windings except that being tested.
2. Legend for test circuits: C = 200 picofarad mica capacitor, corona free; L = RF choke, 20 to 30 millihenries inclusive, with a minimum Q of 50 at 100 kilohertz; HV = high voltage source, corona free.
3. Corona will be evident as a superimposed high-frequency oscillation on the basic power wave.



CIRCUIT 3 – EXTERNAL HIGH-VOLTAGE SOURCE (CASE FLOATING)

FIGURE 3 Corona test circuits.

4.7.8.1 Secondary number 1. Test for intra-winding insulation with the following sequential conditions, increase output voltage to 9050 VRMS. If no corona is present, then unit is acceptable. If corona occurs, reduce output voltage until corona is extinguished. Extinction voltage shall be 7750 volts minimum. The test shall be performed 3 times, one with each of terminals R_1, R_2 and R_3 grounded in turn.

4.7.8.2 Secondary number 2. Test for intra-winding insulation with the following sequential conditions, increase output voltage to 1530 VRMS. If no corona is present, then the unit is acceptable. If corona occurs, reduce output voltage until corona is extinguished. Extinction voltage shall be 1310 VRMS minimum. The test shall be performed 3 times, one with each of terminals S_1, S_2 and S_3 grounded in turn.

4.7.9 Temperature rise (see 3.13). Unless otherwise specified (see 6.2), the temperature-rise test shall be performed on transformers rated at more than 0.8-watt average output. The temperature rise of each winding shall be based on the change-in-resistance method and shall be computed by the following formula:

$$T = \frac{R-r}{r} (t + 234.5) - (T-t)$$

Where:

T = Temperature rise (in °C) above specified maximum ambient temperature (see 3.13)

R = Resistance of winding (in ohms) at temperature (T + T).

r = Resistance of winding (in ohms) at temperature (t).

t = Specified initial ambient temperature (in °C).

T = Maximum ambient temperature (in °C) at time of power shutoff. T shall not differ from t by more than 5°C.

The transformers shall be conditioned for at least 8 hours at temperature (t) in a location free from drafts before resistance (r) is measured. For transformers, rated voltage shall be applied to the primary with the specified loads across the secondaries. Transformers shall be operated until two consecutive resistance readings on the highest resistance winding, taken 30 minutes apart, are the same. If the power is required to be shut off, the resistance measurements (R) shall be made as soon as possible. The transformers shall then be examined for evidence of physical damage. At the option of the supplier, the test may be performed at 60 Hz for transformers rated at 50/60 Hz provided that the primary voltage is increased to 1.2 times the rated voltage and the secondary currents are maintained at rated current.

4.7.9.1 Oil leaks. After enduring the temperature rise test, the transformer shall be checked for any oil leaks.

4.7.10 Winding continuity (see 3.14). All windings of transformers shall be tested for electrical continuity by any suitable means.

4.7.11 Switches. The switches shall be tested in accordance with the following:

4.7.11.1 Thermostatic switch. The thermostatic switch shall be tested to assure opening at the specified temperature.

4.7.11.2 Oil level switch. The oil level switch shall be tested to assure that it opens when oil level drops below the specified level.

4.7.11.3 Overpressure switch. The overpressure switch shall be tested to assure opening at the specified pressure.

5. PREPARATION FOR DELIVERY

(The preparation for delivery requirements specified herein apply only for direct Government procurements. Preparation for delivery requirements of referenced documents listed in Section 2 do not apply unless specifically stated in the contract or order. Preparation for delivery requirements for products procured by contractors shall be specified in the individual order.)

5.1 Preservation, packaging and packing shall be in accordance with MIL-E-17555, at the level specified in the contract or order (see 6.2)

5.1.1 Packing. Packing shall be in a wood-sheathed crate conforming to MIL-C-104, type I. Contents of crate shall be anchored, braced and blocked in accordance with MIL-C-104 and MIL-STD-1186. No blocking or bracing member shall come in contact with the cooling fins or terminals of the transformer.

5.2 Marking. Marking shall be in accordance with MIL-STD-129 and any special requirements specified in the contract or order (see 6.2).

6. NOTES

6.1 Intended use. This transformer is intended for use at transmitter shore stations.

6.2 Ordering data. Procurement documents should specify the following:

(a) Title, number and date of this specification.
(b) Type, size, exposed length of screw terminal (see 3.5.2)
(c) Whether paint is required on mounting area surface (see 3.5.5)
(d) Marking for voltage ratings, if required (see 3.18).
(e) Number of first article samples to be submitted, if other than specified in 4.5.
(f) Number of times for test to be repeated, if other than specified (see 4.5.3).
(g) Temperature rise, if other than specified (see 4.7.9).
(h) Levels of preservation and packaging and packing and applicable marking (see section 5).

6.3 First article. Invitations for bids should provide that the Government reserves the right to waive the requirement for first article samples as to those bidders offering a product which has been previously procured or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending procurement.

Preparing Activity
Navy - EC

(Project 5950-N113)